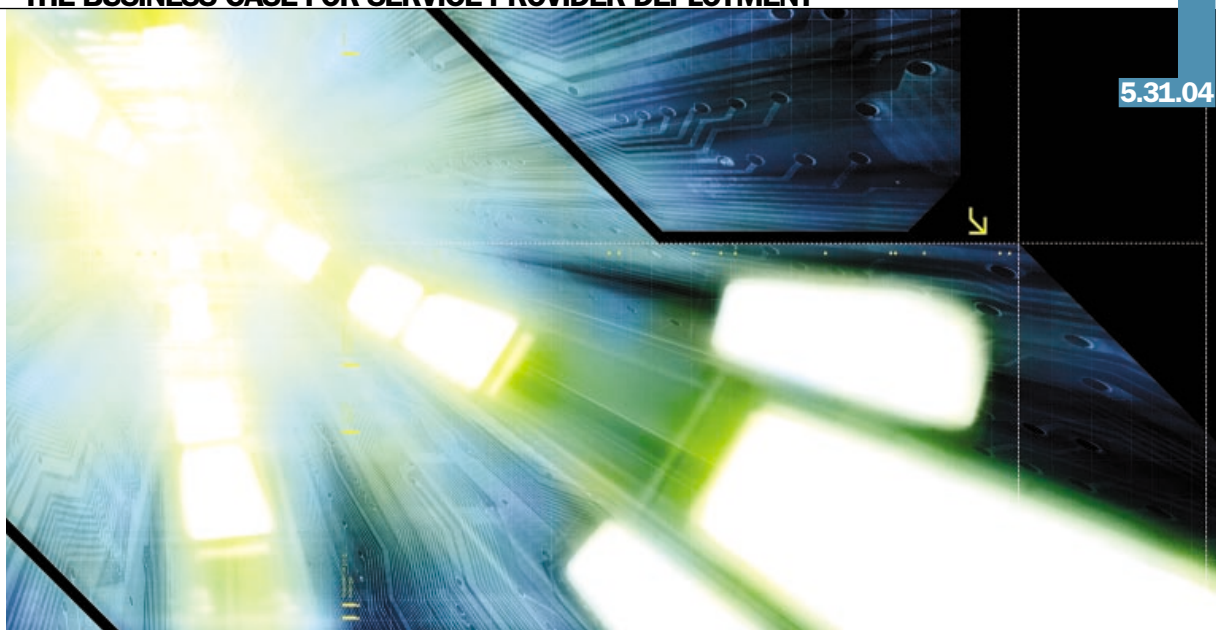
> INSIDE: EXCLUSIVE COMMENTARY FROM THE WiMAX FORUM

A SUPPLEMENT TO TELEPHONY

TELEPHONY'S Complete Guide To WiMAX

THE BUSINESS CASE FOR SERVICE PROVIDER DEPLOYMENT



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> The road to standardization: Tracking the future of WiMAX

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> Where WiMAX fits in the worldwide spectrum scene

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EDITOR'S LETTER

BY JASON MEYERS

Something was still missing. We decided it was necessary to provide further edification about WiMAX to the broader service provider population.

WiMAX DEFINED

The idea for this supplement was hatched earlier this year during the Broadband Wireless World Forum, where members of the editorial and publishing staff of *Telephony* had several discussions with representatives from the broadband wireless sector about the industry's perceptions—and, perhaps more important, misconceptions—about WiMAX.

One of the sessions during that conference assembled a group of experts from broadband wireless vendors to discuss precisely that: What is WiMAX? How is it being developed, and what are the potential benefits for service providers? What are its technological strengths, and what challenges remain to be addressed? When will it become a standard? What does its future hold?

The subject seemed well-received by those in attendance—the panel did a good job of addressing the topic for a broadband wireless audience.

But we felt something was still missing: We decided it was necessary to provide further edification about WiMAX to the broader service provider population—a phrase that also defines *Telephony's* readership. We approached the WiMAX Forum to gain its support, its sponsorship and the sponsorship of several of its members, and this supplement was born.

The result is a comprehensive and objective guide to the past, present and future of WiMAX. Our editors and writers went behind the hype about WiMAX to explore its true potential, define the role it is likely to play in various versions and applications, and discover what industry, technological and regulatory challenges must still be confronted before the technology can become a true broadband contender. We provide what we believe to be the most complete primer yet on the development and evolution of the 802.16 technology and standard. We also handicap the service provider opportunities that exist for WiMAX, both domestically and internationally, and in both licensed and unlicensed spectrum bands. And we close by offering the WiMAX Forum the opportunity to provide its perspective on the future.

As the content of this supplement makes clear, WiMAX is absolutely still in its nascent stage. But the research that went into the production of this supplement tells us that the technology's potential is also clear. We will continue to provide you with the most up-to-the-minute coverage of WiMAX—and any and all other telecom technology innovation—as it evolves. W

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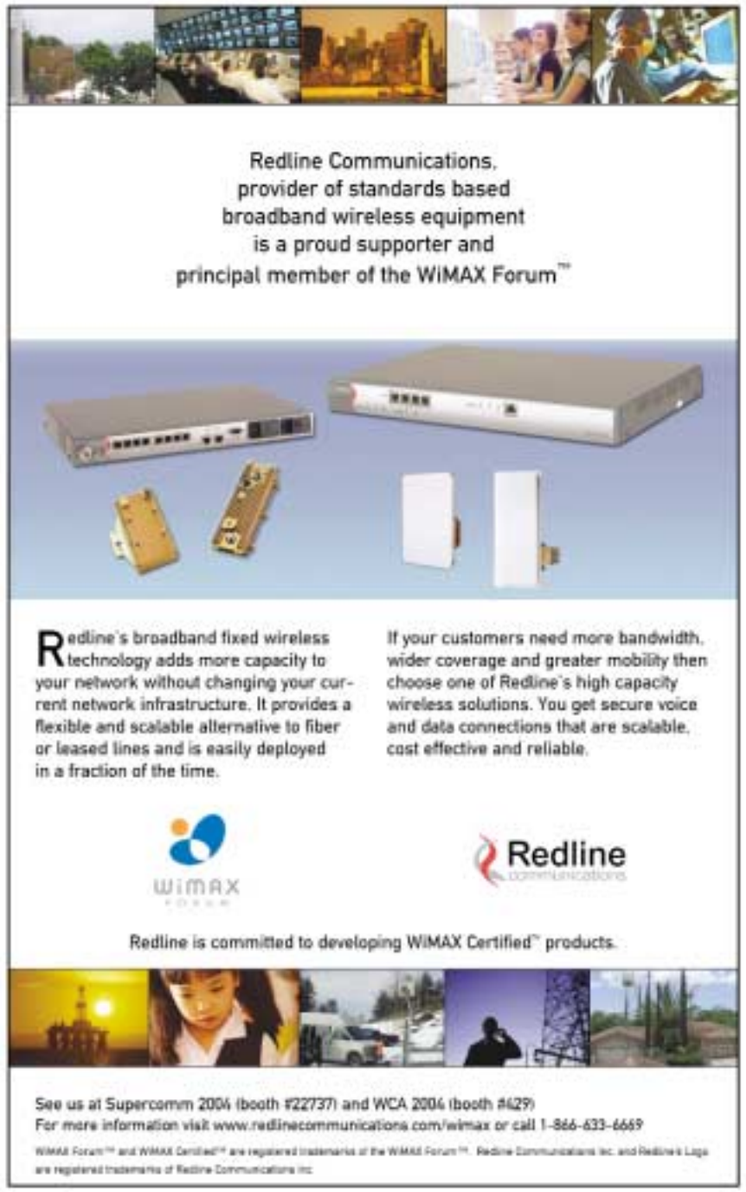


