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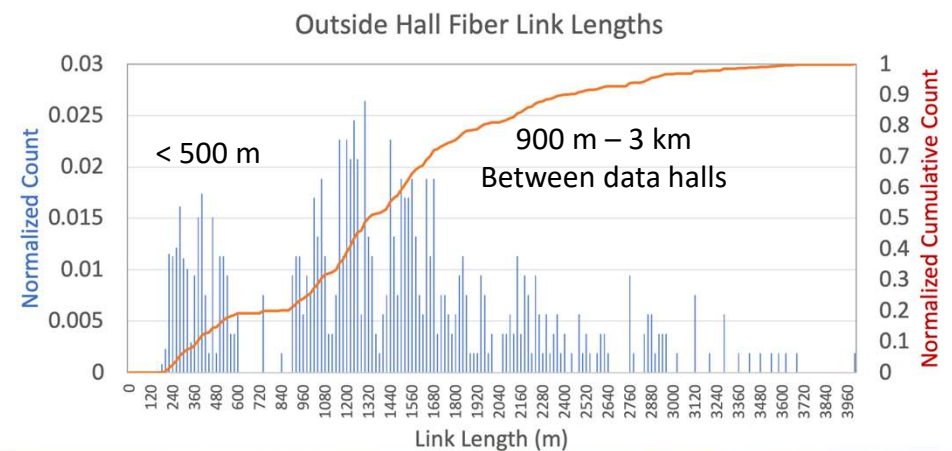
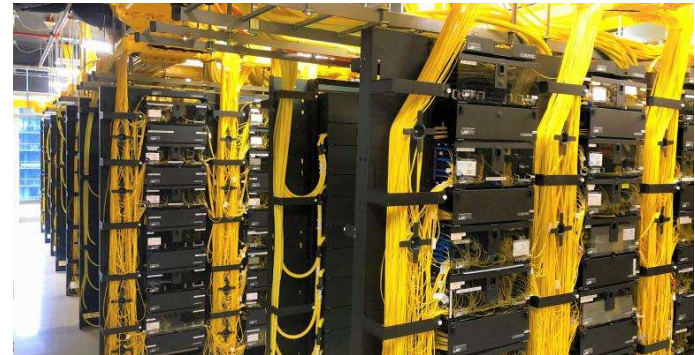
November 8, 2021 | San Jose, CA

Automated Telemetry for Data Center Physical Fiber Layer Analysis

Bob Shine, Alan Gibbemeyer and Tony Kewitsch
Telescent

Fiber in Data Centers

- Hyperscale data centers have >100,000 fiber connections
- Fiber plant typically re-used during compute refresh cycle
- Fiber can be decade old in some data centers



Source: IEEE 802.3 Beyond 400G Study Group May 2021, Stone

Challenges with Fiber Plant

- Remediation required during installation
- Unknown performance as fiber plant ages (poor record keeping)
- Trend to higher bandwidth optics with tighter link budgets
- MPI challenges at higher bandwidth w/ multiple links on a campus

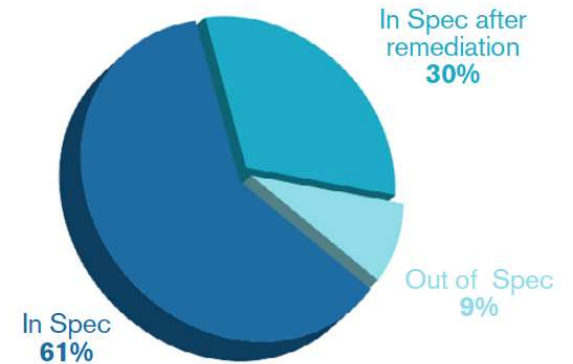
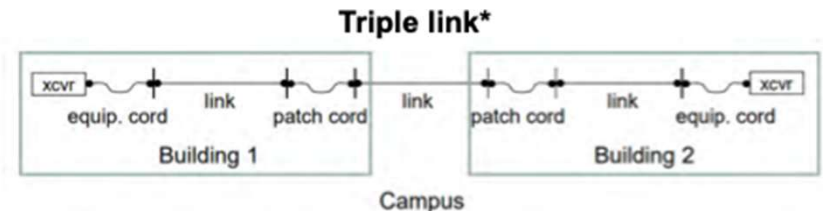


Fig. 1: Microsoft DCI fiber quality statistics ^[3].

