3GPP TSG_CN#6 **NP-99493**
Nice, France
13th – 15th December 1999

Agenda item:

Source: **TSG_N WG2**

Title: **CR to 3G TS 29.060 (Work Item GTP Enhancements)**

Introduction:

This document contains **1** CR on **Work Item GTP Enhancements** agreed by **TSG_N WG2** and forwarded to **TSG_N Plenary** meeting #6 for approval.

3GPP/SMG Meeting #7
Phoenix, USA, 15-19 Nov 1999

Document N2-99K78
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

29.060	CR	031	Current Version:	3.2.0

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

For submission to:	CN#06	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic	X	

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

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

Source: CN2B **Date:** 1999-12-06

Subject: Merged CRs

Work item: GTP Enhancements

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

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

Reason for change:

This CR constitutes a merged document of the following approved CRs:

CR 016r1	E72	New GTP message for Forward Relocation Procedure
CR 018r1	F92	GTP-U SAPs and Primitives
CR 011r2	F94	New Scope for Release99
CR 019r1	F98	GTP-U for R'99
CR 015r3	H73	Authentication Enhancements
CR 021r1	J74	Parallel handling of multiple user application flows
CR 020r2	J82	GTP Messages and the Signalling Plane (GTP-C) for release 99
CR 029	J80	New header for the new GTP version for Release 99
CR 025r1	K20	Clarification of the GSN Address field

Clauses affected:

Other specs affected:

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

Other

comments:

1 Scope

~~This GSM Technical Specification defines the Gn and Gp interfaces for the General Packet Radio Service (GPRS).~~

This Technical Specification defines the second version of GTP used on:

- the Gn and Gp interfaces of the General Packet Radio Service (GPRS),
- the Iu , Gn and Gp interfaces of the UMTS system.

Note: The version number used in the message headers is 0 for the first version of GTP described in GSM 09.60, and 1 for the second version in 3GPP TS 29.060.

2 Normative 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 1998 document, references to GSM documents are for Release 1998 versions (version 7.x.y).

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

[2] GSM 03.03: “Digital cellular telecommunications system (Phase 2+); Numbering, addressing and identification”.

[3] GSM 03.07: “Digital cellular telecommunications system (Phase 2+); Restoration Procedures”

[4] GSM 03.20: “Digital cellular telecommunications system (Phase 2+); Security related network functions”

[5] GSM 03.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service Description; Stage 2".

[6] GSM 03.64: “Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS Radio Interface; Stage 2”

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

[8] GSM 04.64: “Digital cellular telecommunications system (Phase 2+); Mobile Station - Serving GPRS Support Node (MS-SGSN) Logical Link Control (LLC) Layer Specification”

[9] GSM 09.02: "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification”.

[10] TS 25.413: " UTRAN Iu interface RANAP signalling "

[11] STD 0005: “Internet Protocol”, J. Postel.

[12] STD 0006: “User Datagram Protocol”, J. Postel.

[13] STD 0007: “Transmission Control Protocol”, J. Postel.

[14] RFC 1700: “Assigned Numbers”, J. Reynolds and J. Postel.

[15] RFC 2181: “Clarifications to the DNS Specification”, R. Elz and R. Bush.

[16] ITU-T Recommendation X.25: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[17] ITU-T Recommendation X.121: "International Numbering Plan for Public Data Networks".

[18] UMTS TS 33.102: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; 3G Security; Security Architecture"

3 Definitions and abbreviations

3.1 Definitions

For the purpose of this Technical Specification, the following definitions apply:

Conditional When the presence requirement for the information element is conditional, the receiving protocol level can check the presence or absence of an IE based on the received information.

G-PDU: A T-PDU plus a GTP header. A G-PDU is sent in a path.

GTP-Flow: A GTP flow is defined by the unidirectional virtual aggregation of G-PDUs and/or signalling messages related to one or more GTP tunnels. A GTP flow is identified by a Flow Label included in the GTP header. The meaning of the Flow Label is transparent for the transmitter side, only the receiver may evaluate the Flow Label.

GTP tunnel: A GTP tunnel is defined by two associated PDP Contexts in different GSN nodes and is identified with a Tunnel ID. A GTP tunnel is necessary to forward packets between an external packet data network and a MS user.

MM Context: The information sets held in MS and GSNs for a GPRS subscriber related to mobility management (MM) (please refer to the MM Context Information Element).

MM Context ID: IMSI or equivalent for use in conjunction with Anonymous Access (please refer to section GTP Header).

NSAPI: Network Service Access Point Identifier. An integer value in the range [0; 15], identifying a certain PDP Context. It identifies a PDP context belonging to a specific MM Context ID.

Path: The UDP/IP path and TCP/IP path are examples of paths that may be used to multiplex GTP tunnels.

Path Protocol: The Path Protocol is the protocol(s) used as a bearer of GTP between GSNs.

PDP: A Packet Data Protocol (PDP) is a network protocol used by an external packet data network interfacing to GPRS.

PDP Context: The information sets held in MS and GSNs for a PDP address (please refer to the PDP Context Information Element).

Quality of Service: Quality of Service may be applicable for the GPRS backbone if the path media supports it. Separate paths with different priorities may be defined between a GSN pair. However, the possible use of QoS in the GGSN is outside the scope of the GTP specification.

Signalling message: GTP signalling messages are exchanged between GSN pairs in a path. The signalling messages are used to transfer GSN capability information between GSN pairs and to create, update and delete GTP tunnels.

TCP/IP path: A TCP/IP path is a reliable connection-oriented path defined by two end-points and an end-point is defined by an IP address and a TCP port number. TCP/IP paths should be used when the T-PDUs are based on connection-oriented protocols, such as the X.25 packet layer protocol.

Traffic Flow Template: TFTs are used by GGSN to distinguish between different user payload packets and transmit packets with different QoS requirements via different PDP context but to the same PDP address.

T-PDU: An original packet, for example an IP datagram, from a MS or a network node in an external packet data network. A T-PDU is the payload that is tunnelled in the GTP tunnel.

~~**TID:** A Tunnel ID (TID) consists of a MM Context ID and a NSAPI.~~

Tunnel Endpoint Identifier (TEID): This field unambiguously identifies a tunnel endpoint in the receiving GTP-U or GTP-C protocol entity. The receiving end side of a GTP tunnel locally assigns the TEID value the transmitting side has to use. The TEID values are exchanged between tunnel endpoints using GTP-C (or RANAP, over the Iu) messages.

UDP/IP path: A UDP/IP path is a connection-less path defined by two end-points and an end-point is defined by an IP address and a UDP port number. A UDP/IP path carries G-PDUs between GSN nodes related to one or more GTP tunnels. A UDP/IP path should be used when the T-PDUs are based on connection-less protocols, such as IP.

3.2 Abbreviations

Abbreviations used in this specification are listed in GSM 01.04.

For the purpose of this specification the following additional abbreviations apply:

BB	Backbone Bearer
DF	Don't Fragment
FFS	For Further Study
GTP	GPRS Tunneling Protocol
GTP-C	GTP Control
GTP-U	GTP User
IANA	Internet Assigned Number Authority
ICMP	Internet Control Message Protocol
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
MTU	Maximum Transmission Unit
QoS	Quality of Service
RANAP	Radio Access Network Application Part
RNC	Radio Network Controller
TID	Tunnel IDentifier
TCP	Transmission Control Protocol
TFT	Traffic Flow Template
UDP	User Datagram Protocol
UTRAN	UMTS Terrestrial Radio Access System
Gn interface	Interface between GPRS Support Nodes (GSNs) within a PLMN
Gp interface	Interface between GPRS Support Nodes (GSNs) in different PLMNs

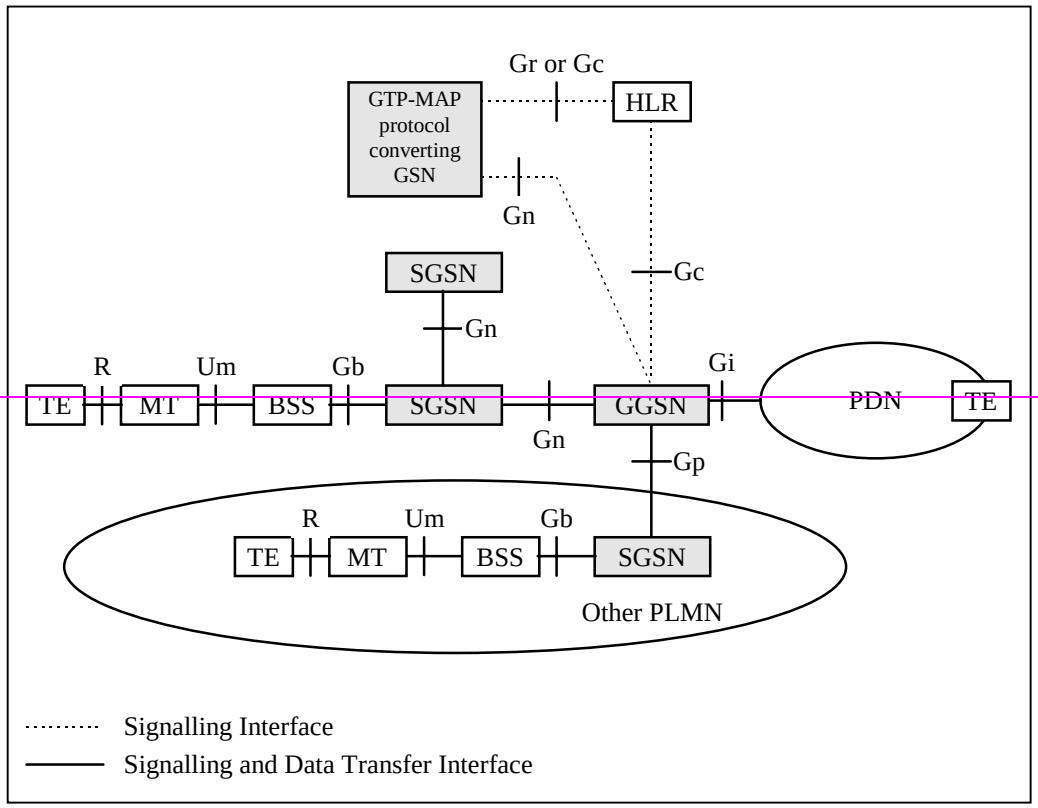
4 General

This document defines the GPRS Tunnelling Protocol (GTP), i.e. the protocol between GPRS Support Nodes (GSNs) ~~nodes~~ in the UMTS/GPRS backbone network. It includes both the GTP signalling (GTP-C) and data transfer (GTP-U) procedures. It also lists the messages and information elements used by the GTP based charging protocol GTP', which is described in GSM 12.15.

GTP is defined ~~both~~ for the Gn interface, i.e. the interface between GSNs within a PLMN, and for the Gp interface between GSNs in different PLMNs. Only GTP-U is defined for the Iu interface between Serving GPRS Support Node (SGSN) and the UMTS Terrestrial Radio Access Network (UTRAN).

On the Iu interface, the Radio Access Network Application Part (RANAP) protocol is performing the control function for GTP-U.

GTP' is defined for the interface between CDR generating functional network elements and Charging Gateway(s) within a PLMN. Charging Gateway(s) and GTP' protocol are optional, as the Charging Gateway Functionalities may either be located in separate network elements (Charging Gateways), or alternatively be embedded into the CDR generating network elements (GSNs) when the GSN-CGF interface is not necessarily visible outside the network element. These interfaces relevant to GTP are between the grey boxes shown in the figure below.



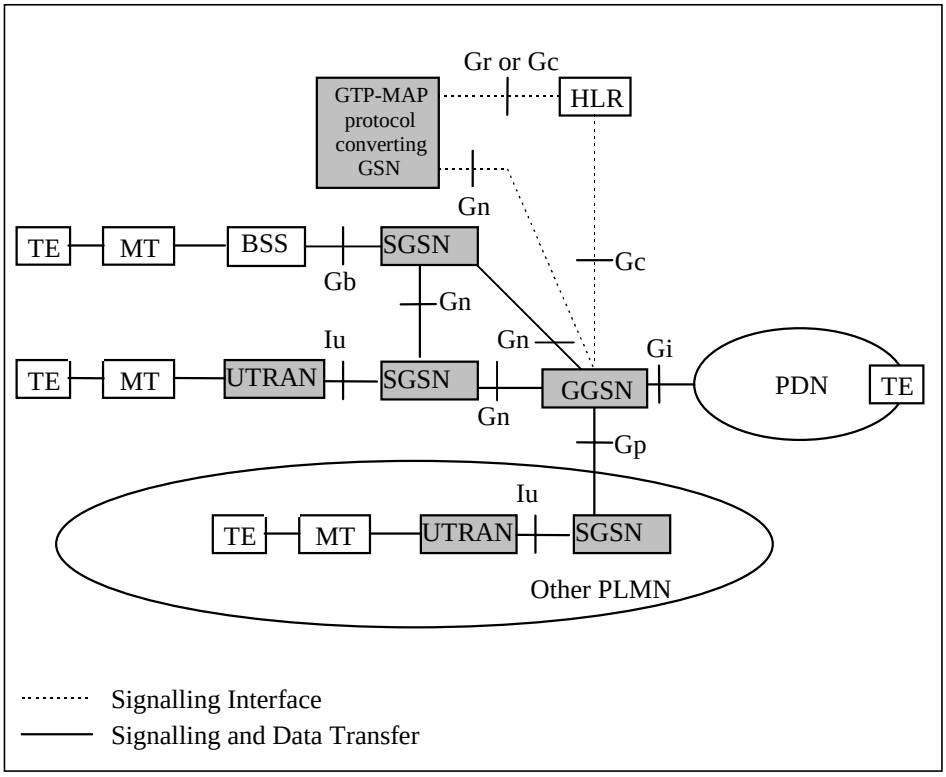


Figure 1: GPRS Logical Architecture with interface name denotations

GTP allows multiprotocol packets to be tunnelled through the UMTS/GPRS Backbone between ~~GPRS Support Nodes (~~GSNs~~),~~ and between SGSN and UTRAN.

In the signalling plane, GTP specifies a tunnel control and management protocol (GTP-C) which allows the SGSN to provide ~~GPRS~~ packet data network access for a MS. Signalling is used to create, modify and delete tunnels.

In the transmission plane, GTP uses a tunnelling mechanism (GTP-U) to provide a service for carrying user data packets. The choice of path is dependent on whether the user data to be tunnelled requires a reliable link or not.

The GTP-U protocol is implemented ~~only~~ by ~~-~~SGSNs and GGSNs in the UMTS/GPRS Backbone and by Radio Network Controllers (RNCs) in the UTRAN. The GTP-C protocol is implemented by SGSNs and GGSNs in the UMTS/GPRS Backbone. No other systems need to be aware of GTP. UMTS/GPRS MSs are connected to a SGSN without being aware of GTP.

It is assumed that there will be a many-to-many relationship between SGSNs and GGSNs. ~~-~~A SGSN may provide service to many GGSNs. A single GGSN may associate with many SGSNs to deliver traffic to a large number of geographically diverse mobile stations.

SGSN and GGSN implementing GTP protocol version 1 should be able to fallback to GTP protocol version 0. All GSNs should be able to support all earlier GTP versions.

5 Transmission order and bit definitions

The messages in this document shall be transmitted in network octet order starting with octet 1.

The most significant bit of an octet in a GTP message is bit 8. If a value in a GTP message spans several octets and nothing else is stated, the most significant bit is bit 8 of the octet with the lowest number.

6 GTP header

The GTP header shall be a ~~fixed~~ variable length ~~format 20-octet~~ header used for both the GTP-C and the GTP-U protocols. ~~all GTP messages.~~The minimum length of the GTP header is 8 bytes. There are three flags that are used to signal the presence of additional optional fields: the PN flag, the S flag and the E flag. The PN flag is used to signal the presence of N-PDU Numbers. The S flag is used to signal the presence of The GTP Sequence Number field. The E flag is used to signal the presence of the Extension Header field, used to enable future extensions of the GTP header defined in this document, without the need to use another version number. If any of these three flags are set, the length of the header is at least 12 octets and the fields corresponding to the flags that are set shall be evaluated by the receiver. The sender shall set all the bits of the unused fields to zero. The unused fields shall not be evaluated by the receiver.

The GTP-C and the GTP-U use some of the fields in the GTP header differently. The different use of such fields is described in the sections related to GTP-C and to GTP-U.

Always present fields:

- Version field:~~bits:~~ ~~If the PT bit is '1' (indicating a GTP message), the Version shall be set to 0 to indicate this, the first version of GTP.~~ This field is used to determine the version of the GTP protocol. For the treatment of other versions, see section 10.1.1, "Different GTP versions". The version number shall be set to '1'.

- Payload Type (PT): ~~(Protocol Type) bit indicates whether the message is a GTP message (when PT is '1') or a GTP' message (when PT is '0').~~ This bit is used as a protocol discriminator between GTP and GTP'. GTP is described in this document and the GTP' protocol in GSM 12.15. The interpretation of the header fields may be different in GTP' than in GTP.

~~- Spare '1': These unused bits shall be set to '1' by the sending side and shall not be evaluated by the receiving side.~~

- Extension Header flag (E): This flag indicates the presence of the Next Extension Header field when it is set to '1'. When it is set to' 0', the Next Extension Header field either is not present or, if present, must not be interpreted .

- Sequence number flag (S): This flag indicates the presence of the Sequence Number field when it is set to '1'. When it is set to '0', the Sequence Number field either is not present or, if present, must not be interpreted. The S flag shall be set to '1' in GTP-C messages.

- N-PDU Number flag (~~SPN~~N): This flag indicates the presence of the ~~SNDCP N-~~N-PDU Number field when it is set to '1'. When it is set to '0', the~~SNDCP N-~~N-PDU Number field either is not present, or, if present, must not be interpreted .

~~- SNN is a flag indicating if SNDCP N-PDU Number is included or not.~~

- Message Type: This field indicates the type of GTP message. The valid values of the message type are defined in section x.x for GTP-C and y.y for GTP-U.

- Length: This field indicates the length in octets of the payload, i.e. the rest of the packet following the mandatory part of the GTP header (that is the first 8 octets). The Sequence Number, the N-PDU Number or any Extension headers shall be considered to be part of the payload, i.e. included in the length count.~~message (G-PDU), excluding the GTP header. Bit 8 of octet 3 is the most significant bit and bit 1 of octet 4 is the least significant bit of the length field~~.

- Tunnel Endpoint Identifier (TEID): This field unambiguously identifies a tunnel endpoint in the receiving GTP-U or GTP-C protocol entity. The receiving end side of a GTP tunnel locally assigns the TEID value the transmitting side has to use. The TEID values are exchanged between tunnel endpoints using GTP-C (or RANAP, over the Iu) messages.

Optional fields:

- Sequence Number: This field is an optional field in GTP-U. It is used as ~~is~~ a transaction identity for signalling messages in GTP-C and as an increasing sequence number for ~~tunnelled~~ T-PDUs, transmitted via GTP-U tunnels, when transmission order must be preserved.

- ~~SNDCP~~ N-PDU Number: This optional field is used at Inter SGSN Routeing Area Update procedure and some SRNS relocation procedures (e.g. between 2G and 3G radio access networks).;. This field is used to co-ordinate the data transmission for acknowledged mode of communication between the MS and the SGSN. -The exact meaning of this field depends upon the scenario. (For example, for GSM/GPRS to GSM/GPRS, the SNDCP N-PDU number is present in this field, while for UMTS to GSM/GPRS, a sequence number derived from the RLC sequence number is present.)

- Next Extension Header Type: This field defines the type of Extension Header that follows this field in the G-PDU.

The format of GTP Extension Headers is depicted in Figure 3. The Extension Header Length field specifies the length of the particular Extension header in 4 octects units. The Next Extension Header Type field specifies the type of any Extension Header that may follow a particular Extension Header. If no such Header follows, then the value of the Next Extension Header Type shall be 0.

~~- TID is the tunnel identifier that points out MM and PDP contexts (see Figure 3: Tunnel ID (TID) format).~~

~~- The flow label identifies unambiguously a GTP flow.~~

~~All fields in the GTP header shall always be present but the content of the fields differs depending on if the header is used for signalling messages (see the sub-section Usage of the GTP Header in the section Signalling Plane) or T-PDUs (see the sub-section Usage of the GTP Header in the section Transmission Plane).~~

Octets	Bits 8	7	6	5	4	3	2	1
1	Version			PT	(*)	E	S	PN
2	Message Type							
3	Length (1st Octet)							
4	Length (2nd Octet)							

5	Tunnel Endpoint Identifier (1st Octet)
6	Tunnel Endpoint Identifier (2nd Octet)
7	Tunnel Endpoint Identifier (3rd Octet)
8	Tunnel Endpoint Identifier (4th Octet)
9	Sequence Number (1st Octet)[1) 4)]
10	Sequence Number (2nd Octet)[1) 4)]
11	N-PDU Number[2) 4)]
12	Next Extension Header Type[3) 4)]

1) This field shall only be evaluated when indicated by the S flag.

2) This field shall only be evaluated when indicated by the PN flag

3) This field shall only be evaluated when indicated by the E flag

4) This fields shall be present when any one or more of the SP, PN and E flags are set.

(*) This bit is a spare bit. It shall be sent as '0'. The receiver shall not evaluate this bit.

Figure 2: outline of the GTP header

~~Bits~~

~~Octets~~	~~8~~	~~7~~	~~6~~	~~5~~	~~4~~	~~3~~	~~2~~	~~1~~
~~1~~	~~Version~~			~~PT~~	~~Spare ' 1 1 1 '~~			~~SNN~~
~~2~~	~~Message Type~~							
~~3 4~~	~~Length~~							
~~5 6~~	~~Sequence Number~~							
~~7 8~~	~~Flow Label~~							
~~9~~	~~SNDCP N PDULLC Number~~							
~~10~~	~~Spare ' 1 1 1 1 1 1 1 1 '~~							
~~11~~	~~Spare ' 1 1 1 1 1 1 1 1 '~~							
~~12~~	~~Spare ' 1 1 1 1 1 1 1 1 '~~							
~~13 20~~	~~TID~~							

~~1) LLC frame number (continued)~~

~~Figure 2: Outline of GTP header~~

Octets	Bits 8	7	6	5	4	3	2	1
1	MCC digit 2				MCC digit 1			
2	MNC digit 1				MCC digit 3			
3	MSIN digit 1				MNC digit 2			
4	MSIN digit 3				MSIN digit 2			
5	MSIN digit 5				MSIN digit 4			
6	MSIN digit 7				MSIN digit 6			
7	MSIN digit 9				MSIN digit 8			
8	NSAPI				MSIN digit 10			

~~NOTE 1: The MCC, MNC and MSIN are parts of the IMSI defined in GSM 03.03. For Anonymous Access, the MSIN shall be replaced by a number assigned by the particular PLMN. The assigned number shall not collide with any MSIN used in the PLMN and shall be unique within the PLMN.~~

~~NOTE 2: MSIN digits not used shall be set to F (HEX).~~

~~Figure 3: Tunnel ID (TID) format~~

Octets	
1	Extension Header Length
2 - m	Extension Header Content
m+1	Next Extension Header Type (*)

(*) The value of this field is 0 if no other Extension header follows.

Figure 3: outline of the extension header format

-The length of the Extension header shall be defined in a variable length of 4 octets, i.e. m+1 = n*4 octets, where n is a positive integer.

Bits 7 and 8 of the Next Extension Header Type define how the recipient shall handle unknown Extension Types. The recipient of an extension header of unknown type but marked as 'comprehension not required' for that recipient shall read the 'Next Extension Header Type' field (using the Extension Header Length field to identify its location in the G-PDU). The recipient of an extension header of unknown type but marked as 'comprehension required' for that recipient shall send an Error notification message to the source of the message.

