WiMAX Backhaul - Wireless Ethernet is Making it Happen

Aviv Ronai
CMO, Ceragon Networks

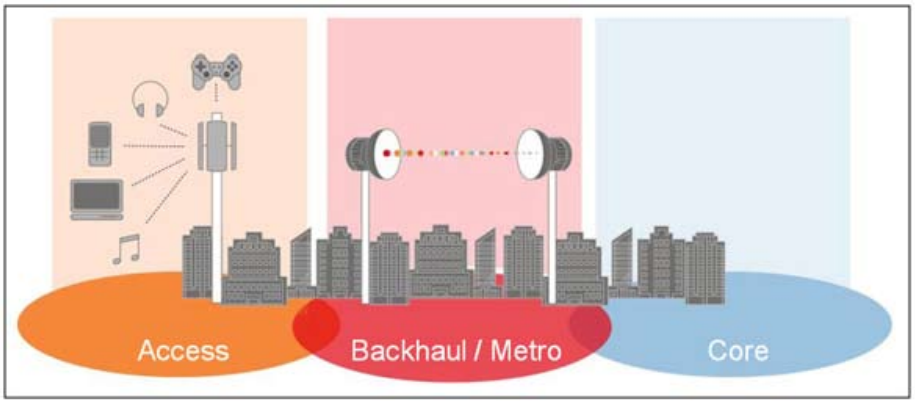
Although a good deal of attention has been dedicated to the access elements of WiMAX networks, little focus has been placed on the wireless backhaul evolution. Wireless backhaul and the aspects of the technology are critical building blocks in the implementation of any WiMAX network topology.

What's Backhaul Got to Do with it?

WiMAX Backhaul is the transport link between a Base Station (BS) and the WiMAX Access Service Network Gateway (ASN-GW). Backhaul is generally defined as the network components which connect client/subscriber access sections of networks with their core switching and management topologies. It transports considerable traffic from a POP to the rest of the network, and essentially acts as the "glue" that pieces all of the network elements together. This enables the network to deliver seamless and transparent broadband communications to its customers effortlessly, and with high reliability and availability.

For service providers who select WiMAX as their underlying technology, high-capacity backhaul is essential for ensuring continuous delivery of rich media service across high-speed data networks. If the backhaul and its components are not cost-effective, resilient, scalable and able to supply sufficient capacity, then a providers' entire network can be seriously compromised – resulting in significant customer churn.

Figure 1: WiMAX Backhaul - enables value added bandwidth-hungry services



Components of WiMAX Backhaul Architecture

The backhaul of the network is recognized as a major enabler of network performance. In order to deliver the expected bandwidth requirements of WiMAX and other newer technologies, the backhaul is critical.

Following is a list of the most critical requirements that must be addressed by any effective WiMAX backhaul architecture:

1) High-capacity - Rich media services enabler

2) Native Ethernet - WiMAX-inherent data architecture/structure

3) Accelerated and Rapid Scalability - Fast-time-to-market new service/solution design

4) 99.999% Availability - Real-time, critical services

5) QoS – Multi-service environment

6) Ultra low latency/jitter - Uncompromised, clean delivery of voice/video communications

7) OPEX and CAPEX Efficient - 4G business model success realization

Backhaul Options

A good game plan for the development of WiMAX solutions is to examine the mobile carriers' business model and learn from their network considerations. Usage of technologies for backhaul is dependent on regional factors such as regulation, fiber reach and competitive environment. This being the case, one might also expect to encounter similar trends when considering the deployment of WiMAX Overall cost of bit-per-distance, target network capacity and traffic type (all IP, TDM, or both) are the main factors which impact the selection of a backhaul solution.

While both wireless and wireline technologies can be used to build these backhaul systems, most WiMAX operators opt for wireless point-to-point (PtP) microwave solutions. This is due for a number of unique advantages offered by PtP microwave including: for a number of reasons including: quick installation, support for high-capacity data traffic, scalability and lower cost-per-bit compared to T1's and fiber. With PtP solutions, WIMAX operators can also build out their own networks therefore avoiding the need to rely on networks owned by their (incumbent) competitors. We will explore these benefits in the following paragraphs.

It is obvious that today's cost factors almost prohibit the use of wired technologies to construct a WiMAX backhaul infrastructure. For instance, the cost of deploying one mile of fiber in an urban environment can run up to $1 million. Bridging the same distance using wireless microwave link would cost less than $50k to set up – all elements and labor included. The dramatic differences in pricing are mostly due to the continued high costs of deploying fiber as well as the availability of fiber, which keeps the costs significantly higher, and requires service providers to search for alternatives.

Though copper T1 lines might cost less to deploy and lease, they have limited capacity of only 1.544 Mb. Even if a carrier uses four T1s, the maximum bandwidth that they are able to support is 6 Mbps. This falls far shorter than the bandwidth required by WiMAX backhaul networks that assume 20-70Mbps capacity per cell-site.

