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SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for IMT-2000

Principles and requirements for convergence of fixed and existing IMT-2000 systems

ITU-T Recommendation Q.1761

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ITU-T Recommendation Q.1761

Principles and requirements for convergence of fixed and existing IMT-2000 systems

Summary

This Recommendation describes requirements for the use of fixed networks in the role of fixed access networks for IMT-2000 networks. This convergence of fixed networks and IMT-2000 networks enables mobile users to roam outside the serving area of their IMT-2000 network and still have access to the same set of services outside their IMT-2000 network boundaries as they do within those boundaries. This Recommendation also describes the framework for fixed mobile convergence and the capability requirements for enhanced fixed terminals that may be utilized to enhance the roaming IMT-2000 user's experience. This Recommendation also details the mobility management functional requirements in fixed networks in support of roaming IMT-2000 subscribers.

Source

ITU-T Recommendation Q.1761 was approved on 10 January 2004 by ITU-T Study Group SSG (2001-2004) under the ITU-T Recommendation A.8 procedure.

Keywords

Convergence, fixed, IMT-2000, mobile.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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CONTENTS

Introduction

The evolution of individual core network technologies towards common Internet Protocol (IP)-based solutions provides long-term opportunities for the convergence of diverse network technologies. This convergence provides, in turn, opportunities for extending the reach and scope of services that a user of one of these networks may obtain beyond what could be supported in a pre-converged environment.

As these long-term convergence opportunities emerge and stabilize, there are opportunities in the near to medium term that may be enabled by providing capabilities to enable IMT-2000 roamers to access their basic and enhanced services, possibly excluding terminal mobility, in environments where IMT-2000 is not yet deployed.

ITU-T Recommendation Q.1761

Principles and requirements for convergence of fixed and existing IMT-2000 systems

1 Scope

This Recommendation describes the requirements for supporting a mobile IMT-2000 user roaming to a fixed network such that the IMT-2000 user may obtain basic services plus access to the user's services per the subscription profile. A number of service level scenarios are possible. This situation provides personal mobility among fixed network users and may exclude terminal mobility.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

2.1 Normative references

[1] ITU-T Recommendation Q.1701 (1999), *Framework for IMT-2000 networks*.

[2] ITU-T Recommendation Q.1702 (2002), *Long-term vision of network aspects for systems beyond IMT-2000*.

[3] ITU-T Recommendation Q.1711 (1999), *Network functional model for IMT-2000*.

[4] ITU-T Recommendation Q.1741.1 (2002), *IMT-2000 references to release 1999 of GSM evolved UMTS core network with UTRAN access network*.

[5] ITU-T Recommendation Q.1741.2 (2002), *IMT-2000 references to release 4 of GSM evolved UMTS core network with UTRAN access network*.

[6] ITU-T Recommendation Q.1742.1 (2002), *IMT-2000 references to ANSI-41 evolved core network with cdma2000 access network*.

2.2 Informative references

[7] ETSI ES 201 912 V1.1.1 (2002-01), *Access and Terminals (AT); Short Message Service (SMS) for PSTN/ISDN; Short Message Communication between a fixed network Short Message Terminal Equipment and a Short Message Service Centre*.

[8] ETSI ES 201 986 V1.2.1 (2003-04), *Services and Protocols for Advanced Networks (SPAN); Short Message Service (SMS) for PSTN/ISDN; Service Description*.

[9] ETSI TS 103 912 V1.2.1 (2003-01), *Access and Terminals (AT); Short Message Service (SMS) for PSTN/ISDN; Short Message Communication between a fixed network Short Message Terminal Equipment and a Short Message Service Centre (Corrections to ES 201 912 V1.1.1)*.

[10] ITU-T Recommendation Q.1521 (2000), *Requirements on underlying networks and signalling protocols to support UPT*.

3 Definitions

This Recommendation defines the following terms:

3.1 convergence: Coordinated evolution of formerly discrete networks towards uniformity in support of services and applications.

3.2 discrete mobility: See "Nomadism".

3.3 discrete terminal mobility: Ability to have discrete mobility using the same terminal.

3.4 enhanced fixed network: Fixed network with the Fixed Mobility Plane and hence capable of communicating with other IMT-2000 family member CNs to support roaming with those networks.

3.5 fixed access network: Existing fixed network with no mobility providing a transport service between end user terminal and FMP in a transparent manner. No changes are visualised in the fixed network to support this transport service.

3.6 fixed mobile convergence: Mechanism by which an IMT-2000 user can have his basic voice as well as other services through a fixed network as per his subscription options, capability of the access technology.

