Broadband Wireless Backhaul

Systems, Trends, Applications & Solutions
Introduction

Traditionally backhaul networks have been acquainted with Ethernet cables, fiber, copper wires and other means of limited and expensive cabled infrastructures. Today the increased demand for high-bandwidth, data-intensive services with guaranteed Quality of Services (QoS) and the exponential growth in consumer devices are posing a real challenge to TELCOs and Service Providers. This confined technological state and a rapidly emerging need to upgrade the existing backhaul networks at a constant rate is concerning Service Providers, as upgrading wired backhaul systems requires large recurring investments and high operational costs.

Accelerated bandwidth requirements and the huge upgrade costs for leased lines have paved the way for the emergence of wireless backhaul systems as a primary alternative for reliable backhaul. With bandwidth capabilities exceeding 1.25 Gbps, wireline-like efficiency in terms of QoS, and above all an incredibly low CAPEX and OPEX – wireless backhaul has clearly emerged as a lucrative choice compared to any other backhaul service on the block.

‘Wireless backhaul’ refers to a high speed broadband transmission medium carrying data across two end nodes (e.g., from an access network to the core network operations center) using high-performance Point-to-Point wireless links. A typical wireless backhaul scenario consists of endpoint pairs communicating via a wireless link which carries high–bandwidth, time-sensitive data in a highly secure manner.

Wireless backhaul systems can be deployed by Carriers, WISPs and enterprises according to their individual needs of capacity and range, avoiding hassles of unexpected link failures or exhausting maintenance procedures which are common to copper/fiber networks. Wireless backhaul systems not only accommodate the latest applications involving high speed mobile data, VoIP, and IP video but also add more capacity for legacy voice and data applications. Further, wireless backhaul solutions help service providers cost-effectively expand their existing coverage footprint in no time to fill in coverage holes.
Fiber vs Wireless

One of the biggest risks for locally-owned fiber-optic systems is the chance that multi-million dollars investments could become obsolete, since RoI for Gigabit Fiber supplies is converged at considerably subdued rates with the recurring maintenance and lease costs. Installation costs of fiber vary according to type of installation (pole installation or underground installation) and distance covered, piling up to billions in CAPEX cost for expensive optical transmitters, receivers and costs to splice the optic fiber to install at sites with longer than 6 Km range – including expensive trenching for new installations and repairs. Scalability is not a convenience for fiber as it has to be handled with great care while installing in rough rural terrains as well as highly urbanized areas due to its sensitivity.

Graph 1: Fiber vs Wireless Cost Estimates

<table>
<thead>
<tr>
<th>Key Factors</th>
<th>Fiber</th>
<th>Wireless</th>
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<tbody>
<tr>
<td>CAPEX &amp; OPEX</td>
<td>High cost of installation and maintenance</td>
<td>Lower cost of installation, simpler maintenance</td>
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<tr>
<td>Deployments</td>
<td>Slow deployments</td>
<td>Faster deployments; some can be deployed in just a matter of hours as opposed to weeks and months</td>
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<tr>
<td>RoI</td>
<td>RoI achieved at a snail’s pace</td>
<td>RoI can be achieved in less than 6 months</td>
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<tr>
<td>Scalability</td>
<td>Scalability is a limitation in rural/remote areas, as well as in densely populated metro environments</td>
<td>Scalability is an advantage for wireless as it can be installed anywhere irrespective of geographical constraints</td>
</tr>
<tr>
<td>Organizational Demands</td>
<td>Fiber is not as cost-effective in most backhaul scenarios</td>
<td>Wireless enables quick &amp; economic backhaul depending on customized needs from small to large deployments</td>
</tr>
<tr>
<td>Roll Out</td>
<td>Vulnerable to physical damage, where repairs require high labor proficiency and very high costs</td>
<td>Physical damages could occur at the antenna or wiring sites, but can easily be replaced to quickly repair the link</td>
</tr>
<tr>
<td>Added Advantage</td>
<td>Cannot carry electrical power to operate terminal devices</td>
<td>Wireless backhaul deployments are capable of powering terminal devices</td>
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Table 1: Key Factors of Fiber vs. Wireless
Understanding Broadband Wireless Backhaul

There are several key points which need to be understood before deploying a wireless backhaul network. Historically, no technology has been the victim of as many myths as wireless technologies have been – and we can safely assume that this situation is a result of the fact that people often find it hard to comprehend the efficiency that wireless solutions have introduced when compared to the already established wired solutions.