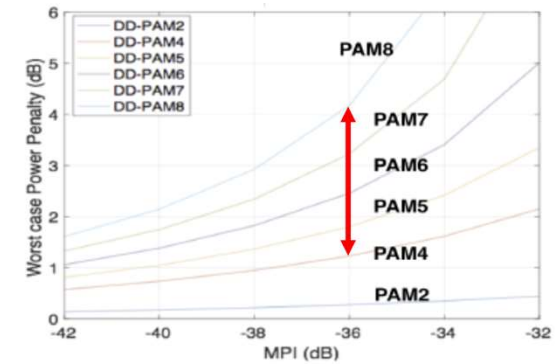
Source: JOCN/Microsoft Oct 2019, Mark Filer



FEC limit: 2e-3	Penalty @ -38 dB (double link)	Penalty @ -35dB (triple link)
112GB PAM4	0.4 dB	1 dB
90GB PAM6	1.2 dB	3 dB

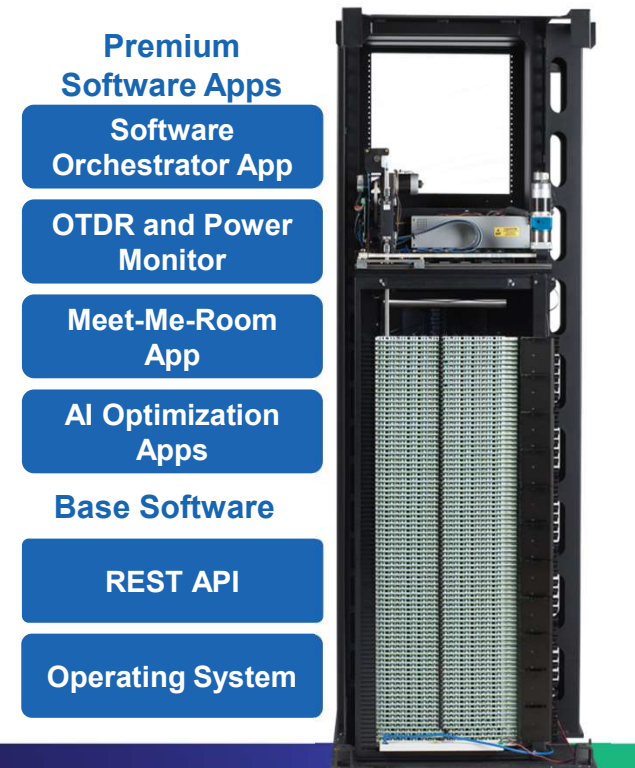
Link Budgets for New Optics

- 400G FR4 and DR4/4+ have a tight loss budget
- Higher order PAM X optics have even tighter loss, tighter back reflection specs
- All of this puts more and more pressure on DC fiber plant and OSP fiber plant
- To avoid failed links the fiber plant can be measured and characterized before use, for troubleshooting and during upgrade cycles



Telemetry with Automated Optical Switch

- Software controlled reconfigurable cross connect with large port count
- Platform for automated in-situ fiber characterization with remote OTDR
- Ability to add other monitoring equipment
- High Reliability
 - Latched Fiber-Fiber Connections
 - NEBS Level 3 Certified with contract manufacturing



Unique Scalable Algorithm

- Telescent knots, braids and strands algorithm
- Truly disruptive
 - Connect, disconnect, reconfigure with any-to-any capability from any initial state
- Protected by 51 patents
 - KBS algorithm, machine learning, compact robotics, tensioned fibers, cleaning unit

