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Satellite Personal Communications Networks (S-PCN); Need and objectives for standards in addition to the ETSs on essential requirements

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Foreword

This ETSI Technical Report (ETR) has been produced by the Satellite Earth Stations and Systems (SES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

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1 Scope

This ETSI Technical Report (ETR) provides information on current thinking on which standards, in addition to the ETSs on essential requirements, are needed to assure short and long term suitability of S-PCN systems in the European technical, operational and regulatory environment.

Needs and objectives for standards, in addition to the ETSs on essential requirements, are considered for:

- numbering issues;
- lawful interception and security issues;
- interconnection and related network issues;
- evolution towards the UMTS satellite component;
- human factors;
- S-PCN MES equipment not currently covered by ETSs;
- mutual recognition of type approval and licenses.

2 References

For the purposes of this ETR, the following references apply:

[1] prETS 300 733: "Satellite Earth Stations and Systems (SES); Satellite Personal Communications Networks (S-PCN); Mobile Earth Stations (MESs) including hand-held earth stations, for S-PCN in the 1,6/2,4 GHz bands, providing voice and/or data communications under the Mobile Satellite Service (MSS)".

[2] prETS 300 734: "Satellite Earth Stations (SES); Satellite Personal Communications Networks (S-PCN); Mobile Earth Stations (MESs) including hand-held earth stations, for S-PCN in the 2,0 GHz bands, providing voice and/or data communications under the Mobile Satellite Service (MSS)".

[3] ETR 093: "Satellite Earth Stations (SES); Possible European standardization of certain aspects of Satellite Personal Communications Networks (S-PCN); Phase 1 report".

[4] ETR 177: "Satellite Earth Stations and Systems (SES); Possible European standardization of certain aspects of Satellite Personal Communications Networks (S-PCN); Phase 2 report. Objectives and options for standardization".

[5] ETR 270: "Satellite Earth Stations and Systems (SES); Survey on the need for an ETS for Aircraft Earth Stations (AES) in the Aeronautical Mobile Satellite Service (AMSS)".

[6] Official Journal of the European Communities, No. L 128, 23 May 1991: "Council Directive on the approximation of the laws of the Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity (91/263/EEC)".

[7] Official Journal of the European Communities, No. L 290, 24 November 1993: "Council Directive supplementing Directive 91/263/EEC in respect of satellite earth station equipment (93/97/EEC)".

[8] EUROCAE ED 14C: "Environmental conditions and test procedures for airborne equipment".

[9] European Union 3922/91/EEC (1991): "Harmonisation of Technical Requirements and Administrative Procedures in Civil Aviation".

[10] European Union 93/65/EEC (1993): "Definitions and Use of Compatible Specifications for the Procurement of ATM Equipment".

[11] ITU-T Recommendation E.162 (1991): "Telephone Network and ISDN; Operation, Numbering, Routing and Mobile Service; Capability for Seven Digit Analysis of International E.164 Numbers at Time T".

[12] ITU-T Recommendation E.164 (1991): "Telephone Network and ISDN; Operation, Numbering, Routing and Mobile Service; Numbering plan for the ISDN era".

[13] Revised Draft Recommendation: Criteria and Procedures for the Reservation, Assignment and Reclamation of E.164 Country Codes - Version 2.

[14] ITU-T Recommendation E.165 (1991): "Timetable for coordinated implementation of the full capability of the numbering plan for the ISDN era".

[15] ITU-T Recommendation E.212: "Identification plan for land mobile stations".

[16] ITU-T Recommendation E.213: "Telephone and ISDN numbering plan for land mobile stations in Public Land Mobile Networks (PLMNs)".

[17] ITU-T Recommendation E.214: "Structure of the Land Mobile Global Title for the Signalling Connection Control Part (SCCP)".

[18] ITU-T Recommendation Q.708: "Specification of Signalling System N°7; Numbering of International Signalling Point Codes".

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

[20] Draft Directive on Interconnection in Telecommunications: Ensuring universal service and interoperability through the application of the principles of Open Network Provision (ONP).

[21] European Interconnection Forum: "Framework Interconnection Guidelines".

[22] TCR-TR 015 (1995-09): "SMG; Work programme for the standardization of the UMTS".

[23] ETR 271 (1996-02): "Special Mobile Group (SMG); Universal Mobile Telecommunications System (UMTS); Objectives and overview (UMTS 01.01)".

[24] ETR 291 (1996-02): "Special Mobile Group (SMG); Universal Mobile Telecommunications System (UMTS); System requirements (UMTS 01.03)".

[25] ETR 309: "Special Mobile Group (SMG); Vocabulary for Universal Mobile Telecommunications System (UMTS) (UMTS 01.02)".

[26] ETR/SMG-50201, Annex A1: "Special Mobile Group (SMG), Framework for services to be supported by the Universal Mobile Telecommunications System (UMTS)".

[27] DTR/SMG-050301U: "Special Mobile Group (SMG); Universal Mobile Telecommunications System (UMTS); Framework of network requirements, interworking and integration for the UMTS (UMTS 03.01)".

[28] DTR/SMG-050104U: "Special Mobile Group (SMG); Scenarios and considerations for the introduction of the Universal Mobile Telecommunications System (UMTS) (UMTS 01.04)".

[29] ETSI PAC EG5 Report: "Global Multimedia Mobility (GMM); A standardization framework".

[30] ETR SMG-51201: "Special Mobile Group (SMG); Technical characteristics, capabilities and limitations of mobile satellite systems applicable to the Universal Mobile Telecommunications System (UMTS)".

[31] ETR SMG-51202: "Satellite Integration within the Universal Mobile Telecommunications System (UMTS)".

[32] ETR 055-01 (1992-12): "Universal Personal Telecommunications (UPT); The service concept; Part 1: Principles and objectives".

[33] International Telecommunications Union, CCIR Recommendations RM Series, Geneva 1992, ITU-R Recommendation M.687-1: "Future Public Land Mobile Telecommunication Systems (FPLMTS)".

[34] International Telecommunications Union, CCIR Recommendations RM Series, Geneva 1992, ITU-R Recommendation M.816: "Framework for services supported on Future Public Land Mobile Telecommunication Systems (FPLMTS)".

[35] International Telecommunications Union, CCIR Recommendations RM Series, Geneva 1992, ITU-R Recommendation M.817: "Future Public Land Mobile Telecommunication Systems (FPLMTS). Network architectures".

[36] International Telecommunications Union, CCIR Recommendations RM Series, Geneva 1992, ITU-R Recommendation M.818: "Satellite operation within Future Public Land Mobile Telecommunication Systems (FPLMTS)".

[37] International Telecommunications Union, CCIR Recommendations RM Series, Geneva 1992, ITU-R Recommendation M.819: "Adaptation of Future Public Land Mobile Telecommunication Systems (FPLMTS) to the needs of developing countries" (see also Temp/123 rev. 2).

[38] International Telecommunications Union, ITU-R Recommendation M.1034: "Requirements for the Radio Interface(s) for FPLMTS (FPLMTS.RREQ)".

[39] International Telecommunications Union, ITU-R Recommendation M.1035: "Framework for the Radio Interface(s) and Radio Subsystem Functionality for FPLMTS (FPLMTS.RFMK)".

[40] International Telecommunications Union, ITU-R Recommendation M.1036: "Spectrum Considerations for Implementation of FPLMTS in the bands 1885-2025 MHz and 2110-2200 MHz (FPLMTS.RFRQ)".

[41] International Telecommunications Union, ITU-R Recommendation M.1079: "Speech and Voice band Data Performance Requirements for FPLMTS (FPLMTS.RFMK)".

[42] UMTSF/1/003/96: "General Requirements and Specifications for Personal Mobile Telecommunications (PMT); Proposal from the MoU on PMT towards the UMTS Forum".

[43] ETSI/PAC Report: "Global Multimedia Mobility (GMM); A standardization framework for Multimedia Mobility in the Information Society".

[44] DTR/NA-002310: "Definition of User Requirements for Lawful Interception of Telecommunications - Requirements of the Law Enforcement Agencies".

[45] ETS 300 507 (1996-01): "Digital cellular telecommunications system (Phase 2+); Lawful Interception - Stage 1" (GSM 02.33).

[46] ETS 300 534 (1994-09): "Digital cellular telecommunications system (Phase 2); Security related network functions" (GSM 03.20).

[47] TCTR/GSM-10-20: "Digital cellular telecommunications system (Phase 2+); Lawful Interception Requirements for GSM" (GSM 10.20).

[48] ETS 300 614 (1995-07): "Digital cellular telecommunications system (Phase 2); Security management" (GSM 12.03).

[49] Official Journal of the European Communities, No. 17 January 1995: "Council Resolution for Lawful Interception (96/C 329/01)".

[50] Treaty on European Union signed at Maastricht on the 7th February 1992.

[51] ETR 029 (1991-10): "Human Factors (HF); Access to telecommunications for people with special needs; Recommendation for improving and adapting telecommunications terminals and service for people with impairments".

[52] ETR 051 (1992-12): "Human Factors (HF); Usability checklist for telephones; Basic requirements".

[53] ETR 068 (1993-09): "Human Factors (HF); European standardization situation of telecommunications facilities for people with special needs".

[54] ETR 095 (1993-09): "Human Factors (HF);Guide for usability evaluations of telecommunications systems and services".

[55] ETR 108: "European digital cellular telecommunications system (Phase 2); GSM Electromagnetic Compatibility (EMC)".

[56] ETR 116 (1994-01): "Human factors (HF); Human factors guidelines for ISDN terminal equipment design".

[57] ETR 170 (1995-01): "Human Factors (HF); Generic user control procedures for ISDN terminals and services".

[58] ETR 208 (1995-09): "Human Factors (HF); Universal Personal Telecommunications (UPT); User requirements".

[59] TC-TR HF-TR 006 (1995-03): "Human Factors (HF); Satellite Personal Communication Network (S-PCN); Statement of user aspects for a S-PCN service".

[60] TCR-TR023 (1994-10): "Human Factors (HF); Assignment of alphabetic letters to digits on push button dialling keypads".

[61] DE/HF-01017: "Minimum man-machine interface (MMI) for the access and control of public network based telecommunication services".

[62] DE/HF-01023: "Specification of characteristics of telephone services tones generated in the network".

[63] ETS 300 295 (1993-10): "Specification of characteristics of telephone services tones when locally generated in terminals".

[64] ETS 300 381 (1994-12): "Telephony for hearing impaired people; Inductive coupling of telephone earphones to hearing aids".

[65] ETS 300 503 (1996-01) Edition 2: "Digital cellular telecommunication system (Phase 2); General on supplementary services" (GSM 02.04).

[66] ETS 300 505 (1996-01) Edition 2: "Digital cellular telecommunication system (Phase 2); Mobile Station (MS) features" (GSM 02.07).

[67] ETS 300 511 (1995-07) Edition 2: "European digital cellular telecommunications system (Phase 2); Man-Machine Interface (MMI) of the Mobile Station (MS)" (GSM 02.30).

[68] ETS 300 512 (1996-01) Edition 2: "Digital cellular telecommunication system (Phase 2); Procedures for call progress indications" (GSM 02.40).

[69] CCITT Recommendation P.31: "Transmission characteristics of digital telephones".

[70] CCITT Recommendation P.35: "Handset telephones".

[71] CCITT Recommendation P.37: "Magnetic Field Strength around the ear-cap of telephone handsets which provide for coupling to hearing aids".

[72] CCITT Recommendation E.121: "Pictograms and symbols to assist users of the telephone service".

[73] CCITT Recommendation E.131: "Subscriber controlled procedures for supplementary telephone services".

[74] ITU-T Recommendation E.134: "Human factors aspects of public terminals: generic operating procedures".

[75] ITU-T Recommendation E.135: "Human factors aspects of public telecommunications terminals for people with special needs".

[76] ITU-T Recommendation E.136: "Specification and use of a tactile identifier for use with telecommunications cards".

[77] CCITT Recommendation E.161: "Arrangement of figures, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".

[78] CCITT Recommendation E.180 (1988): "Tones for use in national signalling systems".

[79] CCITT Recommendation E.181 (1988): "Customer recognition of foreign tones".

[80] CCITT Recommendation E.182 (1988): "Application of tones and recorded announcements in telephone services".

[81] CCITT Recommendation E.183 (1988): "Guiding principles for telephone announcements".

[82] CCITT Recommendation E.184 (1988): "Indications to users of ISDN terminals".

[83] CCITT Recommendation I.250: "ISDN; Definition of Supplementary Services".

[84] CCITT Recommendation I.254: "ISDN; Multiparty Supplementary Services".

[85] ISO/IEC 9995-8: "Information technology - Keyboard layout for text and office systems - Part 8: Allocation of letters to the keys of a numeric keyboard".

[86] ISO/IEC DIS 9995: "Information Technology; Keyboard layouts for test and office systems".

[87] ECMA-136 June 1989: "Ergonomics; Requirements for non-CRT Visual Display Units".

[88] Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).

[89] Council Directive 73/23/EEC on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (Low Voltage Directive).

[90] CEN TC244 N293: "Machine Readable Cards; Man-Machine Interface - Part 2: Dimensions and locations of tactile identifier for ID-1 cards".

[91] GMPCS-MoU.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply:

Mobile Earth Station (MES): An earth station in the mobile satellite service intended to be used in motion or during halts at unspecified points.

Mobile Satellite Service (MSS): A radio-communications service:
- between mobile earth stations and any one or more space stations, or between space stations; used by this service; or
- between mobile earth stations by means of one or more space stations.

This service may also include feeder links.

3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

ACTE	Approvals Committee for Terminal Equipment
AES	Aeronautical Earth Station
AM	Amplitude Modulation
AMPS	Advanced Mobile Phone System
AMSS	Aeronautical Mobile Satellite Service
AOC	Advice Of Charge
AOCC	Advice Of Charge (Charging)
AOCI	Advice Of Charge (Information)
ATM	Asynchronous Transfer Mode
BAIC	Barring of All Incoming Calls
BAOC	Barring of All Outgoing Calls
BOIC	Barring of Outgoing International Calls
BSC	Base Station Controller
BSS	Base Station System
BTS	Base Transmission Station
CAMEL	Customized Application for Mobile network Enhanced Logic
CC	Country Code
CCBC	Completion of Call to Busy Subscriber
CCIR	Comité Consultatif International des Radiocommunications
CCITT	Comité Consultatif International des Télégraphes et Téléphones
CD	Call Deflection
CD	Council Directive
CE	Comission Européenne
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CEPT	Conférence Européenne des Postes et Télécommunications
CFB	Call Forwarding on Busy
CFNRc	Call Forwarding on Mobile Subscriber nort Reachable
CFNRy	Call Forwarding on No Reply
CFU	Call Forwarding Unconditional

CLI	Call Line Identification
CLIP	Call Line Identification Presentation
CLIR	Calling Line Identification Restriction
CoLP	Connected Line identification Presentation
CoLR	Connected Line identification Restriction
CONF	Conference Call Add-on
COREPER	Committee of Permanent Representatives of the Council of Ministers
COST	European Co-operation in the field of Scientific and Technical research
CT	Call Transfer
CTR	Common Technical Regulation
CUG	Closed User Group
CW	Call Waiting
DCS 1800	Digital Communications System at 1,8 GHz
DDI	Direct Dialling In
DECT	Digital Enhanced Cordless Telecommunications
DTMF	Dual Tone Multi Frequency
DTX	Discontinuous Transmission Mode
EC	European Commission
ECMA	European Computer Manufacturers Association
ECTRA	European Committee of Telecommunications Regulatory Authorities
EEC	European Economic Community
EII	European Information Infrastructure
EMC	ElectroMagnetic Compatibility
EN	European Norm
ENF	European Numbering Forum
ERC	European Radiocommunications Committee
ERO	European Radiocommunications Office
ETNO	European Telecommunications Network Operators' Association
ETO	European Telecommunications Office
ETR	ETSI Technical Report
ETS	European Telecommunication Standards (by ETSI)
ETSI	European Telecommunications Standards Institute
EU	European Union
EUROCAE	EURopean Organization for Civil Aviation Equipment
FBI	Federal Bureau of Investigation
FDD	Frequency Division Duplex
FPLMTS	Future Public Land mobile Telecommunications System (now being referred to as IMT-2000)
FSS	Fixed Satellite Service
GII	Global Information Infrastructure
GMM	Global Multimedia Mobility
GMPCS	Global Mobile Personal Communications by Satellite
GMSC	Gate Mobile Switching Centre
GONOW	Global Opening of Networks: Overview and Workplan
GPRS	General Packet Radio Services
GSM	Global System for Mobile communications
HF	Human Factors
HLR	Home Location Register
IEC	International Electrotechnical Committee
ILETS	International Law Enforcement in Telecommunications Seminar
IMSI	International Mobile Subscriber Identity
IMT-2000	International Mobile Telecommunications at 2 GHz (new name for FPLMTS)
IN	Intelligent Network
INTUG	International Telecommunications Users Group
ISDN	Integrated Services Digital Network
ISO	International Standards Organisation
ISPC	International Signalling Point Code
ISUP	ISDN User Part
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union Radiocommunications Committee
ITU-T	International Telecommunications Union Standardization Sector
LEMF	Law Enforcement Monitoring Facility
MCC	Mobile Country Code

MCID	Malicious Call IDentification
ME	Mobile Equipment
MES	Mobile Earth Stations
MF	Multi Frequency (tones)
MGT	Mobile Global Title
MMC	Meet Me Conference
MMI	Man-Machine Interface
MNC	Mobile Network Code
MoU	Memorandum of Understanding
MPTY	Multiparty Service
MS	Mobile Station
MSC	Mobile Switching Centre
MSIN	Mobile Station Identification Number
MSISDN	Mobile Station ISDN (number)
MSN	Multiple Subscriber Number
MSRN	Mobile Station Roaming Number
MSS	Mobile Satellite Service
MTP	Message Transfer Part
NA	Network Aspects
NDC	Network Destination Code
NMSI	National Mobile Station Identity
ONP	Open Network Provision
PAC	Programme Advisory Committee (of ETSI)
PCS	Personal Communications System
PCWG	Police Co-operation Working Group
PLMN	Public Land Mobile Network
PMT	Personal Mobile Telecommunications
PSTN	Public Switched Telecommunications Network
RES	Radio Equipment and Systems
RF	Radio Frequency
RR	Radio Regulation (ITU)
RTCA	Radio Technical Committee for Aeronautics (USA)
SANC	Signalling Area Network Code
SCCP	Signalling Connection and Control Part
SCF	Signalling Control Function
SDH	Synchronous Data Hierarchy
SES	Satellite Earth Station
SES	Satellite Equipment and Systems
SG	Study Group
SIM	Subscriber Identity Module
SMG	Special Mobile Group
SN	Subscriber Number
SOGITS	Senior Officials Group for Information Technology Standardization (CEC)
SOGT	Senior Officials Group on Telecommunications (CEC)
SPC	Signalling Point Code
S-PCN	Satellite Personal Communications Networks (ETSI terminology)
S-PCS	Satellite Personal Communications Services (ERO terminology)
STAG	Security Techniques Advisory Group (ETSI)
STP	Signalling Transfer Point
SUB	Sub-addressing
TBR	Technical Basis for Regulation
TC-TR	Technical Committee - Technical Report
TCR-TR	Technical Committee Reference - Technical Report
TMSI	Temporary Mobile Subscriber Identity
TOS	Terminal Operating System
TP	Terminal Portability
TRAC	Technical Recommendations Application Committee (now NTRAC)
TTE	Telecommunications Terminal Equipment
UMTS	Universal Mobile Telecommunications System
UPT	Universal Personal Telecommunications
USA	United States of America
USIM	UMTS Subscriber Identity Module
UUS	User-User Signalling

VHE	Virtual Home Environment
VLR	Visitor Location Register
WRC	World Radio Conference
WTSC	World Telecommunications Standardization Conference

4 Executive summary

Satellite Personal Communications Networks (S-PCN) are currently being developed by a number of organisations to provide global or near-global coverage, and the first of these are expected to start providing service in 1998. The development of these networks is supported by international consortia, often with significant European participation, but is not under European control. Full details of the user-to-network air interfaces are not being harmonized or published in formal standards. Full technical descriptions of the networks will not necessarily be published at all, and information may be released to manufacturers only under confidentiality agreements. Within ETSI, significant effort has been expended in developing two ETSs for envelope requirements for satellite earth stations for connection to S-PCNs in the 1,6 GHz and 2,0 GHz uplink bands, and these standards are expected to be published in 1997. In addition, two corresponding TBRs are being prepared from these ETSs under a mandate from the European Commission; these TBRs will contain the essential technical requirements for conformance with the Satellite Earth Station Directive (93/97/EEC) [7], and will form the technical bases for regulation to be incorporated in Common Technical Regulations.

This ETR examines telecommunications issues which will impact upon the implementation, deployment and operation of S-PCNs, essentially from a European perspective, and draws conclusions as to the need for further standardization work within Europe, beyond what is currently being done with the above mentioned ETSs and TBRs.

Clause 5 examines numbering issues for S-PCN, and concludes that this is a global matter, which is being addressed at ITU; there is no requirement for specific European standardization work for S-PCN.

Clause 6 examines lawful interception issues for S-PCN, and concludes that although the ETSI STAG committee has already completed a User Requirement [44] document on lawful interception, a Stage 1 description of the requirements for S-PCN is urgently needed to provide clarification on the application of the User Requirement [44] to S-PCN, especially due to its coverage of countries where there may be no network operations or service providers.

Clause 7 examines interconnection and related network issues, and concludes that in the area of network interconnection and integration, a standard should be produced for a multi-purpose SIM for use in multi-mode operation.

Clause 8 examines issues for S-PCN in evolving towards the satellite component of UMTS, and concludes that currently the definition of UMTS is not stable enough to make specific recommendations. In this context, no specific standardization work is required for S-PCN; however the development of UMTS should take into account the strengths and limitations of satellite facilities and the S-PCN community can provide valuable input to the process of developing UMTS and its satellite component.

Clause 9 examines human factors issues for S-PCN, and concludes that this matter is being dealt with adequately within Europe by the appropriate qualified bodies; there is no requirement for additional specific European standardization work for S-PCN.

Clause 10 considers possible MES equipment for S-PCN which are not covered by the ETSs and TBRs currently being prepared. It concludes that some further standardization work is required: for receive-only MESs to cover EMC requirements, and for MESs for aeronautical applications, to cover essential requirements. For MESs for public correspondence in maritime applications there is no further technical work needed beyond the land mobile case for S-PCN, and these could be included in the scope of the current ETSs and TBRs. There is also a need for the standardization bodies responsible for radio stations that may be used in dual or multi-mode equipment alongside S-PCN radio stations to consider the implications of this upon their standards.

Clause 11 examines issues concerning mutual recognition of type approval and licences for S-PCN MESs, and concludes that, within Europe, the mutual recognition of type approval should be achieved by the planned CTRs. However, the creation of a suitable licensing regime for freedom to use S-PCN terminals throughout Europe, although benefiting from the work done in establishing the regime for GSM, has to take account of the sharing of S-PCN bands between dissimilar S-PCNs with very different technical characteristics. In order to facilitate progress, it is therefore suggested that the S-PCN community could assist the regulatory bodies within Europe, and elsewhere in the World, in establishing the necessary framework for freedom to use qualifying S-PCN terminals, taking into account the development of the MoU [91] initiated by the World Telecommunication Policy Forum of ITU.

5 Numbering issues

5.1 Introduction

This clause describes the numbering and addressing issues for the planned Satellite Personal Communications Networks (S-PCNs). The first two of these networks are scheduled for introduction in 1998.

These networks are global. They provide global coverage enabling the use of terminals even in countries where the operators have no direct presence. The development of these networks is supported by international consortia and is not under European control. Full details of the user-to-network air interface are not being harmonized or published in a formal standard. Full technical descriptions of the networks will not necessarily be published at all, and information may be released to manufacturers only under confidentiality agreements.

The purpose of this part of the ETR is:

- to identify the numbering issues;
- to identify any actions that may need to be taken at European level;
- to identify any need for the development of any European standards related to numbering that would facilitate the development of S-PCNs.

This clause of the ETR addresses those numbering aspects of S-PCN that relate to the user or that will need to be the subject of general co-operation between network operators. Thus the ETR addresses:

- numbering for the routing of calls (according to ITU-T Recommendation E.164 [12]);
- identification of the user and the control of his mobility within and between mobile networks (according to ITU-T Recommendation E.212 [15]);
- numbering for the routing of signalling messages between networks in support of mobility (according to ITU-T Recommendation E.214 [17]);
- International Signalling Point Codes used for the routing of signalling messages between networks (according to ITU-T Recommendation Q.708 [18].

