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Technical Specification

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Foreword

This ETSI Technical Specification (TS) has been produced by the Special Mobile Group (SMG) of the European Telecommunications Standards Institute (ETSI).

This TS describes the Subnetwork Dependent Convergence Protocol (SNDCP) for the General Packet Radio Service (GPRS) within the digital cellular telecommunications system.

The contents of this TS are subject to continuing work within SMG and may change following formal SMG approval. Should SMG modify the contents of this TS it will then be released by ETSI with an identifying change of release date and an increase in version number as follows:

Version 6.x.y

where:

6 GSM Phase 2+ Release 1997

x the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated in the specification.

1 Scope

This ETSI TS provides the description of the Subnetwork Dependent Convergence Protocol (SNDCP) for the General Packet Radio Service (GPRS).

The user of the services provided by SNDCP is a packet data protocol (PDP) at the mobile Station (MS) or the Relay at the Serving GPRS Support Node (SGSN). Additionally, a control entity, e.g., AT command interpreter, may be an SNDCP user. SNDCP uses the services provided by the Logical Link Control (LLC) layer [4] and the Session Management (SM) sub-layer [2].

The main functions of SNDCP are:

- Multiplexing of several PDPs.
- Compression/decompression of user data.
- Compression/decompression of protocol control information.
- Segmentation of a network protocol data unit (N-PDU) into Logical Link Control Protocol Data Units (LL-PDUs) and re-assembly of LL-PDUs into a N-PDU.

GSM 04.65 is applicable to GPRS MS and SGSN.

2 Normative references

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case 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.

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

[2] GSM 02.60: “Digital cellular telecommunication system; General Packet Radio Service (GPRS); Service Description, Stage 1”.

[3] GSM 03.60: “Digital cellular telecommunication system; General Packet Radio Service (GPRS); Service Description, Stage 2”.

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

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

[6] GSM 04.64: “Digital cellular telecommunication system; General Packet Radio Service (GPRS); Mobile Station - Serving GPRS Support Node (MS-SGSN) Logical Link Control (LLC) Layer Specification”.

[7] GSM 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".

3 Definitions and Abbreviations

3.1 Definitions

In addition to the definitions in 02.60 [2] the following definitions apply:

N201 LLC layer parameter (see GSM 04.64 for clarity). Defines maximum number of octets in the information field of LL-PDU. Separate values are applicable for I (see N201-I), U and UI (see N201-U) LL-PDUs.

N201-I LLC layer parameter (see GSM 04.64 for clarity). Defines maximum number of octets available to a SN-DATA PDU for a specific SAPI.

N201-U LLC layer parameter (see GSM 04.64 for clarity). Defines maximum number of octets available to a SN-UNITDATA PDU for a specific SAPI.

N-PDU number A sequence number assigned to N-PDUs per NSAPI in unacknowledged mode.

NSAPI For each SN-PDU the NSAPI is an index to the PDP context of the PDP that is using the services provided by the SNDCP layer.

Protection mode Identifies the transfer mode for SN-UNITDATA transfer. In the protected mode, the lower layers shall discard the erroneous data when an error in the check sequence of the received user data is noticed. The erroneous data is not delivered to SNDCP layer at the receiving entity. In the unprotected mode, the correctness of the received information is not checked. The received information is transferred transparently to the peer SNDCP layer and to the user of the peer SNDCP entity.

SAPI SAPI identifies the Service Access Point (with which a QoS profile is associated) that the SN-PDU is using at the LLC layer.

Segment offset Indicates the offset from the beginning of the N-PDU.

SNDCP entity The SNDCP entity handles the service functions provided by the SNDCP layer. The SNDCP entity is temporary logical link identity specific.

SNDCP management entity The SNDCP management entity handles communication with SM sub-layer and controls the operation of the SNDCP entity.

SNDCP user Protocol entity that is using the services provided by the SNDCP layer. PDP entities and control entities, e.g., AT command interpreter, are the SNDCP users at the MS. Relay entity is the SNDCP user at the SGSN.

Refer to GSM 02.60 [2] for further GPRS definitions.

3.2 Abbreviations

In addition to abbreviations in 01.04 [1] and 02.60 [2] the following abbreviations apply:

DCOMP	Identifier of the user data compression algorithm used for the N-PDU
E	Extension bit
IP	Internet Protocol
GMM	GPRS Mobility Management
LLC	Logical Link Control
M	More bit used to indicate the last segment of N-PDU

N-PDU	Network Protocol Data Unit
NSAPI	Network Layer Service Access Point Identifier
PCOMP	Identifier of the protocol control information compression algorithm used for the N-PDU
PDP	Packet Data Protocol e.g., IP or X.25
PDU	Protocol Data Unit
PTP	Point to Point
QoS	Quality of Service
SAPI	Service Access Point Identifier
SDU	Service Data Unit
SGSN	Serving GPRS Support Node
SM	Session Management
SNDCP	Subnetwork Dependent Convergence Protocol
SNSM	SNDCP-SM
TCP	Transmission Control Protocol
TLLI	Temporary Logical Link Identifier
X	Spare bit.

4 General

This document describes the functionality of the GPRS SNDCP. The overall GPRS logical architecture is defined in GSM 03.60 [3]. Location of the SNDCP in GPRS protocol stack can be seen in Figure 1.

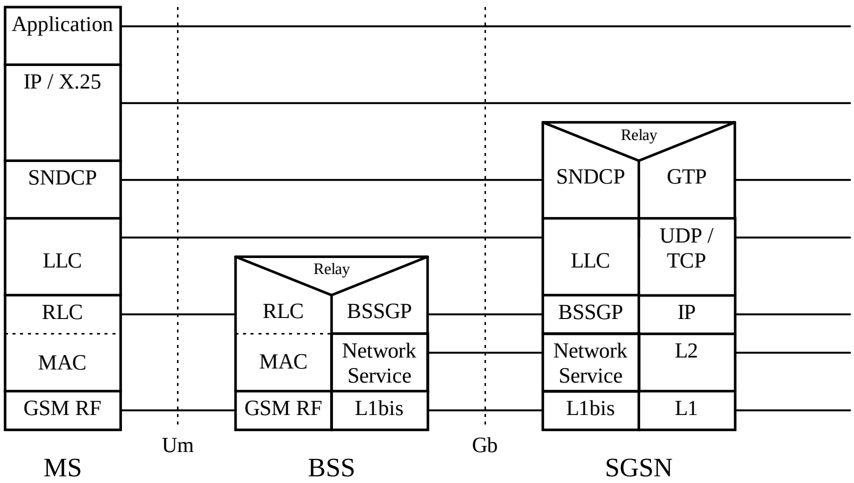


Figure 1: GPRS protocol stack

Network layer protocols are intended to be capable of operating over services derived from a wide variety of subnetworks and data links. GPRS supports several network layer protocols providing protocol transparency for the users of the service. Introduction of new network layer protocols to be transferred over GPRS shall be possible without any changes to GPRS. Therefore, all functions related to transfer of Network layer Protocol Data Units (N-PDUs) shall be carried out in a transparent way by the GPRS network entities. This is one of the requirements for GPRS SNDCP.

Another requirement for the SNDCP is to provide functions that help to improve channel efficiency. This requirement is fulfilled by means of compression techniques.

The set of protocol entities above SNDCP consists of commonly used network protocols. They all use the same SNDCP entity, which then performs multiplexing of data coming from different sources to be sent using the service provided by the LLC layer (figure 2). The Network Service Access Point Identifier (NSAPI) is an index to the PDP context (see GSM 03.60 [3]) of the PDP that is using the services provided by SNDCP. One PDP may have several PDP contexts and NSAPIs. However, it is possible that each allocated NSAPI is used by separate PDP. Each active NSAPI shall use the services provided by the Service Access Point Identifier (SAPI) in the LLC layer. Several NSAPIs may be associated with the same SAPI.

Since the adaptation of different network layer protocols to SNDCP is implementation dependent, it is not defined in this document.

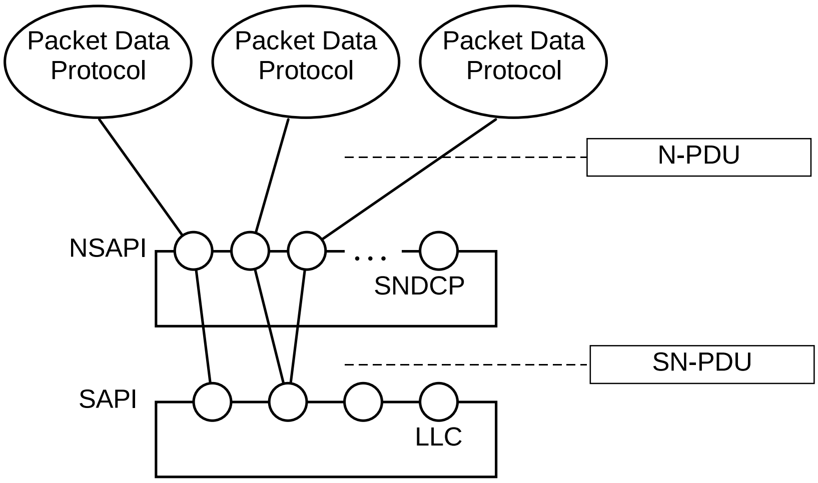


Figure 2: Example for multiplexing of different protocols

5 Service Primitives and Functions

5.1 Service Primitives

This subclause explains the service primitives used for communication between the SNDCP layer and other layers. See also GSM 04.07 [4] to get an overall picture of the service primitives. Figure 3 illustrates the service access points through which the primitives are carried out.

