TSG-RAN Meeting #17 *RP-020554*
Biarritz, France, 3 - 6 September 2002

Title: **Agreed CR (Rel-4) to TR 25.844**

Source: **TSG-RAN WG2**

Agenda item: **7.2.4**

Doc-1st-	Status-	Spec	CR	Rev	Phase	Subject	Cat	Versio	Versio
R2-022399	agreed	25.844	005		Rel-4	Corrections to RFC3095 operation	F	4.2.0	4.3.0

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Tdoc ⌘R2-022399

CR-Form-v7

CHANGE REQUEST

⌘	**25.844**	**CR**	**005**	⌘ **rev**	**-**	⌘	Current version:	**4.2.0** ⌘

*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:	⌘ Corrections to RFC3095 operation		
Source:	⌘ TSG-RAN WG2		
Work item code:	⌘ RANimp-RABSE	***Date:*** ⌘	12/08/2002
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: ⌘	In Table 4 the mapping from PID values to CID values is erroneous.
Summary of change: ⌘	Mapping from PID values to CID values aligned throughout the specification.
Consequences if not approved: ⌘	Mapping from PID values to CID values is erroneous.

Clauses affected:	⌘	5.1.10.3.2			
		Y	**N**		
Other specs affected:	⌘	**X**		Other core specifications	⌘ 25.323
			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.

5.1.10 ROHC Configuration

ROHC has two kinds of parameters; configuration parameters that are mandatory and must be configured between compressor and decompressor peers, and implementation parameters that are optional and when used, mandate how a ROHC implementation operates.

Configuration parameters are mandatory and must be configured (signalled by RRC) between compressor and decompressor, so that they have the same values at compressor and decompressor. An example of a configuration parameter is context identification (CID).

Implementation parameters (ROHC primitives) make it possible to mandate how the ROHC compressor or decompressor should operate. Implementation parameters have local significance, are optional to use and are thus not necessary to be negotiated between compressor and decompressor.

This does not preclude that implementation parameters may be signalled or negotiated using lower layer functionality in order to set the way a ROHC implementation operates. Some implementation parameters are valid only at either the compressor or decompressor. Implementation parameters may further be divided into parameters that describe the way an implementation operates and into parameters that trigger a specific event, i.e., signals.

5.1.10.1 Profiles

As mentioned previously RFC 3095 [6] supports 4 different profiles. A profile describes exactly how to do compression and decompression. A profile is specific for each context and it is established with the IR header. An IR header contains a profile identifier, which determines how the rest of the header is to be interpreted. Note that the profile parameter determines the syntax and semantics of the packet type identifiers and packet types used for a specific context. Profiles have to be negotiated during link establishment. The decompressor indicates which profiles it supports and compressor may not compress using other ones. Currently, the following profiles have been defined:

- Profile 0 is for sending uncompressed IP packets.
- Profile 1 is for RTP/UDP/IP compression.
- Profile 2 is for UDP/IP compression, i.e., compression of the first 12 octets of the UDP payload is not attempted.
- Profile 3 is for ESP/IP compression, i.e., compression of the header chain up to and including the first ESP header, but not subsequent subheaders.

5.1.10.1.1 Context for Uncompressed Packets

It is possible also in the wireless environment to exceed the maximum number of supported contexts per radio bearer. Following possibilities are foreseen and have to be evaluated.

1. Only ROHC protocol used in PDCP entity. PDCP-No-Header PDU is used.
    - Different contexts are separated within ROHC protocol and CID is carried in the ROHC packet. The ROHC has its internal mechanisms to reserve one CID for sending uncompressed data over the radio link. This solution does not put any requirements on PDCP layer. All required mechanisms exist in release 99.
2. Only ROHC protocol used in PDCP entity. PDCP-Data PDU is used. This combination enables the separation of different contexts in ROHC or in PDCP.
    - If the CIDs are carried within the ROHC protocol and the case equals to point 1 above.
    - If the CIDs are carried out in PDCP. The ROHC protocol has to be configured to support only one context. The PDCP requires functionality before ROHC protocol to separate different flows and pass them through ROHC protocol. PDCP is also required to filter out data flows that exceed the maximum number of supported contexts. Such contexts should by-pass header compression and would be indicated with a dedicated CID in the PDCP header to enable bypassing the decompressor.
3. ROHC+RFC2507 protocols used in PDCP entity. As two different protocols are used it implies that PDCP-Data PDU is used.

