

***ITU /ICTP Workshop on New Radiocommunication
Technologies for ICT in Developing Countries
(Africa Region)
Trieste, Italy, May 17-21, 2004***

***Mobile Telecommunications - Evolution and Migration towards 3G
Mobile Technology***

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In this presentation...

- Wireless Generations
- What is IMT-2000?
- What IMT-2000 offers
- Key features and objectives
- Spectrum for IMT-2000
- Technologies for IMT-2000
- Migration paths
- Future Trends
- ITU Activity, BDT Activity, Coordination among the three Sectors
- ISAP (Istanbul Action Plan) for IMT-2000

Mobile Communication

• 1946- 1960s	1980s	1990s	2000s
• Appeared	1G	2G	3G
•	Analog	Digital	Digital
•	Multi Standard	Multi Standard	Unified Standard
	Terrestrial	Terrestrial	Terr. & Sat

Mobile Communication

WIRELESS GENERATIONS

- **1 G - analog (cellular revolution)**
 - only mobile voice services
- **2 G - digital (breaking digital barrier)**
 - mostly for voice services & data delivery possible
- **3 G - voice & data (breaking data barrier)**
 - mainly for data services where voice services will also be possible
- **Beyond 3G -wide band**
 - higher data rates

Mobile Communication

LIMITATIONS OF 2nd GENERATION SYSTEMS

- **No Global standards**
- **No common frequency band**
- **Low information bit rates**

- **Low voice quality**
- **No support of Video**
- **Various categories of systems to meet specific requirements**

What is IMT-2000?

IMT-2000: International Mobile Telecommunications-2000 for Data & Multimedia Services, set of globally harmonized standards for third generation wireless communications (3G)

They will provide access, any time and anywhere, by means of one or more radio links, to a wide range of telecommunications services supported by the fixed telecommunication networks (e.g. PSTN/ISDN/IP), and to other services which are specific to mobile users.

A range of mobile terminal types is encompassed, linking to terrestrial and/or satellite based networks, and the terminals may be designed for mobile or fixed use.

Key features of IMT-2000 (1)

High degree of commonality of design worldwide

Compatibility of services within IMT-2000 and with the fixed networks

Provisioning of these services over wide range of user densities and coverage areas (In-building, Urban, Sub-urban, Global)

High quality, high speed access 144 Kb/s, 384 & 2Mbit/s fast wireless access to Internet

Across Networks, across Technologies using a small pocket terminal for worldwide use

Key features of IMT-2000 (2)

worldwide roaming capability

capability for multimedia applications, and a wide range of services and terminals.

efficient use of radio spectrum consistent with providing service at acceptable cost

IMT-2000 shall cover application areas presently provided by separately systems i.e cellular, cordless and paging etc.

A MODULAR STRUCTURE WHICH WILL ALLOW THE SYSTEM TO GROW IN SIZE AND COMPLEXITY

Key features of IMT-2000 (3)

- **SINGLE UNIFIED STANDARD (Data & Multimedia Services)**

**ACROSS NETWORKS, ACROSS TECHNOLOGIES,
SEAMLESS OPERATION USING A SMALL POCKET
TERMINAL WORLDWIDE.**

- **HIGH SPEED ACCESS 144KB/S, 384 KB/S & 2MB/S FAST WIRELESS ACCESS TO INTERNET**
- **FULL MOTION VIDEOPHONE**
- **TERRESTRIAL & SATELLITE COMPONENTS**

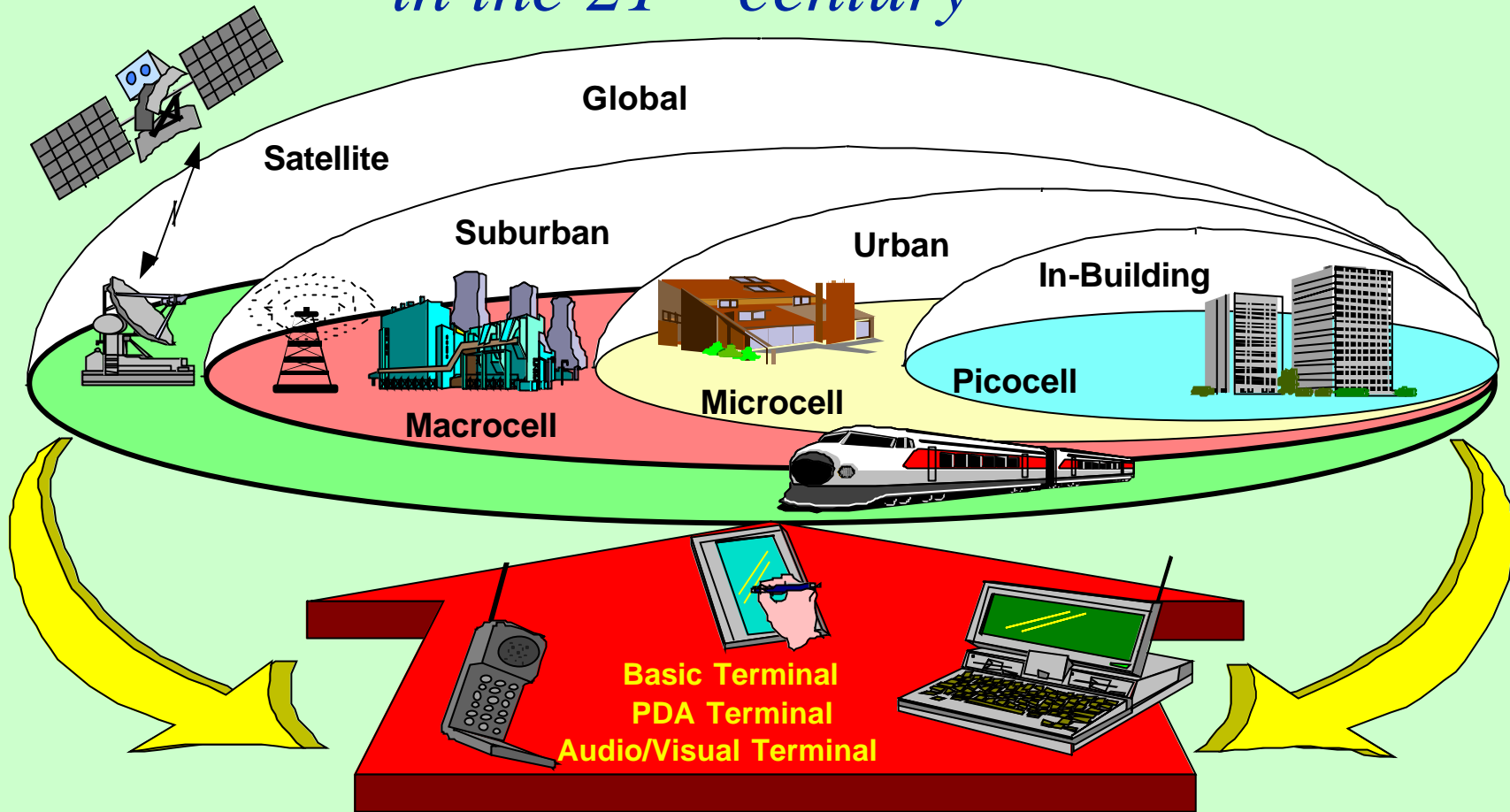
IMT-2000 Will provide

- Simultaneous transfer of speech, data, text, pictures, audio and video
- High-speed, mobile access to Internet
- Entertainment on demand (movies, Music..)
- Video-conferencing
- Mobile-commerce
- Travel information (roads, flights, trains,...)

IMT-2000



*The ITU vision of global wireless access
in the 21st century*



IMT-2000 Spectrum

- **WARC -92 IDENTIFIED 230 MHz GLOBAL SPECTRUM for IMT-2000:**
 - 1885 - 2025 MHz & 2110 - 2200 MHz for terrestrial
 - 1980 – 2010 MHz & 2170 – 2220 MHz for satellite
- **WARC-2000 IDENTIFIED an additional global band of 230 MHz allowing high speed data**
 - 2500-2690 MHz
- **Bands 806-960 MHz and 1710-1885 MHz are generally allocated for Mobile Services and the administrations have the right to implement IMT-2000 in any band allocated for the Mobile Services (not just the identified band)**

IMT Technologies

ITU has finally narrowed down technology options to the following five:

- **IMT -DS (Direct Spread) : W-CDMA UTRA FDD**
- **IMT -MC (Multi Carrier) : CDMA 2000**
- **IMT-TC (Time Code) : TD -SCDMA UTRA TDD**
- **IMT -SC (Single Carrier) : UWC - 136**
- **IMT-FT (Frequency Time) : DECT**



- **PAIRED DS/ MC/SC ; UNPAIRED TDD**



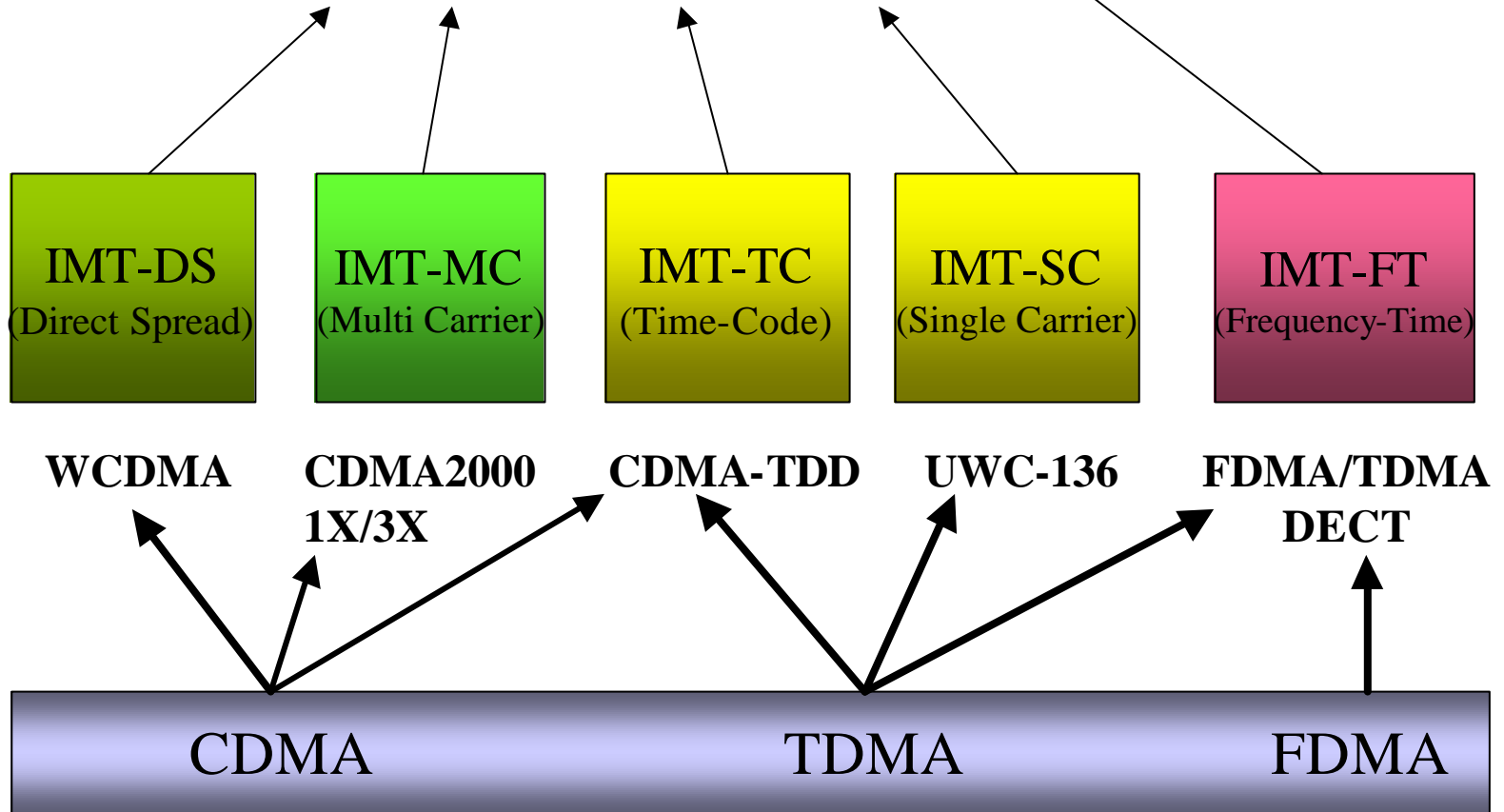
FURTHER HARMONIZATION In Process

UTRA : UTMS Terrestrial Radio Access

UMTS :Universal Mobile Telecommunication System

Technologies for IMT-2000

IMT-2000 TERRESTRIAL RADIO INTERFACES



IMT-2000 Terrestrial Radio Interfaces (1)

- **W-CDMA**, based on the first operational mode of the UMTS Terrestrial Radio Access (UTRA) Frequency Division Duplex (FDD)
- **CDMA2000**, Multi-carrier FDD, US Telecommunications Industry Association
- **TD-CDMA/TD-SCDMA**, based on the second operational mode of the UTRA Time Division Duplex (TDD) harmonized with China's TD-SCDMA

IMT-2000 Terrestrial Radio Interfaces (2)

- **UWC-136 (EDGE)**, single Carrier, Enhanced Data for Global Evolution
- **DECT** used for cordless phone, considered as part of 3G network

Mobile Communication: IMT-2000 harmonization

- **IMT standards development involves extensive collaboration between many different organizations**
- **Today's operators need seamless 2G → 3G**
- **Many Focus groups have been established by industry**
 - **2 G operators GSMA, CDG, UWCC, DECT forum**
 - **3 G Groups UMTS Forum, OHG, CDG**
 - **Focus group for IP-based 3G architecture (3G. IP)**
 - **SDOs created 3G PP and 3G PP2 (Partnership Projects)**

SDO: Standards Development Organizations

From 2G to IMT-2000

- Enhanced voice quality, ubiquitous coverage and enable operators to provide service at reasonable cost
- Increased network efficiency and capacity
- New voice and data services and capabilities
- *An orderly evolution path from 2G to 3G systems to protect investments.*

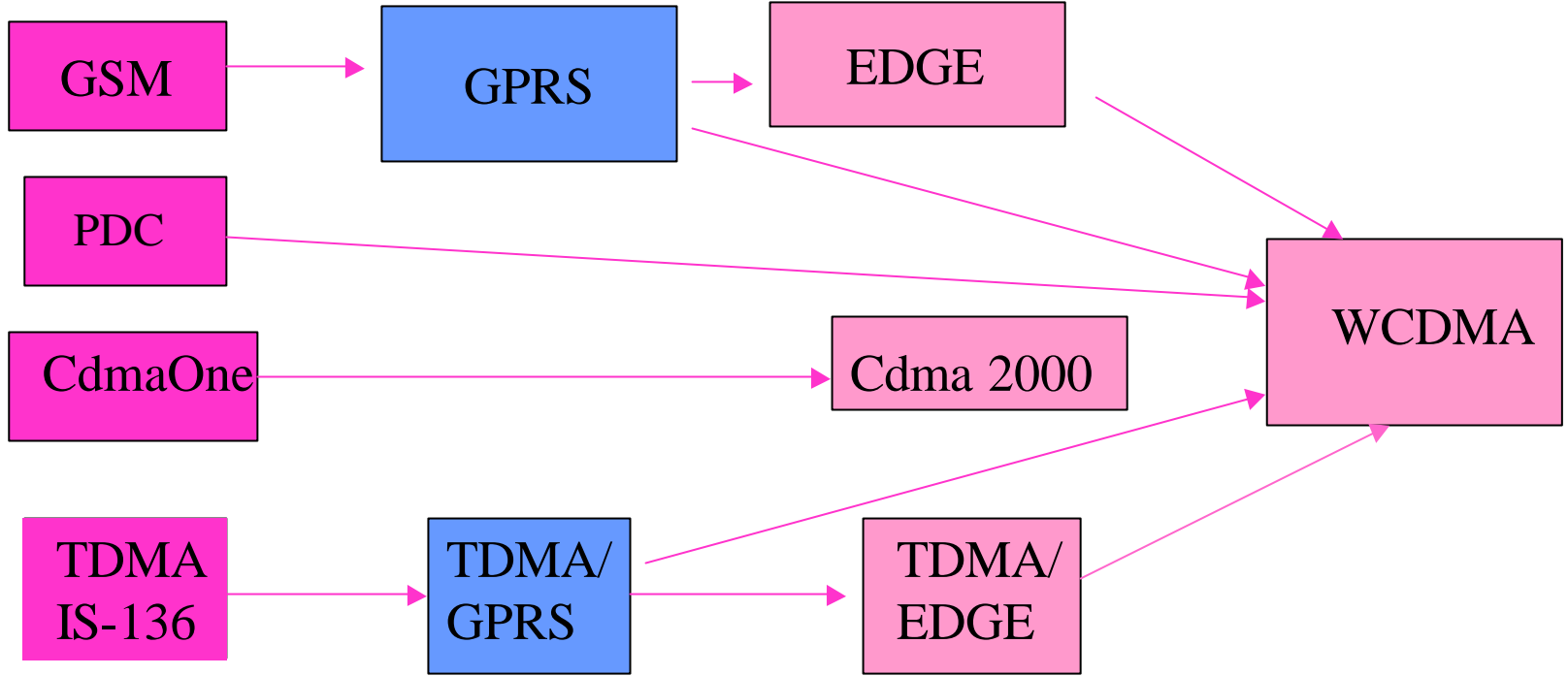
Migration Path

- While a multiplicity of 2G standards have been developed and deployed, the ITU wanted to avoid a similar situation to develop for 3G.
- Hence, the ITU Radio communication Sector (ITU-R) has elaborated on a framework for a global set of 3G standards, which will facilitate global roaming by operating in a common core spectrum and providing migration path from all the major existing 2G technologies.
- The major 2G Radio access networks are based on either CDMA One or GSM technologies and different migration path is proposed for each of these technologies.



