Distributed Fiber LAN Architectures in the Enterprise…Not So Weird Anymore

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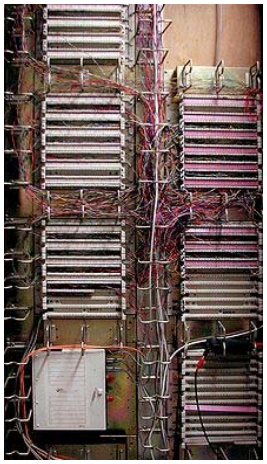
Evolution

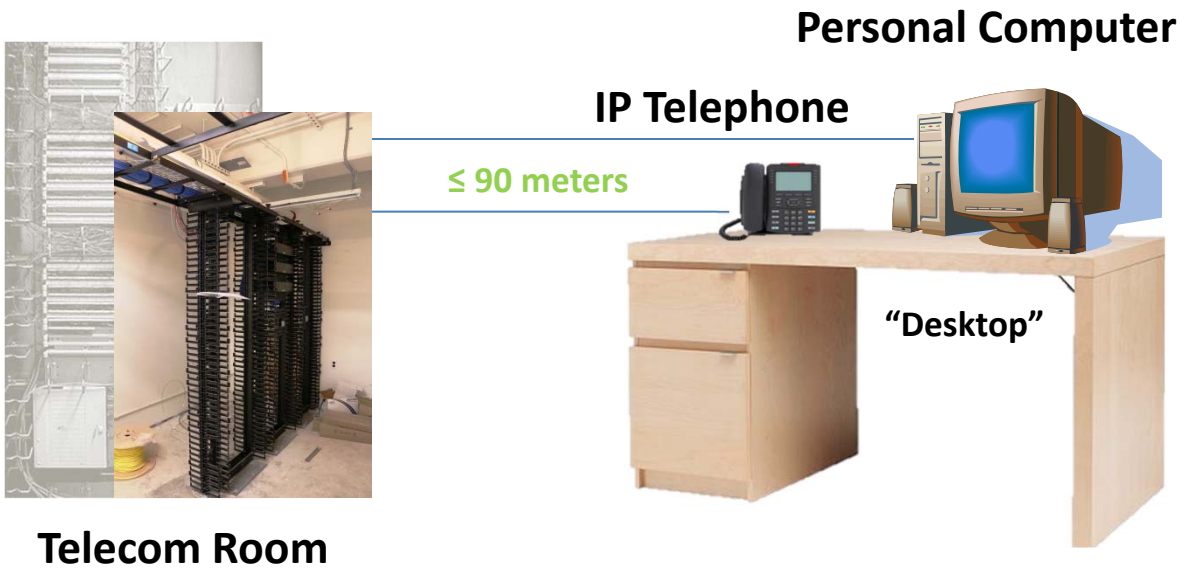


PBX

Analog Telephone

90m was not a technology limitation, but many Telco "closets" were located within that distance.

Evolution



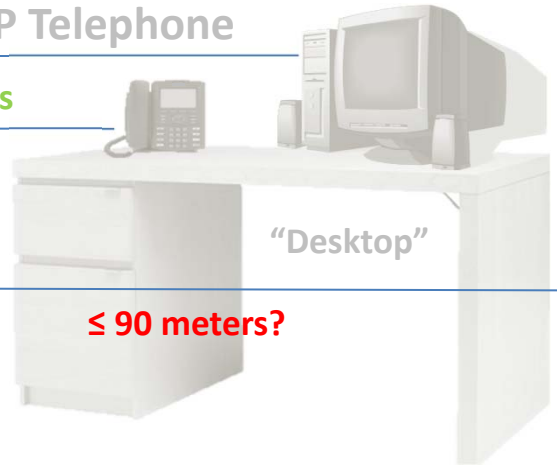
When introducing the desktop computer and IP telephony to the workspace, the logical place for connectivity was in the same location as the telephone connection and thus led to standardization of horizontal cabling distances.

