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TECHNICAL SPECIFICATION

**Satellite Earth Stations and Systems (SES);
Family SL Satellite Radio Interface (Release 1);
Part 1: General Specifications;
Sub-part 1: Services and Architectures**

Important notice

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document is part 1, sub-part 1 of a multi-part deliverable covering the Family SL Satellite Radio Interface (Release 1), as identified below:

Part 1: **"General Specifications";**

    Sub-part 1: **"Services and Architectures";**

    Sub-part 2: "System Operation Overview";

    Sub-part 3: "Satellite Radio Interface Overview";

    Sub-part 4: "Applicable External Specifications, Symbols and Abbreviations";

Part 2: "Physical Layer Specifications";

    Sub-part 1: "Physical Layer Interface";

    Sub-part 2: "Radio Transmission and Reception";

Part 3: "Control Plane and User Plane Specifications";

    Sub-part 1: "Bearer Control Layer Interface";

    Sub-part 2: "Bearer Control Layer Operation";

    Sub-part 3: "Bearer Connection Layer Interface";

    Sub-part 4: "Bearer Connection Layer Operation";

    Sub-part 5: "Adaptation Layer Interface";

    Sub-part 6: "Adaptation Layer Operation";

    Sub-part 7: "NAS Layer Interface Extensions for MBMS Services";

    Sub-part 8: "NAS Layer and User Plane Operation for MBMS Services";

    Sub-part 9: "Initiation and Operation of User Plane";

Part 4: "Enhanced Services and Applications";

    Sub-part 1: "Multiple Voice Services";

    Sub-part 2: "Aeronautical Safety Services";

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

This multi-part deliverable (Release 1) defines a satellite radio interface that provides UMTS services to users of mobile terminals via geostationary (GEO) satellites in the frequency range 1 518,000 MHz to 1 559,000 MHz (downlink) and 1 626,500 MHz to 1 660,500 MHz and 1 668,000 MHz to 1 675,000 MHz (uplink).

1   Scope

The present document describes the range of user services that are provided by the Family SL satellite radio interface and the associated satellite network. The present document also describes the satellite network architecture, the radio interface protocol architecture, and the network interfaces.

The Family SL satellite radio interface is intended to form part of the satellite component of IMT-2000 systems and is based on the components and interfaces of terrestrial UMTS.

2   References

2.1   Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1]   ETSI TS 123 060: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS); Service description; Stage 2 (3GPP TS 23.060 Release 4)".

[2]   Recommendation ITU-T Q.2210: "Message transfer part level 3 functions and messages using the services of ITU-T Recommendation Q.2140".

2.2   Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1]   ETSI TS 122 002: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Circuit Bearer Services (BS) supported by a Public Land Mobile Network (PLMN) (3GPP TS 22.002 Release 4)".

[i.2]   ETSI TS 122 003: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Circuit Teleservices supported by a Public Land Mobile Network (PLMN) (3GPP TS 22.003 Release 4)".

[i.3]   ETSI TS 123 002: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Network architecture (3GPP TS 23.002 Release 4)".

[i.4]   ETSI TR 127 901: "Universal Mobile Telecommunications System (UMTS); Report on Terminal Interfaces - An Overview (3GPP TR 27.901 Release 4)".

[i.5]   ETSI TS 123 246: "Universal Mobile Telecommunications System (UMTS); Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description (3GPP TS 23.246 Release 7)".

[i.6] ETSI TS 126 110: "Universal Mobile Telecommunications System (UMTS); Codec for Circuit Switched Multimedia Telephony Service; General Description (3GPP TS 26.110 Release 4)".

[i.7] Recommendation ITU-T Q.711: "Functional description of the signalling connection control part".

[i.8] ETSI TS 127 010: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Terminal Equipment to Mobile Station (TE-MS) multiplexer protocol (3GPP TS 27.010 Release 4)".

[i.9] ETSI TS 127 007: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; AT command set for User Equipment (UE) (3GPP TS 27.007 Release 4)".

[i.10] ETSI TS 127 005: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS) (3GPP TS 27.005 Release 4)".

[i.11] ETSI TS 131 101: "Universal Mobile Telecommunications System (UMTS); UICC-terminal interface; Physical and logical characteristics (3GPP TS 31.101 Release 4)".

[i.12] ETSI TS 125 410: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu Interface: General Aspects and Principles (3GPP TS 25.410 Release 4)".

[i.13] ETSI TS 125 411: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu Interface Layer 1 (3GPP TS 25.411 Release 4)".

[i.14] ETSI TS 125 412: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface signalling transport (3GPP TS 25.412 Release 4)".

[i.15] ETSI TS 125 413: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface Radio Access Network Application Part (RANAP) signalling (3GPP TS 25.413 Release 4)".

[i.16] ETSI TS 125 414: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface data transport and transport signalling (3GPP TS 25.414 Release 4)".

[i.17] ETSI TS 125 415: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface user plane protocols (3GPP TS 25.415 Release 4)".

[i.18] ETSI TS 125 419: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu-BC interface: Service Area Broadcast Protocol (SABP) (3GPP TS 25.419 Release 4)".

[i.19] ETSI TS 129 016: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Serving GPRS Support Node SGSN - Visitors Location Register (VLR); Gs Interface Network Service Specification (3GPP TS 29.016 Release 4)".

[i.20] ETSI TS 129 018: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS); Serving GPRS Support Node (SGSN) - Visitors Location Register (VLR); Gs interface layer 3 specification (3GPP TS 29.018 Release 4)".

[i.21] ETSI TS 125 323: "Universal Mobile Telecommunications System (UMTS); Packet Data Convergence Protocol (PDCP) specification (3GPP TS 25.323 Release 4)".

[i.22] ETSI TS 102 744-1-3: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 3: Satellite Radio Interface Overview".

[i.23] ETSI TS 102 744-1-4: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 4: Applicable External Specifications, Symbols and Abbreviations".

[i.24] ETSI TS 102 744-3-6: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 6: Adaptation Layer Operation".

[i.25] ETSI TS 124 008: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008 Release 4)".

[i.26] ETSI TS 102 744-2-1: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 2: Physical Layer Specifications; Sub-part 1: Physical Layer Interface".

[i.27] IETF RFC 1661: "The Point-to-Point Protocol (PPP)".

3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 744-1-4 [i.23], clause 3 apply.