EVOLUTION TO IMT-2000/3G

IMT-2000
CAPABLE SYSTEMS



TODAY 2G
19.2 Kbps

2000 EVOLVED 2G
64-115 Kbps

3G
115-384 Kbps 0.384-2 Mbps

Migration techniques of existing Systems to IMT-2000

From Analog Systems (AMPS and NMT-450)

From cdmaOne (CDMA IS-95A/B) Systems

From TDMA Systems

From GSM/GPRS Systems

INTERNATIONAL TELECOMMUNICATION UNION
Telecommunications Development Bureau (BDT)

***Results of World Telecommunication
Development Conference***

Istanbul, 18-27 March 2002

Results of WTDC-02 related to IMT-2000

The recent ITU World Telecommunication Development Conference WTDC-02 (Istanbul, 18-27 March 2002), approved the following texts related to IMT-2000:

Resolution 43 (WTDC-02): Assistance for implementing IMT-2000

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

Programme 2, point 1.4: Mobile terrestrial communications

Resolution 43 (WTDC-02): Assistance for implementing IMT-2000

The World Telecommunication Development Conference (Istanbul, 2002),

• *considering*

) that, at the request of the Member States, the Americas Regional Preparatory Meeting for this conference identified IMT-2000 as a priority to be included in the next action plan of the Telecommunication Development Bureau (BDT);

) the need to promote IMT-2000 throughout the world, and in particular in developing countries,

Resolution 43 (WTDC-02): Assistance for implementing IMT-2000

•noting

the work of the ITU-T Special Study Group on IMT-2000 and Beyond and ITU-R Working Party 8F, and taking into account the need for close coordination with all related initiatives within ITU,

•resolves

to include support for implementation of IMT-2000 as a priority in the action plan adopted by this conference,

•instructs the Director of BDT

in close collaboration with the Directors of the Radiocommunication Bureau (BR) and the Telecommunication Standardization Bureau (TSB), as well as regional telecommunication organizations:

Resolution 43 (WTDC-02): Assistance for implementing IMT-2000

- 1 to encourage and assist countries to implement IMT-2000 systems in the frequency bands identified in the ITU Radio Regulations, using the relevant ITU recommendations, when adopted, for harmonized frequency band implementation;**
- 2 to provide direct assistance to countries in using the relevant frequency band plans, when adopted, the radio technologies and the standards recommended by ITU in order to meet their national requirements for the implementation of IMT-2000 in the short, medium and long term;**
- 3 to provide information on strategies which can be used for the evolution of first-generation and second-generation mobile systems (cellular/PCS) to IMT-2000;**

Resolution 43 (WTDC-02): Assistance for implementing IMT-2000

- 4 to develop means to facilitate the implementation of fixed wireless access applications which allow use of IMT-2000 technology and infrastructure;**
- 5 to provide assistance to administrations on the use and interpretation of ITU recommendations relating to IMT-2000;**
- 6 to promote training on strategic planning for the introduction of IMT-2000, taking into account specific national and regional requirements and characteristics,**

Resolution 43 (WTDC-02): Assistance for implementing IMT-2000

- *encourages Member States*

to review, as necessary, their regulatory framework (e.g.,
licensing, type-approval and customs arrangements) in order
to facilitate global circulation of IMT-2000 terminals, taking
into account the relevant ITU Recommendations

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

1 Statement of the situation

While it seems clear that the migration to third-generation networks will be universal over time, it will not progress evenly in all countries, in particular developing countries. ITU-D can play an important role in assisting Member States and Sector Members in developing countries with a smooth migration of their existing first - and second-generation networks into third generation and beyond, both technically and economically

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

2 Question or issue proposed for study

Identify the economic impact and development aspects for such migration, with particular attention to cost affordability for the end-users, as well as identification of migration techniques taking into consideration the experience of developed countries and the special needs of developing countries (e.g. sparse population, low traffic density, propagation conditions, and the need for a low-cost national IMT-2000 network). Examine The possibility of using first and second generation mobile spectrum for IMT-2000 and beyond.

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

3 Expected output

A guideline for smooth migration, including system interoperability among third-generation technologies, with proper collection, analysis and periodic dissemination of relevant data from relevant groups within ITU and those outside (operator groups for mobile services, etc.).

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

4 Timing

The course of the next ITU-D study period with a mid-term guide by early 2004.

5 Proposers/sponsors

This Question has been requested by ITU-D Study Group 2 and developing countries

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

6 Sources of input

- 1. Collection of related technical progress in both ITU-R and ITU-T.**
- 2. The ITU handbook on IMT-2000 and beyond.**
- 3. Visions of national and/or regional organizations in developed countries (e.g. ETSI, TTA, ARIB, etc.).**
- 4. Experiences of smooth migration by administrations of developed and developing countries.**

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

7 Target audience

	Developed countries	Developing countries	LDCs
Telecom policy-makers	X	X	X
Telecom regulators	X	X	X
Service providers/operators)	-	X	X
Manufacturers	X	-	-

a) Target audience - Who specifically will use the output

Telecommunication operators, policy makers and regulators

b) Proposed methods for the implementation of the results

Operators will directly implement the results of this work

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

8 Proposed methods of handling the question or issue

a) How?

Within a study group:

A core group of voluntary and BDT experts should be established and asked with the timely proposed outputs for consideration by the study group in its yearly meeting. The core group should be composed of mobile services experts, preferably from mobile operators and manufacturers, with geographical balance between developed and developing countries.

b) Why?

The Question output needs a multi-year period to achieve its objectives, being mainly based on future work progress achieved by ITU-R and ITU-T and those national and/or regional organizations concerned in developed countries.

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

9 Coordination

The proposed expert core group should take into consideration (and without duplication of activities):

- output from the study groups in ITU-T and Working Party 8/F of ITU-R;
- any regional study for such migration, especially by regional operator groups (e.g. ETNO, mobile operator groups, etc.);
- output from those involved in dual-mode operations for the mobile services (terrestrial and satellite modes).

10 Other relevant information

Data related to IMT-2000 licensing regimes

Programme 2, point 1.4: Mobile terrestrial communications

In addition to Resolution 43 and Question 18/2, the Istanbul Action Plan for the ITU Telecommunication Development Sector adopted by WTDC-02, in its Program 2 (Technologies and Telecommunication Network Development) point 1.4 dealing with "Mobile terrestrial communications, states that:

1.4 Mobile terrestrial communications

Mobile communications tended to be developed and implemented at the national or regional level, with little thought for global interconnection. The result is a wide range of technical standards which use many parts of the radio-frequency spectrum - analogue and digital cellular phones, pagers, cordless telephones, mobile data systems, wireless local area networks and the new breed of satellite-based mobile telephones, to name just a few. Incumbent mobile operators do not want to have to discard their entire existing infrastructure; rather, they prefer a new system, which can coexist and interoperate with the present one and act as an adjunct to it. Therefore, because of both the explosive growth of second-generation mobile systems, network development and migration to third-generation networks (IMT-2000) and beyond, high priority will be accorded to mobile communications within this programme. Information will be also provided on mobile systems operating below 600 MHz, which are of particular interest to some developing countries.”

INTERNATIONAL TELECOMMUNICATION UNION
Telecommunications Development Bureau (BDT)

***ITU-D studies on the evolution and
migration towards IMT-2000
(Question 18/2)***

BDT Activities on IMT-2000

- **A detailed Work Plan on the implementation of Resolution 43 has been finalised inside BDT for year 2004.**
- **The Objectives for 2003 –2006 are going to be finalized as well.**

Implementation of WTDC-02 Resolution 43

Seminars, Workshops, Production of Handbooks and Guidelines, Cooperation with Regional Organizations, ITU-D SG's Activities, Direct Assistance via BDT Unit/Field Offices, will be part of the BDT Work Plan to implement Resolution 43

Implementation of WTDC-02 Resolution 43

- Resolution 43 is supposed to be implemented within the Programs and Direct Assistance as approved during last WTDC-02.

Results of the studies on Question 18/2

- **The first Rapporteur's Group Meeting on Q.18/2, was held in Geneva, 24-25 June 2002.**
- **Second Meeting during ITU-D SG2, Geneva September 2003**
- **Third Meeting, Geneva 26-29 January 2004**

Results of activities on Question 18/2

Progress of the work

- **Important issues: the economic impact of third generation mobile networks (3G), cost affordability of customer equipment, experience of developed countries, special needs of developing countries (case studies for example), cost of migration to third generation, capabilities of fixed networks to take 3G roamers.**
- **Draft guidelines for a smooth migration for mobile networks to IMT-2000 and beyond should be prepared by mid-2004.**

Results of the studies on Question 18/2

Progress of the work

- There might be no unique solution for migration for developing countries. Migration might be different than for developed countries due to, among other reasons, the penetration levels of mobile networks. The results of the work of the ITU-T and ITU-R Sectors as well as different technologies are under considerations**
- Cost affordability for end users will be a key focus of Question 18/2 work. The study should take into account also the needs of developing countries.**

Results of studies on Question 18/2

Progress of the work

-Licensing for third generation (working under the ITU Secretary General's new initiatives programme) documents are available on the web at the following web address

(<http://www.itu.int/osg/spu/ni/3G/workshop/index.html>).

The final report from the last ITU-Workshop (2001) is the core of the relevant brochure. An official database on licensing for IMT-2000 is under development in ITU.

Results of the studies on Question 18/2

Progress of the work

- **Initial Promotion of the work is done by the BDT Administrative Circular CA/10, 5 July 2002**
- **A living document prepared by the BDT Secretariat in consultation with the ITU-T and ITU-R Sectors and contains a listing of documents/recommendations/deliverables and texts related to IMT-2000 is maintained being updated and supplemented whenever is necessary**

Results of the studies on Question 18/2

Summary of the aspects that have to be investigated during the progress of the work of Q.18/2:

- **Identification of special needs of developing countries regarding migration**
- **Identification of Migration techniques**
- **Cost of network migration for the operator**
 - **using of existing infrastructures**
- **Cost affordability for end users**
- **Experience of developed countries when choosing current or future migration paths**

Results of the studies on Question 18/2

- Possibilities of using first and second generation mobile spectrum for IMT-2000 and beyond
- Interoperability among first and second generation mobile system and IMT-2000 systems and beyond
- Interoperability among IMT-2000 technologies
- Extension of IMT-2000 services regardless of the access system
- Lawful interception and common access to emergency services.

*Progress of Q.18/2 Studies: ITU-D SG2
meeting, Geneva 2-6 September 2002*

Special needs for developing Countries:

- Available market for the new mobile services ?
- Level of Rural coverage (FAO opinion)
- Areas primarily coverage-limited (rural, sparsely populated and/or very low traffic density) Spectrum below 1 GHz allowing big coverage per single cell may be interesting for developing countries (2.1 GHz requires five times more cell sites than 800 MHz and more than thirteen times more cell sites than 450 MHz). Traffic capacity per cell is constant, larger the cell lower per user traffic

Progress of Q.18/2 Studies: ITU-D SG2 meeting, Geneva 2-6 September 2002

Special needs for developing countries

Areas primarily capacity-limited (dense urban areas): cities growing so quickly that fixed lines should be installed fast to meet the demand.

