ETSI TECHNICAL REPORT

ETR 032

December 1991

Source: ETSI TC-NA

Reference:DTR/NA-070101

ICS: 33.080

Key words: Network, UPT

Network Aspects (NA); A standardisations programme for Universal Personal Telecommunications (UPT)

ETSI

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Foreword

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

This ETR has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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1 Scope

Universal Personal Telecommunications (UPT) is a new and universal approach to mobile communications. The first major activities on this subject emerged in various standardisation bodies - in CCITT and CCIR as well as in regional bodies - during 1990.

In spring 1990 the Strategic Review Committee (SRC) of ETSI recommended to the ETSI Technical Assembly that a study should be made on how the standardisation of UPT should be organised in ETSI. This study was completed in early 1991.

This ETSI Technical Report (ETR) is an extract from the study, covering those areas which are considered to be of general interest to the public. The report informs about the basic concepts of UPT, the standardisation issues, proposes the UPT standards and supporting investigations, and finally gives an overview of the ongoing work in international bodies (as of early 1991).

2 Basic concepts of UPT

2.1 Background

The addressing mechanisms in current telecommunications networks are very much related to the physical structure of the networks. In Public Switched Telephone Networks (PSTNs), the dialled number will address the wire from a local exchange to the subscriber's premises. In Integrated Services Digital Networks (ISDNs) the same principle is used but extended such that one out of several terminal equipment connected to the same physical connection can be addressed. In current analogue Public Land Mobile Networks (PLMNs), the addressed entity is the physical terminal itself (the mobile station) as addressed over the radio path.

These network-orientated addressing mechanisms are not very user-friendly. A person will normally have one telephone number to his home and one to his office. In addition he may also have one number to his car telephone, one number to his pocket telephone, one number to his wide area pager, one number to his telefax, one number to a message handling system, etc. With the increasing number of telecommunications services offered, the number of telecommunication addresses related to a single person will become inconveniently high. In addition, if that person is also travelling, he has to inform people of the numbers to hotels and meeting places.

Also the charging and billing mechanisms are related to the physical network ports (wire line or terminal). The subscriber of the physical line or physical terminal is charged irrespective of who is the user. This causes inconvenience e.g. when travelling (telephones at conference centres, etc.), when visiting friends, etc.

However, technology and network developments are providing new possibilities.

The PLMNs are already providing continuous mobility of the terminals. A PLMN keeps track of a moving terminal such that it can be reached for incoming calls anywhere within the coverage area of the PLMN (automatic roaming). The functions required to provide this mobility are already integrated in the PLMNs. An expansion of this functionality to PSTN/ISDN could provide for a personal mobility such that a user could register his own subscription to different network ports (terminals).

In Global System for Mobile communications (GSM), the new Pan European digital mobile telephone system to be brought into service in 1991, the subscription has been separated from the terminal equipment itself. A Subscriber Identity Module (SIM) in the form of a smart-card has been specified. The SIM holds all information related to the subscription, it is a personalised device. The SIM can then be moved between GSM terminals (with a standardised SIM interface) and the calls are always routed/charged to the SIM subscription irrespective of the terminal used.

Considering these aspects and the synergy effects inherent in the developments of ISDN, digital mobile networks and Intelligent Networks (IN), it would now be possible to break the static connection between a line/terminal identity and subscription identity. UPT is intended to provide the necessary mechanisms to handle such a personalised service which is independent of the network used.

2.2 Objectives and basic features of UPT

UPT is anticipated to bring network independent personal identification to reality by decoupling the user identity from the identity/address of the network port/terminal. UPT will provide user-to-user telecommunications services with:

Network independent user identification: A unique UPT number is assigned to every UPT user. All networks should be able to recognise a UPT Number and take appropriate actions (e.g. request UPT databases for routing information).

Personal mobility: The UPT number can be moved freely between terminals and networks at the user's convenience. Outgoing calls are charged to the UPT number and not to the wire line/terminal. Based on the dialled UPT number, incoming calls are automatically routed to the terminal where the UPT number is currently registered.

Universal access: UPT can be accessed from all types of network, fixed or mobile (PSTN, ISDN, PLMN, CPN (Customer Premises Network), etc.), all network generations (analogue, digital, etc.) and all network implementations.

Personal charging and billing: Charging and billing is based on user identity (UPT number) instead of terminal identity.

Personalised service profile and personalised terminals: A UPT service profile will contain a list of services and facilities requested by the UPT subscriber. Personalisation of terminals will give the user the possibility to use the same terminal configuration on any terminal.

Security: Authentication of both users and networks is included.

2.3 Evolutionary aspects

An early introduction in ISDN/PSTN/PLMN of an initial step towards UPT should be possible because much of the required techniques are already known from UPT-like features and services on national or international levels in current networks, e.g.

- credit or telecommunications card calls;
- personal numbering;
- mobility management functions and procedures in mobile radio networks (e.g. Mobile Application Part, MAP) including database interrogation for routing information;
- subscriber identity module (SIM smart-card) in GSM;
- etc.

For an early introduction of real UPT features these existing UPT-like features will require adaption. For the UPT application this will involve e.g. extending some national solutions to the international level, and most importantly, the introduction of the UPT number and the management of databases for UPT numbers. Of course, some initial limitations will be imposed, e.g. only speech, limited security, only incoming calls, only outgoing calls, etc.

