MYTHBUSTERS:
The Honest Facts About
Gigabit Passive Optical Networks (GPON)

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GPON Primer

GPON Adoption

Common GPON Myths (and the real facts)

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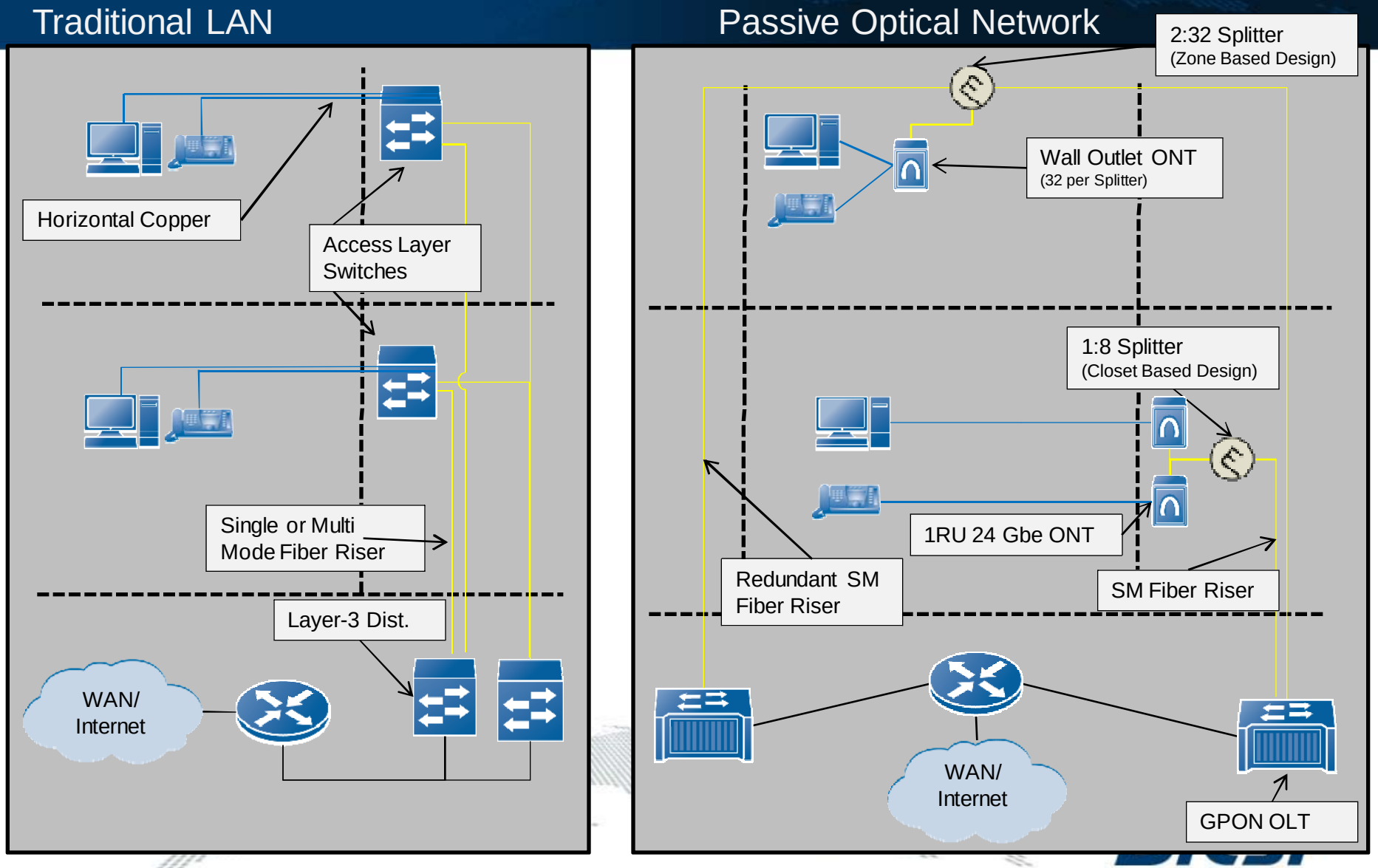
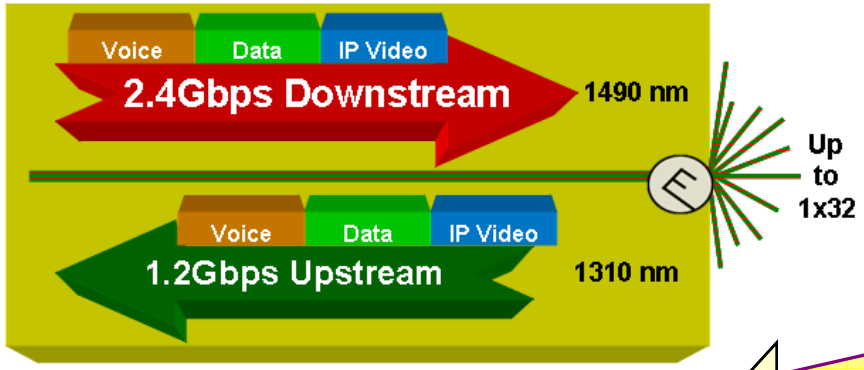
Side-by-Side Comparison



