1 UMTS among other systems

Objectives:

After this chapter the student will:

- be able to understand the relation between IMT-2000 and UMTS.
- be able to distinguish 2G and 3G in the area of services.

1.1 Introduction

Introduction – "FPLMTS"

The World Administrative Radio Conference (WARC) of the International Telecommunication Union (ITU) defined global frequency bands for Future Public Land Mobile Telecommunications Systems (FPLMTS) in 1992. These FPLMTS bands were identified as 1885-2025 MHz and 1980-2010 MHz which included a special band identified for satellite communication of 2170-2200 MHz. FPLMTS is standardised by the Telecommunications Standardisation Sector (ITU-T) and the Radio-communications Sector (ITU-R), formerly known as the CCITT and the CCIR.

1.2 Description of ITU and ETSI and ARIB

ETSI

The European Telecommunications Standards Institute (ETSI) is a non-profit making organisation whose mission is to determine and produce the telecommunications standards. It is an open forum that unites 490 members from 34 countries, representing Administrations, network operators, manufacturers, service providers, and users.

It is ETSI members that fix the standards work program in function of market needs. ETSI produces voluntary standards, but the fact that those who subsequently implement them request the voluntary standards, means that the standards remain practical.

ETSIs work program is based on, and co-ordinated with, the activities of international standardisation bodies, mainly the ITU.

ETSI consists of a General Assembly, a Board, a Technical Organisation and a Secretariat. The Technical Organisation produces and approves technical standards. It encompasses ETSI Projects (EPs), Technical Committees (TCs) and Special Committees. More than 3500 experts are at present working for ETSI in over 200 groups.

The central Secretariat of ETSI is located in Sophia Antipolis, a high tech research park in Southern France.

ITU

The ITU, headquartered in Geneva, Switzerland is an international organisation (United Nations) within which governments and the private sector co-ordinate global telecom networks and services.

On 24 May 1844 Samuel Morse sent his first public message over a telegraph line between Washington and Baltimore, thus ushering in the communication age. Barely ten years later telegraphy had become available to the general public. At this period, however, telegraph lines did not cross national frontiers because each country used a different system and each had its own telegraph code to safeguard the secrecy of its military and political telegraph messages. Messages had to be transcribed, translated and handed over at frontiers before being retransmitted over the telegraph network of the neighbouring country.

It is not surprising, therefore, that countries decided to conclude agreements to interconnect their national networks. Each link required numerous agreements.

20 European States decided to meet in order to work out a framework agreement. They also decided on common rules to standardise equipment in order to guarantee generalised interconnection, adopted uniform operating instructions which had hitherto been different from one country to another and laid down common international tariff and accounting rules.

On 17 May 1865 after two and a half months of negotiations, 20 participating countries signed the first International Telegraph Convention and the International Telegraph Union was set. This marked the birth of the ITU.

Since that time, telecommunications have continued to develop and the history of the ITU reflects the advances that have been made.

With the invention in 1896 of wireless it was decided to convene a preliminary radio conference in 1903 to study the question of international regulations for radiotelegraph communications.

The year 1920 saw the beginning of sound broadcasting at the improvised studios of the Marconi Company. In 1927, the Union allocated frequency bands to the various radio services existing at the time (fixed, maritime and aeronautical mobile, broadcasting, amateur and experimental.

At the 1932 Madrid Conference it decided to change its name to the International Telecommunication Union in order to reaffirm the full scope of its responsibilities, i.e. all forms of communication, by wire, radio, optical systems or other electromagnetic systems.

In 1947 under an agreement with the United Nations, it became a specialised agency of the United Nations.

In order to meet the challenges of the space age, the ITU set up a Study Group responsible for studying space radiocommunication in 1959.

In the area of telecommunications, new trends are emerging: globalisation, deregulation, restructuring, value added network services, convergence (of

services as well as technologies), intelligent networks and regional arrangements. Telecommunications have become a key ingredient in many non-telecommunication services such as banking, tourism, transportation and information services of various types.

In the changing world of telecommunications today new players are constantly appearing on the international scene. The traditional role of telecommunications is being transformed every day with new service dimensions.

ARIB

In Japan it was recognised that an organisation was needed to correspond to the development of internationalisation, the integration of telecommunications and broadcasting, and the promotion of businesses using radio waves.

