TSG-RAN Meeting #22 **RP-030620**
Maui, USA, 09-12 December 2003

Title: **25.322 CRs to Rel-4 (and linked Rel-5)**

Source: **TSG-RAN WG2**

Agenda item: **7.3.4**

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc-2nd-Level	Workitem
25.322	251	-	Rel-4	Indication of discarded SDU in RLC Reset and Re-establishment	F	4.10.0	4.11.0	R2-032602	TEI4
25.322	252	-	Rel-5	Indication of discarded SDU in RLC Reset and Re-establishment	A	5.6.0	5.7.0	R2-032603	TEI4

3GPP TSG-RAN WG2 Meeting #39
San Diego, USA, 17th-21st November, 2003

Tdoc ⌘ R2-032602

CR-Form-v7

CHANGE REQUEST

⌘ **25.322** **CR** **251** ⌘ **rev** **-** ⌘ Current version: **4.10.0** ⌘

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

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	Indication of discarded SDU in RLC Reset and Re-establishment
Source:	⌘	RAN WG2
Work item code:	⌘	TEI4
Date:	⌘	Nov 2003
Category:	⌘	**F**
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)*
Rel-6	*(Release 6)*

Reason for change:	⌘	When SDUs are discarded, RLC informs upper layer of the discarded SDUs in order for upper layer to behave adequately, e.g. PDCP manages Full Header transmission. Currently, only the SDUs discarded by SDU discard function are informed to upper layer. However, SDUs are also discarded during RLC Reset or RLC Re-establishment, which should also be informed to upper layer.
Summary of change:	⌘	SDUs discarded during RLC Reset or RLC Re-establishment are also informed to upper layer. **Isolated Impact Analysis** Impacted functionality: The CR has an isolated impact. Only the RLC Reset and RLC Re-establishment are affected. Correction type: Correction of a function which is incomplete in the current specification. Interoperability: No interoperability problems are foreseen.
Consequences if not approved:	⌘	IF some SDUs are discarded during RLC Reset or RLC Re-establishment, upper layer like PDCP might have inefficient behavior, e.g. degradation of Header Compression efficiency.

Clauses affected:	⌘	9.7.7, 11.4.3, 11.4.4, 11.4.5.3

		Y	N			
Other specs affected:	⌘		X	Other core specifications	⌘	
			X	Test specifications		

	X	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/specs/CR.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.

9.7.7 RLC re-establishment function for acknowledged and unacknowledged mode

The upper layers may re-establish an RLC entity.

The RLC re-establishment function is applicable for AM and UM and is used when upper layers request an RLC entity to be re-established.

When an RLC entity is re-established by upper layers, the RLC entity shall:

- reset the state variables to their initial value;
- set the configurable parameters to their configured value;
- set the hyper frame number (HFN) in UL and DL to the value configured by upper layers;
- if the RLC entity is operating in unacknowledged mode:
  - if it is a receiving UM RLC entity:
    - discard all UMD PDUs.
  - if it is a transmitting UM RLC entity:
    - discard the RLC SDUs for which one or more segments have been submitted to a lower layer;
    - if requested:
      - inform the upper layers of the discarded SDUs;
    - not stop Timer_Discard if the RLC SDU is not discarded.
- otherwise if the RLC entity is operating in acknowledged mode:
  - discard all AMD PDUs and control PDUs in both the receiving side and the transmitting side of the RLC entity;
  - if requested for the transmitting side:
    - inform the upper layers of the discarded SDUs;
  - stop all timers described in subclause 9.5 except Timer_Poll_Periodic and Timer_Status_Periodic.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the re-establishment function until the end of the next TTI.

11.1 Transparent mode data transfer procedure

11.1.1 General

The transparent mode data transfer procedure is used for transferring data between two RLC peer entities, which are operating in transparent mode. Data is transferred from Sender to Receiver. This procedure should only apply to entities in DATA_TRANSFER_READY state. Figure 11.1 below illustrates the elementary procedure for transparent mode data transfer.

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).

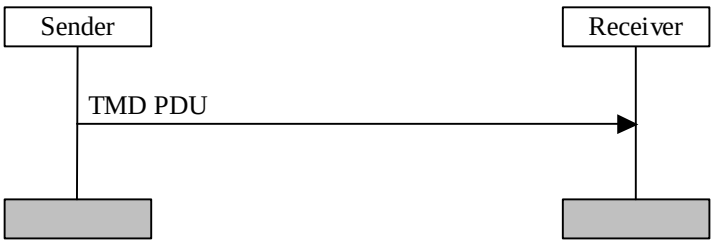

Figure 11.1: Transparent mode data transfer procedure

11.1.2 Transmission of TMD PDU

Upon a request of transparent mode data transfer from upper layer, the Sender shall:

- if no SDU discard configuration has been made by upper layers:
  - discard SDUs received in previous TTIs upon reception of new SDUs from upper layers (see subclause 9.7.3.5);
- otherwise (if "Timer Based SDU Discard without explicit signalling" is configured):
  - start a timer Timer_Discard for each SDU received from upper layers (see subclause 9.7.3);
- schedule the RLC SDUs that have been received from upper layer for transmission;
- if one or more RLC SDUs have been scheduled for transmission:
  - notify the lower layer of reception of data from upper layers;
  - perform the actions specified in subclause 11.1.2.2.

11.1.2.1 TMD PDU contents to set

The Sender shall set the data field of the TMD PDU to all or a subset of the data contained in the SDU as described in subclause 11.1.2.2.

11.1.2.2 Submission of TMD PDUs to the lower layer

If one or more RLC SDUs have been scheduled for transmission, according to subclause 11.1.2, the Sender shall:

- if it is configured for segmented operation:
  - inform the lower layer of the size of the next SDU to be sent;
  - segment the SDU according to the PDU size indicated by the lower layer.
- otherwise (the Sender is configured for non-segmented operation):
  - inform the lower layer of the number and size of SDUs available for transmission;
- submit to the lower layer, the requested number of TMD PDUs;
- buffer the SDUs that are not submitted to the lower layer according to the discard configuration (see subclause 9.7.3).

11.1.3 Reception of TMD PDU

Upon delivery by the lower layer of a set of TMD PDUs (received within one TTI), the Receiver shall:

- if it is configured for segmented operation:
  - reassemble the TMD PDUs received in one TTI into one RLC SDU.

- otherwise (it is configured for non-segmented operation):
  - treat each received TMD PDU as a SDU;
- if "Delivery of Erroneous SDUs" is configured as "no":
  - submit only the RLC SDUs received without error to upper layers through the TM-SAP.
- else if "Delivery of Erroneous SDUs" is configured as "yes":
  - submit all RLC SDUs to upper layers through the TM-SAP;
  - provide an error indication for each SDU received in error.
- otherwise if "Delivery of Erroneous SDUs" is configured as "No detect":
  - submit all RLC SDUs to upper layers through the TM-SAP.

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

11.1.4 Abnormal cases

11.1.4.1 Void

11.1.4.2 SDU discard without explicit signalling

Upon expiry of the timer Timer_Discard in the Sender, the Sender shall:

- discard the associated SDU;
- if requested:
  - inform the upper layers of the discarded SDU.

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.

11.2 Unacknowledged mode data transfer procedure

11.2.1 General

The unacknowledged mode data transfer procedure is used for transferring data between two RLC peer entities, which are operating in unacknowledged mode. Data is transferred from Sender to Receiver. This procedure should only apply to RLC entities in DATA_TRANSFER_READY state or LOCAL_SUSPEND state. Figure 11.2 below illustrates the elementary procedure for unacknowledged mode data transfer.

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.

