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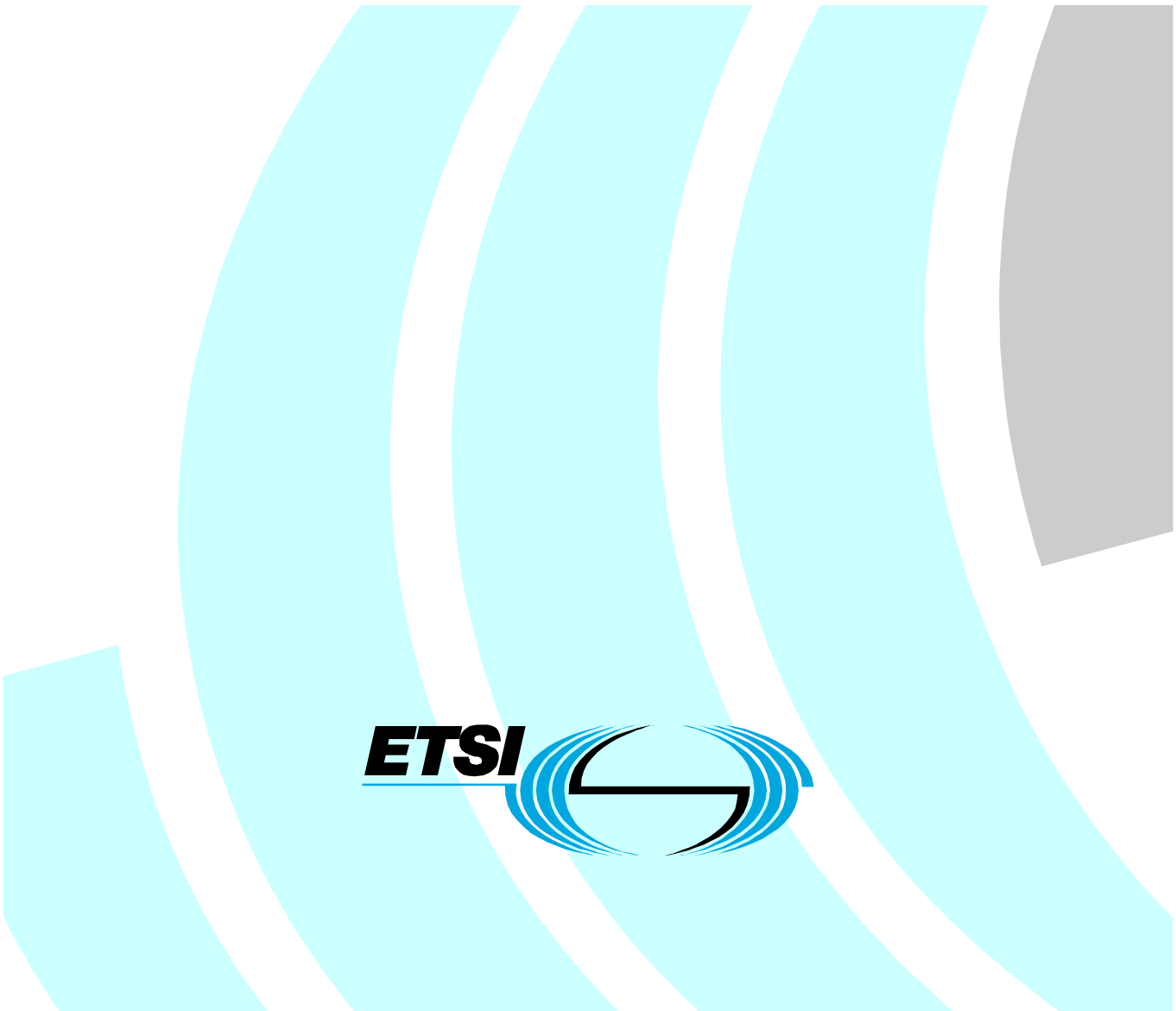
ETSI Guide

Universal Communications Identifier (UCI); Placing UCI in context; Review and analysis of existing identification schemes



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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Human Factors (HF).

1 Scope

The present document gives guidance on the application of identity to Next Generation Networks (NGN).

The present document presents the analysis of identification as below:

- Identification requirements for next generation services including those based on a UCI.
- Analysis of current identification schemes (E.164, E.212, IPv4/IPv6 addresses).
- Impact of identification schemes on user registration procedures.
- Assessment of portability of identification schemes between service providers.
- Quantitative measure of system performance.
- A review of the relevance of SmartCard technology.
- Reviews the viability of existing lawful interception requirements.

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.

[1] ETSI EG 201 795: "Human Factors (HF); Issues concerning user identification in future telecommunications systems".

[2] ETSI EG 201 940 (V1.1.1): "Human Factors (HF); User identification solutions in converging networks".

[3] ETSI ES 201 935: "Numbering, Naming and Addressing".

[4] ITU-T Recommendation E.164 (1997): "The international public telecommunication numbering plan".

[5] ITU-T Recommendation E.191: "B-ISDN addressing".

[6] ITU-T Recommendation E.212 (1998): "The international identification plan for mobile terminals and mobile users".

[7] ETSI TR 121 905: "Universal Mobile Telecommunications System (UMTS); Vocabulary for 3GPP Specifications (3GPP TR 21.905 version 4.4.0 Release 4)".

[8] ETSI TS 100 929: "Digital cellular telecommunications system (Phase 2+) (GSM); Security related network functions (GSM 03.20 version 7.2.0 Release 1998)".

[9] ITU-T Recommendation X.121 (2000): "International numbering plan for public data networks".

[10] ITU-T Recommendation X.213 (2001): "Information technology - Open systems Interconnection - Network service definition".

[11] ISO 3166 (all parts): "Codes for the representation of names of countries and their subdivisions".

[12] ITU-T Recommendation F.401: "Message handling services: Naming and addressing for public message handling services".

3 Definitions and abbreviations

3.1 Definitions

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

address [1]: string or combination of digits and symbols which identifies the specific termination points of a connection and is used for routing

NOTE: See ES 201 935 [3].

address [2]: string or combination of digits and symbols which identifies the specific termination points of a connection and is used for routing

NOTE: See ITU-T Recommendation E.191 [5].

end user [1]: logical concept which may refer to a person, a persona (e.g. work, home, etc.), a piece of equipment (e.g. NTE, phone etc.), an interface, an application (e.g. Video on Demand), or a location

NOTE: See ES 201 935 [3].

end user [2]: logical concept which may refer to a person, a persona (e.g. work, home, etc.), a piece of equipment (e.g. NTE, phone, etc.), an interface, a service (e.g. Freephone), an application (e.g. Video-on-Demand), or a location

NOTE: See ITU-T Recommendation E.191 [5].

name [1]: combination of alpha, numeric, or symbols that are used to identify one or more services linked to an end user

NOTE: See ES 201 935 [3].

name [2]: alpha numeric label used for identification of end users and may be portable.

NOTE: See TR 121 905 [7].

name [3]: combination of characters and is used to identify end users

NOTE 1: Character may include numbers, letters and symbols

NOTE 2: See ITU-T Recommendation E.191 [5].

number [1]: string of decimal digits and can be used as a name address or label.

NOTE: See ES 201 935 [3].

number [2]: string of decimal digits that uniquely indicates the public network termination point

NOTE 1: The number contains the information necessary to route the call to this termination point.

NOTE 2: A number can be in a format determined nationally or in an international format. The international format is known as the International Public Telecommunication Number which includes the country code and subsequent digits, but not the international prefix.

NOTE 3: See TR 121 905 [7].

number [3]: string of decimal digits

NOTE: See ITU-T Recommendation E.191 [5].

subaddress: addressing element that provides a means to convey transparently additional address information through the network

NOTE: Same definition in ES 201 935 [3] and ITU-T Recommendation E.191 [5].

