White Paper

PROXIM WIRELESS NETWORKS

THE BROADBAND WIRELESS ACCESS MARKET

Evolution of the WiMAX Standard

Executive Summary

Enterprises, Internet Service Providers, and Mobile Network Operators are all looking for cost-effective ways to move voice and data amongst multiple, separate locations at broadband speeds. Copper and fiber optics solutions often fall short due to up-front costs, recurring leases from telecommunications companies, and lack of flexibility to scale with the operating organization. Broadband Wireless has emerged as a means to fill these gaps and provide a lower total cost of ownership than wired solutions, while maintaining or exceeding the reliability and performance of those technologies. This paper discusses the current Broadband Wireless Access (BWA) market, its potential for growth with the introduction of WiMAX Forum Certified™ products, and Proxim's role in the development of seamless mobility solutions using future WiMAX Forum Certified products.

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Current Broadband Wireless Access Market

In recent years, the use of Broadband Wireless Access (BWA) solutions to solve connectivity needs for both commercial and residential applications has surged in popularity. Overall system costs have dropped dramatically from the initial BWA deployments made using Multichannel Multipoint Distribution Service (MMDS) technology in the 1990's. The use of license-exempt radio frequency spectrum has enabled thousands of service providers to offer competitive services to leased lines, ISDN, DSL, and cable modems. Today, the BWA market is shifting from initial small-scale installations to large-scale regional and national deployments as confidence in the technologies and the ability to achieve profitable business models accelerate. As the chart below illustrates, accelerating demand for broadband connectivity around the world in residential and commercial settings continues to drive the BWA market.

Figure 2: Worldwide sub-11GHz subscriber base - 802.16a and proprietary
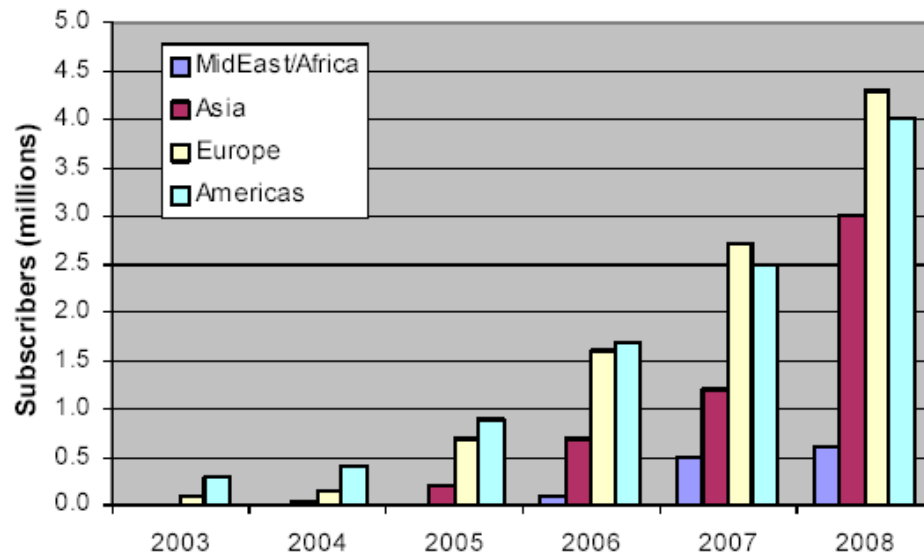
Source: Intel Capital

BWA successfully serves a variety of market and application needs today from Last Mile Access to Video Surveillance to Metropolitan Area Networks.   BWA has been proven as a reliable technology with deployments around the world.

Last Mile Access

As total Internet access subscriber rates rise by leaps and bounds each year – DSL and cable modem subscriptions grow 10% quarter-over-quarter in the US alone[1] – Internet Service Providers of all sizes and kinds are facing a challenge: differentiation of service offering in a competitive market. Further, providers must address customer demand for quick service delivery and high-speed network access at a low cost. The price associated with customer acquisition costs and ongoing last mile maintenance puts pressure on service providers to find new ways to cost-effectively deploy differentiated Internet access services to large numbers of customers.

BWA solutions give wireless ISPs and DSL/cable providers today's fastest pathway to new markets and revenue. Whether well-established and looking to expand, or smaller and newly established – service providers of all types can immediately and cost-effectively create BWA networks or reach out from established points-of-presence to capture new customers. Without the delays and costs of leasing or building a wired infrastructure, BWA networks allow secure and reliable access to high-speed data, voice and video services. Internet access can be extended to business parks, apartment complexes, school districts, and even rural communities several miles/kilometers away – all in a matter of days.

