

Welcome!



2020 Regional Optical LAN Seminar Series



Chicago



Plan

Build

Operate

Passive Optical LANs



slide 2

Start	Duration		Topic	Presenter	
9:00 AM	60		Registration & Breakfast	***	00
9:00 AM	60		***Tellabs Advantage Partner Program Update***	Tellabs	
10:00 AM	5	Plan	(10:00 am START) Welcome, morning logistics and seminar purpose	John Hoover	01
10:05 AM	15		State of the POL Industry	Rich Schroder	02
10:20 AM	20		Flexible connectivity choices with Optical LAN	John Hoover	03
10:40 AM	20		Best practices for fiber-based infrastructure for buildings and campuses (Belden)	Michael Masucci	04
11:00 AM	20		break & interaction at tables	***	
11:20 AM	20	Build	Optical LAN cost comparison and migration to 10 gigabit connectivity	Joel Fischer	05
11:40 AM	20		Best Practices for Powering OLAN equipment (EPS)	Jeromy Kendall	06
12:00 PM	20		Competitive Analysis, Unique Differentiators and Futures	Russ Kulpins	07
12:20 PM	55		Lunch & interaction at tables	***	
1:15 PM	5	Operate	Afternoon Seminar Logistics	John Hoover	08
1:20 PM	20		Live Panorama PON Manager demonstration	Joel Fischer	09
1:40 PM	20		Best Practices for qualifying and troubleshooting enterprise fiber (EXFO)	Jimmy Gagnon	10
2:00 PM	20		Services to Plan, Build and Operate your Optical LAN	Joel Fischer	11
2:20 PM	20		Break & interaction at tables	***	
2:40 PM	20	Delight	Electronics, Layer-1, Services, testing and Powering Technical Panel	Tim Spurgeon, et al	12
3:00 PM	30		AMTRAK experience with Optical LAN customer presentation	Richard Thomson	13
3:30 PM	20		Open Q&A	John Hoover	14
3:50 PM	10		Closing Remarks	Rich Schroder	15
4:00 PM	120		Social Mixer	***	
6:00 PM			End		



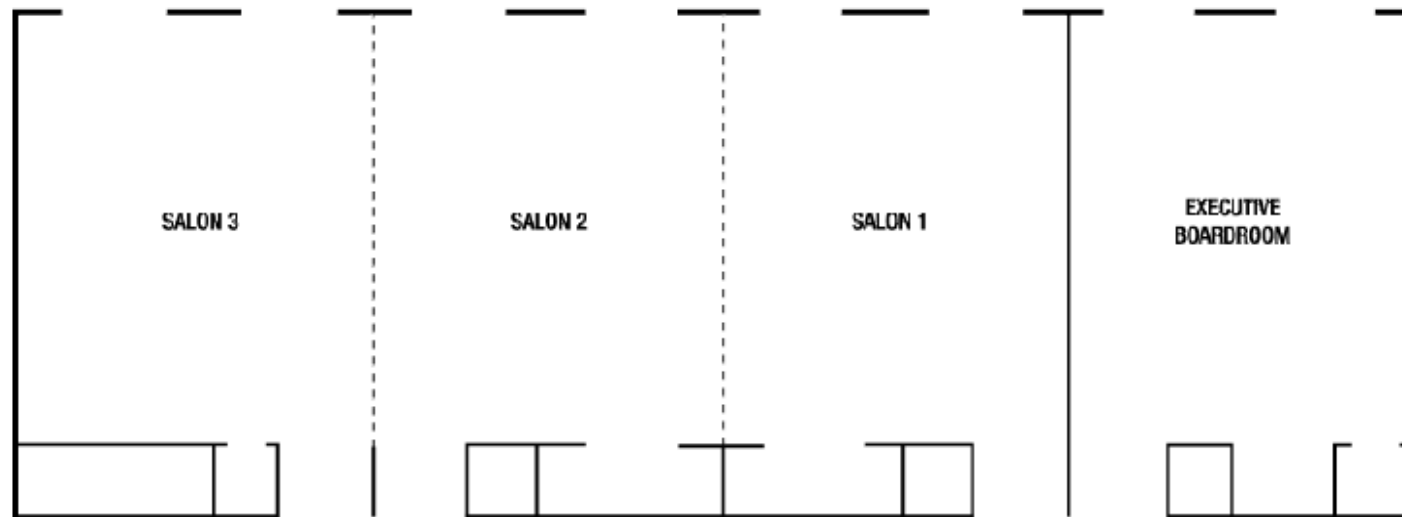
Wi-Fi

Network: Conference
Password: EVENTS

Parking

Parking is complimentary. Stop by the front desk before they leave to get your parking vouchers validated

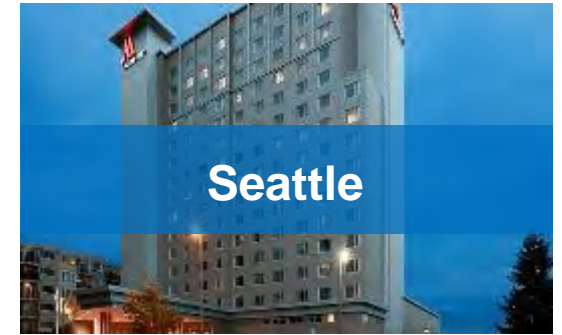
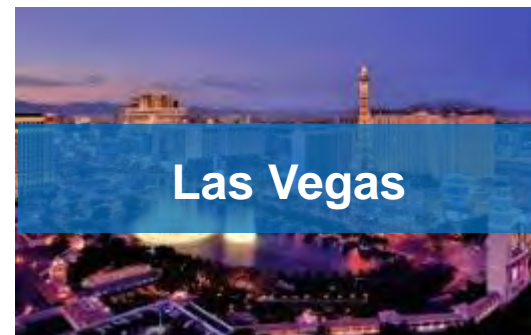
2ND FLOOR



slide 4



Additional OLAN Seminars and Training



Eastern Region Details

- Wednesday, February 19th
- Convene Building 29th floor
- Rosslyn-Arlington, Virginia
- NPD/OPM-Lite Training (TIA HQ)
 - ✓ Thursday, February 20th

Central Region Details

- Thursday, February 27th
- Chicago Marriott Suites O'Hare
- Rosemont, Illinois

Southwest Region Details

- Wednesday, March 18th
- TopGolf Venue
- Las Vegas, Nevada
- **NPD/OPM-Lite Training**
 - ✓ **Thursday, March 19th**

Northwest Region Details

- Wednesday, March 25th
- Residence Inn by Marriott Bellevue
- Bellevue, Washington
- **NPD/OPM-Lite Training**
 - ✓ **Thursday, March 26th**



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State of the POL Industry and Tellabs Optical LAN Strategy

Rich Schroder, Tellabs President and CEO



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Welcome to the Regional OLAN Seminar Series

Today's seminar will give you firsthand knowledge concerning new advancements with our true enterprise Tellabs FlexSym Series Optical LAN solution

- ✓ Access to best-of-breed partners for distribution, infrastructure, powering, and security
- ✓ Gain valuable insight into how OLAN can drive success for you, your company and the greater industry in 2020!



Vendor Alliance Partners

Leaders in Passive Optical Networking Innovations

Belden

- Belden produces and sells a comprehensive portfolio of connectivity and networking products into a variety of markets, including industrial, enterprise, and broadcast. Our customers across all our brands can rely on what we build to outperform and outlast in the most demanding conditions, and they know that we'll support them with uncompromising and responsive service.

EdgePower Solutions

- With over 250 successful GPON and DAS projects under EPS power, the consensus is that EPS products provide for a cleaner and more efficient installation. The success has led to crossover uses in other markets such as DAS/Distributed Antenna Systems and Building Controls.

EXFO

- EXFO develops smarter test, monitoring and analytics solutions for fixed and mobile network operators, webscale companies and equipment manufacturers in the global communications industry. Our customers count on our unique blend of equipment, software and services to accelerate digital transformations related to fiber, 4G/LTE and 5G deployments.



DoD Endorsement of PON

Source: *Digital Modernization Strategy 2019-2023*



Appendix A: Technologies Offering Promise to DoD

Looking toward the future, the Department is exploring a number of technologies that have the promise to provide increased effectiveness, efficiency, and security. Representative technologies include AI, Big Data Analytics, Evergreen IT approaches, DevSecOps, Hyper-Converged Infrastructure, Serverless or Event-Driven Computing, Software Defined Networking (SDN), Block Chain, Cryptographic Modernization, Quantum Computing, Internet of Things (IoT), 5G, Internet Protocol version 6 (IPv6), **Passive Optical Network (PON)**, and Zero Trust Security. These technologies are briefly described below, along with discussion of how each technology might increase the Department's effectiveness, efficiency, and security. A number of these technologies can work together to provide the Department with the potential for quantum leaps in capability.

Passive Optical Network (PON)

A passive optical network is a form of fiber-optic access network that implements a point-to-multipoint architecture, in which unpowered fiber optic splitters are used to enable a single optical fiber to serve multiple end-points. Therefore, PON requires far less infrastructure since it reduces the amount of fiber and central office equipment required, compared with point-to-point architectures.

The main benefits of PON are listed below:

- Lower network operational and maintenance costs
- Lower infrastructure costs
- Large bundles of copper cable are replaced with small, single mode optical fiber cable
- PON provides increased distance between data center and desktop (>20 kilometers)
- Fiber is more secure than copper; it is harder to tap



State of Tellabs Optical LAN

Strong performance in 2019

Launched FlexSym Brand

- New platform that is flexible enabling 10G symmetrical and GPON on same OLT

Strong YoY Customer Growth

- Optical LAN recognized as a superior solution
 - ✓ Large food and beverage companies
 - ✓ International Airports
 - ✓ Multi-national companies
 - ✓ Government Entities

Increased Investment in Sales & Business Development

- Added Director of Business Development and Technology – Bill Buck
- Added Sales Account Executive in the West – Marcia Mark
- Added Sales Executive Account Manager in Texas – Marcus Bellard
- Added Sales Systems Engineer – James Cobb

Continued Expansion of our Service Offerings

- Expanding our professional services offerings with tight partnership with our systems integrators
- Onboarded a new professional services program manager – Matt Hunt, USMC Veteran
- Launched our new Digital Credentialing program



Tellabs 2020 Strategy

Positioned for accelerated growth

Leverage FlexSym Series 10G Capabilities to Optimize Customer Networks

- Multi-rate capabilities allow you to seamlessly mix GPON and 10G
 - ✓ 10G backhaul for WiFi-6 WAP's
 - ✓ GPON for lower speed requirements
 - ✓ Intermix on same OLT and same fiber infrastructure
- 10G is same per-port cost as GPON
 - ✓ Quadruple the bandwidth, Symmetrical 10G/10G

Expand Market Applications

- Enabling reuse of existing infrastructure while providing benefits of Optical LAN
 - ✓ Legacy Ethernet Switch Replacement using new ONT248
 - ✓ Conserving existing copper cable infrastructure when rip and replace not cost effective
 - ✓ Unified management of entire network from a single Panorama EMS platform
- Creates new brownfield opportunities during switch refresh cycles
 - ✓ Promotes migration strategy from traditional ethernet to Optical LAN

Expand Market Presence

- ✓ Western and Central US region
- ✓ Multi-national
- ✓ State, Local and Education (SLED)



Tellabs Product Investments

Products that advance the LAN network

Tellabs FlexSym Series – Available Today

- Dual-mode GPON/XGS-PON OLT
 - ✓ Quadrupled density, 10G at the same price per line as GPON
- 10G ONT with WiFi-6 WAP support
- 8 port GPON ONT for higher port density
- Hardened GPON ONT for outdoor applications
- Enhanced PON protection – critical for very high availability deployments
- Multi-mode fiber capabilities

Tellabs FlexSym Series – 2020 Product Launches

- OLT1 – 1RU, 8 port OLT
- ONT248 – 48 port 10G ONT for copper reuse
- ONT202 – 2 Port 10G Multi-rate ONT for WAP's

Tellabs Products in Planning and Development

- OLT Mini – 2 port GPON/10G outdoor OLT
- BOLT - 16 port modular stackable 1 RU OLT with advanced processing



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Flexible Connectivity Choices with Optical LAN

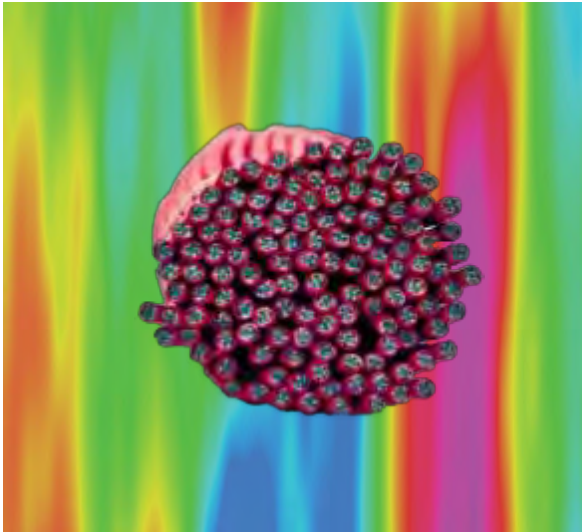
John Hoover, Tellabs Marketing Director and APOLAN Board Director

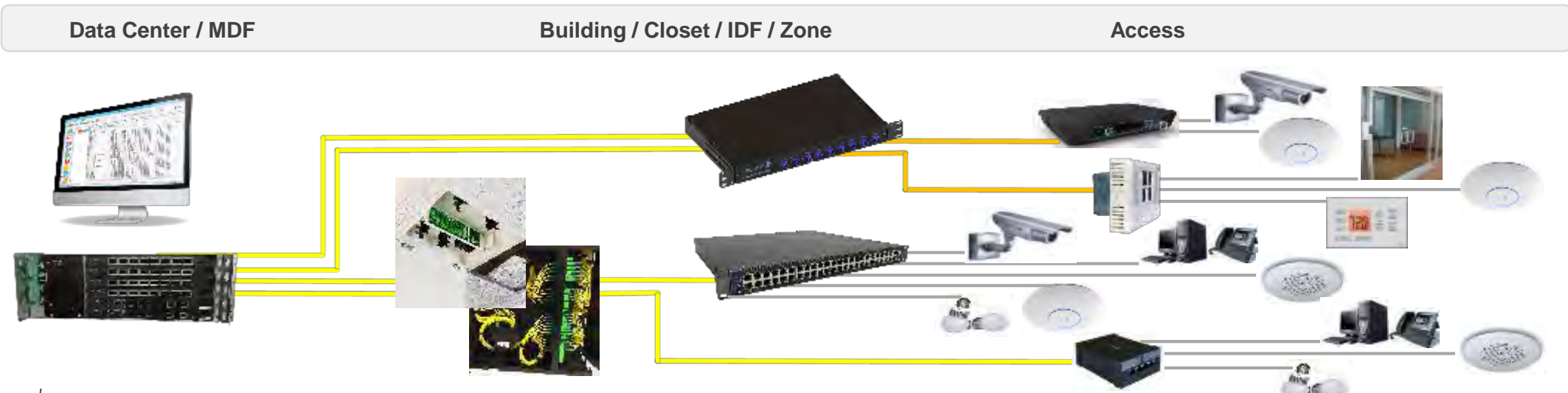


slide 15



- How can you better align real space, energy, heat, noise, radiation, and costs impacts, with your true enterprise bandwidth requirements?





- √ Choose management interface
- √ Choose global profiles to automate provisioning for more M2M actions
- √ Choose PON speed
 - √ Choose infrastructure SMF, MMF, CATx, optical splitters, and power
 - √ Choose ONT location in closet, plenum, floor, wall, furniture, cubes or desktop
 - √ Choose Ethernet speeds at the ONTs
 - √ Choose services, devices and users connected

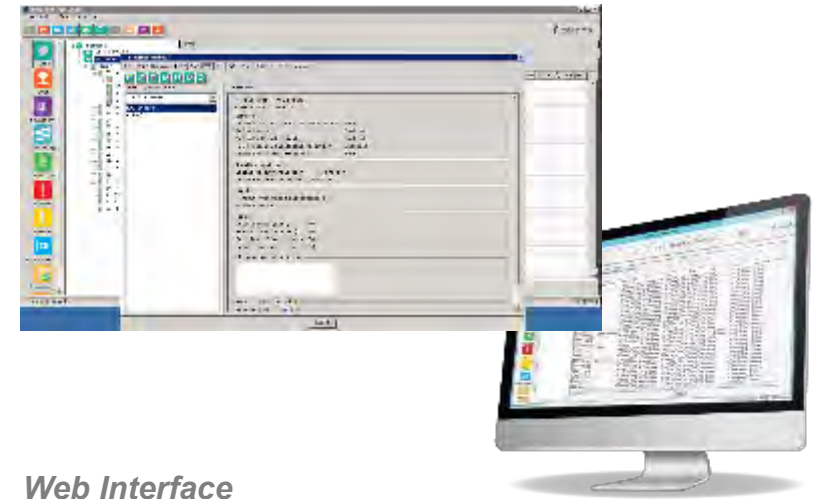
Flexible design choices for inside building and extended campus networks



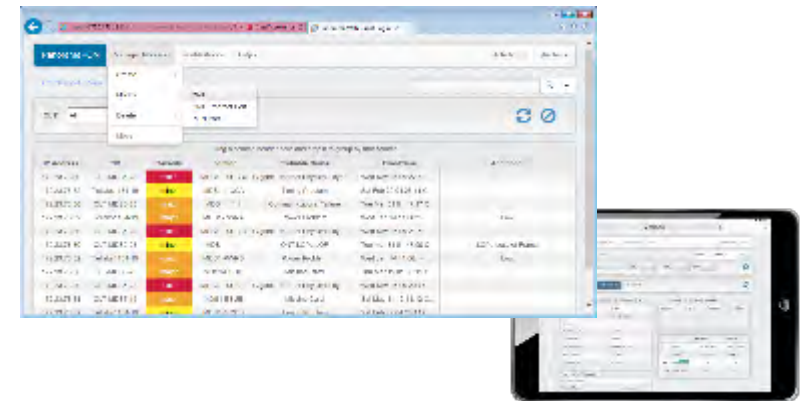


- One screen and one virtual switch
- Virtual Ethernet port extension and software defined LAN functionality
- Global profiles orchestrate error-free, and more secure, M2M automation
- These global profiles set QoS, b/w & security - for services, devices & users
- Less human touch directly improves network security and reliability!
- Management options for desktop, laptop, and smart phone

Full Client



Web Interface



Data Center / MDF

Building / Closet / IDF / Zone

Access



- Either G-PON or symmetrical 10G XGS-PON
- XFPs choice determines G-PON or XGS-PON
- The hardware is ready for 25G or 40G NG-PON
- Many choices for connectivity to the WAN

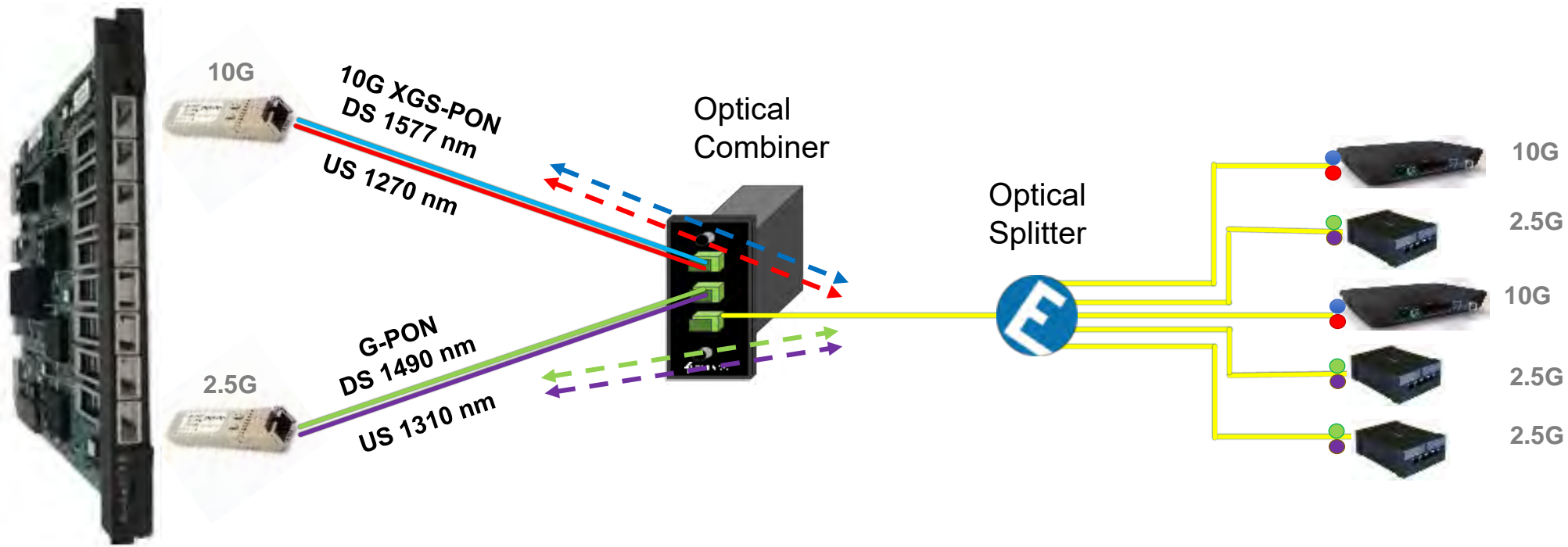
FlexSym Optical Line Terminal Six (OLT6)



FlexSym Optical Interface Unit (OIU8)



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Data Center / MDF

Building / Closet / IDF / Zone

Access



- 1 rack unit and 19" wide form factor
- AC powered with redundant power supplies
- 8-port XFP selectable G-PON or 10G XGS-PON choice
- Up to 512 ONTs (64-way split) and up to 4,096 Ethernet
- 4-ports gigabit Ethernet and 2-ports 10 gigabit Ethernet
- Environmentally hardened with many mounting options

FlexSym Optical Line Terminal One (OLT1)



