TSG-RAN Meeting #12 *RP-010309*
Stockholm, Sweden, 12 - 15 June 2001

Title: **Agreed CRs (Release '99 and Rel-4 category A) to TS 25.322**

Source: **TSG-RAN WG2**

Agenda item: **8.2.3**

Doc-1st-	Status-	Spec	CR	Rev	Phase	Subject	Cat	Version	Versio
R2-011311	agreed	25.322	119	1	R99	Clarification on ACK SUFI	F	3.6.0	3.7.0
R2-011345	agreed	25.322	120		Rel-4	Clarification on ACK SUFI	A	4.0.0	4.1.0
R2-011312	agreed	25.322	121	1	R99	MRW SUFI clarification and enhancement	F	3.6.0	3.7.0
R2-011346	agreed	25.322	122		Rel-4	MRW SUFI clarification and enhancement	A	4.0.0	4.1.0
R2-011313	agreed	25.322	123	1	R99	Clarification on AM states	F	3.6.0	3.7.0
R2-011347	agreed	25.322	124		Rel-4	Clarification on AM states	A	4.0.0	4.1.0
R2-011314	agreed	25.322	125	1	R99	Clarification on HFN update in RESET procedure	F	3.6.0	3.7.0
R2-011348	agreed	25.322	126		Rel-4	Clarification on HFN update in RESET procedure	A	4.0.0	4.1.0
R2-011315	agreed	25.322	127	1	R99	Clarification of RLC Discard	F	3.6.0	3.7.0
R2-011349	agreed	25.322	128		Rel-4	Clarification of RLC Discard	A	4.0.0	4.1.0
R2-011118	agreed	25.322	129		R99	Removal of reference to RRC	F	3.6.0	3.7.0
R2-011350	agreed	25.322	130		Rel-4	Removal of reference to RRC	A	4.0.0	4.1.0
R2-011316	agreed	25.322	131	1	R99	Clarification in the LI Parameters section	F	3.6.0	3.7.0
R2-011351	agreed	25.322	132		Rel-4	Clarification in the LI Parameters section	A	4.0.0	4.1.0
R2-011317	agreed	25.322	135	1	R99	Cleanup of RLC services and functions	F	3.6.0	3.7.0
R2-011352	agreed	25.322	136		Rel-4	Cleanup of RLC services and functions	A	4.0.0	4.1.0
R2-011318	agreed	25.322	137	1	R99	Clarification on RLC re-establishment	F	3.6.0	3.7.0
R2-011505	agreed	25.322	138	1	Rel-4	Clarification on RLC re-establishment	A	4.0.0	4.1.0
R2-011320	agreed	25.322	139	1	R99	Corrections and clarifications to the LIST and RLIST SUFI types	F	3.6.0	3.7.0
R2-011354	agreed	25.322	140		Rel-4	Corrections and clarifications to the LIST and RLIST SUFI types	A	4.0.0	4.1.0

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

Tdoc R2-011311

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **119** ⌘ ev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Clarification on ACK SUFI
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-5-22
Category:	⌘	**F**
Release:	⌘	R99

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change:	⌘	The statements of LSN of ACK SUFI might be misinterpreted as that LSN can be less than VR(R) and cause confusion.
Summary of change:	⌘	1. The allowed range of LSN of ACK SUFI is clarified. 2. A typo in section 9.2.2.11.5 is corrected. **Backwards Compatibility Analysis:** There is no functionality change in this CR. It can be seen as backwards compatible but need to be considered in implementation.
Consequences if not approved:	⌘	Unclear and confusing statements for LSN of ACK SUFI.

Clauses affected:	⌘	9.2.2.11.2, 9.2.2.11.5
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

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.

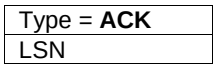

Figure 9.9: The ACK fields in a STATUS PDU

LSN

Length: 12 bits

Acknowledges the reception of all PDUs with sequence numbers < LSN (Last Sequence Number) that are *not* indicated to be erroneous in earlier parts of the STATUS PDU. This means that if the LSN is set to a ~~different~~ value greater than VR(R), all erroneous PDUs must be included in the same STATUS PDU and if the LSN is set to VR(R), the erroneous PDUs can be split into several STATUS PDUs. At the 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. VT(A) is only updated based on STATUS PDUs where ACK SUFI (or MRW_ACK SUFI) is included. The LSN should not be set to a value > VR(H) nor < VR(R).

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~~ than 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).

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

Tdoc R2-011345

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **120** ⌘ ev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Clarification on ACK SUFI
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-5-24
Category:	⌘	**A**
Release:	⌘	REL-4

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

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change:	⌘	The statements of LSN of ACK SUFI might be misinterpreted as that LSN can be less than VR(R) and cause confusion.
Summary of change:	⌘	1. The allowed range of LSN of ACK SUFI is clarified. 2. A typo in section 9.2.2.11.5 is corrected.
Consequences if not approved:	⌘	Unclear and confusing statements for LSN of ACK SUFI.

Clauses affected:	⌘	9.2.2.11.2, 9.2.2.11.5
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

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

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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 PDUs with sequence numbers < LSN (Last Sequence Number) that are *not* indicated to be erroneous in earlier parts of the STATUS PDU. This means that if the LSN is set to a ~~different~~ value greater than VR(R), all erroneous PDUs must be included in the same STATUS PDU and if the LSN is set to VR(R), the erroneous PDUs can be split into several STATUS PDUs. At the 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. VT(A) is only updated based on STATUS PDUs where ACK SUFI (or MRW_ACK SUFI) is included. The LSN should not be set to a value > VR(H) nor < VR(R).

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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~~ than 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).

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

Tdoc R2-011312

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **121** ⌘ rev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	MRW SUFI clarification and enhancement
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	23 May 2001
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
F *(correction)*
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R98 *(Release 1998)*
R99 *(Release 1999)*
REL-4 *(Release 4)*
REL-5 *(Release 5)*

Reason for change: ⌘

1. The MRW SUFI indicates each of the discarded SDU by SN_MRWi. This indication is necessary when an AM RLC is connected to a PDCP which supports lossless SRNS relocation, i.e. when Send MRW is configured. But when Send MRW is not configured, this indication is not necessary because there are no PDCP sequence numbers. It just wastes radio resource.
2. The MRW SUFI is ambiguous, at least two different interpretations of the current description are possible.
3. Initial conditions for the discard procedure are not correct.

Summary of change: ⌘

1. The MRW procedure is split into two cases; Send MRW configured case and not configured case.
2. If Send MRW is configured, the current MRW procedure is used as it is. Each discarded SDU shall be informed to the receiver.
3. If Send MRW is not configured, the MRW SUFI shall contain the information about the last SDU to be discarded in the receiver, but the information about other discarded SDUs may not be informed to the receiver even though they were actually discarded in the transmitter. The rest of the procedure is not changed.
4. Initial conditions for the discard procedure are corrected.

Rev1 : Some editorial changes are made, and they are highlighted.

Backwards compatibility analysis

Optional functionality is added, which does not need implementation change. It means this CR is backwards compatible. But implementation shall be checked.

Consequences if ⌘

1. Useless information of SN_MRWi wastes radio resource when an AM RLC

not approved:	has no connection to a PDCP which supports lossless SRNS relocation. 2. Unclear and incorrect specification.

Clauses affected:	⌘	8.2, 9.2.2.11.8, 11.3.4.4, 11.6.1, 11.6.2, 11.6.2.2, 11.6.3		
Other specs affected:	⌘	Other core specifications Test specifications O&M Specifications	⌘	
Other comments:	⌘			

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8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause 11.8. 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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the information of each discarded SDU shall be sent to the receiver, and the MRW SUFI shall be sent to the receiver even if no segments of the ~~expired~~ SDU to be discarded were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

9.2.2.11.8 The Move Receiving Window (MRW) super-field

The 'Move Receiving Window' super-field is used to request the RLC receiver to move its receiving window and optionally to indicate the ~~amount~~ set of discarded SDUs, as a result of an SDU discard in the RLC transmitter. The format is given in Figure 9.15 below.

Type = **MRW**
LENGTH
SN_MRW_1
SN_MRW_2
...
SN_MRW_{LENGTH}
N_{LENGTH}

Figure 9.15: 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.~~.~~

The values "0001" through "1111" indicate 1 through 15 SN_MRW_i respectively. The value "0000" indicates that one SN_MRW_i field is present and that the ~~discarded~~ SDU to be discarded in the receiver extends above the configured Tx window in the transmitter.~~–~~

SN_MRW_i

Length: 12 bits

When Send MRW is configured, a SN_MRW_i ~~is~~shall be used to indicate the end of each discarded SDU~~.~~, i.e. the number of SN_MRW_i fields shall equal the ~~amount~~number of ~~discarded~~ SDUs discarded by~~within~~ ~~one~~that MRW SUFI. When Send MRW is not configured, SN_MRW_i shall be used to indicate the end of the last SDU to be discarded in the receiver and they may optionally be used to indicate the end of other discarded SDUs. SN_MRW_i is the sequence number of the PDU that contains the LI of the i:th ~~discarded~~ SDU to be discarded in the receiver (except for SN_MRW_{LENGTH} when $N_{LENGTH} = 0$, see definition of N_{LENGTH}). The order of the SN_MRW_i shall be in the same sequential order as the SDUs that they refer to.

Additionally SN_MRW_{LENGTH} requests the RLC receiver to discard all PDUs with sequence number < SN_MRW_{LENGTH}, and to move the receiving window accordingly. In addition, when $N_{LENGTH} > 0$, the receiver has to discard the first N_{LENGTH} LIs and the corresponding data octets in the PDU with sequence number SN_MRW_{LENGTH}.

N_{LENGTH}

Length: 4 bits

N_{LENGTH} is used together with SN_MRW_{LENGTH} to indicate the end of the last ~~discarded~~ SDU to be discarded in the receiver.

N_{LENGTH} indicates which LI in the PDU with sequence number SN_MRW_{LENGTH} corresponds to the last ~~discarded~~ SDU to be discarded in the receiver. $N_{LENGTH} = 0$ indicates that the last SDU ended in the PDU with sequence number $SN\_MRW_{LENGTH} - 1$ and that the first data octet in the PDU with sequence number SN_MRW_{LENGTH} is the first data octet to be reassembled next.

11.3.4 Abnormal cases

11.3.4.1 Timer_Poll timeout

Upon expiry of the Timer_Poll, the sender shall retransmit the poll. The poll can be retransmitted in either a new PDU or a retransmitted PDU.

11.3.4.2 Receiving a PDU outside the receiving window

Upon reception of a PDU with sequence number outside the interval VR(R)≤SN<VR(MR), the receiver shall discard the PDU. The poll bit shall be considered even if a complete PDU is discarded.

11.3.4.3 Timer_Discard timeout

11.3.4.3.1 SDU discard with explicit signalling

Upon expiry of Timer_Discard, the sender shall initiate the SDU discard with explicit signalling procedure. In the case where the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the UE may wait until after it provides MAC with the requested set of PDUs before discarding the afore-mentioned SDU.

11.3.4.4 VT(DAT) ≥ MaxDAT

If SDU discard after MaxDAT number of retransmission is used and VT(DAT) ≥ MaxDAT for any PDU, the sender shall initiate the SDU discard with explicit signalling procedure. ~~for a~~All the SDUs that have segments in PDUs with sequence numbers inside the interval VT(A) ≤ SN ≤ SN of the PDU with VT(DAT) ≥ MaxDAT shall be discarded.~~are made up of PDUs with SN ≥ VT(A) and that predate the SDU to which the PDU with VT(DAT) ≥MaxDAT belongs.~~

If No_discard after MaxDAT number of retransmissions is used, the sender shall initiate the RLC reset procedure when VT(DAT) ≥ MaxDAT.

11.3.4.5 Invalid length indicator value

If the length indicator of a PDU has a value that is larger than the PDU size – RLC header size and is not one of the predefined values listed in the table of subclause 9.2.2.8, the PDU shall be discarded and treated as a missing PDU.

11.3.4.6 Length Indicator value reserved for AMD PDU

Upon reception of an AMD PDU that contains Length Indicator value reserved for AMD PDU, the receiver shall discard that AMD PDU.

11.6 SDU discard with explicit signalling procedure

11.6.1 Purpose

An SDU can be discarded with explicit signalling when MaxDAT number of retransmissions is reached or the transmission time exceeds a predefined value (Timer_Discard) for an SDU in acknowledged mode RLC. 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. If Send MRW is not configured and no segments of an SDU were submitted to a lower layer, the SDU is simply discarded in the transmitter without notification to the receiver. If Send MRW is configured, a Move Receiving Window request shall be sent to the receiver even if no segments of the SDU were submitted to a lower layer. The Send MRW is used when the AM RLC entity is connected to a PDCP layer~~,~~ which supports lossless SRNS relocation.

The MRW command is defined as a super-field in the RLC STATUS PDU, and can be piggybacked to status information of transmissions in the opposite direction.

Figure 11.6 below illustrates the elementary procedure for SDU discard with explicit signalling. The sender is the sender of AMD PDUs and it is either the UE or the network and the receiver is the receiver of AMD PDUs and it is either the network or the UE.

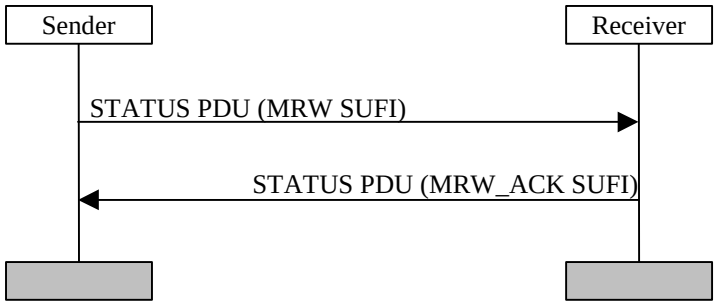

Figure 11.6: SDU discard with explicit signalling

11.6.2 Initiation

This procedure is initiated by the sender when any of the following conditions ~~are~~ is fulfilled:

1) Timer based SDU discard with explicit signalling is used, Timer_Discard expires for an SDU, and one or more segments of the SDU have been submitted to a lower layer.

2) Timer based SDU discard with explicit signalling is used, Timer_Discard expires for an SDU, and Send MRW is configured.

3) SDU discard after MaxDAT number of retransmissions is used, and MaxDAT number of retransmissions is reached for an SDU.

The sender shall discard all PDUs that contain segments of the associated SDUs. If the concatenation function is active, PDUs carrying segments of other SDUs that have not timed out shall not be discarded. VT(A) shall be updated when the procedure is terminated, and VT(S) shall be updated when a new MRW SUFI which includes SN_MRW_{LENGTH} >VT(S) is transmitted.

The sender shall transmit a status report 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.

This status report is sent even if the 'STATUS prohibit' is used and the timer 'Timer_Status_Prohibit' is active, or if the 'EPC mechanism' is used and the timer 'Timer_EPC' is active or 'VR(EP)' is counting down. ~~the 'EPC mechanism' is used and the mechanism is active 'Timer_EPC' are active.~~

The STATUS PDUs have higher priority than data PDUs.

The sender shall start timer Timer_MRW. If a new SDU discard procedure is triggered when Timer_MRW is running, no new MRW SUFIs shall be sent before the current SDU discard procedure is terminated by one of the termination criteria.

11.6.2.1 Piggybacked STATUS PDU

It is possible to piggyback a STATUS PDU on an AMD PDU. If a PDU includes padding a piggybacked STATUS PDU can be inserted instead of the padding.

11.6.2.2 STATUS PDU contents to set

The size of the STATUS PDU shall be equal to one of the allowed PDU sizes. The discard information shall not be split into several MRW SUFIs. If the discard information cannot be fit into one MRW SUFI, another SDU discard with explicit signalling procedure shall be initiated after the current procedure is terminated. ~~within the same STATUS report.~~

The status report shall include the MRW SUFI, other SUFI fields can be used additionally. MRW SUFI shall convey information about the discarded SDU(s) to the receiver.

When Send MRW is configured, the MRW SUFI shall contain the information about each discarded SDU (see subclause 9.2.2.11.8). In order to discard a single SDU that ends in a PDU with SN≥ VT(A)+Configured_Tx_Window_Size, the LENGTH field in the MRW SUFI shall be set to "0000". If more than ~~then~~ one SDU are discarded with the same MRW SUFI, at least the first discarded SDU~~s~~ must end (i.e. the LI must be located) in a PDU with SN in the interval VT(A)≤ SN <VT(A)+Configured_Tx_Window_Size. Otherwise, multiple ~~MRW~~SDU discard with explicit signalling procedures need to be performed in order to signal the set of discarded SDUs.

When Send MRW is not configured, the MRW SUFI shall contain the information about the last SDU to be discarded in the receiver. The information about the other SDUs to be discarded in the receiver may optionally be contained in the MRW SUFI (see subclause 9.2.2.11.8). If the MRW SUFI contains only the information about the last SDU to be discarded in the receiver and if this SDU ends in a PDU with SN≥ VT(A)+Configured_Tx_Window_Size, the LENGTH field in the MRW SUFI shall be set to "0000". If the MRW SUFI contains information about more than one discarded SDUs, at least the first discarded SDU must end (i.e. the LI must be located) in a PDU with SN in the interval VT(A)≤ SN <VT(A)+Configured_Tx_Window_Size.

Padding shall be inserted if the SUFI fields do not fill the entire STATUS PDU. If the STATUS PDU contains padding the last SUFI field shall be either an ACK SUFI or a 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.

11.6.3 Reception of the STATUS PDU by the receiver

The receiver shall upon reception of the STATUS PDU/piggybacked STATUS PDU discard PDUs and update the state variables VR(R), VR(H) and VR(MR) according to the received STATUS PDU/piggybacked STATUS PDU. Additionally, when Send MRW is configured, the receiver ~~should~~ shall inform the higher layers about all of the discarded SDUs that were not previously delivered to upper layer or discarded by other MRW SUFIs.

The receiver shall initiate the transmission of a status report containing an MRW_ACK SUFI.

In the MRW_ACK SUFI, SN_ACK shall be set to the new value of VR(R), updated after reception of the MRW SUFI. The N field in the MRW_ACK SUFI shall be set to N_{LENGTH} field in the received MRW SUFI if the SN_ACK field is equal to SN_MRW_{LENGTH}. Otherwise N shall be set to 0.

The last discarded data octet is the octet indicated by the N_{LENGTH}:th LI field of the PDU with sequence number SN_MRW_{LENGTH} and the succeeding data octet is the first data octet to be reassembled after the discard. When N_{LENGTH} = 0, the first data octet of the PDU with sequence number SN_MRW_{LENGTH} is the first data octet to be reassembled after the discard.

If LENGTH="0000", the sequence number SN_MRW_1 is considered to be above or equal to VR(R). Else, the sequence number SN_MRW_1 is considered to be less than VR(MR). All the SN_MRW_is other than SN_MRW_1 are considered to be in sequential order within the list and sequentially above or equal to SN_MRW_{i-1}.

11.6.4 Termination

The procedure is terminated in the sender in the following cases:

1. On the reception of a STATUS PDU which contains an MRW_ACK SUFI with SN_ACK > SN_MRW_{LENGTH} and with the N field set equal to zero.
2. On the reception of a STATUS PDU which contains an ACK SUFI indicating VR(R) > SN_MRW_{LENGTH}
3. On reception of a STATUS PDU which contains an MRW_ACK with SN_ACK = SN_MRW_{LENGTH} and with the N field set equal to the N_{LENGTH} indicated in the transmitted MRW SUFI.

If one of the termination criteria above is fulfilled, Timer_MRW shall be stopped and the discard procedure is terminated. The SDUs that are requested to be discarded shall not be confirmed to higher layer.

When VT(MRW) reaches MaxMRW, the procedure is terminated and an RLC reset shall be performed.

11.6.5 Expiration of timer Timer_MRW

If Timer_MRW expires before the discard procedure is terminated, the MRW SUFI shall be retransmitted, VT(MRW) is incremented by one and Timer_MRW restarted. MRW SUFI shall be exactly the same as previously transmitted even though some new SDUs would have been discarded during the running of the Timer_MRW. If the retransmitted STATUS PDU contains other SUFIs than the MRW SUFI, the status information indicated by these SUFIs shall be updated.

11.6.6 Abnormal cases

11.6.6.1 Obsolete/corrupted MRW command

If the MRW command contains outdated information about the receiver window (receiver window already moved further than MRW command is indicating), the MRW command shall be discarded and a status report containing SUFI MRW_ACK shall be transmitted indicating the value of VR(R) and the N field shall be set to zero.

11.6.6.2 VT(MRW) equals MaxMRW

If the number of retransmission of an MRW command (i.e. VT(MRW)) reaches MaxMRW, an error indication shall be passed to RRC and RESET procedure shall be performed.

11.6.6.3 Reception of obsolete MRW_ACK

The received MRW_ACK shall be discarded in the following cases.

1. If timer Timer_MRW is not active.
2. If the SN_ACK field in the received MRW_ACK < SN_MRW_{LENGTH} in the transmitted MRW SUFI.
3. If the SN_ACK field in the received MRW_ACK is equal to the SN_MRW_{LENGTH} in the transmitted MRW SUFI and the N field in the received MRW_ACK is not equal to the N_{LENGTH} field in the transmitted MRW SUFI
4. If the SN_ACK field in the received MRW_ACK > SN_MRW_{LENGTH} in the transmitted MRW SUFI and the N field in the received MRW_ACK is not equal to zero.

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

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CR-Form-v4

CHANGE REQUEST

⌘ **25.322 CR 122** ⌘ rev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	MRW SUFI clarification and enhancement
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	24 May 2001
Category:	⌘	**A**
Release:	⌘	REL-4

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

Use one of the following releases:
2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
REL-4 *(Release 4)*
REL-5 *(Release 5)*

Reason for change: ⌘

1. The MRW SUFI indicates each of the discarded SDU by SN_MRWi. This indication is necessary when an AM RLC is connected to a PDCP which supports lossless SRNS relocation, i.e. when Send MRW is configured. But when Send MRW is not configured, this indication is not necessary because there are no PDCP sequence numbers. It just wastes radio resource.
2. The MRW SUFI is ambiguous, at least two different interpretations of the current description are possible.
3. Initial conditions for the discard procedure are not correct.

Summary of change: ⌘

1. The MRW procedure is split into two cases; Send MRW configured case and not configured case.
2. If Send MRW is configured, the current MRW procedure is used as it is. Each discarded SDU shall be informed to the receiver.
3. If Send MRW is not configured, the MRW SUFI shall contain the information about the last SDU to be discarded in the receiver, but the information about other discarded SDUs may not be informed to the receiver even though they were actually discarded in the transmitter. The rest of the procedure is not changed.
4. Initial conditions for the discard procedure are corrected.

Rev1 : Some editorial changes are made, and they are highlighted.

Backwards compatibility analysis

Optional functionality is added, which does not need implementation change. It means this CR is backwards compatible. But implementation shall be checked.

Consequences if ⌘

1. Useless information of SN_MRWi wastes radio resource when an AM RLC

not approved:	has no connection to a PDCP which supports lossless SRNS relocation. 2. Unclear and incorrect specification.

Clauses affected:	⌘	8.2, 9.2.2.11.8, 11.3.4.4, 11.6.1, 11.6.2, 11.6.2.2, 11.6.3		
Other specs affected:	⌘	Other core specifications Test specifications O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause 11.8. 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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the information of each discarded SDU shall be sent to the receiver, and the MRW SUFI shall be sent to the receiver even if no segments of the ~~expired~~ SDU to be discarded were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

9.2.2.11.8 The Move Receiving Window (MRW) super-field

The 'Move Receiving Window' super-field is used to request the RLC receiver to move its receiving window and optionally to indicate the ~~amount~~ set of discarded SDUs, as a result of an SDU discard in the RLC transmitter. The format is given in Figure 9.15 below.

Type = **MRW**
LENGTH
SN_MRW_1
SN_MRW_2
...
SN_MRW_{LENGTH}
N_{LENGTH}

Figure 9.15: 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.~~.~~

The values "0001" through "1111" indicate 1 through 15 SN_MRW_i respectively. The value "0000" indicates that one SN_MRW_i field is present and that the ~~discarded~~ SDU to be discarded in the receiver extends above the configured Tx window in the transmitter.~~–~~

SN_MRW_i

Length: 12 bits

When Send MRW is configured, a SN_MRW_i ~~is~~shall be used to indicate the end of each discarded SDU~~.~~, i.e. the number of SN_MRW_i fields shall equal the ~~amount~~number of ~~discarded~~ SDUs discarded by~~within~~ ~~one~~that MRW SUFI. When Send MRW is not configured, SN_MRW_i shall be used to indicate the end of the last SDU to be discarded in the receiver and they may optionally be used to indicate the end of other discarded SDUs. SN_MRW_i is the sequence number of the PDU that contains the LI of the i:th ~~discarded~~ SDU to be discarded in the receiver (except for SN_MRW_{LENGTH} when $N_{LENGTH} = 0$, see definition of N_{LENGTH}). The order of the SN_MRW_i shall be in the same sequential order as the SDUs that they refer to.

Additionally SN_MRW_{LENGTH} requests the RLC receiver to discard all PDUs with sequence number < SN_MRW_{LENGTH}, and to move the receiving window accordingly. In addition, when $N_{LENGTH} > 0$, the receiver has to discard the first N_{LENGTH} LIs and the corresponding data octets in the PDU with sequence number SN_MRW_{LENGTH}.

N_{LENGTH}

Length: 4 bits

N_{LENGTH} is used together with SN_MRW_{LENGTH} to indicate the end of the last ~~discarded~~ SDU to be discarded in the receiver.

N_{LENGTH} indicates which LI in the PDU with sequence number SN_MRW_{LENGTH} corresponds to the last ~~discarded~~ SDU to be discarded in the receiver. $N_{LENGTH} = 0$ indicates that the last SDU ended in the PDU with sequence number $SN\_MRW_{LENGTH} - 1$ and that the first data octet in the PDU with sequence number SN_MRW_{LENGTH} is the first data octet to be reassembled next.

11.3.4 Abnormal cases

11.3.4.1 Timer_Poll timeout

Upon expiry of the Timer_Poll, the sender shall retransmit the poll. The poll can be retransmitted in either a new PDU or a retransmitted PDU.

11.3.4.2 Receiving a PDU outside the receiving window

Upon reception of a PDU with sequence number outside the interval VR(R)≤SN<VR(MR), the receiver shall discard the PDU. The poll bit shall be considered even if a complete PDU is discarded.

11.3.4.3 Timer_Discard timeout

11.3.4.3.1 SDU discard with explicit signalling

Upon expiry of Timer_Discard, the sender shall initiate the SDU discard with explicit signalling procedure. In the case where the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the UE may wait until after it provides MAC with the requested set of PDUs before discarding the afore-mentioned SDU.

11.3.4.4 VT(DAT) ≥ MaxDAT

If SDU discard after MaxDAT number of retransmission is used and VT(DAT) ≥ MaxDAT for any PDU, the sender shall initiate the SDU discard with explicit signalling procedure. ~~for a~~All the SDUs that have segments in PDUs with sequence numbers inside the interval VT(A) ≤ SN ≤ SN of the PDU with VT(DAT) ≥ MaxDAT shall be discarded.~~are made up of PDUs with SN ≥ VT(A) and that predate the SDU to which the PDU with VT(DAT) ≥MaxDAT belongs.~~

If No_discard after MaxDAT number of retransmissions is used, the sender shall initiate the RLC reset procedure when VT(DAT) ≥ MaxDAT.

11.3.4.5 Invalid length indicator value

If the length indicator of a PDU has a value that is larger than the PDU size – RLC header size and is not one of the predefined values listed in the table of subclause 9.2.2.8, the PDU shall be discarded and treated as a missing PDU.

11.3.4.6 Length Indicator value reserved for AMD PDU

Upon reception of an AMD PDU that contains Length Indicator value reserved for AMD PDU, the receiver shall discard that AMD PDU.

11.6 SDU discard with explicit signalling procedure

11.6.1 Purpose

An SDU can be discarded with explicit signalling when MaxDAT number of retransmissions is reached or the transmission time exceeds a predefined value (Timer_Discard) for an SDU in acknowledged mode RLC. 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. If Send MRW is not configured and no segments of an SDU were submitted to a lower layer, the SDU is simply discarded in the transmitter without notification to the receiver. If Send MRW is configured, a Move Receiving Window request shall be sent to the receiver even if no segments of the SDU were submitted to a lower layer. The Send MRW is used when the AM RLC entity is connected to a PDCP layer~~,~~ which supports lossless SRNS relocation.

