# Alcatel-Lucent

Small Cell | Release BCR 3.0

**HSPA System Definition Specification**

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Alcatel·Lucent

# Contents

# About this document

## Purpose

The purpose of this information product is to provide details of the feature.

The purpose of this information product is to provide details of the following features:

- HSDPA support (34523).
- HSUPA support (74762).
- Full rate HSPA support (113161).
- 64-QAM (116496), MAC-ehs and flexible RLC size (116497)
- 2 ms TTI on E-DCH (131828)

## Reason for reissue

| Issue number | Issue date | Reason for reissue |
|---|---|---|
| 3 | November 2012 | Standard |
| 2 | June 2012 | Standard |
| 1 | March 2012 | Standard |

## New in this release

This section details what is new in this document for Release 3.0

### Features

- 64-QAM (116496), MAC-ehs and flexible RLC size (116497), see Chapter 4, “64-QAM, MAC-ehs and flexible RLC size”
- 2 ms TTI on E-DCH (131828), see Chapter 5, “2 ms TTI on EDCH”

### Other changes

Editorial and formatting updates

## Intended audience

The primary audience for this document is personnel who work with the Small Cell in one of the following capacities:

- Network Operation and Maintenance Specialists.
- System Administrators.
- Engineers with responsibility for network planning, design, configuration, or optimization.

## Supported systems

This document applies to the 3.0 system release.

## How to use this document

Refer to this document for information on the HSDPA and HSUPA-related features.

## Prerequisites

None.

## Vocabulary conventions

None.

## Typographical conventions

No special conventions are used in this information product.

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# 1 HSDPA support

## Overview

### Purpose

This chapter describes the HSDPA support (34523) feature.

### Contents

# HSDPA support

## Feature number

Feature number 34523.

## Feature description

The Small Cell supports the establishment of a PS RAB on either HSDPA or DCH based on UE capability. If the UE is HSDPA capable, then the PS RAB is established on HSDPA.

HSDPA access is a service based on a pool of potentially high-throughput downlink channel resources shared between a group of users. A scheduler in the Small Cell serves users based on traffic, channel conditions, UE capability and QoS requirements. Techniques such as adaptive modulation and hybrid ARQ are introduced.

The Small Cell supports the following HSDPA-related functions:

- HSDPA user plane for HS-DSCH channels and flow control
- HSDPA air interface scheduler providing the requested quality of service performance
- MAC-hs scheduling
- QPSK and 16 QAM

The MAC layer of the Small Cell handles priority control of data flows. MAC-d and MAC-hs (in the baseband processor) interact to provide proper scheduling and priority control of data over HSDPA. The MAC-hs scheduler supports multiple MAC-d flows.

The HSDPA scheduler runs every TTI.

The Small Cell supports HSDPA terminals with categories 1 to 8, 11 and 12, subject to a peak data rate. The Small Cell ensures that the peak HSDPA rate provided to each terminal are compatible with their supported category and within the capacity of the baseband modem.

## Feature benefits

### Benefits for users

- Significant increase of user-perceived data throughput, which is needed to support multimedia services for cellular mobile communication systems
- Reduced delay in signaling and data transport as a result

### Benefits for service providers

- Improved capacity and efficiency
- Increased aggregated cell throughput

## Impacted systems

Small Cells Cluster

## Dependencies

| | |
|---|---|
| Hardware | Small Cell Standalone |
| Feature | None |
| Interworking | None |
| Devices | All 3GPP-compliant UE supporting HSDPA |
| Standards | 3GPP TS 25.308 UTRA High Speed Downlink Packet Access (HSDPA)<br>Overall description; Stage 2, V6.3.0 (2004-12) |
| | TS25.321 v6.3.0 |
| | TS25.331 v6.4.0 |

## Restrictions and limitations

None

## Engineering impacts

None

## Operational requirements

None

## Feature type

Basic

# HSDPA channels

## High speed channels

HSDPA uses 3 additional physical channels, in the DL HS-SCCH and HS-PDSCH, and in the UL HS-DPCCH. HSDPA data is transported in the HS-DSCH transport channel and, associated with this in a UL control channel, HS-DPCCH to carry uplink feedback signaling related to the downlink HS-DSCH transmission. HS-SCCH in the DL informs the UE that data is ready to be sent to it on HS-DSCH.

## Channelization codes

The Small Cell supports up to 10 channelization codes for HSDPA (regardless of the modulation scheme).

# Medium Access Control (MAC)

## MAC

MAC is a sub-layer of the Data link layer in the UTRAN Radio interface protocol stack. MAC provides services to its upper layer, RLC.

The services provided to the upper layer include:

- **Data transfer** - This service provides unacknowledged transfer of MAC SDUs between peer MAC entities. MAC also does scheduling based on the MAC logical channel priority. The data transfer service does not provide any data segmentation. Segmentation/reassembly function is provided by the upper layer.
- **Reallocation of radio resources and MAC parameters** - This service performs radio resource reallocation on request of the RRC. The service also provides change of MAC parameters, that is, re-configuration of MAC functions such as; change of identity of UE, change of transport format (combination) sets and change of transport channel type.
- **Reporting of measurements** - Local measurements such as traffic volume and quality indication are reported to the RRC.
- **Ciphering** - The ciphering function is performed in the MAC-d for CS voice radio bearer using the transparent RLC mode.