This organisation would also be required to unite the wisdom in the fields of telecommunications and broadcasting, and to move forward the research & development of new radio systems and the international standardisation of technical standards in the fields of telecommunications and broadcasting, all with the aim of rapidly advancing the use of radio waves. In response to this need, the Association of Radio Industries and Businesses (ARIB) was established as a public service corporation on May 15, 1995 with the permission of the Minister of Posts and Telecommunications.

CWTS

China Wireless Telecommunication Standard is the standard development organisation responsible for wireless standardisation in China as approved by the Ministry of Information Industry.

3GPP

In November 1998 ARIB, ETSI, T1, TTA and TTC all agreed to co-operate for the production of technical specifications for a 3rd Generation Mobile System based on the evolved GSM core networks and the radio access technologies that they support (both FDD and TDD). In 1999 China Wireless Telecommunication Standard, CWTS) joined the project.

This project is called the “Third Generation Partnership Project” and may be known as “3GPP”.

At a meeting in July 1999, the Third Generation Partnership Project agreed to produce standards for the FDD and TDD modes which follows the recommendations from ITU IMT-2000. According to the agreement, 3GPP will cover the technical issues relating to the development of FDD and TDD modes that form a part of the global 3G CDMA standard. The work

will also include the inter-working between the evolved ANSI-41 and GSM MAP platforms.

In order to work towards global harmonisation, 3GPP has changed the chip rate to 3.84 Mcps and adopted a new downlink pilot structure. The complete 3G standards will ensure global roaming and seamless service provisioning.

The 3GPP have established a schedule of annual releases for the development of the standards. Release 1999 will be completed by 31 December 1999 and will be first deployed in early 2001 in Japan. Release 2000 will include Internet Protocol based networks and will be rolled out in 2002. Further enhancements will be included in later releases.

For more information about 3GPP see: www.3GPP.org.

The six standards development organisations are:

ARIB, www.arib.or.jp.
CWTS.
ETSI, www.etsi.org
T1, www.t1.org
TTA, www.tta.or.kr
TTC, www.ttc.or.jp

The tree market representations partners are:

The GSM Association represents 347 members which is comprised of GSM Network Operators and Regulators with more than 165 million GSM subscribers in 133 countries. See www.gsmworld.com.

The Global Mobile Suppliers Association, GSA, has a cross industry representation world-wide of GSM infrastructure, terminals, customer care and billing suppliers. See www.GSAssociation.org.

UMTS Forum represents 182 members from over 30 countries representing operators, regulators, manufacturers, IT and content providers. See www.UMTS-Forum.org.

3RD Generation Partnership Project 2

3GPP 2 is an effort spearheaded by the International Committee of the American National Standards Institute's (ANSI) board of directors to establish a 3G Partnership Project (3GPP) for evolved ANSI/TIA/EIA-41, "Cellular Radio-telecommunication Intersystem Operations" networks and related radio transmission technologies (RTTs).

Members of the ANSI board were concerned that the ETSI proposal was too limiting, and as a result, established a 3G ad hoc committee to examine how all standards development organisations (SDOs) could be involved. In

June 1999, a meeting was held between this ANSI ad hoc group and a delegation from ETSI in Seattle to further discuss how the 3GPP could accommodate all industry participants.

The 3GPP proposal, originally presented by ETSI to Committee T1 and TIA and other national SDOs, encourages the development of a joint technical committee at the international level which would handle pre-ITU and interregional specification work for IMT-2000 RTTs and related network specifications.

ANSI's response to the ETSI proposal was the creation of the 3G partnership as a multilateral collaboration among national and regional SDOs to facilitate the development of globally applicable technical specifications for 3G mobile systems based on the evolution of the two globally deployed mobile architectures: GSM/Mobile Application Part (GSM/MAP) and ANSI/TIA/EIA-41. The work is to be accomplished co-operatively to facilitate the development of timely ITU IMT-2000 recommendations.

This co-operation may result in either complete specifications or in agreed technical elements, which the participating SDOs may submit to the ITU through their normal national or regional processes.

The proposed 3G partnership is structured into two projects:

3GPP 1: Global specifications for GSM/MAP network evolution to 3G and the UTRA RTT.

3GPP 2: Global specifications for ANSI/TIA/EIA-41 network evolution to 3G and global specifications for the RTTs supported by ANSI/TIA/EIA-41.

1.3 IMT-2000 and UMTS

IMT-2000

IMT-2000 is an initiative of the ITU. It will provide wireless access to the global telecommunication infrastructure through both satellite and terrestrial systems, serving fixed and mobile users in public and private networks.

