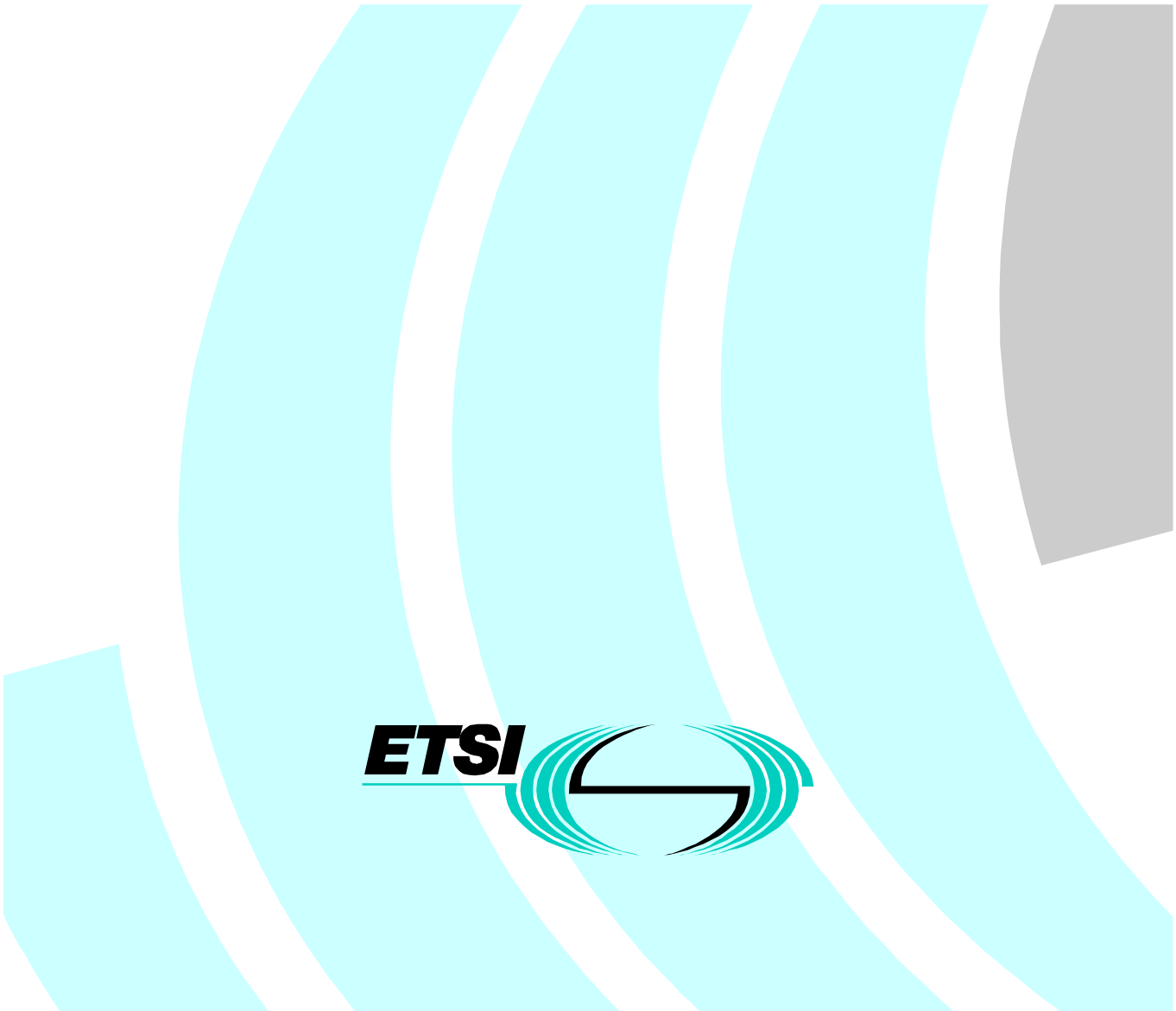
ETSI TR 101 976 V1.1.1 (2001-07)

Technical Report

Terrestrial Trunked Radio (TETRA); Guide to TETRA Advanced Packet Service (TAPS)



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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

1 Scope

The present document contains a reference model for the understanding of an advanced packet data service for TETRA (TAPS). This service adapts (E)GPRS technology to provide an overlay network for TETRA systems.

2 References

For the purposes of this Technical Report (TR) the following references apply:

[1] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

[2] ETSI EN 300 392-3: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI)".

[3] ETSI ETS 300 392-4: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 4: Gateways basic operation".

[4] ETSI EN 300 392-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 5: Peripheral Equipment Interface (PEI)".

[5] ETSI EN 300 392-9: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 9: General requirements for supplementary services".

[6] ETSI ETS 300 392-10 (series): "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 10: Supplementary services stage 1".

[7] ETSI ETS 300 392-11 (series): "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 11: Supplementary services stage 2".

[8] ETSI ETS 300 392-12 (series): "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 12: Supplementary services stage 3".

[9] ETSI ETS 300 395: "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel".

[10] ETSI ETS 300 396 (series): "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO)".