The early user-to-network procedures will have to be adapted to network/terminal capabilities (e.g. dialled digits for authentication from a normal telephone set without smart-card-reader) and may differ between networks and between terminals. However, it should be possible for a user to indicate that an outgoing call is to be charged to the UPT number instead of the terminal (compare credit card calls). It should also be possible to register the UPT number at a specific terminal (fixed or mobile) for incoming calls so that calls addressed to that UPT number can be routed to that terminal without the calling party knowing the geographic location of the called party (compare location updating/mobile terminated calls in mobile networks).

In the long-term, the evolution of UPT would be co-ordinated with the evolution of ISDN, and future public mobile networks, eventually as an integrated part of the services of those networks. Also other systems would be included, e.g. paging systems and messaging systems. A user could be alerted via a paging system and then choose to pick up the call at any convenient terminal. The paging system could also be used to indicate that a message has arrived in the messaging system and can be retrieved from any convenient terminal.

The most important building blocks for these future possibilities are the UPT number and a standardised UPT identification module (e.g. smart-card) for authentication and personalised subscriptions.

3 Overview of standardisation areas relevant to UPT

The objectives described above need, in order to be globally met, studies in a number of areas relevant to standardisation.

A prime objective is to define the service aspects describing UPT from a users point of view. Also principles for charging and service interworking have to be studied.

From a network point of view, principles for numbering and routing (allowing route optimisation) should be established. This is required, as one of the basic ideas behind UPT is network independent user identification.

The IN concept is perhaps the most important platform to use for the implementation of UPT and consequently the guide-lines for standards based on IN should be studied and UPT considered in the definition of IN capabilities.

As regards signalling, signalling architectures for the support of UPT have to be considered and adequate protocols for user/network and network/network dialogues defined. The requirement on universal access means that all relevant network types (PSTN, ISDN, the different types of PLMNs, mixed private/public networks, etc.) have to be considered.

In order to make the services user friendly requirements on the man-machine interface should be analysed. These studies should also include security aspects, especially authentication of the UPT user.

As regards terminals (including identification modules), agreements are required on types suitable for the support of UPT and if necessary special requirements motivated.

As defined for a multi-operator environment, principles for network management, accounting, network performance and quality of service should be established.

Technical reports and standards produced for other areas (IN, GSM, etc.) should be used as a base for the work. In most cases however these results are valid for a specific network or functional area, whereas more general studies are required for UPT.

4 Standardisation issues in details

For a complete standardisation of UPT, work is needed in a wide range of areas, and consequently UPT standardisation will have to be carried out in these areas by appropriate bodies. The various areas of work needed to completely define UPT include:

1) General aspects:

- scope and objectives of UPT;
- priorities of UPT features, evolution and implementation phases;
- vocabulary for UPT.

2) Service aspects:

- numbers and identities;
- charging and billing principles;
- security requirements;
- UPT terminals;
- UPT subscription devices;
- man-machine interface aspects;
- UPT procedures from a user perspective;
- UPT subscriptions and service profiles;
- service interworking;
- service interactions.

3) Operational aspects:

- inter-operator agreements for global operation.

4) UPT user equipment:

- functional requirements on UPT terminals in various serving networks;
- conformance test specifications for UPT terminals in various serving networks;
- functional and physical requirements on UPT subscription devices;
- conformance test specifications for UPT subscription devices.

5) Network aspects:

- network architecture;
- network capabilities;
- numbering, addressing and identification;
- UPT call handling;
- organisation of UPT databases;
- UPT procedures and information flows between UPT network elements;
- security procedures;
- performance objectives.

6) Signalling:

- realisation of UPT procedures in various networks;
- Mobility Services Application Part (MSAP);
- security protocols.

7) Network management:

- UPT subscriber administration;
- tariff, charging and accounting administration;
- UPT network configuration control;
- operations and performance management;
- security management;
- maintenance of UPT functional entities;
- application protocols for UPT management.

The key standardisation issues resulting in the areas listed above are discussed in more detail in the following sections. In Annex A, a systemised overview of the various areas and issues being part of UPT standardisation is provided.

4.1 General service aspects

In the standardisation of UPT there will be a need to define a service description of UPT in general terms, like a stage 1 service description. This involves a wide range of areas, of which specific important areas are treated in separate sections, like numbering, charging and billing, user equipment, security, etc.

In addition to those areas covered by specific sections there are other areas which must be included in a general service description. These may include general areas like scope and objectives of UPT, and UPT vocabulary. In addition, UPT cannot be provided to UPT users with all features from day one. Limitations in network implementations, and simply the fact that it may be desirable to start some form of UPT service before all advanced features are defined, will also make it necessary to define evolution and service implementation phases of UPT.

Of more specific areas not discussed in separate sections are areas like how UPT subscriptions and service profiles are organised, and not at least the UPT procedures from a user perspective. In addition, service interworking between UPT and other services must be considered.

4.2 General network aspects

There is a need to standardise the network functions and capabilities that are required to provide each of the service features of UPT and to support the related user procedures. The issues related with specific network aspects - such as signalling, numbering, etc. are treated in following sections. This section deals with global network aspects, including performance and quality of service.

