3GPP TSG-RAN meeting #4 *Document* ***RP-99331***
Miami, USA, 17-18 June 1999

3G CHANGE REQUEST

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TS 25.301 **CR** **001** Current Version: 3.0.1

3G specification number ↑ *↑ CR number as allocated by 3G support team*

For submission to TSG RAN#4 for approval [X] for information [ ]
list TSG meeting no. here ↑ *(only one box should be marked with an X)*

Form: 3G CR cover sheet, version 1.0 *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/3GCRF-xx.rtf*

Proposed change affects: USIM [ ] ME [X] UTRAN [X] Core Network [ ]
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 08/06/99

Subject: Addition of Common Packet Channel (CPCH)

3G Work item:

Category:
(only one category shall be marked with an X)

F	Correction	
A	Corresponds to a correction in a 2G specification	
B	Addition of feature	X
C	Functional modification of feature	
D	Editorial modification	

Reason for change: The basic concept of Common Packet Channel (CPCH) proposed by Golden Bridge Technology/T1P1 was approved at TSG RAN WG2 meeting #4. This CR includes the WG2-agreed changes in TS 25.301 due to addition of the CPCH. Note that only those sections are shown in this CR that are affected.

Clauses affected:

Other specs affected:

Other 3G core specifications	[ ]	→ List of CRs:
Other 2G core specifications	[ ]	→ List of CRs:
MS test specifications	[ ]	→ List of CRs:
BSS test specifications	[ ]	→ List of CRs:
O&M specifications	[ ]	→ List of CRs:

Other comments:

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<--------- double-click here for help and instructions on how to create a CR.

1 Scope

2 References

3 Definitions and Abbreviations

3.1 Definitions

See [3] for a definition of fundamental concepts and vocabulary.

3.2 Abbreviations

ARQ	Automatic Repeat Request
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
C-	Control-
CC	Call Control
CCCH	Common Control Channel
CCH	Control Channel
CCTrCH	Coded Composite Transport Channel
CPCH	Common Packet channel
CN	Core Network
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
FAUSCH	Fast Uplink Signalling Channel
FCS	Frame Check Sequence
FDD	Frequency Division Duplex
GC	General Control (SAP)
HO	Handover
ITU	International Telecommunication Union
kbps	kilo-bits 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
Nt	Notification (SAP)
OCCCH	ODMA Common Control Channel
ODCCH	ODMA Dedicated Control Channel
ODCH	ODMA Dedicated Channel
ODMA	Opportunity Driven Multiple Access
ORACH	ODMA Random Access Channel
ODTCH	ODMA Dedicated Traffic Channel
PCCH	Paging Control Channel
PCH	Paging Channel
PDU	Protocol Data Unit
PU	Payload Unit
PHY	Physical layer
PhyCH	Physical Channels
RAB	Radio Access Bearer

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
SCCH	Synchronization Control Channel
SCH	Synchronization Channel
SDU	Service Data Unit
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
UE_R	User Equipment with ODMA relay operation enabled
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

4 Assumed UMTS Architecture

5 Radio interface protocol architecture

5.1 Overall protocol structure

5.2 Layer 1 Services and Functions

This section shall provide an overview on services and functions provided by the physical layer. A detailed description of Layer 1 general requirements can be found in 3GPP TS 25.302 [4].

5.2.1 L1 Services

The physical layer offers information transfer services to MAC and higher layers. The physical layer transport services are described by *how* and with what characteristics data are transferred over the radio interface. An adequate term for this is 'Transport Channel'[1].

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 amount of data, e.g. for initial access or non-realtime dedicated control or traffic data.
- **ODMA Random Access Channel (ORACH)**
  A contention based channel used in relaylink.
- **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.
- **DSCH Control Channel**
  A downlink channel associated with a DSCH used for signalling of DSCH resource allocation.

  [Note: It is for further study whether or not the DSCH Control Channel needs to be regarded as separate transport channel type from FACH. Seen from the upper layers, the current requirements are identical to a FACH, but some extra L1 information (e.g.TPC bits) may lead to a different physical channel. See Sec. 5.6.5 for a description of the

[1] This should be clearly separated from the classification of *what* is transported, which relates to the concept of logical channels. Thus DCH is used to denote that the physical layer offers the same type of service for both control and traffic.

