Alcatel-Lucent 1665

Data Multiplexer (DMX) | Release 9.1

Applications and Planning Guide

365-372-300R9.1
Issue 1
November 2011

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About this document

Purpose

This Applications and Planning Guide provides the following information for Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX):

- Features
- Applications
- Operation
- Engineering
- Support
- Specifications

Reason for reissue

This document is issued to provide information about Release 9.1 features, including:

- In-service upgrades
  - LNW82 to LNW59 one port upgrade
  - LNW59 to LNW504 one or two port upgrade
  - LNW56, LNW57, LNW58, and LNW502 to LNW504 upgrade
- LNW7 to LNW801 DS1 capacity upgrade
- LNW8 and LNW801 can exist in the same function group
- Change the initial default state of an external timing reference from Auto to IS
- STS-192c cross-connect support
- Bi-directional ALS on LNW63/64/70/74/87/170
- FEC is provisionable on LNW705
- Additional buffer sizes for FE and GigE for LNW63/70/74/170
- In TL1 cut-through, the last TID specified is remembered and used in all subsequent commands in which a TID is not specified.
- Extra traffic on low-speed or high-speed OC-192 BLSRs when the mains are equipped with VLF packs
- Optional OOS check for loopback on Ethernet, PDH and EC-1 signals

- Ethernet loopbacks are allowed even when RCF or FEFI are active
- Microsoft *Windows*® 7 64-bit, support on *WaveStar*® CIT

Related information

The following table lists the documents included in the Alcatel-Lucent 1665 DMX documentation set.

Table 1 Alcatel-Lucent 1665 DMX documentation set

Document number/Comcode	Title
365-372-330	*WaveStar® User Guide*
365-372-300R9.1	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Applications and Planning Guide*
365-372-301R9.1	*Alcatel-Lucent 1665 Data Multiplexer (DMX) User Operations Guide*
365-372-302R9.1	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Alarm Messages and Trouble Clearing Guide*
365-372-304R9.1	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Installation Manual*
365-372-306R9.1	*Alcatel-Lucent 1665 Data Multiplexer (DMX) TL1 Message Details*
ED8C871-10	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Engineering and Ordering Information*
ED8C871-20	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Interconnect Information*
109783647	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Release 9.1.0 Customer Release Notes* (PDF)
109783274	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Release 9.1.0 Customer Release Notes* (CD-ROM)
109783282	*Alcatel-Lucent 1665 Data Multiplexer (DMX) Release 9.1.X Customer Documentation CD-ROM*

Intended audience

This Applications and Planning Guide is intended for network planners and engineers. However, it is also for anyone who needs specific information regarding the features, applications, operation, engineering, and ordering of Alcatel-Lucent 1665 DMX.

How to use this information product

This guide is divided into ten chapters and an appendix. See the Contents section to locate specific information by chapter.

Conventions used

Bold typeface signifies emphasis.

Italic typeface denotes a particular product line or information product.

`Bold courier` typeface signifies a TL1 command.

Bold typeface signifies a GUI command.

For the remainder of this information product, Alcatel-Lucent 1665 DMX is used in place of Alcatel-Lucent 1665 Data Multiplexer in most cases.

Technical support

For technical support, contact your local Alcatel-Lucent customer support team. See the Alcatel-Lucent Support web site (http://alcatel-lucent.com/support/) for contact information.

How to order

To order Alcatel-Lucent documents, contact your local sales representative or use the Online Customer Support (OLCS) (http://support.alcatel-lucent.com) site.

How to comment

To comment on this document, go to the Online Comment Form (http://infodoc.alcatel-lucent.com/comments/) or e-mail your comments to the Comments Hotline (comments@alcatel-lucent.com).

1 System overview

Overview

Purpose

This chapter introduces Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX).

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Overview of the 1665 products	1-1
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Alcatel-Lucent 1665 Data Multiplexer Extend	1-6
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Overview of the 1665 products

Purpose

Metropolitan, "metro," networks are the communications networks that link homes and businesses to larger, long-distance core networks. These networks are complex because they are filled with both old and new networking equipment and must carry all types of service traffic, including voice, data and video.

Driven by the exponential growth of the Internet, requirements for metropolitan optical transport networks are changing quickly from pure circuit networks to hybrid networks. This evolution requires metro access networks to aggregate the local loop or last-mile bandwidth in order to integrate with the high-speed core/backbone networks. These requirements are driving metropolitan network evolution from traditional SONET multiplexers into more flexible, higher-speed, data-aware platforms-a necessity for optical edge solutions.

Solution

Alcatel-Lucent is helping service providers to cost-effectively deploy solutions that can accommodate a multitude of services, such as voice, Private Line, Ethernet, IP, frame relay, and ATM. The 1665 portfolio offers a seamless evolution to next–Generation metro solutions that can eliminate the bottleneck in the metropolitan network, allowing service providers to deliver new high-speed, revenue–Generating services such as gigabit Ethernet, virtual private networks (VPN), storage area networks and digital subscriber lines (DSL).

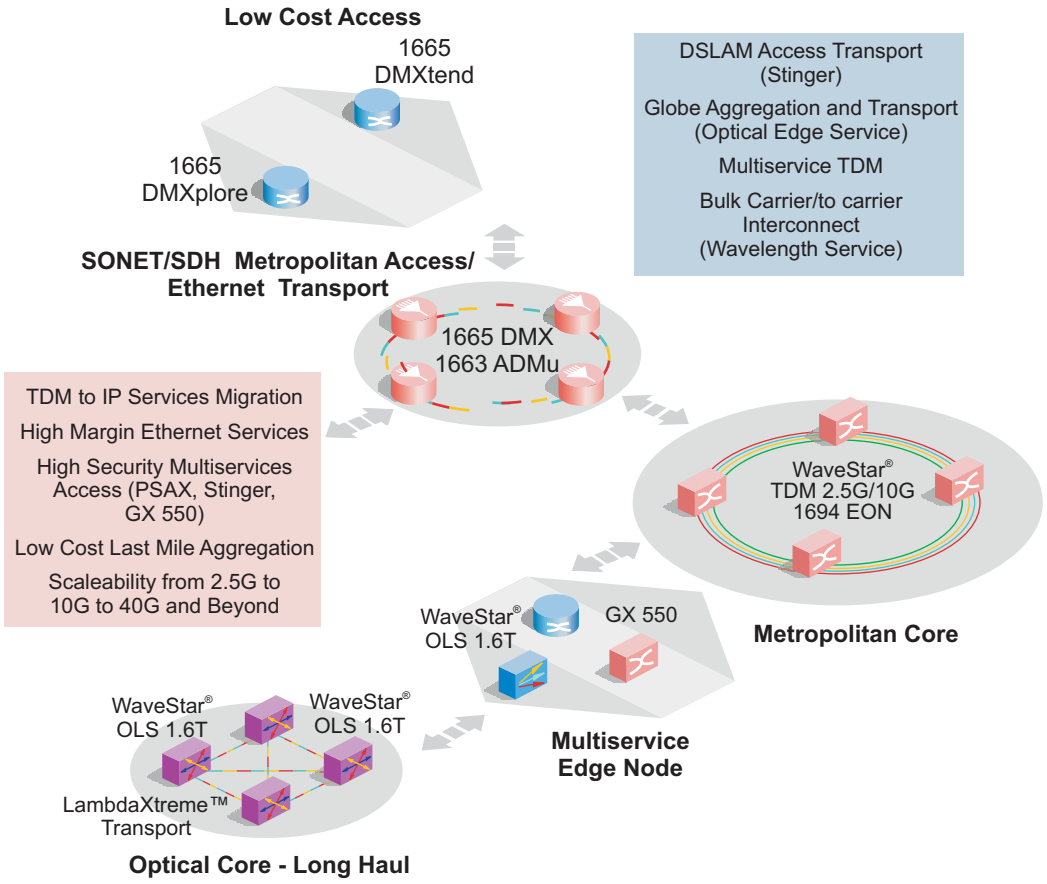
Portfolio

Alcatel-Lucent designed its 1665 portfolio so customers can choose the solution that best accommodates their existing networks, allowing them to bring new services to market quickly and cost effectively.

1665 portfolio includes two categories of next–Generation products based on the most common types of metro networks:

- Next–Generation SONET – Alcatel-Lucent 1665 DMX, Alcatel-Lucent 1665 DMXtend, and Alcatel-Lucent 1665 DMXplore – leverages existing optical equipment while providing a solid foundation for future bandwidth, gigabit Ethernet (GbE) and IP services growth.
- Alcatel-Lucent 1675 LambdaUnite MSS, Alcatel-Lucent 1694 EON, and Alcatel-Lucent 1695 WSM, metro core DWDM solutions for regional traffic.

Each of the 1665 portfolio solutions can fuse with Alcatel-Lucent's new multiservice data switches and existing IP and ATM equipment to provide an end-to-end broadband network that links to long-distance or other metro networks.



2.5G = WaveStar® TDM 2.5G (OC-48) 2F
10G = WaveStar® TDM 10G (OC-192) 2F
1694 EON = 1694 Enhanced Optical Networking
1663 ADMu = 1663 Add Drop Multiplexer-universal
1665 DMX = 1665 Data Multiplexer
1665 DMXtend = 1665 Data Multiplexer Extend
1665 DMXplore = 1665 Data Multiplexer Explore

nc-dmx-111

1665 portfolio metro access solutions

Overview

This section provides a brief description of each of the following products which comprise the 1665 portfolio:

- Alcatel-Lucent 1665 DMX
- Alcatel-Lucent 1665 DMXtend
- Alcatel-Lucent 1665 DMXplore

Introduction to the Alcatel-Lucent 1665 Data Multiplexer

Overview

Alcatel-Lucent 1665 DMX is a single-shelf network multiplexer designed primarily for access transport, business access, and regional interoffice applications transporting voice and data at the OC-3/OC-12/OC-48/OC-192 level via a UPSR, BLSR (OC-48/OC-192), or 1+1 linear optical extension.

Alcatel-Lucent's rich history of SONET multiplexers provides the foundation for Alcatel-Lucent 1665 DMX. Alcatel-Lucent 1665 DMX builds on that tradition by providing the tools necessary for the new generation of access networks: greater capacity, increased network flexibility, diverse functionality, and reliable service.

Alcatel-Lucent 1665 DMX, a SONET line terminating network element, supports a wide array of wideband and broadband transport, including traditional SONET transport of DS1, E1, DS3, EC-1, TransMUX, OC-3, OC-12, OC-48, and OC-192 signals, as well as 10/100/1000 Mbps LAN, DWDM rings, and FICON/ESCON/Fibre-channel SAN transport. The shelf can be equipped to serve many diverse network applications and supports a variety of operations interfaces for current and evolving network operations needs.

Functionality

There are 13 circuit pack slots in each shelf, consisting of the following:

- 1 Control slot (CTL) for the SYSCTL (LNW2)
- 2 Main slots (M1, M2) for high-speed optical line interface units (OC-3, OC-12, OC-48, or OC-192) or the Main Switch Pack (LNW80)

- 8 multipurpose Function Unit slots (A through D) for DS1, DS3, E1, TransMUX, EC-1, OC-3, OC-12, OC-48, 10/100BASE-T/X and 10/100BASE-T/ZX/LX/FX Private Line, 1000BASE-SX/LX/ZX, ESCON, FICON, Fibre-Channel service, and DWDM Mux/Demux
- 2 Growth slots (G1, G2) for OC-3, OC-12, OC-48, 1000BASE-X SX/LX, optical 100BASE-ZX/LX/FX, ESCON, FICON, Fibre-Channel service, and DWDM Mux/Demux. Growth slots can also host the LNW20 TransMUX card in portless DS3 mode.

  The Growth slots are regarded as Function Unit slots and may also be used for additional features.

  Important! DS1, DS3, EC-1, E1, and 10/100-T functionality is not supported in the Growth slots.

Interface density

Alcatel-Lucent 1665 DMX provides a VT1.5 and STS-1 cross-connect fabric. Alcatel-Lucent 1665 DMX's main switch fabric is contained in each of the high-speed (network-side interface) circuit packs, located in the MAIN slots. The MAIN slots house OC-3, OC-12, OC-48, and OC-192 high-speed interfaces. They can also house the LNW80 switch pack. The LNW59, LNW82, and LNW504 VLF Main circuit packs enable 0x1 equipage. In many cases, this doubles the overall capacity of the shelf.

For more detailed information about the number of interfaces supported by Alcatel-Lucent 1665 DMX, see “Interface density” (p. 4-3).

Shelf size

The High-Capacity shelf has the following characteristics (includes integral fan unit):

- Width: 17.6 inches
- Height: 19 inches (includes integral fan unit)
- Depth front to back with rear cover installed
  - 16 inches with flush front cover installed
  - 17 inches with extended front cover installed
  - Removal of the rear cover subtracts 0.8 inches from the depth of the shelf
- Weight (with circuit packs): 57 pounds
- Weight (without circuit packs): 38 pounds

Operations

Alcatel-Lucent 1665 DMX is representative of ten years of Alcatel-Lucent's innovation and experience in network operations, control, and maintenance. Utilizing Level 1 and Level 2 Target Identifier (TID) Address Resolution Protocol (TARP), a consistent and standard form of address resolution is in place, enabling the Alcatel-Lucent 1665 DMX network to be easily monitored and maintained.

Alcatel-Lucent 1665 DMX also supports standard interworking using the Open Systems Interconnection (OSI) seven-layer protocol stack or IP over the DCC. The OSI seven-layer protocol stack refers to the OSI reference model, a logical framework for network operations standardized by the ISO. This provides for large networks up to 1000 NEs via level 1 area provisioning and level 2 routing.

Alcatel-Lucent 1665 DMX is designed for easy installation and operation. Centralized operation is supported by a full set of single-ended operations (SEO), control, and maintenance features. Integrated test capabilities and default provisioning simplifies installation.

Basic maintenance tasks can be performed using faceplate LED displays and controls, while a craft interface terminal (CIT) or a remote OS gives access to sophisticated maintenance, provisioning, and reporting features.

Built-in maintenance capabilities support both installation and system operation. Alcatel-Lucent 1665 DMX can be tested and installed without external test equipment.

Alcatel-Lucent 1665 Data Multiplexer Extend

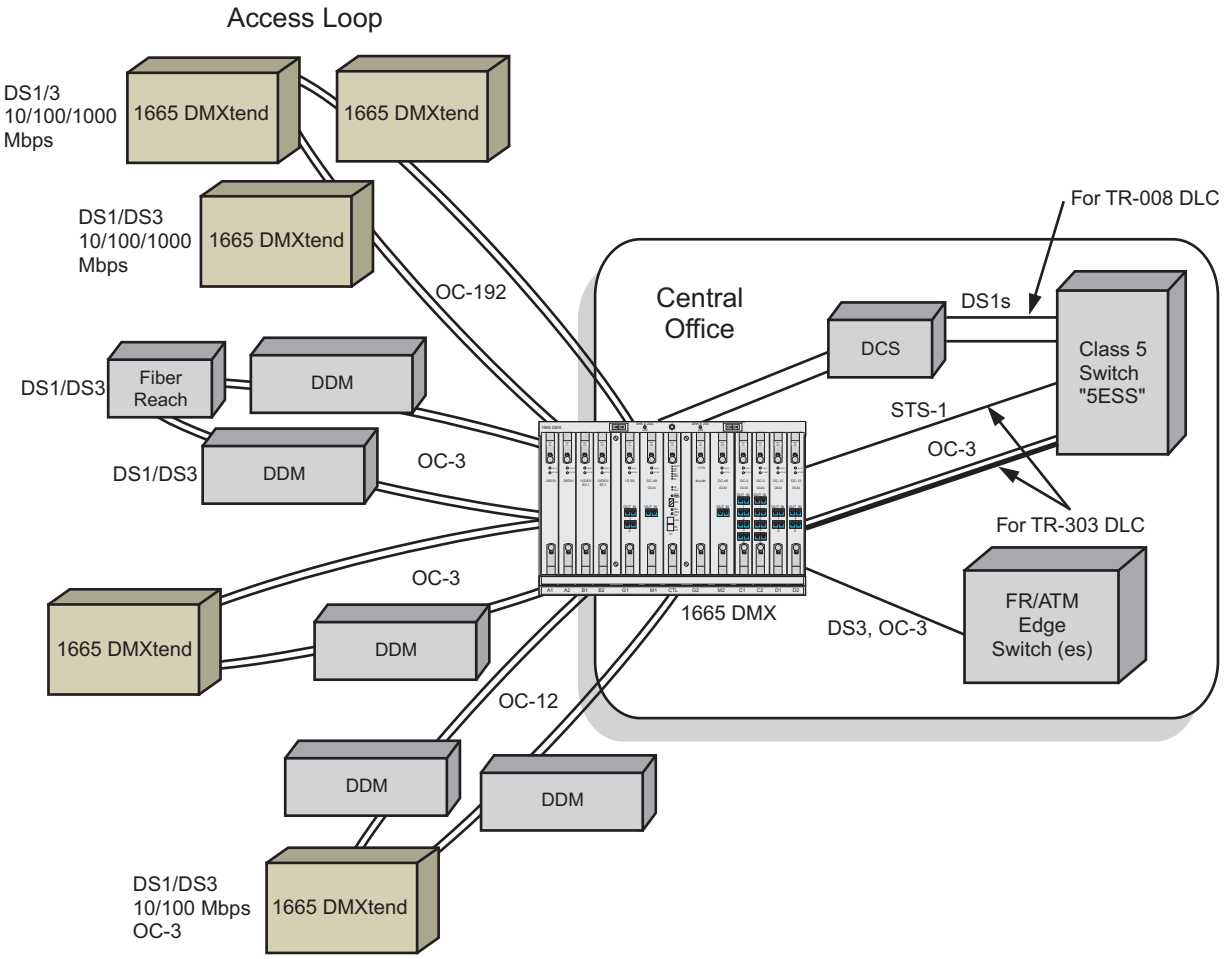
Introduction to Alcatel-Lucent 1665 DMXtend

Alcatel-Lucent 1665 DMXtend is a single-shelf network multiplexer designed primarily for access transport, business access, and regional interoffice applications transporting voice, data, and SAN traffic at the OC-3/12/48/192 level via 1+1, or unidirectional path switched ring (UPSR) protected lines.

Alcatel-Lucent 1665 DMXtend supports a wide array of wideband and broadband transport, including traditional SONET transport of DS1, E1, DS3, EC-1, TransMUX, OC-3, OC-12, OC-48, OC-192 as well as 10/100/1000 Mbps LAN, DWDM rings, and FICON/ESCON/Fibre-Channel SAN transport. The shelf can be equipped to serve many diverse network applications and supports a variety of operations interfaces for current and evolving network operations needs.

The figure below shows the Alcatel-Lucent 1665 DMXtend providing loop access for the various interfaces listed above, and interworking with DDM and FT-2000 to enable a network transition to next–Generation, higher capacity services, and shows how the Alcatel-Lucent 1665 DMXtend can interwork with embedded, legacy equipment.

Figure 1-1 Next-Generation loop access with Alcatel-Lucent 1665 DMXtend



1665 DMX = Alcatel-Lucent 1665 Data Multiplexer
1665 DMXtend = Alcatel-Lucent 1665 Data Multiplexer Extend

NC-DMXtend-002

Alcatel-Lucent 1665 Data Multiplexer Explore

Introduction to Alcatel-Lucent 1665 DMXplore

Alcatel-Lucent 1665 DMXplore has an extremely small footprint that enables its *seamless* integration as a piece of customer premise equipment (CPE). As CPE, it is ideal for Fiber to the Business (FTTB) and end-user access applications. It has a modular architecture that supports DS1, DS3 and 10/100 Mbps Fast Ethernet Private Line transport over high-speed OC-3 or OC-12 interfaces. Working and protection high-speed transport circuit packs are supported, to provide continued service in the event of a failure. The system supports 1+1 protection by default, and can be provisioned to support UPSR applications.

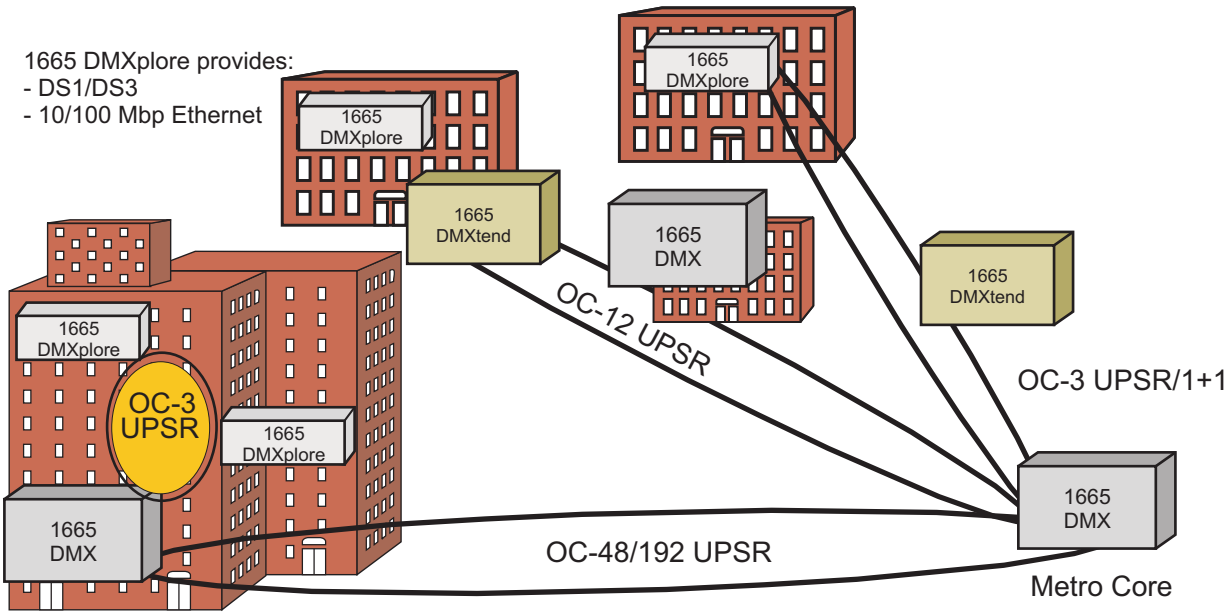
Alcatel-Lucent 1665 DMXplore is designed with a default set of cross-connections to simplify installation and set up. The user can provision whether or not the default cross-connections are established when the Alcatel-Lucent 1665 DMX is installed.

Alcatel-Lucent 1665 DMXplore cards supporting OC-3 or OC-12 interfaces and switch fabric servicing DS1 and DS3 ports can be upgraded in-service.

The Alcatel-Lucent 1665 DMXplore is optimized for low-cost entry into end-user environments. The Alcatel-Lucent 1665 DMXplore can be placed in an office building, medical facility, hotel, college dormitory, or any building housing a moderate amount of multiple end users. In its ability to provide a flexible mix of DS1, DS3, and 10/100 Mbps

interfaces, the Alcatel-Lucent 1665 DMXplore is ideal as a collection point for multiple lines within a diverse MTU (Multi-Tenant Unit), providing a variety of both voice and data services.

Figure 1-2 Alcatel-Lucent 1665 DMXplore providing enterprise access



1665 DMX = Alcatel-Lucent 1665 Data Multiplexer
1665 DMXtend = Alcatel-Lucent 1665 Data Multiplexer Extend
1665 DMXplore = Alcatel-Lucent 1665 Data Multiplexer Explore

MA-DMXplore-11

2 Features

Overview

Purpose

This chapter briefly highlights the features of Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX). These features are more thoroughly described in Chapter 3, “Applications and configurations”, Chapter 4, “Product description”, Chapter 5, “Operations, administration, maintenance, and provisioning”, and Chapter 6, “System planning and engineering”, as applicable.

Contents

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Hardware features

Overview

This section briefly describes the major hardware related features of the Alcatel-Lucent 1665 DMX.

Below is a list of the sections included in Hardware Features:

- High-Capacity Shelf
- System Controller
- Network interface circuit packs (those housed in the MAIN slots of the Alcatel-Lucent 1665 DMX shelf)
- Optical, tributary interface circuit packs
- Electrical, tributary interface circuit packs
- Ethernet circuit packs
- Other hardware features

Important! For more detailed information on the capabilities of these circuit packs, see "Circuit packs" (p. 4-10) in Chapter 4, "Product description". For technical specifications, see Chapter 10, "Technical specifications".

High-Capacity shelf

The High-Capacity shelf is the current standard Alcatel-Lucent 1665 DMX shelf. This shelf incorporates DS1/E1 and DS3/EC-1 interfaces that were not included in the original design, and enables Alcatel-Lucent 1665 DMX to support 224 DS1s/E1s or 192 DS3s/EC-1s. In order to support this amount of traffic, the High-Capacity shelf must be equipped with high density DS1 and DS3 circuit packs.

The shelf is available in both 20 Amp and 30 Amp versions.

20-amp shelf

The 20 Amp version of the High-Capacity shelf contains the same functionality as the 30 Amp High-Capacity shelf, but it is limited to a total current drain of 20.0 amps. In applications where the planned equipage will never exceed 20.0 amps, power cables can be sized accordingly, thus enabling a considerable savings in power cable investment.

Important! With VLF Main packs, overload and overheating in the 20-amp shelf is possible given certain combinations of circuit packs in the low-speed slots. VLF Main packs are not necessarily precluded from use in the 20 Amp shelf, but there are four configurations list in Table 10-106, "Current drains" (p. 10-135) that could cause power issues.

System controller - SYSCTL (no network interfaces)

Alcatel-Lucent 1665 DMX supports the LNW2 SYSCTL. The SYSCTL provides communication with other circuit packs on the Alcatel-Lucent 1665 DMX shelf. The SYSCTL supports all Alcatel-Lucent 1665 DMX operations interfaces, including IAO LAN (OSI or TCP/IP), TL1, CIT, office alarms, and miscellaneous discretes. The SYSCTL also supports DCC terminations for each optical line interface.

Network interface circuit packs

This section briefly details the circuit packs currently available to provide or support network interfaces for the Alcatel-Lucent 1665 DMX. This includes all of the high-speed circuit packs, housed in the MAIN slots of the Alcatel-Lucent 1665 DMX shelf, and used to provide the connection to the core-side of the network.

Main switch circuit pack (no network interfaces)

Alcatel-Lucent 1665 DMX supports the following main switch cards:

- LNW80: headless pack to facilitate switching amongst multiple tributary interfaces, resides in Main slots, provides no high speed or network side optics, VT mapping in 96 STS-1s, OSP hardened

VLF Main circuit packs (LNW59/LNW82/LNW504)

Alcatel-Lucent 1665 DMX supports the following VLF Main circuit packs, and supports 0x1 port application on these packs:

- LNW59 pack supports up to two OC-192 interface and provides a total 140G of Input/Output interfaces. The LNW59 has 180G of usable STS-1 fabric and 30G of usable VT fabric. (The pack could support a 240G STS-1 fabric and a 45G VT fabric with future tributary enhancements.)
- LNW82 pack supports up to 8 OC-3 interfaces, 8 OC-12 interfaces, or 2 OC-48 interfaces. Although mixing of interface rates is supported, OC-48 interfaces are only supported on ports 1 and 5. When one of these ports is operating at the OC-48 rate, then the next three adjacent ports cannot be used. The backplane interfaces can operate at 2.5 Gb/s or at 622 Mb/s, supporting all VLF-compatible low-speed packs. The LNW82 provides a total of 110G of Input/Output interfaces. The LNW82 has 130G of usable STS-1 fabric and 10G of usable VT fabric. (The pack could support a 170G STS-1 fabric and a 20G VT fabric with future tributary enhancements.)
- LNW504 pack supports up to 4 OC-192 interfaces or up to 3 OC-192 interfaces and 4 OC-48 interfaces. Although mixing of interface rates is supported, OC-192 interfaces are only supported on ports 1–4, and OC-48 interfaces are only supported on ports 5–8. The backplane interfaces can operate at 10 Gb/s and/or 2.5 Gb/s, supporting all VLF-compatible low-speed packs. The LNW504 provides a total of 180G of Input/Output interfaces. The LNW504 has 220G of usable STS-1 fabric and 30G of usable VT fabric. (The pack could support a 240G STS-1 fabric and a 45G VT fabric with future tributary enhancements.)

Very Large Fabric (VLF) Main circuit packs drastically increase the overall switch fabric capacity of Alcatel-Lucent 1665 DMX. Their ports can be equipped with PTMs. The LNW59 pack supports OC–192 (1.3SR1, 1.5IR2, 1.5LR2, and DWDM) pluggable optics. The LNW82 multi-rate pack supports OC-3 (1.3SR1, 1.3IR1. 1.3LR1 and CWDM) OC-12 (1.3IR1, 1.3LR1, 1.5LR2, and CWDM), or OC-48 (1.3SR1, 1.3LR1, 1.5LR2, and DWDM) pluggable optics. The LNW504 pack supports OC-48 (1.3SR1, 1.3LR1, 1.5LR2, and DWDM) and OC-192 (1.3SR1, 1.5IR2, 1.5LR2, and DWDM) pluggable optics.

VLF cards can also function in headless mode, providing switching and synchronization functionality without being equipped with optics. The VLF packs enable true 0x1 operation among the tributary slots by supporting unprotected 0x1 interfaces located in the same function or growth unit. All tributary circuit packs, with the exception of the LNW7, are supported by the VLF packs.

OC-192 network interface circuit packs

Alcatel-Lucent 1665 DMX supports the following OC-192 network interface cards:

- LNW56: 1550 nm, intermediate-reach, VT mapping across 48 STS-1s
- LNW58: 1310 nm, short-reach, VT mapping across 48 STS-1s
- LNW59: PTM-based VLF Main, 2 OC-192 ports
- LNW502: PTM-based, VT mapping across 48 STS-1s
- LNW504: PTM-based VLF Main, multi-rate, multi-port, up to 4 ports, can be equipped with OC-192 PTMs

OC-48 network interface circuit packs

Alcatel-Lucent 1665 DMX supports the following OC-48 network interface cards:

- LNW27: 1310 nm, long-reach, VT mapping across 48 STS-1s
- LNW29: 1550 nm, long-reach, VT mapping across 48 STS-1s
- LNW32: 1310 nm, long-reach, VT mapping across 48 STS-1s, OSP hardened
- LNW76: 1310 nm, short-reach, VT mapping across 48 STS-1s
- LNW82: PTM-based VLF Main, multi-rate, multi-port, up to 2 OC-48 PTMs, OSP hardened
- LNW202: PTM-based, VT mapping across 48 STS-1s, OSP hardened
- LNW504: PTM-based VLF Main, multi-rate, multi-port, up to 4 ports, can be equipped with OC-48 PTMs

OC-12 network interface circuit packs

Alcatel-Lucent 1665 DMX supports the following OC-12 network interface cards:

- LNW48: 1310 nm, intermediate-reach, VT mapping across 12 STS-1s, OSP hardened
- LNW50: 1310 nm, long-reach, VT mapping across 12 STS-1s, OSP hardened
- LNW54: 1550 nm, long-reach, VT mapping across 12 STS-1s, OSP hardened

- LNW82: PTM-based VLF Main, multi-rate, multi-port, up to 8 OC-12 PTMs, OSP hardened
- LNW203: PTM-based, VT mapping across 12 STS-1s, OSP hardened

OC-3 network interface circuit packs

Alcatel-Lucent 1665 DMX supports one OC-3 network interface card.

The LNW82 is a PTM-based VLF Main, multi-rate, multi-port pack with up to 8 OC-3 PTMs, OSP hardened.

Tributary interface circuit packs

This section briefly details the circuit packs currently available to provide or support tributary interfaces for the Alcatel-Lucent 1665 DMX. This includes all of the low-speed circuit packs and housed in the Function/Growth slots of the Alcatel-Lucent 1665 DMX shelf

Optical, tributary interface circuit packs

Note: When the shelf is equipped with non-VLF mains, the low-speed circuit packs support the VT mapping as specified below. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains.

Alcatel-Lucent 1665 DMX supports the following optical, tributary interface circuit packs:

- LNW31: OC-48, 1310 nm, intermediate-reach, 1 port, VT mapping across 12 STS-1s, OSP hardened
- LNW37: OC-3, PTM-based, 4 ports, VT mapping across 12 STS-1s, OSP hardened
- LNW45: OC-3, PTM-based, 8 ports, VT mapping across 48 STS-1s, OSP hardened
- LNW49: OC-12, PTM-based, 4 ports, VT mapping across 48 STS-1s, OSP hardened
- LNW55: OC-3/OC-12/OC-48, PTM-based, multi-port, multi-rate (MPMR), 12 ports, only supported in systems equipped with VLF Main circuit packs, OSP hardened
- LNW62: OC-48, PTM-based, 4 ports, only supported in systems equipped with VLF Main circuit packs
- LNW402: OC-48, PTM-based, a single low-speed OC-48 port, VT mapping across 12 STS-1s, OSP hardened
- LNW603: OC-192, PTM-based, a single low-speed OC-192 port. LNW603 is only support in shelf that is equipped with VLF mains.

WDMX, tributary interface circuit packs

WDMX is the name of a family of features that adds metro WDM capabilities to the Alcatel-Lucent 1665 DMX product line. WDMX is the integration of WDM functions directly on the Alcatel-Lucent 1665 DMX shelf platform. It adds ITU-T Optical Transport Network (OTN) layered structure for WDM within the shelf footprint.

Alcatel-Lucent 1665 DMX provides WDMX capabilities with the following circuit packs:

- LNW785: 8 channel low-loss DWDM Mux/Demux (OMD5/8), with integrated variable optical attenuators (VOAs).
- LNW705: PTM-based Muxponder pack (XM10G/8) multiplexes up to 8 ports of high-bandwidth client interfaces (OC-3, OC-12, OC-48 GigE) onto a single 10G wavelength.

The LNW705 and LNW785 must be installed in a shelf with an LNW2 and at least one Main pack. VLF and non-VLF Mains support the WDM packs.

Electrical, tributary interface circuit packs

Alcatel-Lucent 1665 DMX supports the following electrical, tributary interface circuit packs:

- LNW785: 8 channel low-loss DWDM Mux/Demux (OMD5/8), with integrated variable optical attenuators (VOAs).
- LNW705: PTM-based Muxponder pack (XM10G/8) multiplexes up to 8 ports of high-bandwidth client interfaces (OC-3, OC-12, OC-48 GigE) onto a single 10G wavelength.
- LNW7: 28DS1PM, 28 ports, enables PM functionality on DS1 interfaces, not supported on shelves equipped with VLF Mains, OSP hardened
- LNW8: 56DS1/E1, 56 ports, enables PM functionality on DS1 and E1 interfaces (E1 functionality provisionable on a per pack basis), OSP hardened
- LNW16: 12DS3/EC1, 12 ports, DS3 or EC-1 service is provisionable on a per-port basis, OSP hardened
- LNW18: DS1/DS3 TransMUX, 12 ports, capable of collecting various DS1 signals from around a ring and combining them into channelized DS3 signals, OSP hardened
- LNW19B: 48DS3/EC1, 48 ports, DS3 or EC-1 service is provisionable on a per-port basis, supports DS3 loopbacks, OSP hardened
- LNW20: DS1/DS3 TransMUX/Portless, 48 ports, DS3, EC1, and TMUX functionality on a port-by-port basis, supports channelized or unchannelized DS-3s, also offers a portless mode wherein the pack pulls DS1s from channelized DS3 signals that enter Alcatel-Lucent 1665 DMX on a SONET STS-1 interface (on another pack) and then converts them to a VT mapped STS-1, OSP hardened
- LNW801: 56DS1/E1, redesigned version of the LNW8, 56 ports, enables PM functionality on DS1 and E1 interfaces (E1 functionality provisionable on a per pack basis), OSP hardened

Ethernet interface circuit packs

Alcatel-Lucent 1665 DMX supports the following Ethernet interface circuit packs:

- LNW63: 4-port Optical/Electrical Gigabit Ethernet Private Line, 4 optical 1000BASE-SX/LX/ZX or 4 electrical 1000BASE-T PTMs, OSP hardened
- LNW64: 8-port Optical/Electrical Gigabit Ethernet Private Line, 8 optical 1000BASE-SX/LX/ZX or 8 electrical 1000BASE-T PTMs, also supports a mix of 4 optical and 4 electrical PTMs, 168 STS-1 capacity, requires VLF Mains, OSP hardened
- LNW66: Fast Ethernet, 24 ports, 10/100BASE-T
- LNW73: FC-DATA, 4 ports, support of FICON, ESCON, or Fibre-Channel interfaces using PTM optics, pack must be equipped with only one type of PTM: either FICON/FC or ESCON.
- LNW73C: FC-DATA, 4 ports, support of FICON, ESCON, or Fibre-Channel interfaces with compression. Identical to the LNW73, except that is supports compression of SAN traffic, resulting in an increase of bandwidth efficiency to the order of 100%.
- LNW74: Fast Ethernet Private line pack, PTM–based, 16 10/100BASE-T and 8 optical 100BASE-ZX/LX/FX ports, OSP hardened
- LNW87: Private Line Ethernet, PTM-based 4-port Fast Ethernet or Gigabit Ethernet (per port provisionable) 100/1000BASE-T, 100BASE-ZX/LX/FX, and 1000BASE-SX/LX/ZX, OSP hardened
- LNW170: 4-port Gigabit Ethernet and 4-port Fast Ethernet, Private Line or Switched Ethernet, PTM-based, 100/1000BASE-T, 100BASE-ZX/LX/FX, and 1000BASE-SX/LX/ZX ports

Other hardware features

Alcatel-Lucent 1665 DMX also supports the following hardware:

Pluggable transmission modules (PTMs)

PTM optics are pluggable optics. Circuit packs using pluggable optics do not come equipped with optics; you can order only the number and type of optics required at the time of installation. Additional optics can then be ordered as new services are required which makes Alcatel-Lucent 1665 DMX interface density scalable to meet the unique needs of each customer. The PTM optics also allow for some versatility in the span lengths and rates that can be covered by the same pack.

PTMs are either SFPs or XFPs. OC-3, OC-12, OC-48, Fast Ethernet, and Gigabit Ethernet ports use optical SFPs. OC-192 port use optical XFPs. Electrical SFPs are also available for Fast Ethernet and Gigabit Ethernet ports The LNW705 (10G Muxponder) packs use SFPs on the 8 client ports and an XFP on the OTU2 port.

The LNW63/64/87/170 packs support dual-function electrical SFPs that are provisionable for 100 or 1000 Mbps (electrical FE or GbE) traffic. They conform to the IEEE802.3 standards for 100BASE-T and 1000BASE-T in the respective settings (IEEE802.3z and IEE802.3ab). Connectivity is provided for an RJ-45 Cat 5 cable and the SFP has a maximum span length of 100 meters.

External optical amplifiers

For OC-48/192 spans of up to 140 km, Alcatel-Lucent offers external optical amplifiers. The external optical amplifier is a stand-alone shelf and can be used with both OC-48 and OC-192 optics.

External optical amplifiers consist of one booster and one pre-amplifier part. The booster part is connected via a Dispersion Compensation Module (DCM) to the transmit interface of the respective OC-192 or OC-48 port unit. The pre-amplifier part is connected by means of a DCM to the receive interface of the associated port unit.

Passive optics units (POUs)

The Alcatel-Lucent Passive Optics Units (POUs) are a lower-cost solution to using DWDM for transmitting large amounts of traffic on one fiber. This module fits into a bay frame, but reduces the number of Alcatel-Lucent 1665 DMX shelves in a bay to three. The box does not require any electrical powering.

POU shelves are available to support the following applications:

- Optical add-drop module (OADM): 1, 2, or 4 wavelengths
- Optical add-drop module (OADM): one 1310 nm port and four 1550 nm ports
- 16 unidirectional/bidirectional wavelengths (2 versions): MUX/DMUX
- 32 wavelengths; 16 unidirectional/bidirectional wavelengths with a wavelength interleaver used to add another 16 wavelengths: MUXINT/DMUXINT

Cable management bracket

In the interest of helping customers organize the physical networking in their offices, Alcatel-Lucent 1665 DMX provides a fiber management bracket that mounts to the apparatus blanks used in the unoccupied slots of the shelf. This bracket has hooks where fibers can be set until the pack to which they will be attached is installed. This bracket is available with either 16 or 24 LC fiber storage ports.

The bracket is designed to facilitate the organization and storage of pre-wired fibers that are expected to carry service to the shelf in the future. These brackets attach to the apparatus blanks via PEM nuts on the faceplate. PEM Nuts or PEM Fasteners are mounted flush on the faceplate. They provide a fixed receptacle to which the bracket can be screwed in.

This feature is available on both the standard and detectable apparatus blanks and also allows visibility via the CIT.

Electrical continuity test tool (LNW94)

Alcatel-Lucent 1665 DMX supports a circuit pack designed to aid technicians in the installation and maintenance of Electrical interfaces and cables. The Electrical Continuity Test Tool (LNW94) can be placed in any Function Unit slot (A, B, C, and D) on the Alcatel-Lucent 1665 DMX shelf. It is used to test the cables which will be connected to DS1, DS3, or Ethernet electrical interfaces. LNW94 tests the integrity of electrical cables to both identify where trouble exists and which cables or DSX panels are faulty prior to installation and turn up.

In-service electric continuity test tool (LNW93)

The In-service Electrical Continuity Test Tool (LNW93) test circuit pack is used for upgrades in the Alcatel-Lucent 1665 DMX shelf. An in-service shelf might have a function unit with low capacity DS1 (LNW7) or DS3 (LNW16) packs. When these packs are upgraded with higher capacity packs (DS1, LNW8, DS3, LNW19B), as part of the upgrade procedure, new DS1 or DS3 connectorized cables are added to the DSX cross-connect frames and to the Alcatel-Lucent 1665 DMX shelf. The LNW93 pack is used to test out the new wiring without disrupting traffic on the in-service pack.

The LNW93 is very similar to the LNW94 test tool except that it has no backplane connectors for DS1 ports #1–28 or for DS3 ports #1–12. When the LNW93 is plugged in, it makes no contact with the wires on the backplane for those lower ports. Since there is no physical connection, the LNW93 does not interfere with the service of the pack in the other slot of the function unit. The LNW93 tests the integrity of electrical cables to both identify where trouble exists and which cables or DSX panels are faulty prior to installation and turn up of a high density DS1 or DS3 circuit pack.

Blank circuit packs

Alcatel-Lucent 1665 DMX provides blank cards to be used as fillers in unpopulated slots of the shelf. These fillers help to ensure proper air flow, cooling and EMC safety.

Some blanks can be detected and reported.

Alcatel-Lucent 1665 DMX supports two detectable blank circuit packs: LNW97 in an unequipped M2, LNW98 in unequipped Function and Growth slots.

The *WaveStar*® CIT reports the presence of a detectable blank in a slot by displaying a blank faceplate graphic instead of an empty slot graphic. No alarms are associated with the insertion or removal of the detectable blank.

Table 2-1 Blank circuit packs

Blank pack	Slot(s)	Detected
177D	A–D, G1, G2	No
177E	M2	No
LNW97	M2	Yes

Table 2-1 Blank circuit packs (continued)

Blank pack	Slot(s)	Detected
LNW98	A–D, G1, G2	Yes

Topologies

Overview

This section briefly describes the major topologies supported for Alcatel-Lucent 1665 DMX.

High-speed (network interface) OC-192/48/12/3 UPSR for STS-n/VT1.5

Alcatel-Lucent 1665 DMX supports Unidirectional Path Switched Rings (UPSR) at the STS-n and VT1.5 level. When both Main slots are equipped with OC-192/48/12 VLF or large VT fabric circuit packs, an STS-1/VT1.5 switching fabric (STS-1, STS-3c, STS-12c, STS-48cSTS-48c, or STS-192c) supports the low-speed interfaces. OC-48/12 medium VT fabric cards, supporting STS-1, STS-3c, STS-12c, and STS-48c are also available. Each circuit pack establishes both an east-to-west and a west-to-east rotation on the ring. A UPSR ring provides a very valuable and reliable foundation for services protecting against fiber cuts and node failures.

High-speed (Network interface) OC-192/48 BLSR for STS-1/VT1.5

Alcatel-Lucent 1665 DMX supports an OC-192/48 Bidirectional Line Switched Ring (BLSR). When both Main slots are equipped with OC-192/48 high-speed circuit packs, an STS-1 switch fabric supports the low-speed interfaces (STS-1, STS-3c, STS-12c, or STS-48c. When both Main slots are equipped with VLF packs, in addition to low-speed interfaces (STS-1, STS-3c, STS-12c, or STS-48c), STS-192c is also a supported rate.). A 2-fiber bidirectional line-switched ring (BLSR) is a self-healing ring configuration in which bidirectional traffic travels over the same set of nodes in each direction. Bidirectional switching makes use of redundant (protection) bandwidth on the bidirectional lines that interconnect the nodes in the ring to provide protection for traffic carried on the working bandwidth. Because the traffic is bidirectional, a single circuit does not necessarily consume bandwidth on every span in the ring. This leaves the spans between other nodes available for additional traffic. Therefore, with distributed switching patterns, a BLSR can carry more traffic than the same facilities could carry if configured for a unidirectional path-switched ring. In BLSR configurations, the VT switch fabric located in the MAIN packs is used only for Function Unit or Growth Slot hairpins.

Alcatel-Lucent 1665 DMX supports VT BLSRs on all high speed OC-192 interfaces and on high-speed OC-48 interfaces that have a 48 STS-1 VT fabric or VLF (LNW29, LNW27, LNW32, LNW56, LNW58, LNW59, LNW76, LNW82, LNW202, LNW502,LNW504).

Multiple BLSRs

Alcatel-Lucent 1665 DMX supports multiple BLSRs on the low-speed interfaces. Alcatel-Lucent 1665 DMX supports 15 simultaneous BLSR protection groups in a single shelf. The 15 protection groups can be provisioned on any available OC-48 and OC-192 port pairs within the high-speed and low-speed groups.

True 0x1

When equipped with VLF Main packs (LNW59/LNW82/LNW504), Alcatel-Lucent 1665 DMX allows true 0x1 unprotected circuit pack applications. That means that any slot can be equipped with any pack (some restrictions apply). For example, an LNW170 could be used to provide switched Ethernet services in slot D1, while slot D2 could be equipped with another pack, like an LNW62. Two of the same circuit packs can also populate adjacent slots in the same group, yet certain restrictions apply. For more information on 0x1, including circuit pack/slot equipage restrictions, see Chapter 6, “System planning and engineering”.

When VLF Mains are used, the 0x1 OCn application is used instead of 0x1Sn functionality. 0x1Sn is still supported when the shelf is equipped with non-VLF Mains. 0x1 is available on both low-speed/tributary packs, and VLF Main (M1/M2) interfaces. When all lines on an OCn pack are set to 0x1, the pack becomes unprotected and the companion slot can be equipped with a different pack.

VT grooming and squelching

Alcatel-Lucent 1665 DMX supports GR-1230 compliant VT grooming and squelching on OC-48/192 BLSRs. Alcatel-Lucent 1665 DMX also support the automatic generation of VT squelch maps.

High-speed (network interface) OC-192/48/12/3 linear optical extensions

Alcatel-Lucent 1665 DMX supports 1+1 protected linear optical extensions. The high-speed linear optical extension may connect the Alcatel-Lucent 1665 DMX shelf, by way of OC-3/12/48/192 network interfaces in the MAIN slots, to an OC-3/12/48/192 node.

Revertive unidirectional and bidirectional 1+1 are supported, as well as non-revertive.

Beginning in Release 9.0, you can change 1+1 protection group from unidirectional to bidirectional in-service without deleting cross-connections.

Low-speed UPSRs (for STS-1 termination and VT ring closure)

Alcatel-Lucent 1665 DMX can host multiple rings on the low-speed interfaces of the Alcatel-Lucent 1665 DMX shelf. Each circuit pack establishes both an east-to-west and a west-to-east rotation on the ring. A UPSR ring provides a very valuable and reliable foundation for services protecting against fiber cuts and node failures.

Alcatel-Lucent 1665 DMX supports UPSRs on all lines of all equipped function group or growth slots.

Low-speed (tributary interface) linear optical extensions

Alcatel-Lucent 1665 DMX supports 1+1 protected linear optical extensions for data transport originating at a data device. The low-speed linear optical extension may connect the Alcatel-Lucent 1665 DMX shelf, by way of by way of OC-3/12/48/192 tributary interfaces in the Function or Growth slots, to an OC-3/12/48/192 node.

Single- and dual-homed ring extensions

Alcatel-Lucent 1665 DMX supports low-speed OC-3/12/48 0x1 protected broadband tributaries, including single- and dual-homed ring extensions. A DDM-2000 OC-3, OC-12, FiberReach, Alcatel-Lucent 1665 DMXtend, Alcatel-Lucent 1665 DMX, or Alcatel-Lucent 1665 DMXplore may be the add/drop multiplexer on the lower-speed ring.

Hairpinning

In "hairpinning" topologies, low-speed tributary traffic is routed into the system and back out without ever being placed on the high-speed (OC-12, OC-48 or OC-192) interfaces. When a VLF Main pack is used, all cross-connects use the switch fabric located on the VLF pack. Any switch fabrics located on low-speed, tributary packs are disabled when VLF Mains are used.

Dual ring interworking

Alcatel-Lucent 1665 DMX supports UPSR DRI. The dual node ring interworking (DRI) cross-connections comply with *Telcordia* ® GR-1400 (which refers to GR-253-CORE) standards. A service selector exists for each STS-N tributary provisioned for DRI.

Both DRI and dual homed rings are designed to protect against a failure of an interconnecting facility or a failure of the node at which the interconnection occurs. The choice of DRI vs. DHA is driven by the network topology. To provide protection when connecting between two UPSRs, DRI is used. To provide protection when connecting between a UPSR and a single NE, dual homing is used.

GbE Private Line

Alcatel-Lucent 1665 DMX GbE private lines (1000 Mbps) enable premium data transport services offering GbE transport with optional bandwidth provisioning up to full line-rate. GbE private lines provide the user the ability to transport frames completely transparently between two Alcatel-Lucent 1665 DMX NEs. No VLAN knowledge or packet-layer provisioning is required by the user in this application. Simple, SONET cross-connect provisioning is all that is required when using "Private Line" or "no tag" mode. These GbE capabilities allow the Alcatel-Lucent 1665 DMX to provide dedicated bandwidth for individual customers and fast SONET-layer restoration.

Fast Ethernet Private Line

Alcatel-Lucent 1665 DMX Fast Ethernet (10/100 Mbps) private lines enable premium data transport services offering 10/100 Mbps transport with optional bandwidth provisioning up to 100Mbps (variable bandwidth provisioning of 1, 2, or 3 STS1s. Fast Ethernet private lines provide the user the ability to transport frames completely transparently between two Alcatel-Lucent 1665 DMX NEs. No VLAN knowledge or packet-layer provisioning is required by the user in this application. Simple, SONET cross-connect provisioning is all that is required. These Fast Ethernet capabilities allow the Alcatel-Lucent 1665 DMX to provide dedicated bandwidth for individual customers and fast SONET-layer restoration. LNW74 or LNW87 must be used to enable Fast Ethernet private lines.

GbE packet rings

Alcatel-Lucent 1665 DMX supports Gigabit Ethernet (GbE) packet rings that enable cost-effective Internet access and business-to-business LAN services. GbE packet rings allow interworking among 10/100 Mbps and 1000 Mbps (GbE) Ethernet lines while VLAN tagging ensures individual customer privacy. These GbE capabilities allow Alcatel-Lucent 1665 DMX to support various Quality of Service (QoS) features, including fast packet-layer restoration.

4093 VLANs

Alcatel-Lucent 1665 DMX allows the provisioning of up to 4093 separate IEEE 802.1q VLANs. VLANs are a way in which LAN users at the enterprise level, located on physically separated LAN networks, are assigned priority access privileges across a WAN backbone. Although they are in different locations, they appear to be on the same physical segment of an enterprise-level LAN. Thus, VLANs are logical groupings of various users, regardless of their physical location on the network.

Stacked VLANs (VLAN transparency)

Alcatel-Lucent 1665 DMX allows customer traffic to be identified and segregated using "stacked" IEEE 802.1q VLAN tags. VLAN tags enable the formation of Virtual Private Networks (VPNs) by segregating various units of traffic and isolating different

end-customers. This allows data from different customers to efficiently share common bandwidth while simultaneously ensuring a basic level of security for each customer (hence VPN).

The notion of VLAN "transparency" comes from the fact that individual customer packets are tagged using a second tag, a default port tag (default port tag is provided by customer equipment). There is no need to coordinate VLAN tags between the customer and service provider. Therefore, customer packets are transmitted through a service provider's network "transparently".

G.8032 Ethernet ring protection

Alcatel-Lucent 1665 DMX support Ethernet Ring Protection (ERP) functionality, based on ITU-T G.8032 on the LNW170 circuit pack. This feature provides rapid (50ms) revertive switching for

- Physically-connected optical Ethernet links connected in a ring configuration
- Ethernet PTM-based ports
  On the LNW170 Ethernet PTM-based ports, local signal failure is declared when any of the following conditions are present:
  - Signal failure (LOS) detected on the port
  - TX_FAULT bit active on optical PTMs (not on electrical PTMs)
  - PTM failures (for example, rate check failure.)
  - PTM removal
  - port in Admin-down state (admin=disable in ed-eport)
- VCGs
  On VCGs, local signal failure is declared when the VCG is failed or transitions into AUTO state (because all cross-connections have been removed).

Wave Division Multiplexing in Alcatel-Lucent 1665 DMX shelves (WDMX)

WDMX is the name of the family of features that adds metro WDM capabilities to the Alcatel-Lucent 1665 DMX product line. For additional details see, “WDMX optical multiplexing network models” (p. 3-51).

In-service upgrades

Overview

This section briefly describes the in-service network, optical span, and node upgrades supported for Alcatel-Lucent 1665 DMX.

In-service high-speed OC-48 UPSR to OC-192 UPSR upgrade

Alcatel-Lucent 1665 DMX supports an in-service upgrade, enabling you to increase UPSR network capacity from OC-12 to OC-48 (12 STS-1 [small] fabric packs or STS-48 [medium] fabric packs).

In-service high-speed OC-48 BLSR to OC-192 BLSR upgrade

Alcatel-Lucent 1665 DMX supports an in-service upgrade, enabling you to increase BLSR network capacity from OC-48 to OC-192 without affecting service.

In-service OC-12 UPSR to OC-48 UPSR upgrade

Alcatel-Lucent 1665 DMX supports an in-service upgrade, enabling you to increase UPSR network capacity from OC-12 to OC-48 (small, 12 STS-1 fabric packs) without affecting service. In-service network upgrades to the LNW82 are not currently supported

In-service 1+1 upgrade

Alcatel-Lucent 1665 DMX supports an in-service upgrade, enabling you to increase 1+1 network capacity from OC-3 to OC-12or OC-12 to OC-48 (Main and tributary packs) without affecting service.

In-service protected OC-n to DWDM span upgrade

Alcatel-Lucent 1665 DMX supports an in-service upgrade to add DWDM Optical Multiplexer/Demultiplexer (OMD) circuit packs into the optical span, thereby increasing the transmission capacity of the optical span. The original OC-n signal is carried in one of the OMD channels and the remaining OMD channels are available to carry additional service. To insert the OMD circuit packs into the optical span in-service requires that the span be either 1+1 protected or be part of a UPSR/BLSR ring.

In-service LNW1 to LNW2 node upgrade

The LNW1 is not supported by the current Alcatel-Lucent 1665 DMX release. An in-service upgrade from the LNW1 to LNW2 can be performed on any shelf that is running Release 5.1 software. The LNW1 functions with every software release prior to R6.0, but the LNW2 must be used with R6.0 or later releases.

In-service high-speed OLIU circuit pack upgrades

Alcatel-Lucent 1665 DMX supports the following in-service high-speed OLIU circuit packs upgrades:

- Small fabric LNW26B, LNW28, LNW77 OC-48 OLIUs to large fabric LNW27, LNW29, LNW32, LNW76, or LNW202, OLIUs
- Large fabric LNW27, LNW29, LNW32, LNW76, or LNW202 OC-48 OLIUs to Very Large Fabric (VLF) multirate LNW82 OC3/OC12/OC48 OLIUs
- Large fabric LNW27, LNW29, LNW32, LNW76 or LNW202 OC-48 OLIUs to Very Large Fabric (VLF) LNW59 OC-192 OLIUs via LNW56 OLIU. This is a one step upgrade that just needs the LNW56 in one node.
- Large fabric LNW56, LNW57 (DA'd September 2011), LNW58, LNW502, or LNW555 OC-192 OLIUs to Very Large Fabric (VLF) LNW59 OC-192 OLIU
- Very Large Fabric (VLF) multi-port, multi-rate LNW82 OLIU to Very Large Fabric (VLF) LNW59 OC-192 OLIU (one port)
- Large fabric LNW56, LNW57 (DA'd September 2011), LNW58, or LNW502 OC-192 OLIUs to Very Large Fabric (VLF) LNW504 OC-192 OLIU
- Very Large Fabric (VLF) LNW59 OC-192 OLIUs to Very Large Fabric (VLF) LNW504 OC-192 OLIU (one or two port)
- Small fabric LNW48, LNW50, LNW54, LNW203 OC-12 OLIU to a single OC-12 port on the Very Large Fabric (VLF) multi-port, multi-rate LNW82 OLIU

In-service low-speed OLIU circuit pack upgrades

Alcatel-Lucent 1665 DMX supports the following in-service low-speed OLIU circuit packs upgrades:

- low-density 4-port LNW36/LNW37 OC-3 OLIU to high-density 8-port PTM-based LNW45 OC-3 OLIU
- LNW36/LNW37/LNW45 OC-3 OLIU to 12-port PTM-based LNW55 OC3/OC12/OC48 OLIU
- low-density 2-port LNW46 OC-12 OLIU to high-density 4-port PTM-based LNW49 OC-12 OLIU
- LNW46/LNW49 OC-12 OLIU to 12-port PTM-based LNW55 OC3/OC12/OC48 OLIU
- 1-port LNW31 OC-48 OLIU to 12-port PTM-based LNW55 OC3/OC12/OC48 OLIU

In-service PTM upgrades

Alcatel-Lucent 1665 DMX supports in-service, per port upgrades of the OC-3, OC-12, OC-48 PTMs on the multi-port, multi-rate LNW82 and LNW55 circuit packs.

In-service electrical upgrade from low to high-density DS1/DS3 circuit packs

Alcatel-Lucent 1665 DMX supports an in-service electrical upgrade on the High-Capacity shelf, enabling you to increase DS1/DS3 capacity without affecting service. There is an outage of 100 to 200 milliseconds when upgrading DS1 circuit packs. By upgrading the 28-port LNW7 to the 56-port LNW8 or LNW801, the total DS1 capacity is increased from 112 to 224 DS1 interfaces per shelf.

By upgrading the 12-port LNW16 to the 48-port LNW19B/20, the total DS3/EC1 capacity is increased from 48 to 192. Electrical in-service upgrades can be performed on shelves hosting a mix of DS1 and DS3/EC1 circuit packs without affecting service. The Alcatel-Lucent 1665 DMX High-Capacity shelf is required when using high-density DS1/DS3 circuit packs.

The LNW16, LNW18, LNW19/19B, can be upgraded in-service to the LNW20.

LNW70 to LNW170 circuit pack upgrade

Alcatel-Lucent 1665 DMX supports upgrading an unprotected LNW70 (DA'd January 2010) circuit pack to an LNW170 circuit pack in the same slot. Since the LNW70 circuit pack cannot be protected, this is not an in-service upgrade. However, this upgrade can be performed without removing cross-connections or other provisioning. The LNW170 circuit pack supports all the functionality of the LNW70 circuit pack and adds equipment protection.

Networking capabilities

Overview

This section briefly describes the major networking capabilities supported by Alcatel-Lucent 1665 DMX.

Multicast Ethernet packets

Alcatel-Lucent 1665 DMX supports multicast Ethernet packets. A multicast packet is identified by the first bit in the MAC destination address. Such a MAC address will never appear as a source address, and so multicast destination addresses (TIDs) are not learned. Since unknown destination addresses are treated as broadcast, multicast packets/frames are sent to ALL ports in the VLAN (IEEE 802.1Q) or Transparent LAN (customer/port tag) for that packet.

SAN networking via Alcatel-Lucent 1665 DMX

With the LNW73/73C, Alcatel-Lucent 1665 DMX supports native SAN interfaces integrated into the Alcatel-Lucent 1665 DMX shelf. The LNW73/73C is a Storage Area Networking (SAN) interface card designed to facilitate SAN distance extensions via the use of GFP-T (G.7041) to encapsulate SAN traffic and transport it over SONET networks. It utilizes PTM optics to provide the option of FICON, ESCON, or Fibre-channel interfaces natively on the Alcatel-Lucent 1665 DMX shelf. Each pack must be equipped with only one type of PTM (either FICON/FC or ESCON) and can be housed in Slot A1, B1, C1, D1, or G1. The LNW73/73C can operate at 1 Gbps or 2 Gbps. When the pack is operating at 2 Gbps only every other port may be used. So, the total number of SAN interfaces on an Alcatel-Lucent 1665 DMX shelf is 20 when the LNW73/73C is operating at 1G FC/FICON or ESCON, and 10 when it is set to 2G FC/FICON.

For information about Alcatel-Lucent 1665 DMX interworking as certified by EMC eLab Testing, see "EMC certification" (p. A-100).

Data compression for SAN traffic

The implementation of SAN compression enables a high throughput of up to two full-line rate FC-2G interfaces in a single pack.

Data compression is supported on LNW73C SAN packs. The LNW73C is able to compress asynchronous Fibre Channel traffic and conserve up to 50% of bandwidth versus uncompressed asynchronous FC traffic in typical applications.

Compression for asynchronous FC traffic is pre-standard and will be standardized by FC-BB-4.

Fast spanning tree/ IEEE802.1w rapid re-configuration

Ethernet requires a network with a tree structure in order to work effectively. Ethernet bridges and switches build tables that define the paths to specific devices. A MAC bridge, for example, will have a filtering database that defines where to send any packets addressed to a specific MAC within the network. The tables are built based on input from devices within the network. Alcatel-Lucent 1665 DMX supports an improved/faster spanning tree algorithm, documented in IEEE 802.1w Rapid Re-configuration.

LNW170 support spanning tree on LAN ports in addition to VCG ports.

If there is a loop in the network, that is, if there is more than one way to get to a destination device, two problems can result:

Frames may be duplicated in the network.

- That is, the same frame may be sent to a node via two different paths.

The address information is changed as packets from that device are received across different paths. In a meshed network, the re-configuration of the filtering database can begin to use up all the network resources, so that little bandwidth is left for data traffic.

The spanning tree accomplishes two important functions:

- It removes loops from the bridged network
- It allows Ethernet layer re-configuration if a link fails.

  Important! Alcatel-Lucent 1665 DMX has been designed with multi-vendor interoperability in mind. As many vendors' equipment (including legacy equipment) may not be able to use IEEE802.1w, Alcatel-Lucent 1665 DMX can automatically fall back on IEEE802.1d in the event that other NEs in the network are running standard spanning tree protocol. However Alcatel-Lucent 1665 DMX employs IEEE 802.1w as a default spanning tree protocol.

Rapid spanning tree (RSTP) maintenance enhancements for LNW170 circuit packs

The RSTP maintenance enhancements for the LNW170 circuit packs include the following:

- New performance monitoring counters for VCG and LAN ports or Link Aggregation Groups (LAGs) to record spanning tree modification status
- Spanning tree group Automatic Lock parameter to disable a port which is unstable or rapidly reconfiguring. When the Automatic Lock parameter is enabled and any port in the Spanning Tree Group experiences a threshold-crossing alert (TCA) on the spanning tree state counter, the port is moved to the disabled-failure state preventing traffic flow until released.

Link aggregation on LNW170 LAN ports

Alcatel-Lucent 1665 DMX supports link aggregation on any two LNW170 LAN ports of the same rate (i.e. 100 or 100 Mbps) operating in switched mode. With the LNW170, the ports can be on the same or different LNW170 packs in an equipment-protected pair.

Link aggregation can be used to enable hitless bandwidth increases and both facility and equipment protection on LNW170 LAN ports.

Ordinarily, multiple Ethernet links between two bridges form loops (unless a spanning tree blocks all but one) so they can't be used to increase bandwidth. Link Aggregation causes defined groups of links to be treated as a single logical link, making multiple LAN ports appear as one. In this way, Bandwidth can be increased without requiring an upgrade to a higher rate link.

Link aggregation can also remove failed links automatically, thereby providing a means of facility protection. More links than are needed can be added to the group and each is active until it fails (similar to utilizing LCAS protection for SONET). When two links are on different packs they can provide both, facility and equipment protection. In

Active/Standby LAG, one link of the LAG is designated as the protection link and the other is the working link. Only the working link carries MAC client traffic when none of the links fails. When the working link fails, the traffic switches to the protection link. The protection switching is bi-directional and revertive.

MAC address locking

Alcatel-Lucent 1665 DMX allows MAC locking on the LNW170. MAC locking prevents unauthorized users from gaining access to the network through an Ethernet port, thereby providing a level of security against intrusion attempts. MAC locking restricts access to a bridged Ethernet network by requiring that the source address of traffic entering a locked port be registered with that port. Any number of ports, LANs, VCG, or link aggregation groups (LAGs) can be locked. Alcatel-Lucent 1665 DMX permits registering of multiple addresses with a single entity.

True 0x1 operation for optical ports on LNW74 10/100T/F circuit packs

Series 1:2 or higher LNW74 circuit packs are supported in both slots of the same function/growth group in systems equipped with VLF circuit packs in the Main slots provided there are no loopbacks provisioned on the electrical ports or cross-connections provisioned on the VCG tributaries of any of the electrical ports. The LNW74 circuit pack supports user-provisionable Ethernet port mode configurations that allow true 0x1 optical operation. When operating in the true 0x1 configuration, the optical LAN ports and their associated VCGs/tributaries are fully operational while all operations on the electrical LAN ports and their associated VCGs/tributaries are denied.

Additional Ethernet features (LNW74/87/170)

Many hardware and software-based features require the use of the LNW74. LNW87, and LNW170 circuit packs. The features with a circuit pack listed in parenthesis are available only with the use of the indicated pack.

- Committed and Peak rate controls (CIR and PIR) (LNW170)
- 4 classes of services (LNW170)
- 4xGbE density with PTM optics (LNW170)
- Larger MAC tables (LNW170)
- 32 VCGs (star configuration) per G.707 (LNW170)
- 16 virtual switches with independent VLAN space per virtual switch (LNW170)
- Jumbo Frames
  See “Packet size in different tagging modes” (p. A-66) .
- Link Capacity Adjustment Scheme (LCAS) per ITU G.7042
- Generic Framing Procedure (GFP) per ITU G.7041
- Client Signal Fail

- 100BASE-ZX/LX/FX optical, fast Ethernet ports
- VT1.5 VCAT (LNW74 only)

QoS on EoS VCGs

Quality of service (QoS) on Ethernet over SONET (EoS) VCGs is designed to enable aggregation of diverse data streams in multiple topologies amongst LNW170 circuit packs. These topologies include packet rings, hub-and-spoke with LNW170 at the hub, and hybrid ring/hub-and-spoke with LNW170 at the hub.

QoS on EoS VCGs functions by giving EoS VCG ports the same classification options for incoming packets, rate control capabilities for Ethernet services (PIR, CIR), queuing/scheduling capabilities for outgoing, and the same packet transformation functions as on 802.3 LAN ports.

1 Mbps rate limiting

Alcatel-Lucent 1665 DMX supports rate control at the level of 1 Mbps for Ethernet interfaces. This means that Alcatel-Lucent 1665 DMX can automatically establish Ethernet transmission channels to fit the need of the user upon connection. For each connection, the Alcatel-Lucent 1665 DMX will create a virtual channel of the appropriate size (in 1 Mbps intervals) to facilitate the desired Service Level Agreement (SLA). Rate limiting at the 1Mbps level provides a transmission ceiling for highly efficient allocation of shared bandwidth for data communications.

Ethernet interworking with DDM-2000

To facilitate affordable and more immediate delivery of Ethernet services on SONET networks, Alcatel-Lucent 1665 DMX now interworks with new Ethernet circuit packs available for the DDM-2000.

DDM-2000 now supports a circuit pack providing one 100BASE-LX (100 Mbps p/s) and four 10/100BASE-T ports with data transport at the rate of 10/100 Mbps using standard Ethernet switching (IEEE 802.1), standard encapsulation according to ITU G.7041 for Generic Framing Procedure (GFP), ITU G.707 for Virtual Concatenation (VCAT). The DDM-2000 can transmit Ethernet signals across spans as long as 100 meters. The DDM-2000 circuit pack is designed specifically to support Fast Ethernet Private Line applications. Each circuit pack can support 4 private lines. The pack supports VT1.5, STS-1, and STS-3c cross-connections.

The DDM-2000 circuit pack can interwork with the LNW74 and LNW87 circuit packs.

Alcatel-Lucent 1665 DMX/Alcatel-Lucent 1675 LambdaUnite MSS bay configuration

The compact size of the Alcatel-Lucent 1665 DMX allows you to place two Alcatel-Lucent 1665 DMX shelves and one Alcatel-Lucent 1675 LambdaUnite MSS in the same bay. As the needs of an access site grow to the point where equipment is

required to hub more than 6 OC-48 rings, it becomes advantageous to upgrade an Alcatel-Lucent 1665 DMX shelf to an Alcatel-Lucent 1675 LambdaUnite MSS. The Short Reach (SR) OC-48 and OC-192 optics supported by the Alcatel-Lucent 1665 DMX are designed for such an application. Once the Alcatel-Lucent 1675 LambdaUnite MSS is installed as the hub-node, the Alcatel-Lucent 1675 LambdaUnite MSS node can hub 64 OC-48 rings or 16 OC-192 rings while simultaneously using the original Alcatel-Lucent 1665 DMX as a drop node or mini-DCS.

1+1 protection switching

Alcatel-Lucent 1665 DMX supports revertive and non-revertive unidirectional and bidirectional protection switching for all OC-n interfaces.

Beginning in Release 9.0, you can change 1+1 protection group from unidirectional 1+1 to bidirectional 1+1 in-service without deleting cross-connections.

High-speed VT1.5 granularity

VT1.5 granularity is provided across any 12 STS-1 signals within the OC-12 high-speed OLIUs (LNW48, LNW50, LNW54, LNW203). VT1.5 granularity is provided across 48 STS-1 signals within the OC-48 OLIUs (LNW27, LNW29, LNW32, LNW76, LNW202). VT1.5 granularity is provided across 48 STS-1 signals within the OC-192 OLIUs (LNW56, LNW58, and LNW502).

On VLF mains, the available VT bandwidth is not pre-allocated to high-speed and/or low-speed interfaces. Instead, both high- and low-speed interfaces have access to any available STS-1 connection to the VT fabric. For the LNW59 and LNW504, 30G of VT bandwidth is shared by the local high-speed and low-speed interfaces. For the LNW82, 10G of VT bandwidth is shared by the local high-speed and low-speed interfaces.

VT1.5 granularity is provided across 96 STS-1s on the LNW80 (Main Switch Pack).

For the VT granularity of the tributary (low-speed) packs, see “Optical, tributary interface circuit packs” (p. 2-5).

Loopbacks

Terminal loopbacks are used during installation and maintenance procedures to test the integrity of near and far-end interfaces as well as fibers and system circuitry. Facility loopbacks are used to test the integrity of the customer to provider network link by looping the signals back at the far end and comparing counts of sent and received frames.

Terminal

Alcatel-Lucent 1665 DMX supports terminal loopbacks on:

- All OC-3/12/48/192 high-speed (network side) interfaces
- All OC-3/12/48/192 low-speed (tributary side) interfaces

- DS1, E1 and DS3 interfaces
- All Ethernet interfaces, both optical and electrical

Facility

Alcatel-Lucent 1665 DMX supports facility loopbacks on:

- All OC-3/12/48/192 high-speed (network side) interfaces
- All OC-3/12/48/192 low-speed (tributary side) interfaces
- DS1, E1 and DS3 interfaces
- Optical and electrical interfaces of the LNW78 and LNW170 packs.

State check before loopback

Beginning in Release 9.1, **ENT-SYS** supports a new parameter, loopback port check (lpbk_port_ck). The parameter controls how loopbacks are handled for PDH, EC1 and Ethernet ports based on the state of those ports.

Test access

Test access, a traditional DCS function, allows the user visibility into any DS1/DS3 signal in the network. Test access aids users in turning up connections and in identifying faults in existing service connections.

Alcatel-Lucent 1665 DMX supports two different types of test access. The non-intrusive method simply taps the channel as it passes through the system and routes it to an external testing device. The more intrusive mode splits the VT1.5 or STS-1 from the incoming signal and sends it to an external testing device. Test access facilitates Alcatel-Lucent 1665 DMX functioning in a DCS application.

PRBS generation/detection

Test access using PRBS generation/detection via the internal test head on the VLF Main allows the user to test network, NE, and facility performance/integrity without an external test head. The VLF Mains contain an internal test head that can generate and detect errors in Pseudo Random Bit Sequences (PRBSs). This capability is not meant to wholly eliminate the use of external equipment for tests, but can be used for expediency, less complicated tests, and where non-manual set-up is advantageous. PRBS enabled test access involves initiating test access, inserting a test signal (i.e. a PRBS) generated internal to the NE, and/or monitoring a received test signal internal to the NE. PRBS generation/detection is supported on STS1 and STS3c tributaries.

Alcatel-Lucent 1665 DMX allows up to 12 test access sessions at a time and for a mix of test access sessions that specify tatrib(s) and test access sessions to the internal test head within the 12 allowed sessions. The internal test head hardware supports signal generation on up to 12 STS1s, and signal detection on up to 12 STS1s. Internal test access is supported on STS3c signals; requests using the tatrib parameter(s) are denied. It is

important to note that when a generator or detector is allocated to an STS3c session, it uses 3 of the 12-STS1 capacity, and that 3 generators or detectors on the STS3c boundary must be available.

SS bits per circuit pack or port

By default Alcatel-Lucent 1665 DMX transmits 00 in the outgoing SS pointer bits for compatibility with SONET interfaces. Alcatel-Lucent 1665 DMX provides the ability to set the outgoing SS bits to 10 on a LS optical pack basis for compatibility with older SDH equipment. Alcatel-Lucent 1665 DMX ignores incoming SS bits regardless of the outgoing SS bit provisioning. Most SONET equipment ignores SS bits. Alcatel-Lucent 1665 DMX is provisionable to support SS bits on a per pack basis. This prevents LOP defects and allows SONET/SDH interworking.

The following circuit packs can be provisioned for 00 or 10 SS bits on a per port basis:

- LNW55
- LNW59
- LNW62
- LNW82
- LNW504
- LNW603

Automatic ring discovery for BLSR interworking

Alcatel-Lucent 1665 DMX supports automatic ring discovery to better facilitate BLSR interworking with Alcatel-Lucent 1675 LambdaUnite MSS, FT-2000, *WaveStar*® BandWidth Manager, and *WaveStar*® 2.5G/10G.

Nonpreemptive unprotected traffic

Alcatel-Lucent 1665 DMX allows the manual provisioning of nonpreemptive unprotected traffic (NUT) for multi-point Ethernet and 0x1 cross-connections on service tributaries. Though this traffic is unprotected, its transmission priority will not be preempted by other service or protection traffic.

E-NNI control plane connections

E-NNI control plane connections are supported from a single-node access domain to an I-NNI capable edge node of a core domain. Alcatel-Lucent 1665 DMX or Alcatel-Lucent 1665 DMXtend NEs can serve as single-node domain edge nodes and Alcatel-Lucent 1675 LambdaUnite MSS or other vendors' NEs can serve as the core domain nodes. The transport topology for the E-NNI is SONET linear. Unprotected 0x1 connections and line 1+1 protection are supported.

This capability is supported for Alcatel-Lucent 1665 DMX equipped with LNW59, LNW82, or LNW504 Main circuit packs. When VLF Main circuit packs are installed, LNW62 and LNW55 OLIUs can be installed in the shelf, and can support this capability on their low-speed interfaces. For additional information, see "Control plane E-NNI interface" (p. 3-68).

Cross-connection types

Allowable cross-connections

This section highlights some of the cross-connections types supported by Alcatel-Lucent 1665 DMX. For an in depth look at all cross-connections supported by the Alcatel-Lucent 1665 DMX, see "Cross-connections" (p. 6-38) in Chapter 6, "System planning and engineering" of this document.

Atomic cross-connections

Alcatel-Lucent 1665 DMX employs atomic cross-connections for all cross-connect provisioning. Atomic cross-connections are one-way cross-connections between logical ring channels which can be set up and taken down by a single command, and which cannot be broken down into smaller parts. Logical ring channels are the tributaries of a port or port protection group used for transmission in the absence of any line or equipment protection.

Hairpinning cross-connections

Low-speed tributary traffic is routed into the system and back out without being placed on the high-speed (OC-12, OC-48 or OC-192) interfaces. With a VLF Main pack (LNW59/LNW82/LNW504), all cross-connections use the switch fabric located on these packs. Any switch fabrics located on low-speed, tributary packs are disabled when VLF Mains are used.

With the VLF Mains, Alcatel-Lucent 1665 DMX can cross-connect any input on a circuit pack in a function or growth slot to any output on a circuit pack in the same or different function or growth slot. Both slots in a function group can be provisioned independently for working traffic, whether they are the same or different packs. Certain restrictions apply, see "Very large fabric (VLF) engineering rules" (p. 6-15) for more information.

These flexible cross-connect capabilities allow you to use a combination of add/drop and hairpinning of compatible payloads through a variety of interfaces. You can bring traffic in from one remote site and cross-connect it at the VT1.5, STS-1, STS-3c, STS-12c, STS-48c, or STS-192c level back out to other remote sites without consuming any capacity on the ring/line interface.

If hairpinning cross-connections are being provisioned between any interface and a 0x1 unprotected interface, 1-way cross-connections must be used. 1-waypr cross-connections are not allowed in 0x1 unprotected scenarios.

Bridge and roll cross-connections

Bridge and roll cross-connections are coordinated activity between two NEs designed to move traffic from one facility to another, affecting service by a maximum of 10 milliseconds.

Bridged cross-connections

Bridging of an existing cross-connection consists of adding a one-way cross-connection with the same input tributary as that of an existing cross-connection, resulting in a 1x2 multicast from an input tributary to two output tributaries. Alcatel-Lucent 1665 DMX supports bridging for each of the supported SONET cross-connection rates. You can bridge any existing cross-connection to a second output port without impairing the existing signal. Conversely, either half of a bridged signal can be taken down without impairing the remaining cross-connected signal.

Rolling a bridged cross-connection

Alcatel-Lucent 1665 DMX provides the capability to change the location or source of the input tributary of a given cross-connection. Alcatel-Lucent 1665 DMX supports facility rolling for all supported signal rates as follows:

- Disconnection of the circuit cross-connecting input tributary to output tributary
- Cross-connection of either a new input tributary to the corresponding input tributary

Unprotected cross-connections

With unprotected cross-connections on a UPSR Alcatel-Lucent 1665 DMX does not select the best signal from both rotations of a UPSR. Instead, traffic is added and dropped (locked) from one rotation of the ring only (provisionable). The main advantage of locked VT or DS3 cross-connections is the lack of UPSR switching which results in the ability to reuse time slots around a UPSR.

Alcatel-Lucent 1665 DMX has the ability to mix unprotected (locked), protected (unlocked), and pass-through VT1.5s within the same STS-1, and to allow both rotations of a ring to be used simultaneously.

Unprotected cross-connections are also supported to Ethernet VCGs.

Multi-point (Ethernet only)

The data specific multi-point cross-connect is a bidirectional cross-connection between two STS-1 Virtual Concatenation Groups (VCGs) on 100BASE-T or 1000BASE-X ports to two different ring interfaces.

Pipe-mode (adaptive-rate) cross-connections

Pipe mode is a fault monitoring and performance monitoring feature whereby each automatically adapts to changes in the constituent payload structure of a provisioned STS-n rate cross-connection. Fault and PM are based on the payloads carried within a cross-connection rather than the cross-connection rate. Path protection switching continues to operate at the provisioned cross-connect rate.

OCH cross-connections

Alcatel-Lucent 1665 DMX also supports optical channel (OCH) cross-connections between dense wavelength division multiplexing (DWDM) compatible circuit packs/pluggable transmission modules. The OCH cross-connections are used to inform the network element about manual fiber connections.

Operations features

Overview

Alcatel-Lucent 1665 DMX supports a three tiered operations philosophy consisting of the system controller functions and visual indicators, local interface to the shelf via serial ports and LAN ports and remote OS interface over a Data Communications Channel. The following features highlight a few of the key operations features that provide effective operation and maintenance of the system.

WaveStar® CIT with GUI

WaveStar® CIT manages the Alcatel-Lucent 1665 DMX system through the TL1/CIT port, providing TL1 messaging, software download, and full operations and provisioning capability via a Graphic User Interface (GUI) or TL1 cut-through. *WaveStar*® CIT can run a full-featured GUI or TL1 scripts. Using the GUI, a crafts person can access all Alcatel-Lucent 1665 DMX software functions and context-sensitive help. The TL1 cut-through, also known as the TL1 Translation Device (T-TD), is a flexible TL1 interface that supports full TL1 management through TCP/IP or RS-232 interfaces.

WaveStar® CIT is not used to download release software to the system (the PC is used, but not the CIT software). Release software can be copied to other NEs remotely, provided the initial download of Alcatel-Lucent 1665 DMX release software has occurred on each system.

TL1 management

The TL1 cut-through interface provides full TL1 management via the Serial and IAO LAN interfaces.

TL1 management via TCP/IP

TL1 message exchange is supported over TCP/IP via IAO LAN, OSI LAN, and *WaveStar*® CIT interfaces. IAO LAN supports TCP/IP protocol and OSI protocol. These provide a communication link from an Alcatel-Lucent 1665 DMX to a local node that may serve as a gateway to the network.

Beginning in Release 9.1, TL1 command entry in TL1 cut-through mode is simplified. The last TID entered is remembered and used in all subsequent commands in which a TID is not specified until a different TID is entered.

Integrated TCP/IP management interface

Alcatel-Lucent 1665 DMX supports two types of IP Access. In one case, Alcatel-Lucent 1665 DMXcan serve as a TL1 Translation Device (T-TD) by being a gateway network element that allows a OMS and/or *WaveStar*® CIT to communicate to other network elements (NEs) on an OSI network through an IP access network. In the second instance, the Alcatel-Lucent 1665 DMX can functionally encapsulate IP packets within OSI packets to be transmitted through the OSI network to the proper NE. This capability is called IP tunneling.

TL1 translation

Alcatel-Lucent 1665 DMX can copy the application information within an IP packet into an OSI packet. Thus, all IP protocol information is lost. This translation is performed at the application layer. Separate gateways can be provided by a single Alcatel-Lucent 1665 DMX.

IP tunneling

IP tunneling allows for file transfer through an IP access network. IP tunneling is used to perform end-to-end FTP through the OSI portion of the IP access network. In this instance the Alcatel-Lucent 1665 DMX serves as a gateway network element (GNE) that encapsulates an IP packet within an OSI packet. When the final destination of the file is reached, the IP packet is removed from within the OSI packet and processed by the TCP/IP stack. Thus, IP tunneling allows an OMS and/or CIT to reach NEs in an OSI based DCN network with FTP over IP. In this case, the end points of the IP tunnel are the actual terminating points for the IP traffic.

Proxy ARP

In normal ARP usage for an Ethernet LAN, the sending system broadcasts an ARP request on the physical LAN. The ARP request contains the target IP address and asks the system with this IP address to respond with its physical Ethernet address. All systems on the LAN receive the request, but only the system which recognizes the target IP address as its own will send a point-to-point ARP reply to the sending system. The broadcast ARP request on a physical LAN only reaches systems which are attached to this physical LAN. If the sending system and the target system are on different physical networks, the target

system will not receive the ARP request and thus can not respond to it. Proxy ARP lets a system, called ARP subnet gateway, answer ARP requests received from one of its physical (LAN) networks for a target system which is not attached to this physical network.

To allow SNMP manager/NTP server located in the IP-based access Data Communication Network (DCN) to communicate with NEs located in the OSI-based DCN, Alcatel-Lucent 1665 DMX supports IP tunneling solution to encapsulate and route IP packets over OSI-based embedded DCN. The provisioning of static routes on the external router(s) is required to route the IP packets from the access DCN to the embedded DCN. The Proxy ARP support on the Gateway Network Element (GNE) will eliminate this need of static routes on the external router(s).

ARP subnet gateway

The ARP Subnet Gateway implementation adheres to RFC1027 which states that, if the IP networks of the source and target hosts of an ARP request are different, an ARP subnet gateway implementation should not reply to the request. This is to prevent the ARP subnet gateway from being used to reach foreign IP networks and possibly bypass security checks provided by IP gateways.

Because of this RFC requirement, the IP addresses of both the GNE and RNE must be in the same network with respect to network class (A, B and C). For example, if the GNE has a class C IP address 192.168.170.1, the RNE must have an IP address in the same Class C network, in the form 192.168.170.x. For proxy ARP to function properly, the Remote NE IP address must be in the same subnet as the IP address of the router, as specified by the network mask on the router. Otherwise, the router will not send the ARP request to the appropriate LAN port, and will instead route the packet through its default IP gateway into the IP cloud.

However, the IP address of the remote NE should not be in the same subnet as the IP address of the GNE, from either the GNEs network mask perspective or the RNEs network mask perspective. An easy way to achieve this on the RNE is to assign a 32-bit network mask to all RNEs.

FTP/FTAM gateway for remote software download

Also referred to as FTTD (File Transfer Translation Device), the FTTD allows Alcatel-Lucent 1665 DMX to function as a Gateway Network Element (GNE) that can facilitate the download of files located at FTP servers to remote NEs connected to the Alcatel-Lucent 1665 DMX.

SSH File Transfer Protocol (SFTP)

Beginning in 9.0, the LNW2 SYSCTL circuit pack supports SSH File Transfer Protocol (SFTP) for software download, database backup, and database restoration. SSH File Transfer Protocol (SFTP) is a new protocol defined by IETF which runs over a secure SSH channel and provides secure file transfers. Network configurations, user names, passwords, FTP commands and transferred files are protected.

Note: You must have IP connectivity between your NE and your SFTP server, and your NE must have a defined IP address. The *WaveStar*® CIT is not SSH FTP (SFTP) server. You must have access to an SSH FTP server to use this feature.

Software download over DCC

This feature enables software (upgrade) to be downloaded to remote NEs from a central office site via the data communications channel (DCC).

OSI associations and TCP/IP connections

When used as a GNE, Alcatel-Lucent 1665 DMX supports a total of 300 OSI associations (logins). Each TCP/IP (or Telnet) connection can support 300 associations. The Alcatel-Lucent 1665 DMX GNE supports up to 20 TCP/IP connections. The combined number of OSI associations on all TCP/IP sessions cannot exceed 300.

OSI seven-layer protocol stack

This feature provides interworking using the Open Systems Interconnection (OSI) seven-layer protocol stack over the data communications channel (DCC). The OSI seven-layer protocol stack refers to the OSI reference model, a logical structure for network operations standardized by the International Standards Organization (ISO).

Maximum number of OSI nodes

Alcatel-Lucent 1665 DMX can support a total of 250 NEs per Level 1 area.

Remote NE status

This feature partitions a subnetwork into maintenance domains (alarm groups). An Alarm Group is a set of NEs that share status information. Alarm groups can be nodes in a ring or any other logical grouping such as a maintenance or geographical group. Each Level 1 area can be identified as a separate Alarm Group, as long as it does not exceed 50 nodes. You must provision one NE in an Alarm Group as an alarm gateway NE (AGNE) to support office alarms and a summary alarm information of remote NEs in the local alarm report. More than one AGNE can be provisioned per alarm group, but this is not recommended.

TARP

Alcatel-Lucent 1665 DMX is compatible with any other-vendor NEs that support Target ID Address Resolution Protocol (TARP), OSI, IAO LAN, and TL1 as specified in *Telcordia* ® GR-253.

SONET

Many of the traditional SONET maintenance, provisioning, operations, control, and synchronization features are included in the Alcatel-Lucent 1665 DMX. The flexible SONET standard provides a formidable foundation for Alcatel-Lucent 1665 DMX to build upon.

Security

Security features include 1–999 day password aging, customized login proprietary message, and 150 users.

Remote Authentication Dial In User Service (RADIUS) authentication for user logins

When the network element is provisioned to use RADIUS authentication, any user TL1/CLI/Web GUI login attempt triggers the network element, if the maximum number of logins is not reached, to query the designated RADIUS server(s) and act on the response.

Performance monitoring

Performance monitoring (PM) data is reported on the VT1.5, VC12, STS-1, STS-3c, STS-12c, STS-48c, , STS-192c, DS1, E1, DS3, EC-1, Ethernet (LAN and VCG ports), SAN, OC-3, OC-12, OC-48, and OC-192 levels.

Alarm severity assignment profiles (ASAPs)

Alcatel-Lucent 1665 DMX supports adjustable ASAPs. With ASAPs, alarms are grouped into categories called "Profile Types". Each Profile Type can have multiple views (ASAPs). These views include the default view and various user created/provisioned profiles. Each ASAP within a profile type has the same alarms, but alarm severity levels are user provisionable. The user can then assign ASAPs to entities within the shelf.

ASAPs make it possible to assign different alarm severity levels for all alarms. This feature also allows the user to assign different alarm severity levels for the same probable cause to different entities within the shelf. Once alarm severity levels are set, the user can assign the same level to different entities without re-provisioning the level itself.

These capabilities give the user greater control over alarm reporting.

Improved circuit pack failure alarms

Improved circuit pack failure alarms are supported to identify circuit packs that contribute to the failure of another circuit pack. The existing circuit pack failure alarms are augmented by reporting the `CP contributing to a pack failure` alarm for all circuit packs that are contributing to the circuit pack failure. The severity level is provisionable using alarm severity assignment profiles.

TIRKS/NMA/transport compatibility

Alcatel-Lucent 1665 DMX is supported by *Telcordia* ® OSs: *TIRKS*, *NMA*, and *Transport*.

Multivendor operations interworking

Alcatel-Lucent 1665 DMX supports interoperability with many vendors' equipment.

Product Family 2000/WaveStar product family interworking

Alcatel-Lucent 1665 DMX supports TARP interoperability with Product Family 2000 nodes such as the FT-2000 OC-48 Lightwave System, the DDM-2000 OC-3/OC-12 Multiplexer, the DDM-2000 FiberReach Multiplexer, and Alcatel-Lucent 1850 TSS-5.

Alcatel-Lucent 1665 DMX provides interoperability with all *WaveStar*® Product Family nodes supporting TARP over both UPSR and BLSR applications.

Alcatel-Lucent 1665 DMX also provides interoperability with *WaveStar*® BandWidth Manager nodes supporting TARP over both OC-48 and OC-192 BLSRs.

OMS operations support

Alcatel-Lucent 1665 DMX supports operations via OMS and 1340INC.

Support of Simple Network Management Protocol

Alcatel-Lucent 1665 DMX supports Simple Network Management Protocol (SNMP). It is a language protocol for communications between network elements and management systems. As such, it includes verbs (commands), nouns (objects) and a structure and rules (protocol). It has a degree of standardization that is much greater than TL1, particularly with respect to the commands and objects and it’s intended to be a very simple UDP/IP based protocol, with few commands, that is easy to implement at low cost, for monitoring and managing low cost bridges and routers.

Alcatel-Lucent 1665 DMX supports a maximum of 10 enabled SNMP Users for request functionality and a maximum of 10 enabled SNMP Users for receiving traps. However, the NE only supports 16 users total.

The three basic SNMP components are:

- The protocol defines the rules and specifications for exchanging information between a manager and an agent. This includes the detailed specification of the SNMP commands, messages and the command/message PDUs (packet data units) as well as the way security is handled.
- Management Information Base (MIB) is the set of managed objects on which the SNMP commands operate. These managed objects can be provisionable or status parameters or alarms and events entities.

  SNMP applications use public and private Management Information Bases (MIBs) that define the equipment and Ethernet/SONET/SDH/PDH performance monitoring parameters (objects) and alarm/event messages (traps) that can be communicated. Public MIBs are specified in standards. Private MIBs are unique to . The public and private MIBs are stored on the PC that is running the SNMP application.
- Structure of Management Information (SMI) is the rules for the definition of managed objects, including the object name, the Object Identifier (OID), and the object syntax, which in SNMP uses ASN.1 standard encoding.

Alcatel-Lucent 1665 DMX provides SNMP support of certain reports and traps for all Ethernet interfaces. For more information, see "SNMP parameters and traps" (p. 5-110) in Chapter 5, "Operations, administration, maintenance, and provisioning".

Alcatel-Lucent 1665 DMX supports SNMP on DS1/E1 and DS3/EC-1 interfaces. SNMP support of these TDM interfaces includes traps and performance monitoring parameters.

Beginning in 9.0, the Alcatel-Lucent 1665 DMX circuit packs independently support SNMPv3 protocol to monitor individual circuit pack operation. SNMPv3 was developed to provide a higher level of security through the use of encryption.

SNMPv3

SNMPv3 provides secure access by a combination of authenticating and encrypting packets over the network. The

SNMPv3 security features are:

- Message integrity - ensuring that a packet has not been tampered with in-transient.
- Authentication - Determining that the message is from a valid source.
- Encryption - Scrambling the contents of a packet to prevent it from being seen by an unauthorized source.

SNMPv3 control is through a View BasedAccess Control model (VACM). In VACM, users are assigned to groups which define and specify:

- The SNMP version, (v1, v2c or v3) specifies the SNMP version provides the means for allowing some users to access the NE via the earlier SNMP versions with minimum security while allowing other users to access the NE via the more secure V3. While the VACM groups are user provisionable starting with the phase 2 implementation, it would be expected that write access will generally be allowed only to VACM groups that specify SNMPv3.
- The access policy for the users assigned to the group. For example, the SNMP MIBs and objects that can be accessed for reading, writing and creating. The SNMP MIBs and objects are specified in the VACM as a text strings identifying a MIB groups.
- The list of notifications the group's users can receive. Notifications are also specified in the VACM group as a text strings identifying a MIB groups.
- The security model and security level for the group's users. SNMPv3 specifies 3 levels of security:
  - noAuthNoPriv: without authentication and without privacy — for DMX, this is equivalent to the minimal authentication currently provided for SNMPv2
  - authNoPriv: with authentication but without privacy. This level of security uses MD5 and the Secure Hash Algorithm as keyed hashing algorithms to protect against data modification attacks and to provide data origin authentication and to defend against masquerade attacks
  - authPriv: with authentication and with privacy. In addition to secure authentication, this level of security uses the Data Encryption Standard (DES) to encrypt the message content to protect against disclosure.

Synchronization

Synchonization configurations

The OC-3/12/48/192 high-speed circuit packs (as well as LNW80) contain an embedded Stratum 3 timing generator. This timing generator is used when the Alcatel-Lucent 1665 DMX is configured in a free running mode.

Line timing and external timing are also supported by Alcatel-Lucent 1665 DMX. Line timing is derived from an incoming MAIN or tributary OC-3/12/48/192 line, while external timing is derived from an external timing source. Line timing from tributary optical interfaces is supported. The timing generator also provides a BITS clock output derived from the incoming line signal.

Timing output

Alcatel-Lucent 1665 DMX can generate a DS1 timing output to time other externally-timed systems. The DS1 output is derived from a line reference. Alcatel-Lucent 1665 DMX also supports E1 timing output when equipped with a VLF Main circuit pack.

Important! When the Alcatel-Lucent 1665 DMX is provisioned for *SONETSYNC*, both input ext timing reference and ext reference output are DS1. When the Alcatel-Lucent 1665 DMX is provisioned for *SDHSYNC*, both input ext timing reference and ext reference output are E1.

Synchronization status messages (SSM)

Alcatel-Lucent 1665 DMX uses Synchronization Status Messages (SSMs), transported in the S1 byte of the SONET or SDH overhead. To pass timing status information to different nodes in an access transport network, Alcatel-Lucent 1665 DMX also supports SSMs in the DS1 or E1 external timing reference inputs and outputs. They contain clock quality labels that allow the NE to select the most suitable synchronization reference from the set of available references. The purpose of the SSMs is to allow the NEs to reconfigure their synchronization references autonomously while avoiding the creation of timing loops.

Line timing from optical tributary packs

Alcatel-Lucent 1665 DMX can derive timing references from any SONET/SDH optical line entering Main, Function Unit, or Growth slots.

All optical circuit packs, except the LNW705 and LNW785, can derive a 6.48 MHz timing signal from an incoming optical line.

Network Time Protocol

Network Time Protocol (NTP) assures accurate synchronization of the Alcatel-Lucent 1665 DMX with reference to radio and/or atomic clocks located on the Internet.

3 Applications and configurations

Overview

Purpose

Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX) supports a wide range of service applications and a variety of network configurations economically and efficiently.

Because Alcatel-Lucent 1665 DMX is very flexible, most of the applications described in this section can be served over many of the available network topologies. The product configuration deployed depends on many factors such as fiber layout location, mix of services offered, and interconnections to other networks.

The first section of this chapter describes service applications. The second section explains the network topologies supported.

The following information is included in this chapter:

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Service applications

Overview

Purpose

Alcatel-Lucent 1665 DMX provides a wide range of service applications transporting voice and data from the access edge of the network to the core of the network. These applications range from traditional SONET applications to advanced data transport applications.

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Features

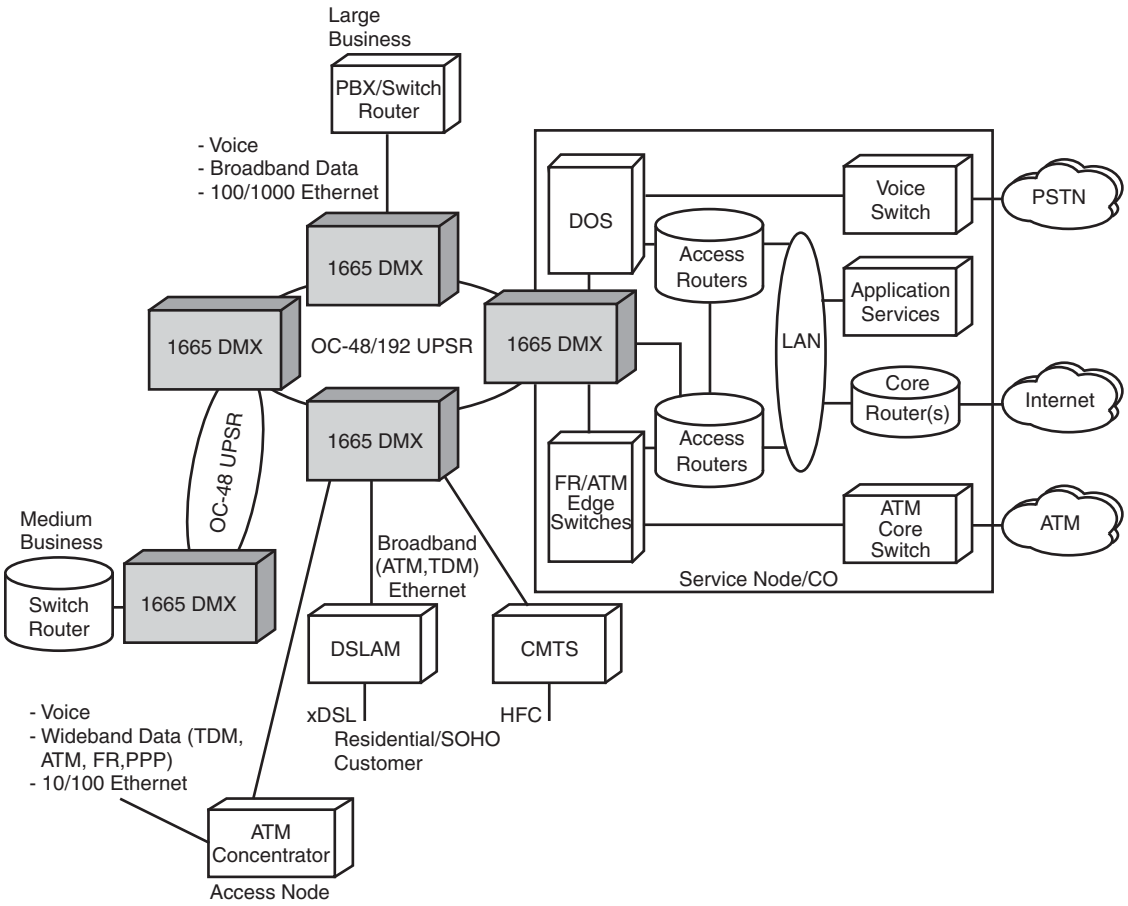
Features

Alcatel-Lucent 1665 DMX provides the following features for the service applications described in this section:

- DS1 transport and switching
- DS3 transport and switching
- E1 transport
- EC-1 transport and switching
- OC-3 transport and switching
- OC-12 transport and switching
- OC-48 transport and switching
- OC-192 transport and switching
- 100BASE-T/ZX/LX/FX transport and switching
- 1000BASE-SX/LX/ZX transport and switching
- SAN (FICON/ESCON/Fibre-Channel) transport
- Synchronization distribution (DS1 timing inputs and outputs)
- Single-ended or independent operations
- Long reach single-mode fiber spans for OC-3, OC-12, OC-48, and OC-192 optics
- Passive wavelength division multiplexing (DWDM)-compatible optics.

The figure below shows how Alcatel-Lucent 1665 DMX fits into Alcatel-Lucent's metropolitan optical networking solution.

Figure 3-1 Multiservice optical access network



1665 DMX = 1665 Data Multiplexer

nc-dmx2-029

Established network evolution

Overview

Alcatel-Lucent 1665 DMX offers a capacity upgrade from an OC-3 or OC-12 network to an OC-12/48/192 network. Implementing an Alcatel-Lucent 1665 DMX ring at the edge of the network, in combination with pre-existing OC-3 and OC-12 rings, provides increased network capacity and flexibility with the opportunity to interwork with or replace current–Generation access multiplexers.

Description

Alcatel-Lucent 1665 DMX can interwork with existing Alcatel-Lucent and other-vendor SONET network elements to support all of the applications and topologies described in this section. The figures below show the network evolving from an OC-3/OC-12 network to an OC-48/192 network. Figure 3-2, “Established network” (p. 3-6) shows the original network, while Figure 3-3, “Established network evolution” (p. 3-7) shows the network evolution when once Alcatel-Lucent 1665 DMX is deployed.

Figure 3-2 Established network

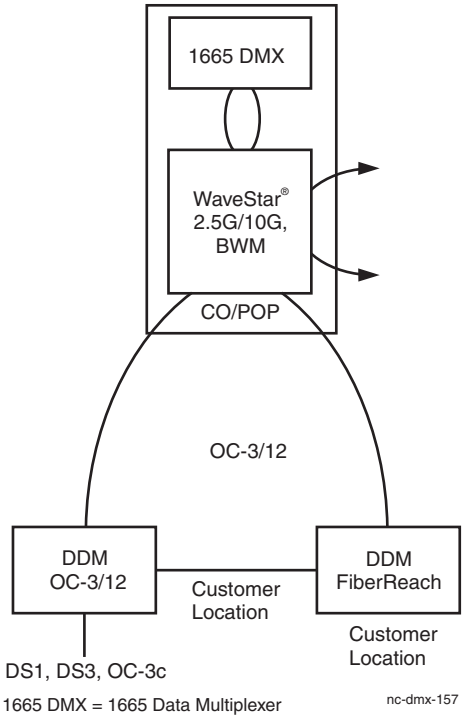
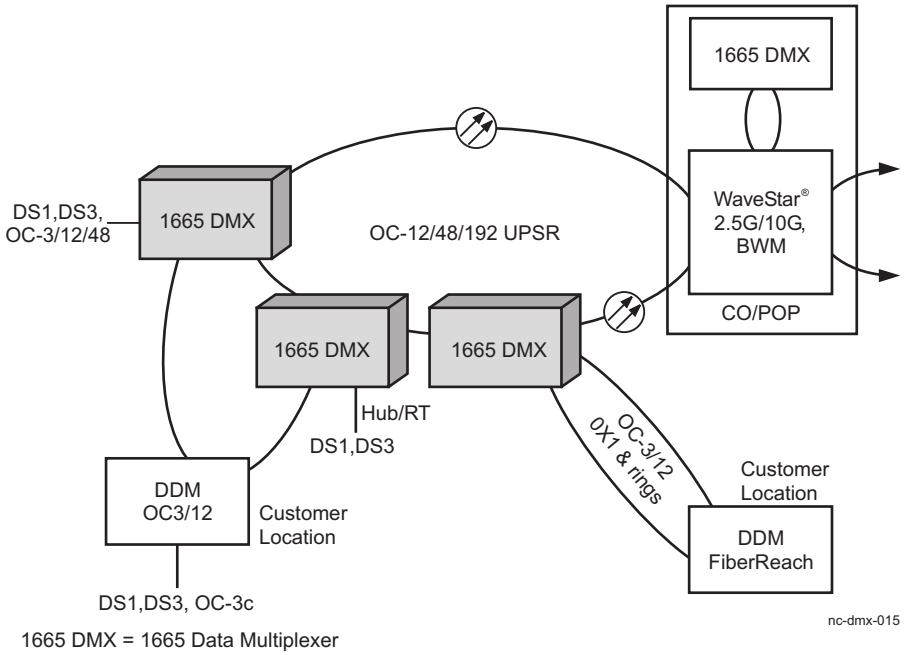


Figure 3-3 Established network evolution



Application advantage

As greater capacity is needed, Alcatel-Lucent 1665 DMX provides customers a graceful upgrade path from smaller capacity OC-3/12 networks to OC-12/48/192 Alcatel-Lucent 1665 DMX networks capable of enhanced applications, topologies, and capacities. The features of the Alcatel-Lucent 1665 DMX enable it to cost-effectively serve your needs now while protecting your networking future.

Access transport for voice and TDM Private Line services

Overview

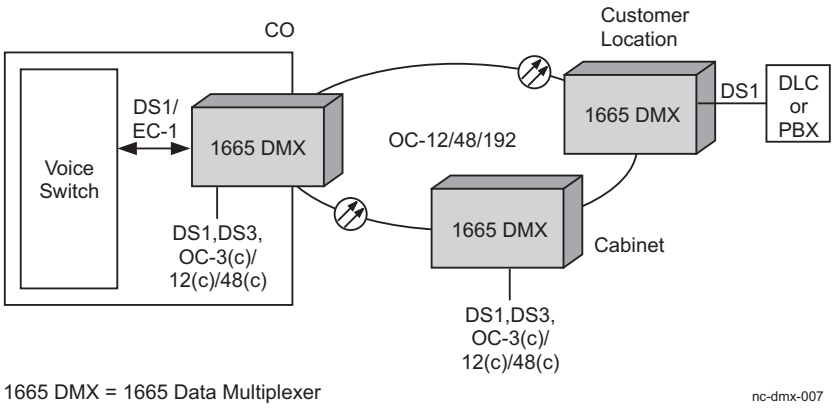
Alcatel-Lucent 1665 DMX supports a full set of interfaces, topologies, and operations to provide the flexibility, upgradability, and ease of operation required to meet the dynamic requirements of the access transport environment. An Alcatel-Lucent 1665 DMX OC-12/48/192 path switched ring for TDM transport of voice and Private Line services is a reliable infrastructure for residential or small business voice services.

Description

Alcatel-Lucent 1665 DMX is particularly suited to the evolving needs of voice and Private Line access transport applications due to its compact size, environmental hardening, and capacity growth potential. Alcatel-Lucent 1665 DMX 's flexibility allows the infrastructure to be optimized for a particular fiber topology, service mix, and growth forecast. Alcatel-Lucent 1665 DMX can simultaneously support wideband and broadband Private Line services for DS1, DS3, E1, EC-1, OC-3, OC-12, and OC-48 client interfaces.

The figure below shows a path switched ring transporting low-speed DS1 signals that are carrying voice services from a PBX or a digital loop carrier (DLC) system over an OC-48 or OC-192 ring. In this application, Alcatel-Lucent 1665 DMX hands off these voice circuits to the voice switch in the central office using a very cost-effective DS1/EC-1 interface.

Figure 3-4 Voice and Private Line access application



Application advantage

The access transport application provides low-cost transport of revenue–Generating voice and Private Line wideband and broadband services in a single multiplexer.

Interoffice transport

Overview

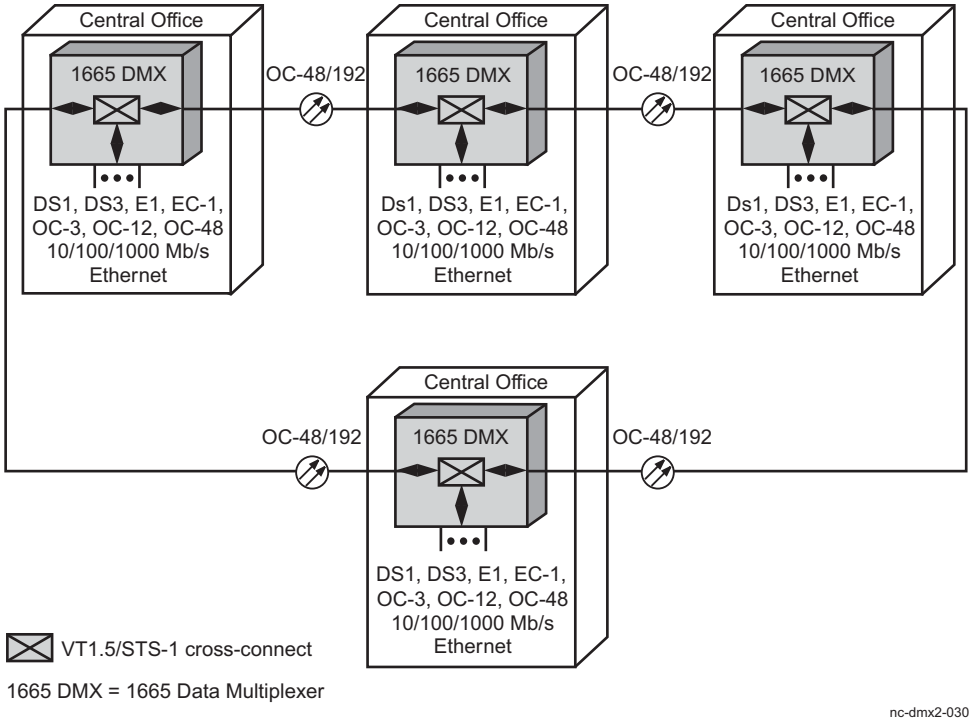
Alcatel-Lucent 1665 DMX provides the features necessary for interoffice transport in a greater metropolitan area, including long-span optics, easy capacity upgrades, and add/drop interfaces to other CO equipment. A VT1.5/STS-1 OC-48 path switched ring is a very effective self-healing network configuration for large cross-section interoffice networks.

Description

Alcatel-Lucent 1665 DMX is ideal for metropolitan interoffice transport applications due to its large capacity and mixture of voice, data, and Ethernet services. An OC-12/48/192 UPSR/BLSR ring provides fast and reliable transport of DS1, E1, DS3, EC-1, OC-3(c), OC-12(c), OC-48(c), and 10/100/1000 Mbps Ethernet services.

The figure below shows a sample interoffice transport configuration.

Figure 3-5 Interoffice transport



Application advantage

Alcatel-Lucent 1665 DMX's interoffice transport applications provide low-cost, self-healing voice, Ethernet, asynchronous transfer mode (ATM), and frame relay (FR) transport on a single multiplexer.

Ethernet Private Line

Overview

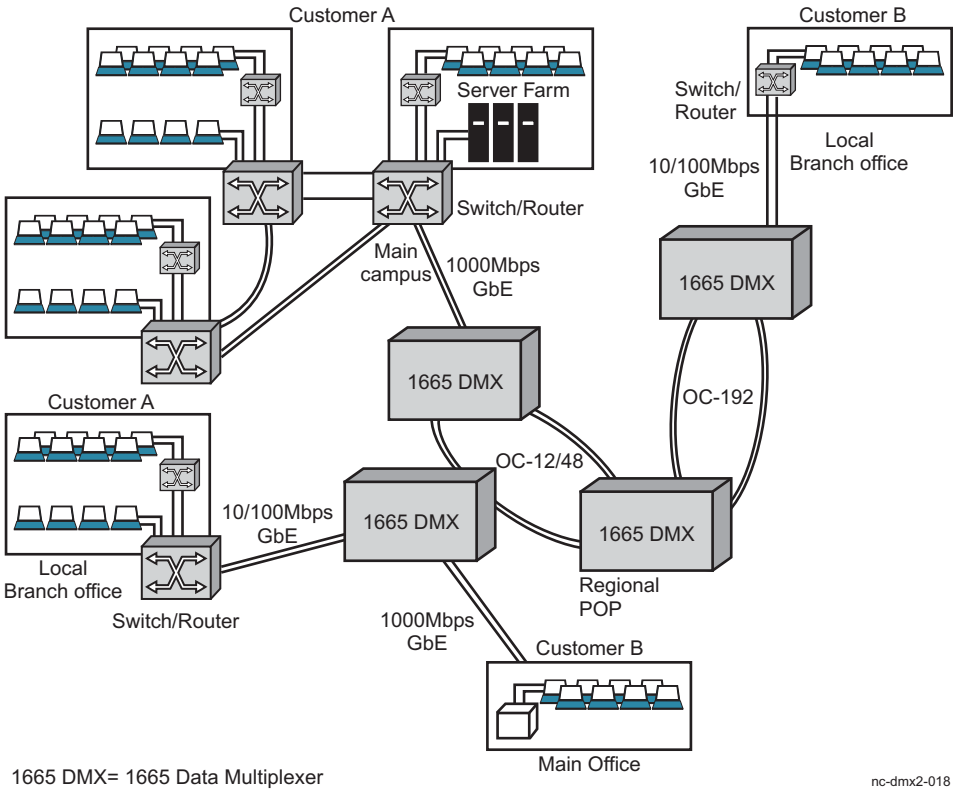
Ethernet private lines provide the user the ability to transport frames completely transparently between two Alcatel-Lucent 1665 DMX NEs. No VLAN knowledge or packet-layer provisioning is required by the user in this application. Simple, SONET STS-1 cross-connect provisioning is all that is required. These Private Line capabilities allow the Alcatel-Lucent 1665 DMX to provide dedicated bandwidth for individual customers and fast SONET-layer restoration in the event of a facility-based failure.

Ethernet Private Line (point-to-point Ethernet) for enterprise LAN transport

Alcatel-Lucent 1665 DMX utilizes standard STS-1 (STS-3(c) can also be used) with virtual concatenation (ITU G.707) to transport 10/100 Mbps or 1000 Mbps Ethernet services over a SONET OC-12/48/192 UPSR/BLSR ring. In this configuration, Ethernet traffic from an end customer may be fed to a core router in the central office (CO), while

voice traffic is fed from the same ring to a voice switch in the CO. In Private Line LAN transport configurations, standard SONET UPSRs/BLSRs provide restoration of service within 50 milliseconds.

Figure 3-6 Ethernet Private Line transport application



Application advantage

Ethernet private lines simplify networks by eliminating intermediate WAN protocols, such as frame relay or ATM while providing service providers an ideal migration path from traditional Private Line, circuit-based services.

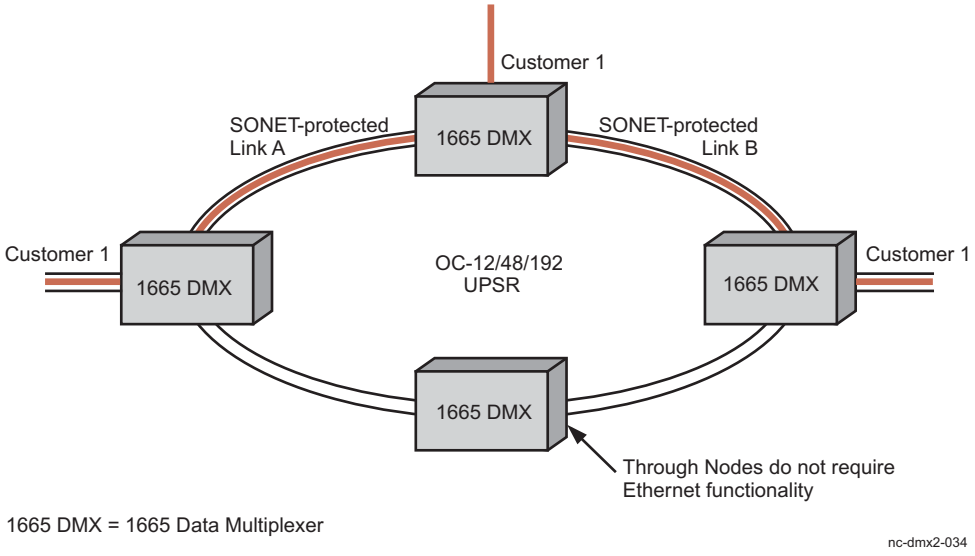
Ethernet private lines also provide dedicated bandwidth and absolute QoS for business critical data transport applications. Private lines are protected by SONET layer protection switching with a guaranteed restoration time of less than 50 milliseconds.

Multi-point Private LAN

Ethernet Private LAN for enterprise LAN transport

Similar to the figure discussed in the previous section, the figure below shows a customer (Customer 1) with a Private LAN connecting multiple sites. In such applications, multi-point connectivity enables simultaneous connectivity to all sites serviced by the Private LAN at all times. Ethernet Private LAN links are sized independently and are configured for 802.1q or Transparent VLAN mode. Finally, in multi-point Ethernet applications, the intermediate nodes (the Alcatel-Lucent 1665 DMX at the bottom of the ring in the figure below) provide a simple bridging function, passing-through all Ethernet traffic on the Private LAN. As such, the intermediate nodes do no require Ethernet functionality.

Figure 3-7 Private LAN application



Multicast Ethernet packets

Multicast Ethernet packets/transmission can be used to facilitate certain Private LAN applications. Yet, Ethernet Private LAN can be implemented using a variety of Ethernet cross-connection types. For more information about Ethernet cross-connection types, see "Cross-connections" (p. 6-38) in Chapter 6, "System planning and engineering".

Multicast Ethernet can also be used to facilitate video distribution, webcasting, and any other application in which multipoint Ethernet cross-connections are used. For more information on the functionality of multicast Ethernet in the Alcatel-Lucent 1665 DMX, see "Networking capabilities" (p. 2-17) in Chapter 2, "Features".

Application advantage

Ethernet Private LANs eliminate the need for an adjunct data switch and further simplify networks by eliminating intermediate WAN protocols, such as frame relay or ATM while giving service providers an ideal migration path from traditional Private Line, circuit-based services.

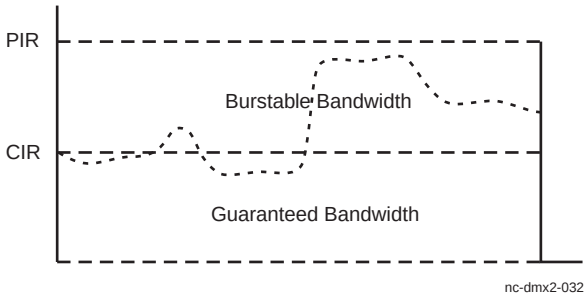
Ethernet Private LANs also provide absolute QoS and security for data transport applications with dedicated bandwidth and SONET layer protection switching (less than 50 millisecond restoration time).

Ethernet rate control services

Overview

Rate-controlled services offer a statistical multiplexing model that makes efficient use of shared bandwidth. Alcatel-Lucent 1665 DMX currently supports two of the primary forms of rate control. The two primary forms of rate control are rate limiting and guaranteed rate services (plus various combinations of both).

Rate limiting is achieved using Peak Information Rate (PIR) provisioning. Guaranteed rate service is achieved using Committed Information Rate (CIR) provisioning. PIR institutes a limit, or "ceiling", of maximum bandwidth to be allocated to a particular customer at any time. CIR, on the other hand, provides a guaranteed minimum, or "floor" throughput even during periods of high congestion. Alcatel-Lucent 1665 DMX provides support of CIR.



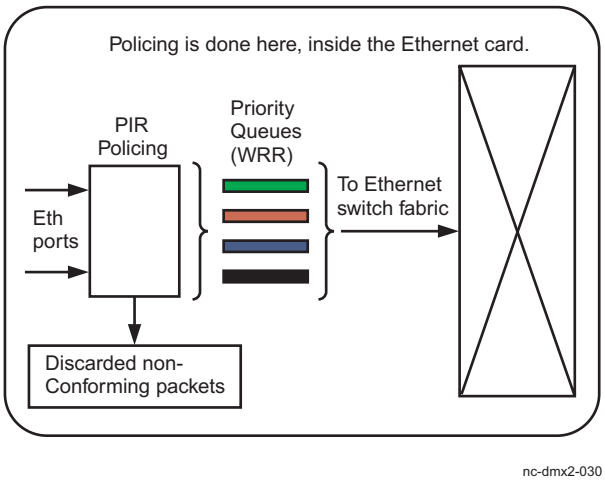
Description

The figure above demonstrates the relationship between CIR and PIR services for a single customer's “bursty” data stream. Again, PIR represents the maximum bandwidth a particular customer will be allocated at any time, while CIR is guaranteed minimum bandwidth that insures a constant level of service even during periods of high congestion.

As the figure above suggests, if the maximum bandwidth for a customer (PIR) is exceeded, surplus packets may be dropped. Rate guarantees can be changed in-service and are provisionable at sub-rate levels (1 Mbps).

Policing takes place first in order to ensure that a customer meets the CIR/PIR stipulations of their contract. The priority queuing relative to other customer's traffic then occurs providing another QoS capability.

Figure 3-8 Bandwidth allocation within Ethernet circuit packs



Application advantage

Rate control provides the capability to offer a maximum "ceiling" throughput at all times (PIR). It also supports commitments to minimum bandwidth availability (CIR). This combination of CIR and PIR rate control enables Alcatel-Lucent 1665 DMX to both help service providers meet detailed service level agreements (SLAs) and to ensure adequate capacity for end-users at all times. SLAs also can be offered with sub-rate guarantees. Rate control can enable oversubscription with increased revenue potential. Finally, all Private Line traffic is protected by time-tested SONET layer protection (1+1, UPSR, and BLSR).

Hitless bandwidth provisioning with LCAS

Overview

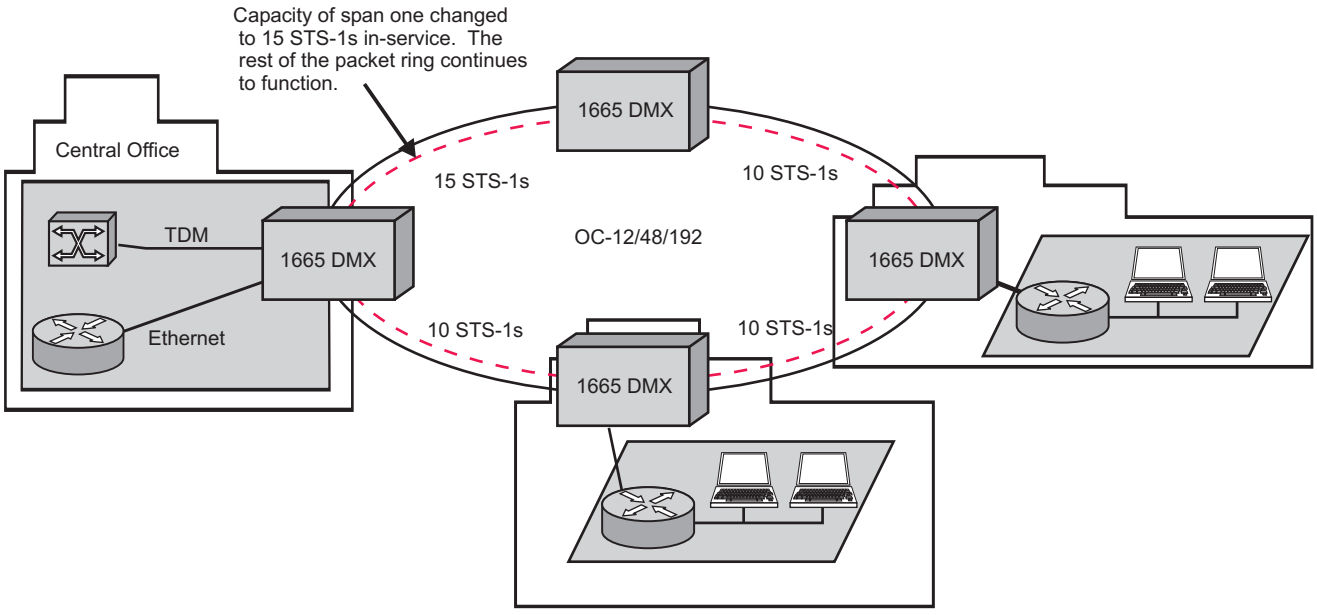
Link Capacity Adjustment Scheme (LCAS) enables in-service (or non-service affecting) bandwidth increases/decreases for Ethernet links. LCAS is a two-way protocol, to function it requires a return path for signaling. It works with two-way cross connects or pairs of one-way cross connects on the span.

Description

Alcatel-Lucent 1665 DMX supports standard LCAS per ITU G.7041. Bandwidth changes to Ethernet links are done one span at a time. Without LCAS, provisioning a bandwidth change on the first span of a packet ring takes down Ethernet service around the rest of the ring until the entire ring is set to operate at the same capacity.

With LCAS, planned increases and/or decreases of bandwidth are hitless (that is, they do not affect service). As the figure below illustrates, when capacity changes to each span around the packet ring are provisioned, service is not interrupted. While the span between nodes A&B is set to 15 STS-1s, the remaining spans continue to function at 10 STS-1s.

Figure 3-9 Hitless bandwidth provisioning: 1st span



Application advantages

As the global market for communication services is in continuous flux, both advances in technology and changes in state, regional, and national economies exert various pressures on your network. Accordingly, capacity changes to your network are necessary on a regular basis.

LCAS enables you to meet the challenges of today's market without affecting service. With LCAS, you are not in danger of violating stringent Enterprise customer SLAs. You can also deploy you SONET network according to long-term growth forecasts, and get the most out of the ability to adjust Private Line and packet ring capacity within your SONET lines.

Link aggregation (LNW170 LAN ports)

Overview

Alcatel-Lucent 1665 DMX supports link aggregation on an unprotected LNW170 for any two LAN ports of the same rate (i.e. 100 or 1000 Mbps), operating in switched mode.

When a slot pair is equipped with LNW170 circuit packs, provisioning the slot to the protected state sets the packs to be equipment protected and assigns certain corresponding ports on the companion circuit packs to the same fixed link aggregation groups. When the slot is provisioned to the unprotected state, if the NE is equipped with VLF MAINs, the LNW170 circuit packs are unprotected and the corresponding ports on the companion packs operate independently. If the NE is equipped with non-VLF MAINs, the LNW170 in the slot is unprotected and any circuit pack in the companion slot is alarmed.

Description

Ordinarily, multiple Ethernet links between two bridges form loops (unless a spanning tree blocks all but one) so they can't be used to increase bandwidth. Link Aggregation causes defined groups of links to be treated as a single logical link, making multiple LAN ports appear as one. In this way, Bandwidth may be increased without requiring an upgrade to a higher rate link.

Link aggregation can also remove failed links automatically, thereby providing a means of facility protection. When a link fails, traffic is shifted to the remaining links in that Link Aggregation Group (LAG). More links than are needed can be added to the group and each is active until it fails (similar to utilizing LCAS protection for SONET tributaries). When two links are on different packs they can provide both, facility and equipment protection.

Active/Standby LAG

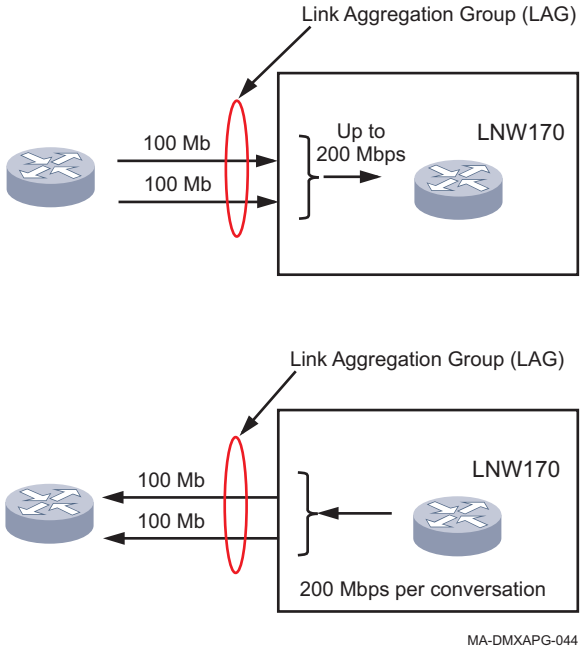
In Active/Standby LAG, one link of the LAG is designated as the protection link and the other is the working link. Only the working link carries MAC client traffic when none of the links fails. When the working link fails, the traffic switches to the protection link. The protection switching is bidirectional and revertive.

Link aggregation example

The figure below depicts link aggregation on two LNW170 LAN ports functioning at 100Mbps. The top portion of the figure shows two ports receiving separate 100 Mbps inbound flows. The bottom portion depicts the same two flows being equally split across the two outbound ports in the LAG. In this example, no failure has occurred and both ports comprising the LAG are in-service.

Traffic entering incoming ports is aggregated into a LAG. While both ports are in-service, outgoing traffic is split between working ports.

Figure 3-10 Link aggregation at 100 Mbps (all ports in-service)



The instance pictured above represents the ideal case, in which there are at least 2 flows, each a maximum of 100Mbps. In this case they can be equally split over the two ports comprising the LAG. The ability to split two or more flows across multiple ports depends on the distribution of MAC or IP addresses used to identify the flows.

Link aggregation employs an algorithm that assigns traffic flows to member ports to prevent mis-ordering. A given flow can be assigned to only one port and cannot be split across multiple ports in the same LAG. To increase flexibility, Alcatel-Lucent 1665 DMX

allows a flow to be defined by either a MAC source and destination address pair or an IP source and address pair. The algorithm uses the XOR of the least significant bits of the address pairs to assign a port/link. Therefore, the actual load balancing achieved depends on the distribution of MAC/IP addresses.

Application advantage

Link Aggregation provides a means of supporting facility protection and bandwidth increases/decreases on LAN ports. Link Aggregation causes defined groups of links to be treated as a single logical link and removes failed links automatically, thereby enabling bandwidth changes and facility protection on 2 paired links comprising a LAG. When the two ports of a LAG are on separate packs, the active-WAN pack (the one selected to send and receive on the SONET network side) is protected against failure by the selection of the second pack. The LNW170 supports this combination of facility and equipment protection.

Virtual LAN services

Overview

The Virtual LAN (VLAN) Service application provides a packet-based Ethernet connection via a shared packet over SONET connection.

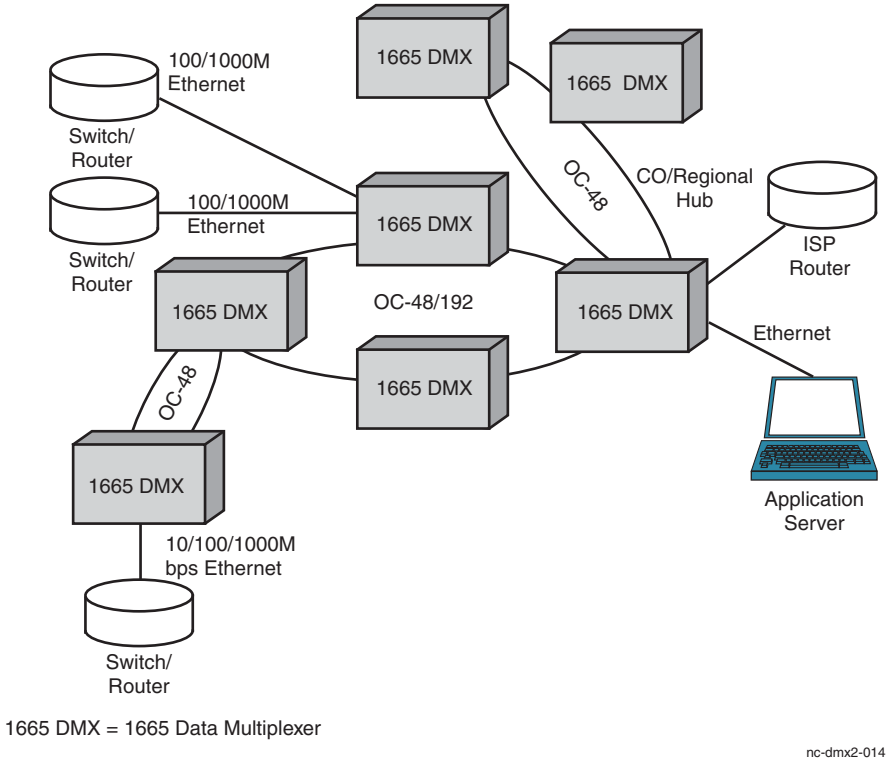
Description

VLAN Service applications can be utilized by multiple customers over a shared ring for improved bandwidth efficiency. Alcatel-Lucent 1665 DMX uses VLANs and allows bandwidth to be shared among customers. Up to 4093 VLANs can be assigned to guarantee privacy among various customers.

Multiple customers can use the VLAN interconnect (multipoint LAN) capability of Alcatel-Lucent 1665 DMX at multiple sites.

The figure below shows Alcatel-Lucent 1665 DMX's varied VLAN capabilities.

Figure 3-11 VLAN service application



Application advantage

Alcatel-Lucent 1665 DMX Ethernet services extend packet switching from the LAN to the WAN. In doing so, enterprise interconnect locations in metropolitan areas can transport traffic much more efficiently over shared and/or provisionable access bandwidth. ISP carrier access applications can use spanning tree protection and flexible bandwidth allocation (using STS-1 virtual concatenation) in the WAN.

Transparent LAN services

Overview

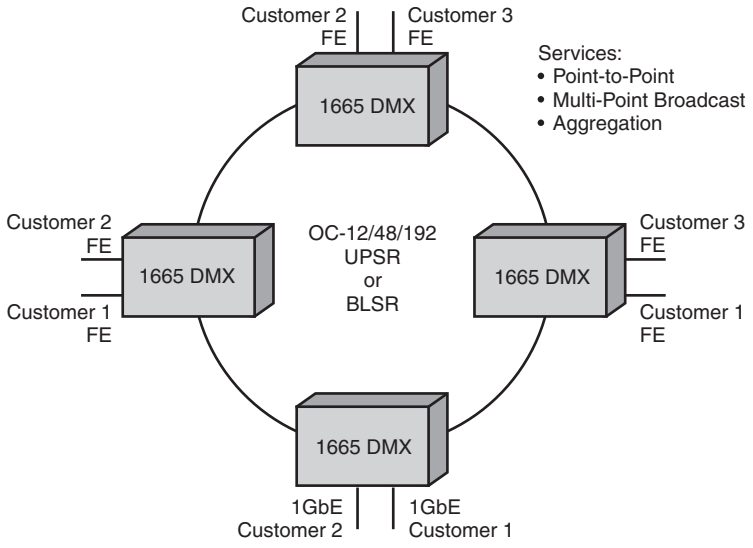
The enterprise LAN (local area network) interconnect and transport applications provide business-to-business networking of routers and data switches. Transparent LAN service is similar to VLAN service, except that Transparent LANs can be deployed using rate control OR on a best effort basis.

Enterprise LAN interconnect (multipoint Ethernet) description

The multipoint LAN interconnect capability of Alcatel-Lucent 1665 DMX allows data to be transported across an Alcatel-Lucent 1665 DMX network from any point to any other point. Protection is provided via the standard spanning tree algorithm. The Alcatel-Lucent 1665 DMX software determines which Alcatel-Lucent 1665 DMX NE is the "root" of the data network. The data spans out from that Alcatel-Lucent 1665 DMX NE, enabling the customer to extend its enterprise network into the WAN as a virtual private LAN.

The figure below depicts two high-speed Alcatel-Lucent 1665 DMX path switched rings transporting data in either a point-to-point or multipoint configuration between Alcatel-Lucent 1665 DMX clients through multiple nodes and switching points.

Figure 3-12 Transparent LAN services



Multicast Ethernet packets

Multicast Ethernet packets/transmission can be used to facilitate certain Transparent LAN applications. Yet, Transparent LANs can be implemented using a variety of Ethernet cross-connection types. For more information, see "Cross-connections" (p. 6-38) in Chapter 6, "System planning and engineering".

Multicast Ethernet can also be used to facilitate video distribution, webcasting, and any other application in which multipoint Ethernet cross-connections are used. For more information on the functionality of multicast Ethernet in the Alcatel-Lucent 1665 DMX, see "Networking capabilities" (p. 2-17) in Chapter 2, "Features".

Application advantage

The Transparent LAN application supports fast, packet-layer protection throughout the WAN, as well as the ability to offer both dedicated and shared bandwidth transport services with improved efficiency and flexible quality of service (QoS).

Best effort Ethernet service

Overview

Best effort Ethernet Services is an over-subscription service model that functions without rate control. Ideal for broadband Internet access within a metro area, Best Effort Ethernet Service enables service providers/carriers to offer an economy-class of service that maximizes revenue potential of a fixed amount of bandwidth.

Description

In the Best Effort service model customers share common bandwidth and are given no quality of service (QoS) or throughput rate guarantees. Thus best effort applications function without rate control services and provide customers with throughput relative to available bandwidth only.

If customers require that their traffic be separated from common network traffic (for security purposes), this can be achieved by VLAN tagging (IEEE 802.1q) or Transparent VLANs (see the sections above). Traffic in best effort applications may also be prioritized via IEEE 802.1p tags.

Protection in this application is provided by both standard SONET layer switching within the WAN and Rapid Spanning Tree protocol (IEEE 802.1w) in the Ethernet environment.

Application advantages

Best effort services are ideal for providing Internet access. This application enables service providers to offer economy-class service facilitated by over-subscribing bandwidth shared by numerous customers. Thus best effort services enable service providers/carriers to maximize the revenue potential of a fixed amount of bandwidth.

Ethernet/TDM access to frame relay and/or ATM service

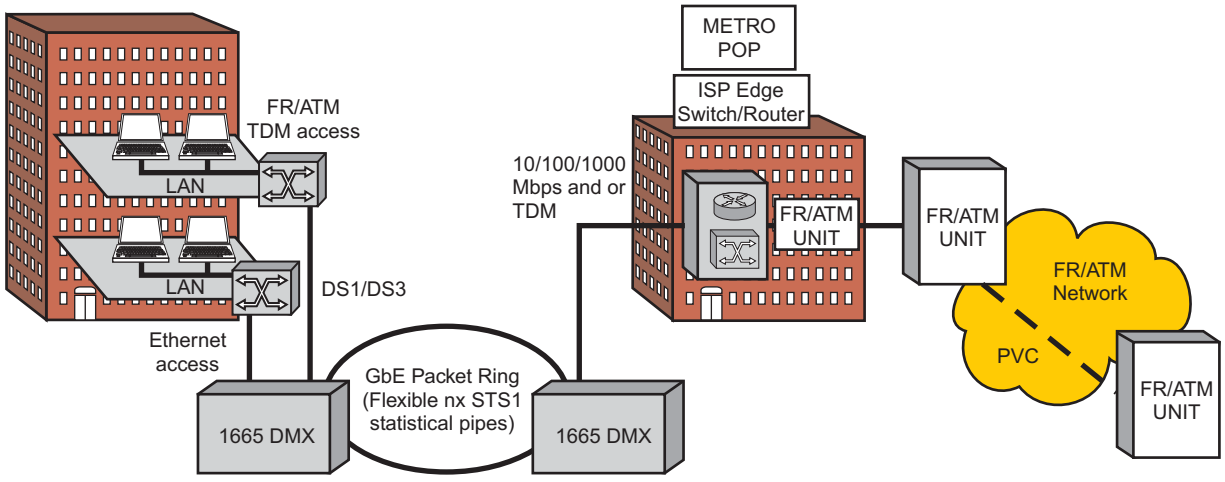
Overview

Alcatel-Lucent 1665 DMX supports business data access applications for a variety of broadband service interfaces. These services can cost-effectively reach remote data aggregation switches at collocated sites and business premises.

Description

In this application, Alcatel-Lucent 1665 DMX transports DS1, DS3, OC-3, OC-12, and OC-48 (c) signals from an edge aggregator to the core switch. See Figure 3-13, “Alcatel-Lucent 1665 DMX providing access to frame relay and/or ATM network” (p. 3-22). It also provides DS1 and DS3 (TDM) low-cost back-haul of frame relay and ATM to the hub multiservice switch. This application also provides 10/100/1000 Mbps Ethernet transport and switching.

Figure 3-13 Alcatel-Lucent 1665 DMX providing access to frame relay and/or ATM network



1665 DMX = 1665 Data Multiplexer

Application advantage

Alcatel-Lucent 1665 DMX satisfies evolving data service delivery requirements for business customers through its flexible, scalable access network infrastructure, offering a next–Generation infrastructure that is stable against the churn of data technology.

Alcatel-Lucent 1665 DMX simplifies data service delivery by enabling access to existing ATM and Frame Relay networks through Ethernet and/or TDM interfaces. Thus, traffic originating at Frame Relay or ATM equipment can enter the Alcatel-Lucent 1665 DMX through a 10/100/1000 Mbps Ethernet or DS1/DS3 TDM interface to be transmitted across SONET networks to its final destination (be it a Frame Relay/ATM based network or an Ethernet LAN).

Ethernet/TDM access to IP network

Overview

Alcatel-Lucent 1665 DMX provides access to the IP service delivering platforms, which enable such capabilities as virtual routing services, Layer 3 VPNs, firewall support, and IPsec Tunnels. These enhanced IP services allow service providers to offer customers state-of-the-art networking capabilities such as network based VPNs, built-in QoS, bullet-proof security, multi-tenant Internet access, voice/data convergence, and other next generation applications.

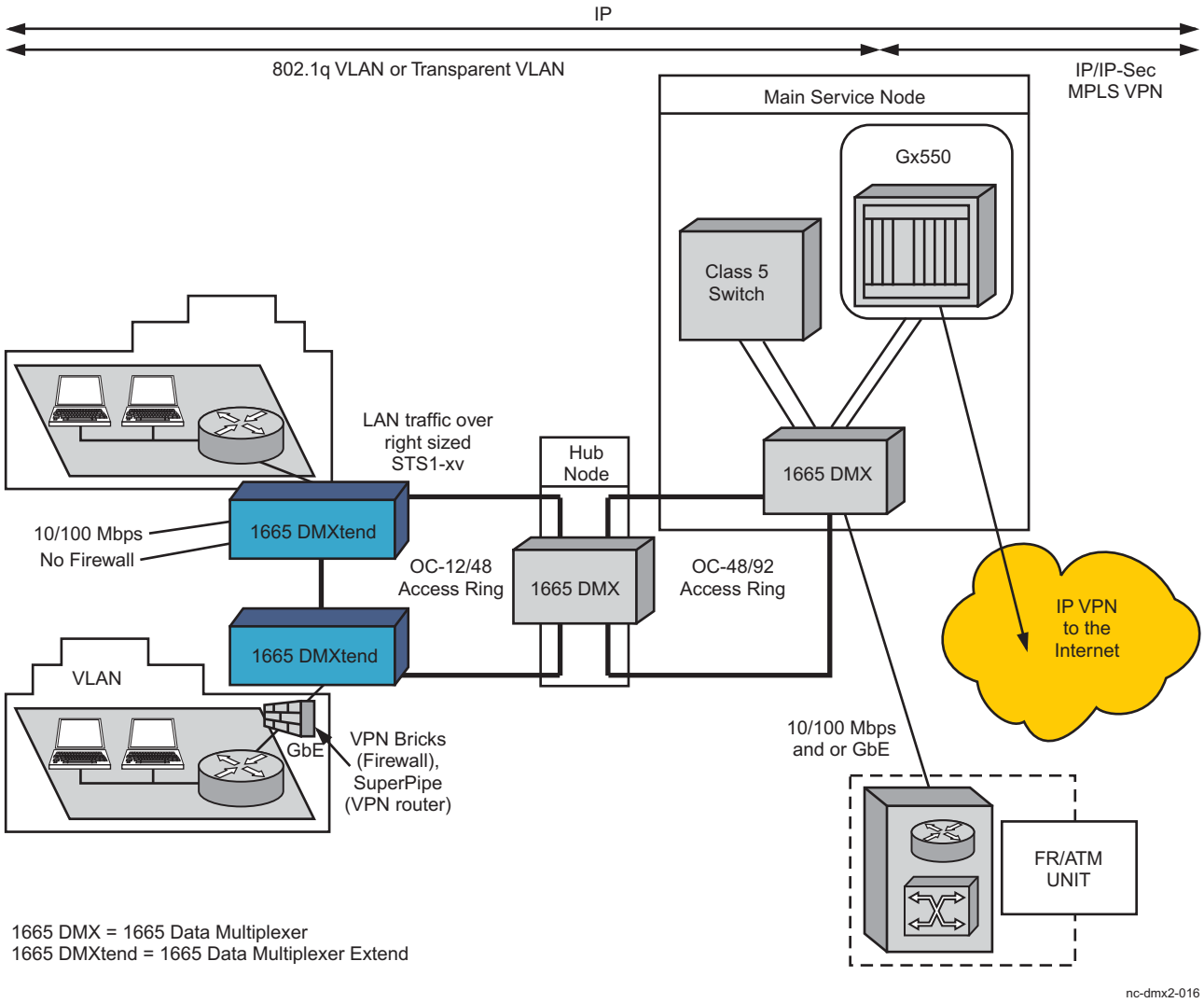
Description

While Alcatel-Lucent 1665 DMX single-handedly enables such things as voice/data convergence, it is important to state that the majority of the services listed above are supported by various IP Services platforms (Alcatel-Lucent's Access Point® Routers, and Brick Firewall Family for example). The Alcatel-Lucent 1665 DMX, however provides an efficient and crucial link between metro area networks and these IP Services platforms located in the network core.

In the figure below the Alcatel-Lucent 1665 DMX is hosting an OC-48/192 metro ring connected to an OC-12/48 access ring on one end, and the metro core on the other. On the access ring side, Alcatel-Lucent 1665 DMX provides a link to CPE sized multiplexers (which are in turn connected to routers or firewalls) or directly to IP routers (over 10/100/1000 Mbps Ethernet interfaces).

On the other side of the metro ring, the Alcatel-Lucent 1665 DMX is connected to an IP Services switch (both TDM and Ethernet interfaces supported by some IP switches). IP services switches can then provide a range of enhanced IP services.

Figure 3-14 Alcatel-Lucent 1665 DMX providing Ethernet/TDM access to the internet



Application advantages

Alcatel-Lucent 1665 DMX allows service provider's access networks to support today's enterprise customer needs with TDM to IP services migration, access to high-security multiservice platforms (i.e. SpringTide®), and efficient aggregation of last-mile voice and data services.

Alcatel-Lucent 1665 DMX as an Ethernet hub using LNW170

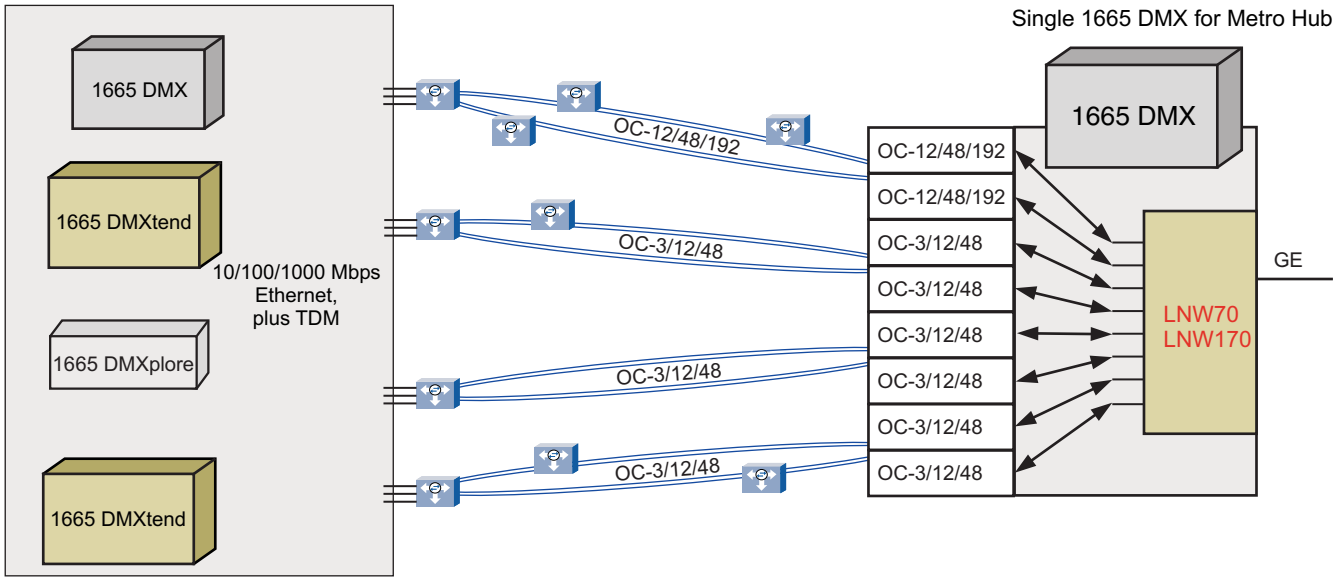
Overview

When Alcatel-Lucent 1665 DMX is equipped with the LNW170 and used as a metro Ethernet hub, it presents many advantages over other next–Generation and non next–Generation metro ADMs.

Description

At the metro edge, the 1665 Portfolio provides integrated CPE/MSPP functionality. With Ethernet over SONET (EoS), the 1665 Portfolio supports Ethernet packet rings up to 2.5 Gb/s. It supports 802.1Q or transparent (stacked VLAN) modes and can provide 802.1w rapid spanning tree restoration (802.1d also supported) whether functioning in Private Line or Packet Ring mode.

Figure 3-15 Alcatel-Lucent 1665 DMX as an Ethernet hub



1665 DMX = 1665 Data Multiplexer
1665 DMXtend = 1665 Data Multiplexer Extend
1665 DMXplore = 1665 Data Multiplexer Explore

MA-DMX-409

As shown in the figure above, the LNW170 contains external ports and a 9Gb/s switch with enough capacity to aggregate 2.5 Gb/s of protected spoke traffic and hand it off through one or more GbE ports to the hub. The integrated packet switch can connect multiple packet rings and/or point-to-point "spokes". Alcatel-Lucent 1665 DMX also supports optical/Ethernet hairpinning at full-rate GbE line speed. Finally, with the

LNW170, Alcatel-Lucent 1665 DMX provides optical 100BASE-ZX/LX/FX and 1000BASE-X, along with electrical 10/100BASE-T and 1000BASE-T ports on one card for data traffic aggregation at the metro edge or data traffic hand-off at the metro core.

Application advantages

Alcatel-Lucent 1665 DMX provides superior Ethernet aggregation and switch capacity with the LNW170. Each LNW170 supports an industry leading, single circuit pack capacity of 2.5Gbps. It supports both optical 100BASE-ZX/LX/FX and 1000BASE-SX/LX/ZX, along with electrical 10/100BASE-T and 1000BASE-T optical ports on the same pack, allowing you to provision the most appropriate and rate-specific data cross-connections for your network. This helps you to get the most out of your investment in both metro edge and data core NEs.

With an array of Ethernet topologies to choose from, Alcatel-Lucent 1665 DMX allows you to deploy the most appropriate network for your customers' needs. Support of industry standard private lines and Packet rings, with both SONET and spanning tree protection schemes, ensures your ability to interwork with CPE networks and provide your customers with the highest level of reliability possible. R5.1 also makes such billable services as CIR and PIR available in structuring Enterprise SLAs. Meeting the reliability requirements of stringent SLAs is easier given R5.1's support of LCAS, which enables hitless bandwidth provisioning.

Alcatel-Lucent 1665 DMX provides all of these capabilities within an industry leading TDM NE that scales from DS1/E1 to OC-192 in the same, compact unit. This makes Alcatel-Lucent 1665 DMX capable of aggregating both Ethernet and SONET traffic with the highest levels of speed, security, and sophistication possible.

SAN distance extensions with Alcatel-Lucent 1665 DMX

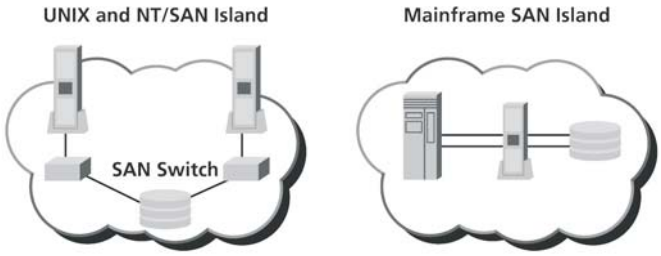
Overview

With today's increasing regulations and heightened concern with Business Continuity and Disaster Recovery, both large and small businesses must consider alternate storage architectures for distance extensions. Alcatel-Lucent 1665 DMX can provide a ubiquitous, flexible, highly reliable platform for both TDM and data-based transport, including voice, DSn Private Line, Ethernet, and storage (SAN) traffic.

Description

When SAN deployments began in corporations and colleges, it was to serve the needs of various, unique departments within a larger organization. The resulting situation, depicted in the figure below, is one of multiple SAN Islands made up of disparate technology with various management and transport requirements.

Figure 3-16 SAN islands today



There are three options available to connect SAN islands: IP, WDM, and SONET. IP is attractive due to its high availability, but it is non-deterministic and prone to packet loss. This makes IP incapable of providing both the capacity and reliability necessitated by enterprise requirements. WDM is not widely available for enterprises today, but is a good choice for large data center connectivity and those enterprises that require many storage ports.

SONET, on the other hand, is ubiquitously available and accepted as a data transport platform by business customers. It provides the most attractive balance of QoS and capacity for small to large-sized Enterprises running both synchronous (disk mirroring) and asynchronous (data replication/backup) applications. With new technology such as GFP, VCAT, and LCAS, SAN over SONET enables simple deployment and traffic engineering for carriers, while ensuring efficient transport by way of low overhead byte count and flexible framing. Due to SONET's advanced protection capabilities it can guarantee little or no packet loss for SAN transport. Plus, given Ethernet's incorporation into SONET platforms, SAN management can be easily centralized and performed over IP. For reliability, capacity, and ease of deployment/management SONET is the clear choice when considering the creation of corporate and campus SAN extensions.

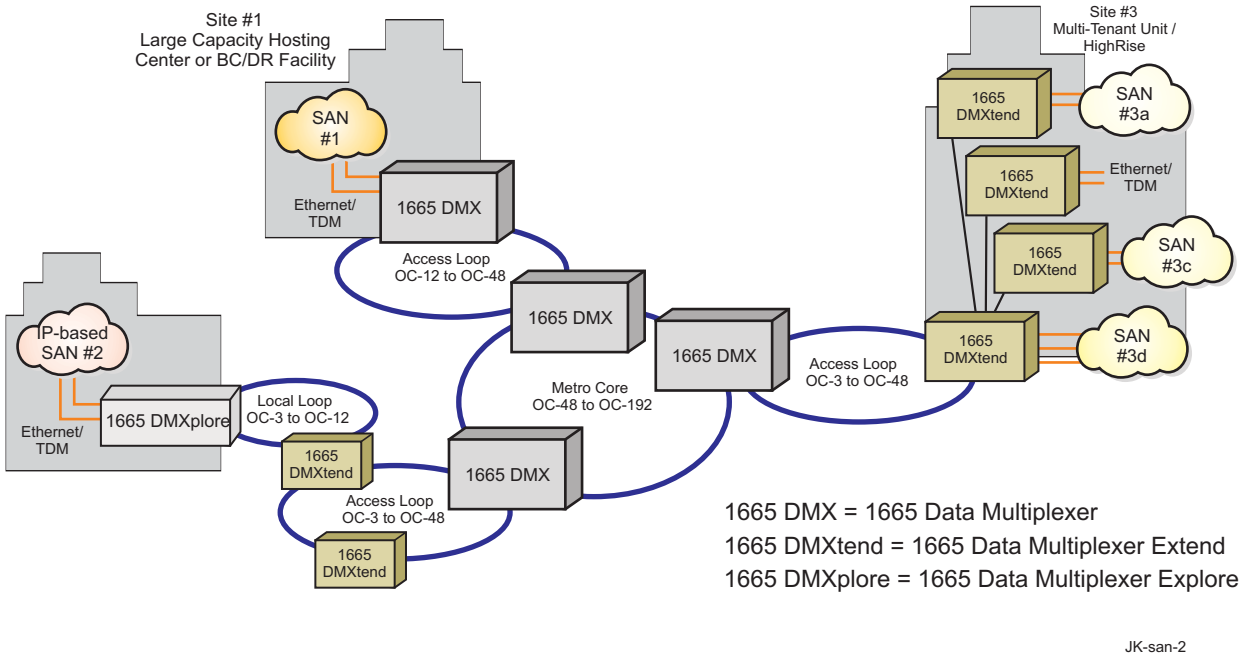
Application advantages

In addition to GFP, VCAT, and LCAS, 1665 products incorporate a full array of SAN interfaces on a single card to enable efficient SAN transport over SONET. The SAN card uses PTM (Pluggable Transmission Module) optics, to provide FICON, ESCON, and Fibre-channel interfaces. The same card can be used on both the Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMXtend, enabling rollout of new services from the metro core to edge, where and when they are requested. It can be equipped with four 200Mbps ESCON ports or four 1Gbs, two 2Gbs, or a mix of one 2Gbs and two 1Gbs

FICON/FC ports. The SAN implementation offers standards-based buffer-to-buffer credit management for long distance operations, sub-rate allocation of asynchronous FC traffic, and provisionable bandwidth levels.

Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMXtend are the ideal platforms for SAN/SONET connectivity. They can easily connect various enterprise SAN islands no matter what protocol is used. The figure below is a network view of multiple SANs connected within the same building or business park, across a region and nation-wide.

Figure 3-17 1665 product family SAN transport



Converged service delivery via 1665 product family

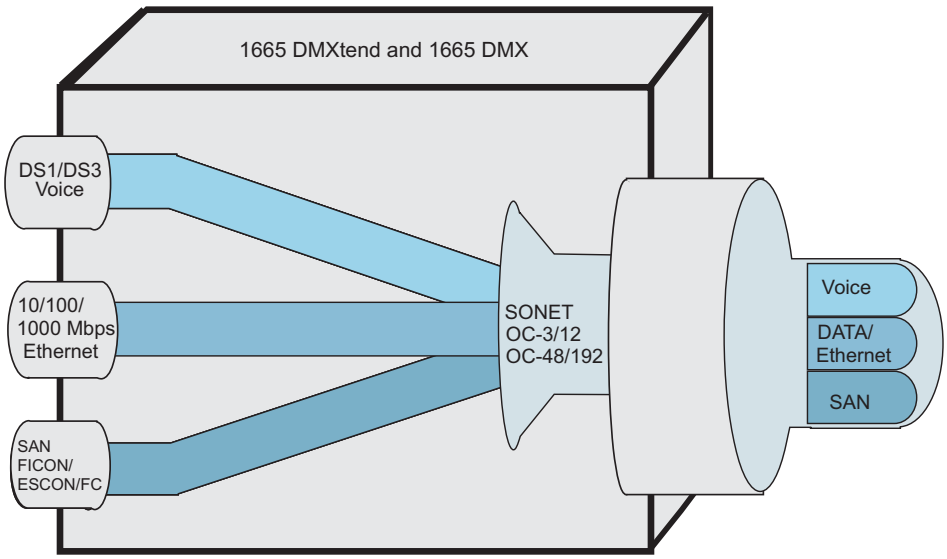
Overview

Modern Ethernet/SONET MSPPs like Alcatel-Lucent 1665 DMX have made it simple for a single provider to offer voice, data, and video on a common, easy-to-manage platform. The hybrid Ethernet/SONET nature of Alcatel-Lucent 1665 DMX has made it an integral part of the top Service Provider (SP) networks moving toward converged offerings. In addition to convergence, there are a host of new service opportunities that demand intelligent access solutions. These include services like Storage Area Network (SAN) distance extensions, secure VPNs, and VoIP; all of which are receiving great attention from industry media and promise high market demand in the future.

Description

The Alcatel-Lucent 1665 DMXplore and Alcatel-Lucent 1665 DMXtend offer high bandwidth optical access at the OC-3/12/48 level in conjunction with DS1/3 interfaces for voice traffic, Fast Ethernet (10/100 Mbps) and Gigabit Ethernet (1000Mbps) for integrated data transport, and on Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMXtend, native SAN interfaces (FICON/ESCON/Fibre-Channel) all in one compact, low-cost unit. These characteristics make the Alcatel-Lucent 1665 DMX family ideal next–Generation converged platforms for their ability to address the concerns of both SPs and end-users alike.

Figure 3-18 1665 product family providing converged service



1665 DMXtend = Alcatel-Lucent 1665 Data Multiplexer Extend
1665 DMX = Alcatel-Lucent 1665 Data Multiplexer

OC-3/12/48/192 high-speed lines provide connections with enough bandwidth to service even very high-bandwidth FTTB and FTTH applications. The rich feature set of the 1665 Product family includes support of Ethernet QoS protocols that rival offerings from other industry vendors and, combined with the legendary reliability of SONET, provides an extremely resilient platform ensuring low-latency and fast restoration in the event of failures. Finally, because the 1665 Product Family is SONET-based and provides fully integrated interfaces for data transport, they can enable SPs and Enterprises alike to preserve their investment in existing network assets.

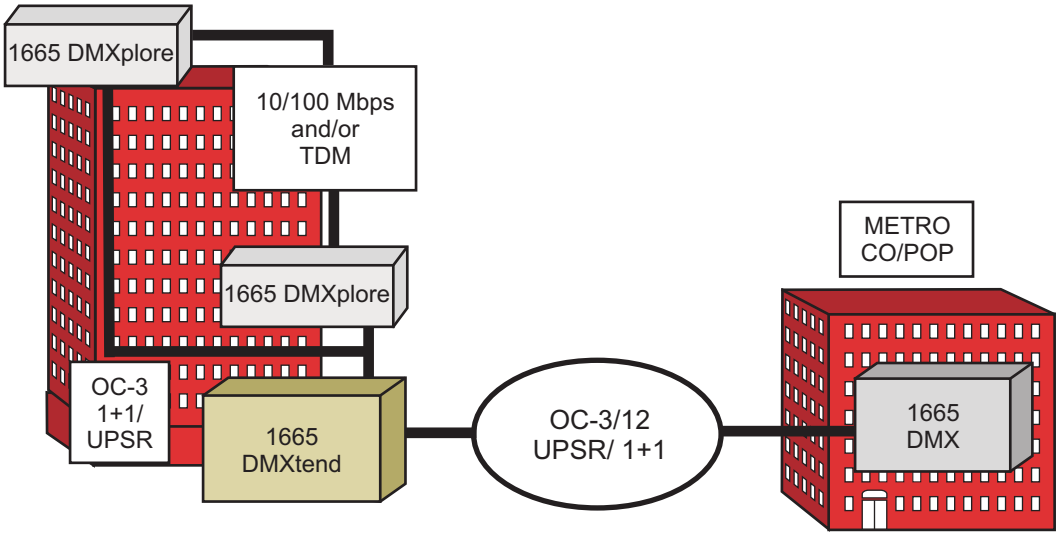
Application advantages

With a metro platform that provides integrated multi-service access, Enterprises can continue to employ their entire data infrastructure, simply connecting to the Alcatel-Lucent 1665 DMX/Alcatel-Lucent 1665 DMXtend/Alcatel-Lucent 1665

DMXplore at the point of transport. In addition to protecting their existing investments in hardware, this approach also enables the continued use of platforms and procedures used to manage their internal LAN. On the SP side, integrated access amounts to enabling converged service offerings with similar advantages. SPs can deliver more revenue generating services without the use of multiple CPEs/CO access devices. This is both an attractive prospect for enterprises, and allows SPs to keep OPEX under control. As SONET-based platforms, the 1665 Product Family can interoperate with SP management systems and be easily integrated into their network.

Across the board, industry analysts agree that OPEX and CAPEX reductions are the compelling force for upgrading to next–Generation network elements. And with a small footprint, great scalability, and fully integrated multi-service interfaces, Alcatel-Lucent 1665 DMXplore and *Metropolis*® DMX*press* simultaneously make the case for a next–Generation CPE and fulfill the need.

Figure 3-19 1665 product family converged service application



1665 DMXplore = 1665 Data Multiplexer Explore
1665 DMX = 1665 Data Multiplexer
1665 DMXtend = 1665 Data Multiplexer Extend

MA-DMXplore-019

DSLAM access

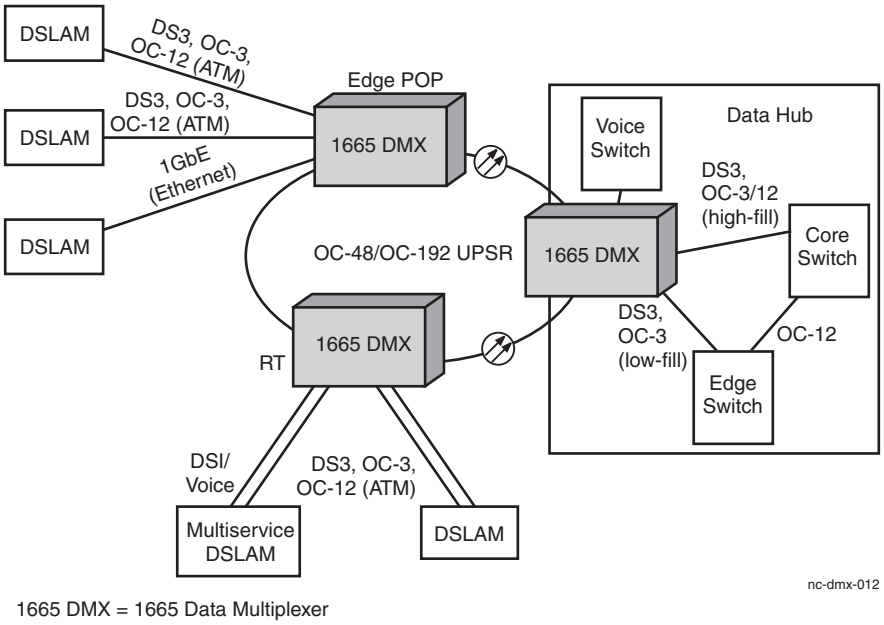
Overview

Alcatel-Lucent 1665 DMX provides a cost-effective aggregation and transport vehicle for digital subscriber line (DSL) or remote digital subscriber line access multiplexer (DSLAM) gateways.

Description

In the figure below Alcatel-Lucent 1665 DMX is located at a central office where it collects DS3 and/or OC-3/OC-12/GbE signals from multiple DSLAMs, multiplexes them to the OC-48/192 line rate, and sends them out on the OC-48/192 ring for back-haul to centrally located ATM switches that can be used more cost-effectively than distributed ATM switches.

Figure 3-20 DSLAM application



1665 DMX = 1665 Data Multiplexer

Application advantage

Alcatel-Lucent 1665 DMX offers a cost-effective, scalable access network infrastructure for DSL access transport.

TransMUX functionality with LNW18/20

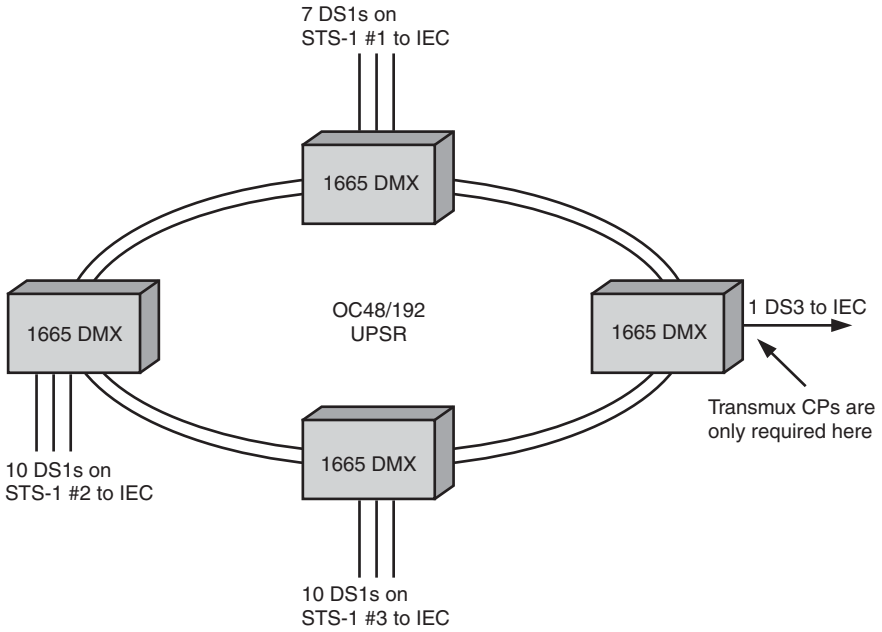
Overview

Alcatel-Lucent 1665 DMX provides a cost-effective/ bandwidth preserving aggregation and transport vehicle for DS1 signals. Using the LNW18 (12 ports) or LNW20 (48 ports), Alcatel-Lucent 1665 DMX can combine multiple DS1 signals into a channelized DS3 for more efficient transport through/to the core network.

Description

In the figure below Alcatel-Lucent 1665 DMX is pictured collecting multiple DS1s around the UPSR and, in the node at the far right of the figure, transmitting them within a channelized DS3 signal back to the core network. This TransMUX capability is provided by the TransMUX circuit packs located in Alcatel-Lucent 1665 DMX at the far right of the picture.

Figure 3-21 TransMUX application



Application advantage

TransMUX functionality enables Alcatel-Lucent 1665 DMX to:

- Groom DS1s for channelized DS3s
- Eliminate the need for separate M-13 MUXs at the DS1 aggregation site
- Pack DS3s with multiple DS1s to use bandwidth back to the network core most efficiently

Enhanced TransMUX functionality with LNW20

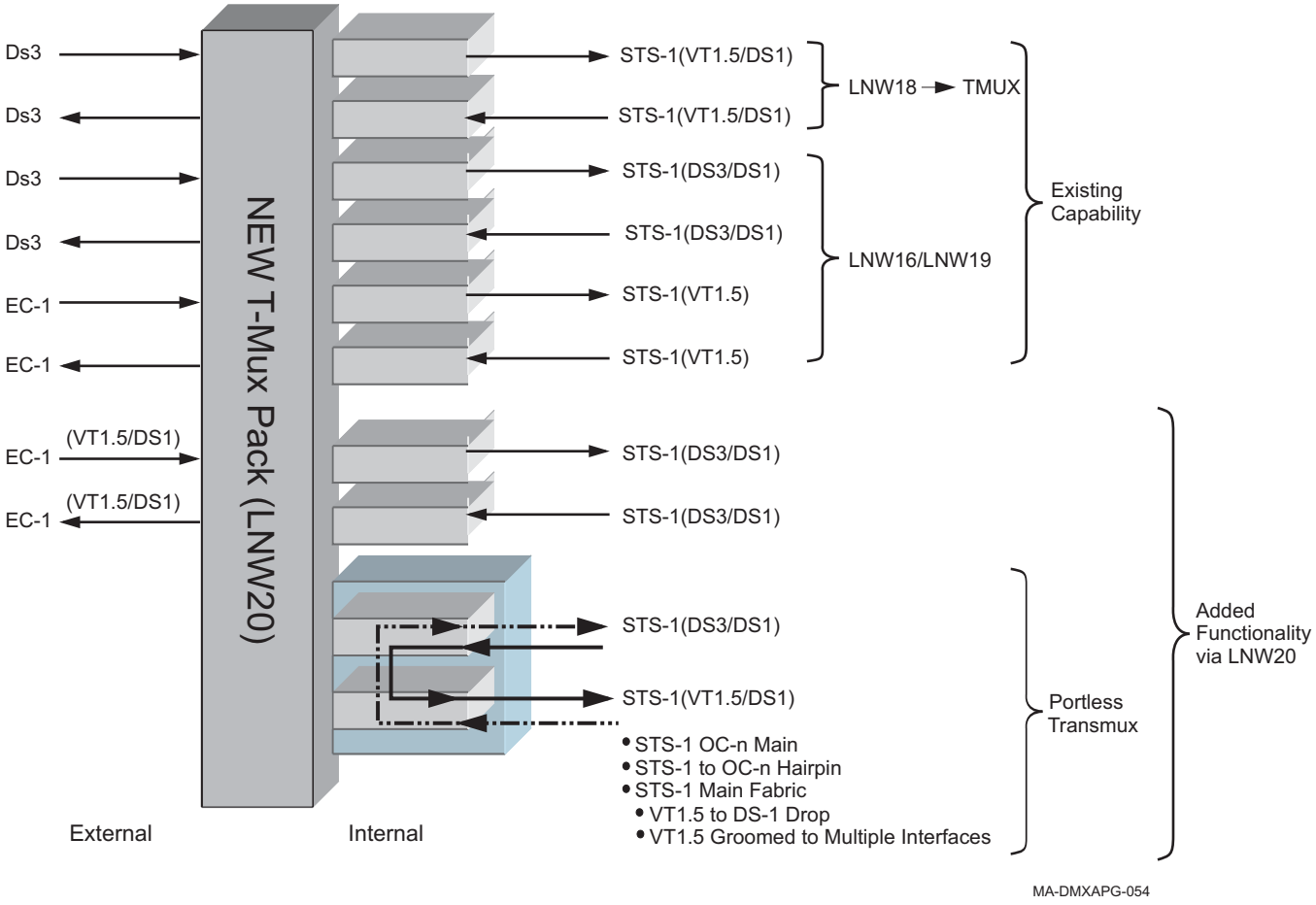
Overview

The LNW20 enhances Alcatel-Lucent 1665 DMX TransMUX functionality by increasing capacity and supporting new configurations. LNW20 provides 48 ports supporting DS3, EC1, and TMUX services provisionable on a port-by-port basis. Each port can be individually provisioned EC1, ported channelized DS3, ported unchannelized DS3, or portless DS3. With the LNW20, one high-density pack can be used for all DS3, EC1, and/or TransMUX applications.

Description

The figure below shows the various capabilities of the LNW20. Notice that the brackets and text at the right of the figure differentiate between legacy features and new capabilities enabled only by the LNW20.

Figure 3-22 LNW20 capabilities



Before the LNW20 was introduced, Alcatel-Lucent 1665 DMX could support TransMUX functionality on DS3 signals using the LNW18. It could also support EC-1 signals using the LNW16/19B.

With the LNW20, Alcatel-Lucent 1665 DMX can support DS3, EC-1, and/or TransMUX using a single circuit pack. As the figure shows, it also supports the portless DS3 mode that allows TransMUX functionality without using any of the physical interfaces on the circuit pack (for ports in portless mode).

When a port is provisioned for Portless DS3 operation, a channelized DS3 signal within an STS-1 tributary from a SONET interface on a different circuit pack (OC-n or EC-1) or the same circuit pack (an EC-1 on another port) is terminated and demultiplexed into

constituent DS1 signals. The DS1 signals are encapsulated into VT1.5 signals and cross-connected at the VT-level within the cross-connection fabric on the Main circuit pack to any other interface that supports DS1 signal transport, including a DS1 interface, a channelized DS3 interface, an EC-1 or OC-n interface. This requires two bidirectional backplane STS-1 signals to convert a single (bidirectional) STS-1 channel.

If the Main slots are equipped with Very Large Fabric LNW59, LNW82, or LNW504 circuit packs, portless operation is supported on all ports when the LNW20 circuit pack is installed in any Function/Growth group.

If the Main slots are equipped with large fabric (non-VLF) circuit packs, portless DS3 operation is supported on the odd ports only when the LNW20 circuit pack is installed in any Function/Growth group. The corresponding even port (odd port plus one) is unavailable.

If the Main slots are not equipped with large fabric or very large fabric OLIU circuit packs, portless DS3 operation is not supported and any attempts to provision portless DS3 operation will be denied.

Application advantage

Enhanced TransMUX functionality with the LNW20 enables Alcatel-Lucent 1665 DMX to:

- Upgrade density for TransMUX to 48 ports per pack
- Support DS3, EC-1 and TransMUX on a single pack
- Portless functionality allows Alcatel-Lucent 1665 DMX to cross-connect any channelized DS3 entering the shelf to any port that accepts VT-mapped STS-1s without using the electrical interfaces on the LNW20 itself.
- Groom DS1s for channelized DS3s
- Eliminate the need for separate M-13 MUXs at the DS1 aggregation site
- Pack DS3s with multiple DS1s to use bandwidth back to the network core most efficiently

WDMX optical multiplexing

Overview

Alcatel-Lucent 1665 DMX offers WDM optical transmitters for main optical packs and also offers non-integrated mux/demux, optical amplification and transponders through the Wavelength Extension Services (WES) portfolio. WDMX is the integration of these types of WDM functions directly on the Alcatel-Lucent 1665 DMX shelf platform. It provides metro transport markets with a state of the art low-cost converged MSPP/MSTP solution for both TDM and WDM. The LNW705 supports this integration on Alcatel-Lucent 1665 DMX.

WDMX comprises feature sets that add the ITU-T Optical Transport Network (OTN) layered structure for WDM within the Alcatel-Lucent 1665 DMX shelf footprint. The optical transport network layered structure consists of optical channel, optical multiplex section and optical transmission section. Pre-existing Alcatel-Lucent 1665 DMX WDM interfaces may also be directly connected to the optical multiplex section without using the ITU defined optical channel encapsulation.

Applications

WDMX is designed for application by service providers in metro access, metro core, and extended metro deployments, as well as high capacity enterprise and campus networks.

Triple play applications

Alcatel-Lucent 1665 DMX R7.1.1 provides a great solution to the low cost Triple Play (voice, video and data) distribution application focusing on data rates below OC48.