Bits 7 and 8 of the Next Extension Header Type have the following meaning:

Bits 8 7	Meaning
0 0	comprehension of this extension header is not required. An Intermediate Node shall forward it to any Receiver Endpoint
0 1	comprehension of this extension header is not required. An Intermediate Node shall discard the Extension Header Content and not forward it to any Receiver Endpoint. Other

	extension headers shall be treated independently of this extension header.
1 0	Comprehension of this extension header is required by the Endpoint Receiver but not by an Intermediate Node. An Intermediate Node shall forward the whole field to the Endpoint Receiver.
1 1	comprehension of this header type is required by recipient (either Endpoint Receiver or Intermediate Node)

Figure 4: Definition of bits 7 and 8 of the Extension Header Type

An Endpoint Receiver is the ultimate receiver of the GTP-PDU (eg an RNC or the GGSN for the GTP-U plane). An Intermediate Node is a node which handles GTP but is not the ultimate endpoint (eg an SGSN for the GTP-U plane traffic between GGSN and RNC).

Next Extension Header Field Value	**Type of extension header**
0000 0000	No more extension headers
1100 0000	RLC PDU number

Figure 5: Definition of Extension Header types

6.1 Extension headers

6.1.1 RLC PDU Number

This extension header is transmitted, for example, at SRNS relocation time to provide the RLC frame number of not yet acknowledged N-PDUs. It's 4 octets long, and therefore the Length field has value 1. The spare bits shall be set to 1 by the sender and they shall not be evaluated by the receiving end.

Octets	Bits 8	7	6	5	4	3	2	1
1	1							
2	RLC PDU number							
3	Spare '1111'							RLC PDU number.
4	Next Extension Header Type (*)							

(*) The value of this field is 0 if no other Extension header follows.

Figure 6: RLC PDU number Extension Header

7 Signalling Plane

7 GTP Messages and Message Formats

The signalling plane in this case relates to GPRS Mobility Management functions like for example GPRS Attach, GPRS Routeing Area Update and Activation of PDP Contexts. The signalling between GSN nodes shall be performed by the GPRS Tunnelling Protocol (GTP).

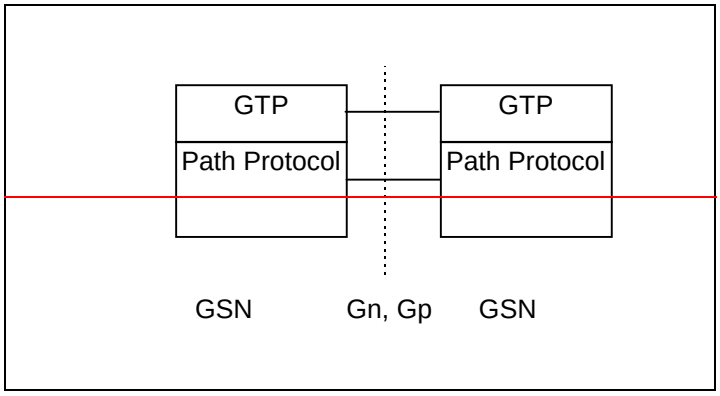


Figure 4: Signalling Plane - Protocol stack

7.1 Signalling protocol

The GTP signalling flow shall be logically associated with, but separate from, the GTP tunnels. For each GSN-GSN pair one or more paths exist. One or more tunnels may use each path. GTP shall be the means by which tunnels are established, used, managed and released. A path may be maintained by keep-alive echo messages. This ensures that a connectivity failure between GSNs can be detected in a timely manner.

7.2 Signalling Message Formats

7.1 Signalling Message Formats

GTP defines a set of signalling messages between two associated GSNs or an SGSN and an RNC. The signalling messages to be used are defined in the table below. The three columns to the right define which parts (GTP-C, GTP-U or GTP') that send or receive the specific message type.

Table 1: Signalling messages in GTP

Message Type value (Decimal)	Signalling message	Reference	GTP-C	GTP-U	GTP'
0	For future use. Shall not be sent. If received, shall be treated as an Unknown message.				
1	Echo Request	7.42.1	X	X	
2	Echo Response	7.42.2	X	X	
3	Version Not Supported	7.42.3	X	X	
4	Node Alive Request	GSM 12.15			X
5	Node Alive Response	GSM 12.15			X
6	Redirection Request	GSM 12.15			X
7	Redirection Response	GSM 12.15			X
8-15	For future use. Shall not be sent. If received, shall be treated as an Unknown message.				
16	Create PDP Context Request	7.53.1	X		
17	Create PDP Context Response	7.53.2	X		
18	Update PDP Context Request	7.53.3	X		
19	Update PDP Context Response	7.53.4	X		
20	Delete PDP Context Request	7.53.5	X		
21	Delete PDP Context Response	7.53.6	X		
22	Create AA PDP Context Request	7.53.7	X		
23	Create AA PDP Context Response	7.53.8	X		
24	Delete AA PDP Context Request	7.53.9	X		
25	Delete AA PDP Context Response	7.53.10	X		
26	Error Indication	7.53.11	X		
27	PDU Notification Request	7.53.12	X		
28	PDU Notification Response	7.53.13	X		
29	PDU Notification Reject Request	7.53.14	X		
30	PDU Notification Reject Response	7.53.15	X		
31	For future use. Shall not be sent. If received, shall be treated as an Unknown message.				
32	Send Routeing Information for GPRS Request	7.64.1	X		
33	Send Routeing Information for GPRS Response	7.64.2	X		
34	Failure Report Request	7.64.3	X		
35	Failure Report Response	7.64.4	X		
36	Note MS GPRS Present Request	7.64.5	X		
37	Note MS GPRS Present Response	7.64.6	X		
38-47	For future use. Shall not be sent. If received, shall be treated as an Unknown message.				
48	Identification Request	7.75.1	X		
49	Identification Response	7.75.2	X		
50	SGSN Context Request	7.75.3	X		
51	SGSN Context Response	7.75.4	X		
52	SGSN Context Acknowledge	7.75.5	X		
53	Forward Relocation Request	7.7.6	X		
54	Forward Relocation Response	7.7.7	X		
55	Forward Relocation Complete	7.7.8	X		
56	Relocation Cancel Request	7.7.9	X		
57	Relocation Cancel Response	7.7.10	X		
583-239	For future use. Shall not be sent. If received, shall be treated as an Unknown message.				
240	Data Record Transfer Request	GSM 12.15			X
241	Data Record Transfer Response	GSM 12.15			X
242-254	For future use. Shall not be sent. If received, shall be treated as an Unknown message.				
255	T-PDU	8.1.1		X	

7.3 Usage of the GTP Header

For signalling messages the GTP header shall be used as follows:

- SNN shall be set to 0.
- Message Type shall be set to the unique value that is used for each type of signalling message.
- Length shall be the length, in octets, of the signalling message excluding the GTP header.
- SNDCP N-PDU Number: this field is not yet used in signalling messages. It shall be set to 255 by the sender and shall be ignored by the receiver.
- Sequence Number shall be a message number valid for a path or a tunnel. Within a given set of contiguous Sequence Numbers from 0 to 65535, a given Sequence Number shall, if used, unambiguously define a GTP signalling request message sent on the path or tunnel (see section Reliable delivery of signalling messages). The Sequence Number in a signalling response message shall be copied from the signalling request message that the GSN is replying to.
- TID (see Figure 3: Tunnel ID (TID) format) shall be set to 0 in all Path Management messages (see section Path Management messages), Location Management messages (see section Location Management messages) and Mobility Management messages (see section Mobility Management messages). In the Tunnel Management messages (see section Tunnel Management messages), TID shall be used to point out the MM and PDP Contexts in the destination GSN.
- In all Path Management messages (see section Path Management messages) and Location Management messages (see section Location Management messages) the Flow Label is not used and shall be set to 0 . In case of Tunnel Management message and Mobility Management messages the Flow Label is set to the requested value and points out the GTP flow except for the Create PDP Context Request message as well as Identification Request/Response and SGSN Context Request message (see section Mobility Management messages).

The GTP header may be followed by subsequent information elements dependent on the type of signalling message. Only one information element of each type is allowed in a single signalling message, except for the Authentication Triplet, the PDP Context and the Flow Label Data II information element where several occurrences of each type are allowed.

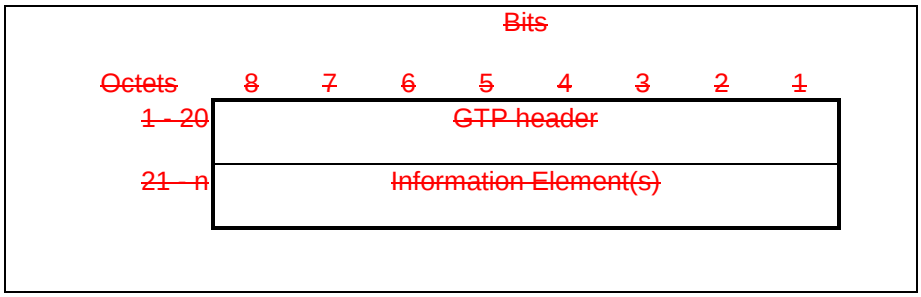


Figure 5: GTP header followed by subsequent Information Elements

7.4 Path Management messages

7.2 Path Management messages

The Path Management messages may be sent between any type of GSN or GSN – RNC pair.

~~7.4.1 Echo Request~~

7.2.1 Echo Request

An Echo Request may be sent on a path to another GSN or RNC to find out if the peer GSN or RNC is alive (see section Path Failure). Echo Request messages may be sent for each path in use. A path is considered to be in use if at least one PDP context uses the path to the other GSN. When and how often an Echo Request message may be sent is implementation specific but an Echo Request shall not be sent more often than every 60 seconds on each path.

A GSN or RNC shall be prepared to receive an Echo Request at any time and it shall reply with an Echo Response. A GSN or RNC may optionally send Echo Request messages.

The optional Private Extension contains vendor or operator specific information.

Table 2: Information elements in an Echo Request

Information element	Presence requirement	Reference
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.4.2 Echo Response~~

7.2.2 Echo Response

The message shall be sent as a response of a received Echo Request.
The Recovery information element contains the local Restart Counter (see section Restoration and Recovery) value for the GSN or RNC that sends the Echo Response message.
The GSN or RNC that receives an Echo Response from a peer GSN or RNC shall compare the Restart Counter value received with the previous Restart Counter value stored for that peer GSN. If no previous value was stored, the Restart Counter value received in the Echo Response shall be stored for the peer GSN or RNC.
If the value of a Restart Counter previously stored for a peer GSN or RNC differs from the Restart Counter value received in the Echo Response from that peer GSN or RNC, the GSN or RNC that sent the Echo Response shall be considered as restarted by the GSN that received the Echo Response. The new Restart Counter value received shall be stored by the receiving entity, replacing the value previously stored for the sending GSN or RNC. If the sending GSN is a GGSN and the receiving GSN is a SGSN, the SGSN shall notify an affected MS next time the MS contacts the SGSN. An affected MS is an MS that has at least one activated PDP context that was using the restarted GGSN. The SGSN shall consider all PDP contexts using the path as inactive.

The optional Private Extension contains vendor or operator specific information.

Table 3: Information elements in an Echo Response

Information element	Presence requirement	Reference
Recovery	Mandatory	7.~~9~~7.1~~4~~2
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.4.3 Version Not Supported~~

7.2.3 Version Not Supported

This message contains only the GTP header and indicates the latest GTP version that the GTP entity on the identified UDP/IP address can support.

~~7.5 Tunnel Management messages~~

7.3 Tunnel Management messages

~~The Tunnel Management messages are the control and management messages, defined in GSM 03.60, used to create, update and delete tunnels to be able to route T-PDUs between a MS and an external packet data network via SGSN and GGSN. The GMM/SM messages that may trigger the sending of the Tunnel Management messages are defined in GSM 04.08.~~

~~7.5.1 Create PDP Context Request~~

7.3.1 Create PDP Context Request

A Create PDP Context Request shall be sent from a SGSN node to a GGSN node as a part of the GPRS PDP Context Activation procedure. The GGSN IP address where the SGSN sends the Create PDP Context Request is the first IP address in the list of IP addresses provided by the DNS server. After sending the Create PDP Context Request message, the SGSN marks the PDP context as 'waiting for response'. In this state the SGSN shall accept G-PDUs from the GGSN but shall not send these G-PDUs to the MS. A valid request initiates the creation of a tunnel between a PDP Context in a SGSN and a PDP Context in a GGSN. If the procedure is not successfully completed, the SGSN repeats the Create PDP Context Request message to the next GGSN address in the list of IP addresses, if there is one. If the list is exhausted the activation procedure fails.

The ~~Flow Label~~Tunnel Endpoint Identifier Data I field specifies a downlink ~~flow label~~Tunnel Endpoint Identifier for G-PDUs which is chosen by the SGSN. The GGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent downlink G-PDUs which are related to the requested PDP context.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies a downlink ~~flow label~~Tunnel Endpoint Identifier for signalling messages which is chosen by the SGSN. The GGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent downlink signalling messages which are related to the requested PDP context.

The MSISDN of the MS is passed to the GGSN inside the Create PDP Context Request; This additional information can be used when a secure access to a remote application residing on a server is needed. The GGSN would be in fact able to provide the user identity (i. e. the MSISDN) to the remote application server, providing it with the level of trust granted to users through successfully performing the GPRS authentication procedures, without having to re-authenticate the user at the application level.

If the MS requests a dynamic PDP address and a dynamic PDP address is allowed, then the PDP Address field in the End User Address information element shall be empty. If the MS requests a static PDP Address then the PDP Address field in the End User Address information element shall contain the static PDP Address. In case the PDP addresses carried in the End User Address and optionally in the Protocol Configuration Option information element contain contradicting information, the PDP address carried in the End User Address information element takes the higher precedence. The Quality of Service Profile information element shall be the QoS values to be negotiated between the MS and the SGSN at PDP Context activation.

The SGSN shall include an SGSN Address for signalling and an SGSN address for user traffic, which may differ from that provided by the underlying network service (e.g. IP). The GGSN shall store these SGSN Addresses and use them when sending signalling on this GTP tunnel or G-PDUs to the SGSN for the MS.

The SGSN shall include a Recovery information element into the Create PDP Context Request if the SGSN is in contact with the GGSN for the very first time or if the SGSN has restarted recently and the new Restart Counter value has not

yet been indicated to the GGSN. The GGSN that receives a Recovery information element in the Create PDP Context Request message element shall handle it in the same way as when receiving an Echo Response message. The Create PDP Context Request message shall be considered as a valid activation request for the PDP context included in the message.

The SGSN shall include either the MS provided APN, a subscribed APN or an SGSN selected APN in the message; the Access Point Name may be used by the GGSN to differentiate accesses to different external networks.
The Selection Mode information element shall indicate the origin of the APN in the message.

For secondary PDP contexts the SGSN shall include the NSAPI of the primary PDP context to associate the secondary PDP context with and a TFT to be used for packet filtering by GGSN. When creating a secondary PDP context, the Selection mode, MSISDN, End User Address, Access Point Name and Protocol Configuration Options information elements shall not be included in the message.

The optional Protocol Configuration Options information element is applicable for the end user protocol 'IP' only.

The SGSN shall select one GGSN based on the user provided or SGSN selected APN. The GGSN may have a logical name that is converted to an address. The conversion may be performed with any name-to-address function. The converted address shall be stored in the "GGSN Address in Use" field in the PDP context and be used during the entire lifetime of the PDP context.

NOTE: A DNS query may be used as the name-to-IP address mapping of the GGSN. The IP address returned in the DNS response is then stored in the "GGSN Address in Use" field in the PDP context.

The IMSI information element together with the NSAPI information element uniquely identifies the PDP context to be created.

The SGSN may send a Create PDP Context Request even if the PDP context is already active.

The GGSN shall check if ~~a~~the PDP context already exists for the ~~TID~~MS. The existing parameters in the PDP context shall then be replaced with the parameters in the Create PDP Context Request message. If a dynamic PDP address has already been allocated for the existing context, this address should be used and copied to the Create PDP Context Response message.

If the GGSN uses the MNRG flag and the flag is set, the GGSN should treat the Create PDP Context Request as a Note MS Present Request and clear the MNRG flag.

The optional Private Extension contains vendor or operator specific information.

Table 4: Information elements in a Create PDP Context Request

Information element	Presence requirement	Reference
Quality of Service Profile	Mandatory	7.~~9~~7.~~6~~7
Recovery	Optional	7.~~9~~7.1~~4~~2
Selection mode	Conditional	7.~~9~~7.1~~5~~3
~~Flow Label~~Tunnel Endpoint Identifier Data I	Mandatory	7.~~9~~7.1~~6~~3
~~Flow Label~~Tunnel Endpoint Identifier Signalling	Mandatory	7.~~9~~7.1~~7~~5
MSISDN	Conditional	7.7.24
End User Address	Conditional	7.~~9~~7.~~20~~18
Access Point Name	Conditional	7.~~9~~7.2~~3~~1
IMSI	Conditional	7.7.2
NSAPI	Mandatory	7.7.28
Primay NSAPI	Conditional	7.9.29
TFT	Conditional	7.9.27
Protocol Configuration Options	~~Optional~~Conditional	7.~~9~~7.24~~2~~
SGSN Address for signalling	Mandatory	GSN Address 7.~~9~~7.2~~5~~3
SGSN Address for user traffic	Mandatory	GSN Address 7.~~9~~7.2~~5~~3
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.2 Create PDP Context Response~~

7.3.2 Create PDP Context Response

The message shall be sent from a GGSN node to a SGSN node as a response of a Create PDP Context Request. When the SGSN receives a Create PDP Context Response with the Cause value indicating 'Request Accepted', the SGSN activates the PDP context and may start to forward T-PDUs to/from the MS from/to the external data network.

The Cause value indicates if a PDP context has been created in the GGSN or not. A PDP context has not been created in the GGSN if the Cause differs from 'Request accepted'. Possible Cause values are:

- 'Request Accepted'
- 'No resources available'
- 'All dynamic PDP addresses are occupied'
- 'No memory is available*
- 'Service not supported'
- 'User authentication failed'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'
- 'Version not supported'

'No resources available' indicates e.g. that all dynamic PDP addresses are occupied or no is memory available. 'Service not supported' indicates e.g. when the GGSN does not support the PDP type, PDP address or Access Point Name. 'User authentication failed' indicates that the external packet network has rejected the service requested by the user.

Only the Cause information element, optionally Protocol Configuration Options and optionally the Recovery information element shall be included in the response if the Cause contains another value than 'Request accepted'.

All information elements, except Recovery, Protocol Configuration Options, and Private Extension, are mandatory if the Cause contains the value 'Request accepted'.

The ~~Flow Label~~Tunnel Endpoint Identifier Data I field specifies an uplink ~~flow label~~Tunnel Endpoint Identifier for G-PDUs which is chosen by the GGSN. The SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent uplink G-PDUs which are related to the requested PDP context.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies an uplink ~~flow label~~Tunnel Endpoint Identifier for signalling messages which is chosen by the GGSN. The SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent uplink signalling messages which are related to the requested PDP context.

The GGSN shall include a GGSN Address for signalling and a GGSN address for user traffic, which may differ from that provided by the underlying network service (e.g. IP). The SGSN shall store these GGSN Addresses and use them when sending signalling on this GTP tunnel or G-PDUs to the GGSN for the MS.

If the MS requests a dynamic PDP address and a dynamic PDP address is allowed, then the End User Address information element shall be included and the PDP Address field in the End User Address information element shall contain the dynamic PDP Address allocated by the GGSN. In case the PDP addresses carried in the End User Address

and optionally in the Protocol Configuration Option information element contain contradicting information, the PDP address carried in the End User Address information element takes the higher precedence.

The QoS values supplied in the Create PDP Context Request may be negotiated downwards by the GGSN. The negotiated values or the original values from SGSN are inserted in the Quality of Service Profile information element of the Create PDP Context Response message.

If a connection-less path is to be used to tunnel T-PDUs for the given PDP context or a reliable connection-oriented path is to be used and a connection already exists, the GGSN may start to forward T-PDUs after the Create PDP Context Response has been sent and the SGSN may start to forward T-PDUs when the Create PDP Context Response has been received. In this case the SGSN shall also be prepared to receive T-PDUs from the GGSN after it has sent a Create PDP Context Request but before a Create PDP Context Response has been received.

If a reliable connection-oriented path is to be used to tunnel T-PDUs for the given PDP context and a connection does not exist between the GSN pair, the SGSN shall establish a connection and the GGSN shall wait for the connection before forwarding of T-PDUs may start.

Only one connection shall be used between any given GSN-pair, and this connection shall be used to tunnel end user traffic in both directions.

The Reordering Required value supplied in the Create PDP Context Response indicates whether the end user protocol benefits from packet in sequence delivery and whether the SGSN and the GGSN therefore shall perform reordering or not, i.e. if reordering is required by the GGSN the SGSN and the GGSN shall perform reordering of incoming T-PDUs on this path.

The GGSN shall include the Recovery information element into the Create PDP Context Response if the GGSN is in contact with the SGSN for the first time or the GGSN has restarted recently and the new Restart Counter value has not yet been indicated to the SGSN. The SGSN receiving the Recovery information element shall handle it as when an Echo Response message is received but shall consider the PDP context being created as active if the response indicates a successful context activation at the GGSN.

The Charging ID is used to identify all charging records produced in SGSN(s) and the GGSN for this PDP context. The Charging ID is generated by the GGSN and shall be unique within the GGSN.

The Charging Gateway Address is the IP address of the recommended Charging Gateway Functionality to which the SGSN should transfer the Charging Detail Records (CDR) for this PDP Context.

The optional Private Extension contains vendor or operator specific information.

Table 5: Information elements in a Create PDP Context Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
Quality of Service Profile	Conditional	7.~~9~~7.6
Reordering required	Conditional	7.~~9~~7.8
Recovery	Optional	7.~~9~~7.1~~4~~2
~~Flow Label~~Tunnel Endpoint Identifier Data I	Conditional	7.~~9~~7.1~~6~~5
~~Flow Label~~Tunnel Endpoint Identifier Signalling	Conditional	7.~~9~~7.1~~7~~6
Charging ID	Conditional	7.~~9~~7.1~~9~~7
End user address	Conditional	7.~~9~~7.~~20~~18
Protocol Configuration Options	Optional	7.~~9~~7.2~~4~~2
GGSN Address for signalling	Conditional	GSN Address 7.~~9~~7.2~~5~~3
GGSN Address for user traffic	Conditional	GSN Address 7.~~9~~7.2~~5~~3
Charging Gateway Address	Optional	7.~~9~~7.2~~6~~5
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.3 Update PDP Context Request~~

7.3.3 Update PDP Context Request

An Update PDP Context Request message shall be sent from a SGSN to a GGSN as part of the GPRS Inter SGSN Routeing Update procedure or the PDP Context Modification procedure or to redistribute contexts due to load sharing. It shall be used to change the QoS and the path. The message shall be sent by the new SGSN at the Inter SGSN Routeing Update procedure.

The NSAPI information element together with the Tunnel Endpoint Identifier in the GTP header unambiguously identifies a PDP Context in the GGSN.

The ~~Flow Label~~Tunnel Endpoint Identifier Data I field specifies a downlink ~~flow label~~Tunnel Endpoint Identifier for G-PDUs which is chosen by the SGSN. The GGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent downlink G-PDUs which are related to the requested PDP context.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies a downlink ~~flow label~~Tunnel Endpoint Identifier for signalling messages which is chosen by the SGSN. The GGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent downlink signalling messages which are related to the requested PDP context.

The Quality of Service Profile information element shall include the QoS negotiated between the MS and SGSN at PDP Context activation or the new QoS negotiated in the PDP Context Modification procedure.

The SGSN shall include an SGSN Address for signalling and an SGSN address for user traffic, which may differ from that provided by the underlying network service (e.g. IP). The GGSN shall store these SGSN Addresses and use them when sending subsequent signalling on this GTP tunnel or G-PDUs to the SGSN for the MS. When active contexts are being redistributed due to load sharing, G-PDUs that are in transit across the Gn-interface are in an undetermined state and may be lost.