This clause of the ETR does not address other forms of numbers such as mobile equipment numbers and security codes.

5.2 Responsibility for numbering

At a world level the responsibility for numbering lies with the ITU and the Principles for Code Assignment and Number Formats are detailed by ITU-T. Recommendations on numbering (the E-series) are prepared by Study Group 2, which handles both numbering policy, i.e. the planning of numbering ranges, and the allocation of country codes. The allocation of digits that follow the country code is usually the responsibility of the national administration. In some cases, these allocations are notified to ITU-T.

European policy on numbering is established in European Committee of Telecommunications Regulatory Authorities (ECTRA), which has a project team on numbering, and is supported by the European Telecommunications Office (ETO), which has special responsibility for numbering. Certain aspects of numbering have also been addressed in European Directives, e.g. the creation of a common pan-European emergency number and international dialling code. The Commission has indicated that it intends to produce a Green Paper on numbering later in 1996.

The European Numbering Forum (ENF) has been established for co-ordination, consultation and the exchange of information and expertise at a European level. It is open to any European organisation with a relevant interest, and its current membership includes ETSI (represented by NA2), ETNO, INTUG, EIIA and the Commission. Its objective is to achieve a consensus on European numbering issues.

Within ETSI, NA2 is responsible for numbering and addressing for all networks and services. It works in close co-operation with ECMA on numbering issues for corporate networks.

5.3 ITU-T Recommendations relevant to S-PCN

5.3.1 Introduction

The seven main ITU-T Recommendations relevant to S-PCN are:

E.162 Telephone Network and ISDN;
Operation, Numbering, Routing and Mobile Service;
Capability for Seven Digit Analysis of International E.164 Numbers at Time "T".

E.164 Telephone Network and ISDN;
Operation, Numbering, Routing and Mobile Service;
Numbering Plan for the ISDN Era.

E.164.1 Revised Draft Recommendation: Criteria and Procedures for the Reservation, Assignment and Reclamation of E.164 Country Codes - Version 2.

E.212 Telephone Network and ISDN;
Operation, Numbering, Routing and Mobile Service;
Identification Plan for Land Mobile Stations.

E.213 Telephone Network and ISDN;
Operation, Numbering, Routing and Mobile Service;
Telephone and ISDN Numbering Plan for Land Mobile Stations In Public Land Mobile Networks (PLMN).

E.214 Telephone Network and ISDN;
Operation, Numbering, Routing and Mobile Service;
Structure of the Land Mobile Global Title for the Signalling Connection Control Part (SCCP).

Q.708 Specifications of Signalling System No 7
Numbering of International Signalling Point Codes.

The following subclauses explain the nature of the numbers mainly for the benefit of a reader who is not familiar in detail with their use. Later sections discuss the issues of allocating these numbers to S-PCN.

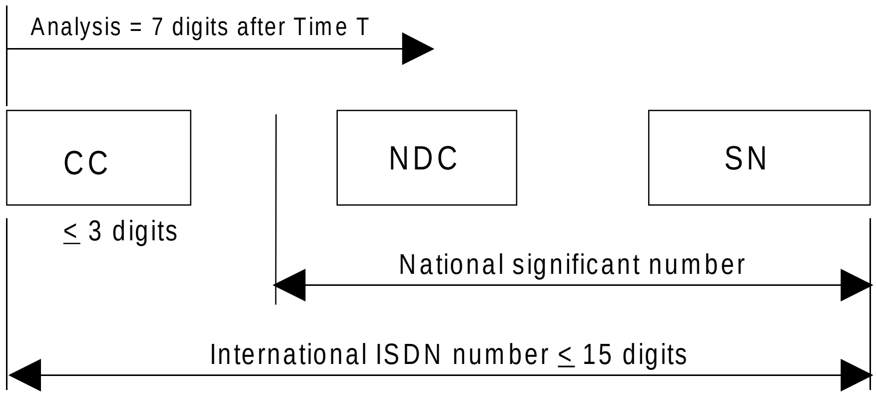
Within ITU-T, the approach to numbering is undergoing radical changes as a result of the introduction of competition and a growth in the number of international networks. In consequence the detailed definitions of various categories in the recommendations may be changed. This ETR discusses the issues from a technical perspective and does not address temporary problems relating to definitions.

5.3.2 E.164 (MSISDN) number

E.164 numbers are used to identify the called party when a call is being established. In other words they are the numbers commonly known and used by users. They have a length of up to 15 digits from end 1996 (known as Time "T", see ITU-T Recommendation E.165 [14]) and 12 digits before that date. This maximum length excludes the international prefix.

In mobile networks such as GSM the E.164 number is also known as the Mobile Station ISDN (MSISDN) number.

The structure of the number is shown in figure 1.



CC Country Code
NDC National Destination Code
SN Subscriber Number

Figure 1: Structure of E.164 numbers

The analysis capability of 7 digits applies from Time T according to ITU-T Recommendation E.162 [11]. Before Time T, the required capability was 4 digits where there is a 1- or 2- digit country code, and 5 digits where there is a 3-digit country code ITU-T Recommendation E.164 [12] initially required this capability to increase to 6 digits from Time T, but this figure was subsequently changed to 7 digits by ITU-T Recommendation E.162 [11]. However in practice some countries outside Europe do not analyse more than the country code for foreign numbers, and in these countries it is very doubtful whether the analysis capacity will be increased by Time T. It is likely that number handling and analysis capacity will increase only when there is a need in practice to extend these capabilities.

The Country Code (CC) is allocated by the ITU Telecommunication Standardization Bureau based on recommendations from Study Group 2. At present there are 1-, 2-, and 3-digit country codes, but the policy of ITU-T is to allocate only 3-digit country codes in future.

Because many countries have been allocated 2-digit codes, there are few spare country codes. Whereas numbering allocations remained stable for many years there have recently been more frequent changes due to political changes including the division of former countries into several new countries.

The following summarises the allocations and the spare capacity (based on the ITU-T list published October 1995). In the past the leading digit was associated with particular geographical regions, but this association is no longer being followed.

Table 1: Use of E.164 Country Codes (CCs)

Leading digit	Spare codes
1	none (integrated plan)
2	15
3	4
4	none
5	none
6	7
7	none
8	41
9	10
0	

From the spare codes, 39 codes (28x, 80x, 83x, and 89x) are considered suitable for allocation as global service codes). The range 87x is currently reserved for the maritime mobile service with the codes 871-874 allocated to Inmarsat, with different codes being used for different ocean regions. By 2015 Inmarsat will use only code 870 and will release the other codes. Codes 875-877 are reserved for maritime mobile service applications, code 878 is reserved for UPT, and code 879 has its reservation currently under investigation.

5.3.3 Mobile Station Roaming Number (MSRN)

The MSRN is a number defined in E.213 [16] that is used for the routing of calls to a mobile that has roamed onto a "foreign" network, i.e. a network other than its home network. The MSRN identifies both the MSC that is serving the mobile and the mobile itself. The MSRN is normally an ITU-T Recommendation E.164 [12] number allocated temporarily on a per-call basis from the national numbering space of the country of the foreign network. In practice the number will be from the numbering space allocated to the foreign mobile network. The allocation is made through an exchange of signalling messages between the HLR and the VLR. It may last either for the whole period during which the mobile is being handled by a particular MSC in the visited network or it may be limited to the duration of the relevant incoming call.

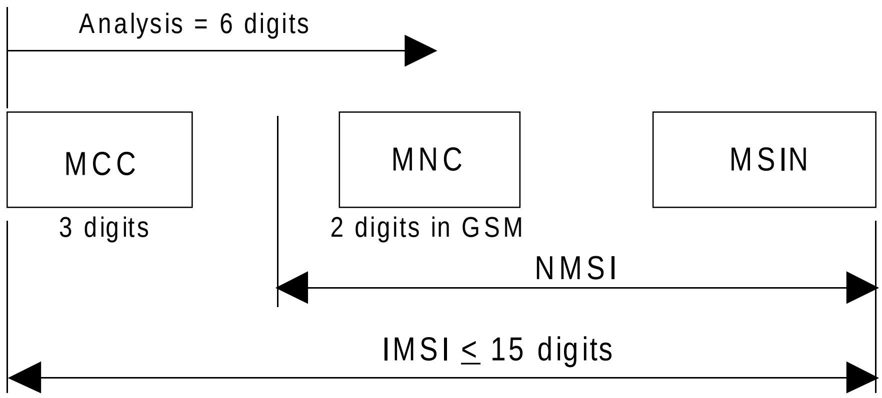
5.3.4 International Mobile Station Identity (IMSI)

The IMSI is a number defined in E.212 [15] that is used to identify the mobile station. The IMSI is an entirely different type of number from the ITU-T Recommendation E.164 [12] number. It is not visible to users and is not dialled.

The purpose of defining this separate numbering scheme for land mobiles is to de-couple their identification from the dialling plans of individual countries. Thus if a country adds an additional digit to its ITU-T Recommendation E.164 [12] numbering plan so that the dialled numbers all change, the IMSIs of its mobiles are not affected.

The structure of the IMSI is similar to that of the ITU-T Recommendation E.164 [12] number in that it begins with a Mobile Country Code (MCC). The detailed structure is shown in figure 2. The MCC is always 3 digits, and the maximum length shall not exceed 15 digits. Only one IMSI can be allocated to each mobile irrespective of the number of services used.

Up to 6 digits of the IMSI are used for the routing of information.



MCC Mobile Country Code
MNC Mobile Network Code
MSIN Mobile Station Identification Number
NMSI National Mobile Station Identity
IMSI International Mobile Station Identity

Figure 2: Structure of the International Mobile Station Identity (IMSI)

The IMSI is used by mobile networks in their handling of mobile terminals. The main uses of the IMSI are:

a) determination of the home mobile network in which a foreign land mobile station is registered;
b) mobile station identification when information about a specific land mobile station is to be exchanged between mobile networks;
c) mobile station identification for all signalling on the radio control path;
d) mobile station identification for charging and billing of foreign land mobile stations;
e) subscription management, e.g. for retrieving, providing, changing and updating subscription data for a specific mobile station.

The values of the MCC are different from those of the Country Code (CC) in ITU-T Recommendation E.164 [12]. The values of the MCC are in many cases the same as the values of the Data Country Code in X.121 [19], but there is no formal linkage between them.

The allocations of MCCs given at March 1996 is as follows:

Table 2: Allocations of MCCs

Leading digit	Region	Spare Codes
1	Reserved for future use	
2	Europe	49
3	North America	65
4	Asia/Far East	58
5	Malaysia/Australia	76
6	Africa	46
7	South America	80
8	Reserved for future use	
9	Reserved for future use	
0	Reserved for future use	

E.212 [15] will be reviewed by ITU-T Study Group 2 during the next study period and may be extended for use in wireline networks.

5.3.5 Mobile Global Title (MGT)

The Mobile Global Title is defined in E.214 [17] and has up to 15 decimal digits. It is one of two addressing mechanisms used in the SCCP to route messages between VLRs and HLRs (the other mechanism is signalling point codes). The MGT is used for routing to and across other networks. The MGT contains a combination of the country code and the network code from E.164, and the mobile station identification number from the IMSI. The mobile station identification number may be truncated if necessary when it is used in the MGT. The reason for the creation and use of the MGT is to provide an address that can be used by networks that do not have the information that would be needed to route the signalling message from the IMSI alone.

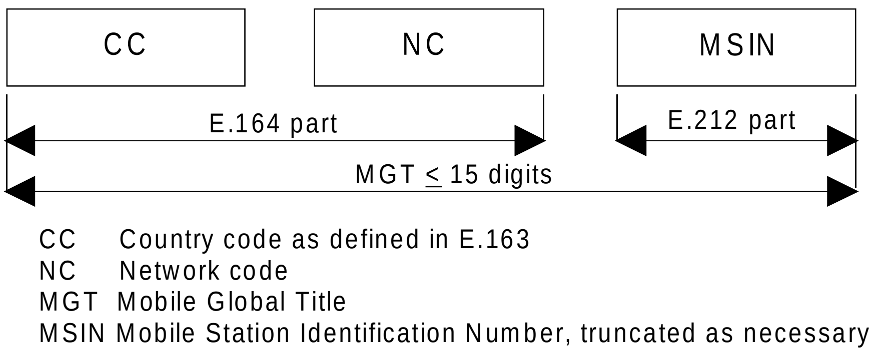


Figure 3: Structure of the Mobile Global Title (MGT)

The ITU-T Recommendation E.164 [12] part of the MGT is generated within the SCCP of a mobile network from the first part of the IMSI using translation tables.

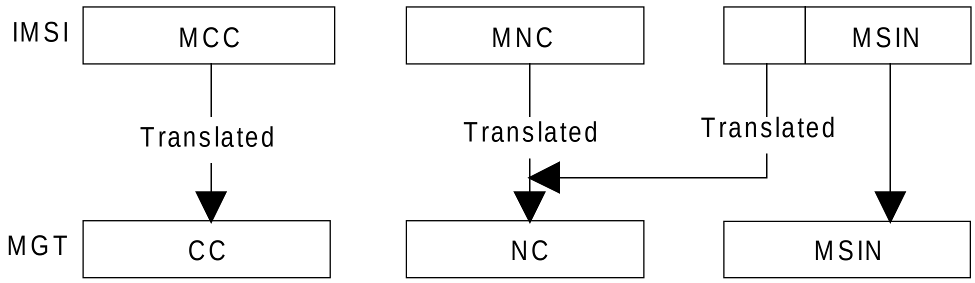


Figure 4: Derivation of Mobile Global Title (MGT)

5.3.6 Temporary Mobile Station Identifier (TMSI)

The TMSI is a mobile station identifier assigned temporarily to a visiting mobile (either of the home network or a roamer from another network) by a VLR to identify signalling communications between the VLR and the mobile. Its use is local. One reason for using the TMSI is to enable signalling communications to be routed from the VLR to the mobile using the existing routing algorithms of the visited network; another is to avoid the need to send the IMSI unencrypted over the radio interface.

5.3.7 Signalling Point Code (SPC)

Signalling Point Codes (SPCs) are used to identify signalling transfer points (normally switches) within the Message Transfer Part (MTP) of Signalling System No 7. These points are the sources and destinations of signalling connections between switches.

Within Signalling System No 7 there is assumed to be a single global international signalling network that uses International Signalling Point Codes (ISPCs) consisting of 14 bits. These codes are defined in Q.708 [18] and their structure is shown in figure 5. This international signalling network includes all international exchanges, and is considered to be separate and above (in hierarchical terms) the national networks in each country. These national networks use their own set of signalling code points. Within Signalling System No 7, international and national code points are identified separately by the network indicator (two bits in a message). International exchanges normally have both international and national SPCs because they "bridge" international and national networks.

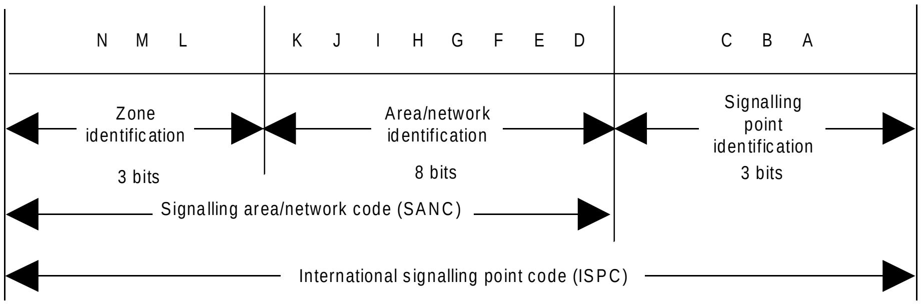


Figure 5: Structure of International Signalling Point Code (ISPC)

The ISPC is normally represented in decimal form as A-BBB-C, where A is the zone identification.

Each country is assigned at least one Signalling Area Network Code (SANC), and several have more than one. These allocations are normally sequential e.g. France is allocated 2-016 through to 2-023. Where there is more than one international operator in a country, each operator has his own SANC. There can be up to 256 SANCs in each zone.

Although there is a separate zone identification, the routing of the signalling information is based on the whole SANC, thus it does not matter whether or not the destination signalling transfer point is actually located in the area indicated by the zone identification bits.

Table 3: Allocation of SANCs

Leading digit	Region	Spare Codes
1	Reserved for future use	
2	Europe	139
3	North America	178
4	Asia/Far East	201
5	Malaysia/Australia	207
6	Africa	201
7	South America	234
8	Reserved for future use	

5.4 Number use in GSM

5.4.1 General

This section explains the numbering procedures in GSM. The purpose of this section is to clarify further the role of each type of number and to provide a basic understanding for the numbering requirements of S-PCN, which will be based on the GSM design.

The IMSI, not the MSISDN, provides the basic mobile identification in GSM. The use of the IMSI makes the mobile network identification system less dependent on the national numbering plan of the country in which it is located. The IMSI is the basic method of identifying the user’s Subscriber Identity Module (SIM).

A feature of GSM is that a user may have more than one MSISDN number. The purpose of this is so that different numbers may be used to differentiate between different types of traffic, where the traffic comes from a PSTN or a network that, unlike ISDN, does not signal the type of bearer service being used. Thus voice telephony may be sent to one number and fax to another number. The mobile can determine from the called MSISDN number the type of the traffic and respond accordingly.

The SIM may also contain one or more MSISDN numbers, but these numbers are stored for the benefit of the user, who may need reminding of his own number, rather than for use during interactions with the network. All interactions with the network over the radio interface use the IMSI, or its temporary equivalent the TMSI. One advantage of the use of the separate IMSI is that when the MSISDN numbers are changed, the SIM cards do not have to be re-programmed from scratch but can retain the same IMSI whilst having the MSISDN numbers updated either by the user or the network.

The following illustrates the use of the IMSI, MGT and SPC.

When a mobile is switched on, or roams outside its own network, but within the coverage of a foreign network, the mobile sends its IMSI to the network to be held in the Visitor Location Register of the MSC that serves the location of the mobile. The VLR then has to determine how to route messages to the HLR of the mobile to obtain further information about the mobile. The VLR then performs one of the following:

a) If the mobile is on its own network, the MSC/VLR uses internal stored information within the SCCP to translate the IMSI into the Signalling Point Code (unique switch address) of the HLR. The SPC can be sent to the MTP to route the messages across the network.

b) If the mobile is not on its own network, the MSC/VLR uses internal stored information to translate the first part of the IMSI into an E.164 number, and thus generate the Mobile Global Title (MGT). Internal information is then used to find the SPC of the gateway exchange to which the messages should be routed. The gateway exchange is identified by its SPC and the message is routed to the SPC, with the MGT being carried with the message. At the gateway exchange, the MGT is passed to the next network, say the international signalling network. The international signalling network determines from the MGT the distant gateway exchange that serves the destination network, and routes the message using the International Signalling Point Code (ISPC). On this section of the route, the message may pass through the international exchanges of several countries. At the destination country, the message is passed to the destination network again with the MGT. The destination network derives the destination SPC of the HLR from the MGT and routes the message to the HLR.

Figure 6 illustrates b) above.

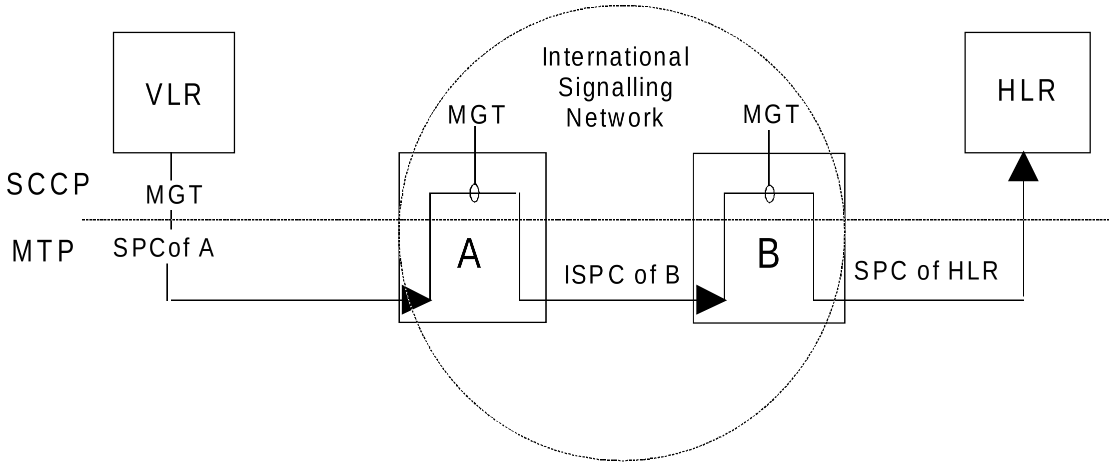


Figure 6: Routing of message from VLR to HLR

When the information requested has been obtained from the HLR, the VLR stores this information for use to support outgoing calls from the mobile. The VLR also stores the current location area of the mobile and may assign a Temporary Mobile Station Identifier (TMSI) to the mobile. The HLR stores the identity of the VLR used by the mobile to support incoming calls.

5.4.2 Incoming calls to a mobile

When an incoming call is generated to a mobile, the call set-up within the mobile network will be controlled either by the MSC that serves the calling mobile or by the Gateway MSC that is handling the call. This MSC will interrogate the HLR to obtain routing information. This interrogation will be based on the MSISDN number. The HLR will return the Mobile Station Roaming Number, and this number will be used to route the call to the MSC concerned. The MSC will signal to the mobile using the Local Area Identification (LAI) and the TMSI.

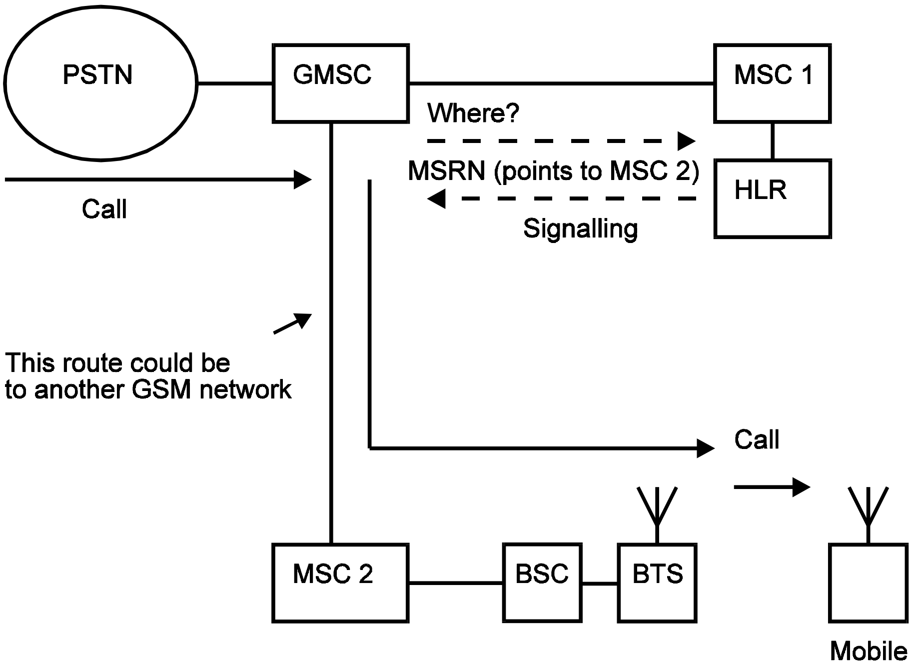


Figure 7: Routing of an incoming call

5.5 Options for the structure of S-PCN numbering in E.164

5.5.1 Introduction

This subclause refers specifically to the options for the allocation of ITU-T Recommendation E.164 [12] numbers to S-PCN subscribers where the numbers are specifically for S-PCN. In practice some S-PCN networks may be integrated with terrestrial mobile networks (e.g. GSM or digital AMPS or PCS) with subscribers having dual mode terminals such that calls to a subscriber's terrestrial mobile number are routed automatically via the S-PCN network if the terminal is outside the coverage of a terrestrial mobile network.

From a technical perspective, there are three basic options for numbering S-PCNs within ITU-T Recommendation E.164 [12]:

Option A: Country code for each operator;
Option B: Country code for S-PCN with 1 or 2 values of next digit for each network;
Option C: National numbering (like the current GSM) based on the location of the fixed network access point, with a separate code for each S-PCN network within each national number.

