WHITEPAPER

Mobilising WiMAX

This whitepaper is an extract from:

Mobile WiMAX
Global Opportunities, Strategies & Forecasts 2007-2013 (Second Edition)

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Mobilising WiMAX

Introduction

Mobile Broadband allows for anytime, anywhere access of high-bandwidth applications, content and communication. This white paper introduces the reader to Mobile WiMAX technology and investigates market drivers/constraints and forecasts.

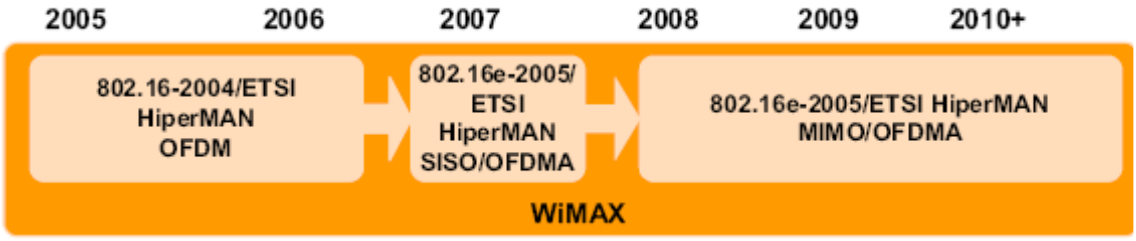
WiMAX Standard

WiMAX is defined as Worldwide Interoperability for Microwave Access, which allows for broadband wireless access of information in the form of packet data. It was introduced in October 2001 and is also known as the IEEE 802.16 standard. The standard defines the air interface, also known as the PHY (Physical) layer as well as the MAC (Media Access Control) layer. These are the bottom two layers, which define the OSI 7 layer model that define a network technology. The protocols defined in these two layers allow it to control how packet data is handled at the air interface and at the first point of entry and exit of a system. The MAC layer is designed in such a way that it controls various PHY specifications. The original specification allowed it to operate in the 10 to 66 GHz range. There were subsequent changes made to the standard, which curtailed it to the 2-11 GHz range. This was primarily done to improve its range. The standard is meant to operate in both licensed and unlicensed frequencies. WiMAX plans to provide fixed as well as mobile access in large metropolitan areas. It was developed as a successor to the Wi-Fi standard, which provides wireless access in local area networks.

The Mobile WiMAX standard has been established to provide specifications for mobile broadband wireless access systems. The IEEE Working group ratified the standard in December 2005. Though the fixed version of WiMAX focuses on the point to multipoint broadband access and the last mile solution, the mobile version of WiMAX will focus on mobility for broadband. The strength lies in the fact that apart from mobility it will also support fixed and nomadic access. The peak throughput rates are expected to be 75 Mbps, but the typical throughput will be less than that. The throughput depends on the bandwidth in which the system operates. 802.16e is supposed to operate in the channel bandwidth of 10 MHz, which gives the 'best possible' throughput at 37 Mbps[i].

The aim of the WiMAX standard is to ensure that interoperability is maintained among devices. The WiMAX Forum will ensure that the standards, which are covered under WiMAX, are released according to their scheduled timelines and that guidelines are maintained by the vendors. The WiMAX forum members include prominent industry vendors like Intel, Fujitsu, Samsung, AT&T, Nokia, Cisco, Motorola, Nortel and operators like Sprint, BT, ZTE, and Korea Telecom. In August 2007, the WiMAX Forum announced that Vodafone had become a principal member. Vodafone is seeking to evaluate the full capabilities and potential of WiMAX.

Figure 1: WiMAX Timeline



Source: WiMAX Forum March 2007

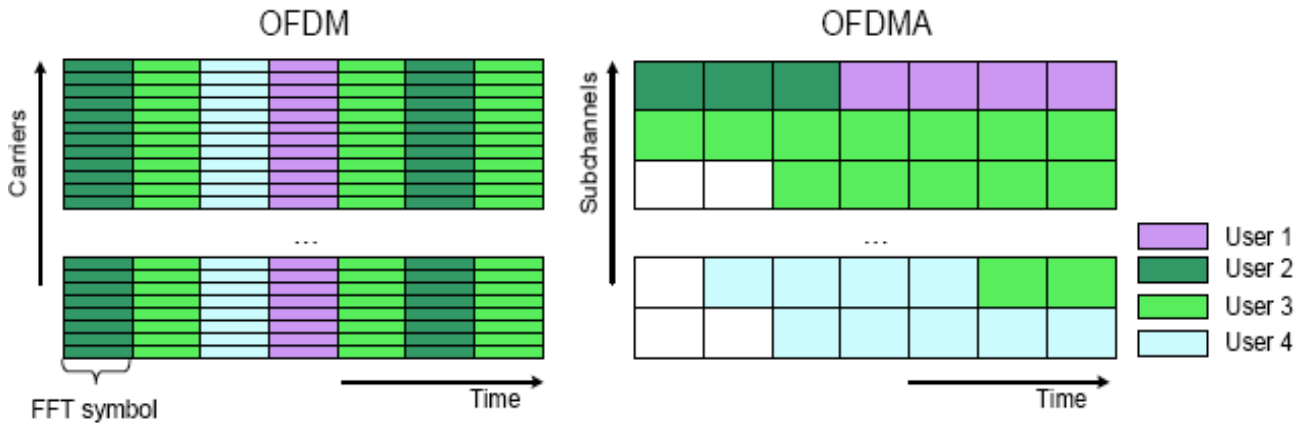
The WiMAX Forum has defined a timeline (see Figure 1) which shows how WiMAX standards will evolve to a full mobility solution 802.16e.

