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*Technical Specification*

**Digital cellular telecommunications system (Phase 2+);  
General Packet Radio Service (GPRS);  
Interworking between the Public Land Mobile Network (PLMN)  
supporting GPRS and Packet Data Networks (PDN)  
(GSM 09.61 version 7.2.0 Release 1998)**

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Reference

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## Foreword

This Technical Specification (TS) has been produced by the Special Mobile Group (SMG).

The present document describes the network interworking for the GSM service General Packet Radio Service (GPRS). Interworking to various external networks is defined together with the interworking for data forwarding while subscribers roam within the digital cellular telecommunications systems.

The contents of the present document is subject to continuing work within SMG and may change following formal SMG approval. Should SMG modify the contents of the present document, it will be re-released by SMG with an identifying change of release date and an increase in version number as follows:

Version 7.x.y

where:

- 7 indicates GSM Phase 2+ Release 1998;
- x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.;
- y the third digit is incremented when editorial only changes have been incorporated in the specification.

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# 1 Scope

The present document defines the requirements for General Packet Radio Service (GPRS) interworking between a:

- a) PLMN and PSDN
- b) PLMN and IP Networks
- c) PLMN and PLMN

In addition, annex X describes the special requirements for interworking between a PCS1900 PLMN and a PSDN within a BOC's LATA.

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# 2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1998 document, references to GSM documents are for Release 1998 versions (version 7.x.y).

- [1] GSM 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".
- [2] GSM 02.60: "Digital cellular telecommunication system (Phase 2+); General Packet Radio Service (GPRS): Stage 1 Service Description".
- [3] GSM 03.60: "Digital cellular telecommunication system (Phase 2+); General Packet Radio Service (GPRS); Stage 2 Service Description".
- [4] GSM 03.61: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Point to Multipoint Multicast Service Description; Stage 2".
- [5] GSM 03.62: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Point to Multipoint Group Call Service Description; Stage 2".
- [6] GSM 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the Radio interface; Stage 2".
- [7] GSM 04.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control / Medium Access Control (RLC/MAC) protocol".
- [8] GSM 04.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Logical Link Control (LLC)".
- [9] GSM 04.65: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Subnetwork Dependent Convergence Protocol (SNDCP)".
- [10] GSM 07.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) supporting GPRS".
- [11] CCITT Recommendation E.164: "Numbering plan for the ISDN era".

- [12] CCITT 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".
- [13] CCITT Recommendation X.75: "Packet-switched signalling system between public networks providing data transmission services".
- [14] CCITT Recommendation X.121: "International Numbering Plan for Public Data Networks".
- [15] IETF RFC 768 (1980): "User Datagram Protocol" (STD 6).
- [16] IETF RFC 791 (1981): "Internet Protocol" (STD 5).
- [17] IETF RFC 792 (1981): "Internet Control Message Protocol" (STD 5).
- [18] IETF RFC 793 (1981): "Transmission Control Protocol" (STD 7).
- [19] IETF RFC 1034 (1987): "Domain Names – Concepts and Facilities" (STD 7).
- [20] Bellcore GR-000301 Issue 2 December 1997; "Public Packet Switched Network Generic Requirements (PPSNGR)".
- [21] IETF RFC 1661 and 1662 (1994): "The Point-to-Point Protocol (PPP)" (STD 51).
- [22] IETF RFC 1700 (1994): "Assigned Numbers" (STD 2).3

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## 3 Definitions, abbreviations and symbols

### 3.1 Definitions

See GSM 02.60.

In GSM 02.02 the bearer services are described. The general network configuration is described in GSM 03.02 and the GSM PLMN access reference configuration is defined in GSM 04.02. The various connection types used in the GSM PLMN are presented in GSM 03.10. Terminology used in this Specification is presented in GSM 01.04. For support of data services between GSM PLMN and other networks see GSM 09-series of Specifications.

### 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

APN	Access Point Name
ATM	Asynchronous Transfer Mode
BG	Border Gateway
BOC	Bell Operating Company
CHAP	Challenge Handshake Authentication Protocol
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
DNIC	Data Network Identification Code
DSE	Data Switch Exchange
GGSN	Gateway GPRS Support Node
IC	Interexchange Carrier
ICMP	Internet Control Message Protocol
IETF	Internet Engineering Task Force
IHOSS	Internet Hosted Octet Stream Service
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISDN	Integrated Services Digital Network

ISP	Internet Service Provider
LATA	Local Access and Transport Area
LAPB	Link Access Protocol Balanced
LAC	L2TP Access Concentrator
LNS	L2TP Network Server
MS	Mobile Station
MT	Mobile Terminal
OSP	Octet Stream Protocol
OSP:IHOSS	Octet Stream Protocol for Internet Hosted Octet Stream Service
PDN	Packet Data Network
PDU	Protocol Data Unit
PHF	Packet Handler Function
PNIC	Pseudo Network Identification Code
PPP	Point-to-Point Protocol
PPSN	Public Packet Switched Network
PSDN	Packet Switched Data Network
PSPDN	Packet Switched Public Data Network
RADIUS	Remote Authentication Dial In User Service
SGSN	Serving GPRS Support Node
SMDS	Switched Multimegabit Data Service
TE	Terminal Equipment
TCP	Transmission Control Protocol
UDP	User Datagram Protocol

### 3.3 Symbols

For the purposes of the present document, the following symbols apply:

Gb	Interface between an SGSN and a BSC.
Gi	Reference point between GPRS and an external packet data network.
Gn	Interface between two GSNs within the same PLMN.
Gp	Interface between two GSNs in different PLMNs. The Gp interface allows support of GPRS network services across areas served by the co-operating GPRS PLMNs.
Gs	Interface between an SGSN and MSC.
R	The reference point between a non-ISDN compatible TE and MT. Typically this reference point supports a standard serial interface.
Um	The interface between the MS and the GPRS fixed network part. The Um interface is the GPRS network interface for providing packet data services over the radio to the MS. The MT part of the MS is used to access the GPRS services through this interface.

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## 4 Network characteristics

### 4.1 Key characteristics of PLMN

The GSM PLMN is fully defined in the GSM technical specifications. The GPRS related key characteristics are found in GSM 02.60 and 03.60.

### 4.2 Key characteristics of PSDN

Packet Switched Data Networks (PSDNs) are defined in the relevant CCITT/ITU-T X series.



## 4.3 Key characteristics of IP Networks

The Internet is a conglomeration of networks utilising a common set of protocols. IP protocols are defined in the relevant IETF STD specifications and RFCs. The networks topologies may be based on LANs (e.g. ethernet), Point to Point leased lines, PSTN, ISDN, X.25 or WANs using switched technology (e.g. SMDS, ATM).

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## 5 Interworking Classifications

### 5.1 Service Interworking

Service interworking is required when the Teleservice at the calling and called terminals are different. For GPRS, service interworking is not applicable at the Gi reference point.

### 5.2 Network Interworking

Network interworking is required whenever a PLMN is involved in communications with another network to provide end-to-end communications. The PLMN shall interconnect in a manner consistent with that of a normal Packet Data Network (type defined by the requirements e.g. IP, PSDN X.75). Interworking appears exactly like that of Packet Data Networks.

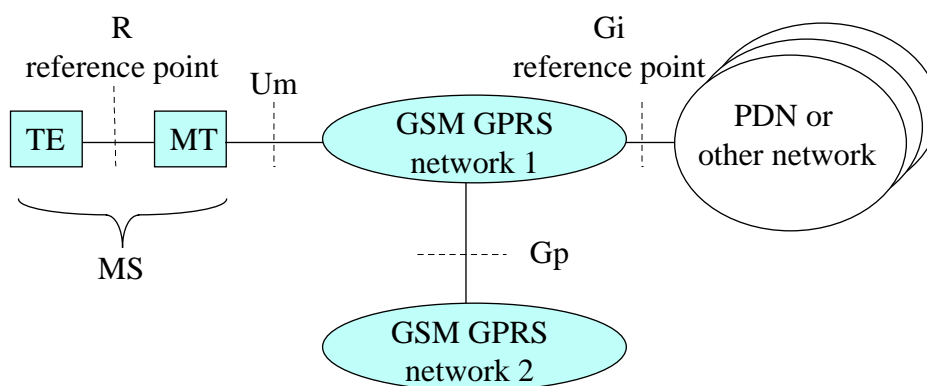
### 5.3 Numbering and Addressing

See GSM 03.03 and the relevant sections for X.25 and IP addressing below.

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## 6 Access reference configuration

Figure 1 shows the relationship between the MS, its terminal equipment and the GSM network in the overall GPRS environment.



**Figure 1: GPRS Access Interfaces and Reference Points**

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## 7 Interface to GPRS Bearer Services

The following Figure 2: Transmission Plane shows the relationship of the GPRS Bearer terminating at the SMDCP layer to the rest of the GPRS environment. It is shown for reference purposes only and detailed information can be found in GSM 03.60, 04.64, and 04.65.