4 User services

4.1 General service assumptions

The User Equipment (UE) will typically be realized as a separate satellite mobile terminal, which may be connected to other user devices such as an external telephone and/or computer, as shown in Figure 4.1. To make use of the network services, users insert their GSM/GPRS/UMTS subscriber identity module (SIM/USIM) into the UE and connect an external telephone handset and/or computer/PDA to the UE via a wireless or cabled connection.
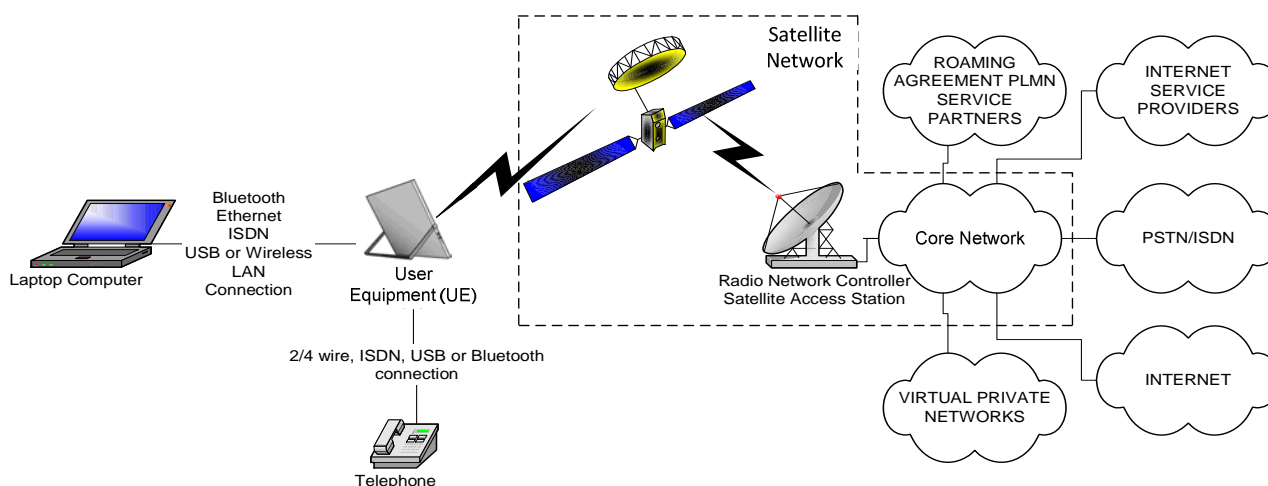
Figure 4.1: Typical Satellite Network Set-up and Services

The satellite network will offer users the ability to make and receive telephony and ISDN calls via the directory telephone number(s) associated with their subscriber identity module (SIM) issued by their home network. Users may also be offered an "always-on" Internet/Intranet connection with fixed or dynamically assigned IP addresses (depending on their subscription).

Data rates and connection options provided to users are dependent on the design and class (i.e. pocket/notebook/briefcase size) of user equipment.

The satellite network operator (or Service Providers/Distribution Partners) will provision the suite of communication services offered to users via the satellite network.

4.2 Circuit switched services

4.2.0 General

The Core Network provides speech telephony, 3,1 kHz audio or UDI/RDI circuit switched (CS) data services to mobile users (UDI/RDI are the ISDN Unrestricted and Restricted Digital Information services, respectively).

Due to constraints within the core network, the satellite network can support the operation of a maximum of one circuit switched call per subscriber (IMSI) at any time. The operation of one or more Internet/GPRS sessions operating concurrently with a single circuit switched call (such as telephony or CS data) to a single subscriber is supported.

The directory telephone number(s) of the user will be those associated with their SIM/USIM subscription in their home network.

4.2.1 Circuit Switched Speech - Basic Telephony Service

The satellite network shall offer speech telephony services. A user may make outgoing and receive incoming speech telephone calls and may make use of a wide range of supplementary services (e.g. calling line ID, call waiting, etc.).

To make use of the service, a user connects an external telephone handset to the UE. The means of connecting the handset (e.g. 2/4 wire socket, Bluetooth, ISDN socket, etc.) is dependent on the features of the UE.

Telephone keypad and display capability depends on the features of the chosen UE type and connected equipment.

Initial user equipment does not use the voice coding technique specified by 3GPP (the Advanced Multi Rate codec, AMR). User equipment instead transmits and receives speech via a satellite optimized low data-rate codec that makes efficient use of satellite capacity whilst maintaining toll level speech quality. Conversion is carried out in the Core Network to ensure interoperability with other networks.

The satellite network incorporates the capability of supporting other codecs (including AMR) to ensure compatibility for future UE types.

4.2.2 Circuit Switched Voice - Emergency Calls

The satellite network shall support mobile originated emergency voice calls to designated Public Service Access Points (PSAPs). The Core Network may be configured by the operator/service provider to enable emergency calls to be made without a USIM/SIM card in the user equipment as described in ETSI TS 124 008 [i.25], clause 4.5.1.5. In addition the RNS may be configured by the operator to transmit a control flag broadcast in the system information which affects the UE behaviour (i.e. whether or not it may register without USIM). This feature is further described in ETSI TS 102 744-3-6 [i.24].

The user equipment (or the Core Network) shall recognize the dialled number as a designated "emergency number" and indicate to the network that an emergency call is required. The network shall route the Emergency Call to the PSAP appropriate to the geographical position reported by the user equipment. The core network incorporates the capability to report the GPS coordinates of the calling user to the called PSAP.

4.2.3 Circuit Switched Data - ISDN UDI/RDI (Unrestricted/Restricted Digital Information)

Selected UE types may offer the capability to initiate and receive ISDN UDI/RDI circuit switched data calls using a single 64 kbit/s channel per subscriber for user plane traffic.

In order to make use of this service some UE designs may feature an integrated or peripheral "basic-rate" ISDN socket with an S/T bus (allowing the UE to act as the network terminating device, NT-1). The socket allows users to connect standard ISDN end-user equipment conformant to the Euro-ISDN Basic Rate standard and make outgoing and incoming ISDN UDI/RDI data calls through the satellite network.

The satellite network may support the ISDN UDI/RDI service by providing one 64 kbit/s "B Channel" per user and may prohibit a user operating other circuit switched services at the same time as ISDN.

RDI user plane transmission is handled in the satellite network as per UDI, i.e. with a guaranteed bit rate of 64 kbit/s.

A potential additional application for the UDI/RDI service is for transporting circuit-switched video conferencing traffic encoded using the 3G-H324M suite of encoding standards (the standards proposed for real-time mixed media circuit-switched calls over 3G mobile networks), as described in ETSI TS 126 110 [i.6]. In cases where the User Equipment does not have built in audio/video capability, the software/hardware for encoding, decoding and presenting these transmissions is assumed to be provided in the equipment attached to the UE.

4.2.4 Circuit Switched Data - 3,1 kHz Audio

The preferred data service for users is the GPRS Packet Switched service. It is anticipated that the majority of users will use the GPRS Packet Switched service for data and facsimile transmission.

To provide a capability to support legacy modem and facsimile users, the satellite network may offer a service to carry PCM coded 3,1 kHz audio via a 64 kbit/s transparent bearer. Via this service a user could, for example, make and receive legacy modem and facsimile calls or speech calls requiring PCM coding to and from the terrestrial PSTN or ISDN. This service would be provided at the UE typically via a UE's analog telephone socket or ISDN connection (where supported). Modem/facsimile performance may be impaired because of satellite delay causing the modems to renegotiate transmission to reduced data rates.

