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Wireless Solutions

In

Education

Backhaul Evolved®

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Executive Summary

Schools and universities are among the leading consumers and early adopters of high-capacity wireless technology. Bandwidth-consuming smartphones and tablet computers are becoming a ubiquitous part of today's college campuses. Students and faculty are straining campus networks with their devices' insatiable need for more capacity. The widespread use of Wi-Fi access hubs for an expanding array of wireless devices, as well as security cameras across campuses, compels the need for capacity that can be quickly and easily deployed. Point-to-point gigabit Ethernet wireless solutions are an ideal way for universities to enable future-proof, high-speed mobile connectivity for students, faculty and administrators, with all the performance benefits of fiber, while yielding a significant cost savings compared to metro fiber cabling.
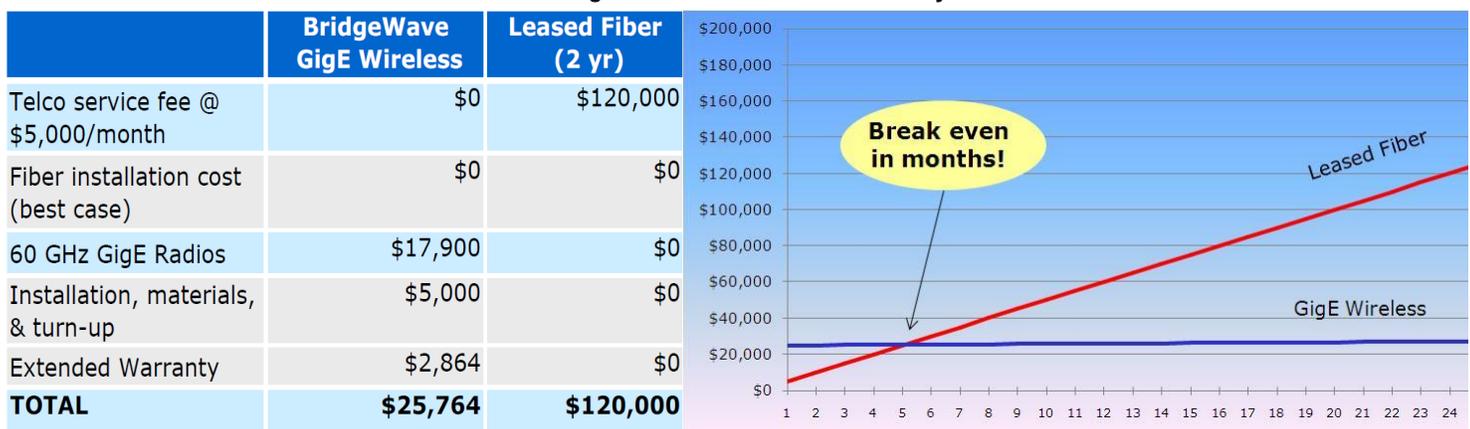
The Value Proposition of Wireless

The number of students that have a laptop, smartphone, or Internet-ready tablet is approaching 100%. Practically every student in higher education uses the Internet in some way to do homework assignments, watch movies, play online video games, and for social networking. This high rate of computer usage among students is adding additional burdens on an already overloaded infrastructure. Due to these pressures, schools and universities are increasingly looking to IT departments to improve productivity and control costs. Schools and universities are recognizing the many advantages of utilizing high-capacity wireless links to replace fiber or aging copper-based leased lines, both in terms of cost and network performance.

Gigabit Ethernet wireless links provide rapid returns on investment, relative to the cost of leasing high-speed circuits. As illustrated in the chart below, a gigabit Ethernet wireless link provides fiber-like speeds and latency for a one-time expenditure of about one fourth of the annual cost of leasing an equivalent fiber based service. Wireless gigabit Ethernet links also eliminate the initial installation costs and long lead times associated with deploying new fiber services.

Fiber vs. Gigabit Ethernet Breakeven Analysis

	BridgeWave GigE Wireless	Leased Fiber (2 yr)
Telco service fee @ $5,000/month	$0	$120,000
Fiber installation cost (best case)	$0	$0
60 GHz GigE Radios	$17,900	$0
Installation, materials, & turn-up	$5,000	$0
Extended Warranty	$2,864	$0
TOTAL	**$25,764**	**$120,000**

Break even in months!