[11] GSM 03.64: "Digital cellular telecommunications system (Phase 2+) (GSM); General Packet Radio Service (GPRS); Overall description of GPRS radio interface; Stage 2".

[12] GSM 05.01: "Digital cellular telecommunications system (Phase 2+) (GSM); Physical layer on the radio path; General description".

[13] GSM 05.04: "Digital cellular telecommunications system (Phase 2+) (GSM); Modulation".

[14] GSM 05.05: "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception".

[15] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[16] GSM 05.10: "Digital cellular telecommunications system (Phase 2+); Radio subsystem synchronization".

[17] GSM 05.02: "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".

[18] GSM 05.03: "Digital cellular telecommunications system (Phase 2+) (GSM); Channel coding".

[19] GSM 04.60: "Digital cellular telecommunications system (Phase 2+) (GSM); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol".

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

[21] GSM 04.65: "Digital cellular telecommunications system (Phase 2+) (GSM); General Packet Radio Service (GPRS); Mobile Station (MS) - Serving GPRS Support Node (SGSN); Subnetwork Dependent Convergence Protocol (SNDCP)".

[22] GSM 09.61: " Digital cellular telecommunications system (Phase 2+) (GSM);General Packet Radio Service (GPRS); Interworking between the Public Land Mobile Network (PLMN) supporting GPRS and Packet Data Networks (PDN)"

[23] 3GPP TS 29.002: "3rd Generation Partnership Project; Technical Specification Group Core Network; Mobile Application Part (MAP) Specification (Release 1999)".

[24] 3GPP TS 29.060: 3rd Generation Partnership Project; Technical Specification Group Core Network; GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface (Release 1999)".

[25] ETSI TS 101 962 (V1.1.1): "Terrestrial Trunked Radio (TETRA); TETRA Advanced Packet Service (TAPS)".

[26] ETSI TS 101 747: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); IP Interworking (IPI)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Air interface (Um interface): the interface between Mobile Station and TAPS network

Gb interface: the interface between an SGSN and a BSS

Gi interface: the interface between Packet Domain and an external packet data network

Gn interface: the interface between two GSNs within the same PLMN

Gp interface: the interface between two GPRS Support Nodes (GSNs) in different PLMNs

Gr interface: the interface between the Serving GPRS Support Node and the Home Location Register

Ud interface: Direct Mode Air Interface

Um interface: the interface between a GSM MS and GSM BTS

3.2 Abbreviations

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

AI	Air Interface
BSS	Base Station System
BTS	Base Transceiver Station
EDGE	Enhanced Data rates for GSM Evolution
EGPRS	EDGE GPRS
(E)GPRS	(Enhanced) General Packet Radio Service (which means both GPRS and EGPRS)
GGSN	Gateway GPRS Support Node

GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
HLR	Home Location Register
ISDN	Integrated Services Digital Network
IP	Internet Protocol
IPI	IP Interworking
ISP	Internet Service Provider
L1	Layer 1
L2	Layer 2
LLC	Logical Link Control
MAC	Medium Access Control
MNI	Mobile Network Identity
MS	Mobile Station
PDN	Packet Domain Network
PEI	Peripheral Equipment Interface
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
RF	Radio Frequency
RLC	Radio Link Control
RX	Receiver
SGSN	Serving GPRS Support Node
SNDCP	SubNetwork Dependent Convergence Protocol
SwMI	Switching and Management Infrastructure
TETRA	TErrestrial Trunked RAdio
UIC	Union International des Chemins de fer
V+D	Voice plus Data

4 Service Requirements

TETRA Advanced Packet Service (TAPS) provides high speed packet data at speeds approximately 10 times that available in existing TETRA, to support multimedia and other high speed data applications required by existing and future TETRA users.

TAPS enables the service subscriber to send and receive data in an end-to-end packet transfer mode, without utilizing network resources in circuit switched mode.

TAPS enables the cost effective and efficient use of network resources for packet mode data applications e.g. for applications that exhibit one or more of the following characteristics:

- intermittent, non-periodic (i.e. bursty) data transmissions, where the time between successive transmissions greatly exceeds the average transfer delay;
- frequent transmissions of small volumes of data, for example transactions consisting of less than 500 bytes of data occurring at a rate of up to several transactions per minute;
- infrequent transmission of larger volumes of data, for example transactions consisting of several kilobytes of data occurring at a rate of up to several transactions per hour.

Within TAPS, two different bearer service types are defined. These are:

- Point-To-Point (PTP);
- Point-To-Multipoint (PTM).

The requirements for TAPS are stated in TS 101 962 [25]

5 Overview of standardized interfaces

The TETRA standards define a number of interfaces to support mobile services as shown in figure 1. The central component of the standard reference model is the Switching and Management Infrastructure (SwMI) which provides circuit and packet switched telecommunication services to mobile stations (MSs).