3.7 fixed mobility plane: Additional capability in the fixed network to add required capabilities of IMT-2000 family member CN.

3.8 mobility: Ability to provide services irrespective of changes that may occur by user/terminal's activities. The user is able to change his network access point, as he moves, without interrupting his current service session, i.e., handovers are possible. In some situations, the handover may lead to a briefly suspended service session or it may require a change in the level of service provided as a consequence of the capabilities of the new access point to which the user has become connected through the handover process.

3.9 nomadism: Ability of the user to change his network access point after moving; when changing the network access point, the user's service session is completely stopped and then started again, i.e., there is no handover possible. It is assumed that the normal usage pattern is that users shutdown their service session before moving to another access point or changing terminal. This is the mobility alluded to in the case of fixed mobile convergence.

3.10 personal mobility: Ability of a user to access telecommunication services at any terminal on the basis of a personal identifier, and the capability of the network to provide those services according to the user's service profile. Note that personal mobility involves the network capability to locate the terminal associated with the user for the purposes of addressing, routing and charging of the user's calls.

3.11 roaming: Ability to provide service to a user through access from a network different than the network he has subscribed to. This defines the visited and the home networks respectively.

3.12 terminal mobility: Ability of a terminal to access telecommunication services from different locations and while in motion, and the capability of the network to identify and locate that terminal.

3.13 universal global terminal: A terminal equipment that supports all IMT-2000 radio interfaces and associated protocols.

4 Abbreviations

This Recommendation uses the following abbreviations:

2G	Second Generation
3G	Third Generation
AT	Access and Terminals
CATV	Community Antenna Television
CN	Core Network
EFN	Evolved Fixed Network
EG	ETSI Guideline
ES	ETSI Standard
ETSI	European Telecommunications Standards Institute
FAP	Fixed Access Point
FAN	Fixed Access Network
FMC	Fixed Mobile Convergence
FMP	Fixed Mobility Plane
FTE	Enhanced Fixed Terminal
GSM	Global System for Mobile Communications
IMT-2000	International Mobile Telecommunications-2000
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
LAN	Local Area Network
NGN	Next Generation Network
POTS	Plain Old Telephone Service
PSDN	Packet Switched Data Network
PSTN	Public Switched Telephone Network
SMS	Short Message Service
UPT	Universal Personal Telecommunications
USO	Universal Service Obligation
VHE	Virtual Home Environment
WISP	Wireless ISP
WLAN	Wireless Local Area Network
WLL	Wireless Local Loop

5 Conventions

There is no particular notation, style, presentation, or other conventions used within this Recommendation.

6 Aim of fixed/mobile convergence

6.1 Broad objectives

The broad objective of next generation IMT-2000 networks is to enable global roaming and the access to the same set of services across different IMT-2000 family network boundaries. Seamless services provisioning across the heterogeneous fixed (i.e., PSTN, ISDN, PSDN, WAN/LAN/CATV, etc.) and evolving mobile networks should be guaranteed in the converged systems. The convergence of various types of networks both provides an opportunity and makes it necessary to address the mechanisms needed to enable IMT-2000 users to take advantage of converged networks as a base for extending their reachability for basic voice service, as well as their specific services as per the subscription options they select.

Global roaming should be achieved independently, as far as possible, of the access mechanism or the technology deployed as the access network. An IMT-2000 mobile network user should be able to register in a fixed network as a foreign subscriber and should be able to obtain the same set of services normally available in the subscriber's home network, except terminal mobility. Suitable mechanisms for handling a foreign subscriber's registration, authentication and access to that user's service profile server of the home network by the visiting fixed network need to be defined.

This is the form of mobile/fixed convergence that would apply in areas where 3G radio technology is not available. It would provide the means to extend 3G services to other access mechanisms, such as fixed, for IMT-2000 users.

6.2 Convergence and harmonization

A universal global terminal and the accessibility of home services across different IMT-2000 family member network boundaries are addressed by harmonization activities. The harmonization activities as carried out by various standard organizations are primarily based on all IP networks and hence are considered medium to long term. Fixed/mobile convergence is achievable based on currently defined and deployed fixed and IMT-2000 networks and is therefore viewed as a near-term objective to meet the immediate needs of users.

6.3 Globally accepted user identity module

By standardizing access technology independent User Identity Module (UIM), any user would be able to move anywhere in the world carrying UIM as a global roaming instrument. The user would not be required to carry highly complex multimode radio technology terminal equipment. Instead, the UIM would be compatible with all kinds of user terminals catering for any wireless or wireline access. Globally applicable mobile terminals supporting all the IMT-2000 family member interfaces are still being developed and may not be widely available for some time.