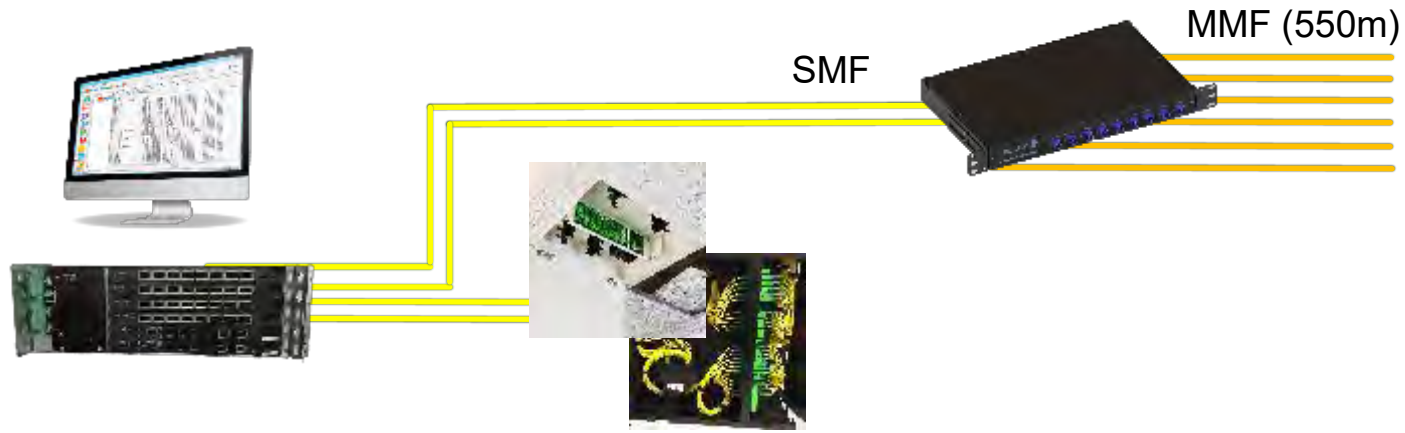
slide 21



- Many splitter options for ceiling, floor, wall, MDF or IDF placement
- Choose centralized, distributed or cascade optical splitters design
- Match true bandwidth requirements with split ratio
- Optional support of Type-B PON redundancy for 99.9999% uptime



Data Center / MDF Building / Closet / IDF / Zone Access

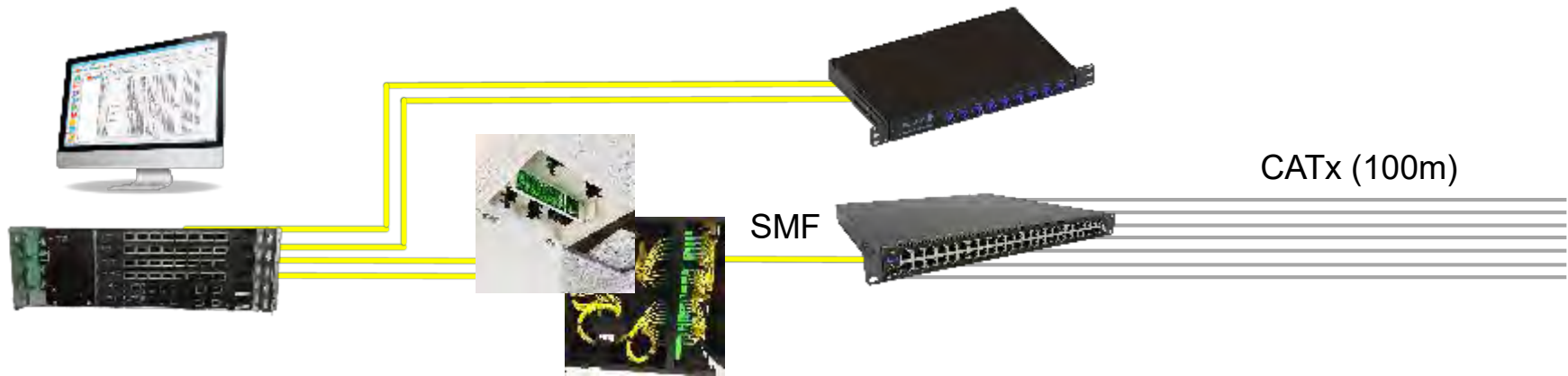


- Enables Optical LAN over existing multimode fiber cabling (2x8, 2x16)
- Supports all OM1, OM2, OM3 and OM4 fiber cable types
- It's passive, so highly reliable, require no monitoring and no maintenance
- 28dB optical budget from OLT to ONT
- Delivers 10 gigabit over MMF cabling further (up to 550m)

SMF to MMF optical splitter



Data Center / MDF Building / Closet / IDF / Zone Access



48-port GbE rack mounted 10G XGS-PON ONT



- 10G XGS-PON 48-port GbE closet-based ONT with up to 2100W PoE
- One-to-one closet-based switch replacement
- Power, cable, and cable management all stays the same
- Reuse last 100m CATx cables in the horizontal, walls and drops
- Fewer cables with multiple bidirectional wavelengths on single fiber
- Extended temperature range lowers impact of AC in telecom room



PON
10/10G SMF
2.4/1.2G SMF
10/10G MMF
2.4/1.2G MMF

28dBm



CATx (100m)

Ethernet

10 or 5 or 2.5 Gbps
1 Gbps
1 Gbps
100 Mbps
10 Mbps

PoE

15W
30W
60W

1. 10G or 2.5G PON over SMF or MMF support
2. From 4 to 48-ports with multi-rate 10M, 100M, 1G, 2.5G, 5G or 10G
3. Options to deliver PoE for 15W, 30W, and 60W to powered devices, with LLDP power management
4. Wide range of mounting and extended temperature range
5. Analog voice (POTS) or VoIP options, plus RF video and all forms of enterprise IP video choices
6. Remote and local powering and with battery backup options



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ONT131W



ONT140W



ONT140C



ONT142R



ONT180C



ONT729GP



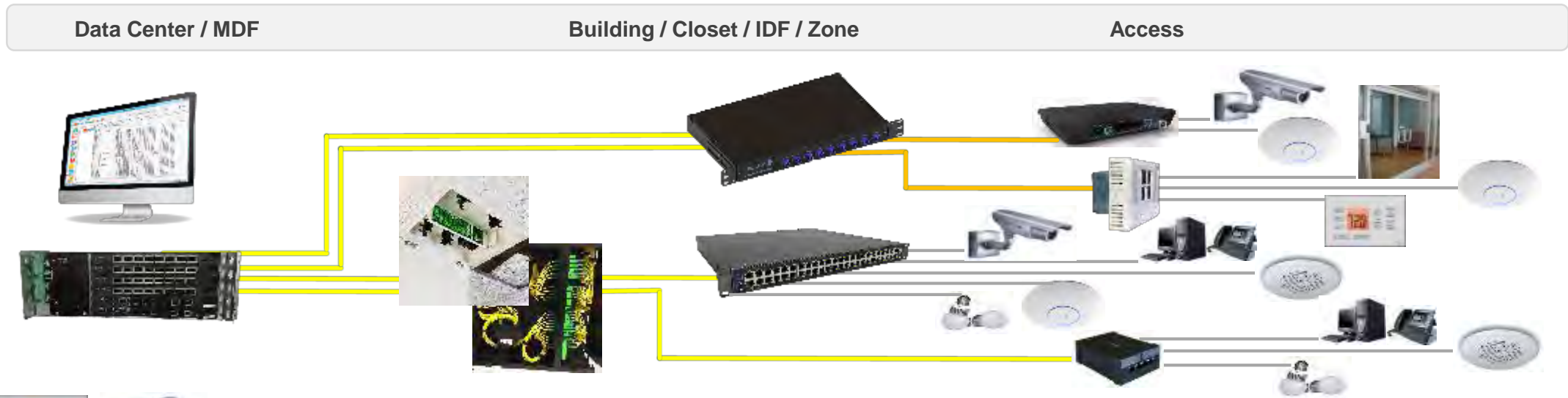
tellabs | FlexSym Series

FlexSym ONT205



FlexSym ONT248





- Global profiles orchestrate error-free, and more secure, M2M automation
- Greater Ethernet density in a smaller footprint for **IoT** and **smart building** connectivity
- Connect four **Wi-Fi 6** (IEEE 802.11ax) at 2.5G over 10G perfectly aligns with 5-port ONTs
- End-to-end QoS ensures better user experience for **cloud-based** and **OLAN as a Service**
- Singlemode fiber, and NG-PON2, are leading choices for 5G wireless infrastructure

Passive Optical LAN's flexible design choices for building and campus networks



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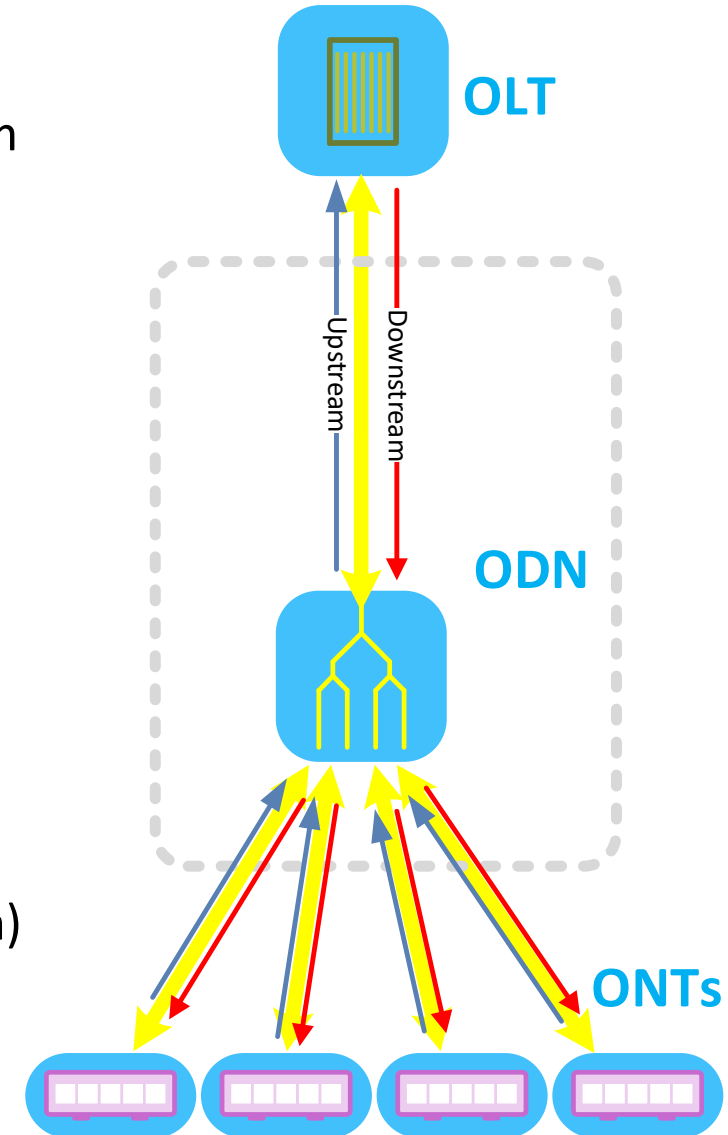


*Michael Masucci RCDD
Field Applications Engineer*



PON Architecture

- Optical Line Terminal (**OLT**)
 - Active central aggregation equipment, located in the MDF/Equipment Room
 - Replace multiple Layer-2 access switches in Telecom Rooms
- Optical Distribution Network (**ODN**)
 - Passive non-wavelength selective optical splitter/coupler
 - Typically 1:32, up to 1:128 based on the link distance and power class
 - Upstream and Downstream
 - Different wavelengths over single SMF thread
 - Rack-mount, wall-mount, ceiling, floor
- Optical Network Terminal (**ONT/ONU**):
 - Active end devices, small switch at access point (e.g. work area, hotel room)
 - Converged services to end user ports
 - Ethernet, PoE, POTS, VoIP, RF Video, IPTV, Video conference ...



POLAN - A Simpler Way to Improve LAN Performance



Reduced power and cooling



Greater distances



Less time spent on maintenance



Inherent security



Significant space savings



High system availability



Capex and Opex savings



LEED credits



Traditional LAN VS POLAN

Traditional LAN

Active Ethernet switches for LAN core, aggregation and access functions

Cable infrastructure per service

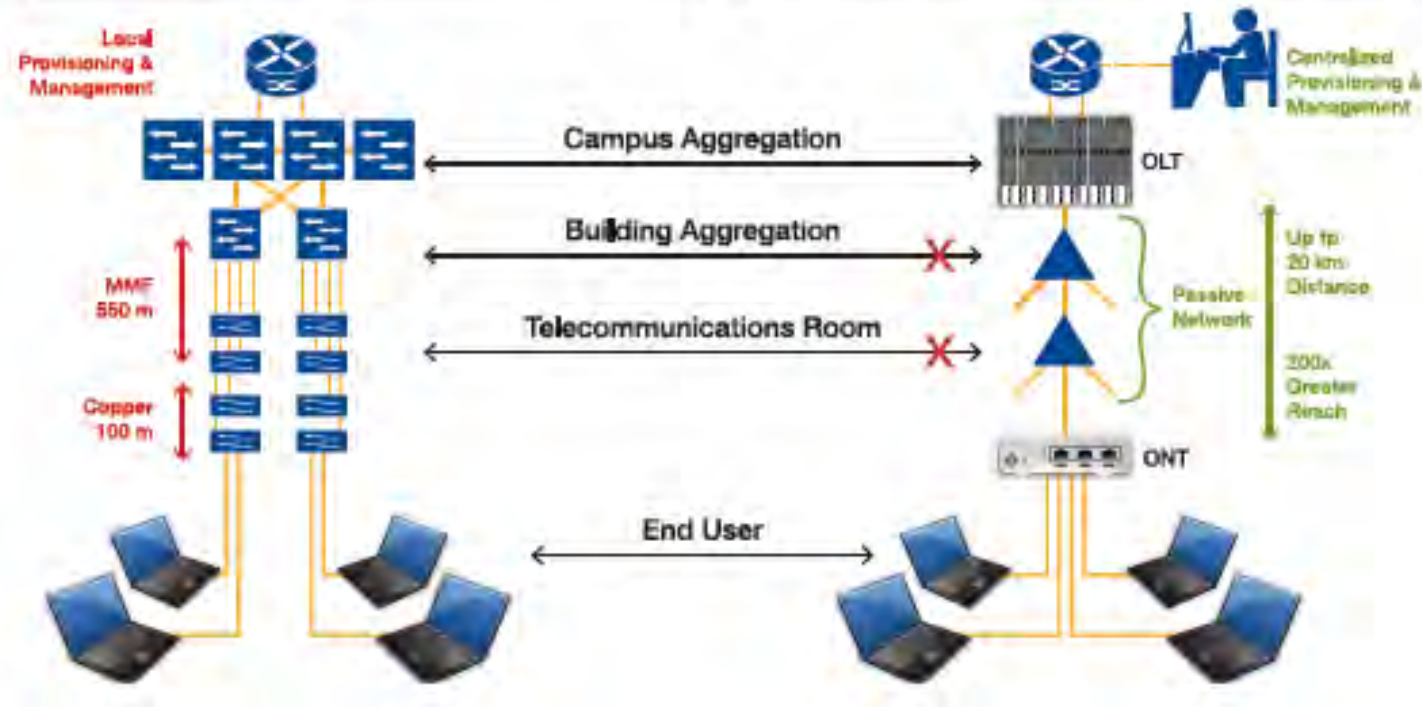
- Category cabling
- Coaxial cabling
- Multimode fiber cabling

Passive Optical LAN

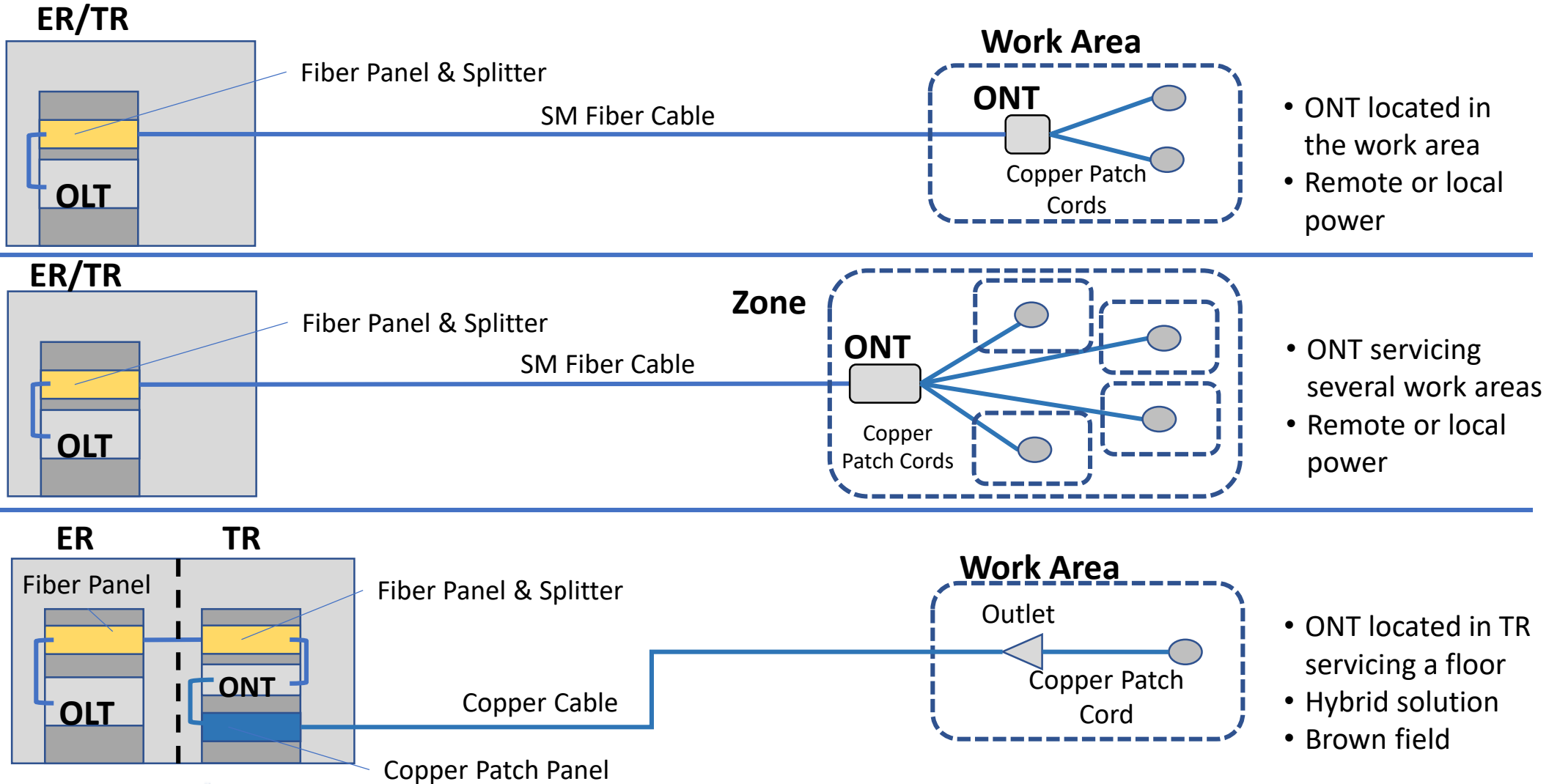
Passive optical network (PON)

- Optical line terminal (OLT)
- Passive optical splitters
- Optical network terminations (ONT)

Single mode fiber converges all building ICT services over single infrastructure



Traditional LAN VS POLAN



Belden Product Families



The Belden Approach

FiberExpress Ultra High Density (FX UHD) vs. Enterprise Cross-Connect Families (ECX)

End-to-end Expertise

- We embrace all technologies required
- We engineer the best solutions for your needs

POLAN Approach

- Structured solution
- Modular fiber connectivity
- Easy installation



Belden FX ECX



Versatile Solution

- Frames / Cassettes / Splice Tray
- Splitters / TAPs / Co-existence
- Rackmount / Wallmount (coming soon)



Flexible

- Cable Holders
- Front/Rear Exit Cassettes
- Clear Top w/ White Interior



Rapid Installation

- Lightweight
- Sliding trays
- Slotted mounting bracket



Belden Passives: FX ECX Splitter Cassettes

Easy Management

- Eliminates bulky harnesses
- Different upstream & downstream connector types
- Compatible with FX UHD and FX ECX Ecosystem



Easy Upgrade Path

- Simple cassette swap for increased network capacity

Integrated Eye Safety

- Internal shutter design eliminates protective caps

Splitter	Upstream	Downstream	Aggregate Throughput	Density	Redundant Path Option
2x8	SC/APC	LC/APC	High	Low	Yes
Dual 2x8	SC/APC	LC/APC	High	Medium	Yes
Quad 2x8	MPO/APC	LC/APC	High	High	Yes
2x16	SC/APC	LC/APC	Medium	Medium	Yes
Dual 2x16	LC/APC	LC/APC	Medium	High	Yes
2x32	SC/APC	LC/APC	Low	High	Yes
Dual 1x16	SC/APC	LC/APC	Medium	High	No
Quad 1x8	LC/APC	LC/APC	High	High	No



FX UHD Wallmount (FX UHD only)



Versatile Solution

- Frames / Cassettes / Optimizers
- Splitters / TAPs
- Pigtails, Mechanical Spice, Splice-On



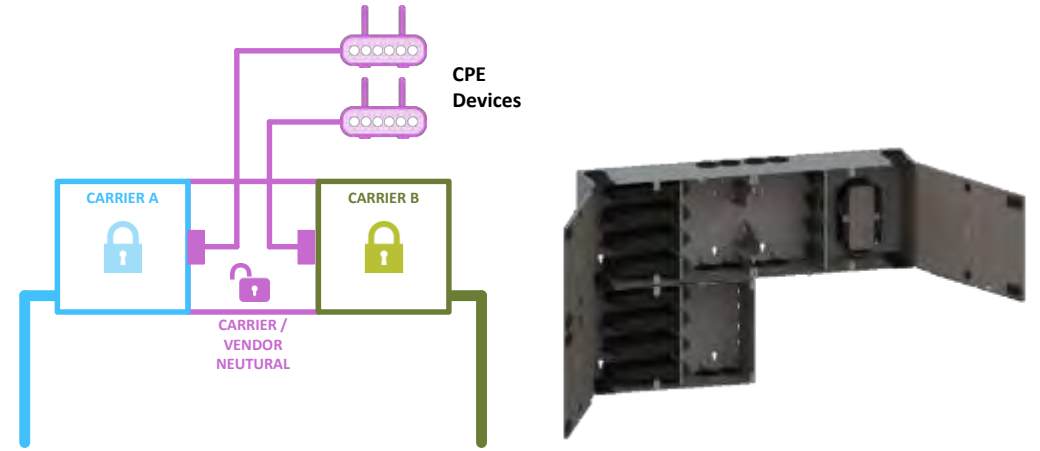
Flexible

- Stackable
- Interconnect & Cross-Connect



Secure

- Independent locking zones
- Carrier neutral access



DCX Optical Distribution Frame



Scalable

- 576 fibers/housing
- 8 housings/cabinet
- Cabinets/ODF ... *unlimited!*



Customizable

- Cabinet options for various applications
- Side-by-side, back-to-back
- L-R and R-L for efficient rows



High Density

- Up to 4608 terminations/cabinet
- >55% Higher density vs ODF competitors



Modular

- Comingle Base 8/12/16/24
- Pre-term & Field-Term
- XC or ToR



Belden Patch Panel Passives – ECX and FX UHD



Versatile Solution

- FX UHD System
- FX ECX System
- FX DCX System



Simple PON Upgrade

- GPON & RFoG
- GPON, XGS-PON & NG-PON2



Rapid Installation

- Cassette Format
- Eliminate Spaghetti Legs



PON WDMs



NG-PON2
Co-Existence
Element



PON Taps

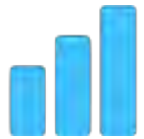


Belden Field-Term: FX Fusion



Versatile Solution

- LC / SC / MPO
- 250 / 900 / Jacketed
- TIA / GR-326



Superior Network Performance

- -65 dB SC/LC OS2 RL
- 0.35 dB SC/LC OS2 IL



Rapid Installation

- 3 min / Single Fiber
- 3 min / MPO (+ 3 min. Ribbonization)