DSCH concepts currently considered in TSG-RAN WG2. This section also includes further notes on ffs. items related to the DSCH.]

- **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.
- **Synchronization Channel (SCH)**
  A downlink channel used for broadcast of synchronization information into an entire cell in TDD mode.

  Note that the SCH transport channel is defined for the TDD mode only. In the FDD mode, a synchronization channel is defined as a physical channel. This channel however should not be confused with the SCH transport channel defined above.
- **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.
- **Fast Uplink Signalling Channel (FAUSCH)**
  An uplink channel used to allocate dedicated channels in conjunction with FACH.
- **ODMA Dedicated Channel (ODCH)**
  A channel dedicated to one UE used in relaylink.

To each transport channel (except for the FAUSCH, since it only conveys a reservation request), 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 3GPP TS 25.302 [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

5.3 Layer 2 Services and Functions

5.3.1 MAC Services and Functions

This sections provides an overview on services and functions provided by the MAC sublayer. A detailed description of the MAC protocol is given in 3GPP TS 25.321 [7].

5.3.1.1 MAC Services to upper layers

5.3.1.1.1 Logical channels

5.3.1.1.2 Mapping between logical channels and transport channels

The following connections between logical channels and transport channels exist:

- SCCH is connected to SCH
- BCCH is connected to BCH

- PCCH is connected to PCH
- CCCH is connected to RACH and FACH
- DTCH can be connected to either RACH and FACH, to RACH and DSCH, to DCH and DSCH, to a DCH, a CPCH (FDD only) or to USCH (TDD only)
- CTCH can be connected to DSCH, FACH or BCH (ffs.)

  [Note: Above potential mappings are proposed by the editor. This channel type will be included into the Figures below when the mappings have been agreed.]

- DCCH can be connected to either RACH and FACH, to RACH and DSCH, to DCH and DSCH, to a DCH, to FAUSCH, CPCH (FDD only), or to USCH (TDD only).

The mappings as seen from the UE and UTRAN sides are shown in Figure 4 and Figure 5 respectively. Figure 6 illustrates the mapping from the UE in relay operation. Note that ODMA logical channels and transport channels are employed only in relaylink transmissions (i.e. not used for uplink or downlink transmissions on the UE-UTRAN radio interface).

