Making the case
for Mobile WiMAX

Executive summary

WiMAX shows great potential to be a leading and cost-effective technology for service providers who lack a 3G license or related infrastructure. WiMAX benefits from widespread industry backing and established standards.

WiMAX will enable a service provider to provide cost-effective broadband wireless access for hundreds of users from each base station. However, successful wide-scale deployment of WiMAX will depend on using licensed spectrum because unlicensed deployments of WiMAX networks will not provide the interference control that service providers need to create a strong business case.

An extensive ecosystem already exists to support WiMAX, helping to ensure its success. Device vendors, infrastructure manufacturers, chipset makers, system integrators, operators, service providers, applications developers and other players are all focused on WiMAX to grow their business with new products and services. Success can be further assured because existing WiMAX standards, which will continue to evolve, will help ensure interoperability of certified equipment from all manufacturers.

Service providers can only offer fixed services with Fixed WiMAX (IEEE 802.16-2004). However, service providers can offer both mobile and fixed services by deploying networks based on Mobile WiMAX (IEEE 802.16-2005). It is even possible to use Mobile WiMAX to offer fixed wireless access initially and then when needed to offer mobility services with the same infrastructure (Figure 1 overleaf).

Service providers wanting to offer Mobile WiMAX will be able to leverage synergies with vendors who fully understand mobility. Moreover, vendors who can offer end-to-end expertise from end user devices, business consulting and infrastructure, right down to turn-key deployment and even managing the service, will provide many benefits to service providers deploying Mobile WiMAX.

This White Paper looks at the different use cases for WiMAX, explains the spectrum choices facing service providers and explores the benefits of choosing Mobile WiMAX.

Why choose WiMAX?

Moving from fixed to mobile broadband access

One of the wireless communications industry's ultimate goals is to be able to economically offer broadband access over a wide geographic area. WiMAX is an essential element in achieving this aim. However, like any other business, a service provider needs to provide a positive return on investment (ROI) at all stages of its business evolution. To realize this ROI, Nokia believes that WiMAX will first be deployed to:

1. Extend broadband access to rural areas or areas impractical to reach with Digital Subscriber Lines (DSL).

2. Add mobility to existing fixed broadband services.

3. Provide as an alternative, wireless broadband services in new growth markets and replace fixed, unbundled last mile access with the service provider's own wireless infrastructure.

Fixed WiMAX access will be the early mainstream revenue generator for operators and other service providers. However, Mobile WiMAX will provide a much wider choice of applications, such as extending existing office WiFi networks, giving users continuous access when out of the office.

❸ Urban, indoor, mobile device

❷ Suburban, indoor, self-install CPE

❶ Rural, outdoor, fixed antenna CPE
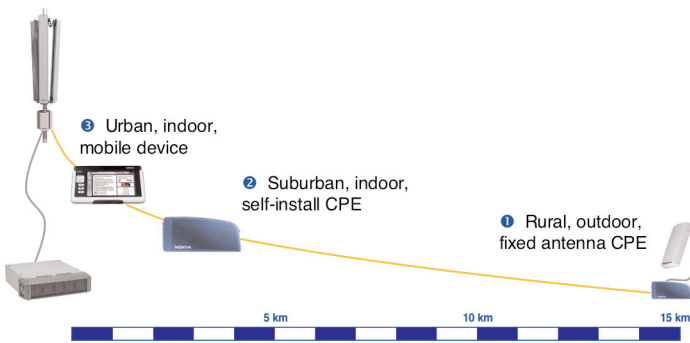
5 km   10 km   15 km

Figure 1: With Mobile WiMAX, operators can offer both mobile and fixed services from the base station, with varying coverage depending on the device being used.

Making the case for Mobile WiMAX

For users, the attraction of Mobile WiMAX is that it will bring personal wireless broadband access on the move, beyond the home and office. For service providers without a 3G network, WiMAX is a viable technology for offering broadband services.

Service providers will find WiMAX networks fast to deploy and easy to operate. WiMAX will be easy to connect and will work seamlessly with the IP Multimedia Subsystem (IMS) that is the basis for the common core network of the future, providing lower overheads and easier service development.

Creating an extensive WiMAX ecosystem

A further compelling reason for WiMAX is the structured and extensive ecosystem that is being created to support the technology. Device vendors, infrastructure manufacturers, chipset makers, system integrators, service providers, applications developers and other players are all focused on making WiMAX a success.

The IEEE has been developing and will continue to evolve the radio interface standards that lie behind WiMAX. Encouraged by the wide acceptance of these standards, infrastructure vendors are designing and manufacturing IEEE-compliant network elements such as base stations and the necessary core network equipment. These vendors have led the way with Fixed WiMAX and many have already launched pre-standard Fixed WiMAX products.

Using this wide choice of infrastructure products, several system integrators have entered the market and are working with manufacturers to provide the essential expertise and support needed to deploy WiMAX technology and ensure it provides the service levels that users expect. Encouraged by the large potential market, chipset makers have also backed the development of WiMAX and are promoting its use worldwide. This will enable them to achieve the economies of scale needed to produce economical, high performance chips that lie at the heart of infrastructure and end user devices.

