



# Sky Network Private Limited

## WiMAX Technology Overview

Sky Network Private Limited

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# CONTENTS

- 1 **WiMAX Technology – An Overview**
- 2 **WiMAX Standards**
- 3 **Mobile WiMAX Releases**
- 4 **Mobile WiMAX Certification Profiles**
- 5 **Technology Roadmap – Where Does WiMAX Stand?**
- 6 **Mobile WiMAX is IMT-2000 Technology**
- 7 **Mobile WiMAX = Near 4G**
- 8 **Future = Migration to 4G (OFDMA-MIMO)**
- 9 **WiMAX (OFDMA-MIMO) Data Overlay Network**
- 10 **WiMAX 16e Migration to WiMAX 16m or LTE**
- 11 **WiMAX Ecosystem - Large & Well Established**
- 12 **WiMAX Performance Worldwide**
- 13 **WiMAX Deployments Worldwide**
- 14 **WiMAX,3G,HSPA+,LTE - The Ground Realities**
- 15 **“Promise of the Free CPE” - WiMAX Embedded Devices**
- 16 **Complementary Technologies: IMT-2000**
- 17 **Complementary Technologies: HSPA+**
- 18 **Complementary Technologies: LTE**

# 1 WIMAX TECHNOLOGY -AN OVERVIEW

- WiMAX = “Worldwide Interoperability for Microwave Access”
- A last mile wireless access technology
  - ❑ Capable of providing high speed broadband connectivity
  - ❑ An all-IP, all packet technology
- An initiative by computer industry to export its way of doing things to telecoms industry [LTE - response of telecom industry]
- All-IP, all packet nature places WiMAX on the performance growth curve of general purpose processors/computing devices
  - ❑ Drive operational expenses very low due to transport efficiency of Internet Protocol for short bursty traffic
  - ❑ Provide networks that continually performs at higher capital and operational efficiency
  - ❑ Takes advantage of 3rd party development from the Internet community

## 2 WiMAX - STANDARDS

	Fixed WiMAX	Evolutionary WiMAX	Mobile WiMAX
<b>Standard</b>	IEEE 802.16d-2004	IEEE 802.16e-2005	IEEE 802.16e-2005
<b>Multiplexing</b>	OFDM	OFDM	OFDMA
<b>Duplexing Mode</b>	TDD, FDD, HFDD	TDD, FDD, HFDD	TDD
<b>Modulation</b>	BPSK, QPSK, 16-QAM, 64-QAM	BPSK, QPSK, 16-QAM, 64-QAM (optional)	QPSK, 16-QAM, 64-QAM (uplink optional)
<b>Mobility</b>	Fixed	Fixed + Nomadic	Universal (Fixed + Nomadic + Mobile)
<b>Channel BW</b>	3.5, 7 & 10 MHz	5 MHz	5,7,8.75 & 10 MHz

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# 3 MOBILE WiMAX RELEASES

## Mobile WiMAX

- Technology Facilitating Mobility.
- Based on Versions of IEEE 802.16 Standards.

## Release 1.0 (Current Release)

- Based on IEEE 802.16e-2005 PHY(Radio) and MAC
- NWG Release 1.0 Defines the Network **Sky Network is here**

## Release 1.5 (Interim Release)

- Based on IEEE 802.16-2009 PHY(Radio) and MAC
- NWG Release 1.5 Defines the Network

## Release 02 (IMT 2000 Advance)

- Based on IEEE 802.16m PHY(Radio) and MAC
- No Exact Network Specification

# 4 MOBILE WIMAX

(802.16E-2005, OFDMA)

## CERTIFICATION PROFILES

Profile Name	Spectrum	Duplexing	Channel BW
MP01	2.3 - 2.4 GHz	TDD	8.75 MHz
MP02	2.3 - 2.4 GHz	TDD	5, 10 MHz (dual)
MP05	2.496 - 2.690GHz	TDD	5, 10 MHz (dual)
MP09	3.4 - 3.6 GHz	TDD	5 MHz
MP10	3.4 - 3.6 GHz	TDD	7 MHz

