1645 Access Multiplexer Compact (AMC)

Release 9.0

Applications and Planning Guide

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Legal notice

Notice

Every effort has been made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.

Release notification

This document describes 1645 AMC release 9.0.

WEEE directive

The *Waste from Electrical and Electronic Equipment (WEEE) directive* for this product can be found in this document at “Eco-environmental statements” (p. 6-5).

Ordering information

The order number of this document is 365-313-102R9.0 (Issue 1).

Technical support

Please contact your Alcatel-Lucent Local Customer Support Team for technical questions about the information in this document.

Information product support

To comment on this information product, go to the Online Comment Form (http://www.lucent-info.com/comments/enus/) or email your comments to the Comments Hotline (comments@alcatel-lucent.com).

Contents

About this document

Purpose

This Applications and Planning Guide (APG) provides the following information about the 1645 AMC, Release 9.0:

- System overview
- Product description
- Features
- Planning network applications
- Quality and reliability
- Product support
- Ordering

Safety information

For your safety, this document contains safety statements. Safety statements are given at points where risks of damage to personnel, equipment, and operation may exist. Failure to follow the directions in a safety statement may result in serious consequences.

Intended audience

The 1645 Access Multiplexer Compact AMC Applications and Planning Guide is primarily intended for network planners and engineers. In addition, others who need specific information about the features, applications, operation, and engineering of 1645 Access Multiplexer Compact AMC may find the information in this manual useful.

How to use this information product

Each chapter of this guide treats a specific aspect of the system and can be regarded as an independent description. This ensures that readers can inform themselves according to their special needs. This also means that the manual provides more information than needed by many of the readers. Before you start reading the manual, it is therefore necessary to assess which aspects or chapters will cover the individual area of interest.

The following table briefly describes the type of information found in each chapter.

Chapter	Title	Description
About this information product		This chapter • describes the guide's purpose, intended audience, and organization • lists related documentation • explains how to comment on this document
1	Introduction	This chapter • presents network application solutions • provides a high-level product overview • describes the product family • lists the features
2	Product description	This chapter includes • System architecture • Hardware overview • Option cards • Technical specifications
3	Features	Describes the features of 1645 Access Multiplexer Compact AMC
4	Operations, administration, maintenance, and provisioning	Describes OAM&P features (such as alarms, operation interfaces, security, and performance monitoring)
5	Planning considerations	Provides planning information necessary to deploy the system
6	Quality and reliability	This chapter • provides the Alcatel-Lucent quality policy • lists the reliability specifications
7	Product support	This chapter • describes engineering and installation services • explains documentation and technical support • lists training courses
8	Ordering	Describes how to order 1645 Access Multiplexer Compact AMC

Chapter	Title	Description
9	SHDSL Overview	This chapter describes • SHDSL configurations • SHDSL frame structure • Remote management and supervision • SHDSL features
Appendix A	SDH Overview	Describes the standards for optical signal rates and formats (SDH)
Glossary	Defines and explains the following : • Telecommunication terms • Abbreviations • Acronyms	
Index	Lists specific subjects and their corresponding page numbers	

Conventions used

These conventions are used in this document:

Numbering

The chapters of this document are numbered consecutively. The page numbering restarts at “1” in each chapter. To facilitate identifying pages in different chapters, the page numbers are prefixed with the chapter number. For example, page 2-3 is the third page in chapter 2.

Cross-references

Cross-reference conventions are identical with those used for numbering. The first number in a reference to a particular page refers to the corresponding chapter.

Keyword blocks

This document contains so-called keyword blocks to facilitate the location of specific text passages. The keyword blocks are placed to the left of the main text and indicate the contents of a paragraph or group of paragraphs.

Typographical conventions

Special typographical conventions apply to elements of the graphical user interface (GUI), file names and system path information, keyboard entries, alarm messages etc.

- Elements of the graphical user interface (GUI)

These are examples of text that appears on a graphical user interface (GUI), such as menu options, window titles or push buttons:

- **Provision...**, **Delete**, **Apply**, **Close**, **OK** (push-button)
- **Provision Timing/Sync** (window title)
- **View Equipment Details...** (menu option)
- **Administration → Security → User Provisioning...** (path for invoking a window)

- File names and system path information

  These are examples of file names and system path information:

  - *setup.exe*
  - *C:\Program Files\Alcatel-Lucent*

- Keyboard entries

  These are examples of keyboard entries:

  - **F1**, **Esc X**, **Alt-F**, **Ctrl-D**, **Ctrl-Alt-Del** (simple keyboard entries)

    A hyphen between two keys means that both keys have to be pressed simultaneously. Otherwise, a single key has to be pressed, or several keys have to be pressed in sequence.

  - **`copy abc xyz`** (command)

    A complete command has to be entered.

- Alarms and error messages

  These are examples of alarms and error messages:

  - `Loss of Signal`
  - `Circuit Pack Failure`
  - `HP-UNEQ`, `MS-AIS`, `LOS`, `LOF`
  - `Not enough disk space available`

Abbreviations

Abbreviations used in this document can be found in the “Glossary” unless it can be assumed that the reader is familiar with the abbreviation.

Related documentation

This section briefly describes the documents that are included in the 1645 Access Multiplexer Compact (AMC) documentation set.

- Installation Guide
  The 1645 Access Multiplexer Compact (AMC) Installation Guide (IG) is a step-by-step guide to system installation and setup. It also includes information needed for pre-installation site planning and post-installation acceptance testing.
- Applications and Planning Guide
  The 1645 Access Multiplexer Compact (AMC) Applications and Planning Guide (APG) is for use by network planners, analysts and managers. It is also for use by the Alcatel-Lucent Account Team. It presents a detailed overview of the system, describes its applications, gives planning requirements, engineering rules, ordering information, and technical specifications.
- User Operations Guide
  The 1645 Access Multiplexer Compact (AMC User Operations Guide (UOG) provides step-by-step information for use in daily system operations. The manual demonstrates how to perform system provisioning, operations, and administrative tasks by use of ITM Craft Interface Terminal (ITM-CIT).
- Alarm Messages and Trouble Clearing Guide
  The 1645 Access Multiplexer Compact (AMC) Alarm Messages and Trouble Clearing Guide (AMTCG) gives detailed information on each possible alarm message. Furthermore, it provides procedures for routine maintenance, troubleshooting, diagnostics, and component replacement.
- OMS Provisioning Guide (Application 1645 AMC)
  The OMS Provisioning Guide (Application 1645 AMC) gives instructions on how to perform system provisioning, operations, and administrative tasks by using the OMS.

The following table lists the documents included in the 1645 AMC documentation set.

Document title	Document code
1645 AMC Applications and Planning Guide Release 9.0	109660936 365-313-102R9.0
1645 AMC User Operations Guide Release 9.0	109660993 (365-313-104R9.0)
1645 Access Multiplexer Compact AMC Alarm Messages and Trouble Clearing Guide 9.0	109660928 (365-313-105R9.0)
1645 Access Multiplexer Compact AMC Installation Guide 9.0	109660969 (365-313-103R9.0)
OMS Provisioning Guide (Application 1645 Access Multiplexer Compact AMC)	109660977 (365-313-106R9.0)

Document title	Document code
CD-ROM Documentation 1645 Access Multiplexer Compact AMC (all manuals on a CD-ROM)	109660944 (365-313-107R9.0)

These documents can be ordered at or downloaded from the Customer Information Center (CIC) at http://www.cic.alcatel-lucent.com/documents.html, or via your local Customer Support.

Related training

For detailed information about the 1645 AMC training courses and how to register, refer to "Training support" (p. 7-10) in this document.

Software Release Document

The Software Release Document (SRD) describes 1645 Access Multiplexer Compact AMC Release 9.0. For technical reasons, some of the documented features might not be available until later software versions. For precise information about the availability of features, consult the Software Release Description (SRD) that is distributed with the network element software. This provides details of the status at the time of software delivery.

Intended use

This equipment shall be used only in accordance with intended use, corresponding installation and maintenance statements as specified in this documentation. Any other use or modification is prohibited.

Optical safety

IEC customer Laser safety guidelines

Alcatel-Lucent declares that this product is compliant with all essential safety requirements as stated in IEC 60825-Part 1 and 2 "Safety of laser products" and "Safety of optical fibre telecommunication systems". Futhermore Alcatel-Lucent declares that the warning statements on labels on this equipment are in accordance with the specified laser radiation class.

Optical safety declaration (if laser modules used)

Alcatel-Lucent declares that this product is compliant with all essential safety requirements as stated in IEC 60825-Part 1 and 2 "Safety of Laser Products" and "Safety of Optical Fiber Telecommunication Systems". Furthermore Alcatel-Lucent declares that the warning statements on labels on this equipment are in accordance with the specified laser radiation class.

Optical Fiber Communications

This equipment contains an Optical Fiber Communications semiconductor laser/LED transmitter. The following laser safety guidelines are provided for this product.

General Laser information

Optical fiber telecommunication systems, their associated test sets, and similar operating systems use semiconductor laser transmitters that emit infrared (IR) light at wavelengths between approximately 800 nanometers (nm) and 1600 nm. The emitted light is above the red end of the visible spectrum, which is normally not visible to the human eye. Although radiant en at near-IR wavelengths is officially designated invisible, some people can see the shorter wavelength energy even at power levels several orders of magnitude below any that have been shown to cause injury to the eye.

Conventional lasers can produce an intense beam of monochromatic light. The term "monochromaticity" means a single wavelength output of pure color that may be visible or invisible to the eye. A conventional laser produces a small-size beam of light, and because the beam size is small the power density (also called irradiance) is very high. Consequently, lasers and laser products are subject to federal and applicable state regulations, as well as international standards, for their safe operation.

A conventional laser beam expands very little over distance, or is said to be very well collimated. Thus, conventional laser irradiance remains relatively constant over distance. However, lasers used in lightwave systems have a large beam divergence, typically 10 to 20 degrees. Here, irradiance obeys the inverse square law (doubling the distance reduces the irradiance by a factor of 4) and rapidly decreases over distance.

Lasers and eye damage

The optical energy emitted by laser and high-radiance LEDs in the 400-1400 nm range may cause eye damage if absorbed by the retina. When a beam of light enters the eye, the eye magnifies and focuses the energy on the retina magnifying the irradiance. The irradiance of the energy that reaches the retina is approximately 105, or 100,000 times more than at the cornea and, if sufficiently intense, may cause a retinal burn.

The damage mechanism at the wavelengths used in an optical fiber telecommunications is thermal in origin, i.e., damage caused by heating. Therefore, a specific amount of energy is required for a definite time to heat an area of retinal tissue. Damage to the retina occurs only when one looks at the light long enough that the product of the retinal irradiance and the viewing time exceeds the damage threshold. Optical energies above 1400 nm cause corneal and skin burns, but do not affect the retina. The thresholds for injury at wavelengths greater than 1400 nm are significantly higher than for wavelengths in the retinal hazard region.

Classification of Lasers

Manufacturers of lasers and laser products in the U.S. are regulated by the Food and Drug Administration's Center for Devices and Radiological Health (FDA/CDRH) under 21 CFR 1040. These regulations require manufacturers to certify each laser or laser product as belonging to one of four major Classes: I, II, lla, IIIa, lllb, or IV. The International Electro-technical Commission is an international standards body that writes laser safety standards under IEC-60825. Classification schemes are similar with Classes divided into Classes 1, 1M, 2, 2M, 3R, 3B, and 4. Lasers are classified according to the accessible emission limits and their potential for causing injury. Optical fiber telecommunication systems are generally classified as Class I/1 because, under normal operating conditions, all energized laser transmitting circuit packs are terminated on optical fibers which enclose the laser energy with the fiber sheath forming a protective housing. Also, a protective housing/access panel is typically installed in front of the laser circuit pack shelves The circuit packs themselves, however, may be FDA/CDRH Class I, IIIb, or IV or IEC Class 1, 1M, 3R, 3B, or 4.

Laser safety precautions for Optical Fiber Telecommunication systems

In its normal operating mode, an optical fiber telecommunication system is totally enclosed and presents no risk of eye injury. It is a Class I/1 system under the FDA and IEC classifications.

The fiber optic cables that interconnect various components of an optical fiber telecommunication system can disconnect or break, and may expose people to laser emissions. Also, certain measures and maintenance procedures may expose the technician to emission from the semiconductor laser during installation and servicing. Unlike more familiar laser devices such as solid-state and gas lasers, the emission pattern of a semiconductor laser results in a highly divergent beam. In a divergent beam, the irradiance (power density) decreases rapidly with distance. The greater the distance, the less energy will enter the eye, and the less potential risk for eye injury. Inadvertently viewing an un-terminated fiber or damaged fiber with the unaided eye at distances greater than 5 to 6 inches normally will not cause eye injury, provided the power in the fiber is less than a few milliwatts at the near IR wavelengths and a few tens of milliwatts at the far IR wavelengths. However, damage may occur if an optical instrument such as a microscope, magnifying glass, or eye loupe is used to stare at the energized fiber end.

CAUTION

Laser hazard

Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.

Laser safety precautions for enclosed systems

Under normal operating conditions, optical fiber telecommunication systems are completely enclosed; nonetheless, the following precautions shall be observed:

1. Because of the potential for eye damage, technicians should not stare into optical connectors or broken fibers
2. Under no circumstance shall laser/fiber optic operations be performed by a technician before satisfactorily completing an approved training course
3. Since viewing laser emissions directly in excess of Class I/1 limits with an optical instrument such as an eye loupe greatly increases the risk of eye damage, appropriate labels must appear in plain view, in close proximity to the optical port on the protective housing/access panel of the terminal equipment.

Laser safety precautions for unenclosed systems

During service, maintenance, or restoration, an optical fiber telecommunication system is considered unenclosed. Under these conditions, follow these practices:

1. Only authorized, trained personnel shall be permitted to do service, maintenance and restoration. Avoid exposing the eye to emissions from un-terminated, energized optical connectors at close distances. Laser modules associated with the optical ports of laser circuit packs are typically recessed, which limits the exposure distance. Optical port shutters, Automatic Power Reduction (APR), and Automatic Power Shut Down (APSD) are engineering controls that are also used to limit emissions. However, technicians removing or replacing laser circuit packs should not stare or look directly into the optical port with optical instruments or magnifying lenses. (Normal eye wear or indirect viewing instruments such as Find-R-Scopes are not considered magnifying lenses or optical instruments.)
2. Only authorized, trained personnel shall use optical test equipment during installation or servicing since this equipment contains semiconductor lasers (Some examples of optical test equipment are Optical Time Domain Reflectometers (OTDR's), Hand-Held Loss Test Sets.)
3. Under no circumstances shall any personnel scan a fiber with an optical test set without verifying that all laser sources on the fiber are turned off
4. All unauthorized personnel shall be excluded from the immediate area of the optical fiber telecommunication systems during installation and service.

Consult ANSI Z136.2, American National Standard for Safe Use of Lasers in the U.S.; or, outside the U.S., IEC-60825, Part 2 for guidance on the safe use of optical fiber optic communication in the workplace.

Technical documentation

The technical documentation as required by the Conformity Assessment procedure is kept at Alcatel-Lucent location which is responsible for this product. For more information, contact your local Alcatel-Lucent representative.

How to order

This information product can be ordered with the order number 365-313-102R9.0 at the Customer Information Center (CIC), see http://www.cic.alcatel-lucent.com/.

An overview of the ordering process and the latest software & licences information is given in Chapter 8, “Ordering” of this manual.

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 Introduction

Overview

Purpose

This chapter introduces the 1645 Access Multiplexer Compact AMC .

Contents

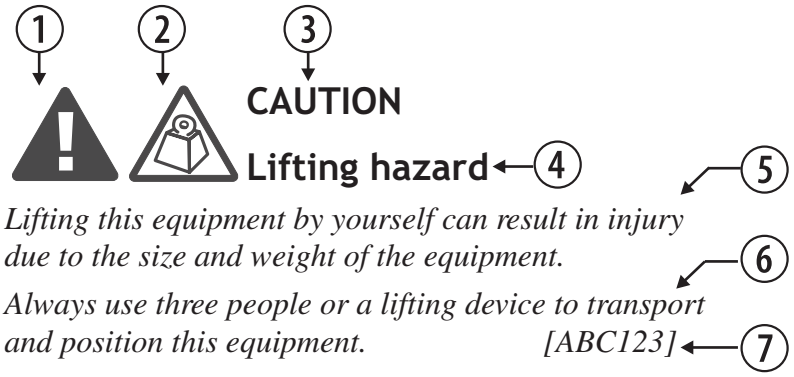
Structure of safety statements

Overview

Safety statements describe the safety risks relevant while performing tasks on Alcatel-Lucent products during deployment and/or use. Failure to avoid the hazards may have serious consequences.

General structure

Safety statements include the following structural elements:



Item	Structure element	Purpose
1	Safety alert symbol	Indicates the potential for personal injury (optional)
2	Safety symbol	Indicates hazard type (optional)
3	Signal word	Indicates the severity of the hazard
4	Hazard type	Describes the source of the risk of damage or injury
5	Safety message	Consequences if protective measures fail
6	Avoidance message	Protective measures to take to avoid the hazard
7	Identifier	The reference ID of the safety statement (optional)

Signal words

The signal words identify the hazard severity levels as follows:

Signal word	Meaning
DANGER	Indicates an extremely hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a hazardous situation not related to personal injury.

1645 Access Multiplexer Compact (AMC) system overview

The 1645 Access Multiplexer Compact AMC is high capacity, flexible and cost-effective wideband multiplexer which can multiplex standard PDH and SDH bit rates as well as Ethernet signals to line transport rates. The system is a useful element in building efficient and flexible networks because of its wide-ranging in capacity in addition to a compact and flexible design.

The standard 1645 AMC without option card is capable of multiplexing up to sixteen 2 Mbit/s signals into an STM-1 or STM-4 signal. The equipment is available unprotected or with 1+1 MSP protection in terminal applications and SNC/N protection for ring applications.

The main board can be upgraded with one of seven option cards as described in Chapter 2, “Product description” and thus be adapted to special network requirements.

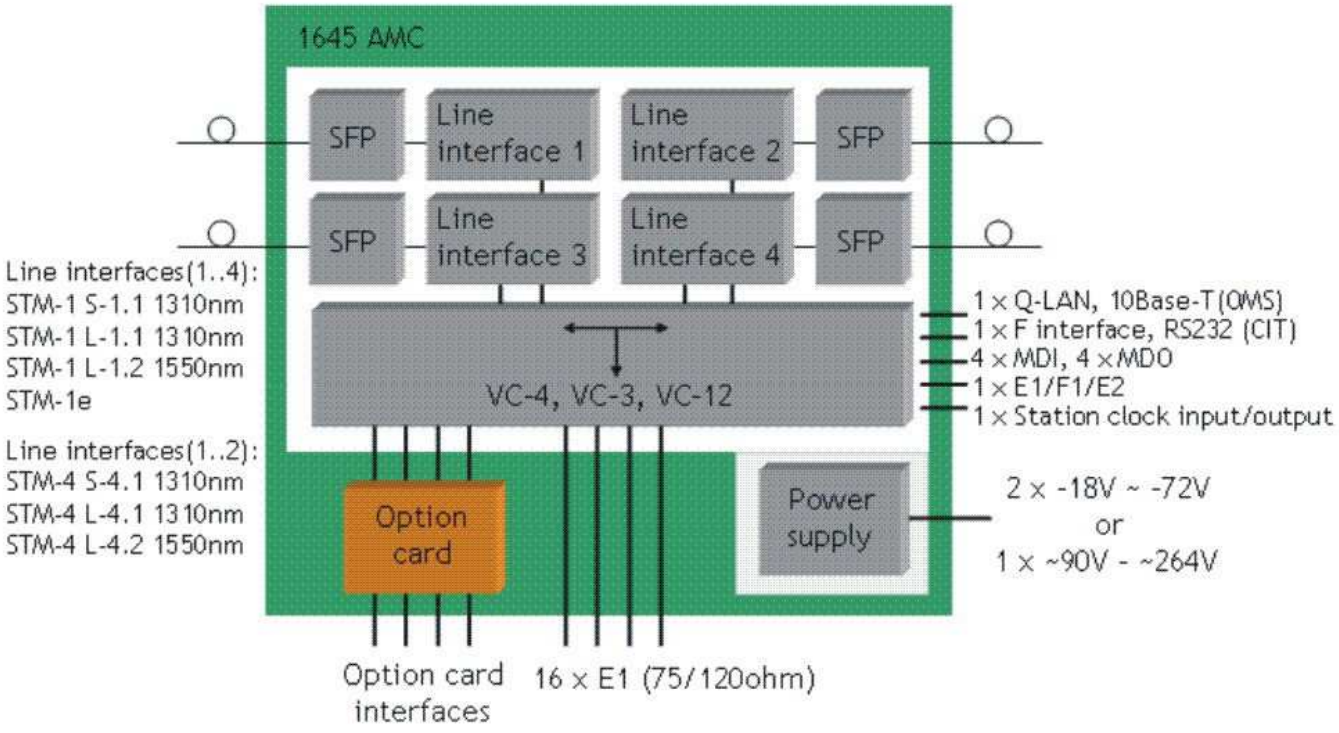
The standard 1645 AMC is capable of multiplexing up to sixteen E1 signals into an STM-1 signal. The equipment is available unprotected or with 1+1 MSP protection in terminal applications and SNC/N protection for ring applications.The main unit comprises two STM-1/STM-4 and two STM-1 optical line interfaces, and 16 E1 interfaces. The optical line interfaces can be equipped with various SFPs (small form-factor pluggable units). All SFPs are equipped with LC connectors. For the STM-1e interfaces, 1.0/2.3 coaxial connectors are used. Additionally, the main board can be upgraded with an option card as described in Chapter 2, “Product description”.

1645 AMC

The 1645 AMC is an SDH STM-1 or STM-4 Terminal or Add-Drop-Multiplexer optimized to provide various tributary services, e.g. STM-1, 1.5 Mbit/s, 2 Mbit/s, 34 Mbit/s, 45 Mbit/s, SHDSLand E/FE/GBE, to business and residential customers. The main card can multiplex tributary signals into a 155 Mbit/s (STM-1) or a 622 Mbit/s (STM-4) optical aggregate signal. The system provides the capability to add one option card. In the access network, the 1645 AMC can be installed at the customer premises for fiber-to-the-business applications, or taking into account the large temperature range, in street cabinets for fiber-to-the curb applications enabling a variety of configurations. Other applications include LAN-to-LAN traffic on campus networks or WANs.

The space-efficient design of 1645 AMC allows for wall, rack or desk mounting; refer to the 1645 AMC Installation Guide.

This figure gives an outline of the basic 1645 AMC building blocks.



Option cards

The 1645 AMC supports the following option cards:

X16E1-V3	16 × E1 interfaces (75/120 Ω)
X16DS1	16 × DS1 interfaces (100 Ω)
X12SHDSL-V2	12 x SHDSL interfaces
X5IP	3 × 10/100BASE-T, 1 × 10/100/1000BASE-T, and 1 × 1000BASE-X Ethernet LAN interfaces (*TransLAN*®)
X10IP	8 × 10/100BASE-T Ethernet interfaces, 2 × 10/100/1000Base-T or optical 1000Base-X/ 100Base-FX interfaces
X8PL	8 × 10/100BASE-T Ethernet LAN interfaces in private line (PL) mode
X6STM1	6 × STM-1 interfaces
X3E3DS3	3 × E3/DS3 interfaces

References

A more detailed product description can be found in Chapter 2, “Product description”.

Key features

Key features of the 1645 AMC include the following:

- Four STM-1 or two STM-4 and two STM-1 optical line interface pairs (transmit/receive)
- Up to sixteen 2 Mbit/s interface ports
- General VC-12, VC-3 and VC-4 SNC/N protection
- 1+1 MSP protection for STM-1 and STM-4
- Performance monitoring
- E1 or DS1 loopbacks
- Cross-connect loopbacks
- Port loopback alarming that allows the user to select an option to alarm the presence of a loopback.
- Declaration of abnormal state in the presence of a loopback and indication of the direction of the loopback.
- E1/E2/F1 access
- Four Miscellaneous Discrete Inputs (MDI)
- Four Miscellaneous Discrete Outputs (MDO)
- 2 MHz station clock output/input
- IP Tunneling in the DCC channels for the management of elements (TCP/IP protocol) such as, Any Media
- Space-efficient for simple and rapid installation within racks, or in customer premises
- Supported by the user-friendly optical management solutions for network management and the optical management system (OMS)
- SNMP traps are supported
- AC/DC powered
- Working in extended temperature range

Usage of option card

1645 AMC can also include one of the following features dependent on the use of a special option card:

- Six additional STM-1 (optical or electrical SFP) tributary ports
- Sixteen 1.5 Mbit/s interfaces
- Sixteen 2 Mbit/s interfaces
- Three 34 Mbit/s or three 45 Mbit/s interfaces

- 3 × 10/100 BASE-T, 1 × 10/100/1000BASE-T, and 1 × 1000BASE-X Ethernet LAN interfaces
- 8 × 10/100BaseT, 2 × 10/100/1000BaseT or optical 1000BaseX/100BaseFX interfaces
- A 2 Mbit timing input and output signal processing system
- Eight Ethernet interfaces in private line mode
- Twelve SHDSL interfaces

These features make the 1645 AMC one of the most cost-effective, future-proof and flexible network elements available in the market today.

Applications

The 1645 AMC supports a large variety of configurations for various network applications:

- Linear application
- Folded ring application
- Ring application
- Single-homed ring application
- Linear extension application
- Grooming application
- IP tunneling in the DCC channel application
- GSM/UMTS application
- SHDSL application
- Multi-service application with the *TransLAN*® option board
- Point-to-point LAN connection

The above mentioned network applications can be found in Chapter 5, “Planning considerations”.

Management

Like most of the network elements of the Alcatel-Lucent optical networking product portfolio, 1645 AMC is managed by the optical management solution family. This includes the local craft terminal ITM-CIT which is available for on-site, but also for remote operations and maintenance activities and the optical management system (OMS) for integrated management of an entire transport network. Additionally, SNMP traps are supported.

Interworking

1645 AMC is a member of the suite of next generation transmission products. The system can be deployed together with other products, for example 1663 ADMu and 1675 Lambda Unite. This makes 1645 AMC one of the main building blocks for today's and future networks.

Besides the inter-working with products of Alcatel-Lucent, the 1645 AMC can interwork as SHDSL LTU with several third party NTUs.

Check with Alcatel-Lucent for a complete list of products that are able to inter-work with 1645 AMC.

2 Product description

Overview

Purpose

The following sections describe the 1645 AMC.

Contents

System architecture

Overview of the 1645 AMC system architecture

Introduction

This section describes the architecture of the equipment and the architecture and function of the option cards.

Main board functionality

The different functions provided by the main board are :

- Microprocessor and control circuits.
  The microprocessor and control circuits manage the different elements of the board, the interfaces (F-interface, LAN-Q) and the LEDs
- Four STM-N optical aggregate interfaces. These interfaces are referred to as “LP1.1, LP1.2, LP1.3 and LP1.4”.
- STM-4 line interface used in STM-4 applications:
  - In the transmit direction, the STM-4 line interface performs the collection of four AU4s and the STM-4 assembly. STM-4 Line interface performs RSOH/MSOH insertion
  - In the receive direction, the STM-4 line interface performs the STM-4 disassembly, the RSOH/MSOH extraction, the management of the four AU4s, and the regeneration of data transmitted to the higher order (HO) cross-connect.
- The HO cross-connect function provides cross connection at VC-4 level.
  The HO cross-connect also performs DCC processing.
- The lower order (LO) cross-connect function provides cross connection at VC-12 and VC3 level.
- HDB3 drivers and receivers are dedicated to the sixteen 2 Mbit/s interfaces of the board.

  Important! The equipment can process IT0 on the 2 Mbit/s G.703 interfaces to G.704/I.431/ETSI ETS 300 011. The bits reserved for national usage support the loop-back command (Sa6 in ETR001/I.604) and the loop signaling. It is possible to replace IT0 in both the PDH to SDH direction and in the SDH to PDH direction.

Cross-connect flexibility

The 1645 AMC cross-connect architecture consists of two cross-connects. A lower-order cross connect (LO-CC) for VC-12 and VC-3 cross-connection and a higher-order cross connect (HO-CC) for VC-4 cross-connection.

Higher-order cross-connects

The 1645 AMC has 50 × 50 VC4 HO-CC capacity. The system supports VC-4 connection between any two AU-4s located in the following interfaces:

Interfaces	line capacity
SDH line	10 STM-1 equivalents
Low order cross connect	16 STM-1 equivalents
SDH, PDH, and/or Ethernet tributary interfaces	22 STM-1 equivalents
2 STM-1 interfaces for internal usage	For VC-4 cross-connection, apply SNC/N protection

Lower-order cross connects

The 1645 AMC has 16 × 16 VC4 LO-CC capacity. The system supports VC-12 or VC3 connection between any two tributary ports or line ports. For VC-12 and VC-3 cross-connections, apply SNC/N protection.

Hardware overview

Hardware overview of the 1645 AMC

This section provides a hardware description of the 1645 AMC Add-Drop-Multiplexer.

Hardware description

The 1645 AMC is a compact and cost-effective STM-1/STM-4 Add/Drop Multiplexer designed to be installed at the customer's premises for fiber-to-the-business applications. The space-efficient design allows for horizontal or vertical wall-mounting within controlled or non controlled environment locations (for example interior closet) or in street cabinets. Refer to the *1645 AMC Installation Guide* for details.

The main board has the following characteristics:

- Two STM-1 optical aggregate line interface pairs (transmit/receive) for SFP usage.
- Two STM-1/ STM-4 optical aggregate line interface pairs (transmit/receive) for SFP usage.
- Sixteen 2 Mbit/s electrical tributary interfaces (E1). The impedance of 75 -120 Ω is automatically set through the cable.
- Supports 33 × 33 / 16 × 16 VC-4s HO/LO non-blocking cross connection capacity
- Supports one V.11 interface for E1/E2/F1 byte.
- Connection facility for tributary interface extensions such as option cards, with a maximum of 22 × VC-4s HOCC connection capacity.
- F-interface (RJ45) complying with V.10/RS-232 for the craft interface terminal (ITM-CIT)
- Q-LAN interface to connect to the EMS or to other NEs is available with an RJ-45 (LAN-10BaseT) connector
- LAN interface 10/100BASE-T (G-LAN)
- Four Miscellaneous Discrete Inputs (MDIs) to read the status of external alarm points, and four Miscellaneous Discrete Outputs (MDOs) to drive external devices are available from a 25 pin male Sub-D connector.
- Station clock input and output interfaces (RJ-45). (2MHz with 75/120 ohm impedance).
- Hardware reset button on faceplate for controller reset.
- Power and failure LEDs support
- System controller for software control of the transmission hardware on the board (including optional interface extensions)
- Necessary hardware for power supply and processing of transmission signals.

- The power supply of the equipment is DC or AC power supply.
- Manual controller reset via NE managers.

Other hardware features include:

- An external and approved 110-230 VAC to -48 VDC converter is available as an option to supply the system with a suitable input voltage.
- On the AMC system, all of the optical connectors are LC types.

Option cards

Overview

Purpose

This section provides an overview of the option cards.

This section describes the option cards which can be used together with the 1645 AMC in order to provide additional interfaces for various data rates or special applications.

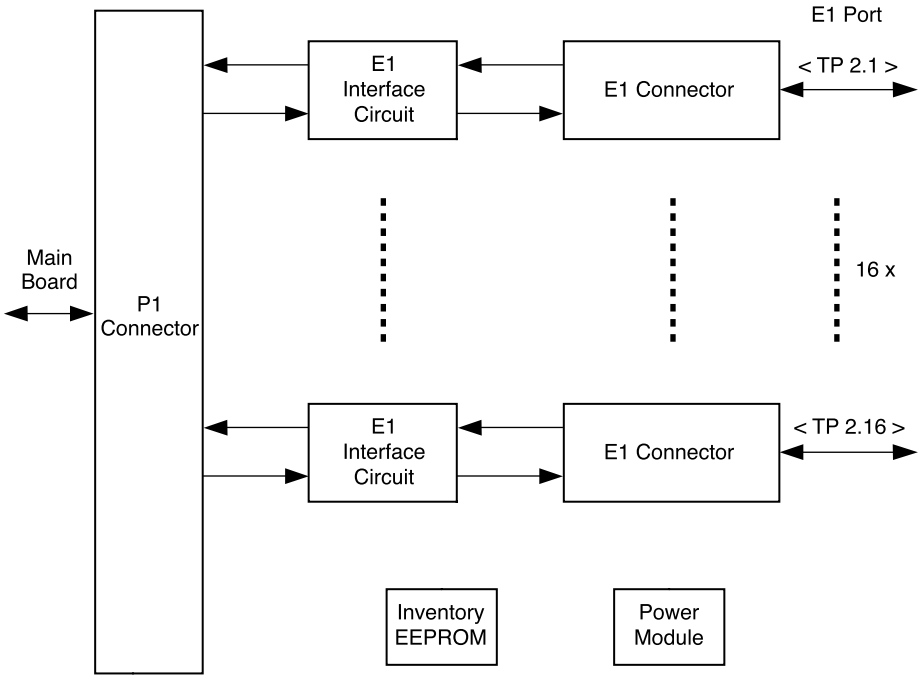
Contents

X16E1-V3 option card

The X16E1-V3 option card provides 16 additional 2 Mbit/s (E1) interfaces.

Physical interfaces to the additional E1 ports are 16 RJ45 connectors for the use of shielded twisted pair cables.

The following figure shows the block diagram of the X16E1-V3 option card:



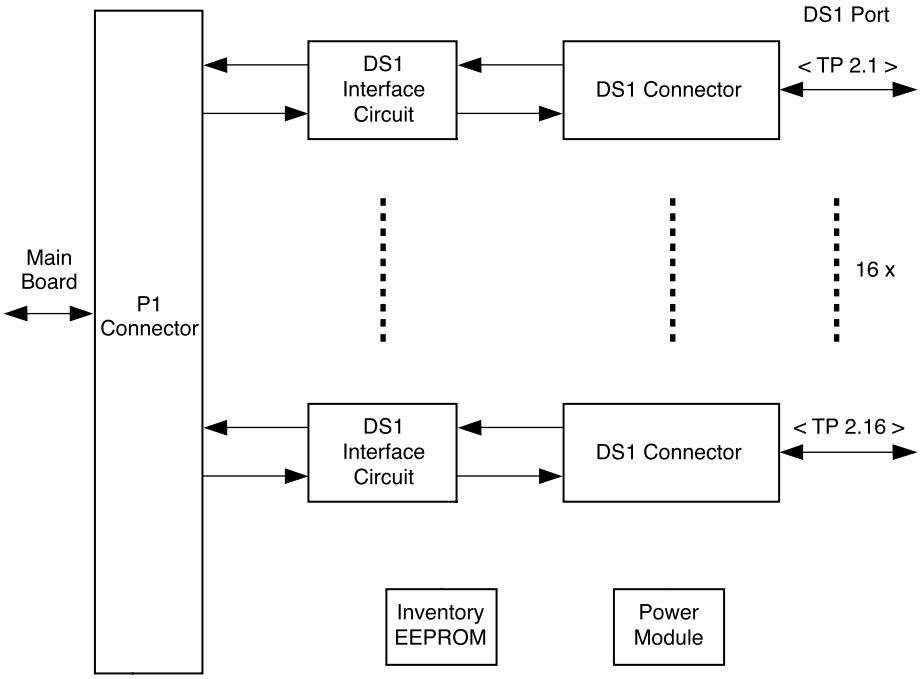
Important! The power of the 1645 AMC must be switched off before the option card is inserted.

X16DS1 option card

The X16DS1-V3 option card provides 16 additional 1.5 Mbit/s (DS1) interfaces.

Physical interfaces to the additional DS1 ports are 16 RJ45 connectors for the use of shielded twisted pair cables.

The following figure shows the block diagram of the X16DS1 option card.



Important! The power of the 1645 AMC must be switched off before the option card is inserted.

X8PL option card

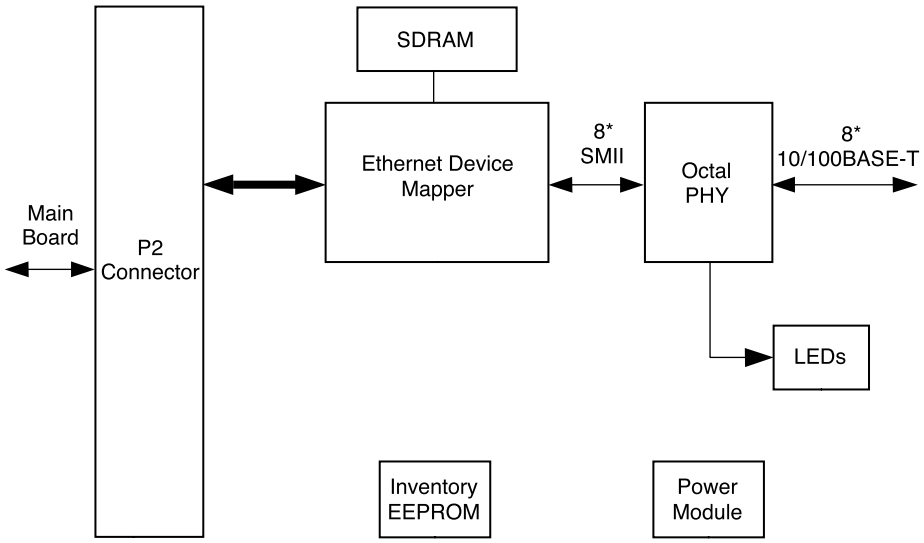
The X8PL option card provides eight Ethernet interfaces in private line mode for the 1645 AMC. The private line mode enables traffic to be mapped from each Ethernet port one-to-one into an SDH container. Thus a private connection from an Ethernet port through an SDH network to another Ethernet port at the remote end of the link is possible.

The X8PL option card supports a flexible allocation of SDH bandwidth to LAN ports by making use of the link capacity adjustment scheme (LCAS, see “LCAS ” (p. 3-12)). All LAN ports have the same capabilities. Each WAN port supports VC-12-Xv (X = 1...63) or VC-3-Xv (X = 1...3).

The VC-12s that form one VCG can be chosen from any TUG-3, in any timeslot order. However, it is recommended to select the VC-12s in sequential order, preferably in one TUG-3. In this way, the end-to-end network design can be kept simple and easy to maintain.

The X8PL option card supports loopbacks on outgoing Ethernet and Fast Ethernet signals.

The following figure shows the block diagram of the X8PL option card:



Important! The power supply to the 1645 AMC must be switched off before the option card is inserted.

X5IP option card

Feature Overview

The X5IP option card provides the following features:

- Repeater mode
- IEEE 802.1Q/IEEE 802.1ad STP switch
- Flexible VCG assignment on VC-3-Xv (X=1..3) and VC-12-Xv (X=1..63)
- rSTP, GVRP
- LPT
- LCAS for VC-3-Xv (X=1..3) and VC-12-Xv (X=1..63)
- TransLAN QoS features: Flow - V-LAN tag and C-port, provisionable PIR/CIR, Fixed scheduling
- Basic and enhanced performance monitoring (PM) counters
- GFP options
- TransLAN QoS features: flow - IP-TOS and D-MAC mask, SP/WRR scheduling
- Provisionable CBS/PBS
- Round trip delay (RTD) measurement
- MAC address table retrieval and configuration

Interfaces

On the faceplate, the X5IP option card provides the following interfaces:

- 10/100/1000BASE-T(X) electrical Ethernet interface using RJ-45 connector supports 10BASE-T, 100BASE-T(X) or 1000BASE-T specifications.
- 10/100BASE-T(X) electrical Ethernet interface using RJ-45 connector supports 10BASE-T and 100BASE-TX specifications
- 1000BASE-SX optical Ethernet interface, covers a distance of 550 m over 50 µm MMF with an operating wavelength of 770-860 nm
- 1000BASE-LX optical Ethernet interface, covers a distance of 5 km over 10 µm SMF with an operating wavelength of 1310 nm
- 1000BASE-ZX optical Gigabit Ethernet interface in single fiber working mode, covers a distance of 70 km with an operating wavelength of 1550 nm for long haul transmission

Alcatel-Lucent connectors

An Alcatel-Lucent connector (LC) based on SFP modules can be used to realize optical Gigabit Ethernet access.

A triple rate Ethernet (10/100/1000BASE-T) access is realized with an RJ-45 connector.

Configurable auto-negotiation

The X5IP option card supports configurable auto-negotiation for 1000BASE-X PHYs, 10/100/1000BASE-T(X), and 10/100BASE-T(X) rates.

1000BASE-X PHYs

1000BASE-X Ethernet PHYs support auto-negotiation for duplexity (full/half duplex) and pause operations (None, Rx only, Tx only or both directions). The X5IP option card only supports the full-duplex mode. Pause operations can only be enabled or disabled by provisioning point-to-point Ethernet services. Other services can only disable this feature.

10/100/1000BASE-T(X)

Triple rate electrical Ethernet PHYs (10/100/1000BASE-T(X)) support auto-negotiation for duplexity (full/half duplex), port rate (10/100/1000 Mbit/s), and pause operation (None, Rx only, Tx only or both directions). The users can override the auto-configuration mechanism with fixed settings or trigger a new auto-negotiation procedure.

10/100BASE-T(X)

The OMS and the ITM-CIT can be used to manually override the auto-negotiation function. If this function is disabled, the users can select a specific operational mode such as port speed, half/full duplex, and flow control.

Ethernet mapping schemes

The following sections describe the mapping schemes for VC3-Xv and VC12-Xv Ethernet frames.

Mapping Ethernet frames into VC3-Xv: GFP encapsulation

The X5IP option card supports the following mapping scheme for Ethernet frames:

AU4 < - > VC4 < - > m *TUG3 < - > X *TU3 < - > X *VC3 < - > VC3-Xv < - > GFP < - > 802.3

The GFP encapsulation scheme follows the ITU-T G.7041 standard. The number of virtual concatenated VC3 containers ranges from 1 to 3.

Mapping Ethernet frames into VC12-Xv: GFP encapsulation

The X5IP option card supports the following mapping scheme for Ethernet frames:

AU4 < - > VC4 < - > m *TUG3 < - > n *TUG2 < - > X*TU12 < - > X*VC12 < - > VC12-Xv < - > GFP < - > 802.3

The GFP encapsulation scheme follows the ITU-T G.7041 standard. The number of virtual concatenated VC12 containers ranges from 1 to 63.

Flexible bandwidth assignment

The X5IP option card supports flexible assignment of VC capacity to create various size VCGs. The available capacity of one VC4 can be divided in three TUG3s. Each TUG3 can be used a single VC3 or as 21 VC12s.

These VC3 and VC12 containers can be assigned to a maximum number of 8 VCGs. For each VCG, the users can choose between VC12-Xv (X=1-63) and VC3-Xv (X=1-3), based on the total number of containers that are available for each container type.

Link capacity adjustment scheme (LCAS)

The 1645 AMC supports the LCAS function for VC3-Xv concatenated signals on the X5IP option card. According to ITU-T G.7042/Y.1305 standard, this function is implemented using H4[1,4] bits of multiframe positions 2, 3, 8, 9, and 10.