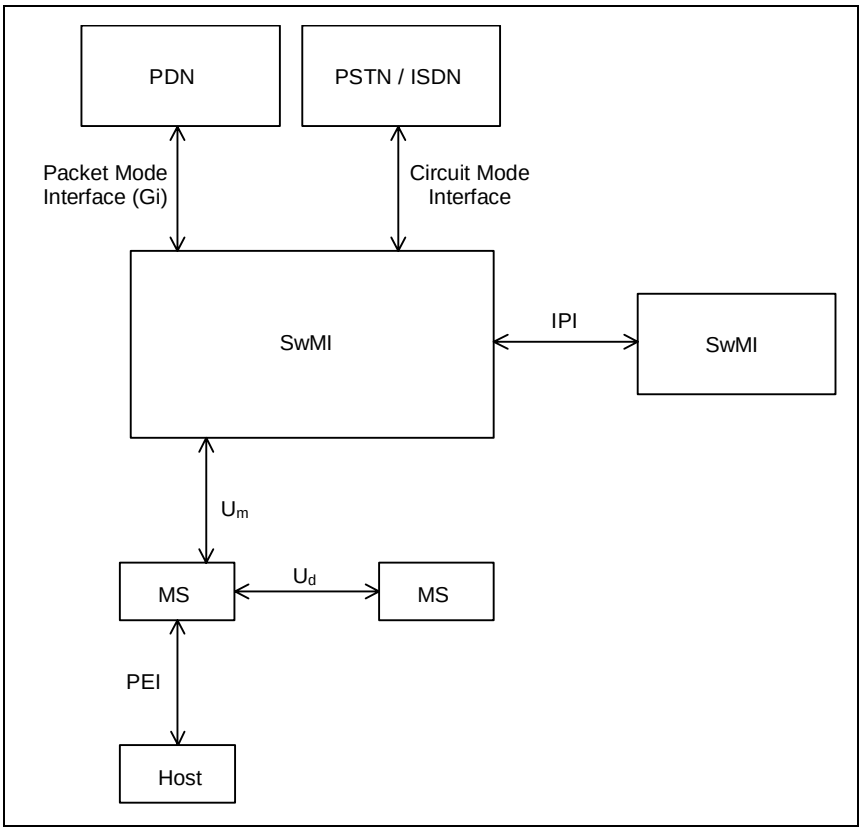

Figure 1: Existing TETRA V+D Interfaces

The internal SwMI architecture is not defined by the standard but only the external interfaces between the SwMI and other entities. The standardized interfaces are:

- Trunked Mode Air Interface (Um) EN 300 392-2 [1]
- Direct Mode Air Interface (Ud) ETS 300 396 [10]
- IP Interface (IPI) [26]
- Inter-system Interface (ISI) EN 300 392-3 [2]
- Peripheral Equipment Interface EN 300 392-5 [4]
- PSTN/ISDN Network Interface ETS 300 392-4 [3]

There are also standards related to operation across multiple interfaces such as the speech codec ETS 300 395 [9] and supplementary services EN 300 392-9 [5], ETS 300 392-10 (series) [6], ETS 300 392-11 (series) [7], ETS 300 392-12 (series) [8].

The TETRA TAPS standard described in the present document seeks to enhance the capability of TETRA to support enhanced data rate capability for packet data. In order to achieve this, additional standard interfaces are proposed as shown in figure 2.