MEMBERS OF THE WiMAX FORUM ARE WORKING TOGETHER TO CAREFULLY PLOT THE EVOLUTION OF 802.16 FROM A VAGUE STANDARD INTO A MARKETABLE TECHNOLOGY. COMMON AMBITION AND EXPERIENCE DEPLOYING Wi-Fi SERVE AS THEIR GUIDE RAILS.

A STANDARD ARGUMENT:

WHY WIMAX WILL RULE

BY DAN O'SHEA

WiMAX is not Wi-Fi—not yet, anyway—but the next evolution in broadband wireless has set off down Wi-Fi's well-worn path. Wi-Fi, based on the 802.11 standard, once claimed only a sparse, polka dot pattern of hot spots around the globe, but that pattern is becoming denser by the day, much faster than wireline broadband technologies could ever match. Its success has given proponents of broadband wireless access, whose visions of success have proved mirages before, reason to hope again.

But if Wi-Fi has resuscitated their dreams, WiMAX might be the technology that fully realizes them.

Three years after the original 802.16 draft was forged by the IEEE, backers of the technology are now working with a much-improved, amended standard: 802.16a, or WiMAX. They are hoping to model WiMAX's evolution after that of its wildly successful and more mature predecessor. The similarities in their methods are clear.

First, they chose a market-friendly moniker that reminds one of Wi-Fi but suggests something better—something new and improved. WiMAX forces have even adopted the model of a progressive—and aggressive—industry trade group set forth by the Wi-Fi Alliance. This group, called the WiMAX Forum, already is helping the industry interpret and modify the original, loosely-scripted 802.16 standard, and is preparing an interoperability testing program that will ensure a broad choice of fairly priced equipment for carriers and other service providers that would deploy the technology in their transport networks at a savings of capital and operational expenses.

WiMAX will have a basis in well-defined standards and industry interoperability right from the start, which is something Wi-Fi didn't fully gain for years after it was developed.

Next, WiMAX will target the end user, with the backing of Intel and other semiconductor developers that can get WiMAX chips into a range of laptops and other customer premises equipment.

Sound familiar? In fact, it might be said that the only thing WiMAX won't take from Wi-Fi is the one thing that could give WiMAX an even better chance for rapid market adoption: WiMAX will have a basis in well-defined standards and industry interoperability right from the start, which is something that Wi-Fi didn't fully gain for years after it was developed—and something that might have ultimately limited Wi-Fi's market acceptance.

"Before standardization, Wi-Fi was nothing like it is today: inside every new laptop," said Ron Resnick, director of Intel's broadband wireless division and president of the WiMAX Forum. "It was a technology that had only a very small market impact."

But before the grand vision can be realized, there is much work still to be done. For all of the industry hope and hype that has been placed at the feet of WiMAX, the technology remains today in an early, pre-market stage.

Mustering the broad array of vendors and service providers from around the world that will contribute to that success is the WiMAX Forum, comprised of more than 100 companies. Advancing the technology to market depends largely on the ability of that one industry cooperative to shape an intentionally vague standard into something more marketable and malleable to mass deployment.

That trench work, much like the work of the Wi-Fi Alliance, mainly consists of devising specifications for product interoperability across a wide range of equipment vendors and overseeing testing of the products at third-party labs in order to certify them for interoperability.

In another nod to the Wi-Fi Alliance, the WiMAX Forum aims to become a marketing collective, promoting WiMAX Forum Certified products, first to operators that will use the technology in their transport networks, and later to end users.

But WiMAX proponents want to advance to that stage of near ubiquity without getting tripped up by some of the hurdles Wi-Fi faced, such as a sub-par security protocol.

"The original 802.11 [Wi-Fi] spec was a dismal failure," said Jeff Orr, product marketing manager at Proxim and a member of the WiMAX Forum's board of directors. "All of the vendors interpreted that spec differently. There was wireless LAN equipment in the market well before there were standards. It was very expensive, and there was no interoperability."

With that in mind, WiMAX is already ahead of the game.

"We have a standard, and we're at the early stage of figuring out how we support WiMAX, how we make it grow," said Dean Chang, chairman of the WiMAX Forum's service provider working group and director of product marketing at vendor Aperto Networks. "The forum helps bring all the information together that vendors and carriers can work with to do that."

As Chang pointed out, it all begins with a standard. The standard he spoke of is 802.16a, which was approved by the IEEE in January 2003, and is basically an amendment to the more general 802.16 core standard developed in December 2001 by IEEE Task Group 1.

The core 802.16 specification was an air interface standard for broadband wireless access systems using point-to-multipoint infrastructure designs, and operating at radio frequencies between 10 GHz and 66 GHz. It targeted an average bandwidth performance of 70 Mb/s and peak rates up to 268 Mb/s.

There is much work still to be done. For all the industry hope and hype placed on WiMAX, it remains today in an early, pre-market stage.

However, that standard wasn't complete in many peoples' minds. It applied only to line-of-sight deployment in licensed spectrum, neglected to offer any conformance guidelines and ignored ongoing development of the similar European HiperMAN standard.

"The original spec isn't so all-encompassing," Orr said. "The IEEE was working quickly, as it typically does, and with 802.16a it built more functionality into that original draft."

The 802.16a collection of amendments took into account the emergence of licensed and license-exempt broadband wireless networks operating between 2 GHz and 11 GHz, with support for non-line-of-sight architectures that could not be supported in higher frequency ranges.