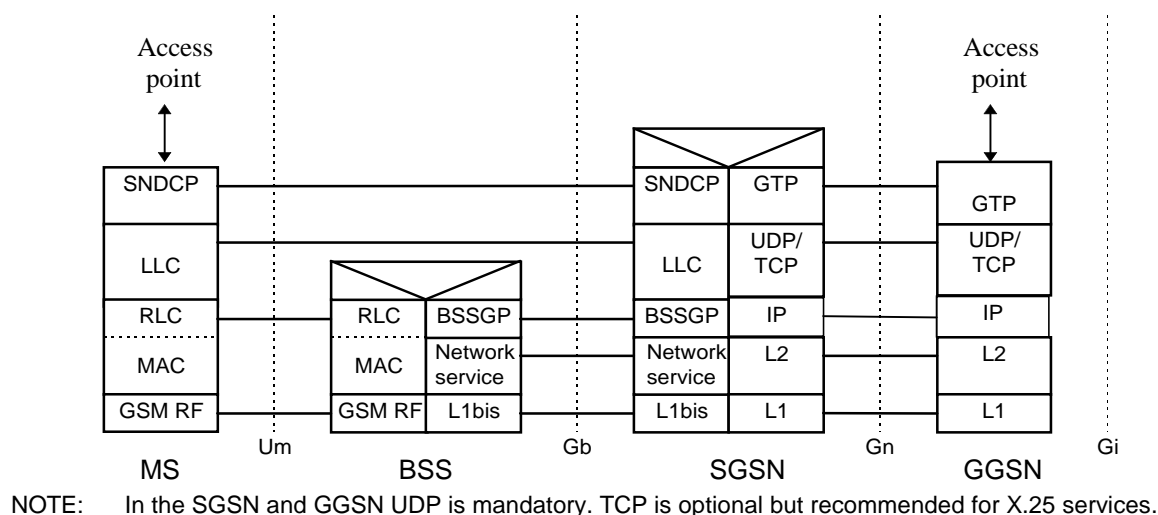


Figure 2: GPRS Transmission Plane

## 8 Subscription checking

Subscription is checked during the GPRS Attach procedure and also during the PDP Context Activation procedure as described in GSM 03.60. The GGSN implicitly checks its internal context related to the destination address for each mobile terminated packet. If there is a context associated with the PDP address the packet shall be forwarded to the MS, otherwise the packet shall be discarded or rejected depending on the implemented protocol.

## 9 Screening

Screening function's reside within the GPRS network and has three levels as described in GSM 02.60 and 03.60. Screening may be applicable for only certain protocols. Screening is outside the scope of GPRS standardisation, however, the following types of screening shall be supported.

### 9.1 Network controlled screening

The PLMN administration and/or the GPRS service provider shall set basic screening functionality, if applicable, (e.g. firewall) to reduce the risk of fraud and misuse. This is to ensure the integrity of the network and to protect subscribers.

### 9.2 Subscription controlled screening

This will not be in GPRS phase 1.

### 9.3 User controlled screening

This will not be in GPRS phase 1.

## 10 Interworking with PSDN (X.75/X.25)

### 10.1 General

GPRS shall support interworking with PSDN networks. The interworking may be either direct or through a transit network.

GPRS shall support both CCITT/ITU-T X.121 and CCITT/ITU-T E.164 addressing.

GPRS shall provide support for CCITT/ITU-T X.25 and CCITT/ITU-T X.75.

The GPRS TE's shall have addresses provided, and controlled, by their GPRS operator. The PSDN TE sends data to the GPRS TE by use of that TE's GPRS DNIC (Data Network Identification Code) or equivalent which uniquely identifies that GPRS network worldwide.

The GGSN for interworking with PSDNs is the access point of the GSM GPRS data network.

There are two models for PSDN interworking.

- X.75 over the Gi reference point.
- X.25 over the Gi reference point with the DCE located within the PSDN and the DTE located within the TE of the GPRS PLMN.

Both X.75 and X.25 access methods are supported when mobile users are resident on HPLMN or VPLMN. A roaming user may be allocated a dynamic address from the VPLMN.

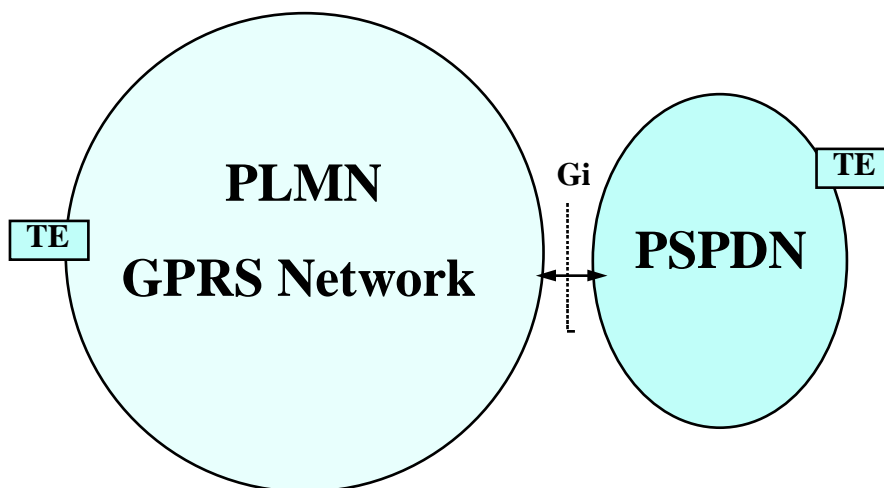
## 10.2 PSDN Interworking Models

The two models of X.75 and X.25 represent the different scenarios for PSDN interworking with the GPRS network.

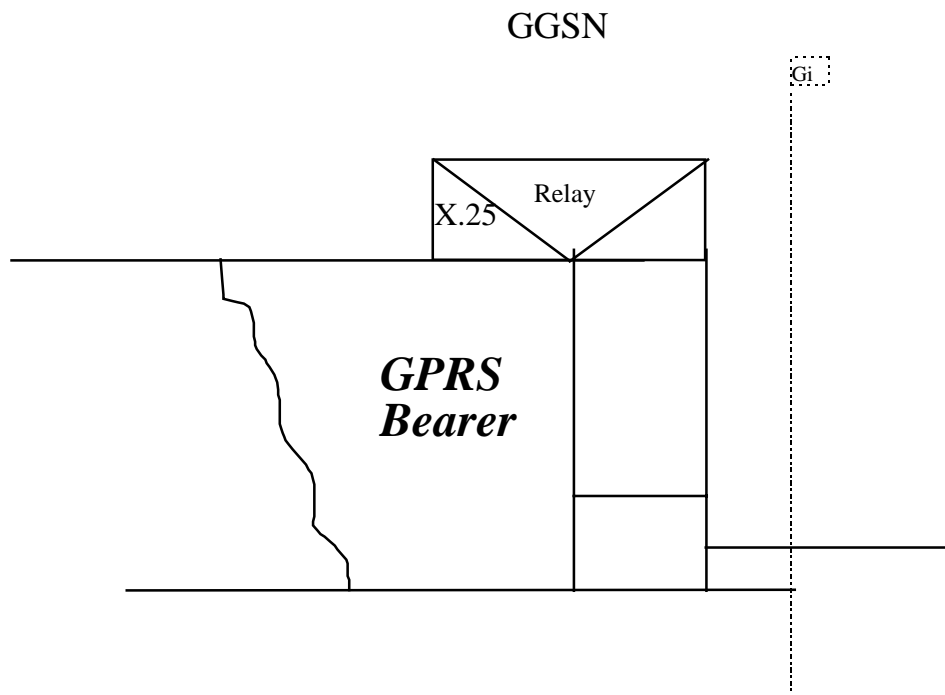
The model differences lie in the interconnection protocol over the Gi reference point.

### 10.2.1 X75 Interworking at the Gi Reference Point

Figure 3 represents the case where X.75 is used as the interworking protocol, as used between interconnect X.25 PSDNs currently. The GPRS network will look like any other PSDN in all respects and uses X.75 addressing. Figure 4 shows the interconnecting protocol stacks to the GPRS bearer. The GPRS bearer is described in GSM 07.60, which uses the protocols described in GSM 03.60.



**Figure 3: PSPDN Interworking with X.75 at Gi Reference Point**



**Figure 4: The Protocol Stack for the X.75 Gi Reference Point**

#### 10.2.1.1 Numbering and Addressing

A PLMN GPRS network requires a DNIC or PNIC.

X.121 addresses allocated to subscribers belong to the PLMN operator.

#### 10.2.1.2 Charging

Charging of X.25 packets is done at the GGSN.

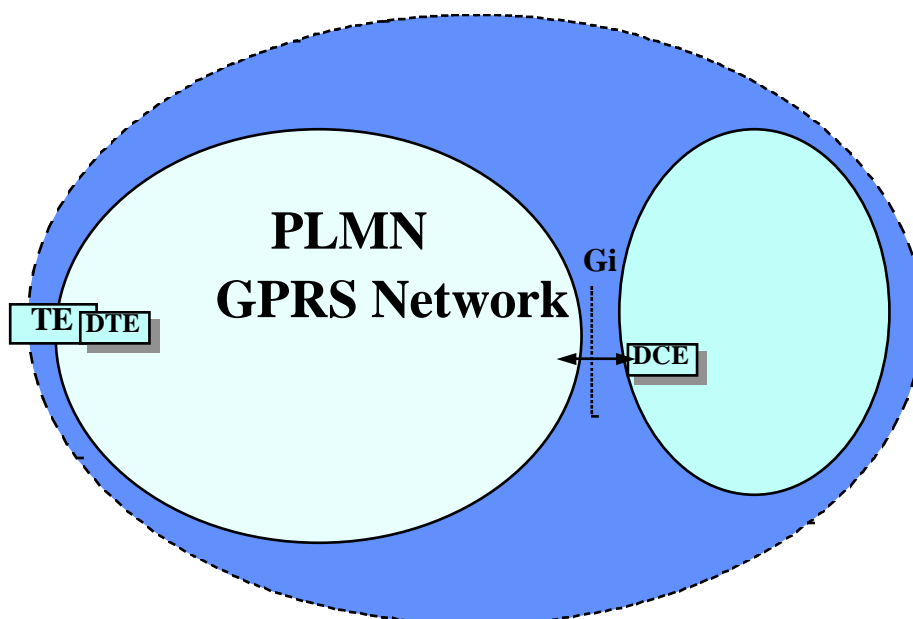
### 10.2.2 X25 Interworking at the Gi Reference Point

Figure 5 represents the case where X.25 is used as the interconnect protocol between a DCE and a DTE.

