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*Technical Specification*

**3rd Generation Partnership Project;  
Technical Specification Group Radio Access Network;  
High Speed Downlink Packet Access (HSDPA);  
Overall description;  
Stage 2  
(Release 5)**

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Keywords

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UMTS, data, stage 2

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# Foreword

This Technical Specification has been produced by the 3<sup>rd</sup> Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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- z the third digit is incremented when editorial only changes have been incorporated in the document.

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# 1 Scope

The present document is a technical specification of the overall support of High Speed Downlink Packet Access in UTRA.

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 25.855: "High Speed Downlink Packet Access (HSDPA): Overall UTRAN Description".

[2] 3GPP TS 25.321: "Medium Access Control (MAC) protocol specification".

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# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

**Data block:** The data transmitted to one UE on HS-DSCH in one TTI.

**Priority class:** One flow of data within a HS-DSCH transport channel. One HS-DSCH can transport several priority classes (only one priority class per TTI).

**HARQ Process:** Peer state machines capable of achieving error correction by retransmission. One process can be used only for one data block at a time.

**HARQ Entity:** Consists of all the HARQ processes of a UE, controlling all the available soft buffer capacity.

**Serving HS-DSCH radio link:** The radio link that the HS-PDSCH physical channel(s) allocated to the UE belongs to.

**Serving HS-DSCH cell:** The cell associated with the UTRAN access point performing transmission and reception of the serving HS-DSCH radio link for a given UE. The serving HS-DSCH cell is always part of the current active set of the UE.

**Serving HS-DSCH Node B:** A role a Node B may take with respect to a UE having one or several HS-PDSCHs allocated. The serving HS-DSCH Node B is the Node B controlling the serving HS-DSCH cell.

**HS-SCCH set:** a set of HS-SCCH which is used for HS-PDSCH allocation. There is a maximum of four HS-SCCHs in a given HS-SCCH set. There can be multiple HS-SCCH sets in one cell. HS-SCCH sets are independent, i.e. they can overlap or have no intersection.

**Serving HS-SCCH set:** the HS-SCCH set being used by a given UE for HS-PDSCH allocations.

**MAC-d flow:** a MAC-d flow is a flow of MAC-d PDUs which belong to logical channels which are MAC-d multiplexed.

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

16QAM	16 Quadrature Amplitude Modulation
CCTrCH	Coded Composite Transport Channel
CQI	Channel Quality Indicator
HARQ	Hybrid Automatic Repeat Request
HSDPA	High Speed Downlink Packet Access
HS-DSCH	High Speed Downlink Shared Channel
HS-PDSCH	High Speed Physical Downlink Shared Channel
HS-SCCH	Shared Control Channel for HS-DSCH
HS-SICH	Shared Information Channel for HS-DSCH
MCS	Modulation and Coding scheme
NW	Network
QPSK	Quadrature Phase Shift Keying
TFCI	Transport Format Combination Indicator
TFRC	Transport Format Resource Combination
TFRI	Transport Format and Resource Indicator
TPC	Transmit Power Control
TSN	Transmission Sequence Number
UE	User Equipment

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## 4 Background and Introduction

High Speed Downlink Packet Access is based on techniques such as adaptive modulation and hybrid ARQ to achieve high throughput, reduce delay and achieve high peak rates.

It relies on a new type of transport channel, the HS-DSCH, which is terminated in the Node B. HS-DSCH is applicable only to PS domain RABs.

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## 5 Basic structure of HS-DSCH

### 5.1 Protocol structure

The HS-DSCH functionality should be able to operate in an environment where certain cells are not updated with HS-DSCH functionality. The PDCP, RLC and MAC-d layers are unchanged from the Release '99 and Release 4 architecture.

RLC can operate in either AM or UM mode (but not in TM mode due to ciphering).

PDCP can be configured either to perform or not to perform header compression.

MAC-d is retained in the S-RNC. Transport channel type switching is therefore feasible.

The new functionalities of hybrid ARQ and HS-DSCH scheduling are included in the MAC layer. In the UTRAN these functions are included in a new entity called MAC-hs located in Node B. The transport channel that the HS-DSCH functionality uses is called HS-DSCH (High Speed Downlink Shared Channel) and is controlled by the MAC-hs.

Two MAC protocol configurations are possible on the UTRAN side:

- Configuration with MAC-c/sh: In this case, the MAC-hs in Node B is located below MAC-c/sh in CRNC. MAC-c/sh shall provide functions to HS-DSCH identical to those provided for the DSCH in the Release '99. The HS-DSCH FP (frame protocol) will handle the data transport from SRNC to CRNC (if the Iur interface is involved) and between CRNC and the Node B.

- Configuration without MAC-c/sh: In this case, the CRNC does not have any user plane function for the HS-DSCH. MAC-d in SRNC is located directly above MAC-hs in Node B, i.e. in the HS-DSCH user plane the SRNC is directly connected to the Node B, thus bypassing the CRNC.

Both configurations are transparent to both the UE and Node B. Figures 5.1-1 and 5.1-2 show the respective radio interface protocol architecture with termination points for the above two configurations.

The same architecture supports both FDD and TDD modes of operation, though some details of the associated signalling for HS-DSCH are different.

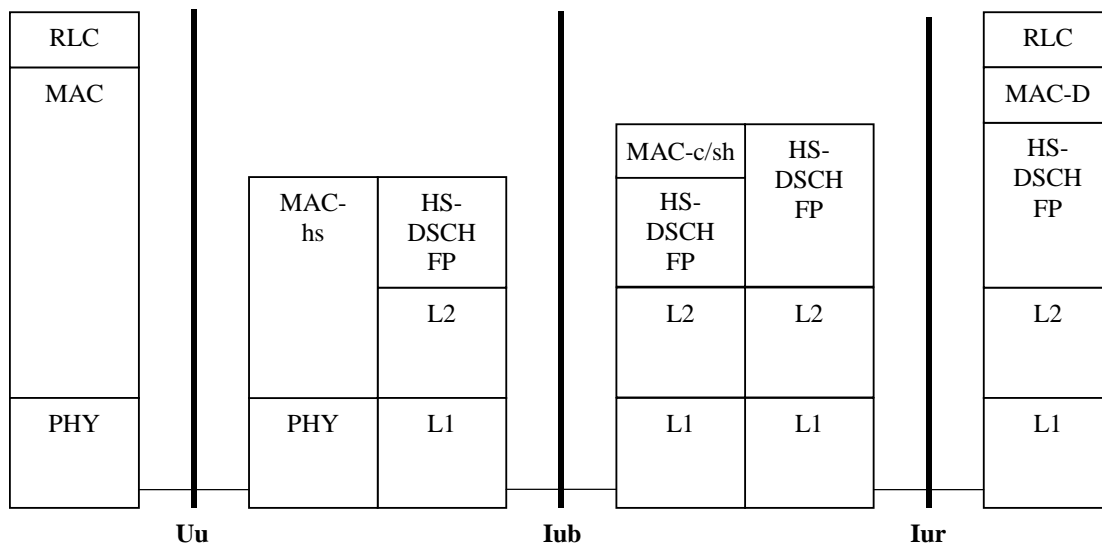


Figure 5.1-1: Protocol Architecture of HS-DSCH, Configuration with MAC-c/sh

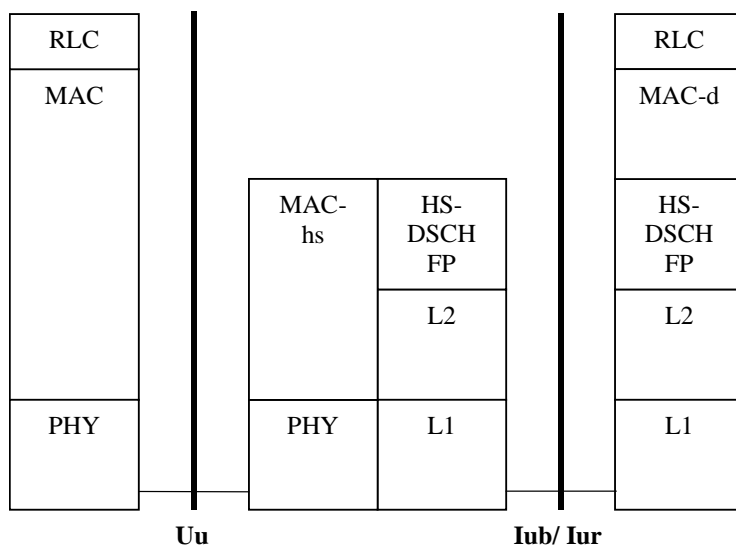


Figure 5.1-2: Protocol Architecture of HS-DSCH, Configuration without MAC-c/sh

## 5.2 Basic physical structure

### 5.2.1 HS-DSCH Characteristics

The HS-DSCH transport channel has the following characteristics:

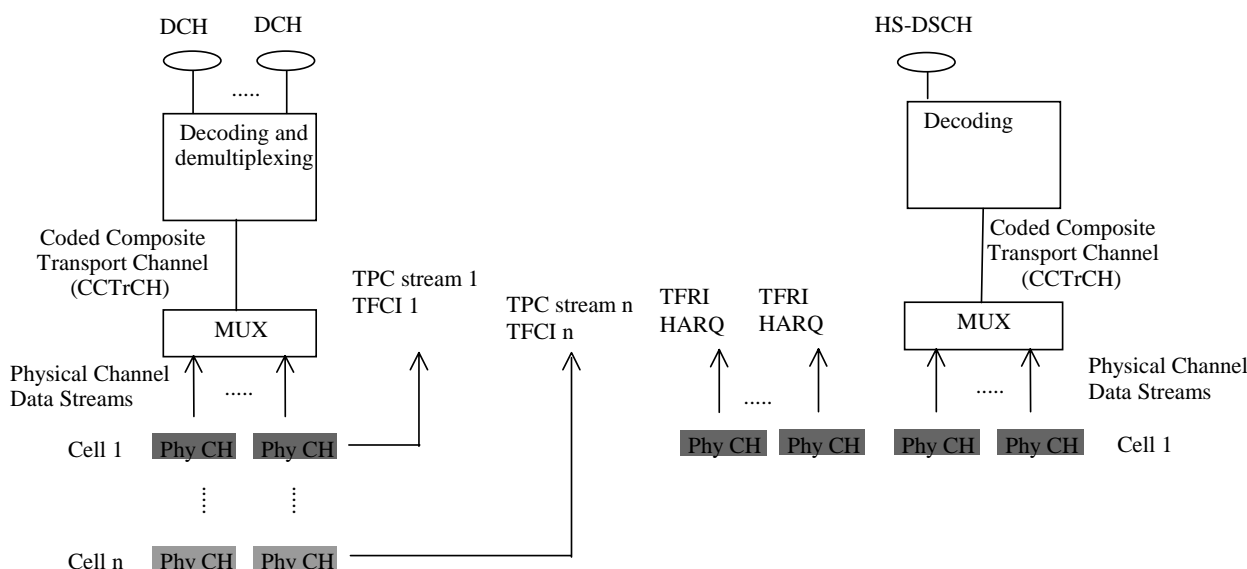
- An HS-DSCH transport channel is processed and decoded from one CCTrCH;

- There is only one CCTrCH of HS-DSCH type per UE;
- The CCTrCH can be mapped to one or several physical channels;
- There is only one HS-DSCH per CCTrCH;
- Existence in downlink only;
- Possibility to use beam forming;
- Possibility of applying link adaptation techniques other than power control;
- Possibility to be broadcast in the entire cell;
- Always associated with a DPCCH and one or more shared physical control channels (HS-SCCHs).

## 5.2.2 DL HS-DSCH Physical layer model

### 5.2.2.1 FDD Downlink Physical layer Model

DCH model with HS-DSCH



**Figure 5.2.2.1-1: Model of the UE's Downlink physical layer - HS-PDSCH with associated DPCH. HS-PDSCH is transmitted from cell 1 in this figure**

The basic downlink channel configuration consists of one or several HS-PDSCHs along with an associated DPCH combined with a number of separate shared physical control channels, HS-SCCHs. The set of shared physical control channels allocated to the UE at a given time is called an HS-SCCH set. The UTRAN may use more than one HS-SCCH set in one given cell. There is a fixed time offset between the start of the HS-SCCH information and the start of the corresponding HS-PDSCH subframe.

The UE is provided one HS-SCCH set on HS-PDSCH configuration/re-configuration via RRC signalling.

The number of HS-SCCHs in a HS-SCCH set as seen from the UE's point-of-view can range from a minimum of one HS-SCCH to a maximum of four HS-SCCHs. The UE shall monitor continuously all the HS-SCCHs in the allocated set.

A two-step signalling approach is used for indicating which UE has been scheduled and for signalling the necessary information required for the UE to decode the HS-PDSCHs.

For each HS-DSCH TTI, each Shared Control Channel (HS-SCCH) carries HS-DSCH-related downlink signalling for one UE. The following information is carried on the HS-SCCH:

- Transport Format and Resource Indicator (TFRI):  
The TFRI includes information about the dynamic part of the HS-DSCH transport format, including transport block set size and modulation scheme. The TFRI also includes information about the set of physical channels (channelisation codes) onto which HS-DSCH is mapped in the corresponding HS-DSCH TTI.
- Hybrid-ARQ-related Information (HARQ information):  
This includes the HARQ protocol related information for the corresponding HS-DSCH TTI (subclause 7.1.2.1) and information about the redundancy version.

The HS-SCCH carries a UE identity (via a UE-specific CRC) that identifies the UE for which it is carrying the information necessary for decoding the HS-PDSCH.

The HS-PDSCH channelisation codes that are used in a given cell are not sent to the UE using RRC signalling. The HS-SCCH signals the set of HS-PDSCH channelisation codes which are allocated to a UE for a given TTI.

The first part of the HS-SCCH contains the channelisation code set and the modulation scheme for the HS-DSCH allocation with the second part containing the transport block size and H-ARQ related information. One CRC is calculated over both parts and the UE id, and attached to the HS-SCCH information.

In case of HS-DSCH transmission to the same UE in consecutive HS-DSCH TTIs, the same HS-SCCH should be used for the corresponding associated downlink signalling.

The upper layer signalling on the DCCH can be mapped to the DCH mapped to the associated DPCH, or in case of TDD, to the HS-DSCH.

### 5.2.2.2 TDD Downlink Physical layer model

DCH model with HS-DSCH(s)

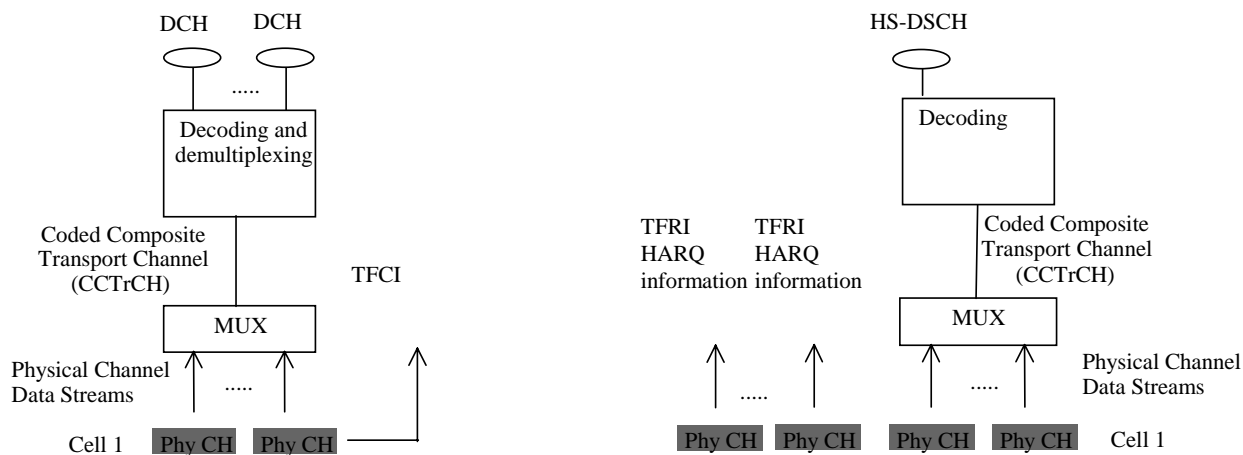


Figure 5.2.2.2-1: Model of the UE's physical layer (3.84 Mcps TDD)

DCH model with HS-DSCH(s)

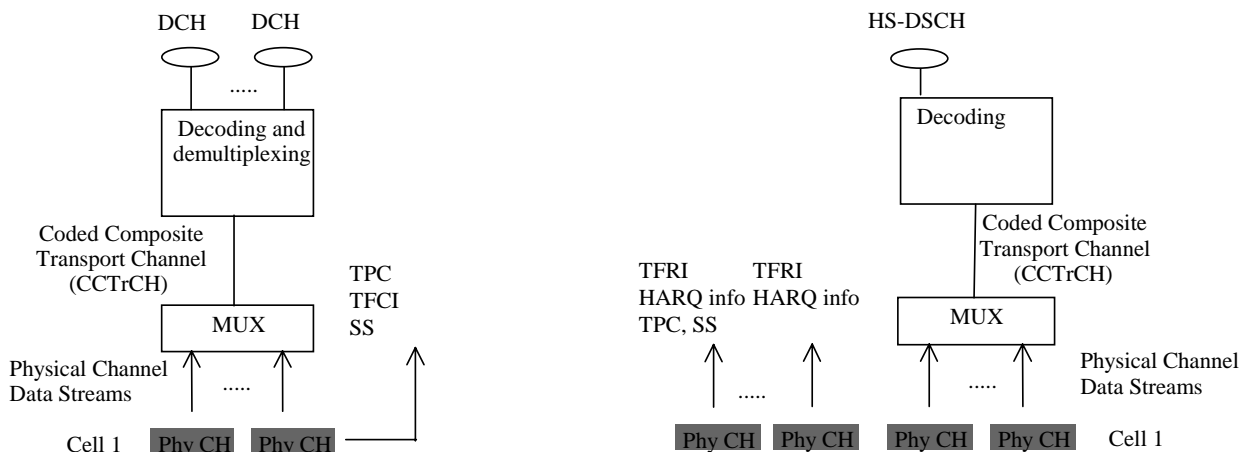


Figure 5.2.2-2: Model of the UE's physical layer (1.28 Mcps TDD)

The TDD overall downlink signalling structure is based on associated dedicated physical channels and shared physical control channels. The downlink signalling information for support of HS-DSCH is carried by the HS-SCCH.