The MAC layer provides data transfer services on logical channels. A set of Logical Channel types is defined for different kinds of data transfer services as offered by MAC. Each logical channel type is defined by the type of information transferred.

The lower layer, that is the physical layer server, serves the MAC by providing the MAC with information transfer services.

## MAC-hs

Small Cell uses a MAC-hs entity to support HSDPA. MAC-hs is responsible for handling data transmitted on the HS-DSCH. Furthermore, the MAC-hs responsible for the management of the physical resources allocated to HSDPA. MAC-hs receives configuration parameters from the RRC layer through the MAC-Control SAP.

The MAC-hs performs the following functions:

- Priority Handling
- MAC-hs flow control
- Reordering buffer handling
- Provides service measurements

The MAC-hs scheduler, a part of the MAC-hs entity, performs the following functions for each user:

- Select which user to transmit
- For that user select the queue to transmit
- Assign TFRC & Tx power
- HARQ handling

### HSDPA Scheduler

The Small Cell HSDPA scheduler supports a Proportional Fail scheduling algorithm with modification to support QOS considerations, primarily, queue prioritization and guaranteed bit rate.

The Small Cell can support up to 4 priority queues per HSDPA user each with a HSDPA priority in the range 0-15. For release 2.1, a single priority queue is used for each HSDPA RAB. RABs with traffic class Interactive (1), (2) & (3) are allocated a HSDPA scheduling priority of 14, 13, 12 respectively and RABs with traffic class background are allocated a HSDPA scheduling priority of 11.

### HARQ

The HARQ Process is a peer state machine capable of achieving error correction by retransmission. The HARQ process keeps control of new transmissions and retransmissions. One process is used for each data block.

The HARQ Entity consists of all the HARQ processes of a UE, controlling all the available soft buffer capacity.

The HARQ Entity is located in the MAC-hs.

There is one HARQ entity per UE, which is capable of supporting multiple instances (HARQ process) of stop and wait HARQ protocols.

There is also one HARQ process per HS-DSCH per TTI.

Chase Combining and Incremental Redundancy are supported with selection of the HARQ scheme based on the UE category.

### RLC

The Small Cell supports a PDU size of 366 bits and 656 bits for PS RABs over HSDPA. Selection depends on UE cat and whether 656 bits is supported.

# HSDPA parameters

### Attributes of BSR class: HSDPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *activateHSDPA* | Feature activation control to enable/disable overall HSDPA functionality availability on the Small Cell. | boolean | |
| *hSDPADynamicPower-Enabled* | Determines whether the Enhanced HSDPA Power Management feature is activated or not. | boolean | |
| *hSDPAMeasurement-PowerOffset* | Power offset as described in TS 25.214 section 6A.2 for signal quality determination on CQI. | real | [-6.0..13.0], precision=1, unit=dB, step=0.5 |

### Attributes of CCPower class: HSDPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *hsdpaDynamicPwr-Headroom* | Specifies the HSDPA power allocation headroom percentage in steps of 0.1%. 0 = 0% 1000 = 100%. | uint16 | [0..1000] |

### Attributes of LCell class: HSDPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *support656bits RLCPDUUECategory* | Lists the HSDPA UE categories that support HSDPA RLC PDU size 656 bits. | sequence [0..12] of struct UECategory | {Category1, Category2,..., Category12} |
| *support656bits HSDSCHFlag* | Enables/disables the support of RLC-PDU 656 bits for HSDPA. | boolean | |

# 2 HSUPA support

## Overview

### Purpose

This chapter describes the HSUPA support (74762) feature.

### Contents

# HSUPA support

## Feature number

Feature number 74762.

## Feature description

HSUPA functionality was introduced in Release 6 of the 3GPP standard. It extends the R99 UL capability, providing a path to achieve more than 384 kbps, which was the limit of R99. It complements HSDPA, which was introduced in release 5 of the 3GPP standard to enhance DL packet rates (see TS25.309).

HSUPA provides higher data packet throughput in the UL, depending on the capability of the UE. It can also improve coverage and round-trip delays compared to R99 DCH. This is achieved through fast physical layer HARQ with incremental redundancy, low TTIs, and fast Node B scheduling.

HSUPA adds a new dedicated transport channel in the UL and 3 new grant channels in the DL. Spreading Factor SF2 and multicode is supported for the data channels. It also adds 2 new MAC entities with one MAC-e in the Node B and one MAC-es entity in the RNC.

Three newly defined UE categories for HSUPA (see TS25.306) are supported.

## Throughput

Two 2 x SF4 (E-DCH categories 1-3) are supported. Hence up to 4 users with an aggregate physical layer throughput of up to 1.45 Mbps are supported in the UL. When there is a simultaneous CS call, the aggregate throughput is 0.71 Mbps in the UL.

