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A REALISTIC LOOK

AT AN EMERGING WIRELESS- BROADBAND TECHNOLOGY.

When, where, and WiMax

By Matthew Miller, Special Projects Editor

CERTAIN CIRCLES in the tech industry have been buzzing lately about something called WiMax. People are saying that WiMax is the long-awaited “third pipe”—a wireless technology that will compete with DSL and cable in the last mile of broadband networks. They’re predicting massive consumer adoption.

If that scenario sounds familiar, you’re not suffering from déjà vu. Rewind to 2000, and you’ll see that pundits back then were also pumped up about the idea of wireless in the last mile. Forecasts called for rapid consumer uptake, and major companies placed some large bets.

They lost. True, a relatively small but thriving industry today provides wireless-broadband service. But those companies largely serve rural areas in which cable and DSL are not available, or they target enterprise customers. The service providers that attempted large-scale consumer rollouts of wireless broadband—notably Sprint—took a bath.

Now comes WiMax, and everybody’s getting all worked up again. It’s no accident, by

the way, that the name sounds like “WiFi.” Although the two technologies are different (see sidebar “Surface similarity,” on the web version of this article at www.edn.com), WiMax proponents would like nothing better than to emulate the smashing success of 802.11. But perhaps because of the association, hype about WiMax is threatening to outrun reality even before vendors ship a single product.

Still, WiMax does hold promise. And, given the support it’s gathering, it’s likely to have a bright future. But how bright? And how soon?

TIGHT FOCUS

Let’s start with what WiMax is, exactly. To be accurate, it’s a marketing name that a group of companies has bestowed upon a certain type of wireless technology that adheres to certain derivations of the IEEE 802.16 standard.

The group of companies calls itself the WiMax Forum. Now boasting more than 80 members, it serves the same purpose that the WiFi Alliance serves for 802.11: promoting the technology and certifying product interoperability.

The 802.16 standard covers a lot of ground. When the IEEE approved it in 2001, it addressed wireless communications in the 10- to 66-GHz range and targeted line-of-sight, point-to-point applications. In January 2003, the IEEE approved an amendment, 802.16a, which expanded the scope to include the 2- to 11-GHz range and, more important, set the stage for point-to-multipoint, non-line-of-sight applications. (Table 1 summarizes the 802.16 standards, including approximate bandwidth and range figures.)

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When the first WiMax-certified products appear, they will likely resemble this proprietary antenna (left) and modem (right) from Aperto Networks.



The WiMax Forum is focusing on 802.16a and more specifically on one of the four PHYs (physical layers) that the standard allows. According to Dean Chang, director of product marketing for equipment-maker Aperto Networks, “802.16 is very flexible. The only way to get interoperability is to narrow down to a certain set of system options,” says Chang who also works with both the WiMax Forum and the IEEE 802.16 working group.

So, the WiMax Forum is devising system profiles, which specify combinations of parameters, such as operating frequency, modulation scheme, and channelization. When equipment companies unveil products built to those profiles, the forum will test them—in labs it is setting up now—for both conformance with the profiles and interoperability. The forum will anoint products that pass with a “WiMax Certified” label.

Then, the believers hope, some magic will occur. As soon as the 802.11 standard was established and the WiFi Alliance started certifying interoperability, we witnessed an amazing phenomenon in volume, price, and adoption, says Derek Dicker, director of marketing for the wireless broadband group at Intel. “I don’t know if the same kind of volume ramp will occur with WiMax,” he cautions, “but the same dynamic will definitely be at work.”

You should be aware of three addi-

tional facts about how WiMax relates to official standards. First, you’ll often see WiMax associated with the 802.16REVd that the IEEE expects to ratify this year. It’s best to think of REVd as a clean draft of the 802.16 standard, says Gordon Antonello, chairman of the WiMax Forum’s technical working group. REVd will incorporate all previous amendments, so 802.16a will cease to exist when REVd attains ratification.

Second, the WiMax Forum’s profiles will also be compatible with the European HiperMAN standard. “So, essentially, you end up with a global standard,” Antonello says.

Finally, the WiMax Forum also has its sights set on 802.16e, an additional amendment that’s wending its way through the IEEE. When the IEEE approves it, probably in the third quarter of this year, 802.16e will allow for portable applications.