OFDM and OFDMA

The earlier version of WiMAX (Fixed 802.16d-2004) is based on the OFDM (Orthogonal Frequency Division Multiplexing) protocol where the information packet is broken down into closely spaced carriers, which are sent on individual frequencies. The data on each individual or orthogonal carrier is independently modulated using QAM (Quadrature Amplitude Modulation) or PSK Phase Shift Keying (PSK) techniques. The orthogonality allows for signals to be perpendicular to each other in mathematical terms, which means that they are able to overlap without interfering with each other. The OFDM signal is the sum of the individual orthogonal carriers.

The advantages of OFDM include high resistance to noise and high spectral efficiency. This means that operators achieve higher utilisation of their costly spectrum. OFDM is normally combined with error correcting codes leading to coded OFDM or COFDM. This gives it the property of coping with multipath fading which is the phenomenon due to which multiple copies of the signal are received at various time intervals. Sub-channelisation is another method that is used in conjunction with OFDM to where a sub-set of carriers in COFDM are used to carry upstream traffic. This is advantageous to the end client as it increases his power and range.

Figure 2: Difference between OFDM and OFDMA



Source: WiMAX Forum

Mobile WiMAX, however, is based on the Orthogonal Frequency Division Multiple Access (OFDMA) protocol. OFDMA allows for multiple users to be placed on various sub carriers on the same channel at the same time. The effect of sub-channelisation is enhanced in OFDMA to enable flexible mobile and nomadic operation. This allows for the various sub-carriers to be assigned to different users. These groups of sub-carriers are also termed as sub-channels. There is also support for features such as Hybrid

Automatic Repeat Request (HARQ), which reduces delays and Multiple Input Multiple Output (MIMO) antenna support, which increases throughput, reduces error rates and multipath fading.

Although 802.16e is incompatible with 802.16d-2004, by supporting the 1024 FFT mode the Mobile WiMAX standard will be compatible with the WiBro (Wireless Broadband) standard in Korea. The WiBro standard is the Korean profile of Mobile WiMAX, which has already been released and it operates in the 2.3 GHz band. It was launched commercially at the end of June 2006.

802.16e vs. 802.16d 2004

The overall progression of 802.16e technology that has been very evident both from Juniper's primary and secondary research programmes is that deployment will begin for fixed network solutions, and then develop into portable usage. Mobile usage will follow on after portable, and will depend on progress with handovers, handset availability, coverage, roaming agreements and not least regulatory and technical spectrum issues. This report relates to mobile rather than fixed and portable usage, as depicted in the following chart from Nokia which compares 802.16e with the earlier 16d standard:

Figure 3: Types of WiMAX Access Possible under the IEEE Standards

Definition	Devices	Locations / Speed	802.16-2004	802.16-2005
Fixed access	Outdoor and indoor CPEs	Single / Stationary	Yes	Yes
Nomadic access	Indoor CPEs, PCMCIA cards	Multiple / Stationary	Yes	Yes
Portability	Laptop PCMCIA or mini cards	Multiple / Walking speed	No	Yes
Simple mobility	Laptop PCMCIA or mini cards, PDAs or smartphones	Multiple / Low vehicular speed	No	Yes
Full mobility	Laptop PCMCIA or mini cards, PDAs or smartphones	Multiple / High vehicular speed	No	Yes