Some of the facts and myths regarding wireless behavior are clearly addressed and resolved in the following sections.

Myths

WiMAX, BWA & related wireless services have flawed security: The concept of better security using leased lines or fiber optics is passé. Wireless backhaul provides a superior level of security with advanced techniques of authentication and encryption – as much or greater than any other backhaul technology provided. This ensures service providers’ ability to provide secure services and assure privacy for their customers.

Not operable in NLOS conditions: Multiple-Input-Multiple-Output (MIMO) is a smart antenna technology that offers tremendous performance gains for wireless devices at relatively low cost. It uses physical layer mechanisms for improved packet transmission and reception capabilities, even in non-line-of-sight (NLOS) environments.

Environmental effects on wireless links are inevitable: The electromagnetic waves produced during a signal transmission are susceptible to unpredicted harsh climatic conditions. For example, ‘Rain Fade’ is a phenomenon where wireless signals are attenuated or weakened due to interference caused by rain drops. However, these drawbacks can be overcome by the network operators by laying out a resistive backhaul setup by performing a thorough link budget analysis determining the appropriate antenna usage and transmitter strength.

Incompatible with existing backhaul zones: The wireless backhaul technology allows harmonious co-existence of older wired backhaul networks with the newly deployed advanced wireless backhaul sites leading to a ‘Hybrid Backhaul’ scenario.

The bandwidth demands at every base cell site have multiplied by a factor of tenfold or even more. Currently, these wired facilities have insufficient capacity, resulting in crippling broadband transmission speeds. Contrary to this, wireless backhaul nodes can handle high level of data rates at every base site. Parallel T1/E1 lines can be streamlined using external devices into the wireless medium which offers the flexibility of extending an existing TDM-based network.

Facts

Range and reliability: The sprawl of hardware advancements like MIMO and OFDM techniques with high gain antennae account for the invariably extended ranges of up to 70km per link offered by today’s WiMAX inspired products. Wirelessly backhauled data networks exhibit high data throughput over long distances ensuring robust transfers.

Enhanced QoS based on 802.16e to tackle real time video streaming & IP based applications: Video, voice & other IP based applications have become crucial requirements for government, health care, enterprises and service provider sectors. To support this range of bandwidth and situation-critical requirements, Quality of Service (QoS) must be ensured. Generally, an important detractor for QoS is latency. But with today’s wireless backhaul technologies offering latencies less than 3 ms, latency is no longer an issue. In addition, most of the BWA products offer modulation schemes (up to QAM-256) to support QoS with up to 99.999% availability.

Low CapEx and OpEx with Incredible RoI: Whether from a coax or fiber loop or from a cellular tower, wireless point-to-point systems can extend existing business investments. Administrators can easily configure wireless devices on the network from a single location using remote monitoring features depending on the demand for bandwidth resources per base site. Cost per megabit is extensively reduced due to better data rates, optimal real time performance, and viable economic figures. With a proven 6-12 month RoI relative to leased line backhaul costs, the business case for adding capacity through wireless equipment is much clearer. Service Providers and cellular operators can leverage brand presence and reach out to new subscribers quickly.
White Paper - Broadband Wireless Backhaul

Spectrum Regulations

Different countries have their own regulatory restrictions - for example, 5.7 - 5.8 GHz band is not allowed for operation in most of the European regions, where as a few countries allow this band to be used only for fixed operations. The licensed frequency bands are strictly regulated by each country and will have country-specific certification requirements.