The MRW command is defined as a super-field in the RLC STATUS PDU, and can be piggybacked to status information of transmissions in the opposite direction.

Figure 11.6 below illustrates the elementary procedure for SDU discard with explicit signalling. The sender is the sender of AMD PDUs and it is either the UE or the network and the receiver is the receiver of AMD PDUs and it is either the network or the UE.

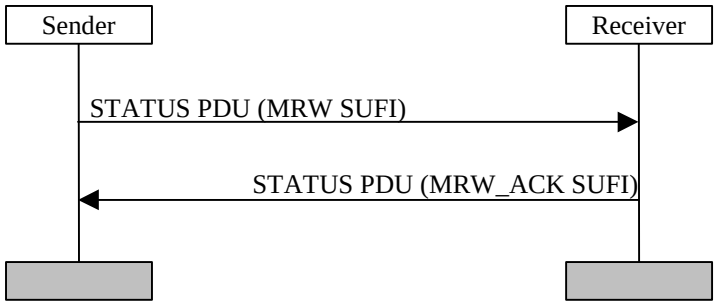

Figure 11.6: SDU discard with explicit signalling

11.6.2 Initiation

This procedure is initiated by the sender when any of the following conditions ~~are~~ is fulfilled:

1) Timer based SDU discard with explicit signalling is used, Timer_Discard expires for an SDU, and one or more segments of the SDU have been submitted to a lower layer.

2) Timer based SDU discard with explicit signalling is used, Timer_Discard expires for an SDU, and Send MRW is configured.

3) SDU discard after MaxDAT number of retransmissions is used, and MaxDAT number of retransmissions is reached for an SDU.

The sender shall discard all PDUs that contain segments of the associated SDUs. If the concatenation function is active, PDUs carrying segments of other SDUs that have not timed out shall not be discarded. VT(A) shall be updated when the procedure is terminated, and VT(S) shall be updated when a new MRW SUFI which includes SN_MRW_{LENGTH} >VT(S) is transmitted.

The sender shall transmit a status report 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.

This status report is sent even if the 'STATUS prohibit' is used and the timer 'Timer_Status_Prohibit' is active, or if the 'EPC mechanism' is used and the timer 'Timer_EPC' is active or 'VR(EP)' is counting down. ~~the 'EPC mechanism' is used and the mechanism is active 'Timer_EPC' are active.~~

The STATUS PDUs have higher priority than data PDUs.

The sender shall start timer Timer_MRW. If a new SDU discard procedure is triggered when Timer_MRW is running, no new MRW SUFIs shall be sent before the current SDU discard procedure is terminated by one of the termination criteria.

11.6.2.1 Piggybacked STATUS PDU

It is possible to piggyback a STATUS PDU on an AMD PDU. If a PDU includes padding a piggybacked STATUS PDU can be inserted instead of the padding.

11.6.2.2 STATUS PDU contents to set

The size of the STATUS PDU shall be equal to one of the allowed PDU sizes. The discard information shall not be split into several MRW SUFIs. If the discard information cannot be fit into one MRW SUFI, another SDU discard with explicit signalling procedure shall be initiated after the current procedure is terminated. ~~within the same STATUS report.~~

The status report shall include the MRW SUFI, other SUFI fields can be used additionally. MRW SUFI shall convey information about the discarded SDU(s) to the receiver.

When Send MRW is configured, the MRW SUFI shall contain the information about each discarded SDU (see subclause 9.2.2.11.8). In order to discard a single SDU that ends in a PDU with SN≥ VT(A)+Configured_Tx_Window_Size, the LENGTH field in the MRW SUFI shall be set to "0000". If more than ~~then~~ one SDU are discarded with the same MRW SUFI, at least the first discarded SDU~~s~~ must end (i.e. the LI must be located) in a PDU with SN in the interval VT(A)≤ SN <VT(A)+Configured_Tx_Window_Size. Otherwise, multiple ~~MRW~~SDU discard with explicit signalling procedures need to be performed in order to signal the set of discarded SDUs.

When Send MRW is not configured, the MRW SUFI shall contain the information about the last SDU to be discarded in the receiver. The information about the other SDUs to be discarded in the receiver may optionally be contained in the MRW SUFI (see subclause 9.2.2.11.8). If the MRW SUFI contains only the information about the last SDU to be discarded in the receiver and if this SDU ends in a PDU with SN≥ VT(A)+Configured_Tx_Window_Size, the LENGTH field in the MRW SUFI shall be set to "0000". If the MRW SUFI contains information about more than one discarded SDUs, at least the first discarded SDU must end (i.e. the LI must be located) in a PDU with SN in the interval VT(A)≤ SN <VT(A)+Configured_Tx_Window_Size.

Padding shall be inserted if the SUFI fields do not fill the entire STATUS PDU. If the STATUS PDU contains padding the last SUFI field shall be either an ACK SUFI or a 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.

11.6.3 Reception of the STATUS PDU by the receiver

The receiver shall upon reception of the STATUS PDU/piggybacked STATUS PDU discard PDUs and update the state variables VR(R), VR(H) and VR(MR) according to the received STATUS PDU/piggybacked STATUS PDU. Additionally, when Send MRW is configured, the receiver ~~should~~ shall inform the higher layers about all of the discarded SDUs that were not previously delivered to upper layer or discarded by other MRW SUFIs.

The receiver shall initiate the transmission of a status report containing an MRW_ACK SUFI.

In the MRW_ACK SUFI, SN_ACK shall be set to the new value of VR(R), updated after reception of the MRW SUFI. The N field in the MRW_ACK SUFI shall be set to N_{LENGTH} field in the received MRW SUFI if the SN_ACK field is equal to SN_MRW_{LENGTH}. Otherwise N shall be set to 0.

The last discarded data octet is the octet indicated by the N_{LENGTH}:th LI field of the PDU with sequence number SN_MRW_{LENGTH} and the succeeding data octet is the first data octet to be reassembled after the discard. When N_{LENGTH} = 0, the first data octet of the PDU with sequence number SN_MRW_{LENGTH} is the first data octet to be reassembled after the discard.

If LENGTH="0000", the sequence number SN_MRW_1 is considered to be above or equal to VR(R). Else, the sequence number SN_MRW_1 is considered to be less than VR(MR). All the SN_MRW_is other than SN_MRW_1 are considered to be in sequential order within the list and sequentially above or equal to SN_MRW_{i-1}.

11.6.4 Termination

The procedure is terminated in the sender in the following cases:

1. On the reception of a STATUS PDU which contains an MRW_ACK SUFI with SN_ACK > SN_MRW_{LENGTH} and with the N field set equal to zero.
2. On the reception of a STATUS PDU which contains an ACK SUFI indicating VR(R) > SN_MRW_{LENGTH}
3. On reception of a STATUS PDU which contains an MRW_ACK with SN_ACK = SN_MRW_{LENGTH} and with the N field set equal to the N_{LENGTH} indicated in the transmitted MRW SUFI.

If one of the termination criteria above is fulfilled, Timer_MRW shall be stopped and the discard procedure is terminated. The SDUs that are requested to be discarded shall not be confirmed to higher layer.

When VT(MRW) reaches MaxMRW, the procedure is terminated and an RLC reset shall be performed.

11.6.5 Expiration of timer Timer_MRW

If Timer_MRW expires before the discard procedure is terminated, the MRW SUFI shall be retransmitted, VT(MRW) is incremented by one and Timer_MRW restarted. MRW SUFI shall be exactly the same as previously transmitted even though some new SDUs would have been discarded during the running of the Timer_MRW. If the retransmitted STATUS PDU contains other SUFIs than the MRW SUFI, the status information indicated by these SUFIs shall be updated.

11.6.6 Abnormal cases

11.6.6.1 Obsolete/corrupted MRW command

If the MRW command contains outdated information about the receiver window (receiver window already moved further than MRW command is indicating), the MRW command shall be discarded and a status report containing SUFI MRW_ACK shall be transmitted indicating the value of VR(R) and the N field shall be set to zero.

11.6.6.2 VT(MRW) equals MaxMRW

If the number of retransmission of an MRW command (i.e. VT(MRW)) reaches MaxMRW, an error indication shall be passed to RRC and RESET procedure shall be performed.

11.6.6.3 Reception of obsolete MRW_ACK

The received MRW_ACK shall be discarded in the following cases.

1. If timer Timer_MRW is not active.
2. If the SN_ACK field in the received MRW_ACK < SN_MRW_{LENGTH} in the transmitted MRW SUFI.
3. If the SN_ACK field in the received MRW_ACK is equal to the SN_MRW_{LENGTH} in the transmitted MRW SUFI and the N field in the received MRW_ACK is not equal to the N_{LENGTH} field in the transmitted MRW SUFI
4. If the SN_ACK field in the received MRW_ACK > SN_MRW_{LENGTH} in the transmitted MRW SUFI and the N field in the received MRW_ACK is not equal to zero.

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Tdoc R2-011313

CR-Form-v4

CHANGE REQUEST

⌘ **25.322 CR 123** ⌘ ev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Clarification on AM states
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-05-22
Category:	⌘	**F**
Release:	⌘	R99

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change: ⌘
1. The RLC reset procedure (subclause 11.4) is not complete and clean-up is needed.
2. The behaviours of the Reset Pending State depend on whether it is entered from Acknowledged Data Transfer Ready State or from the Local Suspend State in current specification, so that the Reset Pending State is not a “pure” and “memoryless” state.

Summary of change: ⌘
1. A fifth state, the reset and suspend state, is added in the AM states.
2. The RLC reset procedure is cleaned up.

Backwards Compatibility Analysis:

There is no functionality change in this CR. It can be seen as backwards compatible but need to be considered in implementation.

Consequences if not approved: ⌘ Incomplete RLC reset procedure.

Clauses affected: ⌘ 9.3.3.1, 9.3.3.2, 9.3.3.3, 9.3.3.4, 9.3.3.5 (new), 9.7.5, 11.4.2, 11.4.4, 11.4.5.3

Other specs affected: ⌘
☐ Other core specifications ⌘
☐ Test specifications
☐ O&M Specifications

Other comments: ⌘

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm.
Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

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

9.3.3 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 a CRLC-CONFIG-Req from higher layer indicating (re)establish, the RLC entity is created and the 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 indicating release, 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 (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU and responds to the peer entity with a RESET ACK PDU.

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

Upon reception of CRLC-SUSPEND-Req from upper layer, the RLC entity is suspended and the local suspend state is entered.

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 a CRLC-CONFIG-Req from higher layer indicating release, the RLC entity is terminated and the null state is entered.

Upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU, the RLC entity resets the protocol (see subclause 11.4.4), sets the hyper frame number HFN (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) equal to the HFNI field in the RESET ACK PDU and ~~one of the following state transitions take place~~enters the acknowledged data transfer ready state.

~~The RLC entity enters the acknowledged data transfer ready state if Reset Pending State was entered from Acknowledged Data Transfer Ready State or if Reset Pending State was entered from Local Suspend State and a CRLC-RESUME-Req was received in Reset Pending State.~~

~~The RLC entity enters into Local Suspend State if Reset Pending State was entered from Local Suspend State or if Reset Pending State was entered from Acknowledged Data Transfer Ready State and a CRLC-SUSPEND-Req was received in Reset Pending State.~~

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET PDU, the RLC entity resets the protocol (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU, sends a RESET ACK PDU and stays in the reset pending state.

Upon reception of CRLC-SUSPEND-Req from upper layer, the RLC entity is suspended and the reset and suspend state is entered.

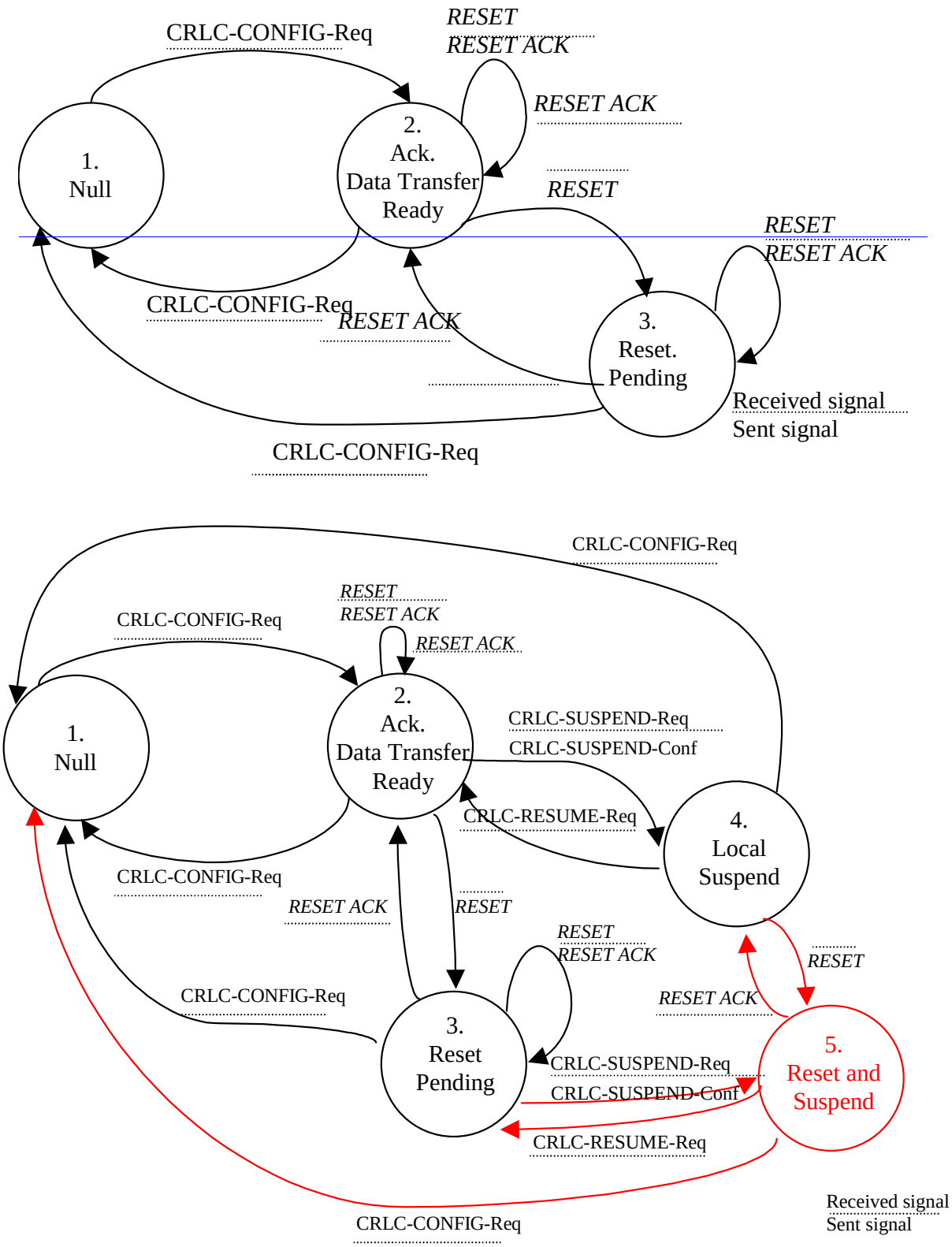


Figure 9.18: The state model for the acknowledged mode entities ~~when reset is performed~~

9.3.3.4 Local Suspend State

~~Upon reception of a CRLC-SUSPEND-Req from higher layer (RRC) in Acknowledge Data Transfer Ready State the RLC entity is suspended and the Local Suspend state is entered.~~ In the Local Suspend state RLC shall not send an RLC-PDUs with SN≥VT(S)+N, where VT(S) is the value of the send state variable when the CRLC-SUSPEND-Req with parameter N was received. Upon reception of CRLC-RESUME-Req from higher layer (RRC) in this state, the RLC

entity is resumed and the Acknowledged Data Transfer Ready state is entered. Upon reception of CRLC-CONFIG-Req from upper layer indicating release, the RLC entity is terminated and the null state is entered.

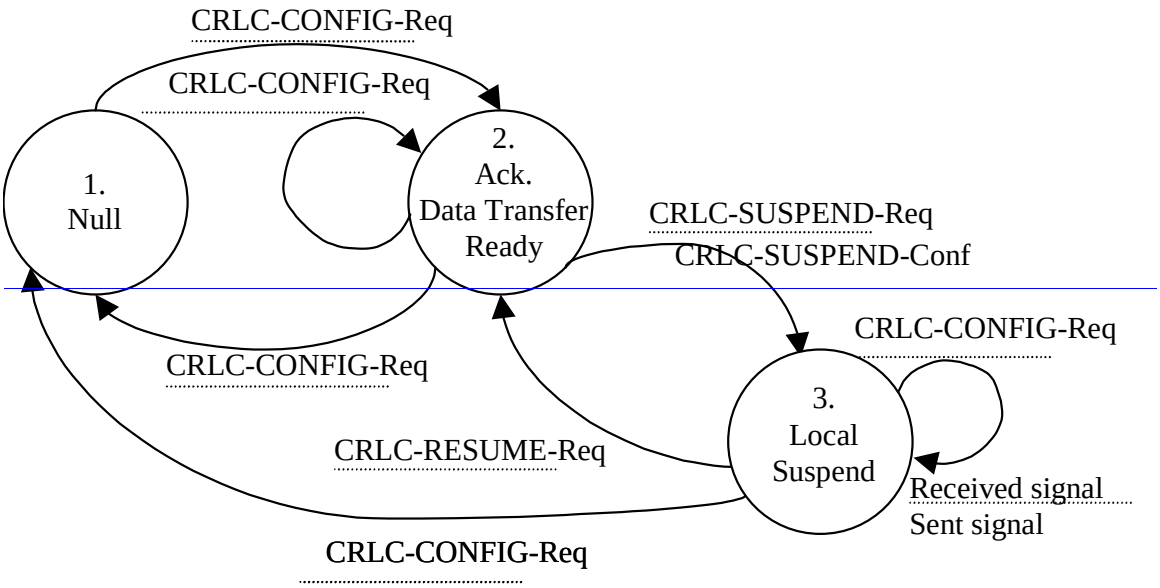
Upon errors in the protocol, the RLC entity sends a RESET PDU to its peer and enters the reset and suspend state.

9.3.3.5 Reset and Suspend ~~Pending~~ State

In the reset and suspend 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 upper layer indicating release, the RLC entity is terminated and the null state is entered.

Upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU, the RLC entity resets the protocol (see subclause 11.4.4), sets the hyper frame number HFN (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) equal to the HFNI field in the RESET ACK and enters the local suspend state.

Upon reception of CRLC-RESUME-Req from upper layer in this state, the RLC entity is resumed and the reset pending state is entered.



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

9.7.5 Local Suspend function for acknowledged and unacknowledged mode

The higher layer (RRC) may suspend the RLC entity. The CRLC-SUSPEND-Req indicates this request. The RLC entity shall, when receiving this request, not send RLC PDUs with SN≥VT(S)+N for AM and SN≥VT(US)+N for UM ,where N is given by the CRLC_SUSPEND-Req primitive. The RLC entity shall acknowledge the CRLC-SUSPEND-Req ordering a suspend with a CRLC-SUSPEND-Conf with the current value of VT(S) for AM and VT(US) for UM. ~~The suspend state is left w~~When a CRLC-RESUME-Req primitive indicating resume is received, the AM RLC entity enters the acknowledged data transfer ready state if it is in the local suspend state and enters the reset pending state if it is in the reset and suspend state.

9.7.6 RLC stop, RLC Continue function

The higher layer may stop the RLC entity. The stop parameter in the CRLC-CONFIG-Req primitive indicates this request. The RLC entity shall, when receiving this request, not submit any RLC PDUs to lower layer or receive any RLC PDUs. The data transmission and reception is continued when the continue parameter in the CRLC-CONFIG-Req primitive is received. If the continue parameter is received when the RLC entity is not stopped, no action shall be taken.

When the RLC entity is stopped, the RLC timers are not affected. Triggered polls and status transmissions are delayed until the RLC entity is continued.

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 an RLC reset. The sender can be either the UE or the network and the receiver is either the network or the UE. During the reset procedure the hyper frame numbers (HFN) in UTRAN and UE are synchronised. Two HFNs used for ciphering needs to be synchronised, DL HFN in downlink and UL HFN in uplink. In the reset procedure, the highest UL HFN and DL HFN used by the RLC entity are exchanged between UE and UTRAN. After the reset procedure is terminated, the UL HFN and DL HFN shall be increased with one in both UE and UTRAN, and the updated HFN values shall be used after the reset procedure.

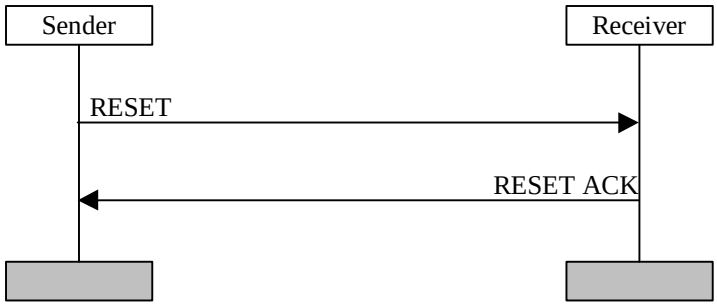


Figure 11.4: RLC reset procedure

11.4.2 Initiation

The procedure shall be initiated when a protocol error occurs.

The sender sends the RESET PDU, enters reset pending state when it ~~is~~ was in data transfer ready state, and enters ~~reset~~ reset and suspend ~~pending~~ state when it was in local suspend 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 hyper frame number indicator field (HFNI) shall be set equal to the currently used HFN (DL HFN when the RESET is sent by UTRAN or UL HFN when the RESET is sent by the UE). 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, but not when a RESET PDU is retransmitted.

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. Both the transmitter and receiver side of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

When a RESET PDU is received, the receiver shall set the HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the received RESET PDU.

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. The hyper frame number indicator field (HFNI) shall be set equal to the currently used HFN (DL HFN when the RESET ACK is sent by UTRAN or UL HFN when the RESET ACK is sent by the UE).

11.4.4 Reception of the RESET ACK PDU by the sender

When the sender is in reset pending state or reset and suspend state and receives 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 (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) shall be set equal to the HFNI field in the received RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value and resets configurable parameters to their configured value. Both the transmitter and receiver side of the AM RLC entity is reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

The sender shall enter data transfer ready state if it was in reset pending state and enter local suspend state if it was in reset and suspend state.

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET ACK PDU in data transfer ready state or local suspend state, the 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 value of the RSN field shall not be incremented.

11.4.5.2 Unrecoverable error (VT(RST) ≥ MaxRST)

If VT(RST) becomes larger or equal to MaxRST, unrecoverable error shall be indicated to higher layer.

11.4.5.3 Reception of the RESET PDU by the sender

Upon reception of a RESET PDU in acknowledged data ready state, reset pending state, local suspend state or reset and suspend state, the sender shall respond with a RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value, resets configurable parameters to their configured value. However, VT(RST) and Timer_RST are not reset. Both the transmitter and receiver side of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded. The hyper frame number, HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) is set equal to the HFNI field in the received RESET PDU. The sender shall stay in ~~the reset pending~~its current state. The sender shall enter data transfer ready state or local suspend state only upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU when it is in reset pending state or reset and suspend state respectively.

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

Tdoc R2-011347

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **124** ⌘ ev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Clarification on AM states
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-05-24
Category:	⌘	**A**
Release:	⌘	REL-4

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R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change:	⌘	1. The RLC reset procedure (subclause 11.4) is not complete and clean-up is needed. 2. The behaviours of the Reset Pending State depend on whether it is entered from Acknowledged Data Transfer Ready State or from the Local Suspend State in current specification, so that the Reset Pending State is not a “pure” and “memoryless” state.
Summary of change:	⌘	1. A fifth state, the reset and suspend state, is added in the AM states. 2. The RLC reset procedure is cleaned up.
Consequences if not approved:	⌘	Incomplete RLC reset procedure.

Clauses affected:	⌘	9.3.3.1, 9.3.3.2, 9.3.3.3, 9.3.3.4, 9.3.3.5 (new), 9.7.5, 11.4.2, 11.4.4, 11.4.5.3
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

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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 a CRLC-CONFIG-Req from higher layer indicating (re)establish, the RLC entity is created and the 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 indicating release, 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 (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU and responds to the peer entity with a RESET ACK PDU.

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

Upon reception of CRLC-SUSPEND-Req from upper layer, the RLC entity is suspended and the local suspend state is entered.

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 a CRLC-CONFIG-Req from higher layer indicating release, the RLC entity is terminated and the null state is entered.

Upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU, the RLC entity resets the protocol (see subclause 11.4.4), sets the hyper frame number HFN (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) equal to the HFNI field in the RESET ACK PDU and ~~one of the following state transitions take place~~enters the acknowledged data transfer ready state.

~~The RLC entity enters the acknowledged data transfer ready state if Reset Pending State was entered from Acknowledged Data Transfer Ready State or if Reset Pending State was entered from Local Suspend State and a CRLC-RESUME-Req was received in Reset Pending State.~~

~~The RLC entity enters into Local Suspend State if Reset Pending State was entered from Local Suspend State or if Reset Pending State was entered from Acknowledged Data Transfer Ready State and a CRLC-SUSPEND-Req was received in Reset Pending State.~~

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET PDU, the RLC entity resets the protocol (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU, sends a RESET ACK PDU and stays in the reset pending state.

Upon reception of CRLC-SUSPEND-Req from upper layer, the RLC entity is suspended and the reset and suspend state is entered.

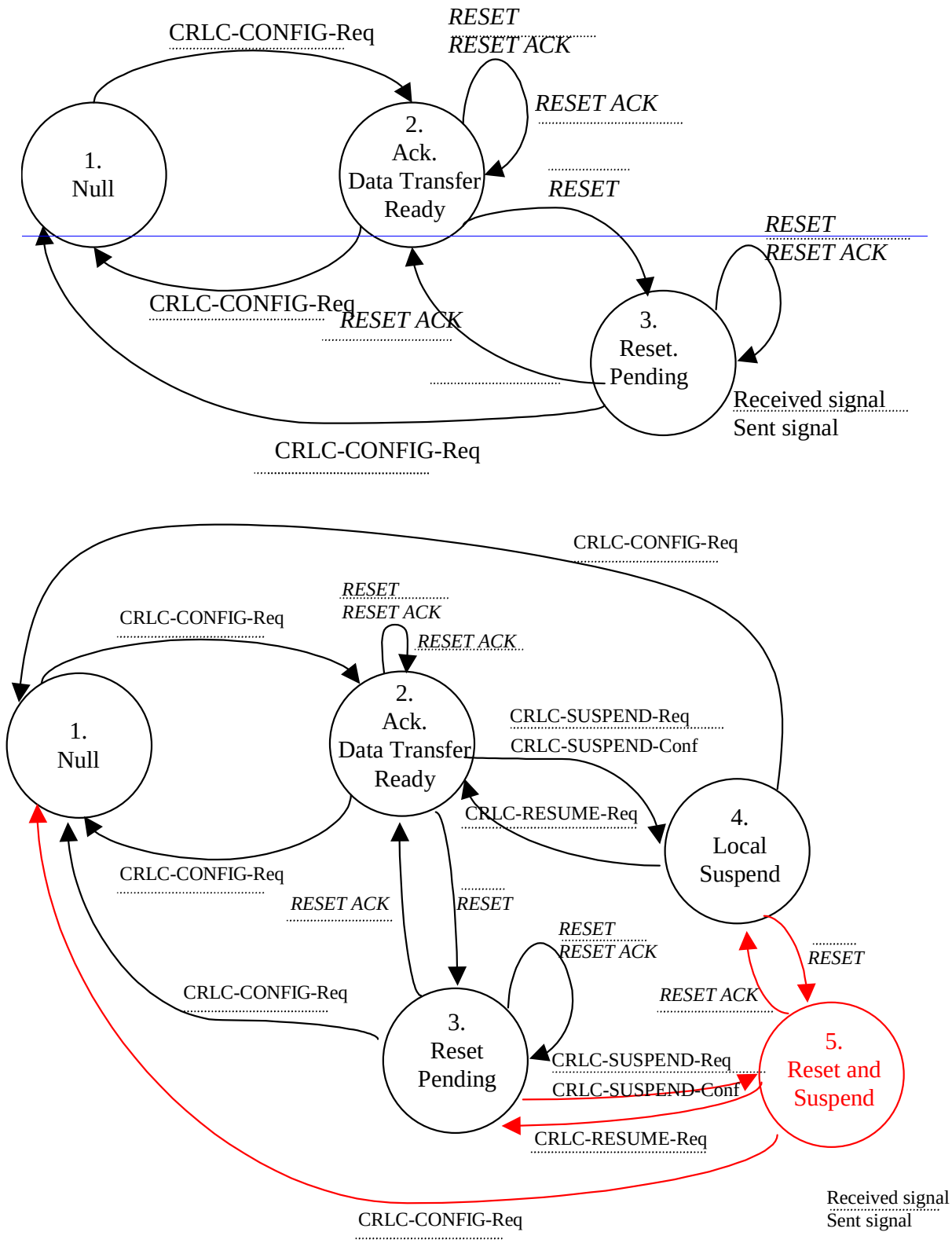


Figure 9.18: The state model for the acknowledged mode entities ~~when reset is performed~~

9.3.3.4 Local Suspend State

~~Upon reception of a CRLC-SUSPEND-Req from higher layer (RRC) in Acknowledge Data Transfer Ready State the RLC entity is suspended and the Local Suspend state is entered.~~ In the Local Suspend state RLC shall not send an RLC-PDUs with SN≥VT(S)+N, where VT(S) is the value of the send state variable when the CRLC-SUSPEND-Req with parameter N was received. Upon reception of CRLC-RESUME-Req from higher layer (RRC) in this state, the RLC

entity is resumed and the Acknowledged Data Transfer Ready state is entered. Upon reception of CRLC-CONFIG-Req from upper layer indicating release, the RLC entity is terminated and the null state is entered.

