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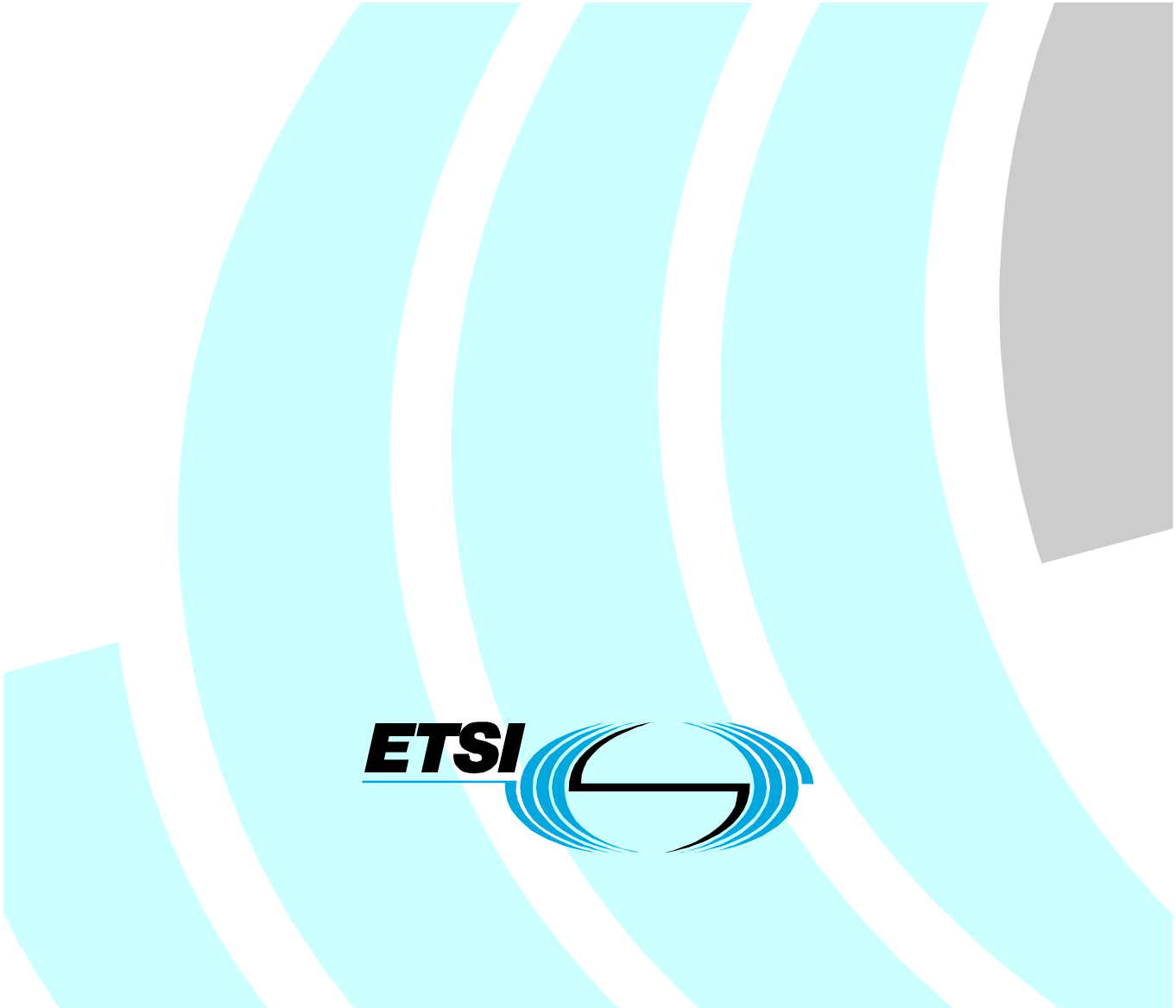
ETSI Guide

User Group;
User interoperability criteria



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Contents

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Foreword

This ETSI Guide (EG) has been produced by ETSI User Group (USER).

The interoperability issue stems to standardization being achieved by experts from manufacturers, operators and service providers who certainly have the users requirements in background but are mainly led by their own aims. In addition, the implementation of most standards is voluntary and therefore areas of interoperability failure can result of lack of implementation. An example of this is the lack of affordable terminal facilities for disabled and elderly people.

Nevertheless, the present document highlights also that users can not get the full interoperability they expect at the application level without coming to an agreement on the format of the information they want to exchange.

Moreover, taking into account the fast evolution of the technology and IT world, it is anticipated that standardization should become a more flexible and living area at least at terminal, service and application level.

Introduction

Standardization developed first in the telecom systems operated by the incumbent operators gaining progressively layers closer to the end-users.

Industry needs standards and interoperability because markets need critical mass. Users need interoperability because they want to take advantage of the competition so as to be able to access any service via any network using devices from different manufacturers.

In the late 90's, competition between operators brought down the profitability of basic standardized systems. Since profits no longer come from the backbone networks, operators certainly look for lower prices for standard equipment but develop competitive advantage in non-standard services.

To keep its profitability, industry needs larger and larger markets.

Today, the implementation of most ETSI standards is voluntary. ETSI "post crisis" strategy is pushing towards standardization of enhanced customer care and after sales services.

ETSI can not reach that goal without users' inputs (including from disabled and older people), especially on the subject of interoperability.

1 Scope

In the current fast evolving telecommunications world, where various technologies are competing, interoperability is more than ever a fundamental feature that users expect from standardization and every effort is required to ensure it across networks and services. Despite significant standardization efforts, the user experience has shown in several occasions that interoperability is not provided end-to-end as anticipated.

It is important to notice that any interoperability failure in a public service area might jeopardize a person's safety and even possibly his life. Therefore it is crucial that interoperability is ensured in this field as widely as possible and that conditions, if any, where the service is not provided, are made clear to everybody.

Nevertheless users, considering the growing complexity of telecommunication technology and the legitimate need of freedom for innovation, understand that it is not possible to make everything conforming to a single standard. Taking into account this limitation, they would like to have, when purchasing devices or services, at least a clear indication on how far interoperability is provided.

The scope of the present document encompasses the main ICT services, such as fixed and mobile telephony basic and supplementary services, directory services, data transmission, Internet access, email, etc. even including requirements for services interoperability needed by certain categories of users and that are not necessarily envisaged by the designers.

The present document endeavours to give principles enabling for interoperability management in the standardization process according to the users' needs. They are based on the result of a survey of users. Such principles are expected to help in identifying areas where users need interoperability and where standardization should allow it to be provided.

The intention was to include the needs of every kind of users but unfortunately and despite many efforts, inputs about the needs of elderly and disable were very difficult to capture and only a few ones were provided belatedly. Therefore an additional work would be needed to fully take into account such needs.

2 References

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

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

[1] ETSI TR 101 153-1: "Users' views on addressing and directories; Part 1: Requirements for design and interworking".

[2] ETSI TR 101 672: "Management services provided by Public Network Operators (PNOs) or service providers; Review of user needs for standardization; Tutorial and recommendations".

[3] ETSI TR 102 068: "Human Factors (HF); Requirements for assistive technology devices in ICT".

[4] ETSI TR 102 125: "Human Factors (HF); Potential harmonized UI elements for mobile terminals and services".

[5] ETSI EG 202 132: "Human Factors (HF); User Interfaces; Guidelines for generic user interface elements for mobile terminals and services".

[6] ETSI EG 201 973-1: "Access and Terminals (AT); Public Switched Telephone Network; Support of legacy terminals by Broadband IP networks and equipment; Part 1: General (common part covering both PSTN Analogue and ISDN TE)".

[7] ETIS standard for electronic billing: "Data model".

[8] ETIS standard for electronic billing: ""Invoic" message implementation guidelines".

[9] ETIS standard for electronic billing: ""Pricat" message implementation guidelines".

NOTE: The reference above is available at: http://www.etis.org/activities/ebg.asp, under Pricat: UGPC3C-20.pdf.

[10] ETIS standard for electronic billing: "Code lists".

[11] ETSI ETS 300 128: "Integrated Services Digital Network (ISDN); Malicious Call Identification (MCID) supplementary service; Service description".

[12] ETSI ETS 300 178: "Integrated Services Digital Network (ISDN); Advice of Charge: charging information at call set-up time (AOC-S) supplementary service; Service description".

[13] ETSI ETS 300 179: "Integrated Services Digital Network (ISDN); Advice of Charge: charging information during the call (AOC-D) supplementary service; Service description".

[14] ETSI ETS 300 180: "Integrated Services Digital Network (ISDN); Advice of Charge: charging information at the end of the call (AOC-E) supplementary service; Service description".

[15] ETSI ETS 300 200: "Integrated Services Digital Network (ISDN); Call Forwarding Unconditional (CFU) supplementary service; Service description".

[16] ETSI ETS 300 202: "Integrated Services Digital Network (ISDN); Call Deflection (CD) supplementary service; Service description".

[17] ETSI ETS 300 381: "Telephony for hearing impaired people; Inductive coupling of telephone earphones to hearing aids".

[18] ETSI ETS 300 488: "Terminal Equipment (TE); Telephony for hearing impaired people; Characteristics of telephone sets that provide additional receiving amplification for the benefit of the hearing impaired".

[19] ETSI ETS 300 679: "Terminal Equipment (TE); Telephony for the hearing impaired; Electrical coupling of telephone sets to hearing aids".

[20] ETSI EN 300 089: "Integrated Services Digital Network (ISDN); Calling Line Identification Presentation (CLIP) supplementary service; Service description".

[21] ETSI EN 300 090: "Integrated Services Digital Network (ISDN); Calling Line Identification Restriction (CLIR) supplementary service; Service description".

[22] ETSI EN 300 199: "Integrated Services Digital Network (ISDN); Call Forwarding Busy (CFB) supplementary service; Service description".

[23] ETSI EN 300 201: "Integrated Services Digital Network (ISDN); Call Forwarding No Reply (CFNR) supplementary service; Service description".

[24] ETSI EN 300 357: "Integrated Services Digital Network (ISDN); Completion of Calls to Busy Subscriber (CCBS) supplementary service; Service description".

[25] ETSI EN 301 065-1: "Integrated Services Digital Network (ISDN); Completion of Calls on No Reply (CCNR) supplementary service; Digital Subscriber Signalling System No. one (DSS1) protocol; Part 1: Protocol specification".

[26] ETSI ES 202 130: "Human Factors (HF); User Interfaces; Character repertoires, ordering rules and assignments to the 12-key telephone keypad".

[27] ETSI TR 121 904: "Universal Mobile Telecommunications System (UMTS); User Equipment (UE) capability requirements (3GPP TR 21.904)".

