Proposal Response to:

The Massachusetts Broadband Institute

for:

Call for Solutions

Dated: December 19, 2008

Nortel

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Executive Overview

Introduction

As a leader in wireless technology for over a decade, with over 1,500 wireless patents globally and significant investments in R&D, Nortel's wireless technology enhances the human experience, ignites global commerce, and secures and protects the world's most critical information. Nortel's wireless solutions deliver optimized networks, advanced technologies, and simplified service and application delivery to increase operator revenues and decrease operational costs. Leveraging our expertise in the wireless industry, Nortel's innovative solutions and platforms are designed to support all major wireless technologies -- GSM/GPRS/EDGE/UMTS, CDMA/CDMA2000 1X/1xEV-DO, WLAN, WiMAX -- and to deliver the advanced multimedia communications end-users demand.

Nortel delivers wireless networks to customers around the globe in over 70 countries, with networks deployed in 6 out of the 7 continents to over 300 wireless networks.

Nortel delivers wireless networks to customers around the globe. We provide solutions to over 70 of the world's countries with networks deployed in 6 out of the 7 continents to over 300 wireless networks. As a global leader, we support billions of calls and hundreds of millions of users.

These wireless networks and solutions can be deployed and managed by Nortel's Global Services organization. Nortel President and CEO, Mike Zafirovski, stated in March 2006, "We have identified services as one of the key strategic areas to drive our business momentum and growth." Our proposal provides details regarding our Services capabilities, specifically addressing our Managed Services and Support Services which ensure that our customers will be in a position to rapidly and effectively implement and manage their network infrastructures, services and applications for their end-user clients.

Today, Nortel is the only WiMAX vendor to deliver a breadth of solutions for both Fixed and Mobile WiMAX. Once a Service Provider Partner has been mutually agreed upon, Nortel will deliver an end-to-end WiMAX solution to meet the following objectives:

- Develop a robust, affordable broadband infrastructure that reaches un served citizens and businesses in western MA.
- Create Partnerships with one or more private sector service providers that make broadband available at price points that are consistent with markets in eastern Massachusetts and capable of uniquely positioning the region for enhanced service and bandwidth offerings.

- Build a network that:
  - Supports business, residential, and government services.
  - Is in part or whole available to other commercial providers at wholesale market prices.
  - Has a sustainable business model in which the service provider is able to continually reinvest without the need for additional capital from the Commonwealth.
  - Leverages the greatest amount of additional capital possible, whether private, federal, or other. The Broadband Institute seeks significant private and other public investment to participate alongside its own capital.
  - Incorporates a solution that applies public investment to those elements which align with the Broadband Institute's intent to own long ived, strategic, and enduring assets.

The information included with these responses is based on Nortel and the MBI engaging a mutually acceptable Service Provider partner that will deliver an end to end solution utilizing Nortel's products, solutions, and services. The end result will be a configurable, scalable, and flexible solution which will meet the evolving needs of the MBI.

Nortel is committed at all levels to the development of market-leading broadband wireless solutions, and will continue to invest and develop partnerships in support of this effort.

This RFI Response includes:

- A point by point response to the MBI's questions
- Technology overviews of:
  - Nortel's Fixed WiMAX solution
  - Mobile WiMAX offer
- Overview information on Nortel's Services capabilities.

Commitment to Industry Standards-Based Solutions

Nortel is committed to the continuing evolution of the wireless broadband industry and its increasing role in communication networks. Nortel is a principal member of all the relevant Wireless and IMS standards bodies, and promotes interoperability and certification of broadband wireless products for delivery of faster, more affordable data, voice and video services for businesses and consumers.

Investment in Technology and Partnerships

Through investments and technology development, Nortel has been, and will continue to be, a big proponent of broadband wireless technology. Our business partnerships permit us to deliver new solutions on a timely basis that meet technology requirements as well as providing Nortel world wide support and integration capabilities. Going beyond simple joint selling agreements, these partnerships are focused on ensuring that our Broadband Wireless Solutions will deliver the requirements of a carrier-class solution while supporting multiple media services, including voice, data and video.

Strong industry partnerships are essential when new or emerging technologies are deployed. By working with industry leaders and partners, Nortel can accelerate the deployment to ensure proper time to market is achieved. As such, Nortel is working closely with the industry leaders and various ODMs to ensure a fully compatible end-to-end network is achieved. Also, from an IMS perspective, Nortel is working with various industry partners such as Broadsoft, Sylantro, Mobile Tornado, Sonim, SS8, Glenayre and many others to deliver a complete turnkey solution.

Fixed WiMAX

Nortel supports the Fixed WiMAX standard. 802.16-2004 or 802.16d or 16d, also called Fixed WiMAX, delivers inexpensive, plentiful bandwidth to homes and businesses where terrestrial bandwidth is limited or non-existent today. It is also the perfect solution to solve today's last mile access problem.

Nortel has selected AirSpan as a partner to deliver Fixed WiMAX access solutions in the 3.5, 4.9, 5.4 & 5.8 GHz spectrum range. The emphasis is on cost-effective, flexible deployment options that have the service quality to support all types of applications across a fixed wireless network.

Nortel has a comprehensive end-to-end solution set, including:

- A full suite of fixed CPE
- Base Station Radio (BSR) in 1 to 6 sector configurations
- Core and Aggregation routers
- EMS 1000 Element Management System
- Full suite of Global Services

Nortel delivers first WiMAX network in Canada

Nortel supplied Netago Wireless with the Fixed WiMAX technology and expertise to deliver a fixed broadband solution into 8,000 square miles of often inhospitable terrain in Alberta Canada. The network provides citizens in this rural area wireless broadband access to online business tools, educational opportunities, and a wealth of entertainment options.

Mobile WiMAX

Nortel supports the Mobile WiMAX standard. IEEE 802.16-2005 or 802.16e or 16e, also called Mobile WiMAX, delivers all of the benefits that Fixed WiMAX offers with the added value of support for mobile devices, and thus will evolve as a super-set of today's standards with the flexibility of application in either fixed or mobile environments. Mobile WiMAX also delivers significant improvements in speed, throughput and capacity that will enable real-time services and bandwidth-intensive applications and services such as streaming music and video, video surveillance, Voice over IP (VoIP) and video conferencing.

Nortel's high-performance, end-to-end WiMAX solution will meet the MBI's objective to reach un served citizens and businesses in western MA.