The SGSN shall include a Recovery information element into the Update PDP Context Request if the SGSN is in contact with the GGSN for the very first time or if the SGSN has restarted recently and the new Restart Counter value has not yet been indicated to the GGSN. The GGSN that receives a Recovery information element in the Update PDP Context Request message element shall handle it in the same way as when receiving an Echo Response message. The Update PDP Context Request message shall be considered as a valid update request for the PDP context indicated in the message.

The Traffic Flow Template (TFT) is used to distinguish between different user traffic flows.

The optional Private Extension contains vendor or operator specific information.

Table 6: Information elements in an SGSN-initiated Update PDP Context Request

Information element	Presence requirement	Reference
Quality of Service Profile	Mandatory	7.~~9~~7.6
Recovery	Optional	7.~~9~~7.1~~4~~2
~~Flow Label~~Tunnel Endpoint Identifier Data I	Mandatory	7.~~9~~7.1~~6~~4
~~Flow Label~~Tunnel Endpoint Identifier Signalling	Mandatory	7.~~9~~7.1~~7~~5
SGSN Address for signalling	Mandatory	GSN Address 7.~~9~~7.2~~5~~3
SGSN Address for user traffic	Mandatory	GSN Address 7.~~9~~7.2~~5~~3
NSAPI	Mandatory	7.7.28
TFT	Optional	7.8.27
Private Extension	Optional	7.~~9~~7.2~~7~~6

An Update PDP Context Request may also be sent from a GGSN to a SGSN to re-negotiate the QoS of a PDP context. This GGSN-initiated Update PDP Context Request can also be used to provide a PDP address to the SGSN (and MS). The latter shall be used by GGSN when ~~then~~ it acts as a DHCP Relay Agent or Mobil IP Foreign Agent.

The Quality of Service Profile information element shall include the GGSN requested QoS.

The End User Address information element shall contain a valid IPv4 or IPv6 address.

The optional Private Extension contains vendor or operator specific information.

Table 7: Information elements in a GGSN-initiated Update PDP Context Request

Information element	Presence requirement	Reference
Quality of Service Profile	Optional	7.9.6
End User Address	Optional	7.9.18
Private Extension	Optional	7.9.27

~~7.5.4 Update PDP Context Response~~

7.3.4 Update PDP Context Response

The message shall be sent from a GGSN node to a SGSN node as a response of an Update PDP Context Request.

If the SGSN receives an Update PDP Context Response with a Cause value other than 'Request accepted', it shall deactivate the PDP context.

Only the Cause information element and optionally the Recovery information element shall be included in the response if the Cause contains another value than 'Request accepted'.

Possible Cause values are:

- 'Request Accepted'
- 'Non-existent'
- 'Service not supported'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'
- 'Version not supported'

The ~~Flow Label~~Tunnel Endpoint Identifier Data I field specifies an uplink ~~flow label~~Tunnel Endpoint Identifier for G-PDUs which is chosen by the GGSN. The SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent uplink G-PDUs which are related to the requested PDP context.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies an uplink ~~flow label~~Tunnel Endpoint Identifier for signalling messages which is chosen by the GGSN. The SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent uplink signalling messages which are related to the requested PDP context.

The QoS values supplied in the Update PDP Context Request may be negotiated downwards by the GGSN. The negotiated values or the original value from SGSN is inserted in the Quality of Service Profile information element. This information element shall be included if the Cause contains the value 'Request accepted'.

If a connection-less path is to be used to tunnel T-PDUs for the given PDP context or a reliable connection-oriented path is to be used and a connection already exists, the GGSN may start to forward T-PDUs after the Update PDP Context Response has been sent and the SGSN may start to forward T-PDUs when the Update PDP Context Response has been received. In this case the SGSN shall also be prepared to receive T-PDUs from the GGSN after it has sent a Update PDP Context Request but before an Update PDP Context Response has been received.

If a reliable connection-oriented path is to be used to tunnel T-PDUs for the given PDP context and a connection does not exist between the GSN pair, the SGSN shall establish a connection and the GGSN shall wait for the connection before forwarding of T-PDUs may start.

Only one connection shall be used between any given GSN-pair, and this connection shall be used to tunnel end user traffic in both directions.

The GGSN shall include a GGSN Address for signalling and an GGSN address for user traffic, which may differ from that provided by the underlying network service (e.g. IP). The SGSN shall store these GGSN Addresses and use them when sending subsequent signalling on this GTP tunnel or G-PDUs to the GGSN for the MS. When active contexts are

being redistributed due to load sharing, G-PDUs that are in transit across the Gn-interface are in an undetermined state and may be lost.

The GGSN shall include the Recovery information element into the Update PDP Context Response if the GGSN is in contact with the SGSN for the first time or if the GGSN has restarted recently and the new Restart Counter value has not yet been indicated to the SGSN. The SGSN receiving the Recovery information element shall handle it as when an Echo Response message is received but shall consider the PDP context as updated and active if the response cause indicates a successful operation at the GGSN.

The Charging ID is used to identify all charging records produced in SGSN(s) and the GGSN for this PDP context. The Charging ID has been previously generated by the GGSN and is unique for this PDP context. If an inter-SGSN routing area update occurs, it is transferred to the new SGSN as part of each active PDP context.

The Charging Gateway Address is the IP address of the recommended Charging Gateway Functionality to which the SGSN should transfer the Charging Detail Records (CDR) for this PDP Context.

The optional Private Extension contains vendor or operator specific information.

Table 8~~7~~: Information elements in an Update PDP Context Response sent by a GGSN

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
Quality of Service Profile	Conditional	7.~~9~~7.6
Recovery	Optional	7.~~9~~7.14~~2~~
~~Flow Label~~Tunnel Endpoint Identifier Data I	Conditional	7.~~9~~7.16~~4~~
~~Flow Label~~Tunnel Endpoint Identifier Signalling	Conditional	7.~~9~~7.17~~5~~
Charging ID	Conditional	7.~~9~~7.19~~7~~
GGSN Address for signalling	Conditional	GSN Address 7.~~9~~7.25~~3~~
GGSN Address for user traffic	Conditional	GSN Address 7.~~9~~7.25~~3~~
Charging Gateway Address	Optional	7.~~9~~7.26~~5~~
Private Extension	Optional	7.~~9~~7.27~~6~~

The message can also be sent from a SGSN node to a GGSN node as a response of a GGSN-initiated Update PDP Context Request.

If the GGSN receives an Update PDP Context Response with a Cause value other than 'Request accepted', it shall abort the update of the PDP context.

Only the Cause information element shall be included in the response if the Cause contains another value than 'Request accepted'.

Possible Cause values are the same as for the Update PDP Context Response sent by a GGSN.

The QoS values supplied in the Update PDP Context Request may be negotiated downwards by the SGSN. The negotiated values or the original value from GGSN is inserted in the Quality of Service Profile information element. This information element shall be included if the Cause contains the value 'Request accepted' and a QoS information element was supplied in the corresponding request message.

Table 9: Information elements in an Update PDP Context Response sent by a SGSN

Information element	Presence requirement	Reference
Cause	Mandatory	7.9.1
Quality of Service Profile	Conditional	7.9.6
Private Extension	Optional	7.9.27

7.3.5 Delete PDP Context Request

A Delete PDP Context Request shall be sent from a SGSN node to a GGSN node as part of the GPRS Detach procedure or the GPRS PDP Context Deactivation procedure or from a GGSN node to a SGSN node as part of the PDP Context Deactivation Initiated by GGSN procedure. A request shall be used to deactivate an activated PDP Context.

A GSN shall be prepared to receive a Delete PDP Context Request at any time and shall always reply regardless if the PDP context exists or not.

If any collision occurs, the Delete PDP Context Request takes precedence over any other Tunnel Management message.

The optional Teardown Ind is used to indicate that all PDP contexts that share the PDP address with the PDP context identified in the request should also be deactivated.

The optional Private Extension contains vendor or operator specific information.

Table 10: Information elements in a Delete PDP Context Request

Information element	Presence requirement	Reference
NSAPI	Mandatory	7.7.28
Teardown Ind	Optional	7.9.28
Private Extension	Optional	7.97.276

~~7.5.6 Delete PDP Context Response~~

7.3.6 Delete PDP Context Response

The message shall be sent as a response of a Delete PDP Context Request.

A GSN shall ignore a Delete PDP Context Response for a non-existing PDP context.

Possible Cause value is:

- 'Request Accepted'

The optional Private Extension contains vendor or operator specific information.

Table 11: Information elements in a Delete PDP Context Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.97.1
Private Extension	Optional	7.97.276

~~7.5.7 Create AA PDP Context Request~~

7.3.7 Create AA PDP Context Request

A Create AA PDP Context Request shall be sent from a SGSN node to a GGSN node as a part of the GPRS Anonymous Access PDP Context Activation procedure. It shall be used to create a tunnel between a PDP Context in a SGSN and a PDP Context in a GGSN. The GGSN IP address where the SGSN sends the Create AA PDP Context Request is the first IP address in the list of IP addresses provided by the DNS server. After sending the Create AA PDP Context Request message, the SGSN marks the PDP context as 'waiting for response'. In this state the SGSN shall accept G-PDUs from the GGSN but shall not send these G-PDUs to the MS. If the procedure is not successfully completed, the SGSN repeats the Create AA PDP Context Request message to the next GGSN address in the list of IP addresses, if there is one. If the list is exhausted the activation procedure fails.

The ~~Flow Label~~Tunnel Endpoint Identifier Data I field specifies a downlink ~~flow label~~Tunnel Endpoint Identifier for G-PDUs which is chosen by the SGSN. The GGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent downlink G-PDUs which are related to the requested PDP context.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies a downlink ~~flow label~~Tunnel Endpoint Identifier for signalling messages which is chosen by the SGSN. The GGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent downlink signalling messages which are related to the requested PDP context.

The Quality of Service Profile information element shall be the QoS values to be negotiated by the MS and SGSN at Anonymous Access PDP Context activation.

The SGSN shall include a Recovery information element into the Create AA PDP Context Request if the SGSN is in contact with the GGSN for the very first time or if the SGSN has restarted recently and the new Restart Counter value has not yet been indicated to the GGSN. The GGSN that receives a Recovery information element in the Create AA PDP Context Request message element shall handle it in the same way as when receiving an Echo Response message. The Create AA PDP Context Request message shall be considered as a valid activation request for a new AA context of the indicated PDP type.

The Selection mode IE shall be set to either 'MS provided APN, subscription not verified' or 'Network provided APN, subscription not verified' depending on the origin of the APN which is included in the message.

The SGSN shall include an SGSN Address for signalling and an SGSN address for user traffic, which may differ from that provided by the underlying network service (e.g. IP). The GGSN shall store these SGSN Addresses and use them when sending signalling on this GTP tunnel or G-PDUs to the SGSN for the MS.

The End User Address contains the requested PDP Type with the PDP Address field left empty. In case the PDP addresses carried in the End User Address and optionally in the Protocol Configuration Option information element contain contradicting information, the PDP address carried in the End User Address information element takes the higher precedence.

The NSAPI information element uniquely identifies the PDP Context to be created.

The optional Protocol Configuration Options information element is applicable for the end user protocol 'IP' only. The GGSN may discard the Protocol Configuration Options information element or may use it for user authentication and configuration, depending on configuration data.

The optional Private Extension contains vendor or operator specific information.

Table 12: Information elements in a Create AA PDP Context Request

Information element	Presence requirement	Reference
Quality of Service Profile	Mandatory	7.~~9~~7.6
Recovery	Optional	7.~~9~~7.1~~4~~2
Selection mode	Mandatory	7.~~9~~7.1~~5~~3
~~Flow Label~~Tunnel Endpoint Identifier Data I	Mandatory	7.~~9~~7.1~~6~~4
~~Flow Label~~Tunnel Endpoint Identifier Signalling	Mandatory	7.~~9~~7.1~~7~~5
End User Address	Mandatory	7.~~9~~7.~~20~~18
Access Point Name	Mandatory	7.~~9~~7.2~~3~~1
Protocol Configuration Options	Optional	7.~~9~~7.2~~4~~2
SGSN Address for signalling	Mandatory	GSN Address7.~~9~~7.2~~5~~3
SGSN Address for user traffic	Mandatory	GSN Address 7.~~9~~7.2~~5~~3
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.8 Create AA PDP Context Response~~

7.3.8 Create AA PDP Context Response

The message shall be sent from a GGSN node to a SGSN node as a response of a Create AA PDP Context Request. When the SGSN receives a Create AA PDP Context Response with the Cause value indicating 'Request Accepted', the SGSN activates the PDP context and may start to forward T-PDUs to/from the MS from/to the external data network.

Only the Cause information element, optionally Protocol Configuration Options and optionally the Recovery information element shall be included in the response if the Cause contains another value than 'Request accepted'.

All information elements, except Recovery, Protocol Configuration Options and Private Extension, are mandatory if the Cause contains the value 'Request accepted'.

Possible Cause values are:

- 'Request Accepted'
- 'No resources available'
- 'Service not supported'
- 'User authentication failed'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'
- 'Version not supported'

The ~~Flow Label~~Tunnel Endpoint Identifier Data I field specifies an uplink ~~flow label~~Tunnel Endpoint Identifier for G-PDUs which is chosen by the GGSN. The SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent uplink G-PDUs which are related to the requested PDP context.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies an uplink ~~flow label~~Tunnel Endpoint Identifier for signalling messages which is chosen by the GGSN. The SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent uplink signalling messages which are related to the requested PDP context.

The GGSN shall include a GGSN Address for signalling and a GGSN address for user traffic, which may differ from that provided by the underlying network service (e.g. IP). The SGSN shall store these GGSN Addresses and use them when sending signalling on this tunnel or G-PDUs to the GGSN for the MS.

The QoS values supplied in the Create AA PDP Context Request may be negotiated downwards by the GGSN. The negotiated values or the original values from SGSN are inserted in the Quality of Service Profile information element.

If a connection-less path is to be used to tunnel T-PDUs for the given PDP context or a reliable connection-oriented path is to be used and a connection already exists, the GGSN may start to forward T-PDUs after the Create AA PDP Context Response has been sent and the SGSN may start to forward T-PDUs when the Create AA PDP Context Response has been received. In this case the SGSN shall also be prepared to receive T-PDUs from the GGSN after it has sent a Create AA PDP Context Request but before a Create AA PDP Context Response has been received.

If a reliable connection-oriented path is to be used to tunnel T-PDUs for the given PDP context and a connection does not exist between the GSN pair, the SGSN shall establish a connection and the GGSN shall wait for the connection before forwarding of T-PDUs may start.

Only one connection shall be used between any given GSN-pair, and this connection shall be used to tunnel end user traffic in both directions.

~~The Reordering Required value supplied in the Create AA PDP Context Response indicates whether the end user protocol benefits from packet in sequence delivery and whether the SGSN and the GGSN therefore shall perform reordering or not.~~

The GGSN shall include the Recovery information element into the Create AA PDP Context Response if the GGSN is in contact with the SGSN for the first time or the GGSN has restarted recently and the new Restart Counter value has not yet been indicated to the SGSN. The SGSN receiving the Recovery information element shall handle it as when an Echo Response message is received but shall consider the AA PDP context being created as active if the response indicates a successful AA context activation at the GGSN.

The Charging ID is used to identify all charging records produced in SGSN(s) and the GGSN for this PDP context. The Charging ID is generated by the GGSN and shall be unique within the GGSN.

The Charging Gateway Address is the IP address of the recommended Charging Gateway Functionality to which the SGSN should transfer the Charging Detail Records (CDR) for this PDP Context.

The PDP Address field in the End User Address information element contains the dynamic PDP Address allocated by the GGSN. In case the PDP addresses carried in the End User Address and optionally in the Protocol Configuration Option information element contain contradicting information, the PDP address carried in the End User Address information element takes the higher precedence.

The optional Private Extension contains vendor or operator specific information.

Table 13: Information elements in a Create AA PDP Context Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
Quality of Service Profile	Conditional	7.~~9~~7.6
~~Reordering Required~~	~~Conditional~~	~~7.9.8~~
Recovery	Optional	7.~~9~~7.1~~4~~2
~~Flow Label~~Tunnel Endpoint Identifier Data I	Conditional	7.~~9~~7.1~~6~~4
~~Flow Label~~Tunnel Endpoint Identifier Signalling	Conditional	7.~~9~~7.1~~7~~5
Charging ID	Conditional	7.~~9~~7.1~~9~~7
End User Address	Conditional	7.~~9~~7.~~20~~18
Protocol Configuration Options	Optional	7.~~9~~7.2~~4~~2
GGSN Address for signalling	Conditional	GSN Address 7.~~9~~7.2~~5~~3
GGSN Address for user traffic	Conditional	GSN Address 7.~~9~~7.2~~5~~3
Charging Gateway Address	Optional	7.~~9~~7.2~~6~~5
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.9 Delete AA PDP Context Request~~

7.3.9 Delete AA PDP Context Request

A Delete AA PDP Context Request shall be sent from a SGSN node to a GGSN node as part of the GPRS PDP Anonymous Access Context Deactivation procedure. The GGSN may also send the request to the SGSN if it detects malicious usage of the service. The request shall be used to deactivate an activated PDP Context.

The Cause information element indicates whether the SGSN shall request the real identities (i.e. IMSI or IMEI) of the anonymous MS. One of the following Cause values shall be used:

- 'Request IMSI'
- 'Request IMEI'

- 'Request IMSI and IMEI'
- 'No identity needed'

The NSAPI information element unambiguously identifies a specific PDP Context in the receiving GSN.

The optional Private Extension contains vendor or operator specific information.

Table 14: Information elements in a Delete AA PDP Context Request

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
NSAPI	Mandatory	7.7.28
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.10 Delete AA PDP Context Response~~

7.3.10 Delete AA PDP Context Response

The message shall be sent as a response of a Delete AA PDP Context Request.

Possible Cause values are:

- 'Request Accepted'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'

If the received Delete AA PDP Context Response contains a cause value other than 'Request accepted', the PDP context shall be kept active.

The optional Private Extension contains vendor or operator specific information.

Table 15: Information elements in a Delete AA PDP Context Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.11 Error Indication~~

7.3.11 Error Indication

The SGSN may send an Error Indication to the GGSN if no PDP context exists or the PDP context is inactive for a received G-PDU. The SGSN shall also send an Error Indication to the GGSN if no MM context exists for a received G-PDU.

At the Inter SGSN Routing Area Update and the Inter SRNS Relocation procedures t~~T~~he new SGSN sends an Error Indication to the old SGSN if no active PDP context exists for a received G-PDU.

The GGSN may send an Error Indication to the SGSN if no PDP context exists for a received G-PDU.

The GGSN shall delete its PDP context and may notify the Operation and Maintenance network element when an Error Indication is received.

The SGSN shall indicate to the MS when a PDP context has been deleted due to the reception of an Error Indication message. The MS may then request the re-establishment of the PDP context.

The old SGSN shall delete its PDP context and may notify the Operation and Maintenance network element when an Error Indication is received.

The ~~TID~~Tunnel Endpoint Identifier used in the Error Indication message shall be fetched from the G-PDU that triggered this procedure

The optional Private Extension contains vendor or operator specific information.

Table 16: Information elements in an Error Indication

Information element	Presence requirement	Reference
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.12 PDU Notification Request~~

7.3.12 PDU Notification Request

When receiving a T-PDU the GGSN checks if a PDP context is established for that PDP address. If no PDP context has been previously established, the GGSN may try to deliver the T-PDU by initiating the Network-Requested PDP Context Activation procedure. The criteria, used by the GGSN to determine whether trying to deliver the T-PDU to the MS or not, may be based on subscription information in the GGSN and are outside the scope of GPRS standardisation.

As part of the Network-Requested PDP Context Activation procedure the GGSN sends a PDU Notification Request message to the SGSN indicated by the HLR, i.e. the current location of the MS. When receiving this message, the SGSN shall be responsible for requesting the MS to activate the indicated PDP Context.

The IMSI is inserted in the IMSI ~~part of the TID in the GTP header of~~information element in the PDU Notification Request message. ~~The NSAPI part of the TID is not used and shall be filled with HEX(F) by GGSN and SGSN shall ignore it.~~

The End User Address information element contains the PDP type and PDP address that the SGSN shall request the MS to activate.

The Tunnel Endpoint Identifier Signalling information element shall be a tunnel endpoint identifier signalling selected by the GGSN and shall be used by the SGSN in the GTP header of the corresponding PDU Notification Response or PDU Notification Request Reject message.

If the GGSN receives a Create PDP Context Request before the PDU Notification Response, the GGSN shall handle the Create PDP Context Request as a normal context activation and ignore the following PDU Notification Response.

If the SGSN receives a PDU Notification Request after a Create PDP Context Request has been sent but before a Create PDP Context Response has been received, the SGSN shall only send a PDU Notification Response with Cause ‘Request accepted’ without any further processing and then wait for the Create PDP Context Response.

The optional Private Extension contains vendor or operator specific information.

Table 17: Information elements in a PDU Notification Request

Information element	Presence requirement	Reference
IMSI	Mandatory	7.7.28
End User Address	Mandatory	7.~~9~~7.1~~5~~8
Tunnel Endpoint Identifier Signalling	Mandatory	7.7.15
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.13 PDU Notification Response~~

7.3.13 PDU Notification Response

The message is sent by a SGSN to GGSN as a response of a PDU Notification Request.

The Cause value 'Request accepted' indicates if the PDP context activation will proceed. The PDP context activation procedure will not proceed for other Cause values.

Possible Cause values are:

- 'Request Accepted'
- 'No resources available'
- 'Service not supported'
- 'System failure'
- 'IMSI not known'
- 'MS is GPRS Detached'
- 'GPRS connection suspended'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'
- 'Version not supported'
- 'Roaming restriction'

After an unsuccessful activation attempt the GSNs may perform some actions to prevent unnecessary enquires to the HLR as described in the section Unsuccessful Network-Requested PDP Context Activation procedure in GSM 03.60.

The optional Private Extension contains vendor or operator specific information.

Table 18: Information elements in a PDU Notification Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.5.14 PDU Notification Reject Request~~

7.3.14 PDU Notification Reject Request

If the PDP context activation proceeds after the PDU Notification Response, but the PDP context was not established, the SGSN sends a PDU Notification Reject Request message. The Cause value indicates the reason why the PDP Context could not be established:

- 'MS Not GPRS Responding'.
- 'MS Refuses'.

When receiving the PDU Notification Reject Request message the GGSN may reject or discard the stored T-PDU(s) depending on the PDP type.

After an unsuccessful activation attempt the GSNs may perform some actions to prevent unnecessary enquires to the HLR as described in the section Unsuccessful Network-Requested PDP Context Activation procedure in GSM 03.60.

The ~~TID~~Tunnel Endpoint Identifier of the PDU Notification Reject Request message shall be the same as the ~~TID~~Tunnel Endpoint Identifier of the PDU Notification Request that triggered the reject.

The End User Address information element contains the PDP type and PDP address of the PDP context that could not be activated.

The optional Private Extension contains vendor or operator specific information.

Table 19: Information elements in a PDU Notification Reject Request

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
End User Address	Mandatory	7.~~9~~7.~~20~~18
Tunnel Endpoint Identifier Signalling	Mandatory	7.7.15
Private Extension	Optional	7.~~9~~7.27

~~7.5.15 PDU Notification Reject Response~~

7.3.15 PDU Notification Reject Response

The message is sent by a GGSN to SGSN as a response of a PDU Notification Reject Request.

Possible Cause values are:

- 'Request Accepted'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'

The optional Private Extension contains vendor or operator specific information.