Evolution

Personal Computer

IP Telephone

≤ 90 meters



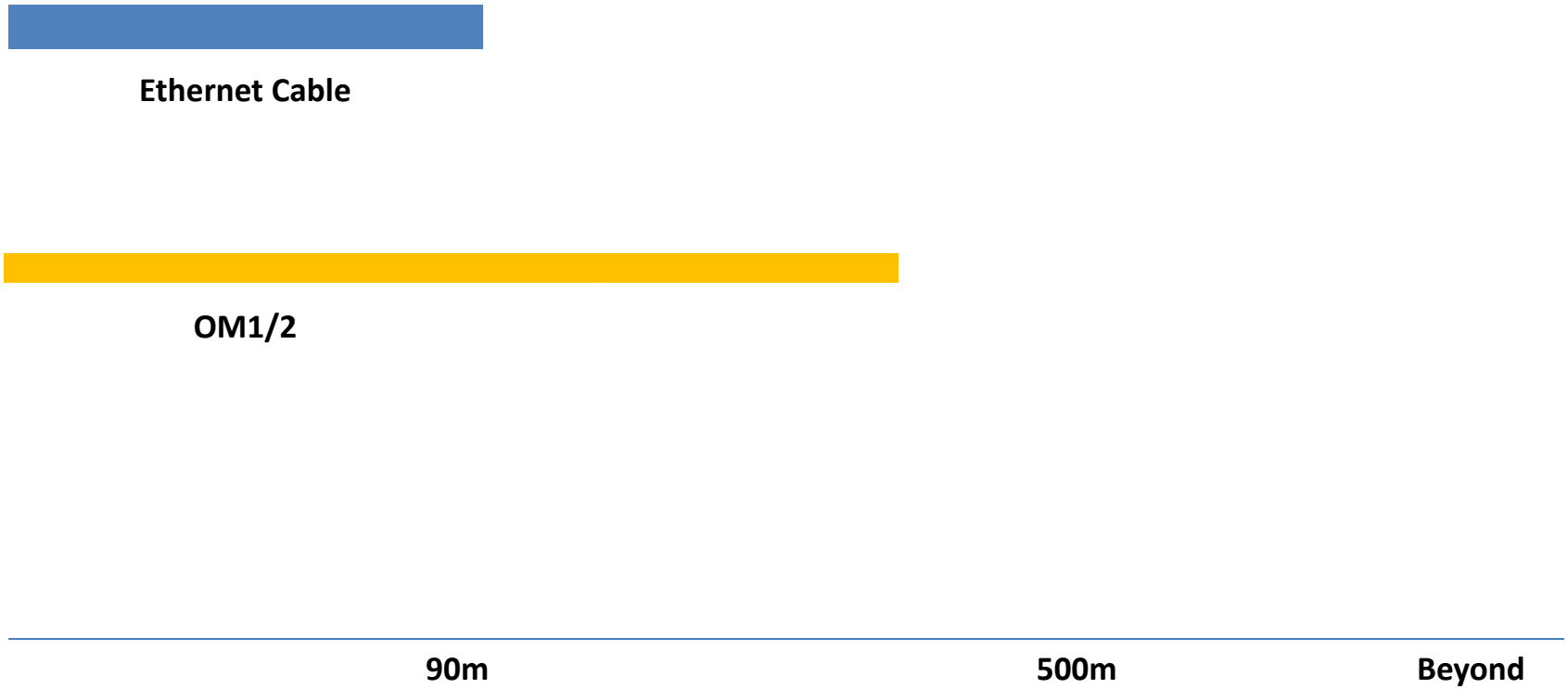
"Desktop"

≤ 90 meters?

Non-Desktop IP Devices

Today we have many other IP Devices that are located throughout our buildings in areas that are not desktops. In many cases we are forced with making the decision of how to adhere with the horizontal cabling distance limitations. Do we violate the limit? Do we build additional Telecom Rooms? Do we locate devices in less than ideal locations to adhere to the limit?