> NOTE: More bandwidth efficient bearers for transmission of legacy modem/facsimile traffic (i.e. requiring less than 64 kbit/s) are offered in terrestrial UMTS through the use of Non Transparent (NT) bearer services.

4.3 Packet switched data services

The satellite network offers IP based Internet/Intranet/VPN connectivity to users via the GPRS service. GPRS shall be implemented as described in ETSI TS 123 060 [1].

To make use of the service, a user inserts their GPRS/UMTS SIM/USIM card into the UE and connects an external laptop computer or personal computing device to the UE (via for example a USB, Ethernet or wireless Bluetooth/Wireless LAN connection) with the appropriate drivers and configuration software running on the laptop/PDA.

A user may activate up to eleven PDP contexts where each PDP context specifies the parameters defining a service requested by the user (where the parameters may include quality of service profile, default gateway, static or dynamically assigned IP address)

The UMTS Quality of Service classes "Streaming", "Background" and "Interactive" are supported in the Packet Switched network. The "streaming" traffic class can allow users to make use of media streaming applications (e.g. users with a PSS (packet streaming service) client installed on their computer/PDA attached to the UE).

Packet data services are further described in Annex A.

4.4 Messaging (SMS)

The satellite network includes a Short Messaging Service Centre (SMSC) platform for transmission of SMS messages to and from users and between the satellite network and other networks offering SMS (subject to agreements).

The means for entering SMS messages (i.e. via UE keypad or connected TE device), for reading messages and for storing messages depends on the UE type and the capabilities/software installed in the attached TE.

The satellite network can offer the transmission of SMS messages either via the Circuit Switched domain or the Packet Switched domain of the Core Network.

Users may be offered more advanced messaging services such as "multimedia messaging services (MMS)" as applications supported over the packet switched GPRS/IP service (depending on their subscription and the application bouquet offered by the users' home network service provider) .

4.5 Location based services

The satellite network includes Gateway Mobile Location Centre/Serving Mobile Location Centre (GMLC/SMLC) Positioning Nodes for support of UMTS location based services. This equipment provides content providers with geographical coordinates of users in the satellite network to enable delivery of applications dependent on position information (such as offering maps, local travel information, etc.). Note that the GMLC collects and distributes GPS positioning information but does not constrain or specify the services that make use of the information which are the responsibility of the Distribution Partner/Service Provider.

4.6 Additional services and service enablers

Chargeable content and applications may be built on top of the telecommunications services described in the above clauses.

5   Outline network architecture

5.1   General

The satellite network is designed to offer communication services to a community of mobile, transportable and semi-fixed customers via satellite. The satellite network offers users traditional circuit switched telephony/ISDN services and Packet (Internet Protocol) applications, using a UE that links them via satellite to the network infrastructure, as shown in Figure 5.1.
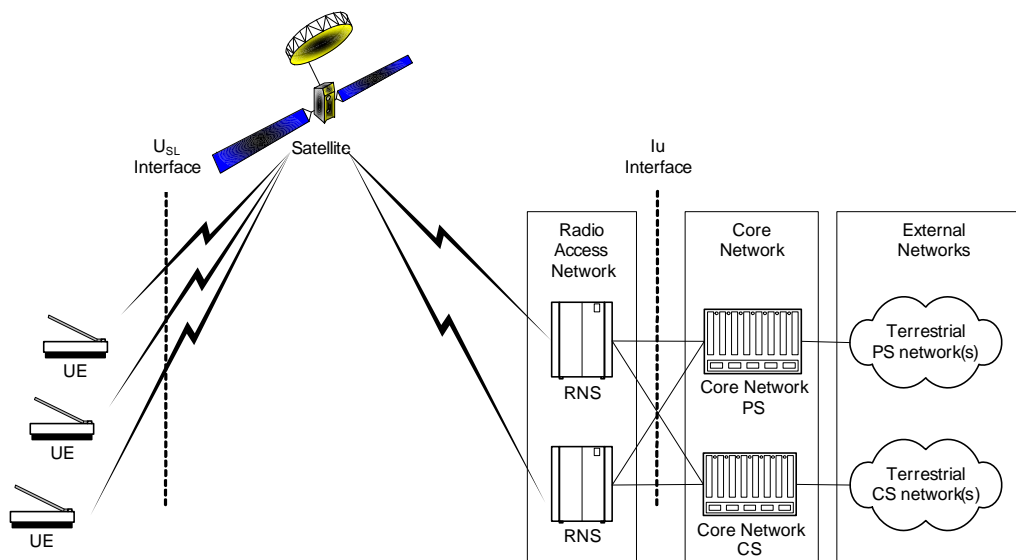
Figure 5.1: Outline network connectivity

In a terrestrial UMTS network the radio interface to the mobile users is Wideband Code Division Multiple Access (WCDMA). The satellite radio interface is based on a TDM-TDMA/FDM physical layer that is optimized for a satellite radio path.

The satellite network architecture is based on a terrestrial UMTS network architecture and is partitioned into three main areas, the Core Network (CN), Radio Access Network (RAN) and User Equipment (UE). The UE contains the user's radio modem and delivers applications. The RAN consists of a number of Radio Network Subsystems (RNS), each consisting of a Radio Network Controller (RNC) controlling the radio link to the UE each with a supporting Radio Frequency Subsystem (RFS). The CN provides the services, switching, and routing of traffic to and from the UE via the RAN towards external terrestrial and mobile networks.

5.2   User Equipment

Users access the network using the user equipment (UE). The UE consists of a satellite modem and a UMTS Subscriber Identity Module (USIM). The UE may also be connected to one (or more) Terminal Equipment "TE" (e.g. a personal computer, PDA, etc.), as shown in Figure 5.2.
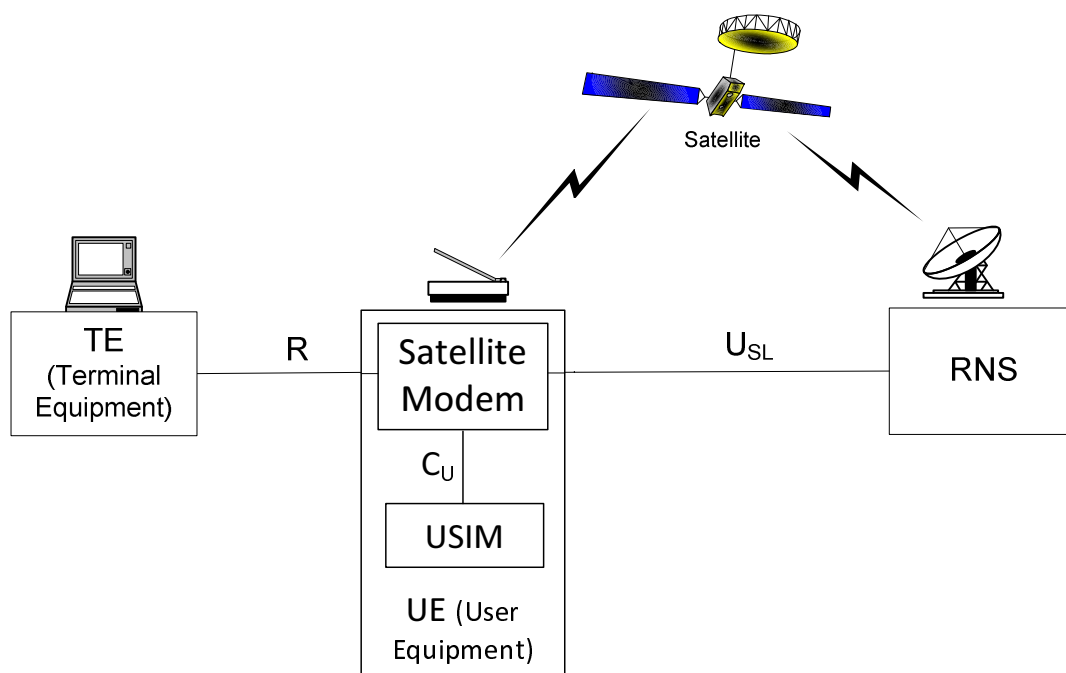
Figure 5.2: User equipment interfaces