3.2 Abbreviations

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

3GPP	3rd Generation Partnership Project
ADMD	Administration Management Domain
AESA	ATM End System Address
AFI	Authority Format Indicator
ATM	Asynchronous Transfer Mode
CC	Country Code
DCC	Data Country Code
DNIC	Data Network Identification Code
DNS	Distinguished Name Service
DTE/DCE	Data Terminal Equipment/Data Circuit-Terminating Equipment
ESI	End System Indicator
GSN	Global Subscriber Number
IC	Identification Code
ICD AESA	International Code Designator AESA
ICD	International Code Designator
IDI	Initial Domain Identifier
IETF	Internet Engineering Task Force
IMSI	International Mobile Station Identity (ITU-T version)
IMSI	International Mobile Subscriber Identity (GSM version)
IND	ITU International Network Designator
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ITU-IND AESA	ITU International Network Designator (IND) AESA
LMSI	Local Mobile Station Identity
MCC	Mobile Country Code
MHS	Message Handling System
MNC	Mobile Network Code
MS	Mobile Station
MSC	Mobile Switching Centre
MSIN	Mobile Subscriber Identification Number
NAPM	Naming and Addressing Plan Manager
NDC	National destination code
NGN	Next Generation Network
NMSI	National Mobile Subscriber Identity
NN	National Number
NSAP	Network Service Access Point
NTE	Network Termination Equipment
NTN	Network Terminal Number
OSI	Open Systems Interconnection
PLMN	Public Land Mobile Network
PRMD	Private Management Domain
PSTN	Public Switched
PUA	Personal User Agent
SGSN	Serving GPRS Support Node
SMTP	Simple Mail Transfer Protocol
SN	Subscriber Number
TDC	Telex Destination Code
TIPHON	Telecommunications and Internet Protocol Harmonization Over Networks (deprecated)
TLD	Top Level Domain
TLLI	Temporary Logical Link Identity
TMSI	Temporary Mobile Subscriber Identities
UCI	Universal Communications Identifier

UMTS	Universal Mobile Telecommunications Service
URL	Universal Resource Locator
URN	Uniform Resource Name
VLR	Visitor Location Register

4 Introduction

The study presented in the present document is the third stage in an ongoing project arising from EG 201 795 [1].

The first stage of research is captured in EG 201 940 [2] which presents generic requirements to give more options and control to users of telecommunications networks, both from the perspective of senders and receivers, with the aim of reducing unsuccessful communication attempts. It further defines a set of requirements for an identifier which would give the additional options and control and considers some of the user identifiers that are in common use (name and address; telephone number and email address). EG 201 940 [2] proposes the UCI as a solution after reviewing and rejecting a number of solutions including directory-based multi-identifier; meta-search; Internet "Common Name" and Internet Uniform Resource Name (URN). The proposed UCI comprises three parts:

1) an alphabetic label;

2) a globally-unique numeric string; and

3) a set of flags to give additional information.

The UCI solution is essentially an overlay on existing networks which relies on "Personal User Agents" (PUAs) to deal with the UCI.

The second stage of the UCI project has been established to:

- fully clarify the system architecture and operations needed for an effective UCI solution;
- consider the standards aspects (existing, developing and additional); and
- investigate the issues associated with UCI implementation (administrative, organizational and commercial).

The present document is to contribute towards the third stage of the UCI project and to:

- identify the range of identification schemes that exist in current and planned communications environments; and
- provide details of the identification schemes.

5 Overview of existing identification (naming, numbering and addressing) schemes

NOTE: There is no intended implication that the schemes described in the present document are to be replaced by UCI, or are directly comparable to UCI.

5.1 ISDN/PSTN and PLMN identification schemes

The ISDN PSTN and PLMN all use the numbering plan according to ITU-T Recommendation E.164 [4]. Identification can be enhanced by a number of supplementary services.

In GSM PLMNs, there is the need for other identification mechanisms described in clause 5.1.2.

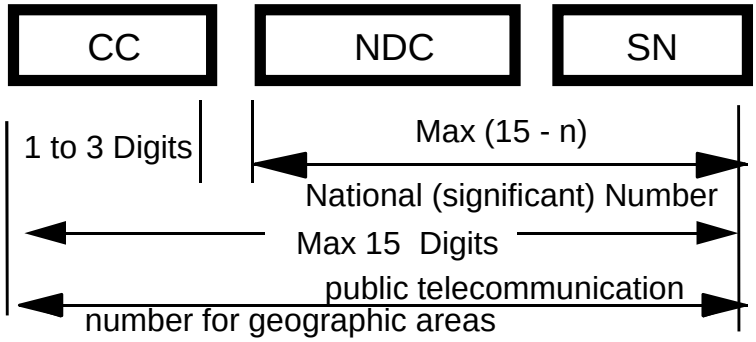
5.1.1 E.164 Numbering Plan

The E.164 numbering plan identifies three different structures for the international public telecommunication number:

- International public telecommunication number for geographic areas.
- International public telecommunication number for global services.
- International public telecommunication number for Networks.

At the time of publication, the ITU-T is developing a separate numbering structure for Groups of Countries. Since the revisions to ITU-T Recommendation E.164 [4] have not been finalized, the new numbering structure is not included in the present document.

The international public telecommunication number for geographic areas (see figure 1) is composed of a variable number of decimal digits arranged in specific code fields. The international public telecommunication number code fields are the country code (CC) and the national (significant) number N(S)N.

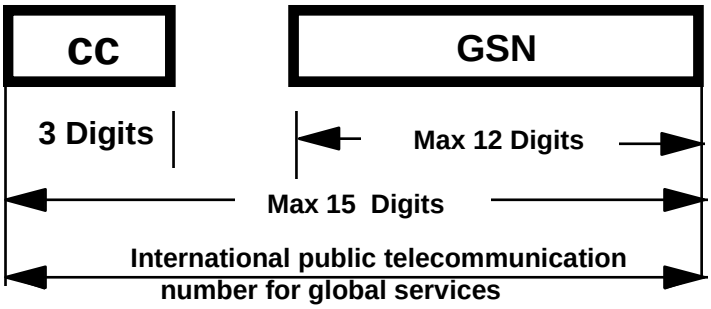


CC Country code for geographic areas
NDC National destination code (optional)
SN Subscriber number
n Number of digits in the country code

Figure 1: International public telecommunication number structure for geographic areas

The E.164 number structure for geographic areas can be used both as a name or an address. The number is an address when it identifies a specific termination point, e.g. 1 732 949 4387. The number is a name when it used for certain non-geographic services (e.g. Toll-Free Service, because it is used for identification) or when it is a ported number.

Figure 2 shows the international public telecommunication number structure for global services. The use of this format is service specific and is dependent on the numbering requirements as detailed in the appropriate Recommendation.

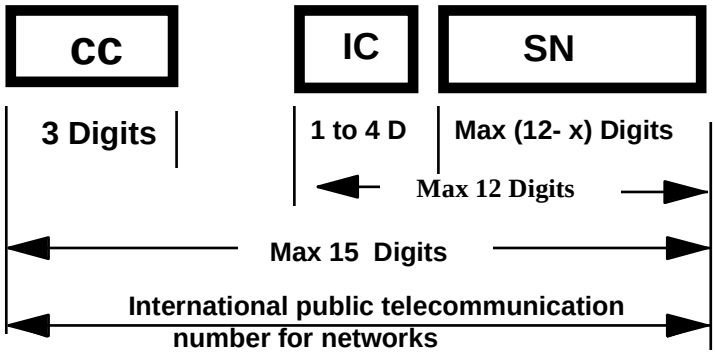


CC Country Code for a Global Service
GSN Global Subscriber Number

Figure 2: International public telecommunication number structure for global services

The international public telecommunication number for Networks (see figure 3) is composed of decimal digits arranged in three code fields. The code fields are the 3 digit shared Country Code (CC) field, the IC field, which vary in length between 1 to 4 digits, and the subscriber number (SN) which can be up to 15 minus the number of digits in the CC and IC fields.

The E.164 number structure for Global Services is a name because it is used solely for identification.



CC Country Code for Networks
IC Identification Code
SN Subscriber Number
x Number of digits in identification code (IC)

Figure 3: International public telecommunication number structure for networks

The E.164 number structure for Networks is a combination of both a name and an address. The first two components of the number, CC + IC, is an address because it identifies the Network to which the call is to be routed while the remainder of the number, SN, is a name because it is used by the Network as a means of identification.

5.1.2 Additional PLMN identification mechanisms

5.1.2.1 International Mobile Subscriber Identity (IMSI)

A unique International Mobile Subscriber Identity (IMSI) is allocated to each mobile subscriber in the GSM system.

In order to support the subscriber identity confidentiality service the Visitor Location Registers (VLRs) and Serving GPRS Support Nodes (SGSNs) may allocate Temporary Mobile Subscriber Identities (TMSI) to visiting mobile subscribers. The VLR and SGSNs must be capable of correlating an allocated TMSI with the IMSI of the Mobile Station (MS) to which it is allocated.

