Mobile Converged Networks

2.1.1 BWA: Standards, Regulatory and Spectrum issues

ITU-BDT Regional Seminar on Fixed Mobile Convergence and new network architecture for the Arab Region

Tunis, Tunisia, 21-24 November 2005

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>THIS IS **THE WAY**

Beyond 3G spectrum management

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Sr. Mgr., International Network Standards
Tunis, Tunisia, 21-24 November 2005

>THIS IS NORTEL

Objective and Outline

- **Objective**
  - Examine spectrum management and the associated process of spectrum allocation in an IMT-2000/3G context
  - Looks beyond IMT-2000/3G to key elements in allocating and managing spectrum for BWA
  - Stimulate thinking about how to approach spectrum allocation
  - Invites participants to get involved in the process
- **Outline**
  - IMT-2000/3G
  - IMT-2000/3G Spectrum Management
  - Beyond 3G
  - Beyond 3G Spectrum Management
  - Summary and Conclusions

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Outline

- **IMT-2000/3G**
  - **What is IMT-2000/3G?**
  - **IMT-2000 Family**
- IMT-2000/3G Spectrum Management
- Beyond 3G
- Beyond 3G Spectrum Management
- Summary and Conclusions

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What is IMT-2000/3G?

- Goal: **anytime, anywhere, anyone**
  - deployment of IMT-2000 systems started in the year 2000
- IMT-2000 minimum requirements for radio technology evaluation:
  - 144 Kbit/s (for vehicular high speed)
  - 384 Kbit/s (for medium speed)
  - 2048 Kbit/s (for indoor, low speed)
- Current standards support up to 10 Mbit/s, enhancements being developed, aiming at 30 Mbit/s and higher
- Research targets for systems beyond IMT-2000 (>2010):
  - 100 Mbit/s for high mobility
  - 1 Gbit/s for low mobility

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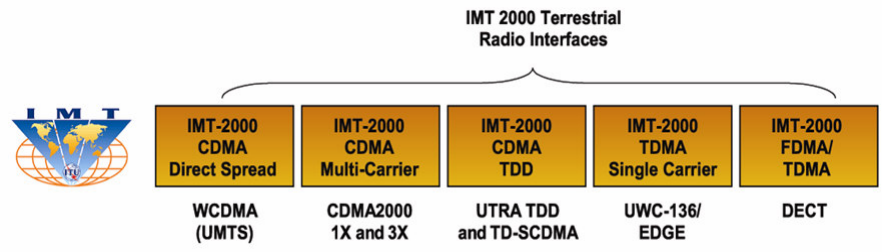
IMT-2000 Radio Access Standards

- A reminder …..



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

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IMT-2000 Network Standards

- And on the network side …

- Designed in response to market, technology & regulatory opportunities & segments
- These standards are also being continually enhanced

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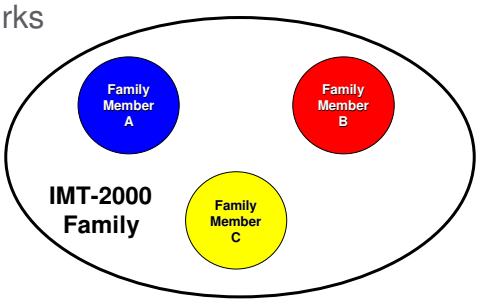
IMT-2000 Family Concept

- Multiplicity of air interfaces and of network protocols endangered 3G initiative
- Resolved by accepting reality that multiple technologies will exist: recognition of IMT-2000 Family concept
- ITU-T Rec. Q.1701 (03/99) Figure 2: Framework for IMT-2000 networks



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Outline

- IMT-2000/3G
- **IMT-2000/3G Spectrum Management**
  - **The process**
  - **ITU Sectors**
  - **ITU-R role and mission**
  - **ITU-R structure highlights**
- Beyond 3G
- Beyond 3G Spectrum Management
- Summary and Conclusions

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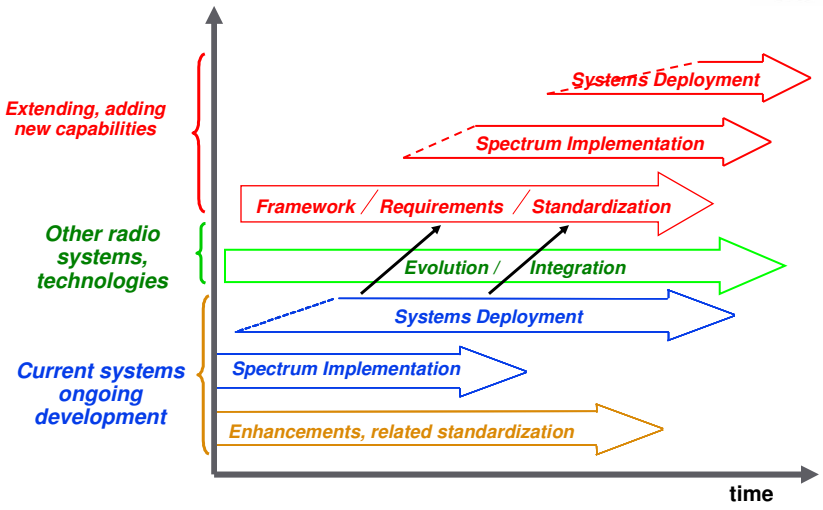
The Process