Wireless systems such as IMT-2000 may be cost effective and flexible for operators that want to expand their network as demand for voice/data services increases: less expensive, faster deployment, handling of both fixed and mobile traffic, voice and data services providing high speed connectivity to be used by clinics, schools, libraries, governments, telecenters and others

*Progress of Q.18/2 Studies: ITU-D SG2
meeting, Geneva 2-6 September 2002*

Special needs for developing countries

Cost affordability for end user: Cost of handsets is a critical factor

Service cost affordability: critical regulatory issue (interconnection rates, tariffs, etc)

*Progress of Q.18/2 Studies: ITU-D SG2
meeting, Geneva 2-6 September 2002*

Special needs for developing countries

**Dispersed population: Sharing Network resources,
speedy deployment of new technologies, lower costs to the
Operators, lower costs to the subscribers
(Regulatory aspects)**

**MVNO's: Scarcity of spectrum, Sharing Network resources,
speedy deployment of new technologies, lower costs to the
Operators, lower costs to the subscribers (Regulatory
aspects)**



Home : ITU-D : <http://www.itu.int/ITU-D/imt-2000/index.html>

BDT Activities

- [ITU BDT activities and Seminars related to IMT-2000](#)
- ITU Handbook on Deployment of IMT-2000 Systems
 - [Structure and Content](#)
 - [On-sale publication](#)
- Direct Assistance on mobile communications
 - [Third GSM License in Kenya](#)

ITU-D Studies and Activities

- [Question 18/2 \(ITU-D SG2 – Strategy for migration of mobile networks to IMT-2000 and beyond\)](#)
- [List of documents: Question 18/2](#)
- [List of documents: ITU-D SG2](#)
- [WTDC-02 Results – Resolution 43](#)

Policy and Regulations

- [Licensing](#)

Other IMT-2000 Activities at ITU

- [IMT-2000 ITU Homepage](#)
- [Radiocommunication Bureau \(ITU-R\)](#)
- [Standardization Bureau \(ITU-T\)](#)
- [ITU Strategy and Policy Unit \(SPU\)](#)

Operations

- [Status of IMT-2000 Deployments](#)

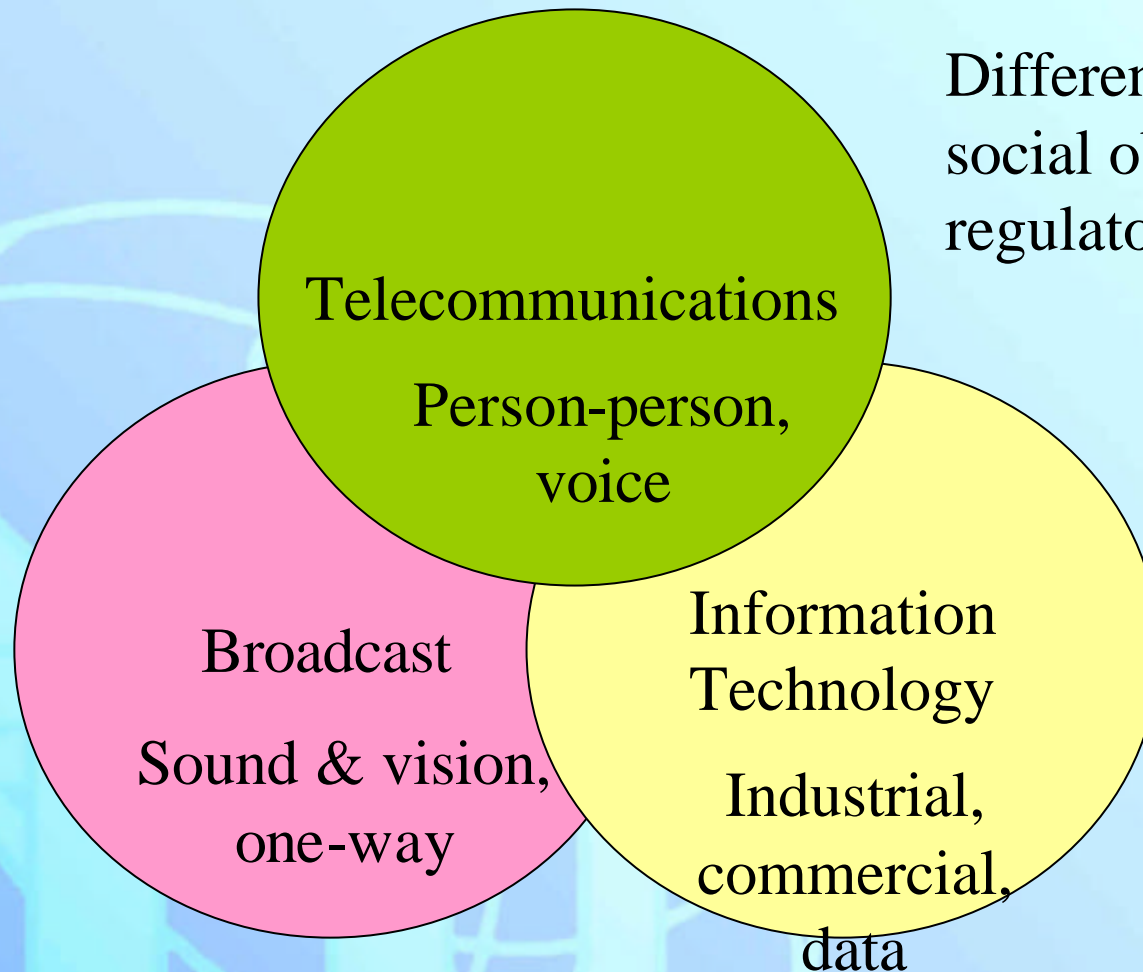
Related Links

- [Useful Links](#)



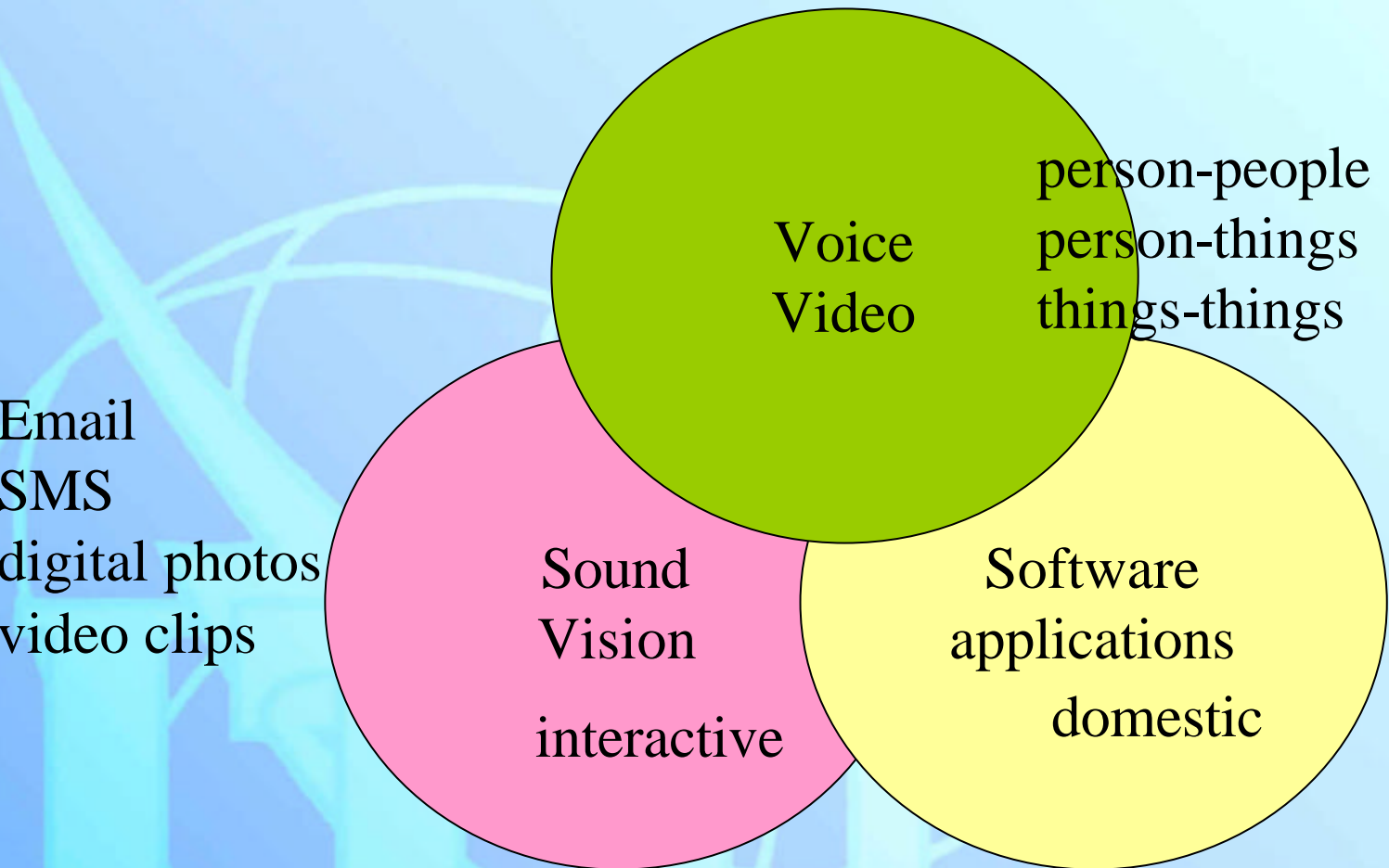
Radio Technology and Spectrum Matters

Convergence: market sectors

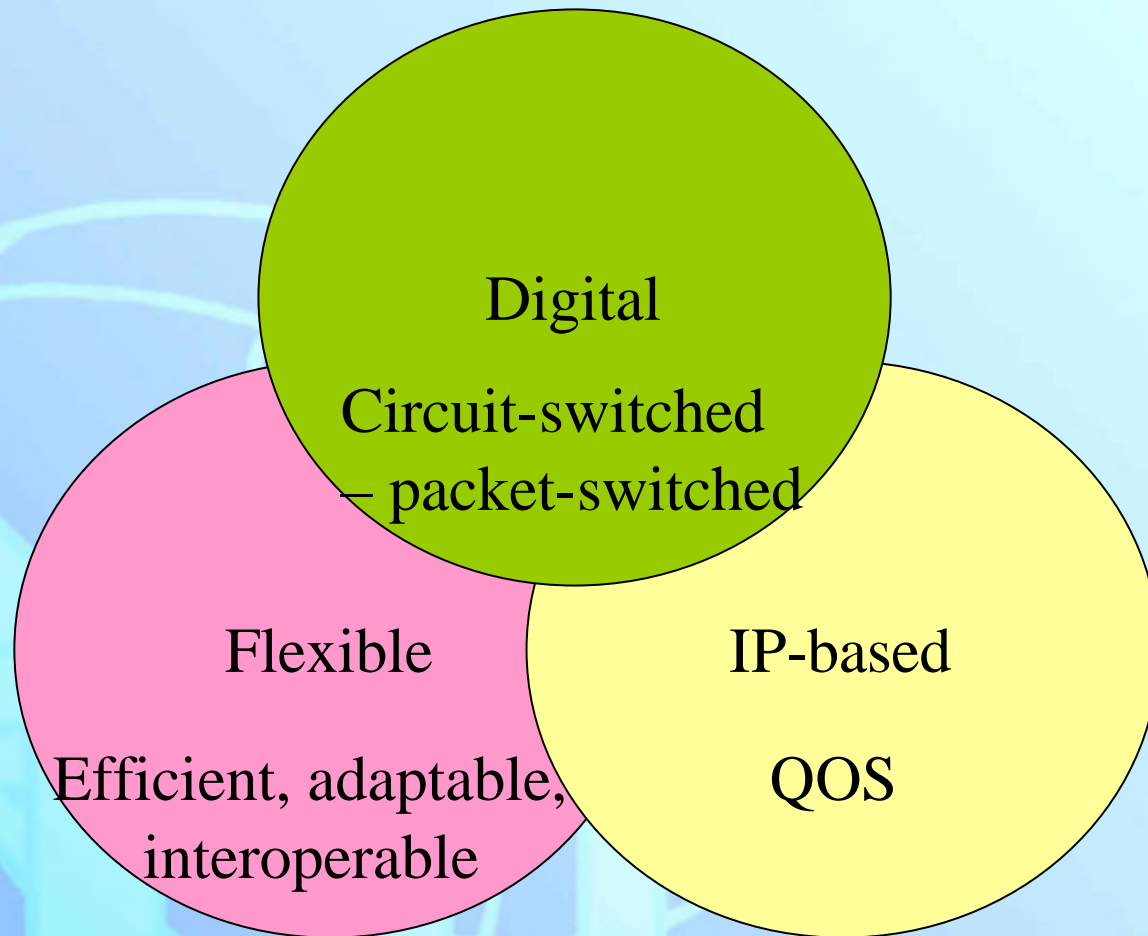


Different structures,
social obligations,
regulatory regimes

Convergence: services



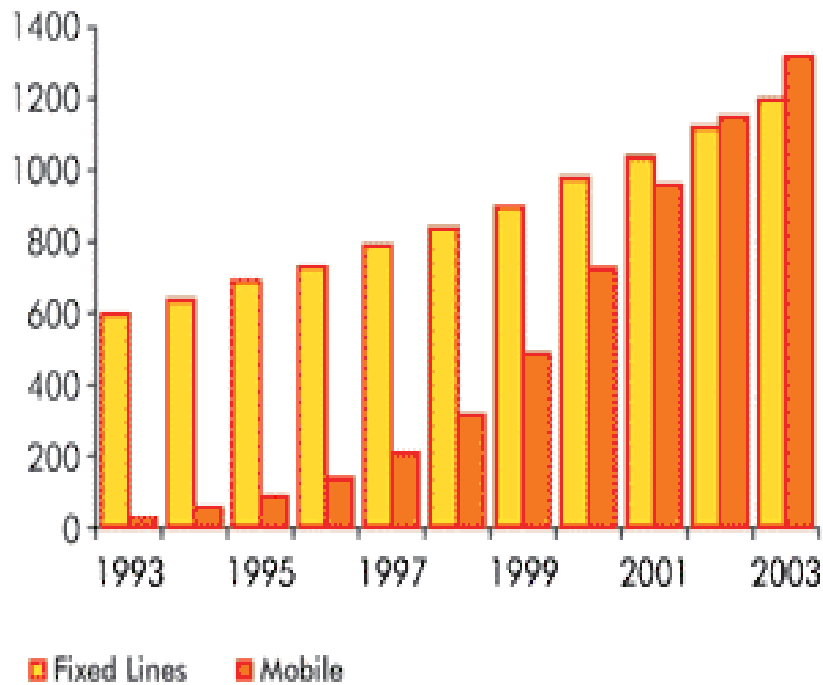
Convergence: technology



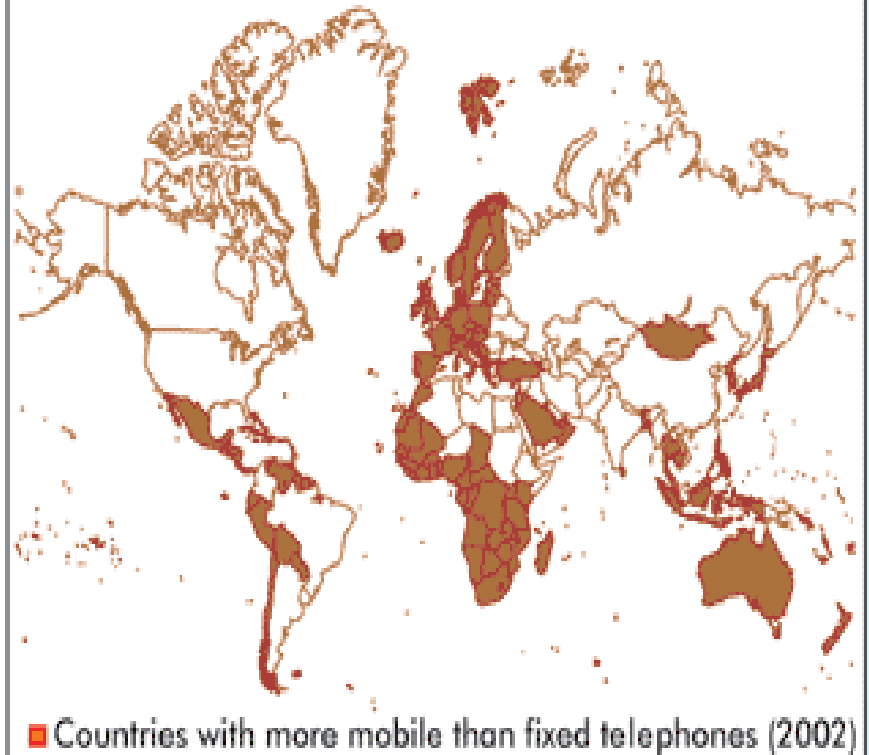
Growth of mobile

Fixed lines and mobile subscribers (millions) and countries in which mobile has overtaken fixed

Mobile overtakes fixed:
total subscribers worldwide (millions)

