The activities of ITU-BDT for Broadband Wireless Communications in Developing Countries

ITU/BDT Regional Seminar on Broadband Wireless Access (BWA) for CIS, CEE and Baltic Countries

Moscow, 26-29 November 2007

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Summary

1)The digital divide problem

Where the divides lie

Overview of the main forms of the digital divide affecting individuals and countries

For individuals	For countries
Socio-economic status	Development stage
Gender	Infrastructure
Age, life stage	Public policy
Language/ethnic status	Skills mix
Rural/urban location	Size of domestic market
Skills balance	Location relative to trading partners

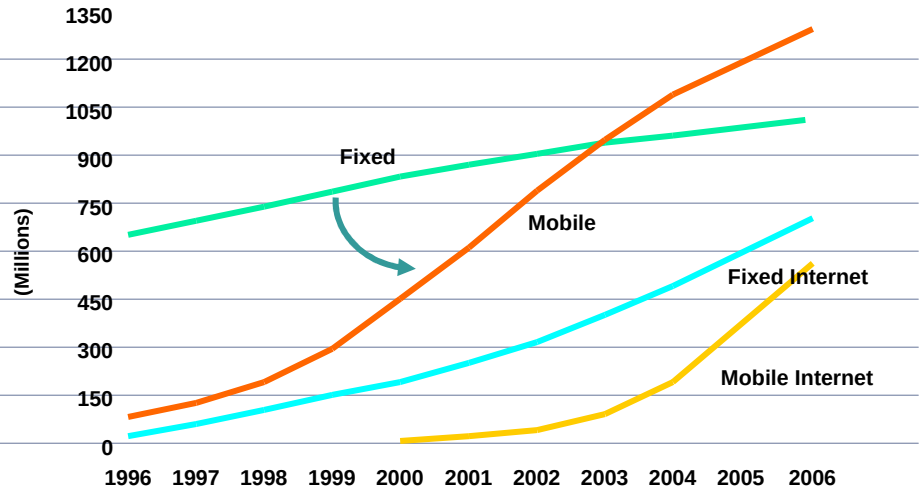
Source: Adapted from *"How real is the Internet market in developing nations?"* by Madanmohan Rao, at http://www.isoc.org/oti.articles/0401/rao.html

The digital divide problem

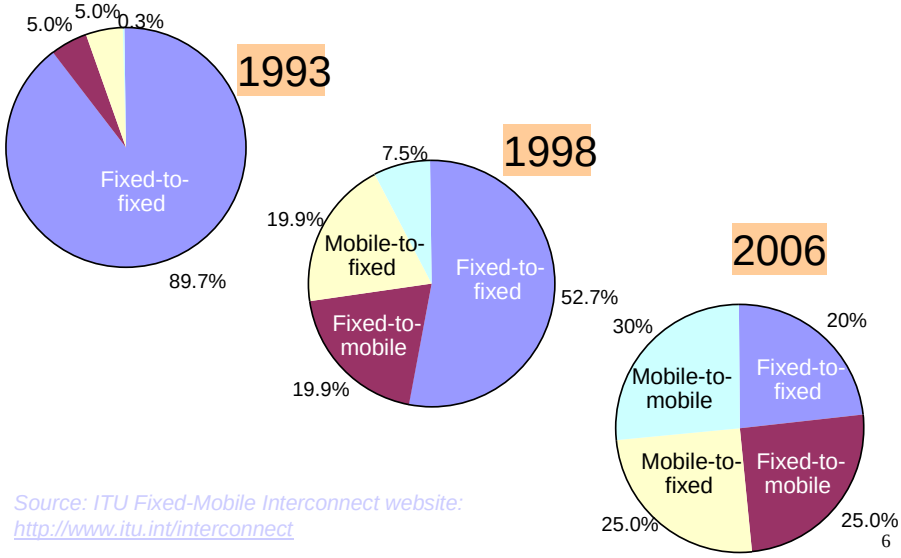
In recent years, as information and communication technologies (ICT) have become the backbone of the global information economy, increasing attention has focused on the gap in access to ICTs between developed and developing countries.

This gap has come to be known as the **"digital divide":** it is multifaceted, with the gap in access to technologies affecting rural and remote populations, females, children, the elderly, those with health problems and disabilities, ethnic minorities, the illiterate and poorly educated and others both within and between nations.

Subscriber Growth



Calling opportunities worldwide



Source: ITU Fixed-Mobile Interconnect website: http://www.itu.int/interconnect

The digital divide problem

Broadband Wireless could bring access to information and communication to huge numbers of the world's population who are currently without it.

Widening access to basic infrastructure should help to reduce the other forms of divide. **In this context, the Broadband Wireless should be seen for the future promise it holds especially in developing countries and in rural and remote areas of the developed world.**

Developed versus developing divides

Nevertheless, given that the developing world accounts for more than **80 per cent of global population**, there is still along way to go to reduce the divide. Even if national populations were growing at similar rates, and current ICT growth rates were sustained, it would take at least ten years for this gap to be reduced.

But in reality, **developing country populations are growing faster than developed ones,** and they have a much higher percentage of their population under the age of 15. In reality, therefore, it will take **much longer to bridge the digital divide**.

Developed versus developing divides

Furthermore, given that more than a billion of the world's developing country population lives on less than USD 2 per day, well below the generally accepted minimum level of income needed for ownership and use of ICTs, it is likely that the fundamental nature of the divide will persist unless there is profound change in basic socio-economic conditions.

BROADBAND WIRELESS, TOOL FOR BRIDGING THE DIGITAL DIVIDE: It may help speed up this process, by making ICT access more affordable and easier to deploy.