Options A and B are mutually exclusive alternatives, whereas Option C could be used by one or more networks, whilst Option A or Option B is used by the others. Option C would be the choice of a network that wishes to present a national identity (e.g. an S-PCN network integrated with a land mobile network, such as GSM). ITU-T is currently preparing to follow Option B (see subclause 5.5.6).

Study Group 2 of ITU-T has decided to reject Option A (see subclause 5.5.6) but it is included for completeness in the following analysis of the issues affected by the choice of options.

5.5.2 Network identity

The identity of a network in the mind of users is an important commercial and marketing issue. Initially with analogue cellular systems and GSM it was easy to identify the network being used by a called party but this has become less easy where there is more than one code allocated to each network.

With Option A, there would be a clear identity of the number with an individual network, particularly if the country codes allocated to the S-PCN operators were well separated numerically.

With Option B, there would be a clear identity of S-PCN as a network type, but the identity of the individual networks, shown in the value of the fourth digit, would be less visible.

With Option C, there would be a clear identity for each S-PCN network apparent to a caller in the same country, but the number would not be easily identifiable as S-PCN to a caller from another country.

5.5.3 Routing of incoming calls

With both Option A and Option B, calls would normally be routed through an international exchange in the caller's country to the nearest gateway into the S-PCN network. Unless the national trunk exchanges analyse more than the country code, this would be true even for calls from within the same country as the S-PCN gateway, which would be an inefficient routing. Analysis beyond the country code for a foreign country code is not common but is technically possible with digital or electronically controlled exchanges.

With Option B, there would be routing problems for calls from countries where the international exchanges are equipped only to route on a country code of up to 3 digits. This limitation may affect a significant number of countries even though ITU-T recommends a greater analysis capacity. Such exchanges would not be able to determine how to route the call and would have to route all calls to that country code to one of the S-PCN operators. There would then have to be an interconnection agreement between the operators for the completion of the call. It should be noted that such an arrangement is not for international standardization. This situation is illustrated in figure 8.

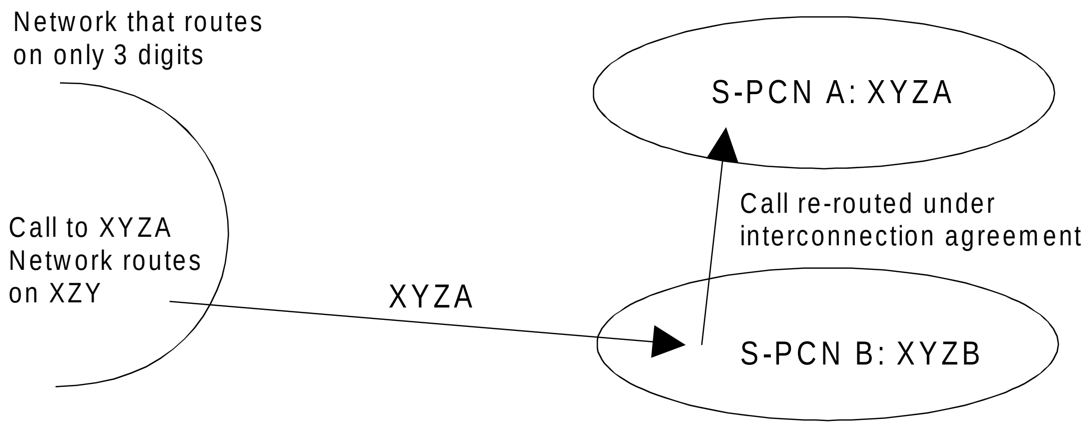


Figure 8: Routing problem of incoming call

Since a significant proportion of the traffic on S-PCNs is expected to involve less developed countries, these routing problems are important.

With Option C, calls will be routed to the international exchange of the country identified by the country code in the number, and thence to the S-PCN network. Calls from within the country will be routed from a local or trunk exchange directly to the S-PCN network.

5.5.4 Billing of incoming calls

The calling party will be billed for calls to the S-PCN network on the basis of the called number. The tariff for calling S-PCN numbers is an important commercial issue for S-PCN network operators because it affects the utility of the service to its customers (customers will tend to prefer a network where it is not too expensive for their colleagues or friends to call them). For example the lower tariffs for incoming calls to DCS 1800 networks in one European country is seen as an important commercial advantage compared to the GSM networks.

Little is known at present about the tariff plans of the S-PCN operators. Tariffs are likely to be at least as high overall as those for GSM networks but it is not clear whether the called party will share part of the cost of incoming calls. Cost sharing is relatively easy as the S-PCN network can log incoming calls and apply its own tariff to the called parties. The accounting between national networks and the S-PCN network can be handled in the same way as accounting between different countries.

The ability of a network to apply different tariffs depends on the sophistication of its exchanges and billing systems, and the analysis of the called number. There may be limitations on the range of tariff level options for calls to S-PCN networks from some countries.

Option A gives a clear network identification for tariff purposes. This identification will allow different S-PCN networks to have different incoming call tariffs, and will thus facilitate competition on incoming tariffs. Option C also facilitates this competition but only for incoming national calls, since another country will not be able to distinguish different S-PCN networks numbered according to Option C.

Option B is likely to prevent the application of different incoming call tariffs to different S-PCN operators until both routing and billing on an analysis of four digits is actually implemented.

Option C carries an additional disadvantage in that many networks will charge the same tariff for all calls to a country. If the tariff for the mobile element of calls to S-PCN is relatively high, this will force the S-PCN operators to charge their customers for receiving calls, because they will be able to obtain only a share of the normal international tariff from the caller.

5.5.5 Segmentation of services

S-PCN operators may wish to segment their services into different numbering ranges. Different numbering ranges may be used to distinguish different services e.g. telephony or facsimile, or basic and enhanced services. Another possibility is that different numbering ranges may be used for different number lengths e.g. one range for 12-digit numbers and another for 15-digit numbers.

With Option A, any segmentation would have to be done through different values of the fourth digit, i.e. the digit following the country code assigned to the S-PCN network. With Option B, according to the intentions of Study Group 2 of ITU-T, each S-PCN network would have up to two values of digit four giving up to two different categories. If more categories were required, the fifth digit would have to be used for further segmentation.

With Option C, either different codes could be used, or different values of the digit following the network identification code.

The options are summarised in table 4 below.

Table 4: Summary of options for E.164 numbers

	Option A Country code each	**Option B Shared country code**	**Option C National code in each country**
Identity in mind of users.	Focus on network identity.	Focus on S-PCN identity.	National not international identity. Focus on network.
Routing of incoming calls.	Normally through international exchange in caller's country to nearest S-PCN gateway. No problem in number analysis as only three digits.	Normally through international exchange in caller's country to nearest S-PCN gateway. Problem for countries where analysis limited to three digits.	Calls from within same country as the S-PCN gateway will be routed directly to S-PCN gateway.
Tariffs for incoming calls.	Allows competition on incoming call tariffs.	Prevents competition on incoming call tariffs where the international exchanges cannot analyse 4th digit for billing.	Allows competition on tariffs for incoming calls within a country, but not for calls from other countries.
Segmentation of services within each network.	Use first digit after country code.	Two categories available from network digit values, otherwise use first digit after network digit.	Use separate national codes, probably 3- or 4-digit numbers.

5.5.6 Current situation in ITU-T

Study Group 2 has considered the allocation of "country codes" to S-PCN. Three of the potential S-PCN operators have participated in the discussions and expressed a preference for Option A (country code each) but Study Group 2 has concluded that there are not sufficient unallocated codes for one "country code" to be allocated to each operator. A major influence on this decision is that an allocation to each S-PCN operator might be seen to set a precedent for the allocation to global fixed networks. Consequently it recommended that the allocation of the code 881 be shared amongst the four S-PCN operators. The following allocations of the reserved values of the fourth digit:

881 0	ICO;
881 1	ICO;
881 2	Odyssey;
881 3	Odyssey;
881 4	Spare;
881 5	Spare;
881 6	Iridium;
881 7	Iridium;
881 8	Globalstar;
881 9	Globalstar;

were made by ballot, agreed at the May 1996 Study Group 2 meeting, and adopted at the World Telecommunications Standardization Conference. They will be included in the revised version of ITU-T Recommendation E.164 [13].

Study Group 2 is currently discussing the introduction of 4-digit identification codes. These allocations may eventually be treated as identification codes.

5.5.7 Structure for S-PCN numbering in E.164; discussion and conclusion

From the technical and marketing perspective of S-PCN, the most attractive arrangement for E.164 numbers would have been either Option A or Option C. The only advantage for S-PCN of Option B over Option A is the clearer identification of S-PCN as a category. This would be beneficial if the caller tariffs expected for S-PCN are likely to be significantly higher than those for other international calls, but this is not expected to be the case.

The decision to follow Option B instead of Option A will make it very important that the ITU-T Recommendation E.164 [12] analysis capability is increased in all countries to at least four digits by the time that S-PCN services commence (according to ITU-T Recommendation E.162 [11] it should be increased to 7 digits from Time T, but there is concern that not all countries outside Europe will follow this Recommendation). Where this analysis capability is not provided, routing limitations will make it necessary to establish interconnection agreements between those S-PCN operators that share a country code for the routing of incoming traffic from networks that do not analyse international traffic beyond the 3 digits of the country code.

It will also be important for network operators to analyse more than the country code to determine the tariffs so that competition can develop between S-PCN operators in terms of the level of the tariffs for incoming calls.

Since Option B will have disadvantages until these problems are overcome, every effort should be made to encourage all countries, especially those in less developed parts of the world where there may be significant S-PCN traffic, to implement the routing and tariffing capabilities based on at least 4 digits.

5.6 Options for IMSI numbering in E.212

5.6.1 Introduction

IMSIs are used for the identification of mobiles. Unlike ITU-T Recommendation E.164 [12] there is no shortage of mobile country codes.

The main options for the allocation of E.212 [15] numbers are:

Option L: allocate an MCC to each network;

Option M: allocate an MCC to S-PCN as a whole and subdivide it between networks using the MNC;

Option N: allocate MNCs at a national level to subscribers in each country.

The options L, N and M are equivalent to the options A, B and C, respectively, for ITU-T Recommendation E.164 [12] numbers. The two numbering systems are related to some extent through the Mobile Global Title (MGT). The numbering scheme under E.212 [15] does not have a shortage of MCCs to the same extent as there is a shortage of CCs in E.164 [12], and so E.212 [15] is less of a constraint than ITU-T Recommendation E.164 [12]. Consequently decisions on numbering in ITU-T Recommendation E.164 [12] should be made first, and the approach to E.212 [15] numbering should be chosen to fit with the solution for ITU-T Recommendation E.164 [12].

The MCCs allocated to date are grouped in geographical zones according to the value of the first digit. MCCs for options L and M could be allocated from a geographical zone but this would be inappropriate for a global service. Currently no MCCs are allocated to global or non-geographic services, and no value of the first digit is assigned to any purpose other than geographical zones. However, since there are four unallocated values of the first digit, it would not be difficult to allocate one of these values to global services.

In practice it is unlikely to make any difference in operational terms whether an MCC is allocated from a geographical zone because all operations in the network will use the MCC as a whole and not take actions solely on the basis of the value of the first digit. For presentational purposes, however, it would be preferable to allocate a new grouping to global services and to use MCCs from this grouping.

5.6.2 Relationship between E.212 and E.164

In deriving the Mobile Global Title (MGT), the MCC is translated into the ITU-T Recommendation E.164 [12] country code and the Mobile Network Code (MNC) is translated into the ITU-T Recommendation E.164 [12] Network Code. This translation is carried out in the SCCP of any network where there is roaming to S-PCN, and thus it is expected that the translations will be carried out by GSM, DCS 1800, PCS, and digital AMPS networks, since some of the S-PCN operators are planning roaming between S-PCN and these networks. In the following comments, the assumption is that it is impracticable to expect that the software for this translation will be modified in these existing networks, although new data will be introduced.

Since the main constraint is the ITU-T Recommendation E.164 [12] numbers, the arrangements for E.212 [15] are now considered in relation to the ITU-T Recommendation E.164 [12] options.

Option A (country code each):

> Option L (MCC each) will work with Option A. There would be a one-to-one relationship between the MCC and the country code. Different values of the MNC could be used to identify different HLRs in the S-PCN network.
>
> Option M (shared MCC) would not work with Option A because there would be a one-to-many relationship between the MCC and the country code. Thus the value of the MCC would not translate directly to the country code as additional information from the MNC would be needed to identify which country code should be chosen.
>
> Option N (separate national MNCs) would not work with Option A because there would be a many-to-many relationship between the MCC and the country code. Thus the value of the MCC would not translate directly to the country code as additional information from the MNC would be needed to identify which country code should be chosen. Furthermore the use of many different MCC/MNC combinations to identify a single network would necessitate changes to the billing arrangements compared to GSM.

Option B (shared country code):

> Option L (MCC each) will work with Option B. There would be a many-to-one relationship between the MCC and the country code, but direct translation would still be possible. The correct value of the digit following the country code would be obtained in the translation from the MNC to the NDC.
>
> Option M (shared MCC) will also work with Option B. There would be a one-to-one relationship between the MCC and the country code, and the correct value of the digit following the country code would be obtained in the translation from the MNC to the NDC.
>
> Option N (separate national MNCs) would not work for the same reasons as for the comparison with Option A, although the relationship would be one-to-many rather than many-to-many.

Option C (national code in each country):

> Neither Option L nor Option M will work with Option C because there would be a one-to-many relationship between the MCC and the country code.
>
> Option N would work because there would be a separate one-to-one translation between the MCC and the country code for each country.

This analysis is summarised in table 5.

Table 5: Related options for E.164 and E.212 numbering

E.164 Option	Satisfactory E.212 Option
A (country code for each S-PCN network)	L (MCC for each S-PCN network)
B (shared country code)	L or M (dedicated or shared MCC)
C (national code in each country)	N (MNC in each country)

5.6.3 S-PCN numbering in E.212; discussion and conclusions

Both options L and M create a unique IMSI identity for each S-PCN, i.e. either a unique MCC or a unique combination of MCC and MNC. This unique identity should facilitate the identification of the HLR and other matters such as billing for which the IMSI is used. In contrast, Option N would create many separate identities, as many identities as there are countries with subscribers. The multiplication of identities could be ameliorated somewhat if the same value of the MNC were allocated in each country to a given S-PCN, and this approach may be possible because of the sparse use of IMSIs.

It is not possible to draw unequivocal conclusions on how IMSIs should be allocated, because the choice of option will depend both on the solution for ITU-T Recommendation E.164 [12] numbering and on the commercial approach of the S-PCN operator. Options L and M appear to be preferable for S-PCN networks that operate as a single global network with their own customers, but Option N could be preferable for an S-PCN that operates solely to provide add-on services for national GSM networks, where the HLR function is provided by the HLR of the GSM network.

Thus the only firm conclusions that can be drawn are:

- the availability of Mobile Country Codes (MCCs) for IMSIs is not a constraint;

- the E.212 [15] arrangements should be chosen to match the ITU-T Recommendation E.164 [12] arrangements, which may be different for different S-PCNs. The choice of E.212 [15] arrangement will be constrained by the ITU-T Recommendation E.164 [12] arrangement if changes to software in other mobile networks are to be avoided;

- if Mobile Country Codes (MCCs) are allocated to S-PCNs, the allocation of one of the unallocated values of the first digit of the MCC to global services would give a presentational advantage, but probably not an operational advantage.

Within ITU-T, Study Group 2 has recommended Option M with the Mobile Country Code value of 901 being reserved for sharing by S-PCN operators. This recommendation has been adopted by the WTSC but the method of sharing has yet to be determined.

5.7 Signalling Point Codes (SPC)

International Signalling Point Codes (ISPCs) need to be allocated to the international signalling transfer points of the S-PCN networks. Under each SANC, there is capacity for numbering 8 Signalling Transfer Points (STP).

Each international gateway (international STP) of an S-PCN network will need an ISPC. Some S-PCN networks will therefore need a number of SPCs amounting to more than one SANC. Other S-PCN networks that are designed to operate solely as extensions of a national land mobile network may not need any ISPC codes.

Where S-PCN gateways operate internationally, it will be necessary for messages to be routed directly to them from other international networks. Therefore they need to be allocated separate SANCs rather than share a SANC with an existing operator in the same country, since the SANC is used for message routing.

The SANCs are allocated from 8 zones of which 6 zones are defined to date, but the zone allocations do not affect the routing of messages and are purely presentational. Whilst it would be good for presentational reasons to allocate one of the two remaining values of the first decimal digit to global networks, this is not a high priority.

The conclusion is that one or more SANCs should be allocated as needed to the S-PCN networks for their international gateways. These SANCs could be allocated either from a regional zone or from a newly created "global zone". The latter would have presentational advantages but is not a high priority.

5.8 S-PCN numbering; conclusions

Numbering decisions are determined primarily by the interaction of the technical and commercial designs of the S-PCN networks, and the constraints that result from the availability of numbers at a world level. Furthermore the differences between the networks are substantial and allow little scope for harmonization through standardization.

The overall conclusions on numbering are the following:

1 The approach to S-PCN numbering depends on the commercial and technical objectives of the different operators. These objectives are not the same and are expected to lead to different numbering arrangements for the different networks.

2 There is no case for standardization at a European level of the numbering arrangements for S-PCN.

3 Allocations of three classes of number are needed for S-PCN:

- E.164 [12] numbers (MSISDNs) for the routing of calls to users.
- E.212 [15] numbers (IMSIs) for the identification of users within and between S-PCN networks and between S-PCN and GSM where dual mode terminals are used.
- International Signalling Point Codes as defined in Q.708 [18] for the identification of Signalling Transfer Points within the S-PCN networks.

There is a relationship between the ITU-T Recommendation E.164 [12] and the E.212 [15] numbers through the translation from E.212 [15] to ITU-T Recommendation E.164 [12] in deriving the Mobile Global Title (MGT). The main constraint is the allocation of ITU-T Recommendation E.164 [12] numbers, and therefore the ITU-T Recommendation E.164 [12] numbering arrangements should be decided first, and then the E.212 [15] arrangements should be designed to fit with the ITU-T Recommendation E.164 [12] arrangements.

4 Within ITU-T Recommendation E.164 [12], the better solutions in the shorter term would be the allocation of a Country Code (CC) to each S-PCN operator, or the allocation of one or more network codes within each country where service is offered.

5 The sharing of an ITU-T Recommendation E.164 [12] Country Code (CC) adopted by ITU-T Study Group 2 has disadvantages in the shorter term because it will:

- prevent competition between S-PCN operators in the level of the tariffs for incoming calls until operators of other networks analyse more than the country code to determine call tariffs;

- require the establishment of interconnection agreements between those S-PCN operators that share a country code for the routing of incoming traffic from networks that do not analyse international traffic beyond the country code.

For these reasons European administrations should take every opportunity to encourage other administrations to implement the capability to route calls on at least four digits.

6 Concerning E.212 [15] numbers for IMSIs:

- the availability of Mobile Country Codes (MCCs) is not a constraint;

- the E.212 [15] arrangements should be chosen to match the ITU-T Recommendation E.164 [12] arrangements, because the choice of E.212 [15] arrangement will be constrained by the ITU-T Recommendation E.164 [12] arrangement. This has been done by ITU-T in its reservation of the MCC value of 901 for S-PCNs.

7 International Signalling Point Codes need to be allocated to the international gateways of S-PCN networks. One or more SANCs should be allocated as needed to each S-PCN network for its international gateways. These SANCs could be allocated either from a regional zone or from a newly created "global zone".

6 Lawful interception and security issues

6.1 Introduction

On 17 January 1995, the European Council adopted the Council Resolution for Lawful Interception (96/C 329/01) [49] noting the details of the requirements for Member States for lawful interception, and calling for co-operation in the implementation of the requirements in relation to network operators and service providers. The details of the requirements are given in annex A.

Lawful interception is the action (based on the prevailing law), performed by a network operator/service provider, of making provision for access to certain information and providing that information to a Law Enforcement Monitoring Facility (LEMF). Such action is undertaken at the request of a law enforcement agency when there is reason to believe that the telecommunications system is being used to further unlawful activities.

Satellite Personal Communications Networks (S-PCN) not only need to be designed to take account of the requirements for lawful interception, but introduce several new issues, especially legal issues, that need to be addressed by the relevant authorities.

The purpose of this part of the ETR is to identify the issues concerning lawful interception and to suggest some possible solutions.

It is important that the issues concerning lawful interception should be considered in detail as early as possible in order to avoid expensive changes to the system close to its introduction into service. One of the objectives should be to ensure a clear identification and agreement on responsibilities so that there are no unwelcome surprises.

6.2 Specialist definitions

The following definitions are taken from the Council Resolution [49] and GSM 10.20 [47] (except that a definition of "target" has been added).

Interception	The statutory based action of providing access and delivery of a subject's telecommunications and call associated data (Council Resolution) [49].
Interception Interface	The physical location within the network operator's/service provider's telecommunications facilities where access to the intercepted communications or call associated data is provided. The interception point is not necessarily a single, fixed point (Council Resolution) [49].
Interception Subject	Person or persons identified in the lawful authorization and whose incoming and outgoing communications are to be intercepted and monitored (Council Resolution) [49].
Lawful Authorization	Permission granted to a law enforcement agency under certain conditions to intercept specified telecommunications. Typically this refers to an order or warrant issued by a legally authorized body (Council Resolution) [49].
Target	The subject whose communications are to be intercepted.
Target Service	A service associated with an interception subject and usually specified in a lawful authorization for interception (Council Resolution) [49].

6.3 Road map of responsibilities for lawful interception

6.3.1 Europe

One of the three "pillars" of the Maastricht Treaty [50] deals with co-operation between Member States in the area of justice and home affairs. Unlike the first "pillar" (traditionally dealing with economic co-operation, etc.), the Commission has no right of initiative, but is however fully involved.

COREPER is the Committee of Permanent Representatives of the Council of Ministers, which prepares work for the Council of Ministers.

The Police Co-operation Working Group (PCWG) amongst other topics, handles interception of telecommunications matters. A subordinate expert group has produced a report entitled "Lawful interception of telecommunications systems outside national boundaries". This report has been noted by the Council of Ministers.

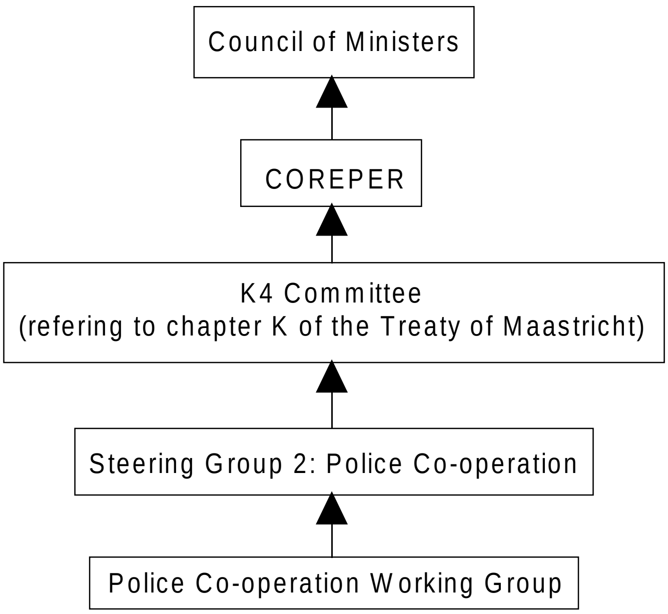


Figure 9: Committee structure on lawful interception

6.3.2 Elsewhere

In parallel with developments in Europe, yearly international seminars on lawful interception, known as ILETS (International Law Enforcement in Telecommunications Seminar) take place. ILETS has agreed to a document on lawful interception requirements, containing requirements similar to those listed in the EU Council Resolution. ILETS members include: Australia, Canada, Hong Kong, New Zealand, Norway, USA, and the Member States of the European Community.

A technical committee of the "ILETS" grouping, with similar membership to that of the PCWG, has been formed with a remit to talk to the S-PCN operators. Meetings have been held with ICO, Globalstar and Iridium.

6.3.3 Within ETSI

Within ETSI the overall responsibility for advice on standards related to lawful interception is held by the Security Techniques Advisory Group (STAG), which has formed an ad hoc group on lawful interception. STAG is undertaking a programme of work to elaborate:

- the user requirements (in conjunction with the PCWG);
- the network requirements (the Stage 1 description of the handover interface);
- the handover interface specification including stages 2 and 3 descriptions.