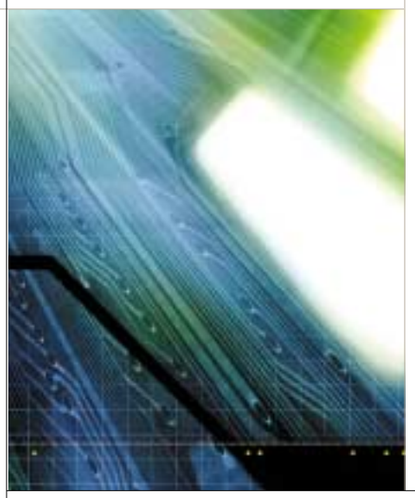
"Support for NLOS performance was one of primary PHY [physical layer] differences in 802.16a," Chang said. "802.16a was developed with the requirements of lower frequencies in mind."

In 802.16a, there were actually three new PHY-layer specifications: a single-carrier layer; a 256-point FFT OFDM layer; and a 2048-point FFT OFDMA layer. The 256-point waveform is the one that is employed in both WiMAX and the ETSI's HiperMAN standard, ensuring worldwide interoperability.

The amended standard also allowed for WiMAX deployment in varying channel capacities to address the different amounts of spectrum carriers own from market to market, and in different parts of the world. The inclusion of TDD and FDD duplexing was yet another nod to the technology's international potential.

Beside the additions at the PHY layer, the 802.16a version made further enhancements to the Media Access Control (MAC) layer. The MAC gained a slotted TDMA uplink/downlink protocol between the

By next year, the IEEE hopes to produce 802.16e, another new amendment that will introduce mobility into what WiMAX proponents hope by that time to be a thriving market for broadband wireless.



WiMAX base station and the subscriber terminal. This type of intelligent scheduling of user access to the network improves latency, affecting the network capability to support voice and video services, and overall service reliability. Other QOS features include automatic retransmission request (ARQ), per-connection QOS and automatic power control.

"802.16a gave us a better set of MAC and PHY profiles to work with," Chang said.

While 802.16a does much to improve on the original standard, the core standard has had enough amendments attached to it that the IEEE is now re-drafting the specification. The new standard, to be referred to as 802.16 Revision D, should be ready in the third quarter of this year. The new core spec will include everything that's changed about the standard thus far.

Yet the evolution of the WiMAX standard still won't be finished with 802.16 RevD. By late next year, the IEEE hopes to produce 802.16e, another new amendment that will introduce mobility into what WiMAX proponents hope by that time will be a thriving market for broadband wireless.

Though WiMAX is not yet market-ready, 2004 is a pivotal year for the technology. If the 802.16 standard is on a journey to broad market adoption, the 802.16a amendments and 802.16 RevD draft are just brief stops on the journey, opportunities to make sure the industry has the most detailed, most current roadmap to get to its destination. Following that thinking, the WiMAX Forum is 802.16's guide to market.

"The forum is a reflection in time of where the standards are," Resnick said. "They aren't stagnant, and the forum addresses what happens as they continue to evolve."

Parallel to the development of the original 802.16 standard, the group was founded in 2001. It picked up steam with last year's approval of 802.16a. While it began with membership from just a few vendors, the WiMAX Forum has grown rapidly in the last year, most impressively in its service provider ranks.

"Recruiting carriers to the forum is a very active process," said forum president Resnick. "We're early in the process of getting the technology to market, but industry analysts have started covering this area, and carriers are wanting to join the forum to see who is building what."

Aperto's Chang said it is more important to get carriers involved at the early stages of WiMAX's development than it was to get them involved in Wi-Fi, because WiMAX's early success will depend most on the ease with which they can deploy it in their own transport networks.

In the long-term future, WiMAX indeed will become a last-mile access technology integrated in laptops and other end-user devices, but in the very near term, it probably will have the most viability for backhauling the rapidly increasing volumes of traffic being generated by Wi-Fi hot spots.

"The first purpose for involving carriers was to educate them about the technology," Chang said. "The next was to pump them for information on functional requirements that needed to be in the standard."

Besides contributing to the new MAC and PHY profiles, carriers also are helping the forum devise a management document with additional QOS details, Chang said.

While carrier input might be most significant in molding a technology that meets all the requirements of commercial networks, the WiMAX Forum's work ultimately must recognize opinions coming from a variety of companies of all sizes from across the industry and around the world. The group has 23 carrier members, but the rest of the more than 100 firms involved are vendors of network equipment, access products, software and chipsets.

"The reality of standards work is that people from across the industry are getting together face to face about once a quarter with calls and e-mails in between," said Carlton O'Neal, vice president of marketing at Alvarion. "The best thing you can have in that situation are a couple of companies that are leading the effort in a way that's not controlling, but helps keep things on track."

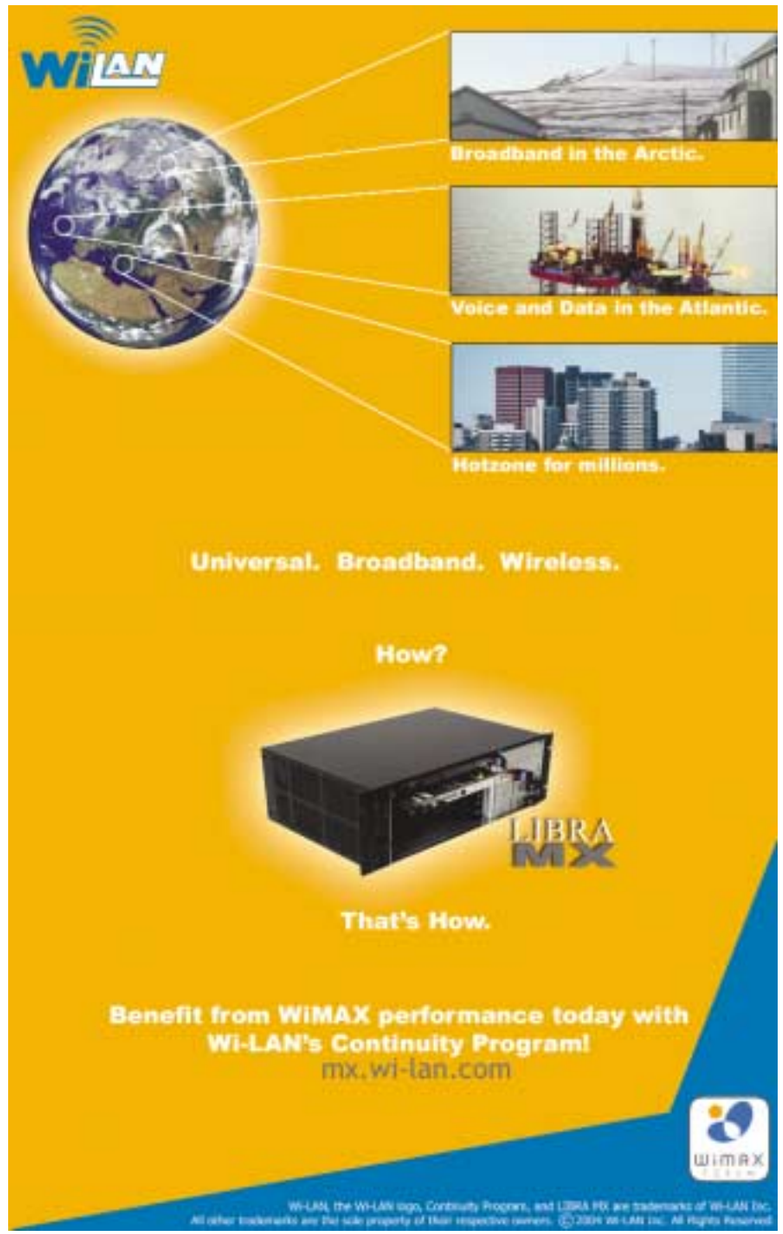
"The forum has reacted well to its growth [during] the last year or so," said Stephane Cohen, vice president of marketing at SR Telecom and a technical director of the forum.