Service providers are dealing with the problem of enhancing video distribution and Ethernet broadcast distribution and making it affordable. WDMX is perfectly matched to meet a major portion of that need.

Some customers have a requirement for full C-band tunable lasers and very long reach without regeneration for their video backbone networks. Although WDMX is not intended as a full range multi-haul system, it can lead to dramatic savings for the service provider. WDMX is expected to be the first system to focus the latest full set of optimized technologies for metro deployments.

Video applications typically have a two tiered network. One tier consists of national video broadcast feeds through a national core network into local Video Broadcast (VBC) and Video-On-Demand (VoD) servers at the regional and local Video Hub Offices (VHO). The second tier connects the VHOs with Video Service Offices (VSO). The VSO distributes the multicast VBC paths and manages the unicast connections for VoD paths.An Ethernet Aggregation Router collects and distributes traffic to and from DSLAMs and routers in the access network.

The typical VSO will house 2 Edge Aggregation Routers (EARS). Each of the EARs will interface to:

- 2 GbE circuits (uni-directional protected east/west) for Multicast Video Channels
- 1 GbE for Internet Data (dropped and added east/west)
- 2 to 3 GbE for Video On Demand (VOD).

This is a total of 6 to 9 GbE. So, most VSOs will require less than 8 wavelengths. However, the VHOs and Optical hubs will require more than 8 wavelengths.

MSPP exhaust applications

There are cases where there is a large jump in high bandwidth service demands along the path of an existing MSPP ring. If such services are projected to exceed the ring capacity (capacity exhaust), WDMX can be used. Alcatel-Lucent 1665 DMX R7.1.1 allows an existing partially filled Alcatel-Lucent 1665 DMX shelf to add 10G wavelengths for client interfaces with data rates of OC-48 or below. The wavelengths added are passed transparently, which is critical to applications that would lose proprietary functionality if the client signals attempted to use standard section and line termination of SONET for transport.

Large data center/SAN high availability applications

The substantial disasters of the last ten years have caused both industry and the government to require geographical redundancy of mission critical data in real-time or near real-time to assure high availability. This requires substantial high capacity transport of Ethernet and Fibre Channel data for Fortune 1000 Enterprises.

Network configurations

Overview

Purpose

Alcatel-Lucent 1665 DMX provides the flexibility required for operation in today's changing telecommunications networks. With topology and capacity upgrades, an Alcatel-Lucent 1665 DMX network can be installed with minimum first cost and then easily grown to add new sites and services.

Network flexibility

The following sections describe some of the network topologies in which Alcatel-Lucent 1665 DMX can be used. Many other combinations of these network configurations can be used to meet specific network and fiber topologies.

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Path switched rings

Overview

This section describes the unidirectional path switched ring configuration available with Alcatel-Lucent 1665 DMX.

Purpose of path switched rings

The need to prevent service outage caused by network failure has created path switched ring applications. The path switched rings configuration provided by Alcatel-Lucent 1665 DMX is a self-healing network that automatically protects against service outages caused by cable cuts and equipment failures, which in turn protects customer traffic and increases revenue opportunity.

Alcatel-Lucent 1665 DMX path switched rings operate in an easily-managed, integrated, single-ended fashion. Restoration is fast and reliable. Complex network-level coordination is not necessary to restore traffic. Furthermore, bandwidth administration and network reconfigurations (for example, adding or deleting nodes) are simple because path switching does not require special time slot assignment rules.

Typical path switched ring application

A network that requires the majority of its traffic to be dropped at a single node is an ideal application for path switched rings. A typical access network, where most traffic is between the customer locations and a point-of-presence (POP) or end office, fits this mold. Such an application calls for reliable delivery between customers and POPs. In cases where a mixture of wideband and broadband services is required, an Alcatel-Lucent 1665 DMX path switched ring is ideal.

OC-3/12/48/192 path switched rings

The OC-3/12/48/192 path switched ring allows several remote sites to share the two-fiber ring facility back to the CO. Alcatel-Lucent 1665 DMX interfaces to the ring through the Main slots at the OC-3/12/48/192 rate and uses its programmable VT1.5/STS-1/STS-3c/STS-12c/STS-48c/STS-192c cross-connect capability. Path switching can be done on VT1.5, STS-1, STS-3c, STS-12c, STS-48c, , or STS-192c paths, or a mixture of these, and all can be added/dropped from the Alcatel-Lucent 1665 DMX path switched ring at any node. Using the ring's path protection scheme, time slots are reserved all the way around the ring. Cross-connections offer full flexibility in assigning signals between low-speed ports and the high-speed interface at each node. Alcatel-Lucent 1665 DMX can easily adapt to unpredictable growth at a ring node.

OC-3/12/48 UPSRs are supported on the low-speed (tributary) interfaces with the same characteristics as the high speed UPSRs described above. Alcatel-Lucent 1665 DMX supports path switching on STS-1, STS-3c, STS-12c, STS-48c, , or STS-192cand VT1.5 paths only.

Ring topology

The ring topology routes traffic between a CO site and a set of remote sites, or between multiple COs, while providing complete protection. In addition, only two OLIUs are needed per Alcatel-Lucent 1665 DMX, which provides a cost savings. Traffic can also be routed between remote nodes. The ring can start with as few as two nodes and grow to support many nodes through in-service node additions.

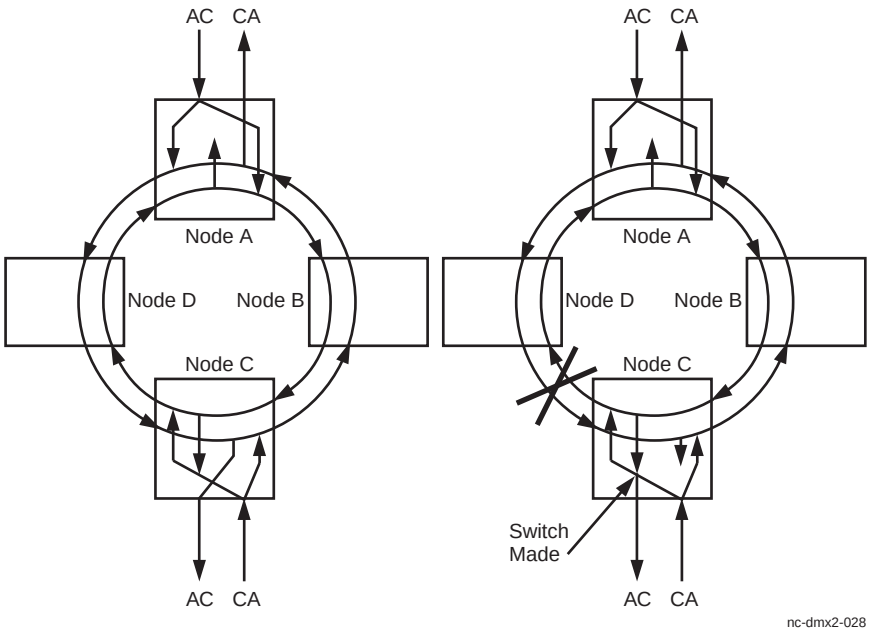
For protection against a CO failure, it may be desirable to include a second CO node in the ring. Alcatel-Lucent 1665 DMX's support for dual homing architectures allows all services to be routed to the alternate CO while the first CO is out of service.

Operation

The Alcatel-Lucent 1665 DMX OC-3/12/48/192 path switched ring operates as shown in Figure 3-23, “Path switched rings” (p. 3-41). Traffic entering a path switched ring node is sent onto both rotations of the ring. At the receiving node, the signal having the highest integrity (based on SONET path information) is selected and dropped as outgoing traffic. At intermediate nodes, the traffic is "passed-through" without changing the SONET path information. The Alcatel-Lucent 1665 DMX VT1.5/STS-1/STS-3c/STS-12c/STS-48c/STS-192c cross-connect capabilities make the provisioning of add/drop and pass-through traffic quick and easy.

The self-healing nature of the path switched ring is shown in Figure 3-23, “Path switched rings” (p. 3-41) (b). In this case, the fiber failure between nodes C and D causes node C to switch from the counterclockwise ring to the clockwise ring, thus maintaining service between all nodes on the ring.

Figure 3-23 Path switched rings



Configuration advantage

Path switched rings are the industry standard for self-healing networks, providing reliable transport for access networks while accommodating almost any type of application.

2-Fiber BLSRs

Overview

A 2-fiber bidirectional line-switched ring (BLSR) is a self-healing ring configuration in which bidirectional traffic travels over the same set of nodes in each direction. Bidirectional switching makes use of redundant (protection) bandwidth on the bidirectional lines that interconnect the nodes in the ring to provide protection for traffic carried on the working bandwidth. Because the traffic is bidirectional, a single circuit does not necessarily consume bandwidth on every span in the ring. This leaves the spans between other nodes available for additional traffic. Therefore, with distributed switching patterns, a BLSR can carry more traffic than the same facilities could carry if configured for a unidirectional path-switched ring.

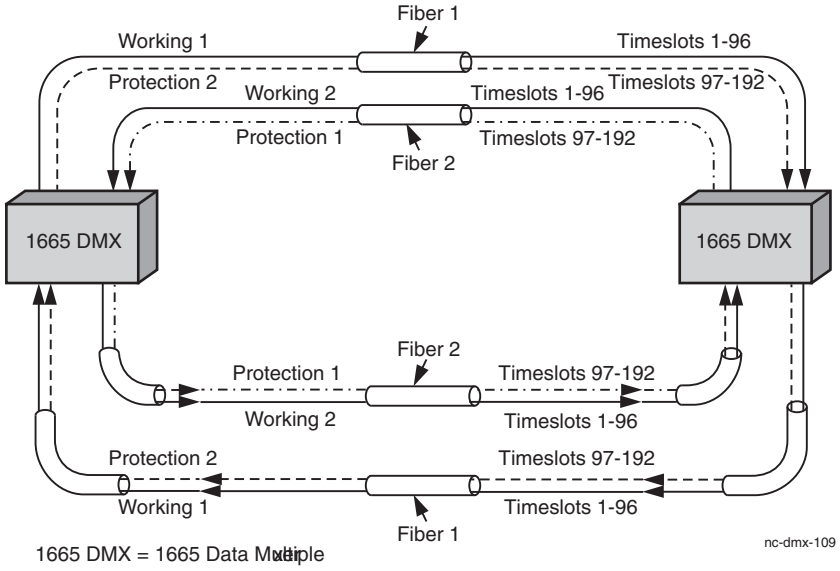
Alcatel-Lucent 1665 DMX supports 15 simultaneous BLSR protection groups in a single shelf. The 15 protection groups can be provisioned on any available OC-48 and OC-192 port pairs within the high-speed and low-speed groups.

For example, you can have an application with two high-speed OC-192 2-fiber BLSR and 13 low-speed OC-48 BLSRs. The low-speed OC-48 BLSRs are hosted by OC-48 circuit packs housed in the Function slots and can add and drop traffic with the high-speed OC-192 circuit packs housed in the Main slots. The low-speed OC-48 BLSRs can also add and drop traffic with interfaces in other tributary (low-speed) slots (includes both Function Units and Growth slots).

Traffic capacity

The following figure shows working and protection traffic capacities in an OC-192 2-fiber BLSR. The OC-48 2-fiber BLSR operates in the same way, but has 48 STS-1 time slots in each direction, 24 for working traffic and 24 for protection.

Figure 3-24 Traffic capacity in an OC-192 2-fiber BLSR



Self-healing rings

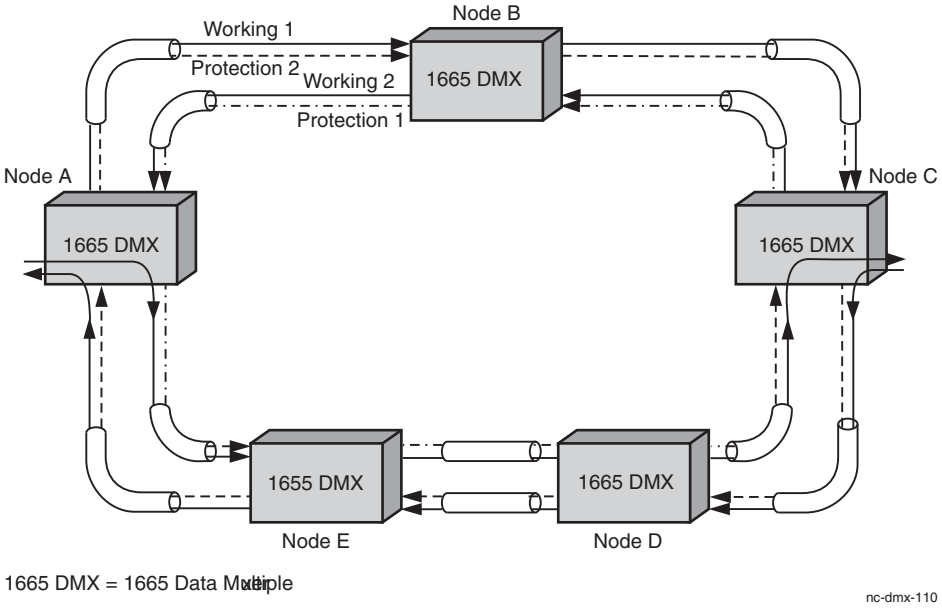
Alcatel-Lucent 1665 DMX 2-fiber BLSRs are self-healing in that transport is automatically restored after node or fiber failures. Each OC-192 line carries 96 STS-1 equivalent time slots of working capacity plus 96 STS-1 equivalent time slots of protection capacity. Each OC-48 line carries 24 STS-1 equivalent time slots of working capacity plus 24 STS-1 equivalent time slots of protection capacity. In the event of a fiber or node failure, service is restored by switching traffic from the working capacity of the

failed line to the protection capacity in the opposite direction around the ring. See the figure below and the figure on the following page. In the event of a node failure, traffic added and dropped from the failed node is not protected by line switching.

2-fiber BLSR traffic flow

The figure below shows normal (non-protection-switched) traffic flow on a 2-fiber BLSR.

Figure 3-25 Normal traffic flow in a 2-fiber BLSR



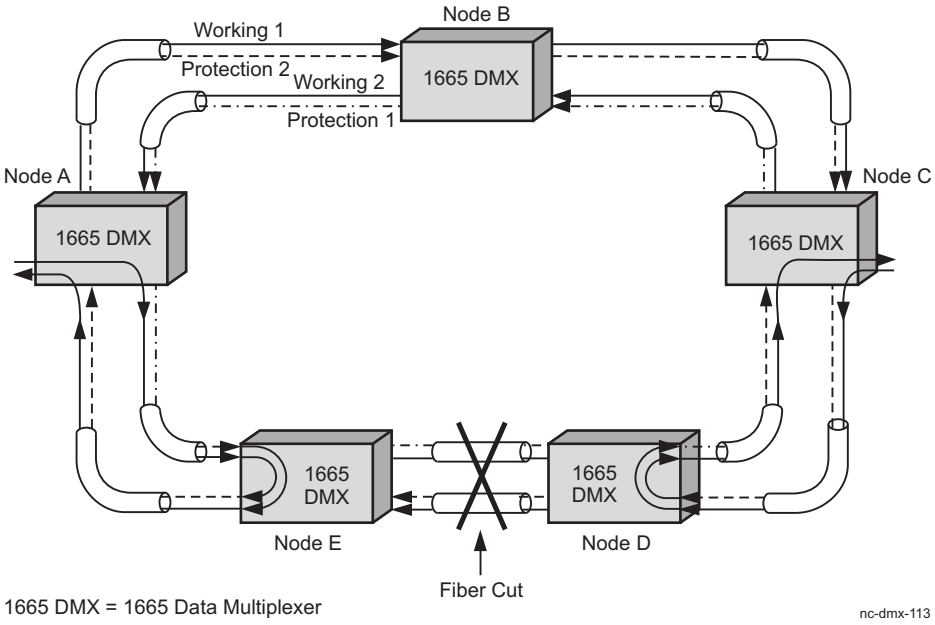
Protection switching

When a line failure triggers a protection switch, the nodes adjacent to the failure switch traffic on to protection capacity. Traffic heading toward the failure is looped back on to the protection capacity traveling away from the failure to reach its destination by traveling the opposite way around the ring (see the figure below). Service is reestablished on the protection capacity in ≤50 milliseconds after detection of the failure (for catastrophic failures in rings without existing protection switches or extra traffic).

Fiber cut example

The figure below illustrates a 2-fiber BLSR protection switch that results from a fiber cut.

Figure 3-26 Loopback protection switch in a 2-fiber BLSR



Protection traffic flow

In the figure above, traffic going from Node A to Node C that normally passes through Node E and Node D on "working 2" capacity is switched at Node E on to the "protection 2" capacity of the line leaving Node E in the direction of Node A. The traffic passes through Nodes A, B, and C on the protection bandwidth to Node D where it is looped back to Node C. Similarly, traffic going from Node C to Node A that normally passes through Node D and Node E on "working 1" capacity is switched at Node D on to the "protection 1" capacity of the line leaving Node D in the direction of Node C. The traffic passes through Nodes C, B, and A on the protection bandwidth to Node E where it is looped back to Node A. Only the nodes adjacent to the failure perform loopback protection switches. The same approach is used for a node failure. For example, if Node D fails, Nodes C and E perform loopback protection switches to provide an alternate route for ring traffic. However, traffic that is added and dropped at the failed node, Node D, cannot be protected by ring switching and is therefore squelched at the switching nodes.

Extra traffic

Alcatel-Lucent 1665 DMX supports extra traffic

- OC-48 BLSR on non-VLF mains
- OC-192 BLSRs (Main and FN) in systems with VLF mains

(OC-192 VLF mains are required in all contiguous nodes participating in the extra traffic part of the network.)

The extra traffic capability allows the protection channels to carry additional low-priority traffic during fault-free conditions. The extra traffic is established by provisioning cross-connections to the high-speed (main) BLSR protection channels. Provisioning cross-connections on the protection channels is only supported on high-speed BLSRs. Pass through cross-connections are provisioned on the protection channels at intermediate nodes. (Protection channels that are not carrying Extra Traffic are terminated at the intermediate nodes.)

If a BLSR protection switch occurs, traffic is switched from the working channels to the protection channels and extra traffic is preempted.

If extra traffic circuits are preempted, AIS-P is used to squelch the circuits. When the BLSR protection switch clears, the extra traffic is restored.

Nonpreemptive unprotected traffic

Non-preemptible unprotected traffic is traffic carried on (working and/or protection) BLSR channels for which protection switching has been provisioned as disabled. As the name implies, NUT is unprotected and not preempted in the event of a protection switch.

BLSR protocols allow the available bandwidth of a BLSR to be partitioned into three types of channels:

- working channel to carry working traffic.
- protection channel which may be used to carry extra traffic.
- NUT channel to carry non-preemptible unprotected traffic.

Working traffic is protected against failure events via the BLSR APS protocol, while extra traffic is unprotected traffic carried on the protection channels. Any failure event that may require the protection channels for protection purposes shall preempt the extra traffic. NUT carried on non-preemptible unprotected channels affords a higher level of survivability as compared to extra traffic, which is preempted during a protection switch, but a lower level of survivability as compared to working traffic, which is carried on its corresponding protection channel during a protection switch. Note that non-preemptible unprotected traffic is not considered extra traffic.

Important! Alcatel-Lucent 1665 DMX supports NUT on 2-fiber OC-48 and OC-192 BLSRs.

Packet rings

Overview

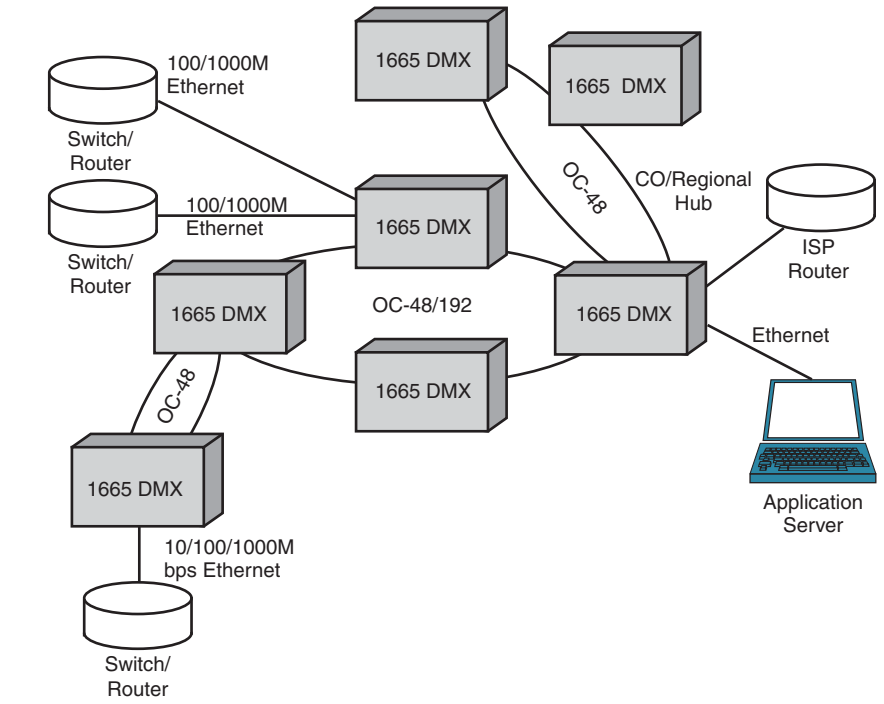
Packet Ring configurations provide business-to-business networking of routers and data switches using Ethernet transport over a reliable, low-cost multiservice network. Alcatel-Lucent 1665 DMX provides the unique capability for a packet ring to span multiple ring topologies. As shown in the figure below packet rings hosted by Alcatel-Lucent 1665 DMX can span multiple OC-192, OC-48, OC-12, OC-3 ring configurations (UPSRs or BLSRs). Additionally, packet rings hosted by Alcatel-Lucent 1665 DMX can reach into areas serviced by dual and single-homed ring extensions (see the figure below).

Ethernet over SONET

A Packet Ring is a set of packet switches connected in a ring topology that use the inherent redundancy of the ring configuration to provide durability and fast restoration in the event of failures.

Packet rings can be used with or without SONET layer protection. At the packet layer, the rapid spanning tree protocol (as defined in IEEE 802.1) is used to provide protection.

Figure 3-27 Packet rings



1665 DMX = 1665 Data Multiplexer

nc-dmx2-014

Alcatel-Lucent 1665 DMX uses standard Generic Framing Procedure (GFP) encapsulation (ITU G.7041) for Ethernet over SONET mapping. Packet rings provide efficient aggregation and transport for Ethernet traffic. Alcatel-Lucent 1665 DMX's virtual concatenation capability (ITU G.707) provides flexible bandwidth granularity in the wide area network (WAN), which can grow with your service demand.

Packet rings over a BLSR

Alcatel-Lucent 1665 DMX allows the manual provisioning of nonpreemptive unprotected traffic (NUT) for multi-point Ethernet cross-connections that originate on low-speed (tributary) interfaces and share bandwidth on the high-speed (Network side) BLSR ring.

When using multi-point cross-connections through a BLSR, packets do not receive standard BLSR protection due to the necessary functioning of NUT. Yet, protection on all data packets is provided for with rapid spanning tree protocol (IEEE 803.1w).

Packet ring capacity

Alcatel-Lucent 1665 DMX supports the following number of packet rings per Ethernet interface circuit pack:

- 1 packet ring on each 10/100 Mbps Fast Ethernet circuit pack (LNW66)
- 16 packet rings on each 10/100/1000 Mbps GbE circuit pack (LNW170)

Specific applications supported

Alcatel-Lucent 1665 DMX supports the following enterprise LAN (local area network) interconnect and transport applications:

- Ethernet Private Line
- Ethernet Rate Control Services
- Virtual LAN Services
- Transparent LAN Services
- Best Effort Service
- Ethernet/TDM Access to Frame Relay or ATM Network
- Ethernet/TDM Access to IP Network
- DSLAM Access

Each of these packet ring applications are detailed in the "Service Applications" section of this chapter.

WDMX shelf models

Overview

WDMX can be implemented by using spare slots in existing Alcatel-Lucent 1665 DMX SONET shelves that already make use of the main slots, and a subset of the function unit and growth slots. For these applications, WDMX is a WDM overlay on top of the existing SONET applications.

Multi-service transport over OTU-2

With the LNW705 muxponder pack, WDMX can be used without requiring SONET application packs in the shelf. Main packs are required for system timing. The LNW705 XM10G/8 Muxponder circuit pack is a highly integrated pack that multiplexes up to 8 ports of the most common high bandwidth client interfaces onto a single 10G wavelength. The 8 client ports can be a mix of the following signals: 1GE, FC100, FICON, FC200, FICON_EXP, or OC3/12/48. One GE is mapped using VCAT and GFP-F. All FC signals and FICON signals are mapped using VCAT and GFP-T. The client signals are mapped into a single STS-192 and then encoded into an OTN OTU-2 signal (including forward error correction) and is transmitted out on a DWDM XFP. The circuit pack is bi-directional and simultaneously handles the inverse function in the receive direction.

Figure 3-28 LNW705 ports

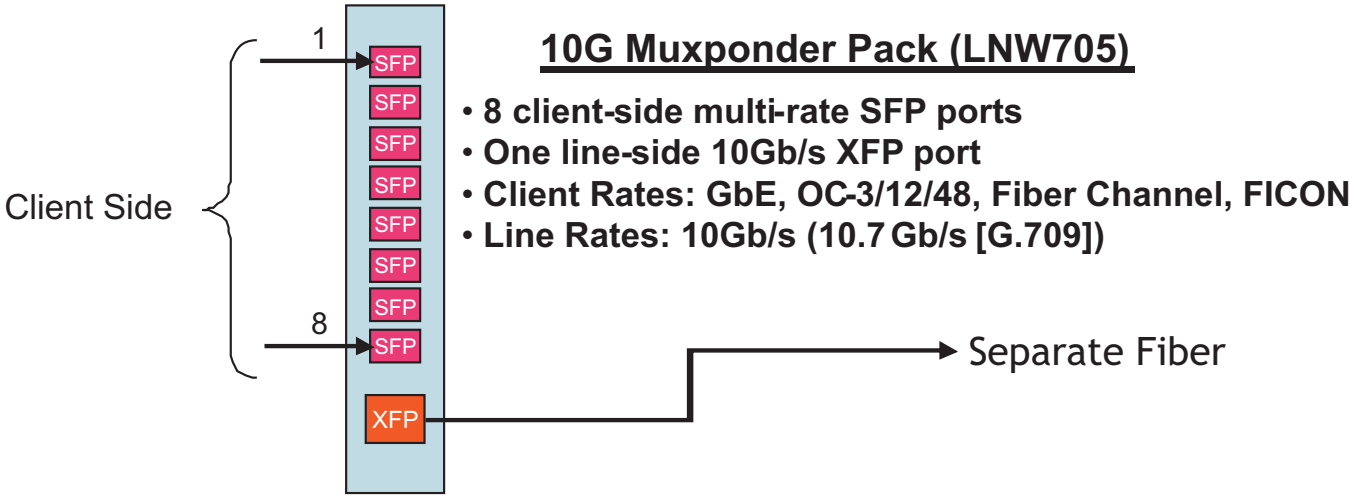
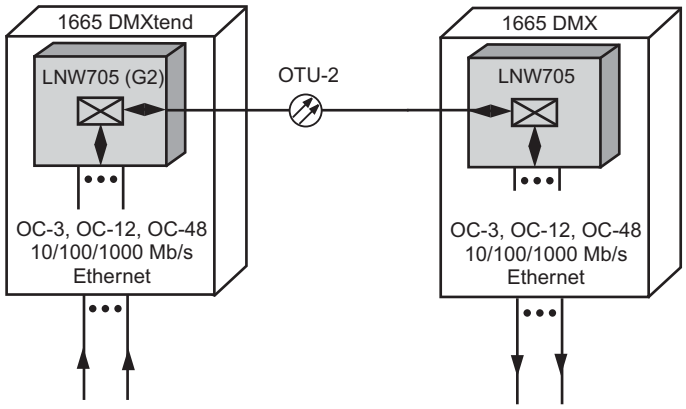


Figure 3-29 WDMX with LNW705 packs



1665 DMX = Alcatel-Lucent 1665 Data Multiplexer
1665 DMXtend = Alcatel-Lucent 1665 Data Multiplexer Extend

DMX-705

In the figure, multiple client signals are coming into a single LNW705 in the G2 slot on the Alcatel-Lucent 1665 DMXtend. The LNW705 multiplexes up to 8 client ports onto the single OTU-2 for transport over the fiber. The single LNW705 in the Alcatel-Lucent 1665 DMX demuliplexes the signals and sends them onto another NE.

One-line unamplified 8 channel end terminal node

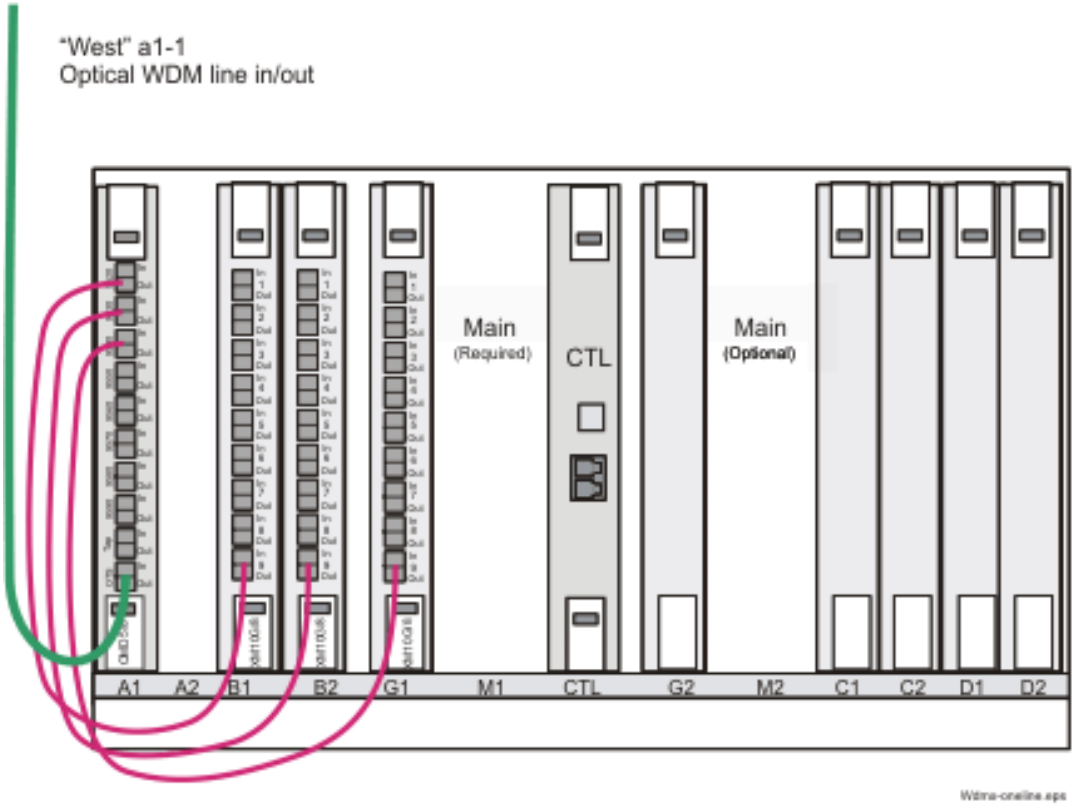
This model consists of an Alcatel-Lucent 1665 DMX shelf, shelf controller, 1 or 2 main packs for shelf timing, an 8 channel OMD pack (LNW785), and the following, optionally directly connected to the OMD:

- Existing Alcatel-Lucent 1665 DMX packs and functions (with the interconnect to the LNW785 OMD pack)
- Alien wavelengths from other equipment

The OMD pack (LNW785) may be equipped in any unequipped function or growth slot. OSMINE supported models for Alcatel-Lucent 1665 DMX allow function groups A, B, C, and D. Growth slots on the Alcatel-Lucent 1665 DMX do not have an OSMINE model because the pass-through fibers between two growth slots on the Alcatel-Lucent 1665 DMX shelf would have to pass around the main-1 slot and the controller slot.

A one-line 8 channel end terminal can have 1 or 2 main packs, 1 LNW2 controller, 1 WDM line, 8 optical channels, and 64 client ports in a single shelf.

Figure 3-30 WDMX 1-line end terminal



Two-line unamplified 8 channel add-drop ring node

This model consists of an Alcatel-Lucent 1665 DMX shelf, shelf controller, 1 or 2 main packs, two 8 channel OMD packs (LNW785), and directly connected to each OMD one or more of the following:

- Existing Alcatel-Lucent 1665 DMX packs and functions with the interconnect to the OMD pack typically equipped in the Main slots
- Alien wavelengths from other equipment

The OMD packs may be equipped in pairs in any unequipped function slot pair A, B, C or D in Alcatel-Lucent 1665 DMX and slots pairs D and Growth in Alcatel-Lucent 1665 DMXtend. A two-line 8-channel end terminal can have: 2 WDM lines, 16 optical channels, and 64 client ports in a single shelf. It can be used in conjunction with more shelves or alien wavelengths to connect the 8 optical channels that exceed the capacity of a single shelf.

WDMX optical multiplexing network models

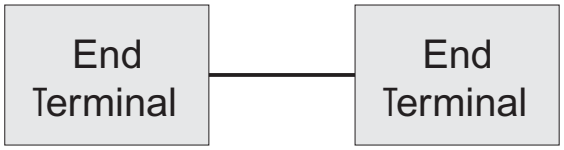
Overview

A WDM line (OTS) is a bidirectional multicolored composite optical line that connect WDM systems into networks. If only one WDM line is used, the system is referred to as an end terminal and can be used in point to point networks or at the end of chain of ring nodes. Two lines are required for optical add/drop multiplexers (OADMs) used as rings, nodes, and in linear chains: one line faces West (slot 1 of an OMD [LNW785] pack pair, e.g., d1-ots), and the other line faces East (slot 2 of an OMD [LNW785] pack pair, e.g., d2-ots).

The following network examples illustrate various arrangements of end-terminals and add/drop ring nodes that can be used for WDMX. In the following examples, a single line represents two-fiber connections between NEs.

Point-to-point/end-terminal-to-end-terminal

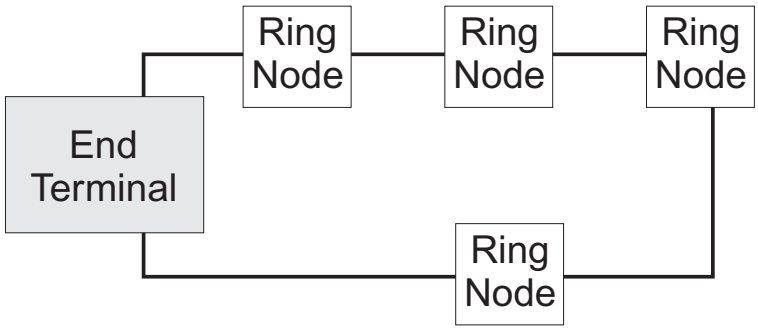
This simple configuration can provide extra wavelengths between two points.



WDMX001

Terminated ring

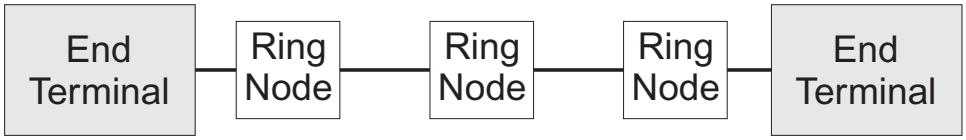
The terminated ring configuration can provide extra wavelengths between three or more points, terminating back at the single end-terminal.



WDMX-002

Linear chain

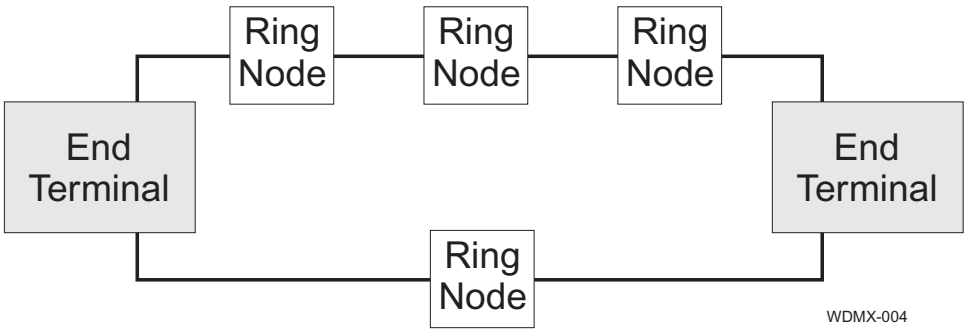
This is expected to be the most common use of WDMX to get extra wavelengths between three or more points in the network for traffic demands that tend to emanate and terminate at two central points in the network. For this approach the traffic from the OADMs is expected to be dual feed to each end-terminal. Some IPTV applications may use this network approach.



WDMX-003

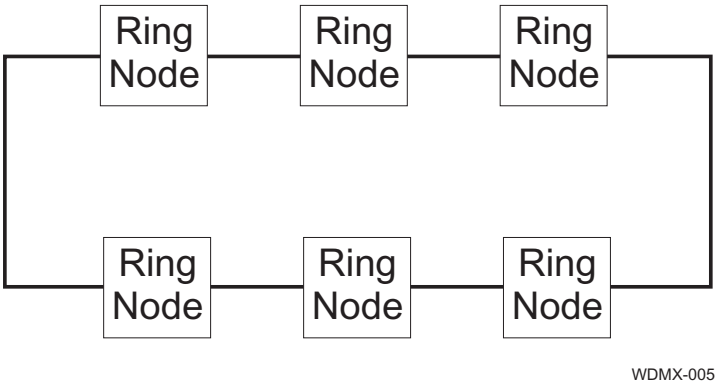
Double-terminated ring

The double terminated ring is also expected to be very a common topology. It is composed of two EAR rings, joined at the end-terminals. The End terminals typically are the hubbing locations that sync and source the traffic. The Ring nodes typically allow relatively small counts of wavelengths to enter the network and send it in diversely routed directions toward independent end-terminals. This allows for the protection of services.



Pure ring

Pure rings contain no end-terminals, and allow any traffic mix between the ring nodes. This arrangement provides greater flexibility. However, care must be taken to assure optical noise loops (lasing) are not created. This is accomplished by creating high attenuation on pass-throughs for all optical channels that are not equipped.



WDMX channel wavelengths

The WDMX channel wavelengths are based on the industry standard ITU-T grid at 100 GHz spacing in the Cband. The lowest frequency is 195200 GHz and the highest is 195900 GHz. The channels are generally described using only the middle four digits. For example, ITU channel 55 is at frequency 195500 GHz. Some device labeling only uses middle 2 digits. For example, 195500 GHz could also be represented on device labeling

as frequency “55”. These 8 channels overlap with the 32 channel wavelength plan of the Lucent Wavelength Extension Solutions (WES) product, and 6 of the 32 channel wavelength plan of the EON system. (EON uses ITU-T channel 52 - 57 in common with WDMX.)

The optical components of WDMX are optimized for transport of XFP based 10G transmitter for metro access and metro core applications. This optimization allows for lower cost of WDMX and allows for better interoperability with the alien wavelengths expected in the metro access and metro core.

DWDM optics

Overview

Alcatel-Lucent 1665 DMX supports low-cost DWDM optics. These optics include 16 different OLIUs (2 wavelengths per OLIU) for OC-48 transmission, the OMD5/8 8-channel mux/demux (LNW785), and a choice of 5 different Passive Optics Units (POUs) where the various wavelengths are combined for transmission over one fiber. The DWDM wavelengths or channels are chosen at 100 GHz increments per the ITU grid.

DWDM PTM-based circuit packs

Alcatel-Lucent 1665 DMX PTM-based OC-48 main and tributary packs support OC-48 DWDM PTMs. In conjunction with the POUs , these packs increase fiber capacity. The PTM-based OC-48 main and tributary packs also support OC-48 CWDM PTMs. The PTM-based OC-192 main and tributary packs support OC-192 DWDM PTMs. In conjunction with a mux/demux system, these packs canincrease the fiber capacity.

OC-48 DWDM/CWDM PTMs

The following circuit packs support OC-48 DWDM/CWDM PTMs

- LNW55
- LNW62
- LNW82
- LNW202
- LNW402
- LNW504

For a list of the DWDM OC-48 PTMs, see Table 10-61, “OC-48 DWDM PTM wavelengths” (p. 10-75).

OC-192 DWDM PTMs

The following circuit packs support OC-192 DWDM PTMs

- LNW59
- LNW502
- LNW504
- LNW705

For a list of the DWDM OC-192 PTMs, see Table 10-72, “OC-192 DWDM PTM wavelengths” (p. 10-83).

Passive optics units

As the variety of applications listed above suggests, there are various versions of the POU, each designed to maximize functionality in a variety of deployment scenarios. The list below details the various forms of POUs:

- 16 Channel MUX or DMUX (odd numbered channels): This POU supports unidirectional and bidirectional transmission systems.
- 16 Channel MUX or DMUX with Interleaver (even numbered channels): This POU supports unidirectional and bidirectional transmission systems, and includes an interleaver to support 16 additional channels.
- Dual 1-Channel Optical Add Drop: This POU supports unidirectional transmission systems and can add/drop one channel from a DWDM line carrying up to 32 different channels.
- Dual 2-Channel Optical Add Drop: This POU supports unidirectional transmission systems and can add/drop two channels from a DWDM line carrying up to 32 different channels.
- Dual 4-Channel Optical Add Drop: This POU supports unidirectional transmission systems and can add/drop four channels from a DWDM line carrying up to 32 different channels.
- Dual 1310 + 4x1550 MUX/DMUX: This POU provides one I/O port for 1310 nm signals and four I/O ports for 1550 nm signals. This POU supports unidirectional transmission systems and can MUX or DMUX a 1310 channel and four 1550 bands to/from a DWDM line.

  Important! The last four bulleted items in the list above describe the various OADMs and MUX/DMUX as "Dual". "Dual" is in reference to the fact that each of these specific POUs are comprised of two complete sets of OADMs or MUX/DMUX units. Thus, the dual 1-channel OADM POU contains 2 OADMs interfaces, enabling it to support 1 add/drop in each direction.

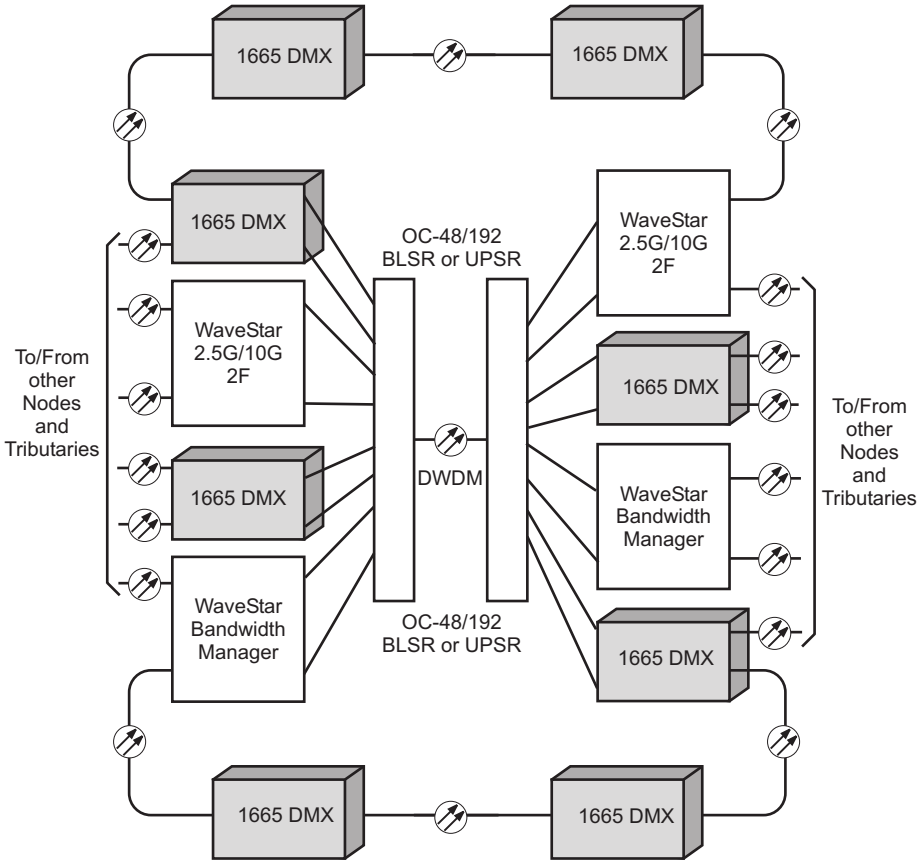
Protection

The passive optic port units support the same protection modes as the standard port units. For example, both sets of passive port units support BLSR, UPSR, and 0x1 protection. The DWDM passive OLIUs also support 1+1 protection.

MUX/DMUX example

The figure below shows 16 lines to and from Alcatel-Lucent 1665 DMX systems. The OC-48 traffic from the 8 incoming (receive) and 8 outgoing (transmit) lines is transmitted over one fiber using DWDM on the Alcatel-Lucent passive optics shelf to a remote Alcatel-Lucent passive optics shelf. The traffic is similarly transmitted and received by that system. Alternatively, the equipment can be set up to handle 16 or 32 transmit lines on one end of the passive optics unit and 16 or 32 receive lines on the other end.

Figure 3-31 Alcatel-Lucent passive optics unit with Alcatel-Lucent 1665 DMX



Increased span length: external DWDM optical amplifiers (OAs)

Overview

For OC-192 spans of up to 140km, Alcatel-Lucent offers DWDM optical amplifiers. The DWDM optical amplifier is a stand-alone shelf and can be used with both regular and DWDM OC-48 and OC-192 optics.

Concept

Optical amplifiers consist of one booster and one pre-amplifier part. The booster part is connected via a Dispersion Compensation Module (DCM) to the transmit interface of the respective OC-192 or OC-48 port unit. The pre-amplifier is connected by means of a DCM to the receive interface of the associated port unit.

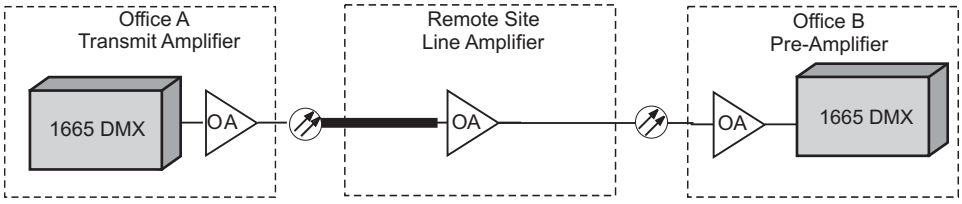
Applications

The DWDM optical amplifier has two main applications:

- Single span application
- Multiple span application

A simple example for a single span application is shown in the following figure.

Figure 3-32 External optical amplifier application



1665 DMX = 1665 Data Multiplexer

Nc-dmx-165

Further information

For a description of the optical amplifier's physical specifications, see “External optical amplifiers” (p. 4-42) in Chapter 4, “Product description”.

Dual node ring interworking

Overview

Dual node ring interworking (DRI) is a configuration that provides path-level protection for selected STS-N circuits that are being carried through two UPSRs. Protection for the route between the two rings is provided by interconnecting the rings at two places (see Figure 3-33, “Dual ring interworking protection” (p. 3-59).

Each circuit that is provisioned with DRI protection is dual-homed, meaning it is duplicated and subsequently passed-through at two different nodes on a ring. The two interconnecting nodes in each ring do not need to be adjacent.

DRI protection

The self-healing mechanisms of the two UPSRs remain independent and together protect against simultaneous single failures on both rings (not affecting the interconnections). The DRI configuration additionally protects against failures in either of the interconnections between the rings, whether the failure is in a facility or an interconnection node.

Ring interworking

All Alcatel-Lucent 1665 DMX tributary SONET interfaces (OC-3, OC-12, and OC-48) support DRI. The Alcatel-Lucent 1665 DMX high-speed ring can be an OC-12/48/192 UPSR. An Alcatel-Lucent 1665 DMX ring supports DRI with UPSRs, including rings using the following products:

- Alcatel-Lucent 1665 DMX
- *WaveStar*® TDM 2.5G/10G (2-Fiber)
- *WaveStar*® BandWidth Manager
- DDM-2000 OC-3
- DDM-2000 OC-12
- FT-2000 ADR

Additionally, there can be intermediate network elements in the interconnection routes between the two rings.

UPSR-to-UPSR interworking

In the UPSR to UPSR interworking both UPSR DRI nodes select the better of two paths travelling in the drop direction and pass traffic to one rotation of the ring in the add direction.

UPSR drop and continue

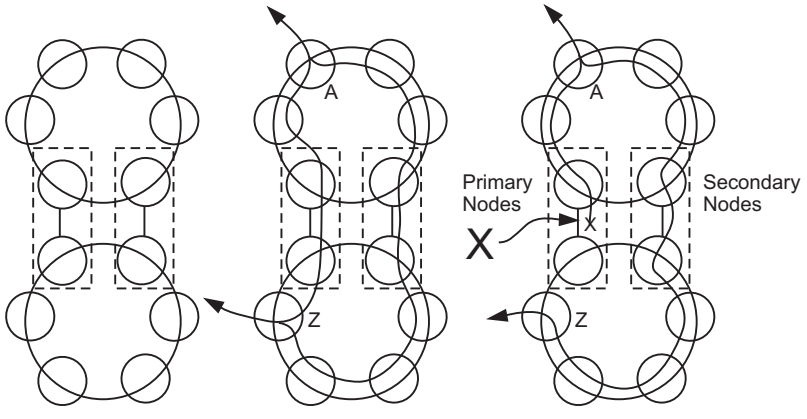
Alcatel-Lucent 1665 DMX supports the drop and continue method of DRI, in which both UPSR DRI nodes select the better of two paths travelling in the drop direction and pass traffic to one rotation of the ring in the add direction. Each node drops the circuit in the direction of the other ring and a pass-through circuit to the other DRI node is made. The best of the 2 resulting signals is dropped at the terminating node of the new ring.

UPSR to UPSR protection switching example

The figure below illustrates a failure of the interconnection to a DRI node at the point labeled "X" in the figure. A failure in the route from Node A to Node Z results in a path switch at the surrounding nodes adjacent to the failure. The DRI nodes themselves will only perform the protection switch if they are the nodes adjacent to the failure. As you can see, while all nodes and lines remain fully functional, DRI functions as described in the section above. Both DRI nodes in the top ring select the best of the 2 signals received from that ring, and transmit them to the DRI nodes in the lower ring. The best of the signals received at the terminating node is dropped.

A path protection switch in an Alcatel-Lucent 1665 DMX occurs in < 50 milliseconds (not counting the detection time) at the nodes adjacent to any failure.

Figure 3-33 Dual ring interworking protection



Single- and dual-homing

Overview

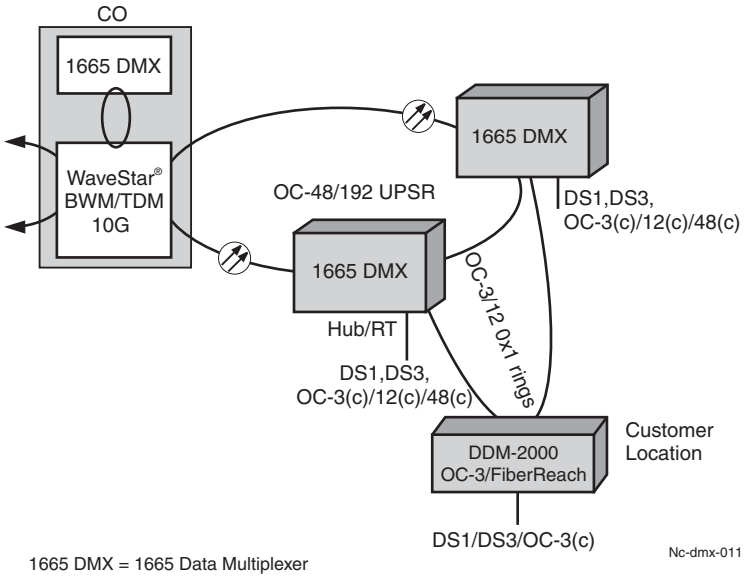
End users are demanding service with high availability. Service providers are responding with tariffs that rely on self-healing networks to offer high availability service. Some of these tariffs even call for penalties for the service provider when service is interrupted or has a high error rate. The Alcatel-Lucent SONET product family offers many options for meeting Alcatel-Lucent 1665 DMX service needs. One of these, OC-3/12/48 ring transport on Alcatel-Lucent 1665 DMX ring networks, can be implemented in single- and dual-homing configurations.

For lower-density TDM applications, Alcatel-Lucent 1665 DMX can provide an OC-3/12/48 optical ring termination for a DDM-2000 OC-3 Multiplexer, DDM-2000 OC-12 Multiplexer, DDM-2000 FiberReach, or any other compliant network element. This feeder ring is useful for evolving lower-density access transport applications into high-rate access networks.

Description

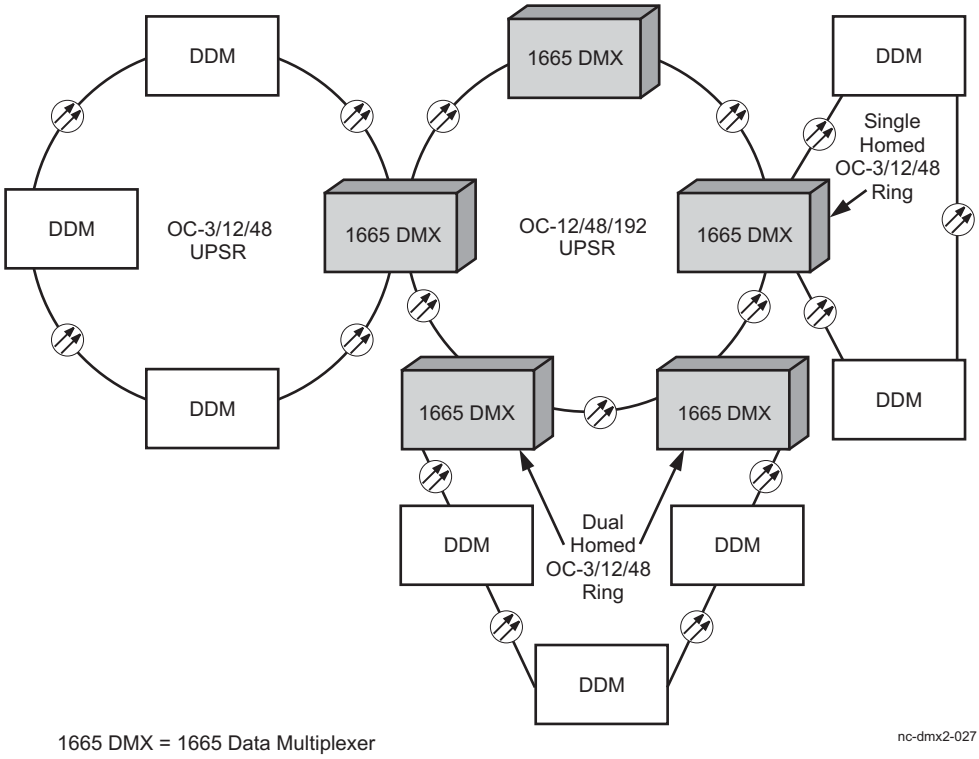
The figure below shows a dual-homed OC-3 extension from two remote nodes on an Alcatel-Lucent 1665 DMX access ring. OC-3 extensions from Alcatel-Lucent 1665 DMX rings are available when the Alcatel-Lucent 1665 DMX Function Unit groups are equipped with OC-3 OLIU circuit packs. OC-12/48 extensions from Alcatel-Lucent 1665 DMX rings are also available. The host nodes must be Alcatel-Lucent 1665 DMX NEs. For an example of single homing, see the following page.

Figure 3-34 Dual homing example



The figure below provides an example of both single and dual-homing. Path protection switching is employed for dual-homed and single-homed applications in the same manner. That is, 50 millisecond path switching is supplied by the remote DDM-2000 OC-3/OC-12/FiberReach nodes and the Alcatel-Lucent 1665 DMX systems. The Alcatel-Lucent 1665 DMX host node dual homing configuration differs from that used for single-homing because each host node transports only one leg of the OC-3/OC-12/OC-48 extension. At each host node, a connection is made from the single OC-3/OC-12/OC-48 extension to just one rotation of the Alcatel-Lucent 1665 DMX host ring. Dual- and single-homed extensions can also be mixed at a host node, allowing the access network to be tailored efficiently to different groups of customers. Host nodes could also be Alcatel-Lucent 1665 DMXtend.

Figure 3-35 Multi-node OC-3/OC-12 ring with OC-48 ring transport



Configuration advantage

Alcatel-Lucent 1665 DMX provides a seamless transmission and operations integration with lower-capacity ring networks, as well as increased scalability for those established networks. So, single and dual-homing provide additional topological flexibility in UPSR configurations supporting voice and data services.

Hairpinning

Overview

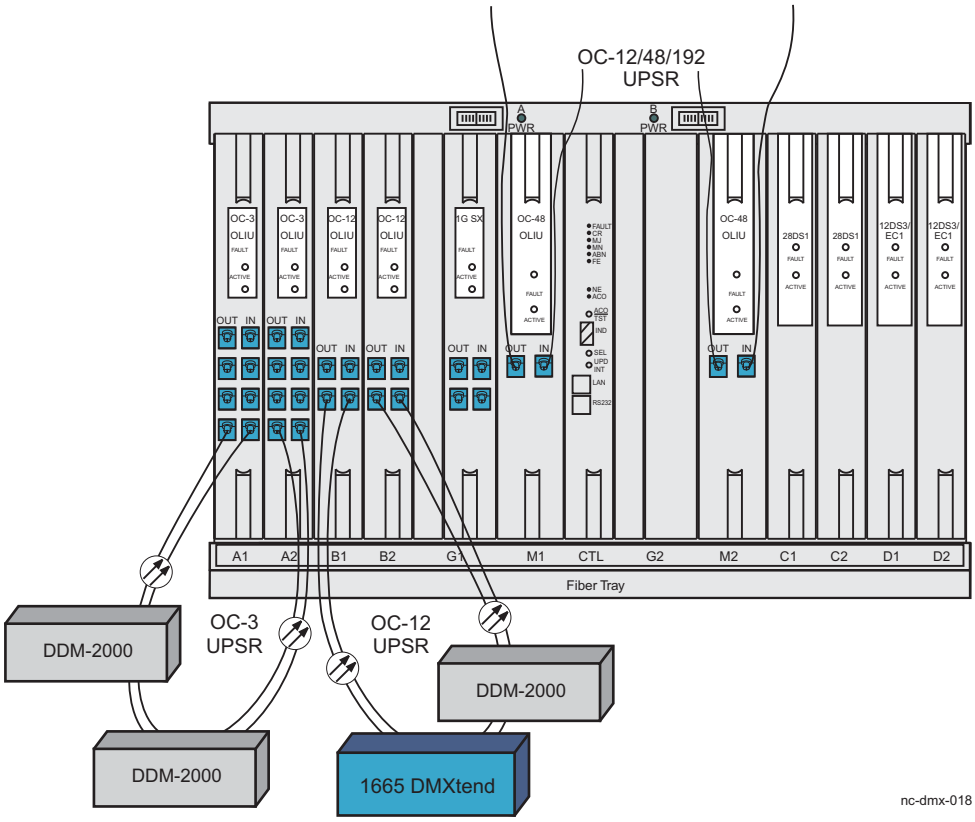
Alcatel-Lucent 1665 DMX supports both inter-function group, intra-function group, intra-port as well as pass-through hairpinning cross-connections. These capabilities allow you to route traffic in and out of Alcatel-Lucent 1665 DMX without consuming bandwidth on the high-speed (OC-3/12/48/192) interfaces, and to host multiple rings on the low-speed interfaces of the Alcatel-Lucent 1665 DMX shelf (OC-48, OC-12, OC-3).

Inter-function group hairpin

In a "hairpinning" topology, low-speed tributary traffic is routed into the system and back out of the system without ever being placed on the high-speed (OC-12/48/192) UPSR interfaces (this description assumes that the MAINs are provisioned for UPSR protection, but intra-function group hairpins are supported on all MAIN application/protection schemes). The cross-connection capability of connecting any input on a circuit pack in a function or growth slot to any output on a circuit pack in a different function or growth slot of the same shelf allows you to use a combination of add/drop and hairpinning of compatible payloads through a variety of interfaces. You can bring traffic in from one remote site and cross-connect it at the VT, STS-1, STS-3c, STS-12c, STS-48c, , or STS-192c level back out to other remote sites without consuming any capacity on the high-speed UPSRs.

The figure below demonstrates a topology in which traffic is hairpinned among OC-12 and OC-3 low-speed interfaces (OC-48 also an option). For instance, a signal dropped from the OC-3 UPSR in the bottom left of the figure can travel out of Alcatel-Lucent 1665 DMX on the OC-12 UPSR on a completely different tributary.

Figure 3-36 Inter-function group hairpin



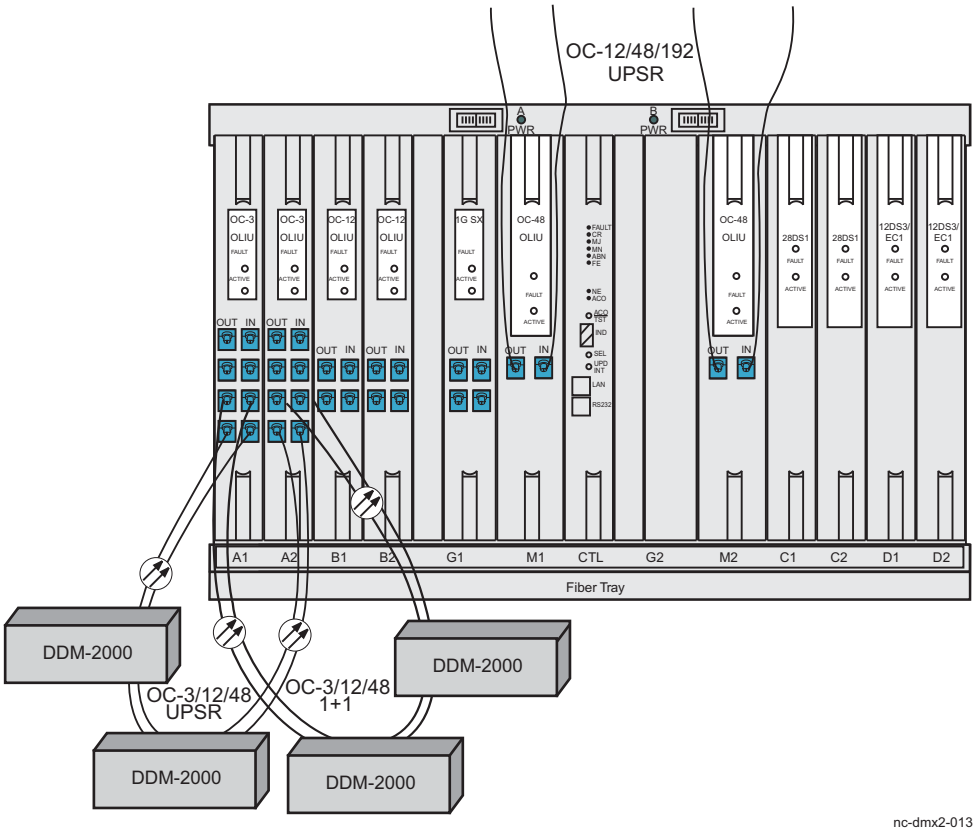
1665 DMXtend = 1665 Data Multiplexer Extend

Low-speed ring closure

Alcatel-Lucent 1665 DMX can host multiple rings on the low-speed interfaces of the Alcatel-Lucent 1665 DMX shelf. This is accomplished by either protected drops from a UPSR or UPSR pass-throughs. Alcatel-Lucent 1665 DMX can close a low-speed ring by supporting a cross-connection between a receive port on one circuit pack and a corresponding transmit port on another companion circuit pack in the same function or growth group (cross-connections can also be made to ports in any other slot on the shelf). All protection switching advantages/capabilities of UPSR configurations still apply in the low-speed ring closure application shown below.

The figure below demonstrates a ring closure topology in which both an OC-3 or OC-12 ring is being hosted on the low-speed interfaces alone. Notice that this consumes no bandwidth on the OC-48, high-speed UPSR in the top of the figure.

Figure 3-37 Low-speed ring closure



Intra-function group hairpin

Alcatel-Lucent 1665 DMX supports intra-function group, hairpin cross-connections that are cross-connections between different tributaries on different ports within the same function group. Again, the application above could be enabled by either intra-function group hairpins or UPSR pass-throughs. Intra-function group hairpins are available in all protection schemes, not just in UPSR applications.

Intra-port hairpin

Alcatel-Lucent 1665 DMX supports the provisioning of intra-port cross-connection on UPSR interfaces. Intra-port characterizes cross-connections between channels/time slots/tributaries hosted on the same port.

Linear optical extensions

Overview

An additional topological flexibility offered by the Alcatel-Lucent 1665 DMX is 1+1 protected linear OC-3, OC-12, OC-48, OC-192 optical extensions from the Alcatel-Lucent 1665 DMX ring. Using this capability, Alcatel-Lucent 1665 DMX can support many of the new network configurations desired in evolving access networks.

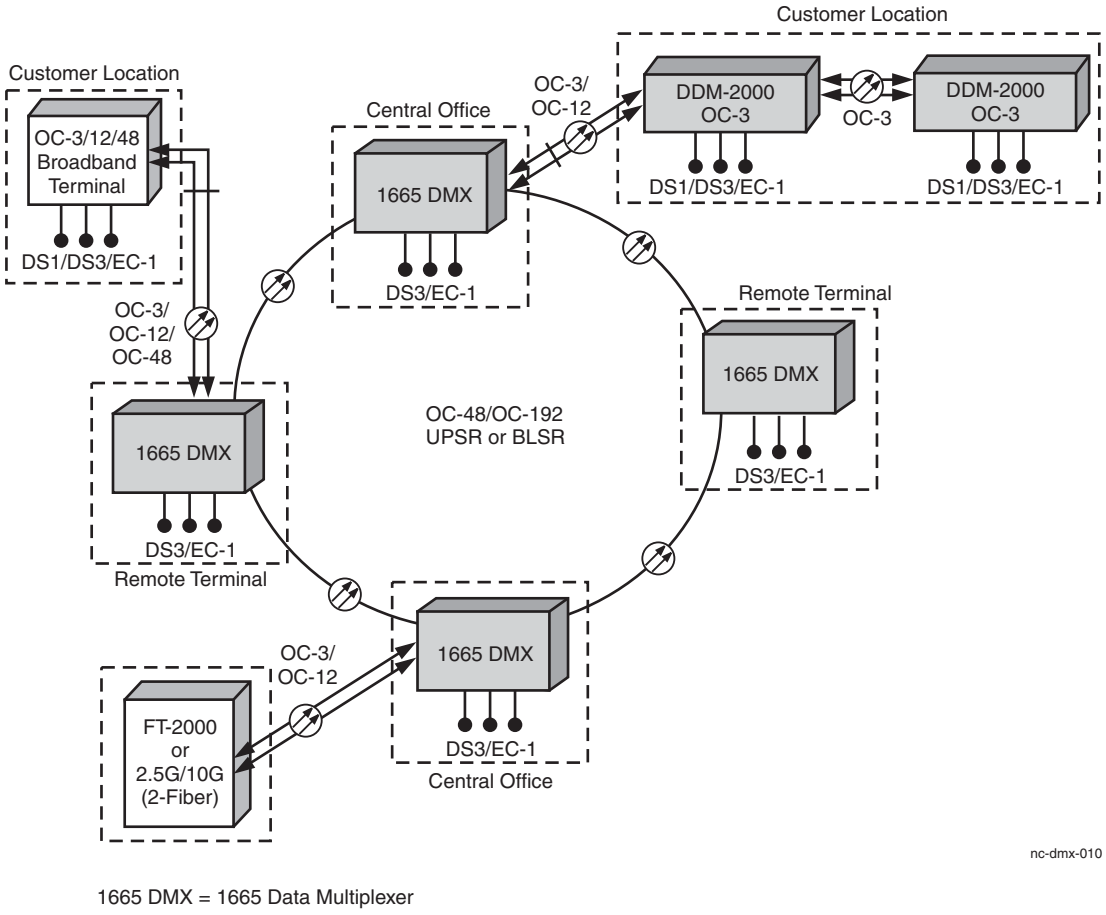
Description

An access provider can use linear optical extensions from an OC-12/48/192 ring to provide OC-3, OC-12, and OC-48 signals directly to end users. This gives the end users the bandwidth they need for large bandwidth applications, such as video, data, and ATM.

Linear optical extensions can also be used to interconnect SONET subnetworks. Examples include interconnection of two access networks and interconnection between access and interoffice rings. Optical extensions can be used to interconnect Alcatel-Lucent 1665 DMX ring networks to an OC-3, OC-12, or OC-48 terminal, an OC-3, OC-12, OC-48, or OC-192 add/drop network, or another OC-3, OC-12, OC-48, or OC-192 ring. Intra-port hairpins are supported on 1+1 protected interfaces.

The figure below shows an Alcatel-Lucent 1665 DMX OC-48/OC-192 path switched ring with OC-3/OC-12/OC-48 services using linear optical extensions.

Figure 3-38 Linear optical extensions



1665 DMX = 1665 Data Multiplexer

Configuration advantage

Optical extensions from an Alcatel-Lucent 1665 DMX ring provide fast, reliable transport of voice, video, data, and ATM directly to end users when fiber topologies warrant protected linear (rather than ring) connections.

Hubbing

Overview

The Alcatel-Lucent 1665 DMX hubbing topology provides metropolitan-area and regional-area network infrastructures based on a single NE.

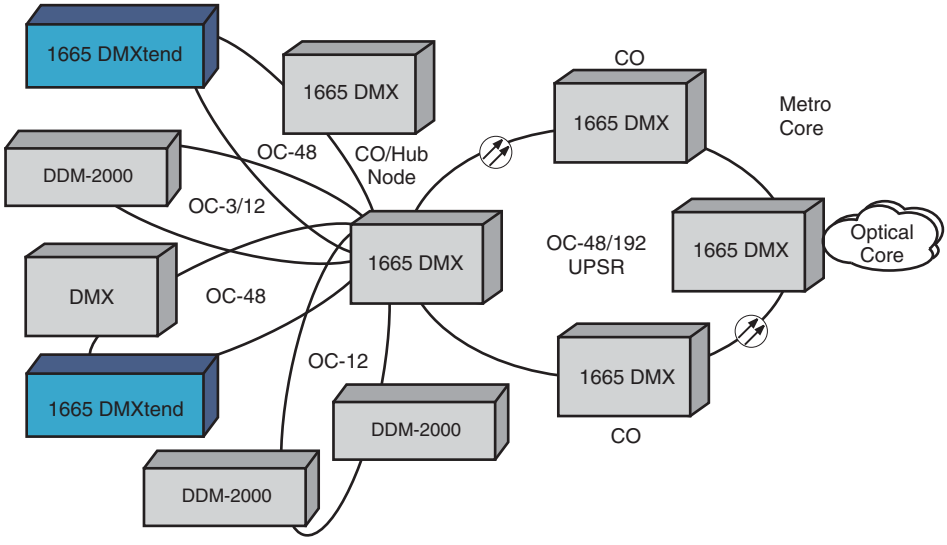
Description

An Alcatel-Lucent 1665 DMX high-speed UPSR ring can serve as a core feeder ring, transporting voice and data from metropolitan networks to the optical core network and vice versa.

As shown in Figure 3-39, "Hubbing application" (p. 3-67), one Alcatel-Lucent 1665 DMX node is configured as a core feeder node, providing a conduit from the optical core to the OC-48/192 access network. On the ring, another Alcatel-Lucent 1665 DMX is configured as the hub node, where several Alcatel-Lucent 1665 DMX and DDM UPSR rings are terminated. The hub node grooms the traffic and cross-connects it to the appropriate ring.

One Alcatel-Lucent 1665 DMX can be configured as a hub node for up to 80 OC-3 rings, 40 OC-12 rings, 20 OC-48 rings, or, as pictured below, a mixture of high- and low-speed rings.

Figure 3-39 Hubbing application



Configuration advantage

Hubbing provides High-Capacity, low-cost grooming between multiple optical rings. It also provides greater flexibility and efficiency in serving large numbers of customers on multiple fiber rings.

Control plane E-NNI interface

Overview

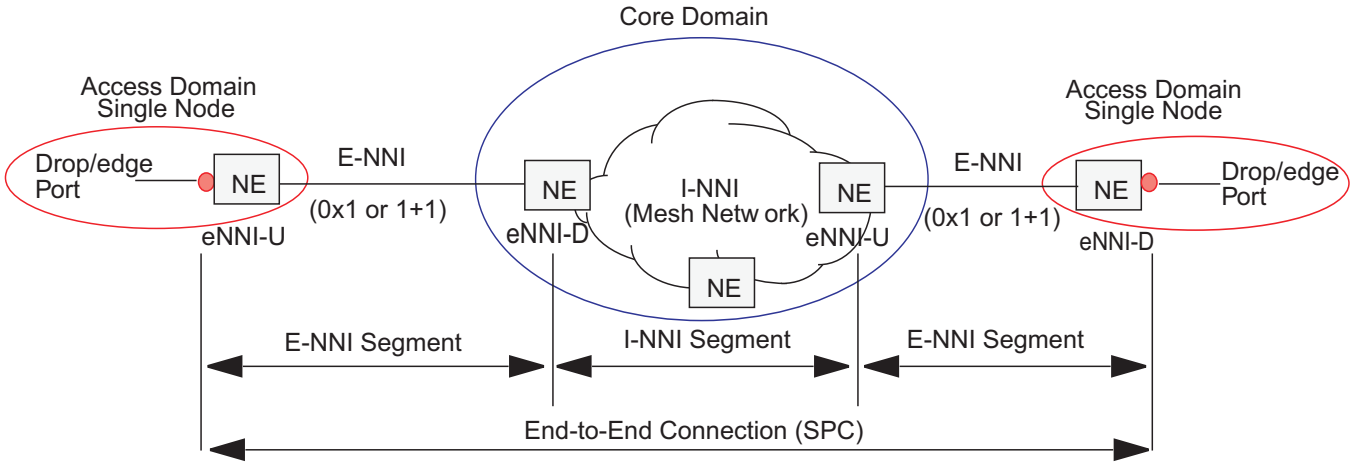
The basic functions of a control plane for an Automatically Switched Optical Network (ASON) are signaling and routing. Signaling is used to establish, maintain, and tear down end-to-end connections. Routing is used to select the most appropriate path between and within network domains. The data communications network for transferring this control plane information (signaling and routing messages) is called Signaling Communications Network (SCN).

In this release, the Alcatel-Lucent 1665 DMX supports the control plane E-NNI logical interface over inter-domain links for single node access domain configuration. The signaling protocol is RSVP-TE and routing protocol is OSPF-TE, based on OIF specifications.

E-NNI Functions

An example of a control plane network with Alcatel-Lucent 1665 DMX E-NNI connecting to an I-NNI capable core is shown below. In this example Alcatel-Lucent 1665 DMX NEs serve as edge nodes and Alcatel-Lucent 1675 LambdaUnite MSS NEs, or other vendors' NEs, serve as core nodes. The core domain nodes support I-NNI within the domain and E-NNI between the domains.

Figure 3-40 Control plane network with Alcatel-Lucent 1665 DMX E-NNI connecting to an I-NNI capable core



eNNI-U = Upstream signaling protocol controller
eNNI-D = downstream signaling protocol controller

MK-DMXAPG-001

The transport topology is SONET linear for the E-NNI, and mesh for the I-NNI. SONET linear topology supports unprotected and line 1+1 protection schemes. The mesh topology supports control plane-based protection schemes including 1+1 path (network) protection, dynamic reroute, and unprotected.

The primary function offered by such a network is the ability to create and delete end-to-end DS3, OCn, and Ethernet Private Line services between an ingress and an egress client-facing edge port. The connection setup and release are invoked by TL1 commands sent to the source edge node from OS, and carried out by the control plane (E-NNI and I-NNI). The connection can be either unidirectional or bi-directional. The signal rates for connections are restricted to STS-1, STS-3c, STS-12c STS-48c, , and STS-192c.

In Alcatel-Lucent 1665 DMX, an optical port is configured as TRADITIONAL, EDGE or ENNI, with TRADITIONAL as the default. The TRADITIONAL ports are outside of the control plane topology. The setup of cross connects associated with TRADITIONAL ports is managed as it was previous to the introduction of ENNI on Alcatel-Lucent 1665 DMX. The setup of cross connects associated with ENNI ports is controlled by the E-NNI control plane. The EDGE ports function as add/drop ports of the end-to-end control plane connections. A sub-network point (time slot) in an EDGE port can be used for either end-to-end control plane connections or traditional connections.

Table 3-1 Supported EDGE and ENNI ports

	EDGE port	E-NNI port
Port types	DS3, EC1, OC3, OC12, OC48, OC192 and Private Line VCG	OC3, OC12, OC48 and OC192 on the following packs: LNW55, LNW59, LNW62, and LNW82
Port protection	0x1 1+1 UPSR unprotected BLSR (Auto squelch map must be enabled)	0x1 1+1

Signaling Communications Network (SCN)

Control plane signaling (particularly E-NNI in this feature) and routing messages must be transferred between network entities by a dedicated IP based data communications network, which is referred to as Signaling Communications Network (SCN). It should be noted that the SCN topology is not necessarily the same as that of the transport network. Alcatel-Lucent 1665 DMX SCN supports both in-fiber (Line DCC) and out-of-fiber (LAN, specifically LAN-3) communication interfaces as signaling control channels. The inter-domain routing for SCN is based on manual routes.

Multi-shelf DCS utilizing a single TID

Purpose

The multi-shelf DCS feature provides a method of adding additional DS1 and DS3 (TMUX) I/O capacity to a system, through the addition of DS1 and/or DS3 add/drop sub-shelves, while maintaining the ability to externally manage the entire multi-shelf system via a single TID. Most features and provisioning currently supported on a Alcatel-Lucent 1665 DMX are supported on the main shelf in the multi-shelf DCS configuration.

Multi-shelf requirements

A main shelf must be equipped with VLF mains to support sub-shelves. The pack types supported in the add/drop sub-shelves are restricted. Each sub-shelf type (DS1 or DS3) supports a fixed set of cross-connections between the DS1/DS3 ports and the main ports in the subshelf. The user can provision cross-connections independently to each DS1/DS3

port in the subshelf. The transmission link between the main shelf and each sub-shelf is a unidirectional, non-revertive 1+1 protected OC-n link (OC-12 for a DS1 sub-shelf and OC-192 for a DS3 sub-shelf).

Maximum number of sub-shelves

Alcatel-Lucent 1665 DMX supports either

- 12 DS1 sub-shelves and 1 DS3 sub-shelf
- 2 DS3 sub-shelves

When the total number of sub-shelves exceeds the limit, the sub-shelf commands are not available from the main shelf.

DS1 sub-shelf

A fully-populated DS1 sub-shelf supports up to 4 pairs of LNW801 packs in the function group slots and one pair of OC-12 packs (LNW48, LNW50, LNW54, LNW203) in the main slots. Any other pack is alarmed as an unexpected circuit pack. The LNW801 ports are configured as DS1 ports. E1 interfaces are not supported. The OC-n ports on the main packs are configured as a unidirectional, nonrevertive 1+1 protection group.

DS1 sub-shelf cross-connects

The following 2-way cross-connectivity is fixed within a DS1 sub-shelf. These cross-connections provide non-blocking access from the main shelf to all 224 DS1s in the sub-shelf.

Table 3-2 DS1 sub-shelf fixed cross-connections

Source AID	Destination AID	Cross-connection Rate
m1-1-1	a1-1	STS-1
m1-1-2	a1-2	STS-1
m1-1-4	b1-1	STS-1
m1-1-5	b1-2	STS-1
m1-1-7	c1-1	STS-1
m1-1-8	c1-2	STS-1
m1-1-10	d1-1	STS-1
m1-1-11	d1-2	STS-1

DS3 sub-shelf

A fully-populated DS3 subshelf supports up to 4 pairs of LNW20 packs in the function slots and one pair of OC-192 packs (LNW56, LNW58, LNW502) in the main slots. Any other pack is alarmed as an unexpected circuit pack. The LNW20 ports are configured as ported DS3 ports. Both channelized and unchannelized operation is supported. The OC-n ports on the main packs are configured as a unidirectional, non-revertive 1+1 protection group.

DS3 sub-shelf cross-connects

The following 2-way cross-connectivity is fixed within a DS3 sub-shelf. These cross-connections provide non-blocking access from the main shelf to all 192 DS3s/5376 DS1s in the sub-shelf.

Table 3-3 DS3 sub-shelf fixed cross-connections

Source AID	Destination AID	Cross-connection Rate
m1-1-[1-48]	a1-[1-48]	STS-1
m1-1-[49-96]	b1-[1-48]	STS-1
m1-1-[97-144]	c1-[1-48]	STS-1
m1-1-[145-192]	d1-[1-48]	STS-1

Mixed release rings

Switched Ethernet and/or LCAS and BLSR

Alcatel-Lucent 1665 DMX supports the following mixed releases in the same ring:

- R5.1.3/R5.1.6/R6.0.3 and R7.0.3
- R5.1.3/R5.1.4/R5.1.6/R6.0.1/R6.0.4 and R7.1.2
- R7.0.2/R7.0.3 and R7.1.2
- R7.1.2 and R8.0

Considerations for mixed release rings

In a mixed network, features are limited to the content of the lowest release for a given node pair.

All nodes should be upgraded to the same release prior to adding or deleting a node in a ring.

All nodes should be upgraded to the same release prior to upgrading the ring to a higher rate (OC-3/STM-1 to OC-12/STM-4) .

A Gateway Network Element (GNE) should be upgraded to the latest release.

4 Product description

Overview

Purpose

This chapter provides a detailed view of the Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX) architecture. After introducing the Alcatel-Lucent 1665 DMX shelf, this chapter describes the system circuit packs, control, and cabling. Detailed information about power and current requirements for the shelf can be found in, "Power specifications" (p. 10-134).

Contents

Shelf description	4-2
Circuit packs	4-10
Circuit pack descriptions	4-15
Passive optics units (POUs)	4-38
External optical amplifiers	4-42
Control	4-44
Cabling	4-47

Shelf description

Overview

Alcatel-Lucent 1665 DMX is a single-shelf multiplexer that can house DS1/E1, DS3/EC1, TransMUX, OC-3, OC-12, OC-48, OC-192, 10/100T (optical and electrical), 1G T/SX/LX/ZX, and SAN (FICON/ESCON/FC) circuit packs.

High-capacity shelf

The High-Capacity shelf is the standard shelf design and can operate using any release of Alcatel-Lucent 1665 DMX software. It incorporates DS1/DS3 D-SUB cable connectors on the rear of the shelf that were not available on an earlier design, and enable Alcatel-Lucent 1665 DMX to support 224 DS1/E1s or 192 DS3/EC-1s. In order to support this amount of traffic, the Alcatel-Lucent 1665 DMX High-Capacity shelf must be equipped with high-density DS1/E1 and DS3/EC-1 circuit packs.

The High-Capacity shelf also has the following characteristics:

- Width: 17.6 inches
- Height: 19 inches (includes integral fan unit)
- Depth front to back with rear cover installed
  - 16 inches with flush front cover installed
  - 17 inches with extended front cover installed
  - Removal of rear cover subtracts 0.8 inches from the depth of the shelf
- Weight (with circuit packs): 57 pounds
- Weight (without circuit packs): 38 pounds

Up to four Alcatel-Lucent 1665 DMX High-Capacity shelves can fit in a bay (including integral fan unit), and all shelves are individually mounted.

The Alcatel-Lucent 1665 DMX High-Capacity shelf is available with 30 amp circuit breakers or 20 amp circuit breakers.

Capacity

When equipped with VLF Mains (LNW59, LNW82, and LNW504), each Function Unit and Growth slot in the Alcatel-Lucent 1665 DMX shelf has a 10 Gb/s IO capacity. The LNW59 VLF Mains increase the capacity of the Main slots to 20 Gb/s. The LNW504 VLF Mains increase the capacity of the Main slots to 40 Gb/s.

When VLF Mains are not used, each Function Unit slot in the Alcatel-Lucent 1665 DMX shelf has a 2.5 Gb/s IO capacity. Even though the Growth slots have 5 Gb/s capacity only 2.5Gb/s is used. The Main slots have 10 Gb/s.

Interface density

Alcatel-Lucent 1665 DMX provides a VT1.5 and STS-1 cross-connect fabric. Alcatel-Lucent 1665 DMX's main switch fabric is contained in each of the high-speed (network-side interface) circuit packs, located in the MAIN slots. The MAIN slots house OC-3, OC-12, OC-48, and OC-192 high-speed interfaces.

They can also house the LNW80 switch pack. The LNW59, LNW82, and LNW504 VLF Main circuit packs support true 0x1 Function/Growth slot equipage. True 0x1 allows different types of circuit packs to be mixed within a function or growth group. In many cases, this doubles the overall capacity of the shelf. A high-speed OC-n line can also be provisioned as 0x1.

The table below details the maximum number of signals that Alcatel-Lucent 1665 DMX can transport if all Function Unit groups, and Growth Slots where applicable, are equipped with a particular circuit pack. For example, if the required VLF Main circuit pack is installed, and both slots in the four Function Unit groups and both Growth slots are equipped with the LNW64 circuit packs, then 80 1000BASE-SX/LX/ZX ports are supported. This results from 5 pairs of LNW64 packs, a total of 10 packs, each supporting 8 ports.

Table 4-1 Interface densities

Interface type	Capacity/Main Switch		Comments
	VLF (0x1 equipped)	Large/Medium Fabric	
DS1/E1	224	224	Electrical TDM packs, and other packs that require rear access, do not support true 0x1. For these packs, overall capacity is not increased with VLF Mains
DS3/EC-1	192	192	
TransMUX	192	192	The 192 capacity requires the 48 ports available on the LNW20.
OC-3	136 (136 unprotected, 68 protected)	80	LNW55 with LNW82 mains The 136 capacity requires the 12 ports available on the LNW55.
OC-12	136 (136 unprotected, 68 protected)	40	LNW55 with LNW82 mains The 136 capacity requires the 12 ports available on the LNW55.
OC-48	48 (48 unprotected, 24 protected)	10	LNW62/LNW55 with LNW82 mains

Table 4-1 Interface densities (continued)

Interface type	Capacity/Main Switch		Comments
	VLF (0x1 equipped)	Large/Medium Fabric	
OC-192	18	2	LNW504 18 capacity requires the 4 OC-192 ports available on the LNW504.
10/100BASE-T	96	96	Electrical backplane-based FE ports (like the LNW66), do not support true 0x1. For these packs, overall capacity is not increased with VLF Mains.[1]
100BASE-T (electrical PTMs)	80	40	Larger capacities associated with VLF Mains require 0x1 equipage in all slots.
100BASE-ZX/LX/FX (optical)	80	40	
1000BASE-ZX/LX/SX	80	20	
1000BASE-T	80	20	
FICON/ESCON/ Fibre-Channel	40	20	

Notes:

1. Alcatel-Lucent 1665 DMX does not allow installation of two packs with electrical interfaces in adjacent slots within the same Function Unit or Growth Group (other than an equipment-protected pair). Therefore, in systems equipped with VLF mains, LNW66 packs can reside in either Slot 1 or Slot 2 of a group, but not both at the same time. *Telcordia* ® only supports electrical packs in Slot 1 of a group. However, another optical (Ethernet or SONET) pack may be installed in the other slot. In non-VLF equipped shelves, LNW66 can only occupy Slot 1 of a particular group.

Alcatel-Lucent 1665 DMX also provides virtual concatenation (VCAT) at the STS-1, STS-3c, or VT1.5 rates, depending on the pack. VCAT increases flexibility when managing Ethernet services.

Front view

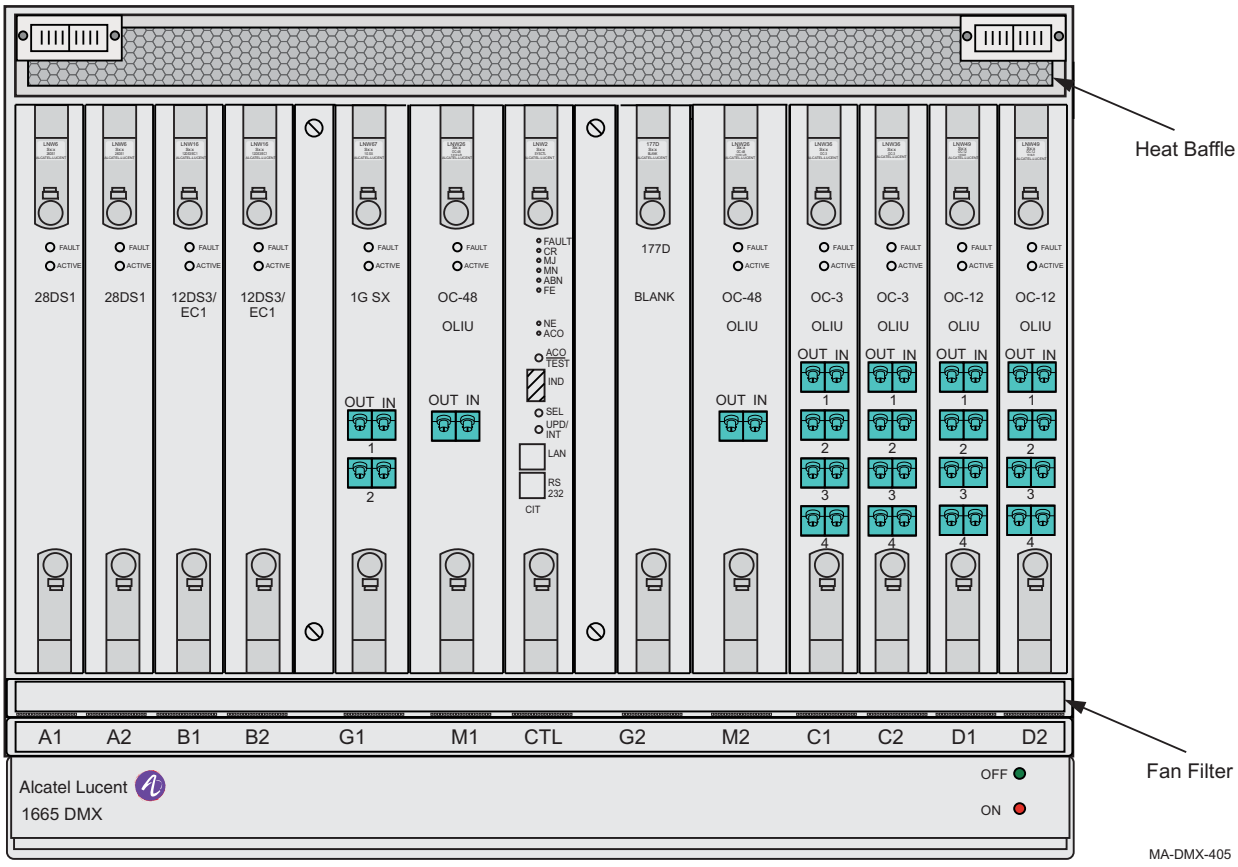
Alcatel-Lucent 1665 DMX shelf is a front access shelf. The figure below shows an example equipage with the following packs:

- 28DS1 circuit packs in Function Unit group A
- 12DS3/EC1 circuit packs in Function Unit group B
- Quad OC-3 circuit packs in Function Unit group C
- Quad OC-12 circuit packs in Function Unit group D

- 1G SX circuit pack in Growth slot G1
- an apparatus blank in Growth slot G2
- OC-48 circuit packs in Main slots 1 and 2
- LNW2 SYSCTL circuit pack in the CTL slot.

For pack-specific slot equipage rules see "Circuit pack slots and compatible circuit packs" (p. 4-5) and "Very large fabric (VLF) engineering rules" (p. 6-15).

Figure 4-1 Shelf front view



Circuit pack slots and compatible circuit packs

The Alcatel-Lucent 1665 DMX High-Capacity shelf has 8 function unit slots, 2 Main slots, 2 Growth slots, and one Control slot.

Function unit slots

The function unit slots are divided into four groups designated A, B, C, and D. Function unit slots A1, A2, B1, B2, C1, C2, D1, and D2 can be equipped, depending on the application, with the following circuit packs:

- 28DS1PM (LNW7)
- 56DS1/E1 (LNW8/LNW801)
- 12DS3/EC1 (LNW16)
- 48DS3/EC1 (LNW19B)
- DS1/DS3 TransMUX (LNW18)
- DS1/DS3/EC-1 TransMUX (LNW20)
- OC-3 PTM-based (LNW37, LNW45)
- OC-12 PTM-based (LNW49)
- OC-48 (LNW31, LNW62, LNW402)
- OC-192 PTM-based (LNW603)
- OC-3/12/48 PTM-based (LNW55)
- 1000BASE-T/SX/LX/ZX Private Line (LNW63, LNW64)
- 10/100BASE-T (LNW66)
- 10/100BASE-T and 100BASE-ZX/LX/FX (LNW74)
- 100/1000BASE-T and 100BASE-ZX/LX/FX Private Line (LNW87)
- 100/1000BASE-T, 100BASE-ZX/LX/FX, 1000BASE-SX/LX/ZX Private Line (LNW170)
- 10G DWDM Muxponder pack (LNW705)
- 8-channel DWDM Mux/Demux with integrated VOAs (LNW785)
- SAN circuit pack with choice of FICON/ESCON/Fibre-channel interfaces using PTM optics (LNW73 and LNW73C)
- Detectable Blank (LNW98)
- Blank (177D)

When the shelf is equipped with non-VLF Mains, Ethernet and SAN circuit packs are restricted to slot 1 of a function unit (for example, slot D1). If slot 1 of a function unit is equipped with an Ethernet or SAN circuit pack, then slot 2 must be equipped with a 177D apparatus blank or an LNW98 detectable blank circuit pack.

When the shelf is equipped with the LNW59, LNW82, or LNW504 VLF Mains, Ethernet and SAN packs can reside in Slots 1 and 2 of a function unit. See Chapter 6, “System planning and engineering” for restrictions.

Growth slots

Growth slots G1 and G2 can be equipped, depending on the application, with the following circuit packs:

- DS1/DS3/EC-1 TransMUX (LNW20)
- OC-3 PTM-based (LNW37, LNW45)
- OC-12 PTM-based (LNW49)
- OC-48 (LNW31, LNW62, LNW402)
- OC-192 PTM-based (LNW603)
- OC-3/12/48 PTM-based (LNW55)
- 1000BASE-T/SX/LX/ZX Private Line (LNW63, LNW64)
- FC-DATA FICON/FC/Fibre-Channel (LNW73/73C)
- 10/100BASE-T and 100BASE-ZX/LX/FX (LNW74)
- 100/1000BASE-T and 100/1000BASE-ZX/LX/FX Private Line (LNW87)
- 100/1000BASE-T, 100BASE-ZX/LX/FX, 1000BASE-SX/LX/ZX Private Line or switched (LNW170)
- 10G DWDM Muxponder pack (LNW705)
- 8-channel DWDM Mux/Demux with integrated VOAs (LNW785)
- Detectable Blank (LNW98)
- Blank (177D)

  Note: The G slots can only support electrical Ethernet services through electrical PTMs. When the LNW74 is installed in the Growth slots, only the optical ports are functional. Because the LNW74 does not support electrical PTMs, 10/100BASE-T ports cannot be utilize when the LNW74 are installed in a Growth slot.

  Since the LNW87 and LNW170 packs support electrical PTMs the PTM-based 100/1000BASE-T ports are supported in the Growth slots when these backs are installed.

When the shelf is equipped with non-VLF Mains, Ethernet and SAN circuit packs are restricted to slot G1. If slot G1 is equipped with an Ethernet or SAN circuit pack, then slot G2 must be equipped with a 177D apparatus blank or an LNW98 detectable blank circuit pack. The LNW66 cannot be housed in the growth slots.

When the shelf is equipped with VLF Mains, Ethernet and SAN packs can reside in Slots G1 and G2. See Chapter 6, “System planning and engineering” for restrictions.

The LNW20 (48 DS3/EC1TransMUX) will not function in Portless mode when the shelf is equipped with certain Main interface packs. It is also restricted to Portless mode only when installed in Growth Slots. Therefore the LNW20 cannot be used in the Growth Slots when certain Main packs are used. Refer to Table 4-3, “Main circuit packs that allow portless LNW20 operation” (p. 4-19).

Main slots

The main slots M1 and M2 can be equipped, depending on the application, with the following circuit packs:

- OC-12 OLIU circuit pack: LNW48, LNW50, LNW54, LNW203
- OC-48 OLIU circuit packs: LNW27, LNW29, LNW32, LNW76, LNW202
- OC-3/12/48 multi-rate VLF OLIU: LNW82
- OC-192 OLIU circuit packs: LNW56 and LNW58, or LNW502
- OC-192 VLF OLIU: LNW59
- Main Switch Circuit Pack: LNW80
- OC-48/192 multi-rate VLF OLIU: LNW504

The Stratum 3 timing generator and central TDM switch fabrics are embedded in all of the MAIN circuit packs. If main slot M1 or M2 is not equipped with a circuit pack, the slot must be equipped with a 177E apparatus blank or an LNW97 detectable blank circuit pack. There is no switch fabric on the blank circuit packs.

Alcatel-Lucent 1665 DMX supports LNW59, LNW82, and LNW504 VLF Main circuit packs. VLF Mains are designed to drastically increase the overall switch fabric capacity of Alcatel-Lucent 1665 DMX. When Alcatel-Lucent 1665 DMX is equipped with VLF Mains, the switch fabrics of the low-speed, tributary packs are not used. Rather, all switching functions are performed on the VLF Main Fabric.

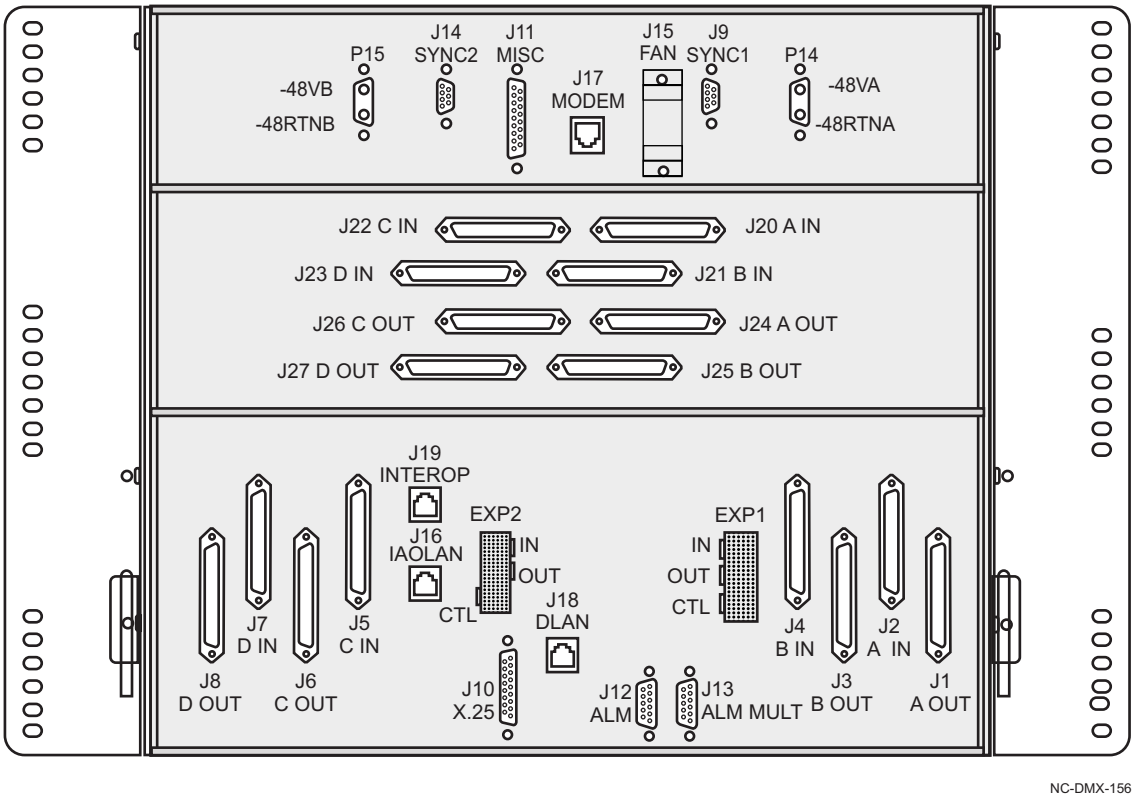
Control slot

The control slot CTL is reserved for the non-redundant System Controller (SYSCTL) circuit pack. Current software requires the use of the LNW2 SYSCTL.

Rear view

The figure below shows the various jacks and cable inputs on the Alcatel-Lucent 1665 DMX High-Capacity shelf backplane.

Figure 4-2 Alcatel-Lucent 1665 DMX High-Capacity shelf backplane connectors



The shelf backplane provides the following connectors:

- Communications modem (J17 MODEM)
- Intraoffice LAN (J16 IAOLAN)
- External DS1 synchronization input and output (J9 SYNC1 and J14 SYNC2)
- Fan shelf power/alarm (J15 FAN)
- −48 VDC power feeder A and B (P14 −48VA, −48RTNA and P15 −48VB, −48RTNB)
- Miscellaneous (environmental) discrete telemetry (J11 MISC)
- TL1 interface (J10)
- Office alarm interface (J12 ALM)
- Office alarm multiple (J13 ALM MULT)
- J18 DLAN (Reserved for use in a future release)
- J19 INTEROP (Reserved for use in a future release)
- EXP1 IN, OUT, CTL (Reserved for use in a future release)

- EXP2 IN, OUT, CTL (Reserved for use in a future release)
- Eight DS1/DS3 and 10/100Base-T inputs (J2 A IN, J4 B IN, J5 C IN, J7 D IN, J20 A IN, J21 B IN, J22 C IN, J23 D IN)
- Eight DS1/DS3 and 10/100Base-T outputs (J1 A OUT, J3 B OUT, J6 C OUT, J8 D OUT, J24 A OUT, J25 B OUT, J26 C OUT,J27 D OUT)

The −48 VDC power feeder interfaces (BAT A and BAT B) are located on the sides of the shelf.

Circuit packs

Available circuit packs

The table below contains a list of each circuit pack supported by the Alcatel-Lucent 1665 DMX, indicates which slots they are able to be housed in, and in what release each circuit pack is available.

Table 4-2 Circuit packs supported in Alcatel-Lucent 1665 DMX shelf

Circuit pack	Apparatus code	Slot(s)	Release	Comments
System Controller (SYSCTL)	LNW2	CTL	6.0	Extended temp. controller for outside cabinet deployment (OSP hardened).
28DS1PM	LNW7	A–D	1.0	28 ports, not supported with VLF Mains, OSP hardened
56DS1/E1	LNW8	A–D	3.1	56 ports, for use in Alcatel-Lucent 1665 DMX High-Capacity Shelf,E1 service is provisionable on a per pack basis, OSP hardened
12DS3/EC1	LNW16	A–D	1.1	12 ports, OSP hardened
DS1/DS3 TransMUX	LNW18	A–D	3.0	12 ports, receives/transmits channelized DS3, OSP hardened
48DS3/EC1	LNW19B	A–D	5.0	48 ports, for use in Alcatel-Lucent 1665 DMX High-Capacity Shelf, supports DS3 loopbacks, OSP hardened
48DS3/EC1/ TMUX (with portless operation)	LNW20	A–G	7.0.1	48 ports, DS3, EC1, and TMUX functionality on a port-by-port basis. LNW20 is supported in G1/2 for portless mode only with certain Mains, OSP hardened. When Mains that don't support portless are used, LNW20 can only be installed in A–D.

Table 4-2 Circuit packs supported in Alcatel-Lucent 1665 DMX shelf (continued)

Circuit pack	Apparatus code	Slot(s)	Release	Comments
OC-48 OLIU	LNW27	M1, M2	2.1	High-speed, long reach, 1310 nm, 48 STS-1 VT fabric
OC-48 OLIU	LNW29	M1, M2	2.1	High-speed, long reach, 1550 nm, 48 STS-1 VT fabric
OC-48 OLIU	LNW31	A–D, G1, G2	2.0	Low-speed, intermediate reach, 1310 nm, 12 STS-1 VT fabric, OSP hardened
OC-48 OLIU	LNW32	M1, M2	4.0	High-speed, long reach, 1310 nm, 48 STS-1 VT fabric, OSP hardened
OC-3 OLIU (4 ports)	LNW37	A–D, G1, G2	4.0	Low-speed, 12 STS-1 VT fabric, PTM optics, supports facility loopbacks, OSP hardened
OC-3 OLIU (8 ports)	LNW45	A–D, G1, G2	5.0	Low-speed, 48 STS-1 VT fabric, PTM optics, supports facility loopbacks, OSP hardened[4]
OC-12 OLIU (1 port)	LNW48	M1, M2	3.1	High-speed, intermediate reach. 1310 nm, 12 STS-1 VT fabric, OSP hardened
OC-12 OLIU (4 ports)	LNW49	A–D, G1, G2	4.0	Low-speed, 48 STS-1 VT fabric, PTM optics, OSP hardened[4]
OC-12 OLIU (1 port)	LNW50	M1, M2	3.1	High-speed, long reach. 1310 nm, 12 STS-1 VT fabric, OSP hardened
OC-12 OLIU (1 port)	LNW54	M1, M2	5.1	High-speed, long reach. 1550 nm, 12 STS-1 VT fabric, OSP hardened
OC-3/OC-12/ OC-48 OLIU (12/4 ports)	LNW55	A–D, G1, G2	7.1	12OC-3/12OC-12/4OC-48, PTM-based, multi-port, multi-rate (MPMR), for use with VLF Main packs, supports facility loopbacks, OSP hardened[4]
OC-192 OLIU	LNW56	M1, M2	2.1	High-speed, intermediate reach, 1550 nm, 48 STS-1 VT fabric
OC-192 OLIU	LNW58	M1, M2	2.1	High-speed, very short reach, 1310 nm, 48 STS-1 VT fabric
OC-192 OLIU	LNW59	M1, M2	7.0	2 port, High-speed, 1.3SR1/1.5IR2/1.5LR2 and DWDM PTMs, 20G optical main, 240G STS fabric, 30G VT termination capacity, and 40G VT fabric

Table 4-2 Circuit packs supported in Alcatel-Lucent 1665 DMX shelf (continued)

Circuit pack	Apparatus code	Slot(s)	Release	Comments
OC-48 OLIU	LNW62	A–D, G1, G2	7.0	4 port, Low-speed, SR, 1.3LR1, 1.5LR2, and DWDM PTMs, no switch fabric, requires use of VLF Main, OSP hardened[4]
1000BASE-SX/LX/ZX (4 ports) Private Line	LNW63	A–G[1]	6.0	1000BASE-SX/LX/ZX Ethernet interface via optical PTMs, can be used in slot 1 and/or 2 in a VLF-equipped Alcatel-Lucent 1665 DMX and either slot 1 or 2 in a non-VLF equipped Alcatel-Lucent 1665 DMX, GbE private lines, includes no switch fabric, OSP hardened[4]
1000BASE-T/SX/LX/ZX (8 ports) Private Line	LNW64	A–G[1]	7.0	1000BASE-T/SX/LX/ZX Ethernet interface via PTMs, can be used in slot 1 and/or 2 in a VLF-equipped Alcatel-Lucent 1665 DMX, GbE private lines, includes no switch fabric, OSP hardened [4]
10/100T (24 ports)	LNW66	A–D [2]	1.1	100BASE-T Ethernet interface
FC-DATA (SAN Interface)	LNW73	A–G[1]	5.1	4 ports, PTM optics supporting either FICON/Fibre-Channel or ESCON, can be installed in slot 1 or 2 of a function group or a growth slot with VLF mains, slot 1 only with non-VLF
FC-DATA w/ compression (SAN Interface)	LNW73C	A–G[1]	7.0	4 ports, PTM optics supporting either FICON/Fibre-Channel or ESCON, also supports compression of SAN traffic, can be installed in slot 1 or 2 of a function group or a growth slot with VLF mains, slot 1 only with non-VLF
100BASE-ZX/LX/FX (8 ports) 10/100BASE-T (16 ports) Private Line	LNW74	A–G[1]	5.0	Hybrid 100BASE-ZX/LX/FX and 10/100 BASE-T Ethernet interface, may only occupy slot 1 of a function group or a growth slot if non-VLF mains are used, slot 1 and 2 are available with VLF mains (Series 1:2 or higher LNW74s), uses PTM optics for ZX/LX/FX interfaces, supports private lines, when installed in the Growth slots, only the optical ports are functional (17–24), OSP hardened.[4]
OC-48 OLIU	LNW76	M1, M2	2.1	High-speed, short reach, 1310 nm, 48 STS-1 VT fabric

Table 4-2 Circuit packs supported in Alcatel-Lucent 1665 DMX shelf (continued)

Circuit pack	Apparatus code	Slot(s)	Release	Comments
Main Switch Pack	LNW80	M1, M2	4.0	High-speed, 96 STS-1 VT fabric, based on LNW27, no optics on pack, OSP hardened
OC-3/OC-12/ OC48 OLIU (8/8/2 ports)	LNW82	M1, M2	7.1	8OC-3/8OC-12/2OC-48 multi-port multi-rate (MPMR) PTM-based pack, 7.5G VT capacity, supports facility loopbacks, OSP hardened[4]
100/ 1000BASE-T 100BASE-ZX/LX/FX (4 ports) FE/GBE PL	LNW87	A–G[1]	9.0	100/1000BASE-T and 100BASE-ZX/LX/FX Ethernet interface via optical PTMs, can be used in slot 1 and/or 2 in a VLF-equipped Alcatel-Lucent 1665 DMX and either slot 1 or 2 in a non-VLF equipped Alcatel-Lucent 1665 DMX, GbE private lines, includes no switch fabric, OSP hardened[4]
In-service Electrical Continuity Test Tool	LNW93	A–D	4.0	For use in Alcatel-Lucent 1665 DMX to test the integrity of cables that will be connected to a High-Capacity DS1, DS3, or Ethernet circuit pack while a lower capacity pack is in-service in the other slot of the function group
Electrical Continuity Test Tool	LNW94	A–D	3.1	For use in Alcatel-Lucent 1665 DMX to test the integrity of cables connected to the DS1, DS3, and Ethernet interfaces on the Alcatel-Lucent 1665 DMX shelf
Detectable Apparatus Blank	LNW97	M2	3.1	Filler plates to be used in unpopulated M2 slot of the Alcatel-Lucent 1665 DMX shelf. *WaveStar*® CIT will show a blank plate when slot is equipped with this pack
Detectable Apparatus Blank	LNW98	A–D, G1, G2	3.1	Filler plates to be used in unpopulated Function Unit or Growth Slot of the Alcatel-Lucent 1665 DMX shelf. *WaveStar*® CIT will show a blank plate when slot is equipped with this pack.
100/1000 BASE-T or 1000BASE-LX/SX/ZX (4 ports) 100BASE-ZX/LX/FX (4 ports)	LNW170	A–G[1]	7.1	100/1000 4 port Ethernet Switch

Table 4-2 Circuit packs supported in Alcatel-Lucent 1665 DMX shelf (continued)

Circuit pack	Apparatus code	Slot(s)	Release	Comments
OC-48 OLIU	LNW202	M1, M2	7.1	High-speed, PTM-based pack, 48 STS-1 VT fabric, OSP hardened[4]
OC-12 OLIU	LNW203	M1, M2	9.0	High-speed, PTM-based pack, 12 STS-1 VT fabric, OSP hardened[4]
OC-48 OLIU	LNW402	A–D, G1, G2	8.0	Low-speed, OC-48 PTM-based, 12 STS-1 VT fabric, OSP hardened[4]
OC-192 OLIU	LNW502	M1, M2	7.1	High-speed, PTM-based pack with 48 STS-1 VT fabric, OSP hardened[4]
OC-48/OC-192 OLIU	LNW504	M1, M2	9.0	4OC-48/4OC-192 PTM-based VLF Main
OC-192 OLIU (1 port)	LNW603	A–D, G1, G2	9.0	Low-speed, PTM-based pack for use with VLF Mains
XM10G/8	LNW705	A–D, G1, G2	R7.1.1	8:1 10G Muxponder - PTM-based pack (1 XFP and up to 8 SFPs)
OMD5/8	LNW785	A–D, G1, G2	7.1	8 channel low-loss DWDM Mux/Demux with integrated VOAs, ITU-T channels 52 through 59 (195.20-195.90 THz)
56DS1/E1	LNW801	A–D	8.0	56 ports, for use in Alcatel-Lucent 1665 DMX High-Capacity Shelf, E1 service is provisionable on a per pack basis, OSP hardened
Apparatus Blank	177D	A–D, G1, G2	1.0	Filler plates to be used in unpopulated slots of the Alcatel-Lucent 1665 DMX shelf
Apparatus Blank	177E	M2	2.0	Filler plates to be used in unpopulated slots of the Alcatel-Lucent 1665 DMX shelf

Notes:

1. In order to support Ethernet and SAN packs in both Slot 1 and 2 of a Function or Growth Group, Alcatel-Lucent 1665 DMX must be equipped with VLF Mains (LNW59/LNW82/LNW504). When the shelf is equipped non-VLF mains, the Ethernet circuit packs are only supported in Slot 1 of a group. However, when the LNW170 is in equipment-protected mode, it is supported in both slots of a group with VLF and non-VLF mains.
2. Alcatel-Lucent 1665 DMX does not allow installation of two packs with electrical interfaces in adjacent slots within the same Function Unit or Growth Group (other than an equipment-protected pair). Therefore, in systems equipped with VLF mains (LNW59/LNW82/LNW504), LNW66 packs can reside in either Slot 1 or

Slot 2 of a group, but not both at the same time. *Telcordia* ® OS systems only support electrical packs in Slot 1 of a group. However, another optical (Ethernet or SONET) pack may be installed in the other slot. In non-VLF equipped shelves, LNW66 can only occupy Slot 1 of a particular group.

3. When populating the MAIN slots in the Alcatel-Lucent 1665 DMX shelf, it is imperative that both MAIN 1 and MAIN 2 contain circuit packs with identical VT switch fabric size. The Alcatel-Lucent 1665 DMX OC-48 circuit packs, for example, contain fabrics ranging from 12 STS-1 to VLF capacity. It is therefore very important that you look carefully at the switch fabric sizes of your high-speed circuit packs while planning your order.
4. These PTM-based circuit packs are OSP hardened, but they must also be equipped with OSP-hardened PTMs to operate in OSP environments.

Circuit pack descriptions

Overview

This section briefly describes Alcatel-Lucent 1665 DMX circuit packs.

System Controller (LNW2)

The SYSCTL provides communication with other circuit packs on the Alcatel-Lucent 1665 DMX shelf. The SYSCTL supports all Alcatel-Lucent 1665 DMX operations interfaces, including IAO LAN (OSI or TCP/IP), CIT, office alarms, and miscellaneous discretes. The SYSCTL also supports DCC terminations for each optical line interface.

The SYSCTL faceplate has push-button switches, alarm/status LEDs, and a 35-segment numeric LED display to facilitate local operations. Data redundancy is provided by two separate NVMs. Transmission is not affected if the SYSCTL fails.

The SYSCTL circuit pack provides a microprocessor, nonvolatile memory to store the generic program software and provisioning database, and additional memory for system operation. The SYSCTL circuit pack also has interfaces across the backplane to monitor and control every circuit pack in the shelf.

The SYSCTL supports CIT front access to the Alcatel-Lucent 1665 DMX via the IAO LAN and a serial RS-232 port located on the back of the Alcatel-Lucent 1665 DMX shelf.

LNW2 comes equipped with two removable Non-volatile Memory (NVM) cards that can also be ordered separately. An Alcatel-Lucent 1665 DMX shelf will only function properly when it is equipped with an LNW2 card that contains two fully functioning NVM cards. The NVM cards are removable/replaceable.

28DS1PM (LNW7)

Note: The LNW7 circuit pack is not supported when Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59/LNW82/LNW504) circuit packs.

The LNW7 circuit pack contains 28 DS1 ports that can be cross-connected to VT1.5 time slots when the system is operating with a UPSR, 1+1, or BLSR Main interface. Hairpin cross-connections to OC-n and other electrical interfaces are also supported. The circuit pack is 1x1 protected, and non-revertive protection switching is supported. Line build-outs and DS1 signal encoding are software provisionable. The pack terminates up to 28 bidirectional DS1 electrical signals and supports the transport of DS1 signals coded in either alternate mark inversion (AMI) or bipolar 8-zero substitution (B8ZS) modes. The signals received from the DSX-1 are mapped into SONET VT1.5 signals and then routed to the high-speed OLIU circuit pack.

The LNW7 circuit pack can occupy Function Unit groups A, B, C, and D. All electric interface circuit packs are 1x1 hardware protected. So, although both slots in each group can house an LNW7 circuit pack, one slot in each group populated by LNW7 circuit packs is always used for hardware protection. Thus the Alcatel-Lucent 1665 DMX shelf supports up to 112 working ports when four Function Unit groups are equipped with the LNW7 circuit pack.

In addition to maintenance and provisioning functions, the 28DS1PM circuit pack provides performance monitoring capabilities.

56DS1/E1 (LNW8/LNW801)

The LNW8 and LNW801 circuit packs can be used only in the High-Capacity shelf and contain 56 DS1/E1 ports that can be cross-connected to VT or STS-1 time slots in DS1 mode and STS3(c) time slots in E1 mode. The LNW8/LNW801 circuit packs have common functionality and they are directly interchangable. Beginning in Release 9.1, an LNW8 and an LNW801 can occupy companion slots at the same time.

The 56DS1/E1 packs are 1x1 protected by default, and non-revertive protection switching is supported. The LNW8/LNW801 does not support true 0x1 operation. The LNW8 and LNW801 can be used as a protection pair. For unprotected operation, install an LNW8/LNW801 in one slot and leave the companion slot empty. There is no application parameter to provision. The Alcatel-Lucent 1665 DMX does not allow electrical TDM packs (and other packs that require rear access) to be paired with any other working packs in the same Function group or Growth group. For a detailed description of circuit pack equipage guidelines, see Chapter 6, “System planning and engineering”.

Line build-outs and DS1 signal encoding are software provisionable. These packs terminate up to 56 bidirectional DS1 electrical signals and support the transport of DS1 signals coded in either alternate mark inversion (AMI) or bipolar 8-zero substitution (B8ZS) modes. The signals received from the DSX-1 are mapped into SONET VT1.5 signals and then routed to the high-speed OLIU circuit pack. DS1 signals can be connected directly to high-speed BLSRs at the VT1 rate. DS1 Bipolar Violations indicate if the BPV threshold has been exceeded and the DS1 signal incoming from the DSX-1 is being translated to an outgoing far-end DS1 signal LOS or LOF.

The E1 ports have 120 Ohm terminations, and are HDB3-encoded. The mapping is E1 <-> VC-12 <-> TU-12 <-TUG2 <-> TUG3 <->VC-4 (treated as an STS3c). When the LNW8/LNW801 is provisioned for E1 interfaces the output of the card will always be an STS-3c regardless of the amount of traffic it is actually handling.

56DS1/E1 circuit packs can occupy Function Unit groups A, B, C, and D. Electric interface circuit packs are 1x1 hardware protected. So, although both slots in each function group can house LNW8/LNW801 circuit packs, one slot in each function group populated by LNW8/LNW801 circuit packs is always used for hardware protection. Thus the Alcatel-Lucent 1665 DMX shelf supports up to 224 working ports when four Function Unit groups are equipped with the LNW8/LNW801 circuit pack.

In addition to maintenance and provisioning functions, the 56DS1/E1 circuit pack provides performance monitoring capabilities.

12DS3/EC1 (LNW16)

The 12DS3/EC1 (LNW16) circuit pack contains 12 ports and supports non-revertive protection switching. The 12DS3/EC1 circuit pack provides bidirectional transport of 12 DS3 or EC-1 signals and maps the DS3s into STS-1 signals, and supports transport of DS3 signals coded in bipolar 3-zero substitution (B3ZS). DS3 or EC-1 service is provisionable on a per-port basis within each pack. LNW16 is environmentally hardened for outside plant (OSP) deployments.

The LNW16 does not support 0x1 operation. For unprotected operation, only install an LNW16 in one slot and leave the companion slot empty. There is no application parameter to provision. The LNW16 may occupy Function Unit groups A, B, C, and D. Electrical interface circuit packs are 1x1 hardware protected. So, although both slots in each function group can house an LNW16 circuit pack, one slot in each function group populated by LNW16 circuit pack is always used for hardware protection. Thus the Alcatel-Lucent 1665 DMX shelf supports up to 48 working ports when four Function Unit groups are equipped with the LNW16 circuit packs.

TransMUX circuit pack (LNW18)

Alcatel-Lucent 1665 DMX supports a 12-port TransMUX card that can collect various DS1 signals from around a ring and combine them into a channelized DS3 signal. The LNW18 circuit pack is environmentally hardened for outside plant (OSP) deployments.

The LNW18 circuit pack may occupy Function Unit groups A, B, C, and D. Electric interface circuit packs are 1x1 hardware protected. So, although both slots in each function group can house an LNW18 circuit pack, one slot in each function group populated by LNW18 circuit pack is always used for hardware protection. Thus the Alcatel-Lucent 1665 DMX shelf supports up to 48 working ports when four Function Unit groups are equipped with the LNW18 circuit packs.

The TransMUX circuit pack functions in the following manner:

Transmit Functions

- Receives a B3ZS-encoded DS3 signal from a DSX-3
- Recovers DS3 clock and NRZ data
- Calculates parity errors on the DS3 input
- Demultiplexes the M13 or C-bit formatted DS3 signal into 28 DS1s
- Maps the 28 DS1s into VT1.5s and then into an STS-1
- Inserts STS-1 path overhead
- Provides the STS-1 signal to the OLIU circuit packs

Receive Functions

- Interprets the STS-1 pointer values
- Terminates the STS-1 path
- De-interleaves the STS-1 signal into 28 VT1.5s and interprets VT pointer values
- Converts the VT1.5 signals to 28 DS1 signals
- Multiplexes the 28 DS1 signals to an M13 or C-bit formatted DS3 signal
- B3ZS encodes the outgoing DS3 signal
- Pre-equalizes the DS3 signal (with LBO) and transmits it to a DSX-3

48DS3/EC1 (LNW19B)

The 48DS3/EC1 (LNW19B) circuit pack contains 48 ports and supports non-revertive protection switching. The 48DS3/EC1 circuit pack provides bidirectional transport of 48 DS3 or EC-1 signals and maps the DS3s into STS-1 signals, and supports transport of DS3 signals coded in bipolar 3-zero substitution (B3ZS). DS3 or EC-1 service is provisionable on a per-port basis within each pack. LNW19B is environmentally hardened for outside plant (OSP) deployments. The LNW19B supports DS3 terminal loopbacks.

The LNW19B does not support 0x1 operation. For unprotected operation, only install an LNW19B in one slot and leave the companion slot empty. There is no application parameter to provision. The LNW19B may occupy Function Unit groups A, B, C, and D. Electric interface circuit packs are 1x1 hardware protected. So, although both slots in each function group can house an LNW19B circuit pack, one slot in each function group populated by LNW19B circuit pack is always used for hardware protection. Thus the Alcatel-Lucent 1665 DMX shelf supports up to 192 working ports when four Function Unit groups are equipped with the LNW19B circuit packs.

48DS3/EC1/TransMUX (LNW20)

The LNW20 circuit pack provides 48 ports supporting DS3, EC1, and TMUX functionality on a port-by-port basis. Each port can be individually provisioned EC1, ported channelized DS3, ported unchannelized DS3, or portless DS3. With the LNW20,

one high-density pack can be used for all DS3, EC1, and/or TransMUX applications. LNW20 can be 1x1 protected or function in 0x1 unprotected mode. It supports hairpins to other packs in the shelf, and between ports on the same pack.

Portless DS3 mode does not utilize any of the electrical ports on the pack. When a port is provisioned for Portless DS3 operation, a channelized DS3 signal within an STS-1 tributary from a SONET interface on a different circuit pack (OC-n or EC-1) or the same circuit pack (an EC-1 on another port) is terminated and demultiplexed into constituent DS1 signals. The DS1 signals are encapsulated into VT1.5 signals and cross-connected at the VT-level within the cross-connection fabric on the Main circuit pack to any other interface that supports DS1 signal transport, including a DS1 interface, a channelized DS3 interface, an EC-1 or OC-n interface. This requires two bidirectional backplane STS-1 signals to convert a single (bidirectional) STS-1 channel.

If the Main slots are equipped with Very Large Fabric LNW59, LNW82, or LNW504 circuit packs, portless operation is supported on all LNW20 ports when the circuit pack is installed in any Function/Growth group.

If the Main slots are equipped with large fabric (non-VLF) circuit packs, portless DS3 operation is only supported on the odd ports in the Function/Growth groups. The corresponding even port (odd port plus one) is unavailable.

Unless the Main slots are equipped with large fabric or very large fabric OLIU circuit packs, portless DS3 operation is not supported and any attempts to provision portless DS3 operation are denied.

LNW20 only functions in portless mode in G1/G2 and only large fabric and VLF Mains support portless mode. If other packs are installed in the main slots, the LNW20 cannot be used in G1/G2.

Table 4-3 Main circuit packs that allow portless LNW20 operation

Main circuit pack	Portless operation allowed in
LNW82 (VLF) LNW59 (VLF) LNW504 (VLF)	all ports A–D, G1, G2

Table 4-3 Main circuit packs that allow portless LNW20 operation (continued)

Main circuit pack	Portless operation allowed in
LNW27 LNW29 LNW32 LNW56 LNW58 LNW76 LNW80 LNW202 LNW203 LNW502	odd ports A–D, G1, G2
All other packs	A–D ; no portless mode ; no portless mode

Alcatel-Lucent 1665 DMX does not allow 2 electrical TDM packs of different types (or any packs that require rear access) to occupy adjacent slots in the same Function Group. So, although 0x1 functionality allows LNW20 to function unprotected, overall capacity is not increased. A total of 192 ports are available when all slots are equipped with LNW20 circuit packs (a maximum of 240 ports are available when the LNW20 is functioning in portless mode and the shelf is equipped with VLF Mains). This is because LNW20 must function in portless mode when installed in the Growth Slots. Though the LNW20 supports 0x1 protection, companion slots (ex. A1 and A2) can only be equipped with LNW20 packs (no circuit pack/interface mixing in the same Function Group) providing 1+1 protection.

OC-48 OLIU (LNW27)

The LNW27 high-speed circuit pack is a single port, long-reach OC-48, 1310 nm optical line interface unit. The LNW27 supports OC-48 add/drop, BLSR and UPSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW27 circuit pack can cross-connect VTs in all 48 STS-1s of the OC-48 signal.

The LNW27 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW27 faceplate.

OC-48 OLIU (LNW29)

The LNW29 high-speed circuit pack is a single port, long-reach OC-48, 1550 nm optical line interface unit. The LNW29 supports OC-48 add/drop, BLSR, UPSR, and 1+1 configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW29, like the LNW27 circuit pack, can cross-connect VTs in all 48 STS-1s of the OC-48 signal.

The LNW29 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW29 faceplate.

OC-48 OLIU (LNW31)

The LNW31 low-speed circuit pack is a single-port (bidirectional), intermediate-reach, OC-48 1310 nm optical line interface unit. The LNW31 supports OC-48 add/drop, BLSR, UPSR, and 1+1 configurations, single- and dual-homing, non-revertive and revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. When the shelf is equipped with non-VLF mains, the LNW31 circuit pack can cross-connect VTs in up to 12 STS-1s of the OC-N signal. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains.

The LNW31 may occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 10 ports are addressable when all Function Unit groups are equipped with the LNW31 circuit pack. Fiber access is provided via a pair of LC-type connectors on the LNW31 faceplate.

The LNW31 is hardened for outside plant (OSP) temperature ranges.

OC-48 OLIU (LNW32)

The LNW32 high-speed circuit pack is a long-reach, OC-48, 1310 nm optical line interface unit. The LNW32 supports OC-48 add/drop, BLSR and UPSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW32 circuit pack can cross-connect VTs in all 48 STS-1s of the OC-48 signal.

The LNW32 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW32 faceplate.

The LNW32 is hardened for outside plant (OSP) temperature ranges.

OC-3 OLIU (LNW37)

The LNW37 low-speed circuit pack is a 4-port, OC-3 PTM-based optical line interface unit supporting VT1.5, STS-1 and STS-3c path switching. The LNW37 can interface with other OC-3 rings in the network and can also be used as an interface for OC-3 linear optical extensions, as well as single- and dual- homed ring extensions. When the shelf is equipped with non-VLF mains, the LNW37 circuit pack can cross-connect VTs in up to 12 STS-1s of the OC-N signal. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains. The LNW37 also supports facility loopbacks for testing purposes. The LNW37 is hardened for outside plant (OSP) temperature ranges.

The LNW37 features Pluggable Transmission Module (PTM) optics. PTM optics are "pluggable" in the sense that they can be plugged into a circuit pack as they become necessary. This allows customers to grow their network incrementally, only realizing the full cost for optics as the need to provision service on (and thus receive revenue from) them becomes necessary. LNW37 packs are purchased and shipped with no sockets populated with functioning optics. The ports remain empty until the customer decides to place optics in them.

The LNW37 can occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 40 ports are addressable when all Function Unit groups are equipped with the LNW37 circuit pack.

The LNW37 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW37 in OSP applications.

OC-3 OLIU (LNW45)

The LNW45 low-speed circuit pack is an 8-port, OC-3 PTM-based optical line interface unit supporting VT1.5, STS-1 and STS-3(c) path switching. The LNW45 can interface with other OC-3 rings in the network and can also be used as an interface for OC-3 linear optical extensions, as well as single- and dual- homed ring extensions. When the shelf is equipped with non-VLF mains, the LNW45 circuit pack can cross-connect VTs in up to 48 STS-1s of the OC-N signal. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains. The LNW45 also supports facility loopbacks for testing purposes.

The LNW45 features Pluggable Transmission Module (PTM) optics. PTM optics are "pluggable" in the sense that they can be plugged into a circuit pack as they become necessary. This allows customers to grow their network incrementally, only realizing the full cost for optics as the need to provision service on (and thus receive revenue from) them becomes necessary. LNW45 packs are purchased and shipped with no sockets populated with functioning optics. The ports remain empty until the customer decides to place optics in them.

The LNW45 can occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 80 ports are addressable when all Function Unit groups are equipped with the LNW45 circuit pack.

The LNW45 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW45 in OSP applications.

OC-12 OLIU (LNW48)

The LNW48 high-speed circuit pack is an intermediate reach OC-12 1310 nm circuit pack. The LNW48 supports OC-12 add/drop, UPSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), and STS-12(c) signal transport. The LNW48 OLIU can cross-connect VTs in 12 of 12 STS-1s. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-12 OLIU.

The LNW48 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW48 faceplate.

The LNW48 is hardened for outside plant (OSP) temperature ranges.

OC-12 OLIU (LNW49)

The LNW49 low-speed circuit pack is a 4-port, OC-12 PTM-based optical line interface unit supporting VT1.5, STS-1, STS-3(c), and STS-12(c) path switching. When the shelf is equipped with non-VLF mains, the LNW49 circuit pack can cross-connect VTs in up to 48 STS-1s of the OC-N signal. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains. The LNW49 provides an OC-12 interface to other OC-12 rings, linear optical extensions, and single- and dual-homed ring extensions.

The LNW49 features Pluggable Transmission Module (PTM) optics. PTM optics are "pluggable" in the sense that they can be plugged into a circuit pack as they become necessary. This allows customers to grow their network incrementally, only realizing the full cost for optics as the need to provision service on (and thus receive revenue from) them becomes necessary. LNW49 packs are purchased and shipped with no ports populated with functioning optics. The ports remain empty until the customer decides to place optics in them.

The LNW49 can occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 40 ports are addressable when all Function Unit groups are equipped with the LNW49 circuit pack.

The LNW49 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW49 in OSP applications.

OC-12 OLIU (LNW50)

The LNW50 high-speed circuit pack is a long reach, OC-12 1310 nm circuit pack. The LNW50 supports OC-12 add/drop, UPSR configurations, single- and dual-homing, non-revertive 1+1 linear protection switching, and VT1.5, STS-1, STS-3(c), and STS-12(c) signal transport. The LNW50 OLIU can cross-connect VTs in 12 of 12 STS-1s. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-12 OLIU.

The LNW50 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW50 faceplate.

The LNW50 is hardened for outside plant (OSP) temperature ranges.

OC-12 OLIU (LNW54)

The LNW54 high-speed circuit pack is a long-reach, OC-12 1550 nm circuit pack. The LNW54 supports OC-12 add/drop, UPSR configurations, single- and dual-homing, non-revertive 1+1 linear protection switching, and VT1.5, STS-1, STS-3(c), and STS-12(c) signal transport. The LNW54 OLIU can cross-connect VTs in 12 of 12 STS-1s. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-12 OLIU.

The LNW54 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW54 faceplate.

The LNW54 is hardened for outside plant (OSP) temperature ranges.

OC-3/OC-12/OC-48 OLIU (LNW55)

The LNW55 low-speed circuit pack is a 12-port, PTM-based, multi-port, multi-rate (MPMR), pack with integrated STS and VT fabrics. The pack supports a maximum of 12 OC-3 interfaces, 12 OC-12 interfaces or 4 OC-48 interfaces. The LNW55 is only supported in systems that are equipped with VLF Main circuit packs.

The mixing of interface rates is supported with the following restrictions:

- OC-48 interfaces are only supported on ports 1, 4, 7 and 10.
- When one of these ports is operating at the OC-48 rate, then the next two adjacent ports cannot be used.

  For example, if port 1 is operating as an OC-48 port, then ports 2 and 3 are unavailable for use.

OC-3, OC-12 or OC-48 operation can be selected independently on a per port basis, up to the maximum number of ports supported for each interface type. The supported protection applications (1+1, 1+1_OPTM, UPSR, 0x1 and BLSR [OC-48]) can also be provisioned on a per port basis. The LNW55 ports can be provisioned as SONET or SDH using the SS bits detection feature on a per port basis

The pack supports true 0x1 operation and can be installed in the function and growth slots of Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMXtend shelves.

The LNW55 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW55 in OSP applications.

OC-192 OLIU (LNW56)

The LNW56 high-speed circuit pack is an intermediate-reach, OC-192 1550 nm circuit pack. The LNW56 supports OC-192 add/drop, UPSR, and BLSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The LNW56 circuit pack can cross-connect VTs in any 48 of 192 STS-1s in the OC-192 signal. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-192 OLIU.

The LNW56 circuit pack may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW56 faceplate.

OC-192 OLIU (LNW58)

The LNW58 high-speed circuit pack is a short-reach, OC-192 1310 nm circuit pack. The LNW58 supports OC-192 add/drop, UPSR, and BLSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The LNW58 circuit pack can cross-connect VTs in any 48 of 192 STS-1s in the OC-192 signal. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-192 OLIU.

The LNW58 circuit pack may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW58 faceplate.

OC-192 OLIU (LNW59)

The LNW59 is a 2-port, PTM-based, OC-192 circuit pack. The LNW59 supports OC-192 add/drop, UPSR, and BLSR configurations, single- and dual-homing, and revertive or non-revertive linear 1+1 protection switching. The LNW59 circuit pack provides 2 ports capable of supporting PTMs. It can also function headless (with no optics), similar to the LNW80.

For overall capacity, the LNW59 circuit pack boasts a 20G optical main with a 180G centralized STS switch fabric and 30G VT switch fabric. When Alcatel-Lucent 1665 DMX is equipped with the LNW59 VLF Main, all switching takes place on the LNW59 circuit pack. The switch fabrics on the low-speed, tributary optical circuit packs are disabled. The LNW59 circuit pack further upgrades the shelf's overall capacity by enabling the Function and Growth slots to house circuit packs with up to 10G bandwidth for a total input/ouput capacity of 140G.

The LNW59 circuit pack also enables true 0x1 operation for low-speed packs. It also enables hairpin cross-connections between unprotected 0x1 interfaces located in the same Function or Growth Unit. The LNW59 ports can be provisioned as SONET or SDH using the SS bits detection feature on a per port basis.

The LNW59 circuit pack supports STS-1, STS-3c, STS-12c, STS-48c, and STS-192c signal transport. The OC-192 OLIU can cross-connect VTs in any 192 STS-1s. LNW59s may occupy Main slots 1 and 2.

All tributary circuit packs, except for LNW6 and LNW7, are supported by the LNW59 circuit pack.

OC-48 OLIU (LNW62)

The LNW62 is a 4 port OC-48, PTM-based circuit pack supporting add/drop, BLSR, and UPSR configurations, single- and dual-homing, non-revertive or revertive linear 1+1 protection switching, and 0x1 operation. A maximum of 15 BLSRs (between low-speed and high-speed slots) are supported per shelf when the LNW62 is equipped in all tributary slots and VLF Mains are used in the Main slots. The LNW62 ports can be provisioned as SONET or SDH using the SS bits detection feature on a per port basis.

The LNW62 does not have an on-board switch fabric and can only be used with the VLF packs in the Main slots. All switching functions are performed on the VLF Main packs.

LNW62 supports VT1.5, STS-1, STS-3c, STS-12c, and STS-48c signal transport. The LNW62 boasts a 10G backplane interface capacity and may occupy both Function and Growth slots, providing a total port density of 40 OC-48 ports per shelf if all Function and Growth slots are equipped with an LNW62.

The LNW62 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW62 in OSP applications.

GbE Private Line (LNW63)

The LNW63 circuit pack is a 4-port, PTM-based, Private Line, Gigabit Ethernet pack that supports Gigabit Ethernet optical and electrical PTMs. For specific details about the supported PTM configurations, see “Ethernet port configurations” (p. A-19). The LNW63 provides data transport at the rate of 1000 Mbps using standard STS-1 virtual concatenation according to ITU G.707.

The LNW63 contains 4 internal WAN ports supporting enhanced Private Line services such as high-order virtual concatenation and Link Capacity Adjustment Scheme (LCAS). These ports have an aggregate capacity of 48xSTS1 (48 STS-1s). Any single port can provide up to 1000 Mbps (subject to this aggregate capacity limitation), but you cannot have each of the 4 ports supporting 1GbE (1000Mbps) service at the same time, because 21 STS-1s per GbE totals 84 STS-1s.

The LNW63 is an unprotected pack.

When Alcatel-Lucent 1665 DMX is not equipped with VLF Main (LNW59/LNW82/LNW504) packs, LNW63 packs can only be placed in Slot 1 of any function group or growth slot in the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supported a total add/drop capacity of 20 Private Line GbE ports if all slots are equipped with LNW63 circuit packs.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main packs, Ethernet packs can occupy both Slot 1 and 2 of a Function or Growth Unit (where applicable). With VLF Mains and all tributary slots populated with LNW63 packs, Alcatel-Lucent 1665 DMX provides a total add/drop capacity of 40 Private Line GbE ports.

When VLF Mains are not used, if the LNW63 circuit packs occupy slot 1 of a Function Unit group. Slot 2 must be populated with an apparatus blank.

The LNW63 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW63 in OSP applications.

GbE Private Line (LNW64) Ethernet interface

The LNW64 circuit pack is an 8-port, PTM-based Private Line Gigabit Ethernet pack. The ports can be populated with either, 8 optical, 8 electrical PTMs, or a mix of 4 electrical and 4 optical PTMs. For specific details about the supported PTM configurations, see "Ethernet port configurations" (p. A-19). The LNW64 contains 8 internal VCG ports supporting enhanced Private Line services such as high-order virtual concatenation (VCAT) and Link Capacity Adjustment Scheme (LCAS). LNW64 supports STS-1 and STS-3c cross-connections with or without VCAT, and STS-12c cross-connections without VCAT. All ports are capable of transmitting at wire speed (1000 Mbps) simultaneously, making full capacity of the pack 168 STS-1s.

The LNW64 is an unprotected pack. The LNW64 can only be used with VLF Mains and can occupy both slots 1 and 2 of a Function/Growth unit, making the total capacity of a system fully populated with LNW64s, 80 GbE Private Line ports.

The LNW64 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW64 in OSP applications.

10/100BASE-T (LNW66) Ethernet interface

The LNW66 circuit pack has 24 10/100T Fast Ethernet ports and provides data transport at the rate of 10/100 Mbps using standard Ethernet switching IEEE 802.1, standard encapsulation, and standard STS-1 virtual concatenation according to ITU G.707. The LNW66 can transmit signals across spans as long as 100 meters. Each LNW66 circuit pack can support 1 packet ring. The LNW66 is an unprotected pack.

Alcatel-Lucent 1665 DMX does not allow installation of two packs with electrical interfaces in adjacent slots within the same Function Unit or Growth Group (other than an equipment-protected pair). Therefore, in systems equipped with VLF mains, LNW66 packs can reside in either Slot 1 or Slot 2 of a group, but not both at the same time. *Telcordia* ® only supports electrical packs in Slot 1 of a group. However, another optical (Ethernet or SONET) pack may be installed in the other slot. In non-VLF equipped shelves, LNW66 can only occupy Slot 1 of a particular group. When the LNW66 circuit pack occupies slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

FC-DATA optical SAN interface (LNW73 and LNW73C)

The LNW73 and LNW73C circuit packs are 4-port Storage Area Networking (SAN) interface cards designed to facilitate SAN distance extensions via the Alcatel-Lucent 1665 DMX platform using GFP-T (G.7041). These cards employ standard encapsulation, and standard STS-1 and VT virtual concatenation according to ITU G.707. For extended FC/FICON interfaces, the LNW73/73c also supports buffer_to_buffer credit management spoofing consistent with ANSI T11 FC-BB-3_GFPT draft standard.

They utilize PTM optics to provide the option of FICON, ESCON, or Fibre-channel interfaces natively on the Alcatel-Lucent 1665 DMX shelf. Each circuit pack must be equipped with only one type of PTM (FICON/FC or ESCON). The LNW73/73c can operate at 1 Gbps or 2 Gbps and in either Asynchronous or Synchronous transmission modes. When operating in async Fibre Channel (FC) mode, 2 ports are available at 2Gbps FC, or 4 ports at 1Gbps FC, or 1 port at 2Gbps FC and 2 ports of 1Gbps FC. When operating in synchronous FC mode, 1 port is available at 2Gbps FC, or 2 at 1Gbps FC.

While the capacity of each port is 2Gbps, the true capacity of each port is relative to the type of PTM it is equipped with. For ESCON traffic, the PTM ports have a capacity of 200 Mbps. The 2Gbps capacity of the ports is sufficient to support FC2G and FICON Express.

While the LNW73 and LNW73C circuit packs do support LCAS, the LNW73 only uses LCAS with asynchronous FC traffic.

The LNW73C circuit pack differs from the LNW73 circuit pack in that it enables compression of SAN traffic.

The implementation of SAN compression enables a high throughput of up to two full-line rate FC-2G interfaces in a single pack.

The LNW73C circuit pack is able to compress asynchronous Fibre Channel traffic and conserve up to 50% of bandwidth versus uncompressed asynchronous FC traffic in typical applications.

Compression for asynchronous FC traffic is pre-standard and will be standardized by FC-BB-4. The R6.0 implementation of SAN compression enables a high throughput of up to two full-line rate FC-2G interfaces in a single pack.

When Alcatel-Lucent 1665 DMX is not equipped with VLF Main (LNW59/LNW82/LNW504) circuit packs, the LNW73/73C circuit packs can only occupy slot 1 of any Function or Growth Unit group on the shelf. When Alcatel-Lucent 1665 DMX is equipped with VLF circuit packs in the Main slots, FC-DATA circuit packs can occupy both Slot 1 and 2 of a Function or Growth Unit.

When VLF Mains are not used, if the LNW73/73C circuit packs occupy slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

10/100BASE-T and 100BASE-ZX/LX/FX (LNW74) Fast Ethernet interface

This LNW74 is a 24-port Fast Ethernet Private Line circuit pack. The LNW74 uses standard GFP encapsulation (G.7041) and standard STS-1 and VT virtual concatenation according to ITU G.707. The LNW74 circuit pack provides 8 ports for optical 100BASE-ZX/LX/FX transport at 100 Mbps The LNW74 circuit pack also provides 16 electrical ports for the 10/100BASE-T interfaces. These electrical ports transmit at 10/100 Mbps using standard Ethernet switching IEEE 802.1, standard encapsulation, and standard STS-1 and VT virtual concatenation according to ITU G.707. For specific details about the supported configurations, see “Ethernet port configurations” (p. A-19). The LNW74 circuit pack electrical interfaces can transmit signals across spans as long as 100 meters.

The LNW74 circuit pack is an unprotected circuit pack and is OSP hardened. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW74 in OSP applications.

The LNW74 circuit pack is designed specifically to support Fast Ethernet Private Line applications. Each LNW74 circuit pack can support 24 private lines. The LNW74 circuit pack can also support STS-3(c) cross-connections instead of virtual concatenation.

When the Main slots are equipped with VLF circuit packs, LNW74 circuit packs can be installed in either slot 1 or 2 of Function Unit or Growth groups to support true 0x1 on optical ports. The LNW74 circuit pack can be installed next to another optical TDM or Ethernet circuit pack within the same group.

When VLF Mains are not used, if the LNW74 circuit packs occupy slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

The LNW74 circuit pack features Pluggable Transmission Module (PTM) optics for all 100BASE-ZX/LX/FX interfaces. PTM optics are "pluggable" in the sense that they can be plugged into a circuit pack as they become necessary. This allows customers to grow their network incrementally, only realizing the full cost for optics as the need to provision service on (and thus receive revenue from) them becomes necessary. LNW74 circuit

packs are purchased and shipped with no ports populated with functioning optics. The ports remain empty until the customer decides to place optics in them. 8 ports are available for 100BASE-ZX/LX/FX optics. There are 24 internal WAN ports (capable of transmitting signals to the MAIN circuit packs) in the LNW74 circuit pack.

OC-48 OLIU (LNW76)

The LNW76 high-speed circuit pack is a short-reach, OC-48 1310 nm optical line interface unit. It is designed for intra-office transmission. The LNW76 supports OC-48 add/drop, BLSR, UPSR, and 1+1 configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW76 circuit pack can cross-connect VTs in all 48 STS-1s of the OC-48 signal.

The LNW76 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW76 faceplate.

Main switch pack (LNW80)

The LNW80 high-speed circuit pack is designed to save cost in CO hub applications where there is no need to transmit traffic over network-side interfaces. LNW80 is best used in a DCS type of application. It can cross-connect signals amongst multiple low-speed tributary interfaces and perform VT mapping into OC-3/12/48 tributaries. It can cross-connect signals at the VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) level. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the LNW80.

The LNW80 circuit pack design is based on the design/capabilities of the LNW27 pack, minus the optical interfaces.

The LNW80 circuit pack supports VT mapping in 96 STS-1s.

The LNW80 may occupy Main slots 1 and 2 and contains NO interfaces on the faceplate of the pack. Due to the increased switch fabric size and the absence of any optics on the pack's faceplate, the LNW80 cannot be upgraded to a high-speed optical pack.

OC-3/OC-12/OC-48 OLIU (LNW82)

The LNW82 high-speed circuit pack is an 8-port, multi-port., multi-rate (MPMR) OC-3, OC-12, OC-48 VLF Main circuit pack. The pack supports a maximum of 8 OC-3 interfaces, 8 OC-12 interfaces or 2 OC-48 interfaces and has integrated STS and VT fabrics.

Mixed interface rates are supported with the following restrictions.

- OC-48 interfaces are only supported on ports 1 and 5.
- When one of these ports is operating at the OC-48 rate, then the next three adjacent ports cannot be used.

  For example, if port 1 is operating as an OC-48 port, then ports 2, 3, and 4 are unavailable for use.

The LNW82 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW82 in OSP applications.

The pack supports true 0x1 operation for low-speed packs. The backplane interfaces can operate at 2.5 Gb/s or at 622 Mb/s, supporting all VLF-compatible low-speed packs. The LNW7 circuit pack is not VLF-compatible.

The overall capacity of the LNW82 is a 10G optical main with 130G of STS switch fabric and 10G VT switch fabric. When the Alcatel-Lucent 1665 DMX is equipped with LNW82 VLF mains, all switching takes place on the LNW82 circuit packs. The switch fabrics on the low-speed, tributary optical circuit packs are disabled. The LNW82 further upgrades the overall capacity of the shelf by enabling the Function and Growth slots to house circuit packs with up to 10G bandwidth for a total input/output capacity of 110G.

The LNW82 provides increased flexibility for equipping low-speed OC-n interfaces with increased port density. OC-3, OC-12, OC-48, or OC-192 operation can be selected on a per port basis, up to the maximum number of ports supported for each interface type. The supported protection applications (1+1, 1+1_BIDIR, 1+1_OPTM, UPSR, 0x1, and BLSR [OC-48 only]) can also be provisioned on a per-port basis. The LNW82 ports can be provisioned as SONET or SDH using the SS bits detection feature on a per port basis.

FE/GbE Private Line (LNW87) Ethernet interface

The LNW87 circuit pack is an 4-port, PTM-based Private Line Fast Ethernet/Gigabit Ethernet pack. The ports can be populated with either, 4 optical, 4 electrical PTMs, or a mix of electrical and optical PTMs. The port mode is provisionable on per port basis. The LNW87 contains 4 internal VCG ports supporting enhanced Private Line services such as high-order virtual concatenation (VCAT) and Link Capacity Adjustment Scheme (LCAS). LNW87 supports STS-1 and STS-3c cross-connections with or without VCAT, and STS-12c cross-connections without VCAT. All ports are capable of transmitting at wire speed (1000 Mbps) simultaneously, making full capacity of the pack 84 STS-1s.

The LNW87 is an unprotected pack. The LNW87 can be used with VLF Mains or non-VLF mains and can occupy both slots 1 and 2 of a Function/Growth unit, making the total capacity of a systems fully populated with LNW87s, 40 GbE Private Line ports.

The LNW87 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW87 in OSP applications.

Electric continuity test tool (LNW91)

Alcatel-Lucent 1665 DMX supports a circuit pack designed to aid technicians in the installation and maintenance of Electrical interfaces and cables. The Electrical Continuity Test Tool (LNW94) can be placed in any Function slot on the Alcatel-Lucent 1665 DMX shelf (NOT including Growth Slots). It is used to test the cables which will be connected to DS1, DS3, or Ethernet electrical interfaces. LNW94 tests the integrity of electrical cables to both identify where trouble exists and which cables or DSX panels are faulty prior to installation and turn up.

In-service electric continuity test tool (LNW93)

The In-service Electrical Continuity Test Tool (LNW93) test circuit pack is used for upgrades in the Alcatel-Lucent 1665 DMX High-Capacity shelf. An in-service shelf might have a function unit with low capacity DS1 (LNW7) or DS3 (LNW16) packs. When these packs are upgraded with higher capacity packs (DS1, LNW8/LNW801; DS3, LNW19B), as part of the upgrade procedure, new DS1 or DS3 connectorized cables are added to the DSX cross-connect frames and to the Alcatel-Lucent 1665 DMX shelf. The LNW93 pack is used to test out the new wiring without disrupting traffic on the in-service pack.

The LNW93 is very similar to the LNW94 test tool except that it has no backplane connectors for DS1 ports #1–28 or for DS3 ports #1–12. When the LNW93 is plugged in, it makes no contact with the wires on the backplane for those lower ports. Since there is no physical connection, the LNW93 does not interfere with the service of the pack in the other slot of the function unit. The LNW93 tests the integrity of electrical cables to both identify where trouble exists and which cables or DSX panels are faulty prior to installation and turn up of a high density DS1 or DS3 circuit pack.

Detectable blank circuit packs

Alcatel-Lucent 1665 DMX supports detectable blank circuit packs: LNW98 in unequipped Function and Growth slots, LNW97 in an unequipped M2.

The *WaveStar*® CIT reports the presence of a detectable blank in a slot by displaying a blank faceplate graphic instead of an empty slot graphic. No alarms are associated with the insertion or removal of the detectable blank.

100/1000BASE-X/T (LNW170) switched Ethernet interface

The LNW170 circuit packs provide four IEEE 802.3-compliant (1000Mbps) GbE interfaces and four IEEE 802.3-compliant (100 Mbps) fast Ethernet interfaces. The LNW170 circuit packs provide Ethernet private line or switched services, with QoS.

The LNW170 packs feature Pluggable Transmission Module (PTM) electrical and optical interfaces. PTMs are "pluggable" in the sense that they can be plugged into a circuit pack as they become necessary. This allows customers to grow their network incrementally, only realizing the full cost for optics as the need to provision service on (and thus receive revenue from) them becomes necessary. LNW170 packs are purchased and shipped with no ports populated with functioning optics. The ports remain empty until the customer decides to place interfaces in them.

The LNW170 supports dual function electrical PTMs that are provisionable for 100 or 1000 Mbps traffic. They conform to the IEEE802.3 standards for 100BASE-T and 1000BASE-T in the respective settings (IEEE802.3z and IEE802.3ab). Connectivity is provided for an RJ-45 Cat 5 cable and the PTM has a maximum span length of 100 meters.

The electrical FE (100BASE-T) PTMs can occupy ports 1–8. The GbE (1000BASE-T/X) PTMs are restricted to ports 1–4. For specific details about the supported configurations, see “Ethernet port configurations” (p. A-19).

The LNW170 packs use standard Ethernet switching (IEEE 802.1), standard encapsulation, and standard STS-1 virtual concatenation according to ITU G.707. Fiber access is provided by LC-type connector pairs on the LNW170 faceplate.

The LNW170 packs are unprotected by default. Support of Link Aggregation on LNW170 LAN ports is available to provide Ethernet facility protection. The LNW170 also supports aggregation across LNW170 circuit packs to provide equipment protection. For more information, see “Link aggregation (LNW170 LAN ports)” (p. 5-58), in Appendix A, “Ethernet/SAN”.

When Alcatel-Lucent 1665 DMX is not equipped with VLF Main packs, unprotected LNW170 packs can only occupy slot 1 of any Function Unit group on the shelf (including Growth slots). Up to 20 1000BASE-X and 20 100BASE-ZX/LX/FX ports are addressable when all Function Unit groups are equipped with unprotected LNW170 circuit packs.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main packs, LNW170 packs can occupy both Slot 1 and 2 of a Function or Growth Unit. With VLF Mains and all tributary slots are populated with LNW170 packs, up to 40 1000BASE-SX/LX/ZX and 40 100BASE-ZX/LX/FX ports are addressable.

When VLF Mains are not used, if unprotected LNW170 circuit packs occupy slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank. When set to equipment-protected, two LNW170s can also be in the same group

OC-48 OLIU (LNW202)

The LNW202 high-speed circuit pack is a PTM-based optical line interface unit. The LNW202 supports OC-48 add/drop, BLSR and UPSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW202 circuit pack can cross-connect VTs in all 48 STS-1s of the OC-48 signal.

The LNW202 may occupy Main slots 1 and 2.

OC-12 OLIU (LNW203)

The LNW203 high-speed circuit pack is a single-port OC-12 PTM-based circuit pack. The LNW203 supports OC-12 add/drop, UPSR configurations, single- and dual-homing, non-revertive 1+1 linear protection switching, and VT1.5, STS-1, STS-3(c), and STS-12(c) signal transport. The LNW203 OLIU can cross-connect VTs in 12 of 12 STS-1s. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-12 OLIU.

The LNW203 may occupy Main slots 1 and 2.

The LNW203 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW203 in OSP applications.

OC-48 OLIU (LNW402)

The LNW402 OC-48 OLIU circuit pack is a single port, low-speed, PTM-based circuit pack. The LNW402 circuit pack supports OC-48 add/drop, BLSR, UPSR, and 1+1 configurations, single- and dual-homing, non-revertive and revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. When the shelf is equipped with non-VLF mains, the LNW402 circuit pack can cross-connect VTs in up to 12 STS-1s of the OC-N signal. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains.

The LNW402 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW402 in OSP applications.

The LNW402 circuit pack may occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 10 ports are addressable when all Function Unit groups are equipped with the LNW402 circuit pack.

OC-48/OC-192 OLIU (LNW504)

The LNW504 high-speed circuit pack is an 8-port, multi-port., multi-rate (MPMR) OC-48/OC-192 VLF Main circuit pack. LNW504 pack supports up to 4 OC-192 interfaces or up to 3 OC-192 interfaces and 4 OC-48 interfaces and has integrated STS and VT fabrics. The LNW504 circuit pack supports STS-1, STS-3c, STS-12c, STS-48c, and STS-192c signal transport.

Note: Because the four OC-48 lines and the fourth OC-192 line share the same internal resources, the operation of OC-48 lines 5–8 is mutually exclusive of the operation of OC-192 line 4.

Mixed interface rates are supported with the following restrictions.

- OC-192 interfaces are only supported on ports 1–4
- OC-48 interfaces are only supported on ports 5–8

Note: The LNW504 faceplate port numbering starts from the bottom of the pack. Port 1 is at the bottom and port 8 is at the top.

The LNW504 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW504 in OSP applications.

The pack supports true 0x1 operation for low-speed packs. The backplane interfaces can operate at 10 Gb/s and/or 2.5 Gb/s, supporting all VLF-compatible low-speed packs. The LNW7 circuit pack is not VLF-compatible.

The LNW504 provides a total of 180G of Input/Output interfaces. The LNW504 has 220G of usable STS-1 fabric and 30G of usable VT fabric. When the Alcatel-Lucent 1665 DMX is equipped with LNW504 VLF mains, all switching takes place on the LNW504 circuit packs. The switch fabrics on the low-speed, tributary optical circuit packs are disabled. The LNW504 further upgrades the overall capacity of the shelf by enabling the Function and Growth slots to house circuit packs with up to 10G bandwidth for a total input/output capacity of 110G.

The LNW504 provides increased flexibility for equipping low-speed OC-n interfaces with increased port density. OC-48 or OC-192 operation can be selected on a per port basis, up to the maximum number of ports supported for each interface type. The supported protection applications (1+1, 1+1_BIDIR, 1+1_OPTM, UPSR, 0x1, and BLSR [OC-48 only]) can also be provisioned on a per-port basis. The LNW504 ports can be provisioned as SONET or SDH using the SS bits detection feature on a per port basis.

OC-192 OLIU (LNW603)

The LNW603 low-speed circuit pack is a single-port, PTM-based OC-192 circuit pack. The LNW603 supports OC-192 add/drop, UPSR, and BLSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), STS-48(c), and STS-192c signal transport.

The LNW603 may occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 10 ports are addressable when all Function Unit groups are equipped with the LNW603 circuit pack.

XM10G/8 muxponder pack (LNW705)

The LNW705 XM10G/8 Muxponder circuit pack is a highly integrated pack that multiplexes up to 8 ports of the most common high bandwidth client interfaces onto a single 10G wavelength. The circuit pack name is XM10G/8: the “X” indicates that the client ports can be SONET/SDH, 1GE or Fibre Channel type interfaces; the “M” represents multiplexer; the “10G” represents the 10G line-side interface; the “8” represents the 8 client ports.

The XM10G/8 circuit pack is 25 mm wide and transports up to 8 client ports. The ports can be a mix of the following signals: 1GE, FC100, FICON, FC200, FICON_EXP, or OC3/12/48. One GE is mapped using VCAT and GFP-F. All FC signals and FICON signals are mapped using VCAT and GFP-T. The client signals are mapped into a single STS-192 and then encoded into an OTN OTU-2 signal (including forward error correction) and is transmitted out on a DWDM XFP. The circuit pack is bi-directional and simultaneously handles the inverse function in the receive direction.

The circuit pack faceplate is equipped with standard LED indicators; 1 fault LED, 1 active LED, and 1 LED for each port.

The LNW705 must be installed in a shelf with an LNW2 and at least one Main pack (VLF or non-VLF).

The LNW705 may occupy any Function Unit or Growth slot on the Alcatel-Lucent 1665 DMX shelf.

Beginning in Release 9.1, the Forward Error Correction (FEC) mode for an OTU2 port is provisionable. Valid values are:

- EFEC: Enhanced Forward Error Correction (default)
- NOFEC: No Forward Error Correction
- RSFEC: Industry-standard Reed-Solomon Forward Error Correction

OMD5/8 DWDM Mux/Demux (LNW785)

The LNW785 circuit pack provides optical multiplexing and demultiplexing of 8 dense-wavelength-division-multiplexed (DWDM) channels (ITU-T channels 52 through 59 [195.20-195.90 THz]). The LNW785 circuit pack has variable optical attenuators (VOAs) on the inputs for individual channel-power control. It can perform automatic channel power balancing of the add channels via the VOAs.

The LNW785 circuit pack allows Alcatel-Lucent 1665 DMX to have channel-power-managed DWDM within the shelf. The LNW785 circuit pack can be installed in any Alcatel-Lucent 1665 DMX function or growth slots. A one-channel system can be upgraded to an 8-channel-capable system by installing one or more LNW785 circuit packs into any open function or growth slot.

The LNW785 circuit pack requires the use of extended shelf covers for Alcatel-Lucent 1665 DMX shelves, which provide 25-mm additional clearance (67-mm total) as opposed to the current shelf covers. This is because additional clearance is required to angle the multiple connectors on this card.

The LNW785 circuit pack is the first Alcatel-Lucent 1665 DMX circuit pack with intra-shelf fiber routing. Special short jumpers are used to connect pass-through channels when two LNW785 circuit packs in adjacent slots are used as an optical add-drop multiplexer (OADM).

The LNW785 must be installed in a shelf with an LNW2 and at least one Main pack (VLF or non-VLF).

Optical cross-connections

The following 1-way optical cross-connections are supported on the OCH interfaces of the LNW785 series.

- OCH to/from OCH pass-through cross-connections
- OCH to/from OTU2 add/drop cross-connections
- OCH to/from OC-192 Line add/drop cross-connections
- OCH to/from Alien (remote shelf) add/drop cross-connections

For cross-connections to or from OCH ports, the NE checks that the expected frequency of the port to which the OCH is cross-connected matches the frequency of the OCH port. However, frequency matching is not required on cross-connections between an OCH port and an alien port.

Cable management bracket

In the interest of helping customers organize the physical networking in their offices, Alcatel-Lucent 1665 DMX provides two types of fiber management brackets that mount to the apparatus blanks used in the unoccupied slots of the shelf. These brackets have LC fiber storage ports where fibers can be set until the pack to which they will be attached is installed. One bracket has 16 hooks and the other has 24 hooks.

The bracket is designed to facilitate the organization and storage of pre-wired fibers that are expected to carry service to the shelf in the future. These brackets attach to the apparatus blanks via PEM nuts on the faceplate. PEM Nuts or PEM Fasteners are mounted flush on the faceplate. They provide a fixed receptacle to which the bracket can be screwed in.

Passive optics units (POUs)

Passive optics units

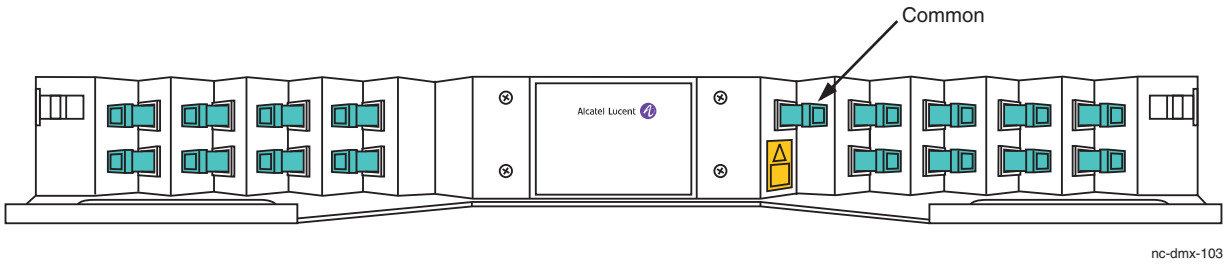
The Passive Optics Units (POUs) are a lower-cost solution to using DWDM for transmitting large amounts of traffic on one fiber. The shelf fits in a bay frame with Alcatel-Lucent 1665 DMX. If the POU is used in the same bay frame with Alcatel-Lucent 1665 DMX, then the number of Alcatel-Lucent 1665 DMX shelves in that bay frame is limited to three. The POUs do not need any power supply or management system.

POU shelves are available to support the following applications:

- Dual optical add-drop module (OADM): 1, 2, or 4 wavelengths
- Dual optical add-drop module (OADM): one 1310 nm port and four 1550 nm ports
- 16 unidirectional/bidirectional wavelengths: MUX or DMUX
- 32 wavelengths using 16 unidirectional/bidirectional wavelengths (MUX or DMUX) with a wavelength interleaver used to add another 16 wavelengths: MUXINT or DMUXINT

The following figure shows the POU shelves.

Figure 4-3 POU shelves (DWDM filter units): MUX/DMUX



Height (mm/inches)	Width (mm/inches)	Depth (mm/inches)
74/2.913	498/19.606	378.64/14.907

POU versions

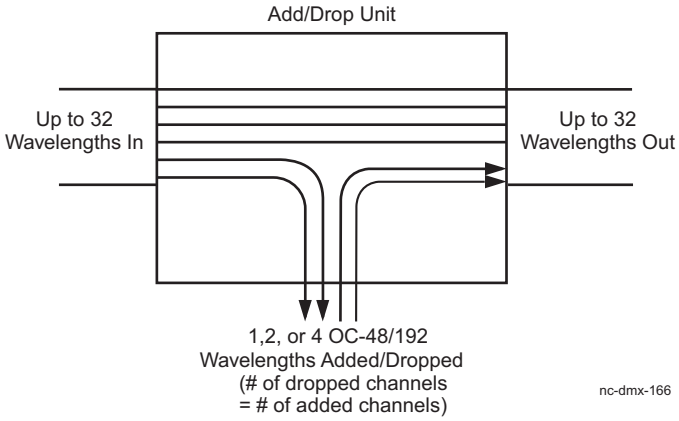
As the variety of applications listed above suggests, there are various versions of the POU, each designed to maximize functionality in a variety of deployment scenarios. The bulleted list below details the various forms of POUs:

- 16 Channel MUX or DMUX (odd numbered channels): This POU supports unidirectional and bidirectional transmission systems.
- 16 Channel MUX or DMUX with Interleaver (even numbered channels): This POU supports unidirectional and bidirectional transmission systems, and includes an interleaver to support 16 additional channels.
- Dual 1-Channel Optical Add Drop: This POU supports unidirectional transmission systems and can add/drop one channel from a DWDM line carrying up to 32 different channels.
- Dual 2-Channel Optical Add Drop: This POU supports unidirectional transmission systems and can add/drop two channels from a DWDM line carrying up to 32 different channels.
- Dual 4-Channel Optical Add Drop: This POU supports unidirectional transmission systems and can add/drop four channels from a DWDM line carrying up to 32 different channels.
- Dual 1310 + 4x1550 MUX/DMUX: This POU provides one I/O port for 1310 nm signals and four I/O ports for 1550 nm signals. This POU supports unidirectional transmission systems and can MUX or DMUX a 1310 channel and four 1550 bands to/from a DWDM line.

  Important! The last four bulleted items in the list above describe the various OADMs and MUX/DMUX as "Dual". "Dual" is in reference to the fact that each of these specific POUs are comprised of two complete sets of OADMs or MUX/DMUX units. Thus, the dual 1-channel OADM POU contains 2 OADMs, enabling it to support 1 add/drop in each direction.

The following figure shows a diagram of transmission with up to 32 wavelengths (channels) being received and passed-through one of the Add/Drop units. Also, the diagram shows how 1, 2, or 4 wavelengths can be added and/or dropped from a passive DWDM OC-48/192 line using the Add/Drop Units.

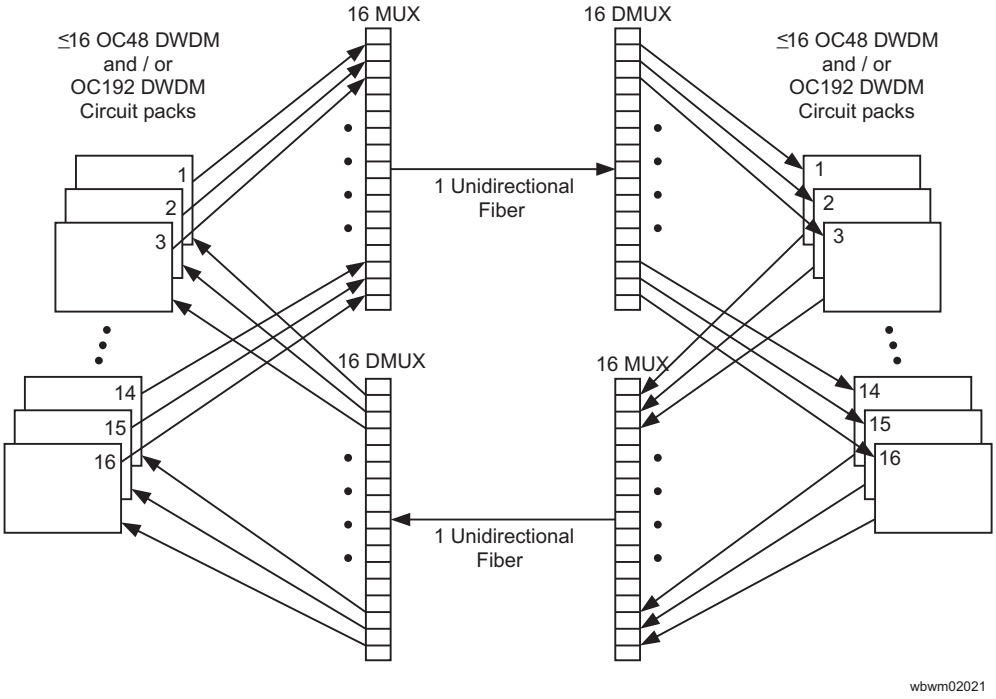
Figure 4-4 Add/Drop unit



The following figure shows a diagram of transmission with 16 lines transmitting at one end of the fiber and 16 lines receiving at the other end. The 16 port units on each side of transmission may be a combination of OC-192 DWDM OLIUs and/or OC-48 DWDM OLIUs. Each OLIU is equipped with a bidirectional port (both transmit and receive). The fiber between the two POUs (DWDM Filter Units) on the upper portion of the figure is unidirectional in the east direction. The fiber between the two Passive Optics Shelves on

the lower portion of the figure is unidirectional in the west direction. Another Passive Optics Shelf, with a wavelength interleaver, can be added to transport 32 wavelengths in each direction at the OC-192 or OC-48 rate on one fiber.

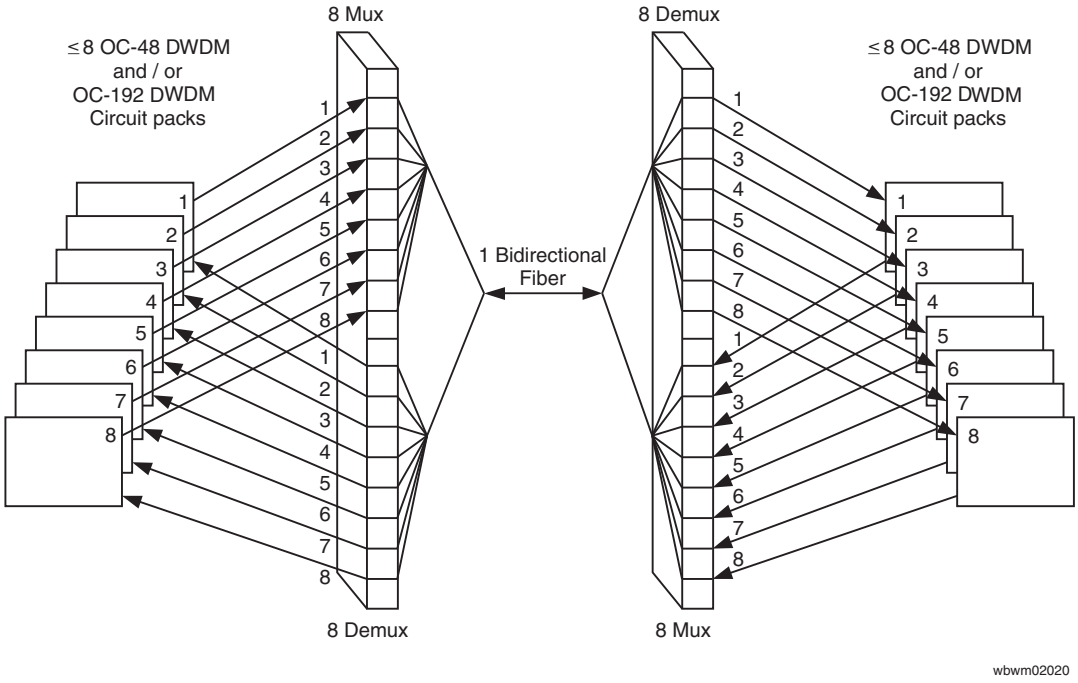
Figure 4-5 MUX/DMUX passive optics shelf (16 transmit at one end, 16 receive at the other end)



The following figure shows a diagram of bidirectional transmission with eight lines transmitting at one end of the fiber and eight lines receiving at the other end. This is the same POU pictured above, except that it is being used in a bidirectional application. The eight port units on each side of transmission may be a combination of OC-192 DWDM

OLIUs and/or OC-48 DWDM OLIUs. Each OLIU is equipped with a bidirectional port (both transmit and receive). The fiber between the two POU shelves (DWDM filter unit box) is bidirectional (transmit and receive).

Figure 4-6 MUX/DMUX passive optics shelf (8 transmit and 8 receive at each end)



Important! This figure assumes a full set of 8 bidirectional point-to-point cross-connections.

External optical amplifiers

Overview

The Alcatel-Lucent external optical amplifier provides service providers, system integrators, and network equipment manufacturers with one of the key technologies needed to build next generation DWDM and OADM networks. With the optical amplifier, operators enhance system performance while minimizing capital expenditures.

The optical amplifier can be configured to provide variable gain between 13 dB and 22 dB. This enables users to optimize optical transmission performance as needs grow. After gain setting is provisioned, the amplifier dynamically controls and maintains signal levels even as the number of amplified wavelengths change.

The amplifier features dynamic transient suppression and gain flattening across C-band to reduce the likelihood of data errors, channel outage, and signal degradation. In dynamic metro access networks or long-haul optical networks, these features allow service providers to provision and deliver reliable wavelength services to their end customers on demand.

The external optical amplifiers are available in front access and rear access versions.

The figure below shows the front access version of the external optical amplifier, and Figure 4-8, “Optical amplifier (rear access)” (p. 4-43) shows the rear access version of the external optical amplifier.

Figure 4-7 Optical amplifier (front access)

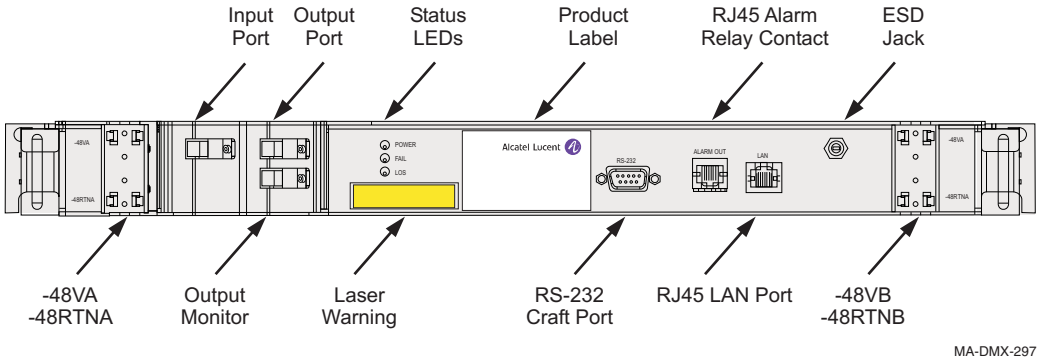
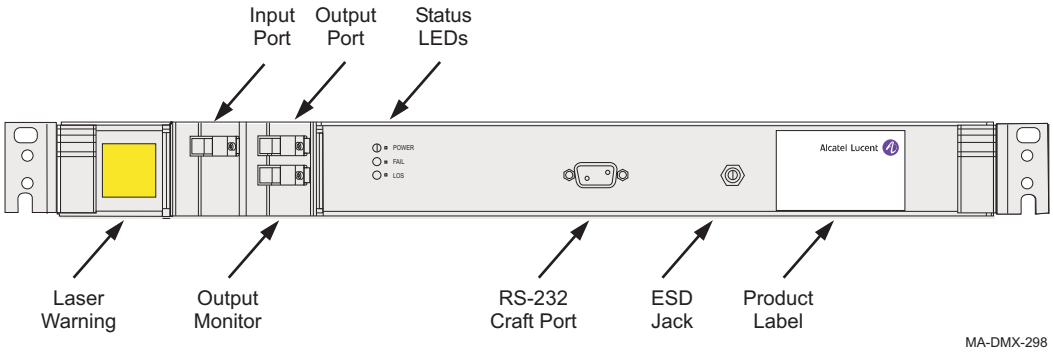


Figure 4-8 Optical amplifier (rear access)



Interfaces

The optical amplifiers provide a 10/100 Mbps and an RS-232 port for operations and maintenance communications (similar to Alcatel-Lucent 1665 DMX). The optical amplifier continuously monitors its own electrical and optical performance. If operating parameters exceed user-specified thresholds, autonomous alarms are reported.

The optical amplifier may be managed by any of the following means:

- Simple Network Management Protocol (SNMP Version 1 and 2c)
- TL1 messages (GR-833 CORE)
- File Transfer Protocol (FTP) (RFC 956)
- Alarm relay contact closures.

For more information about the Alcatel-Lucent external optical amplifiers, consult your account executive.

