Mobile WiMax: The Next Wireless Battleground?

Steven J. Vaughan-Nichols

In the fast-changing field of wireless communications, researchers regularly try to come up with new technologies that satisfy the ongoing demand for faster data rates with longer transmission ranges and that are thus suitable for new applications. This has created a battle among proponents of the various technologies for customers in the lucrative mobile-communications field.

One of the newest technologies to join the fray is mobile WiMax, a version of traditional WiMax (world-wide interoperability for microwave access), which enables high-speed fixed wireless communications. Mobile WiMax proponents hope their approach will compete with cellular, Wi-Fi, and last-mile Internet-access technologies such as DSL and cable.

Several vendors recently released the first mobile products certified by the WiMax Forum (www.wimaxforum.org) industry consortium as compliant with IEEE standards and thus interoperable. WiMax is gaining acceptance in Asia, and vendors plan to release standards-compliant products soon in North America and Europe.

Analysts say mobile WiMax adoption might grow rapidly. In an April 2008 study, the WiMax Forum projected more than 93 million mobile WiMax users globally by 2012. This would mark a huge increase from what Eric Starnes, vice president of the Sales and Services Division of Motorola’s Asian home and networks mobility operations, estimates to be 1.5 million users today.

Because mobile WiMax doesn’t need wireline systems’ expensive and hard-to-install infrastructure, it will be particularly useful for providing basic voice and data services in the developing world and in rural areas in developed countries, said Kirsten West, principal analyst of West Technology Research Solutions, an industry-analysis firm.

“Because mobile WiMax is aimed at untapped markets, almost all vendors, including start-ups, could be on equal footing with the larger, more established players,” added Andy Bae, senior analyst with ABI Research, a market-analysis firm.

Also, mobile WiMax could be popular because it will have the bandwidth to provide voice, data, and multimedia services, said Juniper Research analyst Howard Wilcox.

However, proponents don’t plan to release the technology commercially until 2011 or 2012.

WIMAX PRIMER

Four years ago, the IEEE adopted the original WiMax standard, 802.16-2004. With this radio-based approach, carriers set up small, fixed, indoor or outdoor transceivers as base stations connected to the Internet. Each base station uses WiMax to send data to and receive it from multiple fixed subscriber antennas.

Unlike other wireless standards, WiMax allows data transport over multiple broad frequency ranges. This lets the technology avoid using frequencies that would interfere with other wireless applications.

WiMax achieves high data rates in part via orthogonal frequency division multiplexing. OFDM increases bandwidth by splitting broad channels into multiple narrowband channels—each using a different frequency—that can then carry different parts of a message simultaneously.

The IEEE ratified 802.16e—mobile WiMax—in December 2005 as a set of amendments to 802.16-2004.

How it works

IEEE 802.16e standardizes networking between carriers’ fixed base stations and mobile devices, rather than just between base stations and recipients that are both stationary. The technology delivers mobility by enabling systems to switch data transmissions from one base station to another as clients move between them.
They perform either soft handoffs, in which a station makes a connection to the next one before the switch occurs, which reduces latency; or hard handoffs, which break connections with one station for up to 50 milliseconds before connecting to the next. The original WiMax doesn’t have these capabilities.

Mobile WiMax works via modems powered by chipsets that can sit within a device or on an add-on card or motherboard.

**Added features**

Unlike Wi-Fi, mobile WiMax delivers quality of service. It assigns each participating device its own access slot, which can expand or shrink depending on network usage. Wi-Fi doesn’t use this approach and its access points can be overwhelmed by excessive requests.

Like the proposed IEEE 802.11n version of Wi-Fi, mobile WiMax works with multiple-input, multiple-output technology. MIMO uses multiple antennas as transmitters and receivers to reduce errors and improve data rates by better capturing the signals that scatter during a typical transmission.

And like 802.11n, mobile WiMax uses scalable OFDM, which increases bandwidth by splitting a data-bearing radio signal into smaller signal sets, modulating each onto different subcarriers spaced orthogonally to minimize interference, and assigning subsets of subcarriers to individual base stations.

**Rate, range, and spectrum**

Mobile WiMax can deliver a theoretical maximum data rate of 70 Mbits per second on a single channel, as Table 1 shows. However, that rate attenuates over distance. Thus, today’s WiMax Forum-approved modems support a sustained bandwidth of only 6 Mbps at a range of about a mile.

3G cellular’s maximum data rate is about 3 Mbps. Wi-Fi’s is 54 Mbps for the currently adopted IEEE 802.11g version.

Mobile WiMax has a maximum transmission range of 35 miles. Again, though, because distance lowers the available bandwidth, 10 miles is a practical range in rural areas. One mile is more likely in urban areas because structures interfere with the signals, according to Roger Marks, chair of the IEEE 802.16 Working Group.

This compares to 328 feet for Wi-Fi and three miles for 3G. Mobile WiMax has a higher range because it uses more power to send signals.

Fixed WiMax sends signals in the 10 to 66 GHz frequency range. Mobile WiMax, on the other hand, typically operates at 2.3 GHz in the Asia-Pacific region, 2.5 GHz in the Americas, and 5.5 GHz in the European Union. The WiMax Forum and vendors are also considering a 700-MHz version of mobile WiMax.

### READY FOR TAKEOFF?

Scott Wickware, Nortel Networks’ vice president of carrier networks, said he expects mobile WiMax to become a more cost-effective and quicker way to provide broadband services in rural areas and developing countries without spending a lot of time and money building a copper or fiber infrastructure to users.