STAG has recently finalised a DTR/NA-002310 [44] on "Definition of User Requirements for Lawful Interception of Telecommunications - Requirements of the Law Enforcement Agencies". This is an important document that the operators of S-PCN networks should take fully into account, because it lists in detail the obligations that will apply to network operators and service providers.

The next step of the STAG work is to describe the requirements as they apply to network operators and service providers. These affect manufacturers only indirectly through the procurements made by the network operators and service providers.

SMG has developed a Stage 1 description for lawful interception in GSM phase 2+ (GSM 02.33) [45].

SMG is also developing for GSM an interface known as the "X" interface. The GSM specification GSM 10.20 (June 1996) [47] describes the requirements for the GSM interception interface. This interface is likely to form the basis for interception interfaces for S-PCN. S-PCN network operators will have to procure equipment that provides appropriate interfaces.

6.4 Special issues raised by S-PCN networks

Lawful interception is implemented in the GSM networks and the fixed networks. Both of these categories of networks are national (with the exception of some spill-over of radio coverage at borders), and the interception is handled without undue difficulty under national law. Where the target is in a different country from the national authority requesting the interception, bilateral agreements are used, under which the authorities in the country where the target is located undertake the interception on behalf of the other authority.

The difference between GSM and S-PCN is that with S-PCN, the following parties will normally be in different countries:

- the target;
- the service provider with which the target is registered;
- the gateway at which the interception will be effected;

whereas with GSM they would normally all be in the same country.

The maximum complexity of the S-PCN situation is shown in figure 10. This illustration uses the same letters for each country as the report of the PCWG.

The law enforcement agencies of country F wish to intercept lawfully the communications by a citizen (the target) of country A with another party in country E. The purpose of the interception relates to an illegal activity or intended illegal activity in country F. The target is a customer of a service provider in country B, but the target is currently located (roaming) in country C. The calls that the target will make will go via the satellite to a gateway in country D and thence via the terrestrial network to the other party in country E.

The law enforcement agencies of country F need to obtain a warrant (legal authorisation) for the lawful interception, but the warrant needs to entitle them to intercept the call even though the path of the call does not cross the territory of country F. Multiple bilateral agreements, or multilateral agreements, are needed to give the authorities of country F lawful access to the call. In practice the actual interception would take place in country D if the target is identified through his S-PCN number. The contents of the call would be recorded or forwarded in real time to the authorities in country F.

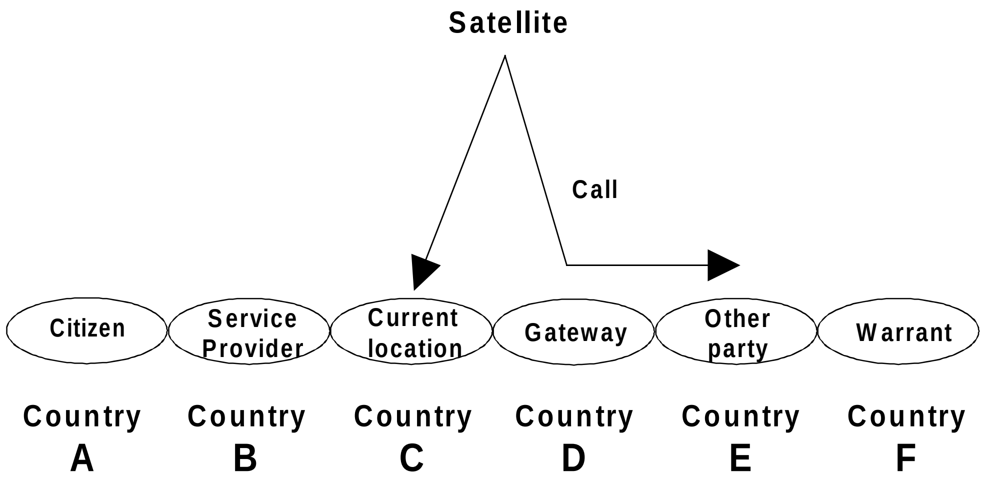


Figure 10: Countries involved in an S-PCN interception

According to draft DTR/NA-002310 [44] a network or service provider who makes a service available in a particular country using equipment in space or in a foreign territory will be required to make arrangements such that:

a) Interception is possible relating to activity of a target identity within a specific national domain.
b) If the interception interface lies in a foreign territory then arrangements are made such that interception is possible as if the interception interface were located in the home country.
c) The act of interception is kept discreet.
d) Any result of interception is kept confidential, possibly by the use of encryption.

e) Any other party involved in the provision of interception facilities is aware of the least detail of operational activities possible.
f) Observation of the networks and services involved will not disclose the act of interception.
g) Observation of the networks and services involved will not disclose the identities involved in any activity relating to interception.
h) Observation of the networks and services involved will not disclose any result of interception.
I) relating to each home country, there shall be a legal entity on whom lawful authorisations can be served.

In these principles, exactly what is meant by "makes available" is significant. With an S-PCN service, the service may be available, in the sense that it can be used, throughout a country without the service being offered commercially or involving any operational network activity in the country. In this case the country concerned would have no legal vires over the providers of the service but could make the licensing of terminal operation conditional on appropriate interception arrangements being established. However in practice the absence of a licence for terminal operation is unlikely to deter a target from using a terminal. Clarification is therefore needed on whether additional features need to be included in the system design of S-PCNs to prevent operation in countries for which interception arrangements have not been established.

The Stage 1 Description for GSM Phase 2+ [45] includes the provision of location information on the target in the form of cell identifiers. The equivalent information for S-PCN will be much less precise if it is based solely on the satellite beam used by the target. Clarification is needed of whether more precise information will be required by the law enforcement agencies.

An international legal framework for S-PCN will be necessary to provide the basis for co-operation and the implementation of the technical solutions that are needed.

6.5 Conclusion

It is clear that all S-PCN operators and service providers who provide services within Europe will have to make provision for the support of lawful interception. Due to the global coverage of S-PCN this may involve the support of provision of interception information to many countries.

Standardization activities for lawful interception are already being handled in ETSI by STAG in co-operation with the relevant technical committees. This work includes the production of general user requirements, a Stage 1 description for GSM, and an interception interface specification for GSM. This interface specification may be sufficient for S-PCN networks which are based on GSM. This situation should be reviewed in mid 1997.

Further clarification of the exact requirements that will be applied to S-PCN service providers and network operators is needed urgently. This clarification could take the form of a Stage 1 description for S-PCN or an addendum to the user requirements already prepared by ETSI in DTR/NA-002310 [44].

7 Interconnection and related network issues

7.1 Introduction

The purpose of this part of the ETR is to give an overview of the main issues concerning interconnection and to identify areas where further standardization work is needed.

There will be three main types of interconnection for S-PCN:

Type A Interconnection to terrestrial fixed and mobile networks for the collection and delivery of calls that originate or terminate on the terrestrial networks. This is the "traditional" form of interconnection such as exists between networks in different countries. It is often known as "any-to-any". There will be many such interconnections with a high volume of traffic.

Type B Interconnection to other mobile networks for the support of services to dual mode terminals. There are different forms of interconnection for this purpose and the different possibilities are discussed in subclause 7.3. There will be many such interconnections with a high volume of traffic.

Type C Interconnection between S-PCN networks for the delivery of incoming calls that are routed incorrectly because of limitations in the number analysis capability of some international exchanges. There will be few such interconnections with a relatively low volume of traffic. The need for this form of interconnection will disappear as the analysis capabilities of other networks increase.

Type A interconnection is shown in figure 11, and the various issues are discussed in subclause 7.4. Type B is discussed further in subclause 7.3. Type C is shown in figure 12.

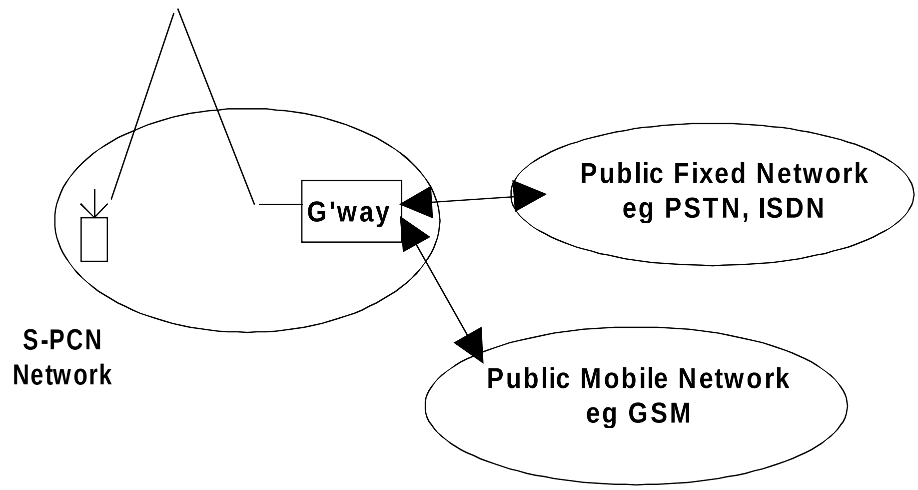


Figure 11: Type A interconnection

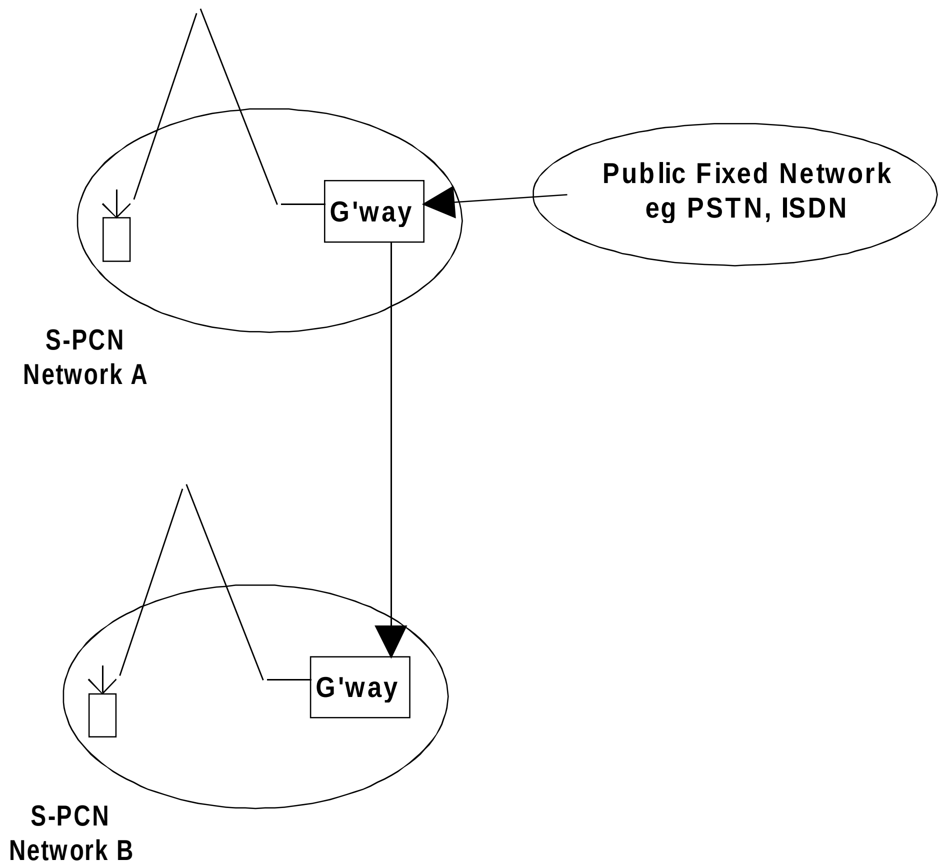


Figure 12: Type C interconnection

7.2 The approach to interconnection

The approach to interconnection and the extent of the problems experienced with it depend strongly on the motivations and commercial interests of the parties involved. Where interconnection involves a significant loss of traffic to an existing established operator (such as interconnection between a former monopolist and a new fixed network operator), regulatory intervention is often necessary and the Commission has prepared a Directive on Interconnection to provide a framework that will ensure effective interconnection in Europe. More information on the Directive is given in subclause 7.5.

The normal approach to interconnection is direct bilateral commercial negotiation. This approach works satisfactorily if both parties have an incentive to conclude the negotiations to their mutual benefit. Where one operator needs to interconnect with a relatively large number of similar other operators, e.g. an incumbent fixed network operator interconnecting with many local cable companies, the operator concerned may publish wholesale tariffs and interconnection conditions. This situation will occur for Type A and Type C, and the S-PCN operators are expected to produce a standardized or proforma interconnection agreement for this purpose.

7.3 Dual mode operation and integration with other mobile networks

7.3.1 Introduction

Three of the potential S-PCN operators (Globalstar, ICO, Iridium) are planning at least some level of integration with other mobile networks such as GSM. The purpose of this integration is to provide higher levels of service to users of dual mode handsets. Details are understood to be different for each operator and detailed information is not available to ETSI. The following are therefore only brief general comments and address only integration with GSM, although the same general principles will apply to integration with other services such as Digital AMPS.

There are three main modes of integration, each using mobile terminals with dual GSM and S-PCN capabilities:

full integration - where both GSM and S-PCN radio systems are used for access to the same core network infrastructure. In effect S-PCN "cells" are integrated with GSM cells in the same mobile network.

partial integration - Where the S-PCN network is interconnected with one or more GSM networks to provide roaming between the two network types.

parallel operation - where there is separate control of the GSM and the S-PCN operation.

These modes of integration are discussed in more detail in the next section. The differences between them are best illustrated by considering the handling of incoming calls from other networks.

The purpose of a dual mode handset rather than a simple S-PCN handset is to enable a form of operation where GSM access is used if the mobile is within the coverage of a GSM network, because GSM access is cheaper, and S-PCN access is used to provide coverage in other areas. Such operation will require extra control facilities within the mobile and may require extra facilities within the networks, depending on the mode of integration.

In areas where the signals from the GSM network are weak, or where there is significant local screening, a mobile may move rapidly in and out of GSM coverage. In order to prevent the mobile from changing frequently between the two networks, the handset control algorithms will need to implement some hysteresis or delay (for example, they would not attempt to change to GSM until they have been within GSM coverage for a certain period of time).

7.3.2 Full integration

With full integration, a single core network uses both GSM and S-PCN forms of access, with, say, a GSM architecture and GSM types of numbers for the mobiles. There is a connection from the base station side of one or more MSCs to the S-PCN network, so that the S-PCN network is used as an alternative to the BSCs and BSSs that are used for GSM access.

The software of the network is modified from that of normal GSM to provide control of the S-PCN "cells". This form of integration may require extensive design work for the modification of the GSM network and it is not possible to predict exactly what would be the optimum design. For example, in GSM a BSC normally controls the operation of all cells in an area. One solution would be for the S-PCN network to simulate a BSS, but this would mean that each BSC would need connection to the S-PCN networks and the cost of these connections might be excessive. The alternative of the S-PCN network simulating a BSC would reduce the number of connections necessary but would lead to more extensive changes to the GSM architecture. Work has been undertaken on the integration of DECT and GSM, but it is unlikely that this will be of great relevance to the integration of S-PCN and GSM networks because of the large differences between the characteristics of S-PCN and DECT.

Incoming calls will be addressed to the mobiles using the GSM number. The calls will be routed by other networks to the Gateway MSC. The Gateway MSC determines the current location of the mobile from the HLR and routes the call to the appropriate GSM BSC or the S-PCN network.

From this preliminary analysis, although full integration appears initially to be a simple method of combining GSM and S-PCN services, and follows the concept elaborated by the GMM Report of separating core networks and access networks, the concept may not be easy to implement in the case of S-PCN. This type of integration may be addressed by the work of the GONOW Committee within ETSI TC-NA.

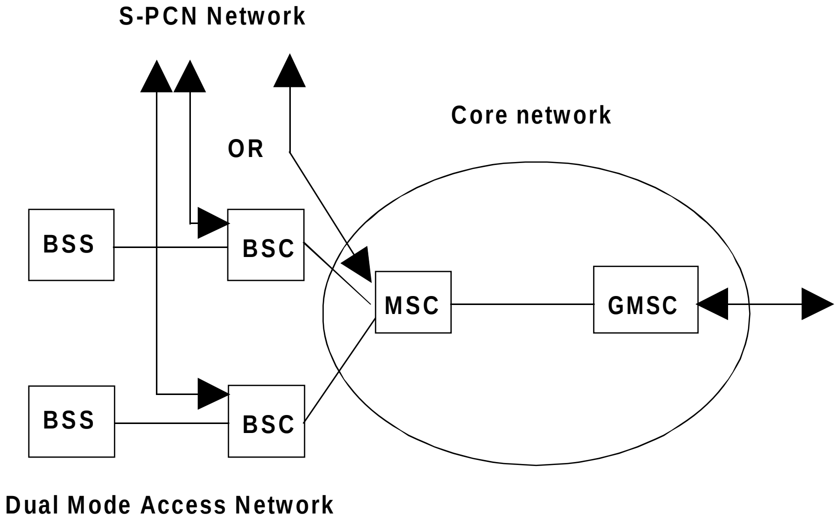


Figure 13: Full integration

7.3.3 Partial integration

Partial integration is integration based on roaming. The dual mode handset would have a single IMSI and a single E.164 number, and be registered on a single network. The choice of network type as the home network would depend on the way in which the service is presented, and could be either an S-PCN network or a GSM network, and the number allocations would vary accordingly.

The control over which network the dual mode mobile logs onto would be handled by the mobile. If the mobile is within the coverage of GSM then it can log onto the GSM network. If it goes outside the coverage of GSM then it would log onto S-PCN. The capabilities for controlling the selection of networks are already built into the GSM protocol and may not need to be changed at all, however the control logic in the mobile would need careful design.

Since the purpose of dual mode operation is to give preference to the use of terrestrial services where the terrestrial services have a commercial relationship with the S-PCN operator, the preferential selection of GSM is likely to be limited to these services.

Partial integration may be illustrated by the following example. Consider a dual mode mobile which is currently within the range of a GSM network with which the S-PCN operator has a special commercial relationship.

Suppose first that the dual mode mobile is identified by an S-PCN ITU-T Recommendation E.164 [12] number and S-PCN IMSI. Incoming calls from other networks will be routed to the gateway of the S-PCN network and the HLR of the S-PCN network will be consulted for the current location of the mobile. The HLR will indicate that the mobile is roaming on the GSM network and the call will be redirected via a terrestrial connection (either a leased line or via the public switched network) to the Gateway MSC of the GSM network. The call would then be routed to the MSC, BSC and BSS in whose area the mobile is located.

Alternatively, the dual mode mobile could be identified by a GSM ITU-T Recommendation E.164 [12] number and a GSM IMSI. When the mobile is logged on to the GSM network, incoming calls are routed in the normal way. When the mobile is outside the coverage of the home GSM network and is roaming on S-PCN, incoming calls would still be routed to the Gateway MSC of the home GSM network. The HLR would be consulted and indicate that the mobile is roaming on S-PCN. The call would then be routed from the GSM Gateway MSC to the Gateway of the S-PCN network and thence to the mobile.

Partial integration based on roaming is likely to involve fewer changes to the GSM networks than full integration, and may also offer simpler and more cost effective interconnection arrangements, with interconnection routes needed only between the Gateway exchanges of both networks.

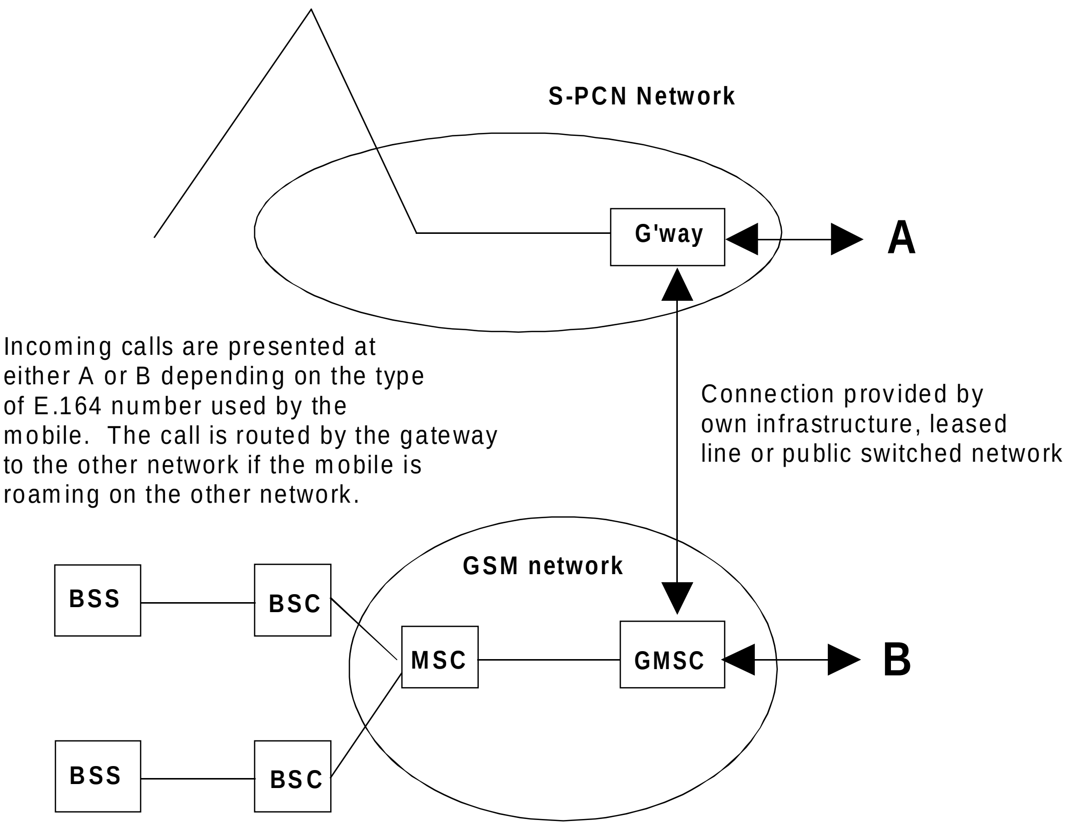


Figure 14: Partial integration based on roaming

7.3.4 Parallel operation

With parallel operation, dual mode handset is two logically separate handsets combined in the same physical unit. Various facilities, such as the keypad and the display, may be shared dynamically between the two systems, but the user is allocated separate GSM and S-PCN ITU-T Recommendation E.164 [12] numbers and also separate IMSIs. The GSM and S-PCN networks are logically and physically separate. The routing of incoming calls depends on the called number. Calls to a GSM number will always be routed to a GSM gateway, and calls to an S-PCN number always to an S-PCN gateway. Billing to the caller will depend on the called number.

With parallel operation, there does not need to be any special commercial arrangement between the GSM and S-PCN networks, and it may be possible for the handset to be logged onto both networks simultaneously, depending on interference considerations.

If a subscriber is not available on one network, normal diversion facilities could be used to divert incoming calls to the other network.

7.3.5 Summary of options for support of dual mode operation

The options for the support of dual mode operation are shown in table 6.

Table 6: Comparison of integration options for the support of dual mode operation

Issue	Full Integration	Partial Integration	Parallel Operation
Basic principle.	One core network, two types of access facility.	Separate core networks, each with their own type of access network, but with roaming agreements.	Separate networks without roaming agreements.
User subscription and registration.	Single subscription to core network.	Single subscription to core network who is offering the dual mode service, could be either GSM or S-PCN depending on marketing considerations.	Separate subscriptions to both networks.
E.164 number.	One number from the range allocated to the core network.	One number from the range allocated to the core network.	Two numbers, one for each network.
IMSI.	One number from the range allocated to the core network.	One number from the range allocated to the core network.	Two numbers, one for each network.
Control over selection of mode.	Control fully or partially within the network.	Control in the mobile.	Control in the mobile.
Topology of interconnection links.	Extensive and complex.	Simple.	None.
Extent of development needed for existing GSM networks, i.e. addition of new features into existing standards.	Probably high.	Low or zero.	Zero.

7.3.6 Implication for the design of SIM cards

For both full and partial integration, the mobile terminal will have a single SIM that holds the IMSI and other subscriber related network information. The design of this SIM may have to be enhanced beyond the design of the basic GSM SIM in order to support dual mode capability, but this will not necessarily be the case.

For parallel operation, the mobile will have two logically separate SIMs, which could be implemented in the same physical unit.

If enhancements are needed to the SIM cards, there would be an advantage in terms of economy of scale if the S-PCN operators were to co-ordinate their requirements such that a single SIM design could be used for all networks. This design could be standardized, but should take account of the requirements not only of GSM but also of the other mobile networks with which S-PCN could be integrated. Furthermore the design of a general purpose dual or multi-mode mobile SIM could be standardized.