Nortel is focused on delivering the right technology to fit the MBI's requirements. We deliver Mobile WiMAX access solutions in the 2.5 GHz, 3.5 GHz and 2.3 GHz spectrum ranges, with our primary focus on 2.5 GHz and 3.5 GHz. Our emphasis continues to be on high performance, flexible deployment options, cost-efficient scaling and service quality to support all types of applications across both fixed and mobile environments.

Nortel has a comprehensive end-to-end solution set, including:

- A full suite of fixed and mobile CPE
- Macro Base Station options, including conventional indoor and outdoor, Tower Top Low Noise Amplifiers (TTLNA), Remote Radio Head (RRH), and zero footprint Micro
- ASN Gateway in standard and Micro format, supporting profile A initially, then profile C, as required by the WiMAX Forum.
- Core and Aggregation routers
- NMS 5000 Network Management System with standard northbound interfaces for OSS integration
- All non-IMS CSN components, including AAA, DNS/DHCP and Home Agent (HA)

- Backhaul options, including Ethernet (optical or copper), Microwave, and a unique In-Band backhaul solution using WiMAX spectrum when available (future)
- Full IMS core infrastructure, including Application Servers
- Full suite of Global Services

"Nortel's WiMAX solution allows us to achieve the goal of affordable broadband for both business and individual customers."

Manuel Bonilla
CEO, Wind Telecom

Dominican Republic goes mobile with Nortel WiMAX
Wind Telecom will use Nortel's MIMO-powered WiMAX solutions to deliver services such as VoIP, video-streaming, and mobile broadband, to help bridge the digital divide in the Dominican Republic.

Nortel's Mobile WiMAX Solution Highlights

High Performance

Nortel's high-performance WiMAX portfolio enables the MBI to achieve the lowest possible cost per megabit performance. Nortel's many years of experience in wireless radio design, and MIMO and OFDM technologies has allowed us to combine our already state-of-the-art radio technology with leading-edge MIMO and OFDM innovations to create the most advanced radio platform in the market. Optimized for 1 Carrier 3 Sector (1C-3S) 2x2 MIMO, each transmit chain supports 14.3W Downlink (DL) power at the antenna port (28.6W/sector), has an available Tower Top LNA to boost receive sensitivity by 3dB on the Uplink (UL) increasing coverage and utilizes standard low-cost, cross-polar antennas. Nortel's MIMO supports both STTD (matrix A) for range improvement on the DL of 3dB, and Spatial Multiplexing (matrix B) for 2x capacity improvement. Nortel has also pioneered UL Collaborative MIMO, which improves UL capacity by as much as 80% by sharing a MIMO channel between two single antenna devices.

Performance continues at the ASG with two options, a standard ASG 5000 and a micro ASG 5100 version, that scale from 30 – 1,000 BTS and support up to 15GB/s of throughput (increasing to 24GB/s in a subsequent release). Capacity and connectivity are provisioned separately, providing the MBI the ability to optimize your network configuration for both performance and cost.

Delivering Fixed Services over Mobile WiMAX

Currently, Nortel supports the ability to disable mobility at the ASN Gateway (ASG), which effectively turns off the hand-off capability at all sites on that ASG. This restricts a potentially mobile device like a PCMCIA card from moving from cell to cell in a mobile fashion, but does not inhibit access in any way.

As an enhancement to this mobility control, Nortel is currently working with our AAA partner to develop a mechanism whereby the AAA returns a list of base stations during a subscriber's authentication reply. This list of base stations would be used by the ASG/BTS to determine whether a subscriber is allowed service on their serving BTS or whether their traffic should be blocked.

Standards Based

As a principal member of the WiMAX Forum™, Nortel continues to design our WiMAX portfolio to adhere to open, standard interfaces to allow and promote interoperability. This enables the rapid certification of infrastructure and broadband wireless products to drive more affordable data, voice and video services.

Nortel is leading contributor to and is committed to WiMAX Standards

A central aspect of Nortel's product strategy is delivering the WiMAX Forum's WAVE 2 certification requirements. With release 1.0 of our product, we are already 77% compliant with WAVE 2 Phase 1 requirements, and expect to achieve 100% compliance with release 2.

Nortel is a leader in MIMO. We presently hold more MIMO patents than any other company and we continue to drive the WIMAX and LTE standards community towards MIMO evolution with our Closed LOOP MIMO proposal. We've focused on delivering MIMO as the key enabler to the high-throughput potential of WiMAX and as such, our release 1 BTS hardware is all MIMO ready.

However, the WiMAX Forum includes Beam Forming as part of Wave 2 Phase 2 specifications. Nortel embraces Digital Beam Forming as it can be used in conjunction with MIMO and in certain instances will provide additional advantages to the operator. For instance, a narrow beam may provide capacity gains at the cell edge for fixed users.

Nortel has had experience with AAS / Beam forming for many years and is using this experience to deliver the right solution for WiMAX.

We look forward to working with the MBI to better understand their plans and to providing the best solution for the MBI's needs.

Quality of Service

Nortel is focused on enabling our WiMAX network to support all types of applications requiring varying levels of QOS. Nortel supports all five levels of QOS over the air as defined by the WiMAX Forum, including BE, nrtPS, rtPS, ertPS and UGS. We also support a complete end-to-end strategy for QOS, including backhaul, CSN and application server components to ensure the best possible service level for the MBI's customers.

WiMAX Ecosystem

With WiMAX, Nortel has made a unique and substantial commitment to delivering a complete portfolio of devices. As of release 1.2, our MIMO release, Nortel is directly providing Nortel/LG-branded devices. We are coordinating this development through our Terminals Center of Excellence in Taiwan, which works closely with many chipset and ODM manufacturers. Nortel is highly diversified in terms of the number of chipset and ODM partners we are working with, including Intel, Sequans, Beceem, Kyocera, Quanta, Foxconn and others. This allows us to deliver not only solid value in our branded products, but flexible IOT supporting a wide array of products.

Power Amplifier Efficiency

Nortel's patented Power amplifier (PA) technology and software defined radio allows the BTS to transmit high RF Power while consuming the least amount of power with high efficiency PA, providing as high as 50% savings in power consumption when contrasted with competitive solutions, lowering the operating expenses substantially. Nortel's Superior radio technology exceeds the regulatory RF emissions specifications lowering the risk for service providers by minimizing the interference caused by the system and also immune to interference created by other systems in the field.