6.4 Network environment for IMT-2000 mobile users

The following are among the access means for consideration:

- multiple IMT-2000 family members;
- fixed access, with seamless mobility with mobile systems: xDSL, Cable, narrow-band (for IP services), WLAN in hot spots (e.g., WISP), etc.;
- Digital Audio Broadcast (DAB).

It should be noted that the various systems listed above encompass very different bandwidth capabilities, as well as very different access technologies (GPRS radio, W-CDMA, cdma2000 and other private radio systems, but also xDSL, cable, etc.). It is therefore not expected to have a single multimode terminal to handle so many accesses. Rather, it is anticipated that users will be granted access to the network by using a range of terminals, some of them capable of multimode operation.

Consequently, mobility across this heterogeneous environment requires service adaptation (VHE) for terminal mobility as well as personal mobility.

6.5 Service requirements

The general user requirements for mobility should include:

- the user's ability to change the access point or the terminal which can be marked as mobile/nomadic users. This implies that the mobility management functions may be applicable only to those users marked as mobile/nomadic;
- the user's ability to gain access from any network access point. This includes all the access technologies identified above, and the ability to use other networks. These possibilities may be limited by subscription and roaming arrangements among various service providers;
- the user's ability to obtain their services in a consistent manner, depending on the constraints they experience in their current situations. This is required for services provided by their network operator as well as services provided by a third party;
- the user's availability and reachability should be known to network functions, and possibly to services and applications, including those provided by a third party.

6.6 Global network requirements

The goals listed above require significant evolution of the current network architectures. Enabling transparent fixed-wireless broadband communications and mobility across various access technologies so that users will be able to move between several types of access means along their needs, wherever and whenever possible, is a significant task.

The following requirements may be derived from the above objectives in a mobility management perspective:

- a consistent approach from initial 3G systems and fixed systems;
- cost reduction (network deployment and operation);
- increased spectrum efficiency; and
- nomadism, mobility and roaming among different access systems, fixed or mobile.

7 High-level principles

7.1 Categories of enhancements

Telecommunication infrastructure enhancement requirements may be classified into two broad groups:

- use of leading-edge complex enabling telecom technology to provide advanced services to existing subscribers; and
- use of mature technology to provide basic telecommunication services and features to the masses on an affordable basis, to address the digital divide.

For developing nations, both types of requirements are important. The first type gives a competitive edge in the globally prevailing multi-operator scenario. The second provides the needed high-volume service access and usage and addresses the universal service obligations (USO) towards the state and the people of the state. Depending on various local socio-economic conditions and in line with normal business criteria, service providers are making suitable decisions for deployment of such leading-edge technologies.

Cost effectiveness and anticipation of future return on investment from the deployment of telecommunication infrastructure are essential to address the second category. This is a strong need for all service providers, and especially so in developing nations. Local and regional solutions are

being successfully deployed. Deployment scenarios worldwide are driven by these basic principles. Fixed Mobile Convergence falls into the second category.

7.2 Use of a fixed network as an IMT-2000 "fixed access network"

An IMT-2000 mobile network consists of a radio access part and a core network part. The radio access part makes use of complex advanced technologies and will therefore be relatively costly until economies of scale from mass production and deployment are realized. At the same time, most subscriber services are provided from the core network. Therefore, enhancements to existing fixed networks so that they can support roaming subscribers through using the fixed network as a "fixed access network" will enable partial or full delivery of services to these roaming subscribers. A "fixed access network" is characterized by mature, cost-effective technology that is simple to use and is capable of providing higher bandwidth and reliability. Expansion to such a "fixed access network" would be immediate and within the technological and financial capacity of developing nations.

A fixed network in the role of a "fixed access network" (FAN) could be based on mass-deployed circuit switching technology or advanced packet switching technology supporting various access mechanisms such as analogue loop, digital line, cable or wireless.

A subscriber making use of this converged network would expect to receive basic telecommunication services from any available access point. The availability of advanced services will depend on the capabilities of the access network and the terminal being used for accessing the services. The service access points could be based on analogue or digital fixed lines, wireless local loop, 2G, 3G or beyond 3G mobile access network technology. The terminal could be a simple POTS terminal, a smart-card-based analogue/digital line terminal, a fixed digital high-capability terminal, a fixed but wireless terminal based on WLAN technology, a single-mode or multimode 2G/3G or beyond 3G mobile terminal as a wireless local loop (WLL) terminal or a mobile terminal supporting 3G capability sets on IMT-2000/2G/2G+ radio access as well as fixed access. For user convenience, automatic registration and de-registration to available Fixed Access Points could be done by utilizing wireless solutions in unlicensed spectrum.

