

BWA Public Hearing

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Definition of Broadband Wireless Access (BWA)

- ITU-R F.1399-1 - Vocabulary of terms for wireless access
- Wireless Access - End-user radio connections to core networks (i.e., PSTN, ISDN, PLMN, PSDN, Internet, WAN/LAN)
- Broadband Wireless Access - Wireless access in which the connections capabilities are higher than the primary rate (> 1.544 Mbps)
 - Fixed wireless access (FWA)
 - Nomadic wireless access (NWA)
 - Mobile wireless access (MWA)

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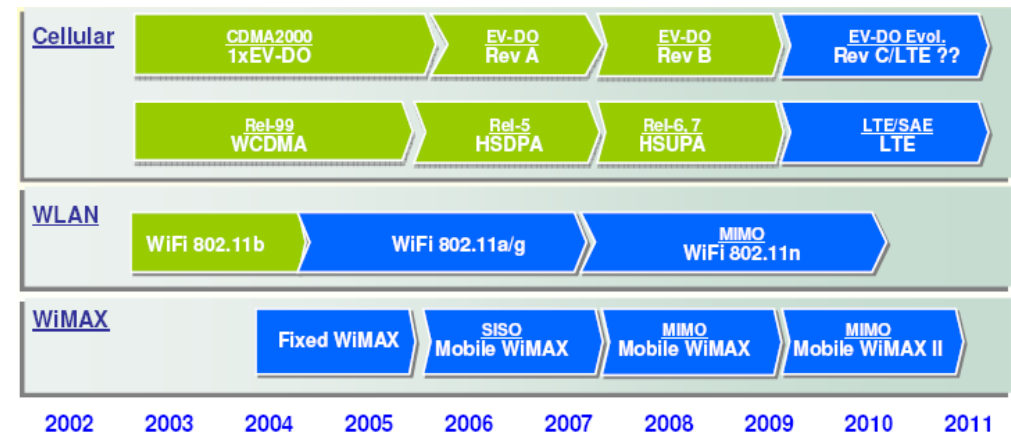
Wireless Technologies

- IMT-2000 Standards and Developments – i.e., WCDMA, HSDPA and HSUPA, EV-DO
- IEEE 802 Standards and Developments – i.e., 802.11 (Wi-Fi), 802.16 (WiMAX), 802.20 (Mobile-Fi)
- Other technologies – i.e., iBurst, QUALCOMM Flarion FLASH-OFDM, IPWireless's UMTS-TDD

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Wireless Technologies

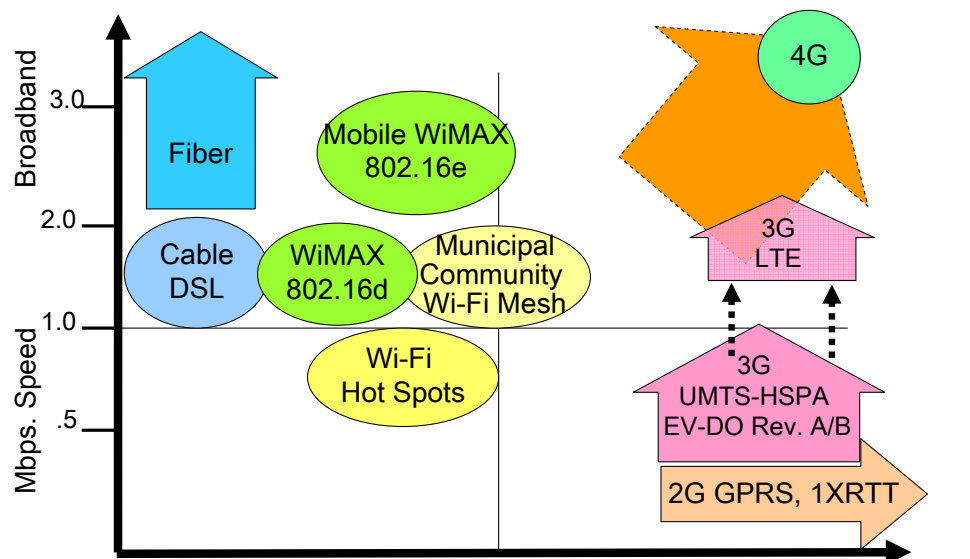


Source: ZTE USA

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Technology Trend



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WiMAX Standard

Current Standard

- **IEEE 802.16-2004** for fixed broadband wireless access
 - OFDM – fixed subcarriers (256 subcarriers)
- **IEEE 802.16e-2005** for mobile broadband wireless access
 - OFDMA – scalable subcarriers