BWA Advantages

- Faster time to market and lower Total Cost of Ownership than traditional leased lines

- Flexibility in service delivery using shared or dedicated bandwidth

- Scalability to handle rural and urban subscriber densities on the same infrastructure

- Meets or exceeds security, performance and reliability of leased line networks

NoWire, a Swedish distributor of wireless solutions has seen success using Proxim's proprietary Tsunami MP.11 family of BWA products to solve last mile access needs for their service provider customers. "We have had great results with Proxim's Tsunami MP.11 and the optimization provided by the WORP protocol," says Michael Blomqvist, Sales and Marketing manager of NoWire. Current BWA solutions enable community-sponsored wireless networks to sprout quickly and gain rapid adoption across the Nordics.

Another example of this trend is demonstrated through announcements made by two of China's largest telecommunications providers, China Telecom and China Unicom. As the demand for both high-speed Internet and voice services has increased across numerous provinces, each saw the need to offer BWA solutions to their residential and commercial customers. Proxim's 5.8 GHz license-exempt BWA product line has been selected to meet market demand for these services beyond the capacity available using licensed spectrum or wired methods of access.

In all cases, service providers offering last mile access solutions using BWA have required high-capacity, scalability, and fast, simple installation.

Security and Surveillance

Institutions of all kinds - from shopping centers to transportation systems to military bases - are being challenged to install video surveillance in areas that are too remote, too costly or physically impossible to reach with traditional cabling.

Specialized BWA security solutions simply leap over these barriers, allowing a virtually unlimited number of video surveillance cameras to be deployed quickly, easily and cost-effectively in a new or expanded security system. High-resolution, real-time video from each security camera is transmitted

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[1] Source: Leichtman Research

directly to a BWA base station in the on-site security office or regional security center. From here, the wireless network can remotely control the cameras.

Current BWA solutions are available in a wide range of capacities and ranges, from economical solutions for campus and mall security to mission-critical regional Homeland Security systems spanning thousands of square miles. Coupled with Wi-Fi solutions for remote monitoring, wireless is ideal for providing surveillance coverage within around buildings and wherever you are.

BWA Advantages

- Eliminates the massive costs and delays of trenching for fiber

- Quickly deployed and reconfigured - operational within hours

- Deploys virtually anywhere -- rugged terrain, bodies of water, remote areas

- Carrier class 99.995% availability ensures non-stop security

- Enables real-time transmission from and control of surveillance cameras

An excellent example of a BWA-driven Video Surveillance network in action was deployed in 2003 by the California Department of Transportation in the United States. Responsible for much of the state's transportation systems including highways, bridges, and tunnels, the organization had to provide a long-term solution to the security challenge posed by the terrorism of 9/11. With costs approaching $1 million per day to have National Guard and US Coast Guard personnel physically present on the seven bridges and two tunnels in the San Francisco Bay Area under the watch of Caltrans, emergency funding was appropriated to implement the world's largest IP video surveillance project.

The initial network called for fiber optics to be laid over the 2,000 square miles blanketed with video cameras and other sensory equipment. But budget limitations did not accept the bid. When the network transport connecting the more than 250 camera locations to the state's fiber optics system was replaced using BWA, budget constraints and the ability to grow the network affordably over time were met. This successful BWA deployment was quickly followed by a similar surveillance system installation at the nearby Port of Oakland seaport.

Metropolitan Area Networks

Networks evolved to enable sharing resources and ideas – and nowhere is the original concept of sharing more present than in Metro-Area Networks. Hot spots are great for the mobile individual, LANs connect a group – but MANs bring people into a community and assist them with social, educational and career challenges. MANs reach the highlands and islands of Scotland to bring university learning to rural students. MANs bring the Internet to villages in India, which aren't even reached by proper infrastructure. In more urban areas, metro networks bring civic groups together – such as government agencies across a city or county – and allow the extension of low-cost Internet access to the community. However, there are two substantial barriers to this community network sharing. First, the cost of leasing or installing fiber across a county or Indian plain would be impossible to fund. Second, the right-of-way required for digging trenches would be impossible to secure.

Current BWA technologies address these two barriers readily. Wireless radio transmissions go where wires can't go – or can't affordably go. Leasing fiber optic lines or installing new cabling to connect corporate offices and rural villages alike is an expensive recurring cost. BWA eliminates that cost. High-speed point-to-multipoint links offer high bandwidth at a fraction of the price – and bring the benefit of fast, easy installation. Networks are installed in weeks, not months, with very limited (if any) right-of-way installation requirements. With a wireless MAN, communities connect and share as never before possible.

