

**TSG-RAN Meeting #26**  
**Athen, Greece, 08-10 December 2004**

**RP-040489**  
**Agenda item 8.4**

**Source: TSG-RAN WG2.**

**Title: Introduction of the MBMS in RAN: CRs to 25.321.**

The following CRs are in RP-040489:

<b>Spec</b>	<b>CR</b>	<b>Rev</b>	<b>Phase</b>	<b>Subject</b>	<b>Cat</b>	<b>Version-Current</b>	<b>Version-New</b>	<b>Doc-2nd-Level</b>	<b>Workitem</b>
25.321	201	1	Rel-6	Introduction of MBMS MAC header	B	6.2.0	6.3.0	R2-042740	MBMS-RAN
25.321	202	-	Rel-6	Introduction of MBMS	B	6.2.0	6.3.0	R2-042713	MBMS-RAN

## CHANGE REQUEST

# **25.321 CR 201** # rev **1** # Current version: **6.2.0** #

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the # symbols.

**Proposed change affects:** UICC apps#  ME  Radio Access Network  Core Network

<b>Title:</b>	# Introduction of MBMS MAC header		
<b>Source:</b>	# RAN WG2		
<b>Work item code:</b>	# MBMS-RAN	<b>Date:</b>	# 01/12/2004
<b>Category:</b>	# <b>B</b>	<b>Release:</b>	# REL-6
	Use <u>one</u> of the following categories: <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification) Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		Use <u>one</u> of the following releases: <b>2</b> (GSM Phase 2) <b>R96</b> (Release 1996) <b>R97</b> (Release 1997) <b>R98</b> (Release 1998) <b>R99</b> (Release 1999) <b>Rel-4</b> (Release 4) <b>Rel-5</b> (Release 5) <b>Rel-6</b> (Release 6)

<b>Reason for change:</b>	# The current 25.321 does not contain MAC headers for MBMS.		
<b>Summary of change:</b>	#		
	1. MBMS-Id is added to MAC PDU format. 2. TCTF coding for MCCH, MTCH and MSCH is added. 3. MBMS-Id coding for MTCH is added. 4. MAC headers for MCCH, MTCH and MSCH are added.		
<b>Consequences if not approved:</b>	# The lack of support for MBMS in TS 25.321 remains		

<b>Clauses affected:</b>	# 9.1, 9.2										
<b>Other specs affected:</b>	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 20px;">Y</td> <td style="width: 20px;">N</td> </tr> <tr> <td style="width: 20px;"><input type="checkbox"/></td> <td style="width: 20px;"><input checked="" type="checkbox"/></td> </tr> <tr> <td style="width: 20px;"><input type="checkbox"/></td> <td style="width: 20px;"><input checked="" type="checkbox"/></td> </tr> <tr> <td style="width: 20px;"><input type="checkbox"/></td> <td style="width: 20px;"><input checked="" type="checkbox"/></td> </tr> </table>	Y	N	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Other core specifications # Test specifications # O&M Specifications #	
Y	N										
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<input type="checkbox"/>	<input checked="" type="checkbox"/>										
<b>Other comments:</b>	#										

**How to create CRs using this form:**

Comprehensive information and tips about how to create CRs can be found at <http://www.3gpp.org/specs/CR.htm>. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked # contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be

downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/> For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

## 9 Elements for peer-to-peer communication

### 9.1 Protocol data units

#### 9.1.1 General

A MAC PDU is a bit string, with a length not necessarily a multiple of 8 bits. In the drawings in clause 9.1, bit strings are represented by tables in which the first bit is the leftmost one on the first line of the table, the last bit is the rightmost on the last line of the table, and more generally the bit string is to be read from left to right and then in the reading order of the lines.

Depending on the provided service, MAC SDUs are bit strings with any non-null length, or bit strings with an integer number of octets in length. An SDU is included into a MAC PDU from first bit onward.

In the UE for the uplink, all MAC PDUs delivered to the physical layer within one TTI are defined as Transport Block Set (TBS). It consists of one or several Transport Blocks, each containing one MAC PDU. The Transport Blocks, shall be transmitted in the order as delivered from RLC. When multiplexing of RLC PDUs from different logical channels is performed on MAC, the order of all Transport Blocks originating from the same logical channel shall be the same as the order of the sequence delivered from RLC. The order of the different logical channels in a TBS is set by the MAC protocol.

#### 9.1.2 MAC PDU (non-HS-DSCH)

A MAC PDU consists of an optional MAC header and a MAC Service Data Unit (MAC SDU), see figure 9.1.2.1. Both the MAC header and the MAC SDU are of variable size.

The content and the size of the MAC header depends on the type of the logical channel, and in some cases none of the parameters in the MAC header are needed.

The size of the MAC-SDU depends on the size of the RLC-PDU, which is defined during the setup procedure.

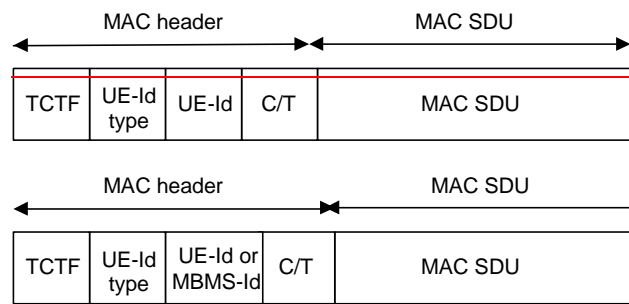


Figure 9.1.2.1: MAC PDU

#### 9.1.3 MAC-d PDU (HS-DSCH)

For HS-DSCH the MAC-d PDU format equals the MAC PDU format for the non HS-DSCH case.

#### 9.1.4 MAC PDU (HS-DSCH)

In case of HS-DSCH a MAC PDU consists of one MAC-hs header and one or more MAC-hs SDUs where each MAC-hs SDU equals a MAC-d PDU. A maximum of one MAC-hs PDU can be transmitted in a TTI per UE. The MAC-hs header is of variable size. The MAC-hs SDUs in one TTI belongs to the same reordering queue.

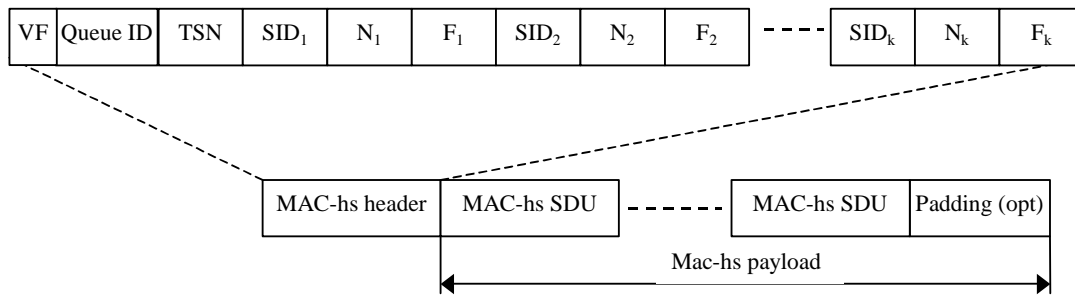


Figure 9.1.4.1: MAC-hs PDU

## 9.2 Formats and parameters

NOTE: MAC header field encodings as specified in this clause with designation "Reserved" are forbidden to be used by a sender in this version of the protocol.

### 9.2.1 MAC PDU: Parameters of the MAC PDU header (non HS-DSCH) and MAC-d PDU header (HS-DSCH)

**NOTE:** In this clause coding and format of MAC header fields for MBMS need to be further studied e.g. based on multiplexing options.

The following fields are defined for the MAC header for transport channels other than HS-DSCH and for the MAC-d PDU header for HS-DSCH:

- Target Channel Type Field

The TCTF field is a flag that provides identification of the logical channel class on FACH and RACH transport channels, i.e. whether it carries BCCH, CCCH, CTCH, SHCCH, [MCCH](#), [MTCH](#), [MSCH](#) or dedicated logical channel information. The size and coding of TCTF for FDD and TDD are shown in tables 9.2.1.1, 9.2.1.2, 9.2.1.3, 9.2.1.4 and 9.2.1.5. Note that the size of the TCTF field of FACH for FDD is ~~either 2, 4~~ or 8 bits ~~depending of the value of the 2 most significant bits~~ and for TDD is either 3 or 5 bits depending on the value of the 3 most significant bits. The TCTF of the RACH for TDD is either 2 or 4 bits depending on the value of the 2 most significant bits.

Table 9.2.1.1: Coding of the Target Channel Type Field on FACH for TDD

TCTF	Designation
000	BCCH
001	CCCH
010	CTCH
01100	DCCH or DTCH over FACH
<a href="#">01101</a>	<a href="#">MCCH</a>
<a href="#">01110</a>	<a href="#">MTCH</a>
<del>01101-01111</del>	<del>MSCH Reserved (PDUs with this coding will be discarded by this version of the protocol)</del>
100	SHCCH
101-111	Reserved (PDUs with this coding will be discarded by this version of the protocol)

Table 9.2.1.2: Coding of the Target Channel Type Field on FACH for FDD

TCTF	Designation
00	BCCH
01000000	CCCH
01000001- <del>01111111</del> 01 001111	Reserved (PDUs with this coding will be discarded by this version of the protocol)
<u>01010000</u>	<u>MCCH</u>
<u>01010001-</u> <u>01011110</u>	<u>Reserved</u> <u>(PDUs with this coding</u> <u>will be discarded by this</u> <u>version of the protocol)</u>
<u>01011111</u>	<u>MSCH</u>
<u>0110</u>	<u>MTCH</u>
<u>0111</u>	<u>Reserved</u> <u>(PDUs with this coding</u> <u>will be discarded by this</u> <u>version of the protocol)</u>
10000000	CTCH
10000001- 10111111	Reserved (PDUs with this coding will be discarded by this version of the protocol)
11	DCCH or DTCH over FACH

Table 9.2.1.3: Coding of the Target Channel Type Field on USCH or DSCH (TDD only)

TCTF	Designation
0	SHCCH
1	DCCH or DTCH over USCH or DSCH

Table 9.2.1.4: Coding of the Target Channel Type Field on RACH for FDD

TCTF	Designation
00	CCCH
01	DCCH or DTCH over RACH
10-11	Reserved (PDUs with this coding will be discarded by this version of the protocol)

Table 9.2.1.5: Coding of the Target Channel Type Field on RACH for TDD

TCTF	Designation
00	CCCH
0100	DCCH or DTCH Over RACH
0101- 0111	Reserved (PDUs with this coding will be discarded by this version of the protocol)
10	SHCCH
11	Reserved (PDUs with this coding will be discarded by this version of the protocol)

- C/T field

The C/T field provides identification of the logical channel instance when multiple logical channels are carried on the same transport channel (other than HS-DSCH) or same MAC-d flow (HS-DSCH). The C/T field is used also to provide identification of the logical channel type on dedicated transport channels and on FACH and RACH when used for user data transmission. The size of the C/T field is fixed to 4 bits for both common transport channels and dedicated transport channels. Table 9.2.1.5a shows the 4-bit C/T field.

**Table 9.2.1.5a: Structure of the C/T field**

C/T field	Designation
0000	Logical channel 1
0001	Logical channel 2
...	...
1110	Logical channel 15
1111	Reserved (PDUs with this coding will be discarded by this version of the protocol)

- UE-Id

The UE-Id field provides an identifier of the UE on common transport channels. The following types of UE-Id used on MAC are defined:

- UTRAN Radio Network Temporary Identity (U-RNTI) may be used in the MAC header of DCCH when mapped onto common transport channels in downlink direction; the U-RNTI is never used in uplink direction;
- Cell Radio Network Temporary Identity (C-RNTI) is used on DTCH and DCCH in uplink, and may be used on DCCH in downlink and is used on DTCH in downlink when mapped onto common transport channels, except when mapped onto DSCH transport channel;
- In FDD, DSCH Radio Network Temporary Identity (DSCH-RNTI) is used on DTCH and DCCH in downlink when mapped onto DSCH transport channel;- the UE id to be used by MAC is configured through the MAC control SAP. The lengths of the UE-id field of the MAC header are given in table 9.2.1.6.