An MS may be allocated two TMSIs, one for services provided through the Mobile Switching Centre (MSC), and the other for services provided through the SGSN (P-TMSI for short).

For addressing on resources used for GPRS, a Temporary Logical Link Identity (TLLI) is used. The TLLI to use is built by the MS either on the basis of the P-TMSI (local or foreign TLLI), or directly (random TLLI).

In order to speed up the search for subscriber data in the VLR a supplementary Local Mobile Station Identity (LMSI) is defined.

The LMSI may be allocated by the VLR at location updating and is sent to the HLR together with the IMSI. The HLR makes no use of it but includes it together with the IMSI in all messages sent to the VLR concerning that MS.

The IMSI is composed of three parts:

1) Mobile Country Code (MCC) consisting of three digits. The MCC identifies uniquely the country of domicile of the mobile subscriber.

2) Mobile Network Code (MNC) consisting of two or three digits for GSM applications. The MNC identifies the home GSM PLMN of the mobile subscriber. The length of the MNC (two or three digits) depends on the value of the MCC. A mixture of two and three digit MNC codes within a single MCC area is not recommended and is outside the scope of this specification.

3) Mobile Subscriber Identification Number (MSIN) identifying the mobile subscriber within a GSM PLMN.

The National Mobile Subscriber Identity (NMSI) consists of the Mobile Network Code and the MSIN.

The IMSI consists of numerical characters (0 through 9) only and the overall number of digits in IMSI shall not exceed 15 digits. The allocation of Mobile Country Codes (MCCs) is administered by the ITU-T according to annex A of ITU-T Recommendation E.212 [6].

The allocation of National Mobile Subscriber Identity (NMSI) is the responsibility of each administration. If more than one GSM PLMN exists in a country, a unique Mobile Network Code should be assigned to each of them.

The allocation of IMSIs should be such that not more than the digits MCC + MNC of the IMSI have to be analysed in a foreign GSM PLMN for information transfer.

5.1.2.2 Structure of TMSI

Since the TMSI has only local significance (i.e. within a VLR and the area controlled by a VLR, or within an SGSN and the area controlled by an SGSN), the structure and coding of it can be chosen by agreement between operator and manufacturer in order to meet local needs.

The TMSI consists of 4 octets. It can be coded using a full hexadecimal representation.

In order to avoid double allocation of TMSIs after a restart of an allocating node, some part of the TMSI may be related to the time when it was allocated or contain a bit field which is changed when the allocating node has recovered from the restart.

In areas where both MSC-based services and SGSN-based services are provided, some discrimination is needed between the allocation of TMSIs for MSC-based services and the allocation of TMSIs for SGSN-based services. The discrimination shall be done on the 2 most significant bits, with values 00, 01, and 10 being used by the VLR, and 11 being used by the SGSN.

The TMSI shall only be allocated in ciphered form. See also TS 100 929 [8].

The network shall not allocate a TMSI with all 32 bits equal to 1 (this is because the TMSI must be stored in the SIM, and the SIM uses 4 octets with all bits equal to 1 for indicating that no valid TMSI is available).

To allow for eventual modifications of the management of the TMSI code space management, MSs shall not check if an allocated TMSI belongs to the range allocated to the allocating node. MSs shall use an allocated TMSI according to the specifications, whatever its value.

5.1.2.3 Structure of Local Mobile Station Identity (LMSI)

The LMSI consists of 4 octets and may be allocated by the VLR.

5.1.2.4 Structure of Temporary Logical Link Identity (TLLI)

A TLLI is built by the MS or by the SGSN either on the basis of the P-TMSI (local or foreign TLLI), or directly (random or auxiliary TLLI), according to the following rules.

The TLLI consists of 32 bits, numbered from 0 to 31 by order of significance, with bit 0 being the LSB.

A local TLLI is built by a MS which has a valid P-TMSI as follows:

bits 31 down to 30 are set to 1; and

bits 29 down to 0 are set equal to bits 29 to 0 of the P-TMSI.

A foreign TLLI is built by a MS which has a valid P-TMSI as follows:

bit 31 is set to 1 and bit 30 is set to 0; and

bits 29 down to 0 are set equal to bits 29 to 0 of the P-TMSI.

A random TLLI is built by an MS as follows:

bit 31 is set to 0;

bits 30 down to 27 are set to 1; and

bits 0 to 26 are chosen randomly.

An auxiliary TLLI is built by the SGSN as follows:

bit 31 is set to 0;

bits 30 down to 28 are set to 1;

bit 27 is set to 0; and

bits 0 to 26 can be assigned independently.

Other types of TLLI may be introduced in the future.

Table 1: Structure of TLLI

Bit						Type of TLLI
31	**30**	**29**	**28**	**27**	**26 to 0**	
1	1	T	T	T	T	Local TLLI
1	0	T	T	T	T	Foreign TLLI
0	1	1	1	1	R	Random TLLI
0	1	1	1	0	A	Auxiliary TLLI
0	1	1	0	X	X	Reserved
0	1	0	X	X	X	Reserved
0	0	X	X	X	X	Reserved

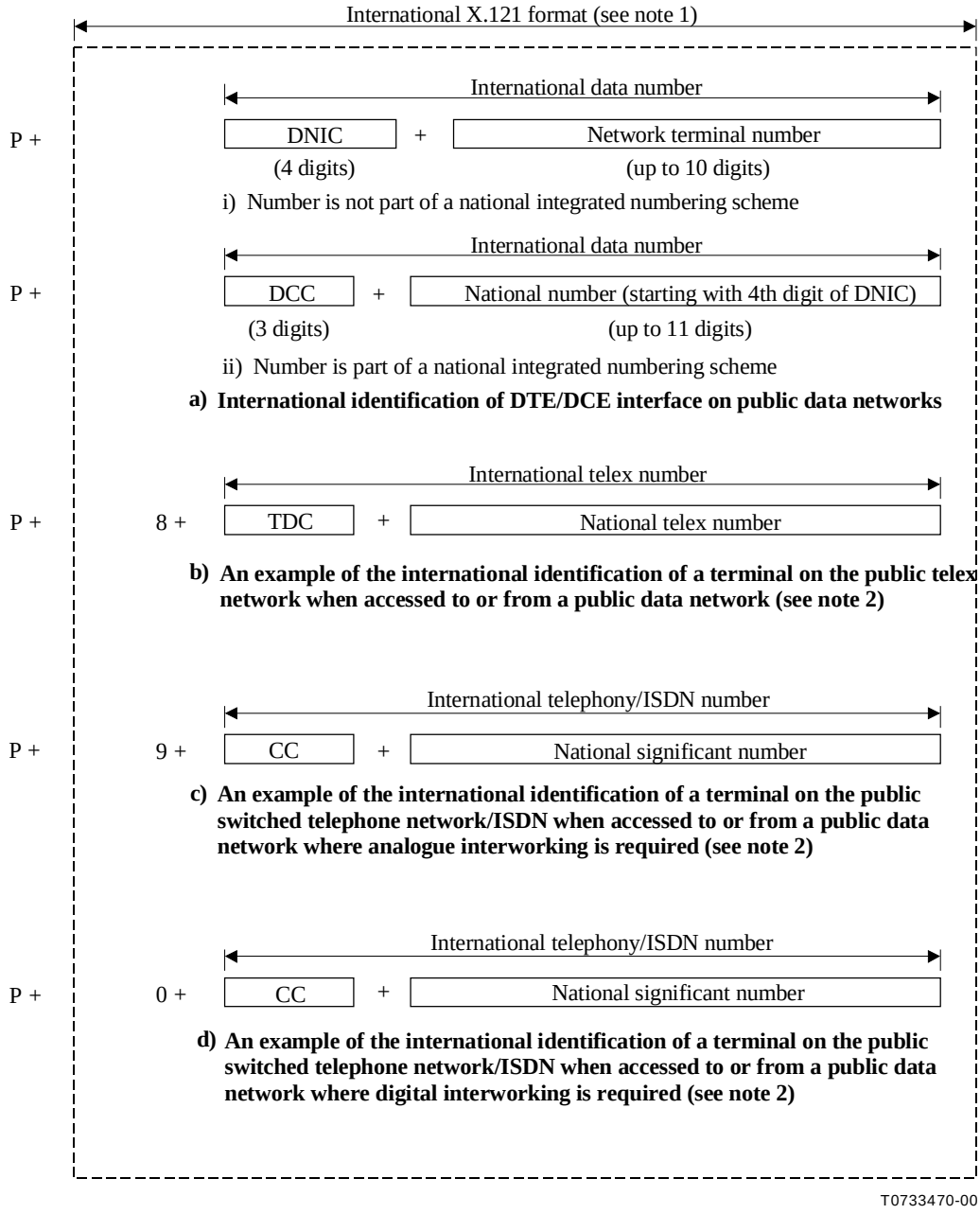
"T", "R", "A" and 'X' indicate bits which can take any value for the type of TLLI. More precisely, "T" indicates bits derived from a P-TMSI, 'R' indicates bits chosen randomly, "A" indicates bits chosen by the SGSN and "X" bits in reserved ranges.

