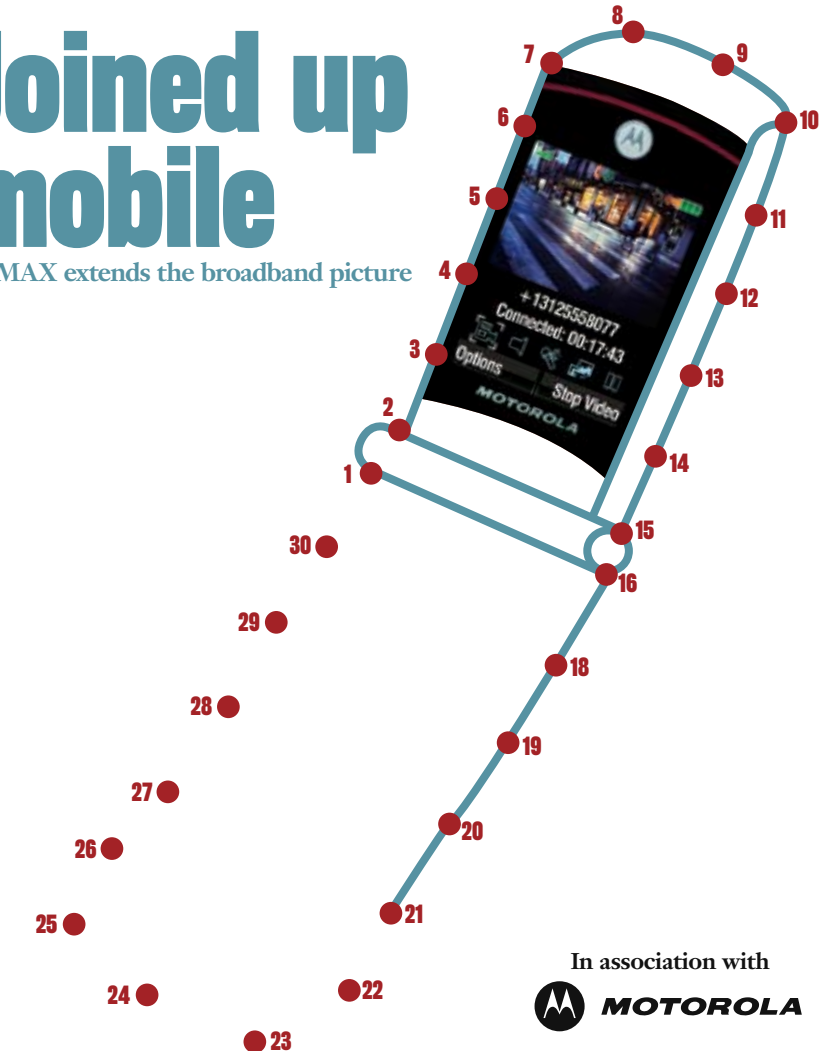


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FOREWORD

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Many technologies already compete to provide fixed and mobile broadband services, and even more are in the pipeline. Yet what operators want is a single network technology that can deliver maximum interoperability, high bandwidth and performance, and that is cost effective to deploy.

According to many experts, the only technology that fits that bill today is Worldwide Interoperability for Microwave Access, better known as WiMAX.

WiMAX already has broad support in the WiMAX Forum. Vodafone recently became a principal member of the Forum, joining more than 470 members comprising the majority of operators, component and equipment companies in the communications sector.

“WiMAX has gained significant momentum in the last year and is set to have a major impact on the converging fixed, portable and mobile broadband markets worldwide,” says Mike Roberts, principal analyst at Informa Telecoms & Media.

But it is the mobile variation of WiMAX—although it is currently subject to regulatory pressures (see p.15)—that many operators are most eagerly eyeing up. Proponents point out that other next-generation mobile technologies such as Long-Term Evolution (LTE) and Ultra Mobile Broadband (UMB) are not yet commercially available on the same level as WiMAX, giving the latter a head start.

Economics

WiMAX is set to deliver the high performance required for fixed broadband, with deep indoor penetration and high throughput, plus mobile broadband for a new generation of devices and applications. Indeed mobile WiMAX, based on the IEEE 802.16e standard, is being hailed by some as the 4G technology of choice.

“By the end of 2012, most subscribers will use WiMAX as a mobile technology,” says Monica Paolini, founder and president of analyst company Senza Fili Consulting. “In developed countries, WiMAX is a natural evolution beyond 3G; in emerging markets, it may represent the first mobile broadband data network for subscribers.” (See p.8 for more from Paolini).

In short, WiMAX is a standards-based technology with wide industry support and a rapidly growing list of commercial installations. As a result, operators and users could benefit from economies of scale and a large embedded base of WiMAX-enabled devices. ■

Heather McLean

MOTOROLA VIEWPOINT



MOTOROLA

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WWW.MOTOROLA.COM/WI4**

Why is Motorola so committed to WiMAX? Put simply, no other technology currently comes as close to WiMAX in providing such rich revenue potential for global services providers. Our belief and significant investment in WiMAX originates from four key drivers:

Demand

WiMAX capitalises on significant demand for high-speed wireless broadband. Consumers expect a rich service experience, with mobile devices already offering advanced game play, high-quality cameras, MP3 compatibility and Internet access.