The forum has been able to make much progress on developing its interoperability testing suites. Independent labs will be hired to conduct the initial testing that will take place in the third quarter. Afterward (possibly in November or December) the forum will hold "plugfests," events at which the first products up for WiMAX certification—probably about five or six different products from multiple vendors—will interface in live demonstrations.

"To get to the plugfest stage is the primary focus of the forum right now," said Gordon Antonello, senior technical advisor at Wi-LAN, and a member of the forum board of directors. "That will happen by very early next year."

The first round of product certifications will be released shortly after the plugfest, and the WiMAX market will be off and running.

The testing and certification processes that are occurring under the WiMAX Forum's guidance puts the technology in the best possible position it can be in for broad market adoption, giving service providers



IEEE 802.16 Standard

Source: WiMAX Forum

	802.16	802.16a/REVd	802.16e
Completed	Dec. 2001	802.16a: Jan 2003 802.16 REVd: Q3 2004	Estimate: 2nd half of 2005
Spectrum	10 to 66 GHz	< 11 GHz	< 6 GHz
Channel Conditions	Line-of-sight only	Non line-of-sight	Non line-of-sight
Bit Rate	32 to 134 Mb/s at 28 MHz channelization	Up to 75 Mb/s at 20 MHz channelization	Up to 15 Mb/s at 5 MHz channelization
Modulation	QPSK, 16 QAM and 64 QAM	OFDM 256, OFDMA 64 QAM, 16 QAM, QPSK, BPSK	Same as REVd
Mobility	Fixed	Fixed and Portable	Mobility, Regional Roaming
Channel Bandwidths	20, 25 and 28 MHz	Selectable channel bandwidths between 1.25 and 20 MHz, with up to 16 logical sub-channels	Same as REVd
Typical Cell Radius	1 to 3 miles	3 to 5 miles; Maximum range 30 miles based on tower height, antenna gain and transmit power (among other parameters)	1 to 3 miles

more affordable prices and assurances that they can create multi-vendor, plug-and-play networks.

But market success itself is not assured. Though analysts believe the WiMAX market will be worth anywhere from $2 billion to $5 billion by 2009, the defining aspects of that anticipated growth remain to be pinpointed. It's very likely that the initial service providers adopting WiMAX next year will be wireless ISPs, many of whom already are demanding pre-certified products from vendors.

"Six months ago, a lot of the WISPs saw WiMAX coming, and some of them said they wouldn't buy anything else until they could get WiMAX equipment," said SR Telecom's Cohen. "They're ready to deploy anything that will evolve to WiMAX certification because they feel it gives them a competitive advantage."

International carriers and licensed CLECs could be next to deploy. Cohen said larger carriers will take longer to adopt the technology—perhaps in 2006. They'll bring solutions in-house to administer their own batteries of tests before following with field trials, and eventually committing to deployment.

The size of those deployments will be one of the most critical factors in WiMAX's evolution. The technology has detractors who believe that product certifications will take longer than the forum hopes, that service providers will be fickle to WiMAX once those products are commercially available, and that WiMAX ultimately could prove to be of only limited potential as a broadband gap-filler in carrier networks.

WiMAX proponents believe affordability, ease of installation and interoperability will prove otherwise.

"WiMAX will be much easier for carriers to install and roll out than past broadband wireless access," Cohen said.

Alvarion's O'Neal added that for wireline telcos, WiMAX could prove less costly and easier to install than DSL, and that the progress toward 802.16e's mobile capability could help them compete better with the mobile carriers to which they are increasingly losing customers. Also, WiMAX with mobility could provide a broadband evolution for mobile carriers that have not yet decided about 3G.

WiMAX has detractors who believe product certifications will take longer, that service providers will be fickle to WiMAX once products are available, and that WiMAX ultimately could prove to be of only limited potential.

"This is something that will definitely get the interest of mobile carriers," Resnick said. "EV-DO is slower than WiMAX." Look for 802.16e to reach market deployment sometime in late 2006 or 2007.

For the time being, WiMAX proponents are hopeful about the prospect for broad market deployment, but they are also trying to keep that hope from mutating into too much hype. It's in the backs of everyone's minds that over-investment, too much marketing hype and exorbitant product cost were among the factors that killed off a previous generation of broadband wireless service providers.

"Some of the companies that started the 802.16 effort are no longer around," O'Neal said.

But WiMAX Forum members believe the mistakes of the past have helped them contribute to a detailed, revised standard and a product certification plan that broadband wireless didn't have before.

This time around, Wi-Fi also exists as a last mile complement that paves the way for WiMAX. "Conceptually, broadband wireless will now be an incremental value on top of something that's already out there," O'Neal said. "It will be a natural extension."

Eventually, WiMAX will transition from complementary status as Wi-Fi's transport partner to a potential Wi-Fi alternative. It's difficult to say when or how effectively that may happen, with the Wi-Fi hot spot boom continuing unabated for now. However, traditional telecom carriers are the most notable parties not to have participated in that boom thus far.

"Big carriers haven't made huge commitments to Wi-Fi," said SR Telecom's Cohen. "These carriers eventually could choose between Wi-Fi and WiMAX, but WiMAX is not advanced enough yet that it's forcing the decision."

On top of the work that's already been done on WiMAX, it might take some luck to make that happen—but you know what they say about luck.

"Luck," O'Neal said, "is when preparation meets opportunity." W

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WHILE NO ONE CAN ARGUE THE BENEFITS OF OWNING SPECTRUM IN THE ACCESS BUSINESS, THE WORLDWIDE SPECTRUM TABLEAU IS GIVING WiMAX ITS FAIR SHARE OF COMPLICATIONS.

