

# ETSI TS 125 301 V4.4.0 (2002-09)

---

*Technical Specification*

## **Universal Mobile Telecommunications System (UMTS); Radio Interface Protocol Architecture (3GPP TS 25.301 version 4.4.0 Release 4)**



## Reference

---

RTS/TSGR-0225301v440

## Keywords

---

UMTS

***ETSI***

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

---

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° 7803/88

---

***Important notice***

---

Individual copies of the present document can be downloaded from:

<http://www.etsi.org>

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at

<http://portal.etsi.org/tb/status/status.asp>

If you find errors in the present document, send your comment to:

[editor@etsi.fr](mailto:editor@etsi.fr)

---

***Copyright Notification***

---

No part may be reproduced except as authorized by written permission.  
The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2002.  
All rights reserved.

**DECT™**, **PLUGTESTS™** and **UMTS™** are Trade Marks of ETSI registered for the benefit of its Members.  
**TIPHON™** and the **TIPHON logo** are Trade Marks currently being registered by ETSI for the benefit of its Members.  
**3GPP™** is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

---

# Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<http://webapp.etsi.org/IPR/home.asp>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

---

# Foreword

This Technical Specification (TS) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities, UMTS identities or GSM identities. These should be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between GSM, UMTS, 3GPP and ETSI identities can be found under [www.etsi.org/key](http://www.etsi.org/key) .



5.4	Layer 3 - Uu Stratum Services and Functions .....	25
5.4.1	Uu Stratum services .....	25
5.4.1.1	General Control .....	25
5.4.1.2	Notification .....	25
5.4.1.3	Dedicated Control .....	25
5.4.2	RRC functions .....	26
5.5	Interactions between RRC and lower layers in the C plane .....	28
5.6	Protocol termination .....	28
5.6.1	Protocol termination for DCH .....	28
5.6.2	Protocol termination for RACH/FACH .....	29
5.6.3	Void .....	31
5.6.4	Protocol termination for CPCH .....	31
5.6.5	Protocol termination for DSCH .....	31
5.6.5.1	DSCH definition .....	31
5.6.5.2	Resource allocation and UE identification on DSCH .....	32
5.6.5.2.1	Case A (UE requires a downlink TFCI on a DPCCH) .....	32
5.6.5.2.2	Case B (UE requires a downlink SHCCH) (TDD only) .....	32
5.6.5.3	Model of DSCH in UTRAN .....	32
5.6.5.4	Protocol termination .....	33
5.6.6	Protocol termination for transport channel of type USCH .....	34
5.6.6.1	USCH definition .....	34
5.6.6.2	Resource allocation and UE identification on USCH .....	34
5.6.6.3	Model of USCH in UTRAN .....	34
5.6.6.4	Protocol termination .....	35
5.6.7	Protocol termination for transport channel of type BCH .....	36
5.6.8	Protocol termination for transport channel of type PCH .....	36
6	User Identification and RRC Connection Mobility .....	37
6.1	UE identification on the radio interface .....	37
6.2	UE connection to UTRAN .....	37
7	UE modes .....	38
<b>Annex A (informative): Change history .....</b>		<b>39</b>
History .....		40

---

# Foreword

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

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

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

---

## 1 Scope

The present document shall provide an overview and overall description of the UE-UTRAN radio interface protocol architecture as agreed within the 3GPP TSG RAN working group 2. Details of the radio protocols will be specified in companion documents.

---

## 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 TS 23.110: "UMTS Access Stratum; Services and Functions".
- [2] 3GPP TS 25.401: "RAN Overall Description".
- [3] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [4] 3GPP TS 25.302: "Services provided by the Physical Layer".
- [5] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode".
- [6] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".
- [7] 3GPP TS 25.321: "MAC Protocol Specification".
- [8] 3GPP TS 25.322: "RLC Protocol Specification".
- [9] 3GPP TS 25.323: "PDCP Protocol Specification".
- [10] 3GPP TS 25.324: "BMC Protocol Specification".
- [11] 3GPP TS 25.331: "RRC Protocol Specification".
- [12] 3GPP TS 25.224: "Physical Layer Procedures (TDD)".
- [13] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".
- [14] 3GPP TS 33.105: "Cryptographic Algorithm Requirements".
- [15] 3GPP TS 33.102: "Security Architecture".
- [16] 3GPP TS 44.005: "Data Link (DL) layer; General aspects".

---

## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in [3] apply.

## 3.2 Abbreviations

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

ARQ	Automatic Repeat Request
AS	Access Stratum
ASC	Access Service Class
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
BMC	Broadcast/Multicast Control
C-	Control-
CC	Call Control
CCCH	Common Control Channel
CCH	Control Channel
CCTrCH	Coded Composite Transport Channel
CN	Core Network
CPCH	Common Packet channel
CRC	Cyclic Redundancy Check
CTCH	Common Traffic Channel
DC	Dedicated Control (SAP)
DCA	Dynamic Channel Allocation
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
DRNC	Drift Radio Network Controller
DSCH	Downlink Shared Channel
DTCH	Dedicated Traffic Channel
FACH	Forward Link Access Channel
FCS	Frame Check Sequence
FDD	Frequency Division Duplex
GC	General Control (SAP)
HO	Handover
ITU	International Telecommunication Union
kbps	kilobits per second
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L3	Layer 3 (network layer)
LAC	Link Access Control
LAI	Location Area Identity
MAC	Medium Access Control
MM	Mobility Management
NAS	Non-Access Stratum
Nt	Notification (SAP)
PCCH	Paging Control Channel
PCH	Paging Channel
PDCP	Packet Data Convergence Protocol
PDU	Protocol Data Unit
PHY	Physical layer
PhyCH	Physical Channels
RAB	Radio Access Bearer
RACH	Random Access Channel
RB	Radio Bearer
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
TCH	Traffic Channel
TDD	Time Division Duplex
TFCI	Transport Format Combination Indicator
TFI	Transport Format Indicator
TMSI	Temporary Mobile Subscriber Identity
TPC	Transmit Power Control
U-	User-
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
URA	UTRAN Registration Area
USCH	Uplink Shared Channel
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network
UuS	Uu (Radio Interface) Stratum

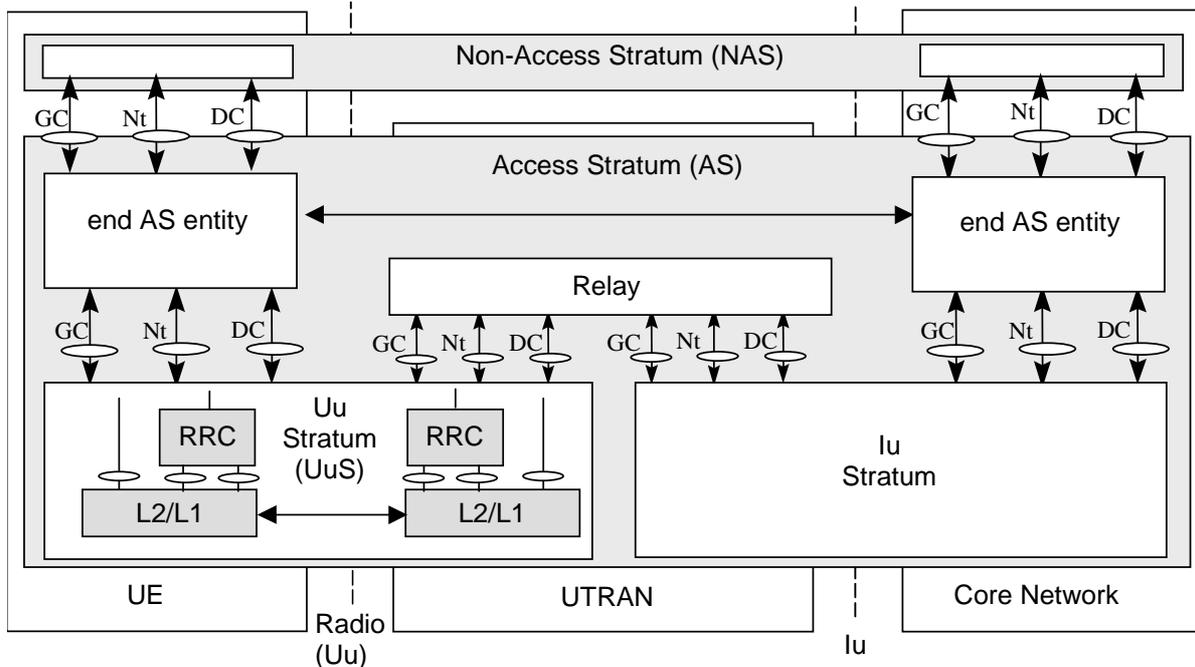
## 4 Assumed UMTS Architecture

Figure 1 shows the assumed UMTS architecture as outlined in [1]. The figure shows the UMTS architecture in terms of its entities User Equipment (UE), UTRAN and Core Network. The respective reference points Uu (Radio Interface) and Iu (CN-UTRAN interface) are shown. The figure illustrates furthermore the high-level functional grouping into the Access Stratum and the Non-Access Stratum.