[28] ETSI TR 125 993: "Universal Mobile Telecommunications System (UMTS); Typical examples of Radio Access Bearers (RABs) and Radio Bearers (RBs) supported by Universal Terrestrial Radio Access (UTRA) (3GPP TR 25.993)".

[29] ETSI TS 134 123-2: "Universal Mobile Telecommunications System (UMTS); User Equipment (UE) conformance specification; Part 2: Implementation conformance statement (ICS) specification (3GPP TS 34.123-2)".

[30] ITU-T Recommendation I.251.9: "Calling name identification presentation".

[31] ITU-T Recommendation I.251.10: "Calling name identification restriction".

[32] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".

[33] ITU-T Recommendation P.370 "Coupling Hearing Aids to Telephone sets".

[34] ITU-T Recommendation H.225.0: "Call signalling protocols and media stream packetization for packet-based multimedia communication systems".

[35] ITU-T Recommendation H.245: "Control protocol for multimedia communication".

[36] ITU-T Recommendation H.248.1: "Gateway control protocol: Version 2".

[37] ITU-T Recommendation H.323: "Packet-based multimedia communications systems".

[38] IEEE 802.11: "Handbook: A Designer's Companion".

[39] IETF RFC 3261: "SIP: Session Initiation Protocol".

[40] IETF RFC 3262: "Reliability of Provisional Responses in Session Initiation Protocol (SIP)".

[41] IETF RFC 3263: "Session Initiation Protocol (SIP): Locating SIP Servers".

[42] IETF RFC 3264: "An Offer/Answer Model with Session Description Protocol (SDP)".

[43] IETF RFC 3265: "Session Initiation Protocol (SIP)-Specific Event Notification".

[44] IETF RFC 3416: "Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)".

3 Definitions and abbreviations

3.1 Definitions

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

access: function that enables a service session from an end user equipment

address: string or combination of decimal digits, symbols, and additional information which identifies the specific termination point(s) of a connection in a public network(s) or, where applicable, in interconnected private network(s)

NOTE: See ITU-T Recommendation E.164 [32], modified.

applications: services, which are designed using service capability features

audio conference: connection between two or more terminals, exchanging audio, text and graphic information only

NOTE: Audio conference is a short name for audiographic conference.

availability: property of a user denoting his/her ability and willingness to communicate based on factors such as the identity or properties of the requester of the information and the preferences and/or policies that are associated with the user

NOTE: This property may be computed through information available from various capabilities within the network including (but not necessarily) the presence service.

Bluetooth ™: technology specification for short range radio links between mobile PCs, mobile phones and other portable devices at 2,45 GHz

instant messaging: differs from email primarily in that its primary focus is substantially immediate end-user delivery

NOTE: Instant messaging allows users to maintain a list of people that they wish to interact with. They can send messages to any of the people in their list, often called a buddy list or contact list, as long as that person is online. Sending a message opens up a small window where either correspondent can type in messages that both can see.

interoperability: capability to ensure the whole set of operations activated when an end-user asks for a service across a mixed environment of different equipment, networks, services including usage services, from different manufacturers and(or) providers

NOTE: Interoperability, in the present document, addresses the different levels: equipment interoperability (terminal, server), protocol interoperability (interconnection), service interoperability (interworking).

location-based services: technologies allowing for customized service provision depending on the customer's position

NOTE: Such positioning may either be GPS based or network based. The network based positioning typically relies on various means of triangulation of the signal from cell sites serving a mobile phone. There are four major categories of Location Based Services:

- Location based information.
- Location sensitive billing.
- Emergency services.
- Tracking.

Multimedia Message Service (MMS): allows transfer of multimedia messages between users without the requirement for the multimedia messages to be transferred in real-time

presence information: set of attributes characterizing current properties of presentities such as status, an optional communication address and other optional attributes, etc.

presence service: capability to support management of presence information between watchers and presentities, in order to enable applications and services to make use of presence information

NOTE: Presence and availability technologies provide the ability to determine the event in which a mobile user is present in a certain location and/or available for certain events to take place such as mobile messaging, games, and other location based services.

presentity (presence entity): any uniquely identifiable entity that is capable of providing presence information to presence service

NOTE: Examples of presentities are devices, services, etc.

Relay service: Telecommunication service that enables users of different modes of communication to interact by providing conversion between the modes of communication

Service Implementation Capabilities (SIC): set of implementation capabilities, in each technical domain, required to enable a UE to support a set of UE Service Capabilities (TR 121 904 [27])

Short Message Service (SMS): gives the ability to send character messages to phones. SMS messages can be Mobile Originate (MO) or Mobile Terminate (MT)

NOTE: SMS allows alphanumeric messaging between mobile phones and other equipment such as voice mail systems and email.

telephone conference: three or more terminals exchanging audio information

teleconference: used as a superset of Telephone conference, Video conference and Audio conference (Audiographic conference)

Text relay service: Telecommunication service that enables text telephone users and voice telephone users to interact by providing conversion between the two modes of communication in substantially real time

NOTE: This conversion is normally provided by a human operator.

UE Service Capabilities (USC): capabilities that can be used either singly or in combination to deliver services to the user

NOTE: The characteristic of UE Service Capabilities is that their logical function can be defined in a way that is independent of the implementation of the UMTS system (although all UE Service Capabilities are of course constrained by the implementation of UMTS).

EXAMPLES:

- a data bearer of 144 kbps;
- a high quality speech teleservice;
- an IP teleservice;
- a capability to forward a speech call (TR 121 904 [27]).

unified messaging: concept of bringing together all messaging media such as voice messaging, SMS and other mobile text messaging, email, and facsimile into a combined communications experience

NOTE: Minimally, the communications experience will take the form of a unified mailbox and/or alert service, allowing the end-user to have a single source for message delivery, repository, access, and notification.

user: individuals, including consumers, or organizations using or requesting telecommunications services available on public or private networks

NOTE: Taking into account the current developing automation, a machine has to be considered as a disembodied "user".

user area: area where a user uses telecommunications services whether or not he/she is in their premises, i.e. including VPN, services or databases outsourced to any supplier

user requirement: requirements made by users, based on their needs and capabilities, on a telecommunication service and any of its supporting components, terminals and interfaces, in order to make use of this service in the easiest, safest, most efficient and most secure way

NOTE: In the present document, the term "user requirement" should be understood as an expression of a usage need from a given category of users.

video conference: service providing an interactive, bi-directional, real time audio-visual communication, normally intended for multiple users at either end

NOTE: The terminals are normally exchanging audio/video/graphic information.

Virtual Private Network (VPN): is that part of a Corporate Telecommunication Network (CTN) that provides corporate networking using shared switched network infrastructures

Wi-Fi: short for Wireless Fidelity and used generically when referring of any type of 802.11 network, whether 802.11b, 802.11a, dual-band, etc

NOTE: The term is promulgated by the Wi-Fi Alliance.

Wireless Local Area Network (WLAN): products based on IEEE 802.11 [38] specification

NOTE: This includes several different and incompatible standards. WiFi is another name for WLAN supported by the Wi-Fi Alliance. R-LAN (Radio Local Area Networks) is also another name for WLAN used sometimes by the European Commission.

3.1.1 Supplementary services definitions

Advice of Charge, Charging Information at Call Setup Time (AoC-S): supplementary service enables a user to receive information about the charging rates at call set-up time and also to receive further information during the call if there is a change of charging rates

NOTE: See ETS 300 178 [12].

Advice of Charge, Charging Information During the Call (AoC-D): supplementary service enables a user to receive information on the recorded charges for a call during the active phase of the call

NOTE: See ETS 300 179 [13].

Advice of Charge, Charging Information at the End of the Call (AoC-E): supplementary service enables a user to receive information on the recorded charges for a call when the call is terminated

NOTE: See ETS 300 180 [14].

Advice of Charge, Charging information on user Request (AoC-R): supplementary service enables a user to receive information on the recorded charges, for a call, at the time of his own request during the active phase of this call

Completion of Calls to Busy Subscriber (CCBS): supplementary service enables user A, encountering a busy destination B, to have the call completed without having to make a new call attempt when the destination B becomes not busy (EN 300 357 [24])

Completion of Calls on No Reply (CCNR): supplementary service enables user A, encountering a destination B, which does not answer the call (No Reply), to have the call completed without having to make a new call attempt when the destination B becomes not busy after having terminated an activity

NOTE: See EN 301 065-1 [25].

Call Deflection (CD): supplementary service enables the served user to respond to an incoming call by requesting redirection of that call to another user

NOTE: The CD supplementary services can only be invoked before the connection is established by the served user, i.e. in response to the offered call, or during the period that the served user is being informed of the call. The served user's ability to originate calls is unaffected by the CD supplementary services (ETS 300 202 [16]).

Call Forwarding Busy (CFB): supplementary service enables a served user to have the network redirect to another user calls which are addressed to the served user's ISDN number and meet busy

NOTE: The CFB supplementary service may operate on all calls, or just those associated with specified basic services. The served user's ability to originate calls is unaffected by the CFB supplementary service (EN 300 199 [22]).

Call Forwarding No Reply (CFNR): supplementary service enables a served user to have the network redirect to another user calls which are addressed to the served user's ISDN number, and for which the connection is not established within a defined period of time

NOTE: The CFNR supplementary service may operate on all calls, or just those associated with specified basic services. The served user's ability to originate calls is unaffected by the CFNR supplementary service (EN 300 201 [23]).

Call Forwarding Unconditional (CFU): supplementary service enables a served user to have the network redirect to another user calls which are addressed to the served user's ISDN number

NOTE: The CFU supplementary service may operate on all calls, or just those associated with specified basic services. The served user's ability to originate calls is unaffected by the CFU supplementary service. After the CFU supplementary service has been activated, calls are forwarded independent of the status of the termination of the served user (see ETS 300 200 [15]).

Call Forwarding Service (CFS): possibility for a subscriber to obtain a telephone number in a distant area and have all calls to that number automatically forwarded at his cost to a telephone number in his premises

Calling Line Identification Presentation (CLIP): supplementary service that provides the called party with the possibility of receiving identification of the calling party

NOTE: See EN 300 089 [20].

Calling Line Identification Restriction (CLIR): supplementary service that enables the calling party to prevent presentation of its ISDN number to the called party

NOTE: See EN 300 090 [21].

Calling Name Identification Presentation (CNIP): is a terminating service that provides either the name associated with the calling party number or an indication of privacy or unavailability to the called party

Calling Name Identification Restriction (CNIR): is an originating service that allows a user to alter the network stored or subscribed privacy status associated with the user's calling name

Delivery Confirmation (DC): supplementary service that provides the originating party with the possibility to request that an explicit notification be returned to it when a submitted message has been successfully delivered to a receiving party

Malicious Call Identification (MCID): supplementary service that enables a user to request that the source of an incoming call is identified and registered by the network

NOTE: See ETS 300 128 [11].

