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**LIGHTPOINTE WHITE
PAPER SERIES**

**The Economics of Millimeter-
Wave Wireless Point-to-Point
Radio Solutions**



Introduction

In 2003, the FCC made available a significant amount of new bandwidth between 71 and 95 GHz for high quality multi-gigabit point-to-point wireless communications. This allocation of the millimeter-wave spectrum, widely known as E-Band, offers over 250 times the bandwidth of the widely used, lower frequency microwave bands. Full duplex data rates of 1 Gbps and beyond, in cost-effective point-to-point wireless configurations, are possible.

For the first time, wireless is able to provide a truly cost-competitive high-speed alternative to fiber. Commercial millimeter-wave systems are priced at such levels that payback against trenching fiber is a few months, and against leasing fiber capacity is much less than one year. This pricing makes the economics of gigabit connectivity very attractive.

This paper explores the economics of E-Band wireless in more detail, outlining the costs for wireless and alternative systems to provide Gigabit per second connectivity.

High Capacity Connectivity Drivers

The growth in demand for high capacity backhaul and broadband connectivity is driven by a multitude of factors. These include:

3G and 4G Network Deployments

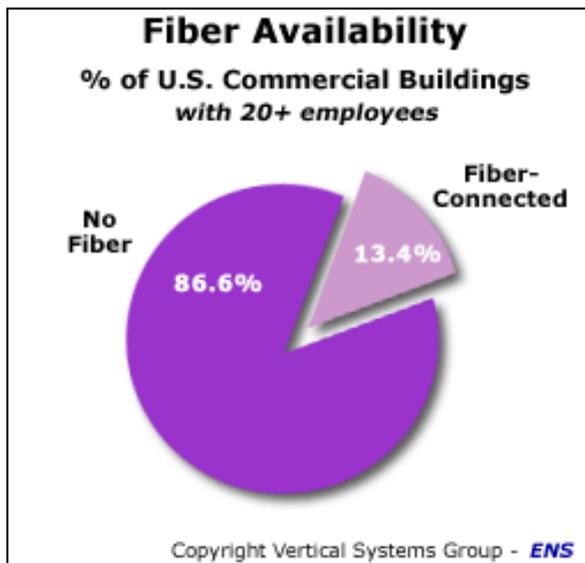
Faster speed cellular networks, driven by increasing multi-media content on mobile phones, places enormous bandwidth requirements on backhaul. Infonetics Research reports that in 2006, there were 200,000 cell sites in the USA with a total of 800,000 Mbps of backhaul. By 2010, this number will increase to 250,000 cell sites, requiring a massive 6,000,000 Mbps of backhaul. This number not only shows that backhaul traffic from cell sites will drastically increase, but is also shows that using traditional PDH facilities like T1/E1 lines or multiples of them is no longer an option in delivering capacity to cell sites. At the present stage of mobile wireless network deployment, the scaling of backhaul traffic by adding more T1/E1 lines has not only come to an end from the technical point of view, but also from the economic point of view. Network operators realize that by adding more leased line circuits the monthly recurring costs (MRCs) will jump up more quickly than the revenue being generated from subscribers and operators can offset. Companies will start losing money following such a strategy.

Backhaul options have historically lagged behind other parts of the network in terms of cost reduction. Carriers currently estimate that 15-20% of their operating expense costs go into leasing backhaul, with this figure expected to raise to 40% by 2010. According to Infonetics the total mobile backhaul service charges hit US\$15.9 billion in 2005 and will grow 99 percent to US\$31.6 billion in 2009.

Michael Howard from Infonetics says that Mobile Operators would prefer to bring fiber to more cell towers to satisfy the requirement for more backhaul capacity, but there are far too many cell towers for this to be a near-term strategy. E-Band high capacity wireless point-to-point radio systems can offer a truly cost-competitive backhaul solution for mobile wireless network operators and a high-speed alternative to fiber.