## Feature benefits

### Benefits for users

- Increased UL data rates for PS from the 384 kbps limit of R99.
- Improved coverage
- Improved round-trip delay

### Benefits for service providers

- Increased UL data rates for PS calls
- Support for Release 6 terminals

## Impacted systems

Small Cells Cluster

## Dependencies

| | |
|---|---|
| Hardware | Small Cell Standalone |
| Feature | None |
| Interworking | None |
| Devices | All 3GPP-compliant UE supporting HSUPA |
| Standards | 3GPP TS25.211, Physical Channels and Mapping of transport Channels onto Physical Channels (FDD), version 6.9.0, December 2007. |
| | 3GPP 25.212, Multiplexing and Channel Coding, version 6.10.0, December 2006. |
| | 3GPP 25.213, Spreading and Modulation (FDD), version 6.5.0, March 2006. |
| | 3GPP TS25.214, Physical Layer Procedures (FDD), version 6.11.0. December 2006. |
| | 3GPP TS25.306, UE Radio Access Capabilities, version 6.12.0, October 2007. |
| | 3GPP TS25.309, FDD Enhanced Uplink: Overall Description (Stage 2), version 6.6.0, April 2006. |
| | 3GPP TS25.321, Medium Access Control (MAC) protocol specification, version 6.15.0, March 2008. |
| | 3GPP TS25.331, Radio Resource Control (RRC) protocol, version 6.18.0, June 2008. |
| | 3GPP TS25.427, UTRAN Iur/Iub interface user plane protocol for DCH data streams, version 6.8.0, December 2006. |
| | 3GPP TS25.433, UTRAN Iub interface Node B Application Part (NBAP) signaling, version 6.17.0, June 2008. |
| | 3GPP TS25.993, Typical examples of Radio Access Bearers (RABs) and Radio Bearers (RBs) supported by Universal Terrestrial Radio Access (UTRA), version 6.15.0, December 2006. |

### Restrictions and limitations

The HSUPA data rate is limited by the spreading factor (2 x SF4i) supported.

### Engineering impacts

None

### Operational requirements

None

### Feature type

Optional

# HSUPA channels

## HSUPA transport channels

For HSUPA, 3GPP introduces one new transport channel E-DCH (Enhanced Dedicated Channel) in the UL.The transport channel E-DCH carries the user data in the uplink direction. It is associated with an uplink/downlink DPCH which carries the physical layer signaling, for example, higher layer signaling and UL power control. In the UL this can be mapped to E-DCH. The baseband supports the E-DCH transport Channel with 10 ms TTIs.

# Medium Access Control

## MAC entities

Two new Medium Access Control (MAC) entities are introduced for HSUPA:

- MAC-e functionality
- MAC-es functionality

As soft handover is not supported on the Small Cell, the MAC-es functionality does not need to combine MAC-es PDUs.

## Small Cell MAC architecture

Only one MAC-e PDU can be transmitted in one TTI. If there is sufficient space, or if scheduling information needs to be transmitted, then an SI of length 18 bits is included at the end of the MAC-e PDU.

A MAC-e PDU consists of multiple MAC-es PDUs from different MAC-d flows. In a single MAC-es there can be several MAC-d PDUs of the same size coming from the same logical channel.

Each MAC-es has the following:

- a transmission sequence number (TSN) (6 bits)
- a DDI field (6 bits)
- the number of MAC-d PDUs, N (6 bits)

## MAC-e functionality

MAC-e functionality includes:

- E-DCH Scheduling – This manages the E-DCH cell resources between UEs. Based on scheduling requests, scheduling grants are transmitted.
- E-DCH control – This is reception of the scheduling requests and transmission of the scheduling grants to the individual users
- De-multiplexing – MAC-e PDUs are de-multiplexed and forwarded as MAC-es PDUs to the associated MAC-d flow.
- HARQ – This handles all the tasks associated with the HARQ protocol and is responsible for ACK/NACK generation.

### MAC-es functionality

MAC-es functionality includes:

- Reordering Queue Distribution – MAC-es PDUs are routed to the correct reordering buffer.
- Reordering – MAC-es PDUs are reordered according to the received TSN. MAC-es PDUs with consecutive TSNs are delivered to the disassembly function. There is one reordering queue per logical channel.
- Disassembly – the MAC-es header is removed and the MAC-d PDUs are extracted and delivered to MAC-d
- Macro Diversity selection – This is not required for the Small Cell.

### HARQ

The HARQ functionality is similar to HARQ for HSDPA , but in the UL. Unlike HSDPA, it is synchronous. HARQ involves the terminal buffering of MAC-e PDUs and retransmitting them when a NACK is received from the Small Cell.

Incremental redundancy is supported by the HARQ process.