As in Release '99, the associated dedicated physical channel can also be a fractionated channel for efficient resource usage with a corresponding repetition period in terms of TTIs. The UE is informed of an HS-DSCH allocation by means of a signalling message on an HS-SCCH. The UE shall be allocated a set of up to four HS-SCCHs, and shall monitor all of these HS-SCCHs continuously. In any given TTI, a maximum of one of these HS-SCCHs may be addressed to the UE. In the case that a UE detects a message for it on a specific HS-SCCH, then it may restrict its monitoring of HS-SCCHs to only that HS-SCCH in the next TTI.

### 5.2.3 UL Physical layer model

DCH model with HS-DSCH support

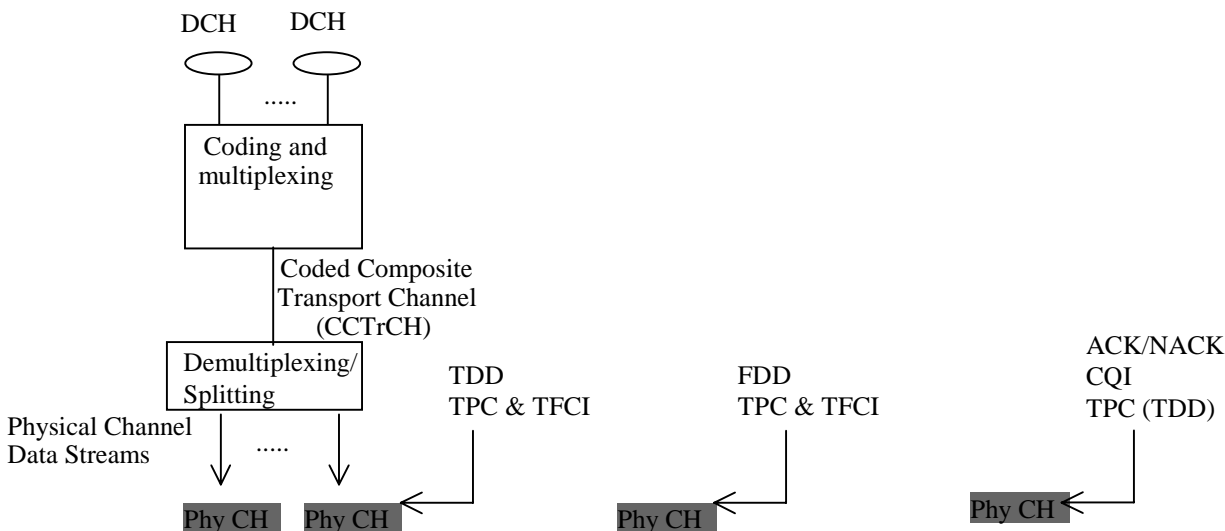


Figure 5.2.3-1: Model of the UE's Uplink physical layer

Fig

In FDD, the uplink signalling uses an additional DPCCH with SF=256 that is code multiplexed with the existing dedicated uplink physical channels. The HS-DSCH related uplink signalling consists of H-ARQ acknowledgement and channel quality indicator.

In TDD, the UE shall use a shared uplink resource (the HS-SICH) for transmitting ACK/NACK and CQI information. The relation between the HS-SCCH in DL and the HS-SICH in UL is pre-defined and is not signalled dynamically on the HS-SCCH.

## 5.2.4 HS-DSCH physical-layer structure in the code domain

### 5.2.4.1 FDD

HS-DSCH relies on channelisation codes at a fixed spreading factor, SF=16. A UE may be assigned multiple channelisation codes in the same TTI, depending on its UE capability. Furthermore, multiplexing of multiple UEs in the code domain within a HS-DSCH TTI is allowed.

### 5.2.4.2 TDD

HS-DSCH relies on one or more channelisation codes with either SF=16 or SF=1, but not both simultaneously. Transmission on one or more timeslots is also allowed. Furthermore, a combination of code multiplexing and time multiplexing by timeslot within a HS-DSCH TTI is allowed, but the same set of channelisation codes must be used in all timeslots allocated to the HS-DSCH. The HS-DSCH TTI is not allowed to cross the frame (3.84 Mcps TDD) or the sub-frame (1.28 Mcps TDD) boundary.

## 5.3 Transport channel attributes

The following is a list of HS-DSCH transport channel attributes:

1. Transport block size - dynamic for first transmission. An identical transport block size shall be applied for any retransmission. There shall be no support for blind transport format detection.
2. Transport block set size. The transport block set always contains only one transport block.
3. Transmission Time Interval (TTI). For FDD the HS-DSCH TTI is fixed and equal to 2ms. The HS-DSCH TTI for 3.84 Mcps TDD is 10 ms. For 1.28 Mcps TDD a fixed 5 ms TTI shall apply.
4. Coding parameters:
  - Type of error protection: turbo code rate 1/3.
5. Modulation - dynamic for first transmission and retransmission. Support for QPSK is mandatory in the UE whereas support for 16QAM depends on the UE capability.
6. Redundancy version - dynamic.
7. CRC size - fixed size of 24 bits. There is one CRC per TTI, i.e. one CRC per TB set.

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## 6 MAC architecture

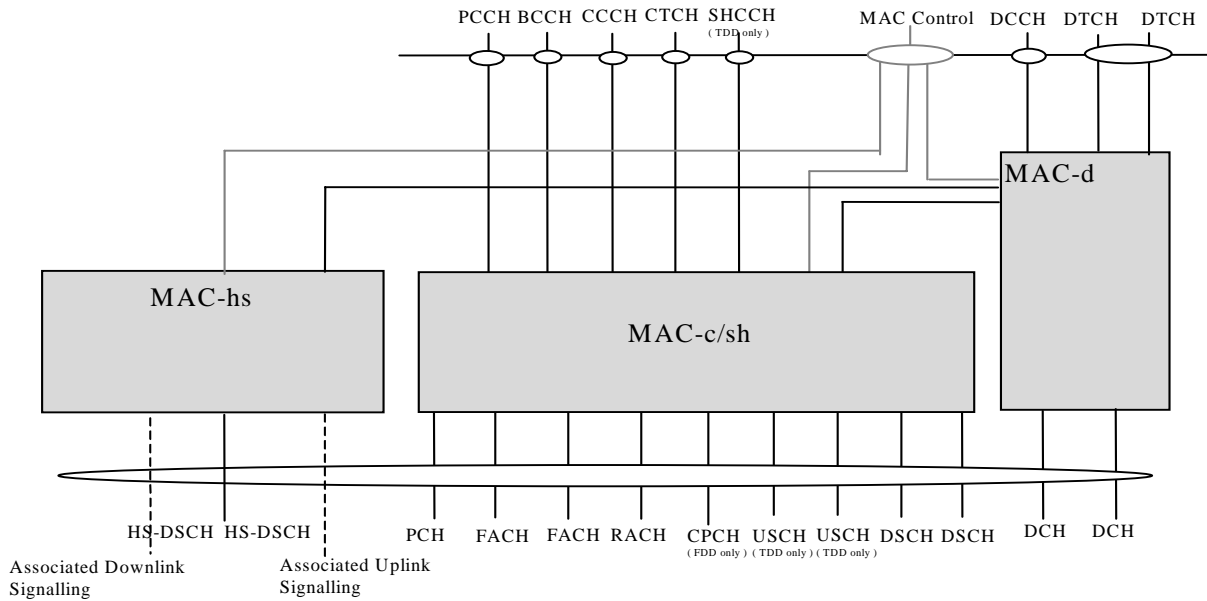
### 6.1 HS-DSCH MAC architecture – UE side

This subclause describes the architecture of the MAC and functional split required to support HS-DSCH on the UE side.

#### 6.1.1 Overall architecture

Figure 6.1.1-1 shows the overall MAC architecture. The data received on HS-DSCH is mapped to the MAC-hs. The MAC-hs is configured via the MAC Control SAP by RRC similar to the MAC-c/sh and MAC-d, to set the parameters in the MAC-hs such as allowed transport format combinations for the HS-DSCH.

The associated Downlink Signalling carries information for support of HS-DSCH while the associated Uplink Signalling carries feedback information.

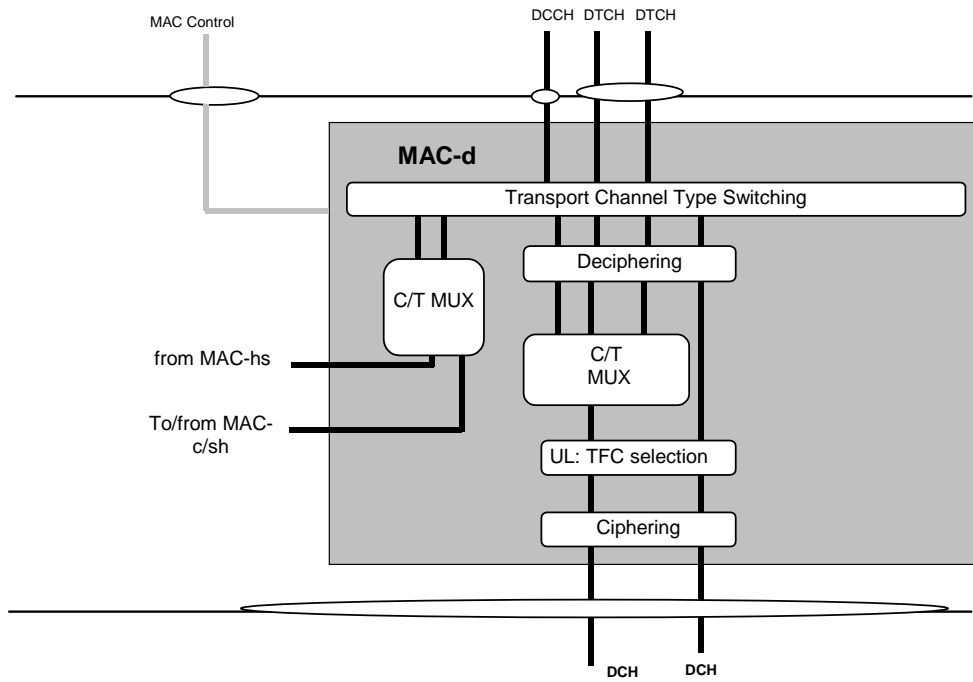


**Figure 6.1.1-1: UE side MAC architecture with HS-DSCH**

### 6.1.2 Details of MAC-d

The MAC-d entity is modified with the addition of a link to the MAC-hs entity. The links to MAC-hs and MAC-c/sh cannot be configured simultaneously in one UE.