The current shift from circuit-switched to IP-based networks, and from fixed-lines to wireless, associated with the development of the portable Internet, **is likely to have a Positive effect , especially given that mobile is overtaking fixed even more decisively in developing countries than in developed ones.**

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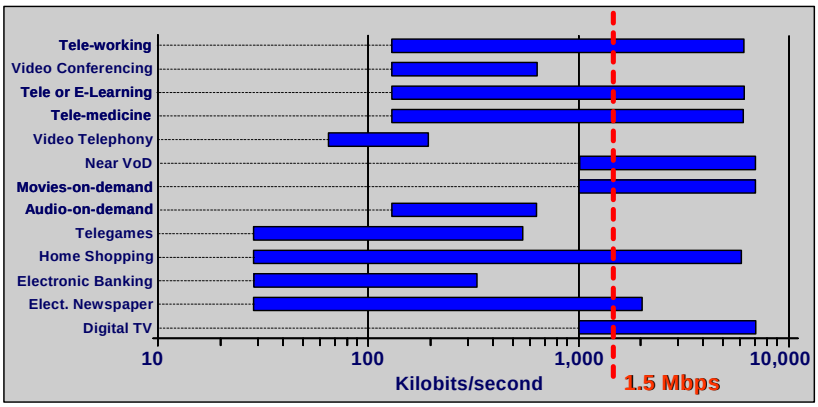
Capacity: Required bit rate capacity per application



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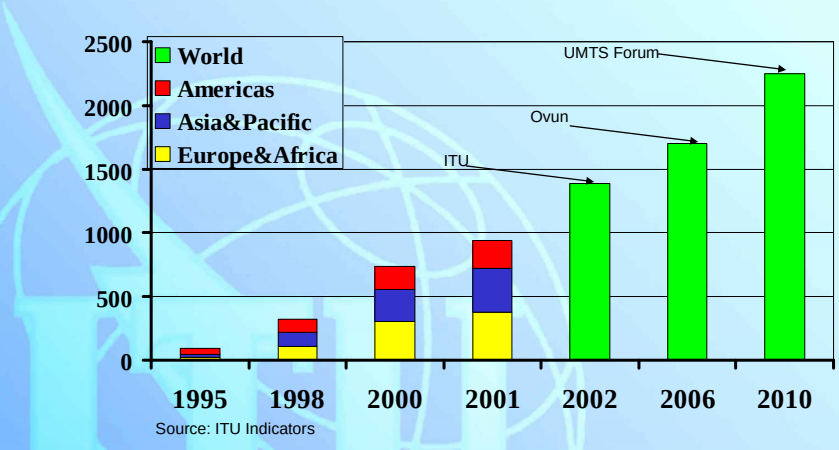
Deploying Wireless Broadband infrastructure

-Mobile Infrastructure

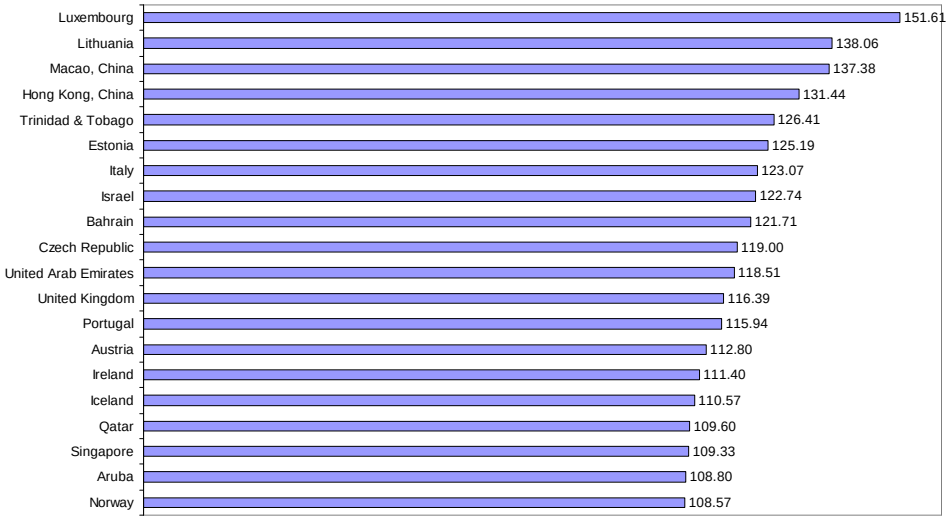
- Fixed Wireless Access (FWA) Infrastructure

2) Trends – Mobile Growth (worldwide)



Number of mobile subscribers already greater than fixed

Mobile Subscribers per 100 inhabitants (Mobile penetration) - Rank 1 to 20 - 2006



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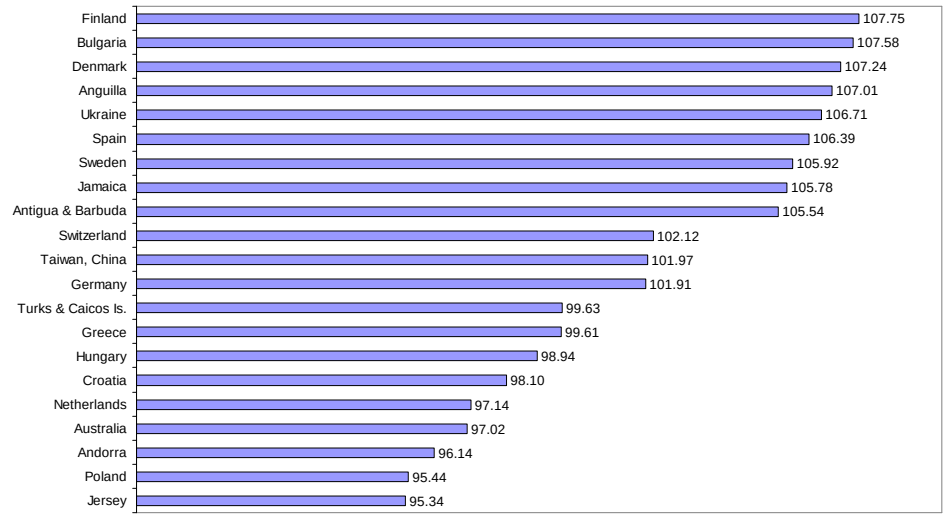
Mobile subscribers per 100 inhabitants (Mobile penetration) - Rank 21 to 41 - 2006



