

Mobile Communications

Universal Mobile Telecommunication System

4. Universal Mobile Telecommunication System

4.1 New service paradigms for mobile communication

4.2 Bandwidth and Standard process for UMTS

4.3 Spread Spectrum Communications - principles

4.4 UMTS Signalling and control functions

4.5 UMTS Core Network – IP integration issues

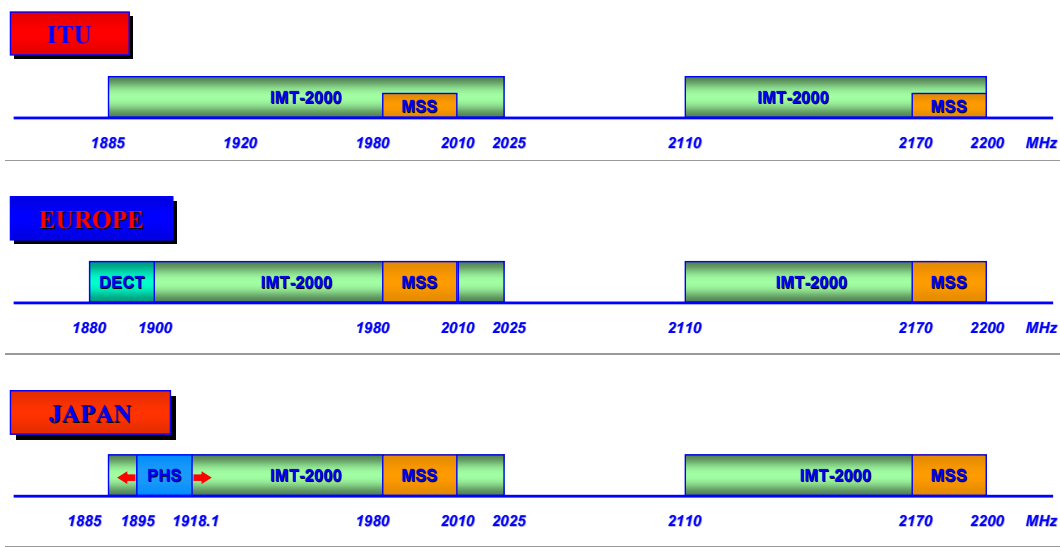
4 Universal Mobile Telecommunications System

4.2 Bandwidth and Standard Process for UMTS

**the assigned spectrum
the operator bandwidth
3GPP activities**

Paragraph 4.2 summarises the Standardisation process that led to the UMTS specification. Also the criteria inspiring the bandwidth assignment are briefly recalled as well as the underlying assumption about the expected development of multimedia services.

Third generation bandwidth assignment



3

TELECOM LAB
ITALIA

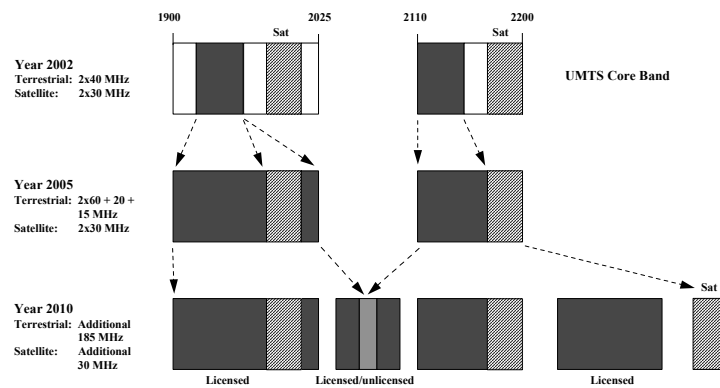
Regardless the service types, the quantitative growth of mobile communications is meaningful in itself. In many countries (including Italy) the penetration of mobile terminals has already passed the fixed lines penetration.

Many forecasting studies underline that this growth should continue until the mobile terminal dimensions and related functions enable further diffusion of mobile services for both consumer and business applications.

A basic issue is then represented by the spectrum requirements for third generation mobile services.