The mapping between C/T MUX entity in MAC-d and the reordering buffer in MAC-hs is configured by higher layers. One reordering buffer maps to one C/T MUX entity and many reordering buffers can map to the same C/T MUX entity.



Note 1: For DCH , DSCH and HS-DSCH, different scheduling mechanism apply  
 Note 2: Ciphering is performed in MAC-d only for transparent RLC mode

Figure 6.1.2-1: MAC-d architecture

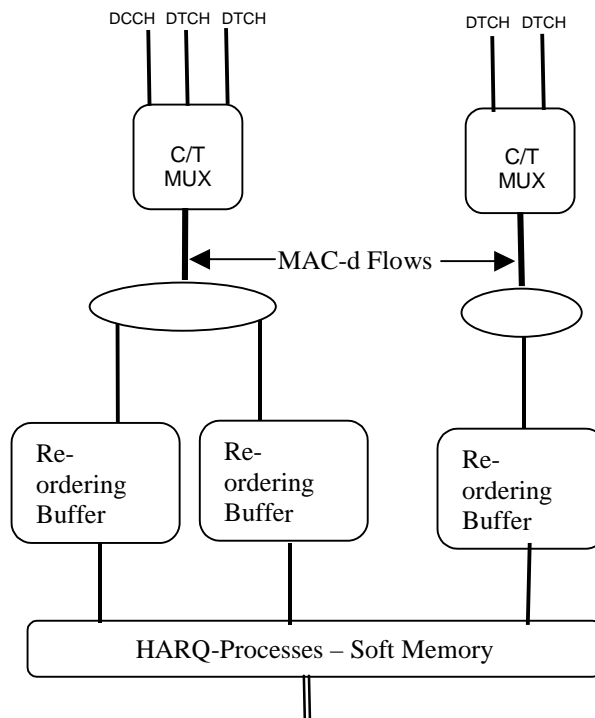


Figure 6.1.2-2: Simplified architecture showing MAC-hs inter-working in UE

### 6.1.3 Details of MAC-c/sh

The MAC-c/sh on the UE side is not modified for HS-DSCH.

### 6.1.4 Details of MAC-hs

The MAC-hs handles the HS-DSCH specific functions. In the model below the MAC-hs comprises the following entity:

- HARQ:  
The HARQ entity is responsible for handling the HARQ protocol. There shall be one HARQ process per HS-DSCH per TTI. The HARQ functional entity handles all the tasks that are required for hybrid ARQ. It is for example responsible for generating ACKs or NACKs. The detailed configuration of the hybrid ARQ protocol is provided by RRC over the MAC-Control SAP.
- Reordering:  
The reordering entity organises received data blocks according to the received TSN. Data blocks with consecutive TSNs are delivered to higher layers upon reception. A timer mechanism determines delivery of non-consecutive data blocks to higher layers. There is one reordering entity for each priority class.
- The following is allowed:
  - One MAC-hs PDU contains only MAC-d PDUs with the same priority, and from the same MAC-d flow;
  - Different MAC-d PDU sizes can be supported in a given MAC-hs PDU.

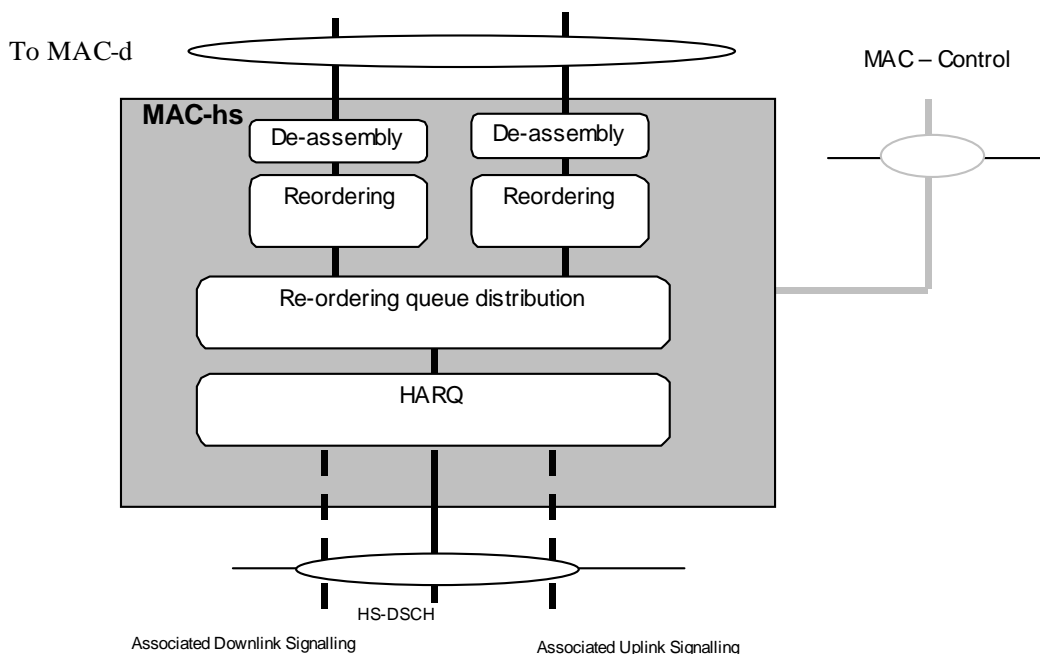


Figure 6.1.4-1: UE side MAC architecture/MAC-hs details

## 6.2 HS-DSCH MAC architecture – UTRAN side

This subclause describes the modifications to the MAC model with respect to the Release 99 model to support the features for HS-DSCH on the UTRAN side.

### 6.2.1 Overall architecture

A new MAC functional entity, the MAC-hs, is added to the MAC architecture of Release '99. The MAC-hs is located in the Node B. If an HS-DSCH is assigned to the UE the MAC-hs SDUs, i.e. MAC-d PDUs to be transmitted are

transferred from MAC-c/sh to the MAC-hs via the Iub interface in case of Configuration with MAC-c/sh, or from the MAC-d via Iur/Iub in case of Configuration without MAC-c/sh.

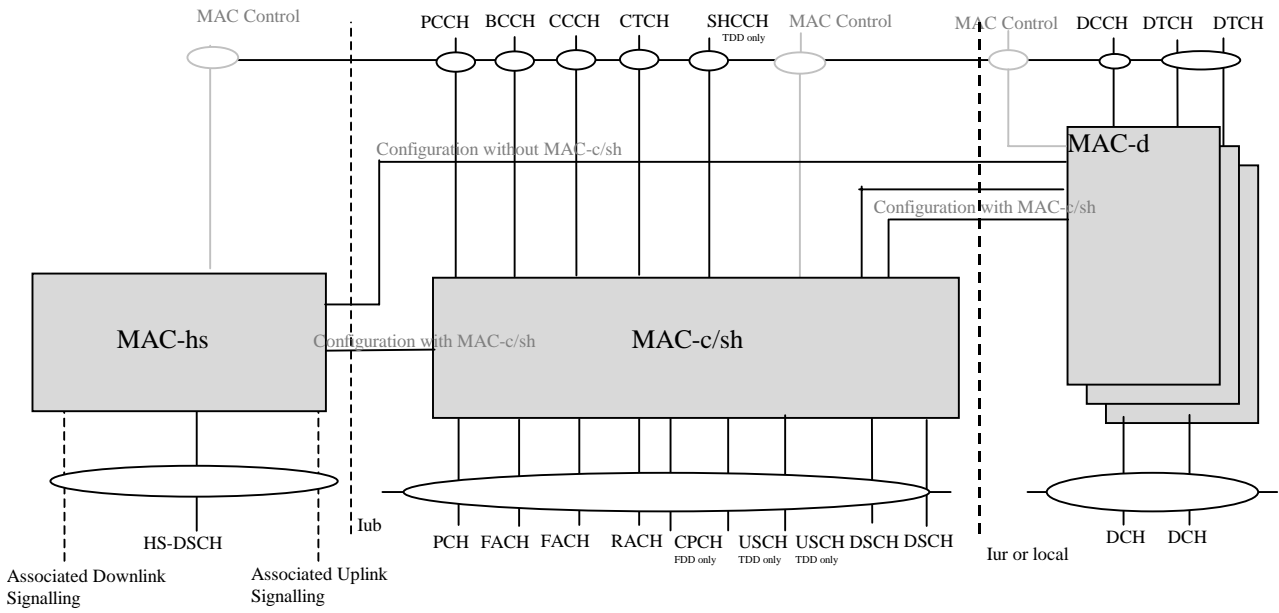


Figure 6.2.1-1: UTRAN side overall MAC architecture

The multiplexing chain for HS-DSCH on the UTRAN side is illustrated below:

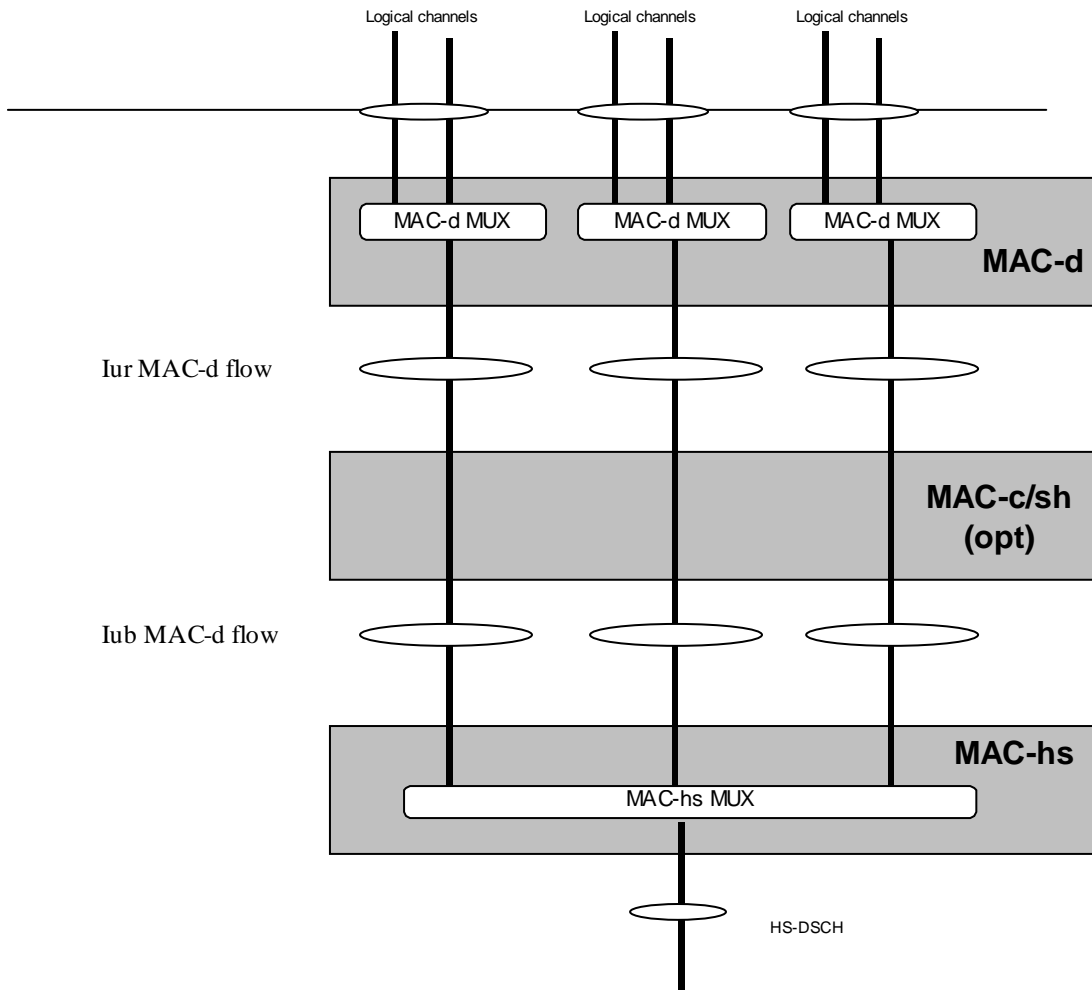


Figure 6.2.1-2: UTRAN side of MAC multiplexing

## 6.2.2 Details of MAC-c/sh

The data for the HS-DSCH is subject to flow control between the serving and the drift RNC.

A new flow control function is included to support the data transfer between MAC-d and MAC-hs.

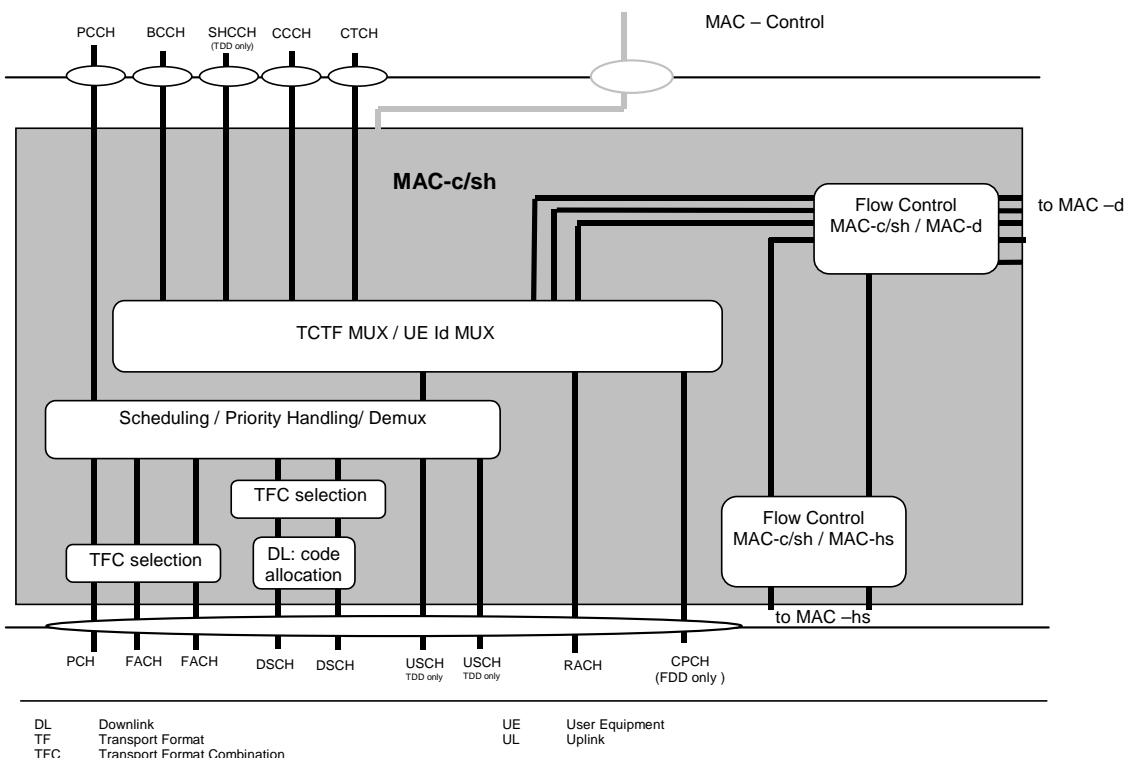


Figure 6.2.2-1: UTRAN side MAC architecture/MAC-c/sh details

## 6.2.3 Details of MAC-hs

The MAC-hs is responsible for handling the data transmitted on the HS-DSCH. Furthermore it is responsible for the management of the physical resources allocated to HS-DSCH. MAC-hs receives configuration parameters from the RRC layer via the MAC-Control SAP. There shall be priority handling per MAC-d PDU in the MAC-hs. The MAC-hs is comprised of four different functional entities:

- Flow Control:
 

This is the companion flow control function to the flow control function in the MAC-c/sh in case of Configuration with MAC-c/sh and MAC-d in case of Configuration without MAC-c/sh. Both entities together provide a controlled data flow between the MAC-c/sh and the MAC-hs (Configuration with MAC-c/sh) or the MAC-d and MAC-hs (Configuration without MAC-c/sh) taking the transmission capabilities of the air interface into account in a dynamic manner. This function is intended to limit layer 2 signalling latency and reduce discarded and retransmitted data as a result of HS-DSCH congestion. Flow control is provided independently per priority class for each MAC-d flow.
- Scheduling/Priority Handling:
 

This function manages HS-DSCH resources between HARQ entities and data flows according to their priority class. Based on status reports from associated uplink signalling either new transmission or retransmission is determined. Further it sets the priority class identifier and TSN for each new data block being serviced. To maintain proper transmission priority a new transmission can be initiated on a HARQ process at any time. The TSN is unique to each priority class within a HS-DSCH, and is incremented for each new data block. It is not permitted to schedule new transmissions, including retransmissions originating in the RLC layer, within the same TTI, along with retransmissions originating from the HARQ layer.
- HARQ:
 

One HARQ entity handles the hybrid ARQ functionality for one user. One HARQ entity is capable of supporting

multiple instances (HARQ process) of stop and wait HARQ protocols. There shall be one HARQ process per TTI.

- TFRC selection:  
Selection of an appropriate transport format and resource combination for the data to be transmitted on HS-DSCH.