FX Brilliance Universal (mechanical NENP)



Reduce Installation Time

- Best in industry, 30% less vs. leading competitor



Eliminate Project Expense Due to Waste

- No-crimp, re-mateable connectors
- 100% Guaranteed connector yield



Mitigate Project Risk

- 25-Year parts and labor warranty
- World class service, support and training



Belden End-Point Connectivity



Versatile Solution

- 1, 2 and 4-Port Versions



Eye Safety

- Internal Shutters

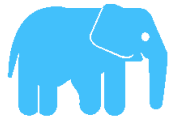


Rapid Installation

- Fusion Splice Management
- Mechanical Splice
- Surface Mount

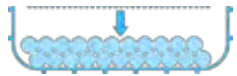


Belden Mini-Distribution Cable



Extreme Durability

- Double Jacket (4.8mm OD)
- Aluminum Interlocked Armor



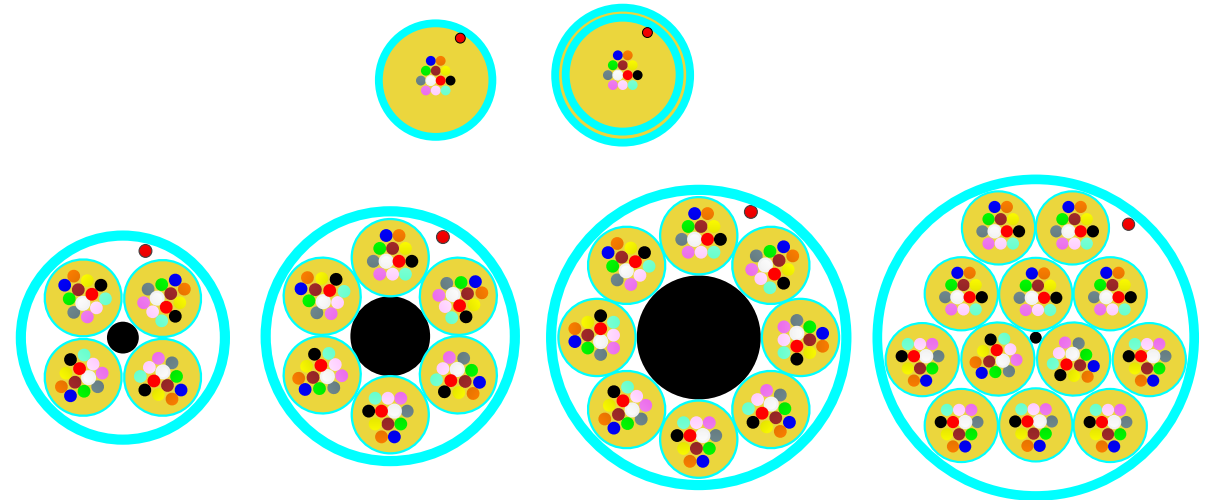
Reduce Space

- 250um Fiber
- 3mm & 2mm Sub-units

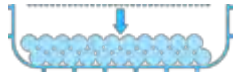


Rapid Installation

- Mass-fusion Splicing



Belden Small OD All-Dielectric Armor



Reduced Space

- Up to 70% smaller vs. Interlocked Armor
- 1f to 24f constructions



Patch Panel Ready

- 10x bend flexible inner jacket



Increased Crush Resistance

- Raised floor applications

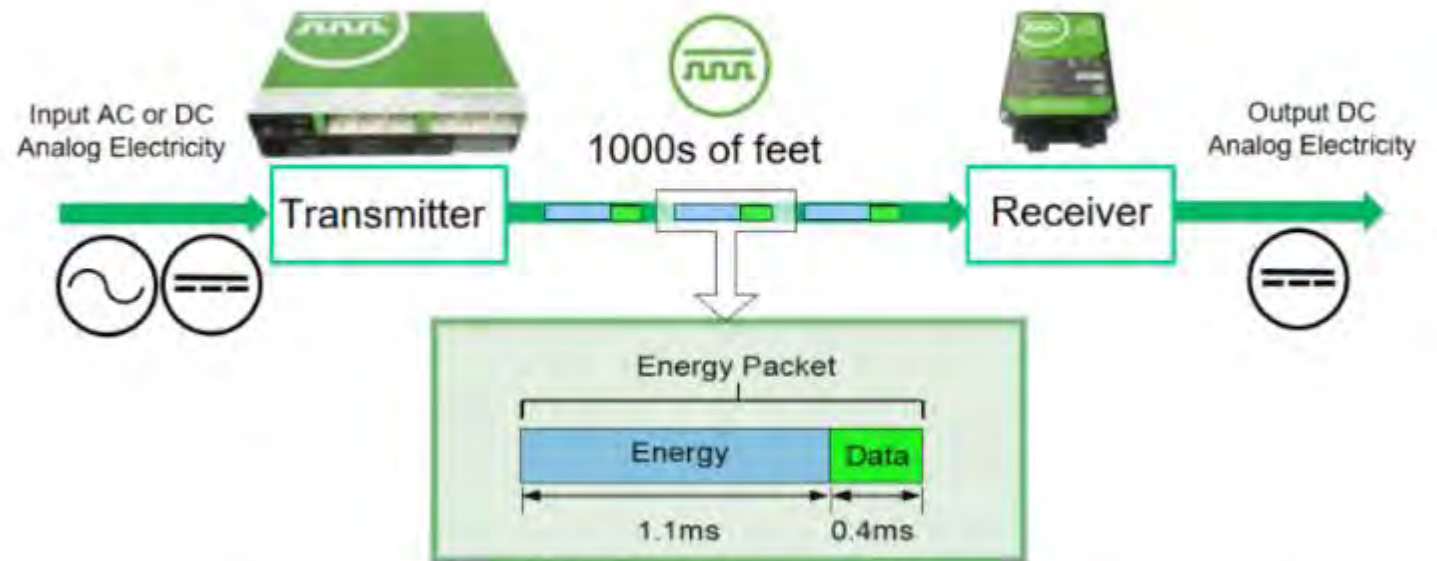


Digital Electricity

What is Digital Electricity?

- Safe delivery of high voltage
- Requires a transmitter and receiver
- Data in “Energy Packet” requires low mutual capacitance

Electricity that is safe to touch & intelligent



- 1) Monitor line condition
- 2) OK? Energize Line and Send Energy Packet, NOT OK STOP
- 3) De-Energize Line then perform Analog/Digital safety verification



Power Delivery Distance Comparison

Constant Voltage DC Power Source

Single Pair Analysis		Max Reach (meters)		
		14AWG	18AWG	20AWG
Power (Watts)	50	310	122	77
	100	155	61	n/a
	1000	n/a	n/a	n/a

Digital Electricity Power Source

Single Pair Analysis		Max Reach (meters)		
		14AWG	18AWG	20AWG
Power (watts)	50	2000	2000	1382
	100	2000	1095	689
	1000	259	103	65

Extended Reach possible with mutual capacitance that is both uniform and <50pF/ft

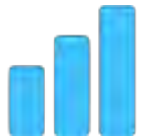


Digital Electricity



Versatile Solution

- Copper only or Copper/Fiber Composite
- 12 – 20 AWG
- 2 – 8 Pairs
- Multiple Shielding Options



Superior Performance

- <math><50\text{ pF/ft}</math> Mutual Capacitance
- Twisted Pairs
- Tinned Copper

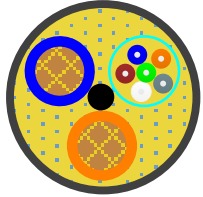


Easy Configuration

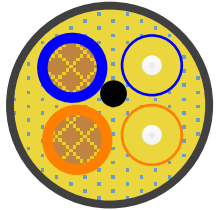
- Intuitive, configurable
SmartPart numbers



Hybrid Cables: 2 Families



- Distribution
 - 2 to 6, 900um Fiber



- Breakout
 - 2, 900um Fiber in 2mm Jacket



CABLE DETAILS

FIBER:

- OM4, OS2(BI-A1), G657.A2/B2, G657.B3

COPPER:

- 2 Stranded Conductors
- 12 to 20 AWG Copper

ENVIRONMENTAL:

- Indoor or Indoor/Outdoor
- Plenum or Riser



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Optical LAN Cost Modeling

Joel Fischer, Director Sales Engineering



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Cost Modeling

- Design Styles
- ROM Estimating
- Pricing Comparison
- Total Cost of Ownership
- Tools
- Best Practices in Modeling
- Benefits Not Captured in a Model



Design Styles

Switched Ethernet



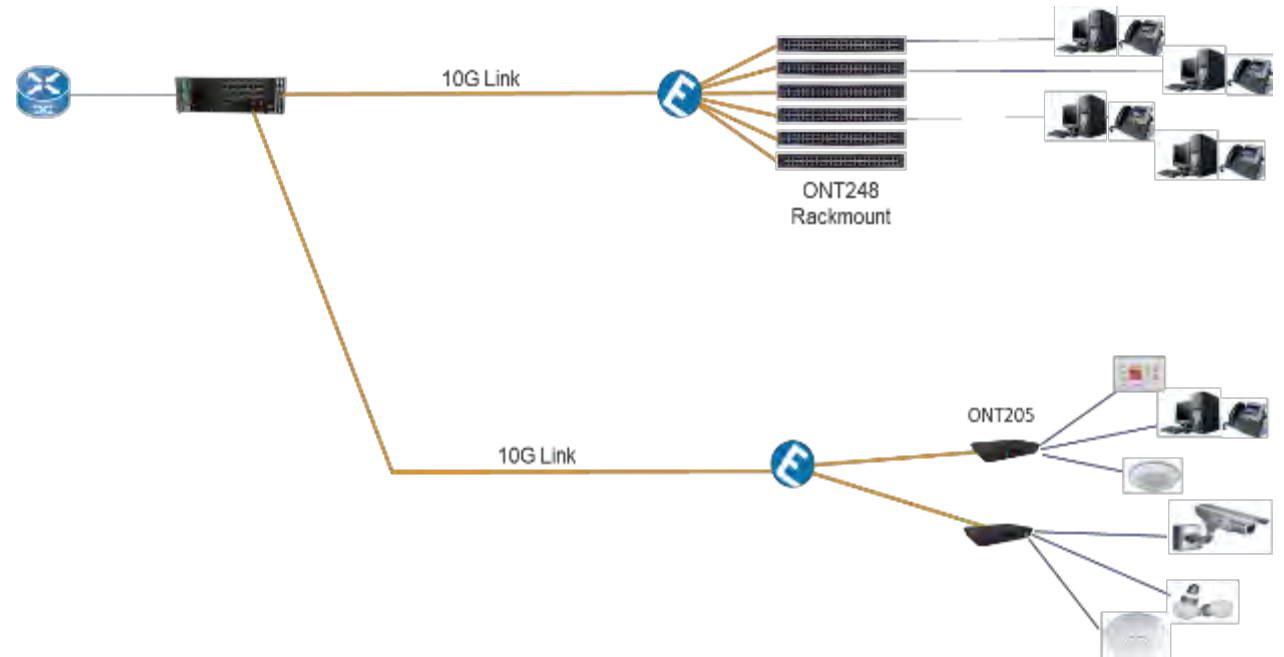
Design Styles

PON is almost too **Flexible!!**



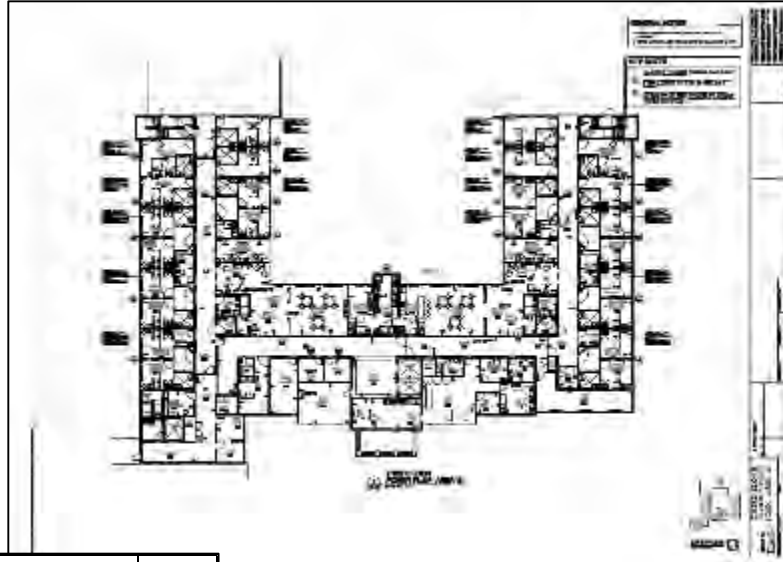
Design Styles

- Splitters in Zone Enclosures
- Splitters in the IDFs
- Splitters in the MDF
- ONTs at the Desk
- ONTs in Zone Enclosures
- ONTs in the closet



ROM Estimating

- BOM
- Floor Plan
- Rough Numbers



Part #	Description	Qty
81.11S-OLT1	FlexSym XGS-PON OLT 1	1
81.11T-XFPGPON-IT	FlexSym XFP, GPON 2.5G/1.25G, B+, I-TEMP	8
C.11T-XO192SR1851M	XFP: 10G, SX, 850NM, MM	2
C.11T-S1GBER450030	SFP: GBE, ELECTRICAL, RJ-45, I-TEMP (note: replaces 4195102)	2
81.SR313BASEOLT1	OLAN Software Release OLT1 Base SR31.3	1
81.SR313AOOLT1	Advanced Operations OLT1 SR31.3	1
81.SR313AAOLT1	Advanced Availability OLT1 SR31.3	1
81.SR313ASOLT1	Advanced Security OLT1 SR31.3	1
81.SR313ANOLT1	Advanced NAC OLT1 SR31.3	1
81.11G-ONT140C-R6	ONT140C 4GE	240
81.11P-PWIL81WM	PWR IN LINE ADPT 54V, 1.5A NO CORD W/MOLEX	170
81.11W-C5TYPB-R6	PWR AC CORD C5 TO TYPE B US	170
81.11G-ONT140WN-R6	ONT140 WALL UNIT, 4GE w/POE, w/o POWER MODULE	90
81.11K-ONT140WP-R6	KIT ONT140 WALL POWER MODULE 10CT	9

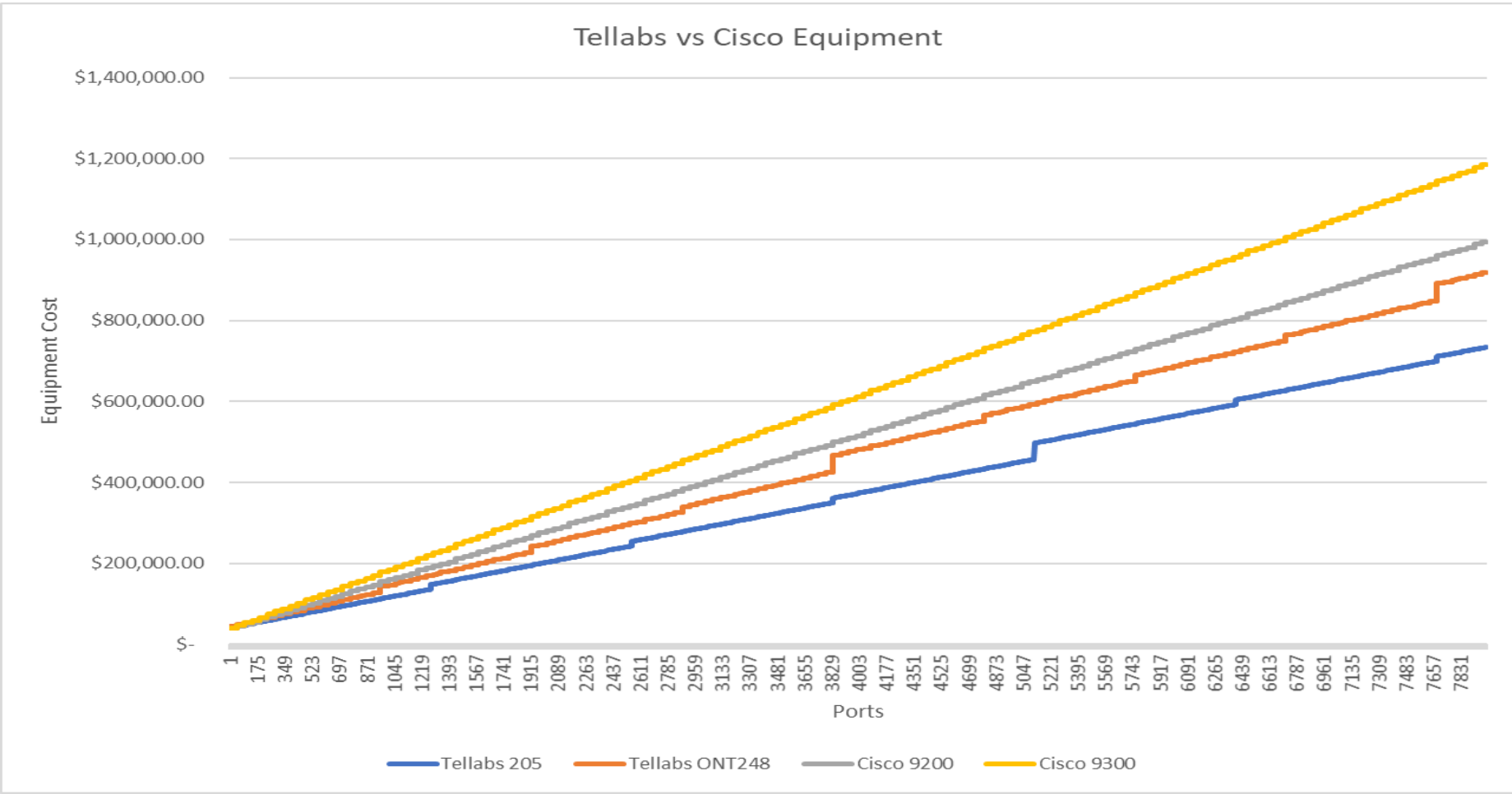


Cost Comparison

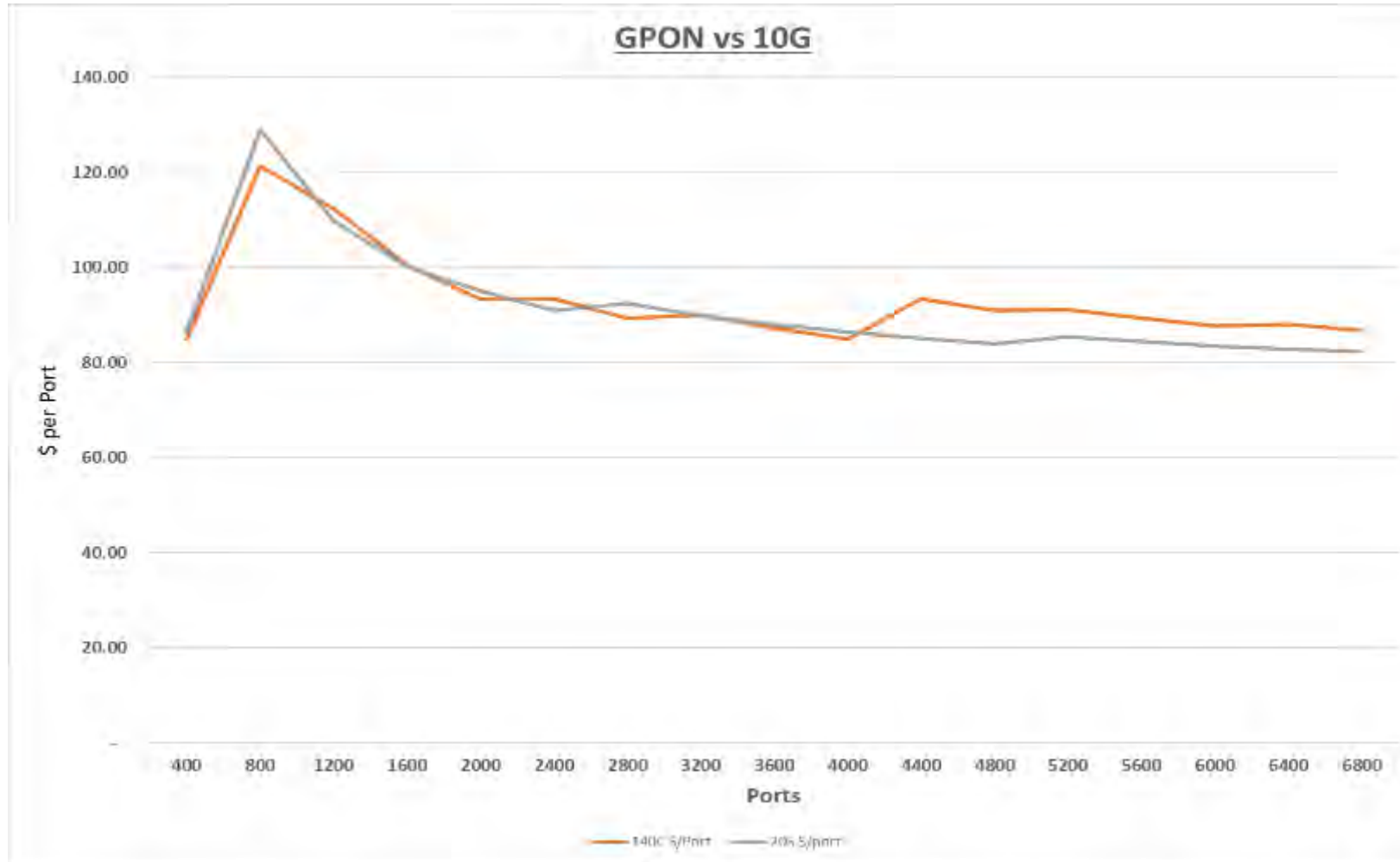
- Requires More Information
- Requires Technology Decisions
- Limited in Comparison Scope



Cost Comparison



Cost Comparison



Total Cost of Ownership

- This Model is More Complicated
- Requires a More Detailed Design
- Questions:
 - Floor Plans
 - Design Style
 - Technology Choices
 - Do Closets Really Go Away
 - Aesthetics



Tools

- Developing Tools to Help Model
- Initially
 - Quick BOM Generation and Pricing
 - Multiple Design Styles
 - Competitive costing