Mobile WiMax has already been deployed in countries such as India, Indonesia, Japan, and Korea. There are experimental implementations in France, Spain, and the UK. Widespread global deployment is planned for the next couple of years.

Sprint Nextel plans to start deploying its Xohm (pronounced Zome) service this year despite missing a self-imposed April deadline.

<table>
<thead>
<tr>
<th>Type of wireless technology</th>
<th>Theoretical maximum data rate</th>
<th>Theoretical maximum transmission range</th>
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<tbody>
<tr>
<td>Mobile WiMax</td>
<td>70 Mbps</td>
<td>35 miles</td>
</tr>
<tr>
<td>3G cellular</td>
<td>3 Mbps</td>
<td>3 miles</td>
</tr>
<tr>
<td>Wi-Fi (802.11g)</td>
<td>54 Mbps</td>
<td>328 feet</td>
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**ROADBLOCKS**

Service providers are concerned about having enough Internet-backbone bandwidth to provide the backhaul necessary to support a potentially large number of mobile WiMax customers.

**Competition from other technologies**

Proponents expect LTE, which the Third Generation Partnership Project (www.3gpp.org) is developing,
to reach 300 Mbps downstream and 100 Mbps upstream.

Sprint claims that when it releases Xohm, it will have at least a two-year advantage over LTE, which won’t be widely deployed until 2012, according to Arun Bhikshesvaran, vice president of business strategy and chief technology for Ericsson’s North American operations.

However, because LTE builds on the existing UMTS infrastructure, which includes the world’s dominant wireless-telephony technologies, it will be deployed quickly and have more subscribers than mobile WiMax after 2015, according to ABI Research.

High-Speed Downlink Packet-Access technology is already available, from carriers such as Airtel-Vodafone, AT&T, and T-Mobile. HSDPA can reach a theoretical maximum of 14.4 Mbps downstream and 384 Kbps upstream, but its real-world speeds are considerably lower. For example, T-Mobile’s service currently tops out at 300 Kbps downstream, while AT&T BroadbandConnect HSDPA typically downloads data at just under 1 Mbps. However, if HSDPA’s performance improves, it could be more competitive with mobile WiMax.

Ultra Mobile Broadband (UMB) is another potential competitor. This TCP/IP-based technology, which the Third Generation Partnership Project 2 is developing, builds on CDMA2000 and would offer theoretical maximum rates of 280 Mbps. The 3GPP2 expects to complete work on the standard this year, with UMB appearing commercially in 2011 or 2012.

Implementation delays

Mobile WiMax network deployments have not gone as smoothly as proponents had hoped.

For example, Sprint has released Xohm only to a limited number of customers in several US cities. It has had to delay Xohm’s release in part because of trouble getting sufficient backhaul to support a widespread deployment, explained Xohm president and Sprint chief technology officer Barry West.

South Korea’s KT experienced deployment delays, and Australia’s Buzz Broadband recently discontinued its mobile WiMax offerings.

Delays in interoperability certification

For mobile WiMax to succeed on a wide scale, products must be interoperable, said Ben Ansell, Motorola’s WiMax solutions marketing manager. The WiMax Forum is addressing this by certifying products as compliant with IEEE 802.16e.

However, the certification process has been slowed by the need to establish testing standards and labs.

So far, the group has certified four base stations and four subscriber unit modules, said WiMax Forum president Ron Resnick.

The forum, which recently opened a testing lab at the University of Maryland, currently certifies jwx 2.3-GHz equipment, which works only in the Asia-Pacific area. This could inhibit growth elsewhere. However, Resnick said, the forum plans to start certifying 2.5-GHz equipment for the Americas and 5.5-GHz equipment for Europe within a few months.

Looking ahead

Carriers will initially use mobile WiMax with their 3G networks to improve the latter’s data rates, leaving the cellular network to handle voice traffic, which it can do adequately, according to Garth Collier, managing director of Intel’s WiMax Division for Asia-Pacific and Japan.

Xohm’s West said the technology will be used primarily to create wide-area Internet-access hotspots.

Julie Ask, an analyst at Jupiter Research, a market-analysis firm, predicted that wireless carriers and cable-communications companies will use mobile WiMax to better compete against telephone and satellite-based carriers for customers who want Internet, telephony, and television services.

A key to WiMax’s success will be how fast vendors can supply the necessary equipment and how quickly carriers can deploy it. And service providers will have to obtain the necessary radio spectrum and convince potential customers of the technology’s value. They will also need capital and sufficient bandwidth on their high-speed Internet backbone.

“The biggest opportunity for mobile WiMax will be to develop a wider device ecosystem and a worldwide subscriber base before LTE starts to do the same,” said ABI Research principal analyst Philip Solis.

Farpoint Group analyst Craig Mathias said he isn’t bullish on WiMax. LTE is based on UMTS technology, already the most widely used, and thus will have a long-term advantage in the marketplace, he explained.

Nonetheless, West Technology’s West predicts that mobile WiMax will be successful and will have a 198 percent compound annual growth rate worldwide over the next five to seven years.

The IEEE plans to adopt mobile WiMax 2.0—formally called IEEE 802.16m—later this year. The technology would offer data rates of 100 Mbps for mobile uses and 1 Gbps for fixed applications via enhanced MIMO technology.

If adopted on schedule, industry observers expect mobile WiMax 2.0 to appear in products by 2012.

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