The 1645 AMC also supports the LCAS function for VC12-Xv concatenated signals on the X5IP option card. According to ITU-T G.7042/Y.1305 standard, this function is implemented using K4[2] multiframe bits 12 through 32.

LAN modes

The X5IP option card supports the following LAN modes:

- LAN bridge mode
- LAN promiscuous mode

LAN bridge mode

According to the IEEE802.1D standard, the Ethernet bridge provides the following functions:

- Point-to-point LAN bridge
- Multiport bridge for 13 ports
- MAC address filtering via self learning protocol (up to 8k MAC addresses)
- Spanning-tree algorithm
- Transparency to VLAN tagged packets from end customers
- Broadcasting, including end user BPDUs

All L2 switching relations can process packets at wire speed. In case of congestion on a specific port, packets will be arbitrarily dropped from the tail.

LAN promiscuous mode

In addition to the L2 switching capabilities of the LAN bridge mode, the X5IP option card supports operations in promiscuous mode. In this mode, the L2 switching function forwards all Ethernet packets that are received without address filtering. This function is only supported for a point-to-point switching relation and can be configured for each switch relation.

VLAN tagging - IEEE 802.1Q

The X5IP option card supports an IEEE 802.1Q compliant VLAN tagging, classification, and filtering standard on all of its external Ethernet LAN ports or internal WAN ports. However, note that this tagging mode is incompatible with the port based VPN customer tagging mode.

The Ethernet packets are processed as follows:

A customer's VLAN tagged packets are VLAN classified according to the VLAN ID contained in the VLAN tag. The system performs VLAN ingress filtering based on the port membership of the receiving port for a specific VLAN.

A customer's untagged and priority-tagged packets are VLAN classified according to a default port VLAN ID (PVID identification for customers through port-based VPN customer tagging) that is assigned to the receiving port. The system inserts the PVID in the VLAN tag. A unique VLAN ID can be provided to customers.

E/FE/GbE VLAN trunking

The X5IP option card aggregates E/FE/GbE traffic of multiple end-users over a single external Ethernet or Fast Ethernet or Gigabit Ethernet port. Such a VLAN trunk port is a shared member of multiple VLANs from different end-users. The VLAN ID list is configurable during the VLAN classification process.

GARP VLAN registration protocol (GVRP)

The 1645 AMC supports the GARP VLAN Registration Protocol (GVRP) on the X5IP option card. This protocol is used to maintain VLAN identification consistency and connectivity throughout the switched WAN network.

Rapid spanning tree protocol (rSTP)

The 1645 AMC supports the Rapid Spanning Tree Protocol for each virtual switch on the X5IP option card based on the IEEE 802.1D standard.

Overlength Ethernet frames

The X5IP option card supports forwarding, encapsulation, and mapping of Ethernet frames with lengths up to 1650 octets/bytes.

The X5IP option card hardware also supports Ethernet frames with lengths up to 9216 bytes in repeater mode.

Enhanced flow classification

The X5IP option card supports Enhanced Flow Classification - 802.1Q mode and 801.2ad mode. Network traffic from end users can be classified into flow categories on the edge ports of a TransLAN® domain. As a result, the ports can be provisioned as “Edge” or “Interior” ports. Edge ports are either Customer Role ports (UNI) or “Virtual ports” on a Trunk port (E-NNI). A virtual port is the traffic over a trunk port belonging to a single end-user and is characterized by an S-VID tag.

The QoS edge ports support up to seven provisionable flows of 1k per unit and can be defined with a combination of the following criteria:

- flow = port
- flow = C-Tag (C-VID, C-UP) previously known as: VID, UP
- flow = IP-TOS field (DSCP)
- flow = Destination address mask (for broadcast/multicast and for customer control traffic)

Additionally, a default flow for each user is already present. When the ports are designated as “Interior”, the flow classification is completely based on the S-UPT bits. There is no rate control and the S-UPT bits are transparently transported through the device. Virtual ports on a trunk port can be provisioned to behave as "Interior" ports, i.e. to use the S-UPT bits for classification instead of the freely provisionable flow. By provisioning a (virtual) port as an "Interior" port, the flow definition is fixed.

Enhanced flow properties

The 1645 AMC supports enhanced flow classification properties that can be provisioned for each flow. The users can provision the properties of each flow by assigning a traffic class and provisioning the threshold rate. The threshold rate (CIR/PIR) can be provisioned in 1 kbit/s steps above 150 kbit/s. A policy can be provisioned for traffic above this threshold rate. For example, immediate dropping (strict policing: CIR=PIR) or marking with high dropping precedence (over-subscription: CIR<= PIR<=MAX). The assigned traffic class and dropping precedence are coded into the S-UPT bits of the frame on the egress side.

The X5IP option card supports Committed Burst Size (CBS) and Peak Burst Size (PBS) provisioning. Users can provision the CBS and PBS parameters to QoS profiles for IEEE 802.1Q and IEEE 802.1ad modes.

QoS provisioning in provider bridge mode (PBM)

The X5IP option card supports Flow Classification of ingress traffic into the L2 switch based on the IEEE 802.1Q tagging mode. For every Flow Classification, users can assign a Flow Profile containing the QoS parameters that are to be applied to the flow.

A Flow Profile can be labelled and pre-provisioned. It can be assigned to multiple flows and contains the following parameters:

- Traffic conditioning parameters such as TransLAN® ingress rate control parameters including dropping precedence marking.
  Frames below CIR are classified as "green" (low dropping precedence). Frames between CIR and PIR are classified as "yellow" (high dropping precedence). Frames above PIR are classified as "red" and are dropped. The high or low dropping precedence is encoded in the LSB of the user_priority field of the S-TAG.
- Traffic class flow assignment including traffic class marking indicating a certain service level.
  Users can assign a traffic class for each flow which determines the value of the 2 MSB user_priority bits in the S-TAG of the frames that are classified to the flow. The relation between the assigned traffic class and the 2 MSB user_priority bits is fixed. Based on the traffic class, the frame will be assigned to a certain queue by a fixed traffic class to queue mapping function that is present in each switch.
- Limits: maximum 250 profiles per system including traffic class and rate control parameters.

Q-tagging mode

The X5IP option card supports Flow Classification in the IEEE 802.1Q tagging mode. Users can assign a similar flow profile as described above for the IEEE 802.1ad tagging mode. Note that the QoS classification operations will only modify the end-user priority (UP) bits.

CQS - Provider Bridge Mode (PBM) and Q-tagging mode

The X5IP option card supports classification, queuing, and scheduling functions for four traffic classes, associated with three queues in the Provider Bridge Mode and Q-tagging mode.

Note: In the Q-tagging mode, this function is a non-standard conformance operation mode in which the customer's user priority (UP) bits will be modified.

Ingress rate control in Provider Bridge Mode (PBM) and Q-tagging mode

The X5IP option card supports ingress rate control values through rate policing per flow at customer role ports in provider bridge mode and Q-tagging mode. This function is based on 'Strict policing' values where (PIR=CIR) and 'Oversubscription' values where (PIR>CIR).

> **Note:** In the Q-tagging mode, this function is a non-standard conformance operation mode in which the third user priority (UP) bit of the customer tag will be modified.

LAN port provisioning

The following sections describe LAN port provisioning capabilities that are supported by the X5IP option card.

Maximum number of IEEE mode V-LANs and provider bridge mode CIDs

In combination with the X5IP option card, the 1645 AMC supports a maximum number of 64 IEEE mode V-LANs and Provider Bridge Mode CIDs based on the 'per NE' rule.

LAN port as network port or customer port

The X5IP option card can be used to operate a LAN port as a network port or customer port. Based on the IEEE 802.1Q and IEEE 802.1ad modes, the 1645 AMC supports a flexible operational port role assignment per LAN port. During port provisioning, a LAN port can be set to a 'network' role.

The following properties are applicable to a port in a 'network' port role:

- No V-LAN tagging operations
- Provider based Spanning Tree Protocol (provisionable, default=enabled)
- GVRP operations (provisionable , default=enabled)

The following properties are applicable to a port in a 'customer' port role:

- V-LAN tagging operations
- No provider based Spanning Tree Protocol
- No GVRP operations

WAN port as network port or customer port

In IEEE 802.1Q and IEEE 802.1ad modes, the network element supports a flexible operational port role assignment per WAN port. Next to the default "network" port role, a WAN port can be set to "customer" role.

The following properties apply to a port in "network" port role:

- No VLAN tag/untag operation
- Provider Spanning Tree Protocol (provisionable, default is enabled)
- GVRP operation (provisionable, default is enabled)

The following properties apply to a port in "customer" port role:

- VLAN tag/untag operation
- No provider spanning tree protocol
- No GVRP operation

Configurable rSTP and GVRP participation

The participation of network ports in the rSTP is configurable for virtual switches that are operating in IEEE 802.1Q and IEEE 802.1ad modes. The network port participation enables BPDUs to be transmitted, received, and interpreted.

The participation in GVRP for network ports that participate in rSTP is user-provisionable. The network port participation in rSTP enables BPDUs to be transmitted, received, and interpreted.

Maximum V-LANs under GVRP control

The X5IP option card supports a maximum number of 247 active IEEE 802.1Q or IEEE 802.1ad CIDs on GVRP enabled virtual switches per unit.

Maximum V-LANs without GVRP control

The X5IP option card supports a maximum number of 247 active VLANs (IEEE 802.1Q or IEEE 802.1ad CIDs) without GVRP.

MAC address management

The X5IP option card supports addition of static MAC address entries into the filtering database. These entries are not submitted to the ageing time process. When required, users can delete MAC address entries from the filtering database using configuration commands.

The X5IP option card supports the programmable ageing pass time feature. To check the MAC address entries automatically, the ageing pass timer can be provisioned for a duration between 10 seconds to 630 seconds in steps of 10 seconds for the whole filtering database. The default value is 300 seconds. The X5IP option card supports queries for whole static MAC address entries and dynamic MAC address entries by specifying the MAC address and V-LAN tag.

MAC layer access control lists

The user has the option to filter frames while provisioning a customer role port. The criteria to filter frames, is the MAC destination address from a list containing predefined individuals or groups of MAC addresses which are usually dedicated to the so called Layer 2 Control Protocols (L2CP). For a customer role port on a virtual switch, the user can create an Access Control List (ACL) by selecting one or more entries from a predefined list of MAC protocols. Incoming frames with a destination MAC address matching one of the values implied by the ACL, are dropped without any alarms being raised.

Security - locked port mode

The X5IP option card enables users to set a port in locked mode. All the new frames that are transmitted into the locked port will be dropped and the SA cannot be learnt. Alarming is reported against new frames in locked port mode.

Link pass-through

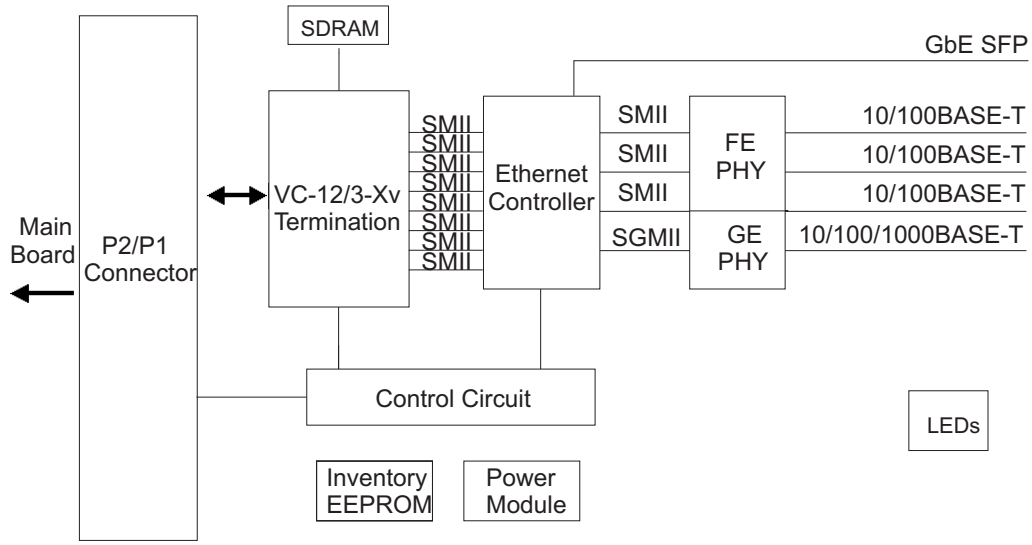
The Fast Ethernet electrical interface and Gigabit Ethernet electrical and optical interfaces on the X5IP option card support link pass-through modes. The Ethernet port transmitter is shutdown in the upstream network due to the following failures:

- loss of signal reported on a remote TransLAN Ethernet option card due to Ethernet cable or fiber failure.
- SDH/SONET network failure
- upstream equipment failure.

Remote failures are reported in-band through the GFP-Client Signal Fail message. The link pass-through mode is only supported on ports that operate on a one-to-one association with a WAN port using GFP encapsulation. Users can enable or disable the link pass-through mode per port.

The X5IP option card supports loopbacks on outgoing Ethernet, Fast Ethernet, and Gigabit Ethernet signals.

The following figure shows the block diagram of the X5IP option card:



Performance monitoring

Support for following performance monitoring features is available on the X5IP card:

- Enhanced Ethernet performance monitoring features.
- Enhanced Basic Ethernet features.
- PM counters for high quality traffic load per TC/port.
- PM counters for low quality traffic load per TC/port.
- Performance monitoring counter for Ethernet service flows.
- RTD measurement.
- RTD PM counters and provides RTD/TCA support.

X5IP-V2 option card

The X5IP-V2 option card supports all the HW and SW features of X5IP.

The system provides an L2 switch Ethernet interface extension (version 2) providing three 10/100BaseT Ethernet interfaces, one 10/100/1000BaseT Ethernet interface and one optical GbE interface to be used with the AMC motherboard.

Note: The X5IP-V2 and X5IP option cards are not compatible with each other.

X12SHDSL-V2 option card

The X12SHDSL-V2 option card provides additional interfaces for the 1645 AMC in order to integrate sites with 2 Mbit/s access into an existing network in cases where no fiber is available.

The X12SHDSL-V2 option card could, for example, be used for the following applications:

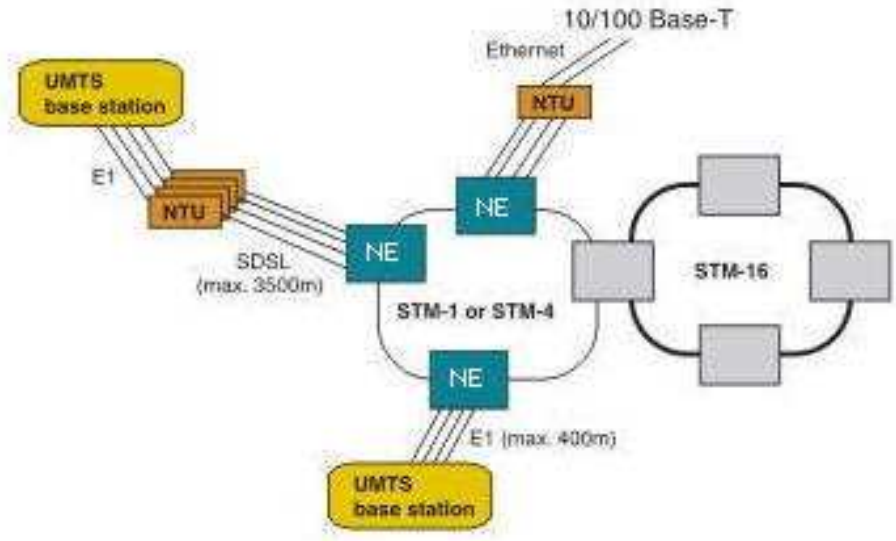
- Connection of UMTS/GSM base stations to the SDH network via copper lines
- Delivery of ISDN traffic to customers via copper lines
- Connection of industrial parks or major customers.

Applications

The following figures show two typical network examples for the connection of UMTS base stations via copper lines:

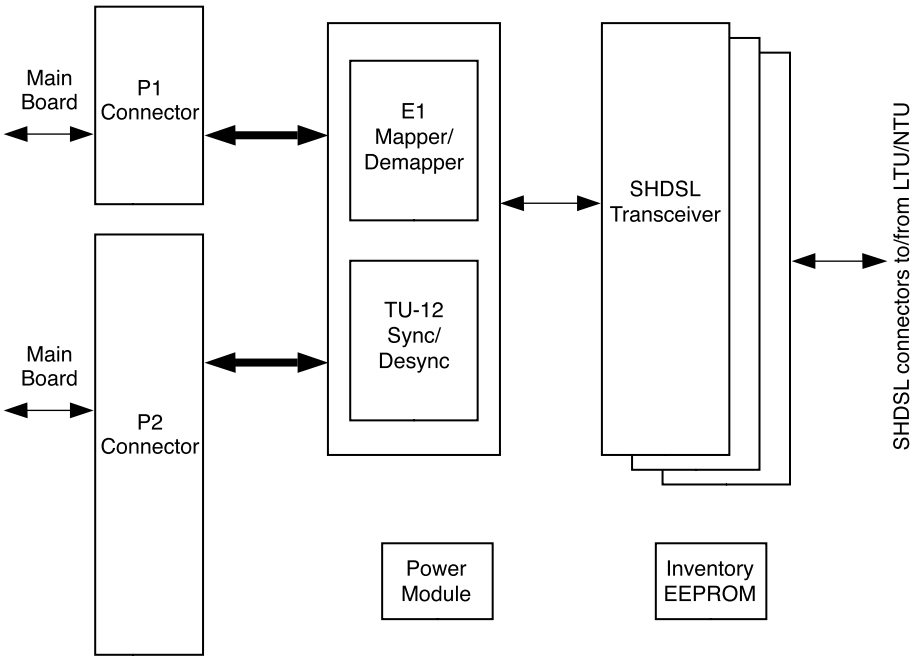
In this example a 1645 AMC provides the interfaces to several third party NTUs to which a base station is connected. The connection to the SDH network is realized via a 1645 AMC which serves as Line Termination Unit (LTU) in this case. The two units are connected via twisted copper pairs.

For the data transmission the SHDSL protocol is used. In this case the copper pairs can have a maximum length of 3.5 km. It is also possible to connect base station directly via 2 Mbit/s (E1) lines as shown in the example. In such an application a maximum length of 400 m can be bridged.



Functional description of the X12SHDSL-V2 option card

The following figure shows the architecture of the X12SHDSL-V2 option card. The option card provides 12 SHDSL interfaces compliant to ITU-T G.991.2. The data rate of each SHDSL interface depends on the selected operation mode. The X12SHDSL-V2 option card uses both the P1 and the P2 connector for the communication with the main board.



Operation modes

The 1645 AMC can be configured as LTU and operated in E1 or TU-12 mode.

The mode selections apply to the 1645 AMC as a whole. The selections cannot be made to individual ports.

The E1 or TU-12 mode can be provisioned using ITM-CIT or OMS. The TU-12 mode offers the possibility to utilize SDH functionalities for the SDH link, e.g. Performance Monitoring or Fault Management.

SHDSL line rates

The SHDSL line rate of the X12SHDSL-V2 option card depends on the TU-12/E1 mode selection:

In TU-12 mode, the SHDSL rate 2320 kbit/s, i.e. 2 × 8 kbit/s overhead and 2304 kbit/s payload.

In E1 mode, the SHDSL rate 2056 kbit/s, i.e. 8 kbit/s overhead and 2048 kbit/s payload.

X6STM1 option card

The X6STM1 option card provides six bidirectional STM-1e/o interfaces to be used with the 1645 AMC main board.

With X6STM1, the 1645 AMC can build a low cost linear access aggregation application, which can aggregate up to 8*STM-1 (six on option board and two on main board) traffic into two unprotected STM-4 ports and then feed into metro core transport network.

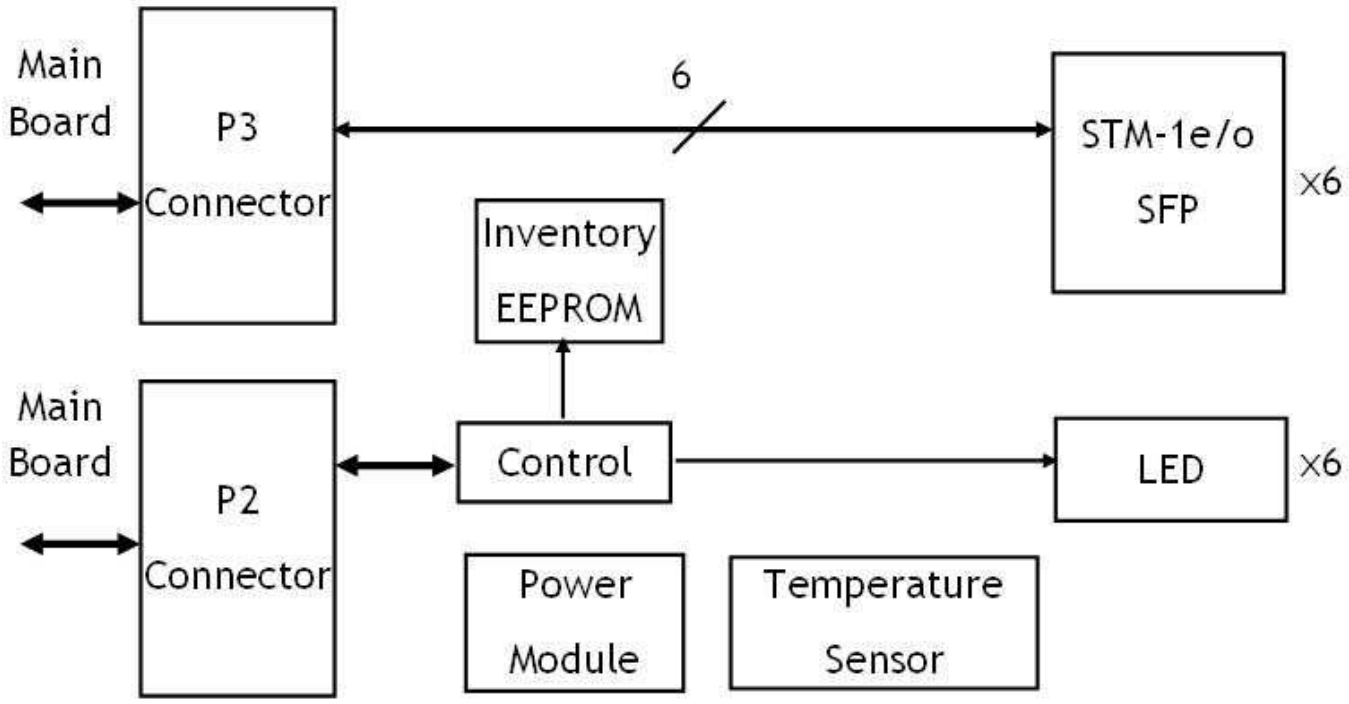
On the X6STM1 option card, there are six SFP cages. Each cage can be equipped with an Alcatel-Lucent qualified STM-1 SFP, either optical or electrical. Other data rate or non Alcatel-Lucent qualified SFPs are not be accepted by the system and will not function properly. Close to each SFP cage, there is a dedicated red LED. Each SFP LED indicator should support three behaviors: ON, OFF and Blink, as listed below.

- OFF: no failure (if SFP module is installed) or the absence of SFP module
- ON: hardware failures or configuration alarms
  - Hardware failures refer to one of the following failures: fWUP, fUNI, fPM-EQF or fPM-UPF
  - Configuration alarms refer to unlicensed or unmatched SFP modules
- Blink: transmission failures caused by LOS and LOF if the port is set to monitor.

The 1645 AMC provides RS/MS termination functionality and pointer processing for six STM-1s. The unit operates in AU-4 mode, with full lower order cross-connection capability.

Together with the1645 AMC main board, the system supports up to 8*MS-DCC.

The following figure shows the block diagram of the X6STM1 option board:



Important! The power of the 1645 AMC must be switched off before the option card is inserted.

X3E3DS3 option card

The X3E3DS3 option card provides three bidirectional E3/DS3 clear channel interfaces.

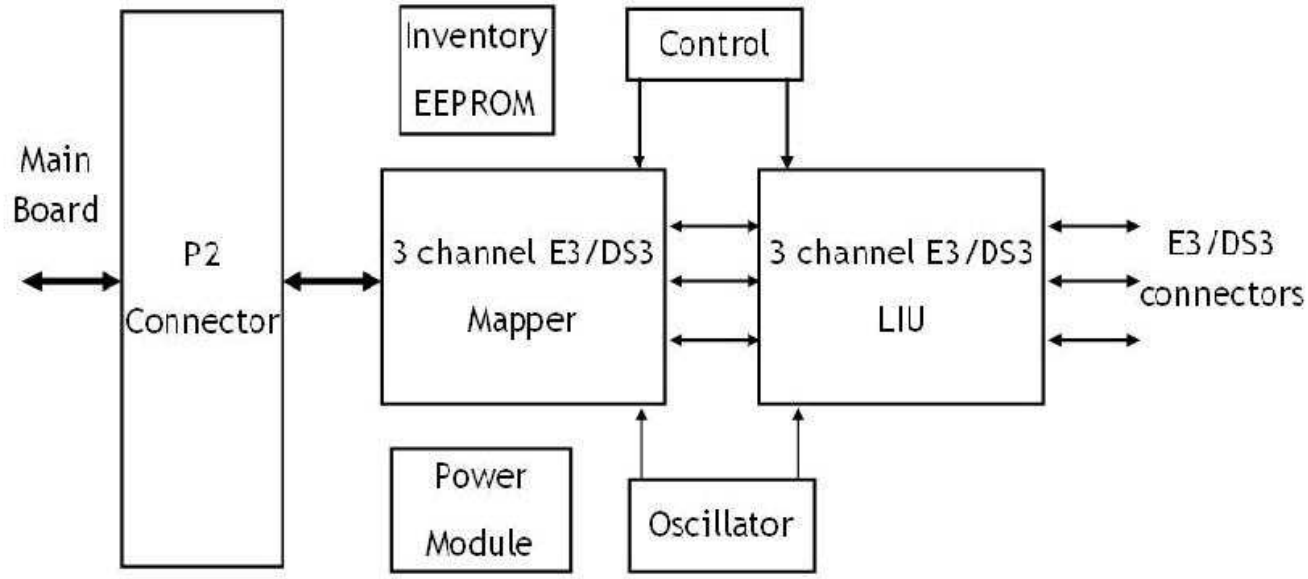
The physical interfaces to the E3/DS3 ports are six DIN1.6/5.6 coaxial connectors: one for the transmit and one for the receive directions for each E3/DS3 port. l.

The electrical interface parameters for the E3/DS3 signals conform to the standards specified in G.703. E3/DS3s are mapped to STM-N (N=1,4) according to AU4-VC4-TUG3-TU3-VC3. Both incoming and outgoing loopbacks are supported for each E3/DS3 signal.

The network element manager can provision the E3 or DS3 mode per option card.

The option card provides three 34 Mbit/s or three 45 Mbit/s interfaces to be used with the 1645 AMC main board.

The following figure shows the block diagram of the X3E3DS3 option board:



Important! The power of the 1645 AMC must be switched off before the option card is inserted.

X10IP option card

Feature overview

The X10IP option card provides the following features:

- Configurable auto-negotiation for 1000BASE-X PHYs, 10/100/1000BASE-T(X), and 10/100BASE-T(X)
- Flexible VCG assignment on VC4-Xv/VC3-Xv/VC12-Xv
- LCAS for VC12-Xv, VC3-Xv, and VC4-Xv concatenated signals
- Link Pass Through (LPT)
- LAN bridge and promiscuous modes
- Repeater and IEEE802.1Q / IEEE802.1ad operation modes
- IEEE 802.1ad provider bridge support
- Port based performance monitoring
- Loopbacks on outgoing E/FE and GbE signals
- Support for Ethernet frames with length ranging from 64 bytes to 1650 bytes on E/FE and GbE ports

Interfaces

On the faceplate, the X10IP option card provides the following interfaces:

- Eight LAN ports with auto-negotiated 10/100BASE-T and two LAN ports switchable between 10/100/1000Base-T and 1000Base-X/100Base-FX optical SFP.
- 10/100BASE-T(X) Ethernet interface conforming to IEEE 802.3 Clause 14 and 25 and supporting 10BASE-T and 100BASE-TX specifications
- 1000BASE-SX optical Ethernet interface, covering a distance of 550 m over 50 µm MMF with an operating wavelength of 770-860 nm
- 1000BASE-LX optical Ethernet interface, covering a distance of 5 km over 10 µm SMF with an operating wavelength of 1310 nm
- An optical Ethernet interface conforming to IEEE 802.3 Clause 26, covering 2 km distance over 50 µm MMF and operating at a wavelength of 1310 nm.
- An optical Gigabit Ethernet interface supporting 1000BASE-ZX optical interface (1550 nm long haul, single mode fiber) with a target distance of 70 km

Alcatel-Lucent connectors

An Alcatel-Lucent connector (LC) based on SFP modules can be used to realize optical Gigabit Ethernet access.

A triple rate Ethernet (10/100/1000BASE-T) and 10/100BaseT Ethernet interface access is realized with an RJ-45 connector.

Configurable auto-negotiation

The X10IP option card supports configurable auto-negotiation for 1000BASE-X PHYs, 10/100/1000BASE-T(X), and 10/100BASE-T(X) rates.

1000BASE-X PHYs

1000BASE-X Ethernet PHYs support auto-negotiation for Duplexity (Full/Half Duplex) and pause operations (none, Rx only, Tx only or both directions). The X10IP option card only supports the Full-Duplex mode. Pause operations can only be enabled or disabled by provisioning point-to-point Ethernet services. Other services can only disable this function.

10/100/1000BASE-T(X)

Triple rate electrical Ethernet PHYs (10/100/1000BASE-T(X)) support auto-negotiation for Duplexity (Full/Half Duplex), Port Rate (10/100/1000 Mbit/s), and Pause operation (None, Rx only, Tx only or both directions). The user can override the auto-configuration mechanism with fixed settings or trigger a new auto-negotiation procedure.

10/100BASE-T(X)

The OMS and the ITM-CIT can be used to manually override the auto-negotiation function. If this function is disabled, the users can select a specific operational mode such as port speed, Half/Full Duplex, and flow control.

Switching between triple-rate and 1000BASE-X PHYs

A logical port on the X10IP option card can support a different port type even via a different physical media. The user has the option to select the port type. A 1000 Mbit/s port can either be used for a 1000BASE-X optical PHY or a 10/100/1000BASE-T(X) triple-rate electrical PHY.

Note: The NE will process the port type provision request and report a failure/reject the request, if it is incompatible with the existing settings.

Ethernet mapping schemes

The following sections describe the mapping schemes for VC3-Xv, VC4-Xv, and VC12-Xv Ethernet frames:

Mapping Ethernet frames into VC3-Xv: GFP encapsulation

The X10IP option card supports the following mapping scheme for Ethernet frames:

AU4 < - > VC4 < - > m *TUG3 < - >X *TU3 < - > X *VC3 < - > VC3-Xv < - > GFP < - > 802.3

The GFP encapsulation scheme follows the ITU-T G.7041 standard. The number of virtual concatenated VC3 containers ranges from 1 to 9.

Mapping Ethernet frames into VC4-Xv: GFP encapsulation

The X10IP option card supports the following mapping scheme for Ethernet frame:

X*AU4 < - > X*VC4 < - > VC4-Xv < - > GFP < - > 802.3

The GFP encapsulation scheme follows the ITU-T G.7041 standard. The number of virtual concatenated VC4 containers ranges from 1 to 8.

Mapping Ethernet frames into VC12-Xv: GFP encapsulation

The X10IP option card supports the following mapping scheme for Ethernet frames:

AU4 < - > VC4 < - > m*TUG3 < - >n*TUG2 < - > X*TU12 < - > X*VC12 < - > VC12-Xv < - > GFP < - > 802.3

The GFP encapsulation scheme follows the ITU-T G.7041 standard. The number of virtual concatenated VC12 containers ranges from 1 to 63.

Flexible bandwidth assignment

Various sizes of VCGs can be created on the X10IP option card providing a flexible assignment of VC capacity. The available capacity of a VC4 can be divided into three TUG3s. Each TUG3 can be used either as a single VC3 or as 21 VC12s. The maximum number of VCGs that can be assigned with the created set of VC4, VC3, and VC12 containers is equal to the number of WAN ports.

Based on the total number of containers available for each type of VCG, the user can select the size of the VC group as shown in the following table:

VCG	Group size
VC12-Xv	X=1-63
VC3-Xv	X=1-9
VC4-Xv	X=1-8

Link Capacity Adjustment Scheme (LCAS)

The 1645 AMC supports the LCAS function for VC12-Xv, VC3-Xv, and VC4-Xv concatenated signals on the X10IP option card. This function is implemented for the VC12-Xv concatenated signals using K4[2] multiframe bits 12 through 32, in accordance with the ITU-T G.7042/Y.1305 standard. For the VC3-Xv and VC4-Xv concatenated signals, this is implemented using H4[1,4] bits of multiframe positions 2, 3, 8, 9, and 10, in accordance with the ITU-T G.7042/Y.1305 standard.

LAN modes

The X10IP option card supports the following LAN modes:

- LAN bridge mode
- LAN promiscuous mode

LAN bridge mode

The Ethernet bridge provides the following functions conforming to the IEEE802.1D standard:

- Point-to-point LAN bridge
- Multiport bridge for 14 ports
- MAC address filtering via self learning protocol (up to 16k MAC addresses)
- Spanning-tree algorithm
- Transparency to VLAN tagged packets from end customers
- Broadcasting, including end user BPDUs

All L2 switching relations are capable of processing packets at wire speed. In case of congestion on a specific port, packets will be arbitrarily dropped from the tail.

LAN promiscuous mode

In addition to the L2 switching capabilities of the LAN bridge mode, the X10IP option card supports operations in promiscuous mode. In this mode, the L2 switching function forwards all Ethernet packets that are received without address filtering. This function is only supported for a point-to-point switching relation and can be configured for each switch relation.

Ethernet frame size support

The X10IP option card supports Ethernet frames with length ranging from 64 bytes to 1650 bytes on E/FE and GbE ports.

Maximum number of IEEE mode V-LANs and Provider Bridge Mode CIDs

In combination with the X10IP option card, the 1645 AMC supports a maximum number of 2048 IEEE mode V-LANs and provider bridge mode CIDs based on the “per NE” rule. This is applicable when the GVRP is turned off. When the GVRP is turned on, the system supports a maximum of 247 IEEE mode V-LANs and provider bridge mode CIDs.

Maximum V-LANs without GVRP control

The X10IP option card supports a maximum number of 2048 active VLANs (IEEE 802.1Q or IEEE 802.1ad CIDs) without GVRP.

Link pass-through

The Fast Ethernet electrical interface, Gigabit Ethernet electrical and optical interfaces on the X10IP option card support link pass-through modes.

The Ethernet port transmitter is shutdown in the upstream network due to the following failures:

- loss of signal reported on a remote TransLAN Ethernet option card due to Ethernet cable or fiber failure
- SDH/SONET network failure
- upstream equipment failure

Remote failures are reported in-band through the GFP-client signal fail message. The link pass-through mode is only supported on ports that operate on a one-to-one association with a WAN port using GFP encapsulation. Users can enable or disable the link pass-through mode per port.

Link pass-through alignment to Alcatel-Lucent standard

The link pass-through feature described above, is adapted to the standard version defined for the Alctatel-Lucent product portfolio. The user can provision/retrieve via OS and CIT, the activation/inactivation of the consequent action triggered by the Remote Client Fail (RCF) indication or SDH path SF/SD status (link pass-through or LPT mode). The consequent action is triggered on the LAN egress port, either as transmitter inhibition or as transmission of an error pattern. The activation of the link pass-through consequent action is allowed only when the LAN port in question, is a member of the virtual switch that contains at most one WAN port (excluding the LAN port in question).

Aligning the link pass-through to the Alcatel-Lucent standard affects:

- Downstream link failure notification:
  The output will be disabled after receiving GFP CSF.
- Upstream deadlock prevention:
  If GFP CSF is received, the incoming signal on the reverse direction will be ignored for 6s.

Loopbacks on Fast Ethernet and Gigabit Ethernet signals

The X10IP option card supports temporary loopbacks on outgoing Ethernet, Fast Ethernet, and Gigabit Ethernet signals. This functionality allows the output signal to be looped back to the corresponding input directly before leaving the system and passing through the maximum number of system parts. These loopbacks can be setup for each output Ethernet/Fast Ethernet port from the local workstation or EMS.

Port based provider bridge tagging (802.1ad)

The 1645 AMC with an X10IP option card allows the user to assign a Customer ID (CID) tag to each customer role port. The CID is unique within an L2 network segment in the WAN and can be used to identify a VPN and isolate traffic from different end-customers over the WAN. The CID can be configured in the range [0...4093] and retrieved via the EMS or CIT interface. This mode is in accordance with the definition of provider bridges in IEEE 802.1ad.

Support for VLAN tagging/untagging mechanism

Each virtual switch inserts a VLAN/provider bridge tag carrying CID on all (tagged and untagged) frames forwarded from customer role port to a network role port and strips off the tag in the reverse direction. This mechanism is transparent to the end-customer. VPNs on transit nodes (excluding customer LAN port) are automatically instantiated by a standard GVRP protocol which can be disabled by the user.

Note:

- The system supports up to 1000 VLANs regardless of GVRP.
- The number of supported VLANs per system is limited to 5000 VLAN-port associations regardless of the method (static or dynamic VLAN registration).

Repeater mode

The *Repeater mode* allows emulating the behavior of a private line port on a unit containing an Ethernet switch. This can be set by creating a two-port virtual switch with a LAN and a WAN port and provision it in the *Repeater mode*. In this mode, all traffic from the LAN or WAN side is transparently passed through, except for the PAUSE frames. The PAUSE protocol operates on the LAN interface and "lossless" transmission can be obtained, if the peer node on the LAN link obeys the PAUSE commands.

Performance monitoring

The X10IP card supports the following performance monitoring features:

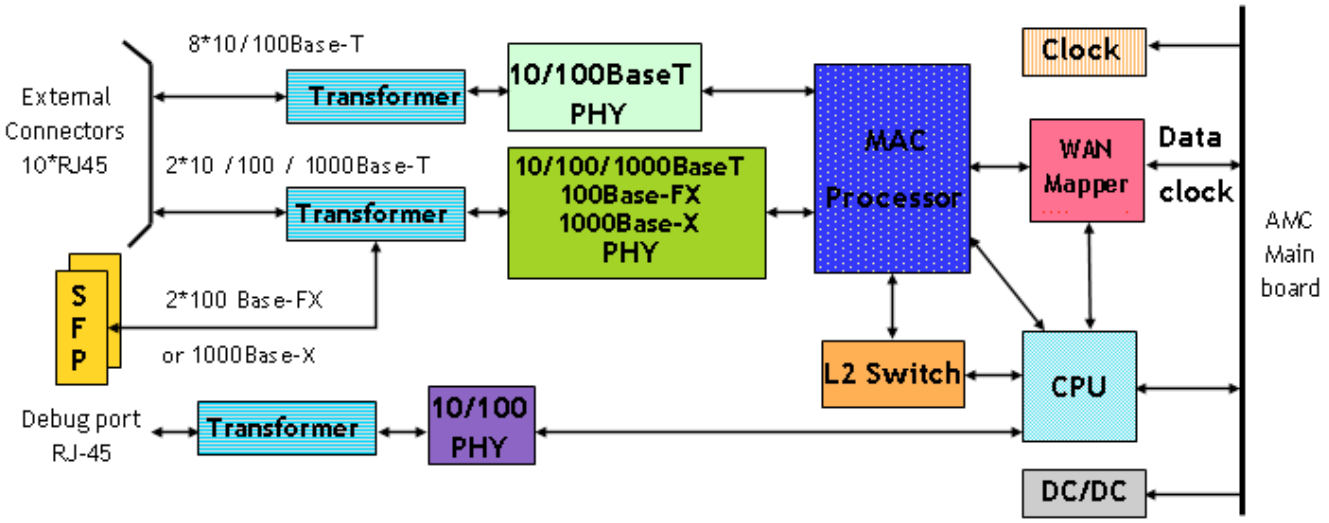
- Enhanced Ethernet performance monitoring features (conforming to China MSTP standards)
- Enhanced basic Ethernet features

Performance monitoring parameters

The following performance monitoring parameters are supported for the X10IP option card:

- MAC entry table size: 16K (Maximum 1k for Multicast MAC entries)
- V-LAN table size: 4k
- MAC address learning speed: wire-speed
- Supports maximum 2k QoS flows

The following figure shows the block diagram of the X10IP option card:



Explicit port role assignment in Provider Bridge Tagging Mode (PBM)

The provider bridge tagging mode allows the user to provision customer or network roles on LAN or WAN ports.

A layer 2 switch port assigned with the “network role” performs the following functions:

Port usage or classification category	Name
Quality of service	DiffServ internal port
Transparency for network tagging	Non-translating network port
Transparency for network protocols	Protocol internal port

When a layer 2 switch port is assigned the “customer role”, it performs the following functions:

Port usage or classification category	Name
Quality of service	DiffServ edge port
Transparency for network tagging	Customer port
Transparency for network protocols	Protocol edge port

E/FE/GbE VLAN trunking

The X10IP option card aggregates E/FE/GbE traffic of multiple end-users over a single external Ethernet or Fast Ethernet or Gigabit Ethernet port. Such a VLAN trunk port is a shared member of multiple VLANs from different end-users. The VLAN ID list is configurable during the VLAN classification process.