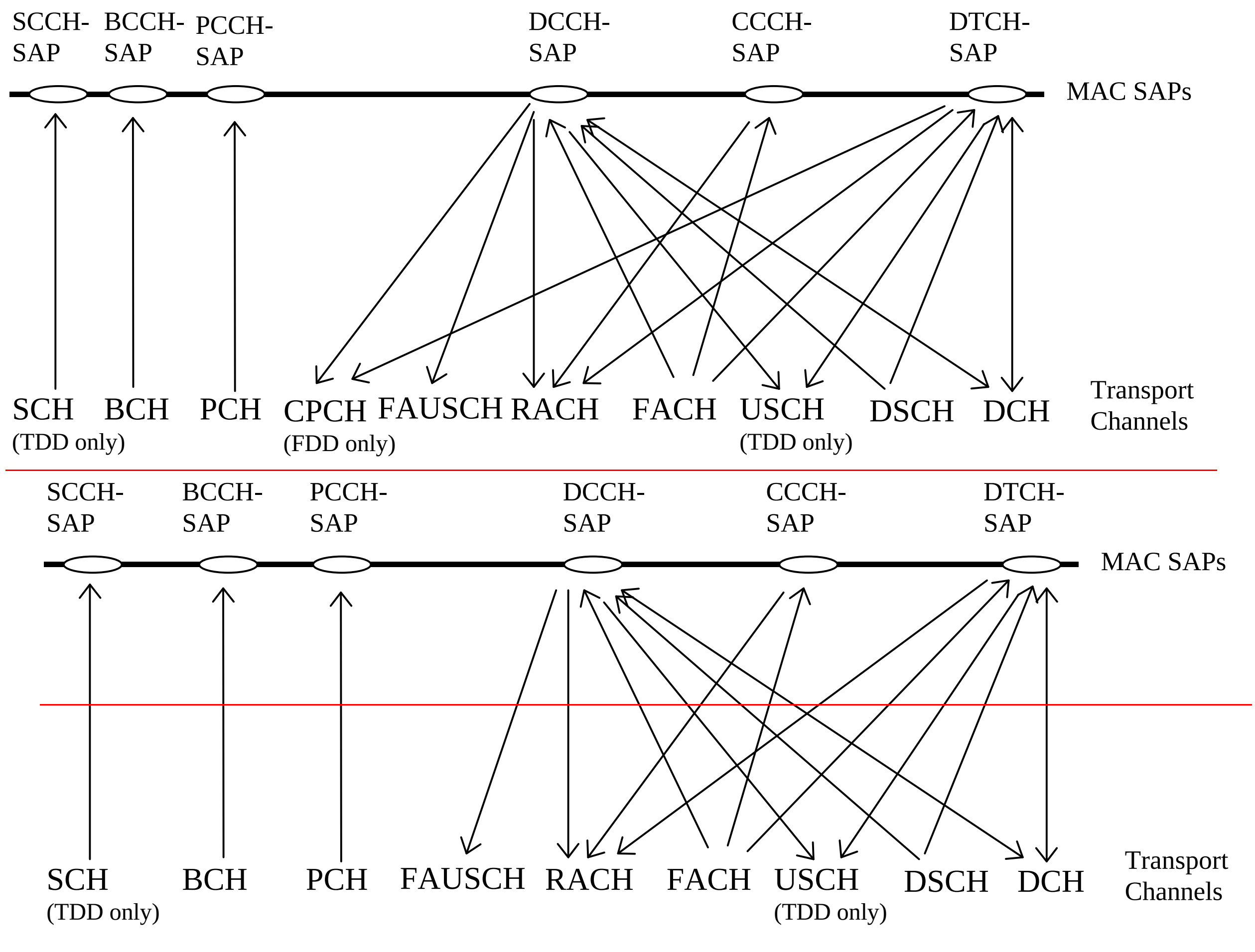

Figure 4: Logical channels mapped onto transport channels, seen from the UE side

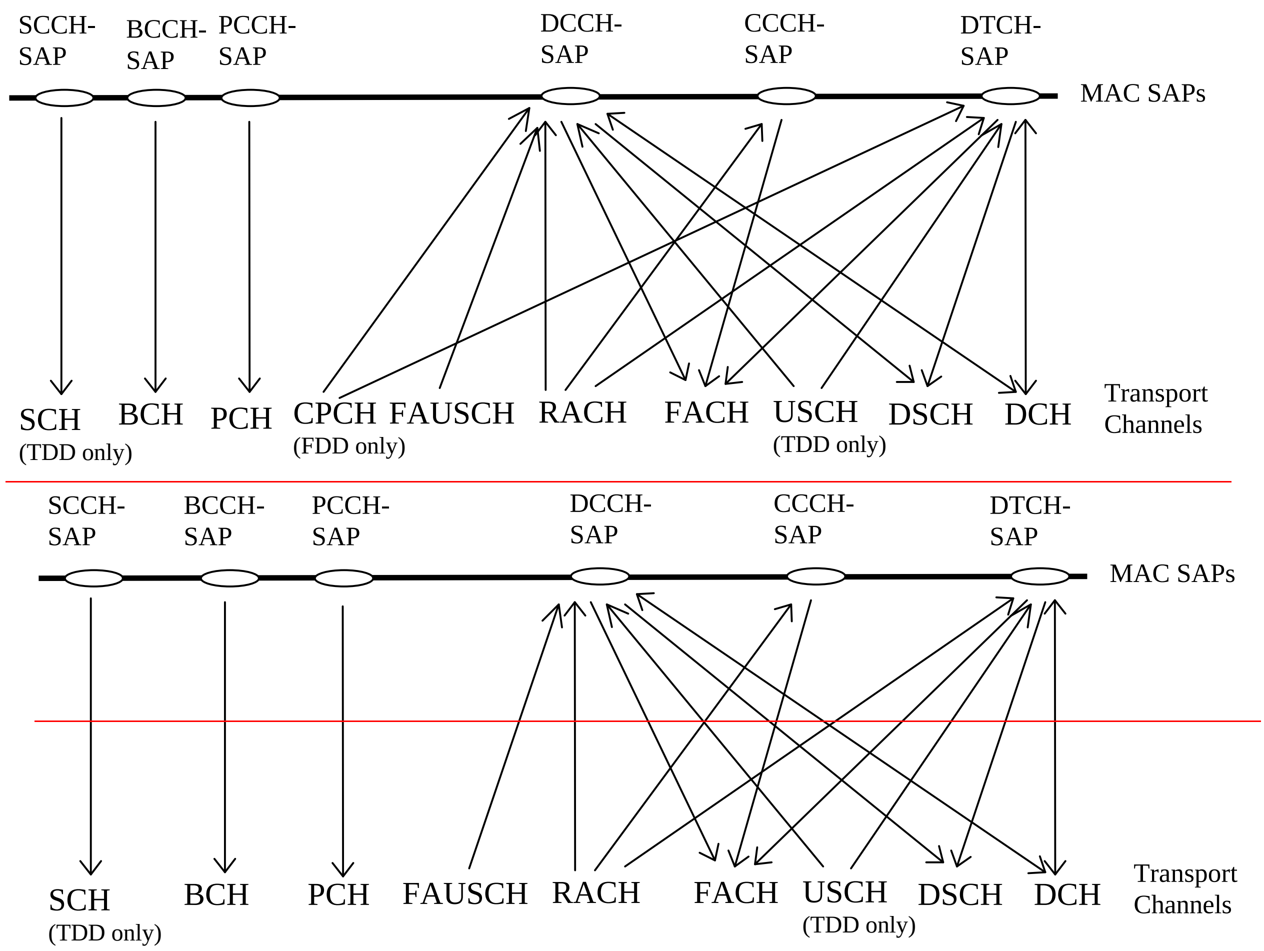

Figure 5: Logical channels mapped onto transport channels, seen from the UTRAN side

5.3.1.2 MAC functions

5.3.2 RLC Services and Functions

5.3.3 Data flows through Layer 2

5.3.3.1 Data flow for BCCH mapped to BCH (ffs.)

5.3.3.2 Data flow for PCCH mapped to PCH (ffs.)

5.3.3.3 Data flow for SCCH mapped to SCH (ffs.)

5.3.3.4 Data flow for CCCH mapped to FACH/RACH (ffs)

5.3.3.5 Data flow for DCCH mapped to FACH/RACH

5.3.3.6 Data flow for DCCH mapped to DSCH

5.3.3.7 Data flow for DCCH mapped to CPCH

For DCCH mapped to CPCH, unacknowledged or acknowledged transmission modes on RLC are employed. The MAC header is needed for logical channel service multiplexing. Figure 10 is the applicable data flow to this case.

~~5.3.2.7~~5.3.3.8 Data flow for DTCH (non-transparent RLC) mapped to FACH/RACH

~~5.3.2.8~~5.3.3.9 Data flow for DTCH (non-transparent RLC) mapped to DSCH

~~5.3.2.9~~5.3.3.10 Data flow for DTCH (transparent RLC) mapped to DCH

~~5.3.2.10~~5.3.3.11 Data flow for DTCH (non-transparent RLC) mapped to DCH

5.3.3.12 Data flow for DTCH (non-transparent RLC) mapped to CPCH.

This case requires both non-transparent RLC and MAC operations. The data flow shown in Figure 10 is applicable.