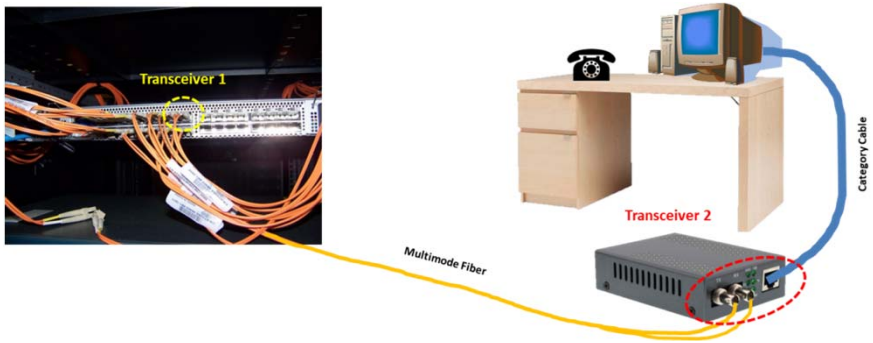
Evolution



A look back… Fiber LANs of the past

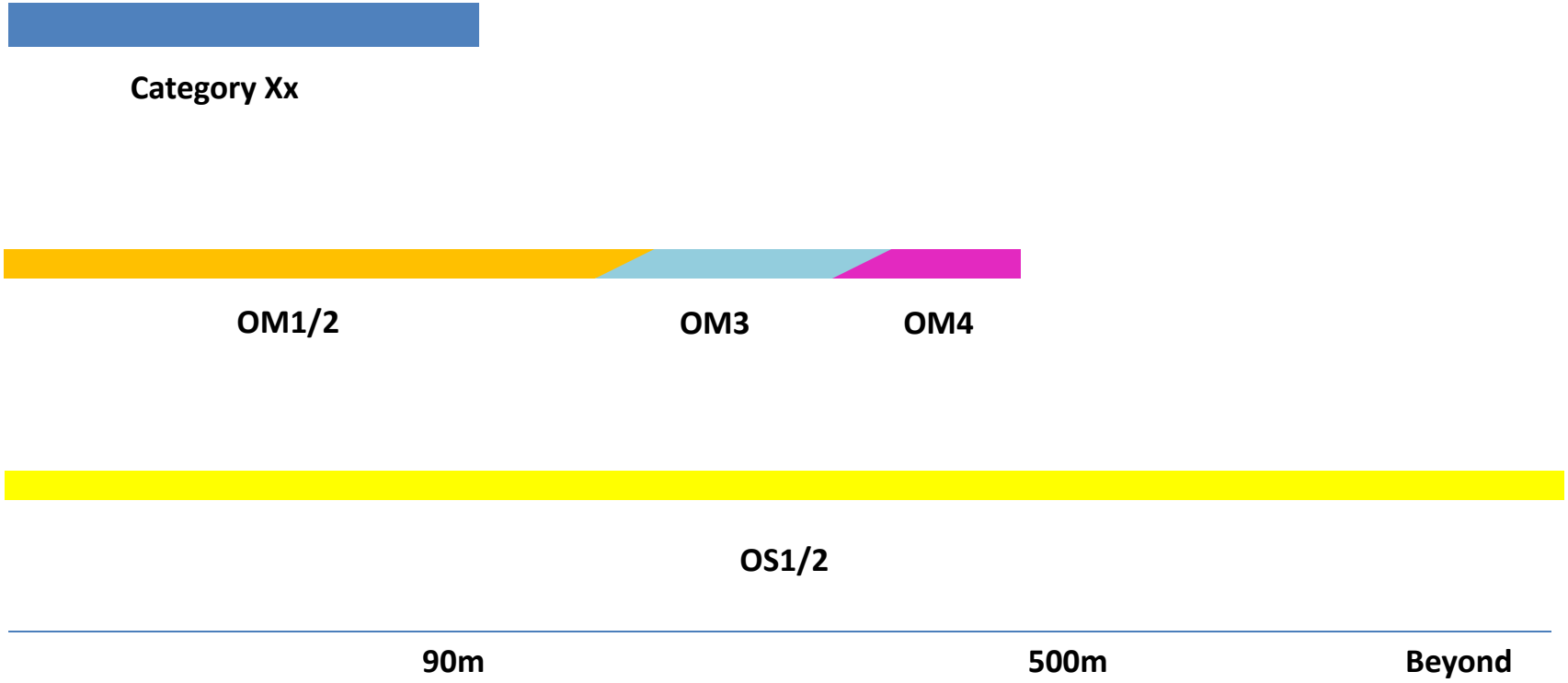
FDDI – 100Mb/s

Challenges



- Two Transceivers per device/location $$$
- Desk side transceiver/media converter reliability ⬇
- Typically ST connectors (non Pull-Proof) ⬇
- Costly multimode fiber $$$
- No management of remote devices ⬇
- Limited physical flexibility ⬇

Evolution



Distributed Fiber LANs

WHAT

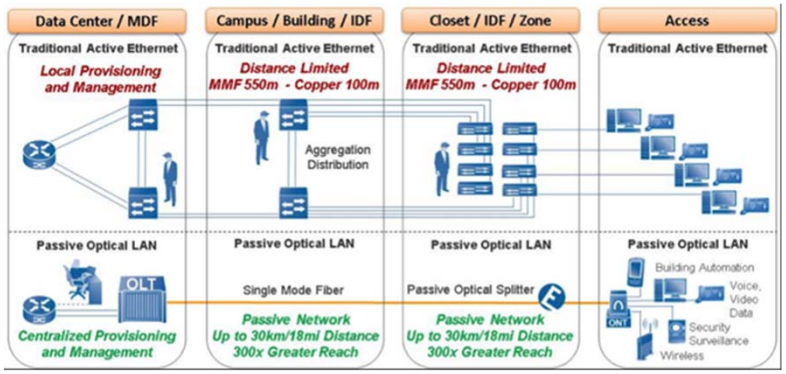
- All Fiber LAN Architectures
- Future proof cabling
- Distributed zone architecture
- Reduction in telecom rooms
- Smaller pathways
- Not distance limited
- Reduction/Elimination of HVAC
- Simplified management
- Flexible architecture