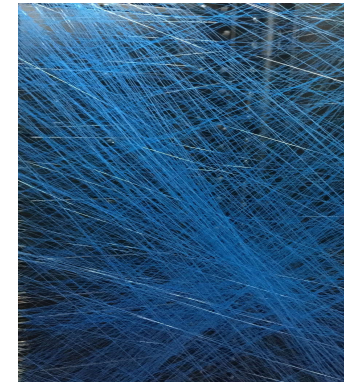
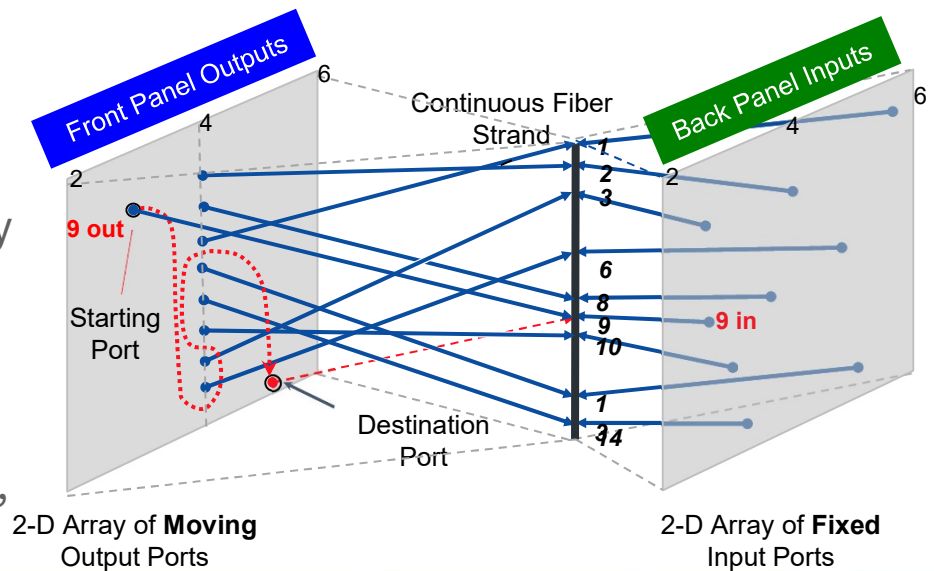
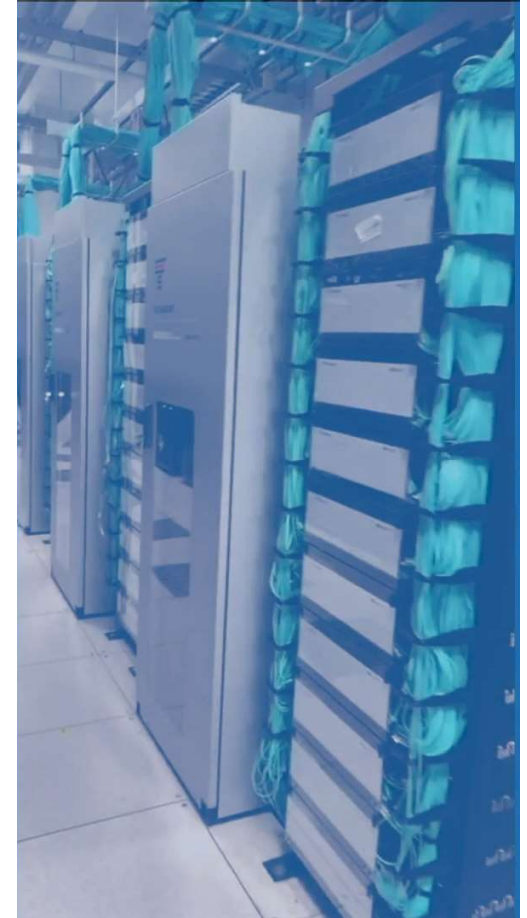