Similarly, device manufacturers are using WiMAX standards to develop innovative Customer Premises Equipment (CPE) and other end user devices like PCMCIA cards and handheld devices. The focus of this joint effort is the WiMAX Forum, which has about 400 member companies. The Forum undertakes testing and certification (through third parties) against the IEEE standards and WiMAX forum profiles to ensure interoperability.

Wireless Internet Service Providers (WISP) and operators have also joined the WiMAX Forum, helping them deploy WiMAX networks. Yet all this effort would be futile without available radio spectrum, which is a scarce resource in many regions. Authorities around the world have recognized this need and are taking on the task of allocating and controlling frequency bands for use by WiMAX service providers and managing the use of adjacent spectrum, such as cellular and WiMAX. It is estimated that more than 550 licenses have been granted around the world.

Herein lies an important decision for service providers – whether to deploy WiMAX in licensed or unlicensed spectrum.

Technology choice is linked to spectrum allocation

Although WiMAX supports a large number of bands in both licensed and unlicensed spectrum, the first deployments are likely to be in the 2.5 GHz and 3.5 GHz licensed bands and some in the 5.8 GHz unlicensed band. Using licensed spectrum will differentiate a service provider from the pack of unlicensed service providers. The exclusive control that a service provider gains with licensed bands enables a highly stable deployment and excellent service quality with mobility, particularly in dense urban environments.

The lower frequencies typical of licensed spectrum also provide better coverage with fewer base stations, helping to reduce deployment and operational costs. Moreover, the cost of licensed WiMAX spectrum is expected to be lower than that paid by service providers for many 3G licenses around the world. Although licensing costs are little impediment to WiMAX deployment, the actual licensing process in some countries could be long-winded and bureaucratic.

WiMAX use cases

Fixed DSL Replacement / Complement

The first commercial WiMAX deployments are likely to provide broadband access to regions too remote for fixed broadband access and to complement DSL in dense urban areas. Many Broadband Wireless Access (BWA) deployments have already focused on rural areas that are uneconomic or impractical to reach with DSL. This trend is likely to continue with WiMAX compliant networks, with greenfield and established service providers deploying new WiMAX networks and existing BWA providers adopting WiMAX technology.

In suburban areas, DSL has sometimes been unable to provide the high speeds that residential users increasingly demand. Similarly, small and medium businesses are often underserved in areas other than urban environments. WiMAX has great potential to break into these market segments.

WiFi backhaul is highly cost-effective

Although WiFi hotspots are cheap to deploy, they still need costly backbones to link them to the public network. WiMAX backhaul could significantly reduce hotspot costs. WiMAX will complement WiFi by adding WiMAX hotzones that will become easier to access as WiMAX chipsets become commonly embedded in laptops and other devices.

Some residential and SoHo users are accustomed to WiFi access with their equipment. These users could access WiMAX directly by using hybrid WiFi / WiMAX gateways that act as a bridge between the two network technologies.

Nomadic Mobility for access on the move

Mobile WiMAX will fill in the coverage gaps between hotspots and provide so-called Nomadic Mobility. Also referred to as Portable Mobility, this allows users with laptops or other devices to stay connected when out of the office. Figure 2 shows the mobility access types supported by WiMAX.

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

Figure 2: The different types of WiMAX access possible under the IEEE standards

The importance of a strong WiMAX industry ecosystem

A successful BWA business will depend on a stable and comprehensive ecosystem. The three key elements to building the WiMAX ecosystem are good standards, widely available devices and cross-industry cooperation.

Well developed standards

Standardization is essential to enable the widespread adoption of any technology. It was true for WiFi and it will be true for WiMAX. While the IEEE has been producing the standards, the WiMAX Forum is encouraging widespread take up of WiMAX by establishing and promoting the WiMAX certification profiles. The Forum undertakes network architecture and related profile definitions, testing and certification of products against profiles and standards to ensure interoperability of equipment from different vendors.

The two IEEE standards behind WiMAX are IEEE 802.16-2004 and IEEE 802.16-2005.

IEEE 802.16-2004 (IEEE 802.16d), also called Fixed WiMAX, brings together the previous IEEE 802.16a standard and its various revisions to provide support for fixed broadband access. In January 2006 the WiMAX Forum certified the first WiMAX products to this standard.

IEEE 802.16-2005 (IEEE 802.16e), also called Mobile WiMAX, extends the IEEE 802.16-2004 standard to include mobile wireless broadband at walking pace, so-called Nomadic Mobility, by providing support for handoffs and roaming. This standard will also support true mobility. The first products to be certified to this standard (IEE 802.16-2005) are expected in the first half of 2007.

Service providers focusing on mobility will need to deploy WiMAX in accordance with IEEE 802.16-2005, which will enable them to also use their network to provide fixed access. On the other hand, service providers providing fixed services have little incentive to upgrade to IEEE 802.16-2005, unless they plan to add mobility into their service portfolio.

Figure 3 summarizes the important aspects of each of the two WiMAX standards.