It is being developed on the basis of the 'family of systems' concept, defined as a federation of systems providing IMT-2000 service capabilities to users of all family members in a global roaming offering.
With almost 5 million new mobile users a month, 1million a month in Japan alone, wireless access will likely overtake fixed access to global telecommunications very early in the 21st century.

As wireless becomes a major form of access to global telecommunications, common network components should be able to be used to provide virtually any desired future service combination between wired or wireless access links.

The ITU began its studies on International Mobile Telecommunications - 2000 (IMT-2000) in 1986, when the availability of hand-held cellular phones offered the potential for global, rather than National/Regional, land mobile systems.

Future public land mobile telecommunication systems (FPLMTS) are aimed at providing global wireless access around the year 2000, based primarily on the 2 GHz spectrum identified at the 1992 World Administrative Radio Conference (WARC-92). Standardisation of FPLMTS is one of the strategic priorities of the ITU.

The acronym FPLMTS where changed to the new name "International Mobile Telecommunications-2000 (IMT-2000)".

The International Mobile Telecommunication vision encompasses complementary satellite and terrestrial components. Satellite systems have limited capacity due to power and radio spectrum. Terrestrial macro, micro and pico cells complement global satellite coverage and provide the frequency reuse necessary to serve a global market estimated to be of the order of one billion wireless access users early in the 21st century.

IMT-2000 represents the satellite and terrestrial portion of IMT that will be available around the year 2000 primarily based on the spectrum identified at 2 GHz.

The satellite component of IMT-2000, together with earlier global satellite systems in other bands, will likely provide the first telephone in many rural villages. The terrestrial infrastructure will then follow as demand increases.

In the 1980s, the pocket telephone was the vision, now it is commonplace. However, many changes have occurred since then: the Internet has become a big factor in life and we are becoming used to multimedia communications. Users of the Internet, like mobile telephony, have grown at a very high rate and both these high growth phenomena are major drivers of change in future telecommunications. One comes from the information technology world and the other from telecommunications.

One of the key benefits of IMT-2000, as a true third generation system, will be its ability to deal efficiently with audio-visual multimedia communications In the future the user's application will control how the negotiated radio bearer is used, which will require a very different radio and control infrastructure.

There are two major areas of technological innovation that may impact on future wireless systems: the first is multimedia, the second is software radio technology. What this really means is that more and more is being done by software rather than by hardware.

The impact of microprocessors and chip will allow greatly increased flexibility in radio equipment which is going to have a dramatic effect on what should, and what should not, be standardised. In the past, radio standards were developed to a certain level of detail based on channel, modulation and coding structures over the radio path because it was difficult to build flexible radios.

IMT-2000 covers a very wide range of radio operating environments, all the way from the satellite to indoor pico cells. An adaptive radio interface is envisaged for IMT-2000 to optimise performance in these widely differing propagation conditions. This adaptation will be controlled by software using digital signal processing technology.

Multi-mode and multiband mobile terminals will be a common mechanism to link IMT-2000 to earlier systems. The ITU standardisation work on IMT-2000 encourages convergence of the many diverse satellite and terrestrial mobile systems towards the ITU vision for third-generation global mobile communications, i.e. IMT-2000. However, with the rapid changes in technology, particularly in the digital processing area, new standards must not be restrictive, but should enable future telecommunication enhancements. In other words the standardisation must be in such away that it can be efficiently controlled by future applications that we do not even dream about today.

UMTS

Responsible for ETSI projects GSM and UMTS

The mission of SMG, Special Mobile Group, is to develop standards for the GSM (Global System for Mobile Communications) family of public digital mobile communications systems with a built-in capability for unrestricted world-wide roaming of users and/or terminals between any networks belonging to this family.

Specifically, its task is to develop and maintain the specifications of the digital cellular telecommunications system operating in the 900 MHz band known as GSM 900 and of its variation in the 1800 MHz band, known as DCS 1800.

In addition it is responsible for maintaining the integrity of the GSM platform by close co-operation with ANSI T1P1, who are responsible for the 1900 MHz version, known as PCS 1900.

SMG is also responsible for studying and defining all aspects of third generation mobile systems based on the concept of Universal Mobile

Telecommunications System (UMTS), in co-operation with studies by the International Telecommunication Union (ITU) regarding a global system known as the International Mobile Telecommunications 2000 System (IMT 2000).

SMG maintains close-working relations with the UMTS FORUM based on the co-operation agreement between ETSI and the FORUM.