Control

Overview

Alcatel-Lucent 1665 DMX provides extensive control features, accessible through a number of technician and operations system (OS) interfaces. In addition to accessing local Alcatel-Lucent 1665 DMX NEs through direct interfaces, technicians and OSs can use the operations features supported via the DCC in the optical signals to access remote NEs. Control functions are supported by the SYSCTL circuit pack.

Three-tiered operations interface

Alcatel-Lucent 1665 DMX maintenance procedures are built on three levels of system information and control. The first tier is provided by the LEDs, displays, and push-button switches located on the faceplate of the SYSCTL circuit pack. The second tier uses *WaveStar*® CIT to provision and retrieve detailed reports of performance monitoring, alarm and status, and system configuration for both local and remote NEs. The third tier uses the OS interfaces such as TL1 and TL1 over IAO LAN (TCP/IP or OSI) or CIT to monitor performance, gather alarm information, and configure the system. Also, the IAO LAN interfaces provisioned for TCP/IP support software download and provisionable database backup/restore via FTP.

SYSCTL faceplate

The faceplate of the SYSCTL circuit pack contains indicators that provide system-level information and control functions. The condition of the individual transmission circuit packs can be determined using faceplate LEDs.

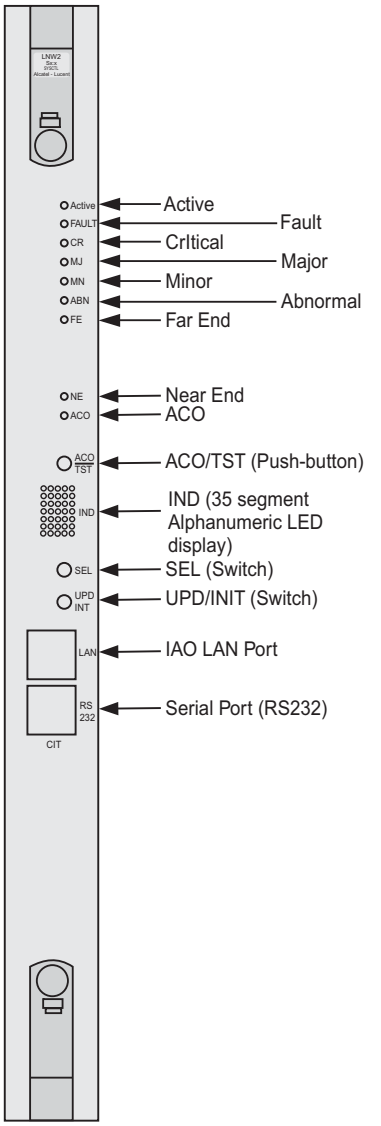
The figure on the following page, shows the SYSCTL faceplate. There is a 35-segment numeric LED display and three push-button switches for Update/Initialize (UPD/INIT), ACO/test (ACO/TEST), and Select (SEL) for local operations.

LNW2 comes equipped with two removable Non-volatile Memory (NVM) cards that can also be ordered separately. The Alcatel-Lucent 1665 DMX shelf will only function properly when it is equipped with an LNW2 that contains two fully functioning NVM cards.

In addition to the Active and FAULT LED, there are also seven alarm/status LEDs on the SYSCTL faceplate, listed below. The FAULT LED is lit if the SYSCTL detects its own failure:

- Critical (CR)
- Major (MJ)
- Minor (MN)
- Abnormal (ABN)
- Far End Activity (FE)
- Near End Activity (NE)
- Alarm Cut-Off (ACO)

Figure 4-9 SYSCTL circuit pack (LNW2)



Nc-dmx-009

Embedded operations channel

Access and control extends beyond the local Alcatel-Lucent 1665 DMX to remote network elements via the SONET section data communications channel (DCC). Craft interface dialogs and operations messages are exchanged in the DCC overhead bytes on each OC-3, OC-12, OC-48, and OC-192 interface.

Cabling

Overview

This section briefly describes cabling information, including the number of particular cables required.

Cable types

The table below lists available interface cables along with the required number (if any).

Table 4-4 Interface cables

Cable Assembly Description	Quantity per Shelf
Power[1]	1 per shelf
DS1/E1 [2]	1 per Function Unit housing a 28DS1 circuit pack- LNW7 (as required) 2 per Function Unit housing 56DS1/E1-LNW8/LNW801
DS3/EC1/TransMUX12 conductors[3]	1 per Function Unit housing an LNW16 or LNW18 circuit pack (as required)
DS3/EC1/TransMUX (High-Capacity)24 conductors[3]	2 per Function Unit housing an LNW19B or LNW20 circuit pack (as required)
LAN 10/100 BASE-T	1 per Function Unit housing a 10/100 Mbps Fast Ethernet circuit pack (as required)
Gigabit Ethernet	1 per Function Unit housing a 1000 Mbps Gigabit Ethernet circuit pack (as required to support the GbE electrical SFPs on the LNW63/64/87/170)
LNW93 and LNW94 cable kit (comcode 848957437)[4]	1 per LNW93 or LNW94 Test Pack (as desired by customer)

Notes:

1. One cable assembly supports both the −48VA and −48VB main power feeders on the Alcatel-Lucent 1665 DMX shelf. Cable assemblies are available in 2, 4, 6, 10, and 14 AWG cable kits including the required Storey connectors for connection the shelf. The connectors are also available separately for customers who choose to supply their own cable.
2. One DS1 Cable Assembly provides one input and one output cable for 28 DS1s, i.e. for one DS1 function group, e.g.: "J1 A OUT" & "J2 A IN" used on both the standard and High-Capacity shelf. Two DS1 Cable Assemblies are required for the High-Capacity 56DS1 LNW8, i.e. for 2 function groups, e.g.: "J1 A OUT" & "J2 A IN" and "J24 A OUT" & "J24 A IN". The DS1 Cable Assembly consists of two separate cables, each containing 28 pairs of 24 gauge shielded cable. On each of the 28 pairs of cable, cable 1 is for input and cable 2 is for output.
3. One DS3/EC1 Cable Assembly (12 conductors) provides one input and one output cable for 12 DS3/EC-1s (LNW16) or TransMUXs (LNW18), i.e. for one "12DS3/EC-1 or TransMUX" function groups, e.g.: for "J1 A OUT" and "J2 A IN".One DS3/EC1 Cable Assembly (24 conductors) provides one input and one output

cable for up to 24 signals, i.e. for the first 12 of 24 connectors used for the LNW16 or LNW18 function groups, e.g.: for "J1 A OUT" and "J2 A IN". Two assemblies are required for the High-Capacity 48DS3 (LNW19B), e.g.: "J1 A OUT" & "J2 A IN" and "J24 A OUT" & "J24 A IN".

4. This cable kit is an accessory to the LNW93 or LNW94 and is meant to aid in testing procedures. It is not critical to the use and function of these packs, but can help ease cabling in testing procedures. The kit contains the following cables: (1) BNC-BNC DS3 3-foot cable, (1) BNC-LCP DS3 3-foot cable, (1) Bantam-Bantam DS1 3-foot cable, (1) RJ45 - RJ45 LAN Patch Cord, (1) DB9-DB9 connector cable for the RS232 port (6 feet).

The table below lists available operations cables along with the required number (if any).

Table 4-5 Operations cables

Cable Assembly Description	Quantity per Shelf
Office Alarm[1]	1 (bottom shelf in bay frame only)
Office Alarm Mult[2]	1 for any adjacent shelves (as required)
Miscellaneous Discrete (straight connector)	1 per shelf (as required)
LAN 10/100 BaseT (Crossover)[3]	1 per shelf (as required)
LAN 10/100 BaseT (Straight Through)[3]	1 per shelf (as required)
LAN 100 BASE-T	1 per Function Unit (as required)
Sync Timing	1 per shelf (as required)
CIT Interface	1 per shelf (as required)
Modem Cable Assembly	1 per shelf (as required)

Notes:

1. One Office Alarm Cable Assembly is required for the bottom Alcatel-Lucent 1665 DMX shelf in a bay frame. Other Alcatel-Lucent 1665 DMX shelves in the bay frame do not require this assembly, but may use the Office Alarm Mult (J13) cables.
2. One Office Alarm Mult Cable Assembly is required for any adjacent Alcatel-Lucent 1665 DMX shelves in a bay frame (above the lowest shelf). For example, if four Alcatel-Lucent 1665 DMX shelves are located in a single 7-foot bay frame, three cable assemblies are required. These cables cannot reach any further than an adjacent shelf.
3. The Crossover cable is used when connecting to a PC. The Straight Through cable is used when connecting with a hub.

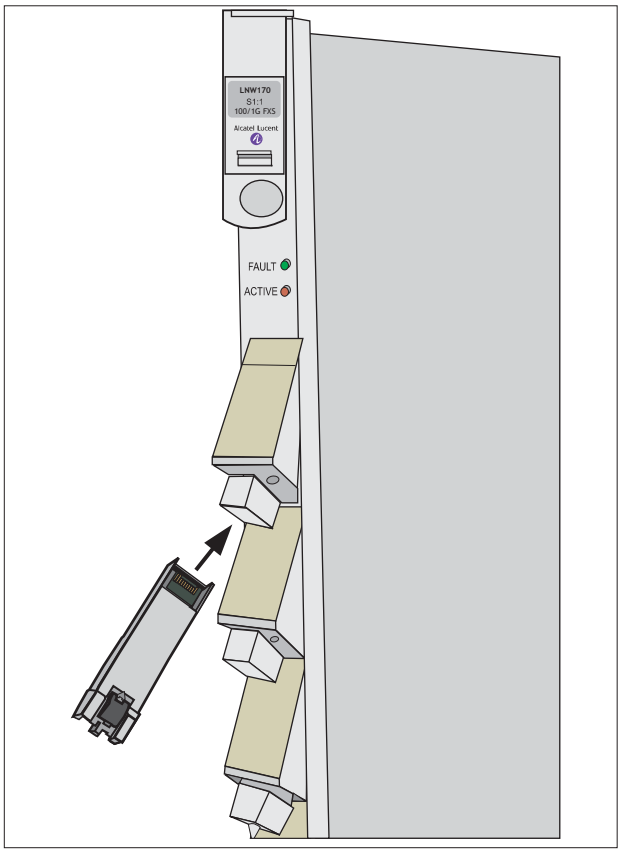
Ethernet faceplate cabling guidelines

The LNW63/64/87/170 can use both optical and electrical PTM transceivers. The figure below shows the connections to the electrical PTM transceivers. The RJ45 cables that connect to the FE/GbE Electrical PTM are directed downward at a 45° angle. In order to ensure proper cable routing, the copper cables must be above any optical cables/attenuators, etc. that may be installed.

For more information on the LNW170, see "100/1000BASE-X/T (LNW170) switched Ethernet interface" (p. 4-32).

For detailed information on all PTMs available, see "Allowed Ethernet/SAN PTM transceivers" (p. 10-102) and the sections that follow.

Figure 4-10 LNW170 faceplate



MA-DMX-437

5 Operations, administration, maintenance, and provisioning

Overview

Purpose

This chapter describes the operations, administration, maintenance, and provisioning (OAM&P) functions for Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX).

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Maintenance

Overview

Purpose

This section describes the maintenance philosophy of Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX).

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Multi-level operations

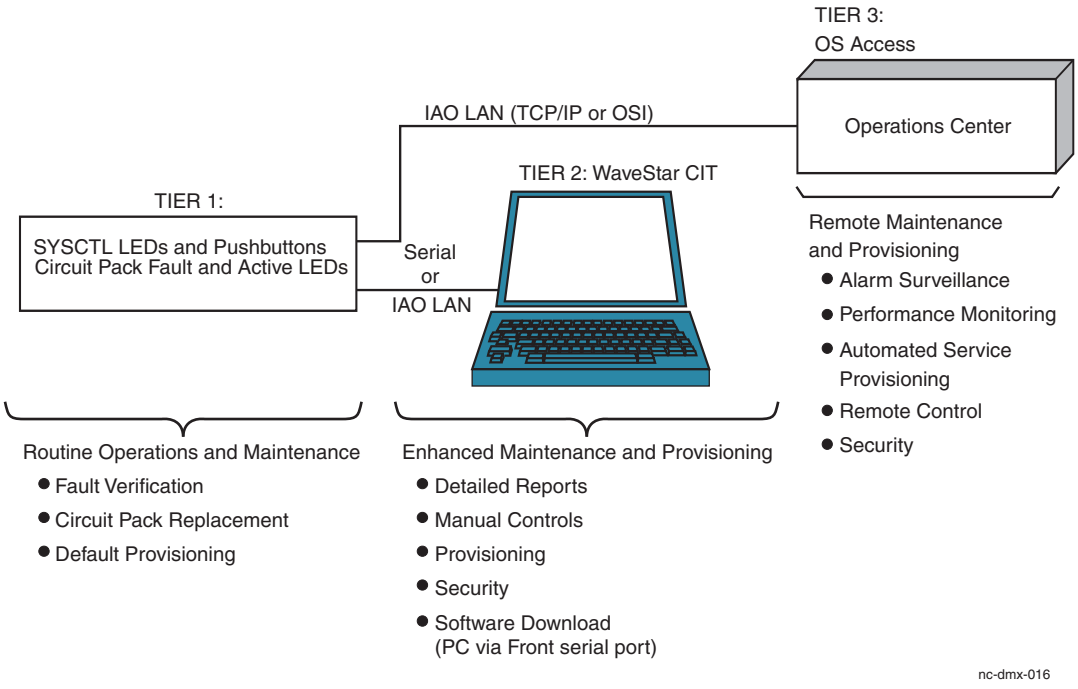
Overview

The following figure shows the multiple levels of operations procedures for Alcatel-Lucent 1665 DMX. The Alcatel-Lucent 1665 DMX operations procedures are built on three levels of system information and control, spanning operations needs from summary-level status to detailed reporting.

Example

The following figure, shows the multi-level operations procedures for Alcatel-Lucent 1665 DMX. The Alcatel-Lucent 1665 DMX operations procedures are built on three levels of system information and control, from on-site indicators and switches, to remote methods for status reporting and control.

Figure 5-1 Three-tiered operation



SYSCTL faceplate (operations level 1)

Office alarms are provided by a set of discrete relays that control office audible and visual alarms. Separate relays handle critical (CR), major (MJ), and minor (MN) alarms, although the CR and MJ alarms can be wire ORed and reported as office major, if desired.

The light-emitting diodes (LEDs) and push buttons on the SYSCTL faceplate allow routine tasks to be performed without a CIT or any test equipment. The SYSCTL faceplate LEDs provide system-level alarm and status information for the local NEs and a summary for all remote NEs in the alarm group. The circuit pack faceplate FAULT LEDs allow fast and easy fault isolation to a particular circuit pack.

The SYSCTL faceplate LEDs default to show local system information. The highest active alarm level is shown by the red LEDs for CR and MJ alarms. Yellow LEDs are shown for MN alarms. An ACO button is used to activate the alarm cutoff function. When activated, the LED is on. The ACO button also initiates an LED test when the button is depressed and held. A green PWR ON LED shows that the power is on and the terminal is receiving a −48V source. Three yellow status LEDs show abnormal (ABN) conditions,

near-end activity (NE), and far-end activity (FE). The yellow ABN LED is lighted when a temporary condition, potentially affecting transmission, exists. For example, this condition could be a manual protection switch or lockout, loopback, or system test in progress.

The Update/Initialize (UPD/INIT) button addresses the local system. The recessed UPD/INIT button serves several functions during installation and circuit pack replacement. During the first 10 seconds after powering up the SYSCTL circuit pack, depressing this button initializes the nonvolatile memory with provisioning and state information. Secondly, after removing a circuit pack, optical module, or low-speed input, depressing this button updates the system equipment list to show the slot, socket, or signal is now unequipped.

The SYSCTL faceplate's remote display functions serve the single-ended maintenance needs of access transport applications. When any alarm or status condition exists at a remote Alcatel-Lucent 1665 DMX shelf in the same alarm group, the FE LED on the faceplate is lit.

The table below details the various LEDs and push-button switches and describes their functions.

Table 5-1 SYSCTL faceplate indicators and functions

LED/Push-button	Indicator name	Function
Active	Active	Indicates the SYSCTL is Active.
FAULT	Fault	Indicates isolated circuit pack failure.
CR	Critical	Indicates critical alarm for local system.
MJ	Major	Indicates major alarm for local system.
MN	Minor	Indicates minor alarm for local system.
ABN	Abnormal	Indicates temporary transmission-affecting condition.
FE	Far-End Activity	Indicates remote alarm or status condition.
NE	Near-End Activity	Indicates local alarm or status condition.

Table 5-1 SYSCTL faceplate indicators and functions (continued)

LED/Push-button	Indicator name	Function
ACO	Alarm Cut-Off	Activates alarm cut-off (will also display software version information when depressed for 3 seconds).
ACO/TEST	Alarm Cut-Off/Test	Performs LED tests.
SEL	Select	When SEL and UPD/INIT button are held down together, you get a 4 segment square (::).
UPD/INIT	Update/Initialize	Updates the local system.

Circuit pack LEDs

To supplement the SYSCTL faceplate's system-level view, each circuit pack provides a red FAULT LED on its faceplate. A lighted FAULT LED shows that the Alcatel-Lucent 1665 DMX has isolated a failure to that circuit pack. On transmission circuit packs, a flashing FAULT LED shows that an incoming signal to that circuit pack has failed.

Important! All circuit packs that use PTM optics have per-port LEDs. The per-port LED is lit solid if there is a socket failure, and blinks if there's an incoming port (signal) failure.

Local craft interfaces (operations level 2)

The local craft interfaces include the CIT, which may be utilized in a variety of ways.

Alcatel-Lucent 1665 DMX has two serial ports for CIT access, one in the front and one at the rear of the shelf.

TL1 is supported for both serial ports, but software download is supported via the front serial port only.

Alcatel-Lucent 1665 DMX also has two LAN ports for CIT (and/or OS) access, one in the front and one in the rear. Both TL1 over OSI and TL1 over TCP/IP are supported via these two LAN ports. Software download via FTAM or FTP and FTTD are also supported.

Remote Operations System (OS) TL1/LAN interfaces (operations level 3)

The third operations level consists of the remote access to OS interfaces. Access for TL1 and related SONET network monitoring is provided via the CIT LAN and serial connection to the SYSCTL.

TL1

The TL1 message-based OS interface provides remote OS access, as well as detailed reporting and control capabilities. The interface uses standard TL1 and needs no mediation device (i.e., the interface can be connected directly). The remote user could be an OS or a user at a terminal. Alcatel-Lucent is involved in an active OSMINE process to ensure compatibility of Alcatel-Lucent 1665 DMX NEs with *Telcordia* ® OSs.

Alcatel-Lucent 1665 DMX supports TL1 alarm surveillance and performance monitoring with OSs such as *Telcordia* ® Network Monitoring and Analysis (NMA). Alcatel-Lucent 1665 DMX supports service provisioning with memory administration OSs such as Alcatel-Lucent's OMS or *Telcordia* ® TEMS. Alcatel-Lucent 1665 DMX also supports remote recovery and control functions, installation provisioning, and security over the TL1 link. The TL1 message set used has been updated to offer full remote reporting capabilities.

The OS can use more than one NE as a GNE to provide redundancy and/or to distribute TL1 message volume. The TL1 GNE serves as a single interface to the OS for the NEs in the same subnetwork. The TL1 GNE receives operations information from all the NEs through the DCC and reports this information, as well as its own information, to the OS. The operations information is in the form of TL1 messages. Through the GNE, the OS can send TL1 commands to any NE in the subnetwork. Alcatel-Lucent's OMS, as well as other-vendor NEs that adhere to GR-253-CORE, can serve as the TL1 GNE for the Alcatel-Lucent 1665 DMX.

CIT (TL1 over TCP/IP)

The CIT is a small CIT interface that provides a flexible TL1 command instructor. The CIT connects to an Alcatel-Lucent 1665 DMX using either the front or rear serial ports, the front IAO LAN port, or the rear IAO LAN port. The CIT supports TCP/IP (or OSI) through both the front and rear IAO LAN interfaces.

The CIT is used for report generation, as well as command and system response. Access to the system is provided via serial or IAO LAN interfaces.

Front IAO LAN

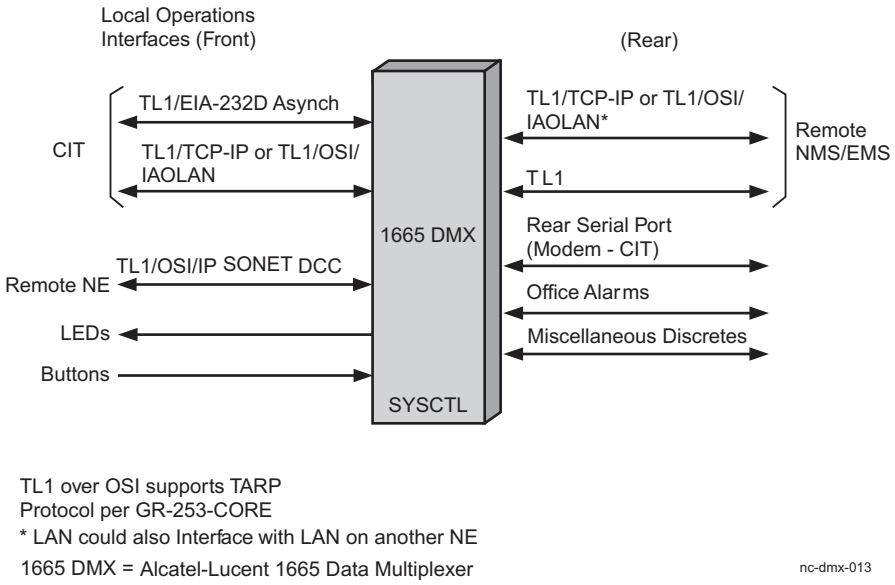
The front IAO LAN interface provides a connection to the CIT and supports OSI or TCP/IP communications. The front IAO LAN is located on the faceplate of the SYSCTL circuit pack.

Rear IAO LAN

The primary purpose of the rear IAO LAN port is to provide remote OS access such as OS TL1 access over TCP/IP Gateway. It also supports a faster software download from any FTP server using file transfer protocol (FTP) to Alcatel-Lucent 1665 DMX systems when software is being upgraded (both the rear and front IAO LAN ports support this functionality). This rear IAO LAN port can also be used for CIT OSI-based interfaces and TCP/IP support.

The figure below shows how Alcatel-Lucent 1665 DMX works with the various operations interfaces.

Figure 5-2 Operations interfaces



IAO LAN ports (detail)

Overview

Alcatel-Lucent 1665 DMX supports a front and rear IAO LAN port. Each IAO LAN port operates independently (Alcatel-Lucent 1665 DMX does not support an *internal* IAO LAN hub). The front IAO LAN port is recommended for convenient, temporary local *WaveStar*® CIT access. When, for example, the *WaveStar*® CIT is directly connected to either IAO LAN port, a LAN crossover cable is required (to connect the transmit wire-pair at one end to the receive wire-pair at the other end, and vice versa).

The rear IAO LAN port is recommended for permanent local *WaveStar*® CIT access and all remote *WaveStar*® CIT access via TCP/IP as well as for OS access. Alcatel-Lucent 1665 DMX's rear IAO LAN port is typically expected to be connected to an Ethernet LAN hub in CO applications, but unused at remote sites.

The Alcatel-Lucent 1665 DMX IAO LAN ports support 10/100BaseT Ethernet (per *Telcordia* ® GR-253, ANSI/IEEE 802.2 and 802.3, and ISO 8802.2 and 8802.3) over four-wire twisted pair using an RJ-45 connector. Each IAO LAN port automatically adapts its rate to 10 Mb/s or 100 Mb/s to match the capability of the other nodes on the same IAO LAN, with 10 Mb/s as the default rate.

OSI on the IAO LAN

When the OSI protocol stack is used on an IAO LAN port, the term "OSI LAN" is sometimes used. The OSI LAN is effectively an extension of the DCC. All remote operations supported over the DCC are also supported over the OSI LAN. The term "DCC connectivity" is used throughout this document to mean DCC and/or OSI LAN connectivity.

OSI communications on the IAO LAN port can be enabled or disabled. By default, OSI is enabled on the front IAO LAN port, but disabled on the rear IAO LAN port.

TCP/IP on the IAO LAN

The IAO LAN ports also support the TCP/IP protocol stack. TCP/IP communications on the IAO LAN ports can be enabled or disabled. By default, TCP/IP is disabled on the IAO LAN ports.

When the TCP/IP protocol stack is used on an IAO LAN port, the term "TCP/IP LAN" is sometimes used.

Alcatel-Lucent 1665 DMX supports TL1 over TCP/IP for the IAO LAN. As a TL1 responder, the Alcatel-Lucent 1665 DMX TCP/IP GNE accepts incoming TL1 connections to the following TCP ports with corresponding TL1 code.

- FTP: user-provisionable, default port 21
- SSH FTP: user-provisionable, default port 22
- SNMP traps: 162 NTP: port 123
- RADIUS: user-provisionable, default port1812
- Port 3081: Length-Value Encoding. With length-value encoding,each TL1 message is encapsulated into the TCP data stream as follows:
  - Version number (1 byte, value set to 3)
  - Reserved (1 byte, value set to 0)
  - Length (2 bytes, value set to length in bytes of TL1 message + 4)
  - TL1 Message (variable length)

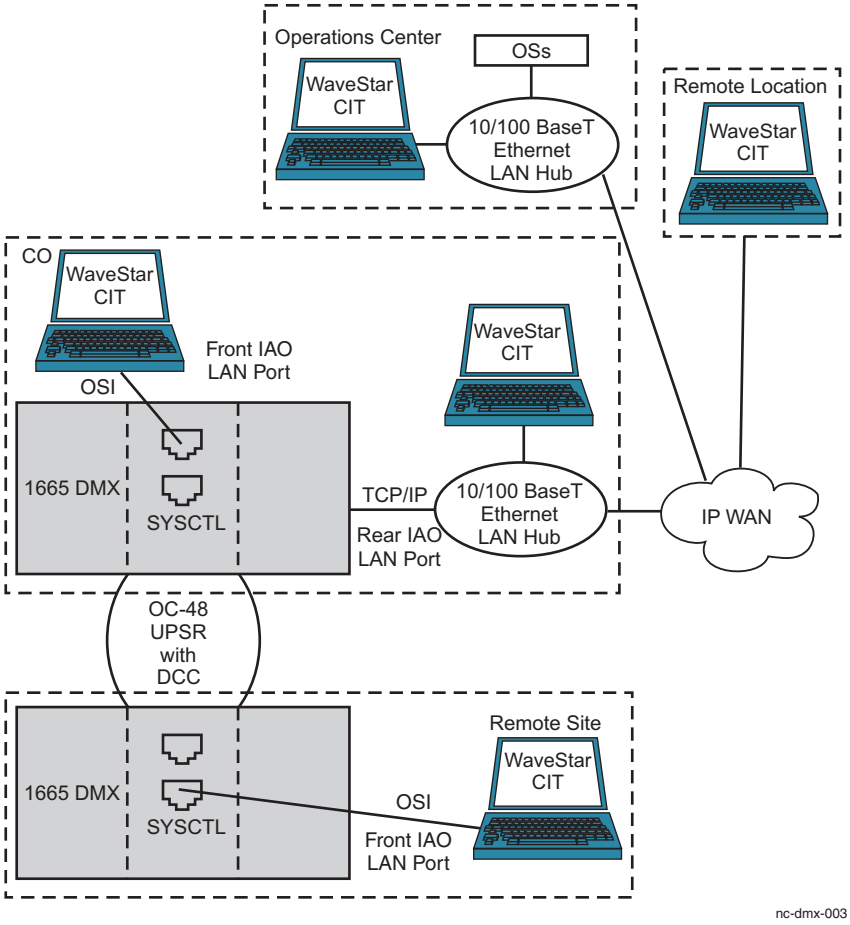
  The length-value encoding is the preferred encoding for machine-machine interactions.
- Port 3082: Raw Encoding. Each raw encoded TL1 message is encapsulated into the TCP data stream of length 1–4096 bytes. The TL1 message must be parsed to find the boundary between successive TL1 messages (see *Telcordia* ® GR-831 CORE for the syntax of TL1 messages).
- Port 3083: Telnet Encoding. The telnet encoding is a variation on the raw encoding. It encapsulates TL1 messages in a TCP stream and uses Telnet for transmitting text over TCP/IP.

OSI or TCP/IP on the same IAO LAN

It is generally recommended that each IAO LAN port be used for OSI or TCP/IP, but not both protocols simultaneously on the same IAO LAN port.

The figure below provides examples of common applications using the IAO LAN ports.

Figure 5-3 IAO LAN port applications



IAO LAN compatibility

The following table documents the Alcatel-Lucent 1665 DMX IAO LAN communications compatibility with other products and the applicable OSI and/or TCP/IP protocol stacks. (*WaveStar*® CIT and OS access applications compatibility via the IAO LAN is covered separately later.)

Table 5-2 IAO LAN compatibility

Product	Alcatel-Lucent 1665 DMX	
	OSI	TCP/IP
Alcatel-Lucent 1665 DMX	yes	yes
Alcatel-Lucent 1665 DMXplore	yes	yes
Alcatel-Lucent 1665 DMXtend	yes	yes
Alcatel-Lucent 1850 TSS-5	yes	yes
Alcatel-Lucent 1850 TSS-100	-	yes
Alcatel-Lucent 1850 TSS-320	-	yes
DDM-2000 OC-3	yes	-
DDM-2000 OC-12	yes	-
FiberReach	-	-
FT-2000 ADR	-	-
WaveStar® TDM 2.5G/10G (2-Fiber)	yes	yes
WaveStar® BandWidth Manager	yes	yes
Alcatel-Lucent 1675 LambdaUnite MSS	yes	yes
WaveStar® CIT	yes	yes
OMS	yes	yes

Operations philosophy

Overview

Alcatel-Lucent 1665 DMX has incorporated an operations philosophy that is optimized for operations in the access transport environment. This allows operation and maintenance of remote NEs from a single location. Similarly, a technician working at a remote site can gain access to other NEs. In addition, OSs are available to allow operation of the Alcatel-Lucent 1665 DMX NEs from a centralized operations center.

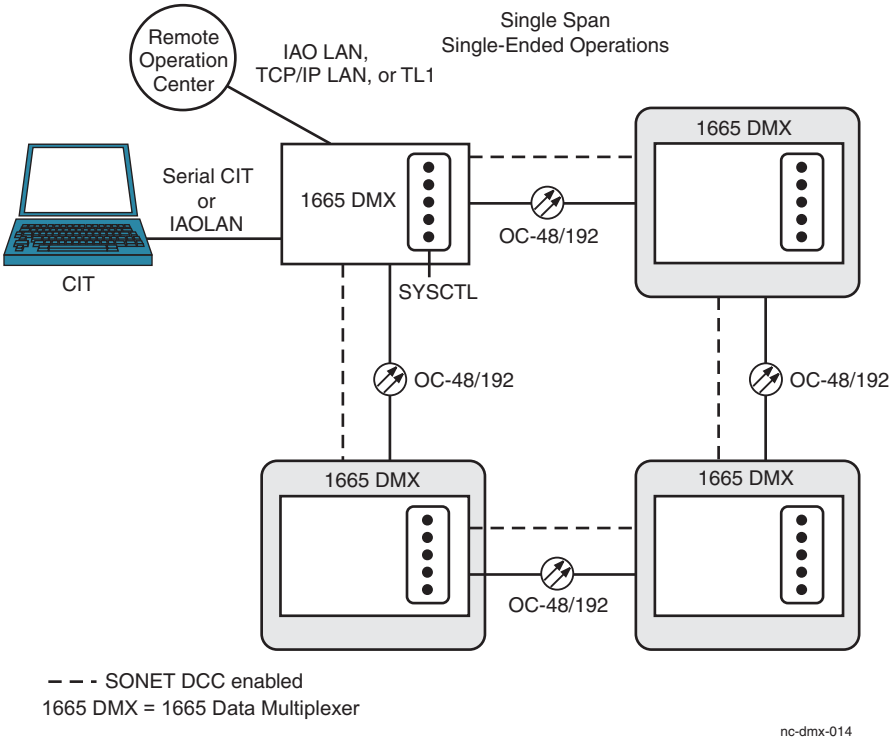
Alcatel-Lucent 1665 DMX uses the SONET data communications channel (DCC) to provide remote CIT access, remote CO alarms, remote alarm reports, and remote OS access. The terms remote operations, single-ended operations (SEO), and Operations Interworking (OI) are synonymous.

SEO capability

The figure below shows the SEO capability that provides remote access to all Alcatel-Lucent 1665 DMX systems in a subnetwork from a single Alcatel-Lucent 1665 DMX location. This minimizes the need for technician travel because most maintenance,

provisioning, and administration can be performed on all NEs with DCC connectivity by accessing any one NE. The SEO capability can be disabled between NEs to create maintenance boundaries (for example, interoffice applications) or for security reasons.

Figure 5-4 Remote operations philosophy



Alcatel-Lucent operations interworking

Overview

Operations interworking (OI) provides the capability to access, operate, administer, maintain, and provision remote Alcatel-Lucent NEs from any Alcatel-Lucent NE with DCC connectivity in a network or from a centralized OS.

OI support

Alcatel-Lucent OI is available among NEs that are connected through the SONET DCC or IAO LAN. With this feature, users can perform OAM&P activities on a centralized basis, saving travel time and money.

OI features including the following:

- Remote OS access via TL1 over TCP/IP (or OSI) or TL1
- Remote OS access via IP over DCC
- Remote CIT access
- Remote NE status
- Remote software download and copy
- Remote time and date synchronization

The following table summarizes Alcatel-Lucent 1665 DMX OI compatibility with the products and releases specified previously.

Table 5-3 OI compatibility summary

Product	DCC	IAO LAN	*WaveStar*® CIT Access	TCP/IP		Remote Software Download	Auto Time/ Date sync	Remote NE Status
				tl1-Gne	tl1-rne			
Alcatel-Lucent 1665 DMX	yes	yes	yes	yes	yes	yes	yes	yes
Alcatel-Lucent 1665 DMXtend	yes	yes	yes	yes	yes	yes	yes	yes
Alcatel-Lucent 1665 DMXplore	yes	yes	yes	yes	yes	yes	yes	yes
Alcatel-Lucent 1850 TSS-5	yes	yes	yes	yes	yes	yes	yes	yes
Alcatel-Lucent 1850 TSS-100	yes	-	-	yes[1]	yes[1]	-	-	-
Alcatel-Lucent 1850 TSS-320	yes	-	-	yes[1]	yes[1]	-	-	-
DDM-2000 OC-3	yes	yes	yes	yes	-	yes	yes	yes
DDM-2000 OC-12	yes	yes	yes	yes	-	yes	yes	-
FiberReach	yes	-	yes	yes	-	yes	yes	yes

Table 5-3 OI compatibility summary (continued)

Product	DCC	IAO LAN	*WaveStar*® CIT Access	TCP/IP		Remote Software Download	Auto Time/ Date sync	Remote NE Status
				tl1-Gne	tl1-rne			
FT-2000 ADR	yes	-	yes	-	-	-	yes	-
WaveStar® TDM 2.5G/10G (2-Fiber)	yes	yes	yes	yes	yes	-	-	-
WaveStar® BandWidth Manager	yes	yes	yes	-	yes	-	-	-
Alcatel-Lucent 1675 LambdaUnite MSS	yes	yes	yes	-	yes	-	-	-
Ciena® Core Director	yes	-	-	yes	-	-	-	-
OMS	-	yes	-	yes	yes	-	yes	-
NMA	-	yes	-	yes	yes	-	-	-
Transport (TEMS)	-	yes	-	yes	yes	-	-	-

Notes:

1. The Host OS Type of the TL1 TCP/IP GNE for Alcatel-Lucent 1850 TSS-100 or Alcatel-Lucent 1850 TSS-320 must be provisioned to TL1PEERCOM. All Message Types for the TL1PEERCOM OS Type must be enabled using **Administration** → **Set TL1 Message Map**.

Alarm groups

An alarm group is a set of NEs that share status information between themselves, such as alarms, LEDs, and ACO status. The set of remote NEs that an NE can exchange status information which is determined by the value of the local alarm group parameter. This parameter is provisioned at each local NE and specifies whether that local NE does or does not exchange remote NE status with other Alcatel-Lucent NEs in the same SONET subnetwork. In Alcatel-Lucent 1665 DMX, all NEs are defaulted into the same alarm group (number 255).

Alarm groups can be nodes in a ring, nodes of a linear extension, or any other logical grouping such as a maintenance group or geographical group. For example, 24 NEs could be provisioned into three alarm groups with eight NEs that share a community of interest such as the same OC-3 low-speed optical interface.

All members of the same alarm group share NE status information but do not share information with other alarm groups.

Alarm group functions

Depending on provisioning, a member of an alarm group can:

- Know the alarm/status of all members of the same alarm group and, if the NE is at the CO, activate audible office alarms for the alarm group.
- List a report of the summary alarm or status condition of other NEs in the group.
- Display composites of the highest alarm level among other member NEs in the same alarm group.

Alarm Gateway Network Element (AGNE)

Members of an alarm group exchange information through one or more alarm gateway NEs (AGNEs) that are defined in the same alarm group. All Alcatel-Lucent 1665 DMX NEs use the DCC to receive and report alarm and status information to the AGNE(s). The AGNE rebroadcasts all alarm and status information from one NE to all the other NEs in the same alarm group.

This information is used to activate remote far-end summary alarm reports and remote office alarms for each NE in the alarm group. At least one NE in each alarm group must be provisioned as the AGNE. An additional AGNE can be provisioned for redundancy, but it is recommended that only one AGNE be provisioned for each alarm group. Considerations for choosing an NE as an AGNE include being central to the group to make communications links easily accessible for maintenance purposes.

The AGNE and TL1 GNE should be separate NEs. Furthermore, the AGNE is a "collection point" and does not have to be a NE in a CO.

Multi-vendor operations interworking

TARP

To support multi-vendor OI, the Alcatel-Lucent 1665 DMX supports Target ID Address Resolution Protocol (TARP).

TARP provides NSAP-TID translations and is the established multi-vendor standard for SONET NEs that support TL1 OS interfaces. Alcatel-Lucent 1665 DMX supports the TARP Data Cache (TDC) function to reduce the frequency of TARP propagation throughout the subnetwork and to improve performance.

Compatibility

Alcatel-Lucent 1665 DMX is developed to be compatible with any other-vendor NEs that support TARP, OSI, IAO LAN, and TL1 as specified in *Telcordia* ® GR-253. In addition, Alcatel-Lucent 1665 DMX's TARP Manual Adjacency feature enables it to operate in networks that include CMISE-based NEs which may not support TARP propagation. Alcatel-Lucent 1665 DMX supports user provisioning of several OSI parameters to allow users to adjust their operations network, if necessary. For example, to support Level 2 Routing in large networks, Alcatel-Lucent 1665 DMX supports user provisioning of NSAP area addresses and Level 2 Intermediate System (IS) functionality.

Alcatel-Lucent 1665 DMX's compatibility with other-vendor NEs may be tested by customers or independent third parties such as *Telcordia* ®.

Data Communications Channel (DCC)

Provisioning the DCC

To support remote operations over the DCC embedded in the SONET section overhead of the optical signal, the DCC itself must be provisioned as indicated in the following paragraphs.

DCC enable/disable

By default, the DCC is enabled on all optical ports. DCC communications can be enabled or disabled on each port independently.

DCC protection mode

The DCC protection mode is determined by the transmission protection mode assigned to each optical port (per the *application* parameter). The protection mode can be linear (1+1) identical, or distinct (UPSR). Linear (1+1) identical is the default for the low-speed optical ports. Support is provided for 15 low-speed OC-48 BLSRs.

The following table summarizes the DCC protection modes.

Table 5-4 DCC protection modes

Optical Port Protection Mode	Shelf Slots	Max. Number Simultaneous Optical Ports[1]	Max. Number Simultaneous Section DCCs
OC-12/OC-48/OC-192 UPSR	High-speed Main slots	1 pair (2 for OC-192)	1 pair (2 for OC-192)
OC-48/OC-192 BLSR		1 pair (2 for OC-192)	1 pair (2 for OC-192)
OC-12/OC-48/OC-192 Linear (1+1)		1 pair (2 for OC-192)	1 (2 for OC-192)
OC-12/OC-48/OC-192 Bidirectional (1+1)		1 pair (2 for OC-192)	1 (2 for OC-192)
OC-192/OC-48 UPSR	Low-speed Function and Growth slots	20 pairs	20 pairs
OC-192/OC-48 BLSR		15 pairs	15 pairs
OC-192/OC-48 Linear (1+1)		20 pairs	20 pairs
OC-192/OC-48 Bidirectional (1+1)		20 pairs	20 pairs
OC-192/OC-48 0x1[2]		20 pairs	20 pairs
OC-48 0x1Sn[2]		20 pairs	20 pairs
OC-12 UPSR		60 pairs	60 pairs
OC-12 Linear (1+1)		60 pairs	60 pairs
OC-12 Bidirectional (1+1)		60 pairs	60 pairs
OC-12 0x1[2]		60 pairs	60 pairs
OC-12 0x1Sn[2]		60 pairs	60 pairs
OC-3 UPSR		80 pairs	80 pairs
OC-3 Linear (1+1)		80 pairs	80 pairs
OC-3 Bidirectional (1+1)		80 pairs	80 pairs
OC-3 0x1[2]		80 pairs	80 pairs
OC-3 0x1Sn[2]		80 pairs	80 pairs

Notes:

1. In this table, each optical port counted includes both a transmit and receive fiber.
2. 0x1 mode is supported with the use of the VLF Main packs. 0x1Sn is supported when non-VLF Mains are used. Since OC-192 tributary packs are only supported with VLF mains, OC-192 0x1Sn is not supported. 0x1 is available on low-speed/tributary packs and VLF high-speed network interface packs.

User side and network side

The operation of each DCC span also depends on one end of the span being designated the "User" side and the other end being designated the "Network" side. The DCC User/Network side assignments are provisionable.

Default User/Network side values

Table 5-5 DCC default values

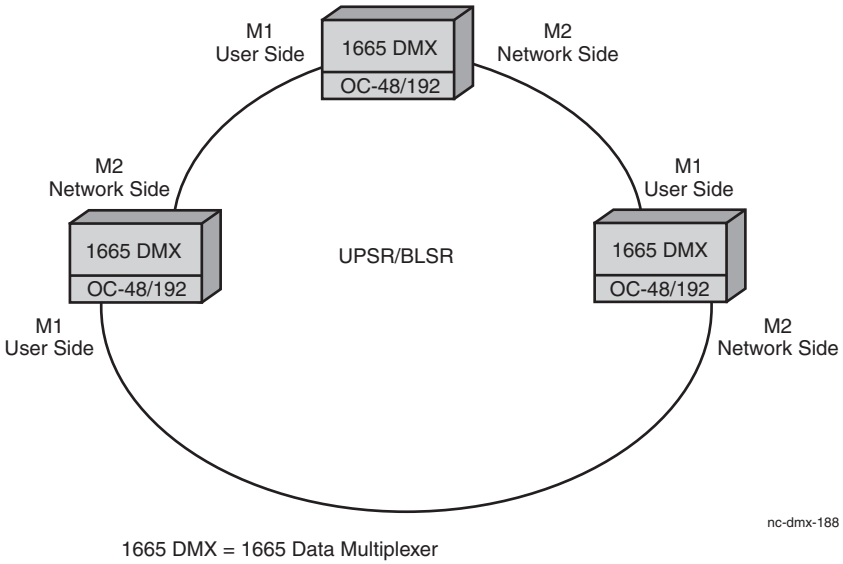
Default User/Network side values		Optical port protection mode					
Slots	**DCC AID**	**BLSR**	**UPSR**	**1+1**	**0x1S1**	**0x1S2**	**0x1**
High-speed Main	dcc-m1-{1-x}	User Side	User Side	-	NA	NA	Network Side
	dcc-m2-{1-x}	Network Side	Network Side	-	NA	NA	Network Side
	dcc-m-{1-x}	-	-	Network Side	NA	NA	-
Low-speed Function/ Growth	dcc-{a,b,c,d,g}1-{1-x}	Network Side	Network Side	-	Network Side	Network Side[1]	Network Side
	dcc-{a,b,c,d,g}2-{1-x}	User Side	User Side	-	Network Side[1]	Network Side	Network Side
	dcc-{a,b,c,d,g}-{1-x}	-	-	Network Side	-	-	-

Notes:

1. Because DCC is disabled on the corresponding 0x1Sn inactive port, this provisioned value has no effect.

The figure below shows an example of the User and Network side designations for Alcatel-Lucent 1665 DMXs on a high-speed UPSR or BLSR.

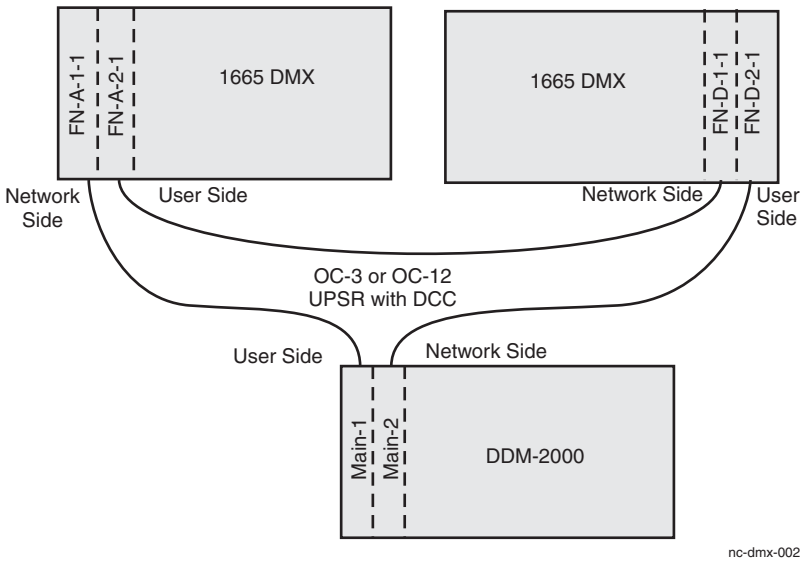
Figure 5-5 User/Network side designation on a UPSR/BLSR



1665 DMX = 1665 Data Multiplexer

The figure below shows an example of the User and Network side designations for Alcatel-Lucent 1665 DMX on a low-speed UPSR with DDM-2000.

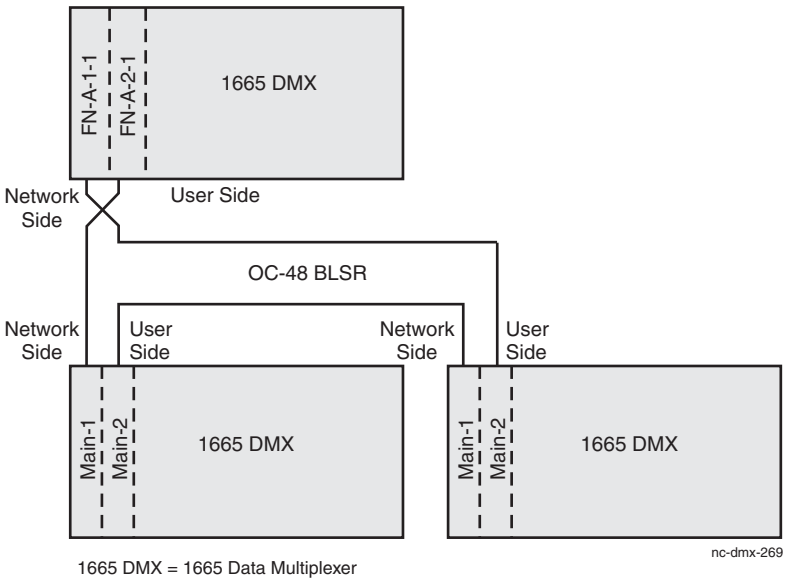
Figure 5-6 User/Network side designation on an OC-3/12 UPSR with DDM-2000



1665 DMX = 1665 Data Multiplexer

The figure below shows an example of the User and Network side designations for Alcatel-Lucent 1665 DMX on a low-speed OC-48 BLSR.

Figure 5-7 User/Network side designation on a low-speed OC-48 BLSR



DCC compatibility

Alcatel-Lucent 1665 DMX supports the optical interfaces with DCC communications compatibility as shown in the following table. Alcatel-Lucent 1665 DMX supports Section DCC running the OSI protocol stack and IP. The “1+1” entries represent linear and bidirectional (1+1) protected DCC compatibility.

Table 5-6 DCC compatibility

Product	Optical interfaces supported		Alcatel-Lucent 1665 DMX							
			High-speed main slots OC-N				Low-speed function and growth slots OC-N			
			192	48	12	3	192	48	12	3
1665 DMX	High-speed	OC-192	UPSR/ BLSR/ 1+1/ 0x1				UPSR/ BLSR/ 1+1/ 0x1			
		OC-48		UPSR/ BLSR/ 1+1/ 0x1				UPSR/ BLSR/ 1+1/ 0x1Sn/ 0x1		
		OC-12			UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1/ 0x1Sn/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1
	Low-speed	OC-192	UPSR/ BLSR/ 1+1/ 0x1				UPSR/ BLSR/ 1+1/ 0x1			
		OC-48		UPSR/ BLSR/ 1+1/ 0x1				UPSR/ BLSR/ 1+1/ 0x1Sn/ 0x1		
		OC-12			UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1

Table 5-6 DCC compatibility (continued)

Product	Optical interfaces supported		Alcatel-Lucent 1665 DMX							
			High-speed main slots OC-N				Low-speed function and growth slots OC-N			
			192	48	12	3	192	48	12	3
1665 DMXplore	High-speed	OC-3				UPSR/ 1+1				UPSR/ 1+1
1665 DMXtend	High-speed	OC-192	UPSR/ 1+1/ 0x1							
		OC-48		UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1		
		OC-12			UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1/ 0x1Sn/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1
	Low-speed	OC-48		UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1		
		OC-12			UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1/ 0x1				UPSR/ 1+1/ 0x1Sn/ 0x1

Table 5-6 DCC compatibility (continued)

Product	Optical interfaces supported		Alcatel-Lucent 1665 DMX							
			High-speed main slots OC-N				Low-speed function and growth slots OC-N			
			192	48	12	3	192	48	12	3
DDM-2000 OC-3	High-speed	OC-12			UPSR				UPSR/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1				UPSR/ 0x1Sn/ 0x1
	Low-speed	OC-3				UPSR/ 1+1				1+1/ 0x1Sn/ 0x1
DDM-2000 OC-12	High-speed	OC-12			UPSR				UPSR/ 0x1Sn/ 0x1	
	Low-speed	OC-3				UPSR/ 1+1				1+1/ 0x1Sn/ 0x1
FiberReach	High-speed	OC-12			UPSR				UPSR/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1				UPSR/ 0x1Sn/ 0x1
FT-2000 ADR	High-speed	OC-48		BLSR				BLSR/ 0x1Sn/ 0x1		
	Low-speed	OC-12			1+1				1+1/ 0x1Sn/ 0x1	
		OC-3				1+1				1+1/ 0x1Sn/ 0x1

Table 5-6 DCC compatibility (continued)

Product	Optical interfaces supported		Alcatel-Lucent 1665 DMX							
			High-speed main slots OC-N				Low-speed function and growth slots OC-N			
			192	48	12	3	192	48	12	3
Wave-Star® TDM 2.5G/10G (2-fiber)	High-speed	OC-48		UPSR/ BLSR						
	Low-speed	OC-12			UPSR/ 1+1				UPSR/ BLSR/ 1+1/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1				1+1/ 0x1Sn/ 0x1
WaveStar® Bandwidth Manager, Release 4.0	High-speed	OC-48		UPSR/ BLSR				UPSR/ BLSR/ 1+1/ 0x1Sn/ 0x1		
	Low-speed	OC-12			UPSR/ 1+1				UPSR/ 1+1/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1				1+1/ 0x1Sn/ 0x1

Table 5-6 DCC compatibility (continued)

Product	Optical interfaces supported		Alcatel-Lucent 1665 DMX							
			High-speed main slots OC-N				Low-speed function and growth slots OC-N			
			192	48	12	3	192	48	12	3
Alcatel-Lucent 1675 LambdaUnite MSS	High-speed	OC-192	UPSR/ BLSR/ 1+1							
		OC-48		UPSR/ BLSR				UPSR/ BLSR/ 0x1Sn/ 0x1		
	Low-speed	OC-12			UPSR/ 1+1				UPSR/ 1+1/ 0x1Sn/ 0x1	
		OC-3				UPSR/ 1+1				1+1/ 0x1Sn/ 0x1

Software download (generic)

Overview

Alcatel-Lucent 1665 DMX supports local and remote software downloads.

For complete coverage of Alcatel-Lucent 1665 DMX's software download procedures, see the *Alcatel-Lucent 1665 Data Multiplexer (DMX) User Operations Guide, 365-372-301*.

Local software download

Alcatel-Lucent 1665 DMX supports the following local software downloads.

- Local software installation via File Transfer Protocol (FTP) from a *WaveStar*® CIT connected to the **CIT LAN** (IAO LAN) port on the SYSCTL circuit pack faceplate or the **J16 IAOLAN** (IAO LAN) port on the shelf backplane. Software installation via FTP requires the following:
  - FTP Client software is enabled on the NE
  - IP parameters are provisioned on the NE.

Important! FTP must be used to install software when using the Microsoft *Windows*® XP Operating System.

Operating software for Alcatel-Lucent 1665 DMX can be downloaded or upgraded remotely over the data communications channel or the operations network.

Via the DCC

Software and software upgrades can be downloaded to remote NEs from a central office site or any Alcatel-Lucent 1665 DMXtend/Alcatel-Lucent 1850 TSS-5 connected to the Alcatel-Lucent 1665 DMX via the data communications channel (DCC).

Remote software download

Remote software download reduces the need to travel to remote sites when the software version of multiple Alcatel-Lucent 1665 DMX systems is being upgraded throughout a network.

- Beginning in Release 9.0, remote software installation via SSH File Transfer Protocol (SFTP). SFTP is a new protocol defined by IETF which runs over a secure SSH channel and provides secure file transfers. Network configurations, user names, passwords, FTP commands and transferred files are protected.
- Remote software download via an FTAM-FTP gateway to Alcatel-Lucent 1665 DMX. The FTAM-FTP gateway is also referred to as the file transfer translation device (FTTD).
- File Transfer Protocol (FTP) from the *WaveStar*® CIT over the IAO LAN connected to the LAN port on the SYSCTL. This requires that FTP is enabled on the NE, and that IP is enabled and properly configured on the SYSCTL LAN port.
- File Transfer and Access Management (FTAM) protocol from the *WaveStar*® CIT over the IAO LAN connected to the LAN port on the SYSCTL. You must have OSI connectivity (via your OSI LAN or DCC) to the network element to use FTAM.
- FTTD (FTAM-FTP gateway) without TCP/IP connectivity.
- Software copy from the local Alcatel-Lucent 1665 DMX to a remote Alcatel-Lucent 1665 DMX.

  Software copy from the local Alcatel-Lucent 1665 DMX to a remote:

  – Alcatel-Lucent 1665 DMX
  – Alcatel-Lucent 1665 DMXtend
  – Alcatel-Lucent 1665 DMXplore
  – DDM-2000 OC-3
  – DDM-2000 OC-12
  – FiberReach

  Important! The software must be in the dormant area of Alcatel-Lucent 1665 DMX. Both the local and remote NEs must have an active software generic.

Impact of software download and activation

Initial local software installation temporarily disrupts operations communications because the system controller is reset to activate the software immediately.

Other local software downloads temporarily disrupt operations communications, too, because a system controller reset is involved, but the dormant software is not activated immediately.

Remote software download or copy of compressed dormant software is accomplished without any disruption of operations communications (that is, no system controller resets), because the dormant software is not activated immediately.

If there is no valid generic or database on the controller, or if there are multiple valid generics or databases when the shelf resets, the shelf enters maintenance mode, using the default database. If necessary, the *WaveStar*® CIT wizard will guide the user through the download/restore process and prompt generic and database selection.

Remote software download compatibility

The following list identifies the products to which you can perform remote software downloads using the *WaveStar*® CIT connected to Alcatel-Lucent 1665 DMX.

- Alcatel-Lucent 1665 DMX
- Alcatel-Lucent 1665 DMXplore
- Alcatel-Lucent 1665 DMXtend
- Alcatel-Lucent 1850 TSS-5
- DDM-2000 OC-3
- DDM-2000 OC-12
- FiberReach

  Important! Alcatel-Lucent 1665 DMX shelves running pre-R6.0 software releases can only perform downloads to other pre-R6.0 Alcatel-Lucent 1665 DMX or other pre-R4.0 Alcatel-Lucent 1665 DMXtend. Any shelf running R6.0 and later releases can download previous releases.

Digital signature capability

Alcatel-Lucent 1665 DMX can verify software downloads using a digital signature. When FTP over TCP/IP is used for a software download, a digital signature is transmitted with the software download and verified by the network element. If the verification fails, Alcatel-Lucent 1665 DMX reports an autonomous message and the software download fails. The digital signature is discarded after verification.

Checking the digital signature of software download can be enabled or disabled using the **Configuration** → **Software** → **Software Download** command.

Database backup and restore

Overview

This section describes the database backup and restore feature in Alcatel-Lucent 1665 DMX. IP tunneling is required to support remote database backup/restore for remote Alcatel-Lucent 1665 DMX systems.

Alcatel-Lucent 1665 DMX uses the following connections to perform database backup and restore:

- A direct IP connection
- OSI connectivity to an FTP GNE.
- FTAM Backup and Restore

Database backup

Alcatel-Lucent 1665 DMX can back up all provisionable data via a local or remote FTP file transfer. Data can be backed up to a remote operations system via an FTAM-FTP gateway. The FTAM-FTP gateway is also referred to as the file transfer translation device (FTTD).

The backup database is stored on a *WaveStar*® CIT, and OMS, or another FTP server. For information about the **Configuration** → **Software** → **Remote Backup** command, see the *WaveStar*® CIT help.

Database restore

In the event of a catastrophic failure, Alcatel-Lucent 1665 DMX can restore all provisionable data (from the backup file) via local or remote FTP. Data can be restored from a remote operations system via an FTAM-FTP gateway. The FTAM-FTP gateway is also referred to as the file transfer translation device (FTTD).

The backup database maybe stored on a *WaveStar*® CIT, and OMS, or another FTP server. For information about the **Configuration** → **Software** → **Remote Restore** command, see the *WaveStar*® CIT help. For more information about restoring the network element database, see the *Alcatel-Lucent 1665 Data Multiplexer (DMX) User Operations Guide, 365-372-301*.

Automatic database backup

Alcatel-Lucent 1665 DMX supports automatic database backups. This allows users to establish a backup interval, date, and time. The database backups may be saved on the *WaveStar*® CIT or another FTP server.

The user can also specify the number of backups to destination files before overwriting those same files with subsequent backups. To eliminate the scenario of multiple Alcatel-Lucent 1665 DMX systems initiating automatic backups simultaneously, Alcatel-Lucent 1665 DMX does not support a default scheduled backup date/time; the user must provision their own date/time. For information about the **Configuration** → **Software** → **Configure Auto Backup Interval** command, see the *WaveStar*® CIT help.

Maintenance signaling

Compliance

Maintenance signaling is compliant with SONET (*Telcordia* ® GR-253) and asynchronous (*Telcordia* ® TR-TSY-000191) network requirements. Alarm indication signals include SONET OC-n line AIS, STS-1 path AIS, virtual tributary (VT) path AIS, DS3 AIS, and DS1 AIS. Remote defect indication signals include STS-1 path RDI and VT path RDI. Other maintenance signals include STS-1 path unequipped, VT path unequipped, Loss of Signal (LOS, Loss of Frame (LOF), and Loss of Pointer (LOP).

Fault detection, isolation, and reporting

Overview

Alcatel-Lucent 1665 DMX continuously monitors incoming signals and internal system conditions.

Incoming signals

Incoming signals are monitored at the line level for loss of signal (LOS), loss of frame (LOF), and Alarm Indication Signal (AIS), and BER threshold crossings. Incoming signals are monitored at the path level for loss of pointer (LOP), Alarm Indication Signal (AIS), unequipped (UNEQ), and BER threshold crossings.

At the OTS and OCH levels, Alcatel-Lucent 1665 DMX monitors for and reports on loss of signal - path (LOS-P) alarms.

At the OTUk level, Alcatel-Lucent 1665 DMX monitors for and reports on loss of signal - path (LOS-P), backward defect indicator (BDI), signal Degrade (DEG), loss of frame (LOF), loss of multiframe (LOM), and server signal failed (SSF) alarms. (AIS is not reported as the reported SSF is sufficient.)

At the ODUk level, Alcatel-Lucent 1665 DMX monitors for and reports on backward defect indicator (BDI), signal Degrade (DEG), locked (LCK), open connection indication (OCI), and server signal failed (SSF) alarms. AIS is detected but not reported.

The BER threshold crossings are detected for DS1, DS3, E1, EC-1, VT1.5, OC-3, OC-12, OC-48, OC-192, STS-1, STS-3c, STS-12c, STS-48c, , and STS-192c signals.

Fault detection

In addition to detecting line and path faults, the system also detects internal circuit pack faults. When an internal fault is detected, automatic diagnostics isolate the faulty circuit pack. Faults are reported to local technician and OSs so that technician dispatch and repair decisions can be made. If desired, OS personnel and local technicians can use the CIT to gain more detailed information on the fault condition.

Fault isolation

All detected fault conditions are stored and are available to be reported on demand. In addition, a history of past alarm and status conditions and events is maintained and available for on-demand reporting. Each event is real-time and date stamped.

Fault reporting

Alcatel-Lucent 1665 DMX reports all detected alarm and status conditions through the appropriate office alarm relays, SYSCTL faceplate LEDs, transmission circuit pack LEDs, and TL1 interfaces.

Alarm masking

In order to minimize the number of alarm conditions reported by the NE, Alcatel-Lucent 1665 DMX automatically masks (suppresses the reporting of) alarms of the same root cause. Alarms/status conditions of the same root cause are arranged in a hierarchical order. When more than one alarm or status condition in a hierarchical group exists in a single NE, only the top level condition in that hierarchy is reported.

Loopbacks and tests

Overview

Alcatel-Lucent 1665 DMX allows technicians to perform loopback tests on all low- and high-speed interfaces. Low-speed DS1, DS3, E1, and EC-1 electronic loopbacks, directed toward the high-speed line (terminal loopback), are individually controllable from the CIT or the OS interface. Active electronic loopbacks are shown by the ABN LED on the SYSCTL faceplate and in the alarm and status report. EC-1, E1, DS1, DS3, and Ethernet facility loopbacks toward the DSX are also available.

Optical loopbacks

Alcatel-Lucent 1665 DMX supports facility, terminal and manual optical loopbacks.

Facility loopbacks

Alcatel-Lucent 1665 DMX supports facility optical loopbacks on high-speed OC-3/12/48/192 ports and low-speed OC-3/12/48/192 ports.

Terminal loopbacks

Alcatel-Lucent 1665 DMX supports facility optical loopbacks on high-speed OC-3/12/48/192 ports and low-speed OC-3/12/48/192 ports.

Manual loopbacks

Front access to the optical connectors on the optical line interface unit (OLIU) circuit pack allows easy manual optical loopback. This loopback is performed by connecting a fiber jumper from the OLIU circuit pack output to its input. In some cases a lightguide build-out assembly is required to prevent receiver overload when performing loopbacks.

DS1, E1, DS3 loopbacks

Alcatel-Lucent 1665 DMX supports terminal and facility loopbacks on DS1, E1 and DS3 interfaces.

Ethernet loopbacks

Beginning in Release 9.1, Ethernet loopbacks are allowed even when Remote Client Fail (RCF) or Far End Failure Indicator (FEFI) is active.

Ethernet terminal loopbacks

Alcatel-Lucent 1665 DMX supports terminal loopbacks on all Ethernet interfaces.

Ethernet facility loopbacks

Alcatel-Lucent 1665 DMX supports facility loopbacks on the LNW78 and LNW170. Facility loopbacks are supported on both individual ports and Link Aggregation Groups (LAGs). Loopbacks on LAGs are permitted simultaneously for both ports in the group because they are treated as failed members allowing transmission on unlooped members. If a facility loopback is set up on a LAG, alarms are suppressed on both the member ports and the LAG.

State check before loopback

Beginning in Release 9.1, **ENT-SYS** supports a new parameter, loopback port check (lpbk_port_ck). The parameter controls how loopbacks are handled for PDH, EC1 and Ethernet ports based on the state of those ports.

- DISABLE (default): The execution of loopbacks for PDH, EC1 and Ethernet ports ignores the value of *cmdmode* in **OPR-LPBK**.
- ENABLE: The execution of loopbacks for PDH, EC1 and Ethernet ports is a function of the respective port's primary state and the value of *cmdmode* in **OPR-LPBK**. If *cmdmode=NORM*, the loopback is denied unless the port is out of service. If *cmdmode=FRCD*, the loopback executes irrespective of port state.

  Note: This parameter does not affect loopback operation for OC-n lines.

Internal testing capabilities

Technicians can use the internal testing capabilities for installation and manual troubleshooting. The DS1 and DS3 test signal generators and detectors are integrated into the system, eliminating the need for external test equipment to perform transmission tests.

Specific testing

Alcatel-Lucent 1665 DMX also allows technicians to test specific system components. In addition to the automatic diagnostics, Alcatel-Lucent 1665 DMX provides tests for LEDs, office alarms, and the SYSCTL circuit pack.

Test access

Overview

Test access, a traditional DCS function, allows the user visibility into any VT1.5/STS-1 signal in the network. Test access aids users in turning up connections and in identifying faults in existing service connections. Alcatel-Lucent 1665 DMX supports three different types of test access. The non-intrusive method simply taps the VT1.5/STS-1 channel as it passes through the system and routes it to an external testing device. The more intrusive mode splits the VT1.5/STS-1 from the incoming signal and sends it to an external testing device. The third form of test access involves using the internal test head, located on the VLF only, to generate and detect Pseudo Random Bit Sequences (PRBSs) on up to 12 STS-1s or 4 STS-3(c) signals. Test access facilitates Alcatel-Lucent 1665 DMX functioning in a DCS application.

PRBS generation/detection

For detailed information regarding internal test access using PRBS, see "PRBS generation/detection" (p. 5-40).

Test access interworking

Alcatel-Lucent 1665 DMX supports interworking with various Test-Head vendors.

Test access rates

Alcatel-Lucent 1665 DMX supports test access sessions at the STS-1, STS3(c) and VT1.5 rates.

Test access modes

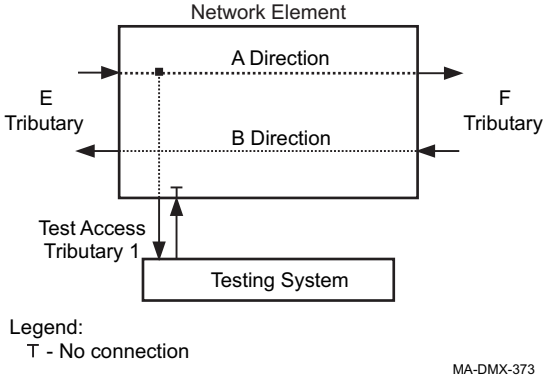
Alcatel-Lucent 1665 DMX supports test access sessions in the following modes:

- MONE
- MONEF
- SPLTE
- SPLTEF
- SPLTA (for PRBS generation/detection only)

MONE mode

The MONE mode is used to monitor the E Tributary input signal of a one-way cross-connection or an idle E Tributary input signal (no cross-connection).

The following figure shows an example of the MONE mode used to monitor the E Tributary input signal of 2 separate one-way cross-connections.

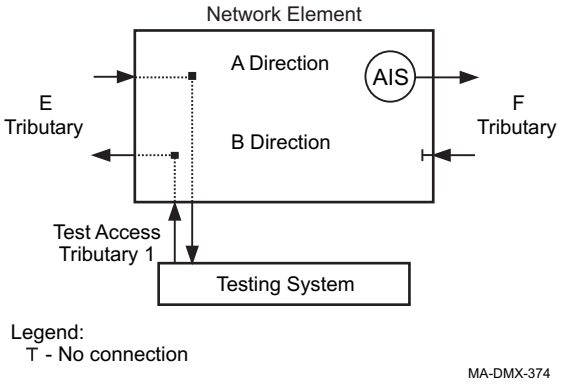


If the F Tributary is entered, the F Tributary must be the destination of a one-way cross-connection that has the E Tributary as the source. If the E Tributary is part of a one-way multicast cross-connection, entering the F Tributary is optional. The system automatically retrieves the other end. The E Tributary or F Tributary can not be on an Ethernet circuit pack.

SPLTE mode

The SPLTE mode is used to test the E Tributary signal.

The following figure shows an example of the SPLTE mode used to test the E Tributary signal of 2 separate one-way cross-connections.



The E Tributary signal is split from the F Tributary signal. AIS is transmitted on the outgoing F Tributary signal. and the incoming F Tributary signal is terminated. If more than one independent one-way cross-connection exists to the E Tributary, the SPLTE mode is denied. The E Tributary can also be idle (no cross-connection). The E Tributary or F Tributary cannot be on an Ethernet circuit pack.

STS-1 test access matrix

The table below provides all the STS-1 test access specifications supported by Alcatel-Lucent 1665 DMX. The numbers in the table below represent the software release number in which that configuration is first supported. Test access on STS-3(c) signals is only supported in SPLTA, SPLTE, and MONE modes using the internal test head located in the VLF Main packs for PRBS generation/detection

Table 5-7 STS-1 test access

TATRIBs								
		Slot	Signal	A-D slots (elect)		A-G slots[1] 1+1 only[2] (opt)		
				DS3/EC1	TMUX	OC-3	OC-12	OC-48
				LNW16 LNW19B LNW20	LNW18 LNW20	LNW37 LNW45 LNW55	LNW49 LNW55	LNW31 LNW55 LNW62
ETRIB and FTRIB	Main Add/Drop STS1 XC To:[4], [5]	A–G	DS3/EC1	R4.0	Deny	R4.0	R5.1	R4.0
		A–G	OC-3/12/48, [6]	R4.0	Deny	R4.0	R5.1	R4.0
	Thru XC		BLSR	R4.0	Deny	R4.0	R5.1	R4.0
			UPSR	R5.1	Deny	R5.1	R5.1	R5.1
	DS3/EC1 (FN A–D) hairpin to:[4], [5]	A–G	DS3/EC1	R4.0	Deny	R4.0	R5.1	R4.0
		A–G	OC-3/12/48, [6]	R4.0	Deny	R4.0	R5.1	R4.0
			TMUX[8]	R7.0	R7.0	R7.0	R7.0	R7.0
	OC3/12/48 (FN A–G) hairpin to:[4], [5]	A–D	DS3/EC1	R4.0	Deny	R4.0	R5.1	R4.0
		A–G	OC-3/12/48, [6]	R4.0	Deny	R4.0	R5.1	R4.0
	OC-192[7] (M1/M2) hairpin to:	M1/M2	OC-192	R7.0	R7.0	R7.0	R7.0	R7.0

Notes:

1. TATRIB1 and TATRIB2 are always connected to the same optical interface.
2. Intended for network-connected testheads where the tributary under test is in one NE and the test head is connected to a different NE.
3. EC1 mode interfaces only.
4. Test Access of locked cross-connections restricted to electrical TATRIBs
5. Test Access of UPSR Dual Ring Interworking cross-connections is not supported
6. Test access of low-speed BLSR cross-connections is not supported
7. All high-speed Main OLIUs allow the STS-1 test access modes specified in this table. Hairpins from high-speed Main interfaces to other high-speed Main interfaces only allowed on the LNW59 because it is the only Main OC-192 pack with multiple ports. Generation and detection of PRBS only supported on the LNW59.

8. TMUX test access in the G slots only supported using the LNW20 in portless mode.

VT1.5 test access matrix

The "dual tatrib" modes (MONEF and SPLTEF) of VT test access are not possible when the system is equipped with small/medium VT fabric Main OLIUs. This applies to all systems equipped with OC3 or OC12 Main OLIUs.

The table below provides all the VT1.5 test access specifications supported by Alcatel-Lucent 1665 DMX. The numbers in the table below indicate the software release number in which that configuration is first supported.

Table 5-8 VT1.5 test access

TATRIBs									
		Slot	Signal	A-D slots			A-G slots[1] unprotected 1+1 only[2]		
				EC1	TMUX	DS1/E1	OC-3	OC-12	OC-48
				LNW16 LNW19B LNW20	LNW18 LNW20	LNW7 LNW8 LNW801	LNW37 LNW45 LNW55	LNW49 LNW55	LNW31 LNW55 LNW62
ETRIB and FTRIB	Main Add/Drop VT1.5 XC to:[5], [6]	A–D	DS3/EC1[3]	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
			TMUX	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
			DS1/E1	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
		A–G	OC-3/12/48	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
	DS1/E1/TMUX (FNA–D) VT1.5 hairpin to:[5], [6]	A–D	DS3/EC1[3]	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
			TMUX	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
			DS1/E1	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
		A–G	OC-3/12/48	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
	OC3/12 /48 (FN A–G) VT1.5 hairpin to:[5], [6]	A–D	DS3/EC1[3]	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
			TMUX	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
			DS1/E1[6]	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
		A–G	OC-3/12/48	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0
			TMUX (LNW20 portless only)	R7.0	R7.0	R7.0	R7.0	R7.0	R7.0
		M1/M2	OC-12/48/192[8]	R4.0	R4.0	R4.0	R4.0	R5.1	R4.0

Notes:

1. TATRIB1 and TATRIB2 are always connected to the same optical interface.
2. Intended for unprotected interfaces to locally-connected testheads only; Network-connected testheads - Future\

3. EC1 mode interfaces only.
4. Large VT Fabric Mains Only; restrictions apply for any OC3/12 Main OLIU.
5. Test Access of locked cross-connections restricted to electrical TATRIBs
6. Test Access of UPSR Dual Ring Interworking cross-connections not supported
7. Test access of low-speed BLSR cross-connections not supported
8. All high-speed Main OLIUs allow the STS-1 test access modes specified in this table. Generation and detection of PRBS only supported on the LNW59, LNW82, and LNW504.

PRBS generation/detection

Test access using PRBS generation/detection via the internal test head on the VLF Main allows the user to test network, NE, and facility performance/integrity without an external test head. VLF Mains contain an internal test head that can generate and detect errors in Pseudo Random Bit Sequences (PRBSs). This capability is not meant to wholly eliminate the use of external equipment for tests, but can be used for expediency, less complicated tests, and where non-manual set-up is advantageous. PRBS enabled test access involves initiating test access, inserting a test signal (i.e. a PRBS) generated internal to the NE, and/or monitoring a received test signal internal to the NE. PRBS generation/detection is supported on STS1 and STS3c tributaries.

Alcatel-Lucent 1665 DMX allows up to 12 test access sessions at a time and for a mix of test access sessions that specify tatrib(s) and test access sessions to the internal test head within the 12 allowed sessions. The internal test head hardware supports signal generation on up to 12 STS1s, and signal detection on up to 12 STS1s. The generators and detectors are separately allocated. Internal test access is supported on STS3c signals; requests using the tatrib parameter(s) are denied. When a generator or detector is allocated to an STS3c session, it uses 3 of the 12-STS1 capacity, and that 3 generators or detectors on the STS3c boundary must be available.

Generation and detection functionality

PRBS Generation is totally independent of detection and error counting. The only similarity is that they both occur in the context of test sessions. One session may produce a signal that is detected/measures by a different session (in the same, or different Alcatel-Lucent 1665 DMX).

While measurement/monitoring of incoming PRBS signals is occurring, the shelf collects total measurement session counts and PM-style counts, including 15-minute and day bins tied to the time-of-day clock. The bins are retrieved by the user on-demand and are freed when the test access session (not the measuring session) ends. Bins survive a shelf restart and are initialized by a power-up of the shelf.

Modes allowed for PRBS functionality

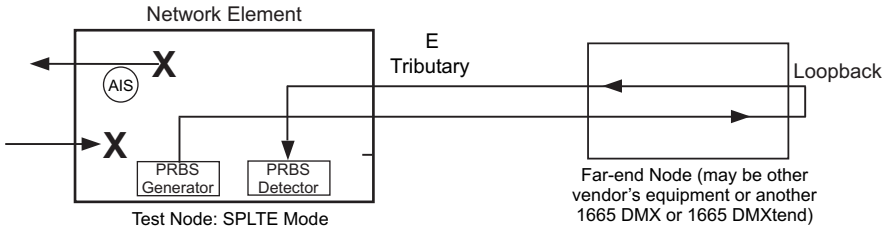
Alcatel-Lucent 1665 DMX supports PRBS enabled internal test access sessions in the following modes:

- MONE
- SPLTE
- SPLTA

Alcatel-Lucent 1665 DMX must be in MONE mode to initiate a PRBS enabled test access session. The mode must then be changed to either SPLTE or SPLTA in order to support the configurations detailed below.

Testing to a far-end loopback

This configuration involves a SPLTE test session at a single Alcatel-Lucent 1665 DMX node, with generation and detection at the same node. The tributary under test must be cross-connected.

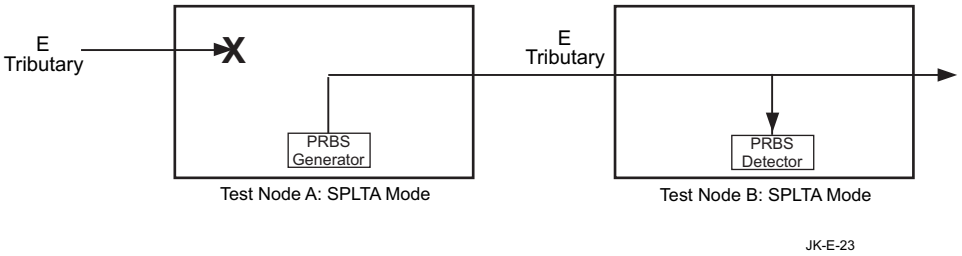


1665 DMX = 1665 Data Multiplexer
1665 DMXtend = 1665 Data Multiplexer Extend

Alcatel-Lucent 1665 DMX is first set to MONE mode and then changed to SPLTE mode. AIS is inserted into the tributary being tested until the PRBS generator is set to generate and insert a bit sequence on that tributary. The Generator and detector are then connected to the tributary. The PRBS is inserted into the tributary, sent to and looped back at the far-end, and then monitored for errors by the PRBS detector located on the VLF Main circuit packs.

Head-to-head testing

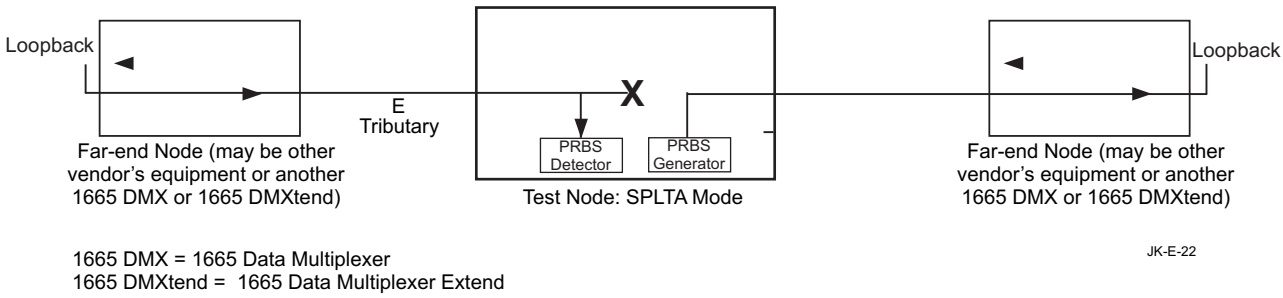
This configuration involves generating a signal at one node (node A), and monitoring the signal at a different node (node B). The tributary under test at node A must be cross-connected. The tributary at node B may or may not be cross-connected.



Node A and B are first set to MONE mode, but while the generator on Node A is then connected to the tributary and the detector on Node B is also connected to the tributary. The PRBS signal originating at Node A is monitored for errors by the PRBS detector located on the VLF Main circuit packs in Node B.

Total network testing

This configuration involves a SPLTA test session at a single Alcatel-Lucent 1665 DMX node, with generation and detection at the same node. The tributary under test must be cross-connected.



1665 DMX = 1665 Data Multiplexer
1665 DMXtend = 1665 Data Multiplexer Extend

Alcatel-Lucent 1665 DMX is first set to MONE mode and then changed to SPLTA mode. AIS is inserted into the tributary being tested until the PRBS generator is set to generate and insert a bit sequence on that tributary. The generator and detector are then connected to the tributary. A PRBS is inserted into the tributary, sent to and looped back at the far-end, passed-through Node A and sent to a far-end node in the other direction where it is looped back to Node A. The PRBS signal is then monitored for errors by the PRBS detector located on the VLF Main circuit packs in Node A before the tributary is terminated.

WaveStar® CIT

Overview

Purpose

This section describes the *WaveStar*® CIT.

Contents

Introduction to the *WaveStar*® CIT	5-43
WaveStar® CIT access	5-44

Introduction to the *WaveStar*® CIT

Purpose

WaveStar® CIT is the primary tool used to interface with Alcatel-Lucent 1665 DMX. It is a personal computer (PC) with the *WaveStar*® CIT user-interface software installed.

WaveStar® CIT supports the following user interface options:

- Graphical user interface (GUI)
- TL1 cut-through access to other NEs

The *WaveStar*® CIT is referred to as the *WaveStar*® CIT because the Alcatel-Lucent 1665 DMX user-interface software is integrated with the *WaveStar*® CIT software for the 1665 Product Family.

WaveStar® CIT functionality

WaveStar® CIT provides an easy-to-use interface and security features to prevent unauthorized access. *WaveStar*® CIT supports the following:

- Local access control based on login and password
- OSI neighbor discovery for easy access to the local NE(s)
- User provisioning of cross-connections, equipment, Ethernet services, software management, protection provisioning, and fault management
- Reports on NE equipage, cross-connections, alarms, and states

TL1 interface

The interface between the *WaveStar*® CIT and the Alcatel-Lucent 1665 DMX supports TL1 messages. This interface allows the *WaveStar*® CIT to issue TL1 commands and receive responses, as well as receive TL1 alarm reports from autonomous events that are detected by the Alcatel-Lucent 1665 DMX.

WaveStar® CIT access

WaveStar® CIT access methods

The *WaveStar*® CIT can access a network element using the following:

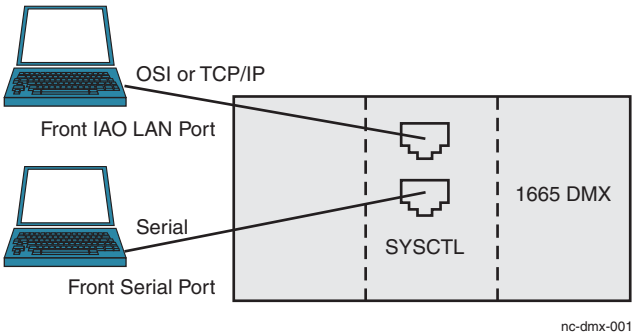
- Front and rear IAO LAN ports supporting OSI communications
- Front and rear IAO LAN ports supporting TCP/IP communications
- Front serial port
- Rear serial port

WaveStar® CIT direct local access

The recommended method for temporary local access is to connect the *WaveStar*® CIT to Alcatel-Lucent 1665 DMX via the CIT **LAN** port on the system controller (**SYSCTL**) circuit pack faceplate.

WaveStar® CIT can also be connected to the serial **CIT RS-232** port on the **SYSCTL** circuit pack faceplate.

Figure 5-8 *WaveStar*® CIT direct local access



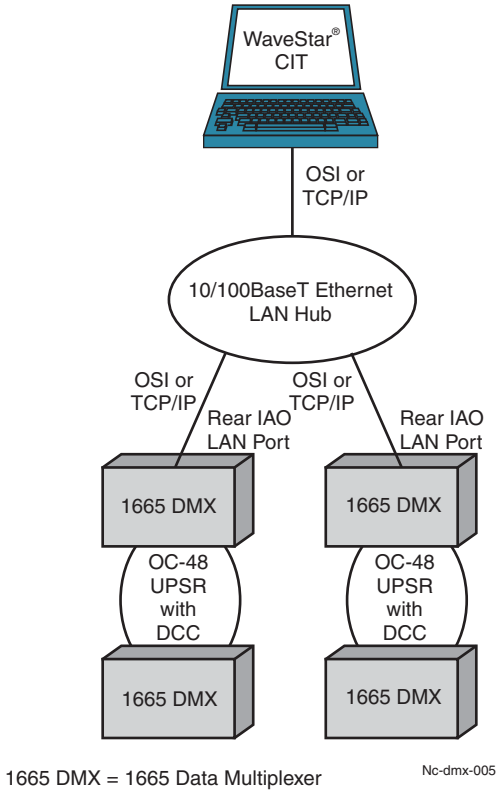
1665 DMX = 1665 Data Multiplexer

Important! When the *WaveStar*® CIT is directly connected to the CIT LAN port (not to an Ethernet LAN hub), a LAN crossover cable is required.

WaveStar® CIT access via rear IAO LAN port

The rear IAO LAN port supports local and/or remote *WaveStar®* CIT access. The figure below shows how the rear IAO LAN port can be used to provide local *WaveStar®* CIT access by connecting to a local Ethernet LAN hub. The *WaveStar®* CIT is depicted as being local but could also be remote. For local access, either the OSI protocol stack or TCP/IP could be used. For remote access, typically TCP/IP would be used.

Figure 5-9 *WaveStar®* CIT access via rear IAO LAN port



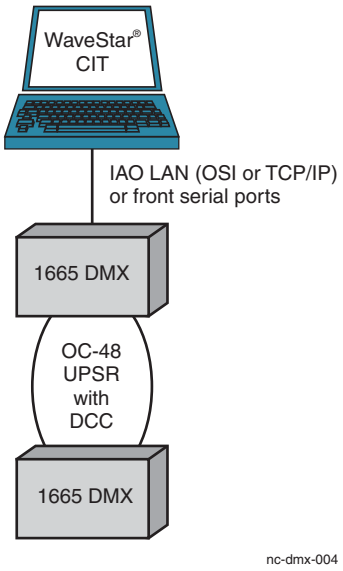
WaveStar® CIT access via TCP/IP LAN

For security reasons (and per SIF standards), neither local nor remote TCP/IP access via the Alcatel-Lucent 1665 DMX IAO LAN ports is allowed by default.

WaveStar® CIT remote access using DCC

A *WaveStar*® CIT with direct physical access to a local Alcatel-Lucent 1665 DMX can also be used to access remote NEs with DCC connectivity to the local Alcatel-Lucent 1665 DMX. *WaveStar*® CIT remote access over DCC is functionally equivalent to *WaveStar*® CIT direct access.

Figure 5-10 *WaveStar*® CIT access via DCC



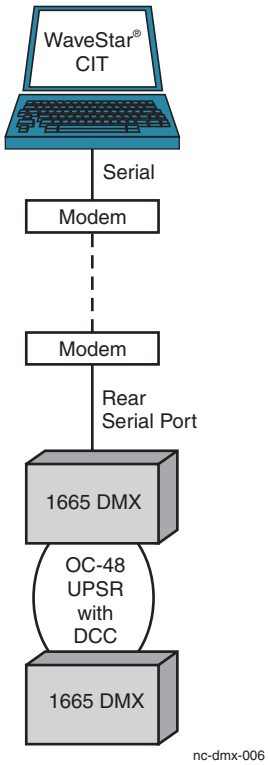
1665 DMX = 1665 Data Multiplexer

Remote access to the rear serial port

Alcatel-Lucent 1665 DMX can also be accessed remotely via dialup modems, but not by the *WaveStar®* CIT software. The rear serial port when equipped with the recommended cable is configured as DTE to allow a permanent modem connection.

A PC with a terminal emulation software package, such as HyperTerminal, can be used for access to Alcatel-Lucent 1665 DMX's rear serial port via dialup modems. The PC can use its internal modem or an external modem (shown). This form of access supports TL1 messages only, and can be used to access remote NEs with DCC connectivity to the Alcatel-Lucent 1665 DMX with the modem connection.

Figure 5-11 Remote *WaveStar®* CIT access via modem



1665 DMX = 1665 Data Multiplexer

Protection switching

Overview

Purpose

This section describes the types and functions of protection switching in Alcatel-Lucent 1665 DMX.

Contents

Protection switching application modes	5-48
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Path protection switching (path switched rings)	5-52
Line protection switching (line switched rings)	5-53
Spanning tree	5-54
Link aggregation (LNW170 LAN ports)	5-58
Equipment protection	5-61

Protection switching application modes

Overview

There are five types of protection application modes, listed below:

- BLSR (OC-48 and OC-192)
- UPSR
- Linear 1+1
  -Unidirectional 1+1 (revertive and non-revertive)
  -Bidirectional 1+1 (revertive and non-revertive)
  -Bidirectional optimized 1+1
- 0x1
- 0x1Sn

The UPSR application mode provides ring path protection switching on all high-speed and low-speed OC-3/12/48 interfaces and on OC-192 high-speed interfaces.

The linear 1+1 application is functionally equivalent to a 1+1 protected configuration, providing path switching on all paths within a high-speed line if that particular line fails.

0x1Sn mode

When equipped with non-VLF Main packs, Alcatel-Lucent 1665 DMX supports an unprotected 0x1Sn mode. This option is user-provisionable on a per-port basis. 0x1S1 and 0x1S2 are provisionable applications for LS OC-n port pairs. For 0x1S1, the port in slot 1 is unprotected and the companion port in slot 2 is unused. For 0x1S2, the port in slot 2 is unprotected and the companion port in slot 1 is unused.

True 0x1 mode

When equipped with VLF main packs, Alcatel-Lucent 1665 DMX supports true 0x1 unprotected circuit packs. Any function or growth slot can be equipped with any pack (some restrictions apply) and two of the same circuit pack can also populate adjacent slots in the same group (this includes some Ethernet packs). For detailed information on circuit pack/slot equipage restrictions in 0x1 mode, see "Very large fabric (VLF) engineering rules" (p. 6-15).

In the case of SONET packs, all ports in a pack must be set to 0x1 application in order for a different pack to be used in the companion slot. If any pair of lines is provisioned for a protected application (1+1, UPSR, BLSR), then both packs in the group must be of the same type.

True 0x1 replaces 0x1Sn functionality when VLF Mains are used. True 0x1 supports all the capabilities 0x1Sn allow, but adds the capability for both slots of a single group to function independently. 0x1Sn is still supported when the shelf is equipped with non-VLF Mains. True 0x1 is available on the low-speed/tributary circuit packs, and VLF Main (M1/M2) interfaces.

When two circuit packs in the same low-speed group are operating in 0x1 mode, all provisioning, reporting and retrieval (of alarms) associated with the pack, ports and tributaries in Slot 1 are independent of the provisioning, reporting and retrieval associated with the pack, ports and tributaries in Slot 2.

When provisioned for 0x1 operation, the affect on service and severity of alarms issued against a pack in Slot 1 of a particular group are independent from the affect on service and the severity of the alarms issued against the pack in Slot 2 of that group.

When Alcatel-Lucent 1665 DMX is equipped with VLF Mains, all 1-way cross-connections supported on an unprotected port/line (including ports/lines on an unprotected pack) in one slot of an LS group can be supported independently and simultaneously on an unprotected port/line in either slot of a Function or Growth group. 1-waypr cross-connections are not allowed to be sourced from 0x1 interfaces.

True 0x1 enables hairpin cross-connections between channels on packs in different slots of the same Function or Growth group.

Ethernet interface protection

On the WAN (SONET) side of the network, Alcatel-Lucent 1665 DMX utilizes standard IEEE 802.1D and fast 802.1w spanning tree protection for multipoint applications and/or STS-1 UPSR protection (for point-to-point applications). See the section entitled "Spanning tree" (p. 5-54) for more information.

Alcatel-Lucent 1665 DMX supports link aggregation on any two LNW170 LAN ports of the same rate (i.e. 100 or 1000 Mbps), operating in switched mode. The LNW170 circuit pack supports LAG operation across two LNW170 circuit packs.

Link aggregation can also provide facility protection on LNW170 LAN ports. Link aggregation is also able to remove failed links automatically, thereby providing a means of facility protection. When a link fails, traffic is shifted to the remaining links in that Link Aggregation Group (LAG). More links than are needed can be added to the group and each is active until it fails (similar to utilizing LCAS protection for SONET tributaries). For more information on link aggregation, see "Link aggregation (LNW170 LAN ports)" (p. 5-58).

Active/Standby LAG

In Active/Standby LAG, one link of the LAG is designated as the protection link and the other is the working link. Only the working link carries MAC client traffic when none of the links fails. When the working link fails, the traffic switches to the protection link. The protection switching is bidirectional and revertive.

Line protection switching

Overview

Alcatel-Lucent 1665 DMX offers 5 modes of linear protection switching: unidirectional 1+1 non-revertive line switching, bidirectional 1+1 non-revertive, unidirectional 1+1 revertive line switching, bidirectional 1+1 revertive, and bidirectional optimized 1+1 protection switching. All linear protection switching occurs automatically in response to detected faults, or in response to external commands from technicians at a local or remote CIT or OS.

Beginning in Release 9.0, you can change 1+1 protection group from unidirectional to bidirectional in-service without deleting cross-connections.

Protection switching priorities

Alcatel-Lucent 1665 DMX uses standard protection switching priorities as follows:

- Lockout of protection
- Forced switch (FS)
- Automatic switch: signal fail (SF)
- Automatic switch: signal degrade (SD)
- Manual switch (MS)

Alcatel-Lucent 1665 DMX allows you to provision these parameters with different priorities in relation to each other. For example, SF can be set with a higher priority than FS and vice versa.

Unidirectional and bidirectional 1+1 non-revertive and revertive line switching use switch procedures as specified by the SONET standards.

Alcatel-Lucent 1665 DMX offers bidirectional optimized 1+1 protection switching which uses switching procedures specified in ITU-T G.841, Annex B. Bidirectional optimized 1+1 is designed to enable interoperability between Alcatel-Lucent 1665 DMX and SDH equipment. It is a separate switching scheme from standard 1+1 bidirectional and does not work with standard 1+1.

Automatic line switching

Automatic line switches are initiated by signal fail and signal degrade conditions on the received OC-n signal. This signal's BER is calculated from violations in the SONET line overhead B2 parity byte. Signal fail is declared for incoming loss of signal, loss of frame, line AIS, or a BER exceeding a provisionable 10^{-3} to 10^{-5} threshold, while a BER exceeding a provisionable 10^{-5} to 10^{-9} threshold causes the signal degrade condition. A line protection switch is completed within 50 milliseconds of the onset of a hard failure such as a fiber cut.

In multispan applications (for example, hubbing), each OC-n span switches independently. For example, in hubbing applications, a switch on the central office-to-hub span will not cause switches on any of the hub-to-remote spans. Similarly, a line switch on a hub-to-remote span will not propagate to other hub-to-remote or central office-to-hub spans.

Path protection switching (path switched rings)

Overview

Alcatel-Lucent 1665 DMX supports path switched ring applications using the path protection switching schemes described in *Telcordia* ® GR-1400. This scheme offers 60-millisecond restoration times and simple network administration for access applications. The ring facility consists of two fibers, with service and protection rotating in opposite directions. Each input is bridged and transmitted in both directions around the ring. The receiving end terminal monitors the quality of both signals and selects the best signal to drop.

UPSR configurations

Alcatel-Lucent 1665 DMX supports the following OC-3/OC-12/OC-48/OC-192 path switched ring configurations:

- OC-3: VT1.5/STS-1/STS-3c
- OC-12: VT1.5/STS-1/STS-3c/STS-12c
- OC-48: VT1.5/STS-1/STS-3c/STS-12c/STS-48c
- OC-192: VT1.5/STS-1/STS-3c/STS-12c/STS-48c/STS-192c

Path protection is user-provisionable on a per-cross-connection basis when the port is set to UPSR. A manual path protection switching command allows switching to the other path for ease of ring maintenance. STS-n path switching is non-revertive and is triggered by path defects Path AIS (AIS-P), UNEQ-P, LOP-P, SF BER (excessive BER) and SD. The system also supports VT path protection switching based on VT AIS (AIS-V), LOP-V, UNEQ-V, and VT SD. Line level defects (LOS, LOF, AIS) indirectly contribute to path switching because these errors generate downstream path AIS (AIS-P).

Mixed protection modes

By supporting protection mode provisioning on a per port basis, Alcatel-Lucent 1665 DMX provides for the mixing of protection modes across the ports of a multi-port pack.

Ethernet interface protection

On the WAN (SONET) side of the network, Alcatel-Lucent 1665 DMX utilizes standard IEEE 802.1D and fast 802.1w spanning tree protection for multipoint applications and/or STS-1 UPSR protection (for point-to-point applications).

Locked cross-connections

In the "locked" mode, Alcatel-Lucent 1665 DMX does not select the best signal from both rotations of a UPSR. Instead, traffic is added and dropped (locked) from one rotation of the ring only (provisionable). The main advantage of locked VT cross-connections is the lack of UPSR switching which results in the ability to reuse time slots around a UPSR.

Locked cross-connections are only used in systems that are not equipped with VLF Mains because VLF mains allow unprotected (linear) UPSR cross-connections which allow users to independently provision cross-connections on UPSR tributaries. In systems with non-VLF Mains, once a locked cross-connection is established from a UPSR tributary, the companion tributary cannot be cross-connected.

Alcatel-Lucent 1665 DMX has the ability to mix locked, unlocked, and pass-through VT1.5s within the same STS-1, and to allow both rotations of a ring to be used simultaneously.

Linear/Unprotected UPSR

Alcatel-Lucent 1665 DMX provides an unprotected cross-connection mode, referred to as Linear/Unprotected UPSR, on OC-3/12/48 low-speed ports and OC-3/12/48/192 high-speed UPSRs. Alcatel-Lucent 1665 DMX allows both rotations of a ring to be used simultaneously. Simultaneous 1WAY cross-connections can be sourced from the 2 associated ring channels in a UPSR application. Simultaneous 1WAY cross-connection can be sourced from a ring channel. Support is also provided for 1WAY or 1WAYPR destined to the associated ring channel.

Line protection switching (line switched rings)

Overview

A 2-fiber bidirectional line-switched ring (BLSR) is a self-healing ring configuration in which switching is bidirectional between each pair of adjacent nodes and is protected by redundant bandwidth on the bidirectional lines that interconnect the nodes in the ring. Because switching is bidirectional between nodes, traffic can be added at one node and dropped at the next without traveling around the entire ring. This leaves the spans between other nodes available for additional traffic. Therefore, with distributed traffic patterns, a BLSR can carry more traffic than the same facilities could carry if configured for a unidirectional line-switched ring.

Alcatel-Lucent 1665 DMX supports 15 simultaneous BLSR protection groups in a single shelf. The 15 protection groups can be provisioned on any available OC-48 and OC-192 port pairs within the high-speed and low-speed groups.

Self-healing rings

Alcatel-Lucent 1665 DMX 2-fiber BLSRs are self-healing in that transport is automatically restored after node or fiber failures. Each OC-192 line carries 96 STS-1 equivalent time slots of working capacity plus 96 STS-1 equivalent time slots of protection capacity. Each OC-48 line carries 24 STS-1 equivalent time slots of working capacity plus 24 STS-1 equivalent of protection capacity. In the event of a fiber or node failure, service is restored by switching traffic from the working capacity of the failed line to the protection capacity in the opposite direction around the ring. In the event of a node failure, traffic added and dropped from the failed node is not protected by line switching.

Protection switching

When a line failure triggers a protection switch, the nodes adjacent to the failure switch traffic on to protection capacity. Traffic heading toward the failure is looped back on to the protection capacity traveling away from the failure to reach its destination by traveling the opposite way around the ring. Service is reestablished on the protection capacity in 50 milliseconds after detection of the failure (for catastrophic failures in rings without existing protection switches or extra traffic).

Spanning tree

Overview

This section provides information on the spanning tree protocol and spanning tree groups. Alcatel-Lucent 1665 DMX now supports a faster spanning tree algorithm documented in IEEE 802.1w.

Important! Alcatel-Lucent 1665 DMX has been designed with multi-vendor interoperobility in mind. As many vendor's equipment (including legacy equipment) may not be able to use IEEE802.1w, Alcatel-Lucent 1665 DMX can automatically fall back on IEEE802.1d in the event that other NEs in the network are running standard spanning tree protocol. However, Alcatel-Lucent 1665 DMX employs IEEE 802.1w as a default spanning tree protocol.

Function of spanning tree

Ethernet requires a network with a tree structure in order to work effectively. Ethernet bridges and switches build tables that define the paths to specific devices. A MAC bridge, for example, will have a filtering database that defines where to send any packets addressed to a specific MAC within the network. The tables are built based on input from devices within the network.

If there is a loop in the network, that is, if there is more than one way to get to a destination device, two problems can result:

- Frames may be duplicated in the network. That is, the same frame may be sent to a node via two different paths.
- The address information is changed as packets from that device are received across different paths. In a meshed network, the re-configuration of the filtering database can begin to use up all the network resources, so that little bandwidth is left for data traffic.

The spanning tree accomplishes two important functions:

- It removes loops from the bridged network
- It allows re-configuration if a link fails.

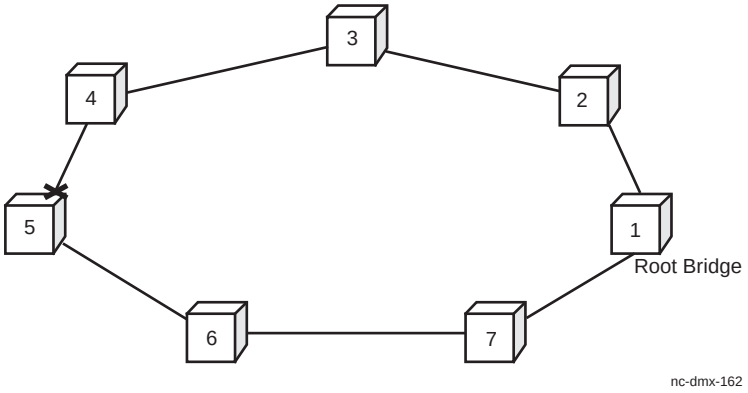
How it works

The spanning tree works as follows:

1. Initially, every node in the group thinks it is the root node.
2. As information about the network becomes clear, one node is designated the root node. It is from this node that the distance to any point in the network may be measured.
3. Configuration BPDUs are sent from each node to determine the most economical route from each node to the root node.
4. Some ports are blocked so that there are no loops in the network and so that the network provides the most efficient paths from the root to the nodes. This effectively creates a tree structure for the network.
5. If an active link fails, the network is re configured so that previously blocked links can be used for traffic.

The following figure illustrates the spanning tree:

Figure 5-12 Spanning tree switch



Legend:

Active links	1–2; 2–3; 3–4; 5–6; 6–7; 7–1
Inactive links	4–5
X	Indicates a blocked port (no packets sent or received on this port).

The configuration provides the shortest (most efficient) path from each node to the root. The configuration also provides only one path from the root node to any other node.

Re-configuration

If one of the active links were broken, the network would re-configure to allow traffic to get to the nodes. For example, if the link between 3 and 4 were broken, the link between 5 and 4 would be enabled. When the failure/break is repaired, the network will revert to the original configuration.

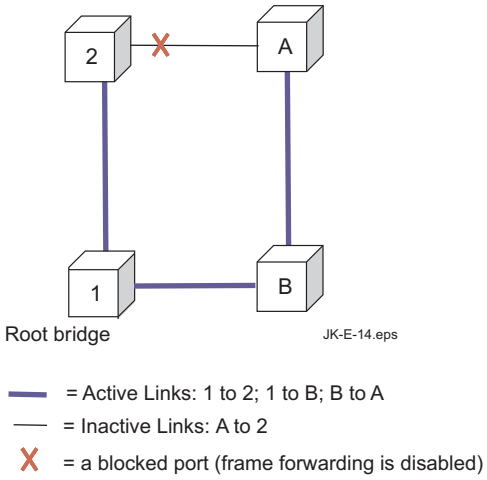
Spanning tree on LAN ports

Alcatel-Lucent 1665 DMX supports spanning tree on the LAN (customer facing) ports. STP on LAN ports ensures that single LAN interconnects are protected. Because redundant LAN interconnects create loops, STP manages the loops. STP is supported on the LAN ports of the LNW170 only.

Both LAN ports and VCGs can belong to STP groups. A LAN port can belong to only one STP group at a time. The BDPU VLAN ID is provisionable. VLAN IDs are provisionable on a per-port basis.

LAN based STP works exactly as described in the section above. The figure below depicts STP functioning on the customer side of an Alcatel-Lucent 1665 DMX with LNW170 circuit packs. The nodes marked A and B represent remote Ethernet switches or similar CPEs.

Figure 5-13 Spanning tree on LAN ports



Legend:

Active links	1 to 2; 1 to B; B to A
Inactive links	A to 2
X	Indicates a blocked port (frame forwarding is disabled)

Rapid spanning tree maintenance enhancements

Alcatel-Lucent 1665 DMX supports the following rapid spanning tree maintenance enhancements:

- Additional performance monitoring counters for VCG and LAN ports or Link Aggregation Groups (LAGs) to record spanning tree modification status
- Spanning tree group Automatic Lock parameter to disable a port which is unstable or rapidly reconfiguring. When the Automatic Lock parameter is enabled and any port in the Spanning Tree Group experiences a threshold-crossing alert (TCA) on the spanning tree state counter, the port is moved to the disabled-failure state preventing traffic flow until released.

Link aggregation (LNW170 LAN ports)

Overview

Alcatel-Lucent 1665 DMX supports link aggregation on any two LNW170 LAN ports of the same rate (that is, 100 or 1000 Mbps), operating in switched mode. The LNW170 supports LAG operation across LNW170 packs, and equipment protected link aggregation.

Link aggregation can also provide facility protection on LNW170 LAN ports.

Hitless bandwidth increase/decrease

Ordinarily, multiple Ethernet links between two bridges form loops (unless a spanning tree blocks all but one) so they can't be used to increase bandwidth. Link Aggregation causes defined groups of links to be treated as a single logical link, making multiple LAN ports appear as one. In this way, Bandwidth may be increased without requiring an upgrade to a higher rate link.

Facility protection

Link aggregation can also remove failed links automatically, thereby providing a means of facility protection. When a link fails, traffic is shifted to the remaining links in that Link Aggregation Group (LAG). More links than are needed can be added to the group and each is active until it fails (similar to utilizing LCAS protection for SONET tributaries). When two links are on different packs they can provide both, facility and equipment protection.

In Active/Standby LAG, one link of the LAG is designated as the protection link and the other is the working link. Only the working link carries MAC client traffic when none of the links fails. When the working link fails, the traffic switches to the protection link. The protection switching is bidirectional and revertive.

Equipment protection

The LNW170 circuit pack can be provisioned for equipment protection, in which link aggregation plays a role. The LNW170 supports equipment protection of function group pairs (e.g. D1, D2) using an interpack interface. Only ports 1, 2, 5 and 6 are usable. Ports 3, 4, 7 and 8 cannot be used. Signals of all usable LAN ports are fed to both LNW170 cards via the interpack interface, so that the same-numbered port of each pack belongs to a preset Link Aggregation Group. When a pair of LNW170s is used in equipment protection mode, both LNW170s are provisioned identically, except for certain physical layer parameters that remain independent. They send and receive the same signals across the backplane toward the Mains. The Mains select which of the pair is the ActiveWAN.

Link aggregation control protocol

Link Aggregation is specified in IEEE 802.3 clause 43, formerly specified in 802.3ad. An LNW170 can be configured to either use this standard protocol to control link aggregation (which negotiates with the equipment at the other end of the link) or to simply force aggregation without a control protocol. Both ends should be provisioned to use the same protocol

General link aggregation rules

Link aggregation behaves along the following basic guidelines:

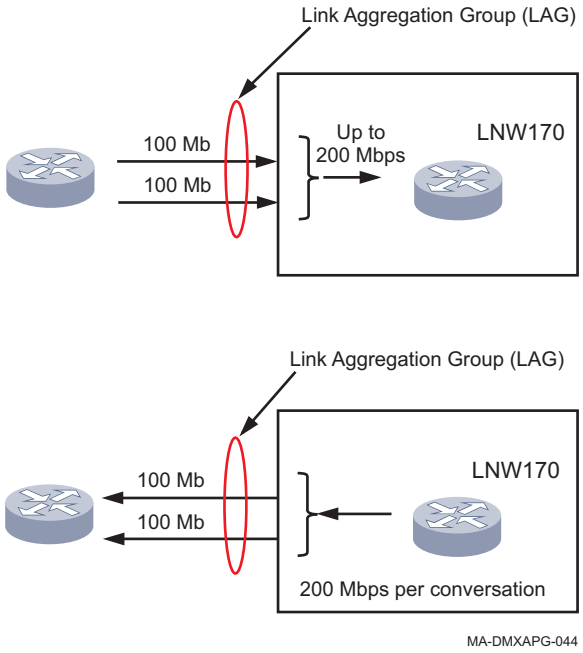
- Available for LAN ports on the LNW170 in switched mode only
- Maximum of 4 LAGs per pack, 2 ports per LAG, and 8 LAGs per function unit or growth group. There are 8 ports on each LNW170 pack.
- The two ports in a LAG must be on the same pack, and be functioning at the same rate (i.e. 100 or 1000 Mbps).
- All links in a LAG are in-service until they fail. Standby links, providing 1x1 SONET-style protection, are a future feature.
- When a LAG is created, the attributes (VLAN, virtual switch, and other L2 provisioning) of the first port used to establish the LAG are transferred to the LAG. When the second port is added, it then inherits the L2, VLAN and Virtual Switch (VS) characteristics of the LAG for the time it remains a member. It can not be part of a VS or have any VLAN provisioning when added.
  - Both member ports can also be added simultaneously and Alcatel-Lucent 1665 DMX recognizes a parameter that distinguishes the "Lead Port". The LAG (and by association, the other port in the LAG) inherits the L2, VLAN, and VS attributes of the Lead Port.
- When a port is removed from a particular LAG, it is no longer a member of a VS.
- A port must have L2 and VS provisioning in order for a port to be used as the Lead port or to establish a LAG (VLAN provisioning not required). This information is then transferred to the LAG once it's created.
- The last port/member of a LAG cannot be removed from the LAG; the LAG itself must be deleted. The last port/member of a LAG inherits the LAG's L2, VLAN, and VS attributes.
  - If the last member in the LAG was the first member added originally, and if there were no subsequent changes to L2 and VLAN attributes, the port will effectively revert to its original state when the LAG is deleted.
  - If the last member/port in the LAG was not the first added initially it will inherit the characteristics of the LAG rather than reverting to its original state.

Link aggregation example

The figure below depicts link aggregation on two LNW170 LAN ports functioning at 100Mbps. The top portion of the figure shows two ports receiving separate 100 Mbps inbound flows. The bottom portion depicts the same two flows being equally split across the two outbound ports in the LAG. In this example, no failure has occurred and both ports comprising the LAG are in-service.

Traffic entering incoming ports is aggregated into a LAG. While both ports are in-service, outgoing traffic is split between working ports.

Figure 5-14 Link aggregation at 100 Mbps (all ports in-service)



The instance pictured above represents the ideal case, in which there are at least 2 flows, each a maximum of 100Mbps. In this case they can be equally split over the two ports comprising the LAG. The ability to split the two flows across multiple ports also depends on the distribution of MAC/IP addresses.

Link aggregation employs an algorithm that assigns traffic to member ports to prevent misreading. A given flow can be assigned to only one port and cannot be split across multiple ports in the same LAG. To increase flexibility, Alcatel-Lucent 1665 DMX allows a flow to be defined by either a MAC source and destination address pair or an IP source and address pair. The algorithm uses the XOR of the least significant bits of the address pairs to assign a port/link. Therefore, the actual load balancing achieved depends on the distribution of MAC/IP addresses.

Equipment protection

True 0x1 mode

The VLF Main circuit packs (LNW59, LNW82, and LNW504), allow true 0x1 unprotected operation for circuit packs. That means that tributary circuit packs can function unprotected and any slot can be equipped with any pack (some restrictions apply). Two unprotected circuit packs of the same type can also populate adjacent slots in the same group (this includes some Ethernet packs). For detailed information on circuit pack/slot equipage restrictions in 0x1 mode, see "Very large fabric (VLF) engineering rules" (p. 6-15).

For OC-n ports, the 0x1 application is provisionable on a per-port basis. This allows packs with multiple ports to function in mixed modes with some ports running in a protected mode (UPSR, BLSR, 1+1), while others can be 0x1 unprotected.

In order for an OC-n pack to be unprotected, allowing 2 packs of the same kind to populate adjacent slots as stated above, all ports on the pack must be provisioned for 0x1.

When unprotected, all provisioning, reporting and retrieval (of alarms) associated with the pack, ports and tributaries in Slot 1 are independent of the provisioning, reporting and retrieval associated with the pack, ports and tributaries in Slot 2.

When provisioned for 0x1 operation, the affect on service and severity of alarms issued against a pack in Slot 1 of a particular group are independent from the affect on service and the severity of the alarms issued against the pack in Slot 2 of that group.

Protection switching priorities

The following protection switching priorities on equipment are user-controllable through TL1 commands:

- inhibit switch (low-speed interfaces only)
- forced switch (low-speed interfaces only)
- signal fail (low and high-speed interfaces)
- manual switch (low and high-speed interfaces)

If protection is not desired, interfaces can be provisioned for no protection by not equipping the adjacent Function Unit slot.

Performance monitoring

Overview

Purpose

This section lists and describes performance monitoring parameters, SNMP traps and parameters, data storage, thresholds, and TCA transmission.

The following performance monitoring information is included in this section:

Contents

Performance monitoring terms	5-63
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DS3 performance monitoring parameters	5-75
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SNMP parameters and traps	5-110

Performance monitoring terms

Overview

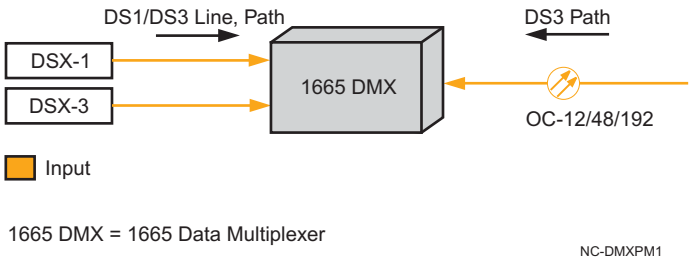
Alcatel-Lucent 1665 DMX uses performance monitoring (PM) to support proactive maintenance of the network and tariffed service performance verification. Proactive maintenance refers to the process of detecting degrading conditions not severe enough to initiate protection switching or alarming but indicative of an impending hard or soft failure. Hard and soft failures result in reactive maintenance. PM conditions are reported on both SONET and electrical interfaces.

Proactive maintenance

Proactive maintenance consists of monitoring performance parameters associated with the SONET sections, lines and paths within the SONET network, as well as incoming and outgoing bytes and frames on electrical (DS1/3) ports. The "Standard SONET PM MIB module" (p. 5-110) section, lists the SONET performance parameters monitored by Alcatel-Lucent 1665 DMX. Thresholds are set for these parameters to identity degraded performance. When a performance-monitoring threshold is crossed, it is reported to the message-based operations system where all threshold crossings associated with a particular path can be correlated, and the likely source of the degradation can be identified. Electrical performance monitoring parameters are listed later in this section.

The figure below shows DS1/DS3 line and path and DS3 path performance monitoring. Alcatel-Lucent 1665 DMX monitors DS3 line and path parameters from the DSX-3 and DS3 path parameters from the optical path.

Figure 5-15 DS1/DS3 line/path performance monitoring



Section parameter

No Far-End PM parameters are defined for the Section layer. The system, as it receives SONET signals, terminates the SONET Section and Line layers and therefore is involved with Section layer PM. Section layer PM applies to optical and electrical SONET interfaces. It also applies to service and protection sections of optical sections.

Line parameter

A line is a physical transport vehicle that provides the means of moving digital information between two points in a network. The line is characterized by a metallic transmission medium and its specific coding type. A line is bounded by its two end points, known as line terminations. A line termination is the point where the electrical, bipolar line signal is generated and transmitted, or received and decoded.

Path parameter

A path is a framed digital stream between two points in a network and represents digital signal transport at a specified rate, independent of the equipment and media providing the physical means of transporting the signal. A path is defined by its two end points, called path terminations, where its frame structure is generated and decoded. A path may be carried wholly within one transport segment (line), or it may span a sequential arrangement of two or more transport segments.

Optical transmission section (OTS) parameter

The OTS layer is the lowest layer of the optical layer network (OLN)/optical transport network (OTN) that provides physical transport of the optical multiplex section (OMS) layer signal via the optical terminal multiplexer (OTM). The OTS layer is terminated on the OTS terminating equipment. The OTS layer represents the server layer for the OMS layer. The OTS layer is comparable in function to the SONET section layer.

Optical channel layer (OCH) parameter

The OCH layer is the top layer of the OLN that provides transport of client signals (e.g., SONET, GbE, OTUk). The OCH layer is terminated on an OCH terminating equipment. The OCH is the information structure used to support the OCH trail. The OCH layer represents the client layer for the OMS layer. The OCH layer is comparable in function to the SONET path layer. The OCH is an information structure consisting of the information payload with a certain bandwidth and non-associated overhead for management of the optical channel.

The LNW785 has 8 OCH ports, supporting ITU-T DWDM channels 52 through 59 (195.20–195.90 THz).

DS1 performance monitoring

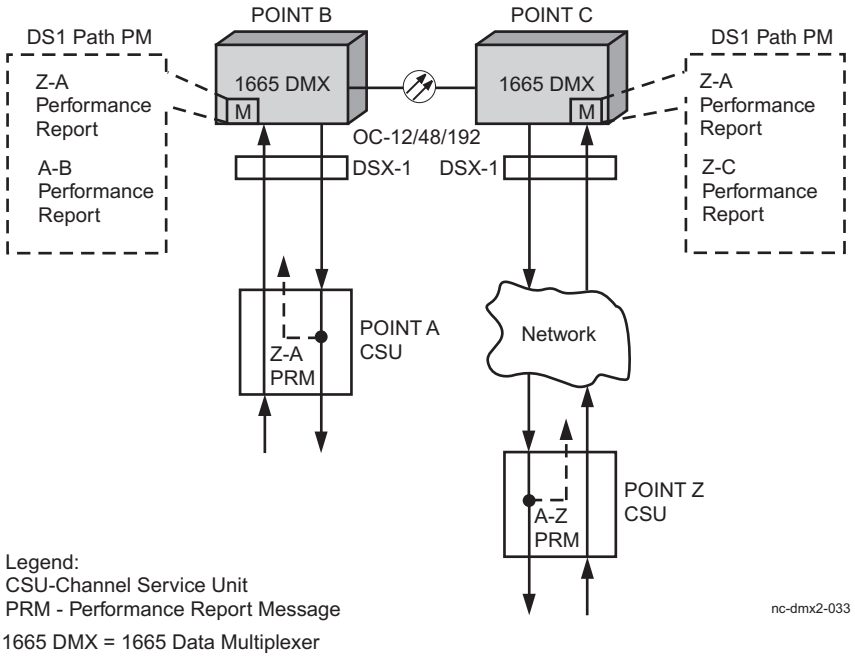
Tariffed service verification consists of monitoring performance parameters that can be associated with the customer's end-to-end service. Alcatel-Lucent 1665 DMX provides this capability for DS1 services with the DS1 performance monitoring feature. Based on *ANSI* T1.403 extended superframe format (ESF), this capability retrieves performance messages written into the ESF data link by the customer's terminal equipment. From these messages, Alcatel-Lucent 1665 DMX can determine and report the end-to-end error performance of the entire DS1 link *as seen by the customer*. The parameters, listed in Table 5-9, “DS1 performance parameters” (p. 5-70), are set and reported to indicate degraded performance. The counts are retrieved by the message-based operations system to determine if the service is operating within tariffed limits.

Application of the DS1 performance monitoring feature for tariffed service verification is shown in the figure below. This shows an *ANSI* T1.403 ESF format DS1 service carried between points A and Z, using an OC-48/OC-192 system and terminated at the customer's premises with channel service units (CSUs). At the "A" end, the received error performance, (Z–A) is detected and written by the customer CSU onto the outgoing (A–Z) ESF data link as a performance report message (PRM). The DS1 PM circuit pack interfacing the A end reads the incoming DS1 signal's PRM (received from the customer's premises) and reports the Z–A performance. Likewise, the OC-48/OC-192 system interfacing the Z end reports the A–Z performance by reading the PRM from the customer's "Z" CSU. By reviewing data from each OC-48/OC-192 system, the service provider can determine the complete end-to-end performance (A–Z) and Z–A) of the customer's service.

DS1PM circuit pack

Additionally, each PM enabled DS1 circuit pack measures the near-end performance of the incoming DS1, allowing the service provider to determine if a good DS1 signal was received from the customer before transporting it through the network. This information can aid in isolating any reported performance problems. The circuit pack can also provide this same near-end information for super frame (SF) formatted (sometimes known as "D4 framing") DS1 services, but complete end-to-end performance verification is limited due to the lack of the PRM in the SF format.

Figure 5-16 DS1 path performance monitoring



DS3 performance monitoring

Alcatel-Lucent 1665 DMX provides DS3 performance monitoring with three DS3 path PM options: P-bit (parity bit), adjusted F&M bit (frame and multiframe bit), and C-bit.

P-Bit

When FMT is set to P-bit, P-bit errors are used as the basis for determining code violation counts. When provisioned for P-bit, the system calculates and provides counts of DS3 P-bit coding violations (CV), errored seconds (ES), and unavailable seconds (UAS) incoming from the fiber. Quarter-hour and day registers are provided with provisionable threshold crossing alerts (TCAs) on a per-shelf basis. Severely errored frame seconds (SEFS) are also monitored.

Because P-bits can be corrected at nodes provisioned for VMR along a DS3 path, the DS3 P-bit PM data may not provide a complete report of the end-to-end DS3 path errors.

Adjusted F&M bit

When FMT is set to FM-bit, F&M bits are used as the basis for determining code violation counts. Adjusted F&M bit performance monitoring provides an alternative method for determining and accumulating DS3 path performance data based on an error estimation technique using errors on the F&M framing bits to approximate the actual error counts in the DS3 path payload. F&M bits are not corrected at nodes provisioned for VMR along a DS3 path. When provisioned for adjusted F&M bit, the system calculates and provides estimated counts of DS3 adjusted F&M bit coding violations (CV), errored seconds (ES), severely errored seconds (SES), and unavailable seconds (UAS) incoming from the fiber.

Quarter-hour and current day registers are provided with provisionable threshold crossing alerts (TCAs) on a per-shelf basis. Severely errored frame/AIS seconds (SAS-P) are also monitored.

C-Bit

When FMT is set to cbit, C-bit errors are used as the basis for determining code violation counts.

The system provides counts of DS3 C-Bit parity coding violations (CV-P), errored seconds (ES-P), severely errored seconds (SES-P), and unavailable seconds (UAS-P) incoming from the DSX-3 and the fiber. The type of performance monitoring is provisioned per DS3 service by a CIT command.

For C-bit PM, the DS3 service can be provisioned in violation monitor (VM) or violation monitor and removal (VMR) modes. In VM mode, the C-bit errors are not corrected as in the P-bit option.

Quarter-hour and day registers are provided with provisionable threshold crossing alerts (TCAs). The TCAs are provisionable on a per-shelf basis. Severely errored frame seconds (SEFS) counts are also provided.

Performance monitoring reports

Summary reports and status reports are available to perform performance monitoring.

TCA summary report

Alcatel-Lucent 1665 DMX provides a report that lists the number of SONET, DS1, and DS3 performance-monitoring parameters that have crossed their thresholds. This report provides a snapshot of the system performance level. If there is signal degradation, it is quickly pinpointed so that corrective action may be taken before customers are affected, thus supporting proactive maintenance. Threshold-crossing alerts (TCAs) are reported on the Ethernet parameters listed in the table above.

This report provides separate parameter summaries for each signal level in the system, including SONET section, line, and path and Electrical line and path. The parameter summaries show the user which performance status to request if they want further information.

Performance status reports

These reports provide detailed information on the current and previous 8 hours in quarter-hour (15-minute) increments, as well as the current and previous day's performance. Threshold crossing alerts are clearly identified and the time the performance registers were last initialized is also shown. Any registers that may have been affected by this initialization are marked. There are separate reports for section, line, and path parameters, as well as Ethernet parameters.

Ethernet performance monitoring

Alcatel-Lucent 1665 DMX provides PM capabilities for the 10/100/1000T, 1G SX, and 1G LX, and 1G ZX Ethernet interfaces. PM data is collected at each LAN and WAN interface in the network for both incoming and outgoing directions. The WAN interface provides a connection to a SONET Virtual Concatenation Group (VCG).

For details regarding Ethernet PM and SNMP capabilities, see “Performance monitoring” (p. 5-62)

DDM monitoring parameters

Digital Diagnostics Monitoring (DDM) monitoring parameters is supported on optical pluggable transmission modules.

Important! Electrical pluggable transmission modules do not support Digital Diagnostics Monitoring.

The following DDM monitoring parameters are supported.

- Laser Bias Current (milliamperes)
  - Range is 0.0 to 131.0.
  - Accuracy is at least ±10% of nominal value.
  - If socket is in AUTO state, then - is displayed.
  - If socket is currently empty, then ? is displayed.
  - If the laser is turned off, then NA is returned.
- Optical Power - Receive (dBm)
  - Range is −40.0 to +8.2, or LOS.
  - Accuracy is ±3 dB.
  - If socket is in AUTO state, then - is displayed.
  - If socket is currently empty, then ? is displayed.

- Optical Power - Transmit (dBm)
  - Range is −40.0 to +8.2
  - Accuracy is ±3 dB.
  - If socket is in AUTO state, then - is displayed.
  - If socket is currently empty, then ? is displayed.
  - If DDM is not supported on the PTM, then NA is displayed.
- Optical Power - Receive Type
  - OMA for Optical Modulation Amplitude
  - AVG for average power
  - If socket is in AUTO state, then - is displayed.
  - If socket is currently empty, then ? is displayed.
  - If DDM is not supported on the PTM, then NA is displayed.
- Temperature (Celsius)
  - SFP: Range is −128°C to +128°C.
  - XFP: Range is −40°C to +125°C.
  - Accuracy is ±3°.
  - If socket is in AUTO state, then - is displayed.
  - If socket is currently empty, then ? is displayed.

DS1 performance monitoring parameters

Overview

This section describes the performance monitoring parameters relevant to DS1 signals incoming from the fiber or DSX-1.

DS1 ESF format

Tariffed service verification consists of monitoring performance parameters that can be associated with the customer's end-to-end service. Alcatel-Lucent 1665 DMX provides this capability for DS1 services when equipped with 28DS1 circuit packs with the DS1 performance monitoring feature (28DS1PM [LNW7]) and the high density LNW8/LNW801 56DS1/E1 circuit pack. Based on *ANSI* T1.403 extended superframe format (ESF), this capability retrieves performance messages written into the ESF data link by the customer's terminal equipment. From these messages, Alcatel-Lucent 1665 DMX can determine and report the end-to-end error performance of the entire DS1 link *as seen by the customer*. The counts are retrieved by the message-based operations system to determine if the service is operating within tariffed limits.

DS1 SF format

Each 28DS1PM and 56DS1/E1 circuit packs measure the near-end performance of the incoming DS1 signals, allowing the service provider to determine if a good DS1 signal was received from the customer before transporting it through the network. This information can then aid in isolating any reported performance problems. The 28DS1PM and 56DS1/E1 circuit packs can also provide this same near-end information for super frame (SF) formatted (sometimes known as "D4 framing") DS1 services, but complete end-to-end performance verification is limited due to the lack of the PRM in the SF format.

Monitored parameters

The following table lists the DS1 line and path performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-9 DS1 performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[2]	Default	Range[2]
DS1 Line	Errored Seconds-Line, Line Far End (ES-L, ES-LFE	65	0–900	648	0–65535
	Coding Violations (fmt=ESF) (CV-L)	13340	0–16383	133400	0–1048575
	Severely Errored Seconds (SES-L)	65	0–900	648	0–65535

Table 5-9 DS1 performance parameters (continued)

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[2]	Default	Range[2]
DS1 Path	Coding Violations (fmt=SF) (CV-P) (CV-P-EGR)[1]	13296	0–16383	132960	0–1048575
	Coding Violations (fmt=ESF) (CV-P) (CV-P-EGR)[1]	65	0–900	648	0–65535
	Errored Seconds (ES-P) (ES-P-EGR)[1] Errored Seconds Far End (ES-PFE) (ES-PFE-EGR)[1]	65	0–900	648	0–65535
	Severely Errored Seconds (SES-P) (SES-P-EGR)[1] Severely Errored Seconds Far End (SES-PFE) (SES-PFE-EGR)[1]	10	0–900	100	0–65535
	Unavailable Seconds (UAS-P) (UAS-P-EGR)[1] Unavailable Seconds Far End (UAS-PFE) (UAS-PFE-EGR)[1]	10	0–900	10	0–65535
	Severely Errored Frame/Alarm Indication Signal Seconds (SAS-P) (SAS-P-EGR)[1] Severely Errored Frame Seconds Far End (SEFS-PFE) (SESFS-PFE-EGR)[1]	2	0–900	17	0–65535

Notes:

1. Egress parameters are reported for the LNW20 in portless mode using the -EGR suffix. Threshold provisioning is common. There are no separate thresholds for the egress parameters.
2. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

DS1 line parameters

Alcatel-Lucent 1665 DMX monitors the near end DS1 line parameter on incoming (from the DSX-1 cross-connect) DS1 signals. The parameter is measured at the input of the DS1 circuit pack on the DS1 line side (also referred to as facility, customer terminal, or DSX side).

Coding violations (CV-L)

The Near-End Line Coding Violation (CVL) parameter for each SONET Line is monitored. The Near-End CVL parameter increments once for every occurrence of a BIP error detected at the Line layer (i.e. using the B2 byte in the incoming SONET signal). Up to 8*N BIP errors can be detected per STS-N frame.

Errored seconds (ES-L)

The near end ES-L parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects either one or more bipolar violations (BPVs) or excessive zeros (EXZ), or one or more LOS defects.

Severely errored seconds (SES-L)

The Near-End Line Severely Errored Seconds (SESL) parameter for each SONET Line is monitored. The Near-End SESL parameter increments once for every second that contains at least K BIP errors detected at the Line layer (at any point during the second), or an AIS-L defect was present. The value of K is hard-coded, see table 7 for a list of the values

DS1 line PM report

Use the **Performance** → **Reports** → **DS1 line** command to obtain the DS1 Line PM Report. Near end DS1 line PM is reported with an AID of the DS1 interface and a modifier of T1. For more information about the DS1 line parameter and the **Performance** → **Reports** → **DS1 line** command, see the *WaveStar*® CIT online help.

Near end DS1 path parameters

Alcatel-Lucent 1665 DMX monitors the following near end DS1 path parameters at the local network element. The parameters are measured at the input of the local DS1 or TMUX circuit pack on the DS1 line side (also referred to as facility, customer terminal, or DSX side).

Coding violations (CV-P)

For the SF format, the CV-P parameter increments once for each frame synchronization bit error (FE) detected at the path level. For the ESF format, the CV-P parameter increments once for each cyclic redundancy check error (CRC) detected at the path level.

Errored seconds (ES-P)

For the SF format, he ES-P parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects FE errors, CS events, SEF defects, or AIS defects. For the ESF format, he ES-P parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects CRC errors, CS events, SEF defects, or AIS defects.

Severely errored seconds (SES-P)

For the SF format, the SES-P parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects 8 or more FE events (if Ft and Fs bits are measured) or 4 or more FE events (if only Ft bits are monitored), or SEF defects, or AIS defects.

Unavailable seconds (UAS-P)

A UAS-P is a second during which the path is unavailable. A path is considered unavailable from the beginning of 10 consecutive severely errored seconds until the beginning of 10 consecutive seconds, none of which are severely errored.

Severely errored frame/alarm indication signal seconds (SAS-P)

The SAS-P parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects either one or more severely errored frame defects, or one or more AIS defects. The SAS-P parameter applies to SF and ESF frame formats.

Near end DS1 path PM report

Use the **Performance** → **Reports** → **DS1 path** command to obtain the DS1 Path PM Report. Near end DS1 path PM is reported with an AID of the DS1 or TMUX interface and a modifier of T1. For more information about the DS1 path parameters and the **Performance** → **Reports** → **DS1 path** command, see the *WaveStar*® CIT online help.

Far end DS1 path parameters

Alcatel-Lucent 1665 DMX monitors the following far end DS1 path parameters at the local network element. If the far end network element detects an incoming error, the far end network element communicates the error back to the local near end network element using Performance Report Message (PRM) frames or a Remote Alarm Indication (RAI) signal.

The far end parameters are measured at the input of the local DS1 or TMUX circuit pack on the DS1 line side (also referred to as facility, customer terminal, or DSX side).

Important! The format must be set to ESF to monitor the far end parameters (CV-PFE, ES-PFE, SES-PFE, and UAS-PFE).

Coding violations Far End (CV-PFE)

The CV-PFE parameter increments based on the PRM G bits defined in the following table.

Table 5-10 CV-PFE parameter increments

PRM Bit = 1	CV Count Accumulated
G1	1
G2	5
G3	10
G4	100
G5	319
G6	333

Errored seconds Far End (ES-PFE)

The ES-PFE parameter is a count of one second PRM intervals containing an RAI or RAI-CI signal, or a 1 in any of the following bits: G1, G2, G3, G4, G5, G6, SE, or SL.

Severely errored seconds Far End (SES-PFE)

The SES-PFE parameter is a count of one second PRM intervals containing an RAI or RAI-CI signal or a 1 in any of the following bits: G6 or SE.

Unavailable seconds Far End (UAS-PFE)

A UAS-PFE is a second during which the path is unavailable. A path is considered unavailable from the beginning of 10 consecutive severely errored seconds until the beginning of 10 consecutive seconds, none of which are severely errored.

Severely errored frame seconds (SEFS-PFE)

The SEFS-PFE parameter is a count of 1 second PRM intervals that SE bit is equal to 1.

Far end DS1 path PM report

Use the **Performance** → **Reports** → **DS1 path** command to obtain the DS1 Path PM Report. Far end DS1 path PM is reported with an AID of the DS1 or TMUX interface and a modifier of T1. For more information about the DS1 path parameters and the **Performance** → **Reports** → **DS1 path** command, see the *WaveStar*® CIT online help.

DS3 performance monitoring parameters

Overview

This section describes the performance monitoring parameters that are monitored on DS3 signals incoming from the high speed fiber and from the local DSX-3 cross-connect.

In order to generate DS3 PM reports, the port Primary State must be IS (in service). (When the PST parameter is provisioned as AUTO and a valid DS3 signal is detected, the PST parameter automatically transitions to the IS state.) The VM mode should be off because the P-bits can be corrected at nodes where the VM Mode is provisioned on, and the DS3 P-bit PM data may not provide a complete report of the end-to-end DS3 path errors.

Monitored parameters

The following table lists the DS3 line and path performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-11 DS3 performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[2]	Default	Range[2]
DS3 Line	Coding Violations (CV-L)	387	0–16383	3865	0–1048575
	Errored Seconds (ES-L)	25	0–900	250	0–65535
	Severely Errored Seconds (SES-L)	4	0–900	40	0–65535

Table 5-11 DS3 performance parameters (continued)

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[2]	Default	Range[2]
DS3 Path	Coding Violations (CV-P) (CV-P-EGR)[1] Coding Violations Far End (CV-PFE) (CV-PFE-EGR)[1]	382	0–16383	3820	0–1048575
	Errored Seconds (ES-P) (ES-P-EGR)[1] Errored Seconds Far End (ES-PFE) (ES-PFE-EGR)[1]	25	0–900	250	0–65535
	Severely Errored Seconds (SES-P) (SES-P-EGR)[1] Severely Errored Seconds Far End (SES-PFE) (SES-PFE-EGR)[1]	4	0–900	40	0–65535
	Unavailable Seconds (UAS-P) (UAS-P-EGR) Unavailable Seconds Far End (UAS-PFE) (UAS-PFE-EGR)[1]	10	0–900	10	0–65535
	SE Frame/Alarm Indication Signal Seconds (SAS-P) (SAS-P-EGR)[1] SE Frame/Alarm Indication Signal Seconds Far End (SAS-PFE) (SAS-PFE-EGR)[1]	2	0–900	8	0–65535

Notes:

1. Egress parameters are reported using the -EGR suffix. Threshold provisioning is common. There are no separate thresholds for the egress parameters.
2. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

DS3 line parameters

Alcatel-Lucent 1665 DMX monitors the following ingress near end DS3 line parameters on incoming (from the DSX-3 cross-connect) DS3 signals. Ingress refers to performance monitoring parameters that are measured at the input of the DS3 or TMUX circuit pack on the DS3 line side (also referred to as facility, customer terminal, or DSX side).

Supported performance monitoring signal formats

Alcatel-Lucent 1665 DMX supports DS3 line performance monitoring on DS3 signals with P-bit parity, FM-bit parity, or CP-bit parity performance monitoring signal formats.

Coding violations (CV-L)

The near end CV-L parameter increments once for each bipolar violation (BPV) and excessive zeros (EXZ) detected at the DS3 line layer.

Errored seconds (ES-L)

The near end ES-L parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects either one or more bipolar violations (BPVs) or excessive zeros (EXZ), or one or more LOS defects.

Severely errored seconds (SES-L)

The near end SES-L parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects either one or more LOS defects, 2444 or more BPVs at a minimum BER of 7.5 X 10^{-5}, or 45 or more BPVs at a minimum BER of 1 X 10^{-6}.

DS3 line PM report

Use the **Performance** → **Reports** → **DS3 Line** command to obtain the DS3 Line PM Report. Ingress near end DS3 line PM is reported with an AID of the DS3 or TMUX interface and a modifier of T3. For more information about the DS3 line parameters and the **Performance** → **Reports** → **DS3 Line** command, see the *WaveStar*® CIT online help.

DS3 path performance monitoring signal format

Alcatel-Lucent 1665 DMX supports the following DS3 path performance monitoring signal formats:

- P-bit parity: The P bits are monitored for detecting code violations at the near end.
- FM-bit parity: The F and M bits are monitored for detecting code violations at the near end.
- CP-bit parity: CP-bit parity is used for end-to-end DS3 path PM (near end and far end). The C bits are monitored for code violations. CP-bit parity is only allowed on DS3 signals with the C-bit signal format.

P-bit parity

When provisioned for P-bit parity, Alcatel-Lucent 1665 DMX calculates and provides counts of the following near end DS3 path parameters incoming from the fiber or DSX-3:

- Coding violations (CV-P)
- Errored seconds (ES-P)
- Severely errored seconds (SES-P)
- Unavailable seconds (UAS-P)
- Severely errored frame/alarm indication signal seconds(SAS-P)

FM-bit parity

FM-bit parity provides an alternative method for determining and accumulating DS3 path performance data based on an error estimation technique using errors on the F&M framing bits to approximate the actual error counts in the DS3 path payload.

Adjusted F&M bit performance monitoring estimates the following near end DS3 path parameters incoming from the fiber or DSX-3:

- Coding violations (CV-P)
- Errored seconds (ES-P)
- Severely errored seconds (SES-P)
- Unavailable seconds (UAS-P)
- Severely errored frame/alarm indication signal seconds (SAS-P)

CP-bit parity

When provisioned for CP-bit parity, Alcatel-Lucent 1665 DMX calculates and provides counts of the following DS3 near end and far end path parameters incoming from the fiber or DSX-3:

- Coding violations (CV-P)
- Coding violations Far End (CV-PFE)
- Errored seconds (ES-P)
- Errored seconds Far End (ES-PFE)
- Severely errored seconds (SES-P)
- Severely errored seconds Far End (SES-PFE)
- Unavailable seconds (UAS-P)
- Unavailable seconds Far End (UAS-PFE)
- Severely errored frame/alarm indication signal seconds (SAS-P)
- Severely errored frame/alarm indication signal seconds Far End (SAS-PFE)

Violation monitoring and removal

The DS3 path performance monitoring signal formats support provisionable P-bit monitoring and correction (violation monitoring mode) on the outgoing DS3 signal toward the DS3 facility.

The following table shows the provisionable DS3 signal formats, performance monitoring signal formats, and VM modes.

Table 5-12 DS3 signal formats, PM signal formats, and VM modes

DS3 Signal Format	Performance Monitoring Signal Format	VM Mode	Monitor P-Bits	Correct P-Bits
C-Bit	P-bit parity	On	X	X
		On	X	
	FM-bit parity	On		X
		On		
	CP-bit parity	On		X
		On		

Near end DS3 path parameters

Alcatel-Lucent 1665 DMX monitors the following ingress and egress near end DS3 path parameters at the local network element. Ingress refers to parameters that are measured on incoming DS3 signals at the input of the local DS3 or TMUX circuit pack on the DS3 line side (also referred to as facility, customer terminal, or DSX side). Egress refers to parameters that are measured on incoming DS3 signals at the input of the local DS3 port unit on the SONET side (also referred to as fiber side).

Coding violations (CV-P)

The near end CV-P parameter increments once for each parity error detected at the path level. The CV-P parameter applies to all performance monitoring signal formats.

In the P-bit parity signal format, P-bit errors corresponding to the same DS3 M-frame also increment the CV-P parameter.

For CP-bit parity signal format, the three C-bits in subframe 3 of a C-bit formatted DS3 frame carry the DS3 path-parity information. At the DS3 transmitter, the CP bits in the DS3 C-bit frame are set equal to the two P-bits in frame "n". These CP bits are then inserted into frame "n+1". Since the CP bits are not modified in any way while passing through the network, the DS3 high-speed receiver can determine if errors occurred in the

DS3 path. The DS3 receiver computes the parity of frame "n" and compares that parity with the value received in the CP bits in frame "n+1". If the values do not match, DS3 path parity violations are counted.

Errored seconds (ES-P)

The near end ES-P parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects either one or more parity errors, one or more SEF defects, or one or more AIS defects. The ES-P parameter applies to all performance monitoring signal formats.

Severely errored seconds (SES-P)

The near end SES-P parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects either one or more AIS or SEF defects, 2444 or more BPVs at a minimum BER of 7.5×10^{-5}, or 45 or more BPVs at a minimum BER of 1×10^{-6}. The SES-P parameter applies to all performance monitoring signal formats.

Unavailable seconds (UAS-P)

A near end UAS-P is a second during which the path is unavailable. A path is considered unavailable from the beginning of 10 consecutive severely errored seconds until the beginning of 10 consecutive seconds, none of which are severely errored. The UAS-P parameter applies to the P-bit parity and FM-bit parity performance monitoring signal formats.

Severely errored frame/alarm indication signal seconds (SAS-P)

The SAS-P parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects either one or more severely errored frame defects, or one or more AIS defects. The SAS-P parameter applies to all performance monitoring signal formats.

Near end DS3 path PM report

Use the **Performance** → **Reports** → **DS3 Path** command to obtain the DS3 Path PM Report. Ingress near end DS3 path PM is reported with an AID of the DS3 or TMUX interface and a modifier of T3. Egress near end DS3 path PM is reported with an AID of the SONET interface and a modifier of T3. For more information about the DS3 path parameters and the **Performance** → **Reports** → **DS3 Path** command, see the *WaveStar*® CIT online help.

Far end DS3 path parameters

Alcatel-Lucent 1665 DMX monitors the following ingress and egress far end DS3 path parameters at the local network element. If the far end network element detects an incoming error, the far end network element communicates the error back to the local near end network element using far end block error (FEBE) bits in the DS3 path overhead. (This allows the local near end Alcatel-Lucent 1665 DMX to perform the PM accumulation, storage, threshold, and reporting functions for both the near end and far end.)

Ingress refers to far end parameters that are measured at the input of the local DS3 or TMUX circuit pack on the DS3 line side (also referred to as facility, customer terminal, or DSX side). Egress refers to far end parameters that are measured at the input of the local DS3 port unit on the SONET side (also referred to as fiber side).

Important! The DS3 signal format must be provisioned for C-Bit and the performance monitoring signal format must be provisioned for CP-Bit Parity to monitor the far-end parameters.

Coding violations Far End (CV-PFE)

The CV-PFE parameter increments as reported by the FEBE indication in the line overhead. At the far end if an incoming DS3 path error (for example, C-bit, F-bit, or M-bit error) is detected, an error indication is communicated back to the near end equipment by using the far end block error (FEBE) bits.

The FEBE message sent back from the far end is set to "111" if no path errors are detected. If a path error is detected, the FEBE message is set to "not 111." The FEBE monitor parameter (CV-PFE) increments once for each occurrence of a received "not all ones" pattern in the received FEBE message.

Errored seconds Far End (ES-PFE)

The ES-PFE parameter increments once for each second containing one or more M-frames with the three FEBE bits not all set to ONE or one or more far-end SEF or one or more far-end AIS defects.

Severely errored seconds Far End (SES-PFE)

The SES-PFE parameter increments once for each second where 2444 or more FEBE errors at a minimum BER of $7.5 \text{ X } 10^{-5}$, or 45 or more FEBE errors at a minimum BER of $1 \text{ X } 10^{-6}$ are detected as reported by the FEBE indication of the path overhead or one or more far-end SEF or one or more far-end AIS defects are detected.

Unavailable seconds Far End (UAS-PFE)

The UAS-PFE parameter is a count of 1 second intervals for which the DS3 path is unavailable at the onset of 10 contiguous SES-PFEs. The 10 SES-PFEs are included in the unavailable time. Once unavailable, the UAS-PFE continues to increment once for each second until ten consecutive seconds without SES-PFE are detected. The 10 seconds without SES-PFEs are excluded from the unavailable time.

Severely errored frame/alarm indication signal seconds Far End (SAS-PFE)

The SAS-PFE parameter increments once for each second where one or more far end severely errored frame defects, or one or more far end AIS defects are detected.

Far end DS3 path PM report

Use the **Performance** → **Reports** → **DS3 Path** command to obtain the DS3 Path PM Report. Ingress far end DS3 path PM is reported with an AID of the DS3 or TMUX interface and a modifier of T3. Egress far end DS3 path PM is reported with an AID of

the SONET interface and a modifier of T3. For more information about the DS3 path parameters and the **Performance** → **Reports** → **DS3 Path** command, see the *WaveStar*® CIT online help.

E1 performance parameters

Overview

This section describes the performance monitoring parameters that are applicable to E1 signals.

Monitored parameters

The following table lists the E1 line performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-13 SONET E1 performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
E1 Line	Errored Seconds (ES-L)	65	0–900	648	0–65535
	Severely Errored Seconds (SES-L)	10	0–900	100	0–65535
E1 Path	Background Block Errors - Path, Path Far End (BBE-P, BBE-PFE)	13290	0–16383	3865	0–1048575
	Errored Seconds - Path, Path Far End (ES-P, ES-PFE)	65	0–900	648	0–65535
	Severely Errored Seconds - Path, Path Far End (SES-P, SES-PFE)	10	0–900	100	0–65535
	Unavailable Seconds - Path, Path Far End (UAS-P, UAS-PFE)	10	0–900	10	0–65535

Notes:

1. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

E1 line parameters

Alcatel-Lucent 1665 DMX monitors the following near end SONET line parameters on incoming (from the local cross-connect) E1 signals. The parameters are measured at the input of the DS1/E1 circuit pack on the E1 line side (also referred to as facility, customer terminal, or STSX-1 side).

Errored seconds (ES-L)

The Near-End Line Errored Seconds (ESL) parameter for each SONET Line is monitored. The Near-End CVL parameter increments once for every second that contains at least one BIP error detected at the Line layer (at any point during the second), or an AIS-L defect was present. The Far-End Line Errored Seconds parameter for each SONET line is monitored. The Far-End ESL parameter increments once for each second where one or more Far-End Line layer BIP errors are detected as reported by the REI-L indication of the line overhead or an RDI-L defect is detected.

Severely errored seconds (SES-L)

The Near-End Line Severely Errored Seconds (SESL) parameter for each SONET Line is monitored. The Near-End SESL parameter increments once for every second that contains at least K BIP errors detected at the Line layer (at any point during the second), or an AIS-L defect was present. The value of K is hard-coded, see table 7 for a list of the values.

The Far-End Line Severely Errored Seconds parameter for each SONET line is monitored. The Far-End SESL parameter increments once for each second where K or more Line layer BIP errors are detected as reported by the REI-L indication of the line overhead or an RDI-L defect is detected. The integer value for K is set by standards and is selectable

EC-1 line PM report

Use the **Performance** → **Reports** → **EC1 Line** command to obtain the EC-1 Line PM Report. For more information about the EC-1 line parameters and the **Performance** → **Reports** → **EC1 Line** command, see the *WaveStar*® CIT online help.

E1 path parameters

Alcatel-Lucent 1665 DMX monitors the following near end path parameters on incoming (from the local cross-connect) E1 signals. The parameters are measured at the input of the DS1/E1 circuit pack on the E1 line side (also referred to as facility, customer terminal, or STSX-1 side).

Background block errors (BBE-P)

The Near-End E1 Background Block Errors (BBE-P) parameter for each E1 Path is monitored. The number of Near-End BBE-Ps in a one second period is equal to the Near-End EBC if the second is not a Near-End SES. Otherwise, the BBE-P is set to zero for that second.

The Far-End E1 Background Block Errors (BBE-P) parameter for each E1 Path is monitored. The number of Far-End E1 BBE-Ps in a one second period is equal to the Far-End EBC if the second is not a Far-End SESP and there is not a Near-End Defect. Otherwise, the BBE-P is set to zero for that second.

The BBE-P parameter applies only to the CRC-4 MultiFrame format.

Errored seconds (ES-P)

The Near-End E1 Path Errored Seconds (ESP) parameter for each E1 signal is monitored. The ESP parameter applies to both FAS format and CRC-4 MultiFrame format.

For the FAS format, the ESP parameter increments once for each one second interval containing one or more errored FAS anomalies, or one or more defects.

For the CRC-4 MultiFrame format, the ESP parameter increments once for each one second interval containing CRC-4 block errors, or one or more defects.

The Far-End E1 Path Errored Seconds (ESP) parameter for each E1 path is monitored. The Far-End ESP parameter applies to both FAS format and CRC-4 MultiFrame format.

For the FAS format, the Far-End ESP parameter increments once for each one second interval containing one or more RDI defects and there is not a Near-End Defect.

For the CRC-4 MultiFrame format, the Far-End ES parameter increments once for each one second interval containing one or more RDI defects, or a Far-End Block Error (FEBE), and there is not a Near-End Defect.

If the A-Bit equals 1 in four or more double frames, then there is an RDI defect.

Severely errored seconds (SES-P)

The Near-End E1 Path Severely Errored Seconds (SESP) parameter for each E1 path is monitored. The SES parameter applies to both FAS frame and CRC-4 MultiFrame formats.

For the FAS format, the SES parameter increments once for each one second interval containing 28 or more frame bit errors, or one or more defects.

For the CRC-4 MultiFrame format, the SES parameter increments once for each one second interval containing 300 or more CRC-4 block errors, or one or more defects.

The Far-End E1 Path Severely Errored Seconds (SESP) parameter for each E1 path is monitored. The Far-End SESP parameter applies to both FAS format and CRC-4 MultiFrame format.

For the FAS format, the Far-End SESP parameter increments once for each one second interval containing one or more RDI defects and there is not a Near-End Defect.

For the CRC-4 MultiFrame format, the Far-END ESP parameter increments once for each one second interval containing one or more RDI defects, or 300 or more FEBEs and there is not a Near-End Defect.

If the A-Bit equals 1 in four or more double frames, then there is an RDI defect.

FEBE is based on the E-bit (ITU-T G.704).

Unavailable seconds (UAS-P)

The Near-End E1 Path UAS Seconds (UASP) parameter for each E1 path is monitored. The UAS parameter is a count of 1 second intervals for which the E1 path is unavailable at the onset of 10 contiguous SESs. The 10 SESs are included in the unavailable time. Once unavailable, the UAS continues to increment once for each second until ten consecutive seconds without SES are detected. The 10 seconds without SESs are excluded from the unavailable time. The UAS parameter applies to both FAS frame and CRC-4 MultiFrame formats.

The Far-End E1 Path UAS Seconds (UASP) parameter for each E1 path is monitored. The Far-End UASP parameter is a count of 1 second intervals for which the E1 path is unavailable at the onset of 10 contiguous SESs. The 10 SESs are included in the unavailable time. Once unavailable, the Far-End UASP continues to increment once for each second until ten consecutive seconds without SES are detected. The 10 seconds without SESs are excluded from the unavailable time. The Far-End UASP parameter applies to both FAS frame and CRC-4 MultiFrame formats.

VT1.5 performance parameters

Overview

This section describes the terminated SONET VT1.5 performance monitoring parameters. Terminated SONET VT1.5 path performance monitoring applies to VT1.5 paths cross-connected to a non-SONET interface (for example, DS1 or TMUX).

Monitored parameters

The following table lists the SONET VT1.5 path performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-14 SONET VT1.5 performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
VT1.5 Path	Coding Violations - Path, Path Far End (CV-P, CV-PFE)	75	0–16383	750	0–1048575
	V5 Errored Seconds - Path, Path Far End (ES-P, ES-PFE)	40	0–900	900	0–65535
	V5 Severely Errored Seconds - Path, Path Far End (SES-P, SES-PFE)	40	0–900	900	0–65535
	V5 Unavailable Seconds - Path, Path Far End (UAS-P, UAS-PFE)	40	0–900	900	0–65535
	Failure Counts - Path, Path Far End (FC-P, FC-PFE)	10	1–72	10	1–4095

Notes:

1. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

VT1.5 path parameters

Alcatel-Lucent 1665 DMX monitors the following near end SONET VT1.5 path parameters on incoming (from the SONET interface) VT1.5 signals.

Coding violations (CV-P)

The Near-End STS Path Coding Violations (CVP) parameter for each SONET path is monitored. The CVP parameter increments once for each BIP error detected at the STS path layer (the B3 byte of the incoming SONET STS Path overhead). Up to 8 BIP errors can be detected per frame.

The Far-End VT Path Coding Violations (CVP) parameter for each SONET path is monitored. The VT Far-End CVP parameter increments as reported by the REI-V indication of the VT path overhead.

Errored seconds (ES-P)

The Near-End STS Path Errored Seconds (ESP) parameter for each SONET path is monitored. The ESP parameter increments once for each second where one or more STS Path layer BIP errors are detected or an AIS-P, LOP-P, or UNEQ-P defect is detected.

The Far-End VT Path Errored Seconds (ESP) parameter for each SONET path is monitored. The VT Far-End ESP parameter increments once for each second where one or more Far-End VT Path layer BIP errors were reported by the far-end VT-PTE (using the REI-V indication), a one-bit RDI-V defect was present, or an ERDI-V (if supported) defect is detected.

Alcatel-Lucent 1665 DMX detects 1-bit RDI, but treats it as though it is the high order bit of a 3-bit ERDI in that it includes UNEQ.

Severely errored seconds (SES-P)

The Near-End STS Path Severely Errored Seconds (SESP) parameter for each SONET path is monitored. The SESP parameter increments once for each second where K or more STS Path layer BIP errors are detected or an AIS-P, LOP-P, or UNEQ-P defect is detected. The integer value for K is set by standards and is selectable (values are shown in Table 8). Alcatel-Lucent 1665 DMX detects 1-bit RDI, but treats it as though it is the high order bit of a 3-bit ERDI in that it includes UNEQ.

The Far-End VT Path Severely Errored Seconds (SESP) parameter for each SONET VT path is monitored. The VT Far-End SESP parameter increments once for each second where K or more BIP errors are reported by the far-end VT-PTE (using the REI-V indication), or a one bit RDI-V defect was present or (if ERDI-V is supported), an ERDI-V defect is detected. The integer value for K is set by standards (values are shown in Table 10).

Alcatel-Lucent 1665 DMX detects 1-bit RDI, but treats it as though it is the high order bit of a 3-bit ERDI in that it includes UNEQ.

Unavailable seconds (UAS-P)

The Near-End STS Path Unavailable Seconds (UASP) parameter for each SONET path is monitored. The UASP parameter increments once for each second where SESP is detected after ten consecutive seconds with SESP detected. UASP continues to increment once for each second until ten consecutive seconds without SESP are detected.

The Far-End VT Path Unavailable Seconds (UASP) parameter for each SONET path is monitored. The VT Far-End UASP parameter increments once for each second where VT Far-End SESP is detected after ten consecutive seconds with VT Far-End SESP detected. VT Far-End UASP continues to increment once for each second until ten consecutive seconds without VT Far-End SESP are detected.

Failure counts path (FC-P)

The Near-End STS Path Failure Counts (FC-P) parameter for each SONET path is monitored. The FC-P parameter increments once for the beginning of each AIS-P event (AIS-P detected and cleared), LOP-P event (LOP-P detected and cleared), UNEQ-P event (UNEQ-P detected and cleared). A failure that begins in one period and ends in another period, is counted in the period in which it begins. The Far-End STS Path Failure Counts (FC-P) parameter for each SONET path is monitored. The Far-End FC-P parameter increments once for the beginning of each RFI-P event (RFI-P detected and cleared). A failure that begins in one period and ends in another period, is counted in the period in which it begins.

VC-12 performance parameters

Overview

This section describes the terminated SONET VC-12 performance monitoring parameters. Terminated SONET VC-12 path performance monitoring applies to all VC-12 paths.

Monitored parameters

The following table lists the SONET VC-12 path performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-15 SONET VC-12 performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
VC-12 Path	Background Block Errors - Path, Path Far End (BBE-P, BB-PFE)	75	0–16383	750	0–1048575
	Errored Seconds - Path, Path Far End (ES-P, ES-PFE)	40	0–900	900	0–65535
	Severely Errored Seconds - Path, Path Far End (SES-P, SES-PFE)	40	0–900	900	0–65535
	Unavailable Seconds - Path, Path Far End (UAS-P, UAS-PFE)	40	0–900	900	0–65535
	Failure Count - Path, Path Far End (FC-P, FC-PFE)	10	1–72	10	1–4095

Notes:

1. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

VC-12 path parameters

Background block errors (BBE-P)

The Near-End E1 Background Block Errors (BBE-P) parameter for each E1 Path is monitored. The number of Near-End BBE-Ps in a one second period is equal to the Near-End EBC if the second is not a Near-End SES. Otherwise, the BBE-P is set to zero for that second.

The Far-End Background Block Errors (BBE-P) parameter for each Low Order Path is monitored. The number of Far-End VC-n BBE-Ps in a one second period is equal to the F_EBC if the second is not a Far-End SES and if the second is not a N_DS. Otherwise, the Far-End BBE-P is set to zero for that second.

ITU-T standards refers to this parameter as F_BBE, but for consistency within the Alcatel-Lucent 1665 DMX product, this parameter is referred to as BBE-P with a locn value of FEND to indicate that it is the Far-End Background Block Errors.

Errored seconds (ES-P)

The Near-End VC-n Errored Seconds (ESP) parameter for each Low Order VC-n is monitored. A Near-End VC-n ES parameter increments for each second in which there is one or more N_Bs (detected at the Low Order Path Layer) or a N_DS defect is present.

ITU-T standards refers to this parameter as N_ES, but for consistency within the Alcatel-Lucent 1665 DMX product, this parameter is referred to as ES with a locn value of NEND to indicate that it is the Near-End Errored Seconds.

The Far-End VC-n Errored Seconds (ESP) parameter for each Low Order VC-n Path is monitored. A Far-End VC-n ES parameter increments for each second in which the Far-End errored block count (F_EBC) is equal to or greater than 1 or when at least one F_DS defect is present for that second, and there is no N_DS present for that second.

ITU-T standards refers to this parameter as F_ES, but for consistency within the Alcatel-Lucent 1665 DMX product, this parameter is referred to as ES with a locn value of FEND to indicate that it is the Far-End errored seconds.

Severely errored seconds (SES-P)

The Near-End VC-n Severely Errored Seconds (SESP) parameter for each Low Order VC-n is monitored. An Near-End VC-n SES parameter increments for each second in which the N_EBC is equal to or greater than K, or an N_DS defect is present. The integer value for K is set by standards (values are shown in Table 9). ITU-T standards refers to this parameter as N_SES, but for consistency within the Alcatel-Lucent 1665 DMX product, this parameter is referred to as SES with a locn value of NEND to indicate that it is the Near-End Severely Errored Seconds parameter.

The Far-End Severely Errored Seconds (SESP) parameter for each Low Order VC-n Path is monitored. A Far-End VC-n SES parameter increments for each second in which the Far-End errored block count (F_EBC) is equal to or greater than K or at least one F_DS defect is present for that second, and there is no N_DS defect present for that second. The integer value for K is set by standards (values are shown in Table 9).

ITU-T standards refers to this parameter as F_SES, but for consistency within the Alcatel-Lucent 1665 DMX product, this parameter is referred to as SES with a locn value of FEND to indicate that it is the Far-End Severely Errored Seconds.

Unavailable seconds (UAS-P)

The Near-End VC-n Unavailable Seconds (UASP) parameter for each Low Order Path is monitored. The Near-End VC-n UAS parameter increments once for every second that the Low Order Path was considered unavailable (at any point during the second). A Low Order Path becomes unavailable at the onset of 10 consecutive seconds that qualify as Near-End VC-n SESP, and continues to be unavailable until the onset of 10 consecutive seconds that do not qualify as Near-End VC-n SES.

The (un)available time can not be determined if it is unknown whether the previous 10 seconds are Severely Errored on non-Severely Errored. Thus the SES must be processed to determine whether the SES are consecutively present or absent. ITU-T standards refers to this parameter as N_UAS, but for consistency within the Alcatel-Lucent 1665 DMX product, this parameter is referred to as UAS with a locn value of NEND to indicate that it is the Near-End Unavailable Seconds.

The Far-End Unavailable Seconds (UASP) parameter for each Low Order Path is monitored. The Far-End VC-n UAS parameter increments once for every second that the Far-End Low Order Path was considered unavailable (at any point during the second). A Far-End Low Order Path becomes unavailable at the onset of 10 consecutive seconds that qualify as Far-End VC-n SESs, and continues to be unavailable until the onset of 10 consecutive seconds that do not qualify as Far-End VC-n SESs.

The (un)available time cannot be determined if it is unknown whether the previous 10 seconds are Severely Errored on non-Severely Errored. Thus the Far-End VC-n SES must be processed to determine whether the Far-End VC-n SES are consecutively present or absent.

ITU-T standards refers to this parameter as F_UAS, but for consistency within the Alcatel-Lucent 1665 DMX product, this parameter is referred to as UAS with a locn value of FEND to indicate that it is the Far-End Unavailable Seconds.

Failure counts path (FC-P)

The Near-End VC-n Path Failure Counts (FC-P) parameter for each Low Order path is monitored. The FC-P parameter increments once for the beginning of each TU-AIS event (TU-AIS detected and cleared), TU-LOP event (TU-LOP detected and cleared), LP-UNEQ event (LP-UNEQ detected and cleared), HP-LOM event (HP-LOM detected and cleared). A failure that begins in one period and ends in another period, is counted in the period in which it begins.

The Far-End VC-n Path Failure Counts (FC-P) parameter for each Low Order path is monitored. The VC-n Far-End FC-P parameter increments once for the beginning of each RDI event (RDI detected and cleared). A failure that begins in one period and ends in another period, is counted in the period in which it begins.

OC-N performance parameters

Overview

This section describes the performance monitoring parameters that are applicable to SONET OC-N signals.

Monitored parameters

The following table lists the SONET OC-N section and line performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-16 SONET OC-N performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
OC-N Section	Section Errored Seconds (ESS)	30	0–900	90	0–65535
	SE Frame Seconds (SEFS/SEFS-S)	10	0–900	30	0–65535
	Severely Errored Seconds (SESS/LESS-S)	30	0–900	90	0–65535
OC-192 Section	Coding Violations (CV-L)	8960	0–16383	86016	0–1048575
OC-48 Section	Coding Violations (CV-L)	2240	0–16383	21504	0–1048575
OC-12 Section	Coding Violations (CV-L)	560	0–16383	5376	0–1048575
OC-3 Section	Coding Violations (CV-L)	140	0–16383	1344	0–1048575
OC-192 Line	Coding Violations (CV-L), CV-L FE	8960	0–16383	86016	0–1048575
OC-48 Line	Coding Violations (CV-L), CV-L FE	2240	0–16383	21504	0–1048575
OC-12 Line	Coding Violations (CV-L), CV-L FE	560	0–16383	5376	0–1048575
OC-3 Line	Coding Violations (CV-L), CV-L FE	140	0–16383	1344	0–1048575

Table 5-16 SONET OC-N performance parameters (continued)

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
OC-N Line	Errored Seconds (ES-L) Errored Seconds Far End (ES-L FE)	40	0–900	900	0–65535
	Far-End Line Failure Counts (FC-L) Far-End Line Failure Counts Far End (FC-L FE)	10	1–72	10	1–4095
	Severely Errored Seconds (SES-L) Severely Errored Seconds Far End (SES-L FE)	30	0–900	90	0–65535
	Unavailable Seconds (UAS-L) Unavailable Seconds Far-End (UAS-L FE)	30	0–900	90	0–65535
	Protection Switch Count Line (PSC-L)	2	0–63	4	0–255
	Protection Switch Count Protection (PSC-P) (BLSR only)	2	0–63	4	0–255
	Protection Switch Count Working (PSC-W) (BLSR only)	2	0–63	4	0–255

Table 5-16 SONET OC-N performance parameters (continued)

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
OC-N Line	Protection Switch Duration (PSC-D) (BLSR Only)	NA			
	Pointer Justification Count Difference (PJCDIFF-P)	60	0–1048575	5760	0–16777215
	Negative Pointer Justification Count Detected (NPJC-PDET)	60	0–1048575	5760	0–16777215
	Positive Pointer Justification Count Detected (PPJC-PDET)	60	0–1048575	5760	0–16777215
	Negative Pointer Justification Count Generated (NPJC-PGEN)	60	0–1048575	5760	0–16777215
	Positive Pointer Justification Count Generated (PPJC-PGEN)	60	0–1048575	5760	0–16777215

Notes:

1. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

OC-N section parameter

Alcatel-Lucent 1665 DMX monitors the following near end SONET section parameters for incoming (from the lightguide cross-connect) OC-N signals. The parameters are measured at the input of the OC-N OLIU circuit pack on the line side (also referred to as LGX side).

Coding violations (CV-S)

The Section Coding Violations (CV-S) parameter for each SONET section is monitored. The CV-S parameter is a count of BIP errors at the Section Layer (i.e., B1 errors). Up to eight Section BIP errors can be detected per STS-N frame, each error increments the CV-S current second register.

Errored seconds (ES-S)

The Section Errored Seconds (ESS) parameter for each SONET section is monitored. The ESS parameter increments once for each second in which at least one Section Layer BIP error was detected or an SEF or LOS defect was present.

Severely errored frame seconds (SEFS/SEFS-S)

The SEFS/SEFS-S parameter increments once for each second during which Alcatel-Lucent 1665 DMX detects one or more near end severely errored frame defects.

OC-N section PM report

Use the **Performance** → **Reports** → **OCn Section** command to obtain the OC-N Section PM Report. For more information about the OC-N section parameter and the **Performance** → **Reports** → **OCn Section** command, see the *WaveStar*® CITonline help.

OC-N line parameters

Alcatel-Lucent 1665 DMX monitors the following near end SONET line parameters for incoming (from the lightguide cross-connect) OC-N signals. The parameters are measured at the input of the OC-N OLIU circuit pack on the OC-N line side (also referred to as LGX side).

Coding violations (CV-L)

The Near-End Line Coding Violation (CVL) parameter for each SONET Line is monitored. The Near-End CVL parameter increments once for every occurrence of a BIP error detected at the Line layer (i.e. using the B2 byte in the incoming SONET signal). Up to 8*N BIP errors can be detected per STS-N frame.

Errored seconds (ES-L)

The Near-End Line Errored Seconds (ESL) parameter for each SONET Line is monitored. The Near-End CVL parameter increments once for every second that contains at least one BIP error detected at the Line layer (at any point during the second), or an AIS-L defect was present.

Severely errored seconds (SES-L)

The Near-End Line Severely Errored Seconds (SESL) parameter for each SONET Line is monitored. The Near-End SESL parameter increments once for every second that contains at least K BIP errors detected at the Line layer (at any point during the second), or an AIS-L defect was present. The value of K is hard-coded, see table 7 for a list of the values

Unavailable seconds (UAS-L)

The Near-End Line Unavailable Seconds (UASL) parameter for each SONET Line is monitored. The Near-End UASL parameter increments once for every second that the Line was considered unavailable (at any point during the second). A Line becomes unavailable at the onset of 10 consecutive seconds that qualify as Near-End SESLs, and continues to be unavailable until the onset of 10 consecutive seconds that do not qualify as Near-End SESLs.

Far-end line failure counts (FC-L)

The Far-End Line Failure Counts (FC-L) parameter for each SONET line is monitored. The Far-End FC-L parameter increments once for the beginning of each RFI-L event (RFI-L detected and cleared). A failure that begins in one period and ends in another period, is counted in the period in which it begins.

Protection switch count (PSC-L)

The PSC parameter records the number of times that service traffic switched to or from another line either automatically, by a *WaveStar*® CIT command, or operations system command. The Near-End Protection Switch Counts (PSC-L) parameter for each SONET line (that supports 1+1 protection switching for that line) is monitored. Separate PSC counters is provided for differentiating between working and protection for each SONET line that supports 2F BLSR for that line. In a 2 Fiber ring, two separate PSC counts are maintained for the working and protection fibers in a given line. These parameters are defined as PSC-W and PSC-P for Protection Switch Counts-Working and Protection Switch Counts-Protection respectively.

Pointer justifications counts difference (PJCDIFF-P)

This is a calculation of the absolute value of the PJC parameters listed under the headings below. PJCDIFF-P is used to calculate the difference between calculate the difference between the PPJC-PGEN, NPJC-PGEN and between PPJC-PDET and NPJC-PDET. Alcatel-Lucent 1665 DMX monitors the first cross-connected STS. From this STS, the calculation is to (A) calculate the difference between the PPJC-PGEN, NPJC-PGEN. (B) Calculate the difference of the PPJC-PDET, NPJC-PDET. The resulting PJC is the absolute value of the difference between A and B.

Negative pointer justifications counts detected (NPJC-PDET)

This parameter summarizes all Negative Pointer Justifications detected by the system. Alcatel-Lucent 1665 DMX monitors negative line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each incoming negative STS pointer justification.

Positive pointer justifications counts detected (PPJC-PDET)

This parameter summarizes all Positive Pointer Justifications detected by the system. Alcatel-Lucent 1665 DMX monitors positive line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each incoming positive STS pointer justification.

Negative pointer justifications counts generated (NPJC-PGEN)

This parameter summarizes all Negative Pointer Justifications generated by the system. Alcatel-Lucent 1665 DMX monitors negative line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each outgoing negative STS pointer justification.

Positive pointer justifications counts generated (PPJC-PGEN)

This parameter summarizes all Positive Pointer Justifications generated by the system. Alcatel-Lucent 1665 DMX monitors positive line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each outgoing positive STS pointer justification.

OC-N line PM report

Use the **Performance** → **Reports** → **OCn Line** command to obtain the OC-N Line PM Report. For more information about the OC-N line parameters and the **Performance** → **Reports** → **OCn Line** command, see the *WaveStar*® CIT online help.

STS-N performance parameters

Overview

This section describes the performance monitoring parameters on terminated (STS-1) and intermediate STS-N (STS-1, STS-3c, STS-12c) paths that are cross-connected through the system. Intermediate SONET STS-N path performance monitoring applies to STS-N paths cross-connected to another SONET interface. Terminated SONET STS-N path performance monitoring applies to STS-N paths cross-connected to a non-SONET interface (for example, DS3).

Monitored parameters

The following table lists the SONET STS-N path performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-17 SONET STS-N performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
STS-192c Path	Coding Violations (CV-P), CV-PFE	20	0–16383	200	0–1048575
STS-48c Path	Coding Violations (CV-P), CV-PFE	300	0–16383	3000	0–1048575
STS-12c Path	Coding Violations (CV-P), CV-PFE	75	0–16383	750	0–1048575
STS-3c Path	Coding Violations (CV-P), CV-PFE	25	0–16383	250	0–1048575
STS-1 Path	Coding Violations (CV-P), CV-PFE	15	0–900	150	0–65535
STS-192c Path	Errored Seconds (ES-P), ES-PFE	16	0–16383	160	0–1048575
STS-48c Path	Errored Seconds (ES-P), ES-PFE	240	0–16383	2400	0–1048575
STS-12c Path	Errored Seconds (ES-P), ES-PFE	60	0–16383	600	0–1048575
STS-3c Path	Errored Seconds (ES-P), ES-PFE	20	0–16383	200	0–1048575
STS-1 Path	Errored Seconds (ES-P), ES-PFE	12	0–900	100	0–65535
STS-N Path	FC-P, FC-PFE	10	1–72	10	1–4095
	Severely Errored Seconds (SES-P), SES-PFE	3	0–900	7	0–65535
	Unavailable Seconds (UAS-P), UAS-PFE	10	0–900	10	0–65535

Notes:

1. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

STS-N path parameters

Alcatel-Lucent 1665 DMX monitors the following near end SONET STS path parameters on incoming (from the SONET interface) STS-N signals.

Coding violations (CV-P)

The Near-End STS Path Coding Violations (CVP) parameter for each SONET path is monitored. The CVP parameter increments once for each BIP error detected at the STS path layer (the B3 byte of the incoming SONET STS Path overhead). Up to 8 BIP errors can be detected per frame.

The Far-End STS Path Coding Violations (CVP) parameter for each SONET path is monitored. The Far-End CVP parameter increments as reported by the REI-P indication of the STS path overhead.

Errored seconds (ES-P)

The Near-End STS Path Errored Seconds (ESP) parameter for each SONET path is monitored. The ESP parameter increments once for each second where one or more STS Path layer BIP errors are detected or an AIS-P, LOP-P, or UNEQ-P defect is detected.

The Far-End STS Path Errored Seconds (ESP) parameter for each SONET path is monitored. The Far-End ESP parameter increments once for each second where one or more Far-End STS Path layer BIP errors are detected as reported by the REI-P indication of the line overhead or an RDI-P defect is present, or an ERDI-P (if supported) defect is detected.

Alcatel-Lucent 1665 DMX detects 1-bit RDI, but treats it as though it is the high order bit of a 3-bit ERDI in that it includes UNEQ.

Severely errored seconds (SES-P)

The Near-End STS Path Severely Errored Seconds (SESP) parameter for each SONET path is monitored. The SESP parameter increments once for each second where K or more STS Path layer BIP errors are detected or an AIS-P, LOP-P, or UNEQ-P defect is detected. The integer value for K is set by standards and is selectable (values are shown in Table 8). Alcatel-Lucent 1665 DMX detects 1-bit RDI, but treats it as though it is the high order bit of a 3-bit ERDI in that it includes UNEQ.

The Far-End STS Path Severely Errored Seconds (SESP) parameter for each SONET path is monitored. The Far-End SESP parameter increments once for each second where K or more STS Path layer BIP errors are detected as reported by the REI-P indication of the path overhead or a one bit RDI-P defect was present or (if ERDI-P is supported), an ERDI-P defect is detected. The integer value for K is set by standards and selectable (values are shown in Table 8).

Alcatel-Lucent 1665 DMX detects 1-bit RDI, but treats it as though it is the high order bit of a 3-bit ERDI in that it includes UNEQ.

Unavailable seconds (UAS-P)

The Near-End STS Path Unavailable Seconds (UASP) parameter for each SONET path is monitored. The UASP parameter increments once for each second where SESP is detected after ten consecutive seconds with SESP detected. UASP continues to increment once for each second until ten consecutive seconds without SESP are detected.

The Far-End STS Path Unavailable Seconds (UASP) parameter for each SONET path is monitored. The Far-End UASP parameter increments once for each second where Far-End SESP is detected after ten consecutive seconds with Far-End SESP detected. Far-End UASP continues to increment once for each second until ten consecutive seconds without Far-End SESP are detected.

Failure counts path (FC-P)

The Near-End STS Path Unavailable Seconds (UASP) parameter for each SONET path is monitored. The UASP parameter increments once for each second where SESP is detected after ten consecutive seconds with SESP detected. UASP continues to increment once for each second until ten consecutive seconds without SESP are detected.

The Far-End STS Path Failure Counts (FC-P) parameter for each SONET path is monitored. The Far-End FC-P parameter increments once for the beginning of each RFI-P event (RFI-P detected and cleared). A failure that begins in one period and ends in another period, is counted in the period in which it begins.

STS-N path PM report

Use the **Performance** → **Reports** → **STSn Path** command to obtain the STS-N Path PM Report. For more information about the STS-N path parameters and the **Performance** → **Reports** → **STSn Path** command, see the *WaveStar*® CIT online help.

EC-1 performance parameters

Overview

This section describes the performance monitoring parameters that are applicable to SONET EC-1 signals.

Monitored parameters

The following table lists the SONET EC-1 line performance parameters that Alcatel-Lucent 1665 DMX monitors, including the default and ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-18 SONET EC-1 performance parameters

Facility	Measured Provisionable Parameter	15-Min		1-Day	
		Default	Range[1]	Default	Range[1]
EC-1 Line	Coding Violations (CV-L), CV-LFE	47	0–16383	448	0–1048575
	Errored Seconds (ES-L), ES-LFE	40	0–900	90	0–65535
	Severely Errored Seconds (SES-L), SES-LFE	30	0–900	90	0–65535
	Unavailable Seconds (UAS-L), UAS-LFE	30	0–900	90	0–65535
	Far-End Line Failure Counts (FC-L) Far-End Line Failure Counts Far End (FC-L FE)	10	1–72	10	1–4095
	Pointer Justification Count Difference (PJCDIFF-P)	60	0–900	5760	0–65535
	Negative Pointer Justification Count Detected (NPJC-PDET)	60	0–900	5760	0–65535
	Positive Pointer Justification Count Detected (PPJC-PDET)	60	0–900	5760	0–65535
	Negative Pointer Justification Count Generated (NPJC-PGEN)	60	0–900	5760	0–65535
	Positive Pointer Justification Count Generated (PPJC-PGEN)	60	0–900	5760	0–65535

Notes:

1. When an individual performance monitoring parameter threshold is provisioned as zero (0), TCA reporting for the affected parameter is disabled.