From a network point of view, the provision of both basic and advanced UPT features is better achieved through the use of databases and advanced signalling in the network, i.e. by using IN techniques. It is recognised that the use of conventional switch-based techniques alone, as for other services of a less global nature, may not be sufficient in the case of UPT. This is primarily due to problems connected with the UPT user mobility and the requirements for optimised call routing.

It must be noted that the network capabilities required for UPT depend directly on the available technology and on the requested UPT features: both these aspects are expected to evolve and need to be phased over time. Therefore, the descriptions relating to network aspects will need to be continually enhanced to meet the requirements for each phase.

Performance requirements will have to be analysed and specified for each phase, in line with the desired quality of service, and both aspects will impact on several specific networks. The requirements that will be specified may either be of a global nature across the network (e.g. call set-up delay) or of a specific nature (e.g. maximum number of queries per time-unit handled by a single UPT database), however further study is needed on these points.

4.3 Signalling

4.3.1 Introduction

UPT requires additional signalling facilities to cope with the roaming capability of a UPT user: the database where the subscription (service profile) information elements are stored and the exchange in charge of the calls would be different in most cases. The mobility management implies exchange of data across the network between the personal database and a local entity taking the charge of a user roaming in its area. A network protocol should be defined for this purpose. The establishment of incoming calls will require signalling exchange so that the network can retrieve all information elements required to route the call (mainly the registration address) and to check if the service required by the calling party fits with the service profile of the personal user. In the opposite direction, the set-up of a UPT user originating call implies the retrieval of service profile data. In addition, the UPT user or his subscription device should be able to dialogue with the network, for registration purposes, or any other kind of requests. For calls destined to the UPT user, a network-user dialogue should take place to identify and alert him.

According to what is described above, four main areas have to be considered for signalling standardisation:

- network protocol for mobility management (including security data transfer);
- network protocol for UPT service management (e.g. supplementary services status modification);
- network protocol for UPT call handling;
- user signalling to support user-network dialogues (e.g. identification, authentication, service requests).

4.3.2 Open issues

The definition of a network signalling to support UPT is one of the aspects to be covered. This protocol should provide facilities to support mobility and service management which is the main specific characteristic of a UPT user. In addition, depending on the evolution of studies on the Integrated Services Control Part (ISCP) and the Intelligent Network Application Part (INAP), this protocol would provide call handling functions if required.

Another area to be studied is the definition of an user-network signalling. This protocol would be used on the access and possibly in the network. The ISDN access signalling Digital Subscriber Signalling System No. one (DSS1) does not provide all the facilities needed: an enhancement of the protocol is required for UPT. In addition, the user request could be transported via the network up to a UPT mode. The INAP should be analysed to see whether it can provide the facilities required for this transfer.

Taking into account that early implementation in networks unable to provide enhanced facilities should be envisaged, the definition of a simplified protocol would be required.

4.4 Interworking

4.4.1 Introduction

In a long term configuration, UPT should be supported by all the telecommunications networks in service. In addition, any user of any telecommunications network should be able to set-up or receive a communication with a UPT user. To reach these objectives, the interworking aspects between these networks and UPT should be studied.

Various interworking aspects have to be considered:

- harmonisation of the services;
- standardisation of the interfaces;
- harmonisation of the network protocols;
- harmonisation of the access protocols.

Since in the long term approach, the core network would be the ISDN, the harmonisation studies could take this network and its facilities as a basis.

4.4.2 Harmonisation of the services

The UPT user should be able to be connected to various networks and to have communication with any user. The networks where the UPT user is registered would provide him the services he requires: some of them could be purely UPT and then given by his UPT service provider, but most of them will be normal telecommunication or ISDN services (e.g. bearer services, teleservices, supplementary services). For these services, the support of UPT users implies a harmonisation of their characteristics as seen from the user (e.g. user operation, man-machine interface): a UPT user should be able to move from one network to another without any difficulty; i.e. to be able to operate these services in a standardised way. In addition, service interworking should be possible, when a call is set up between a UPT user and any other user. In order to reach this objective, the harmonisation of their technical realisation is also required. Beside the

ISDN, one of the main objectives is to harmonise the service provision of the (existing and future) mobile networks.

4.4.3 Standardisation of the network interfaces

When a service is provided to a UPT user, such as call set-up, some specific procedures should take place (e.g. identification, authentication) between the subscriber access and the registration function. The network interfaces should be able to support these dialogues: a certain degree of standardisation of these interfaces is therefore required in order to have a minimum loss of information in the interworking points. This aspect is more likely to concern the interfaces between the ISDN and the mobile and private networks.

4.4.4 Harmonisation of the network protocols

For instance, the set-up of a call with a UPT user will require the co-operation between different networks and with the UPT registration function in order to exchange the relevant data. This would be the case for any other services offered to UPT users. These data exchanges will be supported by the signalling protocols implemented in the networks, therefore, these protocols should be harmonised so that they provide the required facilities.

The IN should provide relevant facilities for UPT so that it could be used for this purpose. The mobile service signalling protocols provide mobility management facilities for their own purpose: a harmonisation of their signalling protocols with UPT is required so that a UPT user could be registered on a mobile subscriber access. This harmonisation would simplify the interworking and avoid some distortion of the information at the signalling interfaces.