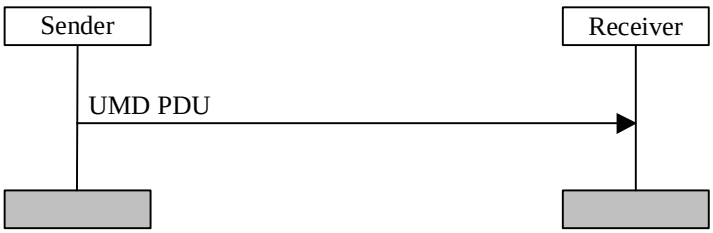

Figure 11.2: Unacknowledged mode data transfer procedure

11.2.2 Transmission of UMD PDU

Upon a request of unacknowledged mode data transfer from upper layer, the Sender shall:

- if no SDU discard configuration has been made by upper layers:
  - only discard SDUs when the Transmission buffer is full (see subclause 9.7.3);
- if "Timer based SDU Discard without explicit signalling" is configured:
  - start a timer Timer_Discard for each SDU received from upper layer (see subclause 9.7.3);
- schedule the RLC SDUs received from upper layer for transmission;
- if one or more RLC SDUs have been scheduled for transmission:
  - notify the lower layer of reception of data from upper layers;
  - perform the actions specified in subclause 11.2.2.2.

A UMD PDU shall 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.

11.2.2.1 UMD PDU contents to set

The Sender shall:

- set the field "Sequence Number" equal to VT(US);
- set a "Length Indicator" field for each SDU that ends in the UMD PDU according to subclause 9.2.2.8.

For each "Extension bit" field in the RLC header, the Sender shall:

- if the next field in the UMD PDU is a "Length Indicator":
  - set the "Extension bit" to "1";
- otherwise if the next field in the UMD PDU is data:
  - set the "Extension bit" to "0".

11.2.2.2 Submission of UMD PDUs to the lower layer

If one or more SDUs have been scheduled for transmission according to subclause 11.2.2, the Sender shall:

- inform the lower layer of the number and size of SDUs scheduled for transmission;
- segment, and if possible concatenate the SDUs according to the PDU sizes indicated by the lower layer (see subclause 9.2.2.9);
- submit to the lower layer, the requested number of UMD PDUs;
- update VT(US) for each UMD PDU submitted to the lower layer (see subclause 9.4);

- buffer the SDUs that are not submitted to the lower layer according to the discard configuration (see subclause 9.7.3).

11.2.3 Reception of UMD PDU

Upon delivery of a set of UMD PDUs from the lower layer, the Receiver shall:

- update VR(US) according to each received UMD PDU (see subclause 9.4);
- if the updating step of VR(US) is not equal to one (i.e. one or more UMD PDUs are missing):
  - discard the SDUs that could have segments or "Length Indicators" indicating the end of the SDUs in the missing UMD PDUs according to subclauses 9.2.2.8 and 9.2.2.9.
- if the special "Length Indicator" "1111 100" or "1111 1111 1111 100" is the first "Length Indicator" of a UMD PDU received on the downlink:
  - consider the first data octet in this UMD PDU as the first octet of an RLC SDU.
- reassemble the received UMD PDUs into RLC SDUs;
- submit the RLC SDUs to upper layers through the UM-SAP.

11.2.4 Abnormal cases

11.2.4.1 Length Indicator value reserved for UMD PDU

Upon delivery by the lower layer of an UMD PDU that contains a "Length Indicator" value specified to be reserved for UMD PDUs in this version of the protocol, the Receiver shall:

- ignore that UMD PDU.

11.2.4.2 Invalid length indicator value

If the "Length Indicator" of an UMD 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 Receiver shall:

- ignore the UMD PDU.

11.2.4.3 SDU discard without explicit signalling

Upon expiry of the timer Timer_Discard in the Sender, the Sender shall:

- discard the associated SDU;
- if requested:
  - inform the upper layers of the discarded SDU;
- for the first UMD PDU to be transmitted after the discard operation, the Sender shall:
  - increment VT(US) so that the "Sequence Number" field in this UMD PDU is incremented with two compared with the previous UMD PDU;
  - fill the first data octet in this UMD PDU with the first octet of an RLC SDU;
  - set the first "Length Indicator" in this UMD PDU to indicate that the previous RLC PDU was exactly filled with the last segment of an RLC SDU (to avoid that the Receiver unnecessarily discards an extra SDU).

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 UMD PDUs before discarding the afore-mentioned SDU.

11.4 RLC reset procedure

11.4.1 General

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. 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 AMD PDUs of "Sequence Number"=VT(S)-1 if at least one AMD PDU had been transmitted or of "Sequence Number"=0 if no AMD PDU had been transmitted, are exchanged between UE and UTRAN.

The RESET PDUs and the RESET ACK PDUs have higher priority than AMD PDUs.

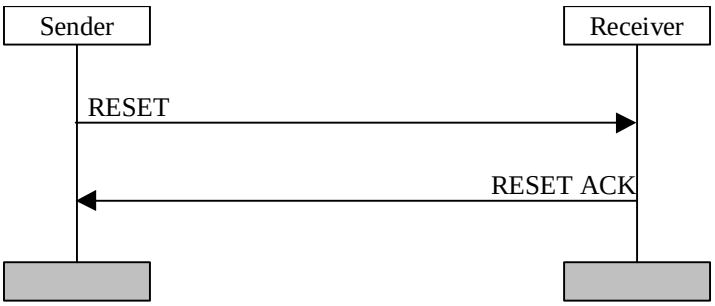

Figure 11.4: RLC reset procedure

11.4.2 Initiation

The Sender shall:

- if one of the following triggers is detected:

1) "No_Discard after MaxDAT number of transmissions" is configured and VT(DAT) equals the value MaxDAT (see subclause 9.7.3.4);

2) VT(MRW) equals the value MaxMRW;

3) A STATUS PDU or a piggybacked STATUS PDU including "erroneous Sequence Number" is received (see clause 10);

   - stop transmitting any AMD PDU or STATUS PDU;

   - ignore any incoming AMD PDU, piggybacked STATUS PDU or STATUS PDU;

   - increment VT(RST) by 1;

   - if VT(RST) = MaxRST:

     - perform the actions specified in subclause 11.4.4a.

   - else (if VT(RST) < MaxRST):

     - submit a RESET PDU to the lower layer;

     - start the timer Timer_RST according to the description in subclause 9.5.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC reset procedure until the end of the next TTI.

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, or upon request of re-establishment or release from upper layer, 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 Sender shall:

- set the HFNI field to the currently highest used HFN (DL HFN when the RESET PDU is sent by UTRAN or UL HFN when the RESET PDU is sent by the UE);
- set the RSN field to the sequence number of the RESET PDU. The sequence number of the first RESET PDU after the AM entity is established or re-established shall be "0". 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:

- if the RSN value in the RESET PDU is the same as the RSN value in the last received RESET PDU:
  - only submit a RESET ACK PDU to the lower layer with the contents set exactly as in the last transmitted RESET ACK PDU (i.e., in this case the RLC entity is not reset).
- if the RESET PDU is the first RESET PDU received since the entity was (re-)established or the RSN value is different from the RSN value in the last received RESET PDU:
  - submit a RESET ACK PDU to the lower layer with the content set as specified in subclause 11.4.3.1;
  - reset the state variables described in subclause 9.4 except VT(RST) to their initial values;
  - stop all the timers described in subclause 9.5 except Timer_RST, Timer_Discard, Timer_Poll_Periodic and Timer_Status_Periodic;
  - reset configurable parameters to their configured values;
  - discard all RLC PDUs in the receiving side of the AM RLC entity;
  - discard all RLC SDUs that were transmitted before the reset in the transmitting side of the AM RLC entity;
  - if requested for the transmitting side:
    - inform the upper layers of the discarded SDUs;
  - set the HFN (DL HFN when the RESET PDU is received in UE or UL HFN when the RESET PDU is received in UTRAN) equal to the HFNI field in the received RESET PDU;
  - increase with one the UL HFN and DL HFN, and the updated HFN values shall be used for the first transmitted and received AMD PDUs after the reset procedure.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC SDUs discard in the transmitting side of the AM RLC entity until the end of the next TTI.