PON Layer-1 cabling and splitters on average cost 40 - 50% less than legacy copper based solutions

Basics of Optical LAN

Optical Infrastructure for Enterprise Customers



Optical Network Terminals (ONT)

1G or 10G Network Uplinks

1490nm

20km

1310nm

Optical Line Terminal (OLT)

Optical Splitter (2:32)

The Optical Line Terminal (OLT)

- Acts as the central aggregation element
- Located in the Core Data Center
- Replaces multiple L2 switches
- Can aggregate up to 8,000 end users

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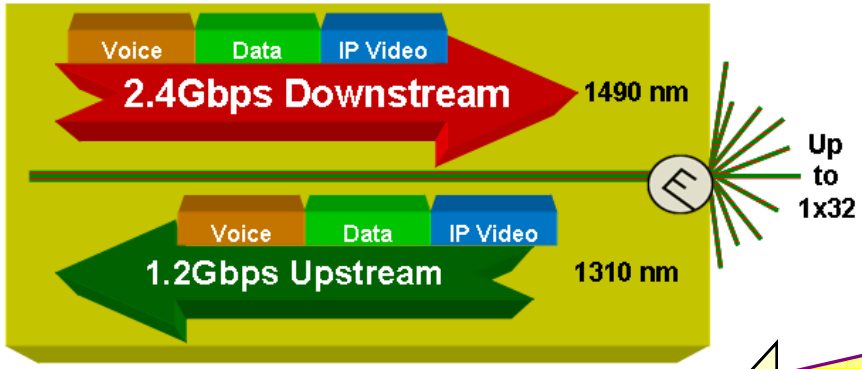
Basics of Optical LAN

Optical Infrastructure for Enterprise Customers



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<u>Passive Optical Network (PON)</u>

- Completely passive infrastructure
- Single fiber carries multiple wavelengths
- 2.48 Gbps downstream
- 1.24 Gbps upstream
- Serve Remote Bldgs Up to 20Km

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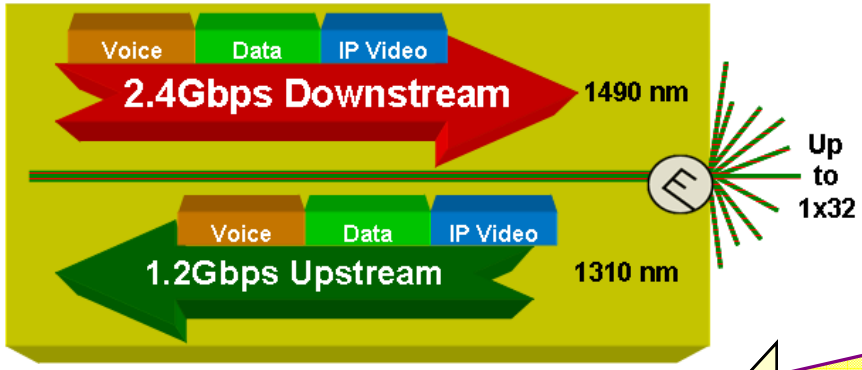
Basics of Optical LAN