BTS Modular Architecture

Nortel's Next Generation BTS Architecture that provide high performance and high power packed into a lightweight and small (1.55 Cu Ft) base station which has a modular design providing deployment flexibility and scalable capacity for growth. Nortel's modular BTS builds on field-proven elements, combining them with state of the art signal processing and radio capabilities to deliver order-of-magnitude improvements in network performance. Whether indoor, outdoor, wall mounted or stacked, this Next Generation architecture and design provides maximum savings for service providers while protecting the investment as the networks grows.

WiMAX Relays, PicoCells and FemtoCells

As the WiMAX industry initial roll-outs occur and the BTS Technology continues to evolve Nortel will be extending their WiMAX coverage through a portfolio of WiMAX 16j relays, PicoCells and FemtoCells. These products will become a focus for the selected Service Providers to as they look for a cost effective way to extend WiMAX coverage.

The MBI will be interested in these products as a way of dealing with coverage issues in small towns such as Middlefield. For example, a local residence or a local business could deploy a small FemtoCell to provide service inside the house or business. The Service Provider could consider deploying a PicoCell inside the town or use a 16j Relay to "boost" coverage in the town.

Although these products are not here today, they are in the Plan of Intent and will certainly be useful to both the MBI and the Service Provider.

Nortel is committed to working with our partners and with the MBI to explore the benefits these solutions can provide.

Key Nortel WiMAX accomplishments

Key Nortel WiMAX accomplishments include:

- Nortel's implementation of MIMO technology was adopted by the WiMAX industry and embedded in the IEEE 802.16-2005 WiMAX standard. Nortel owns over 70 WiMAX patents and has made 164 contributions to the 802.16 standard, including 57 for MIMO alone.
- Six announced WiMAX trials and wins in progress across the globe in North America, Latin America, Europe and Asia.
- Demonstrated handoff of calls among CDMA, UMTS and WiMAX at 3G World Congress in Barcelona – 2006.
- World's First demonstration of IPTV over WiMAX with IMS Core at WiMAX World, Boston.
- World's First demonstration of Collaborative MIMO in Nortel's Advanced Technology Lab.
- Nortel and Toshiba Corporation announced an agreement for the joint development of mobile WiMAX base stations for Japanese and global markets.
- Nortel established the benchmark for IOT at a recent plugfest by demonstrating MIMO A&B with four major device and chipset vendors, and SISO IOT with 12 device and nine chipset vendors. Nortel is now in high demand as an IOT partner.

- FairPoint chooses Nortel. This Fixed WiMAX deployment is the largest announced to date in the US and is being deployed in Q4 2008.
  - The company's fixed WiMAX network will save costs by using a cost-effective spectrum for transmitting its wireless services, eliminating the need to purchase or lease specially licensed spectrum for its network.
  - The WiMAX network will provide subscribers, some of whom live in rural areas and have never before been served by broadband, with the speedy connectivity needed for bandwidth-intense applications like VoIP, streaming video and online gaming.
  - Therefore, Nortel helps to bridge the 'Digital Divide' for these rural areas in Northern New England, which are currently underserved or served by dial up only.

Nortel's Global Services Deliver

Implementing major networks in new technologies can be a daunting prospect for all but the largest organizations and is always a major distraction from any Carrier's core business focus of marketing the Services and gaining new customers. When the technology is new, and skills and knowledge of the new technology are in short supply, then this 'distraction' can be a major obstacle to adoption and a major risk to ultimate success.

Nortel has extensive experience in deploying large-scale wireless networks nationwide.

Nortel Global Services is dedicated to ensuring a smooth introduction for your business and has a range of services to assist your needs.

Nortel's Global Services organization supports customers with multi-vendor and multi-technology networks by offering a services portfolio addressing business critical implementation, maintenance, managed and application services needs.

Nortel's Global Services organization provides a wide range of comprehensive "solution level" services customized to your explicit business requirements. These services are designed to speed time to market, improve ROI, reduce capital expenditures and free your resources to focus on more strategic activities. Additionally, our Managed and Support Services provide ongoing network support and evolution, matched to your specific business needs.

Nortel's Global Services portfolio includes:

- Advisory Services
- Project Management
- Network Design
- Solution Validation

- Engineering
- Installation and Commissioning
- Integration and Acceptance

In short, Nortel's Global Services team can assist The MBI with the planning and deployment of WiMAX networks either in-province or out-of-province.

Conclusion

Nortel appreciates the opportunity to participate in the MBI's evaluation of Broadband Wireless (WiMAX). We would be pleased to present our response to the Call for Solutions RFI in person, in addition to answering any questions or providing clarifications that may have arisen during your analysis of our response.

We understand the challenges that lie ahead and are recognized as a leader in deploying new networks throughout the world. Nortel's innovative technology and vast superior service offerings will ensure that the project will successfully provide higher performance, lower capital expenditures and reduced operational expenses. The MBI will enjoy a Best in Class solution.

Nortel is committed to the MBI's success and looks forward to implementing a winning solution.

We feel that Nortel is in a unique position to provide the best value to the MBI. With our large Service Provider customer base, Nortel has proven that our solutions which have been installed in our Service Provider customer's networks deliver the highest-quality, most cost-effective solution. Our strengths in the areas of VoIP, PSTN, CDMA, LTE and IMS further reinforce Nortel as a compelling WiMAX partner.

The information included with this proposal contains Nortel's responses to each of the RFI questions. Where applicable, further detail has been provided in corresponding documents, which are clearly labeled in the Attachments of our response.

In closing, we encourage you to examine the benefits that our proposal will bring to the MBI. We thank you for your consideration in reviewing our response and look forward to meeting with your evaluation team to further explain our responses and advance our business relationship.

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Key Questions for Respondents

The Institute wishes to understand different conceptual approaches to solving the broadband availability problems in western Massachusetts, keeping in mind the stated goals and objectives listed above. Specifically, the MBI is interested in an approach that weighs any potential tradeoffs that may need to be made in meeting the stated goals and objectives. The "Solutions" should describe the most appropriate technical and business models that can meet these goals as well as clearly demonstrate the economic feasibility and sustainability. Respondents should articulate the following:

TECHNICAL MODEL AND APPROACH

- What technical approach is most appropriate and why?