Leased Fiber

GigE Wireless

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In addition to these significant savings, gigabit wireless links also provide increased capacity and a "future proof" network. Transmission rates provided by gigabit wireless links mean that the backbone will remain free of bottlenecks as application capacity needs grow. Millimeter wave gigabit Ethernet wireless links provide full-rate, non-blocked gigabit throughput speeds with latency comparable to that of an Ethernet switch, yielding a fiber equivalent backbone link that is perfect for transporting real-time applications such as video and VoIP.

For more information on the economics of wireless over a leased line, please click here.

Students' Network Usage

University students are voracious users of network bandwidth. They are the most connected segment of the population. Most of the students entering college today have no recollection of a time before the Internet. Many of them have grown up in households that have had broadband network access since their toddler years. Many, if not all, have no recollection of a dialup modem.

All this translates to the most network savvy generation ever. The amount of time that these students spend using network connected devices is unprecedented. University students' usage of network content can be summarized in the following categories:

Research – The educational resources available to students today are eclipsing the largest libraries in the world. While the benefit of learning in a brick and mortar library is irreplaceable, the ease of research on a computer is undeniable. It now takes only a few keyboard clicks to find information quickly. The two big online encyclopedias, Wikipedia and Encyclopædia Britannica, are free to use and are updated constantly. According to Alexa.com, Wikipedia is the 7th most used website in the world today. Most of the traffic to these sites originates from search engines like Google, which are by far the most popular sites on the net (see insert). Practically all research today starts with an online trip to a favorite search engine.

Social Media – Facebook started out as an application to look up fellow students at Harvard. The idea has remained hugely popular among the social circles of students, who are the most ardent supporters and users of Facebook today.

Email – As popular and pervasive as email is in the world today, surprisingly, its usage is decreasing somewhat among younger people, who are increasingly favoring the use of social media sites and texting to send messages. But the importance and use of email in the educational world today is still significant, as it is the most likely method for students, teachers and administrations to transfer files and information.

Top 20 Websites

1. Google	11. MSN
2. Facebook	12. Sina
3. YouTube	13. Taobao
4. Yahoo!	14. Amazon
5. Blogger	15. LinkedIn
6. Baidu	16. WorldPress
7. Wikipedia	17. Bing
8. Live	18. Yandex
9. Twitter	19. Microsoft
10. QQ	20. 163

(May 2011 – alexa.com)

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Peer- to-Peer – Peer-to-peer file sharing was one of the original "killer apps" of the Internet with the success of Napster and, even before that, online bulletin boards. Despite some past legal battles, students love sites like BitTorrents, Kazaa and other peer-to-peer content distribution technologies. These protocols come at a heavy price to the campus backbone in both bits per second and concurrent connections.

Smartphones and Tablets – Desktop computers have given way to laptops. Tablet computers, and mobile phones that have been upgraded to smartphones, can access huge quantities of data. Using a Wi-Fi connection, most smartphones can be connected to the local university's network (WLAN), thus bypassing 3G connections and putting a bigger load on the university's network.

Streaming Video – High Definition video consumes a massive amount of bandwidth, up to 2 Mbps and more for some video streams! The trend is fast moving toward even greater bandwidth consumption with regular off-the-shelf consumer devices capturing video in 720p and even higher resolutions in hand-held devices. It is no exaggeration that streaming video may be the bandwidth hog for campus networks.

Education Fast Facts
- Tablet usage is growing faster than any electronic device ever introduced.[1]
- Every major university and college in the United States has a YouTube channel.[2]
- 96% of all students own a desktop or laptop computers. 89% own a laptop.[3]
  - Only 4% of students own an eReader.[4]
- 98% of incoming university freshmen students have a Facebook account.[5]
- In one survey nearly all (99%) of the incoming class had cell phones.
  - Only 40% of them had a stuffed animal.[6]

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[1] http://www.pewinternet.org/Reports/2011/Local-mobile-news.aspx
[2] www.youtube.com
[3] http://www.readwriteweb.com/archives/survey_finds_college_students_love_laptops_but_not.php
[4] http://www.readwriteweb.com/archives/survey_finds_college_students_love_laptops_but_not.php
[5] Ibid.
[6] http://www.redlands.edu/current-students/6044.aspx

The Wireless Role

Regardless of how the network is accessed, how bandwidth is consumed, or for what reason, educational campuses today are among the largest consumers of network bandwidth. Today's complex university networks must support a large number of critical services and applications. The proliferation of smartphones and handheld wireless devices has complicated this by further crowding the network. Fast and reliable Internet access across campus, increased storage demands for research computing, and connections between remote facilities and network-based video surveillance cameras have all become essential to the successful workings of the network on campus. Higher education IT organizations must accommodate these rapidly expanding demands for high bandwidth with a robust backhaul infrastructure in a cost-effective manner.