The UE acts a communications bridge between the TE equipment and the external fixed and mobile networks via the satellite network.

The user's subscriber identity (International Mobile Subscriber ID (IMSI) and various security functions) are securely stored as an application (the UMTS Subscriber Identity Module "USIM") in a removable integrated circuit card, the Universal Integrated Circuit Card ("UICC") that is inserted in the UE prior to use.

The scope of the Family SL specification defines as normative the U_{SL} reference point with all other interfaces being defined in external standards or considered informative.

5.3   Satellite component

MTs communicate with the Radio Network Controller (RNC) nodes via the satellite. The satellite provides transparent amplification and frequency translation of the communications and signalling traffic.

Transmission between the satellite and mobile users is in spectrum allocated to mobile satellite services (see ETSI TS 102 744-2-1 [i.26], clauses 5.1.2 and 6.1.2). The user link frequency is re-used by dividing the coverage into a large number of beams. The beam coverages are operator configurable but an example arrangement consists of one global beam over which is overlaid approximately 20 regional beams and upon which is arrayed approximately a further 200 narrow beams.

5.4   Radio Access Network

The Radio Access Network (RAN) consists of a number of Radio Network Subsystems (RNS). Each RNS consists of a Radio Network Controller (RNC) and associated Radio Frequency Subsystem (RFS). The RAN handles all radio related aspects of the ground system network infrastructure. The RFS provides communication to and from the User Equipment (UE) via the satellite. The RNC interfaces to the Core Network (CN) for switching and routing calls and data connections to and from the external networks.

5.5 Core Network

The core network (CN) comprises a suite of UMTS network nodes. The CN is aligned to a 3GPP release 4 architecture having separate Packet Switched (PS) and Circuit Switched (CS) domains. Media Gateway/MSC Server nodes (for user and control plane transmission respectively) are provided for circuit switched communication (PSTN telephony and ISDN). SGSN and GGSN nodes are provided for Internet Protocol (IP) packet switched communications.

5.6 Architectural principles

Terrestrial UMTS networks are specified in a manner that allows UMTS services to be offered over alternative radio access technologies. This enables the satellite network to adopt the same UMTS architecture for the Non Access Stratum (NAS) while replacing the terrestrial WCDMA air interface in the Access Stratum (AS) with a new satellite radio interface, and retaining the AS/NAS architectural split defined by 3GPP. In this manner UMTS services are offered via the satellite network. The Iu interface between the CN and RNC remains unchanged.

The architecture adopts the following principles in interworking UMTS within a satellite environment:

- The CN architecture is unchanged from that in a terrestrial UMTS network, having the same Iu interface to the RNC. Thus the RNC appears to the CN to behave in the same manner as a terrestrial WCDMA RNC, i.e. provide services (i.e. signalling and user plane transport) that allows communication with mobile users.

NOTE: Because the RNC connects to a standard UMTS CN with a standard Iu interface the adaptation to the satellite environment is therefore implemented on the RNC side of the Iu interface.

- The RNC terminates the Iu interface from the core network and provides radio bearers towards the mobile users for signalling and traffic transport using the Family SL radio interface.

- The satellite provides a transparent physical link between the UE and the RNS. There is no protocol processing in the satellite.

- The satellite UE provides a set of services that are equivalent to those provided by a terrestrial UMTS UE.

The architecture and internal interfaces of the RAN and CN as described in the present document are informative rather than normative.

6 Outline protocol architecture

6.1 Circuit Switched User Plane

The Circuit Switched User Plane protocol stack is illustrated in Figure 6.1.
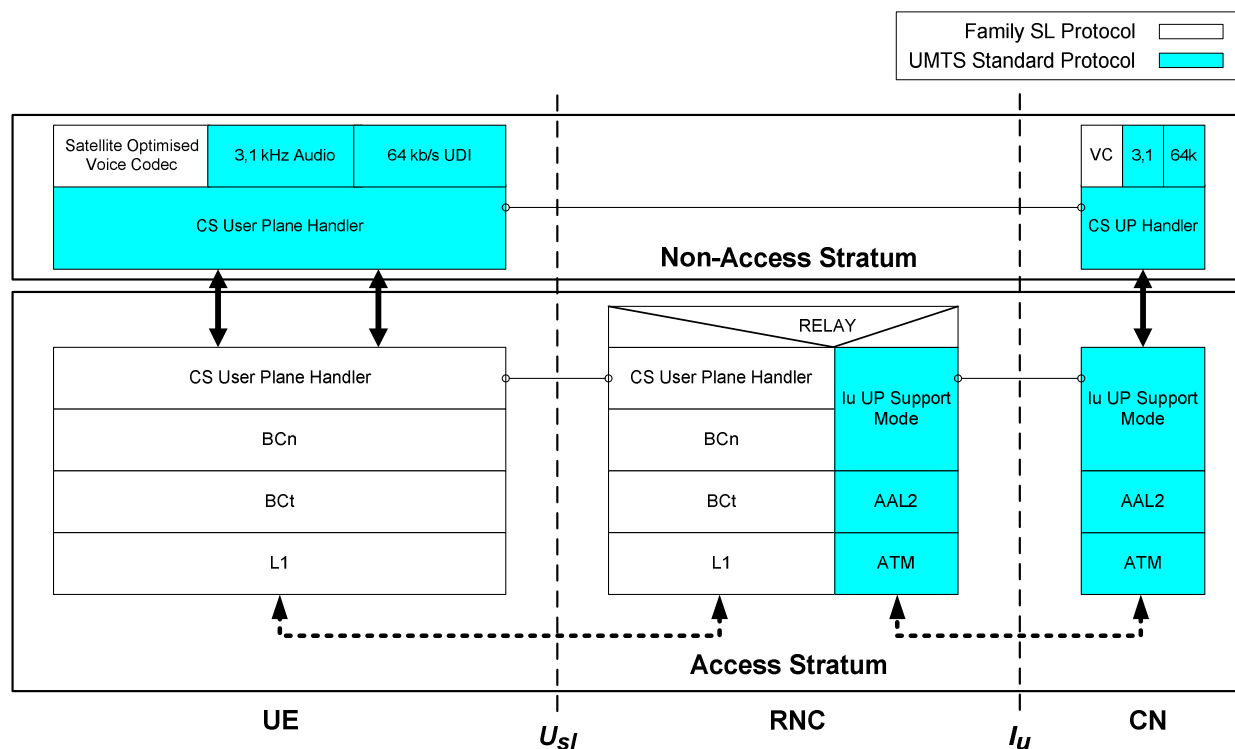
Figure 6.1: Circuit Switched User Plane Protocol Stack for Voice Service