Table 20: Information elements in a PDU Notification Reject Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.6 Location Management messages~~

7.4 Location Management messages

The optional Location Management messages are defined to support the case when Network-Requested PDP Context Activation procedures are used and a GGSN does not have a SS7 MAP interface, i.e. a Gc interface. GTP is then used to transfer signalling messages between the GGSN and a GTP-MAP protocol-converting GSN in the GPRS backbone network. The GTP-MAP protocol-converting GSN converts the signalling messages described in this section between GTP and MAP. The MAP messages are sent to and received from the HLR. The GTP-MAP protocol-converting function is described in GSM 03.60. The MAP protocol describing the corresponding procedures and messages is described in GSM 09.02. This alternative method is illustrated in Figure 6.

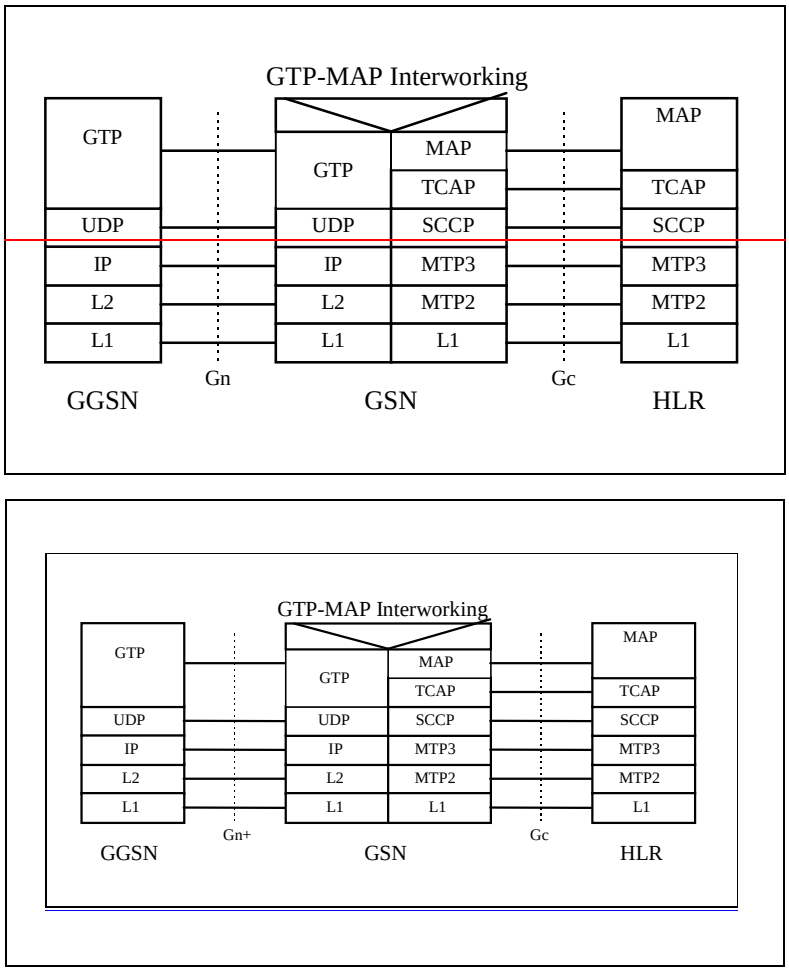


Figure 7: GGSN - HLR Signalling via a GTP-MAP protocol-converter in a GSN

When receiving a T-PDU the GGSN checks if a PDP Context is established for that PDP address. If no PDP context has been previously established the GGSN may store the T-PDU, try to initiate the Network-Requested PDP Context Activation procedure and, when the activation procedure is completed, deliver the T-PDU.

To support Network-Requested PDP Context Activation the GGSN has to have static PDP information about the PDP address.

~~7.6.1 Send Routeing Information for GPRS Request~~

7.4.1 Send Routeing Information for GPRS Request

The GGSN may send a Send Routeing Information for GPRS Request message to a GTP-MAP protocol-converting GSN, to obtain the IP address of the SGSN where the MS is located, when no PDP context is established.

The IMSI information element contains the IMSI to be used as a key to get the IP address of the SGSN.

If the GGSN receives a Create PDP Context Request after a Send Routeing Information for GPRS Request has been sent but before a Send Routeing Information for GPRS Response has been received, the GGSN shall handle the Create PDP Context Request as a normal context activation and ignore the following Send Routeing Information for GPRS Response.

The optional Private Extension contains vendor or operator specific information.

Table 21: Information elements in a Send Routeing Information for GPRS Request

Information element	Presence requirement	Reference
IMSI	Mandatory	7.~~9~~7.2
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.6.2 Send Routeing Information for GPRS Response~~

7.4.2 Send Routeing Information for GPRS Response

The GTP-MAP protocol-converting GSN sends a Send Routeing Information for GPRS Response message as a response to the Send Routeing Information for GPRS Request message to the GGSN that sent the request.

The Cause value indicates if the GTP-MAP protocol-converting GSN accepted the request or not.

Possible Cause values are:

- 'Request Accepted'
- 'No resources available'
- 'Service not supported'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'
- 'Version not supported'

The MAP Cause information element contains the MAP cause value from the HLR and shall not be included if the Cause contains another value than 'Request accepted'.

The GSN Address information element contains the IP address of the SGSN and shall not be included if the Cause contains another value than 'Request accepted'.

It is an implementation issue what to do if the Cause or MAP Cause indicates that no location information is available.

The optional Private Extension contains vendor or operator specific information.

Table 22: Information elements in a Send Routeing Information for GPRS Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
IMSI	Mandatory	7.~~9~~7.2
MAP Cause	Optional	7.~~9~~7.~~11~~9
GSN Address	Optional	7.~~9~~7.2~~5~~3
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.6.3 Failure Report Request~~

7.4.3 Failure Report Request

The GGSN may send this message to the GTP-MAP protocol-converting GSN to set the MNRG flag for the IMSI in the HLR.

The IMSI information element contains the IMSI for which the MNRG shall be set.

The optional Private Extension contains vendor or operator specific information.

Table 23: Information elements in a Failure Report Request

Information element	Presence requirement	Reference
IMSI	Mandatory	7.~~9~~7.2
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.6.4 Failure Report Response~~

7.4.4 Failure Report Response

The GTP-MAP protocol-converting GSN sends a Failure Report Response message as a response to the Failure Report Request message to the GGSN that sent the request.

The Cause value indicates if the GTP-MAP protocol-converting GSN accepted the request or not.

Possible Cause values are:

- 'Request Accepted'
- 'No resources available'
- 'Service not supported'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'
- 'Version not supported'

The MAP Cause information element contains the MAP cause value from the HLR and shall not be included if the Cause contains another value than 'Request accepted'

It is an implementation issue what to do if the Cause or MAP Cause indicates that the HLR has not received the request or rejected the request.

The optional Private Extension contains vendor or operator specific information.

Table 24: Information elements in a Failure Report Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
MAP Cause	Optional	7.~~9~~7.~~11~~9
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.6.5 Note MS GPRS Present Request~~

7.4.5 Note MS GPRS Present Request

The GTP-MAP protocol-converting GSN sends a Note MS GPRS Present message to notify that an MS should be reachable for GPRS again.

The GGSN shall use the IMSI in the request and find all PDP contexts for the IMSI. The MNRG shall be cleared and the SGSN IP address from the request shall be stored in each found PDP context.

The IMSI information element contains the IMSI for the PDP contexts.

The GSN Address information element contains the IP address of the SGSN.

The optional Private Extension contains vendor or operator specific information.

Table 25: Information elements in a Note MS Present Request

Information element	Presence requirement	Reference
IMSI	Mandatory	7.~~9~~7.2
GSN Address	Mandatory	7.~~9~~7.~~7~~23
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.6.6 Note MS GPRS Present Response~~

7.4.6 Note MS GPRS Present Response

The GGSN sends a Note MS GPRS Present Response message to the GTP-MAP protocol-converting GSN as a response to the Note MS GPRS Present Request.

Possible Cause values are:

- 'Request Accepted'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'

The optional Private Extension contains vendor or operator specific information.

Table 26: Information elements in a Note MS Present Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.7 Mobility Management messages~~

7.5 Mobility Management messages

The Mobility Management messages are the signalling messages, defined in GSM 03.60 and 04.08, that are sent between SGSNs at the GPRS Attach and Inter SGSN Routeing Update procedures. The new SGSN derives the address of the old SGSN from the old routeing area identity. The address translation mechanism is implementation specific. Some possible translation mechanisms are found in Annex A.

Generally, the purpose of the signalling is to transfer data associated with the MS from the old SGSN to the new SGSN.

~~7.7.1 Identification Request~~

7.5.1 Identification Request

If the MS, at GPRS Attach, identifies itself with P-TMSI and it has changed SGSN since detach, the new SGSN shall send an Identification Request message to the old SGSN to request the IMSI.

The P-TMSI and RAI is a P-TMSI and an RAI in the old SGSN. The P-TMSI Signature is conditionally provided by the MS to the new SGSN for identification checking purposes as defined in GSM 03.60 and 04.08. If the MS has provided the P-TMSI Signature, the new SGSN shall include this parameter in the Identification Request message.

The optional Private Extension contains vendor or operator specific information.

Table 27: Information elements in an Identification Request

Information element	Presence requirement	Reference
Routeing Area Identity (RAI)	Mandatory	7.~~9~~7.3
Packet TMSI	Mandatory	7.~~9~~7.5
P-TMSI Signature	~~Optional~~Conditional	7.~~9~~7.1~~2~~0
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.7.2 Identification Response~~

7.5.2 Identification Response

The old SGSN shall send an Identification Response to the new SGSN as a response to a previous Identification Request.

Possible Cause values are:

- ‘Request Accepted’
- ‘IMSI not known’
- ‘System failure’
- ‘Mandatory IE incorrect’
- ‘Mandatory IE missing’
- ‘Optional IE incorrect’
- ‘Invalid message format’

- 'Version not supported'
- 'P-TMSI Signature mismatch'

Only the Cause information element shall be included in the response if the Cause contains another value than 'Request accepted'.

The IMSI information element is mandatory if the Cause contains the value 'Request accepted'.

One or several Authentication Triplet or up to 5 Authentication Quintuplet information elements information elements may be included in the message if the Cause contains the value 'Request accepted'.

The optional Private Extension contains vendor or operator specific information.

Table 28: Information elements in an Identification Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
IMSI	Conditional	7.~~9~~7.2
Authentication Triplet	~~Optional~~Conditional	7.~~9~~7.~~9~~8
Authentication Quintuplet	~~Conditional~~ Optional	7.7.27
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.7.3 SGSN Context Request~~

7.5.3 SGSN Context Request

The new SGSN shall send an SGSN Context Request to the old SGSN to get the MM and PDP Contexts for the MS. The MS is identified by its old RAI and old TLLI/old P-TMSI values. The TLLI/P-TMSI and RAI is a TLLI/P-TMSI and an RAI in the old SGSN. One of the TLLI or P-TMSI information fields must be present.

The old SGSN responds with an SGSN Context Response.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies a ~~flow label~~Tunnel Endpoint Identifier for signalling messages which is chosen by the new SGSN. The old SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent signalling messages which are sent from the old SGSN to the new SGSN and related to the PDP context(s) requested.

The MS Validated indicates that the new SGSN has successfully authenticated the MS. . IMSI shall be included if MS Validated indicates 'Yes'.

The P-TMSI Signature is conditionally provided by the MS to the new SGSN for identification checking purposes as defined in GSM 03.60 and 04.08. If the MS has provided the P-TMSI Signature, the new SGSN shall include this parameter in the SGSN Context Request message.

The optional Private Extension contains vendor or operator specific information.

Table 29: Information elements in a SGSN Context Request

Information element	Presence requirement	Reference
IMSI	Conditional	7.~~9~~7.2
Routeing Area Identity (RAI)	Mandatory	7.~~9~~7.3
Temporary Logical Link Identifier (TLLI)	~~Mandatory~~Conditional	7.~~9~~7.4
Packet TMSI (P-TMSI)	Conditional	
P-TMSI Signature	~~Optional~~Conditional	7.~~9~~7.1~~2~~0
MS Validated	Optional	7.~~9~~7.1~~3~~1
~~Flow Label~~Tunnel Endpoint Identifier Signalling	Mandatory	7.~~9~~7.1~~7~~5
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.7.4 SGSN Context Response~~

7.5.4 SGSN Context Response

The old SGSN shall send an SGSN Context Response to the new SGSN as a response to a previous SGSN Context Request.

Possible Cause values are:

- 'Request Accepted'
- 'IMSI not known'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'Invalid message format'
- 'Version not supported'
- 'P-TMSI Signature mismatch'

Only the Cause information element shall be included in the response if the Cause contains another value than 'Request accepted'.

All information elements are mandatory, except PDP Context, and Private Extension, if the Cause contains the value 'Request accepted'.

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling field specifies a ~~flow label~~Tunnel Endpoint Identifier which is chosen by the old SGSN. The new SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent signalling messages which are sent from the new SGSN to the old SGSN and related to the PDP context(s) requested.

The IMSI information element contains the IMSI matching the TLLI or P-TMSI (for GSM or UMTS respectively) and RAI in the SGSN Context Request.

One or several Receive State Variable information elements may be included in the message.

The MM Context contains necessary mobility management and security parameters.

All active PDP contexts in the old SGSN shall be included as PDP Context information elements.

If there is at least one active PDP context, the old SGSN shall start the T3-TUNNEL timer and store the address of the new SGSN in the "New SGSN Address" field of the MM context. The old SGSN shall wait for SGSN Context Acknowledge before sending T-PDUs to the new SGSN. If the old SGSN has one or more active PDP contexts for the subscriber and SGSN Context Acknowledge message is not received within a time defined by T3-RESPONSE, the old SGSN shall retransmit the SGSN Context Response to the new SGSN for as long as the total number of attempts is less than N3-REQUESTS. After N3-REQUESTS unsuccessfully attempts, the old SGSN shall proceed as described in section 'Reliable delivery of signalling messages' in case the transmission of a signalling message fails N3-REQUESTS times.

The optional Private Extension contains vendor or operator specific information.

Table 30: Information elements in a SGSN Context Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
IMSI	Conditional	7.~~9~~7.2
G~~Flow Label~~Tunnel Endpoint Identifier Signalling	Conditional	7.~~9~~7.1~~7~~5
GSM MM Context	Conditional	7.~~9~~7.~~21~~19
UMTS MM Context	Conditional	7.7.30
PDP Context	Conditional	7.~~9~~7.2~~2~~0
Private Extension	Optional	7.~~9~~7.2~~7~~6

~~7.7.5 SGSN Context Acknowledge~~

7.5.5 SGSN Context Acknowledge

The new SGSN shall send an SGSN Context Acknowledge message to the old SGSN as a response to the SGSN Context Response message. Only after receiving the SGSN Context Acknowledge message, shall the old SGSN start to forward user data packets. SGSN Context Acknowledge indicates to the old SGSN that the new SGSN has correctly received PDP Context information and is ready to receive user data packets identified by the corresponding ~~TID~~Tunnel Endpoint Identifier values.

Possible cause values are:

- 'Request accepted'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'
- 'Optional IE incorrect'
- 'No resources available'
- 'Invalid message format'
- 'Version not supported'
- 'Authentication failure'

Only the Cause information element shall be included in the acknowledge if the Cause contains a value other than 'Request accepted'.

For each active PDP context the new SGSN shall include a ~~Flow Label~~Tunnel Endpoint Identifier Data II information element. The ~~Flow Label~~Tunnel Endpoint Identifier Data II field specifies a ~~flow label~~Tunnel Endpoint Identifier which is chosen by the new SGSN for a particular PDP context. The old SGSN shall include this ~~flow label~~Tunnel Endpoint Identifier in the GTP header of all subsequent G-PDUs which are sent from the old SGSN to the new SGSN and related to the particular PDP context.

If any of the PDP contexts has a QoS reliability class which indicates that a reliable connection-oriented path should be used to forward T-PDUs coming via the old route and no connection has already been established, the old SGSN shall set-up a connection to the new SGSN after receiving SGSN Context Acknowledge message.

~~T-PDUs associated with PDP contexts that require a reliable link shall be sent over the reliable connection-oriented path and the other T-PDUs shall be sent over the connection-less path. T-PDUs shall be sent over a connectionless path if connection-oriented resources are exhausted.~~

The new SGSN shall include an SGSN Address for user traffic, which may differ from that provided by the underlying network service (e.g. IP). The old SGSN shall store this SGSN Address and use it when sending G-PDUs to the new SGSN for the MS.

The optional Private Extension contains vendor or operator specific information.

Table 31: Information elements in a SGSN Context Acknowledge

Information element	Presence requirement	Reference
Cause	Mandatory	7.~~9~~7.1
~~Flow Label~~Tunnel Endpoint Identifier Data II	Conditional	7.~~9~~7.1~~8~~6
SGSN Address for user traffic	Conditional	GSN Address 7.~~9~~7.2~~5~~3
Private Extension	Optional	7.~~9~~7.2~~7~~6

7.5.6 Forward Relocation Request

The old SGSN shall send a Forward Relocation Request to the new SGSN to inform nesessary information to perform the SRNS Relocation procedure between new SGSN and Target RNC.

All information elements are mandatory, except Private Extension.

The IMSI information element contains the IMSI of the target MS for SRNS Relocation procedure.

The Tunnel Endpoint Identifier Signalling field specifies a tunnel endpoint identifier, which is chosen by the old SGSN. The new SGSN shall include this Tunnel Endpoint Identifier Signalling in the GTP header of all subsequent signalling messages, which are sent from the new SGSN to the old SGSN .

The MM Context contains necessary mobility management and security parameters.

All active PDP contexts in the old SGSN shall be included as PDP Context information elements.

UTRAN transparent container, Target identification and RANAP Cause are informed from the source RNC in the old SGSN.

The optional Private Extension contains vendor or operator specific information.

Table 32: Information elements in a Forward Relocation Request

Information element	Presence requirement	Reference
IMSI	Mandatory	7.9.2
Tunnel Endpoint Identifier Signalling	Mandatory	7.9.17
MM Context	Mandatory	7.9.21
PDP Context	Mandatory	7.9.22
UTRAN transparent container	Mandatory	7.9.29
Target Identification	Mandatory	7.9.28
RANAP Cause	Mandatory	7.9.30
Private Extension	Optional	7.9.25

7.5.7 Forward Relocation Response

The new SGSN shall send a Forward Relocation Response to the old SGSN as a response to a previous Forward Relocation Request.

Possible Cause values is:

- 'Request Accepted'
- 'System failure'
- 'Mandatory IE incorrect'
- 'Mandatory IE missing'

- 'Optional IE incorrect'
- 'No resources available'
- 'Invalid message format'
- 'Version not supported'

The Cause and RANAP Cause information element shall be included in the response if the Cause contains another value than 'Request accepted'.

All information elements are mandatory, except Private Extension, if the Cause contains the value 'Request accepted'.

RANAP Cause is mandatory if cause value contains in RANAP message.

Tansparent container and RANAP Cause are informed from the target RNC in the new SGSN.

Single number or prural number of Target RNC Information parameter shall be set in this message.

The optional Private Extension contains vendor or operator specific information.

Table 33: Information elements in a Forward Relocation Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.9.1
Target RNC Information	Conditional	7.9.31
UTRAN transparent container	Optional	7.9.29
RANAP Cause	Conditional	7.9.30
Private Extension	Optional	7.9.25

7.5.8 Forward Relocation Complete

The new SGSN shall send a Forward Relocation Complete to the old SGSN to indicate that the SRNS relocation procedure has been successfully finished.

The optional Private Extension contains vendor or operator specific information.

Table 34: Information elements in a Forward Relocation Complete

Information element	Presence requirement	Reference
Private Extension	Optional	7.9.25

7.5.9 Relocation Cancel Request

The Relocation Cancel Request message is sent from the old SGSN to the new SGSN when the old SGSN is requested to cancel the relocation procedure by the source RNC by means of RANAP message.

The optional Private Extension contains vendor or operator specific information.

Table 35: Information elements in a Relocation Cancel Request

Information element	Presence requirement	Reference
IMSI	Mandatory	7.9.2
Private Extension	Optional	7.9.25

7.5.10 Relocation Cancel Response

The Relocation Cancel Response message is sent from the new SGSN to the old SGSN when the relocation procedure has been cancelled in the new SGSN. This message is used as the response to the Relocation Cancel Request message.

Possible Cause values is:

- 'Request Accepted'

The optional Private Extension contains vendor or operator specific information.

Table 36: Information elements in a Relocation Cancel Response

Information element	Presence requirement	Reference
Cause	Mandatory	7.9.1
Private Extension	Optional	7.9.25

~~7.8 Reliable delivery of signalling messages~~

7.6 Reliable delivery of signalling messages

Each path maintains a queue with signalling messages to be sent to the peer. The message at the front of the queue shall be sent with a Sequence Number, and shall be held in a path list until a response is received. Each path has its own list. The Sequence Number shall be unique for each outstanding message in a single path list. A GSN may have several outstanding requests while waiting for responses.

The T3-RESPONSE timer shall be started when a signalling request message is sent. A signalling message request or response has probably been lost if a response has not been received before the T3-RESPONSE timer expires. The request is then retransmitted if the total number of request attempts is less than N3-REQUESTS times. The timer shall be implemented in the signalling application. The wait time for a response (T3-RESPONSE timer value) and the number of retries (N3-REQUESTS) shall be configurable per procedure. The total wait time shall be shorter than the MS wait time between retries of Attach and RA Update messages.

All received request messages shall be responded to and all response messages associated with a certain request shall always include the same information. Duplicated response messages shall be discarded. A response message without a matching outstanding request should be considered as a duplicate.

If a GSN is not successful with the transfer of a signalling message, e.g. a Create PDP Context Request message, it shall inform the upper layer of the unsuccessful transfer so that the controlling upper entity may take the necessary measures.

~~7.9 Information elements~~

7.7 Information elements

A signalling message may contain several information elements. The TLV (Type, Length, Value) or TV (Type, Value) encoding format shall be used for the GTP information elements. The information elements shall be sorted, with the Type fields in ascending order, in the signalling messages. The Length field contains the length of the information element excluding the Type and Length field.

For all the length fields, bit 8 of the lowest numbered octet is the most significant bit and bit 1 of the highest numbered octet is the least significant bit.

Within information elements, certain fields may be described as spare. These bits shall be transmitted with the value defined for them. To allow for future features, the receiver shall not evaluate these bits.

The most significant bit in the Type field is set to 0 when the TV format is used and set to 1 for the TLV format.

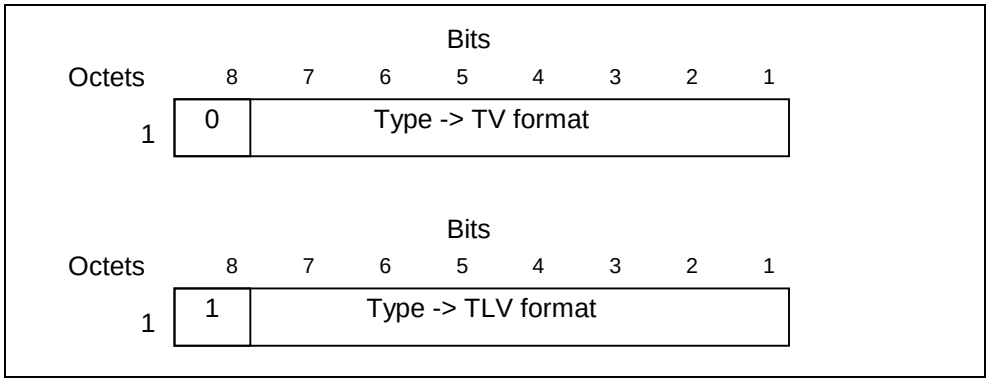


Figure 8: Type field for TV and TLV format

NOTE: Type value 7 (Decimal) is currently not used.

The following TLV Information Element type number ranges are reserved for GPRS charging protocol use (see GTP' in GSM 12.15): 239-250; 252-254.

The following TV Information Element type number range is reserved for GPRS charging protocol use (see GTP' in GSM 12.15): 117-127.

~~7.9.1 Cause~~

7.7.1 Cause

In a request, the Cause Value indicates the reason for the request. The Cause shall be included in the request message.

