TSG-RAN Meeting #12 *RP-010302*
Stockholm, Sweden, 12 - 15 June 2001

Title: **Agreed CRs (Release '99 and Rel-4 category A) to TS 25.301**

Source: **TSG-RAN WG2**

Agenda item: **8.2.3**

Doc-1st-	Status-	Spec	CR	Rev	Phase	Subject	Cat	Version	Versio
R2-011117	agreed	25.301	053		R99	Clarification in the services provided to upper layers by RLC	F	3.7.0	3.8.0
R2-011337	agreed	25.301	054		Rel-4	Clarification in the services provided to upper layers by RLC	A	4.0.0	4.1.0
R2-011322	agreed	25.301	055	1	R99	Cleanup of Layer 2 services and functions	F	3.7.0	3.8.0
R2-011338	agreed	25.301	056		Rel-4	Cleanup of Layer 2 services and functions	A	4.0.0	4.1.0

3GPP TSG-RAN WG2 Meeting #21
Busan, Korea, 21-25 May 2001

Tdoc R2-011117

CR-Form-v4

CHANGE REQUEST

⌘ **25.301** **CR** **053** ⌘ ev **-** ⌘ Current version: **3.7.0** ⌘

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Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network **X** Core Network ☐

Title:	⌘	Clarification in the services provided to upper layers by RLC.
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	14th May 01
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one 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)

Reason for change:	⌘	It was decided after the presentation of Tdoc R2-010950 during RAN WG2#20 that: - The wording 'QoS Setting' in Section 5.3.2.1 shall be clarified.
Summary of change:	⌘	- The wording 'QoS Setting' in Section 5.3.2.1 is remplaced by Maintenance of QoS as defined by upper layers. Backwards Compatibility: This CR is a vocabulary alignment and is backwards compatible.
Consequences if not approved:	⌘	Specification unclear.

Clauses affected:	⌘	5.3.2.1		
Other specs affected:	⌘	**X** Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	25.322
Other comments:	⌘			

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5.3.2.1 Services provided to the upper layer

- **RLC connection establishment/release**. This service performs establishment/release of RLC connections.
- **Transparent data transfer**. This service transmits higher layer PDUs without adding any protocol information, possibly including segmentation/reassembly functionality.
- **Unacknowledged data transfer**. This service transmits higher 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 higher layer that are free of transmission errors by using the sequence-number check function.
  - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.
  - Immediate delivery: The receiving RLC sublayer entity shall deliver a SDU to the higher layer receiving entity as soon as it arrives at the receiver.
- **Acknowledged data transfer**. This service transmits higher 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 higher 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 higher layer protocol will not immediately request retransmission of a missing PDU) allowing out-of-sequence delivery can save memory space in the receiving RLC. The acknowledged data transfer mode has the following characteristics:
  - Error-free delivery: Error-free delivery is ensured by means of retransmission. The receiving RLC entity delivers only error-free SDUs to the higher layer.
  - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.
  - In-sequence delivery: RLC sublayer shall provide support for in-order delivery of SDUs, i.e., RLC sublayer should deliver SDUs to the receiving higher layer entity in the same order as the transmitting higher layer entity submits them to the RLC sublayer.
  - Out-of-sequence delivery: Alternatively to in-sequence delivery, it shall also be possible to allow that the receiving RLC entity delivers SDUs to higher layer in different order than submitted to RLC sublayer at the transmitting side.
- **Maintenance of QoS as defined by upper layers~~QoS setting~~.** The retransmission protocol shall be configurable by layer 3 to provide different levels of QoS. This can be controlled.
- **Notification of unrecoverable errors**. RLC notifies the upper layer of errors that cannot be resolved by RLC itself by normal exception handling procedures, e.g. by adjusting the maximum number of retransmissions according to delay requirements.

There is a single RLC connection per Radio Bearer.