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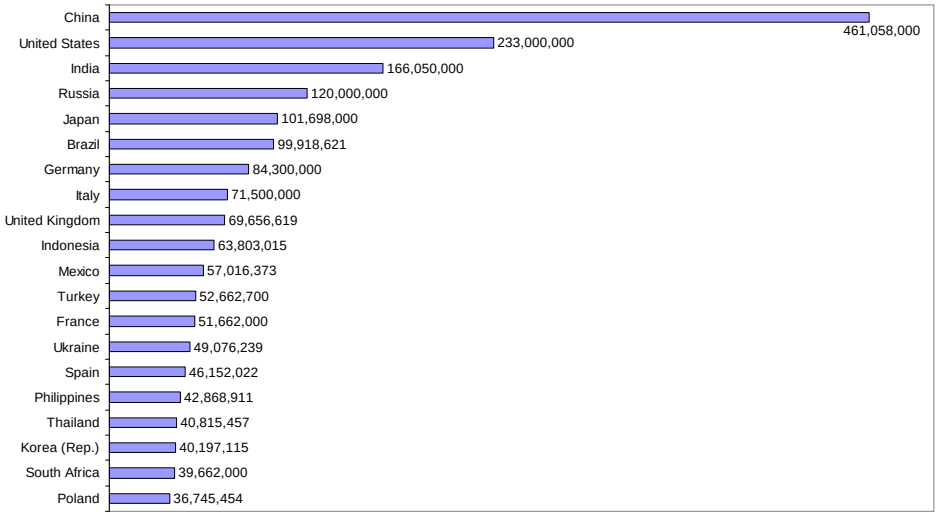
Total mobile subscribers 2006



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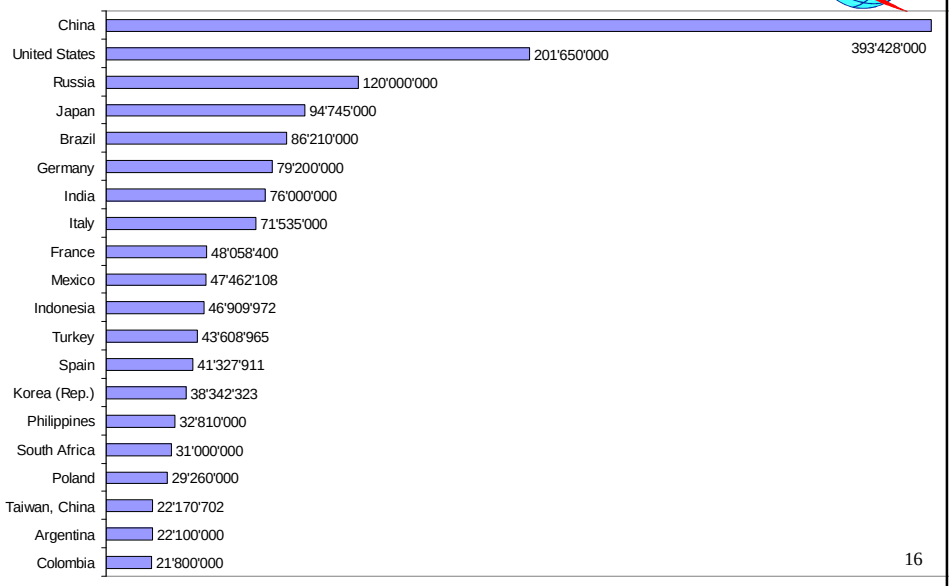
Total mobile subscribers 2005



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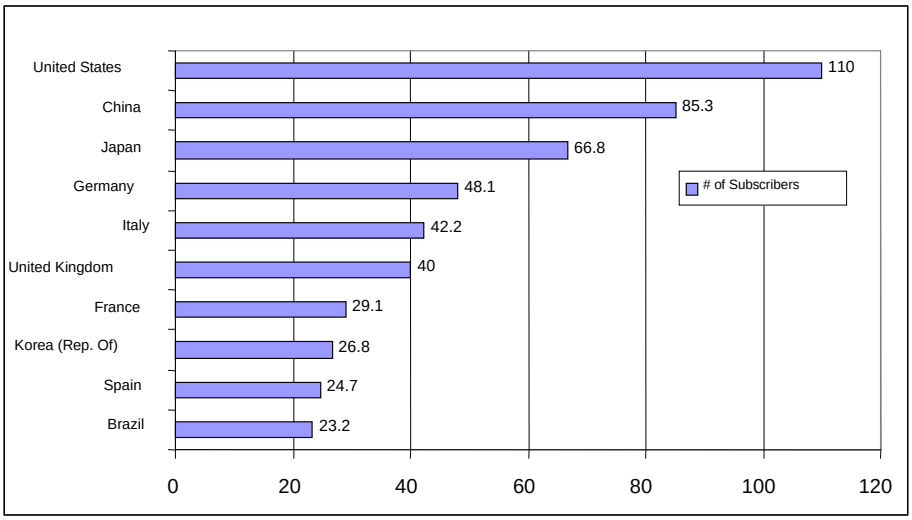
Top Mobile Economies (2000, millions)