WHERE

- Hospitality
- Assisted Living
- Education (K-12 and Higher Ed.)
- Healthcare
- Military / Government
- Campuses
- Commercial Office
- Sporting Arenas / Stadiums
- Airports, Shopping Centers, Casinos

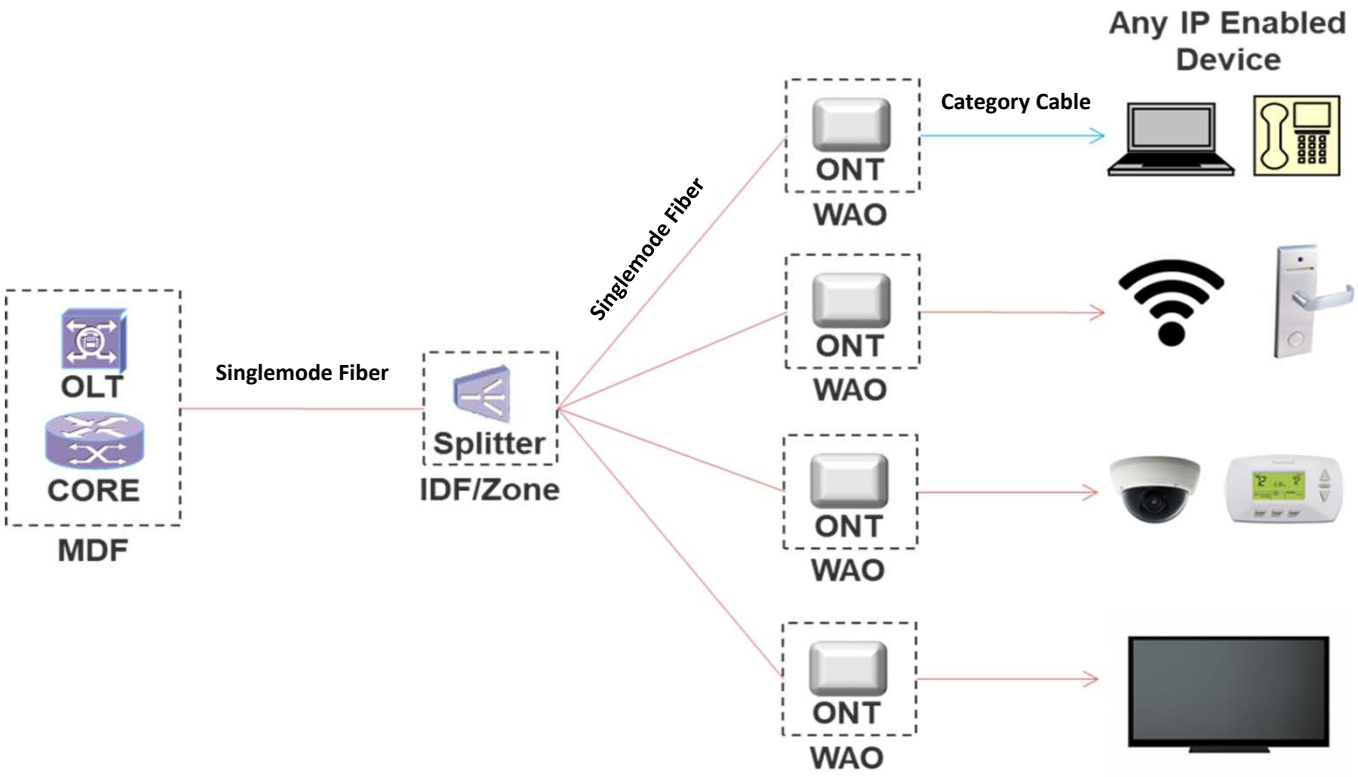
Passive Optical LAN

- Alternate structured cabling topology based on GPON FTTH architecture
- Based on ITU-T standards, but recognized for the Enterprise by ANSI/TIA and BICSI
- Point to multi-point, topology with committed information rates and bandwidth on demand
- **P**assive **O**ptical **N**etwork over Singlemode fiber using passive optical splitters instead of active Ethernet switches