The Access Stratum offers services through the following Service Access Points (SAP) to the Non-Access Stratum:

- General Control (GC) SAPs;
- Notification (Nt) SAPs; and
- Dedicated Control (DC) SAPs.

The SAPs are marked with circles in Figure 1.



**Figure 1: Assumed UMTS Architecture**

The model in Figure 1 distinguishes the end AS entities [1], which provide the services to higher layers, from the local entities, which provide services over respectively the Uu and the Iu reference points.



higher layers. An optional signalling radio bearer may be set up for transferring NAS messages set to "low priority" by the higher layers. Subsequent to the establishment of the signalling connection zero to several TM signalling radio bearers may be set up for transferring RRC signalling messages using transparent mode RLC.

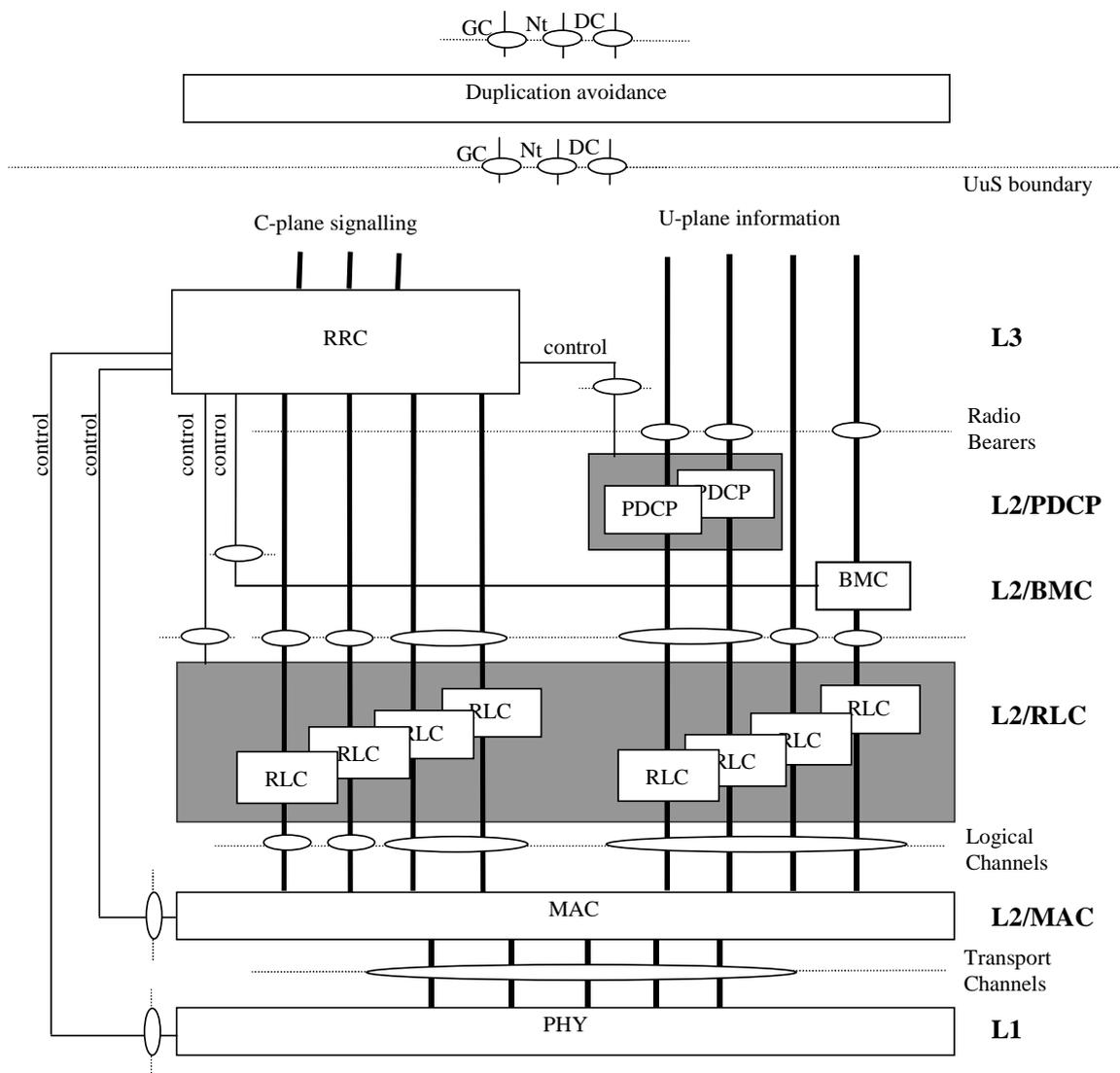


Figure 2: Radio Interface protocol architecture (Service Access Points marked by circles)

### 5.1.1 Service access points and service primitives

Each layer provides services at Service Access Points (SAPs). A service is defined by a set of service primitives (operations) that a layer provides to upper layer(s).

Control services, allowing the RRC layer to control lower layers locally (i.e. not requiring peer-to-peer communication) are provided at Control SAPs (C-SAP). Note that C-SAP primitives can bypass one or more sublayers, see Figure 2.

In the radio interface protocol specifications, the following naming conventions for primitives shall be applicable:

- Primitives provided by SAPs between adjacent layers shall be prefixed with the name of the service-providing layer, i.e. PHY, MAC, RLC, PDCP, BMC or UUS.
- Primitives provided by SAPs to an application shall be prefixed with the name of the service-providing layer, i.e. RRC.
- Primitives provided by Control SAPs, in addition to the name of the service-providing layer, shall be prefixed with a "C", i.e. CPHY, CMAC, CRLC, CPDCP or CBMC.



### 5.2.1.1 Transport channels

A general classification of transport channels is into two groups:

- common transport channels (where there is a need for inband identification of the UEs when particular UEs are addressed); and
- dedicated transport channels (where the UEs are identified by the physical channel, i.e. code and frequency for FDD and code, time slot and frequency for TDD).

Common transport channel types are (a more detailed description can be found in [4]):

- **Random Access Channel (RACH)**  
A contention based uplink channel used for transmission of relatively small amounts of data, e.g. for initial access or non-real-time dedicated control or traffic data.
- **Common Packet Channel (CPCH)**  
A contention based channel used for transmission of bursty data traffic. This channel only exists in FDD mode and only in the uplink direction. The common packet channel is shared by the UEs in a cell and therefore, it is a common resource. The CPCH is fast power controlled.
- **Forward Access Channel (FACH)**  
Common downlink channel without closed-loop power control used for transmission of relatively small amount of data.
- **Downlink Shared Channel (DSCH)**  
A downlink channel shared by several UEs carrying dedicated control or traffic data.
- **Uplink Shared Channel (USCH)**  
An uplink channel shared by several UEs carrying dedicated control or traffic data, used in TDD mode only.
- **Broadcast Channel (BCH)**  
A downlink channel used for broadcast of system information into an entire cell.
- **Paging Channel (PCH)**  
A downlink channel used for broadcast of control information into an entire cell allowing efficient UE sleep mode procedures. Currently identified information types are paging and notification. Another use could be UTRAN notification of change of BCCH information.

Dedicated transport channel types are:

- **Dedicated Channel (DCH)**  
A channel dedicated to one UE used in uplink or downlink.

To each transport channel, there is an associated Transport Format (for transport channels with a fixed or slow changing rate) or an associated Transport Format Set (for transport channels with fast changing rate). A Transport Format is defined as a combination of encodings, interleaving, bit rate and mapping onto physical channels (see [4] for details). A Transport Format Set is a set of Transport Formats. E.g., a variable rate DCH has a Transport Format Set (one Transport Format for each rate), whereas a fixed rate DCH has a single Transport Format.