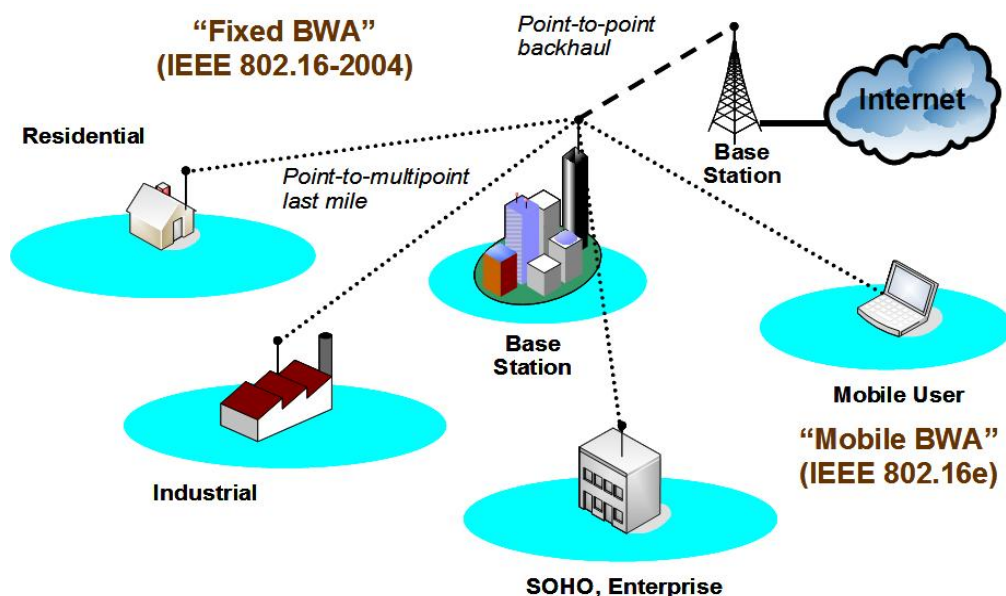
Future Standard

- **IEEE 802.16m** – Gigabit WiMAX and support the convergence of WiMAX and IMT-Advanced – 2009 ?

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IEEE 802.16 Applications



IEEE 802.16 Applications

- Last mile connection to home and small office (comparing to xDSL, Cable modem)
- WiMAX connection for enterprise (replace lease line, T1)
- Wi-Fi hotspot backhaul
- Cellular backhaul
- Public safety services
- Broadband Internet Access

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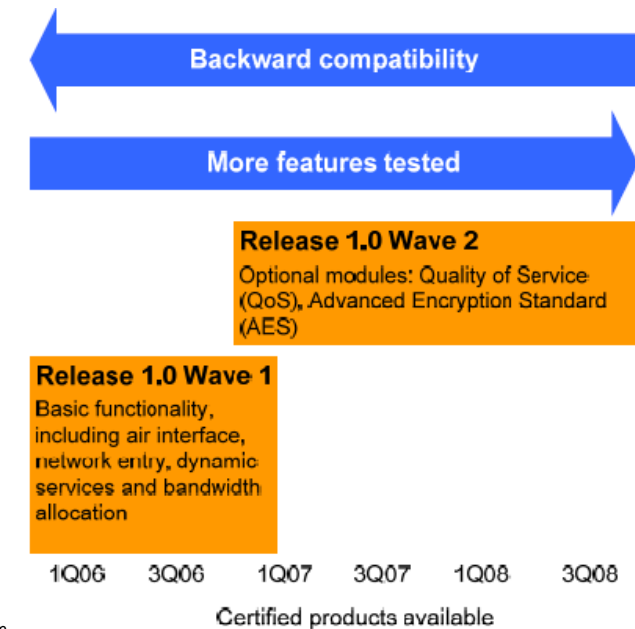
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WiMAX Certification (Fixed Profiles)