In addition to the advantages mentioned above, fixed/mobile convergence would lead to the following:

1) It would be possible to provide services to a mobile user in an area where a radio network is not deployed, or it is not viable to deploy and maintain a radio network.
2) It would lead to value-added in fixed line networks by adding mobility and mobile-like services.
3) Better utilization of radio spectrum in IMT-2000 networks would be possible.
4) Increase in teledensity would be achieved through greater access.
5) Initial deployment of IMT-2000 network in small pockets would become attractive.

Increased teledensity (point 4 above): by dissociating the user subscription from the fixed terminal and putting it into, e.g., a personalized plastic card, substantial growth of fixed network usage is expected. It will give to the user a real feeling of a personal subscription, instead of being a group/family/company subscription. This personalization will tend to replace "group" subscriptions with "personal" subscriptions and thereby increase teledensity. Equipment manufacturing, network expansions and operations for the FAN to meet the increased demand would be within the techno-financial capabilities of the developing nations. Cost-effective ways of making IMT-2000 services available through a FAN would make the services popular and later lead to demand for the IMT-2000 Radio Access Network (RAN) and the 3G terminals.

The initial deployment of IMT-2000 is envisaged to take place only in small pockets (point 5 above). It will not be possible to have the whole nation's geography rapidly covered by expensive IMT-2000 radio technology. Any IMT-2000 subscriber would obviously expect the access to the services outside the 3G radio access, through available 2G/2G+ mobile networks whenever he is mobile, and through the fixed network whenever he is stationary. The higher quality of service available through the economic fixed network will satisfy the IMT-2000 subscriber more than what is available through 2G/2G+ systems. By releasing wireless spectrum when he is stationary and still receiving the same set of services as he was receiving with wireless access, more mobile subscribers can be supported with the available spectrum (point 3 above). This user expectation would further drive the convergence of mobile and fixed networks. Demand for additional radio spectrum for IMT-2000 and systems beyond is being discussed in ITU-R in the context of potential demand where the subscriber expectation is anticipated to grow to 10 Mbit/s data rates, or more. It is anticipated that national regulatory authorities may consider the associated impact on demand for spectrum in light of the advantages of fixed/mobile convergence where a mobile network subscriber would not need to consume scarce radio spectrum while he is stationary and has other access available to him. An additional means of potential reduction of demand for IMT-2000 spectrum is the possibility of continued use of the same IMT-2000 terminal but having it connected to an available fixed access point (FAP) using Bluetooth or WLAN technology, thereby releasing IMT-2000 spectrum automatically. The released radio resource would then be available to satisfy other mobile network users those are actually mobile.

7.3 General enhancements to fixed networks to support mobile users

In the broader context of convergence, there are other systems besides IMT-2000 that exist today (e.g., broadcasting, WLAN, satellite, etc.). The rapidly growing wireless data traffic and importance of IP-based networking are stimulating a revolution in the way fixed and mobile networks are implemented. The interconnection of fixed and mobile networks, interfaces between IMT-2000 networks and other networks and technologies to develop convergence systems are topics that need to be addressed from a global perspective.

One major enhancement considered for fixed networks is the support of mobility, including the provisioning of seamless services. Various types of mobility services may be developed for fixed network users, from user mobility (as it was initially defined for UPT, the user is allowed to move in a discrete manner) to user and terminal mobility (seamless services as the user and his terminal move in a continuous manner), and potential intermediate service offerings. In addition, various types of roaming may be considered across the available network access techniques:

- As a first step, the user may roam between fixed network accesses, and also between public wireless accesses; however, roaming in the fixed environment and in the mobile environment are independent, and from the network perspective they may be *a priori* implemented with different mobility management schemes.
- As a second step, user roaming between fixed and public wireless access is made possible. This scenario results in requirements for the convergence of fixed and IMT-2000 networks at the control layer. Given the current industry landscape, it may be assumed here that a very high proportion of users have both a fixed home environment and a mobile home environment.

In addition, in both cases, the user should have the same service experience when roaming. This is the concept of the virtual home environment (VHE), as it is described in ITU-T Rec. Q.1701.

This Recommendation addresses the second service scenario in the context of fixed IMT-2000 convergence.

