How Enterprises Are Solving Evolving Network Challenges with Optical LAN

Executive Summary

Enterprise businesses that need to upgrade or replace existing telecommunications networks are looking for ways to improve energy efficiency and reduce capital and operating expenses. Technology managers are looking for solutions that furnish high bandwidth while increasing the security and reliability of their networks.

To meet these requirements, enterprises are turning to Gigabit Passive Optical Networks (GPON) Optical LANs. Optical LANs provide enormous value to enterprises without forcing them to alter how they do business, while existing services provided by their networks remain the same with no change to core and user devices.

Additionally, enterprises are saving up to 70% of CapEx, 80% on power requirements and 90% of the rack space while exceeding their environmental "green" goals. Plus, businesses deploying Optical LANs experience long-term savings by future-proofing their network infrastructure while realizing all of the benefits of converging their networked services, including Voice over IP (VoIP), with or without Power over Ethernet (PoE).

This application note explains how Optical LANs work and how they can benefit your organization. It also highlights why enterprises looking to deploy Optical LANs are turning to Tellabs. Tellabs offers a full line of Optical LAN solutions that are environmentally responsible and solve evolving network challenges while significantly cutting CapEx and OpEx, power consumption and space requirements.

Optical LAN vs. Traditional Active Ethernet LAN

An Optical LAN is a Layer-2 transport medium, built with Passive Optical Network (PON) technology, that provides converged video, data and voice services at gigabit speeds over a single strand of fiber to the user's location. Comparing the configurations of a Traditional Active Ethernet LAN and a GPON architecture helps to illustrate more clearly the similarities between the two technologies (Figure 1).

In a Traditional Active Ethernet LAN, a router in the top-most layer (Core Layer) links to the campus or building aggregation switches (Distribution Layer) below. The distribution switches connect down to the Access Layer switches in the communications closets. Copper cables extend from the communications closets to the users.

In an Optical LAN solution, the router is retained in the top-most layer and the Optical Line Terminal (OLT) serves the same purpose as the campus aggregation switches. The building aggregation switching is accomplished by the 1x32 optical splitter, which is a passive device so there are no power requirements. Optical Network Terminals (ONTs) provide connectivity to the users.

It is important to note that both solutions provide data access via 1000Base-T Ethernet connections to the user. Therefore, no client or PC reconfiguration is required when upgrading from active-Ethernet to a GPON infrastructure.