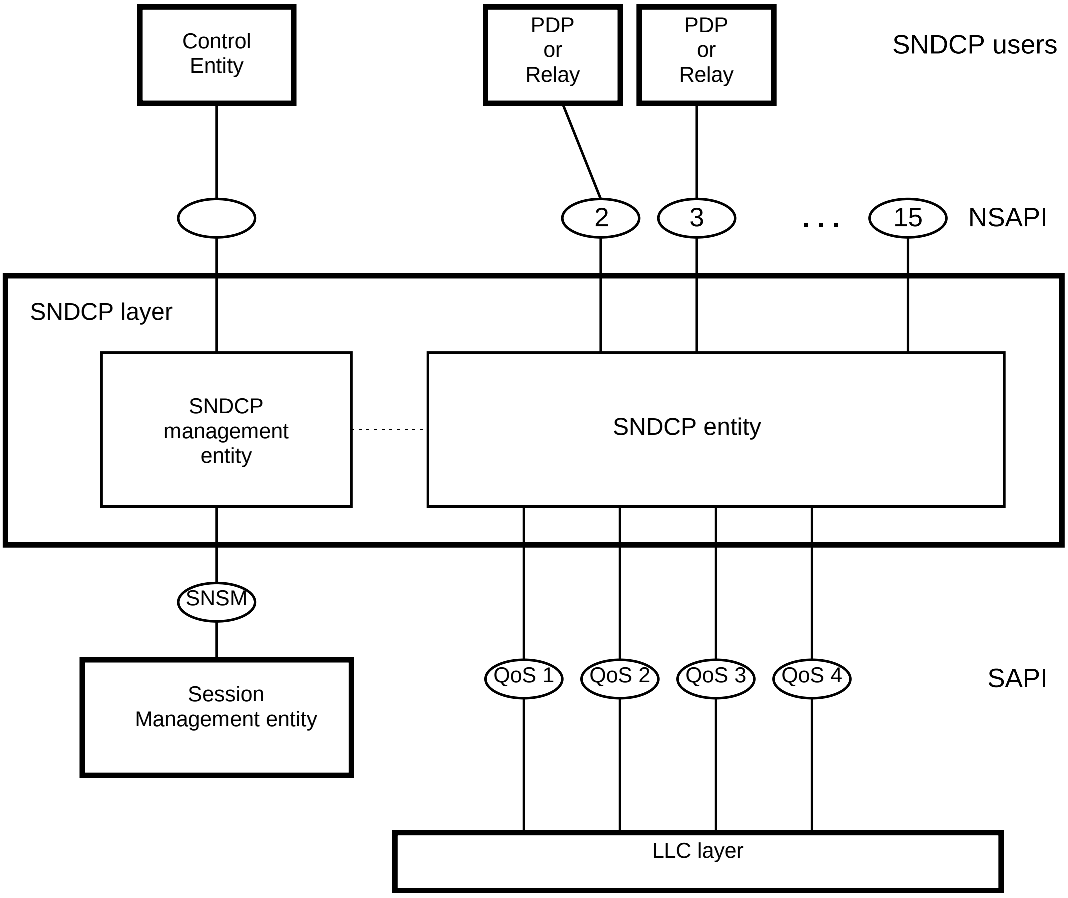


Figure 3: Service Access Points provided and used by SNDCP

5.1.1 SNDCP Service Primitives

The primitives provided by the SNDCP layer are listed in Table 1.

Table 1: SNDCP layer service primitives

Generic Name	**Type**				**Parameters**
	Request	Indication	Response	Confirm	
SNDCP User (PDP or the SGSN Relay) <---> SNDCP					
SN-DATA	X	X	-	-	N-PDU, NSAPI
SN-UNITDATA	X	X	-	-	N-PDU, NSAPI, protection mode
SN-XID	X	X	-	-	Requested SNDCP XID parameters
SN-XID	-	-	X	X	Negotiated SNDCP XID parameters

5.1.1.1 SN-DATA.request

Request used by the SNDCP user for acknowledged transmission of N-PDU. The successful transmission of SN-PDU shall be confirmed by the LLC layer. The SN-DATA.request primitive conveys NSAPI to identify the PDP using the service.

5.1.1.2 SN-DATA.indication

Indication used by the SNDCP entity to deliver the received N-PDU to the SNDCP user. Successful reception has been acknowledged by the LLC layer.

5.1.1.3 SN-UNITDATA.request

Request used by the SNDCP user for unacknowledged transmission of N-PDU. The SN-UNITDATA.request primitive conveys NSAPI to identify the PDP using the service and protection mode to identify the requested transmission mode.

5.1.1.4 SN-UNITDATA.indication

Indication used by the SNDCP entity to deliver the received N-PDU to the SNDCP user.

5.1.1.5 SN-XID.request

Request used by the SNDCP user at the initiating entity to deliver the list of requested XID parameters to the peer entity.

5.1.1.6 SN-XID.indication

Indication used by the SNDCP entity to deliver the list of requested XID parameters to the SNDCP user.

5.1.1.7 SN-XID.response

Response used by the SNDCP user to deliver the list of negotiated XID parameters to the peer entity.

5.1.1.8 SN-XID.confirm

Confirm used by the SNDCP entity to deliver the list of negotiated XID parameters to the SNDCP user.

5.1.2 Service Primitives Used by SNDCP Layer

The SNDCP layer uses the service primitives provided by the SM sublayer and the LLC layer (see Table 2). SM is specified in GSM 04.08 [5] and LLC in GSM 04.64 [6].

Table 2: Service primitives used by the SNDCP entity

Generic Name	Type				Parameters
	Request	Indication	Response	Confirm	
SNDCP <---> LLC					
LL-ESTABLISH	X	-	-	-	TLLI, XID Requested
LL-ESTABLISH	-	X	-	-	TLLI, XID Requested, N201-I, N201-U
LL-ESTABLISH	-	-	X	-	TLLI, XID Negotiated
LL-ESTABLISH	-	-	-	X	TLLI, XID Negotiated, N201-I, N201-U
LL-RELEASE	X	X	-	X	TLLI
LL-XID	X	-	-	-	TLLI, XID Requested
LL-XID	-	X	-	-	TLLI, XID Requested, N201-I, N201-U
LL-XID	-	-	X	-	TLLI, XID Negotiated
LL-XID	-	-	-	X	TLLI, XID Negotiated, N201-I, N201-U
LL-DATA	X	-	-	-	TLLI, SN-PDU, Reference
LL-DATA	-	X	-	-	TLLI, SN-PDU
LL-DATA	-	-	-	X	TLLI, Reference
LL-DATASENT	-	X	-	-	TLLI, Reference, V(S)
LL-UNITDATA	X	-	-	-	TLLI, SN-PDU, Protection mode, Cipher
LL-UNITDATA	-	X	-	-	TLLI, SN-PDU
SNDCP <---> SM					
SNSM-ACTIVATE		X	-	-	TLLI, NSAPI, QoS profile, Ack/Unack indicator, SAPI
SNSM-ACTIVATE	-	-	X		TLLI, NSAPI
SNSM-DEACTIVATE	-	X	-	-	TLLI, NSAPI(s), LLC release indicator
SNSM-DEACTIVATE	-	-	X	-	TLLI, NSAPI
SNSM-MODIFY	-	X	-	-	TLLI, NSAPI, QoS profile, SAPI
SNSM-MODIFY	-	-	X	-	TLLI, NSAPI
SNSM-WINDOW	-	X	-	-	TLLI, NSAPIs+V(R)s

5.1.2.1 LL-ESTABLISH.request

Request used by the SNDCP layer to establish acknowledged peer-to-peer operation in the LLC layer. The request may be used by the SNDCP layer to deliver the requested SNDCP XID parameters to the LLC layer. XID Requested is used to negotiate SNDCP parameters.

5.1.2.2 LL-ESTABLISH.indication

Indication used by the LLC layer to inform SNDCP layer about establishment of acknowledged peer-to-peer operation in the LLC layer. XID Requested is used to negotiate SNDCP parameters. In case the received LLC frameincludes the requested SNDCP XID parameters, the indication shall be used by the LLC layer to deliver the requested SNDCP XID parameters to the SNDCP layer. In case of a link re-establishment, all buffered N-PDUs (i.e. the one whose complete reception has not been acknowledged and the one which has not bee transmitted yet) are to be transmitted starting with the oldest N-PDU when the link is re-established. Also any compression entities associated to this LLC link at the SNDCP layer are reset.

5.1.2.3 LL-ESTABLISH.response

Response used by the SNDCP layer after reception of the LL-ESTABLISH.indication. XID Negotiated is used to negotiate SNDCP parameters. In case the LL-ESTABLISH.indication included the requested SNDCP XID parameters, the response shall be used by the SNDCP layer to deliver the negotiated SNDCP XID parameters to the LLC layer.