### 5.2.2 L1 Functions

The physical layer performs the following main functions:

- Macrodiversity distribution/combining and soft handover execution;
- Error detection on transport channels and indication to higher layers;

- FEC encoding/decoding and interleaving/deinterleaving of transport channels;
- Multiplexing of transport channels and demultiplexing of coded composite transport channels;
- Rate matching;
- Mapping of coded composite transport channels on physical channels;
- Power weighting and combining of physical channels;
- Modulation and spreading/demodulation and despreading of physical channels;
- Frequency and time (chip, bit, slot, frame) synchronisation;
- Measurements and indication to higher layers (e.g. FER, SIR, interference power, transmit power, etc.);
- Closed-loop power control;
- RF processing;
- Support of timing advance on uplink channels (TDD only);
- Support of Uplink Synchronisation as defined in [12] (TDD only).

## 5.3 Layer 2 Services and Functions

### 5.3.1 MAC Services and Functions

This subclause provides an overview on services and functions provided by the MAC sublayer. A detailed description of the MAC protocol is given in [7].

#### 5.3.1.1 MAC Services to upper layers

- **Data transfer.** This service provides unacknowledged transfer of MAC SDUs between peer MAC entities. This service does not provide any data segmentation. Therefore, segmentation/reassembly function should be achieved by upper layer.
- **Reallocation of radio resources and MAC parameters.** This service performs on request of RRC execution of radio resource reallocation and change of MAC parameters, i.e. reconfiguration of MAC functions such as change of identity of UE, change of transport format (combination) sets, change of transport channel type. In TDD mode, in addition, the MAC can handle resource allocation autonomously.
- **Reporting of measurements.** Local measurements such as traffic volume and quality indication are reported to RRC.

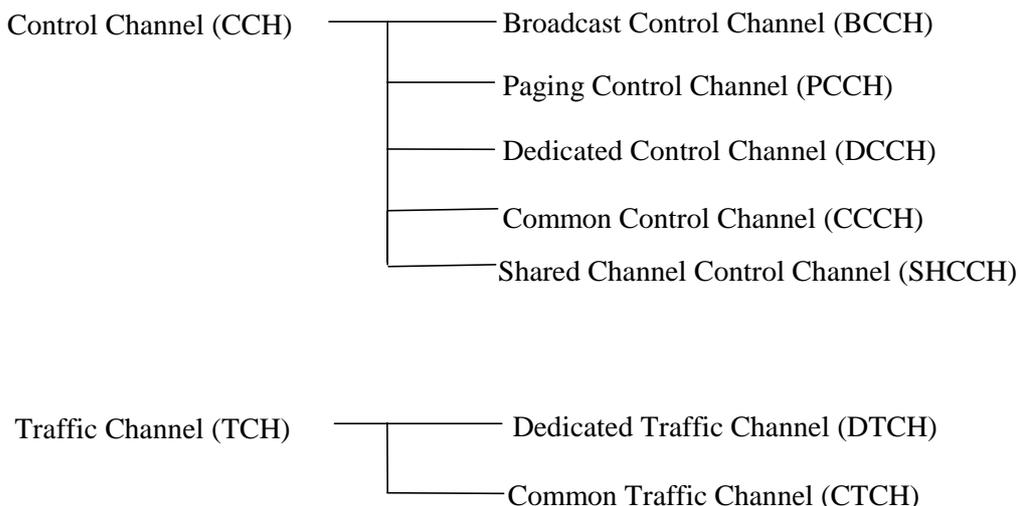
##### 5.3.1.1.1 Logical channels

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.

A general classification of logical channels is into two groups:

- Control Channels (for the transfer of control plane information);
- Traffic Channels (for the transfer of user plane information).

The configuration of logical channel types is depicted in Figure 3.



**Figure 3: Logical channel structure**

### Control Channels

Control channels are used for transfer of control plane information only.

#### **Broadcast Control Channel (BCCH)**

A downlink channel for broadcasting system control information.

#### **Paging Control Channel (PCCH)**

A downlink channel that transfers paging information. This channel is used when the network does not know the location cell of the UE, or, the UE is in the cell connected state (utilising UE sleep mode procedures).

#### **Common Control Channel (CCCH)**

Bi-directional channel for transmitting control information between network and UEs. This channel is commonly used by the UEs having no RRC connection with the network and by the UEs using common transport channels when accessing a new cell after cell reselection.

#### **Dedicated Control Channel (DCCH)**

A point-to-point bi-directional channel that transmits dedicated control information between a UE and the network. This channel is established through RRC connection setup procedure.

#### **Shared Channel Control Channel (SHCCH)**

Bi-directional channel that transmits control information for uplink and downlink shared channels between network and UEs. This channel is for TDD only.

### Traffic Channels

Traffic channels are used for the transfer of user plane information only.

#### **Dedicated Traffic Channel (DTCH)**

A Dedicated Traffic Channel (DTCH) is a point-to-point channel, dedicated to one UE, for the transfer of user information. A DTCH can exist in both uplink and downlink.

#### **Common Traffic Channel (CTCH)**

A point-to-multipoint unidirectional channel for transfer of dedicated user information for all or a group of specified UEs.

### 5.3.1.1.2 Mapping between logical channels and transport channels

#### 5.3.1.1.2.1 Mapping in Uplink

In Uplink, the following connections between logical channels and transport channels exist:

- CCCH can be mapped to RACH;
- DCCH can be mapped to RACH;
- DCCH can be mapped to CPCH (in FDD mode only);
- DCCH can be mapped to DCH;
- DCCH can be mapped to USCH (in TDD mode only);
- DTCH can be mapped to RACH;
- DTCH can be mapped to CPCH (in FDD mode only);
- DTCH can be mapped to DCH;
- DTCH can be mapped to USCH (in TDD mode only);
- SHCCH can be mapped to RACH (in TDD mode only);
- SHCCH can be mapped to USCH (in TDD mode only).

#### 5.3.1.1.2.2 Mapping in Downlink

In Downlink, the following connections between logical channels and transport channels exist:

- BCCH can be mapped to BCH;
- BCCH can be mapped to FACH;
- PCCH can be mapped to PCH;
- CCCH can be mapped to FACH;
- DCCH can be mapped to FACH;
- DCCH can be mapped to DSCH;
- DCCH can be mapped to DCH;
- DTCH can be mapped to FACH;
- DTCH can be mapped to DSCH;
- DTCH can be mapped to DCH;
- CTCH can be mapped to FACH;
- SHCCH can be mapped to FACH (in TDD mode only).
- SHCCH can be mapped to DSCH (in TDD mode only).

The mappings as seen from the UE and UTRAN sides are shown in Figure 4 and Figure 5 respectively.