The overall bandwidth assigned by WARC '92 to the world regions is shown in the figure. The bandwidth assigned to IMT-2000 systems includes both symmetric and asymmetrical portions.

Possible spectrum evolution for UMTS



Source: UMTS Forum

A bandwidth evolution is foreseen for UMTS between years 2000 and 2010. This should happen for both terrestrial and satellite component of UMTS, such as proposed by the UMTS Forum. For the time being, this has been accepted by the ERC market analysis document, issued at the beginning of the Phase 3 of the detailed Spectrum Investigation Process.

Bandwidth requirements, operator needs (I)

Services	User net bit rate	Coding factor	Asymmetry factor	Call duration	Service band (kbit/s)	Switch. mode
High Interactive multimedia	128	2	1/1	144	256/256	Circuit
High multimedia	2000	2	0.005/1	53	20/4000	Packet
Medium Multimedia	384	2	0.026/1	14	20/768	Packet
Switched data	14.4	3	1/1	156	432/432	Circuit
Simple messaging	14.4	2	1/1	30	28.8/28.8	Packet
Speech	16	1.75	1/1	60	28.8/28.8	Circuit

5

 TELECOM LAB
ITALIA

The UMTS Forum has devoted significant efforts to evaluate the needed spectrum in function of the expected third generation service scenario and to calculate (according to the WARC assignment and the minimum spectrum needs) the “optimal” number of UMTS Operators in a given Country.

To perform these calculations, the Forum assumed that:

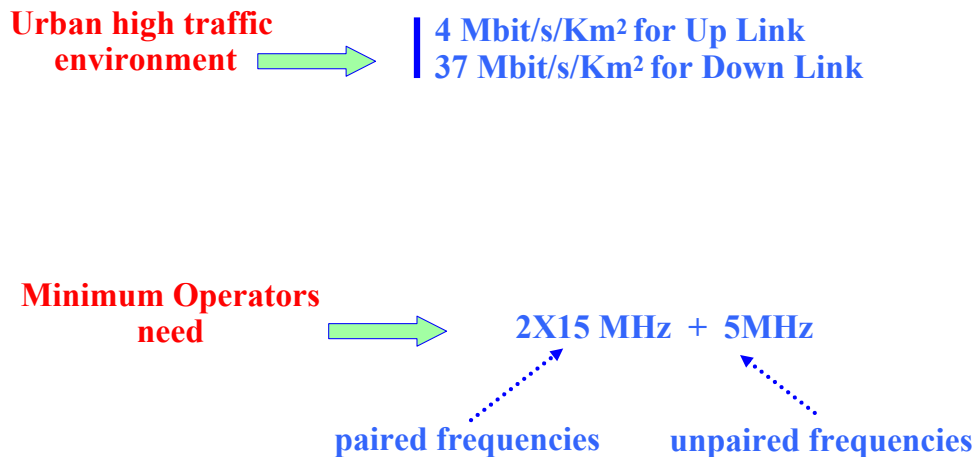
- between 2002 and 2005 most of the services carried out by the UMTS network will be multimedia services
- speech and low bit rate data are assigned to UMTS only for the 10% of the total amount (90% of these services are assigned to second generation systems)
- the minimum carrier spacing is 5MHz, valid for both W-CDMA and TD-CDMA (the two access schemes chosen in ETSI)
- 155 MHz are available for third generation in Europe, as specified by WARC.

In addition, the Forum evaluations have assigned a high degree of asymmetry to high bit rate services for both “session period” ranges (minutes) and “long term” ranges (day).

Asymmetry (ratio of transmitted down link bits to transmitted up link bits over an assigned integration time) can reach values of several tens in a session period.

The table represents the UMTS service classes and the relevant characteristics adopted by the UMTS Forum to perform bandwidth requirement estimates and to evaluate the optimum number of UMTS Operators in a given Country.

Bandwidth requirements, operator needs (II)



6

TELECOM LAB
ITALIA

The Forum assumptions about multimedia penetration are:

- 16% of multimedia users for year 2005 and
- 30% for year 2010.