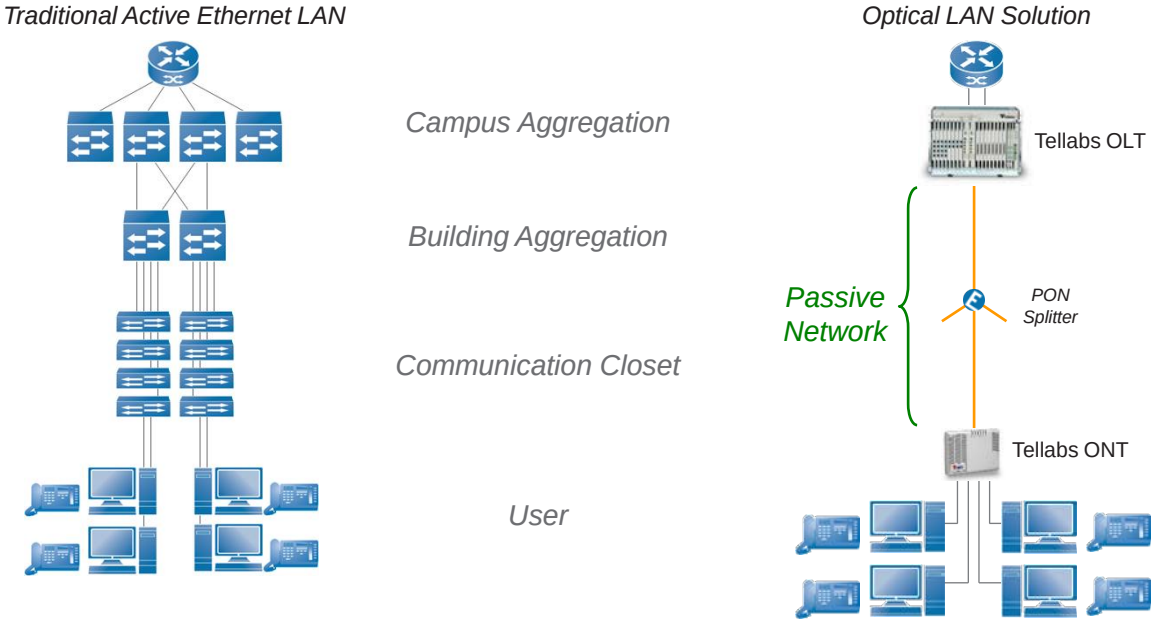

Figure 1. Comparing Traditional Active Ethernet LAN and Optical LAN network architectures

Enterprises also have the flexibility to deploy an Optical LAN in a Fiber-to-the-Desktop (FTTD) topology or a Fiber-to-the-Communications (FTTC) room. A splitter-equipped fiber distribution hub (FDH) on each floor routes the fiber to the desktop ONTs throughout the building. The FTTC closet topology allows for the reuse of existing copper cables between the Communications closets and the desks.

An Optical LAN's ONT has all of the required Layer-2 functionality built in. The Optical LAN provides integrated Ethernet bridging, VLAN capability required for network segmentation and user authentication and security filtering. The ONT, which functions much like an Ethernet switch, makes it possible for an enterprise to seamlessly replace an Ethernet-switched LAN.

Deliver Significant CapEx and OpEx Savings

When upgrading your network infrastructure, it is important to look at both the near-term and long-term expenses. Today's enterprise requires solutions that not only lower initial capital expenses, but also reduce the total cost of ownership (TCO) for the network. Forward-looking managers insist that new systems address more of their telecommunications requirements while minimizing ongoing operational expenses.

GPON technology enables the enterprise to significantly reduce the cabling infrastructure costs from the data center to the user by significantly reducing the number of cable runs. The result is a decrease in overall operational costs and network complexity.

Each ONT model supports multiple densities of Gigabit Ethernet, fast Ethernet, POTS and RF video. This integrated approach provides the ability to connect building automation systems, security cameras and building sensors all on the same infrastructure, thereby removing the requirement and expense of separate transport systems across the campus for each technology. The PON infrastructure also eliminates costly hardware within a network, such as remote switches, as well as their associated provisioning cost, annual maintenance and software licensing fees.

An Optical LAN extends the network lifecycle to 10 years or more. This approach enables:

- Gradual, more predictable costs for bandwidth upgrades over the full 10-year period
- Modest ongoing maintenance costs associated with fiber
- Seamless addition of more technology-based capabilities, such as wave-division multiplexing 40- and 100-Gbps transport and terabyte switching

Developed for low-cost fiber-based converged network service delivery, GPON standards were finalized by the ITU in 2003 (ITU G984.x). Tellabs first publicly demonstrated standards-based GPON OLTs and ONTs to the North American service provider consortium led by Verizon, AT&T and BellSouth in May 2006. Today, the growing market acceptance reflects GPON's ability to support critical enterprise applications with greater efficiency than Active Ethernet. Figure 2 shows an overview of the connectivity and bandwidth configuration of a typical GPON connection.

GPON attains up to 95% bandwidth utilization efficiency, where Active Ethernet suffers from efficiency as low as 69%. Coupled with strong encryption support, GPON delivers the most efficient and secure technology available.