3.2 Abbreviations

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

ADSL	Asymmetric Digital Subscriber Line
AoC-D	Advice of Charge - charging information During the call
AoC-E	Advice of Charge - charging information at the End of the call
AoC-R	Advice of Charge - charging information on user Request
AoC-S	Advice of Charge - charging information at call Setup time
AP	Animated picture
B2B	Business to Business
B2C	Business to Customer
CCBS	Completion of Calls to Busy Subscriber
CCNR	Completion of Calls on No Reply
CD	Call Deflection
CDR	Call Detail Record
CFB	Call Forwarding Busy
CFNR	Call Forwarding No Reply
CFU	Call Forwarding Unconditional
CLI	Calling Line Identification
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CNIP	Calling Name Identification Presentation
CNIR	Calling Name Identification Restriction
CR	Card Reader
CRM	Customer Relationship Management
CTI	Computer-Telecommunications Integration
DC	Delivery Confirmation
DECT	Digital Enhanced Cordless Terminal
DNS	Domain Name Server
DSL	Digital Subscriber Line
DVB	Digital Video Broadcasting
EDIFACT	Electronic Data Interchange For Administration Commerce and Transport
EMS/NMS	Element Management System/Network Management System
ENUM	Enhancement of NUMbering and naming
ETIS	European Telecommunications Informatics Services
ETNS	European Telephony Numbering Space
GPRS	General Packet Radio Services
GSM	Global System Mobile communication
HDSL	High bit rate Digital Subscriber Line
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
IMS	IP based Multimedia Services
IP	Internet Protocol
ISDN	Integrated Service Digital Network
LAN	Local Area Network
LBS	Location-Based Service

MCID	Malicious Call Identification
MMS	Multimedia Message Service
OS	Operating System
OSS	Operations Support Systems
PABX	Private Automatic Branch eXchange
PBX	Private Branch eXchange
PC	Priority Call
PDA	Personal Digital Assistant
PISN	Private Integrated Services Network
PLT	Power Line Telecommunications
PNO	Public Network Operator
PSTN	Public Switched Telephone Network
QoS	Quality of Service
QSIG	Q interface SIGnalling protocol

NOTE: PISN protocol for use between PINXs.

R-LAN	Radio - Local Area Networks
RoD	Rank of Digit
SDSL	Single line Digital Subscriber Line
SIC	Service Implementation Capabilities
SIP	Session Initiation Protocol

NOTE: See RFC 3261 [39] to RFC 3265 [43].

SLA	Service Level Agreement
SME	Small and Medium size Enterprises

NOTE: An EU indicator implying companies of less than 200 employees.

SMS	Short Message Service
SNMP	Simple Network Management Protocol

NOTE: See RFC 3416 [44].

SOA	Service-Oriented-Architectures
SP	Still Picture
TETRA	Terrestrial Trunked Radio
TETRAPOL ®	Proprietary digital private mobile radio network
UCI	Universal Communication Identifier
UM	Unified Messaging.
UMTS	Universal Mobile Telecommunications Systems
UPT	Universal Personal Telecommunications
USC	UE Service Capabilities
VDSL	Very high-data-rate Digital Subscriber Line
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network.
Wi-Fi	Wireless - Fidelity
WLAN	Wireless Local Area Network
WLL	Wireless Local Loop
xDSL	Unspecified DSL such as ADSL, HDSL, VDSL or SDSL

4 Interoperability expectations and limitations

The current ICT world provides services using a mix of software and hardware that are implemented both in terminals and servers. It is necessary for all components to fit together to ensure interoperability. Therefore the present document reviews all those aspects contributing to the overall interoperability that standards are expected to ensure to the end-users:

- areas where standards are missing,
- the lack of implementation of existing standards,

- weaknesses in some standards such that implementations that conform to the standards do not interoperate correctly,
- features or aspects of services that are currently not standardized,

Sometimes, getting interoperability needs an understanding of the human-machine interface that is not always user-friendly enough so that the interoperability even potentially existing is not reached. Hence this interoperability review covers a probably broader field than just the technical interoperability that standard makers have usually in mind and the recommendations proposed are made in the same spirit.

4.1 Market momentum

Every actor in the IT value chain from the network through services to end-users becomes at one moment or another users/providers of equipments, software or services. All these actors are concerned by interoperability considerations. At the system end of the value chain, interoperability requirements are triggered by multi-provisioning considerations, fluctuating alliances with partners/competitors. At the end-user end of the value chain, interoperability considerations are mostly triggered by roaming and portability considerations from operator to operator, seamless interworking from network to network/terminal to terminal, without customized interfaces, in a multi-vendor fast evolving environment. While interoperability can rely on a relatively stable network situation, at the terminal, service and application levels which concern end-users with low negotiation capacity, the pace of innovation is very high and operators and service providers who fear users churn, argue "commercial differentiators" should leave them proprietary developments: the main cause of poor interoperability.

Users can be customers of manufacturers, service providers, operators and enterprises from different perspectives, with some slight differences depending on whether they are business users or residential/private users (including disabled and elderly).

Operators are customers of manufacturers.

Service providers are customers of operators and manufacturers.

Enterprises are customers of manufacturers, service providers and operators.

Each customer wants a homogeneous environment within his premises/networks but also asks for non-standard functions from his provider either to fulfil his specific needs or to get a competitive advantage over his competitors.

Along the standard making process, the interoperability issues taken into consideration by experts are massively dominated by manufacturers, operators and service providers who find that, although they have the users requirements in the background, they are counterbalanced by their own aims. In addition, the implementation of most standards is voluntary with as a possible result additional areas of interoperability failure. Therefore, a minimum set of interoperable functions that end-users could rely on without customized developments, would definitely represent a significant achievement from the end-users' perspective.

Taking into account that statistics show that if for example 80 % of the users were satisfied on one day at the launch time of a service, one year later only 60 % are still satisfied, then it appears that improvements of the service have to be found and, for example, the area of interoperability should progress to contribute keeping the satisfaction rate at a high level. A possible means for such progress to occur could be, as suggested by several respondents and interviewees, to include in the standardization area new services/products as soon as they are available from so many providers that they no longer are a competitive advantage.

4.2 Topics investigated in the survey

In order to ease the understanding, the survey was carried out on the following groups of services:

- Generic Service Access and Provision.
- Voice communications.
- Office Environment.
- On the Move environment and Teleworking.

- Messaging.
- eLearning.
- Teleconferencing.
- Public and Field Services.
- Tele-Medicine.
- Financial Services.
- eCommerce.
- Home Environment.
- Entertainment.

Nevertheless, since little information has been collected on eLearning, Tele-Medicine, Financial Services, eCommerce, Home Environment and Entertainment, the present document does not contain any specific recommendation on these areas. This could be a subject for a further study as well as the specific needs of disabled and elderly.

4.3 Regulation versus business agreements

Interoperability can be achieved in various ways but always needs conformance to common specifications, e.g. standards. The conformance to such standards can be due to a regulatory obligation or to a mutual agreement between several providers. Depending on which is the case, interoperability is provided in a more or less large extent. Again, it is crucial that the area where interoperability is provided is made clear to the users. In this respect disabled and older users are at a certain disadvantage, as the standards that do exist to overcome particular disabilities often require specialized and expensive equipment or are difficult to implement. Ways must be found to use mainstream standards in a way that meet the requirements of disabled users.

If standards are designed according to the disabled users' needs, it will mostly be to the benefit of every user since all of them are more and more often requiring end-to-end interoperability of fully comprehensive services whatever their environment. Users are more and more reluctant to use proprietary solutions.

5 Summary of the interoperability user requirements

The requirements given hereafter are based on the statements given in annex A. Some of these statements may sometimes appear to be related to issues stemming from user-friendliness or quality of service rather than interoperability. They are nevertheless providing indications of the users' concerns about interoperability and the lack of transparency of the current service provision chain.

This chapter takes into account the different levels of the end-to-end interoperability: equipment, networks, services (including usage services) as well as the application level and the main usage issues such as directories, billing, management and security.

Connection issues range from network protocols, numbering, identification, signalling, addressing, authentication to directories. Concerns about numbering/identification are not exactly related to interoperability but rather to the lack of integration e.g. the difficulty of reaching someone managing his multiple call numbers and the communication tools (fixed phone, mobile phone, fax, email, instant messaging) of a single user.

5.1 Access issues

5.1.1 Human-Machine/service interface

Access to network and services (e.g. directory, voice mail, emergency call, supplementary services, etc.) is often achieved via dedicated keying (or short code) differing from one operator or service provider to another one. Defining a common list of keying strokes, short code numbering, etc. is of utmost importance for users as they roam from premises to premises and from network to network. Such minimum set of common interfaces between users and systems, applications and terminals has a fundamental importance for interoperability.

For instance, users expect their Emergency calls is delivered to the usual competent authority (Fire Police Ambulance, Rescue, etc..) in their time of distress. Such Emergency calls are expected to be easily dialled. Not to provide this may hinder the caller when he needs to contact the Emergency Services urgently. Convergence of networks (fixed/wireless/mobile) pushes towards a requirement for one single user interface for a similar service whatever the networks and providers (voice messaging, supplementary services, etc). Although this is not exactly an interoperability issue, a common access interface is required by the users to achieve an actual interoperability between converging services.

5.1.2 User identification issues

In the past, communications were set between terminals with well identified features using basic services such as voice and fax. Current communications aim at linking people together or people with servers, applications or machines using voice, data and any kind of services including SMS, voice servers, eDirectory, Internet, etc.. Hence there is a mix between the terminal identification (fixed phone, fax, or machine including the old telex), the subscriber identification (mobile phone, email, instant messaging) and personal (user) identification (any means). New services like number portability are still adding to the confusion since the relationship between the numbers and the geographic area is going to disappear. Therefore, in most cases, call numbers alone are unable to ensure an appropriate identification.

Authentication is required in various circumstances and is expected to be much stronger before critical (e.g. financial) transactions than for trivial ones. In any case, users are concerned about the multiplication of authentication procedures that can lead to multiple login, password and expensive authentication devices.

5.1.3 Directory issues

Directory services are the most often given example where interoperability is working poorly, while the multiple call numbers to reach a single person and the growing use of mobiles are both asking for more efficient and user-friendly services in this area. Similar claims concern public and private directories, but particularly, there is a strong demand to improve the capability to synchronize proprietary facilities linked to heterogeneous PBX and PNOs with a corporate directory. Users are still more confused with the multiple incompatible directories provided with their proprietary PDA/PC applications.