- This case is equal to point 2 above. A ROHC packet or PDCP header can be used to carry CID information. The CID should be carried in the PDCP headers as this utilises the one octet introduced by the PDCP header for ROHC, without having to use CID bits in the ROHC.

5.1.10.2 Context Identifier

The ROHC scheme has the possibility to support several contexts or unique IP flows. In order to track or identify these flows a Context ID (CID) is required in the ROHC packet format. This CID field is 0 (i.e. not present), 1 or 2 octets in length. Each CID has a context and must maintain enough information in order to correctly compress and decompress these IP flows. This context will be referred to as, CONTEXT_SIZE. Typically, CONTEXT_SIZE will include at least the full/uncompressed IP header. This would be the IP/UDP/RTP header, which is 40 octets for IPv4 and 60 octets for IPv6. The CONTEXT_SPACE is the sum of all CONTEXT_SIZEs.

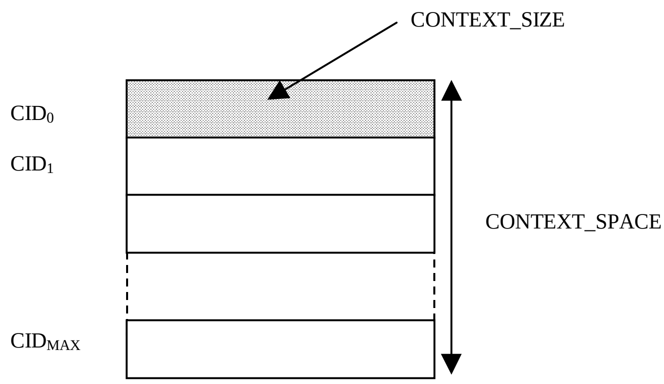

Figure 10: Header compressor contexts

The CID length of 2 octets is encoded to allow a maximum CID value of 16383 and would imply significant memory requirements. The need for such a large number of CIDs is that ROHC could be quite easily used in fixed IP backbone networks. In such cases there are several flows that a router would need to manage. This has been designed for the general case and to be future proof.

However, the requirements on the number of CIDs for each radio bearer in UTRAN pose less of a requirement and the maximum that is seen today is in the order of 5 to 15 flows per radio bearer for mobile terminals in this wireless environment.

Therefore, it is more efficient to signal the actual maximum CID value (CID_{MAX}) by RRC to the UE to configure ROHC with this value. In order for UTRAN to make a suitable choice for the maximum CID value certain capability parameters need to be indicated by the UE.

The UE, could for example indicate the CID_{MAX} in the IE "PDCP Capability". UTRAN could then configure ROHC with a maximum CID value in the range [0, CID_{MAX}]. This would be the simplest approach.

As explained in subclause 5.1.5 of this TR, the ROHC protocol has three modes; Uni-directional (U-mode), bi-directional optimistic (O-mode) and bi-directional reliable (R-mode). Each of these modes has different requirements on the typical amount of information that is required in the stored context, with the first two modes requiring the least amount of memory resources. If the UE were to indicate the CID_{MAX} then this would have to be for the mode that required the most context space, thus providing a worst case estimate.

There are, however, several alternatives:

I) CID_{MAX} (for all modes) is given in combination with $CONTEXT\_SPACE_{MAX}$ (for all modes).

II) CID_{MAX} is given for each mode. In addition a one bit indicator could be included in the IE "PDCP info" to indicate that the reported maximum CID is the same for all modes.

III) $CONTEXT\_SIZE_{MODE}$ is given for each MODE and a $CONTEXT\_SPACE_{MAX}$ also indicated.

IV) $CID_{MAX,1}$ is given for (U-mode and O-mode) and $CID_{MAX,2}$ is given for (R-mode). In this way there is no need for UTRAN to know the UE $CONTEXT\_SPACE_{MODE}$. UTRAN can then choose a maximum CID value (Max_UO_CID) between [0, $CID_{MAX,1}$] for U-mode and O-mode and a maximum CID value (Max_R_CID) [0,

$CID_{MAX,2}$] for R-mode only. In addition a one bit indicator could be included in the IE "PDCP info" to indicate that the reported maximum CID is the same for all modes.