Band Index	Frequency Range (GHz)	Channel Bandwidth (MHz)	FFT Size	Duplexing Mode
1	3.400 – 3.600	3.5	256	TDD, FDD
		7	256	TDD, FDD
2	5.725 – 5.850	10	256	TDD

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WiMAX Certification (Fixed WiMAX)



*Source: WiMAX Forum

WiMAX Certification (Mobile profiles)

Band Index	Frequency Range (GHz)	Channel Bandwidth (MHz)	FFT Size	Duplexing Mode
1	2.3-2.4	5	512	TDD
		10	1024	TDD
		8.75	1024	TDD
2	2.305 – 2.320 2.345 – 2.360	3.5	512	TDD
		5	512	TDD
		10	1024	TDD
3	2.496 – 2.690	5	512	TDD
		10	1024	TDD

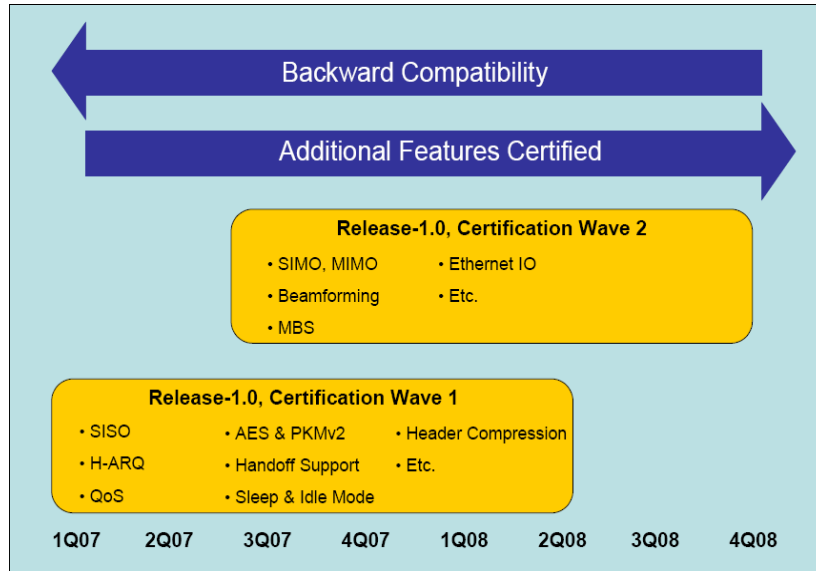
WiBro

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WiMAX Certification (Mobile profiles)

Band Index	Frequency Range (GHz)	Channel Bandwidth (MHz)	FFT Size	Duplexing Mode
4	3.3 – 3.4	5	512	TDD
		7	1024	TDD
		10	1024	TDD
5	3.4 – 3.8	5	512	TDD
		7	1024	TDD
		10	1024	TDD
	3.4 – 3.6	5	512	TDD
		7	1024	TDD
		10	1024	TDD
	3.6 – 3.8	5	512	TDD
		7	1024	TDD
		10	1024	TDD

WiMAX Certification (Mobile WiMAX)



*Source: WiMAX Forum

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WiMAX Spectrum

- Frequency band
 - 5.8 GHz band – Licensed-exempt usage
 - 3.5 GHz band – License usage
 - European countries, England, Canada, Australia, Malaysia, India
 - US (3.650-3.700 GHz)
 - 2.5 GHz band – License usage
 - US, Brazil, Mexico, Singapore
 - Korea (2.3 GHz WiBro)
- Below 1 GHz for the future consideration

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WiMAX Spectrum – 5.8 GHz

- 5.725 – 5.850 GHz (125 MHz bandwidth)
- License-exempt usage but required the registration (Lite License regime) and Apparatus License
- Fixed BWA service, Wi-Fi Backhaul
- 10 MHz channel, TDD
- Dynamic Frequency Selection (DFS) and Transmitter Power Control (TPC)
- **Challenge**
 - Share with Radiolocation (Radar)

