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3GPP

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

http://www.3gpp.org

Contents

Foreword

This Technical Specification has been produced by the 3rd 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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x the first digit:

1 presented to TSG for information;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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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.

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: "UTRA High Speed Downlink Packet Access: Overall Description".

3 Definitions, symbols 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 radio cell is a member 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 more HS-PDSCH(s) allocated. The serving HS-DSCH Node B is the Node B controlling the serving HS-DSCH cell.

3.2 Abbreviations

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

HSDPA	High Speed Downlink Packet Access
MCS	Modulation and Coding scheme
NW	Network
TFRI	Transport Format and Resource Indicator
TSN	Transmission Sequence Number

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 transport channel, the HS-DSCH, which is terminated in the Node B in the UTRAN.

5 Basic structure of HS-DSCH

5.1 Protocol structure

The HSDPA functionality should be able to operate in an environment where certain cells are not updated with HSDPA functionality. The PDCP, RLC and MAC-d layers are unchanged from the R99 and REL-4 architecture.

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

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

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

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

Two configurations of the radio interface protocol are possible:

- Configuration with MAC-c/sh: In this case, the

~~Figure 1 shows the radio interface protocol architecture with termination points.~~ MAC-hs in Node B is located below MAC-c/sh in CRNC. MAC-c/sh shall provide functions to HSDPA already included for DSCH in the R99. 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 userplane the SRNC is directly connected to the Node B, thus bypassing the DRNC.

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

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

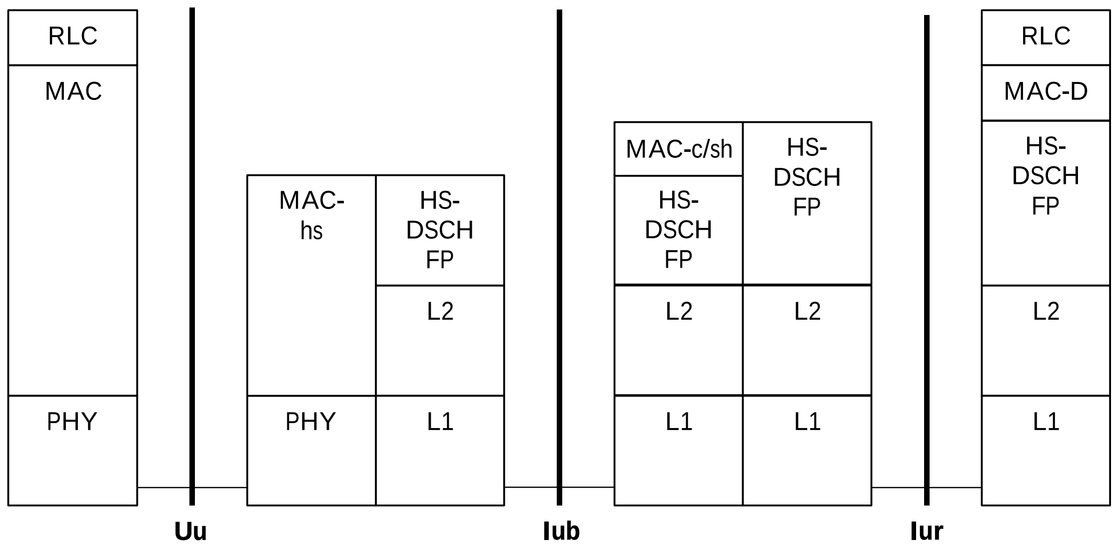


Figure 1: Radio Interface Protocol Architecture of HSDPA, Configuration with MAC-c/sh

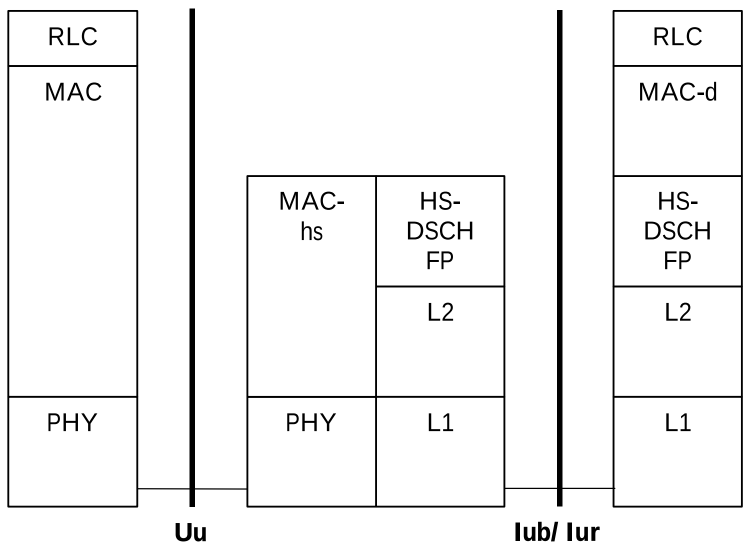


Figure 1a: Radio Interface Protocol Architecture of HSDPA, Configuration without MAC-c/sh

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 ~~may be multiple~~ is only one HS-DSCH per CCTrCH.
- ~~If there are more than one HS-DSCH transport channels in a HS-DSCH CCTrCH, the transport format combinations are configured in such a way that for any transport format combination, there is a maximum of one transport channel having a transport format with one or more transport blocks.~~
- ~~One HS-DSCH shall support one PDU size.~~

- 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 DPCH and one or more shared physical control channels (HS-SCCHs).

As in R99 it shall be possible to simultaneously map certain logical channels to DCH and HS-DSCH.

