TSG-RAN Meeting #9   *RP-000359*
Oahu, HI, USA, 20 – 22 September 2000

Title: **Agreed CRs to TS 25.323**

Source: **TSG-RAN WG2**

Agenda item: 5.2.3

Doc-1st-	Status-	Spec	CR	Rev	Subject	Cat	Version	Versio
R2-001534	agreed	25.323	009	3	Clarification of PDCP Sequence Numbering	F	3.2.0	3.3.0
R2-001524	agreed	25.323	011		Clarification on how to handle invalid PDUs	F	3.2.0	3.3.0
R2-001858	agreed	25.323	012	2	Primitives required for SRNS relocation	F	3.2.0	3.3.0
R2-001829	agreed	25.323	015		Handling of invalid PDCP PDU sequence number	F	3.2.0	3.3.0

CHANGE REQUEST

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25.323	CR	**009r3**	Current Version:	3.2.0

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

For submission to: **TSG-RAN # 9**   for approval **X**   strategic ☐   *(for SMG*
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              ↑   For information ☐

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

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

Source:	TSG-RAN WG2	**Date:**	3-7-2000

Subject: Clarification of PDCP Sequence Numbering

Work item:

Category: F   Correction   **X**   **Release:**   Phase 2   ☐
        A   Corresponds to a correction in an earlier release   ☐   Release 96   ☐
(only one category   B   Addition of feature   ☐   Release 97   ☐
shall be marked   C   Functional modification of feature   ☐   Release 98   ☐
with an X)   D   Editorial modification   ☐   Release 99   **X**
                                                                                    Release 00   ☐

Reason for change: The PDCP SeqNum PDU could be discarded. Before the next PDCP SeqNum PDU is sent a SRNS relocation could occur. At this time, the Send and Receive PDCP Sequence Numbers could be out of sync. This would result in ambiguity between the peer PDCP entities.

Clauses affected: 5.4.1, 7.1

Other specs affected:
	Other 3G core specifications	☐	→ List of CRs:	
	Other GSM core specifications	☐	→ List of CRs:	
	MS test specifications	☐	→ List of CRs:	
	BSS test specifications	☐	→ List of CRs:	
	O&M specifications	☐	→ List of CRs:	

Other comments:

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5.4.1   PDCP Sequence Numbering

PDCP sequence numbering is only applicable when lossless SRNS relocation is to be supported. The value of the PDCP sequence number ranges from 0 to 65535. The PDCP SN window size indicates the maximum number of PDCP PDUs that can be numbered at any given time. The PDCP SN window size is negotiated by RRC. When the PDCP entity is setup for the first time for the PDCP user the PDCP sequence numbers are initialised to zero.

For each radio bearer:

- an UL_Send PDCP sequence number is associated with each sent PDCP-PDU in the UE and is incremented by one when a PDCP PDU is delivered to RLC;

- a DL_Send PDCP sequence number is associated with each sent PDCP-PDU in the NW and is incremented by one when a PDCP PDU is delivered to RLC;

- an UL_Receive PDCP sequence number is associated with each received PDCP-PDU in the NW and is incremented by one when a PDCP PDU is received from RLC or is incremented by one for each discarded RLC SDU, as indicated by the RLC SDU Discard function [5];

- a DL_Receive PDCP sequence number is associated with each received PDCP-PDU in the UE and is incremented by one when a PDCP PDU is received from RLC or is incremented by one for each discarded RLC SDU, as indicated by the RLC SDU Discard function [5].

PDCP sequence numbers are never decremented in the PDCP Tx.

~~The~~ PDCP SeqNum PDUs shall be sent ~~once~~ by the peer PDCP entities when synchronisation of the PDCP SN is required. It shall only be used for radio bearers that support or are configured / reconfigured ~~(by a radio bearer reconfiguration)~~ to support lossless SRNS relocation. ~~Synchronisation of PDCP SN is required after RLC reset or RB reconfiguration.~~

~~If RLC discards a RLC SDU which contains a PDCP SeqNum PDU, the next PDCP PDU delivered to RLC shall be a PDCP SeqNum PDU.~~ When a PDCP entity receives a PDCP SeqNum PDU, the receive PDCP sequence number shall be set to the value indicated in the PDCP SeqNum PDU.