It is recommended that alternative II is chosen. Therefore Max_U_CID, Max_O_CID and Max_R_CID are indicated in the RRC IE "PDCP Capability". However, it has to be evaluated what effect different CID sizes for different modes have on the ROHC protocol. As the decompressor makes the decision of the mode changes, different CIDs in different modes will have an effect on the mode change criteria.

5.1.10.3 0-octet-CID

In subclause 5.1.10.2 it was stated that the CID field in the ROHC packet format could be 0, 1 or 2 octets in length. Large CID spaces are not typically required for terminals in the wireless scenario.

It is possible to include the CID value on the PDCP layer instead of ROHC headers. In 3GPP Release 99, the PDCP layer can be configured to introduce a PDCP header or not to introduce a PDCP header. The PDCP header is typically required for HC protocols that require link layer (i.e. the layer that 'carries' HC) identification of the HC packet types.

3GPP Release'99 includes only one HC protocol (RF2507) and this requires link level identification of the HC packet formats. Header compression protocols that do not require link layer identification do not require PDCP to include a PDCP header. ROHC is one such protocol. PDCP configured to support only ROHC would typically be configured not to introduce a PDCP header.

With the introduction of an additional HC protocol to the suite of HC protocols to be used in UTRAN it is currently not possible to configure PDCP entity to accommodate HC protocols that do and do not require link layer packet identification (or any other header compression information).

It is important that the HC algorithms that will be included in Release 4 can be used on the same PDCP entity. RFC2507 can compress UDP/IP and/or TCP/IP streams while the current ROHC profile can compress RTP/UDP/IP, UPD/IP and ESP/IP streams. It is quite typical that different types of IP streams will be mixed together, for example in streaming applications.

There are two ways that this can be achieved and these are discussed below:

- Introducing a new PDCP PDU type for ROHC packets
- Using the same PDCP PDU type for ROHC and RFC2507

5.1.10.3.1 Introducing a new PDU Type for ROHC packets

The PDCP data PDU is shown below in Table 1. This PDCP header is 1 octet and consists of 2 fields; the PDU type field (3 bits) and the PID field (5 bits).

Table 1: PDCP-Data-PDU format

PDU type	PID
Data	

The PDU Type field in the PDCP PDU header indicates the type of PDCP data PDU and is shown below in Table 2. The PID field identifies the exact header compression packet type and the setting of the PID values is described in [2].

Table 2: PDCP-Data-PDU format

Bit	PDU Type
000	PID field used for header compression information (PDCP-PDU format described in table 5)
001	PID field used for header compression information and the PDCP PDU sequence number included (PDCP-PDU format described in table 6)
010	ROHC CID packet (PDCP-PDU).
011-111	Reserved (PDUs with this encoding are invalid for this version of the protocol)

In order to mix RFC2507 and ROHC there needs to be a header in PDCP as RFC2507 requires link level identification of the HC packet formats. It is only a matter of introducing a PDU type (010: ROHC CID packet) for ROHC packets to allow the possibility to mix RFC2507 and ROHC. The PID field for this PDCP Type (010: ROHC CID packet) would be defined for use as CID identification. The benefit here is that 32 CIDs can be identified and that the ROHC packet format would operate without a CID i.e. in 0-octet-CID mode, thereby saving, at best 2 octets overhead. Therefore, the PDCP PDU format would be as described in Table 3.

Table 3: PDCP-Data-PDU format

PDU type (010)	CID
Data	

The data part as indicated in Table 3 would be the ROHC packet when ROHC would be configured to have CID_{MAX} = 1 context (it will ensure that the CID field is not present in the ROHC packet).

If the number of CIDs is greater than what can be accommodated in the PID field (referred as CID field in table y) of the PDCP PDU header then the CID of 1 or 2 octets in the ROHC packet is/are used. The PID field is therefore unused in this case.