7.3.7 Implication for the approval of dual mode terminals

Dual mode terminals will have to satisfy the approval requirements that relate to both modes of operation. GSM has extensive approval requirements that include:

- the radio parameters;
- the signalling protocols;
- the performance of telephony;
- the operation of the SIM interface.

In contrast, S-PCN approval requirements will address only a subset of the radio parameters that are addressed in GSM, and functional requirements for turning the mobile off.

The lead time for the implementation of changes to approval requirements is extremely long at present. It consists of the development time for the technical modifications and their approval within the ETSI committee structure, plus the ETSI formal approval procedure of Public Enquiry and National Vote necessary for TBRs (typically 12 months), plus the time for the Commission to consult the European Parliament, TRAC and ACTE and to publish a Commission Decision in the Official Journal (typically fifteen months). Thus unless these procedures are changed, the lead time is likely to be at least 33 months.

This lead time could delay the introduction of dual mode terminal operation if the GSM approval requirements have to be changed to support this mode of operation. These delays could be severe if it is not possible to address the changes needed for the GSM approval at an early stage.

Without detailed design information on the S-PCN networks, it is not possible to identify the changes to the GSM approval requirements that would actually be needed, but changes could be required in the following areas:

- Telephony requirements, if there are any incompatibilities between the GSM requirements and the designs used for S-PCN or any effects on telephony performance that result from the presence of S-PCN in the same handset.
- Protocol requirements, if the GSM protocols need to be enhanced, this is most likely for full integration.
- Radio requirements, if any parameters can no longer be met due to the presence of the S-PCN RF elements within the mobile.
- SIM interface, if the SIM interface needs to be altered.

The GSM TBRs will also have to be checked to ensure that the existence of the dual mode operation does not require a change to the exact wording of the GSM TBRs even is it does not require a change to the spirit of the technical requirements.

Since GSM is likely to be used in dual mode with other systems besides S-PCN, a general review of the GSM TBRs to check their compatibility with dual mode operation would be worthwhile. If extensive changes are needed, the development of a standard (a delta to the TBRs) specifying a generic dual mode capability for GSM could be undertaken.

7.3.8 Routing of incoming calls

Until there is a widespread adoption of intelligent networking capabilities in fixed and mobile networks generally (this capability is being developed for GSM as part of Phase 2+, but is unlikely to be available widely for 5 - 10 years), the routing of incoming calls will be determined by the number dialled. With both full and partial integration, there is a choice of whether the mobiles are identified by GSM or S-PCN numbers depending on the type of the "home" network of the mobile. In the case of full integration, it is likely that GSM numbers would be used because it would be unrealistic to integrate many separate GSM accesses in many different countries into a single network. It is therefore necessary to consider how the choice of number type will affect the routing of incoming calls and the economics of network operation. If a GSM type number is chosen, the GSM number will be allocated from within the country code of the country concerned. All incoming calls will be routed to the gateway in that country, including calls from other parts of the world. There are the following possibilities:

- If the subscriber is within the coverage of the GSM network the call can be delivered normally through the GSM or core network.

- If the subscriber is within S-PCN coverage and the GSM and S-PCN networks are fully integrated, the call will be routed to the subscriber through the core network.
- If the subscriber is roaming on another terrestrial GSM network, the call will be routed from the GSM gateway of the home network to the gateway of the visited GSM network. This routing may involve an inefficient "trombone". The path between the gateways may pass through the PSTN/ISDN or a leased line, or via the terrestrial S-PCN infrastructure.
- If the subscriber is roaming on S-PCN (partial integration), the call will be routed from the home GSM gateway to the nearest S-PCN gateway. This routing will probably be via a leased line if there is sufficient traffic. The call will then be delivered by the S-PCN network.

This arrangement will tend to provide an inefficient routing for calls that originate near to a roaming subscriber. It also allows long paths through non-S-PCN networks to reach the gateway. If an international S-PCN type number is chosen (one from the +881 range), all incoming calls will be routed to the nearest S-PCN gateway. There are then the following possibilities:

- If the subscriber is currently logged on to S-PCN, the call will be delivered by S-PCN.
- If the subscriber is using terrestrial GSM access under full integration, the call will be delivered through the core network, but with the GSM rather than the S-PCN access.
- If the subscriber is roaming on GSM, the call will be routed from the S-PCN gateway to the GSM gateway. This routing will use as much of the S-PCN terrestrial infrastructure as possible. The call will then be delivered by the GSM network.

This arrangement will tend to provide an efficient routing for all incoming calls, if there are a reasonable number of S-PCN gateways because the routing to the S-PCN gateway will be fairly short and the gateway will then determine the most effective route to the current location of the mobile. It also provides the maximum scope for the call to be routed within the terrestrial infrastructure of the S-PCN network. If a national S-PCN type number is chosen (one from within a country code), all incoming calls will be routed to the S-PCN gateway in the country concerned. There are then the following possibilities:

- If the subscriber is currently logged on to S-PCN, the call will be delivered by S-PCN.
- If the subscriber is using terrestrial GSM access under full integration, the call will be delivered through the core network, but with the GSM rather than the S-PCN access.
- If the subscriber is roaming on GSM, the call will be routed from the S-PCN gateway to the GSM gateway. This routing will use as much of the S-PCN terrestrial infrastructure as possible. The call will then be delivered by the GSM network.

This arrangement will have the same disadvantages as use of the GSM number (see above).

This analysis leads to the conclusions that the use of international S-PCN numbers from the +881 range combined with the availability of S-PCN access points in many countries will both reduce the probability of inefficient routings involving "trombones" and maximise the potential for carrying a large proportion of the call path within the S-PCN terrestrial infrastructure. It will however mean that all incoming calls will normally pass through international exchanges and this may be less efficient for incoming calls from the same country as the gateway.

To put the issues in perspective, inefficient routings are not inherently very costly given the rapidly reducing costs of transmission. However the tariffs payable to other networks for transmission may be high, especially in parts of the world with relatively low traffic volumes, and the cost implications for the S-PCN operators may therefore be quite high for at least the short to medium term.

7.4 Issues to be addressed for interconnection Type A (any-to-any)

Table 7 lists the issues to be addressed for Type A interconnection.

Table 7: Interconnection issues (to be continued)

Category	Issue	Comment
The Physical Interconnection Point.	Location.	May be on premises of either party or at a junction box in the road ("mid-span meet").
	Technical characteristics of interface and transmission system.	Would normally be a structured 2 Mbit/s interface or higher. SDH will be used increasingly in the future. Optical interfaces may also be used where high capacity is required.
	Access.	If transmission equipment is located on the premises of the other party, arrangements are needed for access for maintenance purposes.
	Monitoring.	Procedures are needed for monitoring the link between the two interconnected nodes.
	Capacity.	The capacity of the interconnection should be defined clearly.
	Testing.	Procedures are needed for testing interworking at the interconnection point.
Inter-network signalling.	Signalling system.	Detailed specification needed including all supplementary services. Would normally be based on CCITT Signalling System No 7. Features implemented in ISUP are fewer than in national signalling systems.
Network management.	Fault investigation and diagnosis.	Procedures are needed for the investigation of complaints from customers about calls that cross the interconnection point.
	Maintenance.	Procedures for co-operation are needed.
	Congestion handling.	The signalling to the customer when a receiving network cannot handle further calls needs to be specified. Possibilities for alternative routing need to be agreed.
Request/Supply Procedure.	Traffic analysis and predictions.	The interconnection point is a bottleneck that requires external procedures to obtain more capacity. It is therefore important to analyse traffic growth and to exchange information about activities that may lead to a sudden growth in demand.
	Ordering procedure.	There should be a properly established procedure for ordering additional capacity.
	Supply times.	A maximum time should be specified for the supply of extra capacity and new service features.

Table 8 (continued): Interconnection issues

Category	Issue	Comment
Service interworking.	Basic services.	Telephony, fax, data needs to take account of bit rate limitations in mobile network.
	Supplementary services.	Agreement on what supplementary services will be provided across the interconnection point.
	Access to freephone and kiosk billing numbers.	Depends on services provided in each network.. Access to freephone numbers even if calls are billed can be better than no access.
	Operators.	Modes of co-operation between operators including reverse charge calls.
	Directory enquiries.	Co-operation.
	Access to emergency services.	The provision of access to emergency services will require careful planning and implementation, because there will need to be a capability to connect calls to the emergency control centres in all countries. This is an issue on which it might be advantageous for the S-PCN operators to co-operate with each other.
Tariffs.	Structure.	Tariffs need to include: - Circuit capacity (including partial fill of transmission capacity). - Additional circuits. - Call charges. - Supplementary services.
	Time periods.	Periods when different rates (e.g. cheap rate) apply.
	Special discounts.	Arrangements for handling special discounts to customers.
	Failed call attempts.	Charging arrangements between operators for call attempts that cross the interconnection point but fail to be connected (arrangement is subject to agreement between operators).
	Shared cost calls.	Arrangements to avoid unforeseen high tariffs for callers to S-PCN customers, especially where the called number is not an S-PCN number but the call is routed via S-PCN.
Billing.	Call records.	Formats of call records to facilitate comparison of data. Interchange of records. Commercial confidentiality and privacy arrangements.
	Billing.	Billing procedures and payment times for interconnection payments.
	Shared cost calls.	Support of the tariff arrangements needed for callers (see above).
Disputes.	Dispute procedures.	Arbitration should be an effective procedure for resolving disputes.

7.5 The Interconnection Directive

The Commission has been following the development of interconnection carefully because of the importance of interconnection to interoperability and competition.

The Commission has prepared a Directive [20] within the framework of Open Network Provision (ONP) which was presented by the Commission to the Council and the Parliament in July 1995. The Directive reached a Common Position (agreement between Commission and Council) in May 1996 but amendments have been proposed by the European Parliament. The Directive is expected to be adopted during the first half of 1997.

The main points in the draft directive, which is still subject to amendment, are:

- Member States are obliged to remove any restrictions that prevent organisations that are authorized to provide telecommunications networks and publicly available services from negotiating interconnection agreements between themselves.

- Member States are obliged to ensure adequate and efficient interconnection to ensure interoperability of the following services:
    - PSTN (telephony, fax and modem data);
    - leased lines;
    - public mobile services.

- Organizations that provide public networks or services and have significant market power are:
    - obliged to meet all reasonable requests for interconnection, including access at points other then the network termination points offered to the majority of end-users;
    - obliged to apply the principle of non-discrimination and the application of similar conditions in similar circumstances (annex 1 services);
    - obliged to publish a reference interconnection offer;
    - apply charges that are transparent and cost based;
    - unbundle charges sufficiently so that it is not necessary to pay for facilities that are not required.

- Organizations that provide public networks or services have a right to negotiate interconnection and an obligation to negotiate in response to a request.

- Organizations that have special or exclusive rights in other sectors shall keep separate accounts for the different activities.

- Financial information shall be provided to the national regulatory authority, and this information may be published to the extent that it would contribute to an open and competitive market.

- National regulatory authorities may intervene to specify issues to be covered by interconnection and may set time limits on negotiation. It may also inspect interconnection agreements.

- National regulatory authorities have to try to resolve disputes, but after two months the dispute may be referred to the Commission who may set up a working group that shall report within three months. The solution recommended by the working group shall be implemented nationally. Use of this procedure forfeits the right to refer the matter to the national courts if the procedure is accepted by all parties.

- The following essential requirements shall be safeguarded:
    - security of network operations;
    - maintenance of network integrity;
    - inter-operability of services.

- National regulatory authorities shall encourage the sharing of facilities that enjoy a right to the use of public or private land.

- Number portability shall be introduced as soon as possible and be available in all major centres of population by 1 January 2003.

- Full account shall be taken of standards.

- The Directive shall be implemented by 31 December 1997.

7.6 The European Interconnection Forum

A European Interconnection Forum has been formed recently and is hosted by the ONP Platform which is an organisation through which the Commission can consult the main groups of interest on ONP. The address of the European Interconnection Forum is:

European Interconnection Forum
c/o Fabrimetal
21, rue des Drapiers
B-1050 Brussels
Belgium

Tel: +32 2 510 2434
Fax: +32 2 512 7059

The main task of the European Interconnection Forum to date has been to prepare the "Framework Interconnection Guidelines" [21] which is a document of some 20 pages that contains a combination of guidance on the provision to be included in interconnection agreements and checklists of items to consider. The first edition was published in May 1996.

The main sections are:

1 Definitions.
2 Points of Interconnection and Interconnect Links.
3 Services.
4 Charges and payments for interconnect links and services.
5 Billing.
6 Numbering.
7 Network Modification.
8 CLI.
9 Quality of service.
10 Interface standards and technical requirements.
11 Network design.
12 Network planning.
13 Installation, operation and maintenance.
14 System protection and safety.
15 System alteration.
16 Provision of information.
17 New services.
18 General contract provisions.

The "Framework Interconnection Guidelines" [21] is a useful guide that will assist S-PCN operators in preparing their interconnection agreements.

7.7 Universal Personal Telecommunications (UPT) and its relationship to S-PCN

UPT is a new service in which a customer is allocated a UPT number from a new numbering range. The country code 878 has been reserved by the ITU-T for UPT services. The service enables the customer to register his location at any terminal of the fixed or mobile networks and make and receive calls at that terminal, with the outgoing calls being billed to him and with the incoming calls being addressed to the UPT number. The extent of the services available to the customer will depend to some extent on the features provided by the network to which the terminal is connected, but a basic service should be possible from any terminal, even if the network operator does not offer UPT services to its own customers. The method of registration at the terminal will depend on the functionality of the terminal. Initially MF tones will be used but terminals with integral card readers may eventually be produced.

UPT will introduce flexibility into the relationship between the terminal and the user for both incoming and outgoing calls. This will be a new facility for fixed networks and the service will primarily be aimed at the users of fixed networks. Flexibility between the terminal and the user is already available in GSM in the mobile network area through the use of SIM cards which can be plugged into different terminals and contain the subscriber's records and identity.

Subscribers to a UPT service may be able to use the service from an S-PCN mobile transparently using MF tones for location registration with a distant UPT service provider. In this case, service registration would be simplified if CLI is available from the S-PCN network to the UPT service provider, as this will automatically identify the routing for incoming calls.

However, in this scenario, the S-PCN has no knowledge of the UPT usage, so all S-PCN charges would be billed to the S-PCN mobile subscriber.

This could be avoided if, for outgoing calls, the UPT access is via some form of free-phone number; the S-PCN could then know to bill outgoing calls, both registration and traffic, to the UPT service provider, who will then associate the charge with the appropriate UPT subscriber.

For incoming calls, the UPT service provider will associate the user's UPT number with the S-PCN number of the terminal and direct incoming calls to the S-PCN terminal. An issue to be resolved will be which party will be billed for the S-PCN element of an incoming call to a UPT subscriber who is registered on a S-PCN mobile. The same issue will presumably apply for a UPT subscriber registered on a roaming GSM mobile, where the GSM subscriber would normally be billed for part of the incoming call.

S-PCN operators may themselves wish to offer UPT services (with UPT numbers) to their customers to enable them to make and receive calls on the fixed network. The operators will have to decide whether this is appropriate commercially given their interest in handling calls via the satellite system.

UPT numbers are separate from S-PCN numbers and an S-PCN subscriber who is also a UPT subscriber will have two numbers even if he chooses to inform his contacts only of the UPT number.

The conclusion is that the introduction of UPT has some issues for the design of S-PCN networks, particularly in the area of correct billing. In later evolutions, when UPT is accessed by a card which would substitute for the S-PCN subscribers card in an S-PCN mobile, there will be further technical implications to be addressed.

7.8 Conclusions

This section has identified the different types of interconnection and the different forms in which S-PCN may be integrated with terrestrial mobile networks. The implications of the choice of integration method have been explored and advantages and disadvantages of each identified. Full integration would involve significant development of the existing GSM architecture, which could be specified in standards. However such a step may not be supported since the choice of integration methods is a commercial matter and any S-PCN operator planning to develop full integration is likely to wish to keep the details confidential.

Further development is needed for SIMs to support integration and there would be an advantage in producing a standard for a multi-purpose SIM in which each system would be treated as a module. ETSI Technical Committee Integrated Circuits Cards (TC-ICC) may be a suitable body to undertake this work.

Dual mode operation will affect the approval of terminals and further work is required on adapting approval standards for dual mode operation.

The Directive on interconnection that is scheduled for adoption during 1997 will generally facilitate the establishment of any-to-any interconnection with other fixed and mobile networks in Europe. However, the obligations under the Directive are unlikely to affect S-PCN operators directly unless they are deemed to have significant market power.

The European Interconnection Forum has prepared a useful set of the "Framework Interconnection Guidelines" [21] which will assist S-PCN operators in preparing their own interconnection contracts. The form of these contracts is not appropriate for standardization because of their highly commercial nature.

8 Evolution towards the UMTS satellite component

8.1 General

UMTS (Universal Mobile Telecommunication System) is currently being defined within ETSI and is planned to be introduced in Europe in the early years of the 21st century.

What is UMTS? Despite its name and the identification of a UMTS frequency band, UMTS is not a separate self contained system, with its own air interface and network specifications, that will wholly replace second generation mobile systems such as GSM. Instead UMTS is best thought of as a framework or collection of services and features including one or more new air interfaces. Consequently it is not yet possible to give a precise answer to exactly what UMTS is nor to exactly where the boundary around "UMTS" lies.

The difficulty in defining UMTS is a consequence of:

- the relatively mature (in terms of investment, technology and services) state of second generation mobile systems;
- the convergence of work in different organisations addressing the same basic objective; and
- the objective of universality.

ITU Study Group 8 is working on the definition of FPLMTS (Future Public Land Mobile Telecommunications Systems) also called now IMT-2000, which addresses similar issues to the European UMTS at the world-wide international level, and Europe (CEPT) participates in the ITU Working Groups in order to align the two concepts of UMTS and FPLMTS.

The work on UMTS is carried out within ETSI by TC-SMG (Special Mobile Group). In parallel, the European Union has formed a UMTS Task Force and stimulated the creation of a UMTS Forum in order to drive the development of UMTS and provide strategic guidance to the European bodies as ETSI and ERC. The UMTS Forum has formed four Working Groups:

- spectrum allocation;
- regulatory and licensing issues;
- technology, research and ITU strategy;
- market and society aspects.

ETSI will be a member of the UMTS Forum Steering Board and an agreement between ETSI and the UMTS Forum has been passed in order to work in co-ordination on the development of UMTS.

During 1995/96 a working group of the Programme Advisory Committee (PAC) of ETSI studied the development of Global Multimedia Mobility (GMM) and the needs and priorities for standardization and its relationship to the European/Global Information Infrastructure (EII/GII). The conclusions of this group have influenced the concept of UMTS [43].

The following factors are dominant in the discussions:

- There is already very large investment in second generation digital mobile systems in USA, Japan and Europe. These systems will provide adequate services for a large part of the market for a significant period of time and are unlikely to be extensively replaced by a new generation of system in the way that analogue first generation systems are being replaced by second generation. Instead there will be an incremental development of these services in the direction of a more universal system, coupled with improved interworking between these systems and interworking with new sub-systems.

- There is a wide range of different services within the mobile area. A single technology is unlikely to be cost effective for all these services, and there needs to be a modular framework with choice between different technologies whilst still preserving aspects of interoperability and co-existence. The combination of a framework and choice will enable market players to determine their own market position and will avoid the risks of regulation and standardization being too prescriptive.

- Mobility, which is already well developed in radio networks, will become a major feature of wireline networks. Changes in the regulatory approach within Europe from 1998 will allow networks to offer both fixed and mobile services. These developments will reduce the distinction between mobile and fixed networks leading to the opportunity for a common core network supporting many different access networks (various different forms of radio air interface and wireline access).

- The convergence to a common core network architecture will enable the convergence of service descriptions so that there will be common descriptions across all networks.

- Broadband services will be developed for implementation on both radio and wireline access. This will necessitate the development of a broadband air interface, which will be a major new development within UMTS and will use the UMTS frequency bands.

- Multi-mode terminals will be developed to enable a single terminal to be used with different air interfaces. They will facilitate service provision beyond the boundaries of a single system. In particular the development of multi-mode terminals including S-PCN will provide global coverage.

In summary, the development of UMTS has started with the identification of frequency bands and various goals and objectives for UMTS (a wish list). This has been followed by further consideration of the market leading to a clearer identification of the concept of a framework of modules with convergence towards a common core network architecture supporting many different access networks and technologies. This in turn is leading to clearer identification of the steps in the convergence process, which will prepare for the development of general service descriptions, standards for the core network architecture, standards for new air interfaces and modifications to existing standards.

8.2 Objectives of UMTS

The main objectives and characteristics of UMTS are as described in ETR 271 (UMTS 01.01) [23]:

- The purpose of UMTS is to provide an integrated telecommunications service to mobile users via infrastructures which may incorporate terrestrial and/or satellite components.

- UMTS is intended to serve a mass market in year 2005. The massive introduction of UMTS implies that the system offers more capabilities and new services for the user than the presently existing mobile systems, at an affordable cost.

- UMTS will cover different types of environments: in-door and out-door usage, residential, public, office, vehicle of all types including aeronautical and maritime mobiles. In the UMTS concept, the separation between mobile environment and fixed environment will tend to disappear.

- UMTS will be economically viable at the same time for regions with high user densities and for regions with low user densities where pre-UMTS systems have not yet penetrated. UMTS will develop in a competitive environment, there will be a plurality of UMTS networks operating within the same geographic area with a minimum spectrum co-ordination. It is expected that the users will be offered a wide choice of networks and service provision possibilities to access UMTS services. The identification number attached to the user will be independent of the network or subscription.

- UMTS will make an efficient and economical use of the frequency spectrum resources.

- UMTS will permit interconnection of users of all types of mobile or fixed networks via all types of networks. UMTS will provide for global roaming between different networks or regions and between terminals. UMTS will integrate intelligent network technology which will at that time be also deployed in fixed networks.

- UMTS will offer services of high quality and high reliability, comparable to those of the fixed networks. UMTS will give access to a large scale of voice and non-voice services: UMTS will integrate services presently offered by the different existing mobile and fixed systems as public cellular, domestic cordless, private mobile radio, ISDN, etc. and will also offer broadband and new advanced services as multimedia applications. It is expected that there will be a provision of services from 128 kbit/s to 2 Mbit/s at a large scale with universal coverage (in a first phase), and a provision of services up to 20 Mbit/s in hot spots in the terrestrial component (in a second phase).

- UMTS will allow service portability: in the UMTS environment, the user will get access transparently to any service he subscribes for, that is in the same way and with the same procedures as in his usual environment. For example, UMTS will support UPT services. As UPT, UMTS will use the service profile concept allowing users and subscribers to manage from their terminals their access to services. The increasing variety of offered services will require that the users be informed in real time about the prices, especially in case of roaming, though the calling party does not have to know the location of the mobile.

- In UMTS, there will be a clear differentiation between the roles of the subscriber and the user. The use of a UMTS User Identity Module (USIM) will permit user mobility to different terminals. As in GSM, the terminal will be identified independently of the user.

- UMTS users will be offered a large variety of terminals as pocket-size hand-held terminals, portable, vehicle mounted terminals or semi-fixed or fixed installations. Bi-mode or multi-mode terminals will be offered at a low price. An alternative to multi-mode standard operation terminals could also be adaptive terminals which are able to be down-loaded with different software.

- UMTS will be provided through multiple networks both terrestrial and satellite, owned and operated independently of each other. When moving between UMTS networks, roaming is taking place; however, in the case when two networks, either terrestrial and satellite are regarded as integrated, handover may take place when moving between them.

8.3 Scenarios for evolution towards UMTS

ETR (UMTS 01.04) [28] describes the scenarios and considerations for the introduction of UMTS in Europe starting from GSM and ISDN. The evolution towards UMTS will be strongly influenced by the market constraints. About the years 2000, pre-UMTS systems will be widely used all around the world with heavy investments made by the operators.

In the high density users areas, UMTS will probably be introduced as an extension of the existing pre-UMTS mobile systems by adding wide-band services. The low density areas will be covered by S-PCNs, but UMTS could be introduced as a solution to provide rapidly and with a reasonable cost a wide range of services in all types of environments.

Broadband ISDN will be added to PSTN and narrow-band ISDN probably through the use of overlay networks and will focus on services such as video, interconnection of LANs, Internet and multimedia. Universal Personal Telecommunications (UPT) and cordless access will add personal and terminal mobility to the fixed networks, and Intelligent Network (IN) capabilities will enable enhanced services.

