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Contacting a UMTS User: Naming/Numbering and Routing Issues

This paper presents a mobility issue related to a long-term vision of the universal telecommunications system (UMTS). Future UMTS call scenarios introduce the concept of globally unique, portable, non-service provider related user identifiers. This paper analyses the user identifier requirements and measures them against those of existing naming, numbering schemes such as E.164 numbers and domain names. This paper also comments on some of the high-level issues around futuristic UMTS service provision scenarios and call scenarios involving locating users, media negotiation and routing strategies.

Introduction

In the long term, the universal mobile telecommunications system (UMTS) is viewed as the evolution of telecommunications into the 21st century, supporting multimedia services on a converged infrastructure with interworking with current fixed and mobile networks. There will be no distinction between fixed and mobile users. As a UMTS service subscriber, you will be able to contact users on their UMTS identifier, regardless of prior knowledge of their location, the type of terminal they are using at the time, the type of networks they are currently on (such as the Internet, global system for mobile communications (GSM), public switch telephone network (PSTN), etc.), or their current network addresses.

This paper presents a mobility issue related to a long-term vision of UMTS. Future UMTS service provision and call scenarios introduce the concept of globally unique, portable, non-service provider related users' identifiers. This paper comments on some of the high-level issues around futuristic UMTS call scenarios involving locating users, media negotiation and routing strategies. It analyses the user's identifier requirements and measures them against those of existing naming, numbering schemes such as E.164 numbers and domain names.

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UMTS

Today, mobile networks mainly provide person-to-person voice communications and are designed and operated as separate entities from the fixed networks, requiring users to accept limited interworking, multiple numbers, multiple subscriptions, multiple service environments, and multiple service providers[1].

Therefore a new mobile communication system, the universal mobile telecommunication system (UMTS) is required to offer significant user benefits including high-quality wireless multimedia services to a convergent network of fixed, cellular and satellite components. It aims to offer mobile personalised communications to the mass market regardless of location, network or terminal used[2]. The European Telecommunications Standards Institute (ETSI) specifications for UMTS phase 1 are a new air interface (wideband code-division multiple access (W-CDMA)), a new access network (UMTS terrestrial radio access), and a core network based on the global system for mobile communications (GSM) and general packet radio service (GPRS). Nevertheless, as it stands, UMTS (phase 1) will not support mobile multimedia nor service/terminal/personal mobility. A GSM-based core network limits the fixed-mobile integration. BT has been supporting a new approach of a core network based on the Internet protocol (IP) to deliver voice and data, and interworking with heterogeneous access technologies (see Figure 1). This vision offers new life scenarios where heterogeneous access networks (GSM, UMTS, and fixed technologies) can internetwork over a flexible platform supporting high data rates, voice, data and multimedia. This fixed-mobile integration vision also affects traditional names and addresses roles.

The Problem

Need for new scenarios

With an IP-based core network, UMTS will support voice, data and multimedia over fixed and mobile networks. Terminal and user mobility in multi-environments will be expected. The core network (GPRS nodes and gateways) will internetwork with fixed existing networks (asynchronous transfer mode (ATM), PSTN, integrated services digital network (ISDN) and mobile legacy networks (GSM), wireless local area networks (LANs)).

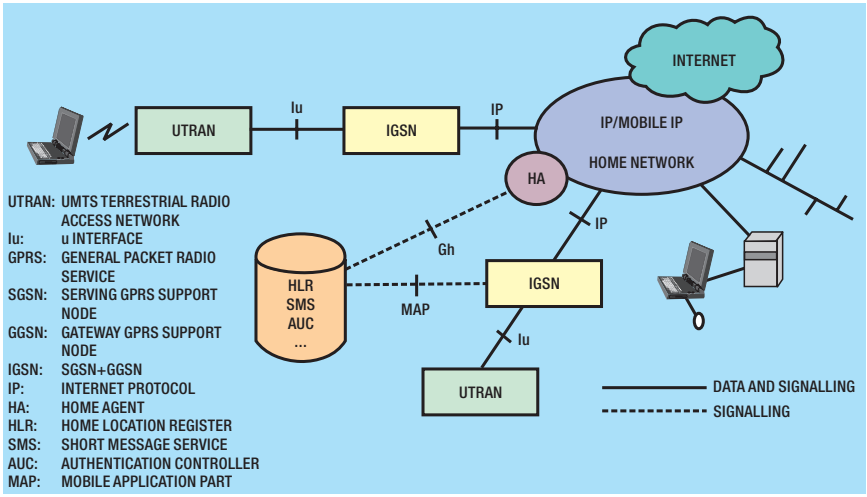


Figure 1—A possible UMTS core network architecture, evolving from the current GPRS backbone elements (ETSI, Draft Technical Report v.0.3, Jan. 1999)

This vision introduces new scenarios. Ideally, users will access their services from any network (Internet, PSTN, GSM, etc.), at any time, with access and delivery via the most appropriate network and terminal for the user at a given time.