Corporations across geographic regions are also keen to enhance broadband access. Coverage is regarded as a prerequisite to foster economic growth, promote inward investment and demonstrate a visible commitment to being a forward-thinking business destination.

Demand is also strong in emerging markets. Consumers are keen to access more advanced services, and service providers require systems to quickly bridge the digital divide where there is no wired infrastructure.

Flexibility

WiMAX offers much more than just broadband services. It's easy to provision VoIP, provide backhaul and introduce vibrant new services such as mobile TV, for both established and new market entrants. Quickly constructed and easily maintained, it provides complementary services for providers with existing infrastructure whether wired, cellular or cable.

Ready-made market

Interoperability and device availability are critical to ensuring uptake of new technologies. We have worked with industry associations to ensure these building blocks are in place. Over the next few years, devices will increasingly offer WiMAX compatibility, creating the ability to roam with a common, high-speed, global, always-on connection to wireless services, voice communications and the Internet.

Economics

Due to broad support for WiMAX, a global ecosystem of interoperable WiMAX coverage is already beginning to take shape. The costs of acquiring coverage are falling as well. The integration of IP into telecoms systems is simplifying network design, making the days of hierarchical technologies, circuit switched systems, and laborious processes to develop, launch and maintain services, all but over. ■

WIMAX NEWS

BUSINESS

SPRINT EXPANDS ON PLANS

One of the biggest WiMAX proponents, Sprint Nextel Corp., has fleshed out details of its project to build a national WiMAX network. Sprint is spending \$2.5 billion through next year and a total of \$5 billion through to 2010. In August, Sprint said it expects revenues of \$2 billion to \$2.5 billion from the network in 2010. The operator is planning to embed access to the network in products such as digital cameras and even billboards, to try to diversify its wireless business away from a traditional subscription model. It announced partnerships with Clearwire, to help build the network, and with Google to provide Web search, interactive and social networking services.

VODAFONE BACKS WIMAX

Vodafone has confirmed that both mobile WiMAX and 3G Long-Term Evolution (LTE) will play a part in its future network rollout plans, although it believes High-Speed Packet Access (HSPA)—an upgrade of existing 3G WCDMA networks—will serve its requirements for the next five years. Vodafone underlined its support for mobile WiMAX by announcing that its application to join the WiMAX Forum has been approved.

UK MOBILE ALLIANCE

Several UK companies are collaborating to demonstrate the benefits of mobile WiMAX ahead of spectrum auctions planned by Ofcom next year. The working group was launched by Nortel Networks and London-based Urban WiMAX, and has expanded to include Macropolitan, which rents space on 9,300 sites to 3G and WiMAX operators. The group plans to build and trial a user-ready WiMAX service in the UK prior to the auctions.

FRENCH NETWORK

Alcatel-Lucent has won a two-year contract with SHD, a joint venture of SFR and Neuf Cegetel, to provide a WiMAX network in France. Alcatel-Lucent will equip the planned sites in the Ile de France and Provence-Alpes-Cote d'Azur regions by mid-2009.

JAPAN GETS READY

NTT DoCoMo and ADSL provider Acca Networks will team up to launch wireless broadband services using mobile WiMAX, if Acca wins a licence in Japan's forthcoming spectrum auction. DoCoMo will put up ¥19 billion for its stake, while Acca Networks is investing ¥30 billion. Softbank and KDDI also plan to bid for WiMAX licences later this year. Reports suggest KDDI plans to team up with its share-

holder Kyocera and others, while Softbank is looking to form a joint venture with ISP eAccess.

CLEARWIRE IN EUROPE

Clearwire launched WiMAX services in Spain in September. The service in Seville covers around 300,000 households. Clearwire already had services in Ireland and Belgium, and says its network now covers more than 2.2 million people in Europe.

NORTEL SIGNS DEALS

Austar United Communications has selected Nortel Networks as the preferred vendor to build its planned WiMAX network in regional Australia. Nortel also signed a partnership deal for Russian systems integrator TechnoServ to promote its WiMAX high-speed Internet hardware, as well as cellular equipment designed for use along rail tracks.

SAMSUNG GROWTH

South Korea's Samsung Electronics expects its WiMAX networks business to be profitable within three to five years, according to its network business chief. Samsung is also expanding its business ties with Sprint Nextel to provide WiMAX wireless broadband network infrastructure for the US operator in New York City.

ZYXEL SIGNS SPRINT DEAL

Taiwan's ZyXEL Communications has announced that Sprint Nextel has selected its WiMAX customer premises equipment for use with the operator's mobile broadband network. ZyXEL will incorporate mobile WiMAX technology in a range of computing, portable and multimedia devices.

WIMAX MOVES TO 3G

WiMAX could be formally counted as a 3G technology before the end of this year thanks to the approval so far of proposals submitted by the IEEE and the WiMAX Forum to the ITU. The 22nd meeting of the ITU Radiocommunication Sector Working Party 8F in Kyoto, in June, has forwarded for approval a new terrestrial radio interface for IMT-2000, as a specific subset of WiMAX.

EMERGING MARKETS

MALAYSIA LICENCES

Malaysia shunned established phone operators such as Telekom Malaysia, Maxis and DiGi.com by awarding wireless broadband licences to four emerging companies. WiMAX licences were given to Green Packet, REDtone International, Bizsurf and Asiaspace Dotcom. There was no licence fee, and each win-

ner is expected to invest between MYR250 million and 300 million in the first three years. Asiaspace, Bizsurf and Green Packet will roll out services in peninsular Malaysia while REDtone will be the only East Malaysian operator.