### Colour Key



Certified Equipment Available

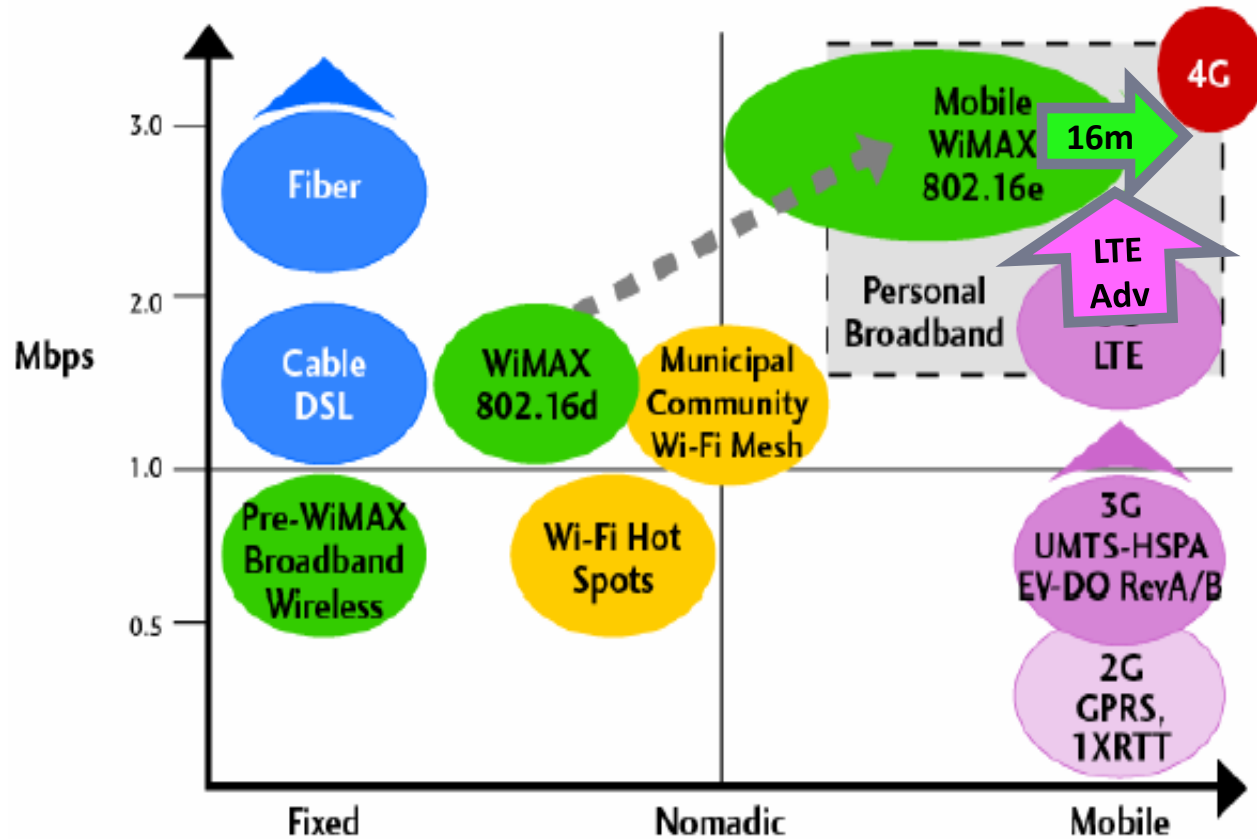


Eligible Certification Profiles

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# 5 TECHNOLOGY ROADMAP

## WHERE DOES WIMAX STAND?



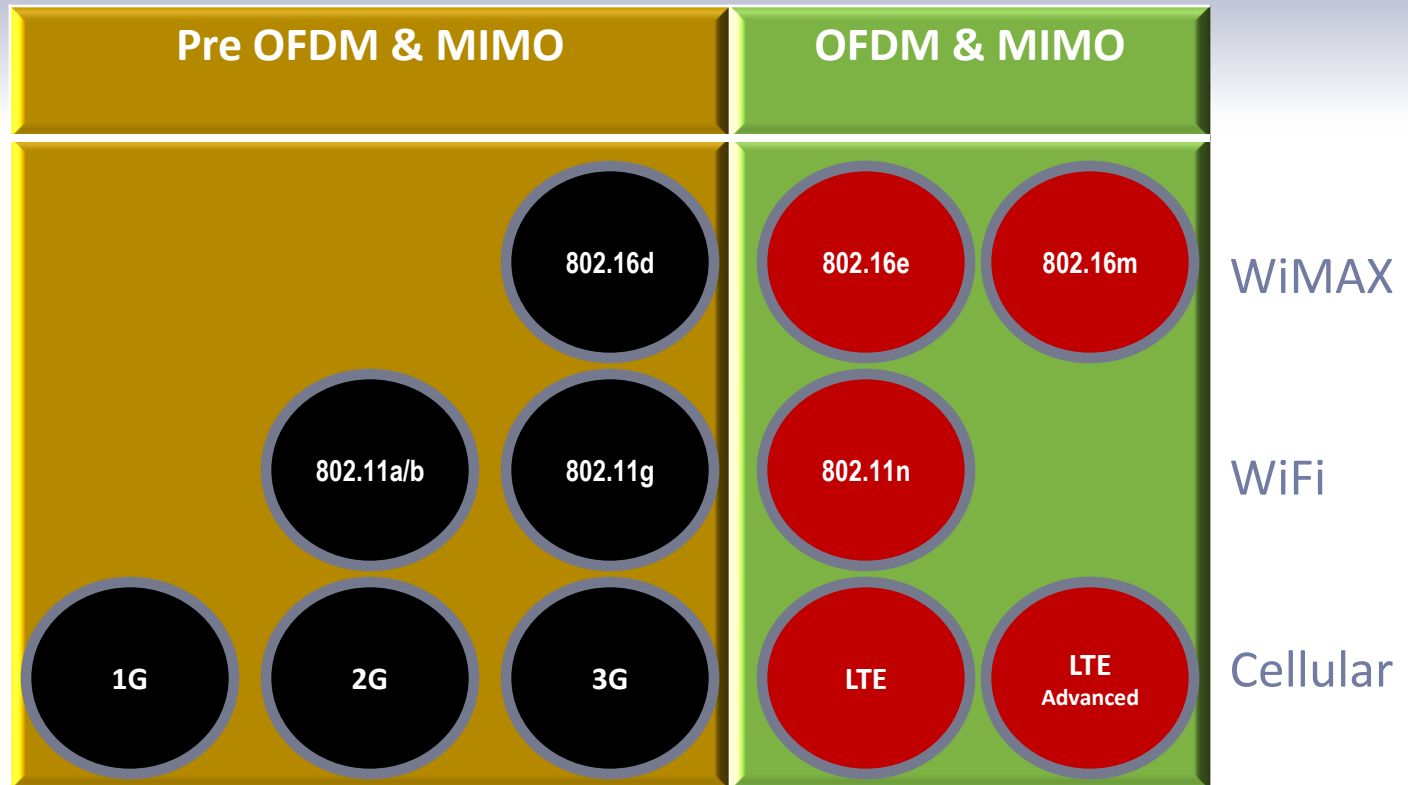
Source: Samsung Custom Yankee Group Report, 2006

# 6 MOBILE WiMAX Is IMT-2000 TECHNOLOGY!

- ITU accepted Mobile WiMAX into the IMT-2000 family in 2007
- This made WiMAX spectrum more expensive and valuable
- An environment that supports roaming, interworking and creation of advanced integrated services + applications is emerging
- Mobile WiMAX services is rapidly move towards Personal Broadband sphere as well



