IEEE 802.16* WirelessMAN* Specification Accelerates Wireless Broadband Access

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Overview: Expanding Wireless Broadband Access

Although broadband has been available for some time, access for most people is still limited. At the end of 2002, statistics showed only 46 million subscribers worldwide had broadband access and in the United States only 17 percent of households were connected (**In-Stat/MDR**). So what's the delay? The problem isn't demand, it's how access is supplied. DSL or cable connections are limited because customers:

- Are out of reach of DSL services
- Are not part of a residential cable infrastructure
- Think it's too expensive

In this article, Intel marketing manager Margaret LaBrecque, who is also president and chair of the WiMAX Forum, and Intel communications engineer D.J. Johnston explain how the new IEEE 802.16 standard and WiMAX (Worldwide Interoperability of Microwave Access) will standardize and promote wireless broadband as a wireless alternative to digital subscriber line (DSL) and cable that can help remove barriers to broadband access.

The 802.16 standard defines the Wireless MAN (metropolitan area network) air interface specification (officially known as the IEEE WirelessMAN* standard). This wireless broadband access standard could supply the missing link for the "last mile" connection in wireless metropolitan area networks.

For many home and business customers, broadband access via DSL or cable infrastructure are still not available. Many customers are outside the range of DSL's reach and/or are not served by broadband-capable cable infrastructure (commercial zones are often not passed by cable.). But with wireless broadband these barriers can be lifted. Because of its wireless nature, it can be faster to deploy, easier to scale and more flexible, thereby giving it the potential to serve customers not served or not satisfied by their wired broadband alternatives.

Wireless broadband access is set up like cellular systems, using base stations that service a radius of several miles/kilometers. Base stations do not necessarily have to reside on a tower. More often than not, the base station antenna will be located on a rooftop of a tall building or other elevated structure such as a grain silo or water tower. A customer premise unit, similar to a satellite TV setup, is all it takes to connect the base station to a customer. The signal is then routed via standard Ethernet cable either directly to a single computer, or to an 802.11 hot spot or a wired Ethernet LAN.

With the 802.16 standard, businesses and residences have a new, faster way to add broadband service. Getting DSL service from the local telephone company is often slow (and may not even be available). Wireless service is faster to deploy using 802.16-compliant equipment that enables access in a broad section of metropolitan areas. A corresponding acceleration in the deployment of 802.11 hotspots throughout metropolitan areas is expected to follow as more wireless stations are constructed.

802.16 Driving Down Costs

LaBrecque estimates that there are over 2,400 wireless Internet service providers (ISPs) in the United States, serving over 6,000 markets (ISP-Market, LLC **Broadband Wireless Access 2002**). But they use expensive, proprietary

equipment that's not interoperable with equipment from other vendors. A lack of standards has also limited the usefulness of the technology and made it hard for wireless broadband access providers to be competitive and profitable. To combat these issues the 802.16 standard was conceived.

802.16 will provide definitive standards for a carrier-class solution that can scale to support thousands of users with a single base station and provide differentiated service levels. For example, a single base station sector can provide enough data rate to simultaneously support more than 60 businesses with T1-type connectivity and hundreds of homes with DSL-type connectivity.

The benefits of 802.16 are many: by enabling standards-based products with fewer variants and larger volume production, it will drive the cost of equipment down, and having standardized equipment will also encourage competition, making it possible to buy from many sources. For areas poorly served by a wired infrastructure, including many developing countries, 802.16 will be important both for its ease of implementation and its low cost.

Wireless Roaming and Mesh Networking

The original 802.16 standard operates in the 10–66GHz frequency band and requires line-of-sight towers. The 802.16a extension, ratified in January 2003, uses a lower frequency of 2–11GHz, enabling nonline-of-sight connections. This constitutes a major breakthrough in wireless broadband access because line-of-sight between your transmission point and the receiving antenna is not necessary. With 802.16a, operations will be able to connect more customers to a single tower and substantially reduce service costs.

The latest 802.16e task group is capitalizing on the new capabilities this provides by working on developing a specification to enable mobile 802.16 clients. These clients will be able to hand-off between 802.16 base stations, enabling users to roam between service areas.

A newly formed group within 802.16, the Mesh Ad Hoc committee, is investigating ways to improve the coverage of base stations even more. Mesh networking allows data to hop from point to point, circumventing obstacles such as hills. Only a small amount of meshing is required to see a large improvement in the coverage of a single base station. If this group's proposal is accepted, they will become Task Force F and develop an 802.16f standard.