EC-1 line parameters

Alcatel-Lucent 1665 DMX monitors the following near end SONET line parameters on incoming (from the local cross-connect) EC-1 signals. The parameters are measured at the input of the 12DS3/EC1 circuit pack on the EC-1 line side (also referred to as facility, customer terminal, or STSX-1 side).

Coding violations (CV-L)

The Near-End Line Coding Violation (CVL) parameter for each SONET Line is monitored. The Near-End CVL parameter increments once for every occurrence of a BIP error detected at the Line layer (i.e. using the B2 byte in the incoming SONET signal). Up to 8*N BIP errors can be detected per STS-N frame.

Errored seconds (ES-L)

The Near-End Line Errored Seconds (ESL) parameter for each SONET Line is monitored. The Near-End CVL parameter increments once for every second that contains at least one BIP error detected at the Line layer (at any point during the second), or an AIS-L defect was present.

Severely errored seconds (SES-L)

The Near-End Line Severely Errored Seconds (SESL) parameter for each SONET Line is monitored. The Near-End SESL parameter increments once for every second that contains at least K BIP errors detected at the Line layer (at any point during the second), or an AIS-L defect was present. The value of K is hard-coded, see table 7 for a list of the values

Unavailable seconds (UAS-L)

The Near-End Line Unavailable Seconds (UASL) parameter for each SONET Line is monitored. The Near-End UASL parameter increments once for every second that the Line was considered unavailable (at any point during the second). A Line becomes unavailable at the onset of 10 consecutive seconds that qualify as Near-End SESLs, and continues to be unavailable until the onset of 10 consecutive seconds that do not qualify as Near-End SESLs.

Far-end line failure counts (FC-L)

The Far-End Line Failure Counts (FC-L) parameter for each SONET line is monitored. The Far-End FC-L parameter increments once for the beginning of each RFI-L event (RFI-L detected and cleared). A failure that begins in one period and ends in another period, is counted in the period in which it begins.

Pointer justifications counts difference (PJCDIFF-P)

This is a calculation of the absolute value of the PJC parameters listed under the headings below. PJCDIFF-P is used to calculate the difference between calculate the difference between the PPJC-PGEN, NPJC-PGEN and between PPJC-PDET and NPJC-PDET. Alcatel-Lucent 1665 DMX monitors the first cross-connected STS. From this STS, the calculation is to (A) calculate the difference between the PPJC-PGEN, NPJC-PGEN. (B) Calculate the difference of the PPJC-PDET, NPJC-PDET. The resulting PJC is the absolute value of the difference between A and B.

Negative pointer justifications counts detected (NPJC-PDET)

This parameter summarizes all Negative Pointer Justifications detected by the system. Alcatel-Lucent 1665 DMX monitors negative line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each incoming negative STS pointer justification.

Positive pointer justifications counts detected (PPJC-PDET)

This parameter summarizes all Positive Pointer Justifications detected by the system. Alcatel-Lucent 1665 DMX monitors positive line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each incoming positive STS pointer justification.

Negative pointer justifications counts generated (NPJC-PGEN)

This parameter summarizes all Negative Pointer Justifications generated by the system. Alcatel-Lucent 1665 DMX monitors negative line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each outgoing negative STS pointer justification.

Positive pointer justifications counts generated (PPJC-PGEN)

This parameter summarizes all Positive Pointer Justifications generated by the system. Alcatel-Lucent 1665 DMX monitors positive line Pointer Justifications on an STS-1 within the OC-n line in 1 second intervals. (Users may select which STS-1 to monitor by provisioning the PJC Monitoring point parameter using the **Performance** → **Provision PM** command.) The count increments for each outgoing positive STS pointer justification.

EC-1 line PM report

Use the **Performance** → **Reports** → **EC1 Line** command to obtain the EC-1 Line PM Report. For more information about the EC-1 line parameters and the **Performance** → **Reports** → **EC1 Line** command, see the *WaveStar*® CIT online help.

WDMX performance monitoring parameters

WDMX port TCA monitoring

TCA monitoring is supported on the LNW785 circuit packs (OCH ports and OTS port). The following table lists the monitored parameters when TCA monitoring is enabled.

Table 5-19 WDMX port TCA monitoring

Port	Parameter	Description
OTS	TOPRL	Total Optical Power Received Low Watermark
	TOPRH	Total Optical Power Received High Watermark
OCH	OPTL	Optical Power Transmitted Low Watermark
	OPTH	Optical Power Transmitted High Watermark
OTU2	BBE-OTU	Background Block Error
	ES-OTU	Errored Seconds
	SES-OTU	Severely Errored Seconds
	UAS-OTU	Unavailable Seconds
	FECC	FEC Errors Corrected
	OPTL	Optical Power Transmitted Low Watermark
	OPTH	Optical Power Transmitted High Watermark
	OPRL	Optical Power Received Low Watermark
	OPRH	Optical Power Received High Watermark
ODU2	BBE-ODU	Background Block Error
	ES-ODU	Errored Seconds
	SES-ODU	Severely Errored Seconds
	UAS-ODU	Unavailable Seconds

Primary WDMX port states

The primary state parameter is supported for each OCH and OTS port. The WDMX port states are:

- IS (In Service)
- OOS-MA-AS (AUTO)
- OOS (Out of Service - Not Monitored)

Ethernet/SAN performance monitoring parameters

Overview

Alcatel-Lucent 1665 DMX provides PM capabilities for the Fast Ethernet and Gigabit Ethernet interfaces. PM data is collected at each LAN and WAN interface in the network for both incoming and outgoing directions and is stored in quarter-hour and day bins. The WAN interface provides a connection to a SONET Virtual Concatenation Group (VCG).

TCAs

Provisionable threshold crossing alerts (TCAs) are not supported on the Ethernet interfaces.

Monitored parameters

The following table lists the Ethernet performance parameters that Alcatel-Lucent 1665 DMX monitors, including the ranges for the 15-minute and 1-day (24-hour) registers.

Table 5-20 Ethernet performance parameters

Facility	Monitored parameters	15-Min	1-Day
		Range	Range
Ethernet (all packs)	EDFC – Ethernet dropped frames congestion	1–7,000,000	1–90,000,000
	EDFE – Ethernet dropped frames errors	1–7,000,000	1–90,000,000
LNW73/73C packs	INTXWD – Count of invalid transmission words received.	1–16383	1–1,048,575

Enabling/disabling

Performance monitoring is enabled/disabled via the *WaveStar*® CIT. From the System View menu, select **Performance** → **Prov PM Settings**, then navigate to the port.

Ethernet parameters

Alcatel-Lucent 1665 DMX monitors several Ethernet parameters.

Ethernet dropped frames (congestion) (EDFC)

The EDFC parameter counts the number of incoming Ethernet frames dropped at a specific LAN/WAN port due to buffer overflow. Buffer overflow occurs when the network is congested.

For LNW170, this count represents the number of frames that could not be transmitted on the specified port because of congestion. For all other circuit packs, this count represents the number of frames that could not be received on the specified port because of congestion. This parameter does not apply to the LNW74 circuit pack.

Ethernet dropped frames (errors) (EDFE)

The EDFE parameter counts the number of incoming Ethernet frames dropped at a LAN/WAN port due to a frame check sequence (FCS) error or another defect in the frame.

For the LNW73: this count represents frames received with invalid CRC on data port. For VCG, this count represents dropped GFP super-block frames due to CRC error.

This parameter is valid only for VCGs; not valid for LAN ports.

Ethernet dropped frames (policer) (EDFP)

This parameter is valid only for VCGs - not LAN ports. This parameter applies only to the LNW66 circuit packs.

Ethernet incoming number of bytes (EINB)

For the LNW73, ordered sets are not included in the count. This parameter is valid for the data ports only, not VCGs.

This parameter monitors the incoming number of bytes

Ethernet incoming number of frames (EINF)

This parameter monitors the incoming number of frames.

Ethernet outgoing number of bytes (EONB)

This parameter monitors the outgoing number of bytes. For the LNW73, ordered sets are not included in the count. This parameter is valid for the data ports only, not VCGs.

Ethernet parameters for LNW73 only

Alcatel-Lucent 1665 DMX monitors the following Ethernet parameters on the LNW73 pack.

Count of invalid transmission words received (INTXWD)

This parameter is valid for data ports only, not VCGs.

Count of instances for loss of signal detected (LOS)

This parameter is valid for data ports only, not VCGs.

Count of instances for sync loss detected (LSYNC)

This parameter is valid for data ports only, not VCGs.

Count of disparity errors received (DSPERR)

This parameter is valid for data ports only, not VCGs.

Count of received overflow frames dropped (RFOVD)

This parameter is valid for data ports only, not VCGs.

Count of transmit overflow frames dropped (TFOVD)

This parameter is valid for data ports only, not VCGs.

Count of transmitted frames with CRC errors (TFCRC)

This parameter is valid for data ports only, not VCGs.

Count of transmitted 10B_ERR errors (T10BERR)

This parameter is valid for data ports only, not VCGs.

Count of received single-bit error corrected GFP headers (RCORH)

This parameter is valid for VCGs only, not data ports.

Count of received uncorrected multi-bit error GFP headers (RCRCH)

This parameter is valid for VCGs only, not data ports.

Count of received single-bit error corrected GFP super-blocks (RCORF)

This parameter is valid for VCGs only, not data ports.

Ethernet parameters for LNW170 only

Alcatel-Lucent 1665 DMX monitors the following Ethernet parameters on the LNW170 pack.

Ethernet dropped green frames - congestion (EDFCG)

This parameter the number of green frames that could not be transmitted due to congestion.

Ethernet dropped yellow frames - congestion (EDFCG)

This parameter the number of yellow frames that could not be transmitted due to congestion.

Ethernet number of dropped frames-broadcast/multicast rate limit (EINDB)

Ethernet number of incoming unicast frames (EINFU)

This parameter is valid for data ports only, not VCGs.

Ethernet incoming number of multicast frames (EINFM)

Multicast frames are frames where the destination address has the group address bit set to 1.

Ethernet incoming number of broadcast frames (EINFB)

Broadcast frames are frames where the destination address is all 1s.

Ethernet outgoing number of unicast frames (EONFU)

Ethernet outgoing number of broadcast frames (EINFB)

Broadcast frames are frames where the destination address is all 1s.

Ethernet number of frames trapped to CPU (EINCP)

Broadcast frames are frames where the destination address is all 1s.

Ethernet number for frames received from CPU (EOCP)

Number of frames received from the CPU.

STP port role changed (STPROLE)

Number of times the STP port role changed.

STP port state changed (STPSTATE)

Number of times the STP port state changed, except to/from disabled.

STP root changed (STPROOT)

Number of times the bridge changed to/from being root.

BPDU timeout (BPDUT)

Number of occurrences of BPDU timeout.

BPDU incoming frames (BPDUI)

Incoming number of BPDU frames.

BPDU outgoing frames (BPDUO)

Outgoing number of BPDU frames.

BPDU dropped frames (BPDUD)

Number of BPDU frames dropped.

All of the above monitored parameters (ALL)

Performance monitoring data storage

Quarter-hour and current day registers

For each parameter supported, Alcatel-Lucent 1665 DMX provides one current 15-minute, one current day, one previous 15-minute, one previous day, and 32 recent 15-minute accumulation and storage registers.

Access/Initialization

Alcatel-Lucent 1665 DMX can initialize these registers through the TL1 interfaces at any time, as well as retrieve and report their contents.

The registers are not initialized by a shelf restart (unless caused by a power failure).

Performance parameter thresholds

Provisioning

The current quarter-hour and current day thresholds for each parameter type are provisionable, on a per-shelf basis (PSD-L, FC-L, and FC-P do not have thresholds). If values other than the defaults are used, only one value for each parameter type needs to be set.

The FC-DATA packs (LNW73 and LNW73C SAN interfaces) provide a different set of parameters. For more information on the parameters supported by these packs, see "Performance monitoring" (p. 5-62).

Threshold crossing alerts (TCAs)

Whenever the current quarter-hour or the current day threshold for a given parameter is exceeded, Alcatel-Lucent 1665 DMX generates a threshold-crossing alert (TCA) that is entered into the performance monitoring exception report and reported to the OS through the TL1 interface.

TCA transmission to OS

Overview

The TCA information can be reported to the OS using any of the TL1 OS interfaces. TCAs can be used to trigger proactive maintenance activity.

TL1 access

The TL1 over TCP/IP OS interfaces should be used to derive full benefit from Alcatel-Lucent 1665 DMX's performance monitoring capabilities. The full set of PM data stored by Alcatel-Lucent 1665 DMX (TCAs and the contents of PM registers) is provided through any of the TL1 interfaces.

SNMP parameters and traps

Standard SONET PM MIB module

Alcatel-Lucent 1665 DMX supports a Standard SONET PM MIB module defined in IETF RFC2558. This module defines SONET PM parameters for the SONET physical medium, section layer, line, path and tributary. This Standard SONET PM MIB module applies to individual SONET ports and tributaries.

Standard SONET PM MIB module parameters

The following table shows the Standard SONET PM MIB module parameters.

Group/Table	Parameters	Definition
SonetMedium Group	sonetMediumType (READ-ONLY)	value: “sonet”
	sonetMediumTimeElapsed	seconds since the beginning of current period
	sonetMediumValidIntervals	number of previous 15-min intervals for which data was collected (usually 32)
	sonetMediumLineCoding (READ-ONLY)	line coding,e.g., B3ZS
	sonetMediumLineType (READ-ONLY)	short range single mode or long range single mode
	sonetMediumCircuitIdentifier (READ-ONLY)	circuit ID
	sonetMediumInvalidIntervals	number of intervals for which no data is available (usually 0)
	sonetMediumLoopbackConfig (READ-ONLY)	no loopback, facility loopback or terminalloopback
SonetSectionCurrent Table	sonetSectionCurrentStatus	Current
	sonetSectionCurrentESs	Current
	sonetSectionCurrentSESs	Current
	sonetSectionCurrentSEFSs	Current
	sonetSectionCurrentCVs	Current
SonetSectionInterval Table	sonetSectionIntervalNumber	15 minute
	sonetSectionIntervalESs	15 minute
	sonetSectionIntervalSESs	15 minute
	sonetSectionIntervalSEFSs	15 minute
	sonetSectionIntervalCVs	15 minute
	sonetSectionIntervalValidData	15 minute
SonetLineCurrent Table	sonetLineCurrentStatus	Current
	sonetLineCurrentESs	Current
	sonetLineCurrentSESs	Current
	sonetLineCurrentCVs	Current
	sonetLineCurrentUASs	Current

Group/Table	Parameters	Definition
SonetLineCurrent Table	sonetLineCurrentStatus	Current
	sonetLineCurrentESs	Current
	sonetLineCurrentSESs	Current
	sonetLineCurrentCVs	Current
	sonetLineCurrentUASs	Current
SonetLineInterval Table	sonetLineIntervalNumber	15 minute
	sonetLineIntervalESs	15 minute
	sonetLineIntervalSESs	15 minute
	sonetLineIntervalCVs	15 minute
	sonetLineIntervalUASs	15 minute
	sonetLineIntervalValidData	15 minute
SonetFarEndLineCurrent Table	sonetFarEndLineCurrentESs	Current
	sonetFarEndLineCurrentSESs	Current
	sonetFarEndLineCurrentCVs	Current
	sonetFarEndLineCurrentUASs	Current
SonetFarEndLineInterval Table	sonetFarEndLineIntervalNumber	15 minute
	sonetFarEndLineIntervalESs	15 minute
	sonetFarEndLineIntervalSESs	15 minute
	sonetFarEndLineIntervalCVs	15 minute
	sonetFarEndLineIntervalUASs	15 minute
	sonetFarEndLineIntervalValidData	15 minute
SonetPathCurrent Table	sonetPathCurrentWidth	Current
	sonetPathCurrentStatus	Current
	sonetPathCurrentESs	Current
	sonetPathCurrentSESs	Current
	sonetPathCurrentCVs	Current
	sonetPathCurrentUASs	Current

Group/Table	Parameters	Definition
SonetPathInterval Table	sonetPathIntervalNumber	15 minute
	sonetPathIntervalESs	15 minute
	sonetPathIntervalSESs	15 minute
	sonetPathIntervalCVs	15 minute
	sonetPathIntervalUASs	15 minute
	sonetPathIntervalValidData	15 minute
SonetFarEndPathCurrent Table	sonetFarEndPathCurrentESs	Current
	sonetFarEndPathCurrentSESs	Current
	sonetFarEndPathCurrentCVs	Current
	sonetFarEndPathCurrentUASs	Current
SonetFarEndPathInterval Table	sonetFarEndPathIntervalNumber	15 minute
	sonetFarEndPathIntervalESs	15 minute
	sonetFarEndPathIntervalSESs	15 minute
	sonetFarEndPathIntervalCVs	15 minute
	sonetFarEndPathIntervalUASs	15 minute
	sonetFarEndPathIntervalValidData	15 minute
SonetVTCurrent Table	sonetVTCurrentWidth	Current
	sonetVTCurrentStatus	Current
	sonetVTCurrentESs	Current
	sonetVTCurrentSESs	Current
	sonetVTCurrentCVs	Current
	sonetVTCurrentUASs	Current
SonetVTInterval Table	sonetVTIntervalNumber	15 minute
	sonetVTIntervalESs	15 minute
	sonetVTIntervalSESs	15 minute
	sonetVTIntervalCVs	15 minute
	sonetVTIntervalUASs	15 minute
	sonetVTIntervalValidData	15 minute
SonetFarEndVTCurrent Table	sonetFarEndVTCurrentESs	Current
	sonetFarEndVTCurrentSESs	Current
	sonetFarEndVTCurrentCVs	Current
	sonetFarEndVTCurrentUASs	Current

Group/Table	Parameters	Definition
SonetFarEndVTInterval Table	sonetFarEndVTIntervalNumber	15 minute
	sonetFarEndVTIntervalESs	15 minute
	sonetFarEndVTIntervalSESs	15 minute
	sonetFarEndVTIntervalCVs	15 minute
	sonetFarEndVTIntervalUASs	15 minute
	sonetFarEndVTIntervalValidData	15 minute

Private SONET day PM MIB module

Alcatel-Lucent 1665 DMX supports private SONET Day PM MIB Module. This module defines 24 hour SONET PM parameters for the SONET physical medium, section layer, line, path and tributary. This MIB module applies to individual SONET ports and tributaries.

Table	Parameters
dmxSonetSectionDay Table	dmxSonetSectionDayNumber
	dmxSonetSectionDayESs
	dmxSonetSectionDaySESs
	dmxSonetSectionDaySEFSs
	dmxSonetSectionDayCVs
	dmxSonetSectionDayValidData
dmxSonetLineDay Table	dmxSonetLineDayNumber
	dmxSonetLineDayESs
	dmxSonetLineDaySESs
	dmxSonetLineDayCVs
	dmxSonetLineDayUASs
	dmxSonetLineDayValidData
dmxSonetFarEndLineDay Table	dmxSonetFarEndLineDayNumber
	dmxSonetFarEndLineDayESs
	dmxSonetFarEndLineDaySESs
	dmxSonetFarEndLineDayCVs
	dmxSonetFarEndLineDayUASs
	dmxSonetFarEndLineDayValidData

Table	Parameters
dmxSonetPathDay Table	dmxSonetPathDayNumber
	dmxSonetPathDayESs
	dmxSonetPathDaySESs
	dmxSonetPathDayCVs
	dmxSonetPathDayUASs
	dmxSonetPathDayValidData
dmxSonetFarEndPathDay Table	dmxSonetFarEndPathDayNumber
	dmxSonetFarEndPathDayESs
	dmxSonetFarEndPathDaySESs
	dmxSonetFarEndPathDayCVs
	dmxSonetFarEndPathDayUASs
	dmxSonetFarEndPathDayValidData
dmxSonetVTDay Table	dmxSonetVTDayNumber
	dmxSonetVTDayESs
	dmxSonetVTDaySESs
	dmxSonetVTDayCVs
	dmxSonetVTDayUASs
	dmxSonetVTDayValidData
dmxSonetFarEndVTDay Table	dmxSonetFarEndVTDayNumber
	dmxSonetFarEndVTDayESs
	dmxSonetFarEndVTDaySESs
	dmxSonetFarEndVTDayCVs
	dmxSonetFarEndVTDayUASs
	dmxSonetFarEndVTDayValidData

Alarm identifiers for alarm and event traps

In addition to standard SNMP traps, Alcatel-Lucent 1665 DMX supports the following five traps for all NE alarms: Alarms (dmxAlarm), Alarm Clears (dmxAlarmCL), Standing Conditions (dmxStandingCond), Standing Condition Clears (dmxStandingCondCL), and Transient Conditions (dmxTransientCond).

Standard DS1/E1 PM MIB module

The following table shows the Standard DS1/E1 PM MIB tables and parameters defined in IETF RFC2495. This MIB module applies to individual DS1/E1 ports.

Table	Parameters	Description
Dsx1CurrentEntry Table	dsx1CurrentIndex	Current
	dsx1CurrentESs	Current
	dsx1CurrentSESs	Current
	dsx1CurrentSEFSs	Current
	dsx1CurrentUASs	Current
	dsx1CurrentCSSs	Current
	dsx1CurrentPCVs	Current
	dsx1CurrentLESs	Current
	dsx1CurrentBESs	Current
	dsx1CurrentDMs	Current
	dsx1CurrentLCVs	Current

Table	Parameters	Description
Dsx1ConfigEntry Table	dsx1LineIndex	ifIndex
	dsx1TimeElapsed	seconds since the beginning of current period
	dsx1ValidIntervals	number of previous 15-min intervals for which data was collected (usually 32)
	dsx1LineType	type of DS1/E1 line, e.g., E1 unframed
	dsx1LineCoding	line coding, e.g. B8ZS
	dsx1SendCode	code being sent
	dsx1CircuitIdentifier	circuit ID: 0,...,255
	dsx1LoopbackConfig	loopback configuration
	dsx1LineStatus	bit mapped line status information
	dsx1SignalMode	signaling mode
	dsx1TransmitClockSource	loop timing, local timing or through timing
	dsx1Fdl	facilities data link capabilities
	dsx1InvalidIntervals	number of intervals for which no data is available (usually 0)
	dsx1LineLength	length of the DS1/E1 line in meters
	dsx1LineStatusLastChange	time this DS1/E1 entered its current line status state
	dsx1LineStatusChangeTrapEnable	indicates whether dsx1LineStatusChange traps should be generated for this DS1/E1
	dsx1LoopbackStatus	current state of the loopback on the DS1/E1 interface
	dsx1Ds1ChannelNumber	0...28
	dsx1Channelization	DS1/E1 channelization: disabled, enabled DS0 or enabled DS1

Table	Parameters	Description
Dsx1IntervalEntry Table	dsx1IntervalIndex	15 minute
	dsx1IntervalNumber	15 minute
	dsx1IntervalESs	15 minute
	dsx1IntervalSESs	15 minute
	dsx1IntervalSEFSs	15 minute
	dsx1IntervalUASs	15 minute
	dsx1IntervalCSSs	15 minute
	dsx1IntervalPCVs	15 minute
	dsx1IntervalLESs	15 minute
	dsx1IntervalBESs	15 minute
	dsx1IntervalDMs	15 minute
	dsx1IntervalLCVs	15 minute
	dsx1IntervalValidData	15 minute
Dsx1TotalEntry Table	dsx1TotalIndex	24 hour
	dsx1TotalESs	24 hour
	dsx1TotalSESs	24 hour
	dsx1TotalSEFSs	24 hour
	dsx1TotalUASs	24 hour
	dsx1TotalCSSs	24 hour
	dsx1TotalPCVs	24 hour
	dsx1TotalLESs	24 hour
	dsx1TotalBESs	24 hour
	dsx1TotalDMs	24 hour
	dsx1TotalLCVs	24 hour
Dsx1ChanMappingEntry Table	dsx1ChanMappedIfIndex	DS1/E1 channel number ifIndex

Table	Parameters	Description
Dsx1FarEndCurrentEntry Table	dsx1FarEndCurrentIndex	Current
	dsx1FarEndTimeElapsed	Current
	dsx1FarEndValidIntervals	Current
	dsx1FarEndCurrentESs	Current
	dsx1FarEndCurrentSESs	Current
	dsx1FarEndCurrentSEFSs	Current
	dsx1FarEndCurrentUASs	Current
	dsx1FarEndCurrentCSSs	Current
	dsx1FarEndCurrentLESs	Current
	dsx1FarEndCurrentPCVs	Current
	dsx1FarEndCurrentBESs	Current
	dsx1FarEndCurrentDMs	Current
	dsx1FarEndInvalidIntervals	Current
Dsx1FarEndIntervalEntry Table	dsx1FarEndIntervalIndex	15 minute
	dsx1FarEndIntervalNumber	15 minute
	dsx1FarEndIntervalESs	15 minute
	dsx1FarEndIntervalSESs	15 minute
	dsx1FarEndIntervalSEFSs	15 minute
	dsx1FarEndIntervalUASs	15 minute
	dsx1FarEndIntervalCSSs	15 minute
	dsx1FarEndIntervalLESs	15 minute
	dsx1FarEndIntervalPCVs	15 minute
	dsx1FarEndIntervalBESs	15 minute
	dsx1FarEndIntervalDMs	15 minute
	dsx1FarEndIntervalValidData	15 minute

Table	Parameters	Description
Dsx1FarEndTotalEntry Table	dsx1FarEndTotalIndex	24 hour
	dsx1FarEndTotalESs	24 hour
	dsx1FarEndTotalSESs	24 hour
	dsx1FarEndTotalSEFSs	24 hour
	dsx1FarEndTotalUASs	24 hour
	dsx1FarEndTotalCSSs	24 hour
	dsx1FarEndTotalLESs	24 hour
	dsx1FarEndTotalPCVs	24 hour
	dsx1FarEndTotalBESs	24 hour
	dsx1FarEndTotalDMs	24 hour

Standard DS1 traps

Alcatel-Lucent 1665 DMX supports the following DS1 trap.

Table	Parameters
ds1Traps	dsx1LineStatusChange

Standard DS3/EC-1 PM MIB module

The following table shows the Standard DS3/EC-1 PM MIB tables and parameters defined in IETF RFC2496. This MIB module applies to individual DS3/EC-1 ports.

Table	Parameters	Description
Dsx3ConfigEntry	dsx3LineIndex	ifIndex
	dsx3TimeElapsed	seconds since the beginning of current period
	dsx3ValidIntervals	number of previous 15-min intervals for which data was collected (usually 32)
	dsx3LineType	type of DS3/E3 line
	dsx3LineCoding	line coding, e.g. B3ZS
	dsx3SendCode	code being sent
	dsx3CircuitIdentifier	N/A - always “0”
	dsx3LoopbackConfig	loopback configuration
	dsx3LineStatus	bit mapped line status information
	dsx3TransmitClockSource	loop timing, local timing or through timing
	dsx3InvalidIntervals	number of intervals for which no data is available (usually 0)
	dsx3LineLength	length of the DS3/E3 line in meters
	dsx3LineStatusLastChange	time this DS3/E3 entered its current line status state
	dsx3LineStatusChangeTrap Enable	indicates whether dsx3LineStatusChange traps should be generated for this DS3/E3 - read only
	dsx3LoopbackStatus	current state of the loopback on the DS3/E3 interface
	dsx3Channelization	“enabled DS1” if CP is TMUX, otherwise “disabled”
	dsx3Ds1ForRemoteLoop	not supported, always “0”

Table	Parameters	Description
Dsx3CurrentEntry	dsx3CurrentIndex	Current
	dsx3CurrentPESs	Current - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3CurrentPSESs	Current - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3CurrentSEFSs	Current
	dsx3CurrentUASs	Current
	dsx3CurrentLCVs	Current
	dsx3CurrentPCVs	Current - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3CurrentLESs	Current
	dsx3CurrentCCVs	Current - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
	dsx3CurrentCESs	Current - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
	dsx3CurrentCSESs	Current - valid only if ENT-rr:fmt=CPBIT, otherwise “0”

Table	Parameters	Description
Dsx3IntervalEntry	dsx3IntervalIndex	Current
	dsx3IntervalNumber	15 minute
	dsx3IntervalPESs	15 minute - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3IntervalPSESs	15 minute - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3IntervalSEFSs	15 minute
	dsx3IntervalUASs	15 minute
	dsx3IntervalLCVs	15 minute
	dsx3IntervalPCVs	15 minute - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3IntervalLESs	15 minute
	dsx3IntervalCCVs	15 minute - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
	dsx3IntervalCESs	15 minute - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
	dsx3IntervalCSESs	15 minute - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
	dsx3IntervalValidData	15 minute

Table	Parameters	Description
Dsx3TotalEntry	dsx3TotalIndex	24 hour
	dsx3TotalPESs	24 hour - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3TotalPSESs	24 hour - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3TotalSEFSs	24 hour
	dsx3TotalUASs	24 hour
	dsx3TotalLCVs	24 hour
	dsx3TotalPCVs	24 hour - valid only if ENT-rr:fmt=PBIT, otherwise “0”
	dsx3TotalLESs	24 hour
	dsx3TotalCCVs	24 hour - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
	dsx3TotalCESs	24 hour - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
	dsx3TotalCSESs	24 hour - valid only if ENT-rr:fmt=CPBIT, otherwise “0”
Dsx3FarEndConfigEntry	dsx3FarEndLineIndex	not supported
	dsx3FarEndEquipCode	not supported
	dsx3FarEndLocationIDCode	not supported
	dsx3FarEndFrameIDCode	not supported
	dsx3FarEndUnitCode	not supported
	dsx3FarEndFacilityIDCode	not supported

Standard DS3 traps

Alcatel-Lucent 1665 DMX supports the following DS3 trap.

Table	Parameter
DS3 Traps	dsx3LineStatusChange

Private DS3/EC-1 PM MIB module

Alcatel-Lucent 1665 DMX supports private DS3/EC-1 PM MIB Module. This MIB module applies to individual DS3/EC-1 ports and tributaries.

Table	Parameters	Description
DmxDmxDsx3CurrentEntry	dmxDsx3CurrentIndex	Current
	dmxDsx3CurrentFMESs	Current - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
	dmxDsx3CurrentFMSESs	Current - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
	dmxDsx3CurrentFMCVs	Current - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
DmxDmxDsx3IntervalEntry	dmxDsx3IntervalIndex	Interval
	dmxDsx3IntervalFMESs	Interval - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
	dmxDsx3IntervalFMSESs	Interval - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
	dmxDsx3IntervalFMCVs	Interval - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
	dsx3DMXIntervalValidData	
DmxDmxDsx3TotalEntry	dmxDsx3TotalIndex	Total
	dmxDsx3TotalFMESs	Total - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
	dmxDsx3TotalFMSESs	Total - valid only if ENT-rr:fmt=FMBIT, otherwise “0”
	dmxDsx3TotalFMCVs	Total - valid only if ENT-rr:fmt=FMBIT, otherwise “0”

Table	Parameters	Description
DmxDsx3FarEndCurrentEntry	dmxDsx3FarEndCurrentIndex	Current
	dmxDsx3FarEndTimeElapsed	Current
	dmxDsx3FarEndValidIntervals	Current
	dmxDsx3FarEndCurrentCFMESs	Current - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndCurrentCFMSESs	Current - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndCurrentCFMCVs	Current - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndCurrentUASs	Current - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndInvalidIntervals	Current
DmxDsx3FarEndIntervalEntry	dmxDsx3FarEndIntervalIndex	15 minute
	dmxDsx3FarEndIntervalNumber	15 minute
	dmxDsx3FarEndIntervalCFMESs	15 minute - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndIntervalCFMSESs	15 minute - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndIntervalCFMCVs	15 minute - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndIntervalUASs	15 minute - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndIntervalValidData	15 minute
DmxDsx3FarEndTotalEntry	dmxDsx3FarEndTotalIndex	24 hour
	dmxDsx3FarEndTotalCFMESs	24 hour - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndTotalCFMSESs	24 hour - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndTotalCFMCVs	24 hour - far end PM based on C-bit, F-bit and M-bit errors
	dmxDsx3FarEndTotalUASs	24 hour - far end PM based on C-bit, F-bit and M-bit errors

Fibre Channel/ESCON/FICON private MIB module

Alcatel-Lucent 1665 DMX supports a private Fibre Channel/ESCON/FICON PM MIB module for retrieving Fibre Channel/ESCON/FICON PM parameters. This private MIB module applies to individual ports for the LNW73 circuit pack.

Private FC/ESCON/FICON MIB Module PM QOS parameters

The following table shows the private Ethernet PM MIB module QOS parameters.

Table	Object	Parameter	Definition
dmxPortStat-CountCurrent-Table	dmxPortStatCountCurrentRxEle-ments	The number of octets or bytes that have been received by this port (EINB).[1]	
	dmxPortStatCountCurrentRxOb-jects	The number of frames/packets that have been received by this port (EINF)[2]	
	dmxPortStatCountCurrentIn-validCRC	Count of frames received with invalid CRC (EDFE)	
	dmxPortStatCountCurrentIn-validTxWords	Count of invalid transmission words received at this port (INTXWD)	
	dmxPortStatCountCurrentLos-sofSignal	Count of instances of signal loss detected at port (LOS)	
	dmxPortStatCountCurrentLos-sofSynchronization	Count of instances of synchronization (LSYNC)	
	dmxPortStatCountCurrentEncod-ingDisparityErrors	Count of disparity errors received at this port (DSPERR)	
	dmxPortStatCountCurrentTxEle-ments	The number of octets or bytes that have been transmitted by this port (EONB)[1]	
	dmxPortStatCountCurrentTxOb-jects	The number of frames/packets/ IOs/etc. that have been transmitted by this port (EONF)[2]	
	dmxPortStatCountCurrentRx-OverflowFramesDropped	Count of received overflow frames dropped (RFOVD)	
	dmxPortStatCountCurrentTx-OverflowFramesDropped	Count of transmit overflow frames dropped (TFOVD)	
	dmxPortStatCountCurrentTx-FramesCRCErrors	Count of transmitted frames with CRC errors (TFCRC)	
	dmxPortStatCountCur-rentTx10BERRErrors	Count of transmitted 10B_ERR errors (T10BERR)	

Table	Object	Parameter	Definition
dmxPortStat-CountInterval-Table	dmxPortStatCountIntervalIndex	15 minute bucket index	1 to 32
	dmxPortStatCountIntervalRx-Elements	The number of octets or bytes that have been received by this port (EINB)[1]	15 minute
	dmxPortStatCountIntervalRxOb-jects	The number of frames/packets that have been received by this port (EINF)[2]	15 minute
	dmxPortStatCountIntervalIn-validCRC	Count of frames received with invalid CRC (EDFE)	15 minute
	dmxPortStatCountIntervalIn-validTxWords	Count of invalid transmission words received at this port (INTXWD)	15 minute
	dmxPortStatCountIntervalLos-sofSignal	Count of instances of signal loss detected at port (LOS)	15 minute
	dmxPortStatCountIntervalLos-sofSynchronization	Count of instances of synchronization (LSYNC)	15 minute
	dmxPortStatCountIntervalEnco-dingDisparityErrors	Count of disparity errors received at this port (DSPERR)	15 minute
	dmxPortStatCountIntervalTx-Elements	The number of octets or bytes that have been transmitted by this port (EONB)[1]	15 minute
	dmxPortStatCountIntervalTxOb-jects	The number of frames/packets/ IOs/etc that have been transmitted by this port (EONF)[2]	15 minute
	dmxPortStatCountIntervalRx-OverflowFramesDropped	Count of received overflow frames dropped (RFOVD)	
	dmxPortStatCountIntervalTx-OverflowFramesDropped	Count of transmit overflow frames dropped (TFOVD)	
	dmxPortStatCountIntervalTx-FramesCRCErrors	Count of transmitted frames with CRC errors (TFCRC)	
	dmxPortStatCountInter-valTx10BERRErrors	Count of transmitted 10B_ERR errors (T10BERR)	

Table	Object	Parameter	Definition
dmxPortStat-CountDayTable	dmxPortStatCountDayIndex	day index	current or previous 24 hour period
	dmxPortStatCountDayRxEle-ments	The number of octets or bytes that have been received by this port (EINB)[1]	24 hour
	dmxPortStatCountDayRxObjects	The number of frames/packets that have been received by this port (EINF)[2]	24 hour
	dmxPortStatCountDayIn-validCRC	Count of frames received with invalid CRC (EDFE)	24 hour
	dmxPortStatCountDayInvalidTx-Words	Count of invalid transmission words received at this port (INTXWD)	24 hour
	dmxPortStatCountDayLossof-Signal	Count of instances of signal loss detected at port (LOS)	24 hour
	dmxPortStatCountDayLossof-Synchronization	Count of instances of synchronization (LSYNC)	24 hour
	dmxPortStatCountDayEncod-ingDisparityErrors	Count of disparity errors received at this port (DSPERR)	24 hour
	dmxPortStatCountDayTxEle-ments	The number of octets or bytes that have been transmitted by this port. (EONB)[1]	24 hour
	dmxPortStatCountDayTxObjects	The number of frames/packets/ IOs/etc that have been transmitted by this port. (EONF)[2]	24 hour
	dmxPortStatCountDayRxOver-flowFramesDropped	Count of received overflow frames dropped (RFOVD)	24 hour
	dmxPortStatCountDayTxOver-flowFramesDropped	Count of transmit overflow frames dropped (TFOVD)	24 hour
	dmxPortStatCountDayTxFrame-sCRCErrors	Count of transmitted frames with CRC errors (TFCRC)	24 hour
	dmxPortStatCountDay Tx10BERRErrors	Count of transmitted 10B_ERR errors (T10BERR)	24 hour

Table	Object	Parameter	Definition
dmxVcgStat-CountCurrent-Table	dmxVcgStatCountCurrentRxObjects	The number of frames/packets that have been received by this port	
	dmxVcgStatCountCurrentInvalidCRC	Count of frames received with invalid CRC (EDFE)	
	dmxVcgStatCountCurrentTxObjects	The number of frames/packets that have been transmitted by this port	
	dmxVcgStatCountCurrentRxSingleBitErrCorrectedGFP	Count of received single-bit error corrected GFP header count (RCORH)	
	dmxVcgStatCountCurrentRxMultiBitUncorrectedGFP	Count of received uncorrected multi-bit error GFP header count (RCRCH)	
	dmxVcgStatCountCurrentRxSingleBitErrCorrectedGFPSuperblk	Count of received single-bit error corrected GFP super-block count (RCORF)	
dmxVcgStat-CountInterval-Table	dmxVcgStatCountIntervalIndex	15 minute bucket index	15 minute
	dmxVcgStatCountIntervalRxObjects	The number of frames/packets that have been received by this port	15 minute
	dmxVcgStatCountIntervalInvalidCRC	Count of frames received with invalid CRC (EDFE)	15 minute
	dmxVcgStatCountIntervalTxObjects	The number of frames/packets that have been transmitted by this port	15 minute
	dmxVcgStatCountIntervalRxSingleBitErrCorrectedGFP	Count of received single-bit error corrected GFP header count (RCORH)	15 minute
	dmxVcgStatCountIntervalRxMultiBitUncorrectedGFP	Count of received uncorrected multi-bit error GFP header count (RCRCH)	15 minute
	dmxVcgStatCountIntervalRxSingleBitErrCorrectedGFPSuperblk	Count of received single-bit error corrected GFP super-block count (RCORF)	15 minute

Table	Object	Parameter	Definition
dmxVcgStat-CountDayTable	dmxVcgStatCountDayIndex	day index	24 hour
	dmxVcgStatCountDayRxObjects	The number of frames/packets that have been received by this port	24 hour
	dmxVcgStatCountDayIn-validCRC	Count of frames received with invalid CRC (EDFE)	24 hour
	dmxVcgStatCountDayTxObjects	The number of frames/packets that have been transmitted by this port	24 hour
	dmxVcgStatCountDayRxSin-gleBitErrCorrectedGFP	Count of received single-bit error corrected GFP header count (RCORH)	24 hour
	dmxVcgStatCountDayRxMulti-BitUncorrectedGFP	Count of received uncorrected multi-bit error GFP header count (RCRCH)	24 hour
	dmxVcgStatCountDayRxSin-gleBitErrCorrectedGFPSuperblk	Count of received single-bit error corrected GFP super-block count (RCORF)	24 hour

Notes:

1. For Fibre Channel, ordered sets are not included in the count.
2. A Fibre Channel frame starts with SOF and ends with EOF.

Private FC/ESCON/Ficon PM MIB module traps

The following table shows the private Ethernet PM MIB module traps. These traps are only supported on the LNW73 pack.

dmxAlarmId	Parameter
dmxPortStatInc1GfcLos	Loss of signal (LOS) on 1GFC port
dmxPortStatInc1GfcLosClr	LOS clear on 1GFC port
dmxPortStatInc2GfcLos	Loss of signal (LOS) on 2GFC port
dmxPortStatInc2GfcLosClr	LOS clear on ESCON port
dmxPortStatIncEsconLos	Loss of signal (LOS) on 2GFC port
dmxPortStatIncEsconLosClr	LOS clear on ESCON port
dmxPortStatIncFiconLos	Loss of signal (LOS) on FICON port
dmxPortStatIncFiconLosClr	LOS clear on FICON port
dmxPortStatInc1GfcLsync	inc. Loss of Synch (LSYNC) on 1GFC port
dmxPortStatInc1GfcLsyncClr	LSYNC clear on 1GFC port
dmxPortStatInc2GfcLsync	inc. Loss of Synch (LSYNC) on 2GFC port
dmxPortStatInc2GfcLsyncClr	LSYNC clear on ESCON port
dmxPortStatIncEsconLsync	inc. Loss of Synch (LSYNC) on 2GFC port
dmxPortStatIncEsconLsyncClr	LSYNC clear on ESCON port
dmxPortStatIncFiconLsync	inc. Loss of Synch (LSYNC) on FICON port
dmxPortStatIncFiconLsyncClr	LSYNC clear on FICON port
dmxPortStatCount1GfcTINTXWD	Invalid transmission words TCA received at this 1GFC port
dmxPortStatCount2GfcTINTXWD	Invalid transmission words TCA received at this 2GFC port
dmxPortStatCountFiconTINTXWD	Invalid transmission words TCA received at this FICON port
dmxPortStatCountEsconTINTXWD	Invalid transmission words TCA received at this ESCON port

Standard Ethernet interface MIB module (RFC2863)

Alcatel-Lucent 1665 DMX supports the standard Ethernet interface MIB module defined in RFC2863. This module defines Ethernet traps and retrievable Ethernet port and PM parameters. This MIB module applies to individual Fast Ethernet and Gigabit Ethernet ports.

Standard Ethernet interface MIB module parameters

The following table shows the standard Ethernet interface MIB module parameters.

Object	Definition
ifIndex	Interface Index
ifDescr	Interface description (mfg, product, version)
ifType	Type of interface
ifMtu	Interface maximum rate (bps) - for GbE circuit pack, this is “1,000,000,000”, for FE circuit pack, value is based on value of the line rate parameter. If the line rate is 10M, ifSpeed value is “10,000,000”. If the line rate parameter is 100M, ifSpeed value is “100,000,000”.
ifPhysAddress	MAC Address
ifAdminStatus	Administration status (up, down or testing) (read only). Value is always “up”.
ifOperStatus	Operational status (up, down, testing, unknown, dormant, notPresent or lowerLayerDown). If board/port is removed, value is “notPresent”. If there is an existing alarm on the port, i.e., Loss of signal (LOS) or Auto-Negotiation Mismatch (ANM) on the port, then the value is “down”, else the value is “up”.
ifLastChange	TimeTicks since last re-initialization
ifInOctets	Total Bytes Received
IfInUcastPkts	Frames Received: Broadcast Frames Received - Multicast Frames Received
ifInMulticastPkts	Multicast Frames Received
ifInBroadcastPkts	Broadcast Frames Received
ifInDiscards	Dropped Frames
ifInErrors	CRC Error + Oversize Frames + Fragments + Jabber + MAC Rx Error
ifInUnknownProtos	(always 0)
ifOutOctets	Bytes Sent
IfOutUcastPkts	Frames Sent - Out Multicast Frames - Out Broadcast Frames
ifOutMulticastPkts	Out Multicast Frames
ifOutBroadcastPkts	Out Broadcast Frames
IfOutDiscards	(always 0) (not supported in this release)
ifOutErrors	(always 0) (not supported in this release)
ifName	Interface name - (always set to NULL)
ifHCInOctets	Total Bytes Received

Object	Definition
ifHCInUcastPkts	Frames Received: Broadcast Frames Received - Multicast Frames Received
ifHCInMulticastPkts	Multicast Frames Received
ifHCInBroadcastPkts	Broadcast Frames Received
ifHCOutOctets	Bytes Sent
ifHCOutUcastPkts	Frames Sent - Out Multicast Frames - Out Broadcast Frames
ifHCOutMulticastPkts	Out Multicast Frames
ifHCOutBroadcastPkts	Out Broadcast Frames
ifLinkUpDownTrapEnable	Traps enabled or disabled - Alcatel-Lucent 1665 DMX, *Metropolis*® DMX*press*, and Alcatel-Lucent 1665 DMXtend support READ-ONLY
ifHighSpeed	Interface speed (Mbps) - for GbE circuit pack, this is “1,000”, for FE circuit pack, value is based on line rate parameter. If the line rate is 10M, ifSpeed value is “10”. If the line rate is 100M, ifSpeed value is “100”.
ifPromiscuousMode	Promiscuous mode (true or false) - Alcatel-Lucent 1665 DMX, *Metropolis*® DMX*press* and Alcatel-Lucent 1665 DMXtend support READ-ONLY
ifConnectorPresent	Physical connector present (true or false)
ifAlias	Interface alias name - READ-ONLY - (always set to NULL)
ifCounterDiscontinuity TimeTimeStamp	Time of last counter discontinuity

Standard Ethernet interface MIB module traps

The following table shows the standard Ethernet interface MIB module traps.

Object	Definition
linkUp	link up
linkDown	link down

Standard Ethernet PM MIB module (RFC2358/RFC2665)

Alcatel-Lucent 1665 DMX supports the standard Ethernet PM MIB module defined in RFC2358 and RFC2665. This module defines additional retrievable Ethernet PM parameters. This MIB module applies to individual Fast Ethernet and Gigabit Ethernet ports.

Standard Ethernet PM MIB module parameters

The following table shows the standard Ethernet PM MIB module parameters.

Object	Definition
ifIndex	Interface Index
dot3StatsAlignmentErrors	Fragments
dot3StatsFCSErrors	CRC Error
dot3StatsSingleCollisionFrames	Collision
dot3StatsMultipleCollisionFrames	(always 0) (not supported in this release)
dot3StatsSQETestErrors	(always 0) (not supported in this release)
dot3StatsDeferredTransmissions	(always 0) (not supported in this release)
dot3StatsLateCollisions	Late Collision
dot3StatsExcessiveCollisions	(always 0) (not supported in this release)
dot3StatsInternalMacTransmitErrors	(always 0) (not supported in this release)
dot3StatsCarrierSenseErrors	(always 0) (not supported in this release)
dot3StatsFrameTooLongs	Oversize Frames
dot3StatsInternalMacReceiveErrors	MAC Rx Error
dot3StatsSymbolErrors	(always 0) (not supported in this release)
dot3StatsDuplexStatus	Duplex Status (half duplex (2), full duplex (3) - added by RFC2665
dot3ControlFunctionsSupported	pause (0) --802.3 flow control - added by RFC2665
dot3ControlInUnknownOpcodes	(always 0) - added by RFC2665 (not supported in this release)
dot3PauseAdminMode	Flow control default mode (read only) - added by RFC2665
dot3PauseOperMode	Flow control operational mode (disabled [1], enabled transmit & receive [4]) - added by RFC2665
dot3InPauseFrames	(always 0) - added by RFC2665 (not supported in this release)
dot3OutPauseFrames	(always 0) - added by RFC2665 (not supported in this release)

Private Ethernet PM MIB module

Alcatel-Lucent 1665 DMX supports a private Ethernet PM MIB module for Ethernet traps and for retrieving Ethernet PM parameters. This private Ethernet PM MIB module applies to individual Fast Ethernet and Gigabit Ethernet ports.

Private Ethernet PM MIB module parameters

The following table shows the private Ethernet PM MIB module parameters.

Object	Parameter	Definition
dmxEthPmonType-Current	port type	FE or GbE port
dmxEthPmonCur-rentEinb	Incoming number of bytes (EINB)	Total Bytes Received
dmxEthPmonCur-rentEinf	Incoming number of frames (EINF)	Frames Received or Total Frames Received
dmxEthPmonCurrent-Edfc	Dropped frames: congestion (EDFC)	Dropped Frames
dmxEthPmonCurrent-Edfe	Dropped frames: errors (EDFE)	CRC Error + Oversize Frames + Fragments + Jabber + MAC Rx Error[2]
dmxEthPmonCurren-tEonb	Outgoing number of bytes (EONB)	Bytes Sent
dmxEthPmonCurren-tEonf	Outgoing number of frames (EONF)	Frames Sent
dmxEthPmonInterval-Index	15 minute bucket index	1 to 32
dmxEthPmon-TypeInterval	port type	FE or GbE port
dmxEthPmonInterval-Einb	Incoming number of bytes (EINB)	Total Bytes Received: 15 minute
dmxEthPmonInterval-Einf	Incoming number of frames (EINF)	Frames Received or Total Frames Received: 15 minute
dmxEthPmonInterval-Edfc	Dropped frames: congestion (EDFC)	Dropped Frames: 15 minute
dmxEthPmonInterval-Edfe	Dropped frames: errors (EDFE)	CRC Error + Oversize Frames + Fragments + Jabber + MAC Rx Error: 15 minute[2]
dmxEthPmonInterval-Eonb	Outgoing number of bytes (EONB)	Bytes Sent: 15 minute

Object	Parameter	Definition
dmxEthPmonInterval-Eonf	Outgoing number of frames (EONF)	Frames Sent: 15 minute
dmxEthPmonDayType	port type	FE or GbE port
dmxEthPmonDayEinb	Incoming number of bytes (EINB)	Total Bytes Received: 24 hour
dmxEthPmonDayEinf	Incoming number of frames (EINF)	Frames Received or Total Frames Received: 24 hour
dmxEthPmonDayEdfc	Dropped frames: congestion (EDFC)	Dropped Frames: 24 hour
dmxEthPmonDayEdfe	Dropped frames: errors (EDFE)	CRC Error + Oversize Frames + Fragments + Jabber + MAC Rx Error: 24 hour[2]
dmxEthPmon-DayEonb	Outgoing number of bytes (EONB)	Bytes Sent: 24 hour
dmxEthPmonDayEonf	Outgoing number of frames (EONF)	Frames Sent: 24 hour
dmxEthPmonCurrent-Edfb	dropped frames - broadcast rate limit (EDFB)	LNW170 only
dmxEthPmonCurrent-Edfcg	dropped green frames - congestion (EDFCG)	LNW170 only
dmxEthPmonCurrent-Edfcy	dropped yellow frames - congestion (EDFCY)	LNW170 only
dmxEthPmonCur-rentEindp	dropped PAUSE frames (EINDP)	LNW170 only
dmxEthPmonCur-rentEincp	number of frames trapped to CPU (EINCP)	LNW170 only
dmxEthPmonCur-rentEinfb	incoming number of broadcast frames (EINFB)	LNW170 only
dmxEthPmonCur-rentEinfm	incoming number of multicast frames (EINFM)	LNW170 only
dmxEthPmonCur-rentEinfu	incoming number of unicast frames (EINFU)	LNW170 only
dmxEthPmonCurren-tEocp	number of frames received from CPU (EOCP)	LNW170 only
dmxEthPmonCurren-tEonfb	outgoing number of broadcast frames (EONFB)	LNW170 only
dmxEthPmonCurren-tEonfm	outgoing number of multicast frames (EONFM)	LNW170 only

Object	Parameter	Definition
dmxEthPmonCurrentEonfu	outgoing number of unicast frames (EONFU)	LNW170 only
dmxEthPmonCurrentStprole	Number of times the STP port role changed (STPROLE)	LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonCurrentStpstate	Number of times the STP port state changed, except to or from DISA (STPSTATE)	LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonCurrentStproot	Number of times the bridge changed to or from being root. The value is reported only on the lowest numbered port (a VCG if present, else a LAN if present, else a LAG) in a spanning tree group. All other ports in the group report 0 (STPROOT)	LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonCurrentBpdut	Number of occurrences of BPDU timeout (BPDUT)	LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonCurrentBpdui	Incoming number of BPDU frames (BPDUI)	LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonCurrentBpduo	Outgoing number of BPDU frames (BPDUO)	LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonCurrentBpdud	Number of BPDU frames dropped (BPDUD)	LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonCurrentRplblk	Number of times the RPL block state changed (RPLBLK)	LNW170 only (VCG and LAN ports)
dmxEthPmonCurrent Erp1blk	Number of times the ERP port #1 block state changed (ERP1BLK)	LNW170 only (VCG and LAN ports)
dmxEthPmonCurrent Erp2blk	Number of times the ERP port #2 block state changed (ERP2BLK)	LNW170 only (VCG and LAN ports)
dmxEthPmonCurrentRapsr	Number of transmitted R-APS PDUs (RAPSR)	LNW170 only (VCG and LAN ports)
dmxEthPmonCurrentRapst	Number of transmitted R-APS PDUs (RAPST)	LNW170 only (VCG and LAN ports)
dmxEthPmonCurrentEdfems	Number of Ethernet Dropped Frames due to Exceeding MTU SIze (EDFEMS)	LNW170 only (VCG and LAN ports) LNW64, LNW74. and LNW87 (LAN ports)
dmxEthPmonIntervalEdfb	dropped frames - broadcast rate limit (EDFB)	15 minute - LNW170 only

Object	Parameter	Definition
dmxEthPmonInterval-Edfcg	dropped green frames - congestion (EDFCG)	15 minute - LNW170 only
dmxEthPmonInterval-Edfcy	dropped yellow frames - congestion (EDFCY)	15 minute - LNW170 only
dmxEthPmonInterval-Eindp	dropped PAUSE frames (EINDP)	15 minute - LNW170 only
dmxEthPmonInterval-Eincp	number of frames trapped to CPU (EINCP)	15 minute - LNW170 only
dmxEthPmonInterval-Einfb	incoming number of broadcast frames (EINFB)	15 minute - LNW170 only
dmxEthPmonInterval-Einfm	incoming number of multicast frames (EINFM)	15 minute - LNW170 only
dmxEthPmonInterval-Einfu	incoming number of unicast frames (EINFU)	15 minute - LNW170 only
dmxEthPmonInterval-Eocp	number of frames received from CPU (EOCP)	15 minute - LNW170 only
dmxEthPmonInterval-Eonfb	outgoing number of broadcast frames (EONFB)	15 minute - LNW170 only
dmxEthPmonInterval-Eonfm	outgoing number of multicast frames (EONFM)	15 minute - LNW170 only
dmxEthPmonInterval-Eonfu	outgoing number of unicast frames (EONFU)	15 minute - LNW170 only
dmxEthPmonInterval-Stprole	Number of times the STP port role changed (STPROLE)	15 minute - LNW170 only
dmxEthPmonInterval-Stpstate	Number of times the STP port state changed, except to or from DISA (STPSTATE)	15 minute - LNW170 only
dmxEthPmonInterval-Stproot	Number of times the bridge changed to or from being root. The value is reported only on the lowest numbered port (a VCG if present, else a LAN if present, else a LAG) in a spanning tree group. All other ports in the group report 0 (STPROOT)	15 minute - LNW170 only
dmxEthPmonInterval-Bpdut	Number of occurrences of BPDU timeout (BPDUT)	15 minute LNW170 only (VCG and LAN ports or LAGs)

Object	Parameter	Definition
dmxEthPmonInterval-Bpdui	Incoming number of BPDU frames (BPDUI)	15 minute LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonInterval-Bpduo	Outgoing number of BPDU frames (BPDUO) dmxEthPmonIntervalBpdut	15 minute LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonInterval-Bpdud	Number of BPDU frames dropped (BPDUD)	15 minute LNW170 only (VCG and LAN ports or LAGs)
dmxEthPmonInterval-Valid Data	Interval valid data	Used to flag counter discontinuities when protection switching between protected packs
dmxEthPmonInterval-Rplblk	Number of times the RPL block state changed (RPLBLK)	15 minute LNW170 only (VCG and LAN ports)
dmxEthPmonInterval Erp1blk	Number of times the ERP port #1 block state changed (ERP1BLK)	15 minute LNW170 only (VCG and LAN ports)
dmxEthPmonInterval Erp2blk	Number of times the ERP port #2 block state changed (ERP2BLK)	15 minute LNW170 only (VCG and LAN ports)
dmxEthPmonDayEdfb	dropped frames - broadcast rate limit (EDFB)	24 hour - LNW170 only
dmxEthPmon-DayEdfcg	dropped green frames - congestion (EDFCG)	24 hour - LNW170 only
dmxEthPmon-DayEdfcy	dropped yellow frames - congestion (EDFCY)	24 hour - LNW170 only
dmxEthPmon-DayEindp	dropped PAUSE frames (EINDP)	24 hour - LNW170 only
dmxEthPmon-DayEincp	number of frames trapped to CPU (EINCP)	24 hour - LNW170 only
dmxEthPmon-DayEinfb	incoming number of broadcast frames (EINFB)	24 hour - LNW170 only
dmxEthPmon-DayEinfm	incoming number of multicast frames (EINFM)	24 hour - LNW170 only
dmxEthPmon-DayEinfu	incoming number of unicast frames (EINFU)	24 hour - LNW170 only
dmxEthPmon-DayEocp	number of frames received from CPU (EOCP)	24 hour - LNW170 only

Object	Parameter	Definition
dmxEthPmon-DayEonfb	outgoing number of broadcast frames (EONFB)	24 hour - LNW170 only
dmxEthPmon-DayEonfm	outgoing number of multicast frames (EONFM)	24 hour - LNW170 only
dmxEthPmon-DayEonfu	outgoing number of unicast frames (EONFU)	24 hour - LNW170 only
dmxEthPmonDaySt-prole	Number of times the STP port role changed (STPROLE)	24 hour - LNW170 only
dmxEthPmonDayStp-state	Number of times the STP port state changed, except to or from DISA (STPSTATE)	24 hour - LNW170 only
dmxEthPmonDaySt-proot	Number of times the bridge changed to or from being root. The value is reported only on the lowest numbered port (a VCG if present, else a LAN if present, else a LAG) in a spanning tree group. All other ports in the group report 0 (STPROOT)	24 hour - LNW170 only
dmxEthPmonDayB-pdut	Number of occurrences of BPDU timeout (BPDUT)	24 hour - LNW170 only
dmxEthPmonDayB-pdui	Incoming number of BPDU frames (BPDUI)	24 hour - LNW170 only
dmxEthPmonDayB-pduo	Outgoing number of BPDU frames (BPDUO)	24 hour - LNW170 only
dmxEthPmonDayB-pdud	Number of BPDU frames dropped (BPDUD)	24 hour - LNW170 only

Notes:

1. The definition of Dropped Frames is based on the counters supported by the Galnet devices. The definition of this parameter for the Private Line board, which doesn't have the Galnet devices, may differ.
2. *Oversize Frames* are not included for LNW170 (LAN and VCG ports) or LNW64, LNW87, LNW74 (LAN ports).

Private Ethernet PM MIB module traps

The following table shows the private Ethernet PM MIB module traps.

Trap Object	Definition
dmxIncFeLanLos	Loss of signal (LOS) on FE LAN port

Trap Object	Definition
dmxIncFeLanLosClr	LOS clear on FE LAN port
dmxIncFeLanAnm	Auto-Negotiation Mismatch (ANM) on FE LAN port
dmxIncFeLanAnmClr	ANM clear on FE LAN port
dmxIncGeLanLos	Loss of signal (LOS) on GbE LAN port
dmxIncGeLanLosClr	LOS clear on GbE LAN port
dmxIncGeLanAnm	Auto-Negotiation Mismatch (ANM) on GbE LAN port
dmxIncGeLanAnmClr	ANM clear on GbE LAN port
dmxIncGeLanECV	Excessive Code Violation on GbE LAN port
dmxIncGeLanECVClr	Excessive Code Violation clear on GbE LAN port
dmxIncGeLanTEDFC	Dropped frames due to congestion TCA on GbE LAN port
dmxIncFeLanTEDFC	Dropped frames due to congestion TCA on FE LAN port
dmxIncGeLanTEDFE	Dropped frames due to errors TCA on GbE LAN port
dmxIncFeLanTEDFE	Dropped frames due to errors TCA on FE LAN port

Private Ethernet PM MIB module QOS parameters

Alcatel-Lucent 1665 DMX supports private Ethernet PM MIB module for retrieving QOS parameters. This private Ethernet PM MIB module applies to individual Fast Ethernet and Gigabit Ethernet ports for the LNW170 pack.

Private Ethernet PM MIB module QOS parameters

The following table shows the private Ethernet PM MIB module QOS parameters.

Object	Parameter	Definition
dmxEthPmonQosCurrentTagid	VLANid in the range 1–4093 except for PORT and COSPORT mode which has a value of “NA”	
dmxEthPmonQosCurrentCos	Class of Service in the range 0–3	
dmxEthPmonQosCurrentQibg	Incoming bytes marked green (QIB–G)	
dmxEthPmonQosCurrentQipg	Incoming packets marked green (QIP–G)	
dmxEthPmonQosCurrentQiby	Incoming bytes marked yellow (QIB-Y)	
dmxEthPmonQosCurrentQipy	Incoming packets marked yellow (QIP-Y)	

Object	Parameter	Definition
dmxEthPmonQosCurrentQibr	Incoming bytes marked red (dropped) (QIB-R)	
dmxEthPmonQosCurrentQipr	Incoming packets marked red (dropped) (QIP-R)	
dmxEthPmonQosIntervalIndex	15 minute bucket index	1 to 32
dmxEthPmonQosIntervalTagid	VLANid in the range 1–4093 except for PORT and COSPORT modewhich has a value of “NA”	15 minute
dmxEthPmonQosIntervalCos	Class of Service in the range 0–3	15 minute
dmxEthPmonQosIntervalQibg	Incoming bytes marked green (QIB–G)	15 minute
dmxEthPmonQosIntervalQipg	Incoming packets marked green (QIP–G)	15 minute
dmxEthPmonQosIntervalQiby	Incoming bytes marked yellow (QIB-Y)	15 minute
dmxEthPmonQosIntervalQipy	Incoming packets marked yellow (QIP-Y)	15 minute
dmxEthPmonQosIntervalQibr	Incoming bytes marked red (dropped) (QIB-R)	15 minute
dmxEthPmonQosIntervalQipr	Incoming packets marked red (dropped) (QIP-R)	15 minute
dmxEthPmonQosDayIndex	day index	current or previous 24 hour period
dmxEthPmonQosDayTagid	VLANid in the range 1–4093 except for PORT and COSPORT modewhich has a value of “NA”	24 hour
dmxEthPmonQosDayCos	Class of Service in the range 0–3	24 hour
dmxEthPmonQosDayQibg	Incoming bytes marked green (QIB–G)	24 hour
dmxEthPmonQosDayQipg	Incoming packets marked green (QIP–G)	24 hour
dmxEthPmonQosDayQiby	Incoming bytes marked yellow (QIB-Y)	24 hour
dmxEthPmonQosDayQipy	Incoming packets marked yellow (QIP-Y)	24 hour
dmxEthPmonQosDayQibr	Incoming bytes marked red (dropped) (QIB-R)	24 hour

Object	Parameter	Definition
dmxEthPmonQosDayQipr	Incoming packets marked red (dropped) (QIP-R)	24 hour

Private VCG MIB module

Alcatel-Lucent 1665 DMX supports a private VCG MIB module for VCG traps. This private VCG MIB module applies to individual VCGs.

Private VCG MIB module traps

The following table shows the private VCG MIB module traps.

Trap Object	Definition
dmxIncVcgFail	Incoming VCG fail
dmxIncVcgFailClr	Incoming VCG fail clear
dmxIncVcgGeLanTEDFC	Dropped frames due to congestion TCA on VCG GbE WAN port
dmxIncVcgFeLanTEDFC	Dropped frames due to congestion TCA on VCG FE WAN port
dmxIncVcgGeLanTEDFE	Dropped frames due to errors TCA on VCG GbE WAN port
dmxIncVcgFeLanTEDFE	Dropped frames due to errors TCA on VCG FE WAN port
dmxIncVcgGfpRcfFail	General framing procedure remote client signal failed (GFP_RCF)
dmxIncVcgGfpRcfFailClr	General framing procedure remote client signal failed (GFP_RCF) clear
dmxIncVcgLopcFail	VCG loss of partial capacity (VCGLOPC)
dmxIncVcgLopcFailClr	VCG loss of partial capacity (VCGLOPC) clear
dmxIncVcgFoprFail	VCG failure of LCAS protocol (Sink) (VCGFOPR)
dmxIncVcgFoprFailClr	VCG failure of LCAS protocol (Sink) (VCGFOPR) clear
dmxIncVcgFoptFail	VCG failure of LCAS protocol (Source) (VCGFOPT)
dmxIncVcgFoptFailClr	VCG failure of LCAS protocol (Source) (VCGFOPT) clear
dmxIncVcgNOTLCAS	Far End Not LCAS (NOTLCAS)
dmxIncVcgNOTLCASClr	Far End Not LCAS clear (NOTLCAS)
dmxIncSts1Lom	Incoming STS1 loss of multiframe
dmxIncSts1LomClr	Incoming STS1 loss of multiframe clear
dmxIncSts3cLom	Incoming STS3C loss of multiframe
dmxIncSts3cLomClr	Incoming STS3C loss of multiframe clear
dmxIncVt1Lom	Incoming VT1 loss of multiframe

Trap Object	Definition
dmxIncVt1LomClr	Incoming VT1 loss of multiframe clear
dmxIncSts1Sqm	Incoming STS1 sequence number mismatch
dmxIncSts1SqmClr	Incoming STS1 sequence number mismatch
dmxIncSts3cSqm	Incoming STS3C sequence number mismatch
dmxIncSts3cSqmClr	Incoming STS3C sequence number mismatch
dmxIncVt1Sqm	Incoming Vt1 sequence number mismatch
dmxIncVt1SqmClr	Incoming Vt1 sequence number mismatch
dmxIncVcgSts1MSUL	STS1 Member Signal Unacceptable -LCAS (MSU-L)
dmxIncVcgSts1MSULClr	STS1 Member Signal Unacceptable -LCAS (MSU-L) Clear
dmxIncVcgSts3cMSUL	STS3c Member Signal Unacceptable -LCAS (MSU-L)
dmxIncVcgSts3cMSULClr	STS3c Member Signal Unacceptable -LCAS (MSU-L) Clear
dmxIncVcgVtMSUL	VT1.5 Member Signal Unacceptable -LCAS (MSU-L)
dmxIncVcgVtMSULClr	VT1.5 Member Signal Unacceptable -LCAS (MSU-L) Clear

Private MIB module

Alcatel-Lucent 1665 DMX supports a private MIB module for retrieving equipment information parameters and equipment traps. This private MIB module applies to individual circuit packs.

Private MIB module parameters

The following table shows the private MIB module parameters.

Object	Definition
dmxCardType	Circuit pack type.
dmxCardAPP	Circuit pack apparatus code
dmxCardSSN	Circuit pack series number
dmxCardCLEI	Common Language Equipment code
dmxCardECI	Equipment Catalog Item code
dmxCardSLN	Circuit pack serial number
dmxSftwVersion	Version of the software currently stored in the circuit pack
dmxCardVlanTagMode	Virtual LAN tagging mode. This parameter is ONLY reported for slots containing an Ethernet circuit pack. Values: 802.1TAG (IEEE 802.1Q mode), TRANS (Transparent mode), NOTAG (No Tag mode)

Object	Definition
dmxCardVtVcat	VT Virtual Concatenation. This parameter specifies the number of STS-1s dedicated to VT virtual concatenation.
dmxCardDataType	Data type. Values are: FC-FICON - in this mode, data ports are configured individually for Fibre Channel or FICON. ESCON - in this mode all ports on the circuit pack are set for ESCON This object applies only to the LNW73 circuit pack

Private MIB module traps

The following table shows the private MIB module traps.

Object	Definition
dmxCpNotAllowed	Circuit pack not allowed
dmxCpNotAllowedClr	Circuit pack not allowed clear
dmxFACTERM	Illegal circuit pack type
dmxFACTERMClr	Illegal circuit pack type clear
dmxFETERM	FE-LAN circuit pack failed
dmxFETERMClr	FE-LAN circuit pack failed clear
dmxGETERM	GE-LAN circuit pack failed
dmxGETERMClr	GE-LAN circuit pack failed clear
dmxCpRemoved	Circuit pack removed
dmxCpRemovedClr	Circuit pack removed clear
dmxCpInserted	Circuit pack inserted

Provisioning

Overview

Purpose

Alcatel-Lucent 1665 DMX allows the user to customize many system characteristics through provisioning features. Provisioning parameters are set by software controls.

This section describes the many types of provisionable parameters available in Alcatel-Lucent 1665 DMX.

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Default provisioning

Default values

Installation provisioning is minimized with thoughtfully chosen default values set in the factory. Every parameter has a factory default value. These factory defaults for software parameters are maintained in the SYSCTL circuit pack, and a single command is provided to restore all default values. The original values assigned at the factory cannot be changed. However, the current values can be overridden through local or remote provisioning. All provisioning data is stored in nonvolatile memory to prevent data loss during power failures and maintenance operations.

A parameter is a characteristic of the system that affects its operation. The parameter value may be a number, text string, or other menu selection.

Remote provisioning

Overview

Software control allows remote provisioning of Alcatel-Lucent 1665 DMX NEs. This feature is provided especially for provisioning parameters likely to change in service, in support of centralized operations practices.

Cross-connection provisioning

Overview

Alcatel-Lucent 1665 DMX can be provisioned for signal routing. Depending on the application, VT1.5, STS-1, STS-3(c), STS-12(c), or STS-48(c) signal cross-connections may be established to route traffic in a specific manner. Cross-connections may be bidirectional or unidirectional.

Alcatel-Lucent 1665 DMX employs atomic cross-connections for all cross-connection provisioning. Atomic cross-connections are one-way cross-connections between logical ring channels which can be set up and taken down by a single command, and which cannot be broken down into smaller parts. Logical ring channels are the tributaries of a port or port protection group used for transmission in the absence of any line or equipment protection.

Atomic cross-connections are more flexible than the cross-connection provisioning structure employed previously. They allow for the support of more detailed applications because you are able to provision each portion of a cross-connection.

Typical cross-connections

Any VT1.5 or STS-n signal may be provisioned for the following signal routes:

- Main to Main
- Main to Function Unit.
- Hairpin (Function Unit to Function Unit).

Alcatel-Lucent 1665 DMX supports unidirectional cross-connections.

STS-1 cross-connections to Ethernet interfaces are also available. The 1WAY and 1WAYPR cross-connection is used for UPSR point-to-point Ethernet applications. A 1WAY UNSWITCHED cross-connection is used for multipoint Ethernet applications.

The unidirectional pass-through cross-connection is used to pass VT1.5 or STS-n signals through the NE all on the same time slot. For pass-through cross-connections, the channel state default is NMON rather than AUTO as with other cross-connections.

OCH cross-connections

Alcatel-Lucent 1665 DMX also supports optical channel (OCH) cross-connections between dense wavelength division multiplexing (DWDM) compatible circuit packs/pluggable transmission modules. The OCH cross-connections are used to inform the network element about manual fiber connections.

The following OCH cross-connections are supported:

- DWDM-compatible OC-192 port to/from OCH port
- OTU2 port to/from OCH port
- Remote DWDM-compatible wavelength (remote shelf) to/from OCH port
- OCH port to/from OCH port (pass through)

Reference

For more information, see "Cross-connections" (p. 6-38) in Chapter 6, "System planning and engineering".

Automatic provisioning on circuit pack replacement

Overview

Replacement of a failed circuit pack is simplified by automatic provisioning of the original circuit pack values. A provisioning map for the entire shelf is stored redundantly within the SYSCTL (LNW2).

Auto provisioning

Auto provisioning is the ability of an NE to detect the presence of equipment, validate it, and then assign default original values or pre-provisioned parameter values to new equipment. Nonvolatile memory (NVM) and/or hardware registers maintain the parameter values. If you have predefined or pre-provisioned some or all of the parameters, the auto provisioning function validates the request and assigns the pre-provisioned values or default values as required. Auto-provisioning allows an NE to be set up initially with minimal user intervention. Auto-provisioning also supports a self inventory function which allows operations center personnel to learn about and track activities at a remotely located NE.

Automatic provisioning on circuit pack replacement

When a failed circuit pack is replaced, it is automatically provisioned with the original circuit pack values. The provisioning map for the entire shelf is stored redundantly within the SYSCTL (LNW2). It doesn't need to be uploaded from other packs. In order to

replace the LNW2, remove the NVM from the old LNW2 and place it in the new LNW2. Alternatively, you may backup the database, install a factory-fresh LNW2 (with new NVM cards), enter maintenance mode, download the generic, and restore the database.

Items auto provisioned

Some items that are auto-provisioned include the following:

- System target identifier (TID) (which can be changed at initial start-up)
- Default threshold-crossing alert (TCA) profiles
- Circuit packs
- Synchronization default mode

Equipment removal

The NE detects and reports the removal of equipment. The removal of equipment does not cause the NE to delete any entities. Removal of a piece of equipment may result in equipment alarms and insertion of maintenance signals when the state related data is updated. However, removal of equipment does not necessarily mean that the provisioning of the shelf slot has changed. The user must execute specific commands to remove an entity from the system database.

Port state provisioning

Overview

Port state provisioning is a feature provided on Alcatel-Lucent 1665 DMX NEs that can help suppress alarm reporting and performance monitoring by supporting multiple states for DS1, DS3, E1, EC-1, OTS, OCH,OTU2, and Ethernet LAN ports.

The DS1, DS3, E1, EC-1, OTS, OCH, OTU2 port states are:

- automatic (OOS-MA-AS)
- in-service (IS)
- not monitored (OOS).

Ethernet LAN port states are:

- automatic (AUTO)
- in-service (IS)
- not monitored (NMON).

Port states

Ports without signals (undriven) are in the automatic state until changed to the in-service state. Ports are changed to the in-service state when a signal is present or they can be provisioned as in-service by the user. Commands allow a user to retrieve and change the state of a port to the not-monitored state or from the not-monitored state to the automatic state.

Client port (LNW705) primary states follow the rules of their provisioned signal type.

Channel state provisioning

Overview

Automatic channel state provisioning is a capability provided on Alcatel-Lucent 1665 DMX NEs that suppresses reporting of transient alarms and events during provisioning by supporting multiple states (see previous section) for VT1.5, VC-12, STS-1, STS-3(c), STS-12(c), STS-48(c) channels.

Automatic channel state provisioning

While an end-to-end circuit is being set up, particularly during VT1.5/VC-12 and STS-n cross-connection provisioning, several transient maintenance signals result. Without automatic channel state provisioning, these are reported as alarms and events. The technicians are expected to ignore these transient alarms and initiate corrective action only if the alarms persist after the provisioning is completed. To avoid the confusion created by this, Alcatel-Lucent 1665 DMX provides automatic channel state provisioning.

Channel states

A VT1.5 or STS-n channel is kept in the default automatic (OOS-MA-AS) state until the reception of a valid signal (for STS channel states, a valid signal is one free of LOP-P, AIS-P, UNEQ-P, and SF-- for VT channel states, a valid signal is one free of LOP-V, AIS-V, and UNEQ-V.) in that channel. While in OOS-MA-AS state, no alarms or events are reported on the channel. On receiving a valid signal, which occurs when the end-to-end circuit is completely provisioned, the channel automatically changes to the in-service (IS) state, where it resumes normal alarm and event reporting. An additional state, not-monitored (OOS), is also supported in which alarm and event reporting is suppressed regardless of the validity of the signal being received on the channel. Like the port state provisioning capabilities already provided for physical ports like DS1, DS3, and EC-1, the user can submit commands to manually change a channel from IS or OOS-MA-AS to OOS, and from OOS to OOS-MA-AS. A user cannot manually change from OOS-MA-AS or OOS to IS.

For pass-through cross-connects, the channel state transitions from OOS-MA-AS to OOS upon receiving a good signal. This is different than what happens on dropped tribs. On dropped tributaries, the channel state automatically transitions from OOS-MA-AS to IS upon receiving a good signal.

Note: LOP-P is reported regardless of channel state. STS LOP (LOP-P) is reported on any cross-connected tributary, even when the STS channel state is HOSANNAS or OOS. For BLSR, LOP-P is also reported on all working and protection tributaries, independent on whether or not there is a cross-connect.

Line state provisioning

Overview

The state of the low-speed OC-3/12/48 and the high-speed OC-12/48/192 ports can be set manually to not monitored (OOS). On OLIUs with multiple ports, the line state default is automatic (OOS-MA-AS). It is also possible to manually provision any equipped line to in-service (IS).

For more information about the AUTO line state, see “Channel state provisioning” (p. 5-151).

Reports

Overview

Purpose

This section describes reports generated by Alcatel-Lucent 1665 DMX.

Contents

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Performance monitoring reports	5-154
Maintenance history reports	5-154
State reports	5-155
Provisioning reports	5-156
Version/equipment list	5-156

Alarm and status reports

Purpose

The system provides alarm reports that list the active alarm and status conditions, including a remote alarm/status feature that summarizes alarms in other NEs in an alarm group. A description of the condition (for example, controller failure, incoming high-speed signal failure, synchronization hardware or reference failure, etc.) is included in the reports along with a time stamp indicating when the condition was detected, its severity, and whether it is service affecting or not. The option to display specified subsets of alarm conditions is provided (for example, critical alarms only).

Circuit pack status conditions

Circuit pack status conditions include:

- Manually initiated abnormal conditions (for example, forced switch, manual lockouts, loopbacks, system testing)
- Incoming AIS detected
- ACO active.

A description of the status condition (for example, DS1 loopback active, DS3 facility loopback active, etc.) is included in the report along with a time stamp indicating when the condition began.

Alcatel-Lucent 1665 DMX supports of Alarm Severity Assignment Profiles (ASAPs). With ASAPs, any alarm supported for a particular circuit pack/interface can also be a status condition.

Performance monitoring reports

TCA summary report

Alcatel-Lucent 1665 DMX provides a report that lists the number of SONET performance-monitoring parameters that have crossed their thresholds. This report provides a snapshot of the system performance level. If there is signal degradation, it is quickly pinpointed so that corrective action may be taken before customers are affected, thus supporting proactive maintenance.

This report provides separate parameter summaries for each signal level in the system, including SONET section, line, and path, as well as dropped/incoming/outgoing Ethernet bytes and frames. The parameter summaries show the user which performance status to request if they want further information.

Performance status reports

These reports provide detailed information on the current and previous 8 hours in quarter-hour (15-minute) increments, as well as the current and previous day's performance. Threshold crossing alerts are clearly identified and the time the performance registers were last initialized is also shown. Any registers that may have been affected by this initialization are marked. There are separate reports for section, line, and path parameters, as well as Ethernet parameters.

Maintenance history reports

Overview

A maintenance history report contains the following past conditions:

- alarms
- status
- protection switching
- user interface commands (e.g., provisioning, loopback request, manual protection, etc.)

Summary

The maintenance history report contains time stamps indicating when each condition was detected and when it cleared, as well as when the command was entered. A system controller (SYSCTL) reset does not clear records in the log. The LNW2 contains removable NVM memory cards that store these logs.

Reference

See the *Alcatel-Lucent 1665 Data Multiplexer (DMX) User Operations Guide, 365-372-301*, for details on the history log.

State reports

Overview

The state report shows the protection state of all circuit packs installed in the system and the state of the individual low/high-speed channels.

Circuit pack states

The circuit pack state is reported as "active" or "standby."

Path states

The state of the individual VT1.5/VC-12 /STS-n channels and paths may be one of the following:

- not monitored (NMON)
- in service (IS)
- auto (AUTO).

The system reports this information on all interfaces. For VT1.5/VC-12/STS-n channels and paths, the AUTO state would transition to the IS state if a good signal is detected.

Line and port states

The state of individual lines may be IS, NMON, or AUTO for all OC-n ports.

Provisioning reports

Overview

Alcatel-Lucent 1665 DMX provides a variety of provisioning reports that contain the current values of all electronically-provisionable parameters. For more information on the provisioning reports generated, see the *Alcatel-Lucent 1665 Data Multiplexer (DMX) User Operations Guide, 365-372-301*.

Version/equipment list

Overview

Alcatel-Lucent 1665 DMX provides a full inventory report on all hardware and software currently installed.

Information provided

The version/equipment list provides the following information relative to circuit packs:

- Circuit pack name
- 10-character *CLEI* code
- 6-digit equipment catalog item (ECI)
- 10-character apparatus code
- 6-character series number
- 12-character serial number (includes date and location of manufacture)
- Program version (software generic) code
- Program versions in dormant area.

The version/equipment list provides the following information relative to pluggable transmission modules (PTMs):

- Comcode
- *CLEI* code
- Date of manufacture
- 10-character apparatus code
- 6-character series number
- 12-character serial number (includes date and location of manufacture)
- Manufacturer identifier
- Module name
- Module product ID
- Reach (i.e. short, intermediate, long)

- DWDM PTM frequency
- PTM laser bias current (if available)
- PTM optical power received (if available)
- PTM optical power received type - Optical Modulation Amplitude or average power (if available)
- PTM optical power transmitted (if available)
- PTM transceiver temperature (if available)

Administration

Overview

Purpose

This section provides information on system administration.

System administration considerations included in this section are:

Contents

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User-settable miscellaneous discrete interface	5-184

Software upgrades

Overview

Alcatel-Lucent 1665 DMX provides an in-service software installation capability to update the generic program in local and remote systems. Upgrades are distributed on CD-ROMs containing the new software and an installation program. These software upgrades are the primary mechanism to add new feature enhancements to the in-service Alcatel-Lucent 1665 DMX network.

Beginning in R6.0, Alcatel-Lucent 1665 DMX employs provisionable alarm severity profiles known as ASAPs. Therefore, previous alarm severity level provisioning is lost when upgrading to R6.0. Also, because R6.0 introduces atomic cross-connections, any existing 2WAY, 2WAYPR, and MLTPT cross-connects will be automatically replaced with equivalent 1WAY, 1WAYPR, and UNSWITCHED cross-connects.

Software download

In the Alcatel-Lucent 1665 DMX system, software download takes place in two stages. In the first stage, the new generic software is downloaded into a dormant "flash" area as a compressed file. In the second stage, the new generic is uncompressed and moved into an active "flash" space. During this process, the old release continues to run from random access memory (RAM). Installation is not service-affecting, so down time is limited to the reboot time.

Note: During the database initialization phase of the SYSCTL startup, the **ACO** LED is continuously lighted and the **FAULT** LED flashes. Following completion of the database initialization, the **ACO** and **Fault** LEDs return to their normal operation.

Local installation procedure

The procedure is straightforward. The technician connects a personal computer (PC) to the IAOLAN port on the local Alcatel-Lucent 1665 DMX, starts the installation program, and is prompted with a few warnings before the upgrade installation actually begins. After the technician confirms to proceed, the PC takes over the process and completes the installation.

Installation may also be performed via Alcatel-Lucent's OMS or CIT over the IAO LAN interface using FTP or FTAM.

IP Access for network management

Overview

For network management purposes, Alcatel-Lucent 1665 DMX supports the following types of IP Access:

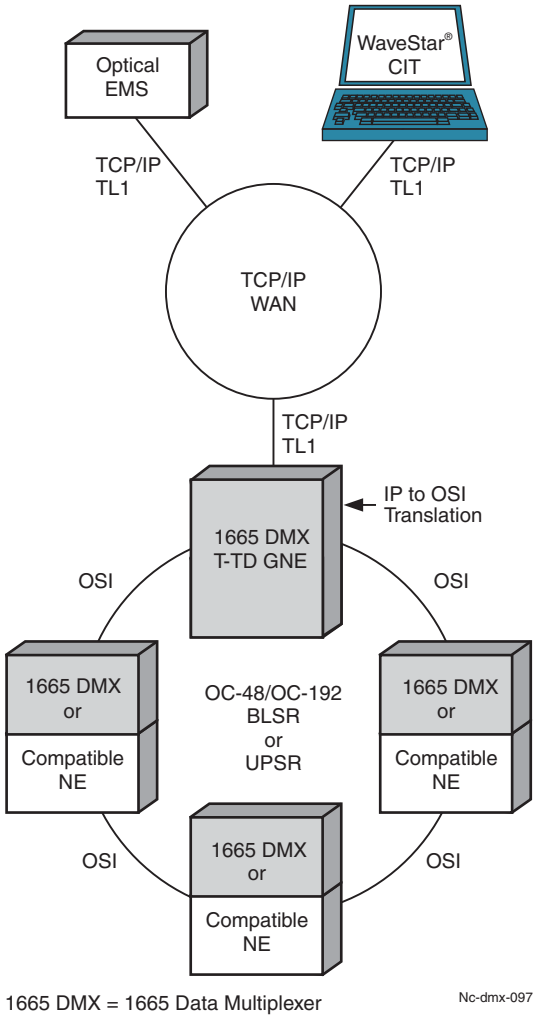
- Alcatel-Lucent 1665 DMX can serve as a TL1 Translation Device (T-TD) by acting as a gateway network element that allows OMS and/or *WaveStar*® CIT to communicate to other network elements (NEs) through an IP access network. This capability allows you to send TL1 commands from OMS or *WaveStar*® CIT located on a TCP/IP based network to various NEs connected on an OSI network.
- Alcatel-Lucent 1665 DMX can functionally encapsulate IP packets within OSI packets to be transmitted through the OSI network to the proper NE. Thus Alcatel-Lucent 1665 DMX supports IP based protocols such as FTP by providing end-to-end IP connectivity between OS and NE. This capability is called IP tunneling. IP tunneling is required to support remote database backup/restore in between Alcatel-Lucent 1665 DMX systems.
- Alcatel-Lucent 1665 DMX can also serve as a File Transfer Translation Device (FTTD) by acting as an FTAM-FTP gateway network element. The FTAM-FTP gateway network element translates FTAM over OSI presentation to FTP over TCP/IP. The FTAM-FTP gateway supports software downloads, database backups, and database restores.
- Alcatel-Lucent 1665 DMX also supports Simple Network Management Protocol (SNMP). Alcatel-Lucent 1665 DMX provides limited support for certain reports and traps (alarms and events autonomous messages).
- Alcatel-Lucent 1665 DMX also supports Network Time Protocol (NTP) using IP tunneling to synchronize the time and date to a standard time reference.

TL1 GNE (T-TD)

Alcatel-Lucent 1665 DMX can copy the application information within an IP packet into an OSI packet. This translation is performed at the application layer. When acting as a TL1 translation device, Alcatel-Lucent 1665 DMX must be provisioned with a list of

possible OSs. If an OS is not on the list residing within the system, a connection from that OS will not be accepted. When Alcatel-Lucent 1665 DMX is used as a TL1 translation device it is referred to as the T-TD GNE (Gateway Network Element).

Figure 5-17 TL1 translation device



OSI associations and TCP/IP connections

When used as a GNE, Alcatel-Lucent 1665 DMX supports a total of 300 OSI associations (logins). Each TCP/IP (or Telnet) connection can support 300 associations. The Alcatel-Lucent 1665 DMX GNE supports up to 20 TCP/IP connections. The combined number of OSI associations on all TCP/IP sessions cannot exceed 300.

IP tunneling

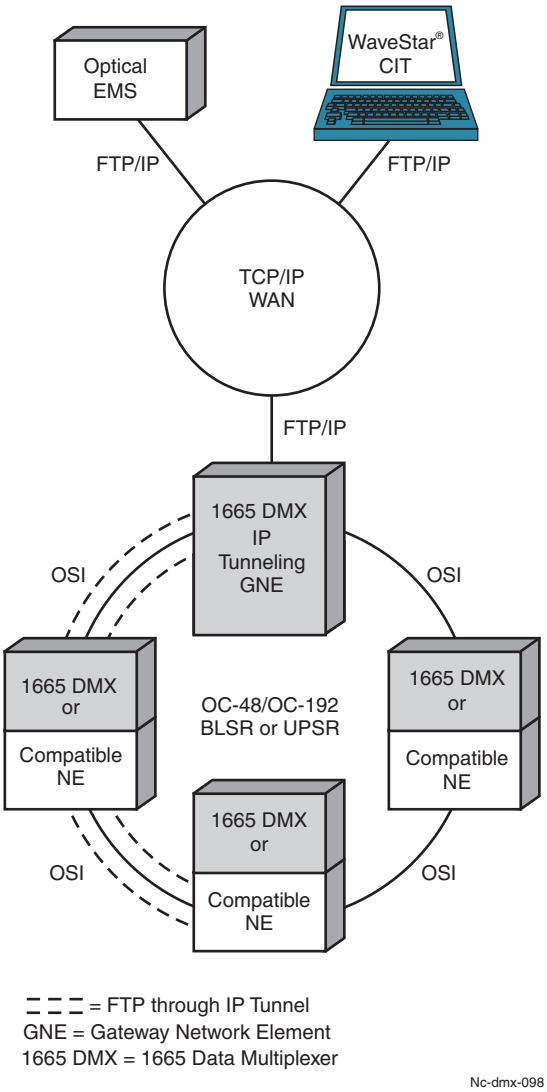
Today, Telecom networks mix a wide range of heterogeneous protocols and applications.

The Alcatel-Lucent IP tunneling solution consists in encapsulating IP packets inside CLNP (ISO 8473 ConnectionLess Network Protocol) PDU, in order to be able to use an existing OSI-based embedded Data Communications Network (DCN) for IP traffic.

With the IP tunneling over CLNP solution, Alcatel-Lucent 1665 DMX NE can support the following two customer applications: IP access and IP fringe.

An IP access application is shown in Figure 5-18, “IP tunneling” (p. 5-162), where an IP based OS (for example, SNMP manager) located in the IP access DCN manages a remote Alcatel-Lucent 1665 DMX NE located in the OSI-based embedded DCN. The IP application initiated at the OS terminates at the remote NE.

Figure 5-18 IP tunneling



An IP fringe application, where an IP based OS located in the IP access DCN manages an IP managed NE (non Alcatel-Lucent 1665 DMX) on the fringe of Alcatel-Lucent 1665 DMX OSI-based embedded DCN. The IP application initiated at the OS terminates at the IP managed NE. If the IP managed NE is not directly connected to Alcatel-Lucent 1665 DMX remote NE via the LAN, but can be reached via additional routers, some static routes have to be provisioned manually on the routers.

Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1850 TSS-100/Alcatel-Lucent 1850 TSS-320 IP tunneling interworking

In a typical network, the Alcatel-Lucent 1665 DMX is a remote NE (RNE) interworking with an Alcatel-Lucent 1850 TSS-100 or Alcatel-Lucent 1850 TSS-320 functioning as the gateway NE (GNE). The Alcatel-Lucent 1850 TSS-100/Alcatel-Lucent 1850 TSS-320 GNE supports T-TD (TL1 Translation Device) to translate TL1 over TCP/IP to TL1 over OSI. This allows TL1 management of a remote Alcatel-Lucent 1665 DMX.

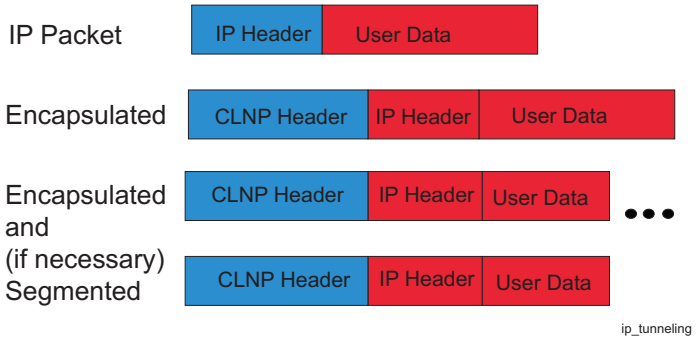
However, to fully support IP tunneling interworking between a remote Alcatel-Lucent 1665 DMX and the Alcatel-Lucent 1850 TSS-100/Alcatel-Lucent 1850 TSS-320 GNE, Alcatel-Lucent 1665 DMX supports a provisionable NSAP selector and a reduced Maximum Transmission Unit (MTU) size.

To support interworking with the Alcatel-Lucent 1850 TSS-100/Alcatel-Lucent 1850 TSS-320, the NSAP selector parameter must be provisioned to f0 (04 default value) at the remote Alcatel-Lucent 1665 DMX. This allows software operations (download/backup/restore) to a remote Alcatel-Lucent 1665 DMX using FT-TD (File Transfer Translation Device) to translate FTP over TCP/IP to FTAM over OSI.

Encapsulating IP packets

The Alcatel-Lucent 1665 DMX GNE acts as the tunnel entrance, i.e., the interface between IP and CLNP. When an IP packet is received from the LAN interface of the GNE, if it is not destined for the GNE, the received IP packet is encapsulated into CLNP PDU(s) as simple CLNP user data, loosing any IP protocol meanings (such as IP addressing and life time), as shown in the figure below.

Figure 5-19 Encapsulated IP packets



For the CLNP PDU that contains the encapsulated IP packet, the CLNP source address is the NSAP of the NE where the IP packet is encapsulated (tunnel entrance), and the CLNP destination address is the NSAP of the NE where the IP packet will be de-capsulated (tunnel exit). The CLNP PDU then is routed via the ISO-10589 "IS to IS intra-domain information exchange protocol (IS-IS)" within the embedded OSI DCN. Therefore, the IP tunneling over CLNP is transparent for the IP world. The CLNP world is only used to carry the IP traffic and there is no possible connections between the OSI applications and the IP applications. The IP tunnel serves as a normal point-to-point link for the IP traffic between two NSAP entities (the tunnel entrance and tunnel exit). Because the IP traffic flows in both directions between two NSAP entities, the tunnel entrance entity also serves as the tunnel exit entity, and vice versa.

In the tunnel entrance, the way to associate an IP destination address in the IP packet with an OSI NSAP address (the NSAP of tunnel exit entity) can be derived by the static user provisioned information or by the automatic distributed tunnel routing information, called Tunnel Auto Provisioning (TAP).

Tunnel auto provisioning (TAP)

In the OSI networks, the network elements use the ISO-10589 "IS to IS intra-domain information exchange protocol (IS-IS)" to exchange the topology information. The knowledge by every network element of the whole network topology at a given time allows the computation of the optimal route to any possible destination on the network. The IS-IS protocol provides for the inclusion of optional variable length fields in all IS-IS packets. This allows additional IP specific information to be added to the OSI IS-IS routing packets.

The topological information between network elements (or called intermediate systems) is communicated by sending a specific IS-IS PDU called LSP (Link-State PDU). In the LSP optional fields, the NEs send (advertise) information about the IP subnets that can be reached via that NE. By default, this will be locally attached, but other subnets can also be provisioned for the advertisement.

Advertising IP information using LSP options can be enabled or disabled via the user interfaces. Based on the specification of the IS-IS protocol, any intermediate systems that can not recognize the encoded optional fields just ignores this and passes them through unchanged. This makes it possible that the NEs that advertise both OSI and IP routing information can seamlessly interwork with the NEs that advertise the OSI routing information only.

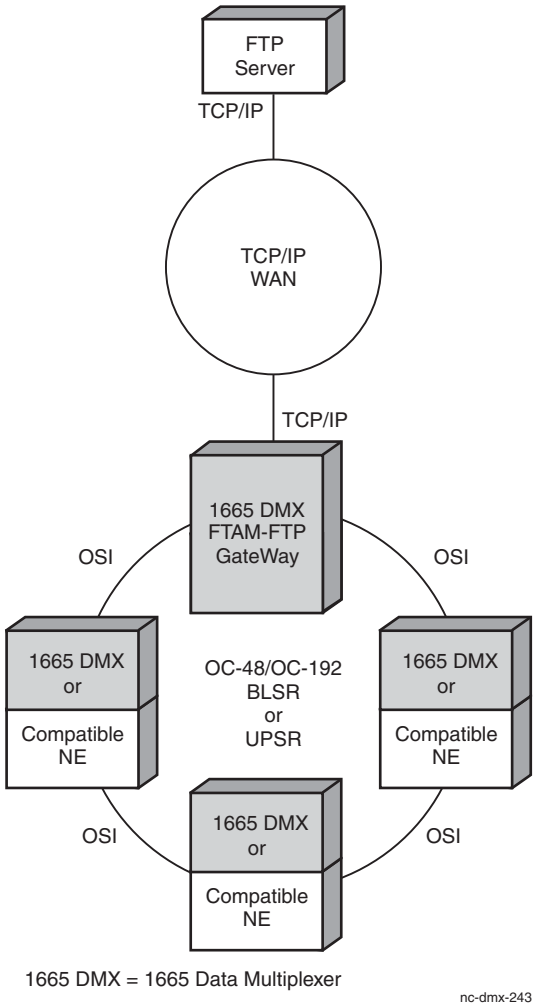
With automatic distribution of IP routing information via IS-IS LSP, a NE, which learned such information, then can associate an IP destination address of an IP packet with an OSI NSAP address, and uses this NSAP address as the destination address of CLNP PDU(s) which encapsulates the IP packet.

FTAM-FTP gateway network element

Alcatel-Lucent 1665 DMX can serve as a File Transfer Translation Device (FTTD) by acting as an FTAM-FTP gateway network element. The FTAM-FTP gateway network element translates FTAM over OSI presentation to FTP over TCP/IP. The FTAM-FTP gateway supports software downloads, database backups, and database restores.

The figure below shows an Alcatel-Lucent 1665 DMX provisioned as an FTAM-FTP gateway network element. The FTAM-FTP gateway network element allows remote Alcatel-Lucent 1665 DMX network elements to request software downloads and database restores from an FTP server. The FTAM-FTP gateway network element also allows remote Alcatel-Lucent 1665 DMX network elements to backup databases to an FTP server.

Figure 5-20 FTAM-FTP gateway



IP over DCC

The sections above described how Alcatel-Lucent 1665 DMX can act as a GNE providing FTTD and TTD functionality. If there is no Alcatel-Lucent 1665 DMX in a particular office where GNE can connect, via IAO LAN interface, to the IP WAN, these options can prove ineffective. For this reason Alcatel-Lucent 1665 DMX incorporates IP communications over the DCC channel. This feature allows operations communications to flow through another device (like Ciena Core Director) to the Alcatel-Lucent 1665 DMX GNE via an IP over DCC link. This feature also enables interworking with Ciena Core Director (CD).

Management traffic flow (OMS to Alcatel-Lucent 1665 DMX)

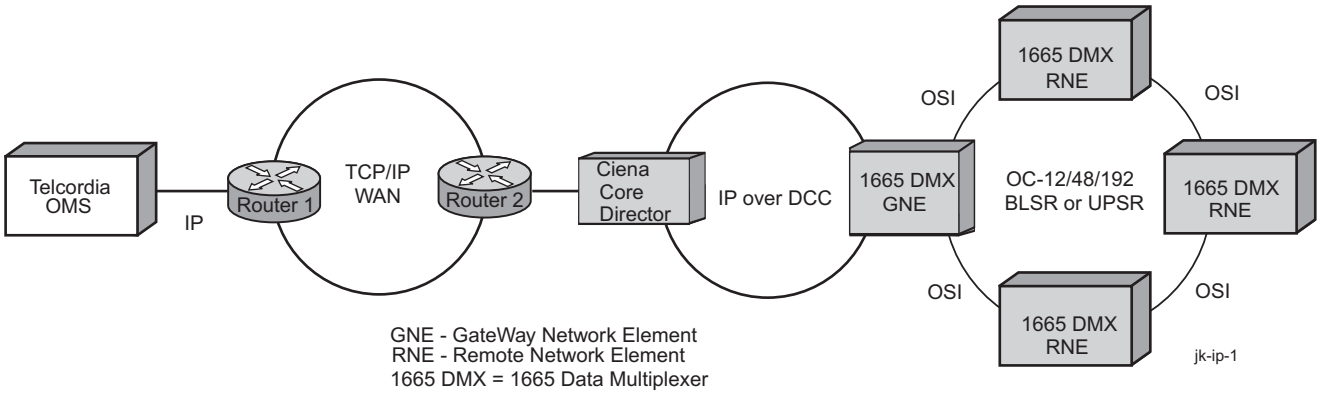
OMS originates IP packets destined to Alcatel-Lucent 1665 DMX GNE, and uses Router R1 as the Default Router. Router R1 routes the packets via IP access DCN to Router R2. Router R2 forwards the packets to CD via Proxy ARP supported by CD. Based on the static routing, CD forwards the IP packets to Alcatel-Lucent 1665 DMX GNE via IP over DCC link. Alcatel-Lucent 1665 DMX GNE translates IP messages to OSI messages and routes CLNP packets to the remote NE (RNE) via OSI embedded DCN.

Management traffic flow (Alcatel-Lucent 1665 DMX to OMS)

Alcatel-Lucent 1665 DMX RNE originates CLNP packets destined to Alcatel-Lucent 1665 DMX GNE, and routes CLNP packets to Alcatel-Lucent 1665 DMX GNE via OSI embedded DCN. The Alcatel-Lucent 1665 DMX GNE translates OSI messages to IP messages, and originates IP packets destined to OMS. Based on static routing, the Alcatel-Lucent 1665 DMX GNE uses the IP over DCC link to forward the IP packets to the CD. CD forwards the IP packets to Router R2 via default routing provisioned by user. Router R2 routes the IP packets via IP access DCN to Router R1.Router R1 forwards the IP packets to OMS.

The figure below depicts the functionality of IP over DCC.

Figure 5-21 Operations communication via IP over DCC



Access control list

The access control list adds a layer of control in addition to the TL1 user ID and password. When the access control list is enabled, an IP-based OS can log in to a remote target NE via a GNE (T-TD) only if the GNE, represented by its TID or NSAP, is included on the target network element access control list. Up to 50 different entries can be included on the access control list.

An OSI-based OS can log in to a remote target NE only if the OSI-based OSI, represented by its NSAP, is included on the target network element access control list.

Important! Specifying a GNE's NSAP is more secure than specifying the TID. Since the TID is provisionable and are generally available, a user attempting unauthorized access to the NE could present a TID that duplicates a TID on the access control list, thereby, bypassing the security provided by the access control list.

Time and date synchronization

Overview

Synchronizing the time and date among all NEs in a network is useful to correlate events reported by different NEs.

The time and date is synchronized:

- Manually using the *WaveStar*® CIT **Administration** → **Set Date and Time** command.
- Automatically from another NE via the DCC.
- Automatically by the OS

Provisioning

In a new installation, it is recommended that the time and date be manually provisioned in at least the first Alcatel-Lucent 1665 DMX in each ring. Each subsequent Alcatel-Lucent 1665 DMX that is added to the network tries to learn the current time and date from one of the existing NEs automatically.

After start-up (or any subsequent controller resets), the Alcatel-Lucent 1665 DMX's time and date revert back to the last time and date before the reset. Alcatel-Lucent 1665 DMX waits 5 minutes, in case other NEs are also resetting (for example, as part of a software upgrade of the network), before starting to check with other NEs for the current time and date. If necessary, the Alcatel-Lucent 1665 DMX checks with all remote NEs for the current time and date.

Alcatel-Lucent 1665 DMX allow up to 2 minutes for each remote NE to respond before checking with the next remote NE for the current time and date, and keep checking until a valid current time and date is found.

Alcatel-Lucent 1665 DMX accepts a provisioned time and date value or any remote NE date later than `00-01-01` as a valid current time and date.

Network time protocol

Network Time Protocol (NTP) assures accurate synchronization of Alcatel-Lucent 1665 DMX with reference to radio and/or atomic clocks located on the Internet.

Considerations

The automatic time and date synchronization is intended to achieve time and date synchronization among compatible NEs with DCC connectivity in a network, but such synchronization can not be guaranteed at start-up for all network configurations or over the course of time.

TL1 command responses and autonomous messages include Alcatel-Lucent 1665 DMX's current time and date. As an alternative to manually provisioning and confirming the current time and date in each Alcatel-Lucent 1665 DMX in a network, OMS, automatically checks the current date and time, periodically or on-demand.

Time and date synchronization compatibility

The following table lists Alcatel-Lucent 1665 DMX Time date Synchronization compatibility with other products.

Table 5-21 Time and date synchronization compatibility

Products	Alcatel-Lucent 1665 DMX
Alcatel-Lucent 1665 DMX	yes
Alcatel-Lucent 1665 DMXplore	yes
Alcatel-Lucent 1665 Data Multiplexer Extend	yes
DDM-2000 OC-3	yes
DDM-2000 OC-12	yes
FiberReach	yes
FT-2000 ADR	yes

Office alarms interface

Description

The office alarms interface is a set of discrete relays controlling audible and visible office alarms. Relays are provided for the following types of alarm conditions:

- CR (critical)
- MJ (major)
- MN (minor)

If desired, critical and major alarm outputs can be wired so that either, neither, or both of the outputs control the major office alarm.

Steady state current

The steady state current for office alarm connections must not exceed 1.0 Amp at 60 Volts or 1.8 Amps at 30 Volts. The maximum transient currents (20 msec duration) during initial contact closure must not exceed 9 Amps at 60 Volts or 18 Amps at 30 Volts.

Provisionable alarm delay and alarm clear delay

Alcatel-Lucent 1665 DMX provides provisionable incoming signal alarm delay and alarm clear delay. The office alarms are not activated unless an incoming signal condition of greater duration than the alarm delay occurs. When a failure clears, a provisionable alarm clear delay prevents premature clearing of the alarm.

Multiple alarms

When multiple alarm conditions occur, the highest-level office alarm (audible and visible) is activated. When the highest-level alarm condition clears, the office alarm "bumps down" to the next highest level alarm condition.

If enabled, the Remote NE Status feature includes alarms at other NEs in the same alarm group as the local NE to determine when to activate the local office alarm and the appropriate alarm level.

Alarm cut-off

The audible office alarms are silenced through activation of the alarm cut-off (ACO) function. Visible alarms are not extinguished by the ACO function.

If the ACO function has been activated to silence the active audible alarm and a "bump down" occurs, the audible alarm remains silent (that is, the lower level visible alarm is activated, but the corresponding audible alarm is not reactivated). If another alarming condition occurs while the ACO is active, the highest level audible alarm is activated

even if the new condition is a lower level. For example, if a major (MJ) alarm was active and silenced using the ACO function and a minor (MN) alarming condition occurs, the MJ audible alarm will sound.

Remote NE status

Overview

If enabled, the Remote NE Status feature reflects the summary alarm/status level for both the local and remote NEs in the same alarm group as the local NE with the following local indications.

Office alarms

The local office visual alarm always shows the highest alarm level. The local office audible alarm is activated in response to each new alarm occurrence among the local and remote NEs. Thus alerting on-site craft of problems in the network with an indication of the severity.

SYSCTL faceplate LEDs

The CR, MJ, or MN LED on the local SYSCTL circuit pack faceplate shows the highest alarm level among the local and remote NEs. The FE LED on the local SYSCTL circuit pack faceplate is illuminated if any remote NE has an active alarm, abnormal status (indicated by the ABN LED), or "activity" status condition, thus identifying the local NE to query further. (Although not dependent on the Remote NE Status feature, the Near-End LED on the local SYSCTL circuit pack faceplate is only illuminated if the local NE itself has an active alarm, abnormal status, or "activity" status condition.)

Remote NE status and alarm/status retrieval

The local NE can retrieve the highest alarm/status level of each NE in a network with an active alarm, abnormal status, or "activity" status condition, thus identifying the remote NE to further query.

Determination of the highest alarm/status level of each NE includes the alarm/status level of active miscellaneous discrete alarm/status inputs.

The Remote NE Status feature can be used to expedite maintenance activities for NEs that report TL1 autonomous alarm/status messages to a maintenance OS at an operations center.

The Remote NE Status feature may be enabled or disabled. By default, the Remote NE Status feature is disabled.

Alarm group

By default, all Alcatel-Lucent 1665 DMX systems are assigned to alarm group 255. This is typically sufficient for small networks of up to 50 nodes. All NEs with DCC connectivity that have the same alarm group number are members of the same alarm group. All alarm group members share summary alarm/status information with each other but not with NEs in different alarm groups. To take advantage of the remote activation of local office alarms, in particular, at least one member of the alarm group should be located in a central office.

In large networks, with IS-IS Level 2 Routing and multiple Level 1 areas, each alarm group *must* be confined to within a single Level 1 area only. For example, a network with three different Level 1 areas would require a minimum of three alarm groups, that is, one alarm group for each Level 1 area. If desired, multiple alarm groups can be defined within a Level 1 area, also. The maximum number of NEs in an alarm group is limited by the maximum number of nodes in a Level 1 area.

Alarm gateway NE (AGNE)

By default, no NE is enabled as an AGNE. Even if the default alarm group number for all NEs is used, at least one NE in each alarm group must be enabled as an AGNE. Any NE in an alarm group can be enabled as an AGNE, for example, an AGNE does not need to be located in a central office, in fact, it is recommended that an AGNE should not also be a TL1 TCP/IP GNE or IS-IS Level 2 Router.

A second NE in each alarm group may be enabled as a backup AGNE, if required. It is recommended that the maximum number of AGNEs per alarm group be limited to at most two to assure good performance.

Instead of having every NE exchange alarm/status information with every other NE in the same alarm group directly, only the AGNE receives alarm/status information from every NE directly, and the AGNE distributes the accumulated alarm/status information for all the NEs to every NE in the alarm group.

Provisioning sequence

If there is no AGNE, each NE in an alarm group reports an `AGNE Communications Failure` alarm; therefore, the following provisioning sequence is recommended:

1. Provision one or two (at most) NEs as the AGNE
   - Enable the Remote NE Status parameter
   - Enable the network element as an Alarm Gateway
   - Provision the alarm group number, if different than the default.
2. Provision the other NEs in the same alarm group
   - Enable the Remote NE Status parameter
   - Provision the alarm group number, if different than the default.

For more information about the **Administration** → **Set NE** command, see the *WaveStar*® CIT online help.

Remote NE status compatibility

The following table lists Alcatel-Lucent 1665 DMX remote NE status compatibility with other products.

Table 5-22 Remote NE status compatibility

Products	Alcatel-Lucent 1665 DMX
Alcatel-Lucent 1665 DMX	yes
Alcatel-Lucent 1665 DMXplore	yes
Alcatel-Lucent 1665 Data Multiplexer Extend	yes
DDM-2000 OC-3	yes
DDM-2000 OC-12	yes
FiberReach	yes

Network size

Overview

There is no inherent limit to the total number of NEs in a SONET transmission network, but there is a limit to the number of nodes that can be part of the same OSI domain, that is, with OSI LAN and/or DCC connectivity for operations communications among the NEs.

Maximum number of OSI nodes

Alcatel-Lucent 1665 DMX supports a total of 300 OSI associations per TCP and 300 OSI associations for TL1 per Gateway Network Element (GNE). Alcatel-Lucent 1665 DMX can support a total of 250 NEs per Level 1 area.

IS-IS level 2 routing

IS-IS Level 2 Routing involves the assignment of NEs to multiple areas of less than 50 nodes each. Level 2 routers support OSI communications between the NEs in different areas. Both the assignment of NEs to areas and the enabling of NEs as Level 2 routers is accomplished by provisioning.

Directory services

What are directory services?

OS and *WaveStar*® CIT users access remote Alcatel-Lucent 1665 DMX using the remote Alcatel-Lucent 1665 DMX Target Identifier (TID, name) but remote Alcatel-Lucent 1665 DMX are addressed on the DCC using Network Service Access Point Address (NSAP). Therefore, a method to provide TID-to-NSAP (name-to-address) and NSAP-to-TID (address-to-name) translations is necessary. Target Identifier Address Resolution Protocol (TARP) provides this capability.

For SONET NEs that support TCP/IP and TL1 OS interfaces, TARP is a directory services standard that supports multi-vendor OI compatibility. TARP is specified in *Telcordia* ® GR-253-CORE, SONET Transport Systems: Common Criteria.

TID provisioning

Each NE in a network must be provisioned with a unique TID. The Alcatel-Lucent 1665 DMX's default TID is "LT-DMX". The terms TID and source identifier (SID) are generally used interchangeably.

Important! Some other-vendor NEs may require that all TIDs adhere to specific rules, for example, that each TID start with an alphabetic character and/or that each TID consist of at least 6-to-7 characters.

To be compatible with other products, Alcatel-Lucent 1665 DMX TIDs should *not* include special characters "%" and "#". Even though Alcatel-Lucent 1665 DMX TID provisioning allows those special characters, T1.245 SONET Directory Services (SDS) does not support those special characters.

NSAP provisioning

By default, each Alcatel-Lucent 1665 DMX has a unique Network Service Access Point (NSAP) address, thus no NSAP provisioning is necessary in small networks. If the network size exceeds 50 OSI nodes, NSAP provisioning is required.

TARP provisioning

Although TARP functions automatically without any user provisioning, using standard default values, Alcatel-Lucent 1665 DMX allows provisioning of the following TARP parameters. All TARP parameters are provisionable:

- Lifetime
- Manual Adjacency
- Timers
- Loop Detection Buffer (LDB) Flush Timer
- TARP Data Cache (TDC) Enable/Disable
- TDC TID-NSAP Entries.

It is recommended that the TARP default values always be used.

TARP TID-to-NSAP translations

The three operations that depend on TARP TID-to-NSAP translations are:

1. TL1 OS access
2. *WaveStar*® CIT access
3. Remote (Software) Install Program/Copy Program.

When a TL1 TCP/IP Gateway Network Element (GNE) receives a TL1 login request for a TL1-RNE, the TL1 login request includes the TL1-RNE's TID. The TL1–GNE relies on TARP to determine the TL1-RNE's NSAP. The TL1–GNE needs the NSAP to establish an OSI association with the TL1-RNE. The TL1 login request is forwarded to the TL1-RNE over that OSI association.

The local Alcatel-Lucent 1665 DMX serves as a TL1–GNE and uses TARP as described above for *WaveStar*® CIT access via Alcatel-Lucent 1665 DMX's serial ports or TCP/IP. When accessing Alcatel-Lucent 1665 DMX via OSI LAN, the *WaveStar*® CIT (or OS)

performs the TL1–GNE function and uses TARP in a similar manner, also. The local Alcatel-Lucent 1665 DMX uses TARP as described above to support remote Install Program/Copy Program.

TARP propagation

The first time a TL1–GNE (or local Alcatel-Lucent 1665 DMX) requires a TARP TID-to-NSAP translation for each remote NE, the TL1–GNE originates a TARP query. The TARP query is propagated to all NEs in the same OSI routing area, and if no response is received from within the area, up to two additional TARP queries are propagated throughout the OSI domain. Each NE forwards the TARP queries to each of its neighboring OSI nodes (that is, adjacencies), except the neighbor from which the TARP query was received.

When the TARP query reaches the remote NE with the requested TID, that remote NE responds to the originating NE with the remote NE's NSAP address. If there is no response to any of the TARP queries for a TID, after the third query times out, an error response (for example, `TL1–GNE unknown TID` or `TID not found`) is returned to the originating NE.

TARP NSAP-to-TID translations

When an Alcatel-Lucent 1665 DMX is commanded to perform this translation, it knows the NSAPs of the remote NEs to be included in the responses but relies on TARP to determine the corresponding TIDs.

To ensure that the responses to these commands always include the most up-to-date network information, real-time TARP queries are originated instead of relying on the TARP Data Cache or TDC (although the TDC is updated, as appropriate, based on the responses to these NSAP-to-TID queries).

Because the NSAPs are known, these TARP queries are addressed directly to each remote NE (TARP propagation is not necessary). Each remote NE responds to the originating NE with the remote NE's TID.

TARP data cache

In order to reduce the frequency of TARP propagation, and to improve the performance of the affected operations, Alcatel-Lucent 1665 DMX supports a TDC option. By default, the TDC is enabled.

Each Alcatel-Lucent 1665 DMX maintains its own TDC, independently. The TDC consists of TID-NSAP translations. Each Alcatel-Lucent 1665 DMX automatically updates its own TDC based on the responses to previous TARP queries. The TDC may also be updated upon receipt of an unsolicited, automatic notification from another NE in

the same OSI domain of a TID or NSAP change. The TDC has a maximum number of 16 entries; up to 15 entries may be manually entered. A circular buffer is used for the dynamic entries in the TARP Data Cache.

Alcatel-Lucent 1665 DMX checks its TDC to see if it already has a required TID-to-NSAP translation before originating a TARP query. If a translation is not found in the TDC, the response to that TARP query is used to update the originating Alcatel-Lucent 1665 DMX's TDC. Alcatel-Lucent 1665 DMX assures that its TDC maintains only one TID-NSAP translation for each unique TID. Alcatel-Lucent 1665 DMX supports TDC sizes of up to 110 TID-NSAP translations. If the TDC is disabled or Alcatel-Lucent 1665 DMX's system controller is reset, the contents of the TDC are deleted.

TDC accuracy

In the unlikely event that a TDC includes an inaccurate TID-to-NSAP translation, Alcatel-Lucent 1665 DMX confirms that both the NSAP and TID of the remote Alcatel-Lucent 1665 DMX are correct before a remote operation proceeds. If there is a mismatch, an error response (for example, `TL1-RNE unknown TID`, `Inconsistent TID`, or `Association Setup Failure`) is returned to the originating NE.

To correct such a situation, delete the subject TID (L4tdctid) from the TDC, then re-request the remote operation for the subject TID. The subsequent TARP query results in an accurate TID-to-NSAP translation, and the TDC is updated accordingly. A broader solution is to disable and re-enable the TDC in which case *all* TDC entries are deleted.

Security

Capabilities

Alcatel-Lucent 1665 DMX provides security capabilities to protect against unauthorized access to the system.

User types

Five types of users (with tiered restriction levels) are allowed access to the system with a valid user ID and password:

- An Administrator user has access to all the security functional capabilities. Only the privileged and administrator users have access to the security and access functions. These functions include assigning/changing user ID/passwords for other users, setting target identifier (TID) names, resetting the system, and system initialization functions.
- Privileged users can execute all commands

A privileged user has access to all the system functional capabilities. Only the privileged and administrator users have access to the security and access functions. These functions include assigning/changing user ID/passwords for other users, setting target identifier (TID) names, resetting the system, and system initialization functions.

A privileged user can terminate the login session of other individual users (including other privileged users) or terminate all login sessions of non-privileged users.

- General users have access to all the system functional capabilities except security, access, system initialization and software installation functions.
- Maintenance users can only execute commands that access the system, extract reports and execute maintenance functions through a specific set of commands. No privileged commands may be executed by maintenance users.
- Reports-only users can only execute commands that retrieve reports from the system.

Security can be set to a "lockout" state, which blocks non-privileged users from logging in to the system.

System initialization

When the system is first initialized, three privileged default user IDs and passwords are provided. Up to 147 user IDs and passwords can be added, deleted, and/or changed by any of the privileged users. Timeouts are provisionable on a per-user basis.

User IDs and passwords

The *WaveStar*® CIT always asks the user for the NE user ID and password with the first NE connection. The user ID and password can be saved for subsequent connections, but the user ID and password can not be saved past the current *WaveStar*® CIT session. User ID and password parameters must be administered on a per-NE basis. You may have a different user ID and/or password on one NE than you have on other NEs.

Each time the number of invalid sequential login attempts reach or exceed the provisionable user ID lockout threshold, the network element reports a Security Alert alarm.

Inactivity timeout period

The inactivity timeout period is the number of minutes after which a user with an inactive session is logged out. A provisionable inactivity timeout period is supported on a per-user basis.

Password aging

The password aging interval is the number of days allowed before a user's password expires. When a user's password expires, the user is prompted to select a new password prior to login. The values for the password aging interval are zero (0) or a range from 7 to 999 days. A value of zero (0) disables password aging. The default value is 0. Password aging does not apply to privileged users' passwords.

WaveStar® CIT default user IDs and passwords

Two default Privileged user IDs and passwords are initially installed in the *WaveStar*® CIT are LUC01 and LUC02 (LUC-zero-one, and LUC-zero-two). Their associated passwords are LUC+01, LUC+02, (LUC-plus sign-zero-one, LUC-plus sign-zero-two), respectively.

NE default user IDs and passwords

Three default Privileged user IDs and passwords are initially installed in the NE is LUC01, LUC02, or LUC03 (LUC-zero-one, LUC-zero-two, and LUC-zero-three). The default password is DMX2.5G10G.

RADIUS authentication for user logins

When the network element is provisioned to use Remote Authentication Dial In User Service (RADIUS) authentication for user logins, any user login triggers the network element to query the designated RADIUS server(s) and act on the response.

The network element (RADIUS client) sends a RADIUS Access-Request packet to the RADIUS server via the IP network. The Access-Request packet contains the User-Name, User-Password, and the network element IP address. The User-Password is hidden (encrypted).

When the RADIUS server receives the Access-Request packet, it validates the sending RADIUS client. A RADIUS client and server must have a provisioned shared secret (the password shared between the RADIUS client and server). If the shared secret is not valid, the Access-Request packet is silently discarded without sending a response. If the shared secret is valid, the RADIUS server searches the user database. If the username is found and the password is correct, the RADIUS server returns an Access-Accept packet to the RADIUS client.

The Access-Accept packet informs the RADIUS client that the user’s login attempt is authenticated and authorized. No further local validation is required.

The Access-Reject packet informs the RADIUS client that the user’s login attempt is rejected due to invalid username and/or password.

If no response is returned within approximately 5 seconds to the RADIUS client, the Access-Request packet is re-sent one time. If the retry to the primary RADIUS server fails, the RADIUS client sends the Access-Request packet to the secondary RADIUS server (if provisioned).

If no response is received after retries to the primary and secondary RADIUS servers, the network element validates the user login using the local database.

MAC address locking

Alcatel-Lucent 1665 DMX allows MAC locking on the LNW170. MAC locking prevents unauthorized users from gaining access to the network through an Ethernet port, thereby providing a level of security against intrusion attempts. MAC locking restricts access to a bridged Ethernet network by requiring that the source address of traffic entering a locked port be registered with that port. Any number of ports, LANs, VCG, or link aggregation groups (LAGs) can be locked. Alcatel-Lucent 1665 DMX permits registering of multiple addresses with a single entity.

Password administration (CIT and system)

Overview

System administration includes performing the following:

- Changing passwords
- Changing notifications
- Performing security administration
- Viewing NE administration
- Setting TIDs
- Setting NE defaults
- Performing a LAN reset
- Provisioning data communications
- Viewing OSI routing map

WaveStar® CIT user ID/password administration

The **Administration** → **Security** → **User Provisioning** command on the *WaveStar*® CIT View menu allows a privileged user to create, change, or delete another user ID or password.

Important! Any changes made to a user's provisioning takes place the next time the user logs in. If the user is currently logged in, no changes take place until that user logs off and logs back in.

Valid *WaveStar*® CIT user IDs

A valid *WaveStar*® CIT user ID must be a minimum of one character to a maximum of ten characters (no character restrictions).

Valid *WaveStar*® CIT passwords

A valid *WaveStar*® CIT password must comply with the following:

- Length must be a minimum of six characters to a maximum of ten characters
- Must begin with a letter
- Must contain at least three non-alphabetic characters (symbol or number)
- At least one of the non-alphabetic characters must be a symbol
- When changing a password, the new password must be different from the previous password by at least three characters and cannot be one of the last 5 passwords used.

  Important! User passwords are case-sensitive.

Characters not allowed in a *WaveStar*® CIT password

The following table lists the characters that are not allowed in a *WaveStar*® CIT password.

Table 5-23 Characters not allowed in a *WaveStar*® CIT password

Character	Description		Character	Description
	Space		“	Quotation mark
@	Commercial at		&	Ampersand
,	Comma		;	Semicolon
:	Colon		_	horizontal bar (underscore)
=	Equals sign		?	Question mark

Characters allowed in a *WaveStar*® CIT password

The following table lists the characters that are allowed in a *WaveStar*® CIT password.

Table 5-24 Characters allowed in a *WaveStar*® CIT password

Character	Description		Character	Description
A... Z	Uppercase letters		*	Asterisk
a... z	Lowercase letters		[	Left square bracket
0... 9	Digits		]	Right square bracket
'	Apostrophe		^	Caret
-	Hyphen		`	Grave accent

Table 5-24 Characters allowed in a *WaveStar*® CIT password (continued)

Character	Description		Character	Description
(	Left parenthesis		{	Left curly brace
)	Right parenthesis		}	Right curly brace
.	Period (full stop)		|	Vertical bar
/	Slash (Solidus)		<	Less than
+	Plus sign		>	Greater than
!	Exclamation mark		~	Tilde
%	Percent sign		#	Number sign

Changing your own *WaveStar*® CIT password

The *WaveStar*® CIT **Administration** → **Change Password** command allows any user to change his or her own *WaveStar*® CIT password. Only privileged users can change another user's ID or password.

The Change Password screen is also automatically invoked immediately after the login screen if a user's password has expired. The user is prevented from performing any other function until the password is successfully changed. This screen is also invoked the first time a login is attempted for a new user ID.

User ID/password administration

The **Administration** → **Security** → **User Provisioning** command on the network element System View menu allows a privileged user to create, change, or delete another network element user ID or password.

> **Important!** Any changes made to a user's provisioning takes place the next time the user logs in. If the user is currently logged in, no changes take place until that user logs off and logs back in.

Valid user IDs

A valid user ID must be a minimum of five allowed characters to a maximum of ten allowed characters.

Valid passwords

A valid password must comply with the following conditions:

- The maximum and minimum password are provisioned by the Security Administrator.
  - The **minimum** password length is provisionable to be between 6 (default) and 18 characters.
  - The provisioned **maximum** password length is provisionable to be equal to or greater than the minimum password length; the maximum is 20 characters.
- If the provisioned value of the maximum password length is less that or equal to 10 characters, the following password composition rules apply:
  - Passwords must contain at least one alphabetic character and at least three non-alphabetic characters (numeric and the special characters)
  - At least one of the non-alphabetic characters must be a numeric character and at least one must be one of the special characters.
- If the provisioned value of the maximum password length is greater than 10 characters, the following password composition rules apply:
  - Passwords must contain a mix of upper-case alphabetic characters, lower-case alphabetic characters, numeric characters, and special characters, including at least two of each type.
  - Passwords cannot contain consecutive identical characters.
  - A password cannot contain the user login.
- When passwords are changed, the old and new passwords must be different in at least three-character positions. The original password, or a significant substring of it, must not be part of the new password.

  If the current and new passwords are the same length, then the characters in at least three-character positions must be different.

  If the current and new passwords are different lengths, then for each possible contiguous sub-string of the length of the shorter password within the longer password, the characters in at least three-character positions must be different between the shorter password and the character sub-string within the longer password.
- The number of most recently used passwords that are not allowed to be reused is provisionable. The range is 5 (default) to 15. If the default is used, the network element prohibits the reuse of the five most recently used passwords.

  Important! User passwords are case-sensitive.

Characters NOT allowed in a password and user ID

The following table lists the characters that are not allowed in a password and user ID.

Table 5-25 Characters NOT allowed in an Alcatel-Lucent 1665 DMX password and user ID

Character	Description		Character	Description
	Space		“	Quotation mark
@	Commercial at		;	Semicolon
,	Comma		*	Asterisk
:	Colon		!	Exclamation Mark
=	Equals sign		?	Question mark
\	Back slash			

Characters allowed in a Alcatel-Lucent 1665 DMX password and user ID

The following table lists the characters that are allowed in a password and user ID.

Table 5-26 Characters allowed in an Alcatel-Lucent 1665 DMX password and user ID

Character	Description		Character	Description
A... Z	Uppercase letters		^	Caret
a... z	Lowercase letters		`	Grave accent
0... 9	Digits		{	Left curly brace
'	Apostrophe		}	Right curly brace
-	Hyphen		|	Vertical bar
(	Left parenthesis		<	Less than
)	Right parenthesis		>	Greater than
.	Period (full stop)		~	Tilde
/	Slash (Solidus)		%	Percent sign
+	Plus sign		#	Number sign
[	Left square bracket		&	Ampersand
]	Right square bracket		_	Horizontal bar (underscore)

Changing your own password

From the network element System View, the **Administration → Change Password** command allows any user to change his or her own password. Only privileged users can change another user's ID or password.

When a user changes their own password, the new password must be different in at least three character positions from the current password.

The original password, or a significant substring of it, must not be part of the new password.

- If the current and new passwords are the same length, then the characters in at least 3 character positions must be different.
- If the current and new passwords are different lengths, then for every possible contiguous substring of the length of the shorter password within the longer password, the characters in at least three character positions must be different between the shorter password and the character substring within the longer password. Also, the password cannot be one of the last 5 used.

User-settable miscellaneous discrete interface

Overview

This section describes the miscellaneous discrete environmental alarm/status input points and (external) control output points.

Description

The user-settable miscellaneous discrete interface allows users to monitor and control equipment collocated with Alcatel-Lucent 1665 DMX through a set of discrete input and output points. There are 19 miscellaneous discrete inputs to monitor environmental conditions such as open doors or high temperature, and 4 miscellaneous discrete outputs to control equipment such as fans and generators.

Local miscellaneous discrete input points are included in the determination of the summary alarm/status level for each NE. But even if the Remote NE Status feature is enabled, the alarm/status of *individual* miscellaneous discrete inputs/outputs is not exchanged among NEs.

Miscellaneous discrete input alarm level

The alarm level to be associated with each miscellaneous discrete input point is provisionable. By default, each miscellaneous discrete input is a minor alarm.

If a miscellaneous discrete input point is provisioned as an alarm (minor, major, or critical), TL1 autonomous message REPT ALARM EVT is used to report the alarm occurrence. This identifies the remote NE to further query.

If a miscellaneous discrete input point is provisioned as not alarmed (that is, status), TL1 autonomous message REPT EVT CON is used to report the condition. This identifies the need to retrieve any active miscellaneous discrete status conditions.

Miscellaneous discrete input description

The description to be associated with each miscellaneous discrete input alarm or status point may be provisioned. The provisioned description appears as the `almmsg` or `conddescr` parameter value in applicable TL1 messages. The default description for each miscellaneous discrete input point is `environment1`, `environment2`, and so forth.

Note: Miscellaneous discrete Input Point 15 is reserved for fan failure.

Miscellaneous discrete output description

The description to be associated with each miscellaneous discrete output control point may be provisioned. The default description for each miscellaneous discrete output point is `control1`, `control2`, and so forth. Control points for miscellaneous discrete outputs may be operated and then released.

Fan failure

Miscellaneous Discrete #15 is reserved for fan failure. The possible alarm levels are CR, MJ, MN, with MJ being the default.

Reference

For information about the **Configuration** → **Misc. Discretes** command, see the *WaveStar*® CIT help. For detailed wiring information, see the *Alcatel-Lucent 1665 Data Multiplexer (DMX) Installation Manual, 365-372-304*.

6 System planning and engineering

Overview

Purpose

This section summarizes basic system planning and engineering information to plan procurement and deployment of Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX).

There are a number of considerations that should be kept in mind when planning the Alcatel-Lucent 1665 DMX's role in the network. Projected customer requirements will determine initial capacity needed, as well as evolution to higher capacities. The advanced networking capabilities of the Alcatel-Lucent 1665 DMX offer many economic and planning benefits, and certain guidelines should be followed to maximize these benefits. Physical installation considerations will be guided by the installation location (central office, uncontrolled, or customer locations). Initial network configuration will determine synchronization requirements. Synchronization should be planned on a network basis considering items like topology, reliability, internetwork connectivity, and service evolution.

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Physical arrangements

Overview

Purpose

This section describes the possible physical arrangements of Alcatel-Lucent 1665 DMX.

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Shelf pack configurations

Overview

Alcatel-Lucent 1665 DMX is designed to provide a vast array of wideband and broadband voice and data services. Therefore, there is great flexibility in the configuration of the shelf. Various combinations of circuit packs may be used for whatever service is desired. The following paragraphs outline the specific packs that may be used in the Function Unit groups for certain applications.

Note: See “Medium and large fabric engineering rules” (p. 6-10) for important information regarding the functioning and capacities of circuit packs.

Requirements

The SYSCTL LNW2 circuit pack must be located in the control CTL slot.

At least one Main (M1/M2) circuit pack is always required in Alcatel-Lucent 1665 DMX to provide timing for the shelf. M1 and M2 can be equipped with any of the following types of packs:

- The Main Switch Pack (LNW80) must be located in the main M1 and M2 slots for protected service.
- OC-12 OLIU LNW48, LNW50, LNW54, LNW203 must be located in the main M1 and M2 slots for protected service.
- OC-48 OLIUs LNW27, LNW29, LNW32, LNW76, LNW82, LNW202, LNW504 must be located in the main M1 and M2 slots for protected service.
- OC-192 OLIUs LNW56, LNW58, LNW59, and LNW502 must be located in the main M1 and M2 slots for protected service
- The VLF LNW59, LNW82, or LNW504 OLIU circuit packs are required in the main M1 and M2 slots when LNW55, LNW62, LNW64, LNW603 OLIU circuit packs are installed in the function/growth slots.

The tributary slots (A1, A2, B1, B2, C1, C2, D1, D2, G1, G2) can be occupied by a variety of service interface packs. Refer to "Tributary interface circuit packs" (p. 2-5) for a comprehensive list of the tributary circuit packs. The following rules apply to the tributary packs.

- The LNW37 and LNW45 (OC-3), LNW49 (OC-12), and LNW31, LNW55, LNW62, LNW402 (OC-48) packs may be used interchangeably.
- Except for unprotected applications, the same circuit pack type is required in the service and protection slots of a function/growth group (for example, D1 and D2) and growth slots G1 and G2. When the main slots are equipped with VLF circuit packs, Alcatel-Lucent 1665 DMX supports true 0x1 configurations. Slots 1 and 2 of a group can be equipped with the same circuit pack type or with different circuit pack types (certain restrictions apply). When a companion slot is unoccupied, an apparatus blank must be installed in the empty slot regardless of the software release or the circuit pack types installed in the shelf.
- The electrical interface circuit packs (LNW7, LNW8, LNW801, LNW16, LNW18, LNW19B, and LNW20) must be located in function unit slots A - D. Growth slots do not support electrical interface circuit packs. However, when the LNW20 circuit pack is installed in the Growth slots, portless DS3 port operation is supported. LNW7 circuit packs are not supported in shelves equipped with VLF circuit packs.
- When non-VLF Main circuit packs are used, the Ethernet circuit packs (LNW63, LNW87, LNW170) must be located in slot 1 of a function unit (including growth slots). The other slot must contain a 177D apparatus blank or an LNW98 detectable blank circuit pack. When VLF Main circuit packs are used, Ethernet circuit packs can be used in both slots of a group. Certain restrictions apply. See "Very large fabric (VLF) engineering rules" (p. 6-15).

- Without VLF Main circuit packs, the FC-DATA SAN circuit packs (LNW73/73C) must be located in slot 1 of a function unit (including growth slots). The other slot must contain a 177D apparatus blank or an LNW98 detectable blank circuit pack. When VLF Main circuit packs are used, SAN circuit packs can be used in both slots of a group. Certain restrictions apply, see "Very large fabric (VLF) engineering rules" (p. 6-15).
- When VLF Main circuit packs are not used, 10/100T (LNW66) circuit packs must be located in slot 1 of a function unit. The other slot must contain a 177D apparatus blank or an LNW98 detectable blank circuit pack. Growth slots G1 and G2 do not support the 10/100T and 10/100-PL circuit packs.

  When VLF Main circuit packs are used, some Ethernet circuit packs can be used in both slots of a group. Certain restrictions apply. See "Very large fabric (VLF) engineering rules" (p. 6-15).
- When VLF Main circuit packs are not used, the Fast Ethernet Private Line circuit pack (LNW74) must be located in slot 1 of a function unit. The other slot must contain a 177D apparatus blank or an LNW98 detectable blank circuit pack. The LNW74 circuit pack can be used in G1 as well, but only the optical ports will function (true for all Releases).

  When VLF Main circuit packs are used, some Ethernet circuit packs can be used in both slots of a group. Certain restrictions apply. See "Very large fabric (VLF) engineering rules" (p. 6-15).
- An apparatus blank (177D or 177E) or detectable blank circuit pack (LNW97 or LNW98) must be used in every unequipped slot.

Shelf application configurations

Overview

This section provides lists detailing the kind of circuit packs that can be used to support various applications.

UPSR shelf

The UPSR shelf configuration has OC-3, OC-12, OC-48, or OC-192 OLIUs in the main M1 and M2 slots and can house the following circuit packs in the Function slots in various combinations:

- 28DS1PM (LNW7)
- 56DS1/E1 (LNW8/LNW801)
- 12DS3/EC-1 (LNW16)
- 48DS3/EC-1 (LNW19B)
- 48DS3/EC-1/TMUX (LNW20)
- TMUX (LNW18)

- OC-3 PTM-based OLIU (LNW37, LNW45)
- OC-12 PTM-based OLIU (LNW49)
- OC-48 OLIU (LNW31, LNW62, LNW402)
  LNW62 and LNW402 are PTM-based
- OC-192 PTM-based OLIU (LNW603)
- OC-3/OC-12/OC-48 OLIU (LNW55)
- 10BASE-T (LNW66, LNW74)
- 100BASE-T (LNW66, LNW74, LNW87, LNW170)
- 1000BASE-T (LNW63, LNW64, LNW87, LNW170)
- 100BASE-ZX/LX/FX (LNW74, LNW87, LNW170)
- 1000BASE-SX/LX/ZX (LNW63, LNW64, LNW87, LNW170, LNW705)
- FC-DATA (SAN) (LNW73/73C)

For detailed information on circuit packs, including shelf equipage rules and port densities, see "Circuit packs" (p. 4-10).

BLSR shelf

The BLSR shelf configuration has OC48 or OC-192 OLIUs in the main M1 and M2 slots and the following circuit packs in the Function slots in various combinations:

- 28DS1PM (LNW7)
- 56DS1/E1 (LNW8/LNW801)
- 12DS3/EC-1 (LNW16)
- 48DS3/EC-1 (LNW19B)
- 48DS3/EC-1/TMUX (LNW20)
- TMUX (LNW18)
- OC-3 PTM-based OLIU (LNW37, LNW45)
- OC-12 PTM-based OLIU (LNW49)
- OC-48 OLIU (LNW31, LNW62, LNW402)
  LNW62 and LNW402 are PTM-based
- OC-3/OC-12/OC-48 PTM-based OLIU (LNW55)
- 10BASE-T (LNW66, LNW74)
- 100BASE-T (LNW66, LNW74, LNW87, LNW170)
- 1000BASE-T (LNW63, LNW64, LNW87, LNW170)
- 100BASE-ZX/LX/FX (LNW74, LNW87, LNW170)
- 1000BASE-SX/LX/ZX (LNW63, LNW64, LNW87, LNW170, LNW705)
- FC-DATA (SAN) (LNW73/73C)
- OC-192 PTM-based OLIU (LNW603)

For detailed information on circuit packs, including shelf equipage rules and port densities, see "Circuit packs" (p. 4-10).

DCS shelf

This DCS shelf configuration is equipped with the Main Switch circuit packs (LNW80) or the VLF Main circuit packs (LNW59/LNW82/LNW504 with no PTMs) in the main M1 and M2 slots and the following circuit packs in the Function slots in various combinations:

- 28DS1PM (LNW7)
- 56DS1/E1 (LNW8/LNW801)
- 12DS3/EC-1 (LNW16)
- 48DS3/EC-1 (LNW19B)
- 48DS3/EC-1/TMUX (LNW20)
- TMUX (LNW18)
- OC-3 PTM-based OLIU (LNW37, LNW45)
- OC-12 PTM-based OLIU (LNW49)
- OC-48 OLIU (LNW31, LNW62, LNW402)
  LNW62 and LNW402 are PTM-based
- OC-3/OC-12/OC-48 PTM-based OLIU (LNW55)
- 10BASE-T (LNW66, LNW74)
- 100BASE-T (LNW66, LNW74, LNW87, LNW170)
- 1000BASE-T (LNW63, LNW64, LNW87, LNW170)
- 100BASE-ZX/LX/FX (LNW74, LNW87, LNW170)
- 1000BASE-SX/LX/ZX (LNW63, LNW64, LNW87, LNW170, LNW705)
- FC-DATA (SAN) (LNW73/73C)
- OC-192 PTM-based OLIU (LNW603)

For detailed information on circuit packs, including shelf equipage rules and port densities, see "Circuit packs" (p. 4-10).

Refer to "Multi-shelf DCS utilizing a single TID " (p. 3-70) for information about the multi-shelf feature and DS1 and DS3 subshelves.

1+1 linear shelf

The linear shelf configuration has OC-3/12/48/192 OLIUs in the main M1 and M2 slots and the following circuit packs in various combinations:

- 28DS1PM (LNW7)
- 56DS1/E1 (LNW8/LNW801)
- 12DS3/EC-1 (LNW16)

- 48DS3/EC-1 (LNW19B)
- 48DS3/EC-1/TMUX (LNW20)
- TMUX (LNW18)
- OC-3 PTM-based OLIU (LNW37, LNW45)
- OC-12 PTM-based OLIU (LNW49)
- OC-48 OLIU (LNW31, LNW62, LNW402)
  LNW62 and LNW402 are PTM-based
- OC-192 PTM-based OLIU (LNW603)
- OC-3/OC-12/OC-48 PTM-based OLIU (LNW55)
- 10BASE-T (LNW66, LNW74)
- 100BASE-T (LNW66, LNW74, LNW87, LNW170)
- 1000BASE-T (LNW63, LNW64, LNW87, LNW170)
- 100BASE-ZX/LX/FX (LNW74, LNW87, LNW170)
- 1000BASE-SX/LX/ZX (LNW63, LNW64, LNW87, LNW170, LNW705)
- FC-DATA (SAN) (LNW73/73C)

For detailed information on circuit packs, including shelf equipage rules and port densities, see "Circuit packs" (p. 4-10).

Single and dual homing shelf

The single homing and dual homing shelf configurations has OC-3, OC-12, OC-48 or OC-192 OLIUs in the main M1 and M2 slots and require at least one of the following circuit packs:

- OC-3 PTM-based OLIU (LNW37, LNW45)
- OC-12 PTM-based OLIU (LNW49)
- OC-48 OLIU (LNW31, LNW62, LNW402)
  LWN62 and LNW402 are PTM-based packs
- OC-3/OC-12/OC-48 PTM-based OLIU (LNW55)
- OC-192 PTM-based OLIU (LNW603)

If an OC-3 shelf is homing to Alcatel-Lucent 1665 DMX, an LNW37 or LNW45 circuit pack must occupy at least one function unit or growth group. With VLF Main packs the other slot of a function unit or growth group can be occupied with a different OLIU or a faceplate-based Ethernet pack. If an OC-12 shelf is homing to Alcatel-Lucent 1665 DMX, the LNW49 must occupy at least one function unit or growth group. If an OC-48 shelf is homing to Alcatel-Lucent 1665 DMX, the LNW31, LNW62, or LNW402 circuit pack must occupy at least one function unit or growth group. It is possible to home to OC-3, OC-12, and/or OC-48 rings on the same shelf. Any other circuit pack may occupy other function units depending on the desired service.

Optical multiplexing shelf

The optical multiplexing shelf has OC-3, OC-12, OC-48 or OC-192 OLIUs in the main M1 and M2 slots and require a LNW785 OMD (Optical MUX/DMUX) pack. The inputs/outputs to/from the LNW785 MUX/DMUX are OC-48 and OC-192 lines with DWDM optics.

OC-48 DWDM PTMs

The following circuit packs support OC-48 DWDM PTMs

- LNW55
- LNW62
- LNW82
- LNW202
- LNW402
- LNW504

For a list of the DWDM OC-48 PTMs, see Table 10-61, “OC-48 DWDM PTM wavelengths” (p. 10-75).

OC-192 DWDM PTMs

The following circuit packs support OC-192 DWDM PTMs

- LNW59
- LNW502
- LNW504
- LNW603
- LNW705

  In addition, the OTU2 port (port 9) of an LNW705 muxponder pack can be connected to the MUX/DMUX ports of the LNW785. The LNW705 mutiplexes/demutiplexes OC-3/12/48/GE/FC signals to/from the OTU2 signal.

For a list of the DWDM OC-192 PTMs, see Table 10-72, “OC-192 DWDM PTM wavelengths” (p. 10-83).

Packet ring shelf

A Packet ring shelf has a pair of OC-3, OC-12, OC-48 or OC-192 OLIUs in the main M1 and M2 slots for the ring interfaces (UPSRs or BLSRs) and requires an FE/GE pack for the add/drop connections from the ring. Other packs are permitted in the shelf.
Alcatel-Lucent 1665 DMX supports the following number of packet rings per Ethernet interface circuit pack:

- 1 packet ring on each 10/100 Mbps Fast Ethernet circuit pack (LNW66)
- 16 packet rings on each 100/1000 Mbps GbE circuit pack (LNW170)

Medium and large fabric engineering rules

Overview

This section describes the functionality and limitations resulting from the use of the medium and large switch fabrics in high-speed circuit packs. Use this section to help plan the use of circuit packs in Main slots of the Alcatel-Lucent 1665 DMX shelf. Because of the smaller switch fabric in these circuit packs, they are less costly; however, the smaller switch fabric (12 STS-1) can not handle the same volume of cross-connections as the large switch fabric (48 STS-1). Therefore, circuit packs with medium-size switch fabrics have cross-connection restrictions.

Medium fabric circuit packs

The table below lists the Alcatel-Lucent 1665 DMX circuit packs equipped with medium switch fabrics.

Table 6-1 Circuit packs with medium switch fabrics

Circuit Pack	Apparatus Code	Slot(s)	Release	Comments
OC-12 OLIU(1 port)	LNW48	M1, M2	3.1	High-speed, Intermediate reach, 1310 nm, OSP hardened, 12 STS-1 VT fabric
	LNW50	M1, M2	3.1	High-speed, Long reach, 1310 nm, OSP hardened, 12 STS-1 VT fabric
	LNW54	M1, M2	5.1	High-speed, Long reach, 1550 nm, OSP hardened, 12 STS-1 VT fabric
	LNW203	M1, M2	9.0	High-speed, PTM-based, 12 STS-1 VT fabric

Large fabric circuit packs

The table below lists the Alcatel-Lucent 1665 DMX circuit packs equipped with large switch fabrics.

Table 6-2 Circuit packs with large switch fabric

Circuit Pack	Apparatus Code	Slot(s)	Release	Comments
OC-48 OLIU	LNW27	M1, M2	2.1	High-speed, long reach, 1310 nm, 48 STS-1 VT fabric
	LNW29	M1, M2	2.1	High-speed, extra long reach, 1550 nm, 48 STS-1 VT fabric
	LNW32	M1, M2	2.1	High-speed, long reach, 48 STS-1 VT fabric
	LNW76	M1, M2	2.1	High-speed, short reach, 1310 nm, 48 STS-1 VT fabric
	LNW202	M1, M2	7.1	High-speed, PTM-based, DWDM, 48 STS-1 VT fabric
OC-192 OLIU	LNW56	M1, M2	2.1	High-speed, intermediate reach, 1550 nm, OSP hardened, 48 STS-1 VT fabric
	LNW58	M1, M2	2.1	High-speed, short reach, 1330 nm, 48 STS-1 fabric
	LNW502	M1, M2	7.1	High-speed, PTM-based, DWDM, OSP hardened, 48 STS-1 VT fabric
Switch	LNW80	M1, M2	4.0	Switch Fabric Pack with no high-speed optical Interface.

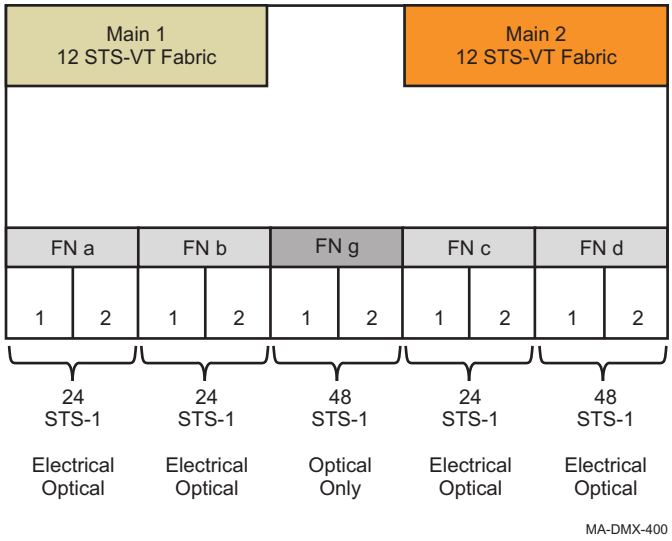
Differences at the shelf level

This sections describes the impact of medium switch fabric circuit packs versus large switch fabric circuit packs at the shelf level.

Shelf with medium fabric main circuit packs

The following figure shows the Alcatel-Lucent 1665 DMX shelf with MAIN circuit packs containing 12 STS-1-VT switch fabric.

Figure 6-1 Alcatel-Lucent 1665 DMX with medium fabric Main circuit packs



A shelf equipped with medium switch fabric main circuit packs has the following capabilities:

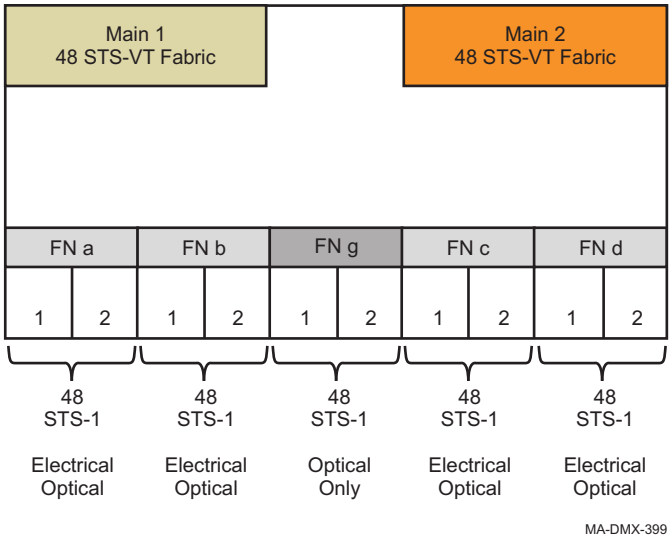
- Function Groups A, B, C, and D are general purpose slots and support all low-speed circuit packs. Some low-speed packs supported in Function Group slots also require the installation of VLF Main circuit packs in the shelf.
- Function Group G is referred to as the growth slot. The growth slot supports only optical, low-speed circuit packs, these includes all of the OC-3/12/48/192 port cards as well as the LNW63, LNW73/73C, LNW74, LNW87, and LNW170 Ethernet cards. (Some low-speed packs supported in Growth slots also require the installation of VLF Main circuit packs in the shelf and are therefore not supported by the medium fabric main packs.)

  When the LNW74 is installed in slot G1 or G2, only optical PTMs can be used.
- Function groups A, B, and C have an STS add/drop capacity of 24 STS-1s. This is a hardware-based restriction imposed by the use of the medium-sized STS switch fabric in the MAIN cards.
- Function Groups A, B, and C support up to 24 ported TMUX DS3 or EC1 ports.
- Function Group D supports up to 48 ported TMUX DS3 or EC1 ports.
- Function Group G does not support TMUX circuit packs.

Shelf with large fabric main circuit packs

The following figure shows the Alcatel-Lucent 1665 DMX shelf with MAIN circuit packs containing 48 STS-1-VT switch fabric.

Figure 6-2 Alcatel-Lucent 1665 DMX with large switch fabric Main circuit packs



A shelf equipped with large switch fabric main circuit packs has the following capabilities:

- Function Groups A, B, C, and D are general purpose slots and support all low-speed circuit packs. (Some low-speed packs supported in these slots also require the installation of VLF Main circuit packs in the shelf.)
- Function Group G is referred to as the growth slot. The growth slot supports optical, low-speed circuit packs. These include all of the OC-3/12/48 packs, the LNW705 and LNW785, as well as the LNW63, LNW73/73C, LNW74, LNW87, and LNW170 Ethernet. (Some low-speed packs supported in Growth slots also require the installation of VLF Main circuit packs in the shelf, and are therefore not supported by the large fabric main packs.) Growth slots can also house LNW20 TransMUX packs functioning in portless mode.

  When the LNW74 is installed in slot G1 or G2, only optical PTMs can be used.
- All function groups have an STS add/drop capacity of 48 STS-1s.
- Function Groups A, B, C, and D support up to 48 ported TMUX DS3 or EC1 ports, 24 portless TMUX DS3 ports
- Function Group G supports up to 24 portless TMUX DS3 ports

Engineering restrictions at the circuit pack level

This section describes engineering/cross-connection restrictions when using medium switch fabric circuit packs.

OC-12 medium fabric

The LNW48, LNW50, LNW54, and LNW203 employ a 12 STS-1/VT1.5 switch fabric with the following capacity:

- 784x784 VT matrix
- 216x216 STS matrix

Function Groups A, B, and C support 24 STS-1 add/drop capacity

- Additional pass-through traffic is supported
- Any circuit pack with a capacity of 48 STS-1s is limited to 24 STS-1s (ex. 24 DS-3 add/drop capacity with LNW19B)
- 1 virtual concatenation group (VCG) pair is accessible to GbE circuit packs

Function Groups D and G support 48 STS-1 add/drop capacity

- Full add/drop capacity to circuit packs capable of 48 STS-1s

OC-48/192 large fabric

The LNW27, LNW29, LNW32, LNW56, LNW58, LNW76, LNW80, LNW202, and LNW502 circuit packs employ a large 48 STS-1/VT1.5 switch fabric with the following capacity:

- 2688x2688 VT matrix
- 432x432 STS matrix (for OC-48); 720x720 STS matrix (for OC-192)

Function Groups A, B, C, D, and G support 48 STS-1 add/drop capacity

- Full add/drop capacity to circuit packs capable of 48 STS-1s
- Two VCG pairs are accessible to GbE circuit packs

Source/destination engineering rules

Due to hardware limitations in medium switch fabric Mains, cross-connections may be denied even though the capacity of the cross-connect fabric has not been exceeded.

In addition to the position of the shelf, source/destination demarcation is also determined by the STS number. The lower STS number is the source and the higher STS number is the destination.

Source	<<<<<<<<<<<<<<<	Destination
Main<<FNA<<FNB<<FNC<<FND<<FNG		

Once a cross-connect utilizing a VT1.5 within an STS-1 is established, no part of that STS-1 can be used in a cross-connect to a slot/group on the other side of the shelf. For example, if a VT1.5 from an STS-1 entering the shelf at Function Group B1 (FNB1) was cross-connected to FNA1, another VT1.5 in that same STS-1 could not be cross connected to FNC, FND, or FNG.

Cross-connections made with the LNW7 circuit packs are exceptions to this rule. This pack is always the cross-connect destination. Hairpin cross-connections between these packs are not allowed.

Intra-port hairpins are supported by Alcatel-Lucent 1665 DMX. Yet when an Alcatel-Lucent 1665 DMX is equipped with medium fabric mains, intra-port hairpins are not allowed.

Very large fabric (VLF) engineering rules

Overview

This section describes the functionality and limitations relating to circuit pack/slot equipage and electrical/optical port availability when the VLF Main circuit packs are used. Use this section to help plan the use of circuit packs in the Function and Growth units of a shelf equipped with VLF Mains.

VLF circuit packs

Alcatel-Lucent 1665 DMX can be equipped with LNW59, LNW82, or LNW504 VLF Main circuit packs. These circuit packs support true 0x1 configurations, in some cases resulting in double the overall port density for a given interface type.

LNW59 pack supports up to two OC-192 interface and provides a total 140G of Input/Output interfaces. The LNW59 has 180G of usable STS-1 fabric and 30G of usable VT fabric.

LNW504 pack supports up to 4 OC-192 interfaces or up to 3 OC-192 interfaces and 4 OC-48 interfaces and has integrated STS and VT fabrics. Although mixing of interface rates is supported, OC-48 interfaces are only supported on ports 5–8, and OC-192 interfaces are only supported on ports 1–4. The backplane interfaces can operate at 10 Gb/s, supporting all VLF-compatible low-speed packs. The LNW504 provides a total of 180G of Input/Output interfaces. The LNW504 has 220G of usable STS-1 fabric and 30G of usable VT fabric.

The LNW82 main pack supports 8 PTM-based multi-rate (OC-3, OC-12, OC-48) ports and integrated STS and VT fabrics. The pack supports a maximum of 8 OC-3 interfaces, 8 OC-12 interfaces or 2 OC-48 interfaces. The LNW82 has a 170G non-blocking, STS fabric and a 20G VT fabric. VLF mains can support 10G per slot or 20G per function/growth group. The pack supports up to 10G of VT1.5s.

- Function Groups A, B, C, and D are general purpose slots and support all low-speed circuit packs (except the LNW7).

  Function Group G is referred to as the growth slot. The growth slot supports only optical, low-speed circuit packs, these include all of the OC-3/12/48/192 packs, the LNW705 and LNW785, as well as the LNW63, LNW64, LNW73/73C, LNW74, LNW87, and LNW170 packs. Growth slots can also house LNW20 TransMUX packs functioning in portless mode.

  VLF Mains provide up to 10G add/drop capacity to each low-speed slot in the shelf.
- Function groups D and G have an STS add/drop capacity of 48 STS-1s.
- Function Groups A, B, C, and D support up to 48 ported TMUX DS3 or EC1 ports, 48 portless TMUX DS3 ports
- Function Group G supports up to 48 portless TMUX DS3 ports

However, there are certain restrictions with regard to which packs can reside next to each other in the same Function Unit or Growth slot. This section details these restrictions and provides general guidelines for circuit pack/slot equipage with the VLF Mains.

With VLF circuit pack in the Main slots, all switching and cross-connect functions are centralized on the STS and VT fabrics located on the VLF Main circuit pack. This is in contrast to shelves equipped with non-VLF Main circuit packs, where switching and cross-connection functions are distributed across the Main (high-speed) and tributary (low-speed) circuit packs/fabrics. When VLF Main circuit packs are used in conjunction with tributary packs that contain their own switch fabrics, the switch fabrics on the tributary circuit packs are automatically disabled.

Tributary circuit packs supported

The VLF Main circuit packs support all circuit packs supported by Alcatel-Lucent 1665 DMX shelf with the exception of the LNW7 28DS1 packs. Customers with VLF Mains requiring DS1 connectivity must employ the LNW8/LNW801 56DS1/E1 pack.

Circuit pack compatibility for unprotected (0x1) configurations

The 0x1 capability allows compatible packs of different types to reside in the same low-speed group. Generally speaking, packs which use the rear-access electrical backplane connectors are not compatible with any other packs; that is, they cannot be installed in adjacent slots within the same group. This includes LNW7, LNW8, LNW801, LNW16, LNW18, LNW19B, LNW20, LNW66 and LNW74 (unless both LNW74s are version S1:2 or later and in FX mode).

Certain circuit pack/slot equipage guidelines are the same whether VLF or non-VLF Mains are used. The use of electrical ports on the LNW170 are not restricted when these packs are installed in the Growth slots because their electrical interfaces are confined to the faceplate only.

Important! When the LNW74 is installed in the Growth slots, only the optical ports are functional. The electrical interfaces on the LNW74 are backplane only and cannot function in the Growth slot. VLF Mains must be used to support true 0x1 with the LNW74s.

Important! When the LNW20 is used in the Growth slots, it will only function in portless DS3 mode.

In the following list of compatibility guidelines, "Ethernet" includes Ethernet and SAN packs, "electrical" not modified by "TDM" refers to any pack that uses rear-access backplane connectors, and "TDM electrical" excludes Ethernet and Data packs. Note that "electrical" does not include Ethernet/Data packs using electrical PTMs.

0x1 circuit pack/slot compatibility guidelines

Listed below are circuit pack combinations that are incompatible for 0x1 configurations:

- TDM electrical pack/any other pack
- Any accepted pack/another TDM electrical pack
- 0x1-compatible Ethernet electrical pack/any other electrical pack

All other packs are compatible with each other for 0x1 configurations:

- OLIU/different OLIU
- OLIU/same OLIU
- non-electrical 0x1-compatible Ethernet pack/non-electrical 0x1-compatible Ethernet pack
- OLIU/0x1-compatible Ethernet pack (whether electrical or not)
- electrical 0x1-compatible Ethernet pack/non-electrical 0x1-compatible Ethernet pack

Supported combinations of packs within a function/growth group

The table below summarizes the guidelines detailed above for 0x1 compatible pack combinations within the same group. An OLIU is in 0x1 mode when all ports in the OLIU are set to the 0x1 application.

Table 6-3 0x1 compatible combinations

Circuit Pack Type			
Slot 2	**Slot 1**		
	Rear Access	**Mixed Front and Rear Access**	**Front Access**
Rear Access	Not Compatible	Not Compatible	Compatible
Mixed Front and Rear Access	Not Compatible	Not Compatible	Compatible
Front Access	Compatible	Compatible	Compatible

Notes:

1. Front access packs include all OLIUs (Optical Line Interface Units), and the following Ethernet/Data packs: LNW63, LNW64, LNW73/73C, LNW87, and LNW170.

Ethernet equipage guidelines

If the Main slots are equipped with Very Large Fabric LNW59, LNW82, or LNW504 OLIU circuit packs, the circuit packs in a Function/Growth group may be the same or different circuit pack type depending on the Slot Protection State.

For Ethernet circuit packs except the LNW170, the Slot Protection State parameter is fixed Unprotected. If the Slot Protection State is Protected and a 10/100 Ethernet circuit pack (other than the LNW170) is installed, the system reports an `unexpected CP type` alarm and service may be impacted.

The following combinations of circuit pack types are supported in Function/Growth Slot 1 and Slot 2 when the Slot Protection State is Unprotected.

Slot 2	**Slot 1**		
	LNW66	**LNW74 (S1:2 and later)**	**Other Front Access Circuit Packs**[1]
LNW66	Not compatible	Not compatible	Compatible
LNW74 (S1:2 and later)	Not compatible	Compatible[2]	Compatible
Other Front Access Circuit Packs[1]	Compatible	Compatible	Compatible

Notes:

1. This includes the LNW63, LNW64, LNW73/73C, LNW87, LNW170, LNW705, LNW785, and all low-speed OLIU circuit packs. The LNW7, LNW8, LNW16, LNW18, LNW19B, LNW20, , LNW74 (S1:1), and LNW801 are not 0x1 compatible.
2. The circuit pack Ethernet Mode parameter must be provisioned as FX to support LNW74 circuit packs in slot 1 and slot 2; otherwise, this configuration is incompatible. When pairing the LNW74 with another LNW74, ONLY the 8 SFP ports on each pack are usable, for a total of 16 SFP ports per function group. When mixing an LNW74 with any optical only pack, all 24 ports (16 electrical and 8 SFP ports) on the LNW74 are available.

If an incompatible circuit pack is installed in a Function/Growth slot, the system reports a `CP not allowed - eqpt` alarm.

The Slot Protection State parameter can be changed from Protected to Unprotected or from Unprotected to Protected.

XM10G/8 port rules

Client ports

The XM10G/8 LNW705 pack supports up to 8 client ports that are populated with PTMs. The 8 ports can be a mix of the following signals: 1GE, FC100, FICON, FC200, FICON_EXP, or OC3/12/48. However, there are equipage restrictions that must be followed. The following table lists the rates that are supported on each port.

Signal type provisioning rules

Table 6-4 Signal type provisioning rules

Port	Supported signal types							
	OC-3	OC-12	OC-48	FC100	FC200	1GE	FICON	FICON_EXP
1 (any supported rate)	x	x	x	x	x	x	x	x
2 (rates 1G and lower)	x	x		x		x	x	
3 (rates 2.5G and lower)	x	x	x	x	x	x	x	x

Table 6-4 Signal type provisioning rules (continued)

Port	Supported signal types							
	OC-3	OC-12	OC-48	FC100	FC200	1GE	FICON	FICON_EXP
4 (rates 1G and lower)	x	x		x		x	x	
5 (any supported rate)	x	x	x	x	x	x	x	x
6 (rates 1G and lower)	x	x		x		x	x	
7 (rates 2.5G and lower)	x	x	x	x	x	x	x	x
8 (rates 1G and lower)	x	x		x		x	x	

Port to tributary assignment

In order to maintain fixed port-tributary allocation, the following rules are used:

- First tributary of any port uses the first STS-1 assigned to that port. This rule implies that tributary allocation segments follows 24xSTS1 boundary. Payload of any client port will be mapped on the carrier starting at 1+24xn STS1 position, where n={0,1,…,7}.
- Each port uses a contiguous set of STS1 tributaries required for transporting service supported by that port.
- If number of tributaries needed to transport the client payload (either number of SONET/SDH tributaries received at the client port or number of tributaries comprising a VCG associated with data port) exceeds 24 STS1s, the client signal claims the tributaries assigned to the adjacent, higher port number, until all client signal carrying tributaries are mapped to STS-192. For example FC200 provisioned on Port1, that requires 37 STS1 tributaries, occupies tributaries 1-37 within an STS192 and renders Port2 unusable for any other service (the port provisioning rules enforce this).

Table 6-5 Port to tributary assignment

Client Port Number	STS-1 tributary range within STS-192 structure
Port 1	1–24
Port 2	25–48
Port 3	49–72
Port 4	73–96
Port 5	97–120
Port 6	121–144
Port 7	145–168
Port 8	169–192

Tributary assignments

The following tables show the ENT-OTPE:signaltype and tributary allocation to a 24xSTS1 segment. Tables show only 4 ports allocation while the remaining ports would follow the same pattern.

Table 6-6 OC-3 bandwidth allocations

ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
OC3	Port 1	1–3	OC3 payload
		4–24	Unequipped
OC3	Port 2	25–27	OC3 payload
		28–48	Unequipped
OC3	Port 3	49–51	OC3 payload
		52–72	Unequipped
OC3	Port 4	73–75	OC3 payload
		76–96	Unequipped
OC3	Port 5	97–99	OC3 payload
		100–120	Unequipped
OC3	Port 6	121–123	OC3 payload
		124–144	Unequipped
OC3	Port 7	145–147	OC3 payload
		148–168	Unequipped
OC3	Port 8	169–171	OC3 payload
		172–192	Unequipped

Table 6-7 OC-12 bandwidth allocations

ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
OC12	Port 1	1–12	OC12 payload
		13–24	Unequipped
OC12	Port 2	25–36	OC12 payload
		37–48	Unequipped
OC12	Port 3	49–60	OC12 payload
		61–72	Unequipped

Table 6-7 OC-12 bandwidth allocations (continued)

ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
OC12	Port 4	73–84	OC12 payload
		85–96	Unequipped
OC12	Port 5	97–108	OC12 payload
		109–120	Unequipped
OC12	Port 6	121–132	OC12 payload
		133–144	Unequipped
OC12	Port 7	145–156	OC12 payload
		157–168	Unequipped
OC12	Port 8	169–180	OC12 payload
		181–192	Unequipped

Table 6-8 OC-48 bandwidth allocations

ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
OC48	Port 1	1–24	OC48 payload
STNA	Port 2	25–48	OC48 payload
OC48	Port 3	49-72	OC48 payload
STNA	Port 4	73–96	OC48 payload
OC48	Port 5	97–120	OC48 payload
STNA	Port 6	121–144	OC48 payload
OC48	Port 7	145–168	OC48 payload
STNA	Port 8	169–192	OC48 payload

Table 6-9 1GE bandwidth allocations

ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
1GE	Port 1	1–21	VCG payload
		22–24	Unequipped
1GE	Port 2	25–45	VCG payload
		46–48	Unequipped

Table 6-9 1GE bandwidth allocations (continued)

ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
1GE	Port 3	49–69	VCG payload
		70–72	Unequipped
1GE	Port 4	73–93	VCG payload
		94–96	Unequipped
1GE	Port 5	97–117	VCG payload
		118–120	Unequipped
1GE	Port 6	121–141	VCG payload
		142–144	Unequipped
1GE	Port 7	145–165	VCG payload
		166–168	Unequipped
1GE	Port 8	169–189	VCG payload
		190–192	Unequipped

Table 6-10 FC200/FICON_EXP bandwidth allocations

ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
FC200/FICON_EXPP	Port 1	1–24	VCG payload
STNA	Port 2	25–37	VCG payload
		38–48	Unequipped
FC200/FICON_EXPP	Port 3	49–72	VCG payload
STNA	Port 4	73–85	VCG payload
		86–96	Unequipped
FC200/FICON_EXPP	Port 5	97–120	VCG payload

Table 6-10 FC200/FICON_EXP bandwidth allocations (continued)

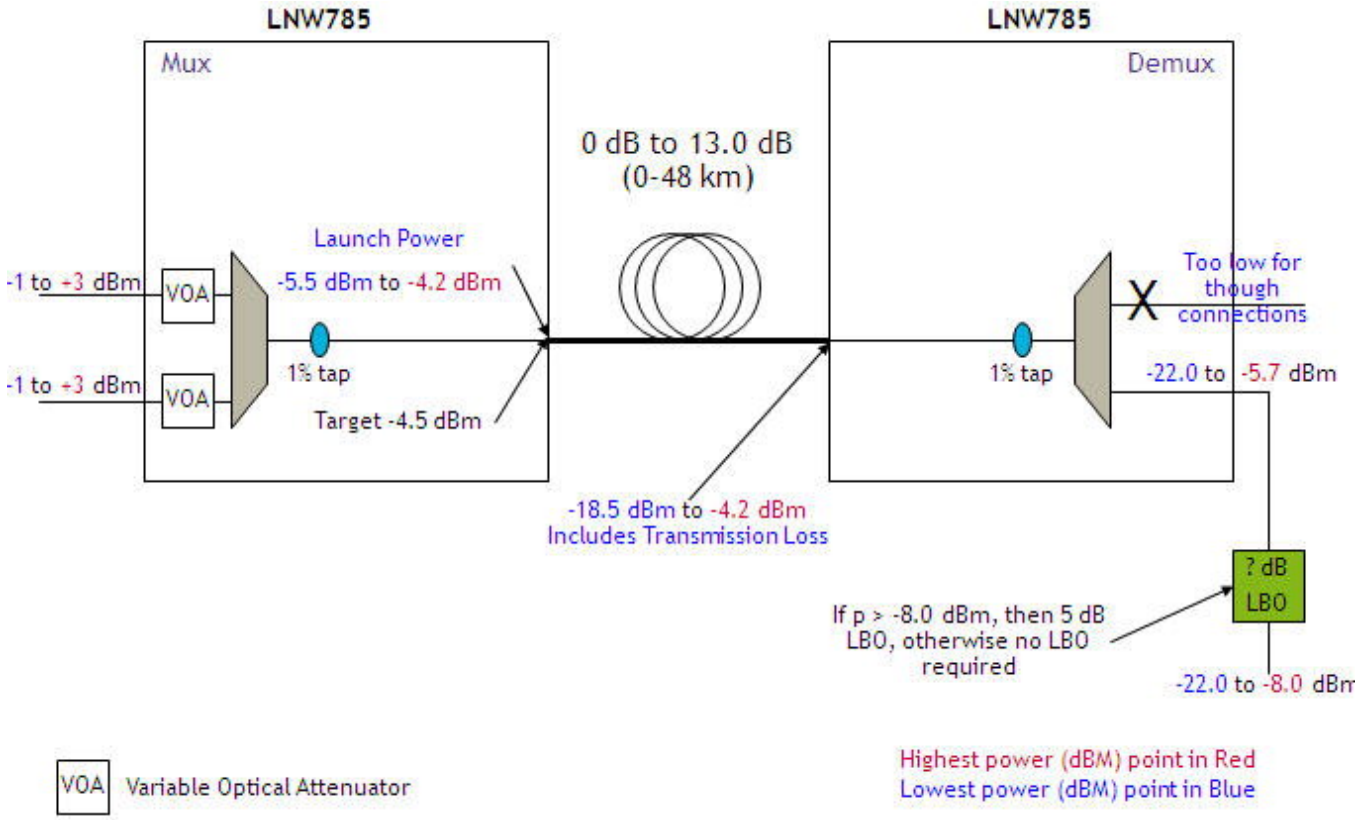
ENT-OTPE:signaltype	Port number usage	STS-1 tributary	Content
STNA	Port 6	121–133	VCG payload
		134–144	Unequipped
FC200/FICON_EXPP	Port 7	145–168	VCG payload
STNA	Port 8	169–179	VCG payload
		180–192	Unequipped

Span engineering considerations

LNW785

Use the figure below to engineer input and output power levels for the LNW785.

Figure 6-3 Input and output power levels



Network bay frames

Overview

These arrangements meet network equipment-building system (NEBS) central office requirements for bay heat dissipation. If typical arrangements are not used, normal heat flow could be interrupted and adversely affect shelf operation. Fan units must be used to guarantee proper air circulation.

Alcatel-Lucent 1665 DMX can be mounted in frames of both 23-inch and 19-inch widths. 23-inch wide frames available through Alcatel-Lucent include the ED8C800 (for rear mounting) and the ED8C801 (for front mounting).

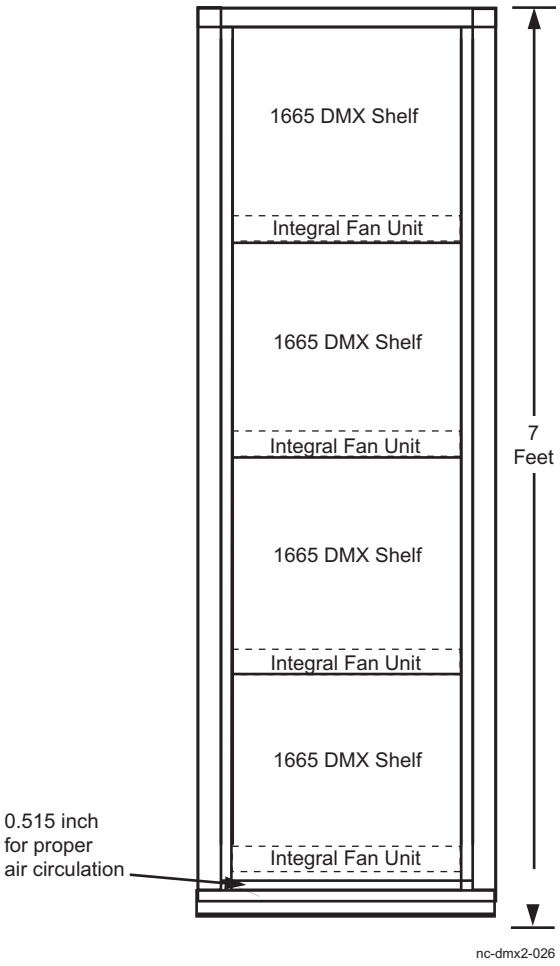
Bay arrangements

A standard 7-foot bay arrangement may contain up to four Alcatel-Lucent 1665 DMX. When a bay frame is fully equipped with four Alcatel-Lucent 1665 DMX shelves, a 0.515-inch space must remain open at the bottom of the rack to allow for proper air circulation. Alcatel-Lucent 1665 DMX shelves should be installed from bottom to top. This arrangement is configured for rear access cabling.

Important! The High-Capacity shelf uses an integral fan unit that comes attached to the Alcatel-Lucent 1665 DMX High-Capacity shelf on the bottom of the shelf. The heat baffle is located at the top of the Alcatel-Lucent 1665 DMX High-Capacity shelf.

The figure below shows a typical bay arrangement using the High-Capacity Alcatel-Lucent 1665 DMX shelf.

Figure 6-4 Typical bay frame arrangement using High-Capacity shelf



Note: When using the High-Capacity Alcatel-Lucent 1665 DMX shelf, 4 shelves can fit in a bay with a fuse panel. The Fan Unit is an integral part of the Alcatel-Lucent 1665 DMX High-Capacity shelf.

Fan unit

Fan units are required (in all environments) to guarantee proper air circulation. The Alcatel-Lucent 1665 DMX High-Capacity shelf includes an integral fan unit.

Fan filters

The fan unit is equipped with a fan filter. To keep the fan unit operating properly, it is recommended that users routinely change the fan filter every 6 to 9 months.

Adding shelves

Shelves can be added incrementally by local technicians (since all cabling is connectorized) if interbay cabling is initially provided for the bay layout. If shelves are incrementally installed, it is recommended that they be installed from bottom to top to simplify bay mult cabling. However, shelves may be added in any position if proper bay mult cabling is selected.

If a shelf is added above existing non-Alcatel-Lucent 1665 DMX equipment one heat baffle (848862181) must be installed between the shelf and the existing equipment.

For detailed information about network bay frame arrangements and installation instructions, see the *Alcatel-Lucent 1665 Data Multiplexer (DMX) Installation Manual, 365-372-304*.

Physical requirements

Overview

The following information about the Alcatel-Lucent 1665 DMX must be taken into consideration during installation.

Cabinet design and equipment reliability

Outside plant cabinets for use with Alcatel-Lucent 1665 DMX equipment in NAR applications have demonstrated compliance with GR-487. GR-487 describes cabinet level requirements to ensure a suitable environment for telecommunications equipment. Typical requirements covered in this specification include Water and Dust Intrusion, Wind-Driven Rain, Thermal Shock, Impact Resistance and Shock and Vibration.

The table below shows the dimensions of the Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMXtend equipment. See the *Alcatel-Lucent 1665 Data Multiplexer Explore (DMXplore) Applications and Planning Guide, 365-372-331* for Alcatel-Lucent 1665 DMXplore product details.