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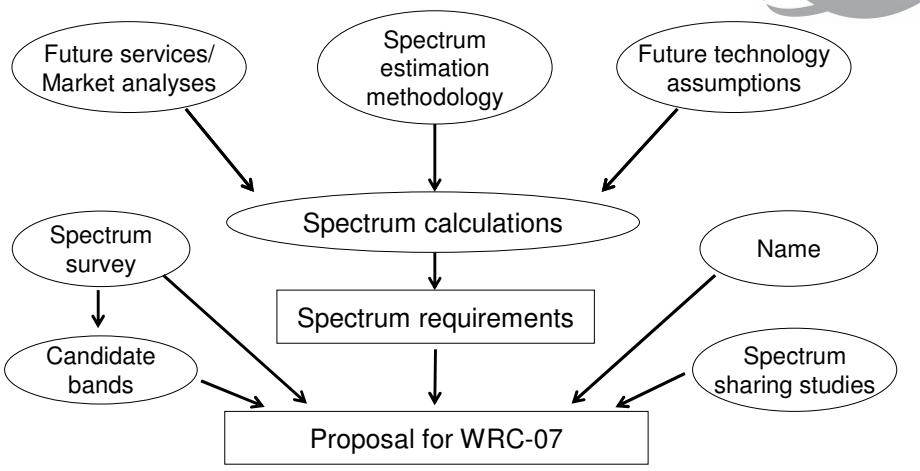
Spectrum for Systems beyond IMT-2000



Development of standards for systems beyond IMT-2000

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ITU Structure

3 sectors:

- Radiocommunication
- Telecommunication Standardization
- Telecommunication Development

Membership

- 189 Member States
- >650 Sector Members
- >50 Associates

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ITU Sector Roles and Mission

- ITU-R: management of radio-frequency spectrum and satellite orbits
- ITU-T: standards covering all fields of telecommunications
- ITU-D: facilitate connectivity and access, foster policy, regulatory and network readiness, and expand human capacity through training programs, formulate financing strategies and e-enable enterprises in developing countries

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World Radiocommunication Conference (WRC)

- Held every ~3-5 years
  - WRC-03: 9 Jun - 4 Jul 2003, Geneva
  - WRC-07: 8 Oct - 2 Nov 2007, Geneva
- Decisions have international treaty status
- Role: reviews and revises the Radio Regulations
  - **use of radio-frequency spectrum** and access to satellite orbital slots
  - determines Questions for study by the RA and SGs

Additional details available on ITU web site:
www.itu.int/aboutitu/overview/index

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Radiocommunication Assembly (RA)

- Normally meets with a WRC
  - RA-03: 2-6 Jun 2003, Geneva
  - RA-07: 1-5 Oct 2007, Geneva
- Sets work priorities, urgency and time-frames
- Approves ITU-R Recommendations, technical studies in support of regulatory work of WRCs

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Additional details available on ITU web site:
www.itu.int/aboutitu/overview/index

Radio Regulations Board (RRB)

- approves Rules of Procedure for applying Radio Regulations and registering frequency assignments made by Member States

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Additional details available on ITU web site:
www.itu.int/aboutitu/overview/index

ITU-R Structure - Study Groups

SG 1	Spectrum management
SG 3	Radiowave propagation
SG 4	Fixed-satellite service
SG 6	Broadcasting services
SG 7	Science services
SG 8	Mobile, radiodetermination, amateur and related satellite services
SG 9	Fixed service
CCV	Coordination Committee for Vocabulary
CPM	Conference Preparatory Meeting
SC	Special Committee on regulatory/procedural matters

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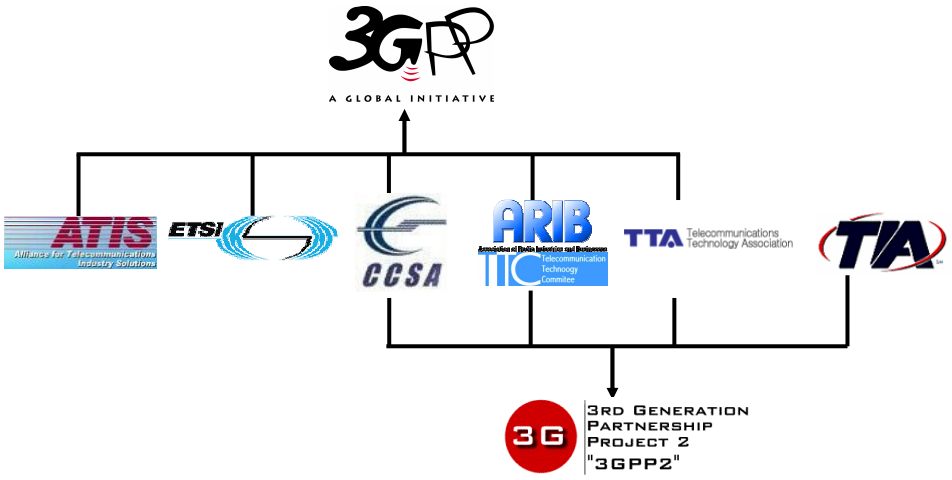
3G Partnership Projects