**Table 9.2.1.6: Lengths of UE Id field**

UE Id type	Length of UE Id field
U-RNTI	32 bits
C-RNTI	16 bits
DSCH-RNTI	16 bits

- UE-Id Type

The UE-Id Type field is needed to ensure correct decoding of the UE-Id field in MAC Headers.

**Table 9.2.1.7: UE-Id Type field definition**

UE-Id Type field 2 bits	UE-Id Type
00	U-RNTI
01	C-RNTI or DSCH-RNTI
10	Reserved (PDUs with this coding will be discarded by this version of the protocol)
11	Reserved (PDUs with this coding will be discarded by this version of the protocol)

- MBMS-Id

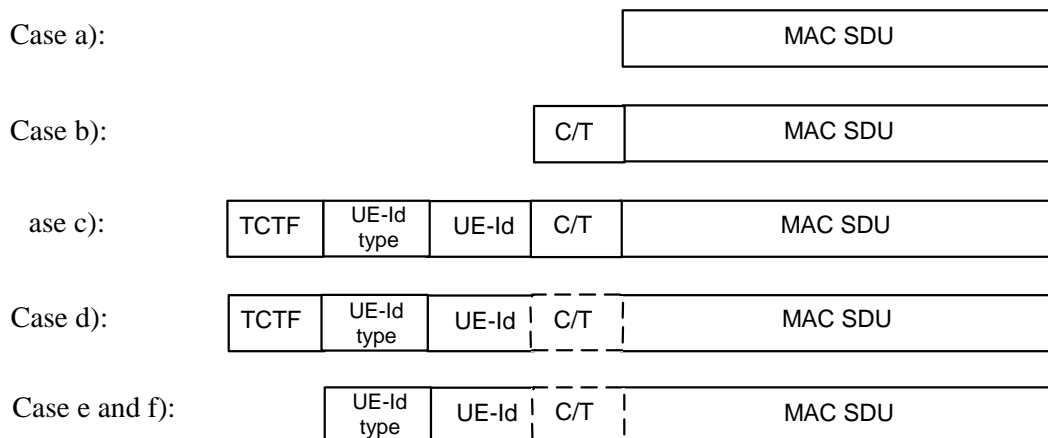
The MBMS-Id field provides an identifier of MTCH for an MBMS service carried on FACH. The MBMS-Id is used in the MAC header of MTCH mapped onto FACH in downlink direction; the MBMS-Id is never used in uplink direction. The MBMS Id to be used by MAC is configured through the MAC control SAP. The length of the MBMS-Id field is 4 bits. Table 9.2.1.7a shows the 4-bit MBMS-Id field.

**Table 9.2.1.8: Structure of the MBMS-Id field**

<u>MBMS-Id field</u>	<u>Designation</u>
<u>0000</u>	<u>MBMS service 1</u>
<u>0001</u>	<u>MBMS service 2</u>
<u>...</u>	<u>...</u>
<u>1110</u>	<u>MBMS service 15</u>
<u>1111</u>	<u>Reserved</u> <u>(PDUs with this coding will be discarded by this version of the protocol)</u>

### 9.2.1.1 MAC header for DTCH and DCCH (not mapped on HS-DSCH)

- a) DTCH or DCCH mapped to DCH, no multiplexing of dedicated channels on MAC:
  - no MAC header is required.
- b) DTCH or DCCH mapped to DCH, with multiplexing of dedicated channels on MAC:
  - C/T field is included in MAC header.
- c) DTCH or DCCH mapped to RACH/FACH:
  - TCTF field, C/T field, UE-Id type field and UE-Id are included in the MAC header. For FACH, the UE-Id type field used is the C-RNTI or U-RNTI. For RACH, the UE-Id type field used is the C-RNTI.
- d) DTCH or DCCH mapped to DSCH or USCH:
  - the TCTF field is included in the MAC header for TDD only. The UE-Id type and UE-Id are included in the MAC header for FDD only. The UE-Id type field used is the DSCH-RNTI. The C/T field is included if multiplexing on MAC is applied.
- e) DTCH or DCCH mapped to DSCH or USCH where DTCH or DCCH are the only logical channels:
  - the UE-Id type and UE-Id are included in the MAC header for FDD only. The UE-Id type field used is the DSCH-RNTI. The C/T field is included in the MAC header if multiplexing on MAC is applied.
- f) DTCH or DCCH mapped to CPCH:
  - UE-Id type field and UE-Id are included in the MAC header. The C/T field is included in the MAC header if multiplexing on MAC is applied. The UE-Id type field used is the C-RNTI.

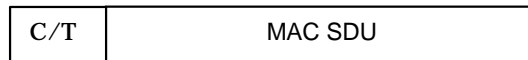
**Figure 9.2.1.1.1: MAC PDU formats for DTCH and DCCH**



### 9.2.1.1a MAC-d Header for DTCH and DCCH (mapped on HS-DSCH)

The MAC-d PDU header for DTCH and DCCH mapped on HS-DSCH is as shown in figure 9.2.1.1a.1.

- C/T field is included in the MAC-d PDU header if multiplexing on MAC is applied.

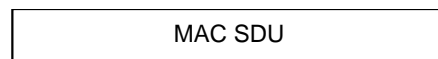


**Figure 9.2.1.1a.1 MAC-d PDU format for DTCH and DCCH mapped on HS-DSCH**

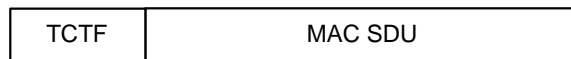
### 9.2.1.2 MAC header for BCCH

- BCCH mapped to BCH:
  - no MAC header is included.
- BCCH mapped to FACH:
  - the TCTF field is included in MAC header.

Case a):



Case b):



**Figure 9.2.1.2.1: MAC PDU formats for BCCH**

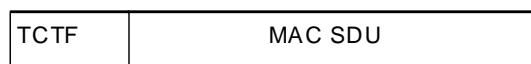
### 9.2.1.3 MAC header for PCCH

There is no MAC header for PCCH.

### 9.2.1.4 MAC header for CCCH

CCCH mapped to RACH/FACH:

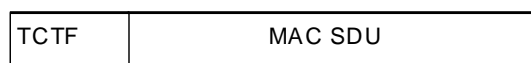
- TCTF field is included in MAC header.



**Figure 9.2.1.4.1: MAC PDU formats for CCCH**

### 9.2.1.5 MAC Header for CTCH

The TCTF field is included as MAC header for CTCH as shown in figure 9.2.1.5.1.



**Figure 9.2.1.5.1: MAC PDU format for CTCH**

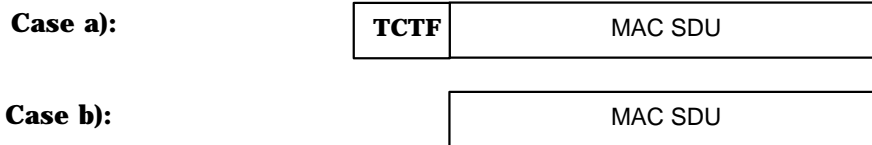
### 9.2.1.6 MAC Header for SHCCH

The MAC header for SHCCH is as shown in figure 9.2.1.6.1.

a) SHCCH mapped to RACH and USCH/FACH and DSCH:

- TCTF has to be included.

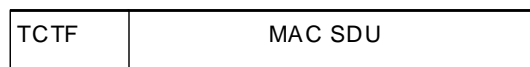
b) SHCCH mapped to RACH and USCH/FACH and DSCH, where SHCCH is the only channel.



**Figure 9.2.1.6.1: MAC PDU format for SHCCH**

### 9.2.1.7 MAC Header for MCCH

The TCTF field is included as MAC header for MCCH as shown in figure 9.2.1.7.1.



**Figure 9.2.1.7.1: MAC PDU format for MCCH**

### 9.2.1.8 MAC Header for MTCH

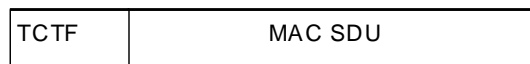
The TCTF field and MBMS-Id field are included in the MAC header for MTCH as shown in figure 9.2.1.8.1.



**Figure 9.2.1.8.1: MAC PDU format for MTCH**

### 9.2.1.9 MAC Header for MSCH

The TCTF field is included in the MAC header for MSCH as shown in figure 9.2.1.9.1.



**Figure 9.2.1.9.1: MAC PDU format for MSCH**

## 9.2.2 MAC PDU: Parameters of the MAC header (HS-DSCH)

- Version Flag (VF):  
The VF field is a one bit flag providing extension capabilities of the MAC-hs PDU format. The VF field shall be set to zero and the value one is reserved in this version of the protocol.
- Queue identifier (Queue ID):  
The Queue ID field provides identification of the reordering queue in the receiver, in order to support independent buffer handling of data belonging to different reordering queues. The length of the Queue ID field is 3 bit.
- Transmission Sequence Number (TSN):  
The TSN field provides an identifier for the transmission sequence number on the HS-DSCH. The TSN field is used for reordering purposes to support in-sequence delivery to higher layers. The length of the TSN field is 6 bit.

- Size index identifier (SID):  
The SID fields identifies the size of a set of consecutive MAC-d PDUs. The MAC-d PDU size for a given SID is configured by higher layers and is independent for each Queue ID. The length of the SID field is 3 bit.
- Number of MAC-D PDUs (N):  
The number of consecutive MAC-d PDUs with equal size is identified with the N field. The length of the N field is 7 bits. In FDD mode, the maximum number of PDUs transmitted in a single TTI shall be assumed to be 70. In 1.28 Mcps TDD mode, the maximum number of PDUs transmitted in a single TTI shall be assumed to be 45. In 3.84 Mcps TDD mode, the maximum number of PDUs transmitted in a single TTI shall be assumed to be 318. If more PDUs than the defined maximum number of PDUs for the corresponding mode are received, the UE behaviour is unspecified.
- Flag (F):  
The F field is a flag indicating if more SID fields are present in the MAC-hs header or not. If the F field is set to "0" the F field is followed by a SID field. If the F field is set to "1" the F field is followed by a MAC-d PDU.

### 9.2.2.1 MAC header for DTCH and DCCH

#### a) DTCH or DCCH mapped to HS-DSCH:

- The Queue ID field and TSN field are always included in the MAC-hs header. One SID field, N field and F field is included for each MAC-d PDU size included in the MAC-hs PDU. Padding is not explicitly indicated but is included in the end of the MAC-hs PDU if the total size of the MAC-hs payload plus the MAC-hs header is smaller than the transport block set size.

**/\*\*\*\*\*\* Remaining sections are omitted below without any change.\*\*\*\*\*\*/**

## CHANGE REQUEST

# 25.321 CR 202 # rev - # Current version: 6.2.0 #

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the # symbols.