New service provision scenarios are introduced since the type of communication is vastly more complicated than in, say, GSM. The network intelligence in conjunction with the terminal intelligence would decide which means of delivery to use based on the caller and called party preferences, charging, urgency and on the network capabilities. Several choices may be available if the user is registered on multiple networks and terminals, and the information may have to be translated from one format to another. For example, you may want to call 'Paul Smith' from your web page; the 'network' finds out 'Paul Smith' subscriber is within a particular area on a GSM network and that he carries a mobile telephone. A ring and a message is displayed on Paul's terminal showing the caller's identity, type of communication (voice, file transfer, e-mail, etc). The same is applied on the caller side together with some charging information. Then the network will route the end-to-end call on the appropriate terminal of 'Paul'.

Similarly, new call scenarios will affect the traditional concept of numbers and addresses. Users could be roaming on different types of networks, using the terminal convenient at the time and, furthermore, may have multiple service providers. If someone wants to contact one of these users then he/she does not know where they are, which network they are on at the time of the call, whether they are fixed or mobile, nor what terminals they are using at the time.

Phases of a multi-media call

Resolution

In order to call these users, a user will first need to dial a unique user identifier (a name or number) and then the network will resolve it into the destination network address and user terminal for the current called party's service provider, in order to route the call (see Figure 2).

The terminal capabilities can be enhanced by some service interfaces such as web-based front-ends and interactive voice systems, which allow users to spell an alphanumeric user's name over an ordinary telephone or keyboard-less mobile terminal. After querying a name directory, the database returns the address of the targeted user's service provider. The called party's current location is stored in a location database either at the service provider or at the network he/she is on. The service provider addresses can be cached on the calling client (phase1). Because the user has neither tariff indications nor network capabilities indications in the number dialled, the network has to inform the user about some characteristics of the call: quality of service, called party's current number, call cost, user availability, terminal capabilities, diversion options, etc.

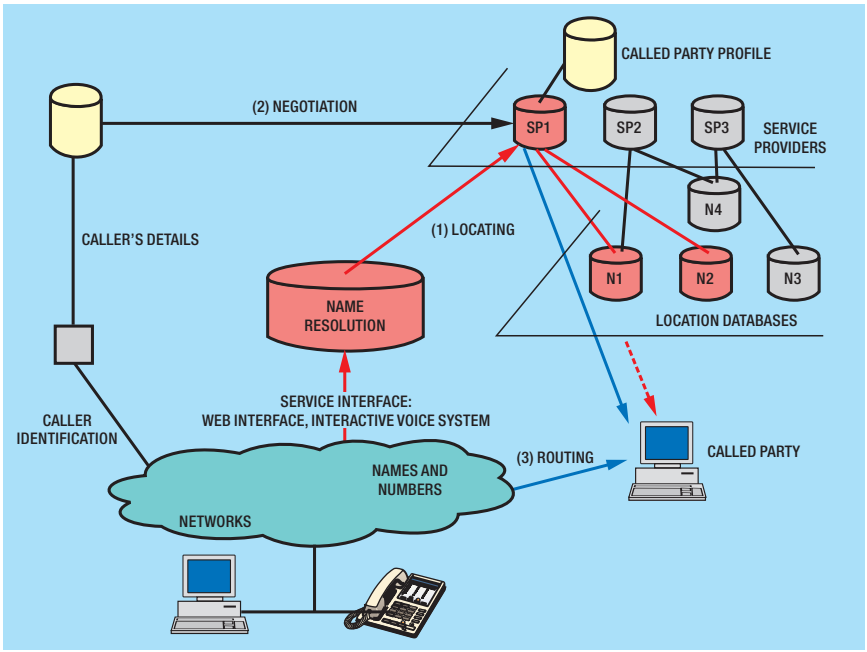
Negotiation

The intelligence in a UMTS negotiation server/database can also compare the call characteristics and charging against the caller's communication subscription (phase 2). It takes the decision to proceed to call (for example, divert it from the PSTN to the called party's PC, or just bar the call) without getting back to the caller. The negotiation server/database is an enhancement of the virtual home environment concept as described in the UMTS concept[3].