The DTE resides within the GPRS network. The DCE resides within the PSDN.

The GPRS Network is seen as part of the PSDN, as the Gi reference point is the interconnect point between the DCE and the DTE.

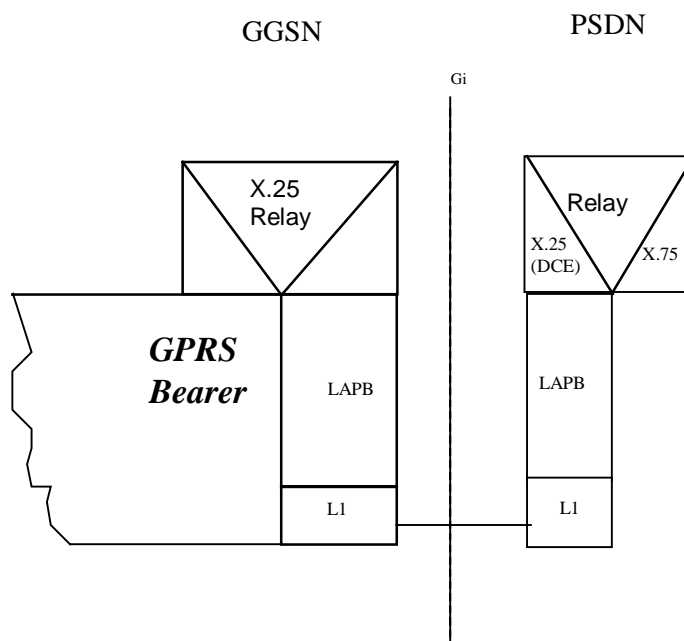
The protocol stack for this model is shown in Figure 6.



## Actual PSDN

NOTE: The PSDN can interwork at X.75 to other PSDN's

**Figure 5: PSDN Interworking with X.25 over Gi Interface**



**Figure 6: The Protocol Stack for the X.25 / Gi Reference point**

Figure 6 shows the transmission plane only. In this case the GGSN shall resolve the association between the MS GPRS bearer and the X.25 DCE. L1 is left to operators to determine connection to other networks.

The X.25 Relay performs the following:

- mapping of logical channel numbers.

### 10.2.2.1 Numbering and Addressing

A fixed X.121 address for the MS maybe allocated by the PSDN operator, and is integral to the PSDN numbering plan. A dynamic X.121 address can also be used which is assigned by the GPRS network at PDP context activation.

### 10.2.2.2 Charging

The charging information may be collected in the X.25 network, depending upon the agreement between the GPRS operator and the PSDN operator. The charging may also be collected in the GPRS network. If the VPLMN assigns the dynamic address, the charging of the GPRS and the external network shall be gathered and sent to the HPLMN.

## 10.3 User Facilities

The set of user facilities as defined in CCITT/ITU-T X.25 may be supported.

As a minimum the following shall be supported:

- reverse charging;
- reverse charging acceptance;
- fast select restricted;
- fast select unrestricted;
- fast select acceptance.

## 10.4 The GPRS Interworking to PSDN Characteristics

The following table describes the differences in addressing, and user profile for each interconnect type. The static X.121 address in the following table indicates an address which is permanently allocated to the GPRS subscriber by the network operator. The dynamic X.121 address is assigned automatically on the PDP Context Activation procedure. The dynamic address is allocated from a free pool held in the GGSN. This is described in GSM 03.60.

**Table 1: PSPDN GPRS Interconnection Characteristics**

Metric	X.75 - Stand Alone PSPDN X.25 - PSPDN Sub Network	
	Static X.121 address	Dynamic X.121 address
X.25 profile	User determined in X.25 DCE	Only Default Profiles allowed in X.25 DCE- Selected upon PDP context activation
X.28/X.29 PAD	Address in GGSN	Address in GGSN after PDP Context Activation

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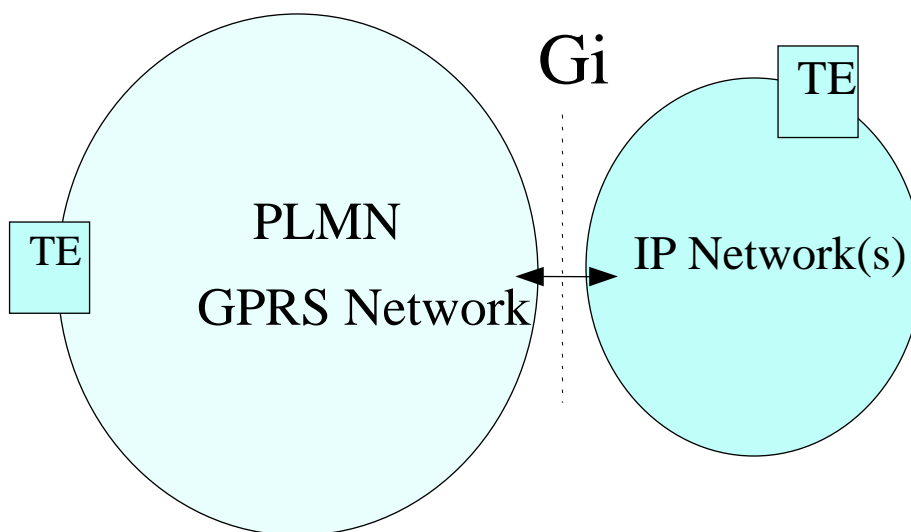
## 11 Interworking with PDN (IP)

### 11.1 General

GPRS shall support interworking with networks based on the Internet Protocol (IP). These interworked networks may be either intranets or the Internet.

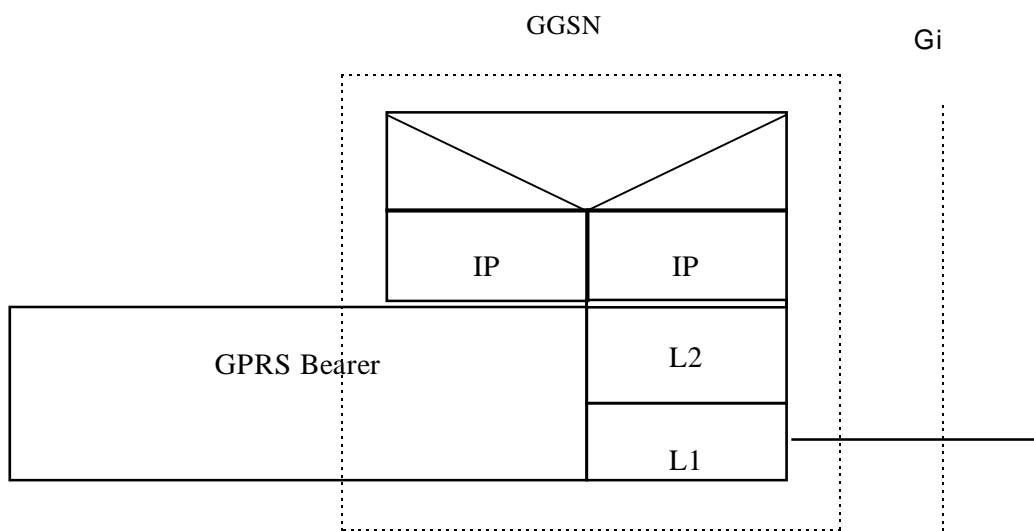
## 11.2 PDN Interworking Model

When interworking with the IP networks, GPRS can operate IPv4 or Ipv6. The interworking point with IP networks is at the Gi reference point as shown in Figure 7.



**Figure 7: IP network interworking**

The GGSN for interworking with the IP network is the access point of the GSM GPRS data network (see Figure 8). In this case the GPRS network will look like any other IP network or subnetwork.



**Figure 8: The protocol stacks for the GiIP reference point**

Typically in the IP networks, the interworking with subnetworks is done via IP routers. The Gi reference point is between the GGSN and the external IP network. From the external IP network's point of view, the GGSN is seen as a normal IP router. The L2 and L1 layers are operator specific.

It is out of the scope of this specification to standardise the router functions and the used protocols in the Gi reference point.

Interworking with user defined ISPs and private/public IP networks is subject to interconnect agreements between the network operators.

No user data or header compression is done in the GGSN.

The following working assumptions are valid in the generic case:

- A firewall is configured by the GPRS operator. In general, all applications that are using IP as the underlying protocol are supported, but the GPRS operator may restrict their usage.
- A Domain Name Server is managed by the GPRS operator. Alternatively, the Domain Name Server can be managed by the external IP network operator.
- From the GPRS network's point of view, the allocation of a dynamic IP address is done by the GGSN as described in GSM 03.60. The GGSN may allocate these addresses by itself or use an external device such as an DHCP server. This external device may be operated by an external organisation such as an ISP or Intranet operator.