**Proposed change affects:** UICC apps  ME  Radio Access Network  Core Network

<b>Title:</b>	# Introduction of MBMS		
<b>Source:</b>	# RAN WG2		
<b>Work item code:</b>	# MBMS-RAN	<b>Date:</b>	# 23/11/2004
<b>Category:</b>	# <b>B</b>	<b>Release:</b>	# REL-6
	Use <u>one</u> of the following categories: <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification) Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) Rel-4 (Release 4) Rel-5 (Release 5) Rel-6 (Release 6)

<b>Reason for change:</b>	# The current 25.321 dose not contain MBMS features.
<b>Summary of change:</b>	# The following MBMS features are introduced:  1. Abbreviations related to MBMS are added. 2. MAC-c/sh is extended to MAC-c/sh/m. 3. MAC-m is added to support selective combining in the UE side. 4. MBMS logical channels, MCCH, MTCH and MSCH, are added. 5. MBMS-Id is added to MAC header for MTCH.
<b>Consequences if not approved:</b>	# The lack of support for MBMS in TS 25.321 remains

<b>Clauses affected:</b>	# 3.2, 4.2, 4.3, 6.1, 6.2, 8.3						
<b>Other specs affected:</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; text-align: center;">Y</td> <td style="width: 20px; text-align: center;">N</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table> Other core specifications	Y	N	<input type="checkbox"/>	<input checked="" type="checkbox"/>	#	
Y	N						
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Y	N						
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	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; text-align: center;">Y</td> <td style="width: 20px; text-align: center;">N</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table> O&M Specifications	Y	N	<input type="checkbox"/>	<input checked="" type="checkbox"/>	#	
Y	N						
<input type="checkbox"/>	<input checked="" type="checkbox"/>						
<b>Other comments:</b>	#						

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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 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 25.301: "Radio Interface Protocol Architecture".
- [3] 3GPP TS 25.302: "Services provided by the Physical Layer".
- [4] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode".
- [5] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".
- [6] 3GPP TS 25.322: "RLC Protocol Specification".
- [7] 3GPP TS 25.331: "Radio Resource Control (RRC); protocol specification".
- [8] 3GPP TR 25.921: "Guidelines and Principles for Protocol Description and Error Handling".
- [9] 3GPP TR 25.990: "Vocabulary for the UTRAN".
- [10] 3GPP TS 33.102: "Security architecture".
- [11] 3GPP TS 25.425: "UTRAN Iur Interface User Plane Protocols for Common Transport Channel Data Streams".
- [12] 3GPP TS 25.133: "Requirements for support of radio resource management (FDD)".
- [13] 3GPP TS 25.214: "Physical layer procedures (FDD)".
- [14] 3GPP TS 25.123: "Requirements for support of radio resource management (TDD)".
- [15] 3GPP TS 33.105: "Cryptographic Algorithm Requirements".

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in [9] and [1] apply.

### 3.2 Abbreviations

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

ASC	Access Service Class
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
C-	Control-

CCCH	Common Control Channel
CPCH	Common Packet Channel (UL)
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DSCH	Downlink Shared Channel
DTCH	Dedicated Traffic Channel
FACH	Forward Link Access Channel
FDD	Frequency Division Duplex
HARQ	Hybrid Automatic Repeat Request
HCSN	HS-SCCH Cyclic Sequence Number
HS-DSCH	High Speed Downlink Shared Channel
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L3	Layer 3 (network layer)
MAC	Medium Access Control
<a href="#">MBMS</a>	<a href="#">Multimedia Broadcast Multicast Service</a>
<a href="#">MCCH</a>	<a href="#">MBMS point-to-multipoint Control Channel</a>
<a href="#">MTCH</a>	<a href="#">MBMS point-to-multipoint Traffic Channel</a>
<a href="#">MSCH</a>	<a href="#">MBMS point-to-multipoint Scheduling Channel</a>
PCCH	Paging Control Channel
PCH	Paging Channel
PDU	Protocol Data Unit
PHY	Physical layer
PhyCH	Physical Channels
RACH	Random Access Channel
RLC	Radio Link Control
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RNTI	Radio Network Temporary Identity
RRC	Radio Resource Control
SAP	Service Access Point
SDU	Service Data Unit
SHCCH	Shared Channel Control Channel
SRNC	Serving Radio Network Controller
SRNS	Serving Radio Network Subsystem
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport Format Indicator
TSN	Transmission Sequence Number
U-	User-
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
USCH	Uplink Shared Channel
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

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## 4 General

### 4.1 Objective

The objective is to describe the MAC architecture and the different MAC entities from a functional point of view.

### 4.2 MAC architecture

The description in this subclause is a model and does not specify or restrict implementations.

According to the RRC functions the RRC is generally in control of the internal configuration of the MAC.

## 4.2.1 MAC Entities

The diagrams that describe the MAC architecture are constructed from MAC entities.

The entities are assigned the following names.

- MAC-b is the MAC entity that handles the following transport channels:
  - broadcast channel (BCH)
- MAC-c/sh/m, is the MAC entity that handles the following transport channels:
  - paging channel (PCH)
  - forward access channel (FACH)
  - random access channel (RACH)
  - common packet channel (UL CPCH). The CPCH exists only in FDD mode.
  - downlink shared channel (DSCH)
  - uplink shared channel (USCH). The USCH exists only in TDD mode.
- MAC-d is the MAC entity that handles the following transport channels:
  - dedicated transport channel (DCH)
- MAC-hs is the MAC entity that handles the following transport channels:
  - high speed downlink shared channel (HS-DSCH)
- MAC-m is the MAC entity that handles the following transport channels:
  - forward access channel (FACH).

The exact functions completed by the entities are different in the UE from those completed in the UTRAN.

NOTE: When a UE is allocated resources for exclusive use by the bearers that it supports the MAC-d entities dynamically share the resources between the bearers and are responsible for selecting the TFI/ TFCI that is to be used in each transmission time interval.

## 4.2.2 MAC-b

The following diagram illustrates the connectivity of the MAC-b entity in a UE and in each cell of the UTRAN.

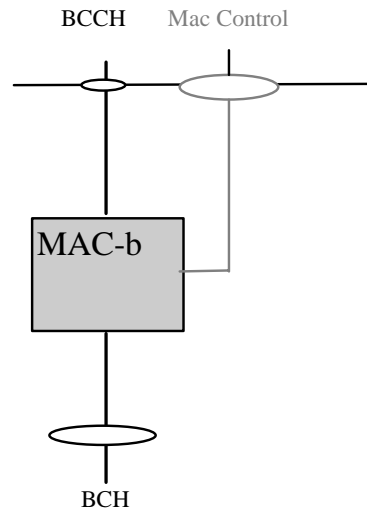
MAC-b represents the control entity for the broadcast channel (BCH).

There is one (current cell) or multiple (current and neighbour cells) MAC-b entities in each UE and one MAC-b in the UTRAN for each cell.

The MAC Control SAP is used to transfer Control information to MAC-b.

The MAC-b entity is located in the Node B.





**Figure 4.2.2.1: UE side and UTRAN side architecture**

### 4.2.3 Traffic Related Architecture - UE Side

Figure 4.2.3.1 illustrates the connectivity of MAC entities.

The MAC-c/sh/m controls access to all common transport channels, except the HS-DSCH transport channel.

The MAC-d controls access to all dedicated transport channels, to MAC-c/sh/m and MAC-hs.

The MAC-hs controls access to the HS-DSCH transport channel.

[In case of selective combining of MTCH channels from multiple cells, the MAC-m controls access to the FACH transport channels used to carry MTCH and MSCH.](#)

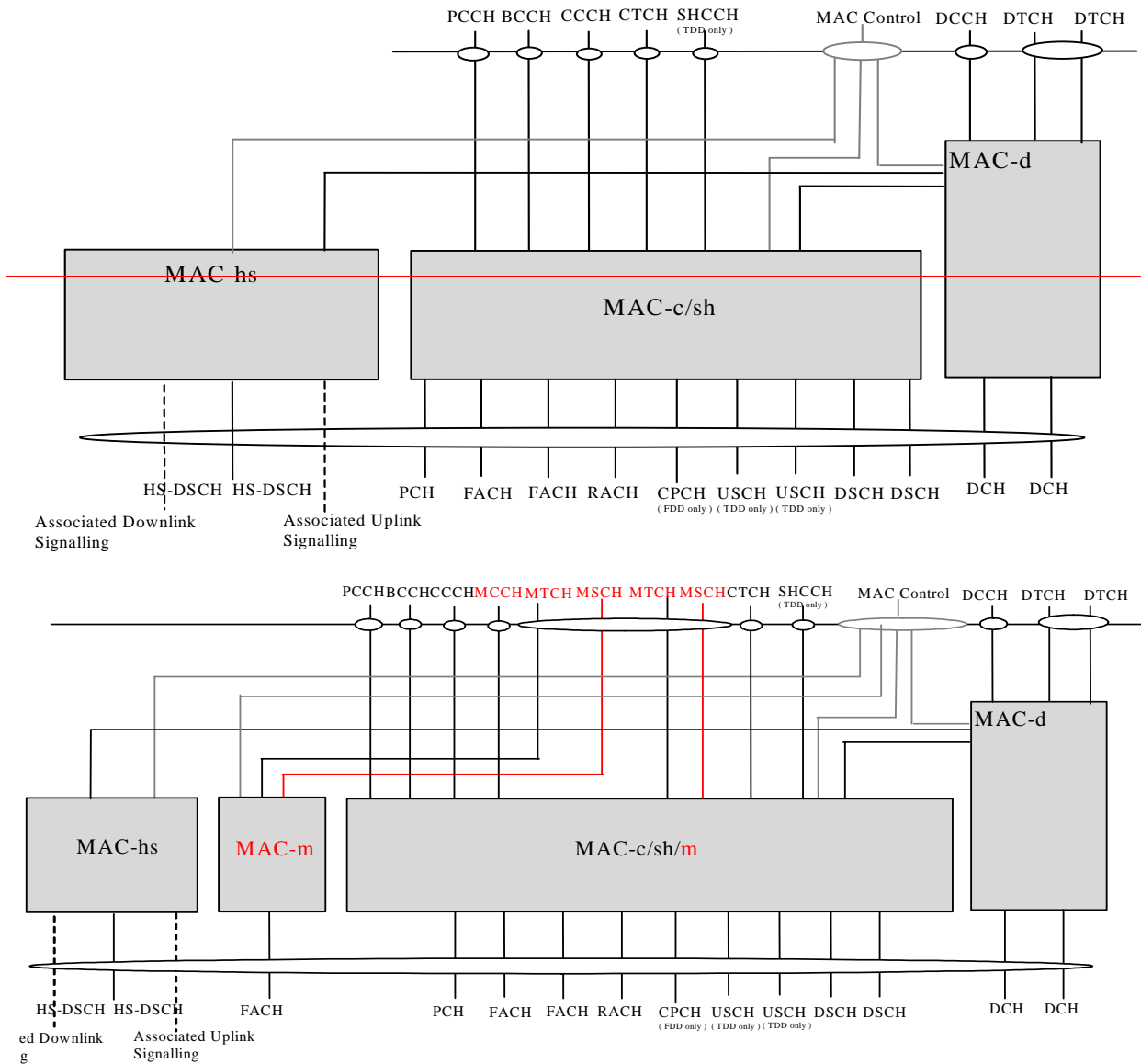
In the downlink, if logical channels of dedicated type are mapped to common transport channels then MAC-d receives the data from MAC-c/sh/m or MAC-hs via the illustrated connection between the functional entities.

In the uplink, if logical channels of dedicated type are mapped to common transport channels then MAC-d submits the data to MAC-c/sh/m via the illustrated connection between the functional entities.

The mapping of logical channels on transport channels depends on the multiplexing that is configured by RRC.

The MAC Control SAP is used to transfer Control information to each MAC entity.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].



**Figure 4.2.3.1: UE side MAC architecture**

#### 4.2.3.1 MAC-c/sh/m entity – UE Side

Figure 4.2.3.1.1 shows the UE side MAC-c/sh/m entity.