IT managers are challenged to ensure that their campus networks keep up with bandwidth demands. To accomplish this, wireless solutions are increasingly being deployed. Here are some of the benefits of using wireless as an effective backhaul solution:

- Unlike those costs incurred with leased fiber, there is no recurring leased line costs associated with wireless links. These considerable savings will quickly pay for the system.
- Wireless links can be easily deployed, usually in a matter of days. The cost and time to install a wireless link is significantly less than trenching and laying fiber.
- These systems are future-proofed as they can be upgraded to a full gigabit of capacity using a software key, thus removing the need and expense for replacement equipment and personnel to make unnecessary tower climbs. This functionality allows for better control over both CAPEX and OPEX, making it an efficient and effective tool for managing backhaul needs.
- Wireless offers fully scalable, high capacity bandwidth, including full-rate, full-duplex gigabit Ethernet capacity with reliable, carrier-class 99.999% availability.
- Narrow wireless beamwidths provide physical data security, which is superior to inter-building fiber cabling which could be tapped.
- The ability to isolate management traffic flow prevents access to application data through management interfaces.
- Advanced security options, such as password protection and 256-bit AES encryption, secures management interfaces.
- Wireless offers link deployments of distances up to 10 miles (16 km).
- Redundancy is available for added availability. In protected configurations, each side has an active and standby system. These systems are interconnected to share health and status information with no more than 50 ms of traffic disruption.
- Wireless links are sophisticated network devices that provide physical and network layer configuration, monitoring and alarm capabilities, including full Ethernet frame capacity and error performance visibility.
- Management data and link configuration is fully accessible through SNMP and secure HTTP/HTTPS web interfaces, and management interfaces can be flexibly configured for in-band or out-of-band access.
- SNMP link-outage traps enable alarm functions and event logs throughout network management stations.

Real-World Examples of Gigabit Wireless

BridgeWave Communications is involved with many notable higher education campus applications, including secure (HIPAA-compliant) campus connectivity, off-site medical office and lab network access, real-time imaging application connectivity, redundant fiber overlay, and disaster recovery.

BridgeWave solutions are well suited for this task as 60 GHz and 80 GHz wireless links are the natural choice for providing fiber equivalent performance combined with fiber equivalent security in a campus environment. For longer distances, BridgeWave's FlexPort µWave® wireless device operates in the 18, 23 and 24 GHz space. Large bandwidth intensive applications are well supported with full gigabit Ethernet bandwidth and ultra-low latency performance. BridgeWave links have very narrow beamwidths that form "spatial pipes" between the ends, providing data security that is superior to inter-building fiber cabling, excellent physical security with fast-to-deploy wireless links, and flexible alternatives to costly inter-building fiber installations.

ORION
The ORION (Ontario Research and Innovation Optical Network) project is one of the world's largest and most advanced networks dedicated solely to research and education facilities. Over 80 sites, which include almost every educational institution, college, university, teaching hospital and public research facility in Ontario, Canada is connected through this ultra high-speed network using optical fiber.

Challenges

- Reliable high-speed network connectivity over long distances.
- Sufficient bandwidth capacity for large data files and research applications.
- A backup system to support their primary connection in case of a power outage and/or equipment failure.
- Capabilities to withstand harsh weather and bridge longer distances over a body of water for uninterrupted quality connectivity.

BridgeWave Solution: BridgeWave AR80X wireless links.

Benefits

- Capacity to handle a gigabit of data and deliver high-speed performance, which is crucial for a research community that transmits information across international borders.
- Cost effective, equipped for rapid deployment, and easy to provision.
- Backup network to ensure availability during extreme weather conditions or equipment problems.
- End-to-end network visibility and control.
- Secure, reliable transfer of mission-critical applications, including patient information.

For more information, click here.
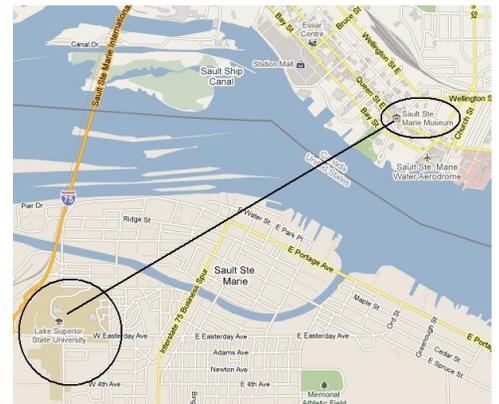
Stanford University

Located close to the Stanford University campus stands the 1,189 acres of Stanford University's Jasper Ridge Biological Preserve (JRBP). The JRBP has been used for scientific studies since the opening of Stanford University in 1885. Since then, Stanford students have written almost one thousand papers, reports, and dissertations about this land.