5.2 Public Data Network Identification schemes

5.2.1 X.121 Numbering plan

ITU-T Recommendation X.121 [9] defines the design, characteristics and the application of the Numbering Plan for Public Data Networks. The X.121 numbering plan has been developed in order to facilitate the operation of public data networks and provide for their interworking on a worldwide basis. The numbering plan allows for a number of public data networks in a country, the identification of a country as well as a specific public data networks within that country and a mechanism for interworking with other numbering plans such as E.164. It also provides for the use of variable Private Network Identification Codes for the numbering of private data networks in harmony with the Public Numbering Plan.

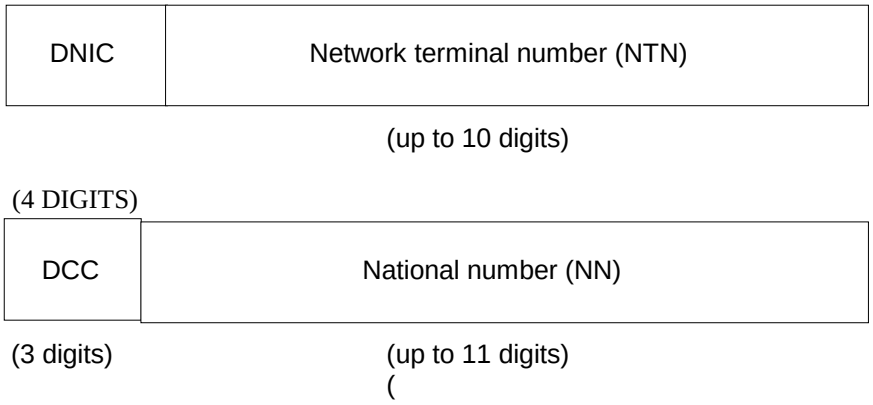
The format of an X.121 number is shown in figures 4 and 5. The maximum length of an X.121 number is 14 digits.



CC: Country Code as defined by ITU-T Recommendation E.164 [4]
DCC: Data Country Code
DNIC: Data Network Identification Code
P: Prefix
TDC: Telex Destination Code

NOTE 1: The term "International X.121 format" refers to the formats included within the dotted lines and excludes prefixes.
NOTE 2: This illustrates the case where use is made of an X.121 escape code to identify a data terminal on either the public telephone network or ISDN (identified by an E.164 number) or on a telex network (identified by an F.69 number). The various interworking scenarios are described in separate Recommendations. It should also be noted that in the case of calls from a PSPDN to an integrated ISDN/PSTN which does not require a distinction between digital and analogue interfaces, only a single escape code (e.g. 9 or 0) may be required. However, all PSPDNs interworking with ISDNs, PSTNs and integrated ISDN/PSTNs should also support both 9 and 0 escape codes when acting as an originating, transit or destination network.

Figure 4: Format of X.121



DNIC: Data Network Identification Code
NTN: Network Terminal Number
DCC: Data Country Code
NN: National Number

Figure 5: Format of X.121 (continued)

5.2.1.1 DNIC

The Data Network Identification Code has 4 digits, of which the three first digits are the DCC. The first digit of the DNIC is as follows:

a) 1 For public mobile satellite systems and public global networks

b) 2 to 7 For country or geographic specific DNICs

The DNIC can identify:

a) Public Data Network within a country,

b) global service,

c) PSTN or an ISDN,

d) group of Public Data Networks,

e) group of private data networks.

5.2.1.2 NTN

The Network Terminal Number, which has a maximum length of 10 digits, identifies a specific Data Terminal Equipment/Data Circuit-Terminating Equipment (DTE/DCE) interface on the network that is identified with the DNIC. A Network which is assigned a DNIC is not part of an integrated national numbering scheme.

5.2.1.3 DCC

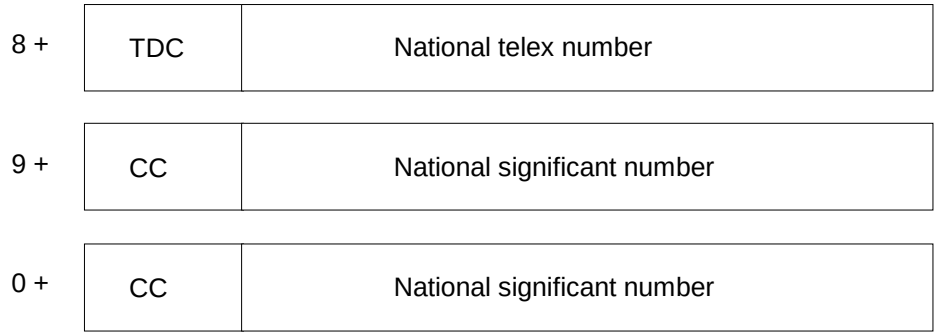
The Data Country Code has 3 digits, and each country is assigned at least one 3-digit DCC. Since the three first digits of the DNIC are the DCC, the DCCs always start with the digits 2, 3, 4, 5, 6, or 7.

5.2.1.4 NN

The National Number, which has a maximum length of 11 digits, identifies a specific DTE/DCE interface on the country that is identified by the DCC. In this case the national number is part of an integrated numbering scheme.

5.2.1.5 Escape Codes

To allow for interworking with either the E.164 numbering plan of the F.69 numbering plan the digits "8", "9" and "0" are used as escape codes. Their allocation is shown in figure 6. The escape codes are not a part of the X.121 number but are part of the "international X.121 format". The X.121 escape codes are provided to enable DTEs and networks (numbered under the X.121 numbering plan) which do not have the capability to support a signalling mechanism such as NPI/TON address format as defined in the X.25, Frame Relay and ATM signalling protocols. Networks and terminals should, where possible evolve, towards supporting the NPI/TON signalling mechanism. It is recommended that any of the new signalling protocols for Public Data Networks should not use the escape code mechanism as a means of number plan interworking.



TDC: Telex Destination Code as defined by F.69
CC: Country Code as defined by E.164 [4]

Figure 6: Use of X.121 Escape Codes for Interworking

5.2.2 Frame Relay Networks

Frame Relay networks are numbered under either X.121 or E.164. The label identifies the DTE point of attachment.

5.2.3 AESA

ATM End System Addresses (AESA) are based on Network Service Access Point (NSAP) addresses as defined in Annex A to ITU-T Recommendation X.213 [10] and ISO8348. An AESA is an NSAP that is used to address ATM end systems.

5.2.3.1 AESA format

There are many types of ATM End System Addresses (AESAs), but they are all 20 octets in length. The format of an AESA is illustrated in figure 7.

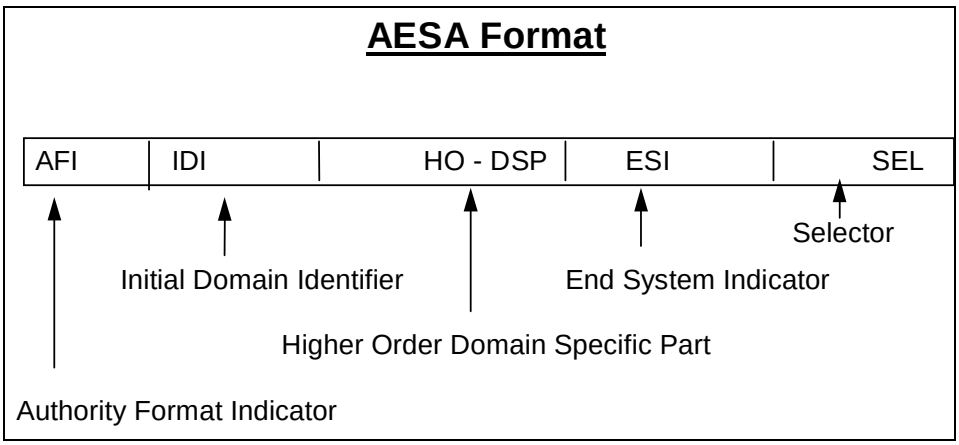


Figure 7: Format of ATM End System Address

5.2.3.1.1 AFI

The Authority Format Indicator indicates the type of AESA that will follow. The length of this field is always 1 octet.

