TSG-RAN Meeting #8
Düsseldorf, Germany, 21 – 23 June 2000

RP-000220

Title: **Agreed CRs to TS 25.322**

Source: **TSG-RAN WG2**

Agenda item: **5.2.3**

Doc-1st-	Status-	Spec	CR	Rev	Subject	Cat	Version	Versio
R2-000757	agreed	25.322	038		Corrections to RLC	F	3.2.0	3.3.0
R2-000768	agreed	25.322	039		Correction to the description of the MRW SUFI fields	C	3.2.0	3.3.0
R2-000942	agreed	25.322	040	1	Editorial corrections to length indicators and local suspend rate	D	3.2.0	3.3.0
R2-001237	agreed	25.322	041	4	Clarification of the RESET PDU	C	3.2.0	3.3.0
R2-001235	agreed	25.322	043	1	Clarification of RLC/MAC interaction	F	3.2.0	3.3.0
R2-001239	agreed	25.322	044	2	General RLC corrections	F	3.2.0	3.3.0
R2-001007	agreed	25.322	045		Clarification of RLC Transparent Mode operation	F	3.2.0	3.3.0
R2-001075	agreed	25.322	048		Editorial corrections to abbreviations, SCCH, BCCH	D	3.2.0	3.3.0
R2-001140	agreed	25.322	052		Updated RLC SDL	D	3.2.0	3.3.0
R2-001141	agreed	25.322	053		Correction to RLC	F	3.2.0	3.3.0
R2-001196	agreed	25.322	055		RLC Logical Channel mapping	D	3.2.0	3.3.0
R2-001244	agreed	25.322	057		Correction of EPC timer mechanism	F	3.2.0	3.3.0

3GPP TSG RAN WG2 meeting #12
Seoul, Korea, 10-13 April 2000

***Document* R2-000757**
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25.322 CR 038 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN #8
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for information	☐	non-strategic	☐	

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 2000-04-05

Subject: Corrections to RLC

Work item:

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

F	Correction	☒	**Release:**	Phase 2	☐
A	Corresponds to a correction in an earlier release	☐		Release 96	☐
B	Addition of feature	☐		Release 97	☐
C	Functional modification of feature	☐		Release 98	☐
D	Editorial modification	☐		Release 99	☒
				Release 00	☐

Reason for change:

1. The criterion for stopping the poll timer can lead to deadlock in some situations. Especially if the poll bit is set in a retransmitted PDU.

Clauses affected: 9.5, 9.7.1

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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9.5 Timers

a) Timer_Poll

This timer is only used when the poll timer trigger is used. It is started when the transmitting side sends a poll to the peer entity. The timer is stopped when receiving a STATUS PDU that contains an acknowledgement or negative acknowledgement of the AMD PDU with SN=VT(S)-1 at the time the poll was transmitted~~that triggered the timer~~. The value of the timer is signalled by RRC.

If the timer expires and no STATUS PDU containing an acknowledgement or negative acknowledgement of the AMD PDU with SN=VT(S)-1 at the time the poll was transmitted ~~that triggered the timer~~ has been received, the receiver is polled once more (either by the transmission of a PDU which was not yet sent, or by a retransmission) and the timer is restarted with a new value of VT(S)-1. If there is no PU to be transmitted and all PUs have already been acknowledged, the receiver shall not be polled.

If a new poll is sent when the timer is running it is restarted.

9.7.1 Polling function for acknowledged mode transfer

The transmitter of AMD PDUs may poll the receiver for a STATUS PDU. The Polling bit in the AMD PDU indicates the poll request. There are several triggers for setting the polling bit. The network (RRC) controls, which triggers should be used for each RLC entity. Following triggers are possible:

1) Last PU in buffer

   The sender transmits a poll when the last PU available for transmission is transmitted.

2) Last PU in retransmission buffer

   The sender transmits a poll when the last PU to be retransmitted is transmitted.

3) Poll timer

   The timer Timer_Poll is started when a poll is transmitted to the receiver and if no STATUS PDU containing an acknowledgement or negative acknowledgement of the AMD PDU ~~that triggered the timer~~ with SN=VT(S)-1 at the time the poll was transmitted has been received before the timer Timer_Poll expires a new poll is transmitted to the receiver.

4) Every Poll_PU PU

   The sender polls the receiver every Poll_PU PU. Both retransmitted and new Pus shall be counted.

5) Every Poll_SDU SDU

   The sender polls the receiver every Poll_SDU SDU.

6) Poll_Window% of transmission window

   The sender polls the receiver when it has reached Poll_Window% of the transmission window.

7) Timer based

   The sender polls the receiver periodically.

The network also controls if the poll prohibit function shall be used. The poll bit shall be set to 0 if the poll prohibit function is used and the timer Timer_Poll_Prohibit is active. This function has higher priority than any of the above mentioned triggers.

3GPP Meeting RAN WG2 #12
Seoul, Korea, 10.-13. Apr, 2000

Document R2-000768
e.g. for 3GPP use the format TP-99xxx
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25.322 CR 039 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN #8
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Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 6. Apr, 2000

Subject: Correction to the description of the MRW SUFI fields

Work item:

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

F	Correction	☒	
A	Corresponds to a correction in an earlier release	☐	
B	Addition of feature	☐	
C	Functional modification of feature	☐	
D	Editorial modification	☐	

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change: The previous description of SN_MRW_i field was sligthly incorrect resulting the improper operation of the SDU discard function in certain conditions.

Clauses affected: 9.2.2.11.7, 9.2.2.11.8

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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9.2.2.11.7 The Move Receiving Window super-field

The ‘Move Receiving Window’ super-field is used to request the RLC receiver to move its receiving window and to indicate the amount of discarded SDUs, as a result of a SDU discard in the RLC transmitter. The format is given in the figure below.

Type = **MRW**
LENGTH
SN_MRW$_1$
...
SN_MRW$_{LENGTH}$

Figure 9.14: The MRW fields in a STATUS PDU

LENGTH

Length: 4 bits

The number of SN_MRW$_i$ fields in the super-field of type MRW. It equals the amount of discarded SDUs within one SUFI.

SN_MRW$_i$

Length: 12 bits

SN_MRW$_i$ fields enumerate each of the discarded SDUs by indicating the sequence number of the ~~next~~ PU in which the succeeding SDU of ~~not anymore belonging to~~ the i:th discarded SDU begins.

Additionally SN_MRW$_{LENGTH}$ requests the RLC receiver to discard all PUs with sequence number < SN_MRW$_{LENGTH}$, and to move the receiving window accordingly. It also indicates the first data byte in the PU with sequence number SN_MRW$_{LENGTH}$ corresponds to the first byte of the SDU to be reassembled next.

9.2.2.11.8 The Move Receiving Window and Ignore First LI (MRW_N_IFL) super-field

The 'Move Receiving Window and ignore first N LIs' super-field is used to request the RLC receiver to move its receiving window and to indicate the amount of discarded SDUs, as a result of a SDU discard in the RLC transmitter. It also indicates to the receiver the presence and the amount of the trailing bytes of the discarded SDU in the PU with sequence number SN_MRW$_{LENGTH}$. The format is given in the figure below.

Type = **MRW_N_IFL**
N
LENGTH
SN_MRW$_1$
...
SN_MRW$_{LENGTH}$

Figure 9.15: The MRW_N_IFL fields in a STATUS PDU

N

Length: 4 bits

The number of LI fields in the PU that shall be ignored in the SN_MRW$_{LENGTH}$. It equals the amount of SDUs in the PU that are discarded from the PU identified by SN_MRW$_{LENGTH}$.

LENGTH

Length: 4 bits

The number of SN_MRW$_i$ fields in the super-field of type MRW. It equals the amount of discarded SDUs within one MRW SUFI.

SN_MRW$_i$

Length: 12 bits

SN_MRW$_i$ fields enumerate each of the discarded SDUs by indicating the sequence number of the ~~next~~ PU in which the succeeding SDU of ~~not anymore belonging to~~ the i:th discarded SDU begins.

Additionally SN_MRW$_{LENGTH}$ requests the RLC receiver to discard all PUs with sequence number < SN_MRW$_{LENGTH}$, and to move the receiving window accordingly. In addition, the receiver has to discard the first N LIs and the corresponding data bytes in the PU with sequence number SN_MRW$_{LENGTH}$.

3GPP Meeting RAN WG2 #12
Seoul, Korea, 10.-13. Apr, 2000

***Document* R2-000942**
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25.322 CR 040r1 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 11 Apr, 2000

Subject: Editorial corrections to length indicators and local suspend state

Work item:

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

F	Correction	☐
A	Corresponds to a correction in an earlier release	☐
B	Addition of feature	☐
C	Functional modification of feature	☐
D	Editorial modification	☒

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change: The use of 7-bit length indicators has been clarified.
The description of local suspend state for unacknowledged mode RLC entities is missing from the specification.

Clauses affected: 9.2.2.8, 9.3.2.3 (new)

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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9.2.2.8 Length Indicator (LI)

The Length Indicator is used to indicate, each time, the end of an *S*DU occurs in the PU. The Length Indicator points out the number of octets between the end of the last Length Indicator field and up to and including the octet at the end of an SDU segment. Length Indicators are included in the PUs that they refer to. The size of the Length Indicator may be either 7bits or 15bits. The maximum value of a Length Indicator will be no greater than the RLC PDU size – AMD PDU Header – PADDING.

A Length Indicator group is a set of Length Indicators that refer to a PU. Length Indicators that are part of a Length Indicator group must never be reordered within the Length Indicator group or removed from the Length Indicator group.

If there can be more than one Length Indicator, each specifying the end of an SDU in a PU, the order of these Length Indicators must be in the same order as the SDUs that they refer to.

In the case where the end of last segment of an SDU exactly ends at the end of a PDU, the next Length Indicator, shall be placed as the first Length Indicator in the next PU and have value LI=0.

In the case where the last segment of an RLC SDU is one octet short of exactly filling the last RLC PU, and 15-bit Length Indicators are used, the next Length Indicator shall be placed as the first Length Indicator in the next PU and have value LI=111 1111 1111 1011.

A PU that has unused space, to be referred to as padding, must use a Length Indicator to indicate that this space is used as padding. A padding Length Indicator must be placed after any Length Indicators for a PU.

All unused space in a PU must be located at the end of the PDU, be a homogeneous space and is referred to as padding. Predefined values of the Length Indicator are used to indicate this. The values that are reserved for special purposes are listed in the tables below depending on the size of the Length Indicator. Only predefined Length Indicator values can refer to the padding space.

STATUS PDUs can be piggybacked on the AMD PDU by using part or all of the padding space. A Length Indicator must be used to indicate the piggybacked STATUS PDU. This Length Indicator takes space from the padding space or piggybacked STATUS PDU and not the PDU data and will always be the last Length Indicator. Where only part of the padding space is used by a piggybacked STATUS PDU then the end of the piggybacked STATUS PDU is determined by one of the SUFI fields NO_MORE or ACK, thus no additional Length Indicator is required to show that there is still padding in the PDU. The padding/piggybacked STATUS PDU predefined Length Indicators shall be added after the very last (i.e. there could be more than one SDU that end within a PDU) Length Indicator that indicates the end of the last SDU segment in the PU.

If RLC PDUs always carry only one PU, 7bit indicators are used in a particular RLC PDU if the address space is sufficient to indicate all possible SDU segment borders. Otherwise 15bit Length Indicators are applied.

The length of the Length Indicator only depends on the size of the largest RLC PDU. The length of the Length Indicator is always the same for all PUs, for one RLC entity.

For Release 99, there is one PU in a AMD PDU.

Length: 7bit

Bit	Description
0000000	The previous RLC PDU was exactly filled with the last segment of a RLC SDU.
1111100	Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111101	Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111110	The rest of the RLC PDU includes a piggybacked STATUS PDU.
1111111	The rest of the RLC PDU is padding.