Similar	Different
Standards Based	Point to Multipoint
Local Area Network	Multiple Services
Enterprise Management	Guaranteed Bandwidth
Ethernet Frame Transport	Single Strand of SM Fiber
802.1x – 802.1Q – PoE	No Access and Distribution

Passive Optical LAN



Benefits

- **CapEx Savings (50-75% reduction)**
  - Significant Cu cable reduction
  - No cooling or battery backup
- **OpEx Savings (~ 50% reduction)**
  - No switches, UPS, and cooling
- **Space and Pathway Savings**
  - Reduction of Telecom Rooms
  - Significant cable mass reduction
  - Reduced fire load and fire stopping

Network Integration	Service Delivery	Monitoring / Management
Multiple 1G and 10G Ethernet Uplinks	802.1p: Class of Service	SNMP v1, v2, v3
IEEE 802.3ad Link Aggregation Control Protocol (LACP)	IP differentiated services code point (DSCP)	CLI Console Port
IEEE 802.1Q VLAN Encapsulation	Quality of Service: Per-VLAN, Per-Port, Per-Service queuing / scheduling *	Remote Monitoring (RMON) software agent
IEEE 802.1w Rapid Spanning Tree (RSTP)	Sophisticated QoS and Traffic Management	RMON I & II
IEEE 802.1s Multiple Spanning Tree (MSTP)	Eight Queues per VLAN	Enhanced SNMP MIB support
Virtual Router-to-Router Redundancy (VRRP)	Policing, Scheduling, Shaping per Queue	RFC 1213-MIB (MIB II)
IPv4 / IPv6	Congestion and Flow Control	Extended MIB support
IGMPv2 / IGMPv3	Hardware Based ACLs: L2, L3, L4	Network Timing Protocol (NTP)
Network Access Control (NAC)	Hardware Based Multicast Management	RADIUS based authentication
IEEE 802.1x (Port-based Authentication)	IEEE 802.3af, 802.3at (PoE)	SSH v1, v2
Dynamic Host Control Protocol (DHCP)	Link Layer Discovery Protocol (LLDP)	VMWare Support for EMS
DHCP Snooping and Option 82 insertion		OLT SysLog support (2014)
Port Security, Sticky MACs		Y.1371 (2014)
RFC-2267 (Denial of Service)		802.1ag Fault Detection (2014)
Traffic Storm Control		
Bridge Protocol Data Unit (BPDU) Guard		

This represents a partial list of supported IEEE and IP/Ethernet protocols

Challenges Compared

FDDI - FTTD	Passive Optical LAN
• Two Transceivers per device/location $$$	• One PON Port per 32 remote locations/One ONT per 4 or 8 devices* (* not including multiple VLAN ports)
• Desk side transceiver/media converter reliability ⬇	• High availability, Telco grade ONT
• Typically ST connectors (non Pull-Proof) ⬇	• Single Fiber, Singlemode SC/APC Path
• Costly multimode fiber $$$	• Inexpensive singlemode fiber
• No management of remote devices ⬇	• Full remote management of ONTs
• Limited physical flexibility ⬇	• Highly flexible and reconfigurable

Benefits

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- One PON Port per 32 remote locations/One ONT per 4 or 8 devices*
- High availability, Telco grade ONT
- Single Fiber, Singlemode SC/APC Path
- Inexpensive singlemode fiber
- Full remote management of ONTs
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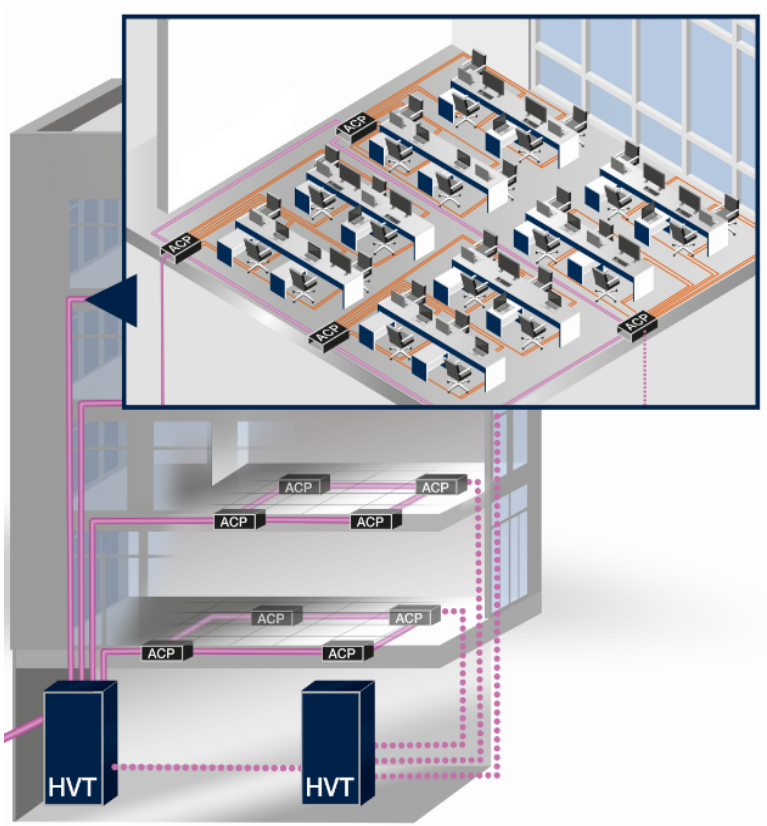
Challenges