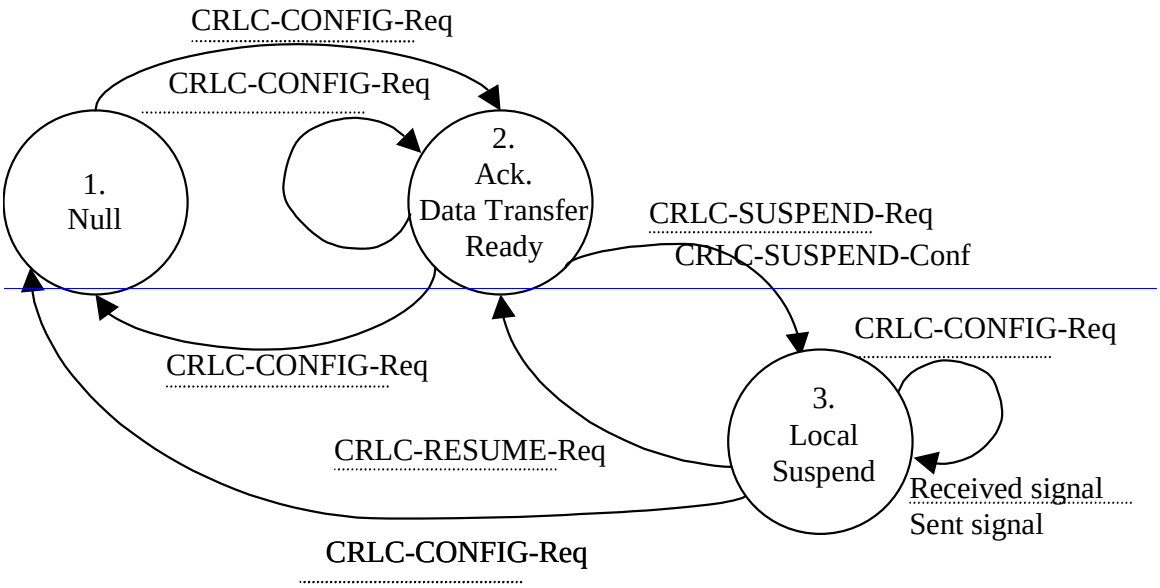
Upon errors in the protocol, the RLC entity sends a RESET PDU to its peer and enters the reset and suspend state.

9.3.3.5 Reset and Suspend ~~Pending~~ State

In the reset and suspend 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 upper layer indicating release, the RLC entity is terminated and the null state is entered.

Upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU, the RLC entity resets the protocol (see subclause 11.4.4), sets the hyper frame number HFN (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) equal to the HFNI field in the RESET ACK and enters the local suspend state.

Upon reception of CRLC-RESUME-Req from upper layer in this state, the RLC entity is resumed and the reset pending state is entered.



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

9.7.5 Local Suspend function for acknowledged and unacknowledged mode

The higher layer (RRC) may suspend the RLC entity. The CRLC-SUSPEND-Req indicates this request. The RLC entity shall, when receiving this request, not send RLC PDUs with SN≥VT(S)+N for AM and SN≥VT(US)+N for UM ,where N is given by the CRLC_SUSPEND-Req primitive. The RLC entity shall acknowledge the CRLC-SUSPEND-Req ordering a suspend with a CRLC-SUSPEND-Conf with the current value of VT(S) for AM and VT(US) for UM. ~~The suspend state is left w~~When a CRLC-RESUME-Req primitive indicating resume is received, the AM RLC entity enters the acknowledged data transfer ready state if it is in the local suspend state and enters the reset pending state if it is in the reset and suspend state.

9.7.6 RLC stop, RLC Continue function

The higher layer may stop the RLC entity. The stop parameter in the CRLC-CONFIG-Req primitive indicates this request. The RLC entity shall, when receiving this request, not submit any RLC PDUs to lower layer or receive any RLC PDUs. The data transmission and reception is continued when the continue parameter in the CRLC-CONFIG-Req primitive is received. If the continue parameter is received when the RLC entity is not stopped, no action shall be taken.

When the RLC entity is stopped, the RLC timers are not affected. Triggered polls and status transmissions are delayed until the RLC entity is continued.

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 an RLC reset. The sender can be either the UE or the network and the receiver is either the network or the UE. During the reset procedure the hyper frame numbers (HFN) in UTRAN and UE are synchronised. Two HFNs used for ciphering needs to be synchronised, DL HFN in downlink and UL HFN in uplink. In the reset procedure, the highest UL HFN and DL HFN used by the RLC entity are exchanged between UE and UTRAN. After the reset procedure is terminated, the UL HFN and DL HFN shall be increased with one in both UE and UTRAN, and the updated HFN values shall be used after the reset procedure.

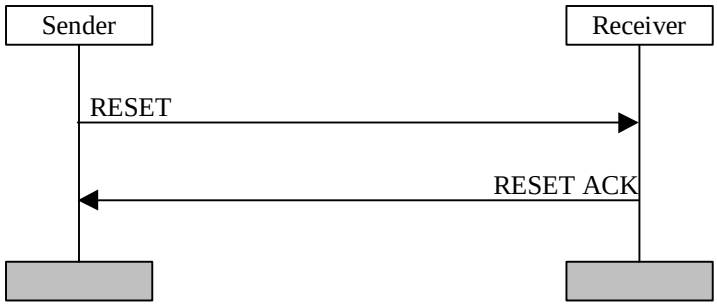


Figure 11.4: RLC reset procedure

11.4.2 Initiation

The procedure shall be initiated when a protocol error occurs.

The sender sends the RESET PDU, enters reset pending state when it ~~is~~ was in data transfer ready state, and enters ~~reset~~ reset and suspend ~~pending~~ state when it was in local suspend 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 hyper frame number indicator field (HFNI) shall be set equal to the currently used HFN (DL HFN when the RESET is sent by UTRAN or UL HFN when the RESET is sent by the UE). 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, but not when a RESET PDU is retransmitted.

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. Both the transmitter and receiver side of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

When a RESET PDU is received, the receiver shall set the HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the received RESET PDU.

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. The hyper frame number indicator field (HFNI) shall be set equal to the currently used HFN (DL HFN when the RESET ACK is sent by UTRAN or UL HFN when the RESET ACK is sent by the UE).

11.4.4 Reception of the RESET ACK PDU by the sender

When the sender is in reset pending state or reset and suspend state and receives 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 (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) shall be set equal to the HFNI field in the received RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value and resets configurable parameters to their configured value. Both the transmitter and receiver side of the AM RLC entity is reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

The sender shall enter data transfer ready state if it was in reset pending state and enter local suspend state if it was in reset and suspend state.

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET ACK PDU in data transfer ready state or local suspend state, the 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 value of the RSN field shall not be incremented.

11.4.5.2 Unrecoverable error (VT(RST) ≥ MaxRST)

If VT(RST) becomes larger or equal to MaxRST, unrecoverable error shall be indicated to higher layer.

11.4.5.3 Reception of the RESET PDU by the sender

Upon reception of a RESET PDU in acknowledged data ready state, reset pending state, local suspend state or reset and suspend state, the sender shall respond with a RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value, resets configurable parameters to their configured value. However, VT(RST) and Timer_RST are not reset. Both the transmitter and receiver side of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded. The hyper frame number, HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) is set equal to the HFNI field in the received RESET PDU. The sender shall stay in ~~the reset pending~~its current state. The sender shall enter data transfer ready state or local suspend state only upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU when it is in reset pending state or reset and suspend state respectively.

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

Tdoc R2-011314

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **125** ⌘ ev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Clarification on HFN update in RESET procedure
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-5-22
Category:	⌘	**F**
Release:	⌘	R99

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change: ⌘

1. There is no explicit 'termination conditions' for the receiver in the reset procedure so that the timing for update of HFN in the RESET procedure is not clarified.
2. There might be two different HFN values associated with different sequence numbers in one RLC entity. The value to be set in the HFNI field of RESET PDU and RESET ACK PDU need to be clarified.

Summary of change: ⌘

1. Timing for update of HFN in the RESET procedure is clarified.
2. Value to be set in the HFNI field is clarified to be the HFN associated with VT(S)-1. In the case that one peer entity has not sent out any data PDU and thus is still in the original state when the RESET PDU is received, HFN associated with SN=0 shall be used.

Backwards Compatibility Analysis:

There is no functionality change in this CR. It can be seen as backwards compatible but need to be considered in implementation.

Consequences if not approved: ⌘ Ambiguous timing for update of HFN and ambiguous HFNI value.

Clauses affected: ⌘ 11.4.1, 11.4.2.1, 11.4.3, 11.4.3.1, 11.4.4, 11.4.5.2, 11.4.5.3

Other specs affected: ⌘
☐ Other core specifications ⌘
☐ Test specifications
☐ O&M Specifications

Other comments: ⌘

How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

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 an RLC reset. The sender can be either the UE or the network and the receiver is either the network or the UE. During the reset procedure the hyper frame numbers (HFN) in UTRAN and UE are synchronised. Two HFNs used for ciphering needs to be synchronised, DL HFN in downlink and UL HFN in uplink. In the reset procedure, the highest UL HFN and DL HFN used by the RLC entity in the transmitting sides, i.e. the HFNs associated with PDUs of SN=VT(S)-1 if at least one data PDU had been transmitted or of SN=0 if no data PDU had been transmitted, are exchanged between UE and UTRAN. After the reset procedure is terminated, the UL HFN and DL HFN shall be increased with one in both UE and UTRAN, and the updated HFN values shall be used for the first transmitted and received PDUs after the reset procedure.

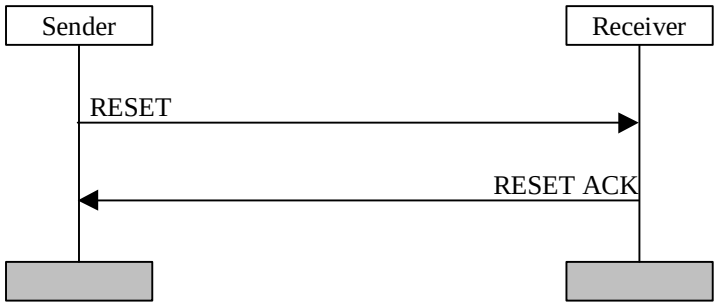


Figure 11.4: RLC reset procedure

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 hyper frame number indicator field (HFNI) shall be set equal to the currently highest used HFN (DL HFN when the RESET is sent by UTRAN or UL HFN when the RESET is sent by the UE). 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, but not when a RESET PDU is retransmitted.

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 except VT(RST) to their initial values, stops all the timers in 9.5 except Timer_RST, and resets configurable parameters to their configured values. Both the ~~transmitter~~ transmitting and ~~receiver~~ receiving sides of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

When a RESET PDU is received, the receiver shall set the HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the received RESET PDU.

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. The hyper frame number indicator field (HFNI) shall be set equal to the currently highest used HFN (DL HFN when the RESET ACK is sent by UTRAN or UL HFN when the RESET ACK is sent by the UE).

11.4.4 Reception of the RESET ACK PDU by the sender

When the sender is in reset pending state and receives 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 (DL HFN when the RESET ACK PDU is received in UE or UL HFN when the RESET ACK PDU is received in UTRAN) shall be set equal to the HFNI field in the received RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value and resets configurable parameters to their configured value. Both the ~~transmitter~~ transmitting and ~~receiver~~ receiving sides of the AM RLC entity ~~is~~ are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

The sender shall enter data transfer ready state.

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET ACK PDU in data transfer ready state the 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 value of the RSN field shall not be incremented.

11.4.5.2 Unrecoverable error (VT(RST) ≥ MaxRST)

If VT(RST) becomes larger than or equal to MaxRST, unrecoverable error shall be indicated to higher layer.

11.4.5.3 Reception of the RESET PDU by the sender

Upon reception of a RESET PDU in reset pending state, the sender shall respond with a RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value, resets configurable parameters to their configured value. However, VT(RST) and Timer_RST are not reset. Both the ~~transmitter~~ transmitting and ~~receiver~~ receiving sides of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded. The hyper frame number, HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) is set equal to the HFNI field in the received RESET PDU. The sender shall stay in the reset pending state. The sender shall 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 #21
Busan, Korea, 21-25 May 2001

Tdoc R2-011348

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **126** ⌘ ev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Clarification on HFN update in RESET procedure
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-5-24
Category:	⌘	**A**
Release:	⌘	REL-4

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

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change: ⌘

1. There is no explicit 'termination conditions' for the receiver in the reset procedure so that the timing for update of HFN in the RESET procedure is not clarified.
2. There might be two different HFN values associated with different sequence numbers in one RLC entity. The value to be set in the HFNI field of RESET PDU and RESET ACK PDU need to be clarified.

Summary of change: ⌘

1. Timing for update of HFN in the RESET procedure is clarified.
2. Value to be set in the HFNI field is clarified to be the HFN associated with VT(S)-1. In the case that one peer entity has not sent out any data PDU and thus is still in the original state when the RESET PDU is received, HFN associated with SN=0 shall be used.

Consequences if not approved: ⌘ Ambiguous timing for update of HFN and ambiguous HFNI value.

Clauses affected: ⌘ 11.4.1, 11.4.2.1, 11.4.3, 11.4.3.1, 11.4.4, 11.4.5.2, 11.4.5.3

Other specs affected: ⌘

- ☐ Other core specifications ⌘
- ☐ Test specifications
- ☐ O&M Specifications

Other comments: ⌘

How to create CRs using this form:
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Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

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 an RLC reset. The sender can be either the UE or the network and the receiver is either the network or the UE. During the reset procedure the hyper frame numbers (HFN) in UTRAN and UE are synchronised. Two HFNs used for ciphering needs to be synchronised, DL HFN in downlink and UL HFN in uplink. In the reset procedure, the highest UL HFN and DL HFN used by the RLC entity in the transmitting sides, i.e. the HFNs associated with PDUs of SN=VT(S)-1 if at least one data PDU had been transmitted or of SN=0 if no data PDU had been transmitted, are exchanged between UE and UTRAN. After the reset procedure is terminated, the UL HFN and DL HFN shall be increased with one in both UE and UTRAN, and the updated HFN values shall be used for the first transmitted and received PDUs after the reset procedure.

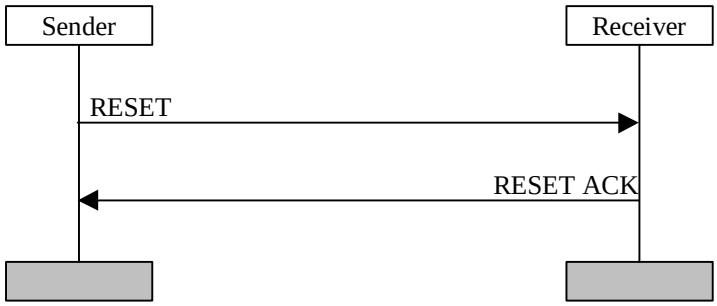

Figure 11.4: RLC reset procedure

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 hyper frame number indicator field (HFNI) shall be set equal to the currently highest used HFN (DL HFN when the RESET is sent by UTRAN or UL HFN when the RESET is sent by the UE). 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, but not when a RESET PDU is retransmitted.

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 except VT(RST) to their initial values, stops all the timers in 9.5 except Timer_RST, and resets configurable parameters to their configured values. Both the ~~transmitter~~ transmitting and ~~receiver~~ receiving sides of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

When a RESET PDU is received, the receiver shall set the HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the received RESET PDU.

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. The hyper frame number indicator field (HFNI) shall be set equal to the currently highest used HFN (DL HFN when the RESET ACK is sent by UTRAN or UL HFN when the RESET ACK is sent by the UE).

11.4.4 Reception of the RESET ACK PDU by the sender

When the sender is in reset pending state and receives 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 (DL HFN when the RESET ACK PDU is received in UE or UL HFN when the RESET ACK PDU is received in UTRAN) shall be set equal to the HFNI field in the received RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value and resets configurable parameters to their configured value. Both the ~~transmitter~~ transmitting and ~~receiver~~ receiving sides of the AM RLC entity ~~is~~ are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded.

The sender shall enter data transfer ready state.

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET ACK PDU in data transfer ready state the 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 value of the RSN field shall not be incremented.

11.4.5.2 Unrecoverable error (VT(RST) ≥ MaxRST)

If VT(RST) becomes larger than or equal to MaxRST, unrecoverable error shall be indicated to higher layer.

11.4.5.3 Reception of the RESET PDU by the sender

Upon reception of a RESET PDU in reset pending state, the sender shall respond with a RESET ACK PDU. The sender resets the state variables in 9.4 to their initial value, resets configurable parameters to their configured value. However, VT(RST) and Timer_RST are not reset. Both the ~~transmitter~~ transmitting and ~~receiver~~ receiving sides of the AM RLC entity are reset. All RLC PDUs in the AM RLC receiver shall be discarded. The RLC SDUs in the AM RLC transmitter that were transmitted before the reset shall be discarded. The hyper frame number, HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) is set equal to the HFNI field in the received RESET PDU. The sender shall stay in the reset pending state. The sender shall 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 #21
Pusan, Korea, 21-25 May 2001

Tdoc R2-011315

CR-Form-v3

CHANGE REQUEST

⌘ **25.322** **CR** **127** ⌘ rev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Clarification of RLC discard
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-05-15
Category:	⌘	**F**
Release:	⌘	R99

Use one of the following categories:
- ***F*** *(essential correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(Addition of feature),*
- ***C*** *(Functional modification of feature)*
- ***D*** *(Editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change: ⌘ It is currently undefined what happens if SDU discard is not configured for UM and TM RLC entities. The configuration for handling of erroneous SDUs in Tr mode is not reflected in RLC.

Summary of change:	⌘	1. The behaviour when SDU discard is not configured is clarified. For UM: RLC PDUs are not discarded, but kept in the transmitter buffer until the transmission buffer is full. For TM: RLC PDUs are discarded upon reception of a new TM PDU from higher layers. This is to avoid that PDUs are buffered without time limit, which would cause an increasing delay for speech PDUs. 2. It is clarified how an RLC receiver in Tr mode shall handle erroneous SDUs depending on the configuration by higher layer. Configuration of "deliver of erroneous SDUs" (see 24.008 and 23.107): "yes": Erroneous SDUs are delivered to higher layers with an error indication "no": Erroneous SDUs are not delivered to higher layers "no detect": No error detection is performed (all SDUs are delivered to higher layer). Note that the error detection itself is performed by the physical layer. However, depending on the RLC configuration, the behaviour will be different. If segmentation is performed in RLC, a SDU is erroneous if one or more of the TBs in a TTI contains an error. If segmentation is not performed, an SDU is erroneous if the corresponding TB is erroneous. **Backwards compatibility:** The clarification describes the preffered RLC behaviour. However, also for other implementations, the protocol will work but with reduced performance. The clarification is therefore considered to be backwards compatible.
Consequences if not approved:	⌘	Unclear and inconsistent behaviour. Configuration made in 24.008 is not reflected in L2.

Clauses affected:	⌘	8.2, 9.7.3.5 (new), 11.1.3, 11.1.4.1			
Other specs affected:	⌘	X	Other core specifications	⌘	25.321, 25.331
			Test specifications		
			O&M Specifications		
Other comments:	⌘				

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at:
http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause 11.8. 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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains e.g. s~~S~~egmentation indication (see subclauses 9.2.2.9 and 11.1.2.1)~~, and~~ Timer_Discard value (see subclause 9.5) and delivery of erroneous SDU indication (see subclause 11.1.3).

9.7.3 SDU discard function for acknowledged, unacknowledged, and transparent mode

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. There will be several alternative operation modes of the RLC SDU discard function. The network (RRC) controls, which discard function shall be used for each RLC entity.

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

Table 9.2: List of criteria 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
No_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 an SDU in acknowledged mode RLC, this SDU is discarded in the transmitter. Following which, if one or more segments of the SDU have been submitted to a lower layer, 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. If Send MRW is configured, an expired SDU whose segments were not submitted to a lower layer is also informed to the receiver by a MRW command.

NOTE: 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 piggybacked 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. For UM RLC, how to update the sequence number is specified in subclause 11.2.4.3.

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.

9.7.3.4 No_discard after MaxDAT number of retransmissions

This alternative uses the number of retransmissions, and is therefore only applicable for acknowledged mode RLC. Reset procedure shall be initiated after MaxDAT number of retransmissions of an AMD PDU (see subclause 11.3.4.4).

9.7.3.5~~x~~ SDU discard not configured

If SDU discard has not been configured for an unacknowledged mode RLC entity, ~~UMD~~ SDUs in the transmitter shall not be discarded unless the transmission buffer is full. If the transmission buffer is full, ~~UMD~~ SDUs may be discarded using SDU discard without explicit signalling. If no segments of the SDU has been transmitted, the SDU may be removed from the buffer without using any of the SDU discard procedures.

If SDU discard has not been configured for a transparent mode RLC entity, ~~TrD~~ SDUs in the transmitter shall be transmitted in the first possible TTI and other not yet transmitted ~~TrD~~ SDUs received from upper layer in previous TTIs shall be discarded upon reception of a new ~~TrD~~ SDU from ~~higher~~upper layer.

For an acknowledged mode RLC entity, an SDU discard mode is always configured.

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.

If delivery of erroneous SDUs is configured as 'yes' by an ~~higher~~upper layer, the receiver shall deliver an erroneous SDU to ~~higher~~upper layer with an error indication. If delivery of erroneous SDUs is configured as 'no' by a ~~higher~~upper layer the receiver shall discard the erroneous SDU. If delivery of erroneous SDUs is configured as 'No detect' by a ~~higher~~upper layer, all SDUs shall be delivered to ~~higher~~upper layer without error indication.

If segmentation is performed in transparent mode RLC, a SDU is erroneous if one or more of the TrD PDUs received in a TTI contains an error. If segmentation is not performed, an SDU is erroneous if the corresponding TrD PDU is erroneous.

11.1.4 Abnormal cases

11.1.4.1 ~~Undefined SDU size at receiver~~Void

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

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

Tdoc R2-011349

CR-Form-v3

CHANGE REQUEST

⌘ **25.322** **CR** **128** ⌘ rev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Clarification of RLC discard
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	2001-05-25
Category:	⌘	**A**
Release:	⌘	REL-4

Use one of the following categories:
- ***F*** *(essential correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(Addition of feature),*
- ***C*** *(Functional modification of feature)*
- ***D*** *(Editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
REL-4	*(Release 4)*
REL-5	*(Release 5)*

Reason for change: ⌘ It is currently undefined what happens if SDU discard is not configured for UM and TM RLC entities. The configuration for handling of erroneous SDUs in Tr mode is not reflected in RLC.

Summary of change:	⌘	1. The behaviour when SDU discard is not configured is clarified. For UM: RLC PDUs are not discarded, but kept in the transmitter buffer until the transmission buffer is full. For TM: RLC PDUs are discarded upon reception of a new TM PDU from higher layers. This is to avoid that PDUs are buffered without time limit, which would cause an increasing delay for speech PDUs. 2. It is clarified how an RLC receiver in Tr mode shall handle erroneous SDUs depending on the configuration by higher layer. Configuration of "deliver of erroneous SDUs" (see 24.008 and 23.107): "yes": Erroneous SDUs are delivered to higher layers with an error indication "no": Erroneous SDUs are not delivered to higher layers "no detect": No error detection is performed (all SDUs are delivered to higher layer). Note that the error detection itself is performed by the physical layer. However, depending on the RLC configuration, the behaviour will be different. If segmentation is performed in RLC, a SDU is erroneous if one or more of the TBs in a TTI contains an error. If segmentation is not performed, an SDU is erroneous if the corresponding TB is erroneous.
Consequences if not approved:	⌘	Unclear and inconsistent behaviour. Configuration made in 24.008 is not reflected in L2.

Clauses affected:	⌘	8.2, 9.7.3.5 (new), 11.1.3, 11.1.4.1			
Other specs affected:	⌘	X	Other core specifications	⌘	25.321, 25.331
			Test specifications		
			O&M Specifications		
Other comments:	⌘				

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at:
http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause 11.8. 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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains e.g. s~~S~~egmentation indication (see subclauses 9.2.2.9 and 11.1.2.1)~~, and~~ Timer_Discard value (see subclause 9.5) and delivery of erroneous SDU indication (see subclause 11.1.3).

9.7.3 SDU discard function for acknowledged, unacknowledged, and transparent mode

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. There will be several alternative operation modes of the RLC SDU discard function. The network (RRC) controls, which discard function shall be used for each RLC entity.

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

Table 9.2: List of criteria 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
No_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 an SDU in acknowledged mode RLC, this SDU is discarded in the transmitter. Following which, if one or more segments of the SDU have been submitted to a lower layer, 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. If Send MRW is configured, an expired SDU whose segments were not submitted to a lower layer is also informed to the receiver by a MRW command.

NOTE: 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 piggybacked 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. For UM RLC, how to update the sequence number is specified in subclause 11.2.4.3.

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.

9.7.3.4 No_discard after MaxDAT number of retransmissions

This alternative uses the number of retransmissions, and is therefore only applicable for acknowledged mode RLC. Reset procedure shall be initiated after MaxDAT number of retransmissions of an AMD PDU (see subclause 11.3.4.4).

9.7.3.x SDU discard not configured

If SDU discard has not been configured for an unacknowledged mode RLC entity, ~~UMD~~ SDUs in the transmitter shall not be discarded unless the transmission buffer is full. If the transmission buffer is full, ~~UMD~~ SDUs may be discarded using SDU discard without explicit signalling. If no segments of the SDU has been transmitted, the SDU may be removed from the buffer without using any of the SDU discard procedures.

If SDU discard has not been configured for a transparent mode RLC entity, ~~TrD~~ SDUs in the transmitter shall be transmitted in the first possible TTI and other not yet transmitted ~~TrD~~ SDUs received from upper layer in previous TTIs shall be discarded upon reception of a new ~~TrD~~ SDU from ~~higher~~upper layer.

For an acknowledged mode RLC entity, an SDU discard mode is always configured.

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.

If delivery of erroneous SDUs is configured as 'yes' by an ~~higher~~upper layer, the receiver shall deliver an erroneous SDU to ~~higher~~upper layer with an error indication. If delivery of erroneous SDUs is configured as 'no' by a ~~higher~~upper layer the receiver shall discard the erroneous SDU. If delivery of erroneous SDUs is configured as 'No detect' by a ~~higher~~upper layer, all SDUs shall be delivered to ~~higher~~upper layer without error indication.

If segmentation is performed in transparent mode RLC, a SDU is erroneous if one or more of the TrD PDUs received in a TTI contains an error. If segmentation is not performed, an SDU is erroneous if the corresponding TrD PDU is erroneous.

11.1.4 Abnormal cases

11.1.4.1 ~~Undefined SDU size at receiver~~Void

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

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

Tdoc R2-011118

CR-Form-v4

CHANGE REQUEST

⌘ **25.322 CR 129** ⌘ ev **-** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Removal of reference to RRC
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	14th May 01
Category:	⌘	**F**
Release:	⌘	R99

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change:	⌘	During RAN WG2 #19, it was decided that the term 'upper layers' should be used for data sources in c-plane and u-plane and also for the controlling layer (RRC).
Summary of change:	⌘	Reference to higher layers and RRC have been replaced by reference to upper layers. The difference with Tdoc R2-010869, presented during RAN WG2#20, is that the case in section 9.7.1 where "higher" priority had mistakenly been replaced by "upper priority" has been corrected. Backwards Compatibility: This CR is a vocabulary alignment and is backwards compatible.
Consequences if not approved:	⌘	Vocabulary misalignment between 25.331 and 25.321.