Source: International Telecommunication Union

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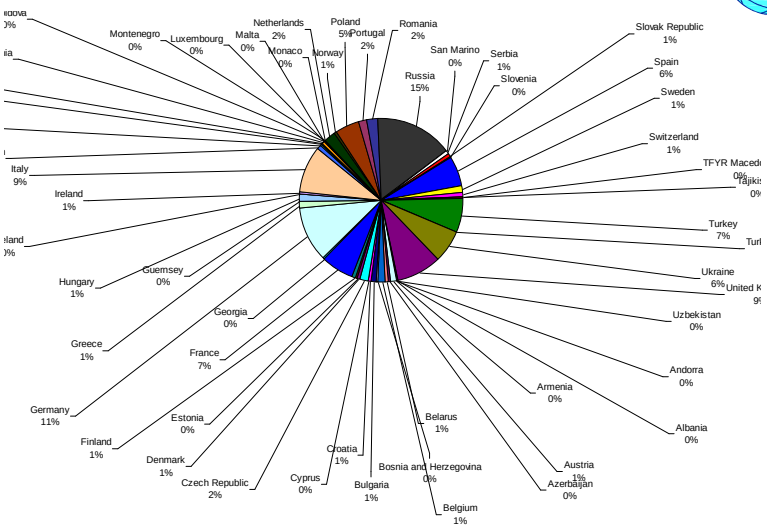
Mobile cellular penetration rates – CIS, CEE & Baltic Countries (2006)



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CIS, CEE and Baltic Countries: Mobile Cellular Subscribers 2006 (Source: ITU)

		(k) 2006	*CAGR (%)* 2000-06	*Per 100 inhabitants* 2006	*As % of total telephone subscribers* 2006
1	Albania	1'530	119.9	48.89	81.2
2	Andorra	65	22.4	96.14	64.6
3	Armenia	318	78.6	10.54	34.9
4	Austria	9'255	7.1	112.80	72.2
5	Azerbaijan	3'324	41.1	39.23	73.7
6	Belarus	5'960	122.3	61.44	63.9
7	Belgium	9'660	9.4	92.55	67.2
8	Bosnia & Herz.	1'888	65.0	48.25	65.6
9	Bulgaria	8'253	49.5	107.59	77.5
10	Croatia	4'470	27.7	98.11	70.9
11	Cyprus	778	23.6	92.06	65.6
12	Czech Rep.	12'150	18.7	119.01	78.5
13	Denmark	5'841	9.6	107.25	65.3
14	Estonia	1'659	19.9	125.19	75.4
15	Finland	5'670	7.2	107.76	74.7
16	**France**	**51'662**	**10.1**	**85.08**	**60.4**
17	Georgia	1'704	43.5	38.43	75.5
18	**Germany**	**84'300**	**9.8**	**101.92**	**60.9**
19	Greece	11'098	11.0	99.62	64.2
20	Guernsey	44	19.0	78.54	49.3
21	Hungary	9'965	21.6	98.95	74.8
22	Iceland	329	7.3	110.58	62.9

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CIS, CEE and Baltic Countries: Mobile Cellular Subscribers 2006 (Source: ITU)

		(k) 2006	*CAGR (%)* 2000-06	*Per 100 inhabitants* 2006	*As % of total telephone subscribers* 2006
23	Ireland	4'690	11.3	111.40	69.1
24	**Italy**	**71'500**	**11.1**	**123.08**	**74.1**
25	Kazakhstan	7'830	84.7	52.86	72.8
26	Kyrgyzstan	542	126.9	10.29	55.2
27	Latvia	2'184	32.6	95.13	76.9
28	Liechtenstein	29	19.2	-	58.9
29	Lithuania	4'718	44.2	138.06	85.6
30	Luxembourg	714	15.3	151.61	74.3
31	Malta	347	20.3	85.96	63.2
32	Moldova	1'358	46.2	32.38	57.2
33	Monaco	17	4.3	48.76	33.6
34	Montenegro	822	-	7.83	69.9
35	Netherlands	15'834	8.0	97.15	67.6
36	Norway	5'041	7.7	108.57	71.0
37	Poland	36'745	32.6	95.45	76.2
38	Portugal	12'226	10.6	115.95	74.3
39	Romania	17'400	38.2	80.45	80.5
40	**Russia**	**120'000**	**105.6**	**83.62**	**75.0**
41	San Marino	17	3.1	-	45.3
42	Serbia	6'644	-	63.29	71.0
43	Slovak Republic	4'893	25.6	90.60	80.7

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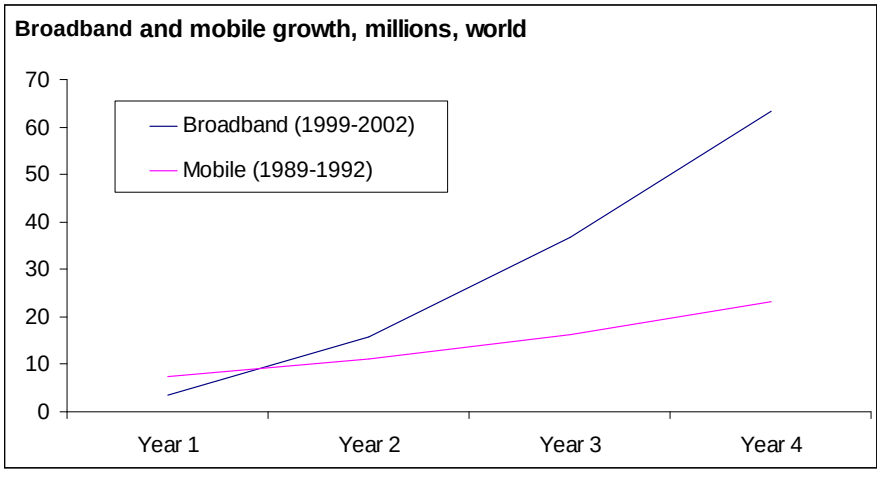
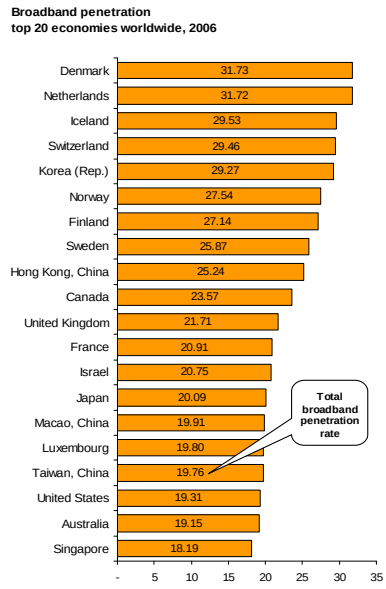
CIS, CEE and Baltic Countries: Mobile Cellular Subscribers 2006 **(Source: ITU)**