Photo of
fibers
inside
system



Robotic System in Action

- Each system is like a self-contained meet-me-room
 - >1,000 duplex ports per system
 - Upgradeable, 96 duplex ports per fiber tray
- Reconfiguration made in 1 to 4 minutes
- Low loss, latched, low power draw
- Operation shown with enclosure doors open

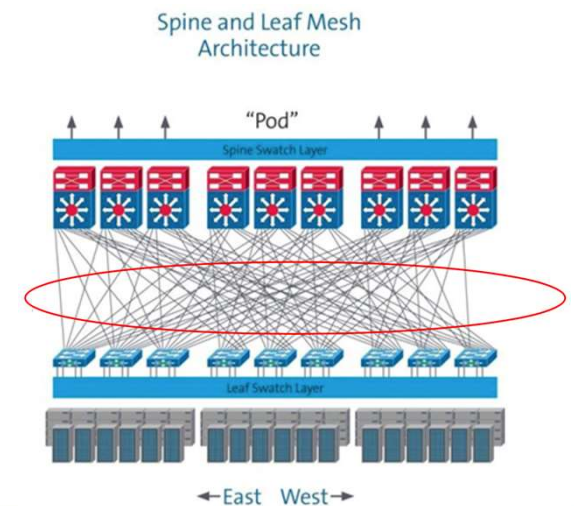
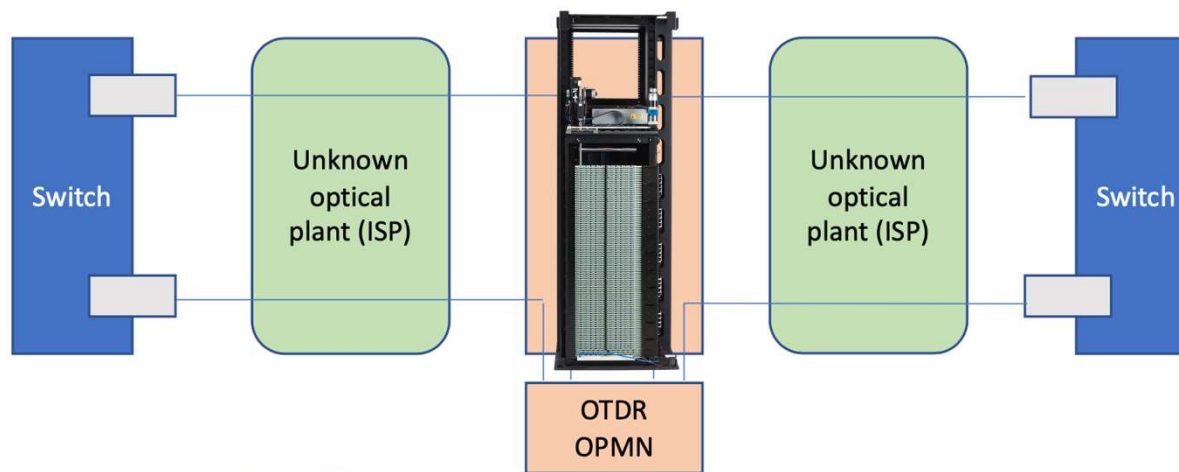


Automated Telemetry Use Cases

- Automated characterization during deployment
 - Provide baseline for future or identify cases for remediation
- Automated characterization during DC refresh
 - Characterize fiber plant to confirm performance for new equipment
- Reduce “turned off” fiber links
 - Match distribution of Tx/Rx with performance of fiber links
- Ongoing automated characterization
 - Confirm performance / monitor for degradation
- Optimization of bandwidth in ML clusters → 3x speed

