3GPP TSG-CN Meeting #10 ***NP-000687***
Bangkok, Thailand - 6 - 8 December, 2000

CR-Form-v3

CHANGE REQUEST

⌘ **04.65** **CR** **A073** ⌘ rev **-** ⌘ Current version: **8.1.0** ⌘

*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 ☐ Core Network **X**

Title:	⌘	Support of V.44 Data Compression in SNDCP
Source:	⌘	Hughes Network Systems/ Motorola
Work item code:	⌘	TEI
Date:	⌘	11-21-00
Category:	⌘	**F**
Release:	⌘	R99

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

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

Reason for change:	⌘	Recommendation V.44 was approved by ITU-T on November 17, 2000. It defines procedures for data compression based upon the LZJH data compression algorithm. V.44 achieves superior performance and requires fewer hardware resources compared to the existing ITU data compression standard V.42bis. Annex B of Recommendation V.44 defines the operation of the LZJH algorithm in packet networks, such as GPRS and UMTS. The implementation of V.44 Annex B will provide higher throughput of RAN portion of the GPRS network.
Summary of change:	⌘	Minor modifications to current text and new text in 04.65 to include support of V.44 data compression for SNDCP. New text is similar to current text that describes support of V.42bis in 04.65.
Consequences if not approved:	⌘	The defined implementation of V.42bis data compression for SNDCP in a GPRS SGSN has several major drawbacks including data expansion, complexity, and memory requirements. For instance, an SGSN supporting 300 PDP sessions could require 9 Mbytes of additional memory to support V.42bis. V.44 Packet Method requires less than 20 Kbytes by comparison, is considerably less complex, and provides excellent compression ratios. By making the correction for support of V.44 in R99, manufacturers that have not implemented V.42bis can implement V.44 instead, thus saving time and complexity.

Clauses affected:	⌘	References, 6.6
Other specs affected:	⌘	☐ Other core specifications ⌘ ☐ Test specifications ☐ O&M Specifications
Other comments:	⌘	Support of additional data compression algorithms is already in place in 04.65.

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

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

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

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

MODIFIED SECTION

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1999 document, references to GSM documents are for Release 1999 versions (version 8.x.y).

[1] 3GPP TS 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] 3GPP TS 02.60: "Digital cellular telecommunication system (Phase 2+); General Packet Radio Service (GPRS); Service Description, Stage 1".

[3] 3GPP TS 03.60: "Digital cellular telecommunication system (Phase 2+); General Packet Radio Service (GPRS); Service Description, Stage 2".

[4] 3GPP TS 04.07: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface signalling layer 3; General aspects".

[5] 3GPP TS 04.08: "Digital cellular telecommunications system (Phase 2+), Mobile radio interface layer 3 specification".

[6] 3GPP TS 04.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station – Serving GPRS Support Node (MS - SGSN) Logical Link Control (LLC) layer specification".

[7] 3GPP TS 09.60: "Digital cellular telecommunications system (Phase 2+), General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[8] ITU-T, Recommendation V.42 bis: "Data compression procedures for data circuit- terminating equipment (DCE) using error correcting procedures".

[9] RFC-1144, V. Jacobson: "Compressing TCP/IP Headers for Low-Speed Serial Links".

[10] RFC-2507, M. Degermark, B. Nordgren, S. Pink: "IP Header Compression".

[11] ITU-T, Recommendation V.44: “Data Compression Procedures”.

NEXT MODIFIED SECTION

6.6 Data compression

Data compression is an optional SNDCP feature. Data compression applies to both SN-DATA and SN-UNITDATA primitives.

Data compression, if used, shall be performed on the entire N-PDU, including the possibly compressed protocol control information.

Figure 8 shows an example how the SNDCP functions may be used. Several NSAPIs may use a common data compression entity, i.e., the same compression algorithm and the same dictionary. Separate data compression entities shall be used for acknowledged (SN-DATA) and unacknowledged (SN-UNITDATA) data transfer. Several NSAPIs may be associated with one SAPI, i.e., they may use the same QoS profile.