5.1.10.3.2 Using the same PDCP PDU type for ROHC and RFC2507

In this case ROHC and RFC2507 protocols are identified by the same PDU Type = '000' but the packet formats for these protocols are distinguished by the 5 bit PID field in the PDCP Data PDU. For RFC2507, the PID values identify the packet formats and for ROHC the PID values are used to identify the CONTEXT ID for the flow. The maximum number of CIDs that can be accommodated in the 5-bit CID/PID field is dependent on the number of PID values that are used for identification of packet types for other header compression protocols. The PID field is not used to identify the ROHC packet formats as this is done within the ROHC

If ROHC is the only protocol that is configured then up to 32 CIDs could be identified. The variables Max_U_CID , Max_O_CID and Max_R_CID are configured by the RRC protocol during configuration or reconfiguration of the header compression protocol. Refer to Alternative II, in subclause 5.1.10.1 above.

The assignment of PIDs for CIDs is shown in Table 4 below.

Table 4: PID values assigned to ROHC header compression protocol

PID value	Optimisation method	Packet type
N+1	ROHC	CID=0~~1~~
N+2	ROHC	CID=1~~2~~
…	ROHC	…
…	ROHC	…
N+n+1	ROHC	CID=n~~n~~

If the number of CIDs is greater than what can be accommodated in the PID field of the PDCP PDU header then the CID of 1 or 2 octets in the ROHC packet is used and the PID field is therefore unused in this case.

The 0-octet-CID option is the recommended CID configuration for ROHC in UTRAN.

5.1.10.4 Segmentation

ROHC protocol supports segmentation. The segmentation can vary packet by packet and it does not cause any overhead to packets that are not segmented. The segmentation may not be used when ROHC is run on top of UM RLC and then MRRU (maximum reconstructed reception unit) shall be equal to 0. The only case when the usage of ROHC segmentation is allowed is when ROHC is run on top of Tr RLC and the Packet_Sizes_Allowed is used to configure ROHC packet sizes. Furthermore, in that case segmentation may only be applied if the produced packet does not fit to the largest packet indicated by Packet_Sizes_Allowed.

5.1.10.5 Packet_Sizes_Allowed

This is a list of positive integer values that mandate the packet sizes that are allowed to be produced by ROHC. If this parameter list is set it has to contain packet size that allows a transmission of an entire IR header. Otherwise ROHC segmentation has to be used. It is also recommended to use packet sizes that are most frequently used in SO and FO states. If segmentation is not allowed/configured, then one of the Packet sizes allowed must accommodate the largest ROHC packet size possible, which typically is the IR packet. NOTE: ROHC has an in-built segmentation functionality, which takes place when the packets do not fit to the defined packet size. Therefore, extra attention has to be paid if the header sizes will be defined e.g. by RRC so that reasonable values are selected. Otherwise, segmentation will be performed in ROHC and possibly in RLC. However, it has to be noted that ROHC segmentation does not add any overhead to the packets that are not segmented (that should be the case in UTRAN).

5.1.10.6 Feedback

Feedback from decompressor to the compressor can be realised in several ways.

1) Feedback is provided as in release 99 when the feedback packets are transmitted with data packets on the same logical channel. This is same as the RLC AM model of operation for control and data RLC PDUs.

2) Another RLC link could be set up under one PDCP entity, which would be used as a dedicated feedback-only link.

3) The feedback packets are piggybacked to the compressed packets in the compressor. This option will require also mechanism 1 or 2 if the traffic to opposite direction does not exist or is very infrequent.

The recommended method of providing feedback is as in option 1) above.

5.1.10.7 Example PDCP Configuration

```
CHOICE Algorithm type: RFC2507 and ROHC
PDCP_Header             Present         PDCP will introduce a 1 octet header (PDU Type = 000 or 010)
RFC2507
        …                                                   …                   …
ROHC
        MAX_CID                                 10                  Maximum CID value for ROHC
        PROFILES SUPPORTED                      0,                  Uncompressed IP
                                                1,                  RTP/UDP/IP
                                                2,                  UDP/IP
                                                3                   ESP/IP
        PACKET_SIZES_ALLOWED                    1, 2, 6, 28, 40     In octets
        REVERSE_DECOMPRESSION_DEPTH             0                   No reverse decompression
        MRRU                                    0                   ROHC segmentation not used.
```