~~5.3.2.11~~5.3.3.13 Data flow for DCCH mapped to DCH

5.4 Layer 3 - RRC Services and Functions

5.4.1 RRC services

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. 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 This function supports broadcast of typically cell-specific information.
- **Broadcast of ODMA relay node neighbour information.** The RRC layer performs probe information broadcasting to allow ODMA routeing information to be collected.
- **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. The RRC layer detects loss of RRC connection and releases resources assigned for the RRC connection in case of connection failure.
- **Collating ODMA neighbour list and gradient information.** The ODMA relay node neighbour lists and their respective gradient information will be maintaining by the RRC.
- **Maintenance of number of ODMA relay node neighbours.** The RRC will adjust the broadcast powers used for probing messages to maintain the desired number of neighbours.
- **Establishment, maintenance and release of a route between ODMA relay nodes.** The establishment of an ODMA route and RRC connection based upon the routeing algorithm.
- **Interworking between the Gateway ODMA relay node and the UTRAN.** The RRC layer will control the interworking with the standard TDD or FDD communication link between the Gateway ODMA relay node and the UTRAN.
- **Establishment, reconfiguration and release of Radio Access Bearers.** The RRC layer can, on request from higher layers, perform the establishment, reconfiguration and release of radio access bearers in the user plane. A number of radio access 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 access 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. Paging and notification can be requested by higher layers on the network side. 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 access bearers can be met. This includes the allocation of a sufficient number of radio resources. The exact requirements on RRC to support this function are ffs.
- **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.
- **Slow DCA**. Allocation of preferred radio resources based on long-term decision criteria. It is applicable only in TDD mode.
- **Contention resolution**. The RRC handles reallocations and releases of radio resources in case of collisions indicated by lower layers in TDD mode. Applicability of contention resolution in FDD mode is ffs.
- **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. Details are ffs.]*
- **Initial cell selection and re-selection in idle mode.** Selection of the most suitable cell based on idle mode measurements and cell selection criteria.

The following functions are regarded as further study items:

- **Arbitration of the radio resource allocation between the cells**. This function shall ensure optimal performance of the overall UTRAN capacity.

  [Note: Some clarification should be provided what exact requirements this function implies on the RRC protocol, beyond general radio resource optimization.]
- **Congestion control.** Further study item**.**

5.5 Interactions between RRC and lower layers in the C plane

5.6 Protocol termination

5.6.1 Protocol termination for DCH

5.6.2 Protocol termination for RACH/FACH

5.6.3 Protocol termination for FAUSCH

5.6.4 Protocol termination for CPCH

The protocol termination for CPCH is identical to the termination for RACH. Figure 14 (for DCCH) presents the control plane protocol termination. Figure 15 presents the user plane protocol termination..

~~5.6.4~~5.6.5 Protocol termination for DSCH

~~5.6.5~~5.6.6 Protocol termination for transport channel of type BCH

~~5.6.6~~5.6.7 Protocol termination for transport channel of type PCH

~~5.6.7~~5.6.8 Protocol termination for ORACH

6 User Identification and RRC Connection Mobility

6.1 UE identification within UTRAN

A Radio Network Temporary Identity (RNTI) is used as an UE identifier on RACH/FACH or RACH+CPCH/FACH by the MAC protocol, or on PCH by the RRC, when a RRC connection exists.

Definition of UE identifiers

Two types of RNTI exist. One is used within the Serving RNC and it is denoted by Serving RNC RNTI (s-RNTI), the other is used within C-RNC, when applicable, and it is denoted by Controlling RNC RNTI (c-RNTI).

s-RNTI is allocated for all UEs having a RRC connection. It is allocated by the Serving RNC and it is unique within the Serving RNC. s-RNTI is reallocated always when the Serving RNC for the RRC connection is changed and deallocated when the RRC connection is released.

In addition for each UE having an RRC connection, there is an identifier of its current serving RNC, which is denoted as S-RNC identifier. The S-RNC identifier together with s-RNTI is a unique identifier of the RRC connection within PLMN.

c-RNTI for an UE is allocated by each controlling RNC through which UE is able to communicate on DCCH. c-RNTI is unique within the allocating C-RNC. c-RNTI is always allocated when a new UE context is created to a RNC. Serving RNC is always aware of all c-RNTIs allocated for the UE.

Usage of UE identifiers

s-RNTI together with the S-RNC identifier is used as a UE identifier in cell update, URA update, RRC connection reestablishment and (UTRAN originated) paging messages and associated responses on the air interface. S-RNC identifier is used by Controlling RNC to route the received uplink messages towards the Serving RNC. For the initial access two different methods of identification, a random number and a unique core network identifier are under consideration.

c-RNTI is used as a UE identifier in all other DCCH/DTCH common channel messages on the air interface.