BWA Advantages

- Extends, replaces or backs up existing fiber infrastructure within hours

- Eliminates fiber trenching and leased line costs

- Overcomes natural and man-made obstacles to fiber

- Bridges "digital divide" by affordably connecting communities

- Empowers rapid expansion into new markets and increased revenues

Campus Connectivity

Today, organizations worldwide are enhancing the mobility and productivity of their professional staffs with BWA networking throughout their corporate facilities. Current BWA campus networking solutions provide flexibility for fast-changing organizations – enabling them to easily redeploy or expand their workforce and facilities without the substantial delays and expense of installing cable or leasing lines.

Current BWA solutions utilizing standards-based Ethernet interfaces enable end-to-end wireless networks to be deployed in days – connecting buildings across an entire campus.

BWA Advantages

- Extends a wired or wireless LAN for instant network access anywhere

- Significantly reduces costs of moves, adds and changes

- Enables a converged voice and data network

- Campus networking solutions eliminate leased line and install in hours

Trillion is a service provider in the southern United States who has rapidly become of one the largest users of today's BWA systems for connecting schools to the Internet. According to the Bedford School System in Tennessee, the Trillion wireless networks saved the school system over $100,000 per year compared to the services provided by a previous ISP. Trillion has already provided these benefits to schools serving over 400,000 students.

Key Criteria for Successful BWA Deployment

In all of the applications described above, BWA has proven itself as a technology that delivers reliable transport and allows the development of profitable business models. Key criteria that define a successful BWA solution include:

Reliable, proven technology

BWA technology can be deployed not just for best-effort, but also mission-critical links. Connections can be designed to provide 99.995% RF link availability over a one-year period. Because BWA systems have been proprietary to their vendor, security has never become a barrier to deployment. Systems include password-protection, scrambling or encryption of data, and proprietary methods of communicating over the air. In fact, there are no known incidents of BWA system security being compromised.

Equipment cost points allow for profitable business models

Initial BWA deployments utilized Multipoint Microwave Distribution System (MMDS) in licensed frequency bands and did not offer equipment costs that enabled a viable business model for any of the carriers who invested in the spectrum. Spectrum was auctioned off by the FCC in the United States for top-dollar and acquired by a select few carriers. Base Stations cost in excess of $80,000 each and Subscriber Units cost over $5,000 each.

Current BWA systems have made significant advances in reducing the cost of the equipment while providing an increased level of performance. Base Stations now cost under $10,000 and Subscriber Units can be acquired for under $300, levels that could only be met by DSL or cable CPE in years past. BWA Base Station Units range in performance from 6 Mbps to 54 Mbps usable throughput per sector and are able to scale to meet the needs of the operator and their clientele.

Unlicensed spectrum creates competitive environment

MMDS systems were only available in a specific frequency band and available through licenses from the regulatory agency. This method limited the number of operators in a given geography to only one. The success of BWA in that market became dependent on the success of that one operator. Today, there is a large swath of unused spectrum as a result of those operators not succeeding with their MMDS deployments. In the last three years, the use of license-exempt spectrum has been an attractive way for a competitive BWA market to emerge. Operators can enter a market quickly and with minimal expense to provide either the first broadband connection or a competitive service to wired offerings.

The Next Stage – An Interoperable Industry Standard

While movement to unlicensed spectrum as the technology basis for BWA solutions has jumpstarted growth and realized significant benefits for customers, further gains are limited by lack of an industry standard and certified interoperable products. Similar to the Wireless LAN (WLAN) market in the late 1990's, adoption was strong in several vertical markets, but the technology was not broadly adopted in enterprise and consumer markets due to lack of standards and interoperability

Recognizing this same scenario, the key industry standards bodies and vendors have come together to solve this problem. To create a common industry specification, the IEEE established the 802.16 technical working groups to study broadband wireless systems. While this specification defines much of how a BWA system should operate at a system-level, a great amount of flexibility also exists within the specification for parameters such as frequency band, modulation, and channel bandwidth. In addition, there is no means for verifying conformance to the ratified specification or a means to test for interoperability of two or more vendors' equipment in a common network.

To solve this latter issue, in April 2003 a non-profit BWA industry association was launched called the WiMAX Forum™. The WiMAX Forum[2] consists of over 100 member companies spanning the entire BWA ecosystem from component suppliers to systems vendors to service providers. The goal of WiMAX Forum is to develop conformance and interoperability specifications that leverage the technical specifications from the IEEE and ETSI for BWA and enable both laboratory and field interoperability testing against these specifications. A side effect of WiMAX Forum is the single voice that it provides to the BWA market and the general awareness of the viability that BWA provides for various markets and applications. The outcome of the work being done in WiMAX Forum will be WiMAX Forum Certified™ products that ensure interoperability for a service provider deploying a BWA network.