NOTE: In theory there are possible 200 types of AESA.

5.2.3.1.2 IDI

The Initial Domain Identifier indicates the authority responsible for allocating values and format of the HO-DSP. The length of this field may vary.

5.2.3.1.3 HO-DSP

The values and format of this field are determined by the authority indicated by the IDI. The length of this field may vary.

5.2.3.1.4 ESI

The End System Indicator identifies the ATM end system and may contain an IEEE MAC address. The length of this field is 6 octets.

5.2.3.1.5 SEL

The selector is used by the end system for internal purposes. The length of this field is 1 octet.

5.2.3.2 Types of AESA

There are many types of AESAs. Some of these are shown in table 2.

Table 2: Types of AESAs

Private Networks	
AFI=37	for X.121 encapsulated NSAP
AFI=41	for F.69 encapsulated NSAP
AFI=45	for E.164 encapsulated NSAP
AFI=35	for IPV6 encapsulated NSAP
AFI=49	for local number plan (not globally unique)
AFI=39	For DCC
AFI=47	For ICD
Public Networks	
AFI=45	for E.164 encapsulated NSAP (E.164 is a specific B-ISDN Number)
AFI=39	for DCC
AFI=47	for ICD
AFI=77	for ITU IND

5.2.3.2.1 E.164 AESA

The IDI of an E.164 AESA contains an E.164 (address). The IDI is always 8 octets in length. In order to encode the E.164 address within the AESA, a single semi-octet (1111=F) is added to the end of the E.164 number to obtain an integral number of octets. The E.164 is then right justified within the IDI and left padded with zeros.

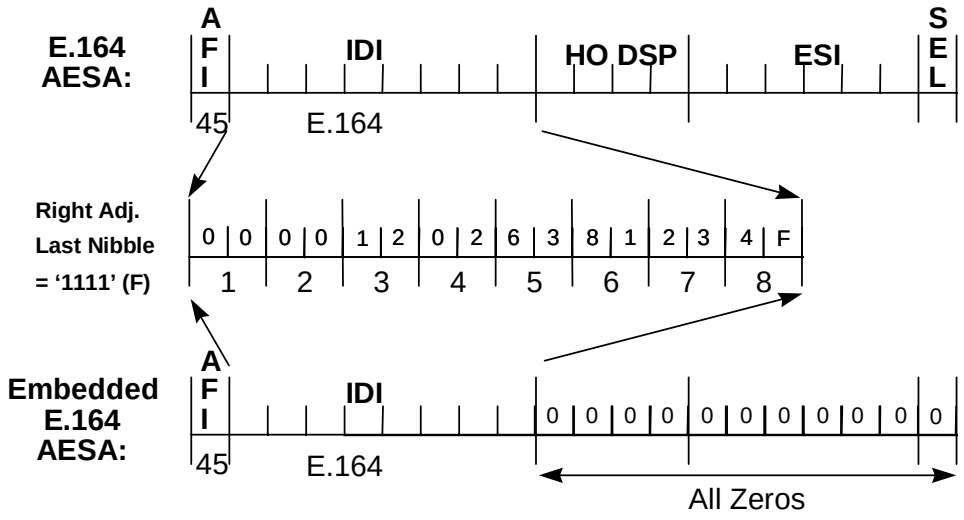


Figure 8: E.164 AESA Format

5.2.3.2.1.1 ICD AESA

This International Code Designator (ICD) identifies an organizational authority responsible for allocating and assigning values of the DSP. The ICD format AESA uses the individual AFI 47. This is followed by a 4 digit (2 octet) IDI.

5.2.3.2.2 DCC AESA

The Data Country Code (DCC) AESA format uses AFI 39 followed by a 4 digit ISO country code (DCC value). The IDI element of the DCC AESA specifies the country in which the address is registered.

5.2.3.2.3 ITU-IND AESA

The ITU International Network Designator (IND) AESA uses AFI 77 and is followed by a 3 octet (6-digit) IND value. The IND is administered by the ITU.

5.3 Network Service Access Point (NSAP) addresses

The NSAP address is the information that the OSI Network service provider needs to identify a particular Network Service Access Point (NSAP). According to the OSI terminology NSAP is the access point between the OSI Network and Transport Layers.

The NSAP addressing scheme and its administration is based on the concept of the hierarchical addressing domain. An addressing domain is a portion of the global addressing domain including all the addresses assigned by the same authority. A domain can be further partitioned into subdomains.

The principle of the hierarchical addressing domains is reflected in the structure of the NSAP address. This implies that the initial part of the address identifies a subdomain and the authority associated with that subdomain is responsible for assigning the remaining part of the address.

There are different types of NSAP addresses depending on the content of the Initial Domain Part field (IDP field) which consists of the Authority and Format Identifier (AFI) and Initial Domain Identifier (IDI). The IDP identifies the addressing authority responsible for the assignment of the remaining part of NSAP called Domain Specific Part (DSP).

According to ITU-T Recommendation X.213 [10] the following IDI formats are allowed:

- X.121,
- ISO DCC (Data Country Code),
- F69,
- E.164,
- ISO ICD (International Code Designator),
- Local.

In the case of ISO DCC the IDI consists of a three-digit code used to identify countries according to ISO 3166 [11] rules. The IDI codes and the responsibility for administration and management of the DSP addressing space are given to the national ISO member bodies. When such a body does not exist the code is assigned to a sponsored organization. In some cases the national ISO member bodies can delegate administration and management of ISO DCC codes to other organizations.

5.4 IP Network Naming

An Internet name is a string of alphanumeric digits used to identify a host. In addition to the Internet name one or more IP addresses are linked to the interface where the host is connected. The IP addresses are used to route the call to the called host through the IP platform. To set up a communication the Internet name of the called host is therefore translated into the corresponding IP addresses.

In the Internet there is then a clear separation between the name used at the application level to identify a host and the address used at the routing level to route the communication to the host interface. This distinction allows the use of Internet names which are not required to reflect the topology of the network and may meet other important requirements such as user friendliness, portability, etc.

An Internet name is structured in several levels: Top Level Domain (TLD), one or more subdomains and host name. The TLDs comprise two categories: generic TLDs such as .com, .org and geographic TLDs (ccTLDs) which are used to identify a specific country or territory.

An Internet Protocol network allows computer to communicate without being on the same physical network. This is accomplished by breaking down the message into packets of variable lengths. Each packet carries a forwarding address, which are assigned in a globally unique fashion. These packets are sent to a router that forwards each packet to another router that is in the best position to forward the packet to its destination. The paths followed by these packets may be different (connectionless).

5.4.1 IP Version 4 Addressing

IP forwards each packet based on a 4 byte (32 bit) destination address which is usually expressed by converting each byte into a decimal (0 to 255) and separating the bytes by a period. Besides easier readability, another reason for this notation is that the IP address is split into a network number (contained in the leading octet) and a host number. The NIC (Network Information Centre) assigns a network number and the recipient is allowed to assign valid IP addresses to hosts within the range.

The sizes of the Network part of the IP address and host part depend on the size of the network.

Table 3: Classes of Networks

Network Type	Properties of IP Address
Class A	Comprises of Networks 1.0.0.0 through 127.0.0.0; The network number is contained in the first Octet. This allows the remaining 24 bits to be used for addressing hosts
Class B	Comprises networks 128.0.0.0 through 191.255.0.0; The network number is in the first two octets. Thus there can be 16320 nets with 65024 hosts each
Class C	Comprises of networks from 192.0.0.0 through 223.255.255.0; The network number is contained in the first three octets. This allows up to 2 million networks with 254 hosts each
Class D, E, F	These network address are in the range 224.0.0.0 through 254.0.0.0; Currently these experimental or reserved for future use

5.4.2 IP Version 6 Addressing

IP Version 6 (IPv6) is the specific protocol chosen by the IETF (RFC 1752, RFC 1883, RFC 1884) as the Internet's Next-Generation IP. IPv6 uses 128-bit addresses as opposed to IPv4 that uses 32-bit addresses, to ensure sufficient addresses to last well into the 21st Century and beyond.