5.2.2 DL HSDPA Physical layer model

5.2.2.1 FDD Downlink Physical layer Model

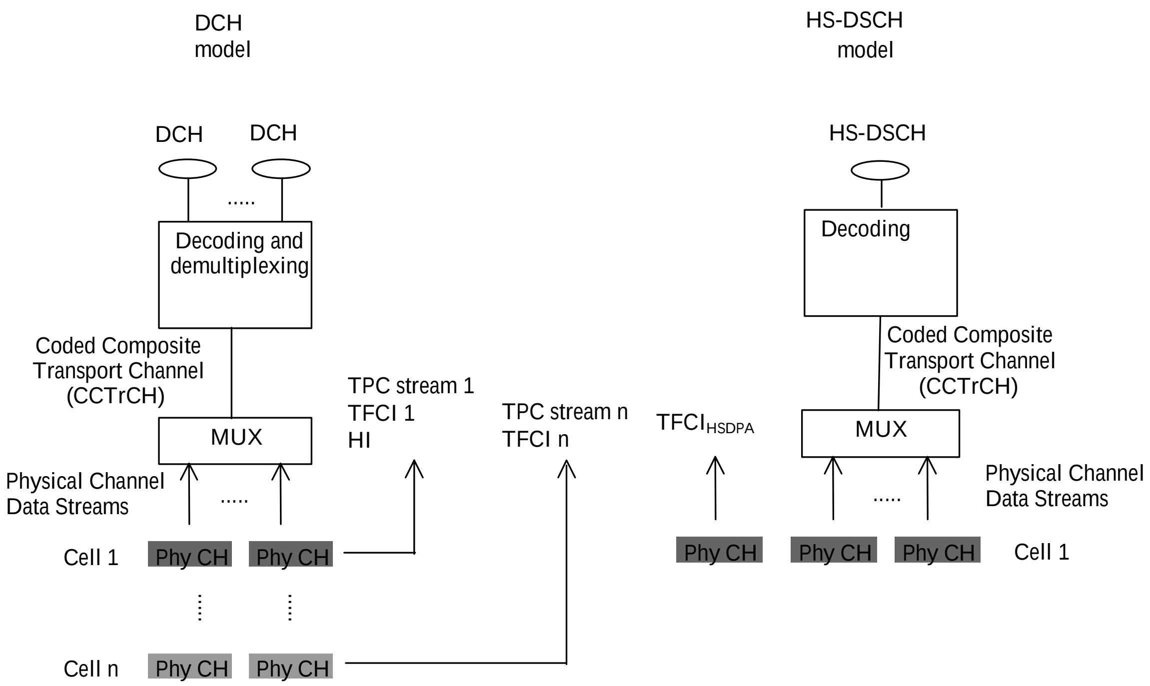


Figure 2: Model of the UE's Downlink physical layer - HS-PDSCH with associated DPCH. HS-PDSCH is transmitted from cell 1 in this figure.

The basic downlink channel configuration consists of an associated DPCH combined with a number of separate shared physical control channels, HS-SCCHs in combination with the HS-PDSCH. The maximum number of ~~shared control channels~~ HS-SCCHs that a single UE needs to receive is four. The UTRAN may configure more than four ~~shared control channels~~HS-SCCHs, but the UE needs to be provided at HS-PDSCH configuration, which set of four ~~shared control channels~~ HS-SCCHs it needs to monitor.

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

The associated DPCH carries a HI (HS-DSCH Indicator). The HI consists of two information bits that indicate the HS-SCCH that carries the HS-DSCH-related signalling for the corresponding UE. ~~The information provided by the HI is under consideration.~~ In order to support the scenario wherein a UE may be in soft handover on the DPCH between a HSDPA supporting cell and a R99/REL-4 cell, the R99/REL-4 Node B does not need to support new slot formats other than that needed for R99/REL-4 DPCH operation only.

The upper layer signalling on the DCCH can be mapped to the associated DPCH or the HS-DSCH, as in the case of R99.

For each HS-DSCH TTI, each ~~shared control~~HS-SCCH ~~channel~~ carries HS-DSCH-related downlink signalling for one UE. The following information is carried on the ~~shared control channel~~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 ~~shared control channel~~HS-SCCH carries a UE identity that identifies the UE for which it is carrying the information necessary for decoding the HS-PDSCH.

The time offset between the start of the DL DPCH slot carrying the HI and the start of the HS-SCCH~~shared control channel~~ information can vary in the interval [0, T_{slot}] depending on the timing of the downlink DPCH, where T_{slot} equals approximately 0.67ms, i.e. the DL DPCH slot carrying the HI can be delayed by a maximum of Tslot with respect to the start of the HS-SCCH. There is a fixed time offset between the start of the ~~shared control channel~~HS-SCCH information and the start of the corresponding HS-DSCH TTI.

5.2.2.2 TDD Downlink Physical layer model

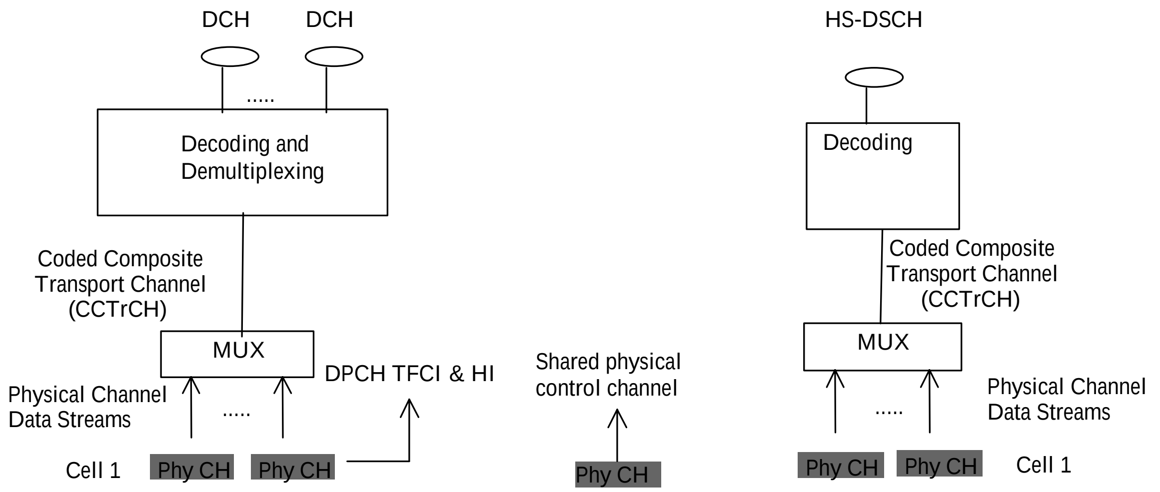


Figure 3: Model of the UE's physical layer (TDD)

The TDD overall downlink signalling structure is a two-step approach based on associated dedicated physical channels and shared physical control channels. The downlink signalling information for support of HS-DSCH is carried by ~~a~~the ~~shared control channel~~HS-SCCH. The HS-DSCH indicator (HI) on the associated dedicated physical channel provides information to the UE about the need to read the ~~shared control channel~~HS-SCCH. There may be multiple ~~shared control channels~~ HS-SCCHs assigned in which case the HI also indicates which of the ~~shared control channels~~ HS-SCCH(s) (of a maximum of four that it monitors) the UE is to read.