Length: 15bit

Bit	Description
000000000000000	The previous RLC PDU was exactly filled with the last segment of a RLC SDU.
111111111111011	The last segment of an RLC SDU was one octet short of exactly filling the last RLC PDU.
111111111111100	Reserved (PDUs with this coding will be discarded by this version of the protocol).
111111111111101	Reserved (PDUs with this coding will be discarded by this version of the protocol).l
111111111111110	The rest of the RLC PDU includes a piggybacked STATUS PDU.
111111111111111	The rest of the RLC PDU is padding.

9.3.2 State model for unacknowledged mode entities

Figure 9.17 illustrates the state model for unacknowledged mode RLC entities (both transmitting and receiving). An unacknowledged mode entity can be in one of following states.

9.3.2.1 Null State

In the null state the RLC entity does not exist and therefore it is not possible to transfer any data through it.

Upon reception of an CRLC-CONFIG-Req from higher layer the RLC entity is created and unacknowledged data transfer ready state is entered.

9.3.2.2 Unacknowledged Data Transfer Ready State

In the unacknowledged data transfer ready, unacknowledged mode data can be exchanged between the entities. Upon reception of an CRLC-CONFIG-Req from higher layer the RLC entity is terminated and the null state is entered.

9.3.2.3 Local Suspend State

Upon reception of CRLC-SUSPEND-Req from higher layer (RRC) the RLC entity is suspended and the Local Suspend state is entered. In the Local Suspend state RLC shall not send ~~a~~ RLC-PDUs with ~~a~~ SN>=VT(US)+N. Upon reception of CRLC-RESUME-Req from higher layer (RRC) the RLC entity is resumed and the Data Transfer Ready state is entered.

Figure 9.17: The state model for unacknowledged mode entities

3GPP TSG RAN WG2#13
Oahu, HI, USA, 22-26 May, 2000

***Document* R2-001237**
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25.322 CR 041r4 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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strategic ☐
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Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from:* ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 2000-05-22

Subject: Clarification of the RESET PDU

Work item:

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

F	Correction	☐
A	Corresponds to a correction in an earlier release	☐
B	Addition of feature	☐
C	Functional modification of feature	☒
D	Editorial modification	☐

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change:

After each RESET procedure both peer RLC entities shall increase the value of the HFN by one in order to prevent the reuse of the same ciphering mask for the same RB. However if the RESET ACK PDU sent by Receiver is either lost or corrupted, this may lead to the situation in where the Receiver side may unnecessarily increase the value of the HFN too many times.
To prevent this kind of situation a new one bit RSN (Reset Sequence Number) field is presented to be included into RESET PDU. With the aid of this field the Receiver can define whether the received RESET PDU was transmitted by the Sender for the first time or whether it was retransmitted caused by e.g. the loss of RESET ACK PDU.

Clauses affected: 9.1.2, 9.2.1.6, 9.2.2, 9.3.3, 11.4

Other specs Affected:

Other 3G core specifications	☐	→ List of CRs:	
Other GSM 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:

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

9.1.2 Control PDUs

a) STATUS PDU and Piggybacked STATUS PDU.

The STATUS PDU and the Piggybacked STATUS PDU are used:

- by the receiving entity to inform the transmitting entity about missing PUs at the receiving entity;
- by the receiving entity to inform the transmitting entity about the size of the allowed transmission window;
- and by the transmitting entity to request the receiving entity to move the receiving window.

b) RESET PDU~~(Reset).~~

The RESET PDU is used in acknowledged mode to reset all protocol states, protocol variables and protocol timers of the peer RLC entity in order to synchronise the two peer entities.

c) RESET ACK PDU~~(Reset Acknowledge).~~

The RESET ACK PDU is an acknowledgement to the RESET PDU.

Table 9.1: RLC PDU names and descriptions

Data Transfer Mode	PDU name	Description
Transparent	TrD	Transparent mode data
Unacknowledged	UMD	Sequenced unacknowledged mode data
Acknowledged	AMD	Sequenced acknowledged mode data
	STATUS	Solicited or Unsolicited Status Report
	Piggybacked STATUS	Piggybacked Solicited or Unsolicited Status Report
	RESET	Reset Command
	RESET ACK	Reset Acknowledgement

9.2.1.6 RESET, RESET ACK PDU

The RESET PDU has a one-bit sequence number field (RSN). With the aid of this field the Receiver can define whether the received RESET PDU is transmitted by the Sender for the first time or whether it is a retransmission of a previous RESET PDU.

Figure 9.6: RESET, RESET ACK PDU

9.2.2 Parameters

If not otherwise mentioned in the definition of each field then the bits in the parameters shall be interpreted as follows: The left most bit string is the most significant and the right most bit is the least significant bit.

9.2.2.1 D/C field

Length: 1bit

The D/C field indicates the type of an acknowledged mode PDU. It can be either data or control PDU.

Bit	Description
0	Control PDU
1	Acknowledged mode data PDU

9.2.2.2 PDU Type

Length: 3 bit

The PDU type field indicates the Control PDU type

Bit	PDU Type
000	STATUS
001	RESET
010	RESET ACK

9.2.2.3 Sequence Number (SN)

This field indicates the sequence number of the payload unit. If header compression is applied the sequence number of the first PU in the PDU is indicated. Otherwise a sequence number is indicated separately for each PU in the extended header.

PDU type	Length	Notes
AMD PDU	12 bits	Used for retransmission and reassembly
UMD PDU	7 bits	Used for reassembly

9.2.2.4 Polling bit (P)

Length: 1bit

This field is used to request a status report (STATUS PDU) from the receiver RLC.

Bit	Description
0	Status report not requested
1	Request a status report

9.2.2.5 Extension bit (E)

Length: 1bit

This bit indicates if the next octet will be a length indicator and E bit.

Bit	Description
0	The next field is data
1	The next field is Length Indicator and E bit

9.2.2.6 Reserved (R)

Length: 3~~4~~ bits

This field is used to achieve octet alignment and for this purpose it is coded as 000~~0~~. Other functions of it are left for future releases.

9.2.2.7 Header Extension Type (HE)

Length: 2 bits

This two-bit field indicates the format of the extended header.

Value	Description
00	The succeeding octet contains data
01	The succeeding octet contains a 7bit length indicator and E bit
10	The succeeding octet contains a 15bit length indicator and E bit
11	Reserved (PDUs with this coding will be discarded by this version of the protocol).

9.2.2.x Reset Sequence Number (RSN)

Length: 1 bit

This field is used to indicate the sequence number of the transmitted RESET PDU. If this RESET PDU is a retransmission of the original RESET PDU then the retransmitted RESET PDU would have the same sequence number value as the original RESET PDU. Otherwise it will have the next reset sequence number. The initial value of this field is zero.

9.3.3 State model for acknowledged mode entities

Figure 9.18 illustrates the state model for the acknowledged mode RLC entity (both transmitting and receiving). An acknowledged mode entity can be in one of following states.

9.3.3.1 Null State

In the null state the RLC entity does not exist and therefore it is not possible to transfer any data through it.

Upon reception of an CRLC-CONFIG-Req from higher layer the RLC entity is created and acknowledged data transfer ready state is entered.

9.3.3.2 Acknowledged Data Transfer Ready State

In the acknowledged data transfer ready state, acknowledged mode data can be exchanged between the entities. Upon reception of a CRLC-CONFIG-Req from higher layer the RLC entity is terminated and the null state is entered.

Upon errors in the protocol, the RLC entity sends a RESET PDU to its peer and enters the reset pending state.

Upon reception of a RESET PDU, the RLC entity resets the protocol (resets the state variables in 9.4 to their initial value and resets configurable parameters to their configured value) and responds to the peer entity with a RESET ACK PDU.

Upon reception of a RESET ACK PDU, the RLC takes no action.

9.3.3.3 *Reset* Pending State

In the reset pending state the entity waits for a response from its peer entity and no data can be exchanged between the entities. Upon reception of CRLC-CONFIG-Req from higher layer the RLC entity is terminated and the null state is entered.

Upon reception of a RESET ACK PDU, the RLC entity resets the protocol (resets the state variables in 9.4 to their initial value,~~, and~~ resets configurable parameters to their configured value, increments the hyper frame number) and enters the acknowledged data transfer ready state.

Upon reception of a RESET PDU, the RLC entity resets the protocol (resets the state variables in 9.4 to their initial value, resets configurable parameters to their configured value, increments the hyper frame number), sends a RESET ACK PDU and ~~enters the acknowledged data transfer ready state~~stays in the reset pending state.

Figure 9.18: The state model for the acknowledged mode entities when reset is performed

9.3.3.4 Local Suspend State

Upon reception of CRLC-SUSPEND-Req from higher layer (RRC) the RLC entity is suspended and the Local Suspend state is entered. In the Local Suspend state RLC shall not send a RLC-PDUs with a SN>=VT(S)+N. Upon reception of CRLC-RESUME-Req from higher layer (RRC) the RLC entity is resumed and the Data Transfer Ready state is entered.

Figure 9.19: The state model for the acknowledged mode entities when local suspend is performed

11.4 RLC reset procedure

11.4.1 Purpose

The RLC reset procedure is used to reset two RLC peer entities, which are operating in acknowledged mode.
Figure 11.4 below illustrates the elementary procedure for a RLC reset. The sender can be either the UE or the network and the receiver is either the network or the UE.

Figure 11.4: RLC reset procedure

11.4.2 Initiation

The procedure shall be initiated when a protocol error occurs.

The sender sends the RESET PDU when it is in data transfer ready state and enters reset pending state. The sender shall start the timer Timer_RST and increase VT(RST) with 1. The RESET PDU shall be transmitted on the DCCH logical channel if the sender is located in the control plane and on the DTCH if it is located in the user plane.

The RESET PDU has higher priority than data PDUs.

When a reset procedure has been initiated it can only be ended upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU, i.e., a reset procedure is not interrupted by the reception of a RESET PDU from the peer entity~~.~~

11.4.2.1 RESET PDU contents to set

The size of the RESET PDU shall be equal to one of the allowed PDU sizes. The RSN field shall indicate the sequence number of the RESET PDU. This sequence number is incremented every time a new RESET PDU is transmitted.

11.4.3 Reception of the RESET PDU by the receiver

Upon reception of a RESET PDU the receiver shall respond with a RESET ACK PDU. The receiver resets the state variables in 9.4 to their initial value and resets configurable parameters to their configured value.

~~From~~In the received RESET PDU the Receiver shall check the value of RSN (Reset Sequence Number) field.~~ Based on the information in this field the Receiver either increases the value of the HFN or not.~~ If the value of the RSN field is different from the RSN value in the previously received RESET PDU the Receiver shall increase the value of the HFN by one.

If the value of the RSN is equal to the RSN value in the previously received RESET PDU, (i.e. the RESET PDU is a retransmitted RESET PDU) ~~PDU, the Receiver knows that the received PDU is a retransmitted RESET PDU (i.e. the first RESET ACK PDU was lost or corrupted) and therefore~~ the value of the HFN shall not be increased and only a RESET ACK PDU shall be sent to the peer RLC entity.

The RESET ACK PDU shall be transmitted on the DCCH logical channel if the sender is located in the control plane and on the DTCH if it is located in the user plane.

The RESET ACK PDU has higher priority than data PDUs.

11.4.3.1 RESET ACK PDU contents to set

The size of the RESET ACK PDU shall be equal to one of the allowed PDU sizes. The RSN field shall always be set to the same value as in the corresponding RESET PDU.

11.4.4 Reception of the RESET ACK PDU by the sender

When the sender is in reset pending state and receives~~Upon reception of~~ a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU the Timer_RST shall be stopped and the value of the HFN shall be increased by one. The sender resets the state variables in 9.4 to their initial value and resets configurable parameters to their configured value. The sender shall enter data transfer ready state.

~~When the sender is in reset pending state and receives~~ Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the~~ sender takes no action~~RESET ACK PDU is discarded.

Upon reception of a RESET ACK PDU in data transfer ready state the ~~sender takes no action.~~RESET ACK PDU is discarded.

11.4.5 Abnormal cases

11.4.5.1 Timer_RST timeout

Upon expiry of Timer_RST the sender shall retransmit the RESET PDU and increase VT(RST) with 1. In the retransmitted RESET PDU the RSN field value shall not be incremented.