Optical Infrastructure for Enterprise Customers



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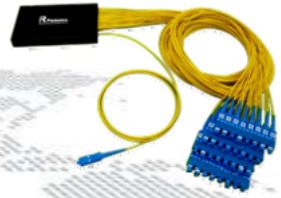

Passive Optical Splitter Feeding FDH

- Completely passive components
- Rack Mounted or Cassette Based
- Splits single fiber up to 32 ways
- Typically located where workgroup switches are deployed
- Can be dual homed to redundant OLT chassis for failover

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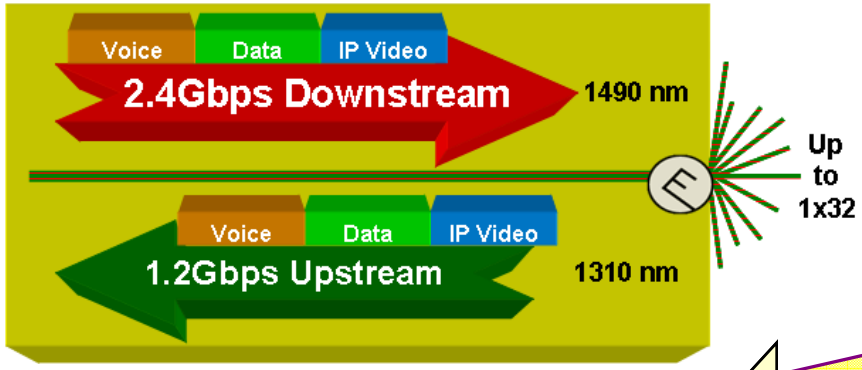
Basics of Optical LAN

Optical Infrastructure for Enterprise Customers



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Optical Splitter (2:32)

<u>Optical Network Terminals (ONT)</u>

- Terminates the fiber at the end user
- Provides Data, VoIP, IP Video services
- Some models also provide native POTS
- Desktop and MultiDesk Unit models

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Fundamentals of GPON Infrastructure

- Completely Single Mode fiber solution
  - Multimode fiber will not support the 20/30Km reach, and not the 60Km reach of 10GPON
  - Multimode cannot support multiple wavelengths allowing for both upstream/downstream traffic on a single filament
  - Single mode supports over 69Tbps of throughput, making it a 'future proof' transport medium
- Benefits of fiber plant vs. copper:
  - Not susceptible to EMI
  - Unmatched security from tampering and intrusion
  - Lower material and installation cost
  - Smaller cable footprint than a copper infrastructure

Turn this:

Into this:

- A single strand of fiber (with a 1x32 splitter) can provided up to 128 Gbe end user ports
- GPON connections primarily SC-APC, however some ONTs are UPC

- Splitters are completely passive, and able to be placed in nearly any accessible space (floor, ceiling box, closet, manholes)
- Communications closets (IDF/TR) become passive spaces for the fiber splitter, or simply a fiber pass thru.

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Network Protocol Support

- Layer 2 – 4 Access Control Lists (ACLs)
- 802.1x Port Security
- Network Access Control Integration
- Advanced QoS offerings to prioritize traffic
- LLDP (CDP) Implementation
- Type-B PON Protection (Dual home ONTs/Splitter to multiple OLTs)
- Q-on-Q VLAN Stacking
- 8 VLANs per ONT physical port
- RSTP BPDU Guard loopback detection and prevention
- MSTP configuration options for the Layer-3 uplinks
- LACP/LAG group to a dynamic router config (i.e.. VSS support)

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Government Adoption

May 2012 DoD Memorandum

DEPARTMENT OF THE ARMY
UNITED STATES ARMY NETWORK ENTERPRISE TECHNOLOGY COMMAND
2133 CUSHING STREET
FORT HUACHUCA AZ 85613-7070