PDCP SeqNum PDUs shall not be delivered to RLC after RLC has confirmed the successful transmission of a RLC SDU which contained a numbered PDCP PDU.

7   Elements for layer-to-layer communication

The interaction between the PDCP layer and other layers are described in terms of primitives where the primitives represent the logical exchange of information and control between the PDCP layer and other layers. The primitives shall not specify or constrain implementations.

7.1   Primitives between PDCP and upper layers

The primitives between PDCP and upper layers are shown in table 3.

Table 3: Primitives between PDCP and upper layers

Generic Name	Parameter			
	Req.	Ind.	Resp.	Conf.
PDCP-DATA	Data	Data	Not Defined	Not Defined
CPDCP-CONFIG	PDCP-Info, RLC-SAP, SN_Sync	Not Defined	Not Defined	Not Defined
CPDCP-RELEASE	RLC-SAP	Not Defined	Not Defined	Not Defined
CPDCP-RELOC	No Parameter	Not Defined	Not Defined	Not Defined

Each Primitive is defined as follows:

a) PDCP-DATA-Req./Ind.

- PDCP-DATA-Req is used by higher user-plane protocol layers to request a transmission of higher layer PDU. PDCP-DATA-Ind is used to deliver PDCP SDU that has been received to upper user plane protocol layers.

b) CPDCP-CONFIG-Req.

- CPDCP-CONFIG Req is used to configure and – in case of already existing PDCP entity – to reconfigure a PDCP entity and to assign it to the radio bearer associated with that entity.

c) PDCP-RELEASE-Req.

- CPDCP-RELEASE-Req is used by RRC to release a PDCP entity.

d) CPDCP- RELOC-Req.

- CPDCP-RELOC-Req initiates the SRNS relocation procedure in PDCP.

The following parameters are used in the primitives:

1) PDCP info:

- contains the parameters for each of the header compression algorithms configured to be used by one PDCP entity.

2) RLC-SAP:

- the RLC-SAP (Tr/UM/AM) used by PDCP entity when communicating with RLC sublayer.

3) SN_Sync:

- Indicates that PDCP should start PDCP sequence number synchronisation

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25.323	CR	**011**	Current Version:	3.2.0

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

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list expected approval meeting # here   For information ☐   non-strategic ☐ *use only)*
↑

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

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

Source:	TSG-RAN WG2	**Date:**	3-7-2000

Subject:	Clarification how to handle invalid PDUs

Work item:	

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

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

Reason for change:	It has not been specified what PDCP should do to invalid PDUs. It has been clarified that invalid PDUs should be disarded.

Clauses affected:	9

Other specs affected:

Other 3G core specifications	☐	→ List of CRs:
Other GSM core specifications	☐	→ List of CRs:
MS test specifications	☐	→ List of CRs:
BSS test specifications	☐	→ List of CRs:
O&M specifications	☐	→ List of CRs:

Other comments:	

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9 Handling of unknown, unforeseen and erroneous protocol data

In case of error situations the following action is foreseen:

1) PDCP entity should discard invalid PDU.

3GPP RAN WG2#15
Sophia Antipolis, France, 21 – 25 August, 2000

Document **R2-001858**

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

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25.323 CR **012r2**   Current Version: **3.2.0**

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

For submission to:	**TSG-RAN #9**	for approval	**X**		strategic		*(for SMG*
list expected approval meeting # here ↑		for information			non-strategic		*use only)*

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

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

Source:	TSG-RAN WG2	**Date:**	2000-08-21

Subject:	Primitives required for SRNS relocation

Work item:	

Category:	F	Correction	**X**	**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification			Release 99	**X**
					Release 00	

Reason for change:	1) Editorial modifications 2) Update of primitives for SRNS relocation. (refer to accompanying CR 035r1 to 25.303). 3) Reset_SN is now no longer needed (CR012r2)

Clauses affected:	5, 5.4, 5.4.1, 7.1

Other specs affected:	Other 3G core specifications	☐	→ List of CRs:	
	Other GSM core specifications	☐	→ List of CRs:	
	MS test specifications	☐	→ List of CRs:	
	BSS test specifications	☐	→ List of CRs:	
	O&M specifications	☐	→ List of CRs:	

Other comments:	

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5 Functions

Packet Data Convergence Protocol shall perform the following functions:

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

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

- provide unconfirmed PDCP SDUs and associated maintenance of PDCP sequence numbers for forwarding to target RNC only when radio bearers that are configured to support lossless SRNS relocation is to be supported;

- multiplexing of different RBs onto the same RLC entity. Multiplexing is not part of Release 1999 but will be included in Release 2000.