SOUTH AFRICAN SERVICES

South African fixed-line operator Telkom SA became the first operator in South Africa to launch commercial WiMAX services. The offering is designed to provide broadband to customers where DSL is not available.

CHILE GETS WIMAX

Mexico's largest fixed-line firm, Telmex, earlier this year launched wireless broadband Internet and phone services in Chile using WiMAX technology. Telmex has started offering services to small- and medium-sized businesses, and plans to expand coverage to 91% of communities in Chile by the end of this year. The company also holds wireless licences in the WiMAX spectrum band in Argentina, Brazil and Peru.

TAIWAN LICENCES

Only one of Taiwan's three big mobile operators, Far EasTone, was among the six winners in the island's regional WiMAX licence auction in July. The government intends to auction at least one 10-year, island-wide licence

within two years of issuing the regional licences, but regional licensees can gain nationwide rights by joining forces. Vmax Telecom Company has already said it plans to join forces with Vastar Cable TV System to operate island-wide WiMAX services. Home-appliance maker Tattung, First International Telecom and Global On Corp were the other regional winners.

MIDDLE EAST NETWORK

Saudi Telecom has selected Huawei Technologies to deploy the first WiMAX 802.16e-based network in the Middle East, covering major cities including Riyadh, Jeddah and Dammam. Under the agreement, Huawei will design and deploy an end-to-end WiMAX 802.16e network.

VIETNAM TRIALS

Motorola announced a partnership with Vietnam Datacommunications Company to begin commercial WiMAX trials in Hanoi and Ho Chi Minh City. The year-long trial with VDC, a subsidiary of state-owned Vietnam Posts and Telecommunications Group, is scheduled to start in October, according to the vendor. Motorola has also deployed WiMAX for Wateen Telecom in Pakistan, and has a nationwide deployment in Bangladesh with Agni.

ANALYST COMMENT



Monica Paolini, founder and president of Senza Fili Consulting, gives her opinion on the future of WiMAX.

In the next five years, WiMAX will become a mature technology for mobile broadband access and will be ready to take on the challenge from next-generation mobile technology LTE.

Initially, the biggest opportunity for WiMAX lies in providing fixed access and nomadic services in emerging countries, and in a few developed countries such as the US and South Korea. That will give WiMAX the opportunity to gain a strong foothold as mobile devices become available and affordable to the mass market.

With time, mobile access will gain more traction, as mobile operators commit to deploying the high-capacity, low-latency, all-IP broadband networks their subscribers demand.

By the end of 2012, most subscribers will use WiMAX as a mobile technology. In developed countries, WiMAX is a natural evolution beyond 3G; in emerging markets, it often represents the first mobile broadband data network for subscribers. In all cases, WiMAX subscribers will increasingly use multiple devices linked to a single account, depending on where they are and which applications they are using.

This is a critical period for WiMAX. Fixed deployments are already a reality, but most of the large operators, and those that have spectrum in the 2.5GHz band, are waiting for mobile WiMAX.

The first pre-certification mobile WiMAX products are becoming available, and certified products are expected in a few months. At this early stage devices are limited to desktop modems and laptop cards, but during 2008 we will see the first mobile devices. We expect them to be mostly targeted at early adopters, with mass market products following in a year or two.

Every player in the wireless industry has followed WiMAX with a keen interest. In some cases, this has led to some hype, excessive expectations and, at the same time, excessive scepticism at its potential.

But in markets where spectrum for WiMAX is available, operators are rapidly moving towards commitments to deploy or are already deploying the technology. In many developed markets, where greenfield operators do not have access to spectrum and mobile operators are still trying to recoup their 3G investments, the level of commitment is understandably lower.

The question many people are asking is will WiMAX eventually dominate over LTE? Currently, WiMAX has a major time-to-market advantage: WiMAX equipment is already available commercially, while LTE is still in its standardization phase. However, LTE enjoys strong support among mobile operators and vendors such as Ericsson and Qualcomm that have decided not to develop WiMAX products.

Eventually, both technologies will be adopted, with LTE appealing mostly to GSM/HSPA operators and WiMAX to

greenfield and wireline operators.

It is not yet clear what the market share of each technology will be. To a great extent that will depend on the early success of WiMAX and the ability of its proponents to show that it is a mature, carrier-grade technology that fully supports mobility and relies on a strong ecosystem. The competition is open and will remain so for at least a couple of years: most mobile operators are in no hurry to declare their technology roadmap, and vendors are hedging their bets by developing WiMAX and LTE products side by side.

Eventually, the real comparison between LTE and WiMAX is going to be IEEE 802.16m, the new version of the standard now under development, rather than the version of mobile WiMAX currently available. LTE and 802.16m WiMAX are both candidate technologies for inclusion in the ITU family of IMT-Advanced technologies.

In terms of performance, however, I do not expect to see major differences between the two technologies. The technologies at the core of both—OFDMA, MIMO, beamforming and a flat IP core—are essentially the same, so it would be surprising if performance were the main driver in the decision of operators towards one or the other.