# 7 MOBILE WIMAX=NEAR 4G



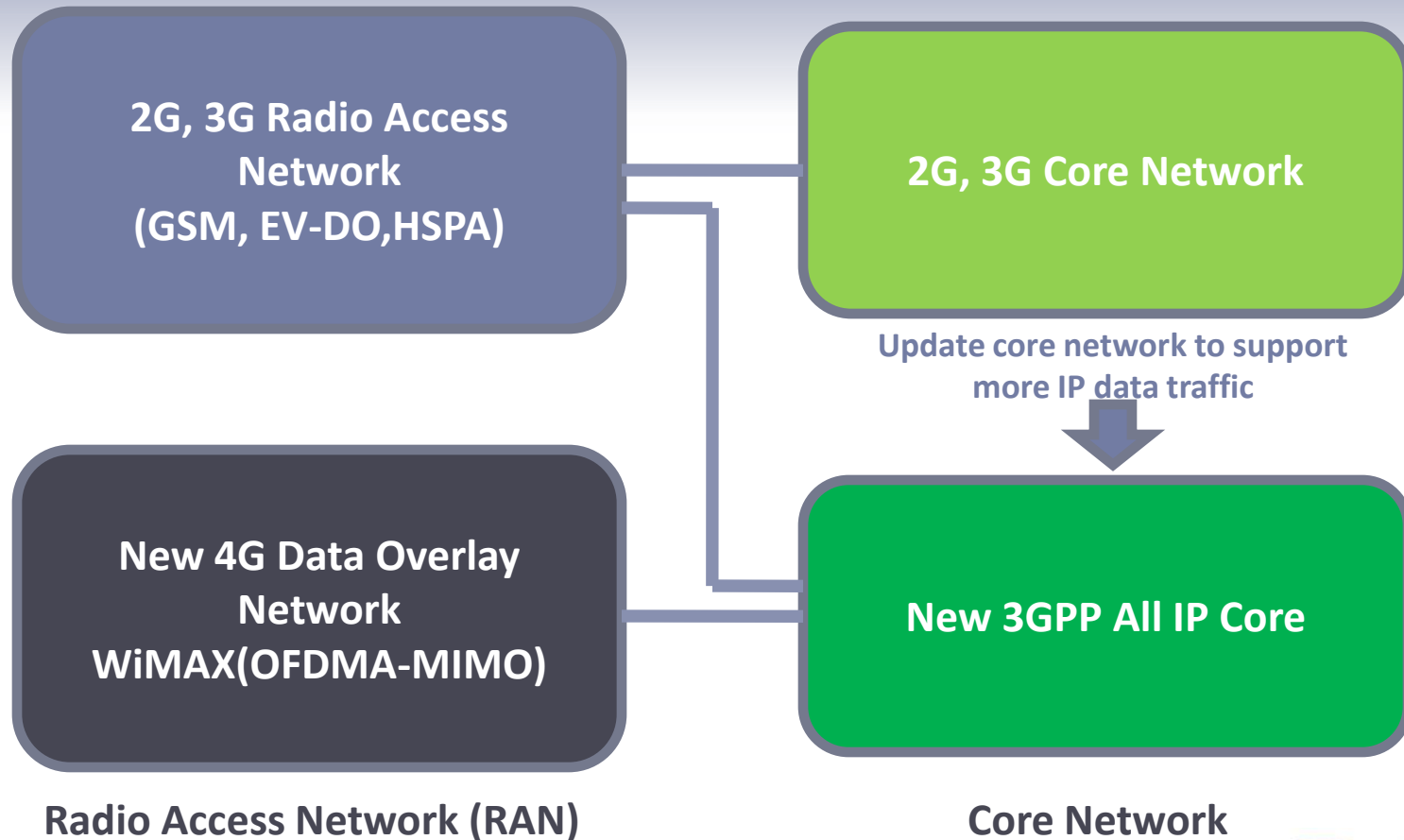
- OFDM, MIMO and BF are emerging as the technologies of choice for future 4G services
- WiMAX 16e is already based on these technologies!