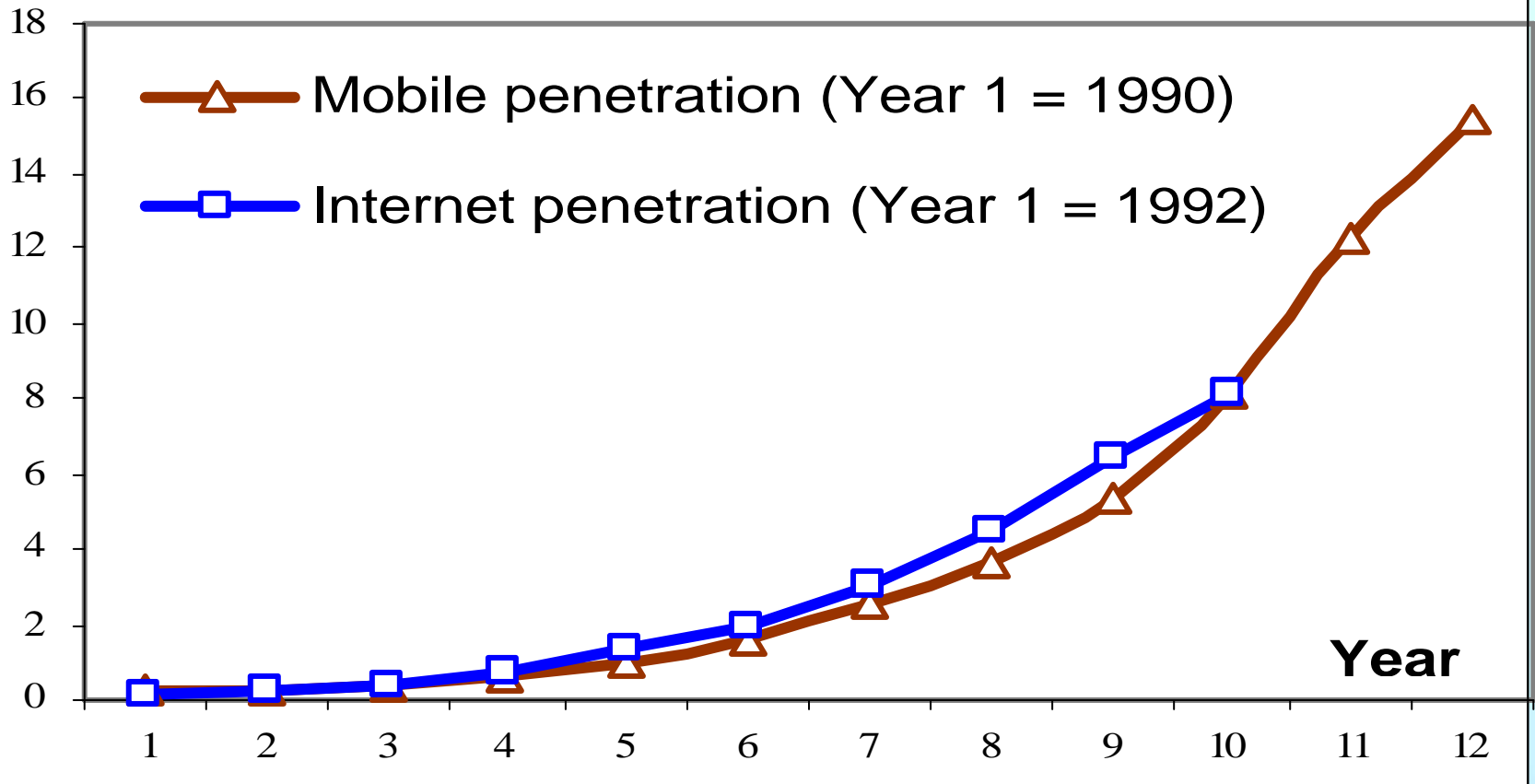


More mobile countries



Growth of Internet

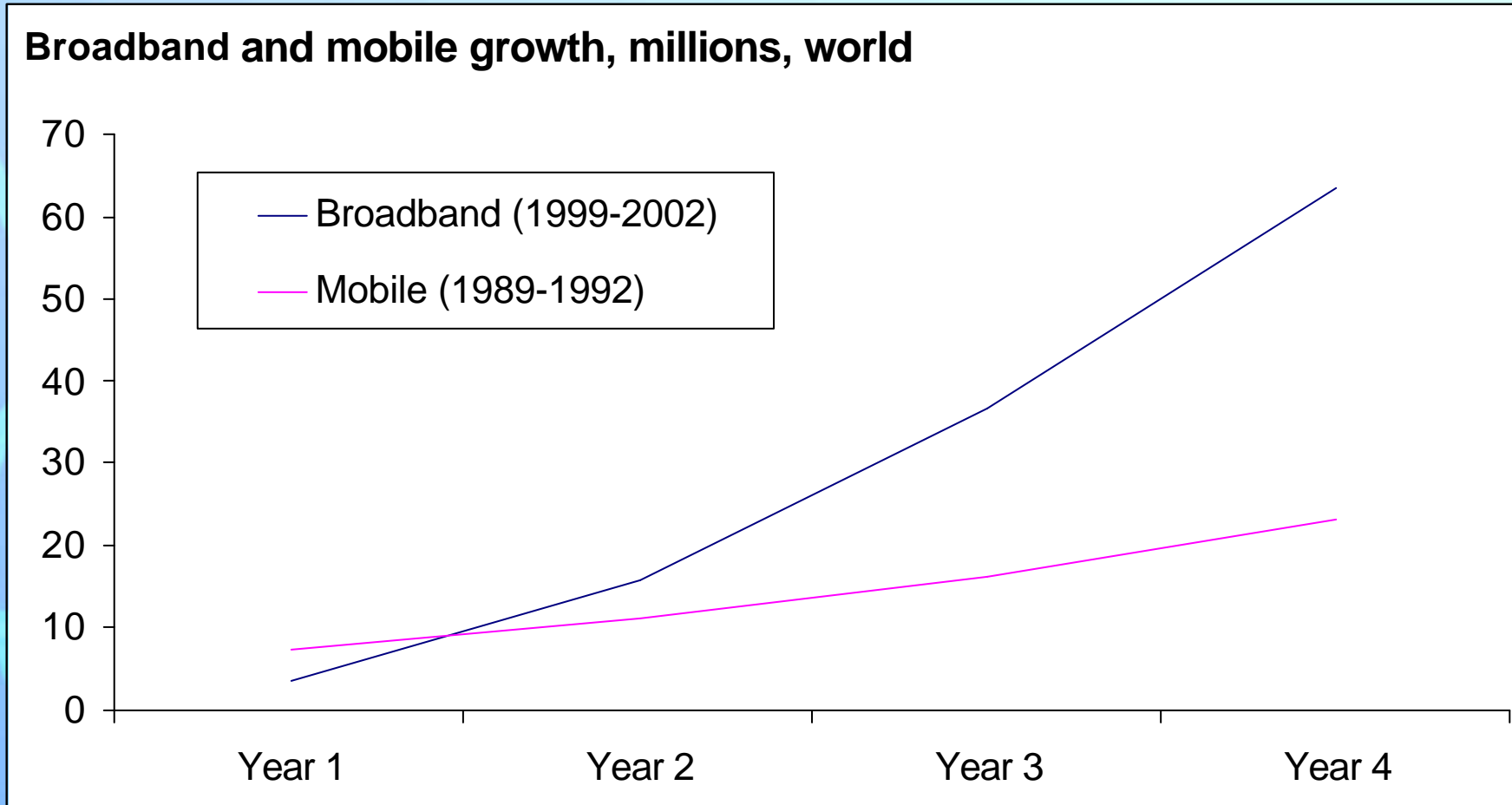
Penetration rate per 100 inhabitants



Source: ITU World Telecommunication Indicators Database



Growth of broadband



IMT-2000 Radio Access Standards

- A reminder

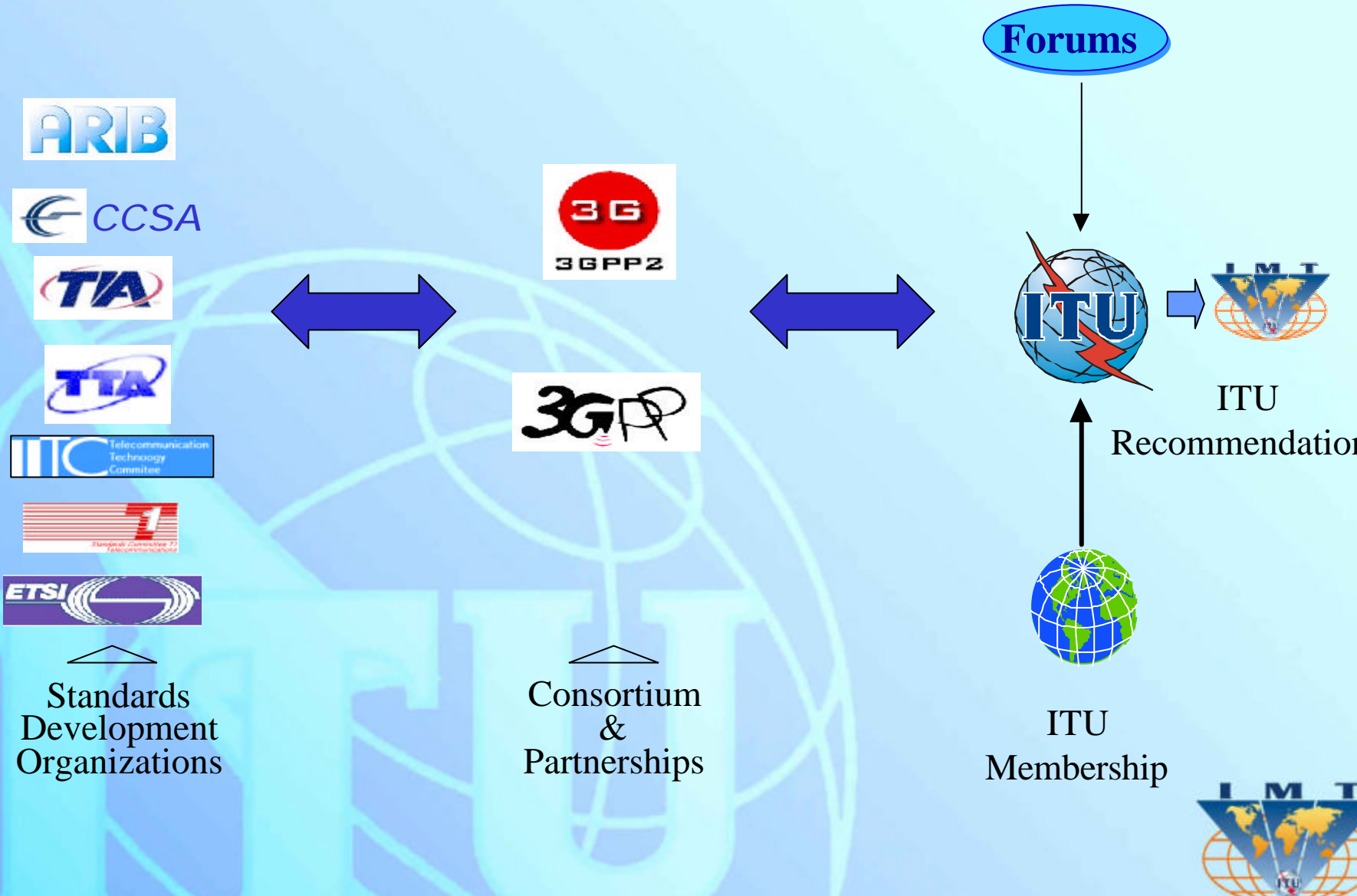
IMT 2000 Terrestrial Radio Interfaces



- Designed mainly in response to market, technology & regulatory opportunities & segments
- Many of these standards are already being enhanced



IMT-2000 Standards Development

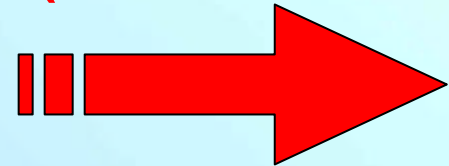


Radio Access - Three Main Phases

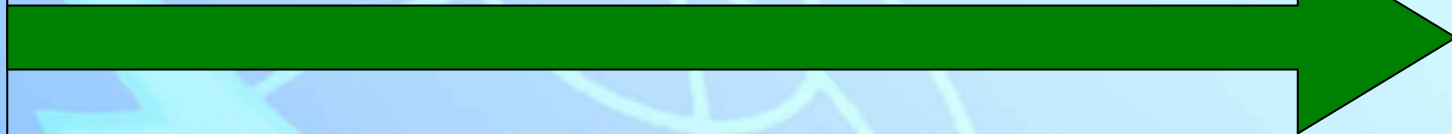


New radio interface(s)

i.e. research target 100 – 1000 Mbit/s (full to low mobility)



Relationship with other radio systems
e.g. Digital broadcast, RLAN, etc.



Enhancing IMT-2000

e.g. “fast packet” up to
30 Mbit/s by 2005 ?

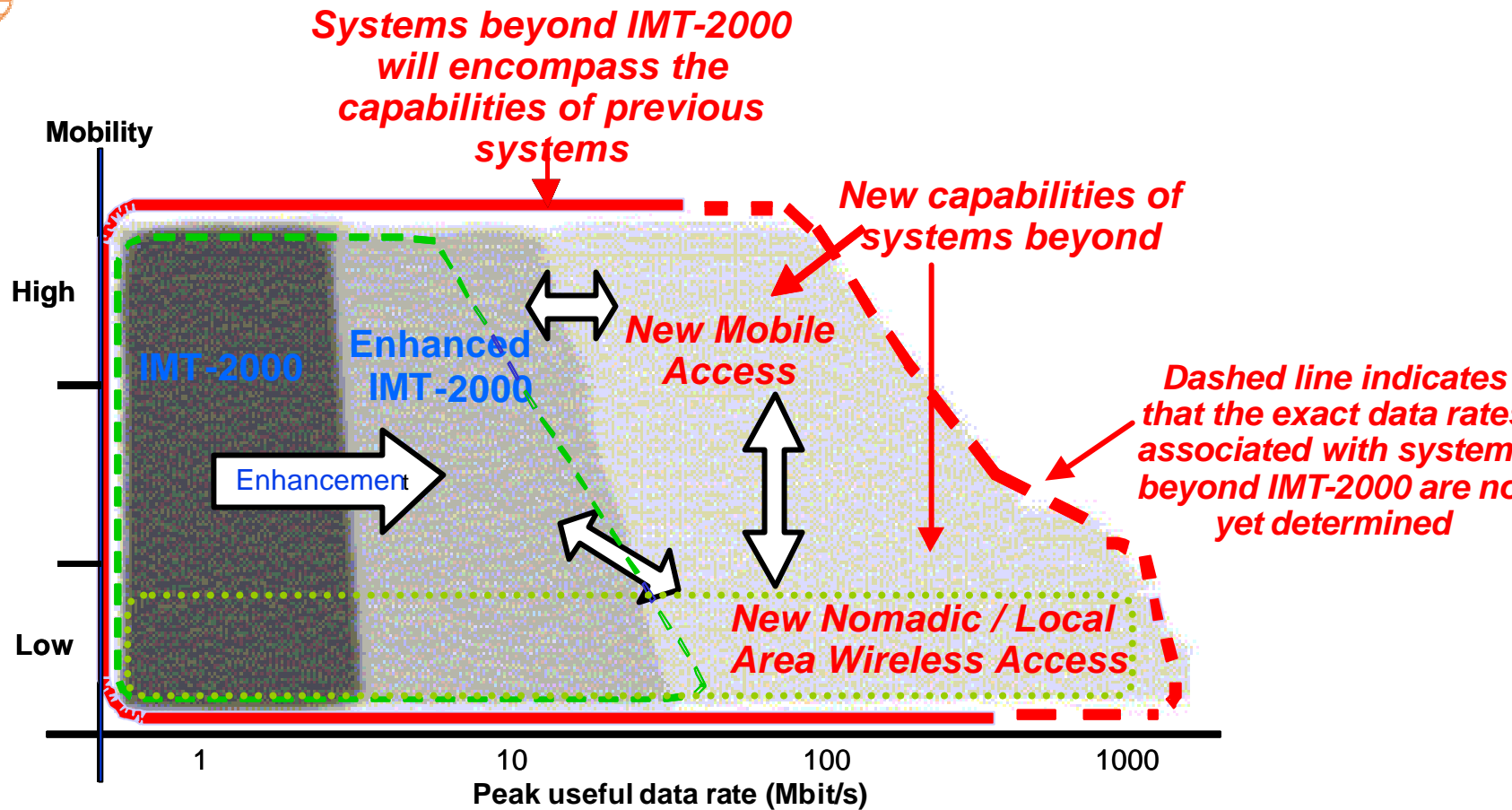


2001

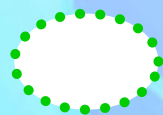
2010



Capabilities ('The Van')