Source: Nokia

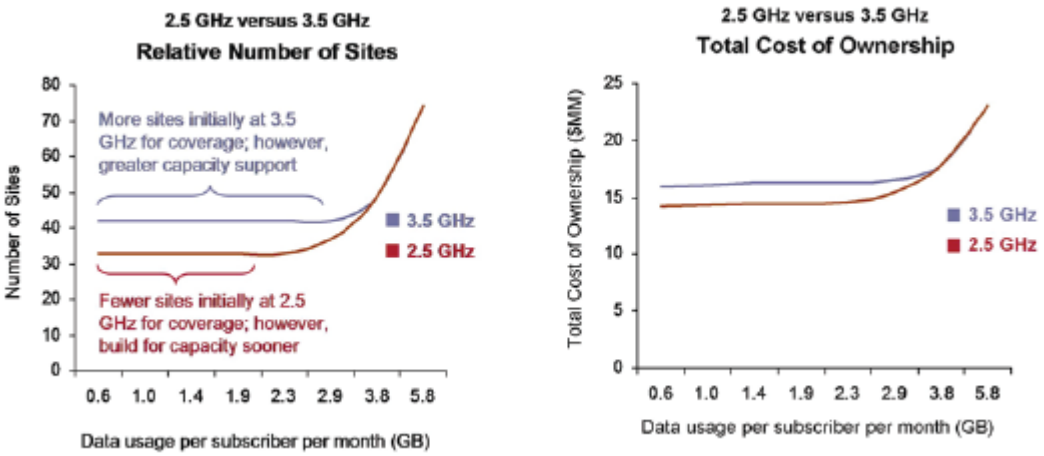
Spectrum Issues

In general, a mobile network at the higher frequency will be more expensive for an operator to deploy because more base stations will be required. Nortel summarises the issues faced as follows:

"In particular, at higher frequency bands such as 3.5 GHz, RF signals can experience propagation and building penetration losses combined with physical environment considerations which may impact coverage and range reach." [ii]

Motorola indicates that a WiMAX network at 3.5GHz could have as many as 30% more base stations for a particular coverage area than one operating at 2.5GHz. However, over time, based on total cost of ownership Motorola indicates that costs will be similar as shown in the following charts:

Figure 4: 2.5GHz vs. 3.5Ghz



Source: Motorola

There are also call handoff challenges at 3.5GHz. However Alcatel-Lucent has recently achieved successfully handoffs with an 802.16e commercial Mobile WiMAX network in conjunction with ONEMAX in the Dominican Republic. Video telephony, high-definition streaming video, mobile broadband web access and VoIP services were delivered over the ONEMAX network to users travelling in a van. Whilst this is the first such example, it does indicate what is technically achievable and suggests that the 3.5GHz band should not be viewed as an obstacle to the delivery of mobile services – especially as technical capabilities improve in the future.

Future developments

In January 2007 the IEEE outlined a proposed work plan for a new version of the 802.16 standard that could increase speeds up to 1 Gbps while maintaining backwards compatibility with existing WiMax products. The new version has been called 802.16m, and the IEEE aims to complete the standard by September 2008 for approval by December 2008. The IEEE wants to develop a "competitive" and "significantly improved" radio access technology that is "compliant with the ITU R/IMT advanced requirements for 4G" while keeping interoperability with mobile WiMAX. Potential new radio interfaces will need to support up to 100Mbps for high mobility such as mobile access and up to 1Gbps for low mobility such as nomadic/local wireless access, by around 2010. A step-change speed increase of this magnitude will enable service providers to offer a range of content-rich multimedia services such as TV, fast music downloads and streamed video as well as greatly improved VoIP performance and capacity.

IMT-2000

The meeting of the ITU Radiocommunication Sector Working Party 8F in early June 2007 put forward for approval the "OFDMA TDD WMAN" new terrestrial radio interface for IMT-2000, as requested by the WiMAX Forum and the IEEE. This was a very significant development for WiMAX because it meant that WiMAX was close to being accepted by the ITU as a wireless standard within the 3G portfolio. In October 2007, the ITU duly approved WiMAX mobile broadband technology as a global 3G communications standard. Some countries objected to the inclusion of WiMAX in the IMT-2000 standard for advanced mobile technologies. China, for example, wanted its indigenous version of 3G called TD-SCDMA to be adopted globally. The decision means that more technology-agnostic 3G licences will be issued in future, increasing the opportunities for WiMAX now that it is recognised as a mainstream technology.

Technology Summary

Clearly there are several more technologies that can deliver mobile broadband services now and in the future such as HSPA for example. Many detailed technical papers have been authored that compare the technical merits of the various solutions, and it is not the intention of this white paper to replicate these. However it is safe to conclude that the ultimate technology choice for network operators depends on a mix of factors, according to their relative importance given the business objective of the operator. Ultimately the technology choice is actually first of all a business case decision that itself depends on the services and applications that the operator wants to roll out. The technology choice will then follow, designed to ensure that it will enable achievement of the business and economic objectives.