Further, the following service scenario applicable to the developing world may be visualized:

Over 50% of the villages of a developing country are connected by one or more telephone lines. These villages are given some more public connections and installed in various community places instead of at the house of the community head. These are unmanned phones, acting as access points of the Wireless Personal Area Network. Village users carry a device in their pocket that has subscriber identity and is capable of composing and receiving text messages in local language. There are lot of e-governance and other useful information services based on text messaging. A number of people use simultaneously the enhanced public phone infrastructure in electronically sharing mode without any manual intervention. Every user pays as per his usage either in post-paid or pre-paid mode. The user device for messaging could be an additional functional capability of other utility device like FM radio or pocket electronic diary. The same devices may be capable of extending the voice call also. Otherwise, the user can use the public phone physically and make the call or receive the call. The expense goes to his own account. All the users can avail of the outgoing and incoming telecom messaging and voice service from any such phone in his village or at any other place. The network keeps track of his current location and the fixed terminal through which he is currently registered to the network. Some of the public end terminals cater for the broadband capability of data transmission as per the utilization needs. The required capability of broadband for Internet access would be extended through the same switch and the same copper cable. As the demand grows, the higher capability end terminals, communication media and the switch infrastructure would be enhanced. This will greatly benefit rural masses of the developing world.

8 Framework for fixed mobile convergence

Fixed mobile convergence (FMC) is achieved by utilizing the existing fixed networks (including PSTN/ISDN) in a transparent manner by introducing an additional functional plane called fixed mobility plane (FMP). The existing fixed network without major modification will be utilized as a fixed access network (FAN) and FMP would support the equivalent functions of a mobile CN for the FAN for delivering mobility and additional services to the fixed network user. The FMP is interfaced to the mobile core network in the same manner as though it is a CN of yet another family member of the same IMT-2000 family, so that the IMT-2000 subscriber may access his home network services through the FAN. A fixed access network together with FMP may be called an Enhanced Fixed Network (EFN). Therefore, an IMT-2000 subscriber, in fixed mobile converged network scenario, will enjoy discrete terminal mobility as long as he is in an EFN, in addition to the continuous terminal mobility he enjoys while visiting in geographical areas covered by suitable radio technology. (See Figure 8-1.)

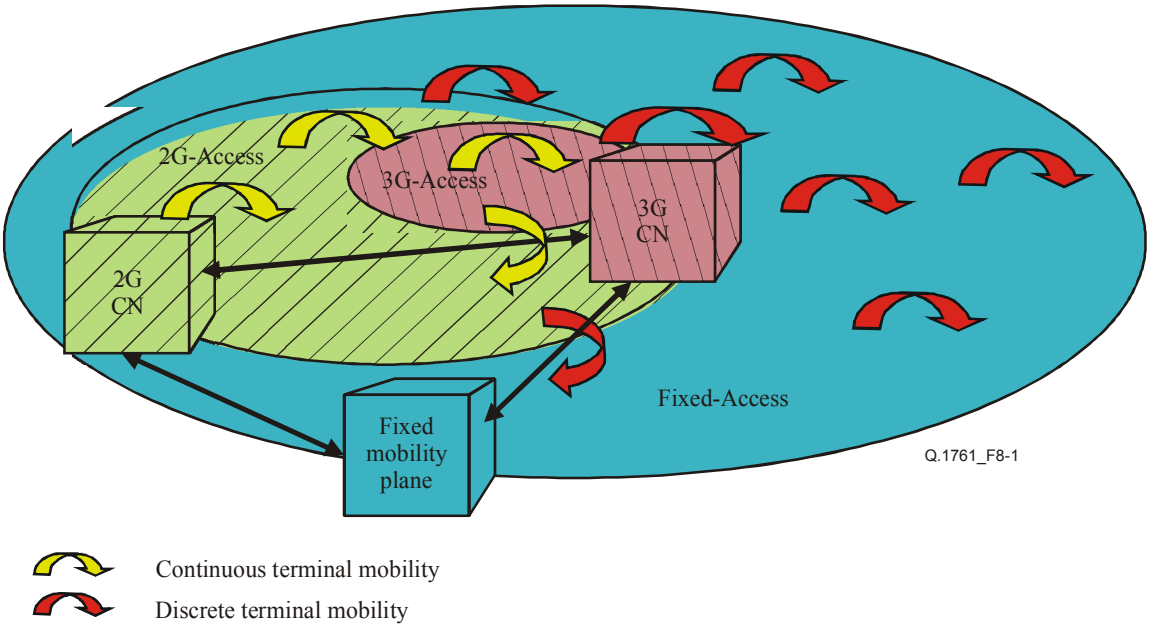

Figure 8-1/Q.1761 – Fixed Mobile Convergence scenario

The fixed mobility plane (FMP) will maintain location information concerning which network, fixed or mobile, the registered user is currently visiting. It will also keep the identification of the fixed terminal (e.g., E.164) to which he is currently registered for the purpose of routing and other functions.