Clauses affected:	⌘	4.2.1.1, 4.2.1.2, 4.2.1.3, 5, 6, 8.1, 8.2, 9.2.2.11.3, 9.3.1.1, 9.3.1.2, 9.3.2.1, 9.3.2.2, 9.3.2.3, 9.3.3.1, 9.3.3.2, 9.3.3.3, 9.3.3.4, 9.5, 9.6, 9.7.1, 9.7.2, 9.7.3, 9.7.3.1, 9.7.5, 9.7.6, 11.1.2, 11.1.3, 11.2.2, 11.2.3, 11.3.2, 11.4.5.2, 11.6.3, 11.6.4, 11.6.6.2, 11.8.
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm.
Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

4.2.1.1 Transparent mode entities

Figure 4.2 below shows the model of two transparent mode peer entities.

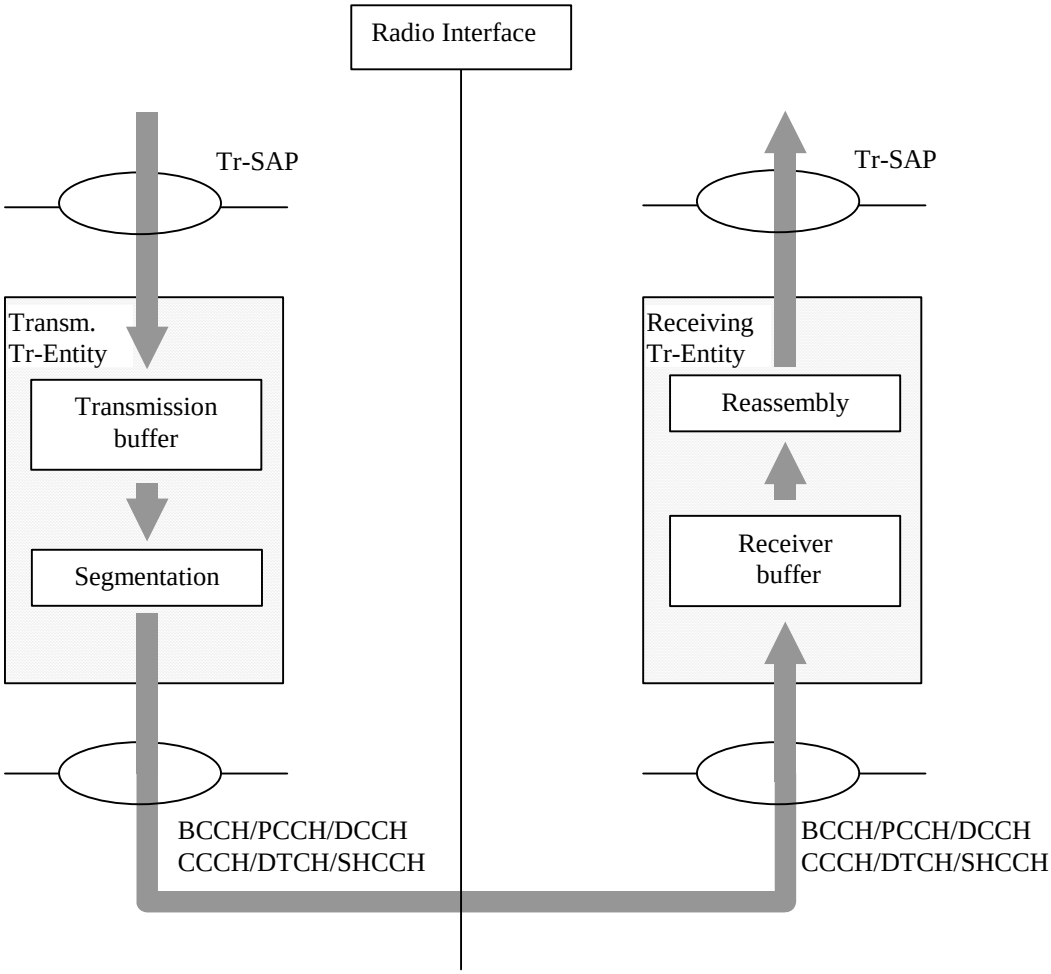

Figure 4.2: Model of two transparent mode peer entities

The transmitting Tr-entity receives SDUs from the upper ~~higher~~ layers through the Tr-SAP. RLC might segment the SDUs into appropriate RLC PDUs without adding any overhead. How to perform the segmentation is decided upon when the service is established. RLC delivers the RLC PDUs to lower layer through either a BCCH, DCCH, PCCH, CCCH, SHCCH or a DTCH. The CCCH and SHCCH uses transparent mode only for the uplink. Which type of logical channel depends on if the ~~higher~~ upper layer is located in the control plane (BCCH, DCCH, PCCH, CCCH, SHCCH) or user plane (DTCH).

The receiving Tr-entity receives PDUs through one of the logical channels from lower layer. RLC reassembles (if segmentation has been performed) the PDUs into RLC SDUs. How to perform the reassembling is decided upon when the service is established. RLC delivers the RLC SDUs to the ~~higher~~upper layer through the Tr-SAP.

4.2.1.2 Unacknowledged mode entities

Figure 4.3 below shows the model of two unacknowledged mode peer entities.

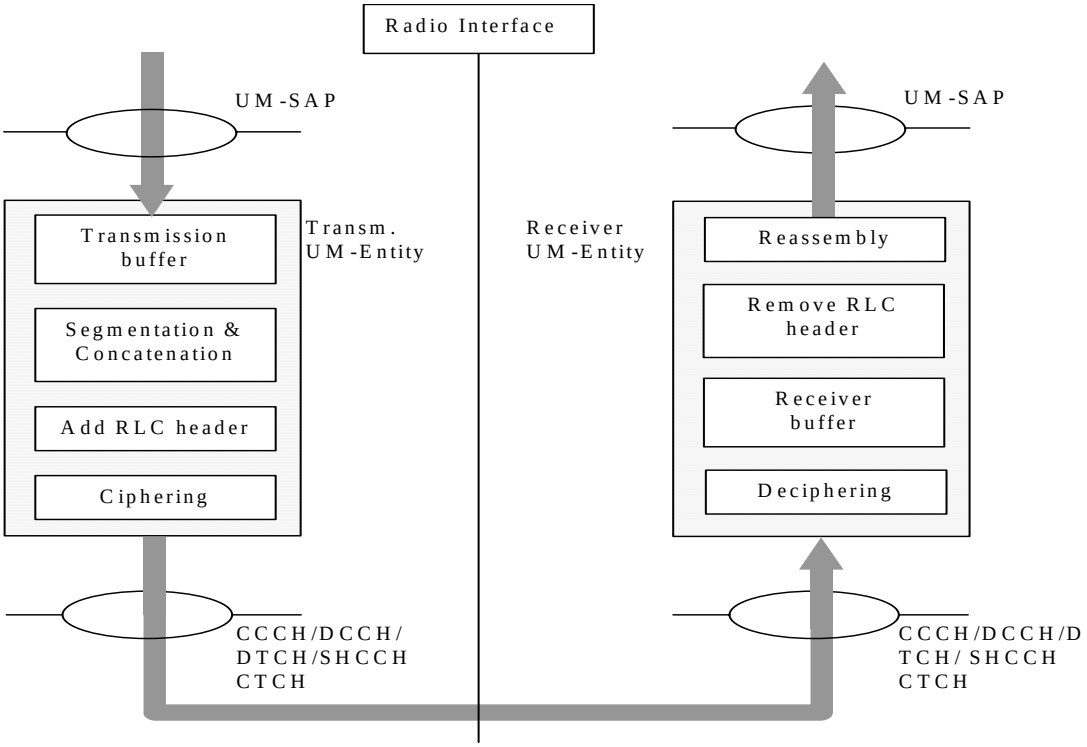

Figure 4.3: Model of two unacknowledged mode peer entities

The transmitting UM-entity receives SDUs from the ~~higher~~upper layers. RLC might segment the SDUs into RLC PDUs of appropriate size. The SDU might also be concatenated with other SDUs. RLC delivers the RLC PDUs to lower layer through either a CCCH, SHCCH, DCCH, CTCH or a DTCH. The CCCH and SHCCH uses unacknowledged mode only for the downlink. Which type of logical channel depends on if the ~~higher~~upper layer is located in the control plane (CCCH, DCCH, SHCCH) or user plane (CTCH, DTCH).

The receiving UM-entity receives PDUs through one of the logical channels from the MAC sublayer. RLC removes header from the PDUs and reassembles the PDUs (if segmentation has been performed) into RLC SDUs. The RLC SDUs are delivered to the ~~higher~~upper layer.

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 first logical channel shall be used for data PDUs and the second logical channel shall be used for control PDUs. In case one logical channel is used, the RLC PDU size shall be the same for AMD PDUs and control PDUs.

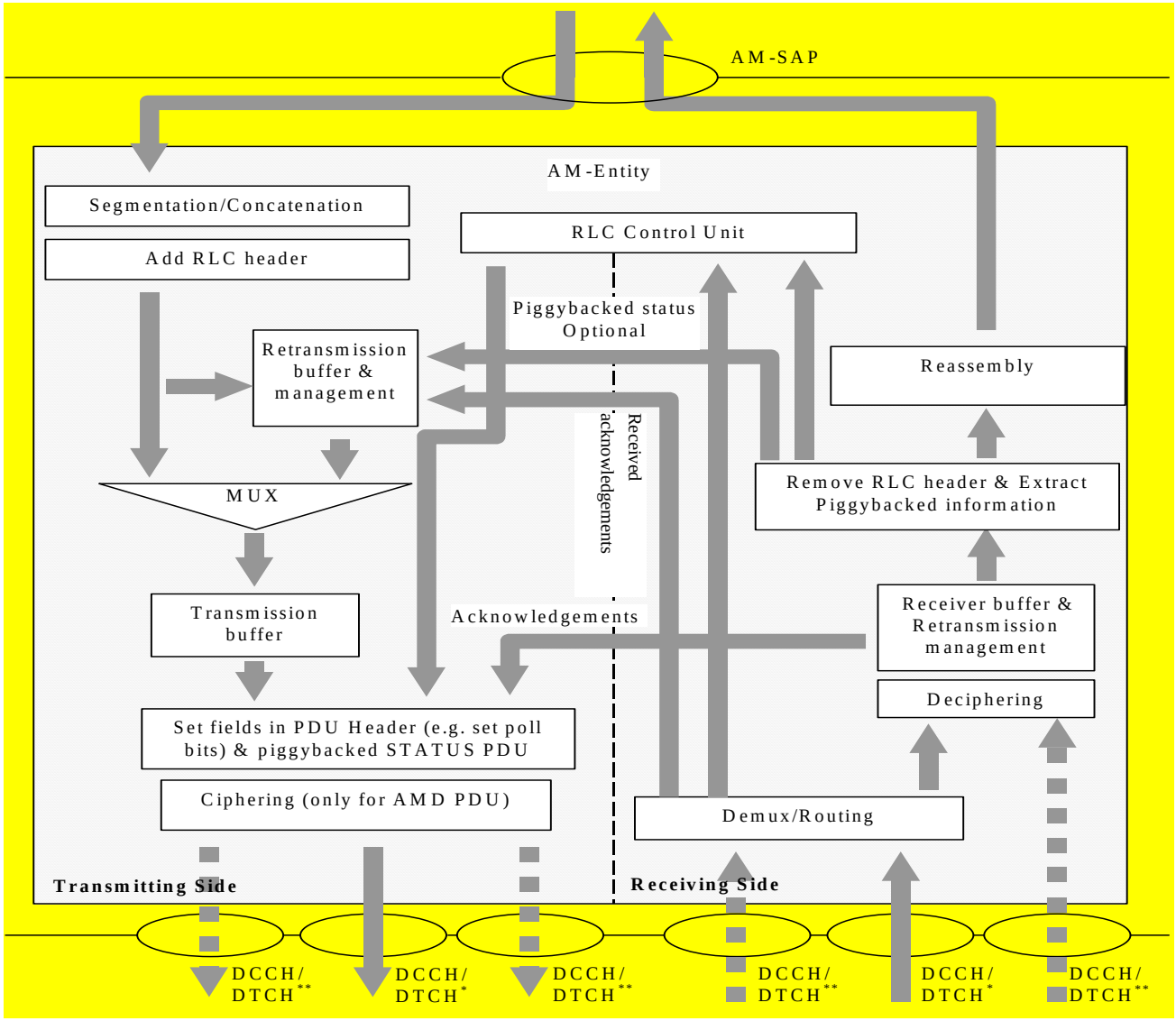

Figure 4.4: Model of an acknowledged mode entity

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

For concatenation or padding purposes, bits of information on the length and extension are inserted into the beginning of the last PDU 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 PDU, they are concatenated and the appropriate length indicators are inserted into the beginning of the PDU. After that the PDUs are placed in the retransmission buffer and the transmission buffer.

The MUX then decides which PDUs and when the PDUs are submitted to the lower layer. The PDUs are submitted via a function that completes the AMD PDU header and potentially replaces padding with piggybacked status information. The RLC entity shall assume a PDU to be transmitted when the PDU is submitted to lower layer.

The ciphering is applied only for AMD PDUs. The fixed 2 octets AMD PDU header is not ciphered. Piggybacked STATUS PDU and Padding parts of AMD PDU when existing are ciphered. The other Control PDUs (i.e. STATUS PDU, RESET PDU, and RESET ACK PDU) shall not be 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 retransmission buffer also receives acknowledgements from the receiving side, which are used to indicate retransmissions of PDUs and when to delete a PDU from the retransmission buffer.

The receiving side of the AM-entity receives PDUs through one of the logical channels from lower layer. Piggybacked status information is extracted, if present. The PDUs are placed in the receiver buffer until a complete SDU has been received. The receiver buffer requests retransmissions of PDUs by sending negative acknowledgements to the peer entity. After that the RLC headers are removed from the PDUs and the PDUs are reassembled into an SDU. Finally the SDU is delivered to the ~~higher~~upper layer. The receiving side also receives acknowledgements from the peer entity. The acknowledgements are passed to the retransmission buffer on the transmitting side.

5 Functions

The following functions are supported by RLC. For a detailed description of the following functions see [3]:

- Segmentation and reassembly.
- Concatenation.
- Padding.
- Transfer of user data.
- Error correction.
- In-sequence delivery of ~~higher~~upper layer PDUs.
- Duplicate detection.
- Flow control.
- Sequence number check.
- Protocol error detection and recovery.
- Ciphering.
- Suspend/resume function.

6 Services provided to upper layers

This clause describes the different services provided by RLC to upper ~~higher~~ layers. It also includes mapping of functions to different services. For a detailed description of the following functions see [3].

- **Transparent data transfer Service:**

  The following functions are needed to support transparent data transfer:

  - Segmentation and reassembly.
  - Transfer of user data.

- **Unacknowledged data transfer Service:**

  The following functions are needed to support unacknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.

- Transfer of user data.
- Ciphering.
- Sequence number check.

- **Acknowledged data transfer Service:**

  The following functions are needed to support acknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.
  - Transfer of user data.
  - Error correction.
  - In-sequence delivery of ~~higher layer~~upper layer PDUs.
  - Duplicate detection.
  - Flow Control.
  - Protocol error detection and recovery.
  - Ciphering.

- **QoS setting.**
- **Notification of unrecoverable errors.**

8.1 Primitives between RLC and upper~~higher~~ layers

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

Table 8.1: Primitives between RLC and ~~upper~~upper layers

Generic Name	Parameter			
	Req.	**Ind.**	**Resp.**	**Conf.**
RLC-AM-DATA	Data, CNF, MUI	Data, DiscardInfo	Not Defined	MUI
RLC-UM-DATA	Data, Use special LI	Data	Not Defined	Not Defined
RLC-TR-DATA	Data	Data	Not Defined	Not Defined
CRLC-CONFIG	E/R, Stop, Continue, Ciphering Elements (UM/AM only), TM_parameters (TM only), UM_parameters (UM 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 upper~~higher~~ layers to request transmission of a ~~higher layer~~upper layer PDU in acknowledged mode.

- RLC-AM-DATA-Ind is used by RLC to deliver to upper~~higher~~ layers RLC SDUs that have been transmitted in acknowledged mode and to indicate upper~~higher~~ layers of the discarded RLC SDU in the peer RLC AM entity.

- RLC-AM-DATA-Conf is used by RLC to confirm to upper~~higher~~ layers reception of an RLC SDU by the peer-RLC AM entity~~.~~.

RLC-UM-DATA-Req/Ind

- RLC-UM-DATA-Req is used by upper~~higher~~ layers to request transmission of a upper~~higher~~ layer PDU in unacknowledged mode.

- RLC-UM-DATA-Ind is used by RLC to deliver to upper~~higher~~ layers RLC SDUs that have been transmitted in unacknowledged mode.

RLC-TR-DATA-Req/Ind

- RLC-TR-DATA-Req is used by upper~~higher~~ layers to request transmission of a upper~~higher~~ layer PDU in transparent mode.

- RLC-TR-DATA-Ind is used by RLC to deliver to upper~~higher~~ layers RLC SDUs that have been transmitted in transparent mode.

CRLC-CONFIG-Req

This primitive is used by ~~RRC~~upper layers to establish, re-establish, release, stop, continue or reconfigure the RLC. Ciphering elements are included for UM and AM operation.

CRLC-SUSPEND-Req/Conf

This primitive is used by ~~RRC~~upper layers to suspend the RLC. The N parameter indicates that RLC shall not send a PDU with SN>=VT(S)+N for AM and SN>=VT(US)+N for UM, where N is an integer. RLC informs ~~RRC~~upper layers~~-~~ of the VT(S) for AM and VT(US) for UM in the confirm primitive.

CRLC-RESUME-Req

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

CRLC-STATUS-Ind

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

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause 11.8. 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 upper layers~~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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

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 minimum and the maximum allowed value is given by upper layers~~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 value of VT(WS) to be used by the transmitter. The range of the WSN is [0, 2^{12}-1]. The minimum value of VT(WS) is 1, if WSN is zero the SUFI shall be discarded by this version of the protocol. The variable VT(WS) is set equal to WSN upon reception of this SUFI. If WSN is greater than Configured_Tx_Window_Size, VT(WS) shall be set equal to Configured_Tx_Window_Size.

9.3.1.1 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 a CRLC-CONFIG-Req from ~~higher~~upper layer the RLC entity is created and transparent data transfer ready state is entered.

9.3.1.2 Transparent Data Transfer Ready State

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

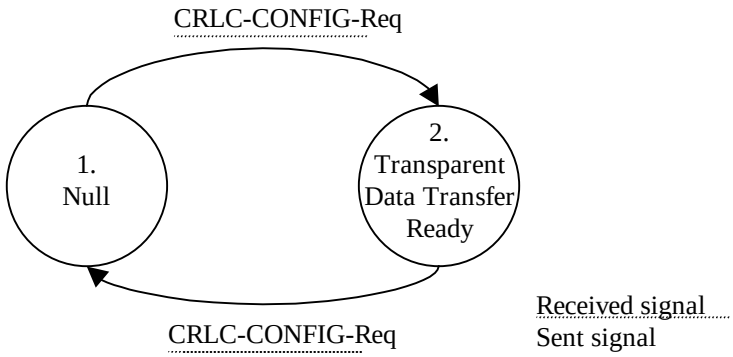

Figure 9.16: The state model for transparent mode entities

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 a CRLC-CONFIG-Req from ~~higher~~upper 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 a CRLC-CONFIG-Req from ~~higher~~upper layer the RLC entity is terminated and the null state is entered.

9.3.2.3 Local Suspend State

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

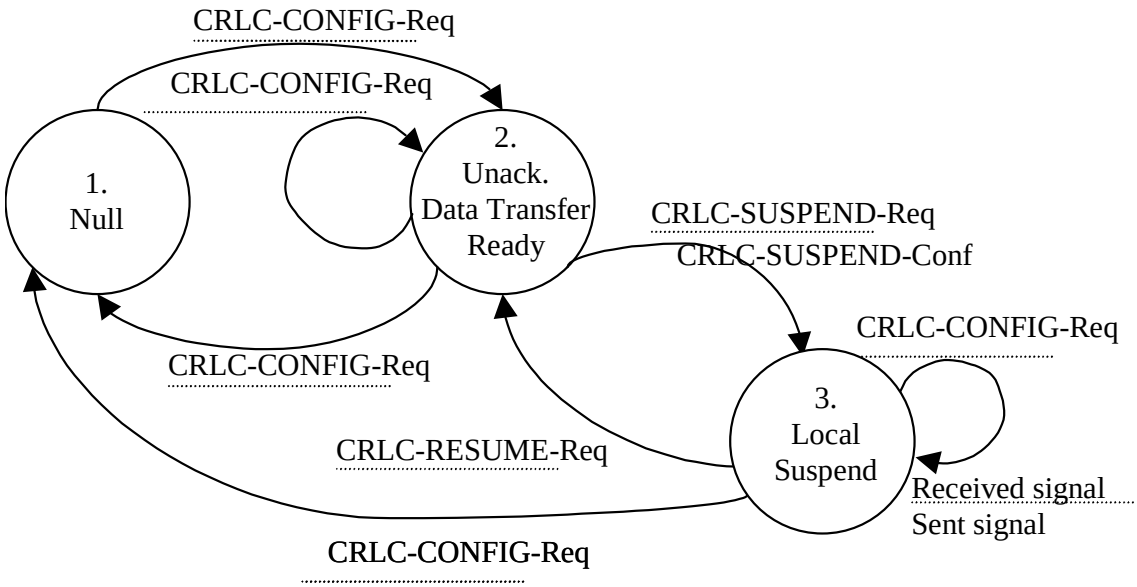

Figure 9.17: The state model for unacknowledged mode entities

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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 a CRLC-CONFIG-Req from ~~higher~~upper 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~~upper 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 (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU 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 a CRLC-CONFIG-Req from ~~higher~~upper layer the RLC entity is terminated and the null state is entered.

Upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU, the RLC entity resets the protocol (see subclause 11.4.4), sets the hyper frame number HFN (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) equal to the HFNI field in the RESET ACK PDU and one of the following state transitions take place.

The RLC entity enters the acknowledged data transfer ready state if Reset Pending State was entered from Acknowledged Data Transfer Ready State or if Reset Pending State was entered from Local Suspend State and a CRLC-RESUME–Req was received in Reset Pending State.

The RLC entity enters into Local Suspend State if Reset Pending State was entered from Local Suspend State or if Reset Pending State was entered from Acknowledged Data Transfer Ready State and a CRLC-SUSPEND-Req was received in Reset Pending State.

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET PDU, the RLC entity resets the protocol (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU, sends a RESET ACK PDU and stays in the reset pending state.

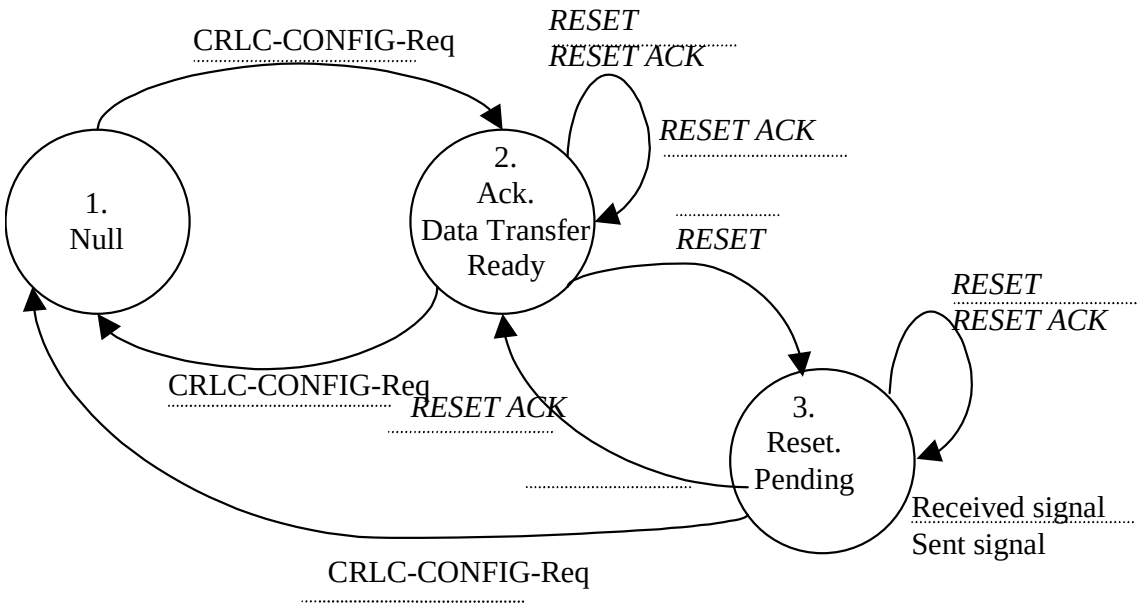

Figure 9.18: The state model for the acknowledged mode entities when reset is performed

9.3.3.4 Local Suspend State

Upon reception of a CRLC-SUSPEND-Req from ~~higher~~ upper layers ~~(RRC)~~ in Acknowledge Data Transfer Ready State the RLC entity is suspended and the Local Suspend state is entered. In the Local Suspend state RLC shall not send an RLC-PDUs with SN≥VT(S)+N. Upon reception of CRLC-RESUME-Req from upper layers ~~higher layer (RRC)~~ in this state, the RLC entity is resumed and the Data Transfer Ready state is entered.

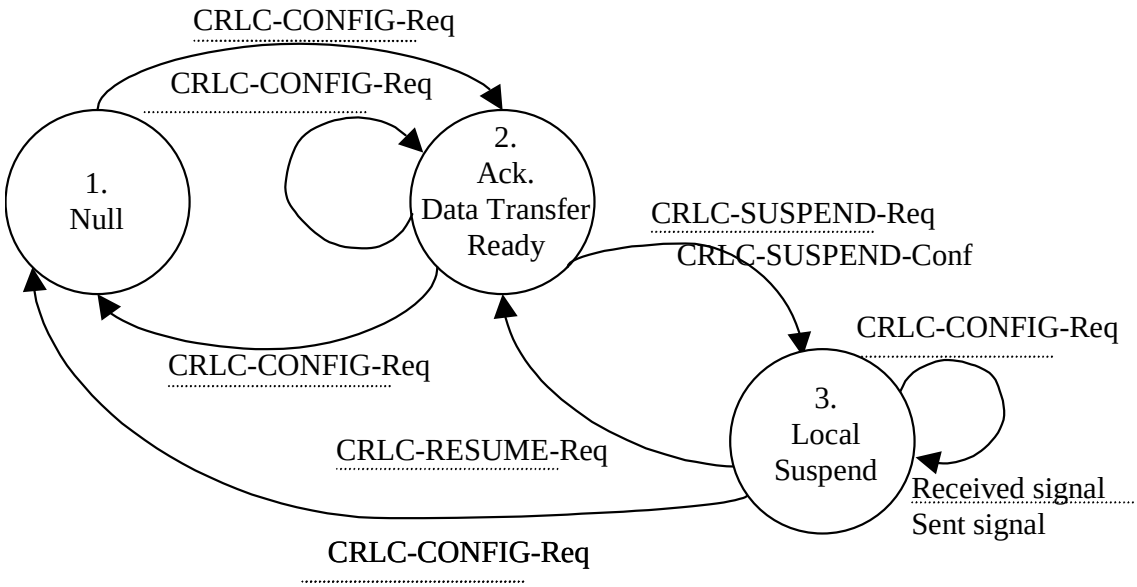

Figure 9.19: The state model for the acknowledged mode entities when local suspend is performed

9.5 Timers

a) Timer_Poll.

This timer is only used when the poll timer trigger is used. It is started when the successful or unsuccessful transmission of a PDU containing a poll is indicated by lower layer (in UE) or a PDU containing a poll is submitted to lower layer (in UTRAN). The timer is stopped when receiving a STATUS PDU that contains an acknowledgement of all AMD PDUs with SN up to and including VT(S)-1 at the time the poll was submitted to lower layer, or when a negative acknowledgement of the same PDU is received. The value of the timer is signalled by upper layers~~RRC~~.

If the timer expires and no STATUS PDU fulfilling the criteria above 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 at the time specified above, with a new value of VT(S)-1.

If a new poll is sent when the timer is running the timer is restarted at the time specified above, with a new value of VT(S)-1.

