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

RP-010310

Title: **Agreed CRs (Release '99 and Rel-4 category A) to TS 25.323**

Source: **TSG-RAN WG2**

Agenda item: **8.2.3**

Doc-1st-	Status-	Spec	CR	Rev	Phase	Subject	Cat	Version	Versio
R2-011321	agreed	25.323	020	1	R99	Clarification on PDCP Sequence numbering	F	3.4.0	3.5.0
R2-011355	agreed	25.323	021		Rel-4	Clarification on PDCP Sequence numbering	A	4.0.0	4.1.0

CR-Form-v4

CHANGE REQUEST

| ⌘ | **25.323** CR **020** | ⌘ | ev | **r1** | ⌘ | Current version: | **3.4.0** | ⌘ |

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

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

Title: ⌘	Clarification on PDCP Sequence numbering	
Source: ⌘	ASUSTeK	
Work item code: ⌘	TEI	***Date:*** ⌘ 2001-5-22

Category: ⌘ **F**	***Release:*** ⌘ R99

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

Reason for change: ⌘	1. The sequence numbers of the current PDCP PDU and the next PDCP PDU to be sent or received are not distinguished clearly.
	2. The explanation of the primitive CPDCP-RELOC-Conf is missing.
	3. There are some typos in subclause 7.1.
Summary of change: ⌘	1. PDCP sequence numbering section is clarified.
	2. A brief explanation of CPDCP-RELOC-Conf is added.
	3. Typos in subclause 7.1 are corrected.
	Backwards Compatibility Analysis:
	There is no functionality change in this CR. It can be seen as backwards compatible but need to be considered in implementation.
Consequences if not approved: ⌘	The specification is ambiguous and incomplete.

Clauses affected: ⌘	5.4, 5.4.1, 7.1

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

Other comments: ⌘	

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

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

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

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

5.4 SRNS Relocation

Lossless SRNS relocation is only applicable when RLC is in-sequence delivery and acknowledged mode PDCP will only support lossless SRNS relocation if it is 'capable' of doing so. This is indicated by ~~higher~~upper layers.

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

- support PDCP sequence numbering as specified in subclause 5.4.1.

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

- provide unconfirmed PDCP SDUs and sequence numbers for forwarding to the target RNC

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 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 [7].

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. Therefore, in header compression case, the first 'compressed' packet is a full header. For later releases of this specification, 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.

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 ~~higher~~upper layers. 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:

- a value of the UL_Send PDCP sequence number is associated with each sent PDCP-PDU in the UE. ~~and~~ The UL_Send PDCP sequence number is set to zero for the first sent PDCP PDU. The UL_Send PDCP sequence number is incremented by one when a PDCP PDU is delivered to RLC;

- a value of the DL_Send PDCP sequence number is associated with each sent PDCP-PDU in UTRAN. ~~and~~ The DL_Send PDCP sequence number is set to zero for the first sent PDCP PDU. The DL_Send PDCP sequence number is incremented by one when a PDCP PDU is delivered to RLC;

- a value of the UL_Receive PDCP sequence number is associated with each received PDCP-PDU in UTRAN. ~~and~~ The UL_Receive PDCP sequence number is set to zero for the first received PDCP PDU. The UL_Receive PDCP sequence number is incremented by one when a PDCP Data 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 value of the DL_Receive PDCP sequence number is associated with each received PDCP-PDU in the UE. ~~and~~ The DL_Receive PDCP sequence number is set to zero for the first received PDCP PDU. The DL_Receive PDCP sequence number is incremented by one when a PDCP Data 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.

PDCP SeqNum PDUs shall be sent by the peer PDCP entities when synchronization of the PDCP SN is required. It shall only be used for radio bearers that support or are configured / reconfigured to support lossless SRNS relocation. Synchronization of PDCP SN is required after RLC reset, RB reconfiguration or reception of invalid next expected UL/DL Receive PDCP Sequence Number after relocation.

When a PDCP entity receives a PDCP SeqNum PDU, the receive PDCP sequence number (i.e. UL_Receive or DL_Receive) 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 that contained a numbered PDCP PDU.

6 Services

6.1 Services provided to upper layers

The following services are provided by PDCP to upper layers:

- PDCP SDU delivery.

6.2 Services expected from RLC layer

For a detailed description of the following functions see [5].

- Data transfer in acknowledged mode.

- Data transfer in unacknowledged mode.

- Data transfer in transparent mode.

- Segmentation and reassembly.

- In-Sequence delivery.

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-SN	PDCP SN	Not Defined	Not Defined	Not Defined
CPDCP-RELOC	Receive_SN	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~~upper user-plane protocol layers to request a transmission of ~~higher~~upper 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) CPDCP-RELEASE-Req.

- CPDCP-RELEASE-Req is used by ~~higher~~upper layers to release a PDCP entity.

d) CPDCP-SN-Req.

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

e) CPDCP- RELOC-Req /Conf.

- 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.

- CPDCP-RELOC-Conf is used to transfer the Receive_SN and/or Send_SN to upper layers for lossless SRNS relocation. The Send_SN is only included at the source RNC.

The following parameters are used in the primitives:

1) ~~PDCP info~~PDCP-Info:

- contains the parameters for each of the header compression protocols 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 synchronization

4) Send_SN:

- The send PDCP sequence number of the next PDCP PDU to be sent. There is one in the uplink (UL_Send_SN) and one in the downlink (DL_Send_SN). Refer to subclause 5.4.1.