The following functionality is covered:

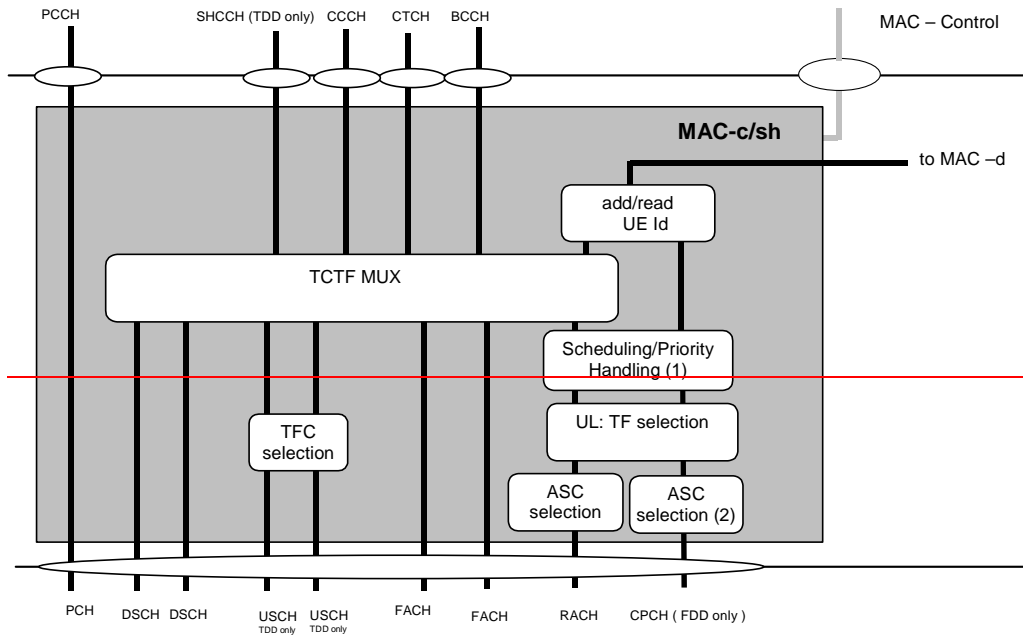
- TCTF MUX:
  - this function represents the handling (insertion for uplink channels and detection and deletion for downlink channels) of the TCTF field in the MAC header, and the respective mapping between logical and transport channels.
    - The TCTF field indicates the common logical channel type, or if a dedicated logical channel is used;
- add/read UE Id:
  - the UE Id is added for CPCH and RACH transmissions
  - the UE Id, when present, identifies data to this UE.
- read MBMS Id
  - the MBMS Id is read in case of MTCH reception;

- [the MBMS Id, when present, identifies received data to an MBMS service.](#)

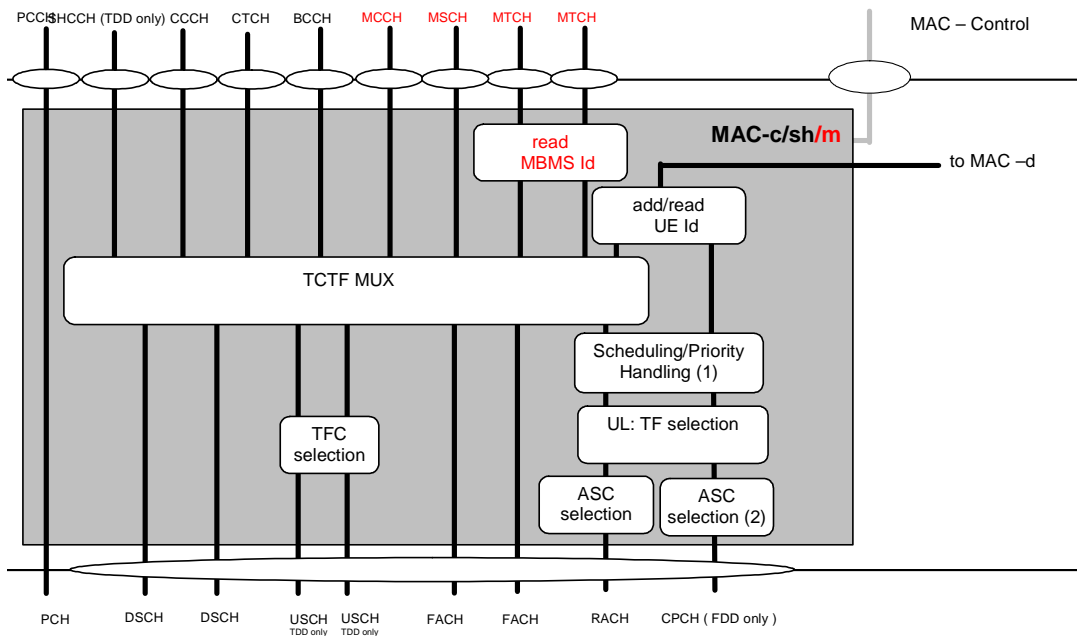
- UL: TF selection:
  - in the uplink, the possibility of transport format selection exists.  
In case of CPCH transmission, a TF is selected based on TF availability determined from status information on the CSICH;
- ASC selection:
  - For RACH, MAC indicates the ASC associated with the PDU to the physical layer. For CPCH, MAC may indicate the ASC associated with the PDU to the Physical Layer. This is to ensure that RACH and CPCH messages associated with a given Access Service Class (ASC) are sent on the appropriate signature(s) and time slot(s). MAC also applies the appropriate back-off parameter(s) associated with the given ASC. When sending an RRC CONNECTION REQUEST message, RRC will determine the ASC; in all other cases MAC selects the ASC;
- scheduling /priority handling
  - this functionality is used to transmit the information received from MAC-d on RACH and CPCH based on logical channel priorities. This function is related to TF selection.
- TFC selection
  - transport format and transport format combination selection according to the transport format combination set (or transport format combination subset) configured by RRC is performed,

The RLC provides RLC-PDUs to the MAC, which fit into the available transport blocks on the transport channels.

There is one MAC-c/sh/m entity in each UE.



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



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

Figure 4.2.3.1.1: UE side MAC architecture / MAC-c/sh/m details

4.2.3.x [MAC-m entity – UE Side](#)

[Figure 4.2.3.x.1 shows the UE side MAC-m entity.](#)

[The following functionality is covered:](#)

- [TCTF DEMUX:](#)

- this function represents the handling (detection and deletion for downlink channels) of the TCTF field in the MAC header, and the respective mapping between logical and transport channels. The TCTF field indicates the common logical channel type;

- read MBMS Id

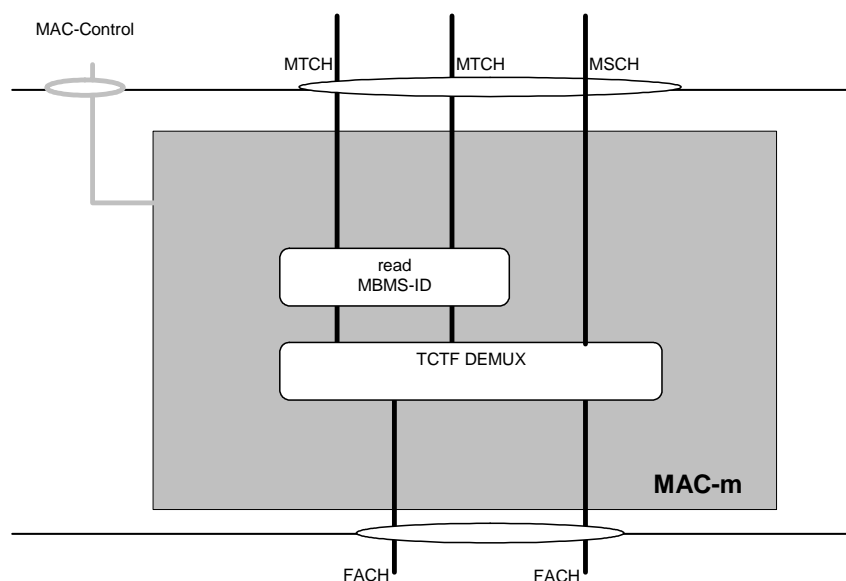
- the MBMS Id is read in case of MTCH reception;

- the MBMS Id, when present, identifies received data to an MBMS service.

The MAC Control SAP is used to transfer control information to MAC-m.

If MTCH channels are selectively combined, the MAC-m entity exists in the UE. Otherwise, the MAC-m entity does not exist.

In case of selective combining of MTCH channels from multiple cells, there are one MAC-c/sh/m for the current cell and one MAC-m entity for each neighboring cell in the UE.



**Figure 4.2.3.x.1: UE side MAC architecture / MAC-m details**

#### 4.2.3.2 MAC-d entity – UE Side

Figure 4.2.3.2.1 shows the UE side MAC-d entity.

The following functionality is covered:

- Transport Channel type switching
  - Transport Channel type switching is performed by this entity, based on decision taken by RRC. This is related to a change of radio resources. If requested by RRC, MAC shall switch the mapping of one designated logical channel between common and dedicated transport channels.
- C/T MUX:
  - The C/T MUX is used when multiplexing of several dedicated logical channels onto one transport channel (other than HS-DSCH) or one MAC-d flow (HS-DSCH) is used. An unambiguous identification of the logical channel is included.
- Ciphering:
  - Ciphering for transparent mode data to be ciphered is performed in MAC-d. Details about ciphering can be found in [10].
- Deciphering:

- Deciphering for ciphered transparent mode data is performed in MAC-d. Details about ciphering can be found in [10].
- UL TFC selection:
  - Transport format and transport format combination selection according to the transport format combination set (or transport format combination subset) configured by RRC is performed.

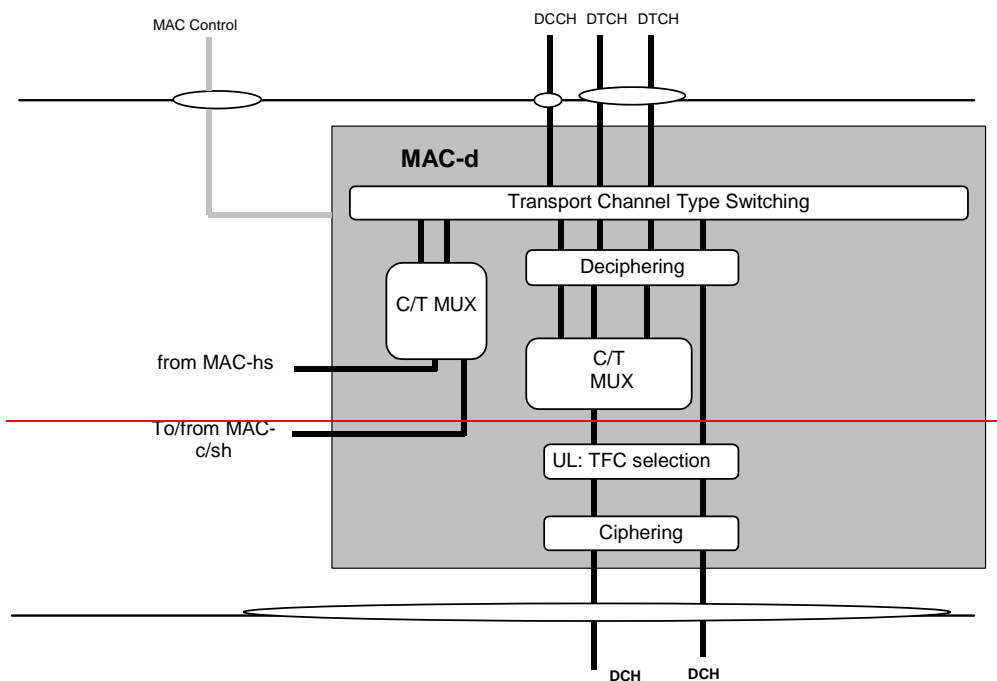
The MAC-d entity is responsible for mapping dedicated logical channels for the uplink either onto dedicated transport channels or to transfer data to MAC-c/sh/m to be transmitted via common channels.