The IPv6 standardization effort also extends and improves on known limitations of IPv4. Specifically, IPv6 has the following advantages:

- Essentially unlimited address space.
- Simplified auto configuration; machines can plug into a network, generate their own addresses without manual intervention.
- Configuration, and gain full Internet access.
- IPv6 header is designed for optimized processing.
- Standard set of security features all IPv6 nodes must implement.
- Support to automatically reconfigure entire networks.

5.4.3 Universal Resource Locators (URLs)

A URL can be thought of as a networked extension of the standard filename concept: not only can it point to a file in a directory, but the file and directory can exist anywhere on the network. URLs can also be used to point to queries, documents stored on databases or whatever.

There are several protocols that are in use including:

- http - hypertext transfer protocol (commonly used on the World Wide Web).
- ftp - file transfer protocol.
- gopher - gopher protocol (retrieves text only documents).
- telnet - connects to remote terminals.

Example of an URL

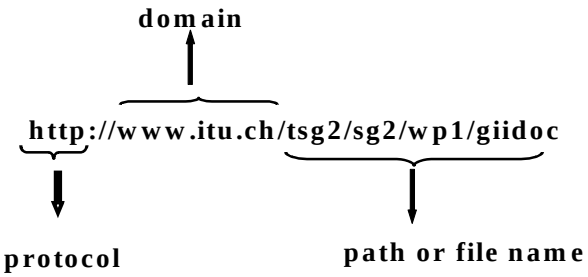


Figure 9: Example of a Universal Resource Locator

The URL serves the function of name since it must be translated to an IP address to establish the connection.

Domain names form an integral part of the URL. All domain names include a top level domain (TLD) e.g., ".com", ".edu", ".int", ".org", followed by a subdomain. The TLD may also be geographical. The geographical TLDs are usually two character codes that indicate the country e.g. ".ch" for Switzerland. The non geographic TLDs are also referred to as generic TLD and are global. Within a TLD names are created and assigned e.g. "itu". The administration is then delegated to the assignee. This is represented in figure 9.

5.5 International Signalling Point Codes

Signalling Point Codes (SPCs) are used in public telephone networks using Signalling System no. 7 (SS#7). SS#7 is a protocol for information interchange between exchanges and other network nodes named signalling points. SPCs are the addresses of the signalling points. There are two types of SPCs: ISPCs and NSPCs. Each of those types constitutes an independent addressing scheme. ISPCs are used in international networks, to address for instance international exchanges. NSPCs are used in national networks. ISPCs and NSPCs are usually individually assigned to network operators. Within the present document only ISCPs are considered.

5.6 X.400

X.400 refers to a set of standards developed by the ITU and ISO, which describe a message handling system to exchange information between originators and recipients. X.400 names have the function of identifying users of Message Handling System services (MHS services). The X.400 naming plan uses so-called Management Domains on two different hierarchical levels: Administration Management Domains (ADMDs) and Private Management Domains (PRMDs). ADMD names are assigned to public MHS providers. Usually, the MHS providers assign PRMD names within their ADMD to users in particular organizations. The independent regulator may assign PRMD names to users directly. Within its own PRMD each organization makes further subdivisions into names to identify its departments and its employees.

In the SMTP Protocol there are certain requirements that must be met for X.400 messages: the message must not be lost or altered during transit, the parties handling the message must be able to interpret the message. In addition X.400 offers delivery notification and receipt notification and has an integrated directory service.

An example of an X.400 address and an e-mail address:

- G=sverre; S=isaksen; O=nett; OU=s; PRMD=telenor; ADMD=telemax; C=no.

ADMD is a name that is assigned by the service provider and thus means one advertises the service provider name whenever one gives the X.400 email address. It also means that if a company wants to migrate from one carrier to another it must change its X.400 address.

The characteristics necessary to specify an X.400 address are specified in ITU-T Recommendation F.401 [12]. The list of characteristics is quite extensive and many of them are not used.

5.7 Telex numbers

Telex numbers are strings of digits used on dedicated telex networks for identification of network termination points. They are hierarchically structured and consist of a telex destination code followed by a national telex number. There are no restrictions to the length of the national telex number. If there is an Naming and Addressing Plan Manager (NAPM), blocks of telex numbers are assigned to telex network operators which assign individual numbers from their blocks to users.

5.8 ISO 8802.3 MAC addresses

ISO 8802.3 MAC level addresses are uniquely assigned to all Ethernet cards produced in the world. Each card has a unique physical address burned into its chip. Addresses of this type have no structure and thus make efficient routing difficult. Further, since the addresses are burned into the chip and chips may fail and be discarded, it is difficult to know if a specific address still exists.

6 Application programming interfaces

6.1 Summary

ETSI has been examining various aspects related to the specifications for Universal Communications. These studies have ranged from a detailed investigation into Human Factor aspects and scenarios, common identifiers for universal communication schemes, network architectures and signalling requirements.

This presentation reports on recent and ongoing work to establish the API requirements for Universal Communications. Of necessity, the API work in ETSI SPAN and 3GPP, OSA/PARLAY has been considered as a prime candidate.

6.2 Introduction

Over the last twenty years, a wide range of different electronic communication media has become available to users at reasonable cost. In addition to the basic fixed voice telephone, users now have a choice of fax, pagers, mobile phones (supporting Short Message Service as well as voice calls) and e-mail.

The undoubted benefit of user choice increases the number of communication options but, inevitably, increases the complexity of the task of managing those communications. For instance, every time users change their contact details (for example by changing their e-mail provider) they will want to ensure that a wide range of potential communicants are notified of the change. Delivering such notification can involve significant effort and cost - and of course some of the communicants may have changed *their* contact details in the meantime!

Increasingly intense lifestyles mean that users often wish to remain contactable at all times, and they may choose to optimize the chances of this happening by letting potential callers know the best means of reaching them at a particular time. In other instances they may wish to be selective about who is able to contact them at particular times - (e.g. at home, in the evenings or even at night). Additionally, the user may wish to place constraints on the medium used for incoming communications - for instance a user wishing to keep in touch while on the road might find it impossible to handle e-mail, but could quite easily cope with voice mail.

6.3 Universal communications model

There are three main components in the universal communications system; the user with a unique identity, the Personal User Agent, and the Service Agent. In such a system, every user has an associated PUA, and every service has an associated SA.

The following is a brief description of these components:

- A **USER** is a logical entity, which may use certain services. A user may take the form of a terminal (e.g. telephone transceiver) or be more directly related to the user (e.g. a human offering credentials). A UCI is a single, unique identifier for a user. A UCI would consist of a user-friendly alpha part, a numeric part and an additional information field (not seen by communicants). It would be allocated by a trusted authority and be stable, i.e. it would not change over time even with a change of service provider.

- A **PUA** is a software entity located in an overlay network and associated with a specific UCI. It has access to information on all of a user's communications services, their service identifiers (e.g. telephone numbers, email addresses, etc.) and also has access to current status and personal preferences information in relation to these services (e.g. mobile phone switched on and reachable, not able to access home telephone, does not wish to receive emails at this time, etc.). This is basically presence and availability information as defined by the IETF IMPP and PAM Forum. A PUA is a software representation of a user and it will only talk to its own user, other PUAs and SAs.

- An **SA** is linked to a communication service (or network). It would typically be provided by a network or service provider and would be specially trusted by some PUAs. It will never forward potentially personal information (such as someone's personal mobile number) to originators, but it can use this information to expedite the set-up of a communication. An SA is the link between the main UCI system and networks and services. It talks to PUAs, other SAs and its own network/service.