3GPP TSG-RAN WG2 Meeting #21
Busan, Korea, 21-25 May 2001

Tdoc R2-011337

CR-Form-v4

CHANGE REQUEST

⌘ **25.301** **CR** **054** ⌘ rev **-** ⌘ Current version: **4.0.0** ⌘

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Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network **X** Core Network ☐

Title:	⌘	Clarification in the services provided to upper layers by RLC.
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	23rd May 01
Category:	⌘	**A**
Release:	⌘	REL-4

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
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Use one 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)*

Reason for change:	⌘	It was decided after the presentation of Tdoc R2-010950 during RAN WG2#20 that: - The wording 'QoS Setting' in Section 5.3.2.1 shall be clarified.
Summary of change:	⌘	- The wording 'QoS Setting' in Section 5.3.2.1 is remplaced by Maintenance of QoS as defined by upper layers.
Consequences if not approved:	⌘	Specification unclear.

Clauses affected:	⌘	5.3.2.1		
Other specs affected:	⌘	**X** Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	25.322
Other comments:	⌘			

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5.3.2.1 Services provided to the upper layer

- **RLC connection establishment/release**. This service performs establishment/release of RLC connections.
- **Transparent data transfer**. This service transmits higher layer PDUs without adding any protocol information, possibly including segmentation/reassembly functionality.
- **Unacknowledged data transfer**. This service transmits higher 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 higher layer that are free of transmission errors by using the sequence-number check function.
  - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.
  - Immediate delivery: The receiving RLC sublayer entity shall deliver a SDU to the higher layer receiving entity as soon as it arrives at the receiver.
- **Acknowledged data transfer**. This service transmits higher 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 higher 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 higher layer protocol will not immediately request retransmission of a missing PDU) allowing out-of-sequence delivery can save memory space in the receiving RLC. The acknowledged data transfer mode has the following characteristics:
  - Error-free delivery: Error-free delivery is ensured by means of retransmission. The receiving RLC entity delivers only error-free SDUs to the higher layer.
  - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.
  - In-sequence delivery: RLC sublayer shall provide support for in-order delivery of SDUs, i.e., RLC sublayer should deliver SDUs to the receiving higher layer entity in the same order as the transmitting higher layer entity submits them to the RLC sublayer.
  - Out-of-sequence delivery: Alternatively to in-sequence delivery, it shall also be possible to allow that the receiving RLC entity delivers SDUs to higher layer in different order than submitted to RLC sublayer at the transmitting side.
- **Maintenance of QoS as defined by upper layers~~QoS setting~~.** The retransmission protocol shall be configurable by layer 3 to provide different levels of QoS. This can be controlled.
- **Notification of unrecoverable errors**. RLC notifies the upper layer of errors that cannot be resolved by RLC itself by normal exception handling procedures, e.g. by adjusting the maximum number of retransmissions according to delay requirements.

There is a single RLC connection per Radio Bearer.

3GPP TSG-RAN WG2 Meeting #21
Busan, Korea, 21 - 25 May 2001

Tdoc R2-011322

CR-Form-v4

CHANGE REQUEST

⌘ **25.301 CR 055** ⌘ rev **r1** ⌘ Current version: **3.7.0** ⌘

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Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network **X** Core Network ☐

Title:	⌘	Cleanup of Layer 2 services and functions
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	23 May 2001
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
F *(correction)*
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Use one 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)*

Reason for change: ⌘ 25.301 is not aligned with 25.321, 25.322, 25.323, and 25.324.

Summary of change: ⌘

1. MAC functions
   - 'Traffic volume monitoring' is changed to 'Traffic volume measurement'.
   - CPCH is added in ASC selection
2. RLC services
   - 'RLC connection establishment/release' is removed since it is not present in 25.322.
   - 'Unique delivery service' is removed for UM because this service is based on the duplicate detection that is AM specific function.
3. RLC functions
   - All the RLC functions are listed.
4. PDCP services and functions
   - The contents are changed according to 25.323.
5. BMC services
   - Tr mode is removed since BMC message uses only RLC UM.

Rev 1

- Some editorial changes are made, and they are highlighted.
- Another CR (R2-011109) was merged to this CR.
  - In Sec. 5.6.2, removal of a reference to an Annex that has been removed with an earlier CR.
  - In Sec. 5.6.5.1, correction of a typo.

Backwards compatibility analysis

Since no functionality is added, this CR shall be backwards compatible.

Consequences if not approved:	⌘	Misalignment between the specs.