# HSUPA parameters

### Attributes of BSR class: HSUPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *activateEDCH* | Flag to activate/deactivate HSUPA feature. If set to TRUE, E-DCH is activated in the cell. If set to FALSE, E-DCH is deactivated. | boolean | |
| *rABCommitLatency-DeltaRBSetupRe-leasePsEdch* | Specifies the delta in frames added to *rABCommitLatencyTime* during a Radio Bearer Setup Procedure and Radio Bearer Release Procedure. This is performed with PS RAB(s) involving E-DCH. | integer | (-256..256) |
| *rABCommitLatency-DeltaRBSetupRe-leasePsEdchCs* | Specifies the delta in frames added to *rABCommitLatencyTime* during a Radio Bearer Setup Procedure and Radio Bearer Release Procedure. This is performed with both CS and PS RABs where the PS RAB involves E-DCH. | integer | (-256..256) |

### Attributes of CCPower class: HSUPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *hsdpaAndEdchTotalD-Lpower* | Specifies the maximum value for the linear sum of the power of all the HS-PDSCH, HS-SCCH, E-HICH, E-AGCH and E-RGCH codes used in a cell.<br>If Transmit Diversity is applied to one downlink physical channel, the power to be considered for this downlink physical channel is the linear sum of the power used for this downlink physical channel on all branches.<br>The Node B always allocates the minimum between the power that is not used for DCH and common channels and *HsdpaAndEdchTotalD-Lpower*.<br>*Note:* In NBAP, this is expressed in absolute dBm terms. With Pico chip it means dB relative to the CPICH power. | real | [0.0..50.0], unit=dB, step=0.1, precision=1 |

### Attributes of EDCH class: HSUPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *maxEdchUsersPerCell* | Specifies the maximum number of users that the Small Cell assigns to E-DCH. | uint16 | [0..4] |
| *maxULNoiseRiseEdch* | Specifies the E-DCH target uplink noise rise, which the E-DCH scheduler takes as the upper limit.<br>If the current uplink noise rise is higher, the scheduler reduces some E-DCH services for that cell. | uint16 | [0..50], unit=dB |

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *eDCHminNoiseFloor* | Specifies a lower bound on the noise floor, which is sent in the Reference Received Total Wide Band Power IE in the Physical Shared Channel Reconfiguration Procedure. | real | [-112.0..-50.0], step=0.1,unit=dB, precision=1 |
| *eDCHmaxNoiseFloor* | Specifies an upper bound on the noise floor, which is sent in the Reference Received Total Wide Band Power IE in the Physical Shared Channel Reconfiguration Procedure | real | [-112.0..-50.0], step=0.1,unit=dB, precision=1 |
| *eAGCHpowerOffset* | Indicates the power offset relative to the pilot bits on the DL DPCCH. This IE is signaled when the OAM parameter *eDCHdlPowerOffsetsSignalled* is set to TRUE, otherwise it is omitted. | real | [-32.00..31.75], step=0.25, unit=dB, precision=2 |
| *eRgchHichPowerOffset* | Sets both the HICH and RGCH power offset signaled in the Physical Shared Channel Reconfiguration. The *eRgchHichPwrOffset* IE indicates the power offset relative to the pilot bits on the DL DPCCH of the HICH and RGCH. This IE is signaled when the OAM parameter *eDCHdlPowerOffsetsSignalled* is set to TRUE, otherwise it is omitted. | real | [-32.00..31.75], step=0.25, unit=dB, precision=2 |
| *maxEdchULBW* | Specifies the maximum bandwidth on backhaul available for E-DCH traffic in kbps. This attribute is relevant on Small Cell to limit the uplink bandwidth for E-DCH users on Uu interface. The value '0' indicates that the value is auto-configured. | integer | [0..10000], unit=kbps |
| *edchBWCorrectionFactor* | Specifies an additional correction factor for the total calculated bandwidth limit forwarded to the MAC-e scheduler. | integer | [10..1000], unit=percent |

## Attributes of EDCHMACdFlow class: HSUPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *eDCHMACdFlowHARQPO* | Specifies the E-DCH HARQ power offset for the MAC-d flow. | uint16 | [0..6] |
| *eDCHMACdFlowMaxRet* | Specifies the maximum number of E-DCH HARQ retransmissions to be performed by the UE for the MAC-d flow. | uint16 | [0..15] |
| *eDCHMACdFlowSIRstepThr1* | Provides a table containing the SIR step size values for the uplink outer loop power control function for the adaptive HARQ control algorithm related to the EDCH MAC-d flow when the number of E-DCH users is less than or equal to *maxNumActiveEdchUsersPerCellForThr1*. | struct EDCHMACdFlowSIRstepThr | |
| *eDCHMACdFlowSIRstepThr2* | Provides a table containing the SIR step size values for the uplink outer loop power control function for the adaptive HARQ control algorithm related to the EDCH MAC-d flow when the number of E-DCH users is greater than *maxNumActiveEdchUsersPerCellForThr1* and less or equal to *maxNumActiveEdchUsersPerCellForThr2*. | struct EDCHMACdFlowSIRstepThr | |
| *eDCHMACdFlowSIRstepThr3* | Provides a table containing the SIR step size values for the uplink outer loop power control function for the adaptive HARQ control algorithm related to the EDCH MAC-d flow when the number of users is greater than *maxNumActiveEdchUsersPerCellForThr2*. | struct EDCHMACdFlowSIRstepThr | |
| *maxNumActiveEdchUsersPerCellForThr1* | Specifies the maximum number of active E-DCH users per cell to use OAM structure *eDCHMACdFlowSIRstepThr1* for outer loop power control. | uint16 | [1..4], step=1 |