As said, speech and low data rate services are assigned to second generation systems for the first UMTS phase. Spectrum requirement (Mbit/s/km²) has been calculated through simplifying assumptions for urban environment only, since it reflects the most congested situation in terms of traffic and required service capacity.

The minimum operative condition for a single Operator is that reported in the figure, implying that no more than 4 Operators are sharing in a given Country the overall bandwidth of 155 MHz.

The bandwidth assigned to each Operator is more or less aligned all over Europe. Except for Sweden, all the licenses are assigned on a national scale.

In case of single size license, the typical bandwidth is 2X10 MHz + 5 MHz in the asymmetrical portion of the spectrum.

Mixed offers refer to 2X10 MHz + 5 MHz and 3X10 MHz + 5 MHz respectively.

Typically, in the first years, it is required that portions between 20 and 25% of the population are covered. Whenever not mentioned, the minimum requested bit rate is 144 kbit/s.

2G - 3G roaming conditions are normally requested for a limited time period, until the new entrant reaches a given percentage of radio coverage. National roaming ensured to new entrants is in some cases giving a very high score in the license assignment criteria. Limits to the electromagnetic pollution are normally posed according to a country-wide (and country-dependent) criteria.

A Standard for UMTS - FPLMTS: the “old” vision

- **Integration of all new and existing services in a new single network universally defined**
- **UMTS has Broadband ISDN as the main partner network**
- **Migration from existing networks to UMTS**
- **Definition of a new type of roaming, based on INAP protocol**
- **FPLMTS as a monolithic standard defined within ITU**

7



In the early phases of the Standardisation process, for Third Generation Mobile Systems, some specific characteristics were addressed that are partially reviewed nowadays. These characteristics were mostly related to the level of integration of third generation mobile services with the fixed network infrastructure.

It was universally pursued a strict integration of Third Generation Mobile Systems with both the B-ISDN Core Network and the evolved Intelligent Network platforms, covering the service control and creation requirements. A key assumption for this integration was the complete independence of the upper hierarchical layers of the network with respect to the underlying radio functions.

The above framework was inducing a natural functions allocation:

- radio and low level mobility management in the access segment of the network
- switching and call control in the UMTS Local Exchange
- service and upper mobility management functions in the IN segment (the evolution of the IN Standards was considered to be a key factor in this sense).

Mobility control functions refer to both call-related and non-call related features. Vice versa, service-control functions contain the typical call-related IN features.

In this vision, the Mobile Terminal has a direct functional relationships with the Local Exchange (call control) and the mobility and service control entities (the IN functions).

UMTS - IMT2000: the “new” vision

- Introduction of new innovative services and support of GSM services (phase 2+)
- UMTS has Intranet and Internet as main partner networks
- Evolution from GSM and ISDN networks, with elements of fixed-mobile convergence
- Evolution of GSM roaming, based on MAP protocol
- IMT-2000 “Family Concept” within ITU and detailed standards in ANSI, ARIB/TTC, ETSI