One dedicated logical channel can be mapped simultaneously onto DCH and DSCH. One dedicated logical channel can be simultaneously mapped onto DCH and HS-DSCH.

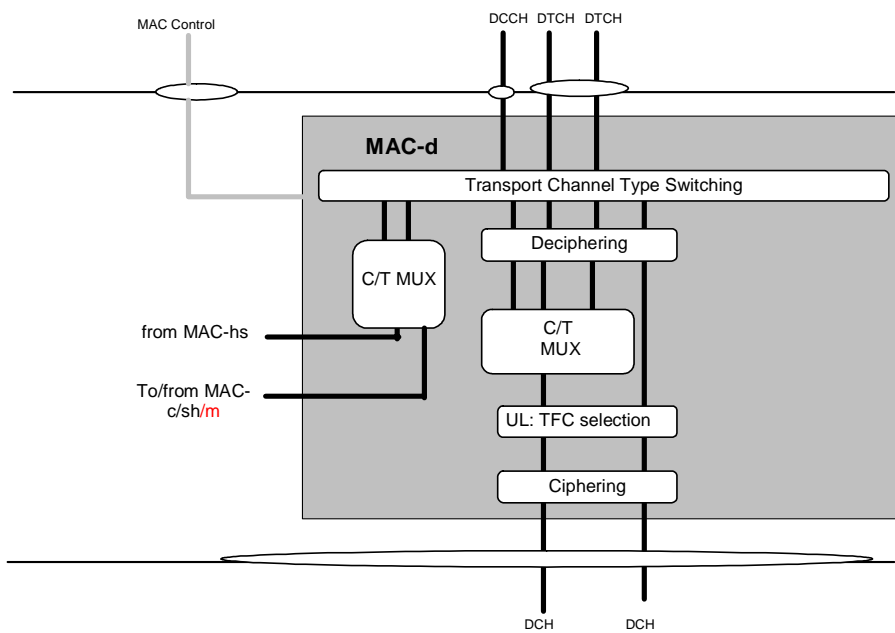
The MAC-d entity has a connection to the MAC-c/sh/m entity. This connection is used to transfer data to the MAC-c/sh/m to transmit data on transport channels that are handled by MAC-c/sh/m (uplink) or to receive data from transport channels that are handled by MAC-c/sh/m (downlink).

The MAC-d entity has a connection to the MAC-hs entity. This connection is used to receive data from the HS-DSCH transport channel which is handled by MAC-hs (downlink).

There is one MAC-d entity in the UE.



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



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 4.2.3.2.1: UE side MAC architecture / MAC-d details**

### 4.2.3.3 MAC-hs entity – UE Side

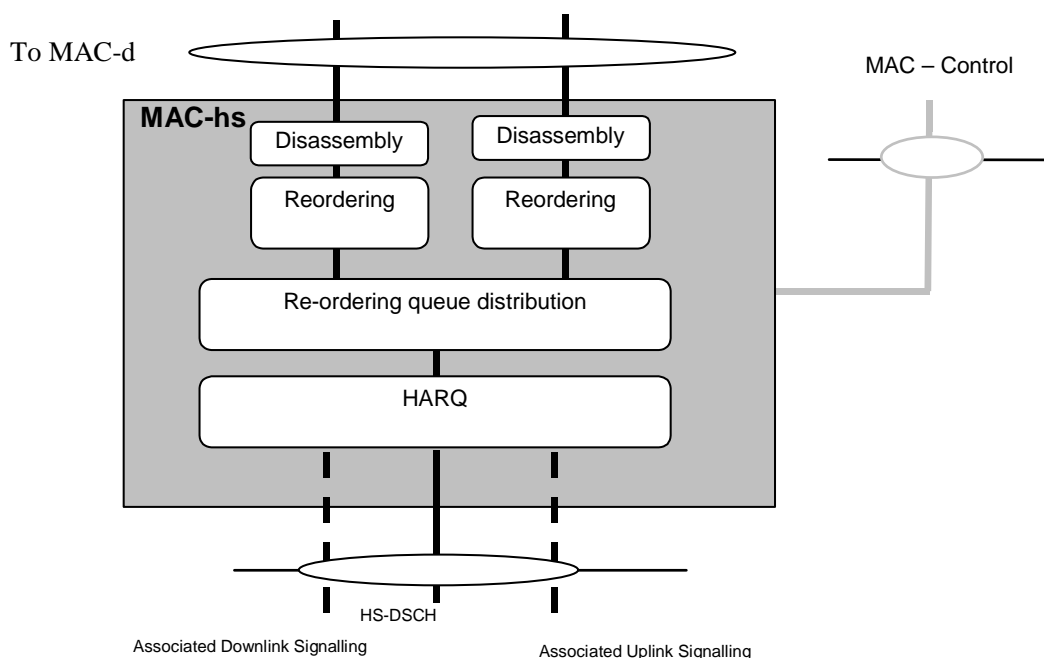
The MAC-hs handles the HSDPA specific functions. In the model below the MAC-hs comprises the following entities:

- HARQ:  
 The HARQ entity is responsible for handling the MAC functions relating to the HARQ protocol. The HARQ

functional entity handles all the tasks that are required for hybrid ARQ. It is responsible for generating ACKs or NACKs. The detailed configuration of the hybrid ARQ protocol is provided by RRC over the MAC-Control SAP.

- Reordering Queue distribution:  
The reordering queue distribution function routes the MAC-hs PDUs to the correct reordering buffer based on the Queue ID.
- Reordering:  
The reordering entity reorders received MAC-hs PDUs according to the received TSN. MAC-hs PDUs with consecutive TSNs are delivered to the disassembly function upon reception. MAC-hs PDUs are not delivered to the disassembly function if MAC-hs PDUs with lower TSN are missing. There is one reordering entity for each Queue ID configured at the UE.
- Disassembly:  
The disassembly entity is responsible for the disassembly of MAC-hs PDUs. When a MAC-hs PDU is disassembled the MAC-hs header is removed, the MAC-d PDUs are extracted and any present padding bits are removed. Then the MAC-d PDUs are delivered to higher layer.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].



**Figure 4.2.3.3.1: UE side MAC architecture / MAC-hs details**

## 4.2.4 Traffic Related Architecture - UTRAN Side

Figure 4.2.4.1 illustrates the connectivity between the MAC entities from the UTRAN side.

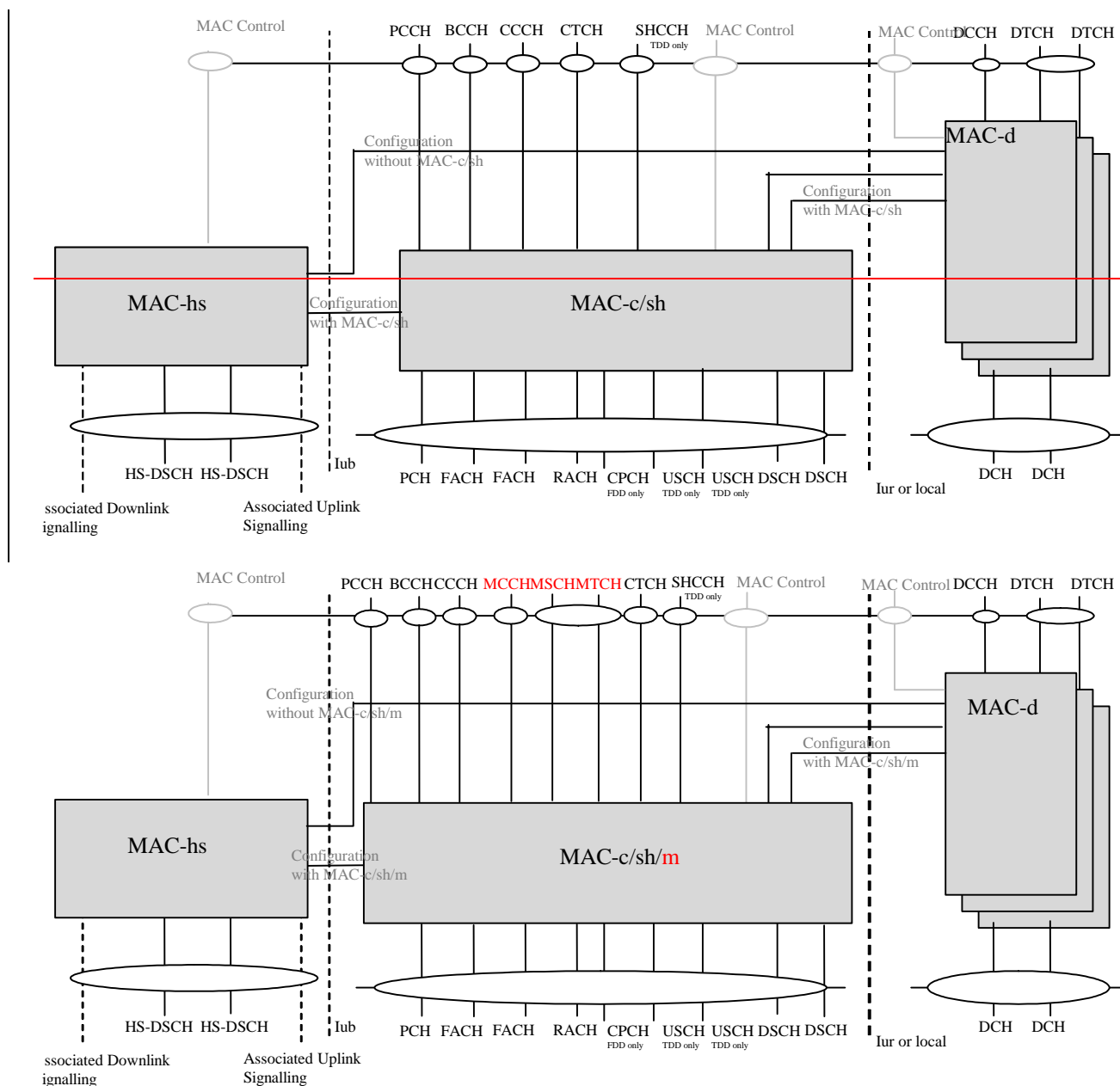
It is similar to the UE case with the exception that there will be one MAC-d for each UE and each UE (MAC-d) that is associated with a particular cell may be associated with that cell's MAC-c/sh/m.

MAC-c/sh/m is located in the controlling RNC while MAC-d is located in the serving RNC. MAC-hs is located in the Node B. The MAC-d PDUs to be transmitted are transferred from MAC-c/sh/m to the MAC-hs via the Iub interface in case of configuration with MAC-c/sh/m, or from the MAC-d via Iur/Iub in case of configuration without MAC-c/sh/m.

The MAC Control SAP is used to transfer Control information to each MAC entity belonging to one UE.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].





**Figure 4.2.4.1: UTRAN side MAC architecture**

#### 4.2.4.1 MAC-c/sh/m entity – UTRAN Side

Figure 4.2.4.1.1 shows the UTRAN side MAC-c/sh/m entity. The following functionality is covered:

- Scheduling – [Buffering](#) – Priority Handling;
- this function manages FACH and DSCH resources between the UEs and between data flows according to their priority [and delay requirements set by higher layers](#).
- TCTF MUX
  - this function represents the handling (insertion for downlink channels and detection and deletion for uplink channels) of the TCTF field in the MAC header, and the respective mapping between logical and transport channels. The TCTF field indicates the common logical channel type, or if a dedicated logical channel is used;
- UE Id Mux;
  - for dedicated type logical channels, the UE Id field in the MAC header is used to distinguish between UEs;

- MBMS Id Mux:

- for MTCH channels, the MBMS Id field in the MAC header is used to distinguish between MBMS services:

- TFC selection:
  - in the downlink, transport format combination selection is done for FACH and PCH and DSCHs;
- Demultiplex;
  - for TDD operation the demultiplex function is used to separate USCH data from different UEs, i.e. to be transferred to different MAC-d entities;
- DL code allocation;
  - this function is used to indicate the code used on the DSCH;
- Flow control;
  - a flow control function exists toward MAC-d to limit buffering between MAC-d and MAC-c/sh/m entities. a flow control function also exists towards MAC-hs in case of configuration with MAC-c/sh/m.