11.4.5.2 VT(RST) ≥ MaxRST

If VT(RST) becomes larger or equal to MaxRST the RRC layer shall be informed.

11.4.5.3 Reception of the RESET PDU by the sender

Upon reception of a RESET PDU in reset pending state the sender resets the state variables in 9.4 to their initial value, resets configurable parameters to their configured value and increments the hyper frame number. The sender shall stay in the reset pending state. The sender shall retransmit the RESET PDU and increase VT(RST) with 1. The sender can enter data transfer ready state only upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU.

3GPP TSG RAN WG2 meeting #13
Oahu, HI, USA, 22 - 26 May 2000

***Document* R2-001235**
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.322 CR 043r1 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN #8
list expected approval meeting # here ↑

for approval ☒
for information ☐

strategic ☐
non-strategic ☐
(for SMG Use only)

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 2000-05-24

Subject: Clarification of RLC/MAC interaction

Work item:

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

F	Correction	☒
A	Corresponds to a correction in an earlier release	☐
B	Addition of feature	☐
C	Functional modification of feature	☐
D	Editorial modification	☐

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change:

1. It should be clarified what RLC should do if MAC prevents some (or all) available PDUs to be transmitted in a TTI. This is valid for Tr, UM and AM mode.

Clauses affected:

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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:

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

9.7.3 SDU discard function

The SDU discard function allows to discharge RLC PDU from the buffer on the transmitter side, when the transmission of the RLC PDU does not success for a long time. The SDU discard function allows to avoid buffer overflow~~, in the case of non-transparent transmission mode~~. There will be several alternative operation modes of the RLC SDU discard function, and which discard function to use will be given by the QoS requirements of the Radio Access Bearer.

The following is a list of operation modes for the RLC SDU discard function.

Table 9.2: List of criteria's that control when to perform SDU discard

Operation mode	Presence
Timer based discard, with explicit signalling	Network controlled
Timer based discard, without explicit signalling	Network controlled
SDU discard after MaxDAT number of retransmissions	Network controlled

9.7.3.1 Timer based discard, with explicit signalling

This alternative uses a timer based triggering of SDU discard (Timer_Discard). This makes the SDU discard function insensitive to variations in the channel rate and provides means for exact definition of maximum delay. However, the SDU loss rate of the connection is increased as SDUs are discarded.

For every SDU received from a higher layer, timer monitoring of the transmission time of the SDU is started. If the transmission time exceeds a predefined value for a SDU in acknowledged mode RLC, this SDU is discarded in the transmitter and a Move Receiving Window (MRW) command is sent to the receiver so that AMD PDUs carrying that SDU are discarded in the receiver and the receiver window is updated accordingly. Note that when the concatenation function is active, PDUs carrying segments of other SDUs that have not timed out shall not be discarded.

The MRW command is defined as a super-field in the RLC STATUS PDU (see subclause 9.2), and piggy backed to status information of transmissions in the opposite direction. If the MRW command has not been acknowledged by receiver, it will be retransmitted. Therefore, SDU discard variants requiring peer-to-peer signalling are only possible for full duplex connections.

9.7.3.2 Timer based discard, without explicit signalling

This alternative uses the same timer based trigger for SDU discard (Timer_Discard) as the one described in the subclause 9.7.3.1. The difference is that this discard method does not use any peer-to-peer signalling. This function is applied only for unacknowledged and transparent mode RLC and peer-to-peer signalling is never needed. The SDUs are simply discarded in the transmitter, once the transmission time is exceeded.

9.7.3.3 SDU discard after MaxDAT number of retransmissions

This alternative uses the number of retransmissions as a trigger for SDU discard, and is therefore only applicable for acknowledged mode RLC. This makes the SDU discard function dependent of the channel rate. Also, this variant of the SDU discard function strives to keep the SDU loss rate constant for the connection, on the cost of a variable delay. SDU discard is triggered at the transmitter, and a MRW command is necessary to convey the discard information to the receiver, like in the timer based discard with explicit signalling.

11 Elementary procedures

11.1 Transparent mode data transfer procedure

11.1.1 Purpose

The transparent mode data transfer procedure is used for transferring of data between two RLC peer entities, which are operating in transparent mode. Figure 11.1 below illustrates the elementary procedure for transparent mode data transfer. The sender can be either the UE or the network and the receiver is either the network or the UE.

Figure 11.1: Transparent mode data transfer procedure

11.1.2 Initiation

The sender initiates this procedure upon a request of transparent mode data transfer from higher layer. When the sender is in data transfer ready state it shall put the data received from the higher layer into TrD PDUs. If needed RLC shall perform segmentation.

Channels that can be used are DTCH, CCCH (uplink only), BCCH, PCCH, SHCCH and SCCH (downlink only). The type of logical channel depends on if the RLC entity is located in the user plane (DTCH) or in the control plane (CCCH/BCCH/SHCCH/PCCH, SCCH). One or several PDUs may be transmitted in each transmission time interval (TTI) and MAC decides how many PDUs shall be transmitted in each TTI. In the UE, the PDUs that can not be transmitted in a TTI (i.e. MAC has indicated that some of the available PDUs can not be transmitted) shall be buffered ~~for later transmission.~~according to the discard configuration set by RRC.

11.1.2.1 TrD PDU contents to set

The TrD PDU includes a complete SDU or a segment of an SDU. How to perform the segmentation is decided upon when the service is established. No overhead or header is added.

11.1.3 Reception of TrD PDU

Upon reception of a TrD PDU, the receiving entity reassembles (if segmentation was performed) the PDUs into RLC SDUs. RLC delivers the RLC SDUs to the higher layer through the Tr-SAP.

11.1.4 Abnormal cases

11.1.4.1 Undefined SDU size at receiver

If the TrD PDUs are reassembled to a SDU which have a size that is not allowed the SDU shall be discarded.

11.1.4.2 SDU discard without explicit signalling

Upon expiry of the Timer_Discard on the sender side the sender shall discard all PDUs that contain segments of the associated SDU. ~~If the concatenation function is active, PDUs carrying segments of other SDUs that have not timed out shall not be discarded.~~

11.2 Unacknowledged mode data transfer procedure

11.2.1 Purpose

The unacknowledged mode data transfer procedure is used for transferring data between two RLC peer entities, which are operating in unacknowledged mode. Figure 11.2 below illustrates the elementary procedure for unacknowledged mode data transfer. The sender can be either the UE or the network and the receiver is either the network or the UE.

Figure 11.2: Unacknowledged mode data transfer procedure

11.2.2 Initiation

The sender initiates this procedure upon a request of unacknowledged mode data transfer from higher layer.

When the sender is in data transfer ready state it shall segment the data received from the higher layer into PDUs.

Channels that can be used are DTCH, DCCH, CCCH (downlink only), CTCH, SHCCH (downlink only). The type of logical channel depends on if the RLC entity is located in the user plane (DTCH, CTCH) or in the control plane (DCCH/CCCH(downlink only)/SHCCH(downlink only)). One or several PDUs may be transmitted in each transmission time interval (TTI) and MAC decides how many PDUs shall be transmitted in each TTI. In the UE, the PDUs that can not be transmitted in a TTI (i.e. MAC has indicated that some of the available PDUs can not be transmitted) shall be buffered ~~for later transmission.~~ according to the discard configuration set by RRC.

The VT(US) state variable shall be updated for each UMD PDU that is transmitted.

11.2.2.1 UMD PDU contents to set

The Sequence Number field shall be set equal to VT(US).

The Extension bit shall be set to 1 if the next field is a length indicator field, otherwise it shall be set to zero.

One length indicator field shall be included for each end of a SDU that the PDU includes. The length indicator shall be set equal to the number octets between the end of the header fields and the end of the segment. If padding is needed another length indicator shall be added. If the PDU is exactly filled with the last segment of a SDU and there is no room for a length indicator field a length indicator field set to only 0’s shall be included in the next PDU.

11.2.3 Reception of UMD PDU

Upon reception of a UMD PDU the receiver shall update VR(US) state variable according to the received PDU(s).

The PDUs are reassembled into RLC SDUs. If a PDU with sequence number < VR(US) is missing then all SDUs that have segments in this PDU shall be discarded. RLC delivers the RLC SDUs to the higher layer through the UM-SAP.

11.2.4 Abnormal cases

11.2.4.1 Length Indicator value 1111110

Upon reception of an UMD PDU that contains Length Indicator value 1111110 or 111111111111110 ("piggybacked STATUS PDU", in case 7bit or 15 bit Length Indicator field is used, respectively) the receiver shall discard that UMD PDU. This Length Indicator value is not used in unacknowledged mode data transfer.

11.2.4.2 Invalid length indicator value

If the length indicator of a PDU has a value that is larger than the PDU size, the PDU shall be discarded and treated as a missing PDU.

11.2.4.3 SDU discard without explicit signalling

Upon expiry of the Timer_Discard on the sender side the sender shall discard all PDUs that contain segments of the associated SDU. If the concatenation function is active, PDUs carrying segments of other SDUs that have not timed out shall not be discarded. The state variable VT(US) shall be updated.

11.3 Acknowledged mode data transfer procedure

11.3.1 Purpose

The acknowledged mode data transfer procedure is used for transferring of data between two RLC peer entities, which are operating in acknowledged mode. Figure 11.3 below illustrates the elementary procedure for acknowledged mode data transfer. The sender can be either the UE or the network and the receiver is either the network or the UE.

Figure 11.3: Acknowledged mode data transfer procedure

11.3.2 Initiation

The sender initiates this procedure upon a request of acknowledged mode data transfer from higher layer or upon retransmission of PUs. Retransmitted PUs have higher priority than PUs transmitted for the first time.

The sender is only allowed to retransmit PUs that have been indicated missing by the receiver. An exception is the PU with SN VT(S)-1 which can always be retransmitted. In addition, the PU with highest SN that has not yet been acknowledged may be retransmitted if the peer Rx window size is less than half the maximum RLC AM sequence number.

RLC shall segment the data received from the higher layer into PUs. When the sender is in data transfer ready state one or several PUs are included in one AMD PDU, which is sent to the receiver. The PDUs shall be transmitted on the DCCH logical channel if the sender is located in the control plane and on the DTCH if it is located in the user plane. One or several PDUs may be transmitted in each transmission time interval (TTI) and MAC decides how many PDUs shall be transmitted in each TTI. In the UE, the PDUs that can not be transmitted in a TTI (i.e. MAC has indicated that some of the available PDUs can not be transmitted) shall be buffered ~~for later transmission.~~ according to the discard configuration set by RRC.

The VT(DAT) state variables shall be updated for each AMD PDU that is transmitted. The PDU shall not include any PU with Sequence Number ≥ VT(MS).

If the poll bit is set in any of the AMD PDUs and the timer Timer_Poll shall be used the sender shall start the timer Timer_Poll.

If timer based SDU discard is used the timer Timer_Discard shall be started when the RLC entity receives an SDU from higher layer.

If the trigger for polling, "Every Poll_PU PU", is used the VT(PU) shall be increased by 1 for each PU that is transmitted.

If the trigger for polling, "Every Poll_SDU SDU", is used the VT(SDU) shall be increased by 1 for each SDU that is transmitted.