Interconnection



Nomadic / Local Area Access Systems



Digital Broadcast Systems

Variety of Access Networks

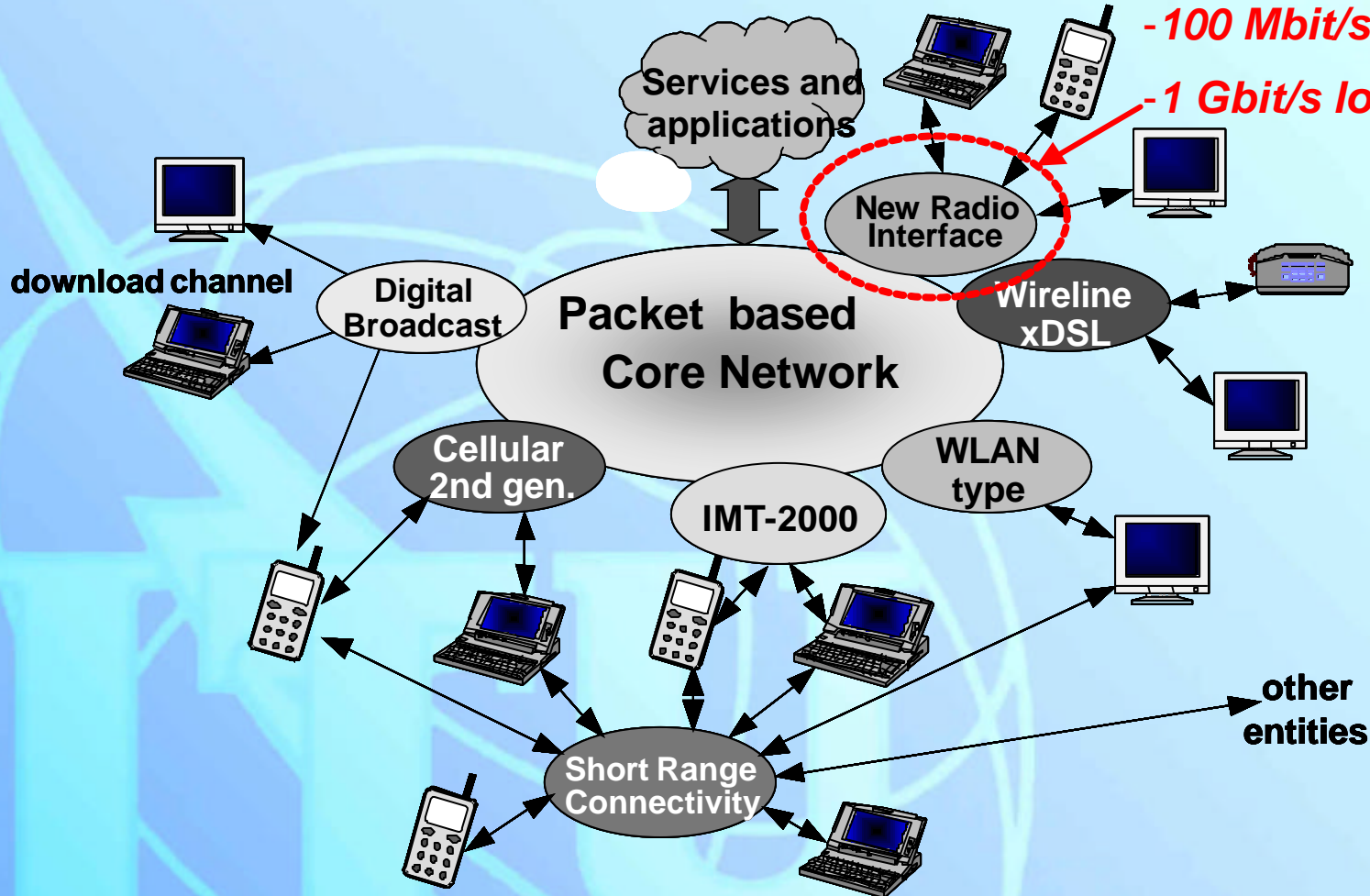


New radio interface(s)

Research Goals:

-100 Mbit/s full mobility

-1 Gbit/s low mobility



Domains

Personal Area



Immediate Area



Wide Area



Fusion

Recommendation ITU-R M.1645

"Systems beyond IMT-2000 will be realized by functional fusion of existing, enhanced and newly developed elements of IMT-2000, nomadic wireless access systems and other wireless systems, with high commonality and seamless interworking"



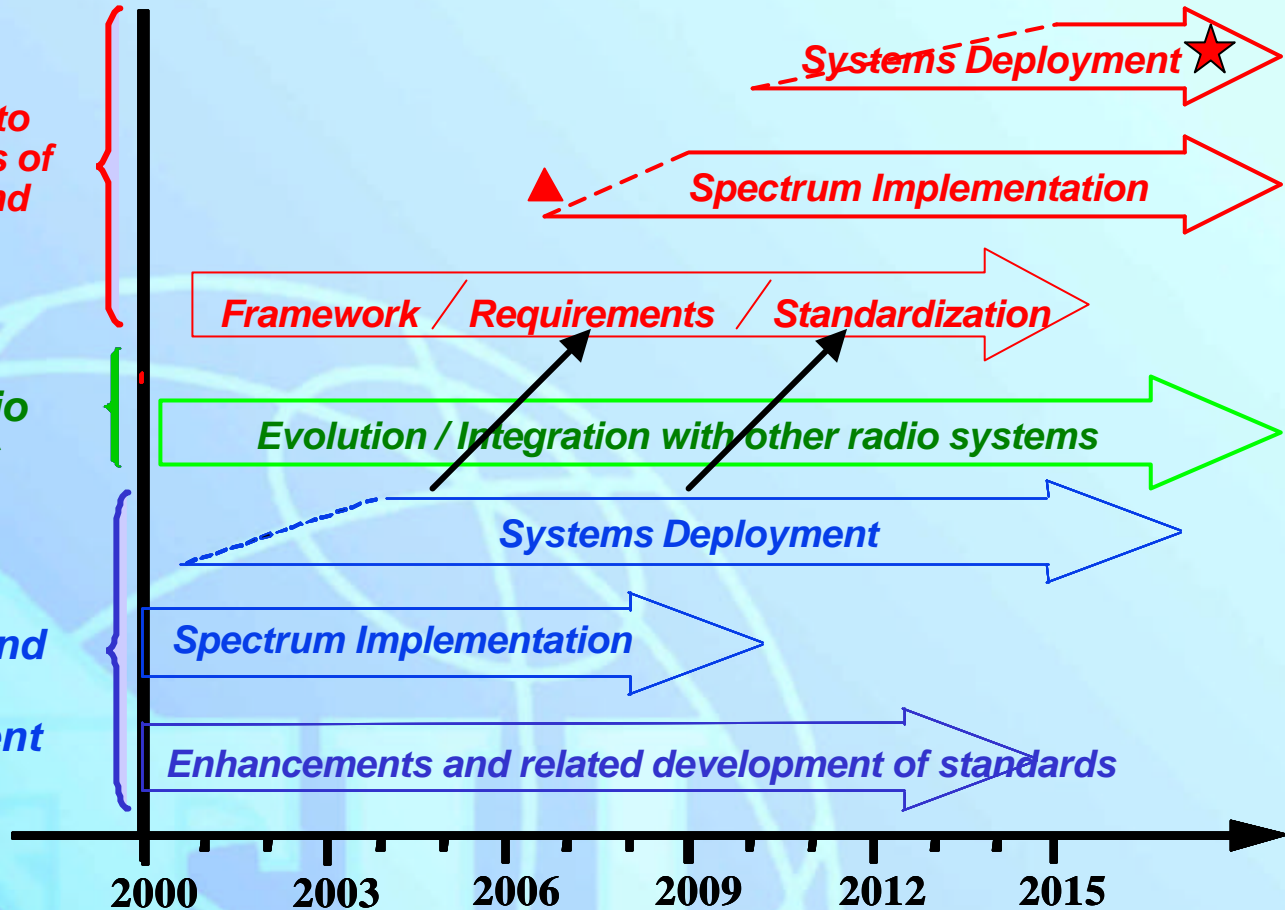
The Plan



New elements to offer capabilities of systems beyond IMT-2000

Other radio systems

IMT-2000 and future development



- - - Indicates that the exact starting point is not yet fixed

▲ Possible spectrum identification at the WRC-07

★ Possible wide deployment around the year 2015 in some countries

Spectrum

- Prerequisite for development and operation of radio systems is the availability of spectrum
- Most of the usable spectrum is already allocated
- There is a long lead-time between identification of spectrum and spectrum availability



Spectrum

- **Needed to plan use of spectrum already identified**
 - **Recommendation ITU-R M.1036**
806-960, 1710-2025, 2110-2200 and 2500-2690 MHz
- **Needed to secure appropriate WRC-07 agenda item to address future requirements**
 - **Recommendation ITU-R M.1645**
 - **Resolution 802 (WRC-03)**
 - **Resolution 228 (Rev.WRC-03)**



Resolution 802 (WRC-03)

2007 World Radiocommunication Conference

Agenda item 1.4

“to consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000, taking into account the results of ITU-R studies in accordance with Resolution 228 (Rev.WRC-03)”



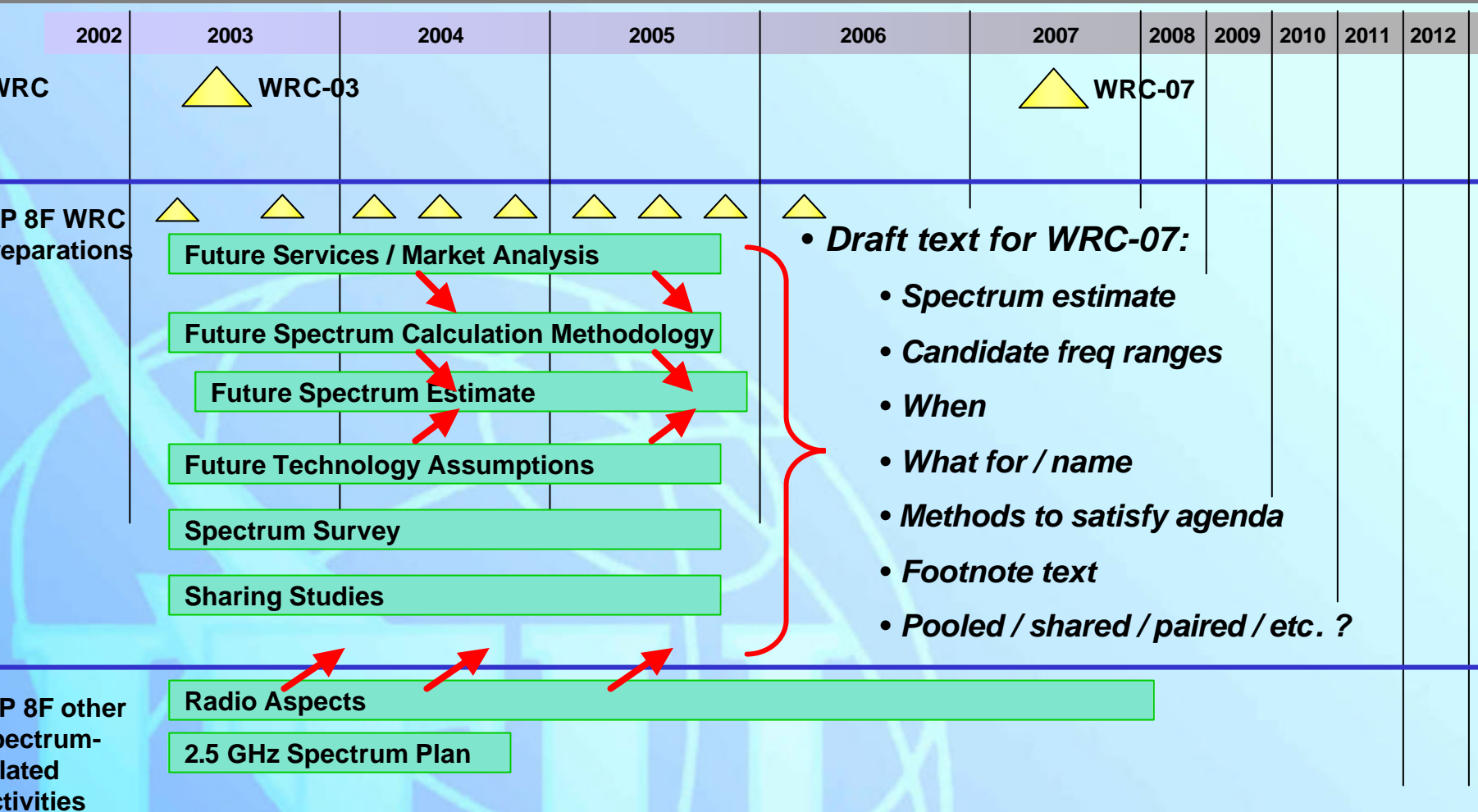
Resolution 228 (Rev.WRC-03)

resolves

- 1 to further study technical and operational issues ...;**
- 2 to report to WRC-07 on the spectrum requirements and potential frequency ranges ...;**
- 3 to conduct regulatory and technical studies on the usage of frequencies below those identified for IMT-2000 ...;**
- 4 to take into consideration the particular needs of developing countries including use of the satellite component of IMT-2000 ...;**
- 5 to include sharing and compatibility studies with services already having allocations in potential spectrum ...;**
- 6 that WRC-07 should consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000**



WP 8F WRC preparation



WP 8F web page

<http://www.itu.int/ITU-R/study-groups/rsg8/rwp8f/index.asp>



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Membership

Working Party 8F - IMT-2000 and systems beyond IMT-2000

- ▶ [Scope](#)
- ▶ [Terms of reference](#)
- ▶ [Chairmen and Vice-Chairmen](#)
- ▶ [Counsellor](#)
- ▶ [Questions](#)

Documents

- ▶ [Chairman's Report: 12th meeting](#)
- ▶ [Contributions - Archives](#)
- ▶ [Information Documents - Archives](#)
- ▶ [GCS updates](#) for Rec. ITU-R M.1457

Next meeting

- ▶ [ITU-R meeting schedule](#)
- ▶ [Invitation to next WP 8F meeting: 16-23 June 2004](#) (Berlin, Germany)

Structure and workplan

- ▶ [WP 8F structure and workplan](#)

Research activities

- ▶ [Focus areas](#)
- ▶ [Recommendation ITU-R M.1645](#) - Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000
- ▶ [Draft Report on Technology Trends](#)

Other IMT-2000 activities at ITU

- ▶ [Telecommunication Development \(ITU-D Question 18/2\)](#)
- ▶ [Telecommunication Standardization \(ITU-T Special Study Group\)](#)
- ▶ [Research and Analysis \(SPU\), General Secretariat](#)

Seminars and workshops

- ▶ [Working Party 8F Workshop on services and market aspects \(Edinburgh, 8 October 2003\)](#)

Electronic facilities

- ▶ [ITU-R electronic facilities](#)
- ▶ [Mailing lists - FTP server](#)
- ▶ [Contributions submission: \[rsg8@itu.int\]\(mailto:rsg8@itu.int\)](#)