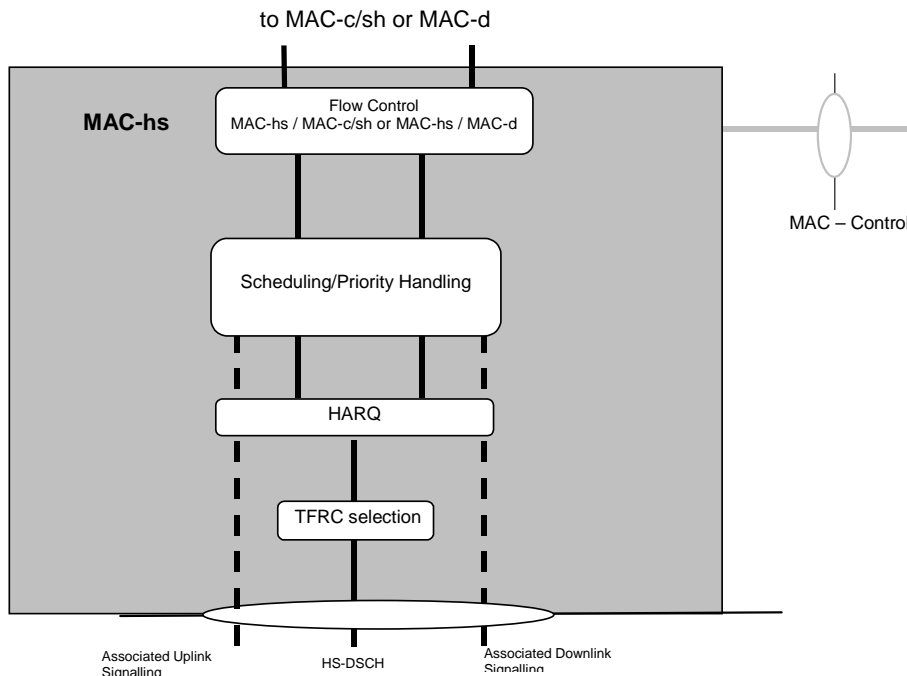


Figure 6.2.3-1: UTRAN side MAC architecture/MAC-hs details

## 7 HARQ protocol

The HARQ protocol is based on an asynchronous downlink and synchronous uplink scheme. The ARQ combining scheme is based on Incremental redundancy. Chase Combining is considered to be a particular case of Incremental Redundancy. The UE soft memory capability shall be defined according to the needs for Chase combining. The soft memory is partitioned across the HARQ processes in a semi-static fashion through upper layer signalling. The UTRAN should take into account the UE soft memory capability when configuring the different transport formats (including possibly multiple redundancy versions for the same effective code rate) and when selecting transport formats for transmission and retransmission.

### 7.1 Signalling

#### 7.1.1 Uplink

In the uplink, a report is used indicating either ACK (positive acknowledgement) or NACK (negative acknowledgement).

#### 7.1.2 Downlink

##### 7.1.2.1 Shared control channel signalling

The following HARQ protocol parameters are carried on the HS-SCCH:

- HARQ process identifier:

- Every HARQ process is assigned an identifier, which is used to couple the processes in the transmitter and the receiver.
- New data indicator:
  - It is used to distinguish between data blocks. It is specific to the HARQ process. It is incremented for each new data block.

### 7.1.2.2 In-band signalling on HS-DSCH

The following parameters are signalled in-band in the MAC-hs header to support in-sequence delivery and priority handling at the UE. These parameters are protected by the same CRC as the Data block.

- Re-ordering Queue Identity:
  - It is used to identify the re-ordering buffer destination of a MAC-hs PDU.
- Transmission sequence number:
  - It is incremented for each new data block destined to a re-ordering buffer. It is used for reordering to support in-sequence delivery.

## 7.2 Void

## 7.3 Void

## 7.4 Error handling

The most frequent error cases to be handled are the following:

- NACK is detected as an ACK. The NW starts afresh with new data in the HARQ process. The data block is discarded in the NW and lost. Retransmission is left up to higher layers.
- ACK is detected as a NACK: If the network retransmits the data block, the UE will re-send an ACK to the network. If in this case the transmitter at the network sends an abort indicator by incrementing the New Packet Indicator, the receiver at the UE will continue to process the data block as in the normal case.
- If a CRC error on the HS-SCCH is detected, UE receives no data and sends no status report. If the absence of the status report is detected, NW can retransmit the block.

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# 8 Signalling parameters

## 8.1 Downlink signalling parameters

### 8.1.1 UE identification

This identifies the UE (or UEs) for which data is transmitted in the corresponding HS-DSCH TTI. The UE identity is implicitly carried on the HS-SCCH through inclusion in the CRC calculation.

### 8.1.2 Transport Block Sizes

This defines what transport block size is used in the corresponding HS-DSCH TTI. The signalled parameter is an index to a pre-defined set of available transport block sizes.

### 8.1.3 Channelisation codes (FDD only)

This identifies to the UE (or UEs) the codes it (they) should receive and decode.

### 8.1.4 HS-PDSCH configuration (TDD only)

This identifies to a UE the timeslots and codes it should receive and decode. Additionally, which transport formats are applied on HS-DSCH is also signalled. An identical set of channelisation codes is used in each of the identified timeslots.

### 8.1.5 HARQ information

Details of signalling parameters for the HARQ Protocol can be found in subclause 7.1.2. In addition, to support the Incremental Redundancy combining scheme, the Redundancy version is also signalled on the HS-SCCH.

### 8.1.6 Measurement feedback rate (FDD only)

This identifies the feedback rate for downlink quality measurement. This information may be sent at a much lower rate than the other parameters described in this subclause.

### 8.1.7 HS-PDSCH power offset

Default power offset between HS-DSCH code channel and P-CPICH (or S-CPICH in case beamforming with S-CPICH is used).

### 8.1.8 Void

### 8.1.9 Void

### 8.1.10 HS-SCCH Cyclic Sequence Number (HCSN) (TDD only)

A cyclic counter that is incremented each time a HS-SCCH transmission is sent to a given UE. Separate counters are maintained for each UE. The counter is used by the UE to estimate the BLER on the HS-SCCH for the purposes of closed loop power control.

## 8.2 Uplink signalling parameters

### 8.2.1 ACK/NACK

A one-bit indication is used by the HARQ protocol to indicate a successful/unsuccessful transmission on the HS-DSCH.

### 8.2.2 Measurement report

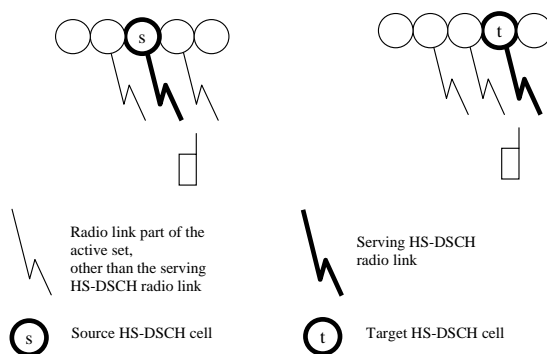
Measurement feedback information contains channel quality indicator that may be used to select transport format and resource by HS-DSCH serving Node-B. For FDD, the transmission rate of the measurement report to the network is configured by higher layer signalling. For TDD, a measurement report is associated with each HS-SCCH transmission.

## 9 Mobility procedures

While in CELL\_DCH state, the UE may be allocated one or more HS-PDSCH(s), allowing it to receive data on the HS-DSCH(s).

Mobile evaluated hard-handover and soft-handover mechanisms provide the RRC connection mobility in CELL\_DCH state. The mobility procedures are affected by the fact that the HS-PDSCH allocation for a given UE belongs to only one of the radio links assigned to the UE, the *serving HS-DSCH radio link*. The cell associated with the serving HS-DSCH radio link is defined as the *serving HS-DSCH cell*.

A *serving HS-DSCH cell change* facilitates the transfer of the role of serving HS-DSCH radio link from one radio link belonging to the source HS-DSCH cell to a radio link belonging to the target HS-DSCH cell.



**Figure 9-1: Serving HS-DSCH cell change**

The serving HS-DSCH cell change may be further categorised in regards to whether the decision of the target HS-DSCH cell is made by the UE or by the network. In Release 5, only network controlled serving HS-DSCH cell changes shall be supported.

In case of a *network-controlled serving HS-DSCH cell change* the network makes the decision of the target HS-DSCH cell, and the decision could be based on UE measurement reports and other information available in the network. A network controlled HS-DSCH cell change is performed as an RRC layer signalling procedure and is based on the existing handover procedures in CELL\_DCH state.

### 9.1 Serving HS-DSCH cell change

NOTE: This sub-clause needs to be reviewed.

With regard to the way a serving HS-DSCH cell change is performed with respect to the dedicated physical channel configuration, the following categories exist:

1. Serving HS-DSCH cell change while keeping the dedicated physical channel configuration and the active set;
2. Serving HS-DSCH cell change in combination with an establishment, release and/or reconfiguration of dedicated physical channels (note: this may by definition imply an update of the active set);
3. Serving HS-DSCH cell change in combination with active set update in soft handover.