Nortel Response:

Solution Overview

WiMAX (Worldwide Interoperability for Microwave Access) is an exciting new technology that delivers carrier class, high-speed, wireless broadband at a much lower cost than cellular and over a much greater range than WiFi. WiMAX delivers not just significant improvements in speed, throughput and capacity to home and small business users, but also enables portable and mobile services to laptops and handheld devices. The appeal of WiMAX systems lies in the fact that they can be applied to a host of applications offered by a range of different providers – including cellular operators, wireline carriers, cable operators, MSOs and new entrants.

WiMAX makes new performance levels and new provider economics possible, transforming the business case for deployment of broadband wireless access. It creates the environment for high quality, multi-megabit services to be delivered to end users more cost effectively by creating a global marketplace and a framework for inspiring innovation. Nortel provides an end-to-end solution for fixed broadband wireless access applications. The WiMAX 1000 portfolio is highly scalable and secure, and supports services for consumers, Small Office Home Office (SOHO) users, Small and Medium Enterprise (SME) owners, and operators looking to deliver residential service, wireless backhaul or last mile access. Fixed WiMAX is ideally suited for:

- Broadband access to underserved areas and extending DSL/cable modem services to rural areas
- Replacing more expensive means of Broadband access such as DSL, cable modem services, and satellite TV.

- Backhauling traffic for wireless service providers or cable operators at a reduced cost
- Interconnecting and backhauling WiFi hot zones built on Nortel's Wireless Mesh Network solution

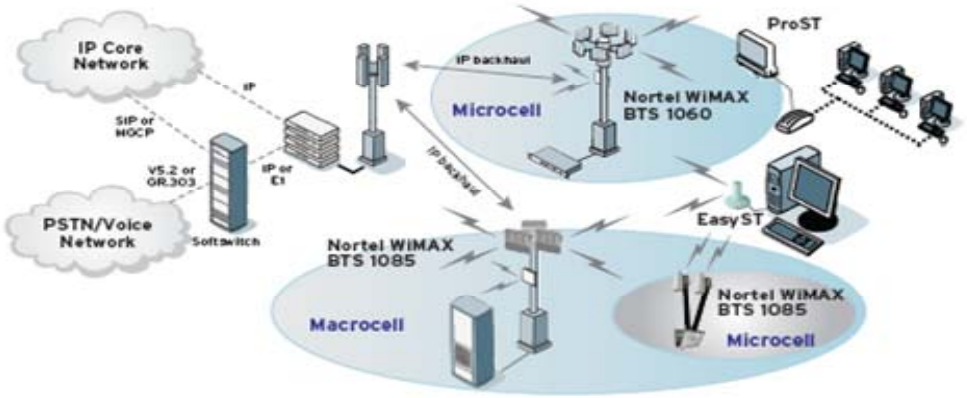
WiMAX delivers non-line-of-site (NLOS) coverage using outdoor transmitters mounted on towers or rooftops to deliver multi-megabit service in both urban and rural environments. WiMAX has two options:

- Fixed WiMAX is based on the standard IEEE 802.16-2004 or 802.16d, and
- Mobile WiMAX is based on IEEE 802.16-2005 or 802.16e that supports both fixed and mobile usage.

Each option offers distinct advantages to operators looking to deploy wireless broadband networks.

Fixed WiMAX will deliver cheap, plentiful bandwidth to homes and businesses in markets where terrestrial bandwidth is limited or nonexistent today. WiMAX 802.16e will deliver all of the benefits that fixed WiMAX offers with the added value of support for mobile devices, and thus it will evolve as a super-set of today's standards with the flexibility of application in either fixed or mobile environments. Fixed WiMAX accommodates operation in licensed and unlicensed band operation (3.3- 3.6GHz, 3.65GHz, 4.9GHz, 5.4GHz, 5.8GHz and more to follow), whereas, so far, Mobile WiMAX operation requires licensed spectrum 2.3 GHz, 2.5 GHz, and 3.5 GHz frequency bands.

WiMAX 1000: A Complete Fixed WiMAX Portfolio



Multiple BTS's, CPE's, WiMAX and WiFi, Management and Configuration System, Antenna Selection, powering options, cabling, lightning and surge protection, a complete ecosystem under one portfolio!

Mobile WiMAX

Nortel and its partners are at the forefront of the development of standards-based WiMAX 802.16e solutions embodying both MIMO and Beam-Forming technologies. These two solutions have been integrated to deliver the most efficient coverage and capacity available for high-performance, wide-area wireless networks appropriate for small, medium, and larger communities.

Mobile WiMAX delivers significant improvements in speed, throughput and capacity that will enable real-time services and bandwidth-intensive applications and services such as streaming music and video, video surveillance, Voice over IP (VoIP) and video conferencing.

Nortel offers a wide range of configurations, such as omni-directional to 6-sector configurations. Since we have developed a whole ecosystem around this new technology, we can offer our customers an integrated end-to-end WiMAX solution that includes not only the Radio Access Network but also the Core network, the Transport network (Backhaul), the Management system, the Subscriber terminals, the Application Servers, and a complete portfolio of services.