Summary

- **Convergence is occurring in many spheres**
- **Mobile, Internet and broadband access is expanding rapidly**
- **IMT-2000 has been standardized and will evolve considerably over next 10-15 years – open and market led process**
- **Ongoing relationship with other access methods**
- **New radio interface(s) are expected to be required sometime between 2010-2015**
- **Spectrum aspects will be considered at WRC-07**
- **ITU-R WP 8F is undertaking the work on enhancement of IMT-2000 and development of systems beyond IMT-2000**



***ITU /ICTP Workshop on New Radiocommunication
Technologies for ICT in Developing Countries
(Africa Region)
Trieste, Italy, May 17-21, 2004***

IMT- 2000 Licensing Principles and Methods

**Riccardo Passerini
Focal Point IMT-2000, ITU-BDT**

IMT-2000 Licensing Principles and Methods

in this Presentation:

The Growth of Mobile Cellular

IMT-200 Spectrum and Licensing Considerations

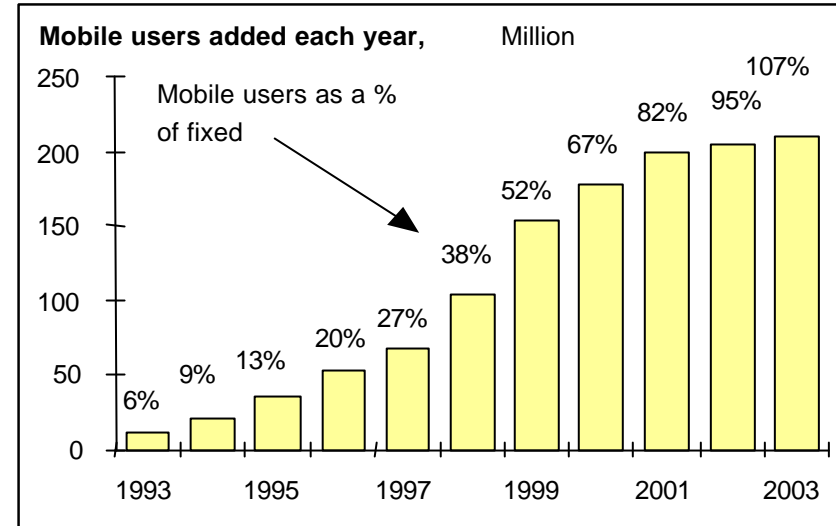
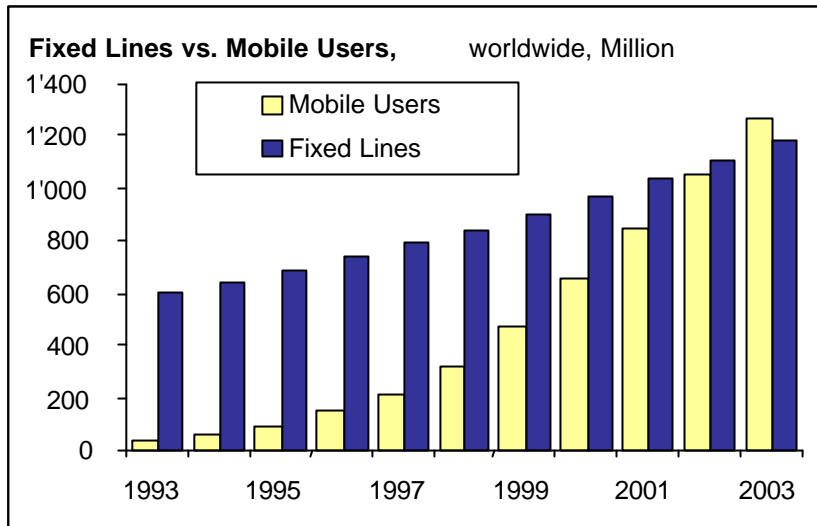
Principles of licensing procedures and methods

- Principles of licensing procedures**
- Licensing methods**

Licensing Condition - Obligations of licensees

The growth of mobile cellular services

1993-1999 actual, with forecasts to 2003.

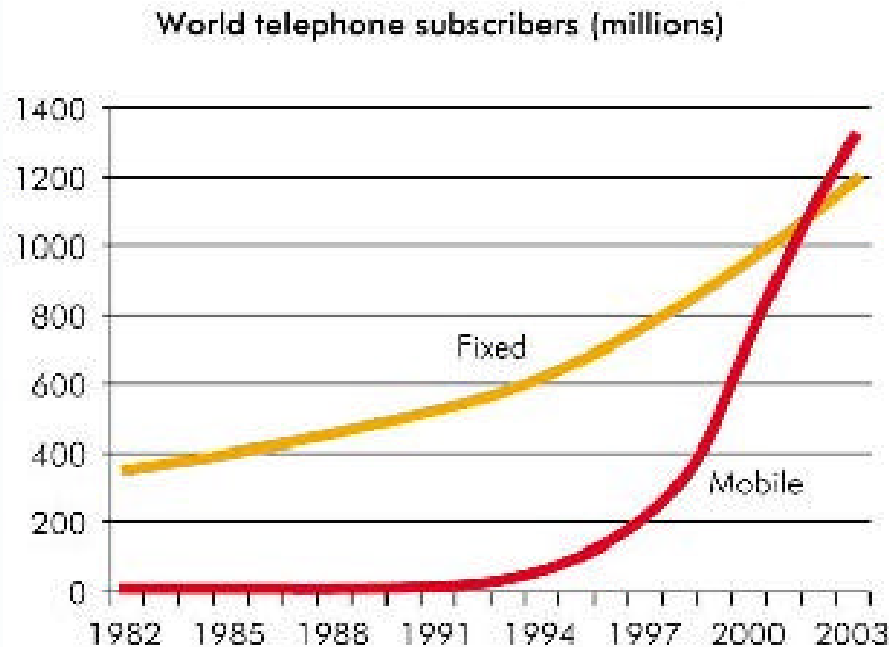


Source: ITU World Telecommunication Indicators Database and ITU forecasts in Trends in Telecommunications Reform, 2000 -2001: Interconnection Regulation .

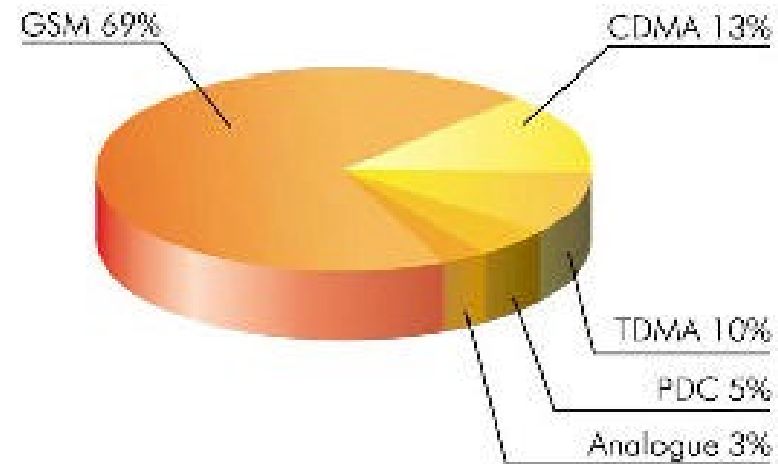
The growth of mobile cellular services

Figure 1 — Mobile overtakes fixed

Number of fixed and mobile telephone subscribers worldwide (1982-2003) and distribution of mobile subscribers worldwide by technology (December 2002)



World mobile subscribers by technology
at year-end 2002
Total = 1134 million

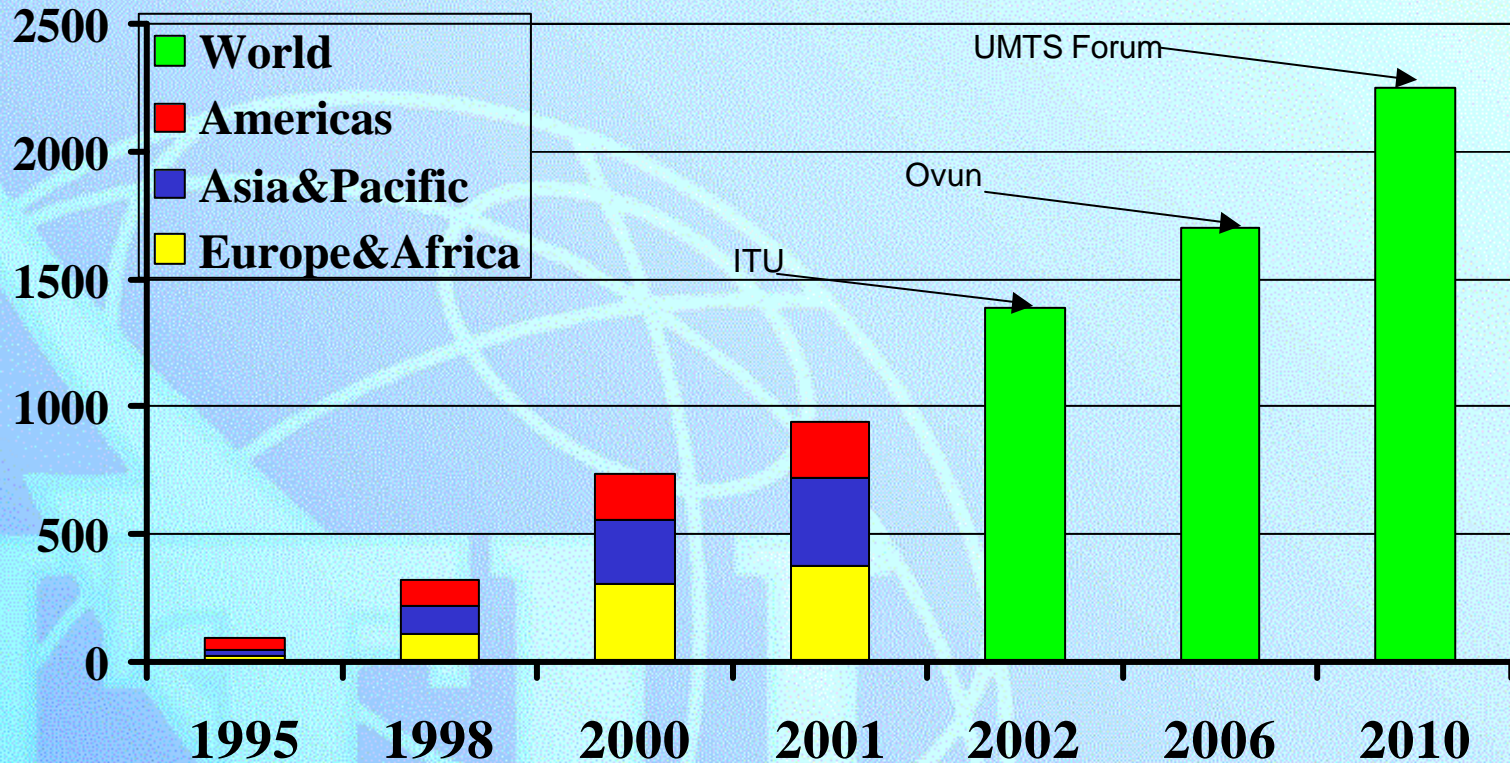


Source: Left chart: ITU World Telecommunication Indicator database.
Right chart: ITU adapted from GSM Association.

Trends – Mobile Growth (worldwide)



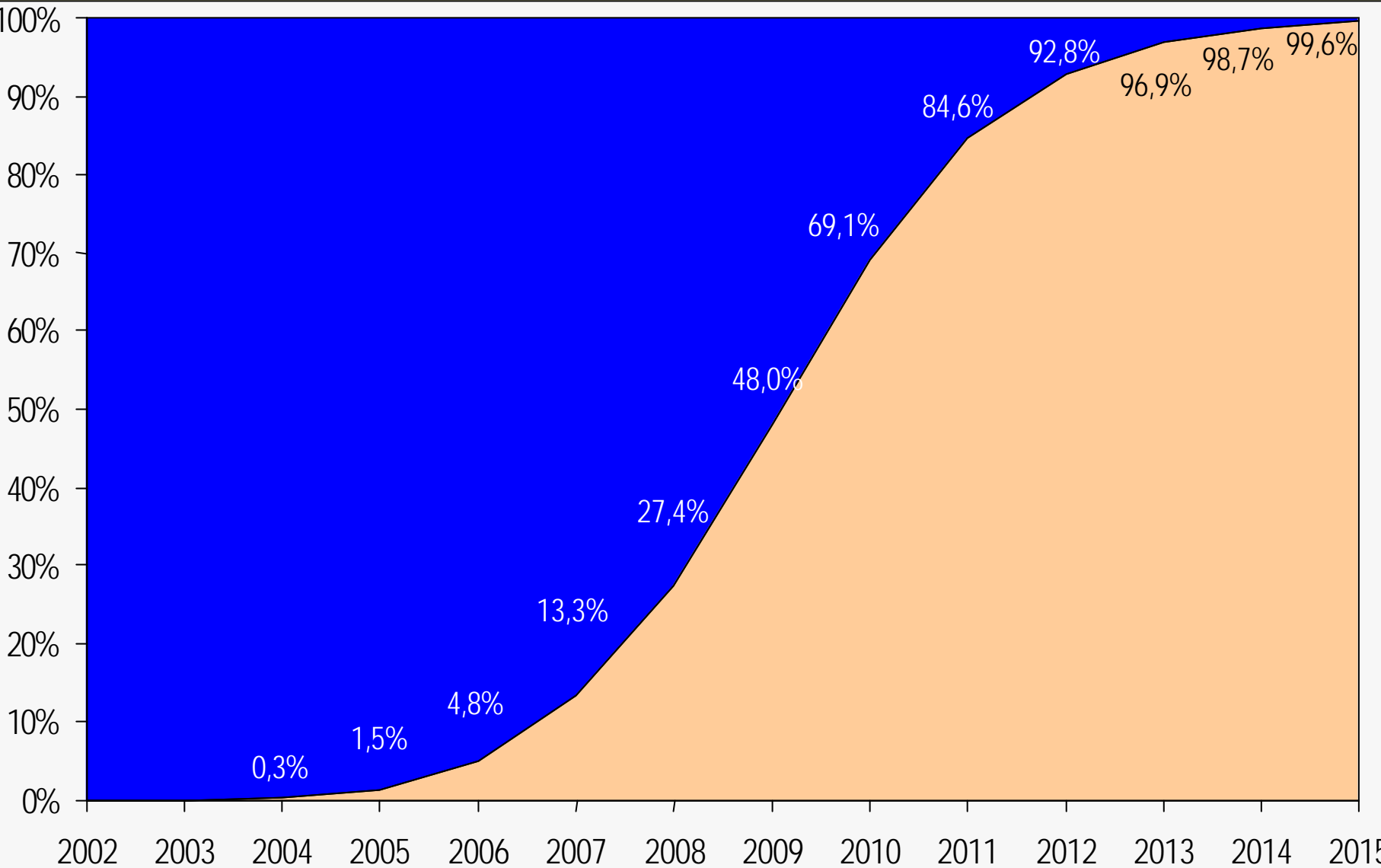
Cellular Subscribers (millions)