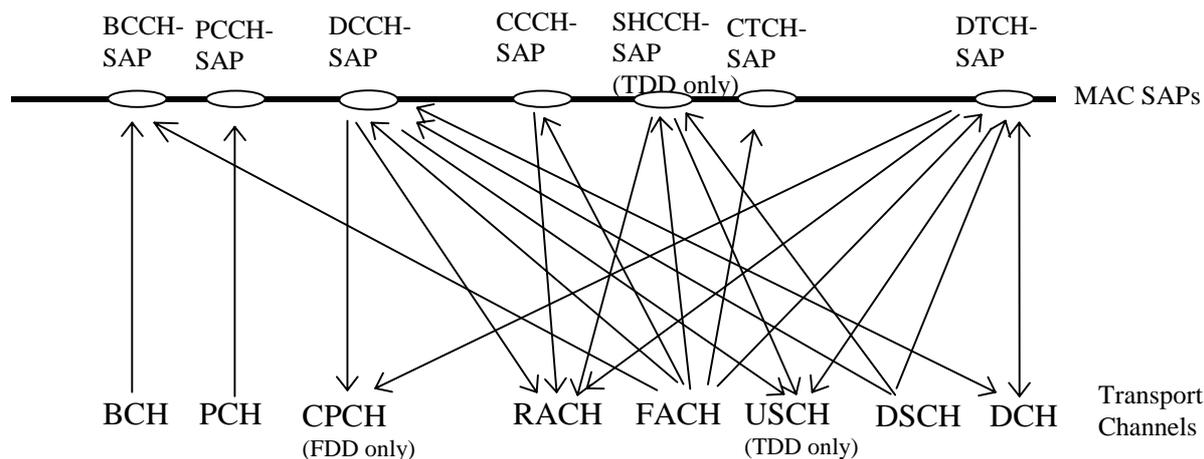


Figure 4: Logical channels mapped onto transport channels, seen from the UE side

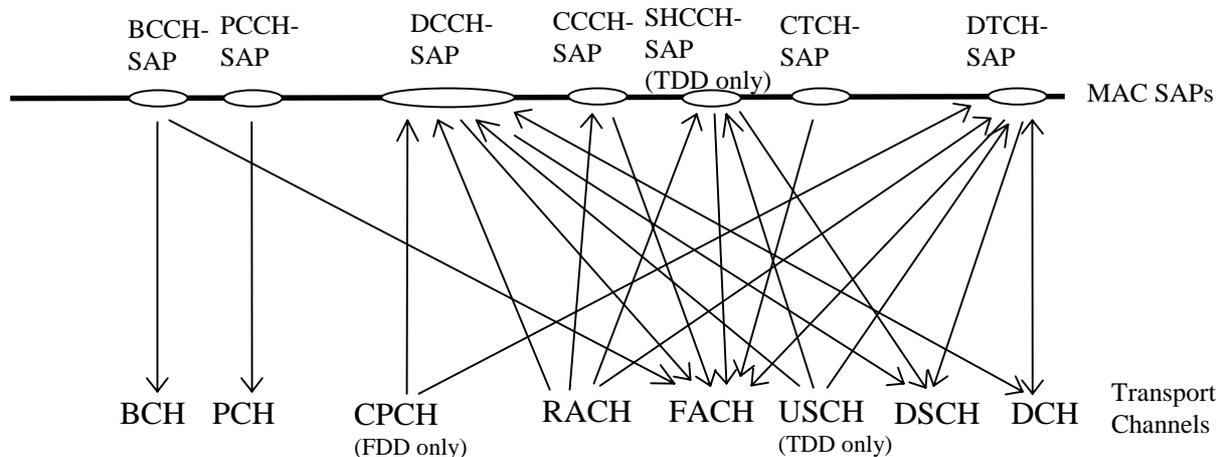


Figure 5: Logical channels mapped onto transport channels, seen from the UTRAN side

### 5.3.1.2 MAC functions

The functions of MAC include:

- **Mapping between logical channels and transport channels.** The MAC is responsible for mapping of logical channel(s) onto the appropriate transport channel(s).
- **Selection of appropriate Transport Format for each Transport Channel depending on instantaneous source rate.** Given the Transport Format Combination Set assigned by RRC, MAC selects the appropriate transport format within an assigned transport format set for each active transport channel depending on source rate. The control of transport formats ensures efficient use of transport channels.
- **Priority handling between data flows of one UE.** When selecting between the Transport Format Combinations in the given Transport Format Combination Set, priorities of the data flows to be mapped onto the corresponding Transport Channels can be taken into account. Priorities are e.g. given by attributes of Radio Bearer services and RLC buffer status. The priority handling is achieved by selecting a Transport Format Combination for which high priority data is mapped onto L1 with a "high bit rate" Transport Format, at the same time letting lower priority data be mapped with a "low bit rate" (could be zero bit rate) Transport Format. Transport format selection may also take into account transmit power indication from Layer 1.
- **Priority handling between UEs by means of dynamic scheduling.** In order to utilise the spectrum resources efficiently for bursty transfer, a dynamic scheduling function may be applied. MAC realises priority handling on

common and shared transport channels. Note that for dedicated transport channels, the equivalent of the dynamic scheduling function is implicitly included as part of the reconfiguration function of the RRC sublayer.

**NOTE:** In the TDD mode the data to be transported are represented in terms of sets of resource units.

- **Identification of UEs on common transport channels.** When a particular UE is addressed on a common downlink channel, or when a UE is using the RACH, there is a need for inband identification of the UE. Since the MAC layer handles the access to, and multiplexing onto, the transport channels, the identification functionality is naturally also placed in MAC.
- **Multiplexing/demultiplexing of upper layer PDUs into/from transport blocks delivered to/from the physical layer on common transport channels.** MAC should support service multiplexing for common transport channels, since the physical layer does not support multiplexing of these channels.
- **Multiplexing/demultiplexing of upper layer PDUs into/from transport block sets delivered to/from the physical layer on dedicated transport channels.** The MAC allows service multiplexing for dedicated transport channels. This function can be utilised when several upper layer services (e.g. RLC instances) can be mapped efficiently on the same transport channel. In this case the identification of multiplexing is contained in the MAC protocol control information.
- **Traffic volume measurement.** Measurement of traffic volume on logical channels and reporting to RRC. Based on the reported traffic volume information, RRC performs transport channel switching decisions.
- **Transport Channel type switching.** Execution of the switching between common and dedicated transport channels based on a switching decision derived by RRC.
- **Ciphering.** This function prevents unauthorised acquisition of data. Ciphering is performed in the MAC layer for transparent RLC mode. Details of the security architecture are specified in [15].
- **Access Service Class selection for RACH and CPCH transmission.** The RACH resources (i.e. access slots and preamble signatures for FDD, timeslot and channelisation code for TDD) and CPCH resources (i.e. access slots and preamble signatures for FDD only) may be divided between different Access Service Classes in order to provide different priorities of RACH and CPCH usage. In addition it is possible for more than one ASC or for all ASCs to be assigned to the same access slot/signature space. Each access service class will also have a set of back-off parameters associated with it, some or all of which may be broadcast by the network. The MAC function applies the appropriate back-off and indicates to the PHY layer the RACH and CPCH partition associated to a given MAC PDU transfer.

## 5.3.2 RLC Services and Functions

This subclause provides an overview on services and functions provided by the RLC sublayer. A detailed description of the RLC protocol is given in [8].

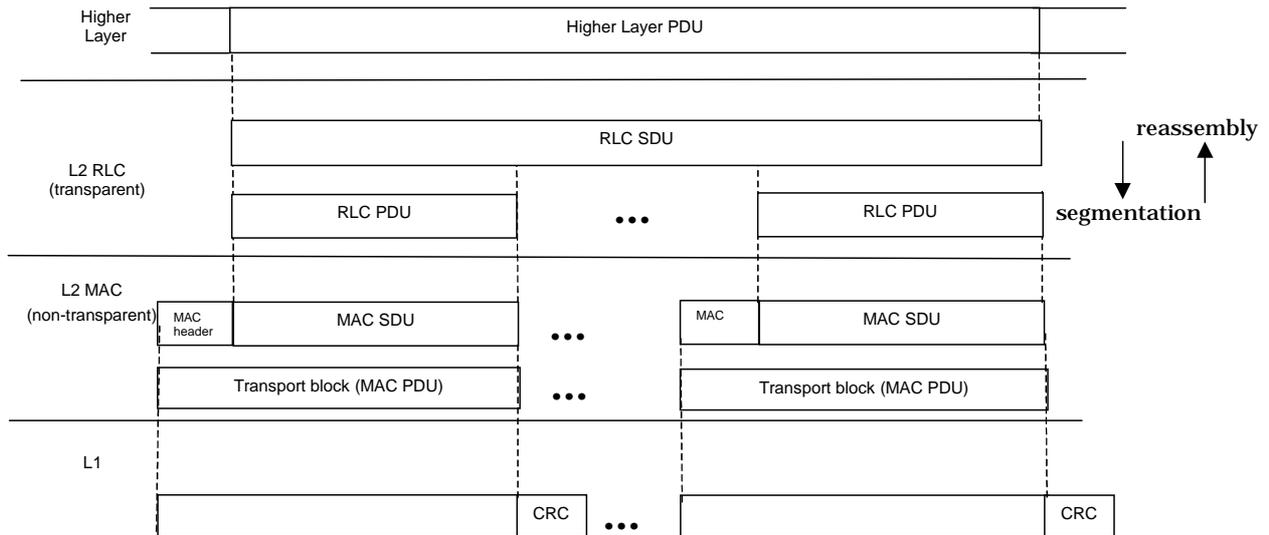
### 5.3.2.1 Services provided to the upper layer

- **Transparent data transfer.** This service transmits upper layer PDUs without adding any protocol information, possibly including segmentation/reassembly functionality.
- **Unacknowledged data transfer.** This service transmits upper layer PDUs without guaranteeing delivery to the peer entity. The unacknowledged data transfer mode has the following characteristics:
  - Detection of erroneous data: The RLC sublayer shall deliver only those SDUs to the receiving upper layer that are free of transmission errors by using the sequence-number check function.
  - Immediate delivery: The receiving RLC sublayer entity shall deliver a SDU to the upper layer receiving entity as soon as it arrives at the receiver.
- **Acknowledged data transfer.** This service transmits upper layer PDUs and guarantees delivery to the peer entity. In case RLC is unable to deliver the data correctly, the user of RLC at the transmitting side is notified. For this service, both in-sequence and out-of-sequence delivery are supported. In many cases a upper layer protocol can restore the order of its PDUs. As long as the out-of-sequence properties of the lower layer are known and controlled (i.e. the upper layer protocol will not immediately request retransmission of a missing PDU) allowing