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. The timer shall be started when the successful or unsuccessful transmission of a PDU containing a poll is indicated by lower layer (in UE) or a PDU containing a poll is submitted to lower layer (in UTRAN). The prohibit time is calculated from the time a PDU containing a poll is submitted to lower layer until the timer has expired. A poll shall be delayed until the prohibit time expires if a poll is triggered during the prohibit time. Only one poll shall be transmitted when the prohibit time expires even if several polls were triggered during the prohibit time. This timer will not be stopped by a received STATUS PDU. The value of the timer is signalled by upper layers~~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 PDU should be received after a status report has been sent. The timer is started when the successful or unsuccessful transmission of the first STATUS PDU of a status report is indicated by lower layer (in UE) or the first STATUS PDU of a status report is submitted to lower layer (in UTRAN) and when it expires VR(EP) can start its counting-down process (see subclause 9.7.4). The value of the timer is signalled by upper layers~~RRC~~.

d) Timer_Discard.

This timer is used for the SDU discard function. In the transmitter, the timer is activated upon reception of an SDU from ~~higher~~upper layer. One timer is used for each SDU that is received from ~~higher~~upper layer. For UM/Tr, if the timer expires before the SDU is submitted to a lower layer, "SDU discard without explicit signalling" specified in subclauses 11.2.4.3/11.1.4.2 shall be started. For AM, if the timer expires before the SDU is acknowledged, "SDU discard with explicit signalling" specified in subclause 11.6 shall be started.

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, the timer is restarted and a poll is triggered (either by the transmission of a PDU which was not yet sent, or by a retransmission). If there is no PDU to be transmitted and all PDUs have already been acknowledged, a poll shall not be triggered and the timer shall only be restarted. The value of the timer is signalled by upper layers~~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 successful or unsuccessful transmission of the last STATUS PDU in a status report is indicated by lower layer (in UE) or the last STATUS PDU in a status report is submitted to lower layer (in UTRAN). The prohibit time is calculated from the time the last STATUS PDU of a status report is submitted to lower layer until the timer has expired and no new status report containing the mentioned SUFIs can be transmitted during the prohibit time. The timer does not prohibit transmission of the SUFIs MRW, MRW_ACK, WINDOW or NO_MORE. The value of the timer is signalled by upper layers~~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 the transmission of a status report is triggered and the timer is restarted. The value of the timer is signalled by upper layers~~RRC~~. This timer can be blocked by upper layers~~RRC~~. In this case, the timer shall not be active. The timer shall be reset and restarted when it is unblocked by upper layers~~RRC~~.

h) Timer_RST.

This timer is used to detect the loss of RESET ACK PDU from the peer RLC entity. This timer is started when the successful or unsuccessful transmission of a RESET PDU is indicated by lower layer (in UE) or a RESET PDU is submitted to lower layer (in UTRAN). It will only be stopped upon reception of RESET ACK PDU, i.e. this timer is not stopped when an RLC reset occurs which was initiated from the peer RLC entity. If it expires, RESET PDU will be retransmitted. The value of the timer is signalled by upper layers~~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 successful or unsuccessful transmission of a STATUS PDU containing the MRW SUFI is indicated by lower layer (in UE) or a STATUS PDU containing the MRW SUFI is submitted to lower layer (in UTRAN). Each time the timer expires the MRW SUFI is retransmitted and the timer is restarted (at the time specified above). It shall be stopped when one of the termination criteria for the SDU discard is fulfilled. The value of the timer is signalled by upper layers~~RRC~~.

9.6 Protocol Parameters

The values of the protocol parameters in this subclause are signalled by upper layers~~RRC~~.

a) MaxDAT.

It is the maximum value for the number of retransmissions of a PDU. This parameter is an upper limit of counter VT(DAT). When the value of VT(DAT) comes to MaxDAT, either RLC RESET procedure or SDU discard procedure shall be initiated according to configuration by ~~higher~~upper layer.

b) Poll_PDU.

This parameter indicates how often the transmitter should poll the receiver in case of polling every Poll_PDU PDU. This is an upper limit for the VT(PDU) state variable, when VT(PDU) reaches Poll_PDU a poll is transmitted to the peer entity.

c) Poll_SDU.

This parameter indicates how often the transmitter should poll the receiver in case of polling every Poll_SDU SDU. This is an upper limit for the VT(SDU) state variable, when VT(SDU) reaches Poll_SDU a poll is transmitted to the peer entity.

d) Poll_Window.

This parameter indicates when the transmitter should poll the receiver in case of performing window-based polling. The range of values of this parameter shall be $0 \leq$ Poll_Window ≤ 100. A poll is triggered for each PDU when $J \geq$ Poll_Window, where J is the window transmission percentage defined by

$$J = \frac{(4096+VT(S) - VT(A)) \textbf{ mod } 4096}{VT(WS)} * 100 ,$$

where the constant 4096 is the modulus for AM described in Subclause 9.4.e) MaxRST.

It is the maximum value for the number of retransmission of RESET PDU. This parameter is an upper limit of counter VT(RST). When the value of VT(RST) comes to MaxRST, unrecoverable error shall be indicated to ~~higher~~upper layer.

f) Configured_Tx_Window_Size.

The maximum allowed transmitter window size.

g) Configured_Rx_Window_Size.

The allowed receiver window size.

h) MaxMRW.

It is the maximum value for the number of retransmissions of a MRW command. This parameter is an upper limit of counter VT(MRW). When the value of VT(MRW) comes to MaxMRW, RLC RESET procedure shall be initiated.

9.7 Specific functions

9.7.1 Polling function for acknowledged mode

The transmitter of AMD PDUs may poll the receiver for a status report (consisting of one or several STATUS PDUs). The Polling bit in the AMD PDU indicates the poll request. If there is no PDU to be transmitted and all PDUs have already been acknowledged, the receiver shall not be polled. There are several triggers for setting the polling bit. Upper layers ~~The network (RRC)~~ controls~~,~~ which triggers should be used for each RLC entity. Following triggers are possible:

1) Last PDU in buffer.

The sender triggers a poll when the last PDU available for transmission is transmitted.

2) Last PDU in retransmission buffer.

The sender triggers a poll when the last PDU to be retransmitted is transmitted.

3) Poll timer.

The timer Timer_Poll is started when the successful or unsuccessful transmission of a PDU containing a poll is indicated by lower layer (in UE) or a PDU containing a poll is submitted to lower layer (in UTRAN) and if the criterion for stopping the timer has not occurred before the timer Timer_Poll expires a new poll is triggered.

4) Every Poll_PDU PDU.

The sender triggers a poll every Poll_PDU PDU. Both retransmitted and new PDUs shall be counted.

5) Every Poll_SDU SDU.

   The sender triggers a poll every Poll_SDU SDU.

6) Window based.

   The sender triggers a poll when it has reached Poll_Window% of the transmission window.

7) Timer based.

   The sender triggers a poll periodically.

Either the trigger "Last PDU in buffer" and "Last PDU in retransmission buffer" or "Timer based" can be chosen to avoid deadlock for every RLC entity. 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. If a poll was triggered during the prohibit time defined in subclause 9.5 b) (Timer_Poll_Prohibit), the poll shall be delayed until the timer expires. Only one poll shall be transmitted when the timer expires even if several polls were triggered during the prohibit time. This function has higher priority than any of the above-mentioned triggers.

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 PDUs that have been received and not received. There are several triggers for sending a status report. ~~The network (RRC)~~Upper layers control~~s~~ 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 PDU(s).

   If the receiver detects one or several missing PDUs it shall trigger the transmission of a status report to the sender.

2) Timer based STATUS transfer.

   The receiver triggers the transmission of a status report periodically to the sender. The timer Timer_Status_Periodic controls the time period. When Periodical Status blocking is configured by ~~higher~~upper layer, the trigger shall not be active.

3) The EPC mechanism.

   The timer Timer_EPC is started and the state variable VR(EP) is set when the successful or unsuccessful transmission of the first STATUS PDU of a status report is indicated by lower layer (in UE) or the first STATUS PDU of a status report is submitted to lower layer (in UTRAN). If not all PDUs requested for retransmission have been received before the variable VR(EP) has reached zero, 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. Upper layers control ~~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 triggering conditions above are fulfilled:

1) STATUS prohibit.

   The Timer_Status_Prohibit is started when the successful or unsuccessful transmission of the last STATUS PDU of a status report is indicated by lower layer (in UE) or the last STATUS PDU of a status report is submitted to lower layer (in UTRAN). The prohibit time is calculated from the time the last STATUS PDU of a status report is submitted to lower layer until the timer has expired. The receiving side is not allowed to transmit a status report during the prohibit time. If a status report was triggered during the prohibit time, the status report is transmitted after the prohibit time has expired. The receiver shall only send one status report, even if there are several triggers during the prohibit time. 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.

9.7.3 SDU discard function for acknowledged, unacknowledged, and transparent mode

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. There will be several alternative operation modes of the RLC SDU discard function. Upper layers control~~The network (RRC) controls~~, which discard function shall be used for each RLC entity.

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

Table 9.2: List of criteria 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
No_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~~upper layer, timer monitoring of the transmission time of the SDU is started. If the transmission time exceeds a predefined value for an SDU in acknowledged mode RLC, this SDU is discarded in the transmitter. Following which, if one or more segments of the SDU have been submitted to a lower layer, 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. If Send MRW is configured, an expired SDU whose segments were not submitted to a lower layer is also informed to the receiver by a MRW command.

NOTE: 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 piggybacked 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.

9.7.5 Local Suspend function for acknowledged and unacknowledged mode

The ~~higher~~ upper layers ~~(RRC)~~ may suspend the RLC entity. The CRLC-SUSPEND-Req indicates this request. The RLC entity shall, when receiving this request, not send RLC PDUs with SN≥VT(S)+N for AM and SN≥VT(US)+N for UM ,where N is given by the CRLC_SUSPEND-Req primitive. The RLC entity shall acknowledge the CRLC-SUSPEND-Req ordering a suspend with a CRLC-SUSPEND-Conf with the current value of VT(S) for AM and VT(US) for UM. The suspend state is left when a CRLC-RESUME-Req primitive indicating resume is received.

9.7.6 RLC stop, RLC Continue function

The ~~higher~~upper layer may stop the RLC entity. The stop parameter in the CRLC-CONFIG-Req primitive indicates this request. The RLC entity shall, when receiving this request, not submit any RLC PDUs to lower layer or receive any RLC PDUs. The data transmission and reception is continued when the continue parameter in the CRLC-CONFIG-Req primitive is received. If the continue parameter is received when the RLC entity is not stopped, no action shall be taken.

When the RLC entity is stopped, the RLC timers are not affected. Triggered polls and status transmissions are delayed until the RLC entity is continued.

11.1.2 Initiation

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

Channels that can be used are DTCH, CCCH (uplink only), SHCCH (uplink only), BCCH and PCCH. 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). One or several PDUs may be transmitted in each transmission time interval (TTI). For each TTI, MAC decides which PDU size shall be used (applicable when segmentation is used) and how many PDUs shall be transmitted. The SDUs that cannot be transmitted in a TTI shall be buffered according to the discard configuration set by upper layers ~~RRC~~.

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

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~~upper layer through the Tr-SAP.

11.2.2 Initiation

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

When the sender is in data transfer ready state it shall segment and, if possible, concatenate the data received from the ~~higher~~upper 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). For each TTI, MAC decides which PDU size shall be used and how many PDUs shall be transmitted.

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

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

A UMD PDU will be considered to be a padding PDU if it consists only of an RLC Header with one length indicator (indicating that the rest of the PDU is padding) and padding.

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 the updating step of the variable VR(US) is greater than one, one or more PDUs are missing. The SDUs that have segments in these missing PDUs shall be discarded. RLC delivers the RLC SDUs to the ~~higher layer~~upper layers through the UM-SAP.

11.3.2 Initiation

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

The sender is only allowed to retransmit PDUs that have been indicated missing by the receiver. An exception is the PDU with SN VT(S)-1, which can be retransmitted. In addition, a PDU that has not yet been acknowledged, may be retransmitted if Configured_Tx_Window_Size is less than 2048.

RLC shall segment the data received from the ~~higher layer~~upper layers into AMD PDUs. 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 cannot be transmitted in a TTI (i.e. MAC has indicated that some of the available PDUs can not be transmitted) shall be buffered according to the discard configuration set by upper layers ~~RRC~~.

The VT(DAT) state variables shall be updated for each AMD PDU that is transmitted. The PDU shall not have a Sequence Number ≥ VT(MS), except for the sequence number VT(S)-1; a PDU with this sequence number may be sent also when VT(S) ≥ 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 successful or unsuccessful transmission of a PDU with the set poll bit is indicated by lower layer (in UE) or submitted to lower layer (in UTRAN).

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

If the trigger for polling, "Every Poll_PDU PDU", is used, the VT(PDU) shall be increased by 1 for each PDU 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.

In AM, a PDU will be considered to be a padding PDU if it is:

- An AMD PDU consisting only of an RLC Header with one length indicator (indicating that the rest of the PDU is padding) and padding.
- A Status PDU consisting only of a NO_MORE SUFI.

11.4.5.2 Unrecoverable error (VT(RST) ≥ MaxRST)

If VT(RST) becomes larger or equal to MaxRST, unrecoverable error shall be indicated to ~~higher layer~~upper layers.

11.6.3 Reception of the STATUS PDU by the receiver

The receiver shall upon reception of the STATUS PDU/piggybacked STATUS PDU discard PDUs and update the state variables VR(R), VR(H) and VR(MR) according to the received STATUS PDU/piggybacked STATUS PDU. Additionally the receiver should inform the upper~~higher~~ layers about all of the discarded SDUs.

The receiver shall initiate the transmission of a status report containing an MRW_ACK SUFI.

In the MRW_ACK SUFI, SN_ACK shall be set to the new value of VR(R), updated after reception of the MRW SUFI. The N field in the MRW_ACK SUFI shall be set to N_{LENGTH} field in the received MRW SUFI if the SN_ACK field is equal to SN_MRW_{LENGTH}. Otherwise N shall be set to 0.

The last discarded data octet is the octet indicated by the N_{LENGTH}:th LI field of the PDU with sequence number SN_MRW_{LENGTH} and the succeeding data octet is the first data octet to be reassembled after the discard. When $N_{LENGTH} = 0$, the first data octet of the PDU with sequence number SN_MRW_{LENGTH} is the first data octet to be reassembled after the discard.

If LENGTH="0000", the sequence number SN_MRW_1 is considered to be above or equal to VR(R). Else, the sequence number SN_MRW_1 is considered to be less than VR(MR). All the SN_MRW_is other than SN_MRW_1 are considered to be in sequential order within the list and sequentially above or equal to SN_MRW_{i-1}.

11.6.4 Termination

The procedure is terminated in the sender in the following cases:

1. On the reception of a STATUS PDU which contains an MRW_ACK SUFI with $SN\_ACK > SN\_MRW_{LENGTH}$ and with the N field set equal to zero.
2. On the reception of a STATUS PDU which contains an ACK SUFI indicating $VR(R) > SN\_MRW_{LENGTH}$
3. On reception of a STATUS PDU which contains an MRW_ACK with $SN\_ACK = SN\_MRW_{LENGTH}$ and with the N field set equal to the N_{LENGTH} indicated in the transmitted MRW SUFI.

If one of the termination criteria above is fulfilled, Timer_MRW shall be stopped and the discard procedure is terminated. The SDUs that are requested to be discarded shall not be confirmed to ~~higher layer~~upper layers.

When VT(MRW) reaches MaxMRW, the procedure is terminated and an RLC reset shall be performed.

11.6.6.2 VT(MRW) equals MaxMRW

If the number of retransmission of an MRW command (i.e. VT(MRW)) reaches MaxMRW, an error indication shall be passed to upper layers ~~RRC~~ and RESET procedure shall be performed.

11.8 RLC re-establishment procedure

The RLC re-establishment procedure is used when ~~higher layer~~upper layers request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. All RLC PDUs in the RLC receiver and transmitter shall be discarded. The hyper frame number (HFN) in UL and DL shall be set to the value configured by ~~higher layer~~upper layers. After the re-establishment, RLC shall enter the data transfer ready state.

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

Tdoc R2-011350

CR-Form-v4

CHANGE REQUEST

⌘ **25.322 CR 130** ⌘ rev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Removal of reference to RRC
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	23rd May 01
Category:	⌘	**A**
Release:	⌘	REL-4

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change:	⌘	During RAN WG2 #19, it was decided that the term 'upper layers' should be used for data sources in c-plane and u-plane and also for the controlling layer (RRC).
Summary of change:	⌘	Reference to higher layers and RRC have been replaced by reference to upper layers.
Consequences if not approved:	⌘	Vocabulary misalignment between 25.331 and 25.321.
Clauses affected:	⌘	4.2.1.1, 4.2.1.2, 4.2.1.3, 5, 6, 8.1, 8.2, 9.2.2.11.3, 9.3.1.1, 9.3.1.2, 9.3.2.1, 9.3.2.2, 9.3.2.3, 9.3.3.1, 9.3.3.2, 9.3.3.3, 9.3.3.4, 9.5, 9.6, 9.7.1, 9.7.2, 9.7.3, 9.7.3.1, 9.7.5, 9.7.6, 11.1.2, 11.1.3, 11.2.2, 11.2.3, 11.3.2, 11.4.5.2, 11.6.3, 11.6.4, 11.6.6.2, 11.8.
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

4.2.1.1 Transparent mode entities

Figure 4.2 below shows the model of two transparent mode peer entities.

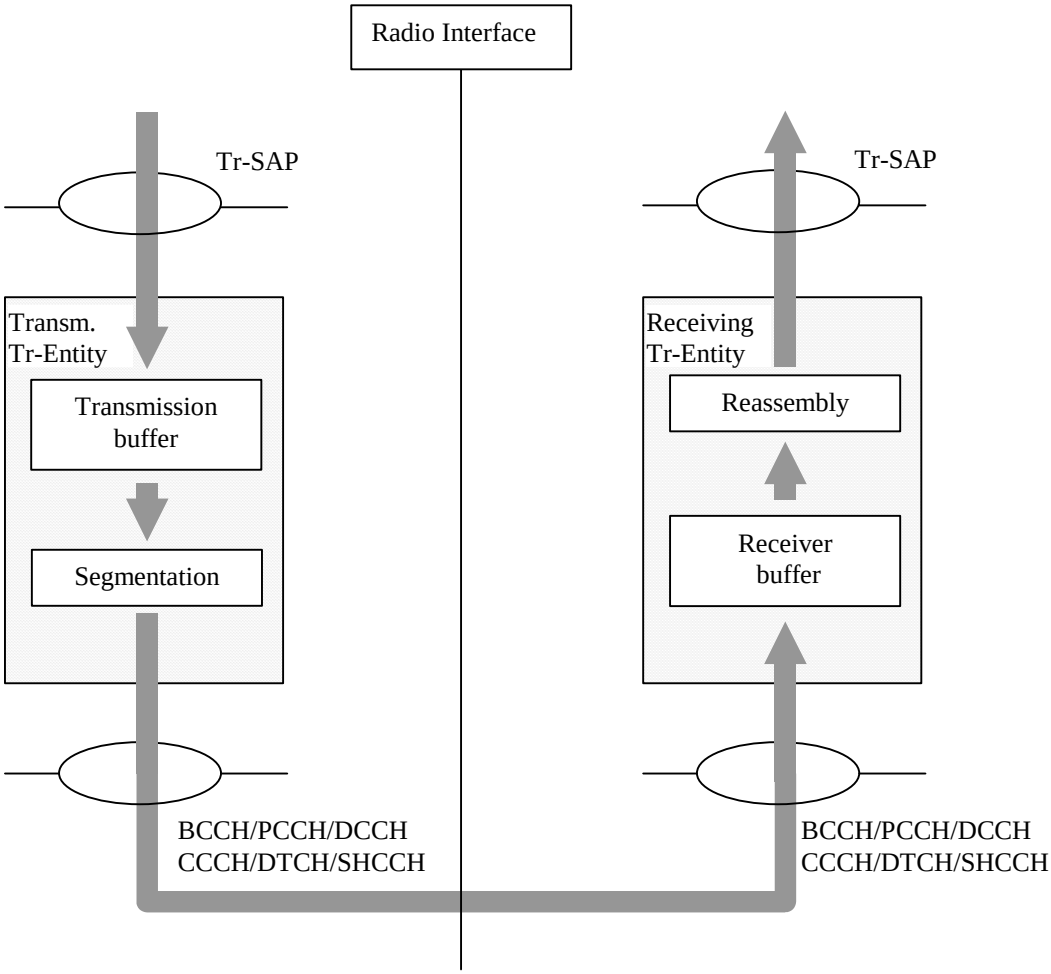

Figure 4.2: Model of two transparent mode peer entities

The transmitting Tr-entity receives SDUs from the upper ~~higher~~ layers through the Tr-SAP. RLC might segment the SDUs into appropriate RLC PDUs without adding any overhead. How to perform the segmentation is decided upon when the service is established. RLC delivers the RLC PDUs to lower layer through either a BCCH, DCCH, PCCH, CCCH, SHCCH or a DTCH. The CCCH and SHCCH uses transparent mode only for the uplink. Which type of logical channel depends on if the ~~higher~~ upper layer is located in the control plane (BCCH, DCCH, PCCH, CCCH, SHCCH) or user plane (DTCH).

The receiving Tr-entity receives PDUs through one of the logical channels from lower layer. RLC reassembles (if segmentation has been performed) the PDUs into RLC SDUs. How to perform the reassembling is decided upon when the service is established. RLC delivers the RLC SDUs to the ~~higher~~upper layer through the Tr-SAP.

4.2.1.2 Unacknowledged mode entities

Figure 4.3 below shows the model of two unacknowledged mode peer entities.

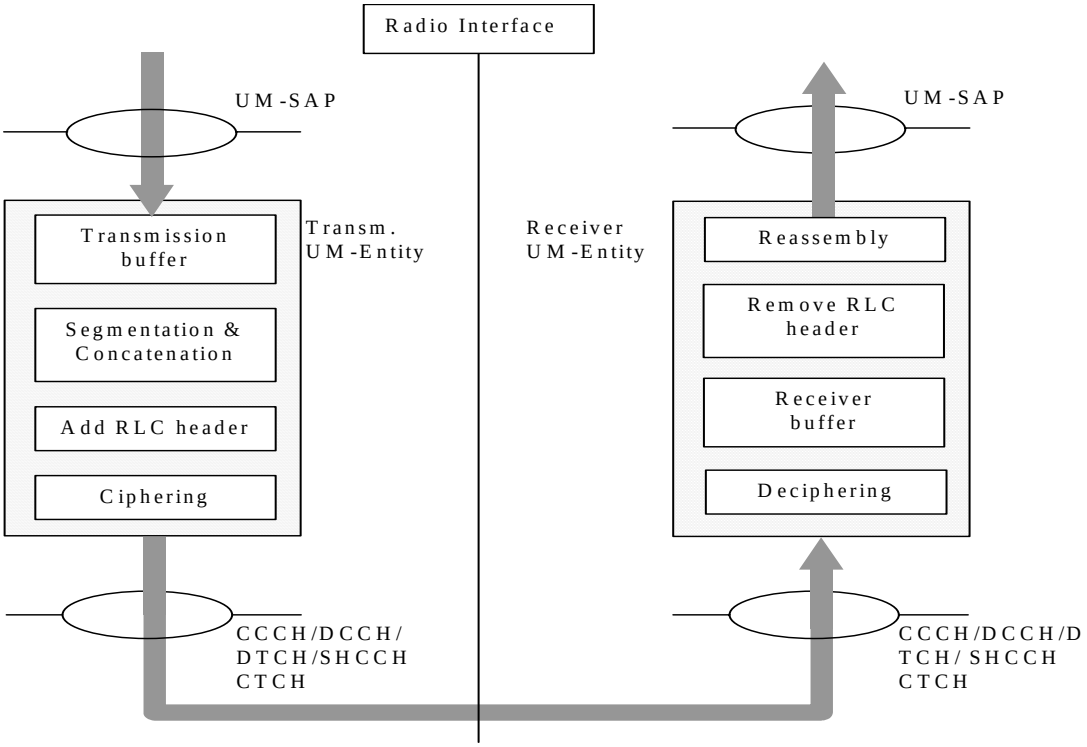

Figure 4.3: Model of two unacknowledged mode peer entities

The transmitting UM-entity receives SDUs from the ~~higher~~upper layers. RLC might segment the SDUs into RLC PDUs of appropriate size. The SDU might also be concatenated with other SDUs. RLC delivers the RLC PDUs to lower layer through either a CCCH, SHCCH, DCCH, CTCH or a DTCH. The CCCH and SHCCH uses unacknowledged mode only for the downlink. Which type of logical channel depends on if the ~~higher~~upper layer is located in the control plane (CCCH, DCCH, SHCCH) or user plane (CTCH, DTCH).

The receiving UM-entity receives PDUs through one of the logical channels from the MAC sublayer. RLC removes header from the PDUs and reassembles the PDUs (if segmentation has been performed) into RLC SDUs. The RLC SDUs are delivered to the ~~higher~~upper layer.

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 first logical channel shall be used for data PDUs and the second logical channel shall be used for control PDUs. In case one logical channel is used, the RLC PDU size shall be the same for AMD PDUs and control PDUs.

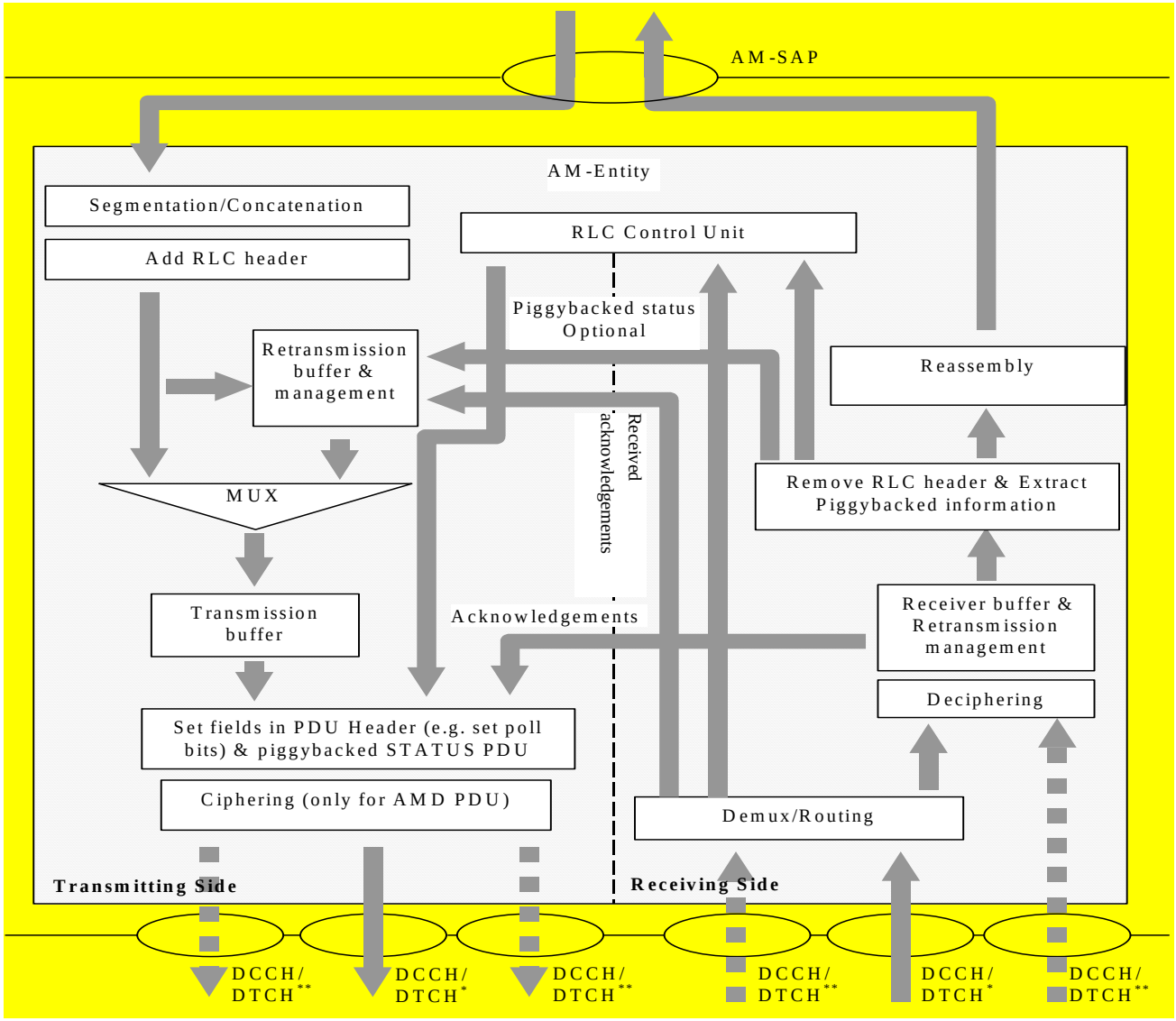

Figure 4.4: Model of an acknowledged mode entity

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

For concatenation or padding purposes, bits of information on the length and extension are inserted into the beginning of the last PDU 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 PDU, they are concatenated and the appropriate length indicators are inserted into the beginning of the PDU. After that the PDUs are placed in the retransmission buffer and the transmission buffer.