As in R99, 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 associated dedicated physical channel carries HI (HS-DSCH Indicator). This HI indicates, that the UE has to read the ~~shared control channels~~HS-SCCHs of the same TTI. If the repetition period is larger than one, the UE has to read in addition the ~~shared control channels~~HS-SCCHs of the following TTIs for the whole repetition period to provide full scheduling flexibility. For continuous dedicated physical channels, the repetition period is consequently set to one TTI. The HI has to be sent in parallel or prior to the ~~shared control channels~~HS-SCCHs.

5.2.3 UL HSDPA Physical layer model

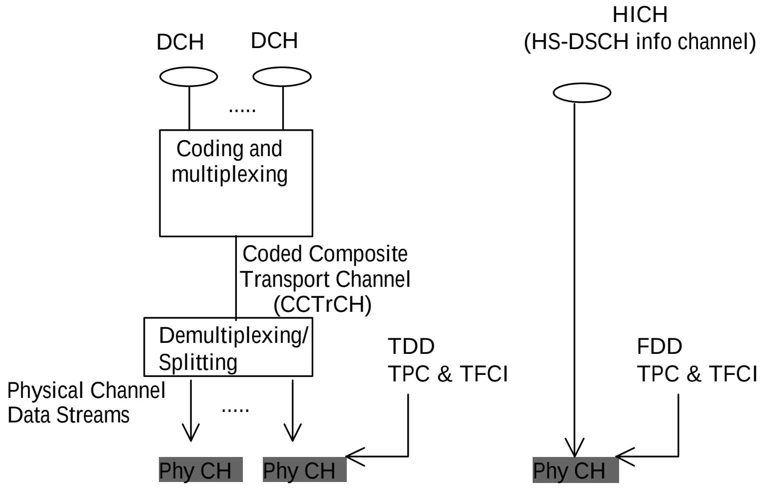


Figure 4: Model of the UE's Uplink physical layer

In FDD, the uplink signalling uses an additional DPCCH with SF=256 that is code multiplexed with the existing dedicated uplink physical channels.

In TDD, the UE shall use a shared uplink resource for transmitting ACK/NACK information. The relation between the ~~shared control channel~~HS-SCCH in DL and shared UL resource can be pre-defined and is not signalled dynamically on the ~~shared control channel~~HS-SCCH.

5.2.4 HSDPA 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 SF 16. 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.

5.3 Transport channel Attributes

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

1. Transport block size - ~~semi-static~~dynamic
2. Transport block set size - dynamic for 1st transmission. An identical transport block set size shall be applied for retransmission. There shall be no support for blind transport format detection.
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 under consideration. For 1.28 Mcps TDD a fixed 5ms TTI shall apply.
4. Coding parameters
   - Type of error protection: turbo code rate 1/3.

5. Modulation - dynamic for first transmission and retransmission. There shall be mandatory support for QPSK and 16QAM.

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.

6 MAC Architecture

6.1 HSDPA MAC architecture– UE side

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

6.1.1 Overall architecture

Figure 4 shows the overall MAC architecture. In case of HSDPA the data received on HS-DSCH is mapped to the MAC-c/sh. 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.

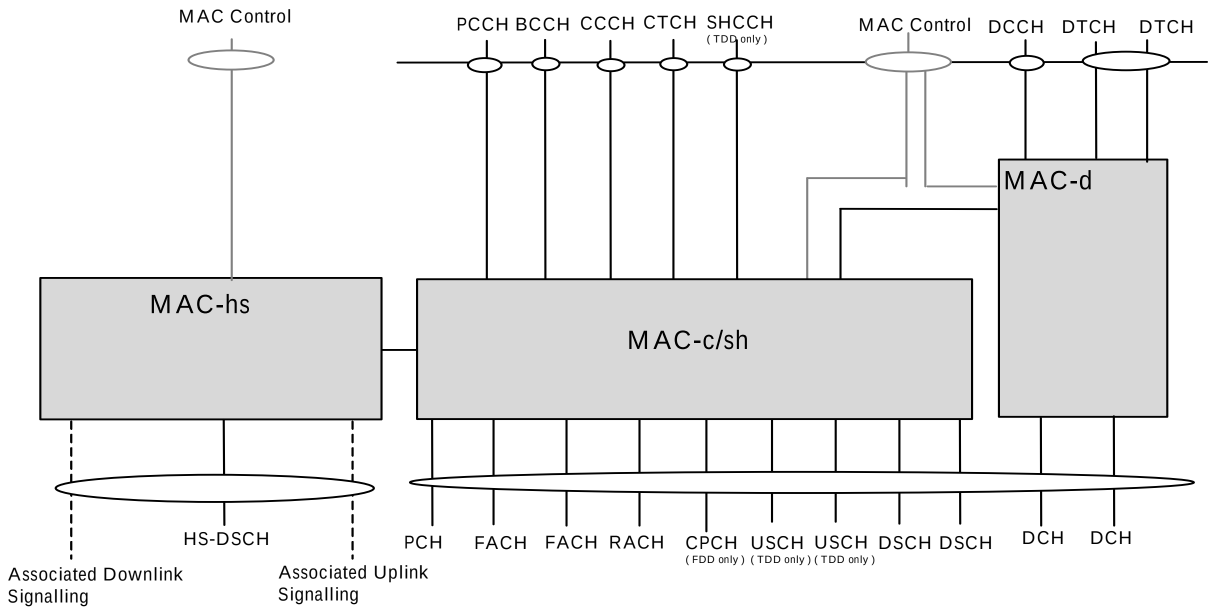
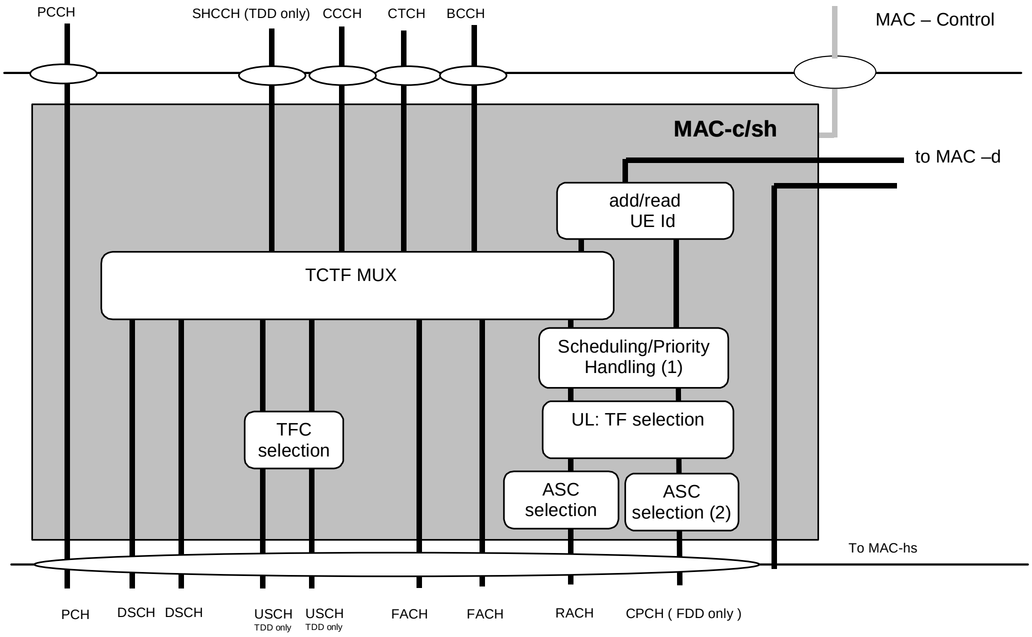