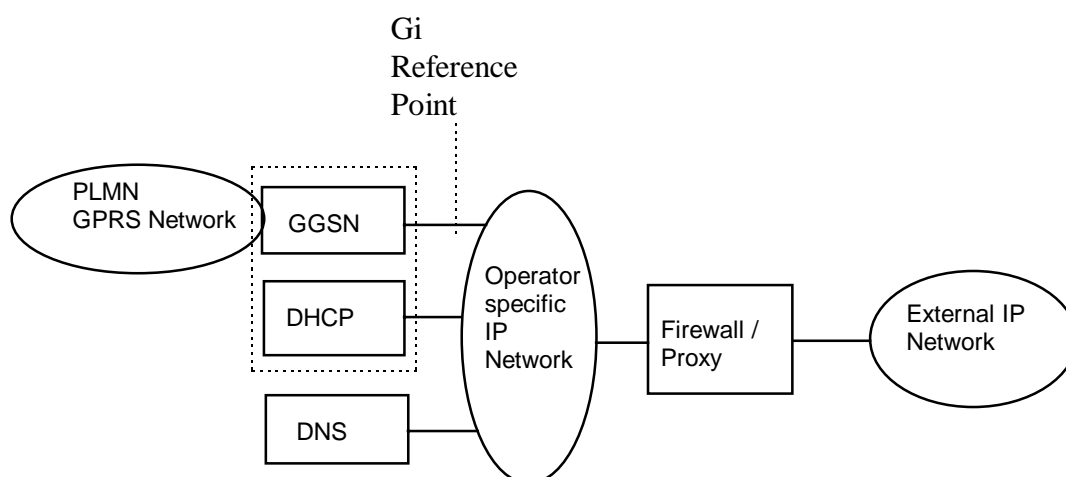
## 11.2.1 Access to Internet, Intranet or ISP through GPRS

The access to Internet, Intranet or ISP may involve specific functions such as : user authentication, user's authorization, end to end encryption between MS and Intranet/ISP, allocation of a dynamic address belonging to the PLMN/Intranet/ISP addressing space, etc.

For this purpose the GPRS PLMN may offer:

- either direct transparent access to the Internet.
- or a non transparent access to the Intranet/ISP. In this case the GPRS PLMN, i.e. the GGSN, takes part in the functions listed above.

### 11.2.1.1 Transparent access to the Internet



**Figure 9: Example of the PDN Interworking Model, transparent case**

In this case (see Figure 9):

- The MS is given an address belonging to the operator addressing space. The address is given either at subscription in which case it is a static address or at PDP context activation in which case it is a dynamic address. This address is used for packet forwarding between the Internet and the GGSN and within the GGSN.
- The MS need not send any authentication request at PDP context activation and the GGSN need not take any part in the user authentication/authorization process.

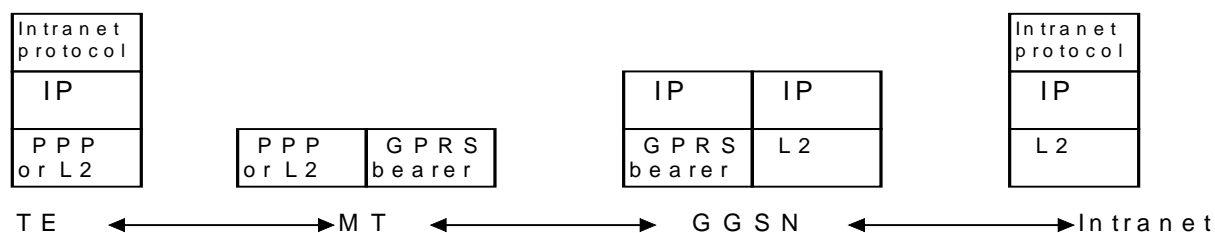
The transparent case provides at least a basic ISP service. As a consequence of this it may therefore provide a bearer service for a tunnel to a private Intranet.

NB The remainder of this section deals with this specific case.

- The user level configuration may be carried out between the TE and the intranet, the GPRS network is transparent to this procedure.

The used protocol stack is depicted in Figure 10.





**Figure 10: Transparent access to an Intranet**

The communication between the GPRS PLMN and the Intranet may be performed over any network, even an insecure network e.g. the Internet. There is no specific security protocol between GGSN and the Intranet because security is ensured on an end to end basis between MS and the intranet by the «Intranet protocol».

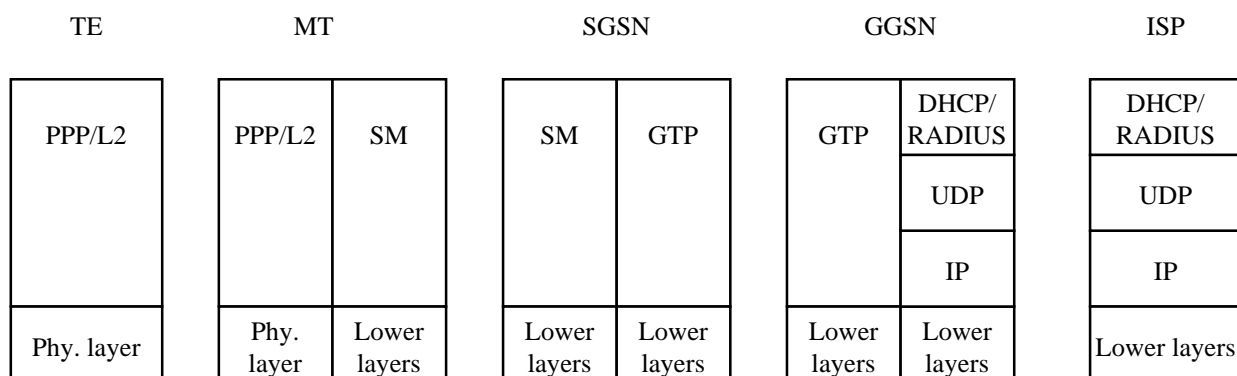
User authentication and encryption of user data are done within the «Intranet protocol» if either of them is needed. This «Intranet protocol» may also carry private (IP) addresses belonging to the address space of the Intranet.

An example of an «Intranet protocol» is IPsec (see RFC 1825). If IPsec is used for this purpose then IPsec authentication header or security header may be used for user (data) authentication and for the confidentiality of user data (see RFC 1826 and RFC 1827). In this case private IP tunnelling within public IP takes place.

### 11.2.1.2 Non Transparent access to an Intranet or ISP

In this case;

- the MS is given an address belonging to the Intranet/ISP addressing space. The address is given either at subscription in which case it is a static address or at PDP context activation in which case it is a dynamic address. This address is used for packet forwarding within the GGSN and for packet forwarding on the Intranet/ISP. This requires a link between the GGSN and an address allocation server, like Radius, DHCP, ..., belonging to the Intranet/ISP;
- the MS shall send an authentication request at PDP context activation and the GGSN requests user authentication from a server, like Radius, DHCP, ..., belonging to the Intranet/ISP;
- the protocol configuration options are retrieved (if requested by the MS at PDP context activation) from some server (Radius or DHCP, ...) belonging to the Intranet/ISP;
- the communication between the GPRS PLMN and the Intranet/ISP may be performed over any network, even an insecure e.g. the Internet. In case of an insecure connection between the GGSN and the Intranet/ISP there may be a specific security protocol in between. This security protocol is defined by mutual agreement between GPRS PLMN operator and Intranet/ISP administrator.



**Figure 11: Signalling plane of non transparent case**

The following description bullet items describe the signal flow.

- 1) The TE sends an AT-command to the MT to set up parameters and enter PPP mode. The MT responds with an AT-response.

- 2) LCP negotiates Maximum-Receive-Unit and authentication protocol. The negotiated authentication protocol is, either CHAP, PAP or 'none'. The MT shall try to negotiate for CHAP as first priority.
- 3) If the negotiated authentication protocol is either of CHAP or PAP, the TE authenticates itself towards the MT by means of that protocol. The MT stores the necessary authentication data and sends a forced positive acknowledgement of the authentication to the TE.
- 4) The TE requests IP configuration by sending the IPCP Configure-Request message to the MT indicating either the static IP address that shall be used or that an IP-address shall be dynamically allocated.
- 5) The MT sends the Activate PDP context request message to the SGSN, including the Protocol Configuration Options. The SGSN sends the Create PDP context req message to the chosen GGSN including the unmodified Protocol Configuration Options.
- 6) The GGSN deduces from the APN :
  - the server(s) to be used for address allocation, authentication and protocol configuration options retrieval;
  - the protocol like Radius, DHCP, ... to be used with this / those server(s);
  - the communication and security feature needed to dialogue with this / those server(s) e.g. tunnel ,IPSec security association, dial-up connection (using possibly PPP), ....

As an example the GGSN may use one of the following options:

- RADIUS for authentication and IP-address allocation.. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN.
- RADIUS for authentication and DHCP for host configuration and address allocation. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN. After a successful authentication, the DHCP client discovers the DHCP server(s) in the ISP/Intranet and receives host configuration data. .

If the received Protocol Configurations Options IE contains a PPP IPCP Configure-Request packet, the GGSN shall analyse all the contained IPCP options and their requested values. In accordance with the relevant PPP RFC[20] the GGSN shall respond with the following messages:

- Zero or one PPP IPCP Configure-Reject packet containing options not supported and options which values cannot be returned,
- zero or one PPP IPCP Configure-Nak packet containing options that are supported but has requested values that are incorrect/unsupported and
- zero or one PPP IPCP Configure-Ack packet containing options that are supported and has requested values that are correct/supported.

Any returned PPP IPCP packets shall be contained in the Protocol Configurations Options IE.