8.1 FMP interfaces

FMP would have NNI interfaces towards various fixed access networks and towards core networks of various IMT-2000 family networks.

8.1.1 Various IMT-2000 network families and FMP NNI interfaces

The fixed mobility plane (FMP) interfaces would be developed in such a way that the core network of IMT-2000 family member 1 (e.g., 3GPP, say IF-1) or IMT-2000 family member 2 (e.g., 3GPP2, say IF-2) would view this fixed network in the same fashion as they view any other CN of the same family. However, the interface between any two evolved fixed networks (EFN) could be IF-1 or IF-2. Therefore, FMP will support all or limited NNI interfaces to meet the deployment objectives. The information regarding the type of supported NNI interface towards a particular IMT-2000 CN (family member 1 or member family 2) would be kept a part of the roaming agreement data. To ensure future safe implementation of a fixed mobile converged network, it is visualized that FMP would have a migration path to support possible NNI interfaces with evolving mobile CNs. (See Figure 8-2.)

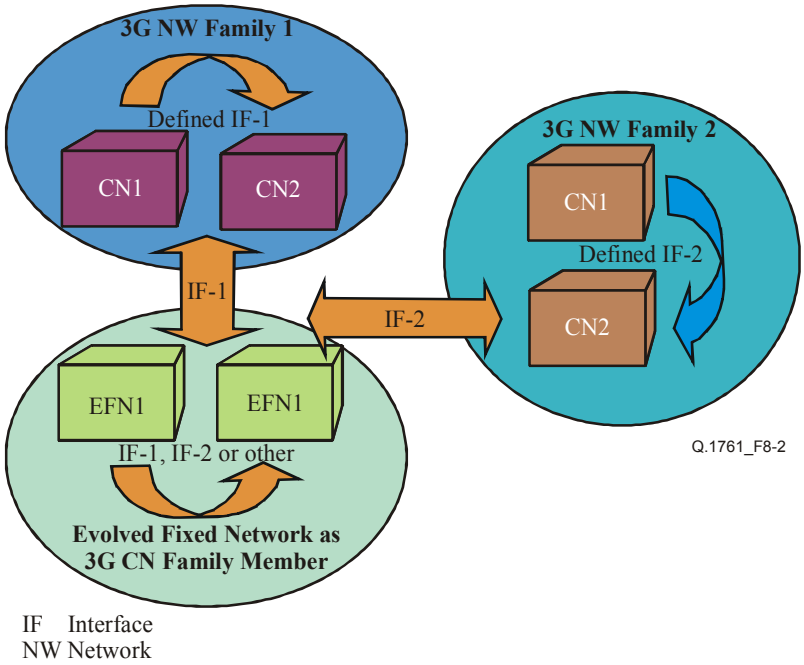

Figure 8-2/Q.1761 – Interfaces to an evolved fixed network as a fixed access network for IMT-2000 family members

8.1.2 FMP interfaces towards fixed networks

FMP will have interfaces towards all existing types of fixed access networks for example, PSTN, ISDN, packet mode networks, cable TV, etc., to suit the specific nature of different types of access networks.

The enhanced fixed terminal (FTE) is capable of performing registration, deregistration, etc., location management/authentication functions with FMP as visiting network. In case of PSTN as fixed access network, upon insertion of UIM, the FTE will set-up circuit switched call and perform required functions through in-band signalling (ETSI's fixed line SMS is an example of such signalling scheme [7], [8] and [9]).

8.2 Inter-operator arrangements for converged network roaming

By adding the fixed mobility plane (FMP) to the existing fixed networks, any subscriber may roam into another fixed network, nationally or internationally, and register himself as a roamer from any fixed terminal available to him. After registration in the visited fixed network, he would be able to make all outgoing calls from this fixed terminal as well as receive incoming calls on the same terminal. In this case, his bills are generated by home fixed network. Adopting well-established roaming agreement and revenue sharing mechanisms from the prevailing mobile networks will enable the settlement of the revenues for the roamer's network usage. However, this aspect is considered outside the scope of the study.