# 8 FUTURE=MIGRATION To 4G (OFDMA - MIMO)

- 2.5 & 3G networks have enabled users around the world to access data on their handsets and laptops
- However mobile data traffic is expected to grow by a factor of 10x between 2010 and 2015
- Such growth will cause capacity constraints, necessitating new networks to offload data-intensive traffic
- The solution would be a OFDM-MIMO, WiMAX overlay network

2/2.5G Operator. No 3G investment	When EDGE capacity insufficient, deploy OFDM overlay solution in new spectrum
3G Operator – HSPA, EV-DO	Continue to evolve HSPA, EV-DO in existing spectrum, OFDM overlay in new spectrum
Fixed Operator	Go straight to OFDM deployment

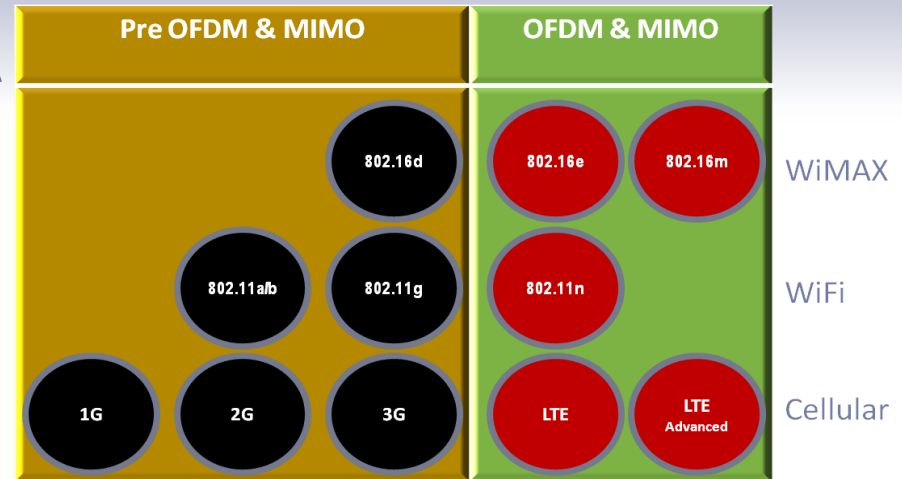
# 9 WiMAX (OFDMA-MIMO) DATA OVERLAY NETWORK



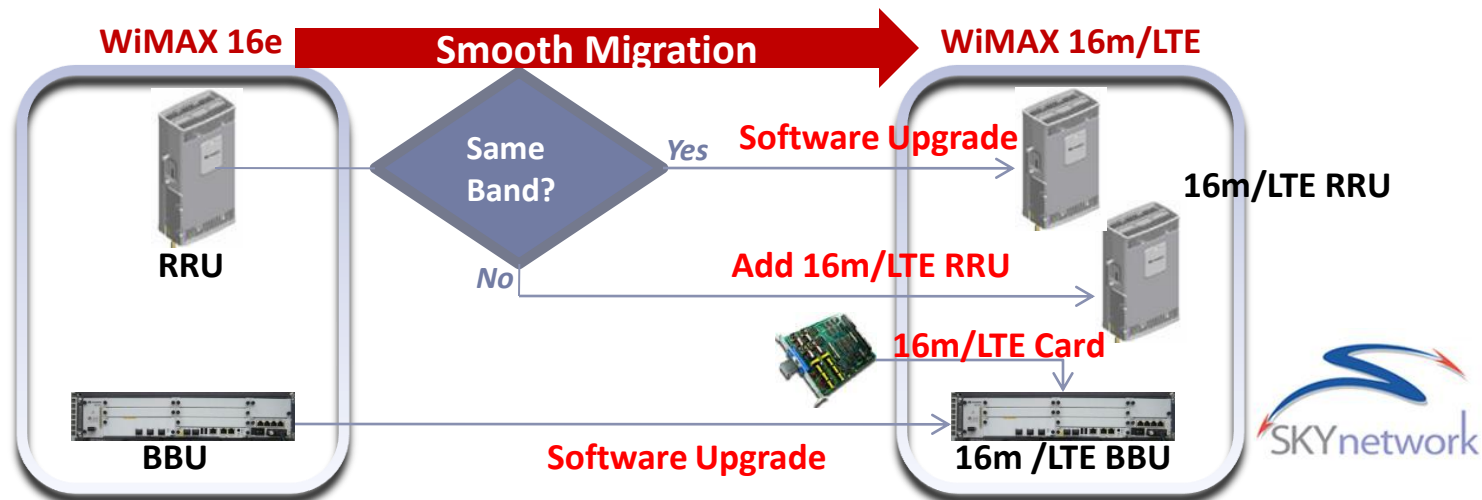
[WiMAX will interface the new 3GPP Enhanced Packet Core]