4.4.5 Harmonisation of the access interface

The introduction of UPT implies some exchanges of data between the user and the network or service provider, e.g. for registration or call set-up. The access signalling of the networks involved in the service should be able to support these transfers. Therefore, a harmonisation of this signalling is required so that the same procedures and the same information elements are used in every case, independent of whether the management dialogue is performed manually or with a subscription device.

4.5 Embedding of UPT in the "IN" concept

Employing IN techniques in the provision of UPT is the most efficient and flexible way of implementing UPT, since IN allows:

- rapid introduction and enhancement of services;
- efficiency and flexibility in numbering, addressing, charging and routing;
- customer control and modification of user data;
- network configuration flexibility.

Hence, the IN functional architecture has been adapted as the basis for studies of UPT network aspects.

The IN architecture provides a platform for the rapid creation and deployment of services to satisfy the customers demands. This is achieved by separating the service logic from the transport network, allowing the services to be developed and optimised for quick and easy provisioning without requiring changes to the transport network.

The main functions of the IN architecture are:

- service control function;
- service switching function;
- specialised database function;
- special resources function;

- service management function.

It is important that these functions are studied to ensure that the functionality required by UPT has been identified and incorporated.

The special resources function (SRF) will contain tones and announcements for dialogue with the user, and since UPT will require a considerable amount of user/network interaction for registration, service profile modifications, notifications, etc., it is important that UPT requirements on the SRF are identified very early on, so that they can be incorporated.

The Service Control Function (SCF) will contain service logic for all the services, including UPT. It is therefore important that the UPT service is analysed for all features so that the corresponding capabilities can be incorporated in the SCF.

The Specialised Database Function (SDF) will contain data related to the UPT service and to the UPT user. Since UPT will require a considerable amount of user related information, i.e., location information, service profile, authentication, etc., to be stored in the network, urgent study is necessary to ensure that the structure and content of this information is incorporated in the SDF.

4.6 Numbering, addressing and routing

4.6.1 Introduction

Addressing and routing, at this stage, are only treated in relation with calls (either circuit-switched or virtual packet-switched) between telecommunication networks users; however, there may be a need in future studies to extend these considerations to the routing and addressing of signalling messages for the service execution (e.g. signalling flow between an exchange and a UPT service control point).

There may be a need for various standards on the addressing and routing in connection with the set-up of incoming calls to UPT users as well as for numbering and identification. In terms of numbering and identification, there may be a need to standardise a set of numbers and identities, possibly including:

- a UPT number;

- a UPT access code;

- a personal subscription identity;

- an access registration address;

- a routing address.

4.6.2 Open issues

The following open issues related to numbering, addressing and routing have been identified:

a) A UPT number uniquely identifies each UPT user and is used by the caller to reach that user. The format, structure and range of values of the UPT numbers need to be studied and standardised, as well as their use during both the initial set-up and the transaction phase of the call: this is the focal point of studies on numbering issues, and a critical issue for the definition of a UPT service on a world-wide basis.

   Issues that need to be considered in the specification of UPT number structure are: the goal of world-wide and network-wide availability of UPT service, the implementation constraints in the near-term and the evolution towards longer term. Ideally a UPT number should not change if the user changes to another UPT service provider or moves to another permanent location.

   Structures may vary from a totally flat numbering scheme on a world-wide basis, to a "country code/area code/subscriber number" structure, or even to a structure containing detailed location and subscription information. It is likely that a compromise has to be found between the two extremes.

b) A UPT access code may be needed in the initial set-up phase of the call to access the facilities of UPT from a communication terminal. Different codes may precede the UPT number in different UPT procedures and their formats and structure should be investigated (CCITT Recommendations E.164 and possibly X.121 should be considered for the structure of UPT access code + UPT number).

The sets of access codes may vary according to the network, to the geographical area and possibly to the service provider related to a given UPT service request. Their standardisation on an international basis is a question for further study.

c) A Personal Subscription Identity (PSI) is the identity by which a UPT user is known to the UPT service provider and may be used as an independent identity to the UPT number for reasons of flexibility and security. The concept of PSI and its use in UPT procedures need to be clarified.

d) An Access Registration Address (ARA) is the address of a network access on which the UPT user has registered in order to receive calls at that access. It has to be investigated how the network or the user should specify the ARA in different UPT procedures (e.g. in the transaction phase of the call for location updating).

e) The Routing Address (RA) is a network tool used, during the final set-up phase of the call, in a similar way as the roaming number is used in GSM standards, in order to complete the call to the terminal where the user is located. Further study is needed whether the issues related to routing calls through different networks and countries (in the final set-up phase, when routing a UPT call to the destination user) have specific connotations for the UPT case, or whether general rules will apply.

4.7 Charging, accounting and billing

UPT will offer personal mobility to UPT users, and thus also a variability of the location of the called UPT user. This may not be known to the calling party, which only knows the UPT number he calls. On the other hand, the roaming UPT user himself knows his location, and as he is the one associated with the subscription to the personal mobility feature, it may be considered to charge his associated subscription for the roaming part of the connection, as is currently done in the Pan-European digital cellular system, GSM. This may, however, not be applicable in all cases, since a UPT user's roaming location in many cases may be quite permanent. The charging principles for UPT must therefore be carefully considered.