The major challenge for WiMAX is to ensure that a compelling selection of devices, with the right form factors and acceptable price points, will be available soon. We expect the largest market for WiMAX in the next five years will be in emerging countries. But this will only

happen if vendors develop devices that specifically address the type of demand that operators are seeing in the market. In the short term, this means low-cost (below US\$100) desktop modems and entry-level, light, data-centric devices that subscribers can easily take with them and share among family members.

In some markets spectrum availability is an issue (see p.14). But in most cases, regulators are working towards making new bands available, so the situation should improve.

In terms of the infrastructure, indoor coverage is rapidly emerging as an issue. As with every wireless technology, walls and windows attenuate the signal. With WiMAX, however, the issue is more severe, because most data access takes place from indoor locations and it therefore places a larger burden on the network capacity.

In short, WiMAX is clearly the way to go for operators that need to deploy a fixed or mobile broadband network today. WiMAX is the only commercial option now among the three competitors of LTE, Ultra Mobile Broadband (UMB) and mobile WiMAX. ■

Senza Fili Consulting provides advisory support on wireless data technologies and services. Its expertise extends to WiMAX, LTE, UMB, WiFi and other fixed and mobile Broadband Wireless Access (BWA) technologies.

Operators are in no hurry to declare their roadmap

Q&A WITH MOTOROLA



Fred Wright, senior vice president, Motorola Home and Networks Mobility

What does Motorola think about WiMAX and where it is going?

WiMAX has the potential to be a game-changing technology in the telecommunications industry, and mobile WiMAX is a term consumers, businesses and governments around the world should get to know.

WiMAX can provide a blanket of broadband wireless Internet coverage across a city or a large regional geographic area that can rival the performance of WiFi service. It is a perfect broadband delivery system that enables people to have high-speed, high-capacity broadband on the go.

Yet WiMAX also complements other broadband wireless technologies like WiFi. In the near future, consumers should expect to see laptop computers equipped with both WiMAX and WiFi modems as standard features, to enable sending and receiving of multimedia and broadband data communications anywhere, anytime.

What is Motorola doing in terms of investment, R&D, and rollouts?

Motorola has taken a big bet on WiMAX. We're leveraging our expertise in 2G and 3G wireless technology development combined with our success with our proprietary wi4Canopy fixed wireless technology, coupled with many years of R&D in OFDM-based technologies, to develop our WiMAX solution.

Motorola's WiMAX technology delivers simple Internet access by supporting fixed, nomadic, portable and mobile applications. We offer an end-to-end solution including WiMAX chips, our flexible access base station portfolio, IMS core, services, customer premises equipment and devices.

We currently have 41 mobile WiMAX trials and deployments in progress across six continents, including with Sprint Nextel and Clearwire in the US; Wateen in Pakistan; VTR in Chile; and Worldmax in the Netherlands.

Where does Motorola see WiMAX doing well?

The emergence of WiMAX has spurred tremendous interest worldwide from incumbent and greenfield operators in both emerging and mature markets. Its success, in part, is that it appeals to many different types of operators: from incumbent telcos like Wateen connecting an unserved market; to NeckarCom in Germany using WiMAX to launch a new business model to connect markets that are underserved by fixed-line broadband; or like Worldmax as a new entrant expanding services in a very mature wireless market in the Netherlands.

What are the advantages of WiMAX versus competing technologies such as LTE and UMB?

All three are OFDM-MIMO technologies, offer a flat IP-based architecture and similar data rates. However, they are competitive technologies despite the fact that they are designed to meet similar

requirements, to provide high-speed, mobile broadband that can support multimedia applications. WiMAX is at least two years ahead of UMB and LTE due to its 802.16e standards already being agreed to by the same IEEE standards group that invented WiFi.

How will WiMAX shape up against technologies such as LTE?

WiMAX is appropriate for many types of market environments, whether deployed as a complementary overlay to existing 2G or 3G networks or as the primary access where alternatives are unavailable or unaffordable. Even carriers committed to the LTE evolutionary path will find that WiMAX can coexist to add flexibility and accelerate time-to-market for broadband wireless services.

Where does Motorola see WiMAX going in the future?

We see WiMAX as changing the way the telecommunications industry connects people. With approximately 1,300 WiMAX licence holders around the world, there remains a huge market potential. WiMAX has already gained industry acceptance among the 480 companies that are members of the WiMAX Forum.

With the availability of low-cost WiMAX subscriber chipsets similar to WiFi, WiMAX is positioned to be incorporated in all types of consumer electronics that can benefit from broadband wireless connectivity. We need to think past the outdoor and indoor fixed customer premises equipment (in

home wireless routers), PC cards and mobile handsets.

Let's consider how WiMAX gets baked into the next generation of gaming consoles, or mp3 players, or television set-top boxes, copy machines, cars, meter reading devices, or even different types of monitoring devices. Think about the pervasiveness of WiFi, but add all the benefits of wide area mobile networking with broadband speeds. That's WiMAX, and it's a tremendous opportunity for connections across a landscape of devices and rich applications.

Why should operators pay attention to WiMAX?

Next-generation technologies like WiMAX should no longer be described in futuristic or visionary terms. WiMAX is a reality. WiMAX offers a broadband wireless access technology that is optimised for high-speed mobile data and multimedia services.