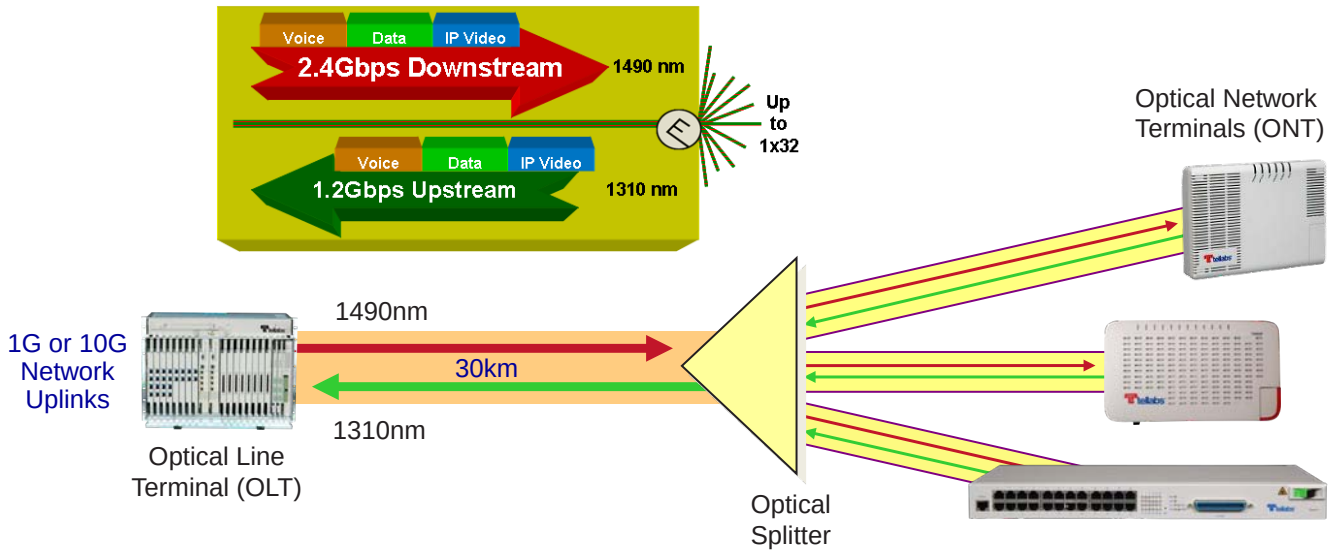

Figure 2. Connectivity and bandwidth configuration of a typical GPON connection

Lower Space Requirements

Cutting back on floor, rack and closet space is also extremely important to organizations looking to save. Reduction in floor space lowers operating expenses by reducing overhead costs, such as space and HVAC. In addition, the smaller footprint associated with GPON technology enables next-generation performance and services in smaller communication closets not originally designed for advanced communications equipment.

A typical Active Ethernet LAN serving up to 2,016 users requires 90 rack units of space. Active Ethernet LAN switches require one full rack for the switches and two additional racks for terminating the large bundles of copper cables associated with the switches. The total solution would require a total of 18 seven-foot-tall equipment racks.

Comparatively, an Optical LAN serves up to 7,700 users. Due to the OLT's 90% greater density, this solution requires only 1 equipment rack and a total of 9 rack units within the rack.

Additionally, an Optical LAN requires fewer communications closets and, in some cases, eliminates them altogether. As a result, a business may recover physical space and cut expenses. The single-mode fiber in the Optical LAN, however, can reach up to 30 kilometers. This enables an enterprise to:

- Reduce or eliminate repeaters, switches and communications closets
- Deploy an OLT in a single, central location

Meet Green Objectives

Optical LAN offers power savings of up to 80% over Active Ethernet solutions supporting green initiatives and reducing total cost of ownership. GPON is a passive architecture, therefore it requires no power within the Optical Distribution Network (ODN), which removes all power requirements from the building aggregation portion of the network. Not only does less equipment require less power, it has a ripple effect on many other areas, including power distribution and switchgear, power conversion and cooling. One in five companies now has a dedicated budget allocated for green IT initiatives, and 44 percent say they are moving toward doing so.

Deploy a Future-Proof Infrastructure

Installing a Single Mode Fiber (SMF) infrastructure virtually future-proofs your network. Since SMF has been demonstrated to carry 69 Tbps of full duplex bandwidth, the next-generation network upgrade will not impact the installed fiber distribution network, and you will only need to upgrade the electronics. Utilizing SMF extends the LAN reach out to 30 kilometers without signal regeneration.

Typically, the cable plant is the most expensive part of a technology upgrade. Installing SMF removes the requirement for additional upgrades to your cable plant in the foreseeable future. Additionally, recent advances in fiber connector technology have reduced the cost of installing fiber significantly and in most cases the installation of fiber is now less labor intensive than installation of a copper cable plant.

Finally, in a direct comparison to CATx copper cable plant, SMF is smaller, lighter, and stronger; has a tighter bend radius, higher bandwidth capacity, and longer reach; is less susceptible to EMI interference; has faster connector solutions and longer life; and entails less material expense than CATx.