Tools

- Initially By
 - Square Feet
 - Closet/Port Count
 - Office/Cubicle Count

By Square Foot	
Total Square Feet:	100000
Total Required Drops:	3000
Access Points:	63
OLT:	OLT 1
Redundant Chassis:	No
Software Options:	Base + Ops
Split Ratio:	x:32
Uplink Bw per OLT 24Gbps Avail:	20 Gbps SMF 1 Gbps MMF 1 Gbps Copper
Remote Power:	No
ONT Overage:	0%
Expected Discount:	0%
Estimate After Discount:	\$ 730,658.00
Total mGig Ports:	0
Total 1Gbps Ports:	0
Total Ports:	0
Tellabs Price per Port:	0

By Closet	
Total Ports:	5000
Total Ports/Closet:	1250
Closets:	4
Access Points:	0
Access Points/Closet:	0
Access Point ONT Ports per Closet:	0
OLT:	OLT 1
Redundant Chassis:	No
Software Options:	Base + Ops
Split Ratio:	x:32
Uplink Bw per OLT 24Gbps Avail:	20 Gbps MMF 1 Gbps Copper 3 Gbps SMF
Remote Power:	Yes
ONT Overage:	0%
Expected Discount:	0%
Estimate After Discount:	\$ 1,337,661.00
Total mGig Ports:	0
Total 1Gbps Ports:	5184
Total Ports:	5184
Tellabs Price per Port:	\$ 258.04

By Count	
Wall Offices:	100
Cubicles:	400
Drops per cubicle:	2
Access Points:	0
OLT:	OLT 1
Redundant Chassis:	No
Software Options:	Base + Ops
Split Ratio:	x:32
Uplink Bw per OLT 24Gbps Avail:	0 Gbps SMF 4 Gbps Copper 0 Gbps SMF
Remote Power:	Yes
ONT Overage:	0%
Expected Discount:	0%
Estimate After Discount:	\$ 287,224.00
Total mGig Ports:	0
Total 1Gbps Ports:	2080
Total Ports:	2080
Tellabs Price per Port:	\$ 138.09



Tools

- Outputs
 - BOM
 - Estimated List Pricing
 - Cost Comparison

Tellabs Equipment			By Square Foot		By Count		By Closet	
Part #	Long Description	List	Qty	List Extended	Qty	List Extended	Qty	List Extended
OLT								
81.11S-OLT1	FlexSym XGS-PON OLT 1	\$ 35,900.00	2	\$ 71,800.00	2	\$ 71,800.00	3	\$ 107,700.00
81.11S-OLT6	FlexSym XGS-PON OLT 6	\$ 8,450.00	0	\$ -	0	\$ -	0	\$ -
81.4115094F5	FlexSym OLT6 FAN ASSEMBLY	\$ 930.00	0	\$ -	0	\$ -	0	\$ -
81.11P-1134ACPW-R6	PWR, 1134AC, AC-DC, 48-53.5V, 800W	\$ 1,503.00	0	\$ -	0	\$ -	0	\$ -
81.11W-PC-C13-B-R6	PWR CORD 14AWG C13 TO 3 PRONG 1.8M	\$ 22.00	0	\$ -	0	\$ -	0	\$ -
81.11C-ESU32F5	FlexSym ESU32	\$ 27,156.00	0	\$ -	0	\$ -	0	\$ -
81.11C-OIU8-R6	FlexSym OIU8 - 8 PORT XGS/GPON OLT LINE CARD	\$ 26,955.00	0	\$ -	0	\$ -	0	\$ -
81.11T-XFPXGSPON	FlexSym XFP, XGS-PON - OLT	\$ 2,800.00	12	\$ 33,600.00	0	\$ -	21	\$ 58,800.00
81.11T-XFPPGPON-IT	FlexSym XFP, GPON 2.5G/1.25G, B+, I-TEMP	\$ 825.00	0	\$ -	10	\$ 8,250.00	0	\$ -
4195098	XFP, TDM, 10Gbps, 1310nm, industrial temp 5/3.3/1.8V - 10 Km	\$ 2,252.00	4	\$ 9,008.00	0	\$ -	0	\$ -
C.11T-XO192SR1851M	XFP: 10G, SX, 850NM, MM	\$ 1,126.00	0	\$ -	0	\$ -	6	\$ 6,756.00
C.11T-S1GBELX1131S	SFP Wideband 1310nm 1.25Gbps - 10km	\$ 844.00	0	\$ -	0	\$ -	9	\$ 7,596.00
128211	GbE SFP Wideband 850nm (1000Base-SX) - 550m	\$ 422.00	2	\$ 844.00	0	\$ -	0	\$ -
C.11T-S1GBER450030	SFP: GBE, ELECTRICAL, RJ-45, I-TEMP (note: replaces 4195102)	\$ 253.00	2	\$ 506.00	8	\$ 2,024.00	3	\$ 759.00
Software								
81.SR313BASEOLT1	OLAN Software Release OLT1 Base SR31.3	\$ 4,080.00	2	\$ 8,160.00	2	\$ 8,160.00	3	\$ 12,240.00
81.SR313A0OLT1	Advanced Operations OLT1 SR31.3	\$ 3,270.00	2	\$ 6,540.00	2	\$ 6,540.00	3	\$ 9,810.00
81.SR313AAOLT1	Advanced Availability OLT1 SR31.3	\$ 3,270.00	0	\$ -	0	\$ -	0	\$ -
81.SR313ASOLT1	Advanced Security OLT1 SR31.3	\$ 3,270.00	0	\$ -	0	\$ -	0	\$ -
81.SR313ANOLT1	Advanced NAC OLT1 SR31.3	\$ 3,270.00	0	\$ -	0	\$ -	0	\$ -
81.SR312BASEOLT6	OLAN Software Release OLT6 Base SR31.2	\$ 8,647.39	0	\$ -	0	\$ -	0	\$ -
81.SR312A0OLT6	OLAN Feature Rel - AO OLT6 SR31.2	\$ 7,317.02	0	\$ -	0	\$ -	0	\$ -
81.SR312AAOLT6	OLAN Feature Rel - AA OLT6 SR31.2	\$ 7,317.02	0	\$ -	0	\$ -	0	\$ -
81.SR312ASOLT6	OLAN Feature Rel - AS OLT6 SR31.2	\$ 7,317.02	0	\$ -	0	\$ -	0	\$ -
81.SR312ISOLT6	OLAN Feature Rel - IS OLT6 SR31.2	\$ 7,317.02	0	\$ -	0	\$ -	0	\$ -
ONT								
81.11G-ONT205	FlexSym ONT205, 4GE, 1-10G,APPOE	\$ 775.00	0	\$ -	0	\$ -	0	\$ -
81.11G-ONT248-T	FlexSym ONT248, 48GE, 48PPOE, TAA	\$ 8,750.00	64	\$ 560,000.00	0	\$ -	108	\$ 945,000.00
81.11P-PW715W	FlexSym 715W POWER SUPPLY	\$ 875.00	128	\$ 112,000.00	0	\$ -	216	\$ 189,000.00
81.11G-ONT140C-R6	ONT140C 4GE	\$ 563.00	0	\$ -	0	\$ -	0	\$ -
81.11P-PWL181WM	PWR IN LINE ADPT 54V, 1.5A NO CORD W/MOLEX	\$ 55.00	0	\$ -	0	\$ -	0	\$ -
81.11W-CSTYPB-R6	PWR AC CORD C5 TO TYPE B US	\$ 22.00	0	\$ -	0	\$ -	0	\$ -
81.11K-BKONTBBU-R6	BRACKET ONT140C OR BBU 10 PACK	\$ 100.00	0	\$ -	0	\$ -	0	\$ -
81.11G-ONT180C-R6	ONT180C 8GE W/POE	\$ 995.00	0	\$ -	200	\$ 199,000.00	0	\$ -
81.11P-PWL150W	PWR IN LINE ADPT 54V, 2.8A NO CORD (C13)	\$ 120.00	0	\$ -	0	\$ -	0	\$ -
81.11W-C13TYPB-3	PWR AC CORD C13 TO TYPE B US 3FT	\$ 30.00	0	\$ -	0	\$ -	0	\$ -
81.11K-ONT205BK-R6	BRACKET 142R,180C,205 - 10 COUNT	\$ 172.50	0	\$ -	20	\$ 3,450.00	0	\$ -
81.16G-729GPOPB-R6	ONT729GP - 24P, 24GE with PoE, MDU; 1 RU 19-inch Rack. 100-240V AC power	\$ 5,200.00	0	\$ -	0	\$ -	0	\$ -
81.11G-ONT140WN-R6	ONT140 WALL UNIT, 4GE w/POE, w/o POWER MODULE	\$ 563.00	0	\$ -	100	\$ 56,300.00	0	\$ -
81.11K-ONT140WP-R6	KIT ONT140 WALL POWER MODULE 10CT	\$ 350.00	0	\$ -	10	\$ 3,500.00	0	\$ -
			List Pricing:		\$ 730,658.00		\$ 287,224.00	
			Expected Discount:		\$ -		\$ -	
			Expected Pricing:		\$ 730,658.00		\$ 287,224.00	

Tellabs Core			By Square Foot		By Count		By Closet		
Part #	Grp	Long Description	List	Qty	List Extended	Qty	List Extended	Qty	List Extended
Core									
C9404R		Cisco Catalyst 9400 Series 4 slot chassis	\$ 2,040.00	0	\$ -	0	\$ -	1	\$ 2,040.00
C9400-PWR-2100AC		Cisco Catalyst 9400 Series 2100W AC Power Supply	\$ 2,040.00	0	\$ -	0	\$ -	2	\$ 4,080.00
C9404-FAN=		Cisco Catalyst 9400 Series 4 slot chassis Fan Tray	\$ 556.00	0	\$ -	0	\$ -	1	\$ 14,280.00
C9404-SHELF-KIT=		Cisco Catalyst 9400 Series 4 slot chassis Shelf Install Kit	\$ 250.00	0	\$ -	0	\$ -	1	\$ 22,480.00
C9400-DNA-E-3Y		Cisco Catalyst 9400 DNA Essential 3 Year License	\$ 3,670.00	0	\$ -	0	\$ -	1	\$ 3,995.00
C9400-SUP-1		Cisco Catalyst 9400 Series Supervisor 1 Module	\$ 14,280.00	0	\$ -	0	\$ -	1	\$ -
C9400-SUP-1/2		Cisco Catalyst 9400 Series Redundant Supervisor 1 Module	\$ 14,280.00	0	\$ -	0	\$ -	1	\$ 3,200.00
C9400-LC-24XS		Cisco Catalyst 9400 Series 24-Port 10 Gigabit Ethernet(SFP+)	\$ 22,480.00	0	\$ -	0	\$ -	1	\$ -
SFP-10G-LR		10GBASE-LR SFP Module	\$ 3,995.00	0	\$ -	0	\$ -	0	\$ -
Power									
EPS-32-v2(-S)		EPS with 1:32 integrated splitter, 100W per Output, 1900W total output @ 120VAC	\$ 3,200.00	0	\$ -	0	\$ -	0	\$ -
			List Pricing:		\$ -		\$ 50,075.00		
			Expected Discount:		\$ -		\$ -		
			Expected Pricing:		\$ -		\$ 50,075.00		



Best Practices in Modeling

- Don't Ignore the Small Things
- Don't Be Too Detailed
- Don't Forget Licensing
- Don't Forget About Support
- Product Lifecycles are Different



PON Benefits Not Captured in a Model

- Flattens and Simplifies the Network Architecture
- Reduces Device and Operational Attack Surface
- Provides a Software Defined LAN Today
- Lowers Operational Costs
- Shifts Staffing Requirements



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Optical LAN Power Options

Jeromy Kendall, RCDD/OSP, EdgePower Solutions President and CEO



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Optical LAN Power Options

Introduction to Edge Power Solutions

- Introduction to Edge Power Solutions
- Options for powering ONTs
- Power Infrastructure Best Practices
- Edge Power Solutions products
- NRTL Listing
- Successful Projects



Optical LAN Power Options

Introduction to Edge Power Solutions

- Office & Production: Melbourne, FL.
- Young Company – 5th Year
- Founded by Industry Professionals
 - Optical LAN professionals
 - Network Professionals
 - Wireless Professionals
 - Security Professionals
- TAA compliant Manufacturer
 - Fixed Power Solutions
 - Custom Power Solutions
 - Power Infrastructure Accessories
- Consulting and Systems Planning



Optical LAN Power Options & Best Practices

Power Options

- LOCAL POWER
- REMOTE “Distributed” POWER

Questions to ask.

- ONT Type ?
 - Surface Mount
 - In-wall
- ONT Location ?
 - Under desk
 - Above ceiling
 - Exposed surface mount
- Backup requirements ?
 - Life safety equipment (IP Phone)
- Intelligent power controls
 - Remote power reset
 - Output monitoring
 - Fault monitoring
 - Reporting



Optical LAN Power Options

Local Power vs Remote Power

- LOCAL AC POWER
 - Advantages
 - Cost Savings when backup not required
 - TC Space Saving
 - Disadvantages
 - Aesthetics
 - Higher cost of back up
 - Higher risk of disconnection
 - Locations
 - Cube farms / Under desk
 - Behind equipment
 - Enclosures



Optical LAN Power Options

Local Power vs Remote Power

- REMOTE POWER (NEC Class 2)
 - Advantages
 - Aesthetics
 - Concentrated Power Distribution
 - Centralized Backup
 - Centralized Maintenance access
 - Intelligent power control capabilities.
 - Disadvantages
 - Slightly more TC space required
 - Possible higher cost



Optical LAN Power Options

Design Considerations

- Life Safety / Code Requirements / Network uptime
 - Critical network connected equipment (IP Phone, BMS)
 - Infrastructure NEC requirements
 - Backup requirements
 - UPS
 - Central High Voltage DC Plant
- Power consumption requirements at ONT
 - Day 1 requirements
 - Future overhead
- Power Conductors
 - Legacy Copper (CAT5e – CAT6)
 - Dedicated copper pair
 - Hybrid Fiber / Copper
 - Conductor Size

<https://edgepowersolutions.net/cable-size-calculator>

Wire Size 14

DC Input Voltage 56

Cable Distance 1500

Distance Type Feet

Load Current (Amps) .5

(Total Watt Draw / Input Voltage = Load Current)

CALCULATE!

Voltage Drop = 3.79
Voltage Drop percentage = 6.76 %
Voltage at ONT = 52.21 VDC



Optical LAN Power Options

EPS REMOTE POWER ADVANTAGES

- Approachable power
 - Easy to install
 - Easy to terminate
 - Simple to specify and configure
- Small form factor
 - 32 Ports of power and 2x32 splitter in 2RU chassis
 - 16 Ports of power and 2x16 splitter in 1RU chassis
 - 32 Ports of power in 1RU chassis – Q2 2020
- Mounting flexibility
 - Rack Mount
 - Wall Mount
 - Above or below ceiling
- Reliability
 - Standard 2 year warranty
 - Power source MTBF 16.5Yrs
 - Redundancy options



Optical LAN Power Options

EPS TRADITIONAL POWER / 8 PORT PDU

- Wall Mount Design
- AC input cord for below ceiling applications
- Direct wire AC input for above ceiling applications
- 14 ¼" H x 12 ½" W x 5 ¼" D (7.4lbs)
- Available with or without integrated splitter
- 56VDC Outputs
- NEC Class 2
- 8 98W outputs
- Individual Resettable Breaker per port
- 110VAC-240VAC Input
- Standard 2Yr Warranty
- Available with High Voltage DC Interface
- 16 Port IPS Series (Available Q2 2020) **



Optical LAN Power Options

EPS TRADITIONAL POWER / 16 PORT PDU

- Rack or Wall Mountable
- 1RU 1.75”H x 16”D x 17”W (16.2lbs)
- Available with or without integrated splitter
- 56VDC Output
- NEC Class 2
- 98W output per port
- Individual Resettable Breaker per port
- 110VAC-240VAC Input
- Standard 2Yr Warranty
- Available with High Voltage DC Interface



Optical LAN Power Options

EPS TRADITIONAL POWER / 32 PORT PDU

- Rack or Wall Mountable
- 2RU 3.5"H x 16"D x 17"W (22.2lbs)
- Available with or without integrated splitter
- 56VDC Output
- NEC Class 2
- 100W output per port
- Individual Resettable Breaker per port
- 110VAC-240VAC Input
- Optional Redundancy
- Standard 2Yr Warranty
- Available with High Voltage DC Interface



Optical LAN Power Options

EPS Intelligent Power Series / 16 PORT PDU

- Rack or Wall Mountable
- 1RU 1.75”H x 16”D x 17”W (15.2lbs)
- Available with or without integrated splitter
- (16) NEC Class 2 56VDC Outputs
- 95W output per port
- Front panel reset buttons, Serial, USB and Network Interface
- Remote output reset
- Remote port monitoring - power, current, fault status
- Software controlled parallel grouping
- Software controlled redundancy grouping
- Reporting functions
- Enhanced inrush current protection
- Over voltage, over current, and fault detection
- 110VAC-240VAC Input
- Available with High Voltage DC Interface
- Standard 2Yr Warranty



Optical LAN Power Options

EPS Intelligent Power Series / 32 PORT PDU

- Rack or Wall Mountable
- 2RU 3.50”H x 16”D x 17”W (21.4lbs)
- Available with or without integrated splitter
- (32) NEC Class 2 56VDC Outputs
- 95W output per port
- Front panel reset buttons, Serial, USB and Network Interface
- Remote output reset
- Remote port monitoring, power, current, fault status
- Software controlled parallel grouping
- Software controlled redundancy grouping
- Reporting functions
- Enhanced inrush current protection
- Fault detection - Over voltage, over current, short
- 110VAC-240VAC Input
- Optional Redundancy
- Available with High Voltage DC Interface
- Standard 2Yr Warranty
- ** 1RU 32 Port coming Q2 2020



Optical LAN Power Options

EPS Custom Power Solutions

- Custom Enclosures
- Variable Input / Output
- Site Specific Solutions



INDUSTRIAL &
AUTOMATION



TEST &
MEASUREMENTS



BROADCASTING



INFORMATION
TECHNOLOGY



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Optical LAN Power Options

NRTL Listing

Alpha. NRTL (Nationally Recognized Testing Laboratory) supervised and administered by OSHA

- B. Listed means holder of NRTL certificate(s)
- C. All NRTL organizations must test and adhere to the same minmal standards for testing category.
- D. EPS products are listed with TÜV under ANSI-UL 62368-1 & CSA C22.2 No. 62368-1 (Replacement for 60950-1)
- E. Listing is an ongoing –monitored process
 1. (4) Factory inspections per year
 2. Full component audits
- F. TÜV Holds over 574,000 product Certificates in U.S.



Intertek



Optical LAN Power Options

EPS Lithium ION UPS units

- Available 1KVA, 2KVA, 2.2KVA, 3KVA, 6KVA
- 120V and 208V Output options
- Online Double Conversion
- Longer Backup Runtime
- Shorter Recharge time
- Communications and Management ports included standard
- Battery Management, Auto Balancing, Charge Balancing
- **15Year Battery Design – 10 Year Battery Warranty**
- Higher Temperature Environmental Rating



Optical LAN Power Options

EPS Lithium ION UPS units

APC 2200 vs EPS/N1C 2200

- APC 1800W / 2200VA EPS 1980W / 2200VA
- APC Recharge = 3Hrs EPS Recharge = 2Hrs
- RUN Time
 - APC Backup @ 1800W = 3.3 Minutes
 - EPS Backup @ 1800W = 30 Minutes
- Warranty
 - APC 3Yr Warranty 2Yr Battery
 - EPS 10 Year Warranty 10 Year Battery
- Operating Environment
 - APC – Loss of ½ battery life every 10 degrees above 71F.
 - EPS – Up to 140F without loss of battery life.

APC SRT2200RMXLA PRODUCT COMPARISON

MANUFACTURER	APC	EPS/N1C	
MODEL	SMART2200RMXLA-NC	EPS L2200	
OUTPUT			
Output Power Capacity	1800 Watts / 2200VA	1980 Watts / 2200VA	
Nominal Output Voltage	120V	120V	
Efficiency at Full Load	95%	95%	
Output Voltage Distortion	Less than 5% at full load	Less than 2% at full load	
Output Frequency	50/60Hz	50/60Hz	
Topology	Offline Double Conversion	Online Double Conversion	
Output Connections	(L) LS-20R, (S) S-20R	(G) S-15/20R	
INPUT			
Nominal Input Voltage	120V	120V	
Input Frequency	50/60Hz +/- 3% (auto sensing)	50/60Hz +/- 3% (auto sensing)	
Input Connections	NEMA 5-20P	NEMA 5-20P	
BATTERIES & RUNTIME			
Battery Type	Maint Free Lead Acid	Lithium Iron Phosphate	** A Lithium battery has a life expectancy of up to 10-15 years vs. 3-5 years for a Lead Acid Battery. Faster recharge time means the ability to protect your system sooner, in the event of multiple outages in a short period of time.
Typical Recharge Time	3 hours	2 hours	**
Backup at 1800W	3.3 Minutes at 1800W	30 Minutes at 1800W	**
Battery Monitoring	Not Available	Includes Battery Management, Auto-Balancing, Charge Balancing, Auto Disconnect	** The batteries are the heart of your UPS system, and they cause 50% of all UPS failures. Monitoring them is priceless.
Transfer Time	Instant	Instant	
COMMUNICATIONS & MANAGEMENT			
Interface Port(s)	RJ-45 Serial, USB, SNMP INCLUDED	EPO, USB, SNMP Card INCLUDED	
Software Management	Included	Included	** A robust Software Suite is standard with N1C UPS units. The software has the ability to manage up to 1000 units from the same desktop, including other brands.
Control Panel	LCD Status Display	LCD Status Display	
Audible Alarm	Standard	Standard	
Emergency Power Off (EPO)	Standard	Standard	
PHYSICAL			
Maximum Height	3.5"	3.5"	
Maximum Width	17.0"	17.2"	
Maximum Depth	28.0"	28.6"	** A key advantage of Lithium is its high power density. The ability to provide more power on runtime in the same or a smaller package.
Rack Height	3U	2U	
UPS Net Weight	75 lbs	60 lbs	**
Mounting Hardware	Tower Feet and 4 Post Rack Kit INCLUDED	Tower Feet and 4 Post Rack Kit INCLUDED	**
ENVIRONMENTAL			
Operating Environment	32-104°	32-140°	** Lithium batteries can withstand temperatures up to 140F without loss of battery life. Lead Acid batteries lose half of their life for every 10 degrees above 71F.
Operating Relative Humidity	0-90%	0-95%	
CERTIFICATION			
UL/ETL Certification	Yes	Yes	
WARRANTY			
Standard Warranty	1 Year Warranty (if registered), Battery 2 Year Warranty	Lifetime (10 Year Exchange UPS), 10 Year Exchange Battery	** EPS Lithium UPS units are designed for you to "set them and forget them". Lead Acid systems will likely have to replace batteries 3 times during the life of 1 Lithium battery.