THE LICENSE GAME

BY KEVIN FITCHARD

Churning in the backwaters of the WiMAX imagination, away from all of the attention and glamour the technology is gathering, lies the specter of the licensed bands. WiMAX has given hope that all of this spectrum—running the gamut from 700 MHz to as high as 66 GHz—may some day be used for broadband wireless access, living up to its original promise and hopefully the exorbitant price tags carriers paid for it.

The problem is that the licensed frequencies are a mishmash of different bands, each with separately regulated channel requirements and vastly different propagation characteristics and power requirements. To make matters worse, the diversity of the licensed frequencies isn't just spread across the spectrum chart—it's spread across the geographic map.

Broadband wireless spectrum varies from government to government, with very little harmonization across continents. Even where common spectrum exists, individual countries often apply different regulation on how that spectrum can be used.

Navigating the mess of international spectrum policy to bring the licensed frequencies into the WiMAX fold will be difficult. That's why the WiMAX Forum isn't even going to try.

"There's simply no easy way to do this," said Mohammed Shakouri, vice president of the WiMAX Forum and assistant vice president of business development Alvarion. "The mishmash of spectrum is too much to overcome. That is why we are selecting a few bands that meet the world's needs, and we've formed a regulatory group that will work towards harmonization."

Essentially, the WiMAX Forum is concentrating on two critical bands: the 2.5 GHz or MMDS band, and 3.5 GHz—by far the most abundant broadband spectrum allocated across borders. While there are other bands under consideration—and, technically, WiMAX could support them all—the forum and most of its vendor members have chosen to concentrate their energies on those two bands.

Licensed spectrum is a mishmash of different bands, with separately regulated channel requirements. The diversity isn't just spread across the spectrum map—it's spread across continents.

After all, WiMAX is intended to be a specification that enables volume sales through standardization. The goal is to generate a lot a buzz about a few spectral bands rather than little interest in numerous bands.

"We think that these few spectrum profiles will meet most of the world's needs," Shakouri said. "So far, we've had positive response. We're getting approached by many governments that want to know how they can help us work toward harmonization. We won't be able to get to everyone, but these profiles should be common enough that we can get 90% of the world."

The impact of licensed spectrum on WiMAX is most likely to be felt internationally, where the 3.5 GHz band is not only commonly distributed across borders but also handed out by many governments. After the European auctions of broadband spectrum in the early 2000s, governments netted billions— but most of that spectrum has sat idle as broadband wireless technologies fell flat of their faces.

Some governments have decided to enforce their "use-it or-lose-it" policies, creating a new breed of provider in the process.

Ireland is one of the countries that has begun redistributing its 3.5 GHz spectrum, taking it back from the big carriers and holding companies that let it lie untouched for years and handing it out free to smaller companies—with the only conditions being they actually have a wireless business plan and execute it. Leap Broadband's original plan was to deploy broadband wireless over the unlicensed 5.8 GHz frequencies, but when the government redistribution was announced, it immediately jumped on the opportunity.

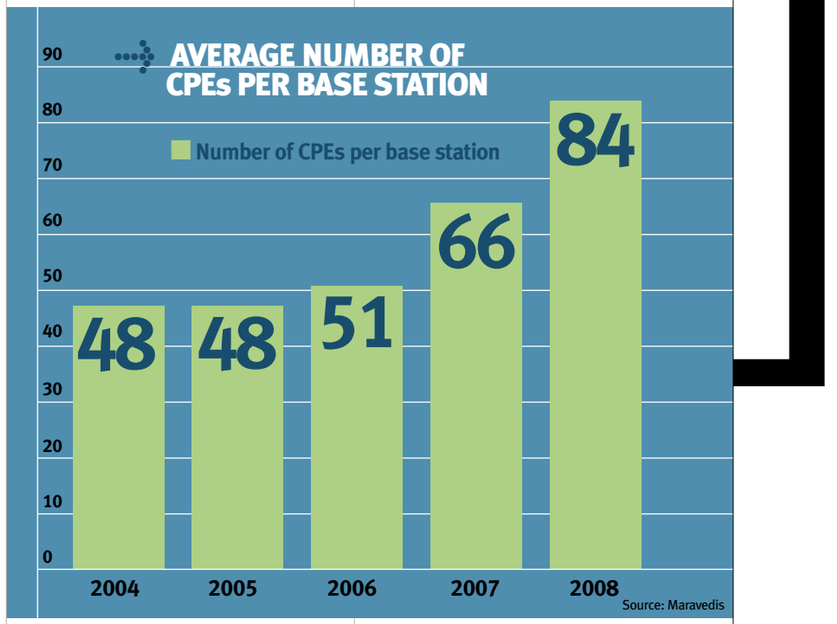
Licensed spectrum is always preferable to unlicensed, said Charlie Ardagh, director of Leap Broadband, but not always for the reasons you might think.

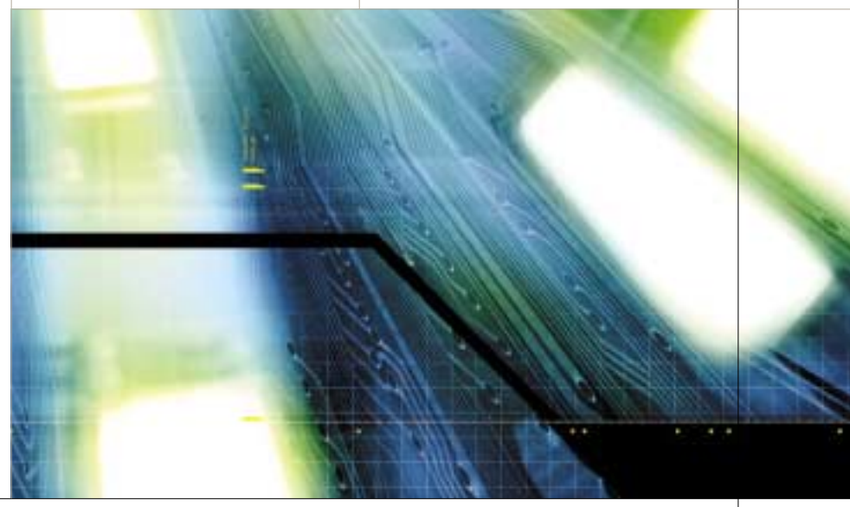
"We were having no trouble with the unlicensed bands," Ardagh said. "There's just a perception that licensed spectrum is more robust than unlicensed spectrum. The truth is they're equally robust."