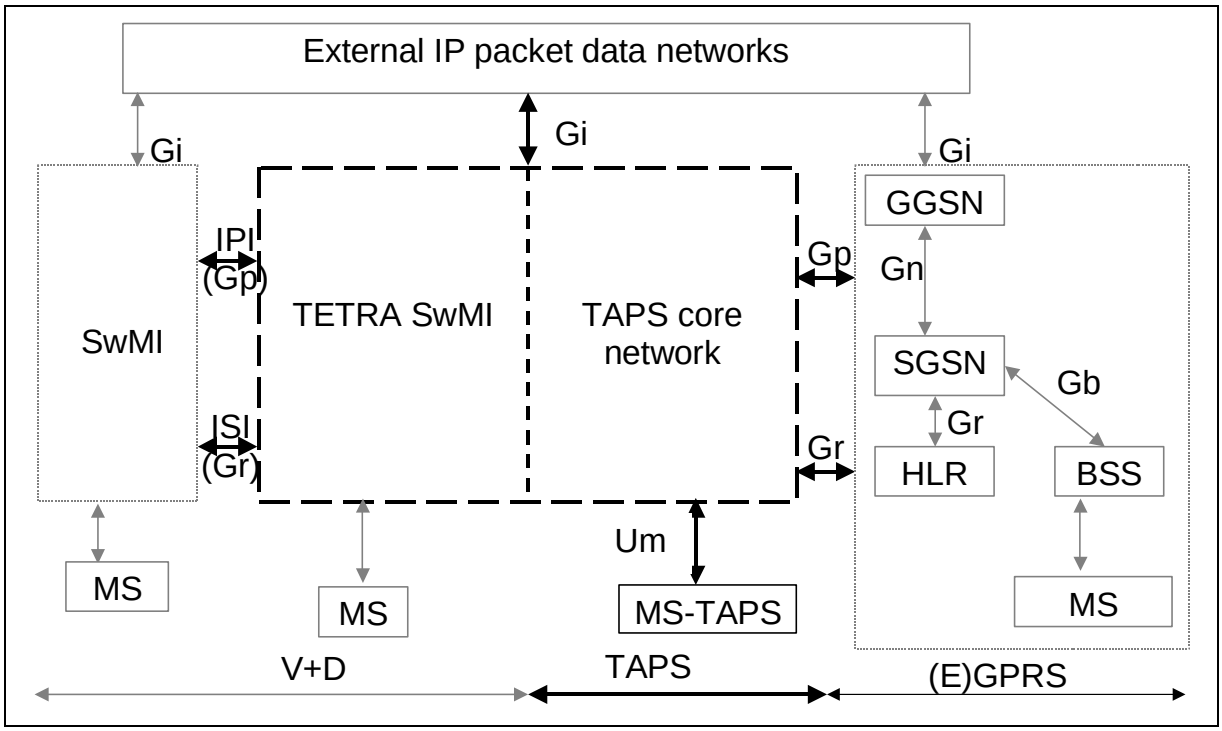

Figure 2: TETRA TAPS Standard Interfaces

Subsequent sections in the present document outline each of the interfaces to be standardized for high speed data operation.

The four interfaces within the scope of the TETRA TAPS standard are:

- Air Interface (Um)
- Packet Data Network Interface (Gi)
- TETRA-GSM Inter-network Interfaces (Gp and Gr)

Future standardization will be driven by the needs of service integration, and that this may result in the incorporation of additional core network interfaces from (E)GPRS.

6 Air Interface

In order to add high speed packet data services to the TETRA standard a new air interface is added between the MS and network. This interface is referred to as U_m with a protocol stack as shown in figure 3. The components of the protocol stack re-use, as far as possible, the (E)GPRS standards drafted by ETSI for GSM systems. An overview of the (E)GPRS air interface is covered by GSM 03.64 [11].

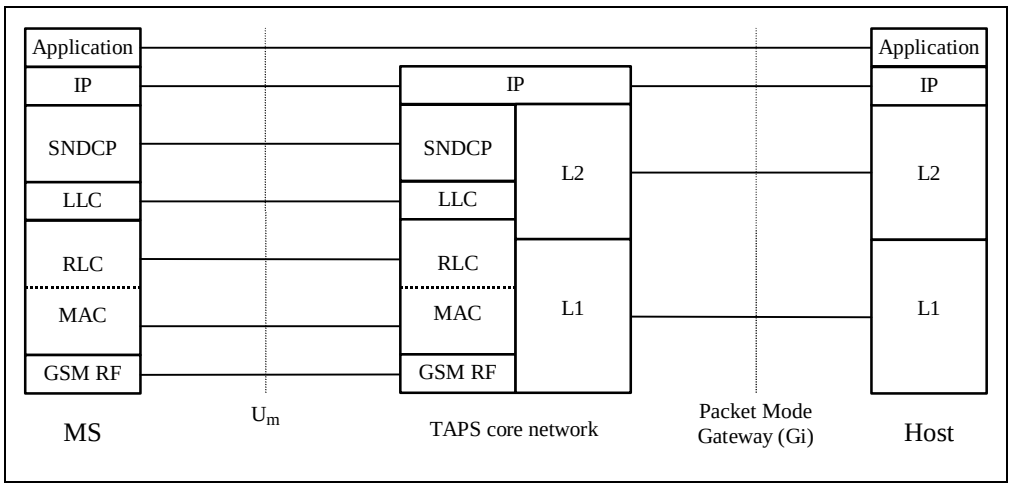

Figure 3: TETRA TAPS Air Interface Protocol Stack

An overview of the air interface protocol can be found in GSM 03.64 [11]. Each layer of the protocol stack is described by GSM standard documents as follows:

- Physical Layer (RF parameters and modulation) GSM 05.01 [12], GSM 05.02 [17], GSM 05.03 [18], GSM 05.04 [13], GSM 05.05 [14], GSM 05.08 [15], GSM 05.10 [16];
- MAC Layer:
  - channel coding GSM 05.03 [18];
  - slot and frame structure GSM 05.02 [17];
  - protocol aspects GSM 04.60 [19];
- LLC Layer GSM 04.64 [20];
- SNDCP (mobility and data transfer) GSM 04.65 [21].

For the purposes of the present document, it is assumed that the packet mode gateway interface for TETRA is the same as the Gi interface for (E)GPRS.

TAPS applies to TETRA TAPS MS and TETRA TAPS network. TAPS covers the variations to the core GSM standards for TETRA TAPS operation.

6.1 Classes of terminal

Class-C mode is the only GSM MS mode of operation supported, as all circuit switched channels, including speech channel are outside the scope of TAPS. In class C mode, the MS is exclusively attached to the GPRS network.

6.2 Service interaction

Service interaction with circuit switched channels is outside the scope of TAPS.