8.3 Service registration

Registration of the subscribers in the home or the visited fixed network may be carried out either manually, by dialling some identification codes from the existing simple fixed network terminals, or automatically by enhanced capability fixed line terminals. Enhanced capability fixed terminals might accept a UIM (similar to a mobile user's SIM card) and initiate the registration and authentication automatically. The UIM may be issued either by the fixed or the mobile network. The enhanced terminal would also allow an IMT-2000 user to register in the fixed network as a roamer and avail himself of the same set of subscribed services as in his home network, subject to the limitations that might be imposed by the capabilities of the available fixed terminal and the

capability of the fixed access network (FAN). A single fixed line terminal may support multiple users attached (registered through) to the same terminal simultaneously in a sharing mode. Many such terminals could be installed in suitable public places as a public access infrastructure. The IMT-2000 user may realize increased satisfaction through fixed access with better bandwidth and reliability for certain types of services. Networks should support subscriber registration, deregistration etc., from the fixed access point to make these terminals sharable among many users and to reduce the load on the network. Provision of tracing and monitoring of the users could also be required.

Following three mechanisms for service registration are visualized:

Case 1: Through normal POTS terminal with manually dialling the access/identity/authorization codes. This mechanism would be useful for early deployment of FMC where there will be no need to change the existing fixed terminal. This mechanism will have limitations with respect to security and the longer call set-up time.

Case 2: Through an enhanced fixed terminal (FTE), by inserting the UIM into the fixed terminal. The FTE will be interacting with fixed mobile plane (FMP) using appropriate signalling mechanism in a way that FAN is transparent. This mechanism will enable FTE to have service registration in a fast and automatic way and will further enhance confidentiality of user identity.

Case 3: Through wireless mechanism where a wireless device hosting UIM remains in the user pocket and it detects the available fixed terminal and does registration. This mechanism would leverage maximum potential of the fixed mobile convergence with full convenience to the user. The FTE as visualized for the Case 2, would additionally have a wireless interface, for interfacing with wireless devices hosting UIM in its vicinity and able to extend the complete communication link between the wireless device and the fixed terminal. In case of multiple available Fixed Access Points (FAP) in its vicinity, the wireless device hosting the UIM may select one of the FAPs based on the signal strength received from them. In such a case, terminal mobility requirement is also visualized. The session/call would be desired to be continued, if the user changes the FAP. Additionally, there is a possibility of having a multimode terminal supporting wide area radio as well as low-range fixed wireless access and a requirement of full terminal mobility between IMT-2000 radio access and low-range fixed wireless access. In this scenario, any IMT-2000 terminal additionally capable of low-range fixed wireless access also would initiate service registration in evolved fixed network through wireless-FAP and therefore leaving the 3G radio spectrum for other mobile users. In this scenario, continuation of the ongoing sessions would be desired.

8.4 Mechanism of unique user identity

In order to have mobility in the fixed networks, it is required to dissociate the user's identity and the identity of fixed access terminal and also, to identify the user uniquely independent of access technology. Since it is expected that an IMT-2000 subscriber will roam into enhanced fixed networks, IMSI (E.212) – an already established identity mechanism in mobile networks – may also be used to uniquely identify FMP subscribers.

Studies are under way to standardize an identity mechanism that meets all the communication needs of a user. Since FMC objectives are to be met in the near term, use of IMSI as an identity mechanism is recommended.

9 Capability requirements for enhanced fixed terminal (FTE)

For convergence, enhanced fixed terminal (FTE) is required to interact with the FMP. It will be necessary to dissociate the user identity from the identity of the access terminal. User-to-terminal association will be dynamic. For this purpose, registration of users through the FTE and hence authentication of the user accessing various network services is required.

9.1 Signalling capability requirement

To provide discrete mobility in fixed networks, the identity of the FTE being used must be dissociated from the user identity. Roamers from different networks can use the FTE as an access point. To gain access to various services, the user has to register himself in the network. The network, on the other hand, will maintain an FTE-to-user association to provide various services. The dynamic association of the FTE and the user requires various procedures to be executed between the network and the terminal. This brings the requirement of an enhanced communication protocol and signalling transport mechanism between the FMP and the FTE. The FTE should be capable of exchanging signalling with the FMP for performing the required mobility management and call control related procedures.

9.2 User identity association requirement

Once the dissociation of the FTE and the user's identity is achieved, it becomes possible for different users to access network services separately and simultaneously through the same FTE acting as a fixed access point. Roaming and discrete mobility functionality require that each user should be identified uniquely. For user identity purposes, diallable sequences (user identity, PIN, etc.), a smart-card-based solution, or any other suitable mechanism is proposed to be adopted. There could be multiple simultaneous users accessing network services through the same FTE. The FTE should unambiguously serve each associated user.

9.3 Enhanced user interface

The mechanism for accessing network services (registration procedure, authentication, multiple user to FTE association at network and FTE end) and the mobile nature of the users requires an enhanced user-FTE interface. Various services visualized for the scenarios will also require an enhanced user-FTE interface.