Figure 6: UE side MAC architecture with HSDPA

6.1.2 Details of MAC-c/sh

The MAC-c/sh on the UE side retains its functionality as defined in R99 with minor additions for HSDPA.



(1) Scheduling /Priority handling is applicable for CPCH
(2) In case of CPCH, ASC selection may be applicable for AP preamble.

Figure 7: UE side MAC architecture / MAC-c/sh details

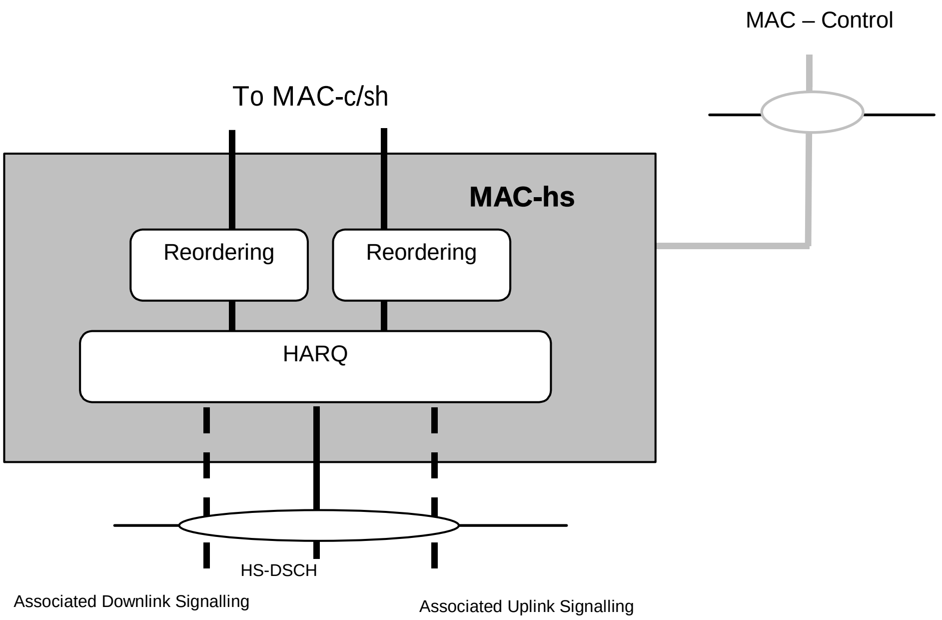
6.1.3 Details of MAC-hs

The MAC-hs handles the HSDPA 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 organizes 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 and MAC-identity configured at the UE.



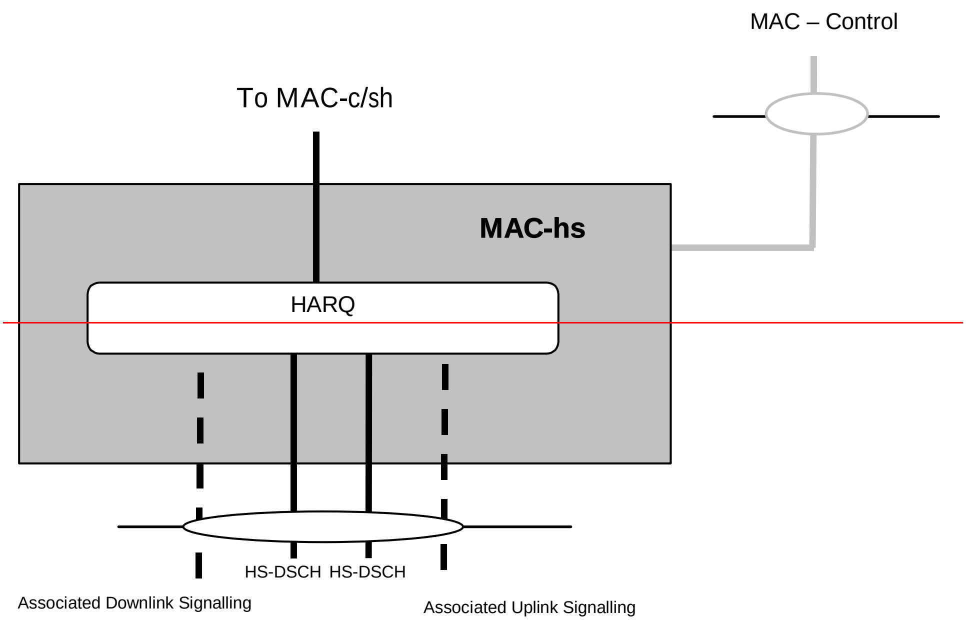


Figure 8: UE side MAC architecture / MAC-hs details

6.2 HSDPA MAC architecture – UTRAN side

This subclause describes the changes that are required to the MAC model to support the features for HSDPA on the UTRAN side.

6.2.1 Overall architecture

A new MAC functional entity, the MAC-hs, is added to the MAC architecture of R99. The MAC-hs is located in the Node B. If ~~one or more~~a HS-DSCHs ar~~e in operation~~ is assigned to the UE the MAC-hs SDUs 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.