6.3 GSM standard references and deltas

The basis for TAPS is the following:

1) The specifications from 3GPP Release 1999, are used as the basis.
2) 77 specifications are wholly applicable.
3) 19 specifications are applicable in part, where some clauses are omitted.
4) 10 specifications contain modifications to individual clauses.
5) The technical changes fall into two main categories:
   a. Changes necessary to exclude circuit-switched connections from the scope of TAPS.
   b. Changes necessary to make the specifications apply to the TETRA frequency bands.

6.3.1 Physical layer

(E)GPRS Transposition to TETRA environment

The following text describes in general the adaptations to the physical layer for TAPS.

Frequency bands and channel arrangement

The TAPS standard is designed to cover the TETRA bands 380 MHz - 400 MHz, 410 MHz - 430 MHz , 450 MHz - 470 MHz, 870 MHz - 876/915 MHz - 921 MHz. These bands are covered by ERC DEC (96)01 and ERC DEC (96)04 with uplink in the lower half of the band and downlink in the upper half. The duplex separation is 10 MHz for the 400 MHz bands and 45 MHz for the 800/900 MHz band. Channel numbering has been adapted to allow for a flexible frequency allocation within the boundaries of the frequency bands.

Transmitter characteristics

The transmitter characteristic is standardized to the same levels as TETRA V+D in the 400 MHz frequency range although being a 200 kHz channel separation service. This obviously needs careful consideration for frequency allocations close to narrow band services because of the associated noise bandwidth. In the 800/900 MHz band similar characteristics as for (E)GPRS have been standardized. Protection to the GSM BTS RX has been maintained to the same level as in the GSM standard. CEPT ERC SE will determine the guard bands necessary for both the 400 MHz and the 800/900 MHz bands.

Receiver characteristics

The Receiver characteristics have been standardized to be the same as (E)GPRS with the exception of the blocking characteristics which because of the service being PMR/PAMR has been made the same as TETRA V+D. This also provides for the flexible frequency arrangement that has been introduced.

Transmitter and receiver performance

The performance of the transmitter and the receiver are generally similar to that of (E)GPRS. The changes introduced are solely concerned with the matching of the frequency bands and the introduction of flexibility in frequency assignment in the 400 MHz bands.

Spectrum characteristics

In terms of spectrum utilization in the 400 MHz bands TAPS is capable of a maximum utilization of 2 x 8 MHz. This has been achieved by limiting the necessary separation between uplink and down link frequencies to 2 MHz. The position of the separation may be entirely in the downlink band, entirely in the uplink band or may be spread between the up- and downlink bands. At the 800/900 MHz band it is anticipated, subject to confirmation from CEPT ERC SE, that a guard band of 1 MHz may be necessary between GSM BTS RX and TAPS if allocated uncoordinated, similar to the border with UIC where a 200 kHz - 600 kHz guard band is anticipated.

Environmental condition

Environmental requirements are the same as for GSM equipment.

Repeater characteristics

Repeater characteristics are the same as for GSM equipment.

6.3.2 Data link layer

The requirements are the same as for (E)GPRS.

6.3.3 RRC/RLC/MAC layer

The requirements are the same as for (E)GPRS, except that requirements associated with circuit-switched connections are deleted.

6.3.4 Mobility management and GPRS session management

The requirements are the same as for (E)GPRS, except that requirements associated with circuit-switched connections are deleted, and that the Mobile Station Classmark and Mobile Station Radio Access Capability information elements are extended to address access to TAPS networks.

7 Interface to packet data networks

The Packet Domain can operate IPv4 or IPv6. The interworking point is the Gi interface. The Gi Reference point is the interface between the Packet Domain and an external packet data network.

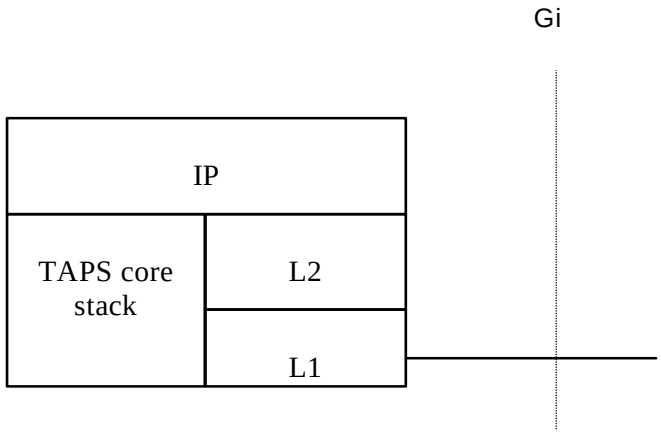

Figure 4: The protocol stacks for the IP/Gi reference point

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

It is out of the scope of the present document to standardize the router functions and the used protocols in the Gi reference point.

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

Access to the Internet and intranets may involve specific functions such as user authentication, user's authorization, end-to-end encryption between MS and Intranet/ISP, allocation of dynamic addresses belonging to the TETRA Network/Intranet/ISP addressing space, high level mobility management. There are multiple options for higher layer interworking to Internet and intranets. These options are not different from those described in GSM 09.61 [22]. Additional options such as those described in further evolution of the GSM 09.61 [22] specifications are also possible (e.g. mobile IP).