With respect to synchronisation between UE and UTRAN as to when transmission and reception is stopped and restarted, two possibilities for a serving HS-DSCH cell change exist:

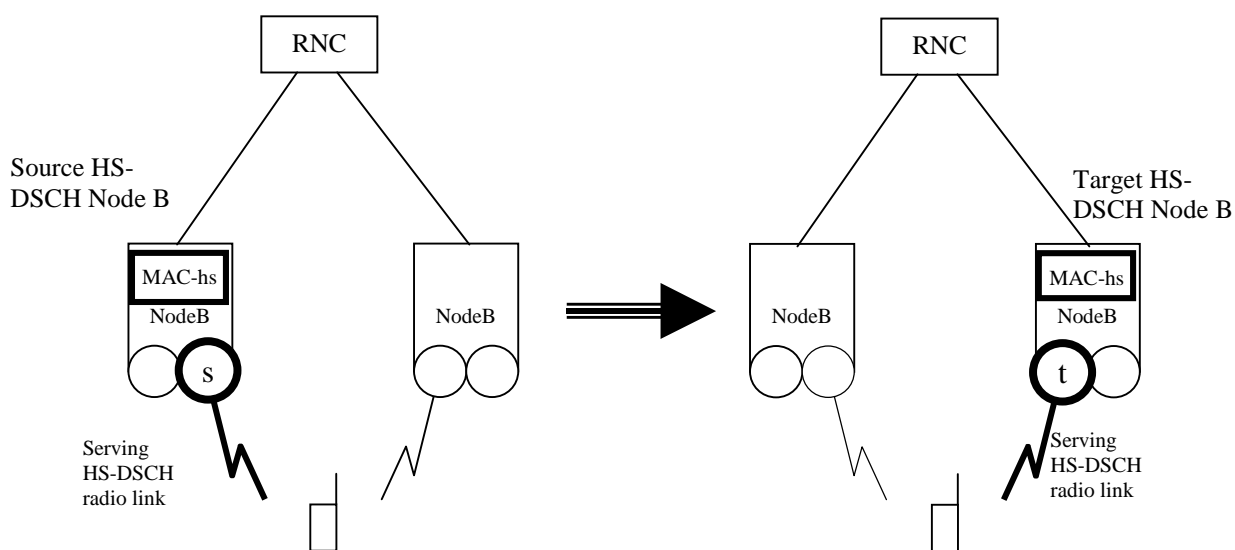
1. Synchronised serving HS-DSCH cell change: Start and stop of HS-DSCH transmission and reception is performed at a certain time typically selected by the network;
2. Unsynchronised serving HS-DSCH cell change: Start and stop of HS-DSCH transmission and reception is performed "as soon as possible" (stated by UE performance requirements) at either side.

The serving HS-DSCH cell change may also be categorised with respect to the serving HS-DSCH Node B:

1. Intra-Node B serving HS-DSCH cell change: The source and target HS-DSCH cells are both controlled by the same Node B. The serving HS-DSCH Node B is not changed.
2. Inter-Node B serving HS-DSCH cell change: The Node B controlling the target HS-DSCH cell is different from the Node B controlling the source HS-DSCH cell.

The cell-Node B relations shall remain transparent for the UE and the UE should therefore shall not be aware of whether the serving HS-DSCH cell change procedure is of an intra-Node B or inter-Node B nature.

At an Inter-Node B serving HS-DSCH cell change, a *serving HS-DSCH Node B relocation* needs to be performed at the UTRAN. Serving HS-DSCH Node B relocation and serving HS-DSCH cell change are two separate procedures, even if serving HS-DSCH Node B relocation cannot be performed without a serving HS-DSCH cell change (but the other way is possible).



**Figure 9.1-1: Inter-Node B serving HS-DSCH cell change combined with serving HS-DSCH Node B relocation**

During a serving HS-DSCH Node B relocation, the HARQ entities located in the source HS-DSCH Node B belonging to the specific UE are deleted and new HARQ entities in the target HS-DSCH Node B are established. Different CRNCs may control the source and target HS-DSCH Node B.

## 9.2 Serving HS-DSCH cell change mechanisms

In the case of AM RLC mode, the polling function either pre- or post- HS-DSCH cell change can be utilised to obtain the status of the data transmission to the UE at the RLC level. In the case of UM RLC mode, the need for relocating the PDUs not transmitted to the UE, is FFS.

**NOTE:** Additional mechanisms would need to be defined in the relevant TSG-RAN WG3 specifications to indicate to the Node B to stop transmission to the UE on a decision to execute an HS-DSCH cell change.

## 9.3 Intra-Node B synchronised serving HS-DSCH cell change

Figure 9.3-1 illustrates an intra-Node B serving HS-DSCH cell change while keeping the dedicated physical channel configuration and the active set, using the Physical channel reconfiguration procedure. The transition from source to target HS-DSCH cell is performed synchronised, i.e. at a given activation time.

In this example, the UE transmits a MEASUREMENT REPORT message containing intra-frequency measurement results, here assumed to be triggered by the event 1D "change of best cell". When the SRNC has performed the

handover decision, the Node B is prepared for the serving HS-DSCH cell change at an activation time indicated with CPHY-RL-Commit-REQ primitive. The SRNC then sends a PHYSICAL CHANNEL RECONFIGURATION message, which indicates the target HS-DSCH cell and the activation time to the UE. Since the same Node B controls both the source and target HS-DSCH cells we assume there is no need to reset the MAC-hs entities. When the UE has completed the serving HS-DSCH cell change it transmits a PHYSICAL CHANNEL RECONFIGURATION COMPLETE message to the network.

In this example it is assumed that HS-DSCH transport channel and radio bearer parameters do not change. If transport channel or radio bearer parameters shall be changed, the serving HS-DSCH cell change would need to be executed by a Transport channel reconfiguration procedure or a Radio bearer reconfiguration procedure, respectively.

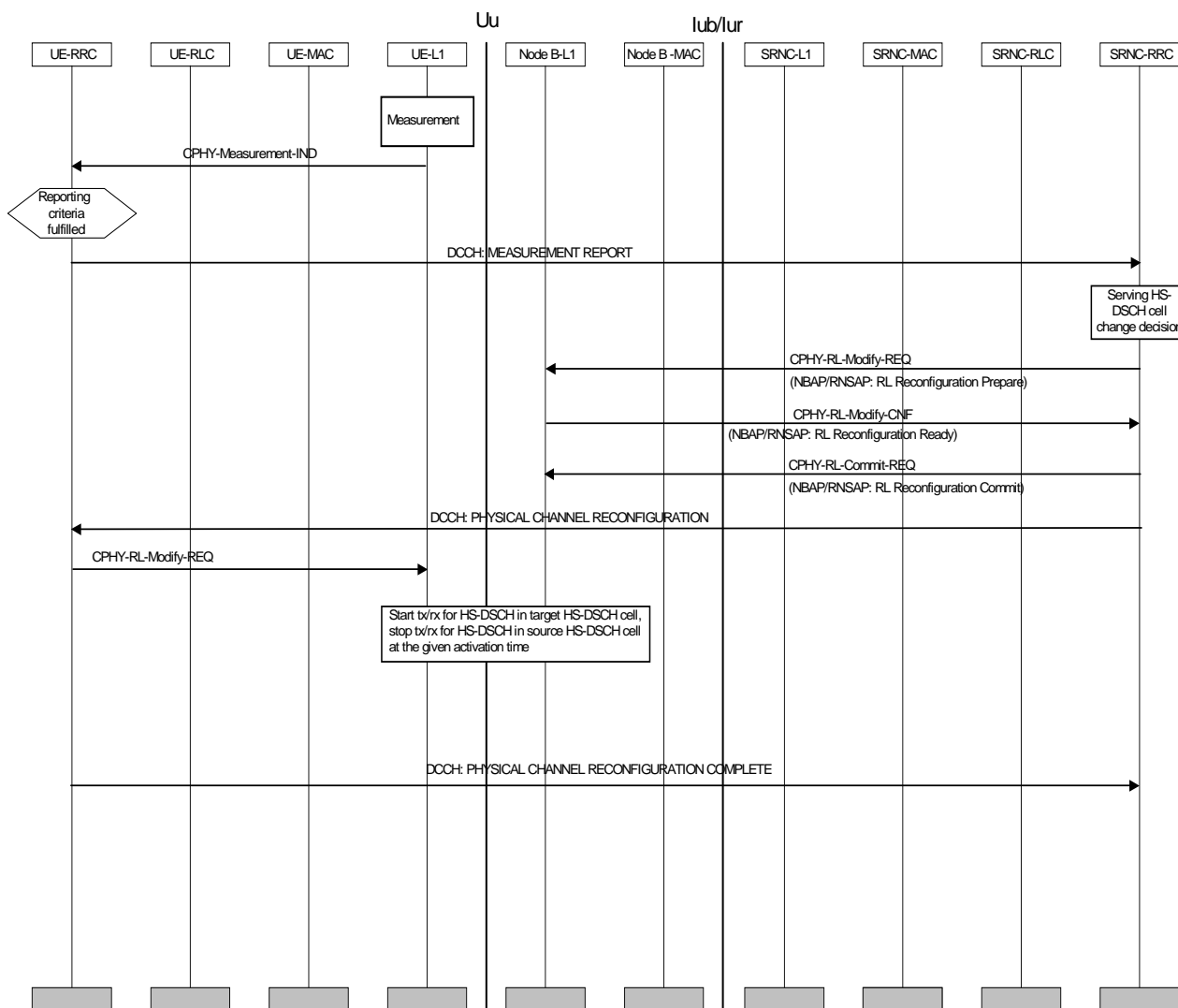


Figure 9.3-1: Intra-Node B synchronised serving HS-DSCH cell change

### 9.4 Inter-Node B synchronised serving HS-DSCH cell change during hard handover

Figure 9.4-1 illustrates a synchronised inter-Node B serving HS-DSCH cell change in combination with hard handover. The reconfiguration is performed in two steps within UTRAN. On the radio interface only a single RRC procedure is used.