Optical LAN Power Options

Accessories

- Power Patch Panels 1RU 32 Port
- Power Patch Cords
- Termination Ferrules
- Ferrule Termination Tools



Optical LAN Power Options

Successful Tellabs – EPS Projects

Cincinnati Union Terminal

Cincinnati Union Terminal entrusted EPS to provide remote power to over 500 Tellabs ONT's in its' newly renovated historic facility. EPS is proud to have been a small part of this \$300 Million project that returned this iconic location back to its' glory.

The ability of EPS to provide remote power & splitter connections in variable unit sizes was integral to the GPON design. The flexibility allowed power to be placed close to the edge in sparse and high concentration areas.

The small form factor of EPS PDU's allowed for the use of smaller TC's for less architectural impact in this historic facility.



Optical LAN Power Options

Successful Tellabs – EPS Projects

The District Wharf, Washington, DC

The District Wharf in Washington DC chose EPS to provide remote Optical LAN power for it's \$2.5 Billion Phase I development.

- 6 Mixed Use Highrise Towers
- 6000 Seat Anthem Auditorium
- 3 Multiuse Piers
- 2 Hotels , 20 Restaurants
- ½ Mile 2 Level Under Ground Garage

EPS PDUs provide remote power to ONTs located from end to end of this expansive waterfront development.

The Site-Wide Optical LAN System provides Wi-Fi, network, BMS, Security and AV connections for the entire site.



Optical LAN Power Options

Successful Tellabs – EPS Projects

American Woodmark Headquarters, VA.

American Woodmark chose EPS to provide remote power for the Tellabs Optical LAN system in their new \$40 million headquarters. EPS PDUs are providing power for more than 600 ONTs

Key factors in the decision:

- More efficient use of limited rack space
- Flexible unit sizes
- Reliability MTBF 16.5 Yrs.
- Ease of installation and use.



Optical LAN Power Options

Successful Tellabs – EPS Projects

DC Hilton National Mall

EPS was selected to provide remote GPON power to this newly renovated property near the National Mall

Project Details:

- Silver LEED Certified Hotel
- 367 Rooms
- World Class Meeting Space and Dining.

The compact design of EPS PDUs allowed for a higher concentration of connections allowing for all 390 ONTs to be serviced from a single Telecommunications Closet.





- **For more information please visit www.edgepowersolutions.net**
- LinkedIn Company - <https://www.linkedin.com/company/edgepowersolutions>
- Email: sales@edgepowersolutions.net
- Phone: 321-499-1919



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 **tellabs**[®] | optical LAN

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- LinkedIn Company - <https://www.linkedin.com/company/tellabs/>
- Twitter - <https://twitter.com/Tellabs> and @Tellabs and using #OpticalLAN
- Facebook - <https://www.facebook.com/TellabsOfficial/> @TellabsOfficial
- Instagram - <https://www.instagram.com/tellabs/>



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Unique Differentiators and Futures

Russ Kulpins, Tellabs Director Product Line Management



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Tellabs Optical LAN Market Dynamics



2019 Cloud User Bandwidth – It's Miniscule

Microsoft recommends **512Kb/s** per user on average

Overestimate approach

Use your current bandwidth figures for Exchange. Caution! Now you will tolerate SMTP traffic.	Use your current bandwidth figures for SharePoint.	Determine how much you will allow for OneDrive for Business and Skype for Business Online.	Round up to the next random number.
--	--	--	-------------------------------------

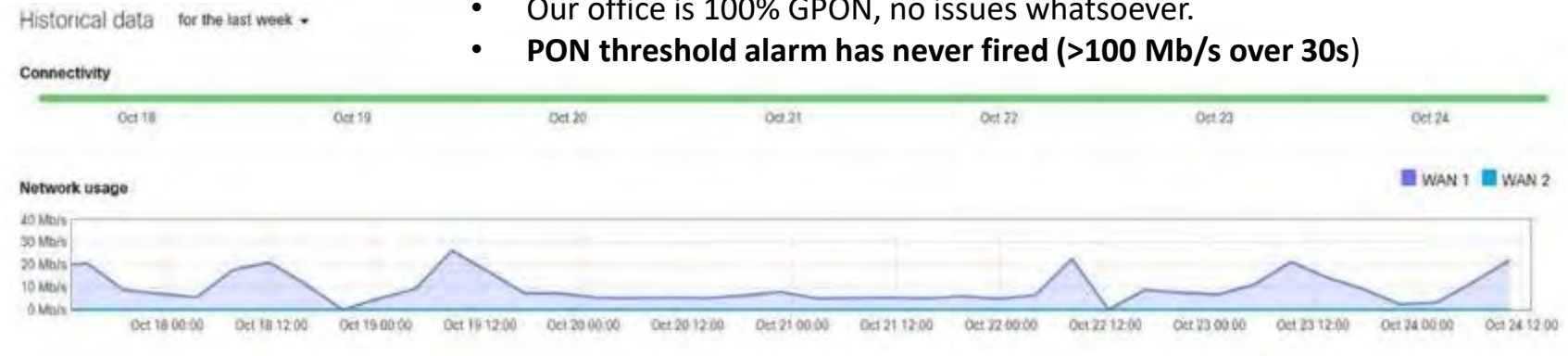
MSIT uses 400Kbps per user as a starting point.
Most of my customers have seen an average increase of ~20%.

- Cloud Adoption poses no issues for PON
- Virtual Desktop poses no issues for PON
- Tellabs and many customers do this every day on PON systems with no issues

512Kbps = .000512 Gbps!!
1,000 Office Users ~.5 Gbps
10,000 users ~ 5 Gbps
40,000 users ~ 20 Gbps

Tellabs Test Data

- Cloud Based – Mail, Office 365, cloud backup, One Drive, etc.
- Tellabs tested at headquarters
 - 473 Kb/s average per user bandwidth
- Our office is 100% GPON, no issues whatsoever.
- **PON threshold alarm has never fired (>100 Mb/s over 30s)**



2020 Update – Enter WiFi-6 and HD Cameras

Higher Bandwidth is Needed in Some Cases

WiFi-6

- Theoretical Speeds up to 10Gbps – actual results very greatly
- WAPs use 802.3bz Ethernet interfaces (2.5 and 5Gbps) to eek out more bandwidth over existing copper
- More bandwidth going to a single port

HD Cameras

- Very high-resolution cameras for facial recognition in secure areas
- Single stream with MPEG4 encoding at can reach 76 Mbps of sustained traffic

Result: *mixture of low-bandwidth end-user services mixed with high bandwidth demand devices such as WAPs and Cameras*

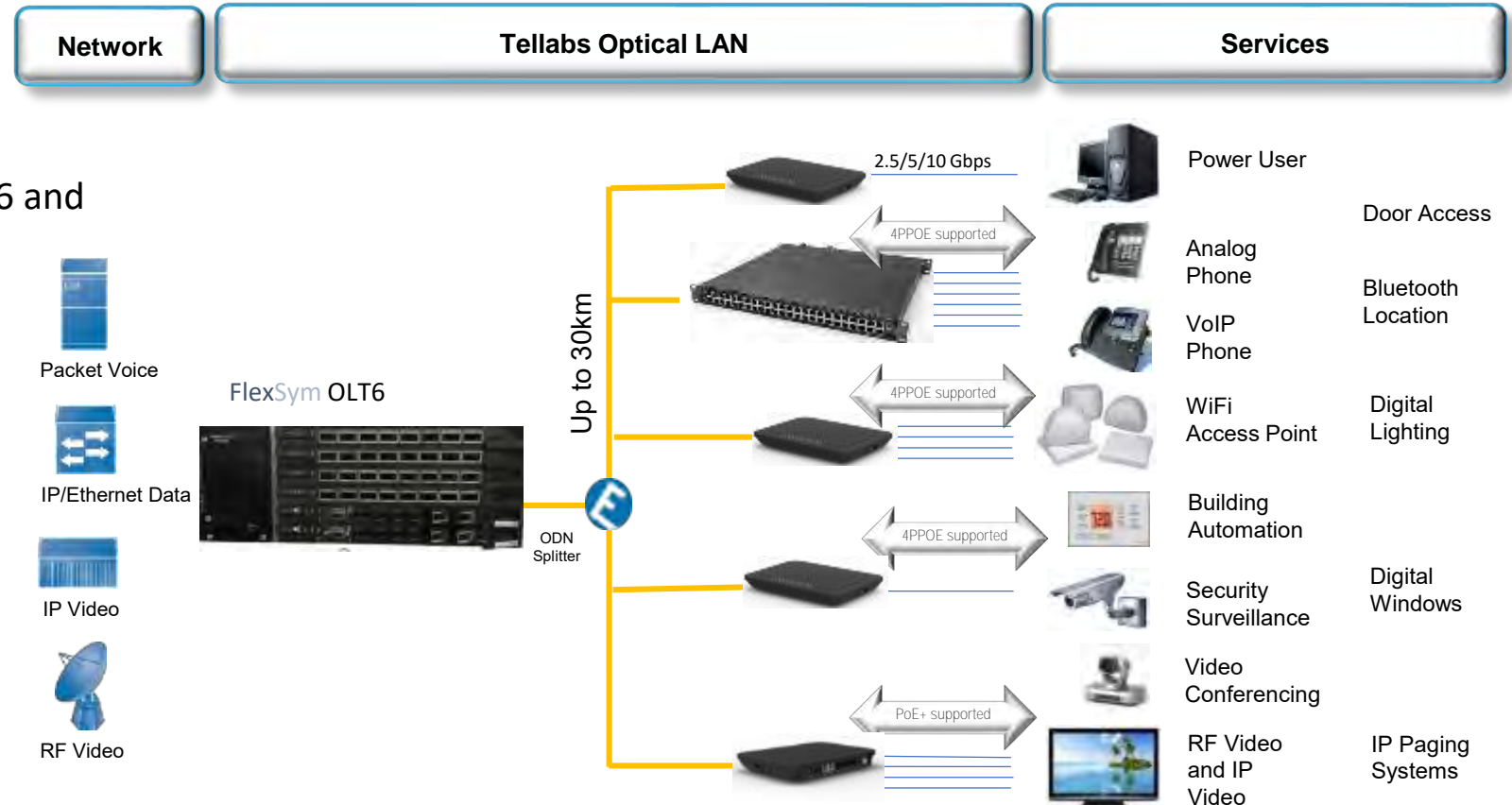


Tellabs OLAN to the Rescue!

We have a Solution

Tellabs Optical LAN

- Unified network for all services
 - Deep fiber, lower bandwidth needs
 - 1:64 splits to keep cost down
 - High speed interfaces or to 10G for WiFi6 and HD Cameras
- Solution components
 - FlexSym family of OLTs
 - Robust family of ONTs
 - Desktop
 - Closet based
 - Panorama PON management System
- Technologies
 - GPON and 10G XGS-PON
 - Shared technologies on same OLT



Tellabs Optical LAN Roadmap



Tellabs OLAN Roadmap 1Q 2020

System Release 31.3

Recently Released ONT 248 for Limited Availability

- ✓ 48 x 1 Gbps UNIs with 10G uplink interface
- ✓ Redundant Power Supplies
- ✓ 4PPoE Support
- ✓ Closet-based switch poised for legacy switch replacement
- ✓ Reuse existing CAT cabling
- ✓ Bandwidth appropriate for desktop usage
- ✓ GEM encapsulation for securing/isolating individual port traffic
- ✓ Uses Panorama PON management interface
 - ✓ Security: One IP address for 8,000 ports
 - ✓ Machine to machine software defined management

Enhanced PON Protection – beyond Type B path protection

- ✓ Seven new monitoring functions to significantly improve the detection of hardware and software faults on the PON card, forcing a PPG switch
 - ✓ 802.1x failover without re-authentication on OIU8
- ✓ All ONTs supported, including new 248 ONT

JITC Lab Entry March 16th



Primed for Ethernet Switch Replacement



Tellabs OLAN Roadmap 1Q 2020

End of March Release



OLT1

- RoHS, NA and International certifications
- 1 RU+ (1.75”), 19” rack mount
- (2) x 10GbE, (4) x 1GbE pluggable uplinks
- (8) PON ports supporting XGS-PON or GPON pluggable optics
- up to 512 ONTs with 64:1 split
- 100/240 VAC power
- Industrial temp rated
 - -40C to +65C
- PPG Enabled Redundancy
- Centralized management with Panorama



Tellabs OLAN Roadmap 4Q 2020

*****Confidential*****

Please contact your Tellabs' sales executive for 2020 roadmap briefing



slide 100



Tellabs Optical LAN Competitive Positioning



CAT Cabling History

CAT 5

- Introduced in 1995
- 10/100 Mbps capable

CAT 5e

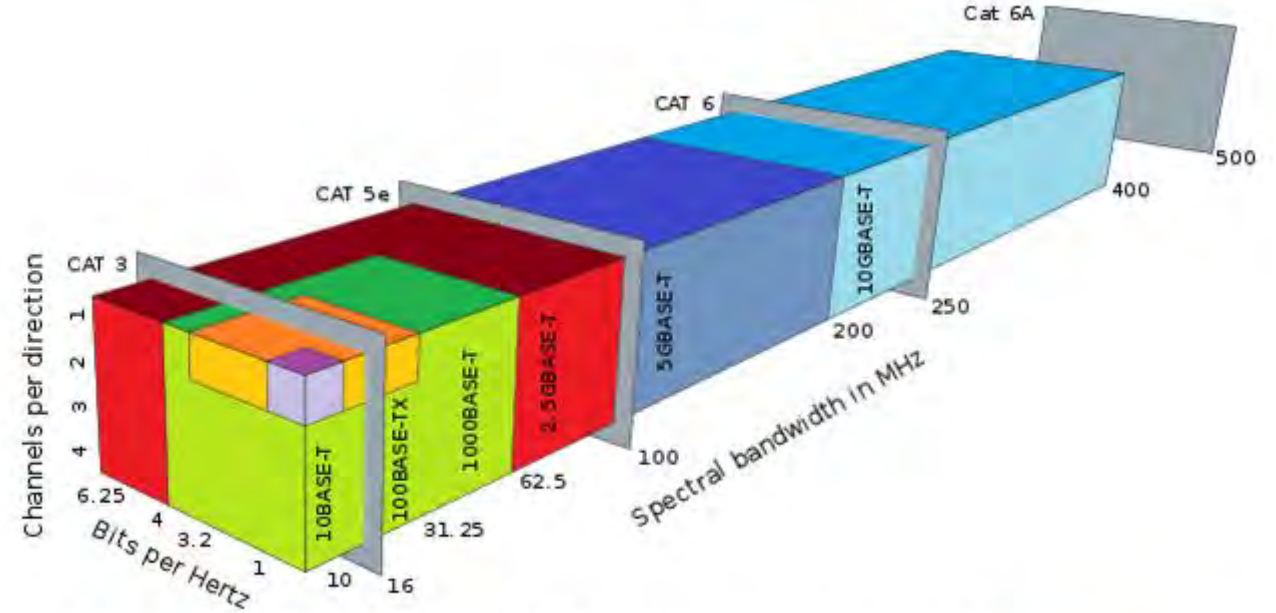
- Introduced in 2001
- Minimized Crosstalk for higher speeds
- 2.5Gbps capable @ 100M

CAT 6

- Introduced in 2002
- Minimized Crosstalk for higher speeds
- 5Gbps capable at 100M
- 10Gbps at up to 55M

CAT 6A

- Introduced in 2008
- Connectors need grounding
- 10Gbps capable at 100M



A handy diagram showing the various properties of different twisted-pair Ethernet standards.

[Per Mejdal Rasmussen](#)

CAT 7

- Introduced in 2010
- 40 Gbps at 50M
- 100 Gbps up to 15M



Fiber based solution is Superior

Single Mode Fiber is the Path to the Future

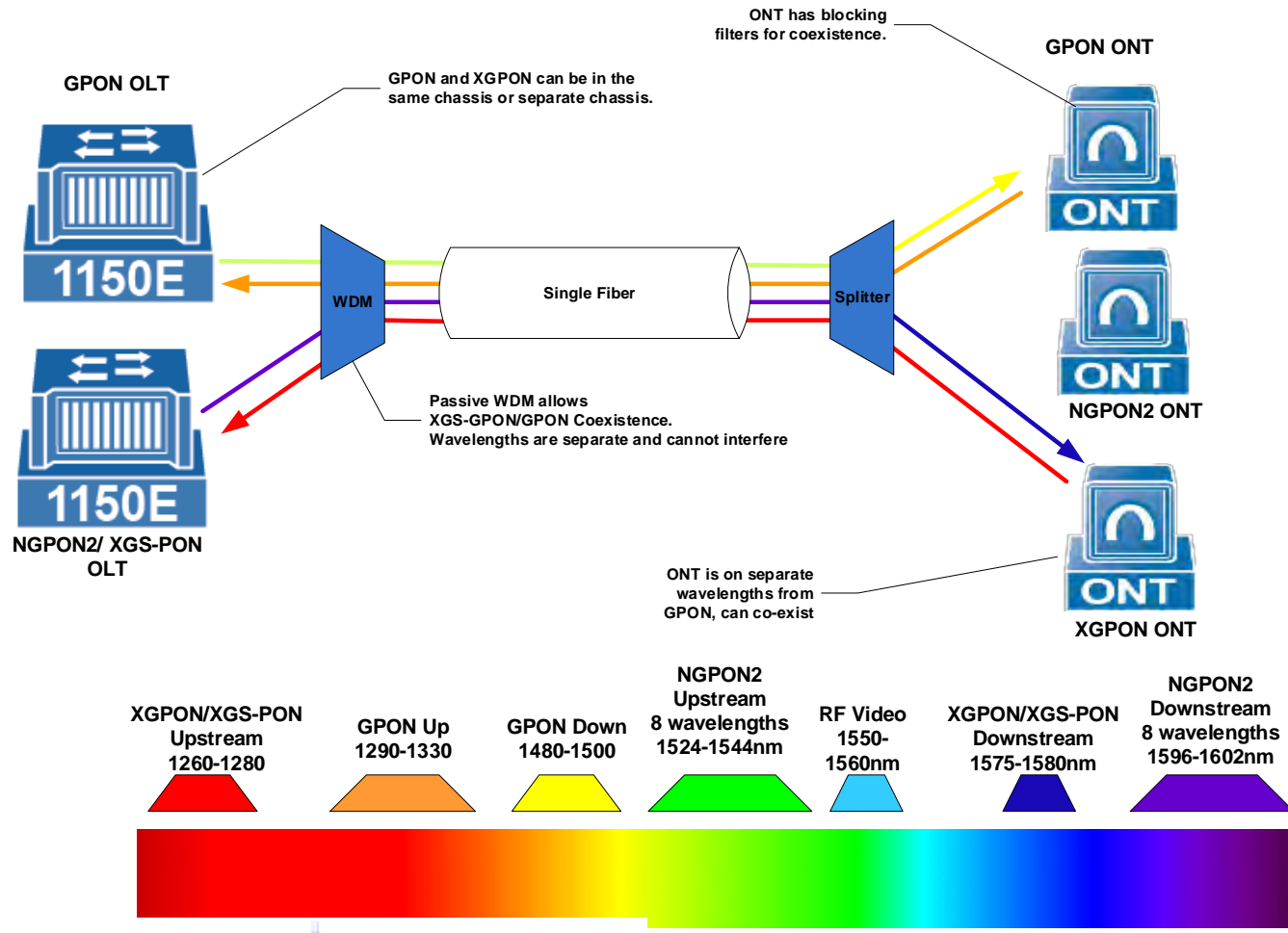
SMF First Installed	Sept 1970
GPON introduced (2.4/1.2)	2003
XGPON1 (10/2.5G)	2010
40G NGPON2 introduced	2013
XGSPON introduced (80Gbps possible)	2016 (lower cost)
4x25G BT 100G PON Demo	2017
50G Single Wavelength Demo	Mar 2019
Max bandwidth	?? TBps

Same fiber cable – continued network speed evolution



Wavelengths Diversity

With Tellabs OLAN Many Wavelengths Mean Options



- ✓ Available today: GPON and XGS-PON on same fiber
- ✓ XGSPON supports the same 8 wavelengths possible with NGPON2
- ✓ Bandwidth can be allocated to ONTs by changing optics
- ✓ Optical wavelengths can be used to separate traffic
 - ✓ Separate tenants
 - ✓ Separate traffic types (e.g. HIPAA vs. internet traffic)
- ✓ Distances up to 30km depending on desired split ratios

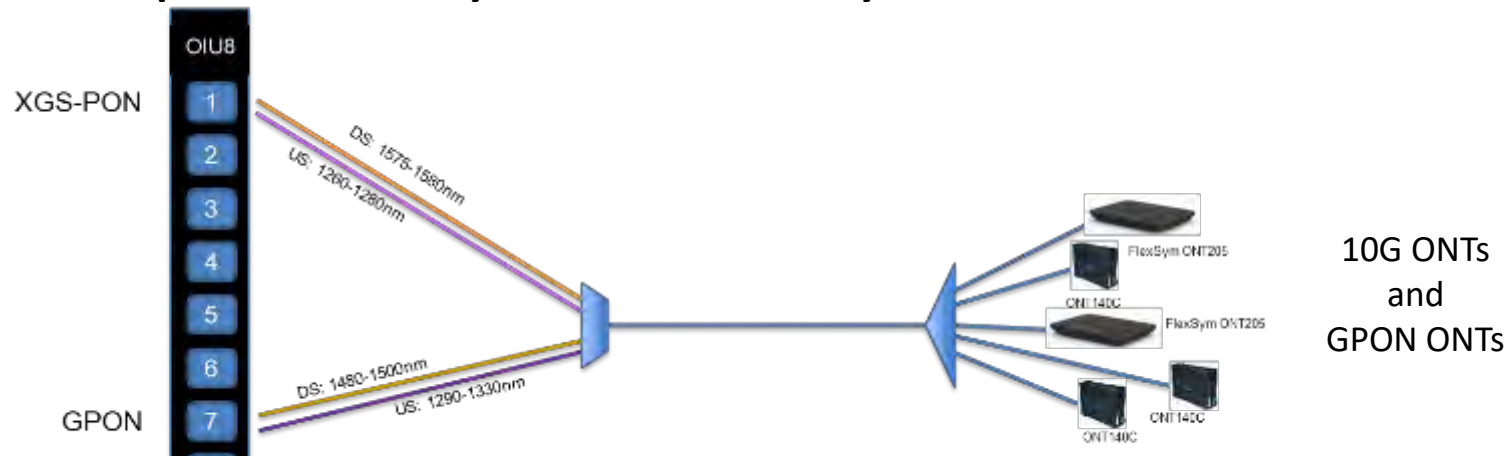


See How Tellabs Stacks-Up Against Competition?

We Can Be Stacked On Top of the Competition - Literally

Tellabs is Ahead of Other OLAN Manufacturers:

- Tellabs is the first to the OLAN market with symmetrical 10G offering – Others don't have it.
- Our 10G offering is at price parity with our competitively priced GPON offering
- Our 10G offering, with the use of a passive wavelength filter/combiner, allows our equipment to be placed on “top” of our competitors' equipment.
 - Perhaps OLAN customer needs 10G in some areas – overlay with Tellabs
 - Perhaps customer has security needs that installed OLAN vendor cannot meet – overlay Tellabs
 - Perhaps multi-tenancy is desired – overlay Tellabs!