- Education/Familiarity on technology
- Electronics brands may not interoperate with each other
- Brand loyalty
- Resistance to change
- Separate budgets for cabling and electronics

Fiber to the Active Consolidation Point (FTT-ACP)



Innovative redundant Ethernet cabling concept with ACP:

- **No IDF/TR required** = Reclaimed space

- **Seamless retrofitting** - Does not interrupt operation

- **Accelerated project lead times and lower material costs**

  - Up to 50% in installation time savings
  - Up to 60% material costs savings for tertiary copper cabling

- **Reduced construction costs:**

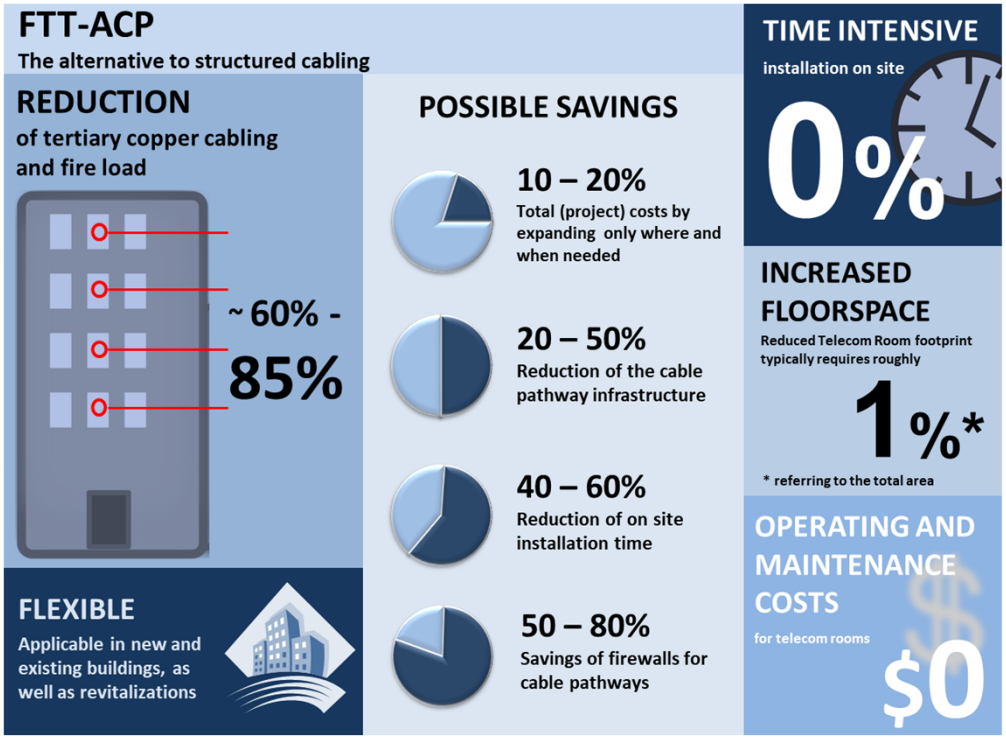
  - Reduced cabling pathways and fire load
  - No IDF/TR, Reduced fire stopping, Reduced coring and drilling
  - Reduced material = Reduced Grey Energy (transport and disposal)
  - Reduced raw materials

Fiber to the Active Consolidation Point (FTT-ACP)

Simple, Flexible and Cost-effective

- Redundant Ring Backbone (SM or MM)
- ACPs within 20m of WAO
- Utilizes a fan-less switch
- < 75dBA
- Reduced Fire Load
- User performance is adjustable (e.g. smaller rings)
- Completely redundant network