- 7) The GGSN sends back to the SGSN a Create PDP Context Response message, containing the Protocol Configuration Options IE. The cause value shall be set according to the outcome of the host -authentication and -configuration. . A PDP context activation shall not be rejected solely due to the presence of unsupported or incorrect PPP IPCP options or option values, received from the MS in the Protocol Configurations Options IE. The MS may however later decide to immediately deactivate the activated PDP context due to the information received in the Protocol Configurations Options IE received from the network.
- 8) Depending on the cause value received in the Create PDP Context Response the SGSN sends either an Activate PDP Context Accept or an Activate PDP Context Reject, to the MS.

If Protocol Configuration Options are received from the GGSN, the SGSN shall relay those to the MS. The MT sends either the configuration-ack packet (e.g. IPCP Configure Ack in PPP case), the configure-nack packet in case of dynamic address allocation (e.g. IPCP Configure Nack in PPP case), or a link Terminate request (LCP

Terminate-Request in PPP case) back to the TE. In the case where a configure-nack packet was sent by the MT, a local negotiation may take place at the R reference point (i.e. the TE proposes the new value to the MT), after which a configuration-ack packet is sent to the TE.

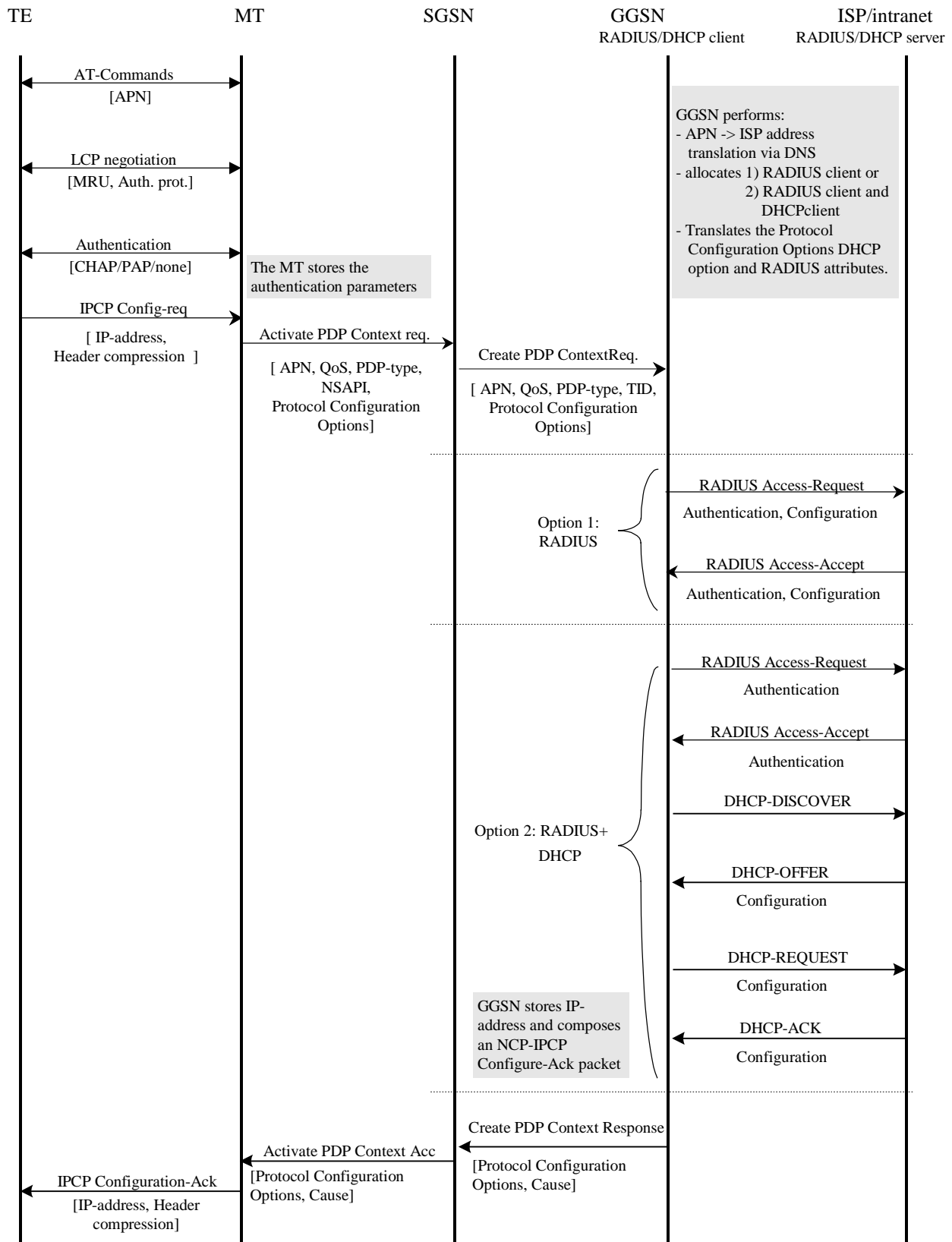
- 9) In case a configuration-ack packet was sent to the TE, the link from the TE to the external ISP/Intranet is established and IP packets may be exchanged.

In case a link terminate request packet was sent to the TE, the TE and MT negotiates for link termination. The MT may then send a final AT-response to inform the TE about the rejected PDP Context activation.

A link terminate request packet (such as LCP Terminate-request in PPP case) causes a PDP context deactivation.

**Example:** In the following example PPP is used as layer 2 protocol over the R reference point.

The MT acts as a PPP server and translates Protocol Configuration Options into SM message IEs. GTP carries this information unchanged to the GGSN which uses the information e.g. for DHCP or RADIUS authentication and host configuration. The result of the host authentication and configuration is carried via GTP to the SGSN which relays the information to the MT. The MT sends an IPCP Configure-Ack to the TE with the appropriate options included.



## 11.3 Numbering and Addressing

In the case of interworking with the public IP networks (such as the Internet), the GPRS operator shall use public network addresses. These public addresses can be reserved from the responsible IP numbering body, or from an ISP with which the GPRS operator has an agreement. In the case of interworking with the private IP networks, the GPRS operator manages internally the subnetwork addresses.

The GPRS operator allocates the IP addresses for the subscribers in either of the following ways.

- The GPRS operator allocates a static IP address when the subscription record is built. The IP address is reserved from a pool of free IP addresses.
- The GPRS operator allocates (either on its own or in conjunction with an ISP) a dynamic IP address when the MS performs the PDP Context Activation procedure with dynamic address allocation as described in GSM 03.60.

## 11.4 Charging

The GPRS operator may define the accuracy of the charging mechanism using one of the following categories:

- Every source/destination pair is logged separately.
- Source/destination pairs are logged to an accuracy of subnetworks.
- Source/destination pairs are logged to an accuracy of connection types (e.g., external data network, corporate network, another mobile).

## 11.5 Domain Name Server (DNS)

Provision of Domain Name services shall be provided by the GPRS operators in the transparent case and the ISP in the non transparent case. Domain name registration is handled by RIPE (Réseaux IP Européens) in Europe (DNS documentation is provided in RFC 1034 and RFC 1035).

## 11.6 Screening

The way the GPRS operator is performing the operator controlled screening and the subscription controlled screening is out of the scope of this specification. These functions may be done, for example, in a firewall.

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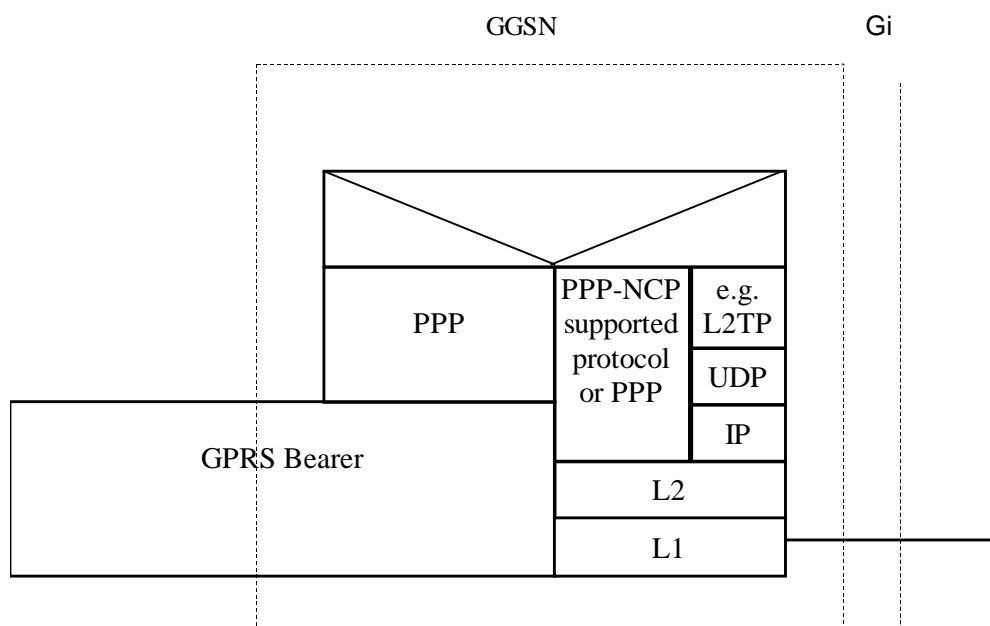
# 12 Interworking with PDN (PPP)

## 12.1 General

By means of the PDP type 'PPP' GPRS may support interworking with networks based on the point-to-point protocol (PPP), as well as with networks based on any protocol supported by PPP through one of its Network Control Protocols (NCPs). All protocols currently supported by PPP NCP's are listed in [21]. It may also support interworking by means of tunnelled PPP, by e.g. the Layer Two Tunnelling Protocol (L2TP).