# 10 WiMAX 16e MIGRATION TO 16m OR LTE

- WiMAX 16e and LTE have 85% shared DNA (flat networks, OFDM based, MIMO + BF, all-IP platforms)
- This allows a smooth migration path from 16e to 16m or LTE



E.g. Base Stations currently used by SNPL



# 11 WIMAX ECOSYSTEM

## - LARGE & WELL ESTABLISHED

- **Established ecosystem for device manufacture/support:** By November 2010, 62 WiMAX Forum certified Base Stations, 191 WiMAX Forum certified devices, over 25 silicon chip manufactures - serving 592 deployments in 149 countries
- **The promise of a free CPE:** Intel & Samsung are strongly backing the technology and are committed to provide WiMAX enabled notebooks/netbooks (100+ in the market), WiMAX embedded MIDs, consumer electronics (game consoles, MP3 players) and <WiMAX + GSM/CDMA> phones & PDAs
- **Balanced IPR position:** Open Patent Alliance (OPA) by eight leading WiMAX vendors promote competitive development and widespread adoption - No single company is in a dominant patent ownership position
- **Globally harmonized common spectrum bands**
- **Cheaper spectrum :** On average half the cost of 3G spectrum

# 12 WIMAX PERFORMANCE - WORLDWIDE IN 2010

→ 592 Worldwide deployments by end Nov  
→ 150 Ongoing Trials

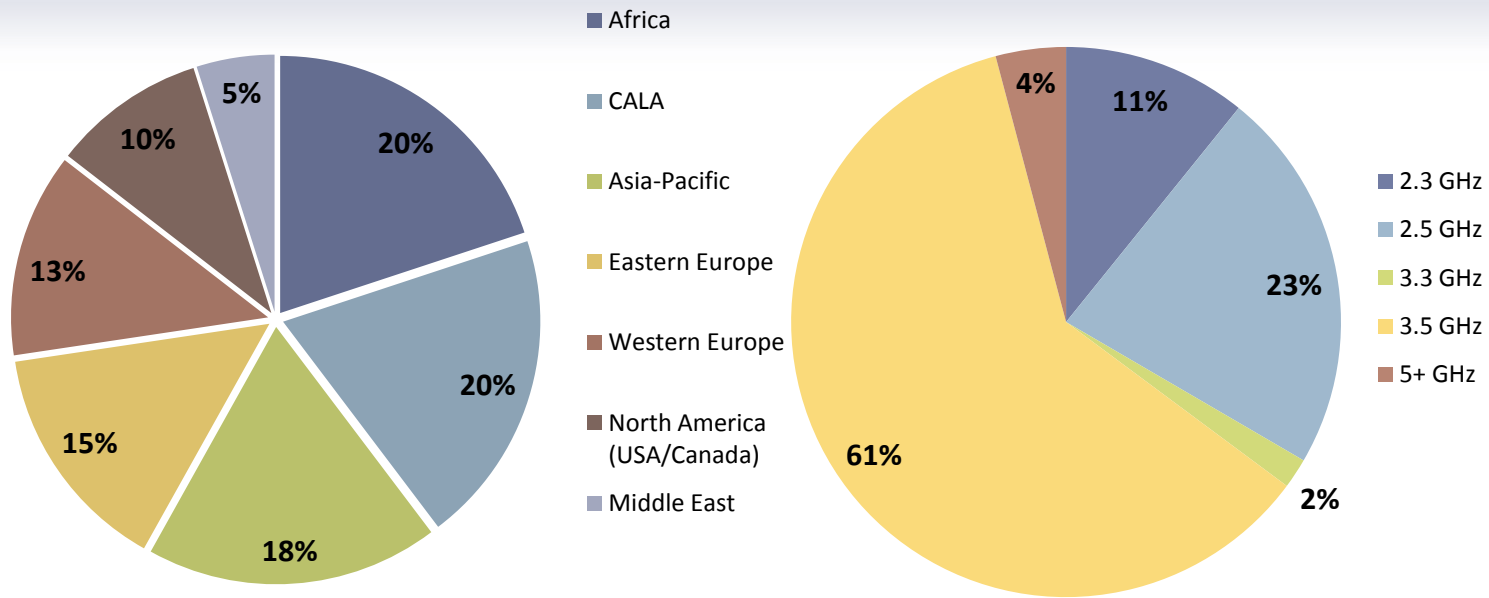
→ Deployed in 149 countries by end Nov

→ 9 M Subs by Q2 (Increase of 25% over Q1)

Revenue US\$ 1.69 billion - 2008  
US\$ 3.03 billion - 2009 (1.34 b, 1<sup>st</sup> half)  
US\$ 1.92 billion - 2010, 1<sup>st</sup> half

**Sources:** WiMAX Forum Quarterly Report  
MARAVEDIS Quarterly Report