Seamless Roaming Between Networks

The IEEE 802 Handoff Study Group, chaired by Intel communications engineer D.J. Johnston, is another group chartered with addressing roaming that studies hand-offs between heterogeneous 802 networks. The key here will be enabling the "hand-off" procedures that allow a mobile device to switch the connection from one base station to another, from one 802 network type to another (such as from 802.11b to 802.16), and even from wired to 802.11 or 802.16 connections. The goal is to standardize the hand-off so devices are interoperable as they move from one network type to another.

Today, 802.11 users can move around a building or a hotspot and stay connected, but if they leave, they lose their connection. With 802.16e, users will be able to stay "best connected"—connected by 802.11 when they're within a hot spot, and then connected to 802.16 when they leave the hot spot but are within a WiMAX service area. Furthermore, having a standard in place opens the door to volume component suppliers that will allow equipment vendors to focus on system design, versus having to develop the whole end-to-end solution.

Johnston foresees the day when having either 802.16e capabilities embedded in a PDA or notebook (or added through an 802.16e-enabled card) will enable a user to remain connected within an entire metropolitan area. For example, a notebook could connect via Ethernet or 802.11 when docked, and stay connected with 802.16 when roaming the city or suburbs.

Flexible and Scalable

LaBrecque believes the 802.16 standard will also provide an important flexibility advantage to new businesses or businesses that move their operations frequently, like a construction company with offices at each building site. Instead of waiting weeks for a T1 or DSL line, wireless broadband access can be quickly and easily set up at new and temporary sites.

Additionally, the 802.16 standard is scalable. Imagine hundreds of hotspot users at a five-day conference trying to access the network. Accessing the local network would be no problem since 802.11 has plenty of bandwidth within the LAN (local area network). But what if those users want to simultaneously access the Internet, or hook up to their corporate network via virtual private network (VPN)? The hotel might have a single T1 connection for servicing its "typical" broadband connectivity use; however, for those five days, it needs a lot more bandwidth. With wireless broadband access, it's easy to ramp up service at a location for a short period of time—something wired broadband access service providers currently don't do.

The Role of WiMAX

The nonprofit WiMAX organization was formed by Intel and a number of other leading communications component and equipment companies to ensure that the interoperability issues encountered with 802.11 would not be repeated. While IEEE creates standards, they don't have a process for driving conformance, compliance and interoperability.

The WiMAX organization is charged with helping promote and certify the compatibility and interoperability of wireless broadband equipment. During the next year, WiMAX will develop conformance test plans, select certification labs, and host interoperability events for 802.16 equipment vendors. The group will also work with the European Telecommunications Standards Institute (ETSI) to align test plans for HIPERMAN*, the European broadband wireless metropolitan area access standard.

The group's efforts should help accelerate the introduction of equipment adhering to the 802.16 standard. LaBrecque puts it more simply: "If WiMAX achieves its goals, the first systems that are out of the chute that are 802.16a compliant will interoperate."

Summary

Intel participates in numerous standards organizations and working groups, believing that collaborating with other companies to define technical criteria that can be broadly adopted is beneficial, ultimately saving development time and money. Intel is also working hard to get broadband access more widely deployed in the United States and beyond, and considers 802.16 part of its vision of a billion connected PCs.

Feedback
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More Info

- See the Intel press release on WiMAX
- Visit the WiMAX Web site
- Visit the IEEE 802.16 WirelessMAN Web site

Author Bios

Margaret LaBrecque is the marketing manager for Intel's Broadband Wireless Access initiative. At Intel since 1994, she has been involved with the development of Intel platforms to support high-speed connectivity delivered via datacasting, Ethernet, cable modem and wireless. She was recently elected president of WiMAX, the World Interoperability for Microwave Access forum that advocates the IEEE* Standard 802.16* WirelessMAN* global specification.

D.J. Johnston is a communications engineer at the Computing and Interconnect Lab (CITL), part of the Corporate Technology Group. He currently works on the 802.16e standard for adding mobility capabilities to 802.16. He also chairs the IEEE 802 Handoff Executive Committee Study Group that is seeking to enable devices to hand off between networks, either across administrative domains or between networks of different types. He previously worked at Mobilian, developing multistandard LAN/PAN devices and becoming active in IEEE 802.11.

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