But the industry being in the nascent state that is, perceptions—especially those of your financial backers and your perspective customers—are important, and the ability to market a wireless service free from interference and crowding is a key competitive tactic that Leap and other smaller players are taking full advantage of, Ardagh said.

Leap is just one of dozens of what is emerging as a new breed of smaller broadband wireless carriers in Europe, created out of the sudden availability of the 3.5 GHz bands and Europe's steep leased-line prices. While many of these carriers are still on small-scale deployments (Leap has only deployed in Dublin so far), the WiMAX specification finalization could trigger a boom for these small carriers, followed by deployments from the larger, more well-funded carriers currently sitting on their spectrum, said Alan Menezes, vice president of marketing for Aperto Networks, the vendor and forum member supplying Leap and other European carriers with 3.5 GHz gear.

"The volume opportunity for WiMAX just on the baseband side will be immense," Dean said. "Buying a laptop that will basically be ready to work on any of these networks will be an enormous advantage. And there are enough carriers





holding the spectrum that 3.5 GHz will have a lot more options than other frequencies."

As is the case with so many other wireless technologies, the U.S. is unique when it comes to broadband wireless potential. While the rest of the world is jumping on 3.5 GHz, regulation has kept those bands off of the table. While there is discussion at the FCC of opening up the similar 3.6 GHz band, most of the U.S.'s hopes lie in the 2.5 GHz MMDS held by Sprint and Nextel, which as yet have not announced their plans.

The U.S., however, is the world's single largest market, and WiMAX is expected to have a singular impact domestically—but most of that impact is expected to be in the unlicensed bands.

The difficulties of deploying WiMAX in licensed frequencies don't appear to have impeded the interest of carriers.

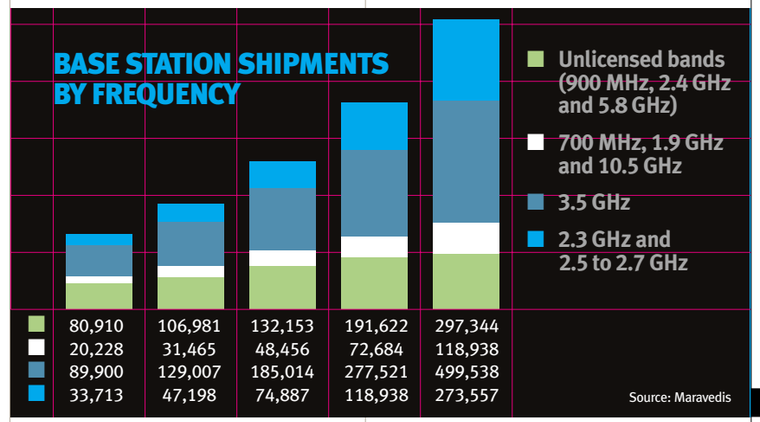
The problem with the U.S. is that there isn't a large amount of licensed spectrum, and what spectrum there is remains allocated along a diverse range of the spectrum chart. Additionally, the majority of licenses in any particular band are owned by a few national carriers, many of whom—because of their position on the spectrum chart—will be left out if WiMAX meets its lofty expectations.

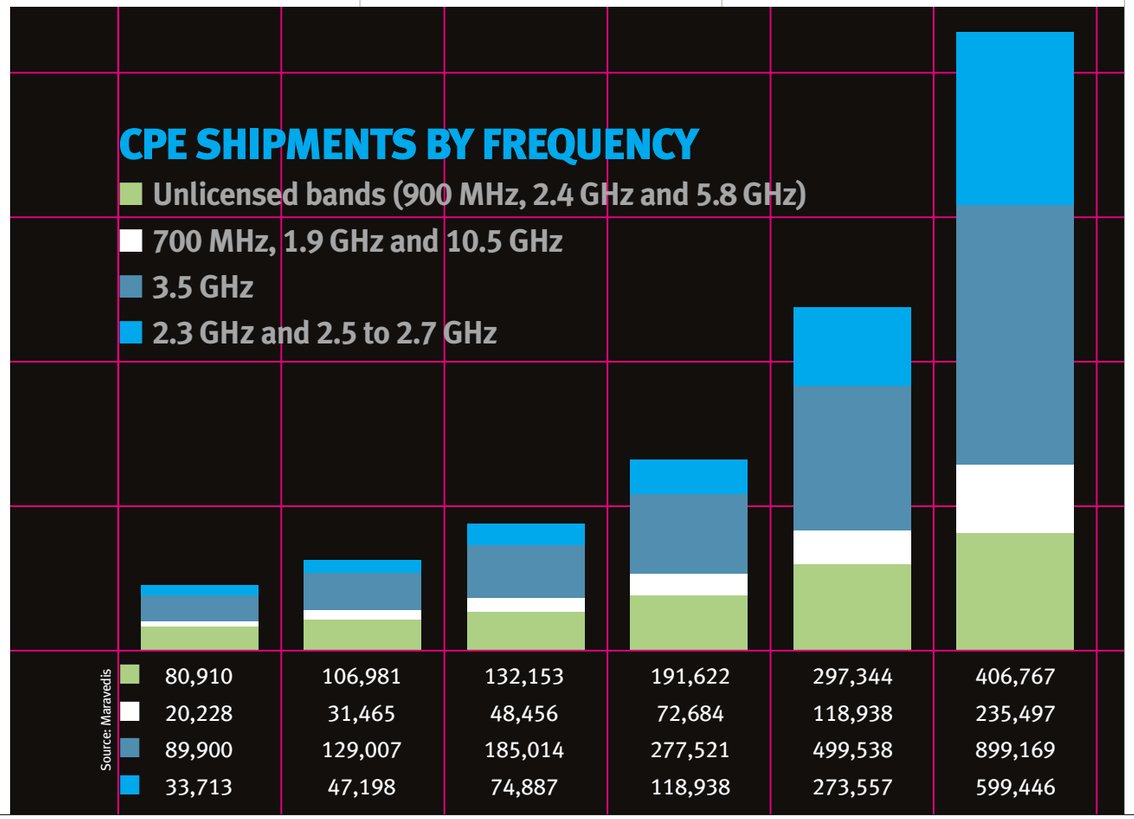
"Standards are great, but how standard can you get?" said Mel Levine, director of wireless broadband for BellSouth, which owns a good deal of spectrum in the WCS band. "We've heard talk of deploying WiMAX all the way up to 8, 9, even 10 GHz. WiMAX seems like a great idea, but eventually everything has to conform to the laws of physics. That's usually where the issues start breaking down."