Tellabs Optical LAN is the right choice

Tellabs OLAN is the most secure, economical, and future-resilient solution for Networking

- **Advanced Security**
 - ONTs store no configuration, user information nor local user interface
 - Best in class Network Access Controls and IEEE 802.1x integration
- **Advanced Availability**
 - PON Protection across geographically dispersed OLTs, PON cards and PON ports
- **Advanced Operations**
 - Centralized management and security controls
 - Automated configuration of OLTs, ONTs, services, devices & users (e.g. Wizards)
 - Enterprise Grade Virtualized (VMWare) EMS Server
- **Most widely deployed POL solution**
 - Deployments across a wide variety of verticals
 - Confirmed system performance by our largest customers

*Physics doesn't lie. New copper cabling will be required for every jump in speed for traditional active Ethernet. **Winner: Tellabs Optical LAN***





tellabs® | optical LAN

- For more information please visit www.tellabs.com
- LinkedIn Company - <https://www.linkedin.com/company/tellabs/>
- Twitter - <https://twitter.com/Tellabs> and @Tellabs and using #OpticalLAN
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Panorama PON Manager Live Demonstration

Joel Fischer, Director Sales Engineering



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2020 Regional Optical LAN Seminar Series



Chicago

Qualifying and Troubleshooting Fiber

Jimmy Gagnon, EXFO Team leader Business Development



slide 110





EXFO

NO. 1

WORLDWIDE IN PORTABLE
OPTICAL TEST SOLUTIONS

INNOVATION

45% WORKFORCE IN R&D

+90%

OF THE TOP 100 NSPs
WORLDWIDE USE EXFO

**2000+ EMPLOYEES IN 25 COUNTRIES AND 2000 CLIENTS IN 120 COUNTRIES.
LISTED ON NASDAQ AND TSX. 35 YEARS OF LEADERSHIP.**



slide 111

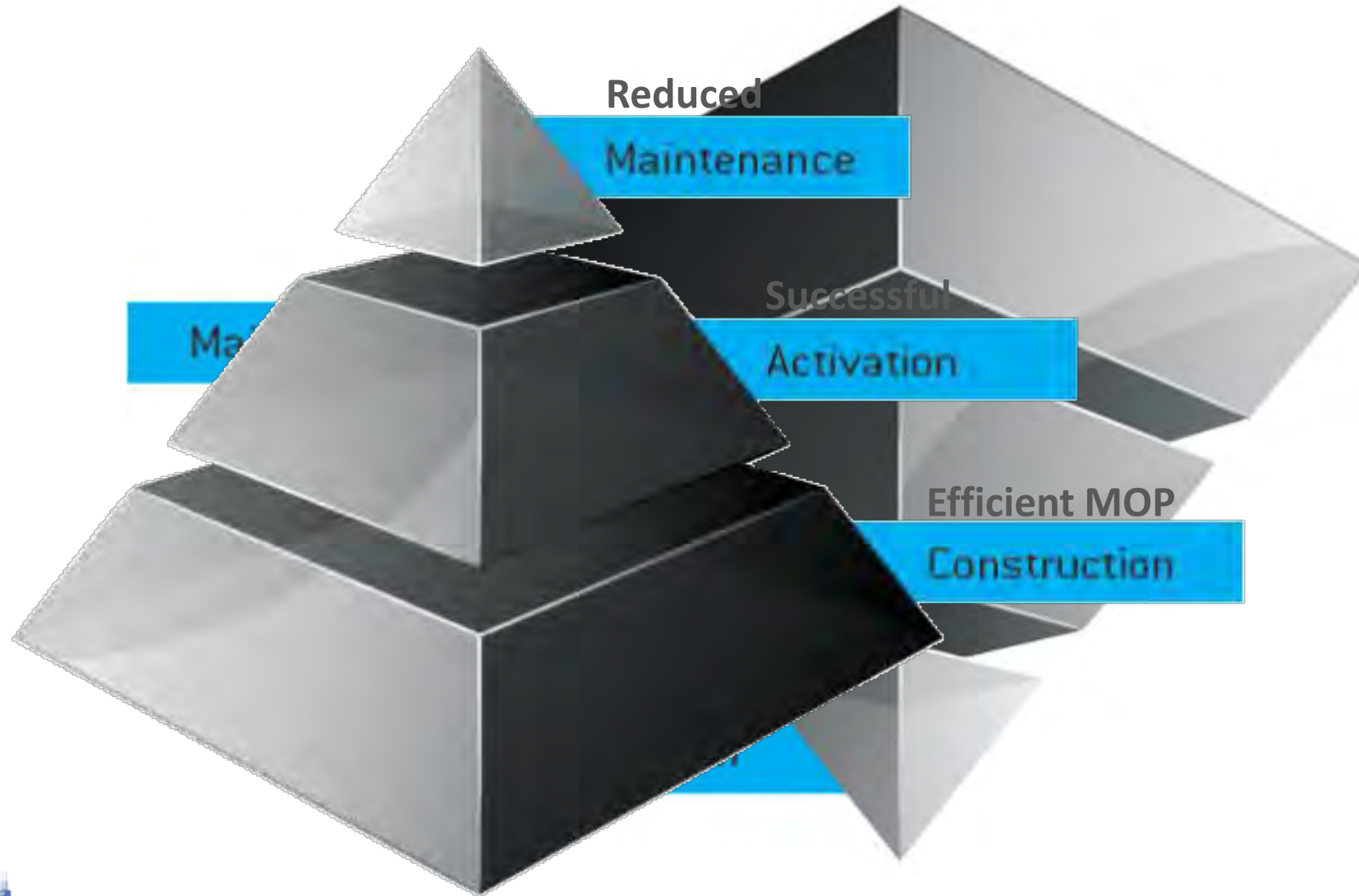


POL is the evolution of FTTH

- Testing tools were developed for FTTH/GPON since 2002, now used for POL
- Use the expertise gained over the years in FTTH and structured cabling to pitfalls
- Deploy quality networks, on time and within budget thanks to proper testing tools and MOPs



3 Fiber Network Deployments Phases



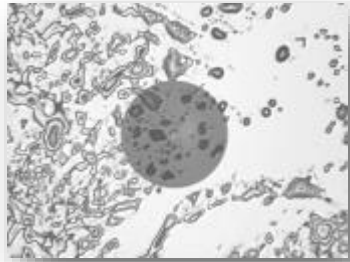
3 important reasons for testing

- Fiber optics are fragile and assembling multiple pieces together increases risk of problems and network failures
- To ensure that transmission-system requirements are met (design, standards, loss budgets,, etc.)
- To avoid delays during system turn-up, and costly repeat jobs



Potential Network Problems

Dirty connectors



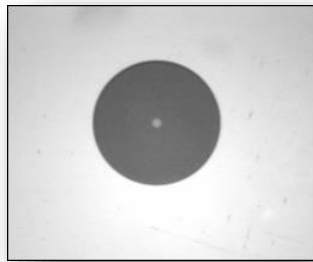
Macro bends



Fiber cuts/High-loss



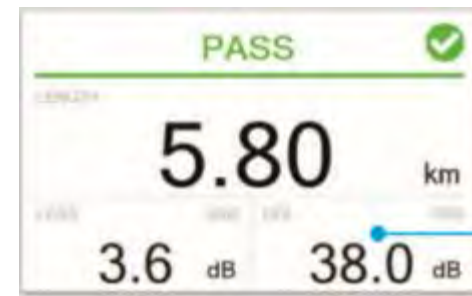
Clean connectors

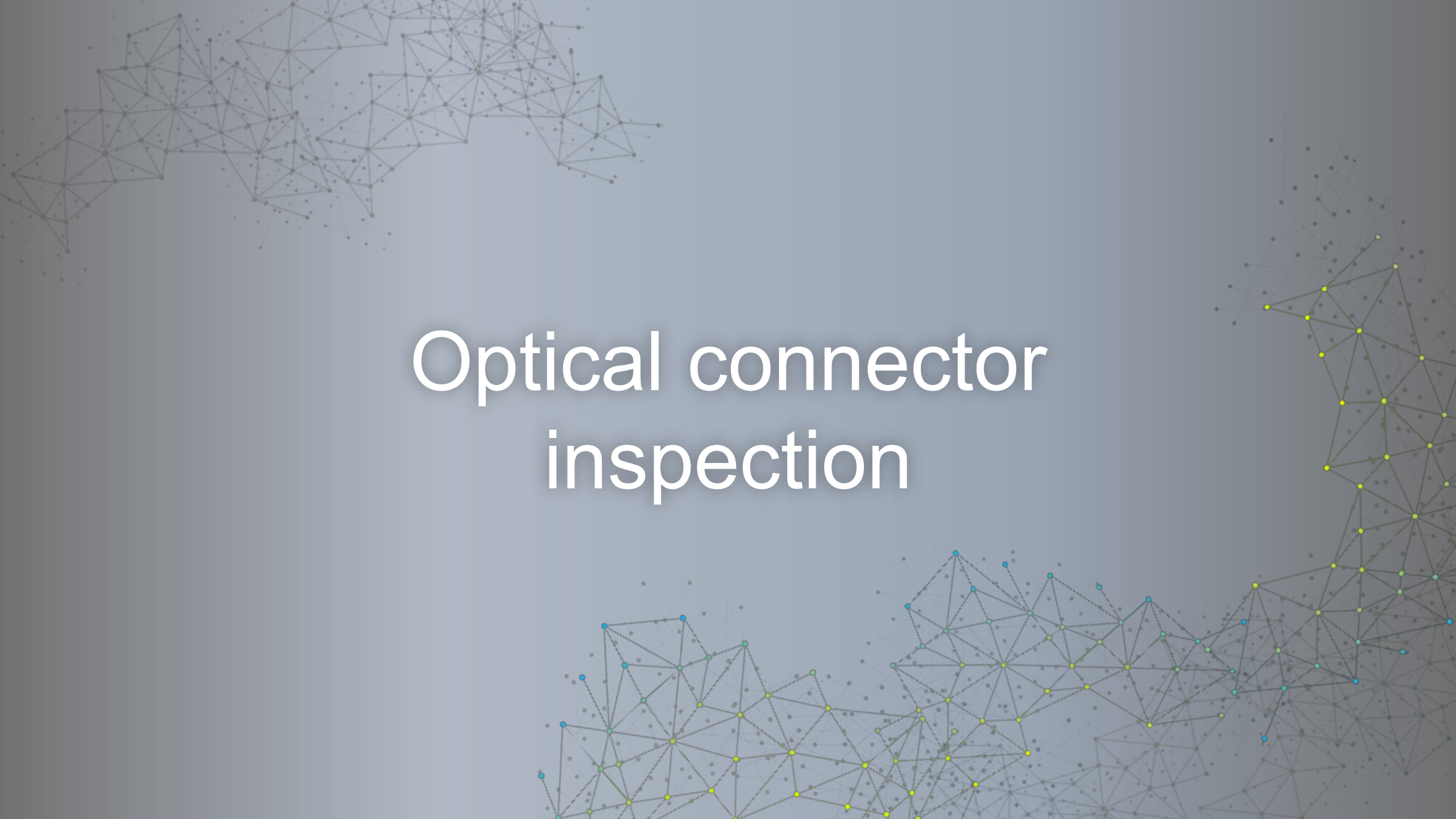


Clean fiber management



Low optical loss





Optical connector inspection

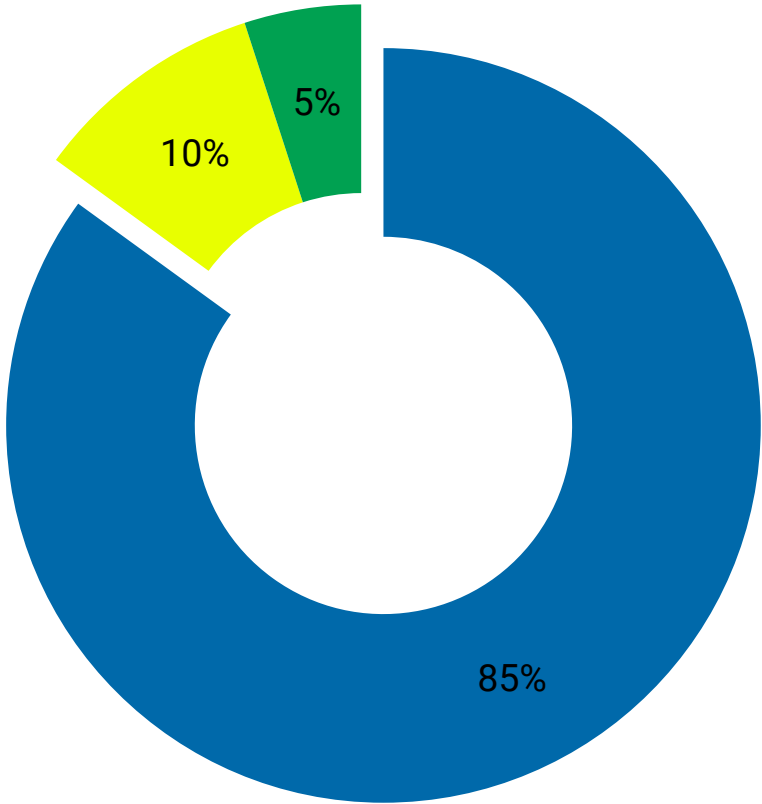
Network failures

1

cause of network failures is:

BAD CONNECTORS

Cause of Network failures*



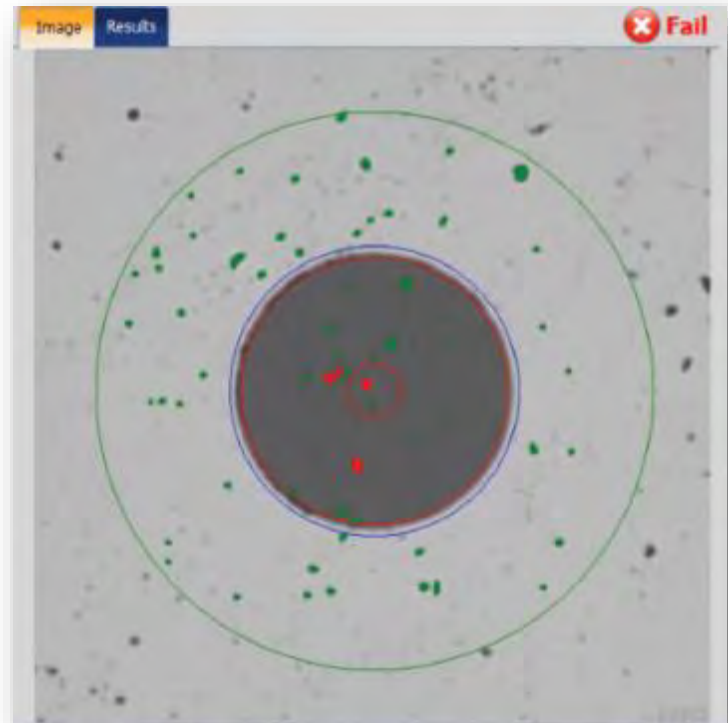
- Dirty/damaged connectors
- Macrobends
- Other



* According to a in-house survey

Quality control in a simple step!

Fully automated wireless fiber scope



100%
AUTOMATED

FAST AND EASY
CONNECTOR
INSPECTION



FULL-DAY
RECHARGEABLE
BATTERY

FAIL



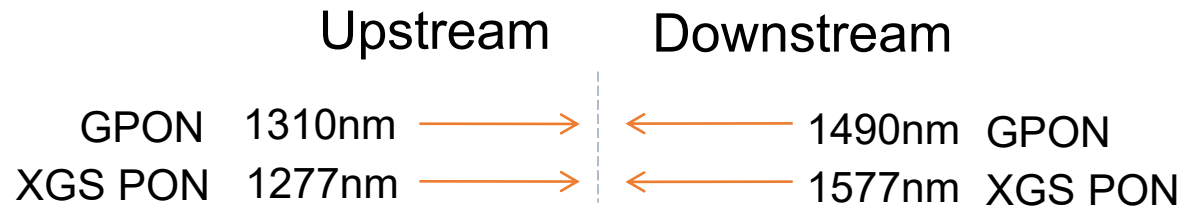
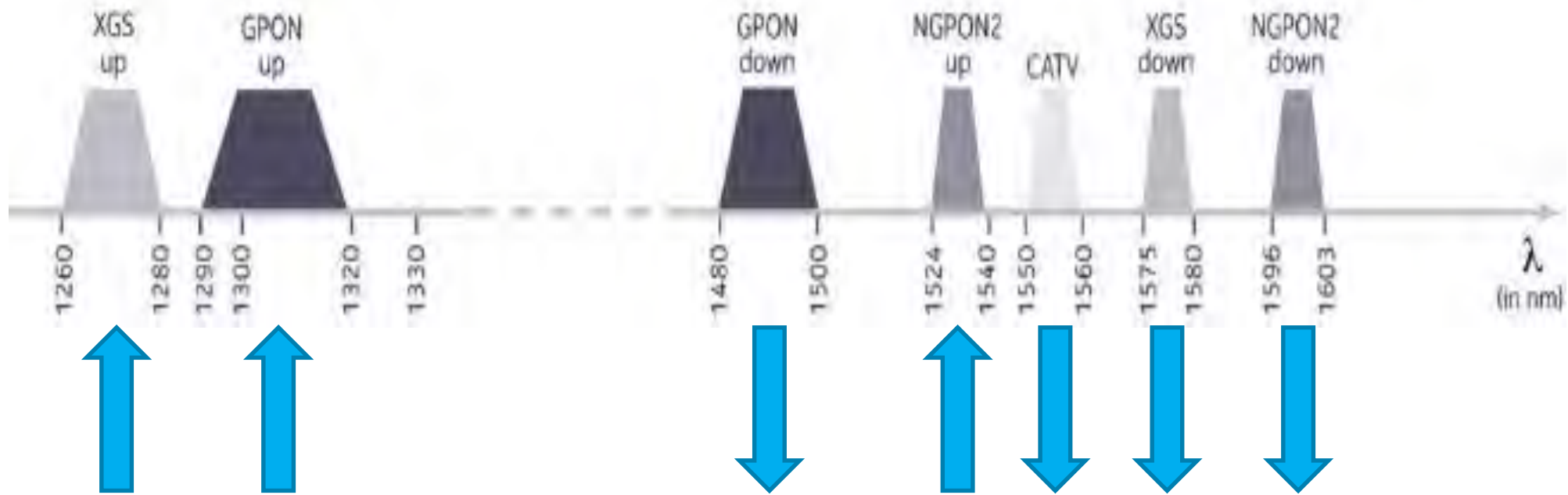
slide 118





Optical power level validation

GPON & 10G PON Wavelengths



Service turn-up for GPON & 10GPON

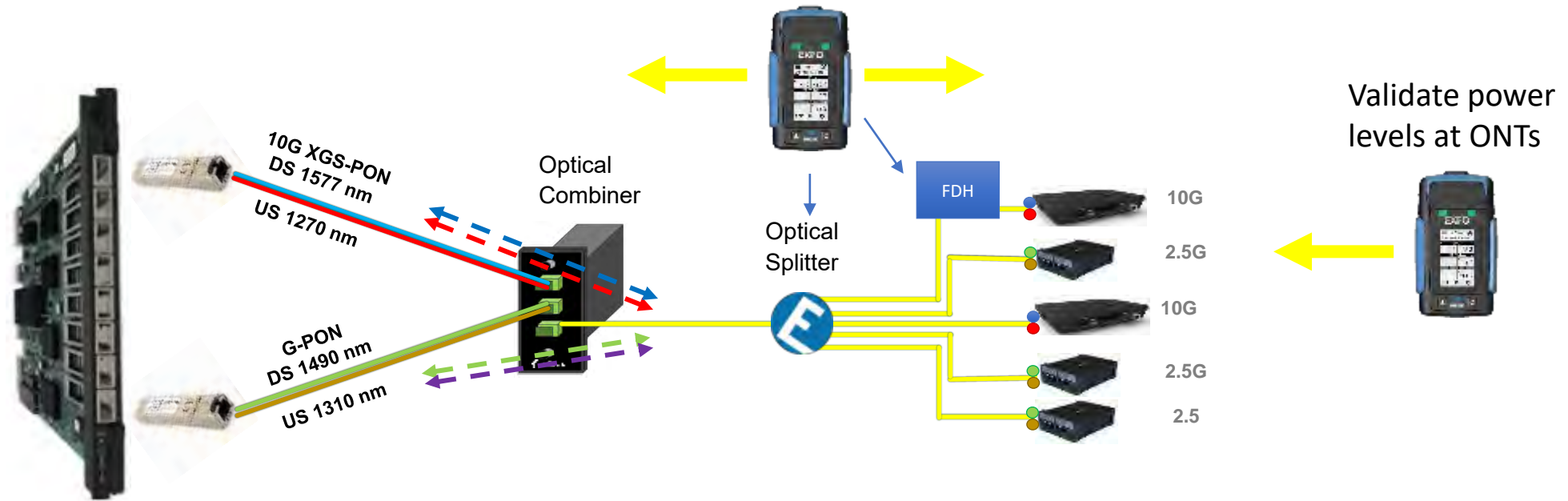
Validate optical power levels

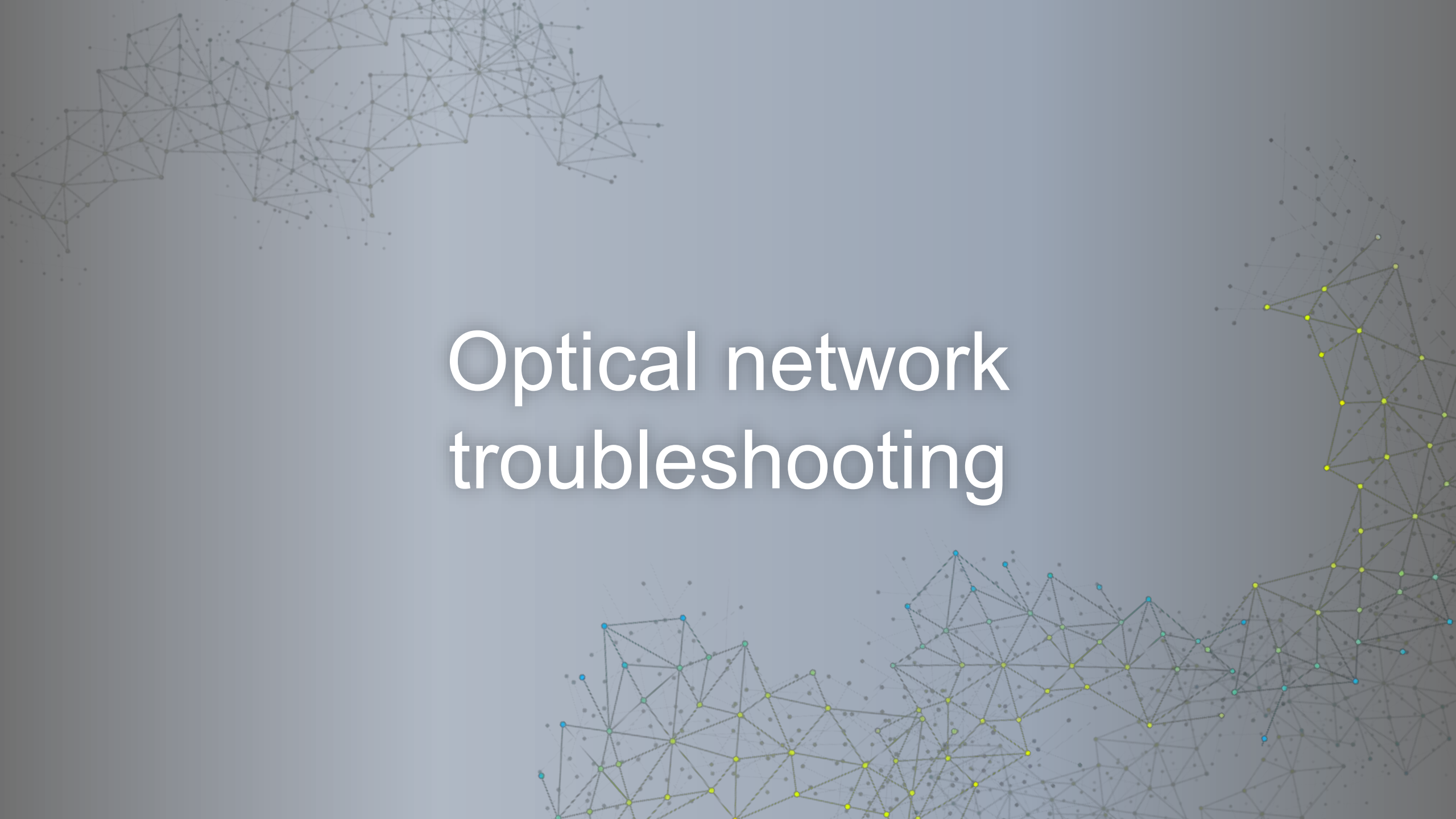
- 10GPON brings complexity in POL service activation
- Regular power meter cannot measure 10G PON signals
- Use a PON Power Meter (PPM) to measure all signals
- Generate test report for each ONT as a proof of install



Service turn-up for GPON & 10GPON

Measure US+DS signal levels



The background features a complex network diagram with nodes and connecting lines. The nodes are represented by small dots, some of which are colored in shades of blue, green, yellow, and red. The lines connecting the nodes form a dense, interconnected web. The overall aesthetic is technical and modern, with a light gray background.