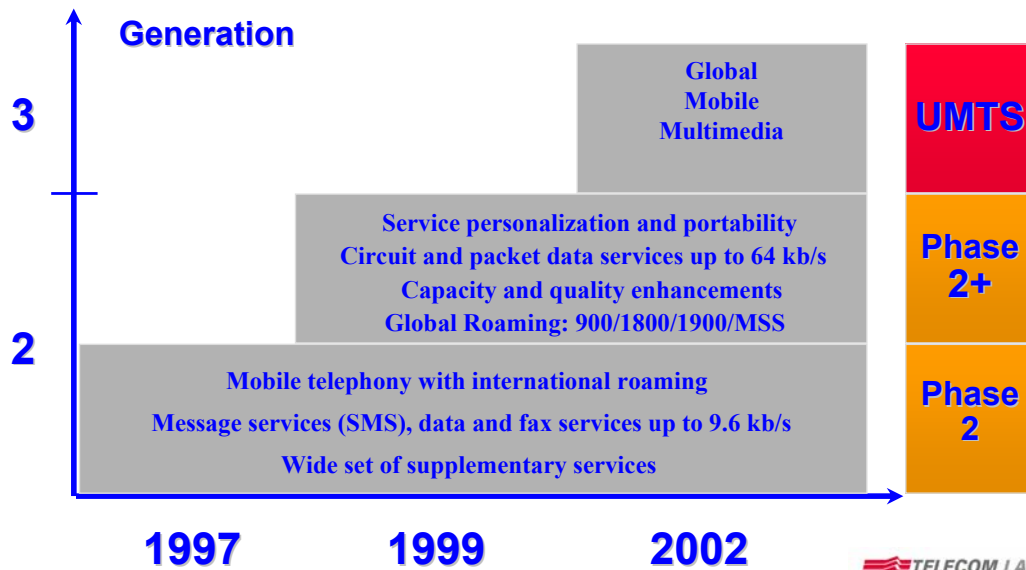
8



But the situation has partially changed in the subsequent phases of the standardisation process. The new Standardisation approach is summarised in the figure. It includes:

- a more significant level of continuity with the GSM infrastructure (mostly with the GPRS architectural approach) at least in the initial development phases of UMTS
- a high level of integration with the IP world which is initially pursued for data services and then extended to real time (delay sensitive) services like voice
- the choice of the radio access modes on the basis of *minimum requirements* commonly agreed (this implies leaving the Standards open to different access schemes).

UMTS as GSM Evolution



The GSM dependency is confirmed when global mobile multimedia services are viewed as the natural extension of the GSM-based services defined in Phase 2 and Phase 2+.

The emerging UMTS standard has been very clearly tailored on a strictly mobile-driven approach.

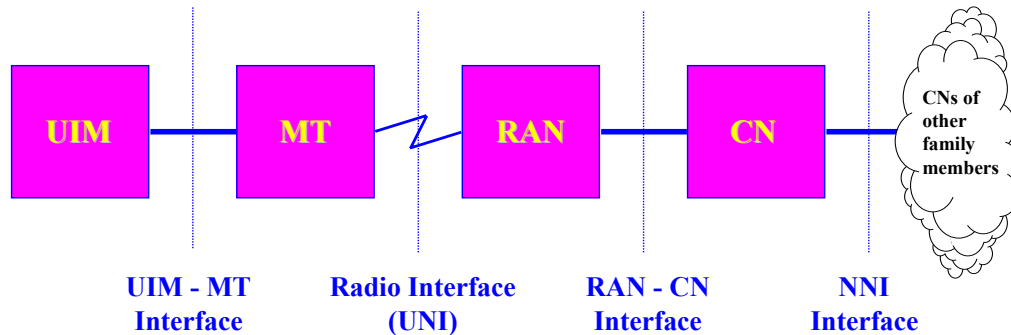
In fact, the agreement reached in SMG about the transition to UMTS assumes that:

- UMTS is a true third generation service and system, constructed through an evolution path from GSM, ISDN and using DECT as a wireless mode only in the access segment.
- UMTS should be developed in phases:
 - Phase 0 is the implementation of UMTS services in evolved GSM networks (using the evolved GSM radio access).
 - Phase 1 shall use the UMTS radio access. Operation has started around year 2002.
- after year 2002 UMTS has evolved in annual phases.
- UMTS specification is following a modular approach; new capabilities and evolution of capabilities should be standardised according to market needs.

IMT2000 Family Concept and Members

A IMT2000 Family Member should support:

- A set of service capabilities and network capabilities (in phases)
- A set of IMT2000 interfaces to be defined by ITU



10

This is the IMT 2000 family concept approved in the ITU-T context. ITU has decided to define a framework for third generation systems in order to allow for migration from different second generation systems developed in the various Regions.

This implies the replacement of the idea of an IMT-2000 target system by a virtual IMT-2000 reference network that is primarily used for specifying necessary interfaces for IMT-2000 family.