Converge All Services

Converging all network services is the foremost feature of the Optical LAN. It will converge all services into a single Optical LAN, eliminating the need for multiple platforms while providing highly scalable high-speed data services to all users. Additionally, voice (analog POTS and VoIP w/PoE), video, video conferencing services and monitoring services (such as building automation system security cameras and building sensors) are all supported on the Optical LAN.

About Tellabs® Optical LAN

Tellabs is the leading North American PON vendor with more than 3,000+ OLTs deployed in the United States and is dedicated to helping our customers succeed by providing enterprise businesses with next-generation Optical LAN solutions. Tellabs® Optical LAN provides highly secure networks, combined with carrier-class reliability of 99.999%. Additionally, Tellabs Optical LAN will greatly improve the energy efficiency of your enterprise network and reduce HVAC requirements.

Businesses using Tellabs Optical LAN have reduced capital and operating expenses significantly. Tellabs Optical LAN has been proven to provide savings of up to 70% on CapEx, 80% of space, and 90% of power, resulting in the lowest TCO in the LAN.

Tellabs Optical LAN also helps you meet tangible environmental goals through LEED certification and Energy Star qualification. LEED is the internationally recognized green building certification. Corporations seeking LEED certification for new construction or existing buildings will receive maximum operational efficiency with the Tellabs Optical LAN. Reduced power and HVAC requirements reduce the environmental impacts of new and upgraded network systems.

Energy Star is an international standard for energy-efficient consumer products that originated in the United States. Tellabs is a major contributor to Energy Star, establishing criteria for PON equipment. Energy Star certification is pending for the Tellabs Optical LAN solution.