PLAN OF ATTACK

Here’s where WiMax stands today. Intel and Fujitsu have promised to release WiMax-capable MAC (media-access-controller) and PHY chips this year. Other chip makers have signaled their intent to follow suit. Meanwhile, vendors such as Sierra Monolithics are working on the RF side of the equation.

The WiMax Forum will late this year start hosting interoperability “plugfests.” Equipment vendors such as Aperto and

TABLE 1—SUMMARY OF 802.16 STANDARDS

	802.16	802.16a/802.16REVd	802.16e
Completion date	Dec 2001	802.16a: Jan 2003; 802.16REVd: Q3 2004	Q3 2004
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 Mbps (28-MHz channelization)	75 Mbps max (20-MHz channelization)	15 Mbps max (5-MHz channelization)
Modulation	QPSK, 16QAM, 64QAM	OFDM 256 subcarriers, QPSK, 16QAM, 64QAM	Same as 802.16a
Mobility	Fixed	Fixed	Pedestrian mobility, regional roaming
Channel bandwidths	20, 25, and 28 MHz	Selectable between 1.25 and 20 MHz	Same as 802.16a with uplink subchannels
Typical cell radius	1 to 3 miles	3 to 5 miles (30 miles max based on tower height, antenna gain, and power transmit)	1 to 3 miles

Courtesy of the WiMax Forum

Notes:

QPSK = Quadrature phase shift keying;

QAM = Quadrature amplitude modulation;

OFDM = Orthogonal frequency division multiplexing

Wi-LAN are making what they term WiMax-class equipment and are vying to be the first to achieve certification. The consensus estimate says that the first WiMax-certified products will hit the market in the first half of 2005. Service providers such as BT, France Telecom, AT&T, and Qwest have joined the WiMax Forum, as well.

Intel is clearly the most vociferous proponent of WiMax and has its own vision for WiMax's ascent. The company expects in the first half of 2005 to see outdoor, professionally installed antennas providing high-speed service to businesses and "premium residential" customers. WiMax will also serve in a backhaul role, linking WiFi hot spots to the greater Internet.

In the second half of next year, Intel asserts, vendors will introduce indoor, self-installable CPE (customer-premises equipment). Consumers will be able to bring home a box resembling a cable modem, plop it down anywhere in the house, and receive high-speed service.

In 2006 and 2007, portable WiMax (courtesy of 802.11e) will enter the mix. Companies offering fixed-antenna WiMax service will be able to offer portable service within their footprints. Other companies will build networks to blanket urban areas. Manufacturers will integrate WiMax into PC Cards and eventually into laptops and other portable devices. People will enjoy high-speed connectivity at home, around town, and even while speeding down the highway.

How feasible is this scenario? That WiMax will serve enterprise and backhaul applications beginning in the middle of next year seems a safe bet. In fact, service providers such as TowerStream today make money providing these services with proprietary equipment. WiMax certification should help these companies by driving down equipment prices.

REAL-WORLD OBSTACLES

Beyond that, however, the picture gets murky. First, the industry will need to generate CPE—especially indoor, consumer-installable CPE—at viable prices. "A real stumbling block in the residential space is the self-install issue," says Ed Rerisi, vice president of ABI Research. Without such user-friendly equipment, you can forget about WiMax's becoming a mass-market success, he says.

Yet, a device that can work anywhere within a home presents a tall engineering order. "The challenge of meeting system-level requirements becomes larger as you try to penetrate walls and compensate for different materials in those walls," says Intel's Dicker. Terrain also plays a role. Intel is confident that technologies such as MIMO (multiple-in, multiple-out) antennas will meet these challenges.

Others inject a note of caution. "The idea that CPE will work in any house, no matter what, is not true," says Monica Paolini, principal consultant with Senza Fili Consulting. "Depending on the coverage that your service provider has in your area, you might prefer to have an outdoor antenna, because all else being equal, an outdoor antenna will always provide better reception."

As for price, some proprietary CPE products now go for as much as \$5000. Think about how long it took for current 802.11-based devices to reach their low prices, and you realize that the WiMax rollout might take awhile. On the other hand,

Intel and Fujitsu are now doing a significant amount of integration work, says Aperto's Chang. Once they deliver, and other chip makers join in, prices should drop.