		(k) 2006	*CAGR (%)* 2000-06	*Per 100 inhabitants* 2006	*As % of total telephone subscribers* 2006
44	Slovenia	1'820	7.0	92.56	68.5
45	**Spain**	**46'152**	**11.3**	**106.39**	**71.5**
46	Sweden	9'607	7.1	105.92	64.0
47	Switzerland	7'418	8.1	102.12	59.5
48	Tajikistan	265	196.3	4.07	48.6
49	TFYR Macedonia	1'417	51.8	69.56	74.3
50	**Turkey**	**52'663**	**21.8**	**71.0**	**73.7**
51	Turkmenistan	105	69.5	2.17	20.9
52	**Ukraine**	**49'076**	**97.8**	**106.72**	**79.9**
53	**United Kingdom**	**69'657**	**8.2**	**116.39**	**67.5**
54	Uzbekistan	720	68.4	2.71	28.6

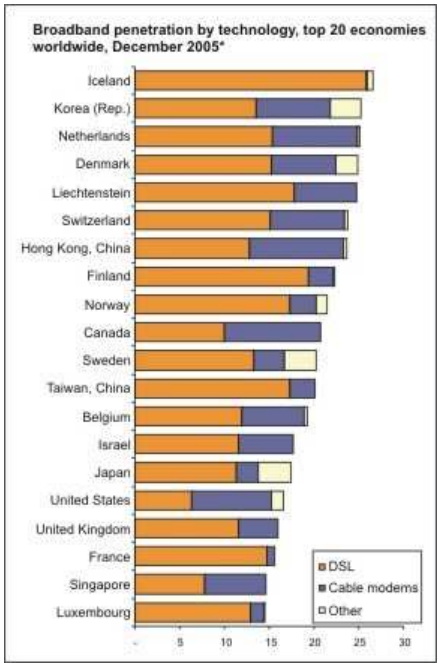
3) Growth of broadband



Source: ITU World Telecommunication Indicators Database


Broadband penetration
top 20 economies worldwide, 2006
Denmark 31.73
Netherlands 31.72
Iceland 29.53
Switzerland 29.46
Korea (Rep.) 29.27
Norway 27.54
Finland 27.14
Sweden 25.87
Hong Kong, China 25.24
Canada 23.57
United Kingdom 21.71
France 20.91
Israel 20.75
Japan 20.09
Macao, China 19.91
Luxembourg 19.80
Taiwan, China 19.76
United States 19.31
Australia 19.15
Singapore 18.19
Total broadband penetration rate
- 5 10 15 20 25 30 35

23


Broadband penetration by technology, top 20 economies worldwide, December 2005*
Iceland
Korea (Rep.)
Netherlands
Denmark
Liechtenstein
Switzerland
Hong Kong, China
Finland
Norway
Canada
Sweden
Taiwan, China
Belgium
Israel
Japan
United States
United Kingdom
France
Singapore
Luxembourg
DSL
Cable modems
Other
- 5 10 15 20 25 30

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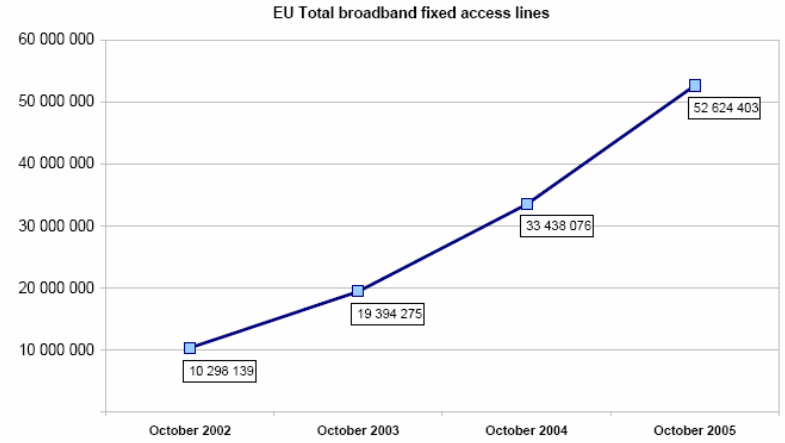
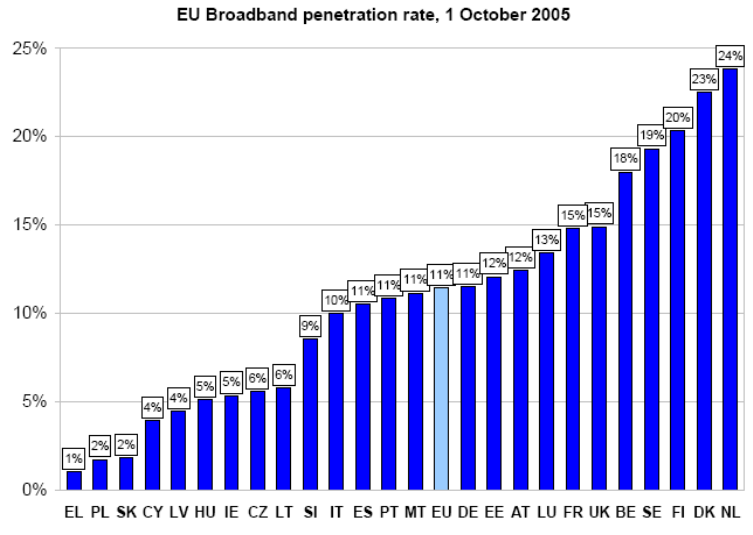
EU Total Broadband Fixed Access Lines