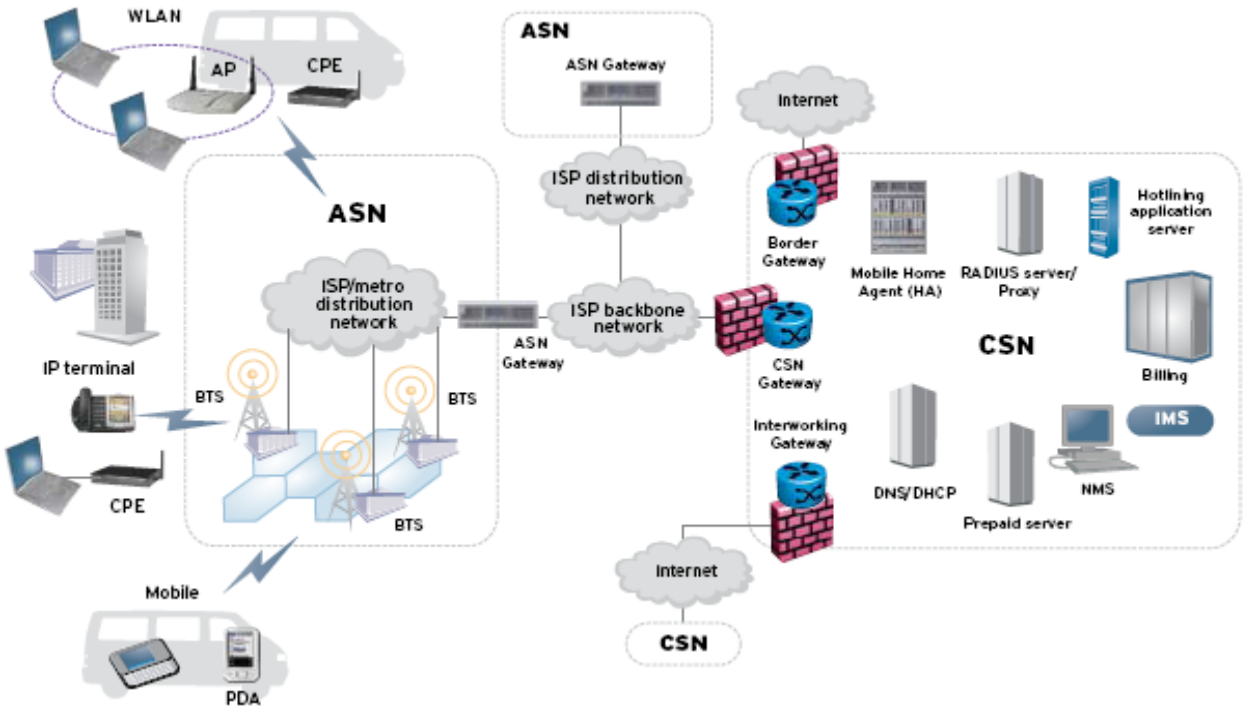


Figure: Nortel WiMAX 802.16e solution

Nortel's vision is to leverage its WiMAX solution to enable the mission critical and secure applications for Enterprises and the high coverage and bandwidth needs of consumers, wherever they may be. With the #1 VoIP solution globally and a leading suite of Enterprise solutions, including a Unified Communications portfolio in collaboration with Microsoft, Nortel is in the unique position to deliver solutions and applications to consumers and enterprises alike that drive traffic on WiMAX networks.

In executing this vision, WiMAX operators globally have shared with us their pain points: performance, end-to-end solution integration, device options and flexibility/lower total cost of ownership. Here's how Nortel is addressing these challenges:

Performance --Customers require a solution that can provide high speed broadband coverage along with the ability to deliver significant capacity as the number of subscribers and usage grows. Nortel's solution is up to the challenge. With its advance antenna technology, it provides up to 80% greater coverage for consumers than some of its competitors which equates up to 30% fewer cell sites from an operator's perspective. In addition, Nortel offers both beamforming and MIMO, two powerful antenna techniques, which double the number of subscribers in a single cell and overall capacity when compared with a standard SISO offering. Lastly, Nortel offers a redundant and highly scalable solution for the ASN Gateway, delivering up to 20 times the BTS capacity and throughput of competing solutions in 1/9th the size, which when combined with Nortel's backhaul solution can smoothly handle the traffic expected on the WiMAX network.

End-to-End Solution Integration — As a leading systems integrator in the 2G and 3G markets, Nortel has 16 years of experience across all wireless technologies and has designed and implemented over 300 networks across 50 countries. Nortel offers a complete end-to-end solution including devices, network and IP core infrastructure, backhaul, applications, professional services and Enterprise. WiMAX is an enabler of the applications that operators will offer consumers and enterprises. Nortel is the only vendor in the WiMAX industry with the #1 VoIP portfolio globally (also the #1 application requested by operators and consumers) as well as a leading-edge portfolio in Enterprise.

Variety of WiMAX devices — Nortel delivers our WiMAX solution with Wave 2 devices. We will be offering our customers a variety of WiMAX devices consisting of PCMCIA Cards, USB Adapters, Indoor Gateways and Outdoor Gateways that support the 2.3, 2.5 and 3.5 GHz frequency band. Nortel's WiMAX devices will provide greater performance in terms of increased coverage and higher capacity needed for basic broadband connection to delivery of bandwidth hungry applications such as VoIP and video. Our open, multi-vendor approach provides our customers with solution options. We are working with best-of-breed vendors such as; Beceem, Sequans and Intel for chips,

Accton and Quanta for devices, and many others to ensure that devices work with our WiMAX network infrastructure.

Flexibility, Lower Total Cost of Ownership — Nortel's WiMAX solution is exceptionally versatile, enabling different types and sizes of deployments. The access portfolio scales from 1 – 6 sectors and offers a configurable TDD ratio. Nortel is also the only vendor with both a distributed and centralized network architecture offering for fixed and nomadic applications, as well as fully mobile service offerings including wide area mobility. Lastly, delivering up to 30% fewer cell sites and a smaller ASG offering translates into lower capital and operational expenses for operators and a lower cost of ownership.

- What specific services and product offerings will be available beyond entry level, commercial Internet access (e.g. video, telephony)?

Nortel Response:

Nortel's Fixed Broadband Wireless solution allows the opportunity for Municipalities and Enterprise customers within the Wireless Coverage area to transform their voice communications with the power of Voice over Internet Protocol (VoIP) and Multimedia Communications Services. These new services, enabled by Nortel Multimedia Communication Servers, allow people to communicate as never before, enhancing productivity, mobility and personalization.

These products are the leading example of the power of IP Telephony to date because they utilize commercially available hardware and open-standards software to unite voice communications with next-generation applications such as Instant Messaging, video conferencing and file sharing. By funneling all incoming and outgoing messages through one network and one interface, users get more control over communications — essential to managing time more efficiently.

Our Call Server and Multimedia Application Server build on Nortel's extensive expertise in developing mission-critical VoIP systems that deliver true carrier-grade reliability, scalability and manageability. One of the key capabilities of Nortel's platform is that the services are independent of the access technology, so they can be delivered across multiple carrier and enterprise networks, allowing WISP partners to deliver hosted services to a multitude of customers from one central application server location.

Additionally, VoIP and Multimedia services are available through Nortel as a hosted offer, capable of being resold by our WISP partners on a price per seat basis, limiting the capital outlay required to deliver these services.

Mobile WiMAX

The end-to-end and proven nature of Nortel's WiMAX offering is reinforced through the integration of Nortel's market-leading Voice over IP (VoIP) and IMS-based solutions. These include the widely deployed Communication and Application Servers that position Nortel as the global leader in VoIP soft switching. Nortel is leveraging its Carrier VoIP portfolio to deliver VoIP over WiMAX with seamless mobility as part of pre-IMS and IMS compliant architectures.