Table 6-11 Dimensions and weight

Dimensions[1]	1665 DMX	1665 DMXtend
Width	17.6	17.2
Height	19	8.75
Depth with flush front cover Depth with extended front cover	16[2] 17[2]	15.6[2] 16.6[2]
Center-to-Center Mounting Hole Width	22.31	22.31
Vertical Hole Spacing	A pattern of 0.5 inch spacing.	
Mounting Screw Size (thread forming screw)	No. 12x24	
Shelf Weight lbs	38 Empty 57 Full	15 Empty 30 Full

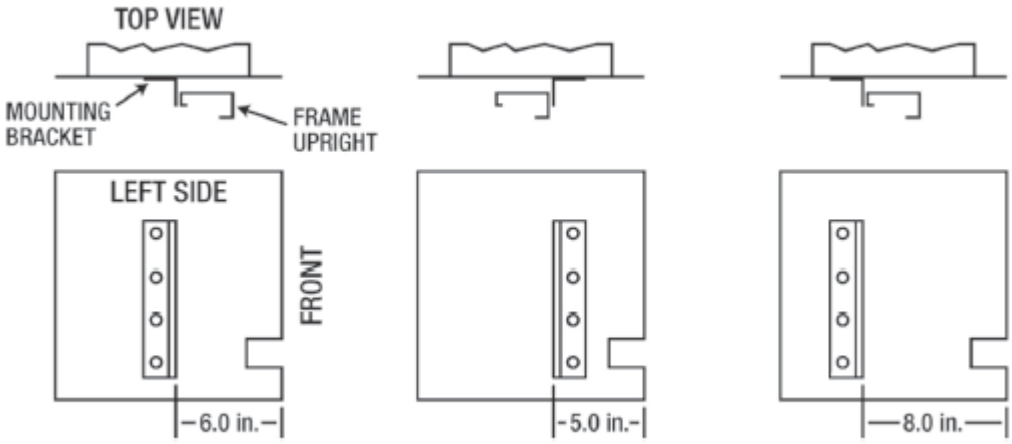
Notes:

1. All dimensions are provided in inches unless otherwise specified.
2. Depth with rear cover installed. If rear cover is removed subtract 0.8 in.

Mounting bracket positions

The figure below illustrates typical mounting bracket placements on the Alcatel-Lucent 1665 DMX shelf.

Figure 6-5 Mounting bracket positions on Alcatel-Lucent 1665 DMX shelf



Alcatel-Lucent 1665 DMXtend and Alcatel-Lucent 1665 DMXplore rack mount shelves offer the same mounting bracket as Alcatel-Lucent 1665 DMX. The mounting brackets can be placed differently depending on customer requirements (6, 5, or 8 inches back from the front of the shelf).

Equipment compartment

All doors, covers and faceplates that are part of the Alcatel-Lucent 1665 DMX systems design must be in place when installed in the cabinet to minimize losses in cooling and maximize resistance to electromagnetic interference. Apparatus Blanks (see *Alcatel-Lucent 1665 Data Multiplexer (DMX) Engineering and Ordering Information, ED8C871-10*) are ordered separately from the shelf and must be used where no circuit packs are installed.

Splicing compartment

Cable access ports must be provided in the base of the splicing compartment to permit the entrance of metallic and fiber cables into the equipment. Ports must be sized to allow cables to be placed in accordance with minimum bend radii guidelines, as specified by the cable supplier.

Battery compartment

If a battery compartment is provided, it must be segregated from the electronics compartment. A seal must be provided to prevent gases from seeping into the electronics and splicing compartments. The compartment must be vented to the outside.

Air flow capacity

The fan unit must supply sufficient air volume to cool the Alcatel-Lucent 1665 DMX equipment whether using Alcatel-Lucent 1665 DMX internal fans or cabinet-level cooling equipment. When installing the Alcatel-Lucent 1665 DMX in OSP environments, the internal fan units may be removed if the air flow requirements are satisfactorily met. The amount of air required is based upon the environmental conditions and the self-heating rates of the electronic equipment. An air mover must be functional whenever circuit packs are in operation including during equipment AC power outages.

For thermal performance requirements, see "Thermal operating temperature for OSP cabinets" (p. 6-35).

Air flow inlet/exhaust

Alcatel-Lucent 1665 DMX requires air to enter the bottom of the shelf, flow vertically upward and exhaust at the top (and rear if an integrated baffle is used). This direction of flow must properly cool the circuit packs installed in the shelf.

The fan filter must be removed for all Alcatel-Lucent 1665 DMX shelves in all cabinets (the heat baffle must also be removed on the Alcatel-Lucent 1665 DMX shelf). If the cabinet fan can guarantee at least 200 LFM (linear feet per minute) through the shelf, then the internal fan is not needed. It is recommended that the fan be removed in these instances, and used as a spare for throughout your network.

Cabling

Alcatel-Lucent offers a full complement of transmission cables and optical jumpers. Alcatel-Lucent 1665 DMX provides rear access for cables.

For more information regarding cable ordering, see Chapter 7, "Ordering". For more information on required cables and cable arrangements, see "Cabling" (p. 4-47) in Chapter 4, "Product description".

Cable placement and routing

For cable placement and routing information, see *Alcatel-Lucent 1665 Data Multiplexer (DMX) Installation Manual, 365-372-304*. Ensure that cables are routed in accordance with the guidelines provided in the Installation Manuals. Circuit pack cables are routed with half of the total number of cables on each side of the shelf.

Cable rating

Cable must be rated for a minimum temperature of 80ºC.

Connector contacts

All connector contacts that mate to Alcatel-Lucent 1665 DMX equipment should be of similar contact finishes. Alcatel-Lucent recommends the use of gold with a minimum of 30 micro-inches.

OSP cabinets

Overview

Outside plant (OSP) cabinet configurations are available using the OSP hardened Main packs: LNW32/LNW202 (OC-48), LNW48/LNW50/LNW54/LNW203 (OC-12), LNW80, LNW82 (OC-3/OC-12/OC-48) OLIUs. Many of the low-speed (tributary) packs supported by Alcatel-Lucent 1665 DMX are OSP hardened.

Air filter in OSP environment

The OSP environment may cause false clogged filter alarms. When the shelf is installed in an outside plant cabinet, the cooling air filter must be removed. The filter is not needed when operating in an OSP. This measure will improve air flow and thus enhance cooling performance and equipment life. See the Alcatel-Lucent 1665 Data Multiplexer (DMX) User Operations Guide, 365-372-301 or *Alcatel-Lucent 1665 Data Multiplexer (DMX) Installation Manual, 365-372-304* for instructions to suppress the clogged filter alarm. Suppression of the clogged air filter alarm is required when installing the shelf in an OSP.

Additional information

Detailed information regarding the installation of all Alcatel-Lucent 1665 DMX products in OSP applications can be found in Chapter 10, “Technical specifications”. For more information regarding the OSP capabilities of low-speed packs, see Chapter 4, “Product description”.

Cabinet requirements

Alcatel-Lucent 1665 DMX equipment must be installed in cabinets that have demonstrated compliance in accordance with GR-487 and all other specifications as required by this document. A cabinet that does not meet the requirements of this specification will negatively affect the performance, reduce service life, and threaten service continuity of any Alcatel-Lucent 1665 DMX system.

Cooling system alarm

A system failure alarm must be provided for cabinet cooling systems with forced air ventilation and other heat exchanger systems

High temperature alarm

A temperature sensor must be located in the electrical equipment compartment to provide a high temperature alarm when an internal cabinet temperature of 65ºC is reached. The air temperature must be measured at the inlet of the upper-most Alcatel-Lucent 1665 DMX shelf.

Power requirements

Overview

The following information describes the general requirements for electrical power supplied for Alcatel-Lucent 1665 DMX. It does not describe specific current or voltage requirements related to the power consumption of Alcatel-Lucent 1665 DMX. The power consumption of the 1665 products is dependent on the circuit packs installed and their operating state. These variables must be taken into account when sizing the power system. For specific voltage and current information see “Power specifications” (p. 10-134) in Chapter 10, “Technical specifications”.

Power quality

Alcatel-Lucent 1665 DMX products require a reliable low noise power source in accordance with GR-9478. This is usually accomplished by float charging batteries at the input to the Alcatel-Lucent 1665 DMX shelves. Batteries are installed to provide back up power in the event of AC power outages. When deployed in a float charge configuration they also provide filtering of AC power line drop outs and noise generated by equipment in the cabinet/bay. In all cases power must be configured to avoid dropping below or exceeding the voltage limits listed in the tables above.

Electrical noise

Care must be taken to insure that electrical noise generated by the power system, fans, or other equipment does not interfere with the operation of the Alcatel-Lucent 1665 DMX products. Electrical noise on the −48 volt power lines at the shelf must not exceed the voice frequency and wide-band noise limits in accordance with GR-947.

Interruptions

Momentary AC power line interruptions are accommodated by the batteries on float charge.

Inrush current

While there is no requirement to limit the rate of power application to the Alcatel-Lucent 1665 DMX shelves, the voltage at the shelf must remain within the specified limits at all times.

Battery backup

In all cases, battery backup power must be configured to avoid dropping below the voltage limits listed in "Power specifications" (p. 10-134). The preferred method of battery backup is a float charge configuration. Alternatively, a separate battery and charger system can be used utilizing a diode "OR" configuration. Systems employing transfer switches are not recommended unless sufficient capacitance is installed to carry the system over through the transfer period.

Grounding and bonding

Grounding must meet the appropriate *Telcordia* ®, UL, and NEC requirements for outside plant and customer premises applications. The Alcatel-Lucent 1665 DMX shelves require a single common ground reference. The Alcatel-Lucent 1665 DMX shelf frame must be bonded to an earth ground within the cabinet/bay. Alcatel-Lucent 1665 DMX shelf mounting screws should be used to provide a low impedance multipoint electrical connection through the mounting structure to earth ground. A frame ground wire located on the shelf must be connected to the ground.

I/O protection

The DS1/E1 and DS3/EC-1 interfaces (traffic ports) or other metallic telecommunications interfaces must not leave the cabinet/bay unless connected to telecommunications devices providing primary and secondary protection, as per GR-1089 and UL-60950 (UL 60950/ CAN/CSA- 22.2 NO. 60950-00 *Safety of Information Technology Equipment*, December, 2000).

The Alcatel-Lucent 1665 DMX DS1/E1, DS3/EC-1, and Ethernet ports are tested according to the following note.

WARNING: The intra-building port(s) of the equipment or subassembly is suitable for connection to intrabuilding or unexposed wiring or cabling only. The intra-building port(s) of the equipment or subassembly MUST NOT be metallically connected to interfaces which connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 5) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

Environmental considerations

Overview

Alcatel-Lucent 1665 DMX meets NEBS Level 3 standards for use in central office environments as specified in GR-63-CORE and GR-1089-CORE. Alcatel-Lucent 1665 DMX also meets standards for uncontrolled environments as specified in GR-63-CORE and GR-499-CORE. For detailed specifications, see Chapter 10, "Technical specifications".

Vibration

The cabinet/bay must be resistant to continuous low level vibrations from sources including train and vehicular traffic, rotating machinery, construction activities, etc. Physical tests must be performed to assure the cabinet/bay does not amplify vibrations from these sources such that the vibration levels transmitted to the equipment do not exceed design limits. Tests must be performed in accordance with GR-487 and GR-63 to verify the performance of the cabinet/bay and equipment during vibratory test conditions.

Thermal operating temperature for OSP cabinets

Inlet air to the Alcatel-Lucent 1665 DMX equipment must be controlled within the range of −40ºC to +65ºC. Ambient air from outside the cabinet cannot be introduced into the electronics compartment or used in any way to directly cool the Alcatel-Lucent 1665 DMX equipment within the cabinet.

Heat exchange systems for cabinet must be sized so that maximum inlet temperature will not exceed 65ºC even when the shelf is equipped in such a way that it approaches the maximum current drains detailed in "Current drains" (p. 10-134). Also, the cabinet must be sized to ensure that inlet temperature does not exceed 65ºC given both severe outside ambient temperature and solar heating relative to the conditions of the region where the shelf is deployed.

The supplier must supply performance data upon request for cabinets cooled by compact heat exchangers or any other method. This information may include the appropriate factor of safety, or excess capacity, accounting for normal fouling of the heat exchanger core. During operation, the time rate of change of the internal air temperature must not exceed 30ºC/hr as the result of solar heating and radiation cooling of the enclosure, and power cycling the equipment.

OSP cabinet condensation

The relative humidity of the internal air of an OSP cabinet must be maintained in accordance with GR-63. This applies even when the equipment within the cabinet is in an unpowered condition, e.g., during installation of equipment. During such times a source of heat, or desiccant packs, must be provided for maintaining the necessary relative humidity level.

Test verification and qualification

Site requirements

Principal requirements for Alcatel-Lucent 1665 DMX equipment are as follows:

- GR-63, covering physical requirements (earthquake resistance, thermal shock, fire, etc.)
- GR-1089 covering electrical requirements (electromagnetic interference, electrostatic discharge, grounding, etc.)
- CSA-C22.2, No. 60950-00, UL609503 Safety of information technology equipment.

System thermal performance verification

For the fully equipped cabinet/bay configuration, a functional test of the Alcatel-Lucent 1665 DMX shelf must be performed with all systems powered at their appropriate levels for typical service applications that approach the maximum current drains detailed in "Current drains" (p. 10-134). The OSP cabinet surfaces must be respectively heated at the appropriate maximum solar radiation levels. Absorbed solar heating must be estimated using the formulations and methods in accordance with GR-487 and the ASHRAE handbook.

During this testing measure, record, and provide upon request:

- Power level into the cabinet/bay in amperes
- Air Velocities in the airflow channels formed by the circuit packs in linear ft/min.
- Air temperature entering and exhausted from the Alcatel-Lucent 1665 DMX shelf (ºC). Three K or T type thermocouples must be added at the inlet and exhaust of all circuit pack slots. Take the average of the three thermocouples for each circuit pack slot for both inlet and exhaust and record (Tinlet_avg, Texhaust_avg, TC type, and slot number).
- Ambient temperature (temperature outside the cabinet/bay and measured in ºC).
- Solar heating loads on respective cabinet/bay surfaces (ºC).

Technical references

- *Telcordia* ® Document − *Network Equipment − Building System (NEBS) Requirements: Physical Protection, GR-63, Issue 2, April 2002*.
- *Telcordia* ® Document − *Electromagnetic Compatibility and Electrical Safety – Generic Criteria for Network Telecommunications Equipment, GR-1089, Issue 3, October 2002*.
- *Telcordia* ® Document – *Generic Requirements for Electronic Equipment Cabinets, GR-487, Issue 2, March 2000*.
- Alcatel-Lucent 1665 DMX Documents
  - *Alcatel-Lucent 1665 Data Multiplexer (DMX) Engineering and Ordering Information, ED8C871-10*, latest Issue.
  - *Alcatel-Lucent 1665 Data Multiplexer (DMX) Installation Manual, 365-372-304*
  - *Alcatel-Lucent 1665 Data Multiplexer (DMX) Applications and Planning Guide, 365-372-300*
- Alcatel-Lucent 1665 DMXtend Documents
  - *Alcatel-Lucent 1665 Data Multiplexer Extend (DMXtend) Engineering and Ordering Information, ED8C951-10*, latest Issue.
  - *Alcatel-Lucent 1665 Data Multiplexer Extend (DMXtend) Installation Manual, 365-372-327*
  - *Alcatel-Lucent 1665 Data Multiplexer Extend (DMXtend) Applications and Planning Guide, 365-372-324*
- *Telcordia* ® Document – *Generic Requirements for a −48 volt Telecommunications Switchmode Rectifier/Power Supply, GR-947, Issue 1, December 1996*.
- *National Fire Protection Agency (NFPA-70), National Electrical Code (NEC), 2002 Edition*.
- *2001 ASHRAE Handbook Fundamentals – American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., Atlanta GA.*.

Cross-connections

Overview

Purpose

This section provides cross-connection information for Alcatel-Lucent 1665 DMX. For cross-connect provisioning information, see Chapter 5, “Operations, administration, maintenance, and provisioning”.

Contents

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Cross-connection types

Overview

Alcatel-Lucent 1665 DMX has cross-connect capabilities offering users flexibility in directing traffic flow through systems to support a wide variety of customer applications using one-way and multi-point (data specific) cross-connections.

Making cross-connections

Cross-connections are made by specifying the SONET rate (VT1.5 or STS-n), the end point addresses (AIDs), and the cross-connection type (for example, 1WAY). Each single cross-connection command establishes a 1-way cross-connection.

Atomic cross-connections

Beginning in Release 6.0, Alcatel-Lucent 1665 DMX employs atomic cross-connections for all cross-connect provisioning. Atomic cross-connections are one-way cross-connections between logical ring channels which can be set up and taken down by a single command, and which cannot be broken down into smaller parts. Logical ring channels are the tributaries of a port or port protection group used for transmission in the absence of any line or equipment protection.

Each portion of a 2way cross-connect is provisioned as 1way cross-connects. This provides increased flexibility in provisioning all cross-connects.

For customers who use the *WaveStar*® CIT, *Telcordia* ® Operating Systems (OS), and INC this change will be transparent. In order to support atomic cross-connections for the first time, customers employing proprietary OS solutions will need to adjust their cross-connection provisioning procedures.

Bidirectional (two-way) cross-connections

A bidirectional connection can be used to send signals between two high-speed ports (pass-through), two low-speed ports (hairpin or pass-through), and a high-speed and low-speed port (add/drop). Bidirectional cross-connections are supported at the VT1.5, STS-1, STS-3c, STS-12c STS-48c, and STS-192c rates as a function of the port types (OC-3/12/48/192-high speed and low-speed).

Unidirectional (one-way) cross-connections

A one-way cross-connection is a unidirectional connection that can be used to send signals between two high-speed ports (pass-through or hairpin, hairpin with the LNW59, LNW82, or LNW504 only), two low-speed ports (hairpin or pass-through), and a high-speed and low-speed port (add/drop). In add/drop applications, this is used where VT1.5, STS-1, STS-3(c), STS-12(c), STS-48(c), STS-192(c) signals on high-speed channels are cross-connected to low-speed DS1/E1, DS3, EC-1, OC-3, OC-12, OC-48, OC-192 10/100/1000BASE-T, 100/1000BASE-X, or FC-DATA ports. Alcatel-Lucent 1665 DMX allows one-way cross-connections in support of DRI, bridge and roll, and true 0x1 unprotected scenarios.

Hairpinning cross-connections

If VLF Main packs are used in “hairpinning” topologies, all cross-connect and switching functions are centralized on the Main pack. Switching within the fabrics on the tributary (low-speed) OLIUs is disabled and traffic is routed directly to the STS fabric on the Mains, bypassing any VT fabric on the tributary OLIUs. When non-VLF Main packs are used, tributary (low-speed) traffic is routed into the system and back out without ever being placed on high-speed (OC-12, OC-48 or OC-192) interfaces. In addition, in systems with non-VLF mains, VT cross-connections on the LNW45 and LNW49 are optimized to minimize the VT fabric usage on the main packs. For example, hairpins between different VTs on an LNW45 or LNW49 are routed using only the VT fabric on the LNW45 or LNW49, and thus do not consume any VT resources on the main packs.

Alcatel-Lucent 1665 DMX is capable of connecting any input on a circuit pack in a function or growth slot to any output on a circuit pack in the same group (known as inter-fn hairpin). Alcatel-Lucent 1665 DMX also supports intra-port hairpins, by which Alcatel-Lucent 1665 DMX can hairpin between different tributaries in the same port. Hairpin cross-connections to 0x1Sn interfaces is also supported. When a VLF Main circuit pack is installed, hairpin cross-connections between unprotected ports on different slots of the same low-speed group are also supported.

These flexible cross-connect capabilities allow you to use a combination of add/drop and hairpinning of compatible payloads through a variety of interfaces. You can bring traffic in from one remote site and cross-connect it at the VT1.5, STS-1, STS-3c, STS-12c, STS-48c, or STS-192c level back out to other remote sites without consuming any capacity on the ring/line interface.

Locked cross-connections

In the "locked" mode, Alcatel-Lucent 1665 DMX does not select the best signal from both rotations of a UPSR. Instead, traffic is added and dropped (locked) from one rotation of the ring only (provisionable). The main advantage of locked VT cross-connections is the lack of UPSR switching which results in the ability to reuse time slots around a UPSR.

Locked, unlocked, and pass-through VT1.5s can be mixed within the same STS-1.

Locked cross-connections are only used in systems that are not equipped with VLF Mains because VLF mains allow unprotected (linear) UPSR cross-connections which allow users to independently provision cross-connections on UPSR tributaries. In systems with non-VLF Mains, once a locked cross-connection is established from a UPSR tributary, the companion tributary cannot be cross-connected.

Linear/unprotected UPSR

Alcatel-Lucent 1665 DMX allows both rotations of a ring to be used. Simultaneous 1WAY cross-connections can be sourced from the 2 associated ring channels in a UPSR application. Simultaneous 1WAY cross-connection sourced from a ring channel, and 1WAY or 1WAYPR destined to the associated ring channel are also supported.

Unswitched cross-connections

Unswitched cross-connections are user-provisionable on a per cross-connection basis and support single- and dual-homed ring on ring topologies. Path protection and internal equipment (switch fabric) protection is disabled in unprotected configurations. Unswitched cross-connections on Ethernet/Data packs that do not require VCG pairing are supported, but not required.

Multi-point (data-specific) cross-connections

The data specific multi-point cross-connect is a bidirectional cross-connection between two STS-1 Virtual Concatenation Groups (VCGs) on 100/1000BASE-X/T ports to two different ring interfaces. All multi-point cross-connections are done at the STS-1 level (multi-point cross-connections can also be made at the STS-3c and STS-12c level using the LNW63, LNW64, LNW87. or LNW170 circuit pack. Multi-point cross-connections are used to create packet rings.

Multiple 1WAY UNSWITCHED cross-connections provide unprotected SONET connections to Ethernet circuit packs. Each can be used to form two individual connections. With atomic cross-connections, multipoint cross-connections are provisioned by way of 1WAY UNSWITCHED cross-connects.

Bridged cross-connections

Alcatel-Lucent 1665 DMX supports multicast (1xN) cross-connections where N is limited only by the available cross-connect fabric (for VTs) and the compatible output tributaries. Bridging of an existing cross-connection consists of adding a one-way cross-connection with the same input tributary as that of an existing cross-connection, resulting in a 1x2 multicast from an input tributary to two output tributaries. Alcatel-Lucent 1665 DMX supports bridging for each of the supported SONET cross-connection rates. You can bridge any existing cross-connection to a second output port without impairing the existing signal. Conversely, either half of a bridged signal can be taken down without impairing the remaining cross-connected signal.

Pipe-mode (adaptive-rate) cross-connections

Pipe mode is a fault monitoring and performance monitoring feature whereby each automatically adapts to changes in the constituent payload structure of a provisioned STS-n rate cross-connection. Fault and PM are based on the payloads carried within a cross-connection rather than the cross-connection rate. Path protection switching continues to operate at the provisioned cross-connect rate.

DRI cross-connections

DRI cross-connections, used in Dual Ring Interworking applications, are accomplished by means of a one-way, protected drop from a UPSR, a one-way pass-through, and a one-way add to the same UPSR.

Manual cross-connection rates

The following lists the signals that can be cross-connected:

- VT1.5
- STS-1
- STS-3c
- STS-12c
- STS-48c
- STS-192c

OCH cross-connections

Optical channel (OCH) cross-connections are supported between dense wavelength division multiplexing (DWDM) compatible circuit packs/pluggable transmission modules. The OCH cross-connections are used to inform the network element about manual fiber connections.

OCH cross-connections to/from OCH ports allow the network element to enable alarm reporting and variable optical attenuators. The variable optical attenuators are enabled only when an OCH port is the destination of an OCH cross-connection.

OCH cross-connections to/from OTU2 ports allow the network element to enable alarm reporting and assign the 10G Muxponder internal STS cross-connection fabric to the provisioned client ports.

The following OCH cross-connections are supported:

- DWDM-compatible OC-192 port to/from OCH port
- OTU2 port to/from OCH port
- Remote DWDM-compatible wavelength (remote shelf) to/from OCH port
- OCH port to/from OCH port (pass through)

  Important! In order to support pass-through cross-connections, the LNW785 OMD circuit pack requires external optical amplification.

  The following circuit packs are DWDM compatible:

  - The LNW55 OC3/OC12/OC48 OLIU with OC-48 DWDM-compatible pluggable transmission modules (channels 52–59)
  - LNW59 OC-192 OLIU with DWDM-compatible pluggable transmission modules (channels 52–59)
  - The LNW62 4OC-48 OLIU with DWDM-compatible pluggable transmission modules (channels 52–59)
  - The LNW82 OC3/OC12/OC48 OLIU with OC-48 DWDM-compatible pluggable transmission modules (channels 52–59)
  - The LNW202 OC-48 OLIU with DWDM-compatible pluggable transmission modules (channels 52–59)
  - The LNW402 OC-48 OLIU with DWDM-compatible pluggable transmission modules (channels 52–59)
  - The LNW502 OC-192 OLIU with DWDM-compatible pluggable transmission modules (channels 52–59)
  - The LNW504 OC-48 and OC-192 OLIU with DWDM-compatible pluggable transmission modules (channels 52–59)
  - The LNW705 XM10G/8 Muxponder with DWDM-compatible pluggable transmission modules (channels 52–59)

Compatible DWDM optical signals that are terminated by other network elements are also supported (alien wavelengths).

Allowable cross-connections

Overview

Alcatel-Lucent 1665 DMX utilizes several types of SONET, DSn/Electrical, and Ethernet cross-connections, including:

- add/drop
  - Unidirectional Path Switched Ring (UPSR)
  - Bidirectional Line Switched Ring (BLSR)
  - Linear 1+1
  - Bidirectional 1+1
  - Unswitched UPSR
- unprotected optical
  - 0x1Sn (available when VLF Main packs are not installed)
  - 0x1 (available only when VLF Main packs are installed)
- hairpin
  - inter-function group
  - intra-function group
  - intra-port
- pass-through
- multi-point (Ethernet only)
- Ethernet hairpinning

Note: This section summarizes the supported cross-connections. For the complete matrix, see Appendix E in *Alcatel-Lucent 1665 Data Multiplexer (DMX) TL1 Message Details, 365-372-306*.

Add/drop

All connections from a high-speed interface to a low-speed interface are considered add/drop. An add/drop cross-connection is bidirectional cross-connection between a high speed interface and a low speed interface. Alcatel-Lucent 1665 DMX also supports unidirectional add and drop cross-connections. A signal can also be add/dropped from electrical and Ethernet interfaces.

Unidirectional path switched ring (UPSR)

A UPSR is self-healing ring configuration in which traffic is sent onto both rotations (both fibers) of the ring in opposite directions. "Path-switched" means that if the working signal fails, the path switches to the protection signal. UPSRs operate in an integrated, single ended fashion- negating the need for complex network-level coordination in the effort to restore traffic.

Bidirectional line switched ring (BLSR)

A 2-fiber is a self-healing ring configuration in which bidirectional traffic travels over the same set of nodes in each direction. Bidirectional switching makes use of redundant (protection) bandwidth on the bidirectional lines that interconnect the nodes in the ring to provide protection for traffic carried on the working bandwidth. Because the traffic is bidirectional, a single circuit does not necessarily consume bandwidth on every span in the ring. This leaves the spans between other nodes available for additional traffic. Therefore, with distributed switching patterns, a BLSR can carry more traffic than the same facilities could carry if configured for a unidirectional path-switched ring.

0x1Sn

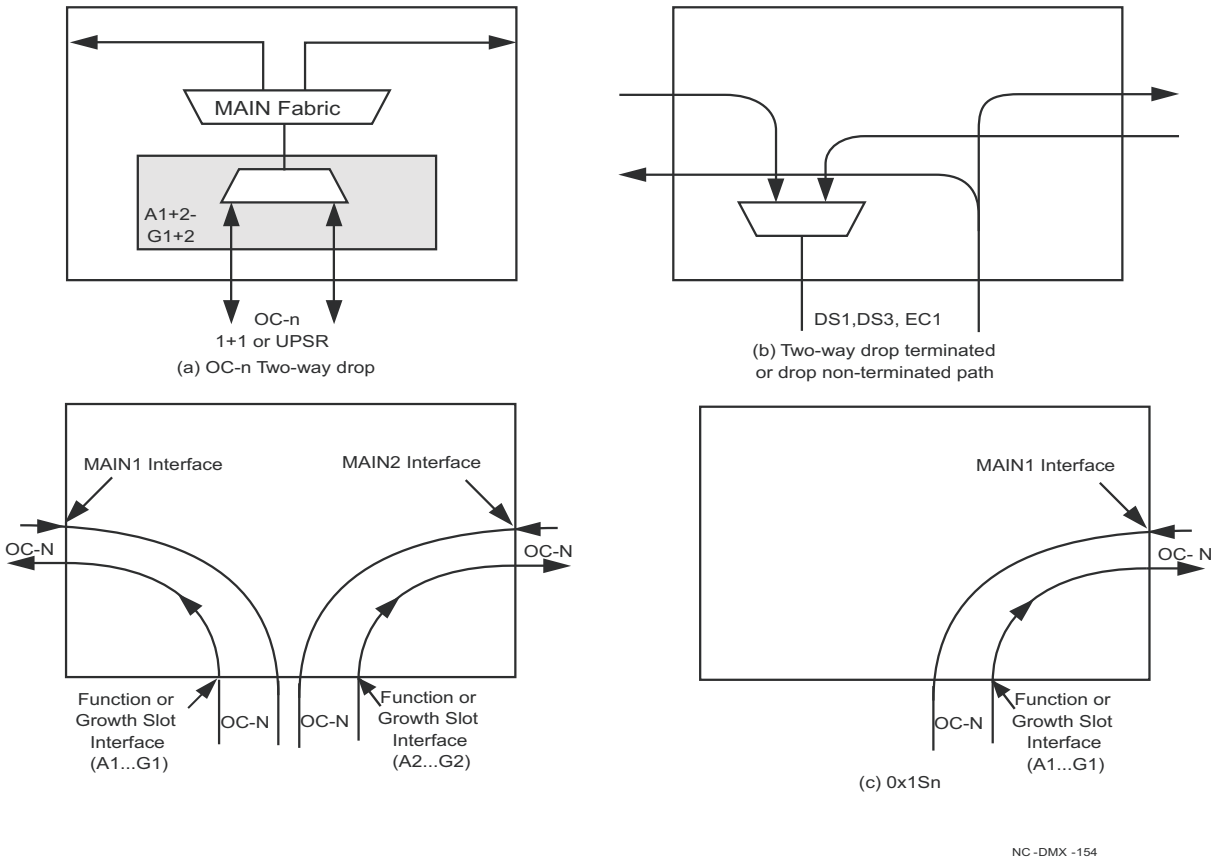
0x1Sn is not supported when Alcatel-Lucent 1665 DMX is equipped with VLF Main packs (LNW59/LNW82/LNW504). VLF Main packs are required to make true 0x1 cross-connections available.

With 0x1Sn, the OC-n 0x1 provisioning and alarming capability provides the user with a method of provisioning a LS OC-n port in one slot of a slot pair to operate as an unprotected interface. Cross-connections to 0x1Sn ports are provisioned using the ring channel AIDs corresponding to the active side/port. The inactive port, if equipped, always outputs STS1 UNEQ or AIS-P on all tributaries, as a function of the system default idle signal provisioning.

Cross-connections are supported between 0x1Sn ports and all other interface types. For DHA applications, 1WAYPR and 1WAY cross-connections between a 0x1Sn port to a UPSR ring channel are required. Cross-connections supported at all rates supported by the LS OC-n port. Multipoint and unswitched cross-connections to 0x1Sn interfaces are not supported.

Figure 6-6, "Two-way add/drop, unswitched, and 0x1Sn" (p. 6-45) shows high-level schematics of two-way add/drop, unswitched, and 0x1Sn cross-connections.

Figure 6-6 Two-way add/drop, unswitched, and 0x1Sn



True 0x1

The VLF Main packs (LNW59/LNW82/LNW504), Alcatel-Lucent 1665 DMX support true 0x1 unprotected circuit packs. That means that any slot can be equipped with any pack (some restrictions apply). Two of the same circuit packs can also populate adjacent slots in the same group (this includes some Ethernet packs). For detailed information on circuit pack/slot equipage restrictions in 0x1 mode, see "Very large fabric (VLF) engineering rules" (p. 6-15).

In the case of SONET packs, all ports in a pack must be set to 0x1 application in order for a different pack to be used in the companion slot. If any pair of lines is provisioned for a protected application (1+1, UPSR, BLSR), then both packs in the group must be of the same type.

True 0x1 replaces 0x1Sn functionality when VLF Mains are used. True 0x1 supports all the capabilities 0x1Sn allow, but adds the capability for both slots of a single group to function independently. 0x1Sn is still supported when the shelf is equipped with non-VLF Mains. True 0x1 is available on the low-speed/tributary packs, and on VLF Main (M1/M2) interfaces.

When two circuit packs in the same low-speed group are operating in 0x1 mode, all provisioning, reporting and retrieval (of alarms) associated with the pack, ports and tributaries in Slot 1 are independent of the provisioning, reporting and retrieval associated with the pack, ports and tributaries in Slot 2.

When provisioned for 0x1 operation, the affect on service and severity of alarms issued against a pack in Slot 1 of a particular group are independent from the affect on service and the severity of the alarms issued against the pack in Slot 2 of that group.

When Alcatel-Lucent 1665 DMX is equipped with VLF Mains, all 1-way cross-connections supported on an unprotected port/line (including ports/lines on an unprotected pack) in one slot of a group can be supported independently and simultaneously on an unprotected port/line in either slot of a Function or Growth group. 1-waypr cross-connections are not allowed to be sourced from 0x1 interfaces.

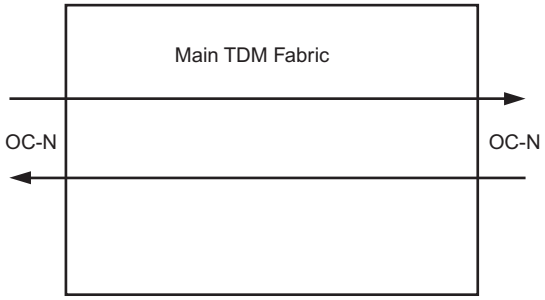
True 0x1 enables hairpin cross-connections between channels on packs in different slots of the same group.

Pass-through

A pass-through cross-connection is made between two ring interfaces in the same MAIN or Function Unit group, allowing the signal to be "passed-through" a ring node on the same time slot.

The figure below shows a pass-through cross-connection on the high-speed interface (OC-12, OC-48, or OC-192).

Figure 6-7 Pass-through cross-connection on high-speed interface



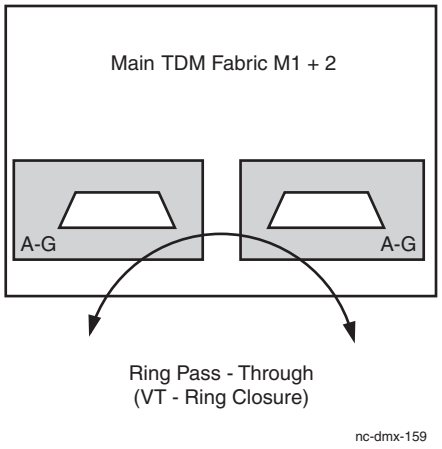
Two-way pass-through path

nc-dmx-160

Low-speed pass-throughs

Alcatel-Lucent 1665 DMX can host multiple rings on the low-speed interfaces of the Alcatel-Lucent 1665 DMX shelf. This is accomplished by intra-function group, pass-through cross-connections. Alcatel-Lucent 1665 DMX can close a low-speed ring by supporting a cross-connection between a receive port on one circuit pack and a transmit port on another circuit pack in the same function or growth group. All protection switching advantages/capabilities still apply in VT and STS-n Ring Closure applications. When VLF Main packs are used, all cross-connect switching occurs on the main packs, including low-speed, tributary pass-through cross-connects. This means that the line depicting the pass-through cross-connect in the figure below would have to extend out of the tributary packs, up into the MAIN switch fabric at the top of the figure when VLF Mains are used.

Figure 6-8 Pass-through hairpin



SONET hairpinning cross-connections

If VLF Main packs are used in “hairpinning” topologies, all cross-connect and switching functions are centralized on the Main pack. Switching within the fabrics on the tributary (low-speed) OLIUs is disabled and traffic is routed directly to the STS fabric on the Mains, bypassing any VT fabric on the tributary OLIUs. When VLF Main packs are not used, tributary (low-speed) traffic is routed into the system and back out without ever being placed on high-speed (OC-12, OC-48 or OC-192) interfaces. In addition, in systems with non-VLF mains, VT cross-connections on the LNW45 and LNW49 are optimized to minimize the VT fabric usage on the main packs. For example, hairpins between different VTs on an LNW45 or LNW49 are routed using only the VT fabric on the LNW45 or LNW49, and thus do not consume any VT resources on the main packs.

Alcatel-Lucent 1665 DMX is capable of connecting any input on a circuit pack in a function or growth slot to any output in the same group (known as inter-fn hairpin). Alcatel-Lucent 1665 DMX also supports intra-port hairpins, by which Alcatel-Lucent 1665 DMX can hairpin between different tributaries on the same port.

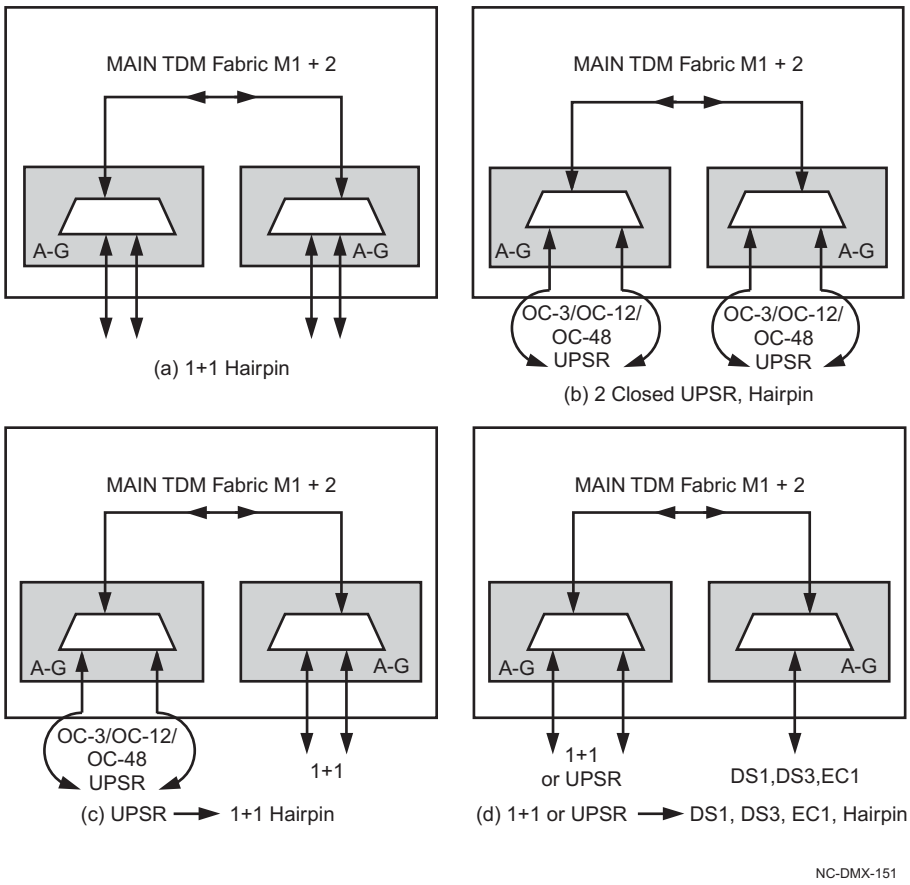
When VLF Main circuit packs are not installed, hairpin cross-connections to 0x1Sn interfaces are supported. When VLF Main circuit packs are installed, hairpin cross-connections between unprotected ports on different slots of the same low-speed group are supported. Certain restrictions apply, see "Very large fabric (VLF) engineering rules" (p. 6-15).

These flexible cross-connect capabilities allow you to use a combination of add/drop and hairpinning of compatible payloads through a variety of interfaces.

Alcatel-Lucent 1665 DMX supports intra-function group, hairpin cross-connections that are cross-connections between different tributaries on different ports within the same function group. Intra-port hairpins are cross-connections between channels hosted by the same physical port of the Alcatel-Lucent 1665 DMX shelf. These intra-port hairpins are only supported on 1+1 protected interfaces.

The figure below shows some of the various SONET hairpinning schemes.

Figure 6-9 SONET hairpinning



Portless mode hairpin cross-connections (LNW20)

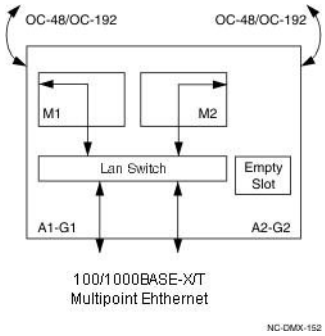
When operating in portless mode, LNW20 pulls DS1s from channelized DS3 signals that enter Alcatel-Lucent 1665 DMX on a SONET STS-1 interface (on another pack) and converts them to VT mapped STS-1s. This VT-mapped STS-1 is cross-connected at the VT level in the Main packs (at least one side of the cross-connect is OCn/EC1) to any interface that supports the signal structure today (DS1, channelized DS3, EC1, optical). For portless functionality, incoming STS-1s must contain a channelized DS3. This STS-1 is cross-connected to the LNW20 and then hairpinned to the STS fabric on the Main pack. Once the signal is finally converted to a VT1.5 it can be cross-connected to any port that accepts that signal format.

Multi-point (Ethernet only)

The data-specific multi-point cross-connect is a bidirectional cross-connection between two STS-1 Virtual Concatenation Group (VCG) on 100/1000BASE-X/T and ports to two different ring interfaces (UPSR or BLSR with NUT provisioning).

The figure below shows Ethernet Multipoint cross-connection schematic.

Figure 6-10 Ethernet multi-point cross-connection



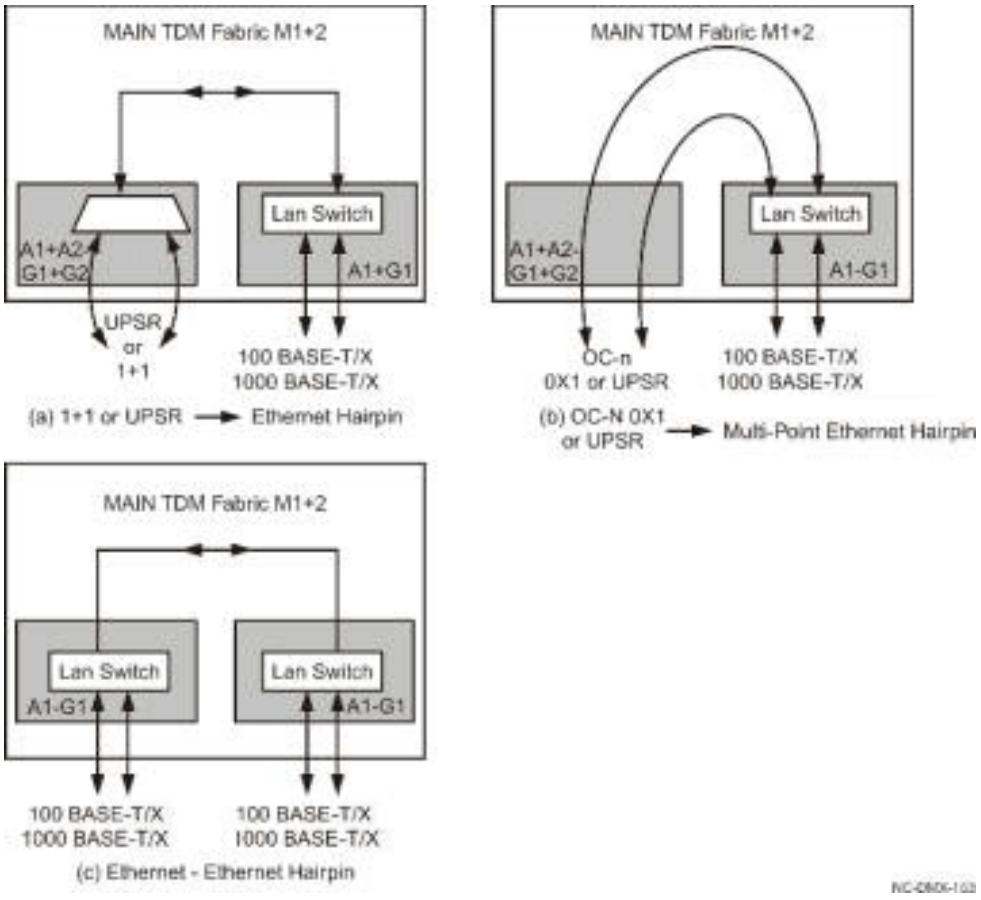
Ethernet hairpining cross-connections

With Ethernet-to-Ethernet hairpinning, traffic may travel from one Ethernet port on a circuit pack in one set of slots, to another port on a circuit pack in a different set of slots (from A1 to C1 or A2 to C2, for example). From there, the traffic may be multiplexed with other packet traffic before being switched onto another Ethernet or SONET interface.

In shelves equipped with VLF Mains (LNW59/LNW82/LNW504), hairpins between 0x1 compatible Ethernet packs located in Slot 1 and Slot 2 of the same group are also supported. For detailed information regarding 0x1 circuit pack compatibility, see “Very large fabric (VLF) engineering rules” (p. 6-15).

The figure below shows some of the high-level schematics of Ethernet hairpinning cross-connections.

Figure 6-11 Ethernet hairpinning



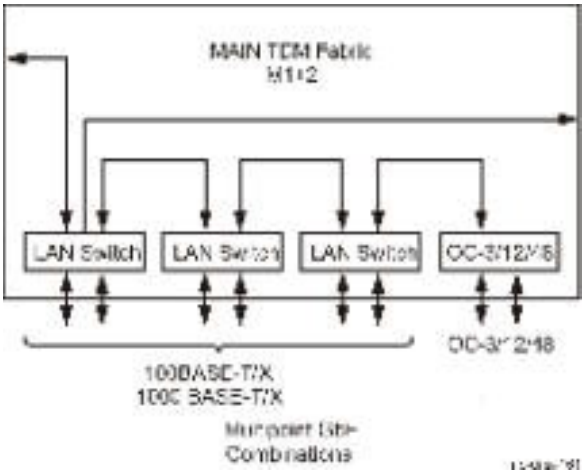
Important! Ethernet hairpins to BLSR interfaces are also supported.

Multi-point Ethernet combinations

Multi-point Ethernet cross-connections are supported from Ethernet ports, to ports provisioned for UPSR or BLSR with NUT only. In much the fashion as shown in the figure below, the Alcatel-Lucent 1665 DMX supports Multi-point Ethernet cross-connections between the following combinations of interfaces:

- OC-3/12/48/192 MAIN OLIUs & one 100/1000BASE-X/T interface (A–G)
- OC-3/12/48/OC192 OLIU (A–G) & one 100/1000BASE-X/T interface (A–G)

Figure 6-12 Multi-point combinations



Ethernet circuit pack capacities summary

The table below details various characteristics of the Ethernet and FC-DATA (SAN) circuit packs. The table covers the rate, transport format (PL or Switched), differential delay, frame size, LCAS capability, OSP capability as well as the number, format and capacity of VCGs supported by each Ethernet circuit pack.

Table 6-12 Ethernet circuit pack capacities summary part 1

Pack	Rate (# of ports)	PL or Switched	VCG Ports	VCG Format and Capacity (Max # of tributaries per VCG)[1]					
				VT1.5-xv	STS-1	STS-1-xv	STS-3c	STS-3c-xv	STS-12c
LNW63 1G SX/LX/ ZX PL	1000BASE-T, 1000BASE-X (4)	PL	4	-	1	21	1	7	1
LNW64 1G SX/LX/ ZX PL	1000BASE-T, 1000BASE-X (8)	PL	8	-	1	21	1	7	1
LNW66 10/100 T	100BASE-T (24)	Switched	2	-	-	21	-	-	-

Table 6-12 Ethernet circuit pack capacities summary part 1 (continued)

Pack	Rate (# of ports)	PL or Switched	VCG Ports	VCG Format and Capacity (Max # of tributaries per VCG)[1]					
				VT1.5-xv	STS-1	STS-1-xv	STS-3c	STS-3c-xv	STS-12c
LNW73/73C FC-DATA (SAN)	FC-1G/FICON (4) or ESCON (4)	PL	4	-	48 FC-FICON 6 ESCON	-	12 FC-FICON 2 ESCON	-	1 FC-FICON
LNW74 10/100 T/F	100BASE-T (16) 100BASE-ZX/LX/FX (8 PTM)	PL	24	63	1	3	1	-	-
LNW87 FE/GBE PL	100BASE-ZX/LX/FX (4 PTM)	PL	4	-	1	21	1	7	1
	1000BASE-SX/LX/ZX/ (4 PTM)			-	1	3	1	-	-
LNW170 100/1G FS[2]	100BASE-ZX/LX/FX/T (4 PTM) 1000BASE-SX/LX/ZX/T (4 PTM)	PL / Switched	1–2	-	1	48	1	16	1
			3–28	-	1	32	1	10	1
			29–32	-	1	10	1	3	-

Notes:

1. Every pack other than the LNW64, supports a maximum of 2.5G (48 STS-1) between any function slot and the backplane, double (5G) with multipoint cross-connections. The LNW64 has a maximum backplane capacity of 10G (192 STS-1s).
2. VCG 1–2 can support up to 48 STS1s or 16 STS3cs for a 2.5G. VCG 3–28 support up to 32 STS1s or 10 STS3cs. VCG 29–32 support up to 10 STS1s or 3 STS3cs.

Table 6-13 Ethernet circuit pack capacities summary part 2

Pack	Slots where packs can reside	Backplane Capacity	Differential Delay (ms)	LCAS Support	Maximum Frame Size	OSP
LNW63 GbE PL	A–G	48 STS-1s	50	Y	10240	Y
LNW64 GbE PL	A–G	168 STS-1s	108	Y	10240	Y (optical PTM/SFPs only)
LNW66 10/100 T	A–D	21 STS-1s	16	-	1536	-
LNW73/73C FC-DATA (SAN)	A–G	38 STS-1s	120	Y[1]	2160[2]	-
LNW74 10/100 T/F	A–G	48 STS-1s 63 VT1.5s	64	Y	9632	Y
LNW87 FE/GBE PL	A–G	84 STS-1s	50	Y	10222	Y
LNW170 100/1G FS	A–G	48 STS-1s	50	Y	10240	-

Notes:

1. The LNW73 and LNW73C do support LCAS, but only for async-FC traffic.
2. Maximum frame size for async-FC provisioned ports is 2160.

Ethernet circuit pack capacities for ring configurations

The table below details the allowable Ethernet-related ring configurations (Ethernet applications within UPSR and BLSR topologies) and the number of these configurations that may be supported by each Ethernet circuit pack in Alcatel-Lucent 1665 DMX.

Important! Capacities for each configuration are available in the later of the release numbers shown at the left of the row and the top of the column.

For more information, see “Packet rings” (p. 3-46), “Ethernet Private Line” (p. 3-10), and “Ethernet rate control services” (p. 3-13), in Chapter 3, “Applications and configurations”.

Table 6-14 Ethernet circuit pack capacities for ring configuration

Config	Release	Circuit Packs					
		1000 Mbps (GbE-PL) (4-port/ 8-port)	10/100 Mbps (FE-BPR)	10/100 Mbps (FE-EPL)/ 1000 Mbps (GbE-PL)	10/100 Mbps (FE-EPL)	10/100/ 1000 Mbps (FE/ GbE-BPR)	10/100/ 1000 Mbps (FE/ GbE-EoS)
Packet Rings on UPSRs	1.1	2/4	1	0	0	16	1
Packet Rings on BLSRs[1]	2.1	2/4	0	0	0	16	-
Packet Rings on BLSRs w/ NUT	3.0	2/4	1	0	0	16	1
PL on UPSR w/ UPSR protection	1.1	2/4	1	16–24	16–24	16–32	6
PL on UPSR w/out UPSR protection	1.1	2/4	2	16–24	NA	16–32	6
PL on BLSR	2.1	2/4	1	16–24	16–24	16–32	6
EPL on BLSR w/ NUT	3.0	2/4	2	16–24	16–24	16–32	6
BPR= Basic Packet Ring							
EPR= Enhanced Packet Ring (w/ rate control)							
EPL= Ethernet Private Line (point-to-point) PL= Private Line (point-to-point)							
FE= Fast Ethernet (10/100 Mbps) GbE= Gigabit Ethernet (1000 Mbps)							
FC-DATA= SAN card (FICON/ESCON/FC)							

Notes:

1. Each span of the packet ring has BLSR protection. It is not necessary to "close" the packet ring on a BLSR: BLSR protection is provided on each span, so spanning tree protection is unnecessary. Capacity on one span of the BLSR can be used for other purposes.
2. The number of EPL cross-connections on the LNW74 is relative to the slot in which the circuit pack is housed and not the cross-connection rate. 24 VCGs are provisionable in slots A–D. 8 VCGs are provisionable in slot G.

Allowable UPSR add-drop cross-connections

The table below contains a list of UPSR add-drop cross-connections supported by Alcatel-Lucent 1665 DMX. The cross-connections in the table below are all drop cross-connections.

Note: In UPSR networks with more than 2 nodes, mixing VT and STS add/drops in the same circuit can lead to cases where individual VT defects are not protected at the STS-1 add/drop node. If you are provisioning VT add/drops, both ends of the add/drop circuit should be VT1.5 cross-connects; mixing VT add/drops and STS-1 add/drops in a multi-node UPSR is not recommended.

Important! With atomic cross-connects, all cross-connections are one-way. For cross-connects not involving UPSR interfaces, the same 1-way cross-connects are supported in the opposite direction to provide two-way connectivity.

The LNW59, LNW82, and LNW504 VLF Main circuit packs make true 0x1 cross-connections and shelf equipage possible. When the VLF Main pack is used, the shelf does not support 0x1Sn cross-connections, or the LNW7 circuit pack. In shelves equipped with VLF Mains, unprotected (linear) UPSR cross-connections are also supported. Unprotected UPSR cross-connections are independent cross-connections to or from the companion UPSR tributaries. For these reasons, the capabilities of the shelf when equipped with the VLF Main packs are listed separately.

In the "To" column of the table below, "TransMUX" includes the LNW18 and LNW20 in both ported and portless mode.

Table 6-15 Allowable UPSR add-drop cross-connections

From	To
VLF Main (LNW59/LNW82/LNW504) OLIU (UPSR)[1]	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), OC-48/192 (BLSR), 100/1000BASE-X/T, FC-DATA

Table 6-15 Allowable UPSR add-drop cross-connections (continued)

From	To
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), 100BASE-X/T (LNW74 only)
1-way unswitched STS-n-------->	OC-3/12/48/192 (UPSR), OC-48/192 BLSR w/ NUT, 100/1000BASE-X/T (no LNW74)
1-way unswitched VT1.5-------->	OC-3/12/48/192 UPSR
1-waypr STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), OC-48 (BLSR), 100/1000BASE-X/T FC-DATA
1-waypr VT1.5 ---------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), 100BASE-X/T (LNW74 only)
Non-VLF OC-192 OLIU (UPSR)	
1-way STS-n ---------->	DS1, DS3, OC-3/12/48 (0x1Sn)
1-way VT1.5-------->	DS1, OC-3/12/48 (0x1Sn)
1-way unswitched STS-n-------->	OC-3/12/48 (UPSR), OC-48 BLSR w/ NUT, 100/1000BASE-X/T
1-way unswitched VT1.5-------->	OC-3/12/48 UPSR
1-waypr STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), OC-48 BLSR, 100/1000BASE-X/T, FC-DATA
1-waypr VT1.5 ---------->	DS1, EC-1, TransMUX, OC-3/12/48 (0x1Sn, 1+1 and UPSR), 100BASE-X/T (LNW74 only)
Non-VLF OC-48 High-Speed OLIU (UPSR)	
1-way STS-n ---------->	DS1, DS3, OC-3/12/48 (0x1Sn)
1-way VT1.5-------->	DS1, OC-3/12/48 (0x1Sn)
1-way unswitched STS-n-------->	OC-3/12/48 (UPSR), OC-48 BLSR w/ NUT, 100/1000BASE-X/T
1-way unswitched VT1.5-------->	OC-3/12/48 UPSR
1-waypr STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), OC-48 BLSR, 100/1000BASE-X/T, FC-DATA

Table 6-15 Allowable UPSR add-drop cross-connections (continued)

From	To
1-waypr VT1.5 ---------->	DS1, EC-1, TransMUX, OC-3/12/48 (0x1Sn, 1+1 and UPSR), 100BASE-X/T (LNW74 only)
Non-VLF OC-12 High-Speed OLIU (UPSR)	
1-way STS-n ---------->	DS1, DS3, OC-3/12/48 (0x1Sn)
1-way VT1.5-------->	DS1, OC-3/12/48 (0x1Sn)
1-way unswitched STS-n-------->	OC-3/12/48 (UPSR), OC-48 BLSR w/ NUT, 100/1000BASE-X/T
1-way unswitched VT1.5-------->	OC-3/12/48 UPSR
1-waypr STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), OC-48 BLSR, 100/1000BASE-X/T, FC-DATA
1-waypr VT1.5 ---------->	DS1, EC-1, TransMUX, OC-3/12/48 (0x1Sn, 1+1 and UPSR), 100BASE-X/T (LNW74 only)

Notes:

1. Because VLF Mains are multi-port packs, cross-connections between different ports on the same Main are possible when they are used. All of the cross-connect types listed in the left column are supported between VLF ports.

Important! In systems equipped with non-VLF main, 1way cross-connects FROM UPSR to E1, TMUX or Ethernet/Data interfaces are not supported. In systems equipped with VLF mains 1way cross-connections from a UPSR are supported to all interfaces.

Allowable 1+1 add-drop cross-connections

The table below contains a list of linear/bidirectional (1+1) add-drop cross-connections supported by Alcatel-Lucent 1665 DMX. The cross-connections in the table below are all drop cross-connections.

Important! Alcatel-Lucent 1665 DMX uses atomic cross-connects, all cross-connections are one-way. For cross-connects not involving UPSR interfaces, the same 1-way cross-connects are supported in the opposite direction to provide two-way connectivity.

Table 6-16 Allowable 1+1 add-drop cross-connections

From	To
VLF Main (LNW59/LNW82/LNW504) OLIU (1+1)[1]	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), OC-48 (BLSR), 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), 100BASE-X/T (LNW74 only)
Non-VLF Main OC-192 OLIU (1+1)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), OC-48 BLSR, 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), 100BASE-X/T (LNW74 only)
Non-VLF OC-48 High-Speed OLIU (1+1)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), OC-48 BLSR, 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), and 100BASE-X/T
Non-VLF OC-12 High-Speed OLIU (1+1)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), OC-48 BLSR, 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), and 100BASE-X/T

Notes:

1. Because VLF Mains are multi-port packs, cross-connections between different ports on the same Main are possible when they are used. All of the cross-connect types listed in the left column are supported between VLF ports.

Allowable BLSR add-drop cross-connections

The table below contains a list of BLSR add-drop cross-connections supported by Alcatel-Lucent 1665 DMX. The cross-connections in the table below are all BLSR drop cross-connections.

Important! With atomic cross-connects, all cross-connections are one-way. For cross-connects not involving BLSR interfaces, the same 1-way cross-connects are supported in the opposite direction to provide two-way connectivity.

Table 6-17 Allowable BLSR add-drop cross-connections

From	To
VLF Main (LNW59/LNW82/LNW504) OLIU (BLSR)[1]	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), OC-48/192 (BLSR), 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), 100BASE-X/T (LNW74 only)
1-way unswitched STS-n-------->	OC-3/12/48/192 (UPSR), 100/1000BASE-X/T
1-way unswitched VT1.5-------->	OC-3/12/48/192 UPSR
Non-VLF OC-192 High-Speed OLIU (BLSR)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, UPSR, 0x1Sn), OC-48 (BLSR), 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48 (1+1, UPSR, 0x1Sn), 100BASE-X/T (LNW74 only)
1-way unswitched STS-n-------->	OC-3/12/48 (UPSR), 100/1000BASE-X/T
1-way unswitched VT1.5-------->	OC-3/12/48 UPSR
Non-VLF OC-48 High-Speed OLIU (BLSR)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), OC-48 BLSR, 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48 (1+1, 0x1Sn, UPSR), 100BASE-X/T (LNW74 only)
1-way unswitched STS-n-------->	OC-3/12/48 (UPSR), 100/1000BASE-X/T

Table 6-17 Allowable BLSR add-drop cross-connections (continued)

From	To
1-way unswitched VT1.5-------->	OC-3/12/48 UPSR

Notes:

1. Because VLF Mains are multi-port packs, cross-connections between different ports on the same Main are possible when they are used. All of the cross-connect types listed in the left column are supported between VLF ports.

Allowable UPSR and BLSR pass-through cross-connections (high-speed interface)

Alcatel-Lucent 1665 DMX supports direct pass-through cross-connections from a particular time slot on one side of a UPSR to/from the same time slot on the other side of the ring. BLSR pass-through cross-connections function in the same manner. Pass-through cross-connections are available at the same rates as add/drop cross-connections.

Allowable hairpin cross-connections

The table below contains a list of hairpin cross-connections supported by Alcatel-Lucent 1665 DMX. The cross-connections in the table below are all Hairpin cross-connections.

Table 6-18 Allowable hairpin cross-connections

From	To
OC-3/12/48/192 (1+1)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1, 0x1Sn), OC-48/192 BLSR, 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1, 0x1Sn), 100BASE-X/T (LNW74 only)
OC-3/12/48 (UPSR) (non-VLF Mains)	
1-way STS-n ---------->	DS1, DS3, EC-1, TransMUX, OC-3/12/48 (UPSR), 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, OC-3/12/48 (0x1Sn)
1-way unswitched STS-n-------->	OC-3/12/48 (UPSR), 100/1000BASE-X/T (no LNW74)
1-way unswitched VT1.5-------->	OC-3/12/48 UPSR

Table 6-18 Allowable hairpin cross-connections (continued)

From	To
1-waypr STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, UPSR, 0x1, 0x1Sn), OC-48 BLSR w/NUT, 100/1000BASE-X/T,FC-DATA
1-waypr VT1.5 ---------->	DS1, EC-1, TransMUX, OC-3/12/48 (1+1, UPSR, 0x1, 0x1Sn), 100BASE-X/T (LNW74 only)
OC-3/12/48/192 (UPSR) (VLF Mains)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), OC-48/OC-192 BLSR, 100/1000BASE-X/T,FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), 100BASE-X/T (LNW74 only)
1-way unswitched STS-n-------->	OC-3/12/48/192 (UPSR), OC-48/OC-192 BLSR w/ NUT, 100/1000BASE-X/T
1-way unswitched VT1.5-------->	OC-3/12/48/192 UPSR
1-waypr STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, 0x1, UPSR), OC-48/OC-192 BLSR, 100/1000BASE-X/T,FC-DATA
1-waypr VT1.5 ---------->	DS1, EC-1, TransMUX, OC-3/12/4/192 (0x1, 1+1 and UPSR), 100BASE-X/T (LNW74 only)
OC-3/12/48/192 (0x1) (requires LNW59/LNW82/LNW504 VLF Main)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (UPSR, 1+1, 0x1) and OC-48/OC-192 BLSR, 100/1000BASE-X/T,FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), 100BASE-X/T (LNW74 only)
OC-3/12/48 (0x1Sn) (non-VLF Mains only)	

Table 6-18 Allowable hairpin cross-connections (continued)

From	To
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (UPSR, 1+1, 0x1Sn) and OC-48 BLSR, 100/1000BASE-X/T, FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48 (1+1, UPSR, 0x1Sn), 100BASE-X/T (LNW74 only)
OC-3/12/48 Low-Speed OLIU (0x1) (requires LNW59/LNW82/LNW504 VLF Main)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (UPSR, 1+1, 0x1) and OC-48/OC-192 BLSR, 100/1000BASE-X/T,FC-DATA
1-way VT1.5-------->	DS1, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1), 100BASE-X/T (LNW74 only)
OC-48 Low-Speed OLIU (BLSR) (non-VLF Mains)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48 (1+1, UPSR, 0x1sn), OC-48 (BLSR), 100/1000BASE-X/T, FC-DATA
1-way unswitched STS-n-------->	OC-3/12/48 (UPSR), 100/1000BASE-X/T
OC-48/192 Low-Speed OLIU (BLSR) (VLF Mains)	
1-way STS-n ---------->	DS1, E1, DS3, EC-1, TransMUX, OC-3/12/48/192 (1+1, UPSR, 0x1, and 0x1Sn), OC-48/OC-192 (BLSR), 100/1000BASE-X/T, FC-DATA
1-way unswitched STS-n-------->	OC-3/12 (UPSR), 100/1000BASE-X/T
100-FEPL (Private Line)[1]	
1-way STS-n ---------->	1000BASE-X/T
TransMUX (LNW18 and LNW20)[1]	
1-way STS-n ---------->	DS1, TransMUX
1-way VT1.5 ------->	DS1, TransMUX
DS1/E1[1]	
1-way STS-n ---------->	DS1/E1, TransMUX
1-way VT1.5 ------->	DS1/E1, TransMUX
DS3[1]	

Table 6-18 Allowable hairpin cross-connections (continued)

From	To
1-way STS-n ---------->	DS3
EC-1[1]	
1-way STS-n ---------->	EC-1, DS1, TransMUX

Notes:

1. The rows in this section only list cross-connections that are not already listed in the previous rows.

Assignment of VT bandwidth on OC-n high-speed interfaces

Overview

When using the OC-n OLIU in M1 and M2, for VT add/drop cross-connections, VT hairpin cross-connections, and VT pass through cross-connection, restrictions apply.

Important! The restrictions do not apply to the LNW27, LNW29, LNW32, LNW76, LNW202, LNW221-255, LNW502 or the VLF circuit packs.

VT fabric capacity

The VT fabric on the main OC-12/48 OLIU circuit packs (M1 and M2) supports several types of VT cross-connections.

- VT add/drop from/to OC-N OLIUs in the Function Unit and Growth slots.
- VT add/drop from/to DS1 ports.
- VT hairpins.
- VT pass-throughs on the MAIN OC-12/48 OLIUs in M1 and M2.

The total provisionable bidirectional VT cross-connect capacity of 336 VT1.5s is shared among the four types of VT cross-connections.

Important! The "dual tatrib" modes (MONEF and SPLTEF) of VT test access are not possible when the system is equipped with small/medium VT fabric Main OLIUs. For more information see the "VT1.5 test access matrix" (p. 5-38).

Source and destination restrictions

The user can not provision a VT1.5 connection whose source STS is the same as the destination STS of another VT1.5 connection. Source and destination are not a function of the src_aid and dest_aid in the ENT-CRS-rr command. Rather source and destination are determined based on the relative STS number. The lower STS number is designated as the source and the higher STS number is designated as the destination based on the following ordering of the slots, main < fna < fnb < fnc < fnd < growth.

The one exception to this rule is for cross-connections to DS1 ports on the LNW7 packs. For these connections the OC-N port is always the source and the DS1 port is always the destination. The following example illustrates the restriction. The commands are not syntactically correct. They are intended only to show the aids.

Example

The ENT-CRS-VT1 command uses the following aid format for the src_aid and dest_aid parameters. {group}-{line}-{STS}-{VTG}-{VT1.5}.

Step 1:

Ent-crs-vt1:b-1-1-1-1,a-1-1-1-1 cross-connects a VT1.5 in FN Group A to a VT1.5 in Function Group B. According to the rule defined above, the lower STS channel (a-1-1) is designated the source and the higher STS channel (b-1-1) is designated the destination.

Step 2:

Ent-crs-vt1:b-1-1-1-2,c-1-1-1-2 cross-connects a VT1.5 in FN Group B to a VT1.5 in Function Group C.

In the above example, the cross-connection in step 2 (b-1-1-1-1 to c-1-1-1-2) would be denied because the source STS (b-1-1) is the same as the destination STS channel (b-1-1) in the cross-connect established in step 1 (b-1-1-1-1 to a-1-1-1-1).

Pass-through restrictions

If the Main slots are equipped with OC-12 OLIU (LNW48, LNW50, LNW54, LNW203) circuit packs provisioned to support VT1.5 signals in up to 12 STS-1 signals, VT pass-through cross-connections on the Main circuit packs can in some cases conflict with VT add/drop cross-connections and VT hairpin cross-connections. This restriction, however, cannot be characterized by a set of rules. Requests to establish a VT cross-connection that would result in a conflict between a VT pass-through cross-connection on the main and a VT add/drop or VT hairpin cross-connection are denied.

Synchronization

Overview

Purpose

This section describes synchronization features and functions for Alcatel-Lucent 1665 DMX.

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Network synchronization environment

Overview

Careful consideration should be given to proper design of the SONET network's synchronization environment. Proper synchronization engineering minimizes timing instabilities, maintains quality transmission network performance, and limits network degradation due to unwanted propagation of synchronization network faults. The synchronization features of the Alcatel-Lucent 1665 DMX are designed to complement the existing and future synchronization network and allow it not only to make use of network timing but also to take on an active role in facilitating network synchronization.

Published sources

A number of published sources give generic recommendations on setting up a synchronization network. Alcatel-Lucent 1665 DMX is designed to operate in a network that complies with recommendations stated in GR-253-CORE and the following documents:

- GR-436-CORE, *Digital Synchronization Network Plan*
- GR-378-CORE, *Generic Requirements for Timing Signal Generators (TSG)*
- *ANSI* T1.101, *Synchronization Interface Standards for Digital Networks*
- GR-1244-CORE, *Clocks for the Synchronized Network: Common Generic Criteria*.

Recommendations

The following are some key recommendations from the documents listed above. For further detailed explanation, the sources should be consulted directly.

1. A node can only receive the synchronization reference signal from another node that contains a clock of equivalent or superior quality (Stratum level).
2. The facilities with the greatest availability (absence of outages) should be selected for synchronization facilities.
3. Where possible, all primary and secondary synchronization facilities should be diverse, and synchronization facilities with the same cable should be minimized.
4. The total number of nodes in series from the Stratum 1 source should be minimized. For example, the primary synchronization network would ideally look like a star configuration with the Stratum 1 source at the center. The nodes connected to the star would branch out in decreasing Stratum level from the center.
5. No timing loops may be formed in any combination of primary and secondary facilities.

Stratum 3 timing generator

Alcatel-Lucent 1665 DMX supports a Stratum 3 Timing Generator (TG3) embedded in each high speed (MAIN) Main Switch pack (LNW80), OC-12, OC-48, and OC-192 optical interface circuit pack. The TG3 operates with an internal oscillator of ±4.6 ppm long-term accuracy in the free running mode, while in holdover the accuracy is ±.37 ppm over the full −40ºC to +65ºC temperature range. The TG3 should be used according to the recommendations in the documents referenced previously.

Synchronization features

Overview

Synchronization is an important part of all SONET products. Alcatel-Lucent 1665 DMX is designed for high performance and reliable synchronization and can be used in a number of synchronization environments. Each Alcatel-Lucent 1665 DMX can be provisioned to free run from an internal oscillator, line time from an incoming high-speed interface, or get external timing from the digital synchronization network via DS1/E1 references. Alcatel-Lucent 1665 DMX also supports distribution of timing references using DS1/E1 timing outputs.

Synchronization features

Alcatel-Lucent 1665 DMX supports three synchronization reference configurations:

- **External timing** from a Stratum 3 or better office clock (typical CO installations should be synchronized with DS1 or E1 timing references from a Stratum 3).
- **Line timing** from incoming high-speed OC-3/OC-12/OC-48/OC-192 signal (for small COs or remote sites).
- **Line timing from tributaries** derived from incoming low-speed OC-3/12/48 signal.
- **Free running** from the multiplexer's internal Stratum 3 Timing Generator (no synchronization inputs).

These timing modes are supported by the embedded Stratum 3 Timing Generator in the OC-12, OC-48 or OC-192 circuit pack. The four basic timing modes can be combined into various network configurations. Line timing from high-speed lines is not available when using the LNW80 in the MAIN slots; line timing from tributaries is available when using the LNW80.

Internal timing functions such as reference interfaces, the on-board clock elements, and timing distribution, are provided by the Stratum 3 Timing Generator. The timing generator distributes clock and frame signals, derived from the selected reference source, to the transmission packs.

External timing mode

In external timing mode, the timing generator accepts two DS1 or E1 references from an external Stratum 3 or better clock. This Stratum 3 (or better) clock would typically be traceable to a primary reference source (PRS). The DS1/E1 references from the clock synchronize the local Alcatel-Lucent 1665 DMX with other network equipment operating under the Alcatel-Lucent 1665 DMX primary clock source. A high-stability digital phase-locked loop (DPLL) removes transient impairments on the DS1/E1 references for improved jitter performance.

The PRS is equipment that provides a timing signal whose long-term accuracy is maintained at 10^{-11} or better with verification to universal coordinated time, and whose timing signal is used as the basis of reference for the control of other clocks in the network. Universal coordinated time is a time and frequency standard maintained by the US National Institute of Standards and Technology.

Beginning in Release 9.1, the initial default state of the DS1 external timing source is in-service (IS). If the external timing source is invalid or missing, the system declares two alarms, **`inc. DS1 sync. ref. LOS`** and **`holdover mode active`** . Prior to 9.1, the default state of the timing source was AUTO and the external timing source was not alarmed.

Line timing mode

In line timing mode, the TG3 derives local shelf timing from the incoming service OC-3, OC-12, OC-48, or OC-192 signal in the Main, Function Unit, or Growth slot. When provisioned for automatic protection switching and one of the OC-n references is corrupted or becomes unavailable, the TG3 makes a revertive or nonrevertive protection switch to the other reference without causing timing degradations. Synchronization reference mode switching can be either revertive or nonrevertive. You can also provision a primary reference. If all OC-n timing signals are lost, the TG3 switches to holdover mode. The TG3 normally switches back to line timing mode when a reference is no longer corrupted and clock mode switching is set to revertive. It can also be provisioned to require a manual switch. Switching between two OC-n reference inputs can also be done using a manual command. All optical circuit packs can derive a 6.48 MHz timing signal from an incoming optical line. DS1/E1 Sync Out is always derived from the provisioned line timing source.

Free running mode

In free running mode, no mode switching is performed. The timing generator derives timing from a high stability temperature-compensated, voltage-controlled crystal oscillator that has an end of life performance of ± 4.6 ppm. This oscillator is capable of Stratum 3 accuracy. Only one Alcatel-Lucent 1665 DMX in a subnetwork can be provisioned in the free running mode. All other Alcatel-Lucent 1665 DMX NEs in the subnetwork must be line timed to this free running system to avoid performance degradation.

DS1/E1 timing output

Alcatel-Lucent 1665 DMX also supports a DS1 or an E1 timing output feature that facilitates network timing distribution. E1 timing outputs are available with the LNW59, LNW82, or LNW504 VLF Main packs. The DS1/E1 timing output is derived from the OC-n line rate, so it is not subjected to multiplexing or pointer processing effects. The result is a DS1/E1 traceable to the far-end source with extremely low jitter and wander.

The timing output can be locked to an OC-n line or the OC-n source can be automatically selected using synchronization messages. In either case Threshold AIS may be enabled to insert AIS if the synchronization message of the OC-n source matches a provisioned threshold.

The frame format on the DS1 output is provisionable as superframe format (SF) or extended SF (ESF). The E1 frame format can be provisioned as FAS or CRC4. The DS1/E1 is a framed all-ones signal under normal conditions or an AIS signal under failure conditions.

SDH synchronization

With the use of the LNW59, LNW82, or LNW504 VLF Main pack, Alcatel-Lucent 1665 DMX supports E1 timing references. SDH synchronization conforms to industry standards for frequency accuracy, pull-in, hold-in and pull-out ranges, wander, jitter, noise tolerance, noise transfer, transient response, holdover performance (per ITU-T G.813), and for SDN Sync Status Messaging (per ITU-T G.704).

Dual reference monitoring (DRM)

With the use of VLF Mains, both external timing references are monitored simultaneously, even when the Timing Generator (TG) is in holdover mode. So, if an external reference fails, the Out of Lock (OOL) status of the standby reference is already known and the decision to switch to the standby reference can be made with certainty that the standby reference is not in an OOL condition. If the TG is in holdover mode, or if it has switched references with revertive reference switching enabled, it can monitor the OOL reference(s) for a non-OOL condition and switch to the good reference with certainty that the reference is in fact not in an OOL condition. It will also autonomously clear the OOL alarm.

With non-VLF MAINs both external timing references are monitored for LOS, LOF, AIS, BER & EOOF failures, but only the active reference can be monitored for frequency offset OOL failures, and only when the TG is locked to the reference. Frequency offset of either external reference cannot be monitored when the TG is in holdover or free-running modes.

When a failure of the active reference occurs, if reference switching is enabled, and if the standby reference doesn't have an LOS, LOF, AIS, BER & EOOF failure, the NE switches to the standby reference and locks to it, and then monitors its frequency offset for an OOL condition. If the standby reference does have an OOL failure, the TG goes into holdover mode and issues a major sync alarm for both references failed (subject to ASAP provisioning).

Holdover mode

When line or external timing is used, in case of unprotected synchronization reference failure, the TG3 will switch to "holdover mode" and continue to provide system timing using the internal oscillator to maintain the last known good reference frequency. If the DS1/E1 timing output is enabled for network synchronization, DS1 or E1 AIS is inserted on detection of unprotected optical reference failure.

Network configurations

Overview

The following pages detail the three different network configuration types: free running/line timing, external timing/line timing, and external timing.

Free running/line timing configuration

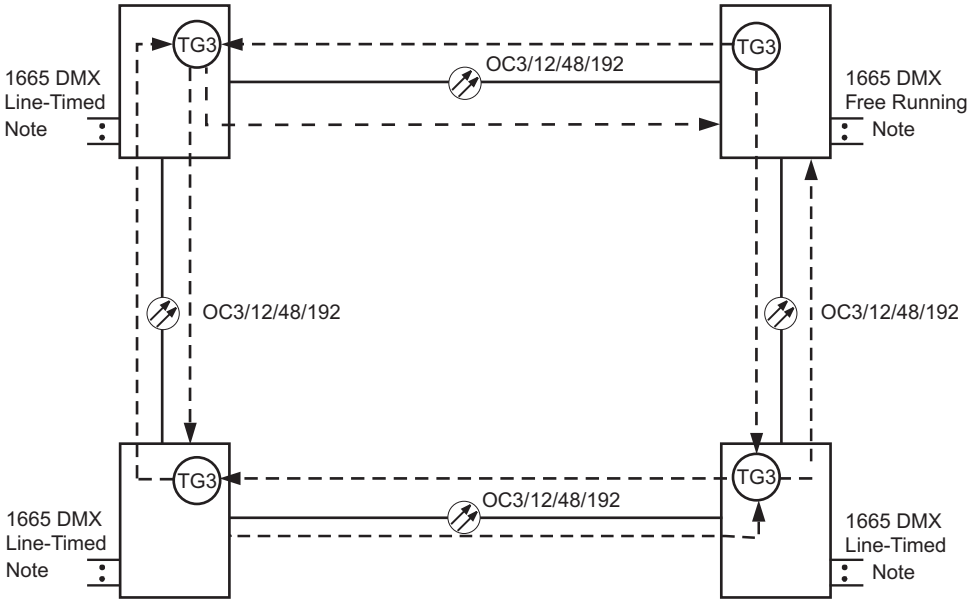
For initial SONET deployment with DS1 and/or DS3 low-speed interfaces, minimum first cost may be a primary concern. The free running/line timing network can operate without an external clock source, so the expense of connecting to one is eliminated. This configuration may be useful for initial access transport and customer location applications, and also meets the needs of an end-office trunk facility. This configuration should not be used to provide OC-n timing distribution or where SONET interconnections to other SONET networks are needed.

The local Alcatel-Lucent 1665 DMX times its transmitted signals at the low- and high-speed interfaces from the internal ± 4.6 ppm of the Stratum 3 timing generator. The remote Alcatel-Lucent 1665 DMX recovers timing from the incoming OC-n signal and uses this timing for its transmitted signals.

Certain interconnected equipment may be sensitive to such jitter and this configuration should not be used in cases where it would cause a problem for that equipment. In particular, downstream equipment containing Stratum 3 or better clocks could be sensitive to this jitter.

The figure below shows free running/line timed configuration in a ring network.

Figure 6-13 Free running/line timed configuration - ring network



Line timing from main interfaces vs. line timing from tributaries

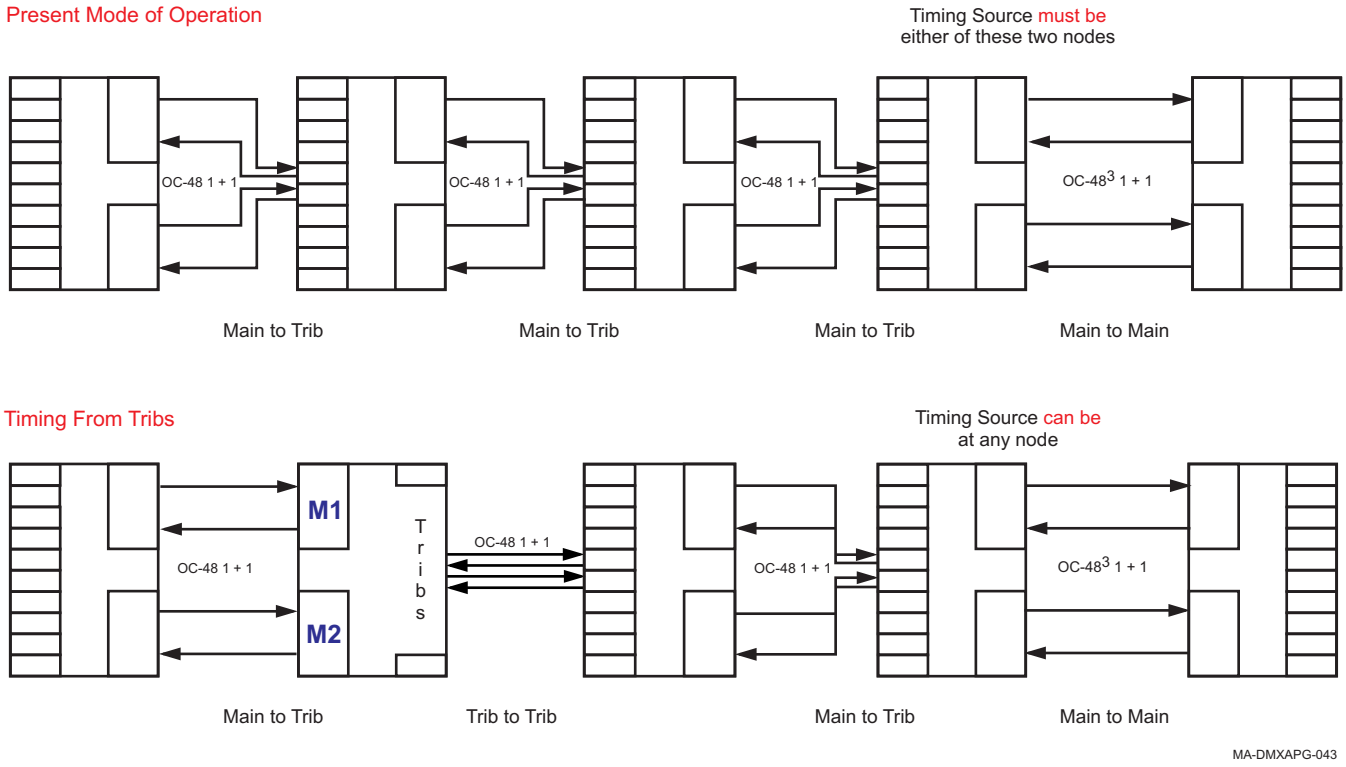
The figure below shows various Alcatel-Lucent 1665 DMX shelves in line timing mode. The top portion of the figure shows the present mode of operation where line timing references must be derived from optical lines entering the Main network interface circuit packs.

The bottom portion of the figure represents Alcatel-Lucent 1665 DMX's capability to derive timing references from optical lines entering both the Main and tributary interface circuit packs. Line timing from tributary interfaces is supported. Alcatel-Lucent 1665 DMX can utilize tributary line timing when equipped with VLF Mains (LNW59/LNW82/LNW504), Non-VLF Mains (all other Main interface optical packs), and headless Main (LNW80) packs.

As shown in the top right of the figure below, the only two shelves that can serve as line timing sources in the present mode of operation are the two furthest to the right. This is because they are connected Main to Main, while the other shelves are transmitting optical

signals from tributary interfaces to Main interfaces (or vice versa). The bottom portion of the figure shows how tributary line timing allows any Alcatel-Lucent 1665 DMX shelf in the topology pictured to serve as the line timing source.

Figure 6-14 Tributary line timing references



External timing/line timing configuration

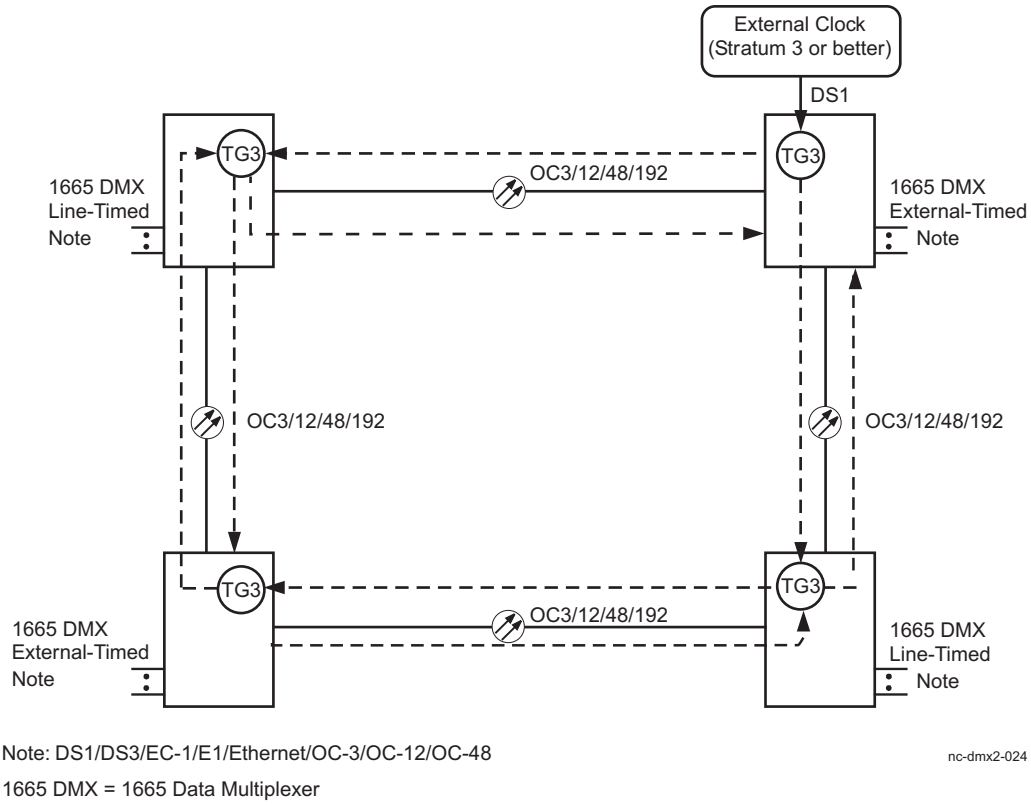
The external timing/line timing configuration integrates access transport and customer location networks into the digital synchronization network as required by the SONET standard. This application is ideal for networks where only one location has a building integrated timing supply (BITS) clock, for example, access transport. The network is synchronized to a local central office clock via DS1 references. The local office clock should be Stratum 3 or better, with timing traceable to a primary reference source. The local Alcatel-Lucent 1665 DMX times its transmitted signals at the low- and high- speed interfaces from the internal oscillator that is locked on the external reference. The remote Alcatel-Lucent 1665 DMX recovers timing from the incoming OC-n (OC-3/12/48/192) signal and uses this timing for its transmitted signals.

External timing is required when EC-1 low-speed interfaces are used to interconnect the local Alcatel-Lucent 1665 DMX with other SONET equipment. Thus, the external timing/line timing configuration should be the long-term goal for all access transport and customer location applications.

In a ring topology, synchronization messaging allows automatic synchronization reconfiguration in the event of a fiber or equipment failure.

The figure below shows external timing/line timing in a ring configuration.

Figure 6-15 External timing/line timing - ring network



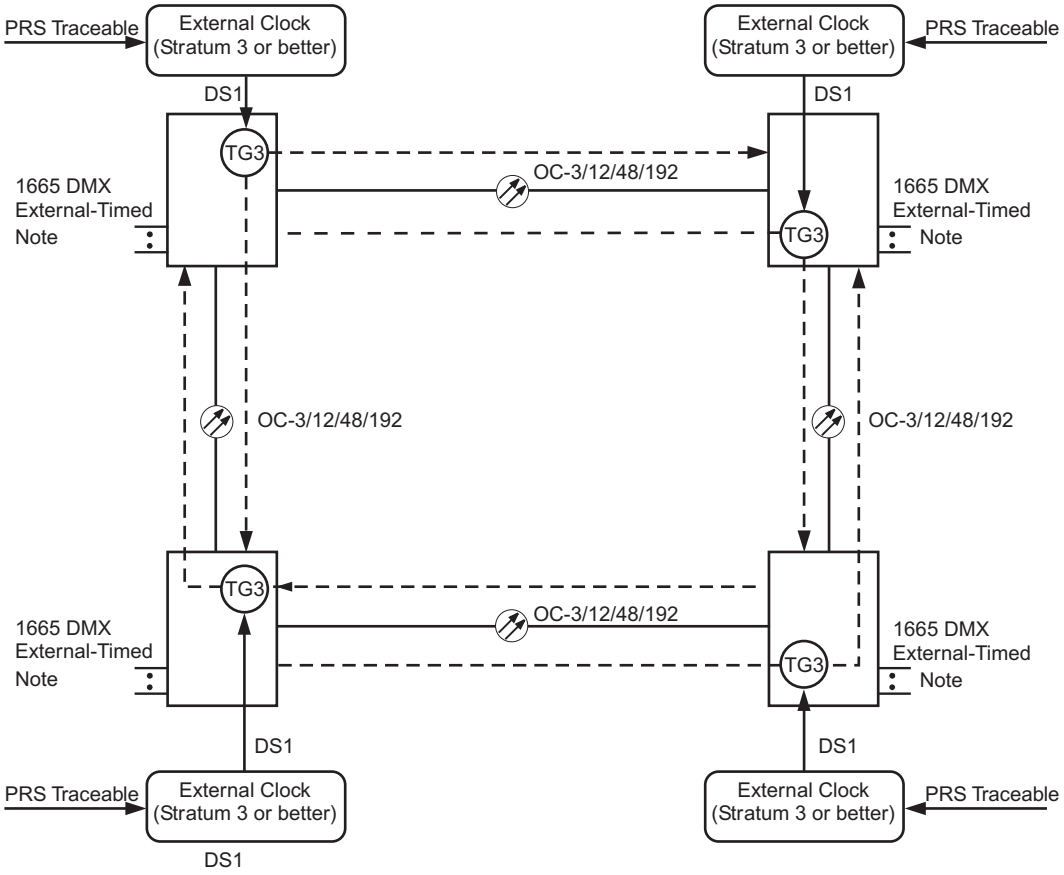
External timing configuration

The external timing configuration uses external DS1 or E1 timing to each Alcatel-Lucent 1665 DMX in the network. Since it requires local office clocks at each site, it is most suited to interoffice applications. An Alcatel-Lucent 1665 DMX network may have all DS1/E1 references traceable to a common primary reference source (for example, out-state trunking) referred to as synchronous, or to multiple primary reference sources (for example, a carrier-to-carrier interface). The multiple primary reference source is referred to as plesiochronous operation. The figure below shows an external timing configuration.

A tributary signal (for example, DS1) that traverses several plesiochronous regions may encounter increased STS-1 and VT pointer adjustments compared to that encountered in a synchronous environment. These pointer adjustments may increase jitter on the tributary when dropped from the SONET network. While standard jitter generation limits are perfectly acceptable for most service needs, some data services or other equipment may

be particularly sensitive to jitter-induced degradations. Therefore, it is generally desirable to minimize the number of plesiochronous regions within a network, through Stratum 1 clock traceability and line timing of remote SONET elements.

Figure 6-16 External timing configuration - ring network



Note: DS1/DS3/EC-1/E1/Ethernet/OC-3/OC-12/OC-48

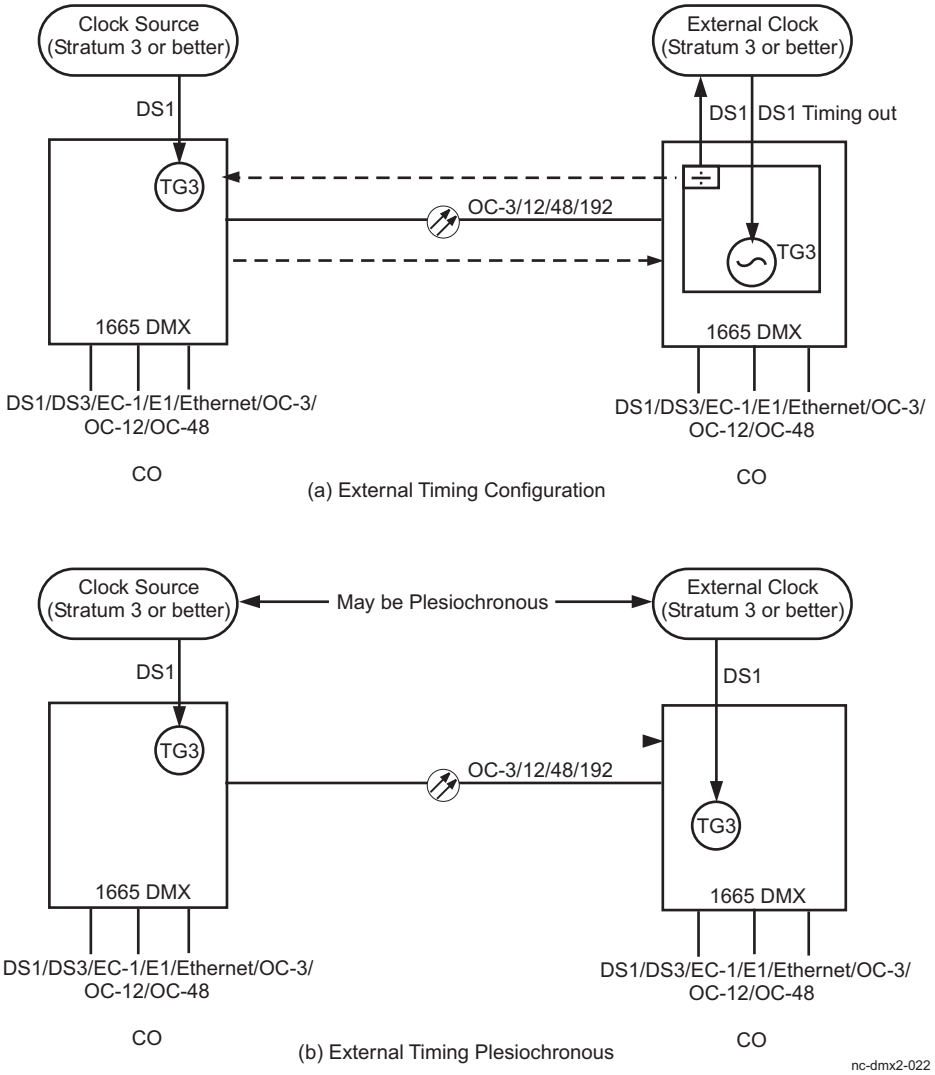
1665 DMX = 1665 Data Multiplexer

nc-dmx2-023

External timing with DS1/E1 timing output

External timing may be combined with the DS1/E1 timing output feature as shown in the figure below (E1 not pictured). The DS1/E1 timing output feature and plesiochronous operation are mutually exclusive. Each of the network topologies (linear, hubbing, ring) can use external timing.

Figure 6-17 DS1/E1 timing output and plesiochronous timing configurations



1665 DMX = 1665 Data Multiplexer

Timing distribution

Network timing distribution

DS1 signals have long been used to pass timing information through the network synchronization hierarchy. With an LNW59, LNW82, or LNW504 VLF Main, E1 timing outputs are also supported. These DS1/E1 timing references should be transmitted between master and slave clock sources over the most reliable facilities available. In some cases, these DS1/E1 signals also carry traffic. The facility of choice has evolved from T-carrier through asynchronous lightwave systems to SONET lightwave systems. As these systems are upgraded to SONET systems, timing distribution plans should be revisited to ensure the quality of the timing signals are not degraded. With proper planning, SONET can be used to improve the overall quality of the network timing.

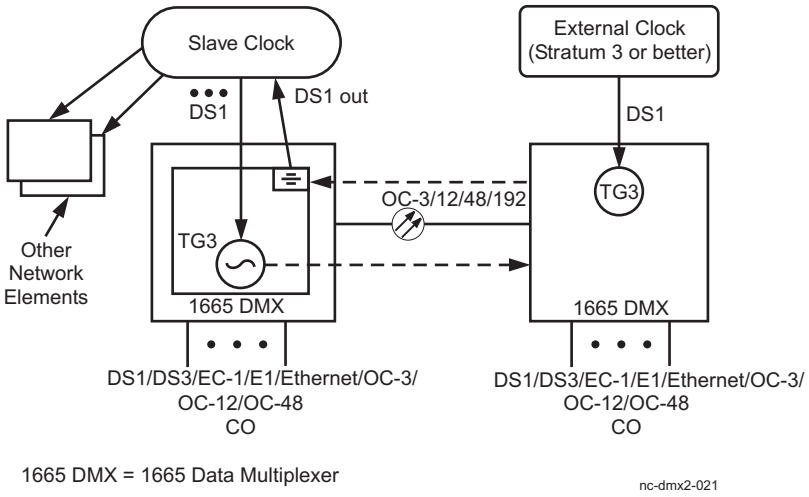
Interoffice timing distribution

One way SONET can be used to improve the quality of interoffice network timing is through the use of OC-n (OC-3/12/48/192) timing distribution. Alcatel-Lucent 1665 DMX supports the evolution to interoffice OC-n timing distribution by providing a DS1/E1 timing output derived from the incoming OC-n signal. The DS1/E1 timing output is traceable to the clock source that times the Alcatel-Lucent 1665 DMX subnetwork and has extremely low jitter and wander. This is true regardless of the number of Alcatel-Lucent 1665 DMX systems connected in the network. This DS1/E1 can be fed to the local BITS clock which subsequently times the local Alcatel-Lucent 1665 DMX and the other equipment in the office. If a BITS clock is not available in the office, the DS1/E1 timing output can be used to time other equipment (including another Alcatel-Lucent 1665 DMX) directly. Alcatel-Lucent 1665 DMX can provide DS1/E1 timing outputs in all supported topologies (for example, add/drop and ring) in the main slots. It also supports line timing from tributary optical interfaces, allowing Alcatel-Lucent 1665 DMX to provide DS1 timing outputs even when equipped with the LNW80 headless main. E1 timing outputs are available only when an LNW59, LNW82, or LNW504 Main is used.

With OC-n timing distribution, the OC-n line signal, rather than a DS1/E1 multiplexed into the SONET payload, will provide a timing transport mechanism better suited to a complex, heavily interconnected SONET network. In this configuration, a DS1 reference

from the CO BITS clock still times the OC-n transmitted to the remote site. At the remote site, a DS1/E1 output reference is created directly from the received OC-n signal, as shown in the figure below (E1 not pictured).

Figure 6-18 OC-n (OC-3/12/48/192) derived DS1 timing reference



Potential advantages

OC-n (OC-3/12/48/192) timing distribution has several potential advantages. It preserves transport bandwidth for customer services and guarantees a high-quality timing signal. Also, as the CO architecture evolves to replace DSX interconnects with SONET EC-1 interconnects and direct OC-n interfaces, OC-n distribution becomes more efficient than multiplexing DS1 references into an access facility in the CO.

A previous drawback to using OC-n timing distribution was that the network timing failures could not be communicated to downstream clocks via DS1 AIS, since the DS1 signal does not pass over the OC-n interface. A standard SONET synchronization messaging scheme to convey synchronization failures is now in place. Alcatel-Lucent 1665 DMX supports this synchronization messaging scheme. With this option, clock Stratum levels can be passed from NE to NE, allowing downstream clocks to switch timing references without creating timing loops, if a network synchronization failure occurs. If a quality timing reference is no longer available, Alcatel-Lucent 1665 DMX sends AIS over the DS1 interface. If the local OC-n lines fail, Alcatel-Lucent 1665 DMX outputs AIS on the DS1 output or an upstream Alcatel-Lucent 1665 DMX enters holdover.

Access network timing distribution

OC-n (OC-3/12/48/192) timing distribution can also be used in access networks or to small COs. In this configuration, a DS1 reference from the CO BITS clock still times the OC-n transmitted to the remote site. The line timing capability of Alcatel-Lucent 1665

DMX provides the ability to recover OC-n timing. The DS1 timing output feature can be used to also extend timing to customer networks or remote sites. In this case, the DS1 timing output may be used to time switch remotes, Alcatel-Lucent 1665 DMX shelves, or other local equipment directly. Ideally, the equipment can provide an external timing reference. Otherwise, the signal must be input to a traffic DS1 port on the external equipment which will tie up some of this equipment's bandwidth. In this configuration, it is important that the DS1 reference to the Alcatel-Lucent 1665 DMX in the CO be traceable to the same clock used to source the DS1s being carried to the customer site or small CO. If it is not, slips may occur.

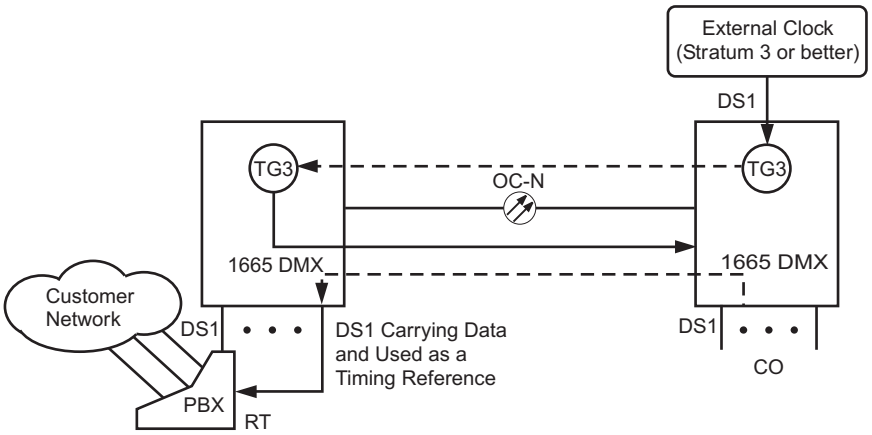
Alternate timing sources

Although an ideal source of timing, OC-n timing distribution, via a DS1 timing output, cannot be used to provide timing in all applications. In cases where the local equipment is not provided with an external timing reference input, or in some private networks where the timing is to be distributed from another private network location, timing may be distributed via traffic-carrying DS1s. In these applications, a stable DS1 timing source can be achieved by ensuring that all elements in the SONET network are directly traceable to a single master clock via line timing. In this environment, the high-performance desynchronizer design of Alcatel-Lucent 1665 DMX allows a DS1 timing reference to be carried as a multiplexed DS1 payload.

It is recommended that, where possible, the DS1 sources (switch, PBX, or other equipment) be traceable to the same timing source used to time Alcatel-Lucent 1665 DMX SONET network. Multiplexed DS1 reference transport is also consistent with current planning and administration methods. Applications include passing synchronization from the public switched network to a PBX-based private network (Figure 6-19, “Timing from multiplexed DS1” (p. 6-81)) and synchronizing an end-office remote switch to a larger office's host switch.

> **Important!** Synchronous operation via line timing eliminates the generation of VT pointer adjustments, thus maintaining the phase stability needed for a high-quality DS1 timing reference. Cross-connecting at the STS-1 level also eliminates the VT pointer adjustments. While the design of the Alcatel-Lucent 1665 DMX maintains jitter/wander within standard DS1 interface requirements, even in the presence of VT pointer adjustments, and while the DS1 is likely to be stable enough for most equipment to use as a timing reference, some equipment may have more stringent stability requirements for its timing references.

Figure 6-19 Timing from multiplexed DS1



Signal may not go directly from 1665 DMX to the PO but may pass through another piece of equipment such as a DDM-2000 OC-3 multiplexer

1665 DMX = 1665 Data Multiplexer

nc-dmx2-020

Synchronization messaging

Overview

Alcatel-Lucent 1665 DMX provides a synchronization messaging feature to ensure the integrity of network synchronization during both normal and abnormal conditions. Through the use of synchronization messaging, the current quality of the timing source can be conveyed from one Alcatel-Lucent 1665 DMX to the next. This capability allows the Alcatel-Lucent 1665 DMX to automatically change its timing reference in order to always maintain the highest quality timing available. The capability also allows Alcatel-Lucent 1665 DMX to inform a local BITS clock when the DS1/E1 timing output has been degraded and should no longer be used as a reference. This synchronization messaging feature is compliant with the scheme developed in the *ANSI* T1X1 standards committee.

Also, the same parameter used to choose between DS1 and E1 timing outputs is employed to choose between SONET sync messaging (*ANSI* T1X1 mentioned above) and SDH sync messaging.

Applications

The applications supported with the synchronization messaging feature can be divided into three categories:

- DS1/E1 timing output integrity
- Automatic synchronization reconfiguration
- Synchronization provisioning integrity.

DS1 timing output integrity

The derived DS1 timing outputs are typically used as a synchronization reference to a BITS clock which provides the timing reference to an externally-timed Alcatel-Lucent 1665 DMX. The synchronization reference is derived from the SONET transmission facility which is synchronized from an upstream timing reference. In this way, the timing from the BITS clock in one office (master) is distributed to the next office (slave) using the SONET transmission facilities between them as the synchronization vehicle.

The BITS are typically capable of synchronizing to a Stratum 3 or better accuracy. Alcatel-Lucent 1665 DMX equipped with the embedded Stratum 3 timing generator is capable of synchronizing to a ± 4.6 ppm clock or better. The Stratum timing hierarchy requires that clocks of equal or better Stratum level be used to synchronize other clocks. In this way, the Stratum timing hierarchy is preserved under all failure conditions. Under non-failure conditions, Alcatel-Lucent 1665 DMX does not introduce its own internal timing source onto the SONET facility, but merely transfers the quality of its timing reference. A failure of all derived DS1 timing references to the BITS at the master office will cause the BITS to enter holdover mode, whose minimum accuracy is dependent on its internal clock. If the BITS internal clock is of equal or better Stratum level than Alcatel-Lucent 1665 DMX, the externally-timed Alcatel-Lucent 1665 DMX will use this reference to synchronize all outgoing SONET transmission facilities. This preserves the required hierarchical structure of the timing network and should be maintained at all times.

If the externally-timed Alcatel-Lucent 1665 DMX at the master office enters holdover due to a disconnected reference cable or a local BITS failure, the quality of the derived DS1 timing output at the slave office will now be traceable directly to the Alcatel-Lucent 1665 DMX. The Stratum timing hierarchy is violated if the slave office BITS requires timing accuracy better than the Stratum level provided by the master Alcatel-Lucent 1665 DMX's internal clock. Because the Alcatel-Lucent 1665 DMX contains the embedded Stratum 3 Timing Generator, Stratum 3 accuracy is maintained indefinitely. This provides acceptable timing for Stratum 3 NEs at slave offices.

Stratum timing rules are also violated when at least one line-timed Alcatel-Lucent 1665 DMX exists at a site between the master and slave offices. In this scenario, a fiber cut between the master office and the line-timed site will cause the line-timed Alcatel-Lucent

1665 DMX to enter holdover (with accuracy dependent upon its internal clock). If the BITS at the slave office requires a higher accuracy clock than that generated by the Alcatel-Lucent 1665 DMX in holdover, the Stratum timing hierarchy is violated.

Automatic synchronization reconfiguration

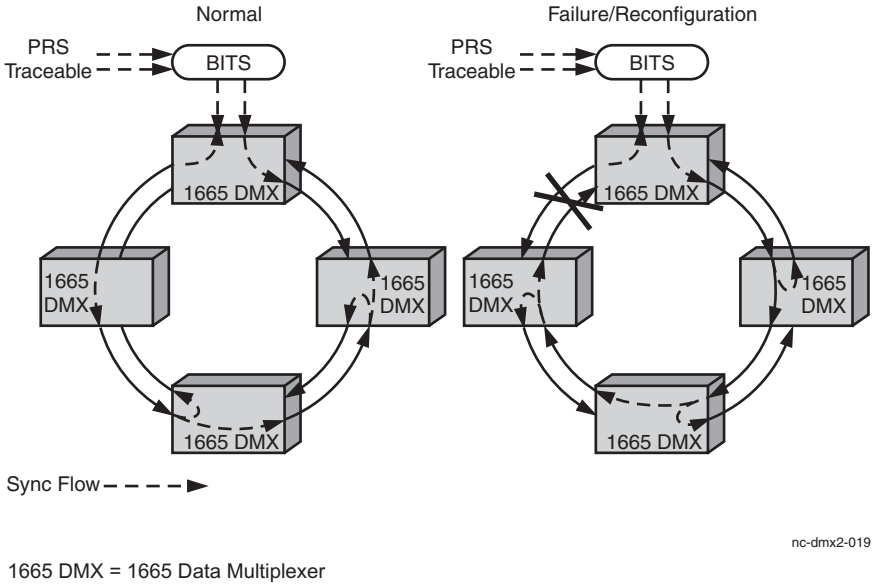
SONET was designed to operate optimally in a synchronous environment. Although plesiochronous and asynchronous operation can be supported through the use of pointer adjustments, transmission quality is affected by the generation of additional jitter and wander due to pointer adjustments. Because of this, it is desirable to maintain synchronous operation whenever possible. Through the use of synchronization messages, the quality of the different timing references can be made available at each Alcatel-Lucent 1665 DMX NE. Alcatel-Lucent 1665 DMX can be optioned to determine the best timing reference available and switch to that reference. Through this mechanism, the synchronous operation of the subnetwork can be maintained. The switching of timing references is hitless, and the synchronization messages also allow it to be done without creating timing loops in the process.

Access ring network

Under normal operation, the access ring network, shown below, has one Alcatel-Lucent 1665 DMX shelf externally timed and the others line timed. If a fiber failure occurs between the first two Alcatel-Lucent 1665 DMX shelves, the synchronization auto-reconfiguration feature causes Alcatel-Lucent 1665 DMX shelves to change their line timing directions to the opposite direction. The result is that the ring is again

operating synchronously. The ring already provides self-healing of the traffic, so it is especially important to maintain synchronous operation during this type of failure to prevent service degradation due to increased jitter and wander.

Figure 6-20 Synchronization reconfiguration - access ring



1665 DMX = 1665 Data Multiplexer

Synchronization provisioning integrity

Synchronization messaging also helps prevent provisioning errors. Provisioned timing loops on Alcatel-Lucent 1665 DMX are quickly detected through the synchronization messaging algorithm and prevented by forcing a shelf into holdover. The system can then be reprovisioned correctly.

Sync messaging feature details and options

Overview

As mentioned previously, SONET sync messaging is used to communicate the quality of the subnetwork timing throughout the subnetwork. This is done using the S1 byte in the SONET or SDH overhead and is supported in the DS1 or E1 external timing reference inputs and outputs. If an Alcatel-Lucent 1665 DMX shelf is deriving timing from a given OC-n interface, and sync messaging is enabled on that interface, the system interprets the received message to determine the system's timing status. The system also determines the state of the DS1 output, if the DS1 output is enabled, by forcing a DS1 AIS on the DS1

sync outputs if the timing status received on the OC-n interface is below a provisioned quality threshold. Alcatel-Lucent 1665 DMX also supports E1 timing output when equipped with a VLF Main circuit pack.

Alcatel-Lucent 1665 DMX also transmits over the particular OC-n interface, and all other OC-n interfaces that are enabled for sync messaging, the appropriate message indicating the quality of its timing and its usability.

Important! When the Alcatel-Lucent 1665 DMX is provisioned for *SONETSYNC*, both input ext timing reference and ext refrence output are DS1. When the Alcatel-Lucent 1665 DMX is provisioned for *SDHSYNC*, both input ext timing reference and ext reference output are E1.

Sync messages using S1 byte

The following table lists the associated internal timing status and DS1/E1 output states that are associated with sync messages (using the S1 byte) received from the OC-n interface when sync messaging is enabled. The same parameter used to choose between DS1 and E1 timing outputs is employed to choose between SONET sync messaging and SDH sync messaging. Messages are listed from low to high quality.

Table 6-19 Sync Messages with the S1 Byte

SONET				SDH			
Received Message	**Active Timing Mode[1]**	**DS1 Output State[2]**	**Quality Level**	**Received Message**	**Active Timing Mode[1]**	**E1 Output State[2]**	**Quality Level**
Don't Use (DUS)	Holdover	AIS	9	Don't Use (DUS)	Holdover	AIS	5
Traceable Stratum 4 (ST4)[4]	Holdover	AIS	8	NA	NA	NA	NA
Traceable SONET Clock w/S3-TG (SMC)	Holdover	AIS	7	DSH Equipment Clock	Holdover	AIS	4
Traceable Stratum 3 (ST3)[3]	OK to use	AIS	6	Synchro-nization Supply Unit - Type B	OK to use	AIS	3
Traceable Stratum 3E (ST3E)	OK to use	AIS	5	NA	NA	NA	NA

Table 6-19 Sync Messages with the S1 Byte (continued)

SONET				SDH			
Received Message	**Active Timing Mode[1]**	**DS1 Output State[2]**	**Quality Level**	**Received Message**	**Active Timing Mode[1]**	**E1 Output State[2]**	**Quality Level**
Traceable Transit Node Clock (TNC)	Ok to use	AIS	4	Synchro-nization Supply Unit - Type A	OK to use	AIS	2
Traceable Stratum 2	OK to use	Good	3	NA	NA	NA	NA
Sync Trace Unknown (STU)	OK to use	Good	2	NA	NA	NA	NA
PRS Traceable[3]	OK to use	Good	1	Primary Reference Clock	OK to use	Good	1

Notes:

1. This column applies only when provisioned for line timing mode.
2. This table represents DS1/E1 output AIS threshold equal to level 4.
3. The embedded TG3 is Stratum 3.
4. *Telcordia* ® has not assigned a value to the S1 byte for ST4.

Disabling sync messaging

Sync messaging using the SONET S1 byte can be disabled on a per OC-n interface basis. A `Don't Use for Service (DUS)` message is transmitted on bits 5–8 of the S1 byte if this is done.

"Don't use" (DUS)

The `DUS` message is sent to indicate that its timing is not suitable for synchronization (for example, back towards the line timing source).

External timing with SYNC OUT

When Alcatel-Lucent 1665 DMX is configured for external timing and its DS1/E1 output port is provisioned for the SYNC OUT mode, the DUS is sent on the OC-n interface towards the NE from which the DS1/E1 timing output is being derived. The Synchronized

- Traceability Unknown (STU) message is sent on all other OC-n interfaces where sync messaging is provisioned. If the DS1/E1 output is generating AIS while the system is configured in this way, the message STU is transmitted on all OC-n interfaces.

TG3 with free running or holdover

When using the embedded TG3, if Alcatel-Lucent 1665 DMX is configured for free running or is in holdover mode, the Traceable Stratum 3 message is sent on all OC-n interfaces for which sync messaging is enabled.

Line timing

When Alcatel-Lucent 1665 DMX is configured for line timing, the DUS message is sent on the OC-n interface towards the NE from which the timing is being derived. The message received on the OC-n interface is sent on all other OC-n interfaces where sync messaging is enabled.

Automatic synchronization reconfiguration

With automatic synchronization reconfiguration, the Alcatel-Lucent 1665 DMX shelves receive and compare the incoming sync messages on the OC-n interfaces available for line timing to select the highest quality synchronization reference available. If the received quality levels are the same on the references available for timing, the active line timing reference takes precedence. This feature guarantees the non-revertive operation of reconfiguration. Although a revertive option is supported.

The existence of automatic synchronization reconfiguration does not affect OC-n line protection switching.

Hitless timing and equipment switching

Hitless timing equipment switching enables switching from an active timing generator (TG) on one Main circuit pack to the TG on the other Main circuit pack without incurring transmission hits on any of the Main, Function Unit, or Growth circuit packs. This feature is only available on the VLF Main packs (LNW59/LNW82/LNW504). Low-speed, tributary OLIUs that allow hitless timing switching include the following: LNW45, LNW49, LNW55. DS1 & DS3 signals/cards are asynchronous, and are not affected by a timing switch. Ethernet packs are also unaffected.

Sync messaging examples

Overview

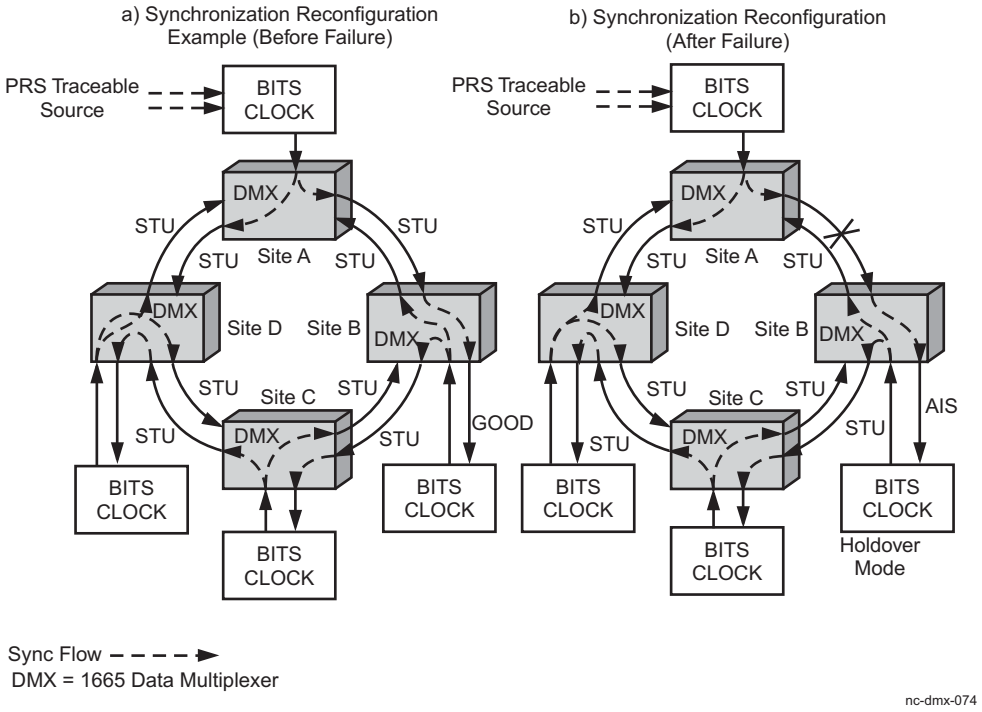
In this section, some detailed examples are given to show specifically how the sync messages propagate through network and assist in the recovery from a fiber failure. Through these examples, one can extend the same concept to any other network that may include different topologies, number of sites, failure locations, and number of BITS clocks. Some examples are depicted in a linear configuration because the particular sync messaging concept is more easily conveyed in linear terms. Those concepts can be applied to Alcatel-Lucent 1665 DMX ring networks.

Derived DS1 with no synchronization auto-reconfiguration using externally timed ring

Part "a" of the figure below illustrates an externally timed access ring operating in its normal configuration. The Alcatel-Lucent 1665 DMX shelf at Site A is externally timed from a BITS clock referenced to a Primary Reference Source (PRS). The remaining Alcatel-Lucent 1665 DMX shelves (Sites B, C, and D) are externally timed from a BITS referenced to a derived DS1 timing reference output. The STU message is sent to indicate where timing is traceable to an external BITS and where it is valid to be used. Automatic synchronization reconfiguration is not an option for externally timed Alcatel-Lucent 1665 DMX shelves. Therefore, a change in the sync message will not cause an automatic synchronization reconfiguration. In part "b", a fiber has been cut between Sites A and B. Immediately, Alcatel-Lucent 1665 DMX at site B changes the format of its derived DS1

to AIS. All other non-host nodes will track the holdover clock at Site B. Although no timing loops have been formed, the timing of all non-host nodes will differ from the host node by the accuracy of the holdover clock at Site B.

Figure 6-21 External timing with derived DS1 output, part A and B

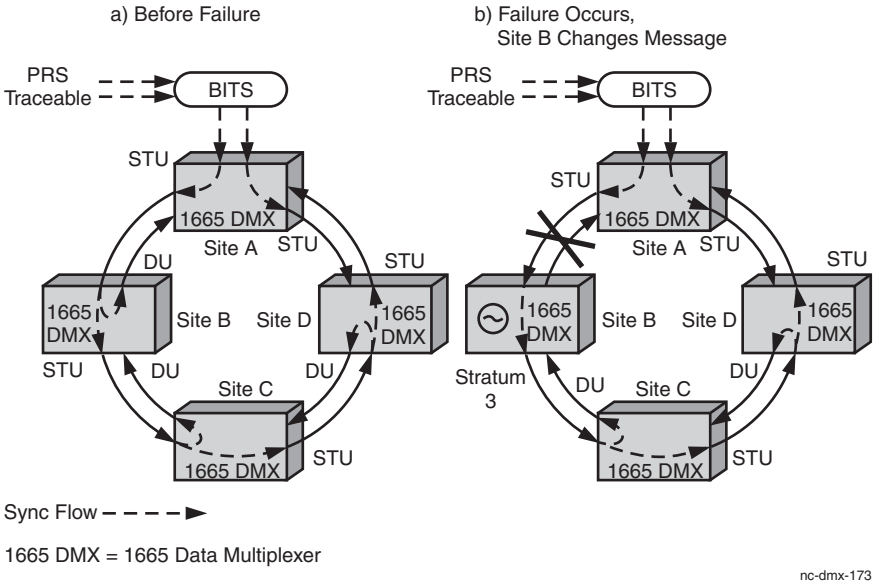


Synchronization auto-reconfiguration in an access ring

Part "a" of the figure below illustrates an access ring operating in its normal configuration. The Alcatel-Lucent 1665 DMX shelf at the CO is externally timed, and each of the other Alcatel-Lucent 1665 DMX shelves are line timed in a counterclockwise direction. The STU message is sent to indicate where timing is traceable to an external BITS and where it is valid to be used. The DUS message is sent on the interface that is being used as the line timing reference and, thus, where using that timing would create a timing loop. Sync messaging and automatic synchronization have both been enabled for this network.

In part "b", a fiber has been cut between sites A and B. Immediately, the Alcatel-Lucent 1665 DMX shelf at site B enters holdover and sends out the Stratum 3 message to site C. The Alcatel-Lucent 1665 DMX shelf at site B cannot switch to line time from site C because it is receiving the DUS message on that interface.

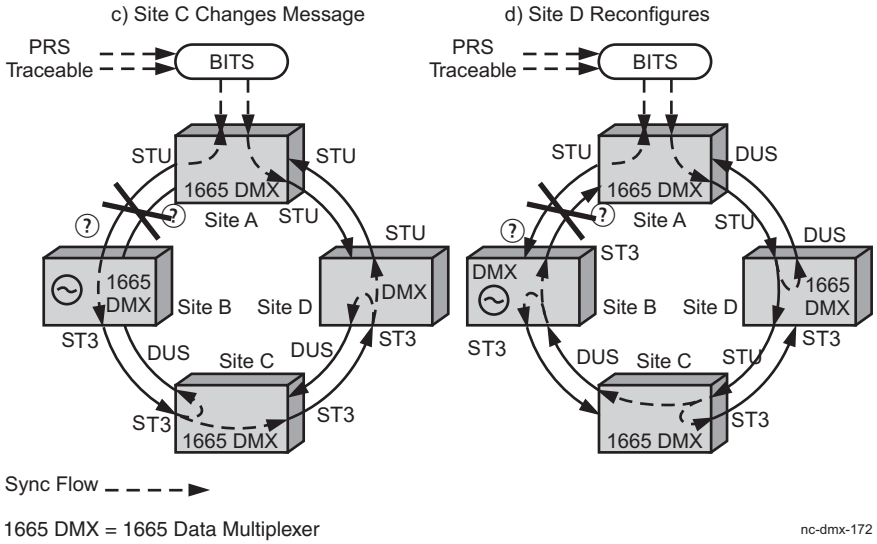
Figure 6-22 Automatic synchronization reconfiguration, part A and B



In part c of the figure below, the Alcatel-Lucent 1665 DMX shelf at site C detects the incoming Traceable Stratum 3 message and sends the message to site D. The Alcatel-Lucent 1665 DMX shelf at site C cannot switch to line timing from the other rotation because it is receiving the DUS message on that interface.

In part D of the figure below, the Alcatel-Lucent 1665 DMX shelf at site D detects the incoming Traceable Stratum 3 message. The STU message is a better quality message than the Traceable Stratum 3 message, so the Alcatel-Lucent 1665 DMX shelf at site D switches to line timing from site A. After the switch occurs, the DUS message is sent back to site A, and the STU message is retransmitted to site C.

Figure 6-23 Automatic synchronization reconfiguration, part C and D

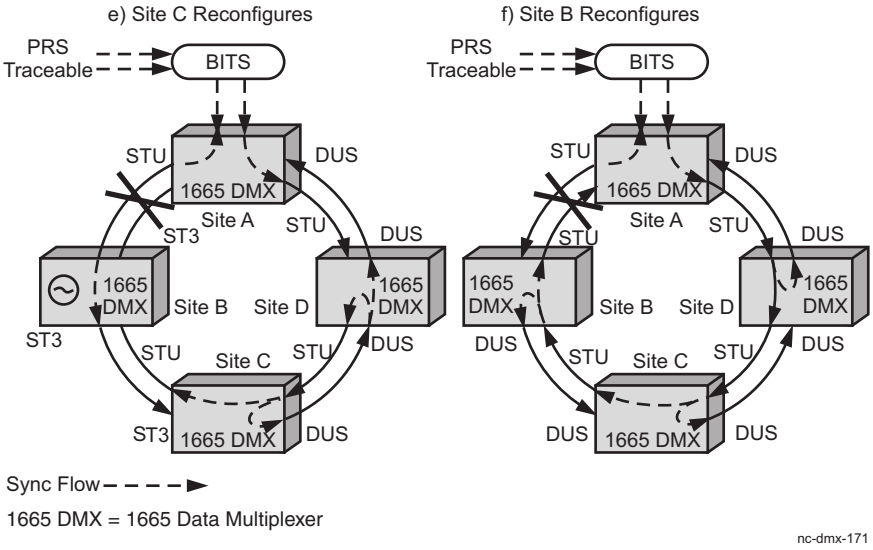


In part e of the figure below, the Alcatel-Lucent 1665 DMX shelf at site C detects the incoming STU message from site D. The STU message is a better quality message than the Traceable Stratum 3 message being received from site B, so the Alcatel-Lucent 1665 DMX shelf at site C switches to line time from site D. After the switch occurs, the DUS message is sent back to site D, and the STU message is retransmitted to site B.

In part f of the figure below, the Alcatel-Lucent 1665 DMX shelf at site B detects the incoming STU message from site C. The STU message is a better quality message than the internal holdover capability, so the Alcatel-Lucent 1665 DMX shelf at site B switches

to line time from site C. After the switch occurs, the DUS message is sent back to site C, and the STU message is forwarded to site A. When the failure clears, the synchronization remains in the new configuration unless it is manually switched back.

Figure 6-24 Automatic synchronization reconfiguration, part E and F



Frequently asked network timing distribution questions

Overview

The following are some frequently asked questions about network timing distribution.

1. *How do I time Alcatel-Lucent 1665 DMX shelves in a central office environment?*

   Each Alcatel-Lucent 1665 DMX should be externally referenced to the BITS clock in the office. If a BITS clock is not available in the office, a traffic-carrying DS1 from the local switch may be bridged (for example, using a bridging repeater) as the reference to the Alcatel-Lucent 1665 DMX. Line timing the Alcatel-Lucent 1665 DMX may also be used, but at least one Alcatel-Lucent 1665 DMX in the network must be externally timed.

2. *Where do I use the DS1 timing output feature?*

   The primary application is for supplying one source for the BITS clock timing input reference. This allows the BITS clock to be slaved to a BITS clock in another office that is, in turn, traceable to the primary reference source (PRS). Typically, the Alcatel-Lucent 1665 DMX supplying the DS1 timing output will, in turn, be externally timed by the BITS clock. The BITS clock should only derive one of its timing reference inputs from a particular network. Its other reference should be derived from another network to assure that it does not enter holdover mode.

If there is no BITS clock, the DS1 timing output can be used to time a switch or switch remote (if the switch remote is equipped for that option) directly- or even another Alcatel-Lucent 1665 DMX.

3. *How do I prevent my BITS clock from using a DS1 timing output when a failure in the network results in this DS1 being timed from a SONET NE in holdover?*

   SONET sync messaging informs the local Alcatel-Lucent 1665 DMX of this condition, and AIS is inserted on the DS1 timing output.

4. *What is the advantage of using the DS1 timing output instead of a multiplexed DS1 as the timing reference?*

   The DS1 timing output is derived from the optical line rate and is superior because:

   - The DS1 is virtually jitter-free
   - Sync messages guarantee the traceability of the timing
   - Administration of traffic DS1s for timing is eliminated.

5. *Can I ever use the Alcatel-Lucent 1665 DMX in the free running timing mode?*

   If a PRS traceable external reference is available, it is the recommended timing mode for any/all CO applications. The free running timing mode can be used but a slight increase in jitter will result. If one Alcatel-Lucent 1665 DMX is provisioned for free running, all other Alcatel-Lucent 1665 DMX NEs in the network must be line timed and SONET interfaces to other equipment are not allowed. The DS1 timing output should not be enabled with a free running network.

6. *How do I provide timing to a central office host switch that does not have the option for an external reference?*

   A DS1 carried over SONET may contain significant jitter/wander and be unacceptable to the switch as a timing reference. If the central office has a BITS clock, the recommendation is to use the output from the BITS clock into an unused DS1 traffic port on the switch. If the central office does not have a BITS clock, the recommendation is to use the DS1 timing output from the Alcatel-Lucent 1665 DMX as the line timing reference into an unused DS1 traffic port on the switch.

7. *Can a DS1 carried over SONET ever be used as a timing reference?*

   YES! In many applications there is no other choice. Most switch remotes, for instance, obtain their timing from a specific DS1 signal generated by their host switch, so these remotes must time from the DS1 signal. In addition, DLC equipment, channel banks, and PBXs will not likely have external references and may be allowed to line time from a DS1 carried over SONET.

8. *Are there any specific concerns when using a DS1 carried over SONET to time equipment such as a switch remote or DLC?*

Yes. The major concern is to make sure all the equipment is synchronous. The Alcatel-Lucent 1665 DMX NEs should be synchronous to each other to prevent pointer adjustments. This can be accomplished by having one source Alcatel-Lucent 1665 DMX that is externally timed. The other Alcatel-Lucent 1665 DMX NEs in the network should be line timed, or they should be externally timed to a clock to which they provide a DS1 timing output. The Alcatel-Lucent 1665 DMX NEs should also be synchronous to the switch to prevent excessive mapping jitter. This can be done by synchronizing the host switch to the BITS clock used to reference the Alcatel-Lucent 1665 DMX.

9. *Will I have any problems providing timing to a customer that has a high quality PBX or switch?*

   If the network is completely synchronous, as described in the previous answer, there should be no problems. If the PBX is sensitive to the jitter produced, even under the synchronous conditions, the DS1 timing output of Alcatel-Lucent 1665 DMX may be required to be used as a timing reference to this equipment.

10. *Why does Telcordia® say that DS1s carried over SONET should not be used for timing?*

    Telcordia ® has provided this recommendation because there are several limitations. *Telcordia* ® says that DS1s carried over SONET must be used in applications such as switch remotes and will be acceptable, provided pointer adjustments are not created.

11. *Can pointer adjustments be prevented?*

    Neither random nor periodic pointer adjustments will occur if the Alcatel-Lucent 1665 DMX shelf is provisioned for line timing.

12. *How do I time Alcatel-Lucent 1665 DMX at a remote site?*

    Line time.

13. *How many Alcatel-Lucent 1665 DMX NEs can I chain together in an add/drop configuration before the timing becomes degraded?*

    The Stratum level traceability of the nth node in an add/drop chain is the same as that in the first node. Also, while timing jitter will theoretically increase as the number of nodes is increased, the high quality timing recovery and filtering on the Alcatel-Lucent 1665 DMX allows add/drop chains to be extended to any practical network limit without detectable increases in jitter levels. In practice, the only effects on timing at the nth node will occur whenever high-speed protection switches occur in any of the previous n-1 nodes. These effects should be rare.

14. *How do I time a Alcatel-Lucent 1665 DMX ring network?*

    An interoffice ring should have each node externally timed if BITS clocks are available. All other rings should have one node externally timed (two in some dual homing architectures) and the rest of the nodes line timed. Synchronization reconfiguration is automatic.

15. *Why are there more issues related to timing with SONET equipment than there are with asynchronous equipment?*

    SONET equipment was designed to work ideally in a synchronous network. When the network is not synchronous, mechanisms such as pointer processing and bit-stuffing must be used and jitter/wander increases.

16. *Can DS3 signals be used to carry DS1 timing signals without the worry of having the network synchronous?*

    Yes, although this option is more expensive.

17. *What are the limitations on automatic synchronization reconfiguration?*

    Automatic synchronization reconfiguration is only available when the Alcatel-Lucent 1665 DMX is provisioned for line timing mode. This allows the timing direction of an OC-n (OC-3/12/48/192) ring network to change automatically in response to a failure. When the Alcatel-Lucent 1665 DMX is provisioned for external timing, automatic synchronization reconfiguration is not available. When an OC-n fault is detected in the timing direction, AIS is inserted on the derived DS1s which forces the BITS to switch to another good timing source or into holdover preventing timing loops.

18. *How do I synchronize a BITS clock and maintain automatic synchronization reconfiguration on a Alcatel-Lucent 1665 DMX ring?*

    Provision all but the host node (node with co-located PRS) for line timing. Provide each non-host BITS clock with a pair of derived DS1s. The Alcatel-Lucent 1665 DMX will detect faults and provide the BITS clocks with good inputs if available. Timing loops will be prevented. The host node should be set for external timing and get its timing from an externally timed BITS clock. To prevent a timing loop, the host BITS clock should get its timing from a PRS traceable source. The non-host nodes should not be timed from the co-located BITS clock since this would disable the automatic synchronization reconfiguration feature.

IS-IS Level 2 routing guidelines

Overview

Purpose

This section details the guidelines for IS-IS Level 2 Routing in networks larger than 250 OSI nodes.

The following topics are included in this section:

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Level 2 router assignment	6-100
IS-IS Level 2 routing remote provisioning sequence	6-100
IS-IS Level 2 routing provisioning confirmation	6-102
Maximum number of OSI nodes	6-103
Engineering rules and guidelines	6-103

Introduction

Purpose

If network sizes of more than 250 OSI nodes are required, hierarchical routing makes it possible to increase the number of nodes in an OSI management domain, (for example, NEs with OSI LAN and/or DCC connectivity for operations communications among the NEs). Increasing the number OS nodes is achieved through the use of IS-IS Level 2 Routing.

IS-IS Level 2 Routing involves assigning NEs to multiple areas of 250 nodes or less. Level 2 routers support OSI communications between the NEs in different areas. Both the assignment of NEs to areas and the enabling of NEs as Level 2 routers is accomplished by provisioning. For additional information, see “Area address assignment” (p. 6-99) and “Level 2 router assignment” (p. 6-100), respectively.

OSI node vs. NE terminology

Each Alcatel-Lucent 1665 DMX is an OSI node, but some other NEs support multiple OSI nodes within a single NE, so the term "OSI node", or simply "node", is generally used in this context instead of "NE".

Advantages

The primary advantage of IS-IS Level 2 Routing is to limit the OSI routing information that needs to be maintained by each node. Each node within an area maintains routing tables to route OSI LAN and DCC messages to the other nodes in the same area. If a node needs to route a message to a node in a different area, the node relies on a Level 2 router in its own area to route the message to a Level 2 router in the target area and from that Level 2 router to the target node within that area.

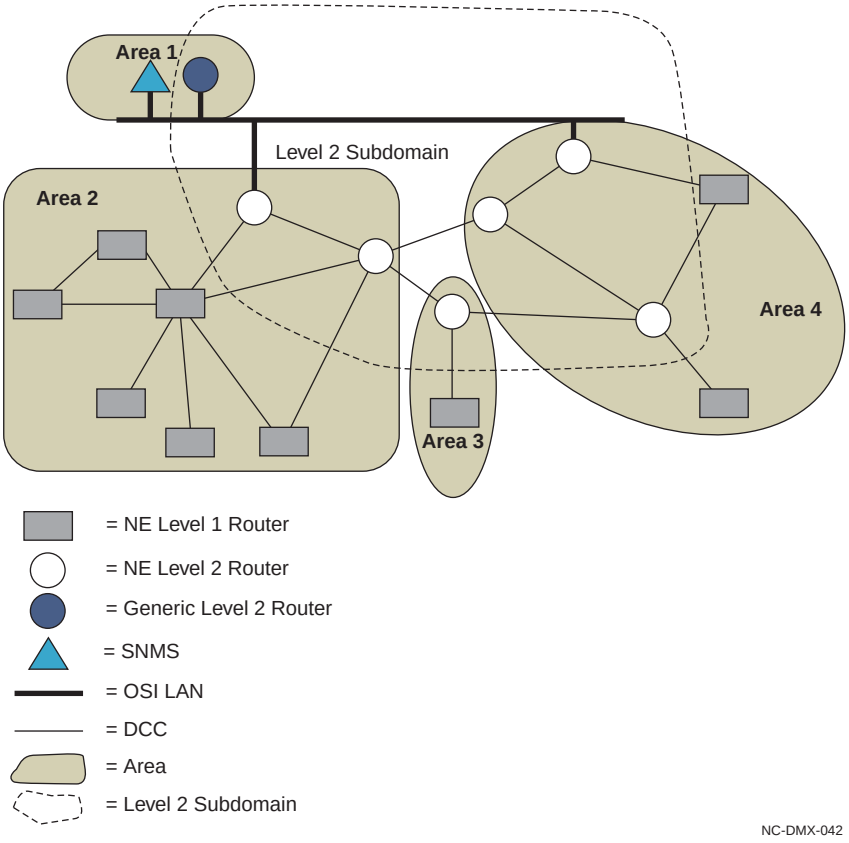
The Level 2 routers route messages between nodes in different areas. These messages include all of the NE-NE (and OS-NE) OSI communications required for the supported OI applications, (for example, TL1 login messages from TL1–GNEs to TL1-RNEs.)

In addition to maintaining a routing table to route messages to other nodes in the same area, Level 2 routers need to maintain routing information for the Level 2 routers in all other areas (but not for all nodes within each of those other areas).

Symbols

The graphical examples is this section use the symbols that are defined in the following figure. Figure 6-25, “Network with Level 2 routers” (p. 6-98) illustrates an example network with nodes assigned to four different areas connected by Level 2 routers.

Figure 6-25 Network with Level 2 routers



Area address assignment

Area address

The area address is the first 26 characters of each Alcatel-Lucent 1665 DMX Network Services Access Point (NSAP). [Alcatel-Lucent 1665 DMX supports a fixed-length 40-character (20-byte) NSAP only.] The first eight characters of the NSAPs are always the same and cannot be changed. The remaining 18 characters of the NSAP area address are provisionable but only the Area field should be changed to assign a node to a different area. The remainder of the NSAP includes the System Identifier field, which is unique to each node, and the Selector (SEL) field.

The following table provides a break-down of an NSAP.

Table 6-20 Area addresses

NSAP Field:	AFI	IDI	IDI PAD	DFI	Org.ID	RES	RD	Area	System ID	SEL
Bytes:	1	2		1	3	2	2	2	6	1
Default Value: (hex)	39	840	F	80	000000	0000	0000	0000	none	00
	not provisionable				user provisionable				not provisionable	

A group of nodes are assigned to an area by changing each node's NSAP Area field to the same value. The entire NSAP area address must be identical for all nodes in an area and different from the NSAP area addresses for all other areas.

If more than one separate area with the same area address exists, routing to these areas from other areas would not be predictable and couldn't be expected to function properly.

Area field

The Area field consists of four hexadecimal characters, with a default value of 0000 (hex). TL1 command **`ENT-ULSDCC-L3`** can be used to change the Area field.

Area terminology

Despite the technical differences between the area address and the Area field described previously, the term area address is commonly used to refer to the Area field value. Thus, for convenience, the term area address is used throughout this document.

Multiple area addresses

Multiple area addressing is the capability for a node to be assigned more than one area address. The provisioning of multiple area addresses is not supported on Alcatel-Lucent 1665 DMX, directly.

Level 2 router assignment

Overview

OSI communications is supported within a network which may consist of a single area or multiple areas. Level 1 routers provide interconnectivity between nodes in an area (all Alcatel-Lucent 1665 DMX are Level 1 routers). Level 2 routers provide connectivity between areas.

Guidelines and default

In a network with multiple areas, each area must contain at least one Level 2 router. An area without a Level 2 router would be isolated from the rest of the network. The adjacent set of Level 2 routers form the Level 2 sub-domain. For proper OSI routing, every Level 2 router should have at least one neighbor (via OSI LAN or DCC) that is also a Level 2 router. At least one of the Level 2 routers in an area must be adjacent to a Level 2 router in another area, otherwise, the former area would be isolated from the rest of the network.

Each Alcatel-Lucent 1665 DMX is not a Level 2 router by default. TL1 command **`ENT-ULSDCC-L3`** can be used to enable any Alcatel-Lucent 1665 DMXas a Level 2 router.

IS-IS Level 2 routing remote provisioning sequence

Avoid isolating nodes

An important goal is to avoid isolating any nodes when provisioning area addresses and Level 2 routers remotely. Isolating a node may require craft dispatch to the isolated node to recover. To avoid isolating nodes, the sequence for remote provisioning is established with respect to the local node to which the *WaveStar*® CIT is connected or the TL1–GNE through which OMS is connected. Typically, the local node or TL1–GNE is provisioned to be a Level 2 router first, but its area address is not changed initially. This general sequence can be modified in networks with redundant OSI LAN or DCC connectivity between and within areas.

1. The nodes and sub-tending rings that are furthest away from this local node or TL1–GNE are provisioned first.
2. Work back toward the local node or TL1–GNE's sub-tending ring.

3. Provision the local node or TL1–GNE's sub-tending ring.
4. Provision the local node or TL1–GNE last.

If OMS is part of the network via an OSI LAN or WAN interface, provision the area address for the OMS.

Important! Before assigning area addresses and Level 2 routers in a network, be sure no alarms (especially `DCC failure` alarms) exist; otherwise, even the recommended remote provisioning sequence might result in isolated nodes. To confirm the network alarm status, it is recommended that a centralized maintenance center with TL1 OS support be consulted.

Provisioning sub-tending rings

Always provision new area addresses for a sub-tending ring by starting with a node that is adjacent to the node that connects this sub-tending ring to the rest of the network, and then provision the area address for each sequential adjacent node going around the sub-tending ring. Provision the area address of the connecting node last, especially if the connecting node supports multiple sub-tending rings.

For single-homed sub-tending rings, provision the node that will be the Level 2 router node last; otherwise, nodes in its area could be isolated. For dual-homed rings, provision one of the nodes that will be Level 2 router first, so that OSI connectivity is established with provisioned nodes as soon as they complete their controller resets.

Both DRI and dual-homed rings are designed to protect against a failure of an interconnecting facility or a failure of the node at which the interconnection occurs. The choice of DRI or dual-homing is driven by the network topology. To provide protection when connecting between two UPSRs, use DRI. To provide protection when connecting between a UPSR and a single NE, use dual homing.

Minimizing OSI communications disruption

Another important goal is to provision the network in such a way that OSI communications disruption is minimized. Changing a node's area address and/or enabling a node as a Level 2 router causes the node to reset its controller. The reset is immediate and is part of the completion of the command. In addition to temporarily disrupting OSI communications, controller resets temporarily disable automatic transmission protection switching.

As one node is undergoing a controller reset in an area, the next adjacent node should be provisioned to minimize the overall time required to provision the nodes in an area and minimize the time that OSI communications with the nodes in the area are lost.

Changing a node's area address and enabling a node as a Level 2 router, if appropriate, should usually both be done with a single command per node.

IS-IS Level 2 routing provisioning confirmation

Overview

TL1 **RTRV-MAP-NETWORK** commands can be used to confirm the area address and Level 2 router assignments of all nodes with OS LAN or DCC connectivity in a network.

Small networks

In a small network without IS-IS Level 2 Routing, the **RTRV-MAP-NETWORK** response includes the NSAPs (including the embedded area address field) of the local node and all remote nodes. This command may also be useful to confirm the uniqueness of the area addresses before combining two existing networks into one large network requiring IS-IS Level 2 Routing.

Large networks

In large networks with IS-IS Level 2 Routing, the **RTRV-MAP-NETWORK** response can vary based on whether or not the local node is a Level 2 router itself.

1. If the local node is not a Level 2 router, the response includes only remote nodes in the same OSI area as the local node and indicates which remote node is the default Level 2 router for the local node.

   The default Level 2 router is the node that the local node would rely on to route an OSI message outside the local NE's own area. When there are multiple Level 2 routers in the same area, not all nodes in the area would identify the same default Level 2 router typically.
2. If the local node is a Level 2 router, user input dictates whether the response includes:
   a. only remote nodes in the same OSI area as the local node (as in #1 above) but indicating which of those remote nodes are Level 2 routers
   b. all remote nodes that are Level 2 routers across all OSI areas.

Thus, with a **RTRV-MAP-NETWORK** command to one Level 2 router in each area, all nodes in a large network with IS-IS Level 2 Routing can be identified. One **RTRV-MAP-NETWORK** command at a time per area should suffice and is recommended to avoid unnecessarily burdening the network with many simultaneous or redundant TARP queries.

Problem isolation

TL1 command **RTRV-MAP-NEIGHBOR** may indicate and help resolve IS-IS Level 2 Routing provisioning mistakes. This command highlights any neighbors with which DCC is enabled but OSI communications is not fully functional. When addressed to a reachable node with an unreachable neighbor, this command identifies the NSAP area address and

the Level 2 router status, if known, of the unreachable neighbor. The unreachable neighbor may simply have the wrong area address or both nodes may need to be enabled as Level 2 routers.

There is no standing alarm or status condition at a node with Level 2 router functionality enabled or disabled. There is no automatic means of determining whether the area address is consistent with the rest of the network. The user must confirm that all IS-IS Level 2 Routing rules have been followed to ensure successful OSI communications among the nodes in a network.

Maximum number of OSI nodes

Maximum number of nodes per area and OSI domain

The total number of nodes per OSI area cannot exceed 250. The total number of nodes in the OSI domain cannot exceed 1000.

Engineering rules and guidelines

Overview

To use IS-IS Level 2 Routing, the user must plan and engineer the provisioning of Level 2 routers and area addresses in the network.

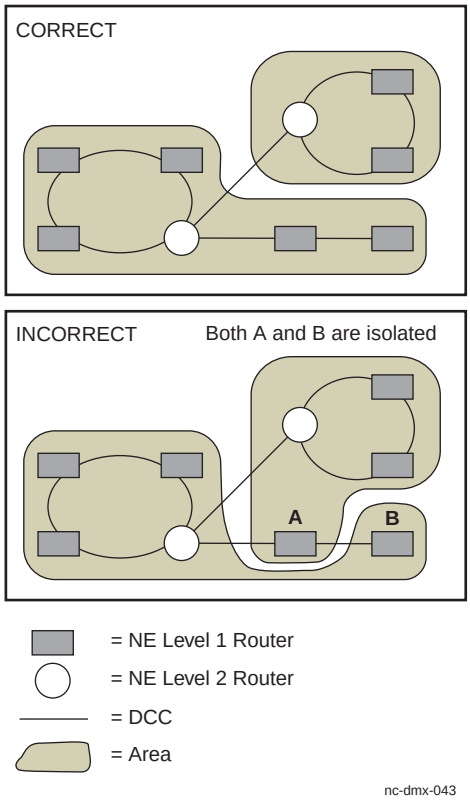
The goal is to create a network with all nodes having OSI LAN or DCC connectivity with each other so that access to all the nodes can be gained from any node in the network.

Rules must be followed to assure OSI LAN and DCC message routing. Guidelines are recommendations that add survivability in the event of a node, OSI LAN or DCC failure. Rules *must* be followed. Guidelines *should* be followed. There may be customer applications that cannot adhere to some or all of the guidelines. In most cases, the potential consequence is that a single failure would at least partially disrupt operations communications.

Rule: OSI LAN or DCC connectivity within an area

All nodes in an area must have OSI LAN or DCC connectivity within the area to all other nodes in the same area. Otherwise, the area would be segmented and message routing could not be expected to function properly. Figure 6-26, “Assigning areas” (p. 6-104) illustrates a correct and an incorrect example of assigning nodes to areas.

Figure 6-26 Assigning areas

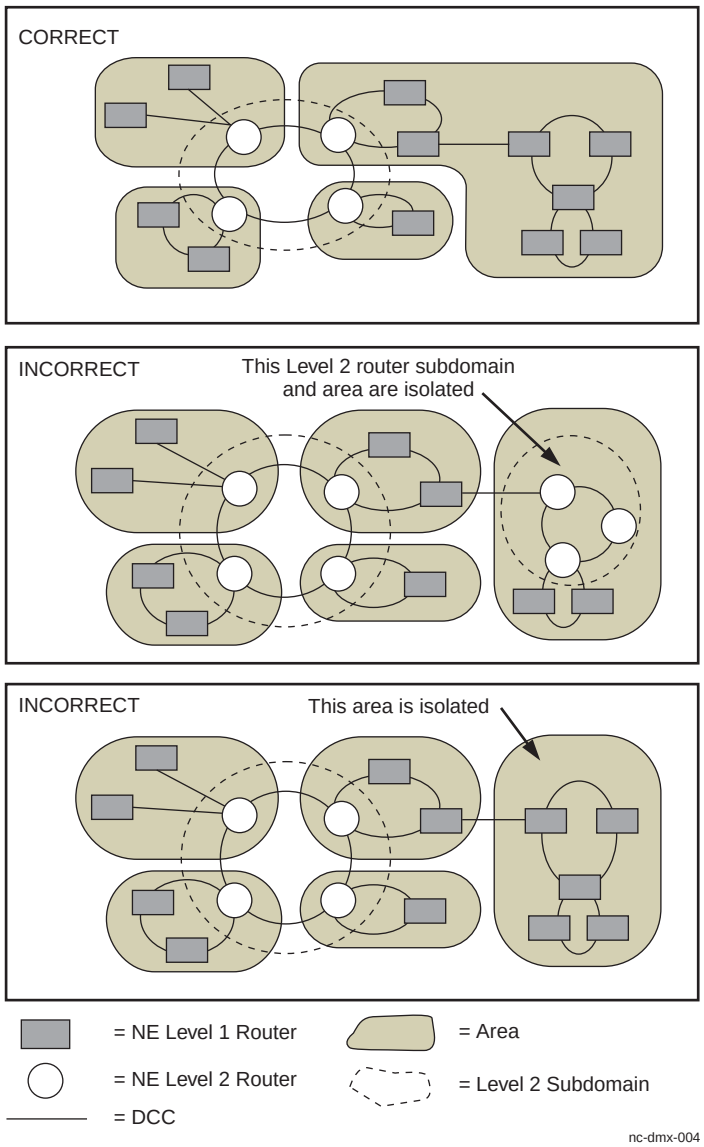


Rule: single Level 2 router sub-domain

All Level 2 routers must have OSI LAN or DCC connectivity, either directly or indirectly via other Level 2 routers, to all other Level 2 routers in the network to form a single Level 2 router sub-domain that provides connectivity to all areas. If more than one Level 2 router sub-domain exists, the network becomes segmented and routing will not function properly.

Figure 6-27, "Assigning sub-domains" (p. 6-105) illustrates a correct and two incorrect examples of assigning a Level 2 router sub-domains.

Figure 6-27 Assigning sub-domains

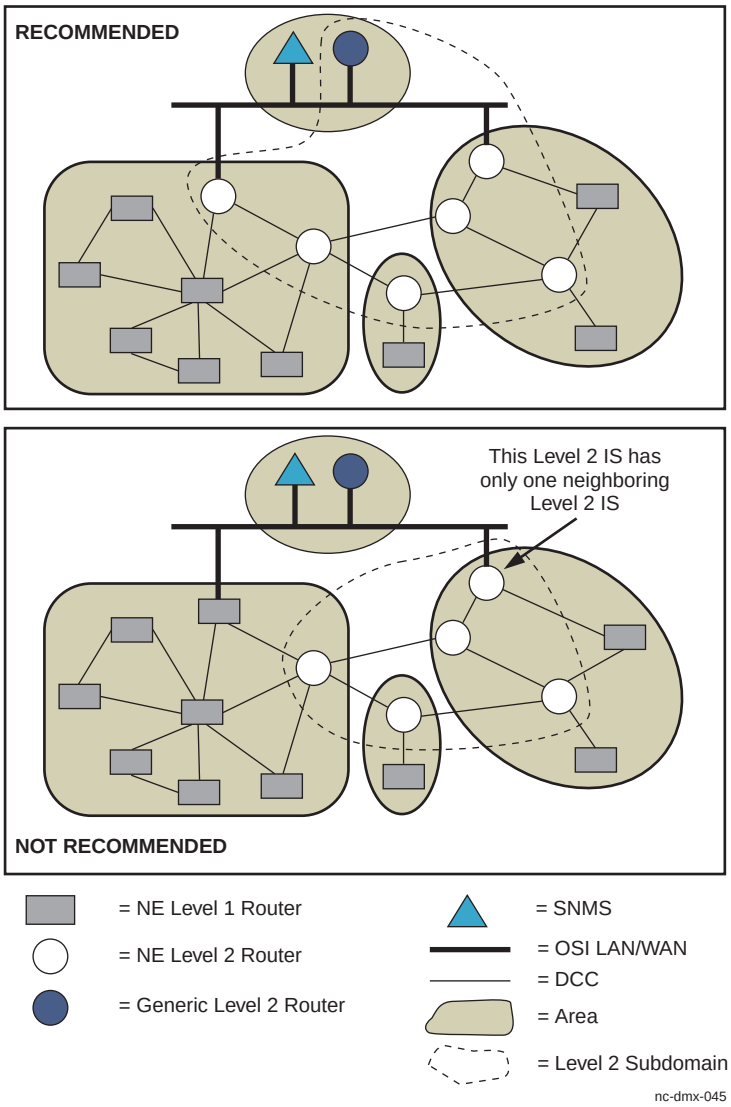


Guideline: redundant routes within the Level 2 sub-domain

When practical, redundant routes in the Level 2 sub-domain should be available between all Level 2 routers to ensure that proper routing will occur in the event of a single failure. To satisfy this guideline, every Level 2 router has at least two other Level 2 routers as direct neighbors.

Figure 6-28, “Redundant routes with the Level 2 sub-domain” (p. 6-106) illustrates a recommended example and an example that is not recommended for redundant routes within the Level 2 sub-domain:

Figure 6-28 Redundant routes with the Level 2 sub-domain



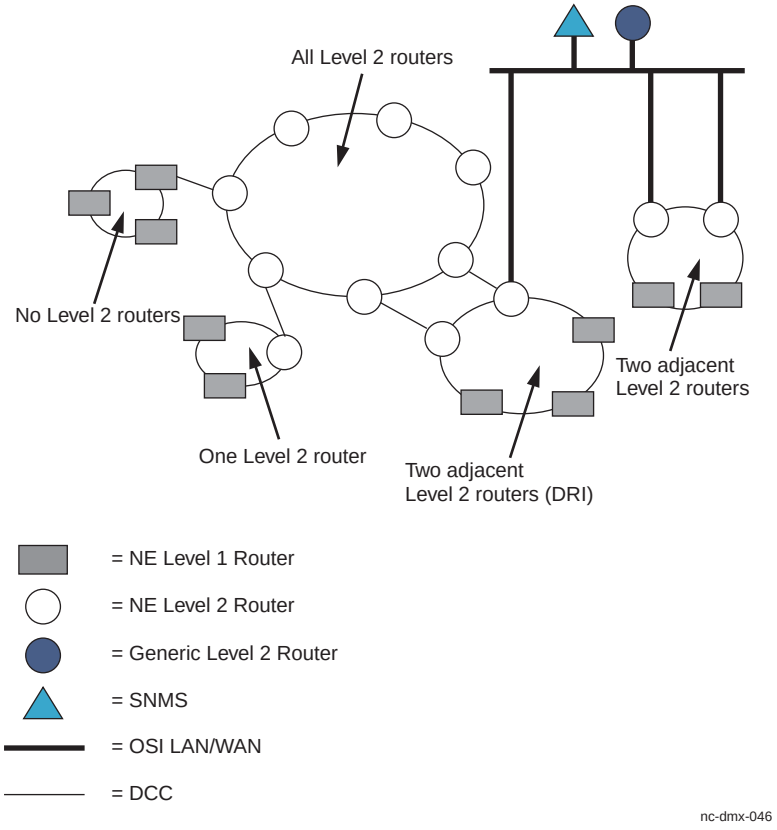
Guideline: Level 2 router assignment in a ring

The recommended number of Level 2 routers in a ring may be one of the following:

- None
- One
- All nodes in the ring
- Two; for example, when dual-homing or dual ring interworking (DRI) is used.

Figure 6-29, "Recommended Level 2 router assignments" (p. 6-107) illustrates examples of recommended Level 2 router assignments in various ring configurations.

Figure 6-29 Recommended Level 2 router assignments



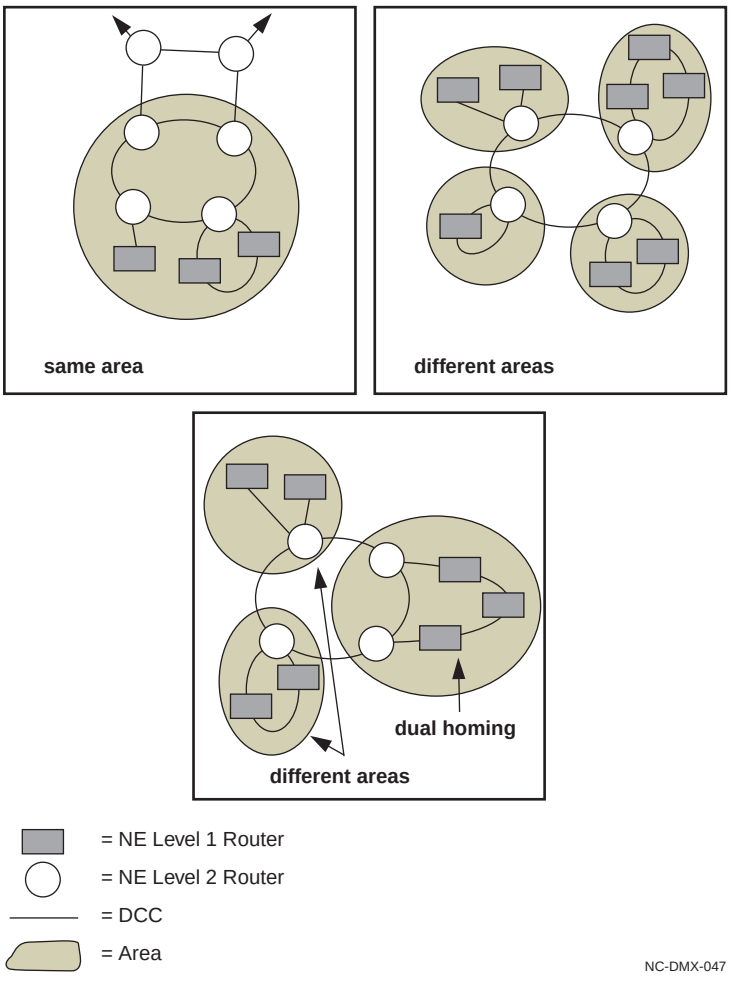
Guideline: Level 2 router area assignments in a ring

For a ring of Level 2 routers, the recommended area assignments may be one of the following:

- All Level 2 routers are part of the same area.
- Each Level 2 router is part of a different area.
- A pair of adjacent Level 2 routers are in the same area (for example, with dual-homing or DRI), with either the other Level 2 routers similarly paired off or individually in different areas.

Figure 6-30, “Recommended area assignments” (p. 6-108) illustrates examples of recommended Level 2 router area assignments in a ring.

Figure 6-30 Recommended area assignments

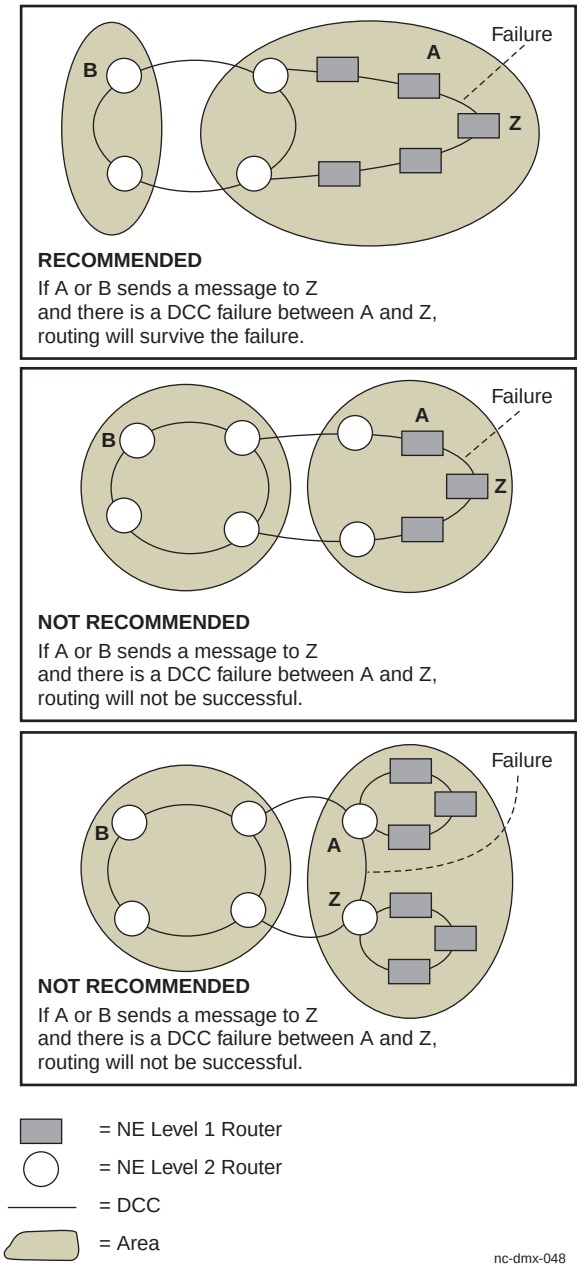


Guideline: Adjacent Level 2 routers within an area

It is recommended that dual Level 2 routers in an area be adjacent to each other and have a redundant route within the area. Failure to meet this guideline would result in some messages not being routed properly in the event of a single failure that divides an area into two separate islands.

Figure 6-31, "Recommended placement of Level 2 routers" (p. 6-110) illustrates a recommended example and two examples that are not recommended of dual Level 2 routers in an area:

Figure 6-31 Recommended placement of Level 2 routers



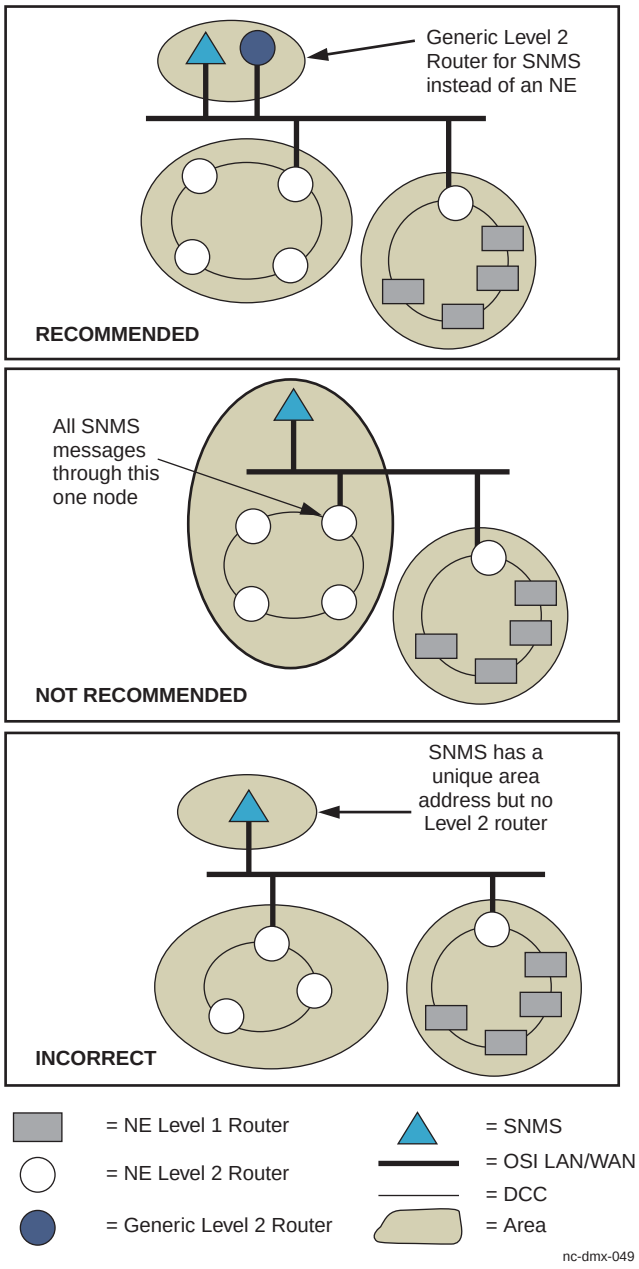
Guideline: OMS own area address and Level 2 router

If OMS (or any other OS) access is via OSI LAN (or WAN), OMS should be assigned to a different area and rely on a generic Level 2 router to communicate with a large network. (OMS is not expected to be a Level 2 router itself.) This is recommended to avoid routing all messages to/from OMS through a single NE serving as a Level 2 router.

Although not shown in the examples below, OMS can support a second, redundant OSI LAN port. Each OMS OSI LAN port has its own unique NSAP but both must be assigned the same area address.

Figure 6-32, "Recommended OMS access via OSI LAN/WAN" (p. 6-112) illustrates a recommended example, an example that is not recommended, and an incorrect example of OMS access via OSI LAN/WAN.

Figure 6-32 Recommended OMS access via OSI LAN/WAN

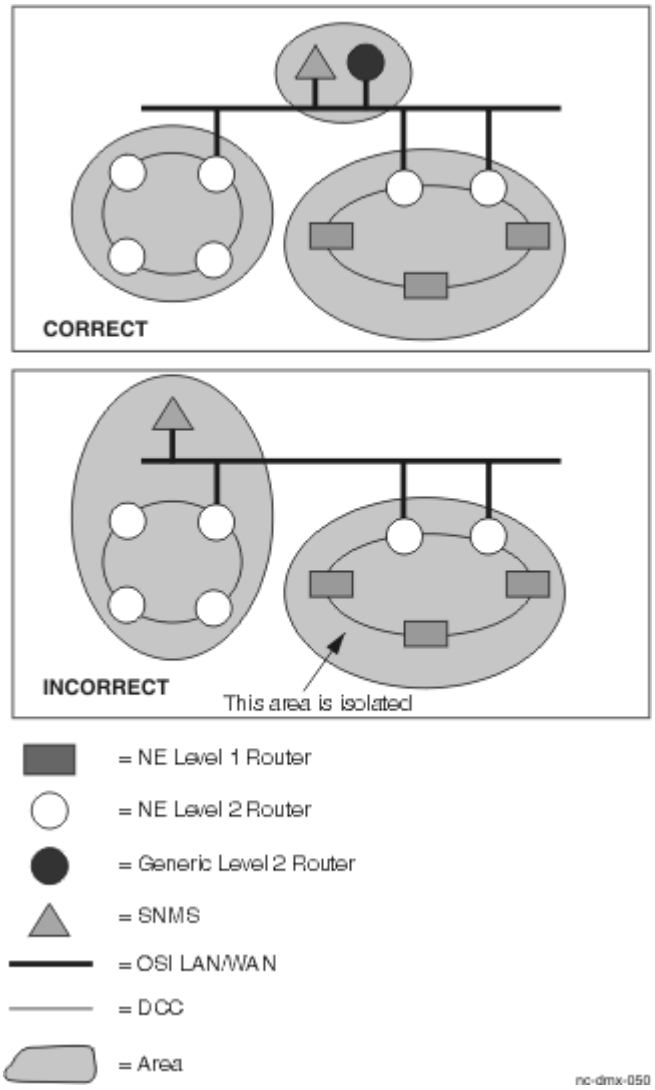


Rule: Level 2 routers on an OSI LAN

If an OSI LAN (or WAN) is used to connect between areas, then at least one node in each area on the OSI LAN must be provisioned to be a Level 2 router. Otherwise, the areas won't route to each other via the OSI LAN.

Figure 6-33, “Level 2 router assignments on an OSI LAN” (p. 6-113) illustrates a correct and an incorrect example of Level 2 router assignments on an OSI LAN:

Figure 6-33 Level 2 router assignments on an OSI LAN

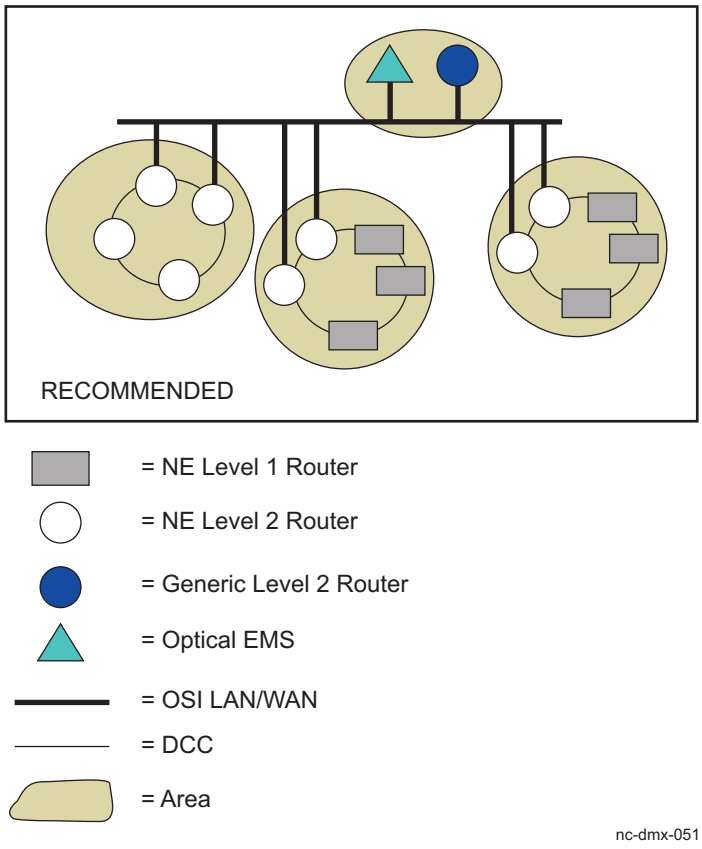


Guideline: OSI LAN redundancy

If an OSI LAN (or WAN) is the only method of connecting between areas, then at least two Level 2 routers directly connected to the OSI LAN for each area are recommended for redundancy purposes. A second, separate OSI LAN hub would provide additional redundancy.

Figure 6-34, "OSI LAN redundancy" (p. 6-114) illustrates a recommended example for providing redundancy between areas connected solely by OSI LANs:

Figure 6-34 OSI LAN redundancy



7 Ordering

Overview

Purpose

This chapter contains information on ordering Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX) equipment and software. The information in this chapter tells you where to go for ordering information.

Contents

Introduction	7-1
Sparing information	7-2
Engineering drawings	7-4
Software and documentation	7-5
Miscellaneous equipment and tools	7-7

Introduction

Overview

Alcatel-Lucent has created a set of engineering drawings to facilitate the ordering of all products. These drawings are updated for each planned release, and contain all of the information needed to order Alcatel-Lucent 1665 DMX equipment. The information contained in the engineering drawings will not be duplicated elsewhere in the interest of keeping all information current and consistent at all times. This chapter will explain how to make sure you are using the most current version of the engineering drawings and where to order the documents.

Any information about particular pieces of equipment (i.e. the uses of various cables versus other) is meant to convey useful information that may/may not be contained in the engineering drawings. This information is meant to be used in conjunction with engineering drawings, but not to replace them.

How to order

Equipment and software orders may be placed via Alcatel-Lucent's online ordering process. For more information, contact your Account Executive.

Sparing information

Overview

This section provides guidelines and a procedure to determine the number of spares needed at each location.

Important! The number of spares for each code must be determined and maintained separately, based on the in-service population of the code at each location.

Lead time

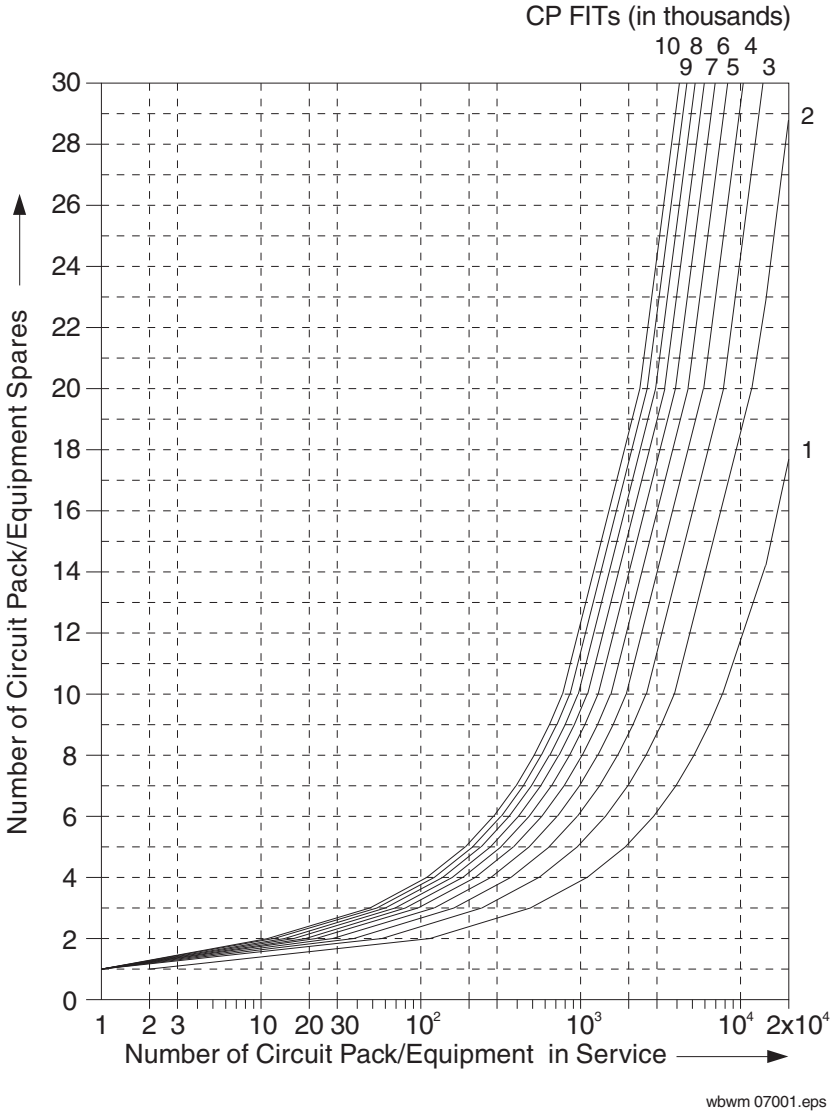
Lead time, or turnaround time is the elapsed time between a known FRU failure at a given service location and the arrival of a repaired (or new) FRU at the location where spare circuit packs are stocked to maintain a spare FRU level consistent with the population in service.

Lead time should not be confused with mean time to repair, which is the elapsed time between discovery of the failure of an in-service FRU and when a replacement is put into service.

Sparing graph for 10-day lead time

Use the graph below to plan the number of spares necessary for the circuit packs and equipment used in Alcatel-Lucent 1665 DMX.

Figure 7-1 Sparing graph for a 10-day lead time



Using the sparing graph

Use the following procedure to determine how many spare circuit packs, PTMs, or other pieces of equipment are required for each code at each location to maintain 99.9% service continuity, given a 10-day lead time.

1. Locate the failure rate for the unit under consideration using the tables above.
2. See Figure 7-1, "Sparing graph for a 10-day lead time" (p. 7-3) and select the curve that represents the nearest failure rate. Interpolation may be necessary.
3. Follow the curve until it intersects the vertical line that represents the number of units in service at the given location. Interpolation may be necessary.
4. Refer to the horizontal line immediately above the intersection. The number associated with this line is the minimum number of spares recommended for that location.
5. Repeat Steps 1–4 for each circuit pack, PTM, and piece of equipment.

Example of using the graph

If there are 100 LNW49 OC-12 OLIUs (failure rate of 4523) in service at a given Central Office location and your lead time is 10 days, then you should order and stock *3* spare LNW49 circuit packs for that location.

Engineering drawings

Overview

To ensure that ordering information is always consistent and up-to-date, Alcatel-Lucent provides engineering drawings that contain all the information required to order Alcatel-Lucent 1665 DMX.