Clauses affected:	⌘	5.3.1.2, 5.3.2.1, 5.3.2.2, 5.3.3.1, 5.3.3.2, 5.3.4.1, 5.3.4.2, 5.6.2, 5.6.5.1			
Other specs affected:	⌘	**X**	Other core specifications	⌘	25.321, 25.322
			Test specifications		
			O&M Specifications		
Other comments:	⌘				

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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.

5.3.1.2 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 ~~higher~~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 ~~higher~~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~~monitoring~~**. 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

~~- **RLC connection establishment/release**. This service performs establishment/release of RLC connections.~~

- **Transparent data transfer**. This service transmits ~~higher~~upper layer PDUs without adding any protocol information, possibly including segmentation/reassembly functionality.

- **Unacknowledged data transfer**. This service transmits ~~higher~~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 ~~higher~~upper layer that are free of transmission errors by using the sequence-number check function.

  ~~- Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.~~

  - Immediate delivery: The receiving RLC sublayer entity shall deliver a SDU to the ~~higher~~upper layer receiving entity as soon as it arrives at the receiver.

- **Acknowledged data transfer**. This service transmits ~~higher~~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 ~~higher~~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 ~~higher~~upper layer protocol will not immediately request retransmission of a missing PDU) allowing out-of-sequence delivery can save memory space in the receiving RLC. The acknowledged data transfer mode has the following characteristics:

  - Error-free delivery: Error-free delivery is ensured by means of retransmission. The receiving RLC entity delivers only error-free SDUs to the ~~higher~~upper layer.

  - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.

  - In-sequence delivery: RLC sublayer shall provide support for in-order delivery of SDUs, i.e., RLC sublayer should deliver SDUs to the receiving ~~higher~~upper layer entity in the same order as the transmitting ~~higher~~upper layer entity submits them to the RLC sublayer.

- Out-of-sequence delivery: Alternatively to in-sequence delivery, it shall also be possible to allow that the receiving RLC entity delivers SDUs to ~~higher~~upper layer in different order than submitted to RLC sublayer at the transmitting side.

- **QoS setting.** The retransmission protocol shall be configurable by layer 3 to provide different levels of QoS. This can be controlled.

- **Notification of unrecoverable errors**. RLC notifies the upper layer of errors that cannot be resolved by RLC itself by normal exception handling procedures, e.g. by adjusting the maximum number of retransmissions according to delay requirements.

There is a single RLC connection per Radio Bearer.

5.3.2.2 RLC Functions

- **Segmentation and reassembly.** This function performs segmentation/reassembly of variable-length ~~higher~~upper layer PDUs into/from smaller RLC PDUs. The RLC PDU size is adjustable to the actual set of transport formats.

- **Concatenation.** If the contents of an RLC SDU cannot be carried by one RLC PDU, the first segment of the next RLC SDU may be put into the RLC PDU in concatenation with the last segment of the previous RLC SDU.

- **Padding.** When concatenation is not applicable and the remaining data to be transmitted does not fill an entire RLC PDU of given size, the remainder of the data field shall be filled with padding bits.

- **Transfer of user data.** This function is used for conveyance of data between users of RLC services. RLC supports acknowledged, unacknowledged and transparent data transfer. QoS setting controls transfer of user data.

- **Error correction.** This function provides error correction by retransmission (e.g. Selective Repeat, Go Back N, or a Stop-and-Wait ARQ) in acknowledged data transfer mode.

- **In-sequence delivery of ~~higher~~upper layer PDUs**. This function preserves the order of ~~higher~~upper layer PDUs that were submitted for transfer by RLC using the acknowledged data transfer service. If this function is not used, out-of-sequence delivery is provided.

- **Duplicate Detection.** This function detects duplicated received RLC PDUs and ensures that the resultant ~~higher~~upper ~~L~~layer PDU is delivered only once to the upper layer.

- **Flow control**. This function allows an RLC receiver to control the rate at which the peer RLC transmitting entity may send information.

- **Sequence number check ~~(Unacknowledged data transfer mode)~~.** This function is used in unacknowledged mode and guarantees the integrity of reassembled PDUs and provides a mechanism for the detection of corrupted RLC SDUs through checking sequence number in RLC PDUs when they are reassembled into a RLC SDU. A corrupted RLC SDU will be discarded.