REPLY TO
ATTENTION OF:

NETC-OP

MAY 11 2012

MEMORANDUM FOR Director, Architecture, Operations, Networks, and Space (AONS), HQDA, CIO/G6, 107 Army Pentagon, Suite 1E629, Washington, DC 20310

SUBJECT: Program Execution Requirements for Installation Information Infrastructure Modernization Program (I3MP) Fiscal Year (FY) 13

1. NETCOM has identified the following program execution requirements for I3MP for FY13.

2. In accordance with the Memorandum dated 29 February 2012, Program Execution Guidance for Installation Infrastructure Modernization Program (I3MP) – Fiscal Years (FY) 12/13, NETCOM concurs with the FY13 budget-constrained plan including the build out of Unified Capabilities (UC) at Fort Hood and engineering at ten posts identified for I3MP upgrades in FY14 as well as the FY13 contingency plan.

3. As part of the FY13 efforts and beyond, and in accordance with the Memorandum dated 23 April 2010, Department of the Army (DA) Directive 2010-XXX, Technical Guidance for Network Modernization, NETCOM has identified a requirement for all new construction and all major renovations to utilize Gigabit Passive Optical Network (GPON) technology. Any deviation from the requirement to utilize GPON for said projects will require a waiver from the CG, NETCOM prior to execution.

4. Points of Contact for these requirements are COL Daniel R. Matchette; G5, (520) 538-8575; daniel.r.matchette.mil@mail.mil and COL Gerald H. Miller; G3, (520) 538-8581; gerald.h.miller.mil@mail.mil.

Follow on to 2010 US Army Directive directing all commands to adopt GPON technology by 2013

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Government Adoption

- Army
  - 2012 memo directs all commands to use GPON as a standard, and any deviations to use traditional switches to require a waiver
- USMC
  - CIO announces at AFCEA West 2011 that the “Marine Corps is standardizing on DWDM and GPON”.
  - Thousands of GPON ports in use today
- Air Force
  - 5,000+ GPON ports in use in both classified and unclassified environments
- DHS
  - Chooses GPON for the St. Elizabeths consolidated HQ, with over 24,000 GPON ports
- Department of Energy
  - Sandia Labs (NM) has deployed over 60,000 GPON ports
- Intelligence Community
  - Multiple GPON deployments supporting National Security related missions
- HHS
  - Current pilot implementation
- USDA
  - Multiple project and sites currently under design and deployment

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Commercial Adoption

- University of Mary Washington
- Deltek Headquarters
- ICE Hotels, Alaska
- Russell Investments
- San Diego Library Project
- Intel Corporation
- Trump Tower, Florida
- Verizon Business Offices
- VA Beach School and Transportation
- Commonwealth of Virginia
- AERTC (NYC)

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GPON Myth #1

Myth: When compared to traditional Ethernet switch technology GPON is not reliable.

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manufacturers advertise a 99.961% availability (more than 3 hours of network down time annually).

GPON Myth #2

Myth: GPON doesn't provide Ethernet Services

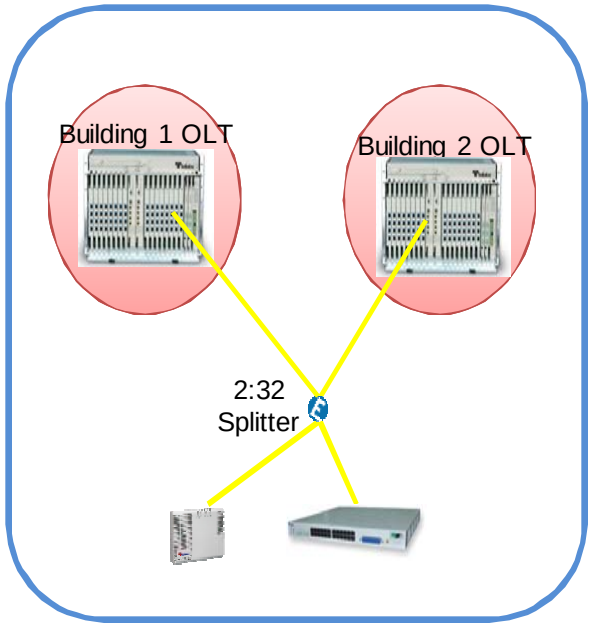
Reality: End-to-end GPON provides IEEE 802.3 standards based Ethernet interfaces for both the network core, aggregation and the user interfaces.