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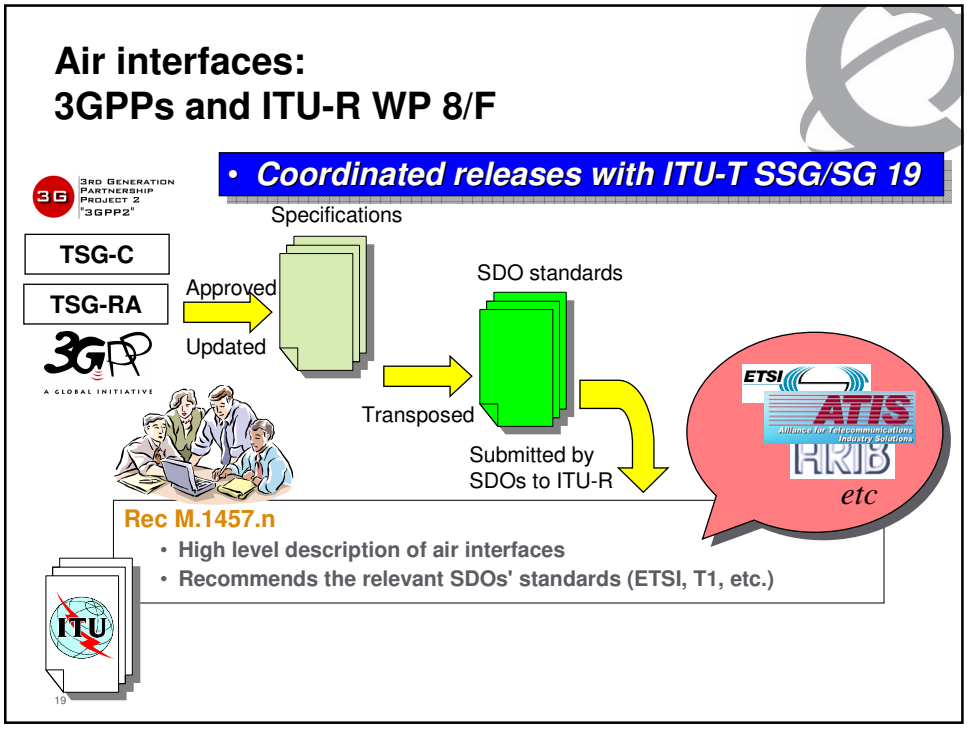
Air interfaces:
3GPPs and ITU-R WP 8/F
• Coordinated releases with ITU-T SSG/SG 19
3RD GENERATION PARTNERSHIP PROJECT 2 "3GPP2"
Specifications
TSG-C
TSG-RA
Approved
Updated
SDO standards
Transposed
Submitted by SDOs to ITU-R
ETSI
ATIS
HRTB
etc
Rec M.1457.n
• High level description of air interfaces
• Recommends the relevant SDOs' standards (ETSI, T1, etc.)
ITU
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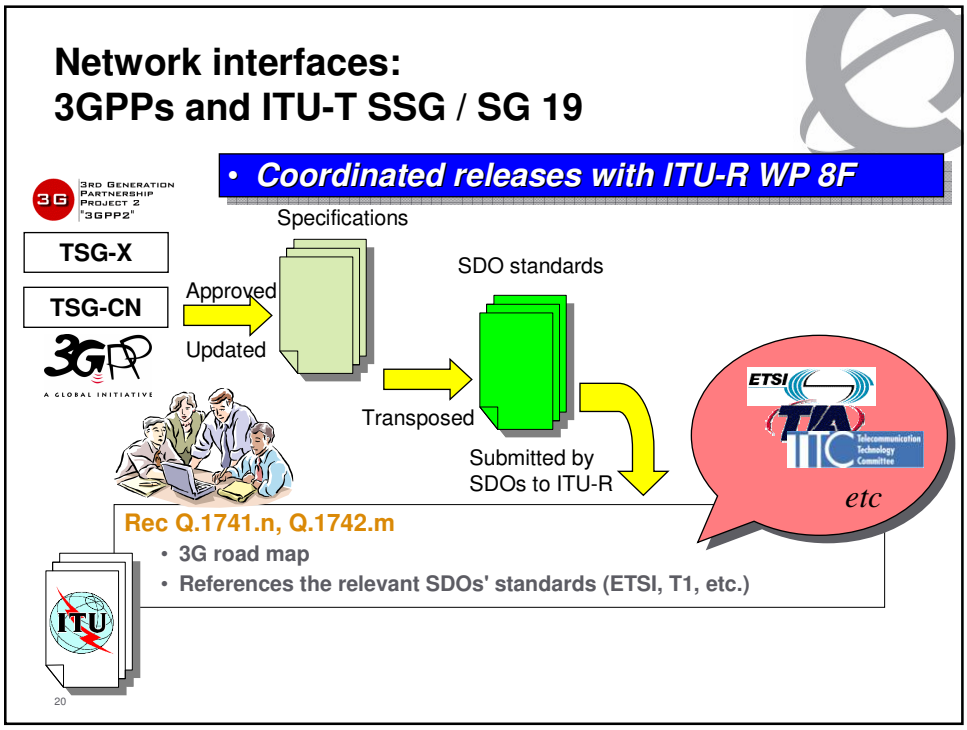
Network interfaces:
3GPPs and ITU-T SSG / SG 19
• Coordinated releases with ITU-R WP 8F
3RD GENERATION PARTNERSHIP PROJECT 2 "3GPP2"
Specifications
TSG-X
TSG-CN
Approved
Updated
SDO standards
Transposed
Submitted by SDOs to ITU-R
ETSI
TIA
TTC
etc
Rec Q.1741.n, Q.1742.m
• 3G road map
• References the relevant SDOs' standards (ETSI, T1, etc.)
ITU
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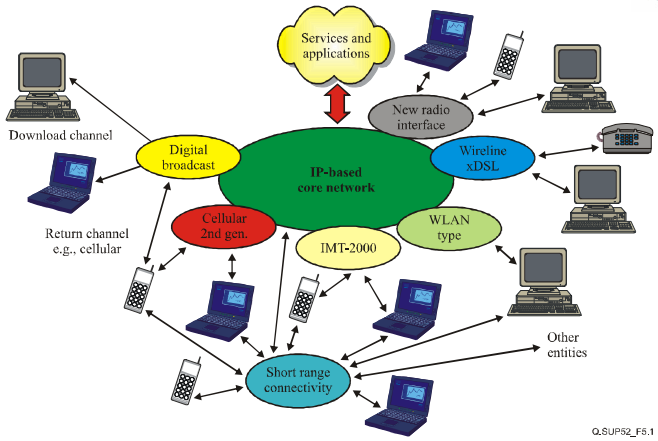
Future network of systems