GSM/DCS will offer enhanced services as General Packet Radio Services (GPRS) and Customized Applications for Mobile network Enhanced Logic (CAMEL). This will be a first step towards the concept of Virtual Home Environment (VHE). UPT is also planned to be provided in the evolutionary process of GSM/DCS 1800 networks with UPT Phase 1 making use of DTMF and UPT Phase 2 making use of a smart card.

Handset technology will permit to have low-cost muti-mode terminals offering to the users increased possibilities to select the networks and services.

The evolutionary path towards UMTS is described in four levels and three steps starting from using the existing networks and offering UMTS service capabilities using pre-UMTS radio transmission technologies in bands outside the UMTS band. S-PCNs appear at Level 2 in this evolution description.

Level 1 corresponds to the situation in 1996 with operation of GSM/DCS Phase 2 and interworking with the existing fixed networks.

Level 2, foreseen for the year 1999 will include the introduction of:

- a common SIM for GSM/DCS 1800 and DECT so that a user can use any of these forms of terminal;
- dual mode terminals with combinations of DECT, GSM, S-PCN and other air interfaces;
- integration of GSM and DECT through the connection of DECT portable parts (base stations) to GSM MSCs, and support of roaming of dual mode terminals between DECT and GSM access;

- integration of GSM (or other digital terrestrial mobile services) and S-PCN so that S-PCN provides coverage in areas not served by GSM. This will involve a new interface to GSM MSC/VLR for the support of satellite applications;
- packet data services by means of GPRS;
- the addition of SCP capability to the GSM MSC.

Level 3, foreseen for the year 2002, will mark the change from pre-UMTS to UMTS and will include the introduction of:

- new terrestrial air interfaces and access systems using the UMTS frequency bands;
- new UMTS terminals, both single mode and multi-mode with second generation systems;
- services according to UMTS standards;
- a new User Identity Module (USIM) card which will allow roaming between all types of mobile or fixed terminals;
- greater IN capabilities.

Level 4 in 2005 will see the complete deployment of UMTS with full capabilities and provision of services up to 2 Mbit/s rate and even more in some cases. The network subsystem will support Asynchronous Transfer Mode (ATM) and will make usage of distributed interconnected databases.

8.4 UMTS requirements

ETR 291 (UMTS 01.03) [24] describes the UMTS requirements.

8.4.1 General requirements

The fact that UMTS is intended to address a mass market has some implications on the aspects of cost of service provision, ease of use, quality, and the ability to serve a wide variety of user densities.

The number of the UMTS user should be independent of the subscription. The user can keep his number when changing of service provider. It should be possible to reach a user via a single diallable number even though the user may move between residential, public and office environments.

Provision of a unified presentation of services to the user in wireless and wired environment is required. For the user, there should be no distinction in service capability in mobile and fixed network access. The difference between fixed and mobile networks will only be in the addition of a radio access system and a wide area mobility management.

UMTS will also include the procedures for private closed user groups, private trunks and access to private networks.

8.4.2 Requirements for services

Service provision will become in the future more network and technology independent, with no strict division between mobile and fixed networks. Service transparency is then a requirement for UMTS: a ISDN or UPT user will get access to all his services in the UMTS environment. So, there is a strong requirement for compatibility of services between UMTS and fixed networks.

UMTS air interfaces should be designed in such a way that the cost of providing widely used services is not increased by their ability to support less widely used services (e.g. bit rates higher than 2 Mbit/s). The provision of wide-band- services in the satellite component of UMTS, even if the rates are less than in the terrestrial part, will require an important change from S-PCNs which are designed to offer only low rate services. UMTS is also required to support variable bit rate services, under control of either the user or the network.

A requirement of UMTS concerning services is service portability across network borders with the Virtual Home Environment (VHE) concept. The visited network should be able to emulate for a roaming user his home network in such a way that he can access to his usual services in the same way as if he were in his home network.

Provision should also be made for some terminals to support location, navigation and traffic management services.

An important requirement is that the caller has to be informed of the price of the call due to the fact that the called number will not give him the information about where is the called party and the roaming situation.

8.4.3 Requirements for mobility

The requirement for global roaming will lead to the standardization of interfaces, especially a minimum number of air interfaces will probably be standardized or at least the commonalties will be maximized. This will also be the case for interfaces between networks. Having a maximum of commonalties in the different air interfaces will simplify the hardware and software of multi-mode terminals, which could also be adaptive: they could be programmed by the network on which they are connected by means of the radio interface. This solution will probably require in the UMTS networks to provide a common globally standardized radio control channel which could be understood by every terminal in every situation and which would permit to a roaming mobile to know what to do to perform the downloading process.

As for S-PCNs, there will be in this multi radio interface environment a requirement for the terminal of not attempting to initiate a communication before ensuring that a system of a given type is present.

The removable User Identity Module (USIM) will offer an element of functional commonality which could be used to smooth over other elements of incompatibility (i.e. radio interface). So, the protocols for roaming and for user mobility, and the interface between USIM and Mobile Terminal will also have to be standardized.

Due to the fact that in some cases, the network coverage will overlap different environments, there will be a need for some selecting procedure to determine which network should be used. It is required also to provide handover capability between different networks when changing of environments to avoid interruption of service.

8.4.4 Requirements for terminals

UMTS will increase considerably the need for multi-mode terminals of different types as cordless/cellular, cellular/satellite, 2nd generation mobile/UMTS terminals, with capabilities to select automatically or under control of the user the most appropriate network. The possibility to download a specific software into the terminal at the choice of network is also envisaged.

As described in the "Proposal from MoU on Personal Mobile Telecommunications (PMT) towards the UMTS Forum" [42], the terminal could be composed of a basic Terminal Operating System (TOS), and the additional software corresponding to the operation in a specific network could be downloaded via the radio interface. This solution would require a minimal standardized hardware and software structure of the terminal, especially the interfaces between the different functional blocks. However, in the interest of having low cost terminals, it is desirable to minimise the degree of adaptation which is required, particularly in the radio frequency hardware.

Another requirement for terminals will be to provide a smart Man Machine Interface (MMI) allowing the user to access easily to a wide variety of services. The smart card could also contain information allowing the operation in different kinds of networks.

8.4.5 Requirements for evolution

The moving and rapidly evolving situation of the telecommunications during the development of UMTS will require that UMTS be defined in a very flexible and modular way to allow for the maximum of possibilities of improvements either in technology, definition of services, or deployment of infrastructures and network organisation.

Due to the enormous investments made in pre-UMTS networks, it is important that as much commonality as possible exist between UMTS and earlier systems candidate to evolve.

An open architecture will allow an easy introduction of new services and an easy access to services and facilities of the fixed networks. At the beginning, UMTS services will be provided through existing fixed networks or second generation mobile networks or pre-UMTS satellite mobile networks (as S-PCNs). So, there will be a possibility to deploy UMTS services in frequency bands presently occupied by 2nd generation mobile systems or pre-UMTS satellite systems.

It is likely also that the UMTS architecture will have to be aligned with the concepts of Intelligent Networks (IN), especially the support of distributed data bases.

The evolution will be facilitated by applying the concept of building blocks in UMTS design. A modular structure in the system design will allow an easy and flexible introduction of UMTS compatible with the existing systems.

In particular, it is desirable that the introduction by an operator or service provider of new services or functionality have no impact on the existing services and equipment. It should be possible to enhance a sub-system to provide additional capabilities without affecting any other subsystem. It should be possible to implement or deploy individual subsystem enhancements in any order to facilitate system upgrading and network operation and evolution. Any enhancement in a sub-system boundary shall be backwards compatible with the previous version, i.e. the new version shall be able to emulate the previous version, which will avoid the need for a synchronised updating of all concerned subsystems.

In the same order of idea, it is desirable to separate in the design of the system functions which are dependent on radio access technologies from functions which are not related to radio access technology. This would optimize the system structure for the different environments of UMTS.

For FPLMTS, ITU-R Recommendation 819 [36] recommends also that FPLMTS be adaptable to the needs of developing countries, with the ability to provide low cost and rapidly implemented telecommunication services in rural or remote areas not yet or poorly equipped with fixed services. In this case, the satellite component is of special importance if the region to cover has a low user density not justifying the implementation of a terrestrial cellular network.

8.5 Spectrum issues

The frequency bands identified for FPLMTS at WRC 92 and WRC 95 are 1 885 MHz to 2 025 MHz and 2 110 MHz to 2 200 MHz, with the parts 1 980 MHz to 2 010 MHz and 2 170 MHz to 2 200 MHz allocated for the Mobile Satellite Service in year 2005. The parts identified for satellite component of FPLMTS are already planned for use by some S-PCN systems.

In Europe, the frequency band 1 880 MHz to 1 900 MHz has also been allocated for DECT, which could cause a problem of compatibility between DECT and terrestrial FPLMTS which partially share the same band. This band will probably not be allocated to UMTS in Europe in an initial phase.

Although frequency band sharing between the terrestrial component of UMTS and the satellite component may be possible, it should not be assumed for initial band planning of UMTS in order to limit implementation risk. So, it is likely that the terrestrial part and the satellite part of a dual-mode mobile station will have to operate in separate bands in order to simplify the interference problems. In fact, the terrestrial and satellite link budget are different and the satellite receiver of a satellite or dual mode mobile station may be very sensitive to interference from an adjacent UMTS terrestrial channel.

ITU-R in the new Recommendation M.818 [36] recommends that the multiple access plans of the terrestrial and the satellite components of FPLMTS be compatible, and that common channels be allocated in the bands reserved for the satellite link in order to facilitate at a world-wide level the frequency planning.

Another important requirement is to have a sufficient duplex separation (frequency separation between up and down links) in order to reduce complexity in the radio part of the multi-mode terminals which will have to work in different bands. With this, a common FDD separation for different modes of operation would simplify the hardware in the terminals.

According to some studies (as the study of ERO on UMTS), more than 2×60 MHz will probably be the minimum allocation required for the terrestrial part of UMTS in high user density regions having several operators. As 2×30 MHz of the FPLMTS reserved band are for the satellite component, there is only the 1 885 MHz to 1 920 MHz segment which is left, but this segment is partially shared with DECT and has no corresponding paired band for FDD operation.

Currently, the UMTS Forum is considering the need for extension of the allocated bandwidth. Particularly, the adjacent bands 2 025 MHz to 2 110 MHz and 2 200 MHz to 2 290 MHz which are presently occupied by the Fixed Service, Space Operation, Earth Exploration Satellite and Space Research services could be used by FPLMTS as an extension if the compatibility issues can be resolved. Perhaps this band could also extend the adjacent satellite component allocation.

In the short term, the bands 1 610 MHz to 1626,5 MHz and 2 483,5 MHz to 2 500 MHz are allocated to S-PCNs which are expected to evolve to provide FPLMTS compatible low-grade services. In the longer term, there may be the possibility to reallocate these bands to full FPLMTS satellite component services.

The feeder links of FPLMTS or UMTS will use bands allocated to the Fixed Satellite Service (FSS) and the high capacities required will probably have an implication on the assignment of frequency bands and sharing criteria with the fixed services will have to be studied.

8.6 Summary of UMTS issues for S-PCNs

Because the definition of UMTS is at a comparatively early stage, it is not possible to identify any major features to facilitate evolution to UMTS that should be included into the initial design of S-PCN beyond those that are already included through the close relationship between GSM and S-PCN. However the following points should be taken into consideration:

- The spectrum allocated to the UMTS satellite component and also practical power limitations in the satellite link may not enable the support of throughput rates equivalent to those of the terrestrial component of UMTS. Nevertheless, there is a necessity to integrate into the design of the UMTS satellite component capabilities to support medium rate services (using signal processing and data compression techniques).

- The space segment of an S-PCN network cannot be mechanically upgraded after the launch of the satellites except by launching new, replacement satellites. The S-PCN satellites will have a working life of typically 5 to 10 years, and this will limit the capability of S-PCN systems to add new facilities in small, frequent increments except where those changes can be implemented by software updates to the space segment.

- S-PCNs are already preparing for operation with multi-mode (or at least bi-mode) terminals allowing roaming with terrestrial pre-UMTS systems such as GSM and its equivalents outside Europe. This concept will need to be extended to include other air interfaces such as DECT. In the longer term developments of software technology may enable terminals to be adapted through the on-line downloading of software to operate with different air interfaces.

- Number portability between network operators is one of the objectives of UMTS, and the widespread introduction of number portability will make it desirable both to be able to re-route incoming calls and to be able to access a database to determine the routing of outgoing calls that may be to ported numbers. These requirements imply that there should be provision for SCF functions in the MSCs of the S-PCN systems.

- The wide variety of services which will be offered through UMTS will require the terminal to have a sophisticated and user friendly MMI in order to facilitate the access of the users to these services.

- The USIM included in a mobile UMTS terminal is a device allowing personal mobility in the use of different terminals. The standardization of the USIM and USIM/ME interface would permit a user to access the UMTS services at different terminals even if these terminals offer different characteristics including a different radio interface. So, S-PCNs should be prepared to evolve towards the support of a universal USIM.

8.7 Reference documents for UMTS

ETSI/SMG5 have already produced several documents on UMTS, concerning the work programme, the objectives, the system requirements, the scenarios for introduction, and the satellite component:

- ETR 271: "UMTS; Objectives and overview (UMTS 01.01)" [23];
- ETR 309: "Vocabulary for the UMTS (UMTS 01.02)" [25];
- ETR 291: "UMTS; System requirements (UMTS 01.03)" [24];
- ETR DTR/SMG-050104U: "Scenarios and considerations for the introduction of the UMTS; (UMTS 01.04)"[28];
- ETR SMG-51201: "Technical characteristics, capabilities and limitations of mobile satellite systems applicable to the UMTS (UMTS 12.01)" [30];
- ETR SMG-51202: "Satellite Integration within the UMTS (UMTS 12.02)" [31].

ITU-R have produced several recommendations about FPLMTS with which the European UMTS is aligned:

- CCIR Recommendation M.687-1: "Future Land Mobile Telecommunications Systems (FPLMTS) [33]";
- CCIR Recommendation M.816: "Framework for services supported on FPLMTS[34]";
- CCIR Recommendation M.817: "FPLMTS Network architecture" [35]";
- CCIR Recommendation M.818: "Satellite operation within FPLMTS Network" [36]";
- CCIR Recommendation M.819: "Adaptation of FPLMTS to the needs of developing countries" [37]";
- ITU-R Recommendation M.1034: "Requirements for the Radio Interface(s) for FPLMTS (FPLMTS.RREQ) [38]";
- ITU-R Recommendation M.1035: "Framework for the Radio Interface(s) and Radio Subsystem Functionality for FPLMTS (FPLMTS.RFMK) [39]";
- ITU-R Recommendation M.1036: "Spectrum Considerations for Implementation of FPLMTS in the bands 1885-2025 and 2110-2200 MHz (FPLMTS.RFRQ) [40]";
- ITU-R Recommendation M.1079: "Speech and Voice-band Data Performance Requirements for FPLMTS [41]";
- ITU-R Recommendation M.(number to be defined): "Security Principles for FPLMTS".

9 Human factors

9.1 Introduction

Human factors are of great importance in the present telecommunications environment which evolving rapidly with introduction of new systems and services to which the users have to adapt. In order to facilitate the access to the new equipment and services, it is important that their usability be carefully considered and that the man-machine interface be designed in such a way as to fulfil the expectations and requirements of the users.

General standardization activities about user aspects are conducted within ETSI by the Technical Committee for Human Factors (TC-HF), and within ITU-T, in Study Group 1 which has a Special Working Group on Human Factors (SG1 SWG-HF).

Two ETSI Technical Reports ETR 093 [3] and ETR 177 [55] have already been produced by the ETSI TC-SES, concerning possible European standardization of certain aspects of S-PCNs. ETR 177 [55] proposes objectives and options for standardization, and contains user aspects that may require consideration within a S-PCN service. These user aspects have been previously identified by the Human Factor Technical Committee, and reported in a technical report HF-TR 006 [59]: "Human Factors (HF); Satellite Personal Communication Network (S-PCN); Statement of user aspects for a S-PCN service".

This clause reviews the existing standards or recommendations related to user aspects which are applicable for S-PCN terminals and examines if there are some points specific to S-PCN terminals which are not addressed by these standards or recommendations and would therefore require a specific standardization. The different topics are listed in table 9.

The source documents for this study on Human Factors are the many CCITT or ITU-T Recommendations and ETSI documents already existing concerning all the aspects of the Man-Machine Interface (MMI) of ISDN terminals or cellular mobile terminals, which are in general relevant also for S-PCN mobile earth stations.

The User Interface includes everything with which the user is likely to come into contact, the exterior hardware (casework, control and display), the software dialogues (display contents and user procedures) and even the product documentation (user guide, training manual). The user interface deals with how the user operates the terminal to pass or receive a call or to access supplementary services, how information is presented from the terminal to the user to facilitate its usability, how co-operation of the user in the procedures is required, how people with special needs might access the services.

Table 9: Human factors aspects for S-PCNs

Items	Reference subclause
Hardware characteristics: - Casework - Keypad - Display	9.2 9.2.1 9.2.2 9.2.3
User input/output features: - Tones, messages and announcements - Numbering and addressing and other input features	9.3 9.3.1 9.3.2
User control procedures: - Basic user control procedures - Supplementary services control procedures	9.4 9.4.1 9.4.2
User requirements in UPT	9.5
User co-operation in S-PCN sessions	9.6
System and user response times	9.7
Health and Safety: - Electrical Hazards - Emergency Calls	9.8 9.8.1 9.8.2
Requirements for people with special needs: - People with visual impairment - People with auditory and/or speech production impairment - People with reading difficulties or reduced language comprehension or intellectual impairment	9.9 9.9.1 9.9.2 9.9.3
User requirements concerning security	9.10

9.2 Hardware characteristics

TC-HF report ETR 116 "Human Factors guidelines for ISDN; Terminal equipment design" [55] provides guidance to ISDN terminal equipment designers on the human factors issues and good human factors design practise. ETR 116 [55] is presently only addressing the case of fixed ISDN terminals or installations; the case of mobile terminals will be considered in a future version. Nevertheless, many requirements or recommendations are also valid for mobile terminals used for S-PCNs. ETR 116 [55] identifies a list of hardware characteristics which are recommended for ISDN terminals. Some of these recommendations are also CCITT or ITU-T Recommendations, and the main ones which could also be valid for S-PCN terminals are listed below:

9.2.1 Casework

The main recommendations concerning the hardware design of the casework are:

- the casework should have no sharp edges and corners, it should not present any split lines or pinching joints;
- the material should be electrically and thermally non-conductive, and chemically and biologically inert, particularly to household and office cleaning agents;
- the surface of controls should not contain chromium, nickel or other material which may cause an allergic reaction;
- for hand-held terminals, the surface should not have any projection likely to snag on pocketing or removal, and the centre of gravity should be close to the approximate centre of the casework to ensure the handset is well balanced when hand-held;

- the positioning between the ear-piece and microphone should respect CCITT Recommendation P.35 [70] in order to ensure that the handset can be placed correctly relative to the user's ear and mouth.

9.2.2 Keypad

Although there could exist S-PCN mobile earth stations working without a numeric keypad, the majority of them will have one as usual fixed or mobile telecommunications terminals. The main recommendations of ETR 116 [55] concerning the hardware design of the keypad are:

- the key size and key spacing should be sufficient to allow use by the majority of people. They should conform to accepted standards and well established ergonomic practise for keys;
- the keypad should respect the standard 3 x 4 keys layout (0-9, *, #) of CCITT Recommendation E.161 [77] shown in figure 15;
- to help low-sight users, the key "5" should be tactically identified by a raised dot or line as recommended in ETR 029 [51] and ETR 051 [52].

1	2	3
4	5	6
7	8	9
*	0	#

Figure 15: CCITT recommended layout for numeric keypad

In addition, ETR 116 [55] makes the following recommendation:

- the assignment of letters to numeric keys should respect CCITT Recommendation E.161 [77] Option A shown in figure 16.

  NOTE: This layout has been adopted in ISO/IEC 9995-8 "Information technology- Keyboard layout for text and office systems - Part 8: Allocation of letters to the keys of a numeric keyboard [85].
  It has also been recommended by GSM as a preferred option in ETS 300 511 "Digital cellular telecommunications system (Phase 2+); Man-Machine Interface of the MS (GSM 02.30) [67]".

The standardization of the assignment of letters and symbols to the numeric keys is a little facility allowing mnemonic dialling, but in the case of S-PCNs which are global networks, terminals are designed for users in countries which could use different alphabets, so it seems not desirable to recommend a specific arrangement.

1	2 ABC	3 DEF
4 GHI	5 JKL	6 MNO
7 PQRS	8 TUV	9 WXYZ
*	0	#

Figure 16: Preferred assignment of letters to numeric keypad

Additional recommendations of ETR 116 [55] concerning the keypad are:

- named function keys should be used to give rapid implementation of single actions;
  separate or use colour coding to reduce the risk of keying errors;
- avoid multiple functions on a single key;
  use soft-key dialogue to minimise the number of function keys with an unambiguous display;
- use clear and easy understandable labels;
  cursor keys (arrow keys) should respect the standard inverted T or cruciform layout of ISO/IEC DIS 9995 [86];
- the terminal should have the capability to give to the user an audible feedback when pressing a key. This audible bip should have an adjustable level with the possibility to switch it off;
- the terminal should include a CANCEL or DELETE key in order to allow deletion of an erroneous keystroke.

ETS 300 511 "Digital cellular telecommunications system (Phase 2+); Man-machine interface of the MS (GSM 02.30)" [67] recommends also to have specific keys or other means to perform easily the ACCEPT, SEND and END functions (accepting an incoming call, initiating or ending a call).

9.2.3 Display

In mobile terminals, it is highly desirable to have a visual display which is an essential element in the user interface providing a flexible and powerful way to exchange information with the user during the procedures. The main recommendations of ETR 116 [56] concerning the hardware design of the display are:

- there should be sufficient display space for the amount of information required and the demands of the tasks in order not to constrain the dialogue;
- for legibility, characters displayed should have a minimum height of 2,9 mm as recommended in ECMA-136 [8787];
- for alphabetic characters, it is recommended to avoid the simple 7 or 9 segment display which do not have enough legibility;
- it is recommended that there be a visual feedback of the characters dialled or the keys pressed.

9.3 User input and output features

The user input and output features of the MES are for example the country/network selection, the choice of format options for numbering, the physical means to perform the ACCESS, SEND and END functions, the entry of Bearer Capability Information Elements for mobile supporting non-voice services, the selection of language of announcements, the indications of call progress signals, display of called number, short message, call charge unit metre, the supervisory tones, etc.

Usually, there are very few requirements on these user features in order to allow for differentiated types of terminals proposing different options and to ease the introduction of future developments in the area of MMI. But there are general rules which are recommended in order for the users not to have to be trained each time they use a different terminal.

9.3.1 Tones, messages and announcements

Auditory tones have since a long time been generated by the telecommunications networks to inform the user of the status of his communication. Now, due to the complexity of digital techniques, it is not always possible to convey auditory tones within the traffic channels, they are often replaced by information sent in a signalling channel and the tones are created or re-generated in some point of the link nearer to the end user which depends on the situation. In many cases, and especially in the case of mobile systems, the tones have often to be generated locally by the terminal. The present situation is so that there exists in the different networks all around the world a great quantity of different tones, which creates a lot of confusion for the users who have the ability to recognize only a few different ones (about six).

The tones can be divided into supervisory tones and comfort tones. The purpose of supervisory tones is to inform the user of the status of the call. Main supervisory tones are dial tone, called party busy tone, congestion tone, ringing tone, call waiting tone (to indicate to a user already engaged in a call that somebody is attempting to call him), caller waiting tone (to indicate to a caller that the called party has a called waiting party service active), warning tone (to indicate to a user engaged in a call that a third party or a recorder is connected). Comfort tones are tones given to the user while waiting for a reaction from the network in order for him not to abandon the call. The main comfort tone is post-dialling tone but the tendency is to suppress it except for calls with very long delays.