The UEs transmit voice over the satellite radio interface using a satellite optimized low data rate codec. Non-voice services such as circuit-switched data will switch-out the codec to provide transparent bit-synchronous services (e.g. 64 kbit/s UDI) or non-transparent services (e.g. 3,1 kHz audio) between UE and the Core Network.

The data from the voice codec is carried by a CS User Plane Handler service to provide error control and discontinuous transmission in conjunction with the voice activity detection and comfort noise insertion functions of the codec. Discontinuous transmission provides bandwidth and power efficiencies for voice transmission over the satellite radio interface by inhibiting transmission during periods of silence.

The Radio Network Controller (RNC) relays voice frames between the Core Network and the UE via the satellite radio interface. The RNC does not interpret the voice codec frames but in relaying the frames it provides error handling and framing for the satellite radio interface.

The RNC relays voice frames to and from the CN MGW via the Iu CS reference point. Error handling and framing over the Iu interface is provided via the Iu User Plane (Iu UP) protocol. The Iu UP protocol is a generic frame handling protocol for user plane traffic between the RNC and CN. When providing frame-handling and error detection services it is said to be operating in "support mode". Voice frames are carried to and from the CN MGW via an AAL-2 ATM adaptation layer connection over the Iu interface. AAL-2 adapts the ATM cell relay link layer to handle low data variable bit-rate time sensitive data, in this case voice or circuit switched data.

6.2 Circuit Switched Control Plane

The circuit switched control plane is illustrated in Figure 6.2. Standard terrestrial UMTS Non-Access Stratum (NAS) control plane signalling (mobility management (MM), Call Control (CC), Supplementary Services (SS) and Short Messaging Service (SMS)) are passed between the UE and the MSC/VLR Server (the CN CS Control Plane Node) via the RNC.
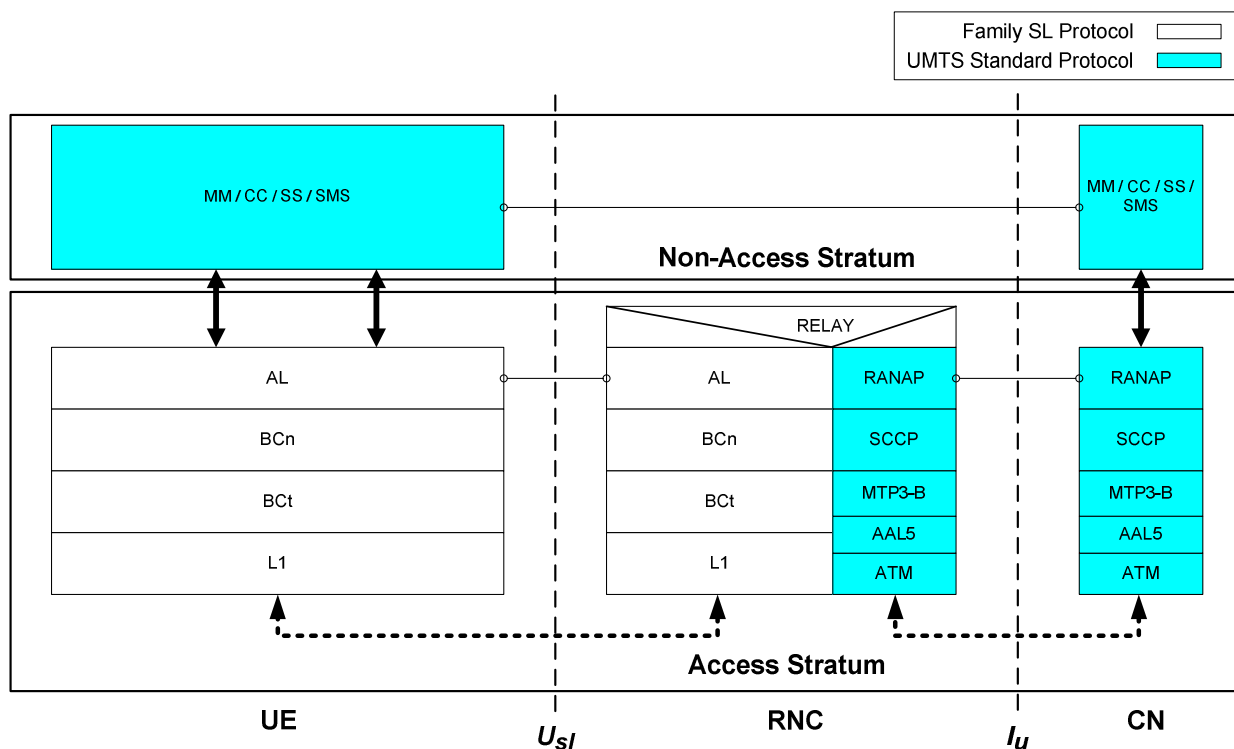
Figure 6.2: Circuit Switched Control Plane Protocol Stack

The Adaptation Layer (AL) provides services to the NAS Layer 3 control plane similar to the Radio Resource Control (RRC) protocol in terrestrial UMTS. During the Registration procedure, a UE-Specific Signalling Connection is established over the satellite radio interface to transmit AL and higher layer signalling between a UE and the RNC. During control and user plane transactions between the CN and a UE, the UE triggers the RNC to establish a dedicated bi-directional signalling connection for that UE over the Iu interface to the MSC/VLR server in the CN (using connection oriented SCCP signalling).

RANAP (Radio Access Network Application Part) [i.15] is a standard terrestrial UMTS protocol for control plane signalling between the RNC and CN. RANAP provides functions to set up and tear down UE specific Iu connections, encapsulate and transfer NAS signalling, request and release user plane capacity, transfer security commands, page UEs from the CN, handovers users between RNCs and CN nodes and handle errors.