## 12.2 PDN Interworking Model

The interworking point is at the Gi reference point. The GGSN for interworking with the ISP/PDN is the access point of the GSM GPRS data network (see Figure 13). The GGSN will either terminate the PPP connection towards the MS or may further relay PPP frames to the PDN. The PPP frames may be tunnelled in e.g. L2TP.



**Figure 13: The protocol stacks for the Gi PPP reference point**

In case the external PDN is an IP based network and the GGSN terminates PPP the same description applies as specified in section 11.2.

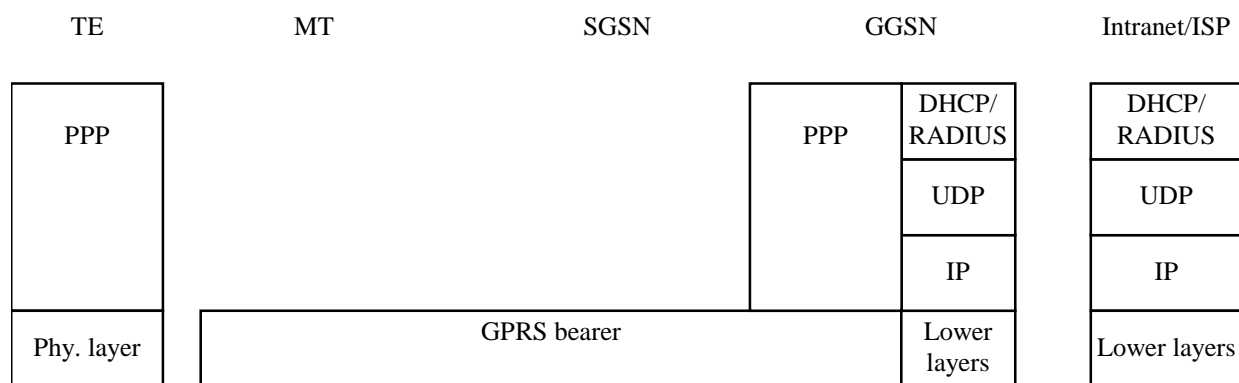
In case the GGSN tunnels PPP frames to the PDN, the GGSN may behave like a LAC towards the external network.

### 12.2.1 Virtual dial-up- and direct Access to PDNs, or ISPs through GPRS

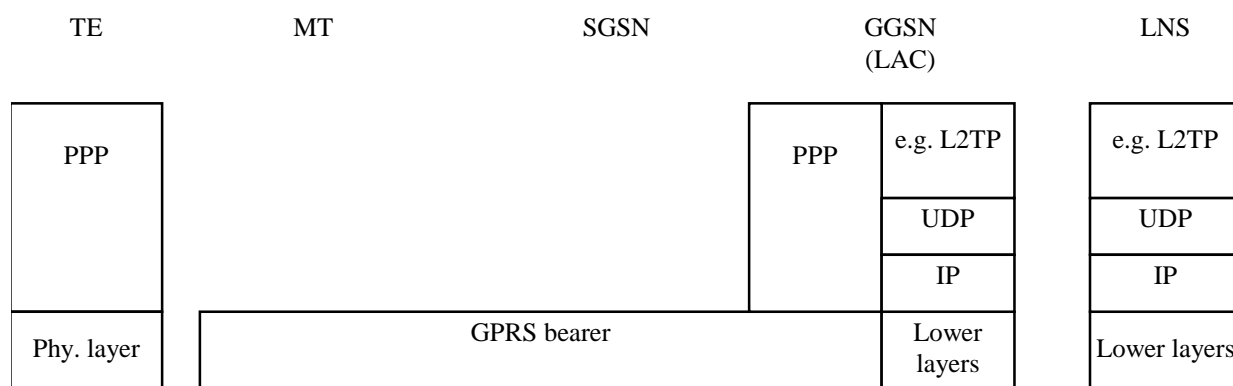
The access to PDNs, or ISPs may involve specific functions such as: user authentication, user's authorization, end to end encryption between MS and PDN/ISP, allocation of a dynamic address belonging to the PLMN/PDN/ISP addressing space, etc.

For this purpose the GPRS PLMN may offer, based on configuration data:

- Direct access to an IP based Intranet/ISP using a protocol configuration as depicted in figure 14. Here DHCP and/or RADIUS are used between the GGSN and Intranet/ISP for performing the specific functions mentioned above. The GPRS PLMN may also offer access to networks based on any protocol supported by PPP through one of its Network Control Protocols (NCPs).

**Figure 14: Protocol stack for direct access to IP-based Intranets/ISPs**

- Virtual dial-up access to a PDN with PPP frame tunnelling as depicted in figure 15.

**Figure 15: Protocol stack for virtual dial-up access with PPP frame tunnelling**

### 12.2.1.2 Procedural description

In this case;

- the MS is given an address belonging to the Intranet/ISP addressing space. The address is given either at subscription in which case it is a static address or at PDP context activation in which case it is a dynamic address. This address is used for packet forwarding within the GGSN and for packet forwarding on the Intranet/ISP. This requires a link between the GGSN and an address allocation server, such as Radius, or DHCP, belonging to the Intranet/ISP;
- the communication between the GPRS PLMN and the Intranet/ISP may be performed over any network, even an insecure e.g. the Internet. In case of an insecure connection between the GGSN and the Intranet/ISP there may be a specific security protocol in between. This security protocol is defined by mutual agreement between GPRS PLMN operator and Intranet/ISP administrator.

The following description bullet items describe the signal flow.

- 1) The TE sends an AT-command to the MT to set up parameters.
- 2) The MT sends the Activate PDP context request message to the SGSN which sends the Create PDP context request message to the chosen GGSN.
- 3) The GGSN deduces from the APN:

- the server(s) to be used for address allocation and authentication;
- the protocol such as Radius, DHCP or L2TP to be used with this / those server(s);
- the communication and security feature needed to dialogue with this / those server(s) e.g. tunnel ,IPSec security association, dial-up connection (using possibly PPP).

As an example the GGSN may use one of the following options:

- RADIUS for authentication and IP-address allocation.. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN.
  - RADIUS for authentication and DHCP for host configuration and address allocation. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN. After a successful authentication, the DHCP client discovers the DHCP server(s) in the ISP/Intranet and receives host configuration data.
  - L2TP for forwarding PPP frames to a L2TP Network Server.
- 4) The GGSN sends back to the SGSN a Create PDP Context Response message.
- 5) Depending on the cause value received in the Create PDP Context Response the SGSN may either send the Activate PDP Context Accept message or send the Activate PDP Context Reject message to the MS.
- 6) The MT responds with an AT-response that may indicate whether the context activation was successful or not. In the case of a non-successful context activation the response may also indicate the cause.
- 7) In case of a successful context activation, the TE will start its PPP protocol after the LLC link has been established. The LCP, Authentication and IPCP (in case of IP) negotiations are then carried out end-to-end, or between the TE and the GGSN.

**Example:** In the following example the successful PDP context activation is shown.



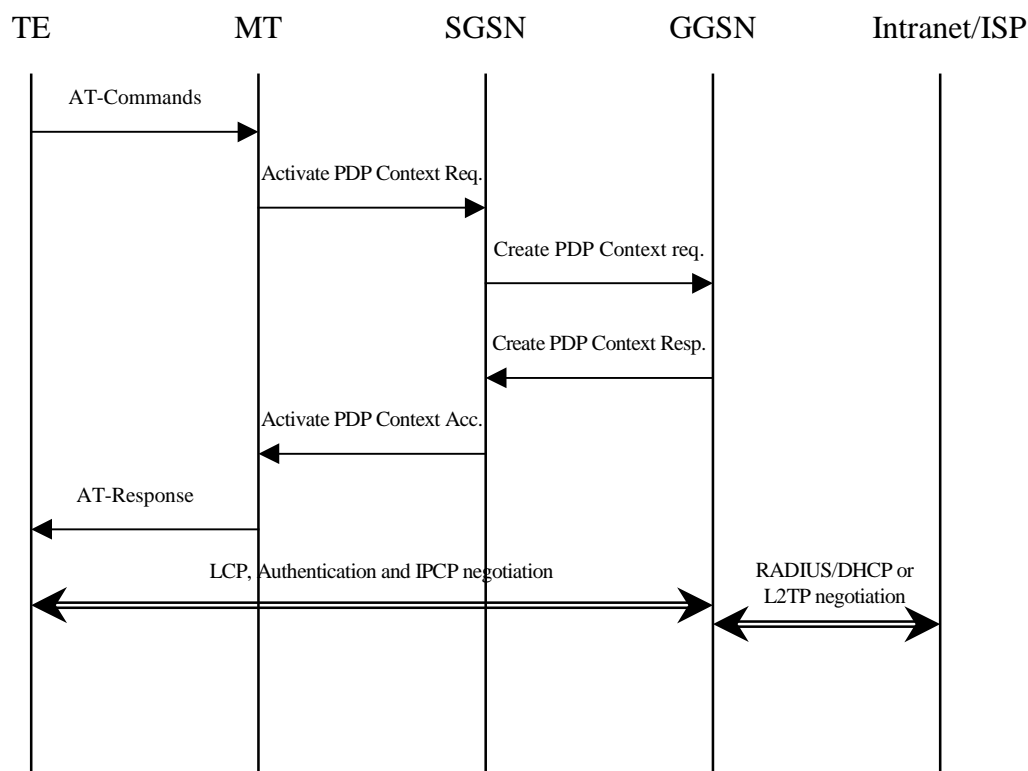


Figure 16

## 13 Internet Hosted Octet Stream Service (IHOSS)

### 13.1 Introduction

This section describes the GGSN aspects of the GPRS Internet Hosted Octet Stream Service (IHOSS). This is a MO-only, connection-oriented service that carries an unstructured octet (character) stream between a GPRS MS and an Internet Host.