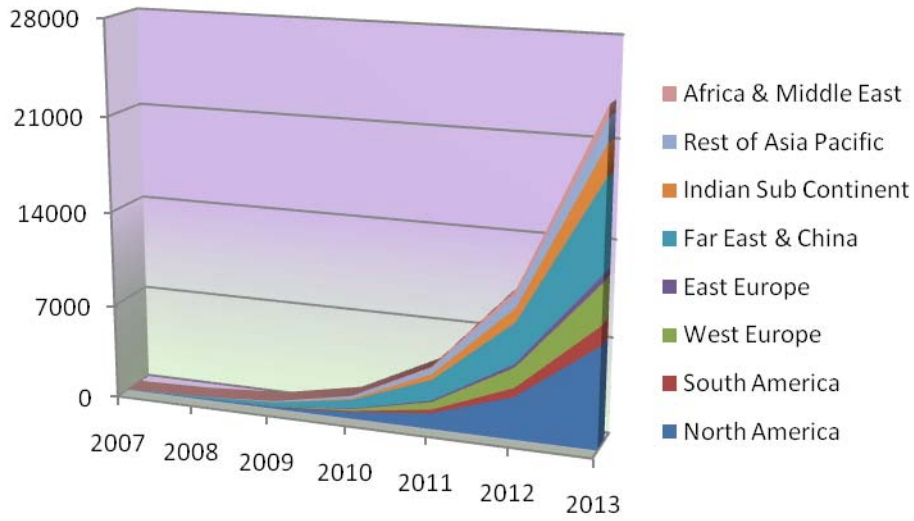
Mobile WiMAX: Market Status

There are over 250 trial Mobile WiMAX networks globally, but only two commercial networks in service. It is also indisputable; however, that Mobile WiMAX has become over the last year a market threat to HSPA technologies, whereas it has previously been just a technical threat. There has been a swathe of Mobile WiMAX trial and network contract announcements: Juniper Research has identified over 50 such announcements to date in 2007 alone.

Mobile WiMAX Subscriber Forecasts

Juniper Research's forecast overleaf shows the development of mobile WiMAX over the 2007 to 2013 timeframe. Mobile WiMAX 802.16e will begin to take off over the 2010 to 2013 period, exceeding 80 million mobile subscribers globally by 2013.

Figure 5: Mobile WiMAX Service Revenues ($m) Forecast by Region 2007 – 2013



Source: Juniper Research

Whitepaper author Howard Wilcox said: "We are seeing more and more Mobile WiMAX 802.16e trials and network contracts – over 50 have been announced so far in 2007 alone: the market is very active in all regions of the world. We anticipate that mobile usage will develop after initial demand for fixed and portable services – WiMAX 802.16e is a flexible platform that can operate in all three modes of usage. Mobile WiMAX will represent a single digit proportion of the global mobile broadband base by 2013. This will be a tremendous achievement for this new technology platform which has recently been boosted by the ITU's endorsement of it as an IMT2000 specification."

Order the Full Report

Mobile WiMAX: Global Opportunities, Strategies & Forecasts - 2007 - 2013

This whitepaper is taken from the second edition of Juniper Research's report entitled "Mobile WiMAX: Global Opportunities, Strategies & Forecasts - 2007 - 2013".

This forward looking report forecasts subscriber numbers and service revenues from 2007 to 2013 for all mobile broadband technologies globally and by region and for 33 countries (mobile WiMAX only). The detailed study first provides an understanding of the technologies that will enable the delivery of Mobile Broadband applications and services and then explores the market drivers and inhibitors of 802.16e Mobile WiMAX whilst giving an overview of its market status by region, including detailed examples of in-service systems and trials. The report also provides a number of in depth case studies analysing operators that have either deployed, or plan to deploy 802.16e Mobile WiMAX networks. The complete report also focuses on the equipment vendors that are active in the area of Mobile WiMAX and reviews their strategies.

The report projects 3G and Mobile broadband subscriber numbers for eight key geographical locations and 33 countries worldwide. Through an exhaustive research methodology, this practical report calculates subscriber numbers for each of the mobile broadband technologies: WiMAX; UMB; HSPA; 3GLTE; and EV-DO. It also predicts vital global and regional mobile WiMAX service revenues and offers ARPU numbers for mobile broadband subscribers. Furthermore, this in-depth analysis report also offers global mobile WiMAX device market predictions.

For more details on this report visit the website www.juniperresearch.com or phone +44 (0)1256 830002.

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About the Author

Howard Wilcox is an Analyst with Juniper Research having written *Mobile Broadband Markets* earlier in 2007. He has over twenty five years' experience in the Telecommunications sector. Howard has extensive experience of analysing markets, vendors and service providers in the telecoms networks marketplace. He was previously Director of Industry Intelligence at Marconi, where he has spent most of his career in a variety of analytical roles.

Howard began his career at Ferranti where he established a win/loss system. From 1997 to 2004 he represented UK Telecoms Industry body Intellect as a Member of European IT Observatory (EITO) Task Force. Howard has a BA in Business Administration with French from Loughborough University.

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[i] The Promise of WiMAX, Motorola
[ii] Source: Nortel