3GPP TSG RAN WG2 meeting #13
Oahu, HI, USA, 22 - 26 May 2000

Document ***R2-001239***
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.322 **CR** **044r2** Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN #8
list expected approval meeting # here ↑

for approval ☒ strategic ☐ *(for SMG*
for information ☐ non-strategic ☐ *Use only)*

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 2000-05-24

Subject: General RLC Corrections

Work item:

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

F Correction ☒
A Corresponds to a correction in an earlier release ☐
B Addition of feature ☐
C Functional modification of feature ☐
D Editorial modification ☐

Release:

Phase 2 ☐
Release 96 ☐
Release 97 ☐
Release 98 ☐
Release 99 ☒
Release 00 ☐

Reason for change:

1. It should be clarified that 15 bit length indicators can be used also for UM.
2. It is unclear when 7bit and 15bit length indicators shall be used.
3. The maximum value of a length indicator in UM is not defined.
4. It shall not be allowed to indicate presence of piggybacked STATUS PDU in an UM PDU.
5. It should not be allowed to give status information about PDUs with SN<VR(R), except when necessary by the bitmap (which is octet aligned).
6. The description of the ACK SUFI is unclear.
7. It should be clarified that the Rx can decrease the Tx window size, but not increase it above the configured value.
8. The status prohibit timer shall only prohibit transmission of ACK, LIST, RLIST and BITMAP. It should still be possible to perform RLC discard and change the Rx window size when the timer is running.
9. The rules for configuration of a STATUS PDU is not clear. It should be clarified that a status message shall contain info of all received PDUs.
10. It should not be allowed to give info of PDUs outside the receiving window in a STATUS PDU

Clauses affected: 9.2.1.3, 9.2.2.2, 9.2.2.8, 9.2.2.x, 9.4, 9.5, 9.7.2, 9.7.4, 11.3.2, 11.3.4.4, 11.5.2.2

Other specs affected:

Other 3G core specifications ☐ → List of CRs:
Other GSM 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:	

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

9.2.1.3 UMD PDU

The UMD PDU transfers user data when RLC is operating in unacknowledged mode. The length of the data part shall be an integer number of octets.

Figure 9.2: UMD PDU

NOTE (1): The Length Indicator may be 15 bits.

9.2.1.4 AMD PDU

The AMD PDU transfers user data and piggybacked status information and requests status report by setting Poll bit when RLC is operating in acknowledged mode. The length of the data part shall be an integer number of octets.

NOTE (1): The Length Indicator may be 15 bits.

Figure 9.3: AMD PDU

9.2.2.2 PDU Type

Length: 3 bit.

The PDU type field indicates the Control PDU type.

Bit	PDU Type
000	STATUS
001	RESET
010	RESET ACK
011-111	Reserved (PDUs with this coding will be discarded by this version of the protocol).

9.2.2.3 Sequence Number (SN)

This field indicates the sequence number of the payload unit, encoded in binary.

PDU type	Length	Notes
AMD PDU	12 bits	Used for retransmission and reassembly
UMD PDU	7 bits	Used for reassembly

9.2.2.4 Polling bit (P)

Length: 1bit.

This field is used to request a status report (one or several STATUS PDUs) from the receiver RLC.

Bit	Description
0	Status report not requested
1	Request a status report

9.2.2.5 Extension bit (E)

Length: 1bit.

This bit indicates if the next octet will be a length indicator and E bit.

Bit	Description
0	The next field is data
1	The next field is Length Indicator and E bit

9.2.2.6 Reserved (R)

Length: 4 bits.

This field in the RESET PDU and RESET ACK PDU is used to achieve octet alignment and for this purpose it is coded as 0000. Other functions of it are left for future releases.

9.2.2.7 Header Extension Type (HE)

Length: 2 bits.

This two-bit field indicates if the next octet will be data or a length indicator and E bit.

Value	Description
00	The succeeding octet contains data
01	The succeeding octet contains a length indicator and E bit
10-11	Reserved (PDUs with this coding will be discarded by this version of the protocol).

9.2.2.8 Length Indicator (LI)

The Length Indicator is used to indicate, each time, the end of an SDU occurs in the PU. The Length Indicator points out the number of octets between the end of the last Length Indicator field and up to and including the octet at the end of an SDU segment. Length Indicators are included in the PUs that they refer to. The size of the Length Indicator may be either 7bits or 15bits. The maximum value of a Length Indicator in AM will be no greater than the RLC PDU size – AMD PDU Header – PADDING. The maximum value of a Length Indicator in UM will be no greater than the RLC PDU size – UM PDU Header – PADDING.

A Length Indicator group is a set of Length Indicators that refer to a PU. Length Indicators that are part of a Length Indicator group must never be reordered within the Length Indicator group or removed from the Length Indicator group.

If there can be more than one Length Indicator, each specifying the end of an SDU in a PU, the order of these Length Indicators must be in the same order as the SDUs that they refer to.

In the case where the end of last segment of an SDU exactly ends at the end of a PDU, the next Length Indicator, shall be placed as the first Length Indicator in the next PU and have value LI=0.

In the case where the last segment of an RLC SDU is one octet short of exactly filling the last RLC PU, and 15-bit Length Indicators are used, the next Length Indicator shall be placed as the first Length Indicator in the next PU and have value LI=111 1111 1111 1011.

A PU that has unused space, to be referred to as padding, must use a Length Indicator to indicate that this space is used as padding. A padding Length Indicator must be placed after any Length Indicators for a PU.

All unused space in a PU must be located at the end of the PDU, be a homogeneous space and is referred to as padding. Predefined values of the Length Indicator are used to indicate this. The values that are reserved for special purposes are listed in the tables below depending on the size of the Length Indicator. Only predefined Length Indicator values can refer to the padding space.

STATUS PDUs can be piggybacked on the AMD PDU by using part or all of the padding space. A Length Indicator must be used to indicate the piggybacked STATUS PDU. This Length Indicator takes space from the padding space or piggybacked STATUS PDU and not the PDU data and will always be the last Length Indicator. Where only part of the padding space is used by a piggybacked STATUS PDU then the end of the piggybacked STATUS PDU is determined by one of the SUFI fields NO_MORE or ACK, thus no additional Length Indicator is required to show that there is still padding in the PDU. The padding/piggybacked STATUS PDU predefined Length Indicators shall be added after the very last (i.e. there could be more than one SDU that end within a PDU) Length Indicator that indicates the end of the last SDU segment in the PU.

~~If RLC PDUs always carry only one PU, 7bit indicators are used in a particular RLC PDU if the address space is sufficient to indicate all~~ possible ~~SDU segment borders. Otherwise 15bit Length Indicators are applied. I.e., for~~For AM, 7bit indicators shall be used if the AMD PDU size is ≤ l26 octets. Otherwise 15bit indicators shall be used. For UM, 7bit indicators shall be used if the UM PDU size is ≤ l25 octets. Otherwise 15bit indicators shall be used.

The length of the Length Indicator only depends on the size of the largest RLC PDU. The length of the Length Indicator is always the same for all PUs, for one RLC entity.

For Release 99, there is one PU in a AMD PDU.

Length: 7bit

Bit	Description
0000000	The previous RLC PDU was exactly filled with the last segment of a RLC SDU.
1111100	Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111101	Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111110	AM PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UM PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111111	The rest of the RLC PDU is padding.

Length: 15bit

Bit	Description
000000000000000	The previous RLC PDU was exactly filled with the last segment of a RLC SDU.
111111111111011	The last segment of an RLC SDU was one octet short of exactly filling the last RLC PDU.
111111111111100	Reserved (PDUs with this coding will be discarded by this version of the protocol).
111111111111101	Reserved (PDUs with this coding will be discarded by this version of the protocol).l
111111111111110	AM PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UM PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).~~The rest of the RLC PDU includes a piggybacked STATUS PDU.~~
111111111111111	The rest of the RLC PDU is padding.

9.2.2.9 Data

RLC SDUs in transparent, unacknowledged and acknowledged mode are mapped to this field.

Transparent mode data:

The length of SDUs is not constrained to a multiple of 8 bits.

The RLC SDUs might be segmented. If segmented, then the segmentation is performed according to a predefined pattern. The allowed size for RLC SDUs and segments shall be known. All the RLC PDUs carrying one RLC SDU shall be sent in one transmission time interval. Only one RLC SDU is segmented in one transmission time interval.

Unacknowledged mode data and Acknowledged mode data:

The length of SDUs is constrained to a multiple of 8 bits.

RLC SDUs might be segmented. If possible, the last segment of a SDU shall be concatenated with the first segment of the next SDU in order to fill the data field completely and avoid unnecessary padding. The length indicator field is used to point the borders between SDUs.

9.2.2.10 Padding (PAD)

Padding has a length such that the PDU has the required predefined total length.

Padding may have any value and the receiving entity shall disregard it.

9.2.2.11 SUFI

Which SUFI fields to use is implementation dependent, but when a STATUS PDU includes information about which PUs have been received and which are detected as missing, information shall not be included about PUs with SN≥VR(H) i.e. PUs that have not yet reached the receiver. ~~.~~Information about PUs with SN<VR(R) shall not be given except when this is necessary in order to use the BITMAP SUFI, see 9.2.2.11.5

Length: variable number of bits.

The SUFI (Super-Field) includes three sub-fields: type information (type of super-field, e.g. list, bitmap, acknowledgement, etc), length information (providing the length of a variable length field within the following value field) and a value.

Figure 9.7 shows the structure of the super-field. The size of the type sub-field is non-zero but the size of the other sub-fields may be zero.

Type
Length
Value

Figure 9.7: The Structure of a Super-Field

The length of the type field is 4 bits and it may have any of following values.

Bit	Description
0000	No More Data (**NO_MORE**)
0001	Window Size (**WINDOW**)
0010	Acknowledgement (**ACK**)
0011	List (**LIST**)
0100	Bitmap (**BITMAP**)
0101	Relative list (**Rlist)**
0110	Move Receiving Window **(MRW)**
0111	Move Receiving Window and ignore first LI **(MRW_N_IFL)**
1000-1111	Reserved (PDUs with this encoding are invalid for this version of the protocol)

The length sub-field gives the length of the variable size part of the following value sub-field and the length of it depends on the super-field type. The value sub-field includes the value of the super-field, e.g. the bitmap in case of a BITMAP super-field, and the length is given by the length of the type sub-field.

9.2.2.11.1 The No More Data super-field

The 'No More Data' super-field indicates the end of the data part of a STATUS PDU and is shown in Figure 9.8 below. It shall always be placed as the last SUFI if it is included in a STATUS PDU. All data after this SUFI shall be regarded as padding and shall be neglected.

Type=**NO_MORE**

Figure 9.8: NO_MORE field in a STATUS PDU

9.2.2.11.2 The Acknowledgement super-field

The 'Acknowledgement' super-field consists of a type identifier field (ACK) and a sequence number (LSN) as shown in Figure 9.9 below. The acknowledgement super-field is also indicating the end of the data part of a STATUS PDU. Thus, no 'NO_MORE' super-field is needed in the STATUS PDU when the 'ACK' super-field is present. The ACK SUFI shall always be placed as the last SUFI if it is included in a STATUS PDU. All data after this SUFI shall be regarded as padding and shall be neglected.

Type = **ACK**
LSN

Figure 9.9: The ACK fields in a STATUS PDU

LSN

Length: 12 bits

Acknowledges the reception of all PUs with sequence numbers < LSN (Last Sequence Number) that are *not* indicated to be erroneous in earlier parts of the STATUS PDU. ~~The LSN should not be set to a value > VR(H).~~ This means that if the LSN is set to a different value than VR(R) all erroneous PUs must be included in the same STATUS PDU and if the LSN is set to VR(R) the erroneous PUs ~~are~~ can be split into several STATUS PDUs. At the ~~receiver~~transmitter, if the value of the LSN =< the value of the first error indicated in the STATUS PDU VT(A) will be updated according to the LSN, otherwise VT(A) will be updated according to the first error indicated in the STATUS PDU. The LSN should not be set to a value > VR(H).

9.2.2.11.3 The Window Size super-field

The 'Window Size' super-field consists of a type identifier (WINDOW) and a window size number (WSN) as shown in Figure 9.10 below. The receiver is always allowed to change the Tx window size of the peer entity during a connection, but the maximum allowed value is given by RRC configuration. The Rx window of the receiver is not changed.

Type = **WINDOW**
WSN

Figure 9.10: The WINDOW fields in a STATUS PDU

WSN

Length: 12 bits

The allowed Tx window size to be used by the transmitter. The range of the window size is [1~~0~~, 2^{12}-1]. The Tx_Window_Size parameter is set equal to WSN upon reception of this SUFI.