The scope of the work is focused to the GSM family. It includes the definition of the GSM services offered and the selection and specification of the most efficient radio techniques and speech coding algorithms.

SMG is also responsible for the elaboration of the GSM network architecture, signalling protocols and conditions of interworking with other networks. In addition SMG is charged with the application of the Telecommunications Management Network (TMN) concept to the GSM network entities regarding operation and maintenance.

UMTS Terrestrial Radio Access (UTRA) is the ETSI candidate for IMT 2000 Radio Transmission Technology (RTT).

The goal for the future work in SMG2 is to provide the standard for the radio access network part of UMTS. In addition, to this goal SMG2 is to provide UTRA as a candidate for IMT-2000 to ITU.

For the work towards the UMTS standard it proposed that this work should consist of the following events and phases:

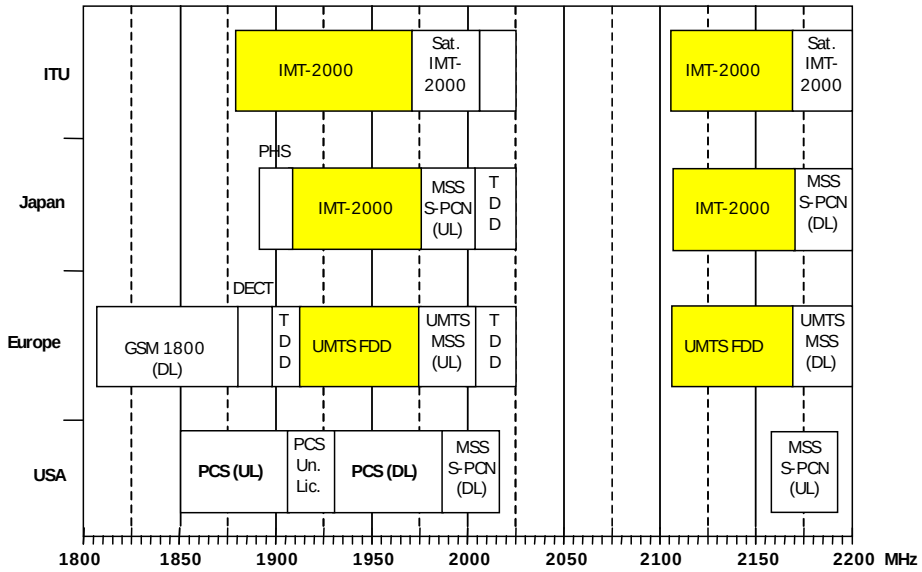
Finalise the SMG2 proposal of the radio access part of IMT2000 and present this (submission from SMG to ITU June 30, 1998).

A first phase is to elaborate technical descriptions and evaluate performance of the final solutions of UTRA. This phase is concluded with a detailed description of UTRA including the mobile station. This includes all radio protocols terminated in UTRA, the UTRA internal protocols and the Iu interface as well as descriptions of the functionality's required of the network nodes and in terminal

A second phase that could be initiated during phase 1 would be to write the actual specifications/standards based on the material elaborated in the first phase. It should be the goal to freeze the specifications/standard in December 1999.

The third phase is the iterative correction phase, where the specification/standard is corrected based on the experience gained with the standard during development and implementation of UMTS. This phase in principle never ends, but should considered done in 2001. The fourth part would further development of UMTS towards the UMTS phase 2 to be introduced 2005.

Spectrum consists of one paired band (1920 – 1980 MHz + 2110 – 2170 MHz) and one unpaired band (1910 – 1920 MHz + 2010 – 2025 MHz). Same spectrum allocation in Europe and Japan.



Spectrum allocation UMTS/IMT-2000.

ETSI decision on UTRA in January 1998:

- WCDMA to be used in the paired band
- TD/CDMA to be used in the unpaired band

It is also stated that it should fit into 2*5 MHz spectrum allocations and that the two modes FDD/TDD should have harmonised parameters.

	UTRA FDD	UTRA TDD
Multiple-Access scheme	W-CDMA	W-TDMA/CDMA
Duplex scheme	FDD	TDD
Chip rate	3.84 Mcps (7.68 Mcps, 15.36 Mcps)	
Carrier spacing (3.84 Mcps)	4.2-5 MHz (200 kHz carrier raster)	
Frame length	10 ms	
Inter-BS synchronisation	Not required	Required
Maximum spreading factor	256	16

UTRA basic parameters.