Benefits



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Benefits and Challenges

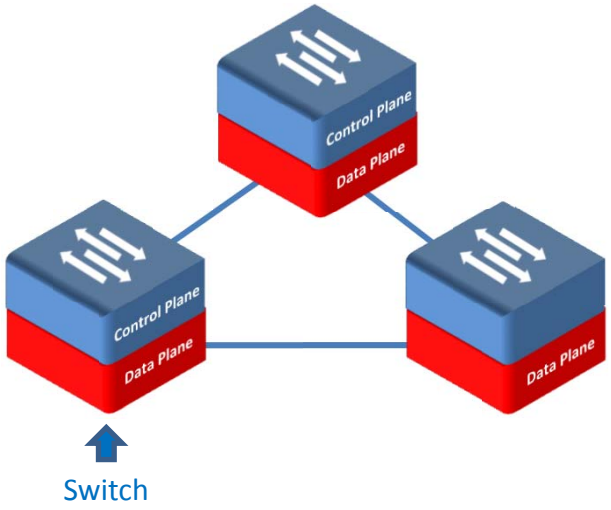
Benefits

- Familiar equipment
- Similar management platform
- Migration path from traditional to POL
- Fan less industrial Ethernet switches
- Connectivity closer to the device
- Reduction or elimination of telecom rooms

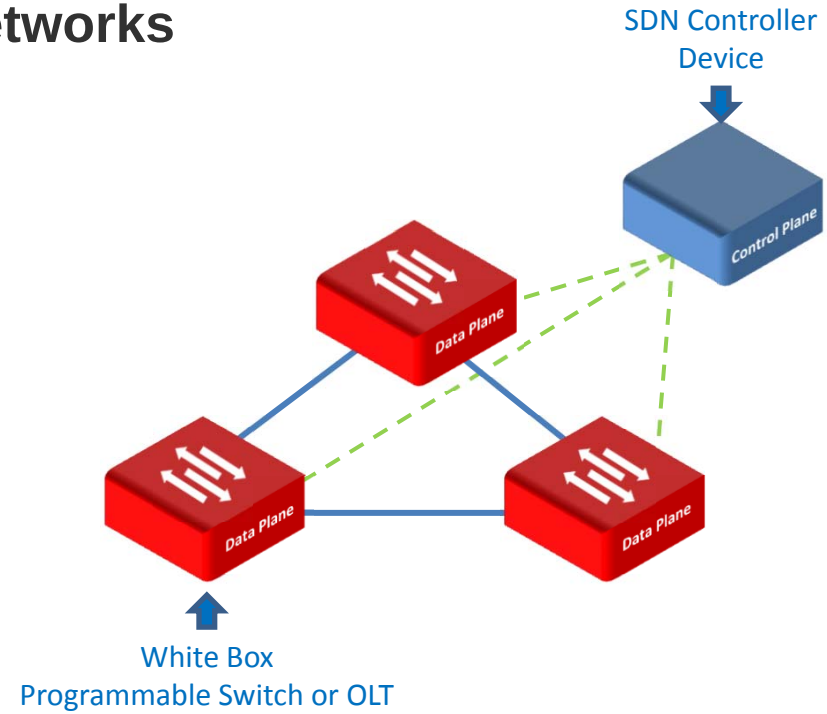
Challenges

- No guaranteed bandwidth
- Decentralized switches
- Requires AC power in zone
- Extra zone enclosures
- May still require longer copper runs
- Potential need for parallel networks