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *maxNumActiveEdchUsersPerCellForThr2* | Specifies the maximum number of active E-DCH users per cell to use OAM structure *eDCHMACdFlowSIRstepThr2* or *eDCHMACdFlowSIRstepThr3* for outer loop power control.<br>If the number of users is greater than *eDCHMACdFlowSIRstepThr1* but less or equal to *maxNumActiveEdchUsersPerCellForThr2* then *eDCHMACdFlowSIRstepThr2* is used.<br>If the number of users is greater than *maxNumActiveEdchUsersPerCellForThr2* then *eDCHMACdFlowSIRstepThr3* is used. | uint16 | [1..4], step=1 |

### Attributes of ETFCS class: HSUPA support

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *eDPCCHPowerOffset* | Specifies the power offset of the E-DPCCH to the DPCCH.<br>Refers to quantization of the power offset as per Table 1B of 25.213 | uint16 | [0..8] |
| *eTFCtable* | Indicates a list of ETFC and power offset for the UE and Node B to base its transport MAC-es block selection calculation. | sequence [1..8] of struct ETFCtable | |
| *eRGCH2StepThreshold* | Refers to an index in the "SG-Table" (see 25.321) to the ratio of E-DPDCH to DPCCH for transmission in the previous TTI. Where if lower than this, but greater than or equal to *eRGCH3StepThreshold*, an E-RGCH command of UP results in an increase of 2 steps.<br>If greater than equal to *eRGCH2StepThreshold*, results in an increase of one step. | uint16 | [0..37] |

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *eRGCH3StepThreshold* | Refers to an index in the "SG-Table" (see 25.321) to the ratio of E-DPDCH to DPCCH for transmission in the previous TTI. Where if lower than this, an E-RGCH command of UP results in an increase of 3 steps. | uint16 | [0..37] |
| *happyBitDelay* | Specifies the happy bit delay (25.321 11.8.1.5). | enum EDCHhappyBitDelay | |
| *punctureLimit* | Puncturing limit used in rate matching and transport block selection for E-DCH. | real | [0.44..1.00], precision=2, step=0.04 |
| *schedulingNoGrantPeriodicity* | Specifies the periodicity for Scheduling Info when there is no grant to the UE. | enum EDCHschedulingPeriod | |
| *schedulingGrantPeriodicity* | Specifies the periodicity for Scheduling Info when there are grants to the UE. | enum EDCHschedulingPeriod | |
| *schedulingPowerOffset* | Specifies the power offset for Scheduling Info. Only used when no MACd PDUs are included in the same MACe PDU. Unit is in dB. | uint16 | [0..6],unit=dB |
| *eDCHreferencePowerOffset* | The E-DCH Reference Power Offset is used to estimate the E-DPDCH power from E-TFCI without decoding MAC-e PDUs as defined in 25.213 4.2.1.3.<br>If included in NBAP, the Node B uses this value as a default HARQ power offset if it is not able to decode the MAC-e PDU and to determine the value of the actual HARQ power offset.<br>It is populated in NBAP IE E-DCH Reference Power Offset. A value of -1 indicates that the IE is omitted. Values of 0..6 indicates that the IE is included and set as per the OAM parameter. | integer | [-1..6] |

# 3 Full rate HSPA

## Overview

### Purpose

This chapter describes the Full rate HSPA (113161) feature.

### Contents

# Full Rate HSPA

## Feature number

Feature number 113161.

## Feature description

This feature provides the following capabilities to the supporting platforms:

- Support for high rate HSDPA.
- Support for higher E-DCH rates.

The higher rates apply to both the user and the cell throughput.

## Feature benefits

### Customer/Service Provider Benefits

Higher data rates to offer the consumer.

### End-User / Subscriber Benefits

Higher data rates when the subscriber has a suitable UE terminal and sufficient backhaul bandwidth.

## Impacted systems

Small Cell

## Dependencies

For full rate CAT9 and CAT10 HSDPA performance, 15 codes are required. This is achieved through the dynamic code allocation feature (77024), and when there is a single user in the system.

## Restrictions and limitations

- High speed E-DCH and HSDPA is provided, only on the hardware platforms supporting the features.
- Only UEs supporting the E-DCH and HS-DSCH categories can support the features.
- The high speeds will require backhaul dimensioned to support the required data rates.
- High speed E-DCH are enabled only in isolated cell configurations.
- The high speeds require TCP/IP tuning on the devices, to achieve the maximum rates.

## Engineering impacts

None

## Operational requirements

None

## Feature type

Basic

# Overview

## Full rate HSPA overview

Feature 113161 introduces support for higher UL data rates on E-DCH and higher DL data rates on HSDPA.