9.2.2.11.4 The List super-field

The List Super-Field consists of a type identifier field (LIST), a list length field (LENGTH) and a list of LENGTH~~+1~~ number of pairs as shown in Figure 9.11 below:

Type = **LIST**
LENGTH
SN_1
L_1
SN_2
L_2
…
SN_{LENGTH}~~+1~~
L_{LENGTH}~~+1~~

Figure 9.11: The List fields in a STATUS PDU for a list

LENGTH

Length: 4 bits

The number of (SN_i , L_i)-pairs in the super-field of type LIST ~~equals LENGTH+1, i.e. LENGTH="0000" means that the SUFI contains one (SN_i , L_i) pair and LENGTH="1111" gives the maximum 16 (SN_i , L_i) pairs.~~

~~. The value "0000" is invalid and the list is discarded.~~

The value "0000" is invalid and the list is discarded.

SN_i

Length: 12 bits

Sequence number of PU, which was not correctly received.

L_i

Length: 4 bits

Number of consecutive PUs not correctly received following PU with sequence number SN_i.

9.2.2.11.5 The Bitmap super-field

The Bitmap Super-Field consists of a type identifier field (BITMAP), a bitmap length field (LENGTH), a first sequence number (FSN) and a bitmap as shown in Figure 9.12 below:

Type = **BITMAP**
LENGTH
FSN
Bitmap

Figure 9.12: The Bitmap fields in a STATUS PDU

LENGTH

Length: 4 bits

The size of the bitmap in octets equals LENGTH+1, i.e. LENGTH="0000" means that the size of the bitmap is one octet and LENGTH="1111" gives the maximum bitmap size of 16 octets.

FSN

Length: 12 bits

The sequence number for the first bit in the bitmap. FSN shall not be set to a value lower than VR(R)-7 when the Rx window size is less then half the maximum RLC AM sequence number. If the Rx window size is larger, FSN shall not be set to a value lower than VR(R).

Bitmap

Length: Variable number of octets given by the LENGTH field.

Status of the SNs in the interval [FSN, FSN + (LENGTH+1)*8 - 1] indicated in the bitmap where each position (from left to right) can have two different values (0 and 1) with the following meaning (bit_position∈[0,(LENGTH+1)*8 - 1]):

1: SN = (FSN + bit_position) has been correctly received.

0: SN = (FSN + bit_position) has not been correctly received.

9.2.2.11.6 The Relative List super-field

The Relative List super-field consists of a type identifier field (RLIST), a list length field (LENGTH), the first sequence number (FSN) and a list of LENGTH number of codewords (CW) as shown in Figure 9.134 below.

Type = **RLIST**
LENGTH
FSN
CW_1
CW_2
…
CW_{LENGTH}

Figure 9.13: The RList fields in a STATUS PDU

LENGTH

Length: 4 bits

The number of codewords (CW) in the super-field of type RLIST., i.e. LENGTH="0000" means that only FSN is present in the SUFI.

FSN

Length: 12 bits

The sequence number for the first erroneous PU in the RLIST.

CW

Length: 4 bits

The CW consists of 4 bits where the three first bits are part of a number and the last bit is a status indicator and it shall be interpreted as follows:

Code Word	Description
$X_1X_2X_3$ 0	Next 3 bits of the number are $X_1X_2X_3$ and the number continues in the next CW. The most significant bit within this CW is X_1.
$X_1X_2X_3$ 1	Next 3 bits of the number are $X_1X_2X_3$ and the number is terminated. The most significant bit within this CW is X_1. This is the most significant CW within the number.

By default, the number given by the CWs represents a distance between the previous indicated erroneous PU up to and including the next erroneous PU.

One special value of CW is defined:

`000 1` ‘Error burst indicator’.

The error burst indicator means that the next CWs will represent the number of subsequent erroneous PUs (not counting the already indicated error position). After the number of errors in a burst is terminated with XXX 1, the next codeword will again by default be the least significant bits (LSB) of the distance to the next error.

9.2.2.12 Reserved (R)

Length: 1 bit

This bit in the Piggybacked STATUS PDU is used to achieve octet alignment and for this purpose it is coded as 0. Otherwise the PDU is treated as invalid and hence shall be discarded by this version of the protocol.

9.4 State variables

This sub-clause describes the state variables used in the specification of the peer-to-peer protocol. PUs are sequentially and independently numbered and may have the value 0 through n minus 1 (where n is the modulus of the sequence numbers). The modulus equals 2^{12} for AM and 2^7 for UM; the sequence numbers cycle through the entire range: 0 through $2^{12} – 1$ for AM and 0 through $2^7 – 1$ for UM. All arithmetic operations on the following state variables and sequence numbers contained in this specification are affected by the modulus: VT(S), VT(A), VT(MS), VR(R), VR(H), VR(MR), VT(US) and VR(US). When performing arithmetic comparisons of transmitter variables, VT(A) is assumed to be the base. When performing arithmetic comparisons of receiver variables, VR(R) is assumed to be the base.

The RLC maintains the following state variables at the transmitter.

a) VT(S) - Send state variable.

   The sequence number of the next PU to be transmitted for the first time (i.e. excluding retransmission). It is updated after transmission of a PDU, which includes not earlier transmitted PUs. The initial value of this variable is 0.

b) VT(A) - Acknowledge state variable.

   The sequence number of the next in-sequence PU expected to be acknowledged, which forms the lower edge of the window of acceptable acknowledgements. VT(A) is updated based on receipt of a STATUS PDU including an ACK super-field. The initial value of this variable is 0.

c) VT(DAT).

   This state variable counts the number of times a PU has been transmitted. There is one VT(DAT) for each PU and it is incremented each time the PU is transmitted. The initial value of this variable is 0.

d) VT(MS) - Maximum Send state variable.

   The sequence number of the first PU not allowed by the peer receiver [i.e. the receiver will allow up to VT(MS) – 1], VT(MS) = VT(A) + Tx_Window_Size. This value represents the upper edge of the transmit window. The transmitter shall not transmit a new PU if VT(S)   VT(MS). VT(MS) is updated based on receipt of a STATUS PDU including an ACK and/or a WINDOW super-field.

e) VT(US) – UM data state variable.

   This state variable gives the sequence number of the next UMD PDU to be transmitted. It is updated each time a UMD PDU is transmitted. The initial value of this variable is 0.

f) VT(PU).

   This state variable is used when the poll every Poll_PU PU function is used. It is incremented with 1 for each PU that is transmitted. It should be incremented for both new and retransmitted PUs. When it reaches Poll_PU a new poll is transmitted and the state variable is set to zero. The initial value of this variable is 0.

g) VT(SDU).

   This state variable is used when the poll every Poll_SDU SDU function is used. It is incremented with 1 for each SDU that is transmitted. When it reaches Poll_SDU a new poll is transmitted and the state variable is set to zero. The poll bit should be set in the PU that contains the last segment of the SDU. The initial value of this variable is 0.

h) VT(RST) - Reset state variable.

   It is used to count the number of times a RESET PDU is transmitted. VT(RST) is incremented with 1 each time a RESET PDU is transmitted. VT(RST) is reset upon the reception of a RESET ACK PDU. The initial value of this variable is 0.

i) VT(MRW) – MRW command send state variable.

   It is used to count the number of times a MRW command is transmitted. VT(MRW) is incremented with 1 each time a MRW command is transmitted. VT(MRW) is reset upon the reception of a STATUS PDU which suggests the acknowledgement of a MRW command in the receiver or the occurrence of discarding new SDU. The initial value of this variable is 0.

The RLC maintains the following state variables at the receiver:

a) VR(R) - Receive state variable.

The sequence number of the next in-sequence PU expected to be received. It is ~~updated~~ set equal to SNmax+1 upon receipt of the next in-sequence PU, where SNmax is the sequence number of the highest received in-sequence PU. The initial value of this variable is 0.

b) VR(H) - Highest expected state variable.

The sequence number of the highest expected PU. This state variable is ~~updated~~ set equal to SN+1 only when a new PU is received with VR(MR)>SN≥VR(H). The initial value of this variable is 0.

c) VR(MR) - Maximum acceptable Receive state variable.

The sequence number of the first PU not allowed by the receiver [i.e. the receiver will allow up to VR(MR) – 1], VR(MR) = VR(R) + Rx_Window_Size. The receiver shall discard PUs with SN VR(MR).~~, (in one case, such a PU may cause the transmission of an unsolicited STATUS PDU).~~

d) VR(US) - Receiver Send Sequence state variable.

The sequence number of the next PDU to be received. It shall set equal to SN + 1 upon reception of a PDU. The initial value of this variable is 0.

e) VR(EP) – Estimated PDU Counter state variable.

The number of PUs that should be received yet as a consequence of the transmission of the latest status report. In acknowledged mode, this state variable is updated at the end of each transmission time interval. It is decremented by the number of PUs that should have been received during the transmission time interval. If VR(EP) is equal to zero, then check if all PUs requested for retransmission in the latest status report have been received.

9.5 Timers

a) Timer_Poll.

This timer is only used when the poll timer trigger is used. It is started when the transmitting side sends a poll to the peer entity. The timer is stopped when receiving a STATUS PDU that contains an acknowledgement or negative acknowledgement of the AMD PDU that triggered the timer. The value of the timer is signalled by RRC.

If the timer expires and no STATUS PDU containing an acknowledgement or negative acknowledgement of the AMD PDU that triggered the timer has been received, the receiver is polled once more (either by the transmission of a PDU which was not yet sent, or by a retransmission) and the timer is restarted. If there is no PU to be transmitted and all PUs have already been acknowledged, the receiver shall not be polled.

If a new poll is sent when the timer is running it is restarted.

b) Timer_Poll_Prohibit.

This timer is only used when the poll prohibit function is used. It is used to prohibit transmission of polls within a certain period. A poll shall be delayed until the timer expires if a poll is triggered when the timer is active. Only one poll shall be transmitted when the timer expires even if several polls were triggered when the timer was active. If there is no PU to be transmitted and all PUs have already been acknowledged, a poll shall not be transmitted. This timer will not be stopped by a STATUS PDU. The value of the timer is signalled by RRC.

c) Timer_EPC.

This timer is only used when the EPC function is used and it accounts for the roundtrip delay, i.e. the time when the first retransmitted PU should be received after a status report has been sent. The timer is started when the ~~last~~

first STATUS PDU of a status report is transmitted and when it expires EPC can start decrease (see subclause 9.7.3). The value of the timer is signalled by RRC.

d) Timer_Discard.

This timer is used for the SDU discard function. In the transmitter, the timer is activated upon reception of a SDU from higher layer. One timer is used for each SDU that is received from higher layer. If the SDU has not been acknowledged and/or transmitted when the timer expires, the SDU is discarded. Following which, if the SDU discard function uses explicit signalling, a Move Receiving Window request is sent to the receiver. The value of the timer is signalled by RRC.

e) Timer_Poll_Periodic.

This timer is only used when the timer based polling is used. The timer is started when the RLC entity is created. Each time the timer expires a poll is transmitted (either by the transmission of a PDU which was not yet sent, or by a retransmission) and the timer is restarted. If there is no PU to be transmitted and all PUs have already been acknowledged, a poll shall not be transmitted and the timer shall only be restarted. The value of the timer is signalled by RRC.

f) Timer_Status_Prohibit.

This timer is only used when the STATUS prohibit function is used. It prohibits the receiving side from sending status reports containing any of the SUFIs LIST, BITMAP, RLIST or ACK. The timer is started when the last STATUS PDU in a status report is transmitted and no new status report containing the mentioned SUFIs can be transmitted before the timer has expired. The timer does not prohibit transmission of the SUFIs MRW, MRW_N_IFL, WINDOW or NO_MORE. The value of the timer is signalled by RRC.

g) Timer_Status_Periodic.

This timer is only used when timer based status report sending is used. The timer is started when the RLC entity is created. Each time the timer expires a status report is transmitted and the timer is restarted. The value of the timer is signalled by RRC.

h) Timer_RST.

It is used to detect the loss of RESET ACK PDU from the peer RLC entity. This timer is set when the RESET PDU is transmitted. And it will be stopped upon reception of RESET ACK PDU. If it expires, RESET PDU will be retransmitted. The value of the timer is signalled by RRC.

i) Timer_MRW.