IHOSS uses OSP:IHOSS which is a subset of the Octet Stream Protocol (OSP) PDP type to provide a 'character pipe' between the MS and the GGSN. In the GGSN there is a relay function between the OSP and the Internet Host protocol (usually TCP). An annex to GSM 07.60 contains the generic description of OSP. The subset of features of OSP that are used by OSP:IHOSS is also described in GSM 07.60.

Figure 17 shows the scope of IHOSS and OSP:IHOSS.

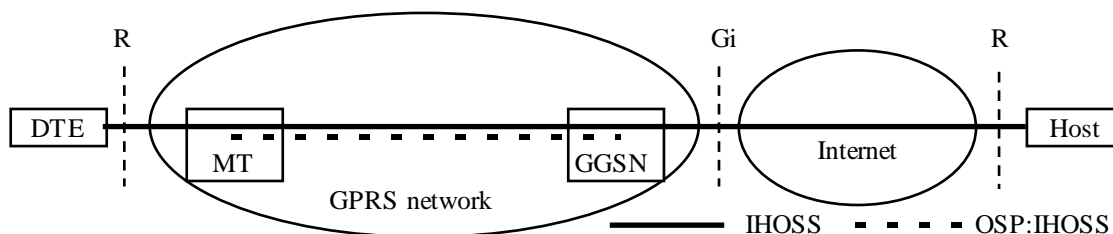
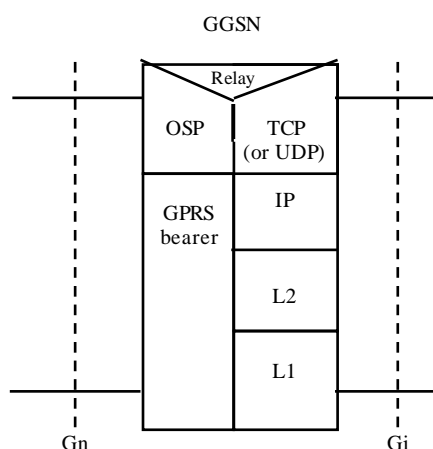


Figure 17: Scope of the Internet Hosted Octet Stream Service and Octet Stream Protocol

## 13.2 Protocol stacks at the GGSN

Figure 18 shows the protocol stacks at the GGSN. The GGSN contains a relay function between OSP and the protocol used on the Internet (usually TCP, alternatively UDP).



**Figure 18: Protocol stacks at the GGSN**

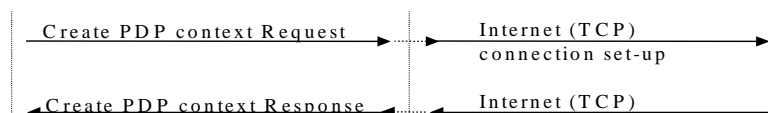
## 13.3 IHOSS connection control and OSP PDP context management

Establishing an IHOSS connection involves setting up two segments, the PLMN segment (using the OSP) between the MS and GGSN, and the Internet segment between the GGSN and the Internet Host. There is a one-to-one mapping between the PLMN segment of an IHOSS connection and an OSP:IHOSS context. When the IHOSS connection is established, an OSP PDP context is activated. When the connection is released, the context is deactivated. Each context supports only one IHOSS connection.

### 13.3.1 Connection establishment and PDP context activation

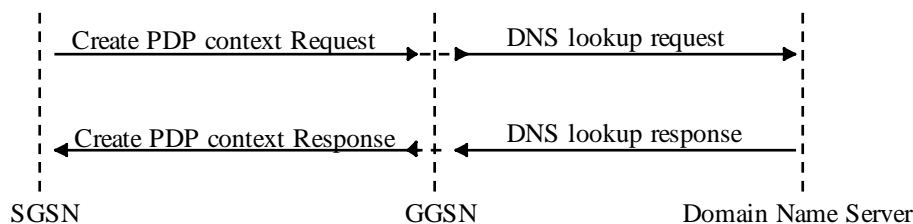
Establishing the PLMN segment of an IHOSS connection follows the normal procedures for PDP context activation described in GSM 03.60 using messages described in GSM 04.08 (MS-SGSN) and GSM 09.60 (SGSN-GGSN).

A request to establish an IHOSS connection is signalled to the GGSN by the receipt of a Create PDP context Request message from an SGSN with the PDP type set to OSP:IHOSS. The PDP configuration options may provide information to enable the GGSN to set up a connection to the Internet host. (The contents and format of the PDP configuration options are described in GSM 07.60.) Alternatively this information may be derived from subscription information in the HLR and configuration information within the GGSN.



**Figure 19: IHOSS connection establishment (TCP over the Internet)**

In the case where TCP is used over the Internet (figure 19), the response creating the context activation request is returned to the SGSN only when the TCP connection to the Internet host has been established. If the TCP connection attempt fails, the request to create a context is rejected.



**Figure 20: IHOSS connection establishment (UDP over the Internet)**

In the case where UDP is used over the Internet (figure 20), the response accepting the context activation request is returned to the SGSN only when a successful DNS lookup of the Internet host name has been completed. If the lookup fails, the request to create a context is rejected. (The GGSN may perform additional checks before responding to the context activation request but these are not specified here.)

### 13.3.2 Connection release and PDP context deactivation

When the IHOSS connection is released the OSP:IHOSS context is deactivated. The disconnection can be originated either by the MS or the Internet host (TCP only), or exceptionally by the SGSN under fault conditions. An MS-initiated or SGSN-initiated disconnection is signalled to the GGSN by the receipt of a Delete PDP context request from an SGSN.

In the case where TCP is used over the Internet, the GGSN first clears the TCP connection and then sends a Delete PDP context response to the SGSN.

In the case where UDP is used over the Internet, the GGSN sends a Delete PDP context response to the SGSN immediately, there being no actual Internet connection to clear.

The GGSN signals an Internet host-initiated disconnection to the SGSN by sending a Delete PDP context request.

## 13.4 OSP:IHOSS - TCP (UDP) relay

### 13.4.1 Required feature

#### 13.4.1.1 Flow control

The OSP flow control procedures shall map on to the TCP flow control procedures. There is no flow control mapping in the case of UDP.

### 13.4.2 Optional features

#### 13.4.2.1 Break handling

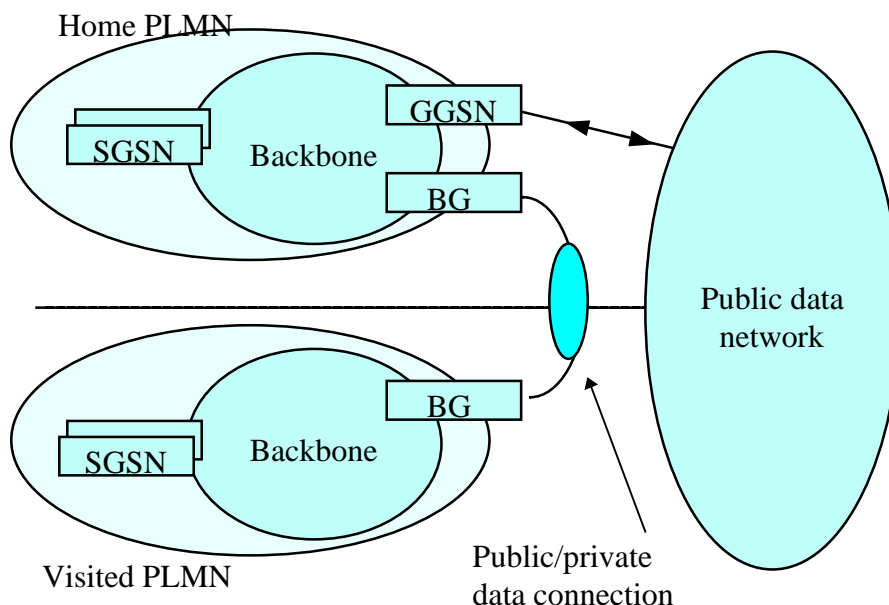
The OSP break procedure may map on to the TCP break procedure. There is no break mapping in the case of UDP.

#### 13.4.2.2 GGSN maximum buffer size

Although the OSP entity in the GGSN does not have a PAD, it still requires buffers to hold the relayed packets. The GGSN PAD maximum buffer size parameters (in the Protocol Configuration Options) may be used to specify the maximum buffer sizes for the two directions of data transfer. Details are given in GSM 07.60.

## 14 Interworking between GPRS networks

The primary reason for the interworking between the GPRS networks is to support roaming GPRS subscribers as described in GSM 03.60. The general model for GPRS network interworking is shown in Figure 21.



**Figure 21: General interworking between GPRS networks to support roaming subscribers**

For roaming subscribers that have a PDP address allocated from the HPLMN a forwarding route between the HPLMN and the VPLMN is created. This route is used for both mobile terminated and mobile originated data traffic. The communication is done via the BGs (Border Gateways) as described in GSM 03.60.