5.1.2.4 LL-ESTABLISH.confirm

Confirm used by the LLC layer to inform SNDCP layer about successful initiation of acknowledged peer-to-peer operation in the LLC layer. XID Negotiated is used to negotiate SNDCP parameters. In case the LLC frameincludes the negotiated SNDCP XID parameters, the confirm shall be used by the LLC layer to deliver the negotiated SNDCP XID parameters to the SNDCP layer. In case of a link re-establishment, all buffered N-PDUs (i.e. the one whose complete reception has not been acknowledged and the one which has not bee transmitted yet) are to be transmitted starting with the oldest N-PDU when the link is re-established. Also any compression entities associated to this LLC link at the SNDCP layer are reset.

5.1.2.5 LL-RELEASE.request

Request used by the SNDCP layer to release acknowledged peer-to-peer operation in the LLC layer.

5.1.2.6 LL-RELEASE.indication

Indication used by the LLC layer to inform SNDCP layer about termination of acknowledged peer-to-peer operation in the LLC layer. The primitive is triggered by the reception of disconnect mode (DISC) LL-PDU in the LLC layer.

If the SNDCP entity receives LL-RELEASE.indication while there are still N-PDUs to be transmitted on that logical link, the SNDCP entity shall establish a new logical link using the LL-ESTABLISH.request. On receipt of LL-RELEASE.indication, compressed N-PDUs queuing to be forwarded to LLC-layer are deleted from the SNDCP layer. Also any compression entities associated to this LLC link are reset.

5.1.2.7 LL-RELEASE.confirm

Confirm used by the LLC layer to inform SNDCP layer about termination of acknowledged peer-to-peer operation in the LLC layer. On receipt of LL-RELEASE.confirm, compressed N-PDUs queuing to be forwarded to LLC-layer are deleted from the SNDCP layer. Also any compression entities associated to this LLC link at the SNDCP are reset.

5.1.2.8 LL-XID.request

Request used by the SNDCP layer to deliver the requested SNDCP XID parameters to the LLC layer.

5.1.2.9 LL-XID.indication

Indication used by the LLC layer to deliver the requested SNDCP XID parameters to the SNDCP layer.

5.1.2.10 LL-XID.response

Response used by the SNDCP layer to deliver the negotiated SNDCP XID parameters to the LLC layer.

5.1.2.11 LL-XID.confirm

Confirm used by the LLC layer to deliver the negotiated SNDCP XID parameters to the SNDCP layer.

5.1.2.12 LL-DATA.request

Request used by the SNDCP layer for acknowledged transmission of a SN-PDU. The SNDCP entity shall associate a reference parameter for each LL-DATA.request.

The logical link shall be established using the LL-ESTABLISH primitives, before the LL-DATA.request may be used.

5.1.2.13 LL-DATA.indication

Indication used by the LLC layer to deliver the successfully received SN-PDU to the SNDCP layer.

5.1.2.14 LL-DATA.confirm

Confirm used by the LLC layer to inform SNDCP layer about successful transmission of SN-PDU. The primitive includes a reference parameter from which the SNDCP entity shall identify the LL-DATA.request this confirmation was associated with. All buffered N-PDUs whose complete reception is confirmed are deleted.

5.1.2.15 LL-DATASENT.indication

The LL-DATASENT.indication primitive is used by the LLC layer in acknowledged mode in the SGSN to inform SNDCP of which LLC send sequence number that was assigned to an LLC PDU. SNDCP uses this information to associate the LLC send sequence number with the corresponding N-PDU.

5.1.2.16 LL-UNITDATA.request

Request used by the SNDCP layer for unacknowledged transmission of a SN-PDU. Unconfirmed transmission shall be used by the LLC layer.

Acknowledged peer-to-peer mode does not need to be established before unacknowledged transmission is allowed.

5.1.2.17 LL-UNITDATA.indication

Indication used by the LLC layer to deliver the received SN-PDU to the SNDCP layer.

There is no need for logical link on the acknowledged-peer-to-peer mode for unacknowledged transmission of SN-PDU.

5.1.2.18 SNSM-ACTIVATE.indication

Indication used by the SM entity to establish or reuse the acknowledged peer-to-peer LLC operation for a specific NSAPI during the ongoing PDP Context Activation procedure. This primitive is used by the SM entity to inform the SNDCP entity about the NSAPI and the related SAPI that has been allocated for the use of the SNDCP entity.

Upon reception of the SNSM-ACTIVATE.indication from the SM sublayer, the SNDCP entity of the MS shall use the LL-ESTABLISH.request primitive to establish the acknowledged peer-to-peer LLC operation, as requested for a specific NSAPI. If an appropriate acknowledged peer-to-peer operation (including the requested XID parameters) is already up and running, there is no need for re-establishment of the link. If an acknowledged peer-to-peer operation is already up and running but the XID parameters are not correct, the SNDCP entity shall issue LL-XID-request to negotiate the requested XID parameters.

5.1.2.19 SNSM-ACTIVATE.response

Response used by the SNDCP layer to inform SM entity that the acknowledged peer-to-peer operation mode is up and running with the requested XID parameters.

5.1.2.20 SNSM-DEACTIVATE.indication

Indication used by the SM entity during the PDP Context Deactivation to trigger termination of the acknowledged peer-to-peer LLC operation for a specific NSAPIs. This primitive is used by the SM entity to inform the SNDCP entity about the NSAPI that has been deallocated and cannot be used by the SNDCP entity anymore. All buffered N-PDUs corresponding to this NSAPI are deleted.

When receiving the SNSM-DEACTIVATE.indication, the SNDCP entity shall check if there are other NSAPIs using the same logical link. If the logical link is not used by other NSAPIs, the SNDCP entity shall use LL-RELEASE.request to terminate the acknowledged peer-to-peer LLC operation. The termination shall be started by the entity (MS or SGSN) where the PDP Context Deactivation was started.

5.1.2.21 SNSM-DEACTIVATE.response

Response used by the SNDCP layer to inform SM entity about successfully deactivated PDP Context and logical links that have not been used by other NSAPIs. The primitive is triggered by the LL-RELEASE.indication and LL-RELEASE.confirm primitives after the SNSM-RELEASE.indication primitive.

5.1.2.22 SNSM-MODIFY.indication

Indication used by the SM entity to trigger change of the QoS for one NSAPI and indication of the SAPI to be used. The primitive triggers release of a logical link (using the LL-RELEASE.request sent by the SNDCP entity of the SGSN) that after the modification of the QoS profile values is not used by any NSAPIs. If no logical link exists for the requested QoS profile, the SNDCP entity of the SGSN shall establish a new logical link with the requested XID parameters using the LL-ESTABLISH.request primitive.

5.1.2.23 SNSM-MODIFY.response

Response used by the SNDCP entity to inform SM entity that the change of the QoS profile values has been carried out for the NSAPIs.

5.1.2.24 SNSM-WINDOW.indication

This primitive is only included in the SGSN and is used in the case of Inter SGSN RA Update. The primitive is used in the new SGSN by the SM entity to inform the SNDCP entity about the LLC PDU sequence number that has been correctly received by the MS. This is indicated by the V(R) value received from the MS during the Inter SGSN RA Update procedure. The SNDCP entity of the SGSN uses this information to delete all buffered N-PDUs whose complete reception is confirmed.

5.2 Service Functions

SNDCP shall perform the following functions (see figure 3):

- Mapping of SN-DATA primitives onto LL-DATA primitives.
- Mapping of SN-UNITDATA primitives onto LL-UNITDATA primitives.
- Multiplexing of N-PDUs from one or several network layer entities onto the appropriate LLC connection.
- N-PDU buffering at SNDCP for acknowledged service.
- Management of delivery sequence for each NSAPI, independently.

- Compression of redundant protocol control information (e.g., TCP/IP header) at the transmitting entity and decompression at the receiving entity. The compression method is specific to the particular network layer or transport layer protocols in use.
- Compression of redundant user data at the transmitting entity and decompression at the receiving entity. Data compression is performed independently for each SAPI, and may be performed independently for each PDP context. Compression parameters are negotiated between the MS and the SGSN.
- Segmentation and reassembly. The output of the compressor functions is segmented to the maximum length of LL-PDU. These procedures are independent of the particular network layer protocol in use.
- Negotiation of the XID parameters between peer SNDCP entities using XID exchange.

Figure 4 shows the transmission flow through SNDCP layer. The order of functions is the following:

- Protocol control information compression.
- User data compression.
- Segmentation of compressed information into SN-DATA or SN-UNITDATA PDUs.

The order of functions is vice versa in the reception flow:

- Reassembly of SN-PDUs to SN-PDUs.
- User data decompression.
- Protocol control information decompression.