ITU-T Q-series Supplement 52 Figure 5.1: (also Figure 4/ITU-R Rec. M.1465): Future network of Systems Beyond IMT-2000 (SBI2K) including a variety of potential interworking access systems

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Outline

- IMT-2000/3G
- IMT-2000/3G Spectrum Management
- **Beyond 3G**
  - **Next generation users**
  - **Next generation expectations**
  - **Synergistic technologies**
- Beyond 3G Spectrum Management
- Summary and Conclusions

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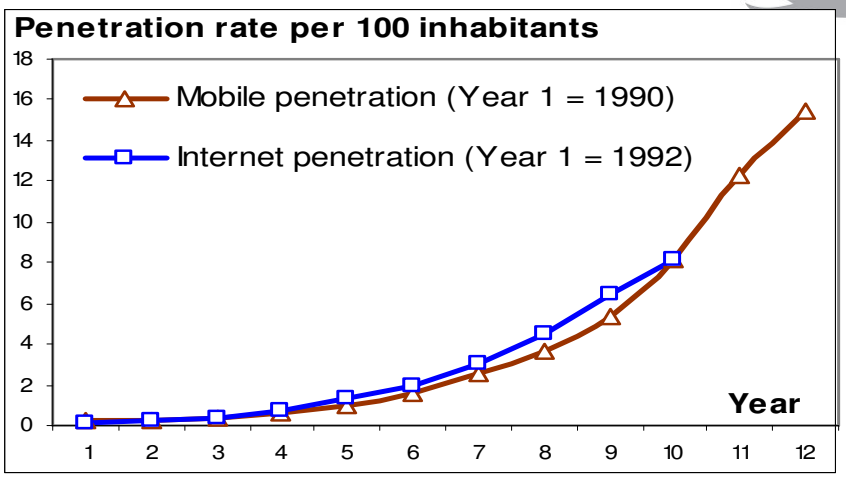
What's Life Like ….

- **Today ...**
  - Most people can't do without their mobile phones
  - Content is on DVDs or magazines or books or a local hard-disk
  - Contact Lists are by application, device, and individual situation
- **In 2010 …**
  - Everyone's connected and can't do without being on-line
  - The first place people go for content is on-line
  - Informal peer groups and sharing is open and legal

- **In 2015 …**
  - Everyone and everything is connected all the time, everywhere
  - The only place people go for content is on-line
  - Dynamic communities of interest without any boundaries

**Today's technology savvy young person is grown up,
a key decision maker at home and at work, and your target customer!**

Growth of the Internet



Source: ITU World Telecommunication Indicators Database

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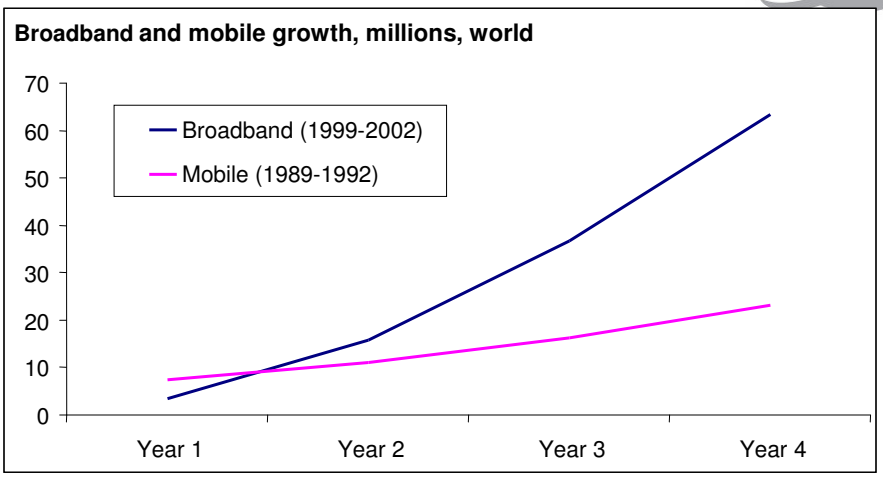
Growth of broadband