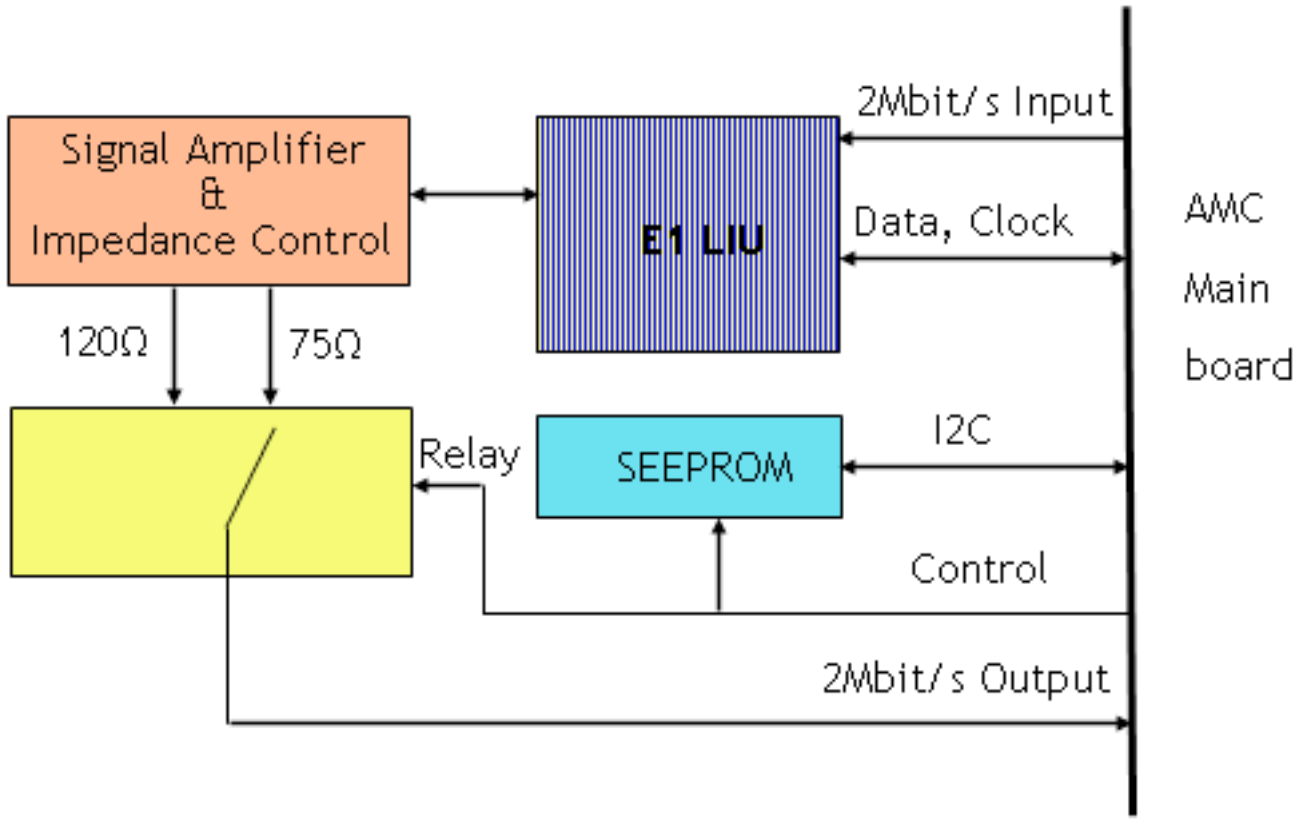
Option board reset

A cold reset can be initiated on the X10IP option card through the CIT or OMS. This action does not affect service on the main board.

STC-2MB option card

The 1645 AMC with an STC-2MB option card, provides a 2 Mbit timing input and output signal processing system. This option card can be mounted on a separate socket on the motherboard and can coexist with other option boards.

The following figure shows the block diagram of an STC-2MB option card:



Please refer to the chapter “Timing features ” (p. 3-17) for more information on the input and output signal processing features provided by the STC-2MB option card.

Technical specifications

Overview

Purpose

The following sections list technical specifications for 1645 AMC.

Contents

System specifications

Optical interfaces/SFPs

STM-1

The table below lists some parameters and the end of life power budgets for the STM-1 SFP cages that are supported by the 1645 AMC.

Application	S-1.1	L-1.1	L-1.2
Operating wavelength range	1260 - 1360 nm	1270 - 1360 nm	1480 - 1580 nm
Transmitter at reference point S			
Source type	MLM	SLM / MLM	SLM
Spectral width at -20 dB (max)	NA	1 nm (SLM)	1 nm
RMS spectral width (max)	7.7 nm	3 nm (MLM)	NA
Side mode suppression ratio (min)	NA	30 dB / NA	30 dB
Mean launched power (max)	-8 dB	0 dB	0 dB
Mean launched power (min)	-15 dB	-5 dB	-5 dB
Extinction ratio (min)	8.2 dB	10 dB	10 dB
Mask of the eye diagram of the optical transmit signal	see G.957	see G.957	see G.957
Optical path between points S and R			
Maximum dispersion	96 ps/nm	NA / 246 ps/nm	NA
Attenuation range	0 - 12 dB	10 - 28 dB	10 - 28 dB
Minimum optical return loss of the cable plant at point S including the optical connector	NA	NA	20 dB

Application	S-1.1	L-1.1	L-1.2
Receiver at reference point R			
Sensitivity (min) at BER = 1×10^{-10}	-28 dBm -34 dBm (aggregate only)	-34 dBm	-34 dBm
Overload (min)	-8 dBm	-10 dBm	-10 dBm
Optical path penalty	< 1 dB	< 1 dB	< 1 dB
Optical return loss of the receiver (min)	NA	NA	25 dB

Overhead access functionality

STM-1 line port overhead access is available as follows:

Byte	Source direction	Sink direction
E1	In every RS termination the E1 byte is fixed to '11111111' (binary).	In every RS termination, the received E1 byte is ignored.
F1	In every RS termination the F1 byte (2,7,1) is fixed to '11111111' (binary).	In every RS termination, the received F1 byte is ignored.
E2	In every MS termination the E2 byte is fixed to '11111111' (binary).	In every MS termination, the received E2 byte is ignored.

This feature is available for E1, F1, and E2 on multi-rate STM-1/4 line interfaces ported overhead access.

The usage is in conformance with the ITU-T Rec. G.707 and ETSI ETS 300417.

A 64 kbit/s channel is available as follows:

- E1 (2,4,1) byte of for order-wire (voice) applications between regenerators or between a regenerator and a terminal (i.e. regenerator sections).
- F1 (2,7,1) byte of for user(-data) applications between regenerators or between a regenerator and a terminal (i.e. on regenerator sections).
- E2 (9,7,1) byte of for order-wire (voice) applications between terminals (i.e. multiplex sections).

STM-4 interfaces

The table below lists some parameters and the end of life power budgets for the fixed STM-4 interfaces that are supported by the 1645 AMC:

Application	S-4.1	L4.1	L-4.2
Operating wavelength range	1274 -1356 nm	1280...1335nm	1480 - 1580 nm
Source type	MLM	SLM	SLM
Spectral width at -20 dB (max)	NA	1 nm	1 nm
RMS spectral width (max)	2.5 nm	NA	NA
Mean launched power (max)	-8 dBm	+2 dBm	+2 dBm
Mean launched power (min)	-15 dBm	-3 dBm	-3 dBm
Side mode suppression ratio (min)	NA	30 dB	30 dB
Extinction ratio (min)	8.2 dB	10 dB	10 dB
Mask of the eye diagram of the optical transmit signal	see G.957	see G.957	see G.957
Optical path between points S and R			
Maximum dispersion	74 ps/nm	NA	NA
Optical attenuation range	0 - 12 dB	10 - 24 dB	10 - 24 dB
Optical return loss of the cable plant at point S including the optical connector	NA	-25 dB	24 dB
Receiver at reference point R			
Sensitivity (min) at BER = 1×10^{-10}	-28 dBm	-28 dBm	-28 dBm
Overload (min)	-8 dBm	-8 dBm	-8 dBm
Optical path penalty	< 1 dB	< 1 dB	< 1 dB
Optical return loss of the receiver (min)	NA	-14 dB	27 dB

Single-fiber bidirectional SFPs, short haul

The table below lists some parameters and the end of life power budgets for the single fiber bidirectional STM-1 optical modules (SFPs), short haul.

	Unit	Downstream	Upstream
Application		**S-1.2**	**S-1.1**
Data rate	**Mbit/s**	**155**	**155**
Target distance	**km**	**15**	**15**
Transmitter at reference point S / TP2			
Source type		SLM	SLM
Wavelength	nm	1480 - 1500	1260 - 1360
Max. spectral width at -20 dB	nm	1	1
Mean launched power (max)	dBm	0	0
Mean launched power (min)	dBm	-6	-6

	Unit	Downstream	Upstream
Application		**S-1.2**	**S-1.1**
Data rate	**Mbit/s**	**155**	**155**
Target distance	**km**	**15**	**15**
Maximum mean launched power in case Tx_Disable = high	dBm	-45	-45
Minimum extinction ratio	dB	6	6
Transmitter eye mask definition		see G.957	see G.957
Maximum reflectance of transmitter, measured at S / TP2	dB	NA	NA
Maximum optical path penalty / Maximum transmitter and dispersion penalty	dB	1	1
Optical path between S / TP2 and R / TP3			
Available power budget (BER = 1×10^{-12})	dB	12.5	12.5
Minimum attenuation	dB	0	0
Maximum dispersion	ps/nm	275	132
Receiver at reference point R / TP3			
Operating wavelength range	nm	1260 - 1360	1480 - 1500
Sensitivity (min) at BER = 1×10^{-12}	dBm	-19.5	-19.5
Minimum overload	dBm	0	0
Maximum reflectance of receiver, measured at R / TP3	dB	-12	-12

Single-fiber bidirectional SFPs, long haul

The table below lists some parameters and the end of life power budgets for the single fiber bidirectional STM-1 and STM-4 optical modules (SFPs), long haul.

	Unit	Downstream	Upstream
Application		**S-1.2**	**S-1.1**
Data rate	**Mbit/s**	**155**	**155**
Target distance	**km**	**40**	**40**
Transmitter at reference point S			
Source type		SLM	SLM
Nominal center wavelength	nm	1480 - 1580	1280 - 1335
Max. spectral width at -20 dB	nm	1	1
Mean launched power (max)	dBm	+2	+2

	Unit	Downstream	Upstream
Application		**S-1.2**	**S-1.1**
Data rate	**Mbit/s**	**155**	**155**
Target distance	**km**	**40**	**40**
Mean launched power (min)	dBm	-5	-3
Maximum mean launched power in case Tx_Disable = high	dBm	-45	-45
Minimum extinction ratio	dB	10	10
Transmitter eye mask definition		see G.957	see G.957
Maximum reflectance of transmitter, measured at S	dB	-12	-12
Optical path between S and R			
Maximum attenuation (at a BER = 1×10^{-10})	dB	22	24
Minimum attenuation (at a BER = 1×10^{-10})	dB	10	10
Maximum dispersion	ps/nm	NA	172
Minimum optical return loss of cable plant at S, including any connectors	dB	24	24
Receiver at reference point R			
Operating wavelength range	nm	1260 - 1360	1480 - 1600
Sensitivity (min) at BER = 1×10^{-10}	dBm	-28	-28
Minimum overload	dBm	-8	-8
Maximum optical path penalty	dB	1	1
Nominal LOS assert level (max)	dBm	-34	-34
Nominal LOS assert level (min)	dBm	-40	-40
LOS hysteresis (max)	dB	4	4
LOS hysteresis (min)	dB	0.5	0.5
Maximum reflectance of receiver, measured at R	dB	-12	-12

1000BASE-SX SFP

The characteristics of the 1000BASE-SX SFP are summarized in the table below.

The 1000BASE-SX pluggable optic (850 nm short haul, multi-mode) uses a Low Power Laser (laser class 1/1 according to FDA/CDRH - 21 CFR 1010 & 1040 / IEC 60825). The 1000BASE-SX pluggable optic complies with IEEE 802.3-2000 Clause 38. The following table describes the various operating ranges for the 1000BASE-SX pluggable optic over each optical fiber type.

Fiber Type	Modal Bandwidth @ 850 nm (min. overfilled launch) (MHz × km)	Minimum range (m)
62.5 µm MMF	160	2 ... 220
62.5 µm MMF	200	2 ... 275
50 µm MMF	400	2 ... 500
50 µm MMF	500	2 ... 550

The following table lists the specific optical characteristics for a 1000BASE-SX pluggable optic:

Application	1000BASE-SX
Bit rate	1.25Gb/s ± 100ppm
Operating wavelength range [Non Peltier cooled]	770 - 860 nm
Transmitter characteristics	
Transmitter type	Shortwave Laser
T^{rise}/T^{fall} (max, 20–80%, $\lambda > 830$ nm)	0.26 ns
T^{rise}/T^{fall} (max, 20–80%, $\lambda \leq 830$ nm)	0.21 ns
RMS spectral width (max)	0.85 nm
Average launch power (max)	-1.1 dBm (Class 1M safety limit as defined by IEEE 802.3–2000 Clause 38.7.2)
Average launch power (min)	–9.5 dBm
Average launch power of OFF transmitter (max)	–30 dBm
Extinction ratio (min)	9 dB
RIN (max)	–117 dB/Hz
Mask of the eye diagram of the optical transmit signal	see IEEE 802.3
Receive Characteristics	
Average receive power (max)	0 dBm
Receive sensitivity (min) at BER = 1×10^{-12}	–17 dBm
Return loss (min)	12 dB
Stressed receive sensitivity (measured with conformance test signal at TP3 for BER = 10–12 at the eye center)	–12.5 dBm (62.5 µm MMF) –13.5 dBm (50 µm MMF)

The following table lists the worst-case power budget and link penalties for a 1000BASE-SX pluggable optic. Link penalties are used for link budget calculations.

Description	Unit	62.5 µm MMF		50 µm MMF	
Modal bandwidth as measured at 850 nm (minimum, overfilled launch)	MHz × km	160	200	400	500
Link power budget	dB	7.5	7.5	7.5	7.5
Operating distance	m	220	275	500	550
Channel insertion loss (a wavelength of 830 nm is used to calculate the values)	dB	2.38	2.60	3.37	3.56
Link power penalties (a wavelength of 830 nm is used to calculate the values)	dB	4.27	4.29	4.07	3.57
Unallocated margin in link power budget (a wavelength of 830 nm is used to calculate the values)	dB	0.84	0.60	0.05	0.37

1000BASE-LX SFP

The following table lists the specific optical characteristics for a 1000BASE-LX pluggable optic.

The 1000BASE-LX pluggable optic uses a Low Power Laser (laser class 1/1 according to FDA/CDRH - 21 CFR 1010 & 1040 / IEC 60825). The 1000BASE-LX pluggable optic complies with IEEE 802.3-2000 Clause 38. The table below describes the various operating ranges for the 1000BASE-LX pluggable optic over each optical fiber type.

Fiber Type	Modal Bandwidth @ 1300 nm (min. overfilled launch) (MHz × km)	Minimum range (meters)
10 µm SSMF	N/A	2 to 5000

The following table lists the specific optical characteristics for a 1000BASE-LX pluggable optic:

Application	1000BASE-LX
Bit rate	1.25Gb/s ± 100ppm
Operating wavelength range [Non Peltier cooled]	1270 - 1355 nm
Transmitter Characteristics	
Transmitter type	Longwave Laser
T^{rise}/T^{fall} (max, 20–80%)	0.26 ns

Application	1000BASE-LX
RMS spectral width (max)	4 nm
Average launch power (max)	-3 dBm
Average launch power (min)	-11 dBm
Average launch power of OFF transmitter (max)	-30 dBm
Extinction ratio (min)	9 dB
Mask of the eye diagram of the optical transmit signal	see IEEE 802.3
RIN (max)	-117 dB/Hz
Receive Characteristics	
Average receive power (max)	-3 dBm
Receive sensitivity	-19 dBm
Return loss (min)	12 dB
Stressed receive sensitivity (measured with conformance test signal at TP3 for BER = 10–12 at the eye center)	-14.4 dBm

The following table lists the worst-case power budget and link penalties for a 1000BASE-LX pluggable optic. Link penalties are used for link budget calculations.

Description	Unit	10 µm SMF
Link power budget	dB	8
Operating distance	m	5000
Channel insertion loss (a wavelength of 1270 nm is used to calculate the values)	dB	4.57
Link power penalties (a wavelength of 1270 nm is used to calculate the values)	dB	3.27
Unallocated margin in link power budget (a wavelength of 1270 nm is used to calculate the values)	dB	0.16

100BASE-FX SFP

The 100BASE-FX pluggable optic complies with IEEE802.3-2002, Clause 26, which has reference to ISO/IEC 9314-3. The following table lists the specific optical characteristics for a 100BASE-FX pluggable optic:

Application	100BASE-FX
Data rate	125 ±50 ppm
Transmitter at reference point TP2	
Source type	LED
Spectral width FWHM[a] (with 3.5 ns t_r, t_f)	100 nm

Application	100BASE-FX
Mean launched power (62.5 µm MMF) (max)	-14 dBm
Mean launched power (62.5 µm MMF) (min)	-20 dBm
Mean launched power (max)	+5 dBm
Mean launched power (min)	0 dBm
Extinction ratio (min)	10 dB
Transmitter eye mask definition (X1, X2, X3, Y1, Y2, Y3, Y4)	see IEEE 802.3ah
Rise and fall time (10%/90%, unfiltered)	3.5 ns
Maximum transmitter total jitter (peak to peak)	1.36 ns
Maximum optical return loss tolerance	12 dB
Optical path between TP2 and TP3 (for 62.5 µm MMF)	
Channel insertion loss[c] (max)	11 dB
Channel insertion loss[c] (min)	0 dB
Minimum modal bandwidth (-3 dB optical)	500 MHz × km
Maximum transmitter and dispersion penalty	NA
Operating wavelength range	1270 - 1380 nm
Minimum sensitivity (at BER = 2.5×10^{-10} for 62.5 µm MMF)	-31 dBm
Minimum sensitivity (at BER = 1×10^{-12} for 62.5 µm MMF)	-29 dBm
Minimum overload	-14 dBm
Total jitter (peak to peak) at TP3	1.96 ns
LOS assert level (min)	-45 dBm
LOS de-assert level (max)	-31 dBm
LOS hysteresis (max)	6 dB
LOS hysteresis (min)	1.5 dB
Maximum reflectance of receiver, measured at TP3	-12 dB

1000BASE-ZX SFP

The 1000BASE-ZX pluggable optic uses a Low Power Laser (laser class 1/1 according to FDA/CDRH - 21 CFR 1010 & 1040 / IEC 60825). The 1000BASE-ZX pluggable optic complies with IEEE 802.3-2002 clause 38. The following table lists the specific optical characteristics for a 1000BASE-ZX pluggable optic:

Application	1000BASE-ZX
Bit rate	1.25Gb/s ±100ppm
Operating wavelength range [Non Peltier cooled]	1500-1580 nm

Application	1000BASE-ZX
Transmitter at reference point TP2	
Source type	SLM
Spectral width at -20 dB	1.0 nm
Side mode suppression ratio (min)	30dB
Mean launched power (max)	+5 dBm
Mean launched power (min)	0 dBm
Extinction ratio (min)	9.0 dB
Mask of the eye diagram of the optical transmit signal	see IEEE 802.3
RIN (max)	-120 dB/Hz
Optical path between points TP2 and TP3	
Optical return loss of the cable plant at point TP2 including the optical connector	20 dB
Maximum dispersion	1600 ps/nm
Attenuation range	5 - 21 dB
Optical path penalty (max)	1.5 dB
Receiver at reference point TP3	
Sensitivity (min) at BER = 1×10^{-12}	-22.5 dBm
Overload (min)	0 dBm
Optical return loss of the receiver (min)	12 dB

Electrical STM-1 interface

The following table lists some parameters of the STM-1 electrical interface unit for the 1645 Access Multiplexer Compact AMC :

	Unit	Value
Application		**intra-office**
SDH Level	type	STM-1
Transmission rate	kbit/s	155,520 ±20 ppm
Line coding	type	Coded Mark Inversion (CMI, G.703-12.1)
Impedance	Ω	75
Return Loss (8 ... 240 MHz.)	dB	15
Maximum cable attenuation (78 MHz)	dB	12.7

Tributary interfaces and ISDN interfaces

- STM-1 optical tributary interface at 155 Mbit/s according to G.957. The card utilizes SFPs with LC connectors.
- STM-1 electrical tributary interface at 155 Mbit/s according to the ITU G703-15. The card utilizes SFPs with DIN 1.0/2.3 type connector.
- Interface at 1.544 Mbit/s ± 130 ppm, AMI or B8ZS encoded (programmable in groups of 8) and conforming to G.703-2 standard 1991, asynchronously mapped via VC-11 to a TU-12. The 1.5 Mbit/s electrical (DS1) interface access is via a RJ45 connector suitable for symmetrical twisted pair cables with an impedance of 100 Ω.
- Interface at 2.048 Mbit/s ± 50 ppm, HDB3 coded and conforming to G.703 standard 1991, asynchronously mapped via a VC-12 in TU-12. The 2 Mbit/s electrical (E1) interface access is via RJ45 connector suitable for symmetrical twisted pair cables either with an impedance of 120 Ω or coaxial cables with an impedance of 75 Ω. Each 2 Mbit/s tributary interface (main card or optional card) can be operated in ISDN PRI (Primary Rate Interface) or Leased-Line mode. It allows to transmit “30 B+D” according to G.962 and I.431. This feature requires the processing of the overhead contained in time slot 0 (TS0) of the 2 Mbit/s signal.
- Interface at 34.368 Mbit/s ± 20 ppm, HDB3 encoded and conforming to G.703-8 October 1998, asynchronously mapped into LO-VC3. The 34 Mbit/s electrical clear channel (E3) interface access is via a coaxial female DIN 1.6/5.6 type connector with an impedance of 75 Ω.
- Interface at 44.736 Mbit/s ± 20 ppm, B3ZS encoded and conforming to G.703-6 October 1998, directly mapped in a LO-VC3. The 45 Mbit/s electrical tributary (DS-3) interface access is via a coaxial female DIN 1.6/5.6 type connector with an impedance of 75 Ω.
- The Ethernet interfaces (X5IP and X5IP-V2) with auto-negotiation supports Ethernet and IEEE 802.3, 1998 access protocols. The card holds one electrical interface (port 1), with RJ-45 connector, that can support 10BASE-T, 100BASE-TX or 1000BASE-T specifications, three 10/100BaseT Ethernet interfaces (ports 2, 3 and 4) via an RJ45 connector, and one Gbe port (port 5) that can be switched between an optical SFP or an electrical RJ45, supporting 1000BASE-T.
  The card also holds one electrical interface, the most left port, with RJ-45 connector, that is meant for card debugging.

X12SHDSL-V2 option board

An SHDSL interface over a single copper pair (two wires) that allows for the transport of either an E1 or an TU-12 over SHDSL in compliance with ITU-T standards.

Interfaces:

- 12 standard SHDSL physical interfaces compliant ITU-T G.991.2 and ETSI TS 101 524 on single (twisted) copper pair
- TC-16-PAM modulation/coding
- RJ-45 connector suitable for symmetrical 135 Ω twisted pair cable.

Possible operation in TU-12 or E1 mode.

Selection made per option board by software:

TU-12 mapping in SHDSL:

- TU-12 to SHDSL synchronous mapping according HDSL: ETSI TS 101 135 clause 7.6
- Interface SHDSL rate of 2320 kbit/s

E1 mapping in SHDSL:

- ITU G.991.2 Appendix E.5 (= ETSI TS 101 524 D2048U) Clear channel TPS-TC framing for unstructured E1 (plesiochronous SHDSL transport).
- Interface SHDSL rate of 2056 kbit/s.

Flexible TU-12 slot / SHDSL port mapping assignment.

SHDSL span fault management Incoming & Outgoing loopbacks at SHDSL interface for installation or fault localization-

Surge protection K.20 and K.21.

SDH Element Management (OMS, ITM-CIT):

- Remote NTUs management via in-band SHDSL EOC channel (~3.3kbit/s). All provisioning of NTU device made via it's associated LTU.
- Support of standard EOC protocol + extensions
- Managed Remote SHDSL Power Supply (RPS) module support
- Enhanced PM support

Mapping

Mapping schemes:

- The 1645 AMC supports an AU-4 <-> VC-4 <-> TUG-3 <-> TUG-2 <-> TU-12 <->VC-12 <->E1 mapping scheme for each VC-12 created and terminated in the system
- The 1645 AMC supports an AU-4 <-> VC-4 <-> TUG-3 <-> TUG-2 <-> TU-12 <-> VC-11 <->DS1 mapping scheme for each VC-11 created and terminated in the system

- The 1645 AMC supports an AU-4 <-> VC-4 <-> TUG-3 <-> TU-3 <-> VC-3 <->E3 mapping scheme for each VC-3 created and terminated in the system
- The 1645 AMC supports a AU-4 <-> VC-4 <-> TUG-3 <-> TU-3 <-> VC-3 <-> DS3 mapping scheme for each VC-3 created and terminated in the system.

Connectivity

Cross-connections

- The equipment supports VC-4 connectivity
- The equipment supports bi-directional, non-blocking cross-connection switching at the VC-3 level and at the VC-12 level within one selected VC-4 from each line interface.
- The equipment supports higher order cross connection switching on VC-4 level for non-blocking lines and tributaries.
- The equipment supports non-blocking cross connection switching at VC-12 level for lines and tributaries.
- The equipment supports non-blocking cross connection switching at VC-11 level for lines and tributaries mapped in TU-12.
- The equipment supports non-blocking cross connection switching at VC-3 level for lines and tributaries.
- The equipment supports a unique unidirectional cross-connecting, wherein the user can set a loopback cross-connection at the VC-4 level.
  The cross connect setting before applying the VC-4 loopback is not retained in memory. This type of connection cannot be set up when the VC-4 is part of a broadcast or SNCP connection.
- The equipment supports connecting each tributary input to each tributary output and vice versa on all levels.

Protection schemes

- The equipment provides VC-11/VC-12, VC-3 or VC-4 SNC/N protection.
- *1+1 MSP on Multiple STM-1/STM-4 optical line interfaces*
  In terminal applications, the user can set up between two optical STM-1 interfaces, a 1+1 MSP protection relation for linear MSP application. 4 × STM-1 or 2 × STM-1 + 2 × STM-4 can be grouped into 2 × MSP groups, which can support linear MSP connections with east and west NEs.
- 1+1 MSP on STM-4 optical line interfaces
  In terminal applications, the user can set up between two optical STM-4 interfaces a 1+1 MSP protection relation.
  The protection switching can be configured revertive and non-revertive and unidirectional and bi-directional (i.e. both directions of transmission are, respectively, switching separately or jointly), provided the other end of the MSP link supports the

necessary features.
Forced, manual and lock-out commands are supported. The MSP implementation is compliant with G.841/Clause 7.1 and ETS 300417-3-1 (i.e. APS protocol optimized for 1:N protection). ETSI failure of protocol applies. Under this protocol, an alarm-free interworking mode with SONET defined MSP is supported.

- *Flexible MSP assignment*
  When the system main board or option boards has more than 2 × STM-1 (or STM-4) ports, then the STM-1 (or STM-4) MSP pairs can be assigned between any two STM-1 (or STM-4) ports without any limitations.

Synchronization and timing

- Synchronization can be derived from the incoming STM-1 or STM-4 aggregate signals
- Synchronization can be derived from the incoming STM-1 tributary signals.
- The 1645 AMC supports synchronization derived from an incoming 2 Mbit/s (E1 or DS1) data inputfrom the main board and option card
- Re-synchronization of the 2 Mbit/s ports is supported
- Support of SSM byte according to ETSI ETS 300 417-6
- Internal clock in accordance with ITU-T G.813 option 1.
- A station clock input connection point for synchronization is available in the system. The signal format can either be 2048 kHz (in accordance with G.703-13) or 2048 kbit/s (in accordance with G.703-9). The user can select the impedance of the interfaces (75 Ω coaxial or 120 Ω symmetrical) by appropriately wiring the cable and setting on ITM-CIT.
- A station clock output connection point for synchronization is available in the system. The signal format can either be 2048 kHz (in accordance with G.703-13) or 2048 kbit/s (in accordance with G.703-9). The user can select the impedance of the interfaces (75 Ω coaxial or 120 Ω symmetrical) by appropriately wiring the cable and setting on ITM-CIT.

Overhead bytes processing

The following table shows the processing of SOH (Section Overhead):

Overhead bytes	Function	Processing
A1-A2	Framing A1=11110110 (HF6) Framing A2=00101000 (H28)	Yes
J0	Regenerator section trace identifier	Yes
C1	Regenerator section trace Trace/frame identifier	Fixed to 00000001
B1	RS Bit error monitoring (BIP-8)	Yes

Overhead bytes	Function	Processing
B2	MS Bit error monitoring (BIP-8)	Yes
D1 to D12	Data communication channel (DCC) D1 to D3 or D4 to D12 can be selected	D1-D3 fixed to 01010101 D4 to D12 used as DCC
E2	Codirectional interfaces at 64 kbit/s (J64), in accordance with G.703 (Service channel)	Yes
F1	64 kbit/s user channel	Fixed to 11111111
K1, K2 (bit 1 to 5)	Automatic Protection Switching (APS) channel for MSP	Yes
K2 (bit 6 to 8)	Remote alarm MS (MS-FERF)	Yes
S1	Synchronization state	Yes
M1	Remote error indication MS (MS-REI)	Yes
Z1, Z2	Reserved	Fixed to 11111111
NU	National use	11111111

The following table shows the processing of the POH (Path Overhead) of VC-12:

Overhead bytes	Function	Processing
V5 (bit 1 to 2)	VC-12 BIP-2 error checking	Yes
V5 (bit 3)	REI path (FEBE)	Yes
V5 (bit 4)	RFI path	Fixed to 0
V5 (bit 5 to 7)	Label of VC-12 path	Yes
V5 (bit 8)	RDI path (FERF)	Yes
J2	VC-12 Trace identifier	Yes
Z6	Connection/monitoring	Fixed to 0
K4 (bit 1 to 4)	VC-12 APS path	Fixed to 0
K4 (bit 5 to 6)	Reserved	Fixed to 0

The next table shows the processing of the POH of VC-3:

Overhead bytes	Function	Processing
J1	VC3 trace identifier	Yes

Overhead bytes	Function	Processing
B3	Path bit error monitoring (BIP-8)	Yes
C2	Path signal label	Yes
G1	REI/RDI path	Yes
F2	User channel	Fixed to 0
F3	User channel	Fixed to 0
H4	Multiframe indicator	Fixed to 11111111
K3 (bit 1 to 4)	VC-4 APS path	Fixed to 0
K3 (bit 5 to 6)	Reserved	Fixed to 0
Z5	Network control	Fixed to 0

The following table shows the processing of the POH of VC-4

Overhead bytes	Function	Processing
J1	VC4 trace identifier	Yes
B3	BIP-8 path	Yes
C2	Path signal label	Yes
G1	REI/RDI path	Yes
F2	User channel	Fixed to 0
F3	User channel	Fixed to 0
H4	Multiframe indicator	Yes
K3 (bit 1 to 4)	VC-4 APS path	Fixed to 0
K3 (bit 5 to 6)	Reserved	Fixed to 0
Z5	Network control	Fixed to 0

Note: The ISDN feature requires the processing of the overhead contained in time slot 0 (TS0) of the 2 Mbit/s signal.

Power supply specifications

Two possibilities of power supply: DC power supply or AC power supply to choose when ordering the equipment (it is not possible to modify only the type of the power supply of an equipment).

- Power consumption: 18 watts for the mother board or 50 watts with any option card.
- The system optionally supports the grounding philosophy according to ETSI Requirements 300 253, January 1995 (battery return connected to ground).
- The system can be installed in together with an external power converter, which can be mounted on a DIN-rail in the same rack. For example, a MeanWell DR-120-48. The external converter accepts input power in the 100-120 VAC and 200-240 VAC ranges at 50/60 Hz and converts it to 48 V DC. The 48 V output can be connected to the system.

Power supply 1645 AMC :

The following possibilities are available:

- Voltage range DC: –24 VDC, –48 VDC and –60 VDC (–18 VDC minimum, –72 VDC maximum)
- Voltage range AC: 120 VAC to 240 VAC (90 VAC minimum, 264 VAC maximum)
- An external AC/DC converter is also available

Supervision interface

- F-interface for Craft Interface Terminal via RJ45 connector with metal shell for grounding (ITM-CIT)
  The interface conforms to V.10/RS-232C standards.
- Q-LAN Interface via RJ45 connector with metal shell for grounding (Ethernet-10BASE-T)
  This interface conforms to IEEE 802.3 Ethernet standards.

Miscellaneous Discrete Inputs/Outputs

- The user can assign, through the EMS or local workstation, an alarm message and alarm severity to each of the four Miscellaneous Discrete Inputs (MDIs). They are equivalent to other system alarms.
- When receiving power, all four Miscellaneous Discrete Outputs (MDOs) are normally open. If power is lost, MDO 1’s contacts close (assigned to indicate power failure). MDO 2-4 are respectively assigned to Prompt alarm, Deferred alarm and Information alarm.

- The MDI inputs and MDO outputs are available from a 25 pin SUB-D male connector.
- The MDI contacts of the system function without external power. The system supports detection of a passive open or closed loop.
  The user has the option to select either the previous normal MDI (that needs external power) or easy MDI (that does not need external power).

Performance monitoring

- Performance monitoring is in accordance with ITU-T G.826 and G.784
- The following four parameters are available to estimate the error performance of a path:
  - SES: number of severely errored seconds in the received signal
  - ES: number of errored seconds in the received signal
  - BBE: number of background block errors in the received signal
  - UAS: number of unavailable seconds in the received signal
- Monitoring can be done on the incoming MS4, MS1, VC-4, VC-3, VC-12, VC-11 signals of the 1645 AMC unit
- Performance monitoring data is stored in one current and sixteen recent 15 minutes registers, and one current and one recent 24 hours registers. Note that these counters are only applicable to OMS users. However, ITM-CIT users will only have access to currently available PM bins.
- Threshold reports are generated when user-settable performance parameters are exceeded during 15 minutes and 24 hours periods
- Ethernet performance monitoring information can be derived from packets sent, bytes received and bytes dropped. This information is available in 15 minute or 24 hour registers.
- ISDN performance monitoring information can be derived for 2 Mbit/s signal from pN_EBC (Near-end Errored Block Count).
- For transparent, it is possible to do near-end performance monitoring on each 2 Mbit/s signal in both directions (PDH to SDH and SDH to PDH) at the 2 Mbit/s system interface. Near-end information is obtained from CRC-4 violations and defects (E1 non-intrusive monitoring).
- The system allows the user to select any TU-12 (= VC-12 CTP) in the network element that can be subject to the following types of near-end unidirectional performance monitoring.
  - Near-end unidirectional performance monitoring
  - Mid-point bidirectional performance monitoring

- The system allows the user to select and monitor the performance of any TU-3 (= VC-3 CTP), TU-12 (= VC-12 CTP), or AU-4 (= VC-4 CTP) in the network element in the following ways:
  - Near-end unidirectional performance monitoring
  - Mid-point bidirectional performance monitoring
- The maximum delay between SDH ports (either line or tributary) does not exceed the following values:
  - VC-12/3 switched: 35 minutes
  - VC-4 switched: 10 minutes

Equipment dimensions

1645 AMC:

- Dimensions (H × W × D): 70 × 448 × 204 mm (without the wall or rack mounting system)
- Weight: 5 kg with an option card

Environmental conditions

The environmental conditions applicable for the 1645 AMC:

- Storage compliant with ETSI 300 019-1-1 Class 1-2, February 1992:
  - Temperature range: – 5°C to + 45°C
  - Humidity of 5 to 95% without condensation.
- Transport compliant with ETSI 300 019-1-2 Class 2-3, February 1992:
  - Temperature range – 5°C to + 45°C
  - Humidity of 5 to 95% without condensation.
- The system operates with convection cooling.
- CE marking compliant with 73/23/EEC and 89/336/EEC
- ETSI EMC - The system meets the requirements of EN 300 386-2 V.1.1.3 (December 1997) for equipment installed in locations other than telecom centers.
- IEC 60950 -Ed3, 1994-04
- Optical safety compliant with IEC 60825-1 Ed 1.1 (1998/01) and IEC 60825-2 Ed 2 (2000/05).

The following table shows the environmental conditions for the 1645 AMC.

Power Type	Min Temp.	Max Temp	Min Hum.	Max Hum	Compliant to ETS 300 019-1-3 of February. 1992 & Amendment A1 June 1997
DC	– 5	+45	5%	95%	Class 3.2
	+5	+40	5%	85%	Class 3.1

AC	– 5	+45	5%	90%	Class 3.1E
	+5	+40	5%	85%	Class 3.1

Important! Ensure that the 1645 AMC units have reached room temperature and are dry before taking them into operation.

For further information, refer to 1645 AMC *Installation Guide*.

3 Features

Overview

Purpose

This chapter briefly describes the features of the 1645 AMC.

For more information on the physical design features and the applicable standards, refer to Chapter 2, “Product description”.

Standards compliance

Alcatel-Lucent SDH products comply with the relevant SDH ETSI and ITU-T standards. Important functions defined in SDH standards such as the Data Communication Channel (DCC), the associated 7-layer OSI protocol stack, the SDH multiplexing structure and the Operations, Administration, Maintenance, and Provisioning (OAM&P) functions are implemented in Alcatel-Lucent product families.

Alcatel-Lucent is heavily involved in various study groups with ITU-T, and ETSI creating and maintaining the latest worldwide SDH standards.

Contents

Physical interfaces

Overview

Purpose

This section provides information about all kinds of external physical interfaces of 1645 AMC. For detailed technical data and optical parameters of the interfaces refer to "Technical specifications" (p. 2-32).

1645 AMC support a variety of additional interfaces dependent on the use of an option card. The choice of the option cards and data interfaces described below provides outstanding transmission flexibility and integration capabilities.

Contents

Transmission interfaces

SDH interface overview

The following synchronous interfaces are available in the present release:

- Two optical STM-4 and two optical STM-1, or four STM-1 line interfaces with SFP (Small Form-Factor Pluggable). With the SFP, several optical interface types can be realized in a modular way by only changing the SFP.
- STM-1 electrical SFP and SFP for single fiber working with 1645 AMC. The X6STM1 option card provides six bidirectional STM-1e/o interfaces to be used with the 1645 AMC main board.

- A 622 Mbit/s G.957/L-4.1 long haul optical interface with an attenuation range from 10 - 24 dB (1E-10 sensitivity) at an operating wavelength of 1310 nm.
- An SFP module supporting an STM-4 interface for two single mode fibers is accepted by the system. This module can be equipped or replaced in the field.
  STM-1/ STM-4 multiple line rate pluggable module can be inserted into STM-1 line port for STM-1 application. It can also be inserted into STM-1/ STM-4 multirate port for multirate applications. The software determines the rate. The default rate is the highest rate of SFP cages.

PDH interface overview

1645 AMC provide the following integrated PDH interfaces:

- Up to sixteen 2 Mbit/s (E1) interface ports, configurable as G.703, G.704, and G.706 interfaces (75 Ω or 120 Ω)

The following PDH interfaces can be configured via an option card:

- Sixteen 1.5 Mbit/s interfaces
- Sixteen 2 Mbit/s interfaces
- Three 34 Mbit/s interfaces
- Three 45 Mbit/s interfaces

Data interfaces

LAN interfaces

The 1645 Access Multiplexer Compact AMC supports a variety of Ethernet interfaces, depending on the option cards in use.

- up to three FE electrical Ethernet interfaces for 10/100BASE-T(X), one triple rate electrical Ethernet interface for 10/100/1000BASE-T(X), and one GE optical Ethernet interface via SFP for 1000BASE-X at the X5IP or X5IP-V2 option card
- up to eight FE electrical Ethernet interfaces for 10/100BASE-T(X) and two triple rate 10/100/1000BASE-T(X) or optical 1000Base-X/ 100Base-FX interfaces at the X10IP option card
- up to eight Ethernet interfaces in private line mode at the X8PL option card

SHDSL interfaces

Via an option card, 12 SHDSL interfaces are available. They can be used in order to configure a Line Termination Unit (LTU). For more information, refer to"Interworking with third party equipment" (p. 9-3).

Timing interfaces

The 1645 AMC provides one external timing output for ITU-T compliant 2048 kHz timing signals, see also "Timing interface features" (p. 3-18). The timing output is realized as an RJ45 connector suitable for symmetrical twisted pair cables with an impedance of 120 Ω or coaxial cables with an impedance of 75 Ω.

Operations interfaces

Operations interfaces

The 1645 AMC offers a wide range of operations interfaces to meet the needs of an evolving Operations System (OS) network. The operation interfaces include:

- One Q interface
  The Q interface enables network-oriented communication between 1645 AMC systems and the element/network manager. This interface uses a Qx interface protocol that is compliant with ITU-T recommendation G.773-CLNS1 to provide the capability for remote management via the Data Communication Channels (DCCs). A Q LAN 10BASE-T connector (twisted pair Ethernet, for twisted pair cables) is used for the Q interface.
- One F interface for a local PC
  One RS-232 F-interface is provided, at the connection board of the 1645 AMC. This interface provides operation access for a locally installed PC, the Craft Interface Terminal (*WaveStar*® ITM-CIT)
- User-settable miscellaneous discrete interfaces
  The 1645 AMC provides four user-selectable Miscellaneous Discrete Inputs (MDIs) and 4 outputs (MDOs). The MDIs can be used to read the status of external alarm points, e.g. power supply detectors, open door detectors or fire alarm detectors. The MDOs indicate the alarm status of the equipment and drive external signalling devices. Labels can be associated to an MDI. An MDO can be coupled to an alarm event.
- Remote SHDSL power supply
  The 1645 AMC is also used as a Line Termination Unit (LTU) for third party Network Termination Units (NTUs). The Remote Power Supply (RPS) unit is used to power SHDSL Regenerator Units (SRU) that connect third party NTUs to SHDSL LTUs and can be connected from the MDI/MDO interfaces located on the NE. For more information about the Remote Power Supply unit, see "Remote SHDSL Power Supply (RPS) support" (p. 9-19). For additional information, refer the 1645 AMC *Installation Guide*.

- Connectorized access to E1, F1 or E2 bytes
  From a single STM-1/STM-4 multi-rate line interface of the system, the user has the option to terminate an E1, F1 or E2 overhead byte channel on a 64 kbit/s contra-directional V.11 interface.
- 2 Mbit timing interface
  A 2 Mbit timing interface can be set on the 1645 AMC in combination with the STC-2MB option card.

Power interfaces

Optionally AC or DC powered

The 1645 AMC can optionally be AC powered or DC powered.

DC power supply

	1645 AMC
Nominal voltage range	–24 V DC to –60 V DC
Permissible voltage range	–18 V DC to –72 V DC
Power inputs	Two redundant power inputs that can protect each other. The system can operate completely normal on only one power feeder.
Power connector	6-pin terminal block connector
Applicable standards	ETS 300132-2

AC power supply

	1645 AMC
Nominal voltage range	120 V AC to 240 V AC with 50-60 Hz
Permissible voltage range	90 V AC to 264 V AC with 50-60 Hz
Power inputs	Single power input
Power connector	3-pin IEC 60320 universal connector
Applicable standards	ETS 300132-2

Related information

Refer to the *1645 AMC Installation Guide*.

Transmission features

Overview

Purpose

This section gives an overview of the transmission related features of the 1645 AMC. For more detailed information on the implementation of the switch function in the NE, refer to Chapter 2, “Product description”.

Contents

Cross-connection features

Cross-connection rates

1645 AMC supports bi-directional cross-connections for VC-3, VC-4 and VC-12 payloads. Support for one arbitrary VC-4 from any line or tributary port to any other line or tributary port is available.

VC-12 or VC-3 structured signals can be transported between the two aggregate lines with timeslot interchange.

Loopback cross-connections are possible on VC-12, VC-3, and VC-4 level.

Cross-connect architecture of 1645 AMC

The HOCC and LOCC of internal ASIC is used for cross connecting service traffic. Support for 50 × 50 HOCC and 16 ×16 STM-1 equivalent LOCC is available. ASIC provides the LO PP/NIM (VC12 NIM/VC3 NIM) and trail trace identifier monitoring for each lower order path.