WiMAX offers true broadband performance, open standards design, interoperability, industry-wide ecosystem support and significant cost advantages. As a result, it offers providers—including mobile, wireless, traditional wireline, cable, governments and municipalities—a wide range of opportunities to expand their service portfolios and reduce delivery costs regardless of their existing investment profile. ■

There is a huge market potential for WiMAX

CONVERGING ON PROFIT

One major advantage of WiMAX over other broadband access technologies, say proponents, is the fact that it is designed from the outset for both fixed and mobile broadband services.

Andy McKinnon, WiMAX principal for EMEA at Motorola, says this interoperability is the key to service providers' ability to make money. He says most fixed operators are trying to get into the mobile business, and vice versa.

"For fixed and mobile providers, both groups are converging on the same core architecture: IP. The difference comes in whether you offer customers a fixed or a mobile service," says McKinnon.

Where some operators might have cause for concern, is the ability of WiMAX to challenge their established business models.

For example, if analysts are right, a whole new generation of WiMAX-only service providers could spring up to deliver offerings. Where WiMAX providers could hit mobile operators is by pricing a wireless data access and VoIP service cheaply and simply. WiMAX could affect mobile operators' revenues, because any customer using WiMAX to access the Internet could also use it to make VoIP calls. "If someone wants to download Skype

[and use it over a WiMAX network]...without service guarantees, they could," says Dan Stroberg, vice president for strategy, planning and business development at Sprint Nextel.

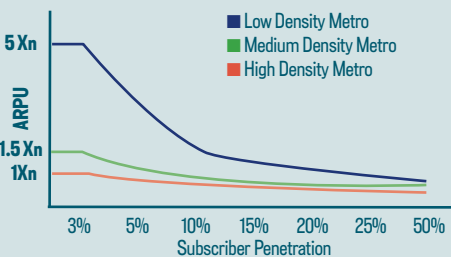
But Sprint Nextel hopes that WiMAX will enable it to secure a new market in the US, providing mobilised broadband access to a range of consumer devices such as gaming machines and cameras. In this way, Sprint believes its national network—costing \$5 billion by 2010—will complement, rather than compete with, its 3G voice network.

"Mobile broadband allows us to go after more specific single-use devices—for example, gaming and cameras—and other types of mobile multimedia plays and give them access to the Internet," Stroberg says. He says WiMAX carries 10 times as much pure data as its 3G equivalent, which is better primed for voice traffic.

Sprint also hopes the scale of its rollout in the US will provide the subscriber numbers for return on its investment. But as the Motorola table (below) shows, that return will be more difficult for operators in low density metropolitan areas.

"While identifying strong infrastructure solutions is imperative to assure the performance, capabilities

ARPU REQUIREMENT FOR 7-YEAR PAYBACK PERIOD



Population density is measured as the number of addressable users in a coverage area. The low density metro area has a five-fold higher ARPU requirement than the high density metro area at low subscriber penetrations, because fewer addressable subscribers are available to support the broader network deployment needed to provide pervasive coverage. But over time, as the subscriber loading increases and the penetration rate grows, each of the market profiles converge toward a much lower, steady-state ARPU threshold. Source: Motorola

Metro Category	Subscriber Density	Example Cities
Low Density	~1,500 Pop/km ²	Atlanta, Prague
Medium Density	~5,000 Pop/km ²	Chicago, London
High Density	~10,000 Pop/km ²	New York City, Moscow

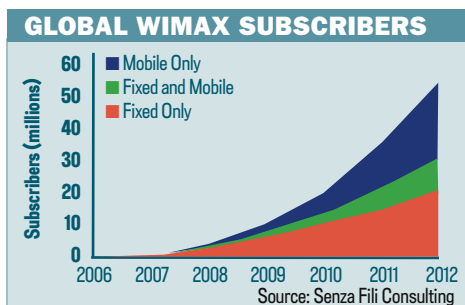
and scalability necessary to deliver a differentiated service offering, WiMAX infrastructure may comprise less than 10% of the cost of ownership in many cases,” says a new white paper from the vendor, *The Business of WiMAX*.

Developing markets could be particularly attractive to operators. “The WiMAX business case in urban areas of developing markets looks quite different to a cellular business plan in terms of cashflows,” says Amrish Kacker, principal consultant at Analysys in a paper. “Despite significant cash outflows in the initial years, the capex typically starts peaking in years five and six, due to increasing capacity demands rather than coverage demands. In that timeframe, the business tends to be cashflow positive and therefore it is seen as less risky to make further investments.”

Another, detailed, study last year from Athens Information Technology, concluded that WiMAX network deployment presented a better economic solution than a Gigabit Ethernet passive optical network infrastructure in the Greek capital (*Total Telecom*, January 2006, p.22). Comparing the technologies over a 5-year period to 2009, it concluded that revenues were almost identical for both (up to €20 million by year five). While costs for the GPON were initially high—14 million compared to 10 million for WiMAX—due to the high investment of fibre installation, in 2007 a significant increase in WiMAX costs was incurred due to a major network upgrade to meet increase in demand. By 2008/9 costs for both were similar, at around €6 million per annum.

But Julien Salanave, director of the telecoms equipment division at IDATE, says it is hard to forecast comparisons with other technologies with certainty. “No-one knows if WiMAX is cheaper than

**‘No-one knows if
WiMAX is cheaper
than 3G/LTE’**



[3G/LTE],” for example, he says. “It is impossible to put a figure on it as the standardisation of mobile WiMAX has not been completed.”