This timer is used as part of the Move Receiving Window protocol. It is used to trigger the retransmission of a status report containing an MRW SUFI field. The timer is started when the last STATUS PDU of the status report is first transmitted. Each time the timer expires the status report is retransmitted and the timer is restarted (when the last STATUS PDU of the status report is retransmitted). It shall be stopped when a STATUS PDU is received that indicates that VR(R) ≥ SN_MRW. It shall also be stopped if a new MRW procedure is triggered while it is running. The value of the timer is signalled by RRC.

9.7.2 STATUS transmission for acknowledged mode

The receiver of AMD PDUs transmits status reports (each status report consists of one or several STATUS PDUs) to the sender in order to inform about which PUs that have been received and not received. There are several triggers for sending a status report. The network (RRC) controls which triggers should be used for each RLC entity, except for one, which is always present. The receiver shall always send a status report when receiving a poll request. Except for that trigger following triggers are configurable:

1) Detection of missing PU(s).

   If the receiver detects one or several missing PUs it shall send a status report to the sender.

2) Timer based STATUS transfer.

   The receiver transmits a status report periodically to the sender. The timer Timer_Status_Periodic controls the time period.

3) The EPC mechanism.

   The Timer EPC is started when the ~~firstlast~~ last STATUS PDU of a status report is transmitted to the peer entity. If not all PUs requested for retransmission have been received before the Timer EPC has expired a new status report is transmitted to the peer entity. A more detailed description of the EPC mechanism is given in subclause 9.7.4.

There are two functions that can prohibit the receiver from sending a status report. The network (RRC) controls which functions should be used for each RLC entity. If any of the following functions is used the sending of the status report shall be delayed, even if any of the conditions above are fulfilled:

1) STATUS prohibit.

   The Timer_Status_Prohibit is started when the last STATUS PDU of a status report is transmitted to the peer entity. As long as the timer is running the receiving side is not allowed to send a status report to the peer entity. If a status report was triggered while the timer was running, t~~T~~he status report is transmitted after the timer has expired. The receiver shall only send one status report, even if there are several triggers when the timer running. This timer only prohibits the transmission of status reports containing any of the SUFIs LIST, BITMAP, RLIST or ACK. Status reports containing other SUFIs are not prohibited.

2) The EPC mechanism.

   If the EPC mechanism is active and the sending of a status report is triggered it shall be delayed until the EPC mechanism has ended. The receiver shall only send one status report, even if there are several triggers when the timer is active or the counter is counting down. This mechanism only prohibits the transmission of status reports containing any of the SUFIs LIST, BITMAP, RLIST or ACK. Status reports containing other SUFIs are not prohibited.

9.7.4 The Estimated PDU Counter

The Estimated PDU Counter is a mechanism used for scheduling the retransmission of status reports in the receiver side. With this mechanism, the receiver will send a new status report in which it requests for PUs not yet received. The time between two subsequent status report retransmissions is not fixed, but it is controlled by the Estimated PDU Counter (EPC), which adapt this time to the current bit rate, indicated in the TFI, in order to minimise the delay of the status report retransmission.

The EPC is a counter, which is decremented every transmission time interval with the estimated number of PUs that should have been transmitted during that transmission time interval. When the receiver detects that PDUs are missing it generates and sends a status report to the transmitter and sets the EPC equal to the number of requested PUs.

A special timer, called EPC timer, controls the maximum time that the EPC needs to wait before it will start counting down. This timer starts immediately after a transmission of a retransmission request from the receiver (when the ~~last~~ ~~first~~ last STATUS PDU of the status report is transmitted). The EPC timer typically depends on the roundtrip delay, which consists of the propagation delay, processing time in the transmitter and receiver and the frame structure. This timer can also be implemented as a counter, which counts the number of 10 ms radio frames that could be expected to elapse before the first requested AMD PDU is received.

When the EPC is equal to zero and not all of these requested PUs have been received correctly, a new status report will be transmitted and the EPC will be reset accordingly. The EPC timer will be started once more.

10 Handling of unknown, unforeseen and erroneous protocol data

The list of error cases is reported below:

a) Inconsistent state variables.

If the RLC entity receives a PDU including "erroneous Sequence Number", state variables between peer entities may be inconsistent. Following shows "erroneous Sequence Number" examples:

- ~~—~~Each Sequence Number of missing PU informed by SUFI LIST ~~or BITMAP parameter~~ is not within the value between "Acknowledge state variable(VT(A))" and "Send state variable(VT(S))", and
- Each Sequence Number of missing PU informed by SUFI BITMAP ~~parameter~~ is not within the value between "Acknowledge state variable(VT(A))-7" and "Send state variable(VT(S))", and
- LSN of SUFI ACK is not within the value between "Acknowledge state variable(VT(A))" and "Send state variable(VT(S))".

In case of error situations the following actions are foreseen:

1) RLC entity should use RESET procedure in case of an unrecoverable error.

2) RLC entity should discard invalid PDU.

3) RLC entity should notify upper layer of unrecoverable error occurrence in case of failed retransmission.

11.3 Acknowledged mode data transfer procedure

11.3.1 Purpose

The acknowledged mode data transfer procedure is used for transferring of data between two RLC peer entities, which are operating in acknowledged mode. Figure 11.3 below illustrates the elementary procedure for acknowledged mode data transfer. The sender can be either the UE or the network and the receiver is either the network or the UE.

Figure 11.3: Acknowledged mode data transfer procedure

11.3.2 Initiation

The sender initiates this procedure upon a request of acknowledged mode data transfer from higher layer or upon retransmission of PUs. Retransmitted PUs have higher priority than PUs transmitted for the first time.

The sender is only allowed to retransmit PUs that have been indicated missing by the receiver. An exception is the PU with SN VT(S)-1 which can always be retransmitted. In addition, the PU with highest SN that has not yet been acknowledged may be retransmitted if the peer Rx window size is less than half the maximum RLC AM sequence number.

RLC shall segment the data received from the higher layer into PUs. When the sender is in data transfer ready state one or several PUs are included in one AMD PDU, which is sent to the receiver. The PDUs shall be transmitted on the DCCH logical channel if the sender is located in the control plane and on the DTCH if it is located in the user plane. One or several PDUs may be transmitted in each transmission time interval (TTI) and MAC decides how many PDUs shall be transmitted in each TTI.

The VT(DAT) state variables shall be updated for each AMD PDU that is transmitted. The PDU shall not include any PU with Sequence Number ≥ VT(MS).

If the poll bit is set in any of the AMD PDUs and the timer Timer_Poll shall be used the sender shall start the timer Timer_Poll when the PDU with the set poll bit is delivered to MAC.~~.~~

If timer based SDU discard is used the timer Timer_Discard shall be started when the RLC entity receives an SDU from higher layer. One timer is used for each SDU that is received from higher layer.

If the trigger for polling, "Every Poll_PU PU", is used the VT(PU) shall be increased by 1 for each PU that is transmitted.

If the trigger for polling, "Every Poll_SDU SDU", is used the VT(SDU) shall be increased by 1 for each SDU that is transmitted.

11.3.3 Reception of AMD PDU by the receiver

Upon reception of a AMD PDU the receiver shall update VR(R), VR(H) and VR(MR) state variables according to the received PU(s).

If any of the PUs include a Polling bit set to 1 the STATUS PDU transfer procedure shall be initiated.

If the detection of missing PU(s) shall be used and the receiver detects that a PU is missing the receiver shall initiate the STATUS PDU transfer procedure.

If timer based SDU discard with~~out~~ explicit signalling is used and a missing PU is detected the timer Timer_Discard is started.

11.3.4.4 VT(DAT) > MaxDAT

If SDU discard after MaxDAT number of retransmission is used and VT(DAT) > MaxDAT for any PU the sender shall initiate the SDU discard with explicit signalling procedure for the SDUs to which the PU with VT(DAT)>MaxDAT belongs.

If the SDU discard is not used the sender shall initiate the RLC reset procedure when VT(DAT) > MaxDAT.

11.5.2.2 STATUS PDU contents to set

The size of the STATUS PDU shall be equal to one of the allowed PDU sizes. The information that needs to be transmitted in a status report can be split into several STATUS PDUs if one STATUS PDU does not accommodate all the information. A SUFI can not be split into several STATUS PDUs.

Which SUFI fields to use is implementation dependent, but the status report shall include information about ~~which~~ all PUs that have been received ~~and~~ or ~~which are~~ detected as missing. No information shall be given for PUs with SN≥VR(H), i.e. PUs that have not yet reached the receiver.

Padding shall be inserted if the SUFI fields do not fill an entire STATUS PDU. If the PDU contains padding the last SUFI field shall be either an ~~Acknowledgement super-field~~ACK SUFI or a ~~No More super-field~~NO_MORE SUFI~~.~~. If there is no padding in the STATUS PDU, NO_MORE SUFI or ACK SUFI does not need to be included in the STATUS PDU.

3GPP TSG RAN WG2 Meeting #13
Oahu, HI, USA, 22 – 26 May, 2000

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e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.322 CR 045 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN #8 *list expected approval meeting # here ↑*	for approval	☒	strategic	☐	*(for SMG use only)*
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Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 22 May 2000

Subject: Clarification of RLC transparent mode operation

Work item:

Category:
(only one category Shall be marked With an X)

F	Correction	☒	
A	Corresponds to a correction in an earlier release	☐	
B	Addition of feature	☐	
C	Functional modification of feature	☐	
D	Editorial modification	☐	

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change: This CR clarifies how transparent mode RLC operation should work.

Clauses affected: 9.2.2.9, 11.1.2, 11.1.2.1

Other specs Affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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:

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

9 Elements for peer-to-peer communication

9.2 Formats and parameters

9.2.2 Parameters

9.2.2.9 Data

RLC SDUs or segments of RLC SDUs are mapped to this field in transparent, unacknowledged and acknowledged mode ~~are mapped to this field~~.

Transparent mode data:

The length of RLC SDUs is not constrained to a multiple of 8 bits.

The RLC SDUs might be segmented. ~~If segmented, then the segmentation is performed according to a predefined pattern.~~ The allowed size for ~~-RLC SDUs and~~the segments shall be ~~known~~determined from the transport formats of the transport channel [4, 8]. All the RLC PDUs carrying one RLC SDU shall be sent in one transmission time interval. Only segments from one RLC SDU ~~is~~ shall be ~~segmented in~~sent in one transmission time interval. Note, if segmentation is not used for the transparent mode RLC entity then more than one RLC SDU can be sent in one transmission time interval using one RLC PDU per RLC SDU. The RLC PDUs need, however, to be of the same size due to L1 limitations.

Unacknowledged mode data and Acknowledged mode data:

The length of ~~-~~RLC SDUs is constrained to a multiple of 8 bits.

RLC SDUs might be segmented. If possible, the last segment of a SDU shall be concatenated with the first segment of the next SDU in order to fill the data field completely and avoid unnecessary padding. The length indicator field is used to point the borders between SDUs.

11 Elementary procedures

11.1 Transparent mode data transfer procedure

11.1.1 Purpose

The transparent mode data transfer procedure is used for transferring of data between two RLC peer entities, which are operating in transparent mode. Figure 11.1 below illustrates the elementary procedure for transparent mode data transfer. The sender can be either the UE or the network and the receiver is either the network or the UE.

Figure 11.1: Transparent mode data transfer procedure

11.1.2 Initiation

The sender initiates this procedure upon a request of transparent mode data transfer from higher layer. When the sender is in data transfer ready state it shall put the data received from the higher layer into TrD PDUs. If ~~needed~~ required RLC shall perform segmentation.

Channels that can be used are DTCH, CCCH (uplink only), BCCH, PCCH, SHCCH and SCCH (downlink only). The type of logical channel depends on if the RLC entity is located in the user plane (DTCH) or in the control plane (CCCH/BCCH/SHCCH/PCCH, SCCH). One or several PDUs may be transmitted in each transmission time interval (TTI) and MAC decides how many PDUs shall be transmitted in each TTI.

11.1.2.1 TrD PDU contents to set

The TrD PDU includes a complete SDU or a segment of an SDU. How to perform the segmentation is decided upon when the service is established. No overhead or header is added., instead segmentation is done based on which of the transport formats of the transport channel that will be used. A particular transport format informs the receiver how the segmentation was performed.