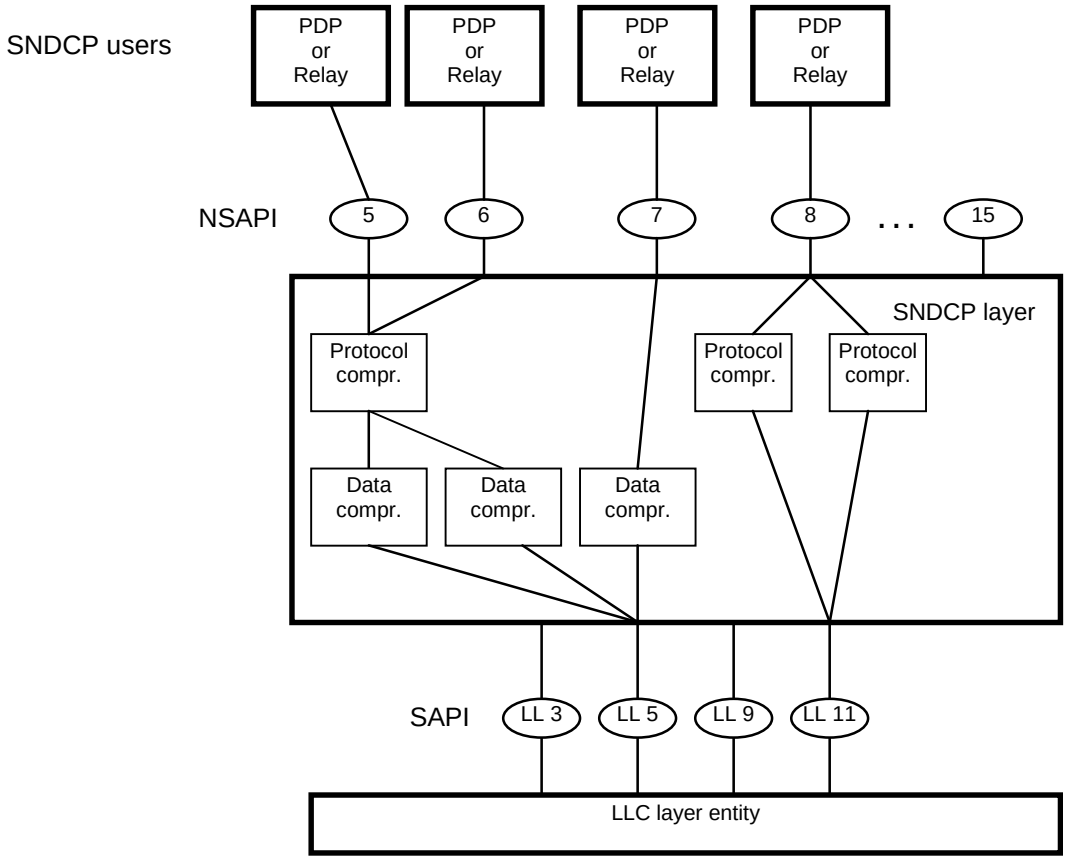

Figure 1~~8~~: An example for the usage of NSAPIs, SNDCP functions, and SAPIs

6.6.1 Negotiation of multiple data compression types

Each SNDCP entity that supports data compression shall be able to negotiate one or several data compression entities with the SNDCP XID format shown in Figure 9. The negotiation shall be carried out using the XID parameter negotiation specified in subclause 6.8. The initiating entity defines a set of requested compression entities, together with the algorithm and parameters for each compression entity. The set of entities and their algorithms and parameters shall be transmitted to the peer entity. The peer entity responds with the set of negotiated entities and their algorithms and parameters. The peer entity shall select the proposed parameter values or other appropriate values for the negotiated entities (the algorithm of a compression entity is non-negotiable once it is proposed).

For each NSAPI one or more data compression are chosen. This choice is also indicated in the SNDCP XID. Only NSAPIs that are using the same SAPI may use the same data compression entity. If more than one compression entity is chosen for an NSAPI, these entities must use different data compression algorithms. However, only one data

compression entity is used for one N-PDU; i.e., the used data compression entity may be changed from N-PDU to N-PDU.

bit	8	7	6	5	4	3	2	1
octet 1	X	X	X	Algorithm Type				
octet 2	Length = n - 2							
octet 3	High-order octet							
…	…							
octet n	Low-order octet							

Figure 2~~9~~: Data compression field format for SNDCP XID negotiation

Spare bit (X):

0 Shall be set to 0. If SN-PDU is received with the Spare bit set to 1, the field shall be ignored without error notification.

Table 6 shows the list of data compression algorithms supported by the SNDCP layer. When new compression algorithms are needed for SNDCP, Table 6 shall be updated.