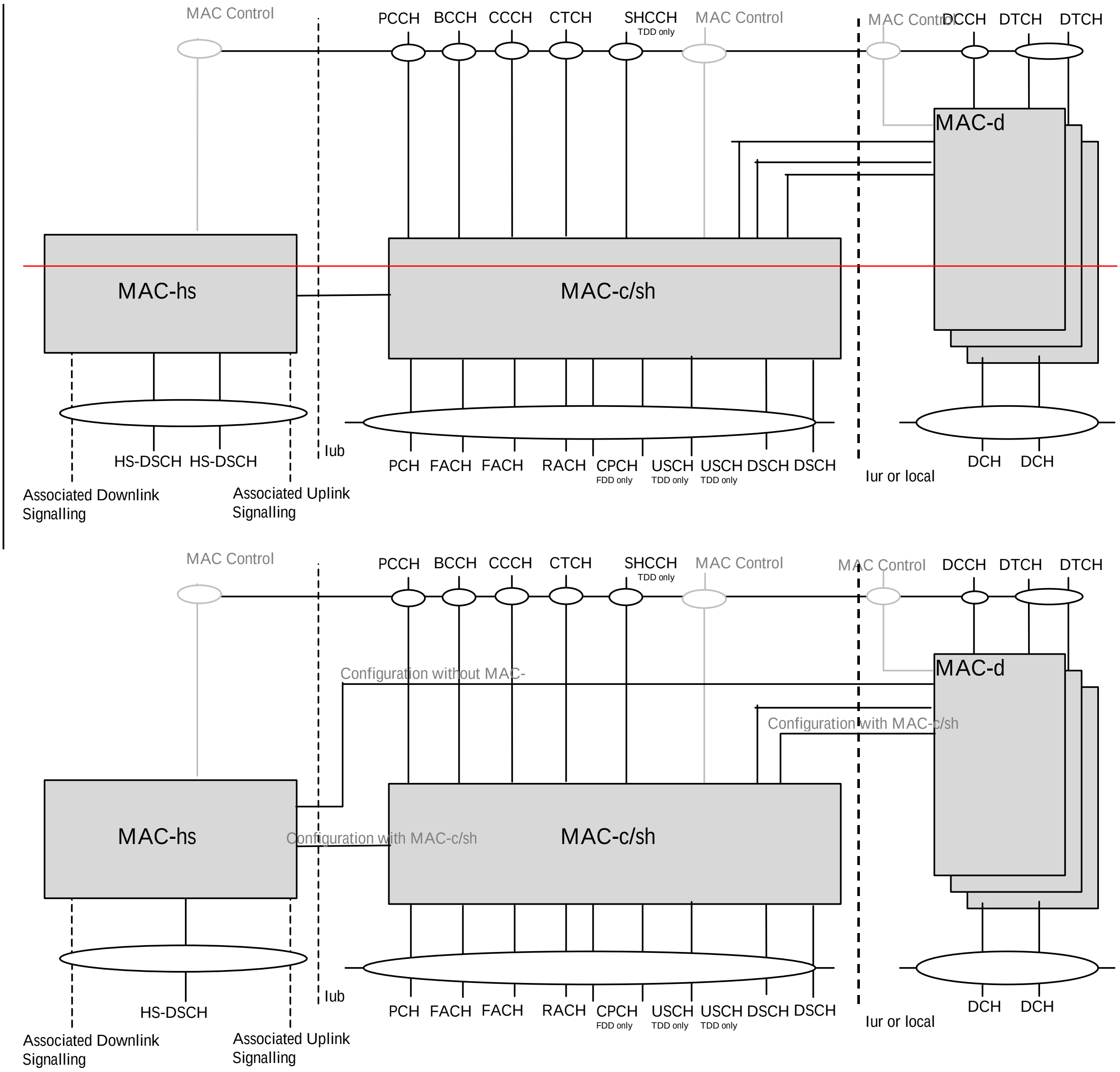


Figure 9: UTRAN side overall MAC architecture

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.

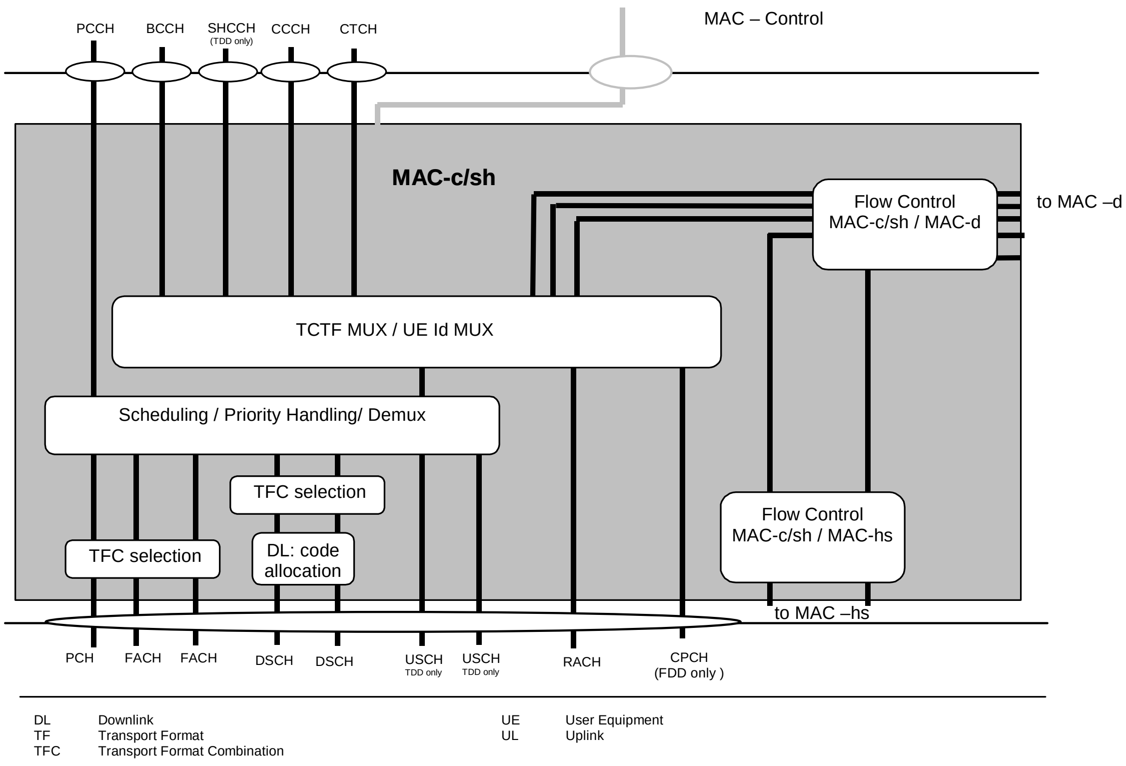


Figure 10: UTRAN side MAC architecture / MAC-c/sh details

6.2.3 Details of MAC-hs

The MAC-hs is responsible for handling the data transmitted on the HS-DSCH. Furthermore it is its responsibility to manage the physical resources allocated to HSDPA. 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 by priority class for each HS-DSCH.