5.2 Equipment issues

In the following, equipment stands for end-user terminal as well as server.

The well-known concern about the current multiple keyboard layouts still persists despite the available ETSI standard. This is clearly not an interoperability issue but is seen by the users as a hindrance to a full interoperability to access the person or service wished.

Users expect their terminal to be able to connect to any network and to access any service it is designed for. Obviously this is like a Xmas wish but it should be taken as a call for a wider terminal interoperability, in particular there have been several claims for the possibility to use a cellular handset as a cordless one when at home or in the office.

More and more often, multifunctional terminals are proposed and then the users face the issue of which services they are capable of accessing.

Regarding the peripherals, disabled users are often compelled to have a specific device connected to their terminal in order to overcome their disability. Therefore they have a strong need to be able to connect their device to any terminal. This requires a standardized interface for such a connection, including power sockets and any connector or immaterial link (radio or infrared).

New services or facilities (e.g. emergency calls) require more and more often a realistic terminal location. While such location is more or less accurately performed within the mobile networks, fixed networks are no longer able to provide reliably that information due to current changes in the numbering plan and the coming of number portability or IP telephony. Therefore, actual location information should be provided by every fixed or mobile network, for example via enhancement of the Calling Line Identification (CLI).

5.3 Network issues

Several concerns were raised about signalling, for inter-network/PBX calls where QSIG does not seem to ensure a full interoperability. Additional standardization of the information content that is passed through the protocol (e.g. rank of digits) is needed.

Concerns were instanced about authentication of the user rights (e.g. supplementary services) that do not appear always to work properly across heterogeneous networks particularly across borders and mobile networks.

5.4 Service issues

If a priori, users would like having all services interoperable whatever the network and the terminal, obvious technological limitations make often it possible only in delimited areas. In any case, they want to have the service provided independently of the bearer and access networks where appropriate. Multiple examples were given of failure of such principle (some supplementary services e.g. CNIP, AoC, prepay services, QSIG, etc). This issue is crucial to disabled and elderly users regarding the particular services needed to overcome their disability such as Relay Services, Text relay service, etc, whatever the access network.

5.5 Applications issues

The development of concepts like eBusiness, eCommerce, eAdministration, etc. raises interoperability issues not only linked to the access, terminal or service but rather to the semantic of the information, e.g. its format and the structure of its content. This is more or less an issue of object definition, for example which piece of information is contained in an administrative form in exchanges between administrations. Data modelling is crucial in this area in order to map the diversity of commercial differences with a coherent user environment.

Similarly, when users want to exchange pieces of information within widespread organizations such as administrations or widely operated systems (pipelines, water, gas, power networks, railways, motorways or intelligent transportation) they have to specify a common data model for the information content.

As an example, in the area of telecommunication e-billing, a data modelling has been initiated (ETIS [7], [8], [9],[10]), based on EDIFACT in the early times, and Internet and XML nowadays. The XML orientation where the message/information format and content is described in a header so enabling the distant partner to decode and re-format dynamically the piece of information is certainly the Xmas wish for applications. The drawback of XML is well known: messages are becoming longer and longer while EDIFACT provided very compact messages.

5.6 Billing issues

According to studies carried out by specialists in charging and billing matters, it appears that the error rate in communication records (terminal identification, duration, dating, zones, tariffs, etc.) can reach 10 % with a consequence on the bills of up to 5 %. There are several causes for these errors but some of them are due to interoperability failures either in signalling between different networks or between billing/charging software used by different operators/providers.

Unexpectedly for a financial instrument, the certification process to ensure that the charging/billing systems are error-free and interoperable is in its infancy. Even, in some countries, like UK or Germany where the regulator has implemented a certification process, each provider is responsible only for his own process and not that of the other operator. Additionally such a certification sometimes only embraces the duration-based billing and not the volume-based billing. A common certification process should be implemented, including the whole information transmission and processing starting from the communication features to the final bill for voice and data.

The issue of billing errors stands alongside that of the inconsistency of the electronic billing files provided by the various suppliers. Web based billing information, although suitable for residential users, are useless in a corporate environment since such applications do not allow for any consolidation of the information provided by multiple suppliers and therefore getting a consolidated picture of the expenses of a company is quite difficult as well as the provision of a consolidated information of the expenses of the different departments of a company or corporation. Additionally, it is almost impossible to figure out what would be the financial consequences of contracting with other providers. This is clearly an hindrance to a fair competition.

5.7 Management issues

Even when telecommunications services are outsourced, management often remains within the user's realm. Actually, management embraces quite different areas: networks, services, Quality of Service (QoS) and security. Unfortunately, interoperability did not progress very much in any of these fields, bringing a lot of concerns to the business users but to a lesser extent to the residential users too. Here again, data modelling and XML-like formats are crucial in this area in order to map the diversity of commercial differences into a coherent integrated multi-vendor user environment (TR 101 672 [2]). The argument of "competitive differentiators" for keeping proprietary data models in this area is strongly against the users' interest.

5.7.1 Network management

Most corporate networks are built using several operators and ICT managers want to be able to manage and monitor them independently of the suppliers. Without such a tool, multiple provider procurement is difficult since, users have concerns about buying products that they are not able to manage conveniently. Of course, a few suppliers are proposing systems in principle which are able to cope with most manufacturers' devices but these systems are costly and more importantly limited in performance. They represent an additional layer to the networks and equipment, aimed to interface underlying items to the management service.

5.7.2 Service management

There is a growing trend to buy services instead of assembling networks and pieces of equipment and operating them, although the development of IP might change this trend. In any case, this does not avoid the need to manage these services nearest to the users with all the usual interoperability issues of heterogeneous provision.

5.7.3 QoS management

Quality of service is a growing user concern since, together with the prices, it is a key parameter in choosing a provider. In this context, SLAs are becoming more and more popular but the tools to measure and monitor its fulfilment are still in their infancy with very limited interoperability capabilities.

At the moment it appears that the current standardization work on classes of services has not achieved a compatible definition in the fixed and mobile networks, hence putting in question the QoS management over networks since it is common to use heterogeneous network for a single communication.

Each operator or service provider and each technology has its own process to conform to the QoS sold to the user but from the user viewpoint the issue is not about such QoS management process but rather to monitor that the QoS sold to him is actually achieved.

QoS being the basis of an SLA, the conformance of the provision to the SLA can not be checked without monitoring all the pieces of QoS information along the whole communication path. This QoS information is also needed at the intermediate management level of a company to check that QoS is at the required level and fulfils the specifications. Achieving such a monitoring across various networks/operators/service providers is obviously not possible seriously without a fully interoperable environment.

5.8 Security issues

Users want security to be kept at the same level whatever the number and technology of networks crossed. This relies on the interoperability of the security infrastructures at the national and international level to ensure it when a communication involves several operators and countries. The traditional switched circuit technology provided a quite well acknowledged level of security that should be taken as a target for other technologies.

6 Generic recommendations

The following set of generic principles aims to improve the users' confidence in interoperability, making clear to them where interoperability is strongly supported and where it is at its infancy stage. Moving from consumers distrust to consumers trust is at stake.

As stated in our definition widely supported in the standardization field, interoperability is based on network interworking, service interworking, equipment (server, terminal and peripheral) interworking and interconnection. Considering that the technological innovation is going much faster in the service and terminal area than at the network level, the pace of standardization and therefore interoperability have to cope with these differing speeds. While interoperability can rely on a relatively stable network standardization, much more flexibility seems needed at the equipment, service and application level.

Therefore, in order to meet the users' interoperability requirements the following principles are proposed, aiming to first define a reliable interoperability background as a basis where fully interoperable services and applications can develop when enough consensus is met.

Then, the confidence in the service interoperability will be based on a list of services identified as mature enough for a reliable interoperability. This list is expected to be the result of a common agreement and to be updated regularly according to the market evolution. Additionally, terminals are classified according to the conformance of their features to the delivery of the service expected.

Finally, a methodology is proposed to ensure interoperability at the application level in a defined area.

6.1 Access recommendations

6.1.1 Identifying the user

The first step is to identify at which terminal the addressee is to be reached. The situation is quite different depending on whether the communication is a phone call, a fax or a SMS, an email or an access to an Internet site or alike.

6.1.1.1 Phone call, SMS on fixed terminal, or fax

If the addressee has a single call number, it is in principle easy to reach him when he is present. Nevertheless without additional authentication process, you can not be sure the communication did not reach somebody else present behind the terminal.

If the addressee has several possible call numbers, without an additional utility, there is no other means to reach him than to dial all the numbers where he is expected to be. Fortunately the addressee has several means to ease the caller task (CD supplementary service, UCI, UPT, ENUM, ETNS, etc.) by addressing him directly to the right number but users are reluctant to use these facilities when available due to their current cost and overall their lack of user-friendliness. This requirement is similar to that of a unified messaging system.

Rec#G01 Universal Communication Identifier development: Users expect a Universal Communication Identifier being developed and implemented to identify the user and the terminal linked to him with as far as possible an automated location procedure to make such a process as low-cost, efficient and user-friendly as possible.

6.1.1.2 SMS on mobile handsets, instant messaging, e-mail, voice mail, access to an Internet secured site

The registration procedures required before consultation of the messages received via these communications means are close to identifying the user with the only exception of theft or piracy. This is why in principle additional authentication procedures are only required for particular transactions, for example financial transactions. Nevertheless, users are concerned with the multiple different login procedures for every service/application. Therefore:

Rec#G02 Customizable login procedure implementation: Users expect a customizable login procedure be set up for every service/application that does not require a high security level. Such a procedure should be merged with the simpler authentication procedure described in clause 6.1.3.3.

6.1.1.3 Authentication

Since users would like a small number of authentication procedures to be used universally, a solution could be to have one simple procedure and a strong one to be used according to strength of the authentication required.

The simple one could be for example based on user customizable login and password. The strongest one should use more sophisticated means such as card reader, electronic signature, voice or other biometric (or "morphological") recognition means, but all of them should be up to the user choice among a set of the most popular ones to avoid buying too many authentication devices. A rule to choose the authentication strength could be to use the low level when the financial consequences of the transaction are up to a contractual level, e.g. the usual monthly bill of the user, and the highest level above this amount.

Rec#G03 Authentication harmonization: Users expect two kinds of authentication procedures:

1) a user configurable login and password including user configurable restrictions for low level authentication;

2) other more sophisticated means at the user's choice according to his own equipment for high level authentication.

6.1.2 Directories

To avoid the need to develop gateways to make any directory application interoperable with all the other ones including public directories, corporate applications and PBX a common data model is needed (see TR 101 153-1 [1]). Directory interoperability is crucial for a proper management of the user rights and security data.