11.4.3.1 RESET ACK PDU contents to set

The Receiver shall:

- set the hyper frame number indicator field (HFNI) to the currently highest used HFN (DL HFN when the RESET ACK PDU is sent by UTRAN or UL HFN when the RESET ACK PDU is sent by the UE);
- set the RSN field to the same value as in the corresponding received RESET PDU.

11.4.4 Reception of the RESET ACK PDU by the Sender

Upon reception of a RESET ACK PDU, the Sender shall:

- if the Sender has already transmitted a RESET PDU which has not been yet acknowledged by a RESET ACK PDU:
  - if the received RSN value is the same as the one in the corresponding RESET PDU:
    - set the HFN value (DL HFN when the RESET ACK PDU is received in UE or UL HFN when the RESET ACK PDU is received in UTRAN) to the HFNI field of the received RESET ACK PDU;
    - reset the state variables described in subclause 9.4 to their initial values;
    - stop all the timers described in subclause 9.5 except Timer_Discard, Timer_Poll_Periodic and Timer_Status_Periodic;
    - reset configurable parameters to their configured values;
    - discard all RLC PDUs in the receiving side of the AM RLC entity;
    - discard all RLC SDUs that were transmitted before the reset in the transmitting side of the AM RLC entity;
    - if requested for the transmitting side:
      - inform the upper layers of the discarded SDUs;
    - increase with one the UL HFN and DL HFN, and the updated HFN values shall be used for the first transmitted and received AMD PDUs after the reset procedure;
  - otherwise (if the received RSN value is not the same as the one in the corresponding RESET PDU):
    - discard the RESET ACK PDU;
- otherwise (if the Sender has not transmitted a RESET PDU which has not been yet acknowledged by a RESET ACK PDU):
  - discard the RESET ACK PDU.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC SDUs discard in the transmitting side until the end of the next TTI.

11.4.4a Reached maximum number of attempts

If VT(RST) = MaxRST, the Sender shall:

- terminate the ongoing RLC RESET procedure;
- stop the timer Timer_RST if it was started;
- indicate unrecoverable error to upper layer.

11.4.5 Abnormal cases

11.4.5.1 Timer_RST timeout

If Timer_RST expires before the reset procedure is terminated, the Sender shall:

- increment VT(RST) by one;
- if VT(RST)<MaxRST:
  - set the RESET PDU as previously transmitted;

- transmit the RESET PDU;
- restart Timer_RST according to the description in subclause 9.5.

- else (if VT(RST) = MaxRST):
  - perform the actions specified in subclause 11.4.4a.

11.4.5.2 Void

11.4.5.3 Reception of the RESET PDU by the Sender

Upon reception of a RESET PDU, the Sender shall:

- submit a RESET ACK PDU to the lower layer with the content set as specified in subclause 11.4.3.1;
- reset the state variables described in subclause 9.4 except VT(RST) to their initial values;
- stop all the timers described in subclause 9.5 except Timer_RST, Timer_Discard, Timer_Poll_Periodic and Timer_Status_Periodic;
- reset configurable parameters to their configured values;
- discard all RLC PDUs in the receiving side of the AM RLC entity;
- discard all RLC SDUs that were transmitted before the reset in the transmitting side of the AM RLC entity;
- if requested for the transmitting side:
  - inform the upper layers of the discarded SDUs;
- set the HFN (DL HFN when the RESET PDU is received in UE or UL HFN when the RESET PDU is received in UTRAN) equal to the HFNI field in the received RESET PDU.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC SDUs discard in the transmitting side until the end of the next TTI.

11.6 SDU discard with explicit signalling procedure

11.6.1 General

The SDU discard with explicit signalling procedure is used for discarding SDUs and transferring the discard information between two peer entities, which are operating in acknowledged mode. The Sender shall discard an SDU that has not been successfully transmitted for a period of time or for a number of transmissions, and send a Move Receiving Window (MRW) SUFI to the Receiver. According to the MRW SUFI, the Receiver shall discard AMD PDUs carrying that SDU and update the reception window. Figure 11.6 below illustrates the elementary procedure for SDU discard with explicit signalling.

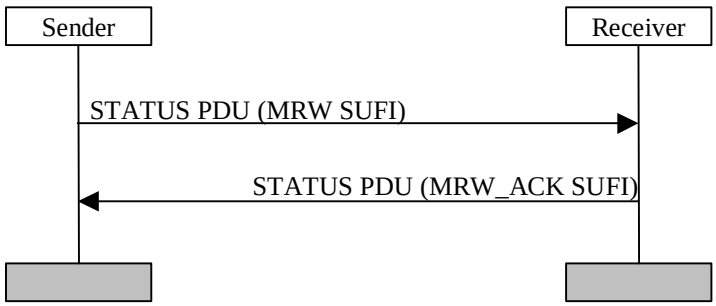

Figure 11.6: SDU discard with explicit signalling

11.6.2 Initiation

The Sender shall initiate the SDU discard with explicit signalling procedure if one of the following triggers is detected:

- "Timer based SDU discard with explicit signalling" is configured, Timer_Discard expires for an SDU, and one or more segments of the SDU have been submitted to lower layer;
- "Timer based SDU discard with explicit signalling" is configured, Timer_Discard expires for an SDU, and "Send MRW" is configured;
- "SDU discard after MaxDAT number of transmissions" is configured, and MaxDAT number of transmissions is reached (i.e. VT(DAT) ≥ MaxDAT) for an AMD PDU.

Upon initiation of the SDU discard with explicit signalling procedure, the Sender shall:

- if "Timer based SDU discard with explicit signalling" is configured:
  - discard all SDUs up to and including the SDU for which the timer Timer_Discard expired.
- if "SDU discard after MaxDAT number of transmissions" is configured:
  - discard all SDUs that have segments or "Length Indicators" indicating the end of the SDUs in AMD PDUs with "Sequence Number" SN inside the interval VT(A) ≤ SN ≤ X, where X is the value of the "Sequence Number" of the AMD PDU with VT(DAT) ≥ MaxDAT.
- if requested:
  - inform the upper layers of the discarded SDUs.
- discard all AMD PDUs including segments of the discarded SDUs or "Length Indicators" indicating the end of the SDUs, unless they also carry a segment of a SDU whose timer has not expired;
- if more than 15 discarded SDUs are to be informed to the Receiver (see subclause 11.6.2.2):
  - if "Send MRW" is not configured:
    - assemble an MRW SUFI with the discard information of the SDUs.
  - otherwise ("Send MRW" is configured):
    - assemble an MRW SUFI with the discard information of the first 15 SDUs; and
    - include the discard information of the rest SDUs in another MRW SUFI which shall be sent by the next SDU discard with explicit signalling procedure (after the current SDU discard with explicit signalling procedure is terminated).
- otherwise (less than or equal to 15 discarded SDUs are to be informed to the Receiver):
  - assemble an MRW SUFI with the discard information of the SDUs.
- schedule and submit to lower layer a STATUS PDU/piggybacked STATUS PDU containing the MRW SUFI;
- if SN_MRW_{LENGTH} in the MRW SUFI >VT(S):

- update VT(S) to SN_MRW_{LENGTH}.

- start a timer Timer_MRW according to subclause 9.5.

If a new SDU discard with explicit signalling procedure is triggered when the current SDU discard with explicit signalling procedure is still going on, no new MRW SUFIs shall be sent before the current SDU discard with explicit signalling procedure is terminated by one of the termination criteria specified in subclause 11.6.4.