Transmission protection

Supported protection mechanisms

To guarantee service availability, these transmission protection mechanisms are supported by the 1645 AMC:

- *Multiplex Section Protection (MSP)*
  - 1+1 MSP on optical STM-1 line interfaces

    The protection switching can be configured revertive and non-revertive as well as unidirectional and bidirectional (i.e. both directions of transmission are, respectively, switching separately or jointly). But the remote end of the Multiplex Section must support the necessary features for this operation.

    Forced, manual and lockout switch commands are supported. The MSP implementation is compliant with the ITU-T Rec. G.841/Clause 7.1 and ETS 300417-3-1 (i.e. the APS protocol is optimized for 1:N protection). ETSI failure of protocol applies. Under this protocol also an alarm-free interworking mode with SONET defined MSP is supported.

    The maximum switch completion time is 50 ms.
  - *1+1 MSP on optical or electrical STM-1 tributary interfaces*

    The protection switching can be configured revertive and non-revertive and unidirectional and bidirectional (i.e. both directions of transmission are, respectively, switching separately or jointly), provided the remote end of the Multiplex Section supports the necessary features.

    Forced, manual and lockout switch commands are supported. The MSP implementation is compliant with the ITU-T Rec. G.841/Clause 7.1 and ETS 300417-3-1 (i.e. the APS protocol is optimized for 1:N protection). ETSI failure of protocol applies. Under this protocol also an alarm-free interworking mode with SONET defined MSP is supported.

    The maximum switch completion time is 50 ms.
  - *1+1 MSP on Multiple STM-1/STM-4 optical line interfaces*

    In terminal applications, the user can set up between two optical STM-1 interfaces, a 1+1 MSP protection relation for linear MSP application. 4xSTM-1 or 2xSTM-1 + 2xSTM-4 can be grouped into 2x MSP groups, which can support linear MSP connections with east and west NEs.
  - 1+1 MSP on STM-4 optical line interfaces

    In terminal applications, the user can set up between two optical STM-4 interfaces a 1+1 MSP protection relation.

    The protection switching can be configured revertive and non-revertive and unidirectional and bi-directional (i.e. both directions of transmission are, respectively, switching separately or jointly), provided the other end of the MSP link supports the necessary features.

Forced, manual and lock-out commands are supported. The MSP implementation is compliant with G.841/Clause 7.1 and ETS 300417-3-1 (i.e. APS protocol optimized for 1:N protection). ETSI failure of protocol applies. Under this protocol also an alarm-free interworking mode with SONET defined MSP is supported.

– *Flexible MSP assignment*

The STM-1 MSP pairs on main board and option card can be assigned between any two STM-1 ports without any limitations.

- *Subnetwork Connection Protection (SNCP)*

  – *VC-11 SNC/N protection (non-revertive)*

  A non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming TU-12 from the east aggregate and any arbitrary incoming TU-12 from the west aggregate line interface (VC-11s are mapped into TU-12s).

  Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

  The maximum switch completion time is 50 ms.

  – *VC-12 SNC/N protection (non-revertive)*

  A non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming TU-12 from the east aggregate and any arbitrary incoming TU-12 from the west aggregate line interface (VC-12s are mapped into TU-12s).

  Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

  The maximum switch completion time is 50 ms.

  – *Lower order VC-3 SNC/N protection (non-revertive)*

  A non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming TU-3 from the east aggregate and any arbitrary incoming TU-3 from the west aggregate line interface.

  Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

  The maximum switch completion time is 50 ms.

  – *Higher order VC-4 SNC/N protection (non-revertive)*

  In 1645 AMC with STM-4 aggregates a non-intrusively monitored subnetwork connection protection (SNC/N) relation can be set up between any arbitrary incoming AU-4 from the east aggregate and any arbitrary incoming AU-4 from the west aggregate line interface.

  Only non-revertive operation is possible. Manual and forced switch commands are supported. In the return channel the signal is simply bridged to both outputs.

  The maximum switch completion time is 50 ms.

  – *VC-12 SNC/N protection (non-revertive.)*

The system supports the setting up of a non-intrusively monitored subnetwork connection protection relation between any arbitrary incoming TU-12 from any line and tributary interface. Only non-revertive operation is possible. Manual, forced, and clear commands are supported. In the return channel, the signal is simply bridged to both outputs.

Ethernet features

Ethernet and Fast Ethernet switched applications

The *TransLAN*® option cards (X5IP, X5IP-V2 and X10IP) can be used for Ethernet and Fast Ethernet switched applications.

Refer to *TransLAN® Ethernet SDH Transport Solution Applications and Planning Guide* for a more detailed description of the *TransLAN*® option card.

For a detailed description of the X5IP option card, refer to " X5IP option card" and refer to "X10IP option card" for a detailed description of the X10IP option card.

Ethernet private line applications

The X8PL option card can be used for Ethernet private line applications in 1645 Access Multiplexer Compact AMC

Refer to "X8PL option card" (p. 2-8) for a more detailed description of the X8PL option card.

Main features of the X8PL and X5IP option cards

The following table lists the main features and differences of the X8PL and X5IP option cards:

X8PL	X5IP
8 ports	5 ports
no switch	Ethernet switch
cost optimized option card for point-to-point applications	supports advanced networking applications like ring connections or point-to-multi-point connections
supports the Link Capacity Adjustment Scheme (LCAS) protocol	supports the Link Capacity Adjustment Scheme (LCAS) protocol
GFP or LAPS (Link Access Procedure SDH) (Refer to "Ethernet mapping schemes" (p. 3-12))	Generic Framing Procedure (GFP)

Note: The details of X5IP option card listed above also apply to the X5IP-V2 option card.

Link Capacity Adjustment Scheme (LCAS)

LCAS

The X8PL, X5IP, X5IP-V2, and X10IP option cards for Ethernet private line applications support the Link Capacity Adjustment Scheme (LCAS).

LCAS defines a synchronization protocol between two termination points of a virtual concatenated path that allows in-service dynamic sizing of the VCn-Xv bandwidth that is available for Ethernet-over-SDH transmission. This bandwidth change can occur either in response to a failure condition on one member or a requirement for a change in bandwidth at an NE (provisioning action).

In case of a failure, the bandwidth will be restored automatically after the failure clears. The size of the VCn-Xv is increased or decreased in steps of one VCn. The provisioning is performed by adding/removing paths to/from the Ethernet tributary card.

The LCAS feature is supported for VC3-Xv, VC4-Xv, and VC12-Xv concatenated signals.

The X5IP, X5IP-V2 and X10IP option cards support the latest LCAS standards as per ITU-Ts G.806 at 2006.3 and G.7042 at 2005.5 recommendations. The following enhancements are implemented:

- G.806 at 2006.3: modified defect and alarm correlation process; hold-off timer is now part of the defect-alarm process
- G.7042 at 2005.5: error corrections

Ethernet mapping schemes

Introduction

1645 Access Multiplexer Compact AMC supports the following schemes for the mapping of Ethernet packets into SDH frames:

- Link access procedure SDH (LAPS encapsulation)
- Generic framing procedure (GFP encapsulation)

LAPS encapsulation

LAPS encapsulation is implemented according to ITU-T X.86. It is supported when using the respective option card.

GFP encapsulation

GFP encapsulation is implemented according to T1X1.5/2000-147. It is supported when using the X8PL, X5IP, X5IP-V2, and X10IP option cards.

GFP provides a generic mechanism to adapt traffic from higher-layer client signals over a transport network.

The following GFP encapsulation is possible:

- Mapping of Ethernet MAC frames into lower order SDH VC12–Xv
- Mapping of Ethernet MAC frames into lower order SDH VC3–Xv
- Mapping of Ethernet MAC frames into lower order SDH VC4-Xv

VC12-Xv GFP encapsulation

The 1645 Access Multiplexer Compact AMC supports virtual concatenation of Lower Order SDH VC-12 as an inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET network. This is noted VC12-Xv, where X = 1...63. Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000).

Additionally, the use of G.707 extended signal label is supported using V5 (bits 5-7) field.

VC3-Xv GFP encapsulation

The 1645 Access Multiplexer Compact AMC supports virtual concatenation of lower order SDH VC-3 as inverse multiplexing technique to size the bandwidth of a single internal WAN port for transport of encapsulated Ethernet and Fast Ethernet packets over the SDH/SONET network. This is noted VC3–Xv, where X = 1...3. Usage is in conformance with ITU-T G.707 Clause 11 (2000 Edition) and G.783 Clause 12.5 (2000) and T1X1 T1.105 Clause 7.3.2 (2001 Edition).

Equipment features

Overview

Purpose

This section provides information about the1645 Access Multiplexer Compact AMC features concerning hardware protection, inventory and failure reports.

Contents

Hardware concept

Standard units and option units

The 1645 Access Multiplexer Compact AMC is a compact and cost-effective Add-Drop-Multiplexer designed to be installed at the customer's premises for fiber-to-the-business applications. The space-efficient design allows for horizontal or vertical wall-mounting such as interior closets within various locations.

The basis of the hardware concept is a compact standard design which includes a central cross-connect, two aggregate interfaces, basic tributary interfaces, power supply and operation interfaces on the main board. The adaptation to specific network requirements are realized by the use of several types of options boards which provide additional tributary interfaces with various bit rates, LAN or SHDSL interfaces. For a more detailed hardware description refer to Chapter 2, “Product description”.

Equipment reports

Equipment inventory

The 1645 Access Multiplexer Compact AMC automatically maintains an inventory of the following information of each installed circuit pack:

- Serial number
- ECI code
- Functional name
- Item code
- Software release (of the NE)
- Comcode
- Interchangeability Marker

You can obtain this information by an inventory request command.

The 1645 AMC additionally supports an inventory of the used SFPs. Besides the administrative state, the following information can be retrieved for the currently present and last accepted SFP:

- Physical identifier
- Connector type
- Transceiver code
- Revision number
- Vendor serial number
- Comcode
- Compatibility byte
- Alcatel-Lucent unique ID
- WES SFP vendor ID
- SFP length
- Module qualifier
- Module type

For detailed information on these parameters refer to the *User Operations Guide, Chapter: Equipment provisioning - Parameters for viewing SFP inventory data*.

Equipment failure reports

Failure reports are generated for equipment faults and can be forwarded via the ITM-CIT or OMS interfaces.

Digital Diagnostics Monitoring (DDM) of SFPs

Overview

This section provides information on 1645 Access Multiplexer Compact AMC features related to Digital Diagnostics Monitoring (DDM) of SFPs.

Note: This feature is only supported by ITM-CIT and not by OMS.

SFP module information

The user can view the performance parameters information of an SFP optical interface module. This data known as “digital diagnostics” depends on the manufacturer and type of SFP module in use.

The “digital diagnostics” feature provides the following information:

- optical input power in dBm (± 3 dB accuracy). This number is displayed as an average value (AVG) or as an optical modulation amplitude (OMA) value. The lowest value reported is −40 dBm
- optical transmit power in dBm (± 3 dB accuracy). The lowest value reported is −40 dBm.
- Laser bias current in mA (± 10% accuracy)
- internal temperature of the module in °C (± 3°C accuracy)
- supply voltage of the module in V (± 3% accuracy)

For each parameter, four thresholds are displayed in the same units. A flag appearing against a parameter indicates deviation from the upper and lower warning and alarm threshold values specified by the manufacturer of the SFP.

The system does not monitor the SFP parameters and no alarms are raised if the SFP thresholds deviate from the specified values.

Note: The system generates an “unavailable” response if:

- digital diagnostics is not supported by the SFP module
- the administrative state of the module is not in the "ACCEPTED" state
- the data in the SFP contains checksum errors.

Synchronization and timing

Overview

Purpose

This section provides the information about synchronization features, timing protection and timing interfaces of 1645 Access Multiplexer Compact AMC .

Contents

Timing features

Synchronization modes

Several synchronization configurations can be used. 1645 Access Multiplexer Compact AMC can be provisioned for the following timing modes:

- free-running operation
- holdover mode
- locked mode

The NE has a real time clock signal available that is synchronized with the EMS. It can be set through the local workstation or the EMS. The clock is used to timestamp operations, maintenance and performance monitoring events.

The time setting is maintained up to two hours after the NE is powered down.

In locked mode, the internal SDH Equipment Clock (SEC) is locked to:

- one of the STM-1/STM-4 aggregate signals.
- one of the sixteen 2 Mbit/s tributary signals from the main board or the respective option card.
- one of the sixteen 1.5 Mbit/s tributary signals from the respective option card.
- one of the STM-1 signals from the respective option card.

Timing interface features

Synchronization Status Message (SSM) signal

A timing marker or synchronization status message signal can be used to transfer the signal-quality level throughout a network. This will ensure that all network elements are always synchronized to the highest-quality clock that is available.

On the 1645 Access Multiplexer Compact AMC systems the SSM algorithm or the timing marker is supported according to ITU-T recommendation G.781 and ETSI recommendation ETS 300-417-6-1. The SSM is supported on all STM-N interfaces.

SSM support on framed 2 Mbit/s external synchronization signals

The 1645 AMC supports reception and transmission of SSM's assigned to an Sa bit location, to provision the external synchronization of signals with 2048 kbits/s format and G.704 framing. The station clock output continuously transmits the SSM in one of the Sa bits of the 2 Mbit/s sub-multiframe.

The transmitted SSM values are determined as displayed in the following table:

QL from system clock process	Transmitted SSM (30 channel)	Transmitted SSM (24 channel)
STU	-	0000
PRS	-	0001
SSU_T	0100	-
SSU_T	0100	-
ST2	-	0111
SSU_L	1000	-
ST3	-	1010
SEC	1011	-
SIC	-	1100
RES	-	1110
DNU/DUS	1111	1111

The location of Sa bits for each of the station clock outputs can be provisioned by the user. The user can assign Sa bit values ranging from 4 to 8 and Sa bit 4 is the default setting. For each of the station clock inputs, the user has the option to enable or disable the extraction of the SSM words received over the Sa-bit channel of the 2048 kbit/s frame. Each timing port can be assigned up to two references and it may be noted that each reference can only be assigned once.

Forcing DNU on external synchronization output

The user can force a Do Not Use for synchronization (DNU) message in the outgoing 2 Mbit/s framed signal. The DNU message will be transmitted in the Sa-bit channel selected for SSMs.

Automatic squelching of 2048 kbps external synchronization output

The user can set threshold values to automatically squelch the external synchronization output when the associated Quality Level (QL) drops below the set values. Squelching is activated by turning off the 2048 kbit/s signal. If the external synchronization output signal selected is of the framed 2048 kbit/s format, squelching can be implemented by enabling the AIS mode or forcing a DNU message in the appropriate Sa-bit channel.

Timing input

1645 Access Multiplexer Compact AMC supports a 2 MHz timing input.

2 Mbit/s and 1.5 Mbit/s tributary retiming

The user can choose whether individual 2 Mbit/s or 1.5 Mbit/s tributary outputs operate in "self-timed" or "re-synchronized" mode. In the (standard) self-timed mode, the phase of the outgoing signal is a moving average of the phase of the 2 Mbit/s/1.5 Mbit/s signal because the signal is embedded in the VC-12 that is disassembled. In the re-synchronized mode the 2 Mbit/s/1.5 Mbit/s signal is timed by the SDH Equipment Clock (SEC) of the network element; frequency differences between the local clock and the 2 Mbit/s/1.5 Mbit/s signal embedded in the VC-12 to be disassembled are accommodated by a slip buffer.

There is also the following option: whenever the traceability of the local clock drops below a certain threshold, the re-timing 2 Mbit/s/1.5 Mbit/s interfaces automatically switch to self-timing. When this fail condition disappears, these interfaces return to re-timing. These changes do not involve any hits in the traffic.

> **Important!** Re-timing should only be applied when the network element which performs the re-timing and the network element which generated the 2 Mbit/s or 1.5 Mbit/s signal have traced back their SECs to the same synchronization source. Otherwise a continuous stream of 2 Mbit/s/1.5 Mbit/s frame slips or skips will occur at the re-timing point which is indicated by a FCS threshold crossing alarm.
>
> The user has the option of operating individual 2 Mbit/s or 1.5 Mbit/s outputs in the "re-synchronized" mode. In this mode the 2 Mbit/s or 1.5 Mbit/s output signal is timed by the system clock of the network element. However, when operating the 1645 Access Multiplexer Compact AMC with the additional option card, jitter requirements for the 32nd port operating in this mode may exceed ITU-T Recommendations G.783, G.813 (option 1), G.823 and G.825.

Synchronization of external equipment

The 1645 AMC enables synchronization of external equipment on the main board using an output connector.

The system has station clock input and output processes enabling the user to select the following types of station clock signals:

- 2 MHz
- 2 Mbit/s unframed
- 2 Mbit/s framed

The values of impedance of the station clock processes at input and output can be set to 75Ω and 120Ω by wiring the connector appropriately.

2 MHz station clock input

The station clock input operates with a 2 MHz clock signal in accordance with ITU-T Rec. G.703.10, with exception to the frequency offset tolerance. The frequency deviation of the input signal from nominal will be less than 4.6 ppm.

2 Mbit/s unframed station clock input

The station clock input operates with a 2 Mbit/s signal in accordance with ITU-T Rec. G.703.6 with exception to the frequency offset and sinusoidal phase variations. The frequency deviation of the input signal from nominal will be less than 4.6 ppm. The station clock input provides tolerance for sinusoidal phase variations as specified in the table below:

Peak-Peak amplitude	Frequency range
250 ns	1 Hz to 20 Hz
5000/f ns (f in Hz)	20 Hz to 50 Hz
100 ns	50 Hz to 100 kHz

2 Mbit/s framed station clock input

The station clock operates with a 2 Mbit/s input signal having a frame/multiframe structure in accordance with ITU-T Rec. G.703.6 and G.704, with exception to the frequency offset and sinusoidal phase variations. The frequency deviation of the input signal from nominal will be less than 4.6 ppm.

The station clock input provides tolerance for sinusoidal phase variations as specified above for “2 Mbit/s unframed station clock input”. The station clock is capable of receiving an AIS signal with a frequency deviation up to 50 ppm from nominal.

2 MHz station clock output

The station clock output is capable of forwarding a 2 MHz clock signal in accordance with ITU-T Rec. G.703.10. The station clock output will be squelched/normal within a range of 200 ms, if the input signal of the station clock process is unacceptable/acceptable.

2 Mbit/s unframed station clock output

The station clock output is capable of forwarding a 2 Mbit/s clock signal in accordance with ITU-T Rec.G.703.6. The station clock output will be squelched/normal within a range of 200 ms, if the input signal of the station clock process is unacceptable/acceptable.

2 Mbit/s framed station clock output

The station clock output is capable of forwarding a 2 Mbit/s signal with a frame/multiframe structure in accordance with ITU-T Rec.G.703.6 and G.704. The system allows the user to provision the AIS mode. In the event of the input signal of the station clock process becoming unacceptable/acceptable, the station clock output will be squelched/normal within a range of 200 ms. This is applicable when the AIS mode is enabled and/or the NE is set to the QL disabled mode. If DNU or AIS is inserted or forced, the frequency of the output signal is derived from a clock with a minimum accuracy of 4.6 ppm.

Return loss requirements

The station clock input at the customer connection point fulfills the requirements of return loss as specified in the following table:

Input type	Frequency	Return loss
Framed/Unframed 2 Mbit/s	between 51 and 102 kHz	12 dB
	between 102 and 2048 kHz	18 dB
	between 2048 and 3072 kHz	14 dB
2 MHz	2048 kHz	15 dB

The station clock output fulfills the requirements of return loss as specified in the following table:

Input type	Frequency	Return loss
Framed/Unframed 2 Mbit/s	51 kHz - 102 kHz	6 dB
	102 kHz - 3072 kHz	8 dB
2 MHz	2048 kHz	8 dB

Operations, Administration, Maintenance and Provisioning

Overview

Purpose

The following section provides information about interfaces for Operations, Administration, Maintenance, and Provisioning (OAM&P) activities and the monitoring and diagnostics features of 1645 Access Multiplexer Compact AMC .

Contents

Remote maintenance, management and control

First maintenance tier

The maintenance procedures of the 1645 Access Multiplexer Compact AMC systems are built on two levels of system information and control. The first maintenance tier consists of the LEDs on the equipment. There are two LEDs on the front of the 1645 Access Multiplexer Compact AMC. Additionally there are LEDs on option cards and near to the SFPs for 1645 AMC. The LEDs indicate basic alarms or basic operation states.

Second maintenance tier

The second maintenance tier employs the Alcatel-Lucent network management system. Detailed information and system control are obtained by using the ITM-CIT (craft interface terminal), which supports provisioning, maintenance and configuration on a local basis. A similar facility (via a Q-LAN connection or via the DCC channels) is remotely available on the element manager, the OMS, which provides a centralized maintenance view and supports maintenance activities from a central location.

1645 Access Multiplexer Compact AMC support SNMP management via the Q-LAN interface.

Optical Management System

At network level (customer's network management center), Alcatel-Lucent Optical Management System (OMS) performs all the tasks that are necessary to supervise, operate, control and maintain an SDH network with the 1645 Access Multiplexer Compact AMC .

SNMP

The 1645 Access Multiplexer Compact AMC supports SNMP access via its Q-LAN interface. The protocol version SMNPv2c is supported according to FRC 2578, RFC 2579, RFC 2580, RFC 3416, RFC 3417, RFC 3584, and RFC 2863.

The managed information is kept in Management Information Bases (MIBs). The system supports a subset of the SNMPv2 MIB (acc. to RFC 3418) and the interfaces group MIB (acc. to RFC 2863). The system supports the inventory retrieval and link supervision aspects of the MIBs.

The following SNMP traps are supported:

- snmpTraps.warmStart acc. to SNMPv2 MIB (RFC3418)
- snmpTraps.coldStart acc. to SNMPv2 MIB (RFC3418)
- snmpTraps.linkDown acc. to The Interface Group MIB (RFC2863)
- snmpTraps.linkUp acc. to The Interface Group MIB (RFC2863)

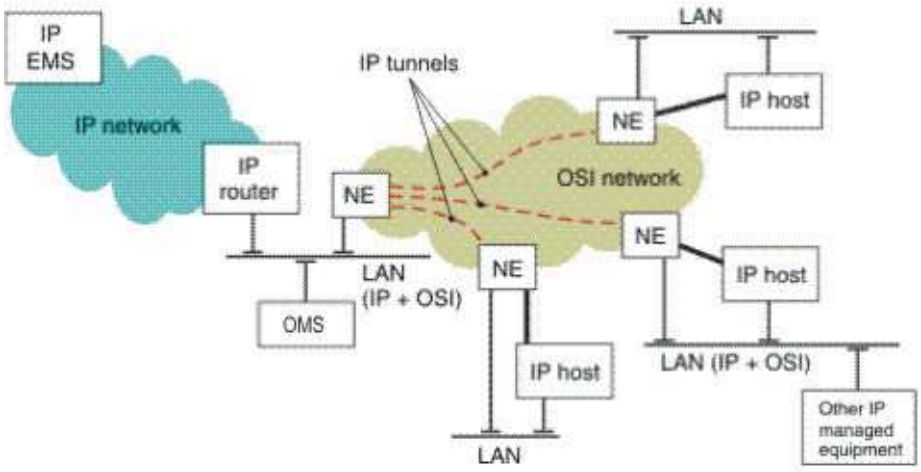
Traps are sent in both, the SNMPv1 and SNMPv2 format.

Tunneling of TCP/IP over DCN

IP tunneling

The 1645 Access Multiplexer Compact AMC is capable of tunneling IP traffic through the OSI DCN network. The tunnel provides a virtual interconnection for IP traffic between the “Ethernet interfaces (LAN)” and/or “end points of other IP-tunnels (terminating in the NE)” of two NE's that support this feature.

Refer to the following figure for an example of IP tunneling:



Note that a tunnel may forward IP traffic to many destinations, that can either be connected to the Q-LAN of the far end tunneling NE, or must be reached through subsequent routing towards/through other IP-tunnels and/or towards/through external IP routers.

The LAN interface supports both IP and OSI traffic simultaneously. Tunneling is achieved by encapsulating the IP packets in CLNP (OSI) packets.

This feature has no effect on the OSI management of the 1645 Access Multiplexer Compact AMC itself, apart from the performance impact of additional IP traffic. This feature requires the NE to act as an IP router itself. The IP router supports ports to the Ethernet Interface (Q-LAN) and to the CLNP (OSI) network (i.e. a number of tunnels).

IP tunneling and purposes

This feature is intended to forward IP traffic between IP managed equipment at the borders of the SDH network and their IP-based management system.

In order to use the tunneling feature, it is necessary to provision the following using the OMS or the ITM-CIT:

- map a “tunnel far-end” to each (masked) IP-destination, where all IP-addresses are implied that fulfil the most significant bits (non-masked) part of the IP-destination. Only the far-end of a tunnel needs to be identified through its NSAP address (the near-end is implicitly this NE). Resources for a maximum of 50 tunnels must be provided.
- provision its own IP-address in the NE.
- enable IP routing.

- add routing information for forwarding towards an external IP router, when the IP-destination is not connected to the Q-LAN of the NE.
- enable (when desired) automatic creation of tunnels, towards all other NEs in this area that have automatic creation enabled. Note that manual provisioning is needed for a tunnel that spans a number of areas, while subsequent tunneling within the destination area can make use of automatically created tunnels.

Alarm severity assignment profile

An Alarm Severity Assignment Profile (ASAP) is a list of alarms with an associated severity value for every alarm. ASAPs allow the user to control alarm reporting with more flexibility, and to create multiple alarm profiles for each alarm category and to assign these profiles to entities within the system. The supports flexible alarm reporting through the Alarm Severity Assignment Profiles (ASAP).

All alarms are classified into a particular alarm category and are pre-defined. The categories containing the alarms are referred to as pre-defined alarm profile types. Each profile type has a default profile and a set of profiles created by users. These profiles and the default profiles within the profile types are referred to as ASAPs. The assigned alarm severity levels refer to each alarm within each ASAP. For each alarm in the alarm profile, users can assign a severity value and reported state. The alarm severity values and reported state constitute the Alarm Severity Assignment Profile. The default profiles are available after system installation. When a failure occurs, the ASAPs created by customers are used to specify the alarm severity level.

All the alarms are categorized into 15 different ASAP types. For example, equipment, DCN, timing, and so on. The default ASAPs contain default settings for the severity and reporting values and can be edited. In addition to the default ASAP, multiple ASAPs can be created, edited, and deleted. For each alarm profile type, a default ASAP is available and can be edited but cannot be deleted. Users can assign labels for each ASAP. However, ASAP values created by customers can only be deleted when they are not assgined to a port or termination point. The default ASAP values are effective, whereas, every new ASAP profile created by customers must be assigned to a functional system entity such as a specific port or termination point to be effective.

During provisioning, ASAPs can be assigned to functional system components such as a circuit pack or a specific port. Each ASAP can be uniquely identified by its type and name. Note that predefined or default alarms or profile types can be edited but the profile name cannot be changed or deleted by the user. Only the profiles created by the user can be changed or deleted.

The severity and reported values are enabled when the ASAP is assigned to a port or termination point that can raise the alarms contained in the alarm profile type. Individual ASAPs can also be assigned to a multiple set of functional system entities according to their ASAP type.

The supports 64 ASAPs including the default profile. In addition to the default ASAPs, customers can create up to 49 new ASAPs.

For more information on how to create, modify, delete, assign or retrieve ASAPs, refer the *1645 AMC User Operations Guide*.

Alarm severities

These alarm severity levels are used in the following description of the ASAP types:

1. Prompt (Urgent alarm that requires immediate (prompt) maintenance action)
2. Deferred (Non-urgent alarm that requires deferred maintenance action)
3. Info (Informational alarm).

Reporting state

Each alarm can be assigned one of the following reporting states:

Reporting state	Meaning
Reported	The alarm - when raised - will be reported to the management systems, and displayed on the graphical user interfaces.
Not reported	The alarm - when raised - will *not* be reported.

Note that changing the alarm reporting state does not affect the display of currently present and history alarms. Especially, the display of already present alarms cannot be removed if their reporting state is changed from “Reported” to “Not Reported”.

4 Operations, Administration, Maintenance and Provisioning

Overview

Purpose

This chapter describes the OAM&P of the 1645 AMC.

It includes the following:

- Operations interfaces
- Maintenance supervision
- Software maintenance
- Maintenance testing
- Performance monitoring (G.826 and G.784)
- Self-diagnostics
- System alarm indicators
- Four Miscellaneous Discrete Input (MDI) contacts
- Four Miscellaneous Discrete Output (MDO) contacts

Contents

Operations overview

Operations interfaces and administration

The 1645 Access Multiplexer Compact AMC is configured for remote and local operations management via the Optical Management System (OMS)and SNMP management solution. Remote management can be realized via the STM-1 or STM-4 DCC and the OMS or ITM-CIT software.

Local connection is available via an RJ45 socket on the main board to connect a PC loaded with the ITM-CIT software.

Management access features include:

- Simultaneous access by the element management system and local workstations
- Remote access to other 1645 AMC in the same network by ITM-CIT
- NE level security via three password controlled authorization levels: ADMIN, CONFIGURE, and VIEW.
- Simultaneous access to the DCC channels. This is for a maximum of eight STM-N interfaces to the system (line and tributary together).
- Two modes of operation are defined to support DCC communication over 1+1 MSP protected STM-4 links (line and tributary).
  The user can select the mode independently for RS-DCC and/or MS-DCC:
  Independent switching, driven by the IS-IS routing protocol or slaved switching, controlled by the MSP switch algorithm.
  This applies only to interfaces for which MSP is supported.

Maintenance

Maintenance supervision

Transmission and equipment fault supervision is monitored remotely via the OMS and locally via LEDs on the unit and via the ITM-CIT. The local ITM-CIT may also be used to remotely access other 1645 AMC nodes in the same network.

Alarm and port termination monitoring features include:

- Physical port provisioning of STM-1 or STM-4 aggregate, STM-1 tributary, E1, E3, DS1, DS3, SHDSL, and Ethernet ports in three different modes: automatic (AUTO), monitored (MON), or non-monitored (NMON)
- VCx (x=11,12,3,4) and P12 (egress) path termination point provisioning in either the MON or NMON mode
- Alarm severity levels of PROMPT, DEFERRED and INFORMATION provisionable for each alarm type by provisioning the alarm severity assignment profile (ASAP)

- Each VC path non intrusive monitor (NIM) function can be in one of two following modes:
  - Monitored (MON)

    In the MON mode, all the alarms that originate in the VC path non intrusive monitoring function are reported.
  - Non-monitored (NMON)

    In NMON mode, all the alarms that originate in the VC path non intrusive monitoring function are suppressed.
- The user can assign an alarm message and severity to each MDI (Miscellaneous Discrete Input) by provisioning the Alarm Severity Assignment Profile (ASAP).

Failure reporting features:

- Failure reports are generated for equipment, configuration and software faults with sufficient information to identify the next step in the fault correction process
- Alarm forwarding to the remote EMS (Element Management System) is supported via OMS (LAN-10BaseT) and to the local workstation via the F-interface (ITM-CIT)
- The NE can store the 500 most recent alarm events and can be accessed by either the local or remote monitoring stations
- Transmission failures are reported as defined in G.783 and ETS 300417
- Centralized supervision alarm system. The ITM-CIT informs of each new alarm change for each accessible NE.

Software maintenance

Software maintenance includes the following:

- Local and remote software download via OMS or ITM-CIT, non-service affecting. Minor LAN traffic interruption may occur in case of switch of the software backup store in order to upgrade/downgrade the system.
- Faster MIB download duration. The ARC timer is set to five minutes. If a local CIT or OMS connection is established within five minutes, the ARC process will continue. If the local CIT or OMS confirms the MIB download within five minutes, the 1645 AMC will restart. However, if the MIB download is not confirmed within five minutes, the 1645 AMC opens the DCC according to the parameters in the safe place.
- The 1645 AMC supports MIB upload and download functions to and from a PC via the local Q-LAN interface. The MIB image can be saved as a binary file.
  The MIB image that is uploaded from the 1645 Access Multiplexer Compact AMC can be downloaded via the Q-LAN interface to the other NEs with hardware variations.
- The 1645 AMC NEQ value is 0.25 and is compatible with the requirements of network management system.
- Database upload/download from the OMS.

- In-service database re-provisioning available via the local workstation running ITM-CIT software.
- The 1645 AMC supports the ITM-CIT and EMS to display a dynamic software download progress indicator per module. This module also indicates the software download percentage for the SHDSL module.
- The system allows the user to trigger a motherboard soft reboot from the network manager. This trigger from the network manager has the same effect as use of the reset button on motherboard. This trigger does not affect transmission.
- The system allows the user to trigger an option board hard reset from the network manager. This affects the transmission of the option board as it is a hard reset.
- Support for running the ITM-CIT application on the Windows Vista operating system is now available.
- A single software load is capable of supporting all possible configurations of a particular hardware revision of the AMC system. The exact behavior of a network element is determined by its configuration data.

The “Fast download” tool permits to load the current software of the equipment via a PC connected to the Q-LAN interface of the equipment.

Maintenance testing

For circuit testing during maintenance operations, the system provides:

- Loopbacks on incoming E1, DS1, E3, DS3.
- Loopbacks on outgoing E1, DS1, E3, DS3, and SHDSL signals
- Cross-Connect loopbacks at AU level
- NT1 (Network Termination) loop-back on a 2 Mbit/s line dedicated to ISDN.

SDH performance monitoring

Provisioning and retrieval of performance monitoring parameters are derived from the overhead bytes (SOH, POH of each VC) and are in accordance with ITU-T Recommendations G.874 and G.826. This is accomplished via OMS and ITM-CIT. The user can set the performance threshold counts. Each managed NE has a current data register for 15 minutes or 24 hours.

The NIM features SDH non-intrusive monitor failure reports. The VC-4, VC-3, VC-12 Non-Intrusive Monitors (NIM's) can be in Monitored (MON) or Non-Monitored (NMON) mode. In MON mode, the cTIM, cUNEQ, cDEG, cRDI and cSSF alarms are forwarded to the OMS.

The following parameters are monitored:

- Severely Errored Seconds (SES)
- Errored Seconds (ES)

- Background Block Errors (BBE)
- Unavailable Seconds (UAS).

Ethernet performance monitoring

Ethernet (LAN and WAN) performance monitoring information can be derived from bytes sent, bytes received, and packets dropped. This information is available in 15 minute or 24 hour registers.

ISDN performance monitoring

ISDN Performance monitoring information can be derived for 2 Mbit/s signal from pN_EBC (Near-end Errored Block Count).

This information is available from:

- Egress (Egress refers to the SDH to PDH transmission direction)
- Ingress (Ingress refers to the PDH to SDH transmission direction).

E1 non-intrusive monitoring

For transparent E1 interfaces, it is possible to do near-end performance monitoring on each 2 Mbit/s signal in both directions (PDH to SDH and SDH to PDH) at the 2 Mbit/s system interface. Near-end information is obtained from CRC-4 violations and defects.

Self-Diagnostics and recovery

The 1645 AMC supports the following diagnostic and recovery features:

- The equipment continuously runs self-diagnostic tests to monitor the health of the transmission system
- Anomalies are reported via system indicators (FAIL LED) or Alarms on the Element Management System and/or *WaveStar*® CIT
- The equipment auto-recovers after a power failure
- The equipment will auto-recover from a database failure by requesting the backup database be downloaded from the OMS.

System indicator information

The 1645 AMC supports the following LEDs which provide the following maintenance information:

- A green LED to indicate power
- A red LED to indicate unit fault or signal failure.
- A green LED located close to the F type interface connector. The green LED is lit when the CIT is connected to the NE.

Miscellaneous Discrete Inputs/Outputs

The 1645 AMC provides four Miscellaneous Discrete Inputs (MDIs) which can be used to read external devices assigned by the customer. Examples are monitoring temperature, humidity, and open doors.

The equipment provides four Miscellaneous Discrete Outputs (MDOs) which can be used to drive external devices assigned by the customer. Examples are signaling devices, temperature conditioning, etc.

When not assigned by the customer, the 1645 AMC functions in a way that MDO 1 has been assigned to indicate a power failure (normally open contacts will close), MDO 1, MDO 2, MDO 3, MDO 4 are respectively assigned to power failure, Prompt, Deferred, Information alarms.

HDLC-transparent DCC

The 1645 AMC systems support one bi-directional HDLC-transparent DCCR connection between the two STM-1 line ports. Note that, selectable per port, either the MS channel or the RS channel can be used at the same time. This feature facilitates the inter-working with third party equipment.

AITS/UITS protocol on LAPD

The user can select the LAPD protocol (ITU-T Q.921) for OSI layer 2 to be based on AITS (Acknowledged Information Transfer Service) or UITS (Unacknowledged Information Transfer Service). In the AITS mode, the receive side sends an acknowledgement back to the transmit side, if a data packet has been received. If this acknowledgement does not arrive, the transmitter sends the packet again. In the UITS mode, no acknowledgements are sent.

5 Planning considerations

Overview

Purpose

This chapter illustrates different applications of the 1645 Access Multiplexer Compact AMC (respective NE capabilities have to be considered).

Contents

General planning information

1645 AMC

When planning your system with the 1645 AMC , the following items should be considered:

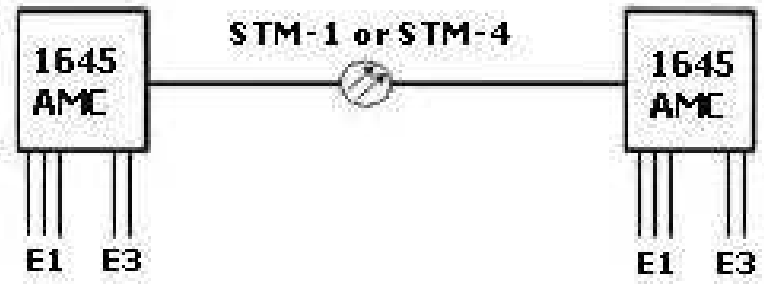
- Synchronous capacity – Two STM-1, two STM-1/STM-4 optical aggregate interfaces.
- Plesiochronous capacity – sixteen 2 Mbit/s E1 interfaces (basic unit)
  - Optional six STM-1 tributary signals (together with sixteen E1s).
  - Optional sixteen additional 2 Mbit/s signals (total of thirty-two E1)
  - Optional sixteen 1.5 Mbit/s signals (total of sixteen E1s and sixteen DS1s)
  - Optional three 34 Mbit/s signals or three 45 Mbit/s (together with sixteen E1s)
  - Optional twelve SHDSL signals (for a combination of sixteen E1s and twelve SHDSLs)
  - Eight 10/100BASE-T Ethernet interfaces and two 10/100/1000Base-T or optical 1000Base-X/100Base-FX interface extensions
  - Eight optional Ethernet interfaces in private line mode
  - 3 × 10/100BASE-TX electrical FE interfaces, 1 × 10/100/1000BASE-T(X) electrical GbE interface, 1 × 1000BASE-X GbE optical interface via SFP.
- Synchronization:
  Synchronization can be enabled using any of the following mechanisms:
  - STM-1 or STM-4 aggregate line interface timing
  - STM-1 tributary line
  - 2 Mbit/s data input
  - 1.5 Mbit/s data input
- Protection: VC-12/VC-3/VC-4 SNC/N
- Protection: 1+1 MSP
- Operation systems: remote and local management with OMS and local and remote (remote to other 1645 AMC) with ITM-CIT, SNMP management is supported
- Three possibilities for power supply :
  - DC (unit contains DC connector)
  - AC (unit contains AC connector)
  - DC via an external AC/DC connector.
- The 1645 AMC provides four Miscellaneous Discrete Inputs (MDIs) which can be used to read external devices assigned by the customer. Examples are monitoring temperature, humidity, open doors, etc.
  The equipment provides four Miscellaneous Discrete Outputs (MDOs) which can be used to drive external devices assigned by the customer. Examples are signaling

devices, temperature conditioning, etc.
When not assigned by the customer, the 1645 AMC behaves such that MDO 1 has been assigned to indicate a power failure (normally open contacts will close), MDO 1, MDO 2, MDO 3, MDO 4 are respectively assigned to power failure, Prompt, Deferred, Information alarms.

Linear applications

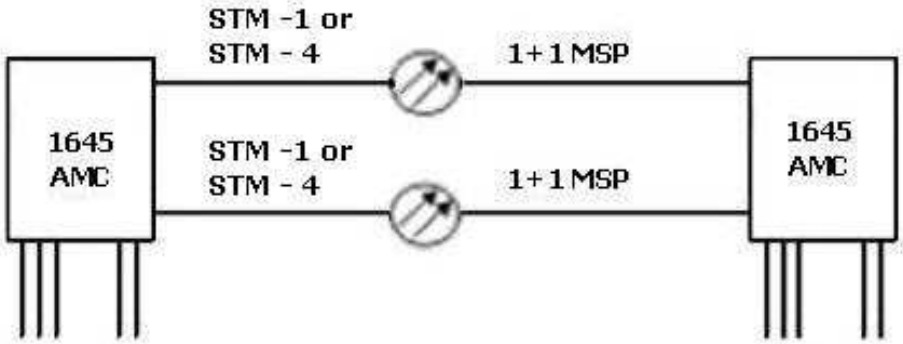
Point-to-point applications without MSP protection

The following figure shows an example of a point-to-point application without MSP protection:



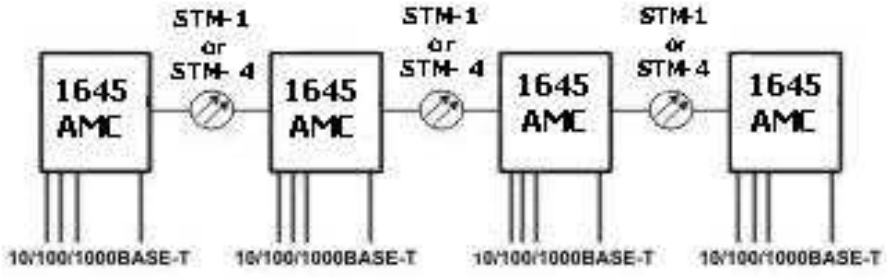
Point-to-point application with MSP protection

The following figure shows an example of a point-to-point application with MSP protection:



LAN-to-LAN linear unprotected application

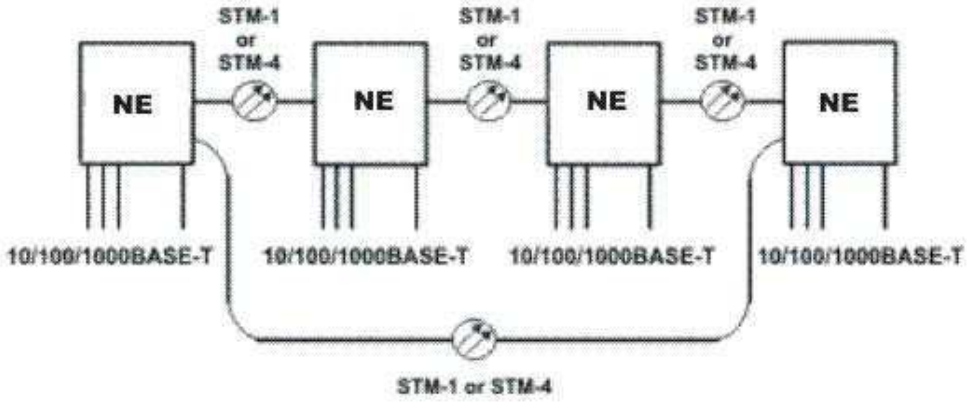
When cost is a major factor, this application requires a minimum amount of equipment and fiber. It is well suited for LAN-to-LAN traffic on campus networks or between business locations requiring cost-effective and reliable communications. Management requirements of this application are minimal.