A chosen spectrum may have country-specific regulations based on

1. Indoor or outdoor application
2. Point-to-point or point-to-multipoint network application
3. Sub-band limitations, per country frequency allocation
4. Antenna and EIRP limits
5. DFS functionality

How to Choose

The process of choosing the correct wireless spectrum depends on the network design and is often application specific. Below is a comparative breakdown of the merits of Licensed and Unlicensed bands

<table>
<thead>
<tr>
<th>Licensed Spectrum</th>
<th>Unlicensed Spectrum</th>
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<tbody>
<tr>
<td>Interference free</td>
<td>Interference can be handled through intelligent carrier sense algorithms settings and DFS techniques</td>
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<tr>
<td>Operational environment is much easier to setup &amp; monitor</td>
<td>Access to spectrum is free of cost</td>
</tr>
<tr>
<td>Applicable for highly sensitive applications and participants capable of the large investment required</td>
<td>Capacity and range depend on number of devices sharing the same band</td>
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<tr>
<td>Less regulatory tabs on power limits</td>
<td>Widely available across the globe</td>
</tr>
<tr>
<td>Ideal for carrier deployment on a large scale where multiple operators exist. These license contracts can be attained through sub lease or auction</td>
<td>Inexpensive solution for rural areas, with low user densities, for newer technologies, and for service providers looking for an economical and fast backhaul solution</td>
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</table>

Table 2: Key Factors of Licensed vs. Unlicensed Spectrum

Wireless Backhaul – Best Practices

Often times, any major interruptions in wireless backhaul links occur due to faulty installations or lack of basic knowledge on wireless systems. Such hurdles can be avoided by following a few simple best practices while setting up the wireless backhaul links.

1. Follow a strategic approach to network design and mapping
2. Choose the right solution based on bandwidth requirements and range
3. Choose between Licensed or Unlicensed spectrums
4. Perform a thorough site survey
5. Calculate link budget
Wireless Backhaul Applications

By re-evaluating backhaul strategies, operators are looking to minimize expenditures and maximize the scope for value-added mobile broadband services transitioning to an all-Ethernet radio access network (RAN) over time.

Wireless backhaul solutions can be extended to all kinds of organizations. A few scenarios for optimized wireless backhaul in real-time applications are illustrated below.

WISPs

The extent of the Internet transcends the scope of imagination for possible ‘last mile’ applications. For instance, the average number of views on YouTube has reached a billion per day. This trend indicates not only increased number of users but also sky rocketing content-rich transfers. In order to meet the bandwidth requirements of smart phones, mobile Web applications, networking media, online gaming, video, voice and newer technologies like LTE, wireless ISPs can rely on wireless backhaul. It not only provides enough bandwidth to support any kind of IP-based applications but also offers dedicated spectrum management in both licensed & unlicensed bands.

Changes in regulations across the world regarding unlicensed spectrum during the past few years have had a significant impact in encouraging the WISPs to adapt to wireless backhaul infrastructures. The backhaul network deployed is entirely owned by the ISPs with simplified OPEX avoiding the need to outsource any maintenance operations. Many WISPs prefer to use unlicensed bands because they are free and faster to deploy.

Video Surveillance

Mission critical applications must be handled with a high level of sensitivity. Time is the driving factor for these applications. Fires, detection and reporting of crime, environmental disasters and other events are unpredictable and geographically indefinite.

High-Definition video surveillance systems for active crime prevention and superior incident management are in high demand. This evolution demands the need for scalable high capacity and secure backhaul links which can be commissioned and managed instantly. In such cases, wireless connectivity can be established instantaneously in a couple of hours to deal with incident reporting and response.
Rural Broadband

Rural sectors have tremendous demand for broadband, but today are left largely under-served by service providers due to low user density, tough terrains, inclement weather conditions and lack of flexible backhaul solutions. With the advent of efficient wireless backhaul solutions, last mile broadband access has become economically viable enabling seamless broadband connectivity.

Building to Building Connectivity

Large corporations of all kinds as well as universities and medical facilities spreading over multiple campuses in various geographical locations all demand robust and secure interconnected networks. Laying Fiber or cables for PtP connectivity within a few miles could end up in tedious attempts of network layouts and disproportionate investments.