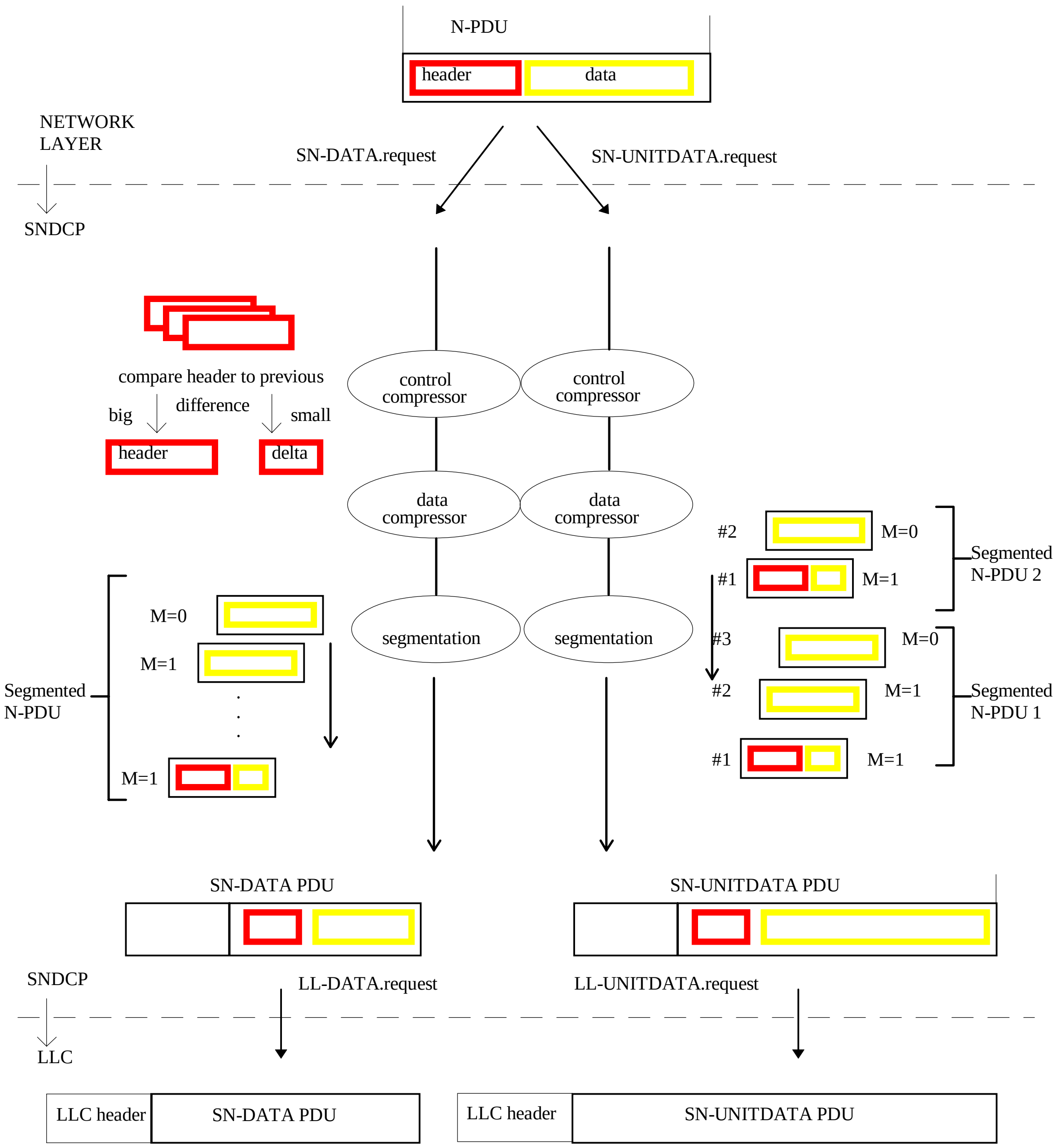


Figure 4: SNDCP model

The SNDCP layer expects the following services to be provided by the LLC layer. LLC layer functionality is defined in GSM 04.64 [6]:

- Acknowledged and unacknowledged data transfer.
- Point-to-point and point-to-multipoint data transfer.
- In-order delivery of SN-PDUs per SAPI (i.e. SN-PDUs using the same SAPI shall appear at the receiving end in the same order as transmitted). This is required only for acknowledged service.
- QoS profile-based transfer of SN-PDUs.
- Support for variable length SN-PDUs.
- Transfer of SNDCP XID parameters.

The SNDCP layer expects the following services to be provided by the SM sublayer. SM sublayer functionality is defined in GSM 04.08 [5]:

- Activation and deactivation of PDP Contexts and informing the SNDCP layer when change in PDP context has happened.
- Carrying out Inter SGSN Routing Area Update and informing the SNDCP layer in the SGSN when the N-PDUs shall be tunneled to the new SGSN.
- Notifying the SNDCP layer when there is need to change the QoS profile parameters of the PDP contexts.

6 Protocol Functions

6.1 Multiplexing of N-PDUs

The NSAPI field shall be used for the identification of the specific PDP type and PDP address pair that is using the services provided by the SNDCP layer. The MS allocates NSAPIs dynamically at the PDP Context Activation. The NSAPI is delivered by the SM sub-layer to the SNDCP layer with the SNSM-ACTIVATE.indication primitive. The transmitting SNDCP entity shall insert the NSAPI value for each N-PDU. The peer SNDCP entity uses the NSAPI to identify the SNDCP user the N-PDU is targeted. Table 3 shows an example for the allocation of the NSAPIs.

Table 3: Example of the NSAPI allocation

PDP type	Allocated NSAPI	PDP address
IP	12	133.12.75.111
X.25	13	13254

6.2 N-PDU buffering

The N-PDUs are buffered in the SNDCP layer before they are compressed segmented and transmitted to the LLC layer. The reception of a SNSM-DEACTIVATE.indication triggers the deletion of the buffer for the related NSAPI.

For acknowledged data transfer, an SNDCP entity shall buffer an N-PDU until successful transmission of all SN-PDUs carrying a segment of the N-PDU have been confirmed by the LLC layer. The confirmation is carried out using the LL-DATA.confirm or SNSM-WINDOW.indication primitives. At SGSN, for each LL-DATA.request sent to the LLC layer a LL-DATASENT.indication primitive is returned to SNDCP as soon as a LLC send sequence number has been assigned to the LLC PDU. This LLC send sequence number is included in the LL-DATASENT.indication primitive. At the SNDCP entities, the buffered N-PDUs which have been completely received as indicated by the acknowledgements in an LL-DATA.confirm primitive are discarded. During the Inter-SGSN RA Update, the N-PDUs whose complete reception by the MS has been confirmed in the SNSM-WINDOW.indication primitive are discarded, as defined in GSM 09.60 [7] and GSM 03.60 [3

For unacknowledged data transfer, the SNDCP shall delete an N-PDU immediately after it has been delivered to the LLC layer.

6.3 Management of delivery sequence

The SNDCP layer shall retain the delivery sequence of N-PDUs of each NSAPI between the peer entities. The delivery sequence of N-PDUs from different NSAPIs may alter according to the QoS requirements.

6.4 Protocol Control Information Compression

Protocol control information compression is an optional SNDCP feature. Only TCP/IP header compression has been specified in this specification.

Negotiation of the supported algorithms and their parameters is carried out between MS and SGSN using the SNDCP XID parameters (see clause 8).

6.4.1 Negotiation of multiple protocol control information compression types

Each SNDCP entity that supports protocol control information compression shall be able to negotiate one or several protocol control information compression types with the SNDCP XID format shown in Figure 5. The negotiation shall be carried out using the XID parameter negotiation specified in subclause 6.7. The initiating entity defines a set of requested algorithms and their parameters. The set of algorithms and their parameters shall be transmitted to the peer entity. The peer entity responds with the set of negotiated algorithms and their parameters. The peer entity shall select the proposed values or other appropriate values for the negotiated algorithms. No more than 15 compression algorithms (excluding the no compression alternative) shall be selected by the peer entity. If the peer entity responds with an algorithm set including more than 15 algorithms and parameters, only the 15 first algorithms shall be taken into consideration. The rest of the negotiated algorithms are ignored without error notification.

bit	8	7	6	5	4	3	2	1
octet 1	X	X	X	Algorithm Type				
octet 2	Applicable NSAPIs for SN-DATA							
octet 3	Applicable NSAPIs for SN-DATA							
octet 4	Applicable NSAPIs for SN-UNITDATA							
octet 5	Applicable NSAPIs for SN-UNITDATA							
octet 6	Length = n - 6							
octet 7	High-order octet							
...	...							
octet n	Low-order octet							

Figure 5: Protocol control information 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 4 show the list of protocol control information compression algorithms supported by the SNDCP layer. When new compression algorithms are needed for SNDCP, Table 4 shall be updated.

Table 4: List of protocol control information compression algorithms supported by SNDCP

Compression algorithm	Algorithm type (Range 0-31)
RFC1144 IP	0
RFC1144 Uncompressed TCP/IP	1
RFC1144 Compressed TCP/IP	2
-	Other values Reserved

The values for the PCOMP shall be defined dynamically, based on the negotiation of the XID parameters for protocol control information compression. PCOMP value 0 is reserved for no compression. Other 15 values (1-15) are derived from the set of negotiated data compression algorithms. If TCP/IP header compression shall be used for at least one NSAPI, PCOMP values must be allocated for each of the algorithm types 0, 1 and 2 in table 4. The NSAPI(s) that wish to use TCP/IP header compression must also be indicated for each of the algorithm types in the XID negotiation.

When a compression algorithm is not included in the XID ‘Protocol Control Information Compressions’ parameter field (Section 8), that algorithm is not applicable for the NSAPI(s) involved in the XID-negotiation; i.e. the default value for the ‘Protocol Control Information Compressions’ parameter is no compression..