5) Receive_SN:

- The receive PDCP sequence number of the next PDCP PDU expected to be received. There is one in the uplink (UL_Receive_SN) and one in the downlink (DL_Receive_SN). Refer to subclause 5.4.1.

6) PDCP SN:

- This includes a PDCP sequence number.

CR-Form-v4

CHANGE REQUEST

| ⌘ | **25.323** CR **021** | ⌘ ⌘ev **-** ⌘ | Current version: | **4.0.0** | ⌘ |

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

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

Title:	⌘	Clarification on PDCP Sequence numbering
Source:	⌘	TSG-RAN WG2
Work item code:	⌘ TEI	***Date:*** ⌘ 2001-5-24

Category:	⌘ **A**	***Release:*** ⌘ REL-4

Use <u>one</u> 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 <u>TR 21.900</u>.

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

Reason for change: ⌘	1. The sequence numbers of the current PDCP PDU and the next PDCP PDU to be sent or received are not distinguished clearly.
	2. The explanation of the primitive CPDCP-RELOC-Conf is missing.
	3. There are some typos in subclause 7.1.
Summary of change: ⌘	1. PDCP sequence numbering section is clarified.
	2. A brief explanation of CPDCP-RELOC-Conf is added.
	3. Typos in subclause 7.1 are corrected.
Consequences if not approved: ⌘	The specification is ambiguous and incomplete.

Clauses affected: ⌘	5.4, 5.4.1, 7.1
Other specs affected: ⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments: ⌘	

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

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

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

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

5.4 SRNS Relocation

Lossless SRNS relocation is only applicable when RLC is in-sequence delivery and acknowledged mode PDCP will only support lossless SRNS relocation if it is 'capable' of doing so. This is indicated by ~~higher~~upper layers.

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

- support PDCP sequence numbering as specified in subclause 5.4.1.

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

- provide unconfirmed PDCP SDUs and sequence numbers for forwarding to the target RNC

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 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 [7].

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. Therefore, in header compression case, the first 'compressed' packet is a full header. For later releases of this specification, 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.

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 ~~higher~~upper layers. 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:

- a value of the UL_Send PDCP sequence number is associated with each sent PDCP-PDU in the UE. ~~and~~ The UL_Send PDCP sequence number is set to zero for the first sent PDCP PDU. The UL_Send PDCP sequence number is incremented by one when a PDCP PDU is delivered to RLC;

- a value of the DL_Send PDCP sequence number is associated with each sent PDCP-PDU in UTRAN. ~~and~~ The DL_Send PDCP sequence number is set to zero for the first sent PDCP PDU. The DL_Send PDCP sequence number is incremented by one when a PDCP PDU is delivered to RLC;

- a value of the UL_Receive PDCP sequence number is associated with each received PDCP-PDU in UTRAN. ~~and~~ The UL_Receive PDCP sequence number is set to zero for the first received PDCP PDU. The UL_Receive PDCP sequence number is incremented by one when a PDCP Data 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 value of the DL_Receive PDCP sequence number is associated with each received PDCP-PDU in the UE. ~~and~~ The DL_Receive PDCP sequence number is set to zero for the first received PDCP PDU. The DL_Receive PDCP sequence number is incremented by one when a PDCP Data 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.

PDCP SeqNum PDUs shall be sent by the peer PDCP entities when synchronization of the PDCP SN is required. It shall only be used for radio bearers that support or are configured / reconfigured to support lossless SRNS relocation. Synchronization of PDCP SN is required after RLC reset, RB reconfiguration or reception of invalid next expected UL/DL Receive PDCP Sequence Number after relocation.

When a PDCP entity receives a PDCP SeqNum PDU, the receive PDCP sequence number (i.e. UL_Receive or DL_Receive) 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 that contained a numbered PDCP PDU.

6 Services

6.1 Services provided to upper layers

The following services are provided by PDCP to upper layers:

- PDCP SDU delivery.

6.2 Services expected from RLC layer

For a detailed description of the following functions see [5].

- Data transfer in acknowledged mode.

- Data transfer in unacknowledged mode.

- Data transfer in transparent mode.

- Segmentation and reassembly.

- In-Sequence delivery.

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-SN	PDCP SN	Not Defined	Not Defined	Not Defined
CPDCP-RELOC	Receive_SN	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 higherupper user-plane protocol layers to request a transmission of higherupper 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) CPDCP-RELEASE-Req.

- CPDCP-RELEASE-Req is used by ~~higher~~upper layers to release a PDCP entity.

d) CPDCP-SN-Req.

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

e) CPDCP- RELOC-Req /Conf.

- 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.

- CPDCP-RELOC-Conf is used to transfer the Receive_SN and/or Send_SN to upper layers for lossless SRNS relocation. The Send_SN is only included at the source RNC.

The following parameters are used in the primitives:

1) ~~PDCP info~~PDCP-Info:

- contains the parameters for each of the header compression protocols 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 synchronization

4) Send_SN:

- The send PDCP sequence number of the next PDCP PDU to be sent. There is one in the uplink (UL_Send_SN) and one in the downlink (DL_Send_SN). Refer to subclause 5.4.1.

5) Receive_SN:

- The receive PDCP sequence number of the next PDCP PDU expected to be received. There is one in the uplink (UL_Receive_SN) and one in the downlink (DL_Receive_SN). Refer to subclause 5.4.1.

6) PDCP SN:

- This includes a PDCP sequence number.