- **Protocol error detection and recovery**. This function detects and recovers from errors in the operation of the RLC protocol.

- **Ciphering**. This function prevents unauthorised acquisition of data. Ciphering is performed in RLC layer for non-transparent RLC mode. Details of the security architecture are specified in [15].

- **Polling**. This function is used when an RLC transmitter requests a status report of an RLC receiver.

- **Status transmission**. An RLC receiver uses this function to transmit status reports to a RLC transmitter in order to inform about which PDUs that have been received and not received.

- **SDU discard**. This function allows an RLC transmitter to discharge RLC SDU from the buffer.

- **Estimated PDU Counter (EPC) mechanism**. This function is used for scheduling the retransmission of status reports in the receiver side.

- **Suspend/resume function**. Suspension and resumption of data transfer ~~as in e.g. LAPDm (cf. [16])~~.

- **Stop/continue function**. Stop and continue of data transfer.

- **Re-establishment function**. Re-establish an acknowledged or unacknowledged mode RLC entity.

5.3.3 PDCP Services and Function

This subclause provides an overview on services and functions provided by the Packet Data Convergence Protocol (PDCP). A detailed description of the PDCP is given in [10].

5.3.3.1 PDCP Services provided to upper layers

- ~~Transmission and reception of Network PDUs in acknowledged, unacknowledged and transparent RLC mode.~~

- PDCP SDU delivery.

5.3.3.2 PDCP Functions

- ~~Mapping of Network PDUs from one network protocol to one RLC entity.~~

- ~~Compression in the transmitting entity and decompression in the receiving entity of redundant Network PDU control information (header compression/ decompression). This may include TCP/IP header compression and decompression.~~

- **Header compression and decompression.** Header compression and decompression of IP data streams (e.g., TCP/IP and RTP/UDP/IP headers) at the transmitting and receiving entity, respectively. The header compression method is specific to the particular network layer, transport layer or upper layer protocol combinations e.g. TCP/IP and RTP/UDP/IP.

- **Transfer of user data.** Transmission of user data means that PDCP receives PDCP SDU from the NAS and forwards it to the RLC layer and vice versa.

- **Support for lossless SRNS relocation.** Maintenance of PDCP sequence numbers for radio bearers that are configured to support lossless SRNS relocation.

5.3.4 Broadcast/Multicast Control - Services and functions

This subclause provides an overview on services and functions provided by the BMC sublayer. A detailed description of the BMC protocol is given in [10].

5.3.4.1 BMC Services

The BMC-SAP provides a broadcast/multicast transmission service in the user plane on the radio interface for common user data in ~~transparent or~~ unacknowledged mode.

5.3.4.2 BMC Functions

- **Storage of Cell Broadcast Messages.**
  The BMC stores the Cell Broadcast messages received over the CBC-RNC interface for scheduled transmission.

- **Traffic volume monitoring and radio resource request for CBS.**
  At the UTRAN side, the BMC calculates the required transmission rate for Cell Broadcast Service based on the messages received over the CBC-RNC interface, and requests for appropriate CTCH/FACH resources from RRC.

- **Scheduling of BMC messages.**
  The BMC receives scheduling information together with each Cell Broadcast message over the CBC-RNC-interface. Based on this scheduling information, at the UTRAN side, BMC generates schedule messages and schedules BMC message sequences accordingly. At the UE side, BMC evaluates the schedule messages and indicates scheduling parameters to RRC, which are used by RRC to configure the lower layers for CBS discontinuous reception.

- **Transmission of BMC messages to UE.**
  This function transmits the BMC messages (Scheduling and Cell Broadcast messages) according to schedule.

- **Delivery of Cell Broadcast messages to upper layer (NAS).**
  This functions delivers the received Cell Broadcast messages to upper layer (NAS) in the UE. Only non-corrupted Cell Broadcast messages are delivered.