6.4.1.1 Assignment of PCOMP values

The assignment of the PCOMP values follows the following general rule:

- PCOMP value 0 is reserved permanently for no compression.
- PCOMP value 1 shall be assigned for the first algorithm on the set of the negotiated algorithms. PCOMP value 2 shall be assigned for the second algorithm on the set of the negotiated algorithms. This rule continues until the PCOMP value has been assigned for all the negotiated algorithms. However, if parameter values have been negotiated for the same algorithm in more than one field inside the XID block (applicable for different NSAPIs), the same PCOMP value shall be assigned to all instances of the same algorithm. The compression entities will be identifiable by a combination of NSAPI and PCOMP values in the SN-(UNIT)DATA frame header. If XID parameters are renegotiated during a connection, the PCOMP value of an algorithm used both before and after the renegotiation shall not be changed.

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

In case the compression parameters are renegotiated during an existing connection, the configuration is not affected if the parameter values do not change. However, if the parameters change, the compression entities and the LLC link are reset. A renegotiation of the compression parameters is performed using LL-XID primitives if the parameters have not been changed in the initiating XID block. If the parameters have been changed in the initiating block, LL-ESTABLISH primitives are used. If the parameters have been modified only in the responding XID block, LLC link and compression entity reset is initialised using LL-ESTABLISH primitives following the reception of the responding XID block.

When an LLC link used for a particular compression entity is reset or released, the compression entity is also reset. The compression entity reset is initialised by reception of LLC-ESTABLISH.indication, LLC-ESTABLISH.confirm, LL-RELEASE.indication, or LL-RELEASE.confirm primitives.

6.4.2 TCP/IP header compression

The protocol control information compression method is specific for each network layer protocol type. TCP/IP (IPv4) header compression is specified in RFC 1144 [9].

The underlying service shall be able to distinguish three types of SN-PDUs (i.e., IP, Uncompressed TCP/IP, and Compressed TCP/IP), as defined in RFC 1144 [9]. Those three SN-PDU types are defined as three different algorithm types in Table 5. When the TCP/IP header compression is negotiated at the SNDCP XID exchange, PCOMP values for the three algorithm types shown in Table 4 shall be negotiated. Also one compression parameter — The Number of State Slots — must be negotiated between the compression entities.

Table 5: RFC 1144 TCP/IP header compression parameters

Algorithm Name	Algorithm Type	Length	Format	Range	Sense of Negotiation	Default Value
RFC 1144 Compressed TCP/IP	2	1	$S_0S_0S_0S_0S_0S_0S_0S_0$	0-254	down	16

S_0 The Number of State Slots

The number of memory locations for saved packet headers. [9]

If the S_0 parameter is not included in the field negotiating the use of RFC 1144 Compressed TCP/IP in either direction of negotiation, the default value for the parameter will apply. If S_0 is not included in the initiating XID block, the responding end reads this as a default value offer and may negotiate another value according to the rules of negotiation.

6.5 Data compression

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

Figure 6 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.

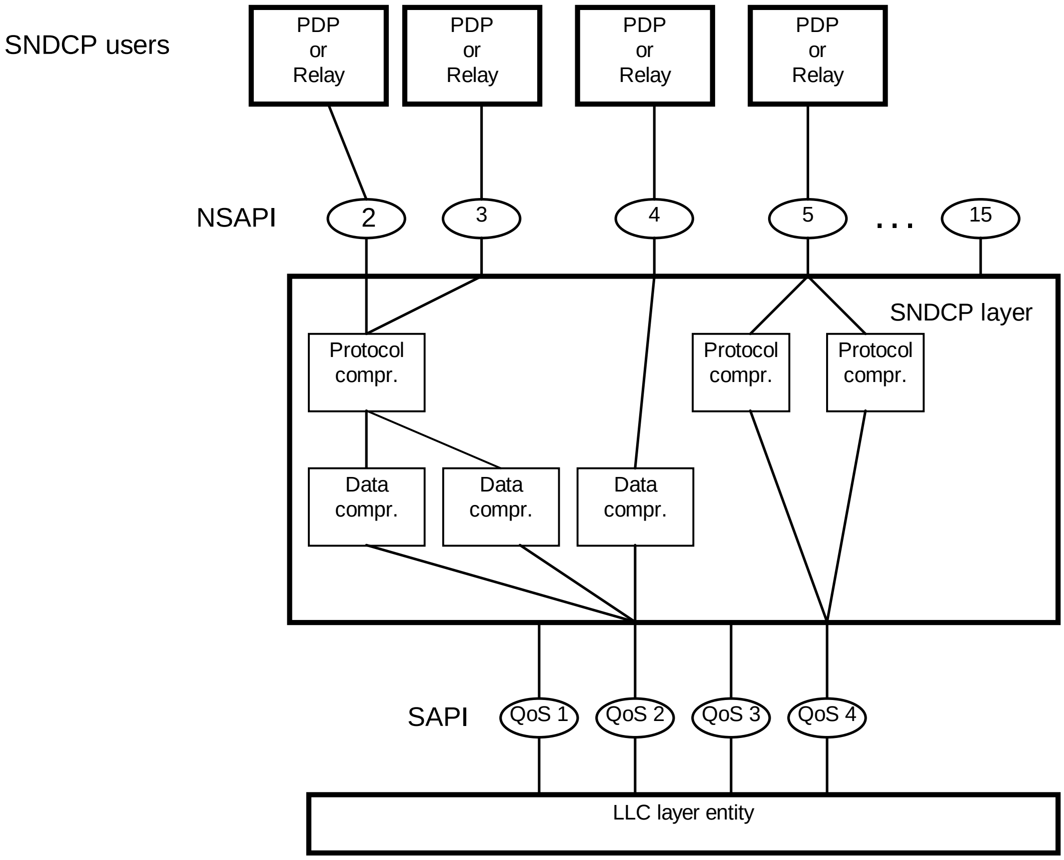


Figure 6: An example for the usage of NSAPIs, SNDCP functions, and SAPIs

6.5.1 Negotiation of multiple data compression types

Each SNDCP entity that supports data compression shall be able to negotiate one or several data compression types with the SNDCP XID format shown in Figure 7. The negotiation shall be carried out using the XID parameter negotiation specified in subclause 6.7. The initiating entitydefines a set of requested algorithms and their parameters. The set of algorithms and their parameters shall be transmitted to the peer entity. The peer entity responds with the set of negotiated algorithms and their parameters. The peer entity shall select the proposed values or other appropriate values for the negotiated algorithms. No more than 15 compression algorithms (excluding the no compression alternative) shall be selected by the peer entity. If the peer entity responds with an algorithm set including more than 15 algorithms and parameters, only the 15 first algorithms shall be taken into consideration. The rest of the negotiated algorithms are ignored without error notification. 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.

<table>
<tr><td>bit</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>octet 1</td><td>X</td><td>X</td><td>X</td><td colspan="5">Algorithm Type</td></tr>
<tr><td>octet 2</td><td colspan="8">Applicable NSAPIs for SN-DATA</td></tr>
<tr><td>octet 3</td><td colspan="8">Applicable NSAPIs for SN-DATA</td></tr>
<tr><td>octet 4</td><td colspan="8">Applicable NSAPIs for SN-UNITDATA</td></tr>
<tr><td>octet 5</td><td colspan="8">Applicable NSAPIs for SN-UNITDATA</td></tr>
<tr><td>octet 6</td><td colspan="8">Length = n - 6</td></tr>
<tr><td>octet 7</td><td colspan="8">High-order octet</td></tr>
<tr><td>...</td><td colspan="8">...</td></tr>
<tr><td>octet n</td><td colspan="8">Low-order octet</td></tr>
</table>

Figure 7: 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.

Table6: List of data compression algorithms supported by SNDCP

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

When a compression algorithm is not included in the XID 'Data Compressions' parameter field (Section 8), that algorithm is not applicable for the NSAPI(s) involved in the XID-negotiation; i.e. the default value for the 'Data Compressions' parameter is no compression..

6.5.1.1 Assignment of DCOMP values

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

- DCOMP value 0 is reserved permanently for no compression.
- DCOMP value 1 shall be assigned for the first algorithm on the set of the negotiated algorithms. DCOMP value 2 shall be assigned for the second algorithm on the set of the negotiated algorithms. This rule continues until the

DCOMP value has been assigned for all the negotiated algorithms. However, if parameter values have been negotiated for the same algorithm in more than one field inside the XID block (applicable for different NSAPIs), the same DCOMP value shall be assigned to all instances of the same algorithm. The compression entities will be identifiable by a combination of NSAPI and DCOMP values in the SN-(UNIT)DATA frame header. If XID parameters are renegotiated during a connection, the DCOMP value of an algorithm used both before and after the renegotiation shall not be changed.

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

In case the compression parameters are renegotiated during an existing connection and only the applicable NSAPI(s) change, the configuration of the compression entity is not affected. However, if the parameters change, the compression entities and the LLC link are reset. A renegotiation of compression parameters is performed using LL-XID primitives if the parameters have not been changed in the initiating XID block. If the parameters have been changed in the initiating block, LL-ESTABLISH primitives are used. If the parameters have been modified only in the responding XID block, LLC link and compression entity reset is initialised using LL-ESTABLISH primitives following the reception of the responding XID block.