The difficulties involved in deploying WiMAX in licensed frequencies in the U.S. don't appear to have impeded the interest of carriers—spectrum license-holders and non-holders alike. Companies as diverse as XO Communications (which holds LMDS spectrum, well beyond the current scope of the WiMAX Forum's efforts) and Qwest Communications have joined the forum, along with companies like Covad, which has never held, bid on or even discussed broadband wireless deployment plans in the past.

Covad, looking for alternate access solutions to reach homes and businesses behind remote terminals, is testing pre-WiMAX technology with unnamed partners over both licensed and unlicensed frequencies later this year.

"All we can say for certain is we're looking at WiMAX as a fill-in technology," said Ron Marquardt, technical director for Covad. "We're not about to go out and spend $5 billion purchasing our spectrum covering the U.S., but if it's possible to purchase, lease or partner with companies in a particular market, this could be a very exciting technology for us." W





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UNLICENSED REBORN

BY NANCY GOHRING

Scrappy start-ups have long been happy to use unlicensed spectrum to deliver broadband wireless Internet services, particularly in underserved areas. That class of operator stands to benefit by using WiMAX in the same unlicensed frequencies that have become their lifeblood.

But the large, established operators have traditionally turned their noses up at unlicensed spectrum as being unreliable and thus unusable. That's beginning to change, and many experts expect to see large operators building WiMAX networks in the unlicensed bands.

But despite the interest in building WiMAX networks in unlicensed spectrum in the United States, operators large and small will have to wait for certified gear. Vendors see the most dollar signs in international markets, so regions outside the United States will be the first to reap the benefits of WiMAX equipment.

WiMAX has Wi-Fi to thank for a growing though limited acceptance of unlicensed bands from the large carriers.

"Traditional carriers are getting more comfortable with certain uses of unlicensed spectrum," said Kevin Kahn, Intel senior fellow and co-director of Intel's communications technology lab. "Carriers that operate Wi-Fi hot spots have become much more savvy about what unlicensed might be good for."

But even though the major carriers—wired and wireless—are growing more open to the unlicensed frequencies, Kahn thinks that comfort zone only extends to using the bands in rural areas. "Unlicensed is a solution that makes good sense in rural deployments and in developing countries," he said.

Others agree. "Broadband in unlicensed has matured to the point where it's not just the entrepreneurial ISP doing it, but it is the larger carrier with the caveat that they're limiting it to rural areas," said Carlton O'Neal, vice president of marketing for Alvarion.

British Telecom, for example, has discussed using wireless in unlicensed frequencies to deliver broadband services in rural areas. Covad, AT&T and Qwest have all joined the WiMAX Forum, and none has licensed spectrum for WiMAX, so if they deploy the technology it likely would be in unlicensed bands.

But none of the major U.S. operators has actually pledged to use WiMAX or described their hopes in detail. "How they're going to do it is still uncertain," said Michael Cai, a senior analyst with Parks Associated. An operator like Covad could use unlicensed spectrum to build an entire new network. "Or, are they going to use the smaller WISPs that have already been built and aggregate those networks?" Cai said.

The large, established operators traditionally turned their noses up at unlicensed spectrum as being unreliable and unusable. That's beginning to change.

Existing wireless ISPs, whose numbers, some say, reach in the thousands, don't need convincing of the worth of unlicensed spectrum. Many of them have become well-established service providers, delivering high quality broadband solutions to businesses.

They've experienced the upsides and the downsides to using unlicensed spectrum firsthand. "The downside to unlicensed is there's no cost of entry, so anyone who has a Linksys can go in and hook it up," said Ken Upcraft, executive vice president at Usurf Americas, a broadband wireless service provider in Colorado and Arizona.

Usurf has had problems with competing in frequencies with people who put up networks without planning or thinking about others who may already be using the spectrum. But clearly the benefits to unlicensed spectrum make the business worthwhile. "The upside is, it's free," Upcraft said.

Unlicensed spectrum users may also have some advantages over licensed users. Unlicensed frequencies can allow operators to quickly meet the needs of customers who may ask to start using broadband access within a very short timeframe. "The responsiveness with license-exempt is very important to certain customers," said Kevin Suitor, vice president of business development for Redline Communications.

Unlicensed users also may have access to more spectrum. "In license-exempt, you're interference-bound. In licensed spectrum, you're spectrum-bound. You only have a finite amount that you pay a lot for and you need to use that to its greatest extent," said Suitor.

NextWeb, the operator of broadband wireless services in California, expects WiMAX to help out with some of the challenges around using unlicensed frequencies.

"Part of the WiMAX effort is to look at ways to move around interference and noise in an RF environment," said Dave Williams, vice president of marketing and business development for NextWeb.

Many WISPs are using proprietary equipment, often based on the 802.11 standard, and they are anxiously awaiting the ar-

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rival of WiMAX gear. In fact, a recent survey of WISPs conducted by ABI Research showed that more than half intend to deploy WiMAX equipment with the hope of lowering costs, both of customer premises equipment and base stations.

The interoperability of WiMAX gear will be one of the biggest benefits for NextWeb, which looks forward to having a wider choice of vendors, said Williams. He also hopes that in time commoditization will decrease the cost of gear for the operator. With that, NextWeb can address a whole new market. NextWeb's network currently covers a potential 50,000 small- and medium-sized businesses, the company's target market.

"That same coverage is home to 25 million households," Williams said. "But with the costs today, it's prohibitive to deliver the carrier class service we provide to the residential market."

Williams said he hopes WiMAX customer premises equipment will become low enough in cost to enable NextWeb to build an overlay network in its markets and begin targeting residential customers or sell the network wholesale to a well-known ISP such as AOL or EarthLink.

Existing wireless ISPs don't need convincing of the worth of unlicensed spectrum. Many already are offering broadband services to businesses.

The main difference for operators currently using proprietary gear will be quality of service mechanisms and bandwidth, said Alvarion's O'Neal. That means operators can more aggressively offer voice and video services, said O'Neal. While operators can use current gear to offer voice, "it's good but not great," said O'Neal.

In addition, WiMAX equipment will be able to handle twice or three times as much throughput as the current offerings, which means operators can take on more customers.

Despite the interest in WiMAX from the small WISPs and some of the larger operators in the U.S., the market here is expected to take a back seat to international markets. The first product that many vendors will ship will operate in the 3.5 GHz band, which is a licensed band in many parts of the world outside of the United States, said O'Neal.

"Outside of the U.S., the bands that have the most traction are the licensed bands," said Dean Chang, director of product marketing for Aperto Networks and chair of the service provider working group at the WiMAX Forum.

Gear that can be used in unlicensed spectrum here won't likely be available until late next year or early 2006, said Cai. But companies like Alvarion are selling equipment today that they pledge to upgrade to WiMAX once the WiMAX Forum finishes the specification and begins certifying gear. Cai said that WISPs will largely be accepting of such offers.