<u>Phases for ETSI UMTS discussed and defined</u>

UMTS Phase 1
- GSM GPRS Release 99 with UMTS

UMTS Phase 2
- Higher bitrates (20 Mbit/s)

UMTS Phase 3
- ?

Milestones for UMTS

December 1999: Standardisation freezes. First operator licences for UMTS. Release 99 completed by 31 December.

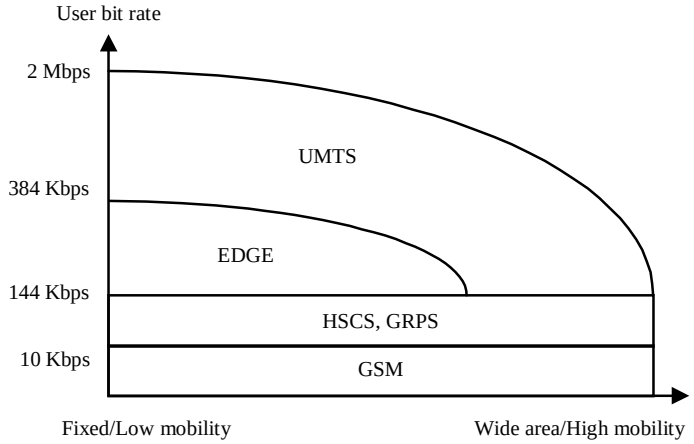
2000 – 2001: Vendors development of network elements. Iterative experimental process that might effect the standards. First launch of UMTS in Japan 2001 based on Release 99.

01 January 2002: UMTS in Europe. Release 2000 including Internet Protocol based networks.

2005: Availability of all core bands for UMTS.

2008-2010: Additional spectrum for terrestrial and satellite use.

The road towards UMTS will include other enhancements in the network to meet the need of higher bitrates and packet data for the user. High Speed Circuit switched Data, HSCD will let the users use more than one timeslot in the TDMA air interface to reach higher bitrates. GSM Packet Radio Switching will add the ability to send and receive packet data. It will also be the backbone in the UMTS/GSM network. EDGE will be a complement to UMTS that might give the operators without UMTS frequencies the possibility to present high bitrates for the customer.



Bit rate and coverage

Services (ideas about the future)

GSM Association (former GSM MoU) has established a Third Generation Interest Group (3GIG) to elaborate positions of the world-wide GSM

community in respect of the design of UMTS, IMT-2000 or any other telecommunication system which may complement GSM in early phases and replace partly or completely GSM technology in the long term future. 3GIG contributes to standardisation and other TG activities rather than doing standardisation itself.

It is in the interest of GSM network operators that new third generation systems are developed in a time frame suitable for them (and their equipment vendors) and that scenarios for a controlled migration of users are properly taken into account.

Main criteria distinguishing 2G and 3G in the area of services

Services in 2G systems can typically be characterised by three main criteria:

- 2G network operators provide a variety of services standardised in detail.

- Roaming where provided is restricted to the system.

- 2G mobile networks are usually restricted to relatively low bit rate services and were designed primarily for speech.

In contrast, 3G systems can be characterised in the area of services by the following main features:

3G system shall meet the individual communication requirements of a customer with his personalised service profile and user interface under the conditions of a still growing mass market.
Instead of individual services the tools for service creation will be standardised.

Access to and invocation of the users' own personalised services shall be possible regardless of the operating environment and access system, thus supporting intersystem roaming.

In addition to services already offered within 2G system, 3G system can offer spectrum efficient access to multimedia services of higher, flexible bandwidth to mobile users.

Users expectations

The user of today expects a variety of services to be offered by various providers and for these services to be flexible enough to meet his individual demands.

In pre-3G mobile systems like GSM but also in ISDN, the user has already a broad choice of services, in particular supplementary services. This variety of services has led to complex instructions on how to use these services. Ordinary users will not accept an increase in complexity of

service handling. Instead they will prefer a simpler ‘personal assistant type’ man-machine interface.

When roaming outside his home environment, the user will not appreciate the need for changes in the MMI, Man Machine Interface. He wishes to continue to communicate as usual, unless tariffs in a host network are different or service quality gives reason to complain. Whatever the difference is, in technical terms, does not bother the user. The user wants to communicate and not study communication technology.

Roles and their relationships

The following actors do traditionally play a role in most models:

Network Operator, Service Provider, Subscriber, User.