Here we assume the UE transmits a MEASUREMENT REPORT message containing intra-frequency measurement results, triggered by the event 1D "change of best cell". The SRNC determines the need for hard handover based on



## 9.5 Inter-Node B synchronised serving HS-DSCH cell change after active set update (radio link addition)

Figure 9.5-1 illustrates an inter-Node B serving HS-DSCH cell change performed subsequent to an active set update. In this example it is assumed that a new radio link is added which belongs to a target Node B different from the source Node B. The cell which is added to the active set is assumed to become the serving HS-DSCH cell in the second step. This combined procedure is comprised of an ordinary Active Set Update procedure in the first step and a synchronised serving HS-DSCH cell change in the second step.

We assume the UE transmits a MEASUREMENT REPORT message containing intra-frequency measurement results. The SRNC determines the need for the combined radio link addition and serving HS-DSCH cell change based on received measurement reports and/or load control algorithms (measurements may be performed in compressed mode for FDD).

As the first step, the SRNC establishes the new radio link in the target Node B for the dedicated physical channels and transmits an ACTIVE SET UPDATE message to the UE. The ACTIVE SET UPDATE message includes the necessary information for establishment of the dedicated physical channels in the added radio link (but not the HS-PDSCH). When the UE has added the new radio link it returns an ACTIVE SET UPDATE COMPLETE message.

The SRNC will now carry on with the next step of the procedure, which is the serving HS-DSCH cell change. The target HS-DSCH cell is the newly added radio link, so far only including dedicated physical channels. For the synchronised serving HS-DSCH cell change, both the source and target Node Bs are first prepared for execution of the handover at the activation time indicated with CPHY-RL-Commit-REQ primitive.

The SRNC then sends a TRANSPORT CHANNEL RECONFIGURATION message, which indicates the target HS-DSCH cell and the activation time to the UE. The message may also include a configuration of transport channel related parameters for the target HS-DSCH cell, including an indication to reset the MAC-hs entity and a status report for each RLC entity associated with the HS-DSCH should be generated.

Since source and target HS-DSCH cell are controlled by different Node Bs, MAC-hs in source and target Node B need to be released and setup, respectively, which is assumed to be done with CMAC-HS-Release-REQ and CMAC-HS-Setup-REQ primitives. These MAC-hs control primitives are assumed to be carried on the same NBAP/RNSAP messages, which carry the CPHY-RL-Reconfig-REQ primitives. Execution of release and setup of MAC-hs entities shall also be performed at the indicated activation time.

When the UE has completed the serving HS-DSCH cell change it returns a TRANSPORT CHANNEL RECONFIGURATION COMPLETE message to the network.

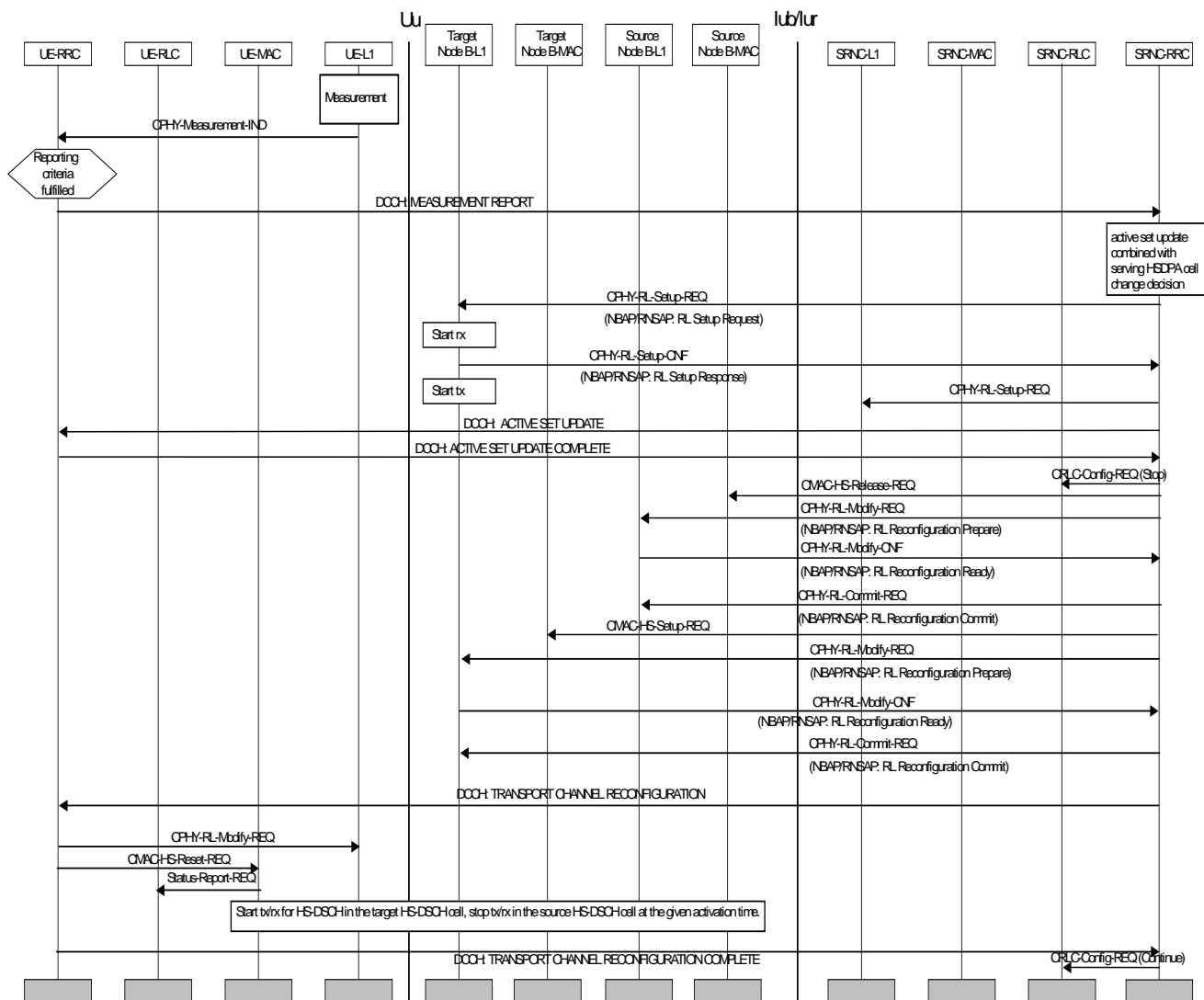


Figure 9.5-1: Inter-Node B synchronised serving HS-DSCH cell change after active set update

## 10 Resource management

For HS-DSCH, the resources at a cell level shall be:

- Channelisation Codes and timeslots (TDD) that can be used for the mapping of HS-PDSCH and the HS-SCCH physical channels.
- Power that can be used for HS-DSCH, i.e. for HS-DSCHs and HS-SCCHs.

The HS-DSCH resources are assigned by the CRNC to a Node B on a cell basis.

The HS-SCCH set for a given UE is decided by the Node B.

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## Annex A (informative): Evaluation criteria

The following considerations should be taken into account in the evaluation of the different techniques proposed for HS-DSCH:

1. The focus shall be on the streaming, interactive and background services. It should be noted that it might not be possible to simultaneously optimise the performance of HS-DSCH for all of the above traffic classes.
2. System performance improvement shall be obtained with concomitant reduction in delay of service.
3. Priority shall be given to urban environments and then to indoor deployments. The techniques shall not be limited to these environments however.
4. The techniques accepted shall be optimised at speeds typical of urban environments but techniques should apply at other speeds also. Full mobility shall be supported, i.e., mobility should be supported for high-speed cases also, but optimisation should be for low-speed to medium-speed scenarios.
5. Features or group of features considered should demonstrate significant incremental gain.
6. Features accepted shall provide the benefit at reasonable cost to the operators. The value added per feature should be considered in the evaluation.
7. The techniques should be compatible with advanced antenna and receiver techniques.
8. The techniques should take into account the impact on Release '99 networks both from a protocol and hardware perspective.
9. The choice of techniques (such as HARQ) shall take into account UE processing time and memory requirements.
10. The UE complexity shall be minimised for a given level of system performance.
11. An evolutionary philosophy shall be adopted as opposed to a revolutionary one in adopting new techniques and architectures.

## Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
09/2001	RP-13	RP-010643	-		Approved at TSG-RAN #13 and placed under Change Control	-	5.0.0
12/2001	RP-14	RP-010774	001		Update to HSDPA Stage 2	5.0.0	5.1.0
03/2002	RP-15	RP-020093	002		HSDPA Updates	5.1.0	5.2.0
	RP-18	RP-020734	003	2	Alignment with the physical layer specifications	5.2.0	5.3.0
12/2002	RP-18	RP-020734	004		Generation of RLC Status Reports to coordinate with MAC-hs reset	5.2.0	5.3.0
03/2003	RP-19	RP-030114	005		Correction on HS-DSCH MAC architecture	5.3.0	5.4.0
	RP-19	RP-030114	006		Correction to HS-SCCH detection description	5.3.0	5.4.0
03/2004	RP-23	RP-040103	007		Corrections to HS-DSCH cell change, applicability of HS-DSCH and Need for Re-ordering queue	5.4.0	5.5.0
09/2004	RP-25	RP-040369	009	1	Application of HS-DSCH to signalling radio bearers, correction to MAC-hs entity and correction to a response message from UE	5.5.0	5.6.0
12/2004	RP-26	RP-040515	011		Removal of sentences into brackets	5.6.0	5.7.0