5.4 SRNS Relocation

Lossless SRNS relocation is only applicable when RLC is in in-sequence delivery and acknowledged mode RLC. PDCP will only support lossless SRNS relocation if it is 'capable' of doing so. This is indicated by RRC in the information element IE "Support for lossless SRNS relocation" in *PDCP Capability* "PDCP Capability" and PDCP info "PDCP info".

The PDCP layer shall, for those radio bearers that are configured to support lossless SRNS relocation:

- support PDCP sequence numbering as specified in subcaluse 5.4.1.

The PDCP layer shall carry out the following functions during lossless SRNS relocation:

- forwarding of provide unconfirmed PDCP SDUs and associated sequence numbering;s for forwarding to the target RNC

- transfer of the next expected PDCP SDU sequence number from UE to target SRNC and vice versa (by RRC); and

- reset of PDCP entities.

For each radio bearer, the Receive PDCP Sequence Number of the next PDCP SDU expected to be received is transferred from the source to target SRNC. For each radio bearer the source SRNC forwards to the target SRNC the downlink PDCP-SDUs. Source SRNC provides the Send PDCP SDU sequence number of the first PDCP SDU to be forwarded to the target SRNC.

The target SRNC shall send to the UE the next expected UL Receive PDCP Sequence Number. The UE shall send to the target SRNC the DL Receive PDCP Sequence Number of the next expected PDCP SDU. The successfully transmitted PDCP SDUs are thus confirmed. More detailed descriptions of this procedure can be found in [4] and [9].

The reset of all compression entities, for an RB, shall be made during SRNS relocation. Header compression is still possible during relocation Negotiated compression parameters remain valid during reset, but all state information is initialised, e.g. header compression contexts. The PDCP sequence numbers are reset to zero after relocation, if lossless SRNS relocation is supported. Therefore, in header compression case, the first 'compressed' packet is a full header. For Release 2000, it may be considered not to reset the PDCP entity, internal protocol information, i.e. states and header compression contexts, but to forward these from the source SRNC to target SRNC. Header compression for a PDCP entity can then continue from the state that it had directly before SRNS relocation.

In the case where lossless SRNS relocation is not supported, the PDCP layer shall carry out following functions:

- reset of PDCP entities.

5.4.1   PDCP Sequence Numbering

PDCP sequence numbering is only applicable when lossless SRNS relocation is to be supported. The value of the PDCP sequence number ranges from 0 to 65535. The PDCP SN window size indicates the maximum number of PDCP PDUs that can be numbered at any given time. The PDCP SN window size is negotiated by RRC. When the PDCP entity is setup for the first time for the PDCP user the PDCP sequence numbers are initialised to zero.

For each radio bearer:

-   an UL_Send PDCP sequence number is associated with each sent PDCP-PDU in the UE and is incremented by one when a PDCP PDU is delivered to RLC;

-   a DL_Send PDCP sequence number is associated with each sent PDCP-PDU in ~~the NW~~ UTRAN and is incremented by one when a PDCP PDU is delivered to RLC;

-   an UL_Receive PDCP sequence number is associated with each received PDCP-PDU in ~~the NW~~ UTRAN and is incremented by one when a PDCP PDU is received from RLC or is incremented by one for each discarded RLC SDU, as indicated by the RLC SDU Discard function [5];

-   a DL_Receive PDCP sequence number is associated with each received PDCP-PDU in the UE and is incremented by one when a PDCP PDU is received from RLC or is incremented by one for each discarded RLC SDU, as indicated by the RLC SDU Discard function [5].

PDCP sequence numbers are never decremented in the PDCP Tx.