The integration of WiMAX with an IMS 'ecosystem' provides a powerful core that becomes the gateway to new multimedia subscriber services such as music, video, gaming, presence and many other consumer and enterprise applications. In addition to VoIP, Nortel's applications offering includes solutions that provide innovative revenue-generating opportunities like Unified Communications, SMB (Small Medium Business), Digital Video Surveillance, Video conference, and others. Anchoring WiMAX access to Nortel's converged core through the CSN also presents countless Fixed Mobile Convergence (FMC) options for seamless, access-independent services across WiMAX, Wi-Fi and cellular technologies.

- What service and speed levels are achievable with your conceptual approach?

Nortel Response:

Some of the key benefits of Nortel's WiMAX solution include high data rates, low installation and operation costs, mobility, quality of service (QoS), and security. A few factors impacting speed levels could be RF receive levels, channel size, the number of subscribers, spectrum, frequency, and TDD ratio.

The **Fixed WiMAX** solution is designed to support many usage applications, including enterprise, rural and infill applications, particularly in unlicensed spectrum as the base station radiates within recognized EiRP (define) limits. Some key features of the Nortel portfolio include:

- Point-to-multipoint access and point to-point backhaul
- Burst-by-burst adaptive modulation and error correction
- High performance radios
- High spectral efficiency
- Low latency radio interface for real-time applications like voice and video
- Self-install Indoor Subscriber Terminals (EasyST) and Outdoor Subscriber Terminals (ProST) for flexible deployment options
- Receive/Transmit diversity to improve link budget

- Full IEEE 802.16 QoS/service classes
- User friendly Element Management System to manage the WiMAX network elements.

Mobile WiMAX enables connections at high data rates. A key component for delivering high data rates is the antenna technology called multiple input multiple output (MIMO).

Coverage - Mobile WiMAX offers line of sight (LOS) coverage for long range transmission and excellent non line of sight (NLOS) coverage. NLOS advantages include coverage of wide area, few BS, simple radio frequency planning, short towers, and fast install times for customer premises equipment (CPE). MIMO is very important to NLOS operation because it provides spatial diversity in addition to the OFDMA time-frequency diversity. Mobile WiMAX is able to deliver broad bandwidth in an NLOS environment.

Quality of Service - Quality of service (QoS) defines transmission ordering and scheduling on the air interface. Mobile WiMAX supports two scheduling types specified by the WiMAX 802.16e-2005 standard. ***Unsolicited grant service*** (UGS) - designed to support real-time data streams consisting of fixed-size data packets issued at periodic intervals, and ***Best effort*** (BE) - which is designed to support data streams for which no minimum service level is required and which can be handled on a space available-basis.

BUSINESS MODEL AND APPROACH

- What business models should be used or considered in the deployment of broadband?

Nortel is responding to this RFP as an end-to-end solution provider that would include hardware, software and end-to-end services. If selected as a vendor of choice, a service provider partner will be chosen and a sustainable business model will be presented.

Nortel's **Fixed WiMAX** network Solution will save costs by using free, publicly available spectrum for transmitting its wireless services, eliminating the need to purchase or lease specially licensed spectrum for its network. For example, Nortel's fixed WiMAX solution uses industry-leading technology from Airspan to run securely on the 3.65 GHz spectrum, an unlicensed spectrum band available in the United States.

Nortel's **Mobile WiMAX** solution is an IP-based wireless system that delivers significant improvements in coverage and speeds over legacy networks. These powerful attributes enable the next generation of converged voice, video, data and multimedia services to address the communication, business and entertainment needs of today and tomorrow. Existing service providers and new entrants are deploying WiMAX-based networks to redefine the end-user experience with real-

time, bandwidth-intensive applications such as streaming music and video, video surveillance, and combined voice and video communications.

Please refer to the Services Attachment for Design and Deploy service information.

- What conditions and services are necessary for a sustainable business model?

Nortel Response: Nortel is responding to this RFP as an end-to-end solution provider that would include hardware, software and end-to-end services. If selected as a vendor of choice, a service provider partner will be chosen and a sustainable business model will be presented.

Nortel's experience in deploying leading edge technologies gives us a distinct advantage in the marketplace, speed to market due to our skilled resources to plan and build, and in some cases, operate the network, as well as coordination and rigorous interoperability testing of our various partners to offer users a distinctly higher quality experience than our competitors are able to provide.

Building a network is one thing. Finding a way to profit from that network can be a bit more challenging. Building a wireless infrastructure to provide data and voice services is an impressive start, but serious consideration should be given to adding additional revenue generating applications that can increase overall take rates and customer satisfaction levels. Experience has shown us that an additional 25% to 35% of top line revenue can be captured with the right balance of applications.

- What are the implications of mandating that the Broadband Institute's expenditures be used to fund a network that is in part or whole available to other commercial providers at wholesale market pricing? How should those wholesale market prices be set?

Nortel Response: It is Nortel's experience, that offering a wholesale network is easily accomplished technically, but more difficult to make successful on a commercial basis. In areas where there are a number of existing service providers, resale of a high quality wholesale network's bandwidth will be quickly accomplished. If there are few (or zero) existing service providers, the viability of the network should be evaluated on it's own merits as a stand alone, direct to the end-customer entity, as the costs to implement and maintain an "open" network will far outweigh the benefit to the Broadband Institute's serving public.

In order to properly set wholesale market prices, a better understanding of the competitive environment will be needed. This is an area in which Nortel has extensive experience and will be willing to provide direction once more of the variables are known.

SERVICE AREA

- Can your conceptual approach reach all un-served citizens in western Massachusetts?

Nortel Response: Conceptually, Nortel's approach can reach all un-served citizens in western Massachusetts. However, this will be a business decision that MBI and the service provider partner will have to evaluate. MBI will need to consider what percentage of the citizens it wishes to cover. Please see the response below for more information.

- If your conceptual approach can not reach all un-served citizens of western Massachusetts, in what towns and areas would you expect to deploy a broadband network, and what percentage of households would you anticipate serving?

Nortel Response: Further analysis is required to determine in which areas Nortel would deploy a broadband network.

Nortel has the capability to perform this type of analysis and would be happy to work with MBI before the RFP is released.