Source: ITU Indicators

Number of mobile subscribers already greater than fixed

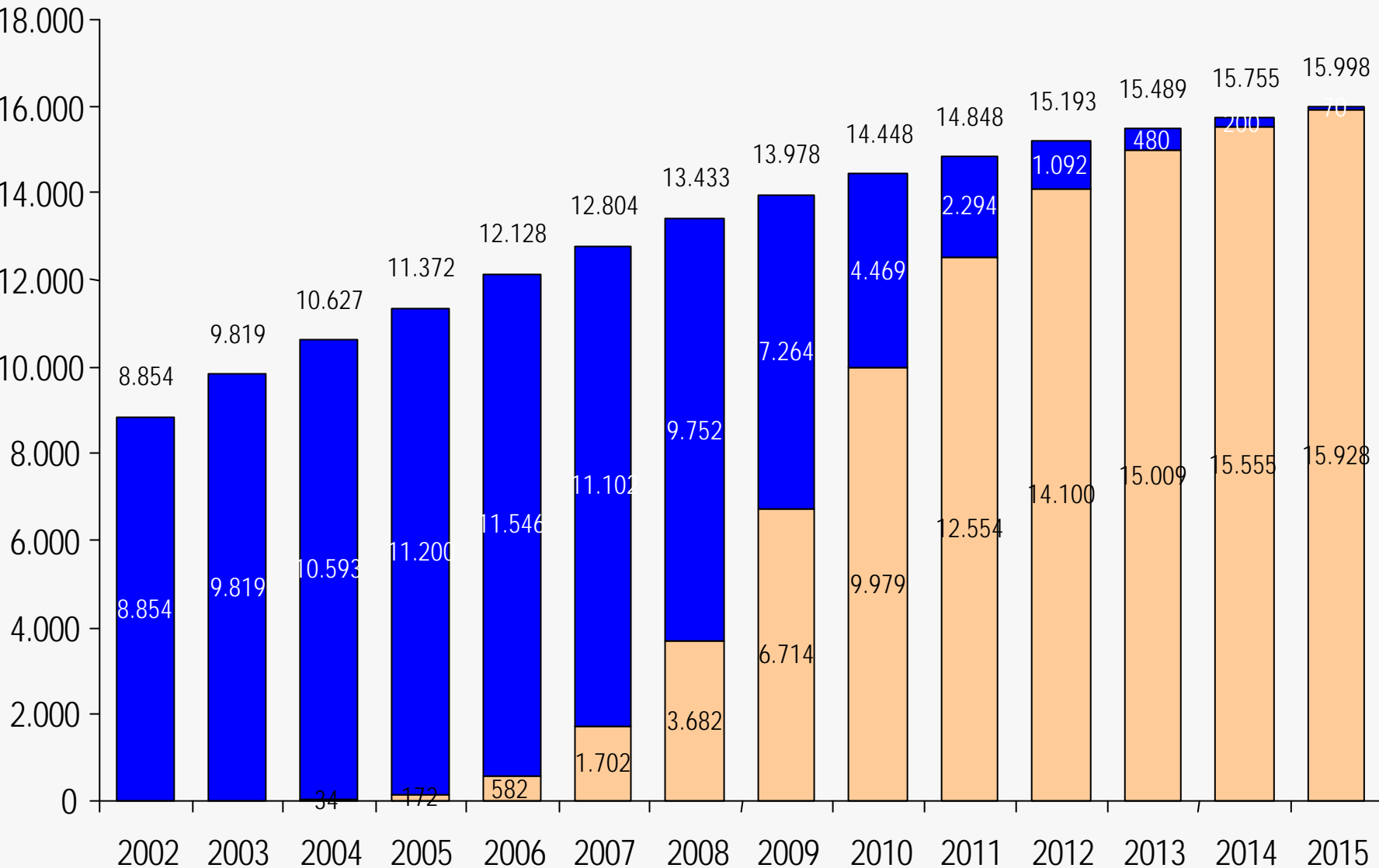
Mobile Technology Split (%)



Source: ITU Draft Guidelines on Smooth Transition to 3G



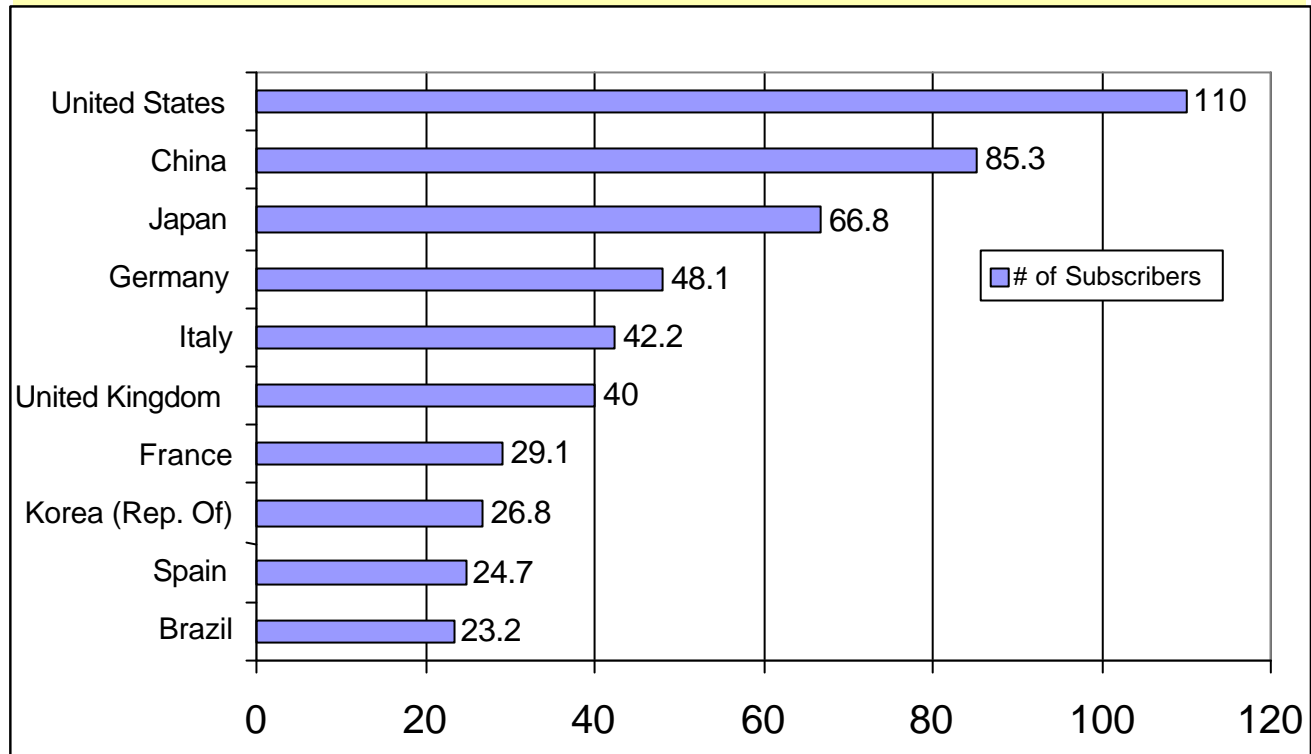
Mobile Subscribers(000)



Source: ITU Draft Guidelines on Smooth Transition to 3G

3G Subs 2G Subs

Figure 1: Top Mobile Economies (2000, millions)



Source: International Telecommunication Union

IMT-2000 spectrum and licensing considerations

Ministry of Communications/National Regulatory Authority

- **Open multi-operator multi-service provider environment**
- **Licensing regimes enable managed development of the sector**
- **Provide for access to scarce resources (Individual Licence)**
 - Spectrum
 - Numbering
 - Access to land
- **Impose rights and obligations**
- **Protect/promote consumer interests**

IMT-2000 spectrum and licensing considerations

Individual Licence

An authorisation which is granted by the **Ministry of Communications/National Regulatory Authority** and which gives an undertaking specific rights and obligations, where the undertaking is not entitled to exercise the rights concerned until it has received the decision is taken by the **Ministry of Communications/National Regulatory Authority**

IMT-2000 spectrum and licensing considerations

- Radio spectrum, which is a scarce, finite and valuable resource, should be allocated in a way that achieves maximum efficiency
- Allocation of spectrum, especially for public mobile networks, raises many economic issues
- Today licensing requires:
 - Technical knowledge (standards + frequencies)
 - Knowledge of local market environment
 - Estimation of the future demand for services
- More than 100 IMT-2000 licences have so far (Table annex 1) been awarded globally

IMT-2000 spectrum and licensing considerations

Key questions before licensing

- How to contribute optimally to the development?
- How to act so that current decisions will meet the requirements when a commercial service of 3G starts?
- What decisions are needed now and what could be decided later?
- How will markets and technology develop?
- Will the regulative framework change before the networks are implemented?

IMT-2000 spectrum and licensing considerations

Spectrum price

Spectrum must be available at the right price

What would be the right market value and the right price?

The right price can change between the licensing process and the start of operation

Large up-front payments for spectrum will adversely affect the growth of 3G services

The end user will always pay for the spectrum in the end

The number of licenses awarded has to be determined taking into account the available spectrum and competition issues

The number of licenses to be awarded is an element of competition policy and can critically determine the success or failure of the 3G regulatory framework and of 3G service provision in general.

The ITU has nominated the bands to be considered for the implementation of IMT-2000. Within these bands, each national government selects the amount of spectrum to be made available for 3G services, taking into account competing demands and uses for the spectrum.

IMT-2000 spectrum and licensing considerations

Spectrum Licence fee

1. Fees can be set by the licensing Authority (Administrative Fee)
 - Fixed fee – (fee may be cost plus)
2. Fees can be set by the market
 - Competitive Offer (Beauty Contest)
 - Competitive Bid (Auction)

IMT-2000 spectrum and licensing considerations

Consideration for setting Licence Fees

- Economic conditions
- Perceived value of the market
- Comparison with fees for other utility licences
- Benchmarking with similar countries
- Extent to which scarce resources are involved
- Amount of spectrum to be used
- Geographical location
- Roll-out costs
- End-user prices
- Cost of issuing licence – including the process

Principles of licensing procedures

- The public interest
- Transparency
- Public participation
- Fairness
- Non-discrimination
- Efficiency

Principles of licensing procedures

Public interest

- criteria for licensing should be based on the public interest (however defined) and not on the interests of any one or more of the parties (published in official government documents as well as in electronic and other media, such as website)
- criteria should be as objective as possible

Principles of licensing procedures

Transparency (re criteria and process)

1. criteria must be published in enough detail to be absolutely clear (in official government documents as well as in electronic and other media, such as website)
2. the entire process should be transparent (no ex parte contact with applicants)

Principles of licensing procedures

Public involvement

1. the public should be invited to participate in a meaningful way in the process
2. Invitations should be transparent, for example, published in electronic and/or other media freely available to the public

Principles of licensing procedures

Fairness

- the process should be fair to all parties involved or interested, including the public
- all interested parties must have an adequate opportunity to be heard
- reasons must be given for decisions - decisions must be rational

Principles of licensing procedures

Efficient

- the process must not impose unnecessary burdens on either the applicants or the independent regulator

Principles of licensing procedures

Non-discrimination

- the criteria and process should be non-discriminatory
- exceptions for appropriate set-asides for example, for nationals

Principles of licensing procedures

Principles - where to find them

- Telecommunications legislation
- Administrative procedures legislation or a constitutional right to fair administrative procedures
- Regulations (subordinate legislation)

Licensing methods

- There are many methods of spectrum licensing that have been used both for first and second generation mobile licenses, as well as for IMT-2000 licenses.
- Most countries have required special licenses in order for operators to provide IMT-2000 services, while other countries have taken a more flexible licensing approach and allow operators to use current spectrum for IMT-2000 services and/or license spectrum use on a more generic basis, such as for “advanced wireless services.”
- Some regulators allow first and second generation systems to migrate to IMT-2000 in their current bands and do not require further authorization to do so

Licensing Methods

- Non-competing application procedures
 - **First-Come, First-Served**
- Competing application procedures
 - Comparative processes (beauty contest)
 - Auctions
 - Lotteries
 - Hybrid

Licensing Methods: Non-competing applications

First-Come, First-Served

- When spectrum was not a scarce resource, regulators used a first-come, first-served approach to licensing spectrum.
- Royalty payments (e.g.):
 - Fixed fee for first five years,
 - thereafter 5% of the annual 3G revenue
- As spectrum has become more valuable, the regulator is unlikely going to assign frequencies on a first-come, first-served basis any more, except in the most remote areas

Licensing Methods: Non-competing applications

First-Come, First-Served

Advantages First Come, First Served

- Speed
- Inexpensive

Disadvantages First Come, First Served

- License may not end up in the hands of an entity that values it the most and can bring greatest value to the economy.
- The value of the license is not taken into account.

Licensing Methods: Competing application procedures

- Comparative applications (Beauty Contest)
- Auctions
- Lotteries
- Hybrid

Competing application procedures: Comparative applications

- In a “beauty contest” (also referred as “beauty parade” or “comparative hearing/parade), the Regulator/Ministry selects/scores the winning applicant using comparative criteria (scoring Matrix, annex 2).
- Used for 2G in many countries and it has also been used in some countries to issue licenses for IMT-2000.
- Criteria to compare the prospective license applications are established and can include:
 - the technical and financial stability of the applicants,
 - the technical characteristics of the system being deployed,
 - the coverage area being proposed,
 - the schedule for build-out”(roll out).

Competing application procedures: Comparative applications

Draft procedure for comparative applications (1)

1. Proposed selection criteria and process chosen by the independent regulator
2. Public given an opportunity to comment on proposals (e.g. three months)
3. Final selection criteria (Tender Document) and process (Scheduling table) made public by the independent regulator
4. Applications are called for

Competing application procedures: Comparative applications

Draft procedure for comparative applications (2)

5. Applications are submitted (e.g. six months)
6. Public given an opportunity to comment on applications (e.g. three months)
7. Applicants given an opportunity to reply to public comment (at least three months)
8. A hearing may be held where the regulator can question the applicants and/or the public can question the applicants

Competing application procedures: Comparative applications

Draft procedure for comparative process (3)

9. The independent regulator may, at any time, call for additional information from applicants
10. The independent regulator considers all information and makes a decision (Evaluation Phase) on who should be awarded the license (with reasons given)
11. There could be an appeal process built in here
12. The license is awarded

Competing application procedures: Comparative applications

Advantages Beauty Contests

- if done properly, the BEST applicant will be awarded the license
- Allows the regulator to determine the contender that will best serve the public interest.
- Final costs for operators are more easily predicted than other options such as auctions. The money to the investment to develop the networks and services for the user benefits.
- Long term benefit for the economy/society than short term help to the state budget
- More freedom for the regulator to amend the regulation if needed (national roaming, convergence, new market needs etc.)
- Allows for equity considerations, such as minority ownership, small business ownership, etc.

Competing application procedures: Comparative applications

Disadvantages Beauty Contests

- Can be a lengthy process, particularly if the license is valuable. Applicants are often willing to exhaust all administration and litigation options. Costly in terms of money and other resources, a subjective process and likely to be reviewed in the courts, requires an experienced and strong regulator to consider applications competently and without undue influence by any of the interested parties
- Can get expensive for the applicants if they are willing to spend large sums of money to succeed in the beauty contest process.
- Provides no method for deciding between two applicants that are essentially equal. The regulator may ultimately have to arbitrarily award the license.
- Government is responsible for choosing between alternative business plans stretching well into the future, and relating to new products and services that have not yet been developed.
- Need to be carefully structured to be fully transparent. Doubts over transparency of beauty contest process can lead to suspicions and dissatisfaction with the outcome.

Competing application procedures: Auctions

- Auctions award the licenses based upon the bidders' willingness to pay. Since the 1990s when spectrum auctions first began to be used for awarding spectrum licenses, billions of dollars have been raised in spectrum auctions and a fierce debate has arisen concerning the efficiency, competitive impact and social implications of this form of allocating spectrum.
- There are a variety of methodologies that have been used for spectrum auctions, including continuous, simultaneous multiple-round, and package.
- Preliminary minimum criteria re technical and financial ability (or other such criteria such as requirements for local participation or empowerment/affirmative action participation) applied to obtain entry as a bidder (pre-qualification phase)

Competing application procedures: Auctions

Advantages Auctions

- The costs to government are less than with comparative application processes and the process is not as lengthy in time
- License goes to the entity that values it the most. Auctions promote economic efficiency, one of the goals of spectrum management. Winning bids should come from the companies that can find ways of maximizing the stream of future benefits.
- Spectrum is a public resource and therefore the profits benefit the citizens. The proceeds of the auction go to the government for national purposes (results in taxpayer sharing of national spectrum resource)
- Auctions can provide information about the economic value of spectrum. For instance, if applicants are willing to pay a high price to be able to provide one service, but will pay a very low price for a different service, then the regulator can determine which service has greater economic benefit and, therefore, can determine where it needs to focus its future spectrum management efforts.