Source: Commission services based on COCOM data

EU Broadband Penetration



Source: Commission services based on COCOM data

The road to BWA

Need
Market
Technology

- Spectrum & regulations
- Radio interface standards
- Sharing and interworking

4) Wireless Broadband Technologies

Portable Internet technologies, by range

The portable Internet will involve a wide range of technologies for different speed and mobility needs

Portable Internet technologies

Long range	Medium range	Short range
• IMT-2000 (3G)	• WLAN	• Bluetooth
• WiMax - IEEE 802.16	➢ Wi-Fi - IEEE 802.11b	• RFID
• IEEE 802.20	➢ IEEE 802.11a	• ZigBee
• HiperMAN	➢ IEEE 802.11g	
• Satellite	➢ IEEE 802.11i	
• HAPS/LAPS	• Free space optics	
• LMDS	• HiperLAN2	
• MMDS	• Ultra wideband	

Source: ITU

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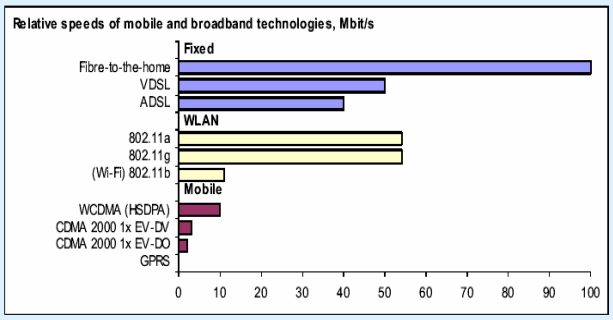
Broadband Technologies

Relative speeds of mobile and broadband technologies

Fixed connections are among the fastest connections available; WLAN technologies offer high-speed connectivity within a very small area of mobility and IMT-2000 (3G) technologies offer the lowest speeds with the highest degree of mobility



Source: ITU

4) Deploying Wireless Broadband infrastructure

4a) Technologies for narrowing the gap: IMT-2000

The number of mobile phone users in the world overtook the total number of fixed line subscribers in 2002.

With this tremendous **growth of mobile communications comes the possibility that the world's vast mobile networks can offer the most promising method of delivering the portable Internet to users.**

Existing 2G and 2.5G cellular networks provide a platform for slow-speed and medium-speed Internet access, as well as for voice. **But for higher speeds, advanced wireless technologies and techniques provide a platform for high-speed data access using Internet Protocol (IP).**

Cellular mobile: IMT-2000 or third-generation (3G) mobile technologies

The great majority of the world is still using second-generation mobile networks, but IMT-2000 (3G) networks have begun to make their impact

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,…)

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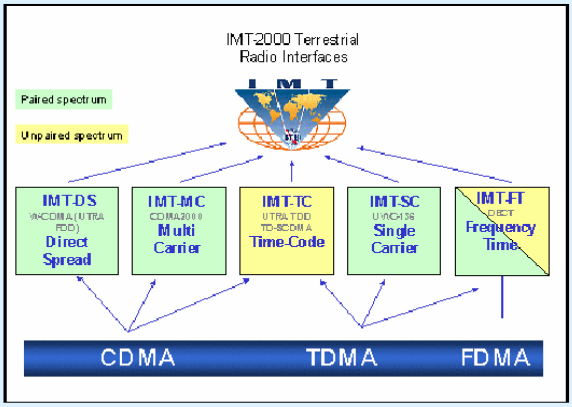
IMT-2000 (3G) and beyond

Looking towards the next generation of networks

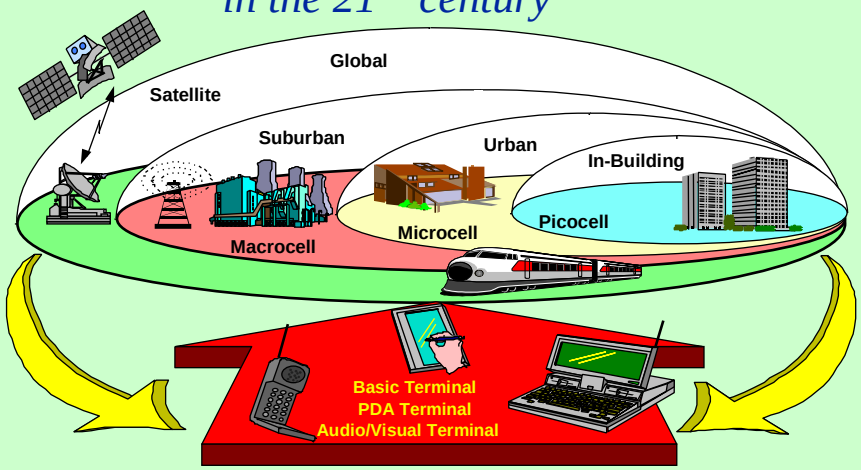
The IMT-2000 project harmonized the standards for third-generation networks with three different access technologies using five different radio interfaces (see graphic below). However, even as network operators proceed with rolling out IMT-2000 networks, work in also proceeding to develop faster, higher capacity networks for future mobile connectivity, known as "Systems beyond IMT-2000" or 4G. The World Telecommunications Standardization Assembly (Montreal, 2000) created a Special Study Group (SSG) to study of four questions regarding network signalling and protocols that can enable next-generation mobile services. Future work on Systems beyond IMT-2000 will help ensure that mobile networks will provide fast data access and reliable multimedia transmission at high mobile speeds.



Note: For acronyms, see Glossary.
Source: ITU

IMT-2000

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



4a) Technologies for narrowing the gap: Fixed Wireless Access (FWA)

IMT-2000 technologies will cover the highly mobile **but lower speed portions of the portable Internet while fixed wireless technology will fill the niche of high-speed, long distance, but stationary connectivity.**

However, **fixed wireless connections are currently being promoted as replacements for wired broadband connections**.