In principle, there may be four types of charges that could be considered for a UPT subscriber or any calling party:

1) subscription related charges;

2) subscription management related charges;

3) call related signalling charges;

4) connection related charges.

Also the billing principles for UPT must be standardised. It may be a fundamental requirement that the UPT user should have to receive only one bill even if he is roaming in different countries and with different network operators.

There may therefore be a need to standardise charging and billing principles specific to UPT.

4.8 UPT user equipment

UPT will decouple a UPT user's identity from terminals and network access points, and will thus require a specific set of UPT procedures, which should be common to all UPT terminals. These may in some cases be carried out manually by the UPT users, but will in most cases require specific UPT functionalities from terminal equipment.

In addition, UPT will in most cases provide the UPT user with a UPT subscription device, which belongs to the UPT subscription. This UPT subscription device is provided in order to facilitate the execution of the UPT procedures and to increase the security level while doing so.

In summary, the UPT user may be faced with the following types of terminal equipment:

1) existing standard terminals for use in the various networks;

2) terminals with built-in UPT terminal functionality for use in the various networks;

3) special UPT terminal adapters to provide UPT terminal functionality to existing standard terminals in various networks;

4) UPT subscription devices.

It will as a consequence be necessary to define these various types of UPT user equipment.

There will also be a need to clarify the formal aspects of the acceptance of UPT subscription devices, which are likely to be distributed by the UPT service providers, but which must have the possibility for global roaming between networks and UPT service providers. It may be desirable to have mutual recognition of a minimum of conformance test results for UPT subscription devices.

4.9 Security

4.9.1 Introduction

The services offered by UPT will need fraud protection, because the user is more vulnerable to attack, since the subscription can be moved between access points. This will involve the following categories of attack: from terminals, from the outside world, from the operator's network.

Protection against the use of lost or stolen subscription devices (such as smart-cards, personalised Dual Tone Multi-Frequency (DTMF) devices) must be provided. Also it is needed to prove that the service requested may be provided on the line and equipment where it is requested from, within the limits of the subscription, and charged to the correct UPT subscriber. The UPT user's general privacy must also be protected, and he should have the possibility to protect himself by explicit actions. The security measures should be implemented in such a way that the users can have confidence in their provision.

These main applications of security measures have to be considered, whereby one must bear in mind that different levels of security measures could be conceivable:

- authentication of UPT user for mobility and service management:

  this is needed to secure the UPT user against intruders, who fraudulently impersonate a user to redirect calls or change a UPT user's subscription data;

- authentication of UPT user for outgoing calls:

  this is needed to secure the UPT user against other users making calls on their subscription;

- service provider authentication:

  this protects the UPT service provider and UPT users against unauthorised access to subscription data;

- secure answer:

  this is the ability to force the called UPT user to authenticate before receiving an incoming call. This guarantees that only authorised users may have the call connected;

- confidentiality of location:

  some UPT users may wish to keep their location secret yet still be able to receive UPT calls. When subscribed to this feature UPT users must be protected from any location-related information (e.g. cost sharing announcements) being passed to the calling party. This may effect the charging associated with such UPT users;

- confidentiality of identity:

  this is the ability to keep the users identity confidential when transmitted between the user and network.

The security mechanisms which are implanted in the user related part (the UPT subscription device) and in the network related part (the security database, e.g. in the UPT service management system) provide the security features to the user. This will allow access to non-personalised standard terminals. The transmission of data between the UPT subscription device and the security database via terminal, switches and transmission equipment will be transparent.

To help the service providers to develop and offer the UPT service with different security levels, three alternatives may be considered, with increasing security:

a) no UPT subscription device:

   in this case, it may be necessary to restrict the authentication procedure to the use of a Personal Identification Number (PIN) only;

b) a DTMF type UPT subscription device:

   in this case, the authentication procedure could be as without a subscription device or for a smart-card type, or both, depending on what is practical. In this case, eavesdropping at audio may be risked;

c) a smart-card type UPT subscription device:

   it must be considered whether or not UPT service provider authentication should be combined with subscriber identity authentication (mutual authentication).

In the network, authentication is a two stage process: first the authentication of the UPT subscription device, then the authentication of the user, using an authentication code. Strong authentication using continuously changing keys is preferable, within the UPT subscription device.

Security level a) only authenticates the user, using a known PIN code. Also security levels a) and b) do not need a complex interface at the terminal and provide the user access from standard terminals. Security level c) requires terminal adaptation and is limited to specialised terminals.

4.9.2 Open issues

- Security measures:

  For the applications mentioned in subclause 4.9.1 security measures have to be studied (such as the use of a PIN together with a secret PSI. It should be noted that the different applications may require different measures.

- Security levels:

  A policy has to be developed, defining different levels of security measures - minimum , advanced (individually for the applications mentioned), along with a general evolutionary concept for the UPT service. This would result in a list of all mandatory and optional security features. In all cases, the security database should negotiate a minimum set of security features.

- Procedures, algorithms:

  For the defined security measures the appropriate procedures have to be specified, such as formats, transmission protocol for security data, security algorithms (e.g. challenge and response).

- Testing methods:

  Methods and rules are needed for testing the conformance of equipment to the specifications of security protocols etc. Different equipment will provide different levels of security and need different sets of tests.