RANAP is carried across the Iu interface via the Signalling Connection Control Part (SCCP) [i.7]. SCCP is the signalling system no. 7 (SS7) protocol for exchanging connection oriented (i.e. specific to a UE) and connectionless signalling in telecommunications networks. It is supported by MTP3-B [2] (message transfer part, layer 3 for broadband), a variant of standard MTP3 for carrying signalling over ATM/AAL-5 links. MTP3-B provides network addressing, error handling and link redundancy for signalling between the CN and RNC over the ATM Iu connection. AAL 5 provides a lightweight low overhead framing facility for transmitting signalling and IP traffic over an ATM cell switched link.

6.3   Packet Switched User Plane

The packet switched user plane provides users with access to packet switched services via the UE. The network shall support the transmission of IP packets between the UE and external networks via a GPRS Gateway Support Node (GGSN) within the CN. Up to eleven simultaneous PDP contexts carrying IP traffic between a single UE and the CN may be invoked at one time.
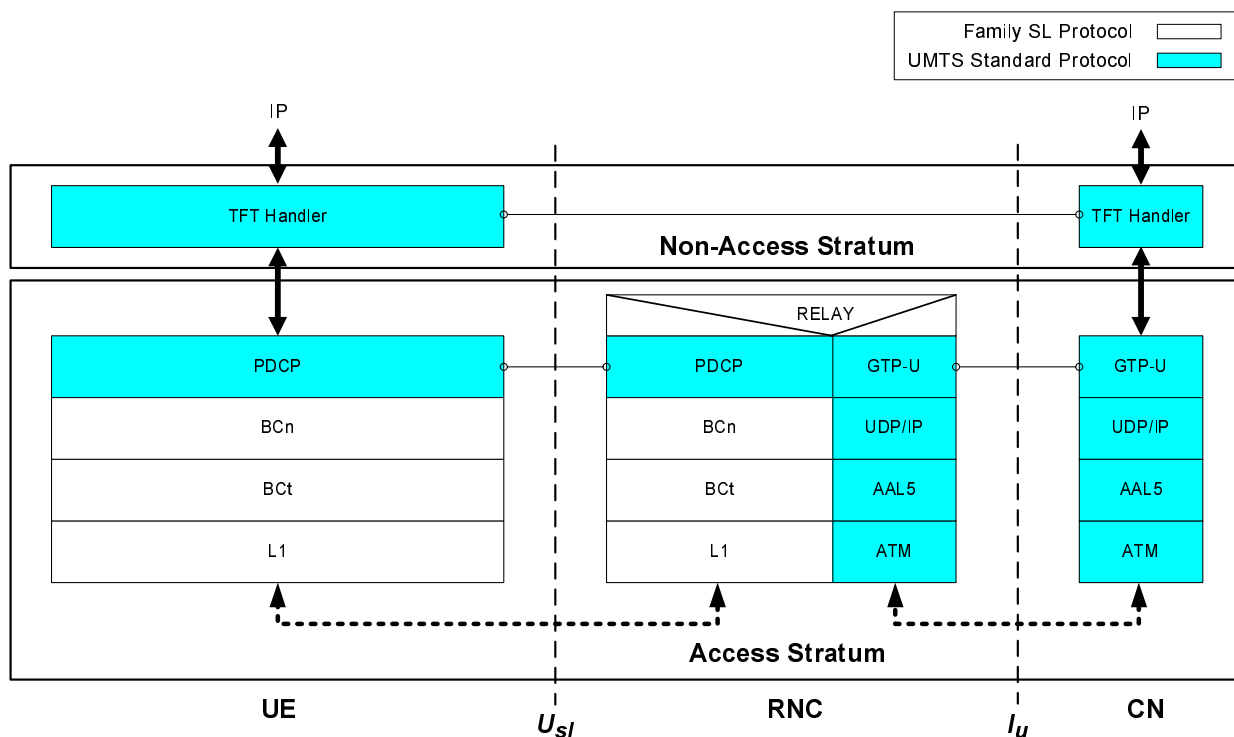
Figure 6.3: Packet Switched User Plane Protocol Stack

Figure 6.3 presents the protocol stack for the IP user plane for a single PDP context carrying one IP packet session (PDP context) for a single UE over the satellite network. IP is supported over the satellite radio interface using Packet Data Convergence Protocol (PDCP) [i.21], a standard protocol providing encapsulation, sequence numbering and header compression for packet protocols in terrestrial UMTS.

PDCP is carried over the satellite link using the satellite radio interface.

End-user IP packets are inspected by the Traffic Flow Template (TFT) Handler and forwarded into an established PDP context based upon information exchanged by the NAS during PDP context activation. The IP packets are forwarded between the RNC and the CN SGSN and between the CN SGSN and the CN GGSN encapsulated in a GTP (GPRS Tunnelling Protocol) tunnel. A GTP tunnel is defined for each PDP Context. The GTP tunnels are carried through the backbone IP network over ATM AAL 5.

6.4 Packet Switched Control Plane

The packet switched control plane is illustrated in Figure 6.4. Standard terrestrial UMTS layer 3 Non-Access Stratum (NAS) control plane signalling (GPRS Mobility Management (GMM), Session Management (SM), and GPRS Short Messaging Service (GSMS)) are passed between the UE and the SGSN (i.e. CN PS Control Plane Node) over the RNC.
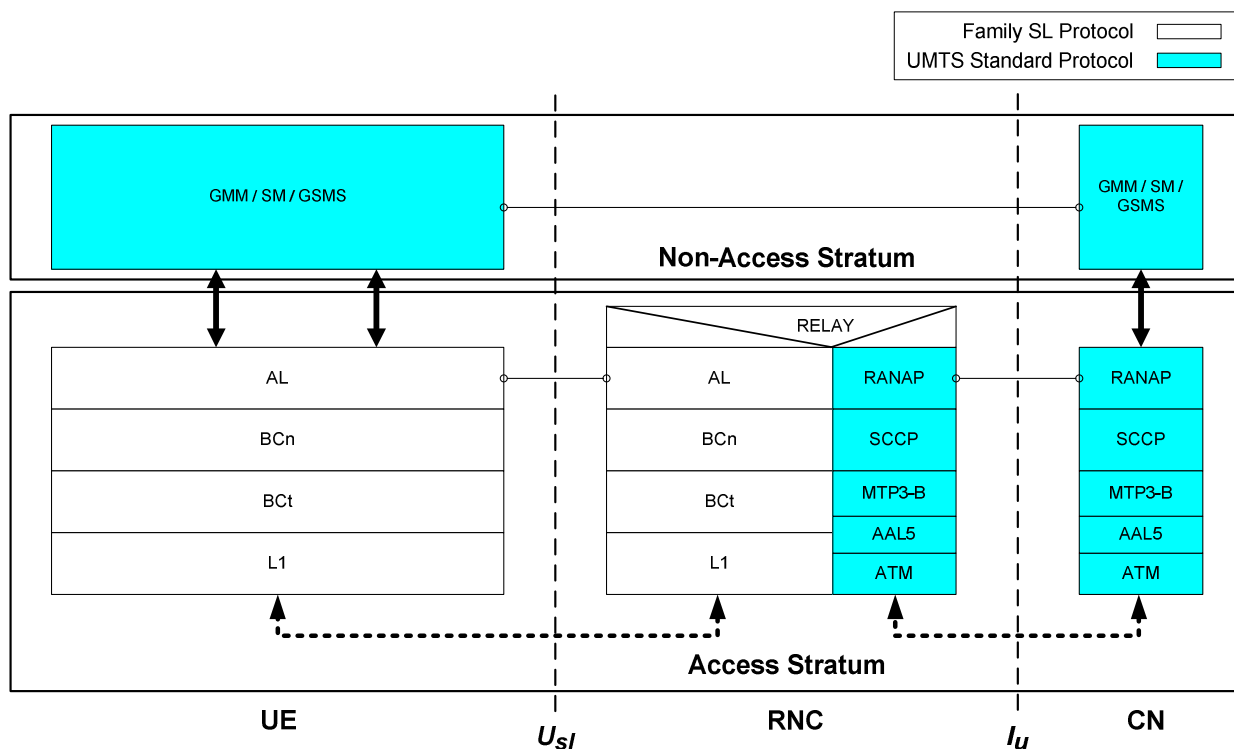
Figure 6.4: Packet Switched Control Plane Protocol Stack