Increase in Business Network Usage

More enterprises are growing corporate networks requiring LAN connections of at least GigE speeds. Applications are becoming more network-oriented and are consuming more and more bandwidth. Enterprises are arming larger portions of their often remote workforce with high data consumption applications such as videoconferencing and web-hosted CRM applications. Financial regulations such as Sarbanes-Oxley require more record keeping and archiving, with the need for regular backup and data warehousing. Optical fiber is well capable of transporting high capacity network traffic. However, when it comes to the penetration of optical fiber in last-mile access networks, a recent study conducted by Vertical Systems Group shows that only 13.4% of commercial buildings in the



United States with more than 20 employees are connected to a fiber network (Fig.1). According to Vertical Systems Group, the lack of access to fiber facilities is holding up the growth of native business Ethernet services. Fiber penetration figures are even lower for many countries outside of the United States. In Europe for example, fiber penetration is far less than in the US, with some estimates saying that as low as 1% of all commercial buildings are lit with fiber. High bandwidth last-mile access and backhaul costs are also significantly higher than in the US. Like the United States has, several European countries are currently looking at opening E-Band frequencies for public and commercial use. Some European countries like England have already done so.

Fig.1: Fiber penetration to Commercial Building in the United States

Network Redundancy and Disaster Recovery

More and more organizations are planning for disaster recovery and continuity of operations in the event of catastrophic failures. Government requirements dictate that all federal buildings have disaster preparedness plans for their networks, requiring diversity in telecommunications systems. There is also growth in offsite backup and storage, both remote and distributed, including network-attached storage (NAS) and storage area networks (SAN).

The Economics of LightPointe's MMW Wireless Solution

LightPointe believes that all wireline and wireless service providers, as well as enterprise users with multiple building connectivity requirements, are looking for a better, and more cost effective last-mile access and backhaul solution. Fortunately, just as better connectivity solutions are needed to support the explosion in demand for broadband wireless access, these technologies have made dramatic advances. LightPointe is helping lead this charge with its AireBeam™ millimeter-wave radio platform that is significantly transforming backhaul economics.

Two different economic scenarios are considered – comparing LightPointe's GigE wireless solution with installing dedicated fiber and leasing high speed lines from a local provider.

Scenario 1: LightPointe's AireBeam™ versus dedicated fiber

The cost of trenching fiber depends on where in the USA the fiber is being laid. In large metro environments such as San Francisco, there is a moratorium on laying fiber and further trenching is prohibited. In major cities, laying fiber can cost up to US\$250,000 per mile to bury¹. In suburban areas the cost drops to \$150,000 per mile. In rural areas, costs fall further to \$100,000 per mile. In European cities like Munich, Frankfurt or London costs are similar and laying fiber can cost in the range between €100,000 -120,000 per kilometer.

Consider now the cost of LightPointe's GigE AireBeam™ wireless. Total costs for installing a complete GigE link might amount as follows:

| | |
|-------------------------|----------------|
| AireBeam™ Wireless Link | \$25,000 |
| Radio license | \$500 |
| <u>Installation</u> | <u>\$4,000</u> |
| TOTAL | \$29,500 |

Just by looking at this number, it is obvious that the wireless solution has a clear economic advantage over fiber. In major cities, ***the AireBeam™ GigE wireless solution can be nearly 10 times less expensive than costs associated with burying a dedicated optical fiber connection.***

Not included in this simple cost analysis are factors such as timing. Fiber installs can take many months of zoning, project planning and construction work and disruption. Wireless installations can be done on a much shorter timescale even considering the time it will take to pull fiber to the rooftop. In addition, costs for laying fiber are sunken costs while a wireless solution can be deployed at a different location if required.

¹ Fiber runs are typically buried and follow the layout of streets in downtown areas or business parks. A 1 mile fiber run is typically long enough to connect buildings that are roughly between 0.5 and 0.75 miles apart when looking at the direct "line-of sight distance" between these buildings.