Source: ITU World Telecommunication Indicators Database

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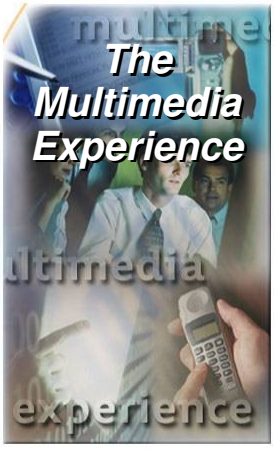
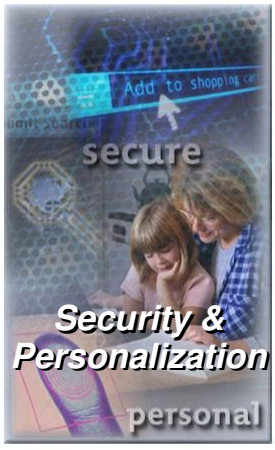
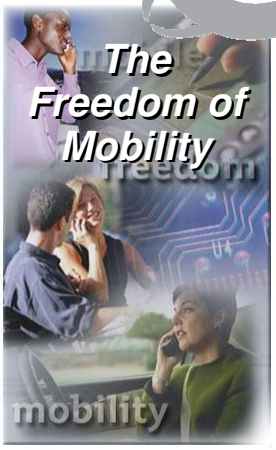
End Users Value ...







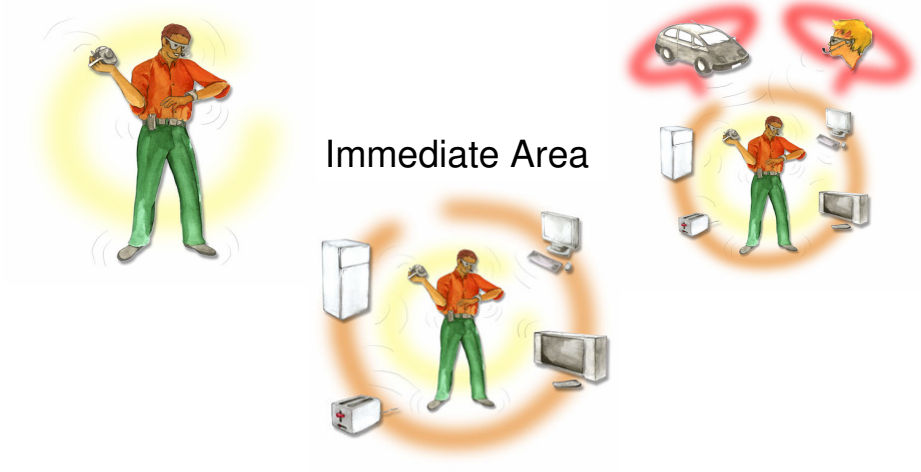
… for enhanced productivity and user experience

Domains

Personal Area

Immediate Area

Wide Area



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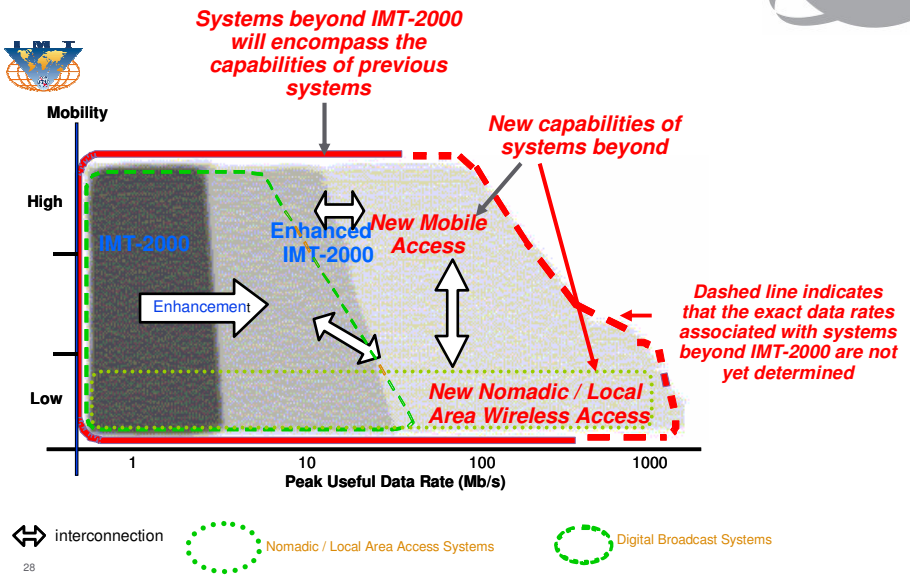
Systems beyond IMT-2000: Figure 2/ITU-R Rec. M.1645