4.10 Human factors

In order to use the UPT Service the UPT user has to perform specific procedures, some of which will have to be far more complicated than we commonly are used to with our present networks.

The most critical procedures from the viewpoint of usability are the mobility and service management procedures, which have to be performed between the UPT user and the UPT service entity in order to register the UPT user for incoming and/or outgoing calls on a visited terminal access and to update his service profile.

The UPT users will also have a range of new UPT terminals and UPT subscription devices to relate to, i.e. the user may have to carry out UPT procedures with at least the following UPT subscription devices:

1) no UPT subscription device;

2) a DTMF type UPT subscription device;

3) a smart-card type UPT subscription device;

4) a combined DTMF/smart-card type UPT subscription device;

As can be understood, it will be very important to ensure user-friendliness of the execution of the UPT procedures. The man-machine interface of the UPT procedures may also need standardisation to some degree. In this field, expertise on human factors may clearly be needed.

4.11 Operational aspects

In order to ensure that UPT can be used across national and network boundaries in a user-friendly way, agreements between network operators supporting UPT and UPT service providers, and possibly other service providers, will have to be established (e.g. so that the UPT subscribers will not have to subscribe to all UPT service providers in the world in order to use UPT universally, but that they may subscribe to one UPT service provider only, and thus will only need to receive one bill). This implies the standardisation of charging information elements and of their transfer to the UPT service provider.

There will as a consequence of this be a need for various standards on operational aspects. However, some of these issues could also be resolved on a multi-lateral basis between UPT service providers and network operators supporting UPT. This must be clarified during the work.

On a global basis, there are existing international principles for accounting, which may be used.

4.12 Network management

All systems or networks will need some form of network management. As UPT necessarily will be provided using a network of databases, this is also necessary for UPT.

The UPT-specific general requirements on various issues related to operation, administration and maintenance of UPT will be needed. There will also be a need to define the UPT-specific application protocols.

International standards for the network management interfaces and the protocol stacks on these exist up to the general purpose application layer, and may be used.

5 Proposed standards

In this section the standards which appear necessary for the introduction of UPT are discussed in detail, area by area. A systematic series of UPT standards is summarised in Annex A.

5.1 General service aspects

There will be a need to define a service description of UPT in general terms, involving a wide range of areas, the main one being,

- a stage 1 service description

of which parts of the possible contents are outlined in other sections. A full service description would also cover other areas including general areas like the scope and objectives of UPT, UPT vocabulary, evolution and service implementation phases of UPT, and specific areas like UPT subscriptions and service profiles, UPT procedures, service interworking and interactions.

5.2 General network aspects

For the general network aspects of UPT, standards will be required in the following areas:

- network capabilities;
- UPT functional architecture;
- organisation of UPT subscriber data;
- technical performance objectives;
- information flows.

The above standards will be consequential to the requirements and procedures identified for the service aspects of UPT.

5.3 Signalling

An ETS should be produced to specify the network signalling required to support UPT. This ETS could present the whole Mobility Service Application Part of Signalling System No. 7, or only the application to UPT (whereby the radio aspects seem not to be relevant for UPT): the studies will determine the better solution.

The IN will support UPT. Therefore an application to UPT would be found in ETSs related to the IN protocol.

The user-network signalling will be subject to publication of one or several ETSs. An intermediate implementation could justify the elaboration of a specific ETS.

5.4 Interworking

Several ETS dealing with the interworking between the various networks (ISDN, PSTN, PDN, mobile and private networks) in respect to UPT, are required to describe the support of the service by these networks.

5.5 Intelligent networks

A considerable number of ETRs and ETSs will be produced for IN, but none specific to one service. A Technical Report will be necessary on the support of UPT in the IN concept. This report will provide useful information and guidance to UPT implementors and also to the IN designers, who would want to know whether all the capabilities necessary to support UPT have been identified in the IN architecture. The necessity for specific standards on the provision of UPT using IN cannot be stated before appropriate studies are conducted.

5.6 Numbering, addressing and routing

In line with CCITT objectives, two standards are proposed:

- "UPT Numbering", including numbering plan and numbering plan interworking for the UPT number, the UPT access code, the PSI in scenarios for the first implementation and for evolution;

- "UPT routing and interworking", including the routing model, based on fundamental interworking, and overall architectural requirements for all networks that support UPT.

5.7 Charging, accounting and billing

The charging and billing principles connected with UPT may clearly differ from those of existing networks, and they have to be agreed on an international basis. The following standard will therefore be needed:

- "charging and billing principles for UPT".

Various related standards will also be needed, e.g. concerning operational aspects such as handling of charging and billing in a multi-operator environment.

5.8 UPT user equipment

For user equipment related to UPT, there will be a need for various standards. These standards include various areas like service aspects, functional specifications and conformance testing. They will cover:

- types and features of UPT terminals;

- types and features of UPT subscription devices;

- functional requirements for UPT terminals and terminal adapters;

- functional and physical requirements for UPT subscription devices;

- conformance test specifications for UPT terminals and terminal adapters;

- conformance test specifications for UPT subscription device.

The functional requirements on terminals and terminal adapters may vary from network to network. Type approval will be needed for these terminals and adapters.

Various related standards will also be needed, e.g. concerning network management relevant to administration of UPT subscribers and subscriber equipment, man-machine interface aspects, etc.