In a response, the Cause Value indicates the acceptance or the rejection of the corresponding request. In addition, the Cause Value may indicate what was the reason for the corresponding request. The Cause value shall be included in the response message.

'Request accepted' is returned when a GSN has accepted a signalling request.

'Non-existent' indicates a non-existent or an inactive PDP context.

'IMSI not known' indicates a non-existent MM context.

'MS is GPRS Detached' indicates an idle MM context.

'MS is not GPRS Responding' and 'MS Refuses' may be used by SGSN to reject a Network-Requested PDP Context Activation.

'Version not supported' is returned when the recipient does not recognise the version number in the request message.

'Request IMSI', 'Request IMEI', 'Request IMSI and IMEI' and 'No identity needed' are used by GGSN to notify SGSN what to do.

'No resources available' is a generic temporary error condition e.g. all dynamic PDP addresses occupied or no memory available.

'Service not supported' is a generic error indicated that the GSN do not support the requested service.

'User authentication failed' indicates that the external packet network has rejected the user's service request.

'System failure' is a generic permanent error condition.

'Roaming restriction' indicates that the SGSN cannot activate the requested PDP context because of the roaming restrictions.

'P-TMSI Signature mismatch' is returned either if the P-TMSI Signature stored in the old SGSN does not match the value sent by the MS via the new SGSN or if the MS does not provide the P-TMSI Signature to the new SGSN while the old SGSN has stored the P-TMSI Signature for that MS.

'Invalid message format', 'Mandatory IE incorrect', 'Mandatory IE missing' and 'Optional IE incorrect' are indications of protocol errors described in the section Error handling.

'GPRS connection suspended' indicates that the GPRS activities of the mobile station are suspended.

'Authentication failure' indicates that the user authentication failed in the new SGSN.

'Context not found' indicates that the PDP Context referenced in an Active Secondary Context Request message was not found in the receiving GGSN.

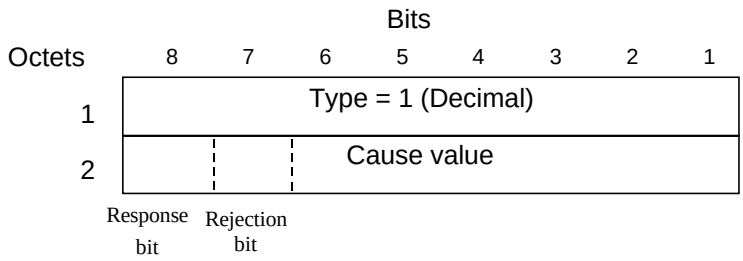


Figure 9: Cause information element

Table 37: Cause values

Cause			Value (Decimal)
Request		Request IMSI	0
		Request IMEI	1
		Request IMSI and IMEI	2
		No identity needed	3
		MS Refuses	4
		MS is not GPRS Responding	5
		For future use	6-48
		Cause values reserved for GPRS charging protocol use (see GTP' in GSM 12.15)	49-63
For future use			64-127
Response	acc	Request accepted	128
		For future use	129-176
		Cause values reserved for GPRS charging protocol use (see GTP' in GSM 12.15)	177-191
	rej	Non-existent	192
		Invalid message format	193
		IMSI not known	194
		MS is GPRS Detached	195
		MS is not GPRS Responding	196
		MS Refuses	197
		Version not supported	198
		No resources available	199
		Service not supported	200
		Mandatory IE incorrect	201
		Mandatory IE missing	202
		Optional IE incorrect	203
		System failure	204
		Roaming restriction	205
		P-TMSI Signature mismatch	206
		GPRS connection suspended	207
		Authentication failure	208
		User authentication failed	209
		Context not found	210
		All dynamic PDP addresses are occupied	211
		No memory is available	212
		For future use	213~~10~~-240
		Cause values reserved for GPRS charging protocol use (see GTP' in GSM 12.15)	241-255

NOTE: With this coding, bits 8 and 7 of the Cause Value respectively indicate whether the message was a request or a response, and whether the request was accepted or rejected.

Table 38: Use of the Cause values

Cause 8	value bits 7	Result
0	0	Request
0	1	For future use (Note)
1	0	Acceptance
1	1	Rejection

NOTE: The value '01' is for future use and shall not be sent. If received in a response, it shall be treated as a rejection.

~~7.9.2 International Mobile Subscriber Identity (IMSI)~~

7.7.2 International Mobile Subscriber Identity (IMSI)

The IMSI shall be the subscriber identity of the MS.

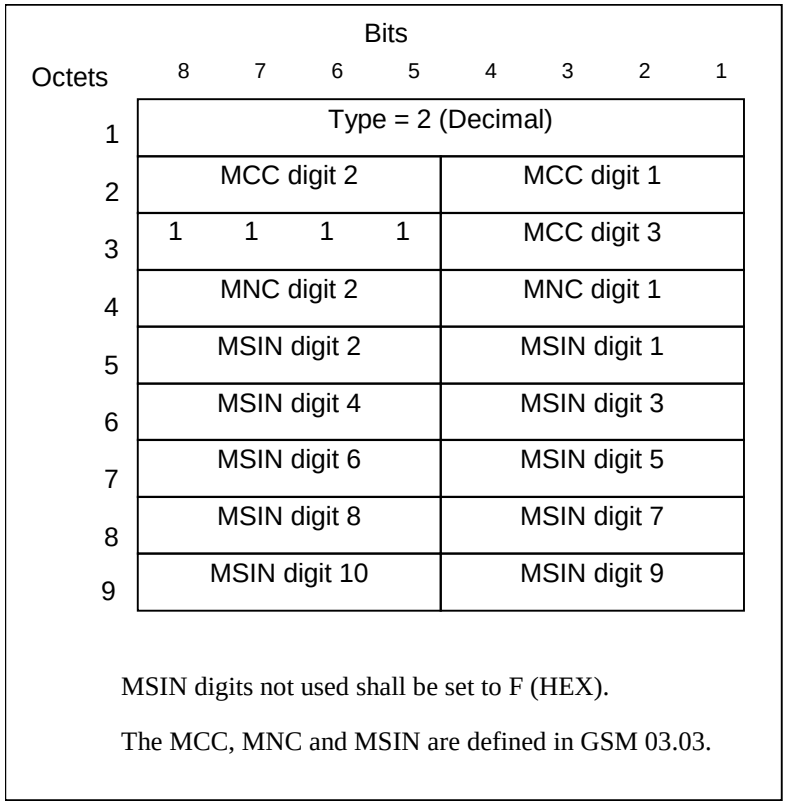


Figure 10: IMSI information element

~~7.9.3 Routeing Area Identity (RAI)~~

7.7.3 Routeing Area Identity (RAI)

The RAI information element is given by:

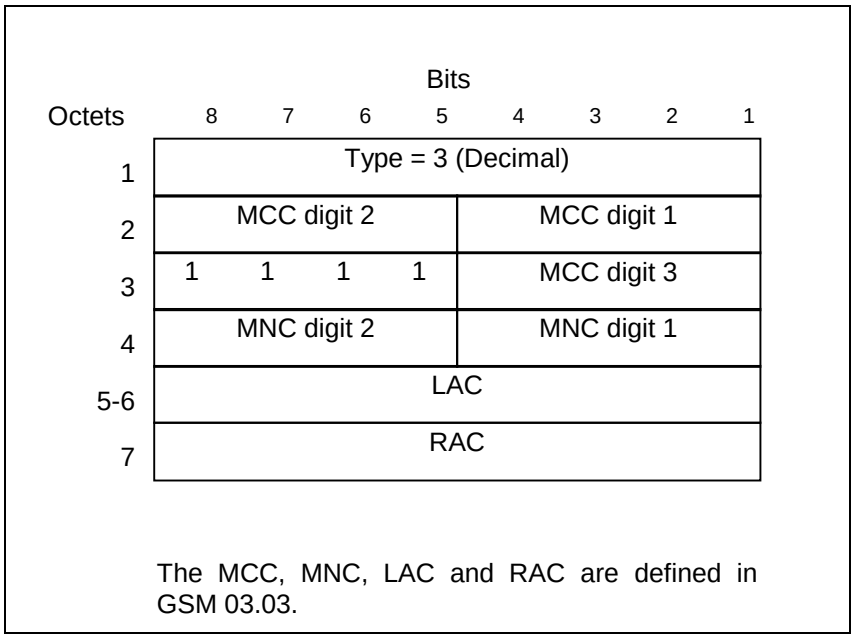


Figure 11: RAI information element

~~7.9.4 Temporary Logical Link Identity (TLLI)~~

7.7.4 Temporary Logical Link Identity (TLLI)

The information element of the TLLI associated with a given MS and routeing area is given by:

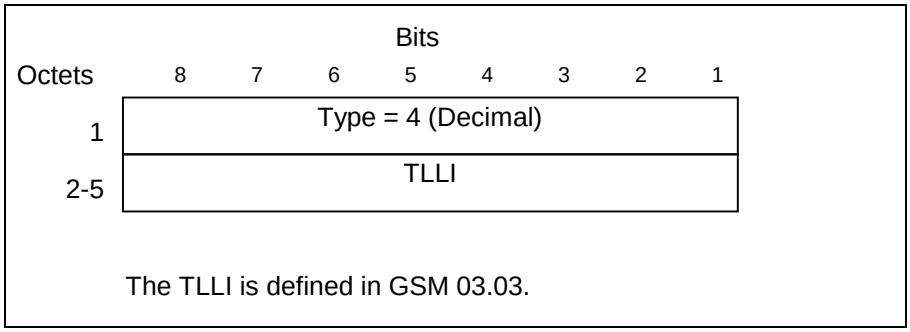


Figure 12: TLLI information element

~~7.9.5 Packet TMSI (P-TMSI)~~

7.7.5 Packet TMSI (P-TMSI)

The Packet TMSI, unambiguously associated with a given MS and routeing area, is given by:

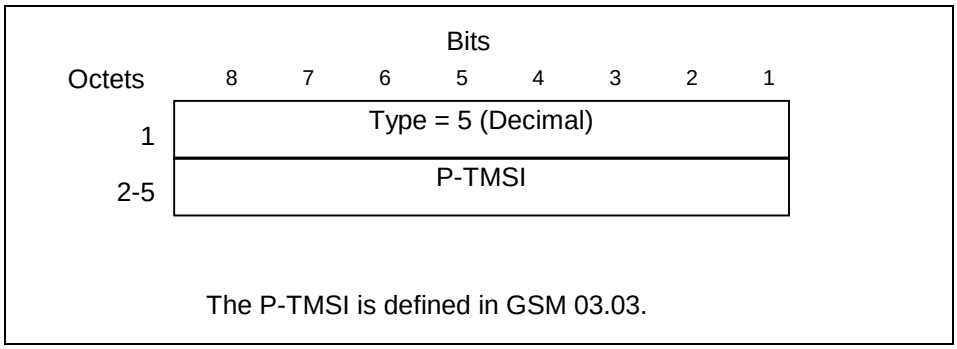


Figure 13: The Packet TMSI information element

~~7.9.6 Quality of Service (QoS) Profile~~

7.7.6 Quality of Service (QoS) Profile

The Quality of Service (QoS) Profile shall include the values of the defined QoS parameters. The content and the coding of the QoS Profile is defined in GSM 04.08.

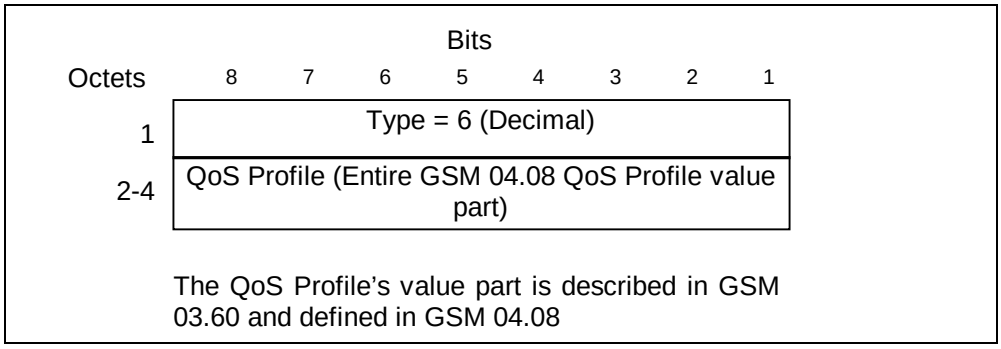


Figure 14: Quality of Service (QoS) Profile information element

~~7.9.7 Reordering Required~~

7.7.7 Reordering Required

The Reordering Required information element states whether reordering by GTP is required or not.

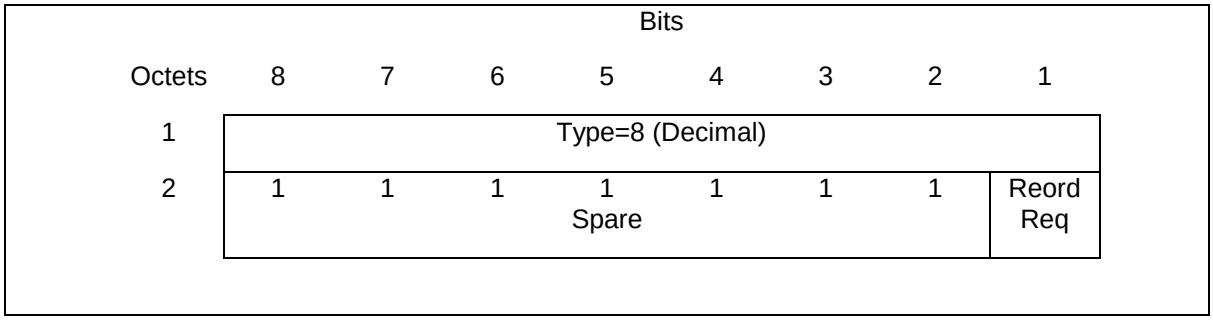


Figure 15: Reordering Required information element

Table 39: Reordering Required values

Reordering required	Value (Decimal)
No	0
Yes	1

~~7.9.8 Authentication Triplet~~

7.7.8 Authentication Triplet

An Authentication triplet consists of a random string (RAND), a signed response (SRES) and a ciphering key (Kc) (see GSM 03.20).

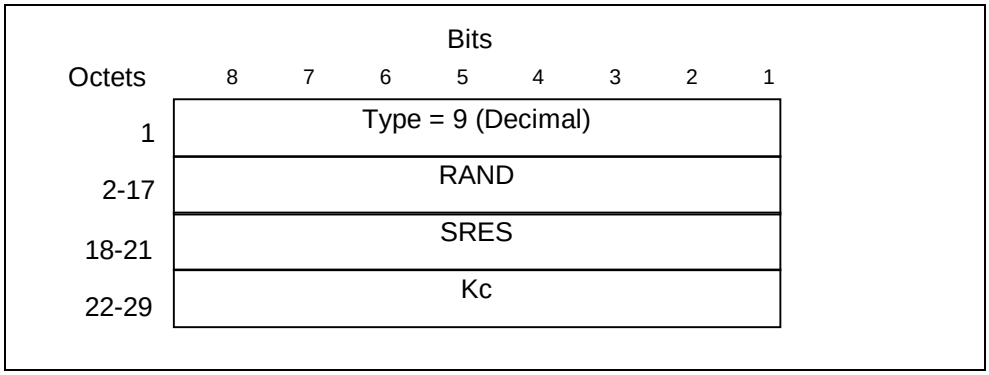


Figure 16: Authentication Triplet information element

~~7.9.9 MAP Cause~~

7.7.9 MAP Cause

The MAP Cause is a value that the GTP-MAP protocol-converting GSN relays transparently from HLR to the GGSN. The possible MAP Cause values for the appropriate messages are described in GSM 09.02.

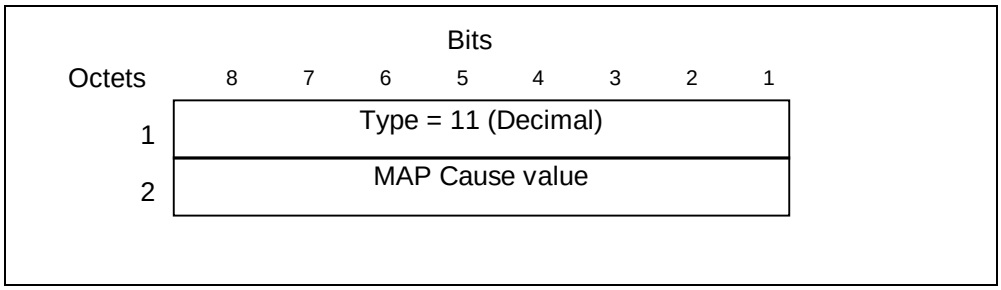


Figure 17: MAP Cause information element

~~7.9.10 P-TMSI Signature~~

7.7.10 P-TMSI Signature

The P-TMSI Signature information element is provided by the MS in the Routing Area Update Request and Attach Request messages to the SGSN for identification checking purposes. The content and the coding of the P-TMSI Signature information element is defined in GSM 04.08.

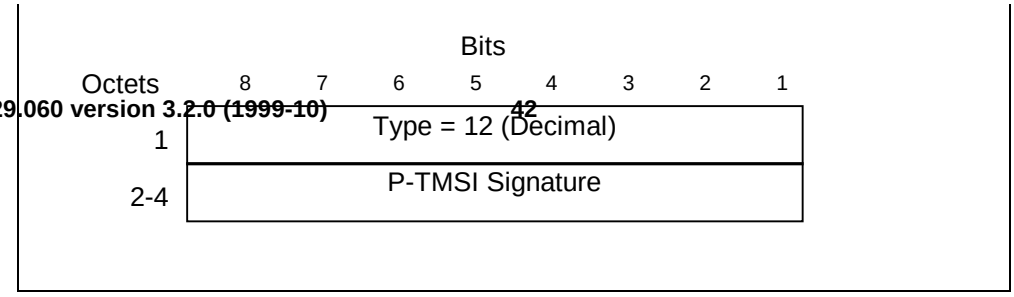


Figure 18: P-TMSI Signature information element

~~7.9.11 MS Validated~~

7.7.11 MS Validated

The MS Validated information element indicates whether the new SGSN has successfully authenticated the MS.

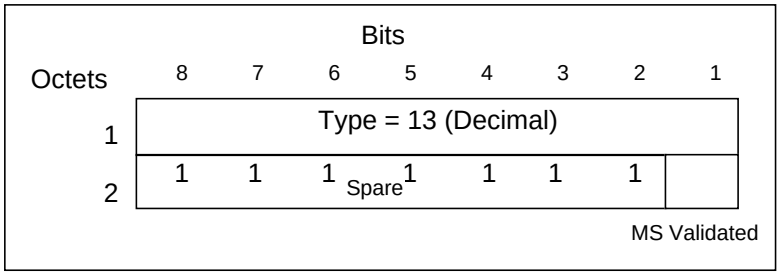


Figure 19: MS Validated information element

Table 40: MS Validated values

MS Validated	Value
No	0
Yes	1

~~7.9.12 Recovery~~

7.7.12 Recovery

The Recovery information element indicates if the peer GSN has restarted. The Restart Counter shall be the value described in the section Restoration and Recovery.

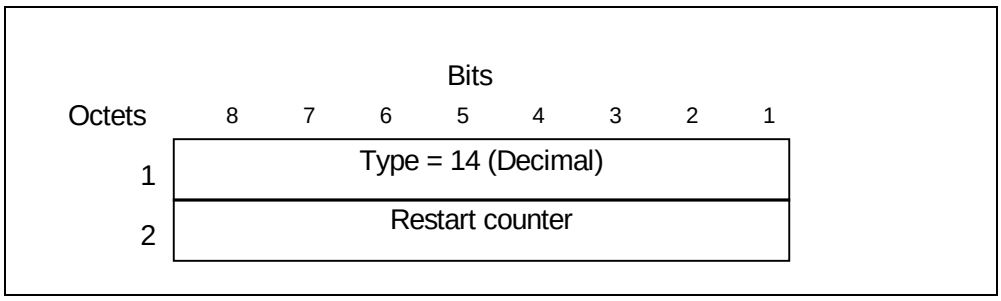


Figure 20: Restart counter information element

~~7.9.13 Selection mode~~

7.7.13 Selection mode

The Selection mode information element indicates the origin of the APN in the message.

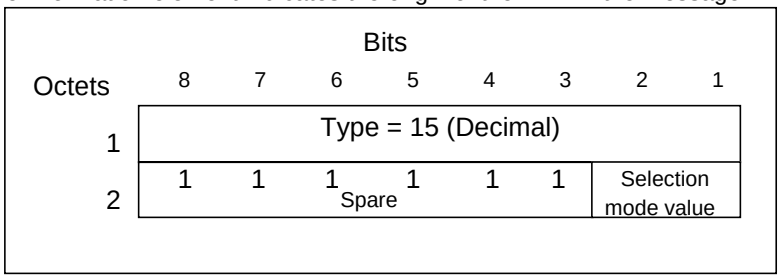


Figure 21: Selection mode information element

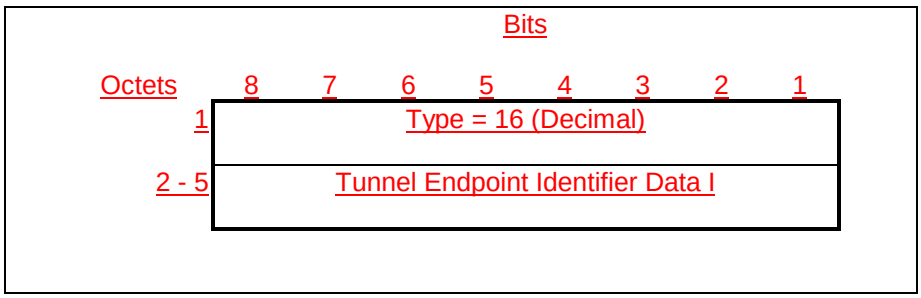
Table 41: Selection mode values

Selection mode value	Value **(Decimal)**
MS or network provided APN, subscribed verified	0
MS provided APN, subscription not verified	1
Network provided APN, subscription not verified	2
For future use. Shall not be sent. If received, shall be interpreted as the value '2'.	3

~~7.9.14 Flow Label Data I~~

7.7.14 Tunnel Endpoint Identifier Data I

The ~~Flow Label~~Tunnel Endpoint Identifier Data I information element contains the ~~Flow label~~Tunnel Endpoint Identifier for data transmission requested by the receiver of the flow.



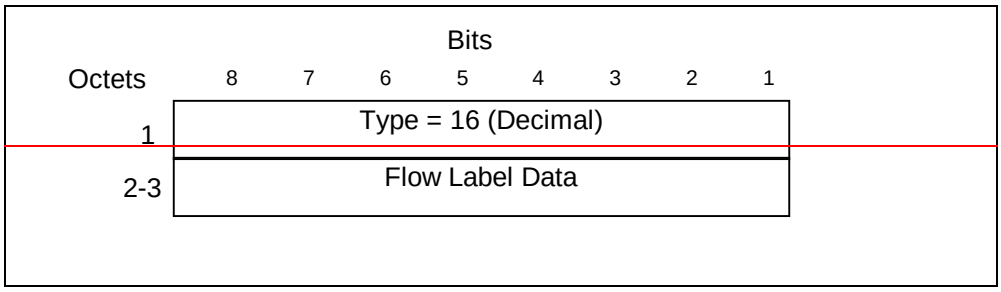
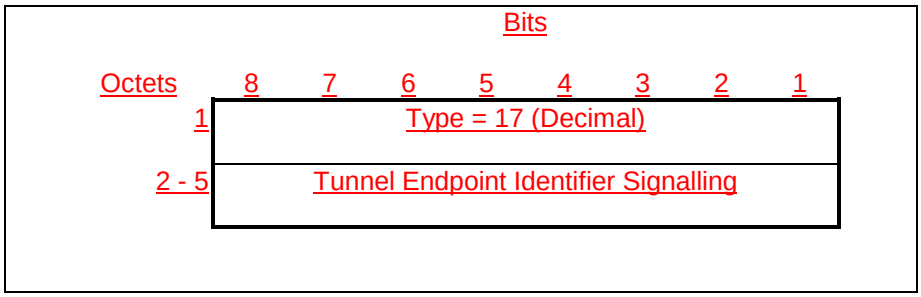


Figure 22: ~~Flow Label~~Tunnel Endpoint Identifier Data information element

~~7.9.15 Flow Label Signalling~~

7.7.15 Tunnel Endpoint Identifier Signalling

The ~~Flow Label~~Tunnel Endpoint Identifier Signalling information element contains the ~~Flow label~~Tunnel Endpoint Identifier for signalling requested by the receiver of the flow.