When an LLC link used for a particular compression entity is reset or released, the compression entity is also reset. The compression entity reset is initialised by reception of LLC-ESTABLISH.indication, LLC-ESTABLISH.confirm, LL-RELEASE.indication, or LL-RELEASE.confirm primitives.

6.5.2 Management of V.42 *bis* data compression

V.42 *bis* data compression may be used with SN-DATA primitives and SN-UNITDATA primitives.

ITU-T V.42 *bis* is specified in [8]. The use of data compression function and associated parameters shall be negotiated at initial connection establishment. The parameters P0, P1, and P2 shall be transferred between the SNDCP layers at the MS and the SGSN.

Table7: V.42 *bis* data compression parameters

Algorithm Name	Algorithm Type	Length	Format	Range	Sense of negotiation	Default value
V.42bis	0	4	0 0 0 0 0 0 P_0 P_0	0-3	down (each direction separately)	3
			$P_1P_1P_1P_1P_1P_1P_1P_1$ $P_1P_1P_1P_1P_1P_1P_1P_1$	512-65535	down	2048
			$P_2P_2P_2P_2P_2P_2P_2P_2$	6-250	down	20

P_0 V.42bis compression request

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

P_1 V.42bis number of codewords

Maximum number of codewords in the compressor dictionary.

P_2 V.42bis maximum string length

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

If the P_0, P_1, and P_2 parameters are not included in the field negotiating the use of V.42bis in either direction of negotiation, the default values for the parameters will apply. If the parameters are not included in the initiating XID block, the responding end reads this as an offer for default values and may negotiate other set of values according to the rules of negotiation.

SNDCP entity shall flush the compression dictionary after each N-PDU.

When V.42 bis is used with SN-UNITDATA primitives the compression shall be terminated and the dictionary reset for each N-PDU, and 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 logical link.

6.6 Segmentation and reassembly

Any (possibly compressed) N-PDU + SNDCP header shall be segmented by SNDCP if it is longer than N201 (see GSM 04.64 [6]). In the segmentation, the SN-PDU is divided into multiple SN-PDUs. The M bit of the last SN-PDU is set to 0 while the M bit of the other segments is set to 1. The receiving SNDCP entity shall reassemble the segments back to the original N-PDU format. The segmentation and reassembly procedures are different for acknowledged and unacknowledged mode of operation.

The PCOMP and DCOMP parameters shall only be included in the first segment.

6.6.1 Segmentation in acknowledged mode

The transmitting SNDCP entity shall segment an N-PDU into an ordered sequence of one or more SN-PDUs. The More bit (M) is used to identify the last segment. This procedure is illustrated in figure 4.

6.6.2 Segmentation in unacknowledged mode

The More bit is used to indicate N-PDU boundaries in the same way as specified for the acknowledged transmission mode. See figure 4 for illustration.

The Segment offset indicates the offset from the beginning of the N-PDU in multiples of 128 octets. Four bits are used for the offset.

The received segments belonging to the same N-PDU shall be buffered. If a timer (implementation dependent) elapses before all segments are received, the N-PDU shall be ignored.

N-PDU number for PTP shall be inserted by the SNDCP entity. The N-PDU numbering starts from 0. For each of the following N-PDUs, the N-PDU number shall be increased by one. Modulo 524287 operation is applied. N-PDUs are numbered per NSAPI. Numbering cycles are reset at PDP context activation.

6.7 XID parameter negotiation

Negotiation of XID parameters between peer SNDCP entities may be carried out to ensure optimal information transfer. The parameters are called SNDCP exchange identity (XID) parameters. SNDCP XID parameter negotiation may be started by the SNDCP entity at the MS or at the SGSN. The XID negotiation is a one-step procedure; i.e. the initiating end proposes parameter values, and the responding end either accepts these or offers different values in their place according to the XID negotiation rules described in this document; the rules limit the range of parameter values as well as the sense of negotiation. The initiating end accepts (or rejects) the values in the response; this concludes the negotiation. The block format for the SNDCP XID parameter negotiation is shown in figure 8. All parameters do not have to be included in the XID block, only parameters that are negotiated. Also it shall be possible to negotiate parameters for more than one NSAPI in one XID block since more than one NSAPI can use the same SAPI. At XID negotiation, all NSAPI(s) using the algorithm in questionshall be mentioned. At XID renegotiation, if additional applicable NSAPI(s) is/are indicated, these NSAPI(s) are added to an existing or to a new functional entity (e.g. a compression entity). At XID renegotiation, the NSAPI(s) which are not indicated anymore, are intepreted as having released the functional entity (e.g. a compression entity). If it is required that an NSAPI does not share a functional entity (e.g. a compression entity) with other NSAPI(s), only this NSAPI's flag is set in the 'Applicable NSAPIs for SN-(UNIT)DATA' field. If there are no vacant entities at the responding SNDCP, no flag is set in the responding field, and the negotiation fails for the parameter in question. Data traffic through the NSAPI shall, however, continue if the failure does not make the connection inoperable. If flags for more than one NSAPI is set in the 'Applicable NSAPIs for SN-(UNIT)DATA' fields the same functional entity will be shared by all the indicated NSAPIs. The responding SNDCP may reject one or more NSAPIs, whose flags were set in the initiating message, by not setting the relevant flags in the answer. If parameters for a connection are renegotiated during an existing connection (e.g. because another NSAPI will share the functional entity) the effects depend on the parameter in question and are discussed in the corresponding sections of this document. One or several fields may be included into XID block while the negotiation between peer entities is carried out. In figure 8 the XID block is described. For each negotiated parameter, except version number, a bitmap is included that indicates which NSAPIs want to use this parameter. The bitmap is 2 octets.

When the negotiation of SNDCP XID parameters has not been carried out prior to data transfer, default values shall be used; however, for parameter types 1 and 2, refer to sections 6.5.1/6.5.2 and 6.4.1/6.4.2, respectively.

Bit	8	7	6	5	4	3	2	1
Octet 1	Parameter type=0							
Octet 2	Version number							
Octet 3	Parameter type=1							
Octet 4	Length=n-4							
Octet 5	X	X	X	Algorithm type				
Octet 6	Applicable NSAPIs for SN-DATA							
Octet 7	Applicable NSAPIs for SN-DATA							
Octet 8	Applicable NSAPIs for SN-UNITDATA							
Octet 9	Applicable NSAPIs for SN-UNITDATA							
Octet 10	Length=k-10							
Octet 11	High-order octet							
…	…							
Octet k	Low-order octet							
Octet k+1	X	X	X	Algorithm type				
Octet k+2	Applicable NSAPIs for SN-DATA							
Octet k+3	Applicable NSAPIs for SN-DATA							
Octet k+4	Applicable NSAPIs for SN-UNITDATA							
Octet k+5	Applicable NSAPIs for SN-UNITDATA							
Octet k+6	Length=m-(k+6)							
Octet k+7	High-order octet							
…	…							
Octet m	Low-order octet							
…	…							
Octet n	Low-order octet							
Octet n+1	Parameter type=2							
Octet n+2	Length=r-(n+2)							
Octet n+3	X	X	X	Algorithm type				
Octet n+4	Applicable NSAPIs for SN-DATA							
Octet n+5	Applicable NSAPIs for SN-DATA							
Octet n+6	Applicable NSAPIs for SN-UNITDATA							
Octet n+7	Applicable NSAPIs for SN-UNITDATA							
Octet n+8	Length=p-(n+8)							
Octet n+9	High-order octet							
…	…							
Octet p	Low-order octet							
Octet p+1	X	X	X	Algorithm type				
Octet p+2	Applicable NSAPIs for SN-DATA							
Octet p+3	Applicable NSAPIs for SN-DATA							
Octet p+4	Applicable NSAPIs for SN-UNITDATA							
Octet p+5	Applicable NSAPIs for SN-UNITDATA							
Octet p+6	Length=q-(p+6)							
Octet p+7	High-order octet							
…	…							
Octet q	Low-order octet							
…	…							
Octet r	Low-order octet							

Figure 8: Example of SNDCP XID block format

The SNDCP user uses SN-XID.request to initiate the negotiation of the XID parameters. The SNDCP entity sends the proposed SNDCP XID parameters to the LLC SAP with the LL-XID.request or LL-ESTABLISH.request. The LLC SAP shall issue an XID command containing the SNDCP XID parameters (see GSM 04.64). The peer LLC SAP shall, upon receipt of the XID command, indicate the SNDCP XID parameters to SNDCP entity using LL-XID.indication or LL-ESTABLISH.indication. The peer SNDCP entity shall select appropriate values for the proposed parameters or negotiate the appropriate values with the SNDCP user entity with the SN-XID.indication and SN-XID.response primitives. When the appropriate parameter values are known by the peer SNDCP entity, it shall use the LL-XID.response or LL-ESTABLISH.response primitive to continue negotiation. Upon reception of the response, the LLC SAP shall send the received parameters to the SNDCP entity using the LL-XID.confirm or LL-ESTABLISH.confirm primitive. The SNDCP entity delivers the negotiated parameters to the SNDCP user. This is illustrated in Figure 9. The originator of the negotiation shall apply the new parameter values after it has received the ’confirm’ primitive. The responding end of the negotiation shall apply the new parameter values after it has sent the replying ’response’ primitive. If the format of the XID block is invalid or if the parameter values violate the sense of negotiation rules, SNDCP rejects the block; following this the initiator reinitiates the negotiation. If the XID block contains a parameter that is not recognised, the parameter is not responded to. If the initiating XID block contains recognisable parameters with invalid values, the responding end replies using valid values within the allowed value range.