The RLC provides RLC-PDUs to the MAC, which fit into the available transport blocks on the transport channels.

There is one MAC-c/sh/m entity in the UTRAN for each cell;

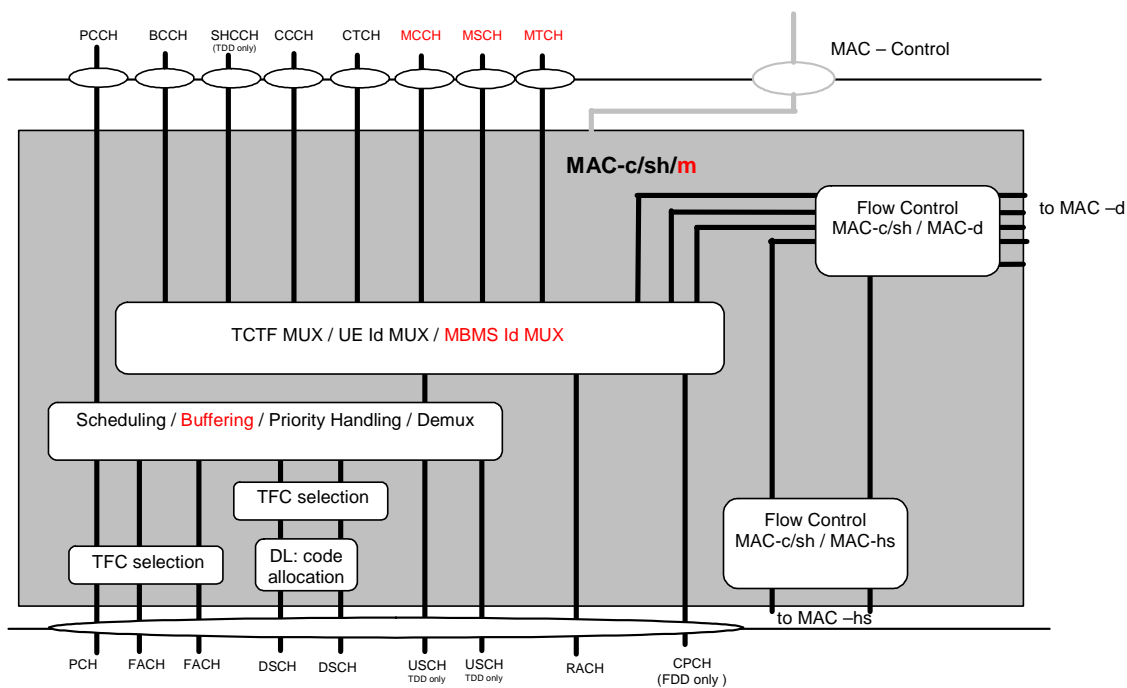
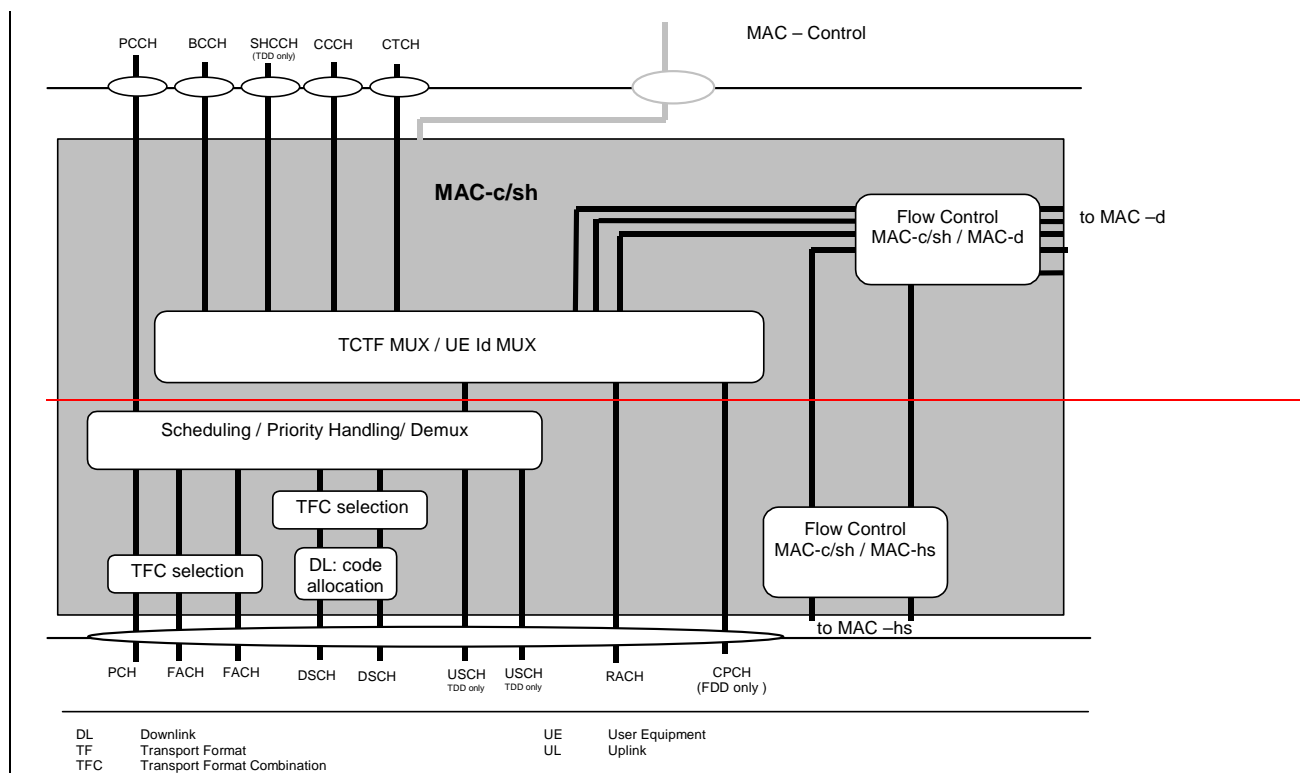


Figure 4.2.4.1.1: UTRAN side MAC architecture / MAC-c/sh/m details

#### 4.2.4.2 MAC-d entity – UTRAN Side

Figure 4.2.4.2.1 shows the UTRAN side MAC-d entity.

The following functionality is covered:

- Transport Channel type switching:
- Transport Channel type switching is performed by this entity, based on decision taken by RRC; this is related to a change of radio resources. If requested by RRC, MAC shall switch the mapping of one designated logical channel between common and dedicated transport channels.

- C/T MUX box;
  - the function includes the C/T field when multiplexing of several dedicated logical channels onto one transport channel (other than HS-DSCH) or one MAC-d flow (HS-DSCH) is used.
- Priority setting;
  - This function is responsible for priority setting on data received from DCCH / DTCH;
- Ciphering;
  - Ciphering for transparent mode data to be ciphered is performed in MAC-d. Details about ciphering can be found in [10].
- Deciphering;
  - Deciphering for ciphered transparent mode data is performed in MAC-d. Details about ciphering can be found in [10].
- DL Scheduling/Priority handling;
  - in the downlink, scheduling and priority handling of transport channels is performed within the allowed transport format combinations of the TFCS assigned by the RRC.
- Flow Control;
  - a flow control function exists toward MAC-c/sh/m to limit buffering between MAC-d and MAC-c/sh/m entities. This function is intended to limit layer 2 signalling latency and reduce discarded and retransmitted data as a result of FACH or DSCH congestion. For the Iur interface this is specified in [11]. A flow control function also exists towards MAC-hs in case of configuration without MAC-c/sh/m, see subclause 4.2.4.2.

A MAC-d entity using common channels other than the high speed downlink shared channel is connected to a MAC-c/sh/m entity that handles the scheduling of the common channels to which the UE is assigned and DL (FACH) priority identification to MAC-c/sh/m;

A MAC-d entity using downlink shared channel is connected to a MAC-c/sh/m entity that handles the shared channels to which the UE is assigned and indicates the level of priority of each PDU to MAC-c/sh/m;

A MAC-d entity using the high speed downlink shared channel may be connected to a MAC-c/sh/m entity that in turn is connected to the MAC-hs entity in the Node B (configuration with MAC-c/sh/m); alternately, a MAC-d entity using the high speed downlink shared channel may be connected to the MAC-hs entity in the Node B in case of configuration without MAC-c/sh/m.

A MAC-d entity is responsible for mapping dedicated logical channels onto the available dedicated transport channels or routing the data received on a DCCH or DTCH to MAC-c/sh/m or to MAC-hs.

One dedicated logical channel can be mapped simultaneously on DCH and DSCH. Different scheduling mechanisms apply for DCH and DSCH. One dedicated logical channel can be mapped simultaneously on DCH and HS-DSCH.

There is one MAC-d entity in the UTRAN for each UE that has one or more dedicated logical channels to or from the UTRAN.