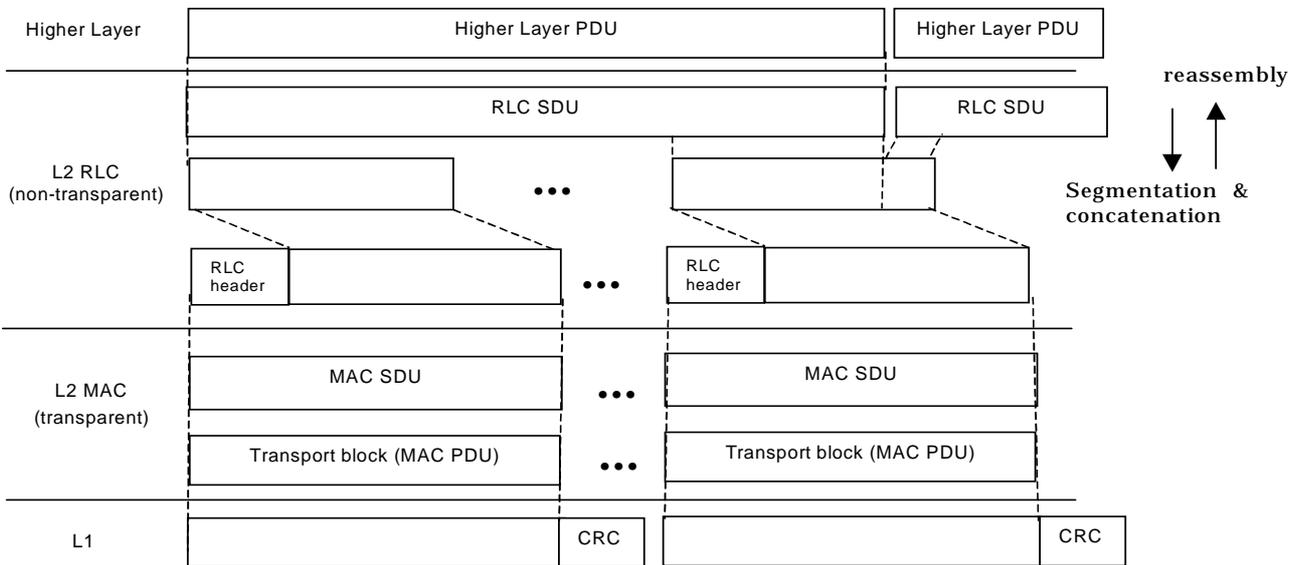








**Figure 7: Data flow for transparent RLC and non-transparent MAC**



**Figure 8: Data flow for non-transparent RLC and transparent MAC**







- A transport channel identity is associated with each USCH transport channel. Each identity is unique within the USCHs configured in the UE;
- A logical channel identity is associated with each logical channel that is multiplexed with other logical channels before being mapped to a transport channel. Each identity is unique within the logical channels mapped to the same transport channel.

## 5.4 Layer 3 - Uu Stratum Services and Functions

This subclause provides an overview on Layer 3 services and functions provided by the Uu Stratum as a whole. A detailed description of the RRC protocol is given in [11]. Examples of structured procedures involving RRC in Idle Mode and Connected Mode are described in [5] and [6], respectively.

### 5.4.1 Uu Stratum services

#### 5.4.1.1 General Control

The GC SAP provides an information broadcast service. This service broadcasts information to all UEs in a certain geographical area. The basic requirements from such service are:

- It should be possible to broadcast non-access stratum information in a certain geographical area.
- The information is transferred on an unacknowledged mode link. Unacknowledged mode means that the delivery of the broadcast information can not be guaranteed (typically no retransmission scheme is used). It seems reasonable to use an unacknowledged mode link since the information is broadcast to a lot of UEs and since broadcast information often is repeated periodically.
- It should be possible to do repeated transmissions of the broadcast information (how it is repeated is controlled by the non-access stratum).
- The point where the UE received the broadcast information should be included, when the access stratum delivers broadcast information to the non-access stratum.

#### 5.4.1.2 Notification

The Nt SAP provides paging and notification broadcast services. The paging service sends information to a specific UE(s). The information is broadcast in a certain geographical area but addressed to a specific UE(s). The basic requirements from such service are:

- It should be possible to broadcast paging information to a number of UEs in a certain geographical area.
- The information is transferred on an unacknowledged mode link. It is assumed that the protocol entities in non-access stratum handle any kind of retransmission of paging information.

The notification broadcast service broadcasts information to all UEs in a certain geographical. The basic requirements from this service are typically the same as for the information broadcast service of the GC SAP:

- It should be possible to broadcast notification information in a certain geographical area.
- The information is transferred on an unacknowledged mode link.

#### 5.4.1.3 Dedicated Control

The DC SAP provides services for establishment/release of a connection and transfer of messages using this connection. It should also be possible to transfer a message during the establishment phase. The basic requirements from the establishment/release services are:

- It should be possible to establish connections (both point and group connections).
- It should be possible to transfer an initial message during the connection establishment phase. This message transfer has the same requirements as the information transfer service.

- It should be possible to release connections.

The information transfer service sends a message using the earlier established connection. According to [1] it is possible to specify the quality of service requirements for each message. A finite number of quality of service classes will be specified in [1], but currently no class has been specified. In order to get an idea of the basic requirements, the CC and MM protocols in GSM are used as a reference. A GSM based core network is chosen since it is one main option for UMTS. Considering the existing GSM specification of CC and MM the basic requirements from the information transfer service provided by the 'Duplication avoidance' function are (these are some of the services provided by the combination of a duplication layer, RR and the data link layer in GSM):

- **In-sequence transfer of messages**  
Messages are delivered to the NAS on the receiver side exactly in the order they have been submitted by the NAS on the sending side, without loss or duplication, except possibly for the loss of last messages in case of connection abortion.
- **Priority handling**  
If SMS messages should be transported through the control plane it should be possible to give higher priority to signalling messages.

The CC and MM protocols also expect other services, which can not be supported by the current primitives of the DC SAP, e.g. indication of radio link failure.

The information transfer service is provided by a combination of the services provided by the data link layer, RNC and the 'Duplication avoidance' function.

## 5.4.2 RRC functions

The Radio Resource Control (RRC) layer handles the control plane signalling of Layer 3 between the UEs and UTRAN. The RRC performs the following functions:

- **Broadcast of information provided by the non-access stratum (Core Network).** The RRC layer performs system information broadcasting from the network to all UEs. The system information is normally repeated on a regular basis. The RRC layer performs the scheduling, segmentation and repetition. This function supports broadcast of higher layer (above RRC) information. This information may be cell specific or not. As an example RRC may broadcast Core Network location service area information related to some specific cells.
- **Broadcast of information related to the access stratum.** The RRC layer performs system information broadcasting from the network to all UEs. The system information is normally repeated on a regular basis. The RRC layer performs the scheduling, segmentation and repetition. This function supports broadcast of typically cell-specific information.
- **Establishment, re-establishment, maintenance and release of an RRC connection between the UE and UTRAN.** The establishment of an RRC connection is initiated by a request from higher layers at the UE side to establish the first Signalling Connection for the UE. The establishment of an RRC connection includes an optional cell re-selection, an admission control, and a layer 2 signalling link establishment. The release of an RRC connection can be initiated by a request from higher layers to release the last Signalling Connection for the UE or by the RRC layer itself in case of RRC connection failure. In case of connection loss, the UE requests re-establishment of the RRC connection. In case of RRC connection failure, RRC releases resources associated with the RRC connection.
- **Establishment, reconfiguration and release of Radio Bearers.** The RRC layer can, on request from higher layers, perform the establishment, reconfiguration and release of Radio Bearers in the user plane. A number of Radio Bearers can be established to an UE at the same time. At establishment and reconfiguration, the RRC layer performs admission control and selects parameters describing the Radio Bearer processing in layer 2 and layer 1, based on information from higher layers.
- **Assignment, reconfiguration and release of radio resources for the RRC connection.** The RRC layer handles the assignment of radio resources (e.g. codes, CPCH channels) needed for the RRC connection including needs from both the control and user plane. The RRC layer may reconfigure radio resources during an established RRC connection. This function includes coordination of the radio resource allocation between multiple radio bearers related to the same RRC connection. RRC controls the radio resources in the uplink and downlink such that UE and UTRAN can communicate using unbalanced radio resources (asymmetric uplink and