GPON Myth #3

Myth: GPON does not provide redundancy in the LAN

Reality: GPON can be architected with many layers of redundancy from both a Layer-1 and Equipment perspective:

1. Chassis have redundant power, cooling, logic/switching cards and backplanes
2. Diverse fiber routing can protect a PON splitter or ONT from a fiber cut
3. ONTs/Splitters can be dual homed to geographically diverse OLT shelves to provide complete equipment protection.



GPON Myth #4

Myth: GPON Operations and Maintenance is more complicated than a current network design.

Reality: GPON was specifically designed for efficient troubleshooting.

Central management minimizes required field technician expertise and supports high volume Moves, Adds and Changes.

GPON fiber infrastructure is typically zone based and using pre-terminated SM fiber cables, allowing for easy infrastructure changes.

GPON Myth #5

Myth: GPON doesn't support PoE.

Reality: GPON ONTs are available with PoE, both in low power IEEE 802.3af (15.4W) and high power IEEE 802.3at (25.6W) standard configurations on all ports of the ONTs.

GPON Myth #6

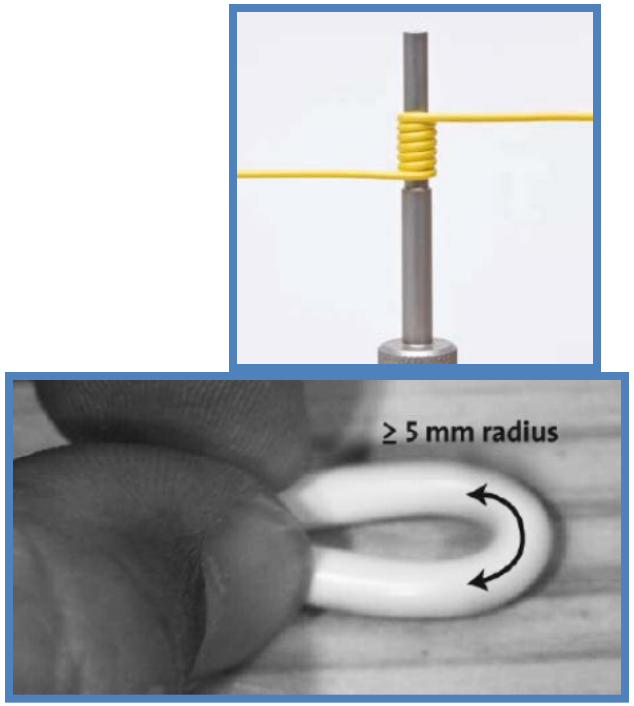
Myth: You need to change out splitters to add users.

Reality: Adding users is as simple as adding a patch cord to an existing ONT port or an additional fiber to an available port on the splitter. The splitter extends the network into the work space supporting up to 128 users on a single fiber.

GPON Myth #7

Myth: Fiber networks are more fragile than traditional copper cable networks.

Reality: Fiber termination and handling practices have dramatically evolved over the years. New bend-insensitive fiber and pre-terminated assemblies allow for easy installation and lower level technicians to complete the job.



Fiber cabling is stronger than copper in both tensile and compression strength. A strand of fiber has the same tensile strength as a as a steel wire of the same gauge.

GPON Myth #8

Myth: A forklift upgrade will be required when upgrading to the ITU G.987 10GPON.

Reality: This is true only for traditional Ethernet.