Nortel's Consulting Services group provides services to help clients solve business, technology, and operations challenges related to strategy, planning, and the implementation of change. The Consulting Services group is comprised of a global team of skilled resources and specialized partners that provide a unique combination of management consulting skills and in-depth technology knowledge.

For companies investigating entering wireless and broadband businesses, Nortel has seen such companies encountering various business, technology, and operations challenges. Nortel assists companies with these types of challenges, often as part of a holistic planning effort that occurs well in advance (e.g., 9 to 18 months) of any equipment decision or deployment effort and that addresses and balances the special considerations of wireless and broadband businesses.

Services provided to clients are highly customized and vary widely, but in the broadband wireless space, the following consulting services are common:

Business Consulting

- **Business Plan and Wireless Strategy** including spectrum requirements, services workshops, best practices reviews, business model definition, and rollup of marketing, technology, operations, and financial considerations in business plan documentation

- **Services Roadmap** assessing service prioritization, proposed wireless services and interrelationships, target roadmap, roll-out strategies, high-level pricing models, per-service demand forecast that accounts for market growth, market penetration, service acceptance, and partnership landscape analysis
- **Marketing and Sales Plan** including detailed market analysis that refines customer, competition, and company analysis to develop tactical marketing and sales plans for pricing, product, placement, and promotion
- **Financial Modelling** including network and operational costs, revenue, componentization of full proformas by application versus core, funding requirements, sensitivity and scenario analysis, and benchmarking
- **Marketing and Sales Plan Execution Support** (also known as MarketForce services) including allocated marketing support for execution activities such as market messaging, customized collateral, sales tools, sales training, customer events

Technology Consulting

- **Network Assessment** through workshops, interviews on current network architecture and service offerings, and inventory and audit activities
- **Network and Technology Requirements** such as spectrum, subscriber bandwidth requirements, radio site coverage and capacity, site requirements, technology development, and core infrastructure for future needs
- **Applications Requirements** through Nortel's extensive resources and experience to develop and analyze technology options such as service level control (e.g., for data access tiers or packages), VoIP, streaming video, mobility services, data content, tenant metering, backup and route diversity, hotspots, etc.
- **Network & Technology Roadmap Strategy** tailored for the needs of the organization's unique situation in terms of specifying the time sequencing and organization of architecture and technology requirements (across network, devices, applications)

Operations Consulting

- **Operations Assessment** including current operations systems, organizational capabilities, and processes and procedures
- **Operations Requirements and Strategy** including future evolution of network interfacing, systems and integration, organization, and process and services requirement (including any interrelationships with customers and partners).
- **Operational Transformation** developing plans and processes to transition the organization (e.g., to handle wireless or multiplay implications about fulfilment, assurance, billing)

PARTNERSHIPS

- Could your organization provide end-to-end services or would it partner with other organizations?

Nortel Response:

Yes, Nortel can act as the prime contractor to provide an end-to-end solution. It will enable the service provider to deliver both public and private services on a single network to improve service efficiency, enhance employee productivity, expand economic development and reduce operations costs.

For specific applications that are requested, Nortel can provide 3rd party agreements. Please refer to Attachment B which identifies application partners whom we support to deliver enhanced services for the network. Nortel would be pleased to work with any application vendor a service provider may choose to engage, to deliver a seamlessly integrated solution.

Nortel has relationships established with hundreds of Partners across North America. Through our Partnership Program we leverage expertise so that Nortel can provide a full end-to-end solution (services and product) that will support the buildout and on-going support of a Wireless Infrastructure.

- How would you envision and arrange such partnerships?

Nortel Response: Nortel has a large partnership program in place today where we leverage the expertise, applications and products required to deliver and support Wireless infrastructure solutions. These partnerships are developed and managed via our Supply Chain Operations processes; these are standard operating processes at Nortel.

- What role should the Broadband Institute play with regard to inducing or enabling the formation of partnerships?

Nortel Response:

MBI should participate in the recommendation and approval of the service provider and application partnerships.

FINANCING

- What long-lived assets would it be appropriate for the state to invest in, and which privately-owned assets will complement that state investment?

Nortel Response:

A few assets worth investing in are towers and fiber loops.

In Nortel's experience, in cases where the service provider can not make a business case to deploy fixed infrastructure, it makes sense for a public entity to invest in fiber loops and towers, which in turn can be leased to multiple service providers over time.

Nortel is responding to this RFP as a manufacturer of hardware and software. If selected as a vendor of choice, a service provider partner will be introduced to address this question.

- What investment structure is appropriate and why?

Nortel Response:

Nortel is responding to this RFP as a manufacturer of hardware and software. If selected as a vendor of choice, a service provider partner will be introduced to address this question.

- How and on what terms should the Broadband Institute structure the deployment of the publicly owned assets for use by participants?

Nortel Response:

Nortel is responding to this RFP as a manufacturer of hardware and software. If selected as a vendor of choice, a service provider partner will be introduced to address this question.

- What is your perception of the Broadband Institute's financing structure for investing in and owning assets required to serve un-served areas of the Commonwealth?

Nortel Response:

Nortel is responding to this RFP as a manufacturer of hardware and software. If selected as a vendor of choice, a service provider partner will be introduced to address this question.

- What other sources of capital are available to support your conceptual model? How much capital is required to implement the proposed conceptual approach?

Nortel Response:

Nortel is responding to this RFP as a manufacturer of hardware and software. If selected as a vendor of choice, a service provider partner will be introduced to address this question.

- What experience do you have in raising capital from these alternative sources?

Nortel Response:

Nortel has experience in areas of raising capital for service providers, but would prefer not to engage those sources until the RFP stage.

PUBLIC ROLE

- How should the performance of the Broadband Institute's investments be monitored?

Nortel Response:

Nortel is responding to this RFP as an end-to-end solution provider that would include hardware, software and end-to-end services. If selected as a vendor of choice, a service provider partner will be chosen that can address this question.

- What reporting requirements are appropriate for service providers?

Nortel Response:

Nortel is responding to this RFP as an end-to-end solution provider that would include hardware, software and end-to-end services. If selected as a vendor of choice, a service provider partner will be chosen that can address this question.

- What public sector demand evaluation and stimulation efforts are appropriate?

Nortel Response:

This will vary depending upon local conditions in the areas to be serviced. Nortel would be happy to provide a greater level of specific advice on this topic once a service provider partner has been fully vetted.