Table 1~~6~~: List of data compression algorithms supported by SNDCP

Data compression algorithm	Algorithm type (Range 0-31)
V.42 bis	0
V.44	1
-	Other values Reserved

6.6.1.1 Assignment of DCOMP values

DCOMP values shall be assigned dynamically to compression algorithms, based on the negotiation of the XID parameters for data compression.

The assignment of the DCOMP values follows the following general rules:

- DCOMP value 0 is reserved permanently for no compression.
- DCOMP values are assigned in ascending order, starting from 1.
- DCOMP values are assigned to compression algorithms, not compression entities (i.e., the same DCOMP value(s) are used by different compression entities using the same compression algorithm).
- An assigned DCOMP value applies to all NSAPIs, whether they are mapped to the same SAPI or different SAPIs.
- An assigned DCOMP value stays assigned until the MS detaches from GPRS. An assigned DCOMP shall not be re-used for another compression algorithm (even if all compression entities using the algorithm to which the DCOMP value is assigned no longer exist).
- The list of negotiated (or re-negotiated) data compression entities shall be examined, starting from the first one in the list. When a compression algorithm is specified to which no DCOMP values has been assigned, one or more DCOMP values shall be assigned to this compression algorithm. The number of DCOMP values to be assigned is specified in the subclause for this algorithm.
- If there are not enough an-used DCOMP values to be assigned to a compression algorithm, the negotiated compression entities using this algorithm shall be ignored without error notification.

While transferring data, the compression algorithm type used for an SN-PDU is conveyed in the DCOMP field of the SNDCP header of the first SN-PDU belonging to the N-PDU. Any successfully negotiated algorithm may be used for compression of an N-PDU.

6.6.1.2 Resetting compression entities following SNDCP XID negotiation

The LL-Establish primitives shall be used for the negotiation of data compression if:

- one or more parameters, excluding the applicable NSAPIs, of existing compression entities used with acknowledged peer-to-peer LLC operation are changed by the originator of the negotiation; or

- one or more NSAPIs are removed, by the originator of the negotiation, from existing compression entities used with acknowledged peer-to-peer LLC operation.

Otherwise, either the LL-Establish primitives or the LL-XID primitives may be used.

If the LL-XID primitives are used for XID negotiation, then in addition to restrictions specified elsewhere in the present document, the following parameters of the data compression entities are non-negotiable by the responding SNDCP entity:

- any parameter of existing compression entities used with acknowledged peer-to-peer LLC operation.

If one or more parameters, other than the applicable NSAPIs, of a compression entity used with unacknowledged peer-to-peer LLC operation are changed, the compression entity shall be reset locally upon completion of the SNDCP XID negotiation.

6.6.1.3 Parameters for compression entities

On negotiating a compression entity, not all the parameters of the entity have to be specified. If a parameter is to be included, all the preceding parameters shall also be specified, and the length field shall be set to the sum of the lengths of all the parameters specified. If any of the parameters is not specified, the rules in subclause 6.8.2 shall apply.

6.6.2 Management of V.42 bis data compression

ITU-T V.42 bis [8] data compression may be used with SN-DATA primitives and SN-UNITDATA primitives.

6.6.2.1 Parameters

Table 7 contains the parameters defined for a compression entity using V.42 bis data compression. They may be negotiated during SNDCP XID negotiation.

Table 2~~7~~: V.42 bis data compression parameters

			Parameters				
Algorithm Name	**Algorithm Type**	**Length**	**Parameter Name**	**Format**	**Range**	**Sense of Negotiation**	**Default Value**
V.42 bis	0	0, 2, 3, 5 or 6	Applicable NSAPIs	bbbbbbbb bbb00000	0, 32, 64, … , 65504	down (each bit separately)	0
			P_0	000000bb	0 through 3	down (each direction separately)	3
			P_1	bbbbbbbb bbbbbbbb	512 through 65535	down	2048
			P_2	bbbbbbbb	6 through 250	down	20

6.6.2.1.1 Applicable NSAPIs

See subclause 7.1.3.

6.6.2.1.2 P_0

Two bits are used to indicate the usage of compression, one bit for each direction.

00 compress neither direction

01 compress MS-to-SGSN direction only

10 compress SGSN-to-MS direction only

11 compress both directions

6.6.2.1.3 P_1

Maximum number of codewords in the compressor dictionary (see [8]).