Negotiation of SNDCP version number is always between the peer SNDCP entities. The version number is not known by the SNDCP user. However, negotiation of the parameters for compression algorithms may be carried out between the SNDCP user entities.

If default XID-parameter values will not be used, XID negotiation shall be carried out prior to data transfer. The SNDCP XID parameters are transferred using either LL-XID or LL-ESTABLISH primitives; LL-ESTABLISH primitives are used only when acknowledged peer-to-peer LLC operation has to be established or re-established.

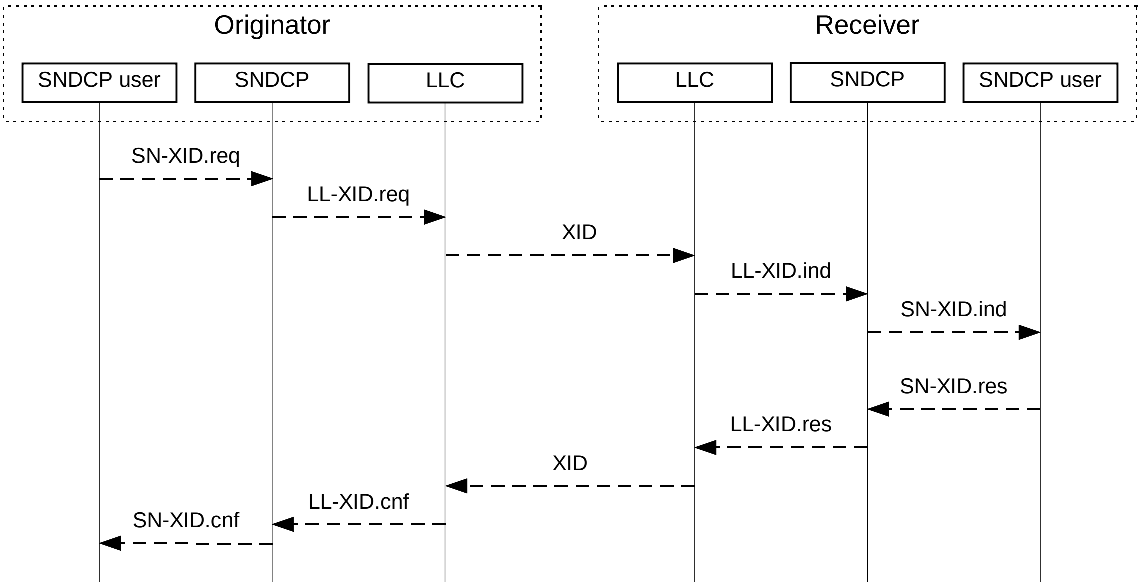


Figure 9: SNDCP XID negotiation procedure

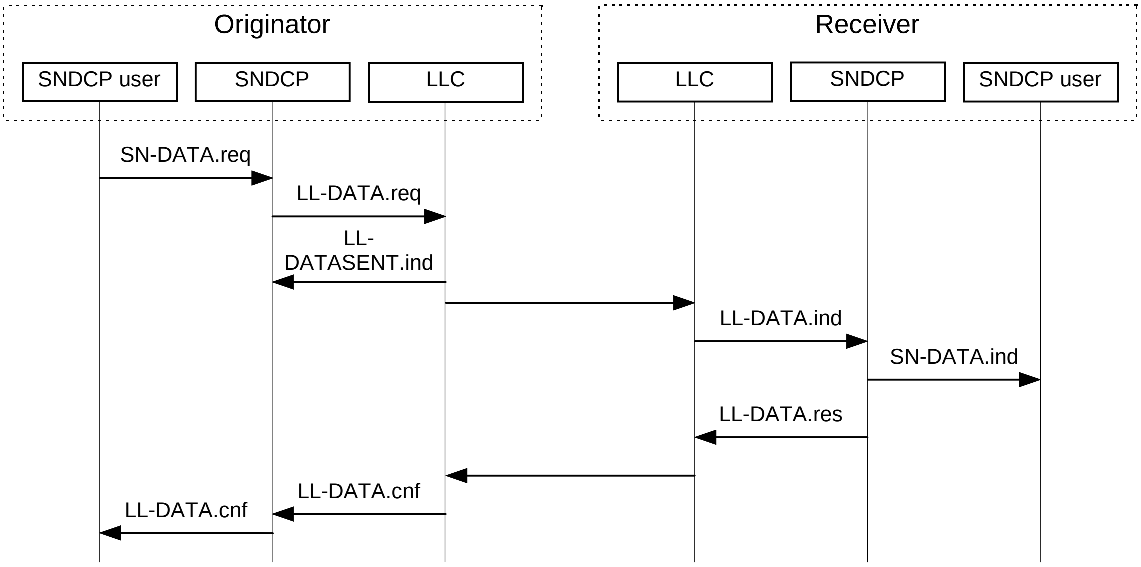
6.8 Data transfer

6.8.1 Acknowledged mode

The SNDCP entity shall initiate acknowledged data transmission only if the PDP context for the NSAPI identified in the SN-DATA.request has been activated and if acknowledged LLC operation has been established. Upon reception of the SN-DATA.request, the SNDCP entity shall perform the compression and segmentation functions, then forward the SN-PDU in LL-DATA.request to the LLC layer. The N-PDU shall be stored into a buffer in the SNDCP entity.

When the peer SNDCP entity receives the SN-PDU in the LL-DATA.indication primitive, the SNDCP entity extracts the N-PDU from the SN-PDU, reassembles and decompresses the information, and forwards it to the SNDCP user with the SN-DATA.indication. The correct SNDCP user is identified by the NSAPI field in the SN-PDU.

The SNDCP entity that has originated the transmission shall wait until the transmission of the SN-PDU is confirmed by an LL-DATA.confirm. After the confirmation of the last SN-PDU carrying a segment of an N-PDU, the N-PDU may be deleted from buffer.



NOTE: LL-DATASENT.ind is returned to the SNDCP layer in the originating side if Originator is a SGSN.

Figure 10: SNDCP acknowledged data transfer

6.8.2 Unacknowledged mode

The SNDCP entity shall initiate unacknowledged data transmission only if the PDP context for the NSAPI identified in the SN-DATA.request has been activated. The SNDCP entity may initiate unacknowledged data transmission even if the acknowledged peer-to-peer operation is not established for that NSAPI. Upon reception of the SN-UNITDATA.request, the SNDCP entity shall compress and segment the information, then forward the SN-PDU in LL-UNITDATA.request to the LLC layer. The N-PDU shall be deleted immediately after the data has been delivered to LLC layer.

When the peer SNDCP entity receives the SN-PDU in the LL-UNITDATA.indication primitive, the SNDCP entity extracts the N-PDU from the SN-PDU, reassembles and decompresses the information, then forwards it to the SNDCP user with the SN-UNITDATA.indication. The correct SNDCP user is identified by the NSAPI field in the SN-PDU.

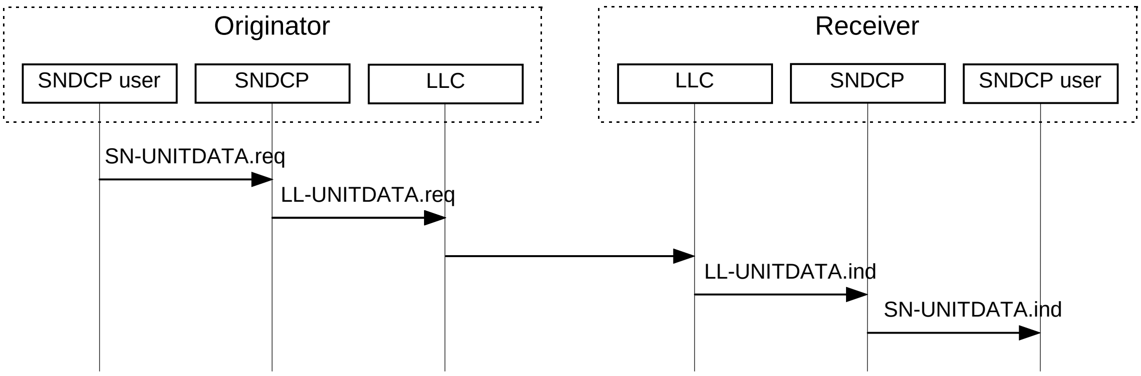


Figure 11: SNDCP unacknowledged data transfer

6.9 Possible combinations of SNDCP Protocol Functions and their connection to service access points

The following combinations of SNDCP protocol functions are allowed:

- One or several NSAPIs may use one SAPI
- Only one SAPI shall be used by one NSAPI
- One or several NSAPIs may use the same protocol control information compression entity
- One NSAPI may use zero, one, or several protocol control information compression entities
- One or several NSAPIs may use the same data compression entity
- One NSAPI may use zero, one, or several data compression entities
- Separate data compression entities shall be used for SN-DATA and SN-UNITDATA PDUs
- Separate protocol control information compression entities shall be used for SN-DATA and SN-UNITDATA PDUs
- One data compression entity shall be connected to one SAPI.
- One protocol control information compression entity shall be connected to one SAPI.
- One or several protocol control information compression entities may be connected to the same data compression entity.
- One protocol control information compression entity shall be connected to zero, one, or several data compression entities

7 Definition of SN-PDU

7.1 Format convention

7.1.1 Numbering convention

The convention used in this specification is illustrated in figure 12. The bits are grouped into octets. The bits of an octet are shown horizontally and are numbered from 1 to 8. Multiple octets are shown vertically and are numbered from 1 to N.