However, a new business environment may create new categories of players such as Value Added Service Provider, Content Providers, Service Brokers and others. Various relationships between the roles can exits. They will be used to clarify relations and to identify interfaces that may need standardisation.

A subscriber may subscribe to services at different service providers while maintaining a single identity. In addition, a service provider may offer services to more than one network.

With the above mentioned variety of relationships, definitions of the home "network" or visited "network" used by second generations system are no longer valid. The term "home environment" as seen from the user’s perspective, is proposed as a replacement.

Regulatory framework

In recent years telecommunication services have been regulated. It is well understood today that service definition is not a matter for regulators. A few exceptions may exist, e.g. for emergency services.

The decision is left to the market. To a limited degree, a commercial club of network operators / service providers may agree on some items such as a minimum set of services and the respective specifications.

As a consequence, IMT-2000 is expected to exist in various shapes and forms.

The position of regulators is also changing in the area of licensing, with a tendency to giving licenses for frequency use rather than to complete systems. This situation increases the complexity of interworking or interoperation of networks for global roaming.

The functions of network operators

In pre-3G networks, e.g. GSM, operators agreed on a set of services to be provided by each operator. This simplified the service management considerably but may no longer be sufficient to satisfy user requirements.

It is proposed that in future the networks should only provide service capabilities, which may differ slightly or fundamentally between different networks (e.g. cordless, cellular, satellite networks). Other parties to compose services for the market use these service capabilities.

This task could be handled by service providers themselves or a new class of actors called service creators.

Service providers may request from the network operator that he enable roaming in other environments for all or some of his customers. Third generation systems must provide the necessary tools.

Impact of technological progress

The design of any third generation mobile system has to take account of latest achievements in modern technologies.

Convergence of communication, information and entertainment technologies, blurring borders between fixed and mobile network concepts, multimedia presentation, transfer of application support software packages (e.g. Java applets), software controllable terminals, high-capacity chips and memories.

Impact of the Internet

The use of Internet service is already today very common and well accepted by the user. The 3G system has to take into account the achievements and also the requirements of Internet and intranet services. This will put high demands on bandwidth requirements.

Basic requirements

3G systems shall have standardised service capabilities required to build 3G services

Flexible service definition.

Personal mobility in mobile and fixed networks.

Support for multi-system terminals.

Support of multi-mode operation.

Capability for international roaming and inter network roaming.

Flexible charging, including pre-payment and electronic purse systems.

Comprehensive real time charging information to the user.

Integrated mailbox-service for voice, fax, text and other formats (in mobile and fixed networks, accessible via both networks).

Personal Assistant and intelligent agent support.

Service categories

Basic services provided in 3G networks are audio, video, facsimile transfer, data communication, Internet services, e-mail/voice mail, paging, messaging, and combinations of these i.e. multimedia.

3G service capabilities for these services should take account of their discontinuous and asymmetric nature in order to make efficient use of network resources.

Supplementary services are generally not standardised.

Speech
3G must provide the capabilities for high quality speech conversation.

Video Communication
It is assumed that video communications will become a mass service second only to ordinary telephony.

Multimedia
3G systems will support multimedia services and provide the necessary service capabilities.

Basic set of services
The definition of a basic set of services will not be part of the 3G standard.

Service Creation
In the Third Generation, a mechanism to create services, will be standardised, not the service itself.

Service operation
The operation of 3G services requires a special mechanism in order to allow complete service portability across network borders and to provide

an easy service handling by the user. It includes the mechanism needed for service access (identification, authentication.), service compilation, service execution, service control and the generation of billing records.

The user requires an easy and fast access to his personalised service. It has to be guaranteed that he will use the service under the conditions agreed with his service provider.

Service portability
Roaming between different 3G environments shall be possible without limiting the user in his personal service set and accustomed user-interface, limited only by physical constraints.

VHE Concept
Virtual home environment (VHE) is a system concept for service portability in the Third Generation across network borders. It should work under the 'mass services for individuals' condition. In this concept, the serving network emulates for a particular user the behaviour of his home environment.

The concept of VHE has been proposed as the technical basis for simplification of service handling at the user's side and for service profile portability across network borders.

Relationship between mobile and fixed networks

Future network operators and service providers will have to offer both wired and wireless access for terminals. Any future system should be designed accordingly as a new type of network.

Mobile Fixed Convergence, MFC, is a technological trend in telecommunications in which the clear distinction between fixed and mobile networks is continuously fading out through increased similarities of network functions in both network types. MFC includes service provision for the user irrespective of the means of the users' access to the network.