Rec#G04 Common directory data modelling: Users expect a common data model being developed with an appropriate protocol to ease the information exchanges between directories and correlated applications and equipment (staff management, PBX, PC, PDA, etc.).An adequate control of these exchanges has to be implemented to comply with the user privacy rights.

6.2 Equipment Recommendations

6.2.1 Addressing the terminal

The first step is to ensure that a communication can be set up between any terminals (peer-to-peer communication) or between any terminal and any server (client-server communication). For that to be achieved, any address has to be understood across every kind of network independently of the operators and the technologies. Any new technology, protocol or operator has to be tested against that with the whole existing technology/operator networks. An appropriate methodology should be identified for such checking. This will be particularly true for services specific to disabled and elderly users such as relay services and textphone communication, or even videophone connections.

Rec#G05 Checking that the terminal address is accessible throughout every network: Users expect an appropriate methodology being identified to check that any address is understood across every kind of network independently of the operators and the technologies. Any supplier should refer to such a checking to self-certify that interoperability is provided in his area.

6.2.2 Locating the terminal

Since new services requires an actual location of the terminal that is not currently provided reliably by all networks, the interoperability of such services depends on the supply of information on a true terminal location. This information is expected to be set as close as possible to the terminal, automatically or by configuration, depending on the technology and possible specificity of the access network. On a case by case basis, users should have the possibility to restrict this location capability to official service only in order not to jeopardize their privacy.

Rec#G06 **Terminal location:** To ensure the interoperability of new services requiring an actual location information, the Calling Line Identification (CLI) should be enhanced to include a caller terminal location information as close as possible to the geographical location that should be provided by every fixed or mobile network. The choice to restrict this capability to the official services (emergency, firemen, police, etc) should be offered to the user.

6.3 Network recommendations

The survey did not raise any generic interoperability requirement in the network area.

6.4 Principles for a service interoperability commitment

Service interoperability relies on standards to enable interconnection and interworking as well as on appropriate terminal capabilities.

It is conceivable that service interoperability is provided via means that can be more or less standardized depending on the market maturity. For example, if there are several competing methods to provide a similar service then gateways capable of ensuring interoperability between all these competing methods are expected by the users. As soon as a service is provided by several suppliers and hence can no longer be used for competitive differentiation, then an agreement for a common standard should be sought among the interested providers. In any case, various profiles within a single standard should be avoided as a strong hindrance to an effective interoperability.

Since there is little chance that this can happen on a voluntary basis, a process has to be agreed between all the players in the telecom market to set a list of services that providers commit themselves to make interoperable, provided that appropriate terminals are used. It should include capabilities specific to services dedicated to disabled users.

6.4.1 Principles to match up the terminal capabilities and the service features

More and more terminals are offered with multifunction capability and therefore, it is becoming more difficult for the users to understand which type of services they are able to access with their terminal. Therefore, a definition of the terminal capabilities is needed to clarify which network and services are accessible with a given terminal. This is a necessary condition to a supplier commitment. The following table is an attempt to provide such a definition. It is clear that with the current fast evolution of the technology, such a table will need regular updating. Therefore it should be designed so that updates are possible without changes in the previous terminal definitions but with additional ranges in the previous features or complementary features. For instance, concepts like the "UE Service Capabilities (USC)" and the Service Implementation Capabilities (SIC) detailed in TR 121 904 [27] and TS 134 123-2 [29] could be enhanced for that purpose and used for any type of terminal.

Table 1: Terminal capabilities

Keyboard:	Y/N/S	Yes/No/Special
Audio capabilities:	N V HQ AA	None, Voice, 300 Hz to 3 000Hz High Quality Additional amplification
Display capabilities:	N L T SP AP	None, Lamp Text only: FAX/B&W/Colour, Still picture, Animated picture
Storage capabilities:	xxMB	xxMBytes
Terminal identification capabilities:	Y/N	Yes/No
Automatic location capabilities:	Y/N	Yes/No
Subscriber identification capabilities:	Y/N	Yes/No
User Authentication capabilities:	N CR O	No specific one Card reader Other
Computing power:	N B M H	None, Basic, Medium, High
Firmware:	N J	None Java
Access network data bit-rate:	A/nn	Analog: 64 kb/s, 128 kb/s, 512 kb/s, 1 024 kb/s, 2 048 kb/s, etc.
User Interface capabilities:	N W C O	None, Wired: RS232/V24, Cordless: Bluetooth™/WiFi/Ir/ULPRF Other: inductive or electrical coupling to hearing aids, etc
User Interface data bit-rate:	I64... O64...	Input: 64 kb/s, 128 kb/s, 512 kb/s, 1 024 kb/s, 2 048 kb/s, etc. Output 64 kb/s, 128 kb/s, 512 kb/s, 1 024 kb/s, 2 048 kb/s, etc.
Physical layer interface:	F M	Fixed: PSTN/ISDN/xDSL/PISN/IPcablecom ™/PLT/VoIP/VPN/xDSL, Mobile: DECT/GSM/UMTS/TETRA/TETRAPOL ®/Bluetooth™/WiFi
Printer:	Y/N	Yes (built-in)/No

It is conceivable that this capability description could stored in a set of bytes in the terminal (like an IMEISV enhancement) and available to ease the communication handling. Once the terminal capabilities are identified, then the service interface between the service and such a terminal can be tuned depending on its capabilities (usage service). This should include the devices connected to the terminal output interface (e.g. the specific devices needed to overcome disabilities. Ideally, a conversion process should be activated when necessary and possible for appropriate text-to-voice or voice-to-text conversions to cope with possible limitations of the terminal capabilities.

In the following table the terminal capabilities suited to access a service are indicated facing each listed service. Of course, this table should be updated according to the table 1 but also irrespective of change in table 1 when new services are offered to the customers.

The segmentation in service scenarios described in annex A of TR 125 993 [28] could be used to feed these tables 1 and 2.

Table 2: Terminal capabilities suited to access a service

Service	Networks suited to the service	Minimal terminal capability suited to the service	Relevant standards
Supplementary services			
AoC-D (Advice of Charge - During the call)	ALL	Display/T	ETS 300 179 [13]
AoC-E (Advice Of Charge - at the End of the call)	ALL	Display/T	ETS 300 180 [14]
AoC-S (Advice Of Charge - at call Set up time)	ALL	Display/T	ETS 300 178 [12]
AoC-R (Advice of Charge - on user Request)	ALL	Display/T	
CCBS (Completion of Calls to Busy Subscriber)	ALL	Voice+keyboard	EN 300 357 [24]
CCNR (Completion of Calls on No Reply)	ALL	Voice+keyboard	EN 301 065-1 [25]
CD (Call Deflection)	ALL	Voice+keyboard	ETS 300 202 [16]
CFB (Call Forwarding Busy)	ALL	Voice+keyboard	EN 300 199 [22]
CFNR (Call Forwarding No Reply)	ALL	Voice+keyboard	EN 300 201 [23]
CFU (Call Forwarding Unconditional)	ALL	Voice+keyboard	ETS 300 200 [15]
CLIP (Calling Line Identification Presentation)	ALL	Display/T	EN 300 089 [20]
CLIR (Calling Line Identification Restriction)	ALL	Display/T	EN 300 090 [21]
CNIP (Calling Name Identity Presentation)	ALL	Display/T	ITU-T Recommendation I.251.9 [30]
CNIR (Calling Name Identification Restriction)	ALL	Keyboard	ITU-T Recommendation I.251.10 [31]
MCID (Malicious Call IDentification)	ALL	Display/T	ETS 300 128 [11]
Other services			
File transfer	ALL	Storage or Output Interface capabilities	
UM	ALL	Storage + Display/T or Output Interface capabilities	
SMS	ALL	Display/T	
Instant messaging	ALL	Storage + Display/T or Output Interface capabilities	
MMS	Digital ones	Display/AP	
Availability	ALL	Keyboard and User authentication	
Presence service	ALL	Keyboard and User authentication	
DVB	Digital ones	Display/AP Access Network Data bit-rate > 512 kbit/s Storage capabilities Computing power	
Audio conference	ALL	Voice+keyboard	
Video conference	Digital ones	Display/AP	ITU-T Recommendations H.323 [37], H.225 [34], H.245 [35], H.248.1 [36], IMS, SIP [39], xDSL
LBS (Location based services)	Mobile ones	Display/T or SP	
Emergency call location	ALL	Keyboard or Terminal identification or Subscriber identification or User authentication	
Authentication:			
low level authentication	ALL	Keyboard, terminal or subscriber authentication	
high level authentication	ALL	User Authentication/CR	
Textphone communication	ALL	Display/T or SP	
Relay Service	ALL	Display/T or SP	

NOTE: The symbol given in column 3 refers to that given in column 2 of the table 1(e.g. T as in Display/T)
The standards references in column 4 are provided as a service description. Most of them come from the ISDN area (EG 201 973-1 [6]) and therefore should not be used without caution for conformance testing in other areas.

Rec#G07 Identification of terminal capabilities suited to access a service: In order to make clear to the users what are the areas where interoperability is provided, users expect a table of terminal capabilities be set-up with a list of services identifying what are the terminal capabilities appropriate to get a particular service.

6.4.2 Definition of a list of interoperable services

More and more often a communication is set up across multiple networks and providers. Therefore, provided the terminal has the appropriate capabilities for a given service, an end-to-end interoperability can be achieved only via a shared commitment between the providers or better at the international level.

In order to gain confidence in the interoperability provided across heterogeneous networks, users expect their suppliers to commit themselves in providing interoperability on a set of well identified services, as long as the terminal is appropriate and of course the user has subscribed to the required access rights if any. Therefore, a list of these interoperable services should be made publicly available by the supplier community with an indication of the possible limitations due to networks or lacks in regulation or mutual agreement between suppliers or at least included in any service contract.

Rec#G08 Service interoperability commitment: A list of the interoperable services should be made publicly available and included in any contract as an interoperability commitment of the supplier. This list should be updated regularly.

6.5 Principles to ensure application interoperability

Even if interoperability is granted on the lower layers, thanks to the adoption of appropriate standards, users have to agree on common data models to ensure interoperability at the application level where it is needed.

This can be an administration or a corporation, but as soon as exchanges are needed outside private borders, mutual agreements have to be set up to ensure the application interoperability in a given area.

Therefore, settlement of such agreements should be encouraged at the highest level in any application field where exchanges are needed: administrations, public services, healthcare, utilities, financial services, home environment, etc. In this context the Service-Oriented-Architectures (SOA) concept could help in implementing such modelling.

Rec#G09 Agreements on common data modelling for application interoperability: settlement of agreements in this area should be encouraged at the highest level in any environment where exchanges are needed. XML-like data modelling could be a path towards application interoperability.