5.6.2 Protocol termination for RACH/FACH

Figure 13 and Figure 14 show the protocol termination for RACH/FACH for the control and user planes, respectively. Control plane termination refers to the case where RACH/FACH carry dedicated, common or shared control information (i.e. CCCH, DCCH or SHCCH, and in the downlink possibly also BCCH). User plane termination refers to the case where RACH/FACH carry dedicated user data (DTCH) ~~(two alternatives cases, referred to as case B and C, are described in the Annex) or common user data (CTCH).~~

It is assumed that macrodiversity/soft handover is not applied for RACH/FACH. Therefore, the physical layer terminates in Node B. For RACH/FACH carrying DCCH, MAC is split between Controlling and Serving RNC. RLC, and in the C plane also RRC terminate in the Serving RNC. Since Iur can support common channel data streams, the users of that common channel can depend on different SRNCs. However, they depend on the same Controlling RNC. Therefore, for a given user, the Controlling RNC and the Serving RNC can be separate RNCs.

For FACH carrying BCCH, MAC, RLC and RRC are terminated in the CRNC.

For RACH/FACH carrying SHCCH, MAC, RLC and RRC are terminated in the Controlling RNC (TDD only).

For RACH/FACH carrying CCCH, MAC, RLC and RRC are terminated in the RNC.

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 ~~i~~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.

3GPP TSG-RAN WG2 Meeting #21
Busan, Korea, 21 - 25 May 2001

Tdoc R2-011338

CR-Form-v4

CHANGE REQUEST

⌘ **25.301** **CR** **056** ⌘ rev **-** ⌘ Current version: **4.0.0** ⌘

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

Proposed change affects: ⌘ (U)SIM ☐ ME/UE **X** Radio Access Network **X** Core Network ☐

Title:	⌘	Cleanup of Layer 2 services and functions
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	24 May 2001
Category:	⌘	**A**
Release:	⌘	REL-4

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one 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)*

Reason for change: ⌘ 25.301 is not aligned with 25.321, 25.322, 25.323, and 25.324.

Summary of change: ⌘

1. MAC functions
   - 'Traffic volume monitoring' is changed to 'Traffic volume measurement'.
   - CPCH is added in ASC selection
2. RLC services
   - 'RLC connection establishment/release' is removed since it is not present in 25.322.
   - 'Unique delivery service' is removed for UM because this service is based on the duplicate detection that is AM specific function.
3. RLC functions
   - All the RLC functions are listed.
4. PDCP services and functions
   - The contents are changed according to 25.323.
5. BMC services
   - Tr mode is removed since BMC message uses only RLC UM.

Rev 1

- Some editorial changes are made, and they are highlighted.
- Another CR (R2-011109) was merged to this CR.
  - In Sec. 5.6.2, removal of a reference to an Annex that has been removed with an earlier CR.
  - In Sec. 5.6.5.1, correction of a typo.

Backwards compatibility analysis

Since no functionality is added, this CR shall be backwards compatible.

Consequences if not approved:	⌘	Misalignment between the specs.

Clauses affected:	⌘	5.3.1.2, 5.3.2.1, 5.3.2.2, 5.3.3.1, 5.3.3.2, 5.3.4.1, 5.3.4.2, 5.6.2, 5.6.5.1			
Other specs affected:	⌘	**X**	Other core specifications	⌘	25.321, 25.322
			Test specifications		
			O&M Specifications		
Other comments:	⌘				

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.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.

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.

5.3.1.2 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 ~~higher~~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 ~~higher~~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~~monitoring~~**. 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

~~- **RLC connection establishment/release**. This service performs establishment/release of RLC connections.~~

- **Transparent data transfer**. This service transmits ~~higher~~upper layer PDUs without adding any protocol information, possibly including segmentation/reassembly functionality.

- **Unacknowledged data transfer**. This service transmits ~~higher~~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 ~~higher~~upper layer that are free of transmission errors by using the sequence-number check function.

  ~~- Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.~~

  - Immediate delivery: The receiving RLC sublayer entity shall deliver a SDU to the ~~higher~~upper layer receiving entity as soon as it arrives at the receiver.