The MUX then decides which PDUs and when the PDUs are submitted to the lower layer. The PDUs are submitted via a function that completes the AMD PDU header and potentially replaces padding with piggybacked status information. The RLC entity shall assume a PDU to be transmitted when the PDU is submitted to lower layer.

The ciphering is applied only for AMD PDUs. The fixed 2 octets AMD PDU header is not ciphered. Piggybacked STATUS PDU and Padding parts of AMD PDU when existing are ciphered. The other Control PDUs (i.e. STATUS PDU, RESET PDU, and RESET ACK PDU) shall not be 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 retransmission buffer also receives acknowledgements from the receiving side, which are used to indicate retransmissions of PDUs and when to delete a PDU from the retransmission buffer.

The receiving side of the AM-entity receives PDUs through one of the logical channels from lower layer. Piggybacked status information is extracted, if present. The PDUs are placed in the receiver buffer until a complete SDU has been received. The receiver buffer requests retransmissions of PDUs by sending negative acknowledgements to the peer entity. After that the RLC headers are removed from the PDUs and the PDUs are reassembled into an SDU. Finally the SDU is delivered to the ~~higher~~upper layer. The receiving side also receives acknowledgements from the peer entity. The acknowledgements are passed to the retransmission buffer on the transmitting side.

5 Functions

The following functions are supported by RLC. For a detailed description of the following functions see [3]:

- Segmentation and reassembly.
- Concatenation.
- Padding.
- Transfer of user data.
- Error correction.
- In-sequence delivery of ~~higher~~upper layer PDUs.
- Duplicate detection.
- Flow control.
- Sequence number check.
- Protocol error detection and recovery.
- Ciphering.
- Suspend/resume function.

6 Services provided to upper layers

This clause describes the different services provided by RLC to upper ~~higher~~ layers. It also includes mapping of functions to different services. For a detailed description of the following functions see [3].

- **Transparent data transfer Service:**

  The following functions are needed to support transparent data transfer:

  - Segmentation and reassembly.
  - Transfer of user data.

- **Unacknowledged data transfer Service:**

  The following functions are needed to support unacknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.

- Transfer of user data.
- Ciphering.
- Sequence number check.

- **Acknowledged data transfer Service:**

  The following functions are needed to support acknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.
  - Transfer of user data.
  - Error correction.
  - In-sequence delivery of ~~higher layer~~upper layer PDUs.
  - Duplicate detection.
  - Flow Control.
  - Protocol error detection and recovery.
  - Ciphering.

- **QoS setting.**
- **Notification of unrecoverable errors.**

8.1 Primitives between RLC and upper~~higher~~ layers

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

Table 8.1: Primitives between RLC and ~~upper~~upper layers

Generic Name	Parameter			
	Req.	**Ind.**	**Resp.**	**Conf.**
RLC-AM-DATA	Data, CNF, MUI	Data, DiscardInfo	Not Defined	MUI
RLC-UM-DATA	Data, Use special LI	Data	Not Defined	Not Defined
RLC-TR-DATA	Data	Data	Not Defined	Not Defined
CRLC-CONFIG	E/R, Stop, Continue, Ciphering Elements (UM/AM only), TM_parameters (TM only), UM_parameters (UM 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 upper~~higher~~ layers to request transmission of a ~~higher layer~~upper layer PDU in acknowledged mode.

- RLC-AM-DATA-Ind is used by RLC to deliver to upper~~higher~~ layers RLC SDUs that have been transmitted in acknowledged mode and to indicate upper~~higher~~ layers of the discarded RLC SDU in the peer RLC AM entity.

- RLC-AM-DATA-Conf is used by RLC to confirm to upper~~higher~~ layers reception of an RLC SDU by the peer-RLC AM entity~~.~~.

RLC-UM-DATA-Req/Ind

- RLC-UM-DATA-Req is used by upper~~higher~~ layers to request transmission of a upper~~higher~~ layer PDU in unacknowledged mode.

- RLC-UM-DATA-Ind is used by RLC to deliver to upper~~higher~~ layers RLC SDUs that have been transmitted in unacknowledged mode.

RLC-TR-DATA-Req/Ind

- RLC-TR-DATA-Req is used by upper~~higher~~ layers to request transmission of a upper~~higher~~ layer PDU in transparent mode.

- RLC-TR-DATA-Ind is used by RLC to deliver to upper~~higher~~ layers RLC SDUs that have been transmitted in transparent mode.

CRLC-CONFIG-Req

This primitive is used by ~~RRC~~upper layers to establish, re-establish, release, stop, continue or reconfigure the RLC. Ciphering elements are included for UM and AM operation.

CRLC-SUSPEND-Req/Conf

This primitive is used by ~~RRC~~upper layers to suspend the RLC. The N parameter indicates that RLC shall not send a PDU with SN>=VT(S)+N for AM and SN>=VT(US)+N for UM, where N is an integer. RLC informs ~~RRC~~upper layers~~-~~ of the VT(S) for AM and VT(US) for UM in the confirm primitive.

CRLC-RESUME-Req

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

CRLC-STATUS-Ind

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

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause 11.8. 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 upper layers~~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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

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 minimum and the maximum allowed value is given by upper layers~~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 value of VT(WS) to be used by the transmitter. The range of the WSN is [0, 2^{12}-1]. The minimum value of VT(WS) is 1, if WSN is zero the SUFI shall be discarded by this version of the protocol. The variable VT(WS) is set equal to WSN upon reception of this SUFI. If WSN is greater than Configured_Tx_Window_Size, VT(WS) shall be set equal to Configured_Tx_Window_Size.

9.3.1.1 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 a CRLC-CONFIG-Req from ~~higher~~upper layer the RLC entity is created and transparent data transfer ready state is entered.

9.3.1.2 Transparent Data Transfer Ready State

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

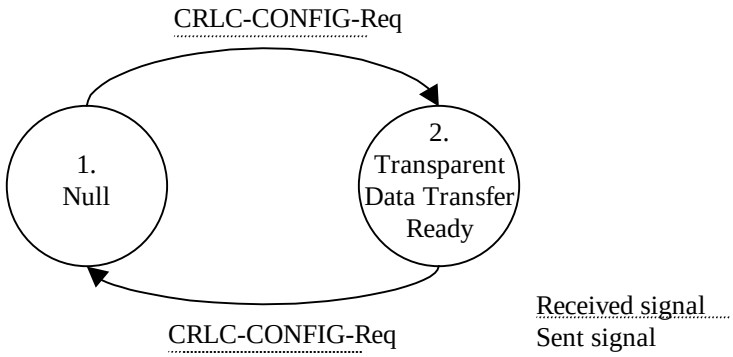

Figure 9.16: The state model for transparent mode entities

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 a CRLC-CONFIG-Req from ~~higher~~upper 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 a CRLC-CONFIG-Req from ~~higher~~upper layer the RLC entity is terminated and the null state is entered.

9.3.2.3 Local Suspend State

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

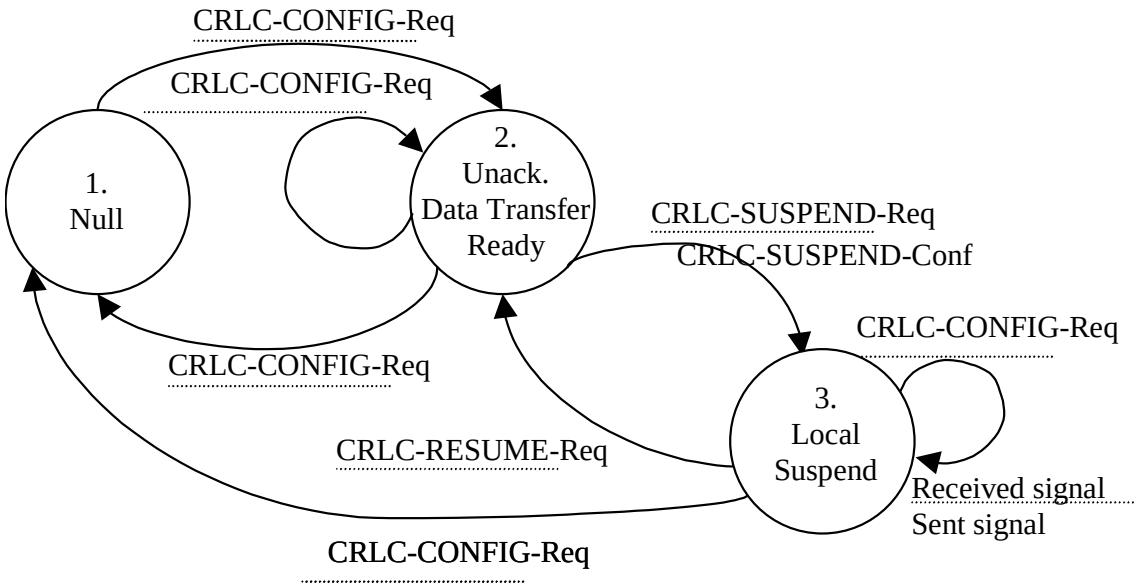

Figure 9.17: The state model for unacknowledged mode entities

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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 a CRLC-CONFIG-Req from ~~higher~~upper 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~~upper 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 (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU 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 a CRLC-CONFIG-Req from ~~higher~~upper layer the RLC entity is terminated and the null state is entered.

Upon reception of a RESET ACK PDU with the same RSN value as in the corresponding RESET PDU, the RLC entity resets the protocol (see subclause 11.4.4), sets the hyper frame number HFN (DL HFN when the RESET ACK is received in UE or UL HFN when the RESET ACK is received in UTRAN) equal to the HFNI field in the RESET ACK PDU and one of the following state transitions take place.

The RLC entity enters the acknowledged data transfer ready state if Reset Pending State was entered from Acknowledged Data Transfer Ready State or if Reset Pending State was entered from Local Suspend State and a CRLC-RESUME–Req was received in Reset Pending State.

The RLC entity enters into Local Suspend State if Reset Pending State was entered from Local Suspend State or if Reset Pending State was entered from Acknowledged Data Transfer Ready State and a CRLC-SUSPEND-Req was received in Reset Pending State.

Upon reception of a RESET ACK PDU with a different RSN value as in the corresponding RESET PDU the RESET ACK PDU is discarded.

Upon reception of a RESET PDU, the RLC entity resets the protocol (see subclause 11.4.3), sets the hyper frame number HFN (DL HFN when the RESET is received in UE or UL HFN when the RESET is received in UTRAN) equal to the HFNI field in the RESET PDU, sends a RESET ACK PDU and stays in the reset pending state.

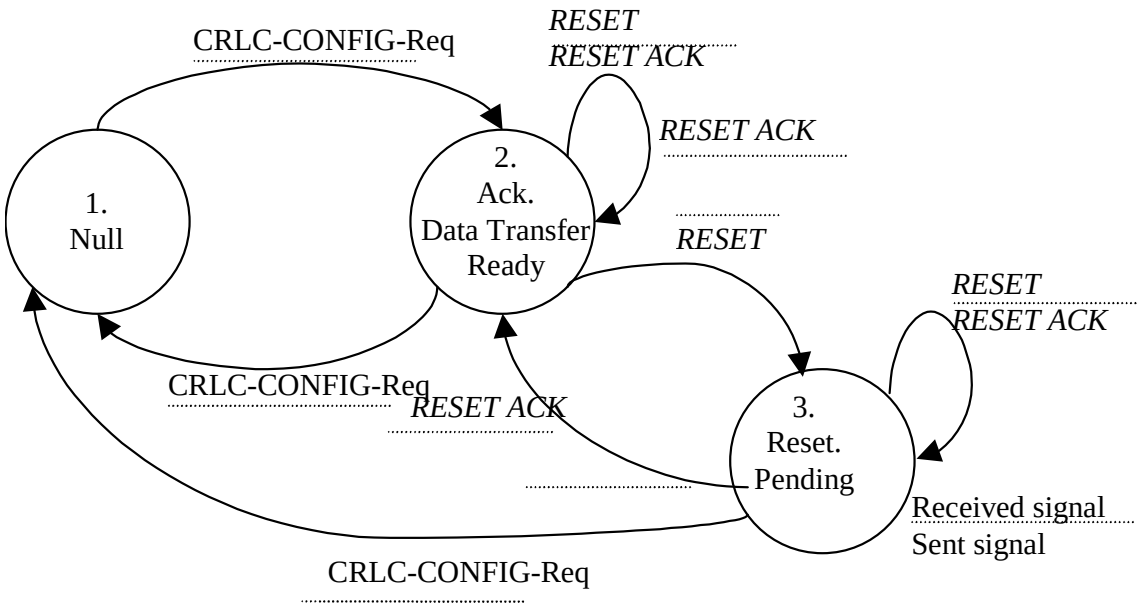

Figure 9.18: The state model for the acknowledged mode entities when reset is performed

9.3.3.4 Local Suspend State

Upon reception of a CRLC-SUSPEND-Req from ~~higher~~ upper layers ~~(RRC)~~ in Acknowledge Data Transfer Ready State the RLC entity is suspended and the Local Suspend state is entered. In the Local Suspend state RLC shall not send an RLC-PDUs with SN≥VT(S)+N. Upon reception of CRLC-RESUME-Req from upper layers ~~higher layer (RRC)~~ in this state, the RLC entity is resumed and the Data Transfer Ready state is entered.

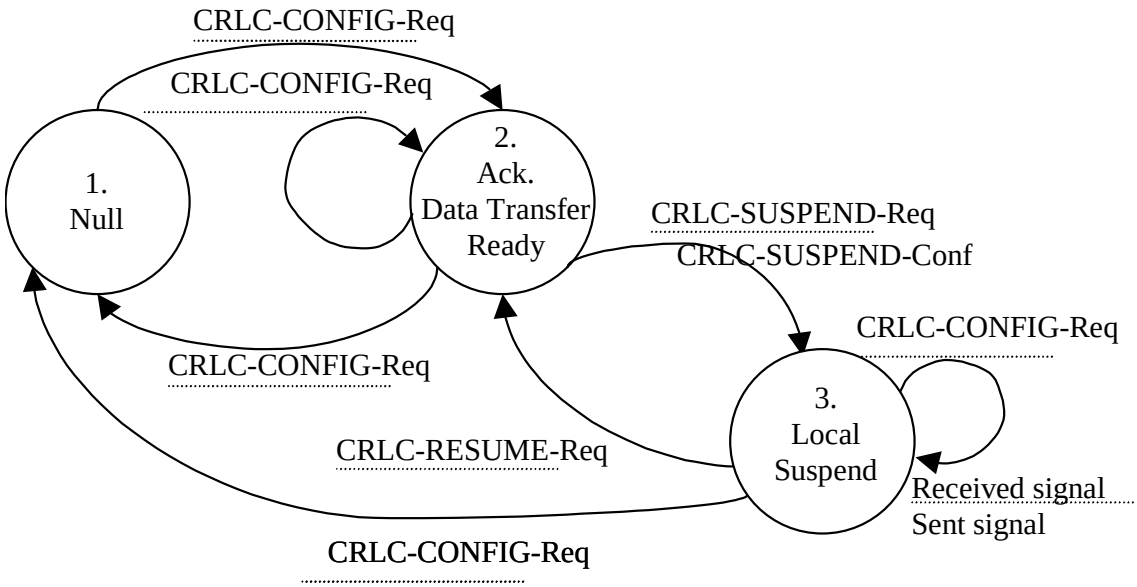

Figure 9.19: The state model for the acknowledged mode entities when local suspend is performed

9.5 Timers

a) Timer_Poll.

This timer is only used when the poll timer trigger is used. It is started when the successful or unsuccessful transmission of a PDU containing a poll is indicated by lower layer (in UE) or a PDU containing a poll is submitted to lower layer (in UTRAN). The timer is stopped when receiving a STATUS PDU that contains an acknowledgement of all AMD PDUs with SN up to and including VT(S)-1 at the time the poll was submitted to lower layer, or when a negative acknowledgement of the same PDU is received. The value of the timer is signalled by upper layers~~RRC~~.

If the timer expires and no STATUS PDU fulfilling the criteria above 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 at the time specified above, with a new value of VT(S)-1.

If a new poll is sent when the timer is running the timer is restarted at the time specified above, with a new value of VT(S)-1.

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. The timer shall be started when the successful or unsuccessful transmission of a PDU containing a poll is indicated by lower layer (in UE) or a PDU containing a poll is submitted to lower layer (in UTRAN). The prohibit time is calculated from the time a PDU containing a poll is submitted to lower layer until the timer has expired. A poll shall be delayed until the prohibit time expires if a poll is triggered during the prohibit time. Only one poll shall be transmitted when the prohibit time expires even if several polls were triggered during the prohibit time. This timer will not be stopped by a received STATUS PDU. The value of the timer is signalled by upper layers~~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 PDU should be received after a status report has been sent. The timer is started when the successful or unsuccessful transmission of the first STATUS PDU of a status report is indicated by lower layer (in UE) or the first STATUS PDU of a status report is submitted to lower layer (in UTRAN) and when it expires VR(EP) can start its counting-down process (see subclause 9.7.4). The value of the timer is signalled by upper layers~~RRC~~.

d) Timer_Discard.

This timer is used for the SDU discard function. In the transmitter, the timer is activated upon reception of an SDU from ~~higher~~upper layer. One timer is used for each SDU that is received from ~~higher~~upper layer. For UM/Tr, if the timer expires before the SDU is submitted to a lower layer, "SDU discard without explicit signalling" specified in subclauses 11.2.4.3/11.1.4.2 shall be started. For AM, if the timer expires before the SDU is acknowledged, "SDU discard with explicit signalling" specified in subclause 11.6 shall be started.

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, the timer is restarted and a poll is triggered (either by the transmission of a PDU which was not yet sent, or by a retransmission). If there is no PDU to be transmitted and all PDUs have already been acknowledged, a poll shall not be triggered and the timer shall only be restarted. The value of the timer is signalled by upper layers~~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 successful or unsuccessful transmission of the last STATUS PDU in a status report is indicated by lower layer (in UE) or the last STATUS PDU in a status report is submitted to lower layer (in UTRAN). The prohibit time is calculated from the time the last STATUS PDU of a status report is submitted to lower layer until the timer has expired and no new status report containing the mentioned SUFIs can be transmitted during the prohibit time. The timer does not prohibit transmission of the SUFIs MRW, MRW_ACK, WINDOW or NO_MORE. The value of the timer is signalled by upper layers~~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 the transmission of a status report is triggered and the timer is restarted. The value of the timer is signalled by upper layers~~RRC~~. This timer can be blocked by upper layers~~RRC~~. In this case, the timer shall not be active. The timer shall be reset and restarted when it is unblocked by upper layers~~RRC~~.

h) Timer_RST.

This timer is used to detect the loss of RESET ACK PDU from the peer RLC entity. This timer is started when the successful or unsuccessful transmission of a RESET PDU is indicated by lower layer (in UE) or a RESET PDU is submitted to lower layer (in UTRAN). It will only be stopped upon reception of RESET ACK PDU, i.e. this timer is not stopped when an RLC reset occurs which was initiated from the peer RLC entity. If it expires, RESET PDU will be retransmitted. The value of the timer is signalled by upper layers~~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 successful or unsuccessful transmission of a STATUS PDU containing the MRW SUFI is indicated by lower layer (in UE) or a STATUS PDU containing the MRW SUFI is submitted to lower layer (in UTRAN). Each time the timer expires the MRW SUFI is retransmitted and the timer is restarted (at the time specified above). It shall be stopped when one of the termination criteria for the SDU discard is fulfilled. The value of the timer is signalled by upper layers~~RRC~~.

9.6 Protocol Parameters

The values of the protocol parameters in this subclause are signalled by upper layers~~RRC~~.

a) MaxDAT.

It is the maximum value for the number of retransmissions of a PDU. This parameter is an upper limit of counter VT(DAT). When the value of VT(DAT) comes to MaxDAT, either RLC RESET procedure or SDU discard procedure shall be initiated according to configuration by ~~higher~~upper layer.

b) Poll_PDU.

This parameter indicates how often the transmitter should poll the receiver in case of polling every Poll_PDU PDU. This is an upper limit for the VT(PDU) state variable, when VT(PDU) reaches Poll_PDU a poll is transmitted to the peer entity.

c) Poll_SDU.

This parameter indicates how often the transmitter should poll the receiver in case of polling every Poll_SDU SDU. This is an upper limit for the VT(SDU) state variable, when VT(SDU) reaches Poll_SDU a poll is transmitted to the peer entity.

d) Poll_Window.

This parameter indicates when the transmitter should poll the receiver in case of performing window-based polling. The range of values of this parameter shall be $0 \leq$ Poll_Window ≤ 100. A poll is triggered for each PDU when $J \geq$ Poll_Window, where J is the window transmission percentage defined by

$$J = \frac{(4096+VT(S) - VT(A)) \textbf{ mod } 4096}{VT(WS)} * 100 ,$$

where the constant 4096 is the modulus for AM described in Subclause 9.4.e) MaxRST.

It is the maximum value for the number of retransmission of RESET PDU. This parameter is an upper limit of counter VT(RST). When the value of VT(RST) comes to MaxRST, unrecoverable error shall be indicated to ~~higher~~upper layer.

f) Configured_Tx_Window_Size.

The maximum allowed transmitter window size.

g) Configured_Rx_Window_Size.

The allowed receiver window size.

h) MaxMRW.

It is the maximum value for the number of retransmissions of a MRW command. This parameter is an upper limit of counter VT(MRW). When the value of VT(MRW) comes to MaxMRW, RLC RESET procedure shall be initiated.

9.7 Specific functions

9.7.1 Polling function for acknowledged mode

The transmitter of AMD PDUs may poll the receiver for a status report (consisting of one or several STATUS PDUs). The Polling bit in the AMD PDU indicates the poll request. If there is no PDU to be transmitted and all PDUs have already been acknowledged, the receiver shall not be polled. There are several triggers for setting the polling bit. Upper layers ~~The network (RRC)~~ controls~~,~~, which triggers should be used for each RLC entity. Following triggers are possible:

1) Last PDU in buffer.

The sender triggers a poll when the last PDU available for transmission is transmitted.

2) Last PDU in retransmission buffer.

The sender triggers a poll when the last PDU to be retransmitted is transmitted.

3) Poll timer.

The timer Timer_Poll is started when the successful or unsuccessful transmission of a PDU containing a poll is indicated by lower layer (in UE) or a PDU containing a poll is submitted to lower layer (in UTRAN) and if the criterion for stopping the timer has not occurred before the timer Timer_Poll expires a new poll is triggered.

4) Every Poll_PDU PDU.

The sender triggers a poll every Poll_PDU PDU. Both retransmitted and new PDUs shall be counted.

5) Every Poll_SDU SDU.

   The sender triggers a poll every Poll_SDU SDU.

6) Window based.

   The sender triggers a poll when it has reached Poll_Window% of the transmission window.

7) Timer based.

   The sender triggers a poll periodically.

Either the trigger "Last PDU in buffer" and "Last PDU in retransmission buffer" or "Timer based" can be chosen to avoid deadlock for every RLC entity. 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. If a poll was triggered during the prohibit time defined in subclause 9.5 b) (Timer_Poll_Prohibit), the poll shall be delayed until the timer expires. Only one poll shall be transmitted when the timer expires even if several polls were triggered during the prohibit time. This function has higher priority than any of the above-mentioned triggers.

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 PDUs that have been received and not received. There are several triggers for sending a status report. ~~The network (RRC)~~Upper layers control~~s~~ 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 PDU(s).

   If the receiver detects one or several missing PDUs it shall trigger the transmission of a status report to the sender.

2) Timer based STATUS transfer.

   The receiver triggers the transmission of a status report periodically to the sender. The timer Timer_Status_Periodic controls the time period. When Periodical Status blocking is configured by ~~higher~~upper layer, the trigger shall not be active.

3) The EPC mechanism.

   The timer Timer_EPC is started and the state variable VR(EP) is set when the successful or unsuccessful transmission of the first STATUS PDU of a status report is indicated by lower layer (in UE) or the first STATUS PDU of a status report is submitted to lower layer (in UTRAN). If not all PDUs requested for retransmission have been received before the variable VR(EP) has reached zero, 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. Upper layers control ~~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 triggering conditions above are fulfilled:

1) STATUS prohibit.

   The Timer_Status_Prohibit is started when the successful or unsuccessful transmission of the last STATUS PDU of a status report is indicated by lower layer (in UE) or the last STATUS PDU of a status report is submitted to lower layer (in UTRAN). The prohibit time is calculated from the time the last STATUS PDU of a status report is submitted to lower layer until the timer has expired. The receiving side is not allowed to transmit a status report during the prohibit time. If a status report was triggered during the prohibit time, the status report is transmitted after the prohibit time has expired. The receiver shall only send one status report, even if there are several triggers during the prohibit time. 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.

9.7.3 SDU discard function for acknowledged, unacknowledged, and transparent mode

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. There will be several alternative operation modes of the RLC SDU discard function. Upper layers control~~The network (RRC) controls~~, which discard function shall be used for each RLC entity.

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

Table 9.2: List of criteria 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
No_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~~upper layer, timer monitoring of the transmission time of the SDU is started. If the transmission time exceeds a predefined value for an SDU in acknowledged mode RLC, this SDU is discarded in the transmitter. Following which, if one or more segments of the SDU have been submitted to a lower layer, 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. If Send MRW is configured, an expired SDU whose segments were not submitted to a lower layer is also informed to the receiver by a MRW command.

NOTE: 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 piggybacked 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.

9.7.5 Local Suspend function for acknowledged and unacknowledged mode

The ~~higher~~ upper layers ~~(RRC)~~ may suspend the RLC entity. The CRLC-SUSPEND-Req indicates this request. The RLC entity shall, when receiving this request, not send RLC PDUs with SN≥VT(S)+N for AM and SN≥VT(US)+N for UM ,where N is given by the CRLC_SUSPEND-Req primitive. The RLC entity shall acknowledge the CRLC-SUSPEND-Req ordering a suspend with a CRLC-SUSPEND-Conf with the current value of VT(S) for AM and VT(US) for UM. The suspend state is left when a CRLC-RESUME-Req primitive indicating resume is received.

9.7.6 RLC stop, RLC Continue function

The ~~higher~~upper layer may stop the RLC entity. The stop parameter in the CRLC-CONFIG-Req primitive indicates this request. The RLC entity shall, when receiving this request, not submit any RLC PDUs to lower layer or receive any RLC PDUs. The data transmission and reception is continued when the continue parameter in the CRLC-CONFIG-Req primitive is received. If the continue parameter is received when the RLC entity is not stopped, no action shall be taken.

When the RLC entity is stopped, the RLC timers are not affected. Triggered polls and status transmissions are delayed until the RLC entity is continued.

11.1.2 Initiation

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

Channels that can be used are DTCH, CCCH (uplink only), SHCCH (uplink only), BCCH and PCCH. 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). One or several PDUs may be transmitted in each transmission time interval (TTI). For each TTI, MAC decides which PDU size shall be used (applicable when segmentation is used) and how many PDUs shall be transmitted. The SDUs that cannot be transmitted in a TTI shall be buffered according to the discard configuration set by upper layers ~~RRC~~.

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

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~~upper layer through the Tr-SAP.

11.2.2 Initiation

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

When the sender is in data transfer ready state it shall segment and, if possible, concatenate the data received from the ~~higher~~upper 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). For each TTI, MAC decides which PDU size shall be used and how many PDUs shall be transmitted.

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

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

A UMD PDU will be considered to be a padding PDU if it consists only of an RLC Header with one length indicator (indicating that the rest of the PDU is padding) and padding.

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 the updating step of the variable VR(US) is greater than one, one or more PDUs are missing. The SDUs that have segments in these missing PDUs shall be discarded. RLC delivers the RLC SDUs to the ~~higher layer~~upper layers through the UM-SAP.

11.3.2 Initiation

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

The sender is only allowed to retransmit PDUs that have been indicated missing by the receiver. An exception is the PDU with SN VT(S)-1, which can be retransmitted. In addition, a PDU that has not yet been acknowledged, may be retransmitted if Configured_Tx_Window_Size is less than 2048.