	Fixed WiMAX 802.16-2004	Mobile WiMAX 802.16-2005
Completed	January 2004	November 2005
Spectrum	<11 GHz	<6 GHz
Channel conditions	Non line of sight	Non line of sight
Maximum peak data rate (10 MHz TDD, PUSC)	Up to 31 Mbps	Up to 31 Mbps
Modulation	OFDM 256 subcarriers, QPSK, 16QAM, 64QAM	OFDMA scalable subcarriers (128-2048), QPSK, 16QAM, 64QAM
Mobility	Fixed	Nomadic, regional roaming, mobile
Channel bandwidth	Scalable 1.5 – 20 MHz	Scalable 1.5 – 20 MHz
Typical cell radius	7–12 km	1–3 km

Figure 3: An overview of the different IEEE standards for WiMAX

Available devices (Home CPE, PCMCIA Cards and Embedded Modules)

The next consideration is achieving widespread availability of interoperable devices that will evolve to meet the differing and growing needs of consumers and business users. The first devices to appear are Customer Premises Equipment (CPE) that needs to be installed professionally with an outdoor antenna. These will be followed by self-installable indoor CPE.

Mobile WiMAX CPE devices will follow the development of PCMCIA cards to give laptop users the benefits of Nomadic Mobility. These will ultimately evolve into embedded chipsets that will be as ubiquitous as the WiFi functionality in today's laptops. Personal Digital Assistants (PDAs), Internet tablets and smartphones with Mobile WiMAX will become available as WiMAX access becomes more universal.

The evolution of Mobile WiMAX and the availability of handheld WiMAX devices will drive the market to more advanced applications using voice, multimedia and data for both consumers and businesses (See Figure 4).

	Potential applications evolution
Consumers	Content download Email / instant messaging Interactive gaming Internet browsing Streaming media VoIP
Enterprises	Content sharing Email / instant messaging Internet and corporate intranet access Secure intranet connections Video conferencing VoIP

Figure 4: The availability of WiMAX technology and devices will spur the development of more advanced applications

Cross-industry cooperation

A wide selection of organizations has been involved with WiMAX for several years and the level of cooperation has been as good as that seen during the development of other wireless ecosystems. Cooperative partnerships have been formed to advance the development of crucial elements of the ecosystem. The expertise needed to evolve the ecosystem is already well developed and in place.

Cooperation extends across the industry, involving major groups that are investing in the development of chipsets, devices and other fundamental components, to smaller players providing the basic building blocks such as antennas and other infrastructure components. This deeply vested interest shows that WiMAX has the coordinated backing of the industry to ensure success.

One outcome of such cooperation is that most manufacturers will develop and launch products at about the same time, thus creating an ecosystem with all elements in place. Consequently service providers will have little need to provide their own solutions because there will be a superb choice of OEM equipment available to them. Service provider R&D costs can be reduced, roll out should be faster and deployment is expected to be more reliable. Good availability of the technology will help to accelerate the take up of Mobile WiMAX services by users.

Conclusion

With the ratification of IEEE 802.16-2005 (Mobile WiMAX) at the end of 2005, the communications industry took a significant step towards the vision of being able to offer mobile broadband access anywhere. It's still early, but the success of WiMAX looks assured because of the sheer weight of support that the technology carries, with widespread and active cooperation across industries.

There are three fundamental issues for service providers to consider when developing the business case for WiMAX.

Firstly, service providers must decide on which version of WiMAX to deploy. While Mobile WiMAX supports both fixed and mobile broadband access, Fixed WiMAX is limited to fixed access only. Choosing Mobile WiMAX leaves service providers' options open and enables them to offer fixed services first and then add mobility as the market demands and devices become available.

Secondly, the control over the frequency band that licensing provides is a critical benefit and enables service providers to offer a high quality service, free of the interference from other networks, that unlicensed WiMAX will be prone to suffer. This is particularly relevant for providing Mobile WiMAX in dense urban areas.

Thirdly, service providers should partner with suppliers that understand their business case, and end-to-end mobility. The vendor should be able to support the service providers' goals, from establishing the initial business case, through equipment supply, deployment and operation of the network, to providing reliable and desirable end user devices. If needed, vendors should also be able to provide complete planning and operational services. Choosing a partner that can provide all of this is critical to service providers' success with WiMAX.

WiMAX will be an enabler of broadband wireless access and service providers will need to differentiate themselves in what will be a crowded market. Deploying Mobile WiMAX could well be a key differentiator.

Glossary

BWA	Broadband Wireless Access
CPE	Customer Premises Equipment
CDMA	Code Division Multiple Access
DSL	Digital Subscriber Line
IEEE	Institute of Electrical and Electronics Engineers
IMS	IP Multimedia Subsystem
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditure
PCMCIA	Personal Computer Memory Card International Association
PDA	Personal Digital Assistant
QoS	Quality of Service
ROI	Return on Investment
SoHo	Small office / Home office
VoIP	Voice over Internet Protocol
WCDMA	Wideband Code Division Multiple Access
WiFi	Wireless LAN based on IEEE 802.11 standards
WiMAX	Worldwide Interoperability for Microwave Access
WISP	Wireless Internet Service Provider

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