Connecting buildings and campuses via wireless backhaul to carry services and data amongst homogenously connected networks proves to be a much easier to deploy and cost-effective solution. Surveillance monitoring can also be implemented from a main office to branch offices for security services. Mobility, along with the flexibility for easy structural expansion of connected services, at low capital costs appears to drive the wireless demand among the corporate sectors and other organizations for building to building connections.

Carriers

Carriers can future-proof their deployments of any access technology – including GSM, WiMAX, 3G, 4G, Wi-Fi, Mesh, WCDMA, GPRS, HSPA, EV-DO, LTE and others – by taking advantage of the enormous data rates offered by next generation wireless backhaul solutions.

With the increased market scope for 3.5G & 4G based applications, operators are keen on extending their reach towards this segment. A significant number of operators have already deployed HSPA and LTE applications carrying an exponentially increased amount of data. Simultaneously, carriers realize the necessity to enhance backhaul capacity to support the technological demands and cost to handle these capacity demands.
Proxim’s Backhaul Solutions

With over 20 years in wireless innovation, Proxim keenly understands the requirements of carrier-grade backhaul solutions. Proxim’s high-capacity, wireless point-to-point (PtP) bridges and point-to-multipoint (PtMP) provide the industry’s most reliable, secure and easily-deployed solutions for interconnecting corporate and telecommunications networks. Proxim’s backhaul solution portfolio includes:

**Tsunami™ QuickBridge 8100 Series**

Proxim’s Tsunami™ QB-8100 is an incredibly cost-effective, high performance and non-line-of-sight 4G point-to-point (PtP) wireless backhaul solution. With 300Mbps data rates in a complete “Hop-in-a-Box” solution, deployments in networks of all sizes will enjoy a quick return on investment. Leveraging the advantages of OFDM and the latest MIMO radio innovations, the Tsunami™ QB-8100 draws on Proxim’s proprietary Wireless Outdoor Router Protocol (WORP) to deliver wireless performance in excess of 4G products on the markets today.

**Tsunami™ MP-8100 Series**

As the industry’s first PtMP product to provide dual Gigabit Ethernet ports with PoE out, the Tsunami™ MP-8100 becomes the first solution capable of powering IP video cameras or additional radios for even greater ease of deployment.

Both the Tsunami™ QB-8100 PtP and the Tsunami™ MP-8100 PtMP provide true 4G wireless backhaul. For more information visit www.proxim.com/products/ 

**GigaLink® Series**

Proxim’s GigaLink® Series is a series of full-duplex point-to-point wireless bridges that offers affordable, highly reliable, short and medium range outdoor links for Gigabit Ethernet (1.25Gbps) interfaces the 57-64 GHz unlicensed frequency band and the licensed 71-76GHz licensed frequency band.

**Tsunami®.GX Series**

The Tsunami family of wireless Ethernet bridges provides a variety of plug-and-play solutions to the growing demand for transparent, reliable, and economical high-speed network interconnectivity. With a wide variety of performance options ranging from 24 to 216 Mbps aggregate throughput, Tsunami®.GX links allow network planners to select the optimum solution for their specific application.

**Lynx®.GX Series**

Proxim is a leader in T1/E1 spread spectrum, unlicensed radios. LYNX™ radios provide unlicensed wireless interconnect solutions in a variety of telecommunications interfaces up to 16xT1. LYNX™ unlicensed radios operate in the 5.8 GHz ISM band.
About Proxim

Proxim Wireless Corporation (OTCQX: PRXM) (PINKSHEETS: PRXM) is a leading provider of end-to-end broadband wireless systems that deliver the quadruple play of voice, video, data and mobility to all organizations today. Our systems enable a variety of wireless applications including Point-to-Point Wireless Backhaul, Security and Surveillance, VoIP, Last Mile access, and Enterprise LAN Connectivity. We have shipped more than 1.8 million wireless devices to more than 235,000 customers in over 65 countries worldwide. Proxim is ISO 9001:2000 certified. Information about Proxim can be found at www.proxim.com. For investor relations information, e-mail ir@proxim.com or call +1 413-584-1425.