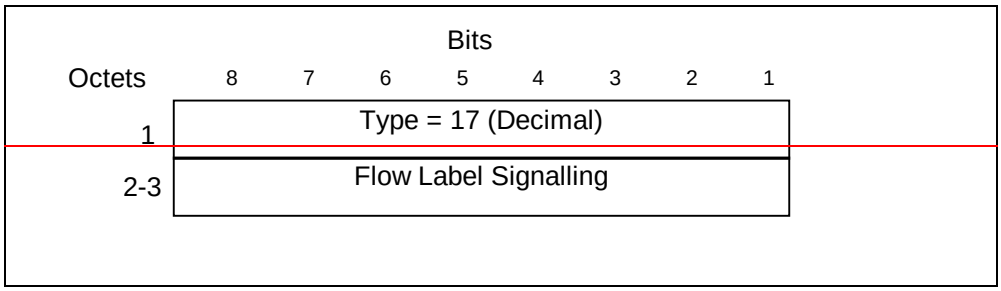


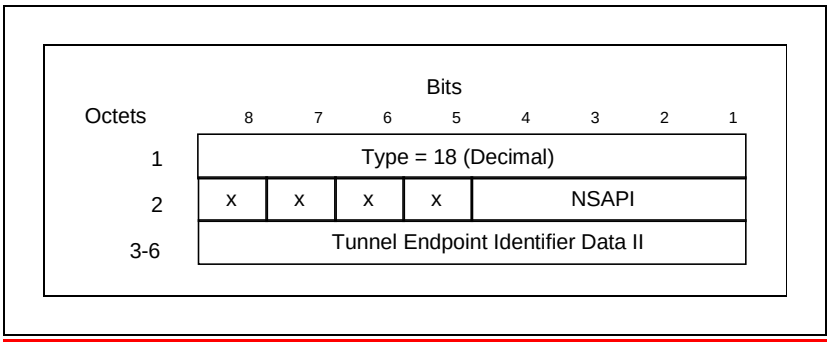
Figure 23: ~~Flow Label~~Tunnel Endpoint Identifier Signalling information element

~~7.9.16 Flow Label Data II~~

7.7.16 Tunnel Endpoint Identifier Data II

The ~~Flow Label~~Tunnel Endpoint Identifier Data II information element contains the ~~Flow label~~Tunnel Endpoint Identifier for data transmission between old and new SGSN for a particular PDP context and is requested by the new SGSN.

The spare bits x indicate unused bits which shall be set to 0 by the sending side and which shall not be evaluated by the receiving side.



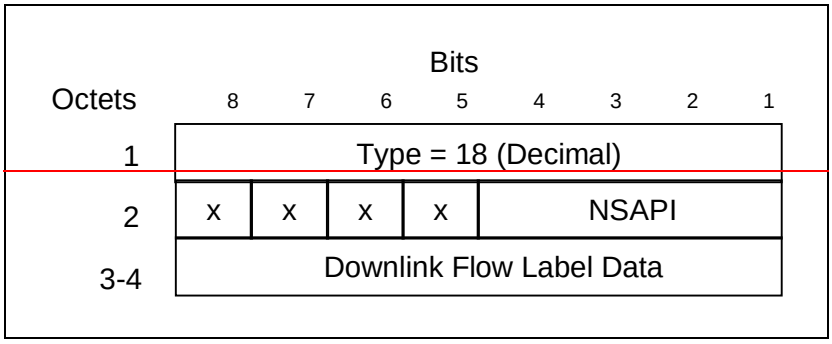


Figure 24: ~~Flow Label~~Tunnel Endpoint Identifier Data II information element

~~7.9.17 Charging ID~~

7.7.17 Charging ID

The Charging ID is a unique four octet value generated by the GGSN when a PDP context is activated. A Charging ID is generated for each activated context. The Charging ID value 0 is reserved and shall not be assigned by the GGSN.

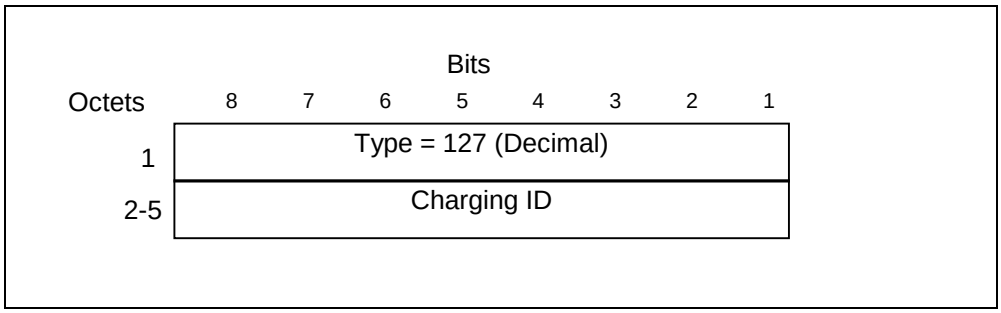


Figure 25: Charging ID information element

~~7.9.18 End User Address~~

7.7.18 End User Address

The purpose of the End User Address information element shall be to supply protocol specific information of the external packet data network accessed by the GPRS subscriber.

The Length field value shall be 2 in an End User Address information element with an empty PDP Address.

The PDP Type defines the end user protocol to be used between the external packet data network and the MS and is divided into an Organization field and a Number field.

The PDP Type Organization is the organization that is responsible for the PDP Type Number field and the PDP Address format.

For X.25 the PDP Type Organization is ETSI and the PDP Type Number is 0 . The PDP Address shall be in the X.121 format for X.25. For PPP the PDP Type Organization is ETSI and the PDP Type Number is 1 and there shall be no address in the End User Address IE. In this case the address is negotiated later as part of the PPP protocol. For OSP:IHOSS the PDP Type Organisation is ETSI and the PDP Type Number is 2 and there shall be no address in the End User Address IE~~. For OSP:IHOSS the PDP Type Organisation is ETSI and the PDP Type Number is 2 and there shall be no address in the End User Address IE.~~

If the PDP Type Organization is IETF, the PDP Type Number is a compressed number (i.e. the most significant HEX(00) is skipped) in the “Assigned PPP DLL Protocol Numbers” list in the most recent “Assigned Numbers” RFC (RFC 1700 or later). The most recent “Assigned PPP DLL Protocol Numbers” can also be found using the URL = ftp://ftp.isi.edu/in-notes/iana/assignments/ppp-numbers.

The PDP Address shall be the address that this PDP context of the MS is identified with from the external packet data network.

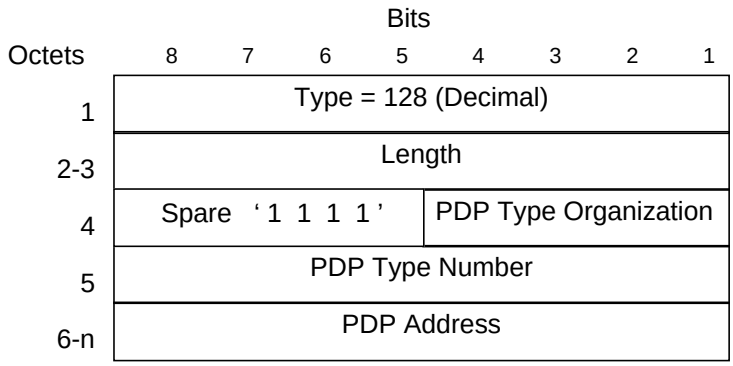


Figure 26: End User Address information element

Table 42: PDP Type Organization values

PDP Type Organization	Value (Decimal)
ETSI	0
IETF	1
All other values are reserved	

Table 43: ETSI defined PDP Type values

PDP Type Number	Value (Decimal)
X.25	0
PPP	1
OSP:IHOSS	2
All other values are reserved	

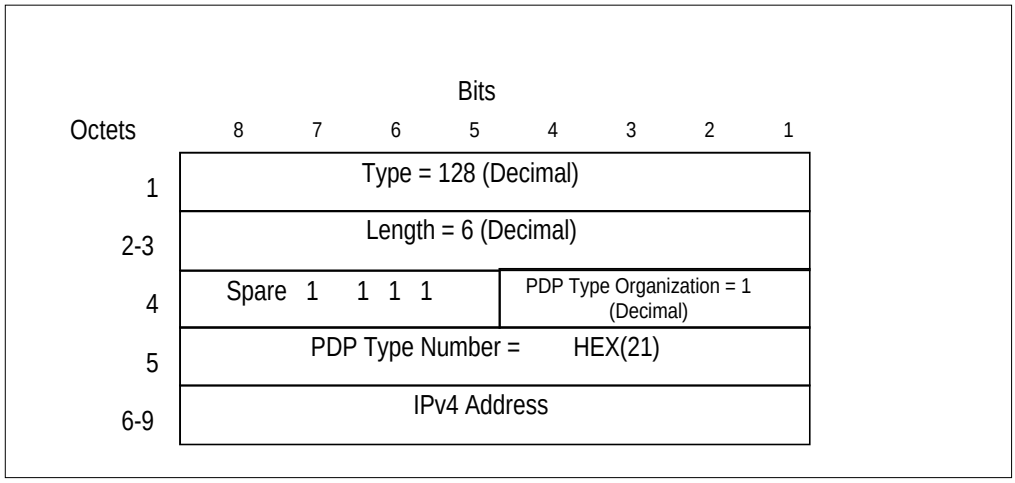


Figure 27: End User Address information element for IPv4

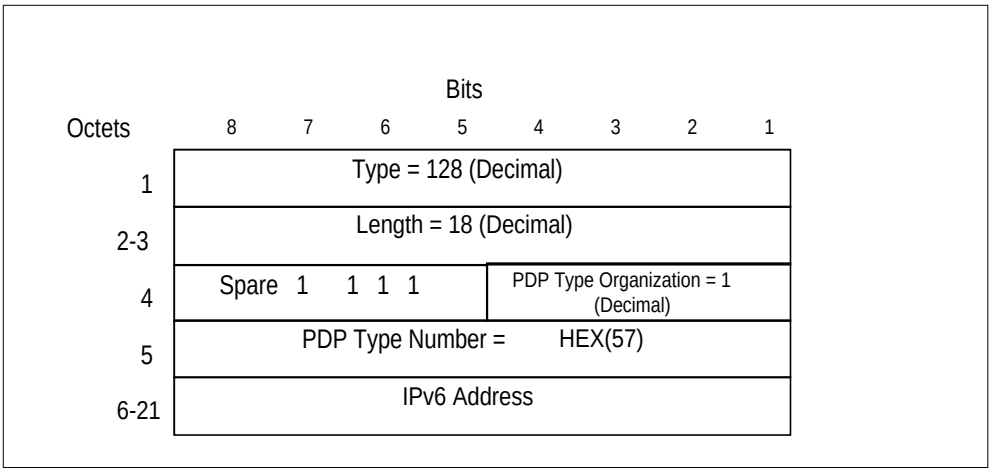
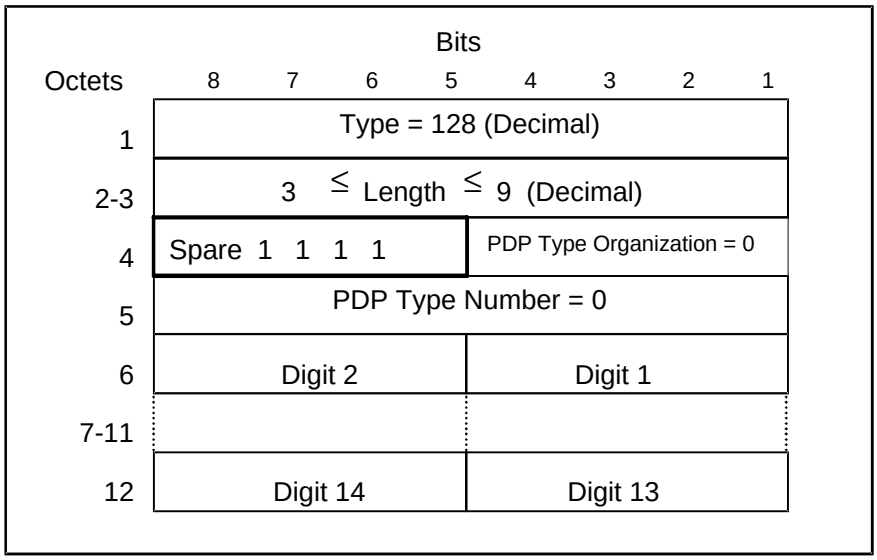


Figure 28: End User Address information element for IPv6



NOTE: Digit 1 contains the first BCD coded digit of the X.121 address. If the X.121 address has an odd number of digits, the last BCD digit shall be padded with HEX(F).

Figure 29: End User Address information element for X.25

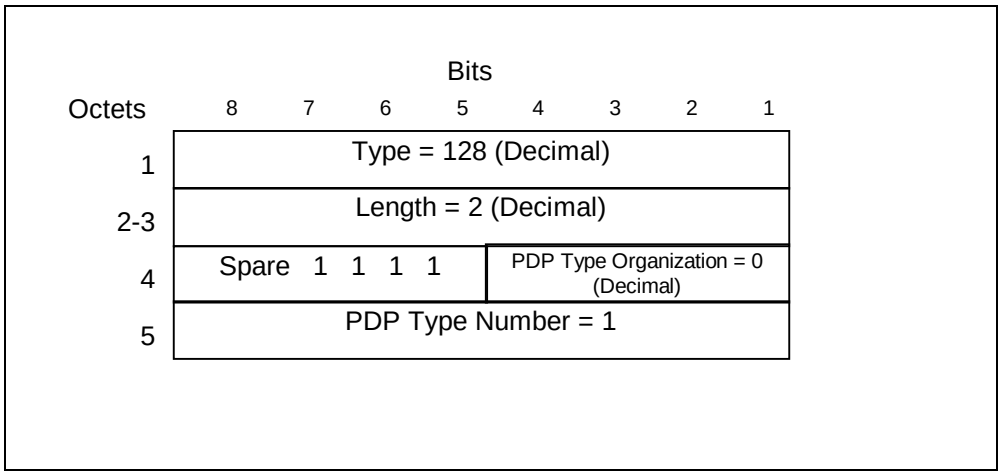


Figure 30: End User Address information element for PPP

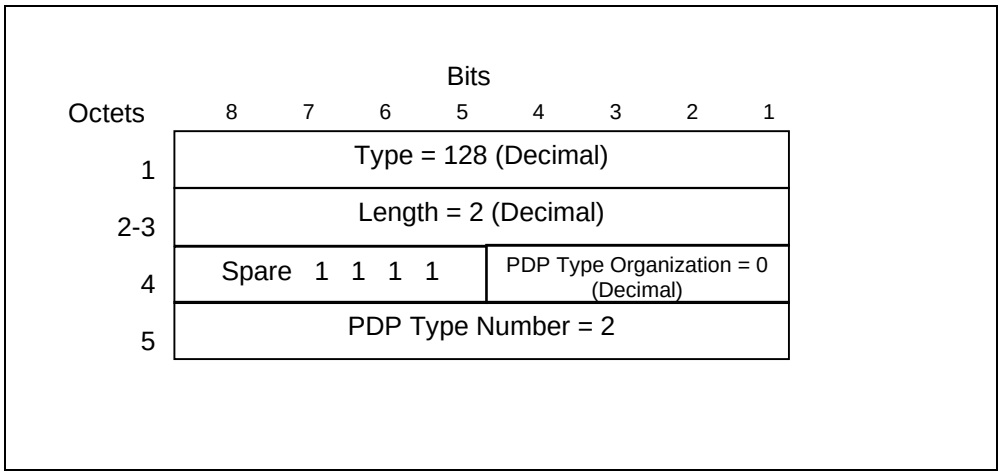


Figure 31: End User Address information element for OSP:IHOSS

~~7.9.19 MM Context~~

7.7.19 MM Context

The MM Context information element contains the Mobility Management, MS and security parameters that are necessary to transfer between SGSNs at the Inter SGSN Routeing Update procedure.

The Authentication Type indicates the Authentication mechanism that is the GSM or UMTS.

The Ciphering Key Sequence Number (CKSN) is described in GSM 04.08. Possible values are integers in the range [0; 6]. The value 7 is reserved. The Ciphering Key Sequence Number shall be presented if Authentication Type is GSM.

The Key Set Identifier (KSI) is described in UMTS 23.060. Possible values are integer in the range [0; 6]. The value 7 is reserved. The Key Set Identifier shall be presented if Authentication Type is UMTS.

The Used Cipher indicates the ciphering algorithm that is in use.

Kc is the ciphering key currently used by the old SGSN . Kc shall be presented if Authentication Type is GSM.

CK is the ciphering key currently used by the old SGSN. CK shall be presented if Authentication Type is UMTS.

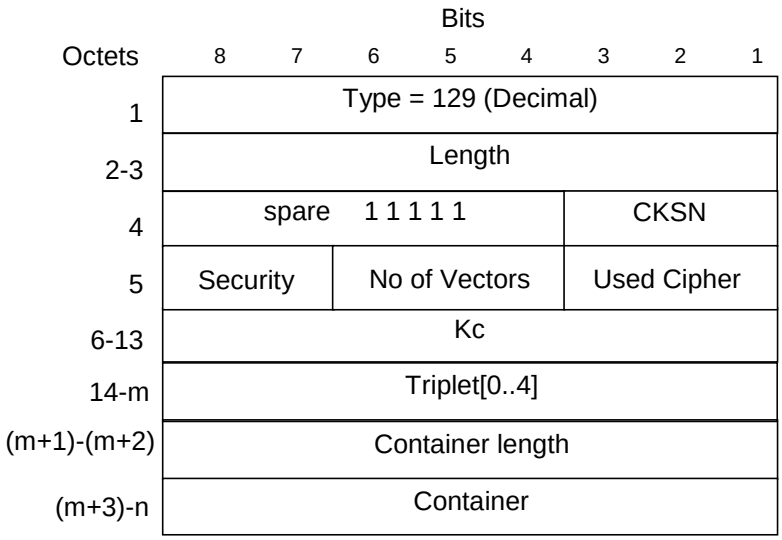
IK is the integrity key currently used by the old SGSN. IK shall be presented if Authentication Type is UMTS.

The Triplet array contains triplets encoded as the value in the Authentication Triplet information element The Triplet array shall be presented if Authentication Type is GSM.

The Quintuplet array contains Quintuplets encoded as the value in the Authentication Quintuplet information element. The Quintuplet shall be presented if Authentication Type is UMTS.

The two octet Container Length holds the length of the Container, excluding the Container Length octets.

The Container contains one or several optional information elements as described in the sub-clause ‘Overview’, from the clause ‘General message format and information elements coding’ in GSM 04.08.



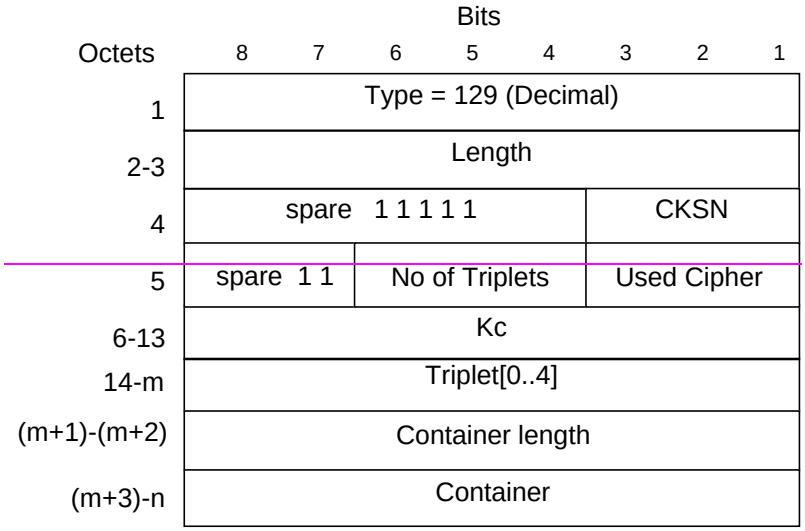


Figure 31: MM Context element in GSM

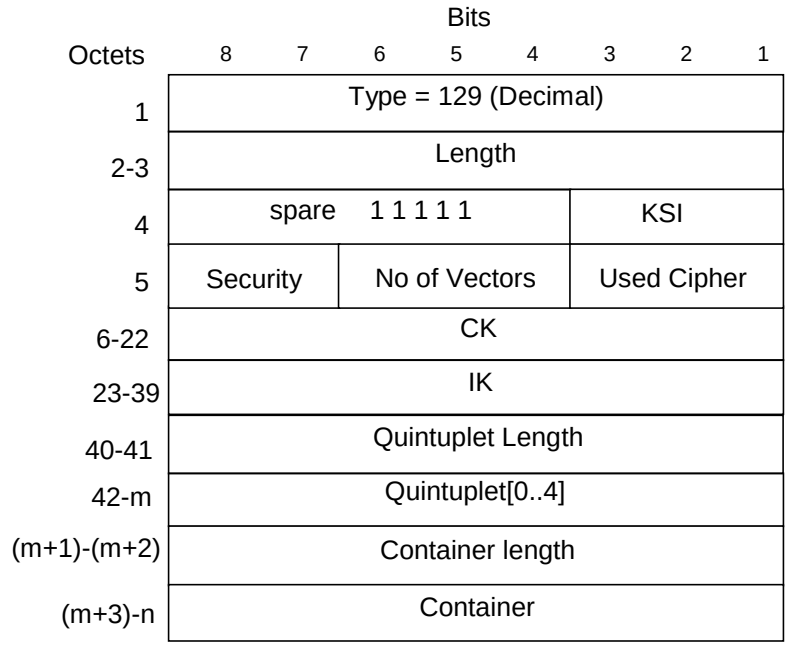


Figure XX: MM Context element in UMTS

Table 37: Used Cipher values

Cipher Algorithm	Value (Decimal)
No ciphering	0
GEA/1	1

Table XX: Security Type Values

Security Type	Value (Decimal)
GSM	3
UMTS	2

~~7.9.20 PDP Context~~

7.7.20 PDP Context

The PDP Context information element contains the Session Management parameters, defined for an external packet data network address, that are necessary to transfer between SGSNs at the Inter SGSN Routeing Area Update procedure.

NSAPI is an integer value in the range [0; 15].

The NSAPI points out the affected PDP context.

The SAPI indicates the LLC SAPI which is associated with the NSAPI.

Transaction Identifier is the 4 bit Transaction Identifier used in the GSM 04.08 Session Management messages which control this PDP Context.

Reordering Required (Order) indicates whether the SGSN shall reorder T-PDUs before delivering the T-PDUs to the MS.

VPLMN Address Allowed (VAA) indicates whether the MS is allowed to use the APN in the domain of the HPLMN only, or additionally the APN in the domain of the VPLMN.

Quality of Service Subscribed (QoS Sub), Quality of Service Requested (QoS Req) and Quality of Service Negotiated (QoS Neg) are encoded as described in section ‘Quality of Service (QoS) Profile’.

The Sequence Number Down is the number of the next T-PDU that shall be sent from the new SGSN to the MS. The number is associated to the Sequence Number from the GTP Header of an encapsulated T-PDU.

The Sequence Number Up is the number that new SGSN shall use as the Sequence Number in the GTP Header for the next encapsulated T-PDU from the MS to the GGSN.