- **Acknowledged data transfer**. This service transmits ~~higher~~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 ~~higher~~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 ~~higher~~upper layer protocol will not immediately request retransmission of a missing PDU) allowing out-of-sequence delivery can save memory space in the receiving RLC. The acknowledged data transfer mode has the following characteristics:

  - Error-free delivery: Error-free delivery is ensured by means of retransmission. The receiving RLC entity delivers only error-free SDUs to the ~~higher~~upper layer.

  - Unique delivery: The RLC sublayer shall deliver each SDU only once to the receiving upper layer using duplication detection function.

  - In-sequence delivery: RLC sublayer shall provide support for in-order delivery of SDUs, i.e., RLC sublayer should deliver SDUs to the receiving ~~higher~~upper layer entity in the same order as the transmitting ~~higher~~upper layer entity submits them to the RLC sublayer.

- Out-of-sequence delivery: Alternatively to in-sequence delivery, it shall also be possible to allow that the receiving RLC entity delivers SDUs to ~~higher~~upper layer in different order than submitted to RLC sublayer at the transmitting side.

- **QoS setting.** The retransmission protocol shall be configurable by layer 3 to provide different levels of QoS. This can be controlled.

- **Notification of unrecoverable errors**. RLC notifies the upper layer of errors that cannot be resolved by RLC itself by normal exception handling procedures, e.g. by adjusting the maximum number of retransmissions according to delay requirements.

There is a single RLC connection per Radio Bearer.

5.3.2.2 RLC Functions

- **Segmentation and reassembly.** This function performs segmentation/reassembly of variable-length ~~higher~~upper layer PDUs into/from smaller RLC PDUs. The RLC PDU size is adjustable to the actual set of transport formats.

- **Concatenation.** If the contents of an RLC SDU cannot be carried by one RLC PDU, the first segment of the next RLC SDU may be put into the RLC PDU in concatenation with the last segment of the previous RLC SDU.

- **Padding.** When concatenation is not applicable and the remaining data to be transmitted does not fill an entire RLC PDU of given size, the remainder of the data field shall be filled with padding bits.

- **Transfer of user data.** This function is used for conveyance of data between users of RLC services. RLC supports acknowledged, unacknowledged and transparent data transfer. QoS setting controls transfer of user data.

- **Error correction.** This function provides error correction by retransmission (e.g. Selective Repeat, Go Back N, or a Stop-and-Wait ARQ) in acknowledged data transfer mode.

- **In-sequence delivery of ~~higher~~upper layer PDUs**. This function preserves the order of ~~higher~~upper layer PDUs that were submitted for transfer by RLC using the acknowledged data transfer service. If this function is not used, out-of-sequence delivery is provided.

- **Duplicate Detection.** This function detects duplicated received RLC PDUs and ensures that the resultant ~~higher~~upper ~~L~~layer PDU is delivered only once to the upper layer.

- **Flow control**. This function allows an RLC receiver to control the rate at which the peer RLC transmitting entity may send information.

- **Sequence number check ~~(Unacknowledged data transfer mode)~~.** This function is used in unacknowledged mode and guarantees the integrity of reassembled PDUs and provides a mechanism for the detection of corrupted RLC SDUs through checking sequence number in RLC PDUs when they are reassembled into a RLC SDU. A corrupted RLC SDU will be discarded.

- **Protocol error detection and recovery**. This function detects and recovers from errors in the operation of the RLC protocol.

- **Ciphering**. This function prevents unauthorised acquisition of data. Ciphering is performed in RLC layer for non-transparent RLC mode. Details of the security architecture are specified in [15].

- **Polling**. This function is used when an RLC transmitter requests a status report of an RLC receiver.

- **Status transmission**. An RLC receiver uses this function to transmit status reports to a RLC transmitter in order to inform about which PDUs that have been received and not received.

- **SDU discard**. This function allows an RLC transmitter to discharge RLC SDU from the buffer.

- **Estimated PDU Counter (EPC) mechanism**. This function is used for scheduling the retransmission of status reports in the receiver side.

- **Suspend/resume function**. Suspension and resumption of data transfer ~~as in e.g. LAPDm (cf. [16])~~.

- **Stop/continue function**. Stop and continue of data transfer.

- **Re-establishment function**. Re-establish an acknowledged or unacknowledged mode RLC entity.