Optical network troubleshooting

Maintenance of POL networks

What can go wrong?

- Network instability, lost of connectivity
- Performance, BER, imited throughput
- Users or services down
- High loss or macrobend
- High reflectance (dirty connector)
- Broken fiber(s), unplugged fibers, macrobends

DIY or subcontract?



Optical Explorer™

Fiber testing
made simple for
you.



EXFO

A new breed of fiber testing tools

Everyone knows about electrical multimeters...

Essential electrician's tool
for go/no-go testing

Measures:
Ohm, volts, amps, continuity



EXFO offers the first optical fiber multimeter (OFM)

Essential fiber technician's tool
for go/no-go testing

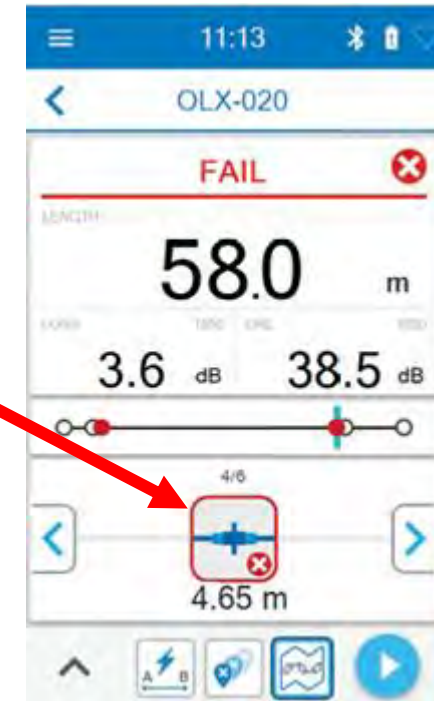
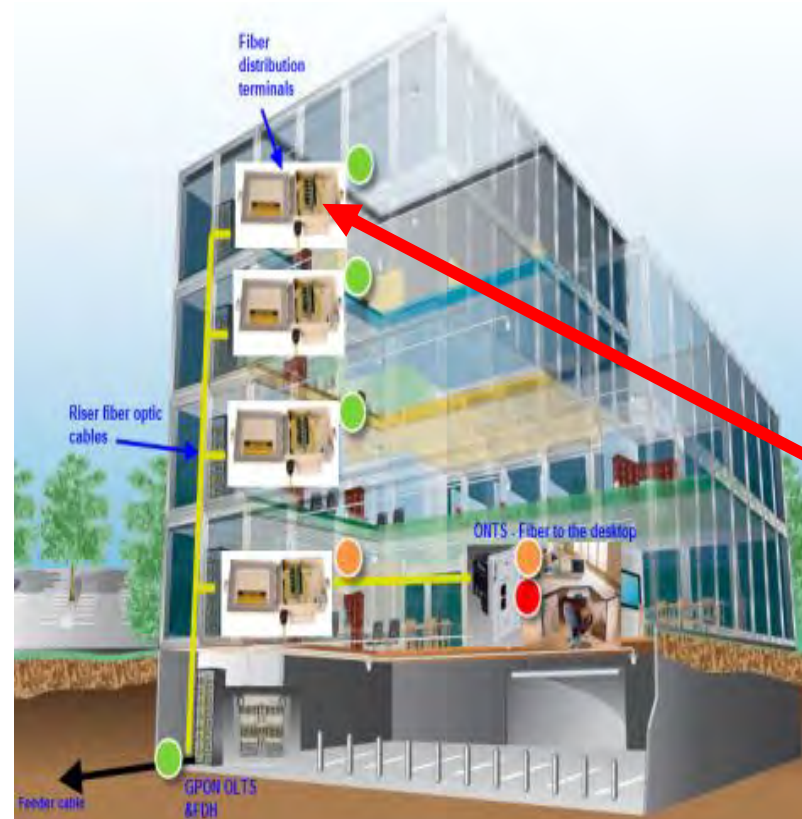
Measures:
Meters, dB, dBm provides length, loss, ORL with intelligent fiber
troubleshooting



Troubleshooting on active networks

Dealing with live fibers

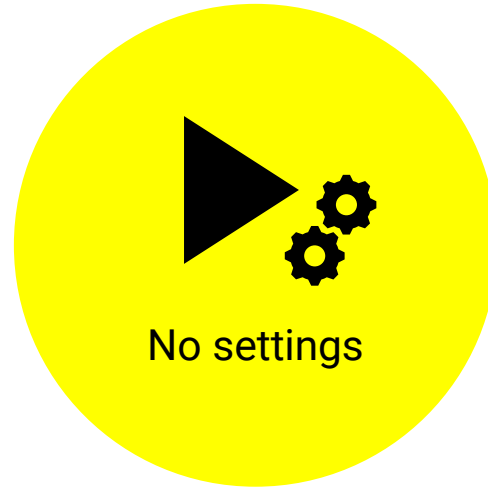
- You can test live fibers without shutting down the entire system
- Optical Fiber Multimeter with built-in live port at 1650nm (out-of-band)
- Filtered port to block incoming signal
- No interference with other active users in the network
- One-button touch to check physical link integrity



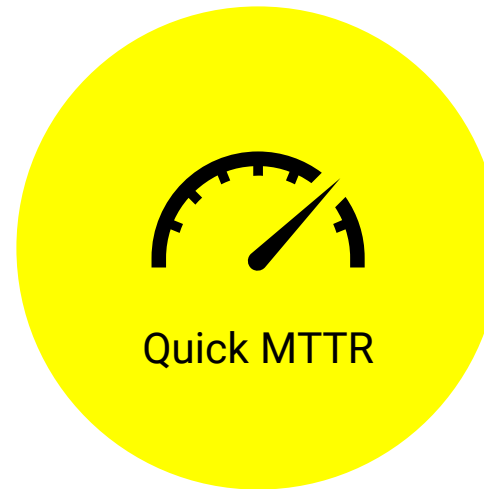
Optical Explorer™



Connect & press
Play



Find & Fix



Leverage technicians
on-site



Recommended Testing approach

4 Documentation

Specify the information you need in the close-out package

3 Best practices during construction

Connector inspection
Fiber characterization – First-time right

2 Create your MOP

Provide your team with proper MOPs to ensure consistency of results across different teams

1 Provide complete training

Fundamental (101: how fiber optic works and how to test) and hands-on training



Jimmy.gagnon@exfo.com

www.exfo.com



- For more information please visit www.tellabs.com
- LinkedIn Company - <https://www.linkedin.com/company/tellabs/>
- Twitter - <https://twitter.com/Tellabs> and @Tellabs and using #OpticalLAN
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Services to Plan, Build & Operate your OLAN

Joel Fischer, Director Sales Engineering



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Services

- Certified Deployment Partner Program
- Professional Services
- Training
- Support
- Technical Publications Changes



Partner Types

Sales Channel Partners

- Monetary Targets
- Sales & Marketing Certification
- Network Planning & Design
- Relies on Tellabs for Implementation Solutions

Deployment

- Site Survey
- Design
- Interop Testing
- Program Management
- Implementation & Testing
- OLAN Deployment Certification
- Network Planning & Design

Hybrid

- Partners with capabilities to perform both product sales and implementation



Certified Deployment Partner

High Level Steps

A green circular icon with a white checkmark inside.

Capability
Evaluation

A green circular icon with a white checkmark inside.

Network
Planning &
Design (2)

A green circular icon with a white checkmark inside.

Deployment
Certification
(2)

A green circular icon with a white checkmark inside.

On-Site
Mentoring

A green circular icon with a white checkmark inside.

Partner
Case Pack
Support



Certified Deployment Partner *Locating Program Details*

- Nexus
 - <https://nexus.tellabs.com>
 - Partner Programs → Certified Deployment Partner Guidelines
- Navigational Buttons at the Top and Bottom of each page guide you through:
 - Assessment
 - Training
 - Mentoring
 - Support



Tellabs Certified Optical LAN Deployment Partner Program Guidelines

Scope

This document provides an overview of the requirements for Tellabs Partners that will be providing product deployment services to their customers. It shall be used as a guide to develop, maintain and update the Partner deployment service functions, processes and infrastructure requirements, along with the service performance objectives.

Service Organization and Processes for Quality Service

Deployment Services are all activities and operations necessary to implement a Tellabs product in the customer's network. "Tellabs Product" can mean the implementation of a new system in the customer's network, the upgrade of an existing system and/or the addition of new functionality to a system. The essential activities and responsibilities for each function of the deployment process are summarized below. While a separate resource is not required for each area, the Partner should be competent in all of these functional areas prior to accepting any customer orders for Tellabs product Deployment Services.

Project Management

The Project Management function is responsible for the management and control of project deployment. The goal of the project manager is to complete the project, execution and the project acceptance by the customer on time, within budget and with the quality that the customer expects. The Partner will have at least one person with project management skills. During the adaptation phase of the program, the number of people dedicated to project management will be agreed upon based on a function or the installed base complexity and the number of customers.

Based on size, some projects may have more than a single individual performing project manager functions; in this case, a single "lead" individual should be identified for the project.

Project Management tasks may include:



Certified Deployment Partner *Capability Assessment*



Certified Deployment Partner Capabilities Assessment

The first step in becoming a Tellabs Certified Deployment partner is an assessment of your current capabilities and certifications.

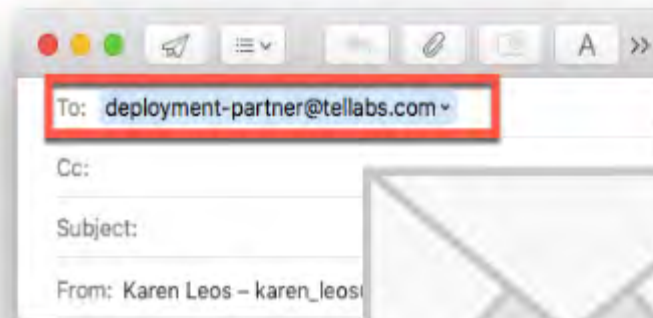
Scheduling Your Assessment

To schedule your assessment, please e-mail the [Deployment Partner Program Administrator](mailto:deployment-partner@tellabs.com).

Assessment Areas

- Project Management Capabilities
- System Design Engineering
- Detail Engineering Certifications & Practices
- Procurement & Logistics Process
- Project Installation
- Number of Personnel
- Training & Experience
- Tools & Equipment
- Fiber Optic Installation Certification and Practices
- Installation Standards Practice and Documentation
- Quality Assurance Processes
- Customer Survey and Feedback Processes
- Collection of References for your work

[Review Full Certified Deployment Partner Guidelines](#)



Professional Services *Supplemental Support*



Professional Services

Plan

Requirements Gathering

Site Survey(s)

Physical & Logical Design

Design Consulting



Build

Layer 1 Implementation

OLT/ONT Installation

Panorama Installation

Turn Up & Test



Operate

Resident Engineer

Audit Services

Software Upgrade
Installation

Server Migration

Moves/Adds/Change
Support



slide 138



Training

Plan

- Network Planning & Design (BICSI CEC Eligible)

Build

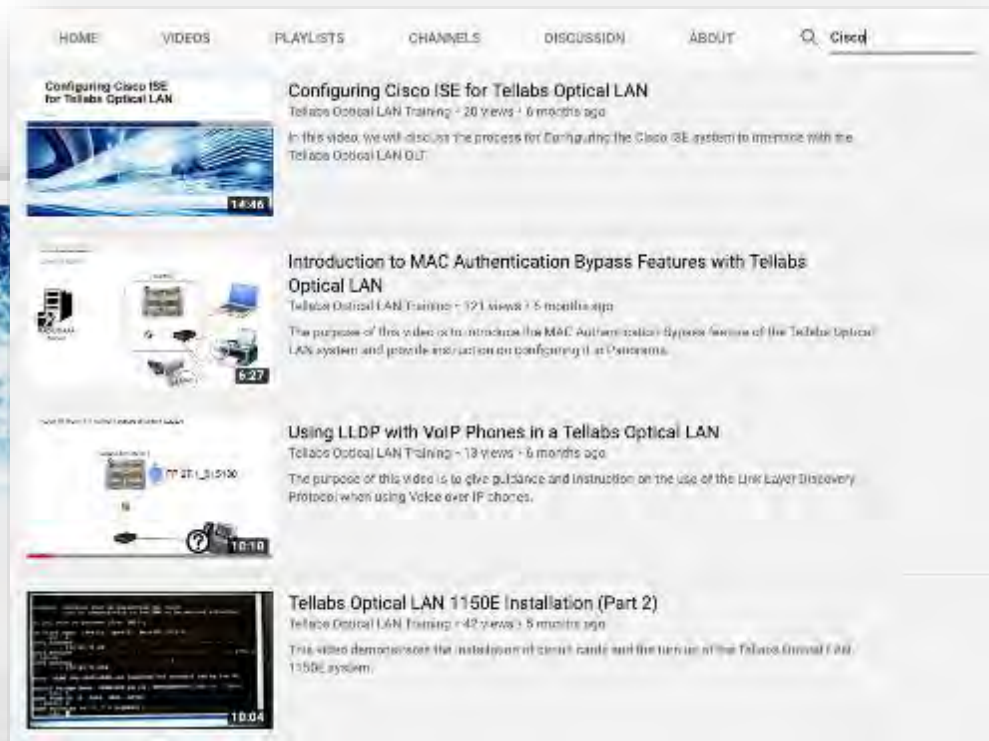
- Optical LAN Deployment Certification
- *Certified Fiber Optic Technician (FOA Certified)*

Operate – End User Focus

- Optical LAN Operations, Provisioning & Maintenance (OPM)
- *Optical LAN OPM + Advanced Troubleshooting*



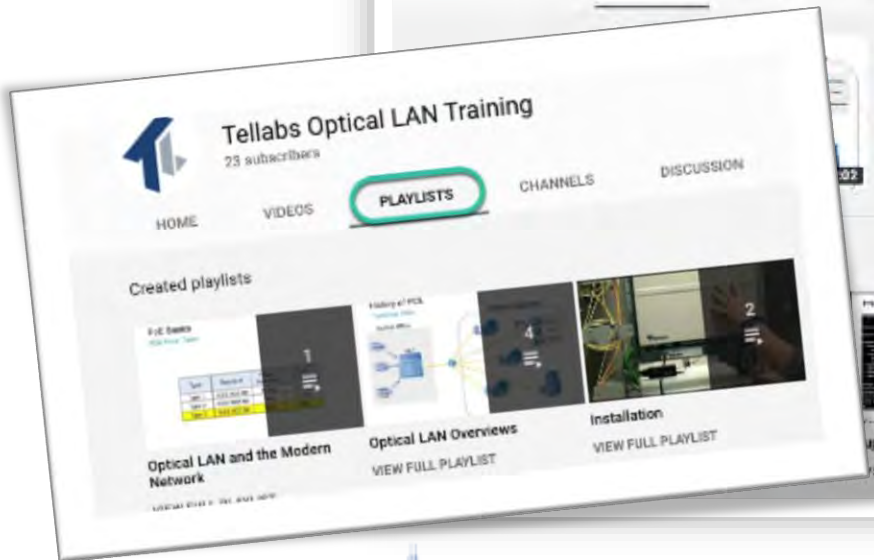
Training YouTube Channel



Introduction to Optical LAN

Tellabs Optical LAN Training • 57 views • 6 months ago

The objective of this video is to provide a solid understanding of Passive Optical LAN or PDL. The topics addressed include a definition for PDL, the basic components of a PDL network, the history ...



Training Digital Credentialing Program



Sample Tellabs digital badge

Tellabs Digital Badge Tracks

- OLAN Planning & Design (Knowledge, Associate, and Certified)
- OLAN Deployment (Knowledge, Associate, and Certified)
- OLAN Operations (Knowledge, Associate, and Certified)
- OLAN Trouble Clearing (Associate)
- Fiber Optic Technician (Certified)
- OLAN Sales Specialist (Certified)

How does it work?

Once you've earned a badge, you'll be notified via email to claim it at our partner Acclaim's website.

To claim and share your badge:

1. Click the link in the email.
2. Create your Acclaim account.
3. Claim your badge.
4. Share on your social media profiles, websites, and in your email signature!



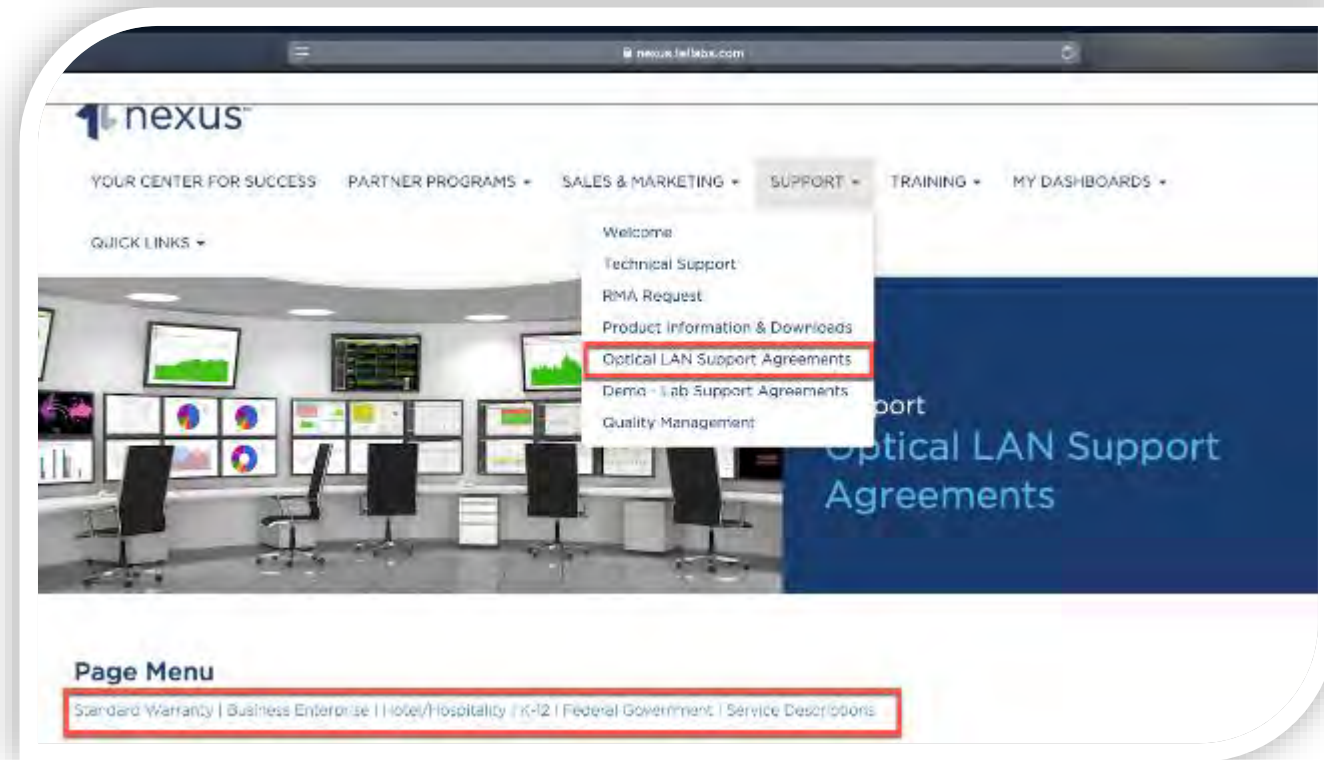
Hank Matthews
Senior Sales Engineer
Tellabs Enterprise Systems
Mobile: (404) 796-1771