Motorola comes back to the revenue opportunity promised by fixed-mobile infrastructure centred on IP. “With the IP foundations of the WiMAX architecture, operators can readily deliver the next wave of both fixed and mobile broadband applications emerging from all corners of the Internet.” What’s more, greater services convergence could increase

its appeal. Senza Fili says while mobile WiMAX can be used for fixed and mobile access, the distinction will disappear as personal broadband services evolve (see chart above).

“A distinct advantage of the [mobile] standard is its ability to deliver powerful connections across fixed, nomadic and mobile applications at the very onset of their service launch,” says Motorola. “With each WiMAX site that is turned up, the service perimeter...can... deliver fixed connections analogous to traditional wireline broadband...as well as nomadic, hot spot coverage similar to WiFi but with greater reach. ■

Material for some of this article was taken from previous issues of Total Telecom magazine.

MAKING WAVES

If WiMAX is to gain widespread traction, it first needs to overcome disparate regulatory policies worldwide. Even the most fervent backers of the technology see spectrum as the most fundamental challenge.

"The success of mobile broadband depends on the availability of sufficient and appropriate spectrum to support planned services at the traffic levels expected, and with the flexibility to use the available spectrum for mobile, nomadic and fixed services," says the WiMAX Forum in a document this year entitled *The role of Regulation in bringing Mobile Broadband to the Mass Market*.

The mobile variation of WiMAX (IEEE 802.16e), and potentially its most disruptive form in terms of affecting mobile revenues through voice over IP, has yet to gain regulatory clearance in some countries in Europe. In the US, Sprint Nextel and Clearwire operate in the 2.5 GHz frequency that is ideal for mobile WiMAX services; in Europe, the position is less clear, with regulators still to allocate spectrum in many countries.

Many trials and commercial rollouts to date have used the 3.5 GHz frequency. Yet many regulators currently allow this spectrum only to be used for fixed broadband, or

fixed-only wireless broadband, deployments. The unspoken reason is to protect the costly investments in 3G licences made by mobile operators at the beginning of the decade.

Free, which owns the only national WiMAX licence in France, will not be allowed to offer the mobile variation of WiMAX. And other regulators in western Europe, currently do not allow new entrants to use WiMAX for providing mobile broadband access.

"One challenge for operators is when they want to offer mobility, but the regulator says it is a fixed-only spectrum," says Andy McKinnon, WiMAX principal for EMEA at Motorola. "For instance, Intel is embedding WiMAX in laptops. If a country

German government is in the process of evaluating national law to allow WiMAX operators to deploy the mobile version.

The first national WiMAX rollout in the 3.5 GHz range was carried out by Wateen Telecom in Pakistan (see p.16). The frequency is also popular in Latin America. In North America, however, it is currently illegal to use the 3.5 GHz frequency commercially because it is used for military purposes.

In Asia, the 2.3 GHz frequency is mostly used for WiMAX rollouts. In South Korea, Samsung's mobile variation of WiMAX, WiBro, was converted to this frequency to harmonise with global standards. Eastern Europe has also seen uses of WiMAX in this range.

Mobile broadband success depends on spectrum

allocates 3.5 GHz for fixed only, I can't legally use my laptop on the train because the handoff isn't allowed," he says.

McKinnon thinks regulators around the globe will soon re-evaluate this restriction. Already, mobility is allowed in the 3.5 GHz frequency in the Netherlands, Norway and Austria thanks to forward thinking regulators, he says. And the

According to the WiMAX Forum, mobile WiMAX operates in three spectrum bands (2.3-2.4 GHz, 2.496-2.69 GHz, and 3.4-3.6 GHz). Yet the frequency getting most global attention is the middle range, generally known as 2.5 or 2.6 GHz. It is widely seen as the spectrum for mobile services because it is better able to penetrate buildings.

McKinnon says the best option

for operators looking to move into WiMAX is to find 2.5 GHz spectrum. Because it is seen as mobile spectrum, there will be no regulatory problems in terms of using it for both fixed and mobile WiMAX offerings, he says.

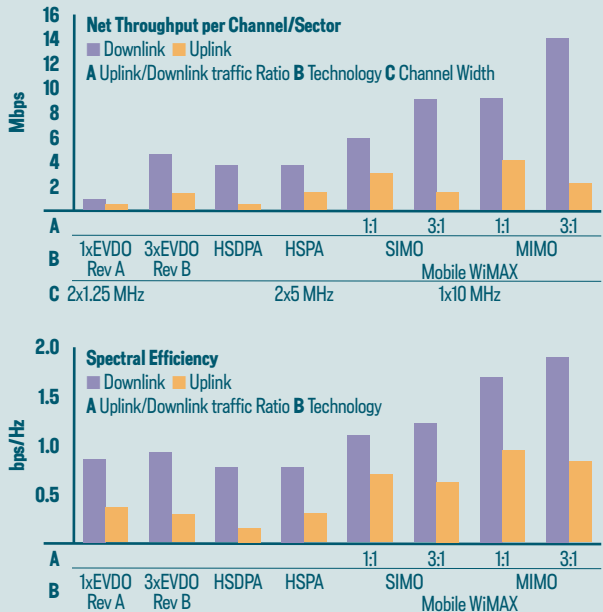
But allocation of 2.5 GHz spectrum in Europe was tied up in the 3G licence auctions, where many regulators withheld a portion of the spectrum to be used in future as UMTS expansion bandwidth.