Challenges

- Provide network connectivity to a disparate research facility off the main campus while minimizing the human impact of the fragile ecosystem.
- The existing connectivity from the mesh network to the main campus was not reliable and proved incapable of providing the high bandwidth performance needed to support ongoing research.
- Guarantee reliability and performance, while remaining cost-effective.
- Meet high bandwidth requirements for backhaul of mesh network, which supports thousands of data collection points that record and upload data automatically.

BridgeWave Solution: BridgeWave BW80X wireless links.

Benefits

- Minimal impact to the environment, as no trenching was required.
- "Future-proof" network for upgrades or additions with full-rate gigabit backbone.
- Lifted restrictions on traffic types that were being transported over the network.
- Instilled researchers' confidence in the network's ability to effortlessly handle large file transfers.
- Significant ROI compared to trenching or leasing fiber circuits.

For more information, click here.

George Brown College

George Brown College, one of Canada's largest, most diversified, and highly respected colleges, with a total enrollment of more than 20,000 full−time equivalent students across three main campuses in the greater Toronto area, is a proven technology pioneer.

Challenges

- The pricing change of the service provider made incumbent fiber connections cost prohibitive.
- High bandwidth connections needed to support seamless connectivity to several campuses.
- Canadian weather and public wireless initiatives created uptime and interference concerns.
- Ultra low-latency performance was required for VoIP and video transmissions.

BridgeWave Solution: BridgeWave GE60 wireless links.

Benefits

- Flawless, "five nines" uptime despite Canada's occasionally challenging weather.
- Narrow beamwidth immune to interference; ultra-low latency ideal for handling voice and video traffic.
- ROI of eight months vs. increased fiber prices of long-time provider.
- Gigabit Ethernet wireless solution is proven and poised for additional deployments during college's aggressive growth.

For more information, click here.

Cornell University

Cornell University, founded in 1865, is a prestigious Ivy League school with more than 20,900 enrolled students. The university's network consists of several miles of inlaid fiber connecting some 260 university buildings over 745 acres. Concerned about disaster recovery, the Cornell team located a point of failure in the fiber network and set out to shore up their network.

Challenges

- Finding a solution that would provide reliable, unwavering network connections, regardless of inclement weather.
- Offering future-proof, high bandwidth technology to guarantee maximum high network capacity in the coming years.
- Ensuring security features protected proprietary staff and student research from network tapping.
- Finding a reliable alternative to fiber, as fiber infrastructure estimates ran upwards of $2 million.
- Meeting regulations from Ithaca Landmarks Preservation Commission, which prohibit visible antennas on historic campus buildings.

BridgeWave Solution: AR60 wireless links.

Benefits

- Establish immediate connectivity with fiber network at point of vulnerability.
- "Future-proof" network for upgrades or additions with gigabit of available bandwidth.
- Provide "tap-proof" network security with narrow beamwidths in 60 GHz spectrum and additional security with integrated 256-bit AES encryption.

For more information, click here.

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Summary

Schools and universities have been leading adopters of wireless technologies. The prevalence of multi-building campus settings and the need to connect off-campus buildings with the core LAN drives the use of high-capacity point-to-point wireless links to provide ubiquitous high-capacity user access. In addition, the widespread use of Wi-Fi access hubs and security cameras across the campus drives the need for capacity that can be quickly and flexibly deployed. BridgeWave's gigabit wireless links have proven to be a cost effective alternative to fiber, while yielding fiber-like performance, for over 140 universities worldwide.

About BridgeWave Communications

BridgeWave Communications is the leading supplier of high-capacity 4G millimeter wave backhaul and gigabit wireless connectivity solutions. BridgeWave's carrier-grade, point-to-point wireless FlexPort® links provide a future-proof mobile backhaul solution for carriers and mobile operators looking to support 4G/LTE/WiMAX adoption. PicoHaul™ links provide the same carrier-grade high-capacity, small-cell backhaul for dense cell deployments. The company's 60 GHz and 80 GHz links offer up to ten times the bandwidth of comparably-priced lower-frequency license-free and licensed-band wireless links, while providing superior interference immunity and data security. Founded in 1999, BridgeWave is headquartered in Santa Clara, California. For more information, visit http://www.bridgewave.com.

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