The protocol stack for the PS control plane follows the architecture of the CS control plane described above.

7 Network interfaces

7.1 General

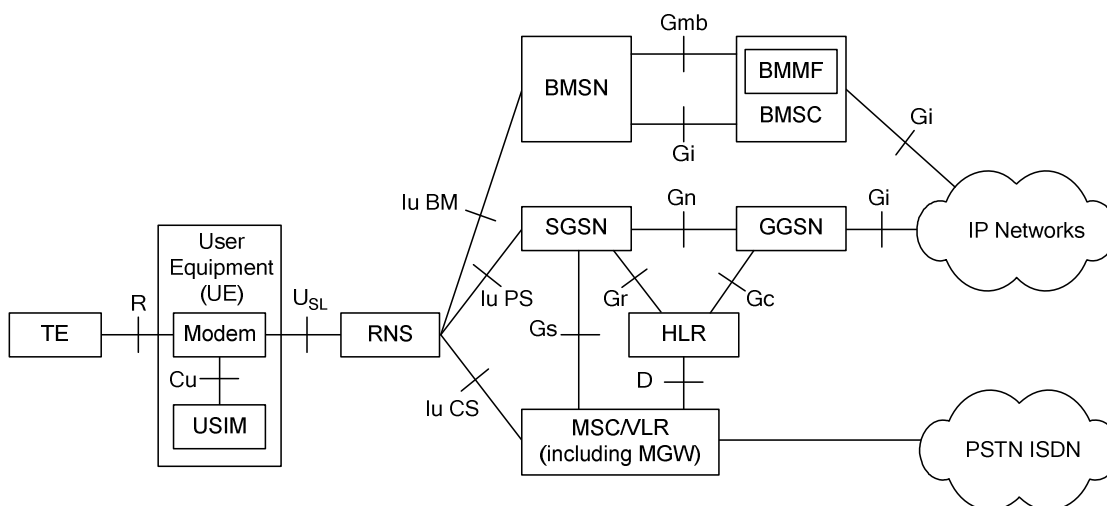The primary network interfaces in the satellite network are illustrated in Figure 7.1.

Figure 7.1: Primary Network Interfaces as adopted by Family SL

NOTE: Figure 7.1 is adapted from ETSI TS 123 002 [i.3], clause 5.1.

7.2 R interface

The User Equipment (UE) "R interface" describes the reference point between the Terminal Equipment (laptop computer, personal digital assistant etc.) and the UE.

The R interface is not defined but is instead open to various implementation options. Typical interface designs may be based on a physical layer of Ethernet, Bluetooth, wireless LAN 802.11, USB, RS-232, etc.

NOTE: ETSI TR 127 901 [i.4] presents examples of physical layer options for UE external interfaces.

Point-to-Point link layer between TE and UE may employ the PPP protocol (RFC 1661 [i.27]). Link layer requirements for operating multiple PDP contexts from a single UE are not defined by 3GPP but options are discussed in 3GPP specification ETSI TS 127 010 [i.8] ("Terminal Equipment to User Equipment (TE-UE) multiplexer protocol").

User configuration of serial links at this interface may use AT commands and use appropriate extensions of the AT command set described in ETSI TS 127 007 [i.9] ("AT command set for 3G User Equipment (UE)") and ETSI TS 127 010 [i.8] ("Terminal Equipment to User Equipment Multiplexer Protocol").

Transmission of SMS short messages across the R interface are defined in ETSI TS 127 005 [i.10].

7.3 Cu Interface

The Cu interface is the standard interface for connecting the UMTS Integrated Circuit Card (UICC) to the User Equipment. The UICC is the physical integrated circuit that provides the secure environment for recording the USIM (UMTS Subscriber Identity Module) records at the user equipment. For details of the characteristics of this interface, refer to the specification ETSI TS 131 101 [i.11] "UICC-terminal interface; Physical and logical characteristics".

Note that UE equipment may offer backward compatibility capability to detect and interoperate with legacy GSM SIM cards. The core network may restrict the access of GSM SIM roaming users at the network operator's discretion.

7.4 U_{SL} Interface

The U_{SL} interface is the satellite radio interface for transmission between the UE and RNS via the satellite. An overview of the satellite radio interface is given in ETSI TS 102 744-1-3 [i.22].

7.5 Iu Interface

7.5.0 General

The Iu interface between the CN nodes and the RNC is described in the 3GPP specifications ETSI TS 125 410 to ETSI TS 125 415 [i.12], [i.13], [i.14], [i.15], [i.16], [i.17] and ETSI TS 125 419 [i.18].

7.5.1 Iu PS

The Iu interface for control and user plane between the Packet Switched domain and the RNC is adapted from ETSI TS 125 410 [i.12].

7.5.2 Iu CS

The Iu interface for control plane and user plane between the Circuit Switched domain and the RNC (Iu CS) is adapted from ETSI TS 125 410 [i.12].

7.5.3 Iu BM

The Iu BM interface supports the interconnection of the Broadcast Multicast (BM) domain of the Core Network to each Radio Network Subsystem of the Radio Access Network. This interface is based upon the Iu PS specification, with minor modifications to RANAP (see ETSI TS 125 413 [i.15]) as required to support the additional satellite-specific features of the Broadcast Multicast Services offered by the Family-SL specifications.

7.6 Gn interface

The Gn interface, provides the connection between the Gateway GPRS Support Nodes (GGSN) and the Serving GPRS Support Node (SGSN) for tunnelling encapsulated IP user traffic (using the GTP-U User Plane) between external IP networks and users. This interface also carries tunnel management traffic (GTP-C Control plane). Gn is an IP/UDP connection using ATM or other link layer.

7.7 Gi Interface

The Gi interface connects external IP networks (private corporate VPNs or the external Internet) to the satellite network via the Gateway GPRS Support Node (GGSN).