6.6 Billing

To overcome the insufficient reliability of the current metering/billing organization, it is recommended that a standard should be developed to ensure the interoperability of the metering/billing process across the various networks, technologies and different providers, for voice and data. Such standard should define testing methods for all the steps of the metering/billing process e.g. logging/metering, transfer of CDRs, mediation, rating, bundling/discounting, billing (post-paid), credit decrement (pre-paid), fulfilment, order handling, customer activation, complaint handling, customer credit and tariff management within each operator organization for voice and data and with the other operators' systems. Ideally, it should lead to the certification of the metering/billing process implemented by each provider.

Rec#G10 Charging/billing standardization: Users expect a standard be developed to ensure the interoperability of the metering/billing process across heterogeneous networks and charging/billing software of the different providers involved in the user communications e.g. in fact all of them. Such document should make provision for a common format of CDR and charging/billing information as well as for testing the reliability of this information for voice and data.

To meet the users needs on control, consolidation, simulation, internal breakdown, etc of bills, a standardized electronic data model is required.

Rec#G11 Billing management interoperability: Business users expect that a standardized format like that developed by ETIS (See ETIS documents [7], [8], [9],[10]) is implemented in order to enable the consolidation of the bill of ICT services from multiple operators to big companies and their breakdown for internal needs.

6.7 Management

Users have many interoperability concerns in this area.

6.7.1 Network management

To enable the management of heterogeneous networks and network components.

Rec#G12 Network Management interoperability: Business users expect the current SNMP standard for the management of networks and network components be improved to allow an effective and unified management of heterogeneous networks and network components without requiring separate proprietary equipment.

6.7.2 Service management

To allow ICT managers to handle conveniently the user profile of their employees across multiple ICT suppliers.

Rec#G13 Users' profile management interoperability: Business users expect a standard be developed to allow them to manage their user profiles across multiple suppliers without requiring separate proprietary equipment.

6.7.3 QoS management

To ensure the interoperable environment needed for the QoS management and therefore to allow for comparability of information to facilitate consumer choice of supplier.

Rec#G14 Common QoS data modelling: Users expect a common data model be developed with an appropriate protocol to ease the exchange of the pieces of QoS information along the whole communication path and the multiple providers to allow for comparability of information.

Rec#G15 Single QoS class definition: Users expect a single QoS class definition be standardized for all fixed and mobile networks.

6.8 Security

Security is an issue that requires much expertise very often beyond the user knowledge.

Rec#G16 Checking security infrastructures interoperability: Users expect that a methodology be developed to check the interoperability of the security infrastructures at the national and international plane in order to ensure that the security level is kept, in particular on the management of encryption keys, across multiple networks and countries. In particular, such methodology should check that there is no leak between restricted and open areas of private and public networks. **An audit of this issue over public networks should be carried out regularly by an independent authority and its results made public.**

6.9 Interoperability check

Plug tests have evidenced that they improve in many area the interoperability of standards before their publications. Therefore Plug Tests should be used systematically before any standard publication.

In addition, some automated process should be defined to help interoperability testing similarly to the QoS tests, for example with automatons appropriate to such tests. This could be carried out when a new network or a new technology is implemented or from time to time to identify interoperability failure initiated by changes in network architectures or equipment failures.

Rec#G17 Interoperability failures identification: Users expect an automated procedure be defined and implemented in addition to the QoS tests by the regulators in order to identify interoperability failures.

7 Specific recommendations for interoperability improvement

Specific claims for interoperability improvement have been identified in the following areas. Any progress on these issues is expected to improve the user confidence in standardization to ensure interoperability. Such examples can be taken as first implementation areas of the generic recommendations given in clause 6. These specific recommendations provided by particular users are generally supported by the vast majority of them but some of them have slightly different views on some particular ones (e.g. T2, T3, A3, HI).

7.1 Human-Machine/Service Interface

Rec#HI **Key strokes and short numbers to access common services:** for example directory consultation, emergency services, messaging services, etc should be standardized. Conformance to TR 102 125 [4], ES 202 130 [26] and EG 202 132 [5] should be sought as far as possible.

Users expect their Emergency calls is delivered to the usual competent authority (Fire Police Ambulance, Rescue, etc..) in their time of distress. Such Emergency calls are expected to be easily dialled.

7.2 Terminals

Rec#T1 **Keyboard layout:** The current terminals have different keyboard layouts hence hindering easy use and service access. A standardized layout (same or "subset-compatible") should be used for the same service when applicable, particularly for "special" characters, like "+", "*", "#", etc.
Tactile screens making feasible a customized keyboard layout could help to fulfil this requirement (VHE principle).
When applicable, the pips for blind people should always be on the right places (e.g. number 5).
UNICODE and ES 202 130 [26] should be used as far as possible to cope with the character sets of the various languages.

Rec#T2 **Backward interoperability:** While developing new technologies, mobile handset backward interoperability with legacy networks is needed. This means that when a technology update occurs, the existing terminals should continue to access the previous services with the new system. As far as possible this should apply to all kinds of terminals without preventing innovation and change.

Rec#T3 **A single communication handling** between mobile and fixed terminal would help to an homogeneous communication environment:

- the mobile in the office acts as a cordless of the fixed terminal which acts as a "base";
- outside the office the mobile acts as a mobile.

NOTE: This is an aspiration not a requirement although already provided in some countries. The capability to do this should be available via the network when not feasible as a terminal feature.

Rec#T4 **Connectivity interoperability:** sockets and connectors used for external power supplies, head set and microphone, … and any interface to another system: car, PC, hearing or disability aids, etc., should be standardized and interoperable. The recommendations and conclusions of TR 102 068 [3] should be implemented.

In particular the standards available for headphone connection should always be applied (ETS 300 381 [17], ETS 300 488 [18], ETS 300 679 [19] and ITU-T Recommendation P.370 [33]).

7.3 Networks

Rec#N1 **VoIP over every network:** Voice over IP service should be accessible to the user from any carrier services: GSM, ISDN, PSTN, VPN, 802.11/b.

Rec#N2 **LAN, GPRS, xDSL Interoperability:** Interoperability of all type of LAN (wired or wireless) with GPRS, xDSL is needed.

Rec#N3 **Roaming between mobile networks of different technologies:** Roaming between every kind of mobile networks including TETRA is needed.

Rec#N4 **Interoperability of voice communications over Wi-Fi:** Interoperability of voice communications is needed between any Wi-Fi area and any kind of wide area public network, i.e. GSM, ISDN, UMTS, PSTN, VPN.

Rec#N5 **Data transmission across fixed/mobile networks:** Interoperability of data transmission using modems across fixed + mobile switched networks is needed even when several operators are involved.

Rec#N6 **Signalling across fixed/mobile networks:** Interoperability of signalling between TETRA and other mobile networks with public fixed or mobile network is needed.

7.4 Services

Rec#S1 **Interoperability of the supplementary services:** (CLIP, CNIP, AoC-D/E/S, etc.) is needed across every kind of networks. Specific attention should be given to Textphone and Relay Service in this respect.

Rec#S2 **A SMS/email acknowledgement:** Fully interoperable mechanism is needed.

Rec#S3 **Interoperability of prepay services:** Across heterogeneous networks needs to be ensured to implement a widespread service both across mobile and fixed networks and using any kind of prepaid card.

Rec#S4 **A standard video format for mobile phones:** Is needed to ensure the interoperability of Internet services with a convenient display quality.

7.4.1 B2B

Rec#O1 **Interoperability in B2B voice communications** is not fully provided. Additional standardization of the information content that is passed through the protocol (e.g. rank of digits) is needed in particular:

1) In inter-exchange calls.

2) In transnational on-board mobile communications due to multiple standards (GSM-R).

3) In transnational private communications as well (QSIG).

7.4.2 B2C

Rec#O2 **CTI/CRM Interoperability:** Interoperability of CTI used for example in CRM is needed between any call centre, even if outsourced, and corporate computer/software/PBX.

Rec#O3 **LAN/WAN/Cellular Interoperability:** Interoperability is needed between on Board R-LAN, GPRS and WiFi in public places including the railway stations in order to ensure high bit-rates when the train is in the stations and continuity of the data service outside the stations.

7.4.3 Teleconference

Rec#O4 **Unique H.323/SIP profile/interpretation:** Since many audio/videoconferencing proprietary solutions are unable to properly interoperate, ITU-T Recommendation H.323 [37] video conference systems have to be tested for interoperability between them and with respect to the gateways between Ethernet networks and public networks. A unique profile/interpretation for H.323/SIP is needed to provide actual interoperability.

Rec#O5 **Minimum bandwidth availability:** Additional standardization/regulation is also needed to ensure a minimum bandwidth availability and synchronization (taking account of things like delay characteristics of channels with respect to their physical routings).

7.4.4 Emergency call location

Rec#EM Emergency call location should be based on terminal location and not on user address to ensure that location is not corrupted by services like VoIP, re-routing, transfer, etc.

8 Recommendations summary

It is clear that interoperability cannot be achieved without standards but more importantly without the goodwill of all the market players. Table 3 shows which interoperability issue each recommendation is linked with while table 4 highlights which market players has a role to implement each recommendation.

Annex B proposes how to handle the recommendations by the ETSI TBs. Users expect this handling being monitored by the ETSI OCG.