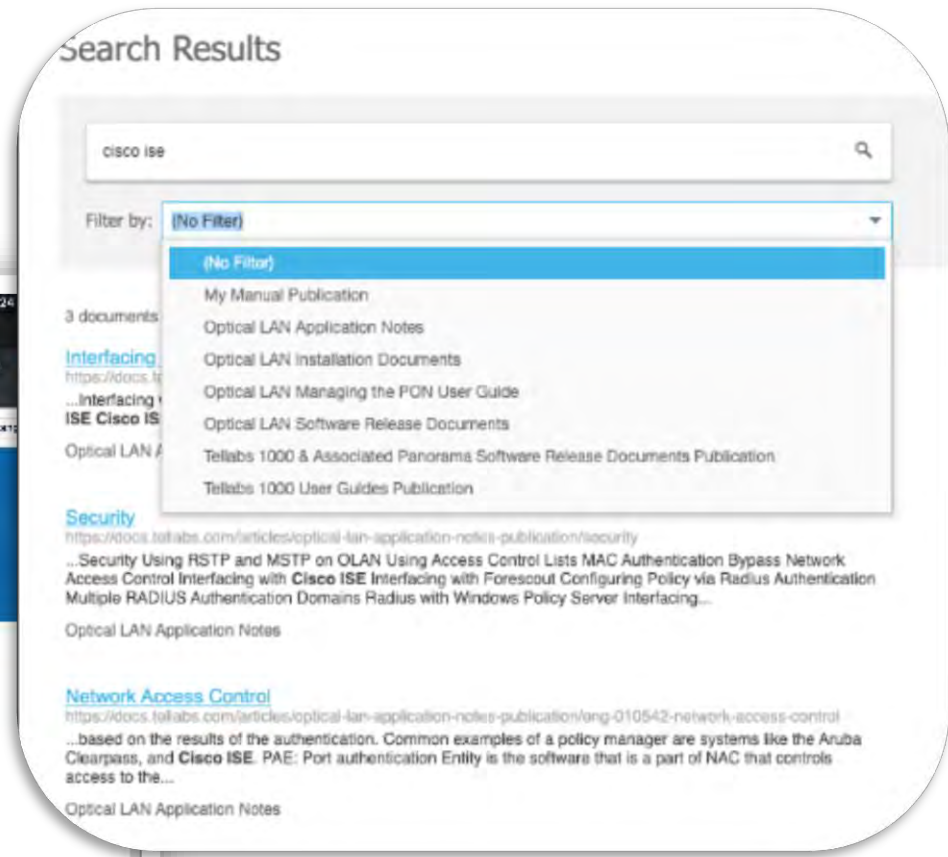
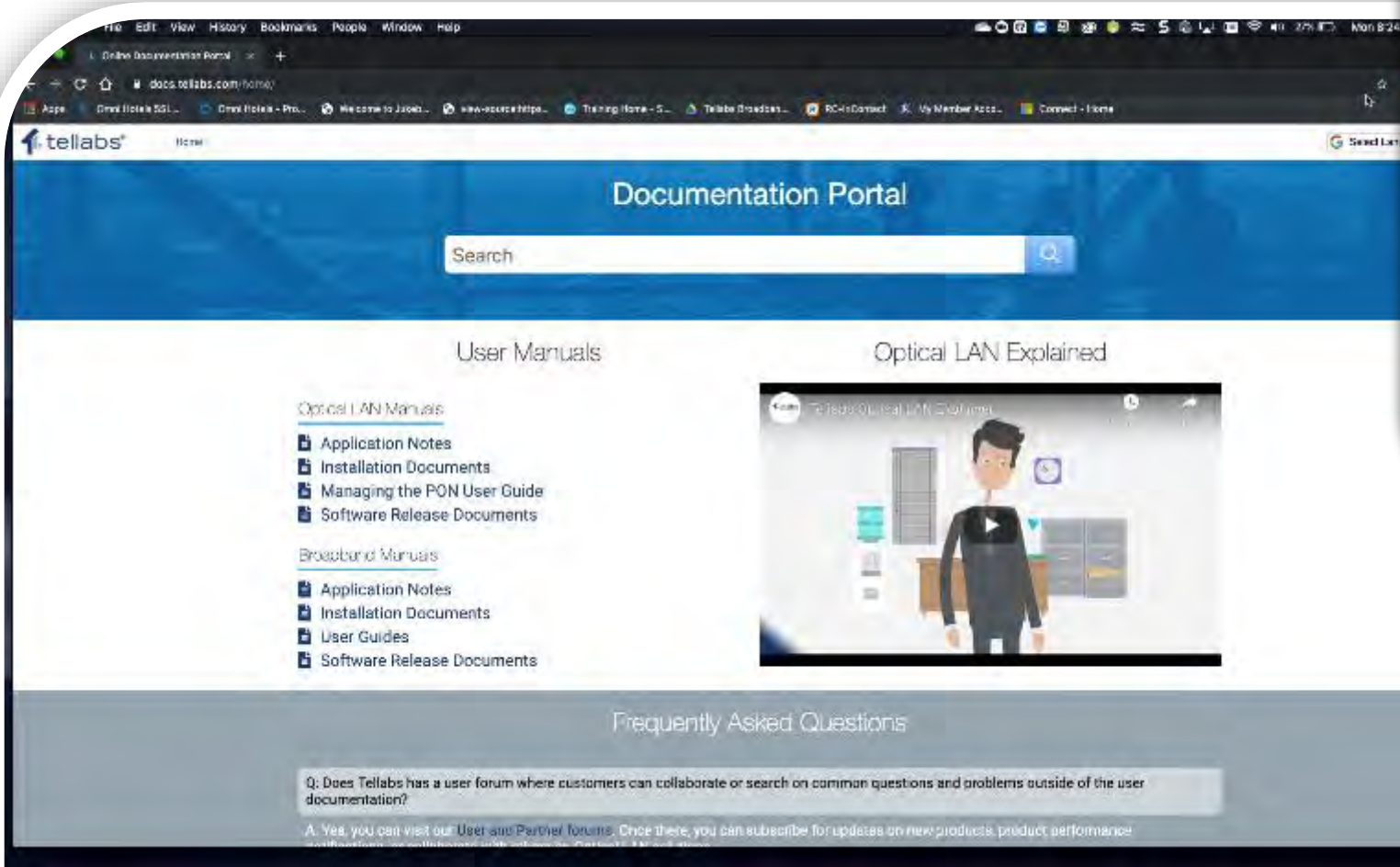
Support

Packages for Every Market Segment

- Multi-Year Discounts
- Technical Support
- Software Updates & Upgrades
- Extended Hardware Warranty
- Advanced Services
 - On-Site Support (Varying SLAs)
 - Software Installation (Remote or On-Site)
- Support Renewals
 - Deal Sheets submitted with PO contain important required information
 - Contacts – Special Instructions
 - 90-60-30 Day Reminders



Technical Publications 2020 Overhaul



- Integrated into the public web
- Searchable
- YouTube videos integrated for applicable application note content



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Technical Panel

Optical LAN Customer Experience - Amtrak

Richard Thompson II, Amtrak Director-Network Planning & Engineering



slide 146





Richard Thompson II
Director-Network Planning & Engineering

More than 25 years of progressive leadership. Has transformed strategic and innovative concepts into solid engineering solutions within the Utility, Transportation, Education and Healthcare Industries. Broad experience in project management, engineering, architecture, contract management, financial analysis and customer support. Practiced analyst who specializes in cost evaluation, benefits of new services and initiatives, presenting options in meeting present and future business requirements with a demonstrated track record in gaining business approvals. An effective change agent skilled in consensus building, stakeholder alignment, and crisis resolution with a high level of integrity.





Voice
IP and POTS



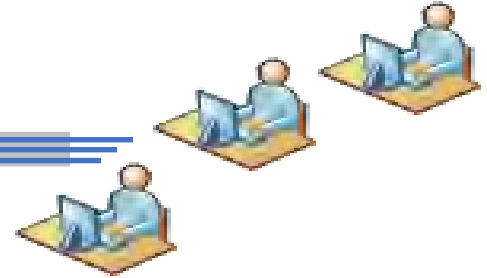
CONDUIT



Data
(Business,
Revenue)



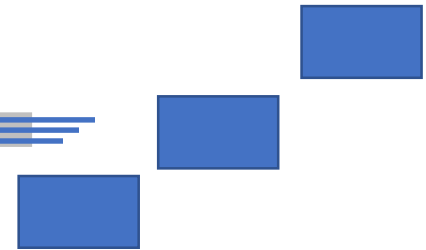
CONDUIT



PIDS



CONDUIT

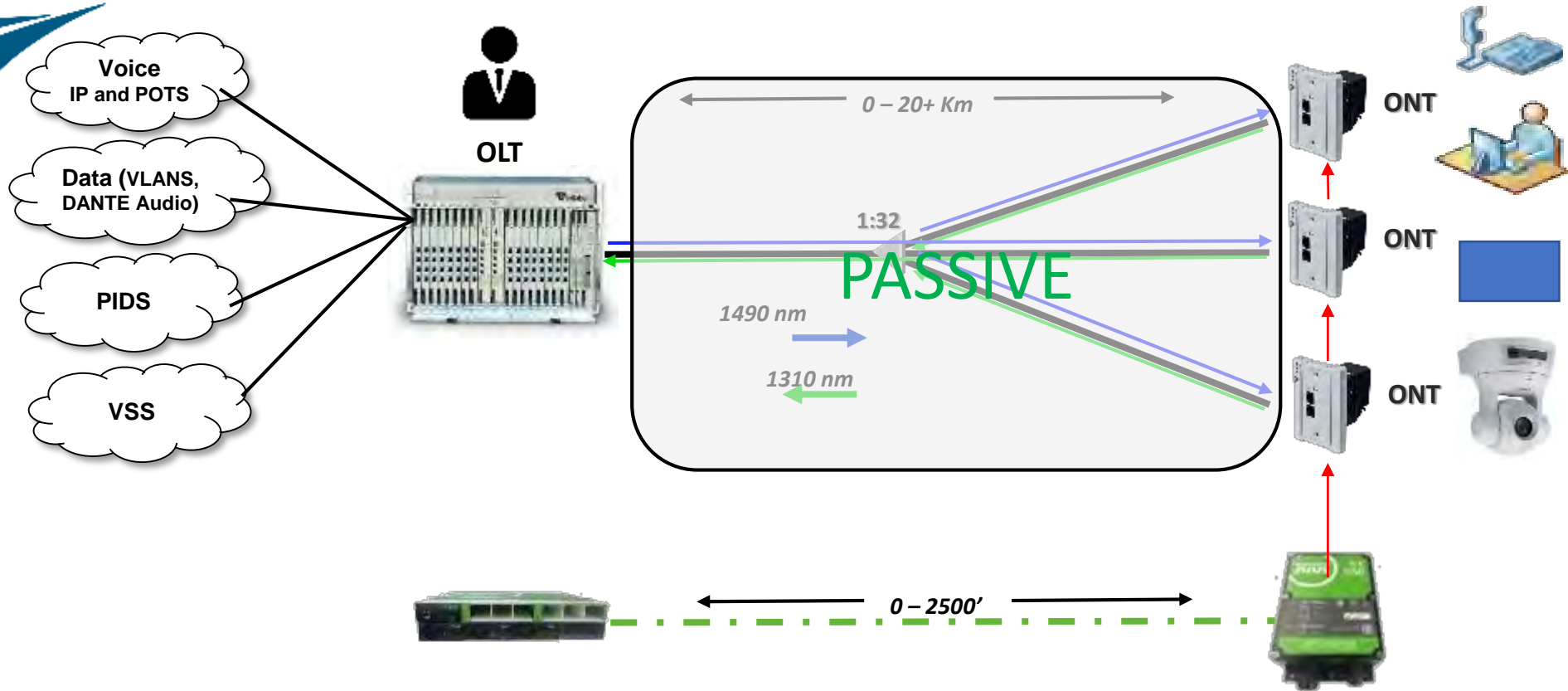


VSS



CONDUIT



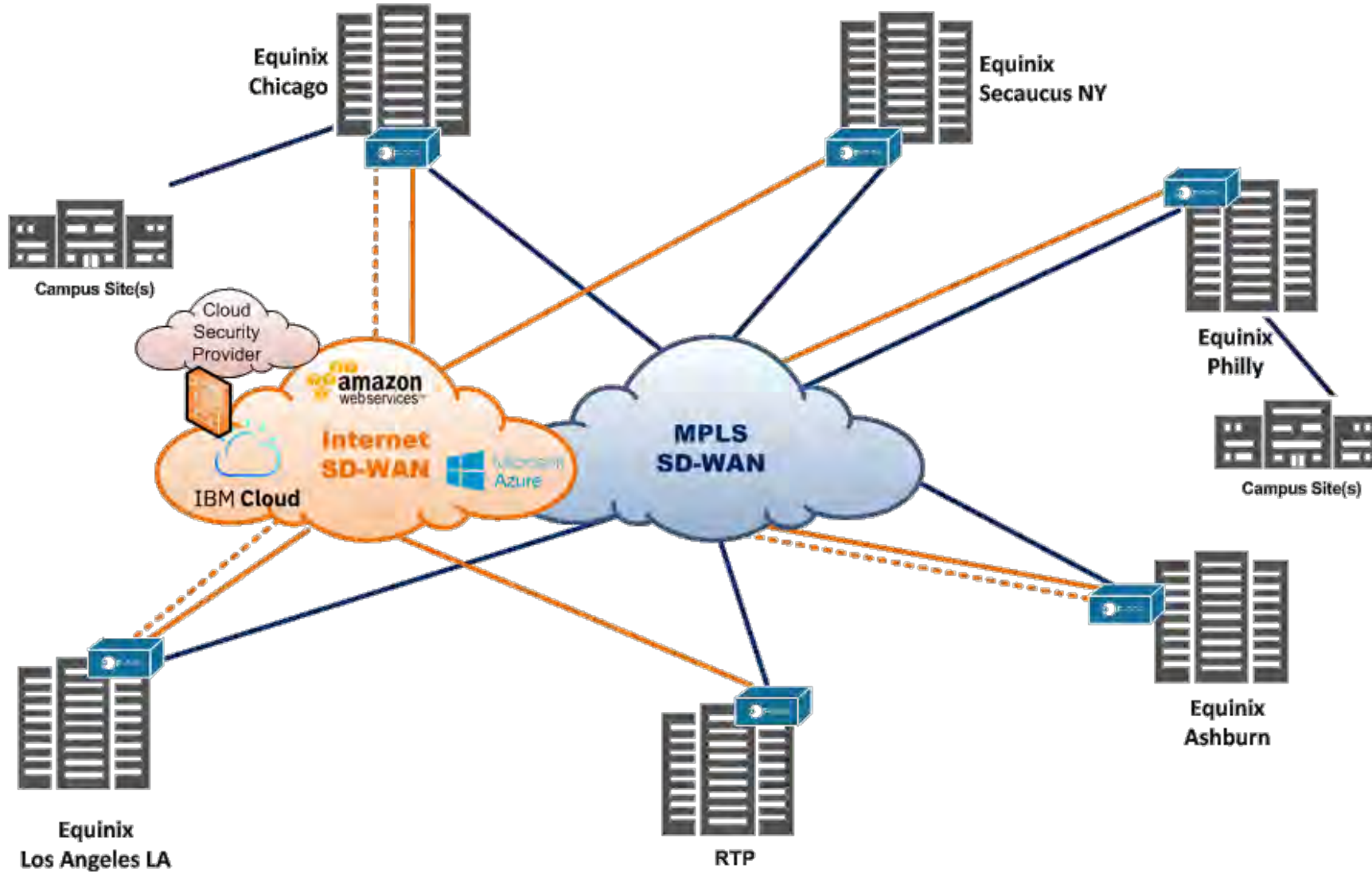


- Each PON supports a single optical fiber carrying 2 wavelengths, a rate of 2.4G/1.2G, up to 64 end devices, and a maximum span of more than 20km
 - 1490 nm downstream (TDM) carrying Voice, Data and Switched Video traffic
 - 1310 nm upstream (TDMA) carrying Voice, Data and Video Signaling traffic
- **GPON Standard Supports Overlay Wavelengths within the 15xx range**
 - Currently used to support RF-based video delivery
 - In the near future will be used to support DWDM services





WAN Architecture





Optical LAN Design and Installation

Amtrak has standardized on Tellabs Optical LAN for all large network deployments and currently has over 8000 ethernet ports live over POL. Locations include Stations, Yards, Office Buildings and other ancillary facilities. A typical system consists of:

- Redundant uplink cards in all instances.
- Tellabs OLT and ONTs. Usually 140W 4-port ONTs but in many instances, 3-port hardened, 24 and 48-port ONTs are used.
- EPS power distribution over Volt Server Digital Electricity.
- Custom zone enclosures with robust backbone cabling to allow for a centralized split.
- Custom DIN mount brackets for harsh environment installations.
- Network devices include all voice, data, revenue systems, security cameras, access control, customer and BOH WIFI, Passenger Information Displays, Room Schedulers, and AV systems.





CASE STUDY: Chicago Yard

The Yard in Chicago is over 4000 feet long and required a major network upgrade in order to secure its boundaries. Challenges and highlights included:

- Optical LAN and Digital Electricity all headend to a single rack in a centrally located building which serves the entire yard. All devices are remotely powered and backed up by a large UPS and standby generator.
- Chicago weather and harsh conditions associated with a rail yard required hardened ONTs, NEMA4x Stainless enclosures and rigid conduit.
- All Wireless, CCTV and access control reside on the OLAN. Additional integration of all networks will take place in Spring 2020.





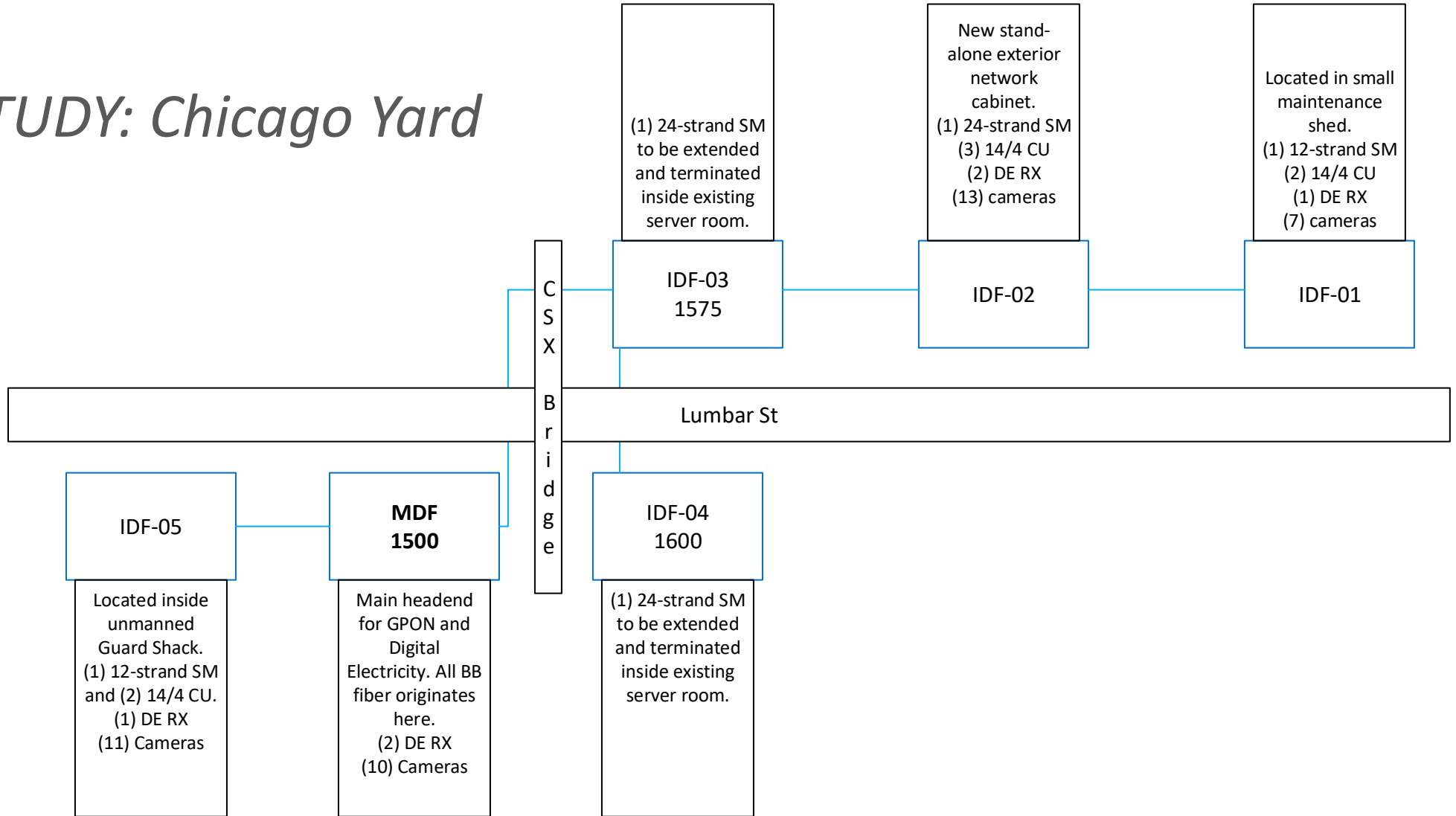
CASE STUDY: Chicago Yard

- The infrastructure was designed as a zone architecture.
- Because IP cameras cover the entire length of the yard, groups of cameras were consolidated to ONTs mounted inside NEMA 4X stainless steel enclosures mounted at strategic locations.
- Backbone cabling consisting of 24-strand single-mode fiber and 16 AWG copper conductors.
- All field ONTs are hardened 3-port, DIN Rail mounted and cabled via hybrid fiber/copper cable.
- All cameras fed from zone boxes pass through a DIN Rail mounted surge protector.





CASE STUDY: Chicago Yard





Lessons Learned: All Projects

- Development of a termination, testing and cleaning plan which is included in all RFPs.
- Splice-on SC/APC Connectors – no mechanical / cam type terminations.
- Clean everything. Dirt and dust are enemies of Passive Optical Networks.
 - New patch cables must be cleaned right before connecting.
 - Optics on ONTs and OLTs must be cleaned right before connecting.
 - Yes... even new cables and equipment.
- Have a PON tester in hand when installing ONTs.
- Demand certified optical test results from the cable installer.
- Remain flexible in design approach from project to project. Don't fall in love with your last good idea.
- Develop customized solutions where applicable. (Zone boxes, DIN rail mounts, etc...)
- Don't try to save pennies on additional fiber strands. Pushing multiple strands deep into the plant will provide resiliency, redundancy, future-proofing and flexibility.
- Choose a good cable installer
- Choose a good PON integrator with experience on the system of choice.
- As-Built system documentation is key.





Previous and current projects

- Chicago Yard Network Upgrade
- Chicago Station – Met Lounge and Customer Wi-Fi
- Chicago Station – Wifi for PTC on platforms
- Chicago Passenger Information Display (PIDS)
- New York Penn Station – Platforms, tunnels and shafts
- New York Moynihan Train Hall
- New York – Sunnyside Yards – Network Upgrade and 500+ cameras
- Philadelphia Station – PIDS, Cameras and Wi-Fi
- Washington DC – Amtrak Headquarters
- Washington DC – REA Building – Will expand to platforms, yards, Amtrak Police Dept HQ
- Washington DC – 10 G St Office Building
- Washington DC – Ivy City Yards – Network Upgrade and 300+ cameras
- Alexandria Virginia – GPON over dark fiber – 10 miles away
- Wilmington DE – Station network upgrade, Customer Wi-Fi
- Sanford FL – Network Upgrade – Station, Cameras, PIDS, Customer Wi-Fi



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Open Q&A

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Thank You!