6.6.2.1.4 P_2

Maximum number of characters in an uncompressed data string that is accepted to be encoded.

6.6.2.2 Assignment of DCOMP values

One DCOMP value shall be assigned to the V.42 bis data compression algorithm.

6.6.2.3 Operation of V.42 bis data compression

When V.42 bis is used with SN-DATA primitives, the data in the compression entity shall be flushed (using the C-FLUSH primitive defined in [8]) after an N-PDU is sent.

When V.42 bis is used with SN-UNITDATA primitives, the data in the compression entity shall be flushed (using the C-FLUSH primitive defined in [8]), and then the compression entity shall be reset, after an N-PDU is sent. The LLC protocol shall operate in the protected mode of operation.

When V.42 bis is used with SN-DATA primitives and an error is detected by the decoder, the SNDCP entity shall use LL-ESTABLISH.request primitive to reset the acknowledged peer-to-peer LLC operation for the SAPI used.

6.6.3 Management of V.44 data compression

ITU-T V.44 data compression, as described in [11], may be used with SN-DATA primitives and SN-UNITDATA primitives. Annex B of ITU-T Recommendation V.44 describes two methods of implementation and operation of V.44 in packet networks: Packet Method and Multi-Packet Method. Multi-Packet Method is a superset of Packet Method and an MS or SGSN that supports Multi-Packet Method must also support Packet Method.

6.6.3.1 Parameters

Table 7 contains the parameters defined for a compression entity using V.44 data compression. They may be negotiated during SNDCP XID negotiation. During V.44 data compression negotiation, unless both the MS and SGSN support Multi-Packet Method, Packet Method is used. Parameter C_0 indicates support of Packet Method (10000000) or both methods (11000000).

NOTE: V.44 data compression negotiation is not required. If V.44 is selected and no compression parameters are specified, then Packet Method with defaults as defined in Clauses 6.6.3.1.4 and 6.6.3.1.5 below and [11] Annex B, Clause B.1.2, is used.

Table 8: V.44 data compression parameters

			Parameters				
Algorithm Name	**Algorithm Type**	**Length**	**Parameter Name**	**Format**	**Range**	**Sense of Negotiation**	**Default Value**
V.44	1	0, 2, 3, 5 or 6	Applicable NSAPIs	bbbbbbbb bbb00000	0, 32, 64, … , 65504	down (each bit separately)	0
			C_0	bb000000	10000000 or 11000000	11000000 down to 10000000	10000000
			P_0	000000bb	0 through 3	down (each direction separately)	3
			P_{1T}	bbbbbbbb bbbbbbbb	256 through 65535	down	Refer to Clause 6.6.3.1.4
			P_{1R}	bbbbbbbb bbbbbbbb	256 through 65535	down	Refer to Clause 6.6.3.1.5
			P_{3T}	bbbbbbbb bbbbbbbb	$\geq (2 * P_{1T})$	down	$3 * P_{1T}$
			P_{3R}	bbbbbbbb bbbbbbbb	$\geq (2 * P_{1R})$	down	$3 * P_{1R}$

NOTE: V.44 parameters P_{2T} and P_{2R} are set to 255 and not negotiated in packet networks.

6.6.3.1.1 Applicable NSAPIs

See subclause 7.1.3.

6.6.3.1.2 C_0

Two bits are used to indicate the V.44 method of operation supported (refer to [11] Annex B).

10 Packet Method supported

11 Packet Method and Multi-Packet Method supported

If parameter C_0 is not specified then Packet Method is selected with its default parameter values (refer to Clauses 6.6.3.1.4 and 6.6.3.1.5 below and [11] Annex B, Clause B.1.2).

6.6.3.1.3 P_0

Two bits are used to indicate the usage of compression, one bit for each direction.

00 compress neither direction

01 compress MS-to-SGSN direction only

10 compress SGSN-to-MS direction only

11 compress both directions

6.6.3.1.4 P_{1T}

Maximum number of codewords for the transmit direction (i.e. in the encoder dictionary). Refer to [11].

The Packet Method default is 1600 codewords.

The Multi-Packet Method default is 2048 codewords.

Note that both defaults above are different from the defaults specified in V.44 Annex B. This is partially due to the fact that data compression in SNDCP includes the control header as well as the information field.

6.6.3.1.5 P_{1R}

Maximum number of codewords for the receive direction (i.e. in the decoder dictionary). Refer to [11].