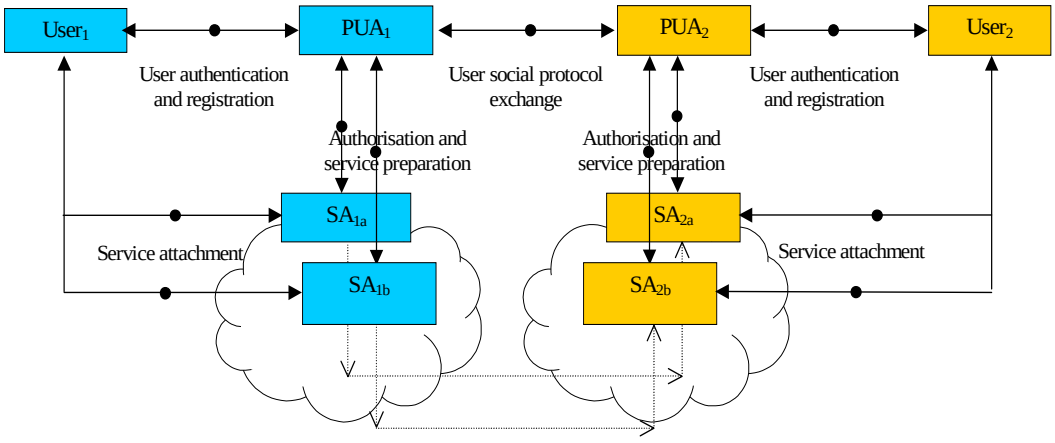


Figure 10: Relationship of UCI components for two PUA users

6.4 API requirements

Parlay 3.0 specifications are now available for public review and currently cover the following sets of specifications:

Joint Working Group APIs that have been defined jointly between ETSI, The Parlay Group and the 3GPP, in co-operation with a number of JAIN™ Community member companies. These APIs build upon the Parlay 2.1 APIs and provide additional functions in the areas of Terminal Capabilities, Data Session Control and Content Based Charging. These Joint Working Group APIs are published in ES 201 915 (see bibliography). This twelve part specification is listed on, and may be downloaded from our specifications page.

Policy Management APIs defined by The Parlay Group. This set of specifications may be downloaded from our specifications page.

Presence and Availability Management (PAM) APIs. The Parlay PAM APIs have been derived from the first release of a PAM interface specification created by the PAM Forum (http://www.pamforum.org) industry consortium. The Parlay PAM APIs are expected to be available for public review by end of the Q1 2002.

6.5 Planned work

Identification methods: ETSI TC-HF is leading the examination of current identification schemes e.g. E.164, IPv4/6, X.121, etc to determine whether universal communications can be supported by current methods. The present document has identified several uses for identifiers e.g. Naming, Addressing and Routeing and recognized that accurate descriptions of these roles has proved somewhat difficult.

API Requirements: ETSI TC-HF is leading the examination of the suitability of the facilities offered by OSA/PARLAY/JAIN APIs for support of PUA and SA in Universal Communications. Early results indicate strong support for telephony-based services in a multi-service provider environment. Further studies into multimedia and e-mail services continue.

Annex A (informative): Methodology

It was clear that in the time available to prepare this guide that it would not be possible to read all the material available in any detail, therefore a way of quickly assessing the material needed to be devised.

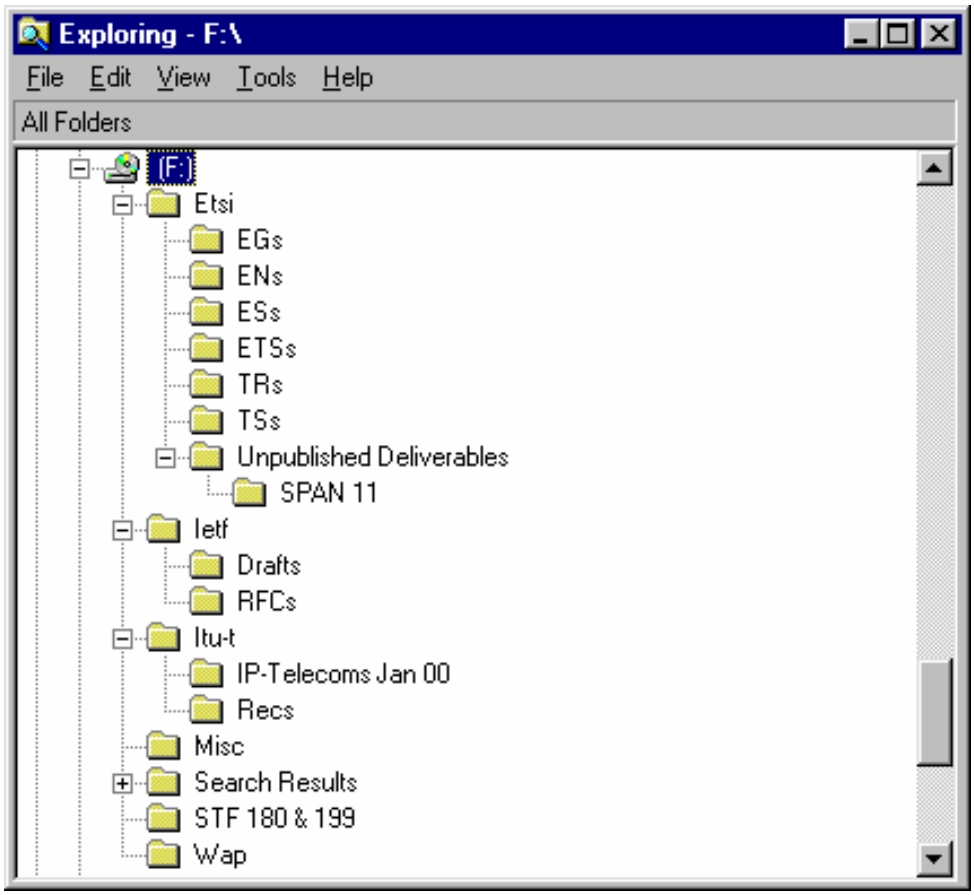
A further problem was working out a method for storing and indexing the reference material so that development of the deliverable could continue after a break, or by somebody else. At present, there are about 80 documents that were identified as possibly having some relevance, with some of these being between 100 and 200 pages in length. Most are about 30 pages in length. The ETSI documents were largely identified by searching the ETSI work programme database, using the advanced feature and including non-active TBs.

A.1 Reference material storage and cross-referencing/indexing

Although it would be possible to directly reference some material on the Internet, this assumes there is continuous, fast access to the internet. The simplest solution was to store the reference material on a CD.

The current version has an extensive Bibliography at the end, with each of the reference documents hyperlinked. There are two options for creating a hyper-link although the result is the same (see clause on how to use hyper-linked documents). One is to give a specific reference, the other is to use a relative path, which was chosen so that the document and its reference material could be moved between PCs. The only requirement is to have the correct directory structure as shown in the screen capture below, with the main document at the highest level (which itself could be a sub-directory). The screen capture is of the CD, which can be used to load the reference material.

As the document is developed, documents that are referred to in the text, will be moved (with the hyperlink) from the bibliography to the reference clause.



A.2 Limitation of Electronic methods

A.2.1 Entitlement to download and use documents

Documents, which are available for electronic download, are usually available in either Adobe Acrobat (pdf) format or Microsoft Word (doc) format. The former can be set to stop or restrict copying via the Windows clipboard.

A.2.2 ITU-T recommendations and temporary/working documents

In this clause, "working documents" refers to those documents made available during ITU-T meetings and are normally referred to as Temporary Documents (TDs). These are only available to download by "TIES" users and the content is restricted to ITU-T members. TDs are normally available in Microsoft Word format.

Electronic versions of ITU-T recommendations only available either with an online payment to the ITU electronic bookshop or with an online subscription and can only be circulated electronically within the member's organization. Recommendations are normally available as either Adobe Acrobat (pdf) files or Word documents.

The filenames of Recommendations online seem to have changed as the ITU's system has developed, so it is not possible to use the filename as an indication of whether one has the correct version. Since downloading is only possible using a browser, the file-date is that of the day on which the file was downloaded - not very helpful! The file has to be opened and the date on the front page checked to see whether it is the correct version.

Recommendations online indicate whether a particular version of a recommendation is "in force" or "superseded".

A.2.3 ETSI standards, reports, etc.

ETSI has a number of different deliverable types, all of which are available to download without payment. Because of this policy, published versions of documents are always available in Adobe Acrobat format, with copying of text allowed but not figures.

Annex B (informative): ITU Global Numbering Resources

Following is a list of ITU-T Global Numbering Resources administered or registered by the ITU. Not all of these schemes have been discussed in the above clauses because some of these schemes are not as relevant to the future telecommunications services, e.g., F.32 Telegram Destination Indicators.