The key role of **fixed wireless technologies in the portable Internet will probably remain as a cost-effective high-speed backhaul connection to a city, village, or even a community access centre.**

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Technologies for narrowing the gap: Fixed Wireless Access (FWA)

Fixed wireless systems have been slow to gain ground when compared with traditional, wired high-speed connections.

However, **a new set of technologies (e.g WiMax and IMT-2000 WLL) is promising to change wireless adoption the same way Wi-Fi has changed localized Internet access.**

Providing mobility ?: Regulatory aspects, Technical aspects

Fixed-wireless as a formula for low-cost Internet access

Fixed Wireless Access is and option that can ensure greater user affordability, particularly by virtue of low-cost installation and roll-out also in countries with rugged terrain and the use of licence-exempt frequencies.

Start-up costs are thus much lower and investment burden is more widely shared. FWA networks are characterised by relatively low sunk costs and networks can grow "organically", as more users join the network. **The spectrum costs for FWA are also likely to be much lower than for Mobile 3G.**

Fixed wireless systems use a small, inexpensive microwave antenna that is attached to a local radio network at the customer premises and their provision costs are far less than digging up the earth to install copper-based cables. **They can be employed as an efficient and cost-effective method for bypassing the last-mile of the existing telecommunication network.**

WLAN (Wireless Local Area Networks)

Fixed-line broadband connections offer the fastest speeds but are confined to wired connections.

However, a subset of wireless technologies, WLANs, is expanding the reach of broadband in the **100-metre range.**

The WLAN market is currently dominated by one technological standard, **IEEE 802.11b (commonly known as Wi-Fi),** though several new variations are quickly gaining popularity.

WLAN (Wireless Local Area Networks)

Table 2.1: Wi-Fi ranges
The various ranges of Wi-Fi in different environments

	Range	
Environment	**Maximum**	**at 11Mbit/s**
Outdoors / open space with standard antenna	225-300 m	45-100 m
Office / light industrial setting	75 - 100 m	30-45 m
Residential setting	40-60 m	20-25 m

Source: The Wi-Fi Alliance at: http://www.weca.net

Wi-Fi: Cheap, unregulated and unlicensed broadband

The advantages of **Wi-Fi for increasing wireless access** include the fact that it can be built from the bottom up, **by small and local entrepreneurs.** Each telecommunication operator can provide services within the local community simply **by purchasing the basic radio equipment and transmitting on these unlicensed frequencies.**

The model is relatively inexpensive, responsive to local needs and realities, able to grow organically and fully scalable. It can also create employment, especially where the provision of Wi-Fi service is combined with sale of other services (e.g. mobile prepaid recharges, photocopying, etc.). As the number of local providers increases, so does the overall capacity of the network. Each new operator increases the number of pathways between any two points.

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Wi-Fi: Cheap, unregulated and unlicensed broadband

However, there are a number of **constraints with WLANs, most notably the small cell size, which may not be appropriate in rural areas.** Furthermore, while WLANs may be cheap to roll-out, **installing and operating conditional access and billing systems may be more expensive.**

For these reasons, it is more likely that **WLANs would be used in developing countries not as a standalone service, but in conjunction with another technology,** like WiMAX, DSL or Very Small Aperture Terminals (VSATs).

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5) Wired vs Wireless Broadband technologies

- At the present time, **wired broadband technologies can transport much more data than wireless technologies.**
- Fibre optic technologies are currently capable of 10 Gbit/s over one wavelength, and fibre should be able to support multiple wavelengths.
- **Wireless technologies, available to consumers, have recently been shown to reach 54 Mbit/s but only over short distances, and still with nearly 200 times less bandwidth than a single fibre strand**.

Wired vs Wireless Broadband technologies

The vastly superior speeds of wired connections mean they will continue to play a key role in providing high-bandwidth applications. Wired connections, where they are available, will be a vital element for high volume and low-cost data transportation.

For the foreseeable future, **wired and wireless technologies are likely to be complementary**, at least in the urban markets of the developed world

On the other hand, **wireless technologies may offer an effective way for countries without extensive fixed-line infrastructure to catch up**, and possibly "leapfrog" over other countries in terms of total connectivity.

Wired vs Wireless Broadband technologies

Residences subscribe to broadband via a fixed connection but then share the connection within the house or apartment via Wi-Fi. Businesses using WLANs almost always rely on wired infrastructure to reach their ISP.

Therefore, **instead of Wi-Fi competing against fixed-line broadband infrastructure, the two work together as complementary technologies.** Fixed broadband connections become more cost effective and attractive to users when they can be shared and Wi-Fi makes this possible.

Wired vs Wireless Broadband technologies

The second area of possible competition of newer portable Internet technologies is **with third generation (3G or IMT-2000) mobile.** As of mid 2004, there were around 118 million 3G subscribers worldwide (compared with around 58 million a year earlier).

Some of the functionality that 3G offers is very similar to that which could be potentially offered by Broadband technologies, **though 3G may still be preferred for use in fast moving vehicles.**

Furthermore, **although 3G may offer better coverage**, the start-up costs of providing nationwide coverage for **3G are likely to be much higher than a hybrid Broadband Wireless solution based on a WiMAX backbone and a Wi-Fi local loop.** The main difference affecting the cost is the size of cells (much smaller for 3G than for WiMAX) and the requirement for cell-handover in a 3G network.

Wired vs Wireless Broadband technologies

The high costs of acquiring licences and rolling out the network are part of the reason why 3G has been slow to arrive

But the main area of competition relates to tariff structures (see pricing discussion below). Mobile operators approach the provision of Internet services from the starting point of per-minute voice tariffs, **whereas Wireless Internet service providers approach it from the starting point of "always-on", flat-rate Internet tariffs.** In any like-for-like competition, flat-rate tariffs are always likely to be preferred in the marketplace over per-minute pricing strategies.

This is one of the reasons why 3G service providers, notably in Japan are moving towards flat-rate tariffs.