Competing application procedures: Auctions

Disadvantages Auctions (1)

Auctions may lead to increased concentration in the industry. The regulator can consider placing spectrum caps to limit the amount of spectrum that one entity can hold, or limit eligibility to participate to non-incumbents. In addition, a nation can address monopoly concerns through its antitrust laws or competition policies.

Auctions may ignore non-financial objectives that are in the public interest, such as equity considerations. The auction design can support those objectives by including strategies such as set-asides and providing bidding credits for certain groups that commit to addressing certain public interest factors.

There may be some incentive for the government to act like any monopoly by restricting output and raising the price. In other words, if the government wanted to maximize the revenues to the treasury, it could withhold spectrum.

Competing application procedures: Auctions

Disadvantages Auctions (2)

- Auctions may result in speculatively high bids for licenses for services that are not commercial at the time of the auction. Auctions can also be affected by hype and other non-economic forces. Auctions may result in speculatively high bids for licenses for services that are not commercial at the time of the auction.
- Full information on IMT-2000 market characteristics is not always available, leaving some or all bidders without adequate information on market conditions, the regulatory environment, demand characteristics and the likely pricing structures.
- Likelihood of winner's curse that results in high prices for the license and leads to decreased investment capacity for operators and high end-user prices
- **often money that should be used to build a network and provide services is spent buying a license in the first place and thus consumers in the end are disadvantaged with higher prices**, and if there is not a clear process and consistent and fair application of the process, then it is likely to be challenged in the courts

Competing application procedures: Lotteries

- Lotteries - preliminary minimum criteria re technical and financial ability (or other such criteria such as requirements for local participation or empowerment/affirmative action participation) applied to obtain entry as a lottery player to participate to the random selection

Competing application procedures: Lotteries

Advantages Lotteries

- the costs are less than with comparative processes and the process is not as lengthy in time
- Provides a mechanism for selecting from substantially equal applications.

Competing application procedures: Lotteries

Disadvantages Lotteries

- The license may be awarded to an entity that is not qualified to build and operate the system. Any person may be able to participate in the lottery if no pre-qualification requirements are set. The regulator can establish criteria for participation in the lottery. However, this can be legally challenged and make the lottery process a lengthy one.
- Speculators will participate in the lottery, with the purpose of reselling the license and reaping huge windfall profits. Reselling the license is known as “flipping it.” So rather than the public getting the benefit of the revenues, the lottery winner will realize the revenues from the sale of licenses they got for minimal investment.
- If an unqualified party wins the lottery, the regulator has the challenge of deciding whether to let them sell it or not.
- winners often use the process to buy a “lottery ticket” and never intend to operate a network or provide a service, but simply want to resell a valuable asset (the license) for profit, thus you are not likely to get the best applicant

Competing application procedures: Hybrid

- A number of countries, including Austria, Italy and Hong Kong, have adopted a “hybrid” approach to IMT-2000 license allocation.**
- Tenderers have to pre-qualify in terms of criteria similar to those established for beauty contests to bid.**
- Licenses are then allocated on the basis of an auction.**
- Advantages and disadvantages of a hybrid approach are themselves a combination of the advantages and disadvantages of beauty contests and auctions.**

Competing application procedures: Hybrid

Advantages Hybrid

Ensures that contenders have appropriate resources and business plans to serve the public interest. Can require that licensees meet specific policy goals.

License goes to the qualified entity that values it the most. Winning bids should come from the qualified companies that can find ways of maximizing the stream of future benefits.

Spectrum is a public resource and therefore the profits benefit the citizens. The proceeds of the auction go to the government for national purposes.

Allows for equity considerations, such as minority ownership, small business ownership, etc.

Competing application procedures: Hybrid

Disadvantages Hybrid (1)

Auctions may lead to increased concentration in the industry. The regulator can consider placing spectrum caps to limit the amount of spectrum that one entity can hold. In addition, a nation can address monopoly concerns through its antitrust laws or competition policies.

Can be time consuming, particularly if the license is valuable. Applicants are often willing to exhaust all administration and litigation options.

Beauty contest portion needs to be carefully structured to be fully transparent. Doubts over transparency of beauty contest process can lead to suspicions and dissatisfaction with the outcome.

Can get expensive for the applicants if they are willing to spend large sums of money to succeed in the beauty contest portion of the process.

Competing application procedures: Hybrid

Disadvantages Hybrid (2)

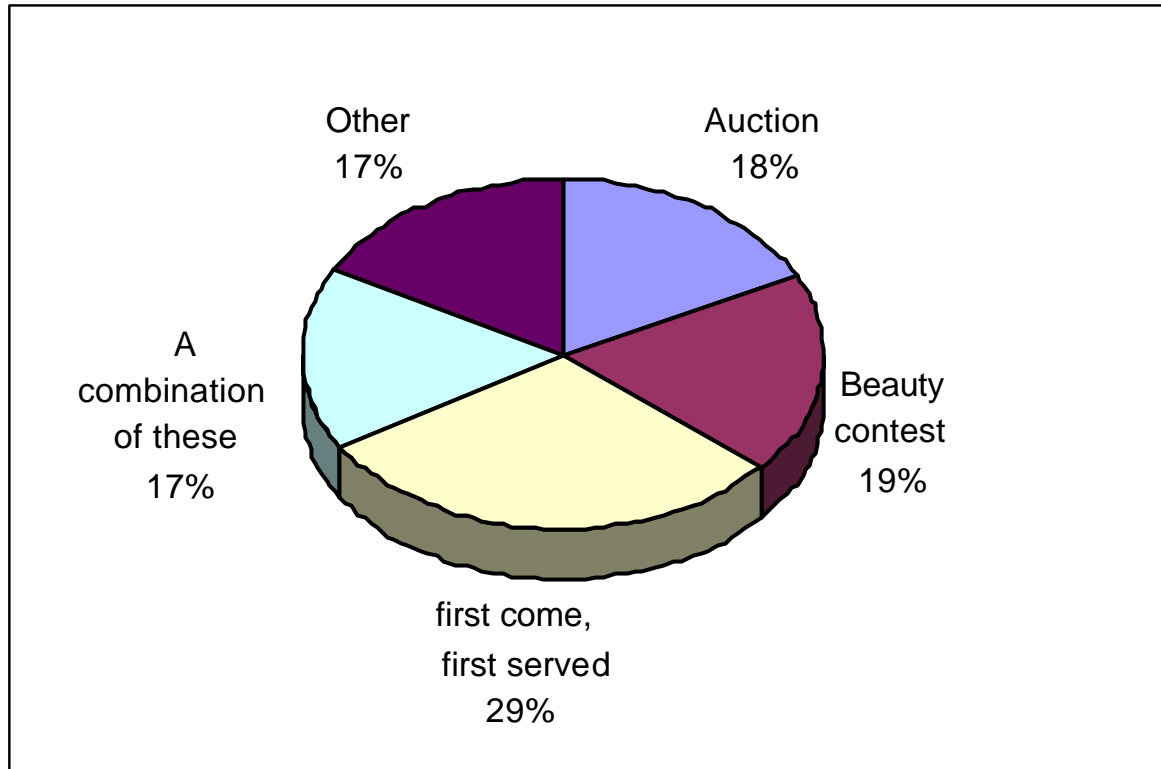
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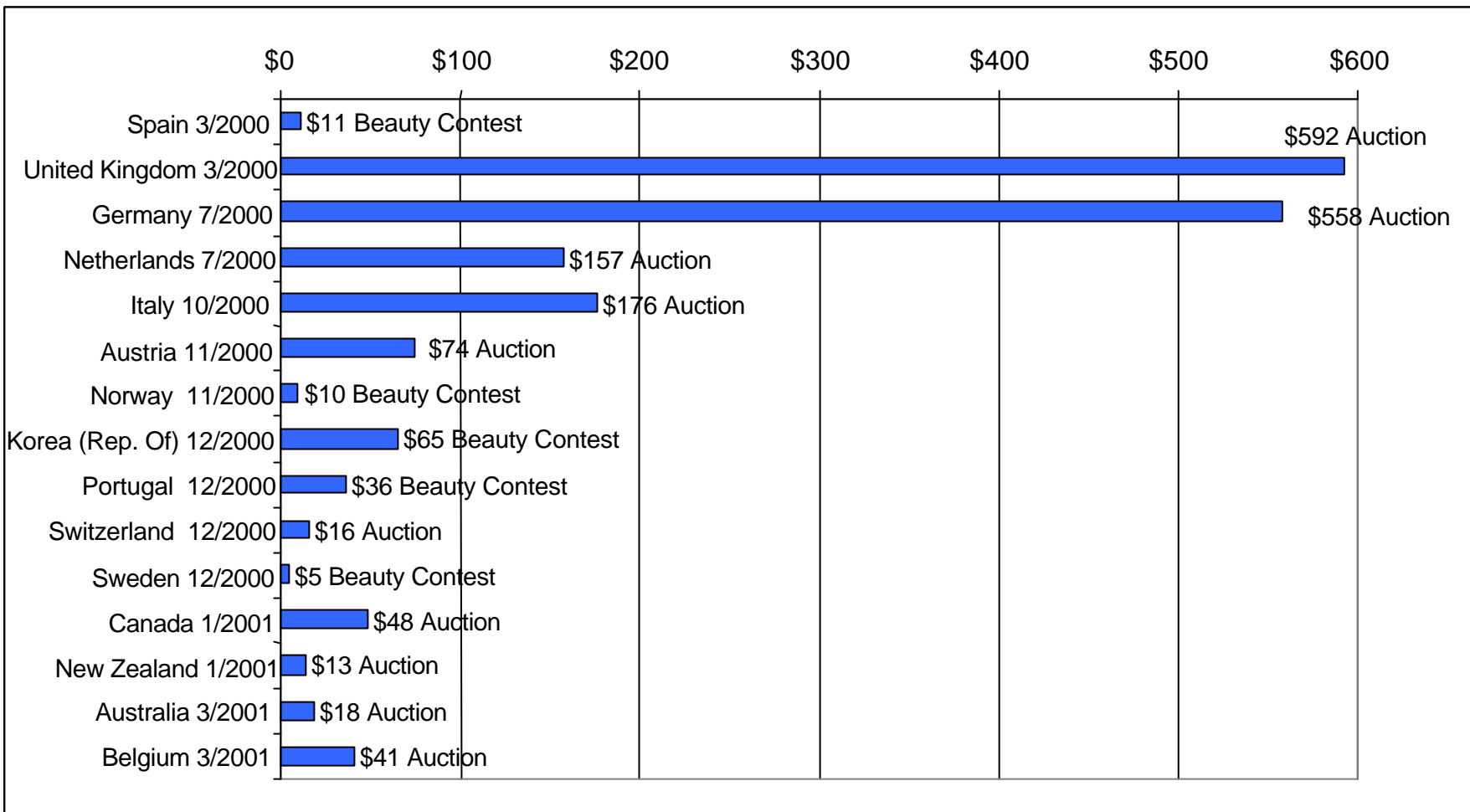
Likelihood of winner's curse that results in high prices for the license and leads to decreased investment capacity for operators and high end-user prices

Spectrum licensing methods



Source: ITU

3G Licences: Average Cost per Inhabitant



Source: ITU

IMT-2000 Licensing

“Licensing Condition - Obligations of licensees”

Licensing condition

- Rights and Obligations should be contained in regulation, not in licenses
- Licensing conditions are among the regulatory issues that are of importance to developing countries
 - **Technology Requirements**
 - **Financial requirements**
 - **Coverage**
 - **Timing of IMT-2000 licenses**
 - **Number of operators**
 - **Infrastructure Sharing**

Licensing condition

Technology Requirements:

It is worth considering whether policy makers/regulators should follow a technology neutral approach or should mandate a particular technology and related migration path. A technology neutral approach on has led to considerable benefits to end users in terms of a rapid technological evolution and lower prices.

Financial requirements:

Helps eliminate non-serious players and ensure a certain level of performance.

Licensing condition

Coverage:

To prevent the development of information-rich and information-poor communities, the policy makers/regulators of the various countries will need to ensure ubiquitous access to IMT-2000 services. However, from the service provider's point of view, it may not be viable to roll out expensive infrastructure in high-cost areas. It may be preferable to roll out network coverage in phases, based on demand and likely applications. Existing technologies and systems in place should have a scalable low cost migration path. Case studies have shown that operators can undertake gradual, phased upgrades to IMT-2000.

Licensing condition

Coverage and Roll-out

- To encourage the efficient use of spectrum by not leaving it unused longer than necessary
- To encourage infrastructure competition
- Coverage obligations introduced in many licences issued so far
- Roll-out of the 3G networks should be done according to market demand
- Coverage obligations should be linked to level of network service capability
- There is a danger of regulation driving the market if the level of these obligations is set too high

Licensing condition

Timing of IMT-2000 licenses:

The timing for introduction of a new service is crucial and varies from country to country. It is necessary to judge the market potential and to deploy technologies that are proven and established. Developing countries can ill-afford to experiment with technology. However, the process of introducing wideband wireless services is time consuming and would require licensing and regulatory preparedness from an early period. It would be advisable that developing countries begin consultation right as early as possible.

Licensing condition

Number of operators:

The limited availability of spectrum restricts the number of operators. In developed countries 3 to 5 operators have been preferred. Another issue is who should be eligible for this license: fixed operators, mobile operators, new operators, all or a combination of these. Japan, as an example, decided to exclude fixed operators from the licensing process. Mandatory roaming on 2 G networks: In case new operators are allowed to enter on the market, the regulator should decide whether to impose or not the obligation, on existing mobile operators, to provide pre-IMT-2000 roaming services to new entrants.

Licensing condition

Infrastructure Sharing:

Infrastructure sharing is particularly important for countries with widely dispersed populations and emerging mobile markets. It reduces the cost of network deployment and can improve penetration. It would also be necessary to identify the elements that can be shared, the amount of cost reduction that such sharing would bring about, for example, antenna masts, towers, and land building. Another issue for discussion is whether the regulator should play a pro-active role to encourage infrastructure sharing or should it be left entirely for operators.

Licensing condition

Sharing of facilities/infrastructure and National Roaming

Sharing of facilities can give a rapid deployment of networks and introduction of services

Sharing of network infrastructure may conflict with the goal of infrastructure competition

Sharing should be on a commercial basis

National roaming may be a way to achieve coverage of unprofitable regions

Licence conditions should allow commercially negotiated roaming agreements, if infrastructure competition is maintained

National roaming should only as an exception be mandatory. It can during a transitionally period help new operators to establish a market

Licensing condition

Miscellaneous items

- **Offered transmission speed**
Some licences indicate minimum requirements, e.g. 256 kbit/s (depending on the level of mobility)
- **Duration of the licence**
Offering licences for a period of less than 10 years would not encourage any serious deployment of infrastructure
- **Technical standard**
Some licences clearly indicate the standard to be used, some "within the ITU IMT-2000 family of standards"

Licensing condition/obligation

Miscellaneous items

- **Universal service obligations**
 - Telecommunications as a right
 - Economic development
 - Close gap between haves and have nots
- **Other social obligations**
 - Human resource development
 - Technical
 - Management
 - Other
- **Encouraging ownership and control to promote diversity – local partners**
 - Minimum ownership and control by certain categories of persons