Some guidance about tones, messages and announcements is given in CCITT Recommendations E. 180 to ITU-T Recommendation E.184 [78] [79] [80] [81] [82] and ETR 116 [55]:

- use acoustic signals to attract attention, for example as the ring signal and as a warning signal where immediate action is needed;
- use auditory tones to provide feedback on the current state of a call, in order for the user not to believe that nothing is happening;
- use acoustic signals as a prompt for action within call set-up/handling;

- for signals and tones, use a very limited number of easily recognised codes using rhythm (cadence) and pitch (frequency) variations, preferably less than 7 in any single context in order to avoid confusion for the user; the following basic tones: dial tone, ringing tone, busy tone, congestion tone, should be used;
- use tones having a frequency between 300 Hz and 3 000 Hz where the human ear is most sensitive;
- ensure that the time delay between terminal, system and network changes and the corresponding signal or tone is minimal (maximum desirable 0,5 seconds);
- ensure the sound level of tones provided by the terminal follows CCITT Recommendation E.180 [78] (the levels of tones at the receiving end shall have a value between -15 dBm0 and –5 dBm0 measured with continuous tone);
- where possible provide a volume control for the user to adjust the loudness of signals to his preferences or to the external circumstances;
- where tones are generated independently by the terminal in response to signalling from the network, the terminal generated tones should copy the local PSTN or ISDN tones in frequencies, cadence and meaning;
- in general, terminals should not generate new tones. If the terminal provides services which require feedback, it is preferred that the terminal makes use only of the minimum set of PSTN/ISDN tones;
- make use of users stereotypes, use accepted telephony tone codes as in CCITT Recommendations E.180 [78], E.181 [79], E.184 [82] and ETS 300 295 [63] (CCITT Recommendation E.182 [80] contains also guidance information about tones and announcements for ISDN supplementary services).

Concerning speech announcements, the following recommendations are made:

- as far as possible, announcements should not commence with a significant word;
- announcements such as acknowledgement messages or error messages should be produced twice;
- the speech rate should not exceed normal conversation speed;
- if an announcement is used for asking an input from the user, a tone should be given to invite him to proceed.

Concerning screen messages, the following recommendations are made:

- use screen messages to give instructions, to offer available choices of actions and to provide error messages and status information;
- use lower case lettering for the main part of the text with only the initial letter of the sentence in capital.

The following recommendations are valid both for speech announcements and screen messages:

- messages should be short, factual and informative;
- they should be phrased in a polite manner;
- use short sentences and easily understandable words;
- avoid technical terms, jargon, and abbreviations;
- use an active verb structure, and when giving instructions, place verb first and object second e.g. "Press cancel key";
- use the affirmative "Do" construction in preference to the negative "Don’t";
- if an action and its consequence are described, the consequence should be stated first, then the action (e.g. to receive this message, press the # key);
- if applicable, the order in which announcement is presented should correspond to the order in which action is required (e.g. to do this, press 0, then press the # key).

Some additional features required for GSM terminals should also be taken into account:

- the called number should be displayed on the screen in order for the caller to check before call set-up if the selected number is correct;
- there should be a visual indication of the status of the battery load;
- there should be a visual indication of the country/network in order for the user to know if the choice of network is correct, and to know if roaming is taking place. When more than one network is accessible for the user, such information should be indicated, in order for him to make a choice;
- it is recommended that the terminal has a Service Indicator (SI) display, that is it gives an indication of the signal strength received from the network on which the mobile station is registered.

ETS 300 512 (GSM 02.40) [68] gives additional requirements for GSM mobile terminals about call progress indications which could be relevant also for S-PCN terminals:

- reserve verbal announcements for situations which are peculiar to a mobile network where users may be unfamiliar with any tone used to report the situation; it is recommended to limit as far as possible verbal announcements received from the network in an environment with international roaming where the language may not be understood by the user (except if the terminal has advanced features allowing it to block the incoming vocal message and replace it by a corresponding one in the language chosen by the user).

9.3.2 Numbering, addressing and other input features

The provision within the terminal memory or within the SIM card of a personal address book where the user can record the numbers of his usual correspondents is a highly desirable facility to save time and limit the opportunities of errors when the user dials a number. The entry of the identities of called numbers is generally made by switching the keypad to the alphanumeric mode to access to the different letters assigned to each numeric key.

Concerning the choice of format options for numbering, the international access function, it is recommended in ETS 300 505 (GSM 02.07) [66] to use the "+" key to access to the international numbering mode. In the case of S-PCNs, this does not seem to be appropriate because even if the user is passing a local call within his country, this call could pass by a gateway which is located in another country and a sophisticated software would be needed in the gateways to adequately translate the dialled numbers. In the case of a dual GSM/S-PCN terminal, a solution could be that when the call is passing by the satellite network, the terminal automatically converts the dialled number into the international format.

Concerning the configuration of the terminal with user parameters as for example the choice of network, choice of language, ringing bell, disabling or restrictions of functions, etc., freedom has to be left to the manufacturer for the design of the menus of the interface to allow for competition. So, nothing specific has to be recommended except that the general rules given for the usability of the dialogues could also be taken as a guidance and that as far as possible the user interface should be made self-explanatory.

9.4 User control procedures

The user control procedures in the Man-Machine Interface (MMI) are the means to access telecommunication sessions. These procedures enable the user to initiate or receive calls or to access supplementary services.

Even in fully standardized systems such as GSM, the requirements on the user control procedures are kept to a minimum, in order to allow for differentiated types of terminals, with competition on this aspect between manufacturers and introduction of future developments in the area of MMI.

9.4.1 Basic requirements for user control procedures

In ETS 300 511 (GSM 02.30) [67], standardized control procedures have been defined, but only by describing the logical actions having to be performed by a user. The main idea is that the basic MMI should allow non-experienced, casual users to make and receive a telephony call. Most of the tasks should be executed by any user with a minimum training. There are three basic tasks that all users should be able to perform: to set up a call, to answer a call and to end a call. Optionally, the user may set the mobile terminal to disable some of the MMI functions.

Attention should also be given to consistency in the terminal operation in order to allow the users to improve their skills and predict the effect of their actions:

- consistency of language should be applied so that the terms or labels used on the display, keyboard and documentation are always the same and the use of synonyms should be avoided.

EXAMPLE: If a key labelled CANCEL (or DELETE, or CLEAR) is used to undo the last action, this word shall be used everywhere in the dialogue or documentation;

- consistency of effect should be applied so that the user perceives an action as having the same outcome regardless of mode or level within the system. Example: a way of switching a feature on and off is to press the feature key. A user may make errors if this strategy does not apply to all feature keys, and if for some of them the cancel key has to be used;
- apply a consistent syntax and logic to procedures and sequences so that frequent users of the system can develop their skill and speed.

ETR 116 [55], ETR 170 [57] and E.134 [74] give general recommendations for Call Handling procedures.

- the call set-up, control and termination dialogues should require the minimum possible user actions and the minimal memory load;
- basic call handling procedures for voice calls should support user stereotypes and expectations by remaining consistent to existing user models of telephone operations;
- novice and casual users should be guided through the basic level of call control using visual display, voice or on-product graphics;
- enable users to dial during call set-up using the standard "overlap" or the newer "en-bloc" dialling;
- ensure the "en-bloc" dialling is supported with a basic numeric display and last digit editing facilities;
- prevent time-outs at the start of dialling and/or at inter-digit intervals from affecting people who key slowly. This will include the accessing of secondary networks;

  NOTE: For hand-held terminals, these rules do not apply as there is generally a send key to press after entering all the numbers on the keypad.

- the interaction should allow for time-saving short-cuts, e.g. programmable direct dial keys, short code dialling or alphabetic directory;
- the terminal and network should provide clear feedback on the progress of the call, through the use of auditory and visual displays;
- the context should be clearly indicated to the user;
- call failure due to user error, terminal and system faults, or congestion should be clearly indicated and options for error recovery or indication of duration of fault condition should be provided.

Another ETR from TC-HF, ETR 170 [57] presents a generic concept and framework for user control procedures. ETR 170 [57] identified twelve general rules for User Control Procedures and seven Generic User Control Procedures. The general rules for User Control Procedures are presented in table 10.

Table 10: Twelve general rules for user control procedures

1	A user procedure comprises a sequence of user control actions and equipment display indications targeted to enable completion of a user's task or sub-task.
2	Every control action requires a clear indication of the status of the system and of the control before the action, and a clear indication (feedback) of the change in status of the control and the system after the action.
3	A user control action is necessary to initiate and complete any task or sub-task. A single action may complete one task and initiate a new task, if the action is explicit in both tasks. Similarly, a single action may complete a number of nested or parallel tasks, if the action and the corresponding indication explicitly confirms the multiple effect.
4	Any change of status of the system (terminal, network, remote terminal) that affects the user's interaction with the system needs to be indicated to the user. Interruptions to a user's task that are initiated by the system (including a remote user's actions) should accommodate the current task, and facilitate the user's choice over the available options.
5	All indications to the user whether static or transitory, need to be appropriate, discriminable, comprehensive and timely.
6	All control actions required to operate the system need to be within the range of the physical and mental capabilities of the possible user population (with due reference with people with special needs).
7	No indication, control action or status of the system should threaten the physical or mental well-being of the possible user population.
8	Any procedure necessary to complete a task (or sub-task) should be concise, consistent, comprehensible and complete; commensurate with minimum user errors and congruent with targeted user preference levels.
9	Any set of procedures which relates to a set of tasks (or sub-tasks) needs to demonstrate the quality of consistency, flexibility, compatibility, self-explanation and user task orientation, to support the user's modelling or comprehension of the tasks and the system.
10	All procedures should support a simple and comprehensive error recovery strategy to enable the user to backtrack and/or exit to erroneous control actions. As far as possible, error recovery should not be penalized by any loss of data of the communication path.
11	New procedures should be tested by a representative sample of people drawn from the possible user population (with reference to people with special needs) and evaluated against previously established criteria of usability.
12	Disregard any or all of the above rules in the interests of developing user control procedures and user interfaces which have a proven higher level of usability.

The Generic User Control Procedures of ETR 170 [57] are:

- call set-up;
- incoming call;
- payment;
- identification;
- change;

- call in progress;
- terminate call.

The first important principle is that the user is guided at each action by prompt and feedback announcements, giving a clear indication to the user of the status of the system before and after the action. The second principle is that a user control procedure should be as far as possible flexible, that is the user is allowed to perform the sequence of actions in different orders to reach to the same result.

ETSI 300 511 (GSM 02.30) [67] contains a specification for a basic public MMI for mobile stations used by unfamiliar users, e.g. in fleet cars, hire cars and pay-phones. This specification contains the basic features of call origination and call termination. A reference is made to CCITT Recommendation E.121 [72] for the design of pictograms and symbols.

Conclusion: It is recommended that S-PCN system designers also adopt these generic rules and principles in the user control procedures of the MES. But a standardization of these procedures would be a restriction to the creativity of manufacturers or service providers which compete on this aspect of MMI to continuously enhance functionality in the terminals they offer to the users.

9.4.2 Supplementary services control procedures

The supplementary services supported by GSM are described in ETS 300 503 (GSM 02.04) [65]. They are:

- Number Identification SS	CLIP	Call Line Identification Presentation;
	CLIR	Calling Line Identification Restriction;
	CoLP	Connected Line Identification Presentation;
	CoLR	Connected Line Identification Restriction;
- Call Offering SS	CFB	Call Forwarding on Busy;
	CFU	Call Forwarding Unconditional;
	CFNRy	Call Forwarding on No Reply;
	CFNRc	Call Forwarding on Mobile Subscriber not Reachable;
- Call Completion SS	CW	Call Waiting;
	HOLD	Hold;
- Multiparty SS	MPTY	Multiparty Service;
- Community of Interest SS	CUG	Closed User Group;
- Charging SS	AoCI	Advice of Charge (Information);
	AoCC	Advice of Charge (Charging);
- Call Restriction SS	BAOC	Barring of All Outgoing Calls;
	BOIC	Barring of Outgoing International Calls;
	BOIC-exHC	Barring of Outgoing International Calls-except those directed to the Home PLMN country;
	BAIC	Barring of All Incoming Calls;
	BIC-Roam	Barring of Incoming Calls when Roaming outside the Home PLMN country.

Some of these Supplementary Services are slightly different to ISDN supplementary services described in CCITT Recommendations I.250 [83] series, e.g.:

- AOC-S/D/E Advice of Charges: at set-up, during or end;
- CF-B/NR/U Call forwarding on busy, on no reply, unconditional;
- 3PTY Three-party conference.

Additional ISDN Supplementary Services are:

- CCBC Completion of Call to Busy Subscriber;
- DDI Direct Dialling In;
- MSN Multiple Subscriber Number;
- TP Terminal Portability;
- CD Call Deflection;
- CONF Conference Call, add-on;
- CT-E/S Call Transfer: explicit;
- FPH Freephone;
- MCID Malicious Call Identification;

- MMC Meet Me Conference;
- SUB Sub-addressing;
- UUS User-User Signalling.

Some of them could be implemented in S-PCNs.

The general rules given in subclause 9.4.1 can also be applied for user control procedures giving access to supplementary services, but in this case, as the procedures are likely to be more sophisticated than for a basic telephony service, and as users generally have less practise with these supplementary services, it is desirable to define some rules in order to minimise the confusion of users in front of different types of mobile stations.

The subscriber control procedures for ISDN supplementary services are described in CCITT Recommendation E.131 [73].

TC-HF has also produced an ETS for a minimum man-machine interface for public network based telecommunications services (DE/HF-01017 [61]). This standard defines the command language (based on * and # code scheme) and the necessary indications that can be used to access and control supplementary services.

As specified in ETS 300 511 (GSM 02.30) [67], it could be recommended that the mobile terminal be equipped with some enhanced MMI functionality using dedicated keys, menu procedures, etc., left to the discretion of the manufacturers.

ETR 116 [55] main recommendations concerning supplementary services access control procedures are:

- design the user interface for accessing and controlling supplementary services to minimise learning time, reduce memory load, and reduce error rates;
- use single action feature keys to support selection of a small range of services but avoid creating a large control panel;
- consider a soft-key interface, if access to a larger number of services is necessary, avoid creating a dialogue that requires the user to learn an extensive directory of numeric codes;
- provide a minimum interface to access all available services;
- ensure the procedures meet user expectations and are fully supported with prompting and feedback indications;
- as an absolute minimum, provide access via an internationally recognised code scheme or stimulus protocol, e.g. CCITT Recommendation E.131 [73];
- when similar services are provided within the terminal, the customer premises equipment or the network, which the user may perceive as providing the same function, the procedures, prompts, feedback, and error handling should be common throughout, i.e. they should have the same look, feel and effect at all levels.

A general recommendation would be for S-PCN to follow CCITT Recommendation E.131 [73] and GSM 02.30 [67], but for the time being, there are differences between the supplementary services provided in the existing networks (PSTN, ISDN, GSM, etc.), which could lead to confusion for the user. For example, the conference service is controlled in a different way in ISDN and GSM, where a simpler procedure has been adopted. A problem of compatibility will arise also for the dual mode terminals where the user procedures of the S-PCN terminal will have to be aligned with the procedures used for the terminal of the cellular network.

So, if it appears that there are significant differences between the procedures used for supplementary services in different networks, a careful consideration will have to be given to the aspect of clarity and simplicity in the procedures in order to avoid confusion for the users.

9.5 User requirements in UPT

The UPT service will allow user-to-user telecommunications with:

- network and terminal independent user identification based on a UPT number;
- personal mobility, enabling the UPT user to move between terminals and networks to make or receive calls based on the UPT service profile;
- universal access procedures for UPT facilities across multiple networks;

- personal user control and flexibility in the selection of the UPT user's telecommunications services in a personalised UPT service profile;
- security and privacy, including authentication of the UPT user.

In collaboration with STC-NA7, TC-HF have produced on the subject a technical report, ETR 208 "User requirements in UPT" [58].

The tasks of UPT users are described with their goals.

The UPT user's primary goal tasks are:

a) to initiate dialogues, and/or send messages to known people, by making outgoing calls:
   - from any supporting terminal/network (public or private) at any geographical location;
   - with secure knowledge that:
   - all calls will be charged to correct account;
   - no unauthorised call will be charged;
   - calls will be person to person and private;
   - most efficient routes will be used, e.g. a "local" call will be made when both parties are "local", even if one or both are roaming;
   - call billing will match published charges, and not include "surprises".

b) to accept dialogues and/or messages from known or unknown people by receiving incoming calls:
   - at any supporting terminal/network (public or private) at any geographical location;
   - with secure knowledge that:
   - calls will be person to person and private;
   - minimum cost routes will be used for any incoming calls bearing charges;
   - no unauthorised calls bearing charges will be charged;
   - unwanted calls do not have to be answered, particularly when roaming.

The UPT user's secondary goal tasks are:

a) to feel in control of their telecommunications environment:
   - by giving other choices than having to answer intrusive calls;
   - by maintaining contact when away from home terminal/network;
   - by maintaining communications capability when away from home terminal/network.

b) to control their communications availability:
   - by choosing when available to whom, without losing calls from unexpected sources.

c) to control their telecommunications costs:
   - by separating business, personal, and other call charges;
   - by identifying individual users costs;
   - by minimising UPT on-costs, e.g. when roaming.

The main differences brought by UPT with regard to classical PSTN or ISDN calls will be in the definition of service profile and its modification by the user. Moreover, a UPT access device may be needed to access UPT services. In UPT Phase 1, DTMF will be used, replaced by the use of a smart card in UPT Phase 2. The review of the existing service profile and its modification could be a rather complex procedure. ETR 055-01 [32] identifies about 27 parameters that the UPT user can affect. For example, the UPT user may need to confirm his identity, the current state of his registration, and any limits that apply to it, mobility and charging parameters, times for personal/home calls, times and call areas for business calls, supplementary and value-added services, black and white lists of callers, etc. So, the UPT user needs a significant display facility to be able to review the existing status and choices of all the service profile options. The UPT user control procedures should in general have to conform to the recommendations given for the basic control procedures.

It has been decided that the UPT service will be supported by UMTS or IMT-2000 in a transparent way. A UPT user will be able to access his UPT services through UMTS, without modification of the procedures. Presently, it is not clear if UPT service will be mature enough to be offered in the networks before the introduction of UMTS, and if UPT could be offered over S-PCNs, but if so, it will be necessary that S-PCNs terminals have the capability to process the UPT smart card and be equipped with a sufficiently sophisticated Man-Machine Interface to access the UPT service.

9.6 User co-operation in S-PCN telecommunication sessions

S-PCN terminals should be designed in such a way that user co-operation is minimise. If needed, it could be recommended to precise clearly that the antenna has to be pulled out properly, and to ask the user to look at the field strength indicator to orient the terminal in order to optimize the link budget.

In the case of dual mode terrestrial/S-PCN terminals, perhaps some care has to be taken in the dialogue proposed to the user to choose between the different scenarios for the selection of type of network.

9.7 System and user response times

ETR 116 [55] has given recommendations for response times in ISDN terminals:

- in principle, response times, from control activation to displayed result, should be as short as possible;
- immediate execution or acknowledgement should be offered as a result of single key strokes or simple commands;
- variation in response times should be less than 10 %;
- ensure that time-outs in the dialogue do not affect slowly reacting people;
- long delays due to network constraints or other reasons should be accompanied with an indication e.g. "please wait". This point needs to be stressed for the case of S-PCNs where response times could be increased with regard to usual cellular mobile or fixed networks. This could be the case for example at switch on, during the cold start acquisition of a satellite.

9.8 Health and safety

9.8.1 Electrical hazards

Concerning the electromagnetic disturbance generated by the terminal and its intrinsic immunity, the EMC Directive applies (Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility [88]). The Low Voltage Directive (Council Directive 73/23/EEC on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits [89]) shall also be respected in order to protect the persons using or getting into contact with the terminal.

Concerning the electrical hazards that could cause harm to the health of users or disturb medical devices they wear (as pacemakers and hearing aids), no recommendation exists presently at the international level. In Europe, some work is undertaken on the subject within the COST 244 program. Sub-committee 111B of CENELEC is also preparing a standard concerning the human exposure to electromagnetic field from 10 kHz to 300 GHz. For GSM, some work has been conducted to analyse the potential of a GSM terminal to interfere with other electrical apparatus. ETR 108 [55] sumarizes the conclusions on these studies:

- the source of disturbance is the 100 % amplitude modulated RF envelope introduced by burst transmission in Time Division Multiple Access (TDMA). As the frame rate and burst rate are in the audio band (220 Hz and 1,7 kHz), audio apparatus having some non-linear component able to demodulate this Amplitude Modulation (AM) envelope will be subject to interference. Another source of disturbance can be the Discontinuous Transmission (DTX) mode of GSM introducing a signal with a rate of 2,1 Hz and 8,3 Hz;
- a person having an hearing aid is disturbed by GSM transmission which causes audible interference at distances which can go up to 20 m for a 2 Watt Mobile Station (MS). The solution is to design new hearing aids having a better immunity;
- DTX transmission is likely to cause interference to some types of cardiac simulators, but the experiments have not given significant results on the subject yet. it has also been identified that GSM hand-held terminals used in a car without a car kit could disturb the operation of certain electronics, such as Automatic Breaking System (ABS);
- when all these studies about electrical hazards and disturbance to apparatus will give results permitting to make a recommendation for terminals at an international level, S-PCN terminals will have to respect it but for the time being the situation is not clear and only national rules are applicable.

9.8.2 Emergency calls

It is highly desirable to implement a simple procedure for the handling of emergency calls, with a standardized number (number "112" already recommended) and procedure. Moreover, the ability for the terminal to establish an emergency call accepted by the network without identification module inserted (as SIM card) and also in the case when outgoing calls are barred in the terminal is recommended. Nevertheless, a number of problems arise in the case of S-PCNs, because the emergency caller could be anywhere on the Globe, could speak any language, and could require any emergency service.

Some considerations for emergency call handling in S-PCNs are:

1 The S-PCN network operators will need to set up Global emergency call-handling services.

2 The emergency caller may speak in any language. The emergency call-handling services therefore need to be able to route the call to an operator who speaks the language of the caller. This might be achieved by routing the call to an emergency call-handling centre in the country where the subscription is based, but there is still the possibility that the person making the emergency call may not be the subscriber.

3 The position of the caller needs to be established. The geographical position (latitude/longitude) of the caller may be established by positioning functions in the MES. however more prosaic positioning is usually desirable (on the corner of the high street, by the sign for the post-office).

4 The type of emergency service required needs to be established and the appropriate emergency service near to the caller needs to be alerted to the emergency requirement. Interfaces between S-PCN emergency call-handling services and emergency services in all parts of the globe therefore need to be established.

9.9 Requirements for people with special needs

People with special needs are people who, for whatever reason, be it for example, advanced age, illness, physical impairment or disability, encounter difficulties in using telecommunications services. This category includes also the case of young children. As these people represent a significant proportion of the population, it is important that the requirements of this category of people are as far as possible taken into consideration in the design of telecommunication equipment to reduce the need for having to provide special terminals for their usage.

ETR 029 [51] gives a list of recommendations for improving and adapting telecommunication terminals and services for people with impairments. Other ETSI documents as ETR 116 [55], ETR 068 [53], ETR 051 [52], ETR 095 [54] and ITU-T Recommendation E.135 [75] give guidelines and recommendations for meeting the needs of people with disabilities.

9.9.1 Requirements for people with visual impairment

- As already said in subclause 9.2.2, it is recommended to use the CCITT E.161 [77] keypad with a tactile marking on key "5" in order to facilitate dialling;
- keys should be marked for easy visual identification with large, high contrast numbers and legends;
- colour coding should not be used alone but as an additional coding feature;
- all colours used should transform into clearly discernible grey tones on the monochrome grey-scale;
- if colours are used to identify different groups of keys, inverse colour contrasts can be acceptable;
- essential visually displayed information should also be given in parallel as acoustic signal or in a tactile form;
- if a smart card or a magnetic card is used in the terminal, it should have a tactile identifier to aid orientation as described in ITU-T Draft Recommendation E.136 [9276] and CEN TC244 N293 [90]. Preferentially, ETR 116 [55] recommends that the tactile identifier is a notch on the longer side of the card;
- additional requirements for people with visual impairment concern the public telephones, they are mainly:
- sound signals or specially patterned pavement to facilitate the access for blind people;
  acoustic feedback for insertion of more coins;
- verbal information given by pre-recorded or synthetic speech for call procedures.

9.9.2 Requirements for people with auditory and/or speech production impairment

Deaf people with no or unintelligible speech cannot communicate vocally. They need to use a text telephone or a video-telephone to communicate by manual sign language or lip reading, but they could also use a normal terminal for sending simple messages or alarms. Also, deaf people capable of intelligible speech can use the telephone for vocal messages to hearing people even if they are not able to receive a vocal reply.