- Scheduling/Priority Handling

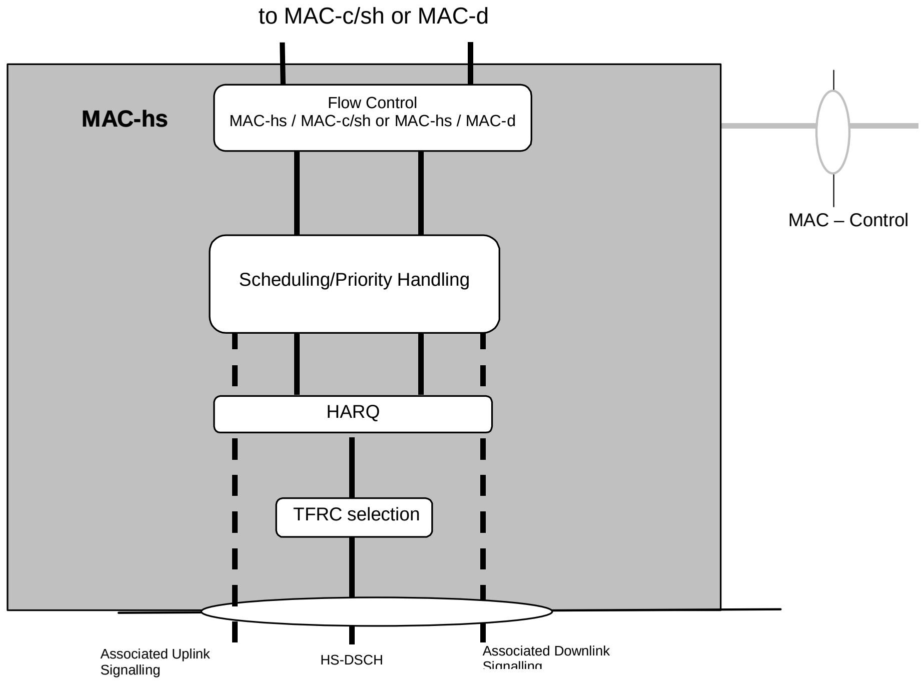
  This function manages HS-DSCH resources between HARQ entities and data flows according to their priority class. Based on status reports from associated uplink signalling either new transmission or retransmission is determined. Further it sets the priority class identifier and TSN for each new data block 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 HS-DSCH~~ per TTI. ~~Based on restrictions on the TFCS of the HS-DSCH CCTrCH, HARQ processes shall not operate in a simultaneous fashion in the transmitter. Details of the HARQ functionality require further study.~~

- ~~Scheduling/Priority Handling~~

~~Due to the restrictions in the physical layer combining process, 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.~~

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



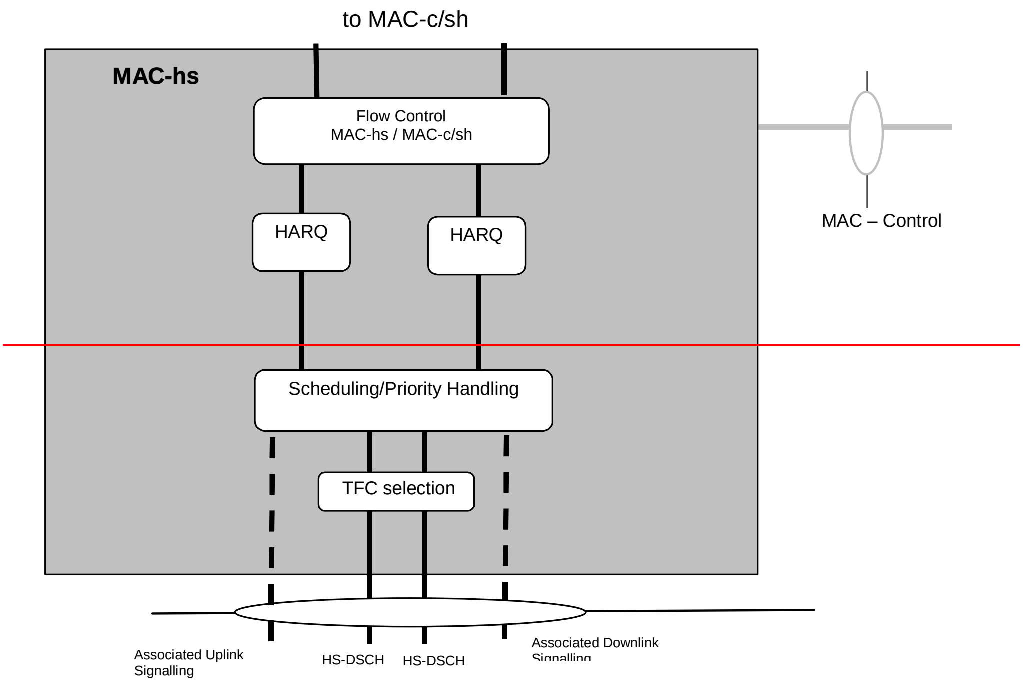


Figure 11: UTRAN side MAC architecture / MAC-hs details

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 ~~shared control channel~~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.

- Priority class identifier
  - It is used to ~~separate~~ distinguish different priority classes in order to differentiate between logical channel ~~priorities~~ multiplexed in the same transport channel.
- Transmission sequence number
  - It is incremented for each new data block within a priority class. It is used for reordering to support in-sequence delivery.

7.2 Network operation

The following are the functions of the various functional entities at the network in support of the HARQ protocol.

7.2.1 Scheduler

The scheduler performs the following functions:

- Schedules all UEs within a cell
- Services priority class queues
  - The scheduler receives MAC-hs SDUs based on information from the Iub frame protocol. One UE may be associated with one or more Iub logical flows. Each Iub logical flow contains HS-DSCH MAC-d PDUs for one priority class.

- Determines the HARQ Entity and the queue to be serv~~ic~~ed
- Scheduling of new transmissions and retransmissions
  - Based on the status reports from HARQ Processes the scheduler determines either new transmission or retransmission. A new transmission can be initiated ~~also~~ on a HARQ process at any time.

7.2.2 HARQ Entity (one per UE)

There is one HARQ entity per UE. It performs the following functions:

- Priority class identifier setting
  - It sets the priority class identifier based on priority class of the queue being serviced.
- Transmission sequence number setting
  - The TSN is incremented for each new data block within the same HS-DSCH and priority class. TSN is initiated at value 0.
- HARQ process identifier setting
  - The HARQ process to service the request is determined and the HARQ process identifier is set accordingly.