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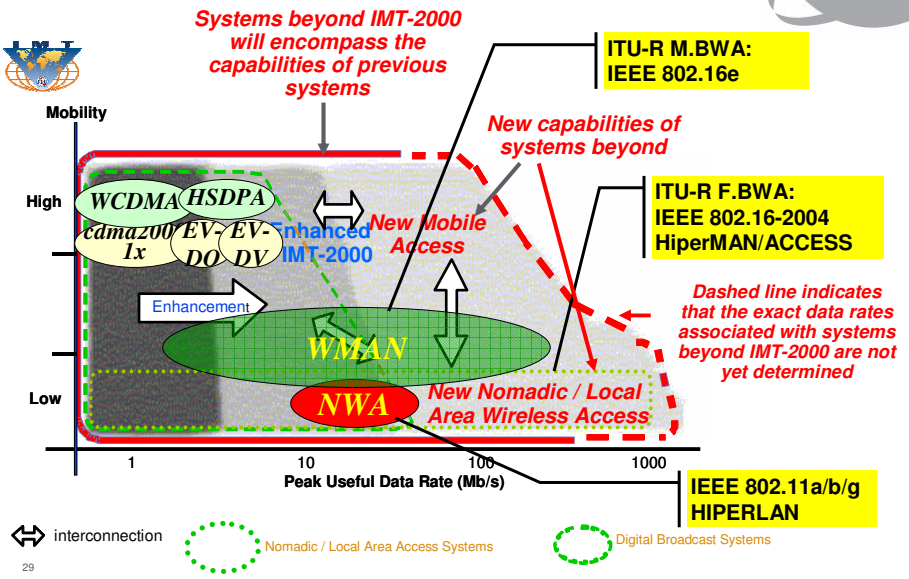
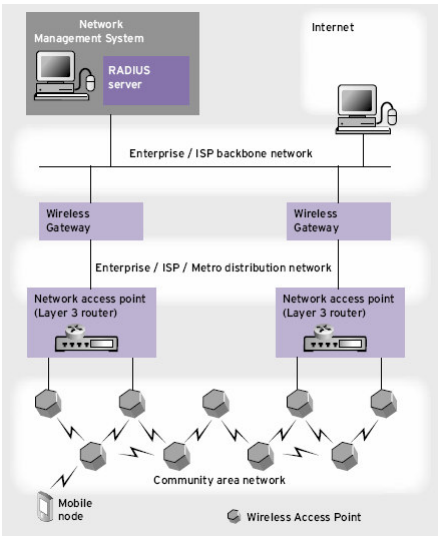
Systems beyond IMT-2000: Figure 2/M.1645 with notes



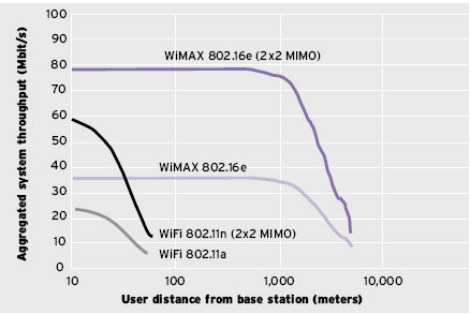
Mesh networks



- A more cost effective, higher performance wireless packet data networking solution than cellular or traditional WLAN
- Reduced costs:
  - no RF engineering needed
  - packaging, low power needs: install almost anywhere
  - Auto-configuring
  - Reduced backhaul: requirement for a wired connection to every access point eliminated
  - Self-healing mesh configuration
  - Centralized network management
- IEEE Standards:
  - 802.11b for end-user access
  - 802.11a (perhaps 802.16 in the future) between access points

Worldwide Interoperability for Microwave Access (WiMAX)

- WiMAX will provide fixed, nomadic, portable, ... eventually mobile wireless broadband connectivity without need for line-of-sight to a base station
- Wireless broadband multimedia data ubiquitously at several times the speed of traditional circuit-switched wireless systems
  - WiFi provides high bandwidth but not distance: “hot spots” at tens of meters
  - 2G/2.5G cellular systems provide distance but not high bandwidth
  - WiMAX complements 3G: tens of kms with greater performance and higher speeds



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WiMAX as an enabler

- Will give users uninterrupted, untethered access to high-bandwidth services around at homes, offices, coffee shops, schools, but also as users roam in rural, suburban, and metropolitan areas
  - networked gaming
  - streamed digital music
  - TV and other entertainment services
  - videoconferencing
  - video surveillance
  - real-time dissemination of a variety of information
- Expected to bring performance parity for internet access

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Outline

- IMT-2000/3G
- IMT-2000/3G Spectrum Management
- Beyond 3G
- **Beyond 3G Spectrum Management**
  - **WiMAX Forum Regulatory Working Group**
  - **Spectrum opportunities**
- Summary and Conclusions

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WiMAX Forum

- ~170 companies promoting compliance, interoperability of IEEE 802.16 broadband wireless products
- Testing and certification program will enable multi-vendor purchasing for service providers
- Expected to see WiMAX technology incorporated in indoor and outdoor desktop customer premises equipment in 2006, with laptops and PDAs to follow in 2007: will allow urban areas and cities to become MetroZones for portable outdoor broadband wireless access

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The Roles of IEEE 802.16 and WiMAX

IEEE 802.16

- Develops voluntary consensus standards for Wireless Metropolitan Area Networks with global applicability
- Mostly PHY and MAC issues
- Recommended practice for the coexistence of FBWA systems
- Network management (802.16f & 802.16g)
- Conformance tests (TGc)
- Enhancements for licence-exempt operation (802.16h)

WiMAX

- Support IEEE 802.16 standard
- Propose and promote access profiles for the IEEE 802.16 standard
- Certify interoperability levels both in network and the cell
- Achieve global acceptance
- Promote use of broadband wireless access overall