Bit	8	7	6	5	4	3	2	1
Oct 1								
2								
...								
N-1								
N								

Figure 12: Format convention

7.1.2 Order of transmission

SN-PDUs are transferred between the SNDCP layer and LLC layer in units of octets, in ascending numerical octet order (i.e., octet 1, 2, …, N-1, N). The order of bit transmission is specific to the underlying protocols used across the Um interface and the Gb interface.

7.1.3 Field mapping convention

When a field is contained within a single octet, the lowest bit number of the field represents the lowest order value. When a field spans more than one octet, the order of bit values within each octet progressively decreases as the octet number increases. In that part of the field contained in a given octet the lowest bit number represents the lowest order value.

For example, a bit number can be identified as a couple (o, b) where o is the octet number and b is the relative bit number within the octet. Figure 13 illustrates a field that spans from bit (1, 3) to bit (2, 7). The high order bit of the field is mapped on bit (1, 3) and the low order bit is mapped on bit (2, 7).

Bit	8	7	6	5	4	3	2	1
1st octet of field						2^4	2^3	2^2
2nd octet of field	2^1	2^0						

Figure 13: Field mapping convention

Figure 14 illustrates an NSAPI field that spans from bit (1,8) to bit (2,1). NSAPI 15 is mapped to bit (1,8) and the other NSAPIs are mapped in decreasingly order until NSAPI 0 that is mapped to bit (2,1). A bit set to 0 means that the compression entity is not applicable to the corresponding NSAPI. A bit set to 1 means that the compression entity is applicable to the corresponding NSAPI.

Bit	8	7	6	5	4	3	2	1
1st octet of field	15	14	13	12	11	10	9	8
2nd octet of field	7	6	5	4	3	2	1	0

Figure 14: NSAPI mapping convention

7.2 SN-PDU Formats

Each SN-PDU shall contain an integral number of octets, and shall comprise a header part and a data part. An SN-PDU shall contain data from a single N-PDU only. Two different SN-PDU formats are defined. The SN-DATA PDU shall be used for acknowledged data transfer and SN-UNITDATA PDU for unacknowledged data transfer.

Bit	8	7	6	5	4	3	2	1
Oct 1	X	C	T	M	NSAPI			
2	DCOMP				PCOMP			
...	Data segment							
N								

Figure 15: SN-Data PDU format

Bit	8	7	6	5	4	3	2	1
Oct 1	X	C	T	M	NSAPI			
2	DCOMP				PCOMP			
3	Segment offset				N-PDU number			
4	E	N-PDU number (continued)						
5	N-PDU number (extended)							
...	Data segment							
N								

Figure 16: SN-Unitdata PDU format

More bit (M):

0 Last segment of N-PDU

1 Not the last segment of N-PDU, more segments to follow

SN-PDU Type (T):

0 SN-DATA PDU

1 SN-UNITDATA PDU

Compression indicator (C):

0 Compression fields are not included.

The octet including DCOMP and PCOMP is not included in the SN-Data PDU or SN-Unitdata PDU format.

1 Compression fields are included.

The values of the DCOMP and PCOMP fields are applicable.

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.

NSAPI:

0 Escape mechanism for future extensions

1 Point-to-Multipoint Multicast (PTM-M) information

2-4 Reserved for future use

5-15 dynamically allocated NSAPI value (see subclause 6.1)

SN-PDU with an unallocated NSAPI value shall be ignored by the receiving SNDCP entity without error notification.

Data compression coding (DCOMP):

0 no compression

1-14 Points to the data compression identifier negotiated dynamically (see subclause 6.4)

15 Reserved for future extensions

SN-PDU with an unallocated DCOMP value shall be ignored by the receiving SNDCP entity without error notification.

Protocol control information compression coding (PCOMP):

0 no compression

1-14 Points to the protocol control information compression identifier negotiated dynamically (see subclause 6.3)

15 Reserved for future extensions

SN-PDU with an unallocated PCOMP value shall be ignored by the receiving SNDCP entity without error notification.

Segment offset:

0-15 Segment offset from the beginning of the N-PDU in units of 128 octets

N-PDU number:

0-2047 Range used if Extension bit is set to 0

2048-524287 Range used if Extension bit is set to 1

The higher range is used only when the N-PDU number is such that more than 11 bits are needed to present the number in binary format. SN-PDU with an N-PDU number that is out of range shall be ignored by the receiving SNDCP entity without error notification.

In the N-PDU number field bit in position (3, 4) is the MSB and the bit in position (5, 1) is the LSB. The extension bit E in position (4, 8) is skipped, i.e. Bit 2^{14} in position (4, 7) is followed by bit 2^{15} in position (3, 1).

Extension bit for N-PDU number (E):

0 Next octet is used for data

1 Next octet is used for N-PDU number extension

8 SNDCP XID parameters

The SNDCP XID parameters are shown in Table 8:

Table 8: SNDCP XID parameters

Parameter name	Parameter Type	Length	Format	Range	Default value	Units	Sense of negotiation
SN-VER (SNDCP version number)	0	1	0000bbbb	0-15	0	-	down
Data Compressions	1	variable	see subclause 6.5.1				
Protocol Control Information Compressions	2	variable	see subclause 6.4.1				

NOTE: The current version of SNDCP is 0. This is also the default value for the version number. It is assumed that the future versions are backward compatible with former ones.

Annex A (informative): Change history

Document history		
Date	**Status**	**Comment**
15.01.1997	0.1.0	Based on the 04.62 v.0.3.0. Specification number changed to GSM 04.65.
13.02.1997	0.2.0	Changes from SMG3 GPRS Ad-hoc 20-22.01.1997: - SMG3 97G012: Buffering of N-PDUs in SNDC - SMG3 97G011: Maximum GPRS N-PDU Size - Ciphering for SN-UNITDATA primitive added Editorial modifications to clean the text
25.02.1997	0.3.0	Change from SMG3 GPRS Ad-hoc 24-28.02.1997: - Ciphering moved from SNDCP layer to the LLC layer.
27.04.1997	0.4.0	Changes from SMG3 GPRS Ad-hoc 21-25.04.1997: - SMG3 97G142: Adapting SN-Unitdata PDU format to PTM-M functions - SMG3 97G193: Negotiation of compression Editorial modifications (not marked with revision marks).
28.05.1997	0.4.1	Converted to 1997 Format regime by ETSI
03.06.1997	1.0.0	Approved by SMG3 plenary, Malmö, Sweden, May 1997
17.06.1997	1.1.0	Changes from GPRS drafting meeting, Oslo, 4-6.06.1997 - Data compression added for unacknowledged transfer - Priority field removed
16.08.1997	proposed version 1.2.0	Major rewrite after GPRS drafting session, Stockholm, 7-11.7.1997 - All explanation texts removed and just specification text was kept. The protocols specified elsewhere are no more re-specified - PTM related issues removed - Scope rewritten - Some normative references added - Figures improved - Major improvements in service primitives - Modifications in service functions - Improvements in protocol functions - Improvements to SN-PDU formats - Definition of SNDCP XID parameters 16.08.1997, Rework to align with latest versions of GSM 04.07 and GSM 04.64.

(continued)

(concluded)

Document history		
09.09.1997	proposed version 1.3.0	- Comments from SMG2/3 WPA 20.-21.9.1997 (Kista) included - Several primitives combined to SN-XID - LL-RESET primitives removed - XID Negotiation and XID field formats improved - NSAPI, SNDCP functions, and SAPI figure improved - Fixed NSAPI value for escape mechanism and PTM-M - Compression indicator (C) added to SN-DATA and SN-UNITDATA PDU formats - Acknowledged and unacknowledged data transfers clarified with figures - Plenty of editorials - Additional improvements to the whole specification - Separate compression entities to be used for acknowledged and unacknowledged services - Alignment with current versions of GSM 04.64 and GPRS CR to 04.07
02.10.1997	1.3.1	Accepted version from SMG3 Plenary 23-25 September 1997. Editorial correction: NSMM primitive names changed to SNSM.
02.10.1997	2.0.0	To SMG#23 for approval (13-17 October, Budapest)
14.10.1997	5.0.0	Updated after SMG#23 approval of version 2.0.0
12.1.1998	5.1.0	Incorporates CRs from SMG#24: A001r1, A003r1, A004r1, A005r1, A007, A008, A010r1, A011r2, A012r1
18.3.1998	6.0.0	Incorporates CRs approved at SMG#25: A013r2, A014r1, A015, A016r1
30.6.1998	6.1.0	Incorporates CRs approved at SMG#26: A017r2, and A018r2
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