OTHER

- What provisions should be included in the agreements to build the necessary infrastructure?

Nortel Response:

Nortel and its partners are able to offer a complete suite of deployment and project management services which may be used as a framework for these agreements. Specific timelines and responsibilities will be determined at the appropriate time.

- What provisions should be included in the agreements governing the use of the infrastructure?

Nortel Response:

Nortel and its partners are able to offer a complete suite of deployment and project management services which may be used as a framework for these agreements. Specific timelines and responsibilities will be determined at the appropriate time.

For information on the design and deploy services, please refer to Attachment A.

- What are the essential questions that must be resolved for the respondent so as to better inform them on the applicability of various solutions?

Nortel Response:

The Nortel Solution is dependent upon what type of Spectrum and how much is available to MBI in Western Mass. There are a number of RF related questions that would need to be answered, such as tower heights, indoor vs outdoor, etc.

In certain areas fiber may be needed for backhaul solutions, in which case Nortel would need to know the proximity of fiber locations to un-served markets.

Nortel would be happy to consult with MBI to help sort through the important questions they may have.

- What are the non financial constraints to network deployment?

Nortel Response:

Some constraints worth considering may be Product and Spectrum availability, or the network deployment time frame.

- What information can you provide to give the Institute a better understanding of where specifically broadband is currently available and where it is soon-to-be available?

Nortel Response:

Once a vendor has been chosen, in conjunction with RFP stage, we can then provide MBI a more detailed view of where broadband is deployed in Western mass.

Nortel continues to demonstrate its leadership in WiMAX, by combining leading-edge technology with the highest quality of applications and services to create the right end-to-end solution for any operator. FairPoint's Fixed WiMAX deployment is the largest announced to date in the US and is being deployed in Q4 2008. The company's fixed WiMAX network will save costs by using a cost-effective spectrum for transmitting its wireless services, eliminating the need to purchase or lease specially licensed spectrum for its network. The WiMAX network will provide subscribers, some of whom live in rural areas and have never before been served by broadband, with the speedy connectivity needed for bandwidth-intense applications like VoIP, streaming video and online gaming. Therefore, Nortel helps to bridge the 'Digital Divide' for these rural areas in Northern New England, which are currently underserved or served by dial up only.

In many rural areas, people who want high-speed Internet access have only one option: relatively slow and expensive satellite dishes. Now parts of rural Vermont could get a new choice. For example, FairPoint has 300,000 phone customers in Vermont, most of whom it acquired from Verizon Communications Inc. this year. Three-quarters of them will have access to broadband by the end of the year through their phone lines. But some phone lines in rural areas extend so far from the phone company's base that the DSL broadband signal doesn't reach the subscriber. For those, FairPoint plans to use wireless WiMAX equipment from Nortel Networks and Airspan Networks Inc.

- Are there other deployments or models used in other areas of the country or globe that could be applicable to the situation and challenges in western MA?

Nortel Response:

Sprint Nextel formally began service in September in the Baltimore metro area, with coverage extending from Waverly to Fairfield, and pockets as far out as Georgetown and Bel Air North.

The company is at least a month ahead of its internal schedule for deploying WiMAX access points with nodes already running in Baltimore, Chicago and Washington, D.C. Sprint has also begun installing equipment in Boston, Philadelphia and Dallas/Fort Worth. The average download speed of the service is expected to be between 3 to 5 Mbps, and the company plans to have a range of devices available

when Xohm launched in September including, modems from Zyxel and ZTE, a PC card from Samsung, and Nokia's WiMAX tablet.

With most American mobile data networks busy trying to deliver third-generation (3G) mobile wireless access to traveling businesspeople, Sprint's newly launched Xohm service takes a giant step forward by offering America's first 4G system. Based on WiMAX technology, it can deliver broadband data speeds to notebooks, Internet tablets and eventually smartphones.

The location-aware technology will be available on a wide range of products using the Xohm network from laptops to mobile handsets to car navigation systems and even digital camera's.

Sprint is also making the application programming interfaces for XOHM available so that developers can create new services for Xohm devices.

The specific location-based services that will be available at launch include: uLocate Communications, which will offer its Buddy Beacon technology for tracking friends as well as its Where platform for accessing local information about restaurants, news, events and weather; Yelp, which provides local business reviews of restaurants, doctors, and more; Eventful, which offers local event listings with a map view; Topix, which provides local news; Navteq, which offers real time local traffic information; Accuweather, which offers local weather; and Google, which will offer its local search.

Texas based AMA/TechTel is perhaps the largest broadband wireless carrier in the US with over 8,700 broadband fixed wireless customers. It adds about 200 new wireless subscribers monthly. Today AMA/TechTel is also a competitive local exchange carrier (CLEC) with some 30,000 total subscribers on voice, dial, wireless and other services. It owns a multi-dwelling-unit (MDU) company and a structured cabling service.

AMA/TechTel's network of 100 markets spans more than 25,000 square miles of both metropolitan and ultra rural markets as small as 21 households and as big as 200,000. It holds no licensed spectrum, although it would be interested if such were available. It heavily invested in voice over Internet Protocol (VoIP) service and uses wireless gear from Alvarion, Motorola, Aperto, Ceragon, Avantri, Axxcelera and others---the bulk being Alvarion product.

CommSpeed also has a large broadband wireless carrier in the US, they are based in Northern Arizona, and is primarily a licensed band carrier. It sports over 6,000 subscribers served by a network encompassing 27,000 square miles it is very representative of a larger licensed band rural carrier.

Until recently the company continued to field first generation 2.5 GHz licensed band gear, partly because its geography (low tree cover and advantageous high-ground relay sites) made it very tenable.

However, the company controls licenses in the Midwest where tree cover is a significant issue. Currently CommSpeed uses 5.8 GHz unlicensed spectrum for backhaul with licensed at the edge.

Comstar-United TeleSystems, Russia's leading integrated telecommunications service provider, announced in August 2008 that it has chosen Nortel's mobile WiMAX solution for its network in Moscow. The new Comstar WiMAX wireless broadband network will provide users with high-speed Internet access to support mobile applications. Comstar will use WiMAX to provide mobile Internet services throughout the city, giving its subscribers broadband access similar to their wireline home services. Comstar subscribers will be able to use the mobile WiMAX network to access popular e-mail clients and on-line games or catch up with friends using social networking sites.