11.1.3 Reception of TrD PDU

Upon reception of a TrD PDU, the receiving entity reassembles (if segmentation was performed) the PDUs into RLC SDUs. RLC delivers the RLC SDUs to the higher layer through the Tr-SAP.

11.1.4 Abnormal cases

11.1.4.1 Undefined SDU size at receiver

If the TrD PDUs are reassembled to a SDU which have a size that is not allowed the SDU shall be discarded.

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Oahu, USA, 22-26 May 2000

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or for SMG, use the format P-99-xxx

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Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 16th May 2000

Subject: Editorial corrections to abbreviations, SCCH, BCCH

Work item:

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

F	Correction	☐	
A	Corresponds to a correction in an earlier release	☐	
B	Addition of feature	☐	
C	Functional modification of feature	☐	
D	Editorial modification	☒	

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change:
Abbreviations that are not used in the specification are removed.
Abbreviations LSB, MSB, MRW are added.
Segmentation/concatenation function is removed for BCCH in tables in section 6 since these functions are not need for BCCH.
Obsolete references to SCCH are removed since SCCH is not supported any more.

Clauses affected: 3, 6.1, 11.1.2

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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3 Abbreviations

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

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
~~CN~~	~~Core Network~~
CRC	Cyclic Redundancy Check
~~DC~~	~~Dedicated Control (SAP)~~
DCCH	Dedicated Control Channel
DCH	Dedicated Channel
DL	Downlink
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~~	~~kilo-bits per second~~
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L3	Layer 3 (network layer)
LSB	Least Significant Bit
MAC	Medium Access Control
MRW	Move Receive Window
MSB	Most Significant Bit~~bile Station~~
~~MM~~	~~Mobility Management~~
~~Nt~~	~~Notification (SAP)~~
PCCH	Paging Control Channel
PCH	Paging Channel
PDU	Protocol Data Unit
PU	Payload Unit.
PHY	Physical layer
PhyCH	Physical Channels
RACH	Random Access Channel
RLC	Radio Link Control
~~RNTI~~	~~Radio Network Temporary Identity~~
RRC	Radio Resource Control
SAP	Service Access Point
SDU	Service Data Unit
SHCCH	Shared Channel Control Channel
TCH	Traffic Channel
TDD	Time Division Duplex
TFI	Transport Format Indicator
~~TFCI~~	~~Transport Format Combination Indicator~~
~~TPC~~	~~Transmit Power Control~~
U-	User-
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System

~~URA~~	~~UTRAN Registration Area~~
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

6.1 Mapping of services/functions onto logical channels

The following tables show the applicability of services and functions to the logical channels in UL/DL and UE/UTRAN. A '+' in a column denotes that the service/function is applicable for the logical channel in question whereas a '-' denotes that the service/function is not applicable.

Table 6.1: RLC modes and functions in UE uplink side

Service	Functions	CCCH	SHCCH	DCCH	DTCH
Transparent Service	Applicability	+	+	+	+
	Segmentation	-	-	+	+
	Transfer of user data	+	+	+	+
Unacknowledged Service	Applicability	-	-	+	+
	Segmentation	-	-	+	+
	Concatenation	-	-	+	+
	Padding	-	-	+	+
	Transfer of user data	-	-	+	+
	Ciphering	-	-	+	+
Acknowledged Service	Applicability	-	-	+	+
	Segmentation	-	-	+	+
	Concatenation	-	-	+	+
	Padding	-	-	+	+
	Transfer of user data	-	-	+	+
	Flow Control	-	-	+	+
	Error Correction	-	-	+	+
	Protocol error correction & recovery	-	-	+	+
	Ciphering	-	-	+	+

Table 6.2: RLC modes and functions in UE downlink side

Service	Functions	BCCH	PCCH	SHCCH	CCCH	DCCH	DTCH	CTCH
Transparent Service	Applicability	+	+	+	-	+	+	-
	Reassembly	-~~+~~	+	-	-	+	+	-
Unacknowledged Service	Applicability	-	-	+	+	+	+	+
	Reassembly	-	-	+	+	+	+	+
	Deciphering	-	-	-	-	+	+	-
	Sequence number check	-	-	+	+	+	+	+
Acknowledged Service	Applicability	-	-	-	-	+	+	-
	Reassembly	-	-	-	-	+	+	-
	Error correction	-	-	-	-	+	+	-
	Flow Control	-	-	-	-	+	+	-
	In sequence delivery	-	-	-	-	+	+	-
	Duplicate detection	-	-	-	-	+	+	-
	Protocol error correction & recovery	-	-	-	-	+	+	-
	Deciphering	-	-	-	-	+	+	-

Table 6.3: RLC modes and functions in UTRAN downlink side

Service	Functions	BCCH	PCCH	CCCH	SHCCH	DCCH	DTCH	CTCH
Transparent Service	Applicability	+	+	-	+	+	+	-
	Segmentation	-~~+~~	+	-	-	+	+	-
	Transfer of user data	+	+	-	+	+	+	-
Unacknowledged Service	Applicability	-	-	+	+	+	+	+
	Segmentation	-	-	+	+	+	+	+
	Concatenation	-	-	+	+	+	+	+
	Padding	-	-	+	+	+	+	+
	Ciphering	-	-	-	-	+	+	-
Acknowledged Service	Applicability	-	-	-	-	+	+	-
	Segmentation	-	-	-	-	+	+	-
	Concatenation	-	-	-	-	+	+	-
	Padding	-	-	-	-	+	+	-
	Transfer of user data	-	-	-	-	+	+	-
	Flow Control	-	-	-	-	+	+	-
	Error Correction	-	-	-	-	+	+	-
	Protocol error correction & recovery	-	-	-	-	+	+	-
	Ciphering	-	-	-	-	+	+	-

Table 6.4: RLC modes and functions in UTRAN uplink side

Service	Functions	CCCH	SHCCH	DCCH	DTCH
Transparent Service	Applicability	+	+	+	+
	Reassembly	-	-	+	+
Unacknowledged Service	Applicability	-	-	+	+
	Reassembly	-	-	+	+
	Deciphering	-	-	+	+
	Sequence number check	-	-	+	+
Acknowledged Service	Applicability	-	-	+	+
	Reassembly	-	-	+	+
	Error correction	-	-	+	+
	Flow Control	-	-	+	+
	In sequence delivery	-	-	+	+
	Duplicate detection	-	-	+	+
	Protocol error correction & recovery	-	-	+	+
	Deciphering	-	-	+	+

11.1.2 Initiation

The sender initiates this procedure upon a request of transparent mode data transfer from higher layer. When the sender is in data transfer ready state it shall put the data received from the higher layer into TrD PDUs. If needed RLC shall perform segmentation.

Channels that can be used are DTCH, CCCH (uplink only), BCCH, PCCH and~~,~~ SHCCH ~~and SCCH (downlink only)~~. The type of logical channel depends on if the RLC entity is located in the user plane (DTCH) or in the control plane (CCCH/BCCH/SHCCH/PCCH~~, SCCH~~). One or several PDUs may be transmitted in each transmission time interval (TTI) and MAC decides how many PDUs shall be transmitted in each TTI.

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25.322 CR 052 Current Version: 3.2.0

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Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 2000-5-22

Subject: Updated RLC SDL

Work item:

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

F	Correction	☐
A	Corresponds to a correction in an earlier release	☐
B	Addition of feature	☐
C	Functional modification of feature	☐
D	Editorial modification	☒

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change: The RLC SDL is updated in accordance with the latest RLC specification.

Clauses affected: Annex A

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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Annex A (informative): SDL diagrams

This annex contains the SDL diagrams. For Release’99, it is meant for informative purposes only.

NOTE: All the SDL diagrams presented are [FFS].

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25.322 CR 053 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 2000-5-22

Subject: Correction to RLC

Work item:

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

F	Correction	☒
A	Corresponds to a correction in an earlier release	☐
B	Addition of feature	☐
C	Functional modification of feature	☐
D	Editorial modification	☐

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change: The parameter “Ciphering Sequence Number” which is one of the ciphering elements shall be changed with “HFN” since HFN is appropriate rather than Ciphering Sequence Number.

Clauses affected: 8.1

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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-

8.1 Primitives between RLC and higher layers

The primitives between RLC and upper layers are shown in Table 8.1.

Table 8.1: Primitives between RLC and upper layers

Generic Name	Parameter			
	Req.	**Ind.**	**Resp.**	**Conf.**
RLC-AM-DATA	Data, CNF, MUI	Data, DiscardInfo	Not Defined	MUI
RLC-UM-DATA	Data,	Data	Not Defined	Not Defined
RLC-TR-DATA	Data	Data	Not Defined	Not Defined
CRLC-CONFIG	E/R, Ciphering Elements (UM/AM only), AM_parameters (AM only)	Not Defined	Not Defined	Not Defined
CRLC-SUSPEND (UM/AM only)	N	Not Defined	Not Defined	VT(US) (UM only), VT(S) (AM only)
CRLC-RESUME (UM/AM only)	No Parameter	Not Defined	Not Defined	Not Defined
CRLC-STATUS	Not Defined	EVC	Not Defined	Not Defined

Each Primitive is defined as follows:

RLC-AM-DATA-Req/Ind/Conf

- RLC-AM-DATA-Req is used by higher layers to request transmission of a higher layer PDU in acknowledged mode.
- RLC-AM-DATA-Ind is used by RLC to deliver to higher layers RLC SDUs, that have been transmitted in acknowledged mode and to indicate higher layers of the discarded RLC SDU in the receiving RLC.
- RLC-AM-DATA-Conf is used by RLC to confirm to higher layers the transmission of a RLC SDU.

RLC-UM-DATA-Req/Ind

- RLC-UM-DATA-Req is used by higher layers to request transmission of a higher layer PDU in unacknowledged mode.
- RLC-UM-DATA-Ind is used by RLC to deliver to higher layers RLC SDUs, that have been transmitted in unacknowledged mode.

RLC-TR-DATA-Req/Ind

- RLC-TR-DATA-Req is used by higher layers to request transmission of a higher layer PDU in transparent mode.
- RLC-TR-DATA-Ind is used by RLC to deliver to higher layers RLC SDUs, that have been transmitted in transparent mode.

CRLC-CONFIG-Req

This primitive is used by RRC to establish, release or reconfigure the RLC. Ciphering elements are included for UM and AM operation.

CRLC-SUSPEND-Req/Conf

This primitive is used by RRC to suspend the RLC. The N parameter indicates that RLC shall not send a PDU with SN>=VT(S)+N, where N is an integer. RLC informs RRC of the VT(S) value in the confirm primitive.

CRLC-RESUME-Req

This primitive is used by RRC to resume RLC when RLC has been suspended.

CRLC-STATUS-Ind

It is used by the RLC to send status information to RRC.

Following parameters are used in the primitives:

1) The parameter Data is the RLC SDU that is mapped onto the Data field in RLC PDUs. The Data parameter may be divided over several RLC PDUs. In case of a RLC-AM-DATA or a RLC-UM-DATA primitive the length of the Data parameter shall be octet-aligned.

2) The parameter Confirmation request (CNF) indicates whether the RLC needs to confirm the correct transmission of the RLC SDU.

3) The parameter Message Unit Identifier (MUI) is an identity of the RLC SDU, which is used to indicate which RLC SDU that is confirmed with the RLC-AM-DATA conf. primitive.

4) The parameter E/R indicates (re)establishment, release or modification of RLC If it indicates (re)establishment, all protocol parameters, variables and timers shall be set or reset and RLC shall enter the data transfer ready state. If it indicates release, all protocol parameters, variables and timers shall be released and RLC shall exit the data transfer ready state. If it indicates modification, the protocol parameters indicated by RRC (e.g. ciphering parameters) shall only be modified with keeping the other protocol parameters, the protocol variables, the protocol timers and the protocol state.

5) The parameter Event Code (EVC) indicates the reason for the CRLC-STATUS-ind (i.e., unrecoverable errors such as data link layer loss or recoverable status events such as reset, etc.).