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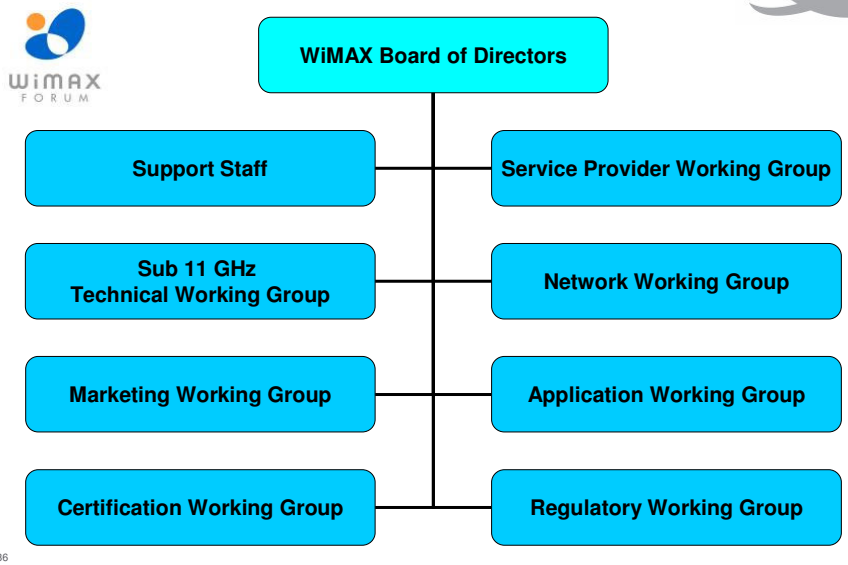
WiMAX Forum Structure



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WiMAX Forum Spectrum Policy

- FLEXIBLE management of spectrum for superior availability to cost-effective services & access devices
- Flexibility to support rapid technology innovation
  - Limiting technology options risks rapid obsolescence
  - License holders should be able to deploy the best solution for their market, as long as they adhere to regulation
- Flexibility to support evolving usage models
  - Fixed, Nomadic and Mobile services are converging
- Market-driven frameworks to help operators efficiently acquire sufficient spectrum for “true” broadband

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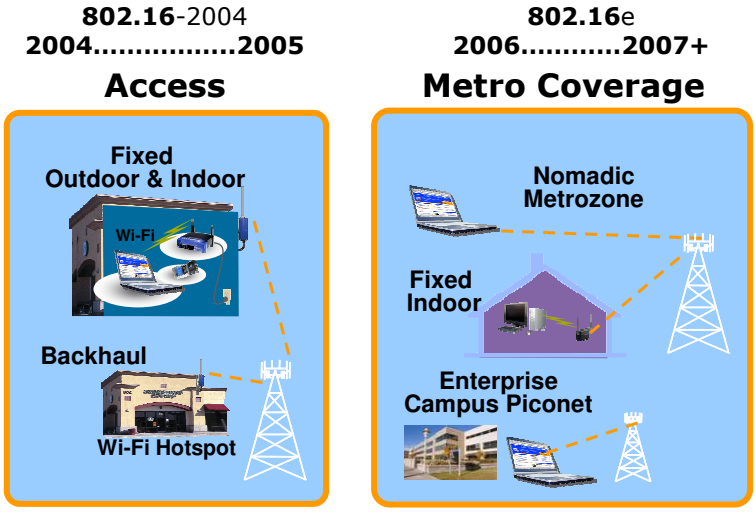
WiMAX Usage Models & Timeframes



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WiMAX Spectrum Goals Next 3 Years

- Sufficient harmonized spectrum to enable volume WiMAX Forum Certified products
- Two licensed band ranges
  - 3.3-3.8+ GHz -> initial focus is 3.4-3.6 GHz
    - Fixed, Nomadic
  - 2.3-2.4 GHz, 2.5-2.69 GHz
    - Nomadic, Mobile, Fixed
- One license exempt band range
  - 5.725–5.85 GHz
    - Allocated at higher EIRP (4W over 20 MHz) for outdoor use
- Anticipate above bands will be covered by a single RF chip in ~'07 timeframe
  - Flexibility for vendors to address national situations

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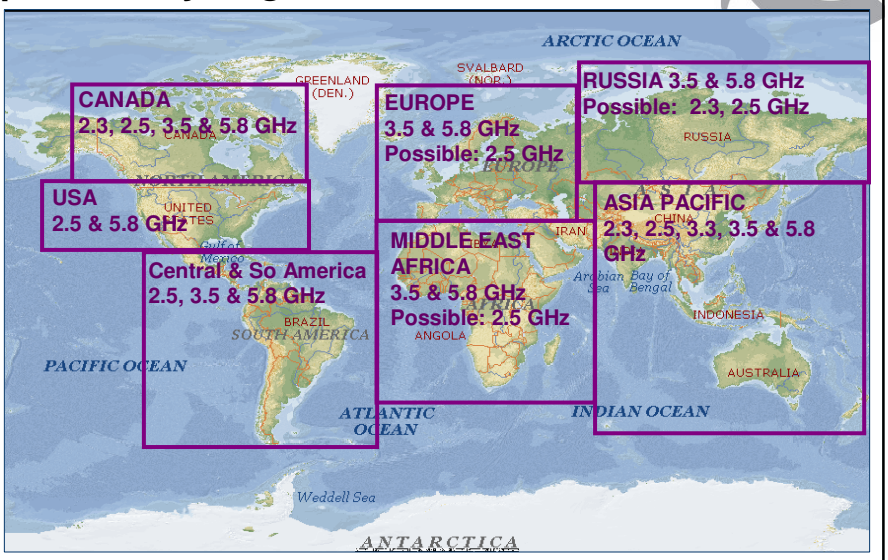
Spectrum by Region



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Anticipated '05-'07 Deployment Bands

Fixed & Nomadic Mapping Based upon ITU-R Definitions

	Fixed	Nomadic
Use	Service limited to installed area No roaming between service areas or operators	Location of end user terminal may change but stationary when in use
Devices	Standalone outdoor subscriber station	Indoor modems; some outdoor use (cafe, backyard, ...) Laptops
WiMAX Certified product	2005	2005-2007

National/regional regulations on Fixed Services need to allow Nomadic applications to ensure viable business models.