# 13 WIMAX DEPLOYMENTS - WORLDWIDE (BY Nov, 2010)



**Deployment % by Region**

**Deployment % by Frequency**

Source: WiMAX Forum Reports

# 14 WiMAX, 3G, HSPA+, LTE

## - THE GROUND REALITIES

- WiMAX is based on an all-IP network architecture. Although HSPA+ is evolving towards an IP network, it is still tied to a CDMA based circuit-switched legacy network optimized for voice
- WiMAX is already based on OFDM & MIMO with a sound ecosystem while 3G evolution path is just embracing OFDM & MIMO through LTE. LTE has no ecosystem yet
- Although LTE is being discussed, the era of 3G is still just beginning (E.g. China 2009, India 2010) with massive investments going into 3G
- How long will it take to monetize these huge investments?
- Can these carriers opt for further CAPEX on LTE in the near future?
- Is this a conducive environment for the development of a sound ecosystem for LTE in the near future?
- **However, WiMAX (supported by a sound ecosystem) offers today's operators the opportunity to overlay an existing network with a next generation access network based on OFDM & MIMO**

# 15 “PROMISE OF THE FREE CPE” - WIMAX EMBEDDED DEVICES



World's first 3G/4G  
Android handset  
from HTC



Notebook Computer  
(libretto W100 series)  
Toshiba Corporation



Notebook Computer  
(dynabook RX3series)  
Toshiba Corporation



NEC LaVie series



NotePC (M513)  
Onkyo



CF-C  
Panasonic



LIFEBOOK MH series  
Fujitsu



ThinkPad  
Lenovo Group Limited

**There Are More Than 150 WiMAX Embedded Devices !!!**

Visit [http://www.wimaxforum.org/certification/products/device\\_type/mobile-station](http://www.wimaxforum.org/certification/products/device_type/mobile-station)