8 Roaming between TETRA TAPS and TETRA V+D

This is outside the scope of TETRA TAPS at this time.

9 Roaming with GSM networks

This clause describes the basis for roaming/migration between TETRA TAPS and (E)GPRS networks.

The high speed packet data overlay allows a TETRA TAPS MS to obtain high-speed packet data services from a TETRA TAPS network. Given that this service is provided using (E)GPRS technology, it is desirable to facilitate interworking and roaming between TETRA TAPS high speed data networks and (E)GPRS networks. Such interworking can be enabled by supporting network interfaces between a TETRA TAPS network and (E)GPRS network as shown in figure 5.

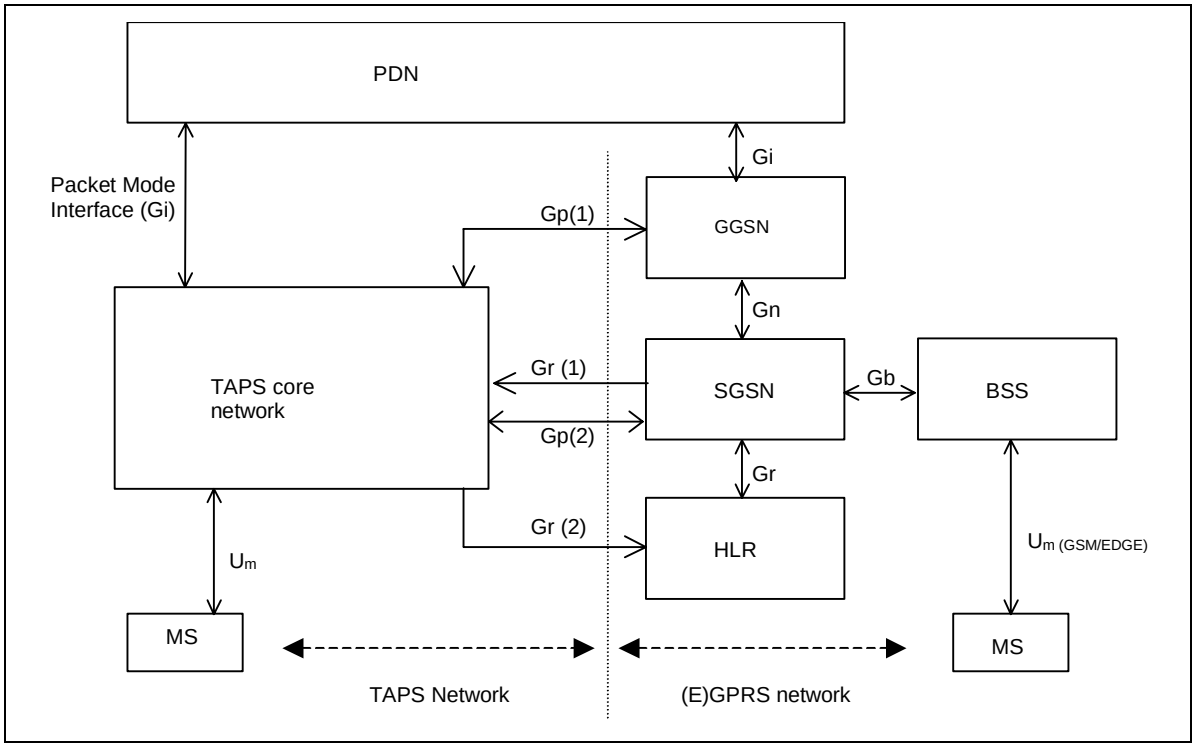

Figure 5: Interfaces between TETRA TAPS and (E)GPRS

The interworking between (E)GPRS and TETRA TAPS is defined by two interface specifications:

- Mobility management, Gr interface (defined within GSM MAP specification 3GPP TS 29.002 [23])
- Data transfer and call control, Gp interface (defined along with Gn interface in 3GPP TS 29.060 [24])

The Gr interface allows the TETRA TAPS network to retrieve packet data service parameters for a GSM subscriber that has migrated to a TETRA TAPS network (Gr (2) in figure 5) and for a TETRA TAPS subscriber that has migrated to a (E)GPRS PLMN (Gr (1) in figure 5). The Gp interface in figure 5 provides a tunnel for data transfer between the GSM and TETRA TAPS networks. When the GSM subscriber migrates to a TETRA TAPS network, the TETRA TAPS network uses the Gp(2) interface to inform the GSM network that packet data for that subscriber should be tunnelled to the TETRA TAPS network for delivery to the subscriber. Similarly, the converse is true for a TETRA TAPS subscriber migrating to a (E)GPRS PLMN using the Gp(1) interface.

10 Implementation examples

Since TAPS references GSM (E)GPRS standards, there are various possible implementations that take advantage of (E)GPRS core network components and internal interfaces. Figure 6 shows one such implementation possibility which shows how TAPS may be implemented using such components.