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WiMAX Spectrum – 3.5 GHz

- 3.4 – 3.7 GHz (125 MHz bandwidth)
- License Usage
- Fixed and Mobile BWA service
- 5 MHz channel, TDD or FDD
- **Challenge**
 - Share with Fixed Satellite Service
 - Spectrum sharing between FSS & BWA has now been extensively discussed in every ITU-R forums. The disagreement is mainly between those countries who have satellites, and those who support BWA.
 - So far there has been no conclusion on the spectrum & sharing issue. This will finally be discussed in WRC-07 at the end of this year under Agenda 1.4

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WiMAX Spectrum – 3.5 GHz

■ Challenge

- A number of share studies have been conducted and reported in ITU WP8F and APT
- Interference from BWA to FSS
- The results show BWA and FSS cannot be shared without constraints (i.e., separation distances of tens of kilometers, or hundreds of kilometers in some cases, are required)
- Recommendation – Conduct the share studies between BWA and FSS in Thailand

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WiMAX Spectrum – 2.5 GHz

- 2.5 – 2.690 GHz
- License Usage
- Mobile BWA service
- Good propagation → Larger coverage
- 5 MHz channel, TDD
- **Challenge**
 - Share with Fixed Service

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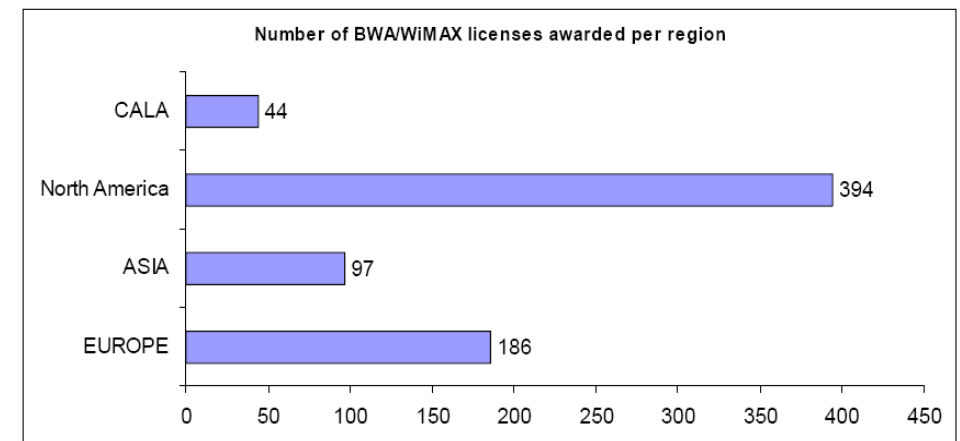
Future development

- Converging Mobile WiMAX to IMT-Advanced
- ITU developed IMT-2000 to harmonize 3G Mobile
- IMT-2000 currently support 5 radio interfaces defined in ITU Rec. M.1457-6
 - CDMA-Direct Spread (Universal Terrestrial Radio Access – UTRA, known as WCDMA)
 - CDMA-Multi Carrier (cdma2000)
 - CDMA TDD (UTRA TDD)
 - TDMA Single Carrier (UWC-136, Universal Wireless Communication)
 - FDMA/TDMA (Digital Enhanced Cordless Communication – DECT)
- IEEE 802.16 contributed a proposal to ITU-R WP8F to add a new radio interface, designated as IP-OFDMA and based on the specific case of IEEE 802.16 to ITU Rec. M.1457-7
 - IP-OFDMA

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Spectrum Analysis

- Number of BWA/WiMAX Licenses (2.5 GHz and 3.5 GHz)