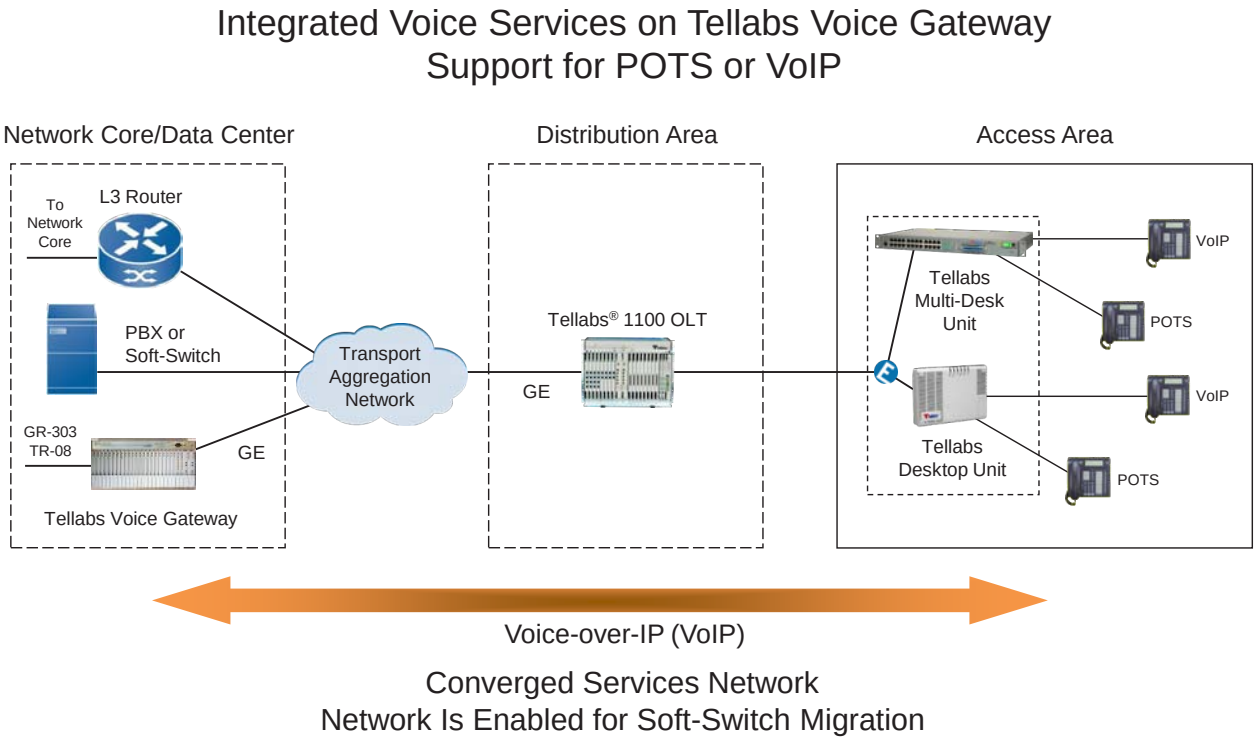

Figure 3. Network diagram of a typical VoIP installation

Smooth Upgrade Path to Next-Generation Services

Tellabs Optical LAN supports legacy voice, including Session Initiation Protocol (SIP); video, including IPTV and RF over Glass (RFoG); high-speed data; and business services. The ITU created the GPON standard with the ability to support multiple services, and Tellabs Optical LAN takes advantage of this capability by providing a smooth upgrade path from existing to next-generation services. The GPON network easily scales as the campus network expands and evolves, providing a simple and cost-effective migration path.

To understand how it works, see Figure 3. Figure 3 is a network diagram of a typical VoIP installation. On the left is the Router, Voice Gateway and either an IP-enabled PBX or a Soft-switch. The network is then connected to the Tellabs OLT in the center (Distribution Area) of the network. A PON port on the OLT is then connected to the splitter that feeds a series of ONTs in either the closet or work area. The Ethernet ports on the ONTs are then connected to either a PC or VoIP telephone instrument. Enterprises also have the option to connect POTS analog telephone sets to selected ONT ports.

Improve Security and Reliability

Tellabs Optical LAN is highly secure and produces no EMI radiation that is typically associated with traditional copper-wired facilities. Utilizing fiber optic cable for the transport mechanism effectively removes all TEMPEST concerns. In addition, Tellabs Optical LAN provides powerful security measures at the physical layer, data layer, and at the user port to greatly reduce the potential for Denial of Service (DoS), redirects or other malicious attacks.

Tellabs Optical LAN provides Access Control Lists (ACLs), Broadcast Datagram Rate Limiting at each user device and strong authentication. Authentication based on 802.1x allows multiple devices per user port along with advanced intrusion detection — effectively locking down the physical port upon detection of an untrusted device. ACLs provide flexibility to statically and/or dynamically permit/deny datagrams based on Layer 2 (Ethernet) rules, Layer 3 (IP) rules, Layer 4 (TCP/UDP) rules and Network Access Control (NAC).

Seamlessly Upgrade to VoIP

Typically, upgrading to VoIP requires not only the installation of a soft-switch, but also the upgrade of each user's handset to a VoIP phone, which can cost $300 to $700 per set. It is estimated that in a normal office environment only 5% to 20% of users actually require advanced VoIP features. Tellabs Optical LAN enables the enterprise to continue using the existing analog handsets for users that do not require the advanced VoIP features, eliminating the need for costly handset upgrades.

Time-Saving Tellabs Optical LAN Training

Getting an Optical LAN up and running is easy with Tellabs training, which is available either at the Tellabs training facility or at your location. The amount of training required to Test and Turn-up the Tellabs Optical LAN is far less than with an Active Ethernet network. Simplified training is possible due to the central management of the EMS system combined with the central intelligence provided by the OLT, which simplifies and reduces the amount of training required to support an Optical LAN network. The Tellabs Test and Turn-up class includes the Optical LAN and EMS system and is only 3½ days long, compared to the several weeks of training that is typically required for an Active Ethernet network.

Summary

Enterprises looking to upgrade or replace their network infrastructure are realizing the value of Optical LAN. Optical LAN provides significant benefits without forcing enterprises to alter what they are already doing or changing out the core and user devices. Businesses are saving up to 70% of CapEx, 80% on power requirements and 90% of the rack space while exceeding green goals and gaining assistance in acquiring LEED facility certification.

Deploying an Optical LAN helps an enterprise future-proof their network infrastructure while realizing all of the benefits of converged network services. The Tellabs Optical LAN provides solutions that furnish high bandwidth while increasing the security and reliability of existing networks.

Next Step:

Visit www.tellabs.com to learn more about how Tellabs Optical LAN solutions are solving enterprise network challenges while significantly reducing CapEx and OpEx, power consumption, and space requirements. If you have a question, please email ask@tellabs.com.

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