Where to obtain engineering drawings

The engineering drawing is likely to be updated more frequently than the Applications and Planning Guide. Order the most current version of the engineering drawing from the Online Customer Support (OLCS) (http://support.alcatel-lucent.com) site.

Important! When ordering equipment, obtain the current version of the *Alcatel-Lucent 1665 Data Multiplexer (DMX) Engineering and Ordering Information, ED8C871-10*.

How to order engineering drawings

The most up-to-date version of the *Alcatel-Lucent 1665 Data Multiplexer (DMX) Engineering and Ordering Information, ED8C871-10* may be obtained through the Online Customer Support (OLCS) (http://support.alcatel-lucent.com).

Software and documentation

Overview

This section provides information about software and documentation.

Software ordering information

The following list provides some need-to-know items before ordering Alcatel-Lucent 1665 DMX software:

- Alcatel-Lucent 1665 DMX software is shipped separately from the hardware. Software orders must be placed in addition to the hardware order to receive software.
- Order one set of software for each shelf ordered.
- All system controller (SYSCTL) circuit packs are shipped without software loaded on them. Therefore, software loading must occur at or before installation.
- It may be desirable to have backup CD-ROMs for all releases on hand for backup or initial downloading.
- Release software includes a CD containing the current documentation to accompany the Alcatel-Lucent 1665 DMX. Hardcopies of the most current documentation are available through the Online Customer Support (OLCS) (http://support.alcatel-lucent.com) site.

Available software

The table below lists the Alcatel-Lucent 1665 DMX software that may currently be ordered.

Table 7-1 Orderable software

Comcode	Release	Description
109783415	9.1.0	Initial 9.1.0 Installation Software, includes NE software CD-ROM, Right to Use License Fee, CRN on CD-ROM, and customer documentation CD-ROM
109783431	9.1.0	Upgrade Software from R5.1.3/5.1.7 to 9.1.0
109783449	9.1.0	Upgrade Software from R5.1.4/5.1.5 to 9.1.0[1]
109783456	9.1.0	Upgrade Software from R6.0.1/6.0.2/6.0.4 to 9.1.0[2]
109783308	9.1.0	Upgrade Software from R7.0.2 to 9.1.0[2]
109783316	9.1.0	Upgrade Software from R7.1.1/7.1.4 to 9.1.0[3] Upgrade Software from R7.1.2 to 9.1.0
109783324	9.1.0	Upgrade Software from R8.0.2/8.0.3/8.0.4/ 8.0.5/8.0.6 to 9.1.0
109783332	9.1.0	Upgrade Software from R9.0.1 to 9.1.0

Notes:

1. This upgrade is a three-step upgrade through R7.0.2 and then through R8.0.5.
2. This upgrade is a two-step upgrade through R8.0.5
3. This upgrade is a two-step upgrade through R8.0.6.

Available documentation

For specific information about documentation available for this release, see Table 1, “Alcatel-Lucent 1665 DMX documentation set” (p. xxx).

Miscellaneous equipment and tools

Lightguide build-outs

Alcatel-Lucent 1665 DMX utilizes Alcatel-Lucent's state-of-the-art *AllWave ADVANTAGE TM* Fiber Optic Attenuators. These attenuators reduce optical power from the transmitter that can result in over-saturation of the receiver, have low reflection to meet stringent system requirements, and are backward-compatible with existing transmission systems. Unique to the AllWave ADVANTAGE optical connectivity solution (OCS), the *LC TM* optic attenuators are designed to provide flat spectral loss across the full spectrum, allowing the attenuators to be used in the 1300 nm, 1400 nm, and 1500 nm bands. LC optical attenuators are ideal for networks deploying AllWave fiber, metropolitan or regional networks, applications supported by conventional single-mode optical fiber, multiservice network protocols, and DWDM networks.

Table 7-2, “Lightguide build-outs” (p. 7-7) lists the available LC-type lightguide build-out attenuators for the Alcatel-Lucent 1665 DMX.

Table 7-2 Lightguide build-outs

Description	Comcode
LC Build-Out Attenuators[1]	
5 dB	108279381
10 dB	108279431
15 dB	108279480
20 dB	108279530
AllWave ADVANTAGE™ Fiber Optic Identification Kit[2]	108622929

Notes:

1. The LC build-out attenuators listed are polished connector (PC) style connectors at the fiber end. These attenuators must be used on the receive side in all cases. For the LNW37, LNW45 OC-3 and LNW49 OC-12 circuit packs, the specified attenuation may not be achieved if a SM-MM (single-mode-multi-mode) fiber signal is incoming to the LC SM-SM attenuator. In this case, a 15 dB attenuator, for example, may achieve an attenuation value less than the specified 15 dB.
2. The AllWave ADVANTAGE Fiber Optic Identification Kit includes labels for fiber optic apparatus products to identify Alcatel-Lucent AllWave Fiber paths. An instruction sheet is included with recommendations on how to install and use the labels.

Pluggable transmission modules

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Modules (PTMs), on the LNW37, LNW45, LNW49, LNW55, LNW59, LNW62, LNW63, LNW64, LNW73/73C, LNW74, LNW82, LNW87, LNW202, LNW203, LNW402, LNW502, LNW504, LNW603 LNW170, and LNW705 packs.

To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent approved PTM transceivers listed in Chapter 10, "Technical specifications" must be used.

Only the Alcatel-Lucent specified PTM transceivers listed in Chapter 10, "Technical specifications" are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will be inoperable until approved parts are installed.

> **Important!** Use only the Alcatel-Lucent specified Class 1 transceivers listed in the referenced tables.

OC-3 PTMs

The LNW37, LNW45, LNW55, LNW82, LNW705 packs support OC-3 PTMs.

See Table 10-46, "OC-3 PTMs" (p. 10-61).

OC-12 PTMs

The LNW49, LNW55, LNW82, LNW203, , and LNW705 packs support OC-12 PTMs.

See Table 10-47, "OC-12 PTMs" (p. 10-61).

OC-48 PTMs

The LNW55, LNW62, LNW82, LNW202, LNW504 LNW402 and LNW705 packs support OC-48 PTMs.

See Table 10-48, "OC-48 PTMs" (p. 10-61).

OC-192 PTMs

The LNW59, LNW504, LNW502, LNW603, LNW705 packs support OC-192 PTMs.

See Table 10-49, "OC-192 PTMs" (p. 10-63).

Ethernet/SAN PTMs

The LNW63, LNW64, LNW73/73C, LNW74, LNW87, LNW170, and LNW705 circuit packs support Ethernet/SAN PTMs.

See Table 10-79, "Ethernet/SAN PTMs" (p. 10-102).

Blanks

See "Blank circuit packs" (p. 2-9) for the orderable blanks.

Additional equipment

See *Alcatel-Lucent 1665 Data Multiplexer (DMX) Engineering and Ordering Information, ED8C871-10* for additional information about orderable items, like the fan filter and cable management brackets.

Accessories

The table below shows the miscellaneous accessories available for Alcatel-Lucent 1665 DMX.

Table 7-3 Miscellaneous accessories

Product	Model/Description	Comcode	ITE#	Installation Order #
Optical Fiber Scope	Noyes OFS 300-200X	408197028	ITE-7129	33712900
2.5mm Universal Adapter Cap	For use with the Noyes OFS 300-200X	408197044	ITE-7129D1	33712901
1.25mm Universal Adapter Cap	For use with the Noyes OFS 300-200X	408197069	ITE-7129D2	33712902
Video Fiber Scope[1]	Noyes VFS-1	TBD	TBD	TBD
Individual, presaturated alcohol wipes	99% pure isopropyl alcohol	901375147	ITE-7136	33713600
CLETOP Cleaning Cassette	Type A Reel	901375154	ITE-7137	33713700
CLETOP Cleaning Cassette Replacement Reel	Type A Reel	901375014	ITE-7137 D1	33713701
Luminex Stick port cleaners	1.25 mm	901375030	ITE-7134	33713400
Luminex Stick port cleaners	2.5 mm	901375022	ITE-7135	33713500
Luminex Stick port cleaners	5.5" x 5.5"	408201226	R6033	23603300

Notes:

1. This equipment may not be necessary at all locations. It is to be used when the ports need to be verified for cleanliness. If care is exercised when cleaning fibers, the video scope may not be needed.

8 Product support

Overview

Purpose

This chapter describes the support services available to Alcatel-Lucent customers, including product-specific training courses.

Contents

Support services	8-2
Accessing and navigating the OLCS web site	8-2
Training	8-4

Support services

Technical support

For technical support, contact your local Alcatel-Lucent customer support team. See the Alcatel-Lucent Support web site (http://alcatel-lucent.com/support/) for contact information.

How to order

To order Alcatel-Lucent documents, contact your local sales representative or go to the Online Customer Support (OLCS) (http://support.alcatel-lucent.com) site.

Accessing and navigating the OLCS web site

Introduction

The online customer support (OLCS) web site is part of the Alcatel-Lucent Customer and Business Partner Portals (http://support.alcatel-lucent.com). The web site is designed mainly for registered customers and business partners.

Registration benefits

Depending on your service level as outlined in your customer contract, you can enjoy the following benefits as a registered user:

- Create, view, edit, delete, and share your product lists.
- Receive 24/7 technical support service to help you operate and maintain your communications network at peak performance.
- Keep current on relevant news and events with customized alerts.
- Review a library of technical documents, case studies, white papers, catalogs, industry intelligence, and expert articles to help advance your research and business practices.

The level of benefits to which you may be entitled is determined by the customer contract for your company or organization.

If your company or organization is a registered business partner, you can use the following options:

- Gain access to powerful marketing tools that help you make the most of your Alcatel-Lucent products and solutions.
- Enhance the cooperation and efficiency of your team by sharing documents and ideas in the collaboration work space.

- Create, view, edit, delete, and share your product lists.
- Draw on our extensive library of case studies, white papers, catalogs, and expert articles to advance your research and work.

Registering for the portals

To register for the Alcatel-Lucent Customer and Business Partner Portals (http://support.alcatel-lucent.com), proceed as follows:

1. Click **Register for Access**.
2. On the **Registration for access to Alcatel-Lucent Customer and Business Partner Portals** page, follow the steps displayed under **Registration Progress**.

You will receive an e-mail confirmation of your registration and site access privileges. Alcatel-Lucent strives for two business days or less response.

How the site is designed

The "My Customer Support" portal is the umbrella portal to all of the underlying content and tools. Product-specific content is organized by product. You can also gain access to content and tools by going directly to each of the underlying applications.

Navigating on OLCS

The following primary ways to navigate are provided on OLCS.

- **Jump to Content Page** list

  This option is the primary means to navigate between "My Customer Support" home and the underlying applications or among the applications without returning home.
- **Technical Content for** portlet

  This option allows easy access to product-specific content without navigating deeper into the product pages.
- **My Products**

  This option takes you to the **My Products** page, the access to both product-specific content and any other available applications. The names of products for which your company has service agreements or warranties are displayed on this page. If your company has purchased a number of products from Alcatel-Lucent, and you wish to shorten the list to only those products that you are responsible for, select **Manage My Products**.
- Quick access portlets

  These portlets provide easy access from the home page to heavily used applications and useful support information. For example, the portlets provide quick access to the "CARES" system and the "ask AL Knowledgebase" .

Technical support information

To locate technical support telephone numbers and e-mail contact information for your area, use the **Product Technical Support, Phone and E-mail Contact Information** drop-down menu.

Technical documentation on OLCS

Depending on the product, technical documentation may include:

- Manuals and guides
- Technical notes
- Release information

The **Manuals and Guides** category of documentation points directly to corporate libraries for our highest volume products. In addition to listing documents available for online viewing, the libraries may include CD-ROMs, videos, and other tangible media for purchase. The libraries use "Topic Finder" which is a search engine designed to search documents more efficiently than full text search.

Training

Overview

Alcatel-Lucent offers a formal training curriculum to complement your product needs.

Registering for a course

To explore the available courses, enroll in a training course at one of Alcatel-Lucent's corporate training centers, or to arrange for a suitcase session at your facility, choose one of the following contact methods:

- Refer to Product Training web site (https://training.lucent.com/) for access to the training catalog
- Within the United States, call 888-582-3688 and select *Prompt 2*.
- Outside the United States:
  - Telephone: +1 407 767 2667
  - Fax: +1 407 767 2677
  - Refer to Product Training web site (https://training.lucent.com/) and click Contact Us for a detailed list of international contact numbers.
  - Contact your in-country training representative

9 Quality and reliability

Overview

Purpose

This chapter provides quality and reliability information for Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX).

Contents

Alcatel-Lucent Quality Policy	9-1
Reliability program and specifications	9-2
Failure rates	9-3
Quality certifications	9-14
Warranty	9-15
Eco-environmental statements	9-16

Alcatel-Lucent Quality Policy

Quality Policy

We ensure that everything we do must be focused on becoming the trusted partner of our customers by:

- Delivering high quality, secure and reliable products, services, software and solutions the first time, every time, and on time - as promised.
- Continuously making improvements and looking for innovative ways to anticipate and fully meet the highest expectations of our customers.
- Counting on all employees to be personally accountable for putting the customer first and honoring the commitments we make.

Reliability program and specifications

Overview

The reliability program provides enhanced reliability and is implemented as an integral part of the Alcatel-Lucent Product Life Cycle (PLC) process. The reliability program is comprehensive, and includes activities such as setting and ensuring compliance with customer-focused system-reliability requirements, ensuring component qualification is consistent with use environment and system design, assuring satisfactory component-attachment reliability, predicting failure rates of Field Replaceable Units (FRUs), making sparing recommendations, assessing reliability architecture, modeling system reliability, assuring satisfactory system-downtime performance, reducing hardware failure rates through Environmental Stress Testing (EST), and tracking field returns.

Design and development

During the design and development stage, reliability predictions, qualification and selection of components, definition of quality assurance audit standards, and prototyping of critical areas of the system ensure built-in reliability.

Manufacturing and field deployment

During manufacturing and field deployment, techniques such as environmental stress testing, production quality audits, field-return tracking, failure-mode analysis, and feedback and corrective-action further enhance the ongoing reliability improvement efforts on the Alcatel-Lucent 1665 DMX.

Environmental Stress Testing

Alcatel-Lucent 1665 DMX circuit packs are subjected to an Environmental Stress Testing (EST) program. The purpose of the program is to improve reliability by reducing early life failures and implementing root-cause analysis and corrective action on circuit packs that fail EST.

Transmission downtime

Alcatel-Lucent 1665 DMX satisfies a stringent set of reliability specifications. Some of the critical specifications include *Telcordia* ® downtime requirements and objectives for multiplexers. *Telcordia* ® requirements state that the downtime of a two-way channel within a SONET multiplexer, due to hardware failure, must be less than 1.75 minutes per year in a Central Office (CO) environment and 5.25 minutes per year in a Outside Plant (OSP) environment. The corresponding objectives for these parameters are 0.25 minutes per year in a CO environment and 0.75 minutes per year in an OSP environment. These requirements and objectives appear in *Telcordia* ® GR-418-CORE.

These requirements and objectives apply to all system elements needed to process a two-way channel, including the core system as well as the high-speed and low-speed interfaces. System-reliability analysis employing Markov modeling is used to determine the system downtimes. As specified in *Telcordia* ® GR-418-CORE, this analysis assumes a mean time to repair of 2 hours for the CO environment and 4 hours for the OSP environment. Individual Field Replacable Unit (FRU) failure rates used in the model were determined using the method described in *Telcordia* ® SR-332, *Reliability Prediction Procedure for Electronic Equipment (RPP)*. FRUs are system elements that can be replaced in the field, including items such as circuit packs, removable optical interfaces, housings, cooling units, and removable LEDs.

Failure rates

Overview

This section provides circuit pack, PTM, and equipment failure rates for Alcatel-Lucent 1665 DMX.

Circuit pack failure rates

The following table lists failure-rate predictions for all circuit packs. These failure rates were calculated using either

- *Telcordia* ® SR-332, Issue 1 or earlier.
- *Telcordia* ® SR-332, Issue 2.

Important! Failure-rate predictions are estimates; actual values may vary.

Table 9-1 Circuit pack failure rates

Apparatus Code	Comcode	Description	Slot	Release available		Failure Rate (FIT)	
				DMX	DXT	Central Office[3]	Outside Plant[5]
LNW2[1]	108994989	SYSCTL – Enhanced System Controller	CTL	R6.0	R4.0	7747	15494
LNW7[1]	108764036	28DS1PM	A–D	R1.0	R1.0	5575	11150
LNW8[1]	109164889	56DS1/E1	A–D	R3.1	R1.1	5309	10618
LNW16[1]	108694845	12DS3/EC1	A–D	R1.1	R1.0	4520	9040
LNW18[1]	109164905	TMUX	A–D	R3.0	R1.1	4294	8587
LNW19B[1]	109492470	48DS3/EC1	A–D	R5.0	R3.0	5909	11818
LNW20[2]	109535070	48DS3/EC1 TMUX	A–G[4]	R7.0.1	R5.0.1	4201	8402
LNW27[1]	108923525	OC-48 1310 LR OLIU	M1, M2	R2.1		8090	NA
LNW29[1]	108923541	OC-48 1550 LR OLIU	M1, M2	R2.1		8259	NA
LNW31[1]	109008987	OC-48 1310 IR OLIU	A–D, G1, G2	R2.0	R3.0	5404	NA
LNW32[1]	109008995	OC-48 1310 LR OLIU	A–D, G1, G2	R4.0		8167	16335
LNW37[1]	109068783	OC-3 OLIU	A–D, G1, G2	R4.0	R2.0	5047	10094
LNW45[1]	109411082	OC-3 OLIU	A–D, G1, G2	R5.0	R3.0	5226	10452
LNW48[1]	109187575	OC-12 OLIU	M1, M2	R3.1		5091	10182
LNW49[1]	109319582	OC-12 OLIU	A–D, G1, G2	R4.0	R3.0	4523	9046
LNW50[1]	109319590	OC-12 OLIU	M1, M2	R3.1		5236	10472
LNW54[1]	109506055	OC-12 OLIU	M1, M2	R5.1		4628	9256
LNW55[2]	109532283	OC-3/OC-12/OC-48 OLIU	A–D, G1, G2	R7.1	R5.1	2608	5216
LNW56[1]	108848052	OC-192 IR OLIU	M1, M2	R2.1.2		8527	NA
LNW58[1]	109164939	OC-192 VSR OLIU	M1, M2	R2.1.2		7902	NA

Table 9-1 Circuit pack failure rates (continued)

Apparatus Code	Comcode	Description	Slot	Release available		Failure Rate (FIT)	
				DMX	DXT	Central Office[3]	Outside Plant[5]
LNW59[1]	109494799	OC-192 VLF OLIU	M1, M2	R7.0		9979	NA
LNW62[1]	109532291	OC-48 OLIU	A–D, G1, G2	R7.0	R5.0	6639	13278
LNW63[1]	109535088	GbE PL	A1, B1, C1, D1, G1[6] A–D, G1, G2[7]	R6.0	R4.0	6884	13768
LNW64[1]	109599696	GbE PL	A–D, G1, G2	R7.0	R5.0	4510	9020
LNW66[1]	108848078	10/100-FE	A1, B1, C1, D1[6] A–D, G1, G2[7]	R1.1	R1.1	5102	NA
LNW73[1]	109461491	FC-1X/2X	A1, B1, C1, D1, G1[6] A–D, G1, G2[7]	R5.1	R3.1	6445	NA
LNW73C[1]	109575605	FC-1X/2X C	A1, B1, C1, D1, G1[6] A–D, G1, G2[7]	R7.0	R5.0	5561	NA
LNW74[1]	109492504	10/100-T/F	A1, B1, C1, D1, G1[6] A–D, G1, G2[7]	R5.0	R3.0	7191	14383
LNW76[1]	109164947	OC-48 SR 1310 nm OLIU	M1, M2	R2.1		7042	NA
LNW80[1]	109461509	Switch Pack	M1, M2	R4.0		6108	12216
LNW82[2]	109643932	OC-3/12/48 OLIU	M1, M2	R7.1		2663	5326
LNW87[2]	109709188	FE/Gbe PL	A–D, G1, G2	R9.0	R9.0	1352	2704
LNW170[2]	109642728	100/1G FXS	A–D, G1, G2	R7.1	R5.1	3119	NA
LNW202[2]	109589135	OC-48 OLIU	M1, M2	R7.1		1082	2165
LNW203[2]	109702555	OC-12 OLIU	M1, M2	R9.0		1132	2263
LNW402[2]	109678870	OC-48 OLIU	A–D, G1, G2	R8.0	R8.0	752	1505
LNW502[2]	109589127	OC-192 OLIU	M1, M2	R7.1		1412	NA
LNW504[2]	109709014	OC-192/OC-48 OLIU	M1, M2	R9.0		4891	NA

Table 9-1 Circuit pack failure rates (continued)

Apparatus Code	Comcode	Description	Slot	Release available		Failure Rate (FIT)	
				DMX	DXT	Central Office[3]	Outside Plant[5]
LNW603[2]	109680496	OC-192 OLIU	A–D, G1, G2	R9.0		1620	NA
LNW705[2]	109589242	10G DWDM Muxponder pack (XM10G/8) – 8 SFPs + 1 XFP, 1GbE/GFP-F/VCAT into OC-192 (OUT2 with Enhanced FEC); SAN (1G, 2G, FC/Ficon) and SONET (OC-3/12/48) clients	A–D, G1, G2	R7.1.1	R9.0	4530	NA
LNW785[2]	109616565	8-channel low-loss DWDM Mux/Demux (OMD5/8), with integrated VOAs	A–D, G1, G2	R7.1	R5.1	1592	NA
LNW801[2]	109664490	56DS1/E1	A–D	R8.0	R8.0	2184	4368

Notes:

1. FIT rate calculated using *Telcordia* ® SR-332, Issue 1 or earlier.
2. FIT rate calculated using *Telcordia* ® SR-332, Issue 2.
3. The predictions for the central office environment assume a system-inlet air temperature of 25°C.
4. LNW20 can always occupy slots A1/A2 through D1/D2. Only certain Main packs can support the LNW20 in G1/G2 slots. The following Mains support LNW20 installation in G1/G2 slots and portless operation in all slots: OC-48: LNW27, LNW29, LNW32, LNW76, LNW82, LNW202, LNW504 and OC-192: LNW56, LNW58, LNW59, LNW502.
5. NA in the Outside Plant (OSP) column indicates that the circuit pack is not used in OSP environments.

6. When Alcatel-Lucent 1665 DMX is equipped with non-VLF Main packs, Ethernet packs can only occupy slot 1 of any Function Unit group or Growth slot on the shelf (A1–G1). LNW66 cannot be installed in G1. However, the LNW170 in equipment-protected mode is allowed for VLF or non-VLF mains.
7. When Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59, LNW82, or LNW504) packs, Ethernet packs can be installed in either slot 1 or 2 of Function Unit or Growth groups.
8. LR: Long Reach
9. IR: Intermediate Reach
10. SR: Short Reach

PTM (SFP/XFP) failure rates

The following table provides failure-rate predictions for all Pluggable Transmission Modules (PTMs), also known as SFPs and/or XFPs.

These failure rates were calculated using *Telcordia* ® SR-332, Issue 2.

Important! Failure-rate predictions are estimates; actual values may vary.

Table 9-2 Pluggable Transmission Module (SFP/XFP) failure rates

Apparatus Code	Type	Circuit Pack	Failure Rate (FIT)	
			Central Office[1]	Outside Plant
S155I2 (OC3SR1-I1)	SFP, OC-3 SR1, SM, 1310 nm, 2 km	LNW37/45/ 55/82/705	207	413
OC3IR1-I1	SFP, OC-3 IR1, SM, 1310 nm, 15 km	LNW37/45/ 55/82/705	207	413
OC3LR1-I1	SFPOC-3 LR1, SM, 1310 nm, 40 km	LNW37/45/ 55/82/705	207	413
OC12IR1-I1	SFP, OC-12 IR1, 1310 nm, SM, 15 km	LNW49/55 /82/203/705	207	413
OC12LR1-I1	SFP, OC-12 LR1, 1310 nm, SM, 40 km	LNW49/55 /82/203/705	207	413
OC12LR2-I1	SFP, OC-12 LR2, SM, 1550 nm, 80 km	LNW49/55 /82/203/705	207	413
OC48SR1-I1	SFP, OC-48 SR1, SM, 1310 nm, 2 km	LNW55/62/82/ 202/402/504/705	207	413
OC48LR1-I1	SFP, OC-48 LR1, SM, 1310 nm, 40 km	LNW55/62/82/ 202/402/504/705	207	413
OC48LR2-I1	SFP, OC-48 LR2, SM, 1550 nm, 80 km	LNW55/62/82/ 202/402/504/705	207	413

Table 9-2 Pluggable Transmission Module (SFP/XFP) failure rates (continued)

Apparatus Code	Type	Circuit Pack	Failure Rate (FIT)	
			Central Office[1]	Outside Plant
OC192SR1-C1	XFP, OC-192 SR1, SM, 1310 nm, 2 km	LNW59/502/504/603/705	523	NA
OC192IR2-I1	XFP, OC-192 IR2, SM, 1550 nm, 40 km	LNW59/705	523	1047
OC192IR2-C1	XFP, OC-192 IR2, SM, 1550 nm, 40 km	LNW59/502/504/603/705	523	NA
OC192LR2-C1	XFP, OC-192 LR2, SM, 1550 nm, 80 km	LNW59/502/504/603/705	523	NA
OC3X12X48-IR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 15 km, 1310 nm	LNW55/82	207	413
OC3X12X48-LR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 15 km, 1310 nm	LNW55/82	207	413
S2D23C6	SFP, OC-48/STM-16 OTU1 DWDM, 192.3 THz, 1558.983 nm, commercial temperature range	LNW55/62/82/202/402/705	207	NA
S2D25C6	SFP, OC-48/STM-16 OTU1 DWDM, 192.5 THz, 1557.363 nm, commercial temperature range	LNW55/62/82/202/402/705	207	NA
S2D27C6	SFP, OC-48/STM-16 OTU1 DWDM, 192.7 THz, 1555.747 nm, commercial temperature range	LNW55/62/82/202/402/705	207	NA
S2D31C6	SFP, OC-48/STM-16 OTU1 DWDM, 193.1 THz, 1552.524 nm, commercial temperature range	LNW55/62/82/202/402/705	207	NA
S2D33C6	SFP, OC-48/STM-16 OTU1 DWDM, 193.3 THz, 1550.918 nm, commercial temperature range	LNW55/62/82/202/402/705	207	NA
S2D35C6	SFP, OC-48/STM-16 OTU1 DWDM, 193.5 THz, 1549.315 nm, commercial temperature range	LNW55/62/82/202/402/705	207	NA
S2D37C6	SFP, OC-48/STM-16 OTU1 DWDM, 193.7 THz, 1547.715 nm, commercial temperature range	LNW55/62/82/202/402/705	207	NA

Table 9-2 Pluggable Transmission Module (SFP/XFP) failure rates (continued)

Apparatus Code	Type	Circuit Pack	Failure Rate (FIT)	
			Central Office[1]	Outside Plant
S2D45C6	SFP, OC-48/STM-16 OTU1 DWDM, 194.5 THz, 1541.349 nm, commercial temperature range	LNW55/62/82/ 202/402/705	207	NA
S2D47C6	SFP, OC-48/STM-16 OTU1 DWDM, 194.7 THz, 1539.766 nm, commercial temperature range	LNW55/62/82/ 202/402/705	207	NA
S2D49C6	SFP, OC-48/STM-16 OTU1 DWDM, 194.9 THz, 1538.186 nm, commercial temperature range	LNW55/62/82/ 202/402/705	207	NA
S2D53C6	SFP, OC-48/STM-16 OTU1 DWDM, 195.3 THz, 1535.036 nm, commercial temperature range	LNW55/62/82/ 202/402/705	207	NA
S2D55C6	SFP, OC-48/STM-16 OTU1 DWDM, 195.5 THz, 1533.465 nm, commercial temperature range	LNW55/62/82/ 202/402/705	207	NA
S2D59C6	SFP, OC-48/STM-16 OTU1 DWDM, 195.9 THz, 1530.334 nm, commercial temperature range	LNW55/62/82/ 202/402/705	207	NA
S2G7C47LI	SFP, OC48/STM16 CWDM 1471 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413
S2G7C49LI	SFP, OC48/STM16 CWDM 1491 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413
S2G7C51LI	SFP, OC48/STM16 CWDM 1511 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413
S2G7C53LI	SFP, OC48/STM16 CWDM 1531 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413
S2G7C55LI	SFP, OC48/STM16 CWDM 1551 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413
S2G7C57LI	SFP, OC48/STM16 CWDM 1571 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413
S2G7C59LI	SFP, OC48/STM16 CWDM 1591 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413
S2G7C61LI	SFP, OC48/STM16 CWDM 1611 nm, industrial temperature range	LNW55/62/82/ 202/402/504	207	413

Table 9-2 Pluggable Transmission Module (SFP/XFP) failure rates (continued)

Apparatus Code	Type	Circuit Pack	Failure Rate (FIT)	
			Central Office[1]	Outside Plant
S622C47EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1471 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
S622C49EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1491 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
S622C51EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1511 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
S622C53EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1531 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
S622C55EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1551 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
S622C57EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1571 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
S622C59EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1591 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
S622C61EL	SFP, OC-3/STM-1 or OC-12/STM-4, CWDM, 1611 nm, extended temperature range	LNW37/45/49/ 55/82/203/705	207	[2]
X10G21C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.1 THz, 1560.606 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G22C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.2 THz, 1559.794 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G23C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.3 THz, 1558.983 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA

Table 9-2 Pluggable Transmission Module (SFP/XFP) failure rates (continued)

Apparatus Code	Type	Circuit Pack	Failure Rate (FIT)	
			Central Office[1]	Outside Plant
X10G24C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.4 THz, 1558.173 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G25C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.5 THz, 1557.363 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G26C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.6 THz, 1556.555 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G27C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.7 THz, 1555.747 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G28C5	XFP, OC-192/STM-64/OTU2 DWDM, 192.8 THz, 1554.940 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G31C5	XFP, OC-192/STM-64/ OTU2 DWDM, 193.1 THz, 1552.524 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G33C5	XFP, OC-192/STM-64/ OTU2 DWDM, 193.3 THz, 1550.918 nm, extended temperature range	LNW59/502/504/ 603/705	523	NA
X10G35C5	XFP, OC-192/STM-64/ OTU2 DWDM, 193.5 THz, 1549.315 nm, extended temperature range	LNW59/502/504/ 603/705	523	NA
X10G37C5	XFP, OC-192/STM-64/ OTU2 DWDM, 193.7 THz, 1547.715 nm, extended temperature range	LNW59/502/504/ 603/705	523	NA
X10G45C5	XFP, OC-192/STM-64/ OTU2 DWDM, 194.5 THz, 1541.349 nm, extended temperature range	LNW59/502/504/ 603/705	523	NA
X10G47C5	XFP, OC-192/STM-64/ OTU2 DWDM, 194.7 THz, 1539.766 nm, extended temperature range	LNW59/502/504/ 603/705	523	NA

Table 9-2 Pluggable Transmission Module (SFP/XFP) failure rates (continued)

Apparatus Code	Type	Circuit Pack	Failure Rate (FIT)	
			Central Office[1]	Outside Plant
X10G49C5	XFP, OC-192/STM-64/ OTU2 DWDM, 194.9 THz, 1538.186 nm, extended temperature range	LNW59/502/504/ 603/705	523	NA
X10G52C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.2 THz, 1535.822 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G53C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.3 THz, 1535.036 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G54C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.4 THz, 1534.250 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G55C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.5 THz, 1533.465 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G56C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.6 THz, 1532.681 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G57C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.7 THz, 1531.898 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G58C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.8 THz, 1531.116 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
X10G59C5	XFP, OC-192/STM-64/OTU2 DWDM, 195.9 THz, 1530.334 nm, commercial temperature range	LNW59/502/504/ 603/705	523	NA
100BASE-LX-I1	SFP, Fast Ethernet 100 Mb/s (XT). 1550 nm, SM, industrial temperature range	LNW74/87/170	207	413
100BASE-ZX-I1	SFP, Fast Ethernet 100 Mb/s (XT), 1550 nm SM, industrial temperature range	LNW74/87/170	207	NA

Table 9-2 Pluggable Transmission Module (SFP/XFP) failure rates (continued)

Apparatus Code	Type	Circuit Pack	Failure Rate (FIT)	
			Central Office[1]	Outside Plant
100BASE-FX-I1	SFP, Fast Ethernet 100 Mb/s (XT). 1310 nm MM, industrial temperature range	LNW74/87/170	207	413
1000BASE-ZX-I1	SFP, GbE 1550 nm SM	LNW63/64/87/170	207	413
ESCON-MM-I1	SFP, ESCON 1310 nm MM	LNW73/73C	207	413
GE-1X2XFC-LX-I1	SFP, 1X Fibre Channel or 2X Fibre Channel or GbE (1.0625, 2.125, 1.25 Gb/ sec), 10km min for all three data rates, using 9/125 µm SMF, 1310 nm, SM	LNW63/64/ 73C/87/170/705	207	413
GE-1X2XFC-SX-I1	SFP, 1X Fibre Channel or 2X Fibre Channel or GbE, 550m at 1xFC and GbE and 300m at 2xFC using 50/125um MMF, 300m at 1xFC and GbE and 150m at 2xFC using 62.5/125 µm MMF, 850nm, MM	LNW63/64/ 73C/87/170/705	207	413
BASE-T-C1	SFP, 10 Mb/s, 100 Mb/s and GbE Copper, Fast Ethernet 100 Mbits: Gigabit Ethernet 1.25 Gbits	LNW63/64/87/ 170	244	NA

Notes:

1. The predictions for the central office environment assume a system-inlet air temperature of 25°C.
2. The S622CxxEL PTMs (xx = 47–61) are approved to operate at −5°C to +85°C. When operating within this temperature range, the S622CxxEL PTMs have a predicted failure rate of 413 FIT.
3. NA in the Outside Plant (OSP) column indicates that the circuit pack is not used in OSP environments.
4. LR: Long Reach
5. IR: Intermediate Reach
6. SR: Short Reach

Equipment failure rates

The table below provides failure-rate predictions for Alcatel-Lucent 1665 DMX hardware. These failure rates were determined per *Telcordia* ® SR-332.

Important! Failure-rate predictions are estimates; actual values may vary.

Table 9-3 Equipment failure rates

Equipment	Failure Rate (FIT)	
	Central Office	Outside Plant
Non-volatile memory (NVM) card	197	394
High-Capacity Shelf Assembly – 30 Amp	1622	3244
High-Capacity Shelf Assembly – 20 Amp	1622	3244
Cooling Unit [1]	4016	8032

Notes:

1. Cooling unit design life is 7 years.

Quality certifications

Overview

Alcatel-Lucent 1665 DMX is a TL 9000-certified product within the Alcatel-Lucent-wide registration. This registration includes ISO certification.

Quality Management System

The Alcatel-Lucent 1665 DMX product family adheres to the Alcatel-Lucent Quality Management System (ALU QMS) as described in the *OMSN North America (NA) Product Realization (PR) Quality Manual*.

The ALU QMS enables Alcatel-Lucent to demonstrate a global approach for quality management, deploy common processes, share lessons learned for improving efficiency and customer satisfaction, and achieve consolidated registration to international standards.

TL 9000

TL 9000 is a telecommunications industry-specific set of requirements and measurements for software, hardware and services. TL 9000 is built on existing industry standards, including ISO 9001. Conformance to TL 9000 constitutes conformance to corresponding ISO 9001 requirements. TL 9000 consolidates various industry requirements and customer requests for measurements; it reduces problems caused by multiple requirements and audits; and it standardizes reporting and use of supplier performance

data via defined measurements. TL 9000 requires well-documented, implemented controls for design development, production, delivery, installation, and service. The primary purpose of TL 9000 is to ensure that manufacturers produce products with consistently high levels of quality and service.

Warranty

Hardware warranty

Alcatel-Lucent provides a one year hardware warranty on Alcatel-Lucent 1665 DMX, effective from the date the unit is shipped.

Hardware failure emergencies

In the event of a service outage or failure during the initial installation and turn-up of Alcatel-Lucent 1665 DMX, go to Global Reverse Supply Chain web site (http://esupply.web.lucent.com/grsc/). The instructions and contacts for various global locations are listed under, “Returns Information” in the upper right part of the page.

OLCS

Alcatel-Lucent provides one year of access to the Online Customer Support (OLCS) (http://support.alcatel-lucent.com) site. Any 3rd-party vendor warranty terms will be pass-through from original vendor.

Software warranty

Alcatel-Lucent offers a 1-year warranty for defect resolution. All warranties pertain to the deployment of a release and do not apply to individual software licenses.

Alcatel-Lucent's warranty on any software release will not exceed 90 days for defect resolution. All warranties pertain to the deployment of a release and do not apply to individual software licenses.

For more warranty information, contact your local Alcatel-Lucent account executive.

Eco-environmental statements

Overview

The statements that follow are the eco-environmental statements that apply to Alcatel-Lucent 1665 DMX when deployed in the European Union, China, Canada, and the United States.

Packaging collection and recovery requirements

Countries, states, localities, or other jurisdictions may require that systems be established for the return and/or collection of packaging waste from the consumer, or other end user, or from the waste stream. Additionally, reuse, recovery, and/or recycling targets for the return and/or collection of the packaging waste may be established.

For more information regarding collection and recovery of packaging and packaging waste within specific jurisdictions, please contact the Alcatel-Lucent Services - Environmental Health and Safety organization.

Material content compliance

European Union RoHS

European Union (EU) Directive 2002/95/EC, “Restriction of the use of certain Hazardous Substances” (RoHS), restricts the use of lead, mercury, cadmium, hexavalent chromium, and certain flame retardants in electrical and electronic equipment. This Directive applies to electrical and electronic products placed on the EU market after 1 July 2006, with various exemptions, including an exemption for lead solder in network infrastructure equipment. Alcatel-Lucent products shipped to the EU after 1 July 2006 comply with the EU RoHS Directive.

China RoHS

The Peoples Republic of China Ministry of Information Industry has published a regulation (Order #39) and associated standards regarding restrictions on hazardous substances (China RoHS). Currently, the legislation requires all Electronic and Information Products (EIP) to comply with certain labeling and documentation requirements. Alcatel-Lucent products manufactured on or after 1 March 2007, that are intended for sale to customers in the China market, comply with these requirements.

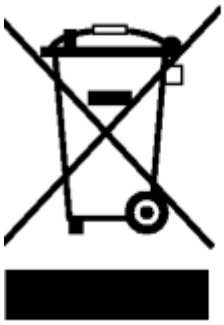
In accordance with the People's Republic of China Electronic Industry Standard "Marking for the Control of Pollution Caused by Electronic Information Product" (SJ/T11364- 2006), customers may access Alcatel-Lucent's Hazardous Substances Table information at either of the following two URLs (for the convenience of our diverse customer base):

- Access via the Alcatel-Lucent Corporate website at:
  http://www.alcatel-sbell.com.cn/live/home/index.jsp (http://www.alcatel-sbell.com.cn/live/home/index.jsp)
- Access via the Alcatel Shanghai Bell website at:
  http://www.alcatel-sbell.com.cn/wwwroot/images/upload/private/1/media/China-RoHS-HST-3.1.pdf (http://www.alcatel-sbell.com.cn/wwwroot/images/upload/private/1/media/China-RoHS-HST-3.1.pdf)

Recycling / take-back / disposal of products

Electronic products bearing or referencing the symbols shown below shall be collected and treated at the end of their useful life, in compliance with applicable European Union and other local legislation. They shall not be disposed of as part of unsorted municipal waste. Due to materials that may be contained in the product and batteries, such as heavy metals, the environment and human health may be negatively impacted as a result of inappropriate disposal.

Note: For electronic products put on the market in the European Union, a solid bar under the crossed-out wheeled bin indicates that the product was put on the market after 13 August 2005.



Moreover, in compliance with legal requirements and contractual agreements, where applicable, Alcatel-Lucent will offer to provide for the collection and treatment of Alcatel-Lucent products bearing the logo at the end of their useful life, or products displaced by Alcatel-Lucent equipment offers.

For information regarding take-back, recycling, or disposal of equipment by Alcatel-Lucent or for equipment take-back requests, visit the Alcatel-Lucent Take-Back web page (http://www.alcatel-lucent.com/product_takeback) or contact Alcatel-Lucent Takeback Support (takeback@alcatel-lucent.com). For technical information on product treatment, consult the Alcatel-Lucent Recycling Information web page (http://www.alcatel-lucent.com/product_recycling).

10 Technical specifications

Overview

Purpose

This chapter contains the technical specifications for Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX). In addition to the specifications identified in this chapter, established standards for transmission interfaces are supported as described in “Transmission interface standards” (p. 10-4).

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Established standards

Interface standards

Transmission interface standards

Table 10-1, "Transmission interface standards" (p. 10-4) lists the transmission interface standards for electrical, optical, and data interfaces.

Table 10-1 Transmission interface standards

Interface	Standard	Comments
E1	ITU G.703, G.704, G.706, G.736, G.775, M.2100	
DS1/DS3/EC-1	ANSI T1.231-1997 GR-499-CORE, Issue 2, 1998	B8ZS/AMI option, SF/ESF/UF (DS1) VMR, VM, and clear channel (DS3)
OC-3/OC-12/OC-48/OC-192	GR-253-CORE, Issue 3, 2000 GR-496-CORE, Issue 1, 1998 GR-1400-CORE, Issue 3, 2001 ANSI T1.231-1997	
10/100BASE-T, 1000BASE-T, 100BASE-ZX, 100BASE-LX, 100BASE-FX, 1000BASE-ZX, 1000BASE-LX, 1000BASE-SX	IEEE 802.3 IEEE 802.1D IEEE 802.1Q ITU G.7041 ITU G.707	
VC-12	ITU M.2101 ITU G.707	
FICON/ESCON/Fibre-Channel	ITU G.7041 SA22-7202-02 SA23-0394-03 SG24-4662-00 ANSI X3.296-1977 ANSI INCITS 352-2002	

Power and EMI substation standards

Purpose

Alcatel-Lucent 1665 DMX complies fully and partially with the substation standards that follow. All five standards are harmonized with each other.

Full compliance

Alcatel-Lucent 1665 DMX complies with the following standards:

- IEEE STD C37.90.1-2002: IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus (SWC)
- IEEE STD C37.90.2-2004: IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers (RFI)
- IEEE STD C37.90.3-2001: IEEE standard electrostatic discharge tests for protective relays (ESD)

Partial compliance

Alcatel-Lucent 1665 DMX complies with most of the criteria listed in the following standards:

- IEEE STD C37.90-2005: IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus (Revision of C37.90-1989)
- IEEE STD 1613 -2003: IEEE Standard for Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations

  Note: Alcatel-Lucent 1665 DMX does not conform to all the requirements listed in these referenced documents.

Electrical interfaces

Overview

Purpose

This section contains the technical specifications for the low-speed electrical interfaces.

Contents

28DS1PM (LNW7) and 56 DS1/E1 (LNW8/LNW801)	10-6
12DS3/EC1 (LNW16) and 48DS3/EC1 (LNW19B)	10-8
DS3 TransMUX (LNW18)	10-9
48DS3/EC1/TransMUX (LNW20)	10-10

28DS1PM (LNW7) and 56 DS1/E1 (LNW8/LNW801)

Overview

When LNW59, LNW82, or LNW504 VLF Main packs are installed, the LNW7 circuit packs are not supported. However, non-VLF Mains support the LNW7.

DS1 electrical specification

The DS1 low-speed interface transmits and receives a standard electrical DS1 signal as specified in GR-499-CORE (1.544 Mb/s nominal rate, DSX-1 interconnect specification). Line coding is provisionable per DS1 port to alternate mark inversion (AMI) or AMI with bipolar 8-zero substitution (B8ZS).

E1 electrical specification

The E1 low-speed interface transmits and receives a standard electrical E1 signal as specified in ITU G.703, G.704, G.706, G.736, G.775, M.2100 (2.048 Mb/s nominal rate, DSX-1 interconnect specification).

Format specification

The LNW7, LNW8, or LNW801 can be provisioned for the following DS1 formats: unframed (UF), superframe (SF), or extended superframe (ESF) as specified in GR-499-CORE, Section 10. In the case of SF or ESF format selections, DS1 performance monitoring information is collected by monitoring the associated DS1 framing format per *ANSI* T1.231-1997.

Alarm thresholding

The following parameters are monitored on the DS1 interfaces:

- Loss of signal (LOS): 28DS1 + 28DS1PM + 56DS1/E1
- Bit error rate threshold (BER) based online coding violations (CV-L)

The alarm level for the monitored parameters can be provisioned to critical (CR), major (MJ), minor (MN), not alarmed or status conditioned (NA), not reported (NR).

DS1/E1 transmission length

When transmitting DS1/E1 signals to a DSX panel, the maximum cable length is 655 feet.

Loopbacks

The LNW7, LNW8, or LNW801 interfaces support the following loopbacks:

- Per-port DS1/E1 facility loopback
- Per-port DS1/E1 terminal loopback.

Line build-outs (LBOs)

Line build-outs are software-provisionable. The maximum distance depends on the cable type. The maximum cable length for DX1 lines is 665 feet.

Performance monitoring

PM data is reported for DS1/E1 signals when Alcatel-Lucent 1665 DMX is equipped with the LNW7, LNW8, or LNW801 circuit packs.

For a detailed list of PM parameters and thresholds, see “Performance monitoring” (p. 5-62).

12DS3/EC1 (LNW16) and 48DS3/EC1 (LNW19B)

DS3 electrical specification

The low-speed DS3 interfaces transmit/receive a standard electrical DS3 signal as specified in GR-499-CORE, Section 9 (44.736 Mb/s rate, DSX-3 interconnect specification, bipolar 3-zero substitution (B3ZS) encoding). However, the signal does not have to contain a standard DS3 frame.

LNW111

When LNW141 or LNW84 VLF Main packs are installed, the LNW111 circuit packs are not supported. However, non-VLF Mains do support the LNW111.

EC-1 electrical specification

The EC-1 low-speed interfaces provide transport of any STS-1 signal compatible with the electrical STS-1 interface specification in GR-253-CORE, Issue 3. The EC-1 low-speed port can be provisioned to provide STS-1 path termination functions for a VT1.5 structured STS-1 with an asynchronous DS1 mapping.

The low-speed EC-1 interfaces transmit/receive a standard electrical EC-1 signal as specified in GR-253-CORE, Issue 3 (51.844 Mb/s rate, STSX-1 interconnect specification, bipolar 3-zero substitution (B3ZS) encoded and scrambled).

DS3/EC-1 port provisioning

The LNW16 and LNW19B circuit packs support DS3 or EC-1 service on a per-port basis. Therefore, a single circuit pack can support a variety of DS3 and/or EC-1 traffic.

DS3/EC-1 transmission length

Line build-outs are software-provisionable. The maximum distance depends on the cable type.

Table 10-2 DS3/EC-1 cable lengths

Cable type	LBO in	LBO out
728A/B	0–255 ft.	255–450 ft.
735A	0–112 ft.	112–225 ft.

DS3 TransMUX (LNW18)

Electrical specification

The TransMUX circuit pack provides 12 ports for DS3 service.

DS3 interfaces transmit/receive a standard electrical DS3 signal as specified in GR-499-CORE, Section 9 (44.736 Mb/s rate, DSX-3 interconnect specification, bipolar 3-zero substitution (B3ZS) encoding).

TransMUX circuit pack DS1 and DS3 signals

Alcatel-Lucent 1665 DMX supports a 12-port TransMUX card that can collect various DS1 signals from around a ring and combine them into a channelized DS3 signal.

The TransMUX circuit pack functions in the following manner:

Transmit functions

- Receives a B3ZS-encoded DS3 signal from a DSX-3
- Recovers DS3 clock and NRZ data
- Calculates parity errors on the DS3 input
- Demultiplexes the M13 or C-bit formatted DS3 signal into 28 DS1s
- Maps the 28 DS1s into VT1.5s and then into an STS-1
- Inserts STS-1 path overhead
- Provides the STS-1 signal to the OLIU circuit packs

Receive functions

- Interprets the STS-1 pointer values
- Terminates the STS-1 path
- Disinterleaves the STS-1 signal into 28 VT1.5s and interprets VT pointer values
- Converts the VT1.5 signals to 28 DS1 signals
- Multiplexes the 28 DS1 signals to an M13 or C-bit formatted DS3 signal
- B3ZS encodes the outgoing DS3 signal
- Pre-equalizes the DS3 signal (with LBO) and transmits it to a DSX-3

48DS3/EC1/TransMUX (LNW20)

Electrical specification

DS3 interfaces transmit/receive a standard electrical DS3 signal as specified in GR-499-CORE, Section 9 (44.736 Mb/s rate, DSX-3 interconnect specification, bipolar 3-zero substitution (B3ZS) encoding).

The LNW20 provides 48 ports supporting DS3, EC1, and TMUX functionality on a port-by-port basis. Each port can be individually provisioned as DS3 or EC1 (unchannelized), or as TransMUX (channelized DS3s). With the LNW20, one high-density pack can be used for all DS3, EC1, and/or TransMUX applications.

LNW20 can be 1x1 protected or function in 0x1 unprotected mode. It supports hairpins to other packs in the shelf, and between ports on the same pack.

LNW20 can always occupy slots A1/A2 through D1/D2. Only certain Main packs can support the LNW20 in G1/G2 slots. Because the G1/G2 slots do not have any electrical backplane connections, only optical or "port-less TMUX" can work in the G slots. The following Mains support the LNW20 in G1/G2 slots and portless operation in all slots:

- OC-48: LNW27, LNW29, LNW32, LNW76, LNW82, LNW202
- OC-192: LNW56, LNW58, LNW59, LNW502, LNW504
- Switch pack: LNW80

Ported channelized DS3 mode of operation

The LNW20 TransMUX card that can collect various DS1 signals from around a ring and combine them into a channelized DS3 signal.

Transmit functions

- Receives a B3ZS-encoded DS3 signal from a DSX-3
- Recovers DS3 clock and NRZ data
- Calculates parity errors on the DS3 input
- Demultiplexes the M13 or C-bit formatted DS3 signal into 28 DS1s
- Maps the 28 DS1s into VT1.5s and then into an STS-1
- Inserts STS-1 path overhead
- Provides the STS-1 signal to the OLIU circuit packs

Receive functions

- Interprets the STS-1 pointer values
- Terminates the STS-1 path
- Disinterleaves the STS-1 signal into 28 VT1.5s and interprets VT pointer values
- Converts the VT1.5 signals to 28 DS1 signals

- Multiplexes the 28 DS1 signals to an M13 or C-bit formatted DS3 signal
- B3ZS encodes the outgoing DS3 signal
- Pre-equalizes the DS3 signal (with LBO) and transmits it to a DSX-3

Unchannelized DS3 operation

The low-speed DS3 interfaces transmit/receive a standard electrical DS3 signal as specified in GR-499-CORE, Section 9 (44.736 Mb/s rate, DSX-3 interconnect specification, bipolar 3-zero substitution (B3ZS) encoding). However, the signal does not have to contain a standard DS3 frame.

EC-1 operation

The EC-1 low-speed interfaces provide transport of any STS-1 signal compatible with the electrical STS-1 interface specification in GR-253-CORE, Issue 3. The low-speed EC-1 port can be provisioned to provide STS-1 path termination functions for a VT1.5 structured STS-1 with an asynchronous DS1 mapping.

The low-speed EC-1 interfaces transmit/receive a standard electrical EC-1 signal as specified in GR-253-CORE, Issue 3 (51.844 Mb/s rate, STSX-1 interconnect specification, bipolar 3-zero substitution (B3ZS) encoded and scrambled).

Line build-outs (LBOs)

Line build-outs are software-provisionable. The maximum distance depends on the cable type.

Table 10-3 DS3/EC-1 cable lengths

Cable type	LBO in	LBO out
728A/B	0–225 ft.	225–450 ft.
735A	0–112 ft.	112–225 ft.

DS3 portless mode of operation

The LNW20 can also function in portless mode. Portless mode does not utilize any of the electrical ports on the pack. When operating in portless mode, LNW20 converts channelized DS3 signals that enter Alcatel-Lucent 1665 DMX on a SONET STS-1 interface (on another pack) to VT mapped STS-1s. This VT-mapped STS-1 is cross-connected at the VT level in the Main packs (at least one side of the cross-connect is OCn/EC1) to any interface that supports the signal structure today (DS1, channelized DS3, EC1, optical). Portless mode can be provisioned on a per-port basis when VLF Mains are used. When non-VLF Mains are used, odd numbered ports can be configured as portless and the corresponding even-numbered port will be unavailable for service.

OC-N optical interfaces

Overview

Purpose

This section contains technical specifications for the low- and high-speed Alcatel-Lucent 1665 DMX optical interfaces.

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Single-port, high-speed OC-12 OLIU (LNW48, LNW50, LNW54)	10-22
4-port, low-speed OC-12 OLIU (LNW49)	10-25
12-port, low-speed OC-3/12/48 OLIU (LNW55)	10-27
Single-port, high-speed OC-192 OLIUs (LNW56 and LNW58)	10-31
Two-port, high-speed OC-192 VLF Main OLIU (LNW59)	10-34
4-port, low-speed OC-48 OLIU (LNW62)	10-36
8-port, high-speed OC-3/12/48 VLF Main (LNW82)	10-38
Single-port, high-speed OC-48 OLIU (LNW202)	10-42
1-port, high-speed OC-12 OLIU (LNW203)	10-44
Single-port, low-speed OC-48 OLIU (LNW402)	10-45
Single-port, high-speed OC-192 OLIU (LNW502)	10-47
8-port, high-speed OC-48/OC-192 VLF Main (LNW504)	10-49
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Single-port, high-speed OC-48 OLIUs (LNW27, LNW29, LNW32, and LNW76)

Optical specification

LNW27 and LNW32

The high-speed LNW27 and LNW32 OC-48 interfaces meet or exceed SONET OC-48 1310 nm LR-1 specifications.

The LNW32 is hardened for outside plant (OSP) temperature ranges; the LNW27 is not.

These interfaces supports span lengths up to 51 km. In OSP environments, the LNW32 support spans of 49 km.

LNW29

The high-speed LNW29 interface meets or exceeds SONET OC-48 1550 nm LR-2 specifications and supports span lengths up to 81 km.

LNW76

The high-speed LNW76 meets or exceeds SONET OC-48 1310 nm SR-1 specifications and supports span lengths up to 2 km.

System specifications

The table below lists the LNW27, LNW29, LNW32, and LNW76 system specifications.

Table 10-4 LNW27, LNW29, LNW32, LNW76 optical system specifications

System information	LNW27	LNW29	LNW32	LNW76
Optical Line Rate	2.488 Gb/s			
Optical Line Coding	Scrambled NRZ			
Optical Wavelength	1310 nm	1550 nm	1310 nm	

Table 10-4 LNW27, LNW29, LNW32, LNW76 optical system specifications (continued)

System information	LNW27	LNW29	LNW32	LNW76
Performance	SONET Long Reach, LR-1	SONET Very Long Reach, LR-2	SONET Long Reach, LR-1	SONET Short Reach, SR-1
Temperature Range	Central Office/Commercial (0°C to 70°C)		OSP hardened/Industrial (−40°C to 85°C)	Central Office/Commercial (0°C to 70°C)

Transmitter specifications

The table below lists the OC-48 transmitter information.

Table 10-5 LNW27, LNW29, LNW32, LNW76 optical transmitter information

Transmitter information	LNW27	LNW29	LNW32	LNW76
Optical Device Temperature Controller	None			
IEC 60825 Laser Classification	Class 1			
FDA Laser Classification	Class I			
Optical Source	Distributed Feed-Back (DFB) Laser			Fabry-Perot (FP) Laser
Faceplate Optical Connector	LC connector			

Receiver specifications

The table below lists the OC-48 receiver information.

Table 10-6 OC-48 optical receiver information

Receiver information	LNW27	LNW29	LNW32	LNW76
Optical Detector	Avalanche Photo Diode (APD)			InGaAsP PIN
Faceplate Optical Connector	LC connector			

Link budgets

The table below lists the OC-48 link budgets.

Table 10-7 OC-48 optical specifications and link budgets

Parameter[1]	LNW27 OC-48 LR-1	LNW29 OC-48 LR-2	LNW32 OC-48 LR-1	LNW76 OC-48 SR-1
Minimum Wavelength	1280 nm	1500 nm	1280 nm	1266 nm
Maximum Wavelength	1335 nm	1580 nm	1335 nm	1360 nm
Maximum Spectral Width ($\Delta\lambda_{20}$)	1.0 nm	1.0 nm	1.0 nm	−4.0 nm
Maximum Transmitter Power	+3.0 dBm	+3.0 dBm	+3.0 dBm	−3.0 dBm
Minimum Transmitter Power	−2.0 dBm	−2.0 dBm	−2.0 dBm	−10.0 dBm
Maximum Received Power ($1x10^{-12}$ BER)	−8.0 dBm	−8.0 dBm	−8.0 dBm	−3.0 dBm
Minimum Received Power ($1x10^{-12}$ BER)	−29.0 dBm	−29.0 dBm	−29.0/−28.0 dBm[10]	−18.0 dBm
Minimum System Gain[2]	27.0 dB	27.0 dB	27.0/26.0 dB[10]	8.0 dB
Dispersion	NA	1600 ps/nm	NA	NA
Optical Path Penalty[3]	1.0 dB	2.0 dB	1.0 dB	1.0 dB
Minimum Optical Return Loss[4]	24.0 dB	24.0 dB	24.0 dB	24.0 dB
Maximum Receiver Reflectance[4]	−27.0 dB	−27.0 dB	−27.0 dB	−27.0 dB
Additional Connector Loss Margin[5]	1.5 dB	1.5 dB	1.5 dB	1.5 dB
Additional Unallocated Margin[6]	1.5 dB	1.5 dB	1.5 dB	1.5 dB
Minimum Loss Budget[7]	11.0 dB	11.0 dB	11.0 dB	0.0 dB
Maximum Loss Budget[8]	23.0 dB	22.0 dB	23.0/22.0 dB[10]	4.0 dB
Approximate Span Length[9]	51 km	81 km	51/49 km[10]	2 km

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3. All values are worst-case end of life. Optical specifications meet or exceed equivalent GR-253-CORE requirements.
2. The System Gain includes connector loss at the transmitter and receiver points S and R in GR-253-CORE, Issue 3.

3. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm optics is 1.0 dB maximum. The optical path penalty for the 1550 nm optics is 2.0 maximum.
4. See GR-253-CORE for more information about these parameters.
5. One additional connector (0.75 dB) on each end is assumed to connect station cable to outside plant.
6. Additional unallocated margin, or safety margin, can be 0−3 dB. Typically, a 1.5 dB value is assumed.
7. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.
8. The stated maximum loss budget equals the System Gain, less the Optical Path Penalty, the Additional Connector Loss Margin, and the Additional Unallocated Margin. The resultant Maximum Loss Budget is available for station cable loss, transmission cable loss, and splice loss.
9. The approximate span length values are calculated per an attenuation assumption. As a general rule, for attenuation-limited systems, an attenuation of 0.45 dB/km is used for 1310 nm optics. This estimate includes typical cable loss (0.40 dB/km) and up to 11 splice losses (0.2 dB per splice). For 1310 nm OC-48 systems, dispersion is not a limiting factor, and the applications are attenuation-limited. For 1550 nm optics, an attenuation of 0.27 dB/km is used. Again, appropriate fiber-cable loss and numerous splice losses are included. For long-reach 1550 nm applications, dispersion may be a limiting factor. Approximate Span Lengths can be calculated more precisely based on particular fiber and splice characteristics and local engineering rules.
10. The LNW32 is an environmentally hardened OLIU; it is capable of operating in outside plant temperature ranges. The first number applies to deployments in standard CO applications; the second number applies to deployments where temperature excursions (found in OSP environments) may occur.

Alarm thresholding

The following parameters are monitored on the OC-48 interface:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-48 interface, see “Performance monitoring” (p. 5-62).

Single-port, low-speed OC-48 OLIU (LNW31)

Optical specification

The low-speed LNW31 circuit packs meet or exceed SONET OC-48 1310 nm IR-1 specifications and support span lengths up to 20 km.

System specifications

The table below lists the LNW31 system specifications.

Table 10-8 LNW31 optical system specifications

System information	LNW31
Optical Line Rate	2.488 Gb/s
Optical Line Coding	Scrambled NRZ
Optical Wavelength	1310 nm
Performance	SONET Intermediate Reach, IR-1
Temperature Range	Central Office/Commercial (0°C to 70°C)

Transmitter specifications

The table below lists the LNW31 transmitter information.

Table 10-9 LNW31 optical transmitter information

Transmitter information	LNW31
Optical Device Temperature Controller	None
IEC 60825 Laser Classification	Class 1
FDA Laser Classification	Class I
Optical Source	Distributed Feed-Back (DFB) Laser
Faceplate Optical Connector	LC connector

Receiver specifications

The table below lists the LNW31 receiver information.

Table 10-10 LNW31 optical receiver information

Receiver information	LNW31
Optical Detector	PIN
Faceplate Optical Connector	LC connector

Link budgets

The table below lists the LNW31 link budgets.

Table 10-11 LNW31 optical specifications and link budgets

Parameter[1]	LNW31 OC-48 IR-1
Minimum Wavelength	1260 nm
Maximum Wavelength	1360 nm
Maximum Spectral Width ($\Delta\lambda_{20}$)	1.0 nm
Maximum Transmitter Power	0.0 dBm
Minimum Transmitter Power	−5.0 dBm
Maximum Received Power ($1x10^{-12}$ BER)	0.0 dBm
Minimum Received Power ($1x10^{-12}$ BER)	−18.0 dBm
Minimum System Gain[2]	13.0 dB
Dispersion	NA
Optical Path Penalty[3]	1.0 dB
Minimum Optical Return Loss[4]	24.0 dB
Maximum Receiver Reflectance[4]	−27.0 dB
Additional Connector Loss Margin[5]	1.5 dB
Additional Unallocated Margin[6]	1.5 dB
Minimum Loss Budget[7]	0.0 dB
Maximum Loss Budget[8]	9.0 dB
Approximate Span Length[9]	20 km

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3. All values are worst-case end of life (EOL). Optical specifications meet or exceed equivalent GR-253-CORE requirements.
2. The System Gain includes connector loss at the transmitter and receiver points S and R in GR-253-CORE, Issue 3.

3. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm optics is 1.0 dB maximum. The optical path penalty for the 1550 nm optics is 2.0 dB maximum.
4. See GR-253-CORE for more information about these parameters.
5. One additional connector (0.75 dB) on each end is assumed to connect station cable to outside plant.
6. Additional unallocated margin, or safety margin, can be 0−3 dB. Typically, a 1.5 dB value is assumed.
7. The LNW31 does not require an external lightguide build-out (optical attenuator) as part of the connector assembly for optical loopbacks.
8. The stated maximum loss budget equals the System Gain, less the Optical Path Penalty, the Additional Connector Loss Margin, and the Additional Unallocated Margin. The resultant Maximum Loss Budget is available for station cable loss, transmission cable loss, and splice loss.
9. The approximate span length values are calculated per an attenuation assumption. As a general rule, for attenuation-limited systems, an attenuation of 0.45 dB/km is used for 1310 nm optics. This estimate includes typical cable loss (0.40 dB/km) and up to 11 splice losses (0.2 dB per splice). For 1310 nm OC-48 systems, dispersion is not a limiting factor, and the applications are attenuation-limited. Approximate Span Lengths can be calculated more precisely based on particular fiber and splice characteristics and local engineering rules.

Alarm thresholding

The following parameters are monitored on the OC-48 interface:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-48 interface, see “Performance monitoring” (p. 5-62).

Low-speed OC-3 OLIU (LNW37 and LNW45)

Optical specification

The LNW37 and LNW45 OLIUs use Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), and is OSP hardened. PTM optics can be "plugged" into the circuit pack as they become needed. Because the optics are pluggable, different ranges are available. The LNW37 and LNW45 can be equipped with OC-3 SR-1, IR-1, LR-1, or CWDM optics. These optics meet standard optical specs per *Telcordia* ® GR-253-CORE and ITU G.957.

The LNW37 supports 4 ports and the LNW45 supports 8 ports.

The multi-longitudinal-mode/Fabry-Perot (FP) laser is used for short or intermediate-reach transmission. Either a FP or a single-longitudinal-mode/distributed feedback (DFB) laser transmitter is employed in long-reach applications. The PTM optics for the LNW37 and LNW45 supply a 1310 nm, scrambled non-return-to-zero (NRZ) coded signal (155.52 Mb/s).

The LNW37 and LNW45 circuit pack and three OC-3 PTMs are approved for OSP deployments.

For system, transmitter, receiver, and link budget specifications, see "OC-3 PTM optical specifications" (p. 10-66).

Allowed optics for LNW37 and LNW45 packs

The table below lists the PTM optics that may be used in the LNW37 and LNW45 circuit packs.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW37 and LNW45 circuit packs. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-12 Supported PTMs for LNW37 and LNW45

Apparatus code	Description
S155I2	OC-3 SR-1 SFP, 2 km, 1310 nm
OC3IR1-I1	OC-3 IR-1 SFP, 15 km, 1310 nm
OC3LR1-I1	OC-3 LR-1 SFP, 40 km, 1310 nm

Table 10-12 Supported PTMs for LNW37 and LNW45 (continued)

Apparatus code	Description
S622C47EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1471 nm
S622C49EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1491 nm
S622C51EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1511 nm
S622C53EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1531 nm
S622C55EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1551 nm
S622C57EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1571 nm
S622C59EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1591 nm
S622C61EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1611 nm

Alarm thresholding

The following parameters are monitored on the OC-3 interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-3 interfaces, see "Performance monitoring" (p. 5-62).

Single-port, high-speed OC-12 OLIU (LNW48, LNW50, LNW54)

Optical specification for LNW48

The LNW48 optics meet or exceed SONET OC-12 intermediate-reach specifications (SONET OC-12 IR-1). The multi-longitudinal-mode/Fabry-Perot (FP) laser supplies a 1310 nm, scrambled NRZ-coded signal (622.08 Mb/s).

The LNW48 high-speed interface supports span lengths up to 20 km and is OSP hardened.

Optical specification for LNW50

The LNW50 optics meet or exceed SONET OC-12 long-reach specifications (SONET OC-12 LR-1). The single-longitudinal-mode/distributed feedback laser (DFB) supplies a 1310 nm, scrambled NRZ-coded signal (622.08 Mb/s).

The LNW50 high-speed interface supports span lengths up to 53 km and is OSP hardened.

Optical specification for LNW54

The LNW54 optics meet or exceed SONET OC-12 long-reach specifications (SONET OC-12 LR-2). The single-longitudinal-mode/distributed feedback laser (DFB) supplies a 1550 nm, scrambled NRZ-coded signal (622.08 Mb/s).

The LNW54 high-speed interface supports span lengths up to 81 km and is OSP hardened.

System specifications

The table below lists the LNW48, LNW50, and LNW54 OC-12 system specifications.

Table 10-13 LNW48, LNW50, and LNW54 optical system specifications

System information	LNW48	LNW50	LNW54
Optical Line Rate	622.08 Mb/s		
Optical Line Coding	Scrambled NRZ		
Optical Wavelength	1310 nm		1550 nm
Performance	SONET OC-12, Intermediate Reach IR-1	SONET OC-12 Long Reach, LR-1	SONET OC-12 Very Long Reach, LR-2
Temperature Range	OSP hardened/Industrial (−40°C to 85°C)		

Transmitter specifications

The table below lists the LNW48, LNW50, and LNW54 OC-12 transmitter information.

Table 10-14 LNW48, LNW50, and LNW54 optical transmitter information

Transmitter information	LNW48	LNW50	LNW54
Optical Device Temperature Controller	None		
IEC 60825 Laser Classification	Class 1		
FDA Laser Classification	Class I		
Optical Source	Fabry Perot (FP) Laser	Distributed Feed-Back (DFB) Laser	
Faceplate Optical Connector	LC connector		

Receiver specifications

The table below lists the LNW48, LNW50, and LNW54 OC-12 receiver information.

Table 10-15 LNW48, LNW50, and LNW54 optical receiver information

Receiver information	LNW48, LNW50, LNW54
Optical Detector	InGaAsP PIN
Faceplate Optical Connector	LC connector

Link budgets

The table below lists the LNW48, LNW50, and LNW54 link budgets.

Table 10-16 LNW48, LNW50, and LNW54 optical specifications and link budgets

Parameter	LNW48 OC-12 IR-1[1]	LNW50 OC-12 LR-1[1]	LNW54 OC-12 LR-2[1]
Minimum Wavelength	1274 nm	1280 nm	1480 nm
Maximum Wavelength	1356 nm	1335 nm	1580 nm
Maximum Spectral Width ($\Delta\lambda_{20}$)	NA	1.0 nm	1.0 nm
Maximum RMS Spectral Width (σ)	2.5 nm	NA	NA
Minimum Side Mode Suppression Ratio	NA	30.0 dB	30.0 dB

Table 10-16 LNW48, LNW50, and LNW54 optical specifications and link budgets (continued)

Parameter	LNW48 OC-12 IR-1[1]	LNW50 OC-12 LR-1[1]	LNW54 OC-12 LR-2[1]
Maximum Transmitter Power	−8.0 dBm	2.0 dBm	2.0 dBm
Minimum Transmitter Power	−15.0 dBm	−2.5 dBm	−3.0 dBm
Maximum Received Power	−8.0 dBm	−7.0 dBm	−8.0 dBm
Minimum Received Power ($1x10^{-12}$ BER)	−28.0 dBm	−30.5 dBm	−29.0 dBm
System Gain[2]	13.0 dB	28.0 dB	26.0 dB
Optical Path Penalty[3]	1.0 dB	1.0 dB	1.0 dB
Minimum Optical Return Loss[4]	NA	20.0 dB	24.0 dB
Maximum Receiver Reflectance[4]	NA	−14.0 dB	−27.0 dB
Additional Connector Loss Margin[5]	1.5 dB	1.5 dB	1.5 dB
Additional Unallocated Margin[6]	1.5 dB	1.5 dB	1.5 dB
Minimum Loss Budget[7]	0.0 dB	9.0 dB	10.0 dB
Maximum Loss Budget[8]	9.0 dB	24.0 dB	22.0 dB
Approximate Span Length[9]	20 km	53 km	81 km

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3. All values are worst-case end of life.
2. The System Gain includes connector loss at the transmitter and receiver points S and R in GR-253-CORE, Issue 3.
3. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. At OC-12 rates, the optical path penalty is normally 1.0 dB for both 1310 nm and 1550 nm optics.
4. Refer to GR-253-CORE for more information about these parameters.
5. One additional connector (0.75 dB) on each end is assumed to connect station cable to outside plant.
6. Additional unallocated margin, or safety margin, can be 0−3 dB. Typically, a 1.5 dB value is assumed.
7. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.

8. The stated maximum loss budget equals the System Gain, less the Optical Path Penalty, the Additional Connector Loss Margin, and the Additional Unallocated Margin. The resultant Maximum Loss Budget is available for station cable loss, transmission cable loss, and splice loss.
9. The Approximate Span Length values are calculated per an attenuation assumption. As a general rule, for attenuation-limited systems, an attenuation of 0.45 dB/km is used for 1310 nm optics. This estimate includes typical cable loss (0.40 dB/km) and up to 11 splice losses (0.2 dB per splice). For 1550 nm optics, an attenuation of 0.27 dB/km is used. Again, appropriate fiber-cable loss and numerous splice losses are included. For 1310 nm OC-3 and OC-12 systems, dispersion is not a limiting factor, and the applications are attenuation-limited. Approximate span lengths can be calculated more precisely based on particular fiber and splice characteristics and local engineering rules.

Alarm thresholding

The following parameters are monitored at the OC-12 high-speed (network-side) interface.

- LOF
- LOS
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-12 high-speed interface, see “Performance monitoring” (p. 5-62).

4-port, low-speed OC-12 OLIU (LNW49)

Optical specification

The LNW49 OLIU uses Pluggable Transmission Module (PTM) optics. PTM optics can be "plugged" into the circuit pack as they become needed. Because the optics are pluggable, different ranges are available. The LNW49 can be equipped with IR-1, LR-1, LR-2, or CWDM optics. These optics meet standard optical specs per *Telcordia* ® GR-253-CORE and ITU G.957.

The IR-1 optics available for this circuit pack also conform to SR-1 specifications. Thus, the LNW49 can also be employed in short reach applications.

The multi-longitudinal-mode/Fabry-Perot (FP) laser is used for short or intermediate-reach transmission. A single-longitudinal-mode/ distributed feedback (DFB) laser transmitter is employed in long-reach applications. The IR-1 and LR-1 PTM optics for the LNW49 supply a 1310 nm, scrambled non-return-to-zero (NRZ) coded signal (622.08 Mb/s). The LR-2 PTM optics for the LNW49 supply a 1550 nm, scrambled non-return-to-zero (NRZ) coded signal (622.08 Mb/s).

The LNW49 circuit pack some of the supported OC-N PTMs are approved for OSP deployments. You must install PTMs that are approved for industrial temperatures to use the LNW49 in OSP environments. All of the CWDM PTMs are approved for extended temperatures and are therefore only approved for Central Office environments.

For detailed system, transmitter, receiver, and link budget specifications, see "OC-12 PTM optical specifications" (p. 10-70).

Allowed optics for LNW49 packs

The table below lists the PTM optics that may be used in the LNW49 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW49 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-17 Supported PTMs for LNW49

Apparatus code	Description
OC12IR1-I1	OC-12 IR-1 SFP, 15 km, 1310 nm
OC12LR1-I1	OC-12 LR-1 SFP, 40 km, 1310 nm
OC12LR2-I1	OC-12 LR-2 SFP, 80 km, 1550 nm
S622C47EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1471 nm
S622C49EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1491 nm
S622C51EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1511 nm
S622C53EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1531 nm
S622C55EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1551 nm
S622C57EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1571 nm
S622C59EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1591 nm
S622C61EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1611 nm

Alarm thresholding

The following parameters are monitored on the OC-12 interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-12 interfaces, see "Performance monitoring" (p. 5-62).

12-port, low-speed OC-3/12/48 OLIU (LNW55)

Optical specification

The LNW55 OC3/OC12/OC48 OLIU circuit pack is a 12-port, PTM-based, multi-port, multi-rate (MPMR), OC-3, OC-12, OC-48 low-speed optical circuit pack.

The LNW55 circuit pack and some of the supported OC-N PTMs are approved for OSP deployments. You must install PTMs that are approved for industrial temperatures to use the LNW55 in OSP environments. All of the DWDM PTMs are approved for commercial temperatures and are therefore only approved for Central Office environments.

The LNW55 OLIU circuit pack supports a maximum of 12 OC-3 ports, 12 OC-12 ports, or 4 OC-48 ports. Mixing port optical rates is supported with the following restrictions:

- OC-48 interfaces are only supported on ports 1, 4, 7, and 10.
- When port 1, 4, 7, or 10 is used for an OC-48 interface, then the next two adjacent ports are unavailable for use.
- For example, if an OC-48 pluggable transmission module is installed in port 1, then ports 2 and 3 are unavailable for use.

For detailed system, transmitter, receiver, and link budget specifications, see

- "OC-3 PTM optical specifications" (p. 10-66)
- "OC-12 PTM optical specifications" (p. 10-70)
- "OC-48 PTM optical specifications" (p. 10-74)
- "OC-3/OC-12/OC-48 multi-rate PTM optical specifications" (p. 10-79)

Allowed optics for LNW55 packs

The table below lists the OC-3. OC-12, and OC-48 Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), that may be used in the LNW55 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW55 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Supported multi-rate PTMs

Table 10-18 Supported multi-rate PTMs for LNW55

Apparatus code	Description
OC3X12X48-IR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 15 km, 1310 nm
OC3X12X48-LR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 40 km, 1310 nm
S622C47EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1471 nm
S622C49EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1491 nm
S622C51EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1511 nm
S622C53EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1531 nm
S622C55EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1551 nm
S622C57EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1571 nm
S622C59EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1591 nm
S622C61EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1611 nm

Supported OC-3 PTMs

Table 10-19 Supported OC-3 PTMs for LNW55

Apparatus code	Description
S155I2	OC-3 SR-1 SFP, 2 km, 1310 nm
OC3IR1-I1	OC-3 IR-1 SFP, 15 km, 1310 nm
OC3LR1-I1	OC-3 LR-1 SFP, 40 km, 1310 nm

Supported OC-12 PTMs

Table 10-20 Supported OC-12 PTMs for LNW55

Apparatus code	Description
OC12IR1-I1	OC-12 IR-1 SFP, 15 km, 1310 nm
OC12LR1-I1	OC-12 LR-1 SFP, 40 km, 1310 nm
OC12LR2-I1	OC-12 LR-2 SFP, 80 km, 1550 nm

Supported OC-48 PTMs

Table 10-21 Supported OC-48 PTMs for LNW55

Apparatus code	Description
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm

Table 10-21 Supported OC-48 PTMs for LNW55 (continued)

Apparatus code	Description
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm
S2G7C47LI	OC-48/STM-16 CWDM SFP, 80 km, 1471 nm
S2G7C49LI	OC-48/STM-16 CWDM SFP, 80 km, 1491 nm
S2G7C51LI	OC-48/STM-16 CWDM SFP, 80 km, 1511 nm
S2G7C53LI	OC-48/STM-16 CWDM SFP, 80 km, 1531 nm
S2G7C55LI	OC-48/STM-16 CWDM SFP, 80 km, 1551 nm
S2G7C57LI	OC-48/STM-16 CWDM SFP, 80 km, 1571 nm
S2G7C59LI	OC-48/STM-16 CWDM SFP, 80 km, 1591 nm
S2G7C61LI	OC-48/STM-16 CWDM SFP, 80 km, 1611 nm

Alarm thresholding

The following parameters are monitored on the OC-N interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-N interfaces, see "Performance monitoring" (p. 5-62).

Single-port, high-speed OC-192 OLIUs (LNW56 and LNW58)

Optical specification

This section briefly details the optical specifications for the OC-192 LNW56 and LNW58 circuit packs.

LNW56

The LNW56 circuit pack is a high-speed, intermediate reach OLIU that meets or exceeds SONET OC-192 1550 IR-2 specifications. The LNW56 circuit pack bridges span lengths up to 40 km. The LNW56 transmits in the general 1550 nm range.

LNW58 (optical interface for intra-office applications)

The LNW58 is a high-speed, very short reach (VSR) OC-192 OLIU that meets or exceeds ITU G.693 VSR600-2R1 specifications. The LNW56 circuit pack bridges span lengths up to 600 meters. The LNW58 transmits in the general 1310 nm range.

System specifications

The table below lists the OC-192 OLIU system specifications.

Important! At high optical launch powers, SBS can cause an acoustic back-scattering phenomenon in fibers. The dither tone effectively broadens the spectrum of the narrow optical pulse, thus raising the threshold power where SBS becomes an issue.

For fibers carrying multiple wavelengths in DWDM systems, it should be noted that the individual channel (individual wavelength) power determines the SBS threshold, not the total composite power of all the channels.

Table 10-22 LNW56 and LNW58 optical system specifications

System information	LNW56	LNW58
Optical Line Rate	9953.28 Mb/s	
Optical Line Coding	Scrambled NRZ	
Optical Wavelength	1550 nm	1310 nm
Performance	GR-253-CORE OC-192 Intermediate Reach, IR-2	ITU-T G.693 Very Short Reach, VSR600-2R1
Temperature Range	Central Office/Commercial (0°C to 70°C)	

Transmitter specifications

The table below lists the LNW56 and LNW58 OLIU transmitter information.

Table 10-23 LNW56 and LNW58 optical transmitter information

Transmitter information	LNW56	LNW58
Optical Device Temperature Controller	None	
IEC 60825 Laser Classification	Class 1	
FDA Laser Classification	Class I	
Optical Source	1550 nm, EML Laser Structure	1310 nm, FP or DFB Laser Structure
Faceplate Optical Connector	LC connector	

Receiver specifications

The table below lists the LNW56 and LNW58 OLIU receiver information.

Table 10-24 LNW56 and LNW58 optical receiver information

Receiver information	LNW56	LNW58
Optical Detector	PIN Diode	PIN Diode
Faceplate Optical Connector	LC connector	

Link budgets

The table below lists the LNW56 and LNW58 OLIU link budgets.

Table 10-25 LNW56 and LNW58 specifications and link budgets

Parameter[1]	LNW56	LNW58
Minimum Wavelength	1530 nm	1260 nm
Maximum Wavelength	1565 nm	1360 nm
Maximum Spectral Width ($\Delta\lambda_{20}$)	1.0 nm	NA
Maximum RMS Spectral Width (σ)	NA	3.0 nm
Minimum Side Mode Suppression Ratio	30 dB	NA
Maximum Transmitter Power	2.0 dBm	−1.0 dBm
Minimum Transmitter Power	−1.0 dBm	−6.0 dBm
Maximum Received Power	−1.0 dBm	−1.0 dBm

Table 10-25 LNW56 and LNW58 specifications and link budgets (continued)

Parameter[1]	LNW56	LNW58
Minimum Received Power ($1x10^{-12}$ BER)	−14.0 dBm	−11.0 dBm
Minimum System Gain[2]	13.0 dB	5.0 dB
Dispersion	800 ps/nm	NA
Optical Path Penalty[3]	2.0 dB	1.0 dB
Minimum Optical Return Loss[4]	24.0 dB	14.0 dB
Maximum Receiver Reflectance[4]	−27.0 dB	−14.0 dB
Optical Signal to Noise Ratio (OSNR); $1x10^{-12}$ BER, −10 to −20 dBm, +1600 ps/nm, 0.1 nm RBW	NA	NA
Minimum Loss Budget[5]	3.0 dB	0.0 dB
Maximum Loss Budget[6]	11.0 dB	4.0 dB
Approximate Span Length[7]	40 km	600 meters

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3 and ITU G.693. All values are worst-case end of life. Optical specifications meet or exceed equivalent GR-253-CORE requirements.
2. The system gain includes connector loss at the transmitter and receiver points S and R in GR-253-CORE, Issue 3.
3. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm is a maximum of 1.0 dB. The optical path penalty for 1550 nm is a maximum of 2.0 dB.
4. Refer to GR-253-CORE for more information about these parameters.
5. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.
6. The stated maximum loss budget equals the minimum system gain, minus the optical path penalty. Maximum loss budget is available for both station and transmission cable and splices.
7. The Approximate Span Length values are calculated per an attenuation assumption. As a general rule, for attenuation-limited systems, an attenuation of 0.27 dB/km is used for 1550 nm optics. This estimate includes typical cable loss (0.22 dB/km) and up to 11 splice losses (0.2 dB per splice). For 1550 nm OC-192 systems, dispersion can also be a limiting factor. Approximate Span Lengths can be calculated more precisely based on particular fiber and splice characteristics and local engineering rules. Note that the 1310 nm VSR OC-192 LNW58 is recommended for spans of up to 600 meters only.

Alarm thresholding

The following parameters are monitored on the OC-192 interface:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-192 interface, see "Performance monitoring" (p. 5-62).

Two-port, high-speed OC-192 VLF Main OLIU (LNW59)

Optical specification

The LNW59 OC-192 OLIU circuit pack is a two-port, PTM-based, high-speed VLF Main circuit pack.

For detailed system, transmitter, receiver, and link budget specifications, see "OC-192 PTM optical specifications" (p. 10-82).

Allowed optics for LNW59 packs

The table below lists Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (XFPs), that may be used in the LNW59 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW59 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-26 Supported OC-192 PTMs for LNW59

Apparatus code	Description
OC192SR1-C1	OC-192 SR-1 XFP, 2 km, 1310 nm
OC192IR2-I1	OC-192 IR-2 XFP, 40 km, 1550 nm
OC192IR2-C1	OC-192 IR-2 XFP, 40 km, 1550 nm
OC192LR2-C1	OC-192 LR-2 XFP, 80 km, 1550 nm
X10G21C5	OC-192/STM-64/OTU2 DWDM XFP, 192.1 THz, 1560.606 nm
X10G22C5	OC-192/STM-64/OTU2 DWDM XFP, 192.2 THz, 1559.794 nm
X10G23C5	OC-192/STM-64/OTU2 DWDM XFP, 192.3 THz, 1558.983 nm
X10G24C5	OC-192/STM-64/OTU2 DWDM XFP, 192.4 THz, 1558.173 nm
X10G25C5	OC-192/STM-64/OTU2 DWDM XFP, 192.5 THz, 1557.363 nm
X10G26C5	OC-192/STM-64/OTU2 DWDM XFP, 192.6 THz, 1556.555 nm
X10G27C5	OC-192/STM-64/OTU2 DWDM XFP, 192.7 THz, 1555.747 nm
X10G28C5	OC-192/STM-64/OTU2 DWDM XFP, 192.8 THz, 1554.940 nm
X10G31C5	OC-192/STM-64/OTU2 DWDM XFP, 193.1 THz, 1552.524 nm
X10G33C5	OC-192/STM-64/OTU2 DWDM XFP, 193.3 THz, 1550.918 nm
X10G35C5	OC-192/STM-64/OTU2 DWDM XFP, 193.5 THz, 1549.315 nm
X10G37C5	OC-192/STM-64/OTU2 DWDM XFP, 193.7 THz, 1547.715 nm
X10G45C5	OC-192/STM-64/OTU2 DWDM XFP, 194.5 THz, 1541.349 nm
X10G47C5	OC-192/STM-64/OTU2 DWDM XFP, 194.7 THz, 1539.766 nm
X10G49C5	OC-192/STM-64/OTU2 DWDM XFP, 194.9 THz, 1538.186 nm
X10G52C5	OC-192/STM-64/OTU2 DWDM XFP, 195.2 THz, 1535.822 nm
X10G53C5	OC-192/STM-64/OTU2 DWDM XFP, 195.3 THz, 1535.036 nm
X10G54C5	OC-192/STM-64/OTU2 DWDM XFP, 195.4 THz, 1534.250 nm
X10G55C5	OC-192/STM-64/OTU2 DWDM XFP, 195.5 THz, 1533.465 nm
X10G56C5	OC-192/STM-64/OTU2 DWDM XFP, 195.6 THz, 1532.681 nm
X10G57C5	OC-192/STM-64/OTU2 DWDM XFP, 195.7 THz, 1531.898 nm
X10G58C5	OC-192/STM-64/OTU2 DWDM XFP, 195.8 THz, 1531.116 nm
X10G59C5	OC-192/STM-64/OTU2 DWDM XFP, 195.9 THz, 1530.334 nm

Alarm thresholding

The following parameters are monitored on the OC-192 interface:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-192 interface, see "Performance monitoring" (p. 5-62).

4-port, low-speed OC-48 OLIU (LNW62)

Optical specification

The LNW62 circuit pack and some of the supported OC-N PTMs are approved for OSP deployments. You must install PTMs that are approved for industrial temperatures to use the LNW62 in OSP environments. All of the DWDM PTMs are approved for commercial temperatures and are therefore only approved for Central Office environments.

For detailed system, transmitter, receiver, and link budget specifications, see "OC-48 PTM optical specifications" (p. 10-74).

Allowed optics for LNW62 packs

The table below lists Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), that may be used in the LNW62 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW62 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-27 Supported OC-48 PTMs for LNW62

Apparatus code	Description
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm
S2G7C47LI	OC-48/STM-16 CWDM SFP, 80 km, 1471 nm
S2G7C49LI	OC-48/STM-16 CWDM SFP, 80 km, 1491 nm
S2G7C51LI	OC-48/STM-16 CWDM SFP, 80 km, 1511 nm
S2G7C53LI	OC-48/STM-16 CWDM SFP, 80 km, 1531 nm
S2G7C55LI	OC-48/STM-16 CWDM SFP, 80 km, 1551 nm
S2G7C57LI	OC-48/STM-16 CWDM SFP, 80 km, 1571 nm
S2G7C59LI	OC-48/STM-16 CWDM SFP, 80 km, 1591 nm
S2G7C61LI	OC-48/STM-16 CWDM SFP, 80 km, 1611 nm

Alarm thresholding

The following parameters are monitored on the OC-48 interfaces:

- LOS
- LOF
- AIS-L

- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-48 interfaces, see "Performance monitoring" (p. 5-62).

8-port, high-speed OC-3/12/48 VLF Main (LNW82)

Optical specification

The LNW82 OC3/OC12/OC48 OLIU circuit pack is an 8-port, PTM-based, multi-rate (OC-3, OC-12, OC-48), high-speed optical circuit pack.

The LNW82 circuit pack and some of the supported OC-N PTMs are approved for OSP deployments. You must install PTMs that are approved for industrial temperatures to use the LNW82 in OSP environments. All of the DWDM PTMs are approved for commercial temperatures and are therefore only approved for Central Office environments.

The LNW82 OLIU circuit pack supports a maximum of 8 OC-3 ports, 8 OC-12 ports, or 2 OC-48 ports. Mixing port optical rates is supported with the following restrictions:

- OC-48 interfaces are only supported on ports 1 and 5.
- When port 1 or 5 is used for an OC-48 interface, then the next three adjacent ports are unavailable for use. For example, if an OC-48 pluggable transmission module is installed in port 1, then ports 2, 3, and 4 are unavailable for use.

For detailed system, transmitter, receiver, and link budget specifications, see

- "OC-3 PTM optical specifications" (p. 10-66)
- "OC-12 PTM optical specifications" (p. 10-70)
- "OC-48 PTM optical specifications" (p. 10-74)
- "OC-3/OC-12/OC-48 multi-rate PTM optical specifications" (p. 10-79)

Allowed optics for LNW82 packs

The table below lists the OC-3. OC-12, and OC-48 Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), that may be used in the LNW82 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW82 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Supported multi-rate PTMs

Table 10-28 Supported multi-rate PTMs for LNW82

Apparatus code	Description
OC3X12X48-IR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 15 km, 1310 nm
OC3X12X48-LR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 40 km, 1310 nm
S622C47EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1471 nm
S622C49EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1491 nm
S622C51EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1511 nm
S622C53EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1531 nm
S622C55EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1551 nm
S622C57EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1571 nm
S622C59EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1591 nm
S622C61EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1611 nm

Supported OC-3 PTMs

Table 10-29 Supported OC-3 PTMs for LNW82

Apparatus code	Description
S155I2	OC-3 SR-1 SFP, 2 km, 1310 nm
OC3IR1-I1	OC-3 IR-1 SFP, 15 km, 1310 nm
OC3LR1-I1	OC-3 LR-1 SFP, 40 km, 1310 nm

Supported OC-12 PTMs

Table 10-30 Supported OC-12 PTMs for LNW82

Apparatus code	Description
OC12IR1-I1	OC-12 IR-1 SFP, 15 km, 1310 nm
OC12LR1-I1	OC-12 LR-1 SFP, 40 km, 1310 nm
OC12LR2-I1	OC-12 LR-2 SFP, 80 km, 1550 nm

Supported OC-48 PTMs

Table 10-31 Supported OC-48 PTMs for LNW82

Apparatus code	Description
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm

Table 10-31 Supported OC-48 PTMs for LNW82 (continued)

Apparatus code	Description
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm
S2G7C47LI	OC-48/STM-16 CWDM SFP, 80 km, 1471 nm
S2G7C49LI	OC-48/STM-16 CWDM SFP, 80 km, 1491 nm
S2G7C51LI	OC-48/STM-16 CWDM SFP, 80 km, 1511 nm
S2G7C53LI	OC-48/STM-16 CWDM SFP, 80 km, 1531 nm
S2G7C55LI	OC-48/STM-16 CWDM SFP, 80 km, 1551 nm
S2G7C57LI	OC-48/STM-16 CWDM SFP, 80 km, 1571 nm
S2G7C59LI	OC-48/STM-16 CWDM SFP, 80 km, 1591 nm
S2G7C61LI	OC-48/STM-16 CWDM SFP, 80 km, 1611 nm

Alarm thresholding

The following parameters are monitored on the OC-N interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-N interfaces, see "Performance monitoring" (p. 5-62).

Single-port, high-speed OC-48 OLIU (LNW202)

Optical specification

The high-speed LNW202 is a single-port OLIU that employs PTM pluggable optics to offer 1310 nm, 1550 nm, CWDM, or DWDM optics with a 48 STS-1 VT fabric.

The LNW202 circuit pack and three of the supported OC-48 PTMs are approved for OSP deployments. You must install a PTM that is approved for industrial temperatures (OC48SR1-I1, OC48LR1-I1, OC48LR2-I1, CWDM [S2G7C47LI– S2G7C61LI]) to use the LNW202 in OSP environments. All of the DWDM PTMs are approved for commercial temperatures and are therefore only approved for Central Office environments.

For detailed system, transmitter, receiver, and link budget specifications, see "OC-48 PTM optical specifications" (p. 10-74).

Allowed optics for LNW202 packs

The table below lists Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), that may be used in the LNW202 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW202 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-32 Supported OC-48 PTMs for LNW202

Apparatus code	Description
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm

Table 10-32 Supported OC-48 PTMs for LNW202 (continued)

Apparatus code	Description
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm
S2G7C47LI	OC-48/STM-16 CWDM SFP, 80 km, 1471 nm
S2G7C49LI	OC-48/STM-16 CWDM SFP, 80 km, 1491 nm
S2G7C51LI	OC-48/STM-16 CWDM SFP, 80 km, 1511 nm
S2G7C53LI	OC-48/STM-16 CWDM SFP, 80 km, 1531 nm
S2G7C55LI	OC-48/STM-16 CWDM SFP, 80 km, 1551 nm
S2G7C57LI	OC-48/STM-16 CWDM SFP, 80 km, 1571 nm
S2G7C59LI	OC-48/STM-16 CWDM SFP, 80 km, 1591 nm
S2G7C61LI	OC-48/STM-16 CWDM SFP, 80 km, 1611 nm

Alarm thresholding

The following parameters are monitored on the OC-48 interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-48 interfaces, see "Performance monitoring" (p. 5-62).

1-port, high-speed OC-12 OLIU (LNW203)

Optical specification

The LNW203 OLIU uses Pluggable Transmission Module (PTM) optics. PTM optics can be "plugged" into the circuit pack as they become needed. Because the optics are pluggable, different ranges are available. The LNW203 can be equipped with IR-1, LR-1, or LR-2 optics. These optics meet standard optical specs per *Telcordia* ® GR-253-CORE and ITU G.957.

The IR-1 optics available for this circuit pack also conform to SR-1 specifications. Thus, the LNW203 can also be employed in short reach applications.

The multi-longitudinal-mode/Fabry-Perot (FP) laser is used for short or intermediate-reach transmission. A single-longitudinal-mode/ distributed feedback (DFB) laser transmitter is employed in long-reach applications. The IR-1 and LR-1 PTM optics for the LNW203 supply a 1310 nm, scrambled non-return-to-zero (NRZ) coded signal (622.08 Mb/s). The LR-2 PTM optics for the LNW203 supply a 1550 nm, scrambled non-return-to-zero (NRZ) coded signal (622.08 Mb/s).

The LNW203 circuit pack and the supported OC-12 PTMs are approved for OSP deployments. You must install PTMs that are approved for industrial temperatures to use the LNW203 in OSP environments.

For detailed system, transmitter, receiver, and link budget specifications, see “OC-12 PTM optical specifications” (p. 10-70).

Allowed optics for LNW203 packs

The table below lists the PTM optics that may be used in the LNW203 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW203 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-33 Supported PTMs for LNW203

Apparatus code	Description
OC12IR1-I1	OC-12 IR-1 SFP, 15 km, 1310 nm
OC12LR1-I1	OC-12 LR-1 SFP, 40 km, 1310 nm

Table 10-33 Supported PTMs for LNW203 (continued)

Apparatus code	Description
OC12LR2-I1	OC-12 LR-2 SFP, 80 km, 1550 nm

Alarm thresholding

The following parameters are monitored on the OC-12 interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-12 interfaces, see "Performance monitoring" (p. 5-62).

Single-port, low-speed OC-48 OLIU (LNW402)

Optical specification

The low-speed LNW402 is a single-port OLIU that employs PTM pluggable optics to offer 1310 nm, 1550 nm, or DWDM optics with a 12 STS-1 VT fabric.

The LNW402 circuit pack and three of the supported OC-48 PTMs are approved for OSP deployments. You must install a PTM that is approved for industrial temperatures (OC48SR1-I1, OC48LR1-I1, OC48LR2-I1, CWDM [S2G7C47LI– S2G7C61LI]) to use the LNW402 in OSP environments. All of the DWDM PTMs are approved for commercial temperatures and are therefore only approved for Central Office environments.

For detailed system, transmitter, receiver, and link budget specifications, see "OC-48 PTM optical specifications" (p. 10-74).

Allowed optics for LNW402 packs

The table below lists Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), that may be used in the LNW402 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW402 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-34 Supported OC-48 PTMs for LNW402

Apparatus code	Description
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm
S2G7C47LI	OC-48/STM-16 CWDM SFP, 80 km, 1471 nm
S2G7C49LI	OC-48/STM-16 CWDM SFP, 80 km, 1491 nm
S2G7C51LI	OC-48/STM-16 CWDM SFP, 80 km, 1511 nm
S2G7C53LI	OC-48/STM-16 CWDM SFP, 80 km, 1531 nm
S2G7C55LI	OC-48/STM-16 CWDM SFP, 80 km, 1551 nm
S2G7C57LI	OC-48/STM-16 CWDM SFP, 80 km, 1571 nm
S2G7C59LI	OC-48/STM-16 CWDM SFP, 80 km, 1591 nm
S2G7C61LI	OC-48/STM-16 CWDM SFP, 80 km, 1611 nm

Alarm thresholding

The following parameters are monitored on the OC-48 interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-48 interfaces, see "Performance monitoring" (p. 5-62).

Single-port, high-speed OC-192 OLIU (LNW502)

Optical specification

The high-speed LNW502 is a single-port OLIU that employs PTM pluggable optics to offer 1310 nm or 1550 nm optics with a 48 STS-1 VT fabric.

For detailed system, transmitter, receiver, and link budget specifications, "OC-192 PTM optical specifications" (p. 10-82).

Allowed optics for LNW502 packs

The table below lists the PTMs that may be used in the LNW502 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW502 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Table 10-35 Supported PTMs for LNW502

Apparatus code	Description
OC192SR1-C1	OC-192 SR-1 XFP, 2 km, 1310 nm

Table 10-35 Supported PTMs for LNW502 (continued)

Apparatus code	Description
OC192IR2-C1	OC-192 IR-2 XFP, 40 km, 1550 nm
OC192LR2-C1	OC-192 LR-2 XFP, 80 km, 1550 nm
X10G21C5	OC-192/STM-64/OTU2 DWDM XFP, 192.1 THz, 1560.606 nm
X10G22C5	OC-192/STM-64/OTU2 DWDM XFP, 192.2 THz, 1559.794 nm
X10G23C5	OC-192/STM-64/OTU2 DWDM XFP, 192.3 THz, 1558.983 nm
X10G24C5	OC-192/STM-64/OTU2 DWDM XFP, 192.4 THz, 1558.173 nm
X10G25C5	OC-192/STM-64/OTU2 DWDM XFP, 192.5 THz, 1557.363 nm
X10G26C5	OC-192/STM-64/OTU2 DWDM XFP, 192.6 THz, 1556.555 nm
X10G27C5	OC-192/STM-64/OTU2 DWDM XFP, 192.7 THz, 1555.747 nm
X10G28C5	OC-192/STM-64/OTU2 DWDM XFP, 192.8 THz, 1554.940 nm
X10G31C5	OC-192/STM-64/OTU2 DWDM XFP, 193.1 THz, 1552.524 nm
X10G33C5	OC-192/STM-64/OTU2 DWDM XFP, 193.3 THz, 1550.918 nm
X10G35C5	OC-192/STM-64/OTU2 DWDM XFP, 193.5 THz, 1549.315 nm
X10G37C5	OC-192/STM-64/OTU2 DWDM XFP, 193.7 THz, 1547.715 nm
X10G45C5	OC-192/STM-64/OTU2 DWDM XFP, 194.5 THz, 1541.349 nm
X10G47C5	OC-192/STM-64/OTU2 DWDM XFP, 194.7 THz, 1539.766 nm
X10G49C5	OC-192/STM-64/OTU2 DWDM XFP, 194.9 THz, 1538.186 nm
X10G52C5	OC-192/STM-64/OTU2 DWDM XFP, 195.2 THz, 1535.822 nm
X10G53C5	OC-192/STM-64/OTU2 DWDM XFP, 195.3 THz, 1535.036 nm
X10G54C5	OC-192/STM-64/OTU2 DWDM XFP, 195.4 THz, 1534.250 nm
X10G55C5	OC-192/STM-64/OTU2 DWDM XFP, 195.5 THz, 1533.465 nm
X10G56C5	OC-192/STM-64/OTU2 DWDM XFP, 195.6 THz, 1532.681 nm
X10G57C5	OC-192/STM-64/OTU2 DWDM XFP, 195.7 THz, 1531.898 nm
X10G58C5	OC-192/STM-64/OTU2 DWDM XFP, 195.8 THz, 1531.116 nm
X10G59C5	OC-192/STM-64/OTU2 DWDM XFP, 195.9 THz, 1530.334 nm

Alarm thresholding

The following parameters are monitored on the OC-192 interfaces:

- LOS
- LOF
- AIS-L

- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-192 interfaces, see "Performance monitoring" (p. 5-62).

8-port, high-speed OC-48/OC-192 VLF Main (LNW504)

Optical specification

The LNW504 OC48/OC-192 OLIU circuit pack is an 8-port, PTM-based, multi-rate (OC-48/OC-192), high-speed optical circuit pack.

The LNW504 high-speed circuit pack is an 8-port, multi-port., multi-rate (MPMR) OC-48/OC-192 VLF Main circuit pack. LNW504 pack supports up to 4 OC-192 interfaces or up to 3 OC-192 interfaces and 4 OC-48 interfaces and has integrated STS and VT fabrics.

Note: Because the four OC-48 lines and the fourth OC-192 line share the same internal resources, the operation of OC-48 lines 5–8 is mutually exclusive of the operation of OC-192 line 4.

Mixed interface rates are supported with the following restrictions.

- OC-192 interfaces are only supported on ports 1–4
- OC-48 interfaces are only supported on ports 5–8

Note: The LNW504 faceplate port numbering starts from the bottom of the pack. Port 1 is at the bottom and port 8 is at the top.

For detailed system, transmitter, receiver, and link budget specifications, see:

- "OC-48 PTM optical specifications" (p. 10-74)
- "OC-192 PTM optical specifications" (p. 10-82)

Allowed optics for LNW504 packs

The table below lists the OC-48 and OC-192 Pluggable Transmission Modules (PTMs) that may be used in the LNW504 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW504 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Supported OC-48 PTMs

Table 10-36 Supported OC-48 PTMs for LNW504

Apparatus code	Description
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm
S2G7C47LI	OC-48/STM-16 CWDM SFP, 80 km, 1471 nm
S2G7C49LI	OC-48/STM-16 CWDM SFP, 80 km, 1491 nm
S2G7C51LI	OC-48/STM-16 CWDM SFP, 80 km, 1511 nm
S2G7C53LI	OC-48/STM-16 CWDM SFP, 80 km, 1531 nm
S2G7C55LI	OC-48/STM-16 CWDM SFP, 80 km, 1551 nm
S2G7C57LI	OC-48/STM-16 CWDM SFP, 80 km, 1571 nm
S2G7C59LI	OC-48/STM-16 CWDM SFP, 80 km, 1591 nm

Table 10-36 Supported OC-48 PTMs for LNW504 (continued)

Apparatus code	Description
S2G7C61LI	OC-48/STM-16 CWDM SFP, 80 km, 1611 nm

Supported OC-192 PTMs

Table 10-37 Supported OC-192 PTMs for LNW504

Apparatus code	Description
OC192SR1-C1[1]	OC-192 SR-1 XFP, 2 km, 1310 nm
OC192IR2-C1[1]	OC-192 IR-2 XFP, 40 km, 1550 nm
OC192LR2-C1[1]	OC-192 LR-2 XFP, 80 km, 1550 nm
X10G21C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.1 THz, 1560.606 nm
X10G22C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.2 THz, 1559.794 nm
X10G23C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.3 THz, 1558.983 nm
X10G24C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.4 THz, 1558.173 nm
X10G25C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.5 THz, 1557.363 nm
X10G26C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.6 THz, 1556.555 nm
X10G27C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.7 THz, 1555.747 nm
X10G28C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 192.8 THz, 1554.940 nm
X10G31C5	OC-192/STM-64/OTU2 DWDM XFP, 193.1 THz, 1552.524 nm
X10G33C5	OC-192/STM-64/OTU2 DWDM XFP, 193.3 THz, 1550.918 nm
X10G35C5	OC-192/STM-64/OTU2 DWDM XFP, 193.5 THz, 1549.315 nm
X10G37C5	OC-192/STM-64/OTU2 DWDM XFP, 193.7 THz, 1547.715 nm
X10G45C5	OC-192/STM-64/OTU2 DWDM XFP, 194.5 THz, 1541.349 nm
X10G47C5	OC-192/STM-64/OTU2 DWDM XFP, 194.7 THz, 1539.766 nm
X10G49C5	OC-192/STM-64/OTU2 DWDM XFP, 194.9 THz, 1538.186 nm
X10G52C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.2 THz, 1535.822 nm
X10G53C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.3 THz, 1535.036 nm
X10G54C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.4 THz, 1534.250 nm
X10G55C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.5 THz, 1533.465 nm
X10G56C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.6 THz, 1532.681 nm
X10G57C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.7 THz, 1531.898 nm
X10G58C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.8 THz, 1531.116 nm

Table 10-37 Supported OC-192 PTMs for LNW504 (continued)

Apparatus code	Description
X10G59C5[1]	OC-192/STM-64/OTU2 DWDM XFP, 195.9 THz, 1530.334 nm

Notes:

1. Due to thermal limitations, the OC192SR1-C1, OC192IR2-C1, OC192LR2-C1, some DWDM (X10G21C5 to X10G28C5 and X10G52C5 to X10G59C5) should not be used in high altitudes otherwise marginal performance (even LOS) may be observed.

Alarm thresholding

The following parameters are monitored on the OC-N interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-N interfaces, see "Performance monitoring" (p. 5-62).

1-port, low-speed OC-192 OLIU (LNW603)

Optical specification

The LNW603 low-speed circuit pack is a single-port, PTM-based OC-192 circuit pack.

For detailed system, transmitter, receiver, and link budget specifications, see "OC-192 PTM optical specifications" (p. 10-82).

Allowed optics for LNW603 packs

The table below lists the OC-192 Pluggable Transmission Modules (PTMs) that may be used in the LNW603 circuit pack.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Supported OC-192 PTMs

Table 10-38 Supported OC-192 PTMs for LNW603

Apparatus code	Description
OC192SR1-C1	OC-192 SR-1 XFP, 2 km, 1310 nm
OC192IR2-C1	OC-192 IR-2 XFP, 40 km, 1550 nm
OC192LR2-C1	OC-192 LR-2 XFP, 80 km, 1550 nm
X10G21C5	OC-192/STM-64/OTU2 DWDM XFP, 192.1 THz, 1560.606 nm
X10G22C5	OC-192/STM-64/OTU2 DWDM XFP, 192.2 THz, 1559.794 nm
X10G23C5	OC-192/STM-64/OTU2 DWDM XFP, 192.3 THz, 1558.983 nm
X10G24C5	OC-192/STM-64/OTU2 DWDM XFP, 192.4 THz, 1558.173 nm
X10G25C5	OC-192/STM-64/OTU2 DWDM XFP, 192.5 THz, 1557.363 nm
X10G26C5	OC-192/STM-64/OTU2 DWDM XFP, 192.6 THz, 1556.555 nm
X10G27C5	OC-192/STM-64/OTU2 DWDM XFP, 192.7 THz, 1555.747 nm
X10G28C5	OC-192/STM-64/OTU2 DWDM XFP, 192.8 THz, 1554.940 nm
X10G31C5	OC-192/STM-64/OTU2 DWDM XFP, 193.1 THz, 1552.524 nm
X10G33C5	OC-192/STM-64/OTU2 DWDM XFP, 193.3 THz, 1550.918 nm
X10G35C5	OC-192/STM-64/OTU2 DWDM XFP, 193.5 THz, 1549.315 nm
X10G37C5	OC-192/STM-64/OTU2 DWDM XFP, 193.7 THz, 1547.715 nm
X10G45C5	OC-192/STM-64/OTU2 DWDM XFP, 194.5 THz, 1541.349 nm
X10G47C5	OC-192/STM-64/OTU2 DWDM XFP, 194.7 THz, 1539.766 nm
X10G49C5	OC-192/STM-64/OTU2 DWDM XFP, 194.9 THz, 1538.186 nm
X10G52C5	OC-192/STM-64/OTU2 DWDM XFP, 195.2 THz, 1535.822 nm
X10G53C5	OC-192/STM-64/OTU2 DWDM XFP, 195.3 THz, 1535.036 nm
X10G54C5	OC-192/STM-64/OTU2 DWDM XFP, 195.4 THz, 1534.250 nm
X10G55C5	OC-192/STM-64/OTU2 DWDM XFP, 195.5 THz, 1533.465 nm
X10G56C5	OC-192/STM-64/OTU2 DWDM XFP, 195.6 THz, 1532.681 nm
X10G57C5	OC-192/STM-64/OTU2 DWDM XFP, 195.7 THz, 1531.898 nm
X10G58C5	OC-192/STM-64/OTU2 DWDM XFP, 195.8 THz, 1531.116 nm
X10G59C5	OC-192/STM-64/OTU2 DWDM XFP, 195.9 THz, 1530.334 nm

Alarm thresholding

The following parameters are monitored on the OC-192 interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the OC-N interfaces, see "Performance monitoring" (p. 5-62).

Single-port, low-speed OC-3/12/48/192, 1GE, FC, 2XFC, FICON OLIU (LNW705)

Optical specification

The LNW705 XM10G/8 circuit pack multiplexes/demultiplexes up to 8 high bandwidth client interfaces onto a single 10G wavelength. The client signals (low-speed side) can be a mix of 1GE, FC, 2XFC, FICON, or OC-3/12/48 signals provided by PTMs. 1GE is mapped using VCAT and GFP-F. The mix of client signals are mapped into a single STS-192 and then encoded into an OC-192 OTN OTU-2 signal, provided by an OC-192 XFP PTM.

For detailed system, transmitter, receiver, and link budget specifications, see "1000BASE-SX optical Ethernet/SAN specification" (p. 10-107), "1000BASE-LX optical Ethernet/SAN specification" (p. 10-105), "OC-3 PTM optical specifications" (p. 10-66), "OC-12 PTM optical specifications" (p. 10-70), "OC-48 PTM optical specifications" (p. 10-74), and "OC-192 PTM optical specifications" (p. 10-82).

The LNW705 must be installed in a shelf with an LNW2 and at least one Main pack (VLF or non-VLF).

Allowed PTMs for LNW705 packs

The table below lists the PTMs that may be used in the LNW705 circuit pack.

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Module (PTM) optics on the LNW705 circuit pack. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Supported multi-rate PTMs

Table 10-39 Supported multi-rate PTMs for LNW705

Apparatus code	Description
S622C47EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1471 nm
S622C49EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1491 nm
S622C51EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1511 nm
S622C53EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1531 nm
S622C55EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1551 nm
S622C57EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1571 nm
S622C59EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1591 nm
S622C61EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1611 nm

Supported OC-3 PTMs

Table 10-40 Supported OC-3 PTMs for LNW705

Apparatus code	Description
S155I2	OC-3 SR-1 SFP, 2 km, 1310 nm
OC3IR1-I1	OC-3 IR-1 SFP, 15 km, 1310 nm
OC3LR1-I1	OC-3 LR-1 SFP, 40 km, 1310 nm

Supported OC-12 PTMs

Table 10-41 Supported OC-12 PTMs for LNW705

Apparatus code	Description
OC12IR1-I1	OC-12 IR-1 SFP, 15 km, 1310 nm
OC12LR1-	OC-12 LR-1 SFP, 40 km, 1310 nm
OC12LR2-I1	OC-12 LR-2 SFP, 80 km, 1550 nm

Supported OC-48 PTMs

Table 10-42 Supported OC-48 PTMs for LNW705

Apparatus code	Description
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm

Table 10-42 Supported OC-48 PTMs for LNW705 (continued)

Apparatus code	Description
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm

Supported OC-192 PTMs

Table 10-43 Supported OC-192 XFPs for the OTU2 Port on the LNW705

Apparatus code	Description
OC192SR1-C1[1]	OC-192 SR-1 XFP, 2 km, 1310 nm
OC192IR2-I1[1]	OC-192 IR-2 XFP, 40 km, 1550 nm
OC192IR2-C1[1]	OC-192 IR-2 XFP, 40 km, 1550 nm
OC192LR2-C1[1]	OC-192 LR-2 XFP, 80 km, 1550 nm
X10G21C5	OC-192/STM-64/OTU2 DWDM XFP, 192.1 THz, 1560.606 nm
X10G22C5	OC-192/STM-64/OTU2 DWDM XFP, 192.2 THz, 1559.794 nm
X10G23C5	OC-192/STM-64/OTU2 DWDM XFP, 192.3 THz, 1558.983 nm
X10G24C5	OC-192/STM-64/OTU2 DWDM XFP, 192.4 THz, 1558.173 nm
X10G25C5	OC-192/STM-64/OTU2 DWDM XFP, 192.5 THz, 1557.363 nm
X10G26C5	OC-192/STM-64/OTU2 DWDM XFP, 192.6 THz, 1556.555 nm
X10G27C5	OC-192/STM-64/OTU2 DWDM XFP, 192.7 THz, 1555.747 nm
X10G28C5	OC-192/STM-64/OTU2 DWDM XFP, 192.8 THz, 1554.940 nm
X10G31C5	OC-192/STM-64/OTU2 DWDM XFP, 193.1 THz, 1552.524 nm
X10G33C5	OC-192/STM-64/OTU2 DWDM XFP, 193.3 THz, 1550.918 nm
X10G35C5	OC-192/STM-64/OTU2 DWDM XFP, 193.5 THz, 1549.315 nm
X10G37C5	OC-192/STM-64/OTU2 DWDM XFP, 193.7 THz, 1547.715 nm
X10G45C5	OC-192/STM-64/OTU2 DWDM XFP, 194.5 THz, 1541.349 nm
X10G47C5	OC-192/STM-64/OTU2 DWDM XFP, 194.7 THz, 1539.766 nm
X10G49C5	OC-192/STM-64/OTU2 DWDM XFP, 194.9 THz, 1538.186 nm
X10G52C5	OC-192/STM-64/OTU2 DWDM XFP, 195.2 THz, 1535.822 nm
X10G53C5	OC-192/STM-64/OTU2 DWDM XFP, 195.3 THz, 1535.036 nm
X10G54C5	OC-192/STM-64/OTU2 DWDM XFP, 195.4 THz, 1534.250 nm
X10G55C5	OC-192/STM-64/OTU2 DWDM XFP, 195.5 THz, 1533.465 nm
X10G56C5	OC-192/STM-64/OTU2 DWDM XFP, 195.6 THz, 1532.681 nm
X10G57C5	OC-192/STM-64/OTU2 DWDM XFP, 195.7 THz, 1531.898 nm

Table 10-43 Supported OC-192 XFPs for the OTU2 Port on the LNW705 (continued)

Apparatus code	Description
X10G58C5	OC-192/STM-64/OTU2 DWDM XFP, 195.8 THz, 1531.116 nm
X10G59C5	OC-192/STM-64/OTU2 DWDM XFP, 195.9 THz, 1530.334 nm

Notes:

1. This non-DWDM OC-192 XFP is supported on the LNW705; its operation has been verified at 10.7G.

Supported Ethernet PTMs

Table 10-44 Supported Ethernet PTMs for LNW705

Apparatus code	Description
GE-1X2XFC-SX-I1	GbE short-reach, Multi-Mode PTM, supports Ethernet and Fibre-Channel traffic, LC-type connectors, OSP hardened/Industrial (−40°C to 85°C), (GbE/FC/2FC-850).
GE-1X2XFC-LX-I1	GbE long-reach, Single-Mode PTM, supports Ethernet, FICON, and Fibre-Channel traffic, LC-type connectors, OSP hardened/Industrial (−40°C to 85°C), (GbE/FC/2FC-1310)

Format specification

The Ethernet/SAN interfaces comply with the following formatting standards:

- Maximum frame size see “Packet size in different tagging modes” (p. A-66)
- standard IEEE 802.1Q VLANs
- Ethernet to SONET Mapping, (G.7041 (GFP) and G.707 (Virtual Concatenation)
- Protection (SONET and/or 802.1W) and Ethernet Bridging (802.1D)

Alarm thresholding

The following parameters are monitored on the OC-N interfaces:

- LOS
- LOF
- AIS-L
- RFI-L (FERF)
- Signal Degrade (BER)
- Signal Fail (BER)

Performance monitoring

SONET line and path performance monitoring complies with the standards outlined in GR-253-CORE. For detailed PM parameter thresholds on the interfaces, see "Performance monitoring" (p. 5-62).

8 channel DWDM Mux/Demux OMD5/8 (LNW785)

Optical specification

The LNW785 series supports supporting ITU-T DWDM channels 52 through 59 (195.20–195.90 THz). These channels, which have wavelengths between 1530.3 and 1535.8 nm, are at the short-wavelength end of the C-band. This region is chosen because it has the lowest chromatic dispersion in standard single-mode fiber (SSMF) and because it contains Alcatel-Lucent 1665 DMX's most popular DWDM channel, 59.

The LNW785 must be installed in a shelf with an LNW2 and at least one Main pack (VLF or non-VLF).

Cross-connections

The following 1-way optical cross-connections are supported on the OCH interfaces of the LNW785.

- OCH to/from OCH pass-through cross-connections
- OCH to/from OTU2 add/drop cross-connections
- OCH to/from OC-192 Line add/drop cross-connections
- OCH to/from alien (remote shelf) add/drop cross-connections

OC-3, OC-12, OC-48, OC-192 PTMs

Overview

The following table described the SONET PTMs that are supported by Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMXtend, and identifies the circuit packs in which they are used.

Multi-rate PTMs

The following table lists the allowable multirate PTMs and identifies the circuit packs in which they can be installed.

Table 10-45 Multi-rate OC-n PTMs

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
OC3X12X48-IR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 15 km, 1310 nm	OM155// OM622// 2.5G	1.3IR1/ 1.3IR1/ 1.3IR1	LNW55/82
OC3X12X48-LR1-I1	OC-3/STM-1/OC-12/STM-4/OC-48/STM-16 SFP, 40 km, 1310 nm	OM155// OM622// 2.5G	1.3LR1/ 1.3LR1/ 1.3LR1	LNW55/82
S622C47EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1471 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705
S622C49EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1491 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705
S622C51EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1511 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705
S622C53EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1531 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705
S622C55EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1551 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705
S622C57EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1571 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705
S622C59EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1591 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705
S622C61EL	OC-3/STM-1 or OC-12/STM-4 CWDM SFP, 96 km, 1611 nm	OM155// OM622	CWDM-LR	LNW37/45/49/55/82/705

OC-3 PTMs

The following table lists the allowable OC-3 PTMs and identifies the circuit packs in which they can be installed.

Table 10-46 OC-3 PTMs

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
S155I2	OC-3 SR-1 SFP, 2 km, 1310 nm	OM155	OC3SR1	LNW37/45/55/82/705
OC3IR1-I1	OC-3 IR-1 SFP, 15 km, 1310 nm	OM155	OC3IR1	LNW37/45/55/82/705
OC3LR1-I1	OC-3 LR-1 SFP, 40 km, 1310 nm	OM155	OC3LR1	LNW37/45/55/82/705

OC-12 PTMs

The following table lists the allowable OC-12 PTMs and identifies the circuit packs in which they can be installed.

Table 10-47 OC-12 PTMs

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
OC12IR1-I1	OC-12 IR-1 SFP, 15 km, 1310 nm	OM622	OC12IR1	LNW49/55/82/203/705
OC12LR1-I1	OC-12 LR-1 SFP, 40 km, 1310 nm	OM622	OC12LR1	LNW49/55/82/203/705
OC12LR2-I1	OC-12 LR-2 SFP, 80 km, 1550 nm	OM622	OC12LR2	LNW49/55/82/203/705

OC-48 PTMs

The following table lists the allowable OC-48 PTMs and identifies the circuit packs in which they can be installed.

Table 10-48 OC-48 PTMs

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
OC48SR1-I1	OC-48 SR-1 SFP, 2 km, 1310 nm	OM2.5G	1.3SR1	LNW55/62/82/202/402/504/705
OC48LR1-I1	OC-48 LR-1 SFP, 40 km, 1310 nm	OM2.5G	1.3LR1	LNW55/62/82/202/402/504/705
OC48LR2-I1	OC-48 LR-2 SFP, 80 km, 1550 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705

Table 10-48 OC-48 PTMs (continued)

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
S2D23C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.3 THz, 1558.983 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D25C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 1192.5 THz, 1557.363 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D27C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 192.7 THz, 1555.747 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D31C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.1 THz, 1552.524 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D33C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.3 THz, 1550.918 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D35C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.5 THz, 1549.315 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D37C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 193.7 THz, 1547.715 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D45C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.5 THz, 1541.349 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D47C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.7 THz, 1539.766 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D49C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 194.9 THz, 1538.186 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D53C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.3 THz, 1535.036 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2D55C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.5 THz, 1533.465 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705

Table 10-48 OC-48 PTMs (continued)

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
S2D59C6	OC-48/STM-16/OTU1 DWDM SFP, 96 km, 195.9 THz, 1530.334 nm	OM2.5G	1.5LR2	LNW55/62/82/202/402/504/705
S2G7C47LI	OC-48/STM-16 CWDM SFP, 80 km, 1471 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504
S2G7C49LI	OC-48/STM-16 CWDM SFP, 80 km, 1491 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504
S2G7C51LI	OC-48/STM-16 CWDM SFP, 80 km, 1511 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504
S2G7C53LI	OC-48/STM-16 CWDM SFP, 80 km, 1531 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504
S2G7C55LI	OC-48/STM-16 CWDM SFP, 80 km, 1551 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504
S2G7C57LI	OC-48/STM-16 CWDM SFP, 80 km, 1571 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504
S2G7C59LI	OC-48/STM-16 CWDM SFP, 80 km, 1591 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504
S2G7C61LI	OC-48/STM-16 CWDM SFP, 80 km, 1611 nm	OM2.5G	SL-16.2	LNW55/62/82/202/402/504

OC-192 PTMs

The following table lists the allowable OC-192 PTMs and identifies the circuit packs in which they can be installed.

Table 10-49 OC-192 PTMs

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
OC192IR2-I1	OC-192 IR-2 XFP, 40 km, 1550 nm	OM10G	1.5IR2	LNW59/705
OC192SR1-C1	OC-192 SR-1 XFP, 2 km, 1310 nm	OM10G	1.3SR1	LNW59/502/504/603/705
OC192IR2-C1	OC-192 IR-2 XFP, 40 km, 1550 nm	OM10G	1.5IR2	LNW59/502/504/603/705
OC192LR2-C1	OC-192 LR-2 XFP, 80 km, 1550 nm	OM10G	1.5LR2	LNW59/502/504/603/705

Table 10-49 OC-192 PTMs (continued)

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
X10G21C5	OC-192/STM-64/OTU2 DWDM XFP, 192.1 THz, 1560.606 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G22C5	OC-192/STM-64/OTU2 DWDM XFP, 192.2 THz, 1559.794 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G23C5	OC-192/STM-64/OTU2 DWDM XFP, 192.3 THz, 1558.983 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G24C5	OC-192/STM-64/OTU2 DWDM XFP, 192.4 THz, 1558.173 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G25C5	OC-192/STM-64/OTU2 DWDM XFP, 192.5 THz, 1557.363 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G26C5	OC-192/STM-64/OTU2 DWDM XFP, 192.6 THz, 1556.555 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G27C5	OC-192/STM-64/OTU2 DWDM XFP, 192.7 THz, 1555.747 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G28C5	OC-192/STM-64/OTU2 DWDM XFP, 192.8 THz, 1554.940 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G31C5	OC-192/STM-64/OTU2 DWDM XFP, 193.1 THz, 1552.524 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G33C5	OC-192/STM-64/OTU2 DWDM XFP, 193.3 THz, 1550.918 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G35C5	OC-192/STM-64/OTU2 DWDM XFP, 193.5 THz, 1549.315 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G37C5	OC-192/STM-64/OTU2 DWDM XFP, 193.7 THz, 1547.715 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705

Table 10-49 OC-192 PTMs (continued)

PTM apparatus code	Short Description	Name	Qualifier	Circuit pack apparatus code
X10G45C5	OC-192/STM-64/OTU2 DWDM XFP, 194.5 THz, 1541.349 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G47C5	OC-192/STM-64/OTU2 DWDM XFP, 194.7 THz, 1539.766 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G49C5	OC-192/STM-64/OTU2 DWDM XFP, 194.9 THz, 1538.186 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G52C5	OC-192/STM-64/OTU2 DWDM XFP, 195.2 THz, 1535.822 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G53C5	OC-192/STM-64/OTU2 DWDM XFP, 195.3 THz, 1535.036 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G54C5	OC-192/STM-64/OTU2 DWDM XFP, 195.4 THz, 1534.250 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G55C5	OC-192/STM-64/OTU2 DWDM XFP, 195.5 THz, 1533.465 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G56C5	OC-192/STM-64/OTU2 DWDM XFP, 195.6 THz, 1532.681 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G57C5	OC-192/STM-64/OTU2 DWDM XFP, 195.7 THz, 1531.898 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G58C5	OC-192/STM-64/OTU2 DWDM XFP, 195.8 THz, 1531.116 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705
X10G59C5	OC-192/STM-64/OTU2 DWDM XFP, 195.9 THz, 1530.334 nm	OM10G	DWDM-LR (DW100U-2AxC[F])	LNW59/502/504/603/705

OC-3 PTM optical specifications

Purpose

Alcatel-Lucent 1665 DMX supports SR-1, IR-1, LR-1, and CWDM OC-3 Pluggable Transmission Module (PTMs).

The following circuit packs support OC-3 PTMs

- LNW37
- LNW45
- LNW55
- LNW82
- LNW705

System specifications

The following table lists the system specifications for OC-3 PTM interfaces.

Table 10-50 OC-3 PTM optical system specifications

System information	OC-3 SR-1	OC-3 IR-1	OC-3 LR-1	OC-3/STM-1 CWDM-LR
Optical Line Rate	155.52 Mb/s			
Optical Line Coding	Scrambled NRZ			
Optical Wavelength	1310 nm			See Table 10-51, "OC-3/STM-1 or OC-12/STM-4 CWDM-LR PTM wavelengths" (p. 10-67).
Performance	Short Reach, SR-1	Intermediate Reach, IR-1	Long Reach, LR-1	Coarse Wavelength Division Multiplexing (CWDM), Long Reach
Temperature Range	OSP hardened/Industrial (−40°C to 85°C)			Extended temperature range (−5°C to 85°C)

Table 10-51 OC-3/STM-1 or OC-12/STM-4 CWDM-LR PTM wavelengths

Apparatus Code	Channel #	Wavelength
S622C47EL	47	1471 nm
S622C49EL	49	1491 nm
S622C51EL	51	1511 nm
S622C53EL	53	1531 nm
S622C55EL	55	1551 nm
S622C57EL	57	1571 nm
S622C59EL	59	1591 nm
S622C61EL	61	1611 nm

Transmitter specifications

The table below lists the OC-3/STM-1 PTM transmitter information.

Table 10-52 OC-3/STM-1 PTM optical transmitter information

Transmitter information	OC-3 SR-1	OC-3 IR-1	OC-3 LR-1	OC-3/STM-1 CWDM-LR
Optical Device Temperature Controller	None			
IEC 60825 Laser Classification	Class 1			
FDA Laser Classification	Class I			
Optical Source	Fabry Perot (FP)/Light Emitting Diode (LED) Laser	Fabry Perot (FP) Laser	Fabry Perot (FP)/Distributed Feed-Back (DFB) Laser	Distributed Feed-Back (DFB) Laser

Receiver specifications

The table below lists the OC-3 PTM receiver information.

Table 10-53 OC-3/STM-1 PTM optical receiver information

Receiver information	OC-3 SR-1, IR-1, LR-1	OC-3/STM-1 CWDM-LR
Optical Detector	InGaAsP PIN	Avalanche Photo Diode (APD)
Faceplate Optical Connector	LC connector	

Link budgets

The table below lists the OC-3/STM-1 PTM link budgets.

Table 10-54 OC-3/STM-1 PTM optical specifications and link budgets

Parameter	OC-3 SR-1[1]	OC-3 IR-1[1]	OC-3 LR-1[1]	OC-3/STM-1 CWDM-LR[2]
Minimum Wavelength	1260 nm	1261 nm	1263 nm	λ_c −7 nm
Maximum Wavelength	1360 nm	1360 nm	1360 nm	λ_c +7 nm
Maximum Spectral Width ($\Delta\lambda_{20}$)	NA	NA	NA /1.0 nm[3]	1.0 nm
Maximum RMS Spectral Width (σ)	40/80 nm	7.7 nm	3.0 nm /NA[3]	NA

Table 10-54 OC-3/STM-1 PTM optical specifications and link budgets (continued)

Parameter	OC-3 SR-1[1]	OC-3 IR-1[1]	OC-3 LR-1[1]	OC-3/STM-1 CWDM-LR[2]
Minimum Side-Mode Suppression Ratio (SSMR)	NA	NA	NA /30 dB[3]	30 dB
Maximum Transmitter Power	−8.0 dBm	−8.0 dBm	0.0 dBm	+5.0 dBm
Minimum Transmitter Power	−15.0 dBm	−15.0 dBm	−5.0 dBm	−1.0 dBm
Maximum Received Power	−8.0 dBm	−8.0 dBm	−10.0 dBm	−9.0 dBm
Minimum Received Power ($1x10^{-10}$ BER)	−23.0 dBm	−28.0 dBm	−34.0 dBm	−28.0 dBm
System Gain[4]	8.0 dB	13.0 dB	29.0 dB	27.0 dB
Maximum Dispersion	NA	NA	NA	1600 ps/nm
Optical Path Penalty[5]	1.0 dB	1.0 dB	1.0 dB	1.0 dB
Minimum Optical Return Loss[6]	NA	20.0 dB	24.0 dB	24.0 dB
Maximum Receiver Reflectance[6]	NA	−14.0 dB	−27.0 dB	−27.0 dB
Minimum Loss Budget[7]	0 dB	0 dB	10.0 dB	14.0 dB
Maximum Loss Budget[8]	7.0 dB	12.0 dB	28.0 dB	26.0 dB
Target Distance	2 km	15 km	40 km	96 km

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3. All values are worst-case end of life. Optical specifications meet or exceed equivalent GR-253-CORE requirements.
2. The OC-3/STM-1 CWDM PTMs can also operate as OC-12/STM-4 PTMs.
3. x/y: x is using Fabry Perot (FP) and y is using Distributed Feed-Back (DFB) laser.
4. The System Gain is Minimum Transmitter Power minus Minimum Received Power.
5. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm optics is normally 1.0 dB.
6. Refer to GR-253-CORE for more information about these parameters.

7. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.
8. The stated maximum loss budgets are assumed to be worst-case values including losses due to splices, connectors, optical attenuators or other passive optical devices, and any additional cable margin.

OC-12 PTM optical specifications

Purpose

Alcatel-Lucent 1665 DMX supports IR-1, LR-1, LR-2, and CWDM OC-12 Pluggable Transmission Modules (PTMs).

The following circuit packs support OC-12 PTMs

- LNW49
- LNW55
- LNW82
- LNW705

System specifications

The following table lists the system specifications for OC-12 PTM interfaces.

Table 10-55 OC-12 PTM optical system specifications

System information	OC-12 IR-1	OC-12 LR-1	OC-12 LR-2	OC-12/STM-4 CWDM-LR
Optical Line Rate	622.08 Mb/s			
Optical Line Coding	Scrambled NRZ			
Optical Wavelength	1310 nm		1550 nm	See Table 10-56, "OC-3/STM-1 or OC-12/STM-4 CWDM-LR PTM wavelengths" (p. 10-71).
Performance	Intermediate Reach, IR-1	Long Reach, LR-1	Very Long Reach, LR-2	Coarse Wavelength Division Multiplexing (CWDM), Long Reach

Table 10-55 OC-12 PTM optical system specifications (continued)

System information	OC-12 IR-1	OC-12 LR-1	OC-12 LR-2	OC-12/STM-4 CWDM-LR
Temperature Range	OSP hardened/Industrial (−40°C to 85°C)			Extended temperature range (−5°C to 85°C)

Table 10-56 OC-3/STM-1 or OC-12/STM-4 CWDM-LR PTM wavelengths

Apparatus Code	Channel #	Wavelength
S622C47EL	47	1471 nm
S622C49EL	49	1491 nm
S622C51EL	51	1511 nm
S622C53EL	53	1531 nm
S622C55EL	55	1551 nm
S622C57EL	57	1571 nm
S622C59EL	59	1591 nm
S622C61EL	61	1611 nm

Transmitter specifications

The table below lists the OC-12 PTM transmitter information.

Table 10-57 OC-12 PTM optical transmitter information

Transmitter information	OC-12 IR-1	OC-12 LR-1	OC-12 LR-2	OC-12/STM-4 CWDM-LR
Optical Device Temperature Controller	None			
IEC 60825 Laser Classification	Class 1			
FDA Laser Classification	Class I			
Optical Source	Fabry Perot (FP) Laser	Distributed Feed-Back (DFB) Laser		

Receiver specifications

The table below lists the OC-12 optical receiver information.

Table 10-58 OC-12 PTM optical receiver information

Receiver information	OC-12 IR-1, LR-1, LR-2	OC-12/STM-4 CWDM-LR
Optical Detector	InGaAsP PIN	Avalanche Photo Diode (APD)
Faceplate Optical Connector	LC connector	

Link budgets

The table below lists the OC-12 PTM link budgets.

Table 10-59 OC-12 PTM optical specifications and link budgets

Parameter	OC-12 IR-1[1]	OC-12 LR-1[1]	OC-12 LR-2[1]	OC-12/STM-4 CWDM-LR[2]
Minimum Wavelength	1274 nm	1280 nm	1480 nm	λ_c −7 nm
Maximum Wavelength	1356 nm	1335 nm	1580 nm	λ_c +7 nm
Maximum Spectral Width ($\Delta\lambda_{20}$)	NA	1.0 nm	1.0 nm	1.0 nm
Maximum RMS Spectral Width (σ)	2.5 nm	NA	NA	NA
Minimum Side-Mode Suppression Ratio (SSMR)	NA	30 dB	30 dB	30 dB
Maximum Transmitter Power	−8.0 dBm	+2.0 dBm	+2.0 dBm	+5.0 dBm
Minimum Transmitter Power	−15.0 dBm	−3.0 dBm	−3.0 dBm	−1.0 dBm
Maximum Received Power	−8.0 dBm	−8.0 dBm	−8.0 dBm	−9.0 dBm
Minimum Received Power ($1x10^{-10}$ BER)	−28.0 dBm	−28.0 dBm	−28.0 dBm	−28.0 dBm
System Gain[3]	13.0 dB	25.0 dB	25.0 dB	27.0 dB
Maximum Dispersion	NA	NA	1600 ps/nm	1600 ps/nm
Optical Path Penalty[4]	1.0 dB	1.0 dB	1.0 dB	1.0 dB

Table 10-59 OC-12 PTM optical specifications and link budgets (continued)

Parameter	OC-12 IR-1[1]	OC-12 LR-1[1]	OC-12 LR-2[1]	OC-12/STM-4 CWDM-LR[2]
Minimum Optical Return Loss[5]	NA	20.0 dB	24.0 dB	24.0 dB
Maximum Receiver Reflectance[5]	NA	−14.0 dB	−27.0 dB	−27.0 dB
Minimum Loss Budget[6]	0 dB	10 dB	10.0 dB	14.0 dB
Maximum Loss Budget[7]	12.0 dB	24.0 dB	24.0 dB	26.0 dB
Target Distance	15 km	40 km	80 km	96 km

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3. All values are worst-case end of life. Optical specifications meet or exceed equivalent GR-253-CORE requirements.
2. The OC-12/STM-4 CWDM PTMs can also operate as OC-3/STM1 PTMs.
3. The System Gain is Minimum Transmitter Power minus Minimum Received Power.
4. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm optics is normally 1.0 dB.
5. Refer to GR-253-CORE for more information about these parameters.
6. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.
7. The stated maximum loss budgets are assumed to be worst-case values including losses due to splices, connectors, optical attenuators or other passive optical devices, and any additional cable margin.

OC-48 PTM optical specifications

Purpose

Alcatel-Lucent 1665 DMX supports SR-1, LR-1, LR-2, CWDM, and DWDM OC-48 Pluggable Transmission Modules (PTMs).

The following circuit packs support OC-48 PTMs

- LNW55
- LNW62
- LNW82
- LNW202
- LNW402
- LNW504
- LNW705

System specifications

The following table lists the system specifications for OC-48 PTM interfaces.

Table 10-60 OC-48 PTM optical system specifications

System information	OC-48 SR-1	OC-48 LR-1	OC-48 LR-2	OC-48 CWDM	OC-48 DWDM
Optical Line Rate	2.488 Gb/s				
Optical Line Coding	Scrambled NRZ				
Optical Wavelength	1310 nm		1550 nm	See Table 10-62, "OC-48/STM-16 CWDM PTM wavelengths" (p. 10-75).	See Table 10-61, "OC-48 DWDM PTM wavelengths" (p. 10-75).
Performance	SONET Short Reach, SR-1	SONET Long Reach, LR-1	SONET Very Long Reach, LR-2	Coarse Wavelength Division Multiplexing (CWDM), Long Reach	DWDM
Temperature Range	OSP hardened/Industrial (−40°C to 85°C).				Central Office/Commercial (0°C to 70°C).

Table 10-61 OC-48 DWDM PTM wavelengths

Apparatus Code	Channel #	Wavelength (nm)	Frequency (THz)
S2D23C6	23	1558.983	192.30
S2D25C6	25	1557.363	192.50
S2D27C6	27	1555.747	192.70
S2D31C6	31	1552.524	193.10
S2D33C6	33	1550.918	193.30
S2D35C6	35	1549.315	193.50
S2D37C6	37	1547.715	193.70
S2D45C6	45	1541.349	194.50
S2D47C6	47	1539.766	194.70
S2D49C6	49	1538.186	194.90
S2D53C6	53	1535.036	195.30
S2D55C6	55	1533.465	195.50
S2D59C6	59	1530.334	195.90

Table 10-62 OC-48/STM-16 CWDM PTM wavelengths

Apparatus Code	Channel #	Wavelength
S2G7C47LI	47	1471 nm
S2G7C49LI	49	1491 nm
S2G7C51LI	51	1511 nm
S2G7C53LI	53	1531 nm
S2G7C55LI	55	1551 nm
S2G7C57LI	57	1571 nm
S2G7C59LI	59	1591 nm
S2G7C61LI	61	1611 nm

Transmitter specifications

The following table lists the OC-48 PTM transmitter information.

Table 10-63 OC-48 PTM optical transmitter information

Transmitter information	OC-48 SR-1	OC-48 LR-1	OC-48 LR-2	OC-48 CWDM	OC-48 DWDM
Optical Device Temperature Controller	None			Yes	
IEC 60825 Laser Classification	Class 1				
FDA Laser Classification	Class I				
Optical Source	Fabry Perot (FP) Laser	Distributed Feed-Back (DFB) Laser			
Faceplate Optical Connector	LC connector				

Receiver specifications

The following table lists the OC-48 PTM receiver information.

Table 10-64 OC-48 PTM optical receiver information

Receiver information	OC-48 SR-1	OC-48 LR-1	OC-48 LR-2	OC-48 CWDM	OC-48 DWDM
Optical Detector	InGaAsP PIN	Avalanche Photo Diode (APD)			
Faceplate Optical Connector	LC connector				

Link budgets

The following table lists the OC-48 PTM link budgets.

Table 10-65 OC-48 PTM optical specifications and link budgets

Parameter	OC-48 SR-1[1]	OC-48 LR-1[1]	OC-48 LR-2[1]	OC-48 CWDM	OC-48 DWDM[1]
Minimum Wavelength	1266 nm	1280 nm	1500 nm	λ_c −7 nm	λ_c −100 pm
Maximum Wavelength	1360 nm	1335 nm	1580 nm	λ_c +7 nm	λ_c +100 pm

Table 10-65 OC-48 PTM optical specifications and link budgets (continued)

Parameter	OC-48 SR-1[1]	OC-48 LR-1[1]	OC-48 LR-2[1]	OC-48 CWDM	OC-48 DWDM[1]
Maximum Spectral Width ($\Delta\lambda_{20}$)	NA	1.0 nm	1.0 nm	1.0 nm	NA
Maximum RMS Spectral Width (σ)	4.0 nm	NA	NA	NA	NA
Minimum Side Mode Suppression Ratio	NA	30 dB	30 dB	30 dB	30 dB
Maximum Transmitter Power	−3.0 dBm	3.0 dBm	3.0 dBm	5.0 dBm	4.0 dBm
Minimum Transmitter Power	−10.0 dBm	−2.0 dBm	−2.0 dBm	0 dBm	0 dBm
Maximum Received Power	−3.0 dBm	−9.0 dBm	−9.0 dBm	−8.0 dBm	−9.0 dBm
Minimum Received Power ($1x10^{-10}$ BER)	−18.0 dBm	−27.0 dBm	−28.0 dBm	NA	NA
Minimum Received Power ($1x10^{-12}$ BER)	NA	NA	NA	−28.0 dBm	−28.0 dBm
Maximum Negative Dispersion	NA	NA	NA	−300 ps/nm	−300 ps/nm
Maximum Dispersion	NA	NA	1600 ps/nm	1640 ps/nm	2400 ps/nm
Minimum System Gain[2]	8.0 dB	25.0 dB	26.0 dB	28.0 dB	28.0 dB
Optical Path Penalty[3]	1.0 dB	1.0 dB	2.0 dB	2.5 dB[9]	2.0 dB
Minimum Optical Return Loss[4]	24.0 dB	24.0 dB	24.0 dB	24.0 dB	24.0 dB
Maximum Receiver Reflectance[4]	−27.0 dB	−27.0 dB	−27.0 dB	−27.0 dB	−27.0 dB
Optical Signal to Noise Ratio (OSNR); $1x10^{-12}$ BER, −10 to −20 dBm	NA	NA	NA	NA	See Table 10-66, "Noise-limited performance for OC-48 DWDM PTMs" (p. 10-78)

Table 10-65 OC-48 PTM optical specifications and link budgets (continued)

Parameter	OC-48 SR-1[1]	OC-48 LR-1[1]	OC-48 LR-2[1]	OC-48 CWDM	OC-48 DWDM[1]
Minimum Loss Budget[5]	0 dB	12.0 dB	12.0 dB	13.0 dB	13.0 dB
Maximum Loss Budget[6]	7.0 dB	24.0 dB	24.0 dB	25.5 dB	26.0 dB
Target Distance[7]	2 km	40 km	80 km	80 km[10]	96 km

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3. All values are worst-case end of life (EOL). Optical specifications meet or exceed equivalent GR-253-CORE requirements.
2. The System Gain is Minimum Transmitter Power minus Minimum Received Power.
3. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm optics is 1.0 dB maximum. The optical path penalty for the 1550 nm optics is 2.0 dB maximum.
4. Refer to GR-253-CORE for more information about these parameters.
5. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.
6. The stated maximum loss budgets are assumed to be worst-case values including losses due to splices, connectors, optical attenuators or other passive optical devices, and any additional cable margin.
7. The target distance assumes no passive optical units are being used.
8. Although not specified, the OC-48 XFPs may tolerate some amount of negative dispersion, approximately −100 ps/nm.
9. CWDM optical path penalty includes effects of dispersion, reflection, and jitter and a 0.3 dB penalty due to optical filters and cross-talk.
10. The CWDM target distance is dispersion-limited at the 1611 nm wavelength and attenuation-limited at the 1471 nm wavelength.

Table 10-66 Noise-limited performance for OC-48 DWDM PTMs

Data Rate	OSNR Required 0 ps/nm dispersion	OSNR Required 2400 ps/nm dispersion	OSNR Required 2400 ps/nm dispersion 120 ps of Differential Group Delay
2.488 Gb/s	16.0 dB	18.0 dB	19.0 dB

OC-3/OC-12/OC-48 multi-rate PTM optical specifications

Purpose

Alcatel-Lucent 1665 DMX supports IR-1 (OC3X12X48-IR1-I1) and LR-1 (OC3X12X48-LR1-I1) Pluggable Transmission Module (PTMs). These PTMs are OC-48 compliant and OC-3 and OC-12 compatible.

The following circuit packs support OC-3/OC-12/OC-48 multi-rate PTMs

- LNW55
- LNW82

System specifications

The following table lists the system specifications for OC-3/OC-12/OC-48 multi-rate PTM interfaces.

Table 10-67 OC-3/OC-12/OC-48 multi-rate PTM optical system specifications

System information	OC3X12X48-IR1-I1			OC3X12X48-LR1-I1		
	OC-3 IR-1	OC-12 IR-1	OC-48 IR-1	OC-3 LR-1	OC-12 LR-1	OC-48 LR-1
Optical Line Rate	155.52 Mb/s	622.08 Mb/s	2.488 Mb/s	155.52 Mb/s	622.08 Mb/s	2.488 Mb/s
Optical Line Coding	Scrambled NRZ					
Optical Wavelength	1310 nm					
Performance	Intermediate Reach, IR-1			Long Reach, LR-1		
Temperature Range	OSP hardened/Industrial (−40°C to 85°C)					

Transmitter specifications

The table below lists the OC-3/OC-12/OC-48 multi-rate PTM transmitter information.

Table 10-68 OC-3/OC-12/OC-48 multi-rate PTM optical transmitter information

Transmitter information	OC3X12X48-IR1-I1			OC3X12X48-LR1-I1		
	OC-3 IR-1	OC-12 IR-1	OC-48 IR-1	OC-3 LR-1	OC-12 LR-1	OC-48 LR-1
Optical Device Temperature Controller	None					
IEC 60825 Laser Classification	Class 1					
FDA Laser Classification	Class I					
Optical Source	Distributed Feed-Back (DFB) Laser					

Receiver specifications

The table below lists the OC-3/OC-12/OC-48 multi-rate PTM receiver information.

Table 10-69 OC-3/OC-12/OC-48 multi-rate PTM optical receiver information

Receiver information	OC3X12X48-IR1-I1			OC3X12X48-LR1-I1		
	OC-3 IR-1	OC-12 IR-1	OC-48 IR-1	OC-3 LR-1	OC-12 LR-1	OC-48 LR-1
Optical Detector	InGaAsP PIN			Avalanche Photo Diode (APD)		
Faceplate Optical Connector	LC connector					

Link budgets

The table below lists the OC-3/OC-12/OC-48 multi-rate PTM PTM link budgets.

Table 10-70 OC-3/OC-12/OC-48 multi-rate PTM optical specifications and link budgets

Parameter	OC3X12X48-IR1-I1[1]			OC3X12X48-LR1-I1[1]		
	OC-3 IR-1	OC-12 IR-1	OC-48 IR-1	OC-3 LR-1	OC-12 LR-1	OC-48 LR-1
Minimum Wavelength	1260 nm			1280 nm		

Table 10-70 OC-3/OC-12/OC-48 multi-rate PTM optical specifications and link budgets (continued)

Parameter	OC3X12X48-IR1-I1[1]			OC3X12X48-LR1-I1[1]		
	OC-3 IR-1	OC-12 IR-1	OC-48 IR-1	OC-3 LR-1	OC-12 LR-1	OC-48 LR-1
Maximum Wavelength	1360 nm			1335 nm		
Maximum Spectral Width ($\Delta\lambda_{20}$)	1.0 nm					
Minimum Side-Mode Suppression Ratio (SSMR)	30 dB					
Maximum Transmitter Power	0.0 dBm			+3.0 dBm		
Minimum Transmitter Power	−5.0 dBm			−2.0 dBm		
Maximum Received Power	−10.0 dBm	0.0 dBm		−15.0 dBm	−9.0 dBm	
Minimum Received Power ($1x10^{-10}$ BER)	−18.0 dBm			−27.0 dBm		
System Gain[2]	13.0 dB			25.0 dB		
Optical Path Penalty[3]	1.0 dB					
Minimum Optical Return Loss[4]	24.0 dB					
Maximum Receiver Reflectance[4]	−27.0 dB					
Minimum Loss Budget[5]	10.0 dB	0.0 dB		18.0 dB	12.0 dB	
Maximum Loss Budget[6]	12.0 dB			24.0 dB		
Target Distance	15 km			40 km		

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3. All values are worst-case end of life. These PTMs are OC-48 compliant, and OC-3 and OC-12 compatible..
2. The System Gain is Minimum Transmitter Power minus Minimum Received Power.
3. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm optics is normally 1.0 dB.
4. Refer to GR-253-CORE for more information about these parameters.
5. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.
6. The stated maximum loss budgets are assumed to be worst-case values including losses due to splices, connectors, optical attenuators or other passive optical devices, and any additional cable margin.

OC-192 PTM optical specifications

Purpose

Alcatel-Lucent 1665 DMX supports SR-1, IR-2, LR-2, and DWDM OC-192 Pluggable Transmission Modules (PTMs).

The following circuit packs support OC-192 PTMs

- LNW59
- LNW502
- LNW504
- LNW603
- LNW705

System specifications

The table below lists the OC-192 PTM system specifications.

Table 10-71 OC-192 PTM optical system specifications

System information	OC-192 SR-1	OC-192 IR-2	OC-192 LR-2	OC-192 DWDM
Optical Line Rate	9953.28 Mb/s			9.9–11.1 Gb/s
Optical Line Coding	Scrambled NRZ			
Optical Wavelength	1310 nm	1550 nm		See Table 10-72, "OC-192 DWDM PTM wavelengths" (p. 10-83).
Performance	Short Reach, SR-1	Intermediate Reach, IR-2	Long Reach, LR-2	Long Reach
Temperature Range	Central Office/ Commercial (0°C to 70°C)	Central Office/ Commercial (0°C to 70°C) or OSP hardened/ Industrial (−40°C to 85°C).	Central Office/ Commercial (0°C to 70°C)	Central Office/ Commercial (0°C to 70°C) or Extended temperature (−5°C to 85°C).

Table 10-72 OC-192 DWDM PTM wavelengths

Apparatus Code	Channel #	Wavelength (nm)	Frequency (THz)
X10G21C5	21	1560.606	192.10
X10G22C5	22	1559.794	192.20
X10G23C5	23	1558.983	192.30
X10G24C5	24	1558.173	192.40
X10G25C5	25	1557.363	192.50
X10G26C5	26	1556.555	192.60
X10G27C5	27	1555.747	192.70
X10G28C5	28	1554.940	192.80
X10G31C5	31	1552.524	193.10
X10G33C5	33	1550.918	193.30
X10G35C5	35	1549.315	193.50
X10G37C5	37	1547.715	193.70

Table 10-72 OC-192 DWDM PTM wavelengths (continued)

Apparatus Code	Channel #	Wavelength (nm)	Frequency (THz)
X10G45C5	45	1541.349	194.50
X10G47C5	47	1539.766	194.70
X10G49C5	49	1538.186	194.90
X10G52C5	52	1535.822	195.20
X10G53C5	53	1535.036	195.30
X10G54C5	54	1534.250	195.40
X10G55C5	55	1533.465	195.50
X10G56C5	56	1532.681	195.60
X10G57C5	57	1531.898	195.70
X10G58C5	58	1531.116	195.80
X10G59C5	59	1530.334	195.90

Transmitter specifications

The table below lists the OC-192 PTM transmitter information.

Table 10-73 OC-192 PTM optical transmitter information

Transmitter information	OC-192 SR-1	OC-192 IR-2	OC-192 LR-2	OC-192 DWDM
Optical Device Temperature Controller	None			Yes
IEC 60825 Laser Classification	Class 1			
FDA Laser Classification	Class I			
Optical Source	Distributed Feed-Back (DFB) Laser	Externally Modulated Laser (EML) Laser		
Faceplate Optical Connector	LC connector			

Receiver specifications

The table below lists the OC-192 PTM receiver information.

Table 10-74 OC-192 PTM optical receiver information

Receiver information	OC-192 SR-1	OC-192 IR-2	OC-192 LR-2	OC-192 DWDM
Optical Detector	InGaAsP PIN		Avalanche Photo Diode (APD)	
Faceplate Optical Connector	LC connector			

Link budgets

The table below lists the OC-192 PTM link budgets.

Table 10-75 OC-192 PTM optical specifications and link budgets

Parameter[1]	OC-192 SR-1	OC-192 IR-2	OC-192 LR-2	OC-192 DWDM
Minimum Wavelength	1290 nm	1530 nm	1530 nm	λ_c −100 pm See Table 10-72, "OC-192 DWDM PTM wavelengths" (p. 10-83).
Maximum Wavelength	1330 nm	1565 nm	1565 nm	λ_c +100 pm See Table 10-72, "OC-192 DWDM PTM wavelengths" (p. 10-83).
Maximum Spectral Width ($\Delta\lambda_{20}$)	1.0 nm	1.0 nm	0.25 nm	15 GHz
Maximum RMS Spectral Width (σ)	NA	NA	NA	NA
Minimum Side Mode Suppression Ratio	30 dB	30 dB	30 dB	30 dB
Maximum Transmitter Power	−1.0 dBm	2.0 dBm	4.0 dBm	3.0 dBm
Minimum Transmitter Power	−6.0 dBm	−1.0 dBm	0.0 dBm	−1.0 dBm
Maximum Received Power	−1.0 dBm	−1.0 dBm	−7.0 dBm	−8.0 dBm

Table 10-75 OC-192 PTM optical specifications and link budgets (continued)

Parameter[1]	OC-192 SR-1	OC-192 IR-2	OC-192 LR-2	OC-192 DWDM
Minimum Received Power ($1x10^{-12}$ BER)	−11.0 dBm	−14.0 dBm	−24.0 dBm	See Table 10-76, "Dispersion-limited receiver sensitivity for OC-192 DWDM PTMs" (p. 10-87).
Minimum System Gain[2]	5.0 dB	13.0 dB	24.0 dB	23.0 dB
Maximum Negative Dispersion	NA	NA	NA	0 ps/nm[7]
Maximum Dispersion	NA	800 ps/nm[7]	1600 ps/nm[7]	1300 ps/nm for 9.95 Gb/s
				1600 ps/nm for 10.7 Gb/s
Optical Path Penalty[3]	1.0 dB	2.0 dB	2.0 dB	2.0 dB
Minimum Optical Return Loss[4]	14.0 dB	24.0 dB	24.0 dB	24.0 dB
Maximum Receiver Reflectance[4]	−14.0 dB	−27.0 dB	−27.0 dB	−27.0 dB
Optical Signal to Noise Ratio (OSNR); $1x10^{-12}$ BER, −10 to −20 dBm	NA	NA	NA	See Table 10-77, "Noise-limited performance for OC-192 DWDM PTMs" (p. 10-87).
Minimum Loss Budget[5]	0.0 dB	3.0 dB	11.0 dB	11.0 dB
Maximum Loss Budget[6]	4.0 dB	11.0 dB	22.0 dB	21.0 dB for 9.95 Gb/s
				24.0 dB for 10.7 Gb/s
Target Distance	2 km	40 km	80 km	NA

Notes:

1. All terminology is consistent with GR-253-CORE, Issue 3 and ITU G.693. All values are worst-case end of life. Optical specifications meet or exceed equivalent GR-253-CORE requirements.
2. The System Gain is Minimum Transmitter Power minus Minimum Received Power.

3. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path. The optical path penalty for 1310 nm is a maximum of 1.0 dB. The optical path penalty for 1550 nm is a maximum of 2.0 dB.
4. Refer to GR-253-CORE for more information about these parameters.
5. For all packs and PTMs where the Minimum Loss Budget (MLB) is 0, no attenuator is required for loopbacks. For all packs and PTMs where the MLB is greater than 0, an attenuator is required. The value of the LBO must be equal to or greater than the MLB.
6. The stated maximum loss budget equals the minimum system gain, minus the optical path penalty. Maximum loss budget is available for both station and transmission cable and splices.
7. Although not specified, the OC-192 XFPs may tolerate some amount of negative dispersion, approximately −100 ps/nm.

Table 10-76 Dispersion-limited receiver sensitivity for OC-192 DWDM PTMs

Data Rate	Receiver Sensitivity 0 ps/nm dispersion	Receiver Sensitivity 1300 ps/nm dispersion	Receiver Sensitivity 1600 ps/nm dispersion
9.9 Gb/s	−24.0 dBm	−22.0 dBm	NA
10.7–11.1 Gb/s with Forward Error Correction (FEC) enabled	−27.0 dBm	NA	−25.0 dBm

Table 10-77 Noise-limited performance for OC-192 DWDM PTMs

Data Rate	OSNR Required 0 ps/nm dispersion	OSNR Required 1300 ps/nm dispersion	OSNR Required 1600 ps/nm dispersion
9.9 Gb/s	24.0 dB	26.0 dB	NA
10.7–11.1 Gb/s with Forward Error Correction (FEC) enabled	18.0 dB	NA	20.0 dB

Lightguide jumpers and build-outs

Overview

Alcatel-Lucent 1665 DMX provides standard LC-type connectors on all optical interfaces. 5 dB, 10 dB, 15 dB, and 20 dB attenuating build-outs are supported.

Single-mode jumpers

The OC-3, OC-12, OC-48, OC-192, and 1000BASE-LX lightguide interfaces use single-mode jumpers for connecting to and from the outside plant *LGX* panel and Alcatel-Lucent 1665 DMX.

Multi-mode jumpers

The 1000BASE-SX interface must use multi-mode jumpers.

Build-outs

Alcatel-Lucent 1665 DMX supports the use of single-mode to single-mode (SM-SM) fiber exclusively, except on the 1000BASE-SX interface.

Reference

For more information, including a complete list of available jumpers and build-outs, see "Miscellaneous equipment and tools" (p. 7-7) in Chapter 7, "Ordering".

Multimode fiber transmission with OC-3 and OC-12 circuit packs

Overview

The OC-3 and OC-12 circuit packs can transmit signals over Multi-Mode Fiber (MMF). OC-3 and OC-12 circuit packs used on Alcatel-Lucent 1665 DMX are designed to meet or exceed Optical Performance Standards per *Telcordia* ® GR-253-CORE on standard Single-Mode Fiber (SMF). This section reflects the results of tests demonstrating successful transmission over shorter distances of MMF. Based on this testing, transmission of OC-3 and OC-12 signals over MMF can be supported by an Alcatel-Lucent 1665 DMX system equipped with LNW37, LNW45, LNW49, LNW50, LNW55, or LNW82 circuit packs within the limits specified.

Core diameters

Standard SMF core diameters are specified to be in the range of 8−10 mm.

MMF core diameters are specified to be 50 mm or 62.5 mm.

Receiver ports

All existing Alcatel-Lucent 1665 DMX circuit pack codes that utilize OC-3 or OC-12 optical interfaces incorporate optical receiver ports that accept optical inputs from fiber cores up to 62.5 mm in diameter. Therefore, the receivers are designed to capture all of the incoming light from both SMF and MMF.

Transmitter ports

The LNW37, LNW45, LNW49, LNW50, LNW55, or LNW82 circuit packs utilize optical interfaces that incorporate laser transmitter ports designed to launch into 8−10 mm SMF. The laser transmitters in these circuit packs are Distributed Feedback (DFB) or Single Longitudinal (SLM) mode lasers.

Recommendations

With multi-mode fiber specified to meet 1 GbE fiber standards per the original IEEE 802.3zTM (now found in IEEE 802.3-2002) and rated at 500 MHz-km or greater, "Single-mode Fiber Offset-Launch Mode- Conditioning Patch Cords" (Mode-Conditioning Patch Cord) are required for the transmitter ports of LNW37, LNW49, and LNW50 circuit packs. Mode-Conditioning Patch Cords take the transmitter port output from the single-mode fiber and couple it to the multi-mode fiber core at an offset. This offset launch into the MMF minimizes differential mode delay and modal dispersion. With the use of Mode-Conditioning patch cords, transmission distances of up to 300 meters are allowed. See Figure 10-1, “Transmission over multi-mode fiber connection using single-mode fiber offset-launch mode-conditioning patch cord” (p. 10-90).

With improved, recently introduced MMF specified to exceed 1 GbE fiber standards, transmission distances of up to 300 meters are allowed without the use of Mode-Conditioning patch cords. Several manufacturers offer this improved MMF (see the table below). These fibers, or their equivalents, do not require Mode-Conditioning patch cords when used with the LNW37, LNW49, and LNW50 circuit pack codes.

Table 10-78 MMF types that do not require mode-conditioning patch cords

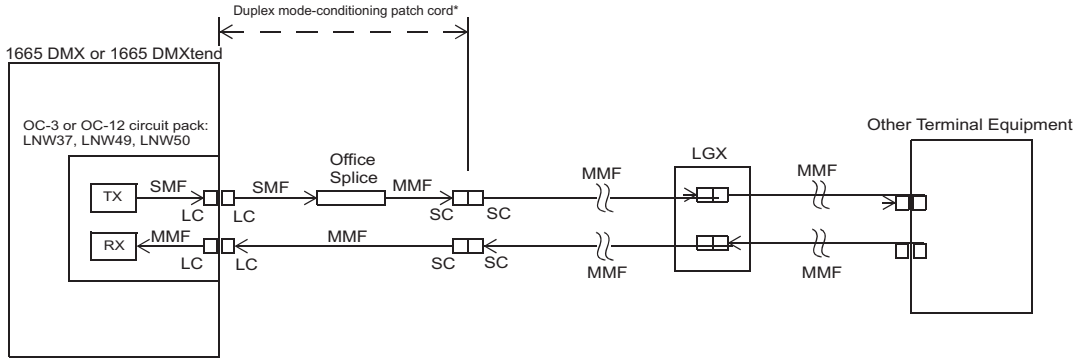
Manufacturer	Product Name	Core Size
OFS Fitel	GigaGuide 62.5	62.5 mm
OFS Fitel	GigaGuide 62.5 XL	62.5 mm
Corning	InfiniCor CL 1000	62.5 mm

Table 10-78 MMF types that do not require mode-conditioning patch cords (continued)

Manufacturer	Product Name	Core Size
Draka Comteq	HiCap 62.5 mm	62.5 mm

Per usual practice, one must adhere to Alcatel-Lucent's receiver overload and sensitivity specifications for the circuit pack codes listed above. Multimode attenuators may be needed at the LGX.

Figure 10-1 Transmission over multi-mode fiber connection using single-mode fiber offset-launch mode-conditioning patch cord



LC = LC-type optical connector
SC = SC-type optical connector
SMF = single-mode fiber
MMF = multi-mode fiber
* Mode-Conditioning Patch cord may extend to the LG
1665 DMX = 1665 Data Multiplexer
1665 DMXtend = 1665 Data Multiplexer Extend

Ethernet/SAN specifications

Overview

Purpose

This section contains technical specifications for the optical and electrical interfaces for the Ethernet/SAN OLIUs.

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4-port 1000BASE-X/T (optical/electrical) Private Line Ethernet (LNW63)

Description

The LNW63 provides 4 PTM ports that can be equipped with very long-reach (1000BASE-ZX) 1550 nm, long-reach (1000BASE-LX) 1310 nm, and/or short-reach (1000BASE-SX) 850 nm optical PTMs. LNW63 can also be equipped with 100/1000BASE-T electrical Ethernet PTMs, although only 1000BASE-T rates are supported on the LNW63.

The LNW63 provides data transport at the rate of 1000 Mbps using standard encapsulation, and standard STS-1 virtual concatenation according to ITU G.707. The LNW63 is an unprotected pack.

The LNW63 contains 4 internal 1000 Mbps WAN ports supporting enhanced Private Line services such as high-order virtual concatenation (VT1.5) and Link Capacity Adjustment Scheme (LCAS).

The LNW63 and the supported PTMs are approved for OSP deployments. You must install PTMs that are approved for industrial temperatures to use the LNW63 in OSP environments.

When Alcatel-Lucent 1665 DMX is equipped with non-VLF Main packs, LNW63 packs can only be placed in Slot 1 of any Function Group or Growth slot in the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supports a total add/drop capacity of 20 Private Line GbE ports if all available slots are equipped with LNW63 circuit packs. If the LNW63 circuit packs occupy only slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59, LNW82, or LNW504) packs, Ethernet packs can occupy both Slot 1 and 2 of a Function or Growth Unit. With VLF Mains and all tributary slots populated with LNW63 packs, Alcatel-Lucent 1665 DMX provides a total add/drop capacity of 40 Private Line GbE ports.

Optical specification

The LNW63 utilizes 1000BASE-SX/LX/ZX PTM optics.

For the detailed specifications of these optics, see:

- “1000BASE-ZX optical Ethernet specification” (p. 10-103)
- “1000BASE-LX optical Ethernet/SAN specification” (p. 10-105)
- “1000BASE-SX optical Ethernet/SAN specification” (p. 10-107)
- “Allowed Ethernet/SAN PTM transceivers” (p. 10-102).

Electrical specification

The LNW63 uses electrical PTMs that are provisionable to support either 100BASE-T or 1000BASE-T traffic.

For detailed specifications, see "100/1000BASE-T electrical Ethernet specification" (p. 10-116).

Performance monitoring

Performance monitoring capabilities are available on the GbE circuit packs. For a detailed list of monitored parameters, see "Performance monitoring" (p. 5-62).

8-port 1000BASE-X/T (optical/electrical) Private Line Ethernet (LNW64)

Description

The LNW64 provides 8 Private Line Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), GbE ports. The ports can be equipped with 8 1000BASE-SX/LX/ZX PTMs or 8 100/1000BASE-T electrical PTMs, though only 1000BASE-T rates are supported on the LNW64. LNW64 can also support a mix of 4 electrical and 4 optical PTMs. The LNW64 contains 8 internal VCG ports supporting enhanced Private Line services such as virtual concatenation and Link Capacity Adjustment Scheme (LCAS).

LNW64 is OSP hardened and can only be used with VLF Mains (LNW59, LNW82, or LNW504). You must install PTMs that are approved for industrial temperatures to use the LNW64 in OSP environments.

LNW64 supports STS-1 and STS-3c cross-connections with or without VCAT, and STS-12c cross-connections without VCAT. All ports are capable of transmitting at wire speed (1000 Mbps) simultaneously, making full capacity of the pack 168 STS-1s.

Ethernet packs can occupy both Slot 1 and 2 of a Function or Growth Unit (where applicable). With VLF Mains and all tributary slots populated with LNW64 packs, Alcatel-Lucent 1665 DMX provides a total add/drop capacity of 80 Private Line GbE ports.

Optical specification

The LNW64 utilizes 1000BASE-SX/LX/ZX PTM optics.

For the detailed specifications of these optics, see:

- "1000BASE-ZX optical Ethernet specification" (p. 10-103)
- "1000BASE-LX optical Ethernet/SAN specification" (p. 10-105)

- "1000BASE-SX optical Ethernet/SAN specification" (p. 10-107)
- "Allowed Ethernet/SAN PTM transceivers" (p. 10-102).

Electrical specification

The LNW64 uses electrical PTMs that are provisionable to support either 100BASE-T or 1000BASE-T traffic.

For detailed specifications, see "100/1000BASE-T electrical Ethernet specification" (p. 10-116).

Performance monitoring

Performance monitoring capabilities are available on the GbE circuit packs. For a detailed list of monitored parameters, see "Performance monitoring" (p. 5-62).

10/100T Ethernet (LNW66)

Electrical specification

The 10/100T circuit packs provide a 24-port, 100BASE-T, IEEE 802.3-compliant interface that is capable of spanning distances of 100 meters. The 10/100T circuit pack provides Fast Ethernet switched services. The 10/100T interface auto-negotiates mode (full/half duplex) and speed (10/100 Mbps) when interfacing with other 802.3-compliant devices over twisted pair media. The 10/100T circuit packs are not equipment protected. However, facility protection can be provided through the WAN via SONET (UPSR, BLSR, or 1+1) and/or (on the LNW66) through the IEEE 802.1W spanning tree algorithm.

The 10/100T Ethernet interfaces comply with the following transmission standards:

- Standard IEEE 802.1D for transparent bridging and spanning tree protection.
- Standard IEEE 802.3, Section 25 for 10/100 Mb autonegotiation (including flow control, full-duplex transmission, and half-duplex transmission).

When Alcatel-Lucent 1665 DMX is equipped with non-VLF Main packs, Ethernet packs can only occupy slot 1 of any Function Unit group or Growth slot on the shelf (A1–G1). When all available slots are equipped with LNW66 circuit packs, up to 120 ports are addressable. If the circuit packs only occupy slot 1 of a Function Unit or Growth group, slot 2 must be populated with an apparatus blank.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59, LNW82, or LNW504) packs, Ethernet packs can be installed in either slot 1 or 2 of Function Unit or Growth groups. When all available slots are equipped with LNW66 circuit packs, up to 240 ports are addressable.

Format specification

The 10/100T circuit packs comply with the following formatting standards:

- Maximum frame size see "Packet size in different tagging modes" (p. A-66)
- standard IEEE 802.1Q VLANs
- Ethernet to SONET Mapping, (G.7041 (GFP) and G.707 (Virtual Concatenation)
- Protection (SONET and/or 802.1W) and Ethernet Bridging (802.1D)

Performance monitoring

Performance monitoring capabilities are available on the 10/100T circuit packs, however Threshold Crossing Alerts (TCAs) are not supported (except on the first two items listed below). Monitored parameters include:

- Dropped Frames (congestion)
- Dropped Frames (errors)
- Incoming Number of Bytes
- Outgoing Number of Bytes
- Incoming Number of Frames
- Outgoing Number of Frames

Performance monitoring capabilities are available on the 10/100T circuit packs. For a detailed list of monitored parameters, see "Performance monitoring" (p. 5-62).

FC-DATA: FICON/ESCON/Fibre-Channel (LNW73 and LNW73C) SAN transport interface

Description

The LNW73 and LNW73C are 4-port Storage Area Networking (SAN) interface cards designed to facilitate SAN distance extensions vian Alcatel-Lucent 1665 DMX using GFP-T (ITU G.7041). These cards employ standard encapsulation, and standard STS virtual concatenation according to ITU G.707. For extended FC/FICON interfaces, the LNW73/73C also supports buffer_to_buffer credit management spoofing consistent with ANSI T11 FC-BB-3_GFPT draft standard.

They utilize PTM optics to provide the option of FICON, ESCON, or Fibre-channel interfaces natively on the Alcatel-Lucent 1665 DMX shelf. Each pack must be equipped to support only one type of traffic at a time (FICON/FC or ESCON). The LNW73/73C can operate at 1 Gbps or 2 Gbps. When the pack is operating at 2 Gbps only every other port may be used. Therefore, the total number of SAN interfaces on an Alcatel-Lucent 1665 DMX shelf varies depending on the main circuit packs, equipage and configuration of the ports.

When Alcatel-Lucent 1665 DMX is equipped with non-VLF Main packs, LNW73/73C packs can only be placed in Slot 1 of any Function Unit group or Growth slot on the shelf (A1–G1). If all available slots are equipped with LNW73/73C circuit packs, Alcatel-Lucent 1665 DMX supports a total add/drop capacity of 20 when the LNW73/73c is operating at 1G FC/FICON or ESCON and 10 when LNW73/73C is operating at 2G FC/FICON. If the LNW73/73C circuit packs occupy only slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59, LNW82, or LNW504) packs, Ethernet packs can occupy both Slot 1 and 2 of any Function Unit group or Growth slot on the shelf (A1–G1). With VLF Mains and all tributary slots populated with LNW73/73C packs, Alcatel-Lucent 1665 DMX provides a total add/drop capacity of 40 when the LNW73/73c is operating at 1G FC/FICON or ESCON and 20 when LNW73/73c is operating at 2G FC/FICON.

While the capacity of each port is 2 Gbps, the true capacity of each port is relative to the type of PTM it is equipped with. For ESCON traffic, the PTM ports have a capacity of 200 Mbps. The 2 Gbps capacity of the ports is sufficient to support FC2G and FICON Express.

The LNW73C differs from the LNW73 in that it enables compression of asynchronous FC traffic. The LNW73C is able to conserve up to 50% of bandwidth versus uncompressed SAN traffic in typical applications. SAN compression enables a high throughput of up to two full-line rate FC-2G interfaces in a single pack.

Optical specification

The LNW73 and LNW73C can utilize both 1000BASE-LX and 1000BASE-SX PTM optics. Both the 1000BASE-LX and 1000BASE-SX optics can support FICON traffic. The LNW73/73C can also utilize ESCON PTM optics for ESCON traffic. These PTM optics can be ordered and plugged into the LNW73/73C as their capacity becomes needed.

For the detailed specifications of these optics, see:

- “1000BASE-LX optical Ethernet/SAN specification” (p. 10-105)
- “1000BASE-SX optical Ethernet/SAN specification” (p. 10-107)
- “ESCON SAN transport specification (LNW73/73C)” (p. 10-116)
- “Allowed Ethernet/SAN PTM transceivers” (p. 10-102).

Performance monitoring

Performance monitoring capabilities are available on the LNW73/73C circuit packs. A detailed list of monitored parameters can be found in “Performance monitoring” (p. 5-62).

100BASE-X optical and 10/100BASE-T electrical Ethernet Private Line (LNW74)

Description

The LNW74 circuit packs provide 16 10/100BASE-T, IEEE 802.3-compliant electrical interfaces (via the backplane of the shelf) that are capable of spanning distances of 100 meters. The LNW74 also provides 8 optical 100BASE-ZX/LX/FX IEEE 802.3-compliant (100 Mbps) fast Ethernet interfaces. The LNW74 is a Private Line circuit pack.

The 10/100T interface function is full duplex mode and auto-negotiates speed (10/100 Mbps) when interfacing with other 802.3-compliant devices over twisted pair media. The LNW74 circuit pack must be housed in slot 1 of a Function Unit group and is not equipment protected. However, facility protection can be provided through the WAN via SONET (UPSR, BLSR, or 1+1). The LNW74 also supports low- and high-order (STS/VT) VCAT.

When Alcatel-Lucent 1665 DMX is equipped with non-VLF Main packs, LNW74 packs can only be placed in Slot 1 of any Function or Growth group in the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supports a total capacity of 64 10/100BASE-T electrical ports and 40 100BASE-X optical ports if all available slots are equipped with LNW74 circuit packs. When the LNW74 circuit packs occupy only slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59, LNW82, or LNW504) packs, LNW74 packs can occupy Slot 1 and Slot 2 of any Function or Growth group (A1–G1). The Port Configuration of the circuit packs must be provisioned as FX to support LNW74 packs in both companion slots. With VLF Mains and available tributary slots populated with LNW74 packs, up to 64 10/100BASE-T electrical ports and 40 100BASE-X optical ports are provided if all available slots are equipped with LNW74 circuit packs and the Port Configuration of the circuit packs is FT_FX. Additional ports can be added if the companion slot to the LNW74 is populated with a compatible front-access Ethernet pack, like an LNW170. With VLF Mains and available tributary slots populated with LNW74 packs, up to 80 100BASE-X optical ports are provided if all available slots are equipped with LNW74 circuit packs and the Port Configuration of the circuit packs is FX.

In all scenarios, when the LNW74 is installed in slot G1 or G2, the Port Configuration of the circuit pack is FX and only optical PTMs can be used.

Optical specification

The LNW74 utilizes 100BASE-X PTM optics. These PTM optics can be ordered and plugged into the LNW74 as their capacity becomes needed.

For the detailed specifications of these optics, see:

- "100BASE-ZX optical Ethernet specification" (p. 10-111)
- "100BASE-LX optical Ethernet specification" (p. 10-112)
- "100BASE-FX optical Ethernet specification" (p. 10-114)
- "Allowed Ethernet/SAN PTM transceivers" (p. 10-102).

Electrical specification

The LNW74 provides 16 electrical ports for the 10/100BASE-T interfaces. These electrical ports transmit at 10/100 Mbps using standard Ethernet switching IEEE 802.1, standard encapsulation, and standard STS-1 and VT virtual concatenation according to ITU G.707. The LNW74 electrical interfaces can transmit signals across spans as long as 100 meters.

The LNW74 circuit pack is designed specifically to support Fast Ethernet Private Line applications. Each LNW74 circuit pack can support 24 private lines. The LNW74 can also support STS-3(c) cross-connections instead of virtual concatenation.

The 10/100T Ethernet interfaces comply with the following transmission standards:

- standard IEEE 802.1D for transparent bridging and spanning tree protection.
- standard IEEE 802.3, Section 25 for 10/100 Mb autonegotiation (including flow control, full-duplex transmission, and half-duplex transmission).

For detailed specifications, see "100/1000BASE-T electrical Ethernet specification" (p. 10-116).

Performance monitoring

Performance monitoring capabilities are available on the LNW74 circuit packs. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

100/1000BASE-T/X Ethernet Privatel Line (LNW87)

Description

The LNW87 circuit pack is an 4-port, PTM-based Private Line Fast Ethernet/Gigabit Ethernet pack. The ports can be populated with either, 4 optical, 4 electrical PTMs, or a mix of electrical and optical PTMs. The port mode is provisionable on per port basis.

The LNW87 and some of the supported PTMs are approved for OSP deployments. You must install PTMs that are approved for industrial temperatures to use the LNW87 in OSP environments.

When Alcatel-Lucent 1665 DMX is equipped with non-VLF Main packs, LNW87 packs can only be placed in Slot 1 of any Function or Growth group in the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supports a total capacity of 20 10/100BASE-T electrical ports and 20 100BASE-X optical ports if all available slots are equipped with LNW87 circuit packs. When the LNW87 circuit packs occupy only slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank. Additional ports can be added if the companion slot to the LNW87 is populated with a compatible front-access Ethernet pack, like an LNW170.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59, LNW82, or LNW504) packs, LNW87 packs can occupy Slot 1 and Slot 2 of any Function or Growth group (A–G) and the number or ports available doubles..