5.9 Security

For security aspects related to UPT, there will a need for various standards. These standards include various areas like, e.g. service aspects, network aspects, network management, etc., as well as authentication algorithms, summarised as:

- UPT service requirements on security features;

- security procedures and protocols;

- security algorithms;

- security management.

The standards on security may have to take into account a range of different procedures and algorithms due to different UPT subscription services, as many different and complex security algorithms are likely to reside in these devices.

5.10 Human factors

For human factors as such no standards are foreseen. As being common practice in ETSI today, human factors expertise will support standardisation, in this case the development of UPT ETSs.

5.11 Operational aspects

For operational aspects related to the universal operation of UPT, there will be a need for various standards. These may include:

- general requirements for UPT operation in a multi-operator environment;
- transfer of charging information between operators and service providers;
- international accounting.

These standards may not necessarily have to be very detailed. However, some general rules and principles should be established. The exact procedures will be part of the standards on UPT network management.

5.12 Network management

For network management aspects related to UPT, there will be a need for various standards. These may include:

- general principles of UPT network management;
- UPT subscriber administration;
- tariff, charging and accounting administration;
- UPT configuration control;
- operations and performance management;
- security management;
- maintenance of UPT functional entities;
- the UPT management application part.

6 State of UPT-related work in international bodies

6.1 General service aspects

No work other than in ETSI Sub-Technical Committee (STC) NA7 has so far been carried out within ETSI on general service aspects of UPT.

CCITT Study Group I (SGI) has carried out initial work towards a service description of UPT and towards general aspects of UPT, like scope and objectives, etc.

CEPT/SF UPCS has initiated market studies on "Universal Personal Communications Services (UPCS)" of which results are expected in May 1991.

6.2 General network aspects

The network aspects of UPT are currently being investigated in CCITT by SGs XI (CCITT Recommendations Q.3 and Q.17) and XVIII (CCITT Recommendation Q.14).

SG XI is responsible for the stage 2 and 3 description of UPT features, while SG XVIII is responsible for the definition of the functional architecture, functional models and network capabilities associated with UPT provisioning.

Up to now, both SGs have proceeded in the study of UPT by updating a common document, the "Baseline Document on UPT", however, at its latest meeting (Nov.-Dec. 1990) SG XVIII decided to freeze the baseline document and to start the preparation of a draft Recommendation (I.39X) entitled "Network capabilities to support UPT".

6.3 Signalling and interworking

CCITT SG XI, Working Party XI/1 has started UPT signalling studies under Q.17/XI. The objectives are to produce recommendations for the next study period. For the current study period, it is planned to elaborate a functional model and to define the signalling flow for UPT. In addition, it envisaged to prepare the description of the service primitives to be used in MSAP.

In ETSI for network signalling a starting activity on MSAP has been proposed to SPS and allocated to SPS 2. In addition, NA6 has considered that UPT could be one of the possible applications of INs.

6.4 Intelligent network

In CCITT, SGs XI and XVIII is where the main studies on IN aspects take place. SG XVIII is primarily involved in the architectural and modelling aspects of IN and, SG XI is responsible for the switching and signalling aspects. Joint IN activity between SG XI and SG XVIII will take place essentially on the topic Service Independent Building Blocks (SIBs) concept. SG XI is currently engaged in extensive studies towards the production of a set of implementable recommendations by 1992 (commonly called IN Capability Set 1 (CS1)). It is important that at least the basic features of UPT are included in the CS1 set of recommendations.

In ETSI, the overall IN co-ordination is the responsibility of ETSI STC NA6. NA6 published Technical Report No. 1 on "IN Framework", where UPT is mentioned as one of the services to be supported. The IN Framework provides a platform for the studies necessary to embed UPT in the IN concept. The Technical Report No. 2 on "IN - Guide-lines for Standards" will contain standards requirements for IN and may discuss areas related to UPT in more detail.

6.5 Numbering, addressing and rerouting

In CCITT the responsible group for these issues is SG II. Especially Q.5/II (Evolution of numbering and numbering plan interworking for the ISDN era) and Q.6/II (Evolution of the Routing Plan in the ISDN era) will be affected from the beginning (i.e. during this study period), but other questions may be involved/created in the future (1992-1996 study period).

Currently, for UPT studies SG II has nominated 3 associate rapporteurs, for UPT requirements respectively in Q.4/II, Q.5/II and Q.6/II. The special rapporteur of Q.4/II will act as an overall SG co-ordinator on UPT.

6.6 Charging, accounting and billing

In CCITT SG III the question Q.33/III "Charging and accounting principles to be applied to Universal Personal Telecommunications" has been proposed, but no concrete work has been done to date.

6.7 UPT user equipment

Concerning terminals, there exists today a wide range of terminal equipment for various services and networks, as well as functional and test specifications for these. Only specific issues, however, are of relevance for UPT.

Concerning UPT subscription devices (and UPT terminals), ISO has defined a set of standards for various types of smart-cards on a global basis. CEN TC224 co-ordinates and monitors the development of standards for cards, related device interfaces and operations in Europe.

Within ETSI, TC GSM has defined functional and physical requirements for a device to be used in the Pan-European digital cellular GSM system similar to what is envisaged for the UPT subscription device, and in particular for the smart-card type. This device is referred to as the "Subscriber Identity Module (SIM)". STC RES3 has followed this approach for the DECT system as well.