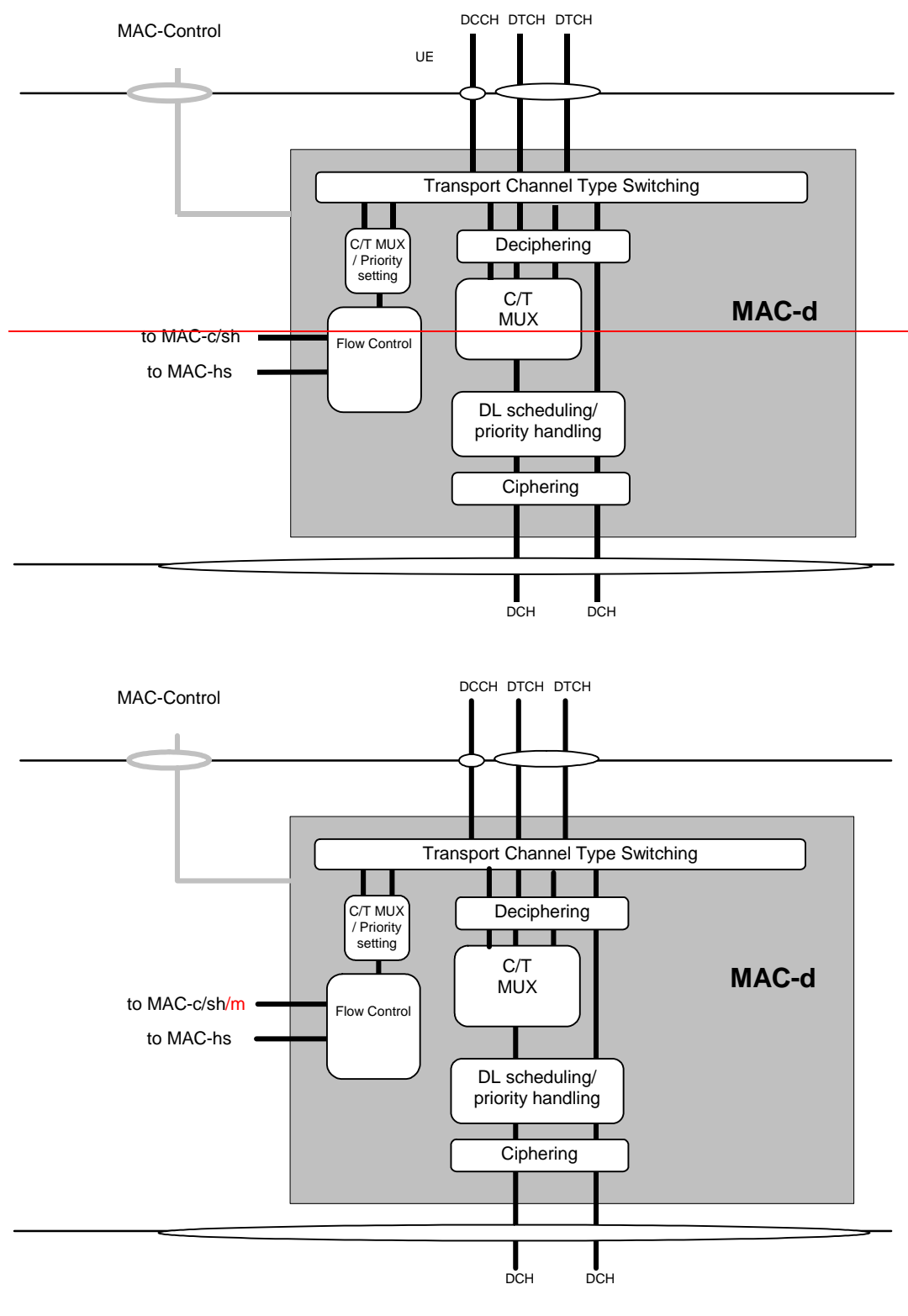


Figure 4.2.4.2.1: UTRAN side MAC architecture / MAC-d details

#### 4.2.4.3 MAC-hs entity – UTRAN Side

There is one MAC-hs entity in the UTRAN for each cell that supports HS-DSCH transmission. 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 HSDPA. MAC-hs receives configuration parameters from the RRC layer via the MAC-Control SAP. There should 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/m in case of configuration with MAC-c/sh/m and MAC-d in case of configuration without MAC-c/sh/m. Both entities together provide a controlled data flow between the MAC-c/sh/m and the MAC-hs (Configuration with MAC-c/sh/m) or the MAC-d and MAC-hs (Configuration without MAC-c/sh/m) 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 MAC-d flow for a given MAC-hs entity.
- Scheduling/Priority Handling:  
This function manages HS-DSCH resources between HARQ entities and data flows according to their priority. Based on status reports from associated uplink signalling either new transmission or retransmission is determined. Further it determines the Queue ID and TSN for each new MAC-hs PDU being serviced, and in the case of TDD the HCSN is determined. A new transmission can be initiated instead of a pending retransmission at any time to support the priority handling.
- 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.
- TFRC selection:  
Selection of an appropriate transport format and resource for the data to be transmitted on HS-DSCH.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].

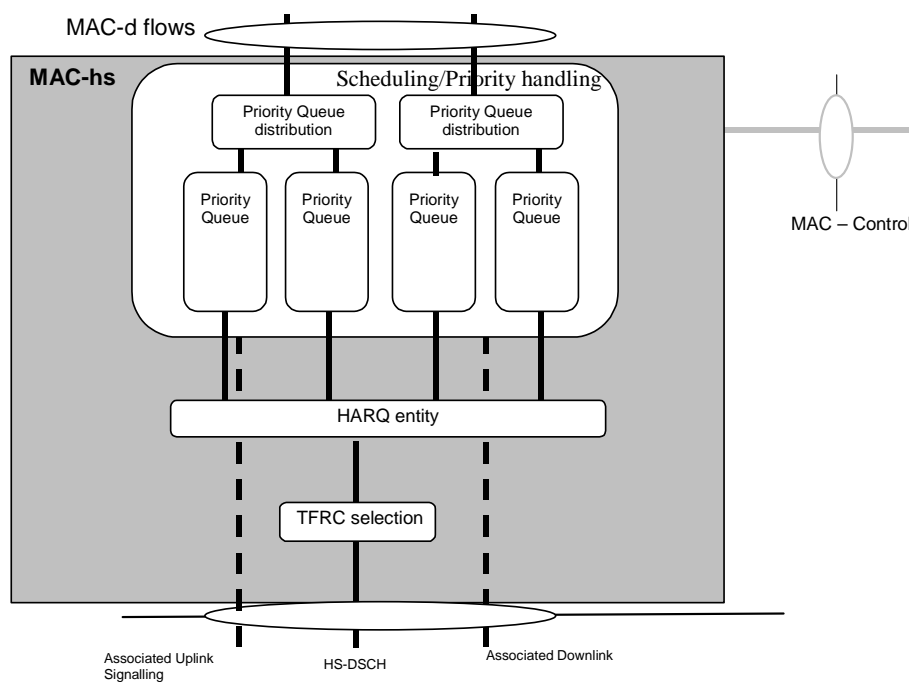


Figure 4.2.4.3.1: UTRAN side MAC architecture / MAC-hs details

## 4.3 Channel structure

The MAC operates on the channels defined below; the transport channels are described between MAC and Layer 1, the logical channels are described between MAC and RLC.

The following subclauses provide an overview, the normative description can be found in [2] and [3] respectively.

### 4.3.1 Transport channels

Common transport channel types are:

- Random Access Channel(s) (RACH);
- Forward Access Channel(s) (FACH);
- Downlink Shared Channel(s) (DSCH);
- High Speed Downlink Shared Channel(s) (HS-DSCH);
- Common Packet Channel(s) (CPCH) for UL FDD operation only;
- Uplink Shared Channel(s) (USCH), for TDD operation only;
- Broadcast Channel (BCH);
- Paging Channel (PCH).

Dedicated transport channel types are:

- Dedicated Channel (DCH).

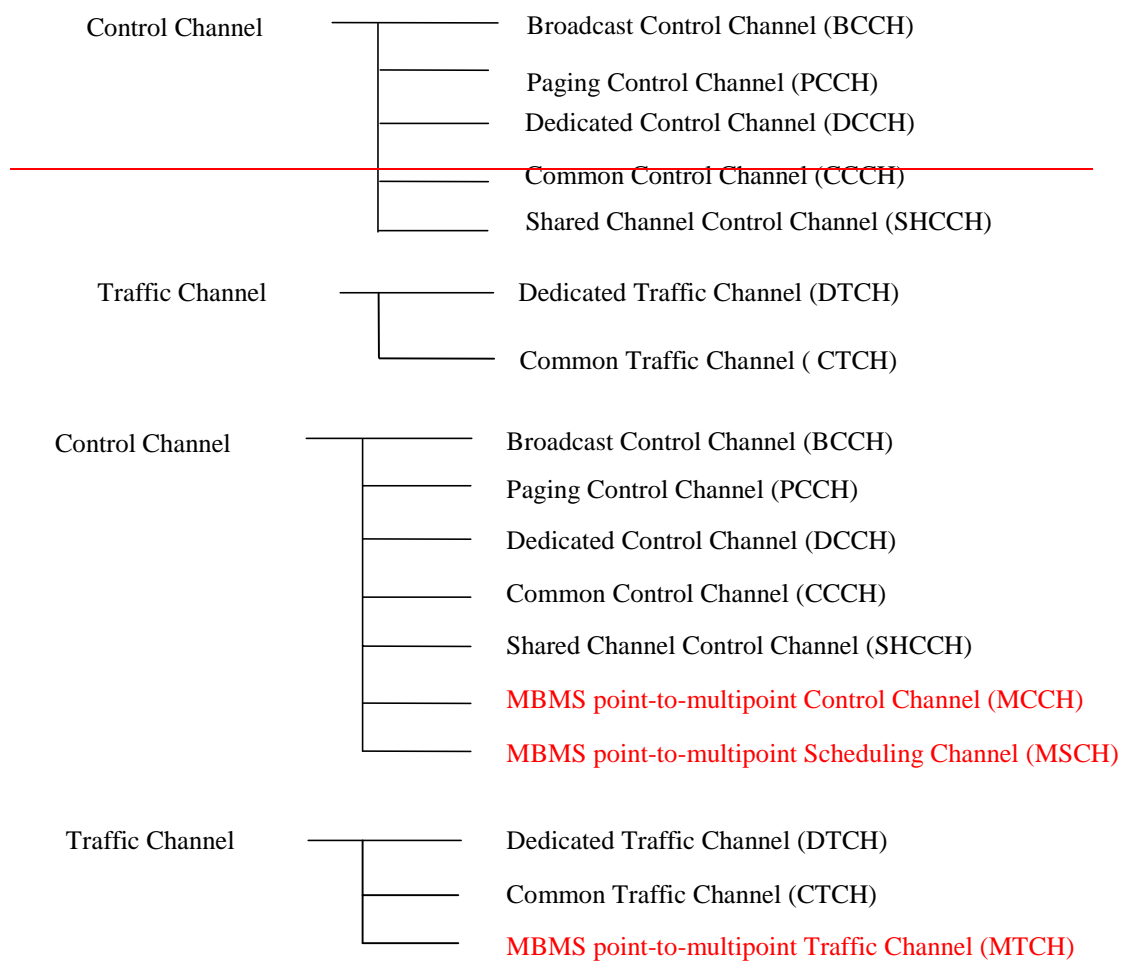
### 4.3.2 Logical Channels

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 what type of information is transferred.

#### 4.3.2.1 Logical channel structure

The configuration of logical channel types is depicted in figure 4.3.2.1.



**Figure 4.3.2.1: Logical channel structure**

#### 4.3.2.2 Control Channels

Following control channels are used for transfer of control plane information only:

- Broadcast Control Channel (BCCH);
- Paging Control Channel (PCCH);
- Common Control Channel (CCCH);
- Dedicated Control Channel (DCCH);
- Shared Channel Control Channel (SHCCH);
- [MBMS point-to-multipoint Control Channel \(MCCH\)](#);
- [MBMS point-to-multipoint Scheduling Channel \(MSCH\)](#)

#### 4.3.2.3 Traffic Channels

Following traffic channels are used for the transfer of user plane information only:

- Dedicated Traffic Channel (DTCH);
- Common Traffic Channel (CTCH);



- [MBMS point-to-multipoint Traffic Channel \(MTCH\)](#).

---

## 5 Services provided to upper layers

This clause describes the different services provided by the MAC to higher layers. For a detailed description of the following functions see [2].

### 5.1 Description of Services provided to upper layers

- Data transfer: This service provides unacknowledged transfer of MAC SDUs between peer MAC entities without data segmentation.
- Reallocation of radio resources and MAC parameters: This service performs on request of RRC execution of radio resource reallocation and change of MAC parameters.
- Reporting of measurements: Local measurements are reported to RRC.

---

## 6 Functions

### 6.1 Description of the MAC functions

The functions of MAC include:

- mapping between logical channels and transport channels;
- selection of appropriate Transport Format for each Transport Channel depending on instantaneous source rate;
- priority handling between data flows of one UE;
- priority handling between UEs by means of dynamic scheduling;
- identification of UEs on common transport channels;
- [identification of MBMS services on common transport channels](#);
- multiplexing/demultiplexing of upper layer PDUs into/from transport blocks delivered to/from the physical layer on common transport channels;
- multiplexing/demultiplexing of upper layer PDUs into/from transport block sets delivered to/from the physical layer on dedicated transport channels;
- traffic volume measurement;
- Transport Channel type switching;
- ciphering for transparent mode RLC;
- Access Service Class selection for RACH and CPCH transmission;
- control of HS-DSCH transmission and reception including support of HARQ;
- HS-DSCH Provided Bit Rate measurement.