Optical specification

The LNW87 utilizes 100BASE-X and 1000BASE-X PTM optics. These PTM optics can be ordered and plugged into the LNW87 as their capacity becomes needed.

For the detailed specifications of these optics, see:

- “1000BASE-ZX optical Ethernet specification” (p. 10-103)
- “1000BASE-LX optical Ethernet/SAN specification” (p. 10-105)
- “1000BASE-SX optical Ethernet/SAN specification” (p. 10-107)
- “100BASE-ZX optical Ethernet specification” (p. 10-111)
- “100BASE-LX optical Ethernet specification” (p. 10-112)
- “100BASE-FX optical Ethernet specification” (p. 10-114)
- “Allowed Ethernet/SAN PTM transceivers” (p. 10-102).

Electrical specification

The LNW87 uses electrical PTMs that are provisionable to support either 100BASE-T or 1000BASE-T traffic.

For detailed specifications, see “100/1000BASE-T electrical Ethernet specification” (p. 10-116).

Performance monitoring

Performance monitoring capabilities are available on the LNW87 circuit packs. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

100/1000BASE-X/T (optical/electrical) Ethernet (LNW170)

Description

The LNW170 circuit packs provide four 1000BASE-X (SX, LX, and/or ZX- very long reach 80km), IEEE 802.3-compliant (1000Mbps) GbE interfaces and four 100BASE-ZX/LX/FX IEEE 802.3-compliant (100 Mbps) fast Ethernet interfaces. The LNW170 circuit packs provide Ethernet private line or switched services, with QoS. Protection is provided via SONET UPSR/BLSR or through the IEEE 802.1w (or 802.1d) spanning tree algorithm.

The LNW170 can also use electrical PTMs that are provisionable to support either 100BASE-T or 1000BASE-T traffic. The electrical PTMs can occupy ports 1−8.

The LNW170 is an unprotected pack by default. Alcatel-Lucent 1665 DMX supports link aggregation on LNW170 LAN ports, which can be used to provide facility protection. The LNW170 can also support aggregation across LNW170 circuit packs. For more information on Link Aggregation, see "Link aggregation (LNW170 LAN ports)" (p. 5-58).

When Alcatel-Lucent 1665 DMX is equipped with non-VLF Main packs, unprotected LNW170 packs can only be placed in Slot 1 of any Function Unit group or Growth slot on the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supports a total add/drop capacity of 20 1000BASE-X ports and 20 1000BASE-ZX ports if all available slots are equipped with LNW170 circuit packs. If the LNW170 circuit packs occupy only slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank. However, the LNW170 can be populated on both slots with non-VLF Mains if it is in equipment-protected mode.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main (LNW59, LNW82, or LNW504) packs, Ethernet packs can occupy both Slot 1 and 2 of a Function or Growth Unit (where applicable). With VLF Mains and all tributary slots populated with LNW170 packs, up to 40 1000BASE-X and 40 100BASE-LX ports are addressable.

Optical specification

The LNW170 can utilize 1000BASE-X optics. The LNW170 can also utilize 100BASE-X PTM optics for optical fast Ethernet. These PTM optics can be ordered and plugged into the LNW170 as their capacity becomes needed.

For the detailed specifications of these optics, see:

- "1000BASE-ZX optical Ethernet specification" (p. 10-103)
- "1000BASE-LX optical Ethernet/SAN specification" (p. 10-105)
- "1000BASE-SX optical Ethernet/SAN specification" (p. 10-107)
- "100BASE-ZX optical Ethernet specification" (p. 10-111)
- "100BASE-LX optical Ethernet specification" (p. 10-112)
- "100BASE-FX optical Ethernet specification" (p. 10-114)
- "Allowed Ethernet/SAN PTM transceivers" (p. 10-102).

Electrical specification

The LNW170 use electrical PTMs that are provisionable to support either 100BASE-T or 1000BASE-T traffic. The electrical PTMs can occupy ports 1−8.

The dual function electrical PTMs are provisionable for 100 or 1000 Mbps traffic. They conform to the IEEE802.3 standards for 100BASE-T and 1000BASE-T in the respective settings (IEEE802.3z and IEE802.3ab). Connectivity is provided for an RJ-45 Cat 5 cable and the PTM has a maximum span length of 100 meters.

The 100/100BASE-T Ethernet interfaces comply with the following transmission standards:

- standard IEEE 802.1D for transparent bridging and spanning tree protection.
- standard IEEE 802.3, Section 25 for 10/100 Mb autonegotiation (including flow control, full-duplex transmission, and half-duplex transmission).

For more information on the PTM optics available for the LNW170, see "100/1000BASE-T electrical Ethernet specification" (p. 10-116) and "100/1000BASE-X/T (optical/electrical) Ethernet (LNW170)" (p. 10-100).

Performance monitoring

Performance monitoring capabilities are available on the LNW170 circuit packs. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

Allowed Ethernet/SAN PTM transceivers

Overview

Alcatel-Lucent 1665 DMX utilizes Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), transceivers on the LNW63, LNW64, LNW73/73C, LNW74, LNW87, LNW170, and LNW705 circuit packs. To ensure proper optical performance, mechanical fit, compliance with EMC, and compliance with laser safety standards, the Alcatel-Lucent specified PTM transceivers listed in the table below must be used.

Only the Alcatel-Lucent specified PTM transceivers listed below are compatible with Alcatel-Lucent 1665 DMX software. If non-Alcatel-Lucent specified PTM transceivers are installed in Alcatel-Lucent 1665 DMX, the system will reject that transceiver, and that optical port will become inoperable (until approved parts are installed).

Allowed Ethernet/SAN PTMs

The table below lists the PTM transceivers that may be used in the LNW63, LNW64, LNW73/73C, LNW74, LNW87, LNW170, and LNW705 circuit packs.

Table 10-79 Ethernet/SAN PTMs

Apparatus Code	Description	Circuit pack
100BASE-ZX-I1	Optical Fast Ethernet PTM, LC-type connectors (FE-15510SM), OSP hardened/Industrial (−40°C to 85°C). Specification: “100BASE-ZX optical Ethernet specification” (p. 10-111)	LNW74/87/170
100BASE-LX-I1	Optical Fast Ethernet PTM, LC-type connectors (FE-1310SM), OSP hardened/Industrial (−40°C to 85°C). Specification: “100BASE-LX optical Ethernet specification” (p. 10-112)	LNW74/87/170
100BASE-FX-I1	Optical Fast Ethernet PTM, LC-type connectors (FE-1310MM), OSP hardened/Industrial (−40°C to 85°C). Specification: “100BASE-FX optical Ethernet specification” (p. 10-114)	LNW74/87/170
GE-1X2XFC-SX-I1 (1000BASE-SX, 1Gbps and 2 Gbps Fibre-Channel)	GbE short-reach, Multi-Mode PTM, supports Ethernet and Fibre-Channel traffic, LC-type connectors, OSP hardened/Industrial (−40°C to 85°C), (GbE/FC/2FC-850). Specification: “1000BASE-SX optical Ethernet/SAN specification” (p. 10-107)	LNW63/64/73/ 73C/87/170/705

Table 10-79 Ethernet/SAN PTMs (continued)

Apparatus Code	Description	Circuit pack
GE-1X2XFC-LX-I1 (1000BASE-LX, 1Gbps and 2 Gbps Fibre-Channel/FICON)	GbE long-reach, Single-Mode PTM, supports Ethernet, FICON, and Fibre-Channel traffic, LC-type connectors, OSP hardened/Industrial (−40°C to 85°C), (GbE/FC/2FC-1310) Specification: "1000BASE-LX optical Ethernet/SAN specification" (p. 10-105)	LNW63/64/73/ 73C/87/170/705
1000BASE-ZX-I1 (1000BASE-ZX, 1Gbps)	GbE very long-reach, 1550 nm, Single-Mode PTM, supports Ethernet, LC-type connectors, and is OSP hardened/Industrial, (−40°C to 85°C), (GbE-1550). Specification: "1000BASE-ZX optical Ethernet specification" (p. 10-103)	LNW63/64/87/170
BASE-T-C1 FE and GbE (electrical- NOT OSP)	Electrical PTM, provisionable to 100 or 1000 Mbps, Alcatel-Lucent Approved RJ-45 Cat 5-E cable, maximum span length of 100 meters	LNW63/64/87/170
ESCON-MM-I1 (ESCON)	ESCON, Multi-Mode PTM, LC-type connectors (ESCON-1310), Specification: "ESCON SAN transport specification (LNW73/73C)" (p. 10-116)	LNW73/73C

1000BASE-ZX optical Ethernet specification

Overview

The 1000BASE-ZX PTMs can be used for GbE service over Single-Mode Fiber (SMF). The 1000BASE-ZX PTMs are OSP hardened for outside plant applications.

System specifications

The following are the 1000BASE-ZX system specifications:

- Optical Line Rate: 1.25 GBd (±100 ppm)
- Optical Line Coding: 8B/10B
- Fiber Type: 10 µm SMF
- Minimum Range: 2 to 80,000 m
- Performance: long-reach (80 km)

Transmitter specifications

The 1000BASE-ZX optical transmitter meets the specifications defined in IEEE802.3. The table below shows some of the 1000BASE-ZX optical transmitter specifications.

Table 10-80 1000BASE-ZX transmit specifications

Description	1000BASE-ZX
Transmitter type	Longwave Laser
Signaling speed (range)	1.25 GBd (±100 ppm)
Wavelength (λ, range)	1500 to 1580 nm
T_{rise}/T_{fall} (max; 20%−80% response time)	0.26 ns
Maximum Spectral Width ($\Delta\lambda_{20}$)	+1.0 nm
Average launch power (max)	+5.0 dBm
Average launch power (min)	0 dBm
Average launch power of OFF transmitter (max)	−40.0 dBm
RIN (max)	−120 dB/Hz

Receiver specifications

The 1000BASE-ZX receiver meets the specifications defined in the table below.

Table 10-81 1000BASE-ZX receive specifications

Description	1000BASE-ZX
Signaling speed (range)	1.25 GBd (±100 ppm)
Wavelength (range)	1500 to 1580 nm
Average receive power (max)	0 dBm
Receive sensitivity	−22.5 dBm
Return loss (min)[1]	12.0 dB

Notes:

1. See the IEEE802.3 standards for more information about return loss (min).

Link budgets

The worst-case power budget and link penalties for a 1000BASE-ZX channel are shown in the table below.

Table 10-82 1000BASE-ZX link budgets and penalties

Parameter	1000BASE-ZX
Maximum Channel Insertion Loss	+21.0 dB

Table 10-82 1000BASE-ZX link budgets and penalties (continued)

Parameter	1000BASE-ZX
Minimum Channel Insertion Loss	+5.0 dB
Maximum Dispersion	1600 ps/nm
Optical Path Penalty	+1.5 dB

Format specification

The 1000BASE-ZX Ethernet/SAN interface complies with the following formatting standards:

- standard IEEE 802.1Q VLANs
- Ethernet to SONET Mapping, G.7041 (GFP) and G.707 (Virtual Concatenation)
- Protection (SONET and/or 802.1W) and Ethernet Bridging (802.1D)

Performance monitoring

Performance monitoring capabilities are available on the 1000BASE-ZX interface. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

1000BASE-LX optical Ethernet/SAN specification

Overview

The 1000BASE-LX PTMs can be used for GbE, 1Gbps and 2 Gbps Fibre-Channel, and FICON service over Single-Mode Fiber (SMF).

System specifications

The following are the 1000BASE-LX system specifications:

- Optical Line Rate: 1.25 GBd (±100 ppm)
- Optical Line Coding: 8B/10B
- Fiber Type: 10 µm SMF
- Minimum Range: 2 to 10,000
- Performance: long-reach

GbE/FC/2XFC/FICON compliance

The PTM optics are compliant with GbE and compatible with FC, 2XFC, and FICON specifications.

Transmitter specifications

The optical 1000BASE-LX optical transmitter meets the specifications defined in IEEE802.3. The table below shows some of the 1000BASE-LX optical transmitter specifications. The 1000BASE-LX transceiver also meets ANSI INCITS FC-PI standards for FC and 2xFC traffic (352-2002).

Table 10-83 1000BASE-LX transmit specifications

Description	1000BASE-LX
Transmitter type	Longwave Laser
Signaling speed (range)	1.25 GBd (±100 ppm)
Wavelength (λ, range)	1270 to 1355 nm
T_{rise}/T_{fall} (max; 20%−80% response time)	0.26 ns
Maximum RMS Spectral Width (σ)	4.0 nm
Average launch power (max)	−3.0 dBm
Average launch power (min)	−11.0 dBm
Average launch power of OFF transmitter (max)	−30.0 dBm
RIN (max)	−120 dB/Hz

Receiver specifications

The 1000BASE-LX receiver meets the specifications defined in IEEE 802.3. The table below shows some of the 1000BASE-LX optical receiver specifications.

Table 10-84 1000BASE-LX receive specifications

Description	1000BASE-LX
Signaling speed (range)	1.25 GBd (±100 ppm)
Wavelength (range)	1270 to 1355 nm
Average receive power (max)	−3.0 dBm
Receive sensitivity	−19.0 dBm
Return loss (min)[1]	12.0 dB
Receive electrical 3 dB upper cutoff frequency (max)	1500 MHz

Notes:

1. See the IEEE802.3 standards for more information about return loss (min).

Link budgets

The worst-case power budget and link penalties for a 1000BASE-LX channel are shown in the table below.

Table 10-85 1000BASE-LX link budgets and penalties

Parameter	1000BASE-LX
Link power budget	8.0 dB
Operating distance	10,000 m
Allocation for link penalties[1]	2.0 dB

Notes:

1. A wavelength of 1270 nm is used to calculate the link penalty.

Format specification

The 1000BASE-LX Ethernet/SAN interface complies with the following formatting standards:

- Maximum frame size see "Packet size in different tagging modes" (p. A-66)
- standard IEEE 802.1Q VLANs
- Ethernet to SONET Mapping, G.7041 (GFP) and G.707 (Virtual Concatenation)
- Protection (SONET and/or 802.1W) and Ethernet Bridging (802.1D)

Performance monitoring

Performance monitoring capabilities are available on the 1000BASE-LX interface. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

1000BASE-SX optical Ethernet/SAN specification

Overview

The 1000BASE-SX PTMs can be used for Gigabit Ethernet, Fibre-Channel, and FICON service over Multi-Mode Fiber (MMF).

System specifications

The following are the 1000BASE-SX system specifications:

- Optical Line Rate: 1.25 GBd (±100 ppm)
- Optical Line Coding: 8B/10B
- Performance: short-reach

GbE/FC/2XFC compliance

The PTM optics are compliant with GbE, FC, and 2XFC specifications.

Operating range

The table below shows the operating range for the 1000BASE-SX optical Ethernet/SAN interface. A 1000BASE-SX compliant transceiver supports both 50 µm and 62.5 µm fiber media types. A transceiver that exceeds the operational range requirement while meeting all other optical specifications is considered compliant (for example, a 50 µm solution operating at 600 m meets the minimum range requirement of 2 to 550 m).

Table 10-86 1000BASE-SX operating range over each optical fiber type

Fiber Type	Modal Bandwidth @ 850 nm (minimum overfilled launch)	Minimum Range
62.5 µm MMF	160 MHz-km	2 to 220 m
62.5 µm MMF	200 MHz-km	2 to 275 m
50 µm MMF	400 MHz-km	2 to 500 m
50 µm MMF	500 MHz-km	2 to 550 m
10 µm SMF	Not supported	Not supported

Transmitter specifications

The 1000BASE-SX optical transmitter meets the specifications defined in IEEE 802.3. The table below shows some of the 1000BASE-SX optical transmitter specifications. Measurement techniques are defined in IEEE 802.3, Section 38, Clause 6. The 1000BASE-SX transceiver also meets ANSI INCITS FC-PI standards for FC and 2xFC traffic (352-2002).

Table 10-87 1000BASE-SX transmit specifications

Description	1000BASE-SX
Transmitter type	Shortwave Laser
Signaling speed (range)	1.25 GBd (±100 ppm)
Wavelength (λ, range)	770 to 860 nm
T_{rise}/T_{fall} (max; 20%−80%; l > 830 nm)	0.26 ns
T_{rise}/T_{fall} (max; 20%-80%; l ≤ 830 nm)	0.21 ns
Maximum RMS Spectral Width (σ)	0.85 nm
Average launch power (max)	0 dBm[1]
Average launch power (min)	−9.5 dBm

Table 10-87 1000BASE-SX transmit specifications (continued)

Description	1000BASE-SX
Average launch power of OFF transmitter (max)[2]	−30.0 dBm
Extinction ratio (min)	9.0 dB
RIN (max)	−117 dB/Hz
Coupled Power Ratio (CPR) (min)[3]	9 < CPR dB

Notes:

1. The 1000BASE-SX launch power must be the lesser of the class 1 safety limit as defined by IEEE 802.3, Section 38, Clause 7.2 or the average receiver power (maximum) defined by Table 10-88, “1000BASE-SX receive specifications” (p. 10-109).
2. Examples of an OFF transmitter are as follows: no power supplied to the optical module, laser shutdown for safety conditions, and activation of a "transmit disable" or other optional module laser shut-down conditions.
3. Radial overfilled launches (described in IEEE 802.3, Section 38A, Clause 2) should be avoided even if they meet CPR ranges.

Receiver specifications

The 1000BASE-SX optical receiver meets the specifications defined in IEEE802.3, Section 38.3.2. The table below shows some of the 1000BASE-SX optical receiver specifications. Measurement techniques are defined in IEEE802.3, Section 38, Clause 6.

Table 10-88 1000BASE-SX receive specifications

Description	1000BASE-SX	
	62.5 µm MMF	50 µm MMF
Signaling speed (range)	1.25 GBd (±100 ppm)	
Wavelength (range)	770 to 860 nm	
Average receive power (max)	0 dBm	
Receive sensitivity	−17.0 dBm	
Return loss (min)[1]	12.0 dB	
Receive electrical 3 dB upper cutoff frequency (max)	1500 MHz	

Notes:

1. See the IEEE802.3 standards for more information about return loss (min).

Link budgets

The worst-case power budget and link penalties for a 1000BASE-SX channel are shown in the table below.

Table 10-89 1000BASE-SX link budgets and penalties

Parameter	1000BASE-SX			
	62.5 µm MMF		50 µm MMF	
Modal bandwidth as measured at 850 nm (minimum, overfilled launch)	160 MHz-km	200 MHz-km	400 MHz-km	500 MHz-km
Link power budget	7.5 dB	7.5 dB	7.5 dB	7.5 dB
Operating distance	220 m	275 m	500 m	550 m
Channel insertion loss[1]	2.38 dB	2.60 dB	3.37 dB	3.56 dB
Link power penalties[1]	4.27 dB	4.29 dB	4.07 dB	3.57 dB
Unallocated margin in link power budget	0.84 dB	0.60 dB	0.05 dB	0.37 dB

Notes:

1. A wavelength of 830 nm is used to calculate the channel insertion loss, link power penalties, and unallocated margin.

Format specification

The 1000BASE-SX Ethernet/SAN interface complies with the following formatting standards:

- Maximum frame size see “Packet size in different tagging modes” (p. A-66)
- standard IEEE 802.1Q VLANs
- Ethernet to SONET Mapping, (G.7041 (GFP) and G.707 (Virtual Concatenation)
- Protection (SONET and/or 802.1W) and Ethernet Bridging (802.1D)

Performance monitoring

Performance monitoring capabilities are available on the 1000BASE-SX interface. A detailed list of monitored parameters can be found in “Performance monitoring” (p. 5-62).

100BASE-ZX optical Ethernet specification

Overview

The 100BASE-ZX PTMs can be used on the LNW74, LNW87, and LNW170.

System specifications

The following are the 100BASE-ZX system specifications:

- Optical Line Rate: 125 MBd ±50 ppm
- Optical Line Coding: 4B/5B
- Fiber Type: 10 µm SMF
- Minimum Range: 2 to 80,000 m
- Performance: Long-reach (80 km)

Transmitter specifications

The table below describes some of the transmit specifications for 100BASE-ZX.

Table 10-90 100BASE-ZX transmit specifications

Description	100BASE-ZX
Transmitter type	Longwave Laser
Signaling speed (range)	125 MBd (± 50 ppm)
Wavelength (range)	1480 to 1600 nm
Maximum RMS Spectral Width (σ)	1 nm
Average launch power (max)	2.0 dBm
Average launch power (min)	−3.0 dBm

Receiver specifications

The table below describes some of the receiver specifications for 100BASE-ZX.

Table 10-91 100BASE-ZX receive specifications

Description	100BASE-ZX
Signaling speed (range)	125 MBd (±50 ppm)
Wavelength (range)	1480 to 1600 nm
Average receive power (max)	−8.0 dBm
Receive sensitivity	−31.0 dBm
Return loss (min)	25.0 dB

Link budgets

The worst-case power budget and link penalties for a 100BASE-ZX channel are shown in the table below.

Table 10-92 100BASE-ZX link budgets and penalties

Parameter	100BASE-ZX
Maximum Channel Insertion Loss	27.0 dB
Minimum Channel Insertion Loss	10.0 dB
Maximum Dispersion	1700 ps/nm
Optical Path Penalty	1 dB

Performance monitoring

Performance monitoring capabilities are available on the 100BASE-ZX interface. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

100BASE-LX optical Ethernet specification

Overview

The 100BASE-LX PTMs can be used on the LNW63, LNW64, LNW74, LNW87, and LNW170.

System specifications

The following are the 100BASE-LX system specifications:

- Optical Line Rate: 125 MBd ±50 ppm
- Optical Line Coding: 4B/5B
- Fiber Type: 10 µm SMF
- Minimum Range: 2 to 10,000 m
- Performance: long-reach

Transmitter specifications

The 100BASE-LX transmitters meets these specifications defined in IEEE 802.3. The table below describes some of the transmit specifications for 100BASE-LX.

Table 10-93 100BASE-LX transmit specifications

Description	100BASE-LX
Transmitter type	Longwave Laser
Signaling speed (range)	125 MBd (± 50 ppm)
Wavelength (range)	1260 to 1360 nm
Maximum RMS Spectral Width (σ)	7.7 nm
Average launch power (max)	−8.0 dBm
Average launch power (min)	−15.0 dBm

Receiver specifications

The 100BASE-LX receiver meets these specifications defined in IEEE 802.3. The table below describes some of the receiver specifications for 100BASE-LX.

Table 10-94 100BASE-LX receive specifications

Description	100BASE-LX
Signaling speed (range)	125 MBd (±50 ppm)
Wavelength (range)	1260 to 1360 nm
Average receive power (max)	−8.0 dBm
Receive sensitivity	−25.0 dBm
Return loss (min)[1]	12.0 dB

Notes:

1. See the IEEE802.3 standards for more information about return loss (min).

Link budgets

The worst-case power budget and link penalties for a 100BASE-LX channel are shown in the table below.

Table 10-95 100BASE-LX link budgets and penalties

Parameter	100BASE-LX
Link power budget	10.0 dB
Operating distance	10,000 m
Allocation for link penalties[1]	4.0 dB

Notes:

1. A wavelength of 1270 nm is used to calculate the link penalty allocation.

Format specification

The 100BASE-LX Ethernet interface complies with the following formatting standards:

- standard IEEE 802.1Q VLANs
- Ethernet to SONET Mapping, G.7041 (GFP) and G.707 (Virtual Concatenation)
- Protection (SONET and/or 802.1W) and Ethernet Bridging (802.1D)

Performance monitoring

Performance monitoring capabilities are available on the 100BASE-LX interface. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

100BASE-FX optical Ethernet specification

Overview

The 100BASE-FX PTMs can be used on the LNW74, LNW87, and LNW170.

System specifications

The following are the 100BASE-FX system specifications:

- Optical Line Rate: 125 MBd ±50 ppm
- Optical Line Coding: 4B/5B
- Fiber Type: 50/62.5 µm MMF
- Minimum Range: 2 to 2,000 m
- Performance: short-reach

Transmitter specifications

The 100BASE-FX transmitters meets these specifications defined in IEEE 802.3. The table below describes some of the transmit specifications for 100BASE-FX.

Table 10-96 100BASE-FX transmit specifications

Description	100BASE-FX
Transmitter type	Longwave Laser
Signaling speed (range)	125 MBd (± 50 ppm)
Wavelength (range)	1270 to 1380 nm

Table 10-96 100BASE-FX transmit specifications (continued)

Description	100BASE-FX
Maximum RMS Spectral Width (σ)	74 nm
Average launch power (max)	−14.0 dBm
Average launch power (min)	−20.0 dBm

Receiver specifications

The 100BASE-FX receiver meets these specifications defined in IEEE 802.3. The table below describes some of the receiver specifications for 100BASE-FX.

Table 10-97 100BASE-FX receive specifications

Description	100BASE-FX
Signaling speed (range)	125 MBd (±50 ppm)
Wavelength (range)	1260 to 1580 nm
Average receive power (max)	−14.0 dBm
Receive sensitivity	−29.0 dBm
Return loss (min)[1]	12.0 dB

Notes:

1. See the IEEE802.3 standards for more information about return loss (min).

Link budgets

The worst-case power budget and link penalties for a 100BASE-FX channel are shown in the table below.

Table 10-98 100BASE-FX link budgets and penalties

Parameter	100BASE-FX
Link power budget	9.0 dB
Operating distance	2000 m
Allocation for link penalties	NA

Performance monitoring

Performance monitoring capabilities are available on the 100BASE-FX interface. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

100/1000BASE-T electrical Ethernet specification

Electrical specification

The LNW63/64/87/170 circuit packs support dual function electrical Pluggable Transmission Modules (PTMs), also known as small form-factor plug-ins (SFPs), that are provisionable for either 100 or 1000 Mbps traffic. On the LNW170 and LNW87, the PTMs can function at both 100 and 1000BASE-T rates. On the LNW63 and LNW64 only the 1000BASE-T rate is supported.

The electrical Ethernet PTMs conform to the IEEE802.3 standards for 100BASE-T and 1000BASE-T in the respective settings (IEEE802.3z and IEE802.3ab). Connectivity is provided for an RJ-45 Cat 5 cable and the PTM has a maximum span length of 100 meters.

The 100/100BASE-T Ethernet interfaces comply with the following transmission standards:

- standard IEEE 802.1D for transparent bridging and spanning tree protection.
- standard IEEE 802.3, Section 25 for 10/100 Mb autonegotiation (including flow control, full-duplex transmission, and half-duplex transmission).

Performance monitoring

Performance monitoring capabilities are available on the 10/100T circuit packs. For a detailed list of monitored parameters, see “Performance monitoring” (p. 5-62).

ESCON SAN transport specification (LNW73/73C)

ESCON specifications

The following are the ESCON system specifications for the LNW73/73C:

- Optical Line Rate: 200 MBd
- Optical Line Coding: 8B/10B
- Performance: Short-reach.

Operating range

The table below shows the operating range for the ESCON optical SAN interface. The ESCON transceiver supports 62.5 and 50 µm multi-mode fiber media types.

Table 10-99 ESCON optics operating range multi-mode fiber

Fiber Type	Range
62.5 µm MMF	3 km

Table 10-99 ESCON optics operating range multi-mode fiber (continued)

Fiber Type	Range
50 µm MMF	2 km

Transmitter specifications

The ESCON transmitter conforms to the IBM Corporation SA23-0394-03 standard. The table below describes some of the transmit specifications for ESCON transmitter.

Table 10-100 ESCON transmit specifications

Description	ESCON
Transmitter	LED
Signaling speed (range)	200 Mb/s (± 0.04)
Wavelength (range)	1280 to 1380 nm
T_{rise}/T_{fall} (max; 20%−80% response time)	1.7 ns
Maximum RMS Spectral Width (σ)	175 nm
Average launch power (max)	−14.0 dBm
Average launch power (min)	−20.5 dBm
Extinction ratio (min)	+8.0 dB

Receiver specifications

The ESCON receiver conforms to the IBM Corporation SA23-0394-03 standard. The table below describes some of the receive specifications for ESCON receiver.

Table 10-101 ESCON receive specifications

Description	ESCON
Signaling speed (range)	200 Mb/s (±0.04)
Average receive power (max)	−14.5 dBm
Receive sensitivity	−29.0 dBm

Link budgets

The worst-case power budget and link penalties for an ESCON channel are shown in the table below.

Table 10-102 ESCON maximum link loss

Parameter	ESCON	
	62.5 µm SMF	50 µm SMF
Link power budget	8.0 dB	8.0 dB
Operating distance	3 km	2 km

Format specification

The LNW73/73C interface complies with the following formatting standards:

- The LNW73/73C supports 4 VCGs with a capacity of 48 STS-1s
- FICON/ESCON/FC to SONET Mapping, G.7041 and G.707 (Virtual Concatenation), SA22-7202-02, SA23-0394-03, IBM SG24-4662-00, ANSI X3.296-1977
- Protection SONETBLSR and UPSR (split routing available with BLSR)

Performance monitoring

Performance monitoring capabilities are supported on the FICON/ESCON/Fibre-channel interfaces. A detailed list of monitored parameters can be found in "Performance monitoring" (p. 5-62).

System performance

Overview

Purpose

This section provides performance specifications for Alcatel-Lucent 1665 DMX.

Contents

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SONET overhead bytes

Purpose

Alcatel-Lucent 1665 DMX uses SONET transport and path overhead bytes as specified in GR-253-CORE.

V4 byte

The reserved V4 byte in the VT1.5 superframe is sometimes used for internal error detection in an Alcatel-Lucent 1665 DMX shelf. This internal usage of the V4 byte may cause the value of a transmitted V4 byte to vary. The Alcatel-Lucent 1665 DMX always ignores the value of the V4 byte received from another network element as required by GR-253-CORE.

Wander/jitter

Maximum time interval error (MTIE)

For SONET optical interfaces, the maximum time interval error (MTIE) does not exceed 60 nanoseconds phase variation when timed with a wander-free reference.

Wander requirements

Wander transfer, tolerance, and generation requirements are met as specified in GR-253-CORE.

Jitter requirements

Jitter transfer, tolerance, and generation requirements are met as specified in GR-253-CORE and GR-499-CORE.

Short-term stability

The SONET interfaces meet the T1.101 OC-N output short-term stability mask as specified in GR-253-CORE, Section 5.

Signal performance

Overview

The following specifications apply to the standard networks defined in GR-499-CORE, Issue 3.

DS1 rate

For systems interfacing at the DS1 rate, the number of errored seconds during a 7-hour, one-way loopback test, is less than 10.

DS3 rate

For systems interfacing at the DS3 rate, the number of errored seconds during a 2-hour, one-way loopback test, is less than 29.

BER

The BER is less than $2x10^{-10}$ for both the DS1 and DS3 rates. Burst-errored seconds are excluded.

Burst-errored seconds

The frequency of burst-errored seconds, other than those caused by protection switching induced by hard equipment failures, averages less than 4 per day.

Synchronization

Overview

The embedded Stratum 3 Timing Generator meets the specifications of GR-253-CORE, SONET Transport Systems Generic Criteria. The timing generator function is embedded in the 1x1 protected optical interface circuit packs in the main slot pair.

Timing modes

The timing generator supports four timing modes:

- **External timing**
  Locked to an external Stratum 3 (±4.6 ppm) or better DS1/E1 reference.
- **Line timing**
  Locked to recovered clock from an OC-N signal (from Main or tributary OC-3/OC-12/OC-48/OC-192).
- **Free running**
  Timing derived from high-stability temperature-compensated voltage-controlled crystal oscillator (TCVCXO) with a long-term accuracy of ±4.6 ppm and temperature stability of −40º C to +65ºC.
- **Holdover**
  Timing derived from the internal oscillator in the case of an unprotected synchronization reference failure. In this instance, the Stratum Timing Generator switches to "holdover mode" and continues to provide system timing, using the internal oscillator to maintain the last known good reference frequency. If the DS1/E1 timing output is enabled for network synchronization, DS1/E1 AIS will be inserted on detection of unprotected optical reference failure. In holdover mode, the accuracy is ±.37 ppm over the full −40°C to +65ºC temperature range.
- **DS1/E1 timing outputs**
  In addition, each timing generator (main circuit pack) provides a single DS1 or E1 sync output derived from a received optical interface signal (OC-N). These DS1/E1 timing outputs may be used to provide a timing reference signal to a local BITS clock For more information, see Chapter 5, “Operations, administration, maintenance, and provisioning”.

DS1 timing functions

The DS1 timing reference inputs and outputs meet the specifications of GR-499-CORE for DS1 interfaces and GR-253-CORE for timing references. The following are the DS1 timing functions:

- Two DS1 timing reference inputs
- Two DS1 timing reference outputs
- Alarms (Out of Frame, AIS, BER).

E1 timing functions

The E1 timing reference inputs and outputs meet the specifications of ITU-T G.813 for frequency accuracy, pull-in, hold-in and pull-out ranges, wander, jitter, noise tolerance, noise transfer, transient response and holdover performance. E1 references also comply with ITU-T G.704 standards for SDN SSM. The following are the E1 timing functions:

- Two E1 timing reference inputs
- Two E1 timing reference outputs
- Alarms (Out of Frame, AIS, BER).

Protection switching

1+1 networks

Alcatel-Lucent 1665 DMX complies with SONET 1+1 unidirectional and bidirectional revertive and nonrevertive protection switching requirements as specified in GR-253-CORE. Automatic line switches are initiated by signal fail and signal degrade conditions on the received low-speed (OC-3/12/48) or high-speed (OC-12/48/192) optical signal and are completed within 50 milliseconds of a signal failure. The signal's BER is calculated from violations of the SONET line overhead B2 parity bytes. Signal fail is declared for incoming LOS, LOF, line AIS, or BER exceeding a provisionable 10^{-3} to 10^{-5} threshold, while a BER exceeding a provisionable 10^{-5} to 10^{-9} threshold causes the signal degrade condition. Manual switch commands are available through the local and remote operations interfaces.

Important! Alcatel-Lucent 1665 DMX supports Bidirectional Optimized 1+1 Linear Protection Switching per ITU-T G.841 Annex B. Bidirectional optimized 1+1 is designed to enable interoperability between Alcatel-Lucent 1665 DMX and SDH equipment. It is a separate switching scheme from standard 1+1 bidirectional and does not work with standard 1+1.

Alcatel-Lucent 1665 DMX also supports non-revertive bidirectional 1+1 switching to enable interworking between Alcatel-Lucent 1665 DMX and Ciena Core Director.

High-speed UPSR networks

Path protection rings feed a SONET payload (STS or virtual tributary [VT]) from the ring entry point, simultaneously in both rotations of the ring, to the signal's ring exit point. The node that terminates the signal from the ring monitors both ring rotations and is responsible for selecting the signal that has the highest quality based on LOS, LOF, and path BER performance. On pass-through paths, all detected hard failures (LOS, LOF, line AIS, or STS-1 path AIS) result in VT AIS insertion in the outgoing signals. This allows the terminating node to be aware of the failure and to switch to protection. Protection switching is completed within 50 milliseconds of failure detection.

Under normal conditions, both incoming SONET path signals to the switch selection point are of high quality, and the signal can be selected from either ring. A failure or transmission degradation on one of the rings requires that the other ring path be selected. Alcatel-Lucent 1665 DMX provides nonrevertive switching. When and if the critical service should revert to a particular ring, a manual path protection switching command allows switching back to the original path for ease of ring maintenance in non-revertive applications.

Low-speed UPSR networks

On low-speed SONET optical interfaces (OC-3/12/48), UPSR is optional and protection switching is provisionable (UPSR or 1+1) on a per-line basis.

BLSR

Alcatel-Lucent 1665 DMX supports OC-192 and OC-48 2-fiber BLSR protection groups in the high-speed or low-speed slots, with STS-n cross-connectivity between any BLSR working tributary and the tributaries of all supported interfaces. This includes BLSR to BLSR cross-connections. Limited support is also provide for VT cross-connections (large fabric non-VLF mains only) and Extra Traffic). BLSR through cross-connections are also supported. However, cross-connections between different tributaries (timeslots) on the east and west ports of the ring are not supported. The BLSR ring map may be provisioned manually or automatically discovered. The squelch map entries may be manually provisioned or automatically generated. The BLSR switching is GR-1230-CORE complaint. However, external switch requests that must be signaled on the DCC channels are not supported.

Transient performance

Power loss restart

After system shutdown due to power loss, the system will exhibit a 2-second error free transmission interval which begins within 5 minutes of restoration of power.

Transmission start-up on signal application

The system, after having no signal applied for greater than 1 minute at the DSX-n interface, will exhibit a 2-second error free transmission interval which begins within 5 seconds of the reapplication of a signal.

Transmission delay

One-way transmission delay

The table below, lists the maximum one-way transmission delay (microseconds) between Alcatel-Lucent 1665 DMX interfaces.

Table 10-103 Transmission delay in microseconds

Cross-connect rate	Input	Output	Transmission delay (µsec)
STSn	OC-n	OC-n	80
	OC-n	EC1	80
	OC-n	DS3	155
	OC-n	TMUX	155
	EC1	EC1	80
	EC1	TMUX	155
	DS3	DS3	230
	TMUX	TMUX	230

Table 10-103 Transmission delay in microseconds (continued)

Cross-connect rate	Input	Output	Transmission delay (µsec)
VT	OC-n	OC-n	130
	OC-n	EC1	130
	OC-n	DS1	180
	OC-n	TMUX	180
	EC1	EC1	80
	EC1	DS1	180
	EC1	TMUX	180
	DS1	DS1	230
	TMUX	TMUX	230

Performance monitoring

Overview

Alcatel-Lucent 1665 DMX performance monitoring complies with GR-253-CORE and *ANSI* T1.231-1997 specifications for SONET and asynchronous networks.

SONET PM parameters

For information concerning PM parameters and all other PM capabilities associated with Alcatel-Lucent 1665 DMX, see "Performance monitoring" (p. 5-62).

Ethernet parameters

Alcatel-Lucent 1665 DMX provides PM capabilities for the 10/100T, 100BASE-ZX/LX/FX and 1000BASE-ZX/LX/SX Ethernet interfaces as well as the FICON/FC and ESCON interfaces. PM data is collected at each LAN and WAN interface in the network for both incoming and outgoing directions and is stored in quarter-hour and day bins. The WAN interface provides a connection to a SONET Virtual Concatenation Group (VCG).

Provisionable threshold crossing alerts (TCAs) are supported on the Ethernet interfaces. For more information about PM parameters, see "Performance monitoring" (p. 5-62).

Operations interfaces

Overview

Purpose

This section presents the operation interfaces that are required to support technician access to the system and allow alarms and status information generated by the system to be reported. The operation interfaces include the CIT interface, IAO LAN (via OSI or TCP/IP), SYSCTL faceplate LEDs, and equipment indicators. Alcatel-Lucent 1665 DMX supports office alarms, user-definable miscellaneous discretes, and TL1.

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Craft Interface Terminal (CIT)

Overview

The *WaveStar*® CIT is the primary tool used to interface with the Alcatel-Lucent 1665 DMX for managing synchronous interfaces and SONET operations. The *WaveStar*® CIT client software is installed on a personal computer (PC), and provides the Alcatel-Lucent 1665 DMX user-interface for SONET operations.

Requirements

It is anticipated that most customers will dedicate a laptop or personal computer (PC) to run the *WaveStar*® CIT software. However, any properly configured computer will suffice.

The following table lists the customer-provided PC minimum and recommended requirements for using the *WaveStar*® CIT.

Table 10-104 *WaveStar*® CIT PC requirements

Component	Minimum[1]	Recommended
Processor	Pentium II 266 MHz	Pentium IV 1GHz or higher
RAM (one System View)	256 MB	512 MB
RAM (up to 5 System Views)	512 MB	1 GB
Virtual memory	139 MB	267 MB
Available disk space	750 MB	850 MB[2]
Video	800x600 256 colors (8 bit)	1024x768 16 million colors (24 bit)
Network Interface card	10/100BASE-T Network Interface Card 10/100 BASE-T LAN interface Pin Designations/signals are: • 1 TD+ • 2 TD− • 3 RD+ • 6 RD−	
CD-ROM drive	Required	
Operating System	Supported Operating Systems are: • Microsoft *Windows*® 7 • Microsoft *Windows*® 2000 • Microsoft *Windows*® XP The customer is responsible for ensuring that the PC remains virus-free.	
Internet Browser	*Microsoft* ® Internet Explorer 5.0, 5.5, 6.0, or 7.0	

Notes:

1. Minimum requirements are sufficient to run two or three graphical System Views, unless otherwise noted. Recommended requirements are intended to be used as a general guideline to optimize *WaveStar*® CIT performance. Since the *WaveStar*® CIT is used with multiple NE connections and multiple NE types, the processor type and speed and the memory size all factor into the performance.
2. Available hard disk space required to install and store the *WaveStar*® CIT and on-line help files is approximately 750 MB. During installation, an additional 100 MB is required. To store a copy of an NE generic, another 125 MB is needed for each generic

TL1/LAN

Overview

Alcatel-Lucent 1665 DMX supports a TL1 over TCP/IP interface or TL1 over OSI LAN interface for communication between an Alcatel-Lucent 1665 DMX NE and an Element Management System (EMS) of a Network Management System (NMS). TL1 over TCP/IP LAN complies with requirements specified in IEEE 802.3 and NSIF-AR-9806-088R11.

TL1 translation device (T-TD Gateway)

The T-TD is a device that translates TL1 messages over a TCP/IP connection to a TL1 over OSI association, providing a TL1 TCP-OSI gateway. The T-TD, when used in conjunction with the CIT, is an open system interconnection (OSI) proxy that accepts TCP/IP connections and sets up matching OSI connections. This requires the support of the TCP/IP stack and the seven-layer OSI stack.

Front IAO LAN interface

Alcatel-Lucent 1665 DMX provides an RJ45-compatible front IAO LAN interface that is intended for use with a local PC. This interface will support a TL1/TCP gateway via an IEEE 802.3-compliant interface with a graphical user interface (GUI) in future releases.

Rear IAO LAN interface

TL1 over TCP/IP or TL1 over OSI LAN is supported via an RJ45-compatible IAO LAN rear interface on Alcatel-Lucent 1665 DMX, enablingAlcatel-Lucent 1665 DMX to connect with any NMS possessing a compatible TCP/IP or OSI interface (such as the EMS or the *WaveStar*® CIT). This allows TL1 communication over a data network between several different NEs. For instance, Alcatel-Lucent's Element Management System (EMS) can communicate with a DDM-2000 that is on the same network as Alcatel-Lucent 1665 DMX connected to the EMS via the rear IAO LAN interface. The IAO LAN complies with OSI requirements as specified in GR-253-CORE, Section 8.

SONET DCC

The SONET DCC provides TL1 over OSI connections with remote NEs in a subnetwork.

Personal computer specifications for software download

Specifications

The PC used for software download should have:

- Microsoft *Windows*® 2000 or XP
- CD-ROM drive for CD-ROM download.

Compatible modems

A compatible modem must meet the following minimum requirements:

- 300, 1200, 2400, 4800, 9600, 19,200 or 115,000 baud
- Full duplex
- 8 data bits
- No parity bits
- 1 start bit
- 1 stop bit
- No flow control.

LEDs, indicators, and office alarms

LNW2 SYSCTL faceplate

The LNW2 SYSCTL circuit pack faceplate contains the following push-button switches and LEDs:

- ACTIVE LED
- FAULT LED
- Critical (CR) LED
- Major (MJ) LED
- Minor (MN) LED
- Abnormal (ABN) LED
- Far End Activity (FE) LED
- Near End Activity (NE) LED
- Alarm Cut-Off/Test (ACO) LED
- ACO/TEST (ACO SW) button
- Select (SEL) button
- Update/Initialize (UPD INIT) button
- alphanumeric LED display

The alphanumeric LED numeric display is used to identify the remote system presently displayed on the local user panel.

A green PWR ON LED is lighted when the shelf is receiving −48 V power. A green ACO LED is lighted when the ACO function is active.

The SEL, ACO SW, and UPD INIT push-buttons are provided to control system operation.

Equipment indicators

A red LED FAULT indicator is provided on all circuit packs. A green LED ACTIVE indicator is provided on all 1x1 protected circuit packs to indicate which circuit packs are actively carrying traffic.

Office alarms

The office alarms interface is a set of discrete relays that control office audible and visual alarms. Separate relays handle CR, MJ, and MN alarms. Each contact closure is rated at 1 A, 60 V maximum. The CR and MJ alarms can be wire-ORed. The CR alarm relays are fail safe against unprotected power failures.

User-settable miscellaneous discrete interface

Overview

The user-settable miscellaneous discrete interface allows an operations system (OS) to control and monitor equipment collocated with Alcatel-Lucent 1665 DMX through a set of input and output contact closures. Miscellaneous discrete environmental inputs can monitor conditions like open doors or high temperature, miscellaneous discrete outputs control equipment such as fans and generators. The status of the miscellaneous discrete environmental inputs can be queried on demand via the *WaveStar*® CIT. Alcatel-Lucent 1665 DMX collects miscellaneous discrete alarms and automatically sends them to the operations system (OS).

External customer equipment

Any external customer equipment to be monitored by Alcatel-Lucent 1665 DMX must provide the electrical equivalent of a contact closure across the corresponding environmental input wiring pairs. The contact closure must be capable of passing at least 10 mA of drive current.

Power source

The power source to enable the control of external customer equipment may have a voltage range from a minimum of 3V to a maximum of 72V. Alcatel-Lucent 1665 DMX provides a unidirectional opto-isolator connection across each corresponding control output wiring pair. The load current across each control output wiring pair must be limited by the external customer equipment and must not exceed 35 mA.

Reference

For detailed wiring information, see the *Alcatel-Lucent 1665 Data Multiplexer (DMX) Installation Manual, 365-372-304*.

Physical specifications

Overview

Purpose

This section provides Alcatel-Lucent 1665 DMX physical characteristics, including environmental and power specifications.

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Physical specifications

Alcatel-Lucent 1665 DMX High-Capacity shelf physical characteristics

The Alcatel-Lucent 1665 DMX High-Capacity shelf has the following characteristics:

- Width: 17.6 inches
- Height: 19 inches (includes integral fan unit)
- Depth front to back with rear cover installed
  - 16 inches with flush front cover installed
  - 17 inches with extended front cover installed
  - Removal of the rear cover subtracts 0.8 inches from the depth of the shelf
- Weight (with circuit packs): 57 pounds
- Weight (without circuit packs): 38 pounds

Environmental specifications

Temperature and humidity

Alcatel-Lucent 1665 DMX meets *Telcordia ® Network Equipment Building System "NEBS Generic Equipment Requirements," GR-63-CORE* requirements for use in CO environments.

A Fan Assembly is required above the standard Alcatel-Lucent 1665 DMX shelf in any environment except an outside cabinet (with ventilation) application. The Alcatel-Lucent 1665 DMX High-Capacity shelf has a fan unit built into the right side of the shelf.

Alcatel-Lucent 1665 DMX is environmentally hardened and will function at temperatures of −40ºC to +65ºC and humidity of 5 to 95 percent (noncondensing) in all TDM applications when equipped with the following circuit packs:

LNW2, LNW7, LNW8, LNW16, LNW18, LNW19B, LNW20, LNW32, LNW37, LNW45, LNW48, LNW49, LNW50, LNW54, LNW55, LNW63, LNW64, LNW74, LNW80, LNW82, LNW87, LNW203, or LNW801.

In all other applications, Alcatel-Lucent 1665 DMX functions at temperatures of 0ºC to +50ºC.

EMC requirements

Alcatel-Lucent 1665 DMX has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residence is likely to cause harmful interference in which case the user will be required to correct the interference at the user's own expense.

Earthquake requirements

Alcatel-Lucent 1665 DMX meets the earthquake requirements defined in *Telcordia ®* GR-63-CORE and Pacific Bell Standard PBS-000-102PT.

Fire resistance

Alcatel-Lucent 1665 DMX meets ignitability requirements specified in *ANSI* T1.307-1997. In addition, Alcatel-Lucent 1665 DMX meets the fire resistance requirements of *UL* 60950, 3rd Edition.

Underwriters Laboratories

Alcatel-Lucent 1665 DMX is *UL* recognized for restricted access installations in business and customer premises applications installed in accordance with Articles 110–16 and 110–17 of the *National Electric Code*, *ANSI*/NFPA Number 70–87. Other installations exempt from the requirements of the National Electric Code may be engineered according to the accepted practices of the local telecommunications utility.

Canadian Standards Association

Alcatel-Lucent 1665 DMX has been certified by the Canadian Standards Association per standard CAN/CSA-C22.2 Number 60950-00.

Power specifications

Power supply

The following table lists Alcatel-Lucent 1665 DMX High-Capacity shelf power requirements.

Table 10-105 Alcatel-Lucent 1665 DMX power supply requirements

Item	30-amp shelf	20-amp shelf
Circuit Breakers (two per shelf)	30.0 A	20.0 A
Voltage range, all components	−40.0V to −60.0 VDC	
Power Feeders	two −48V power feeders [BREAKER (A) and BREAKER (B)]	

Circuit breakers

Alcatel-Lucent 1665 DMX uses on-board power conversion eliminating the need for slots for bulk power converters. Two independent −48V office power feeders (A and B) enter the shelf through connectors and are filtered and distributed to the circuit packs through circuit breakers. Power conversion is performed through modular power converters located on the circuit packs. In each circuit pack, the feeders are diode ORed, fused, filtered, and regulated by the board-mounted power modules. This provides the required redundancy in case of the loss of one feeder or circuit breaker. The green Power LEDs located next to each circuit breaker (A and B) indicate power is being fed to the breaker.

Current drains

The following table provides current drain information for Alcatel-Lucent 1665 DMX shelves with a single power feed.

Table 10-106 Current drains

Shelf	Current Drain @ −48V	Current drain @ −40V
Alcatel-Lucent 1665 DMX 30-amp High Capacity Shelf	23A	27.5A[1]
Alcatel-Lucent 1665 DMX 20-amp High Capacity Shelf	14.6A	17.5A[2]

Notes:

1. If your shelf is equipped with 1xLNW2, 2xLNW59s, 10xLNW170s, and 1xFan unit, and you lose one power feed or circuit breaker, the shelf's current drain will exceed the 30.0A capacity of the remaining circuit breaker and your shelf will lose power.
2. In the following four configurations, if you lose one power feed or circuit breaker, the shelf's current drain will exceed the 20.0A capacity of the remaining circuit breaker and your shelf will lose power: *Configuration 1:* 1xLNW2, 2xLNW59s, 10xLNW170s, and 1xFan unit; *Configuration 2:* 1xLNW2, 2xLNW59s, 10xLNW20s, and 1xFan unit; *Configuration 3:* 1xLNW2, 2xLNW59s, 8xLNW20s 2x(any OC-n low-speed circuit pack), and 1xFan unit; *Configuration 4:* 1xLNW2, 2xLNW82s, 10xLNW170s, and 1xFan unit.

Heat dissipation

The following list provides maximum heat dissipation information for Alcatel-Lucent 1665 DMX.

Table 10-107 Maximum heat dissipated

Shelf	Maximum Heat Dissipated
Alcatel-Lucent 1665 DMX 30-amp High Capacity Shelf	1100 Watts
Alcatel-Lucent 1665 DMX 20-amp High Capacity Shelf	700 Watts

Appendix A: Ethernet/SAN

Overview

Purpose

This section describes the Ethernet implementation for the Alcatel-Lucent 1665 Data Multiplexer (Alcatel-Lucent 1665 DMX).

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Introduction to Ethernet services

Ethernet services

Ethernet services are what network operators provide their subscribers. Alcatel-Lucent 1665 DMX supports Private Line, Private LAN, Virtual Private LAN, and Virtual Private Line.

The Private services are transported over their own dedicated SONET time slots. If present, Ethernet switching functions may or may not be shared.

Subscribers of Virtual Private services share network bandwidth to take advantage of the efficiency of statistical multiplexing that is available due to the intermittent nature of data transmission. VLAN Tags are used to separate subscribers and maintain privacy. Alcatel-Lucent 1665 DMX supports VLANs in the 1–4093 range for customer identification and isolation.

Private Line services are point-to-point in nature while Private LAN services are multipoint. Private LAN services always involve internal Ethernet switching while Private Line services do not.

Private line

Private Line service provides a dedicated link between two locations. The Ethernet ports and SONET bandwidth are dedicated to the subscriber and not shared. Private line service is characterized by minimal provisioning - typically just the SONET cross-connection. A subclass, Fractional Private Line, is distinguished by less than Ethernet-line-rate SONET connectivity. It is a form of rate control that also improves efficiency by only consuming the required SONET bandwidth in STS-1 increments. For more information about how STS-1 tributaries can be virtually concatenated to provide Fractional Private Line service, see “Virtual concatenation” (p. A-24).

Another characteristic of Private Line service is little or no Layer 2 functionality. With Fast Ethernet, the physical layer must be terminated precluding transparency of auto-negotiation. In addition, performance of the Fractional Private Line may be improved by enabling flow control, a Layer 2 function. For more information about flow control, see “Flow control” (p. A-44).

MAC address learning is another function. For more information, see “Ethernet LAN/VCG port density” (p. A-32). Circuit packs that support multiple service modes For more information about Ethernet circuit packs, see “Ethernet/SAN circuit packs” (p. A-7).

Private LAN

Private LAN service extends the concept of Private Line to connect more than two locations in an extended Ethernet LAN. This is accomplished by introducing embedded Ethernet switching at each node. The SONET bandwidth is still dedicated to one subscriber. Because this is a switched service, the attendant QoS features are available.

VLAN tagging is an integral part of Private LAN service. VLANs are used to distinguish customers or organizations within customers. In the Transparent Mode, the service provider provisions a port tag, or customer ID, for each Ethernet port. This port tag is added to each incoming packet and carried with the Alcatel-Lucent 1665 DMX network in order to keep the traffic for each subscriber separate. When the packets exit the Alcatel-Lucent 1665 DMX network, the port tag is removed. Any subscriber-inserted VLAN tags within the packets are carried through the network unchanged.

In 802.1Q mode, the provider coordinates VLAN tags with the subscriber to further manage traffic flows. For example, some VLANs can limit traffic among particular groups of sites representing communities of interest while others may be used for traffic common to all. This can be coupled with QoS features such as PIR and priorities to optimize the Private LAN network. For more information about Quality of Service, see "Quality of Service" (p. A-67). For more information about Tagging modes, see "Tagging Modes" (p. A-60).

Virtual Private LAN

Virtual Private LAN service extends the concepts of Private LAN service to include bandwidth sharing among multiple customers. In this way, less SONET bandwidth can be used to serve customers by taking advantage of the efficiency of statistical multiplexing. VLAN tags or port tags are used to keep each subscriber's traffic private.

Virtual Private Line

Virtual Private Line, a shared service between two points, is a special case of Virtual Private LAN. It requires the use of Ethernet switching functions and is therefore configured and managed in the same way as Virtual Private LAN.

Network topologies and configurations

Network topologies consist of two layers: the packet layer and the underlying SONET layer. Packet networks can be created over a variety of SONET topologies, and have different properties as a result. For example, a Private Line service uses a point-to-point packet topology, but may be carried over a SONET ring, which may in turn be configured with UPSR protection or no SONET protection.

The following packet topologies are supported:

- Point-to-point
- Multipoint
- Hub-and-spoke.

Point-to-point

The point-to-point topology is used to join two nodes. For example, a business may connect to an ISP via a point-to-point connection. Because of its simplicity point-to-point configurations have a variety of protection options available. They may use any of the SONET layer protection mechanisms. They may also forgo SONET protection and use data-layer protection such as Link Aggregation.

Multipoint

In a multipoint network all points converse with each other. Note that connecting three locations by two point-to-point connections is not the same as if done by a multipoint connection. The location in the middle of the point-to point connections would have to provide external switching to enable the outer locations to converse with each other.

One useful case of multipoint configurations is a packet ring. In a closed-ring configuration all nodes may converse. An internal spanning tree may be configured for protection and loop prevention. This is independent of any spanning tree protocol that may be running on the subscriber's network. The spanning tree *breaks* one link, necessary with a ring of interconnected bridges. In the case of a link failure, the spanning tree algorithm restores connectivity by moving its *break* to coincide with the failed link.

A special case of multipoint configuration is where one node acts as a hub and all other nodes converse only with it. This hub configuration differs from a hub-and-spoke network only in that the spokes share bandwidth to reach the hub. It is more efficient and may be more practical because it conserves hub ports; only two VCG (WAN) ports are needed, regardless of the number of spokes. (In a packet ring configuration the broken link is placed between the two nodes most remote from the hub; because those nodes don't converse, there is no loss of useful bandwidth.) Both this topology and the hub-and-spoke described next are sometimes called point-to-multipoint.

Hub-and-spoke

The hub-and-spoke network is a hybrid between point-to-point and multipoint. Each node connects to the hub via a dedicated link; but, the links terminate on an embedded switch at the hub. In a typical back-haul application, the switch aggregates the traffic into a single Ethernet link for hand off. As in the multipoint hub network, tags are used to identify and direct traffic to and from the hub.

Applications

Ethernet applications are examples of what users can do with the services and topologies described in previous sections. The user can be the owner of the equipment or a client of the owner. For example, an ISP can have a private network or buy the services from an LEC to construct the application.

Alcatel-Lucent 1665 DMX supports the following applications:

- LAN interconnect
- LAN extension
- ISP access
- Internet access
- Video distribution

LAN interconnect

Two or more enterprise LANs are interconnected. The LANs may be point-to-point Private Line connections, in which case Ethernet switching services are not provided. If Virtual private lines are desired, Ethernet switching is required. Even so, in a three-node LAN Interconnect application composed of Virtual private lines the middle node has two termination ports, one for each neighbor. This is different from a three-node LAN Extension (next application) using Virtual Private LAN in which the middle node may have only one (effectively a hub) port.

LAN extension

Sometimes called intranet or Layer 2 VPN, this extends an enterprise LAN to multiple locations via embedded Ethernet switching. Either Private LAN or Virtual Private LAN may be used.

Transparent LAN is a common form of LAN Extension in which the subscriber's traffic is transported without regard to the presence of subscriber VLAN tags. Transparency is achieved by the use of Port Tags, avoiding the need for the provider to administer VLANs with subscribers. The Port Tag is effectively a customer ID; only ports in the network assigned a particular customer ID will exchange traffic.

In *Non-Transparent LANs*, greater flexibility is available when the subscriber's 802.1Q tags are used for traffic management (802.1Q mode). For example, the priority bits within the tag can be used to give a portion of the traffic, for example VoIP, preferential treatment versus file transfer or other internet traffic. DSCP offers an alternative to priority bits. DSCP can also be used to give certain packets/data streams preferential treatment.

Although in a Virtual Private LAN service a Non-transparent LAN application requires the administration of VLAN Id's among customers, in a Private LAN where no other customers share the embedded Ethernet switch this is not necessary. For more information about priority bits, see “Priorities” (p. A-35).

ISP Access

In this application an ISP uses a provider's network to collect internet traffic. It is also an example of a trunking application, where traffic from multiple customers is handed off to the ISP router on a single trunk link for efficiency. The Virtual Private LAN service may be used to efficiently transport the best-effort internet traffic. It is typically done using the

802.1Q mode for separating the ISP's clients' traffic. If the ISP's router supports stacked VLANs then it can be done in Transparent Mode The trunk link may be GbE while the access links may be 10 or 100 Mb/s Ethernet.

Internet access

In this application the ISP owns the network. In this case the clients' traffic is untagged. The ISP adds tags for customer separation using the 802.1Q mode. The ISP administers the tags directly, there is no third party involved.

Video distribution

Video distribution can be accomplished using Ethernet Multicasting. A Private LAN service is used to guarantee the bandwidth. Video traffic, generated at the head end, is sent using a multicast address. Transparent mode or 802.1Q mode may be used. At each node the traffic is dropped to its user and also duplicated and sent to the rest of the Private LAN.

An alternative is to use SONET drop-and-continue cross-connections to implement multicasting. This is a variation of the Private LAN service. Although it is limited to one-way video distribution, it supports full line rate throughput.

Ethernet/SAN circuit packs

Overview

Table A-1 Optical specifications

Application/Circuit Pack	Code	Compatible Shelf Slots	Description
1000BASE-X/T (4 ports) Private Line	LNW63	A–G[1]	1000BASE-SX/LX/ZX Ethernet interface via optical PTMs, can be used in slot 1 and/or 2 in a VLF-equipped Alcatel-Lucent 1665 DMX and either slot 1 or 2 in a non-VLF equipped Alcatel-Lucent 1665 DMX, GbE private lines, includes no switch fabric, OSP hardened
1000BASE-X/T (8 ports) Private Line	LNW64	A–G[1]	1000BASE-T/SX/LX/ZX Ethernet interface via PTMs, can be used in slot 1 and/or 2 in a VLF-equipped Alcatel-Lucent 1665 DMX, GbE private lines, includes no switch fabric, OSP hardened
10/100T (24 ports)	LNW66	A-D[2]	100BASE-T Ethernet interface
FC-DATA(SAN Interface)	LNW73	A–G[1]	4 ports, PTM optics supporting either FICON/Fibre-Channel or ESCON, can be installed in slot 1 or 2 of a function group or a growth slot with VLF mains, slot 1 only with non-VLF
FC-DATA w/ compression(SAN Interface)	LNW73C	A–G[1]	4 ports, PTM optics supporting either FICON/Fibre-Channel or ESCON, also supports compression of SAN traffic, can be installed in slot 1 or 2 of a function group or a growth slot with VLF mains, slot 1 only with non-VLF

Table A-1 Optical specifications (continued)

Application/Circuit Pack	Code	Compatible Shelf Slots	Description
100BASE-X (8 ports) 10/100BASE-T (16 ports) Private Line	LNW74	A–G[1]	Hybrid 100BASE-ZX/LX/FX and 10/100 BASE-T Ethernet interface, may only occupy slot 1 of a function group or a growth slot if non-VLF mains are used, slot 1 and 2 are available with VLF mains (Series 1:2 or higher LNW74s), uses PTM optics for ZX/LX/FX interfaces, supports private lines, when installed in the Growth slots, only the optical ports are functional (17–24), OSP hardened.
FE/GBE PL	LNW87	A–G[1]	100/1000BASE-T and 100BASE-ZX/LX/FX Ethernet interface via optical PTMs, can be used in slot 1 and/or 2 in a VLF-equipped Alcatel-Lucent 1665 DMX and either slot 1 or 2 in a non-VLF equipped Alcatel-Lucent 1665 DMX, GbE private lines, includes no switch fabric, OSP hardened
Enhanced Ethernet Switch Pack (100/1000 BASE-X/T ports	LNW170	A–G[1]	Hybrid 100/1000 BASE-X/T Ethernet interface, uses PTMs, supports enhanced Ethernet QoS, equipment protection using Link Aggregation when equipped in pairs of slots

Notes:

1. With non-VLF Mains, most Ethernet and SAN pack can only occupy slot 1 of a FN or Growth group. Those packs that can occupy either slot are noted in the Description column. The unprotected LNW170 can occupy both slots with non-VLF Mains. In order to support all other Ethernet and SAN packs in both Slot 1 and 2 of a Function Group or Growth Slot, Alcatel-Lucent 1665 DMX must be equipped with VLF Mains (LNW59/LNW82/LNW504).
2. Alcatel-Lucent 1665 DMX does not allow installation of two packs with electrical interfaces in adjacent slots within the same Function Unit or Growth Slot. Therefore, in systems equipped with LNW59, LNW82, or LNW504 VLF mains, LNW66 and LNW74 packs can reside in either Slot 1 or Slot 2 of a group, but not both at the same time. However, another optical (Ethernet or SONET) pack may be installed in the other slot. In non-VLF equipped shelves, LNW66 can only occupy Slot 1 of a particular group.

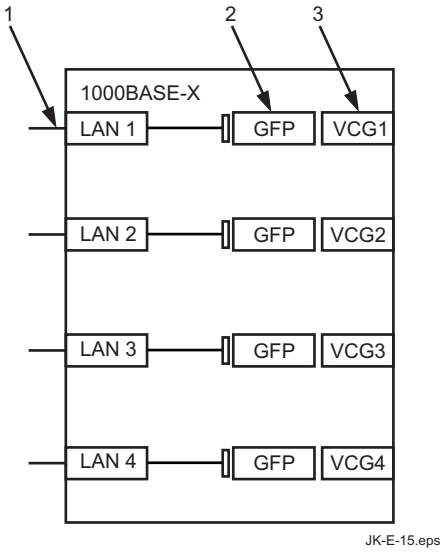
4-port GbE-PL Private Line Fast Ethernet circuit pack (LNW63)

The GbE-PL Private Line Gigabit Ethernet (LNW63) circuit pack provides point-to-point (Ethernet Private Line Service) data transport at the 1000 Mb/s rate. The GbE-PL circuit pack supports generic framing procedure (GFP) encapsulation and STS virtual concatenation.

The LNW63 circuit pack supports STS-1, STS-3c, STS-12c cross-connects. LNW63 has 4 VCGs, and each VCG can have up to 21 STS-1 tributaries and the total available backplane link space is 48 STS-1s to Main-1 and 48 STS-1s to Main-2. The tributaries may be assigned freely, all VCGs have access to all tributaries. See Figure A-1, “LNW63 Gigabit Ethernet (Private Line) circuit pack” (p. A-10).

Each VCG can use 1 STS-1, or up to 21 (STS-1-xv, x=1–21) tributaries. Each VCG can use 1 STS-3c, or up to 7 (STS-3-xv, x=1–7) or 1 STS-12c tributary.

Figure A-1 LNW63 Gigabit Ethernet (Private Line) circuit pack



1 = External Ethernet Port
2 = Generic Framing Procedure
3 = Virtual Concatenation Group

LNW63 packs can be placed in Slot 1 of any function group or growth slot in the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supports a total add/drop capacity of 20 Private Line GbE ports if all slots are equipped with LNW63 circuit packs.

For detailed information about Ethernet technologies, see "Ethernet transport" (p. A-21).

When an LNW63 circuit pack occupies only 1 slot of a Function Unit group, the other slot must be populated with an apparatus blank.

With VLF Mains, LNW63 can occupy both slots 1 and 2 of a Function/Growth group, making the total capacity of a system fully populated with LNW63s, 40 GbE Private Line ports.

The LNW63 contains 4 internal 1000 Mbps WAN ports suporting enhanced Private Line services such as high-order virtual concatenation (STS) and Link Capacity Adjustment Scheme (LCAS). The LNW63 and PTM optics are also OSP hardened for outside plant applications.

1000BASE-T electrical PTM

The LNW63 supports electrical GbE PTMs that are provisionable for 1000 Mbps traffic. They conform to the IEEE802.3 standards for 1000BASE-T in the respective settings (IEEE802.3z and IEE802.3ab). Connectivity is provided for an RJ-45 Cat 5 cable and the PTM has a maximum span length of 100 meters.

The electrical PTMs can be installed in ports 1–4 of the LNW63.

8-port GbE-PL Private Line Fast Ethernet circuit pack (LNW64)

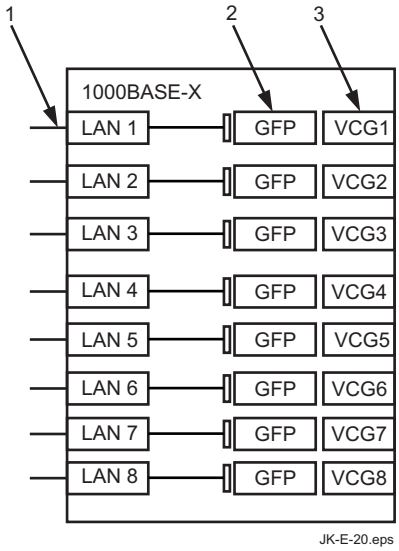
The 8-port GbE-PL Private Line Gigabit Ethernet (LNW64) circuit pack provides point-to-point (Ethernet Private Line Service) data transport at the 1000 Mb/s rate. The GbE-PL circuit pack supports generic framing procedure (GFP) encapsulation and STS virtual concatenation.

The LNW64 provides 8 Private Line, PTM (also known as SFP) GbE ports. The ports can be populated with 8 1000BASE-SX/LX/ZX PTMs or 8 100/1000BASE-T electrical PTMs. LNW64 can also support a mix of 4 electrical and 4 optical PTMs.

LNW64 supports STS-1 and STS-3c cross-connections with or without VCAT, and STS-12c cross-connections without VCAT. All ports are capable of transmitting at wire speed (1000 Mbps) simultaneously, making full capacity of the pack 168 STS-1s. LNW64 has 8VCGs, and each VCG can have up to 21 STS-1 tributaries. The tributaries may be assigned freely, all VCGs have access to all tributaries (Figure A-2, “LNW64 Gigabit Ethernet (Private Line) circuit pack” (p. A-11) shows the LNW64 circuit pack).

Each VCG can use 1 STS-1, or up to 21 (STS-1-xv, x=1–21) tributaries. Each VCG can use 1 STS-3c, or up to 7 (STS-3-xv, x=1–7) or 1 STS-12c tributary.

Figure A-2 LNW64 Gigabit Ethernet (Private Line) circuit pack



1 = External Ethernet Port
2 = Generic Framing Procedure
3 = Virtual Concatenation Group

With VLF Mains, LNW64 can occupy both slots 1 and 2 of a Function/Growth unit, making the total capacity of a system fully populated with LNW64s, 80 GbE Private Line ports.

For detailed information about Ethernet technologies, see "Ethernet transport" (p. A-21).

When an LNW64 circuit pack occupies only 1 slot of a Function Unit group, the other slot must be populated with an apparatus blank.

The LNW64 contains 8 internal 1000 Mbps WAN ports supporting enhanced Private Line services such as high-order virtual concatenation (STS) and Link Capacity Adjustment Scheme (LCAS). The LNW64 and PTM optics are also OSP hardened for outside plant applications.

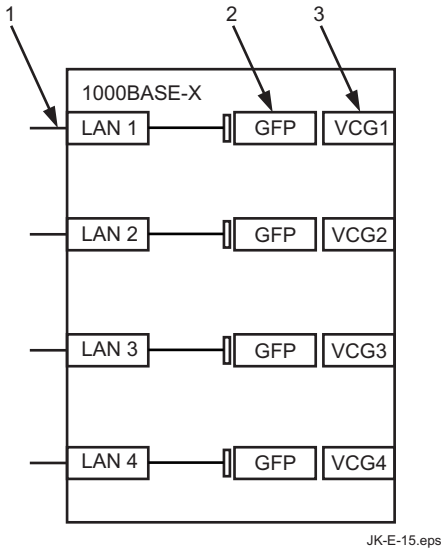
FC/FICON/ESCON SAN circuit pack (LNW73 and LNW73C)

LNW73 and LNW73C circuit pack provides point-to-point SAN transport. The LNW73/73C circuit pack supports generic framing procedure (GFP) encapsulation and STS virtual concatenation. The LNW73/73C circuit pack can be provisioned to operate in the STS-1 or STS-3c mode. In the STS-1 mode, the LNW73/73C circuit pack supports up to 24 VCG ports. In the STS-3c mode, the LNW73/73C circuit pack supports up to 16 VCG ports.

The LNW73/73C circuit pack supports STS-1, STS-3c, STS-12c cross-connect. The LNW73/73C has 4 VCGs, and each VCG can have up to 48 tributaries (maximum capacity of 48 virtual concatenated STS-1s) and the total available backplane link space is 48 STS-1s to Main-1 and 48 STS-1s to Main-2. The tributaries may be assigned freely, all VCGs have access to all tributaries.Figure A-3, "LNW73/73C Gigabit Ethernet (Private Line) circuit pack (STS-1 mode)" (p. A-13) shows the LNW73/73C circuit pack).

When the LNW73/73C is provisioned for STS-1 mode, each VCG can use 1 STS-1, or up to 48 (STS-1-xv, x=0–48) tributaries. When the LNW63 is provisioned for STS-12c mode, each VCG can use 1 STS-3c, or up to 16 (STS-3-xv, x=1–16) or 1 STS-12c tributary. The circuit pack mode is user provisionable.

Figure A-3 LNW73/73C Gigabit Ethernet (Private Line) circuit pack (STS-1 mode)



1 = External Ethernet Port
2 = Generic Framing Procedure
3 = Virtual Concatenation Group

The LNW73C differs from the LNW73 in that it enables compression of SAN traffic.

The LNW73C is able to compress asynchronous Fibre Channel traffic and conserve up to 50% of bandwidth versus uncompressed asynchronous FC traffic in typical applications.

Compression for asynchronous FC traffic is pre-standard and will be standardized by FC-BB-4. The implementation of SAN compression enables a high throughput of up to two full-line rate FC-2G interfaces in a single pack.

The R6.0 implementation of SAN compression enables a high throughput of up to two full-line rate FC-2G interfaces in a single pack.

LNW73/73C packs can be placed in Slot 1 of any function group or growth slot in the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supports a total add/drop capacity of 20 Private Line GbE ports if all slots are equipped with LNW73/73C circuit packs.

For detailed information about Ethernet technologies, see “Ethernet transport” (p. A-21).

When an LNW73 or LNW73C circuit pack occupies only 1 slot of a Function Unit group, the other slot must be populated with an apparatus blank.

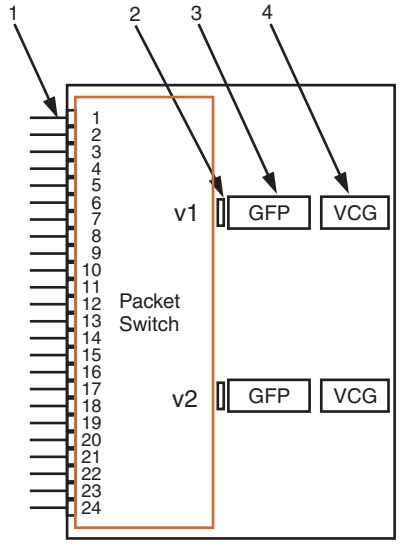
The LNW73/73C contains 4 internal 1000 Mbps WAN ports supporting enhanced Private Line services such as low-and high order virtual concatenation (VT1.5/STS) and Link Capacity Adjustment Scheme (LCAS). The LNW73/73C and PTM optics are also OSP hardened for outside plant applications.

10/100T Fast Ethernet circuit pack (LNW66)

The 10/100T Fast Ethernet (LNW66) circuit pack has 24 LAN ports and provides data transport at the rate of 10/100 Mb/s using standard Ethernet bridging, generic framing procedure (GFP) encapsulation, and STS-1 virtual concatenation. For additional information, see Figure A-4, "LNW66 Fast Ethernet circuit pack" (p. A-14). Connections to the 100BASE-T interface are via multi-service connectors on the Alcatel-Lucent 1665 DMX system backplane.

Each LAN port provides Fast Ethernet switched services. The ports auto-negotiate mode (full/half duplex), speed (10/100 Mb/s), and flow control when interfacing with other 802.3-compliant devices over twisted pair media. The LNW66 can group (concatenate) between 1 and 21 STS-1 SONET tributaries.

Figure A-4 LNW66 Fast Ethernet circuit pack



1 = External Ethernet Port
2 = Virtual Concatenation Group Port
3 = Generic Framing Procedure
4 = Virtual Concatenation Group

For detailed information about Ethernet technologies, see "Ethernet transport" (p. A-21).

The 10/100T circuit pack must be housed in slot 1 of a Function Unit group (A, B, C, or D, but not G) and is not equipment protected. However, facility protection can be provided through the WAN via SONET UPSR or through the spanning tree algorithm. When the 10/100T circuit pack occupies slot 1 of a Function Unit group, slot 2 must be populated with a 177D apparatus blank or an LNW98 Detectable Blank circuit pack.

100BASE-X/T (LNW74) hybrid optical/electrical Ethernet interface

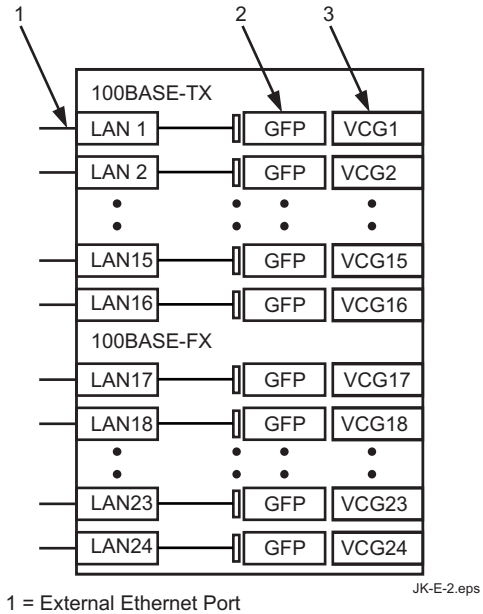
This 24-port Ethernet interface provides private line services using standard GFP encapsulation (G.7041) and standard STS-1 and VT virtual concatenation according to ITU G.707. The LNW74 circuit pack provides 8 ports for optical 100BASE-X transport at 100 Mbps The LNW74 circuit pack also provides 16 electrical ports for the 10/100BASE-T interfaces. These electrical ports transmit at 10/100 Mbps using standard Ethernet switching IEEE 802.1, standard encapsulation, and standard STS-1 and VT virtual concatenation according to ITU G.707. The LNW74 circuit pack electrical interfaces can transmit signals across spans as long as 100 meters. The LNW74 circuit pack is an unprotected circuit pack and is OSP hardened.

The 10/100-PL circuit pack supports STS-1, STS-3c, and VT1.5 (all may be used on different ports). Up to 336 VT1.5s may be used with between 0 and 63 assigned to any VCG. When VT mapping is selected, 12 STS-1s are reserved for the 336 VTs. Then 36 STS-1s are reserved for STS-1 VCAT or STS-3cs. Otherwise there is no VT mapping. In this case, 48 STS-1s are available for STS-1 VCAT or STS-3cs. Each VCG can use 1 (STS-1) or (STS-1-xv, x=0–3) or 1 (STS-3c), or (VT1.5-xv, x=0–63) tributaries. The circuit pack mode is user provisionable.

Connections to the 100BASE-T interface are via multi-service connectors on the Alcatel-Lucent 1665 DMX system backplane. Fiber access for optical ports is provided by LC-type connector pairs on the LNW74 faceplate.

The LNW74 circuit pack is designed specifically to support Fast Ethernet Private Line applications. Each LNW74 circuit pack can support 24 private lines.

Figure A-5 LNW74 Fast Ethernet hybrid (optical/electrical) pack



1 = External Ethernet Port
2 = Generic Framing Procedure
3 = Virtual Concatenation Group

The electrical ports auto-negotiate speed (10/100 Mbps for T ports only - X ports operate at 100 Mbps only) and flow control when interfacing with other 802.3-compliant devices over twisted pair media. The ports supports the full duplex mode only. Optical ports on the LNW74 do not auto-negotiate flow control.

For detailed information about Ethernet technologies, see "Ethernet transport" (p. A-21).

When the Main slots are equipped with VLF circuit packs, LNW74 circuit packs can be installed in either slot 1 or 2 of Function Unit or Growth groups to support true 0x1 on optical ports. Up to 80 100BASE-X ports and 128 100BASE-T ports are addressable when all Function Unit groups are equipped with LNW74 circuit packs. The LNW74 circuit pack can be installed next to another optical TDM or Ethernet circuit pack within the same group.

When non-VLF Mains are used, the LNW74 circuit packs may only occupy slot 1 of a Function Unit group. Up to 40 100BASE-X ports and 64 100BASE-T ports are addressable when all Function Unit groups are equipped with LNW74 circuit packs. When the LNW74 circuit packs occupy slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

When the LNW74 circuit pack is installed in slot G1 or G2, only optical PTMs can be used.The circuit pack Ethernet Mode parameter must be provisioned as FX to support LNW74 circuit packs in slot 1 and slot 2; otherwise, this configuration is incompatible.

When pairing the LNW74 with another LNW74, ONLY the 8 SFP ports on each pack are usable, for a total of 16 SFP ports per function group. When mixing an LNW74 with any optical only pack, all 24 ports (16 electrical and 8 SFP ports) on the LNW74 are available.

The LNW74 may occupy slot 1 of any Function Unit group on the shelf (including Growth slots), and The LNW74 may also be housed in the Growth slot (G1), but only the optical ports are supported in the Growth slot.

FE/GbE Private Line (LNW87) Ethernet interface

The LNW87 circuit pack is an 4-port, PTM-based Private Line Fast Ethernet/Gigabit Ethernet pack. The ports can be populated with either, 4 optical, 4 electrical PTMs, or a mix of electrical and optical PTMs. The port mode is provisionable on per port basis. The LNW87 contains 4 internal VCG ports supporting enhanced Private Line services such as high-order virtual concatenation (VCAT) and Link Capacity Adjustment Scheme (LCAS). LNW87 supports STS-1 and STS-3c cross-connections with or without VCAT, and STS-12c cross-connections without VCAT. All ports are capable of transmitting at wire speed (1000 Mbps) simultaneously, making full capacity of the pack 84 STS-1s.

The LNW87 is an unprotected pack. The LNW87 can be used with VLF Mains or non-VLF mains and can occupy both slots 1 and 2 of a Function/Growth unit, making the total capacity of a systems fully populated with LNW87s, 40 GbE Private Line ports.

The LNW87 is hardened for outside plant (OSP) temperature ranges. However, you must install PTMs that are approved for industrial temperatures (OSP hardened) to use the LNW87 in OSP applications.

1000BASE-X/100BASE-X (LNW170) hybrid optical Ethernet interface

This 8-port Ethernet interface provides 4-ports for short-reach and/or long-reach high-speed optical data transport at the rate of 1 Gb/s and 4-ports for optical 100BASE-X transport at 100 Mbps using standard Ethernet switching IEEE 802.1, standard encapsulation, and virtual concatenation according to ITU G.707.

The LNW170 circuit packs support STS-1, STS-3c, STS-12c cross-connect. LNW170 may have up to 32 VCGs, and each VCG can have up to 48 tributaries (maximum capacity of 48 virtual concatenated STS-1s) and the total available backplane link space is 48 STS-1s to Main-1 and 48 STS-1s to Main-2. The tributaries may be assigned freely, all VCGs have access to all tributaries.

When the LNW170 is provisioned for STS-1 mode, each VCG can use 1 STS-1, or up to 48 (STS-1-xv, x=0–48) tributaries. When the LNW170 is provisioned for STS-12c mode, each VCG can use 1 STS-3c, or up to 16 (STS-1-xv, x=0–16) or 1 STS-12c tributary. The circuit pack mode is user provisionable.

Connections to the LNW170 are PTMs on the circuit pack faceplate.

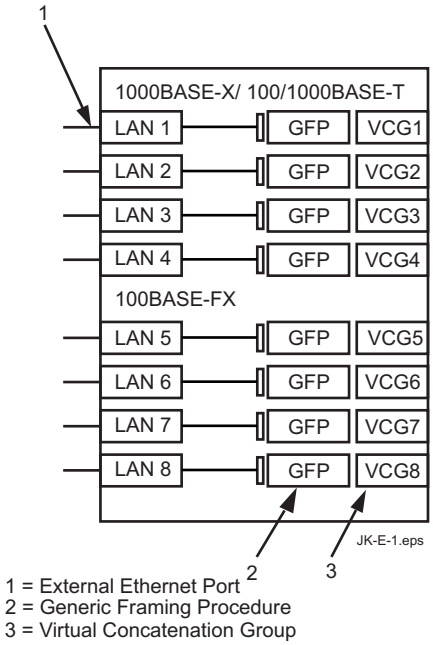
100BASE-T/1000BASE-T Electrical PTM for the LNW170

The LNW170 supports dual function electrical PTMs that are provisionable for 100 or 1000 Mbps traffic. They conform to the IEEE802.3 standards for 100BASE-T and 1000BASE-T in the respective settings (IEEE802.3z and IEE802.3ab). Connectivity is provided for an RJ-45 Cat 5 cable and the PTM has a maximum span length of 100 meters.

The electrical PTM can only be installed in ports 1–4 of the LNW170. Ports 5–8 are always reserved for 100BASE-X optical Fast Ethernet interfaces.

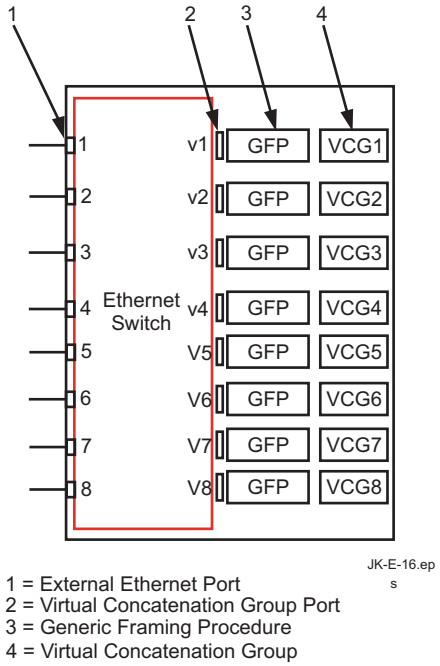
The figure below shows the LNW170 in Private Line mode.

Figure A-6 LNW170 in Private Line mode



The figure below shows the LNW170 in Switched (802.1q or Transparent) mode.

Figure A-7 LNW170 in switched mode



For detailed information about Ethernet technologies, see "Ethernet transport" (p. A-21).

The LNW170 may occupy any slot of any Function Unit group on the shelf (including Growth slots), and up to 40 1000BASE-X and 40 100BASE-X ports are addressable when all Function Unit groups are equipped with LNW170 circuit packs.

Ethernet port configurations

The LNW63, LNW64, LNW74, and LNW170 support the following provisionable Ethernet port configurations for pluggable transmission modules.

Table A-2 Ethernet port configurations

Ethernet port mode parameter setting	Ethernet Circuit Packs			
	LNW63	LNW64	LNW74	LNW170
GX_FX	—	—	—	Ports 1-4: optical GbE Ports 5-8: optical FE

Table A-2 Ethernet port configurations (continued)

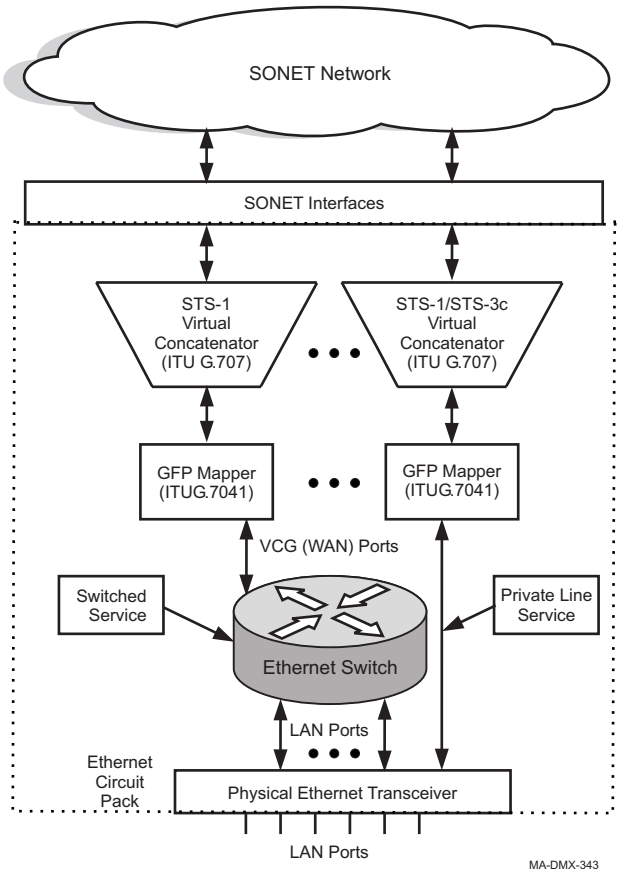
Ethernet port mode parameter setting	Ethernet Circuit Packs			
	LNW63	LNW64	LNW74	LNW170
GT_FX	—	—	—	Ports 1-4: electrical GbE Ports 5-8: optical FE
FT_FX	—	—	Electrical FE Backplane Ports 1-16: Enabled Ports 17-24: optical FE	Ports 1-4: electrical FE Ports 5-8: optical FE
GX_FT	—	—	—	Ports 1-4: optical GbE Ports 5-8: electrical FE
GT_FT	—	—	—	Ports 1-4: electrical GbE Ports 5-8: electrical FE
FT	—	—	Electrical FE Backplane Ports 1-16: Disabled Ports 17-24: optical FE	Ports 1-8: electrical FE
GX	Ports 1-4: optical GbE	Ports 1-8: optical GbE	—	—
GT	Ports 1-4: electrical GbE	Ports 1-8: electrical GbE	—	—
GT_GX	—	Ports 1-4: electrical GbE Ports 5-8: optical GbE	—	—

Ethernet transport

Overview

An Alcatel-Lucent 1665 DMX network accepts Ethernet frames at an ingress port and transmits them out of one or more egress ports. The egress port(s) can be on the same network element or on a different network element. If it is on a different network element, Ethernet frames are transmitted over a SONET network. To transport an Ethernet frame across the SONET network, the Ethernet Frame is moved between a LAN port and the SONET network.

Figure A-8 Ethernet transport through Alcatel-Lucent 1665 DMX



The following occurs to transport an Ethernet frame over a SONET network

- Alcatel-Lucent 1665 DMX accepts an Ethernet Frame at an ingress LAN Port.
- The Ethernet frame is accepted at an Ethernet switch's LAN port for switched services, processed, and then transmitted out one or more of its LAN and/or VCG (WAN) port(s). For Private Line circuit packs that support only non-switched services, the Ethernet frame is sent directly to the GFP mapper via a VCG port.

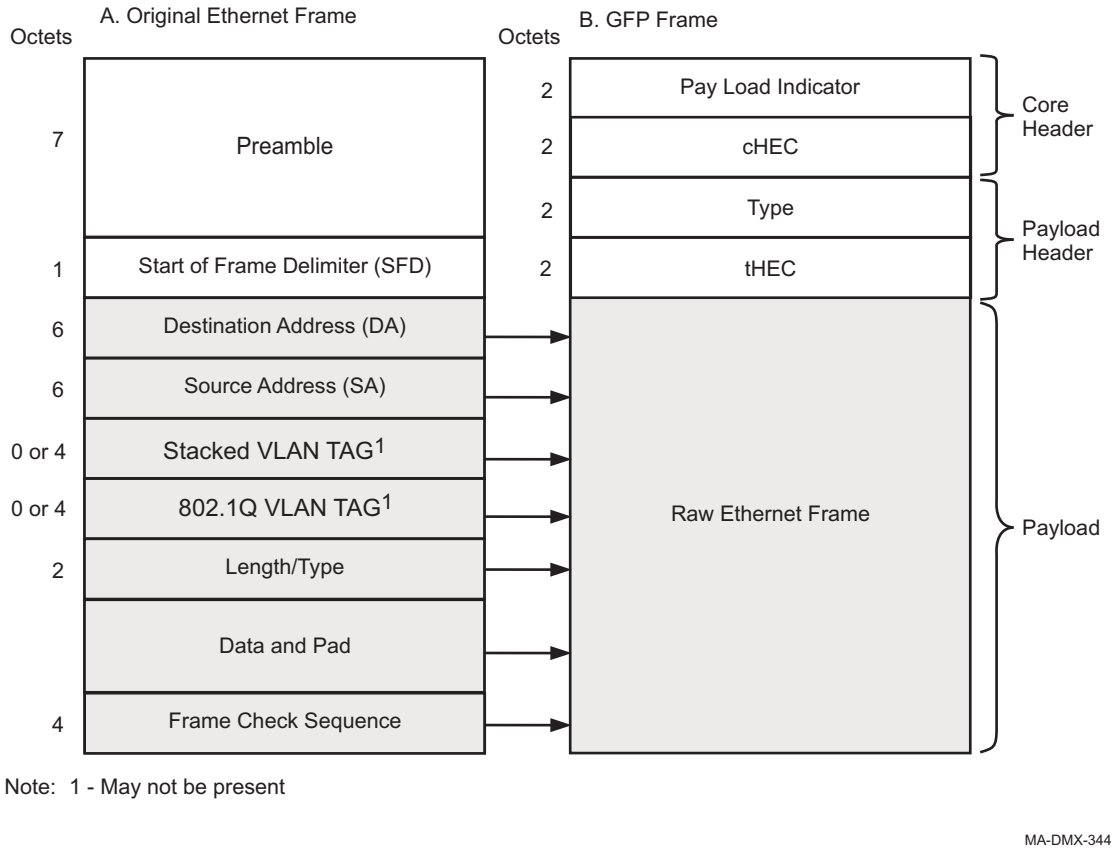
- The generic framing procedure (GFP) mapper encapsulates the Ethernet frame into a GFP Frame.
- The Virtual Concatenator maps the Ethernet stream into one or more SONET tributaries (time slots). This allows the network to carry traffic (Ethernet stream) at higher speeds than allowed by a single SONET tributaries (time slot). The group of virtually concatenated tributaries is referred to as a Virtual Concatenation Group (VCG).
- The VCG is then placed on SONET tributaries and transmitted over the SONET network.

Generic framing procedure (GFP)

Generic Framing Procedure (GFP) is used to encapsulate Ethernet frames for transport over a SONET network. Alcatel-Lucent 1665 DMX uses frame-based GFP with the core header and no optional extension headers. The GFP Frame Check Sequence (FCS) is provisionable (on/off) on LNW63, LNW64, LNW87, LNW705 ports (**`ed-eport`**).

To encapsulate an Ethernet frame, the Ethernet preamble and Start of Frame Delimiter (SFD) fields are removed from the frame. A Type header and check (tHEC) is added to the Ethernet frame creating a GFP payload. The GFP payload is then scrambled and a Core header is added. The GFP frame is then sent to the Virtual Concatenator. The following figure shows the format of a GFP frame.

Figure A-9 GFP frame format



Section	Field	Description
Core Header	Payload Indicator (PLI)	Binary number representing the number of octets in the GFP payload.
	Core Header Error Control (cHEC)	CRC-16 checksum that protects the integrity of the contents of the Core Header.
Payload Header	Type	The type of information contained in the Payload field. The value is 01hex.
	Type Header Error Control (tHEC)	CRC-16 checksum that protects the integrity of the contents of the Type Field.

Section	Field	Description
Payload		The raw Ethernet Frame (that is, the original Ethernet Frame without the Preamble and SFD.

In the opposite direction when the GFP Mapper receives a GFP frame from the Virtual Concatenator, it removes the Core Header and, using the cHEC field, performs a Header Error Check. If the header is correct, the payload area of the GFP is then unscrambled and the Type field and tHEC in the GFP header are checked for correctness. The Ethernet frame is extracted and the Preamble and SFD are added.

The GFP mapper at the far end of the network inserts idle GFP frames when there are no Ethernet frames to send. The near end GFP Mapper discards any idle GFP frames it receives over the SONET network. The idle GFP frames are not forwarded to the Ethernet Switch. (Private line packs do not contain an Ethernet switch.)

The GFP Mapper contains GFP queues that are used to store Ethernet frames while they are being processed.

The Generic Framing Procedure is defined in ITU-T G.7041/Y.1303 and ANSI T1X1.105 Sections 7.3.2 and 7.3.3.

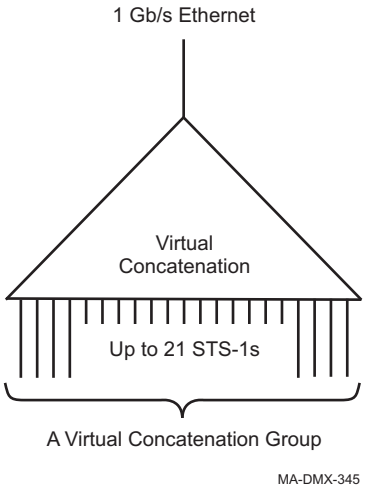
Virtual concatenation

Virtual Concatenation is a standard *inverse multiplex* scheme for transporting a payload using multiple channels each of which has a lower capacity than the payload to be transported. It allows finer granularity in allocating the transport bandwidth than is available in standard contiguous concatenation (STS-3c, STS-12c, STS-48c, STS-192c etc.). For example, an STS-1 tributary has a usable bandwidth of approximately 48.4 Mb/s. This is too slow for a 1 Gbits/s Ethernet stream. An STS-48c tributary has approximately 2.4 Gb/s which would waste 1.4 Gb/s of bandwidth if used to carry a 1 Gb/s Ethernet stream.

Using virtual concatenation, 21 STS-1 tributaries can be used providing an effective rate of approximately 1.02 Gb/s. Fewer STS-1 tributaries can be virtually concatenated to provide sub-rate (fractional rate) service.

The grouped SONET tributaries form a Virtual Concatenation Group (VCG). A VCG is treated as a single logical serial byte stream whose payload capacity equals that of the sum of the payload capacities of the constituent SONET tributaries. The following figure shows a virtual concatenation group.

Figure A-10 Virtual Concatenation Group



Individual tributaries in the VCG are independently transported through the SONET network. Only the initial and final SONET nodes perform the Virtual Concatenation. Since the VCGs are invisible to the intermediate SONET nodes, the intermediate nodes only need to transport normal SONET traffic and do not need to understand VCGs. This allows the tributaries to be transported through equipment which does not handle VCGs.

Differential delay buffers

Because the individual tributaries of a virtual concatenation group (VCAT) can take different paths through the SONET network, they may experience different delays through the network.

The table below provides the differential delay buffers for each of the Ethernet circuit packs.

Circuit Pack Name	Delay (in milliseconds)
LNW63/64	100 ms
LNW66	16 ms
LNW73/73C	120 ms
LNW74	64 ms
LNW87	100 ms
LNW170	50 ms

Circuit Pack Name	Delay (in milliseconds)
LNW705[1]	32 ms

Notes:

1. See "WDMX, tributary interface circuit packs" (p. 2-5) for additional details about the LNW705.

SONET transport

Ethernet circuit packs contain LAN ports and VCG ports. The LAN ports connect to external Ethernet equipment. The VCG ports connect to the OLIUs via Generic Framing (GFP) Mappers and Virtual Concatenation Groups (VCGs).

The OLIUs contain the hardware that perform the SONET cross-connections and process traffic at the SONET tributary level. They do not know about the embedded Ethernet frames or Virtual Concatenation Groups.

Connections to the SONET network can be configured to provide SONET layer protection. Alcatel-Lucent 1665 DMX supports three types of SONET protection: Unidirectional Path Switched Rings (UPSRs), Bidirectional Line Switched Rings (BLSRs), and 1+1.

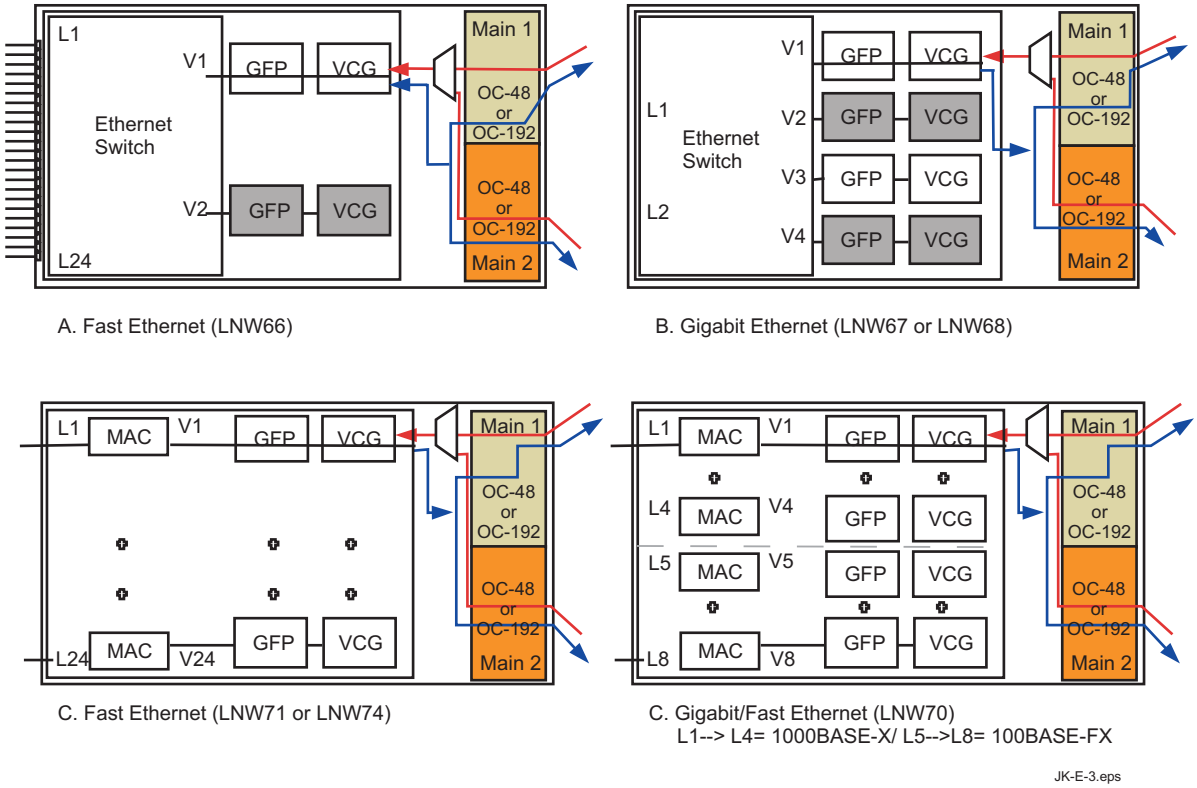
Alcatel-Lucent 1665 DMX supports transport of Ethernet frames on the following:

- UPSR tributaries
- Unswitched UPSR tributaries
- BLSR tributaries
- 1+1 point-to-point tributaries
- 0x1Sn tributaries
- Ethernet-to-Ethernet hairpin cross-connections

Protected tributaries

On protected tributaries, both rings carry the same traffic placed in the same tributaries (time slots), but in opposite directions in the case of UPSR. UPSR protected cross-connections are provisioned as one 1wayPR cross-connections and two 1way cross-connections. BLSR protected cross-connections are provisioned using 1way cross-connections only.

Figure A-11 SONET protected cross-connections



On LNW66 circuit packs, only the odd numbered VCG ports can be used for SONET protected cross-connections because some of the hardware associated with the even numbered VCG ports is used to protect the odd number ports.

On the LNW63, LNW64, LNW74, LNW87, and LNW170 circuit packs, all VCG ports can be used. For the LNW63, LNW64, LNW74, LNW87, and LNW170, circuit packs, all ports are supported regardless of STS mode. The picture above depicts the LNW170 in Private Line mode. The LNW170 can also function in switched mode. For figures depicting the LNW170 in switched mode, see Figure A-12, “Multi-point cross-connections (unprotected)” (p. A-28) and/or Figure A-14, “LNW170 Gigabit multipoint cross-connections (unprotected)” (p. A-29).

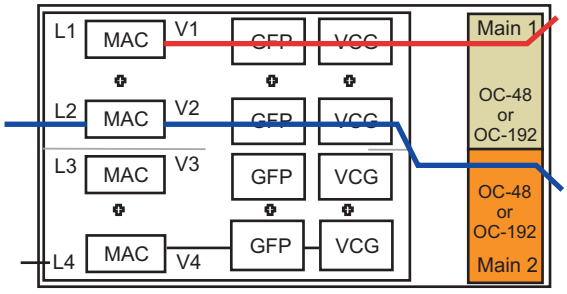
Unprotected tributaries

In the case of UPSR unprotected tributaries, the two sides of the ring carry different traffic. Each VCG is connected to only one side of the ring.

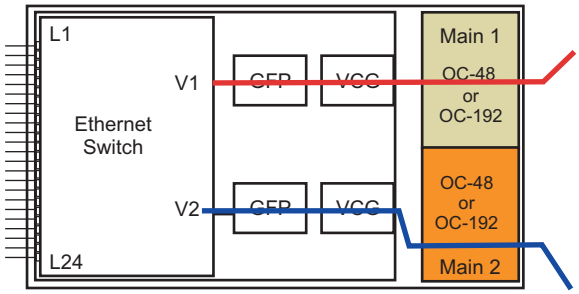
1-way unswitched cross-connections provide unprotected SONET connections to Ethernet circuit packs on a UPSR. On BLSR w/NUT, only 1way cross-connections are used. Each can be used to form two individual connections. One VCG is connected to MAIN 1 while the other VCG is connected to Main 2.

The following figure shows examples of the multipoint cross-connections provisioned by way of 1-way and 1-way unswitched cross-connects.

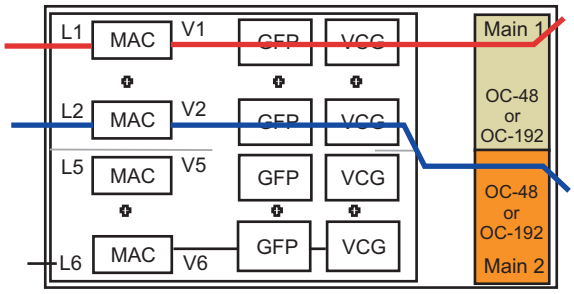
Figure A-12 Multi-point cross-connections (unprotected)



A. Gigabit Ethernet (LNW63)



B. Fast Ethernet (LNW66)

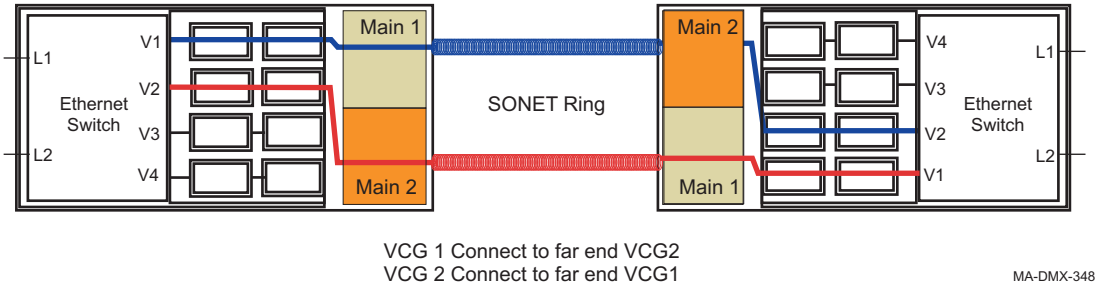


C. Gigabit/Fast Ethernet (LNW170)
L1--> L2= 1000BASE-X/ L5-->L6= 100BASE-FX

JK-E-4.eps

On the LNW66 and LNW74 circuit packs, the odd number VCGs are paired with the next higher number VCG (VCG 1 is paired with VCG 2, and VCG 3 is paired with VCG 4.) For example, VCG 2 must be connected to one OLIU when VCG 1 is provisioned to be connected to the other OLIU. Both cross-connections use the same SONET tributaries. The following figure shows an example of the VCG port pairing.

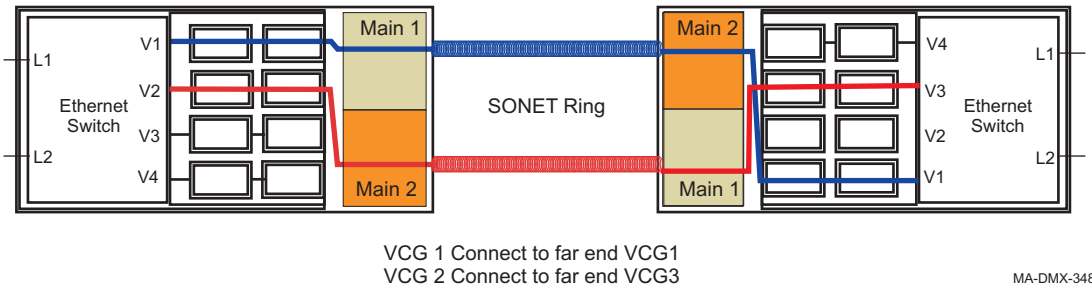
Figure A-13 Gigabit multipoint cross-connections (unprotected)



Multipoint cross-connections can either be used as two unprotected point-to-point connections or as part of a packet ring. If they are used as part of a packet ring, the Ethernet switch will process traffic received on one side of the packet ring before it is forwarded out the other side of the ring.

On the LNW63, LNW64, LNW74, LNW87, and LNW170, any VCG can be connected to any OLIU. Additionally, the pairing of VCG ports for multipoint applications is not fixed. As the figure below demonstrates, V1 and V2 are paired in the shelf on the left while V1 and V3 are paired in the shelf on the right.

Figure A-14 LNW170 Gigabit multipoint cross-connections (unprotected)



A multipoint cross-connection is made up of multiple 1-way or 1-way unprotected cross-connections.

STS-1 Mode		STS-3c Mode	
Port	**Paired with Port...**	**Port**	**Paired with Port...**
1	13	1	9

STS-1 Mode		STS-3c Mode	
Port	**Paired with Port...**	**Port**	**Paired with Port...**
2	14	2	10
3	15	3	11
4	16	4	12
5	17	5	13
6	18	6	14
7	19	7	15
8	20	8	16
9	21	9	1
10	22	10	2
11	23	11	3
12	24	12	4
13	1	13	5
14	2	14	6
15	3	15	7
16	4	16	8
17	5		
18	6		
19	7		
20	8		
21	9		
22	10		
23	11		
24	12		

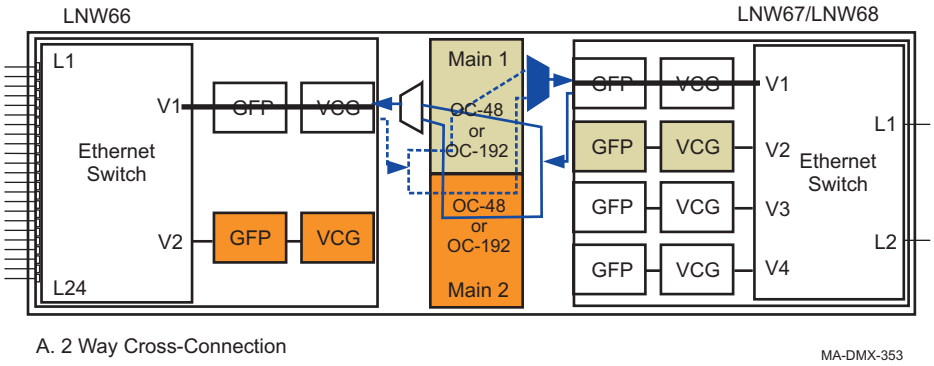
Ethernet-to-Ethernet hairpin cross-connections

Ethernet-to-Ethernet hairpin cross-connections are used to connect a circuit pack to another circuit pack within the same Alcatel-Lucent 1665 DMX. The cross-connection goes through either Main 1 or Main 2, but not over the SONET ring.

Hairpin cross-connections with an Ethernet circuit pack are used to either connect a VCG on that circuit pack with a VCG on another circuit pack or to connect a VCG with an OLIU located in a function or growth slot. Hairpin connections between VCG ports are

used to combine Ethernet traffic from different cards before it is transmitted over a packet ring or out of a LAN port. The following figure shows examples of 1-way hairpin cross-connections between two Ethernet circuit packs.

Figure A-15 Ethernet-to-Ethernet hairpin cross-connections



The table below details the support of 1way cross-connections between Ethernet packs. For hairpins between packs on the same shelf, only 1way cross-connections are used.

Table A-3 1way cross-connection support

From	To
LNW63	LNW63, LNW64, LNW66, LNW74, LNW87, LNW170
LNW64	LNW63, LNW64, LNW66, LNW74, LNW87, LNW170
LNW66	LNW63, LNW64, LNW66, LNW87, LNW170
LNW73/73C	LNW73/73C
LNW74	LNW63, LNW64, LNW74, LNW87, LNW170
LNW87	LNW63, LNW64, LNW66, LNW74, LNW87, LNW170
LNW170	LNW63, LNW64, LNW66, LNW74, LNW87, LNW170

Ethernet LAN/VCG port density

The Ethernet Switch, also referred to as a Media Access Control (802.1D MAC) bridge, processes the Ethernet frames and handles Virtual LANs, frame priority, frame forwarding, and switching functions. The ports on the customer's side of the switch are referred to as LAN ports, and the ports on the SONET side are referred to as VCG or WAN Ports.

Circuit pack		Number of ports		Maximum capacity of a VCG port
Name	LAN port line rate	LAN (Boundary)	VCG (Interior)	
LNW63	1 Gbps	4	4	1 Gbps
LNW64	1 Gbps	8	8	1 Gbps
LNW66	10/100 Mbps	24	2	1 Gbps
LNW74	10/100 Mbps	24	24	100 Mbps
LNW87	1 Gbps	4	4	1 Gbps
LNW170[1]	1 Gbps and 100 Mbps	8	8 (Private line mode) 32 (Switched mode)	2.5 Gbps

Notes:

1. QoS provisioning on EoS VCGs in transparent mode allows LNW170 VCGs i transparent mode to be provisioned as either interior or boundary.

Virtual LANs (VLANs)

A virtual LAN (VLAN) is a logical grouping of LAN ports, possibly spread across multiple Alcatel-Lucent 1665 DMX nodes, that act as if they comprise a single LAN. Since a physical LAN can be associated with multiple virtual LANs, VLANs can be used to segregate traffic across a network. VLANs can be used to segregate different types of traffic for a single customer or to separate traffic belonging to multiple subscribers.

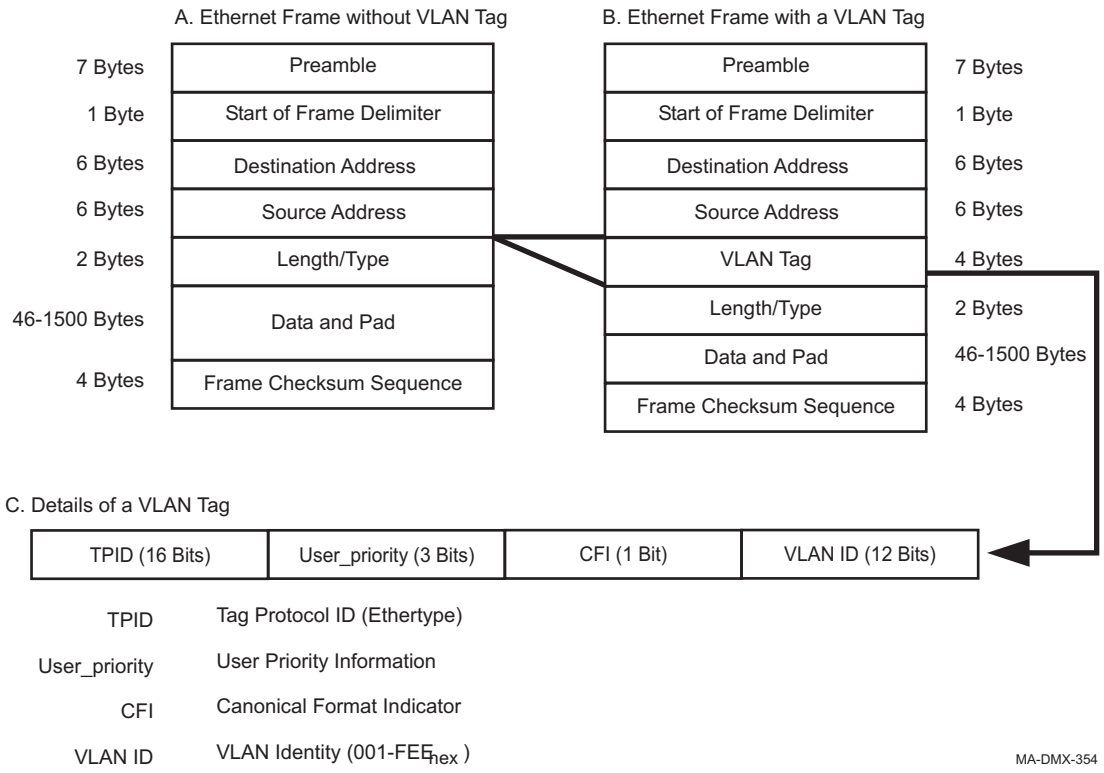
VLANs operate at the Ethernet (MAC) Layer. This allows different VLANs to be carried on the same physical media and hides the VLANs from higher-level protocols (for example, TCP and IP). The higher-level protocols treat each VLAN as if it was a separate physical LAN. VLAN-aware Ethernet Switches will forward VLAN traffic only on ports assigned to that VLAN. A port can be part of several VLANs and a VLAN can be assigned to several ports.

A frame's VLAN can be assigned either by the subscriber's equipment or by network equipment. User equipment specifies the VLAN by including a VLAN Tag in the frame. Alcatel-Lucent 1665 DMX determines a frame's VLAN either from the frame's existing VLAN Tag or by the default VLAN ID assigned to the frame's ingress port. Alcatel-Lucent 1665 DMX can be provisioned to drop frames that do not contain a tag.

VLAN tags

VLAN Tags are located in the Ethernet Header. The following figure shows the format of Ethernet frames without a VLAN Tag, frames with a VLAN Tag, and the format of the VLAN Tag.

Figure A-16 Ethernet frame format

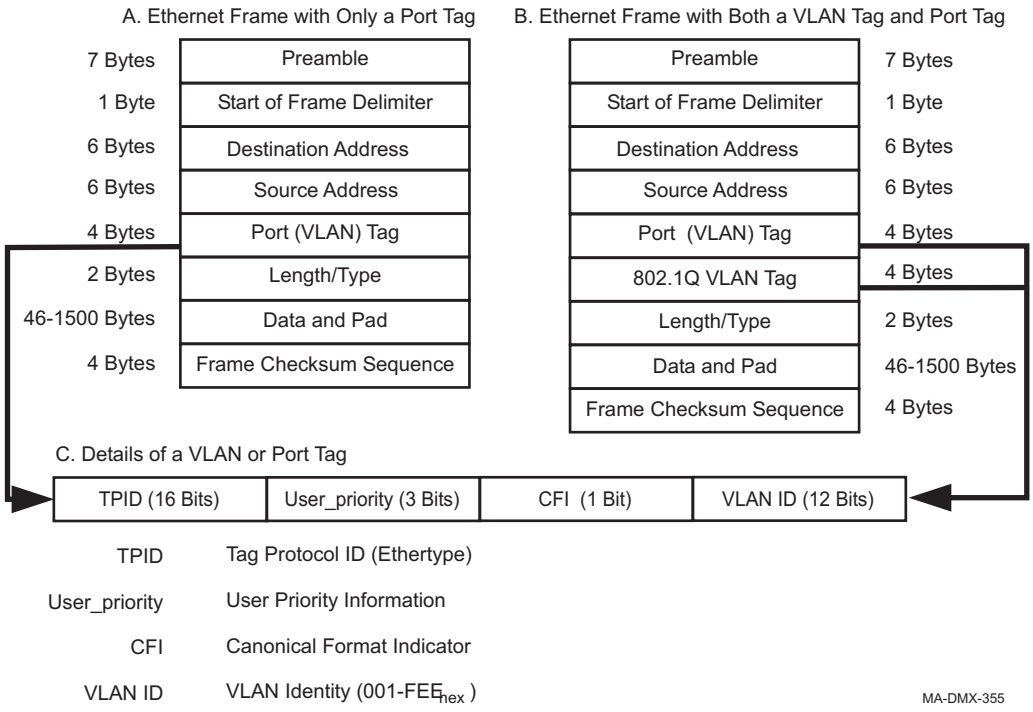


VLAN Tags can be generated by either user equipment or a switch. If a switch adds a VLAN Tag to a frame, it must also recalculate the frame's Checksum (FCS). Alcatel-Lucent 1665 DMX supports provisioning of 4093 VLAN IDs within the range of 1–4093. Additional information about VLAN tags can be found in IEEE 802.1Q.

Stacked VLANs (VLAN transparency)

In order to allow carriers to administer VLAN IDs independent of their subscribers, Alcatel-Lucent 1665 DMX can be provisioned to add a second VLAN Tag to Ethernet Frames. This tag, referred to as a Port Tag or Stacked VLAN Tag, can be used by the service provider to identify and segregate customer (subscriber) traffic. The following figure shows the format of an Ethernet frame that contains stacked VLAN tags.

Figure A-17 Ethernet frame format with stacked VLAN tags



The port tag is formatted according to IEEE 802.1Q except:

- The frame is given a provisioned Ethertype (TPID).
- The Canonical Format Indicator (CFI) field is set to 0.
- A Customer ID is encoded into VLAN ID field and can contain a value in the range of 1–4093.

Alcatel-Lucent 1665 DMX is capable of handling frames with multiple layers of VLAN tags; ultimately the limit is that frames greater than the MTU size are rejected as too large. When processing VLAN tags, Alcatel-Lucent 1665 DMX only looks at the outermost tag (that is, the one that most closely follows the Source Address) that it recognizes. Recognition of a tag is based on the TPID value. In 802.1Q mode, the expected TPID value is 8100hex. In transparent mode, the expected TPID value is provisioned by the user, with the default value being FFFFhex. Legal provisioned values for TPID are between 0601hex and FFFFhex. These TPID values are also used to identify any tags inserted by Alcatel-Lucent 1665 DMX.

Based on provisioning at the network ingress and egress points, it is possible for an Ethernet frame to enter and leave the network with a different number of VLAN tags.

Priorities

Each Ethernet frame is assigned a priority level. The priority level can be based on a field in a VLAN Tag or a default priority assigned to the frame's ingress port. If an ingress port is provisioned with a default priority, the default priority will take precedence over the priority field in the VLAN tag.

A VLAN Tag contains a three-bit user_priority field. This allows higher priority frames to be processed at a faster rate than lower priority frames. For the LNW66 packs, Alcatel-Lucent 1665 DMX maps the three-bit user priority field to two priority levels. These circuit packs contain two priority queues. Ethernet frames are processed using an 8:1 weighted round robin queue service algorithm. The LNW170 packs contains 4 priority queues. For more information about the LNW170, see "QoS services (LNW170)" (p. A-69).

For tagged frames, the following table shows the mapping between values in the user priority field and the priority queues for all of the Ethernet packs except the LNW170. An Ethernet port can be provisioned to drop untagged frames, or add a VLAN tag containing the port's default user priority field value of 0 (low) or 7 (high).

VLAN Tag User Priority Field Value	Queues
0	Low
1	Low
2	Low
3	Low
4	High
5	High
6	High
7	High

For tagged frames, the following table shows the default mapping between values in the user priority field and the priority queues for the LNW170 when the pack is in no traffic management mode (NOTC).

VLAN Tag User Priority Field Value	Queues(1=lowest --> 4=highest)
0	(2)
1	(1)
2	(1)

VLAN Tag User Priority Field Value	Queues(1=lowest --> 4=highest)
3	(2)
4	(3)
5	(3)
6	(4)
7	(4)

For more information about frame priority rules, see "802.1Q VLAN mode" (p. A-61) and "QoS services (LNW170)" (p. A-69).

Ethernet bridge/switch

This section pertains to the LNW66 and LNW170.

An Ethernet bridge moves a frame from an ingress port to an egress port(s). It will not forward a frame if the frame contains errors or has the same source and destination addresses.

The bridge looks up the destination MAC address/VLAN ID combination in the address table. If the MAC address is found, the bridge sends the frame to the port(s) found in the address table. If the MAC address is not found, the bridge sends the frame to all ports associated with the VLAN ID (except the originating port).

All multicast and broadcast frames are broadcast, including spanning tree BPDUs.

The size of the address table is 8K entries for the LNW66. The size of the address table is 256K for the LNW170 packs. Each combination of MAC Address/VLAN ID is one entry. Entries are removed if they are not used within 300–600 seconds (5–10) minutes. During a topology change, they are deleted as soon as the change is detected.

Virtual switch

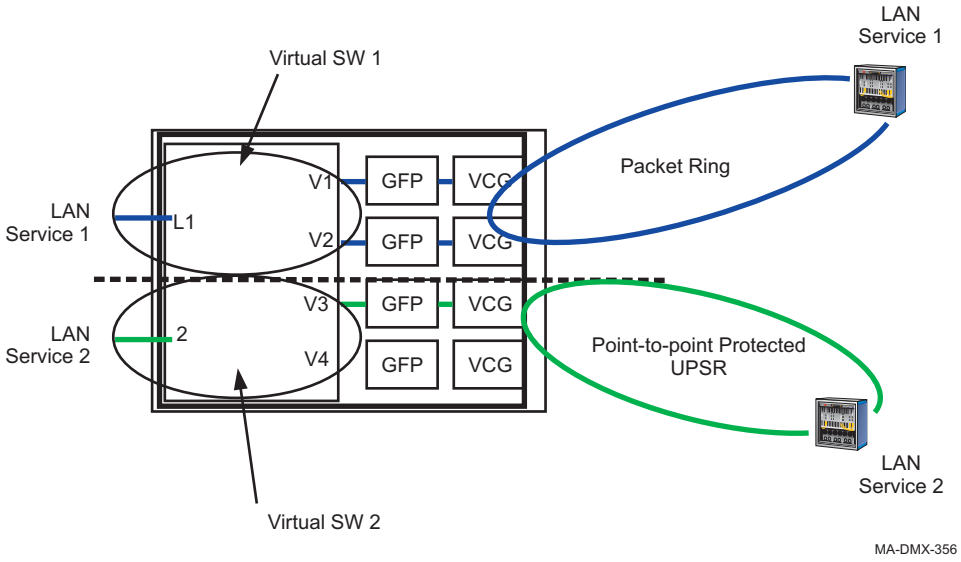
The single physical Ethernet switch on an LNW66/170 Ethernet circuit pack can be logically divided into multiple virtual switches. A virtual switch, identified by an id number between 1 and 4095 (between 1 and 16 on LNW170), consists of a collection of LAN and VCG ports.

Any VLANs and spanning tree groups associated with the ports also become associated with the virtual switch. Each LAN port, VCG port, VLAN ID and spanning tree group id can only be associated with one virtual switch per Ethernet circuit pack. On the LNW66 each VLAN ID can only be associated with one virtual switch. On the LNW170, the same VLAN ID can be associated with many virtual switches and each virtual switch has its own VLAN ID. A minimum of one virtual switch must be created on the LNW66/170 Ethernet circuit pack in order to provision VLANs and spanning tree groups when in

802.1Q or Transparent Tagging mode. When a port is removed from a virtual switch it returns to its default parameters. Virtual switches are not used in Private Line mode or on LNW74 circuit packs.

The following figure shows one possible assignment of LAN ports and VCG ports into virtual switches. The figure shows one physical switch that is divided into two virtual switches. Virtual switch 1 supports a packet ring configuration encompassing LAN port 1 and VCG ports 1 and 2. Virtual Switch 2 supports a point-to-point configuration encompassing LAN port 2 and VCG ports 1 and 2. Ethernet traffic will not be allowed to cross between the virtual switches.

Figure A-18 Virtual switches



Spanning tree protocol (STP)

Spanning tree protocol (STP) provides a protection scheme for Ethernet packet transmission as a by-product of its primary function of eliminating loops in Ethernet networks. This protection is independent of any SONET-level protection mechanisms such as UPSR switching. In fact, undesirable interactions can occur if both protection mechanisms are used, so it is recommended that spanning tree protocol be used only in configurations with no SONET protection.

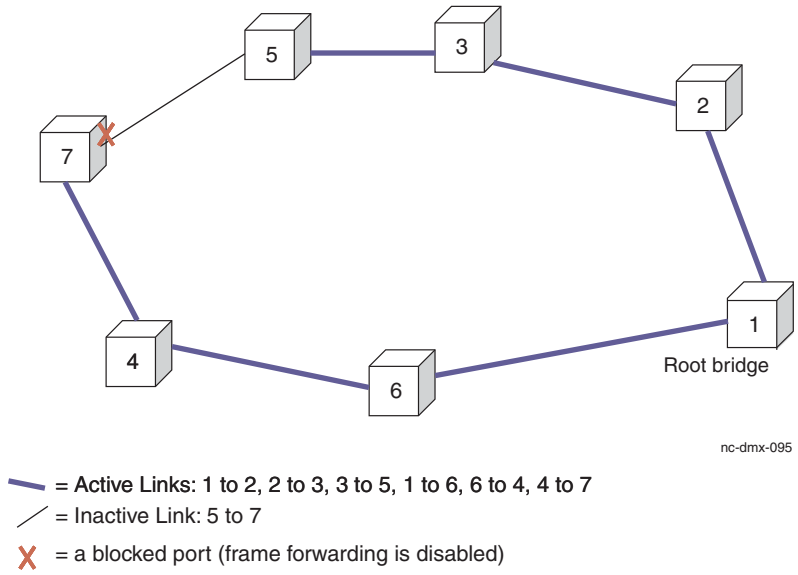
Loops can arise within Ethernet networks as a result of multiple paths between a source and a destination. The spanning tree protocol identifies links that must be blocked to ensure that no such multiple paths can exist. Any link failure in the resulting network triggers the spanning tree protocol to analyze the network and identify a new set of blocked links that provide full connectivity with no duplicated paths. It is this reconfiguration in response to failures that constitutes the packet layer protection mechanism.

How it works

Spanning tree works as follows:

1. Initially, every node in the group thinks it is the root node.
2. Configuration BPDUs are sent from each node to determine the most economical route from each node to the root node.
3. As information about the network becomes clear, one node is designated the root node; from this node, the distance to any point in the network may be measured.
4. Once the network has become clear, some ports are blocked so that there are no loops in the network and so that the network provides the most efficient paths from the root to the nodes. This effectively creates a tree structure for the network.
5. If an active link fails, the network is reconfigured so that previously blocked links can be used for traffic.

Figure A-19 Spanning tree



Important! The configuration provides the least (most efficient) path from each node to the root. The configuration also provides only one path between any two nodes.

Reconfiguration

If one of the active links is broken, the network reconfigures to activate the inactive link. For example, if the link between 2 and 3 is broken, the link between 5 and 7 would be enabled.

802.1W rapid spanning tree protocol

The 802.1W rapid spanning tree protocol (RSTP) improves upon the 802.1D version of spanning tree protocol. The key improvements are:

- Faster Failure Detection - Alcatel-Lucent 1665 DMX uses SONET-layer failure detection to trigger packet-layer (spanning tree) reconfiguration, so packet-layer reconfiguration starts within a few milliseconds after a failure rather than several seconds later.
- IEEE 802.1W Rapid Reconfiguration - Alcatel-Lucent 1665 DMX supports standard packet-layer restoration protocol, which uses messages between spanning tree protocol entities to significantly reduce convergence time.
- Spanning tree version interworking - Each Alcatel-Lucent 1665 DMX node will query its Ethernet link partners to determine if they are capable of running the 802.1W rapid spanning tree protocol. If so, the 802.1W protocol will be used. If not, Alcatel-Lucent 1665 DMX will fall back to running the 802.1D version of spanning tree protocol.
- Enhanced STP configuration reports and controls - Together with 802.1W, these enable support for much larger networks than are supported with IEEE 802.1D Spanning Tree Protocol.

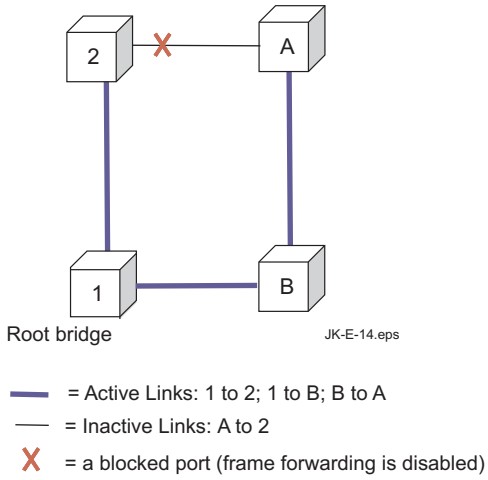
Spanning tree on LAN ports

Alcatel-Lucent 1665 DMX supports spanning tree on the LAN (customer facing) ports. STP on LAN ports ensures that single LAN interconnects are protected. Because redundant LAN interconnects create loops, STP manages the loops. STP is supported on the LAN ports of the LNW170 only.

Both LAN ports and VCGs can belong to STP groups. A LAN port can belong to only one STP group at a time. The BDPU VLAN ID is provisionable on a per-port basis.

LAN based STP works exactly as described in the section above. The figure below depicts STP functioning on the customer side of an Alcatel-Lucent 1665 DMX with LNW170 circuit packs. The nodes marked A and B represent remote Ethernet switches or similar CPEs.

Figure A-20 Spanning tree on LAN ports



Link aggregation on LNW170 LAN ports

Alcatel-Lucent 1665 DMX supports link aggregation on any two LNW170 LAN ports of the same rate (i.e. 100 or 1000 Mbps), operating in switched mode. The LNW170 supports LAGs that span LNW170 packs.

Link aggregation can also be used for facility protection on LNW170 LAN ports. The LNW170 also provides support for equipment protection of function group pairs, using a mate interface.

Bandwidth increase/decrease

Ordinarily, multiple Ethernet links between two bridges form loops (unless a spanning tree blocks all but one) so they can't be used to increase bandwidth. Link Aggregation causes defined groups of links to be treated as a single logical link, making multiple LAN ports appear as one. In this way, Bandwidth may be increased without requiring an upgrade to a higher rate link.

Facility protection

Link aggregation can also remove failed links automatically, thereby providing a means of facility protection. When a link fails, traffic is shifted to the remaining links in that Link Aggregation Group (LAG). More links than are needed can be added to the group and each is active until it fails (similar to utilizing LCAS protection for SONET tributaries). When two links are on different packs they can provide both, facility and equipment protection.

In Active/Standby LAG, one link of the LAG is designated as the protection link and the other is the working link. Only the working link carries MAC client traffic when none of the links fails. When the working link fails, the traffic switches to the protection link. The protection switching is bidirectional and revertive.

Equipment protection

The LNW170 circuit pack can be provisioned for equipment protection, in which link aggregation plays a role. The LNW170 supports equipment protection of function group pairs (e.g. A1, A2) using an interpack interface. Only ports 1, 2, 5 and 6 are usable. Ports 3, 4, 7 and 8 cannot be used. Signals of all usable ports are fed to both LNW170 packs via the interpack interface, so that the same-numbered port of each pack belongs to a preset Link Aggregation Group. When a pair of LNW170s is used in equipment protection mode, both LNW170s are provisioned identically, except for certain physical layer parameters that remain independent. They send and receive the same signals across the backplane toward the Mains. The Mains select which of the pair is the ActiveWAN.

Equipment protection is supported on the LNW170 in shelves equipped with VLF or non-VLF main packs. In shelves with non-VLF main packs, the companion LNW170 in the slot-pair is alarmed when the protection state of the pack is not provisioned as protected (prot_state = PROT).

Link aggregation control protocol

Link Aggregation is specified in IEEE 802.3 clause 43, formerly specified in 802.3ad. The LNW170 can be configured to either use this standard protocol to control link aggregation (which negotiates with the equipment at the other end of the link) or to simply force aggregation without a control protocol. Both ends should be provisioned to use the same protocol

General link aggregation rules

Link aggregation, available for LAN ports on LNW170 packs, behaves along the following basic guidelines:

- Available for LAN ports on the LNW170 in switched mode only
- Maximum of 4 LAGs per pack, 2 ports per LAG, and 8 LAGs per function unit or growth group. There are 8 ports on each LNW170 pack.
- The ports can be on different LNW170 packs.
- All links in a LAG are in-service until they fail. Standby links, providing 1x1 SONET-style protection, are a future feature.
- When a LAG is created, the attributes (VLAN, virtual switch, and other L2 provisioning) of the first port used to establish the LAG are transferred to the LAG. When the second port is added, it then inherits the L2, VLAN and Virtual Switch (VS) characteristics of the LAG for the time it remains a member. It can not be part of a VS or have any VLAN provisioning when added.

Both member ports can also be added simultaneously and Alcatel-Lucent 1665 DMX recognizes a parameter that distinguishes the "Lead Port". The LAG (and by association, the other port in the LAG) inherits the L2, VLAN, and VS attributes of the Lead Port.

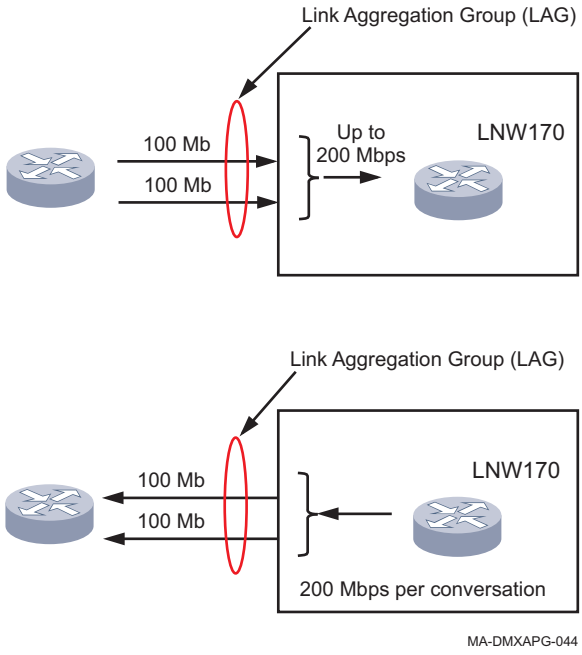
- When a port is removed from a particular LAG, it is no longer a member of a VS.
- A port must have L2 and VS provisioning in order for a port to be used as the Lead port or to establish a LAG (VLAN provisioning not required). This information is then transferred to the LAG once it's created.
- The last port/member of a LAG cannot be removed from the LAG; the LAG itself must be deleted. The last port/member of a the inherits the LAG's L2, VLAN, and VS attributes.
  - If the last member in the LAG was the first member added originally, and if there were no subsequent changes to L2 and VLAN attributes, the port will effectively revert to its original state when the LAG is deleted.
  - If the last member/port in the LAG was not the first added initially it will inherit the characteristics of the LAG rather than reverting to its original state.

Link aggregation example

The figure below depicts link aggregation on two LNW170 LAN ports functioning at 100Mbps. The top portion of the figure shows two ports receiving separate 100 Mbps inbound flows. The bottom portion depicts the same two flows being equally split across the two outbound ports in the LAG. In this example, no failure has occurred and both ports comprising the LAG are in-service.

Traffic entering incoming ports is aggregated into a LAG. While both ports are in-service, outgoing traffic is split between working ports.

Figure A-21 Link aggregation at 100 Mbps (all ports in-service)



The instance pictured above represents the ideal case, in which there are at least 2 flows, each a maximum of 100Mbps. In this case they can be equally split over the two ports comprising the LAG. The ability to split the two flows across multiple ports also depends on the distribution of MAC/IP addresses.

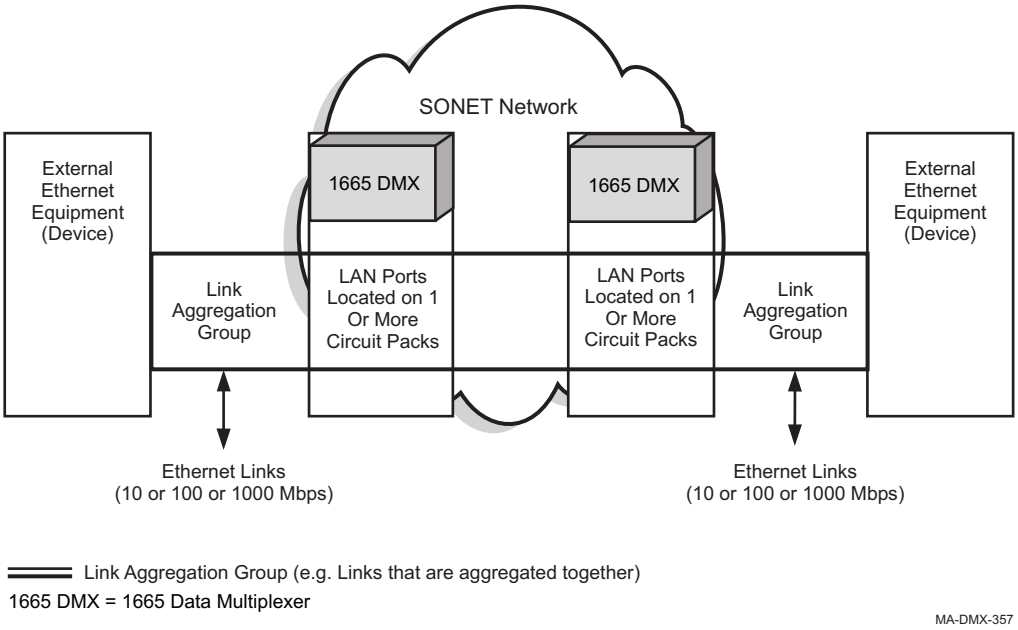
Link aggregation employs an algorithm that assigns traffic to member ports to prevent misreading. A given flow can be assigned to only one port and cannot be split across multiple ports in the same LAG. To increase flexibility, Alcatel-Lucent 1665 DMX allows a flow to be defined by either a MAC source and destination address pair or an IP source and address pair. The algorithm uses the XOR of the least significant bits of the address pairs to assign a port/link. Therefore, the actual load balancing achieved depends on the distribution of MAC/IP addresses.

Link aggregation transparency

Link aggregation allows multiple physical links between Ethernet switches to be treated as a single link. This provides for more bandwidth between the switches than can be transmitted over a single Ethernet port and it can provide protection from a cable, Ethernet port, or Ethernet circuit pack failure.

The Alcatel-Lucent 1665 DMX supports link aggregation transparency, as shown in the following figure. This allows the attached equipment to use link aggregation without participation by the Alcatel-Lucent 1665 DMX provisioning.

Figure A-22 Link aggregation



The figure shows two Ethernet devices running link aggregation interconnected via Ethernet circuit packs and a SONET Network. The Alcatel-Lucent 1665 DMX shelves and the SONET network are invisible to the two Ethernet devices. The Ethernet traffic is transparently transferred between the external devices. Link aggregation is typically implemented using two dedicated unprotected point-to-point links (Ethernet Private Line Service) for each pair of external ports.

Link aggregation transparency requires a default VLAN ID tag or port tag in 802.1Q and Transparent Tagging mode. If a default VLAN or port tag is not specified at the port, the link aggregation messages are dropped.

Flow control

This section describes how Alcatel-Lucent 1665 DMX controls the flow of Ethernet traffic. Alcatel-Lucent 1665 DMX supports the following types of flow control:

- Local flow control
- End-to-end flow control

Prior to Release 9.1, the software sets the buffer size and flow control thresholds based on the MTU and flow control provisioning (enable or disable/drop.) Beginning in Release 9.1, the automatic buffer size provisioning is decoupled from the MTU and flow control

provisioning on the LNW63, LNW74 and LNW70/170 (private line applications only). Using the existing queue size parameters (qsz), in the ED-EPORT and ED-VCG commands, the user can optionally provision the buffer size independently of the mtu size (mtu_size) and flow control mode (fcmd).

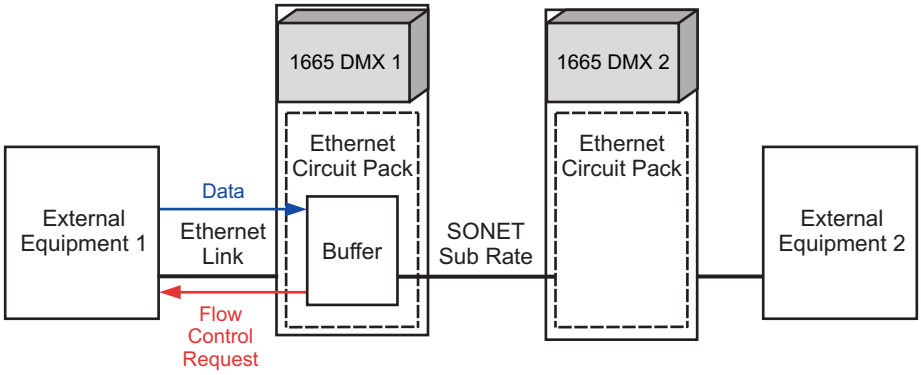
Beginning in Release 9.1, ports on the LNW63 and LNW74 support the following values for total queue size. These values also apply to the LNW70/170 VCGs when in private line mode.

- NA (default) Not Applicable. The ingress queue size is automatically set as a function of mtu_size and fcmd, consistent with releases prior to Release 9.1
- 128 The ingress queue size is 128 Kbytes. This value is supported for FE ports only.
- 512 The ingress queue size is 512 Kbytes. This value is supported for GE ports only.

Local flow control (ingress traffic direction)

If the external equipment delivers Ethernet frames to the Ethernet circuit pack faster than they can be delivered across the network, the data buffers in the Ethernet circuit pack fill up. When the data buffers reach the flow control threshold, the Ethernet circuit pack initiates flow control. On full duplex links, the Ethernet circuit pack issues a flow control request to the external equipment, requesting that the flow of frames be suspended. On half duplex links, the JAM signal is used to stop all traffic. The flow control request is repeated periodically, or the JAM signal continuously generated until the buffers empty sufficiently.

Figure A-23 Local flow control of ingress traffic



When data rate from External Equipment 1 exceeds SONET bandwidth, DMX 1 will invoke flow control toward External Equipment 1
1665 DMX = 1665 Data Multiplexer

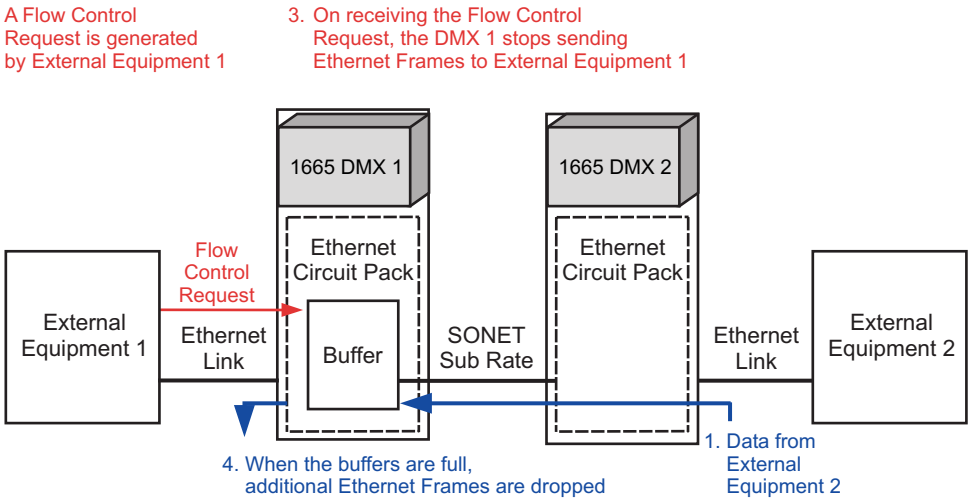
MA-DMX-358

Note that this local flow control mechanism is concerned only with congestion (full packet buffers) at the local Alcatel-Lucent 1665 DMX. If the Alcatel-Lucent 1665 DMX at the other end of the SONET network is unable to deliver the Ethernet frames to the attached external equipment due to flow control conditions there, that does *not* directly affect the local flow control operation at the ingress Alcatel-Lucent 1665 DMX.

Local flow control (egress traffic direction)

If the local Ethernet circuit pack attempts to deliver Ethernet frames to the attached external equipment faster than the external equipment can accept them, the external equipment may initiate flow control. On full duplex links, the external equipment issues a flow control request to the Ethernet circuit pack requesting that the flow of frames be suspended. On half duplex links, the JAM signal is used to stop all traffic.

Figure A-24 Local flow control of egress traffic



A Flow Control Request generated by External Equipment 1 is handled in the local Ethernet Circuit Pack

DataFrames generated by External Equipment 2, will be stored in a buffer in DMX 1
Any frames received after the buffer is filled will be dropped
1665 DMX = 1665 Data Multiplexer

MA-DMX-359

This causes the Ethernet circuit pack to stop sending Ethernet frames to the external equipment for the time requested in the flow control request. During this time, Ethernet frames accumulate in the packet buffers in the Ethernet circuit pack. Once these buffers fill completely, further Ethernet frames arriving from the SONET network for the egress Ethernet port are dropped.

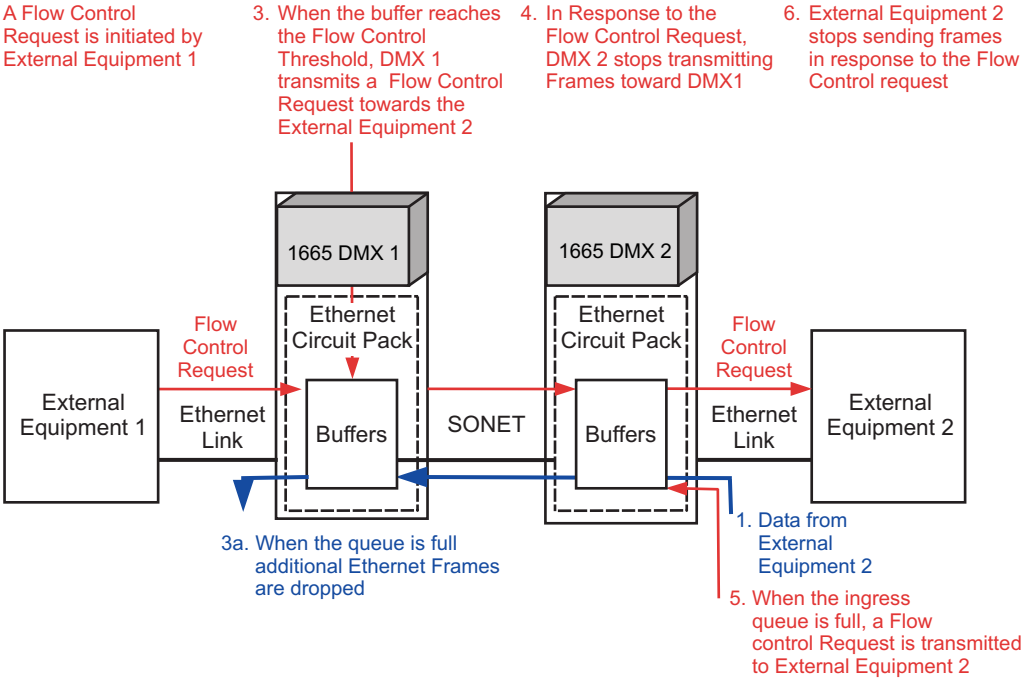
End-to-end flow control

If the external equipment at the destination of an Ethernet connection cannot handle the rate of traffic being sent to it, it may be desirable to apply back pressure across the network to slow down the external source of the Ethernet traffic. This cross-network back pressure can only work well, however, when the source of the traffic can be identified unambiguously. Only the Ethernet Private Line Service offers this opportunity; thus, it is the only service that supports End-to-End Flow Control.

End-to-end flow control (LNW66 circuit packs)

With end-to-end flow control, flow control requests that are received by the LNW66 Ethernet circuit packs at the egress point of the network, are regenerated during congested conditions by the Ethernet circuit pack at the ingress point of the network and transmitted to the originating external equipment.

Figure A-25 End-to-end flow control (LNW66)



While waiting for the originating external equipment to receive and process the flow control request, the destination Ethernet circuit pack buffers Ethernet frames received over the SONET network. If the buffer fills before the frame flow stops, the excess frames are discarded.

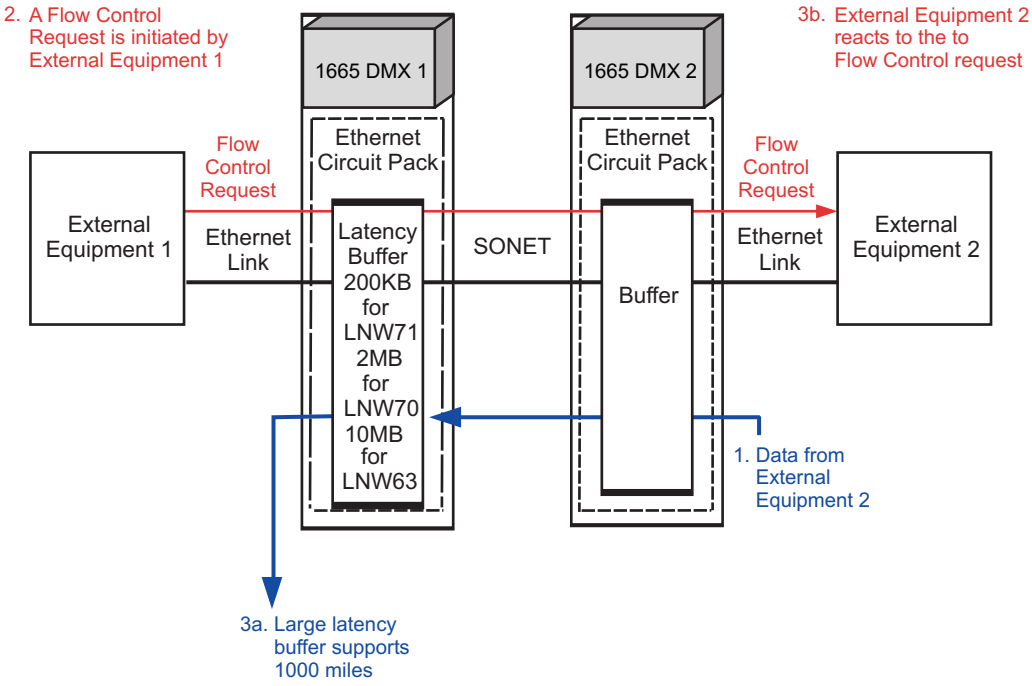
> **Important!** In the LNW66 if the ingress traffic sent to a VCG port is less than 1 Gbps, but greater than the SONET bandwidth available, packets are dropped without being counted.

End-to-end flow control (LNW63/170 circuit pack)

The LNW63/170 circuit pack implements the following changes intended to improve the frame loss behavior of end-to-end flow control.

- When provisioned for end-to-end flow control, the LNW63/170 circuit pack sends a flow control request across the SONET network immediately upon receiving a flow control request from external equipment.
- The LNW63/170 circuit pack contains large latency buffers to hold data while waiting for far-end equipment to respond to end-to-end flow control requests.

Figure A-26 End-to-end flow control (LNW63/170)



Flow Control Request is generated by External Equipment 1

Flow Control Request is sent immediately to External Equipment 2

Data Frames received from External Equipment 2 will be stored in a large latency buffer

External Eqipment 2 stops sending data in time for a loss-less transmission

1665 DMX = 1665 Data Multiplexer

JK-E-6

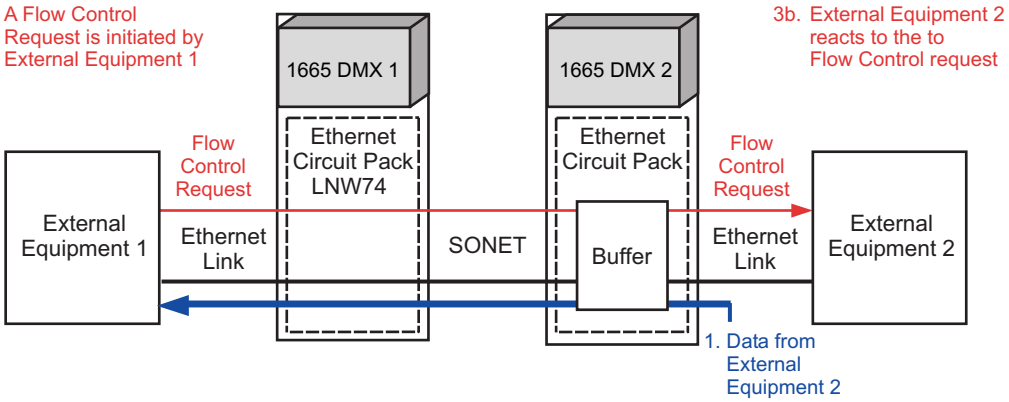
After a flow control request is received, the LNW63/170 circuit pack buffers frames instead of sending them to the equipment that generated the flow control request. Each port has its own latency buffer. A latency buffer can store 16ms of traffic that allows the equipment to be about 1000 miles apart (2000 miles round trip).

End-to-end flow control (LNW64/74/87)

The LNW64/74/87 circuit pack implements the following changes intended to improve the frame loss behavior of end-to-end flow control.

- When provisioned for end-to-end flow control, the LNW64/74/87 circuit pack sends a flow control request across the SONET network immediately upon receiving a flow control request from external equipment.
- The LNW64/74/87 circuit pack does not buffer data while waiting for far-end equipment to respond to end-to-end flow control requests. Data is transmitted to the client, as shown in the following figure.

Figure A-27 End-to-end flow control (LNW64/74/87)



Flow Control Request is generated by External Equipment 1

Flow Control Request is sent immediately to External Equipment 2

External Eqipment 2 stops Sending data in time for a loss-less transmission

1665 DMX = 1665 Data Multiplexer

JK-E-7

Flow control provisioning (LNW66 circuit packs)

A combination of flow control settings on the LNW66 circuit pack LAN ports and VCGs determine how flow control operates.

The following table shows the flow control settings for the LNW66 circuit packs.

LAN Port Flow Control State	VCG Flow Control Provisioned Value	Flow Control Status	Use/Comments
Disabled	Don't Care	Disabled	Flow control is disabled for that port/link. Flow control requests are ignored and discarded.

LAN Port Flow Control State	VCG Flow Control Provisioned Value	Flow Control Status	Use/Comments
Enabled	Transparent	End-to-End Mode Enabled	The LAN port responds to flow control requests by stopping frame transmission. Flow control requests are generated and sent to far end Alcatel-Lucent 1665 DMX based on congestion. Frames are dropped once the egress buffer is full. LAN port generates flow control requests due to congestion from the far end Alcatel-Lucent 1665 DMX. For Ethernet Private Line Full Rate Service (Point-to-Point).
	Local	Local Mode Enabled	The LAN port responds to flow control requests by stopping frame transmission. No flow control requests are sent to far end Alcatel-Lucent 1665 DMX. LAN port generates flow control requests for fractional service. For Ethernet Private Line Fractional (Partial) Rate Service and Packet Ring Services.
	None (Disabled)	Disabled	The LAN port responds to flow control requests by stopping frame transmission. No flow control requests are sent to the far end Alcatel-Lucent 1665 DMX. LAN port does not generate flow control requests.

Flow control provisioning (LNW63/64/74/87/170)

The LNW63/64/74/87/170 circuit pack automatically provides both local and end-to-end flow control if flow control is enabled for a LAN port. Similarly, disabling flow control for an LAN port disables both forms of flow control.

The following table shows the flow control settings for the LNW63/64/74/87/170 circuit pack.

LAN Port Flow Control State	Flow Control Status	Use/Comments
Disabled	Disabled	Alcatel-Lucent 1665 DMX does not participate in flow control. The LAN port does not respond to flow control requests. The LAN port does not generate flow control requests due to congestion. Flow control requests are transported when received.
Enabled	Enabled	The LAN port generates flow control requests for fractional service. For LNW170/63 the LAN port responds to flow control requests by stopping frame transmission. Flow control requests are sent to the far end Alcatel-Lucent 1665 DMX. Frames are stored in the Latency buffer for loss-less transmission. For LNW74/64 flow control requests are sent to the far-end Alcatel-Lucent 1665 DMX.
Drop	Drop	Disables Network-element controlled flow control and drops end-to-end flow control messages.

Physical interface

Each Ethernet circuit pack contains a transceiver that implements the physical interface for that circuit pack's line type. For the 10/100 Mbps circuit packs, this physical interface must be provisioned to or auto-negotiate to the proper line rate and duplex mode in order to communicate successfully with the connected equipment. Gigabit Ethernet interfaces only support the 1000 Mbps line rate and full duplex mode, so this is not an issue for these circuit packs. All optical 100BASE-X interfaces support the 100 Mbps line rate only.

At the physical layer, many types of LANs can be used for multiple line rates and duplex modes. For example the LAN port on most PCs can be connected to a 10BASE-T (10 Mbps) or a 100BASE-T (100 Mbps) LAN. Before data traffic can be transmitted onto a LAN, all ports connected to the LAN must operate with the same line rate and duplex mode. LAN ports can either be provisioned with these values or provisioned to automatically negotiate (auto-negotiate) the values.

Auto-negotiation

In the auto-negotiation process, a LAN port advertises its acceptable parameters, compares these with the advertised parameters of its link partner, and then agrees upon a set of parameters with the link partner. IEEE 802.3 allows the line rate, duplex mode, and flow control mode to be auto-negotiated. A LAN port not configured to support auto-negotiation will use provisioned values for these parameters. A LAN port configured for auto-negotiation that is connected to a LAN port not configured for auto-negotiation will follow prescribed rules for parameter settings.

On connected Gigabit Ethernet ports with auto-negotiation enabled, if transmission is interrupted in one direction of transmission on a Gigabit Ethernet port, then transmission is disabled in the other direction. For example, if one fiber in the transmit/receive pair is cut, then one-way transmission on the other fiber is maintained only if auto-negotiate is disabled and the link state is forced good at the transmit source equipment.

Line rate operation for LNW66 and LNW74 circuit packs

The following table summarizes line rate operation for the LNW66 and LNW74 Ethernet circuit packs.

LAN Port Rate Provisioning	Connected Equipment Provisioning		Ethernet Link Rate (Note 1)
	Auto-Negotiation	Advertised/Set at	
10	Disabled	10	10
	Disabled	100	No Link
	Enabled	10	10
	Enabled	100	No Link
	Enabled	10/100	10
100	Disabled	10	No Link
	Disabled	100	100
	Enabled	10	No Link
	Enabled	100	100
	Enabled	10/100	100
Auto	Disabled	10	10
	Disabled	100	100
	Enabled	10	10
	Enabled	100	100
	Enabled	10/100	100

Notes:

1. Both the Alcatel-Lucent 1665 DMX and the connected equipment will try to determine a common line rate. The link will not come up if both ends have auto-negotiation enabled and advertise incompatible duplex modes.

Duplex mode operation for LNW66 circuit packs

The following table summarizes duplex mode operation for the LNW66 Ethernet circuit packs.

LAN Port Provisioning		Connected Equipment Provisioning		Duplex Mode State		Bidirectional Traffic (Link Rate must be resolved)
Duplex Mode	Auto-Negotiation State[1]	Auto-Negotiation	Advertised/Set at	DMX[2]	Connected Equipment	
Auto	Enabled	Disabled	Full	Half	Full	No
		Disabled	Half	Half	Half	Yes
		Enabled	Full	Full	Full	Yes
		Enabled	Half	Half	Half	Yes
		Enabled	Half/Full	Full	Full	Yes
Full	Enabled	Disabled	Full	Unavailable	Full	No
		Disabled	Half	Unavailable	Half	No
		Enabled	Full	Full	Full	Yes
		Enabled	Half	Full	[3]	No
		Enabled	Half/Full	Full	Full	Yes
	Disabled	Disabled	Full	Full	Full	Yes
		Disabled	Half	Full	Half	No
		Enabled	Full	Unavailable	[4]	No[4]
		Enabled	Half	Full	Half	No
		Enabled	Half/Full	Full	Half	No
Half	Enabled	Disabled	Full	Half	Full	No
		Disabled	Half	Half	Half	Yes
		Enabled	Full	Unavailable	[4]	No
		Enabled	Half	Half	Half	Yes
		Enabled	Half/Full	Half	Half	Yes

LAN Port Provisioning		Connected Equipment Provisioning		Duplex Mode State		Bidirectional Traffic (Link Rate must be resolved)
Duplex Mode	Auto-Negotiation State[1]	Auto-Negotiation	Advertised/Set at	DMX[2]	Connected Equipment	
Half	Disabled	Disabled	Full	Half	Full	No
		Disabled	Half	Half	Half	Yes
		Enabled	Full	Half	[4]	No [4]
		Enabled	Half	Half	Half	Yes
		Enabled	Half/Full	Half	Half	Yes

Notes:

1. Auto-negotiation is enabled if Line Rate or Duplex Mode or Flow Control is provisioned for auto-negotiation.
2. Duplex mode is reported as unavailable if the link could not be established.
3. The link will not come up because the duplex mode could not be established.
4. According to IEEE 802.3, the connected equipment should default to half duplex. Because that equipment doesn't support half duplex the link may be prevented from coming up. If it does come up, bidirectional traffic will not be supported.

Flow control operation for LNW66 and LNW74 circuit packs

The following table summarizes flow control operation for the LNW66 and LNW74 Ethernet circuit packs.

LAN Port Provisioning		Connected Equipment Provisioning		Duplex Mode State		Comments[4]
Flow Control	Auto-Negotiation State[1]	Auto-Negotiation	Advertised/ Set at [2]	DMX [3]	Connected Equipment	
Auto	Enabled	Disabled	Disabled	Enabled	Disabled	Inconsistent Provisioning
			Enabled	Enabled	Enabled	Inconsistent Provisioning
		Enabled	Disabled	[5]	Disabled	
			Enabled	[6]	Enabled	

LAN Port Provisioning		Connected Equipment Provisioning		Duplex Mode State		Comments [4]
Flow Control	Auto-Negotiation State [1]	Auto-Negotiation	Advertised/ Set at [2]	DMX [3]	Connected Equipment	
Enabled	Enabled	Disabled	Disabled	Enabled	Disabled	Inconsistent Provisioning
			Enabled	Enabled	Enabled	Inconsistent Provisioning
		Enabled	Disabled	Enabled	Disabled	
			Enabled	Enabled	Enabled	
	Disabled	Disabled	Disabled	Enabled	Disabled	Inconsistent Provisioning
			Enabled	Enabled	Enabled	
		Enabled	Disabled	Enabled	Unknown	Inconsistent Provisioning
			Enabled	Enabled	Unknown	Inconsistent Provisioning
Disabled	Enabled	Disabled	Disabled	Disabled	Disabled	Inconsistent Provisioning
			Enabled	Disabled	Enabled	Inconsistent Provisioning
		Enabled	Disabled	Disabled	Disabled	
			Enabled	Disabled	Disabled	
	Disabled	Disabled	Disabled	Disabled	Disabled	
			Enabled	Disabled	Enabled	Inconsistent Provisioning
		Enabled	Disabled	Disabled	Unknown	Inconsistent Provisioning
			Enabled	Disabled	Unknown	Inconsistent Provisioning

Notes:

1. Auto-negotiation is enabled on the LNW66 LAN port if Line Rate or Duplex Mode or Flow Control is provisioned for auto-negotiation.
2. Flow control will only be enabled if the connected equipment is capable of Symmetric Flow Control.
3. IEEE 802.3 does not define flow control states for half duplex links or when only one side of a link is provisioned for auto-negotiation. This is the expected behavior of the connected equipment.

4. IEEE 802.3 recommends that equipment be configured for auto-negotiation to avoid inconsistent provisioning.
5. On LNW66 LAN ports, flow control is enabled if the duplex mode is provisioned for half duplex and disabled if the duplex mode is provisioned for full duplex or auto-negotiate.
6. On LNW66 LAN ports, flow control is enabled if the duplex mode is provisioned for full duplex, or auto-negotiates to full duplex, or is provisioned for half duplex. It is disabled on LNW66 LAN ports if the duplex mode auto-negotiates to half duplex.

Important! Flow control on all optical Fast Ethernet ports must be provisioned manually.

Flow control operation for LNW170 circuit packs (100BASE-X ports only)

The following table summarizes 100BASE-X flow control operation for the LNW170 Ethernet circuit packs.

LAN Port Flow Control Provisioning	Connected Equipment Provisioning		Flow Control State		Comments [3]
	Auto-Negotiation	Advertised/ Set at [2]	DMX [2]	Connected Equipment	
Auto	Disabled	Disabled	Enabled	Disabled	Inconsistent Provisioning
		Enabled	Enabled	Enabled	Inconsistent Provisioning
	Enabled	Disabled	Disabled	Disabled	
		Enabled	Enabled	Enabled	
Enabled	Disabled	Disabled	Enabled	Disabled	Inconsistent Provisioning
		Enabled	Enabled	Enabled	
	Enabled	Disabled	Enabled	Unknown	Inconsistent Provisioning
		Enabled	Enabled	Unknown	Inconsistent Provisioning
Disabled (Drop on LNW170 only)	Disabled	Disabled	Disabled	Disabled	
		Enabled	Disabled	Enabled	Inconsistent Provisioning
	Enabled	Disabled	Disabled	Unknown	Inconsistent Provisioning
		Enabled	Disabled	Unknown	Inconsistent Provisioning

Notes:

1. The link will not be operational if the connected equipment is not configured for 1 Gbps and full duplex mode.
2. Flow control will only be enabled if the connected equipment is capable of Symmetric Flow Control.
3. IEEE 802.3 recommends that equipment be configured to avoid inconsistent provisioning.
4. Drop mode only applies for the LNW170 circuit pack.

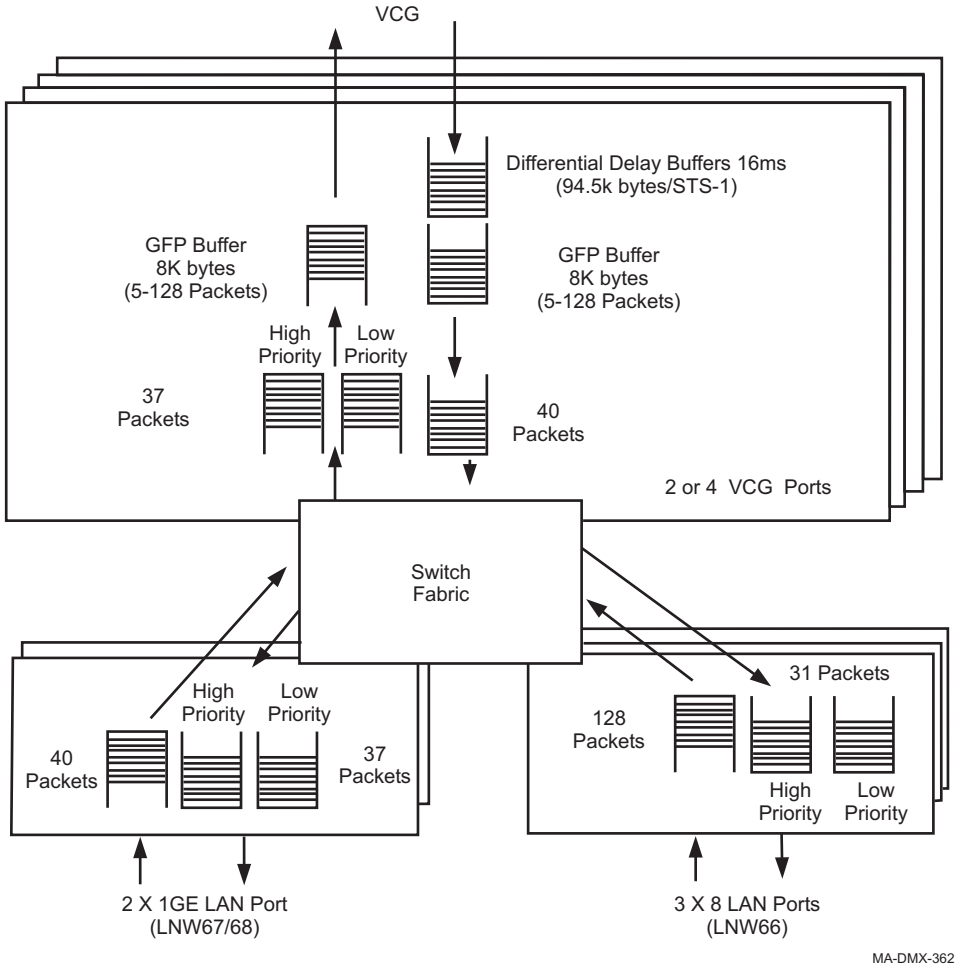
Queues and buffers

Ethernet circuit packs contain small buffer pools that provide storage of Ethernet frames for brief periods of congestion or until flow control requests can be honored. These small buffer pools are associated with the Ethernet switch and the Generic Framing Procedure (GFP) mechanism. The GFP mechanism is described further in "Generic framing procedure (GFP)" (p. A-22). A larger buffer pool designed to handle different path lengths for individual STS-1s is associated with the virtual concatenation process. Its function is described in more detail in "Virtual concatenation" (p. A-24). Two priority-based queues are provided on the LNW66 to allow high priority traffic to be forwarded ahead of low priority traffic. The LNW170 provides 4 priority queues. For more information, see "Metering (CIR and PIR)" (p. A-77).

LNW66 circuit pack queues and buffers

The Ethernet switches on LNW66 circuit packs contain ingress (input) and egress (output) buffers. The following figure shows the LNW66 circuit pack queue and buffer architecture.

Figure A-28 Queue and buffer architecture (LNW66)



High and low priority queues are provided for packets leaving the Ethernet switch in the direction of either the SONET network or a customer port. Each LAN and VCG port has one ingress and two egress queues. Ingress queues buffer Ethernet frames going into the Ethernet switch and egress queues buffer Ethernet frames leaving the Ethernet switch. One egress queue is for high priority Ethernet frames and the other egress queue is for low priority Ethernet frames.

On the LNW66 circuit pack, the LAN ports are divided into groups of eight. The groups consist of LAN ports 1–8, 9–16, and 17–24. Each group of eight LAN ports shares a set of 128 frame buffers. In the egress direction, each LAN port can buffer up to 31 Ethernet

frames which can be placed in a high or low priority queue. Each LNW66 circuit pack VCG port can buffer 40 Ethernet frames in the ingress queue and a total of 37 Ethernet frames across the high and low priority egress queues.

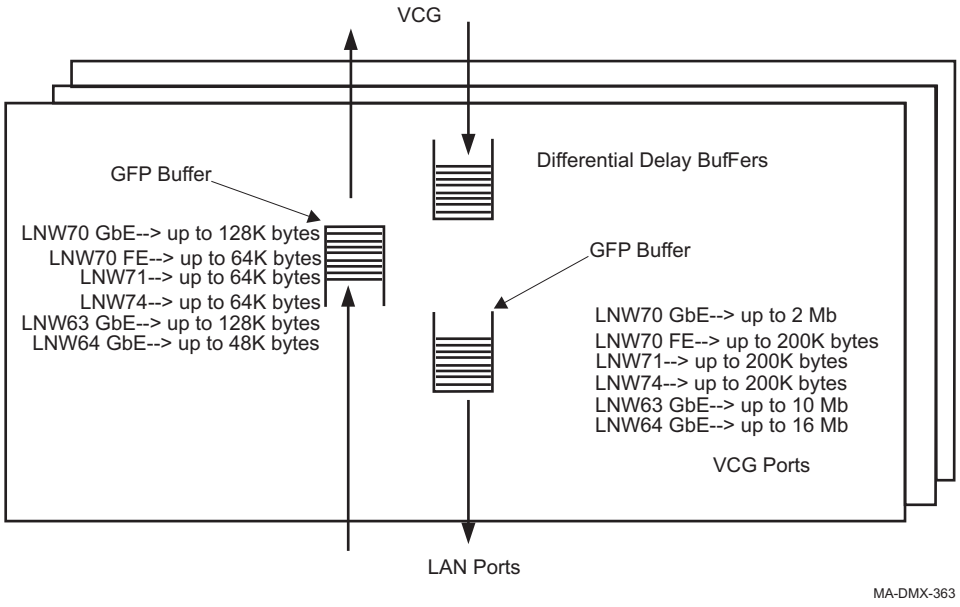
All frame buffers are sized to handle the maximum frame size (1536 bytes). The buffer pool sizes described above are independent of frame size (that is, they do not increase if the Ethernet traffic consists of small frames).

LNW63/64/74/170 circuit pack buffers

In Private Line Mode, the Ethernet frame buffers are all associated with the Generic Framing Procedure (GFP) and virtual concatenation mechanisms. The following figure shows the LNW63/64/74/170 circuit pack buffer architecture.

> **Note:** In switched mode, the LNW170 buffers are provisionable up to 256 K. Each port buffer accommodates four CoS queues

Figure A-29 Buffer architecture (LNW63/64/74/170)



The LNW63/64/74/170 circuit pack provides larger buffer pools to allow for longer response times to flow control requests. In addition, buffer storage can be flexibly assigned to Ethernet frames, allowing maximal usage of the memory available.

> **Note:** For additional information on differential delay buffers, see "Differential delay buffers" (p. A-25).

Head-of-line (HOL) blocking prevention

As an Ethernet frame arrives from the SONET network destined for a customer LAN port on LNW66 circuit packs, it is placed in the egress queue associated with the destination LAN port(s). If that queue is full, the VCG port on which the packet arrived could hold

the packet until space is available, but that would stop the incoming flow of all packets arriving on that VCG port, even those destined for uncongested LAN ports. This situation is known as Head-of-Line (HOL) blocking.

To avoid Head-of-Line (HOL) blocking, the LNW66 circuit packs support the discarding of packets received on a VCG port destined for a LAN port with a full egress queue. Broadcast frames, multicast frames, and frames with unknown destination addresses are not discarded but are forwarded only to those LAN ports that are accepting traffic. Frames dropped due to HOL blocking prevention are not reported as dropped in the performance monitoring statistics.

HOL blocking prevention is used in the 802.1Q and transparent modes. These modes are described in "Tagging Modes" (p. A-60).

Tagging Modes

Overview

Alcatel-Lucent 1665 DMX supports the following tagging modes.

- Private line mode (also know as no tag or repeater mode)
- Switched mode
- 802.1Q mode
- Transparent mode.

The tagging mode is user provisionable on a circuit pack basis. Different circuit packs on a single Alcatel-Lucent 1665 DMX shelf can be provisioned for different modes but, all ports on a circuit pack must use the same mode.

Private line mode

The Private Line mode (also known as no tag or repeater mode) is used to establish simple point-to-point connections between two ports with no Ethernet switching functions applied. No additional Ethernet provisioning is required after the cross-connection is established. Private line mode can be used to provide either a full rate or sub-rate (fractional rate) dedicated Ethernet link across SONET networks. No preferential treatment for high priority packets is provided. In a sub-rate service, frames may be dropped due to congestion. Any correctly formatted Ethernet frame received at a source port is transmitted out of the destination port.

The Private Line mode supports the following features:

- Point-to-point topology with only two LAN ports
- MAC address filtering is enabled (not available for LNW74)
- Protection is provided at the SONET network layer by either UPSR switching

- No spanning tree protocol (supports transparency of customer spanning tree protocol)
- No VLAN ingress filtering or classification (VLAN tags are not verified or added)
- Ethernet PM per port

For packet size info, see "Packet size in different tagging modes" (p. A-66).