The procedures to set the link between the SGSN in the VPLMN and the GGSN in the HPLMN is described in GSM 03.60.

The inter-PLMN link may be any packet data network or dedicated link as described in GSM 03.60. The GPRS operators may have a dedicated inter-PLMN link to fulfil the QoS requirements of a certain protocol.

### 14.1 Security Agreements

Each GPRS operator may support IPsec (RFC 1825) and accompanying specifications for authentication (RFC 1826) and encryption (RFC 1827) as a basic set of security functionality in its border gateways. The GPRS operators may decide to use other security protocols based on bilateral agreements.

### 14.2 Routing protocol agreements

Each GPRS operator may support BGP (RFC 1771) as a basic set of routing functionality in its border gateways. The GPRS operators may decide to use other routing protocols based on bilateral agreements.

### 14.3 Charging agreements

Sharing the cost of the inter-PLMN link is subject to the agreement between the GPRS operators.

There may be a requirement to collect charging information in the Border Gateway (see Figure 12) and this is down to the normal interconnect agreement between PLMN and PDN operators.

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## Annex A (normative): Interworking PCS1900 with PSDNs

### A.1 Key characteristics of interworking PCS1900 with PSDNs

Bell Operating Company's (BOC's) Public Packet Switching Networks provide data transport services within its LATA and support data transport as follows:

- between Terminal Equipment (TE) and host computers,
- between TE to TE, between host computer to host computer,
- and interface to Private Networks within LATA.

The interface to other Packet Switched Public Data Networks (PSPDNs) outside the LATA is via Interexchange Carriers (ICs).

For PCS1900, two types of PSDN may exist - those outside a BOC's LATA and those inside.

#### A.1.1 PSPDNs which are outside the BOC's LATA

PSPDNs which are outside the BOC's LATA are connected via X.75 interface. Interworking is the same as described in section 10.2.1, X.75 Interworking at the Gi Reference Point.

#### A.1.2 PSPDNs which are inside the BOC's LATA

BOC's PPSN consists of Data Switching Exchanges (DSE) and ISDN Packet Handler Functions (PHFs).

The Bellcore defined X.75' protocol is used on intranetwork DSE to DSE, DSE to ISDN Packet Handler Function (PHF), and ISDN PHF to ISDN PHF within BOC administered networks, and is used for intra-LATA packet data calls. X.75 interface is used on ICs connected to other PSPDNs outside the LATA.

Therefore, in order to support packet data services within BOC's LATA for PCS 1900 subscribers, support of Bellcore defined X.75' interface is required at the Gi interface.

Bellcore defined X.75' protocol is an extension of X.75 protocol. The extension consists primarily of additional utilities some of which are analogous to X.25 facilities. The extension is necessary to maintain service transparency when interconnection equipment supplied by different manufacturers within a single network.

The rest of this annex describes X.75' interworking.

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## A.2 Subscription checking

Subscriptions checking for Bellcore defined X.75' interface is outside the scope of this specification.

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## A.3 Interworking PCS1900 with PSDN using X.75'

### A.3.1 General

GPRS shall support interworking with PSDN networks. The interworking may be either direct or through a transit network (e.g. ISDN).

GPRS shall support both ITU-T X.121 and ITU-T E.164 addressing.

GPRS shall provide support for interworking using Bellcore specified X.75' protocol for data transport within BOC's LATA.

The GPRS TE's shall have addresses provided, and controlled, by their GPRS operator. The PSDN TE sends data to the GPRS TE by use of that TE's GPRS DNIC (Data Network Identification Code) or equivalent which uniquely identifies that GPRS network worldwide.

The GGSN for interworking with PSDNs is the access point of the GSM GPRS data network.

The X.75' access method is supported when mobile users are resident on HPLMN or VPLMN. A roaming user may be allocated a dynamic address from the VPLMN.

### A.3.2 PSDN Interworking Model using X.75' Interworking at the Gi Reference Point

Figure X.1 represents the case where X.75' is used as the interworking protocol, as used between interconnect X.25 PSDNs within the BOC's LATA. The GPRS network will look like any other PSDN in the BOC's LATA and will use X.75' addressing. Figure 4 shows the interconnecting protocol stacks to the GPRS bearer. The GPRS bearer is described in GSM 07.60, which uses the protocols described in GSM 03.60.

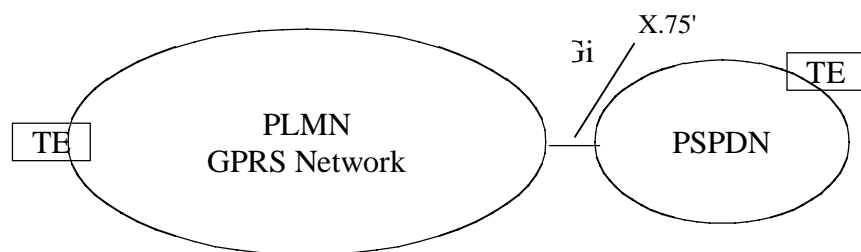


Figure A.1: PSPDN Interworking with X.75' at Gi Reference Point

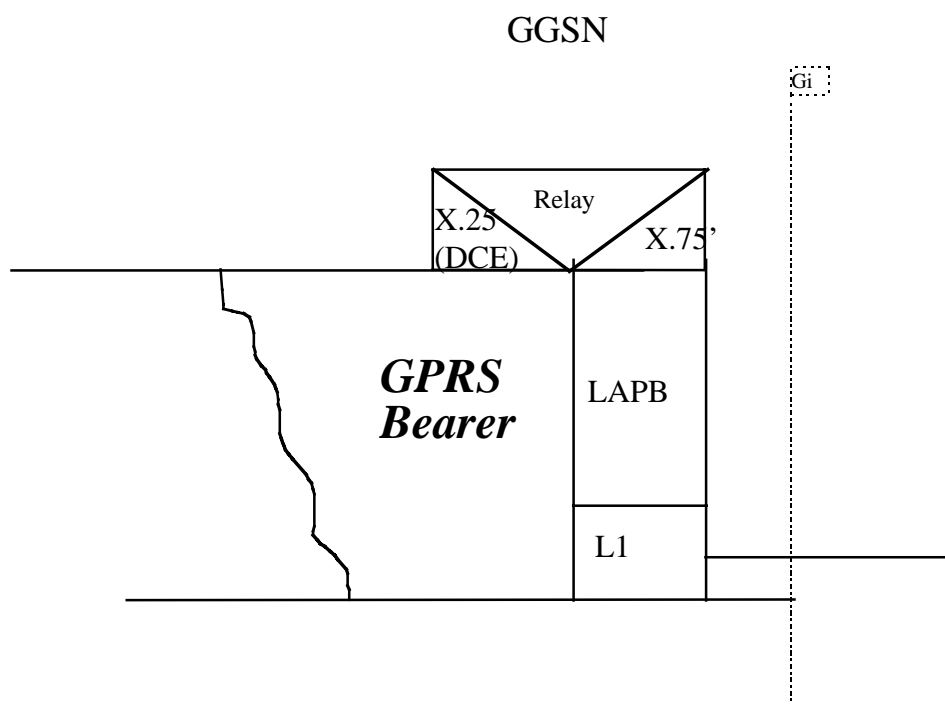


Figure A.2: The Protocol Stack for the X.75' Gi Reference Point

### A.3.3 Numbering and Addressing

A PLMN GPRS network requires a DNIC or PNIC.

X.121 addresses allocated to subscribers belong to the PLMN operator.

### A.3.4 Charging

Charging of X.25 packets is done at the GGSN.

### A.3.5 User Facilities

These are the same as in section 10.3 in the main part of this specification.

### A.3.6 The GPRS Interworking to PSDN Characteristics

These are the same as in section 10.4 in the main part of this specification.

## Annex B (informative): Document change history

SMG#	TDoc	SPEC	CR	RE	PHA	OLD_V	SUBJECT	CAT	NEW_V
s25	98-0101	09.61	A001		R97	5.0.0	Access to an Intranet or ISP through GPRS	C	6.0.0
s26	98-0292	09.61	A002		R97	6.0.0	Authentication protocol when accessing an intranet or ISP through GPRS	F	6.1.0
s26	98-0292	09.61	A003		R97	6.0.0	Clarifications to Intranet/ISP Interworking section	F	6.1.0
s26	98-0292	09.61	A004		R97	6.0.0	Architecture Diagrams	F	6.1.0
s26	98-0292	09.61	A005		R97	6.0.0	Editorial review of 09.61	F	6.1.0
s26		09.61			R97	6.1.0	Correction of Word 95/97 problem (incomplete incorporation of CR A003 into V6.1.0)		6.2.0
s27	98-0735	09.61	A006		R97	6.2.0	Protocol Configuration Options at PDP context activation failure	F	6.3.0
s27	98-0735	09.61	A008		R97	6.2.0	Clarifications on IP interworking	F	6.3.0
s28	99-0062	09.61	A011		R98	6.3.0	X.75' interface specifications at GGSN-PSPDN (Gi) interface	B	7.0.0
s29	99-0058	09.61	A012		R98	7.0.0	Access to PDNs and ISPs with the PDP-type PPP	B	7.1.0
s29	99-0058	09.61	A013		R98	7.0.0	GPRS Internet Hosted Octet Stream Service (IHOSS)	B	7.1.0
TSG#6	NP-99431	09.61	A015		R98	7.1.0	ICPC negotiations for interworking at the Mtf for NT IP	D	7.2.0



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## History

Document history		
V7.1.0	July 1999	Publication
V7.2.0	February 2000	Publication