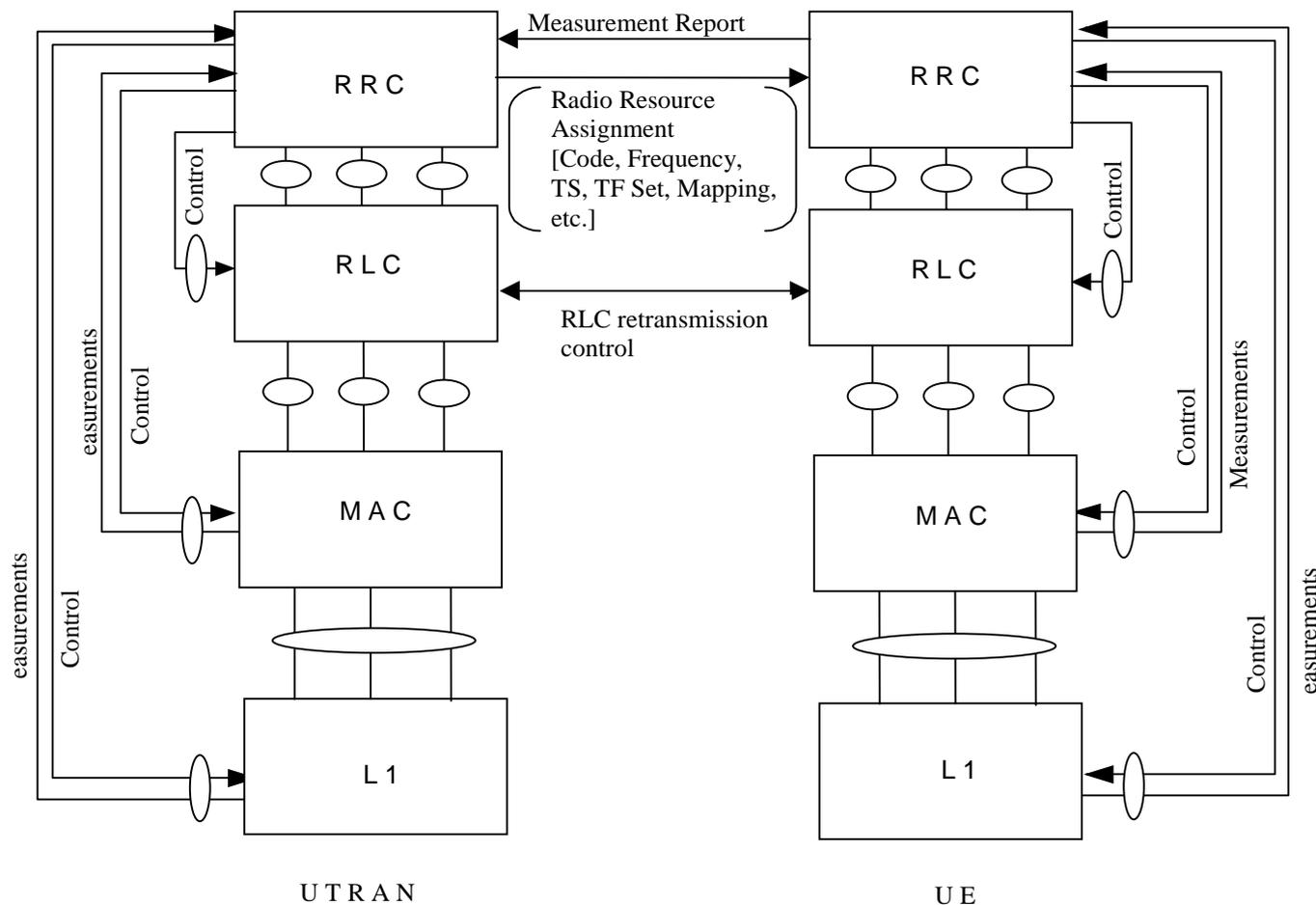
downlink). RRC signals to the UE to indicate resource allocations for purposes of handover to GSM or other radio systems.

- **RRC connection mobility functions.** The RRC layer performs evaluation, decision and execution related to RRC connection mobility during an established RRC connection, such as handover, preparation of handover to GSM or other systems, cell re-selection and cell/paging area update procedures, based on e.g. measurements done by the UE.
- **Paging/notification.** The RRC layer can broadcast paging information from the network to selected UEs. Higher layers on the network side can request paging and notification. The RRC layer can also initiate paging during an established RRC connection.
- **Routing of higher layer PDUs.** This function performs at the UE side routing of higher layer PDUs to the correct higher layer entity, at the UTRAN side to the correct RANAP entity.
- **Control of requested QoS.** This function shall ensure that the QoS requested for the Radio Bearers can be met. This includes the allocation of a sufficient number of radio resources.
- **UE measurement reporting and control of the reporting.** The measurements performed by the UE are controlled by the RRC layer, in terms of what to measure, when to measure and how to report, including both UMTS air interface and other systems. The RRC layer also performs the reporting of the measurements from the UE to the network.
- **Outer loop power control.** The RRC layer controls setting of the target of the closed loop power control.
- **Control of ciphering.** The RRC layer provides procedures for setting of ciphering (on/off) between the UE and UTRAN. Details of the security architecture are specified in [15].
- **Slow DCA.** Allocation of preferred radio resources based on long-term decision criteria. It is applicable only in TDD mode.
- **Arbitration of radio resources on uplink DCH.** This function controls the allocation of radio resources on uplink DCH on a fast basis, using a broadcast channel to send control information to all involved users.

NOTE: This function is implemented in the CRNC.

- **Initial cell selection and re-selection in idle mode.** Selection of the most suitable cell based on idle mode measurements and cell selection criteria.
- **Integrity protection.** This function adds a Message Authentication Code (MAC-I) to those RRC messages that are considered sensitive and/or contain sensitive information. The mechanism how the MAC-I is calculated is described in [14].
- **Initial Configuration for CBS**  
This function performs the initial configuration of the BMC sublayer.
- **Allocation of radio resources for CBS**  
This function allocates radio resources for CBS based on traffic volume requirements indicated by BMC. The radio resource allocation set by RRC (i.e. the schedule for mapping of CTCH onto FACH/S-CCPCH) is indicated to BMC to enable generation of schedule messages. The resource allocation for CBS shall be broadcast as system information.
- **Configuration for CBS discontinuous reception**  
This function configures the lower layers (L1, L2) of the UE when it shall listen to the resources allocated for CBS based on scheduling information received from BMC.
- **Timing advance control.** The RRC controls the operation of timing advance. It is applicable only in 3.84 Mcps TDD.

## 5.5 Interactions between RRC and lower layers in the C plane



**Figure 10: Interactions between RRC and lower layers**

The RRC protocol controls and signals the allocation of radio resources to the UE. RRC allows MAC to arbitrate between users and Radio Bearers within the radio resource allocation. The RRC uses the measurements done by the lower layers to determine which radio resources that are available. Therefore it is a need for a measurement report from the UE RRC to the UTRAN RRC. Figure 10 illustrates the principle. The local control and local measurements reporting is handled through the control SAPs between RRC and the lower layers.

## 5.6 Protocol termination

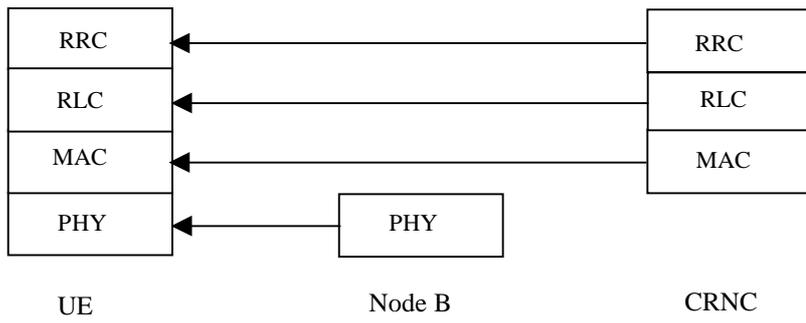
This subclause specifies in which node of the UTRAN the radio interface protocols are terminated, i.e. where within UTRAN the respective protocol services are accessible. Dashed lines indicate those protocols whose presence is dependent on the service provided to upper layers.