11.6.2.1 Void

11.6.2.2 STATUS PDU contents to set

The Sender shall:

- if "Send MRW" is configured:
  - if the last discarded SDU ended in an AMD PDU, and its "Length Indicator" is present in the same AMD PDU, and no new SDU is present inside this AMD PDU:
    - set the last SN_MRW_i field in the MRW SUFI to 1 + "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last discarded SDU;
    - set the N_{LENGTH} field in the MRW SUFI to "0000".
  - otherwise:
    - set the last SN_MRW_i field in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last discarded SDU;
    - set the N_{LENGTH} field in the MRW SUFI so that the last data octet to be discarded in the Receiver shall be the octet indicated by the N_{LENGTH}:th "Length Indicator" field of the AMD PDU which contains the "Length Indicator" of the last discarded SDU;
  - set each of the other SN_MRW_i fields in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the i:th discarded SDU.
- otherwise ("Send MRW" is not configured):
  - if the last SDU to be discarded in the Receiver ended in an AMD PDU, and its "Length Indicator" is present in the same AMD PDU, and no new SDU is present inside this AMD PDU:
    - set the last SN_MRW_i field in the MRW SUFI to 1 + "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last SDU to be discarded in the Receiver;
    - set the N_{LENGTH} field in the MRW SUFI to "0000".
  - otherwise:
    - set the last SN_MRW_i field in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last SDU to be discarded in the Receiver;
    - set the N_{LENGTH} field in the MRW SUFI so that the last data octet to be discarded in the Receiver shall be the octet indicated by the N_{LENGTH}:th "Length Indicator" field of the AMD PDU which contains the "Length Indicator" of the last SDU to be discarded in the Receiver;
  - optionally set each of the other SN_MRW_i fields in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the i:th SDU to be discarded in the Receiver;
- if the MRW SUFI contains only one SN_MRW_i field and the value of SN_MRW_i field ≥ VT(A)+Configured_Tx_Window_Size:
  - set the LENGTH field in the MRW SUFI to "0000".
- otherwise:

- set the LENGTH field in the MRW SUFI to the number of SN_MRW_i fields in the same MRW SUFI. In this case, SN_MRW_1 shall be in the interval $VT(A) \leq SN\_MRW_1 < VT(A)+Configured\_Tx\_Window\_Size$.

11.6.3 Reception of the STATUS PDU by the Receiver

Upon reception of the STATUS PDU/piggybacked STATUS PDU containing an MRW SUFI, the Receiver shall:

- if the LENGTH field in the received MRW SUFI is "0000":
  - consider SN_MRW_1 to be above or equal to VR(R).
- otherwise:
  - consider SN_MRW_1 to be less than VR(MR);
- consider all the SN_MRW_is other than SN_MRW_1 to be in sequential order within the list and sequentially above or equal to SN_MRW_{i-1}.
- discard AMD PDUs up to and including the PDU with sequence number $SN\_MRW_{LENGTH}-1$;
- if the N_{LENGTH} field in the received MRW SUFI is "0000":
  - reassemble from the first data octet of the AMD PDU with sequence number SN_MRW_{LENGTH} after the discard.
- otherwise:
  - discard further the data octets in the AMD PDU with sequence number SN_MRW_{LENGTH} up to and including the octet indicated by the N_{LENGTH}:th "Length Indicator" field of the PDU with sequence number SN_MRW_{LENGTH};
  - reassemble from the succeeding data octet in the AMD PDU with sequence number SN_MRW_{LENGTH} after the discard;
- if "Send MRW" is configured:
  - inform upper layers about all of the discarded SDUs that were not previously delivered to upper layer or discarded by other MRW SUFIs;
- update the state variables VR(R), VR(H) and VR(MR) according to the received STATUS PDU/piggybacked STATUS PDU;
- assemble a MRW_ACK SUFI according to subclause 11.6.3.1;
- schedule and submit to lower layer a STATUS PDU/piggybacked STATUS PDU containing the MRW_ACK SUFI.

11.6.3.1 STATUS PDU contents to set

The Receiver shall:

- set the SN_ACK field in the MRW_ACK SUFI to the new value of VR(R), updated after reception of the MRW SUFI;
- if the SN_ACK field in the MRW_ACK SUFI is set equal to the SN_MRW_{LENGTH} field in the received MRW SUFI:
  - set the N field in the MRW_ACK SUFI to the N_{LENGTH} field in the received MRW SUFI.
- otherwise:
  - set the N field in the MRW_ACK SUFI to "0000".
- include the MRW_ACK SUFI in the next STATUS PDU/piggybacked STATUS PDU to be transmitted, according to subclause 11.5.2.

11.6.4 Termination

The Sender shall terminate the SDU discard with explicit signalling procedure if one of the following criteria is fulfilled:

- a STATUS PDU/piggybacked STATUS PDU containing an MRW_ACK SUFI is received, and the SN_ACK field in the received MRW_ACK SUFI > the SN_MRW_{LENGTH} field in the transmitted MRW_SUFI, and the N field in the received MRW_ACK SUFI is set equal to "0000";
- a STATUS PDU/piggybacked STATUS PDU containing an MRW_ACK SUFI is received, and the SN_ACK field in the received MRW_ACK SUFI = the SN_MRW_{LENGTH} field in the transmitted MRW_SUFI, and the N field in the received MRW_ACK SUFI is set equal to the N_{LENGTH} field in the transmitted MRW SUFI;
- a STATUS PDU/piggybacked STATUS PDU containing an ACK SUFI is received, and this STATUS PDU/piggybacked STATUS PDU indicates that all AMD PDUs up to and including the AMD PDU with "Sequence Number" equal to the SN_MRW_{LENGTH} field in the transmitted MRW SUFI has been received or discarded by the peer entity.

Upon termination of the SDU discard with explicit signalling procedure, the Sender shall:

- stop the timer Timer_MRW;
- update VT(A) and VT(MS) according to the received STATUS PDU/piggybacked STATUS PDU;

The Sender shall not confirm to upper layers the SDUs that are requested to be discarded.

11.6.4a Reached maximum number of attempts

If VT(MRW) = MaxMRW, the Sender shall:

- terminate the SDU discard with explicit signalling procedure;
- stop the timer Timer_MRW if it was started;
- initiate the RLC RESET procedure (see subclause 11.4).

11.6.5 Expiration of timer Timer_MRW

If Timer_MRW expires before the discard procedure is terminated, the Sender shall:

- increment VT(MRW) by one;
- if VT(MRW)<MaxMRW:
  - set the MRW SUFI as previously transmitted (even if additional SDUs were discarded in the mean-time);
  - include the MRW SUFI in a new status report (if other SUFIs are included, their contents shall be updated);
  - transmit the status report by either including it in a STATUS PDU or piggybacked in an AMD PDU;
  - restart Timer_MRW for this discard procedure according to the description in subclause 9.5.
- else (if VT(MRW) = MaxMRW):
  - perform the actions specified in subclause 11.6.4a.

11.6.6 Abnormal cases

11.6.6.1 Reception of obsolete/corrupted MRW SUFI by the Receiver

If the received MRW SUFI contains outdated information about the reception window (reception window already moved further than MRW SUFI is indicating), the Receiver shall:

- discard the MRW SUFI;

- set the SN_ACK field in the MRW_ACK SUFI to the current value of VR(R);
- set the N field in the MRW_ACK SUFI to "0000";
- include the MRW_ACK SUFI in the next STATUS PDU/piggybacked STATUS PDU to be transmitted, according to subclause 11.5.2.

11.6.6.2 Void

11.6.6.3 Reception of obsolete/corrupted MRW_ACK SUFI by the Sender

The Sender shall discard the received MRW_ACK SUFI if one of the following cases occurs:

- no ongoing SDU discard with explicit signalling procedure;or
- the SN_ACK field in the received MRW_ACK SUFI < the SN_MRW_{LENGTH} field in the transmitted MRW SUFI; or
- the SN_ACK field in the received MRW_ACK SUFI = the SN_MRW_{LENGTH} field in the transmitted MRW SUFI, and the N field in the received MRW_ACK SUFI is not equal to the N_{LENGTH} field in the transmitted MRW SUFI; or
- the SN_ACK field in the received MRW_ACK SUFI > the SN_MRW_{LENGTH} field in the transmitted MRW SUFI, and the N field in the received MRW_ACK SUFI is not equal to "0000".