Folded ring application

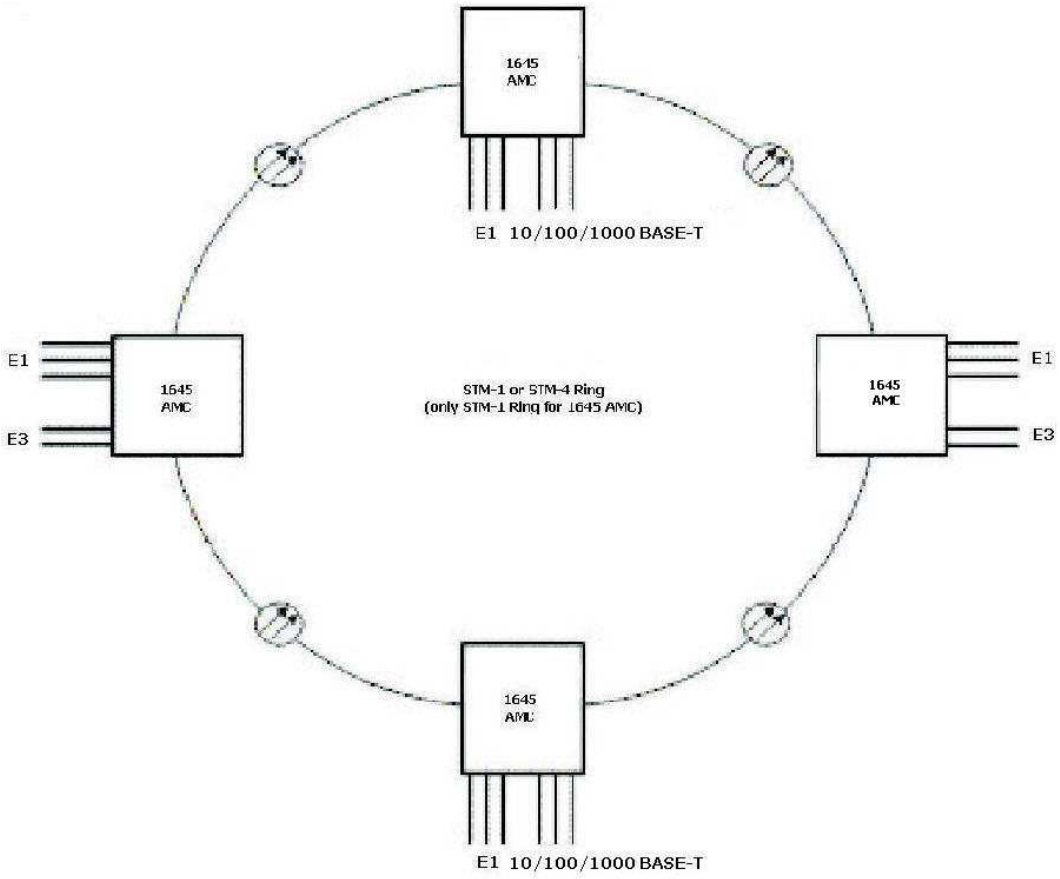
The figure below shows an STM-1 or STM-4 Folded Ring application.

Compared to the linear application in “LAN-to-LAN linear unprotected application” (p. 5-4), the folded-ring provides extra reliability by protecting the NE chain by building a ring. Within the chain NEs can flexibly be added or removed while the protection within the ring remains untouched.



Ring application

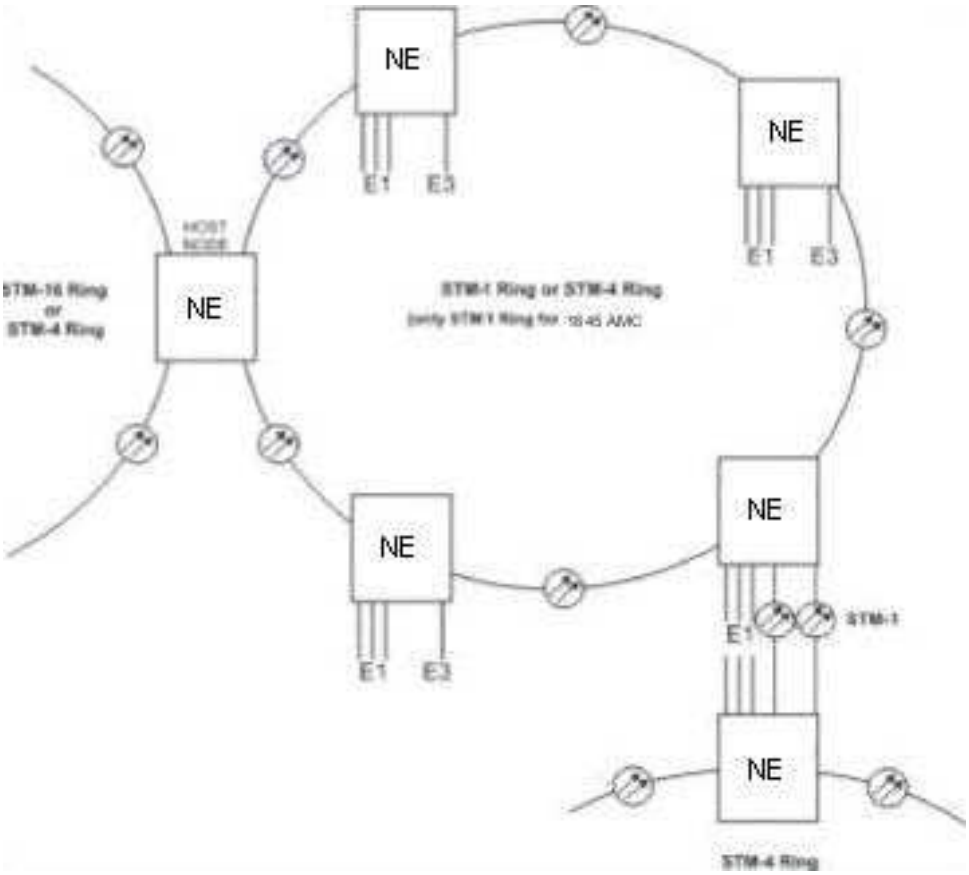
The STM-1 or STM-4 Ring application illustrated in the figure below is an example of a simple and inexpensive way of transporting all signals that can be connected to a 1645 AMC , like STM-1 tributary, E1, DS1, E3, DS3, and 10/100 BASE-T. The individual nodes can be managed remotely or locally by either OMS or ITM-CIT.



Single-homed ring application

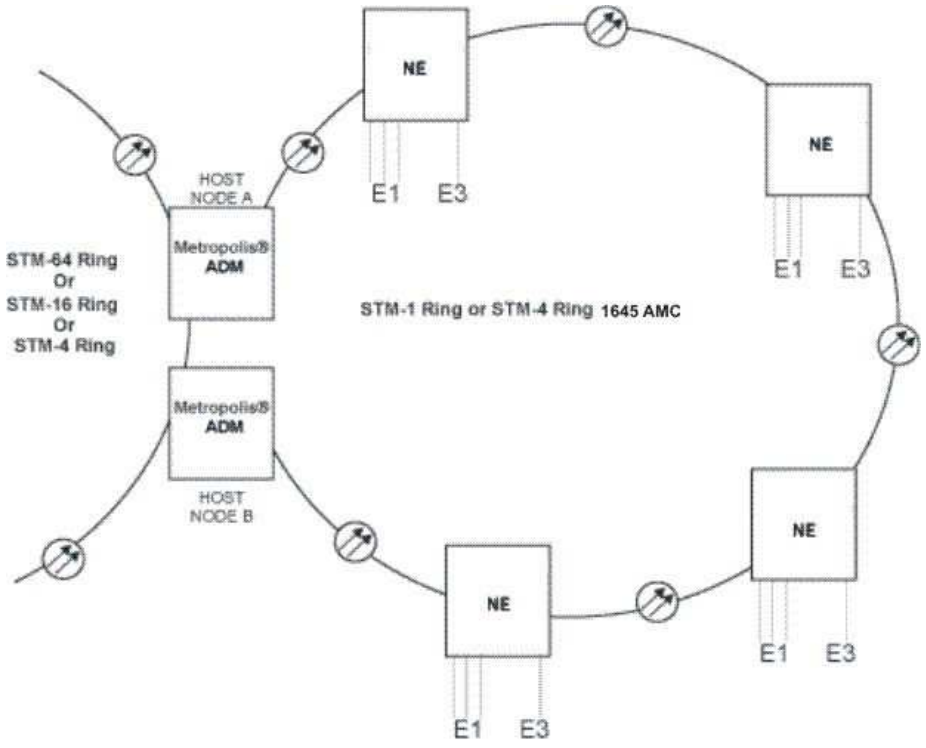
The figure below illustrates a single-homed ring application. This configuration connects the STM-4 ring to the STM-N network through a host node.

An STM-1 line (STM-1 tributary interface) with MSP protection allows the connection between e.g. two 1645 AMC .



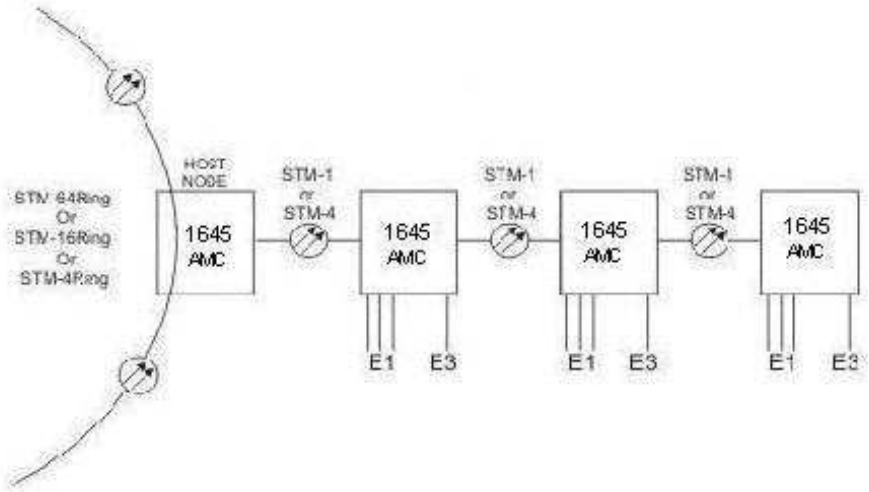
Dual-homed ring application

The figure below shows an example of a dual-homed ring application. Similar to the single-homed example in the previous chapter, access to the STM-N network is through two hosts. This may be preferable to the single-host application where completing the STM-1 or STM-4 ring may be difficult due to geographical features. It also provides protection against node failure through the second host node.



Linear extension application

The following figure shows a linear extension hosted by a *WaveStar*®ADM 16/1 or Metropolis® ADM (compact shelf) / Metropolis® ADM (universal shelf) NE. It is a low cost solution for extending E1 and E3 services from the STM-N ring.

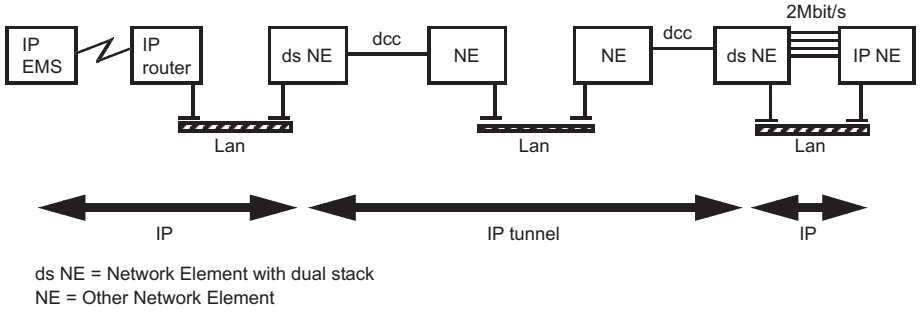


IP tunneling in the DCC channels application

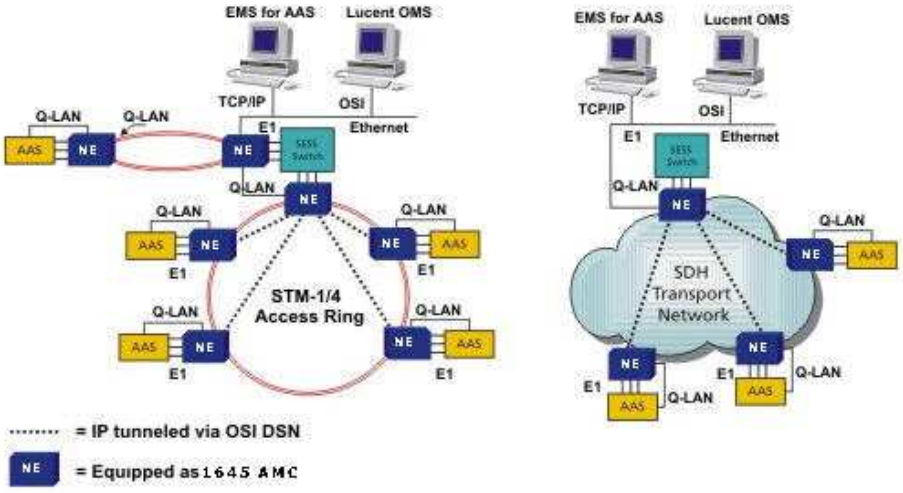
The following figure shows an example of the IP tunneling in the DCC channels application. This feature provides a way to manage IP devices through the data communication network (DCN). An IP EMS (element management system) is used to manage NEs which use IP based management protocols (IP NEs).

The embedded overhead channel (data communication channel) of the 1645 AMC is used to transport the management data between the IP EMS and the different NEs.

An IP tunnel can be seen as a set of two static routing entries in nodes on the edge of the OSI network and the corresponding static entries in the routing table. The LAN used by IP EMS can also be used by the OMS.



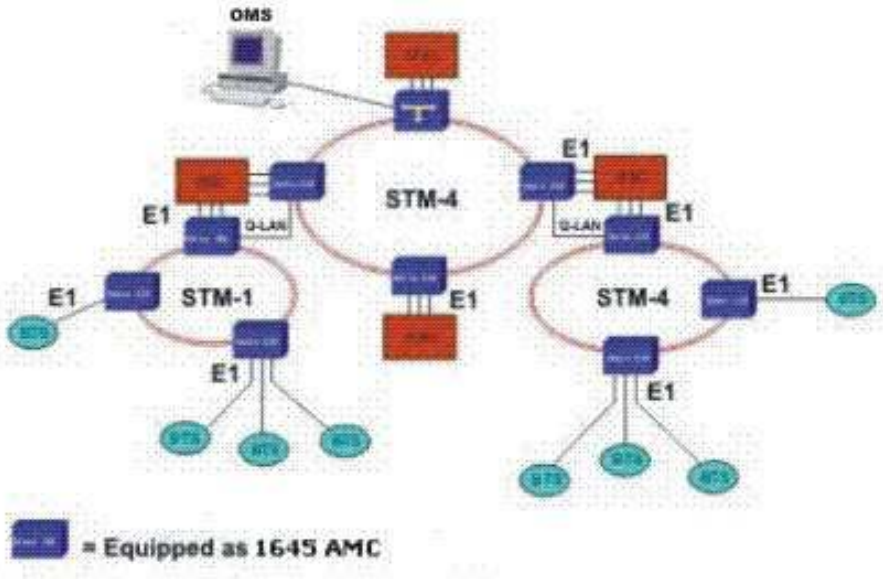
The following figure shows an application with Anymedia Access Equipments (AAS). The EMS for AAS realizes the management of the different AAS equipments via the Q-LAN interfaces and using the DCC channels of the different 1645 AMC.



GSM/UMTS application

The 1645 AMC is an attractive offer in a ring topology for serving GSM/UMTS base stations.

The following figure illustrates an example of 1645 AMC in a GSM/UMTS application:

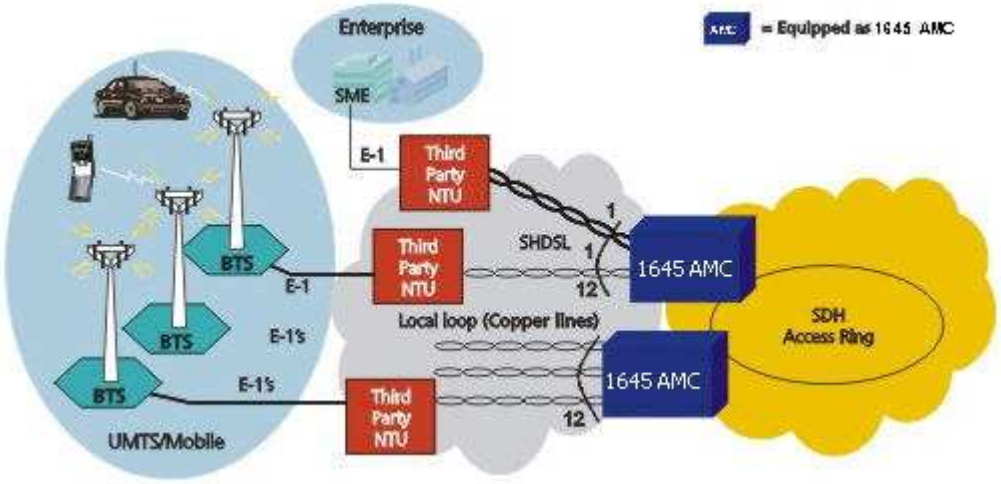


SHDSL applications

E1 over SHDSL

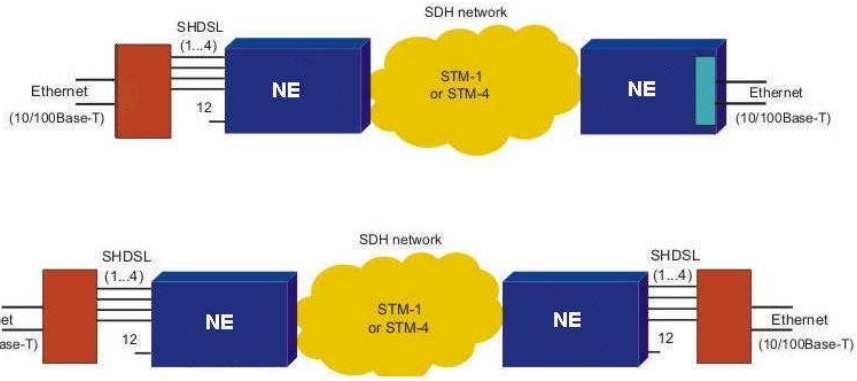
For locations that cannot be reached via fiber, the 1645 AMC offers an SHDSL extension option board. This allows the transmission of E1s in a frame structure over copper lines. Distances of up to 3.5 km can be reached. The E1s are either directly mapped to the SHDSL structure or first mapped into a TU-12 and then into SHDSL. The latter allows full SDH path monitoring for the path which is terminated in the SHDSL Network Termination Unit (NTU). The 12 SHDSL ports on the 1645 AMC option board allow for a cost effective solution.

Alcatel-Lucent supports a variety of E1 and TU-12 third party NTU modems.



Ethernet over SHDSL

Ethernet data can be transmitted over SHDSL by using a third party TU-12 NTU modem. The data are first mapped into a TU-12 and then into the SHDSL structure according to GFP mapping. Two examples are shown in the following figure. The 1645 Access Multiplexer Compact AMC facilitates the transmission of Ethernet data from an NTU via the SDH network to another NTU. But they provide also the compatibility for a connection between an NTU and the Ethernet option cards X5IP, X5IP-V2 X10IP or X8PL within the 1645 Access Multiplexer Compact AMC.



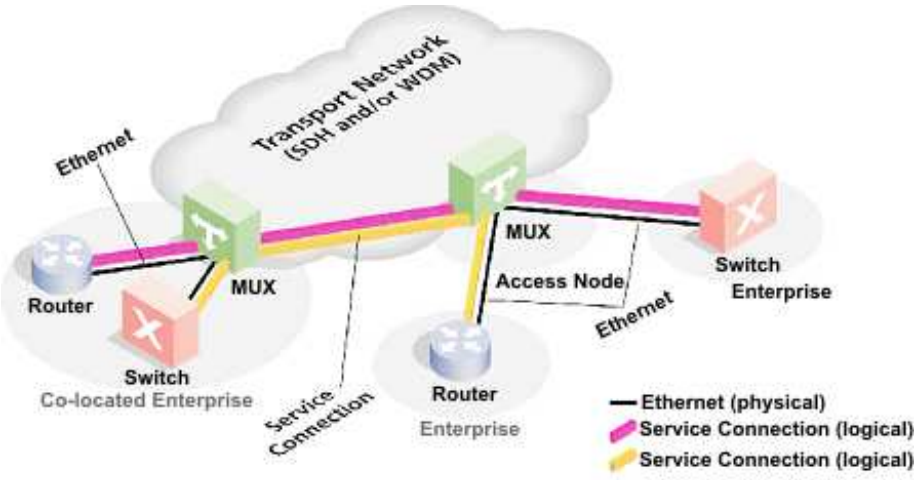
For a detailed description of enhanced SHDSL features, refer to Chapter 9, “SHDSL Overview”.

Multi-service application with the *TransLAN*® option board

The *TransLAN*® option board, enables the SDH network elements to provide Ethernet over SDH, and offers variable data applications on top of the traditional TDM applications. This results in cost-effective, simple and reliable multi-service solutions for customers. *TransLAN*® can provide VLAN functions, and bandwidth can be shared for different customers.

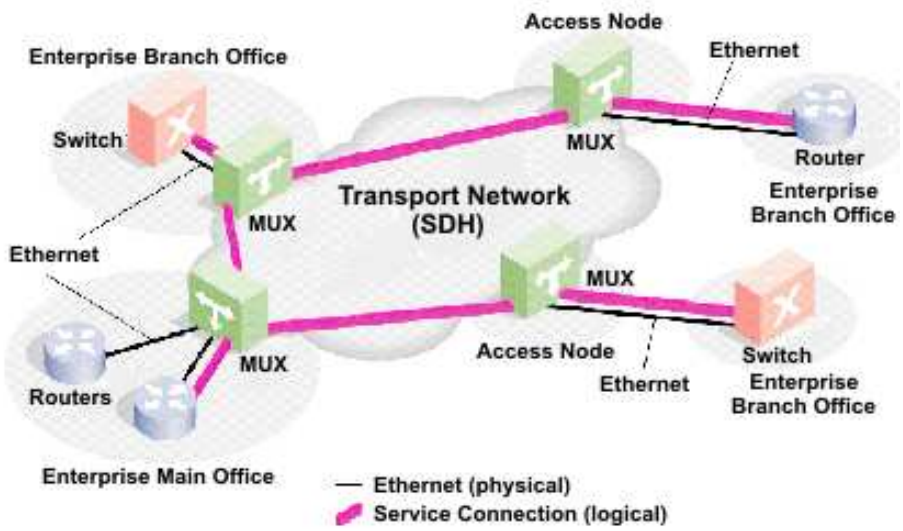
Direct LAN-to-LAN interconnect (two LAN's)

The most straightforward application of the *TransLAN*® option board is to interconnect two LAN segments that are at a distance that cannot be reached with a simple Ethernet repeater, since that would violate the collision domain size rules. Both LAN's do not have to be of the same speed. It is possible to interconnect a 10BASE-T and a 100BASE-T LAN this way. This application is shown in the following figure:



Direct LAN-to-LAN interconnect (Multiple LAN's)

A next step in complexity is to interconnect multiple LAN's, more than two, at different locations. It is possible to associate a single LAN port with two or more WAN ports. In this way multiple sites can be interconnected, forming a fully Layer 2 switched WAN Ethernet network. This application is shown in the following figure:

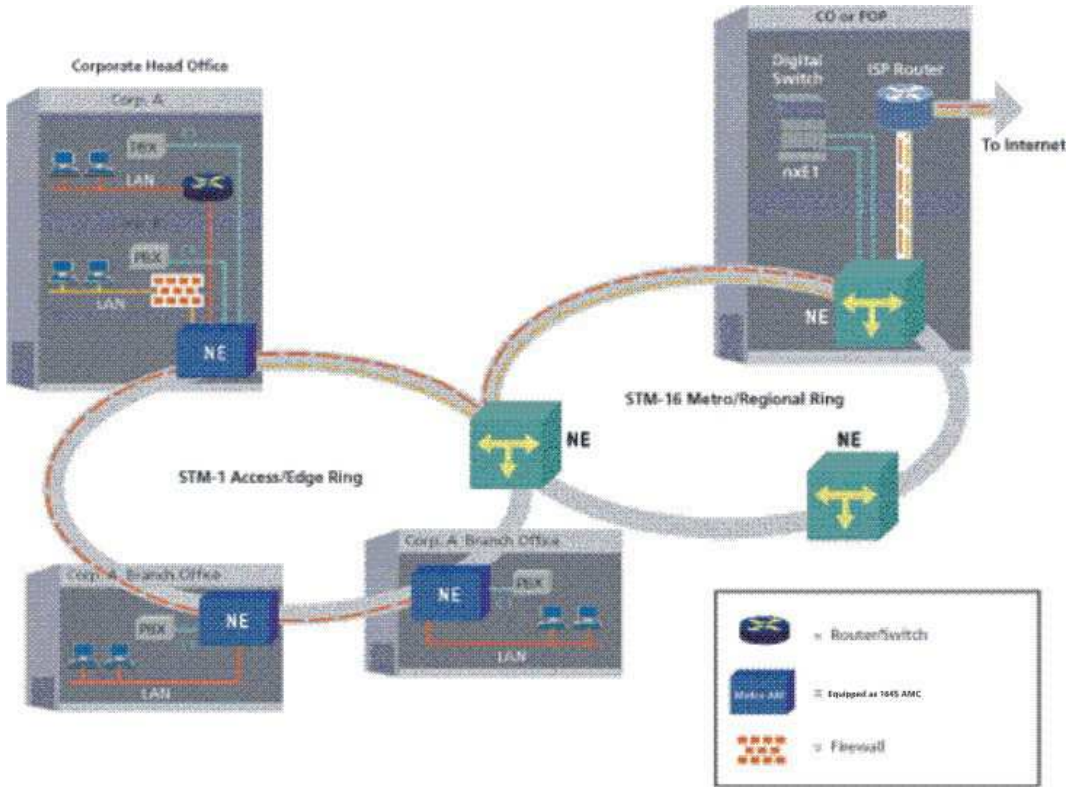


LAN-ISP interconnect

An extension of the previous application is to have one LAN drop of a multi-point LAN-to-LAN interconnection at the point of presence of an ISP (internet service provider), to provide for instance Internet access to the users in the company LANs.

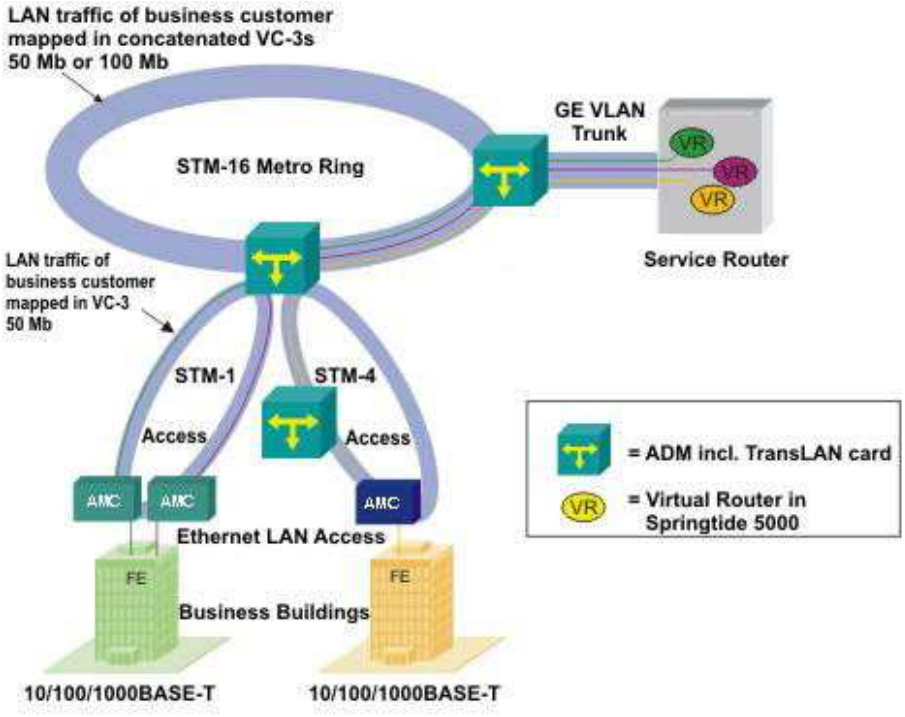
Multiple customers sharing a WAN connection

To increase the efficiency of the bandwidth usage, it is possible to route the Ethernet traffic of multiple end-users over the same SDH facilities. This feature is called LAN-VPN and makes use of customer VPN tags, a tagging scheme derived from the IEEE802.1Q VLAN standard to separate the traffic of the different users. Via the IEEE 802.1ad provider bridge mode it is additionally possible to use provider-defined tags for different customers and thus to be independent from customer VPN tags. A respective application is shown in the following figure:



VLAN Trunking

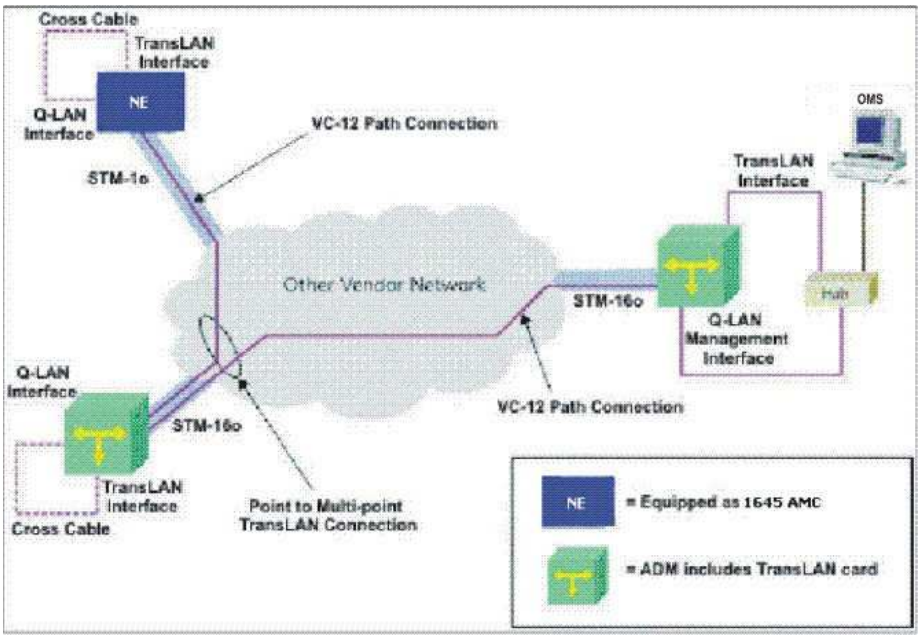
At the ISP premises, the aggregated LAN traffic from multiple customers (i.e. multiple VLANs) via one single high capacity Ethernet link (Fast Ethernet) to data equipment in a Central Office or ISP POP such as an IP edge Router, IP Service Switch or ATM Switch, can be handled by means of the VLAN trunking feature. VLAN trunking is a possible application of the IEEE 802.1Q and IEEE 802.1 ad VLAN tagging scheme. Main benefit of the VLAN trunking feature is that *TransLAN*® cards can hand off end user LAN traffic via one high capacity LAN port instead of multiple low speed LAN ports, thus reducing port, space and cabling costs. The following figure illustrates an example of VLAN Trunking:



DCN support with the *TransLAN*® unit

The *TransLAN*® option board can also be used for DCN engineering purposes. An important application in this respect is to use the Ethernet interfaces to make a long distance Q-LAN connection. This solution can replace the current solution that uses external modems or routers. It is often cheaper and easier to manage if the long distance Q-LAN connection can be made over the SDH infrastructure (at the cost of the bandwidth of a few VC-12s). The DCN application of the *TransLAN*® option board assumes the OMS is collocated with at least one of the NEs equipped with a *TransLAN*® card (e.g., 1645 AMC, Metropolis® ADM (universal shelf) or Metropolis® ADM (compact shelf)). In such a case, one can connect the Ethernet port of the OMS to one of the designated 10BASE-T/100BASE-TX LAN ports and configure the associated WAN port with desired bandwidth (e.g., VC12) to carry the management traffic.

Additionally it is possible to integrate the 1645 Access Multiplexer Compact AMC in other vendorś networks and to pass through their DCC_R transparently.

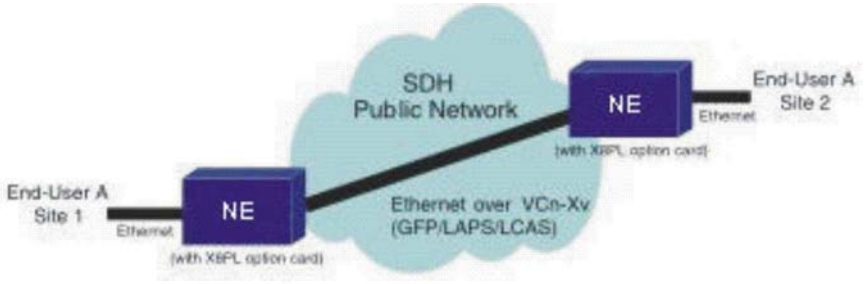


Point-to-point LAN connection

The point-to-point LAN connection is used to interconnect two sites of a customer each of which has a LAN interface. Another application is the interconnection of the sites of two service providers that have Ethernet interfaces.

Some dedicated SDH bandwidth is allocated to the connection between both end points. Virtual concatenation allows the operator to assign a customized SDH bandwidth. Such an application can cost-effectively be realized with 1645 AMC using the X8PL option card which provides the GFP and LAPS Ethernet mapping schemes and the LCAS protocol (refer to "Ethernet features" (p. 3-11), "Ethernet mapping schemes" (p. 3-12) and "Link Capacity Adjustment Scheme (LCAS)" (p. 3-12)).

The following figure shows an example of a point-to-point LAN connection:



6 Quality and reliability

Overview

Purpose

This chapter presents the Alcatel-Lucent quality policy and describes the reliability of 1645 AMC.

Contents

Quality

Overview

Purpose

This section describes Alcatel-Lucent's commitment to quality and reliability and how quality is ensured.

Contents

Alcatel-Lucent's commitment to quality and reliability

Alcatel-Lucent is committed to providing its customers with products of the highest level of quality and reliability in the industry. The 1645 AMC is a prime example of this commitment.

In line with this policy, all major transmission facilities in USA, Europe and China are ISO-9000 certified. In line with the above, Alcatel-Lucent's policy statement in this respect is as follows.

Quality policy

We ensure that our customers view us as an essential partner to their success - today and tomorrow - by:

- Building on our global capabilities to deliver the best communications solutions and services.
- Providing the best customer and end-user experience through innovation, teamwork, supplier partnerships, and continual improvement.
- Delivering on the commitments we make.

Reliability in the product life-cycle

Each stage of the life cycle of 1645 AMC relies on people and processes that contribute to the highest product quality and reliability possible. The reliability of a product begins at a stage as early as the planning stage and continues into:

- Product architecture
- Design and simulation
- Documentation
- Prototype testing during development
- Design change control
- Manufacturing and product testing (including 100% screening)
- Product quality assurance
- Product field performance
- Product field return management

The R&D community of Alcatel-Lucent is certified by ISO 9001.

Ensuring quality

This section describes the critical elements that ensure product quality and reliability within:

- Product development
- Manufacturing

Critical elements of product development

The product development group's strict adherence to the following critical elements ensures the product's reliability:

- Design standards
- Design and test practices
- Comprehensive qualification programs
- System-level reliability integration
- Reliability audits and predictions
- Development of quality assurance standards for manufactured products

Critical elements of manufacturing

Note: Independent Quality Representatives are also present at manufacturing locations to ensure the quality of the shipped product.

The manufacturing and field deployment groups' strict adherence to the following critical elements ensures the product's reliability:

- Pre-manufacturing
- Qualification
- Accelerated product testing
- Product screening
- Production quality tracking
- Failure mode analysis
- Feedback and corrective actions

Conformity statements

CE conformity

Hereby, Alcatel-Lucent declares that the Alcatel-Lucent product

1645 Access Multiplexer Compact AMC, Release 9.0:

- is in compliance with the essential requirements and other relevant provisions of the following Directive
  Directive 1999/5/EC of 9 March 1999 on Radio and Telecommunication Terminal Equipment of the European Parliament and of the Council
- is tested and conforms with the essential requirements for protection of health and the safety of the user and any other person and Electromagnetic Compatibility. Conformity is indicated by the CE mark affixed to the product. For more information regarding CE marking and Declaration of Conformity (DoC), contact your local Alcatel-Lucent Customer Service Organization.
- This product is in conformity with Article 3, Paragraph 3 of the R&TTE Directive and interworks in networks with other equipment connected to the optical telecommunication network.
- is in conformance with specifications of optical interfaces is granted as stated in the Official Journal of the European Union.

Compliance statement in other European languages

English

Hereby, Alcatel-Lucent, declares that this 1645 AMC is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Finnish

Alcatel-Lucent vakuuttaa täten että 1645 AMC tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

Dutch

Bij deze verklaart Alcatel-Lucent dat deze 1645 AMC voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.

French

Par la présente, Alcatel-Lucent déclare que ce 1645 AMC est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables.

Swedish

Härmed intygar Alcatel-Lucent att denna 1645 AMC står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

Danish

Undertegnede Alcatel-Lucent erklærer herved, at følgende udstyr 1645 AMC overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF

German

Hiermit erklärt Alcatel-Lucent die Übereinstimmung des Gerätes 1645 AMC mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG.

Greek

ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Alcatel-Lucent ΔΗΛΩΝΕΙ ΟΤΙ ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ

Italian

Con la presente Alcatel-Lucent dichiara che questo 1645 AMC è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.

Spanish

Por medio de la presente Alcatel-Lucent declara que el 1645 AMC cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE

Portuguese

Alcatel-Lucent declara que este 1645 AMC está conforme com os requisitos essenciais e outras provisões da Directiva 1999/5/CE.

Eco-environmental statements

The statements that follow are the eco-environmental statements that apply to the *Waste from Electrical and Electronic Equipment (WEEE) directive*.

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, contact the Alcatel-Lucent Field Services / Installation - Environmental Health and Safety organization.

For installations not performed by Alcatel-Lucent, contact the Alcatel-Lucent Customer Support Center at:

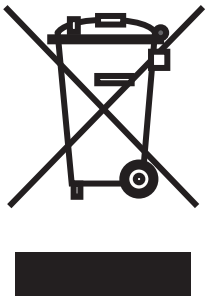
Technical Support Services, Alcatel-Lucent.

Within the United States: +1 866 582 3688, prompt 1

From all other countries: +1 630 224 4672, prompt 2

Recycling / take-back / disposal of product

Electronic products bearing or referencing the symbol shown below when put on the market within the European Union, shall be collected and treated at the end of their useful life, in compliance with applicable European Union and local legislation. They shall not be disposed of as part of unsorted municipal waste. Due to materials that may be contained in the product, such as heavy metals or batteries, the environment and human health may be negatively impacted as a result of inappropriate disposal.



Note: 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 at the end of their useful life, or products displaced by Alcatel-Lucent equipment offers.

For information regarding take-back of equipment by Alcatel-Lucent, or for more information regarding the requirements for recycling/disposal of product, contact your Alcatel-Lucent Account Manager or Alcatel-Lucent Takeback Support at takeback@alcatel-lucent.com.

Material content compliance

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 from 1 July 2006, with various exemptions, including an exemption for lead solder in network infrastructure equipment. Alcatel-Lucent products shipped to the EU from 1 July 2006 will comply with the RoHS Directive.

Technical documentation

The technical documentation as required by the Conformity Assessment procedure is kept at Alcatel-Lucent location which is responsible for this product. For more information, contact your local Alcatel-Lucent representative.

1645 AMC Eco declaration

Alcatel·Lucent

EcoDeclaration
(Derived from ECMA-370 standard)

Product Type: *SDH Communication Equipment*
PRODUCT NAME: *1645AMC*

Supplier's Name: *Alcatel-Lucent Technology*
Supplier's Address: XinYe Building, 6 floor,
No. 388, Tianlin Road
Shanghai 200233, P.R. China

declares that the product

Product Name: *1645AMC*

has been developed, manufactured and/or delivered under the following environmental program/system

Alcatel-Lucent has implemented the Alcatel-Lucent EH&S Management System which facilitates the use of a common EH&S management model across *all* of Alcatel-Lucent to maintain compliance and promote EH&S excellence.

and conforms to the environmental specifications, as listed below.

Signature & Function

Roberto Castelli

Location and date ..... *BG/BD CS & Q*
Vimercate, 19 September 2008

Location and date .....*BG/BD Product Line Manager*
Vimercate, 19 September 2008

Klaus Dechet

Originator	Zhang kirk	EcoDeclaration
Date	20080905	

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Reliability specifications

Overview

Purpose

This section describes how reliability is specified.

Contents

General specifications

This section provides general reliability specifications for 1645 AMC.

Mean time between failures

The Mean Time Between Failures (MTBF) for the whole 1645 AMC is described in "1645 Access Multiplexer Compact AMC circuit-pack fit rates and MTBF values" (p. 6-11).

Infant mortality factor

Note: The steady state failure rate is equal to the failure rate of the system.

The number of failures that a product experiences during the first year of service after turn-up may be greater than the number of subsequent annual steady state failures. This is the early life or infant mortality period. The ratio of the first year failure rate to the steady state failure rate is termed the infant mortality factor (IMF).

Reliability program

Introduction

Reliability is a key ingredient of products life cycle from the earliest planning stage. Major occurrences at the start of the project involve modeling of system reliability. During the design and development stage, reliability predictions, qualification and selection of components, definition of quality assurance standards and prototyping of critical system areas ensured built-in reliability. Manufacturing and field deployment, techniques such as pre-manufacturing, qualification, tracking of production quality, burn-in tests, failure mode analysis and feedback and correction further enhance the ongoing reliability of the 1645 AMC.

Reliability specifications

Introduction

The 1645 AMC provides various protective switching mechanisms where necessary to support a high level of service availability.

