

## Passive Optical LAN Executive Summary

### Overview

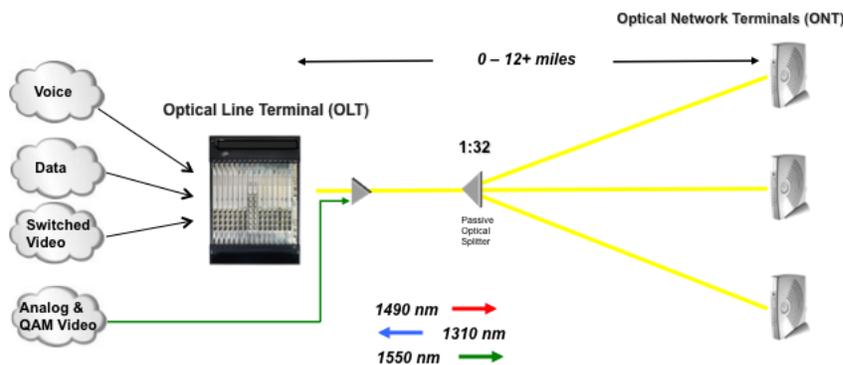
Passive Optical LAN (POL) is a solution that provides a great option for enterprises interested in significant capital and operational cost savings. Savings are typically greater than 50 percent over today's traditional LAN architectures when looking at five-year total cost of ownership, including significant capital investment savings and 50-70 percent in energy savings. POL simplifies LAN management, allows for the optimization of IT resources and provides IT leadership the ability to focus on strategic initiatives driving advances in information technologies and energy savings.

### Components

A POL solution includes an Optical Line Terminal (OLT), optical network terminals (ONT), and an element management system that allows an enterprise to view multiple OLTs and thousands of Ethernet ports as part of the same local area network. The passive cabling infrastructure includes passive optical splitters, cable management, and all interconnecting, bend-insensitive, single-mode fiber.

### Topology

Scale and reach are the two distinct advantages to using POL over traditional switched copper LANs. Reach is accomplished through the use of single-mode fiber in the cabling plant as it provides a footprint of 12.4 miles as opposed to the 300-foot limitation of copper. Scale comes from the fact that POL is a point to multipoint technology. Single-mode fibers connect to Passive Optical Network (PON) ports on the OLT, reach into the enterprise, and then terminate into a passive optical splitter, turning the one single-mode fiber into 32 fibers. Each of these then typically terminate into a 4-port ONT, providing a total of 128 Ethernet ports. In contrast, a traditional LAN would require 128 home runs of copper to accomplish what POL provides with 33 total fibers. Below is a snapshot of the POL topology.



- Each Passive Optical Network (PON) supports:
  - Splits for up to 64 end devices
  - A data rate of 2.4Gbps/1.2Gbps
  - Maximum span of 12+ miles
- GPON Standard Supports Overlay Wavelengths within the 15xx range

To put these advantages into perspective, consider that an optical line terminal that has 14 PON cards with 4 ports each can provide a total of 56 PONs feeding 1x32 splitters, which then terminate into 4-port ONTs. In other words, a total of 7,168 Ethernet ports supported by one aggregation switch at distances up to 12.4 miles. One switch can support an entire hospital facility, including additional buildings in the campus setting.

### Benefits

Benefits of POL include:

- Rapid ROI and low TCO at half the cost of copper-based LANs
- Easy installation and operation
- Highly secure with all-fiber reliability
- Green IT
  - Reduced impact on the environment as a small enterprise can potentially reduce LAN energy dependency by 50 percent and a large enterprise by potentially 70 percent using a POL solution
  - Reduction in cabling means reduction in non-renewable materials, reduction in space, and reduction on fire load
- Future proofing
  - The use of single mode fiber gives potential through-put of over 100tbps
  - Compatibility of PON standards means bandwidth upgrades occur at hardware and do not require rip/replace of cabling
- **Reduction or elimination of telecom closets**