7.2.3 HARQ process

The following are the functions of the HARQ process:

- New Data Indicator setting
  - The New data indicator is incremented each time when there is new data for this HARQ process.
- Processes ACK / NACK from the receiver
  - The status report from the UE is passed to the scheduler.

7.3 UE Operation

The UE operation in support of the HARQ protocol is split among the following three functional units with their associated functions.

7.3.1 HARQ Entity

There is one HARQ entity at the UE performing the following function:

- Processes HARQ process identifiers
  - It allocates received data blocks to different HARQ processes based on the HARQ process identifiers.

7.3.2 HARQ process

The HARQ process at the UE performs the following functions:

- New Data Indicator processing
  - If the New Data Indicator has been incremented compared to the value in the previous transmission, if any, the data currently in the soft buffer can be replaced with the received data block.
  - If the New Data Indicator is identical to the value used in the previous transmission, the received data is combined with the data currently in the soft buffer.
- Error detection result processing

  - The physical layer decodes the data in the soft buffer and checks for errors
  - If no error was detected, the decoded data is forwarded to the reordering entity and an ACK is generated.
  - If an error was detected a NACK is generated.
- Status report transmission
  - The status report is scheduled for transmission based on predetermined configuration.
- Priority class identifier processing
  - Received data is arranged in queues based on priority class identifiers.

7.3.3 Reordering entity

There is one re-ordering entity for each priority class and transport channel configured at the UE. It performs the following functions:

- Reordering of received data based on transmission sequence numbers
  - A received data block is inserted to its appropriate position in the queue according to the TSN.
- Forwarding data to higher layer
  - If the received data block is the next to be delivered to higher layer, all data blocks with consecutive TSNs up to the first not received data block are delivered to higher layer.
  - A timer mechanism determines the delivery of non-consecutive data blocks to higher layer.

A stall avoidance mechanism in the reordering buffer based on upper layer configured timers is used. Additional mechanisms to be used in combination with the timer based mechanism, in order to account for the modulo nature of the TSN, are FFS.

7.3.3.1 Timer based mechanism

Timer T1 controls the stall avoidance in the UE reordering buffer. The value of T1 is configured by upper layers.

If no timer T1 is active:

- the timer T1 shall be started when a data block with TSN=SN is correctly received but can not be delivered to higher layer due to that a data block with lower TSN is missing.

If a timer T1 is already active

- no additional timer shall be started, i.e. only one timer T1 may be active at a given time.

The timer T1 shall be stopped if

- the data block for which the timer was started can be delivered to higher layer before the timer expires.

When the timer T1expires,

- all data blocks up to and including TSN-1 shall be removed from the reordering buffer
- all data blocks up to the first missing data block shall be delivered to higher layer.

When the timer T1 is stopped or expires, and there still exist some received data blocks that can not be delivered to higher layer,

- timer T1 is started for the data block with lowest TSN among those data blocks that can not be delivered.

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.
- [A threshold to detect lost status message is up to NW implementation. If detecting is possible, better performance is achieved by defaulting to a NACK.]
- If a CRC error on the ~~shared control channel~~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.

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 Format

This defines what transport format (Transport Block Set Size) is used in the corresponding HS-DSCH TTI.

8.1.3 ~~Code channels in case of code multiplexing~~Channelization Codes (FDD only)

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

8.1.4 HS-PDSCH ~~physical channel~~ configuration (TDD only)

This identifies to a UE (or UEs) the timeslots and codes it (they) should receive and decode. Additionally, which transport formats are applied on HS-DSCH is also signalled.

8.1.5 HARQ Information

Details of signalling parameters for the HARQ Protocol can be found in subclause 7.1.2~~.1~~. In addition, to support the Incremental Redundancy combining scheme, the Redundancy version is also signalled on the ~~shared control channel~~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 BLER Threshold

BLER value that UE uses for selecting the TFRC provided as a channel quality indicator.

8.1.9 Padding Indicator

In order to account for ~~potential~~possible limited granularity in the Transport Block Set Size a padding indicator alongwith number of padding blocks i~~d~~s indicated in the MAC-hs header.

~~MAC-d PDU size/ Number od MAC-d PDUs~~

~~In order to facilitate the segmentation of the transport block into its component MAC-d PDUs the MAC-hs header includes either the PDU size or ht enumber of MAC-d PDUs concatenated into the Transport Block.~~

The following table identifies the downlink signalling parameters.

Parameter	**Location**	**Length in bits**
HARQ Parameters		
Process Identity	HS-SCCH	3
New Data Indicator	HS-SCCH	[1]
Redundancy Version	HS-SCCH	[2]
Priority Class Indicator	HS-PDSCH	3
TSN	HS-PDSCH	6
Padding Block Indicator and TB count	HS-PDSCH	
Transport Format and Resource Indication Parameters		
Channelization-Code Set	HS-SCCH	7
Modulation	HS-SCCH	1
Transport Block Set Size	HS-SCCH	6
Other Parameters		
Measurement Feedback Rate	Upper Layer signalling on set-up	
Power Offset	Upper Layer signalling on set-up	
$BLER_{threshold}$	Upper Layer signalling on set-up	

Table 1: Downlink Signalling Parameters

8.2 Uplink Signalling Parameters

8.2.1 ACK/NACK

~~This will be~~A one-bit indication is used by the HARQ protocol to~~for~~ indicate~~ing~~ a successful/unsuccessful transmission on the HS-DSCH.

8.2.2 Measurement Report

This may be used in the choice of modulation and coding rate by the network. The transmission rate of the measurement report to the network ~~can be~~is configured by ~~higher~~ upper layer signalling. In TDD, measurement reports may be specifically requested in DL signalling, and downlink channel quality measurements may be reported for specifically requested timeslots.

The following table identifies the uplink signalling parameters.

Parameter	**Channel Location**	**Length in bits**
Status Indicator (ACK/NACK)	DPCCH-HS	1
Channel Quality Indicator	DPCCH-HS	[5]

Table 2: Uplink Signalling Parameters

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.

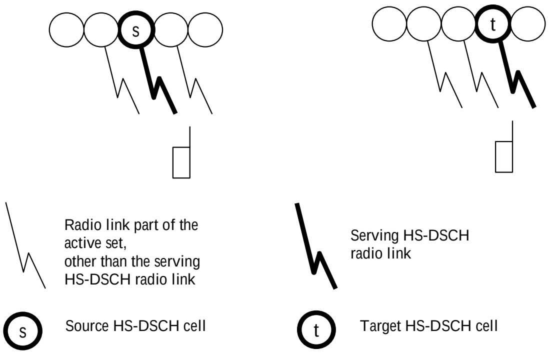


Figure 12. Serving HS-DSCH cell change

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 prior to submission to the RAN#14 plenary.