Routing

During the negotiation phase the network intelligence will have decided which means of delivery to use (phase 3). But several choices may be available. Two of them are

Figure 2—Locating (1), negotiation (2) and routing (3) phases of a call



that the call can be proceeded from the caller's terminal or from the called party's service provider. If the call is routed from the service provider's network, it can also provide interworking interfaces without affecting the clients but may affect the call tariff. If the call is routed from the caller's terminal, the service provider will need to send back the called party's address plus other call characteristics. Some specific interfaces and intelligence on the client is expected to support the routing.

In a call scenario where the called party's location, service provider, network and terminal used, and cost of calls are not known at the time of the call, none of this information can be embedded within the dialled number. The user's identifier becomes an entity only referring to a person/persona.

Names, Numbers and Addresses Roles

Traditionally, telephone numbers act as users' identifiers, network locators, routing addresses, and as an indication of the cost of the call. E.164 provides the numbering structure and functionality for telephone numbers used for international public telecommunication: geographic areas, global services, and networks. In E.164 a number indicates the public network termination point and it contains the information necessary to route the call to this termination point either by some of its parts or externally by some mapping functions. E.164 fields for geographic areas are the country code (CC), national destination code (NDC) that is optional and the subscriber number (SN). E.164 fields for networks are composed of a country code, an identification code (IC) for the required network and a subscriber number (SN).

In order to support call scenarios where the network termination point is not known at the time of the call, it is crucial to separate the addressing and routing roles from the user's identifier. BT put forward at the ITU-T and ATM Forum standard bodies the following definition:

The role of a name is to identify end-users and it may be portable. It can be an alpha label, a numeric label (a number obtained from a recognised numbering plan) or an alphanumeric label (for example, 07074 Hertz). The role of an address is to locate a physical end-point within the network. It is used for routing information; it is technology-related and is not portable. It can be a numeric string of characters, alphanumeric characters, related to the network topology. The key difference between the name and address concept is that you can migrate from address1 to address2 and still keep the same name/number. A name/number can be associated with many addresses, or multiple names may be associated with a single address and the mapping is stored in a database.

Need for a User's Identifier

At the time of the call, the called party network is not known. The user's identifier acts as a name and it needs to support basic requirements: to uniquely identify the user across fixed and mobile networks, not to identify a terminal (terminal SimCard), to be memorable, to be non service provider related (unlike myself@bt.com), to be non topologic, to be portable, to be free from tariff assumptions.

Personal numbers as users' identifiers

Personal numbers offer a limited approach to the problem. These logical numbers identify a person, they are shared between all GSM/PSTN network operators, and allow you to have your calls routed to any single telephone you might be using at the time. You can control your routing service to any telephone, fixed and mobile or to a voice mailbox by calling a re-routing number and then by dialing your personal number and PIN number. Then you enter the new destination for your calls to be routed to.

UMTS requirements

But to support the UMTS call scenarios, the user's identifier needs to offer some other features. It needs to break away from traditional tariff assumptions and charging mechanisms. Indeed, a UMTS call will offer in-call variable bandwidth according to the networks it will be delivered on and it will require another charging mechanism (other than time and distance). Furthermore, the called parties should not have to forward their calls themselves and could expect the network to do it automatically on their behalf.

Legacy networks

Finally, one needs to consider having one's calls rerouted to an Internet PC. The GSM/PSTN network intelligence will need to interoperate with the Internet and vice versa. Currently, the Internet domain name service does not resolve E.164 names into network resource IP addresses, which affects the Internet world integration to legacy networks[4].

Possible Solutions

In the UK, one of the regulator's requirements is for new ranges of national E.164 numbers to be portable between network operators; that is, to behave as names[5]. One option is to allocate E.164 names to users. However, uniqueness and portability of the E.164 identifiers could only be guaranteed between UK service operators. Nevertheless, it is possible to extend a service to a global one. An operator can obtain from the ITU 'global numbers' which are E.164 numbers with a special country code and are allocated to a specific global type of service. But these numbers are only allocated to special value-add global services that do not compete with services offered by the same operator using national numbers.