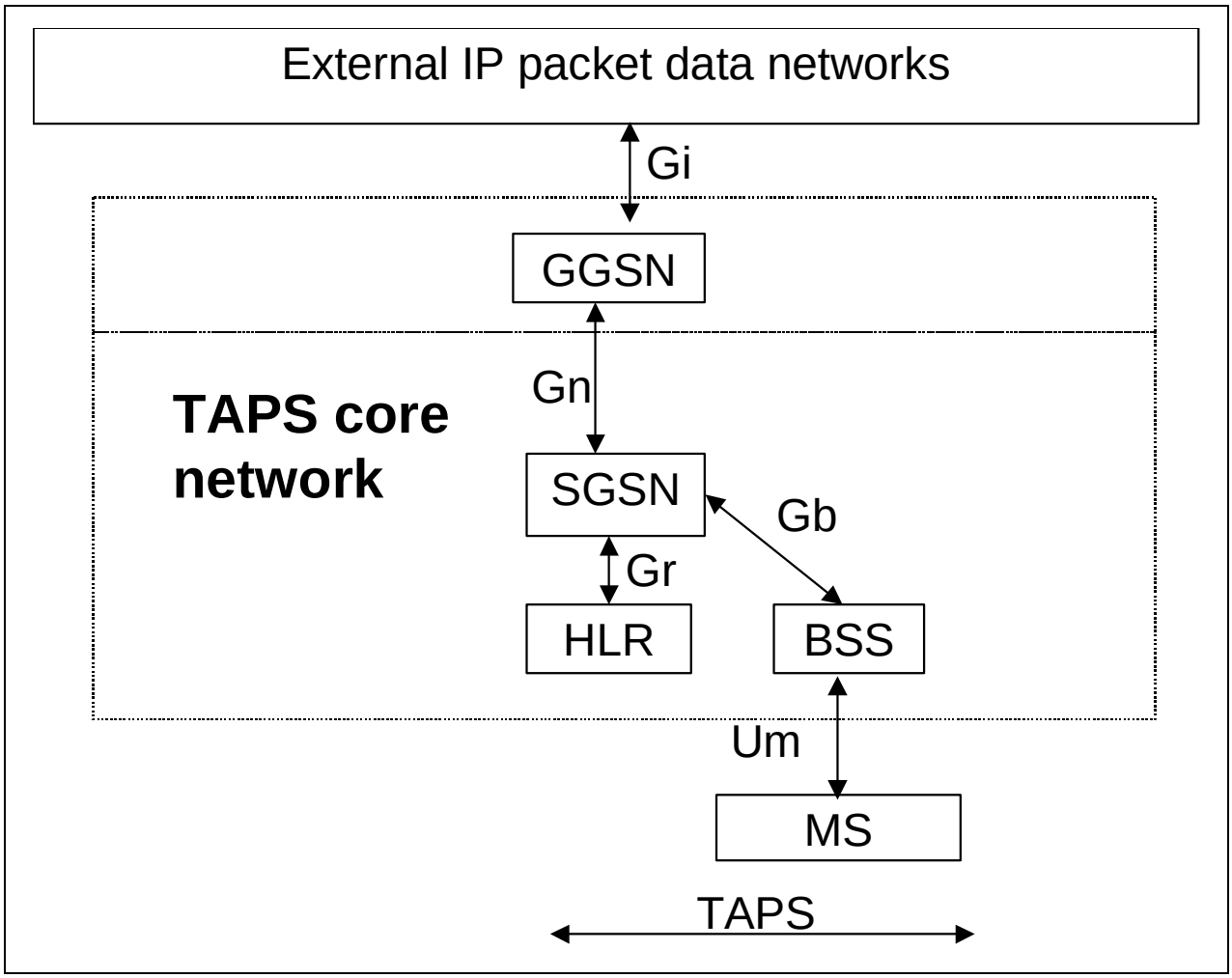

Figure 6: Possible TAPS Implementation

Since TAPS is an overlay on the already standardized TETRA V+D SwMI, it may not be evident how it may interwork with packet data provided by the already existing TETRA V+D standard. Figures 7 and 8 show two possible implementations that provide a common interface point using Gi (i.e. IP) or Gn (GPRS Tunnelling Protocol (GTP)). These figures provide examples of possible levels of integration between TETRA V+D packet data and TAPS.