### 5.6.1 Protocol termination for DCH

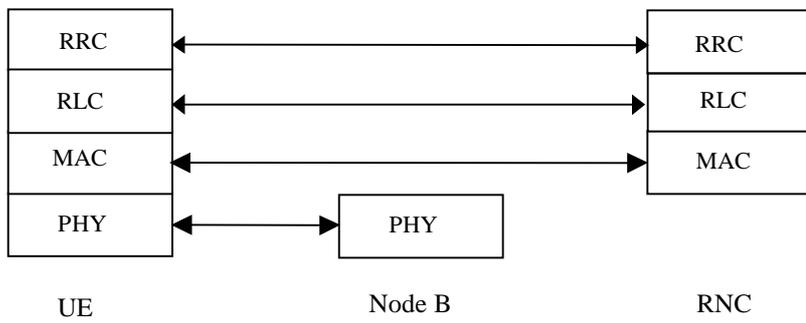
Figure 11 and Figure 12 show the protocol termination for DCH for the control and user planes, respectively. The part of physical layer terminating in the Serving RNC is the topmost macro-diversity combining and splitting function for the FDD mode. If no macrodiversity applies, the physical layer is terminated in Node B.



**BCCH :**

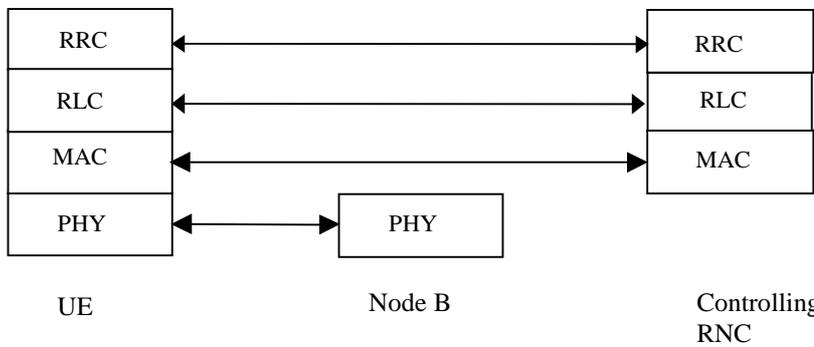


**CCCH :**



**SHCCH:**

(TDD only)



**DCCH:**

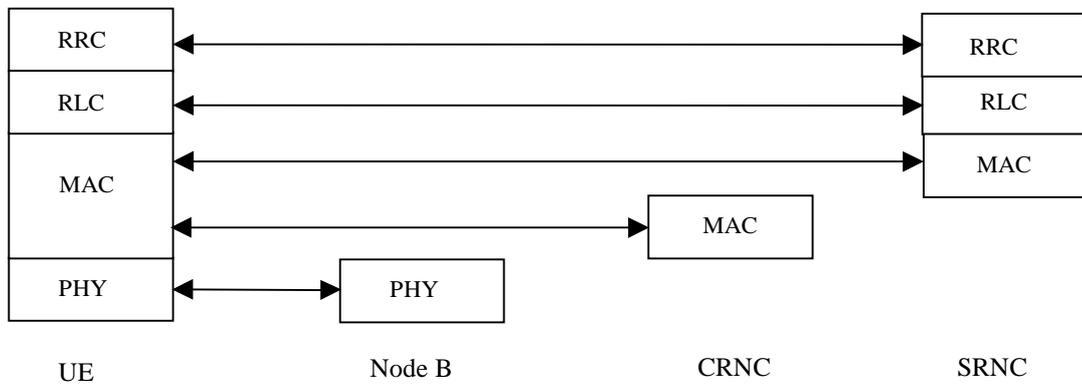
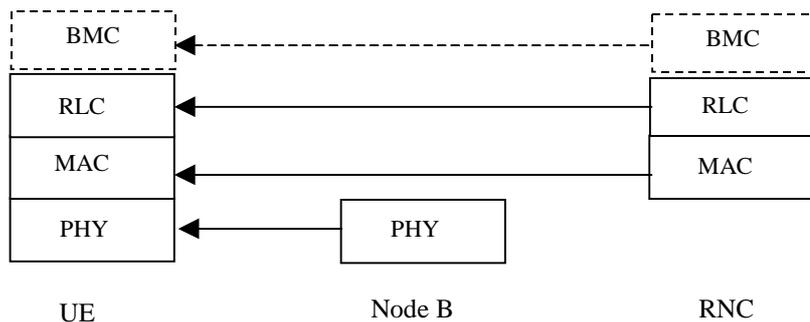
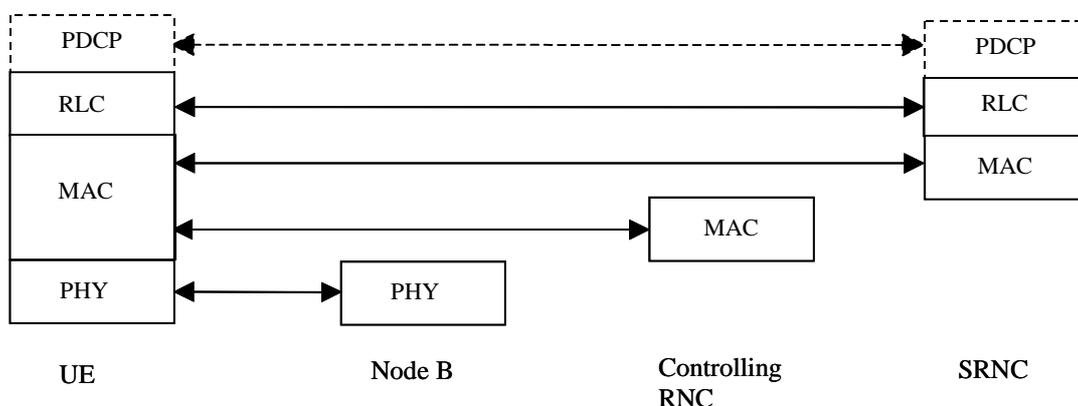


Figure 13: Protocol Termination for RACH/FACH, control plane

**CTCH:**



**DTCH:**



**Figure 14: Protocol Termination for RACH/FACH, user plane**

5.6.3 Void

5.6.4 Protocol termination for CPCH

The protocol termination for CPCH is identical to the termination for RACH. Figure 13 (for DCCH) presents the control plane protocol termination. Figure 14 presents the user plane protocol termination.

5.6.5 Protocol termination for DSCH

5.6.5.1 DSCH definition

The DSCH is a resource that exists in downlink only. It has only impact on the physical and transport channel levels, so there is no definition of shared channel in the logical channels provided by MAC.

The DSCH is a transport channel shared dynamically between several UEs. The DSCH is mapped to one or several physical channels such that a specified part of the downlink resources is employed. For the DSCH no macrodiversity is applied, i.e. a specific DSCH is transmitted in a single cell only.

The following two DSCH cases are supported in Release 99, in the following denoted as cases A and B:

- **Case A:** The DSCH is defined as an extension to DCH transmission. DSCH related resource allocation is signalled utilising the transport format indication field (TFI) that will be mapped to the TFCI of the associated DCH.
- **Case B:** The DSCH is defined as a shared downlink channel for which resource allocation is performed by RRC in Controlling RNC. The allocation messages, including UE identification, are transmitted on SHCCH, which is

mapped on RACH/FACH. Several DSCH can be multiplexed on a CCTrCH in the physical layer, the transport formats of the DSCHs have to be selected from the transport format combination set of this CCTrCH. Each CCTrCH is mapped on one or more PDSCHs. If the transport format combination subset of a CCTrCH contains more than one transport format combination, a TFCI can be transmitted inside the PDSCH, or blind detection can be applied in the UE. This case is supported for TDD only.

NOTE: Cases A and B of DSCH can be employed concurrently for TDD (at the same time on a single PDSCH).

Interleaving for the DSCH may be applied over a multiplicity of radio frames. Nevertheless, here the basic case is considered where the interleaving is rectangular for a given MAC PDU, and equal to one radio frame (10 ms). The framing is synchronised on the SCH.

In every radio frame, one or several PDSCHs can be used in the downlink. Therefore, the DSCH supports code multiplexing. MAC multiplexing of different UEs shall not be applied within a radio frame, i.e. within one radio frame a PDSCH is assigned to a single UE. However, MAC multiplexing is allowed on a frame by frame basis, i.e. one PDSCH may be allocated to different UEs at each frame.