RLC shall segment the data received from the ~~higher layer~~upper layers into AMD PDUs. 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 cannot be transmitted in a TTI (i.e. MAC has indicated that some of the available PDUs can not be transmitted) shall be buffered according to the discard configuration set by upper layers ~~RRC~~.

The VT(DAT) state variables shall be updated for each AMD PDU that is transmitted. The PDU shall not have a Sequence Number ≥ VT(MS), except for the sequence number VT(S)-1; a PDU with this sequence number may be sent also when VT(S) ≥ 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 successful or unsuccessful transmission of a PDU with the set poll bit is indicated by lower layer (in UE) or submitted to lower layer (in UTRAN).

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

If the trigger for polling, "Every Poll_PDU PDU", is used, the VT(PDU) shall be increased by 1 for each PDU 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.

In AM, a PDU will be considered to be a padding PDU if it is:

- An AMD PDU consisting only of an RLC Header with one length indicator (indicating that the rest of the PDU is padding) and padding.
- A Status PDU consisting only of a NO_MORE SUFI.

11.4.5.2 Unrecoverable error (VT(RST) ≥ MaxRST)

If VT(RST) becomes larger or equal to MaxRST, unrecoverable error shall be indicated to ~~higher layer~~upper layers.

11.6.3 Reception of the STATUS PDU by the receiver

The receiver shall upon reception of the STATUS PDU/piggybacked STATUS PDU discard PDUs and update the state variables VR(R), VR(H) and VR(MR) according to the received STATUS PDU/piggybacked STATUS PDU. Additionally the receiver should inform the upper~~higher~~ layers about all of the discarded SDUs.

The receiver shall initiate the transmission of a status report containing an MRW_ACK SUFI.

In the MRW_ACK SUFI, SN_ACK shall be set to the new value of VR(R), updated after reception of the MRW SUFI. The N field in the MRW_ACK SUFI shall be set to N_{LENGTH} field in the received MRW SUFI if the SN_ACK field is equal to SN_MRW_{LENGTH}. Otherwise N shall be set to 0.

The last discarded data octet is the octet indicated by the N_{LENGTH}:th LI field of the PDU with sequence number SN_MRW_{LENGTH} and the succeeding data octet is the first data octet to be reassembled after the discard. When $N_{LENGTH} = 0$, the first data octet of the PDU with sequence number SN_MRW_{LENGTH} is the first data octet to be reassembled after the discard.

If LENGTH="0000", the sequence number SN_MRW_1 is considered to be above or equal to VR(R). Else, the sequence number SN_MRW_1 is considered to be less than VR(MR). All the SN_MRW_is other than SN_MRW_1 are considered to be in sequential order within the list and sequentially above or equal to SN_MRW_{i-1}.

11.6.4 Termination

The procedure is terminated in the sender in the following cases:

1. On the reception of a STATUS PDU which contains an MRW_ACK SUFI with $SN\_ACK > SN\_MRW_{LENGTH}$ and with the N field set equal to zero.
2. On the reception of a STATUS PDU which contains an ACK SUFI indicating $VR(R) > SN\_MRW_{LENGTH}$
3. On reception of a STATUS PDU which contains an MRW_ACK with $SN\_ACK = SN\_MRW_{LENGTH}$ and with the N field set equal to the N_{LENGTH} indicated in the transmitted MRW SUFI.

If one of the termination criteria above is fulfilled, Timer_MRW shall be stopped and the discard procedure is terminated. The SDUs that are requested to be discarded shall not be confirmed to ~~higher layer~~upper layers.

When VT(MRW) reaches MaxMRW, the procedure is terminated and an RLC reset shall be performed.

11.6.6.2 VT(MRW) equals MaxMRW

If the number of retransmission of an MRW command (i.e. VT(MRW)) reaches MaxMRW, an error indication shall be passed to upper layers ~~RRC~~ and RESET procedure shall be performed.

11.8 RLC re-establishment procedure

The RLC re-establishment procedure is used when ~~higher layer~~upper layers request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. All RLC PDUs in the RLC receiver and transmitter shall be discarded. The hyper frame number (HFN) in UL and DL shall be set to the value configured by ~~higher layer~~upper layers. After the re-establishment, RLC shall enter the data transfer ready state.

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

Tdoc R2-011316

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **131** ⌘ rev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Clarification in the LI Parameters section
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	14th May 01
Category:	⌘	**F**
Release:	⌘	R99

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change:	⌘	If the last SDU in the transmitter ends exactly at the end of a PDU, or, in the case of 15 bits LI, if it is one octet short, a new PDU shall be generated. These are no mention of those 2 cases in the specification and a clarification would make the understanding easier.
Summary of change:	⌘	It is clarified that in those cases a new PDU shall be generated. The content of the PDU is also given. Revision 1: update after comments. Backwards Compatibility: This CR is a clarification and is backwards compatible. But implementation shall be checked.
Consequences if not approved:	⌘	Specification unclear.

Clauses affected:	⌘	9.2.2.8		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

9.2.2.8 Length Indicator (LI)

The Length Indicator is used to indicate, each time, the end of an SDU occurs in the PDU. 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 PDUs that they refer to. The size of the Length Indicator may be either 7bits or 15bits. The value of a Length Indicator shall not exceed the values specified in subclauses 11.2.4.2 and 11.3.4.5.

A Length Indicator group is a set of Length Indicators that refer to a PDU. 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 PDU, 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 the last segment of an SDU exactly ends at the end of a PDU and there is no LI that indicates the end of the SDU, the next Length Indicator, shall be placed as the first Length Indicator in the following PDU and have value LI=0. In case, this SDU was the last one to be transmitted, a PDU consisting of an RLC Header with LI=0 followed by a padding Length Indicator and padding mayshall be transmittedgenerated.

In the case where a PDU contains a 15-bit LI indicating that an SDU ends with one octet left in the PDU, the last octet of this PDU shall be ignored and shall not be filled with the first octet of the next SDU data.

In the case where the last segment of an RLC SDU is one octet short of exactly filling the previous RLC PDU, and 15-bit Length Indicators are used, the Length Indicator shall be placed as the first Length Indicator in the following PDU and have value LI=111 1111 1111 1011. The remaining one octet in the previous RLC PDU shall be ignored. In case, this SDU was the last one to be transmitted, a PDU consisting of an RLC Header with LI=111 1111 1111 1011 followed by a padding Length Indicator and padding mayshall be transmittedgenerated.

A PDU that has unused space, to be referred to as padding, shall use a Length Indicator to indicate that this space is used as padding unless the padding size is one octet for PDUs with 15-bit LIs. A padding Length Indicator must be placed after any Length Indicators for a PDU.

All unused space in a PDU 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 PDU.

If SDU discard with explicit signalling is used an AMD PDU can contain a maximum number of 15 LIs indicating the end of an SDU and the rest of the AMD PDU space shall be used as padding/piggybacked STATUS PDU.

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 UMD 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 UMD PDUs or AMD PDUs, for one RLC entity.

If the maximum RLC PDU size for an RLC entity is not explicitly configured (e.g. on FACH), the length of the Length Indicator is determined by the maximum configured TB size for the transport channel on which the logical channel is mapped.

Length: 7bits

Bit	Description
0000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
1111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111111	The rest of the RLC PDU is padding. The padding length can be zero.

Length: 15bits

Bit	Description
000000000000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
111111111111011	The last segment of an RLC SDU was one octet short of exactly filling the previous RLC PDU and there is no LI that indicates the end of the SDU in the previous RLC PDU. The remaining one octet in the previous RLC PDU is ignored.
111111111111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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).
111111111111110	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
111111111111111	The rest of the RLC PDU is padding. The padding length can be zero.

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

Tdoc R2-011351

CR-Form-v4

CHANGE REQUEST

⌘ **25.322 CR 132** ⌘ rev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Clarification in the LI Parameters section
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	23rd May 01
Category:	⌘	**A**
Release:	⌘	REL-4

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change:	⌘	If the last SDU in the transmitter ends exactly at the end of a PDU, or, in the case of 15 bits LI, if it is one octet short, a new PDU shall be generated. These are no mention of those 2 cases in the specification and a clarification would make the understanding easier.
Summary of change:	⌘	It is clarified that in those cases a new PDU shall be generated. The content of the PDU is also given.
Consequences if not approved:	⌘	Specification unclear.

Clauses affected:	⌘	9.2.2.8		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:
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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

9.2.2.8 Length Indicator (LI)

The Length Indicator is used to indicate, each time, the end of an SDU occurs in the PDU. 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 PDUs that they refer to. The size of the Length Indicator may be either 7bits or 15bits. The value of a Length Indicator shall not exceed the values specified in subclauses 11.2.4.2 and 11.3.4.5.

A Length Indicator group is a set of Length Indicators that refer to a PDU. 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 PDU, 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 the last segment of an SDU exactly ends at the end of a PDU and there is no LI that indicates the end of the SDU, the next Length Indicator, shall be placed as the first Length Indicator in the following PDU and have value LI=0. In case, this SDU was the last one to be transmitted, a PDU consisting of an RLC Header with LI=0 followed by a padding Length Indicator and padding may be transmitted.

In the case where a PDU contains a 15-bit LI indicating that an SDU ends with one octet left in the PDU, the last octet of this PDU shall be ignored and shall not be filled with the first octet of the next SDU data.

In the case where the last segment of an RLC SDU is one octet short of exactly filling the previous RLC PDU, and 15-bit Length Indicators are used, the Length Indicator shall be placed as the first Length Indicator in the following PDU and have value LI=111 1111 1111 1011. The remaining one octet in the previous RLC PDU shall be ignored. In case, this SDU was the last one to be transmitted, a PDU consisting of an RLC Header with LI=111 1111 1111 1011 followed by a padding Length Indicator and padding may be transmitted.

A PDU that has unused space, to be referred to as padding, shall use a Length Indicator to indicate that this space is used as padding unless the padding size is one octet for PDUs with 15-bit LIs. A padding Length Indicator must be placed after any Length Indicators for a PDU.

All unused space in a PDU 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 PDU.

If SDU discard with explicit signalling is used an AMD PDU can contain a maximum number of 15 LIs indicating the end of an SDU and the rest of the AMD PDU space shall be used as padding/piggybacked STATUS PDU.

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 UMD 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 UMD PDUs or AMD PDUs, for one RLC entity.

If the maximum RLC PDU size for an RLC entity is not explicitly configured (e.g. on FACH), the length of the Length Indicator is determined by the maximum configured TB size for the transport channel on which the logical channel is mapped.

Length: 7bits

Bit	Description
0000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
1111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111111	The rest of the RLC PDU is padding. The padding length can be zero.

Length: 15bits

Bit	Description
000000000000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
111111111111011	The last segment of an RLC SDU was one octet short of exactly filling the previous RLC PDU and there is no LI that indicates the end of the SDU in the previous RLC PDU. The remaining one octet in the previous RLC PDU is ignored.
111111111111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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).
111111111111110	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
111111111111111	The rest of the RLC PDU is padding. The padding length can be zero.

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

Tdoc R2-011317

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **135** ⌘ rev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

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

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

Use one of the following releases:
2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
REL-4 *(Release 4)*
REL-5 *(Release 5)*

Reason for change: ⌘ 25.322 is not aligned with 25.301.

Summary of change: ⌘
1. All the RLC specific functions described in section 9.7 are listed in section 5.
2. 2. Since RLC re-establishment and Ciphering are known to be 'Funciton', they are moved from section 11 Elementary procedure to section 9.7 Specific functions.

Rev 1 : Some editorial changes are made, and they are highlighted.

Backwards compatibility analysis

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

Consequences if not approved: ⌘ Misalignment between the specs.

Clauses affected: ⌘ 5, 8.2, 9.7.5, 9.7.6, 9.7.7 (new), 9.7.8 (new), 11.7, 11.8

Other specs affected: ⌘
☐ Other core specifications
☐ Test specifications
☐ O&M Specifications
⌘

Other comments: ⌘

How to create CRs using this form:
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Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

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

5 Functions

The following functions are supported by RLC. For a detailed description of the following functions see [3]:

- Segmentation and reassembly.
- Concatenation.
- Padding.
- Transfer of user data.
- Error correction.
- In-sequence delivery of higher layer PDUs.
- Duplicate detection.
- Flow control.
- Sequence number check.
- Protocol error detection and recovery.
- Ciphering.
- Polling.
- Status transmission.
- SDU discard.
- Estimated PDU Counter (EPC) mechanism.
- Suspend/resume function.
- Stop/continue function.
- Re-establishment function.

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause ~~11.8~~9.7.7. 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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

9.7 Specific functions

9.7.5 Local Suspend function for acknowledged and unacknowledged mode

The ~~higher~~upper layer (RRC) may suspend the RLC entity. The CRLC-SUSPEND-Req indicates this request. The RLC entity shall, when receiving this request, not send RLC PDUs with SN≥VT(S)+N for AM and SN≥VT(US)+N for UM ,where N is given by the CRLC_SUSPEND-Req primitive. The RLC entity shall acknowledge the CRLC-SUSPEND-Req ordering a suspend with a CRLC-SUSPEND-Conf with the current value of VT(S) for AM and VT(US) for UM. The suspend state is left when a CRLC-RESUME-Req primitive indicating resume is received.

9.7.6 RLC ~~s~~Stop, RLC Continue function for acknowledged and unacknowledged mode

The ~~higher~~upper layer may stop the RLC entity. The stop parameter in the CRLC-CONFIG-Req primitive indicates this request. The RLC entity shall, when receiving this request, not submit any RLC PDUs to lower layer or receive any RLC PDUs. The data transmission and reception is continued when the continue parameter in the CRLC-CONFIG-Req primitive is received. If the continue parameter is received when the RLC entity is not stopped, no action shall be taken.

When the RLC entity is stopped, the RLC timers are not affected. Triggered polls and status transmissions are delayed until the RLC entity is continued.

9.7.7 RLC re-establishment function for acknowledged and unacknowledged mode

The RLC re-establishment function is used when upper layer request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. All RLC PDUs in the RLC receiver and transmitter shall be discarded. The hyper frame number (HFN) in UL and DL shall be set to the value configured by upper layer. After the re-establishment, RLC shall enter the data transfer ready state.

9.7.8 Ciphering for acknowledged and unacknowledged mode

The ciphering function is performed in RLC, according to the following rules if a radio bearer is using a non-transparent RLC mode (AM or UM). The data unit that is ciphered, depends on the transmission mode as described below.

- For RLC UM mode, the ciphering unit is the UMD PDU excluding the first octet, i.e. excluding the RLC UMD PDU header. This is shown below in Figure 9.x.

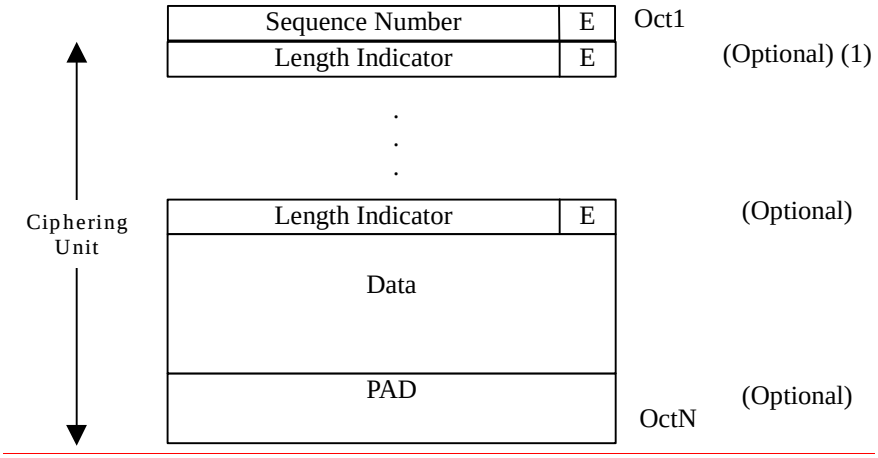


Figure 9.x: Ciphering unit for a UMD PDU

- For RLC AM mode, the ciphering unit is the AMD PDU excluding the first two octets, i.e. excluding the RLC AMD PDU header. This is shown below in Figure 9.y.

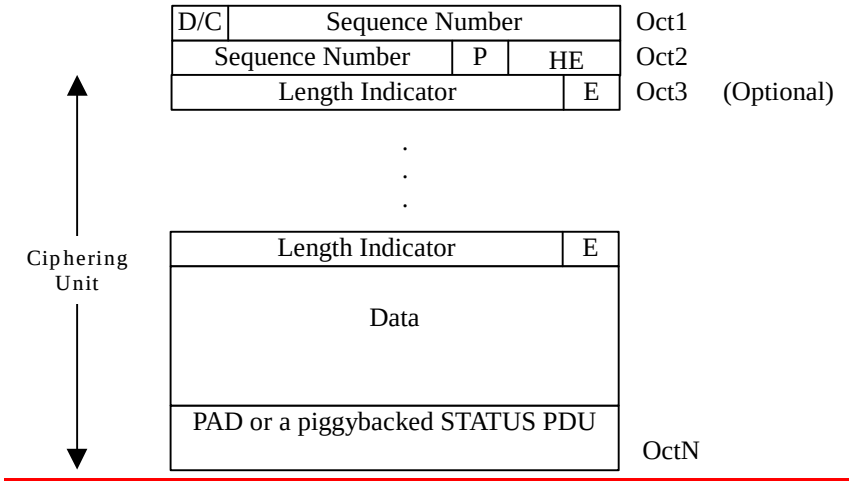


Figure 9.y: Ciphering unit for an AMD PDU

The ciphering algorithm and key to be used are configured by upper layers [8] and the ciphering method shall be applied as specified in [10].

The parameters that are required by RLC for ciphering are defined in [10] and are input to the ciphering algorithm. The parameters required by RLC which are provided by upper layers [8] are listed below:

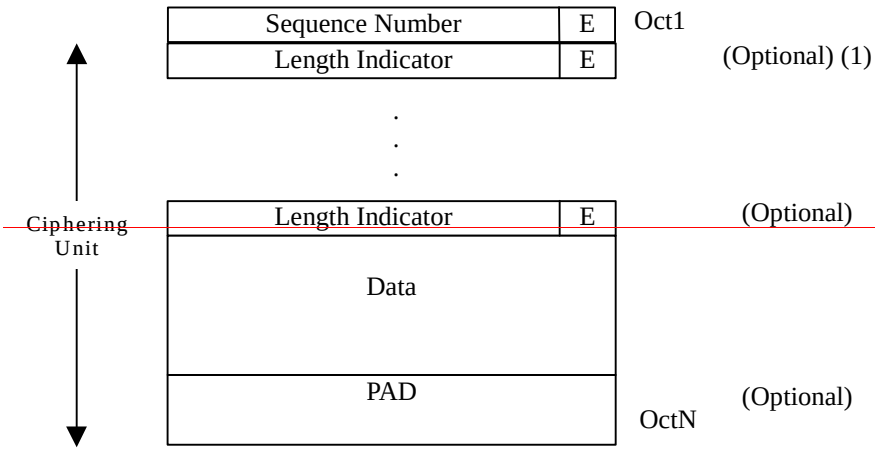
- RLC AM HFN (Hyper frame number for radio bearers that are mapped onto RLC AM)
- RLC UM HFN (Hyper frame number for radio bearers that are mapped onto RLC UM)
- BEARER (Radio Bearer ID)
- CK (Ciphering Key)

11 Elementary procedures

11.7 ~~Ciphering~~Void

~~The ciphering function is performed in RLC, according to the following rules if a radio bearer is using a non-transparent RLC mode (AM or UM). The data unit that is ciphered, depends on the transmission mode as described below.~~

- ~~For RLC UM mode, the ciphering unit is the UMD PDU excluding the first octet, i.e. excluding the RLC UMD PDU header. This is shown below in Figure 11.7.1.~~



~~Figure 11.7.1: Ciphering unit for a UMD PDU~~

- ~~For RLC AM mode, the ciphering unit is the AMD PDU excluding the first two octets, i.e. excluding the RLC AMD PDU header. This is shown below in Figure 11.7.2.~~

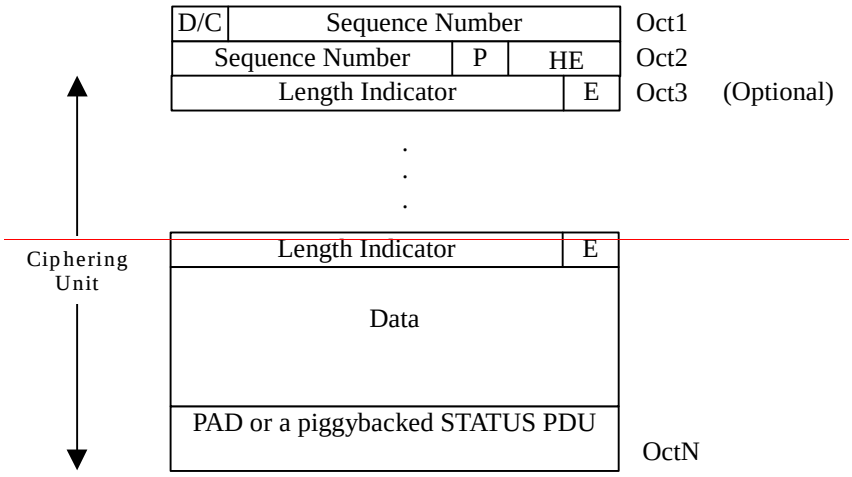


Figure 11.7.1: Ciphering unit for an AMD PDU

The ciphering algorithm and key to be used are configured by upper layers [8] and the ciphering method shall be applied as specified in [10].

The parameters that are required by RLC for ciphering are defined in [10] and are input to the ciphering algorithm. The parameters required by RLC which are provided by upper layers [8] are listed below:

- RLC AM HFN (Hyper frame number for radio bearers that are mapped onto RLC AM)
- RLC UM HFN (Hyper frame number for radio bearers that are mapped onto RLC UM)
- BEARER (Radio Bearer ID)
- CK (Ciphering Key)

11.8 RLC re-establishment procedureVoid

The RLC re-establishment procedure is used when higher layer request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. All RLC PDUs in the RLC receiver and transmitter shall be discarded. The hyper frame number (HFN) in UL and DL shall be set to the value configured by higher layer. After the re-establishment, RLC shall enter the data transfer ready state.

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

Tdoc R2-011352

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **136** ⌘ rev **-** ⌘ Current version: **4.0.0** ⌘

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

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

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

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

Use one of the following releases:
2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
REL-4 *(Release 4)*
REL-5 *(Release 5)*

Reason for change: ⌘ 25.322 is not aligned with 25.301.

Summary of change: ⌘
1. All the RLC specific functions described in section 9.7 are listed in section 5.
2. 2. Since RLC re-establishment and Ciphering are known to be 'Funciton', they are moved from section 11 Elementary procedure to section 9.7 Specific functions.

Rev 1 : Some editorial changes are made, and they are highlighted.

Backwards compatibility analysis

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

Consequences if not approved: ⌘ Misalignment between the specs.

Clauses affected: ⌘ 5, 8.2, 9.7.5, 9.7.6, 9.7.7 (new), 9.7.8 (new), 11.7, 11.8

Other specs affected: ⌘
☐ Other core specifications
☐ Test specifications
☐ O&M Specifications
⌘

Other comments: ⌘

How to create CRs using this form:
Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm.
Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

5 Functions

The following functions are supported by RLC. For a detailed description of the following functions see [3]:

- Segmentation and reassembly.
- Concatenation.
- Padding.
- Transfer of user data.
- Error correction.
- In-sequence delivery of higher layer PDUs.
- Duplicate detection.
- Flow control.
- Sequence number check.
- Protocol error detection and recovery.
- Ciphering.
- Polling.
- Status transmission.
- SDU discard.
- Estimated PDU Counter (EPC) mechanism.
- Suspend/resume function.
- Stop/continue function.
- Re-establishment function.

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, the state variables and configurable parameters are initialised according to subclause ~~11.8~~9.7.7. 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. RLC shall always be re-established if the PDU size is changed.

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

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

7) The AM_parameters are only applicable for AM operation. It contains PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

9.7 Specific functions

9.7.5 Local Suspend function for acknowledged and unacknowledged mode

The ~~higher~~upper layer (RRC) may suspend the RLC entity. The CRLC-SUSPEND-Req indicates this request. The RLC entity shall, when receiving this request, not send RLC PDUs with SN≥VT(S)+N for AM and SN≥VT(US)+N for UM ,where N is given by the CRLC_SUSPEND-Req primitive. The RLC entity shall acknowledge the CRLC-SUSPEND-Req ordering a suspend with a CRLC-SUSPEND-Conf with the current value of VT(S) for AM and VT(US) for UM. The suspend state is left when a CRLC-RESUME-Req primitive indicating resume is received.

9.7.6 RLC ~~s~~Stop, RLC Continue function for acknowledged and unacknowledged mode

The ~~higher~~upper layer may stop the RLC entity. The stop parameter in the CRLC-CONFIG-Req primitive indicates this request. The RLC entity shall, when receiving this request, not submit any RLC PDUs to lower layer or receive any RLC PDUs. The data transmission and reception is continued when the continue parameter in the CRLC-CONFIG-Req primitive is received. If the continue parameter is received when the RLC entity is not stopped, no action shall be taken.

When the RLC entity is stopped, the RLC timers are not affected. Triggered polls and status transmissions are delayed until the RLC entity is continued.

9.7.7 RLC re-establishment function for acknowledged and unacknowledged mode

The RLC re-establishment function is used when upper layer request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. All RLC PDUs in the RLC receiver and transmitter shall be discarded. The hyper frame number (HFN) in UL and DL shall be set to the value configured by upper layer. After the re-establishment, RLC shall enter the data transfer ready state.

9.7.8 Ciphering for acknowledged and unacknowledged mode

The ciphering function is performed in RLC, according to the following rules if a radio bearer is using a non-transparent RLC mode (AM or UM). The data unit that is ciphered, depends on the transmission mode as described below.

- For RLC UM mode, the ciphering unit is the UMD PDU excluding the first octet, i.e. excluding the RLC UMD PDU header. This is shown below in Figure 9.x.

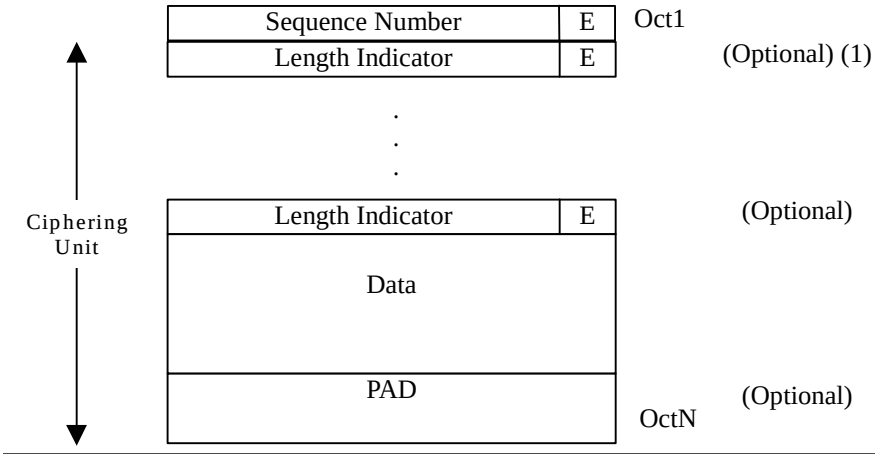


Figure 9.x: Ciphering unit for a UMD PDU

- For RLC AM mode, the ciphering unit is the AMD PDU excluding the first two octets, i.e. excluding the RLC AMD PDU header. This is shown below in Figure 9.y.

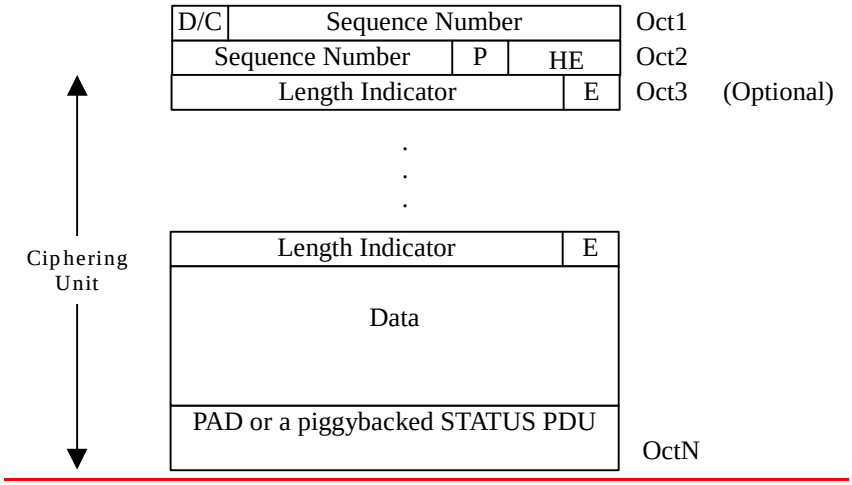


Figure 9.y: Ciphering unit for an AMD PDU

The ciphering algorithm and key to be used are configured by upper layers [8] and the ciphering method shall be applied as specified in [10].