Software Defined Distributed Fiber Networks

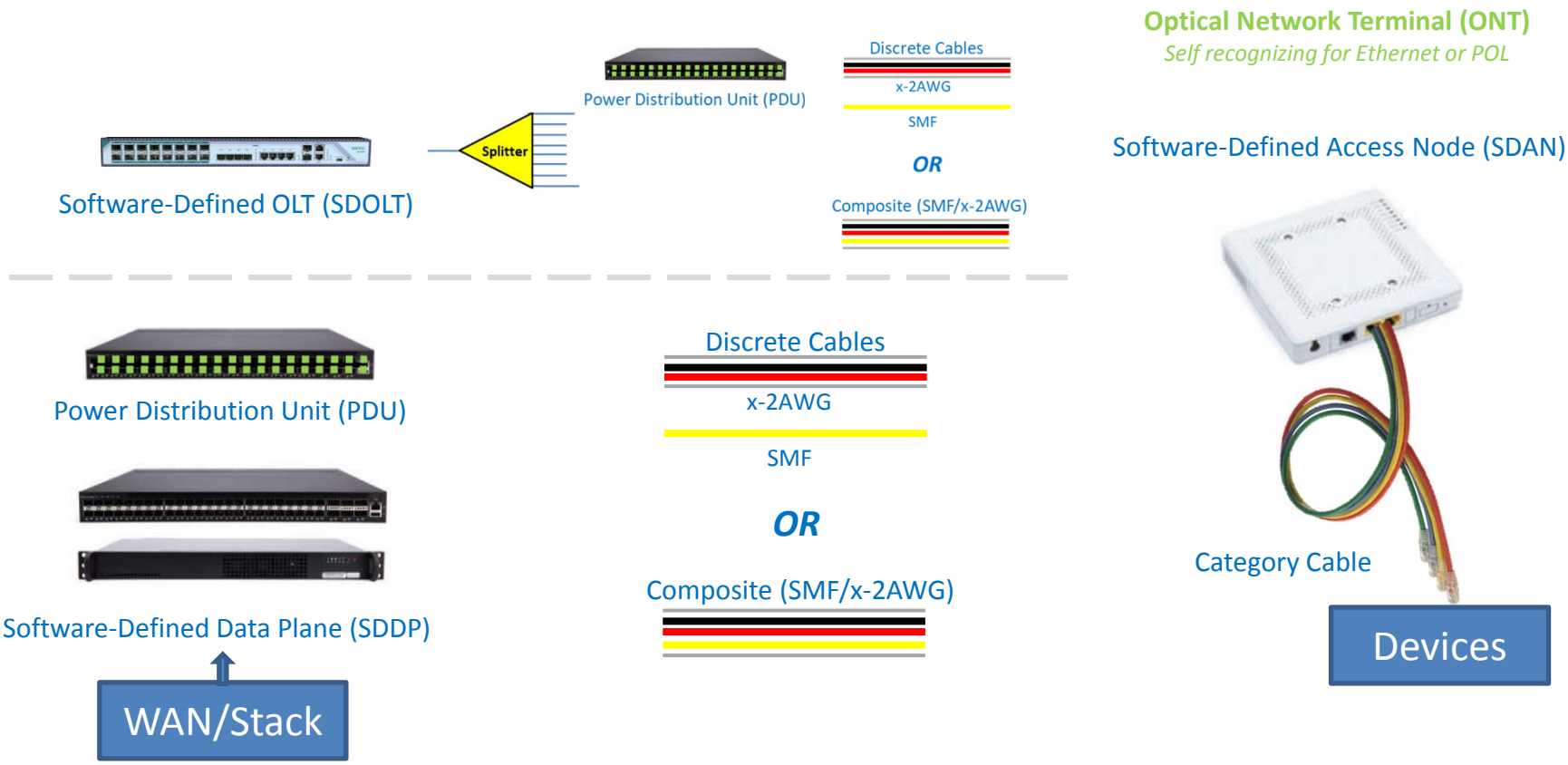


Traditional Network



Software Defined Network

Software Defined Distributed Fiber Networks



Benefits and Challenges

Benefits

- Enables separate hardware and software layers
- Enables Ethernet and/or passive optical LAN using a common Software Defined Access Node (ONT)
- Technology Neutral - Supports audiovisual, building automation, cellular, Ethernet LAN, Passive Optical LAN, security, WiFi, Zigbee, etc.
- Significant reduction of up-front and future upgrade costs due to reduced equipment and use of singlemode fiber to the edge
- Minimized overall network complexity and which helps improve network performance

Challenges

- Opposition to new equipment brands
- Opposition to different management
- Organizational challenges to converged networks
- Doesn't "look" or "feel" traditional
- Potential single brand management
- May be perceived as more than needed

Summary

- Not intended to “kill” copper
- Category cabling can be used for the same 90m beyond the ONT, ACP, or SDAN
- Simply extends the “Backbone” cable (fiber) deeper into the zone
- SDN and POL management systems provide detailed insight and functional remote management to alleviate concerns over distributed equipment maintenance
- View and manage the entire network from a “single pane of glass”

Summary

- Locating switching nodes closer to the device allows for design flexibility, extended reach, and reduction or elimination of valuable floor space typically occupied by equipment
- Allow simple network extensions to provide connectivity to parking lots, remote buildings, or even across town provided that you own the fiber
- These “collapsed backbone” style topologies enable a grow as you go deployment model where you only deploy when and where needed
- Allows network design based on connected devices, not the other way around
- May allow for more finite management of bandwidth allocation, flow control, traffic prioritization, troubleshooting, visibility, and more

Summary

While they may appear visually different from what we are accustomed to, we shouldn't let that, or what someone calls it, cloud the fact that network devices operate as if there were no difference as Core to NIC communication has not changed. Just like any other network topology, the task is to move Ethernet packets from point A to point B, on time and error free. They don't seem so weird anymore.

Thank You!

Rosenberger

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