Support for these higher rates requires:

- Small Cell hardware platform support
- The feature enabled
- Up to Category 10 HSDPA and Category 5 E-DCH UE support
- High bandwidth backhaul support
- Good RF conditions
- TCP/IP tuning on the PC
- Feature 77024, Dynamic code allocation, enabled

# Principles

### E-DCH

A set of rules are defined for the allocation of the high speed E-DCH rates. These rules are broadly based upon the following factors:

- Hardware capability of the high rate E-DCH
- OAM feature switch *BSR::eDCHmaxCatPerf,* enabling the higher performance.
- RAB Assignment Requested rate requesting the higher rate.
- UE E-DCH category support.
- OAM parameter *EDCH::maxEdchCellRate,* being high enough to deliver higher performance.

  **Note:**

  - High rate E-DCH must not be enabled in all deployments, as there are uplink interference considerations, which must be applied when the Small Cell neighbors other cells.
  - Also, residential ADSL deployments do not generally support rates higher than 1.4 Mb/s today.

### HSDPA

The HSDPA is activated with the following factors:

- Hardware capability of the high rate HSDPA.
- OAM parameter *HSPDA::maxHsdpaUserRate*, set to a high value.
- UE HS-DSCH category support.
- RAB Assignment Request with a maximum bit rate, to support the high speed.

The HSDPA can be more widely used than a high speed E-DCH, as the downlink does not suffer from the same interference issues. And the downlink backhaul can be faster even in a residential environment.

# Configuration Management

## Parameters

| Parameter | MOC/Type | Interface | Syntax | Default | Description |
|---|---|---|---|---|---|
| eDCHmax CatPerf | EDCH | bulkcm, Preprovision | Int 1...5 | 3 | Determines the maximum E-DCH UE category performance which can be supported, capped to the maximum capability of the Small Cell platform. |
| maxEdch CellRate | EDCH | bulkcm, Preprovision | [0-6000], kbps, step 1 | 5740 | Maximum UL cell throughput for E-DCH, capped by the platform capability. |
| maxHsdpa UserRate | HSDPA | bulkcm, Preprovision | [0-20000], kbps, step 1 | 14000 | Maximum DL user throughput for HSDPA, capped by the platform capability. |

# 4 64-QAM, MAC-ehs and flexible RLC size

## Overview

### Purpose

This chapter describes the 64-QAM, MAC-ehs and flexible RLC size features (116496 and 116497).

### Contents

# 64-QAM for HSDPA and Flexible RLC and MAC-ehs support

## Feature number

Feature numbers 116496 and 116497.

## Feature description

Feature 116496 supports 64-QAM modulation for HSDPA. When used with MAC-ehs and flexible RCS sizes (feature 116497) in ideal radio conditions, theoretical over-the-air data rates of up to 21.6 Mbps can be achieved by UEs of category 14 and 18. (Support for UEs of category 13 and 17 will be configured when such UEs are available.)

The feature depends on the baseband device supporting 64-QAM, MAC-ehs and flexible RLC sizes.

## Feature benefits

### Customer/Service Provider Benefits

New HSDPA DL service offering higher data rates.

### End-User / Subscriber Benefits

Higher DL data rates when the subscriber has a suitable UE terminal and sufficient backhaul bandwidth.

## Impacted systems

- Small Cell
- Small Cell Management System

## Dependencies

Features 116496 and 116497 are dependent on the following features:

- Feature 77024 – Dynamic Code Allocation
- Feature 113161 – Full Rate HSDPA (includes HS-DSCH flow control based on credits)
- Feature 100888 – Inter-frequency Femto to 3G Handover
- Feature 101684 – 3G Macro to Femto PS and CS+PS Handover

## Restrictions and limitations

- 64QAM/MAC-ehs does not apply to V1 boards.
- 64QAM is supported on V2 boards for Enterprise Cells and Metro Cells only.

- Peak 64QAM rates are reduced when in combination with simultaneous CS voice and CS data calls.
- Peak 64QAM rates can only be supported in good radio conditions and in isolated cells where interference is limited and no constraints exist on the DL backhaul.

### Engineering impacts

None

### Operational requirements

None

### Feature type

Optional

# Principles

## Introduction

64-QAM and MAC-ehs are new features introduced in 3GPP Release 7 that allow higher throughputs for HSDPA. Achievable over-the-air rates depend on the UE category and radio conditions and can be up to 21.6 Mbps at 3GPP release 7. MAC-ehs is a prerequisite for 64-QAM.

Support for flexible RLC sizes is also a 3GPP release 7 feature and together with 64-QAM and MAC-ehs ensures that high data rates can be achieved. Flexible RLC can only be used with MAC-ehs.