UK regulator Ofcom later decided that forcing a technology on a spectrum could lead to a lack of competition, so in late 2006 it said it would auction the 2.5 GHz spectrum as technology-agnostic. That has led the way for change across Europe as other regulators followed suit.

A spokesman for Ofcom says a number of regulators have signed up to a European initiative, Wireless Access Policy for Electronic Communication Services (WAPECS), which advocates allocating spectrum on the basis of service and technology neutrality, rather than defining which services operators can offer within a certain frequency band.

The WiMAX Forum also suggests regulators "will increasingly need to define broad spectrum usage rights that allow network operators the freedom

PERFORMANCE COMPARISON: WIMAX AND 3G



Performance comparison between WiMAX and 3G technologies. Note: 1xEV-DO uses one 1.25 MHz channel for the uplink and one for the downlink, 3xEV-DO uses three 1.25 MHz channels for the uplink and three for the downlink. Single Input, Multiple Output (SIMO) refers to the use of multiple (in this case two) receiver chains at the mobile unit. No results for beamforming are shown as they are dependent on the base station implementation and results can vary according to the deployment scenario.

Source: WiMAX Forum.

to adopt the most advanced and cost-effective technologies”.

A 2.5 GHz auction will take place in the UK next year, and the bidding is set to be frenzied. Already, Several companies including Nortel are collaborating to demonstrate the

benefits of mobile WiMAX in the UK ahead of the auctions. The business case for buying into 2.5 GHz bandwidth is strengthened when operators consider the roaming opportunities afforded by the same frequency being used in the US and the UK. ■

CASE STUDY: WATEEN TELECOM

Wateen Telecom and Motorola deployed a WiMAX network to 17 cities in Pakistan in just nine months. Wateen Telecom chose Motorola's WiMAX and IP Multimedia Subsystem (IMS) core technology to provide wireless broadband voice and data services for residential and corporate use.

The new network delivers high-speed Internet access and a range of enhanced voice services, including voice over IP (VoIP) with features such as voicemail, caller identification and call forwarding for residential customers.

Business users also have access to high-speed data services complemented by cost-effective VoIP, with features that provide rich PBX functions through Web-based management tools.

In 2005, when the project began, Wateen faced a country with a population of 169 million people but only 30,000 broadband connections. Providing high-speed data connectivity to a country without infrastructure was a huge challenge.

Wateen began to research emerging technologies and chose WiMAX because it felt it would not only enable a high quality network, but also that it would facilitate a fast network rollout.

Wateen then approached Motorola for assistance in the project. "When we chose Motorola, we not only focused on the technology and the technical expertise of Motorola, we looked at their capability to deliver an end to end service," says Shahid Miah, CTO at Wateen. "From day one they engaged with us at all levels, whether we were talking about the design, the deployment or managed services. They knew exactly what questions to ask, what information was required to ensure that the delivery was as painless as possible, and that the operation would be as smooth as possible once we started offering the service," he says.

To suit both business and residential use, Motorola deployed its next-generation wi4 WiMAX technology, based on the IEEE 802.16e-2005 mobile

standard. This also enabled interoperability between GSM, WiMAX and WiFi networks.

The fact that Motorola was able to deploy its infrastructure in 17 major cities—including Islamabad, Karachi and Lahore—in just nine months was a big advantage to Wateen's competitive plans. And because of the speed and cost effectiveness of the deployment, Wateen says it has demonstrated how an emerging country can go straight to innovative services.

"It demonstrates how an emerging country can leapfrog directly to innovative next-generation technology, and smoothly deploy a cutting edge communications infrastructure," says Jose Figueroa, corporate vice president, Motorola Networks & Enterprise.

Power applications

Because WiMAX does not depend on scattered hotspots, Wateen will be able to provide its subscribers with one far-reaching broadband Internet hotspot.

Motorola says its wi4 WiMAX solution was designed to support fixed, portable, nomadic and mobile applications, such as VoIP, online gaming, mobile TV and personalised "infotainment".

"Wateen believes that WiMAX 802.16e has a bright future," says Miah. "If we didn't believe that, we wouldn't have invested in the technology." ■

WiMAX could facilitate a fast network rollout

CASE STUDY: MENA TELECOM

Mena Telecom is working with Motorola to plan, deploy and manage a nationwide mobile WiMAX and IMS network in the Kingdom of Bahrain. It will be one of the first countries to deploy a nationwide WiMAX 802.16e-based network.

The end-to-end network, operating in the 3.5-GHz frequency band, will comprise WiMAX infrastructure, an IMS core, customer premises equipment, voice and data applications, and operational and business support systems.

Mena Telecom says integration with Motorola's WiMAX and IMS solutions will enable it to offer enhanced communication services for its business and consumer customers. What's more, the Motorola IMS network provides the necessary platform to allow Mena Telecom to continuously enhance its services with minimal impact to its deployed infrastructure.

For business customers, Mena Telecom will be able to offer enterprise data, IP Centrex, PBX connectivity and conferencing services. Existing Mena Telecom voice services, including carrier pre-selection (CPS), pre-paid calling and international VoIP termination, will be migrated to the new network over time.

Motorola will also deliver and operate a multi-channel contact centre combined with integrated operational support system (OSS) and business support system (BSS) capabilities, helping Mena Telecom to deliver a differentiated customer experience.