[Note: Initial access, when no RRC connection exists, needs further study. The following two methods could be applied: (i) The initial access message carried on RACH/FACH transport channels and CCCH logical channel includes a unique UE identity (e.g. TMSI + LAI). (ii) The initial access message includes a random number as temporary

identity. The unique UE identity is then exchanged in a second phase after establishment of DCH transport channels on DCCH. In TDD mode, the first approach may imply initial access message length too large to be carried on RACH. Therefore the above second approach is preferred for TDD. In FDD mode, the first approach would be preferable. It is thus currently not decided whether the same or different initial access methods will need to be applied in FDD and TDD modes. Further contributions on this issue are invited. Also, it is ffs. whether messages with s-RNTI and RNC-ID will use the CCCH or the DCCH logical channel and whether the protocol layer providing the address field (and C-RNC routing) is MAC or RRC.]

A specific s-RNTI or c-RNTI (ffs.) is valid in several cells, thus decreasing the RNTI reallocation signalling for moving inactive packet data UE's.

6.2 UE connection to UTRAN

The different levels of UE connection to UTRAN are listed below:

- 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); note that FAUSCH can be used to allocate a dedicated channel for data transmission.

7 UE modes

8 Ciphering

Appendices

Annex A (informative): Protocol termination

This Annex describes protocol termination cases which have been excluded from the initial UMTS release. These cases are captured here for information. They potentially may be considered for future releases.

A.1 Alternative protocol termination for DCH

A.2 Protocol termination for RACH/FACH

A.3 Alternative Protocol termination for transport channel of type PCH

Annex B (informative):

Overview of CPCH Channel Access Procedure

[Note: This description needs to be reviewed and completed in future meetings.]

B.1 Overview of PHY and MAC

- The CPCH Random Access procedure is based on a DSMA-CD multiple access method.
- Access Preamble (AP) signatures are used to identify the particular CPCH resource which the UE is attempting to access.
- The access preamble ramp-up is similar to the RACH mechanism. However, there is a collision detection/resolution mechanism that follows the access preamble ramp-up. The UEs receive AICH indicating their success in ramp-up and granting accessing to the CPCH. The UEs will refrain requesting a busy CPCH channel. All UEs log and timestamp all received AICHs in a recency table. This table allows the UE to estimate the probability that a given CPCH is unused at any particular time. This models the DSMA-CD protocol.
- Layer 1 in Node B is responsible for Call Admission Control and resource management for the CPCH set assigned by the RNC to Node B.

B.2 Temporal Sequence of CPCH Events for Normal Access

The following describes the normal CPCH access procedure and entails both the UE and UTRAN side:

1. The UE will initiate RRC connection procedure and transition to the RRC connection mode. Transport Format Sets will be assigned to the UE by UTRAN, by RAB set-up.

2. The UE enters the idle mode where it performs the following tasks:
- monitoring the CPCH cell resources and parameters in BCCH,
- execution of the RLC ARQ procedure,
- monitoring of the AICH/ASSIGN to update CPCH availability table,
- reporting of traffic measurement Data as required by UTRAN.

3. UTRAN will be performing the following tasks in the idle mode:
- collection of traffic measurements from the UEs and the cells,
- reassignment of priorities to all UE RABs to maintain QoS,
- allocation of CPCHs to cells based on traffic measurements (cell demand),
- calculation of persistency values from all CPCHs to balance loads and relieve congestion.

- UTRAN broadcasts the CPCH parameters and resources on BCCH. The UTRAN transmits the system messages which contain the following information:

For each CPCH physical channel allocated to a cell the following parameters are included in the System Information message:

- CPCH Set ID to which this CPCH belongs.
- UL Access Preamble (AP) code (256 chip)
- DL AICH preamble code (256 chip)
- UL CD preamble code (256 chip)
- DL ASSIGN preamble code (256 chip)
- CPCH UL scrambling code (40,960 chip)
- CPCH UL channelisation code (variable, data rate dependant)
- CPCCH DL channelisation code (512 chip) [FFS]
- Data rate (spreading factor) (64, 128Kbps, 256Kbps, 384Kbps, or 2 Mbps)
- N_frames_max: Maximum packet length in frames [2-64] [FFS]
- Persistency value: assigned by RNC to control congestion and for load balancing
- Signature set: set of preamble signatures (up to 16, 16 bits long) for AP to access this CPCH