### Solution Comparison

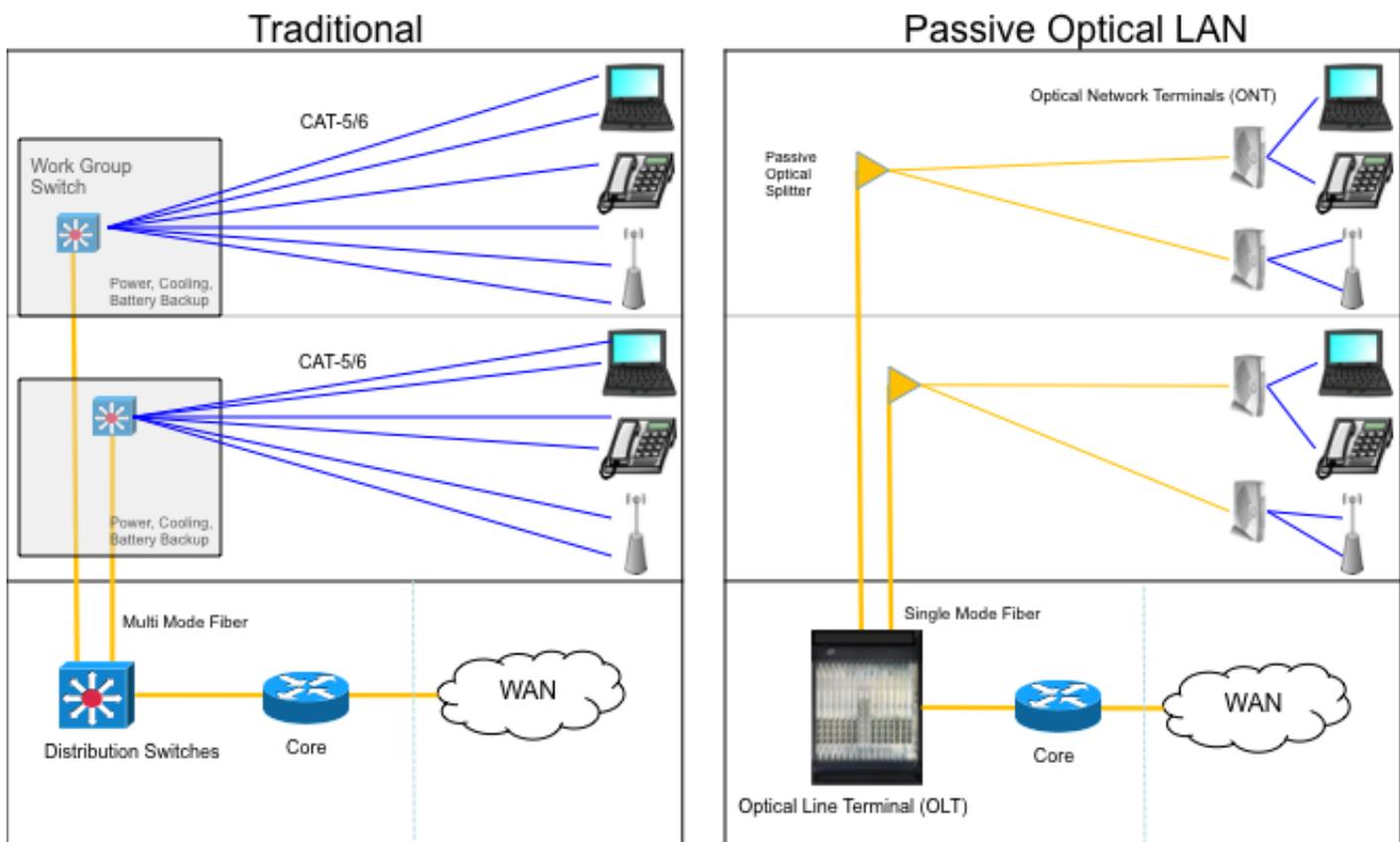
When drawing comparisons between Passive Optical LAN and a typical switched copper infrastructure solution, it is vitally important to ensure that all comparable aspects of each solution are taken into consideration. POL represents a true evolution of LAN connectivity by pushing the Ethernet edge out of the telco closets and to the end-user. Unlike a traditional infrastructure with the demarcation between the switches aggregated in the telco closets and the home runs to the end user, the POL solution is inclusive of the fiber connectivity. Therefore, a POL system is a turnkey approach to the traditional copper cabling AND the distribution and workgroup switches. An accurate comparison must take into consideration each of the following components and activities:

- Structured cabling
  - Copper cabling
  - Fiber backbone
  - Racks
  - Patch panels/Cable management
  - Faceplates, jacks, etc.
- Workgroup access switches
  - Switches
  - Transceivers

- Patch cables
- Maintenance
- Professional services
  - Rack/stack
  - Configuration
  - Documentation

Based on an accurate comparison, taking all of the above factors into consideration, capital expenditure savings should be 30-50%.

Operating expenses will also be drastically reduced. The most significant contributor to these savings is the reduction in power consumption that comes from the elimination of the workgroup access switches. The removal of the switches reduces or eliminates the impact on UPS and HVAC in the closets. Lastly, maintenance costs associated with the switches, UPS, and HVAC are reduced or eliminated. The image below shows the comparison of traditional network architecture to the POL architecture.



### Additional Considerations

Additional considerations in the evaluation of POL include security, reliability, green benefits, and future proofing. The security benefits provided by POL come from several sources. First, using an all fiber-cabling infrastructure, the physical security of the cabling is improved, as fiber is extremely difficult to tap and is immune to electro-magnetic interference. Additionally, the GPON standard calls for the use of AES 128-bit encryption on all downstream traffic.

The use of bend-insensitive single-mode fiber improves the overall quality and reliability of the cabling plant as it is stronger and more flexible than copper cabling and less sensitive to erosive element and vibration events in buildings. Additionally, the use of factory pre-terminated fiber assemblies drastically reduces install times and improves the quality of the overall assembly. The use of pre-terminated, plug-n-play assemblies means that future moves, adds, and changes can be handled by facilities personnel and does not always require certified cabling installers.

In addition to the space and power savings outlined above, POL's use of a point to multipoint topology creates a drastic reduction in cabling mass including reductions in the use of non-renewable materials, fire load, and floor/ceiling space. The future proofing benefit comes from the fact that single-mode fiber has over 100tbps of potential throughput and the PON standards call for backwards compatibility. This means that migrations to 10gbps, 100gbps, or above would only require changes in the active components and that a rip and replace of the structure cabling infrastructure would not need to occur for the next several generations of LAN speeds.

### POL Deployments

A common concern and misconception about Passive Optical LAN is that it is a new technology or solution. Telecommunications carriers have used passive Optical Networking (PON) since the mid 1990s. The use of PON based LAN solutions like POL dates back to 2008 with the first federal government deployments. The idea of converging networks onto a common backbone using fiber has been explored extensively over the past decade.

PON hardware manufacturers have been focused on enterprise customers since 2011. The creation of a network of value added resellers, similar to the Cisco go-to-market strategy, is meant to stimulate the growth of POL adoption. Companies like IBM, Johnson Controls, Verizon, GDIT, and Leidos have all developed POL sales strategies. Additionally, cabling system manufacturers like TE Connectivity, Corning, 3M, and CommScope all have product lines supporting POL solutions.

### Conclusion

Passive Optical LAN is a solid enterprise LAN solution based on industry proven standards. To date there are several thousand OLTs and millions of ONTs in deployment across multiple verticals. The benefits that this technology and solution bring to the enterprise, particularly environments with heavy users and multiple floors or buildings, are evident. Customers that have adopted POL have recognized significant total cost of ownership savings and deployed an extremely reliable and robust platform that will support their enterprise's needs today with minimal investment required to support future growth.