The Send N-PDU Number is used only when acknowledged peer-to-peer LLC operation is used for the PDP context. The Send N-PDU Number is the N-PDU number to be assigned by SNDCP to the next downlink N-PDU received from the GGSN. It shall be set to 255 if unacknowledged peer-to-peer LLC operation is used for the PDP context.

The Receive N-PDU Number is used only when acknowledged peer-to-peer LLC operation is used for the PDP context. The Receive N-PDU Number is the N-PDU number expected by SNDCP from the next uplink N-PDU to be received from the MS. It shall be set to 255 if unacknowledged peer-to-peer LLC operation is used for the PDP context.

The Uplink ~~Flow Label~~Tunnel Endpoint Identifier Signalling is the ~~Flow Label~~Tunnel Endpoint Identifier used between the old SGSN and the GGSN in uplink direction for signalling purpose. It shall be used by the new SGSN within the GTP header of the Update PDP Context Request message.

The PDP Type Organization and PDP Type Number are encoded as in the End User Address information element.

The PDP Address Length represents the length of the PDP Address field, excluding the PDP Address Length octet.

The PDP Address is an octet array with a format dependent on the PDP Type. The PDP Address is encoded as in the End User Address information element if the PDP Type is IPv4, IPv6 or X.25.

The GGSN Address Length represents the length of the GGSN Address field, excluding the GGSN Address Length octet.

The old SGSN includes the GGSN Address for signalling that it has received from GGSN at PDP context activation or update.

The APN is the APN in use in the old SGSN. I.e. the APN sent in the Create PDP Context request message.

The spare bits x indicate unused bits which shall be set to 0 by the sending side and which shall not be evaluated by the receiving side.

1	Type = 130 (Decimal)				
2-3	Length				
4	Res-rved	AA	Res-rved	rder	NSAPI
5	X	X	X	X	SAPI
6-8	QoS Sub				
9-11	QoS Req				
12-14	QoS Neg				
15-16	Sequence Number Down (SND)				
17-18	Sequence Number Up (SNU)				
19	Send N-PDU Number				
20	Receive N-PDU Number				
21-2~~2~~4	Uplink ~~Flow Label~~Tunnel Endpoint Identifier Signalling				
2~~3~~5	Spare 1 1 1 1				PDP Type Organization
2~~4~~6	PDP Type Number				
2~~5~~7	PDP Address Length				
2~~6~~8-m	PDP Address [1..63]				
m+1	GGSN Address for signalling Length				
(m+2)-n	GGSN Address for signalling [4..16]				
n+1	APN length				
(n+2)-o	APN				
o+1	Spare (sent as 0 0 0 0)				Transaction Identifier

Figure 33: PDP Context information element

Table 45: Reordering Required values

Reordering Required	Value (Decimal)
No	0
Yes	1

Table 46: VPLMN Address Allowed values

VPLMN Address Allowed	Value (Decimal)
No	0
Yes	1

~~7.9.21 Access Point Name~~

7.7.21 Access Point Name

The Access Point Name is information from the MS or SGSN , that may be used by the GGSN to differentiate between accesses to different external packet data networks using the same PDP Type.

The Access Point Name contains a logical name which is the APN Network Identifier (see GSM 03.60). It is coded as in the value part defined in GSM 04.08 (i.e. the GSM 04.08 IEI and GSM 04.08 octet length indicator are not included).

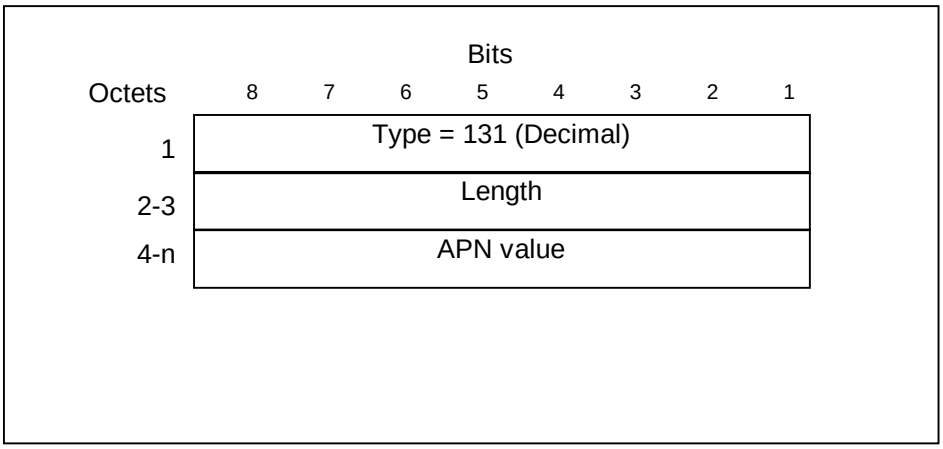


Figure 34: Access Point Name information element

~~7.9.22 Protocol Configuration Options~~

7.7.22 Protocol Configuration Options

The Protocol Configuration Options contains external network protocol options that may be necessary to transfer between the GGSN and the MS. The content and the coding of the Protocol Configuration is defined in octet 3-z of the Protocol Configuration Options in GSM 04.08.

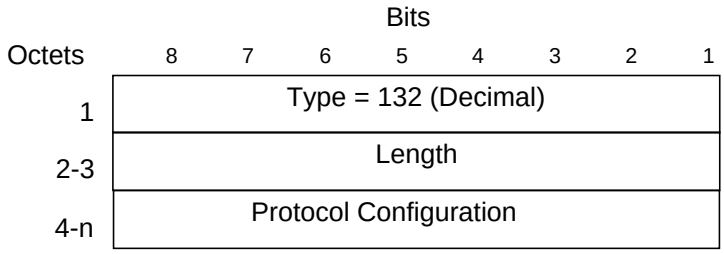


Figure 35: Protocol Configuration Options information element

~~7.9.23 GSN Address~~

7.7.23 GSN Address

The GSN Address information element contains the address of a GSN as defined in GSM 03.03. The Address Type and Address Length fields from 03.03 are not included in the GSN Address field.

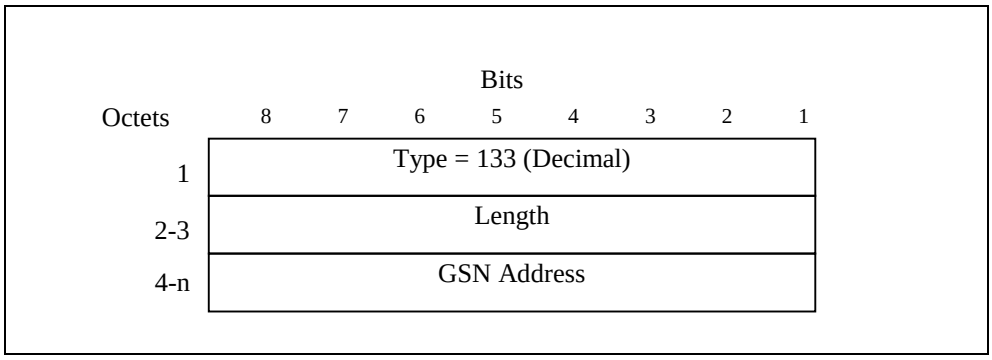


Figure 36: GSN Address information element

~~7.9.24 MS International PSTN/ISDN Number (MSISDN)~~

7.7.24 MS International PSTN/ISDN Number (MSISDN)

The MS international ISDN numbers are allocated from the CCITT Recommendation E.164 numbering plan, see GSM 03.03. The MSISDN is coded according to the contents of ISDN-AddressString data type defined in 3G TS 29.002. The MSISDN shall be in international format and the "nature of address indicator" shall indicate "international number".

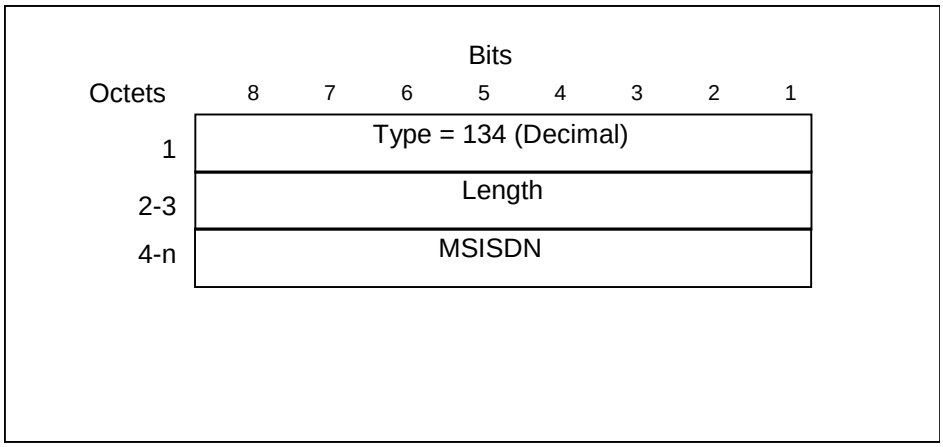


Figure 37: MSISDN information element

~~7.9.25 Charging Gateway Address~~

7.7.25 Charging Gateway Address

The Charging Gateway Address information element contains an IP address of a Charging Gateway.

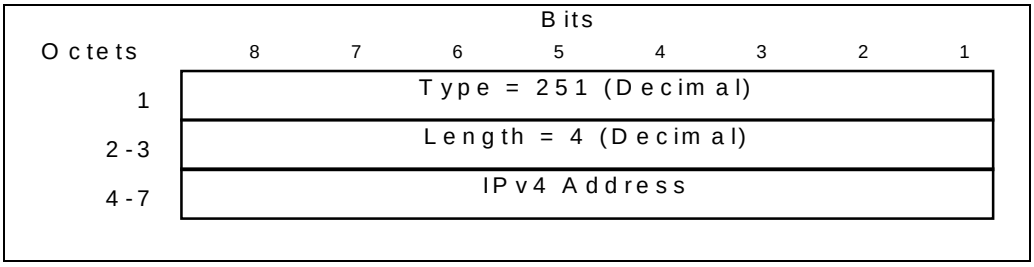


Figure 38: Charging Gateway Address information element

~~7.9.26 Private Extension~~

7.7.26 Private Extension

The Private Extension information element contains vendor specific information. The Extension Identifier is a value defined in the Private Enterprise number list in the most recent "Assigned Numbers" RFC (RFC 1700 or later).

This is an optional information element that may be included in any signalling message. A signalling message may include more than one information element of the Private Extension type.

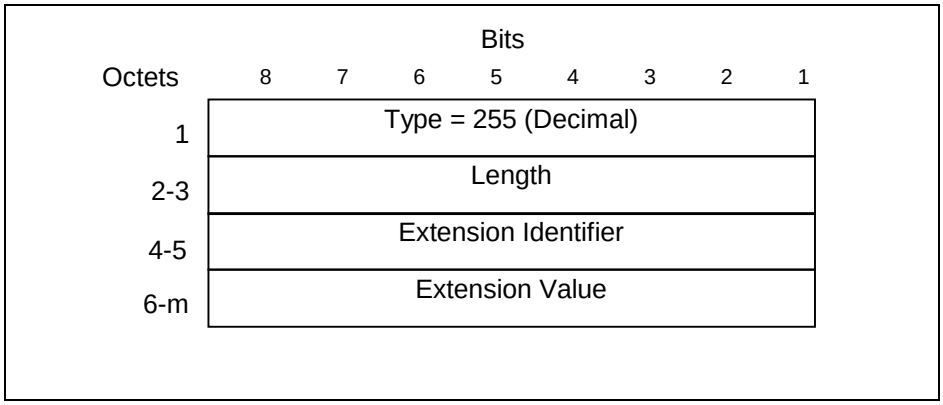


Figure39: Private Extension information element

7.7.27 Authentication Quintuplet

An Authentication Quintuplet consists of a Random challenge (RAND), an Expected user response (XRES), a Cipher key (CK), an Integrity key (IK), an Authentication token (AUTN) (see UMTS TS 33.102).

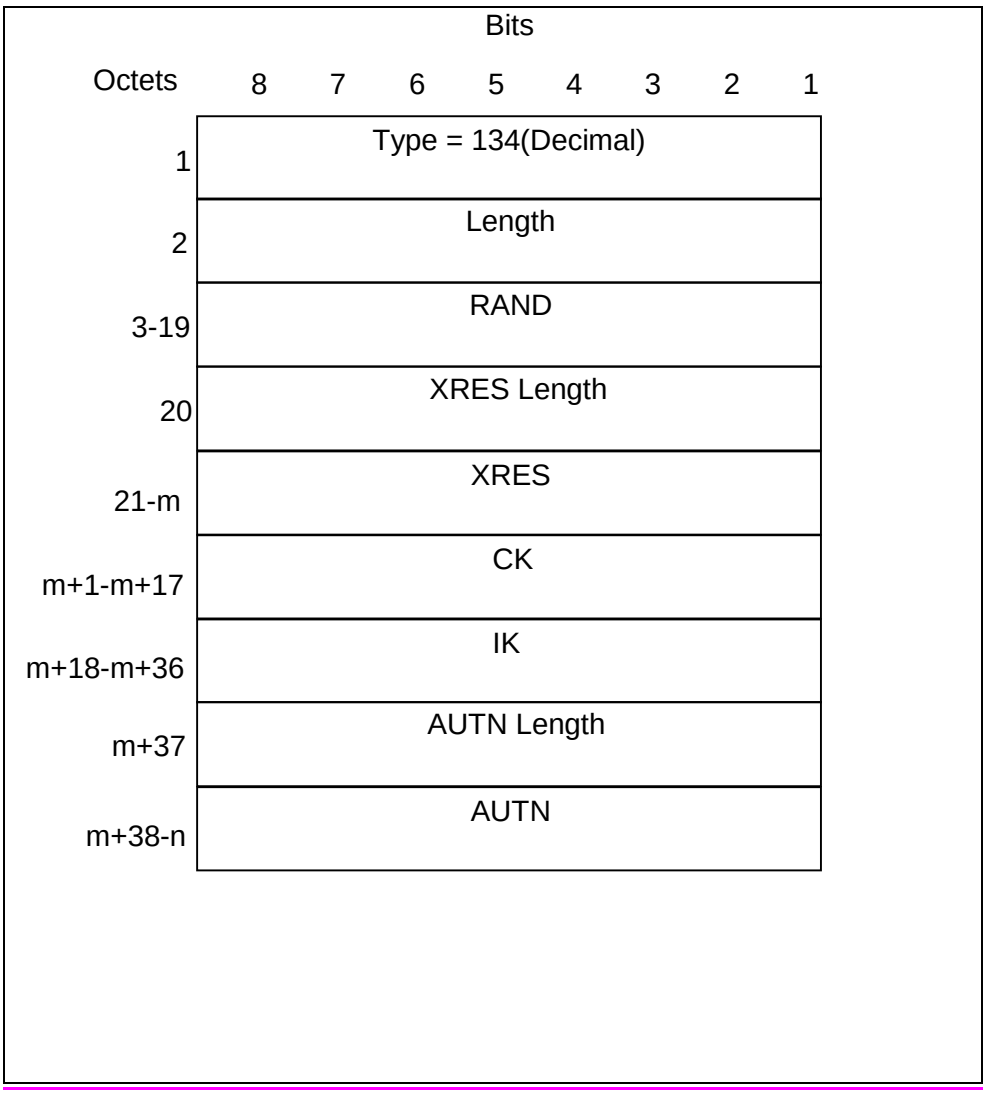


Figure 40: Authentication Quintuplet information element

~~This IE is FFS~~.

7.7.2~~8~~7 Traffic Flow Template (TFT)

The Traffic Flow Template (TFT) is used to distinguish between different user traffic flows.
The content and the coding of the TFT is defined in GSM 04.08.

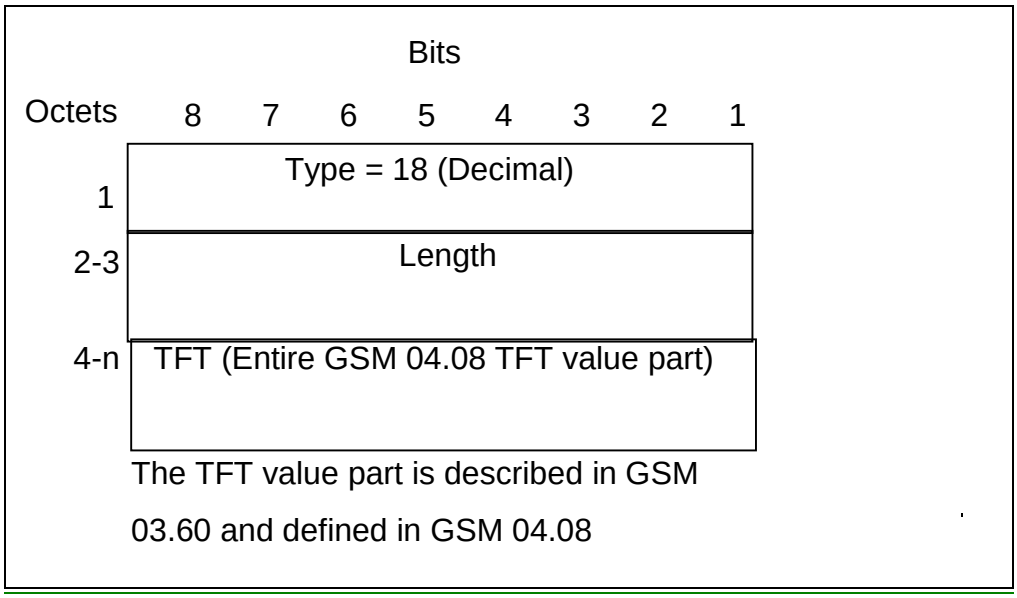


Figure 40X: Traffic Flow Template information element

7.7.298 Teardown Ind

The Teardown Ind information element, when included in the Delete PDP Context Request, indicate that the message applies to all PDP contexts that share the same PDP address.

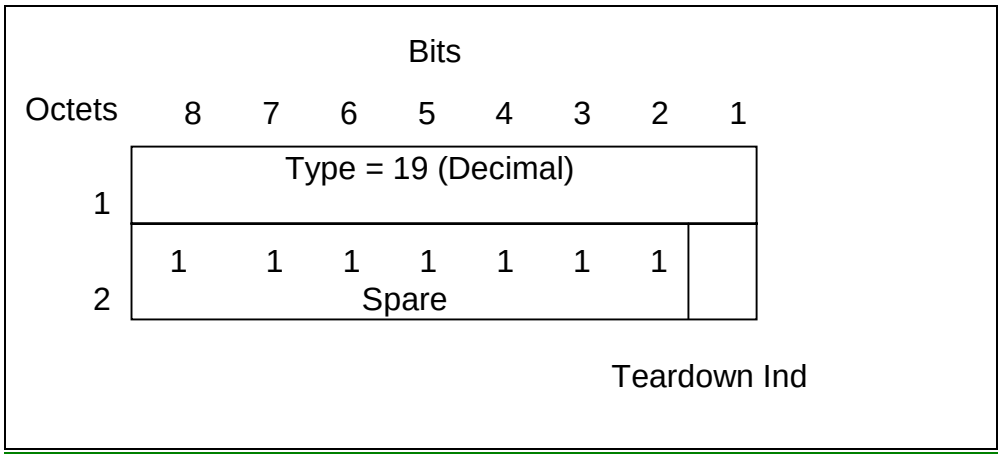


Figure 41X: Teardown Ind information element

Table 47X: Teardown Ind

Teardown Ind	Value
No	0
Yes	1

7.7.3029 NSAPI

The NSAPI information element contains an NSAPI identifying a PDP Context in a mobility management context specified by the Tunnel Endpoint Identifier Signalling.

The spare bits x indicate unused bits, which shall be set to 0 by the sending side, and the sending side shall not evaluate them.

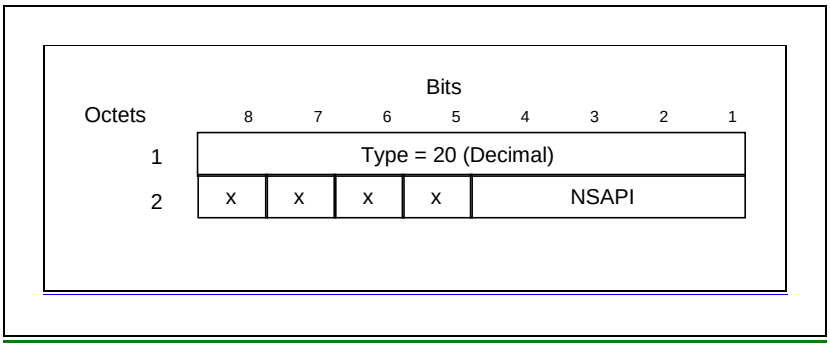


Figure 42X: NSAPI information element

7.7.31 Target Identification

The Target Identification information element contains the identification of a target RNC as defined in TS 25.413

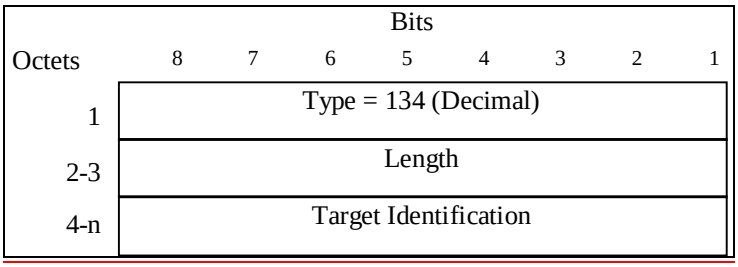


Figure 43: Target Identification information element

7.7.32 UTRAN transparent container

The UTRAN transparent container information element contains the radio-related information. The contents of this informatin element are only used by RNC so that GSN does not refer the contents.

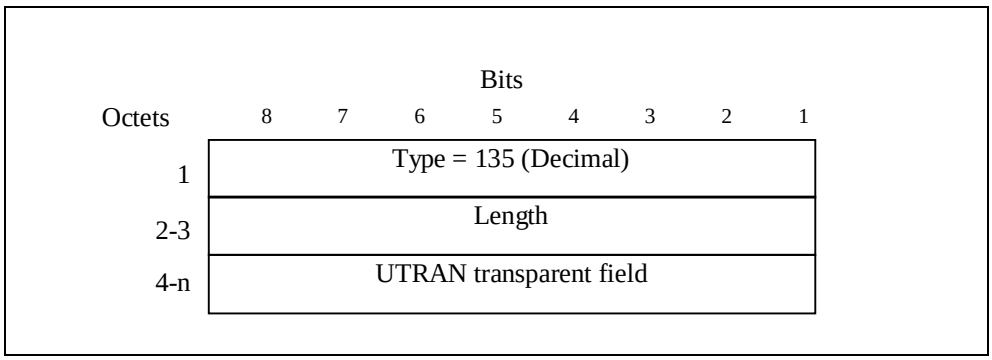


Figure 44: UTRAN transparent container information element

7.7.33 RANAP Cause

The RANAP Cause information element contains the cause as defined in TS 25.413.

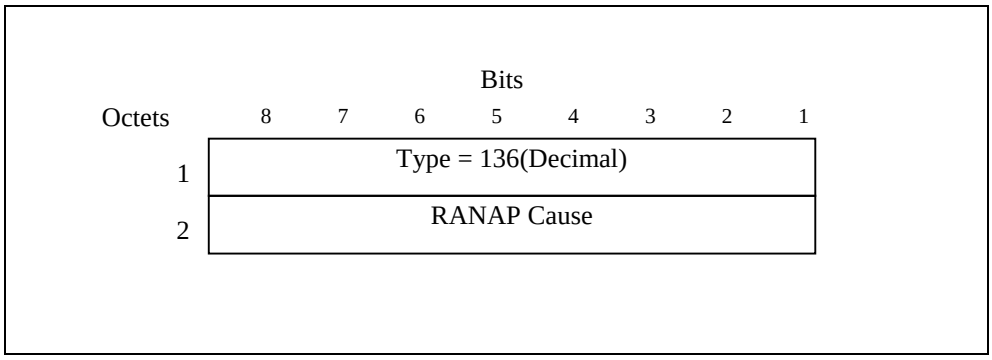


Figure 45: RANAP Cause information element

7.7.34 Target RNC Information

The Target RNC Information information element contains the RNC Tunnel Endpoint Identifier and RNC IP address for data transmission from source RNC to target RNC.