Table 3: Recommendations versus interoperability issue

Recommendations	Access	Management	Market	Terminal	Services	interoperabilit	Security
Rec#G01 Universal Communication Identifier development	x				x		
Rec#G02 Customizable login procedure implementation	x				x		
Rec#G03 Authentication harmonization	x				x		
Rec#G04 Common directory data modelling		x			x		
Rec#G05 Checking network independent terminal addressing	x						
Rec#G06 Terminal location	x			x	x		
Rec#G07 Identification of terminal capabilities suited to access a service				x			
Rec#G08 Service interoperability commitment					x		
Rec#G09 Agreements on common data modelling for application interoperability					x		
Rec#G10 Charging/billing standardization		x					
Rec#G11 Billing management interoperability		x					
Rec#G12 Network Management interoperability		x					
Rec#G13 Users' profile management interoperability		x					
Rec#G14 Common QoS data modelling		x			x		
Rec#G15 Single QoS class definition for all networks		x			x		
Rec#G16 Checking security infrastructures interoperability						x	x
Rec#G17 Interoperability failures identification						x	
Rec#T1 Keyboard layout				x			
Rec#T2 Backward interoperability				x			
Rec#T3 A single communication handling				x			
Rec#T4 Connectivity interoperability				x			
Rec#N1 VoIP over every network	x						
Rec#N2 LAN, GPRS, xDSL Interoperability	x						
Rec#N3 Roaming between mobile networks of different technologies	x						
Rec#N4 Interoperability of voice communications over Wi-Fi	x						
Rec#N5 Data transmission across fixed/mobile networks	x						
Rec#N6 Signalling across fixed/mobile networks	x						
Rec#HI Key strokes and short numbers to access common services	x			x	x		
Rec#S1 Interoperability of the supplementary services					x		
Rec#S2 A SMS/email acknowledgement					x		
Rec#S3 Interoperability of prepay services					x		
Rec#S4 A standard video format for mobile phones				x	x		
Rec#O1 Interoperability in B2B voice communications			x				
Rec#O2 CTI/CRM Interoperability			x				
Rec#O3 LAN/WAN/Cellular Interoperability			x				
Rec#O4 Unique H.323/SIP profile/interpretation			x				
Rec#O5 Minimum bandwidth availability			x				
Rec#EM Emergency call location	x				x		x

Table 4: Market players' role in implementing each recommendation

Recommendations	Operators	Manufacturers	Service provision	Regulation	Mutual agreement	Users
Rec#G01 Universal Communication Identifier development	x		x	x	x	
Rec#G02 Customizable login procedure implementation	x		x	x	x	
Rec#G03 Authentication harmonization	x		x	x		
Rec#G04 Common directory data modelling	x	x	x	x	x	x
Rec#G05 Checking network independent terminal addressing	x	x		x		
Rec#G06 Terminal location	x	x		x		
Rec#G07 Identification of terminal capabilities suited to access a service	x	x	x	x	x	
Rec#G08 Service interoperability commitment	x	x	x	x	x	
Rec#G09 Agreements on common data modelling for application interoperability				x		x
Rec#G10 Charging/billing standardization	x	x	x	x		
Rec#G11 Billing management interoperability	x	x	x	x	x	x
Rec#G12 Network Management interoperability	x	x		x	x	
Rec#G13 Users' profile management interoperability	x		x	x	x	x
Rec#G14 Common QoS data modelling	x		x	x		
Rec#G15 Single QoS class definition for all networks	x	x	x	x		
Rec#G16 Checking security infrastructures interoperability	x			x		
Rec#G17 Interoperability failures identification				x		
Rec#T1 Keyboard layout		x		x	x	
Rec#T2 Backward interoperability	x	x		x		
Rec#T3 A single communication handling	x	x		x		
Rec#T4 Connectivity interoperability	x	x		x		
Rec#N1 VoIP over every network	x	x		x		
Rec#N2 LAN, GPRS, xDSL Interoperability	x			x		
Rec#N3 Roaming between mobile networks of different technologies	x	x		x		
Rec#N4 Interoperability of voice communications over Wi-Fi	x	x		x	x	
Rec#N5 Data transmission across fixed/mobile networks	x	x			x	
Rec#N6 Signalling across fixed/mobile networks	x	x			x	
Rec#HI Key strokes and short numbers to access common services	x	x	x	x		
Rec#S1 Interoperability of the supplementary services	x	x	x	x	x	
Rec#S2 A SMS/email acknowledgement	x		x	x	x	
Rec#S3 Interoperability of prepay services	x		x	x	x	
Rec#S4 A standard video format for mobile phones	x	x	x	x	x	
Rec#O1 Interoperability in B2B voice communications	x	x				
Rec#O2 CTI/CRM Interoperability	x	x	x		x	
Rec#O3 LAN/WAN/Cellular Interoperability	x	x			x	
Rec#O4 Unique H.323/SIP profile/interpretation	x	x			x	
Rec#O5 Minimum bandwidth availability	x	x	x		x	
Rec#EM Emergency call location	x	x		x		

Annex A (informative): Users' claims about interoperability

This annex contains the statements provided by the users from Belgium, France, Italy, India, UK, either in fulfilling forms or answering interviews. Most of them are based on actual cases of interoperability failure. They are the basis of the recommendations offered in table 4.

This survey was carried out with 19 face to face interviews and 3 email inquiries. The related market areas are:

Nb	Market area
2	Administration
2	Bank
1	Insurance
2	University
5	Utility (Railways, Power)
3	Service provider
1	Consumer organization
2	Telecomm Business User organization
2	Telecomm User organization

For an easier reading, the inputs reported hereafter are only the most meaningful examples but often several others not reported here support the same idea.

A.1 Generic issues

Users would like all the access networks to be interoperable whatever the technology, fixed, mobile, legacy or IP, while several examples were given of lack of network interoperability. They would also like any relevant service to be interoperable across every kind of network while several examples were given of lack of service interoperability across networks.

A.1.1 Access interoperability issues

A.1.1.1 Numbering

1) Signalling in inter-exchange calls is not always working properly. When entities like PBX, enterprise networks interconnect with the public network on dial up lines, both ends need to understand the digit streams being sent to set up call connections. Rank of Digit (RoD) helps the receiving end to prefix predetermined digits to process the call. It is not the protocol (e.g. QSIG) compliance. It is the information content that is passed through the protocol. In legacy systems and signalling, RoD was a parameter in sending the subscriber number information for call processing. If this information is not synchronized, the digits are misinterpreted.

2) Some users who are used to work in multiple places would like to be reached on the same number but this facility, though technically possible cannot be implemented for regulatory reasons, if these places are not in the same geographical area.

3) Addressing the user instead of the terminal taking into account all the mobility and nomadic aspects as well as the protocols (H.323/SIP) is a crucial issue for the interoperability in the future.

A.1.1.2 Directories

Directory services area is one of the most often reported examples of lack of interoperability issue.

1) Today Corporate directories should be built thanks to the consolidation/replication of email directories, PABX directories, staff management files, etc in real time to avoid errors and duplication of work but management tools are not interoperable to enable such synchronization.

2) Until recently, X.500 was the reference for exchange between every directory and other ones. This reference is no longer valid so requiring gateways with all the other ones.

3) Directory interoperability within a business area relies on the definition and publication of a data model of a "META-DIRECTORY" common to this business area.

4) There are 2 interoperability issues with directories. One is to have the display of the right caller name on the PBX terminals whatever the calling source, public network or other private PBX from the company or from other companies.
The other issue is to have a single corporate directory fed with the various sources of personal information and vice versa, depending on what is the most appropriate and reliable source of information.

A.1.2 Terminal interoperability generic issues

1) Mobile handset backward interoperability with legacy networks (e.g. 3G handset working with GSM networks).

2) The current terminals have differing keyboard layouts so hindering easy use and service access. All terminals should have a standardized (same or "subset-compatible") keyboard layout, particularly for "special" characters, like "+", "*", "#", etc.

3) The identification of the terminal capability is a key issue to make the interoperability area clear to the user.

A.1.3 Service interoperability generic issue

1) Today services are more and more often delivered across multiple networks using various protocols and security features. This trend is expected to grow still further in the future. A major user concern is that some interoperability weaknesses might jeopardize security while information uses such complex paths. An appropriate mechanism is needed to ensure that security is kept at the same level whatever the number and technology of networks crossed.

2) Ensuring security relies on the interoperability of the security infrastructures at the national and international level which is not certified nowadays when a communication involves several operators and countries.

3) The current trend to the development of IP technology makes it appear that interoperability provision may require proprietary solutions, and not open ones. This can be in fact a barrier to the interoperability that users expect and therefore a big concern to the users.

A.1.4 Service management generic issue

A.1.4.1 Management of networks provided by different operators and manufacturers

The management of heterogeneous networks and network components has been proven unrealistic due in particular to divergent evolutions of the protocols and of the semantic of the information. This makes multiple provider procurement difficult since users have concerns to buy products they are not able to manage conveniently. Several specific examples were given. Nevertheless, the management of heterogeneous networks and network components is a clear target for many companies although it is impossible to achieve it at the moment due to the lack of a sufficiently performing standard in addition to the unwillingness of the providers.

A.1.4.2 Management of bill from different operators or service providers

The financial management of each corporate department requires that communication costs be split according to their own traffic. As long as a common standard is not used to make possible the consolidation of the bills of the various suppliers, as well as the control and comparison of each of them with the internal sources of information, it is a nightmare.

An open format should be standardized for charging to allow comparisons between the suppliers bills and records from the PBX and from other management sources (data traffic). Experience shows that a lot of errors are usually identified in this area with significant financial consequences.

Some providers are beginning to use the standardized format developed by ETIS for the eBilling of ICT services to big companies while the bills of SME or residential users are made available via Web based services. There is a tremendous need for the implementation of such a standard to enable control, consolidation, simulation, etc.

A.1.4.3 Management of the end-to-end Quality of Service through heterogeneous networks

In the same way, the current trend toward outsourcing and service purchase requires efficient tools for QoS monitoring through the various networks/providers in order to build a manager instrument panel. Therefore there is a strong need for end-to-end QoS indicators delivered according to a standard to feed these tools.

A.1.5 Specific interoperability issues

1) Roaming between networks of different technologies in the mobile networks.

2) There is a feeling that confidentiality is easier to ensure in a proprietary environment. A common belief is that the more open the standards on which a communication system is based the higher the threat on data privacy. Therefore, users have to be made well confident on the security guarantees provided along the entire communication path, in particular in the management of the security keys.

3) Operations Support Systems (OSS) (Provisioning, Mediation, Service assurance) which are "Offline" systems are dependent on the technology of the network they serve (e.g. 2G, 2.5G, 3G wireless). Checking their interoperability is a critical factor.

A.1.6 Specific examples of interoperability failure

1) Interoperability of non voice traffic like FAX, High speed data is not ensured across Wireless Local Loop (WLL) access with PSTN network.

2) Operations Support Systems that include applications like Billing, Provisioning, Service assurance, Taxation, etc. which are third party software, are customized to each vendor's system on an ad-hoc basis according to the implementation needs. Some elementary level of standardization in the way they interwork with the corresponding network elements would be essential. For example, there is a good amount of standardization in Service Assurance through standards in Element Management System/Network Management System (EMS/NMS).

A.2 Voice communications

A.2.1 Service interoperability issues

1) Prepay service, one of the successful services deployed by network operators over PSTN, is dependent on the network on which it is deployed. While these applications are running on open platforms, they are connected to one or more of the network elements to get and provide operational data. Implementing a widespread service needs interoperability to be ensured at this level.

2) There are limitations in providing evolving supplementary services over the legacy voice network. When the network operator rolls out a service in an heterogeneous network, this is one of the aspects to be tested and confirmed.

3) VoIP available to the user over GSM, ISDN, PSTN, VPN, 802.11/b.

4) A standard should be developed to handle the calls originated from any Wi-Fi "gateway" to any kind of wide area public network, i.e. GSM, ISDN, UMTS, PSTN, VPN.