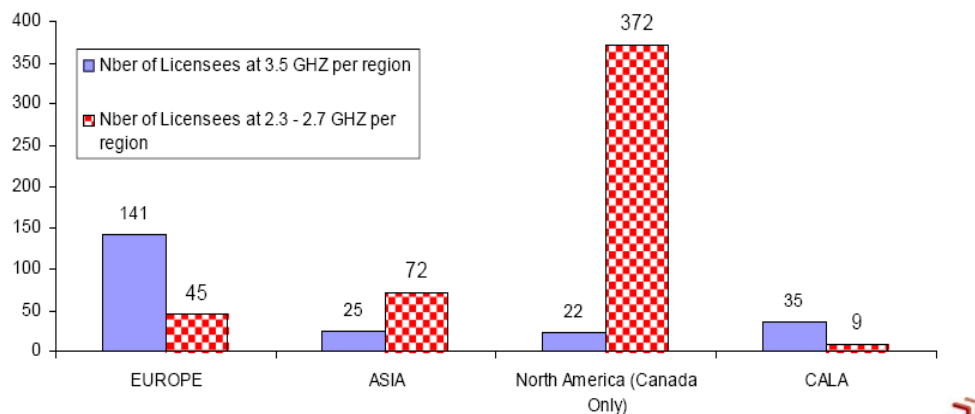
*Source: Maravedis

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Spectrum Analysis

Number of Licensees per region by frequency band

Number of Licensees per region by Frequency band



*Source: Maravedis

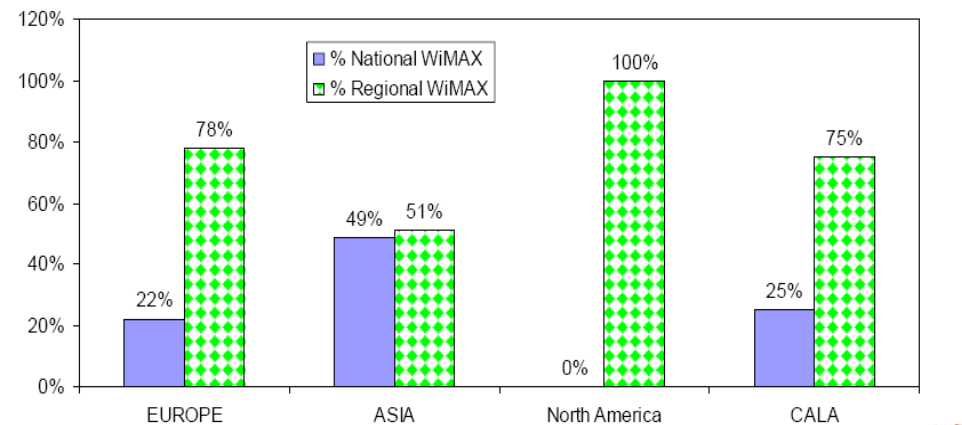
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Spectrum Analysis

BWA/WiMAX License coverage analysis by region

BWA/WiMAX License Coverage Analysis by Region



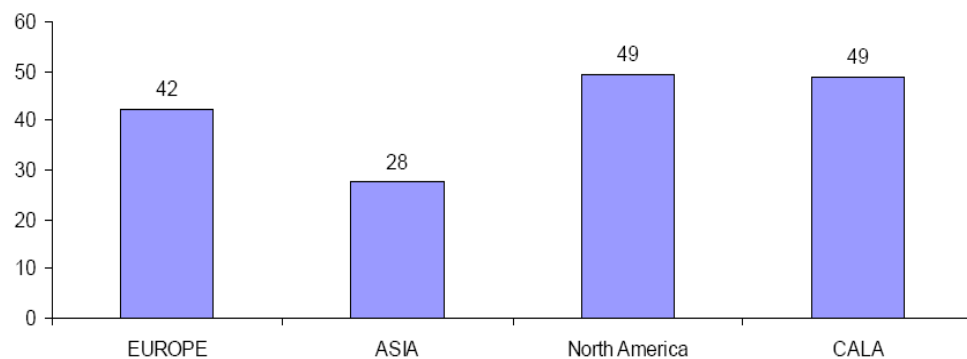
*Source: Maravedis

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Spectrum Analysis

Average amount of spectrum per carrier by region (MHz)



*Source: Maravedis

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What drive the WiMAX market ?

- Emerging market
 - Fixed and nomadic broadband services drive first
 - Mobile broadband service later
- Mature market
 - Mobile personal broadband services
 - Example, expected in North America, Korea
- Keys to drive
 - Availability of robust, compelling contents and applications for mobile broadband
 - Availability of suitable licensed spectrum provisioning for mobile services
 - Cost effective of WiMAX equipments
 - Robust network deployment and aggressive marketing
 - Service pricing

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