In 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 re-started, 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 a 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).

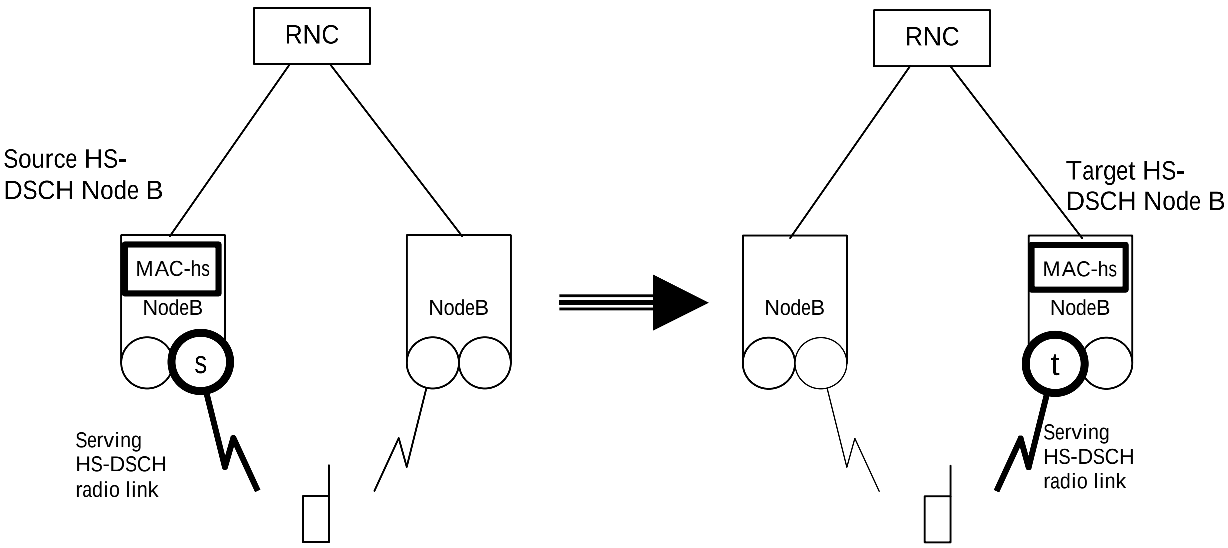


Figure 13. Inter-Node B serving HS-DSCH cell change combined with serving HS-DSCH Node B relocation

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 utilized 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 RAN WG3 specifications to indicate to the Node B to stop transmission to the UE on a decision to execute a HS-DSCH cell change.

~~9~~10 Resource Management

For HSDPA, the resources shall be:

- Number of Codes
- Power that can be allocated for the codes
- Managed on a cell basis

Annex A (informative):
Evaluation Criteria

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

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 HSDPA 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.

~~The following signalling parameters are under consideration.~~

~~B.1.1 Downlink Parameters~~

~~B.1.1.1 HS-DSCH power level~~

~~For FDD, this defines the relationship of HS-PDSCH and CPICH code power level while for TDD it defines the P-CCPCH to HS-DSCH power ratio.~~

~~Table B.1 is a template of the signalling parameters and the associated information to be considered in the evaluation of the downlink signalling parameters for HSDPA.~~

~~Table B.1: Parameters and range for consideration in signalling approach evaluation~~

~~Parameter~~		**~~Before the HSDSCH data packet~~**			**~~Simultaneously with HSDSCH data packet~~**		
		~~Min~~	**~~Prop~~**	**~~Max~~**	**~~Min~~**	**~~Prop~~**	**~~Max~~**
~~UE identification~~							
~~MCS~~							
~~HS-DSCH power level~~							
~~Code channels~~							
~~HARQ process identifier~~							
~~HARQ redundancy version~~							
~~New Data Indicator~~							
~~Power offset for uplink~~							
~~Measurement feedback rate~~							
~~UL Resource ID for HS-PUSCH (TDD)~~							
~~Resource Allocation Information for PUSCH (TDD)~~							
	~~HS UE-Id~~						
	~~UL Resource ID for PUSCH~~						
	~~Synchronisation shift (Low chip rate TDD)~~						
~~Resource Allocation Information for PUCCH (TDD)~~							
	~~HS UE-Id~~						
	~~UL Resource ID for PUCCH~~						
	~~UL Resource ID for PUCCH~~						
	~~Synchronisation shift (Low chip rate TDD)~~						
~~Total~~							

~~The current working assumption is a range of 10-20 bits for FDD for the various downlink signalling fields irrespective of the precise final list of parameters and their placement or splitting of the parameters across the various downlink signalling channels (i.e. dedicated control channel and shared control channel).~~

~~Table B.4 contains the summary of the uplink signalling parameters for TDD.~~

~~Table B.4: Summary of parameters and suggested range for uplink signalling in TDD~~

~~UL Acknowledgement/Measurement Report~~			
~~Parameter~~			
	~~Min~~	~~Prop~~	~~Max~~
~~H-ARQ ack/nack~~	~~[1]~~	~~[1]~~	~~[y]~~
~~Downlink channel quality~~	~~[7]~~	~~[38]~~	~~[60]~~
~~Total Bits →~~ ~~(Note1)~~	~~[8]~~	~~[39]~~	~~[60 + y bits]~~

~~NOTE 1: UL signalling parameters are optional in individual UL acknowledgement/measurement reports.~~

~~NOTE 2: "y" in the above Table refers to the total bits that may be required due to additional information that may be transmitted on the uplink.~~

~~D.1 Protocol Structure~~

~~The possibility to connect directly the HS-DSCH user plane of the SRNC and Node B using the transport network, i.e. by-pass the DRNC for the HS-DSCH user plane, is under consideration.~~

~~D.4 Modulation~~

~~It is under consideration whether there shall be optional support for 64QAM based on a UE capability.~~

~~D.6 Transport Block Set size~~

~~Depending on the granularity of the TB set size a dummy MAC-hs PDU may need to be supported with a corresponding indication in the MAC-hs header.D.7 Shared Control Channels~~

~~RAN WG2 needs to study the impacts on scheduling due to the limitation of maximum four shared control channels that a UE needs to monitor.D.8 Measurements~~

~~It is under consideration what measurements need to be fed back to the UTRAN.~~

Annex ~~A~~ 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		1	0		5.0.0	5.1.0