## Baseband

For the baseband device supporting 64QAM the following is supported:

| Small Cell Type | Board | No. of users | HSDPA flow control | MAC sup-port | RLC Size | Modulation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | QPSK | 16QAM | 64QAM |
| Enter-prise / Metro | V2 | Up to 32 | Credits | MAC-ehs from release 7 | Flexible only | Y | Y | Y |

The baseband device is responsible for the 64-QAM modulation and MAC-ehs, with support for flexible RLC sizes. The baseband device is responsible for layer 1 channel formatting in support of 64-QAM and the selection of modulation depending on the CQI values received from the UE. New CQI tables are implemented in the baseband device for 64-QAM. The baseband device provides an extended layer 1 Interface to support 64QAM.

The baseband device selects the modulation scheme and schedules the DL transmission depending on radio conditions and the sizes of the queues.

## Call processing

If the 64-QAM feature is not activated, then the Small Cell will continue to support QPSK and 16QAM modulation with MAC-hs for HSDPA. MAC-ehs will not be enabled and flexible RLC sizes will not be supported. Only fixed RLC PDU sizes 320 bits and 640 bits will be supported. Only UE categories up to 12 will be supported.

If the 64-QAM feature is activated, then the Small Cell supports DL 64-QAM with 16-QAM and QPSK modulation and MAC-ehs for HSDPA. 64-QAM/MAC-ehs is allowed if the underlying baseband device and the UE category supports 64-QAM/MAC-ehs. Flexible RLC sizes are supported, with MAC-ehs added to achieve the higher data rates. UE categories 13, 14, 17, 18, 19 and 20 are supported.

64-QAM is allowed for interactive/background PS RABs on HSDPA under the following conditions:

- The 64-QAM feature is activated
- The Small Cell is HSDPA enabled
- Full Rate HSDPA is enabled (Feature 113161)
- The UE supports MAC-ehs
- The UE is category 13, 14, 17, 18, 19 or 20
- Platform supports 64-QAM and MAC-ehs
- The maximum allowable HSDPA DL configurable throughput is greater than 14 Mbps
- The UE is positioned at the centre of the cell

If these conditions are met, and the PS RAB is for 64QAM, then flexible RLC sizes are used.

### Assumptions

The system must be tuned to achieve optimum data rate performance.

### Performance counters

This feature uses the following performance counters:

- RRC.SuccRRCConnEstab64QAMCapUE
- RAB.AttEstab64QAMPS.sum
- RAB.SuccEstab64QAMPS.sum

# 64-QAM parameters

### Attributes of class HSDPA

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *enable64QAMFlag* | Enables the feature. | boolean | |
| *rLCLengthIndicatorSize* | Specifies the length of RLC frames in bits. | enum RLCLengthIndicatorSize | 7bit<br>15bit |
| *support1296bitsOrFlexibleRLCPDUUECategory* | Lists the HSDPA UE categories that support HSDPA RLC PDU size 1296 bits, or Flexible size when using 64-QAM. | sequence [0..20] of struct UECategory | 14<br>18 |
| *maxHsdpaUserRate* | Specifies the maximum DL user throughput for HSDPA, capped by the capabilities of the platform. | uint16 | [0..42000]<br>unit=kbps |

# 5 2 ms TTI on EDCH

## Overview

### Purpose

This chapter describes the 2 ms TTI on EDCH (131828) feature.

### Contents

# 2ms TTI on E-DCH

## Feature number

Feature number 131828.

## Feature description

Feature b131828 introduces the ability to support higher UL data rates on E-DCH. Support for the higher rates requires the following:

- Small Cell Hardware platform support
- The feature enabled
- UE category support (See the tables below)
- High bandwidth backhaul support
- Good RF conditions
- Optimized TCP/IP, RoT and OLPC settings

The following table (derived from 3GPP TS25.306 Rel-6) describes the E-DCH capabilities of the different terminal types. Prior to this feature, the maximum supported E-DCH was the Category 5 UE 2xSF2 option. The **highlighted** values in the table show the additional higher rate UE E-DCH options that this feature enables.

| E-DCH UE category | Minimum spreading factor | Support for 10 ms and 2 ms TTI E-DCH |
|---|---|---|
| 1 | 1xSF4 | 10 ms |
| 2 | 2xSF4 | 10 ms |
| 3 | 2xSF4 | 10 ms |
| 4 | 2xSF2 | 10 ms |
| | | **2 ms** |
| 5 | 2xSF2 | 10 ms |
| 6 | 2xSF2+2xSF4 | **10 ms** |
| | | **2 ms** |

## Feature benefits

### Service provider benefits

Higher UL data rates and lower latency.

### End user / subscriber benefits

Higher data rates and lower latency for a single user when the subscriber has a capable UE terminal and sufficient backhaul bandwidth.