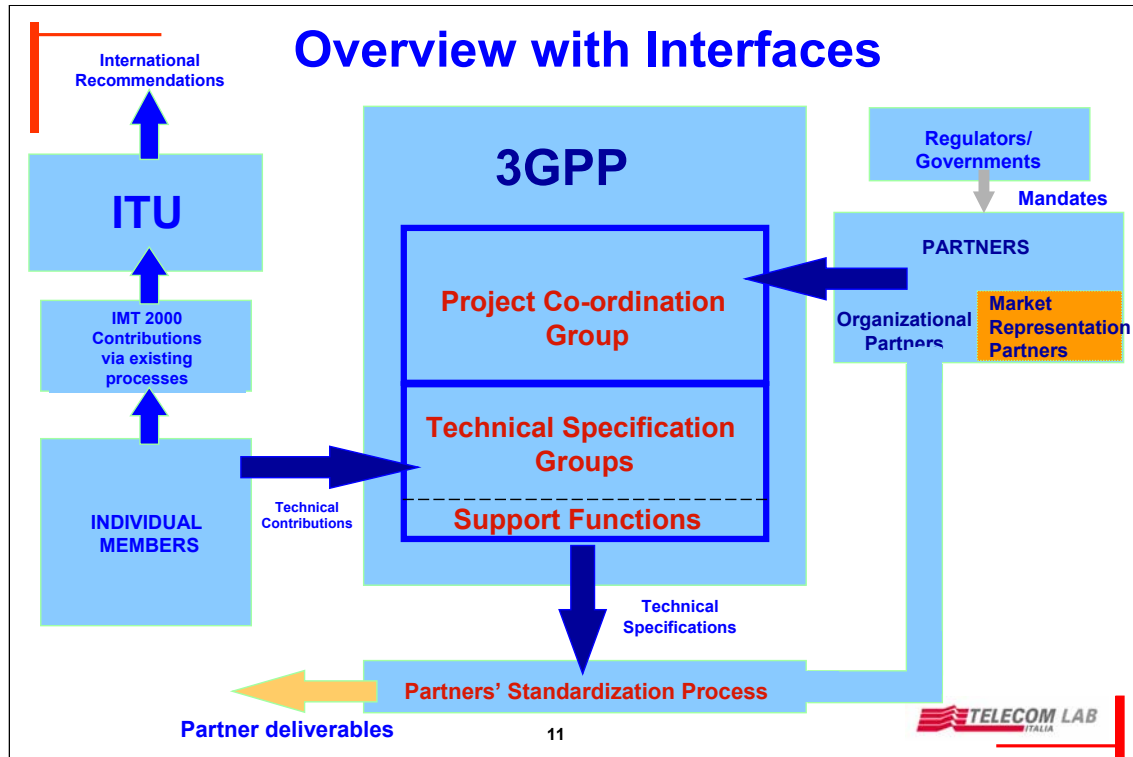
It should allow compatible systems to co-exist and inter-operate irrespective of the evolutionary path and generic requirements addressing the different ways of realising particular service capabilities or network capabilities.

In this context, a mobile system can be considered a member of IMT 2000 family whenever it can support a minimum set of services and network capabilities and be compatible with a set of interfaces defined by ITU.

An extensive agreement has been established among five Standardization Bodies to jointly develop specifications for a Third Generation Mobile System, as a member of the IMT-2000 family. It is based on:

- UTRAN, FDD (W-CDMA) and TDD (TD-CDMA) mode
- Core Network evolved from GSM/GPRS.

The Standard Bodies are: ETSI (Europe); ARIB – TTC (Japan); TTA; T1 (USA). The Body in charge of the related specification is the *Third Generation Partnership Project* (3GPP).



This is the organisation of 3GPP Standardisation Group.

The figure highlights the relationships arising between 3GPP, the related partners, the individual members and ITU.

Technical specification take place through the co-ordinated work of four technical specification groups, namely:

- the Radio Access Network TSG
- the Core Network TSG
- the Terminals TSG
- the System Aspects TSG.