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[2] http://www.wimaxforum.org/

Benefits of an Industry Standard and Certified Products

Faster innovation

BWA system vendors currently develop the entire system including the ASIC, the hardware system, and software architecture. Because a single vendor is responsible for the entire ecosystem, development cycles are long and products are designed for a broad set of users and applications. With standardization, component suppliers are able to enter the market in greater numbers, allowing for faster development cycles as multiple companies innovate in different areas of the solution.

Continued improvement in cost points

While BWA Subscriber Unit prices have come down in price from the high of $5,000 to only $300 today, continued price pressure from wired broadband customer premise equipment and the need of network operators to obtain a payback period of under 18 months necessitates that the Subscriber Unit price needs to continue to become more affordable. Standardization drives higher volumes, which ultimately can deliver lower cost points to end customers.

Increased end user confidence

Successful deployments of BWA systems have been made by thousands of enterprise customers and community-based service providers. While the number of total customers is large, most BWA deployments tend to not be dense in customer size or large scale.

Lack of interoperability amongst vendor systems has been a contributing factor in limiting deployment size and scale. Since each system is proprietary to a vendor, large operators have not been able to source multiple vendors' equipment to use interchangeably within their networks. For example, a service provider may prefer some of the management characteristics from one vendor's Base Station Unit, while preferring the form-factor or functionality found in a different vendor's Subscriber Station. The flexibility for a network operator to choose the equipment that meets their network requirements best for both ends of the service is unprecedented today.

Proxim's Role in WiMAX Forum

The creation of industry standards indicates a maturing stage for technology, which Proxim wholeheartedly welcomes. Through the effort of WiMAX Forum, broader adoption of BWA solutions will occur, including large regional and even national service provider deployments. To ensure success, Proxim has taken an active role in WiMAX Forum by joining during the launch in April 2003 as a Principal Member. In that capacity, Proxim has both a voting board member and non-voting officer on the WiMAX Forum Board of Directors and is active in the established working groups of the Forum. This close involvement with the WiMAX Forum organization readies Proxim to meet its goal of facilitating higher productivity and new applications through the convergence of wireless standards.

Driving Innovation in the BWA Market

Proxim Corporation is a recognized leader in the BWA market. Established in 1979, the company continues to solve market challenges today through understanding customer needs and technological innovation. In the BWA market, Proxim offers two complete families of Point-to-Multipoint solutions designed to meet the capacity, management, and budget requirements for both enterprise and service provider customers.

The Tsunami MP family is the highest capacity, license-exempt point-to-multipoint solution offering an aggregate throughput of up to 54 Mbps. Tsunami MP incorporates Proxim's patented Active Interference Rejection (A.I.R.) technology to nullify potential interference from other RF devices

operating within range of the BWA network, ensuring operator peace-of-mind that their network will continue to operate in areas where other RF systems may be deployed.

The Tsunami MP.11 family is the most affordable, robust point-to-multipoint broadband wireless access solution on the market. It enables a competitive service offering versus DSL or cable modems while maintaining the highest quality and reliability. Tsunami MP.11 delivers the ease of use necessary for a residential last mile solution, while maintaining operator management of the BWA network. And with the recent addition of Subscriber Unit roaming among Base Station Units, new applications within cities and counties such as Public Safety, Transportation, and City/County Maintenance and Logistics can now be addressed.

Extending Market Leadership with WiMAX

With the introduction of our 802.16-based point-to-multipoint family, Tsunami MP.16, Proxim intends to drive the convergence of voice and data solutions along with wireless technologies like Wi-Fi and 3G cellular. This convergence will enable seamless mobility for enterprise and consumer users, obtaining voice and data services no matter where they are – in the office, at home, or on the road.

Enterprise benefits
- Savings through integrated services and billing
- Fewer devices and systems to support

Service Provider benefits
- Higher ARPU through additional differentiated services
- Fewer vendors to interface with for product selection, training, and support

Consumer benefits
- Voice and data services no matter where you are – in the office, at home, or on the road
- Integrated voicemail and email through a single device

Deploying BWA Solutions Today with Confidence

In advance of the Tsunami MP.16 family, Proxim continues to innovate in our current product lines and address current customer needs. Current BWA solutions are available that address the criteria necessary for successful BWA deployment – high performance, reliability, excellent network management, and CPE prices that enable competitive services. Partnering today with Proxim enables enterprises and service providers to begin reaping the benefits of BWA in advance of WiMAX Forum Certified products. These benefits include:

Immediate expertise in last mile access, security and surveillance, and enterprise campus BWA applications. Proxim solutions provide documented quick return on investment. Proxim solutions can solve time-to-market challenges and address even the largest IP video surveillance projects. Proxim solutions reduce costs associated with recurring telecommunications expenses.