- For the usage of these people, it is recommended that all operations to be performed and all signals to react on be also visually displayed;
- for people who have difficulty for hearing, it is recommended that the telephones provide for inductive coupling to hearing aids (e.g. use of electro-dynamic earphones, coils, etc.). See ETS 300 381 [64] and CCITT Recommendation P.37 [71];
- if possible, adjustable acoustic amplification and adjustable ringing level should also be provided. An alerting light or a vibrator would also be useful to this category of people to signal an incoming call.

9.9.3 Requirements for people with reading difficulties or reduced language comprehension or intellectual impairment

This category of people includes in addition to people with visual, auditory or mental impairment, people with insufficient reading education, small children, foreigners or lingual minorities. To facilitate the access to telephone services for these people, it is recommended:

- that basic user instructions should not demand reading skills or knowledge of the local language;
- to use pictograms, symbols and icons with easy recognition and understanding as described in CCITT Recommendation E.121 [72];
- that the time-outs in the terminal allow slow users to complete the procedures.

9.10 User requirements concerning security

Security issues are treated in clause 6 of this ETR. Security aspects related to the user interface are locks and passwords in the terminal to prevent unauthorized or abusive use, log-on and authentication processes. ETR 116 [55] gives several recommendations related to security from the user's point of view:

- user authority to access secure systems or networks should be established during the initial log-on procedure;
- sophisticated authentication procedure should be used to verify the accessibility of the user to the different offered services;
- consider the use of double passwords for additional security in exceptional circumstances;
- consider setting a low maximum limit for unsuccessful attempts;
- provide mechanisms to help rapid user recovery from simple syntax, data entry or keying errors;
- prevent data loss at log-off, indicating if there are current transactions to be completed.

Additionally, ETS 300 614 "Digital cellular telecommunications system (Phase 2); Security management (GSM 12.03)" [48] contains the description of the security mechanisms of GSM with periodically modified encryption of the user related data to ensure confidentiality. It would be desirable that S-PCNs provide at least a security management system similar to GSM.

9.11 Summary and conclusion

Clause 9 presents an overview of the standards and recommendations concerning the Human Factors aspects which are presently available for PSTN/ISDN and GSM terminals, and which could also be taken into consideration for the design of S-PCN mobile earth stations.

It appears that the majority of the Human Factors requirements relevant for S-PCNs are already covered by these recommendations.

Apart from the general PSTN/ISDN recommendations, it is recommended in this report to follow for GSM/S-PCN dual-mode terminals the GSM standards concerning the Human Factors related features, which would have the advantage to provide a coherent interface for the user.

10 S-PCN MES equipment not currently covered by ETSs

10.1 Introduction

The ETS 300 733 [1] and ETS 300 734 [2], and the ETS being developed in ETSI STC-RES 09 for EMC, apply to S-PCN land mobile earth stations with both transmit and receive capabilities. Other types of S-PCN MES equipment are not covered, e.g.:

- Receive-only MES;
- MES intended for aeronautical applications;
- MES intended for maritime applications;
- Dual or multi mode MES.

Possible requirements for each of these types of MES are discussed below.

10.2 Receive-only MES

Following a ruling of the Court of Justice of the European Communities, Case C-80/92 of the 24th of March, 1994, equipment designed for receive-only of radio messages is not subject to regulatory requirements apart from the CE marking provided for in the EMC Directive [88].

The current practice in Europe is that the technical requirements for EMC, both for generated emissions limits and immunity to external emissions, for a radio product should be contained in an ETS. Such an ETS for S-PCN MESs with both transmit and receive capabilities is currently in work within ETSI. This ETS could either be extended to cover receive-only MESs, or be used as a model to produce a dedicated EMC ETS for receive only MESs.

10.3 MES intended for aeronautical applications

The aeronautical environment is one with special requirements, because of the potential for a MES to interfere with other systems on board the aircraft and, when at altitude, to interfere with other external systems over a wide area. ETR 270 [5] covers the relevant issues.

The aeronautical environment for S-PCN MESs is expected to be mainly for public correspondence only, i.e. not used as an alternative to professional aeronautical navigation and communications equipment operating in the bands allocated to aeronautical services.

The market for public correspondence only MESs could be in airliners as a trunked service to passengers or in leisure and semi-professional applications in small aircraft.

However, some airlines may wish to use S-PCN for administrative and operational communications, and this case, may lead to additional requirements under the responsibility of the civil aviation authorities (see ETR 270 [5]).

10.3.1 Relevant points from ETR 270

The following are some extracts from ETR 270 [5] which are relevant to S-PCN:

- Europe supports a present population of some 45 000 general aviation (i.e. light) aircraft together with many additional thousands of micro-light aircraft, balloons, gliders, etc.

- For MESs in aircraft, whether installed or portable, which operate on frequencies allocated to the AMSS or MSS providing public correspondence services, there is no obligation arising from air safety or air-worthiness requirements other than that of physical safety and freedom from interference effects to mandatory carriage aircraft systems. Specifications for such systems may therefore be agreed on the basis of system requirements alone and be responsive to any commercial and other imperative consideration. Air-worthiness approval is therefore granted on the basis of "no hazard to the aircraft".

- Aviation is characterised by a strong world-wide network of formal international agreement, supported by specialist voluntary bodies. Safety and inter-operability are fundamental and essential objectives in the process. World-wide harmonisation of standards, specifications and operational procedures is the means adopted in the achievement of these objectives. In any proposed ETSI work, collaboration with concerned aviation bodies is essential for the production of acceptable and appropriate standards.

- There is a requirement for an ETS to be produced by ETSI for Mobile Earth Stations operating in the bands allocated to the AMSS, or the MSS, which are intended for use in aircraft, installed or carried on board, for public correspondence purposes. To ensure the safety aspects and the compatibility with other radio and electronic systems on the aircraft, the preparation of the ETS shall be undertaken in collaboration with the Joint Aviation Authorities, supported as necessary by other interested organisations.

- ETSI should seek clarification from the European Commission regarding the need for an ETS on MES/AES that may form the basis for regulation, considering the TTE and SES Directives. Additionally it should seek clarification of the relationship of such a possible ETS with other legislation, such as EU Council Regulation 3922/91/EEC [9], the Air Traffic Management (ATM) Directive 93/65/EEC [10], etc.

  NOTE: This appears to be in the context of MESs used for services other than public correspondence only.

- Radio systems which do not support the navigation or communication needs of the aircraft for safety purposes do not have to conform to the full Air-worthiness requirements. In these cases, the radio systems approval to the level required for the award of a "Certificate of Air-worthiness" to an aircraft type relates to physical safety and interference aspects (often described as a "no-hazard" approval). In essence only the following would apply:
  incorporation with antenna, cabling, indications and control of the aircraft to meet aerodynamic, structural, EMC, and physical safety requirements.

- However, in cases of conflict with safety systems, there is general recognition within ITU and regulatory practice that the needs of the safety systems take precedence. Therefore, provided these criteria are met, no requirement for the functional and system elements of the specification need to be agreed by national aviation authorities. Nevertheless, it makes good sense to consult with, and invite the participation of, aviation bodies in all the stages of system evaluation and specification to ensure its safe integration into the aircraft.

- The EMC standard for aeronautical equipment is EUROCAE ED 14C (equivalent to RTCA-D0160C) [8].

10.3.2 Conclusions

For MESs intended for fitting into an aircraft and providing only public correspondence services, the essential requirements for control of unwanted emissions so as to avoid undue interference with other external systems should be specified in an ETS to be produced by ETSI TC-SES, in collaboration with the Joint Aviation Authorities, supported as necessary by other interested organisations.

For MESs providing other aeronautical services, ETR 270 [5] should be consulted for the requirements for applicable standardization.

10.4 MES intended for maritime applications

The maritime environment for S-PCN MESs is expected to be for public correspondence only, i.e. not used as an alternative to professional navigation and communications equipment operating in the bands allocated to maritime services. The markets for such MESs could be in liners and ferries as a trunked service to passengers or in leisure and semi-professional applications in small craft.

There do not appear to be any special essential requirements for MESs in this application over and above those for land mobile applications, so they could be included in the scope of the ETSs and TBRs currently under development.

10.5 Dual or multi mode MES

The S-PCN community have recognised the likelihood of an S-PCN function being combined with other radios in a single equipment. Of particular interest in Europe is the combination of S-PCN with GSM, DCS 1800 or DECT, but in the rest of the World, it can be envisaged that S-PCN could be combined with Digital AMPS (DAMPS), IS95, Japanese Handy-phone, etc.

The ETSs and TBRs for S-PCN MESs include a requirement that "fellow" radio stations in a S-PCN MES shall be of the "receive-first" type; i.e. they should not transmit unless permitted to do so by receipt of an enabling signal of some description from the system with which they wish to communicate.

However, the standards within Europe for transmitting radio equipment all include requirements to limit unwanted emissions outside their "necessary" bandwidth or outside the band allocated to their service. In this context, the carrier-on emissions from the S-PCN mode of a terminal in normal S-PCN operation, will appear in bands regarded as unwanted emissions by the standard of any fellow mode. Whilst technically this is no surprise, legally, it may require that the standards for fellow modes need to be modified to include in their scope statements a waiver that, in a multi mode equipment, the standard only applies to that mode and that for the purposes of the standard, carrier-on emissions from other fellow modes are not to be considered as unwanted emissions.

11 Mutual recognition of type approval and licences

11.1 Introduction

This clause discusses issues related to mutual recognition of type approval and licenses for the planned Satellite Personal Communications Networks (S-PCNs). The first two of these networks are scheduled for introduction in 1998.

The purpose of this subclause is:

- to identify the mutual recognition issues;
- to identify any actions that may need to be taken at European level;
- to identify any need for the development of European standards related to mutual recognition that would facilitate the deployment of S-PCNs.

These networks are global. They provide global coverage enabling the use of terminals even in countries where the operators have no direct presence. The development of these networks is supported by international consortia and is not under European control. Full details of the user-to-network air interface are not being harmonized or published in a formal standard. Full technical descriptions of the networks will not necessarily be published at all, and information may be released to manufacturers only under confidentiality agreements.

The ETSI publication on Global Multimedia Mobility (GMM) [29] states:

"Mobile satellite services (S-PCN) are likely to be an early implementation of GMM services. It shall be stressed that only world-wide standardization and regulation can meet the requirements of operators and users in this area".

"As a particular aspect of the general licensing framework, the licensing conditions governing the right to use spectrum will have to be harmonized across the European countries with the objective of a mutual recognition of licences, and a one-stop procedure. This is of utmost importance for the implementation of professional regional cross-border networks when justified by the market, and when a limited, but sufficient harmonization of the spectrum is possible (full harmonization remains an objective for the whole of Europe)".

"Any harmonization within GMM should be based on well justified functional requirements and not on the technical implementations".

11.2 Current situation

Until recently, both type approval of telecommunications equipment and licensing for use of radio equipment were under the control of individual sovereign states. Within the European Union, Directive 91/263/EEC, the TTE Directive [6] has, for terrestrial radio equipment, made conformance with the Directive the basis for mutual recognition of type approval for both the placing on the market and the use of conformant equipment within the member states. The right of use is not itself the grant of a licence for use, but it obliges the member states to implement a licensing regime where the user does not have to obtain an individual licence. This situation is achieved in many countries through "class" or "general" licences.

However, for satellite earth stations, Directive 93/97/EEC, the SES Directive [7], supplementing Directive 91/263/EEC [6], makes conformance with this Directive the basis of mutual recognition of type approval for the placing on the market only, of conformant equipment within the member states, and does not grant the right of use. This situation leaves the member states the opportunity to apply individual licences for use of satellite earth stations within their territory.

There have been various discussions on the mutual recognition of licenses for telecommunications services, but progress has been slow because the right to issue licences is regarded as a matter of national sovereignty. Consequently, some current discussions are focusing on establishing harmonized conditions for licences.

The need to avoid individual equipment licences and significant differences in conditions of class licences from state to state for mobile terminals is understood by regulators. For the GSM terrestrial system, the licensing issue has been dealt with by the ERC issuing a "Decision" that GSM equipment conforming with the TTE Directive should be subject to a "Class" licence, permitting usage without the need for individual equipment licences. An ERC "Decision" has the status of a recommendation and is not mandatory, but in the case of GSM it has been adopted by all member states.

For S-PCN, TBRs are currently under preparation within ETSI for both the 1,6 GHz and 2,0 GHz bands. Conformance with the consequent CTRs will form the basis for the mutual recognition of type approval of S-PCN satellite earth stations within the EEA.

Within the ERC of CEPT, there are several activities relating to S-PCN:

- project team SE28 is tasked with determining the requirements for these equipment to share the radio spectrum with other services and systems;
- project team RR6 is addressing licensing issues;
- project team RR7 is addressing free circulation and use of mobile terminals;
- project team RR9 is addressing mutual recognition of type approval.

The CTRs and the findings of CEPT project teams will be used by national regulatory authorities within CEPT countries to form the technical basis of their licensing requirements.

On a world wide basis, the World Telecommunication Policy Forum of ITU (Geneva 1996) has developed a draft MoU (GMPCS-MoU) [91] to facilitate the free circulation of user terminals for global mobile personal communications by satellite.

11.3 Discussion

Existing mobile satellite earth stations tend to be relatively bulky and expensive, professional or semi-professional equipment, often mounted in vehicles or in brief-case size enclosures. the current regime of mutual recognition of type approval and of a mutually recognised usage license for each individual equipment is a compromise that has worked reasonably well for these types of equipment, meeting most of the needs of users, to support their mobility, and of the regulators, to manage the radio spectrum and the protection of other radio services within their territories.

S-PCN satellite earth stations will generally be physically much smaller and less expensive, and will include hand-held equipment. They will be viewed by users more as consumer durable equipment like GSM phones rather than professional or semi-professional equipment. The type of user of these equipment will expect to be able to use them without the need to carry additional authorising documentation; however, the regulators in each territory have a duty to manage the radio spectrum and the protection of other radio services within their territories.

To meet these conflicting needs, it will be necessary for the technical performance of S-PCN satellite earth station equipment to meet the needs of all states within whose territory usage is required. In effect, this means that the equipment shall conform with an envelope of requirements which, for each parameter, is the tightest requirement of any of the states within whose territory usage is required.

11.4 Conclusions

The achievement of mutual recognition of type approval for S-PCN MESs should be possible through the planned CTRs to be based on TBRs derived from the ETSs.

Further work is needed to create a suitable licensing regime for usage of S-PCN MESs. To some extent S-PCN licensing can follow the approach used by GSM, but a class licence will have to take account of the sharing of the S-PCN bands between dissimilar S-PCNs, with very different technical characteristics.

In order to facilitate progress, it is therefore suggested that the S-PCN community could assist the regulatory bodies within Europe, and in the rest of the World, in establishing the necessary framework for freedom to use qualifying S-PCN terminals, taking into account the development of the GMPCS-MoU [91] initiated by the World Telecommunication Policy Forum of ITU.

12 Summary of findings and recommendations

12.1 Numbering issues

12.1.1 Summary of findings

This is a global matter which is being resolved at ITU.

12.1.2 Recommendations

There is no requirement for specific European standardization work for numbering for S-PCN.

12.2 Lawful interception

12.2.1 Summary of findings

Although the ETSI Security Techniques Advisory Group STAG) has already completed a User Requirement document on lawful interception [44], a Stage 1 description of the requirements for S-PCN is urgently needed to provide clarification on the application of the user requirement to S-PCN, especially due to its coverage of countries where there may be no network operations or service providers.

12.2.2 Recommendations

Progress on the work within ETSI STAG to generate an interception interface specification for GSM should be monitored by the S-PCN community for compatibility with the timescales to launch of service.

Further clarification of the exact requirements that will be applied to S-PCN service providers and network operators is needed urgently. This clarification could take the form of a Stage 1 description for S-PCN or an addendum to the user requirements already prepared by ETSI in DTR/NA-002310 [44].

12.3 Interconnection and related network issues

12.3.1 Summary of findings

Within ETSI, TC-NA is the body responsible for network issues. The Directive [93] on interconnection that is scheduled for adoption during 1997 will generally facilitate the establishment of any-to-any interconnection with other fixed and mobile networks in Europe. However, the obligations under the Interconnection Directive [20] are unlikely to affect S-PCN operators directly unless they are deemed to have significant market power.

Within ETSI, TC Integrated Circuits Cards (TC-ICC) is the body responsible for card issues. No standard currently exists for a multi-purpose SIM for use in multi-mode operation.

12.3.2 Recommendations

A standard should be produced for a multi-purpose SIM for use in multi-mode operation. TC-ICC may be a suitable body to carry out this work.

12.4 Evolution towards the UMTS satellite component

12.4.1 Summary of findings

Within ETSI, TC-SMG is the body responsible for UMTS issues. The definition of UMTS is not stable at this time, However, the need for support from a satellite component which utilises the strengths of satellite facilities whilst not demanding performance beyond their limitations is clear.

12.4.2 Recommendations

No specific standardization work is required for S-PCN at this time; however the development of UMTS should take into account the strengths and limitations of satellite facilities and the S-PCN community can provide valuable input to the process of developing UMTS and its satellite component.

12.5 Human Factors (HF)

12.5.1 Summary of findings

Within ETSI, TC-HF is the body responsible for human factors issues. This matter is being dealt with adequately within Europe by the appropriate qualified bodies.

12.5.2 Recommendations

There is no requirement for specific European standardization work for human factors for S-PCN.

12.6 S-PCN MES equipment not currently covered by ETSs

12.6.1 Summary of findings

Equipment not currently covered by ETSs include:

- receive-only MES;
- aeronautical MES for public correspondence;
- aeronautical MES for functions in addition to public correspondence;
- maritime MES for public correspondence.

There is also a need for the standardization bodies responsible for radio stations that may be used in dual or multi-mode equipment alongside S-PCN radio stations to consider the implications of this upon their standards.

12.6.2 Recommendations

For receive-only MESs, an EMC ETS should be produced by STC-RES09, in co-operation with TC-SES; alternatively, the EMC ETS being developed for EMC requirements for MESs with both transmit and receive capabilities could be further developed to include receive only MESs.

For MESs intended for public correspondence in aeronautical applications, an ETS covering essential requirements should be produced by TC-SES in collaboration with the Joint Aviation Authorities (JAA), supported as necessary by other interested organisations.

For MESs intended to provide functions in addition to public correspondence in aeronautical applications, the aeronautical community should establish the need for such equipment and the associated standardization work.

For MESs intended for public correspondence in maritime applications there is no further technical work needed beyond the land mobile case for S-PCN, and these could be included in the scope of the current ETSs and TBRs.

TC-SES needs to draw to the attention of the standardization bodies responsible for radio stations that may be used in dual or multi-mode equipment alongside S-PCN radio stations, the need to consider the implications of this upon their standards.

12.7 Mutual recognition of type approval and licences

12.7.1 Summary of findings

The achievement of mutual recognition of type approval for S-PCN MESs should be possible through the planned CTRs to be based on TBRs derived from the ETSs.

However, this type approval is for the placing on the market only, of conformant equipment within the EU member states, and does not grant the right of use. This situation leaves the member states the opportunity to apply individual licences for use of satellite earth stations within their territory.

On a world wide basis, the World Telecommunication Policy Forum of ITU (Geneva 1996) has developed a draft MoU (GMPCS-MoU) [91] to facilitate the free circulation of user terminals for global mobile personal communications by satellite.

12.7.2 Recommendations

The S-PCN community could assist the regulatory bodies within Europe, and in the rest of the World, in establishing the necessary framework for freedom to use qualifying S-PCN terminals, taking into account the development of the GMPCS-MoU [91] initiated by the World Telecommunication Policy Forum of ITU.

Annex A: Requirements for lawful interception

As specified in the Council Resolution of 17 January 1995, quote:

"REQUIREMENTS

This section presents the Requirements of law enforcement agencies relating to the lawful interception of telecommunications. These requirements are subject to national law and should be interpreted in accordance with applicable national policies. Terms are defined in the attached glossary.

1 Law enforcement agencies require access to the entire telecommunications transmitted, or caused to be transmitted, to and from the number or other identifier of the target service used by the interception subject. Law enforcement agencies also require access to the call-associated data that are generated to process the call.

1.1 Law enforcement agencies require access to all interception subjects operating temporarily or permanently within a telecommunications system.

1.2 Law enforcement agencies require access in cases where the interception subject may be using features to divert calls to other telecommunications services or terminal equipment, including calls that traverse more than one network or are processed by more than one network operator/service provider before completing.

1.3 Law enforcement agencies require that the telecommunications to and from a target service be provided to the exclusion of any telecommunications that do not fall within the scope of the interception authorization.

1.4 Law enforcement agencies require access to call associated data such as:

1.4.1 Signalling of access ready status;
1.4.2 Called party number for outgoing connections even if there is no successful connection established;
1.4.3 Calling party number for incoming connections even if there is no successful connection established;
1.4.4 All signals emitted by the target, including post-connection dialled signals emitted to activate features such as conference calling and call transfer;
1.4.5 Beginning, end and duration of the connection;
1.4.6 Actual destination and intermediate directory numbers if call has been diverted.

1.5 Law enforcement agencies require information on the most accurate geographical location known to the network for mobile subscribers.

1.6 Law enforcement agencies require data on the specific services used by the interception subject and the technical parameters for those types of communication.

2 Law enforcement agencies require a real-time, full-time monitoring capability for the interception of telecommunications. Call associated data should also be provided in real-time. If call associated data cannot be made available in real time, law enforcement agencies require the data to be available as soon as possible upon call termination.

3 Law enforcement agencies require network operators/service providers to provide one or several interfaces from which the intercepted communications can be transmitted to the law enforcement monitoring facility. These interfaces have to be commonly agreed on by the interception authorities and the network operators/service providers. other issues associated with these interfaces will be handled according to accepted practices in individual countries.

3.1 Law enforcement agencies require network operators/service providers to provide call associated data and call content from the target service in a way that allows for the accurate correlation of call associated data with call content.

3.2 Law enforcement agencies require that the format for transmitting the intercepted communications to the monitoring facility be a generally available format. This format will be agreed upon on an individual country basis.

3.3 If network operators/service providers initiate encoding, compression or encryption of telecommunications traffic, law enforcement agencies require the network operators/service providers to provide intercepted communications "en clair".

3.4 Law enforcement agencies require network operators/service providers to be able to transmit the intercepted communications to the law enforcement monitoring facility via fixed or switched connections.

3.5 Law enforcement agencies require that the transmission of the intercepted communications to the monitoring facility me et applicable security requirements.

4 Law enforcement agencies require interceptions to be implemented so that neither the interception target nor any other unauthorized person is aware of any changes made to fulfil the interception order. In particular, the operation of the target service shall appear unchanged to the interception subject.

5 Law enforcement agencies require the interception to be designed and implemented to preclude unauthorized or improper use and to safeguard the information related to the interception.

5.1 Law enforcement agencies require network operators/service providers to protect information on which and how many interceptions are being or have been performed, and not disclose information on how interceptions are carried out.

5.2 Law enforcement agencies require network operators/service providers to ensure that intercepted communications are only transmitted to the monitoring agency specified in the interception authorization.

5.3 According to national regulations, network operators/service providers could be obliged to maintain an adequately protected record of activation of interceptions.

6 Based on a lawful inquiry and before implementation of the interception, law enforcement agencies require (1) the interception subject's identity, service number or other distinctive identifier, (2) information on the services and features of the telecommunications system used by the interception subject and delivered by network operators/service providers, and (3) information on the technical parameters of the transmission to the law enforcement monitoring facility.

7 During the interception, law enforcement agencies may require information and/or assistance from the network operators/service providers to ensure that the communications acquired at the interception interface are those communications associated with the target service. The type of information and/or assistance required will vary according to the accepted practices in individual countries.

8 Law enforcement agencies require network operators/service providers to make provisions for implementing a number of simultaneous intercepts. Multiple interceptions may be required for a single target service to allow monitoring by more than one law enforcement agency. In this case, network operators/service providers should take precautions to safeguard the identifies of the monitoring agencies and ensure the confidentiality of the investigations. The maximum number of simultaneous interceptions for a given subscriber population will be in accordance with national requirements.

9 Law enforcement agencies require network operators/service providers to implement interceptions as quickly as possible (in urgent cases within a few hours or minutes). The response requirements of law enforcement agencies will vary by country and by the type of target service to be intercepted.

10 For the duration of the interception, law enforcement agencies require that the reliability of the services supporting the interception at least equals the reliability of the target services provided to the interception subject. Law enforcement agencies require the quality of service of the intercepted transmissions forwarded to the monitoring facility to comply with the performance standards of the network operators/service providers".

Unquote.

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