3GPP TSG-RAN WG2 Meeting #39
San Diego, USA, 17th-21st November, 2003

Tdoc ⌘ R2-032603

CR-Form-v7

CHANGE REQUEST

⌘ **25.322** **CR** **252** ⌘ **rev** **-** ⌘ Current version: **5.6.0** ⌘

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

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	Indication of discarded SDU in RLC Reset and Re-establishment
Source:	⌘	RAN WG2
Work item code:	⌘	TEI4
Date:	⌘	Nov 2003
Category:	⌘	**A**
Release:	⌘	Rel-5

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)*
Rel-6	*(Release 6)*

Reason for change:	⌘	When SDUs are discarded, RLC informs upper layer of the discarded SDUs in order for upper layer to behave adequately, e.g. PDCP manages Full Header transmission. Currently, only the SDUs discarded by SDU discard function are informed to upper layer. However, SDUs are also discarded during RLC Reset or RLC Re-establishment, which should also be informed to upper layer.
Summary of change:	⌘	SDUs discarded during RLC Reset or RLC Re-establishment are also informed to upper layer. **Isolated Impact Analysis** Impacted functionality: The CR has an isolated impact. Only the RLC Reset and RLC Re-establishment are affected. Correction type: Correction of a function which is incomplete in the current specification. Interoperability: No interoperability problems are foreseen.
Consequences if not approved:	⌘	IF some SDUs are discarded during RLC Reset or RLC Re-establishment, upper layer like PDCP might have inefficient behavior, e.g. degradation of Header Compression efficiency.

Clauses affected:	⌘	9.7.7, 11.4.3, 11.4.4, 11.4.5.3

		Y	N			
Other specs affected:	⌘		X	Other core specifications	⌘	
			X	Test specifications		

	X	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/specs/CR.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.

9.7.7 RLC re-establishment function for acknowledged and unacknowledged mode

The upper layers may re-establish an RLC entity.

The RLC re-establishment function is applicable for AM and UM and is used when upper layers request an RLC entity to be re-established.

When an RLC entity is re-established by upper layers, the RLC entity shall:

- reset the state variables to their initial value;
- set the configurable parameters to their configured value;
- set the hyper frame number (HFN) in UL and DL to the value configured by upper layers;
- if the RLC entity is operating in unacknowledged mode:
  - if it is a receiving UM RLC entity:
    - discard all UMD PDUs.
  - if it is a transmitting UM RLC entity:
    - discard the RLC SDUs for which one or more segments have been submitted to a lower layer;
    - if requested:
      - inform the upper layers of the discarded SDUs;
    - not stop Timer_Discard if the RLC SDU is not discarded.
- otherwise if the RLC entity is operating in acknowledged mode:
  - discard all AMD PDUs and control PDUs in both the receiving side and the transmitting side of the RLC entity;
  - if requested for the transmitting side:
    - inform the upper layers of the discarded SDUs;
  - stop all timers described in subclause 9.5 except Timer_Poll_Periodic and Timer_Status_Periodic.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the re-establishment function until the end of the next TTI.

11.1 Transparent mode data transfer procedure

11.1.1 General

The transparent mode data transfer procedure is used for transferring data between two RLC peer entities, which are operating in transparent mode. Data is transferred from Sender to Receiver. This procedure should only apply to entities in DATA_TRANSFER_READY state. Figure 11.1 below illustrates the elementary procedure for transparent mode data transfer.

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).

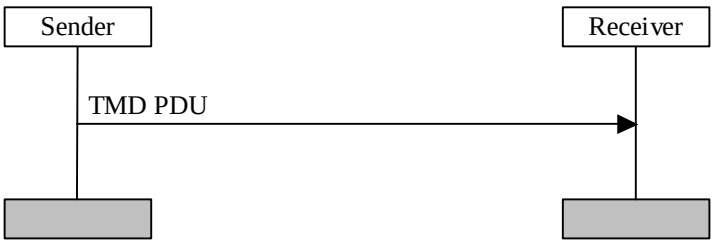

Figure 11.1: Transparent mode data transfer procedure

11.1.2 Transmission of TMD PDU

Upon a request of transparent mode data transfer from upper layer, the Sender shall:

- if no SDU discard configuration has been made by upper layers:
  - discard SDUs received in previous TTIs upon reception of new SDUs from upper layers (see subclause 9.7.3.5);
- otherwise (if "Timer Based SDU Discard without explicit signalling" is configured):
  - start a timer Timer_Discard for each SDU received from upper layers (see subclause 9.7.3);
- schedule the RLC SDUs that have been received from upper layer for transmission;
- if one or more RLC SDUs have been scheduled for transmission:
  - notify the lower layer of reception of data from upper layers;
  - perform the actions specified in subclause 11.1.2.2.

11.1.2.1 TMD PDU contents to set

The Sender shall set the data field of the TMD PDU to all or a subset of the data contained in the SDU as described in subclause 11.1.2.2.

11.1.2.2 Submission of TMD PDUs to the lower layer

If one or more RLC SDUs have been scheduled for transmission, according to subclause 11.1.2, the Sender shall:

- if it is configured for segmented operation:
  - inform the lower layer of the size of the next SDU to be sent;
  - segment the SDU according to the PDU size indicated by the lower layer.
- otherwise (the Sender is configured for non-segmented operation):
  - inform the lower layer of the number and size of SDUs available for transmission;
- submit to the lower layer, the requested number of TMD PDUs;
- buffer the SDUs that are not submitted to the lower layer according to the discard configuration (see subclause 9.7.3).

11.1.3 Reception of TMD PDU

Upon delivery by the lower layer of a set of TMD PDUs (received within one TTI), the Receiver shall:

- if it is configured for segmented operation:
  - reassemble the TMD PDUs received in one TTI into one RLC SDU.

- otherwise (it is configured for non-segmented operation):
  - treat each received TMD PDU as a SDU;
- if "Delivery of Erroneous SDUs" is configured as "no":
  - submit only the RLC SDUs received without error to upper layers through the TM-SAP.
- else if "Delivery of Erroneous SDUs" is configured as "yes":
  - submit all RLC SDUs to upper layers through the TM-SAP;
  - provide an error indication for each SDU received in error.
- otherwise if "Delivery of Erroneous SDUs" is configured as "No detect":
  - submit all RLC SDUs to upper layers through the TM-SAP.

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

11.1.4 Abnormal cases

11.1.4.1 Void

11.1.4.2 SDU discard without explicit signalling

Upon expiry of the timer Timer_Discard in the Sender, the Sender shall:

- discard the associated SDU;
- if requested:
  - inform the upper layers of the discarded SDU.

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.

11.2 Unacknowledged mode data transfer procedure

11.2.1 General

The unacknowledged mode data transfer procedure is used for transferring data between two RLC peer entities, which are operating in unacknowledged mode. Data is transferred from Sender to Receiver. This procedure should only apply to RLC entities in DATA_TRANSFER_READY state or LOCAL_SUSPEND state. Figure 11.2 below illustrates the elementary procedure for unacknowledged mode data transfer.

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.

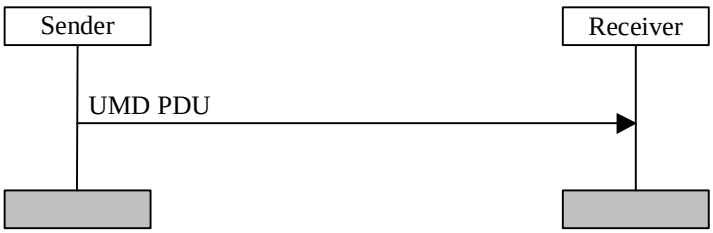

Figure 11.2: Unacknowledged mode data transfer procedure

11.2.2 Transmission of UMD PDU

Upon a request of unacknowledged mode data transfer from upper layer, the Sender shall:

- if no SDU discard configuration has been made by upper layers:
  - only discard SDUs when the Transmission buffer is full (see subclause 9.7.3);
- if "Timer based SDU Discard without explicit signalling" is configured:
  - start a timer Timer_Discard for each SDU received from upper layer (see subclause 9.7.3);
- schedule the RLC SDUs received from upper layer for transmission;
- if one or more RLC SDUs have been scheduled for transmission:
  - notify the lower layer of reception of data from upper layers;
  - perform the actions specified in subclause 11.2.2.2.