## 6.2 Relation between MAC Functions and Transport Channels

### 6.2.1 Relation between MAC Functions and Transport Channels in UTRAN

Table 6.2.1.1: UTRAN MAC functions corresponding to the transport channel

Associated MAC Functions	Logical Ch	Transport Ch	TF Selection	Priority handling between UEs	Priority handling (one UE)	Scheduling	Identification of UEs or MBMS services	Mux/ Demux on common transport channels	Mux/ Demux on dedicated transport channels	HARQ support
Uplink (Rx)	CCCH	RACH						X		
	DCCH	RACH					X	X		
	DCCH	CPCH					X	X		
	DCCH	DCH							X	
	DTCH	RACH					X	X		
	DTCH	CPCH					X	X		
	DTCH	DCH							X	
	SHCCH	RACH					X	X		
	SHCCH	USCH						X		
	DTCH	USCH						X		
	DCCH	USCH						X		
Downlink (Tx)	BCCH	BCH				X				
	BCCH	FACH	X			X		X		
	PCCH	PCH	X			X				
	CCCH	FACH	X	X		X		X		
	CTCH	FACH	X			X		X		
	MCCH	FACH	X			X		X		
	MSCH	FACH	X			X		X		
	MTCH	FACH	X			X	X	X		
	DCCH	FACH	X	X		X	X	X		
	DCCH	DSCH	X	X			X	X		
	DCCH	DCH	X		X				X	
	DCCH	HS-DSCH	X (1)	X	X	X	X	X		X
	DTCH	FACH	X	X		X	X	X		
	DTCH	DSCH	X	X			X	X		
	DTCH	DCH	X		X				X	
DTCH	HS-DSCH	X (1)	X	X	X	X	X		X	
SHCCH	FACH	X	X			X	X			
SHCCH	DSCH	X	X				X			

NOTE 1: In case of HS-DSCH the TF selection is replaced by TFRC selection.

## 6.2.2 Relation of MAC Functions and Transport Channels in UE

Table 6.2.2.1: UE MAC functions corresponding to the transport channel

Associated MAC Functions	Logical Ch	Transport Ch	TF Selection	Priority handling (one UE)	Identification	Mux/Demux on common transport channels	Mux/Demux on dedicated transport channels	HARQ support
Uplink (Tx)	CCCH	RACH				X		
	DCCH	RACH	X	X	X	X		
	DCCH	CPCH	X	X	X	X		
	DCCH	DCH	X	X			X	
	DTCH	RACH	X	X	X	X		
	DTCH	CPCH	X	X	X	X		
	DTCH	DCH	X	X			X	
	SHCCH	RACH				X		
	SHCCH	USCH	X	X		X		
	DCCH	USCH	X	X		X		
	DTCH	USCH	X	X		X		
Downlink (Rx)	BCCH	BCH						
	BCCH	FACH				X		
	PCCH	PCH						
	CCCH	FACH				X		
	CTCH	FACH				X		
	MCCH	FACH				X		
	MSCH	FACH				X		
	MTCH	FACH			X	X		
	DCCH	FACH			X	X		
	DCCH	DSCH				X		
	DCCH	DCH					X	
	DCCH	HS-DSCH			X	X		X
	DTCH	FACH			X	X		
	DTCH	DSCH				X		
	DTCH	DCH					X	
DTCH	HS-DSCH			X	X		X	
SHCCH	FACH				X			
SHCCH	DSCH				X			

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## 7 Services expected from physical layer

The physical layer offers information transfer services to MAC. For detailed description, see [3].

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## 8 Elements for layer-to-layer communication

The interaction between the MAC layer and other layers are described in terms of primitives where the primitives represent the logical exchange of information and control between the MAC layer and other layers. The primitives shall not specify or constrain implementations. The MAC is connected to layer 1, RLC and RRC. The following subclauses describe the primitives between these layers.

## 8.1 Primitives between layers 1 and 2

### 8.1.1 Primitives

The primitives are described in [3].

### 8.1.2 Parameters

a) Transport Format Resource Indicator (TFRI) for HS-DSCH:

- For HS-DSCH the Transport Block size is derived from the TFRI value signalled on the HS-SCCH. The mapping between TFRI value and Transport Block size is specified in subclause 9.2.3.

## 8.2 Primitives between MAC and RLC

### 8.2.1 Primitives

The primitives between MAC layer and RLC layer are shown in table 8.2.1.1.

**Table 8.2.1.1: Primitives between MAC layer and RLC layer**

Generic Name	Parameter			
	Request	Indication	Response	Confirm
<b>MAC-DATA</b>	Data, BO, UE-ID type indicator, RLC Entity Info	Data, No_TB, TD (note), Error indication		
<b>MAC-STATUS</b>		No_PDU, PDU_Size, TX status, Status_Report_REQ	BO, RLC Entity Info	
NOTE: TDD only.				

#### MAC-DATA-Req/Ind:

- MAC-DATA-Req primitive is used to request that an upper layer PDU be sent using the procedures for the information transfer service;
- MAC-DATA-Ind primitive indicates the arrival of upper layer PDUs received within one transmission time interval by means of the information transfer service.

#### MAC-STATUS-Ind/Resp:

- MAC-STATUS-Ind primitive indicates to RLC for each logical channel the rate at which it may transfer data to MAC. Parameters are the number of PDUs that can be transferred in each transmission time interval and the PDU size; it is possible that MAC would use this primitive to indicate that it expects the current buffer occupancy of the addressed logical channel in order to provide for optimised TFC selection on transport channels with long transmission time interval. At the UE, MAC-STATUS-Ind primitive is also used to indicate from MAC to RLC that MAC has requested data transmission by PHY (i.e. PHY-DATA-REQ has been submitted, see Fig. 11.2.2.1), or that transmission of an RLC PDU on RACH or CPCH has failed due to exceeded preamble ramping cycle counter.
- MAC-STATUS-Resp primitive enables RLC to acknowledge a MAC-STATUS-Ind. It is possible that RLC would use this primitive to indicate that it has nothing to send or that it is in a suspended state or to indicate the current buffer occupancy to MAC.

### 8.2.2 Parameters

a) Data:

- it contains the RLC layer messages (RLC-PDU) to be transmitted, or the RLC layer messages that have been received by the MAC sub-layer.
- b) Number of transmitted transport blocks (No\_TB) :
- indicates the number of transport blocks transmitted by the peer entity within the transmission time interval, based on the TFI value.
- c) Buffer Occupancy (BO):
- the parameter Buffer Occupancy (BO) indicates for each logical channel the amount of data in number of bytes that is available for transmission and retransmission in RLC layer. When MAC is connected to an AM RLC entity, control PDUs to be transmitted and RLC PDUs outside the RLC Tx window shall also be included in the BO. RLC PDUs that have been transmitted but not negatively acknowledged by the peer entity shall not be included in the BO.
- d) RX Timing Deviation (TD), TDD only:
- it contains the RX Timing Deviation as measured by the physical layer for the physical resources carrying the data of the Message Unit. This parameter is optional and only for Indication. It is needed for the transfer of the RX Timing Deviation measurement of RACH transmissions carrying CCCH data to RRC.
- e) Number of PDU (No\_PDU):
- specifies the number of PDUs that the RLC is permitted to transfer to MAC within a transmission time interval.
- f) PDU Size (PDU\_Size):
- specifies the size of PDU that can be transferred to MAC within a transmission time interval.
- g) UE-ID Type Indicator:
- indicates the UE-ID type to be included in MAC for a DCCH and DTCH when they are mapped onto a common transport channel (i.e. FACH, RACH, DSCH in FDD or CPCH). On the UE side UE-ID Type Indicator shall always be set to C-RNTI.
- h) TX status:
- when set to value "transmission unsuccessful" this parameter indicates to RLC that transmission of an RLC PDU failed in the previous Transmission Time Interval, when set to value "transmission successful" this parameter indicates to RLC that the requested RLC PDU(s) has been submitted for transmission by the physical layer.
- i) RLC Entity Info
- indicates to MAC the configuration parameters that are critical to TFC selection depending on its mode and the amount of data that could be transmitted at the next TTI. This primitive is meant to insure that MAC can perform TFC selection (see subclause 11.4).
- j) Error indication
- When a MAC SDU is delivered to upper layer, an error indication is given for the SDU to upper layer if an error indication for the SDU has been received from lower layer.
- k) Status\_Report\_REQ
- indicates to all AM RLC entities mapped on HS-DSCH to generate a status report when the MAC-hs resets.

## 8.3 Primitives between MAC and RRC

### 8.3.1 Primitives

The primitives between MAC and RRC are shown in table 8.3.1.1.

Table 8.3.1.1: Primitives between MAC sub-layer and RRC

Generic Name	Parameter			
	Request	Indication	Response	Confirm
<b>CMAC-CONFIG</b>	UE information elements, RB information elements, TrCH information elements, RACH transmission control elements, Ciphering elements, CPCH transmission control elements, <a href="#">MBMS information elements</a>			
<b>CMAC-MEASUREMENT</b>	Measurement information elements	Measurement result		
<b>CMAC-STATUS</b>		Status info		

**CMAC-CONFIG-Req:**

- CMAC-CONFIG-Req is used to request for setup, release and configuration of a logical channel, e.g. RNTI allocation, switching the connection between logical channels and transport channels, TFCS update or scheduling priority of logical channel.

**CMAC-MEASUREMENT-Req/Ind:**

- CMAC-MEASUREMENT-Req is used by RRC to request MAC to perform measurements, e.g. traffic volume measurements;
- CMAC-MEASUREMENT-Ind is used to notify RRC of the measurement result.

**CMAC-STATUS-Ind:**

- CMAC-STATUS-Ind primitive notifies RRC of status information.

## 8.3.2 Parameters

See [7] for a detailed description of the UE, RB and TrCH information elements.

- UE information elements
  - S-RNTI
  - SRNC identity
  - C-RNTI
  - Activation time
- RB information elements
  - RB multiplexing info (Transport channel identity, Logical channel identity, MAC logical channel priority)
- TrCH information elements
  - Transport Format Combination Set
  - MAC-hs reset indicator
  - Re-ordering release timer (T1)
- Measurement information elements
  - Reporting Quantity identifiers
  - Time interval to take an average or a variance (applicable when Average or Variance is Reporting Quantity)
- Measurement result
  - Reporting Quantity
- Status info
  - when set to value "transmission unsuccessful" this parameter indicates to RRC that transmission of a TM RLC PDU failed (due to e.g. Maximum number of preamble ramping cycles reached for RACH in FDD), when set to value "transmission successful" this parameter indicates to RRC that the requested TM RLC PDU(s) has been submitted for transmission by the physical layer.

- g) RACH transmission control elements
  - Set of ASC parameters (identifier for PRACH partitions, persistence values)
  - Maximum number of preamble ramping cycles (FDD) or synchronisation attempts (1.28 Mcps TDD)  $M_{\max}$
  - Minimum and maximum number of time units between two preamble ramping cycles,  $N_{\text{BO1min}}$  and  $N_{\text{BO1max}}$  (FDD only)
  - ASC for RRC CONNECTION REQUEST message
- h) Cipherring elements
  - Cipherring mode
  - Cipherring key
  - Cipherring sequence number
- i) CPCH transmission control elements
  - CPCH persistency value, P for each Transport Format
  - Maximum number of preamble ramping cycles  $N_{\text{access\_fails}}$
  - NF\_max (Maximum number of frames for CPCH transmission for each Transport Format)
  - N\_EOT (Number of EOT for release of CPCH transmission)
  - Backoff control timer parameters
  - Transport Format Set
  - Initial Priority Delays
  - Channel Assignment Active indication
- j) [MBMS information elements](#)
  - [MBMS Id](#)