Currently T1 is a very cost-effective solution with relatively low costs per single T1. However, if a T1-based network needs to support higher bandwidth – in the tens and even hundreds of Mbps – the added copper lines multiplied by the cost per-line renders the technology uneconomical. In contrast, wireless backhaul solutions can offer data rates reaching up to 500Mbps over a single radio channel (aggregated capacities can reach up to several Gbps). Plus, wireless links can be deployed quickly and – where limited or no infrastructure is in place – they eliminate the costs associated with digging up the ground to lay fiber or copper.

With these examples in mind, and due to its rapid implementation cycle and scalability, it is clear that wireless backhaul is the most reasonable, cost-effective solution for WiMAX backhaul networks.

The Case for Ethernet

Combining wireless Ethernet over microwave is ideal for WiMAX backhaul. Apart from its inherent scalability features (unlike the rigid structure of T1 or STM connec-

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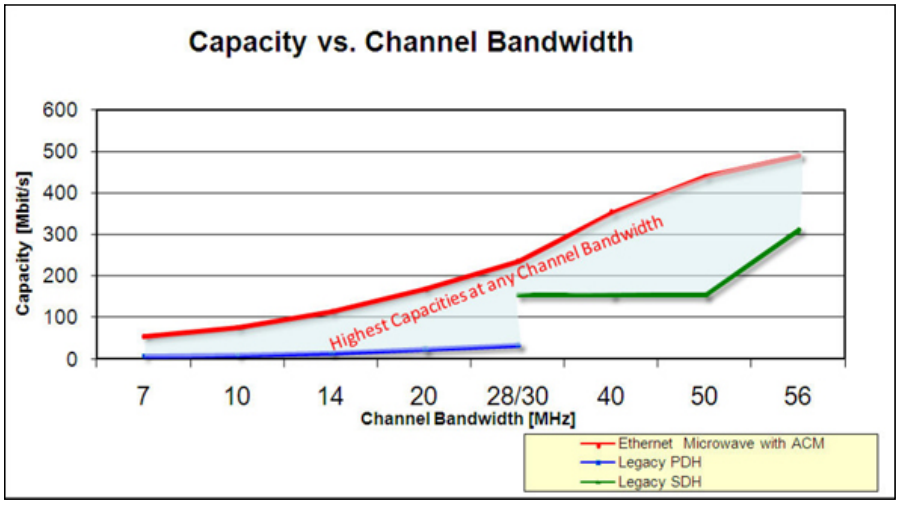
Figure 2: Wireless Ethernet - Higher Capacity at any channel bandwidth



tions) Ethernet makes for "flatter", more cost efficient network topologies.

Ethernet backhaul can be used either by mapping Ethernet over a PDH/SDH connection, or by employing native-Ethernet solutions. The advantage of native Ethernet is that packets are not mapped into fixed length frames, such as SDH virtual containers or PDH frames. Instead, packet traffic is enabled using the smallest possible overhead and with an optimal frame size for each throughput and modulation scheme. At the same time, TDM interfaces are maintained to coexist within the same frame.

Ethernet can also support ultra-high data-rates, exceeding TDM-based solutions' capacity in all wireless channel bandwidths. The diagram below shows the performance of Ceragon's FibeAir® IP-10 under different deployment scenarios compared with PDH and SDH systems.

What does the future of WiMAX backhaul hold?

WiMAX is a versatile technology, enabling different service providers to offer rich media and data-oriented services over wireless broadband networks. It fits the strategy of incumbent Telcos, cable companies, satellite operators and broadband ISPs without a wireless play to extend their services in cities and rural areas.

Meanwhile looking at the global landscape of telecom infrastructure, it is clear that wireless backhaul will support the deployment of WiMAX worldwide by improving the business case of both competitive service providers and incumbent's rural operations.

Wireless microwave backhaul provides bandwidth flexibility that the WiMAX industry has been missing. Microwave backhaul continues to thrive in places where fiber is either too expensive, or is unavailable. The recent economic downturn is making PtP microwave backhaul even more attractive as it offers a quick and cost-efficient path for new deployments or network upgrades with almost no compromise on performance and capacity compared to fiber. ■

About the Author
Aviv Ronai is a 17 years veteran of the Telecom industry. Ronai is a frequent speaker in all major industry events.

About Ceragon Networks Ltd.
Ceragon Networks Ltd. (NASDAQ/TASE: CRNT) provides high-capacity LTE-ready wireless backhaul solutions for mobile and fixed operators, WiMAX and enterprises networks.

"WIRELESS MICROWAVE BACKHAUL PROVIDES BANDWIDTH FLEXIBILITY THAT THE WIMAX INDUSTRY HAS BEEN MISSING."