6) The parameter ciphering elements are only applicable for UM and AM operation. These parameters are Ciphering Mode, Ciphering Key, Activation Time (SN to activate a new ciphering configuration) and ~~Ciphering Sequence Number~~HFN(Hyper Frame Number).

7) The AM_parameters is only applicable for AM operation. It contains PU size, Timer values (see subclause 9.5), Protocol parameter values (see subclause 9.6), Polling triggers (see subclause 9.7.1), Status triggers (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3).

8) The parameter DiscardInfo indicates the upper layer of each of the discarded RLC SDU. It is applicable only when in-sequence delivery is active and it is purposed to be used when the upper layer requires the reliable data transfer and especially the information of the discarded RLC SDU.

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25.322 CR 055 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 24 May 2000

Subject: RLC logical channel mapping

Work item:

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

F	Correction	☐	
A	Corresponds to a correction in an earlier release	☐	
B	Addition of feature	☐	
C	Functional modification of feature	☐	
D	Editorial modification	☒	

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change: In case two logical channels are used in the uplink the UTRAN can indicate that the first logical channel shall be used for data PDUs and the second logical channel shall be used for control PDUs. If the indication is not given from the UTRAN, data and control PDUs can be sent on either of the two logical channels.

Clauses affected: 4.2.1.3

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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4.2.1.3 Acknowledged mode entity

Figure 4.4 below shows the model of an acknowledged mode entity, when one logical channel (shown as a solid line) and when two logical channels (shown as dashed lines) are used.

In case two logical channels are used in the uplink the UTRAN can indicate that the first logical channel shall be used for data PDUs and the second logical channel shall be used for control PDUs. If the indication is not given from the UTRAN, data and control PDUs can be sent on either of the two logical channels. The indication of the logical channel mapping is signalled by RRC.

Figure 4.4: Model of a acknowledged mode entity

The transmitting side of the AM-entity receives SDUs from the higher layers. The SDUs are segmented and/or concatenated to PUs of fixed length. PU length is a semi-static value that is decided in bearer setup and can only be changed through bearer reconfiguration by RRC.

For purposes of RLC buffering and retransmission handling, the operation is the same as if there would be one PU per PDU. For concatenation or padding purposes, bits of information on the length and extension are inserted into the beginning of the last PU where data from an SDU is included. Padding can be replaced by piggybacked status information. This includes setting the poll bit.

If several SDUs fit into one PU, they are concatenated and the appropriate length indicators are inserted into the beginning of the PU. After that the PUs are placed in the retransmission buffer and the transmission buffer. One PU is included in one RLC PDU.

The MUX then decides which PDUs and when the PDUs are delivered to MAC~~, e.g. it could be useful to send RLC control PDUs on one logical channel and data PDUs on another logical channel~~. The PDUs are delivered via a function that completes the RLC-PDU header. The fixed 2 octet AMD PDU header is not ciphered.

When Piggybacking mechanism is applied the padding is replaced by control information, in order to increase the transmission efficiency and making possible a faster message exchange between the peer to peer RLC entities. The piggybacked control information is not saved in any retransmission buffer. The piggybacked control information is contained in the piggybacked STATUS PDU, which is in turn included into the AMD-PDU. The piggybacked STATUS PDUs will be of variable size in order to match with the amount of free space in the AMD PDU.

~~The dashed lines illustrate the case where AMD PDUs and control PDUs are transmitted on separate logical channels.~~ The retransmission buffer also receives acknowledgements from the receiving side, which are used to indicate retransmissions of PUs and when to delete a PU from the retransmission buffer.

The Receiving Side of the AM-entity receives PDUs through one of the logical channels from the MAC sublayer. The RLC-PDUs are expanded into separate PUs and potential piggybacked status information are extracted. The PUs are placed in the receiver buffer until a complete SDU has been received. The receiver buffer requests retransmissions of PUs by sending negative acknowledgements to the peer entity. After that the headers are removed from the PDUs and the PDUs are reassembled into a SDU. Finally the SDU is delivered to the higher layer. The receiving side also receives acknowledgements from the peer entity. The acknowledgements are passed to the retransmission buffer on the transmitting side.

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25.322 CR 057 Current Version: 3.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Proposed change affects: (U)SIM ☐ ME ☒ UTRAN / Radio ☒ Core Network ☐
(at least one should be marked with an X)

Source: TSG-RAN WG2 **Date:** 2000-05-22

Subject: Correction of EPC timer mechanism

Work item:

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

F	Correction	☒
A	Corresponds to a correction in an earlier release	☐
B	Addition of feature	☐
C	Functional modification of feature	☐
D	Editorial modification	☐

Release:

Phase 2	☐
Release 96	☐
Release 97	☐
Release 98	☐
Release 99	☒
Release 00	☐

Reason for change:

1. The EPC timer shall be started when the first STATUS PDU of a status report is transmitted. Reason:

This is a timer which estimates the time to when the first retransmitted PDU can be expected after a status report has been sent. If a status report consists of several STATUS PDUs and if you implement EPC is such a way that the timer starts when the last STATUS PDU of a status report is transmitted and this PDU is transmitted somewhat later than the first, then it is useless to start the EPC timer since a retransmitted PDU may already have arrived at the receiver side.
If this occurs, the receiver will think that some of the PDUs where lost when they in fact was received before the timer expired. Thus, the EPC will (erroneously) retransmit the status report, .i.e. the EPC mechanism will not work correctly.

Clauses affected: 9.5, 9.7.2, 9.7.4

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM 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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9.5 Timers

a) Timer_Poll.

This timer is only used when the poll timer trigger is used. It is started when the transmitting side sends a poll to the peer entity. The timer is stopped when receiving a STATUS PDU that contains an acknowledgement or negative acknowledgement of the AMD PDU that triggered the timer. The value of the timer is signalled by RRC.

If the timer expires and no STATUS PDU containing an acknowledgement or negative acknowledgement of the AMD PDU that triggered the timer has been received, the receiver is polled once more (either by the transmission of a PDU which was not yet sent, or by a retransmission) and the timer is restarted. If there is no PU to be transmitted and all PUs have already been acknowledged, the receiver shall not be polled.

If a new poll is sent when the timer is running it is restarted.

b) Timer_Poll_Prohibit.

This timer is only used when the poll prohibit function is used. It is used to prohibit transmission of polls within a certain period. A poll shall be delayed until the timer expires if a poll is triggered when the timer is active. Only one poll shall be transmitted when the timer expires even if several polls were triggered when the timer was active. If there is no PU to be transmitted and all PUs have already been acknowledged, a poll shall not be transmitted. This timer will not be stopped by a STATUS PDU. The value of the timer is signalled by RRC.

c) Timer_EPC.

This timer is only used when the EPC function is used and it accounts for the roundtrip delay, i.e. the time when the first retransmitted PU should be received after a status report has been sent. The timer is started when the ~~last~~ first STATUS PDU of a status report is transmitted and when it expires EPC can start decrease (see subclause 9.7.3). The value of the timer is signalled by RRC.

d) Timer_Discard.

This timer is used for the SDU discard function. In the transmitter, the timer is activated upon reception of a SDU from higher layer. If the SDU has not been acknowledged and/or transmitted when the timer expires, the SDU is discarded. Following which, if the SDU discard function uses explicit signalling, a Move Receiving Window request is sent to the receiver. The value of the timer is signalled by RRC.

e) Timer_Poll_Periodic.

This timer is only used when the timer based polling is used. The timer is started when the RLC entity is created. Each time the timer expires a poll is transmitted (either by the transmission of a PDU which was not yet sent, or by a retransmission) and the timer is restarted. If there is no PU to be transmitted and all PUs have already been acknowledged, a poll shall not be transmitted and the timer shall only be restarted. The value of the timer is signalled by RRC.

f) Timer_Status_Prohibit.

This timer is only used when the STATUS prohibit function is used. It prohibits the receiving side from sending status reports. The timer is started when the last STATUS PDU in a status report is transmitted and no new status report can be transmitted before the timer has expired. The value of the timer is signalled by RRC.

g) Timer_Status_Periodic.

This timer is only used when timer based status report sending is used. The timer is started when the RLC entity is created. Each time the timer expires a status report is transmitted and the timer is restarted. The value of the timer is signalled by RRC.

h) Timer_RST.

It is used to detect the loss of RESET ACK PDU from the peer RLC entity. This timer is set when the RESET PDU is transmitted. And it will be stopped upon reception of RESET ACK PDU. If it expires, RESET PDU will be retransmitted. The value of the timer is signalled by RRC.

i) Timer_MRW.

This timer is used as part of the Move Receiving Window protocol. It is used to trigger the retransmission of a status report containing an MRW SUFI field. The timer is started when the last STATUS PDU of the status report is first transmitted. Each time the timer expires the status report is retransmitted and the timer is restarted (when the last STATUS PDU of the status report is retransmitted). It shall be stopped when a STATUS PDU is received that indicates that VR(R) ≥ SN_MRW. It shall also be stopped if a new MRW procedure is triggered while it is running. The value of the timer is signalled by RRC

9.7.2 STATUS transmission for acknowledged mode

The receiver of AMD PDUs transmits status reports (each status report consists of one or several STATUS PDUs) to the sender in order to inform about which PUs that have been received and not received. There are several triggers for sending a status report. The network (RRC) controls which triggers should be used for each RLC entity, except for one, which is always present. The receiver shall always send a status report when receiving a poll request. Except for that trigger following triggers are configurable:

1) Detection of missing PU(s).

   If the receiver detects one or several missing PUs it shall send a status report to the sender.

2) Timer based STATUS transfer.

   The receiver transmits a status report periodically to the sender. The timer Timer_Status_Periodic controls the time period.

3) The EPC mechanism.

   The EPC is started when the ~~last~~ first STATUS PDU of a status report is transmitted to the peer entity. If not all PUs requested for retransmission have been received before the EPC has expired a new status report is transmitted to the peer entity. A more detailed description of the EPC mechanism is given in subclause 9.7.4.

There are two functions that can prohibit the receiver from sending a status report. The network (RRC) controls which functions should be used for each RLC entity. If any of the following functions is used the sending of the status report shall be delayed, even if any of the conditions above are fulfilled:

1) STATUS prohibit.

   The Timer_Status_Prohibit is started when the last STATUS PDU of a status report is transmitted to the peer entity. As long as the timer is running the receiving side is not allowed to send a status report to the peer entity. The status report is transmitted after the timer has expired. The receiver shall only send one status report, even if there are several triggers when the timer running.

2) The EPC mechanism.

If the EPC mechanism is active and the sending of a status report is triggered it shall be delayed until the EPC mechanism has ended. The receiver shall only send one status report, even if there are several triggers when the timer is active or the counter is counting down.

9.7.4 The Estimated PDU Counter

The Estimated PDU Counter is a mechanism used for scheduling the retransmission of status reports in the receiver side. With this mechanism, the receiver will send a new status report in which it requests for PUs not yet received. The time between two subsequent status report retransmissions is not fixed, but it is controlled by the Estimated PDU Counter (EPC), which adapt this time to the current bit rate, indicated in the TFI, in order to minimise the delay of the status report retransmission.

The EPC is a counter, which is decremented every transmission time interval with the estimated number of PUs that should have been transmitted during that transmission time interval. When the receiver detects that PDUs are missing it generates and sends a status report to the transmitter and sets the EPC equal to the number of requested PUs.

A special timer, called EPC timer, controls the maximum time that the EPC needs to wait before it will start counting down. This timer starts immediately after a transmission of a retransmission request from the receiver (when the ~~last~~ first STATUS PDU of the status report is transmitted). The EPC timer typically depends on the roundtrip delay, which consists of the propagation delay, processing time in the transmitter and receiver and the frame structure. This timer can also be implemented as a counter, which counts the number of 10 ms radio frames that could be expected to elapse before the first requested AMD PDU is received.

When the EPC is equal to zero and not all of these requested PUs have been received correctly, a new status report will be transmitted and the EPC will be reset accordingly. The EPC timer will be started once more.