It is desirable that the user interface provide following indicators to the user:

a) A short mnemonic or code identifying the network with which the user is currently registered.

b) It is desirable to know through an indicator if the user is registered as a "roamer".

c) A suitable menu-based system to allow the user to conveniently use all possible services in the converged scenario.

d) In case of multiple users registered through the same FTE, the interface should be able to maintain necessary information of all such users to facilitate the following:

- Unambiguous announcement of the identity of the potential recipient of an incoming call.
- Provision to authenticate the user locally in the above case and while the user attempts to access various services and/or menus.

e) Means to allow the user to set/alter/inquire various service parameters either locally in his UIM (e.g., validity period, signature in case of messaging service) or on the network side (e.g., activation/deactivation/status enquiry of subscribed services).

Additionally, the following indications from the user need to be conveyed to the network if required:

f) The password/authentication code of the user during registration, authentication, invocation of a service, etc. (see Case 1 in 8.3).

g) Various other indications from the user depending on the service currently in use (e.g., the user's willingness to accept/reject an incoming call or incoming MMS message, additional information during the call like DTMF digits, etc.).

9.4 Power requirement

To address power availability conditions in developing nations, it may be desirable that the proposed enhanced capability FTE, in case of PSTN as FAN, would continue to work based on power supplied by the network element (local exchange), by incorporating power-efficient design mechanisms to be able to work within the permissible limits of power sources of local exchanges.

10 Mobility management functional requirements in fixed networks

The general environment for networks is mainly focused on the coexistence of complementary technologies, in particular for access techniques, and the future development of multimode and adaptable terminals and adaptable services. In a first step, these various technologies need to be linked to achieve interoperability, and in a further step, integration should be considered.

The IP in the core network for the transfer plane will enable the bridging of diverse fixed and wireless technologies such as those listed above. However, interoperability of the various access means at the transfer layer is not sufficient to achieve the above goals. In order to support global mobility in such a heterogeneous environment, further work is needed to develop network functions at the control layer:

- *Identification and authentication mechanisms*:

  The definition of such functions should consider existing identification and authentication mechanism in current networks in order to avoid duplication of control mechanisms from the user's point of view.

- *Access control and authorization function*:

  The result of the authorization function is a yes/no to a connection request made by the user and, in a next step, to a global access network configuration adapted to the mobile/nomadic user, including a global set of QoS levels for user connections determined from the user's subscription and the technical capabilities and constraints of the access network.

- *Location management*:

  The location management functions consist of network location and geographical location management. Network location management provides location data (e.g., network access point) which are normally used by network functions (e.g., for incoming traffic routing). Geographic location management provides location data which are normally used by services and applications (e.g., zip code for local services, such as "closest restaurant and movie theatres").

- *IP address allocation and management*:

  Some solutions enable a user to keep a fixed IP address which requires specific mobility management scheme to handle a local IP address granted to the user (e.g., Mobile IP)

- *User environment management (VHE)*:

  The user environment is defined as the "access network and terminal". This environment determines the global constraints placed on a nomadic/mobile user to get his services based on a combination of subscription parameters and the technical constraints of the access and network being used. The purpose of this function is to give an abstract view of the main user environment characteristics. These data may be used by services in order to adapt to and provide relevant service rendering to mobile/nomadic users.

  This function is of major importance in a heterogeneous environment, and appears quite new, while homogeneous systems (e.g., 3GPP systems, xDSL, etc.) do not require such data *per se* because they are implicitly the same for all users. In the case of a broad network environment for NGN, this will no longer be true for nomadic/users.

This function realizes a first stage of Virtual Home Environment: determining the characteristics of the user environment and enabling services to adapt to the current user environment.

- *User profile management*:

  The above functions are all based on some data which are either "subscription data" or "network data" (e.g., current network access point, network location). The storage and the update of these data are handled by the user profile management functions.

  It is therefore required to determine exactly the data and which functions (above mobility management functions) manipulate them.

- *Access to user data*:

  Services and other network functions require some user data in order to be appropriately customized. These can be either "user subscription data" or "network data". This function provides filtered access to the user data, which may be restricted to some interrogating entities (restricted rights to access user data), in order to guarantee user data privacy. This function is a necessary for VHE, as described above.

11 International emergency preference schemes in fixed mobile convergence

FMP is an overlay network and no specific emergency scheme is visualized at FMP. It is expected that users of FMP will be able to avail of emergency services prevailing in the FAN they are in.

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