The parameters that are required by RLC for ciphering are defined in [10] and are input to the ciphering algorithm. The parameters required by RLC which are provided by upper layers [8] are listed below:

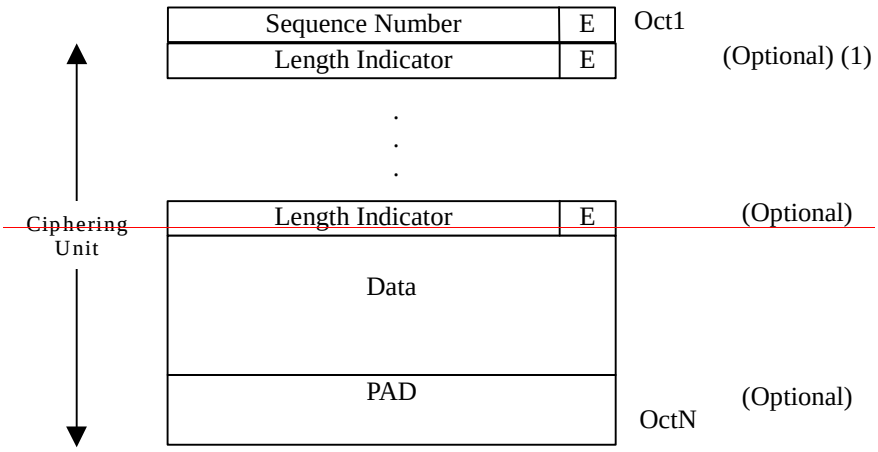
- RLC AM HFN (Hyper frame number for radio bearers that are mapped onto RLC AM)
- RLC UM HFN (Hyper frame number for radio bearers that are mapped onto RLC UM)
- BEARER (Radio Bearer ID)
- CK (Ciphering Key)

11 Elementary procedures

11.7 ~~Ciphering~~Void

~~The ciphering function is performed in RLC, according to the following rules if a radio bearer is using a non-transparent RLC mode (AM or UM). The data unit that is ciphered, depends on the transmission mode as described below.~~

- ~~For RLC UM mode, the ciphering unit is the UMD PDU excluding the first octet, i.e. excluding the RLC UMD PDU header. This is shown below in Figure 11.7.1.~~



~~Figure 11.7.1: Ciphering unit for a UMD PDU~~

- ~~For RLC AM mode, the ciphering unit is the AMD PDU excluding the first two octets, i.e. excluding the RLC AMD PDU header. This is shown below in Figure 11.7.2.~~

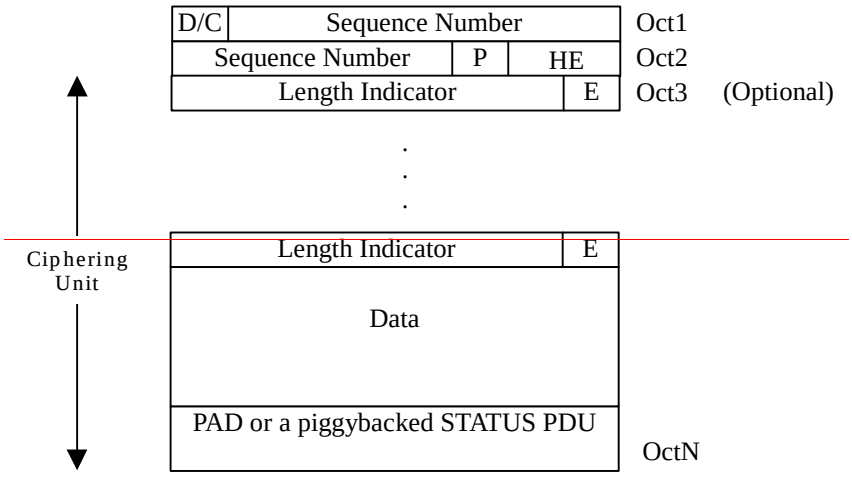


Figure 11.7.1: Ciphering unit for an AMD PDU

The ciphering algorithm and key to be used are configured by upper layers [8] and the ciphering method shall be applied as specified in [10].

The parameters that are required by RLC for ciphering are defined in [10] and are input to the ciphering algorithm. The parameters required by RLC which are provided by upper layers [8] are listed below:

- RLC AM HFN (Hyper frame number for radio bearers that are mapped onto RLC AM)
- RLC UM HFN (Hyper frame number for radio bearers that are mapped onto RLC UM)
- BEARER (Radio Bearer ID)
- CK (Ciphering Key)

11.8 RLC re-establishment procedureVoid

The RLC re-establishment procedure is used when higher layer request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. All RLC PDUs in the RLC receiver and transmitter shall be discarded. The hyper frame number (HFN) in UL and DL shall be set to the value configured by higher layer. After the re-establishment, RLC shall enter the data transfer ready state.

3GPP TSG-RAN Meeting #21
Busan, Korea, 5/21/2001

R2-011318

CR-Form-v4

CHANGE REQUEST

⌘ **25.322 CR 137** ⌘ ev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Clarification on RLC re-establishment
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	5/15/2001
Category:	⌘	**F**
Release:	⌘	R99

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change: ⌘ Currently, though not explicitly stated in the specifications, it was assumed that re-establishment only applies to AM RLC. It turns out however, that in the case of SRNS relocation, it is necessary to be able to re-establish UM entities also, otherwise it is possible that state variables will lose synchronization.

Changes made in R2-ADHOC12
It was agreed that instead of performing re-establishment when the RLC size is changed in UM, the problem that could arise with the LI is directly addressed.
It is still agreed that re-establishment should apply to UM entities.

Summary of change: ⌘ Clarified, both in the primitive and in the re-establishment procedure sections that re-establishment applied to both AM and UM entities.

Changes made in R2-ADHOC12:
The changes in R2-011120 were incorporated.
Changed the name of the primitive parameter RLC size to AM RLC size and size of largest UM PDU to largest UM PDU size.
Changed the wording in the LI section to make it clear that the aforementioned parameters define the size of the LI.
Specified the behaviour when the LI length changes from 15 bits to 7 bits and the LI type that needs to be transmitted is not available.

Changes made in R2-011318:
Clarified that the elimination of the last octet was done at the receiver.
Reinstated the sentence clarifying that the LI length is only linked to the PDU sizes.
Clarified that the particular case where the LI length passes from 15 to 7 bits only applies to UM.

Backward Compatibility Analysis:
This change is backward compatible.
Correction to a function where the specification was :
- Procedural text or rules were missing.

		Would not affect implementations behaving like indicated in the CR, would affect implementations supporting the corrected functionality otherwise~~a clarification and is aligned with 3GPP-R2 understanding but should be checked against implementations.~~
Consequences if not approved:	⌘	The use of the re-establishment procedure will remain ambiguous. This ambiguity may lead to interoperability problems when SRNS relocation is performed.

Clauses affected:	⌘	6, 8.2, 9.2.2.8, 11.8		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:

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1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

6 Services provided to upper layers

This clause describes the different services provided by RLC to higher layers. It also includes mapping of functions to different services. For a detailed description of the following functions see [3].

- **Transparent data transfer Service:**

  The following functions are needed to support transparent data transfer:

  - Segmentation and reassembly.
  - Transfer of user data.

- **Unacknowledged data transfer Service:**

  The following functions are needed to support unacknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.
  - Transfer of user data.
  - Ciphering.
  - Sequence number check.

- **Acknowledged data transfer Service:**

  The following functions are needed to support acknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.
  - Transfer of user data.
  - Error correction.
  - In-sequence delivery of higher layer PDUs.
  - Duplicate detection.
  - Flow Control.
  - Protocol error detection and recovery.
  - Ciphering.

- **Maintenance of QoS as defined by upper layers~~QoS setting~~.**

- **Notification of unrecoverable errors.**

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, where re-establishment is applicable for AM and UM RLC entities only. If it indicates (re-)establishment, the state variables and configurable parameters are initialised according to subclause 11.8. 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. AM RLC entities shall always be re-established if the AMD PDU size is changed. The modification of other protocol parameters does not warrant re-establishment.

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

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

7) The AM_parameters are only applicable for AM operation. It contains AMD PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5) and largest UMD PDU size (see subclause 9.2.2.8).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

9.2.2.8 Length Indicator (LI)

The Length Indicator is used to indicate, each time, the end of an SDU occurs in the PDU. 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 PDUs that they refer to. The size of the Length Indicator may be either 7bits or 15bits. The value of a Length Indicator shall not exceed the values specified in subclauses 11.2.4.2 and 11.3.4.5.

A Length Indicator group is a set of Length Indicators that refer to a PDU. 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 PDU, 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 the last segment of an SDU exactly ends at the end of a PDU and there is no LI that indicates the end of the SDU, the next Length Indicator, shall be placed as the first Length Indicator in the following PDU and have value LI=0.

In the case where a PDU contains a 15-bit LI indicating that an SDU ends with one octet left in the PDU, the last octet of this PDU shall be ignored and shall not be filled with the first octet of the next SDU data.

In the case where 15-bit Length Indicators are used for the previous PDU and the last segment of an RLC SDU is one octet short of exactly filling the PDU, and: ~~the previous RLC PDU~~, ~~and 15-bit Length Indicators are used,~~

- if a 15-bit ~~the~~ Length Indicator is used for the following PDU then the LI with value LI=111 1111 1111 1011 shall be placed as the first Length Indicator ~~in the following PDU and have value LI=111 1111 1111 1011.~~ The remaining one octet shall be ignored at the receiver

- if a 7-bit Length Indicator is used for the following PDU then the LI with value LI=0000000 shall be placed as the first Length indicator and its SN shall be incremented by 2 before it is transmitted (Note this can only occur in UM).

~~The remaining one octet in the previous RLC PDU shall be ignored.~~

A PDU that has unused space, to be referred to as padding, shall use a Length Indicator to indicate that this space is used as padding unless the padding size is one octet for PDUs with 15-bit LIs. A padding Length Indicator must be placed after any Length Indicators for a PDU.

All unused space in a PDU 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 PDU.

If SDU discard with explicit signalling is used an AMD PDU can contain a maximum number of 15 LIs indicating the end of an SDU and the rest of the AMD PDU space shall be used as padding/piggybacked STATUS PDU.

For AM, 7bit indicators shall be used if the AMDD PDU size is ≤ l26 octets. Otherwise 15bit indicators shall be used. For UM, 7bit indicators shall be used if the largest UMDD 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. TBetween RLC modifications the length of the Length Indicator is the same for all UMD PDUs. The length of the Length Indicator is always the same for all UMD PDUs or AMD PDUs, for one RLC entity.

If the maximum RLC PDU size for an RLC entity is not explicitly configured (e.g. on FACH), the length of the Length Indicator is determined by the maximum configured TB size for the transport channel on which the logical channel is mapped.

Length: 7bits

Bit	Description
0000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
1111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111111	The rest of the RLC PDU is padding. The padding length can be zero.

Length: 15bits

Bit	Description
000000000000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
111111111111011	The last segment of an RLC SDU was one octet short of exactly filling the previous RLC PDU and there is no LI that indicates the end of the SDU in the previous RLC PDU. The remaining one octet in the previous RLC PDU is ignored.
111111111111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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).
111111111111110	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
111111111111111	The rest of the RLC PDU is padding. The padding length can be zero.

11.8 RLC re-establishment procedure

The RLC re-establishment procedure is applicable for AM and UM and is used when higher layer request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. In AM, Aall RLC PDUs in the RLC receiver and transmitter shall be discarded. In UM, the RLC SDU for which one or more segments have been submitted to a lower layer in the transmitter shall be discarded. The hyper frame

number (HFN) in UL and DL shall be set to the value configured by higher layer. After the re-establishment, RLC shall enter the data transfer ready state.

3GPP TSG-RAN Meeting #21
Busan, Korea, 5/21/2001

R2-011505

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **138** ⌘ ev **r1** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Clarification on RLC re-establishment
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	5/30/2001
Category:	⌘	**A**
Release:	⌘	REL-4

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change:	⌘	Currently, though not explicitly stated in the specifications, it was assumed that re-establishment only applies to AM RLC. It turns out however, that in the case of SRNS relocation, it is necessary to be able to re-establish UM entities also, otherwise it is possible that state variables will lose synchronization. Changes made in R2-ADHOC12 It was agreed that instead of performing re-establishment when the RLC size is changed in UM, the problem that could arise with the LI is directly addressed. It is still agreed that re-establishment should apply to UM entities.
Summary of change:	⌘	Clarified, both in the primitive and in the re-establishment procedure sections that re-establishment applied to both AM and UM entities. Changes made in R2-ADHOC12: The changes in R2-011120 were incorporated. Changed the name of the primitive parameter RLC size to AM RLC size and size of largest UM PDU to largest UM PDU size. Changed the wording in the LI section to make it clear that the aforementioned parameters define the size of the LI. Specified the behaviour when the LI length changes from 15 bits to 7 bits and the LI type that needs to be transmitted is not available. Changes made in R2-011318: Clarified that the elimination of the last octet was done at the receiver. Reinstated the sentence clarifying that the LI length is only linked to the PDU sizes. Clarified that the particular case where the LI length passes from 15 to 7 bits only applies to UM.
Consequences if not approved:	⌘	The use of the re-establishment procedure will remain ambiguous. This ambiguity may lead to interoperability problems when SRNS relocation is performed.

Clauses affected:	⌘	6, 8.2, 9.2.2.8, 11.8		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

6 Services provided to upper layers

This clause describes the different services provided by RLC to higher layers. It also includes mapping of functions to different services. For a detailed description of the following functions see [3].

- **Transparent data transfer Service:**

  The following functions are needed to support transparent data transfer:

  - Segmentation and reassembly.
  - Transfer of user data.

- **Unacknowledged data transfer Service:**

  The following functions are needed to support unacknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.
  - Transfer of user data.
  - Ciphering.
  - Sequence number check.

- **Acknowledged data transfer Service:**

  The following functions are needed to support acknowledged data transfer:

  - Segmentation and reassembly.
  - Concatenation.
  - Padding.
  - Transfer of user data.
  - Error correction.
  - In-sequence delivery of higher layer PDUs.
  - Duplicate detection.
  - Flow Control.
  - Protocol error detection and recovery.
  - Ciphering.

- **Maintenance of QoS as defined by upper layers~~QoS setting~~.**

- **Notification of unrecoverable errors.**

8.2 Primitive parameters

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 an RLC-AM-DATA or an 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 reception of the RLC SDU by the peer-RLC AM entity.

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, where re-establishment is applicable for AM and UM RLC entities only. If it indicates (re-)establishment, the state variables and configurable parameters are initialised according to subclause 11.8. 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. AM RLC entities shall always be re-established if the AMD PDU size is changed. The modification of other protocol parameters does not warrant re-establishment.

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

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

7) The AM_parameters are only applicable for AM operation. It contains AMD PDU size, In-sequence Delivery Indication (indicating that SDUs shall be deliver to the upper layers in sequence or out of sequence), 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), Periodical Status blocking configuration (see subclause 9.7.2), SDU discard mode (see subclause 9.7.3), Minimum WSN (see subclause 9.2.2.11.3), and Send MRW. The Minimum WSN shall always be greater than or equal to the number of transport blocks in the smallest transport block set. The Send MRW indicates that the MRW SUFI shall be sent to the receiver even if no segments of the expired SDU were submitted to a lower layer.

8) The parameter DiscardInfo indicates to upper layer the discarded RLC SDU in the peer-RLC AM entity. 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.

9) The Stop parameter indicates that the RLC entity shall not transmit or receive RLC PDUs. The Continue parameter indicates that the RLC entity shall continue transmission and reception of RLC PDUs.

10) The parameter Use special LI indicates that the LI indicating that an RLC SDU begins in the beginning of an RLC PDU (the first data octet of the PDU is the first octet of an SDU) shall be used. If the RLC SDU does not begin in the beginning of the RLC PDU, or if the LI indicating that an SDU ended exactly in the end or one octet short (only when 15 bit LI is used) of the previous RLC PDU is present, the LI shall not be used.

11) The UM_parameters are only applicable for UM operation. It contains Timer_Discard value (see subclause 9.5) and largest UMD PDU size (see subclause 9.2.2.8).

12) The TM_parameters are only applicable for TM operation. It contains Segmentation indication (see subclauses 9.2.2.9 and 11.1.2.1) and Timer_Discard value (see subclause 9.5).

9.2.2.8 Length Indicator (LI)

The Length Indicator is used to indicate, each time, the end of an SDU occurs in the PDU. 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 PDUs that they refer to. The size of the Length Indicator may be either 7bits or 15bits. The value of a Length Indicator shall not exceed the values specified in subclauses 11.2.4.2 and 11.3.4.5.

A Length Indicator group is a set of Length Indicators that refer to a PDU. 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 PDU, 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 the last segment of an SDU exactly ends at the end of a PDU and there is no LI that indicates the end of the SDU, the next Length Indicator, shall be placed as the first Length Indicator in the following PDU and have value LI=0.

In the case where a PDU contains a 15-bit LI indicating that an SDU ends with one octet left in the PDU, the last octet of this PDU shall be ignored and shall not be filled with the first octet of the next SDU data.

In the case where 15-bit Length Indicators are used for the previous PDU and the last segment of an RLC SDU is one octet short of exactly filling the PDU, and: ~~the previous RLC PDU~~, ~~and 15-bit Length Indicators are used,~~

- if a 15-bit ~~the~~ Length Indicator is used for the following PDU then the LI with value LI=111 1111 1111 1011 shall be placed as the first Length Indicator ~~in the following PDU and have value LI=111 1111 1111 1011.~~ The remaining one octet shall be ignored at the receiver

- if a 7-bit Length Indicator is used for the following PDU then the LI with value LI=0000000 shall be placed as the first Length indicator and its SN shall be incremented by 2 before it is transmitted (Note this can only occur in UM).

~~The remaining one octet in the previous RLC PDU shall be ignored.~~

A PDU that has unused space, to be referred to as padding, shall use a Length Indicator to indicate that this space is used as padding unless the padding size is one octet for PDUs with 15-bit LIs. A padding Length Indicator must be placed after any Length Indicators for a PDU.

All unused space in a PDU 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 PDU.

If SDU discard with explicit signalling is used an AMD PDU can contain a maximum number of 15 LIs indicating the end of an SDU and the rest of the AMD PDU space shall be used as padding/piggybacked STATUS PDU.

For AM, 7bit indicators shall be used if the AMDD PDU size is ≤ l26 octets. Otherwise 15bit indicators shall be used. For UM, 7bit indicators shall be used if the largest UMDD 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. TBetween RLC modifications the length of the Length Indicator is the same for all UMD PDUs. The length of the Length Indicator is always the same for all UMD PDUs or AMD PDUs, for one RLC entity.

If the maximum RLC PDU size for an RLC entity is not explicitly configured (e.g. on FACH), the length of the Length Indicator is determined by the maximum configured TB size for the transport channel on which the logical channel is mapped.

Length: 7bits

Bit	Description
0000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
1111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
1111111	The rest of the RLC PDU is padding. The padding length can be zero.

Length: 15bits

Bit	Description
000000000000000	The previous RLC PDU was exactly filled with the last segment of an RLC SDU and there is no LI that indicates the end of the SDU in the previous RLC PDU.
111111111111011	The last segment of an RLC SDU was one octet short of exactly filling the previous RLC PDU and there is no LI that indicates the end of the SDU in the previous RLC PDU. The remaining one octet in the previous RLC PDU is ignored.
111111111111100	UMD PDU: The first data octet in this RLC PDU is the first octet of an RLC SDU. AMD PDU: 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).
111111111111110	AMD PDU: The rest of the RLC PDU includes a piggybacked STATUS PDU. UMD PDU: Reserved (PDUs with this coding will be discarded by this version of the protocol).
111111111111111	The rest of the RLC PDU is padding. The padding length can be zero.

11.8 RLC re-establishment procedure

The RLC re-establishment procedure is applicable for AM and UM and is used when higher layer request the RLC entity to be re-established.

When an RLC entity is re-established, the state variables in the RLC entity (see 9.4) shall be reset to their initial value and the configurable parameters shall be set to their configured value. In AM, Aall RLC PDUs in the RLC receiver and transmitter shall be discarded. In UM, the RLC SDU for which one or more segments have been submitted to a lower layer in the transmitter shall be discarded. The hyper frame

number (HFN) in UL and DL shall be set to the value configured by higher layer. After the re-establishment, RLC shall enter the data transfer ready state.

3GPP TSG-RAN2 Meeting #21

Pusan, South Korea, May 21 – 25, 2001

Tdoc R2-011320
Tdoc R2-011163

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **139** ⌘ ev **r1** ⌘ Current version: **3.6.0** ⌘

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

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

Title:	⌘	Corrections and clarifications to the LIST and RLIST SUFI types
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	May 21, 2001
Category:	⌘	**F**
Release:	⌘	R99

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

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
REL-4 (Release 4)
REL-5 (Release 5)

Reason for change: ⌘

LIST SUFI Type
The error handling for LIST SUFI when the LENGTH field contains an invalid value is incorrectly specified.

The definition of the LENGTH field of the LIST SUFI given in section 9.2.2.11.4 indicates that “the value of “0000” is invalid and the list is discarded”.

This definition is incorrect in that if the value of the length is 0, the LIST SUFI **alone** cannot be discarded since we don’t know what its length is, and consequently where the next SUFI begins. Instead, **the entire** STATUS PDU must be discarded.

RLIST SUFI Type
The specification for handling of error cases for RLIST SUFI should be added.

The value of the LENGTH field of the RLIST SUFI, as defined in section 9.2.2.11.6, indicates the number of 4-bit codewords (CW) in the RLIST SUFI.

There is a possibility of error cases when:
- the last CW as indicated by the value of the LENGTH field **does not** contain a “1” in the least significant (rightmost) position, or
- the last CW as indicated by the value of the LENGTH field **does** contain a “1” in the least significant (rightmost) position but is a special “error burst indicator” codeword (CW) which always needs to be followed by another set of one or more codewords (CW).

A solution in this case is to discard the entire STATUS PDU, as we’re not sure if the value of LENGTH was erroneous OR the CW was encoded incorrectly. Consequently, we cannot skip the RLIST SUFI, and continue processing the next SUFI as we don’t know where the next SUFI begins.

		Backwards compatibility: This CR can be considered as backwards compatible, since it is consistent with current WG2 assumptions, but it needs to be considered in implementation
Summary of change:	⌘	**LIST SUFI Type** The wording of the definition of the LENGTH field in the LIST SUFI is changed to provide for the correct handling of the Status PDU by the transmitting RLC AM entity. That is, in case the LENGTH field of the LIST SUFI has an invalid value of "0000", the **entire** Status PDU shall be discarded (and not just the erroneous SUFI field). **RLIST SUFI Type** The description is added to the RLIST SUFI section to indicate that in the cases when the previously-mentioned errors are detected, the entire STATUS PDU shall be discarded.
Consequences if not approved:	⌘	Inconsistent implementations.

Clauses affected:	⌘	9.2.2.11.4, 9.2.2.11.6		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

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 number of pairs as shown in Figure 9.11 below:

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

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

SN_i

Length: 12 bits

Sequence number of PDU, which was not correctly received.

L_i

Length: 4 bits

Number of consecutive PDUs not correctly received following PDU with sequence number SN_i.

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 9.13 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.

FSN

Length: 12 bits

The sequence number for the first erroneous PDU in the RLIST, i.e. LENGTH="0000" means that only FSN is present in the SUFI.

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 PDU up to and including the next erroneous PDU.

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 PDUs (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.

If the last CW, as indicated by the value of the LENGTH field, does not contain a "1" in its rightmost position, or the last CW, as indicated by the value of the LENGTH field does contain a "1" in its rightmost position, but is a special "error burst indicator" CW, the encoding of the RLIST SUFI is invalid, and the STATUS PDU is discarded.

3GPP TSG-RAN2 Meeting #21 ***Tdoc R2-011354***

Pusan, South Korea, May 21 – 25, 2001

CR-Form-v4

CHANGE REQUEST

⌘ **25.322** **CR** **140** ⌘ ev **-** ⌘ Current version: **4.0.0** ⌘

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

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

Title:	⌘	Corrections and clarifications to the LIST and RLIST SUFI types
Source:	⌘	TSG-RAN WG2
Work item code:	⌘	TEI
Date:	⌘	May 24, 2001
Category:	⌘	**A**
Release:	⌘	Rel-4

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

Use one of the following releases:
2 *(GSM Phase 2)*
R96 *(Release 1996)*
R97 *(Release 1997)*
R98 *(Release 1998)*
R99 *(Release 1999)*
REL-4 *(Release 4)*
REL-5 *(Release 5)*

Reason for change: ⌘

LIST SUFI Type
The error handling for LIST SUFI when the LENGTH field contains an invalid value is incorrectly specified.

The definition of the LENGTH field of the LIST SUFI given in section 9.2.2.11.4 indicates that “the value of “0000” is invalid and the list is discarded”.

This definition is incorrect in that if the value of the length is 0, the LIST SUFI **alone** cannot be discarded since we don’t know what its length is, and consequently where the next SUFI begins. Instead, **the entire** STATUS PDU must be discarded.

RLIST SUFI Type
The specification for handling of error cases for RLIST SUFI should be added.

The value of the LENGTH field of the RLIST SUFI, as defined in section 9.2.2.11.6, indicates the number of 4-bit codewords (CW) in the RLIST SUFI.

There is a possibility of error cases when:
- the last CW as indicated by the value of the LENGTH field **does not** contain a “1” in the least significant (rightmost) position, or
- the last CW as indicated by the value of the LENGTH field **does** contain a “1” in the least significant (rightmost) position but is a special “error burst indicator” codeword (CW) which always needs to be followed by another set of one or more codewords (CW).

A solution in this case is to discard the entire STATUS PDU, as we’re not sure if the value of LENGTH was erroneous OR the CW was encoded incorrectly. Consequently, we cannot skip the RLIST SUFI, and continue processing the next SUFI as we don’t know where the next SUFI begins.

Summary of change:	⌘	**LIST SUFI Type** The wording of the definition of the LENGTH field in the LIST SUFI is changed to provide for the correct handling of the Status PDU by the transmitting RLC AM entity. That is, in case the LENGTH field of the LIST SUFI has an invalid value of "0000", the **entire** Status PDU shall be discarded (and not just the erroneous SUFI field). **RLIST SUFI Type** The description is added to the RLIST SUFI section to indicate that in the cases when the previously-mentioned errors are detected, the entire STATUS PDU shall be discarded.
Consequences if not approved:	⌘	Inconsistent implementations.

Clauses affected:	⌘	9.2.2.11.4, 9.2.2.11.6		
Other specs affected:	⌘	☐ Other core specifications ☐ Test specifications ☐ O&M Specifications	⌘	
Other comments:	⌘			

How to create CRs using this form:

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

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

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 number of pairs as shown in Figure 9.11 below:

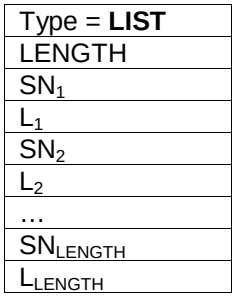

Figure 9.11: The List fields in a STATUS PDU for a list

LENGTH

Length: 4 bits

The number of (SN_i , L_i)-pairs in the super-field of type LIST. The value "0000" is invalid and the ~~list~~STATUS PDU is discarded.

SN_i

Length: 12 bits

Sequence number of PDU, which was not correctly received.

L_i

Length: 4 bits

Number of consecutive PDUs not correctly received following PDU with sequence number SN_i.

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 9.13 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.

FSN

Length: 12 bits

The sequence number for the first erroneous PDU in the RLIST, i.e. LENGTH="0000" means that only FSN is present in the SUFI.

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 PDU up to and including the next erroneous PDU.

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 PDUs (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.

If the last CW, as indicated by the value of the LENGTH field, does not contain a "1" in its rightmost position, or the last CW, as indicated by the value of the LENGTH field does contain a "1" in its rightmost position, but is a special "error burst indicator" CW, the encoding of the RLIST SUFI is invalid, and the STATUS PDU is discarded.