The PDCP SeqNum PDU shall be sent once by the peer PDCP entities when synchronisation of the PDCP SN is required. It shall only be used for radio bearers that support or are configured (by a radio bearer reconfiguration) to support lossless SRNS relocation. Synchronisation of PDCP SN is required after RLC reset or RB reconfiguration.

If RLC discards a RLC SDU which contains a PDCP SeqNum PDU, the next PDCP PDU delivered to RLC shall be a PDCP SeqNum PDU. When a PDCP entity receives a PDCP SeqNum PDU, the receive PDCP sequence number shall be set to the value indicated in the PDCP SeqNum PDU.

7   Elements for layer-to-layer communication

The interaction between the PDCP layer and other layers are described in terms of primitives where the primitives represent the logical exchange of information and control between the PDCP layer and other layers. The primitives shall not specify or constrain implementations.

7.1   Primitives between PDCP and upper layers

The primitives between PDCP and upper layers are shown in table 3.

Table 3: Primitives between PDCP and upper layers

Generic Name	Parameter			
	Req.	Ind.	Resp.	Conf.
PDCP-DATA	Data	Data	Not Defined	Not Defined
CPDCP-CONFIG	PDCP-Info, RLC-SAP~~, Reset_SN~~	Not Defined	Not Defined	Not Defined
CPDCP-RELEASE	RLC-SAP	Not Defined	Not Defined	Not Defined
CPDCP-SN	PDCP SN	Not Defined	Not Defined	Not Defined
CPDCP-RELOC	~~No Parameter~~Receive_SN	Not Defined	Not Defined	~~Not Defined~~Receive_SN, Send_SN

Each Primitive is defined as follows:

a) PDCP-DATA-Req./Ind.

- PDCP-DATA-Req is used by higher user-plane protocol layers to request a transmission of higher layer PDU. PDCP-DATA-Ind is used to deliver PDCP SDU that has been received to upper user plane protocol layers.

b) CPDCP-CONFIG-Req.

- CPDCP-CONFIG Req is used to configure and – in case of already existing PDCP entity – to reconfigure a PDCP entity and to assign it to the radio bearer associated with that entity.

c) PDCP-RELEASE-Req.

- CPDCP-RELEASE-Req is used by RRC to release a PDCP entity.

d) PDCP-SN-Req.

- CPDCP-SN-Req is used to transfer the PDCP SN to PDCP.

ded) CPDCP- RELOC-Req.

- CPDCP-RELOC-Req initiates the SRNS relocation procedure in PDCP for those radio bearers that are configured to support lossless SRNS relocation. The Receive_SN is only included when the UE receives a new U-RNTI.

The following parameters are used in the primitives:

1) PDCP info:

- contains the parameters for each of the header compression algorithms configured to be used by one PDCP entity.

2) RLC-SAP:

- the RLC-SAP (Tr/UM/AM) used by PDCP entity when communicating with RLC sublayer.

3) Reset_SN:

- Resets the PDCP sequence numbers in both the uplink and downlink.

3) Send_SN:

- The send PDCP sequence number. There is one in the uplink and one in the downlink. Refer to subclause 5.4.1.

54) Receive_SN:

- The receive PDCP sequence number. There is one in the uplink and one in the downlink. Refer to subclause 5.4.1.

65) PDCP SN:

- This includes a PDCP sequence number.

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25.323	**CR**	**015**		Current Version:	3.2.0

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

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list expected approval meeting # here ↑		For information		non-strategic		*use only)*

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

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

Source:	TSG-RAN WG2		**Date:**	3-7-2000

Subject:	Handling of invalid PDCP PDU sequence number

Work item:	

Category: F   Correction   **X**   **Release:**   Phase 2   ☐
                       A   Corresponds to a correction in an earlier release   ☐   Release 96   ☐
(only one category   B   Addition of feature   ☐   Release 97   ☐
shall be marked   C   Functional modification of feature   ☐   Release 98   ☐
with an X)   D   Editorial modification   ☐   Release 99   **X**
                                                                                                           Release 00   ☐

Reason for change:	It has not been specified what PDCP should do if after relocation packets are requested that can not be delivered by PDCP. In such case PDCP sequence number synchronisation shall be started.