Currently, the most advanced naming scheme comes from the computer world. Internet names offer globally unique identifiers, alphanumeric, widely used and resolvable. In the UK, BT 's Millennium Project will offer to everyone in the country an e-mail address[6]. This will provide a globally unique identifier to every potential user. Nevertheless, since Internet names are designed to identify some components of the network, they are only portable within their domains (Internet service provider domain).

Developments

Friendly names

The portability and friendliness of names is raising a lot of interest. One IETF Working Group is currently looking at naming schemes for Internet resources: the *human friendly names* (HFNs)[7]. Although unified resource locators (URLs) (such as http://guest.btinternet.com/html/about.html to visit BT Internet products) provide a powerful mechanism to resolve the location of resources on the Internet, for many

applications URLs are complex, totally unpredictable, and too lengthy to memorise. HFNs aim at simplifying the Internet navigation via a simpler globally-available human-friendly naming system. That scheme is being implemented to replace the use of URL-based navigation. Users can navigate the Web by typing unique and meaningful words like company names (SUN, Opel, etc), product titles (Mondeo, *OneNumber*), trademarks (Nike), or advertising slogans without the need to remember the unfriendly URL syntax (*'just do it'* or *'it's good to talk'*). Although several organisations have deployed services that resolve the friendly names (such as the RealName system developed by Centraal), there have been no efforts to standardise the information going to and coming from the service. The HFN group intends to address these issues and release standards to allow the services to become widespread and interoperable.

Another working group is to be established for the development of the common name resolution protocol (CNRP), which aims to process HFNs and return a URL to the user interface[8]. Browsers would have a CNRP client embedded in them. Some of the anticipated applications of HFNs and of the CNRP are an increased visibility of Internet sites and products, search engines improvements, and the resolution of E.164 numbers (acting as addresses but also as names) into an address (postal address or other address spaces). BT may want to run a 'British' CNRP registry.

Interworking

Interworking between heterogeneous networks is another major area of investigation. With the convergence of the Internet and PSTN, there is an increasing desire for events occurring in the PSTN domain to be propagated to the Internet domain. For example, the IPTEL WG is looking at PIN services for advanced caller ID delivery. Scenarios such as the one following are being studied**:** a display is to appear on your PC that your telephone is ringing at home, and you can then pick up the call from your PC. A service subscriber has one or more telephone numbers (residential, business, mobile). The service subscriber also has many Internet accounts. The PSTN tries to contact the subscriber and if this fails then it handovers to an advanced PINT gateway, which inspects each of the accounts. If the subscriber is on-line then a popup window appears on the screen with a clickable caller number. If the subscriber is off-line then he/she is be sent an e-mail with the caller ID included[9].

For applications such as Internet telephony, users of the PSTN may want to address an Internet entity on a telephony number. Therefore, using E.164 telephony addresses as IPv6 addresses has been proposed**:** a unique addressing scheme for future telephony equipment that has simultaneous access to PSTN services and to the Internet via the IPv6 protocol. It can also be used for IP telephony where both IP and PSTN routing information are needed simultaneously[10].

Mobility

Regarding mobility, roaming and user naming schemes on the Internet domain, the ROAMOPS Working Group is to develop procedures, mechanisms and protocols to support user roaming among groups of Internet service providers (ISPs). The ROAMOPS group is specifically concerned with the movements of users. So far, the group has been describing the basic mechanisms required to support user roaming and a description of several existing roaming implementations. The group is also defining a standard username syntax to support roaming[11].

Conclusion

In a world where roaming on heterogeneous networks, terminal mobility, personal mobility and multiple service providers are supported, the user's identifier will break away from traditional numbers, and will act as a name. Existing user naming schemes fail to support uniqueness, portability and globality at the same time. As the user's identifier becomes a name, added complexity to the user interface, service interface and to name resolution mechanisms are expected. Many activities at the IETF have started investigation of naming and addressing issues regarding interworking of heterogeneous networks, roaming between different ISPs, and portability of Internet resources identities. Today, Internet resource naming schemes are becoming necessary, but, in the author's view, new user's naming schemes are soon to require the same attention.

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Biography

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Delphine Plasse graduated from the Institut National des Sciences Appliquees de Toulouse, genie Physique in 1996. She also gained an M.Sc. in Optical Communications from the University of Essex. In 1996, she joined BT in 1996 to work on mobility-related issues. Currently she is developing a virtual home environment architecture for the future UMTS architectures.