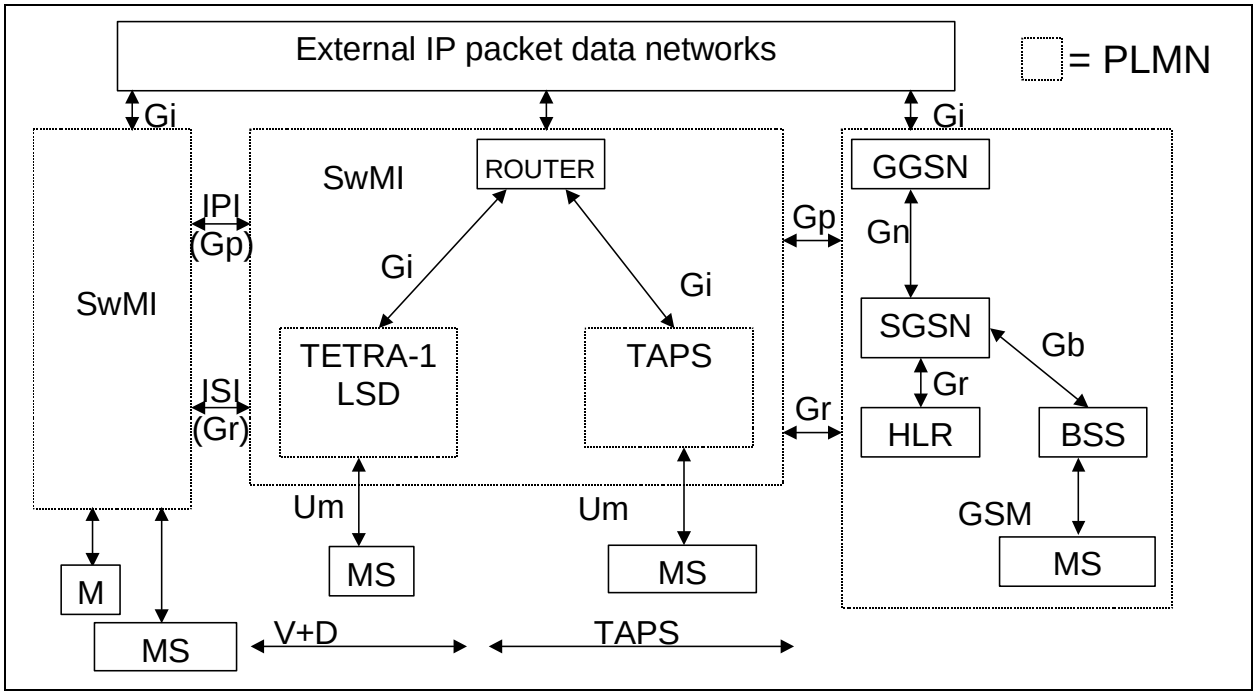

Figure 7: Possible Interworking Implementation based on Gi

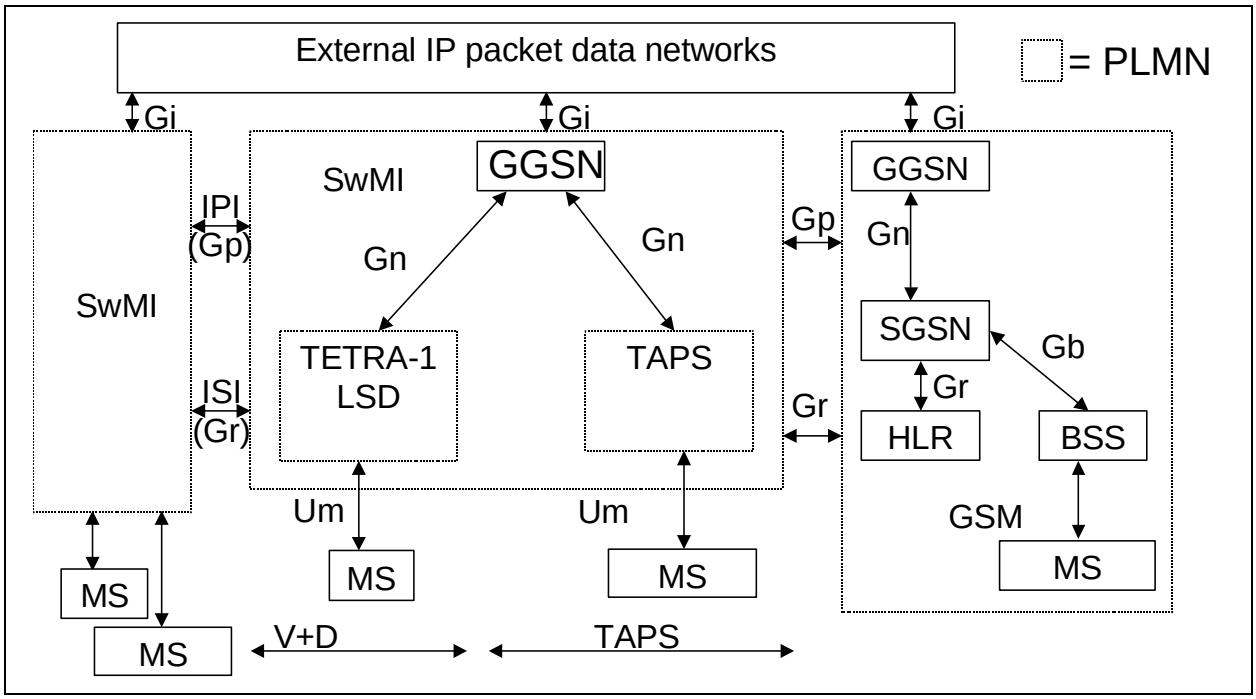

Figure 8: Possible Interworking Implementation based on Gn

Note that the interfaces to GSM networks shown in figures 7 and 8 are expected to evolve so that these interfaces will also provide connectivity to UMTS networks.

History

Document history		
V1.1.1	July 2001	Publication