10GPON standards allow for a single card replacement and an ONT replacement to provide a new 10GPON user along with an existing GPON network over the same fiber and splitter infrastructure as 10GPON utilizes a different set of WDM wavelengths (1270nm and 1580nm)

GPON Myth #9

Myth: GPON doesn't support multiple VLANs or QoS for VoIP and Data traffic.

Reality: Most GPON ONTs ports are capable of supporting up to 8 different VLANS including a mixture of tagged and untagged VLANs, varying QoS and Class of Service, and rate shaping.

Enterprise GPON platforms provide advanced QoS services allowing for DSCP mappings, PBIT prioritization, various class of services, and direct bandwidth rate shaping. As data services are managed at the per port level, GPON QoS usually exceeds that of traditional Ethernet switching.

GPON Myth #10

Myth: You can not deploy both analog and VoIP handsets in the same GPON network.

Reality: GPON does support both analog voice and IP voice services. This benefit results in significant savings for those customers that want to continue to leverage their analog voice hand-sets.

Many gov't agencies have deployed GPON Optical LAN strictly for analog voice transport over a more cost effective and reliable fiber media; and utilize the data services as a 'bonus'.

GPON Myth #11

Myth: Deploying GPON in a building will cause a major impact to the network.

Reality: Deploying GPON will create a very minimal impact to the existing network. GPON is a transport network, and the infrastructure that supports this transport is smaller and more agile than traditional copper based infrastructure.

Additionally, changes type work can be accomplished with less disruption to the network and the surrounding users; especially in a zone based architecture. Most Zone Move/Add/Change drops are <50-ft runs of pre-terminated fiber.

GPON Myth #12

Myth: GPON doesn't support power users

Reality: GPON delivers 2.5 Gbps of bandwidth to each ONT, so a "power user's" Service Level Agreement (SLA) can be configured so the user can take full advantage of the 10/100/1000 Mbps Ethernet interface capacity.

Most Common Bandwidth Consuming Devices in the Networks	
Typical VoIP Phone:	512kbps*
Typical VDI Session Rate:	512kbps*
Typical PC User Sustained Rate:	780kbps
Typical VDI Burst Rate:	1,024kbps
Typical PC User Burst Rate:	1,812kbps
Tandberg TelePresence T3 VTC:	10,500kbps
Typical 'Power User' Sustained Rate:	40,000kbps

GPON Myth #13

Myth: GPON doesn't support security

Reality: The GPON Optical LAN supports advanced security mechanisms including:

- Per-port, per-service VLANS
- Layers 2/3/4 Access Control Lists (ACL)
- 802.1x port-based Network Access Control (NAC)
- Integration w/ standards compliant 802.1x systems (Cisco ACS/ICE/TACACS, Juniper UMC, FreeRADIUS, etc)
- Fiber is inherently more secure than copper

GPON Myth #14

Myth: GPON is a shared medium and therefore is less secure than Active Ethernet.

Reality: GPON provides more secure functionality compared to active Ethernet. GPON utilizes advanced security mechanisms, such as AES-128 encryption, to ensure secure delivery of end user information.

In fact, an Ethernet switch is also a shared medium, typically with higher over-subscription rates than Optical LAN. Optical LAN is an efficient management of oversubscription compared to best effort bandwidth allocation.

GPON Myth #15

Myth: GPON is going to ruin our cabling business!

Reality: By deploying a GPON network architecture, a layer-1 infrastructure company should have the ability to also present the GPON active components to the end customer, providing additional sources of revenue and potential sustainment contracts.

Additionally, GPON solutions can generate more demand for infrastructure upgrades in a tight economy.

GPON Myth #16

Myth: GPON requires an ONT be placed on each desk or mounted to the wall. My customers don't want to see that.

Reality: New ONTs recently released actually fit into a single-gang wall plate, allowing for a simple transition to GPON Optical LAN without adding devices to the desktop.

These remotely powered devices are architected to provide remote power, PoE for phones, and Gbe w/ advanced QoS like all other GPON solutions.

Questions and Answer

Myth: What myths about GPON Optical LAN does the audience have?

Reality:
Pre-emptive

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