Transport blocks on the DSCH may be of constant size, so that the Transport Block Set may be derived from the code allocated to each UE on the DSCH. For case B, the transport format combination set can change with each transmission time interval.

### 5.6.5.2 Resource allocation and UE identification on DSCH

The principles of capacity allocation and UE identification on the DSCH are described in more detail below.

#### 5.6.5.2.1 Case A (UE requires a downlink TFCI on a DPCCH)

The TFCI of the dedicated physical channel may carry the information that a given code of the DSCH must be listened to by the UE. Fast power control can be applied per code based on the dedicated physical control channel, DPCCH.

Alternatively, a UE may be requested on the DCH to listen to a DSCH for a given period of time, and to decode the data so that the address of the destination UE can be decoded. This does not require more TFCI values because signalling is done in layers 2 and 3.

#### 5.6.5.2.2 Case B (UE requires a downlink SHCCH) (TDD only)

The information which physical downlink shared channels to listen to and when, is sent by RRC on the SHCCH logical channel, which is mapped on RACH and USCH/FACH and DSCH. The transmitted Layer 3 messages contain information about the used PDSCHs and the timing of the allocation.

### 5.6.5.3 Model of DSCH in UTRAN

Figure 15 captures the working assumption on the Downlink Shared Channel (DSCH). The two RLCs point to logical channel (DTCH) specific RLC-entities of specific users while MAC refers to the provision of MAC sublayer functions for all users.

The MAC sublayer of a DSCH is split between the Controlling RNC and SRNC. For a given user, the RLC sublayer is terminated in its SRNC. Since Iur can support DSCH data streams, the users on that DSCH can depend on different SRNCs. For a given user, the Controlling RNC and the Serving RNC can be separate RNCs. The MAC in the network takes care of mapping downlink data either to a common channel (FACH, not shown in this figure), or to a DCH and/or the DSCH.

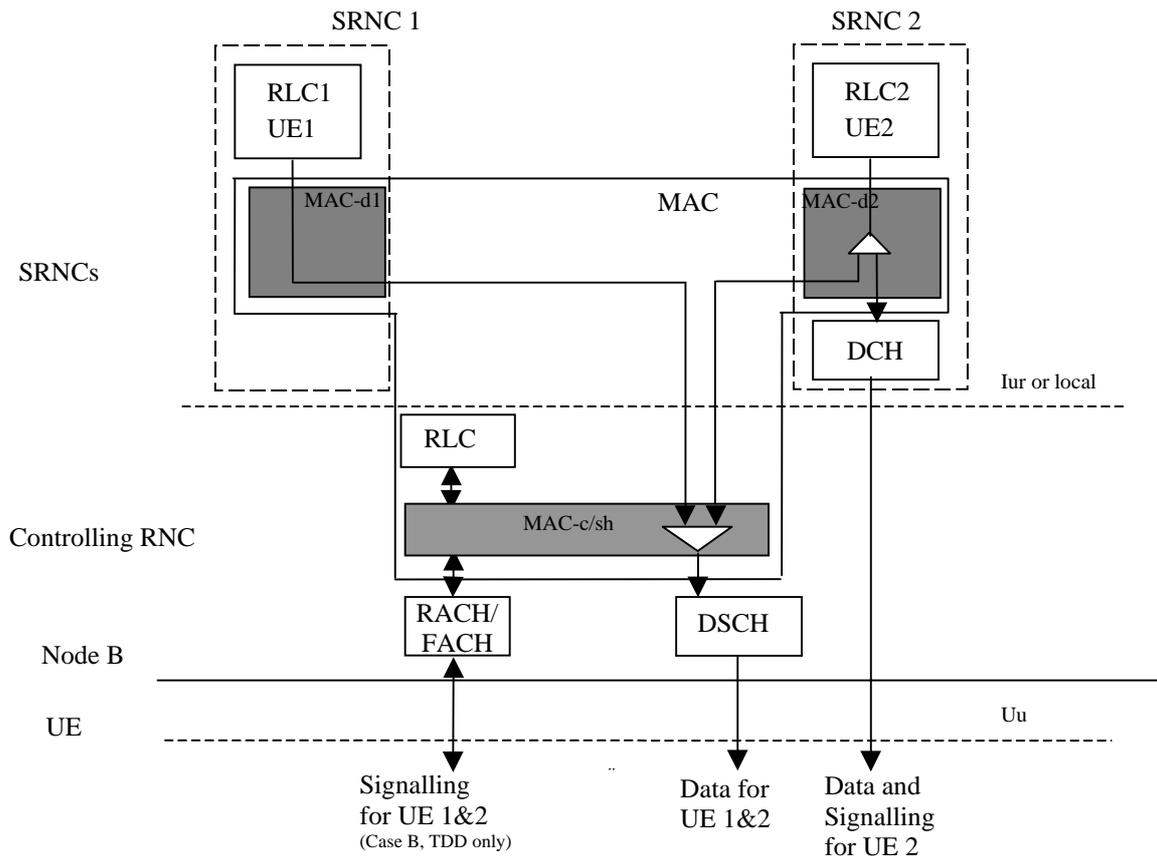


Figure 15: Model of downlink shared channel (DSCH) in UTRAN

5.6.5.4 Protocol termination

The protocol termination points for DSCH in control and user planes are presented in Figure 16 and Figure 17, respectively.

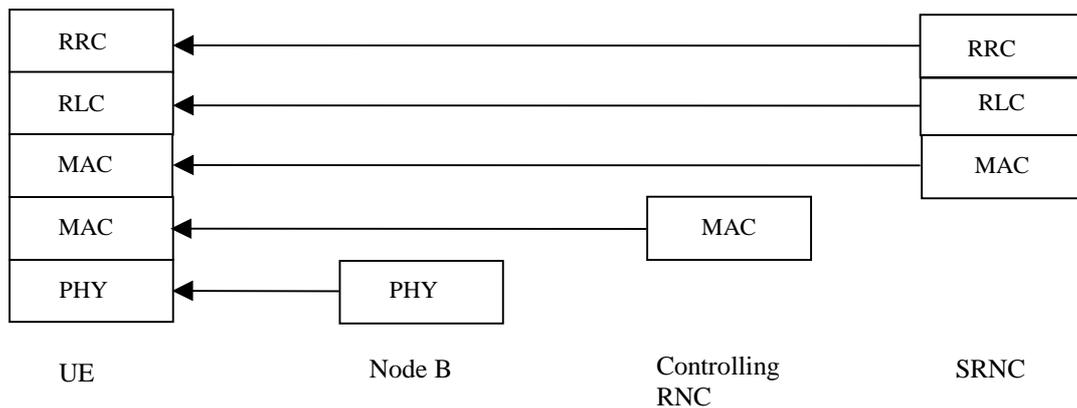


Figure 16: Protocol termination points for DSCH, control plane









- No signalling connection exist  
The UE has no relation to UTRAN, only to CN. For data transfer, a signalling connection has to be established.
- Signalling connection exist  
There is a RRC connection between UE and UTRAN. The UE position can be known on different levels:
  - UTRAN Registration Area (URA) level  
The UE position is known on UTRAN registration area level. URA is a specified set of cell, which can be identified on the BCCH.
  - Cell level  
The UE position is known on cell level. Different channel types can be used for data transfer:
    - Common transport channels (RACH, FACH, CPCH, DSCH);
    - Dedicated transport channels (DCH).

---

## 7 UE modes

Two modes of operation are currently defined for the UE, idle mode and connected mode [5, 6].

After power on, the UE stays in idle mode until it transmits a request to establish an RRC connection. In idle mode the UE is identified by non-access stratum identities such as IMSI, TMSI and P-TMSI. In addition, the UTRAN has no own information about the individual idle mode UEs, and can only address e.g. all UEs in a cell or all UEs monitoring a specific paging occasion.

The connected mode is entered when the RRC connection is established. A RRC connection is established between the UE and a RNC called SRNC. The UE is assigned a radio network temporary identity (U-RNTI and possibly in addition C-RNTI or DSCH-RNTI) to be used as UE identity on common transport channels. RRC connection is within a UTRAN identified with the U-RNTI.

The UE leaves the connected mode and returns to idle mode when the RRC connection is released or at RRC connection failure.

Reception of SMS cell broadcast can be done in both idle and connected mode.



---

## History

<b>Document history</b>		
V4.0.0	March 2001	Publication
V4.1.0	June 2001	Publication
V4.2.0	December 2001	Publication
V4.3.0	June 2002	Publication
V4.4.0	September 2002	Publication