5) QSIG manages a subset of the supplementary services available on the various PBX. Such proprietary services may use either internal or external information. When such service outside the QSIG service set uses external information, each manufacturer should make the specifications of this information publicly available to enable its interpretation by another PBX and QSIG should be able to route it to a distant PBX.

A.2.2 Specific interoperability issues

1) Voice communications over Private networks:

   - Interoperability issue with transnational on-board mobile communications due to multiple standards (GSM-R).

   - Interoperability issue with transnational private communications as well (QSIG).

2) Specific aspects of VoIP communications:

   - All the supplementary services currently provided by the PABX are not available on VoIP.

   - Interfaces between VoIP PBX, the legacy private network and the public network as well are not fully interoperable.

   - Echo may occur in telephone conversations between fixed/mobile phones and PC (VoIP).

A.2.3 Specific examples of interoperability failure

1) TETRA networks have their own protocols for call processing. While interfacing with public fixed or mobile network, the use of SS7 as the interconnection protocol is required. Interoperability of this implementation has to be verified and confirmed for all possible scenarios.

2) Name of calling party display on called terminal.

3) Charging information to calling party between mobile networks.

4) Charging information to calling party in international fixed to mobile calls.

5) Interoperability problems can make the QoS of international communications so poor that they may have to be set up again.

6) Interoperability of data transmission using modems across fixed + mobile switched networks fails when several operators are involved.

7) Others failures in relation to textphone relay services for both fixed line and mobile links through relay services have been reported.

A.3 Office environment

A.3.1 Service interoperability issue

1) Any user should be able to have a same number for his Fixed/GSM/Wi-Fi communications.

2) Data services are reasonably open and interoperable, encapsulation and transit time management allow for any kind of interoperability, with little drawbacks. Ethernet is fed with innovation in all areas. The only issue is the network/service management.

3) It is important that all the LAN technologies (wired + wireless (WLAN)) be able to interwork with xDSL customer premises terminations.

A.3.2 Terminal interoperability issues

Single communication handling between mobile and fixed terminal:

- the mobile in the office acts as a cordless of the fixed which acts as a "base";
- outside the office the mobile acts as a mobile.

A.3.3 Specific interoperability issues

1) R-LAN Security rely on OS of the terminals. Any not up-to-date OS can jeopardize the information security.
2) Any new technology has to be checked against leaks between the exploitation flows and public flows.

A.3.4 Specific examples of interoperability failure

1) Interoperability of CTI used for example in CRM is not granted between corporate computer/software/PBX and outsourced call centre when CRM is outsourced to another provider.
2) When a customer call comes from a terminal different from the customer registered one, then the CRM fails. A User Identifier instead of terminal identification is needed to avoid such problem.
3) Most suppliers are unable to ensure the security and QoS specifications of VPN in particular for SME or small sites of big corporations.
4) It is impossible to use different PNOs to route the incoming and the outgoing calls to a CRM system.
5) To prevent common mode failures, it would be useful to route the traffic via more than one network operator but it is very difficult to achieve such routing diversification within a full value added provision. In practice, the dispatching of the traffic between the different operators has to be managed internally, hence preventing to outsource a high value added service to an operator or requiring to outsource the provision to an integrator.
6) In the context of a VPN using multiple operators, the DNS and spanning tree are not managed properly.

A.4 On the move environment and teleworking

A.4.1 Service interoperability issue

1) Interoperability is needed between on Board R-LAN, GPRS and WiFi in public places including the railway stations in order to ensure high bit-rates when the train is in the stations and continuity of the data service outside the stations.
2) The lack of a standardized authentication criteria/procedure is often an hindrance to the service interoperability.
3) Interoperability problems exist to ensure continuity of the vocal communication service across GSM, GPRS and UMTS.
4) Interoperability problems exist with collect call service on mobile phones between different operators.
5) A standard video format is needed to avoid distortion on mobile phones.
6) Public places are not well suited to allow for textphone access.

A.4.2 Specific examples of interoperability failure

1) Devices for recharging batteries of mobile phones as well as common use accessories are not interchangeable. This is a key concern to the disable people who usually need specific add-on to overcome their disabilities.

2) A standardized interchange is not provided between the integrated handset directory and other directories (corporate, PC, public directories, etc.).

3) The poor implementation of the ITU-T Recommendation P.370 [33] and ETS 300 679 [19] socket standard for connection of hearing aids and other audio devices to telephone sets was reported.

A.5 Messaging

1) Despite the use of standardized languages like HTML, interoperability is not fully provided in exchanges between heterogeneous messaging systems. In particular, attachments might be corrupted.

2) The lack of a standardized protocol makes difficult the interoperability between multi-environment messaging systems.

3) A single environment is needed for SMS/Fax/e-mail/Instant messaging/MMS/UM.

A.5.1 Service interoperability issue

1) Interoperability is expected from the recommendation to choose a messaging system conforming to a list of standards selected by experts in the area.

A.5.2 Terminal interoperability issues

1) Reading emails hosted on the corporate messaging system from mobiles raises hard interoperability issues in particular to avoid a breach in the information security (use of an independent VPN).

A.5.3 Specific examples of interoperability failure

1) Experience shows that the receipt confirmation mechanism for e-mail is not always working properly.

2) Experienced failures in end-to-end SMS routing are asking for the development of an acknowledgement mechanism in this area too.

A.6 Teleconferencing

A.6.1 Service interoperability issue

H.323 is not always interpreted in the same way by conventional PABX and VoIP PBX manufacturers.

A.6.2 Specific examples of interoperability failure

1) Many proprietary solutions are unable to properly interoperate in this area.

2) H.323 video conference systems have to be tested for interoperability between them and with respect to the gateways between Ethernet networks and public networks.

3) A minimum bandwidth availability should be ensured to customer by regulation when using proprietary solutions.

4) In international videoconferencing based on ISDN (multichannel) very often there is not sufficient bandwidth available to customers; a standard (or like) should determine provision to guarantee synchronization (taking account of things like delay characteristics of channels with respect to their physical routings).

5) When ISDN is used as back-up to leased lines very often a lack of synchronization among channels is experienced.

6) We have to use different systems and providers depending on the number of terminals. A relatively high failure rate is often experienced: more or less 1 %.

7) Interoperability problems exist in the video conference service between parties using different applications.

A.7 Public and field services

A.7.1 Service interoperability issue

1) Those who are used to work in these areas have made clear that any interoperability failure might jeopardize people's safety and even possibly their life. Therefore it is crucial in this field that interoperability is ensured as widely as possible and that conditions, if any, where the service is not provided, are made clear to everybody.

2) Some applications requires the authentication of a person or a device across networks. Equipment involved in such processes have to be certified by an appropriate organism.

3) Access to the emergency services is crucial to Disabled and Elderly people and should not be jeopardized in any way by any interoperability failures. A highly reliable access at all times and for people with any common disability should be provided.

A.7.2 Specific interoperability issues

Setting up a Common Consistency Framework for the development of an eAdministration bears on the definition of a list of public, open recommended standards that all interested parties can comment when needed. In addition data models are also published to ensure interoperability of the applications within a professional area.

A.7.3 Specific examples of interoperability failure

1) EDIFACT was recommended for exchanges between administrations and also to ensure the documents are everlasting (perennial). This recommendation was not effective due to an incompatibility with legacy applications.

2) VoIP can jeopardize emergency call location.

A.8 eCommerce

A.8.1 Service interoperability issue

A standardized authentication criteria/procedures is crucial to the interoperability in this area.

A.9 Home environment

A.9.1 Service interoperability issue

1) All instances of LAN, wired or wireless (WLAN) be interoperable with GPRS and other mobile services;

2) All instances of LAN, wired or wireless be interoperable with the xDSL customer premises termination and customer premises wide area network terminations in general.

Annex B (informative): Proposed handling of the recommendations by ETSI TBs

To help to an optimal handling of the recommendations, table B.1 proposes a mapping of these recommendations across the ETSI Technical Bodies and other usual partners. In addition, organizations for disabled and elderly people could be usefully consulted while processing the recommendations within these TBs.

Table B.1: ETSI TBs handling the recommendations

Recommendations		TC HF	TC TISPAN	STQ	3GPP	TC AT	Ecma	EMTEL	ELSIGN, TC ESI, IETF	PLUGTEST	TC TM	TC Broadcast	EP BRAN
Rec#G01	Universal Communication Identifier development	x	x		x		x						
Rec#G02	Customizable login procedure implementation								x				
Rec#G03	Authentication harmonization								x				
Rec#G04	Common directory data modelling						x						
Rec#G05	Checking network independent terminal addressing		x		x	x	x						
Rec#G06	Terminal location		x		x	x							
Rec#G07	Identification of terminal capabilities suited to access a service		x		x	x	x						
Rec#G08	Service interoperability commitment		x		x		x						
Rec#G09	Agreements on common data modelling for application interoperability						x						
Rec#G10	Charging/billing standardization		x	x	x		x		x	x			
Rec#G11	Billing management interoperability		x		x		x						
Rec#G12	Network Management interoperability		x		x		x						
Rec#G13	Users' profile management interoperability		x		x		x						
Rec#G14	Common QoS data modelling			x						x			
Rec#G15	Single QoS class definition for all networks		x	x	x		x						
Rec#G16	Checking security infrastructures interoperability			x			x		x				
Rec#G17	Interoperability failures identification									x			
Rec#T1	Keyboard layout	x			x	x	x						
Rec#T2	Backward interoperability		x		x	x	x			x			
Rec#T3	A single communication handling					x							
Rec#T4	Connectivity interoperability					x							
Rec#N1	VoIP over every network		x	x			x				x		
Rec#N2	LAN, GPRS, xDSL Interoperability		x		x		x				x		
Rec#N3	Roaming between networks of different technologies		x		x		x						
Rec#N4	Interoperability of voice communications over Wi-Fi		x				x						x
Rec#N5	Data transmission across fixed/mobile networks		x		x		x						
Rec#N6	Signalling across fixed/mobile networks		x		x		x						
Rec#HI	Key strokes and short numbers to access common services	x	x		x	x	x	x	x	x			x
Rec#S1	Interoperability of the supplementary services		x		x		x			x			
Rec#S2	A SMS/email acknowledgement		x		x		x			x			
Rec#S3	Interoperability of prepay services		x		x								
Rec#S4	A standard video format for mobile phones				x	x						x	
Rec#O1	Interoperability in B2B voice communications		x		x		x						
Rec#O2	CTI/CRM Interoperability		x		x		x						
Rec#O3	LAN/WAN/Cellular Interoperability		x		x		x						x
Rec#O4	Unique H.323/SIP profile/interpretation		x		x		x						
Rec#O5	Minimum bandwidth availability		x				x				x		
Rec#EM	Emergency call location		x					x					

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