Automated Solution Example

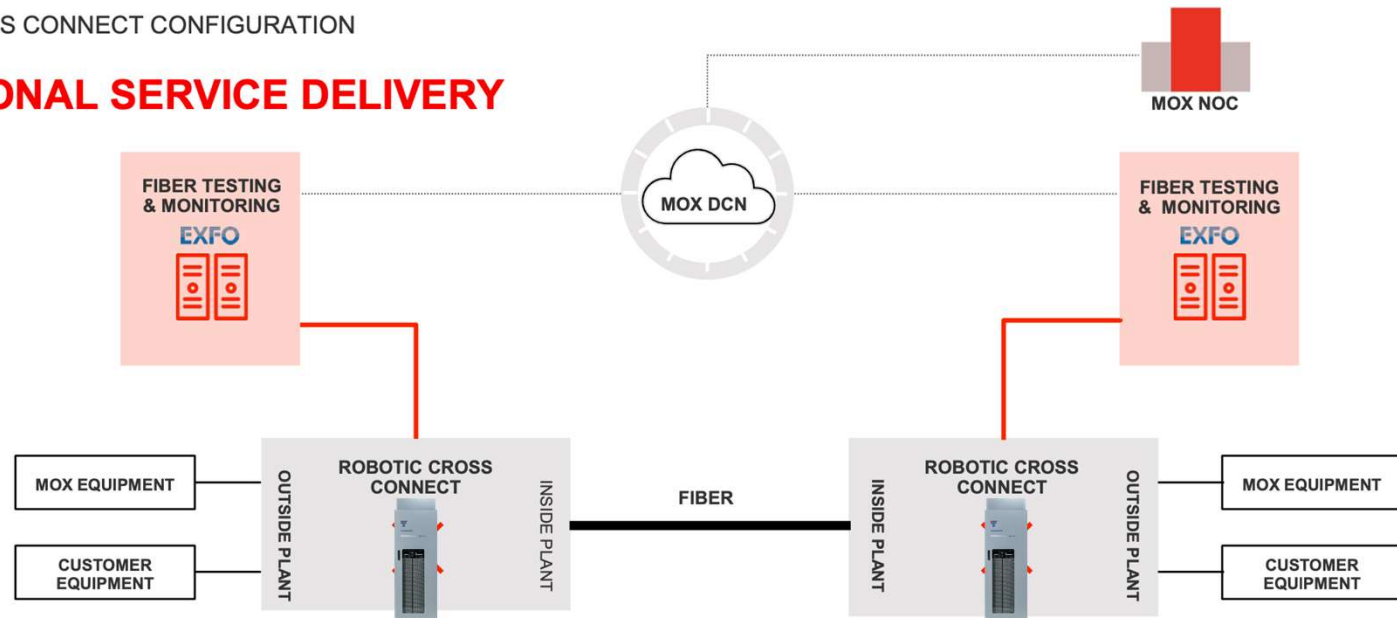
- Deploy robotic cross connects with instrumentation for power and OTDR measurements
- Pre-connect all cabling and automatically test fiber plant – collect test database and verify dark fiber performance
- Robotic provisioning of connections over fiber – test
- Remedy poor fiber or automatically re-provision links to good fiber



Case Study: Mox Networks

ROBOTIC CROSS CONNECT CONFIGURATION

EXCEPTIONAL SERVICE DELIVERY



PERFORMANCE METRICS:

- ✓ REMOTE TEST AND PROVISIONING OF FIBER = EXCEPTIONAL SERVICE DELIVERY
- ✓ REMOTE TESTING WITH CUSTOMERS = RAPID CUSTOMER SUPPORT
- ✓ SERVICE RESTORATION = QUALITY ASSURANCE
- ✓ CONTINUOUS FIBER TESTING AND MONITORING = OPTIMAL PERFORMANCE
- ✓ HISTORICAL RECORD OF ALL TESTS = OPTIMAL PERFORMANCE
- ✓ CABLE FAULT ISOLATION WITH GEOGRAPHIC LOCATION = QUALITY ASSURANCE



Summary

- Fiber plant remains in use over multiple compute refresh cycles
- New optics driving tighter loss budgets
- Robotic system with automated diagnostic equipment allows for remote telemetry of fiber plant
- Can be integrated with other network control software to provide visibility and control of the fiber layer

Thank You

shine@telescent.com

gibbemeyer@telescent.com

kewitsch@telescent.com





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