Reliability and service availability

Protection mechanisms are supported by the 1645 AMC: :

- path protection or SNC/N protection (SubNetwork Connection protection with Non-intrusive monitoring) for higher and lower order VCs
- 1+1 multiplex section protection (MSP) for STM-1/STM-4 interfaces

Ethernet traffic can be protected by:

- spanning tree protocol
- link capacity adjustment scheme (LCAS)

1645 Access Multiplexer Compact AMC circuit-pack fit rates and MTBF values

The following tables give an overview of the circuit packs fit rates and MTBF values (calculated according to RIN 8.0, confidence level 60 %).

1645 AMC Products	FIT (10^{-9}/h)	MTBF (years)
AMC-AC (CC: 109642280)	4451.6	26
AMC-DC (CC: 109642298)	4554.8	25

The next table lists the failure rate calculation (FIT) and the MTBF (Mean Time Between Failures) of the different option cards (calculated according to RIN8.0 with confidence level of 60 %). Note that the failure rates of packs in this document may differ from rates of similar packs in previous documents. This is due to differences in parameters that match design specifications and applications such as electrical stress level.

1645 AMC Products	FIT (10^{-9}/h)	MTBF (years)
1645 AMC - optional 16 E1 75/120 Ω X16E1-V3 option card (CC: 109011528)	647	176
1645 AMC - optional 16 DS1 X16DS1 option card (CC: 108756081)	604	189
1645 AMC - optional 12 SHDSL tributary X12SHDSL-V2 option card (CC: 109579912)	3955	29
1645 AMC X8PL - optional 8 Ethernet PL option card (CC: 109480707)	601	190
1645 AMC X5IP - optional 5 Ethernet LAN interface option card (CC: 109599845)	2736	42
1645 AMC X5IPV-2 - optional 5 Ethernet LAN interface option card (CC: 109667931)	2737	42
1645 AMC X10IP - optional 8 Ethernet LAN interface option card and 2 LAN ports switchable between 10/100/1000Base-T and 1000Base-X/100Base-FX optical SFP (CC: 109660910)	2608	44
1645 AMC STC-2MB - 2 Mbit timing option card for input and output signals (CC: 109657411)	84	1359
X3E3DS3 - optional three 34 Mbit/s or three 45 Mbit/s interfaces (CC: 109642306)	607	188
X6STM1 - optional six bidirectional STM-1e/o interfaces (CC: 109642314)	470	243

The next table lists the failure rate calculation (FIT) and the MTBF (Mean Time Between Failures) of the different SFPs (calculated according to SR-332 RPP with confidence level of 90% therefore it may not be comparable to other Alcatel-Lucent Products):

1645 AMC Products	FIT (10^{-9}/h)	MTBF (years)
1645 AMC STM-1 S1.1 SFP short range (CC: 109469809)	250	457

1645 AMC Products	FIT (10^{-9}/h)	MTBF (years)
1645 AMC STM-1 L1.1 SFP middle range (CC: 109469825)	250	457
1645 AMC STM-1 L1.2 SFP long range (CC: 109469817)	250	457
1645 AMC STM-1 electrical SFP (CC: 109543561)	250	457
1645 AMC STM-1/STM-4 SH 1490, single fiber bidirectional SFP short haul (CC: 109559492)	250	457
1645 AMC STM-1/STM-4 SH 1310, single fiber bidirectional SFP short haul (CC: 109559500)	250	457
STM-4, S-4.1, short haul, 15 km, 1310 nm (CC: 109509687)	250	457
STM-4 L4.1 SFP middle range (CC: 109509695)	250	457
STM-1/4 BiDi 1310 nm upstream 40 km (CC: 109671446)	250	457
STM-1/4 BiDi 1550 nm downstream 40 km (CC: 109671438)	250	457
STM-4 L4.2 SFP long range (CC: 109509703)	250	457
Gigabit Ethernet SFP, ZX 1550 nm (CC: 109534347)	250	457
Gigabit Ethernet SFP, LX 1300 nm (CC: 109526491)	250	457
Gigabit Ethernet SFP SX 850 nm (CC: 109526483)	250	457
100Base-FX SFP, 1310 nm TX, 2 km (CC: 109643809)	250	457

7 Product support

Overview

Purpose

This chapter provides information about the support for the 1645 AMC.

Contents

Installation services

This section describes the installation services available to support the 1645 AMC.

Alcatel-Lucent offers Installation Services focused on providing the technical support and resources needed to efficiently and cost-effectively install your network equipment. Alcatel-Lucent Installation Services provide unparalleled network implementation expertise to help install your wireline and wireless networks. We use state-of-the-art tools and technology, and highly skilled technicians to install your equipment and help to ensure the timely and complete implementation of your network solution. By relying on our installation experts, we can rapidly build or expand your network, help manage the

complexity of implementing new technologies, reduce operational costs, and help improve your competitive position by enabling your staff focus on the core aspects of your business rather than focusing on infrastructure details.

Description

Within Alcatel-Lucent's overall Installation Services portfolio, Basic Equipment Installation and Site Supplemental Installation are the two services most closely linked to the initial deployment of Alcatel-Lucent's products into your network.

Basic equipment installation

Provides the resources, experience and tools necessary to install the 1645 AMC product into your network. We assemble, cable and wire, and test the 1645 AMC, helping to ensure it is fully functioning as engineered and specified.

Site supplemental installation

Enhances the Basic Equipment Installation service by performing supplemental work that is unique to your specific site location, configuration, or working requirements. Includes installation of material other than the main footprint product (such as earthquake bracing); provision of services unique to your site (such as, hauling and hoisting, multi-floor cabling, rental and local purchases) or as may be required by your operations (such as, overtime to meet your compressed schedules, night work requested by you, abnormal travel expenses, abnormal transportation or warehousing); and any other additional effort or charges associated with your environment.

Benefits

When implementing our installation services, Alcatel-Lucent becomes a strategic partner in helping you realize your long-term strategies and achieve your business and technological goals. We combine our state-of-the-art technical background, high-quality processes, expertise in the latest technologies, knowledge of revolutionary equipment breakthroughs, and feature-rich project management tools to get your network up and running - quickly, efficiently, and reliably. With Alcatel-Lucent, you can concentrate on your core business, while we apply our years of knowledge and experience to installing your network.

Our installation services let you:

- *Rapidly expand your network* — by turning hardware into working systems, with the capability to deploy multiple networks in parallel rollouts
- *Reduce operational expense* — of recruiting, training, and retaining skilled installation personnel
- *Leverage Alcatel-Lucent's resources and expertise* — by utilizing our team of knowledgeable and fully equipped experts that implement projects of any size, anywhere around the world

- *Implement quality assurance* — through our total quality management approach
- *Reduce operational expenses* — by avoiding the purchase of the necessary state-of-the-art tools, test equipment, specialized test software, and spare parts that Alcatel-Lucent Installation Services utilize
- *Ensure high-quality support* — with Alcatel-Lucent' extensive support structure, including proven methods and procedures, mechanized tools, professional training, technical support.

Reference

For more information about specialized installation services and/or database preparation, contact your local Account Executive.

Engineering services

This section describes the engineering services available to support the 1645 AMC.

Alcatel-Lucent Worldwide Services offers engineering services focused on providing the technical support and resources needed to efficiently and cost-effectively engineer your network equipment. We provide the best, most economical equipment solution by ensuring your network equipment is configured correctly, works as specified, and is ready for installation upon delivery. With our proven, end-to-end solutions and experienced network engineering staff, Alcatel-Lucent Worldwide Services is the ideal partner to help service providers engineer and implement the technology that supports their business.

Description

Within Alcatel-Lucent's overall engineering services portfolio, site survey, basic equipment engineering, site engineering, and site records are the four services most closely linked to the initial deployment of 1645 AMC into your network; each is described below.

Site Survey

A site survey may be required to collect your site requirements needed for proper equipment engineering. If adequate site requirements and records are not available up front, a site survey would be performed to collect information required for configuration of the equipment and integration of the equipment into the site.

Basic Equipment Engineering

Ensures that the correct footprint hardware is ordered and that the ordered equipment is configured for optimal performance in the network for the customer. Alcatel-Lucent engineering configures equipment requirements based on inputs from the customer order,

completed questionnaires, and/or site survey data. The decisions as to specific equipment needs are based on each component's functionality and capacity, and the application of engineering rules associated with each component.

Site engineering

Ensures that the correct site material is ordered and that the optimal equipment layout for the installation of the ordered equipment in the customer's site is determined. Site engineering will be used in assisting the customer with determining the necessary site conditions, layout and equipment required to properly install/integrate the footprint hardware components into a specific location.

Site records

Site records service provides detailed record keeping which accurately documents the physical placement and configuration of specified customer equipment. Depending on the customer request, this can involve the initial creation of site records, updating of existing records, or ongoing maintenance of the customer's records.

Benefits

When implementing our engineering services, Alcatel-Lucent becomes a strategic partner in helping you realize your long-term strategies and achieve your business and technological goals. Our Engineering Services portfolio delivers quick, responsive support, with state-of-the-art tools, top technicians and end-to-end services to help you engineer an optimal network solution. Whether you are looking to outsource your total engineering effort or simply supplement basic coverage gaps, our portfolio of services provides the flexible level of support you need. With Alcatel-Lucent, you can concentrate on your core business while we apply our years of knowledge and experience in engineering your equipment solutions.

Our Engineering Services let you:

- *Rapidly expand your network* — by turning products into working systems, with the capability to deploy multiple networks in parallel rollouts
- *Reduce costs* — by determining the most cost-effective network configuration and optimal use of office space when planning and providing an equipment solution
- *Reduce operational expense* — of recruiting, training, and retaining skilled engineering personnel
- *Leverage Alcatel-Lucent's resources and expertise* — by utilizing our team of knowledgeable and fully equipped experts that can plan, design, and implement projects of any size, anywhere around the world
- *Implement quality assurance* — through our total quality management approach and use of ISO-certified processes
- *Provide one–stop shopping* with a globally deployed engineering workforce, saving the time, delays and coordination challenges of dealing with multiple equipment vendors and service providers

- *Keep pace with rapidly changing technology* — by supporting the latest technologies and equipment breakthroughs, including Alcatel-Lucent's and other vendor's products
- *Ensure high-quality support* — with Alcatel-Lucent's extensive support structure, including proven methods and procedures, mechanized tools, professional training, and technical support.
- *Maintain and track vital office records* — keep track of equipment locations and connections.

Reference

For more information about specialized engineering services, engineering consultations, and/or database preparation, contact your local Account Executive.

Maintenance services

This section describes the maintenance services available to support the 1645 AMC.

Description

Maintenance services is composed of three primary services to support your maintenance needs. The services are:

- Remote Technical Support Service (RTS)
- On-site Technical Support Service (OTS)
- Repair and Exchange Services (RES)

Remote Technical Support Service (RTS)

RTS provides remote technical support and Software Patches and Software Updates, as available, for deployed Alcatel-Lucent network elements to help cost-effectively maximize network availability and performance. With this service, system engineers deliver remote support via phone or modem connection for rapid response, diagnoses, and resolution of system outages and issues.

Support from our expert remote system engineers will:

- enable trouble tracking, resolution, and restoration
- answer technical product-related questions and specific feature and function questions
- help identify and apply available Software Patches and Software Updates on Covered Products.

Single Point of Contact — access to Alcatel-Lucent engineers and information to help identify and resolve technical issues via phone or modem.

Alcatel-Lucent OnLine Customer Support —

- web-based tracking and management of Assistance Requests (AR)
- self-help services i.e., Knowledge Database, Documentation, E-mail.

Service options —

- Premium RTS: 24 hours a day, 7 days a week (24 × 7)
- Standard RTS: 8 hours a day (8 a.m. – 5 p.m. Client local time) 5 days per week (8 × 5), Monday - Friday, excluding Alcatel-Lucent holidays.

On-site Technical Support (OTS)

OTS provides cost-effective support for Alcatel-Lucent products including systems that incorporate select third-party equipment.

- OTS Dispatched Technician — Alcatel-Lucent will dispatch a technician to your location to provide on-site assistance. We offer multiple coverage options to meet your needs from same-day dispatch, with 24 × 7 or 8 × 5 response, to next-business-day dispatch, with 8 × 5 response.
- OTS Dedicated Technician — a Alcatel-Lucent technician works at your location to perform daily maintenance tasks that keep your system running at peak performance.
- OTS Dedicated Engineer — an expert Alcatel-Lucent engineer provides you with customized on-site support and assistance in areas such as maintenance of new equipment, administration of software releases, and support with your administrative processes.

Repair and Exchange Services (RES)

RES provides rapid replacement or repair of your defective hardware, eliminating the need for you to purchase and maintain a costly spares inventory. These services can dramatically reduce investment capital and recurring operating expenses while helping to assure maximum network availability. RES offers:

- Same day advanced exchange — delivers a replacement part to Customer equipment site within four hours to enable rapid restoration of service to equipment and the ability to return parts to Alcatel-Lucent later. We have established an infrastructure of multi-point, overlapping-coverage field stocking locations and automated electronic process controls that help us approach a 100% on-time delivery track record.
- Next day advanced exchange — delivers a replacement part on the very next day, 7 days a week, including holidays. Consider what is at risk when you compare this service to a “business day” program.
- Return for repair — is an economical solution, which allows the customer to return your field-replaceable parts to Alcatel-Lucent for repair or replacement. Alcatel-Lucent returns them in a very timely manner and without unexpected repair fees.

Contact

For maintenance service contact information refer to "Technical support" (p. 7-7).

Technical support

This section describes the technical support available for the 1645 AMC.

Services

1645 AMC is complemented by a full range of services available to support planning, maintaining, and operating your system. Applications testing, network integration, and upgrade/conversion support is also available.

Technical support groups

Technical support is available through

- Local/Regional Customer Support - TAC
- Technical Excellence Center (TEC)

Contacting your TAC

TAC personnel troubleshoot field problems 24 hours a day over the phone and on site (if necessary) based on Alcatel-Lucent Service Contracts:

for Europe, Africa, Asia and the pacific region (EMEA and APAC)	International Customer Management Centre (ICMC): • +353 1 692 4579 (toll number) • 00 800 00 Alcatel-Lucent (toll free number in most EMEA countries)

For technical assistance, call your Local/Regional Customer Support Team. If the request cannot be solved by TAC, it will be escalated to the central Technical Excellence Center (TEC) team.

Technical Excellence Center

Alcatel-Lucent's Technical Excellence Center (TEC) organization is committed to providing customers with quality product support services. Each segment of the TEC organization regards the customer as its highest priority and understands your obligations to maintain quality services for your customers.

The TEC team maintains direct contact with Alcatel-Lucent manufacturing, Bell Laboratories development, and other organizations to assure fast resolution of all assistance requests.

Technical support platform

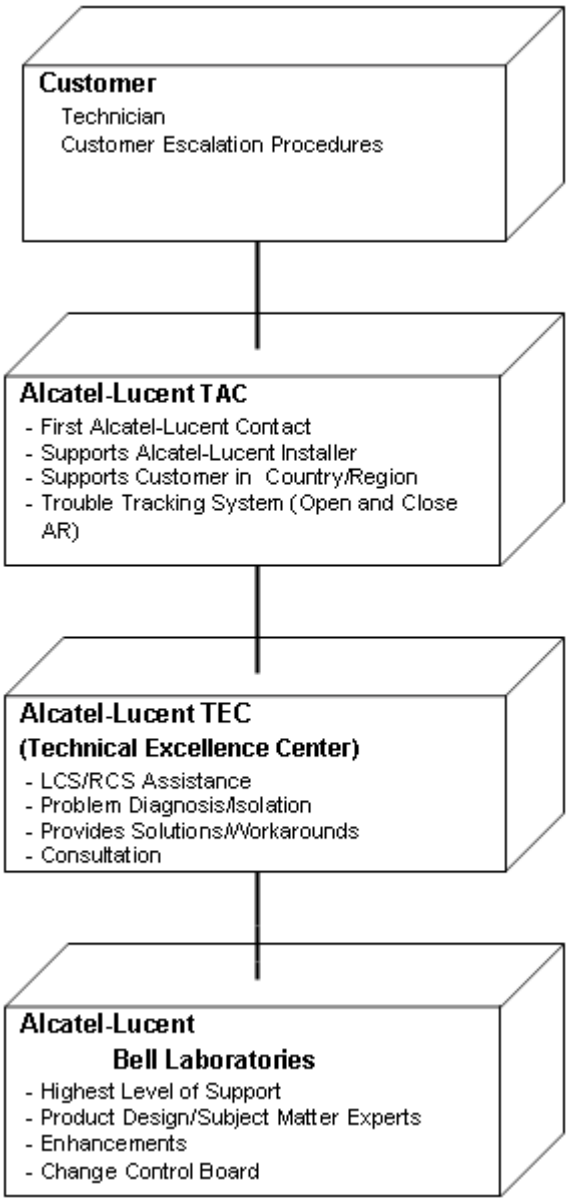
A global online trouble tracking system is used by all support teams to track customer assistance requests. The system communicates details about product bulletins, troubleshooting procedures, and other critical information to customers. All details of a request are entered into this database until closure. For online access to your trouble tickets via the web contact your local support team or check the following website: (https://support.lucent.com/support)

Reference

For additional information about technical support, contact your Account Executive for the 1645 AMC or your Alcatel-Lucent local Customer Team.

Product support levels

The following figure shows the levels of product support for Alcatel-Lucent products:


Customer
Technician
Customer Escalation Procedures
Alcatel-Lucent TAC
- First Alcatel-Lucent Contact
- Supports Alcatel-Lucent Installer
- Supports Customer in Country/Region
- Trouble Tracking System (Open and Close AR)
Alcatel-Lucent TEC
(Technical Excellence Center)
- LCS/RCS Assistance
- Problem Diagnosis/Isolation
- Provides Solutions/Workarounds
- Consultation
Alcatel-Lucent
Bell Laboratories
- Highest Level of Support
- Product Design/Subject Matter Experts
- Enhancements
- Change Control Board

Documentation support

Alcatel-Lucent provides comprehensive product documentation tailored to the needs of different audiences. An overview of the documentation set can be found at "Related documentation" (p. xiii).

Customer comment

As customer satisfaction is extremely important to Alcatel-Lucent, every attempt is made to encourage feedback from customers on our information products. Thank you for your feedback.

To comment on this information product online, go to: http://www.alcatel-lucent-info.com/comments.

Training support

To complement your product needs, the Alcatel-Lucent Learning organization offers a formal training package, with the single training courses scheduled regularly at Alcatel-Lucent's corporate training centers or to be arranged as on-site trainings at your facility.

Registering for a course or arranging an on-site training

To enroll in a training course at one of the Alcatel-Lucent's corporate training centers or to arrange an on-site training at your facility (suitcasing), contact:

Asia, Pacific, and China	Training center Singapore, Singapore voice: +65 6240 8394 fax: +65 6240 8017
Central America and Latin America	Training center Mexico City, Mexico voice: +52 55 527 87187 fax: +52 55 527 87185
Europe, Middle East, and Africa	Training center Nuremberg, Germany voice: +49 911 526 3831 fax: +49 911 526 6142
North American region	Training center Altamonte Springs, USA voice: +1-888-582-3688 - prompt 2

To review the available courses or to enroll in a training course at one of Alcatel-Lucent's corporate training centers, you can also visit: https://training.lucent.com/Saba/Web/Main

Warranty

Introduction

Warranty, support, and trouble escalation procedures have been established on a per country basis. Contact your Alcatel-Lucent account representative for details.

Discontinued Availability

Alcatel-Lucent ONG reserves the right to notify the customer in advance of the intention to Discontinue the Availability (DA) of a product. Alcatel-Lucent' ONG also reserves the right to offer a Technical Support Contract (TSC) to make repair and technical support services available for an additional period of time after a product has been discontinued. All TSC services will be at a specified price dependent on the terms and conditions of the contract.

The rights and obligations of Alcatel-Lucent' ONG and the customer shall neither be assigned nor delegated without prior written consent of the other party, except that Alcatel-Lucent' ONG may assign its obligations to any of its affiliates or non Alcatel-Lucent contractors without further consent by the customer.

Standard repair

Introduction

If Alcatel-Lucent' ONG determines that a product is not defective or is in conformance, the customer shall pay Alcatel-Lucent' ONG the costs of handling, inspection, testing, and transporting the product and, if applicable, travel and related expenses.

Repair interval

Alcatel-Lucent' ONG repair locations set their own standards for return intervals. On an average, the minimum time to return repairs to the customer is 14 days from the receipt of the product by the repair location. The maximum time to return repairs to the customer can range from 50 to 180 days.

Out-of-Warranty provisions

For any activity associated with repair or replacement of hardware and/or software systems that is determined by Alcatel-Lucent' ONG to be out of warranty, materials and labor will be billed at Alcatel-Lucent' ONG list price (time-and-materials plus additional incurred expenses), or in accordance with a separate Technical Support Contract.

International repair and service

The customer or the customer's in-country representative should send a description of the material to be returned for repair or service including the quantity, comcodes, and serial numbers (if available).

After the material has been shipped, the following information should be faxed to the Service Center:

- Customer's return address
- Customer contact name, telephone number, and fax number
- Value of material
- Identification of any hazardous equipment or material
- Shipping information including the date of shipment, air waybill, carrier name, flight number, number of cartons, and weight of material.

When the material arrives at the Service Center, it is entered into the Repair, Service, and Return database for tracking purposes.

The repair location will repair the material. If it is determined that an item is not repairable and the item is under factory warranty, a replacement will be sent. If the item is out of factory warranty, the customer will advise their Country Desk Representative if they would like to order a replacement.

The Service Center will prepare the paperwork for exporting the material, and ship the material to the customer. When available, the Service Center will fax the shipping information to the customer or the customer's in-country representative.

Upon receipt of the material, the customer or the customer's in-country representative should send the Service Center the order numbers of the material received and the date the material was received. The Service Center will then close the order on the Repair, Service, and Return database.

Important! Note that Alcatel-Lucent warranty is contingent upon the use of Alcatel-Lucent specified SFPs for the 1645 AMC. Use of other SFPs is not approved by Alcatel-Lucent and is fully at the customer's own risk. Any warranty obligation of Alcatel-Lucent is extinguished when non Alcatel-Lucent specified SFPs are used.

8 Ordering

Overview

Purpose

This chapter provides an overview of the ordering process and the current ordering information for the 1645 AMC.

The different comcodes listed hereafter can change. Contact your Alcatel-Lucent representative for updated information.

Contents

Ordering information

The 1645 AMC has been carefully engineered and all equipment kitted to simplify the ordering process. In this section the current ordering information are shown, as available on the issue date of this document.

Contact and further information

For all questions concerning ordering of the 1645 AMC, for any information about the marketable items and their comcodes, and for ordering the equipment contact your Account Executive for the 1645 AMC or your Alcatel-Lucent local customer team.

Orderable 1645 AMC products

The tables below list the comcodes of the 1645 AMC Products. Software needs to be ordered together with the network element. To get the ordering information for available software versions, contact your local customer team.

The following table provides a list of 1645 AMC products available for ordering:

1645 AMC Products	Apparatus code	Comcode	Comments
1645 AMC DC	CMB421	109642298	1645 AMC DC version
1645 AMC AC	CMB422	109642280	1645 AMC AC version
1645 AMC VERTICAL MOUNTKIT - ETSI shelf	AM VERT. MOUNTKIT-ETSI	109528356	1645 AMC vertical mounting kit for ETSI racks
1645 AMC VERTICAL MOUNTKIT for 19"	AM VERT. MOUNTKIT-19"	109528349	1645 AMC vertical mounting kit for 19” racks

1645 AMC option cards

The following table lists the comcodes of the 1645 AMC option cards:

Unit short name	1645 AMC Products	Comcodes
X16E1-V3	1645 AMC - optional 16 E1 75/120 Ω option card	109011528
X16DS1	1645 AMC - optional 16 DS1 option card	108756081
X12SHDSL-V2	1645 AMC- optional 12 SHDSL option card	109579912
X5IP	1645 AMC - 3 × FE electrical Ethernet interfaces for 10/100BASE-T(X), 1 × triple rate electrical Ethernet interface for 10/100/1000BASE-T(X), and 1 × GE optical Ethernet interface via SFP for 1000BASE-X.	109599845
X5IP-V2	1645 AMC - 3 × FE electrical Ethernet interfaces for 10/100BASE-T(X), 1 × triple rate electrical Ethernet interface for 10/100/1000BASE-T(X), and 1 × GE optical Ethernet interface via SFP for 1000BASE-X. **Note:** The X5IPV-2 card supports all the HW and SW features of X5IP card. The board is not SW compatible with X5IP.	109667931
X10IP	1645 AMC - 8 × 10/100BASE-T Ethernet interfaces, 2 × 10/100/1000Base-T or optical 1000Base-X/100Base-FX interface extension	109660910
X8PL	1645 AMC - optional 8 Ethernet PL option card	109480707
X3E3DS3	1645 AMC - three 34 Mbit/s or three 45 Mbit/s interfaces to be used with the AMC board.	109642306
X6STM1	1645 AMC - six STM-1 interfaces to be used with the AMC main board.	109642314

Unit short name	1645 AMC Products	Comcodes
STC-2MB	1645 AMC - A 2 Mbit timing option card to be used with the AMC motherboard.	109657411

1645 AMC SFPs

1645 AMC Products	Apparatus code	Comcodes
1645 AMC STM-1 S1.1 SFP short range	OM155T101	109469809
1645 AMC STM-1 L1.1 SFP middle range	OM155T103	109469825
1645 AMC STM-4 L4.2, long haul, 80 km, 1550 nm	OM155T102	109469817
1645 AMC STM-1 electrical SFP	OM155T104	109543561
1645 AMC STM-1/STM-4 SH 1490 nm, single fiber bidirectional SFP Downstream	OM155T105	109559492
1645 AMC STM-1/STM-4 SH 1310 nm, single fiber bidirectional SFP Upstream	OM155T106	109559500
1645 AMC 1000BASE-SX, 550 m, 770-860 nm	OMGBET101	109526483
1645 AMC 1000BASE-LX, 5 km, 1310 nm	OMGBET102	109526491
1645 AMC 1000BASE-ZX, 40-90 km, 1550 nm	OMGBET103	109534347
1645 AMC STM-4, S-4.1, short haul, 15 km, 1310 nm	OM622T101	109509687
1645 AMC STM-4, L-4.1, long haul, 40 km, 1310 nm	OM622T102	109509695
1645 AMC STM-4 (80 km) L4.2 SFP long range	OM622T103	109509703
1645 AMC STM-1/4 BiDi 1310 nm upstream 40 km	OM622T105	109671446
1645 AMC STM-1/4 BiDi 1550 nm downstream 40 km	OM622T106	109671438
1645 AMC 100Base-FX SFP, 1310 nm TX, 2 km	OM100BT103	109643809

1645 AMC accessories

The following table lists the comcodes of the 1645 AMC accessories.

1645 AMC accessories	Comcode
Connecting Cable ITM-CIT Interface to Computer	848069795
1645 AMC AC to DC Ext.Power Converter.	408876472

1645 AMC accessories	Comcode
FAN UNIT for 1645 AMC	848949657

Recommended cables

Refer to the 1645 AMC Installation Guide.

9 SHDSL Overview

Overview

Purpose

This chapter describes the SHDSL principles and features realized for 1645 Access Multiplexer Compact (AMC).

Contents

SHDSL concepts

Overview

Purpose

This section describes the SHDSL principles which are supported by 1645 Access Multiplexer Compact (AMC). .

Contents

SHDSL configurations

Applications

There are two application possibilities for the SHDSL feature:

- End-user access for E1 via a E1 NTU (NT2M modem)
- End-user access for Ethernet using a 10Base-T or a 100-Base-TX interface via an Ethernet NTU (NT10ETH modem). There can be one to four parallel SHDSL links to each NTU providing 2.2 Mbit/s to 8.7 Mbit/s throughput. Each NT10ETH modem has 1 or 2 Ethernet ports towards the end-user

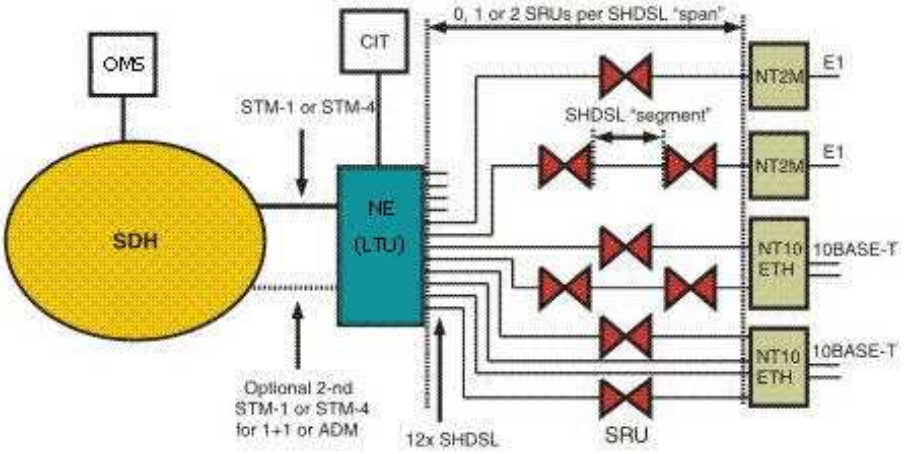
The 1645 Access Multiplexer Compact (AMC) has to be equipped with an X12SHDSL-V2 option card and is then operating as a Line Termination Unit (LTU). All ports of the X12SHDSL-V2 option card operate either in the E1/SHDSL mode or in the TU12/SHDSL mode.

An E1 modem provides one E1 user interface and one single SHDSL link. This means a one-to-one correspondence between an LTU SHDSL port, the NT2M and the E1 end-user interface.

An NT10ETH modem has two 10/100BASE-T(X) interfaces and can have one to four parallel SHDSL links, that are all connected to the same X12SHDSL-V2 option card.

Each SHDSL link can have up to two SHDSL Regenerator Units (SRUs) depending on the span connected to the LTU port. Each SRU supports one SHDSL link.

The following figure shows a network example with a 1645 Access Multiplexer Compact (AMC) configured as LTU with 12 SHDSL links connected.



Interworking with third party equipment

1645 Access Multiplexer Compact (AMC) supports the following types of third party SHDSL equipment:

- E1 Network Termination Units (NTUs) for E1 over SHDSL
- E1 NTUs for TU-12 over SHDSL
- Ethernet NTUs
- SHDSL Regenerator Units (SRUs) (up to two per LTU port)

E1 and TU12 payload mapping

The 1645 Access Multiplexer Compact (AMC) LTU supports two types of payload mapping into the SHDSL signal:

- E1 mode, maps an E1 directly into the SHDSL signal
- TU-12 mode, maps a TU-12 containing a VC-12 into the SHDSL signal. The VC-12 may contain various signal types, e.g. E1, Ethernet data, etc.

NTU management

The third party NTU modems can be remotely managed. For this purpose a communication channel is reserved in the SHDSL overhead, called the Embedded Operations Channel (EOC). The message set ist defined in ITU-T Rec. G991.2. This message set deals with SHDSL layer aspects. Additionally there is a proprietary extension (here called EOC- ext.) which addresses the non-SHDSL aspects of modem management. This proprietary message set enhances the standard EOC messages by messages covering the interface towards the end-user.

Naming system for SRUs and NTUs

The LTU can manage up to 12 NTUs and 24 SRUs. In order to identify the particular SRU or NT quickly, a fixed naming scheme is to be used for NTU and SRU identification on the GUIs that allows easy recognition of the relative location of the device:

Each NTU or SRU is identified with a four digit number prefixed with a string “SRU” or “NTU” depending on the object that is addressed.

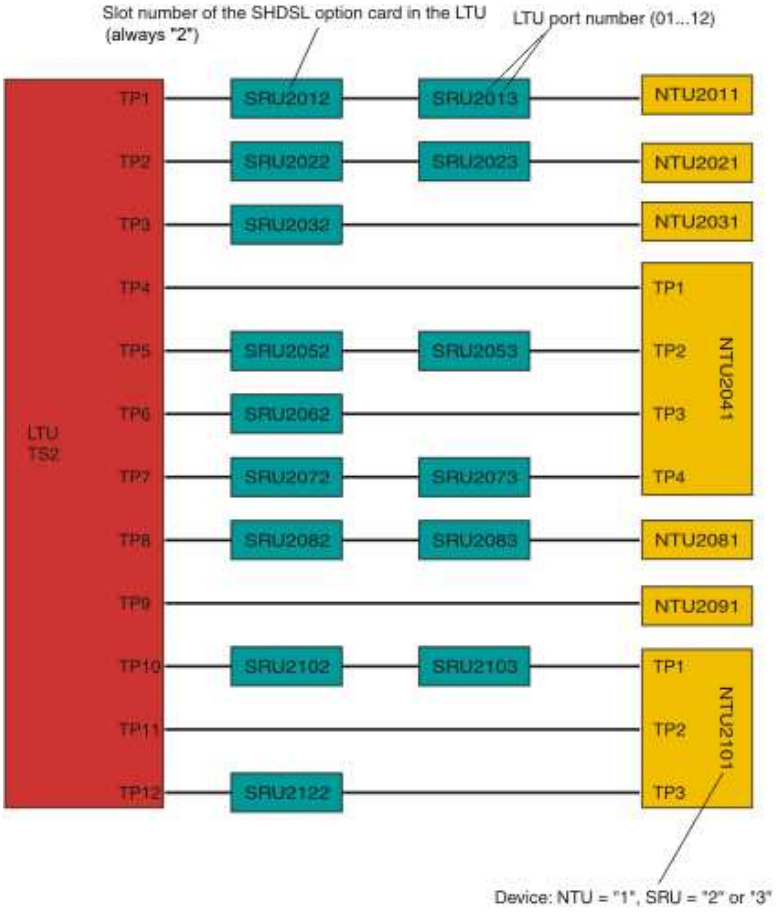
The first digit indicates the slot number in which the SHDSL unit is inserted in the LTU. For 1645 Access Multiplexer Compact (AMC) this value is “2”.

The following two digits indicate the LTU port number, ranging from 01 to 12, corresponding with the TP 1 to TP12 numbering that is used on the X12 SBDSHL faceplate.

The last digit can be “1”, “2” or “3”. The “1” is used for the NTU, while “2”and “3” are used for numbering the SRUs, starting from the SRU connected to the LTU and numbering incrementally in the direction of the NTU.

For NT10ETH NTUs, the LTU port number connected to NTU port #1 is used.

The following figure shows an example for the name assignment:



SHDSL frame structure

Purpose

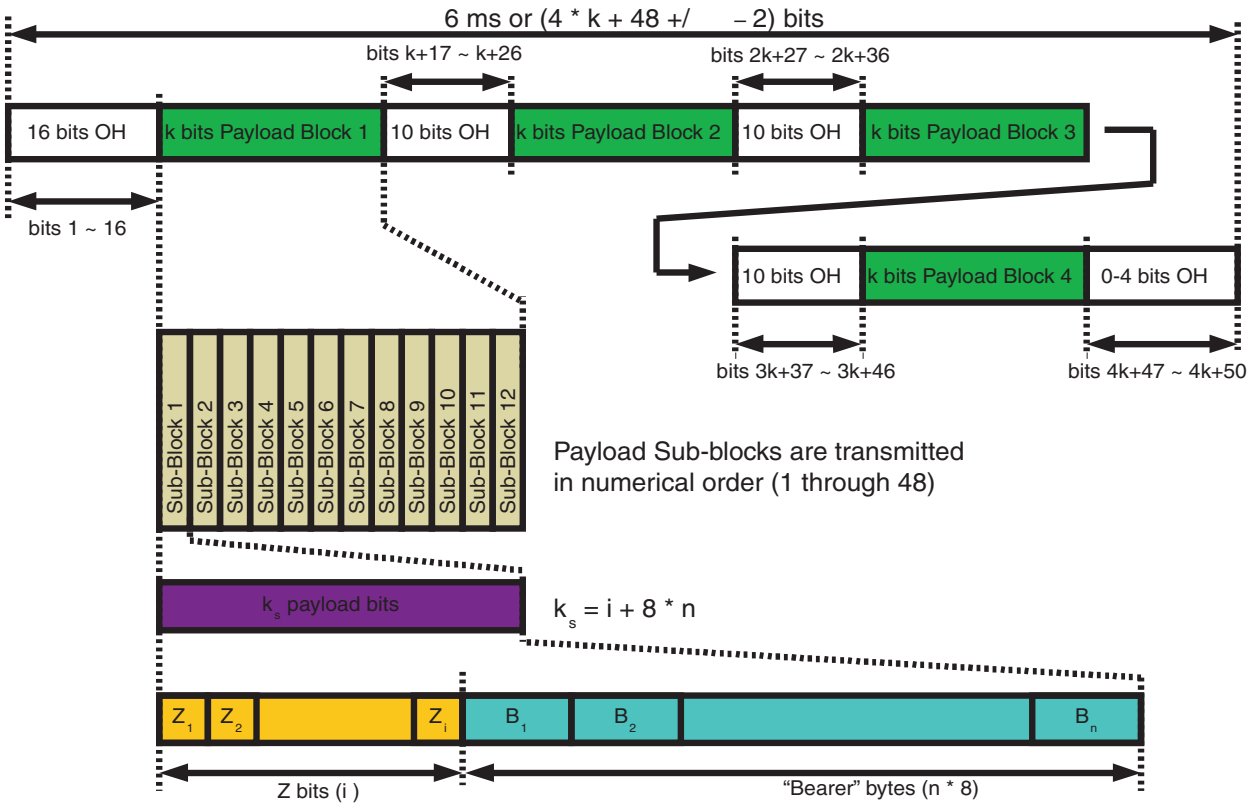
This chapter explains the SHDSL frame structure.

General structure and overhead

An SHDSL line can transport a payload of max. 2312 kbit/s. The overhead of the SHDSL signal adds, nominally, 8 kbit/s to the payload rate which makes the overall maximum bitrate 2320 kbit/s.

The SHDSL signal is organized in frames with a nominal length of 6 ms, where each frame contains 4 payload blocks of $k = 12 \times (i + 8 \times n)$ bits each and, overall, nominally 48 overhead bits. But this number can also be 46 or 50 to allow for positive and negative stuff operations, to align the payload to the SHDSL line clock in case of asynchronous operation. The payload bits associated with the parameter i are often called “Z-bits”.

The length of an SHDSL frame, expressed in bits, depends on the payload rate, so on the parameters n and i. The structure is always the same; the payload is divided in four equal blocks separated and surrounded by overhead bits as shown in the figure below.



The SHDSL frame structure and the overhead bits are defined in ITU-T Rec. G.991.2.

Payload mapping

The 1645 Access Multiplexer Compact (AMC) LTU supports the "unaligned" E1 mapping according to ITU-T Rec. G991.2 and the TU-12 mapping.

The two mapping schemes are described in the following.

E1 mapping acc. to ITU-T Rec. G.991.2/Annex E.5, E.6 and E.7

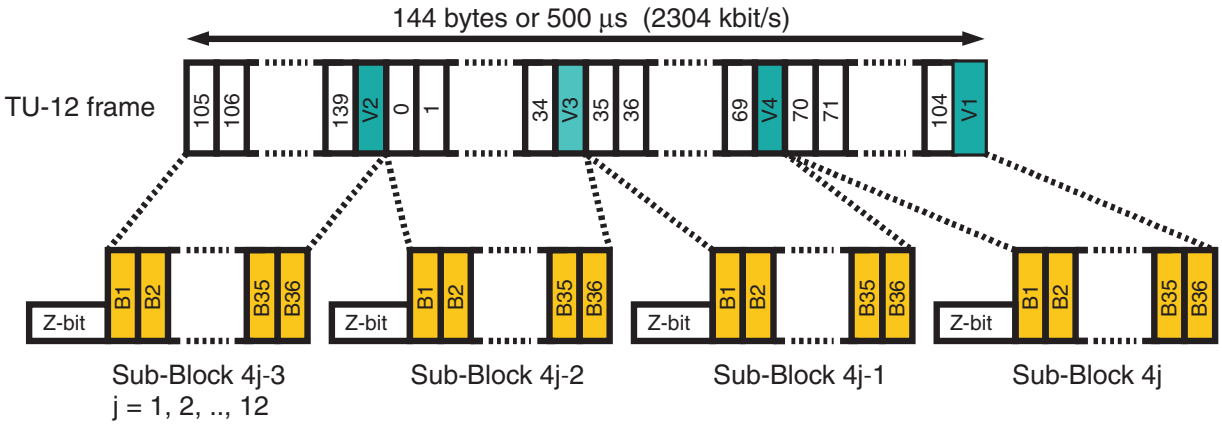
The SHDSL standards define E1 over SHDSL mapping to use the parameters n = 32 and i = 0, i.e. there is no Z-bit channel and 32 bytes per SHDSL payload subblock, sufficient to hold 125 ms of E1 traffic. In the "unaligned" mode there is no further relationship between the position of the E1 bits and the SHDSL payload octets: An E1 frame can start anywhere, even in the middle of an octet position.

This mode is implemented asynchronously, i.e. the SHDSL bit-stuffing mechanism is used to accommodate the frequency differences between the SHDSL carrier, frequency locked to the LTU NE clock, and the E1 signal of which the timing is set by the NE that

created this signal. In asynchronous mode each SHDSL frame has either four or zero stuff bits present. The long term average is such that the clock differences are exactly compensated.

TU-12 mapping

The TU-12 frame has a length of 144 octets or 500 µs. The octets are numbered according to the figure below:



Each TU-12 frame is mapped into four subsequent subblocks with n = 36, using positions B1 through B36 in each sub-block. The first TU-12 frame uses subblocks 1 through 4, the second uses subblocks 5 through 8, all the way up to the 12th TU-12 frame in subblocks 45 through 48. The TU-12 mode operates synchronously, i.e. the SHDSL stuffing mechanism is not used and the SHDSL line clock and TU-12 payload clock are the same. They are both derived from the TG function in the LTU in the downstream direction. Since the NTU is supposed to operate in loop-timed mode, the same is true for the upstream signal. SRUs operate in through-timed mode, so the synchronization keeps untouched.

Concatenation of SHDSL links

It is possible to combine the capacity of multiple SHDSL links that run in parallel. Thus the bandwidth of a link between LTU and NTU can be increased. Ethernet traffic of up to 8 Mbit/s can be transported via a VC-12-4v. The individual SHDSL links carry one TU-12 which contains one VC-12 member of the VC-12-4v group. The Ethernet frames are encapsulated using GFP (Generic Framing Procedure) before mapping into the VC-12-4v group. The LCAS protocol is used to dynamically control the size of the VC-12-4v group.