The spare bits x indicate unused bits, which shall be set to 0 by the sending side and which shall not be evaluated by the receiving side.

The format of the RNC IP address is the same as the GSN address as defined in TS 23.003.

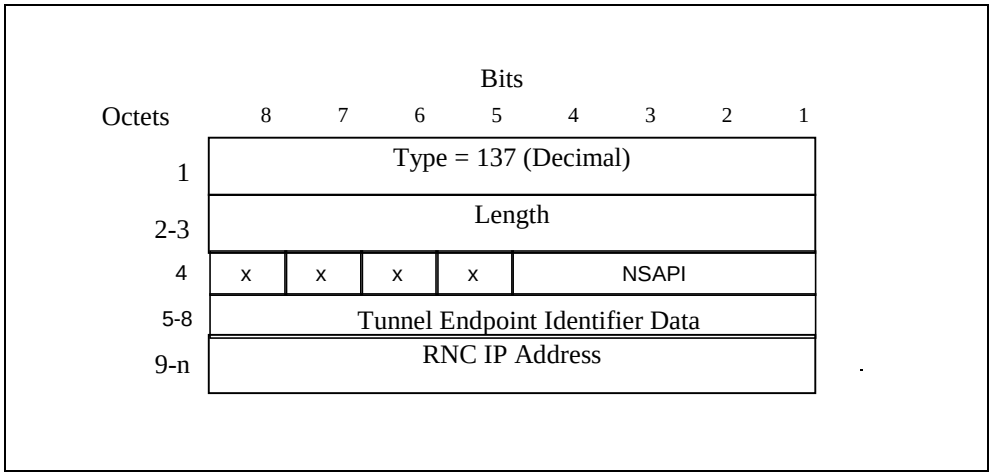


Figure 46: Target RNC Information information element

~~35~~

8 Signalling Plane (GTP-C)

The signalling plane in this case relates to GPRS Mobility Management functions like for example GPRS Attach, GPRS Routeing Area Update and Activation of PDP Contexts. The signalling between GSN nodes shall be performed by the GPRS Tunnelling Protocol (GTP).

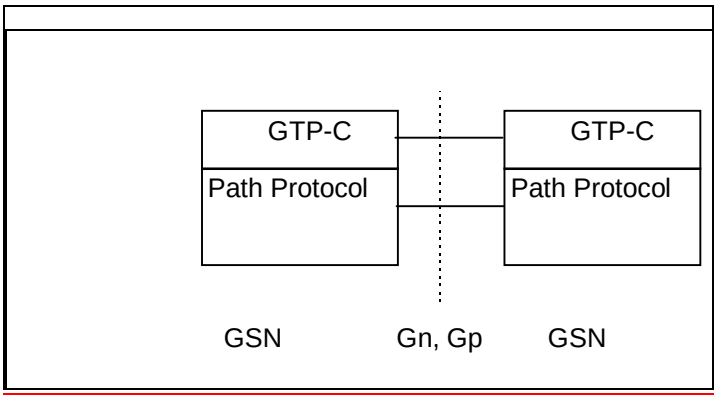


Figure 47: Signalling Plane - Protocol stack

8.1 Signalling protocol

The GTP signalling flow shall be logically associated with, but separate from, the GTP tunnels. For each GSN-GSN pair one or more paths exist. One or more tunnels may use each path. GTP shall be the means by which tunnels are established, used, managed and released. A path may be maintained by keep-alive echo messages. This ensures that a connectivity failure between GSNs can be detected in a timely manner.

8.2 Usage of the GTP Header

For signalling messages the GTP header shall be used as follows:

- Version shall be set to decimal 1 (‘001’).
- Payload Type (PT) shall be set to ‘0’.
- (S) shall be set to ‘0’.
- SNN shall be set to ‘0’.- Message Type shall be set to the unique value that is used for each type of signalling message. Valid message types are marked with a x in the GTP-C column in Table 1.
- Length shall be the length, in octets, of the signalling message excluding the GTP header.
- The Tunnel Endpoint Identifier is set to the requested value and points out the mobility management context (e.g. the MS), except for the following cases:
    - The first Create PDP Context Request message sent to a specific GGSN shall have the Tunnel Endpoint Identifier set to all zeros, since this will be the message that establishes the tunnel in the signalling plane.
    - The Identification Request/Response messages where the Tunnel Endpoint Identifier shall be set to all zeros.
    - The SGSN Context Request message where the Tunnel Endpoint Identifier shall be set to all zeros.
    - The Version Not Supported message where the Tunnel Endpoint Identifier shall be set to all zeros.
- Sequence Number shall be a message number valid for a path or a tunnel. Within a given set of contiguous Sequence Numbers from 0 to 65535, a given Sequence Number shall, if used, unambiguously define a GTP signalling request message sent on the path or tunnel (see section Reliable delivery of signalling messages). The Sequence Number in a signalling response message shall be copied from the signalling request message that the GSN is replying to.
- SNDCP N-PDU Number shall not be present.

The GTP header may be followed by subsequent information elements dependent on the type of signalling message. Only one information element of each type is allowed in a single signalling message, except for the Authentication

Triplet, the PDP Context and the Tunnel Endpoint Identifier Data II information element where several occurrences of each type are allowed.

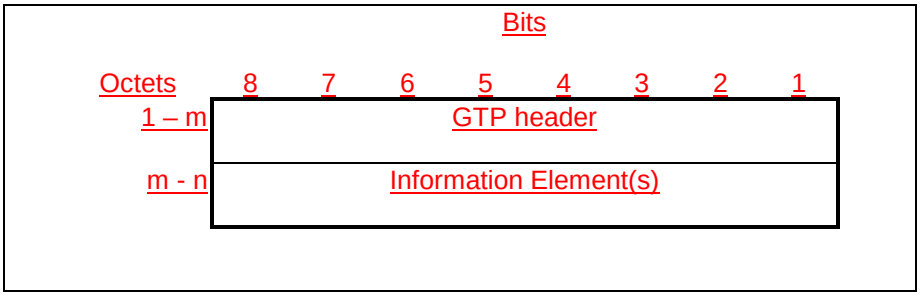


Figure 48: GTP header followed by subsequent Information Elements

89 ~~Transmission Plane~~GTP-U

GTP-U Tunnels are used to carry encapsulated T-PDUs between a given pair of ~~a given GSN pair for individual MSs~~GTP-U Tunnel Endpoints. The ~~key~~ Tunnel Endpoint ID (TEID) which is present in the GTP header shall indicate which tunnel a particular T-PDU belongs to. In this manner, packets are multiplexed and demultiplexed by GTP-U between a given ~~GSN GSN~~ pair of Tunnel Endpoints. The ~~Tunnel ID~~TEID value to be used in the TEID field ~~key field~~ shall be ~~established~~ negotiated ~~by~~ for instance during the GTP-C Create PDP Context ~~establishment~~ and the RAB assignment procedures which take~~s~~ place on the signalling plane.

The maximum size of a T-PDU that may be transmitted without fragmentation by GGSN or the MS is defined in ~~GSM~~UMTS 23.060. The GGSN shall fragment, reject or discard T-PDUs, depending on the PDP type and implementation decisions, directed to the MS if the T-PDU size exceeds the maximum size. The decision if the T-PDUs shall be fragmented or discarded is dependent on the external packet data network protocol.

9.1 GTP-U protocol entity

The GTP-U protocol entity provides packet transmission and reception services to user plane entities in the GGSN, in the SGSN and, in UMTS systems, in the RNC. The GTP-U protocol entity receives traffic from a number of GTP-U tunnel endpoints and transmit traffic to a number of GTP-U tunnel endpoints. There is a GTP-U protocol entity per IP address.

The TEID in the GTP-U header is used to demultiplex traffic incoming from remote tunnel endpoints so that it is delivered to the User plane entities in a way that allows multiplexing of different users, different packet protocols and different QoS levels. Therefore no two remote GTP-U endpoints shall send traffic to a GTP-U protocol entity using the same TEID value.

9.1.1 Handling of sequence numbers

This functionality is provided only when the S bit is set to 1 in the GTP-U header.

The GTP-U protocol entity must reorder out of sequence T-PDUs when in sequence delivery is required. This is optional at the SGSN in UMTS. The GTP-U protocol entity shall deliver to the user plane entity only in sequence T-PDUs and notify the sequence number associated to each of them. The notification of the sequence number is not necessary at the GGSN, but it is mandatory at the SGSN and RNC. The user plane entity shall provide a sequence number to the GTP-U layer together with T-PDUs to be transmitted in sequence. GTP-U protocol entities at the GGSN may optionally generate autonomously the sequence number, but should be able to use sequence numbers provided by the user plane entity.

When the sequence number is included in the GTP-U header, a user plane entity acting as a relay of T-PDUs between GTP-U protocol entities, or between PDCP (or SNDCP) protocol entities and GTP-U protocol entities, shall relay the

sequence numbers between those entities as well. In this way it is possible to keep consistent values of sequence numbers from the GGSN to the UE (MS in GPRS) by relaying the sequence number across the CN GTP-U bearer, the Iu GTP-U bearer and the Radio bearer (via PDCP or SNDCP N-PDU numbers). This functionality is beneficial during SRNS relocation.

9.2 GTP-U Service Access Points and Primitives

The GTP-U protocol entity offers packet Transmission services between a pair of GTP-U tunnel endpoints. The tunnel between two GTP-U endpoints is established via control plane procedures defined in protocols such as GTP-C and RANAP. The control of GTP-U resource allocation and tunnel set-up takes place via the GTP-U-CONTROL SAP. The GTP-U packet transmission (and packet reception) services are accessed via the GTP-U-UNIT-DATA SAP.

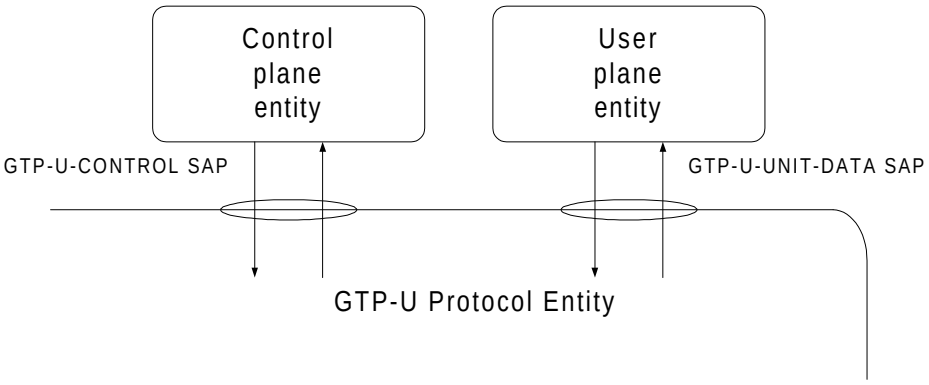


Figure 49: The GTP-U-Control SAP and GTP-U-DATA SAP

9.2.1 GTP-U-CONTROL SAP

The GTP-U-CONTROL SAP is used by a control plane entity to control the allocation of GTP-U resources and associate them to an identifier (the TEID) a user plane entity uses to access them via the GTP-U-UNIT-DATA SAP. It also defines in which way to control tunnel establishment. In particular, it provides means to control the GTP-U packet reception section and the GTP-U packet transmission section. The RX and TX suffix is used in the following to discriminate between primitives used to control the reception section and primitives used to control the transmission section.

9.2.1.1GTP-U-CONTROL-RX primitives

PRIMITIVE	PARAMETERS	REFERENCE
GTP-U-CONTROL-RX-SETUP.request	QoS info; IP address; TEID	9.2.1.1.1
GTP-U-CONTROL-RX-SETUP.confirm	Result	9.2.1.1.2
GTP-U-CONTROL-RX-RELEASE.request	TEID	9.2.1.1.3
GTP-U-CONTROL-RX-RELEASE.confirm	-	9.2.1.1.4
GTP-U-CONTROL-RX-ERROR.indication	Cause	9.2.1.1.5

9.2.1.1.1 GTP-U-CONTROL-RX-SETUP.request

This primitive is used to allocate packet reception resources according to a QoS profile specified via the 'QoS' parameter. These resources are to be associated to a tunnel endpoint identified via the TEID specified in the 'TEID' parameter. In case this TEID is already being used, this shall be interpreted as a resource modification request.

The 'IP address' parameter is used to identify the IP address of the remote GTP-U protocol entity where the GTP-U tunnel is terminated. This implicitly identifies the path being used. The PATH may be TCP or UDP based depending on

the QoS required (namely depending on whether reliable transmission is required or not). The knowledge of the path being used is necessary in order to send ECHO messages used to detect path failure.

9.2.1.1.2 GTP-U-CONTROL-RX-SETUP.confirm

This primitive acknowledges the corresponding resources set up request. Any information to be reported is delivered in the parameter 'Result', which may be used to indicate set up failure and the reason of the failure.

9.2.1.1.3 GTP-U-CONTROL-RX-RELEASE.request

This primitive is used to dispose the resources associated to a tunnel identified by TEID.

9.2.1.1.4 GTP-U-CONTROL-RX-RELEASE.confirm

This primitive acknowledges the corresponding resources release request.

9.2.1.1.5 GTP-U-CONTROL-RX-ERROR.indication

This primitive is used to indicate to the controlling entity any error conditions detected on the GTP-U reception section. The error condition is specified in the parameter 'Cause'.

9.2.1.2 GTP-U-CONTROL-TX primitives

PRIMITIVE	PARAMETERS	REFERENCE
GTP-U-CONTROL-TX-SETUP.request	QoS info; IP address; TEID	9.2.1.2.1
GTP-U-CONTROL-TX-SETUP.confirm	Result	9.2.1.2.2
GTP-U-CONTROL-TX-RELEASE.request	TEID; IP address	9.2.1.2.3
GTP-U-CONTROL-TX-RELEASE.confirm	-	9.2.1.2.4
GTP-U-CONTROL-TX-ERROR.indication	Cause	9.2.1.2.5

9.2.1.2.1 GTP-U-CONTROL-TX-SETUP.request

This primitive is used to allocate packet transmission resources according to a QoS profile specified via the 'QoS' parameter. These resources are to be associated to a tunnel endpoint identified via the TEID specified in the 'TEID' parameter. In case this TEID is already being used, this shall be interpreted as a resource modification request.

The 'IP address' parameter is used to identify the IP address of the remote GTP-U protocol entity where the GTP-U tunnel is terminated. This implicitly identifies the path being used. The PATH may be TCP or UDP based depending on the QoS required (namely depending on whether reliable transmission is required or not). The knowledge of the path being used is necessary in order to send ECHO messages to detect PATH failure.

9.2.1.2.2 GTP-U-CONTROL-TX-SETUP.confirm

This primitive acknowledges the corresponding resources set up request. Any information to be reported is delivered in the parameter 'Result', which maybe used to indicate set up failure and the reason of the failure.

9.2.1.2.3 GTP-U-CONTROL-TX-RELEASE.request

This primitive is used to dispose the resources associated to a tunnel identified by TEID and the IP address of the remote GTP-U protocol entity where the tunnel is terminated.

9.2.1.2.4 GTP-U-CONTROL-TX-RELEASE.confirm

This primitive acknowledges the corresponding resources release request.

9.2.1.2.5 GTP-U-CONTROL-TX-ERROR.indication

This primitive is used to indicate to the controlling entity any error conditions detected on the GTP-U reception section. The error condition is specified in the parameter 'Cause'.

9.2.2 GTP-U-UNIT-DATA SAP and primitives

The GTP-U-UNIT-DATA SAP is used to send and receive T-PDUs in an unacknowledged mode. Sequence numbers and system dependent info is conditionally passed to the user plane entity using the GTP-U-. This information is identified as *'Other info'* in the following.

PRIMITIVE	**PARAMETERS**	**REFERENCE**
GTP-U-UNIT-DATA.request	DATA; TEID; IP address; *Other info**	9.2.2.1
GTP-U- UNIT-DATA.indication	DATA; TEID;*Other info**	9.2.2.2

*It is conditionally present (only if the TEID is associated to tunnels providing in sequence delivery, see section 9.1.1).

9.2.2.1 GTP-U-UNIT-DATA.request

This primitive is used to send a T-PDU (DATA) by means of a specific GTP-U layer resource (tunnel) identified by the parameter TEID and the IP address where the tunnel is terminated. *Other info* may be conditionally present and transmitted together with T-PDUs .

9.2.2.2 GTP-U- UNIT-DATA.indication

A T-PDU (DATA) is received from a GPT-U peer entity and delivered to a user plane entity. The T-PDU is associated to the to the PDP or RNC context identified by TEID (that is the Tunnel Endpoint ID). *Other info* may be conditionally present and delivered together with T-PDUs.

~~8~~9.~~3~~1 Protocol Stack

The GTP-U protocol ~~carries T-PDUs through the GPRS backbone.~~ is used to transmit T-PDUs ~~are carried in a tunnel~~ between GSN pairs (or between an SGSN and an RNC in UMTS), encapsulated in G-PDUs. A G-PDU is a packet including ~~with~~ a GTP-U header and a T-PDU. The Path Protocol defines the path and the GTP-U header defines the tunnel. Several tunnels may be multiplexed on a single path. The frames have the following general structure:

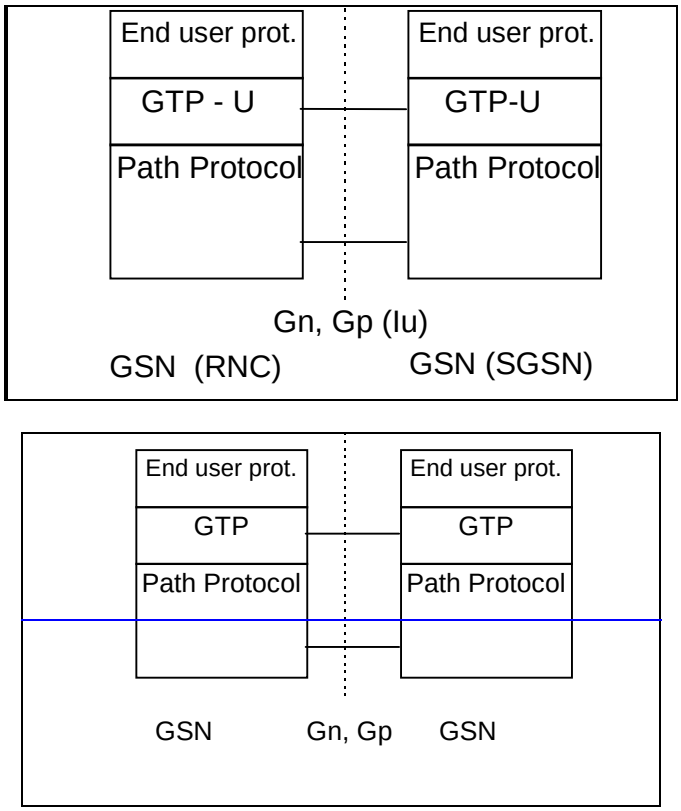


Figure 50: ~~Transmission Plane~~GTP-U - Protocol Stack (GTP-U over the Iu in brackets)

~~8~~9.~~3~~1.1 Usage of the GTP-U Header

~~For the transmission plane messages~~T ~~t~~he GTP-U header shall be used as follows:

- Version shall be set to decimal 1 (‘001’).
- Payload Type (PT) shall be set to '0’.
- If the S field is set to '1' the sequence number field is present otherwise it is set to '0'
- SNN flag: The GTP-U header includes the optional SNDCP N-PDU Number field if the ~~LFN~~ SNN flag is set to 1.
- Message Type shall be set ~~set to the decimal value 255 indicating a T-PDU~~according to Table 1. The value 255 is used when T-PDUs are transmitted. The value 1 and 2 are used for "Echo" messages. The value 3 for "Version Non Supported" messages.
- Length: Size of the T-PDU excluding the GTP-U header size.
- Sequence Number: This field is present only if the S field is set to 1~~value~~. The handling of this field is specified in section 9.1.1. It shall be used in order to decide whether or not to discard a received T-PDU, as specified in sub-clause ~~8~~9.~~3~~1.1 Usage of the Sequence Number.
- SNDCP N-PDU Number: This field shall be included if and only if the SNN flag is set to 1. In this case, it is used by the old SGSN (or RNC), at the Inter SGSN Routeing Area Update procedure (or SRNS relocation), to inform the new SGSN (or RNC) of the N-PDU number assigned to T-PDU. If an N-PDU number was not assigned to the T-PDU by SNDCP, or if the T-PDU is to be transferred using unacknowledged peer-to-peer LLC operation, then SNN shall be set to 0. ~~The SNDCP N-PDU Number shall be set to 255 if the SNN flag is 0~~.

~~The Flow Label identifies the flow which the T-PDU belongs to. The Flow Label is chosen by the receiver of the flow during the context establishment, update or SGSN change procedure.~~

- TEID: Contains the tunnel identifier for the tunnel to which this T-PDU belongs. The TEID shall be used by the receiving ~~GSN~~ end as a de-multiplexing field. It shall be passed to upper layer User Plane Entities for further interpretation.~~to find the MM and PDP contexts.~~

~~8~~9.~~3~~1.1 Usage of the Sequence Number

The sending GSN shall use 0 for the value of the Sequence Number of the first T-PDU in a tunnel and shall increment the Sequence Number for each following T-PDU. The value shall wrap to zero after 65535.

When a dialogue is opened beween GSNs, the receiving GSN shall set the content of a counter to zero. When the receiving GSN receives a valid T-PDU, it shall increment this counter by one. This counter shall wrap to zero after 65535. It defines the 'Expected Sequence Number'.

Based on the received and Expected Sequence Number values, the receiving GSN may decide whether or not to discard the received T-PDU. Annex B (Informative) describes a method to determine whether a received T-PDU is valid.

The receiving GSN shall reorder the incoming T-PDUs in sequence if the Reordering Required flag in the PDP context is set. In this case, if needed, the receiving GSN shall take into account a maximum number of valid received frames and a maximum elapsed time to assume that a T-PDU was lost.

~~8~~9.~~4~~2 Tunnelling between SGSNs

T-PDUs, stored in the old SGSN and not yet sent to the MS, shall be tunnelled to the new SGSN as a part of the Inter SGSN Routeing Update procedure described in GSM 03.60. Some T-PDUs may still be on their way from the GGSN to the old SGSN because they have been sent before the tunnels change. These T-PDUs shall also be tunnelled to the new SGSN.

9.5 Tunnelling between Source RNC and Target RNC Via SGSNs

T-PDUs stored in the Source RNC and not yet sent to the MS shall be tunnelled to the Target RNC, via the pair of SGSNs the Source RNC and the Target RNC are attached to, as a part of the SRNS relocation procedure. Some T-PDUs may still be on their way from the source SGSN to the Source RNC because they have been sent before the tunnels change. These T-PDUs shall also be tunnelled to the Target RNC via the SGSN.

If Source RNC and Target RNC are attached to the same SGSN, then the SGSN will receive from the Source RNC all the T-PDUs that cannot be sent to the MS and forward them to the Target RNC via the Iu GTP-U tunnels.

~~8~~9.~~6~~3 Tunnelling between GGSNs

GTP shall not specify tunnelling between GGSNs. Transfer of MS-to-MS traffic between GGSNs shall use the Gi interface.

********** Next Modification **********'

10.1.1 Different GTP versions

If a receiving node receives a GTP signalling message of an unsupported version, that node shall return a GTP Version Not Supported message indicating in the Version field of the GTP header the latest GTP version that that node supports. The received G-PDU shall then be discarded. ~~All GSNs shall be able to support all earlier GTP versions.~~