Redline expects that Western Europe will be its biggest market, followed closely by China, India and Russia. "Canada and the U.S., because of the deep penetration of DSL and cable modems, are good markets but they won't be the markets that drive the business," said Suitor.

Many international markets have more available licensed spectrum so operators may use it or a mixture of licensed or unlicensed. But regardless of which kind of spectrum is used, some say that those markets stand to gain the most from WiMAX.

WiMAX may affect economies in other parts of the world, such as India or China, much more so than here. "In a country with reasonably developed wired infrastructure, WiMAX provides a competitive capability or an advantage for customers," said Intel's Kahn. "In developing countries, there are a lot of places where there's just no practical way to extend service economically out to parts of the country where even a small amount of service could have a huge affect on the populace. I think that wireless will be very important as a way of getting a first-level service out to important markets." W

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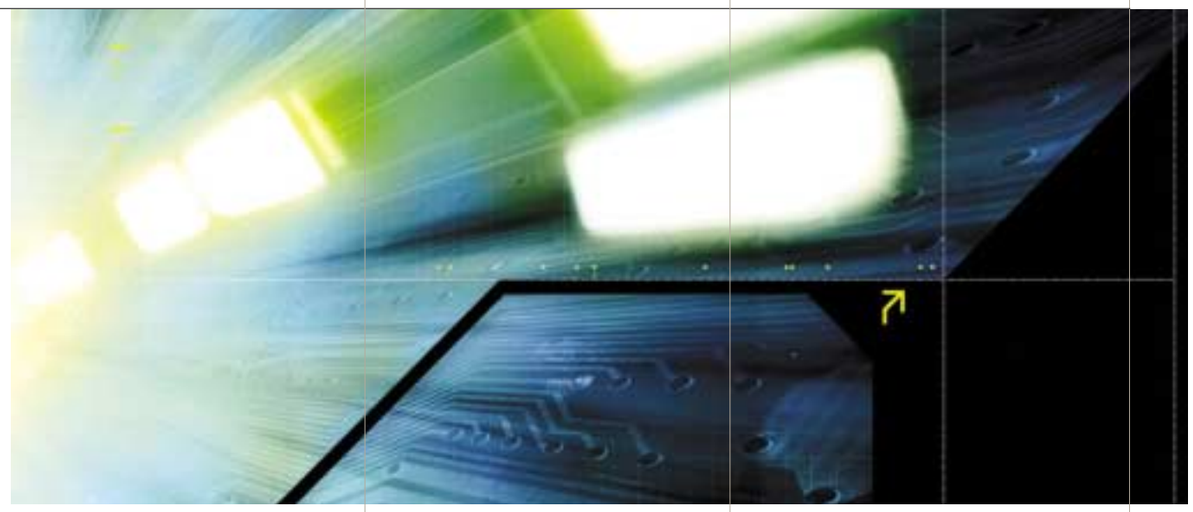

BY RON RESNICK
president of the WiMAX Forum

THE WiMAX BRIDGE TO BROADBAND

Evolution to a standards-based, interoperable, carrier-class solution gives WiMAX the trifecta needed to drive widescale deployment.

Perhaps even before the phrase "digital divide" was coined, the telecom industry has been searching for a cost-effective way to bridge the gap between the "haves" and "have nots," making broadband services accessible to all. In the U.S., cable and DSL have effectively narrowed the divide, but they're not without limitations.

The problem is far more complex in developing countries, where in some cases vast sectors of the population have limited access to even the most basic telephone services.

For service providers eager to tap into these underserved markets, WiMAX holds the promise of delivering broadband services on a ubiquitous scale. Though broadband wireless is not an entirely new technology, the evolution to a standards-based, interoperable, carrier-class solution gives WiMAX the trifecta needed to drive widescale deployment.

Service providers seeking to build broadband infrastructure in developing countries should take fiber as far as they can, then go wireless. WiMAX will allow these companies to deploy more quickly and at lower costs. For those looking to fill the holes in their cable or DSL networks, wireless is the most viable solution.

Accelerating the introduction of cost-effective broadband wireless access services into the market is the ultimate goal of the WiMAX Forum. The advent of a standards-based, interoperable solution will create economies of scale that will drive price and performance to levels unachievable with proprietary equipment.

But a standard alone is not enough to incite mass adoption of a technology. To impact and deliver broadband as we'd like to see it, the industry needs an organization like the WiMAX Forum to promote and certify that products put on the market live up to the promise of interoperability and conformance.

As such, the WiMAX Forum will conduct testing and label vendor systems "WiMAX Forum Certified," guaranteeing that products have been independently verified to be both conformant to the standard and interoperable with other vendor equipment. These systems will be scalable for up to thousands of users, and because of their interoperability, service providers will be able to purchase equipment from more than one vendor—reducing investment risk and creating a price-competitive marketplace.

Some have posed the question, "How real is WiMAX?" The answer is that WiMAX is as real as it gets.

WiMAX is not a new technology—it is a more innovative and commercially viable adaptation of a proven technology that is delivering broadband services around the global today. In fact, wireless broadband access systems from WiMAX Forum members are already deployed in more than 125 countries around the world. These leading equipment providers are on a migration path to WiMAX.

The first generation of WiMAX Forum Certified CPEs will be outdoor-installable subscriber stations akin to a satellite dish. These are expected to be available in the first quarter of 2005 and priced above $350. The second generation of CPEs will be indoor-installable modems similar to a cable or DSL modem, will be priced under $200 and are expected to be available in the Q3 2005 timeframe. No truck roll will be required with indoor-installable modems.

With the advent of a standard and economies of scale driving down price and improving performance, many analysts predict a virtual explosion in the market size for broadband wireless. In fact, In-Stat/MDR forecasts the market will grow to more than $1.2 billion by 2007.

Perhaps one of the most exciting aspects of WiMAX—one with the potential to make this a significantly bigger market—is the evolution to mobility. The WiMAX Forum is working aggressively to incorporate mobile capabilities into the 802.16 standard by the end of 2004. In the 2006 timeframe, we expect that WiMAX will be incorporated into end-user devices like notebook computers and PDAs along with Wi-Fi and Bluetooth, enabling the delivery of wireless broadband directly to the end user—at home, in the office and on the move.

In the 2007 timeframe, we expect to see WiMAX integrated into 3G phones along with Wi-Fi, providing a simplified network connection for voice and data. The WiMAX Forum is working to drive a common platform for harmonization between standards that will enable users to remain connected wherever they go.

WiMAX has the potential to be the great equalizer in broadband access. In short, bridging the gap of the digital divide has never been more within our reach. W