7.8 Gs Interface

The Gs Interface between the SGSN and the MSC/VLR Server provides the capability for coordination of selected signalling procedures between the CS and PS domains in order to reduce signalling load on the satellite radio interface. In a network where the Gs interface is activated (Network Mode of Operation I (NMO-I), a UE with CS/PS operation capability may undertake (among others) combined IMSI/GPRS Attach/Detach, combined Location/Routing Area Updates and may receive CS paging messages via the SGSN. The Gs Interface is specified in ETSI TS 129 016 [i.19] and ETSI TS 129 018 [i.20]. Combined PS/CS procedures are described in ETSI TS 123 060 [1], clause 6.3.

7.9 Gmb Interface

The Gmb interface is used to control access to the Multimedia Broadcast and Multicast Services (MBMS) that are offered by the Broadcast Multicast domain of the Core Network, which comprises the Broadcast Multicast Service Node (BMSN) and the Broadcast Multicast Service Centre (BMSC). This interface performs the functions as defined in ETSI TS 123 246 [i.5], and in addition provides capabilities that allow the features of the satellite-specific elements of the multicast services to be administered by the Broadcast Multicast Management Function (BMMF) within the BMSC (not shown in these diagrams as it is a functional entity within the BMSC).

7.10 HLR Interfaces D, Gc, Gr

The D, Gc and Gr interfaces provide the means by which authentication, authorization and mobility management information is exchanged between the various nodes and the Home Location Register (HLR). These interfaces are described in ETSI TS 123 002 [i.3].

Annex A (informative):
Bearer services and teleservices

A.1 Circuit switched services summary

A.1.1 Introduction

The list of circuit bearer services is derived from ETSI TS 122 002 [i.1] ("Circuit Bearer Services supported by a Public Land Mobile Network").

The list of circuit teleservices is derived from ETSI TS 122 003 [i.2] ("Circuit Teleservices supported by a Public Land Mobile Network").

A.1.2 Circuit switched bearer services

A.1.2.0 General

Circuit switched bearer services are low layer communications services offered to users. These services are characterized by information transfer attributes, access attributes and general attributes.

Circuit switched bearer services are offered for the following applications:-

- 3,1 kHz audio

- UDI/RDI

The following Generic Circuit Switched Bearer Services are defined in the 3GPP specifications:

Table A.1: 3GPP Documents Defining Circuit Switched Bearer Services

Service	Document Ref
Duplex Asynchronous Data Circuit BS 20	ETSI TS 122 002 [i.1]
Duplex Synchronous Data Circuit BS 30	ETSI TS 122 002 [i.1]

A.1.2.1 Bearer Service 20 - Asynchronous

Bearer Service 20 defines a wide range of variants for Asynchronous Circuit Mode Data, including both "Transparent" and "Non-Transparent" bearer services.

None of these bearer services are supported in the satellite network.

A.1.2.2 Bearer Service 30 - Synchronous

Bearer Service 30 contains a number of variants for Synchronous Circuit Mode Data.

A subset of these bearer services are supported in the satellite network as defined in Tables A.2 and A.3.

Table A.2: BS 30 transparent in regular mode for digital interworking

Fixed Network User Rate	Access Structure	Information Transfer Capability	Rate Adaptation	QoS Attribute	Notes
56 kbit/s	Synch	RDI	-	T	Notes 1 and 2
64 kbit/s	Synch	UDI	-	T	Notes 1 and 2
NOTE 1: This bearer service is used to provide ISDN B channel data services for UEs which offer an S bus ISDN termination (NT-1) connection for standard Euro-ISDN terminal equipment.					
NOTE 2: A custom variant of this BS is required for the 3,1 kHz audio service (namely FNUR = 64 kbit/s, ITC = 3,1 kHz Audio).					

Table A.3: BS 30 transparent for multimedia interworking

Fixed Network User Rate	Access Structure	Information Transfer Capability	Rate Adaptation	QoS Attribute	Notes
56 kbit/s	Synch	RDI	H.223 & H.245	T	
64 kbit/s	Synch	UDI	H.223 & H.245	T	

A.1.3   Teleservices

Teleservices comprise the end-to-end communications service offered to users over an underlying bearer. The following teleservices should be supported by the satellite network.

Table A.4: Teleservices

Teleservice	Description	Notes
TS 11	Telephony	Provided using satellite optimized low data rate voice codec.
TS 12	Emergency Calls	Provided using satellite optimized low data rate voice codec. Emergency calls are mobile originated only. The network operator may optionally enable emergency calls without the SIM card.
TS 21	SMS Mobile Terminated Point to Point	This teleservice may be offered via the CS or PS core network domains
TS 22	SMS Mobile Originated Point to Point	This teleservice may be offered via the CS or PS core network domains

A.1.4   Support of ISDN

User equipment designs may offer an S-bus 2B+D basic rate Euro-ISDN socket (where the UE acts as the network terminating device NT-1). This allows the user to initiate and receive calls to and from the external ISDN, in the form of circuit switched voice, emergency calls or circuit switched UDI/RDI data. Circuit switched 3,1 kHz audio may also be transferred via the ISDN socket by use of an appropriate PCM coding terminal adaptor. The B (traffic) channel is carried to the core network via the BS-30 synchronous 64 kbit/s channel for digital interworking (see above), with the following exception:-

ISDN voice calls to or from an ISDN handset are carried across the satellite radio interface using the satellite optimized low data rate voice codec as used for TS 11 voice calls (see clause A.1.3) in order to conserve bandwidth. This will mandate PCM to voice codec transcoding in user equipments supporting ISDN.

The D channel Q.931 (signalling) is translated at the user equipment and core network media gateway into Call Control protocol signalling over the satellite link.

The Core Network may not support multiple simultaneous circuit switched calls to a single mobile (the core network is limited to one Circuit Switched call per subscriber). This restriction should not preclude multiple B channel support in the User Equipment for subsequent Core Network support.

V.110/V.120 rate adaptation requires an appropriate terminal adaptor external to the UE.

A.2   Packet switched services summary

This clause presents a summary of the packet switched services.

Table A.5: Packet Switched Services Summary

Service	Acronym	Description	Comment
IP connectivity	GPRS	Connection to the Internet or an (IP based intranet/VPN) for packet switched telecommunication using IPv4. Shared Channel bandwidth up to approx 432 kbit/s dependent on UE type and allocated channel. Contention ratio of numbers of users per channel dependent on subscription and radio resource management technique.	Mobile initiated IP sessions only. Network initiated PDP contexts are not supported. No supplementary services are supported over the packet domain. Up to 11 PDP contexts may be supported per UE.
Short Messaging Service	SMS MO/MT		SMS may be offered by the packet switched domain or the circuit switched domain.
IP broadcast/ IP multicast	-	Broadcast or multicast of IP traffic to mobile users (fixed to mobile).	

History

Document history		
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