Switched mode

Switched mode allows 802.1Q or Transparent mode to be selected based on a virtual switch (grouping of ports). For more information, see "Virtual switch" (p. A-86) and "QoS services (LNW170)" (p. A-69).

802.1Q VLAN mode

In 802.1Q Mode, a circuit pack can be provisioned to use an incoming frame's VLAN tag, to add a VLAN tag associated with the port for untagged frames, or to drop an incoming frame if its VLAN tagging does not meet provisioned specifications. The priority bits in an incoming frame's VLAN tag can also be used to affect the handling of the frame.

The following table summarizes the 802.1Q Mode VLAN ID and Frame Priority Rules. For more information regarding frame priority rules on the LNW170, see "QoS services (LNW170)" (p. A-69).

Frame Contains a VLAN Tag	Ingress Port is Provisioned with a Default		Results
	VLAN ID	Priority	
Yes	Don't Care	Yes	The frame's VLAN ID is used. It must be on the Port's VLAN List, otherwise the frame is discarded. The port's user_priority field is used for queuing.
		No	The frame's VLAN ID is used. It must be on the Port's VLAN List, otherwise the frame is discarded. The frame's priority is used for queuing.
No	Yes	Yes	A VLAN tag is added to the frame containing the port's default VLAN ID and priority.
		No	A VLAN tag is added to the frame containing the port's default VLAN ID and the priority is set to low (VLAN Tag's User_priority field set to 0).
	No	Don't Care	Frame is dropped.

A VLAN ID can only be assigned to one virtual switch on a circuit pack.

On the LNW170/78, the same VLAN ID can be assigned to different virtual switches on the same pack.

When using the 802.1Q mode, a service provider must coordinate (specify) the use of VLAN IDs with customers. If a VLAN ID is assigned to more than one customer, the customers could receive each others traffic.

In Alcatel-Lucent 1665 DMX, the VLAN ID may be a numerical value in the range 1–4093.

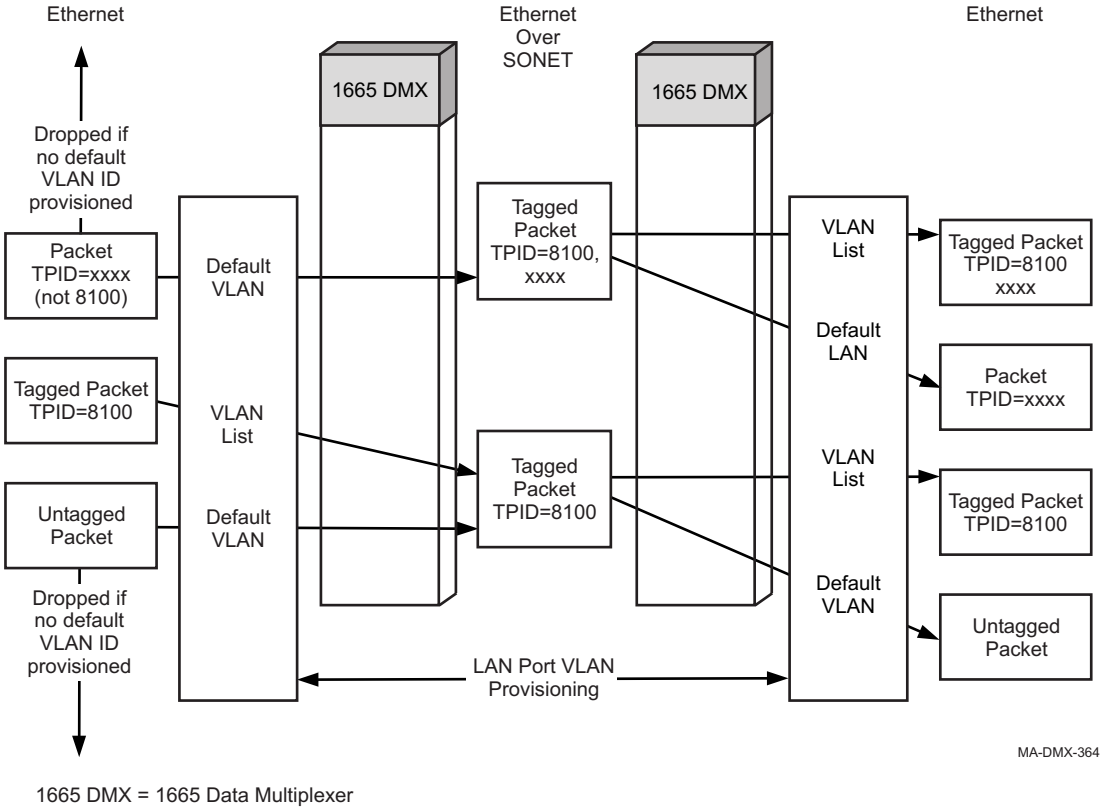
If a port has been provisioned with a default VLAN ID for untagged frames, all incoming untagged frames (this includes frames containing a VLAN tag with a TPID value other than 8100hex) will have VLAN tag added with the default VLAN ID. Any frame exiting the Alcatel-Lucent 1665 DMX network tagged with the default VLAN ID will have its VLAN tag removed before the frame is sent out the LAN port. Thus, assuming symmetric provisioning at the network edges, frames that enter the Alcatel-Lucent 1665 DMX network untagged will leave untagged as well.

Frames that enter the network carrying a standard 802.1Q VLAN tag (identified with a TPID value of 8100hex) have their VLAN ID checked against a VLAN list for the entry port. If a match is found, the frame is admitted; otherwise, the frame is discarded. On exiting the network, customer-tagged frames are delivered with the customer-provided VLAN tag intact unless it matches the default VLAN ID for the exiting port. In such a case, the customer-provided VLAN tag is removed before the frame is delivered.

The following figure shows the end-to-end frame processing combinations considering the following:

- Incoming frame tagging
- Default VLAN ID provisioning for source LAN port
- Default VLAN ID provisioning for destination LAN port

Figure A-30 802.1Q mode VLAN tag processing



If VLAN tags are used, the ports support a maximum packet size of 1536 bytes (10236 for LNW170/78). If VLAN tags are not used, the ports support a maximum packet size of 1532 bytes (10240 for LNW170/78).

The LNW66 and LNW170 circuit packs support the 802.1Q mode.

> **Important!** After the VLAN ID is provisioned for untagged incoming Ethernet frames and service is established in the 802.1Q mode, changing the VLAN ID may affect service. When the VLAN ID for untagged incoming Ethernet frames is changed at one point in the network, the VLAN ID must be changed at all points. If the VLAN IDs are different, service is affected.

Transparent mode

In Transparent Mode, port tags (which are actually VLAN tags with a provisionable TPID value) are used to separate traffic for different customers. A port tag is added to each incoming frame at the ingress LAN port. The port tag contains a provisionable customer ID and priority level.

The port tag, along with the destination MAC address, is used in switching the Ethernet frame to its correct destination. Assuming the destination port is also provisioned for Transparent Mode, the port tag is removed as the frame is delivered out the destination port.

When using the Transparent Mode, service providers usually assign one customer ID to each customer LAN port. The service provider need not coordinate the selection of this customer ID with the customer since it is independent of any 802.1Q VLAN tags generated by the customer. Customers can use any VLAN ID they want without interfering with any other customer carried on the service provider's network.

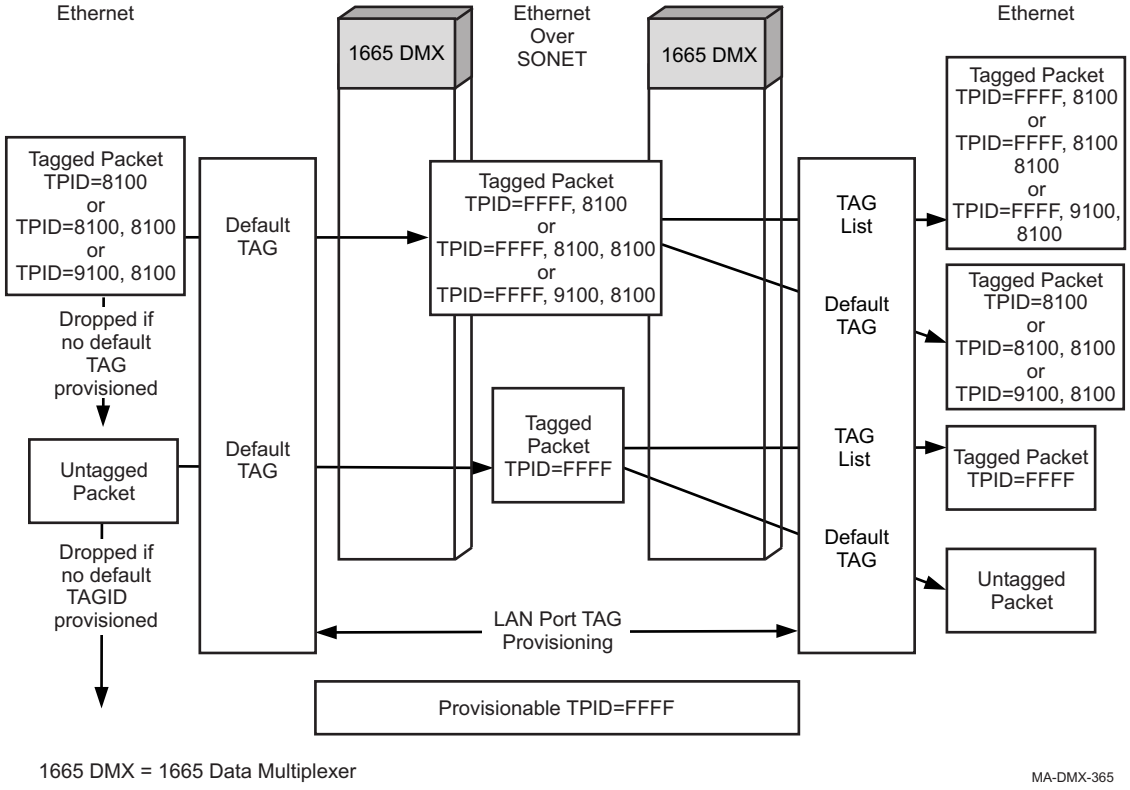
In the transparent mode, the ports support a maximum packet size of 1532 bytes (LNW66) or 10240 bytes (LNW170).

The LNW66 and LNW170 circuit packs support the transparent mode. The LNW74 circuit packs do not support the transparent mode.

The following figure shows end-to-end frame processing combinations considering the following:

- Provisionable TPID value set to its default value (0xFFFF)
- Incoming frame tagging
- Default port tag provisioning for the source LAN port
- Port tag provisioning for the destination LAN port.

Figure A-31 Transparent mode tag processing



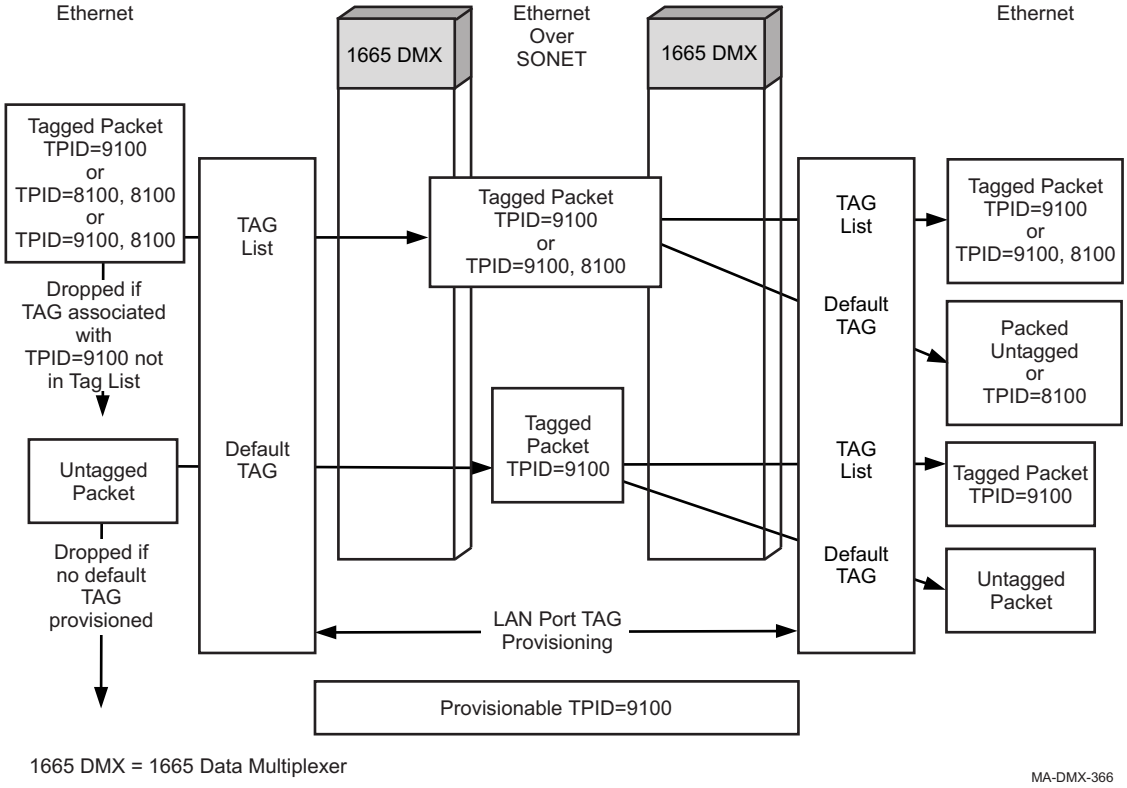
TPID provisioning and tag list provisioning

The value of the TPID (Ethertype) parameter used with generated VLAN Tags can be provisioned (in transparent mode only). Also, the user may provision a list of acceptable customer tags for a LAN port. This pair of features allows Alcatel-Lucent 1665 DMX to interoperate with other equipment that supports stacked VLANs.

The following figure shows the end-to-end frame processing combinations considering the following:

- User provisionable TPID value (to 0x9100 in the example)
- Incoming frame tagging
- Default port tag provisioning for the source LAN port
- Port tag provisioning for the destination LAN port.

Figure A-32 Transparent mode tag processing with stacked VLANs



Packet size in different tagging modes

The following table shows a comparison of the Ethernet tagging modes.

Tagging Mode	Max. Frame Size (Bytes)[1]	Applicable Circuit Packs	Max MTU size (Bytes)[2]
Private Line	9632	LNW74	9614
	10240	LNW63, LNW64, LNW87, LNW170, LNW705	10222
802.1Q and Transparent	1536 (Tagged) 1532 (Untagged[3])	LNW66	NA
	10240	LNW170	10222

Notes:

1. Max frame size is the largest size frame (DA to FCS) that can enter a LAN port.
2. MTU size, where applicable, is provisionable. Max MTU size is the same as Max frame size, less 18.
3. Does not apply for VCG ports

Quality of Service

Overview

Alcatel-Lucent 1665 DMX supports the following Quality of Service (QoS) capabilities:

- Private line service provides dedicated bandwidth between two points service (best QoS).
- Fractional rate services provide basic rate control with SONET tributary granularity.
- Committed information rate (CIR) policing provides rate limiting with 1 Mbps granularity.
- Peak information rate (PIR) policing provides rate limiting with 1 Mbps granularity.
- LNW170 enables advanced QoS capabilities including CIR rate metering.
  For detailed information about Ethernet frame priority levels, see "Priorities" (p. A-35) and "802.1Q VLAN mode" (p. A-61).

Peak information rate (PIR) control on LNW66 circuit packs

The LNW66 circuit packs support a provisionable PIR rate limiting mechanism for traffic entering the SONET network. A PIR value, in multiples of 1 Mbps, can be provisioned per VLAN for traffic leaving a VCG toward the SONET network. Traffic in excess of the provisioned value for each VLAN is dropped. The PIR capability applies to all tagging modes supported by the listed circuit packs.

The PIR policer uses a leaky bucket mechanism with a provisionable burst size and credit interval. The burst size determines how many tokens get put into the bucket each time it is replenished. This determines the length of a traffic burst that can be tolerated before packets are discarded. The credit interval determines the frequency with which the bucket is replenished. The burst size and credit interval parameters affect policing for all ports (in Private Line mode), all VLANs (in 802.1Q mode) or all port tags (in transparent mode) on a particular Ethernet circuit pack.

When sending data from a Gigabit Ethernet circuit pack, through the SONET network to a Fast Ethernet circuit card, the function described above is slightly different. With this configuration, the worst case is that a number of bytes equal to the full size of the token bucket in the GbE circuit pack will be sent using whatever SONET bandwidth has been provisioned (approximately 1 Gb/s in the worst case) to the Fast Ethernet card. The egress FE LAN port is limited to sending the data out at 100 Mb/s. If the rapid arrival of a token bucket's worth of bytes exceeds the limited egress buffering capacity of the FE LAN port, packets are dropped. This loss of packets can be minimized by minimizing the number of bytes in the token bucket at the GbE sending end by setting the smallest practical credit interval and burst size.

For more information, see "Metering (CIR and PIR)" (p. A-77).

Adding tokens

Every *credit interval*, tokens are added to the token bucket for each VLAN/Port TAG/LAN port for which a PIR is provisioned. Each token represents 1 byte. (One credit interval is provisioned per circuit pack, and the provisioned credit interval applies to all VLANs/Port TAGs/LAN ports on that circuit pack. The credit interval is a multiple of 524.288s; the multiple is determined by the provisionable credit interval parameter.)

The number of available tokens (*A*) in the token bucket for each VLAN/Port TAG/LAN port is increased by, at most (PIR*credit interval)/8 each credit interval. *PIR* is the provisioned PIR in Mbps, and *credit interval* is the provisioned credit interval for the circuit pack. The divisor, *8*, is required to convert from bits to bytes.

The number of available tokens (*A*) in each token bucket is subject to a maximum, which is determined by the provisioned PIR, the provisioned credit interval, and the provisioned maximum burst parameter. So each credit interval (*A*) = min (A + (PIR*credit interval)/8, BRST*(PIR*credit interval)/8).

The maximum burst represents the maximum size (in bytes) of the *burst* (above the PIR) that is passed by the policer. That is, a burst of this size (or smaller) is allowed through the policer if the token bucket for the VLAN/Port TAG/LAN port is full (for example, because no packets have been processed for *BRST* credit intervals). If a burst of this size is passed, then the token bucket is emptied and another burst will not be allowed through the policer until enough tokens have been accumulated in the token bucket. Another way to look at this is that the policer will pass a burst of packets above the PIR, as long as the long term average is no more than the provisioned PIR, where long term is defined as *BRST*credit_interval*.

Removing tokens

When a packet arrives, the token bucket for the associated VLAN/Port TAG/LAN port is checked. If no tokens are available for the VLAN/Port TAG/LAN port, then the packet is discarded. If tokens are available, the packet is forwarded and the number of available tokens for that VLAN/Port TAG/LAN port is decreased by the packet size.

If A >= 1 A = A - packet size, forward the packet, else discard the packet.

QoS services (LNW74)

The LNW74 circuit packs provide 10 Mbps and 100 Mbps Private Line services. They do not contain an Ethernet Switch. Each LAN port is connected to its own VCG. 100 Mbps traffic can be rate-limited by provisioning less SONET bandwidth than required to carry the full line rate. Traffic is buffered and flow control is invoked when ingress traffic on a LAN port exceeds the VCG's SONET bandwidth. If flow control is disabled or ignored by the external equipment, Ethernet frames are dropped when the ingress buffer overflows. The LNW74 offers 1.5Mbps VT granularity.

QoS services (LNW170)

The capabilities of the LNW170 enable enhanced QoS features. The LNW170 can function in either Private Line or Switched mode.

The QoS capabilities of the LNW170 are different depending on the mode the card is in. Also, within the two modes below, there are a variety of traffic conditioners which can be applied, depending on the mode) which further govern the QoS capabilities of the pack.

- Private Line: Alcatel-Lucent 1665 DMX can perform rate controlling at a sub-STS level and on a per-port basis in PL mode. In PL mode, if rate control is desired, the traffic management mode will be port mode (see Traffic Conditioners below).
- Switched Mode: Alcatel-Lucent 1665 DMX can perform VLAN processing and enhanced QoS in switched mode. There are two settings within switched mode: Transparent and IEEE 802.1q mode. See "Tagging Modes" (p. A-60).

In order to provide enhanced QoS services, traffic must be classified, and conditioned. This is accomplished using traffic conditioners that are applied to packets at the boundary port (see Boundary vs. Interior Port below).

Traffic Management Mode

The QoS features available on any given port will vary depending on the particular traffic conditioners applied to that port. The 5 traffic conditioners supported by Alcatel-Lucent 1665 DMX are as follows:

- PORT mode: One traffic conditioner for the port. All traffic that is permitted to be transported flows through a single traffic conditioner.
- COSPORT mode: One traffic conditioner for each class of service at the port. All traffic for an individual CoS is provisioned with its own traffic conditioner.
- TAGPORT mode: One traffic conditioner for each Packet Tag at the port. Traffic for all classes of service that have the same Packet Tag flow through a single traffic conditioner.
- COSTAGPORT mode: One traffic conditioner for each class of service for each Packet Tag/VLAN at the port. All traffic for an individual CoS on each Packet Tag is provisioned with its own traffic conditioner.
- NOTC mode: In this mode all traffic is bridged through the switch as usual but there is no traffic conditioning performed on the traffic. NOTC mode emulates the (basic) QoS behavior on the older Alcatel-Lucent 1665 DMX circuit packs (user_priority values 0,1,2 and 3 are mapped to CoS 0 and user_priority values 4,5,6 and 7 are mapped to CoS 3; no modification of user_priority bits in user packets).

Boundary versus interior ports

When speaking of QoS, a port is either a Boundary or Interior port. A boundary port is at the edge of a differentiated services (DiffServ) domain and an Interior port in a the core of a DiffServ domain. All traffic policing, conditioning, and marking is done at boundary ports. It is assumed that these functions have been performed by the time packets reach

the interior ports. Boundary/Interior demarcation is controlled by an explicit parameter. By way of provisioning, a LAN port or VCG can be either boundary or interior. A LAN port is usually (and by default) a boundary port, and a VCG is usually (and by default) an interior port.

QoS functionality is built around the concept of boundary and interior ports. Though the terminology customer and network are often used in place of boundary and interior (where customer equals boundary and interior equals network), this is incorrect with reference to Alcatel-Lucent 1665 DMX. However, customer and network terminology is still applied to ports with respect to their overall VLAN tagging behavior, rather than QoS specific functions.

The table below details what traffic management modes are allowed to be provisioned on ports depending on wether they are boundary or interior ports. Attempts to provision a VLAN tagging mode/traffic management mode combination that is not listed in the table below will be denied.

Table A-4 Allowed traffic management modes per port type

VLAN Tagging Mode	Port Type	Traffic Management Mode
		LNW170
Private Line	Boundary Port[1]	NOTC
		PORT
	Interior Port[1]	N/A
Transparent	Boundary Port	COSPORT
		NOTC
		PORT
	Interior Port	N/A
802.1TAG	Boundary Port	NOTC
		PORT
		TAGPORT
		COSPORT
		COSTAGPORT
	Interior Port	N/A

Notes:

1. In Private Line mode, it is not possible to change the Boundary/Interior demarcation of LAN and VCG ports. A VCG can be a boundary port, but this limits the traffic management mode provisionable for that port to NOTC only.

Untagged or unprovisioned packets

The table below explains what happens at the ingress when untagged or unconditioned packets are received. If a packet arrives at a port and it is marked with a CoS and Packet Tag for which a traffic conditioner has not been provisioned at that particular port, the traffic is handled as described in the table below.

Table A-5 Handling of untagged or unprovisioned service at boundary ports

VLAN tagging mode	Traffic Management mode	Untagged traffic	CoS-Packet Tag Traffic Conditioner not provisioned
Private Line	NOTC	Pass all traffic unmodified	Pass all traffic unmodified
Private Line	PORT	Pass all traffic unmodified	Pass all traffic unmodified
Transparent	NOTC	Tag with default port tag and default CoS and pass traffic	Not Applicable
Transparent	PORT	Tag with default port tag and default CoS and pass traffic	Tag with default port tag and default CoS and pass traffic unmetered (marked Yellow)
802.1TAG	NOTC	Tag with default VLANid and default CoS and pass traffic	Not Applicable

QoS in Private Line mode

Private Line mode should be employed when deploying point-to-point service connections using dedicated resources. Private Line can either be a full-rate service or a sub-rate service. Full-rate services dedicate enough network resources to transport the data from the ingress Boundary Port through the network to the egress Boundary Port at the full data rate of the Boundary Ports. Sub-rate services transport data at a fraction of the full data rate of the Boundary Ports.

In Private Line Mode, the Boundary Ports (see Boundary vs. Interior Ports above) can have either NOTC or PORT traffic management mode; the Interior Ports are always NOTC. All packets received are handled uniformly using a single queue. Packets are not modified or remarked in this mode. Therefore, it is not possible to encode color. Consequently, packets are either dropped or passed-through transparently. This is achieved by setting CIR values equal to PIR values and by forcing CBS to equal PBS.

QoS in transparent and 802.1q mode

Transparent mode provides a trunked Private Line or "Virtual Private LAN" service. The Boundary Ports use either a NOTC or PORT traffic management mode. In transparent mode, customers packets are not changed.

In NOTC mode, just as with Private Line, there is no traffic conditioning performed on any of the boundary Ports. Traffic conditioning is never performed on the Interior ports.

In the PORT mode all traffic that enters the port is tagged (stacked VLAN) with the provisioned TPID and the default port tag. The CoS is set to the default priority for that port and the user_priority is set based on this CoS and the conformance level determined in the traffic conditioner.

Packets that are within the committed contract parameters are marked with a Drop Precedence of DP1 (green). Packets that arrive out of the guaranteed contract, but within some allowable excess, are marked with a Drop Precedence of DP0 (yellow). Packets that arrive outside of the allowed excess are discarded.

The user_priority is determined from the CoS level and Drop Precedence. The packet is remarked with this user_priority before leaving the egress port.

In both NOTC and PORT mode, if no default priority is specified for the port, the CoS value is set to 0. There is no traffic conditioning on Interior Ports (see Boundary vs. Interior Ports above).

With Transparent tagging, both PIR, CIR, PBS and CBS are used to allocate the appropriate network resources to each service. Transparent mode supports user network configurations with more than two nodes in case a multipoint "Virtual Private LAN" service is needed. For this service each Boundary Port is provisioned with the same default port tag and default priority. This results in the required traffic separation to provide a virtual private network.

802.1q mode

The 802.1TAG tagging mode assumes that packets arrive at the boundary to the network already tagged with a standards-compliant VLAN tag. It is possible then to offer a number of services at a single port simultaneously.

In 802.1q mode, the packets should be tagged by the subscriber, however, some packets may arrive untagged. The CoS level for tagged packets is determined either by the default port CoS level (PORT mode) or the default VLAN CoS level (TAGPORT mode), or by examining the user_priority and setting the CoS according to a fixed mapping (NOTC and PORT mode), or according to a provisionable mapping table. The mapping table is associated either with a port (COSPORT mode) or a VLAN (COSTAGPORT mode). Untagged traffic is tagged with the default VLAN. The CoS is then set to either the default port CoS level (NOTC,PORT,COSPORT mode) or the default VLAN CoS level (TAGPORT, COSTAGPORT mode). The packets are then conditioned (except for NOTC) in the same fashion as tagged traffic.

Priority-tagged traffic is tagged with the default VLAN, and the CoS level is determined as it would be for a tagged packet.

In all cases, the Drop Precedence (DP) is set according to the level of conformance specified in the customer's SLA contract.

The functionality of each traffic management with regard to 802.1q mode is detailed below:

- PORT: The PORT mode of operation, is very similar to the services offered in the Transparent tagging mode, except that in this case the standard TPID (Ethertype) of 8100 is used so that this mode is interoperable with other 802.3 networks. Also more than one VLANid can be supported at a single port and treated as a single traffic flow. In this mode the traffic conditioning for all traffic that is admitted to the port is performed as an aggregate data flow by a single traffic conditioner. Only traffic that is either untagged or tagged with a VLANid that has been provisioned at the port is admitted. In this mode the user_priority bits are remarked according to the user_priority (0,1,2,3 map to CoS 0 and 4,5,6,7 map to CoS 3) of the packets unless overruled by the default priority. Drop Precedence is determined as a result of the packets conformance to the SLA. Any remarking that occurs is irreversible and is present on the packet at the network egress.
- TAGPORT: In the TAGPORT mode of operation, a single CoS is associated with each VLAN. The traffic flows through a traffic conditioner per VLAN where it is metered and policed as per the terms of the SLA. In this mode each VLAN has its own PIR, CIR, PBS and CBS. Packets that arrive untagged are tagged with the port default VLANid and CoS for that VLAN. As with the other modes, the Drop Precedence is determined based on the conformance to the SLA. Any remarking that occurs is irreversible and is present on the packet at the network egress.
- COSTAGPORT: In the COSTAGPORT mode of operation, traffic for each CoS on each VLAN flows through its own traffic conditioner. Traffic that is tagged with one of the port's provisioned VLANids is admitted to the network. Packets that arrive untagged or priority-tagged are tagged with the port default VLANid. Packets tagged with an unprovisioned VLANid are discarded. The user_priority bits in a priority-tagged frame are used to determine the CoS when selecting the traffic conditioner. In this mode each CoS on each VLAN has its own PIR, CIR, PBS and CBS. On each VLAN each CoS can be individually enabled or disabled. The Drop Precedence is determined by the SLA conformance level and the packet is remarked accordingly. This marking is not reversible and is present when the packet egresses the network.
- COSPORT: In the COSPORT mode of operation, traffic for each class of service flows through its own traffic conditioner. Traffic that is tagged with one of the port's provisioned VLANids is admitted to the network. Packets that arrive untagged or priority-tagged are tagged with the port default VLANid. Packets tagged with an unprovisioned VLANid are discarded. The user_priority bits in a priority-tagged

frame are used to determine the CoS when selecting the traffic conditioner. In this mode each CoS has its own PIR, CIR, PBS and CBS. Each CoS can be individually enabled or disabled. The Drop Precedence is remarked according to the conformance to the SLA. This marking is not reversible and is present when the packet egresses the network.

The table below shows the default mapping of user priority bits to CoS.

Table A-6 Default mapping of user priority to CoS

user_priority	CoS
000	1
001	0
010	0
011	1
100	2
101	2
110	3
111	3

The table below shows the default mapping of DSCP to CoS. Alcatel-Lucent 1665 DMX supports DSCP for traffic classification on the LNW170. DSCP to CoS is available in PORT mode only. DSCP can be used as an alternative to priority bits. The criteria for traffic classification can be user priority bits, DSCP, VLANid, or default value. DSCP allows for three differentiated services code point values: IP precedence value (also called Class Selector-- CS in the table below), Assured Forwarding (AF), and Expedited Forwarding (EF).

Table A-7 Default mapping of DSCP to CoS

CoS	DSCP	Binary	Decimal
0	Default	000000	0
0	CS1	001000	8
2	AF11	010010	10
2	AF12	001100	12
2	AF13	001110	14
1	CS2	010000	16
1	AF21	010010	18
1	AF22	010100	20

Table A-7 Default mapping of DSCP to CoS (continued)

CoS	DSCP	Binary	Decimal
1	AF23	010110	22
1	CS3	011000	24
0	AF31	011010	26
0	AF32	011100	28
0	AF33	011110	30
2	CS4	100000	32
0	AF41	100010	34
0	AF42	100100	36
0	AF43	100110	38
2	CS5	101000	40
3	EF	101110	46
3	CS6	110000	48
3	CS7	111000	56

The tables below show the characteristics of services offered with the different VLAN tagging modes and traffic management modes. These characteristics include the number of services allowed at a port as well as the number allowed on the network.

Table A-8 802.1 VLAN tagging and traffic management modes

	802.1TAG				
	NOTC	PORT	TAGPORT	COSPORT	COSTAG-PORT
No. Services at 1 port[1]	1	1	1 per VLANid 4093 max.	1 per CoS Level 4 max.	1 per CoS Level per VLANid 16,372 max.
No. Services on Network[2]	1	1 to 4093	1 to 4093	1 to 16,372	1 to 16,372
Max. CoS Support[3]	No	4 CoS/Port	4 CoS/VLAN	4 CoS/Port	4 CoS/VLAN

Table A-8 802.1 VLAN tagging and traffic management modes (continued)

	802.1TAG				
	NOTC	**PORT**	**TAGPORT**	**COSPORT**	**COSTAG-PORT**
Traffic Conditio-ning[4]	None	PIR PBS CIR CBS	PIR PBS CIR CBS	PIR PBS CIR CBS	PIR PBS CIR CBS
Packets Altered[5]	Maybe untag'd	Maybe VLANid user_priority	Maybe VLANid user_priority	Maybe VLANid user_priority	Maybe VLANid user_priority

Notes:

1. The number of services at a port is the number of traffic conditioners used, except for the NOTC mode where there is 1 service with no traffic conditioner.
2. The number of services on a network is the total number of separate VLANids/default port tags allowed on the network in separate services times the number of traffic conditioners that are allowed for each VLANid/default port tag.
3. The maximum number of Classes of Service supported is the number that will be passed through any traffic conditioner on that port. For example, in 802.1TAG mode the PORT mode will allow all 4 CoS Levels to pass through a common traffic conditioner, whereas, in Transparent mode the PORT mode tags all traffic with the default CoS and therefore only a single CoS is supported.
4. The traffic conditioning parameters shown are those available via TL1. In a practical sense fewer parameters are needed to provision the service.
5. Packets are considered altered if the user packet that leaves the network at an egress Customer Port is not identical to the packet that entered the network at an ingress Customer Port. Packets are generally altered in 802.1TAG mode due to the addition of a VLAN tag or the alteration of the user_priority.

Table A-9 Private Line and transparent VLAN tagging and traffic management modes

	Private Line		Transparent		
	NOTC	**PORT**	**NOTC**	**PORT**	**COSPORT**
No. Services at 1 port[1]	1	1	1	1	
No. Services on Network[2]	1	1	1	1 to 4093	
Max. CoS Support[3]	No	No	No	1 CoS/Port	

Table A-9 Private Line and transparent VLAN tagging and traffic management modes (continued)

	Private Line		Transparent		
	NOTC	**PORT**	**NOTC**	**PORT**	**COSPORT**
Traffic Conditio-ning[4]	None	PIR PBS CIR CBS	None	PIR PBS CIR CBS	
Packets Altered[5]	No	No	No	No	

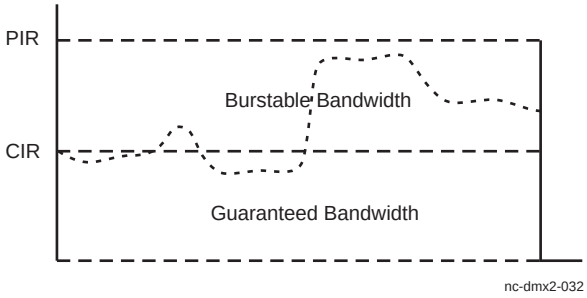
Notes:

1. The number of services at a port is the number of traffic conditioners used, except for the NOTC mode where there is 1 service with no traffic conditioner.
2. The number of services on a network is the total number of separate VLANids/default port tags allowed on the network in separate services times the number of traffic conditioners that are allowed for each VLANid/default port tag.
3. The maximum number of Classes of Service supported is the number that will be passed through any traffic conditioner on that port. For example, in 802.1TAG mode the PORT mode will allow all 4 CoS Levels to pass through a common traffic conditioner, whereas, in Transparent mode the PORT mode tags all traffic with the default CoS and therefore only a single CoS is supported.
4. The traffic conditioning parameters shown are those available via TL1. In a practical sense fewer parameters are needed to provision the service.
5. Packets are considered altered if the user packet that leaves the network at an egress Customer Port is not identical to the packet that entered the network at an ingress Customer Port. Packets are generally altered in 802.1TAG mode due to the addition of a VLAN tag or the alteration of the user_priority.

Metering (CIR and PIR)

Rate-shaped services offer a statistical multiplexing model that makes efficient use of shared bandwidth. Alcatel-Lucent 1665 DMX supports two of the primary forms of rate control. The two primary forms of rate control are rate limiting, and guaranteed rate services (plus various combinations of both).

Rate limiting is achieved using Peak Information Rate (PIR) provisioning. Guaranteed rate service is achieved using Committed Information Rate (CIR) provisioning. PIR institutes a limit, or "ceiling", of maximum bandwidth to be allocated to a particular customer at any time. CIR, on the other hand, provides a guaranteed minimum, or "floor" throughput even during periods of high congestion.

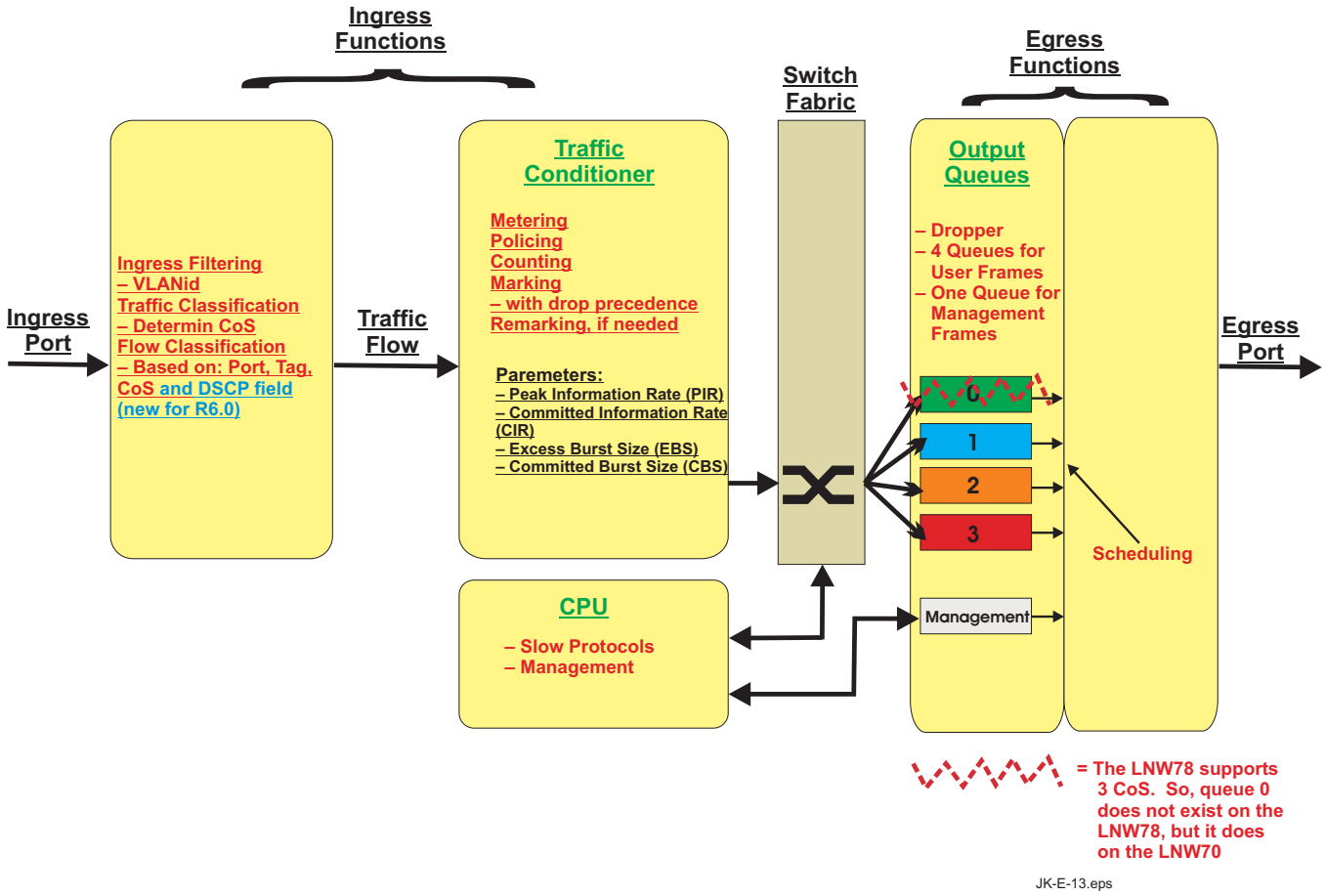


When SLAs are written using CIR, Excess Burst Size (PBS), and Committed Burst Size (CBS), they guarantee a CIR and CBS at a particular data rate. Traffic can be allowed to burst up to an excess burst size (PBS) beyond the CBS. This traffic will only be transmitted on a Best Effort basis. Any traffic above the PBS is discarded. In this type of SLA, PIR is equal to CIR. The CIR must always be less than the maximum bandwidth that the port can support. If either CIR or PBS is set to zero, service is effectively terminated.

The second method used to specify SLAs employs CBS, PIR, CIR, and PBS. Burst Time can also be used in place of PBS. With SLAs of this sort, PIR, CIR, PBS, and CBS must be provisioned.

The figure below details the flow of traffic through the QoS packet with on the LNW170 circuit packs. The ingress and egress functions of the switch are explained further below the figure. The DSCP Field on the ingress port. DSCP functions only on the LNW170, though DSCP.

Figure A-33 Flow and classifications of traffic through QoS packet switch



The Ingress Port functions are as follows:

- Traffic Classification: Determines class of service (CoS), the criteria can be 802.1p user priority, DSCP, VLANid, or default value. Each class is mapped to an output queue. Internal management is classified into its own class.
- Flow Classification: A flow is a grouping of traffic based on certain criteria. The flow classification determines which Traffic Conditioner is used and multiple flows can be aggregated at a single traffic conditioner. Criteria is based on packet header, input port, flow, physical port, VLANid, DSCP, and/or 802.1p user priority.
- Traffic Conditioner: Traffic Conditioners perform the metering, policing, marking, and counting of ingress packets. The parameters are PIR, CIR, PBS, and CBS. Metering measures the data rate which determines wether the packets conform to the settings for the user/port. Packets are marked according to conformance level (this is an internal marking). Policing discards packets that exceed the PIR, PBS, or PBS (see Metering above). The conformance level determines the drop precedence (DP) for non-conforming packets.

  Note: Flow Classification and Traffic Conditioning only apply to boundary ports. Once CoS and DP are determined at the boundary port, they are used consistently throughout the network. At internal ports, CoS and DP are then used to determine egress functions (i.e. dropping and queuing). For information on boundary and internal port demarcation, see the section below entitled Boundary versus Interior Ports.

The Egress Port functions are as follows:

- Dropping: Also known as Egress Queueing, Dropping is based on conformance level and the fullness of the queue. The drop function takes into account the total allocation queue for a particular port only. There are two drop methods employed by Alcatel-Lucent 1665 DMX: Tail Drop and Weighted Random Early Detection (WRED). The tail drop method discards all packets exceeding the maximum queue size. It uses only one parameter: Maximum Queue Size. WRED dropping starts at the minimum threshold and increases up to the maximum. Two drop parameters govern WRED: Minimum Threshold and Maximum Threshold. The CoS parameter, Maximum Drop Probability, is also provisionable in the WRED method. packets labeled with a higher drop precedence (DP) are discarded prior to those with a lower drop precedence.
- Scheduling: Scheduling allocates service for each queue. There are queues for each port: Expedited Forwarding (EF), Assured Forwarding (AF). A combination of two algorithms controls scheduling. Packets in the Strict Priority queue are transmitted first. Strict Priority is used for EF queue. Weighted Round Robin (WRR) ensures that the remaining bandwidth is allocated to each queue based on a provisioned weighting factor. WRR is used for the AF queues.

Egress functions support four classes of service (CoS). EF guaranteed low latency. There are three levels of AF offering various degrees of guaranteed delivery including best-effort. Packets are handled differently depending on wether they originated from Boundary or Interior ports.

- Three Colors: RED: for packets that exceed peak rate limits.
  Yellow: for packets that exceed committed rate limits.
  Green: for packets within committed rate limits.

Ethernet service management

Overview

The Ethernet services are managed by provisioning the following:

- Tagging (VLAN) mode
- Cross-connections
- LAN ports
- VCG (WAN) ports
- Virtual switches
- Quality of service (QoS) features.
- Performance monitoring.

For detailed information about provisionable parameters and their values, see "Performance monitoring" (p. 5-62).

Tagging (VLAN) modes

Alcatel-Lucent 1665 DMX supports the Private Line, transparent, and 802.1Q tagging modes. Tagging modes are provisioned on a circuit pack basis. Changing tagging modes will impact service. For detailed information about the tagging modes, see "Tagging Modes" (p. A-60) and the *WaveStar*® CIT online help.

Cross-connections

The following types of cross-connections are used with Ethernet circuit packs.

- 1way
- 1wayPR
- 1way unswitched

For detailed information about supported cross-connections refer "Cross-connections" (p. 6-38) in Chapter 6, "System planning and engineering" and the *WaveStar*® CIT online help.

Cross-connections with SONET layer protection

All SONET protected services are implemented using 1way or 1wayPR cross-connections. They are used to form a pair of bidirectional links between a VCG port and one side of a SONET tributary. 1way or 1wayPR cross-connection use two VCGs on LNW66 Ethernet circuit packs and one VCG on all other Ethernet circuit packs (LNW63, LNW64, LNW73, LNW73C, LNW74, LNW87, LNW170). 1way or 1wayPR cross-connections are described in "Protected tributaries" (p. A-27). The use of VCG ports is summarized in "VCG (WAN) ports" (p. A-85).

Cross-connections without SONET layer protection

Services that are not protected by the SONET layer are provisioned using either 1way or 1way unswitched cross-connections.

1way cross-connections can be used to provide unprotected services on BLSRs, only if the tributary (time slot) is provisioned to carry non-preemptible unprotected traffic (NUT). The BLSR tributary(s) must be provisioned for NUT before the cross-connection is established or protected services are provided. A packet ring bandwidth could be split between working and protection (extra traffic) freeing up protected working bandwidth for other TDM services. 1way cross-connections can be used to provide unprotected services over BLSR w/ NUT, but they are less efficient than 1way unswitched cross-connections.

1way unswitched cross-connections can be used to provision unprotected traffic on UPSRs. One cross-connection can be made between a VCG port and one side of the SONET ring, and the other can be made between the paired VCG and the other side of the SONET ring.

Unprotected cross-connections (1way unswitched) to UPSRs and BLSRs w/ NUT are all provisioned independently per VCG.

This pairing of VCG ports and USPR unprotected cross-connections is described in "Unprotected tributaries" (p. A-28). The use of VCG ports is summarized in "VCG (WAN) ports" (p. A-85).

Cross-connection types and supported configurations

The number of Private Line Services and Packet Rings an Ethernet circuit pack can support is dependent on the type of cross-connection used and whether SONET layer protection is used.

The following table shows the cross-connection types and supported services.

Table A-10 Ethernet Private Line services

Ethernet Private Line cross-connections							
SONET	**cross-connection Type**	**Ethernet Circuit Pack**					
		LNW63	**LNW64**	**LNW66**	**LNW74**[1]	**LNW87**	**LNW170**
UPSR	VT1.5 1WAYPR and 1WAY	N/A	N/A	N/A	24	N/A	N/A
	STS-1 1WAYPR and 1WAY	4	8	1	12–24[2]	4	8
	STS-3c 1WAYPR and 1WAY	4	8	N/A	8 or 16[2]	4	8
	STS-12c 1WAYPR and 1WAY	1	1	N/A	N/A	1	1
	STS-1 1WAY UNSWITCHED	4	8	2	N/A	4	8
	STS-3c 1WAY UNSWITCHED	4	8	N/A	N/A	8	8
	STS-12c 1WAY UNSWITCHED	1	1	N/A	N/A	1	1
1+1	VT1.5 1WAY	N/A	N/A	N/A	24	N/A	N/A
	STS-1 1WAY	4	8	1	24	8	8
	STS-3c 1WAY	4	8	N/A	8 or 16[2]	8	8
	STS-12c 1WAY	1	1	N/A	N/A	1	1
BLSR[3]	VT1.5 1WAY	N/A	N/A	N/A	24	N/A	N/A
	STS-1 1WAY	4	4	1	12–24[2]	4	8
	STS-3c 1WAY	4	4	N/A	8 or 16[2]	4	8
	STS-12c 1WAY	1	1	N/A	N/A	1	1

Table A-10 Ethernet Private Line services (continued)

Ethernet Private Line cross-connections							
SONET	**cross-connection Type**	**Ethernet Circuit Pack**					
		LNW63	**LNW64**	**LNW66**	**LNW74**[1]	**LNW87**	**LNW170**
BLSR[3] w/ NUT	VT1.5 1WAY UNSWITCHED	N/A	N/A	N/A	N/A	N/A	N/A
	STS-1 1WAY UNSWITCHED	4	4	2	N/A	4	8
	STS-3c 1WAY UNSWITCHED	4	4	N/A	N/A	4	8
	STS-12c 1WAY UNSWITCHED	1	1	N/A	N/A	1	1

Notes:

1. A mix of VT1.5, STS-1, & STS-3c connections allowed; Max of 336 VT1.5 (12 STS-1s) of VT1.5 cross connect capacity.
2. When using small or medium fabric MAINs, the small value reflects the capacity for function groups A, B, & C. Values for function groups D & G are represented by the larger value. When using all large fabric MAINs, ALL function groups support the larger value.
3. SONET protection is provided if NUT is not provisioned, and disabled if NUT is provisioned.

The following table shows the cross-connection types and supported services.

Table A-11 Ethernet packet ring services

Ethernet Packet Ring cross-connections				
SONET	**Cross-connection Type**	**Ethernet Circuit Pack**		
		LNW66	**LNW170**	**LNW74**
UPSR	1WAY UNSWITCHED	1	16	N/A
	1WAYPR and 1WAY	N/A	16	N/A
BLSR	1WAY	0	16	N/A
BLSR w/ NUT	1WAY UNSWITCHED	N/A	16	N/A

Notes:

1. When using small or medium fabric MAINs, the small value reflects the capacity for function groups A, B, & C. Values for function groups D & G are represented by the larger value. When using large fabric MAINs, ALL function groups support the larger value.

LAN ports

All LAN ports have characteristics that must be the same on both sides of a link. Some characteristics are strictly physical in nature. They can only be changed by using different equipment. Some examples of these characteristics are cable type (for example, twisted pair, fiber) and optical type (short reach, long reach). For more information about the Ethernet circuit packs, see "Ethernet/SAN circuit packs" (p. A-7).

The **Configuration** → **Provision Equipment** *WaveStar*® CIT command is used to provision LAN ports. For more information about the **Configuration** → **Provision Equipment** command and LAN port provisioning, see the *WaveStar*® CIT online help.

VCG (WAN) ports

The **Configuration** → **Provision Equipment** *WaveStar*® CIT command is used to provision VCG (WAN) ports. For more information about the **Configuration** → **Provision Equipment** command and VCG (WAN) port provisioning, see the *WaveStar*® CIT online help.

The following table shows the available VCG (WAN) ports available on Ethernet circuit packs.

Table A-12 VCGs available on Ethernet circuit packs

Ethernet Circuit Pack			Provisionable VCG Ports	
Type	Slot	Tagging Mode	PWDM Equivalent OLIUs	All other OLIUs
LNW63	A, B, C, D, G	Private Line	VCG1–VCG4	VCG1–VCG4
	A, B, C, D, G			
LNW64	A, B, C, D, G	Transparent and 802.1Q(Switched)	VCG1 to VCG8	VCG1 to VCG8
LNW66[2]	A, B, C, D, G	Transparent and 802.1Q(Switched)	VCG1, VCG2	VCG1, VCG2
LNW74	A, B, C, D, G	Private Line	VCG1–VCG24	VCG1–VCG24
	A, B, C, D, G		VCG1–VCG24	VCG1–VCG24
LNW87	A, B, C, D, G	Private Line	VCG1–VCG4	VCG1–VCG4
LNW170	A, B, C, D, G	Private Line	VCG1–VCG8	VCG1–VCG8
	A, B, C, D, G	Transparent and 802.1Q(Switched)	VCG1–VCG32	VCG1–VCG32

Notes:

1. All 24 VCGs are available only when unswitched cross-connections are used. Only 12 VCGs are available if protected cross-connections are used.
2. Only VCG1 is available when protected cross-connection is used.
3. VCG2 is not available when protected cross-connection is used on VCG1. VCG4 is not available when protected cross-connection is used on VCG3
4. Although the LNW74 can be used in slot G1, only the optical ports are functional. When mixing an LNW74 with an optical only pack, all 24 ports (16 electrical and 8 SFP) ports on the LNW74 are available. When pairing the LNW74 with another LNW74, ONLY the 8 SFP ports on each pack are usable, for a total of 16 SFP ports per function group
5. When a VLF Main pack (LNW59, LNW82, or LNW504) is used, Alcatel-Lucent 1665 DMX allows Ethernet packs to be installed in Slot 1 and/or 2 of a function unit or growth slot. Certain circuit pack/slot equipage restrictions apply. For more information see "Very large fabric (VLF) engineering rules" (p. 6-15). When VLF Mains are not used, Ethernet packs, except for the LNW170 in protected mode, can only be installed in Slot 1 of a function unit or growth slot. When it is in protected mode, the LNW170 can occupy both slots with VLF or non-VLF Mains installed.

Virtual switch

A virtual switch is a logical grouping of LAN ports and VCG ports that share interconnect and share a common set of properties. A virtual switch may support one or more spanning trees; a spanning tree can only belong to one virtual switch.

A port (LAN or VCG) can only be assigned to one virtual switch at a time. On the LNW66 packs VLANs (802.1Q mode) and port tags (transparent mode) that are assigned to a virtual switch cannot be assigned to another virtual switch on the same circuit pack.

The LNW170 circuit packs can support a maximum of 16 virtual switches on each circuit pack (LNW66 support 2).

The following *WaveStar*® CIT commands support virtual switch provisioning:

- **Configuration → Data → Create a Virtual Switch**
- **Configuration → Data → Delete a Virtual Switch**
- **Configuration → Data → Provision a Virtual Switch**

For more information about provisioning virtual switches and the *WaveStar*® CIT commands, see the *WaveStar*® CIT online help.

Quality of service (QoS)

The following Quality of Service (QoS) parameters are provisionable using the *WaveStar*® CIT.

- Default port priority (high, low, NA)
- Rate Policing (PIR)

- Peak information rate (PIR) is provisioned on a VLAN/port TAG or on a LAN port basis for protected Private Line.
- Burst size length
- Credit interval for adding tokens to the token buckets used by the PIR

For more information about Quality of Service, see "Quality of Service" (p. A-67) and "QoS services (LNW170)" (p. A-69). For more information about the provisionable QoS parameters, see the *WaveStar*® CIT online help.

Performance monitoring

Each Ethernet port has associated performance monitoring parameters and counters. The counters are provided for incoming and outgoing frames. For detailed information about Ethernet performance monitoring parameters, see "Performance monitoring" (p. 5-62).

Remote Client Fail Reverse Defect Indication

This parameter is used to enable/disable the reverse direction of two-way Auto Link Shutdown (ALS) using GFP RDI control frames and may have one of the following values:

- ENABLE — Enable Two-way (ALS) Auto Link Shutdown (Initial Value).
- DISABLE

This parameter applies to both FE and GE interfaces on the LNW63, LNW64, LNW70, LNW74, LNW87, and LNW170.

This parameter is significant when both **Remote Client Fail** and **Remote Client Fail Link Shutdown** are enabled.

Figure A-34 Example of bidirectional ALS for Ethernet level failures

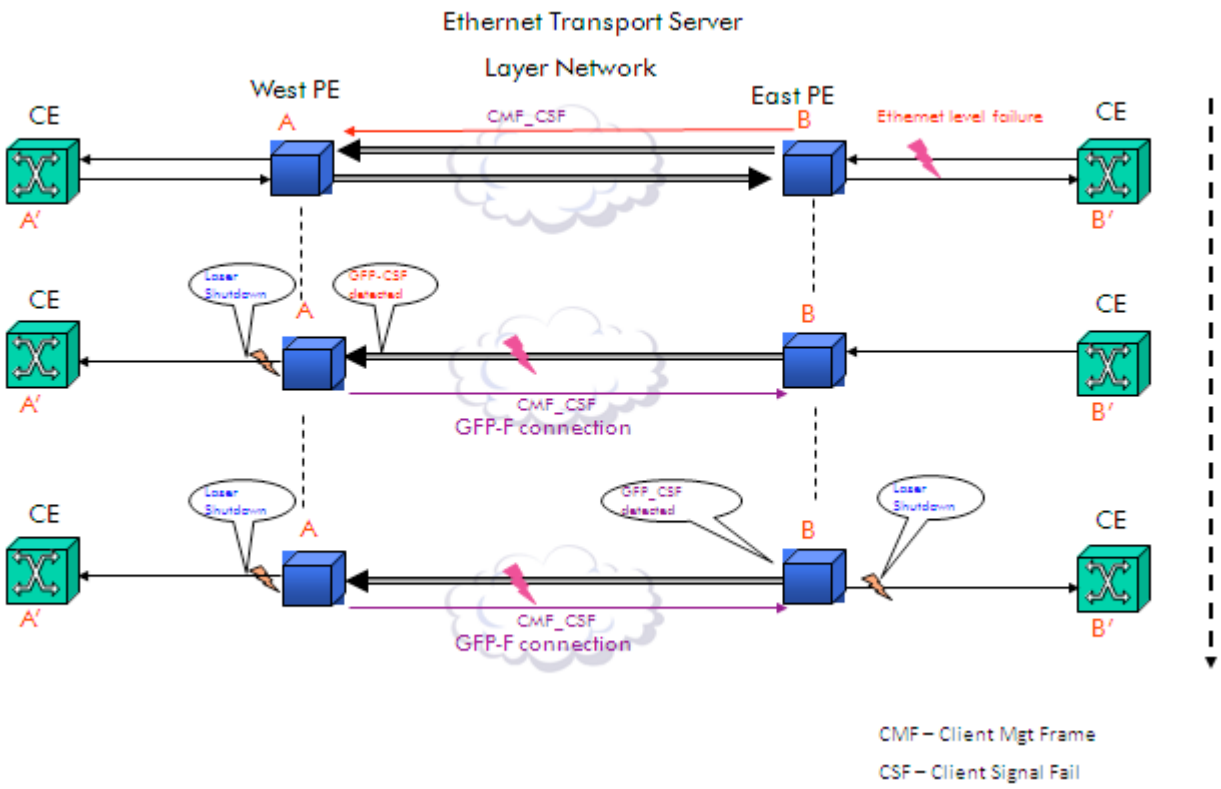
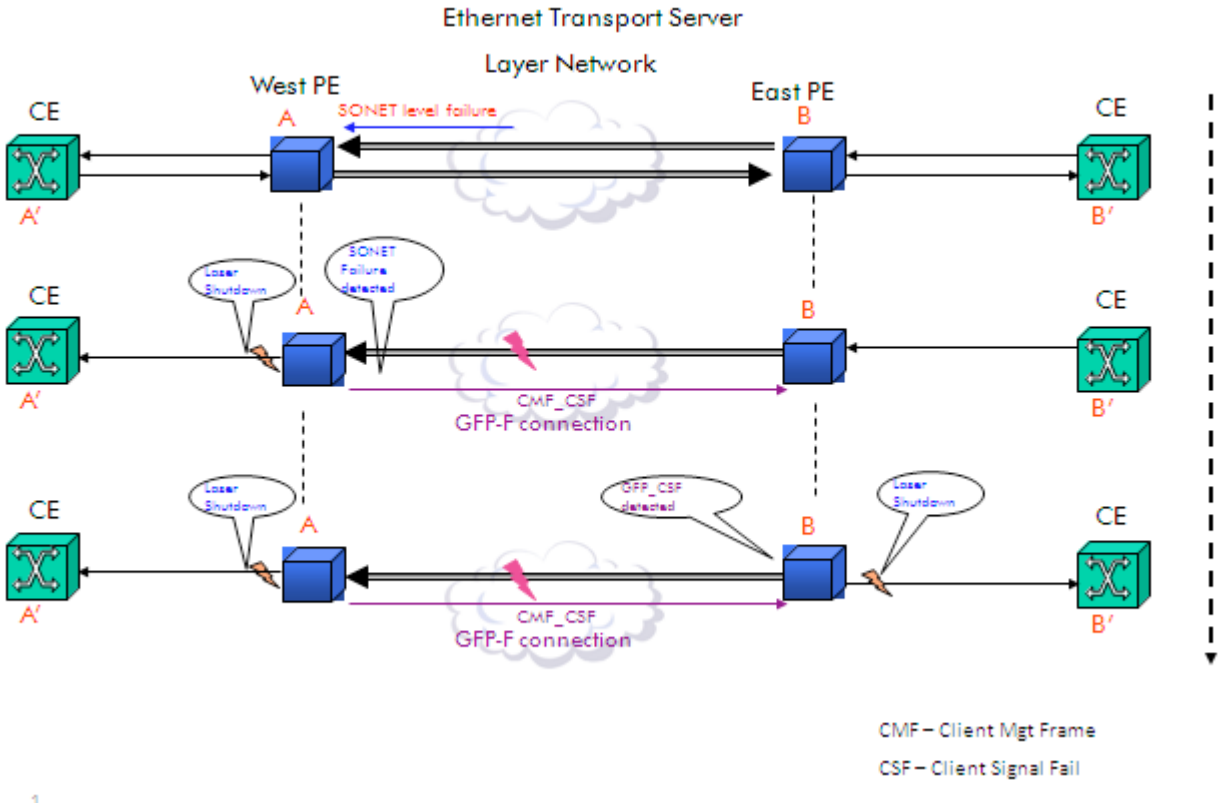


Figure A-35 Example of bidirectional ALS for SONET level failures



Ethernet service configurations

Overview

Alcatel-Lucent 1665 DMX supports the Ethernet services shown in the following table.

Table A-13 Supported Ethernet services

Service	VCGs (per Circuit Pack)	Ethernet Ports	SONET Capacity	Tagging Mode	Ethernet Forwarding (Switching) based on
Private Line	1 Private Line per VCGProtected	Dedicated	Dedicated	Private Line (No tag)	No Ethernet switching. Point-to-Point connection is preconfigured.
	1 Private Line per VCGUnpro-tected	Dedicated	Dedicated	Transparent	No Ethernet switching. Point-to-Point
				802.1Q	
Private LAN	1 Subscriber per VCG	Dedicated	Dedicated	Transparent	Stacked VLAN Tag
				802.1Q	Original or Port Default VLAN Tag
Virtual Private LAN	Several Subscribers per VCG	Dedicated or Shared	Shared	Transparent	Stacked VLAN Tag
				802.1Q	Original or Port Default VLAN Tag
Ethernet Virtual Private LAN	1 Subscriber per LAN port	Dedicated	Shared	Transparent	Stacked VLAN Tag
				802.1Q	Original or Port Default VLAN Tag

The following table shows the typical Ethernet service configurations.

Table A-14 Typical Ethernet service configurations

Service	Cross-connect type	Protection		Ring type	Tagging mode
		SONET	Spanning tree		
Private Line	1wayPR, 1way	Yes	Not allowed	UPSR	Private Line
	1way unswitched	No		UPSR	
	1way	Yes		BLSR	
	1way unswitched	No		BLSR w/NUT	

Table A-14 Typical Ethernet service configurations (continued)

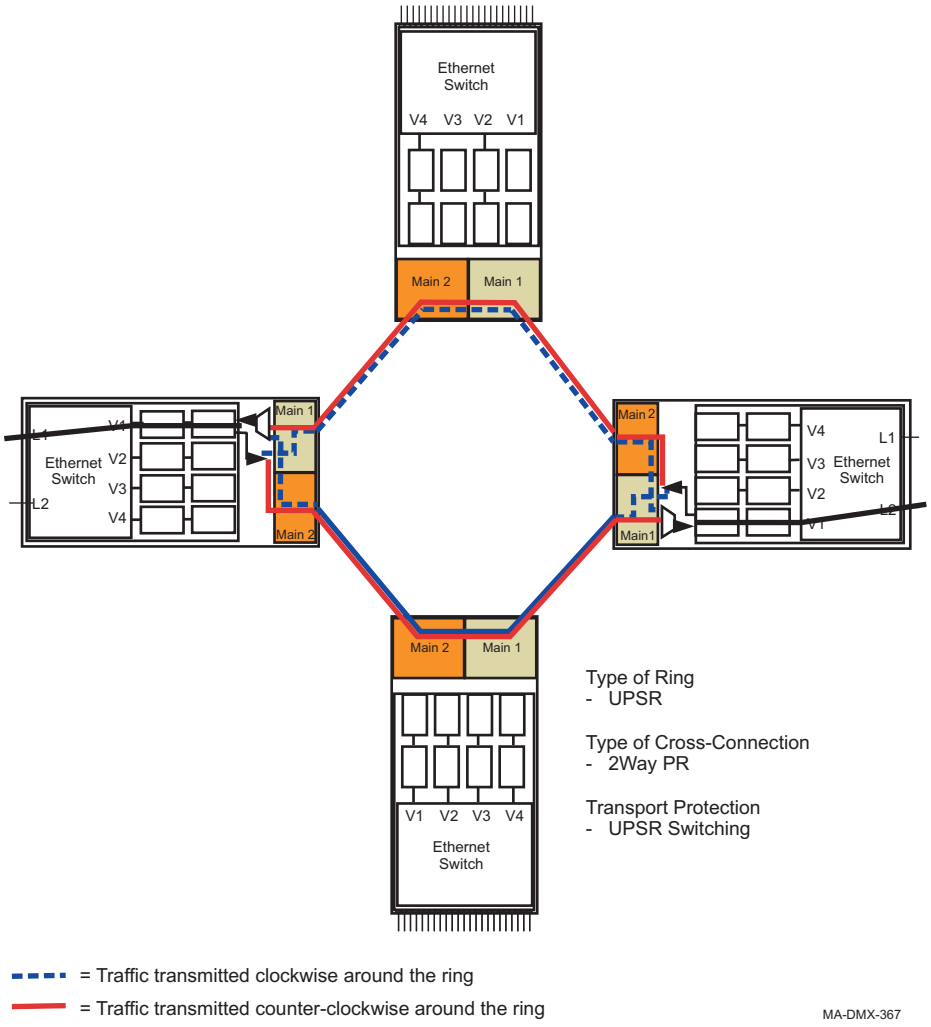
Service	Cross-connect type	Protection		Ring type	Tagging mode
		SONET	Spanning tree		
Private LAN	1way unswitched	No	Yes	UPSR	Transparent or 802.1Q
	1way unswitched			BLSR w/NUT	
Virtual Private LAN	1way unswitched	No	Yes	UPSR	802.1Q
	1way unswitched			BLSR w/NUT	
Virtual Private Line service	1wayPR, 1way	Yes	No	UPSR	Transparent or 802.1Q
	1way unswitched	No	Yes	UPSR	
	1way	Yes	No	BLSR	
	1way unswitched	No	Yes	BLSR w/NUT	

Private line service

Private line service is a point-to-point service with two dedicated LAN ports and dedicated SONET capacity. Because it is a point-to-point service, spanning tree protection is not used. Protection is provided at the SONET layer only.

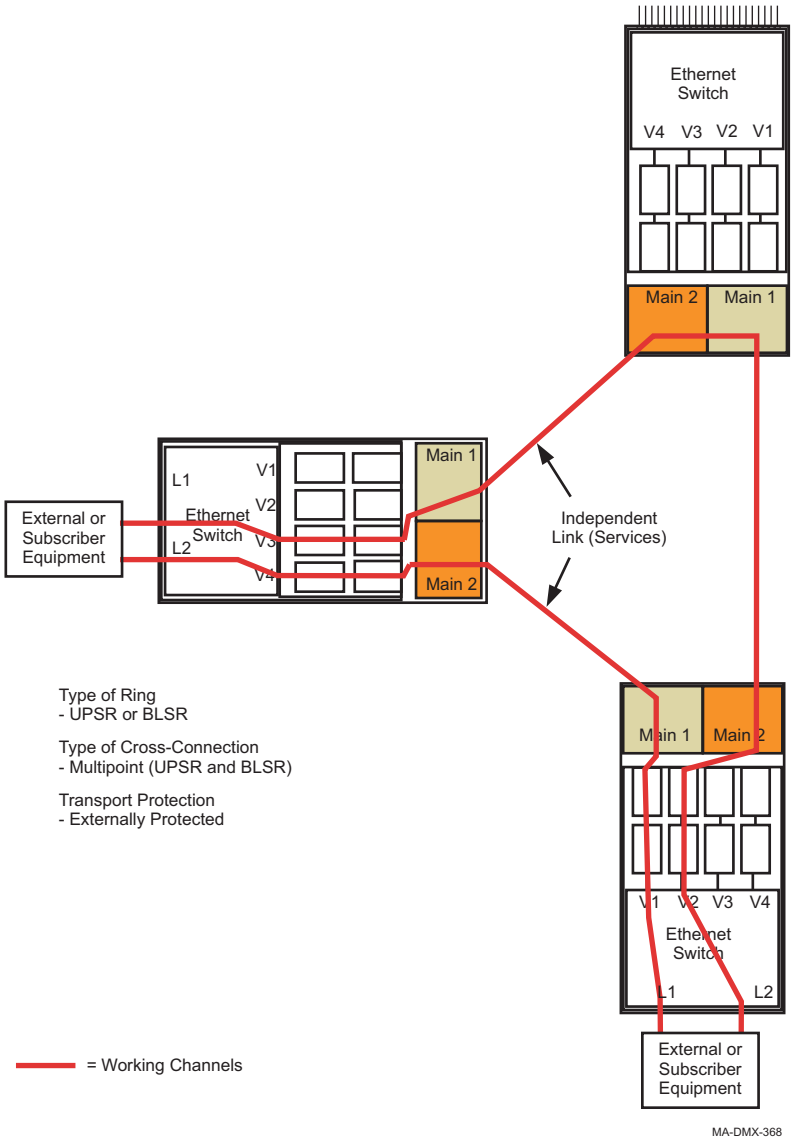
Ethernet Private Line service can be provided over SONET UPSRs. The following figure shows an example of Private Line service with protection provided by a SONET UPSR.

Figure A-36 Ethernet Private Line service over protected UPSR



The following figure shows two independent unprotected links. External or subscriber equipment can use these links to either provide two paths between equipment or separate paths for link aggregation.

Figure A-37 Dual unprotected Ethernet Private Line over UPSR or BLSR



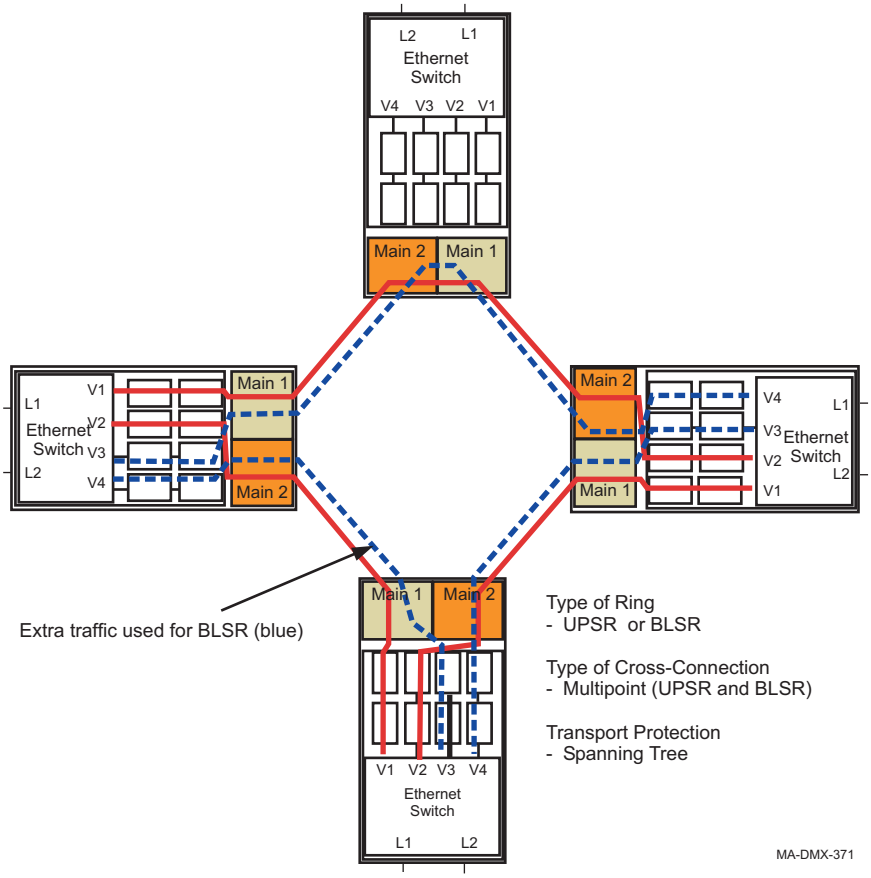
Private LAN, Virtual Private LAN, and Virtual Private Line services

In Private LAN service, LAN ports and SONET capacity are dedicated to one subscriber. In Virtual Private LAN service, several subscribers share SONET capacity and can share LAN ports. Traffic is segregated by its VLAN/port TAG. Virtual Private Line service is subset of Virtual Private LAN service, where the subscriber is given a point-to-point service with dedicated LAN ports.

Protection can be provided either by packet layer spanning tree protocols, by the SONET layer, or by both. The network could also use tributaries provisioned for nonpreemptible unprotected traffic (NUT). If NUT is provisioned, the Ethernet traffic is protected by the spanning tree protocol.

The following figure shows multipoint cross-connections used to form a packet ring.

Figure A-38 Spanning tree protected private LAN and virtual private LAN services

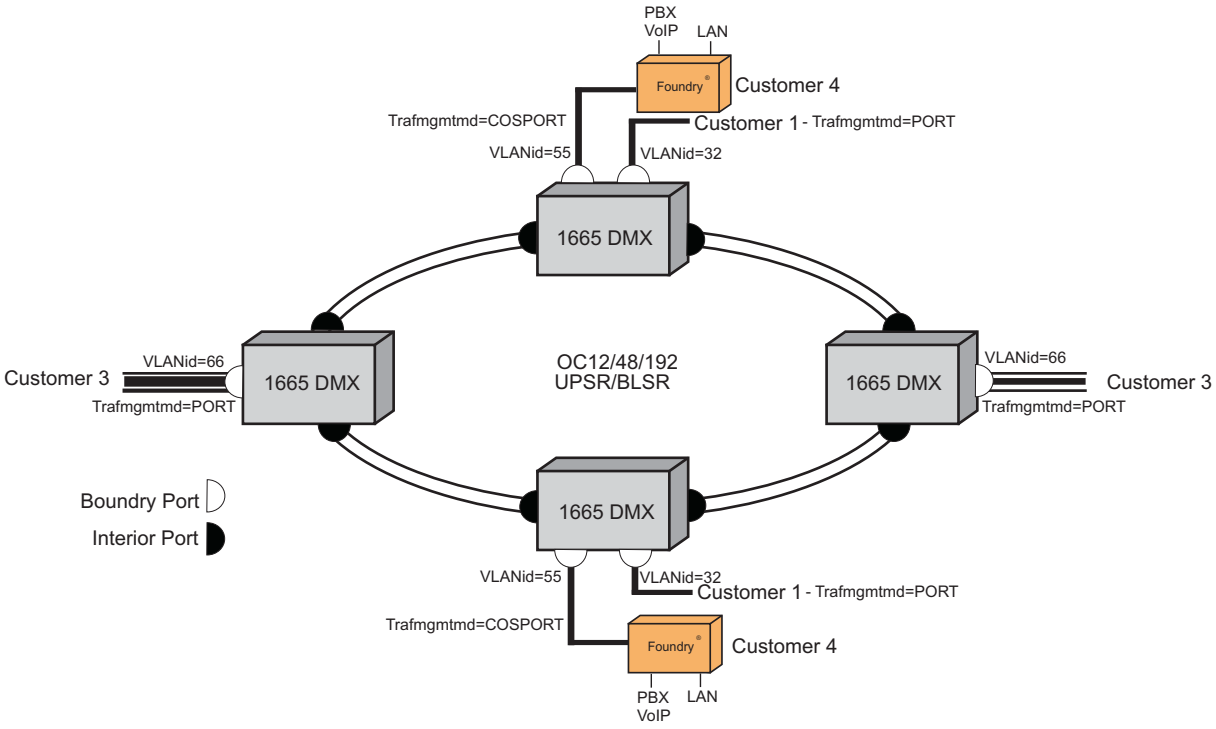


A spanning tree is required to eliminate Ethernet forwarding loops. The Ethernet traffic is protected by the spanning tree. In UPSRs, an additional packet ring could be supported on VCG 3 and VCG 4 protected by its spanning tree.

Virtual Private Line LNW170

The figure below depicts the traffic flow of multiple virtual private lines in transparent mode over shared media (optical fiber). For more information on private lines in transparent mode, see the information under "Transparent mode" (p. A-63). For information on Boundary and Interior port demarcation, see "Boundary versus interior ports" (p. A-69).

Figure A-39 Virtual Private Line with LNW170



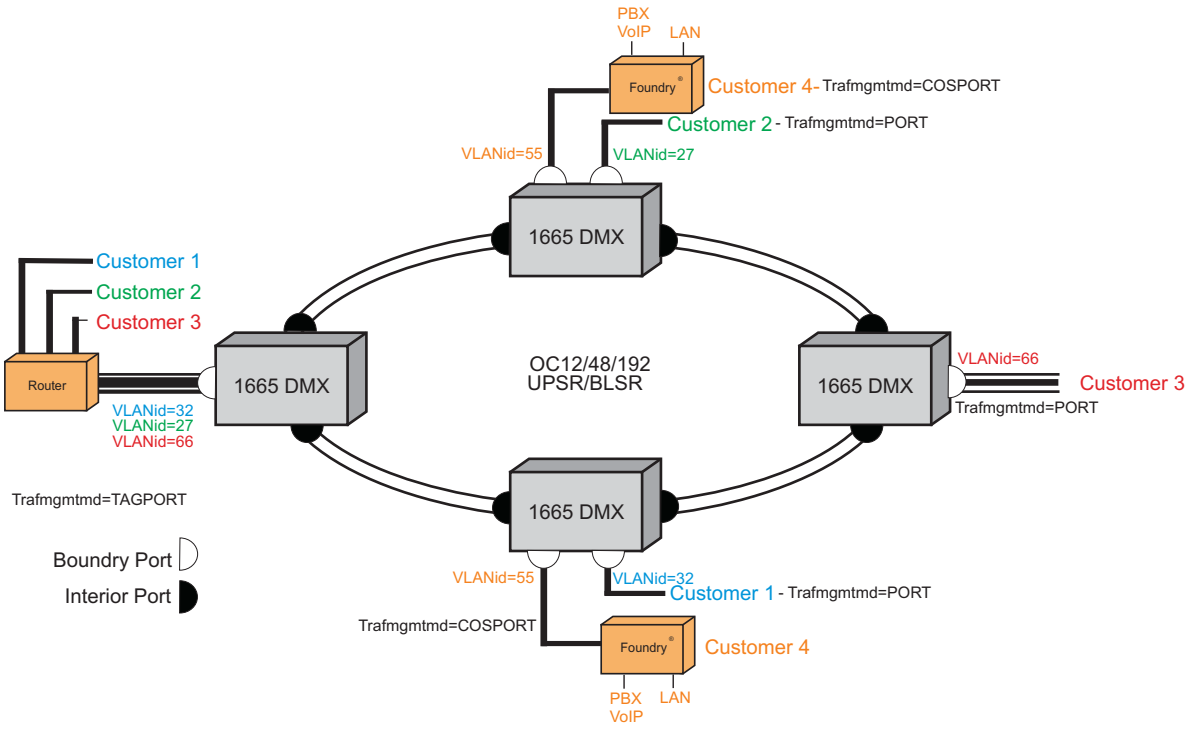
1665 DMX = 1665 Data Multiplexer

JK-E-11.eps

LAN service with LNW170

The figure depicts the traffic flow of multiple VLANs over shared media (optical fiber). For more information on VLANs, see "Private LAN, Virtual Private LAN, and Virtual Private Line services" (p. A-93). For information on Boundary and Interior port demarcation, see "Boundary versus interior ports" (p. A-69).

Figure A-40 LAN service with LNW170



1665 DMX = 1665 Data Multiplexer

JK-E-12.eps

SONET-based distance extensions for ESCON/FICON/Fibre-channel services

Overview

This section details the functionality of SONET-based SAN distance extension supported by the LNW73. For other information on the functionality of the LNW73, see "Ethernet/SAN circuit packs" (p. A-7)and "Differential delay buffers" (p. A-25).

ESCON design guidelines

ESCON services enter Alcatel-Lucent 1665 DMX or Alcatel-Lucent 1665 DMXtend through ESCON PTM attached to LNW73 plug-in circuit and are routed out OC48/192 SONET interfaces from SONET plug-ins in slot main-1 (and main-2, if protection is desired). The SONET signal can be routed through any number of intermediate SONET systems (including none) and terminates into another Alcatel-Lucent 1665 DMX or Alcatel-Lucent 1665 DMXtend to provide a network transport of ESCON services.

When a shelf is equipped with non-VLF Mains, an LNW73 may be placed in slots fn-a-1,fn-b-1,fn-c-1, fn-d-1 or growth-1 (5 slots). When the shelf is equipped with VLF Mains, LNW73 can occupy both slots 1 and 2 of a Function/Growth unit. Up to 4 ESCON services may be provided in a single LNW73 plug-in, each service requiring 4 STS-1 bandwidth reserved in the SONET domain. A Alcatel-Lucent 1665 DMX/OC48 system can provide 12 ESCON services (limited by SONET bandwidth).

A Alcatel-Lucent 1665 DMX/OC192 system with non-VLF Mains can provide 20 ESCON services (limited by the number of slots that may be equipped with LNW73). When equipped with VLF Mains, it can provide up to 40 ESCON services.

Reliability/Line and pack protection options

To protect against SONET network failures and main pack failures, Alcatel-Lucent 1665 DMX can be equipped with redundant circuit packs in both main slots and can be provisioned for UPSR or BLSR protection. To protect against SONET network failures and main pack failures, Alcatel-Lucent 1665 DMX can be equipped with redundant circuit packs in both main slots and be provisioned for UPSR protection. Using SONET protection significantly increases the reliability of individual end-to-end ESCON services.

Circuit pack equipage and provisioning

Each LNW73/73C used must be set to select the pack type of ESCON (see ED-EQPT). Each port to be used must be equipped with an Alcatel-Lucent specified ESCON Pluggable Transmission Module (PTM). A PTM is similar in functionality to a GBIC pluggable unit. If a Virtual Concatenated (VCAT) signal format is desired, the ED-DPORT-DATA command is used to select it.

Circuit bandwidth choices

A full rate ESCON service may be provisioned as a SONET STS-1-4v (VCAT), STS-3c-2v(VCAT) or a STS-12c Contiguously Concatenated (CCAT). The most bandwidth efficient is STS-1-4v.

Interface specifications to ESCON interfaces

Alcatel-Lucent 1665 DMX/Alcatel-Lucent 1665 DMXtend use standards compatible PTM modules. See Chapter 10, "Technical specifications" for optical specification, loss budget, connector and fiber type requirements.

Distance limitations/transmission delay engineering

Distance between the ESCON equipment and the Alcatel-Lucent 1665 DMX/Alcatel-Lucent 1665 DMXtend are typically limited by the interface link specification of the ESCON interface.

The total distance allowed including the SONET extension is typical a function of the delay requirements of the ESCON application.

Synchronous ESCON applications typically suffer performance droop if the application is subjected to more than 100 microseconds of one way transmission delay (the equivalent of delay through 20 km of fiber). For planning purposes, each Alcatel-Lucent 1665 DMX adds the equivalent 25 microseconds or 5 km of fiber. Therefore, synchronous ESCON applications would suffer droop if the total actual fiber distance (adding the ESCON to Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMX to Alcatel-Lucent 1665 DMX links) is more than 10 km.

Asynchronous ESCON applications are much more tolerant to transmission delay, typically able to function at delays of 1000 microseconds (200 km) or longer. Each Alcatel-Lucent 1665 DMX/Alcatel-Lucent 1665 DMXtend or other SONET system in the path of such a network would add the equivalent of 5 km of fiber.

Full-rate FICON/FC design guidelines

FICON/FC services enter Alcatel-Lucent 1665 DMX or Alcatel-Lucent 1665 DMXtend through FICON/FC PTM attached to LNW73 plug-in circuit is routed out OC48/192 SONET interfaces from SONET plug-in in slot main-1 (and main-2, if protection is desired).

The SONET signal can be routed through any number of intermediate SONET systems (including zero) and terminates into another Alcatel-Lucent 1665 DMX or Alcatel-Lucent 1665 DMXtend to provide a network transport of a FC/FICON service.

An LNW73 may be placed in slots fn-a-1,fn-b-1,fn-c-1, fn-d-1 or growth-1 (5 slots) of a Alcatel-Lucent 1665 DMX. When the shelf is equipped with VLF Mains, LNW73 can occupy both slots 1 and 2 of a Function/Growth unit.

Up to 2 full rate 1G FICON/FC services (or one 2G FICON/FC service) may be provided in a single LNW73 circuit pack, each service requiring 19 STS-1 or 6 STS-3c bandwidth units reserved in the SONET domain (37 STS-1 or 12 STS-3c for 2G FICON/FC).

When operating in asynchronous Fibre Channel (FC) mode, 2 ports are available at 2Gbps FC, or 4 ports at 1Gbps FC, or 1 port at 2Gbps FC and 2 ports of 1Gbps FC. When operating in synchronous FC mode, 1 port is available at 2Gbps FC, or 2 at 1Gbps FC.

A Alcatel-Lucent 1665 DMX/OC48 system can provide 2 full rate FICON/FC 1G services (limited by SONET bandwidth).

A Alcatel-Lucent 1665 DMX/OC192 system can provide 10 FICON/FC 1G services (limited by the number of slots that may be equipped with LNW73).

Buffer-to-buffer credits are handled exclusively by FICON/FC switches/devices.

Reliability/Line and pack protection options

To protect against SONET network failures and main pack failures, Alcatel-Lucent 1665 DMX can be equipped redundant circuit packs in both main slots and be provisioned for UPSR or BLSR protection.

Using SONET Protection dramatically increases the reliability of end to end FICON/FC services.

Circuit pack equipage and provisioning

Each LNW73 used must be set to select the pack type of FICON/FC (see ED-EQPT). Each port to be used must be equipped with an Alcatel-Lucent specified FC/FICON Pluggable PTM. A PTM is similar in functionality to a GBIC pluggable unit. If a VCAT signal format is desired, the ED-DPORT-DATA command is used to select it.

Circuit bandwidth choices

A full rate 1G FICON/FC service may be provisioned as a SONET STS-1-19v (VCAT), STS-3c-6v(VCAT). The most bandwidth efficient is STS-3c-6v. A full rate 2G FICON/FC service may be provisioned as a SONET STS-1-37v (VCAT), STS-3c-12v (VCAT). The most bandwidth efficient is STS-3c-12v.

Interface specifications to FICON/FC interfaces

Alcatel-Lucent 1665 DMX uses standards compatible PTMs. The same PTM works for both FICON and FC and both 1G and 2G. See Chapter 10, “Technical specifications” for optical specification, loss budget, connector and fiber type requirements.

Distance limitations/transmission delay engineering

Distance between the FICON/FC equipment and the Alcatel-Lucent 1665 DMX are typically limited by the interface link specification of the FICON/FC interface.

The total distance allowed including the SONET extension is typically a function of the delay requirements of the FICON/FC application.

Synchronous FICON/FC applications performance typically suffers if the application is subjected to more than 600 microseconds of one way transmission delay (the equivalent of delay through 120 km of fiber). Refer to your particular client equipment engineering rules for distance limitations. For planning purposes, each Alcatel-Lucent 1665 DMX adds the equivalent 25 microseconds or 5 km of fiber.

Asynchronous FICON/FC applications are much more tolerant to transmission delay, typically able to function at delays of 1000 microseconds (200 km) or longer. Many FC switches offer extended buffer credits for asynchronous applications that allow up to 3600 microseconds of delay without performance droop. Each Alcatel-Lucent 1665 DMX or other SONET system in the path of such a network would add the equivalent of 5 km of fiber.

FC/FICON services-extended distances - BB credits managed in Alcatel-Lucent 1665 DMX/Alcatel-Lucent 1665 DMXtend

To extend asynchronous FICON/FC applications beyond the buffer to buffer credit limits of the attached FC Switches, Alcatel-Lucent 1665 DMX and Alcatel-Lucent 1665 DMXtend can be provisioned to manage the BB Credits and eliminate performance droop related to insufficient BB credit across the network. This implementation is based on the ITU G.7041 and T11 FC-BB-3_GFPT standards work and provides sufficient credits for full performance at 2500 km for 2G services.

To use this mode, the gfptype (in the ED-DPORT-DATA command) must be provisioned to ASYNC-FC (even if it is a FICON service). Buffer credits are automatically adjusted within Alcatel-Lucent 1665 DMX and no additional provisioning required. Attached FICON/FC devices should be provisioned to use for R_RDY flow control (as opposed to proprietary Inter-Switch Link (ISL) flow control schemes.

Illustrative examples of some FC switch configurations are provided below.

EMC certification

Alcatel-Lucent 1665 DMX has been qualified by EMC eLab Testing and with Brocade Fabric Aware Testing. Alcatel-Lucent 1665 DMX has been tested with various FC/FICON switches used with storage equipment. This testing has yielded some simple guidelines (listed below) that need to be followed to ensure smooth interworking between Alcatel-Lucent 1665 DMX and some of the FC/FICON switches listed above.

General FC/FICON equipment port configuration for connection to Alcatel-Lucent 1665 DMX

Please use the following guidelines to ensure interoperability between FC/FICON equipment and Alcatel-Lucent 1665 DMX.

To assure minimal link start up and recovery times, the following configurations are recommended for all ports attached to Alcatel-Lucent 1665 DMX:

- Configure port speed to match application: I.e. use 1G or 2G mode instead of auto-negotiate mode.
- Configure ports to not waste time trying to determine if Alcatel-Lucent 1665 DMX is arbitrated loop port type

To use buffer credits in Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, configure ports to use R_RDY mode buffer credit management instead of proprietary link buffer credit management.

If compression is desired on Alcatel-Lucent 1665 DMX and gfptype is set to async-FC, set the number of link buffer credits to 8 or less, otherwise the operational state of compression will stay disabled.

Brocade interworking examples

Please use the following guidelines to ensure interoperability between the specified Brocade equipment and Alcatel-Lucent 1665 DMX.

Brocade Silkworm 3800

Perform the following tasks on all ports connected to the Alcatel-Lucent 1665 DMX:

- Through the CLI, use the portcfgSPEED {port num}, {1 or 2, not 0}
- Then use the portcfgGPORT {portnum}, {1, not 0}

In addition, to use buffer credits on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, use portcfgISLMODE {portnum}, {1, not 0}.

To use compression on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, use switchdisable, then use the configure command to set fabric.ops.BBCredit to 8 or less.

Brocade Silkworm 2250

Perform the following tasks on all ports connected to the Alcatel-Lucent 1665 DMX:

- Through the CLI, use the portcfgSPEED {port num}, {1 or 2, not 0}
- Then use the portcfgGPORT {portnum}, {1, not 0}

In addition, to use buffer credits on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, use switchdisable, then use the configure command to set fabric.ops.longdistance=1

To use compression on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, use switchdisable, then use the configure command to set fabric.ops.BBCredit to 8 or less.

Cisco MDS 9120 or MDS 9216 interworking examples

Please use the following guidelines to ensure interoperability between the Cisco MDS 9120 or MDS 9216 equipment and Alcatel-Lucent 1665 DMX.

Perform the following tasks on all ports connected to the Alcatel-Lucent 1665 DMX:

- Through the GUI, click on FC port, set admin Speed to 1Gb or 2Gb not auto
- Through the GUI, click on FC port, set admin Mode to E or TE, not auto

In addition, to use buffer credits on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, it is important to note that Cisco uses ISL mode as R_RDY mode by default.

To use compression on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, through the GUI, click on FC port, then click on BBCredit and then set admin BBCredit to 8 or less.

MC Data Sphereon 4500 interworking examples

Please use the following guidelines to ensure interoperability between the MC Data Sphereon 4500 equipment and Alcatel-Lucent 1665 DMX.

Perform the following tasks on all ports connected to the Alcatel-Lucent 1665 DMX:

- Through the GUI, click on Configure, then click on ports, on the appropriate ports, set Speed to 1Gb/sec or 2Gb/sec
- Through the GUI, click on Configure, then click on ports, on the appropriate ports, set Type to E port

In addition, to use buffer credits on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, it is important to note that Sphereon uses ISL mode as R_RDY mode by default.

To use compression on Alcatel-Lucent 1665 DMX when gfptype is set to async-FC, set any port numbered "4" or higher to use 5 credits (ports 0–3 use 12 credits).

Appendix B: Circuit pack availability

Overview

Purpose

This appendix lists the circuit packs that are available in Alcatel-Lucent 1665 DMX, Release 9.1. In addition, circuit packs that have been declared Discontinued Availability (DA) prior to the GA of Release 9.1 and those that are planned to be DA'd shortly after the GA of Release 9.1 are noted. Although DA'd circuit packs are no longer orderable as of the DA date, they may still be in existing Network Elements. Descriptions of the DA'd circuit packs appear in this appendix as well. For descriptions of the available circuit packs, see Chapter 4, "Product description".

Contents

Circuit pack availability in Release 9.1	B-1
DA'd circuit pack descriptions	B-25

Circuit pack availability in Release 9.1

The following table lists all the available and DA'd Alcatel-Lucent 1665 DMX circuit packs as of Release 9.1.

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW1	108695586	SYSCTL – System Controller	R1.0	R1.0	8/2009	LNW2

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW2	108994989	SYSCTL – Enhanced System Controller	R6.0	R4.0		
LNW6	108694837	28 DS1	R1.0	R1.0	11/2006	LNW8
LNW7	108764036	28xDS1 PM	R1.0	R1.0		
LNW8	109164889	56xDS1/E1 PM	R3.1	R1.1		
LNW16	108694845	12xDS3/EC-1	R1.1	R1.0		
LNW18	109164905	Transmux (12 ports)	R3.0	R1.1		
LNW19	109187567	48xDS3/EC-1	R3.1	R2.0	8/2007	LNW19B
LNW19B	109492470	48xDS3/EC-1 with terminal loopbacks	R5.0	R3.0		
LNW20	109535070	48 port portless/ported DS3 transmux/EC-1	R7.0.1	R5.0.1		
LNW26	108694852	1 OC-48 HS, LR port per pack with VT granularity of 6 STS-1s	R1.0		5/2002	LNW27
LNW26B	109152058	1 OC-48 HS, LR port per pack with VT granularity of 12 STS-1s	R2.0		3/2008	LNW27
LNW27	108923525	1 OC-48 HS, LR port per pack with VT granularity of 48 STS-1s	R2.1			

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW28	108923533	1 OC-48 HS, LR (50 km) port per pack, OSP hardened with VT granularity of 12 STS-1s	R2.0		5/2006	LNW32
LNW29	108923541	1 OC-48 HS, Extended LR (1550 nm) ports per pack with VT granularity of 48 STS-1s	R2.1			
LNW31	109008987	1 OC-48 LS, IR port per pack with VT granularity of 12 STS-1s	R2.0	R3.0		
LNW32	109008995	1 OC-48 HS, LR port per pack OSP hardened with VT granularity of 48 STS-1s	R4.0		10/2012	LNW202 with PTMs
LNW36	108694860	4 OC-3 LS, LR ports per circuit pack, OSP hardened with VT granularity of 12 STS-1s	R1.0	R1.0	12/2007	LNW37
LNW37	109068783	4 OC-3 LS, SFP ports per circuit pack with VT granularity of 12 STS-1s supporting facility loopbacks	R4.0	R2.0		

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW38	109196352	1 OC-12 HS, IR port per pack, OSP hardened with VT granularity of 12 STS-1s		R1.0		
LNW39	109296360	16 DS1 ports and 3 DS3 ports per pack		R1.0		
LNW40	109197111	1 OC-3 HS, IR port per pack, OSP hardened with VT granularity of 6 STS-1s		R1.0		
LNW41	109197129	1 OC-48 HS, PTM per pack, OSP hardened with VT granularity of 48 STS-1s		R3.1		
LNW45	109411082	8 OC-3 LS, PTM ports per pack, , OSP hardened with 48 STS-1 VT fabric	R5.0	R3.0		
LNW46	108694878	2 OC-12 LS, LR ports per circuit pack, OSP hardened with VT granularity of 12 STS-1s	R1.1	R1.1	12/2007	LNW49

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW48	109187575	1 OC-12 HS, IR port per pack, OSP hardened with VT granularity of 12 STS-1s	R3.1			
LNW49	109319582	4 OC-12 LS, PTM ports per pack, , OSP hardened with VT granularity of 48 STS-1s	R4.0	R3.0		
LNW50	109319590	1 OC-12 HS, LR port per pack, OSP hardened with VT granularity of 12 STS-1s	R3.1			
LNW51	109423269	1 OC-12 HS, LR port per pack, OSP Hardened with VT granularity of 12 STS-1s		R1.1		
LNW52	109492488	1 OC-48 HS, port per pack, OSP hardened with VT granularity of 12 STS-1s (upgrade pack)		R4.0		
LNW54	109506055	1 OC-12 HS, LR 1550 nm port per pack, , OSP hardened with VT granularity of 12 STS-1s	R5.1		10/2012	LNW203 with PTMs

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW55	109532283	12 port, OC-3/OC-12/OC-48 Multi-rate LS, 10G capacity, PTMs, OSP hardened	R7.1	R5.1		
LNW56	108848052	1 OC-192 HS, IR (1550 nm, 40 km) ports per pack with VT granularity of 48 STS-1s	R2.1.2			
LNW57	109126391	1 OC-192 HS, LR port per pack with VT granularity of 48 STS-1s – equipped with Tone circuitry	R4.0		9/2011	LNW502 with PTMs (no tone circuitry)
LNW58	109164939	1 OC-192 HS, Short Reach port per pack (based on the LNW56) with VT granularity of 48 STS-1s	R2.1.2			
LNW59	109494799	2 OC-192 HS, XFP ports per pack with VT granularity of 192 STS-1s	R7.0			

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW60	109522821	1 OC192 HS, LR port per pack with VT granularity of 48 STS-1s – equipped with optical amplifier	R5.1		3/2011	
LNW62	109532291	4 OC-48 LS, PTM ports per pack, OSP hardened	R7.0	R5.0		
LNW63	109535088	4 ports, 1000BASE-SX/LX/ZX, optical, GbE private line, PTM ports per pack – maximum throughput of 2.5 Gb/s, protected SONET connections only, OSP hardened	R6.0	R4.0		
LNW64	109599696	8 Ethernet LAN, GbE Private Line, PTM ports per pack. OSP hardened	R7.0	R5.0		
LNW66	108848078	24 10BASE-T electrical ports and 2 GbE WAN ports per pack	R1.1	R1.1	10/2012	LNW170

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW67	108848086	2 ports 1000BASE-SX – optical, GbE LAN, SR (850nm, multimode, 500m) ports and 2 GbE WAN ports per circuit pack	R1.1	R1.1	3/2008	LNW170
LNW68	108869660	2 ports 1000BASE-LX optical, GbE LAN, LR (1310nm, single mode, 10km) ports and 2 GbE WAN ports per pack	R1.1	R1.1	3/2008	LNW170
LNW70	108869660	8 Ethernet LAN PTMs, (4 1000BASE-SX/LX/LX10 and 4 100BASE-FX), per pack 32 VCGs	R5.1	R3.1	1/2010	LNW170
LNW71	108869660	24 10BASE-T/100BASE-TX, electrical ports and 24 100Mbps WAN ports per pack	R3.1	R1.0	3/2008	LNW74

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW73	109461491	SAN Private Line transport (Fibre Channel/FICON/ESCON) over SONET, and 4 client-side ports using PTM optics	R5.1	R3.1		
LNW73C	109575605	SAN Private Line transport (Fibre Channel/FICON/ESCON) over SONET, and 4 client-side ports using PTM optics with Data Compression capabilities	R7.0	R5.0	2/2012	LNW73
LNW74	109492504	8 100BASE-FX LAN ports w/SFP optics and 16 10BASE-T/100Base-TX LAN ports and 24 100 Mb/s WAN ports OSP hardened	R5.0	R3.0		
LNW76	109164947	1 OC-48 HS, SR port per pack with VT granularity of 48 STS-1s	R2.1			
LNW77	109167627	1 OC-48 HS, IR (1310 nm) port per pack with 12 STS-1 VT fabric	R2.0		2/2007	LNW27

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW78	109167635	Switched Ethernet pack for RPR application, 8 SFP ports (6 usable-2GbE/4FE) per pack	R6.0.1	R4.0.1	1/2010	
LNW80	109461509	Main Switch Pack, HS Main without optics	R4.0			
LNW82	109643932	8-port, OC-3/12, 2x48 Multi-rate HS, VLF main, 5G capacity, PTM optics, OSP hardened	R7.1			
LNW84	109643940	8-port, OC-3/12/48, 2x48, 16 DS1, 3 DS3, Multi-rate HS, VLF main, 5G capacity, PTM optics, OSP hardened		R8.0		
LNW87	109709188	4-port FE/GigE Private line, OSP	R9.0	R9.0		
LNW111	109310839	3 DS3 ports per pack		R2.0		
LNW112	109310821	16 DS1 ports per circuit pack		R2.0		

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW121	109150946	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW121B	109184788	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		3/2005	LNW202
LNW123	109150961	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW123B	109184796	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202
LNW125	109150987	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW125B	109184804	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		9/2007	LNW202

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW127	109151001	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW127B	109184812	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		9/2007	LNW202
LNW131	109151027	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW131B	109184820	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202
LNW133	109151043	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW133B	109184838	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW135	109151068	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW135B	109184846	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202
LNW137	109151084	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW137B	109184853	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202
LNW140	109567131	1 OC-3 HS and 16 DS1s per pack (full width pack)		R5.0	10/2012	LNW40 and the LNW112
LNW141	109567149	1 OC192 HS, XFP per pack, OSP hardened with VT granularity of 192 STS-1s		R5.0		

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW143	109151118	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW143B	109184861	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202
LNW145	109151134	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW145B	109184879	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202
LNW147	109151159	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW147B	109184887	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		11/2004	LNW202

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW149	109151175	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW149B	109184895	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		3/2005	LNW202
LNW153	109151191	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW153B	109184903	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		9/2007	LNW202
LNW155	109151217	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW155B	109184911	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		9/2007	LNW202

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW157	109151233	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW157B	109184929	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		3/2005	LNW202
LNW159	109151258	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		4/2002	LNW202
LNW159B	109184937	1 OC-48 HS, PWDM (16 lambdas) port per pack with VT granularity of 6 STS-1s	R2.0		3/2005	LNW202
LNW170	109642728	8 Ethernet LAN PTMs, (4 1000BASE-SX/LX/LX10 and 4 100BASE-FX), per pack 32 VCGs, mate LAG support	R7.1	R5.1		
LNW202	109589135	OC-48 HS, with PTM optics	R7.1			

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW203	109702555	OC-12 HS SFP OSP with 12 STS-1 VT fabric	R9.0			
LNW221	109171355	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2005	LNW202
LNW223	109171363	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW225	109171371	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		12/2008	LNW202
LNW227	109171389	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW231	109171397	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW233	109171405	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		12/2008	LNW202
LNW235	109171413	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW237	109171421	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		12/2008	LNW202
LNW243	109171439	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2005	LNW202
LNW245	109171447	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW247	109171454	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW249	109171462	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW253	109171470	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW255	109171488	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW257	109171496	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2005	LNW202
LNW259	109171504	1 OC-48 HS, DWDM (32 lambdas) ports per pack with VT granularity of 48 STS-1s	R2.1		3/2009	LNW202
LNW302	109706416	OC-3 HS, PTM-based, OSP Hardened with VT granularity of 6 STS-1s		R9.0		

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW380	109610527	1 OC-12 HS, LR 1550 nm (LR2) port per pack, OSP Hardened with VT granularity of 12 STS-1s		R5.0	10/2012	LNW382 with PTMs
LNW382	109706408	OC-12 HS, PTM-based, OSP Hardened with VT granularity of 12 STS-1s		R9.0		
LNW391	109664508	16 DS1 ports and 3 DS3 ports per pack		R8.0		
LNW402	109678870	OC-48 LS, with PTM optics	R8.0	R8.0		
LNW421	109185116	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	3/2005	LNW402
LNW423	109185124	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402
LNW425	109185132	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	5/2009	LNW402

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW427	109185140	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	5/2009	LNW402
LNW431	109185157	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402
LNW433	109185165	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402
LNW435	109185173	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402
LNW437	109185181	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402
LNW443	109185199	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW445	109185207	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402
LNW447	109185215	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	5/2009	LNW402
LNW449	109185223	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	5/2009	LNW402
LNW453	109185231	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	5/2009	LNW402
LNW455	109185249	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	11/2009	LNW402
LNW457	109185256	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	6/2004	LNW402

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW459	109185264	1 OC-48 LS, PWDM (32 lambdas) port per pack with VT granularity of 12 STS-1s	R3.0	R3.0	5/2009	LNW402
LNW502	109589127	OC-192 mains w/XFP optics	R7.1			
LNW504	109709014	4xOC192 XFP + 4xOC-48 SFP HS VLF main, with a 40G VT Enhanced Fabric	R9.0			
LNW523	109207225	1 OC-192 HS, WDM (4 lambdas tunable) per pack port per pack with VT granularity of 48 STS-1s	R4.0		6/2007	LNW502
LNW527	109207266	1 OC-192 HS, WDM (4 lambdas tunable) per pack port per pack with VT granularity of 48 STS-1s	R4.0		9/2009	LNW502
LNW554	109207530	1 OC-192 HS, WDM (4 lambdas tunable) per pack port per pack with VT granularity of 48 STS-1s	R4.0		2/2007	LNW502

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW555	109207548	1 OC-192 HS, WDM Long Reach (80 km) port per pack with VT granularity of 48 STS1s	R3.1		2/2007	
LNW601	109589242	1 OC-3, HS, 1310 nm, long-reach, OSP hardened with VT granularity of 6 STS-1s		R4.0		
LNW603	109680496	One port OC-192 PTM-based (XFP) tributary pack	R9.0			
LNW705	109589242	10G DWDM Muxponder pack (XM10G/8) – PTM-based (8 SFPs + 1 XFP) 1GbE/GFP-F/VCAT into OC-192 (OTU2 w/Enhanced FEC); SAN (1G, 2G, FC/Ficon) and SONET (OC-3/12/48) clients	R7.1.1	R9.0		

Table B-1 Alcatel-Lucent 1665 DMX circuit packs as of January 2011 (continued)

Apparatus Code	Comcode	Description	Release available		DA date	Suggested replacement
			DMX	DMXtend		
LNW785	109616565	8-channel low-loss DWDM Mux/Demux (OMD5/8), with integrated VOAs, hw-ready for OSC	R7.1	R5.1		
LNW801	109664490	56xDS1/E1 PM	R8.0	R8.0		

Notes:

1. HS: High-Speed; installed in the Main slots
2. LS: Low-Speed; installed in the Function Groups or Growth slots
3. OSP: Outside Plant hardened
4. LR: Long Reach
5. IR: Intermediate Reach
6. SR: Short Reach
7. PTM: Pluggable Transmission Module, also referred to as a small form-factor plug-in (SFP)

DA’d circuit pack descriptions

Purpose

This section briefly describes Alcatel-Lucent 1665 DMX circuit packs that are DA'd and no longer orderable. These packs could be present in your existing network.

System Controller (LNW1)

The SYSCTL provides communication with other circuit packs on the Alcatel-Lucent 1665 DMX shelf. The SYSCTL supports all Alcatel-Lucent 1665 DMX operations interfaces, including IAO LAN (OSI or TCP/IP), TL1/X.25, PC-CIT, office alarms, and miscellaneous discretes. The SYSCTL also supports DCC terminations for each optical line interface.

The SYSCTL faceplate has push-button switches, alarm/status LEDs, and a 7-segment numeric display to facilitate local operations. The SYSCTL provides redundancy by duplicating all cross-connect information on the OLIU circuit packs. Transmission is not affected if the SYSCTL fails.

The SYSCTL circuit pack provides a microprocessor, nonvolatile memory to store the generic program software and provisioning database, and additional memory for system operation. The SYSCTL circuit pack also has interfaces across the backplane to monitor and control every circuit pack in the shelf.

The SYSCTL supports PC-CIT front access to the Alcatel-Lucent 1665 DMX via the IAO LAN and a serial RS-232 port located on the back of the Alcatel-Lucent 1665 DMX shelf.

28DS1 (LNW6)

The LNW6 is not supported when Alcatel-Lucent 1665 DMX is equipped with VLF Main packs. LNW6 contains 28 DS1 ports that can be cross-connected to VT1.5 timeslots when the system is operating with a UPSR, 1+1, or BLSR Main interface. Hairpin cross-connections to OCn and other electrical interfaces are also supported. This circuit pack is 1x1 protected, and non-revertive protection switching is supported. Line build-outs and DS1 signal encoding are software provisionable. This circuit pack terminates up to 28 bidirectional DS1 electrical signals and supports the transport of DS1 signals coded in either alternate mark inversion (AMI) or bipolar 8-zero substitution (B8ZS) modes. The signals received from the DSX-1 are mapped into SONET VT1.5 signals and then routed to the high-speed OLIU circuit pack.

The LNW6 circuit pack can occupy Function Unit groups A, B, C, and D. All electric interface circuit packs are 1x1 hardware protected. So, although both slots in each function group can house a LNW6 circuit pack, one slot in each function group populated by LNW6 circuit pack is always used for hardware protection. Thus the Alcatel-Lucent 1665 DMX shelf supports up to 112 working ports when four Function Unit groups are equipped with the LNW6 circuit pack.

In addition to maintenance and provisioning functions, the 28DS1PM circuit pack provides performance monitoring capabilities.

Whenever upgrading LNW6 to LNW7 circuit packs, it is necessary to first install an LNW8 circuit pack to ensure that the upgrade is completed without loss of service.

48DS3/EC1 (LNW19)

The 48DS3/EC1 (LNW19) circuit pack can be used only in the high capacity shelf, contains 48 ports, is 1x1 protected, and supports nonrevertive protection switching. The 48DS3/EC1 circuit pack provides bidirectional transport of 48 DS3/EC-1 signals and maps the DS3/EC-1 signals into corresponding STS-1 signals, and supports transport of DS3 signals coded in bipolar 3-zero substitution (B3ZS). DS3 or EC-1 service is provisionable on a per-port basis within each pack.

The LNW19 may occupy Function Unit groups A, B, C, and D, on the Alcatel-Lucent 1665 DMX shelf. All electric interface circuit packs are 1x1 hardware protected. So, although both slots in each function group can house a LNW19 circuit pack, one slot in each function group populated by LNW19 circuit pack is always used for hardware protection. Thus the Alcatel-Lucent 1665 DMX shelf supports up to 192 working ports when four Function Unit groups are equipped with the LNW19 circuit packs.

OC-48 OLIU (LNW26)

The OC-48 OLIU (LNW26) high speed circuit pack is a long reach 1310 nm optical line interface unit. The LNW26 supports OC-48 add/ drop, BLSR and UPSR configurations, single- and dual-homing, nonrevertive protection switching, and VT1.5, STS-1, STS-3(c), STS- 12(c), and STS-48(c) signal transport. The LNW26 OLIU can crossconnect VTs in any 6 of 48 selected STS-1s. The stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW26 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW26 faceplate.

OC-48 OLIU (LNW26B)

The LNW26B high-speed circuit pack is a long reach OC-48, 1310 nm optical line interface unit. The LNW26B supports OC-48 add/drop, BLSR and UPSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48) signal transport. The LNW26B pack can cross-connect VTs in 12 of 48 STS-1s of the OC-48 signal. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW26B may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW26B faceplate.

OC-48 OLIU (LNW28)

The LNW28 has the same capabilities as the LNW26B circuit pack. It is, however, designed specifically for outside cabinet deployment and has been certified to withstand extreme temperatures.

The OC-48 OLIU (LNW28) high-speed circuit pack is a long reach 1310 nm optical line interface unit. The LNW28 supports OC-48 add/ drop, BLSR and UPSR configurations, single- and dual-homing, nonrevertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The LNW28 can cross-connect 12 of 48 selected STS-1s. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW28 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW28 faceplate.

OC-3 OLIU (LNW36)

The quad OC-3 OLIU low-speed circuit pack is a four-port, long-reach, 1310 nm optical line interface unit supporting VT1.5, STS-1 and STS-3c path switching. LNW36 supports VT mapping in 12 STS-1s. The LNW36 can interface with other OC-3 rings in the network and can also be used as an interface for OC-3 linear optical extensions, as well as single- and dual- homed ring extensions. Fiber access is provided via four pairs of LC-type connectors on the LNW36 faceplate.

The LNW36 can occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 40 ports are addressable when all Function Unit groups are equipped with the LNW36 circuit pack.

OC-12 OLIU (LNW46)

The dual OC-12 OLIU (LNW46) low-speed circuit pack is a two-port, long-reach, 1310 nm optical line interface unit supporting VT1.5, STS-1, STS-3(c), and STS-12(c) path switching. LNW46 supports VT mapping in 12 STS-1s. The LNW46 provides an OC-12 interface to other OC-12 rings, linear optical extensions, and single- and dual-homed ring extensions. Fiber access is provided via two pairs of LC-type connectors on the LNW46 faceplate.

The LNW46 can occupy any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 20 ports are addressable when all Function Unit groups are equipped with the LNW46 circuit pack.

OC-192 OLIU (LNW57)

The LNW57 high-speed circuit pack is a long-reach (80 km) OC-192 1533.47 nm circuit pack. The LNW57 supports OC-192 add/drop, UPSR, and BLSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The LNW57 circuit pack can cross-connect VTs in any 48 of 192 STS-1s in the OC-192 signal. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-192 OLIU.

The LNW57 circuit pack may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW57 faceplate.

The LNW57 circuit pack utilizes a "dither tone" to frequency modulate the laser. This technique is used to minimize the effects of Stimulated Brillouin Scattering (SBS). At high optical launch powers, SBS can cause an acoustic back-scattering phenomenon in fibers. The dither tone effectively broadens the spectrum of the narrow optical pulse, thus raising the threshold power where SBS becomes an issue.

Normally, Alcatel-Lucent recommends that optical output of the OC-192 circuit packs be amplified to no more than +10 dBm. However, with the dither tone circuit incorporated into the LNW57 circuit pack, optical amplification of this circuit pack to much higher power levels is acceptable.

For fibers carrying multiple wavelengths in DWDM systems, it should be noted that the individual channel (individual wavelength) power determine the SBS threshold, not the total composite power of all the channels.

OC-192 OLIU (LNW60)

The LNW60 circuit pack is based on the LNW57 circuit pack. It has the same characteristics, capabilities, and specifications as the LNW57 circuit pack, but it also includes an on-board, integrated optical amplifier. When the on-board amplifier is in use, the LNW60 circuit pack is capable of bridging spans of up to 127 km. The LNW60 circuit pack presents the possibility of savings in CAPEX, OPEX (no separate management for external optical amplifier required), and space.

1000BASE-SX (LNW67) optical Ethernet interface

This 2-port Ethernet interface provides short-reach high-speed optical data transport at the rate of 1 Gb/s using standard Ethernet switching IEEE 802.1, standard encapsulation, and standard STS-1 virtual concatenation according to ITU G.707.

The LNW67 is an unprotected pack. Fiber access is provided by two LC-type connector pairs on the LNW67 faceplate. The LNW67 transmits signals at a wavelength of 850 nm. The LNW67 requires the use of multimode fiber cable. Each LNW67 circuit pack can support 2 packet rings or 2 GbE private lines (protected or unprotected).

When Alcatel-Lucent 1665 DMX is not equipped with VLF Main packs, LNW67 packs can only be placed in Slot 1 of any function group or growth slot in the shelf (A1-G1). Alcatel-Lucent 1665 DMX support a total add/drop capacity of 10 optical GbE ports if all slots are equipped with LNW67 circuit packs.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main packs, Ethernet packs can occupy both Slot 1 and 2 of a Function or Growth Unit (where applicable). With VLF Mains and all tributary slots populated with LNW67 packs, Alcatel-Lucent 1665 DMX provides a total add/drop capacity of 20 optical GbE ports.

When VLF Mains are not used, if the LNW67 circuit packs occupy slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

1000BASE-LX (LNW68) optical Ethernet interface

1000BASE-LX (LNW68) optical Ethernet interface While providing the same functionality as the 1G SX interface, the LNW68 supports long-reach optics. LNW68 transmits signals at a wavelength of 1310 nm. The LNW68 requires the use of single-mode fiber cable. Each LNW68 circuit pack can support 2 packet rings.

100/1000BASE-X/T (LNW70) switched Ethernet interface

The LNW70 circuit pack provides four 1000BASE-X (SX, LX, and/or ZX-very long reach 80km), IEEE 802.3-compliant (1000Mbps) GbE interfaces and four 100BASE-LX IEEE 802.3-compliant (100 Mbps) fast Ethernet interfaces. The LNW70 circuit pack provides Ethernet private line or switched services, with QoS. The LNW70 packs are not equipment protected, however, WAN facility protection is provided via SONET UPSR/BLSR or through the IEEE 802.1w (or 802.1d) spanning tree algorithm.

The LNW70 pack can also use electrical PTMs that are provisionable to support either 100BASE-T or 1000BASE-T traffic. The electrical FE (100BASE-T) PTMs can occupy ports 1–8. The GbE (1000BASE-T/X) PTMs are restricted to ports 1–4.

The LNW70 pack uses standard Ethernet switching (IEEE 802.1), standard encapsulation, and standard STS-1 virtual concatenation according to ITU G.707. Fiber access is provided by LC-type connector pairs on the LNW70 faceplate.

The LNW70 pack is unprotected by default. Support of Link Aggregation on LNW70 LAN ports is available to provide Ethernet facility protection.

When Alcatel-Lucent 1665 DMX is not equipped with VLF Main packs, the LNW70 pack can only occupy slot 1 of any Function Unit group on the shelf (including Growth slots). Up to 20 1000BASE-X and 20 100BASE-LX ports are addressable when all Function Unit groups are equipped with LNW70 circuit pack.

When Alcatel-Lucent 1665 DMX is equipped with VLF Main packs, Ethernet packs can occupy both Slot 1 and 2 of a Function or Growth Unit (where applicable). With VLF Mains and all tributary slots populated with LNW70 pack, up to 40 1000BASE-X and 40 100BASE-LX ports are addressable.

When VLF Mains are not used, if the LNW70 circuit pack occupies slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

The LNW70 pack feature Pluggable Transmission Module (PTM) electrical and optical interfaces. PTMs are "pluggable" in the sense that they can be plugged into a circuit pack as they become necessary. This allows customers to grow their network incrementally, only realizing the full cost for optics as the need to provision service on (and thus receive revenue from) them becomes necessary. LNW70 pack is purchased and shipped with no ports populated with functioning optics. The ports remain empty until the customer decides to place interfaces in them. The electrical FE (100BASE-T) PTMs can occupy ports 1–8. The GbE (1000BASE-T/X) PTMs are restricted to ports 1–4.

The LNW70 supports dual function electrical PTMs that are provisionable for 100 or 1000 Mbps traffic. The pack conforms to the IEEE802.3 standards for 100BASE-T and 1000BASE-T in the respective settings (IEEE802.3z and IEE802.3ab). Connectivity is provided for an RJ-45 Cat 5 cable and the PTM has a maximum span length of 100 meters.

10/100T (LNW71) Private Line Ethernet interface

The LNW71 circuit pack conforms to the same specifications as the LNW66 described above. Yet, rather than supporting packet ring transport (like the LNW66), the LNW71 circuit pack is designed specifically to support Fast Ethernet Private Line applications. Each LNW71 circuit pack can support 24 private lines. The LNW71 can also support STS-3(c) cross-connections instead of virtual concatenation.

The 10/100T-PL may occupy slot 1 of Function Unit groups A, B, C, and D, and 96 10/100T ports are addressable when four Function Unit groups are equipped with LNW71 circuit packs. When the LNW71 circuit packs occupy slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

OC-48 OLIU (LNW77)

The LNW77 circuit pack is a intermediate reach (20km), high-speed 1310 nm optical line interface unit. The LNW77 supports OC-48 add/ drop, BLSR and UPSR configurations, single- and dual-homing, nonrevertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

The LNW77 pack can cross-connect VTs in 12 of 48 STS-1s of the OC-48 signal.

The LNW77 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW77 faceplate.

100/1000BASE-X/T (LNW78) RPR Ethernet interface

This 8-port Ethernet interface provides 4 ports for short-reach and/or long-reach high-speed optical data transport at the rate of 1 Gb/s and 4 ports for optical 100BASE-LX transport at 100 Mbps. The first 4 ports (1–4) are for the GbE traffic (ports 3 and 4 are not currently available) and the second 4 ports (5–8) are for FE traffic. The LNW78 circuit pack utilizes PTM optics, allowing you to equip additional ports as necessary. LNW78 circuit pack also supports the electrical 100/1000BASE-T, electrical Ethernet PTM. This PTM may only occupy ports 1 and 2 of the pack.

The LNW78 circuit pack supports port, switching, and traffic management capabilities similar to the LNW70/170.

The LNW78 circuit pack supports standards compliant RPR switching per IEEE 802.17 and 802.1. The LNW78 circuit pack supports one RPR instance. The LNW78 circuit pack provides two internal Virtual Concatenation Group (VCG) WAN ports with a total capacity of 2.5 Gbps capacity for Ethernet RPR traffic (24 STS-1s in each direction).

VCG ports 17–22 are available to provide EoS connectivity. This feature allows EoS port connectivity to RPR ring interfaces via the faceplate of the LNW78 and/or hairpin cross-connects. Interconnection of multiple RPR rings on the same shelf or separate shelf using EoS VCGs is also supported. Finally, EoS traffic can be managed with QoS support on EoS VCGs.

Without a VLF Main pack, LNW78 circuit packs can only be placed in Slot 1 of a function group or growth group in the shelf (A1–G1) and Alcatel-Lucent 1665 DMX supported a total add/drop capacity of 10 RPR GbE ports and 20 RPR FE ports if all slots were equipped with LNW78 circuit packs.

With the use of true 0x1 and a VLF Main, LNW78 can occupy slots 1 and 2 of a Function or Growth group. This can increase the overall capacity of the system to 20 RPR GbE (optical only) ports and 20 RPR FE (optical only) ports per shelf.

When VLF Mains are not used, if an LNW78 circuit packs occupy slot 1 of a Function Unit group, slot 2 must be populated with an apparatus blank.

OC-48 High-speed (network interface) DWDM OLIUs

The Alcatel-Lucent 1665 DMX OC-48 DWDM OLIUs are optical port units designed for use with passive MUX/DMUX and optical add/drop shelves. This DWDM feature supports 32 different wavelengths. Each port unit supports two wavelengths via a special hardware configuration. These units are compatible with the SONET and SDH standards.

The optical port units are designed to be used with the Lucent Passive Optics Units (POUs). By using the DWDM port units and the POUs, you are able to increase fiber capacity by a factor of 16 or 32.

OC-48 DWDM OLIUs support add/drop, BLSR and UPSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-48 OLIU.

One set of OC-48 DWDM OLIUs can cross-connect VTs in any 12 of 48 selected STS-1s (LNW121B-159B). Another set of OC-48 DWDM OLIUs can cross-connect VTs in all 48 STS-1s of the OC-48 signal (LNW221-259)

The OC-48 DWDM OLIUs may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the OC-48 DWDM OLIU faceplate.

The Alcatel-Lucent 1665 DMX OC-48 DWDM OLIUs (LNW223–237, LNW245–255, and LNW259) are OLIUs designed for use with passive MUX/DMUX and optical add/drop shelves. This DWDM feature supports 26 different wavelengths. Each port unit supports two wavelengths via a special hardware configuration. These units are compatible with the SONET and SDH standards.

When the shelf is equipped with non-VLF mains, the DWDM circuit pack can cross-connect VTs in up to 48 STS-1s of the OC-N signal. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains.

OC-48 Low-speed (tributary interface) DWDM OLIUs

The low-speed OC-48 DWDM OLIUs (LNW421-459) are similar to those mentioned above, except that they are tributary interface circuit packs that any Function Unit group on the Alcatel-Lucent 1665 DMX shelf (including Growth slots), and up to 10 ports are addressable when all Function Unit groups are equipped with the low-speed DWDM circuit packs. These packs can cross-connect VTs in any 12 of 48 selected STS-1s. When the shelf is equipped with non-VLF mains, the PWDM circuit pack can cross-connect VTs in up to 12 STS-1s of the OC-N signal. When the shelf is equipped with VLF mains, all VT connections are performed in the Mains.

OC-192 OLIU (LNW527)

The OC-192 OLIU (LNW527) circuit pack is a DWDM optical line interface unit. This WDM pack supports OC-192 add/drop, UPSR, and BLSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. This circuit pack can cross-connect VTs in any 48 of 192 STS-1s in the OC-192 signal. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-192 OLIU.

The LNW527 circuit pack may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW527 faceplate.

The LNW527 circuit pack employs tunable lasers that support 4 separate frequencies. The LNW527 lasers can be made to transmit different frequencies. This feature offers obvious advantages to single frequency circuit packs in that one pack may be ordered and used to support a variety of frequency requirements. Packs can be reused in applications requiring different frequencies and thus the need to order packs simply to support different frequencies can, in some cases, be avoided.

OC-192 OLIU (LNW523/554)

The OC-192 OLIU (LNW523/554) circuit pack is a DWDM optical line interface units. These DWDM packs support OC-192 add/ drop, UPSR, and BLSR configurations, single- and dual-homing, nonrevertive linear and bidirectional 1+1 protection switching,

and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. These circuit packs can cross-connect VTs in any 48 of 192 STS-1s in the OC-192 signal. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-192 OLIU.

The LNW523/554 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW554 faceplate.

The LNW523/554 employ tunable lasers that support 4 separate frequencies on each of the three packs. The LNW523/554 lasers can be made to transmit different frequencies. This feature offers obvious advantages to single frequency circuit packs in that one pack may be ordered and used to support a variety of frequency requirements. Packs can be reused in new applications requiring different frequencies and thus the need to order new packs simply to support different frequencies can, in some cases, be avoided.

OC-192 OLIU (LNW555)

The OC-192 OLIU (LNW555) circuit pack is a long reach (80 km) 1533.47 nm optical line interface unit. The LNW555 supports OC-192 add/drop, UPSR, and BLSR configurations, single- and dual-homing, non-revertive linear and bidirectional 1+1 protection switching, and VT1.5, STS-1, STS-3(c), STS-12(c), and STS-48(c) signal transport. The LNW555 circuit pack can cross-connect VTs in any 48 of 192 STS-1s in the OC-192 signal. The Stratum 3 timing generator and central TDM switch fabrics are embedded in the OC-192 OLIU.

The LNW555 may occupy Main slots 1 and 2. Fiber access is provided via a pair of LC-type connectors on the LNW555 faceplate.

Glossary

Type of diagnostic test used to compare an original transmitted signal with the resulting received signal. A loopback is established when the received optical or electrical external transmission signal is sent from a port or tributary input directly back toward the output.

Symbols

µ

Microns

µm

Micrometer

Numerics

1+1 (bidirectional)

The bidirectional 1+1 protection switching architecture protects against failures of the optical transmit/receive equipment and their connecting fiber facility. One bidirectional interface (two fibers plus associated OLIUs on each end) is designated "service," and the other is designated "protection." In each direction, identical signals are transmitted on the service and protection lines ("dual-fed"). The receiving equipment monitors the incoming service and protection lines independently and selects traffic from one line (the "active" line) based on performance criteria and technician/OS control. In bidirectional 1+1 switching, the network elements are not independent. When a protection switch is requested at a network element, both network elements perform protection switching.

1+1 (unidirectional)

The unidirectional 1+1 protection switching architecture protects against failures of the optical transmit/receive equipment and their connecting fiber facility. One bidirectional interface (two fibers plus associated OLIUs on each end) is designated "service," and the other is designated "protection." In each direction, identical signals are transmitted on the service and protection lines ("dual-fed"). The receiving equipment monitors the incoming service and protection lines independently and selects traffic from one line (the "active" line) based on performance criteria and technician/OS control. In unidirectional 1+1 switching, both service and protection lines could be active at the same time (service in one direction, protection in the other).

1GE

Gigabit Ethernet - 1.250 Gbps line rate.

1xN, 1x1

1xN protection switching pertains to circuit pack protection that provides a redundant signal path through Alcatel-Lucent 1665 DMX (it does not cover protection switching of an optical facility; see "1+1"). In 1xN switching, a group of N service circuit packs share a single spare protection circuit pack. 1x1 is a special case of 1xN, with N=1. In 1x1, only one is active at a time.

802.1Q Mode

In 802.1Q Mode, a circuit pack can be provisioned to use an incoming frame's VLAN tag either to add a VLAN tag associated with the port for untagged frames or to drop an incoming frame if its VLAN tagging does not meet provisioned specifications. The priority bits in an incoming frame's VLAN tag can also be used to affect the handling of the frame.

A

ABN

Abnormal (status condition)

AC

Alternating Current

ACIDs

Application Context IDs

Active

Active identifies any protected entity which is currently selected by the receiver at either end as the payload carrying signal that is currently carrying service (see Standby).

Adaptive Rate

See Pipe Mode.

Add/Drop Multiplexer (ADM)

The term for a synchronous network element capable of combining signals of different rates and having those signals added to or dropped from the stream.

ADM

Add/drop multiplexer

ADR

Add/drop ring

Aging

The filtering database entries are automatically removed after an aging period (300 seconds).

AGNE

Alarm gateway network element

AIS

Alarm indication signal

Alarm

Visible or audible signal indicating that an equipment failure or significant event/condition has occurred.

Alarm Cut-Off (ACO)

A button on the SYSCTL used to silence audible alarms.

Alarm Gateway Network Element (AGNE)

A defined network element in an alarm group through which members of the alarm group exchange information.

Alarm Indication Signal (AIS)

A code transmitted downstream in a digital network that shows that an upstream failure has been detected and alarmed.

Alarm Severity Assignment Profile (ASAP)

A user provisioned mechanism to control an alarm level.

Alien Wavelength

A compatible DWDM optical signal that is sourced or terminated by a different network element.

Alternate Mark Inversion (AMI)

A line code that employs a ternary signal to convey binary digits, in which successive binary ones are represented by signal elements that are normally of alternating, positive and negative, polarity but equal in amplitude, and in which binary zeros are represented by signal elements that have zero amplitude.

American Standard Code for Information Interchange (ASCII)

A standard 7-bit code that represents letters, numbers, punctuation marks, and special characters in the interchange of data among computing and communications equipment.

AMI

Alternate Mark Inversion

ANSI

American National Standards Institute

APD

Avalanche PhotoDiode

APS

Automatic Protection Switch

APS Channel

The signalling channel carried in the K1 and K2 bytes of the SONET overhead on the protection line. It is used to exchange requests and acknowledgments for protection switch actions.

ASAP

Alarm Severity Assignment Profile

ASCII

American Standard Code for Information Interchange

ASN.1

Abstract Syntax Notation 1

Asynchronous Transfer Mode (ATM)

A high-speed transmission technology characterized by high bandwidth and low delay. It utilizes a packet switching and multiplexing technique which allocates bandwidth on demand.

ATM

Asynchronous Transfer Mode

Auto

Automatic

Auto

One possible state of ports, lines, and channels. In this state, the port, line, or channel will automatically be put "in service" if a good signal is detected coming from the DSX panel.

Automatic Protection Switch

A feature that allows another source to be automatically selected and reconfigured in the event of a source failure or network change; for example, a fiber cut.

Avalanche Photodiode (APD)

A diode that increases its electrical conductivity by a multiplication effect when hit by light. APDs are used in lightwave receivers because the APDs have a greater sensitivity to weakened light signals (for example, those which have traveled long distances over fiber).

B

B3ZS

Bipolar 3-Zero Substitution

B8ZS

Bipolar 8-Zero Substitution

Backbone Ring

A host ring.

Backout

Refers to backing out of an upgrade in progress. A backout returns a node(s) to the pre-upgrade state.

Backup

The backup and restoration features provide the capability to recover from loss of network element data because of such factors as human error, power failure, and network element design flaws.

Bandwidth

The difference in Hz between the highest and lowest frequencies in a transmission channel. The data rate that can be carried by a given communications circuit.

Baud Rate

Transmission rate of data (bits per second) on a network link.

BDFB

Battery Distribution and Fuse Bay

BER

Bit Error Rate

Bidirectional Line

A transmission path consisting of two fibers that handle traffic in both the transmit and receive directions.

Bidirectional Line-Switched Ring (BLSR)

A bidirectional ring in which protection switching is accomplished by switching working traffic into protection time slots in the line going in the opposite direction around the ring.

Bidirectional Ring

A ring in which both directions of traffic between any two nodes travel through the same network elements (although in opposite directions).

Bidirectional Switch

Protection switching performed in both the transmit and receive directions.

BIP

Bit Interleaved Parity

Bipolar 8-Zero Substitution (B8ZS)

A line coding technique that replaces eight consecutive zeros with a bit sequence having special characteristics accomplishing two objectives: First, this bit sequence accommodates the density requirements of the ones for digital T1 carrier; second, the sequence is recognizable at the destination (due to deliberate bipolar violations) and is removed to produce the original signal.

Bit

The smallest unit of information in a computer, with a value of either 0 or 1.

Bit Error Rate (BER)

The ratio of error bits received to the total number of bits transmitted.

Bit Error Rate Threshold

The point at which an alarm is issued for bit errors.

Bit Interleaved Parity-N(BIP-N)

A method of error monitoring over a specified number of bits (BIP-3 or BIP-8).

BITS

Building Integrated Timing Supply

BITS clock

A BITS (Building Integrated Timing Source) clock is a clock within a central office that distributes timing to all the equipment in that central office. The BITS clock is tied to an external, stable timing source, such as a GPS (global positioning satellite).

Blocking

The state in which an Ethernet port does not participate in frame relay. The forwarding process discards received frames.

BLSR

Bidirectional line-switched ring

BPDU

Bridge protocol data unit

Bridge Cross-Connection

Setting up a cross-connection leg with the same input tributary as that of an existing cross-connection leg, forming a 1:2 bridge from an input tributary to two output tributaries.

Broadband

Any communications channel with greater bandwidth than a voice channel; sometimes used synonomously with wideband.

Burst Size

The provisioned burst size determines the length or size of the data burst that is allowed by the peak information rate policer. This affects policing for all VLANs (in 802.1Q mode), all port tags (in transparent mode), and all Private Line services (in Private Line or No Tag mode) on the LNW66 Ethernet circuit packs.

Byte

Refers to a group of eight consecutive binary digits.

C

C-Bit

A framing format used for DS3 signals produced by multiplexing 28 DS1s into a DS3. This format provides for enhanced performance monitoring of both near-end and far-end entities.

CC

Clear Channel

CCITT

Comité Consultatif International Télégrafique & Téléphonique
(International Telephone and Telegraph Consultative Committee)

CCITT - International Telephone and Telegraph Consultative Committee

An international advisory committee under United Nations sponsorship that has composed and recommended for adoption worldwide standards for international communications. Recently changed to the International Telecommunications Union Telecommunications Standards Sector (ITU-TSS).

CD-ROM

Compact Disk, Read-Only Memory

Channel

A logical signal within a port. For example, for an EC-1 port, there is one STS-1 channel and sometimes 28 VT1.5 channels. See Port.

Channel State Provisioning

A feature that allows a user to suppress reporting of alarms and events during provisioning by supporting multiple states (automatic, in-service and not monitored) for VT1.5 and STS-n channels. See Port State Provisioning.

Circuit

A set of transmission channels through one or more network elements that provides transmission of signals between two points to support a single communications path.

CIT

Craft Interface Terminal

Clear Channel (CC)

A provisionable mode for the DS3 output that causes parity violations not to be monitored or corrected before the DS3 signal is encoded.

CLEI

Common Language Equipment Identifier

Client Signal Fail (CSF)

The local network element sends a Client Signal Fail (CSF) signal to the far-end equipment when a defect is detected in the ingress client signal (Ethernet/Data protocol).

CLK

Clock

CMISE

Common Management Information Service Element

CO

Central Office

Coding Violation (CV)

A performance monitoring parameter indicating that bipolar violations of the signal have occurred.

Collocated

System elements that are located in the same location.

Concatenation

A procedure whereby multiple virtual containers are associated with each other resulting in a combined capacity that can be used as a single container across which bit sequence integrity is maintained.

Constituent Signals

List of received signals for an adaptive rate (pipe mode) optical port.

Cost

Cost is used to help determine the efficiency of any given path. Cost is provisioned for a port (depending on speed of transmission) and calculated automatically for a path (sum of the port costs for the path).

CP

Circuit Pack

CPE

Customer Premises Equipment

CR

Critical (alarm status)

Craft Interface Terminal (CIT)

The user interface terminal used by craft personnel to communicate with a network element.

Credit Interval

The provisioned interval for adding tokens to the token bucket used by the peak information rate policer. This affects policing for all VLANs (in 802.1Q mode), all port tags (in transparent mode), and all Private line services (in Private Line or No Tag mode).

Critical (CR)

Alarm that indicates a severe, service-affecting condition.

CRN

Customer Release Notes

Cross-Connect Capacity

The total bandwidth of cross-connections as measured by the bandwidth of input and output tributaries. A system with N STS-1 equivalent input tributaries and N STS-1 equivalent output tributaries (referred to as "NxN") provides a cross-connection capacity of N STS-1 equivalents. This system could provide N one-way point-to-point cross-connections or N^2 two-way

point-to-point cross-connections at the equivalent rate of STS-1.

Cross-Connect Loopback

A cross-connection from an input tributary to the output of that same tributary via the cross-connect fabric.

Cross-Connect Rate

The attribute of a cross-connection that defines the constituent signal rate(s) it can carry. For a cross-connection with an STS-3 "pipe" cross-connection rate, the constituent signals carried by the cross-connection can be either an STS-3c signal or three STS-1 signals. Similarly, for a cross-connection with an STS-12 "pipe" cross-connection rate, the constituent signals carried by the cross-connection can be either an STS-1 signal or an allowed mix of STS-12c signals and STS-3c signals.

CSF

Client Signal Fail

CTL

Controller

CTS

Customer Technical Support; now known as Technical Support Services (TSS)

Cut-Through

Refers to a simple ASCII interface to an network element. It enables the user to send TL1 messages directly to the network element with no interpretation or assistance provided by the WaveStar CIT.

CV

Coding Violation

CVFE

Coding Violation Far End

D

DACS

Digital Access Cross-Connect System

DACS III-2000

Digital Access and Cross-Connect System that provides clear channel switching at either the DS3 or the STS-1 rates, eliminating the need for manual DSXs.

DACS IV-2000

Digital Access and Cross-Connect System that provides electronic DS3/STS-1 or DS1/VT1.5 cross-connect capability, eliminating the need for manual DSXs.

Data Communications Channel (DCC)

The embedded overhead communications channel in the synchronous line, used for end-to-end communications and maintenance. The DCC carries alarm, control, and status information between network elements in a synchronous network.

Data Communications Equipment (DCE)

The equipment that provides signal conversion and coding between the data terminating equipment (DTE) and the line. The DCE may be separate equipment or an integral part of the DTE or of intermediate equipment. A DCE may perform other functions usually performed at the network end of the line.

Data Terminating Equipment (DTE)

The equipment that originates data for transmission and accepts transmitted data.

dB

Decibels

DC

Direct Current

DCC

Data Communications Channel

DCE

Data Communications Equipment

DDM-2000

Alcatel-Lucent SONET multiplexers that multiplex DS1, DS3, or EC-1 inputs into EC-1, OC-1, OC-3, or OC-12 outputs.

Default Provisioning

The parameter values that are preprogrammed as shipped from the factory.

Demultiplexing

A process applied to a multiplexed signal for recovering signals combined within it and for restoring the distinct individual channels of these signals.

DEMUX

Demultiplexer

DEMUX - Demultiplexer

The DEMUX direction is from the fiber toward the DSX.

Dense Wavelength Division Multiplexing (DWDM)

Transmitting two or more signals of different wavelengths simultaneously over a single fiber.

Digital Cross-Connect Panel (DSX)

A panel designed to interconnect to equipment that operates at a designated rate. For example, a DSX-3 interconnects equipment operating at the DS3 rate.

Digital Multiplexer

Equipment that combines time-division multiplexing several digital signals into a single composite digital signal.

Digital Signal Levels 0, 1, 3 (DS0, DS1, DS3)

An ANSI-defined signal or service level corresponding to the following: DS0 is 64 Kb/s, DS1 is 1.544 Mb/s (equivalent to T1), and DS3 is 44.736 Mb/s (equivalent to 28 T1 channels or T3).

Directory Services Network Element (DSNE)

A designated network element that is responsible for administering a database that maps network element names (TIDs) to addresses (NSAPs - network service access points) in an OSI subnetwork. There can be one DSNE per ring. Can also be a GNE.

Disable admin

An Ethernet port that does not participate in the spanning tree. The port is disabled by management.

Disable failure

A port in this state does not participate in the spanning tree. The port is disabled due to a hardware or software failure.

DLC

Digital Loop Carrier

DRI

Dual Ring Interworking

DS1

Digital Signal Level 1

DS3

Digital Signal Level 3

DS3 Format

Specifies the line format of a DS3 interface port, such as M23 or C-bit parity.

DSCP

Differentiated Services Code Point

DSLAM

Digital Subscriber Line Access Multiplexer

DSNE

Directory Services Network Element

DSX

Digital Cross-Connect Panel

DTE

Data Terminating Equipment

Dual Homing

A network topology in which two OC-3, OC-12, or OC-48 shelves serve as hosts.

DWDM

Dense Wavelength Division Multiplexing

E

E1

E1 is an SDH/PDH (Synchronous Digital Hierarchy/Pleiseosynchronous Digital Hierarchy, the European equivalent of SONET/DSx) electrical signal comparable to (but slightly faster than) a DS1. E1 is also sometimes called CEPT-1 (Conference of European Posts and Telecommunications) and is at 2.048 Mb/s.

EC-1

Electrical Carrier Level 1

EC-1, EC-n - Electrical Carrier

The basic logical building block signal with a rate of 51.840 Mb/s for an EC-1 signal and a rate of n times 51.840 Mb/s for an EC-n signal. An EC-1 signal can be built in two ways: A DS1 can be mapped into a VT1.5 signal and 28 VT1.5 signals multiplexed into an EC-1 (VT1.5 based EC-1), or a DS3 can be mapped directly into an EC-1 (DS3 based EC-1).

ECI

Equipment Catalog Item

EEPROM

Electrically-Erasable Programmable Read-Only Memory

EIA

Electronic Industries Association

Electromagnetic Compatibility (EMC)

A measure of equipment tolerance to external electromagnetic fields.

Electromagnetic Interference (EMI)

High-energy, electrically induced magnetic fields that cause data corruption in cables passing through the fields.

Electronic Industries Association (EIA)

A trade association of the electronic industry that establishes electrical and functional standards.

Electrostatic Discharge (ESD)
Static electrical energy potentially harmful to circuit packs and humans.

EMC
Electromagnetic Compatibility

EMI
Electromagnetic Interference

Enterprise Systems Connection (ESCON)
A 200-Mb/s data signal used in storage area networking applications.

EOOF
Excessive Out of Frame

EoS
Ethernet over SONET

EPORT
Ethernet Port

EPROM
Erasable Programmable Read-Only Memory

EQ
Equipped (memory administrative state)

EQPT
Equipment

Equipment Catalog Item (ECI)
The bar code number on the faceplate of each circuit pack used by some inventory systems.

Errored Seconds (ES)
A performance monitoring parameter.

ES
Errored Seconds

ESD
Electrostatic Discharge

ESF
Extended Super Frame

EST
Environmental Stress Testing

Establish

A user-initiated command, at the WaveStar CIT, to create an entity and its associated attributes in the absence of certain hardware. (Does not apply to Alcatel-Lucent 1665 DMX

Event

A significant change. Events in controlled network elements include signal failures, equipment failures, signals exceeding thresholds, and protection switch activity. When an event occurs in a controlled network element, the controlled network element will generate an alarm or status message and send it to the management system.

Extended Superframe Format (ESF)

A T1 format that uses the framing bit for non-intrusive signaling and control. A T1 frame is sent 8,000 times a second, with each frame consisting of a payload of 192 bits, and with each frame preceeded by a framing bit. Because ESF only requires 2,000 framing bits for synchonization, the remaining 6,000 framing bits can be used for error detection.

Externally Timed

An operating condition of a clock in which it is locked to an external reference and is using time constants that are altered to quickly bring the local oscillator's frequency into approximate agreement with the synchronization reference frequency.

Extra traffic

Unprotected traffic that is carried over protection channels when their capacity is not used for the protection of working traffic. However, the extra traffic is unprotected and is preempted (lost) if a protection switch is activated. Preempted traffic is reestablished when the protection switch clears.

F

Facility

A one- or two-way circuit that carries a transmission signal.

Facility Loopback

A facility loopback is where an entire line is looped back.

Facility Roll

The disconnection of the circuit cross-connecting input tributary to an output tributary followed, within the required completion time, by a cross-connection of an input tributary to an output tributary.

Failure Rate (FIT)

Circuit pack failure rates per 10^9 hours as calculated using the method described in Reliability Prediction Procedure for Electronic Equipment, *Telcordia* ® Method I, Issue 5, September 1995. One FIT represents one failure per billion operating hours.

Far End (FE)

Any other network element in a maintenance subnetwork other than the one the user is at or is working on. Also called remote.

Far-End Receive Failure (FERF)

An indication returned to a transmitting network element that the receiving network element has detected an incoming section failure. Also known as RFI (Remote Failure Indication).

Fault

Term used when a circuit pack has a hard (not temporary) fault and cannot perform its normal function.

Fault Management

Collecting, processing, and forwarding of autonomous messages from network elements.

FC

Fibre Channel

FC - 1G

Fibre Channel - 1 Gigabit

FC -2G

Fibre Channel - 2 Gigabit

FC-100

Fibre Channel 100 MBps Interface - 1.0625 Gbps line rate.

FC-200

FFibre Channel 200 MBps Interface - 2.125 Gbps line rate.

FCC

Federal Communications Commission

FE

Far End

FE

Fast Ethernet

FE ACTY

Far End Activity

FEBE

Far End Block Error

FEC

Forward Error Correction

FEPROM

Flash EPROM

Fibre Channel - 1G (FC-1G)

A Fibre Channel 1.0625 Gb/s data signal.

Fibre Channel -2G (FC-2G)

A Fibre Channel 2.1250 Gb/s data signal.

Fibre Connection (FICON)

A 1.0625 Gb/s data signal.

File Transfer and Access Management (FTAM)

FTAM is the Open Systems Interconnection (OSI) standard for file transfer, file access, and file management.

Filtering database

The filtering database maintains a dynamic list of paths to which packets should be routed based on the destination address. The database entries are created, updated, and removed by the learning process.

FIT

Failures in 10^9 hours of operation.

Flash EPROM

A technology that combines the nonvolatility of EPROM with the in-circuit reprogrammability of EEPROM (electrically-erasable PROM).

FN

Function Unit

Forced

Term used when a protected entity (either working or protection) has been locked into a service-providing state by user command.

Forced Switch to Protection

The WaveStar CIT command that forces the protection group to be the "Active Unit." The clear command is required to remove the Forced Switch state. While in the Forced Switch state, the system may not switch the active unit either automatically, by means of the WaveStar CIT Forced Switch or Manual Switch command.

Forwarding

The state in which an Ethernet port participates in frame relay.

Free Running

An operating condition of a clock in which its local oscillator is locked to an internal synchronization reference and is using no storage techniques to sustain its accuracy.

FT-2000

An Alcatel-Lucent SONET OC-48 Lightwave System.

FTAM

File Transfer and Access Management

FTAM-FTP Gateway

The Alcatel-Lucent 1665 DMX supports an FTAM-FTP gateway function. This is also referred to as file transfer translation device (FTTD). The FTTD translates FTAM over OSI presentation to FTP over TCP/IP.

FTP

File Transfer Protocol

FTTD

File Transfer Translation Device

Function Unit (FN)

Refers to any one of a number of different circuit packs that can reside in the A, B, C, or D function unit slots on Alcatel-Lucent 1665 DMX.

G

Gateway Network Element (GNE)

A network element that passes information between other network elements and management systems through a data communication network.

GB

Gigabytes

Gb/s

Gigabits per second

GbE

Gigabit Ethernet

Generic Framing Procedure (GFP)

The Generic Framing Procedure, described in ITU-T G.7041/Y1303, provides a generic mechanism to adapt traffic from higher-layer client signals over a SONET network.

GFP

Generic Framing Procedure

GHz

Gigahertz

GNE

Gateway Network Element

GR-XXX

Telcordia ® General Requirement-XXX

GUI

Graphical User Interface

H

Hairpin Routing

A cross-connection between function units (inter-function unit). For example, function unit C to function units A, B, or D. Also, a cross-connection within the same function unit (intra-function unit). Cross-connections go through Main, but no bandwidth or time slots are taken from the backbone ring. Eliminates need for another shelf.

Hashed FTP

The hashed FTP (digital signature) capability prevents tampering with a downloadable software image.

Holdover

An operating condition of a network element in which its local oscillator is not locked to any synchronization reference but is using storage techniques to maintain its accuracy with respect to the last known frequency comparison with a synchronization reference.

HS

High Speed

Hz

Hertz

I

I/O

Input/Output

IAO LAN

Intraoffice Local Area Network

ID

Identifier

IEC

International Electrotechnical Commission

IEEE

Institute of Electrical and Electronics Engineers

IMF

Infant Mortality Factor

In-Service (IS)

A memory administrative state for ports. IS refers to a port that is fully monitored and alarmed.

INC

Incoming Status

Insert

To physically insert a circuit pack into a slot, thus causing a system-initiated restoral of an entity into service and/or creation of an entity and associated attributes.

Intermediate Reach (IR)

A term used to describe distances of 15 to 40 km between optical transmitter and receiver without regeneration. See long reach.

IP

Internet Protocol

IR

Intermediate Reach

IS

In Service

ISDN

Integrated Services Digital Network

ISO

International Standards Organization

ISP

Internet Service Provider

J

Jitter

Timing jitter is defined as short-term variations of the significant instants of a digital signal from their ideal positions in time.

Jumbo frame

Jumbo frames increase network efficiency by reducing the number of frames to be processed.

K

Kb/s

Kilobits per second

L

LAG

Link Aggregation Group

LAN

Local Area Network

LAPD

Link Access Procedure "D"

LBC

Laser Bias Current

LBO

Lightguide Build Out

LCAS

Link Capacity Adjustment Scheme

LCN

Local Communications Network

LEC

Local Exchange Carrier

LED

Light-Emitting Diode

LFD

Loss of Frame Delineation

LGX

Lightguide Cross-Connect

Light Emitting Diode (LED)

Used on a circuit pack faceplate to show failure (red) or service state. It is also used to show the alarm and status condition of the system.

Lightguide Build-Out (LBO)

An attenuating (signal-reducing) element used to keep an optical output signal strength within desired limits.

Lightguide Cross-Connect (LGX)

A SONET device that contains ports for optical fiber connections to an optical network element. An LGX is used to make and change connections to an network element without changing the cabling on the network element itself.

Line

A transmission medium, together with the associated equipment, required to provide the means of transporting information between two consecutive network elements. One network element originates the line signal; the other terminates it.

Line Timing

The capability to directly derive clock timing from an incoming OC-N signal while providing the user the capability to provision whether switching to an alternate OC-N from a different source (as opposed to entering holdover) will occur if the OC-N currently used as the timing reference for that network element becomes unsuitable as a reference. For example, intermediate nodes in a linear network are line timed. See Loop Timing.

Link Aggregation

A method of combining a group of IEEE 802.3 Ethernet links into a single logical link of up to the aggregate rate.

Link Capacity Adjustment Scheme (LCAS)

LCAS is an enhancement to SONET/SDH Virtual Concatenation that allows adding or removing Virtual Concatenation Group (VCG) members, to vary its bandwidth, by management command. It also automatically removes and restores failed members.

Listening

The state in which an Ethernet port is preparing to participate in frame relay. In the listening state, frame relay is disabled. This is an interim state between blocking and learning.

LOA

Loss of Alignment

Local

See Near-End.

Local Area Network (LAN)

A communications network that covers a limited geographic area, is privately owned and user administered, is mostly used for internal transfer of information within a business, is normally contained within a single building or adjacent group of buildings, and transmits data at a very rapid speed.

Locked DSn Cross-Connections

Locked DSn cross-connections add/drop traffic to/from only one rotation of a UPSR. Path switching is disabled. Time slots can be reused at different nodes around the UPSR.

LOF

Loss of Frame

Long Reach (LR)

A term used to describe distances of 40 km or more between optical transmitter and receiver without regeneration. See Intermediate Reach.

LOP

Loss of Pointer

LOS

Loss of Signal

Loss of Alignment (LOA)

One or more STS-1s that compose a VCG are out of multiframe alignment because of excess delay difference.

Loss of Frame (LOF)

A failure to synchronize to an incoming signal.

Loss of Frame Delineation (LFD)

Lack of sufficient bandwidth that is reported when there is a mismatch in the number of STS tributaries.

Loss of Pointer (LOP)

A failure to extract good data from an STS-n payload.

Loss of Signal (LOS)

The complete absence of an incoming signal.

LPBK

Loopback

LR

Long Reach

LS

Low Speed

M

M23-Format

A standard framing format used for DS3 signals produced by multiplexing 28 DS1s into a DS3 (sometimes referred to as M13-format, without C-bit parity).

MAC

Media Access Control

MAC Address

A unique hardware address that identifies each node of a network.

Main

The two slots (M1 and M2) on an Alcatel-Lucent 1665 DMX shelf in which the OC-n (n = 3, 12, 48, or 192) high-speed OLIU circuit packs are installed.

Main shelf

A shelf in a multi-shelf configuration that has one or more provisioned sub-tending sub-shelves.

Maintenance Condition

An equipment state in which some normal service functions are suspended, either because of a problem or to perform special functions (copy memory) that cannot be performed while normal service is being provided.

Major

Indicates a service-affecting failure, main or unit controller failure, or power supply failure.

MB

Megabytes

Mb/s

Megabits per second

Minor (MN)

Indicates a nonservice-affecting failure of equipment or facility.

Miscellaneous Discrete Interface

Allows an operations system to control and monitor equipment collocated within a set of input and output contact closures.

MJ

Major Alarm

MM

Multimode

MML

huMan-Machine Language

MN

Minor Alarm

MPEG

Moving Picture Experts Group

MSPP

Multi Service Provisioning Platform

MTBF

Mean Time Between Failures

MTBMA

Mean Time Between Maintenance Activities

Mult

Multipling

Multi Service Provisioning Platform (MSPP)

SONET Add/Drop Multiplexer Network Element with Ethernet/Data capability.

Multiplexer

A device (circuit pack) that combines two or more transmission signals into a combined signal on a shared medium.

Multiplexing

The process of combining multiple signals into a larger signal at the transmitter by a multiplexer. The large signal is then split into the original smaller signals at the receiver by a demultiplexer.

MUX

Multiplex

N

NA

Not Applicable

NARTAC

North American Regional Technical Assistance Center

NE

network element

NE ACTY

Near-End Activity

Near End

The network element the user is at or is working on. Also called local.

NEBS

Network Equipment-Building System

Network Element (NE)

A node in a telecommunication network that supports network transport services and is directly manageable by a management system.

Network Service Access Point (NSAP) Address

Network Service Access Point Address (used in the OSI network layer 3). An automatically assigned number that uniquely identifies a network element for the purposes of routing DCC messages.

Network Time Protocol

Network time protocol is an easy, accurate, and automatic method to get and synchronize date/time.

NIC

Network Interface Card

nm

Nanometer (10^{-9} meters)

NMA

Network Monitoring and Analysis

NMON

Not Monitored (provisioning state)

No Request State

This is the routine-operation quiet state in which no external command activities are occurring.

Node

A network element in a ring or, more generally, in any type of network. In a network element supporting interfaces to more than one ring, node refers to an interface that is in a particular ring. Node is also defined as all equipment that is controlled by one system controller. A node is not always directly manageable by a management system.

Nonpreemptible unprotected traffic (NUT)

Traffic carried on (working and/or protection) BLSR channels for which protection switching has been provisioned as disabled. NUT must be employed when using an alternate protection scheme for data such as RSTP. As the name implies, NUT is unprotected and not preempted in the event of a protection switch. NUT carried on nonpreemptible unprotected channels affords a higher level of survivability as compared to extra traffic, which is preempted during a protection switch, but a lower level of survivability as compared to working traffic, which is carried on its corresponding protection channel during a protection switch.

Nonrevertive Switching

In nonrevertive switching, an active and standby line exist on the network. When a protection switch occurs, the standby line is selected to support traffic, thereby becoming the active line. The original active line then becomes the standby line. This status remains in effect even when the fault clears. That is, there is no automatic switch back to the original status.

Nonvolatile Memory (NVM)

Memory that retains its stored data after power has been removed. An example of NVM would be a hard disk.

Not Monitored (NMON)

A provisioning state for equipment that is not monitored or alarmed.

NR

Not Reported

NRZ

Nonreturn to Zero

NSA

Not Service Affecting

NSAP Address

Network Service Access Point Address (used in the OSI network layer 3)

NTF

No Trouble Found

NTP

Network time protocol

NUT

Nonpreemptible unprotected traffic

NVM

Non-Volatile Memory

O

OAM&P

Operations, Administration, Maintenance, and Provisioning

OC-1

Optical Carrier, Level 1 Signal (51.84 Mb/s)

OC-12

Optical Carrier, Level 12 Signal (622.08 Mb/s)

OC-192

Optical Carrier, Level 192 Signal (9953.28 Mb/s) (10 Gb/s)

OC-3

Optical Carrier, Level 3 Signal (155.52 Mb/s)

OC-48

Optical Carrier, Level 48 Signal (2488.32 Mb/s) (2.5 Gb/s)

OC, OC-n - Optical Carrier

The optical signal that results from an optical inversion of an STS signal; that is, OC-1 from STS-1 and OC-n from STS-n.

OCH

Optical Channel

OI

Operations Interworking

OLIU

Optical Line Interface Unit

OOF

Out of Frame

OOL

Out of Lock

OOS

Out-of-Service

Open Systems Interconnection (OSI)

Referring to the OSI reference model, a logical structure for network operations standardized by the International Standards Organization (ISO).

Operations Interface

Any interface providing you with information on the system behavior or control. These include the equipment LEDs, SYSCTL faceplate, WaveStar CIT, office alarms, and all telemetry interfaces.

Operations Interworking (OI)

The capability to access, operate, provision, and administer remote systems through craft interface access from any site in a SONET/SDH network or from a centralized operations system.

Operations System (OS)

A central computer-based system used to provide operations, administration, and maintenance functions.

OPS/INE

Operations System/Intelligent Network Element

Optical Channel (OCH)

The top layer of the DWDM network that provides transport of client signals (for example, SONET, 1GE, OTU2). The OCH layer is comparable in function to the SONET path layer.

Optical Channel Transport Unit 2 (OTU2)

The OTU2 is the information structure used for transport over one or more optical channel connections. It consists of the optical channel data unit and OTU2 related overhead (FEC and overhead for management of an optical channel connection). It is characterized by its frame structure, bit rate, and bandwidth.

Optical Transport Network (OTN)

Network used to transport user signals via ITU compliant wavelengths. The OTN is composed of the OTU2, OCH, and OTS layers.

Optical Transport Section (OTS)

The lowest layer of the OTN that provides physical transport. The OTS layer is terminated on an OTS terminating equipment. The OTS layer is comparable in function to the SONET section layer.

OS

Operations System

OSI

Open Systems Interconnection

OSMINE

Operations Systems Modifications for the Integration of Network Elements

OSP

Outside Plant

OTN

Optical Transport Network

OTS

Optical Transport Signal

OTU2

Optical Channel Transport Unit 2

P

P-bit

Performance Bit

Pass Through

Paths that are cross-connected directly across an intermediate node in a ring network.

Path

A logical connection between the point at which a standard frame format for the signal at the given rate is assembled, and the point at which the standard frame format for the signal is disassembled.

Path Protection Group

The part of a cross-connection topology that is provisioned to provide path-level protection switching for all the constituent signals carried by the cross-connection. A path protection group can be identified as an entity by its logical output tributary and its cross-connection rate. A path protection group consists of one or more constituent path selectors.

PC

Personal Computer

PCMCIA

Personal Computer Memory Card International Association

Peak Information Rate Policer

The peak information rate policer meters packet traffic leaving the internal packet switch and going toward the SONET network. If the packets exceed the provisioned peak information rate, the packets are dropped.

Performance Monitoring (PM)

Measures the quality of service and identifies degrading or marginally operating systems (before an alarm would be generated).

PID

Program Identification

Pipe Mode

Alcatel-Lucent 1665 DMX supports cross-connections on adaptive rate OC-n ports (pipe mode). The signal rates adapt to the supported set of signal rates. Cross-connections may be provisioned at any cross-connection rate that is supported for the tributaries associated with the OC-n ports. A cross-connection can carry any set of constituent signals; however, the total of the constituent signal rates must not exceed the cross-connection rate. Fault monitoring and performance monitoring occur on the accepted incoming rates.

PIR

Peak information rate

PJC

Pointer Justification Count

Plesiochronous Network

A network that contains multiple maintenance subnetworks, each internally synchronous and all operating at the same nominal frequency, but whose timing may be slightly different at any particular instant. For example, in SONET networks, each timing traceable to their own Stratum 1 clock are considered plesiochronous with respect to each other

PLL

Phase-Locked Loop

PM

Performance Monitoring

POP

Points of Presence

Port (also called Line)

The physical interface, consisting of both an input and output, where an electrical or optical transmission interface is connected to the system and may be used to carry traffic between network elements. The words "port" and "line" may often be used synonymously. "Port" emphasizes the physical interface, and "line" emphasizes the interconnection. Either may be used to identify the signal being carried.

Port Protection Group

A user provisioned association of protected optical interface ports. This association is used for line protection. The group of ports represent both a protection switching entity and also a set of lines that carry services to/from another network element. The port protection groups also determine the set of logical tributaries from and to which cross-connections can be provisioned.

Port State Provisioning

A feature that allows a user to suppress alarm reporting and performance monitoring during provisioning by supporting multiple states (automatic, in-service, and not monitored) for low-speed ports.

Ported Mode

In the Ported mode, a DS3 port receives and transmits a DS3 signal on the backplane electrical interface to the DSX.

Portless Mode

In the Portless mode, a DS3 port does not use backplane electrical connector. This mode is used to map a DS1 being received in a channelized DS3 within an STS1 into a VT, and vice versa. The DS1 is cross-connected at the VT1.5 level.

POTS

Plain Old Telephone Service

PRBS

Psuedo-random Bit Sequence

Proactive Maintenance

Refers to the process of detecting degrading conditions not severe enough to initiate protection switching or alarming, but indicative of an impending signal fail or signal degrade defect (for example, performance monitoring).

Protection

Extra capacity (channels, circuit packs) in transmission equipment that is not intended to be used for service, but rather to serve as backup against failures.

Protection Group

A logical grouping of ports or circuit packs that share a common protection scheme; for example, UPSR switching or 1+1 line.

PROTN

Protection

Provisioning

The modification of certain programmable parameters that define how the node functions with various installed entities. These modifications are initiated locally or remotely by either a CIT or an OS. They may arrive at the node via the IAO LAN, CIT port, or any DCC channel. The provisioned data is maintained in NVM and/or hardware registers.

PTM

Pluggable Transmission Module

PWR

Power

Q

QoS

Quality of Service

R

RADIUS

Remote Authentication Dial In User Service

RAI

Remote Alarm Indication

RAM

Random Access Memory

RDI

Remote Defect Indication

Reactive Maintenance

Refers to detecting defects/failures and clearing them.

Remote

See Far-End (FE).

Remote Defect Indication (RDI)

An indication returned to a transmitting terminal that the receiving terminal has detected an incoming section failure. [Previously called far-end-receive failure (FERF).]

Remote Network Element

Any network element that is connected to the referenced network element through either an electrical or optical link. It may be the adjacent node on a ring or N nodes away from the reference. It also may be at the same physical location, but is usually at another (remote) site.

Revertive

A protection switching mode in which, after a protection switch occurs, the equipment returns to the nominal configuration (that is, the service equipment is active, and the protection equipment is standby) after the clearing of any failure conditions that caused a protection switch to occur or after any external switch commands are reset. See Nonrevertive.

RFI

Remote Failure Indication

Ring

A configuration of nodes comprised of network elements connected in a circular fashion. Under normal conditions, each node is interconnected with its neighbor and includes capacity for transmission in either direction between adjacent nodes. Path switched rings use a head-end bridge and tail-end switch. Line switched rings actively reroute traffic over a protection line.

Ring (0x1) Low-Speed Interface

Formerly referred to as dual 0x1 or single 0x1. In ring applications, Alcatel-Lucent 1665 DMX may use a 0x1 interface, meaning both fibers carry service, as opposed to a linear (1+1) low-speed interface where one fiber is used for service and other for protection. See 1+1.

RNE
Remote network element

Root node
The node from which path cost to any other node is measured.

RSTP
Rapid Spanning Tree Protocol

RTAC
Alcatel-Lucent Regional Technical Assistance Center (1-800-225-RTAC)

RTRV
Retrieve

RU
Rack Unit

RZ
Return to Zero

S

SA
Service Affecting

SARB
Status All Resources Busy

SARB Error
This error response indicates the condition “Status, All Resources Busy.”

SD
Signal Degrade

SEFS
Severely Errored Frame Seconds

Self-Healing
Ring architecture in which two or more fibers are used to provide route diversity. Node failures only affect traffic dropped at the failed node.

Service
The operational mode of a physical entity that indicates that the entity is providing service. This designation will change with each switch action.

SES
Severely Errored Seconds

Severely Errored Seconds (SES)

This performance monitoring parameter is a second in which a signal failure occurs, or more than a preset amount of coding violations (dependent on the type of signal) occur.

SF

Super Frame (format for DS1 signal)

SFP

Small Form Factor Pluggable - Type of pluggable transmission modules used for OC-3, OC-12, OC-48, and optical Ethernet/Data interfaces.

Shelf ID

A switch-settable parameter with values from 1 to 8. Used to log into a selected shelf in a bay using the CIT (does not apply to Alcatel-Lucent 1665 DMX).

Shelf View

A graphical depiction of one shelf. Selectable objects in this view are the shelf, the slots/circuit packs, and the ports.

SID

System Identification

Site ID

A switch-settable parameter with values from 1 to 8. Displayed on the SYSCTL circuit pack to indicate to which site the faceplate alarms and LEDs apply (does not apply to Alcatel-Lucent 1665 DMX).

SLA

Service Level Agreement

Slot

A physical position in a shelf for holding a circuit pack and connecting it to the backplane. This term is also used loosely to refer to the collection of ports or tributaries connected to a physical circuit pack placed in a slot.

SM

Single Mode

SMC

SONET Minimum Clock

SNMP

Simple Network Management Protocol

Software Backup

The process of saving an image of the current network element's databases, which are contained in its NVM, to a remote location. The remote location could be the WaveStar CIT or an OS.

Software Download

The process of transferring a software generic from a remote entity to the target network element's memory. The remote entity may be the WaveStar CIT or an OS. The download procedure uses bulk transfer to move an uninterpreted binary file into the network element.

SONET

Synchronous Optical NETwork

Spanning Tree Group

Nodes can be provisioned to belong to a spanning tree group. Only the nodes within that group participate in the spanning tree for the group.

SPE

Synchronous Payload Envelope

Squelch Map

This map contains information for each cross-connection in a ring and indicates the source and destination nodes for the low-speed circuit that is part of the cross-connection. This information is used to prevent traffic misconnection in rings with isolated nodes or segments.

Stand-alone shelf

A shelf that does not have provisioned sub-tending sub-shelves and is not provisioned to operate as a sub-shelf.

Standby

Standby identifies a protected entity which is not currently selected by the receiver at either end as the payload carrying signal hat is not currently carrying service. See Active.

Standing Condition

A standing condition (SC) is either an event (usually user initiated such as a switch request) or an alarm that is provisioned NA (Not Alarmed).

Status

The indication of a short-term change in the system.

STQ

Secondary Transit Queue

Stratum 3 Timing Generator

The timing generator circuit pack, located in the high-speed OLIU circuit pack, that generates clock signals for distribution to the transmit circuits. It operates in the free-running, line-timing, externally timed, and holdover modes.

STS-1 SPE

STS-1 Synchronous Payload Envelope

STS-1 SPE - STS-1 Synchronous Payload Envelope

A 125-µsec frame structure composed of STS path overhead and the STS-1 payload.

STS-12c

Synchronous Transport Level 12 Concatenated Signal

STS-192c

Synchronous Transport Level 192 Concatenated Signal

STS-3c

Synchronous Transport Level 3 Concatenated Signal

STS-3c

Synchronous Transport Level 3 Concatenated Signal. *See OC-3c*.

STS-48c

Synchronous Transport Level 48 Concatenated Signal

STS, STS-n

Synchronous Transport Signal

STS, STS-n - Synchronous Transport Signal

The basic building block signal with a rate of 51.840 Mb/s for an STS-1 signal and a rate of n times 51.840 Mb/s for an STS-n signal.

STU

Synchronized - Traceability Unknown

Sub-shelf

A shelf in a multi-shelf configuration that is provisioned to operate as a sub-tending sub-shelf.

Subnetwork

A group of interconnected/interrelated network elements. The most common connotation is a synchronous network in which the network elements have data communications channel (DCC) connectivity.

Superframe Format (SF)

A DS1 framing format in which 24 DS0 time slots plus a coded framing bit are organized into a frame which is repeated 12 times to form the superframe.

Suspend

Suspend refers to temporarily stopping an upgrade in progress.

Synchronization Messaging

SONET synchronization messaging is used to communicate the quality of network timing, internal timing status, and timing states throughout a subnetwork.

Synchronous Network

The synchronization of transmission systems with synchronous payloads to a master (network) clock that can be traced to a reference clock.

Synchronous Optical Network (SONET)

The North American standard for the rates and formats that defines optical signals and their constituents.

Synchronous Payload

Payloads that can be derived from a network transmission signal by removing integral numbers of bits from every frame. Therefore, no variable bit-stuffing rate adjustments are required to fit the payload in the transmission signal.

Synchronous Payload Envelope (SPE)

The combined payload and path overhead of an STS-1, STS-3c, STS-12c, STS-48c, , or STS-192c signal.

SYSCTL

System Controller (circuit pack)

SYSCTL - System Controller

The system controller circuit pack that provides overall administrative control of the terminal.

System View

A graphical depiction of the entire network element. Selectable objects in this view are the bays and shelves.

T

T1

A carrier system that transmits at the rate of 1.544 Mb/s (a DS1 signal).

T1X1 and T1M1

The ANSI committees responsible for telecommunications standards

T2

A carrier system that transmits at the rate of 6.312 Mb/s (a DS2 signal).

T3

A carrier system that transmits at the rate of 44.736 Mb/s (a DS3 signal).

TA

Telcordia ® Technical Advisory

Target Identifier (TID)

A provisionable parameter that is used to identify a particular network element within a network. It is a character string of up to 20 characters where the characters are letters, digits, or hyphens (-).

TARP

Target Identifiers Address Resolution Protocol

TBD

To Be Determined

TCA

Threshold-Crossing Alert

TCP/IP

Transmission Control Protocol/Internet Protocol

TDC

TARP Data Cache

TDM

Time Division Multiplexing

Telcordia ®

Telcordia ® is a well-recognized telecommunications' standards organization.

Test Access

A set of cross-connection topologies used in conjunction with a testing system to monitor and "split" signal paths for purposes of fault isolation.

Threshold-Crossing Alert (TCA)

A message type sent from a network element that indicates that a certain performance monitoring parameter has exceeded a specified threshold.

Through (or Continue) Cross-Connection

A cross-connection within a ring, where the input and output tributaries have the same tributary number but are in lines opposite each other.

Through Timing

Refers to a network element that derives its transmit timing in the east direction from a received line signal in the east direction and its transmit timing in the west direction from a received line signal in the west direction.

THz

Terahertz (10^{12} Hz)

TID

Target Identifier

Time Division Multiplexing (TDM)

A technique for transmitting a number of separate data, voice, and/or video signals simultaneously over one communications medium by interleaving a portion of each signal one after another.

Time Slot Assignment (TSA)

A capability that allows any tributary in a ring to be cross-connected to any tributary in any lower-rate, nonring interface or to the same-numbered tributary in the opposite side of the ring.

Time Slot Interchange (TSI)

A set of nodes configured as a ring with paths established in both directions of the ring. Switching occurs per-path at the drop nodes.

TIRKS

Trunks Integrated Records Keeping System

TL1

Transaction Language 1

TR

Telcordia ® Technical Requirement

Transaction Language One (TL1)

The permission level associated with each user login that defines which commands the user can execute.

Transparent Mode

In Transparent Mode, port tags (which are actually VLAN tags with a TPID value other than 8100hex) are used to separate traffic for different customers. A port tag is added to each incoming frame at the ingress LAN port. The port tag contains a provisionable customer ID and priority level.

Tributary

A path-level unit of bandwidth within a port, or the constituent signal(s) being carried in this unit of bandwidth; for example, an STS-1 tributary within an OC-N port.

TSA

Time Slot Assignment

TSI

Time Slot Interchange

TSO

Technical Support Organization

TSS

Technical Support Services

U

UAS

Unavailable Seconds

Unavailable Seconds (UAS)

In performance monitoring, the count of seconds in which a signal is declared failed or in which 10 consecutively severely errored seconds (SES) occurred, until the time when 10 consecutive non-SES occur.

Unidirectional Path-Switched Ring (UPSR)

Path-Switched rings employ redundant fiber optic transmission facilities in a pair configuration, with one fiber transmitting in one direction (for example, East) and the backup fiber transmitting in the other direction (for example, West). If the primary ring fails, then the protection ring takes over.

UPD/INIT

Update/Intialize

UPD/INIT

A push button on the SYSCTL faceplate.

UPSR

Unidirectional Path Switched Rings

User Privilege

Permits a user to perform on the computer system on which the system software runs.

V

VAC

Volts Alternating Current

VCG

Virtual Concatenation Group

VDC

Volts Direct Current

Virtual LAN (VLAN)

A virtual LAN (VLAN) is a subset of a LAN. A VLAN is created by putting VLAN IDs in packets that indicate membership to a VLAN of that ID. A Local Area Network (LAN) can have multiple VLANs within it, up to the number of IDs available. Members (ports) of different VLANs do not see the traffic of VLANs of which they are not members. A port may be a member of many VLANs (LAN ports in 802.1Q mode, WAN ports). In the Transparent mode, a LAN port is typically assigned membership to a single VLAN.

In Transparent mode, VLANs are assigned to ports using Port Tag (ed-eport and ed-vcg. In 802.1Q mode, VLANs are assigned to ports using VLAN IDs (ent-vlan/ed-vlan).

A VLAN tag is the specific field of information in a packet that carries the VLAN ID number.

Virtual Switch

A virtual switch is a grouping of ports on an Ethernet switch that results in partitioning of the switch into multiple "logical" switches. A port may only be a member of one virtual switch.

Virtual Tributary (VT)

A structure designed for transport and switching of sub-STS-1 payloads. There are currently four sizes: VT1.5 (1.728 Mb/s), VT2 (2.304 Mb/s), VT3 (3.456 Mb/s), and VT6 (6.912 Mb/s).

VLAN

Virtual Local Area Network

VLF

Very Large Fabric

VM

Violation Monitor

VMR

Violation Monitor and Removal

VoIP

Voice over Internet Protocol

VPN

Virtual Private Network

vslot

Virtual Slot

VT

Virtual Tributary

VT-G - Virtual Tributary Group

A 9-row by 12-column SONET structure (108 bytes) that carries one or more VTs of the same size. Seven VT groups (756 bytes) are byte-interleaved within the VT-organized STS-1 synchronous payload envelope

VT1.5

Virtual Tributary 1.5 (1.728 Mb/s)

VT1.5 Tributary

A SONET logical signal with a data rate of 1.728 Mb/s. In the 9-row structure of the STS-1 SPE, a VT1.5 occupies three columns. VT-structured STS-1 SPEs are divided into seven VT groups. Each VT group occupies 12 columns of the 9-row structure and, for VT1.5s, contains four VTs per group.

W

Wait to Restore Time (WRT)

Corresponds to the time to wait before switching back after a failure has cleared (in a revertive protection scheme). The WRT can be between 0 and 12 minutes, in increments of 1 minute.

Wait-to-Rename

Wait to Rename timer for Optimized 1+1 optical line protection. After a protection switch clears, the system waits the provisioned length of time before renaming the working section 1 and working section 2 as Primary and Secondary.

WAN

Wide Area Network

Wavelength Division Multiplexing (WDM)

A means of increasing the information-carrying capacity of an optical fiber by simultaneously transmitting signals at different wavelengths.

WDCS

Wideband Digital Cross-Connect System

WDM

Wavelength Division Multiplexing

Wide Area Network (WAN)

A communication network that uses common-carrier provided lines and covers an extended geographical area.

Wizard

A form of user assistance that automates a procedure through a dialog with the user.

WTR

Wait to Restore Time

X

XFP

10 Gb/s Small Form Factor Pluggable - Type of pluggable transmission modules used for OC-192 interfaces.

Z

Zero Code Suppression

A technique used to reduce the number of consecutive zeros in a line-codes signal (B3ZS for DS3 signals and B8ZS for DS1 signals).

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