Scenario 2: LightPointe's Airebeam™ versus leasing high speed services

Many enterprises lease rather than own the last-mile high bandwidth connections. In most cases this is driven by right-of-way issues and the tremendous amount of upfront money needed to lay fiber. In the USA, typical monthly lease pricing for higher speed bandwidth connections is as shown below. These charges can vary within parts of the USA. In particular, the ability to get access to higher capacity connections beyond a DS-3 capacity level will greatly depend on fiber availability².

| Connection Speed | Monthly Expense |
|--------------------------------------|-----------------------|
| T-1 (1.5 Mbps) | US\$300 per month |
| DS-3 (45 Mbps) | US\$3,000 per month |
| OC-3 (155 Mbps) | US\$5,000 per month |
| OC-12 (622 Mbps) | US\$9,000 per month |
| GbE (variable bit rate up to 1 Gbps) | US\$6,500 per month |
| GbE (dedicated full rate 1 Gbps) | US\$15,000 per months |

From the capacity and \$/Mbps transport cost point of view, circuit switched PDH and SDH/SONET connections provide slower speed access and, in general, these connections are more expensive when compared to Ethernet based connectivity of similar bandwidth. Packet switched Gigabit Ethernet connections, and/or Ethernet connections are typically less expensive from the \$/Mbps point of view, and besides dedicated, full access speed connections, the service offerings typically include variable bit rate connections providing a “peak Bandwidth” up to a specified bit rate. Given that the installed cost of a LightPointe GbE AireBeam™ wireless link is about \$29,500, the **payback on purchasing a wireless system over leasing a dedicated GigE connection is less than 2 months.**

On a 36 month lease, which is typical for certain higher speed fiber connections, a LightPointe GigE interconnection could be obtained at less than US\$1,000 per month, about the price of leasing just a few T1s. Even when considering paying US\$1,000 per months to rent roof space, **this is an 88% discount on the price of leasing a dedicated GbE connection from the local service provider.**

This simple financial model is not limited to system usage within the United States alone, but also applicable to other countries, like many European countries that have started to open E-Band frequencies for deployments in the public sector.

² The monthly lease rates are typically for a simple connection from the service provider's POP to the end customer building. To establish a connection between two buildings, the monthly leasing charges can double because a separate connection between a remote building and the service provider POP might be required. These monthly charges also do not include one-time setup fees and especially higher speed fiber connections can be subject to longer term lease agreements.

Summary

Leasing or installing dedicated high speed fiber lines is an expensive proposition. In addition, high capacity fiber based services are very often not readily available and laying fiber to buildings that are not connected is a very time consuming process.

LightPointe's Airebeam™ GigE wireless platform offers similar speeds as fiber, but at a fraction of the installed cost. This paper shows that compared to burying dedicated fiber, LightPointe's wireless solution can be nearly 10 times less expensive. When compared to leasing high speed GbE services, a much more common proposition, LightPointe's solution has a payback in just 2 months compared to leasing a dedicated full rate fiber connection. In an equipment leasing scenario savings close to 90% over current GigE fiber leased line rates can be realized.

About LightPointe

LightPointe was founded in 1998 and has become the global market leader for high capacity wireless outdoor bridges with over 5000 systems deployed in over 60 countries worldwide and in vertical markets such as Health Care, Education, Military & Government networks, large and small campus enterprise networks, Wireline and Wireless Service Provider networks. Over the last 10 years the company has established a unique diversified product portfolio based on high capacity Free Space Optics (FSO) and Millimeter Wave (MMW) technology. With more than 10 patents granted in the FSO, RF/MMW and in the hybrid bridging solution space LightPointe has established a strong IP and patent portfolio position manifesting the company's technology leadership position.

LightPointe has a long list of global customers including but not limited to Wal-Mart, DHL, Sturms Foods, Siemens, Sprint, AOL, FedEx, BMW, Lockheed Martin, Dain Rauscher, Barclays, Nokia, Deutsche Bank, IBM, Corning, Cisco, Huawei just to mentioned a few. For more information please visit the Lightpointe website at www.lightpointe.com