The Packet Method default is 1600 codewords.

The Multi-Packet Method default is 2048 codewords.

Note that both defaults above are different from the defaults specified in V.44 Annex B. This is partially due to the fact that data compression in SNDCP includes the control header as well as the information field.

6.6.3.1.6 P_{3T}

Number of characters in the history for the transmit direction. Refer to [11].

This parameter is not used in Packet Method.

6.6.3.1.7 P_{3R}

Number of characters in the history for the receive direction. Refer to [11].

This parameter is not used in Packet Method.

6.6.3.2 Assignment of DCOMP values

The underlying service shall be able to distinguish three types of N-PDUs processed by V.44 data compression (i.e., not V.44 compressed, V.44 Packet Method compressed, and V.44 Multi-Packet Method compressed). These three V.44 processed N-PDU types are differentiated by using different DCOMP values.

Two DCOMP values shall be assigned to the V.44 compression algorithm, the smaller one of which for Packet Method compressed, and the larger one for Multi-Packet Method compressed.

The DCOMP value of 0 shall be used for SN-PDUs belonging to N-PDUs that expanded during V.44 compression and are sent in their original form (i.e. not V.44 compressed).

6.6.3.3 Operation of V.44 data compression

V.44 data compression has two possible methods of operation in SNDCP, Packet Method and Multi-Packet Method.

6.6.3.3.1 Packet Method

Refer to [11] Annex B, Clause B.1, for a general description of the operation of V.44 packet method.

When V.44 Packet Method is used with SN-DATA primitives:

- the data in the compression entity shall be flushed (using the C-FLUSH primitive defined in [11]) after the last character of an N-PDU is passed to the encoder.
- If the length of the N-PDU after compression is greater or equal to the length of the original N-PDU, the original N-PDU is sent and the DCOMP field in the SN-PDU header of the first segment of the N-PDU is set to 0, not V.44 compressed.
- In between processing of N-PDU, the dictionary shall be re-initialised as defined in [11].
- If an error is detected by the decoder, the SNDCP entity shall use LL-ESTABLISH.request primitive to reset the acknowledged peer-to-peer LLC operation for the SAPI used.

When V.44 Packet Method is used with SN-UNITDATA primitives:

- the data in the compression entity shall be flushed (using the C-FLUSH primitive defined in [11]) after the last character of an N-PDU is passed to the encoder.

- If the length of the N-PDU after compression is greater or equal to the length of the original N-PDU, the original N-PDU is sent and the DCOMP field in the SN-PDU header of the first segment of the N-PDU is set to 0, not V.44 compressed.
- After an N-PDU is sent, the dictionary shall be re-initialised as defined in [11].
- The LLC protocol shall operate in the protected mode of operation.

6.6.3.3.2 Multi-Packet Method

Refer to [11] Annex B, Clause B.2, for a general description of the operation of V.44 multi-packet method.

When V.44 Multi-Packet Method is used with SN-DATA primitive:

- the data in the compression entity shall be flushed (using the C-FLUSH primitive defined in [11]) after the last character of an N-PDU is passed to the encoder.
- If the length of the N-PDU after compression is greater than the length of the original N-PDU, the original N-PDU is sent and the DCOMP field in the SN-PDU header of the first segment of the N-PDU is set to 0, not V.44 compressed.
- In the case above of not V.44 compressed where the original N-PDU is sent, after the N-PDU is sent the encoder dictionary shall be re-initialised as defined in [11]. The peer entity, upon receipt of an N-PDU with the DCOMP field set to 0, not V.44 compressed, shall re-initialise its decoder dictionary.
- If an error is detected by the decoder, the SNDCP entity shall use LL-ESTABLISH.request primitive to reset the acknowledged peer-to-peer LLC operation for the SAPI used.

When V.44 Multi-Packet Method is used with SN-UNITDATA primitives:

- the data in the compression entity shall be flushed (using the C-FLUSH primitive defined in [11]) after the last character of an N-PDU is passed to the encoder.
- After an N-PDU is sent the dictionary shall be re-initialised as defined in [11].
- If the length of the N-PDU after compression is greater or equal to the length of the original N-PDU, the original N-PDU is sent and the DCOMP field in the SN-PDU header of the first segment of the N-PDU is set to 0, not V.44 compressed.
- The LLC protocol shall operate in the protected mode of operation.