A UMD PDU shall 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.

11.2.2.1 UMD PDU contents to set

The Sender shall:

- set the field "Sequence Number" equal to VT(US);
- set a "Length Indicator" field for each SDU that ends in the UMD PDU according to subclause 9.2.2.8.

For each "Extension bit" field in the RLC header, the Sender shall:

- if the next field in the UMD PDU is a "Length Indicator":
  - set the "Extension bit" to "1";
- otherwise if the next field in the UMD PDU is data:
  - set the "Extension bit" to "0".

11.2.2.2 Submission of UMD PDUs to the lower layer

If one or more SDUs have been scheduled for transmission according to subclause 11.2.2, the Sender shall:

- inform the lower layer of the number and size of SDUs scheduled for transmission;
- segment, and if possible concatenate the SDUs according to the PDU sizes indicated by the lower layer (see subclause 9.2.2.9);
- submit to the lower layer, the requested number of UMD PDUs;
- update VT(US) for each UMD PDU submitted to the lower layer (see subclause 9.4);

- buffer the SDUs that are not submitted to the lower layer according to the discard configuration (see subclause 9.7.3).

11.2.3 Reception of UMD PDU

Upon delivery of a set of UMD PDUs from the lower layer, the Receiver shall:

- update VR(US) according to each received UMD PDU (see subclause 9.4);
- if the updating step of VR(US) is not equal to one (i.e. one or more UMD PDUs are missing):
  - discard the SDUs that could have segments or "Length Indicators" indicating the end of the SDUs in the missing UMD PDUs according to subclauses 9.2.2.8 and 9.2.2.9.
- if the special "Length Indicator" "1111 100" or "1111 1111 1111 100" is the first "Length Indicator" of a UMD PDU received on the downlink:
  - consider the first data octet in this UMD PDU as the first octet of an RLC SDU.
- reassemble the received UMD PDUs into RLC SDUs;
- submit the RLC SDUs to upper layers through the UM-SAP.

11.2.4 Abnormal cases

11.2.4.1 Length Indicator value reserved for UMD PDU

Upon delivery by the lower layer of an UMD PDU that contains a "Length Indicator" value specified to be reserved for UMD PDUs in this version of the protocol, the Receiver shall:

- ignore that UMD PDU.

11.2.4.2 Invalid length indicator value

If the "Length Indicator" of an UMD 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 Receiver shall:

- ignore the UMD PDU.

11.2.4.3 SDU discard without explicit signalling

Upon expiry of the timer Timer_Discard in the Sender, the Sender shall:

- discard the associated SDU;
- if requested:
  - inform the upper layers of the discarded SDU;
- for the first UMD PDU to be transmitted after the discard operation, the Sender shall:
  - increment VT(US) so that the "Sequence Number" field in this UMD PDU is incremented with two compared with the previous UMD PDU;
  - fill the first data octet in this UMD PDU with the first octet of an RLC SDU;
  - set the first "Length Indicator" in this UMD PDU to indicate that the previous RLC PDU was exactly filled with the last segment of an RLC SDU (to avoid that the Receiver unnecessarily discards an extra SDU).

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 UMD PDUs before discarding the afore-mentioned SDU.

11.4 RLC reset procedure

11.4.1 General

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. 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 AMD PDUs of "Sequence Number"=VT(S)-1 if at least one AMD PDU had been transmitted or of "Sequence Number"=0 if no AMD PDU had been transmitted, are exchanged between UE and UTRAN.

The RESET PDUs and the RESET ACK PDUs have higher priority than AMD PDUs.

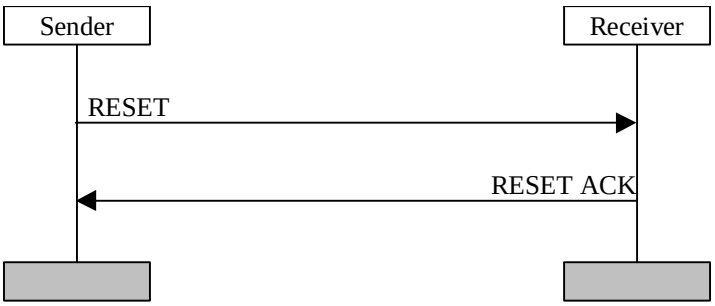

Figure 11.4: RLC reset procedure

11.4.2 Initiation

The Sender shall:

- if one of the following triggers is detected:

1) "No_Discard after MaxDAT number of transmissions" is configured and VT(DAT) equals the value MaxDAT (see subclause 9.7.3.4);

2) VT(MRW) equals the value MaxMRW;

3) A STATUS PDU or a piggybacked STATUS PDU including "erroneous Sequence Number" is received (see clause 10);

   - stop transmitting any AMD PDU or STATUS PDU;

   - ignore any incoming AMD PDU, piggybacked STATUS PDU or STATUS PDU;

   - increment VT(RST) by 1;

   - if VT(RST) = MaxRST:

     - perform the actions specified in subclause 11.4.4a.

   - else (if VT(RST) < MaxRST):

     - submit a RESET PDU to the lower layer;

     - start the timer Timer_RST according to the description in subclause 9.5.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC reset procedure until the end of the next TTI.

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, or upon request of re-establishment or release from upper layer, 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 Sender shall:

- set the HFNI field to the currently highest used HFN (DL HFN when the RESET PDU is sent by UTRAN or UL HFN when the RESET PDU is sent by the UE);
- set the RSN field to the sequence number of the RESET PDU. The sequence number of the first RESET PDU after the AM entity is established or re-established shall be "0". 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:

- if the RSN value in the RESET PDU is the same as the RSN value in the last received RESET PDU:
  - only submit a RESET ACK PDU to the lower layer with the contents set exactly as in the last transmitted RESET ACK PDU (i.e., in this case the RLC entity is not reset).
- if the RESET PDU is the first RESET PDU received since the entity was (re-)established or the RSN value is different from the RSN value in the last received RESET PDU:
  - submit a RESET ACK PDU to the lower layer with the content set as specified in subclause 11.4.3.1;
  - reset the state variables described in subclause 9.4 except VT(RST) to their initial values;
  - stop all the timers described in subclause 9.5 except Timer_RST, Timer_Discard, Timer_Poll_Periodic and Timer_Status_Periodic;
  - reset configurable parameters to their configured values;
  - discard all RLC PDUs in the receiving side of the AM RLC entity;
  - discard all RLC SDUs that were transmitted before the reset in the transmitting side of the AM RLC entity;
  - if requested for the transmitting side:
    - inform the upper layers of the discarded SDUs;
  - set the HFN (DL HFN when the RESET PDU is received in UE or UL HFN when the RESET PDU is received in UTRAN) equal to the HFNI field in the received RESET PDU;
  - increase with one the UL HFN and DL HFN, and the updated HFN values shall be used for the first transmitted and received AMD PDUs after the reset procedure.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC SDUs discard in the transmitting side of the AM RLC entity until the end of the next TTI.

11.4.3.1 RESET ACK PDU contents to set

The Receiver shall:

- set the hyper frame number indicator field (HFNI) to the currently highest used HFN (DL HFN when the RESET ACK PDU is sent by UTRAN or UL HFN when the RESET ACK PDU is sent by the UE);
- set the RSN field to the same value as in the corresponding received RESET PDU.