Results of WTDC-06 related to IMT-2000

The last ITU World Telecommunication Development Conference WTDC-06 approved the following texts related to IMT-2000:

- **Resolution 43** (WTDC-06): Assistance for implementing IMT-2000

-**Question 18-1/2**: Strategy for migration of mobile networks to IMT-2000 and beyond

-**Programme 2, point 1.4**: Mobile terrestrial communications

ITU-BDT Broadband Activities

Developing Regions

- Growing demand for Broadband
- Lack of Wireline infrastructure needed to meet the growing demand for Broadband
- BWA, economical and easy to install, is a good high-performance solution to address the needs of these Regions
- Availability of Broadband Services in Rural and Remote areas can address a variety of challenges posed by the distance

ITU-D Broadband Activities Presentation Agenda

- ITU-D Introduction
- Question 20-2/2: Broadband Access Technology
- Results of Questionnaire: Factors affecting broadband deployment
- Strategies to Promote Broadband
- Invitation to Participate

ITU-D Study Group 2 Question 20-2/2 Broadband Access Technologies

- **Approved at World Telecommunications Development Conference 2006:**
  - –Identify the technical, economic, and development factors influencing the effective deployment of broadband access technologies and applications.
- **Technology Scope:**
  - –All broadband technologies- as inclusive as contributions permit.
- **Report on Broadband Access Technologies currently available on ITU-D website:**
  - **– 3 sections: 1) General broadband matters; 2) Technology Matrices, 3) Country experiences**
  - **–General broadband matters:**
    - •Social and Economic Benefits of Broadband
    - •Broadband Applications
    - •Broadband Deployment
    - •Strategies to Promote Broadband Development
  - **–Technology Descriptions:**
    - •Wireline: DSL, Cable, Fiber to the Home, Powerline, etc
    - •Wireless: Satellite, FWA, WLAN, IMT-2000, etc.
    - •Non-Standardized Technologies
  - **–Country experiences:**
    - •Africa
    - •Americas
    - •Asia and Asia Pacific
    - •Europe

Conclusions: Strategies to Promote Broadband (1/2)

In order to promote demand for broadband deployment, governments and businesses private sector can aim to:

- Increase broadband availability in schools, and other public centers (increases awareness of broadband benefits).
- Educate users on successful applications such as IP telephony, video chat, audio over broadband.
- Promote teleworking, e-health, e-learning, and e-government transactions (such as filing of tax forms and other administrative procedures).
- Encourage content development in local languages.
- Ensure regulatory environment protects intellectual property rights and user security.
- A competitive market structure is vital to sustain low prices in order to attract consumers.
- Support for research and development on broadband technologies and applications.

Conclusions: Strategies to Promote Broadband (2/2)

In order to promote broadband supply, governments and businesses can aim to:

- Create incentives for competition both among providers of the same broadband technologies, and between providers of different broadband technologies.
- Establish policies that allow service providers the flexibility to independently choose technologies based on commercial and competitive considerations.
- Promote use of existing infrastructure to enable broadband rollout while at the same time encouraging new investment
- Utilize schools, hospitals, and community access centers as effective anchors for broadband demand in areas where individual household connections are not yet viable.
- Consider wireless broadband as a viable community alternative to fixed line solutions such as broadband via DSL or cable modem.
- Participate at all levels: national, regional and city-wide initiatives and community participation projects have been successful in expanding access.
- Particularly for rural and underserved areas, consider potential economic incentives for broadband build-out such as tax credits, grants for community planning efforts, subsidized or low-interest loans.

The concept of Universal Service in EU

In *e*Communications, universal service **is a safety net** for those whose financial resources or geographical location do not allow them to access the basic services that are already available to the great majority of citizens.

Universal service-EU

- The Directive defines universal service as the *"minimum set of services, of specified quality to which all end-users have access, at an affordable price in the light of national conditions, without distorting competition"* (Art. 1.2).

The current scope of Universal Service

- **Connection to the public telephone network at a fixed location**
  - *capable of supplying functional Internet access, taking into account prevailing technologies used by majority of subscribers and technological feasibility*
- **Access to publicly available telephone services**
- **Directories and directory enquiry services, public pay telephones, special measures for disabled users**

Revision of the scope of Universal Service

In recognition that universal service will evolve over time, Article 15 of the Directive requires the Commission to Review the scope of universal service in 2005 (and every 3 years thereafter):

"The review shall be undertaken in the light of social, economic and technological developments, taking into account, inter alia, mobility and data rates in the light ofthe prevailing technologies used by the majority of subscribers. The review process shall be undertaken in accordance with Annex V."

According to Annex V and Recital 25, any change of scope is subject to the following criteria,

Annex V and Recital 25 EU Directive

According to Annex V and Recital 25, any change of scope is subject to both the following criteria, in short:

a) A minority of consumers would be excluded from society by not being able to afford specific services that are both available to and used by the majority; and

b) Inclusion of these services within the scope would convey a general net benefit to all consumers in case they are not provided to the public under normal commercial circumstances.

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Test for possible inclusion of mobile

Recital 25 & Annex V of US Directive

- are **mobile** services available to, and used by, a majority of consumers ?

  YES

- does the lack of availability or non-use by a minority of consumers result in social exclusion for those that cannot afford them?

  NO

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Conclusion on Mobile

"The competitive provision of mobile communications has resulted in consumers already having widespread affordable access to mobile communications.

The conditions for including mobile communications within the scope of universal service are therefore not fulfilled."

Test for possible inclusion of broadband

Recital 25 & Annex V of US Directive

• are **broadband** services available to, and used by, a majority of consumers ?

NO

Conclusion on Broadband

Broadband has not yet become necessary for normal participation in society, such that lack of access implies social exclusion. At the present time, therefore, the conditions for including broadband services within the scope of universal service (as set out in the Directive) are not fulfilled.

Conclusion

- Considering that both Mobile and Broadband can bridge the digital divide such conclusions should be carefully analysed in the case of Developing Countries