5.3.3 PDCP Services and Function

This subclause provides an overview on services and functions provided by the Packet Data Convergence Protocol (PDCP). A detailed description of the PDCP is given in [10].

5.3.3.1 PDCP Services provided to upper layers

- ~~Transmission and reception of Network PDUs in acknowledged, unacknowledged and transparent RLC mode.~~

- PDCP SDU delivery.

5.3.3.2 PDCP Functions

- ~~Mapping of Network PDUs from one network protocol to one RLC entity.~~

- ~~Compression in the transmitting entity and decompression in the receiving entity of redundant Network PDU control information (header compression/ decompression). This may include TCP/IP header compression and decompression.~~

- **Header compression and decompression.** Header compression and decompression of IP data streams (e.g., TCP/IP and RTP/UDP/IP headers) at the transmitting and receiving entity, respectively. The header compression method is specific to the particular network layer, transport layer or upper layer protocol combinations e.g. TCP/IP and RTP/UDP/IP.

- **Transfer of user data.** Transmission of user data means that PDCP receives PDCP SDU from the NAS and forwards it to the RLC layer and vice versa.

- **Support for lossless SRNS relocation.** Maintenance of PDCP sequence numbers for radio bearers that are configured to support lossless SRNS relocation.

5.3.4 Broadcast/Multicast Control - Services and functions

This subclause provides an overview on services and functions provided by the BMC sublayer. A detailed description of the BMC protocol is given in [10].

5.3.4.1 BMC Services

The BMC-SAP provides a broadcast/multicast transmission service in the user plane on the radio interface for common user data in ~~transparent or~~ unacknowledged mode.

5.3.4.2 BMC Functions

- **Storage of Cell Broadcast Messages.**
  The BMC stores the Cell Broadcast messages received over the CBC-RNC interface for scheduled transmission.

- **Traffic volume monitoring and radio resource request for CBS.**
  At the UTRAN side, the BMC calculates the required transmission rate for Cell Broadcast Service based on the messages received over the CBC-RNC interface, and requests for appropriate CTCH/FACH resources from RRC.

- **Scheduling of BMC messages.**
  The BMC receives scheduling information together with each Cell Broadcast message over the CBC-RNC-interface. Based on this scheduling information, at the UTRAN side, BMC generates schedule messages and schedules BMC message sequences accordingly. At the UE side, BMC evaluates the schedule messages and indicates scheduling parameters to RRC, which are used by RRC to configure the lower layers for CBS discontinuous reception.

- **Transmission of BMC messages to UE.**
  This function transmits the BMC messages (Scheduling and Cell Broadcast messages) according to schedule.

- **Delivery of Cell Broadcast messages to upper layer (NAS).**
  This functions delivers the received Cell Broadcast messages to upper layer (NAS) in the UE. Only non-corrupted Cell Broadcast messages are delivered.

5.6.2 Protocol termination for RACH/FACH

Figure 13 and Figure 14 show the protocol termination for RACH/FACH for the control and user planes, respectively. Control plane termination refers to the case where RACH/FACH carry dedicated, common or shared control information (i.e. CCCH, DCCH or SHCCH, and in the downlink possibly also BCCH). User plane termination refers to the case where RACH/FACH carry dedicated user data (DTCH) ~~(two alternatives cases, referred to as case B and C, are described in the Annex) or common user data (CTCH).~~

It is assumed that macrodiversity/soft handover is not applied for RACH/FACH. Therefore, the physical layer terminates in Node B. For RACH/FACH carrying DCCH, MAC is split between Controlling and Serving RNC. RLC, and in the C plane also RRC terminate in the Serving RNC. Since Iur can support common channel data streams, the users of that common channel can depend on different SRNCs. However, they depend on the same Controlling RNC. Therefore, for a given user, the Controlling RNC and the Serving RNC can be separate RNCs.

For FACH carrying BCCH, MAC, RLC and RRC are terminated in the CRNC.

For RACH/FACH carrying SHCCH, MAC, RLC and RRC are terminated in the Controlling RNC (TDD only).

For RACH/FACH carrying CCCH, MAC, RLC and RRC are terminated in the RNC.

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.

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