11.4.4 Reception of the RESET ACK PDU by the Sender

Upon reception of a RESET ACK PDU, the Sender shall:

- if the Sender has already transmitted a RESET PDU which has not been yet acknowledged by a RESET ACK PDU:
  - if the received RSN value is the same as the one in the corresponding RESET PDU:
    - set the HFN value (DL HFN when the RESET ACK PDU is received in UE or UL HFN when the RESET ACK PDU is received in UTRAN) to the HFNI field of the received RESET ACK PDU;
    - reset the state variables described in subclause 9.4 to their initial values;
    - stop all the timers described in subclause 9.5 except Timer_Discard, Timer_Poll_Periodic and Timer_Status_Periodic;
    - reset configurable parameters to their configured values;
    - discard all RLC PDUs in the receiving side of the AM RLC entity;
    - discard all RLC SDUs that were transmitted before the reset in the transmitting side of the AM RLC entity;
    - if requested for the transmitting side:
      - inform the upper layers of the discarded SDUs;
    - increase with one the UL HFN and DL HFN, and the updated HFN values shall be used for the first transmitted and received AMD PDUs after the reset procedure;
  - otherwise (if the received RSN value is not the same as the one in the corresponding RESET PDU):
    - discard the RESET ACK PDU;
- otherwise (if the Sender has not transmitted a RESET PDU which has not been yet acknowledged by a RESET ACK PDU):
  - discard the RESET ACK PDU.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC SDUs discard in the transmitting side until the end of the next TTI.

11.4.4a Reached maximum number of attempts

If VT(RST) = MaxRST, the Sender shall:

- terminate the ongoing RLC RESET procedure;
- stop the timer Timer_RST if it was started;
- indicate unrecoverable error to upper layer.

11.4.5 Abnormal cases

11.4.5.1 Timer_RST timeout

If Timer_RST expires before the reset procedure is terminated, the Sender shall:

- increment VT(RST) by one;
- if VT(RST)<MaxRST:
  - set the RESET PDU as previously transmitted;

- transmit the RESET PDU;
- restart Timer_RST according to the description in subclause 9.5.

- else (if VT(RST) = MaxRST):
  - perform the actions specified in subclause 11.4.4a.

11.4.5.2 Void

11.4.5.3 Reception of the RESET PDU by the Sender

Upon reception of a RESET PDU, the Sender shall:

- submit a RESET ACK PDU to the lower layer with the content set as specified in subclause 11.4.3.1;
- reset the state variables described in subclause 9.4 except VT(RST) to their initial values;
- stop all the timers described in subclause 9.5 except Timer_RST, Timer_Discard, Timer_Poll_Periodic and Timer_Status_Periodic;
- reset configurable parameters to their configured values;
- discard all RLC PDUs in the receiving side of the AM RLC entity;
- discard all RLC SDUs that were transmitted before the reset in the transmitting side of the AM RLC entity;
- if requested for the transmitting side:
  - inform the upper layers of the discarded SDUs;
- set the HFN (DL HFN when the RESET PDU is received in UE or UL HFN when the RESET PDU is received in UTRAN) equal to the HFNI field in the received RESET PDU.

NOTE: If the TFC selection exchange has been initiated by sending the RLC Entity Info parameter to MAC, the RLC entity may delay the RLC SDUs discard in the transmitting side until the end of the next TTI.

11.6 SDU discard with explicit signalling procedure

11.6.1 General

The SDU discard with explicit signalling procedure is used for discarding SDUs and transferring the discard information between two peer entities, which are operating in acknowledged mode. The Sender shall discard an SDU that has not been successfully transmitted for a period of time or for a number of transmissions, and send a Move Receiving Window (MRW) SUFI to the Receiver. According to the MRW SUFI, the Receiver shall discard AMD PDUs carrying that SDU and update the reception window. Figure 11.6 below illustrates the elementary procedure for SDU discard with explicit signalling.

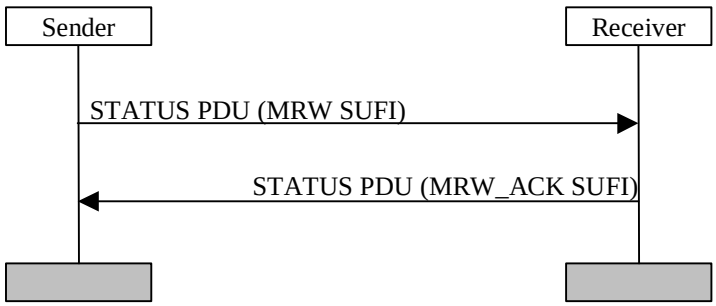

Figure 11.6: SDU discard with explicit signalling

11.6.2 Initiation

The Sender shall initiate the SDU discard with explicit signalling procedure if one of the following triggers is detected:

- "Timer based SDU discard with explicit signalling" is configured, Timer_Discard expires for an SDU, and one or more segments of the SDU have been submitted to lower layer;
- "Timer based SDU discard with explicit signalling" is configured, Timer_Discard expires for an SDU, and "Send MRW" is configured;
- "SDU discard after MaxDAT number of transmissions" is configured, and MaxDAT number of transmissions is reached (i.e. VT(DAT) ≥ MaxDAT) for an AMD PDU.

Upon initiation of the SDU discard with explicit signalling procedure, the Sender shall:

- if "Timer based SDU discard with explicit signalling" is configured:
  - discard all SDUs up to and including the SDU for which the timer Timer_Discard expired.
- if "SDU discard after MaxDAT number of transmissions" is configured:
  - discard all SDUs that have segments or "Length Indicators" indicating the end of the SDUs in AMD PDUs with "Sequence Number" SN inside the interval VT(A) ≤ SN ≤ X, where X is the value of the "Sequence Number" of the AMD PDU with VT(DAT) ≥ MaxDAT.
- if requested:
  - inform the upper layers of the discarded SDUs
- discard all AMD PDUs including segments of the discarded SDUs or "Length Indicators" indicating the end of the SDUs, unless they also carry a segment of a SDU whose timer has not expired;
- if more than 15 discarded SDUs are to be informed to the Receiver (see subclause 11.6.2.2):
  - if "Send MRW" is not configured:
    - assemble an MRW SUFI with the discard information of the SDUs.
  - otherwise ("Send MRW" is configured):
    - assemble an MRW SUFI with the discard information of the first 15 SDUs; and
    - include the discard information of the rest SDUs in another MRW SUFI which shall be sent by the next SDU discard with explicit signalling procedure (after the current SDU discard with explicit signalling procedure is terminated).
- otherwise (less than or equal to 15 discarded SDUs are to be informed to the Receiver):
  - assemble an MRW SUFI with the discard information of the SDUs.
- schedule and submit to lower layer a STATUS PDU/piggybacked STATUS PDU containing the MRW SUFI;
- if SN_MRW_{LENGTH} in the MRW SUFI >VT(S):

- update VT(S) to SN_MRW_{LENGTH}.

- start a timer Timer_MRW according to subclause 9.5.

If a new SDU discard with explicit signalling procedure is triggered when the current SDU discard with explicit signalling procedure is still going on, no new MRW SUFIs shall be sent before the current SDU discard with explicit signalling procedure is terminated by one of the termination criteria specified in subclause 11.6.4.