Remote management and supervision of SHDSL devices

Purpose

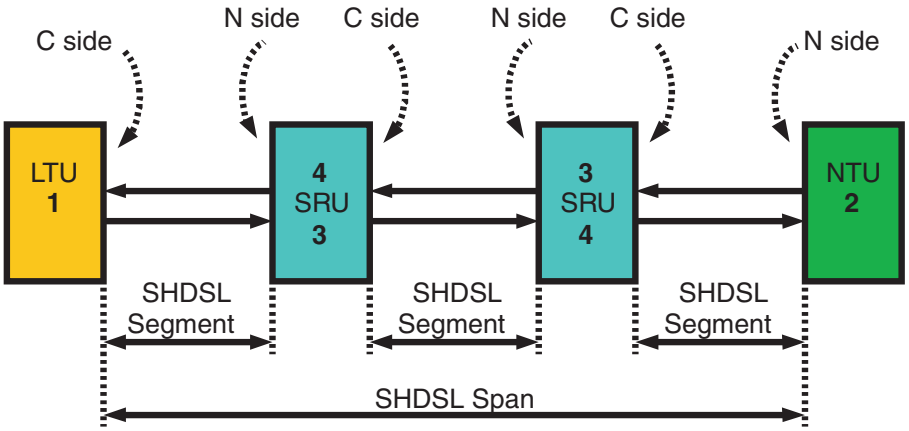
This chapter describes the remote management of NTUs and SRUs which is controlled by the LTU.

EOC Management Reference Model

The LTU maintains an information database of all attached NTUs and SRUs for the purpose of configuration, performance and fault information retrieval or control by network management. All elements attached to an SHDSL span have to respond to queries made to them from other elements. The database in the LTU is considered the “master database”. Conflicts between the entities in the SHDSL span are resolved in favour of the LTU.

The alarm status of the SHDSL devices (NTU and SRUs) that are attached to an SHDSL port on the LTU is polled by the LTU in regular intervals. Polling is realized by means of EOC messages or by a combination of EOC and EOC-ext. messages (see below).

The following figure shows the reference configuration for management purposes:



N = “Network facing”, C = “Customer facing”

EOC messages

Management of the SRUs and NTUs is exercised via the embedded operations channel (EOC) in the SDHSL overhead. The capacity of this channel is 20 bits per 6 ms frame or 3333 kbit/s. EOC messages are protected by a CRC16 code, appended in the last two octets of the message.

EOC addressing

The addressing scheme on the EOC can distinguish between the LTU, the NTU and up to 8 SRUs per SHDSL span. At most two SRUs per LTU port are possible. During a discovery phase, the number of SRUs and their addresses are established.

The detailed procedure for address discovery is described in clause 9.5.3 of ITU-T Rec. G.991.2. Note that SRUs can have different addresses in each direction of transmission.

Proprietary messages (EOC-ext.)

In addition to a subset of the G.991.2 (EOC) message set, a number of proprietary messages for remote management of SRUs and NTUs is supported. The reason for this proprietary addition is that the standard message set is only covering the SHDSL aspects of the service, but not the interface towards the enduser, which can be E1, ISDN-PRI, ISDN-LL or E/FE. In the following this additional message set ist called EOC-ext.

When the LTU processes an EOC-ext. message, it is already validated as an EOC message (correct CRC). The LTU only supports EOC-ext. commands and requests in the transmit direction and confirmation and response messages in the receive direction.

EOC management communication

The communication from the LTU to an SRU or an NTU goes through three distinct phases:

- Discovery phase:
  This is the initial phase where the presence of the SHDSL devices (NTU and SRUs) is detected. Additionally the EOC addresses are assigned and distributed.
- Inventory phase:
  This is the secondary phase where the inventory data from a discovered SHDSL device is collected. The LTU can determine the equipment type (SRU, NT2M or NT10ETH). and whether an NTU is already connected to the LTU via another SHDSL port.
- Operational phase:
  This phase is entered after the completion of the inventory phase of an SHDSL device. At the start of the operational phase and automatic configuration download to the NTu or SRU is initiated in case the target was discovered on the port before. Otherwise, the user has to provide a manual command to download the configuration. After that normal alarm and performance monitoring starts. On user request additional reconfiguration requests are possible.

Software download

Attached SHDSL devices that support the EOC-ext. message extension can be provided with new software images remotely from the NE. In the system the image is stored in a non-volatile memory. To initiate the software download a user command is needed. Once

the software is successfully downloaded, a reset command needs to be issued to the SHDSL device in order to activate the new software image. Only one SW image for an NTU can be stored in the NE of at most 2 Mbyte.

The 1645 AMC supports the ITM-CIT and OMS to display a dynamic software download progress indicator per module. This module also indicates the software download percentage for the SHDSL module.

Configuration download

The NE keeps in its MIB a copy of all (managed) configurational settings related to each attached SHDSL device. Upon user request these settings can be downloaded to the target device, causing the device settings to be synchronized with the NE MIB. Automatic download of the configuration happens after a power cycle of an SHDSL device or after an interruption of the link. The NE detects in both cases the same SHDSL device (same serial number etc.) to be present.

In case a new SHDSL device is detected on an LTU SHDSL port (i.e. different serial number etc.), you will be notified by means of a “new device detected” alarm. You then have the option to initiate a configuration download in order to download the configuration of a previously connected SHDSL device to the new SHDSL device (provided the new SHDSL device is of the same type).

SHDSL features

Electronic label

The user can remotely retrieve, on request, information of an electronic label of an NTU or SRU. The LTU keeps this information in its database. The GUI can display the information on request; it is not used by the LTU for any other purpose.

The following information can be retrieved:

- Module type
- Vendor SISA identifier
- Production year
- Production number
- Product identification
- Manufacturer ID
- Hardware version
- Hardware revision

SHDSL performance monitoring

The performance of SHDSL segments that are terminated on the LTU, SRU and NTU can be monitored. The SHDSL standard (ITU-T Rec. G.991.2) prescribes a set of parameters that needs to be monitored and stored in 15 minute and 24 hour bins for near-end performance monitoring (PM). The following table provides an overview of the PM parameters:

Parameter	Name	Definition
CV/BBE	Code Violation/background Block Error	Each CRC6 anomaly is counted a CV/BBE during non-SES and non-UAS seconds
ES	Errored Seconds	Each second with one or more CRC6 anomaly is counted as an ES, unless that second is UAS
SES	Severely Errored Second	Each second with 50 or more CRC6 anomalies (> 30%)or one or more LOSW events is counted as an SES, unless that second is UAS
LOSWS	Loss of SyncWord Second	Each second in which LOSW is declared as LOSWS
UAS/US	Unavailable Second	Each second that is part of unavailable time (UAT) is counted as UAS. UAT is declared at the begin of 10 consecutive SES and cleared at the begin of 10 consecutive non-SES.
OFS/AIS	OOF or AIS Second	Second containing ab LOSW or AIS event
CRC6	CRC6 anomaly	Number of CRC6 block errors (same as BBE, but not inhibited by SES or UAS)
TMP	Total Measurement Period	Elapsed time in current interval

The default thresholds of the parameters are fix preset and cannot be changed. For more details, refer to the *User Operations Guide, Chapter: Performance monitoring concepts - Available PM data.*

Definitions of PM parameters for SHDSL

For SHDSL, a performance monitoring block coincides with an SHDSL frame. Since the SHDSL frame length is 6 ms, there are 1662/3 blocks per second. The following definitions are applicable for PM parameters that are used for SHDSL segment termination points:

- UAS:
  Each second that is part of unavailable time is counted as a UAS. Unavailable time starts after 10 consecutive SESs. These 10 seconds are part of unavailable time. Unavailable time stops after 10 consecutive non-SESs. These 10 seconds are not part of unavailable time.
- SES:
  Each second in which 50 or more CRC-6 words are in error or in which a LOSW defect is active is counted as a Severely Errored Second, provided the second is not a UAS. An SES detection threshold of 30% is equivalent to 50 errored blocks.
- ES:
  Each second in which one or more CRC-6 word is errored or in which a LOSW defect is active is counted as an Errored Second, provided the second is not a UAS.
- BBE (CV):
  Each SHDSL frame with an errored CRC-6 word is counted as a Background Block Error (Code Violation), provided the second in which the error occurs is not an SES or a UAS. Hence, the maximum possible number of BBEs per second is 49.

Individual Sa bit provisioning case of ISDN modes

Three types of 2 Mbit/s services can be provided over SHDSL links, which can be selected from the user interface per NTU. These features work only for NEs which support QD2.

- Transparent E1:
  In this case there is a leased-line connection between two end-user sites providing 2048 kbit/s throughput. This signal remains unmonitored and does not have G.704 framing. From a TS0 processing and monitoring point of view this is a trivial case: TS0 is not monitored and transparently passed through.
- ISDN-PRI:
  In this case there is a “traditional” ISDN-PRI connection between the end-user on one end and a 64 kbit/s PSTN switch with ISDN features on the other. The effective throughput is 1920 kbit/s (30 B-channels). TS0 is used for monitoring and maintenance purposes by the operator. TS16 is used for signaling between the switch and the end-user client equipment. From a transport perspective TS16 is transparently transported. Compared with the ISDN-LL mode, the ISDN terminating equipment on both ends of the ISDN link have a different role (ET or TE); it is asymmetric.
- ISDN-LL: In this case there is a leased-line connection between two end-user sites providing 1984 kbit/s throughput. TS0 is used for monitoring and maintenance purposes by the operator. Compared with the ISDN-PRI mode, the ISDN terminating equipment on both ends of the ISDN link have the same role (TE); it is symmetric. The role of the LTU is to translate request and response messages between the management system and the NTUs regarding the provisioning of the TS0 functions.

AIS options in NTUs

It is possible for the user to provide certain AIS options via the GUI. This feature works only for NEs which support EOC-ext.

The following options are possible:

- NTU to End-user direction (SDH/SHDSL to PDH):
  - Force S-interface or customer interface AIS – enable/disable: This command is applicable in all modes and forces an all ones AIS pattern on the outgoing E1 interface in the end-user direction.
  - Channel AIS conversion – enable/disable: This command is applicable in both ISDN modes and controls whether a Channel AIS request in Sa6 (“1100”) received from the LTU direction is converted to an all ones pattern on the E1 output towards the end-user or is transparently passed through as channel AIS.
- NTU to LTU direction (PDH to SDH/SHDSL):
  - Force U-interface or network interface AIS – enable/disable: This command is applicable in all modes and forces an AIS pattern according to the selected format on the P12 logical interface towards the LTU.
  - AIS signaling method for ISDN – Channel AIS (“1100”), Channel AIS (“1000”): This command is applicable in both ISDN modes and controls the sa6 alarm code to be used towards the network in case a failure is detected on the incoming E1 signal from the end-user or when AIS is forced via management. Channel AIS is defined as an all-ones pattern in TS 1-31 and a valid TS0 (regenerated CRC-4 and E-bits based on signal from network; A-bit set to “0”; Sa5 set to “1”), with an Sa6 bit-pattern of “1100” or “1000”, whichever is selected.
  - Channel AIS/Full AIS selection – This command is available in both ISDN modes and determines whether “channel AIS” or “full AIS (all ones)” is sent to the network during E1 input failures or when AIS is forced by management.

Loopback control

For maintenance operations, the user has the option to activate and release loopbacks via the management systems on the following interfaces:

- LTU: Supports an SHDSL outloop
- SRU: Supports an SHDSL outloop (loop on the customer side of the SRU)
- E1 NTU in E1 mode (E1 over SHDSL): Supports an SHDSL outloop (on the SHDSL side of the E1 NTU) and supports an outloop on the customer interface (on the E1 side of the modem)
- E1 NTU (NT2M) in TU12 mode (TU12 over SHDSL): Supports an outloop on the customer interface (on the E1 side of the TU12 mode E1 NTU)
- Ethernet NTU (NT10ETH): Supports an inloop on the Ethernet NTU (on the SHDSL side of the Ethernet NTU)

SSM messaging

An NT2M modem has two functions for which a synchronization reference signal is necessary:

- Supplying a 2048 kHz timing output signal (according to G.703-13), 120W symmetrical.
- Retiming the outgoing 2048 kbit/s E1 signal towards the end-user.

To be able to provide these synchronization services, the NT2M derives the synchronization reference signal from the incoming SHDSL signal. This timing signal can be traced back immediately to the LTU internal clock, since this clock is used to generate the timing for the outgoing SHDSL links on the LTU. Possible SRUs in the link will not change the traceability of the timing, since they always operate in through-timed mode. In order for the NT2M to know the quality of the recovered clock signal, the LTU sends the current quality level (SSM) to the NTU on a regular basis, but certainly after each completed inventory phase and each time the Quality Level of the internal clock changes in the LTU.

The NT2M will declare the recovered reference as insufficient, when the quality level is SEC or worse.. So an 1645 Access Multiplexer Compact AMC) clock that is free-running or in hold-over will not be accepted by the NT2M. For the 2048 kHz output of the NT2M, the following requirements are important. It is turned-off (squelched) as long as the SHDSL link is not functioning and when the level of the reference is SEC or worse. Finally, it is possible to turn-off the timing output by management command.

Performance monitoring on LAN ports

On NT10ETH the following PM parameters are monitored: TxOctets, RxOctets and RxDiscardedFrames. They are supported on both Ethernet ports and on the single WAN port. The support includes threshold alarms for discarded frames.

NTU support

The following sections describe Ethernet NTU support features for SHDSL configurations.

Enhanced NTU Ethernet PM: Ethernet traffic and error bin

The 1645 AMC supports a 2 port Ethernet SHDSL modem as an NTU, which is connected via 1 to 4 parallel TU12s over SHDSL mapped links. For increased bandwidth, the Ethernet traffic is encapsulated in GFP-F and uses VC12-Xv virtual concatenation with LCAS support.

The 1645 AMC supports the following Enhanced NTU Ethernet ports PM counters via the QD2-Lite extension.

- Ethernet Outgoing Number of Bytes (pCbS)
- Ethernet Incoming Number of Good Bytes (pCbR)

- Ethernet Outgoing Number of Frames (eONF)
- Ethernet Incoming Number of Good Frames (eINF)
- Ethernet Outgoing Number of Pause Frames transmitted (pPPS)
- Ethernet Number of Layer1 Link Down (eNLD)
- Ethernet Incoming Number of Frames with CRC Error (pPCR)
- Ethernet Incoming Number of Frames with oversize (eINFO)
- Ethernet Incoming Number of Frame with undersize (eINFU)
- Ethernet Dropped Frames due to Error (ppDE)
- Ethernet Incoming Number of Frame with collisions (eINFC)
- Ethernet Outgoing Number of Frame with collisions (eONFC)
- Ethernet Forwarded Discarded Frames due to overflow in egress direction (eFDFO).
- Ethernet Outgoing Discarded Frames due to lifetime end (eODFT).

Note that the above Ethernet traffic and Error PM bins are applicable for both LAN and WAN ports of the NTU. However, the WAN port does not support pPPS, eINFC, and eONFC counters.

Note: The PM counters -pCbR, -pCbS and -ppDE are supported since 1645 AMC Release 6.1.

NTUs Bridge Mode provisioning

The 1645 AMC supports bridge mode provisioning to the Ethernet NTU.

The following bridge modes are supported.

- Self learning bridge (IEEE 802.1D)
- V-LAN bridge (IEEE 802.1Q)
- Provider bridge (IEEE 802.1ad)

NTU V-LAN Bridge Mode support

The 1645 AMC provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

When an NTU works in V-LAN bridge mode (IEEE802.1Q), the NTU's V-LAN table is used to assign the VID to ETH ports and WAN ports. The QD2-Lite message is only used to write to the table; a readout of the existing entries is not provided. The network element is the configuration master and retains a V-LAN table of its own. It ensures by corresponding commands that the V-LAN table in the NTU matches the V-LAN table in the AMC.

Using the V-LAN Entry command, individual entries in the table can be added, modified or deleted. This command is used when individual V-LAN entries are changed by the EMS.

A table entry for a VID is deleted by a V-LAN Table Entry command in which all WAN(x) bits and LAN(x) bits are set to "0". The V-LAN Table command can be used to copy the entire V-LAN table from the AMC to the NT10ETH. The entire V-LAN table is deleted by an "empty" V-LAN Table command that contains no table entry. The length of such a message is L=2.

After the restoration of an SDSL link, the NE (AMC) must refresh the entire V-LAN table with the V-LAN Table command. Refreshing the V-LAN table with the V-LAN Table command is not allowed to result in the interruption of individual or of all V-LANs.

NTU LPT support

The 1645 AMC supports Link Pass Through (LPT) functionality via EOC commands.

Users can enable or disable LPT using the following parameters.

- CA-CSF: GFP Client Signal Fail Signalling
- CA-SSF: Disabling LAN interfaces during WAN connection failure

NTU Ethernet QoS support

The 1645 AMC provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

The 1645 AMC supports the following NTU Ethernet QoS functions:

- PriorityMode
- IngressRateControl
- CIRAverageBitRate
- CIRMaxBurstSize
- PortPriority

NTU software download

The 1645 AMC provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

The 1645 AMC can use up to four SHDSL links in parallel via z-bits to download NTU software.

NTU web interface

The OMS of the 1645 AMC can be used to set user passwords for the NTU web interface.

NTU general configuration support

The 1645 AMC provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

The 1645 AMC supports the following enhanced NTU configuration.

1. Enhanced NTU SDH port configuration:
   - **CA-PLM_cmd**
   - **TIMdis_cmd**
   - **rxTTI**
   - **exTTI**
   - **txTTI**
   - **rxTSL**
2. Enhanced NTU Ethernet port configuration:
   - **FlowCtrlPause**
   - **Tagging**
   - **C-TagDefaultVID**
   - **PortPriority**
   - **S-TagDefaultVID**
   - **CIRAverageBitRate**
   - **CIRMaxBurstSize**
   - **AutoNegMode**
   - **DuplexMode**
   - **Speed**
   - **AutoNegRestart**
   - **CrossoverMode**
   - **LinkAdminCtrl**

3. Enhanced NTU Ethernet WAN port configuration:
   - **LCAS-Enable**
   - **CA-CSF**
   - **CA-SSF**
   - **VC(n)AdminCtrl**
   - **HoldOffTime**
   - **WaitToRestoreTime**
4. NTU Ethernet Bridging Configuration:
   - **BridgeMode**
   - **PriorityMode**
   - **RestartBridge**
   - **IngressRateCtrl**

NTU Alarms and status reports

The 1645 AMC provides enhanced PM support for third party NTUs. It supports a two port Ethernet SHDSL modem (NTU) which is connected via 1 to 4 parallel TU-12s over SHDSL mapped links. The Enhanced NTU ETH LAN port PM counters are available via the QD2-Lite extension. The Ethernet traffic bandwidth is optimized by GFP-F encapsulation and VC-12-Xv virtual concatenation using LCAS.

The 1645 AMC supports the following enhanced NTU alarms and status reports.

- SDH port status
  Note that dEQP, dINTB, dNAE, dDEG-N, dAIS-U, dLOP-U, dPLM-V, dTIM-V, dRDI-V, dDEG-V, and dUNEQ-V are supported in Release 6.0.
- Ethernet port status
  Note that dANM and dLOS are supported in Release 6.0.
- Updated Encaps and VCG status: TLCR, PLCR, FOPR, TLCT, PLCT, FOPT, LOA
  Note that dLOF-G, dPLM-G, SQM

Remote SHDSL Power Supply (RPS) support

The 1645 AMC manages an external Remote SHDSL Power Supply (RPS) box via the MDI/MDO interfaces. Note that remote power supply must be set to 'managed mode' by the DIP switch=ON in the power box.

The OMS can also be set to 'managed mode' for the remote power supply.

The 1645 Access Multiplexer Compact (AMC) supports the following remote power supply provisioning functions:

- **Restart_cmd**: Restarts the RPS module after forced shutdown
- Enable/Disable RPS related alarms (per port and not per alarm). This provisioning is used to suppress alarms generated by the RPS module.

The 1645 Access Multiplexer Compact (AMC) remote power supply module supports the following alarms:

- RPS power failure (per box)
- Overl: Overload (per port)
- OpenC: Open circuit (per port)
- FSD: Forced shut down (per port)
- Leak: Leakage asymmetrical (per port)
- HVolt: Overvoltage alarm (per port)

Note:

- The external power supply module has a maximum number of 12 SHDSL ports.
- The MDI interfaces 1...4 and MDO interfaces 1...4 will not function as normal when the RPS is set to managed mode.

Appendix A: An SDH overview

Overview

Purpose

This chapter briefly describes the Synchronous Digital Hierarchy (SDH).

Synchronous Digital Hierarchy

In 1988, the ITU-T (formerly CCITT) came to an agreement on the Synchronous Digital Hierarchy (SDH). The corresponding ITU-T Recommendation G.707 forms the basis of a global, uniform optical transmission network. SDH can operate with plesiochronous networks and therefore allows the continuous evolution of existing digital transmission networks.

The major features and advantages of SDH are:

- Compatibility of transmission equipment and networks on a worldwide basis
- Uniform physical interfaces
- Easy cross connection of signals in the network nodes
- Possibility of transmitting PDH (Plesiochronous Digital Hierarchy) tributary signals at bit rates commonly used at present
- Simple adding and dropping of individual channels without special multiplexers (add/drop facility)
- Easy transition to higher transmission rates
- Due to the standardization of the network element functions SDH supports a superordinate network management and new monitoring functions and provides transport capacity and protocols (Telecommunication Management Network, TMN) for this purpose in the overheads of the multiplex signals.
- High flexibility and user-friendly monitoring possibilities, e.g. end-to-end monitoring of the bit error ratio.

Purpose of SDH

The basic purpose of SDH is to provide a standard synchronous optical hierarchy with sufficient flexibility to accommodate digital signals that currently exist in today's network, as well as those planned for the future.

SDH currently defines standard rates and formats and optical interfaces. Today, mid-span meet is possible at the optical transmission level. These and other related issues continue to evolve through the ITU-T committees.

ITU-T addressed issues

The set of ITU-T Recommendations defines

- Optical parameters
- Multiplexing schemes to map existing digital signals (PDH) into SDH payload signals
- Overhead channels to support standard operation, administration, maintenance, and provisioning (OAM&P) functions
- Criteria for optical line Automatic Protection Switch (APS)

References

For more detailed information on SDH, refer to:

- ITU-T Recommendation G.703, "Physical/electrical characteristics of hierarchical digital interfaces", October 1996
- ITU-T Recommendation G.707, "Network Node Interface For The Synchronous Digital Hierarchy (SDH)", March 1996
- ITU-T Recommendation G.780, "Vocabulary of terms for synchronous digital hierarchy (SDH) networks and equipment" , November 1993
- ITU-T Recommendation G.783, "Characteristics of Synchronous Digital Hierarchy (SDH) Multiplexing Equipment Functional Blocks ", April 1997
- ITU-T Recommendation G.784, "Synchronous Digital Hierarchy (SDH) Management ", January 1994
- ITU-T Recommendation G.785, "Characteristics of a flexible multiplexer in a synchronous digital hierarchy environment ", November 1996
- ITU-T Recommendation G.813, "Timing characteristics of SDH equipment slave clocks (SEC)", August 1996
- ITU-T Recommendation G.823, "The control of jitter and wander within digital networks which are based on the 2048-kbit/s hierarchy", March 1993
- ITU-T Recommendation G.825, "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)", March 1993

- ITU-T Recommendation G.826, " Error performance Parameters and Objectives for International, Constant Bit Rate Digital Paths at or Above the Primary Rate", February 1999
- ITU-T Recommendation G.957, "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy", July 1995

Contents

SDH signal hierarchy

This section describes the basics of the SDH hierarchy.

STM-1 Frame

The SDH signal hierarchy is based on a basic "building block" frame called the Synchronous Transport Module 1 (STM-1), as shown in "SDH STM-1 frame" (p. A-4).

The STM-1 frame has a rate of 8000 frames per second and a duration of 125 microseconds

The STM-1 frame consists of 270 columns and 9 rows.

Each cell in the matrix represents an 8-bit byte.

Transmitting signals

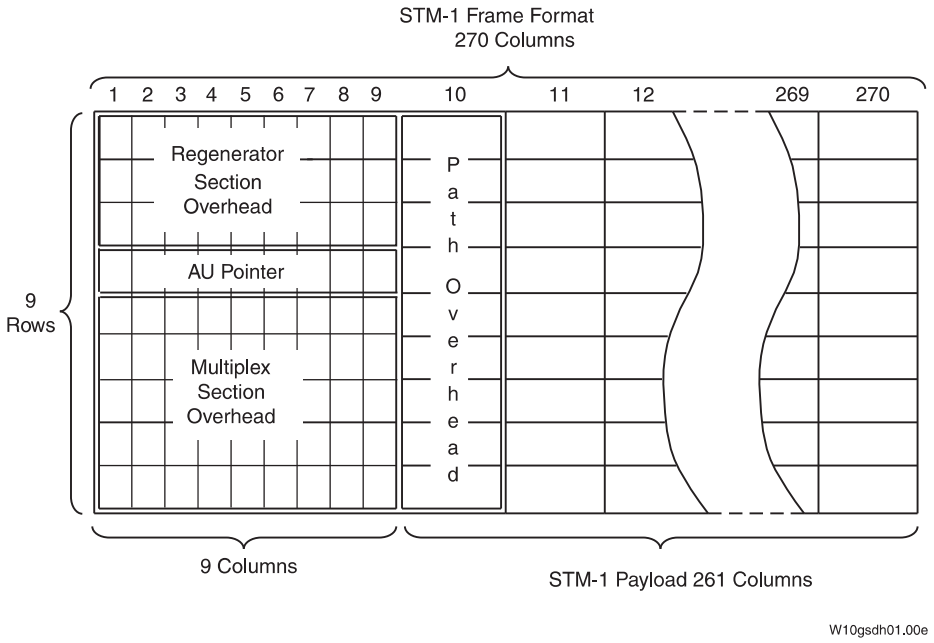
The STM-1 frame (STM = Synchronous Transport Module) is transmitted serially starting from the left with row 1 column 1 through column 270, then row 2 column 1 through 270, continuing on, row-by-row, until all 2430 bytes (9x270) of the STM-1 frame have been transmitted. Because each STM-1 frame consists of 2430 bytes and each byte has 8 bits, the frame contains 19440 bits a frame. There are 8000 STM-1 frames a second, at the STM-1 signal rate of 155.520.000 (19440 x 8000) kbit/s.

Three higher bit rates are also defined:

- 622.080 Mbit/s (STM-4)
- 2488.320 Mbit/s (STM-16)
- 9953.280 Mbit/s (STM-64)
- 39813.120 Mbit/s (STM-256)

The bit rates of the higher order hierarchy levels are integer multiples of the STM-1 transmission rate.

SDH STM-1 frame



Section overhead (SOH)

The first nine bytes of each row with exception of the fourth row are part of the SOH (Section OverHead). The first nine byte of the fourth row contain the AU pointer (AU = Administrative Unit).

STM-1 payload

Columns 10 through 270 (the remainder of the frame), are reserved for payload signals.

SDH path and line sections

This section describes and illustrates the SDH path and line sections.

SDH layers

SDH divides its processing functions into the following three path and line sections:

- Regenerator section
- Multiplex section
- Path

These three path and line sections are associated with

- Equipment that reflects the natural divisions in network spans
- Overhead bytes that carry information used by various network elements

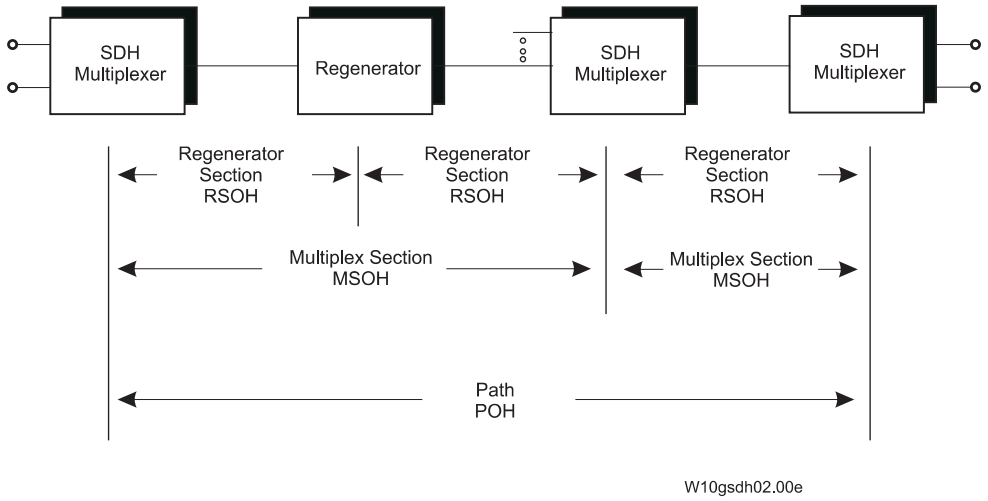
Equipment layers

The following table lists and defines each SDH equipment path and line section.

Path and line sections	Definition
Regenerator section	A regenerator section describes the section between two network elements. The network elements, however, do not necessarily have to be regenerators.
Multiplex section	A multiplex section is the section between two multiplexers. A multiplex section is defined as that part of a path where no multiplexing or demultiplexing of the STM-N frame takes place.
Path	A path is the logical signal connection between two termination points. A path can be composed of a number of multiplex sections which themselves can consist of several regenerator sections.

Path, MS and RS

The following figure illustrates the equipment path, multiplex sections and regenerator sections in a signal path.



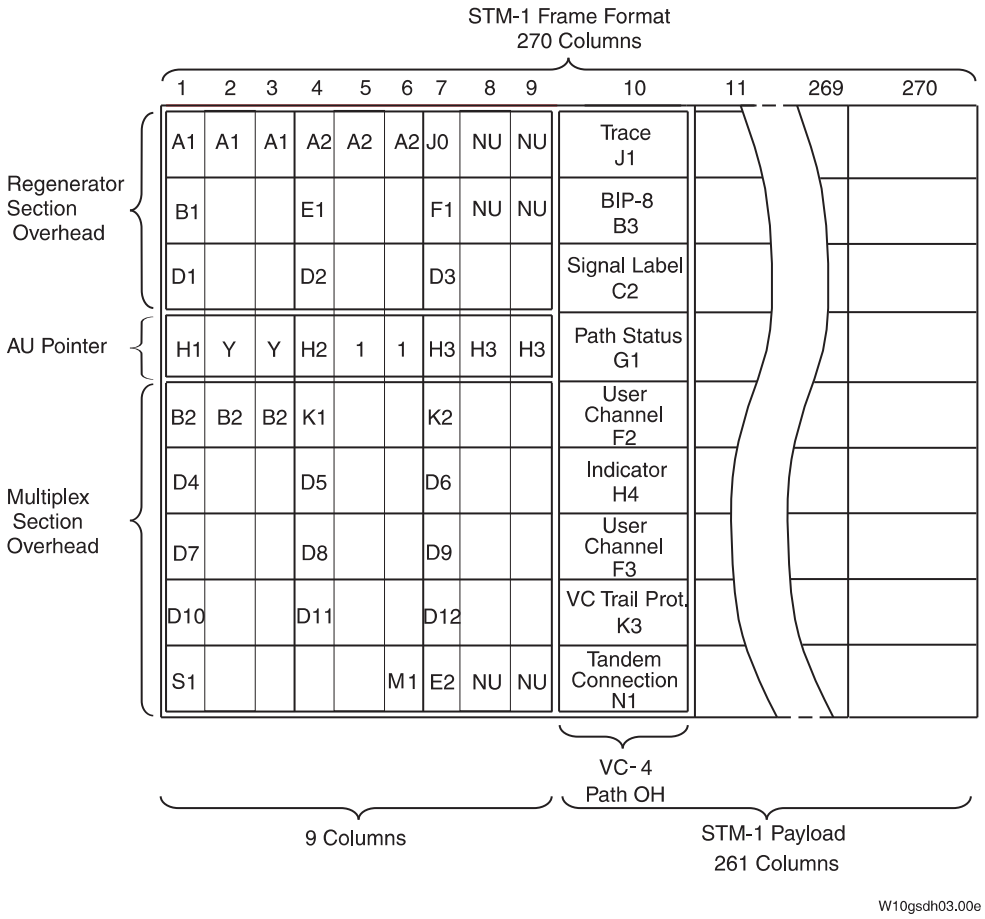
Overhead bytes

The following table lists and defines the overhead associated with each SDH path and line section.

Overhead byte section	Definition
Regenerator section	Contains information that is used by all SDH equipment including repeaters.
Multiplex section	Used by all SDH equipment except repeaters.
Path	The POH contains all the additional signals of the respective hierarchy level so that a VC can be transmitted and switched through independently of its contents.

SDH frame

The following figure illustrates the SDH frame sections and its set of overhead bytes.



SDH frame structure

This section provides detailed information on the locations and functions of various overhead bytes for each of the following SDH path and line sections:

- Regenerator Section
- Multiplex Section
- Path

Section overhead

The following table identifies the location and function of each regenerator section overhead byte.

Bytes	Function
A1, A2	Frame alignment A1 = 1111 0110 ; A2 = 0010 1000 ; These fixed-value bytes are used for synchronization.
B1	BIP-8 parity test Regenerator section error monitoring; BIP-8 : Computed over all bits of the previous frame after scrambling; B1 is placed into the SOH before scrambling; BIP-X: (Bit Interleaved Parity X bits) Even parity, X-bit code; first bit of code = even parity over first bit of all X-bit sequences;
B2	Multiplex section error monitoring; BIP-24 : B2 is computed over all bits of the previous STM-1 frame except for row 1 to 3 of the SOH (RSOH); B2 is computed after and placed before scrambling;
Z0	Spare bytes
D1 - D3 (= DCC_R) D4 - D12 (= DCC_M)	Data Communication Channel (network management information exchange)
E1	Orderwire channel
E2	Orderwire channel
F1	User channel
K1, K2	Automatic protection switch
K2	MS-AIS/RDI indicator
S1	Synchronization Status Message
M1	REI (Remote Error Indication) byte
NU	National Usage

Path overhead

The Path Overhead (POH) is generated for all plesiochronous tributary signals in accordance with ITU-T Rec. G.709. The POH provides for integrity of communication between the point of assembly of a Virtual Container VC and its point of disassembly. The following table shows the POH bytes and their functions.

Byte	Location and Function
J1	Path Trace Identifier byte
B3	Path Bit Interleaved Parity (BIP-8) Provides each path performance monitoring. This byte is calculated over all bits of the previous payload before scrambling.
C2	Signal Label All "0" means unequipped; other and "00000001" means equipped
G1	Path Status Conveys the STM-1 path terminating status, performance, and remote defect indication (RDI) signal conditions back to an originating path terminating equipment.
F2, F3	User Data Channel Reserved for user communication.
H4	Multiframe Indicator Provides a general multiframe indicator for VC-structured payloads.
K3	VC Trail protection.
N1	Tandem connection OH

AU pointer

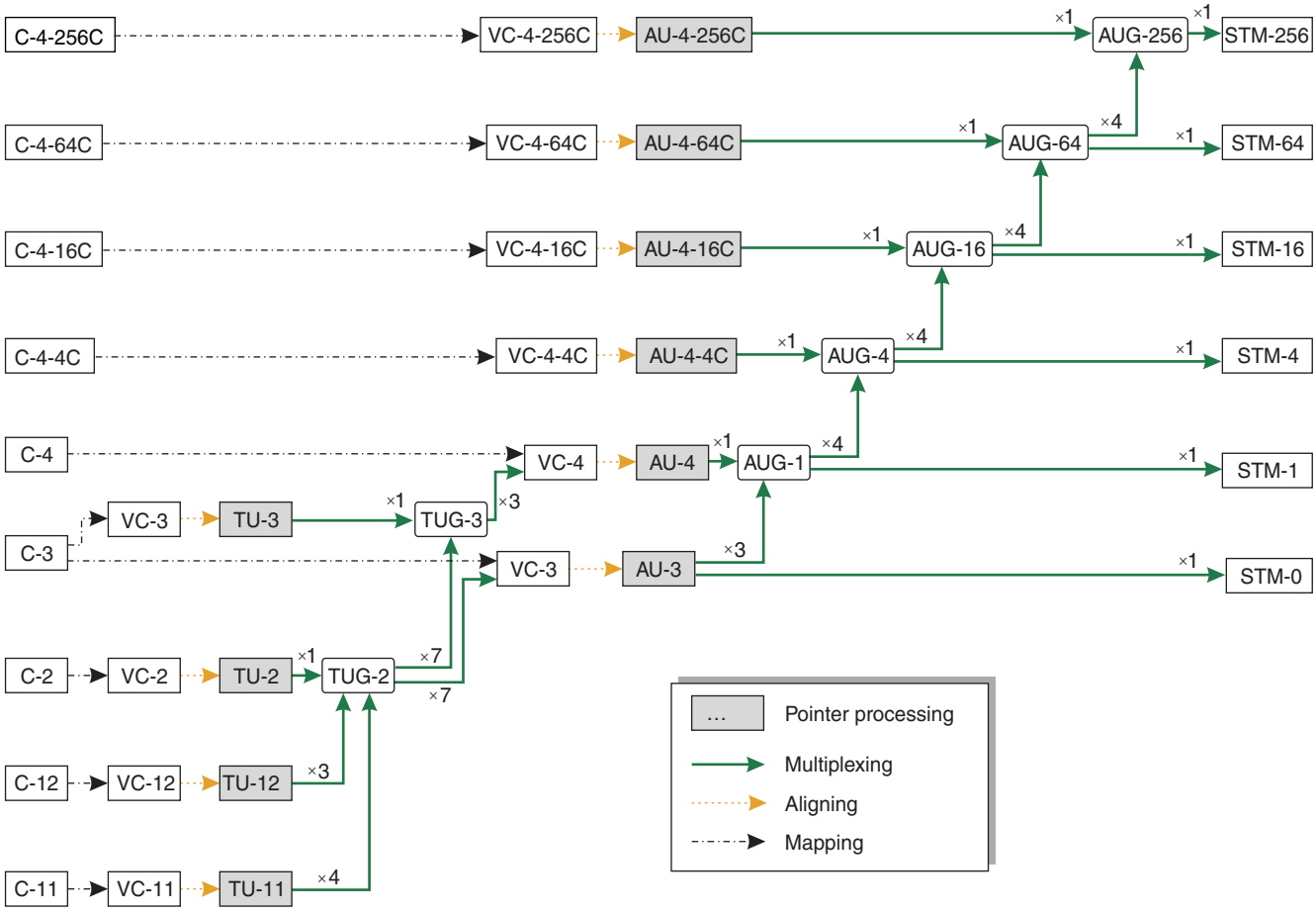
The AU pointer together with the last 261 columns of the STM-1 frame forms an AUG (Administrative Unit Group). An AUG may contain one AU-4 or three byte-multiplexed AU-3s (an AU-3 is exactly one third of the size of an AU-4). AU-3s are also compatible with the SONET standard (Synchronous Optical NETwork) which is the predecessor of SDH (and still the prevailing technology within the USA). Three byte-multiplexed STS frames (SONET frame), each containing one AU-3 can be mapped into one STM-1.

SDH digital multiplexing

Digital multiplexing is SDH's method of byte mapping tributary signals to a higher signal rate, which permits economical extraction of a single tributary signal without the need to demultiplex the entire STM-1 payload. In addition, SDH provides overhead channels for use by OAM&P groups.

SDH digital multiplexing

The following figure illustrates the SDH technique of mapping tributary signals into the STM frames.



Transporting SDH payloads

Tributary signals are mapped into a digital signal called a virtual container (VC). The VC is a structure designed for the transport and switching of STM payloads. There are various sizes of VCs: VC-11, VC-12, VC-2, VC-3, VC-4, VC-4-4C, VC-4-16C, VC-4-64C and VC-4-256C.

Table

The following table shows the mapping possibilities of some digital signals into SDH payloads.

Input tributary	Voice Channels	Rate	Mapped Into
1.5 Mbit/s	24	1.544 Mbit/s	VC-11
2 Mbit/s	32	2.048 Mbit/s	VC-12
6 Mbit/s	96	6.312 Mbit/s	VC-2
34 Mbit/s	672	34.368 Mbit/s	VC-3
45 Mbit/s	672	44.736 Mbit/s	VC-3
140 Mbit/s	2016	139.264 Mbit/s	VC-4

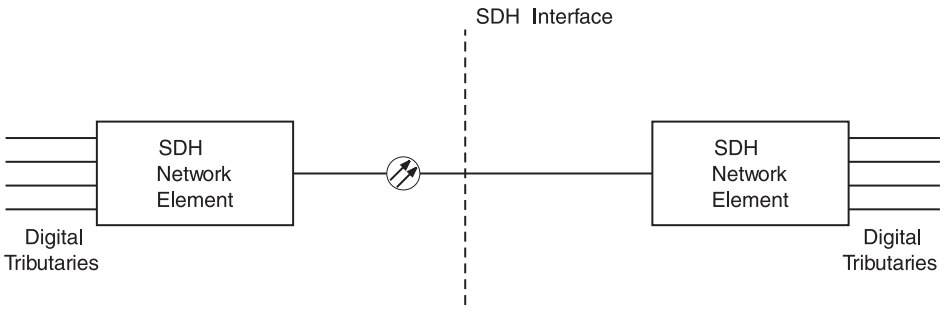
SDH interface

This section describes the SDH interface.

Description

The SDH interface provides the optical mid-span meet between SDH network elements. An SDH network element is the hardware and software that affects the termination or repeating of an SDH standard signal.

SDH interface



Standard optical interconnect at SDH interface

Family of standard rates at N x 155.52 Mbit/s [Synchronous Transport Module (STM-1)]

Overhead channels defined for interoffice operations and maintenance functions

W10gsdh06.00e

SDH multiplexing process

SDH provides for multiplexing of 2-Mbit/s (C-12) and 34-Mbit/s (C-3) signals into an STM-1 frame.

Furthermore, multiplexing paths also exist for the SONET specific 1.5-Mbit/s, 6-Mbit/s and 45-Mbit/s signals.

Process

The following describes the process for multiplexing a 2-Mbit/s signal. The "SDH digital multiplexing" (p. A-10) illustrates the multiplexing process.

1 Input 2-Mbit/s tributary is mapped

- Each VC-12 carries a single 2-Mbit/s payload.
- The VC-12 is aligned into a Tributary Unit TU-2 using a TU pointer.
- Three TU-2 are then multiplexed into a Tributary Unit Group TUG-2.
- Seven TUG-2 are multiplexed into an TUG-3.
- Three TUG-3 are multiplexed into an VC-4.
- The VC-4 is aligned into an Administrative Unit AU-4 using a AU pointer.
- The AU-4 is mapped into an AUG which is then mapped into an STM-1 frame.

2 After VCs are multiplexed into the STM-1 payload, the section overhead is added.

3 Scrambled STM-1 signal is transported to the optical stage.

SDH demultiplexing process

Demultiplexing is the inverse of multiplexing. This topic describes how to demultiplex a signal.

Process

The following describes the process for demultiplexing an STM-1 signal to a 2 Mbit/s signal. The "SDH digital multiplexing" (p. A-10) illustrates the demultiplexing process.

1 The unscrambled STM-1 signal from the optical conversion stages is processed to extract the path overhead and accurately locate the payload.

2 The STM-1 path overhead is processed to locate the VCs. The individual VCs are then processed to extract VC overhead and, via the VC pointer, accurately locate the 2-Mbit/s signal.

3 The 2-Mbit/s signal is desynchronized, providing a standard 2-Mbit/s signal to the asynchronous network.

Key points

SDH STM pointers are used to locate the payload relative to the transport overhead.

