Report from the WCA Symposium: January 11-14, 2005: New Broadband Fixed Wireless standard (WiMAX) may be used to access Grid Computer sites

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1. Introduction to WiMAX technology and applications

The **IEEE 802.16-2004 WiMAX** technology provides wireless "last mile" broadband access in the Metropolitan Area Network (MAN) with performance comparable to or better than traditional DSL, Cable or DS1 (T1)/E1 leased line services. The term MAN as used here refers to radius of coverage, rather then to population density. In fact WiMAX technology is being used both in rural and metropolitan/urban areas to provide fixed location, wireless broadband access (based on IEEE 802.16-2004). A later version of the WiMax standard (IEEE 802.16e) will be used for mobile broadband wireless access.

Up until recently, the fixed WiMAX applications have been focused on three primary areas:

1. **Wireless DSL for Internet access:** The focus here has been primarily for rural areas with low population density or in developing countries with no wire-line infrastructure. In some cases, the WiMAX technology can cost-effectively meet the requirements of small and medium size businesses not only in low population density environments, but also in urban areas competing with DSL and leased line services.

2. **Small and Medium Business:** This market segment is very often underserved in areas other than the highly competitive big city environments. But even there, speed of deployment and built in QOS are key advantages of the WiMAX technology. The applications range from higher speed (1.5M to 6Mb/s) Internet access, replacement of one or more DS1 private lines, and wireless IP VPNs or Ethernet MANs/VLANs. VoIP over WiMAX is an emerging application for this market segment – one that Covad Communications is now pursuing on a wholesale basis.

3. **WiFi Hot Spot Backhaul:** WiFi hot spots are being installed worldwide at a rapid pace. One of the obstacles for continued hot spot growth is the availability of high capacity, cost-effective backhaul solutions. This application can also be addressed with the WiMAX technology. And with nomadic capability, WiMAX can also fill in the coverage gaps between WiFi hot spot coverage areas.

Other potential uses of WiMAX technology include **Cellular Backhaul (**using WiMAX as an overlay network with IEEE 802.16-2004 based point-to-point links sharing the PMP infrastructure), and **Public Safety Services and Private Networks (**Support for nomadic services and the ability to provide ubiquitous coverage in a metropolitan area provides a tool for law enforcement, fire protection and other public safety organizations enabling them to maintain critical communications under a variety of

adverse conditions). At the WCA Symposium, there were talks from Disney and AOL of using of fixed **WiMAX technology (IEEE 802.16-2004) to deliver "last mile" broadband video content**.

II. WiMAX (IEEE 802.16-2004) for fixed access to large Grid Computing Sites

A new application of WiMAX is now just emerging- one that has great potential for use in providing broadband access to Grid computer sites. AT&T and other long distance carriers have been interested in using **WiMAX to extend their long haul private line and broadband data networks (e.g. n x DS1, Frame Relay, IP-VPN, Ethernet/ VLANs) to business customers.** In doing so, the long distance carriers would save considerably on the access charges they would need to pay to local exchange carriers that connected to their networks. They would also reap considerable savings on operating expenses (OPEX) that they would otherwise pay for dedicated wired access lines and equipment (e.g. repeaters, remote terminals and central office terminals).

In the WCA Symposium talk on **Broadband Wireless Access: Why AT&T Joined The WiMAX Forum,** N. K. Shankaranarayanan (Shanker), Senior Technical Specialist, Access Technology and Applications Research, AT&T Labs-Research documented the cost savings in access charges that AT&T might realize through fixed broadband wireless access. As the largest CLEC in the U.S., AT&T has direct fiber optic connections to the largest business customers, with DS1 leased line connections to smaller locations. Shanker stated that **AT&T could save billions of dollars on the access charges** it currently pays to LECs and in the associated access network OPEX. Noting that dedicated access and data services are growing market segments, he opined that: **"WiMAX addresses the sweet spot for dedicated broadband access."** That is: 0-3 miles, 1 – 4 DS1's (up to about 6 Mbps), needed by many small to medium size business customers. ***AT&T will be conducting WiMAX based, broadband wireless trials in 2005. Shanker hinted that AT&T would extend their broadband IP network with last mile broadband wireless access. One could then expect an IP-VPN service to be delivered over WiMAX.***

In another WCA Symposium session, Mick Reeve, Group Technology Officer**, BT Group** explained the important role that broadband wireless will play in their **21st Century Network**. Gridtoday previously reported that the 21CN would be used as the infrastructure for **BT's managed grid interconnection service**. Please refer to:

http://www.gridtoday.com/04/1011/103940.html

Global harmonization of wireless and wire-line networks is a major goal for BT. Mr Reeve stated that the the 21 CN's standards based architecture allows BT to effectively integrate a wide range of wire-line and wireless broadband technologies, including fixed, nomadic, and mobile/ roaming. **BT would like broadband wireless initiatives and developments to merge into the NGN architecture efforts** that are ongoing in the ITU-T, ATIS, and ETSI.

Please refer to the recent **Gridtoday article on NGNs**: In Search of the Next Generation Network at:

http://www.gridtoday.com/05/0117/104474.html

Mr Reeve's noted that the IEEE 802.16 WiMAX standards effort was restricted to MAC and PHYs. Other functionality and hooks are needed for the systems aspects: QoS and CoS, radio reporting, smart antennas, interfacing to rest of network, OSS's, etc. BT is keenly interested in the mobile version of WiMAX- IEEE 802.16e - to match with their vision of mobile access to the 21CN.

Many other telecom carriers (telcos) have joined the WiMAX Forum. Besides AT&T and BT, these include: Deutsche Telecom, France Telecom, Portugal Telecom, Altitude, Qwest, SBC, Covad, Sprint, Nextel, XO Communications, Reliance Telecom, and others. There is an active **Service Provider WG** there. That WG has prioritized optional features in IEEE 802.16-2004 and has just completed a survey of WiMAX system requirements, which will be used to guide the development for WiMAX certified products. Please refer to:
http://www.wimaxforum.org/news/press_releases/WiMAX_ServiceProviderAnnouncement_FINAL.pdf

III. Summary and Conclusions

The WiMAX fixed broadband wireless technology could provide a very cost effective means for smaller computing centers to access larger grid computing sites, over a long distance network. In particular, if the access bandwidth required is on the order of 1.5M bps to 10 Mbps, the fixed version of WiMAX (IEEE 802.16-2004) technology could be used to provide the following network services:

-n x DS1/E1 private line, n=1,…6
-n x DS1/E1 Frame Relay or IP VPN service, n=1,…6
-1 to 10M bps Ethernet private line, VLAN/ Transparent LAN/ Private LAN
-Higher speed connections – perhaps up to 30 Mbps – for higher bandwidth applications

The telco providing WiMAX last mile access, could offer the above services as customer administered or as a **managed service to interconnect grid computer sites.**

A future version of WiMAX (IEEE 802.16e) might be cost effective in providing notebook PC or PDA based, **mobile access to grid sites or corporate data centers.** However, IEEE 802.16e has not been standardized yet and will face competition from a variety of 3G -like mobile broadband technologies, as well as IEEE 802.20.