11.6.2.1 Void

11.6.2.2 STATUS PDU contents to set

The Sender shall:

- if "Send MRW" is configured:
  - if the last discarded SDU ended in an AMD PDU, and its "Length Indicator" is present in the same AMD PDU, and no new SDU is present inside this AMD PDU:
    - set the last SN_MRW_i field in the MRW SUFI to 1 + "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last discarded SDU;
    - set the N_{LENGTH} field in the MRW SUFI to "0000".
  - otherwise:
    - set the last SN_MRW_i field in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last discarded SDU;
    - set the N_{LENGTH} field in the MRW SUFI so that the last data octet to be discarded in the Receiver shall be the octet indicated by the N_{LENGTH}:th "Length Indicator" field of the AMD PDU which contains the "Length Indicator" of the last discarded SDU;
  - set each of the other SN_MRW_i fields in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the i:th discarded SDU.
- otherwise ("Send MRW" is not configured):
  - if the last SDU to be discarded in the Receiver ended in an AMD PDU, and its "Length Indicator" is present in the same AMD PDU, and no new SDU is present inside this AMD PDU:
    - set the last SN_MRW_i field in the MRW SUFI to 1 + "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last SDU to be discarded in the Receiver;
    - set the N_{LENGTH} field in the MRW SUFI to "0000".
  - otherwise:
    - set the last SN_MRW_i field in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the last SDU to be discarded in the Receiver;
    - set the N_{LENGTH} field in the MRW SUFI so that the last data octet to be discarded in the Receiver shall be the octet indicated by the N_{LENGTH}:th "Length Indicator" field of the AMD PDU which contains the "Length Indicator" of the last SDU to be discarded in the Receiver;
  - optionally set each of the other SN_MRW_i fields in the MRW SUFI to the "Sequence Number" of the AMD PDU which contains the "Length Indicator" of the i:th SDU to be discarded in the Receiver;
- if the MRW SUFI contains only one SN_MRW_i field and the value of SN_MRW_i field ≥ VT(A)+Configured_Tx_Window_Size:
  - set the LENGTH field in the MRW SUFI to "0000".
- otherwise:

- set the LENGTH field in the MRW SUFI to the number of SN_MRW_i fields in the same MRW SUFI. In this case, SN_MRW_1 shall be in the interval $VT(A) \leq SN\_MRW_1 < VT(A)+Configured\_Tx\_Window\_Size$.

11.6.3 Reception of the STATUS PDU by the Receiver

Upon reception of the STATUS PDU/piggybacked STATUS PDU containing an MRW SUFI, the Receiver shall:

- if the LENGTH field in the received MRW SUFI is "0000":
  - consider SN_MRW_1 to be above or equal to VR(R).
- otherwise:
  - consider SN_MRW_1 to be less than VR(MR);
- consider all the SN_MRW_is other than SN_MRW_1 to be in sequential order within the list and sequentially above or equal to SN_MRW_{i-1};
- deliver all the successfully received SDUs from the SDU that have segments or "Length Indicators" indicating the end of the SDUs in AMD PDU with "Sequence Number" of VR(R) up to and including the last SDU that is indicated by the MRW SUFI;
- discard AMD PDUs up to and including the PDU with sequence number $SN\_MRW_{LENGTH}-1$;
- if the N_{LENGTH} field in the received MRW SUFI is "0000":
  - reassemble from the first data octet of the AMD PDU with sequence number SN_MRW_{LENGTH} after the discard.
- otherwise:
  - discard further the data octets in the AMD PDU with sequence number SN_MRW_{LENGTH} up to and including the octet indicated by the N_{LENGTH}:th "Length Indicator" field of the PDU with sequence number SN_MRW_{LENGTH};
  - reassemble from the succeeding data octet in the AMD PDU with sequence number SN_MRW_{LENGTH} after the discard;
- if "Send MRW" is configured:
  - inform upper layers about all of the discarded SDUs that were not previously delivered to upper layer or discarded by other MRW SUFIs;
- update the state variables VR(R), VR(H) and VR(MR) according to the received STATUS PDU/piggybacked STATUS PDU;
- assemble a MRW_ACK SUFI according to subclause 11.6.3.1;
- schedule and submit to lower layer a STATUS PDU/piggybacked STATUS PDU containing the MRW_ACK SUFI.

11.6.3.1 STATUS PDU contents to set

The Receiver shall:

- set the SN_ACK field in the MRW_ACK SUFI to the new value of VR(R), updated after reception of the MRW SUFI;
- if the SN_ACK field in the MRW_ACK SUFI is set equal to the SN_MRW_{LENGTH} field in the received MRW SUFI:
  - set the N field in the MRW_ACK SUFI to the N_{LENGTH} field in the received MRW SUFI.
- otherwise:
  - set the N field in the MRW_ACK SUFI to "0000".

- include the MRW_ACK SUFI in the next STATUS PDU/piggybacked STATUS PDU to be transmitted, according to subclause 11.5.2.

11.6.4 Termination

The Sender shall terminate the SDU discard with explicit signalling procedure if one of the following criteria is fulfilled:

- a STATUS PDU/piggybacked STATUS PDU containing an MRW_ACK SUFI is received, and the SN_ACK field in the received MRW_ACK SUFI > the SN_MRW_{LENGTH} field in the transmitted MRW_SUFI, and the N field in the received MRW_ACK SUFI is set equal to "0000";

- a STATUS PDU/piggybacked STATUS PDU containing an MRW_ACK SUFI is received, and the SN_ACK field in the received MRW_ACK SUFI = the SN_MRW_{LENGTH} field in the transmitted MRW_SUFI, and the N field in the received MRW_ACK SUFI is set equal to the N_{LENGTH} field in the transmitted MRW SUFI;

- a STATUS PDU/piggybacked STATUS PDU containing an ACK SUFI is received, and this STATUS PDU/piggybacked STATUS PDU indicates that all AMD PDUs up to and including the AMD PDU with "Sequence Number" equal to the SN_MRW_{LENGTH} field in the transmitted MRW SUFI has been received or discarded by the peer entity.

Upon termination of the SDU discard with explicit signalling procedure, the Sender shall:

- stop the timer Timer_MRW;

- update VT(A) and VT(MS) according to the received STATUS PDU/piggybacked STATUS PDU;

The Sender shall not confirm to upper layers the SDUs that are requested to be discarded.

11.6.4a Reached maximum number of attempts

If VT(MRW) = MaxMRW, the Sender shall:

- terminate the SDU discard with explicit signalling procedure;

- stop the timer Timer_MRW if it was started;

- initiate the RLC RESET procedure (see subclause 11.4).

11.6.5 Expiration of timer Timer_MRW

If Timer_MRW expires before the discard procedure is terminated, the Sender shall:

- increment VT(MRW) by one;

- if VT(MRW)<MaxMRW:

  - set the MRW SUFI as previously transmitted (even if additional SDUs were discarded in the mean-time);

  - include the MRW SUFI in a new status report (if other SUFIs are included, their contents shall be updated);

  - transmit the status report by either including it in a STATUS PDU or piggybacked in an AMD PDU;

  - restart Timer_MRW for this discard procedure according to the description in subclause 9.5.

- else (if VT(MRW) = MaxMRW):

  - perform the actions specified in subclause 11.6.4a.

11.6.6 Abnormal cases

11.6.6.1 Reception of obsolete/corrupted MRW SUFI by the Receiver

If the received MRW SUFI contains outdated information about the reception window (reception window already moved further than MRW SUFI is indicating), the Receiver shall:

- discard the MRW SUFI;
- set the SN_ACK field in the MRW_ACK SUFI to the current value of VR(R);
- set the N field in the MRW_ACK SUFI to "0000";
- include the MRW_ACK SUFI in the next STATUS PDU/piggybacked STATUS PDU to be transmitted, according to subclause 11.5.2.

11.6.6.2 Void

11.6.6.3 Reception of obsolete/corrupted MRW_ACK SUFI by the Sender

The Sender shall discard the received MRW_ACK SUFI if one of the following cases occurs:

- no ongoing SDU discard with explicit signalling procedure; or
- the SN_ACK field in the received MRW_ACK SUFI < the SN_MRW_{LENGTH} field in the transmitted MRW SUFI; or
- the SN_ACK field in the received MRW_ACK SUFI = the SN_MRW_{LENGTH} field in the transmitted MRW SUFI, and the N field in the received MRW_ACK SUFI is not equal to the N_{LENGTH} field in the transmitted MRW SUFI; or
- the SN_ACK field in the received MRW_ACK SUFI > the SN_MRW_{LENGTH} field in the transmitted MRW SUFI, and the N field in the received MRW_ACK SUFI is not equal to "0000".