STC TE9 is working on card terminals together with Project Team 14 (PT14), which may be of relevance to UPT in the case of smart-card type UPT subscription devices. Currently, specifications of an application independent card and a corresponding terminal are being developed.

6.8 Security

In CCITT, especially in SG XI/1 Q.17 questions on security related issues are under discussion. The results may be considered in the framework of UPT.

The work done by the GSM Authentication and Security Experts Group can be a basis for UPT security considerations, in particular the use of authentication schemes, Temporary Mobile Subscriber Identities (TMSI) and the use of black lists to restrict the use of lost or stolen equipment.

RES3S-DAS (DECT Authentication and Security Experts Group) has extended the ideas of GSM for cordless telephony. Faced with a multi-vendor environment, black-lists have been used to control access to neighbouring networks. This is contrary to the universality of the UPT Service, but may be used for restricted subscriptions.

STC TE9 also works on security for card based subscription devices.

In CENELEC a taxonomy of security standardisation is developed describing a standard way of defining security requirements. This may be useful for UPT security standardisation.

6.9 Human factors

In CCITT SG I studies have been initiated.

6.10 Operational Aspects

On a global basis, there are existing international principles for accounting, which may be used in many cases.

Within ETSI, TC GSM together with its MOU organisation has carried out work on operational aspects for the support of Pan-European roaming.

6.11 Network management

Extensive standardisation on network management is carried out on a global basis mainly within ISO and CCITT SG IV WP 11/7. Within ETSI, STC NA4 is doing similar work. Of main importance is that the interfaces for network management will be standardised all the way up to the general purpose application layer. A complete protocol stack to support the various applications exists, which can be used for UPT.

What is not standardised, however, are the specific applications for UPT.

Within ETSI, TC GSM has carried out standardisation work on the GSM-specific requirements and application protocols. These may not be directly applicable to UPT, but could form valuable background information for UPT applications.

Annex A: Resulting series of UPT standards (perspective)

This annex summarises the areas and issues that have been identified as necessary to resolve in the standardisation of UPT. The areas and issues have been grouped and systemised, and may form the basis for a consistent set of standards for UPT. They may also be used as a basis for inputs to CCITT on CCITT recommendations, which eventually will be needed for global standardisation of UPT.

The areas and issues are:

A.1 General

1) Scope and objectives of UPT
2) General structure of UPT recommendations
3) Evolution and implementation phases of UPT
4) Vocabulary for UPT

A.2 Service aspects

1) General UPT service description
2) UPT access to telecommunications services
3) UPT numbers and identities
4) Charging and billing principles
5) Security aspects
6) Types of UPT terminals
7) Features of UPT terminals
8) Types of UPT subscription devices
9) Features of UPT subscription devices
10) Man-machine interface aspects
11) UPT subscription and UPT service profiles
12) UPT subscriber states and UPT procedures
13) Subscriber access to UPT subscription data

A.3 Operational aspects

1) General requirements for UPT operation in a multi-operator environment
2) Transfer of charging information between operators and service providers
3) International accounting

A.4 Network aspects

1) UPT network aspects - general
2) UPT network capabilities
3) UPT network architecture
4) UPT numbering, addressing, identification and routing
5) Organisation of UPT subscriber data
6) UPT call handling
7) Technical performance objectives
10) UPT procedures - general
11) Security procedures
12) Personal mobility procedures
13) UPT call handling procedures
14) UPT service management procedures

A.5 Signalling

1) General UPT protocol models
2) Realisation in PSTN
3) Realisation in ISDN
4) Realisation in PDN's
5) Realisation in PLMN's
6) Realisation in satellite systems
7) Realisation in private networks

8) Security protocols
9) The Mobility Services Application Part (MSAP)

A.6 Terminal aspects

1) UPT terminals and subscription devices - general description
2) Functional description of terminals connected to PSTN
3) Functional description of terminals connected to ISDN
4) Functional description of terminals connected to PSPDN
5) Functional description of terminals connected to PLMN's
6) Functional description of terminals connected to satellite networks
7) Functional description of terminals connected to private networks
8) Functional description of smart-card type UPT subscription devices
9) Functional description of DTMF type UPT subscription devices
10) Security algorithms

A.7 Network management aspects

1) General principles of UPT network management
2) UPT subscriber administration
3) Tariff, charging and accounting administration
4) UPT configuration control
5) Operations and performance management
6) Security management
7) Maintenance of UPT functional entities
8) The UPT management application part

A.8 Equipment specifications

1) General principles for type approval of UPT terminals
2) Conformance test specification for UPT terminals connected to PSTN
3) Conformance test specification for UPT terminals connected to ISDN
4) Conformance test specification for UPT terminals connected to PSPDN
5) Conformance test specification for UPT terminals connected to PLMN's
6) Conformance test specification for UPT terminals connected to satellite networks
7) Conformance test specification for UPT terminals connected to private networks
8) Principles for acceptance of UPT subscription devices
9) Conformance test specification for smart-card type UPT subscription devices
10) Conformance test specification for DTMF-type UPT subscription devices
11) Conformance test equipment for UPT terminals
12) Test equipment for UPT subscription devices

History

Document history	
December 1991	First Edition
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)