"Mena Telecom aims to make broadband services available to customers throughout the Kingdom of Bahrain at better value-for-money prices," said Abdulhakeem Al Khayyat, chairman of Mena Telecom. "Equally, using wireless technology, we aim to provide customers with the convenience that will come from nomadic service availability... We will be a full service provider of voice and data, and Motorola's WiMAX and IMS solutions and services

allow us to achieve our goal of affordable broadband for both business and individual consumers, without the complexity of building a wired network."

With Motorola's WiMAX solution, Mena Telecom's infrastructure will be compatible with technology that will be embedded in future devices, including laptops.

Under the terms of the contract, Motorola will also take responsibility for the customer relationship management systems, as well as the technical operations of the project and management of the entire WiMAX and IMS network.

Evolving structure

The services included in the contract will ensure that Mena Telecom's evolving WiMAX infrastructure stays current and responsive to business and residential demand as well as technological development, says the operator.

Mena Telecom expects the network to be ready for service by the end of the year. In the first phase, a full range of services is expected to be available from Manama to the Seef Area beginning in January 2008, with coverage extended to other areas in the Kingdom by March.

Mena says the 802.16e WiMAX standard delivers significant advantages over the fixed standard, including advanced antenna technology to improve capacity and range performance. ■

IMS will allow Mena to evolve services

CASE STUDY: NECKARCOM

Residents and small businesses in rural areas of Germany are set to benefit from new WiMAX wireless broadband services from Motorola.

NeckarCom Telekommunikation has selected Motorola to plan, deploy and integrate a 3.5-GHz WiMAX network in the Ulm region in Baden-Württemberg, the country's third largest state.

Motorola's WiMAX solution will enable NeckarCom to deliver broadband services to homeowners and small businesses in areas that are currently underserved by fixed line broadband, due to their more remote locations.

The first stage of the network rollout that began in May will offer NeckarCom subscribers broadband data services. Within weeks of the rollout, subscribers will additionally be provided with access to voice over IP (VoIP) services.

The contract follows a successful trial that was carried out in selected communities in the region. During this trial period, NeckarCom deployed Motorola's WiMAX equipment in a rollout period of three weeks. NeckarCom then delivered broadband services on WiMAX to homes involved in the trial. Upon completion of the initial rollout phase, NeckarCom intends to expand the service across the entire region.

"New WiMAX technology offers us, especially in rural areas, the ability to develop large potential markets with low-cost broadband internet access," said Jürgen Herrmann, managing director at NeckarCom Telekommunikation. "Motorola convinced us both with respect to the quality of its product portfolio, as well as the best price and most economic operating costs.

In addition to the WiMAX solution, including WiMAX access points (the WAP 400 series) and customer premises equipment (CPEi 600 series), Motorola will provide planning and integration services for the operator.

"This contract reflects the increasingly

competitive nature of the broadband market in Germany," said Motorola's corporate vice president, Jose Figueroa. "WiMAX significantly disrupts traditional broadband business models, allowing organisations such as NeckarCom to rapidly enter new markets and offer services to previously untouched regions. We are pleased that NeckarCom recognises the benefits that WiMAX offers."

Fibre play

NeckarCom is a subsidiary of EnBW Baden-Württemberg, the third largest energy supply company in Germany, and primarily markets the fibre infrastructure of EnBW.

In addition, as a regional carrier NeckarCom offers business customers in Baden-Württemberg telecoms services such as location networking, broadband Internet access and VoIP.

"Based on the long term expertise of Motorola and the positive customer acceptance during the pilot phase, we are confident that we have an excellent partner with whom we can work," said Herrmann. ■

**'WiMAX enables us
to develop low-cost
broadband Internet'**

PRIME NUMBERS

PRICING DEVICES

Senza Fili Consulting says the cost of subscriber devices must come down to accelerate WiMAX adoption. The analyst company says a €150 device is not sustainable in markets with ARPU's below €15 per month, and adds that a zero subsidy model is not an option.

54million

the latest report from Senza Fili. That is up from 15.4 million, and revenues of US\$16.5 billion in 2010, says another report by the company.

BROADBAND WIRELESS GROWING

US research firm Maravedis says there were 950,000 WiMAX/BWA subscribers worldwide by the end of the first quarter of this year. The US, Spain and Australia were the top 3 countries in terms of subscriber numbers, accounting for 0.5 million BWA/WiMAX subscribers in Q1 2007. Asia Pacific accounted for 38% of deployments, Europe 33%, North America 17%, and CALA 13%. WiMAX service revenues in 2006 totalled US\$322 million, with recorded ARPUs of US\$40.76 and US\$145.54 for residential and business subscribers respectively. The split by subscriber type was 58% residential and 42% business.

LOW CAPITAL COSTS

According to Motorola, over the course of 7 years capital expenses—including components such as base station, core and wireless backhaul equipment—will contribute roughly 20% of the total cost of ownership of a typical WiMAX network. The low proportion is due to an all-IP, peer-to-peer architecture. Operating expenses—including maintenance, support, device subsidies and administration—will contribute the other 80%.

WiMAX networks deployed at 3.5 GHz may require almost 30% more sites for a given coverage area than a 2.5 GHz installation. But the 3.5 GHz network will have 30% additional capacity inherently built into the system.
— Motorola



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Motorola wi4 WiMAX

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