## Impacted systems

- Small Cell

## Dependencies

Feature 131828 is dependent on the following features:

- Feature 113430 – V2-AI-1 - 1900 MHz / 850 MHz 16 user Enterprise Cell
- Feature 104831 – 16 user capacity for Enterprise Cell
- Feature 104830 – V2-AE-1- 1900 MHz / 850 MHz Enterprise Cell
- Feature 104829 – V2-AC-1 - DNI 1900 MHz / 850 MHz Standalone Small Cell
- Feature 104828 – V2-AC-0 - Sagem 1900 MHz / 850 MHz Standalone Small Cell
- Feature 103280 – V2-EE-1 - 2100 MHz Enterprise Cell
- Feature 103279 – BCR2.4 software porting on V2 Metro/Enterprise platform
- Feature 103277 – BCR2.4 software porting to V2 Consumer Small Cell platform

## Restrictions and limitations

- High speed E-DCH and HSDPA are only provided on hardware platforms supporting these features.
- Only UEs supporting the E-DCH and HS-DSCH categories can support the feature.
- The high speeds require backhaul dimensioned to support the required data rates.
- High speed E-DCH should only be enabled in isolated cell configurations.
- Alcatel-Lucent recommends that in scenarios where the Small Cell has neighbors that are other cells, high rate E-DCH should only be enabled when BCR3.0 Feature b116495 (UL Interference Management) is also enabled. Feature b116495 [R.8] helps mitigate potential UL interference race conditions.
- Residential ADSL deployments do not currently generally support rates higher than 1.4Mbps.

## Feature type

Basic

# Principles

### E-DCH

A set of rules is defined for the allocation of the high speed E-DCH rates. These rules are broadly based on the following factors:

- Hardware capability of the high rate E-DCH
- The following OAM feature switches enabling higher performance:
  - *BSR::eDCH2msActivation*
  - *BSR::eDCH2msMaxUser*
  - *BSR::eDCHmaxCatPerf*
- RAB Assignment Requested rate requesting the higher rate
- UE E-DCH category support
- OAM parameter *EDCH::maxEdchCellRate,* being high enough to deliver higher performance

# 2ms TTI on EDCH parameters

### Attributes of class BSR

| Parameter | Description | Syntax | Values |
|---|---|---|---|
| *sparePara35* | This attribute specifies the following values:<br>• **eDCH2msMaxUser** – specifies the maximum number of users for E-DCH 2ms TTI.<br>This parameter is only applied when *eDCH2msActivation* = TRUE. If the user does not set this, the Small Cell assumes a default value of 2.<br>After the limit has been reached, additional 2 ms TTI capable E-DCH users will be downgraded to 10 ms TTI.<br>• **maxUser302** – PC302-specifies the maximum number of 2ms TTI users supported.<br>• **maxUser333** – PC333-specifies the maximum number of 2 ms TTI users supported.<br>• **Cap302** – specifies the PC302-specific EDCH scheduler maximum bitrate (ETFC) limit.<br>• **Cap333** – specifies the PC333-specific EDCH scheduler maximum bitrate (ETFC) limit.<br>• **allowSimB** – forces PS to 10 ms when CS is present.<br>• **allowHI** – forces PS to 10 ms when hand-in occurs. | eDCH2msMaxUser =<value> | range [1..32] |

Changes made to these parameters while the Small Cell is still operating will only take effect after the Small Cell has been reset.

# Glossary

**Numerics**

**3G**
Third-generation wireless
Used to describe technologies such as UMTS and CDMA-2000 that support both voice channels and higher-capacity data channels.
Also used to describe products that support these technologies.

**3GPP**
Third Generation Partnership Project

**A**

**Ack**
Acknowledge

**B**

**BSR**
Base Station Router

**C**

**CQI**
Channel Quality Information

**CS**
Circuit Switched

**D**

**DBC**
Dynamic Bearer Control

**DCH**
Dedicated Channel

**DL**
Downlink

**DPCCH**
Dedicated Physical Control Channel

**DSCH**
Downlink Shared Channel

**H**

**HARQ**
Hybrid Automatic Repeat Request

**HS-DPCCH**
High Speed Dedicated Physical Control Channel

**HS-DSCH**
High Speed Downlink Shared Channel

**HS-PDSCH**
High Speed Physical Downlink Shared Channel

**HSDPA**
High Speed Downlink Packet Access

**HSPA**
High Speed Packet Access

**I**

**IE**
Information Element

**M**

**MAC**
Medium Access Control

**MAC-d**
Medium Access Control - dedicated

**MAC-hs**
Medium Access Control - high speed

**N**

**NACK**
Negative Acknowledgment

**NBAP**
Node B Application Part

**P**

**PDU**
Packet Data Unit

**PS**
Packet Switched

**Q** **QAM**
Quadrature Amplitude Modulation

**QPSK**
Quaternary Phase Shift Keying

**R** **RAB**
Radio Access Bearer

**RLC**
Radio Link Control

**RRC**
Radio Resource Control

**RTT**
Round Trip Time

**S** **SDU**
Service Data Unit

**SF**
Spreading Factor

**T** **TFRC**
Transport Format Resource Combination

**TS**
Technical Specification

**TTI**
Time Transmission Interval

**TX**
Transmitter, Transmit side

**U** **UE**
User Equipment

**UL**

Uplink

**UMTS**

Universal Mobile Telecommunication System

**UTRAN**

UMTS Terrestrial Radio Access Network

**W** **W-CDMA**

Wideband - Code Division Multiple Access

# Index