- E.164 Country Codes (including shared country codes and associated Identification Codes).
- Registration and administration of E.169.1 Universal International Freephone Numbers (UIFNs).
- E.164 Dialling Procedures (International prefix, national (trunk) prefix and national significant number).
- E.118 Issuer Identifier Numbers (IINs) for the International Telecommunication Charge Card.
- E.212 Mobile Country or Geographical Area Codes (including shared country codes and associated MNCs).
- Q.708 Signalling Area/Network Codes (SANCs) and International Signalling point Codes (ISPCs).
- F.69 Telex Destination Codes and Telex Network Identification Codes.
- F.1 Five-letter Code Groups used in the International Public Telegram Service.
- F.32 Telegram Destination Indicators.
- X.121 Data Country Codes (DCCs) and Data Network Identification Codes (DNICs).
- F.400 and X.400 Administration Management Domains.
- M.1400 International Carrier Codes ITU ATM End System Addresses (AESA) (ITU-T Recommendation E.191 [5] refers).
- Universal Personal Telecommunication Numbers (ITU-T Recommendation E.168 refers).
- Universal International Premium Rate Numbers (ITU-T Recommendation E.169.2 refers).
- Universal International Shared Cost Numbers; and possibly (ITU-T Recommendation E.169.3 refers).

Annex C (informative): Bibliography

Presentations from ITU-T IP-Telecoms Interworking Workshop (Numbering, Naming, Addressing and Routing) Geneva 25-27 January 2000:

- IPW-9 Beyond Naming & Addressing: Identifying & Reaching - presented by Mr. Keith Knightson (Nortel Networks).
- IPW-10 User Identification Solutions in Converging Networks - presented by Mr. Mike Pluke (Castle Consulting Ltd.).
- IPW-11 TIPHON Perspective on VoIP Numbering - presented by Mr. John Horrocks (DTI), TIPHON WG4 Chair.
- IPW-13 Interworking Between Public Data Networks and the Internet; A Numbering Perspective - presented by Mr. Peter Hicks (Rapporteur ITU-T SG7 Q3: Data Network Numbering).

3GPP and ETSI numbering/identification plans

- ETSI TS 100 927: "Digital cellular telecommunications system (Phase 2+) (GSM); Numbering, addressing and identification (GSM 03.03 version 7.3.0 Release 1998)".
- ETSI TS 123 003: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Numbering, Addressing and Identification (3GPP TS 23.003 version 4.3.0 Release 4)".

ETSI NA/SPAN Identification (supplementary) service descriptions

- ETSI EN 300 089 (V3.1.1): "Integrated Services Digital Network (ISDN);Calling Line Identification Presentation (CLIP) supplementary service; Service description".
- ETSI EN 300 090 (V1.2.1): "Integrated Services Digital Network (ISDN); Calling Line Identification Restriction (CLIR) supplementary service; Service description".
- ETSI EN 300 094 (V2.1.1): "Integrated Services Digital Network (ISDN); Connected Line Identification Presentation (COLP) supplementary service; Service description".
- ETSI ETS 300 095 (Edition 1): "Integrated Services Digital Network (ISDN); Connected Line Identification Restriction (COLR) supplementary service; Service description".
- ETSI ETS 300 648 (Edition 1): "Public Switched Telephone Network (PSTN); Calling Line Identification Presentation (CLIP) supplementary service; Service description".
- ETSI ETS 300 649 (Edition 1): "Public Switched Telephone Network (PSTN); Calling Line Identification Restriction (CLIR) supplementary service; Service description".
- ETSI TR 101 078 (V1.1.1): "Public Switched Telephone Network (PSTN); General aspects of standardization of PSTN services related to the transfer of identification information over the PSTN".
- ETSI ETS 300 128 (Edition 1): "Integrated Services Digital Network (ISDN); Malicious Call Identification (MCID) supplementary service; Service description".
- ETSI ETS 300 128/A1 (Edition 1): "Integrated Services Digital Network (ISDN); Malicious Call Identification (MCID) supplementary service; Service description".
- ETSI TR 101 480 (V1.1.2): "Integrated Services Digital Network (ISDN); Public Switched Telephone Network (PSTN); Framework for the provision of calling party name information".

ETSI GSM Identification (supplementary) service descriptions

- ETSI TS 100 514: "Digital cellular telecommunications system (Phase 2+) (GSM); Line identification Supplementary Services - Stage 1 (GSM 02.81 version 7.0.0 Release 1998)".
- ETSI TS 100 542: "Digital cellular telecommunications system (Phase 2+) (GSM); Line identification supplementary services; Stage 2 (GSM 03.81 version 7.0.1 Release 1998)".
- ETSI EN 300 951: "Digital cellular telecommunications system (Phase 2+) (GSM); Line identification supplementary services; Stage 3 (GSM 04.81 version 7.0.1 Release 1998)".
- ETSI TS 101 394: "Digital cellular telecommunications system (Phase 2+) (GSM); Name identification supplementary services; Stage 1 (GSM 02.96 version 7.0.0 Release 1998)".
- ETSI TS 101 395: "Digital cellular telecommunications system (Phase 2+) (GSM); Name identification supplementary services; Stage 2 (GSM 03.96 version 7.0.0 Release 1998)".
- ETSI TS 101 396: "Digital cellular telecommunications system (Phase 2+) (GSM); Name identification supplementary services; Stage 3 (GSM 04.96 version 7.0.0 Release 1998)".

3GPP/UMTS Identification (supplementary) service descriptions

- ETSI TS 122 081: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Line identification Supplementary Services; Stage 1 (3GPP TS 22.081 version 4.0.0 Release 4)".
- ETSI TS 123 081: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Line identification supplementary services - Stage 2 (3GPP TS 23.081 version 4.0.0 Release 4)".
- ETSI TS 124 081: "Universal Mobile Telecommunications System (UMTS); Line identification supplementary services - Stage 3 (3GPP TS 24.081 version 4.0.0 Release 4)".

3GPP/ETSI Vocabulary

- ETSI TR 121 905: "Universal Mobile Telecommunications System (UMTS); Vocabulary for 3GPP Specifications (3GPP TR 21.905 version 4.4.0 Release 4)".

OSA/Parlay (http://www.parlay.org/)

- ETSI ES 201 915-1 (V1.1.1): "Open Service Access (OSA); Application Programming Interface (API); Part 1: Overview".
- ETSI ES 201 915-2 (V1.1.1): "Open Service Access (OSA); Application Programming Interface (API); Part 2: Common Data Definitions".
- ETSI ES 201 915-4 (V1.1.1): "Open Service Access (OSA); Application Programming Interface (API); Part 4: Call Control SCF".

IETF RFCs (http://www.ietf.org/)

- IETF RFC 1034: "Domain names - concepts and facilities".
- IETF RFC 1035: "Domain names - implementation and specification".
- IETF RFC 1591: "Domain Name System Structure and Delegation".
- IETF RFC 2136: "Dynamic Updates in the Domain Name System".
- IETF RFC 2137: "Secure Domain Name System Dynamic Update".
- IETF RFC 2141: "URN Syntax".
- IETF RFC 2168: "Resolution of Uniform Resource Identifiers using the Domain Name System".

- IETF RFC 2169: "A Trivial Convention for using HTTP in URN Resolution".
- IETF RFC 2181: "Clarifications to the DNS Specification".
- IETF RFC 2182: "Selection and Operation of Secondary DNS Servers".
- IETF RFC 2234: "Augmented BNF for Syntax Specifications".
- IETF RFC 2396: "Uniform Resource Identifiers (URI): Generic Syntax".
- IETF RFC 2535: "Domain Name System Security Extensions".
- IETF RFC 2536: "DSA KEYs and SIGs in the Domain Name System (DNS)".
- IETF RFC 2537: "RSA/MD5 KEYs and SIGs in the Domain Name System (DNS)".
- IETF RFC 2538: "Storing Certificates in the Domain Name System (DNS)".
- IETF RFC 2782: "A DNS RR for specifying the location of services (DNS SRV)".
- IETF RFC 2845: "Secret Key Transaction Authentication for DNS (TSIG)".
- IETF RFC 2915: "The Naming Authority Pointer (NAPTR) DNS Resource Record".
- IETF RFC 2916: "E.164 number and DNS".
- IETF RFC 2929: "Domain Name System (DNS) IANA Considerations".
- IETF RFC 2930: "Secret Key Establishment for DNS".
- IETF RFC 2931: "DNS Request and Transaction Signatures".
- IETF RFC 2972: "Context and Goals for Common Name Resolution".
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- ITU-T Recommendation X.121: "International numbering plan for public data networks".
- ITU-T Recommendation X.400: "Message handling services: Message handling system and service overview".

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