Remember the following key points about signal demultiplexing:

- The SDH frame is a fixed time (125 μs) and no bit-stuffing is used.
- The synchronous payload can float within the frame. This is to permit compensation for small variations in frequency between the clocks of the two systems that may occur if the systems are independently timed (plesiochronous timing).

SDH transport rates

Higher rate STM-N frames are built through byte-multiplexing of N STM-1 signals.

Creating higher rate signals

A STM-N signal can only be multiplexed out of N STM-1 frames with their first A1 byte at the same position (i.e. the first A1 byte arriving at the same time).

STM-N frames are built through byte-multiplexing of N STM-1 signals. Not all bytes of the multiplexed SOH (size = N x SOH of STM-1) are relevant in an STM-4/16.

For example there is only one B1 byte in an STM-4/16 frame which is computed the same way as for an STM-1. Generally the SOH of the first STM-1 inside the STM-N is used for SOH bytes that are needed only once. The valid bytes are given in ITU-T G.707.

SDH transport rates

Designation	Line rate (Mbit/s)	Capacity
STM-1	155.520	1 AU-4 or 3 AU-3
STM-4	622.080	4 AU-4 or 12 AU-3
STM-16	2488.320	16 AU-4 or 48 AU-3
STM-64	9953.280	64 AU-4 or 192 AU-3
STM-256	39813.120	256 AU-4 or 768 AU-3

Glossary

Numerics

12 digit Numerical Code (12NC)
Used to as the unique identifier of an item or product. The first ten digits identify an item. The eleventh digit specifies the particular variant of the item. The twelfth digit indicates the revision issue. Items for which the first eleven digits are the same are functionally equal and may be exchanged.

5ESS
Number 5 Electronic Switching System

5TAD
Five Tributary Add-Drop subrack

9TAD
Nine Tributary Add-Drop subrack

A

AAU
Alarm Adapter Unit. Radio Relay circuit pack that is used for the collection of external alarms and remote control of external equipment.

AC
Alternating Current

ACU
Alarm Collection Unit. Radio Relay circuit pack that collects of equipment alarms, analogue measurements from internal monitoring points and calculation data.

ADM
Add-Drop Multiplexer

Administrative Unit (AU)
Carrier for TUs

Administrative-Unit Pointer (AU PTR)
Indicates the phase alignment of the VC-n with respect to the STM-N frame. The pointer position is fixed with respect to the STM-N frame.

Administrator

The OMS administrator.

Agent

Performs operations on managed objects and issues events on behalf of these managed objects. All SDH managed objects will support at least one agent. Control of distant agents is possible via local “Managers”.

Alarm

The notification (audible or visual) of a significant event. See also Event.

Alarm Indication Signal (AIS)

Code transmitted downstream in a digital Network that shows that an upstream failure has been detected and also alarmed if the upstream alarm has not been suppressed. Also called to as All OneS.

Alarm Severity

An attribute that defines the priority of the alarm message. The way in which alarms are processed depends on the severity.

Aligning

Using a pointer to indicate the head of a virtual container, e.g. to create an Administrative Unit (AU) or a Tributary Unit (TU).

ALS

Automatic Laser Shutdown

Alternate Mark Inversion (AMI)

A line code that employs a ternary signal to convert binary digits. In this line code successive binary ones are represented by signal elements that are normally of alternately positive and negative polarity but are equal in amplitude, binary zeros are represented by signal elements that have zero amplitude.

American Standard Code for Information Interchange (ASCII)

A standard 8-bit code that is used to exchange information among data processing systems and associated equipment.

Anomaly

A difference between the actual and the desired operation of a function.

ANSI

American National Standards Institute

APS

Automatic Protection Switching

AS

Alarm Suppression assembly

Assembly

Gathering together of payload data with overhead and pointer information (an indication of the direction of the signal).

Association

A logical connection between manager and agent through which management information can be exchanged.

Asynchronous

See Non-synchronous.

ATC

Auxiliary Transmission Channel

ATM

Asynchronous Transfer Mode

ATPC

Automatic Transmit-Power Control

AU

Administrative Unit

AU4AD

Administrative Unit 4 Assembler/Disassembler

AUG

Administrative Unit Group

AUTO

Automatic

Automatic Transmit Power Control (ATPC)

Reduces the power output from the transmitter during normal propagation conditions and increases the power output to maximum during fading periods to try to maintain the nominal level of receiver input.

Autonomous Message

A message transmitted from the controlled network element to the OMS and was not a response to a command that originated in the OMS.

B

B3ZS

Bipolar 3-Zero Substitution

B8ZS

Bipolar 8-Zero Substitution

BBTR

Backplane Bus Transceiver

BC

Board Controller

BCC

Board Controller Complex

BIN

BINary

BIP

Bit-Interleaved Parity

BISDN

Broadband Integrated Services Digital Network

Bit Error Ratio (BER)

The ratio of bits received in error to bits sent.

Bit Interleaved Parity (BIP)

A method of error monitoring that uses a specified number of bits (BIP-8)

BLD OUT LG

Build-Out Lightguide

Board Controller Local Area Network (BC-LAN)

The internal local area network that provides communications between the Line Controller circuit pack and board controllers on the circuit packs that are associated with a high-speed line.

Branching

Interconnection of independent line systems.

Broadband Communication

Voice, data, and/or video communication at greater than 2 Mbit/s rates.

Broadband Service Transport

STM-1 concatenation transport over the SLM for ATM applications.

BUSTR

BUS Transmitter and Receiver

C

CAS

Channel Associated Signaling

CAT

CATastrophic

CC

Cross-Connection, Cross-Connect

CCIR

See ITU-R.

CCITT

See ITU-T.

CCS

Common Channel Signaling

CEPT

Conférence Européenne des Administrations des Postes et des Télécommunications

Channel

A sub-unit of transmission capacity within a defined higher level of transmission capacity, e.g. a CEPT-4 (140 Mbit/s) within a 565 Mbit fiber system.

CIR

Committed Information Rate

Circuit

A combination of two transmission channels that permits bidirectional transmission of signals between two points to support a single communication.

CIT

Craft Interface Terminal

Clear Channel (Cl. Ch.)

A provisionable mode for the 34 and 140 Mbit/s tributary outputs that causes parity violations not to be monitored or corrected before the 34 and 140 Mbit/s outputs are encoded.

Client

Computer in a computer network that generally offers a user interface to a server. See also Server.

CMI

Coded Mark Inversion

CO

Central Office

Co-resident

A hardware configuration where the OMS and ITM-NM applications can be independently active at the same time on the same hardware and software platform without interfering with each other's

functioning.

Common Object Request Broker Architecture (CORBA)

CORBA allows applications to communicate with one another no matter where they are located or who has designed them.

Concatenation

A procedure whereby a multiplicity of Virtual Containers are associated with each other with the result that their combined capacity can be used as a single container across which bit-sequence integrity is maintained.

CONN PCB

Connector Printed Circuit Board

Container (C)

Carries plesiochronous signal, the “payload”.

CP

Circuit Pack

Craft Interface Terminal (CIT)

Local manager for SDH network elements.

CRC

Cyclic Redundancy Check

Cross-Connect Map

Connection map for an SDH network element; contains information about how signals are connected between high speed time slots and low speed tributaries. See also Squelch Map.

Cross-Polarization Interference Cancellation

This feature permits both orthogonal polarizations of one Radio Frequency carrier to be used simultaneously, which provides greater spectral efficiency.

CTP

Connection Termination Point

CV

Code Violation

D

DACS

Digital Access & Cross-connect System

DACScan-T

See Integrated Transport Management Network Manager.

Data Communication Channel (DCC)

The embedded overhead communication channel in the SDH line. The DCC is used for end-to-end communication and maintenance. It carries alarm, control, and status information between network elements in an SDH network.

Data Communication Equipment (DCE)

Provides the signal conversion and coding between the data terminating equipment and the line. The DCE may be separate equipment or a part of the data terminating equipment.

Data Terminating Equipment (DTE)

Originates data for transmission and accepts transmitted data.

Database Administrator

A user who administers the database of the OMS application. See also User Privilege.

DC

Direct Current

DCF

Data Communications Function

DCN

Data Communications Network

DCS

Digital Cross-connect System

DDF

Digital Distribution Frame

Dedicated Protection Ring (DP-Ring)

A protection method used in some network elements.

Default Value Provisioning

The original values are preprogrammed at the factory. These values can be overridden using local or remote provisioning.

Defect

A limited interruption of the ability of an item to perform a required function. The defect may or may not lead to maintenance action this depends on the results of additional analysis.

Demultiplexing

A process applied to a multiplexed signal to recover signals combined within it and restore the distinct individual channels of these signals.

Digital Link

A transmission span such as a point-to-point 2 Mbit/s, 34 Mbit/s, 140 Mbit/s, VC12, VC3 or VC4 link between controlled network elements. The channels within a digital link are insignificant.

Digital Section

A transmission span such as an STM-N or 565 Mbit/s signal. A digital section may contain multiple digital channels.

DIL

Dual In Line

Directory-Service Network Element (DSNE)

A designated network element that is responsible for administering a database that maps network element names (node names) to addresses (node Id). There can be one DSNE per (sub)network.

Disassembly

Splitting up of a signal into its constituents as payload data and overhead (an indication of the direction of a signal).

Domain

The domain of a OMS is the set of all SDH network elements that are controlled by that particular OMS.

Downstream

At or towards the destination of the considered transmission stream, i.e. in the direction of transmission.

DPLL

Digital Phase-Locked Loop

DPS

Data communication Packet Switch

DR

Digital Radio

DRI

Dual-Ring Interworking

DS-n

Digital Signal, Level n

DSL

Digital Subscriber Line

DTMF

Dual-Tone Multi-Frequency

Dual Homing

An STM-1/STM-4 ring with AMC equipment can be dual homed on a ring consisting of 1645 AMC , Metropolis® ADM (Compact shelf) or *WaveStar*® ADM 16/1. Also STM-16 rings can be dual homed with the 1645 AMC).

Dual-Node Interworking

Dual Node Interworking (DNI) is a configuration of two ring networks that share two common nodes. DNI allows a circuit with one termination in one ring and one termination in another ring to survive a loss-of-signal failure of the shared node that is currently carrying service for the circuit.

DUS

Do not Use for Synchronization

DWDM

Dense-Wavelength Division Multiplexing

E

EC-n

Electrical Carrier, Level n

ECC

Embedded Control Channel

ECI

Equipment Code Identifier

EH&S

Environmental Health and Safety

EINB

Ethernet Incoming Number of Mbytes

Electronic Industries Association (EIA)

A trade association of the electronic industry that establishes electrical and functional standards.

Element Management System (EMS)

See Integrated Transport Management Subnetwork Controller.

EMC

ElectroMagnetic Compatibility

EMI

ElectroMagnetic Interference

EOC

Embedded Operations Channel

EOC-ext. (Proprietary EOC message extension)

A proprietary message set to enhance the standard EOC management capabilities.

EONB

Ethernet Outgoing Number of Mbytes

EOW

Engineering Order Wire

Equivalent Bit Error Ratio (EBER)

The calculated average bit error rate over a data stream.

Errored Second (ES)

A performance monitoring parameter.

ES

End System

ESD

ElectroStatic Discharge

ESPG

Elastic Store & Pointer Generator

ETSI

European Telecommunication Standardisation Institute

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 OMS.

Event Management (EM)

Subsystem of the OMS that processes and logs event reports of the network.

Externally Timed

An operating condition of a clock in which it is locked to an external reference and uses 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 the protection channels when that capacity is not used for the protection of service traffic.

F

Far End Block Error (FEBE)

An indication returned to the transmitting node that an errored block has been detected at the receiving node. A block is a specified grouping of bits.

Far End Receive Failure (FERF)

An indication returned to a transmitting network element that the receiving network element has detected an incoming section failure.

FAS

Frame Alignment Signal

FAW

Frame Alignment Word

FC

Full contact Connector

FCC

Federal Communications Commission

FDDI

Fiber Distributed Data Interface

FEP

Front End Processor

Free Running

An operating condition of a network element in which its local oscillator is not locked to any synchronization reference and uses no storage techniques to sustain its accuracy.

G

GARP

Generic Attribute Registration Protocol

Gateway Network Element (GNE)

Passes information between other network elements and management systems via a Data Communications Network.

Gbit/s

Gigabits per second

Geographic Location

Location of the OMS server. The geographic location is entered as part of the installation procedure of the OMS.

Geographic Redundancy (GR)

Allows protection of management for a network element by assigning the network element to two OMSs. The first primary OMS usually manages the Network Element and is now in the protected domain. If the primary OMS or the link between the network element and the primary OMS fails, the secondary OMS will automatically take over management of the network element and is now in the protecting domain. The two OMSs are connected by a peer to peer link, which they use to pass Geographic Redundancy management information to each other. This link must be established before any network element can be protected by Geographic Redundancy.

GFP

Generic Framing Procedure

Global Wait to Restore Time

The time to wait before switching back to the timing reference occurs after a timing link failure has cleared. This time applies for all timing sources in a system hence the name global. This can be between 0 and 60 minutes, in increments of one minute.

GNE

Gateway network element - A network element that passes information between other network elements and operations systems via a data communications network.

GUI

Graphical User Interface

GVRP

GARP VLAN Registration Protocol (refer to "GARP" (p. GL-11))

H

HE

Host Exchange

High Density Bipolar 3 code (HDB3)

Line code for e.g. 2 Mbit/s transmission systems.

High level Data Link Control (HDLC)

Protocol in the data-link layer of the OSI reference model.

Higher order Path Adaptation (HPA)

Function that adapts a lower order Virtual Container to a higher order Virtual Container by processing the Tributary Unit pointer which indicates the phase of the lower order Virtual Container Path Overhead relative to the higher order Virtual-Container Path Overhead, and assembling/disassembling the complete higher order Virtual Container.

Higher order Path Connection (HPC)

Function that provides for flexible assignment of higher order Virtual Containers within an STM-N signal.

Higher order Path Termination (HPT)

Function that terminates a higher order path by generating and adding the appropriate Virtual-Container Path Overhead to the relevant container at the path source and removing the Virtual-Container Path Overhead and reading it at the path sink.

HMI

Human Machine Interface

HO

High Order

Holdover

An operating condition of a clock in which its local oscillator is not locked to an external reference but uses storage techniques to maintain its accuracy with respect to the last known frequency comparison with a synchronized reference.

Host Name

Name of the server on which the OMS is running.

HS

High Speed

I

I/O

Input/Output

ICB

Interconnection Box

ICP

InterConnection Panel

IEC

International Electrotechnical Committee

IEEE

Institute of Electrical and Electronic Engineers

IF

Intermediate Frequency

IFT

InterFace Terminal

Integrated Transport Management Craft Interface Terminal (ITM-CIT)

Local manager for SDH network elements in a subnetwork. Also called the to as Craft Interface Terminal.

Intelligent Synchronous Multiplexer (ISM)

A network multiplexer that is designed to flexibly multiplex plesiochronous and STM-1 tributary port signals into STM-1 or STM-4 line port signals.

Intermediate System (IS)

A system that routes/relays management information. An SDH network element may be a combined Intermediate and end system.

IPS

Inter Processor Status

IS

In-Service

IS-IS Routing

The network elements in a management network, route packets (data) between each other using an IS-IS level protocol. The size of a network that is running IS-IS Level 1 is limited, and therefore certain mechanisms are employed to facilitate the management of larger networks. For STATIC ROUTING, it is possible to disable the protocol over the LAN connections and thereby effectively cause the management network to be partitioned into separate IS-IS Level 1 areas. In order for the OMS to communicate with a specific network element in one of these areas, the OMS must identify the Gateway network element through which this specific network element is connected to the LAN. All packets to this specific network element are routed directly to the Gateway network element by the OMS, before being re-routed (if necessary) within the Level 1 area. For DYNAMIC ROUTING an IS-IS Level 2 routing protocol is used that allows a number of Level 1 areas to interwork. The network elements that connect an IS-IS area to another area are set to run the IS-IS Level 2 protocol within the network element and on the connection to other network elements. Packets can now be routed between IS-IS areas and the OMS does not have to identify the Gateway network elements.

ISDN

Integrated Services Digital Network

ISO

International Standards Organisation

ITU

International Telecommunications Union

ITU-R

International Telecommunications Union - Radio standardization sector. Formerly known as CCIR: Comité Consultatif International Radio; International Radio Consultative Committee.

ITU-T

International Telecommunications Union - Telecommunication standardization sector. Formerly known as CCITT: Comité Consultatif International Télégraphique & Téléphonique; International Telegraph and Telephone Consultative Committee.

J

Jitter

Short term variations of amplitude and frequency components of a digital signal from their ideal position in time.

L

LAN

Local Area Network

LBA

Lightwave Booster Amplifier.

LBO

Line Build Out - An optical attenuator that guarantees the proper signal level and shape at the receiver input.

LCAS

Link Capacity Adjustment Scheme

LCN

Local Communications Network

LDI

Linear Drop/Insert (Add-Drop)

LED

Light Emitting Diode

LEN

Local Exchange Node

LF

Low Frequency

LH

Long Haul

License key

An encrypted code that is required to enable the use of specific modules in the OMS. Valid license keys can be obtained from your provider.

Line

Transmission line; refers to a transmission medium, together with the associated high speed equipment, that are required transport information between two consecutive network elements, one of which originates the line signal and the other terminates the line signal.

Line Build Out (LBO)

An optical attenuator that guarantees the proper signal level and shape at the receiver input.

LNC

LiNe Controller (SLM)

LO

Low Order

LOF

Loss Of Frame

LOM

Loss Of Multiframe

Loop Timing

A timing mode in which the terminal derives its transmit timing from the received line signal.

LOP

Loss Of Pointer

LOS

Loss Of Signal

Lower order Path Adaptation (LPA)

Function that adapts a PDH signal to a synchronous network by mapping the signal into or de-mapping the signal out of a synchronous container.

Lower order Path Connection (LPC)

Function that provides for flexible assignment of lower order VCs in a higher order VC.

Lower order Path Termination (LPT)

Function that terminates a lower order path by generating and adding the appropriate VC POH to the relevant container at the path source and removing the VC POH and reading it at the path sink.

LPU

Line Port Unit

LRX

Line Receiver

LS

Low Speed

LTA

Line Terminal Application

LTU

Line Termination Unit

LTX

Line Transmitter

M

MAF

Management Application Function

Management Connection

Identifies the type of routing used (STATIC or DYNAMIC). If STATIC is selected, Management Connection allows the gateway network element to be identified. See also IS-IS Routing.

Management Information Base (MIB)

The database in the network element. Contains the configuration data of the network element. A copy of each MIB is available in the OMS and is called the MIB image. Under normal circumstances the MIB and MIB image of one network element are synchronized.

Manager

Is capable of issuing network management operations and receiving events

Manager

Capable of issuing network management operations and receiving events. The Manager communicates with the Agent in the controlled network element.

Manufacturer Executable Code (MEC)

Network element system software in binary format that is downloaded to one of the stores can be executed by the system controller of the network element.

Mapping

Gathering together of payload data with overhead, i.e. packing the PDH signal into a virtual container.

MDI

Miscellaneous Discrete Input

MDO

Miscellaneous Discrete Output

Mediation Device (MD)

Allows for exchange of management information between Operations System and network elements.

MEF

Maintenance Entity Function (in NE)

MEM

System MEMory unit

Message Communications Function (MCF)

Function that provides facilities for the transport and routing of Telecommunications Management Network messages to and from the Network Manager.

MF

Mediation Function

MFS

Multi Frame Synchronization signal

MIB

The Management Information Base is the database in the node. The MIB contains the configuration data of the node. A copy of each MIB is available in the EMS and is called the MIB image. Under normal circumstances, the MIB and MIB image of one node are synchronized.

MIB image

See Management Information Base.

Midspan Meet

The capability to interface between two lightwave network elements of different vendors. This applies to high speed optical interfaces.

MLAN

MultiLAN

MMI

Man-Machine Interface Also called Human Machine Interface (HMI)

MO

Managed Object

Motif

X-Windows System supplied by Open Software Foundation.

MS

Multiplexer Section

MSOH

Multiplex Section Overhead. Part of the SOH (Section Overhead). Is accessible only at line terminals and multiplexers.

MSP

Multiplex Section Protection. Provides capability of switching a signal from a working to a protection section.

MTBF

Mean Time Between Failures

MTBMA

Mean Time Between Maintenance Activities

MTIE

Maximum Time Interval Error

MTPI

Multiplexer Timing Physical Interface

MTTR

Mean Time To Repair

Multiplexer Section OverHead (MSOH)

Part of the Section Overhead. Is accessible only at line terminals and multiplexers.

Multiplexer Section Protection (MSP)

Provides capability of switching a signal from a working to a protection section.

Multiplexer Section Shared Protection Ring (MS-SPRING)

A protection method used in multiplex line systems.

Multiplexer Section Termination (MST)

Function that generates the Multiplexer Section Overhead in the transmit direction and terminates the Multiplexer Section Overhead in the receive direction.

Multiplexer Timing Source (MTS)

Function that provides the timing reference to the relevant component parts of the multiplex equipment and represents the SDH network element clock.

Multiplexing

A procedure by which multiple lower order path layer signals are adapted into a higher order path, or by which the multiple higher order path layer signals are adapted into a multiplex section.

N

NE

Network element. The NE is comprised of telecommunication equipment (or groups/parts of telecommunication equipment) and support equipment that performs network element functions. A network element has one or more standard Q-type interfaces.

NEF

Network element function

NEM

Network element manager

NEQ

Network Element Equivalence. NEQ calculations based on

Network Element (NE)

A network element is comprised of telecommunication equipment (or groups/parts of telecommunication equipment) and support equipment that performs network element functions. A network element has one or more standard Q-type interfaces. A network element can be directly managed by a management system. See also Node.

Network Element Equivalent (NEE)

The functionality, database size and processing power that are required from the OMS are different for each type of network element that is supported. Therefore each type represents a

certain amount of Network Element Equivalent.

Network Mediation Unit (NMU)

Collects fault and alarm events from transmission equipment. The OMS can forward alarms to the NMU. The NMU can forward alarms to an Operations System.

Network Service Access Point (NSAP)

An end system address of the System Controller according to ISO 8348 AD2. The format is ISO_DCC_LUCENT.

NMC

Network Maintenance Center

NNE

Non-SDH network element

NNI

Network Node Interface

Node

A node or network element is defined as all equipment that is controlled by one system controller.

Node

Defined as all equipment that is controlled by one system controller. A node can not always be directly managed by a management system. See also network element.

NOMC

Network Operation Maintenance Channel

Non-revertive switching

In non-revertive switching, there is an active and standby high-speed line, circuit pack, etc. When a protection switch occurs, the standby line, circuit pack, etc., is selected causing the old standby line, circuit pack, etc., to be used for the new active line, circuit pack, etc. The original active line, circuit pack, etc., becomes the standby line, circuit pack, etc. This status remains in effect when the fault clears. Therefore, this protection scheme is “non-revertive” in that there is no switch back to the original status in effect before the fault occurred.

Non-revertive switching

In non-revertive switching there is an active and a standby high speed line, circuit pack, etc. When a protection switch occurs, the standby line, circuit pack, etc. is selected which causes the old standby line, circuit pack, etc, to be used for the new active line, circuit pack, etc. The original active line, circuit pack, etc. becomes the standby line, circuit pack, etc. This status remains in effect when the faults clears. Therefore, this protection scheme is non-revertive in that there is no switch back to the original status that was in effect before the fault occurred.

Non-synchronous

The essential characteristic of timescales or signals such that their significant instants do not necessarily occur at the same average rate.

Not Protected Domain

The Not Protected Domain for the OMS contains all the network elements that are managed by that OMS and are not currently protected by another OMS. If the OMS fails, the network elements in this domain are not managed by any OMS. See also Geographic Redundancy.

NPI

Null Pointer Indication

NRZ

Non-Return to Zero

NSA

Non-Service Affecting

NTU

Network Termination Unit

NUT

Non pre-emptible Unprotected Traffic

NVM

Non-Volatile Memory

O

OA

Optical Amplifier

OAA case tools

A software package/tool to aid the process of requirements, analysis, design and implementation of object orientated systems.

OAM&P

Operations, Administration, Maintenance and Provisioning

OC-n

Optical Carrier, Level n

ODF

Optical Distribution Frame

ODU

Optical Demultiplexer Unit

OFS

Out of Frame Second

OI

Optical Interface

OMU

Optical Multiplexer Unit

OOF

Out Of Frame

OOS

Out Of Service

Operations System (OS)

The Operations System is the system that provides operations, administration and maintenance functions.

Operator

A user of the OMS application with Operator privileges. See also User Privilege.

Optical Line System (OLS)

A high-capacity lightwave system that is designed to multiplex eight optical signals with different wavelengths into one combined signal through an optical fiber. There is a difference of 1.5 micrometer in wavelength between two multiplexed signals.

OS

Operations System - A central computer-based system that is used to provide operations, administration and maintenance functions.

OSB

Optical Splice Box

OSI

Open Systems Interconnection

OW

(Engineering) Order Wire

P

PABX

Private Automatic Branch eXchange

Paddle Board - Peripheral Control and Timing link (PB-PCT)

A small circuit board used in a 5ESS exchange for protection switching and optical to electrical conversion of the PCT-link.

Path

A logical connection between one termination point at which a standard format for a signal at the given rate is assembled and from which the signal is transmitted, and another termination point at which the received standard frame format for the signal is disassembled.

Path AIS

Path Alarm Indication Signal - A path-level code that is sent downstream in a digital network as an indication that an upstream failure has been detected and alarmed.

Path Overhead (POH)

The Virtual-Container Path Overhead provides integrity of communication between the point of assembly of a Virtual Container and its point of disassembly.

Path Terminating Equipment

Network elements in which the path overhead is terminated.

PC

Personal Computer

PCB

Printed Circuit Board

PCM

Pulse Code Modulation

PCT-link

Peripheral Control and Timing-link

PDH

Plesiochronous Digital Hierarchy

Peer OMS

An OMS at the other end of the peer-to-peer link.

Peer to Peer link

Connection between two OMSs with Geographic Redundancy. The link is used to co-ordinate the management of a network element. See also Geographic Redundancy.

Performance Monitoring (PM)

Measures the quality of service and identifies degrading or marginally operating systems (before an alarm is generated).

Peripheral Control and Timing Facility Interface (PCTFI)

A proprietary physical link interface that supports the transport of 21 * 2 Mbit/s signals.

PI

Physical Interface, Plesiochronous Interface

PIR

Peak Information Rate

PJE

Pointer Justification Event

Platform

Family of equipment and software configurations that are designed to support a particular Application.

Plesiochronous Network

A network that contains multiple subnetworks, each of which is internally synchronous and operates at the same nominal frequency, but the timing of any of the subnetworks may be slightly different at any particular instant.

PLL

Phase Lock Loop

PM

Performance Monitoring - Measures the quality of service and identifies degrading or marginally operating systems (before an alarm is generated).

PMA

Performance Monitoring Application

Pointer

An indicator whose value defines the frame offset of a virtual container with respect to the frame reference of the transport entity on which the Virtual Container is supported.

POTS

Plain Old Telephone Service

PP

Pointer Processing

PPC

Pointer Processor and Cross-connect

PPDE

Ethernet Dropped Frames due to errors

Primary OMS

An OMS that usually manages a network element. If the primary OMS fails, management of the network element is passed over to the secondary OMS. A network element should be provisioned normally on the primary OMS and then be configured for use on the secondary OMS. See also Geographic Redundancy.

Primary Reference Clock (PRC)

The main timing clock reference in SDH equipment.

Protected Domain

The protected domain for an OMS contains all the network elements for which this manager is the primary OMS and which are protected by another secondary OMS. See also Geographic Redundancy.

Protecting Domain

The protecting domain for an OMS contains all the network elements for which this manager is the secondary OMS. See also Geographic Redundancy.

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 equipment failures.

Provisioning

Assigning a value to a system parameter.

PSA

Partially Service Affecting

PSDN

Public Switched Data Network

PSF

Power Supply Filter

PSF-SIP

Power Supply Filter; originally designed for an Italian customer.

PSN

Packet-Switched Network

PSTN

Public Switched Telephone Network

PT

Protected Terminal Power-supply filter and Timing circuit pack

PVID

Port VLAN ID

Q **Q-LAN**

Thin Ethernet LAN (10BaseT) that connects the manager to gateway network elements so that management information can be exchanged between network elements and management systems.

QAF

Q-Adapter Function (in NE)

QoS

Quality of Service

Quality Level (QL)

The quality of the timing signal(s) that are provided to clock a network element. The level is provided by the Synchronization Status Marker which can accompany the timing signal. If the System and Output Timing Quality Level mode is “Enabled”, and if the signal selected for the Station-Clock Output has a quality level below the Acceptance Quality Level, the network element “squelches” the Station-Clock Output Signal, which means that no signal is forwarded at all. Possible levels are: - PRC (Primary Reference Clock) - SSU_T (Synchronization Supply Unit - Transit) - SSU_L (Synchronization Supply Unit - Local) - SEC (SDH Equipment Clock) - DUS (Do not Use for Synchronization).

R

RA

Regenerator Application

Radio Protection Switching system (RPS)

The main function of the RPS is to handle the automatic and manual switching from a main channel to a common protection channel in an N+1 system.

Radio Relay (RR)

A point-to-point Digital Radio system to transport STM-1 signals via microwaves.

RCU

Rigid Connect Unit

RCVR Data Distribution Unit (RCVR)

Radio Relay circuit pack that distributes of the protection channel and the low-priority traffic in the receiver side.

RDDU

RCVR Data Distribution Unit

RDI

Remote Defect Indicator. Previously known as Far End Receive Failure (FERF).

RDI

Ring Drop/Insert (Add-Drop)

RDSV

Running Digital Sum Violations

Receive-direction

The direction towards the cross-connect.

REGEN

Regenerator

Regenerator Loop

Loop in a network element between the Station Clock Output(s) and one or both Station Clock Inputs, which can be used to dejitterize the selected timing reference in network applications.

Regenerator Overhead Controller (ROC)

SLM circuit pack that provides user access to the SDH overhead channels at repeater sites.

Regenerator Section Termination (RST)

Function that generates the Regenerator Section Overhead (RSOH) in the transmit direction and terminates the RSOH in the receive direction.

REI

Remote Error Indication. Previously known as Far End Block Error (FEBE).

Relay Unit (RU)

Radio Relay circuit pack whose main function is to perform protection switching when the Alignment Switch in the demodulator unit is unable to perform protection switching.

Restore Timer

Counts down the time (in minutes) during which the switch waits to let the worker line recover before switching back to it. This option can be set to prevent the protection switch continually switching if a line has a continual transient fault. This field is greyed out if the mode is non-revertive.

Revertive Switching

In revertive switching, there is a working and protection high speed line, circuit pack, etc. When a protection switch occurs, the protection line, circuit pack, etc. is selected. When the fault clears, service reverts back to the original working line.

RF

Radio Frequency

RFI

Remote-Failure Indicator

RGU

ReGenerator Unit

Route

A series of contiguous digital sections.

RPS

Ring Protection Switching

RSOH

Regenerator-Section OverHead; part of the SOH.

RZ

Return to Zero

S

SA

Service Affecting Synchronous Adapter

SAI

Station Alarm Interface

SC

Square coupled Connector

SD

Signal Degrade

SDH

Synchronous Digital Hierarchy. Definition of the degree of control of the various clocks in a digital network over other clocks.

SDH-TE

SDH - Terminal Equipment

SEC

SDH Equipment Clock

Secondary OMS

Backup OMS for a network element should the primary OMS fail. A network element should be provisioned normally on the primary OMS and then be configured for use on the secondary OMS. See also Geographic Redundancy.

Section

A transport entity in the transmission media layer that provides integrity of information transfer across a section layer network connection by means of a termination function at the section layer.

Section Adaptation (SA)

Function that processes the AU-pointer to indicate the phase of the VC-3/4 POH relative to the STM-N SOH and assembles/disassembles the complete STM-N frame.

Section Overhead (SOH)

Capacity added to either an AU-4 or to an assembly of AU-3s to create an STM-1. Always contains STM-1 framing and can contain maintenance and operational functions. SOH can be subdivided into MSOH (multiplex section overhead) and RSOH (regenerator section overhead).

SEF

Support Entity Function (in NE)

Self-healing

A network's ability to automatically recover from the failure of one or more of its components.

Server

Computer in a computer network that performs dedicated main tasks that require generally sufficient performance. See also Client.

Service

The operational mode of a physical entity that indicates that the entity is providing service. This designation will change with each switch action.

Severely Errored Frame Seconds (SEFS)

A performance monitoring parameter.

Severely Errored Second (SES)

A second that has a binary error ratio. SES is used as a performance monitoring parameter.

Severity

See Alarm Severity

SFP

Small Form-Factor Pluggable Optics

SH

Short Haul

SHDSL

Single-pair high-speed Digital Subscriber Line

SI

Synchronous Interface

SIB

Subrack Interface Box

SLC

Subscriber Loop Carrier

SLM

Signal Label Mismatch

Smart Communication Channel (SCC)

An HDLC messaging channel between the SDH-TE and the 5ESS host node. Similar to the DCC messaging channels that are located in the STM-N section overhead.

SML

Service Management Level

SMN

SDH Management Network

SMS

SDH Management Subnetwork

SNC/I

SubNetwork Connection (protection) / Inherent monitoring

SNC/NI

SubNetwork Connection / Non Intrusive monitoring

SNR

Signal to Noise Ratio

Soft Windows

PC emulator package for HP platforms.

SOH

Section Overhead. Capacity added to either an AU-4 or to an assembly of AU-3s to create an STM-1. Always contains STM-1 framing and can contain maintenance and operational functions. SOH can be subdivided in MSOH (Multiplex Section OverHead) and RSOH (Regenerator Section OverHead).

SONET

Synchronous Optical Network

Space Diversity (SD)

Reception of the Radio signal via mirror effects on Earth.

SPB2M

Subrack Protection for 2 Mbit/s Board

Specification and Design Language (SDL)

This is a standard formal language for specifying (essentially) finite state machines.

SPI

SDH Physical Interface Synchronous-Plesiochronous Interface

Squelch Map

Traffic map for SLM Add-Drop Multiplexer network elements that contains information for each cross-connection in the ring and indicates the source and destination network elements for the low-speed circuit to which the cross-connection belongs. This information is used to prevent traffic misconnection in rings that have isolated network elements or segments. See also Cross-Connect Map.

SSM

Synchronization Status Marker

Standby

The operational mode of a physical entity that indicates that the entity is not providing service, but standby. This designation changes with each switch action.

Standby

The operational mode of a physical entity that indicates that the entity is not providing service but is on standby. This designation will change with each switch action.

Station Clock Input (SCI)

An external clock may be connected to a Station Clock Input.

Station Clock Output (SCO)

A clock signal that can be used for other systems.

STM

Synchronous Transport Module Building block of SDH.

STM

Synchronous Transport Module building block of SDH

STP

Spanning Tree Protocol

Stretched Ring (STRING)

An open ring in which each node is an Add-Drop Multiplexer. The end nodes operate with one equipped high-speed line.

STS

Synchronous Transport Signal; used in SONET.

STVRP

Spanning Tree with VPN Registration Protocol

Subnetwork

A group of interconnected/interrelated network elements. The most common connotation is an SDH network in which the network elements have Data Communications Channels (DCC) connectivity.

Supervisor

A user of the OMS application with Supervisor privileges. See also User Privilege.

Supervisory Unit (SU)

Radio Relay circuit pack that gives comprehensive supervision and control facilities to the user by collecting information from the Alarm Collection Units and Alarm Adapter Units.

SVCE

Service

Switch Receive Unit (SWR)

SLM circuit pack that provides the cross-connect in the receive direction between high speed line timeslots and low speed tributaries.

Switch Transmit Unit (SWT)

SLM circuit pack that provides the cross-connect in the transmit direction between high speed line timeslots and low speed tributaries.

Switching Module (SM)

An access module from the 5ESS switch.

Synchronization Supply Unit (SSU)

A circuit pack that recovers and reshapes the clock signal in order to filter out jitter. Local (SSU_L) and Transit (SSU_T) types are available.

Synchronous

The essential characteristic of time-scales or signals such that their corresponding significant instants occur at precisely the same average rate.

Synchronous Digital Hierarchy (SDH)

A hierarchical set of digital transport structures that is standardized for the transport of suitably adapted payloads over transmission networks.

Synchronous Equipment Management Function (SEMF)

Function that converts performance data and implementation-specific hardware alarms into object-oriented messages for transmission over the DCC and/or the Q-interface. The SEMF also converts object-oriented messages that are related to other management functions so that they can pass across the S reference points.

Synchronous Line Multiplexer (SLM)

A line multiplexer that is designed to multiplex VC-4 and STM-1 tributary port signals into STM-16 line port signals.

Synchronous Network

The synchronization of synchronous transmission systems with synchronous payloads to a master Network clock that can be traced to a single reference clock.

Synchronous Transport Module (STM)

The information structure that is used to support (section layer) connections in SDH.

System Administrator

A user of the computer system on which the OMS application can be installed. See also User Privilege.

System Controller (CTL)

ISM circuit pack that controls the configuration of an Intelligent Synchronous Multiplexer system.

System Controller (SC)

A circuit pack that controls and provisions all units. It also contains the data communication packet switch functionality that is necessary for routing of management information between network elements and their management system.

System Controller (SCT)

SLM Line Terminal and Regenerator network element circuit pack that provides the highest level of system control for the Synchronous Line Multiplexer system. The SCT circuit pack provides overall administrative control of the system. The SCT memory is included in the same one circuit pack.

System Controller (STC)

SLM Add-Drop Multiplexer network element circuit pack that provides the highest level of system control for the Synchronous Line Multiplexer system. The STC circuit pack provides overall administrative control of the system. The STC memory is provided by the MEM circuit pack.

System Controller (SYSCTL)

OLS circuit pack that provides the highest level of system control for the Optical Line System. The SYSCTL circuit pack provides overall administrative control of the system. The SYSCTL memory is provided by the SYSMEM circuit pack.

System Memory Unit (MEM)

SLM Add-Drop Multiplexer network element circuit pack that provides the highest level of system control for the Synchronous Line Multiplexer system. The MEM circuit pack provides memory support for the System Controller (STC) circuit pack.

System Memory Unit (SYSMEM)

OLS circuit pack that provides the highest level of system control for the Optical Line System. The SYSMEM circuit pack provides memory support for the SYSCTL circuit pack.

T

TCA

Threshold Crossing Alarm

TCP/IP

Transmission Control Protocol/Internet Protocol

TDEV

Timing DEViation

TDM

Timing Division Multiplexing

Template

A collection of parameters that define a specific network element configuration. A template gives the user the opportunity to configure parameters in a network element with a single operation. The

template is re-usable and allow the user to configure the parameters in many network elements in the same way. A set of default templates is provided, and the user can create new templates and edit or delete user-created ones. Note that a template is always associated with one specific network element type and can not be used for other network element types.

TERM

Terminal Multiplexer

TGU

Timing Generator Unit

TI

Timing Interface

TLM

TeLeMetry Unit

TLP

Terminal with Line Protection

TMN

Telecommunications Management Network

TPU-PCT

Tributary Port Unit - Peripheral Control and Timing link

TPU155

Tributary port Unit 155 Mbit/s

TPU2

Tributary port Unit 2 Mbit/s

Transmit-direction

The direction outwards from the cross-connect.

Trellis Code Modulation

A combined coding and modulation scheme for improving the reliability of a digital transmission system without increasing the transmitted power or the required bandwidth.

TRF

TRansFer unit

Tributary

A signal of a specific rate (2 Mbit/s, 34 Mbit/s, 140 Mbit/s, VC12, VC3, VC4, STM-1 or STM-4) that may be added to or dropped from a line signal.

Tributary Overhead Controller (TOC)

SLM circuit pack that allows access to the overhead bytes of the incoming tributary signal.

Tributary Overhead Controller (TOHCTL)

OLS circuit pack that allows access to the overhead bytes of the Supervisory channel.

Tributary Unit (TU)

An information structure that provides adaptation between the lower order path layer and the higher path layer. Consists of a VC-n plus a tributary unit pointer TU PTR.

Tributary Unit Pointer (TU PTR)

Indicates the phase alignment of the VC with respect to the TU in which it resides. The pointer position is fixed with respect to the TU frame.

TSA

Time Slot Assignment

TSI

Time Slot Interchange

TTP

Trail Termination Point

TUG

Tributary Unit Group

U

UAS

UnAvailable Seconds

ULDT

Ultra Long Distance Transmission

Unavailable Seconds

A performance monitoring parameter.

Uninterruptable Power Supply (UPS)

Allows connected computer equipment to gracefully shutdown and therefore prevents damage in the case of a power failure. Also absorbs dips in the power supply.

Universal Co-ordinated Time (UTC)

An indication of the time of an event that is independent of the time-zone in which the event occurred. The local time can be calculated from the Universal Co-ordinated Time.

Upgrade

An upgrade is the addition of new capabilities (feature). An upgrade requires new software and may require new hardware.

UPL

User PaneL

Upstream

At or towards the source of the considered transmission stream, i.e. in the direction that is opposite to the direction of transmission.

User Privilege

A permission of a user that allows to perform actions on the computer system on which the OMS application runs. The following different types of users are:

1. User Type: System Administrator; User name: root (fixed); Permissions: maintain platform.
2. User Type: Database Administrator; User name: informix (fixed); Permissions: maintain database.
3. User Type: ITM-SC System Administrator; User name: i2kadmin (fixed); Permissions: maintain ITM-SC application, maintain Network Element templates, maintain MEC files on the ITM-SC, set default ITM-SC parameters.
4. User Type: Supervisor; User name: free choice; Permissions: perform all data retrieval functions, perform all alarm suppression functions, perform configuration changes.
5. User Type: Operator; User name: free choice; Permissions: perform all data retrieval functions, perform all alarm suppression functions.

V

Value

A number, text string, or other menu selection that is associated with a parameter.

VCAT

Virtual Concatenation

VF

Voice Frequency

Virtual Container (VC)

Container with a path overhead.

VLAN

Virtual LAN

VPN

Virtual Private Network

W

Wait to Restore Time (WRT)

The time to wait before switching back after a failure has cleared in a revertive protection scheme. This time can be between 0 and 15 minutes, in increments of one minute.

WAN

Wide Area Network

Wander

Long term variations of amplitude frequency components (below 10 Hz) of a digital signal from their ideal position in time. Wander can result in buffer problems at a receiver.

WDM

Wavelength Division Multiplexing

What You See Is What You Get (WYSIWYG)

Information as displayed on the screen will appear in the same way on printed output.

Wideband Communications

Voice, data, and/or video communication at digital rates from 64 kbit/s to 2 Mbit/s.

Windows

Graphical User Interface on PC systems.

Working

Label attached to a physical entity. In the case of revertive switching the working line or unit is the entity that carry service under normal operation. In the case of non-revertive switching this label has no particular meaning.

WS

WorkStation

WSF

Work Station Facility

X **X-Terminal**

Workstation that can support an X-Windows interface

XMTR

Transmitter

XSU

XMTR Switch Unit

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