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WiMAX Forum RWG: Call To Action for Regulators

- 3.x GHz– fixed & nomadic services
  - Allow Nomadic use in Fixed Wireless spectrum to support modems and laptops for indoor, some outdoor use
  - Larger block sizes for new allocations to support wider channel bandwidths
  - Access to 3.3-3.4 & 3.6-3.8 GHz bands where 3.4-3.6 GHz has limited availability
- 5.8 GHz– fixed outdoor for Wireless ISPs
  - Power output @ 4W EIRP (or 200 mW/MHz)
  - Greater access across Europe in a reasonable timeframe
- 2.5-2.69 GHz– mobile services
  - Allow technically compatible technologies – such as IEEE 802.16 – access to the band

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Outline

- IMT-2000/3G
- IMT-2000/3G Spectrum Management
- Beyond 3G
- Beyond 3G Spectrum Management
- **Summary and Conclusions**
  - **Rapid evolution**
  - **Critical elements: telecom and ICT**
  - **What does this mean for Regulators?**

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Rapid evolution

- The telecommunications landscape is evolving. In the past decade:
  - the availability of IP networks has become widespread
  - the number of mobile phone subscriptions has grown enormously while fixed network subscriptions have languished
  - new wireless access technologies have emerged: Wi-Fi, 3G
  - broadband access (xDSL, Cable) has become widely available
  - advanced technologies (broadband, IP, optical, wireless) are leading to network convergence, and the decoupling of services from the underlying network infrastructure
- The telecommunications landscape will continue to evolve. In the next decade:
  - technology will deliver high data rates combined with wide area mobility: Mesh Networks, WiMAX

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Critical elements with rapid change: Telecom & ICT

- Telecom Policy is critical to a nation's future: ICT is and will be a key competitive tool for everyone
- Society is becoming more networked: intelligent secure networks enabled by advanced technologies, and the applications and services that flow over this infrastructure, are essential to the global economy
- Rapid change in the telecom landscape brings challenges governments (regulators), operators and vendors must face, and face globally

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What does this mean for regulators?

- Telecom and ICT drawing closer together, with mobility an integral element leading to more spectrum demand
  - Spectrum management should be an integral part of telecom policy
  - Encourage service and technology agnostic spectrum allocation (technologies will emerge that more effectively use spectrum if made available for multiple uses).
  - With technology- and service-neutrality, care must be taken to ensure current licensees in adjacent spectrum or geography are not compromised by the new users
- Get involved in the process to ensure your requirements are satisfied by future standards and spectrum!

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Thank you!

Acronyms (1/2)

3G	Third Generation
3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project 2
ANSI	American National Standards Institute
ARIB	Association of radio Industries and Businesses
ATIS	Alliance for Telecommunications Industry Solutions
CCSA	China Communications Standards Association
CCV	Coordination Committee for Vocabulary
CDMA	Code Division Multiple Access
CDMA-DS	CDMA Direct Spread
CPM	Conference Preparatory Meeting
DECT	Digital Enhanced Cordless Telecommunications
DSL	Digital Subscriber Loop
DVD	Digital Versatile Disk
EDGE	Enhanced Data rate for GSM Evolution
EIRP	Effective Isotropic Radiated Power
ETSI	European Telecommunication Standards Institute
EV-DO	CDMA2000 1xEV-DO: Data Optimized
EV-DV	CDMA2000 1xEV-DV: Data and Voice
FBWA	Fixed Broadband Wireless Access
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
Gbit/s	Billion (10**9) bits per second
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
IMT	International Mobile Telecommunications
IMT-2000	Now known as “IMT-Advanced”
IP	Internet Protocol
ISP	Internet Service Provider
ITU	International Telecommunication Union
ITU-D	ITU Development Sector
ITU-R	ITU radio Sector
ITU-T	ITU - Telecommunication Standardization Sector
Kbit/s	Thousand (10**3) bits per second
LAN	Local Area Network
MAC	Media Access Control
MAP	Mobile Application Part
Mbit/s	Million (10**6) bits per second
MIMO	Multiple Input Multiple Output
NWA	Nomadic Wireless Access
PDA	Personal Digital Assistant
PHY	Physical layer Protocol
RA	Radio Assembly
RADIUS	Remote Authentication Dial In User Service
RF	Radio Frequency
RRB	Radio Regulations Board
RWG	Regulatory Working group (WiMAX Forum)
SBI2K	Systems Beyond IMT-2000
SDO	Standards Development Organization

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Acronyms (2/2)

SG	Study Group
SSG	Special Study Group
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TD-SCDMA	Time Division-Synchronous Code Division Multiple Access
TIA	Telecommunications Industry Association
TSG	Technical Study Group
TSG-C	TSG-CDMA
TSG-CN	TSG-Core Network
TSG-RA	TSG-Radio Access
TSG-X	TSG-Core Networks
TTA	Telecommunications Technology Association
TTC	Telecommunication Technology Committee
UMTS	Universal Mobile terrestrial Service
UTRA	Universal Terrestrial Radio Access (WCDMA)
WCDMA	Wideband CDMA
Wi-Fi	Wireless Fidelity (WLAN)
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network
WMAN	Wireless metropolitan Area Network
WRC	World Radiocommunication Conference
WWAN	Wireless Wide Area Network
xDSL	DSL of type x

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