Clauses affected:	5.4, 5.4.1

Other specs affected:	Other 3G core specifications	☐	→ List of CRs:	
	Other GSM core specifications	☐	→ List of CRs:	
	MS test specifications	☐	→ List of CRs:	
	BSS test specifications	☐	→ List of CRs:	
	O&M specifications	☐	→ List of CRs:	

Other comments:	

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5.4 SRNS Relocation

Lossless SRNS relocation is only applicable when RLC is in in-sequence delivery and acknowledged mode RLC. PDCP will only support lossless SRNS relocation if it is 'capable' of doing so. This is indicated by RRC in the information element "Support for lossless SRNS relocation" in *PDCP Capability* and *PDCP info*.

The PDCP layer shall carry out the following functions during lossless SRNS relocation:

- forwarding of PDCP SDUs and associated sequence numbering;

- transfer of the next expected PDCP SDU sequence number from UE to target SRNC and vice versa (by RRC); and

- reset of PDCP entities.

For each radio bearer, the Receive PDCP Sequence Number of the next PDCP SDU expected to be received is transferred from the source to target SRNC. For each radio bearer the source SRNC forwards to the target SRNC the downlink PDCP-SDUs. Source SRNC provides the Send PDCP SDU sequence number of the first PDCP SDU to be forwarded to the target SRNC.

The target SRNC shall send to the UE the next expected UL Receive PDCP Sequence Number. The UE shall send to the target SRNC the DL Receive PDCP Sequence Number of the next expected PDCP SDU. The successfully transmitted PDCP SDUs are thus confirmed.

The reset of all compression entities, for an RB, shall be made during SRNS relocation. Header compression is still possible during relocation Negotiated compression parameters remain valid during reset, but all state information is initialised, e.g. header compression contexts. ~~The PDCP sequence numbers are reset to zero after relocation, if lossless SRNS relocation is supported.~~ Therefore, in header compression case, the first 'compressed' packet is a full header. For Release 2000, it may be considered not to reset the PDCP entity, internal protocol information, i.e. states and header compression contexts, but to forward these from the source SRNC to target SRNC. Header compression for a PDCP entity can then continue from the state that it had directly before SRNS relocation.

In the case where lossless SRNS relocation is not supported, the PDCP layer shall carry out following functions:

- reset of PDCP entities.

5.4.1 PDCP Sequence Numbering

PDCP sequence numbering is only applicable when lossless SRNS relocation is to be supported. The value of the PDCP sequence number ranges from 0 to 65535. The PDCP SN window size indicates the maximum number of PDCP PDUs that can be numbered at any given time. The PDCP SN window size is negotiated by RRC. When the PDCP entity is setup for the first time for the PDCP user the PDCP sequence numbers are initialised to zero.

For each radio bearer:

- an UL_Send PDCP sequence number is associated with each sent PDCP-PDU in the UE and is incremented by one when a PDCP PDU is delivered to RLC;

- a DL_Send PDCP sequence number is associated with each sent PDCP-PDU in the NW and is incremented by one when a PDCP PDU is delivered to RLC;

- an UL_Receive PDCP sequence number is associated with each received PDCP-PDU in the NW and is incremented by one when a PDCP PDU is received from RLC or is incremented by one for each discarded RLC SDU, as indicated by the RLC SDU Discard function [5];

- a DL_Receive PDCP sequence number is associated with each received PDCP-PDU in the UE and is incremented by one when a PDCP PDU is received from RLC or is incremented by one for each discarded RLC SDU, as indicated by the RLC SDU Discard function [5].

PDCP sequence numbers are never decremented in the PDCP Tx.

The PDCP SeqNum PDU shall be sent once by the peer PDCP entities when synchronisation of the PDCP SN is required. It shall only be used for radio bearers that support or are configured (by a radio bearer reconfiguration) to support lossless SRNS relocation. Synchronisation of PDCP SN is required after RLC reset, or RB reconfiguration or reception of invalid next expected UL/DL Receive PDCP Sequence Number after relocation.

If RLC discards a RLC SDU which contains a PDCP SeqNum PDU, the next PDCP PDU delivered to RLC shall be a PDCP SeqNum PDU. When a PDCP entity receives a PDCP SeqNum PDU, the receive PDCP sequence number shall be set to the value indicated in the PDCP SeqNum PDU.