Portfolio of successful customer deployments. Proxim has over 20 years of wireless network design and deployment experience. This experience is witnessed through hundreds of thousands of radio systems in use today throughout the world. Customer installations range from WAN office connections to cellular backhaul for mobile carriers to broadband Internet access for new housing communities.

Ongoing revenue for business expansion. Current deployments of Tsunami-branded multipoint systems create a customer base and revenue stream for future network growth. Proxim multipoint solutions enable quick deployment today and scalability to enter additional markets over time while maintaining consistent management of the entire network.

Recent Proxim advances with current Tsunami point-to-multipoint products include:

Tsunami MP family

Tsunami MP 60MB Base Station Unit with External Antenna Connector

The highest capacity, license-exempt radio system able to help network operators shape Base Station Unit coverage through broader coverage sectors without the capital expense of additional Base Station Units.

Tsunami MP 60MB Subscriber Unit with External Antenna Connector

Extends the effective range of this high-performance multipoint system by 100%. Network operators can now reach more target locations without the expense of additional Base Station Units.

Tsunami MP.11 family

250 Subscriber Unit Densities per Base Station Unit

Service Providers can capture a larger percentage of their market per Base Station Unit. Denser networks can be supported with Base Station Unit throughputs of up to 36 Mbps.

Mobility Applications Through Subscriber Unit Roaming

The first license-exempt point-to-multipoint systems able to support both fixed and mobile Subscriber Units. Creates new application opportunities for Public Safety, Local Government, and Service Provider markets to provide broadband wireless services across a metropolitan region.

5.8 GHz UK Band Support

The first system to support the recently established 5.8 GHz band in the United Kingdom. Service Providers now have more frequency channel choices for increased user density or separation from other BWA providers.

These represent only a few of the new capabilities that Proxim has added to the Tsunami multipoint families in just the first half of 2004. As Proxim continues to innovate, this functionality and the applications and experience you gain from deploying Proxim multipoint solutions will be carried forward to Proxim's Tsunami MP.16 products as they are introduced in 2005.

Appendix

WiMAX Forum Certified products

One of the goals of the WiMAX Forum is to develop and manage a certification program where vendors can submit their products for conformance and interoperability testing to independent laboratories. Upon completing the requirements, the products earn the WiMAX Forum Certified mark denoting they will interoperate with other WiMAX Forum Certified products bearing the same mark.

Products that can be submitted for WiMAX Forum Certified testing consists of two types: Base Stations (BS) and Subscriber Stations (SS). From a network topology perspective, these devices are similar to the Base Station Units and Subscriber Units found in Proxim solutions like the Tsunami MP and Tsunami MP.11 families.

The BS and SS products will be tested against profiles established by the WiMAX Forum. These profiles define many of the characteristics, such as frequency band, modulation type, and channel bandwidth, which determine the countries and applications for each product. As of June 2004, WiMAX Forum had approved three profiles for WiMAX Forum Certified testing – one at 2.5 GHz, one at 3.5 GHz, and one at 5.8 GHz.

The first WiMAX Forum PlugFest is slated to occur in December 2004 and sets the stage for the first round of laboratory conformance and interoperability testing to occur by March 2005. Products passing the laboratory testing will be eligible to use the WiMAX Forum Certified mark.

Dispelling myths about WiMAX Forum Certified products

Some vendors have claimed that they offer WiMAX compliant, WiMAX ready, or WiMAX like products today. The only mark that has any value is the WiMAX Forum Certified mark earned once products complete lab testing for conformance and interoperability. The first round of testing is expected no sooner than Q1'2005. No products prior to that timeframe should be considered an equivalent to this mark. Similarly, there is no guarantee that any products sold today can be upgraded after deployment to WiMAX Forum Certified status.

Some vendors have claimed that they offer 802.16a-compliant radios today. Unfortunately, there are no tests, procedures, or compliance programs for 802.16a-based devices. There is no guarantee that the devices will communicate with another vendor claiming that they also comply with the 802.16a specifications. This is precisely the reason that WiMAX Forum was formed. Interoperability can only be accomplished through the process and timeline that WiMAX Forum is working towards.