Moving on to the question of portable clients, more challenges arise. "The overall power budget you have to design for is obviously less than for a device you're going to plug into the wall," Dicker says. Thermal and electrical envelopes become tighter, too. And issues such as authentication and handoff from cell to cell and network to network will require attention, Antonello notes. Again, these challenges aren't insurmountable, but progress will take time.

Turning to the other side of the network connection, you can find another hurdle. In general, supporting indoor antennas and portable-system users requires smaller cells, which translates into more base stations and higher capital expenditures, says Alan Mendez, vice president of marketing for Aperto Networks.

Who's going to finance that expenditure, especially when many companies have been burned by wireless broadband before? "Everyone is pitching slow, controlled growth," Rerisi says. "You won't see them blanketing an area for the sake of blanketing an area." Instead, companies will judiciously launch service in areas in which payback will be quick.

And, of course, WiMax won't be alone in the broadband access game. Cable and DSL will fight to keep their customers. And in the mobile sphere, WiMax will face competition from the various flavors of 3G cellular technology, proprietary schemes such as ArrayComm's iBurst and Flarion's Flash-OFDM, and possibly the as-yet-unfinished 802.20 standard.

SLOW BUT STEADY

"When you read these scenarios about WiMax achieving the same popularity WiFi has now, you need to think more about the 2008 to 2009 time frame," Paolini says. In the near term, you'll see small-scale, proof-of-concept trials, she predicts. The residential market won't begin building momentum until 2007. Vendor's aren't likely to ship WiMax-enabled PC Cards and notebooks until 2007 or 2008, and, when they do, the products' prices will exceed those of today's WiFi gear, she adds.

"We see subscriber growth being very slow over the next few years," says ABI's Rerisi. "It won't be an instant-turn-on kind of thing." In fact, not until 2009 will spending on WiMax equipment surpass proprietary fixed-wireless gear, ABI predicts. That same year, the number of WiMax subscribers will reach 10 million, with residential users accounting for less than two-thirds of the total, Rerisi adds.

The glow from WiFi has created not only awareness of WiMax, but also some unrealistic expectations, Paolini observes. On the other hand, the future of wireless broadband certainly looks better today with WiMax than it did a few years ago without it. □

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SURFACE SIMILARITY

How similar are WiMax and Wi-Fi? And how much will the work that the industry has already put into Wi-Fi benefit WiMax? The best answer to both those questions is “somewhat.”

Some opportunities exist to leverage Wi-Fi chip technology for WiMax devices, according to Derek Dicker, director of marketing for the wireless broadband group at Intel. For example, both technologies use OFDM (orthogonal-frequency-division-multiplexing) modulation. However, the two implementations are not identical.

Because the two technologies

operate in the same frequency neighborhoods, RF specialists will have an opportunity to “draft off of Wi-Fi work,” Dicker says. But here too, the technologies require substantially different implementations, says Dean Chang, director of product marketing for equipment-maker Aperto Networks and a member of both the WiMax Forum and the IEEE 802.16 working group. WiMax radios require higher power because they must transmit over much longer distances than Wi-Fi radios. By extension, regulatory issues play more of a role.

The fact that WiMax operates in licensed as well as unlicensed swaths of spectrum represents another big contrast with Wi-Fi, Dicker notes. Because of that difference, vendors and cross-industry organizations like the WiMax Forum must cultivate relationships with the governmental bodies that control spectrum allocation worldwide, Dicker says. “It’s a challenge for the industry, to be consistent about what areas of spectrum we’d like to deploy in, and then work with the governments to make sure that spectrum is available,” he says.

Another major point of contrast: the flexibility (or lack thereof) inherent in the standards. Whereas each 802.11 standard dictates one channel width and one frequency (either 2.4 or 5 GHz), 802.16a/REVd can work in a number of frequency bands, and the available frequency can be sliced into a variety of channel widths, says Gordon Antonello, chairman of the WiMax Forum’s technical working group. This flexibility explains why you’re likely to see widely varying numbers for the bandwidth and range capabilities of WiMax systems.