**to find out!**



# 16 COMPLEMENTARY TECHNOLOGIES: IMT-2000

	Carrier Freq	Channel BW	Duplex	Peak data rate		Spectral Efficiency	
				DL	UL	DL	UL
3GPP WCDMA (HSPA)	2GHz	5MHz	FDD	14Mbps @ 5MHz	5.8Mbps @ 5MHz	0.8bps per Hz	0.3bps per Hz
3GPP2 CDMA2000 (1xEVDO-RevB)	2GHZ	1.25MHz (15 channel/ max 5MHz)	FDD	3.1Mbps @ 1.25MHz	1.8Mbps @ 1.25MHz	1bps per Hz	0.3bps per Hz
IEEE 802.16e Mobile WiMAX	2.5GHz	5,7,8.75, 10 MHz	TDD	46Mbps*/ 32Mbps** @ 10MHz	8Mbps*/ 14Mbps** @ 10MHz	1.9bps per Hz *	0.8bps per Hz *

\*: DL/UL=3    \*\*:DL/UL=1    All for 2x2 MIMO or CSM

**WiMAX delivers higher spectral efficiency and better speeds**



# 17 COMPLEMENTARY TECHNOLOGIES: HSPA+

Parameter	HSPA <sup>1</sup>			WiMAX	
	Rel-7		Rel-8	Rel 1.5	
Frequency	2000 MHz			2500 MHz	
Duplex	FDD			FDD	TDD
Channel BW	2 x 5 MHz			2 x 5 MHz	10 MHz
BS Antenna	(1x2) SIMO	(2x2) MIMO		(2x2) MIMO	
MS Antenna	(1x2) SIMO			(1x2) SIMO	
DL Mod-Coding <sup>2</sup>	64QAM-5/6	16QAM-3/4	64QAM-5/6	64QAM-5/6	64QAM-5/6
UL Mod-Coding <sup>2</sup>	16QAM-3/4			64QAM-5/6	64QAM-5/6
DL Peak User Rate	17.5 Mbps	21 Mbps	35 Mbps	36 Mbps	48 Mbps <sup>3</sup>
UL Peak User Rate	8.3 Mbps	8.3 Mbps	8.3 Mbps	17 Mbps	24 Mbps <sup>4</sup>

1. Source: "Release 7 HSPA+ for Mobile Broadband Evolution", Qualcomm Inc. December 2007
2. Results for unity coding are often reported for HSPA, code rate used in table is considered more realistic for actual deployments and provides a more direct comparison to Mobile WiMAX
3. Assumes DL/UL ratio 3:1
4. Assumes DL/UL ratio 1:3

**WiMAX delivers higher spectral efficiency and better speeds**

# 18 COMPLEMENTARY TECHNOLOGIES: LTE

Parameter	Reported LTE Results				WiMAX Rel 1.5	
	Motorola <sup>1</sup>		T-Mobile <sup>2</sup>	Qual-comm <sup>3</sup>		
BS Antenna	2x2	4x4	2x4	4x2	2x2	4x4
Channel BW	2 x 20 MHz				2 x 20 MHz	
Mod-Code Rate	64QAM-5/6		64QAM-5/6	64QAM-?	64QAM-5/6	
DL Peak User Rate	117 Mbps	226 Mbps	144 Mbps	277 Mbps	144.6 Mbps	289 Mbps
MS Antenna			1x2	1x2	1x2	
Mod-Code Rate			64QAM <sup>4</sup> -?	16QAM <sup>4</sup> -?	64QAM-5/6	
UL Peak User Rate	?	?	50.4 Mbps	75 Mbps	69.1 Mbps	

1. Motorola website, "LTE In Depth", Reference does not show UL peak rate projections
2. "Trials—Ensuring Success for Innovation", Joachim Horn, T-Mobile, NGMN Conference presentation, June 25-27, 2008
3. "3GPP Long-Term Evolution (LTE)", Qualcomm, January 2008
4. 64QAM is optional for UL in LTE specification, 16QAM is mandatory

**WiMAX is already capable of high speeds. LTE is not here yet.**