

MDI Requirements - MPO with Flat Interface (In support of comment #1-33)

Yi Tang, Cisco

Mark Nowell, Cisco

Ray Nering, Cisco

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Supporters

- Jeffery Maki, Juniper Networks
- Angela Lambert, Corning
- Vince Ferretti, Corning
- Jose Castro, Panduit
- Eric Maniloff, Ciena
- Rick Pimpinella, Panduit

Context

- The MDI to support PMDs defined by 802.3db are either the “MPO-12” (200GBASE-xR2 or 400GBASE-xR4), or the “LC” (100GBASE-xR1)
- IEEE 802.3 has only defined MPO-12 MMF MDI’s previously that have a flat polish (known as PC – Physical Contact)
 - 40GBASE-SR4, 100GBASE-SR4, 200GBASE-SR4, 100GBASE-SR2, 400GBASE-SR4.2
- This has resulted in a significant installed base across the industry of PC-based MMF infrastructure and current building wiring standards only define PC based MMF solutions
- This is different to SMF where APC (angled-polish) is ubiquitous for parallel fiber modules and installations

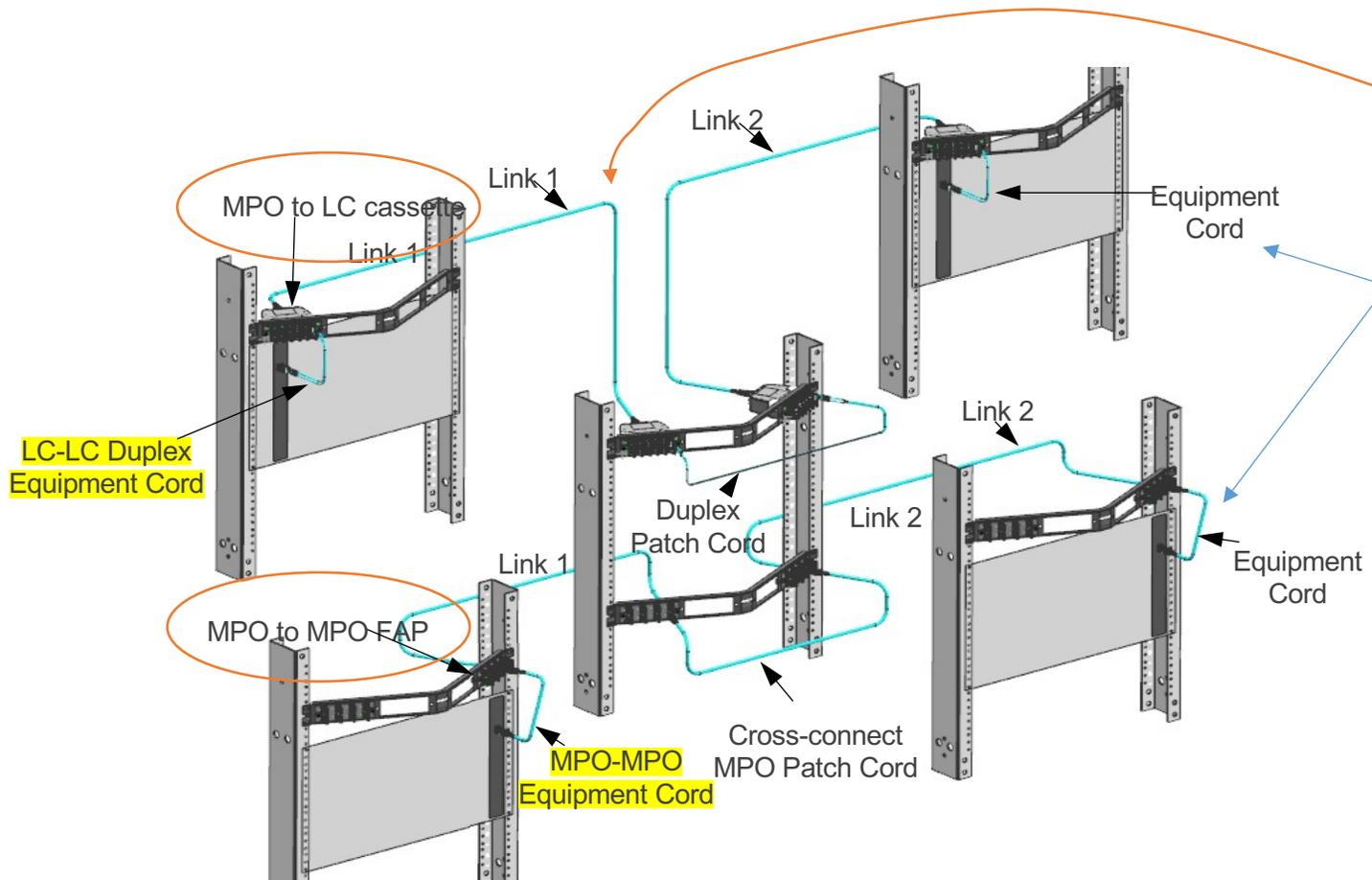
Adoption of APC into MMF products

- PAM4 modulated VCSELs, generally , have a greater sensitivity to reflections and due care needs to be made during design and manufacturing to minimize reflections into the laser.
- 802.3cm-2020 (400 Gb/s over MMF) defined 400GBASE-SR8 with PAM4 modulated VCSELs @ 50 Gb/s
 - Both an MPO-24 (2x 12) and MPO-16 MDI were defined with PC
- However, early deployment challenges around 400GBASE-SR8 due to reflection sensitivity resulted in a network operator defining an APC MDI for their own MPO-16 installations to mitigate risks.
- To date no industry spec is complete defining an APC based MMF connector (but one is in progress).

P802.3db D3.0 MDI specification

- Currently P802.3db MDI specification (Cl 167.10.3.x) defines:
 - PC polish for LC connectors (single lane duplex fiber)
 - APC polish for MPO-12 connectors (parallel fiber)
- However, the current installed based of MMF MPO-12 infrastructure is dominated by MPO-12 PC
- We believe there exist guaranteed deployment issues if an APC-based module is deployed into a PC-based infrastructure

Deployment: Structured Cabling – Plug & Play



Infrastructure is all MPO based. All PC polish

Equipment cords connect from the patch panels into the Equipment module at the MDI interface

LC equipment cords connect LC MDIs to MPO cabling through cassettes

MPO equipment cords connect MPO MDIs to MPO cabling

Structured Cabling does not define any APC

Courtesy: Panduit Labs, Panduit Corp

Existing MPO-12 Deployment

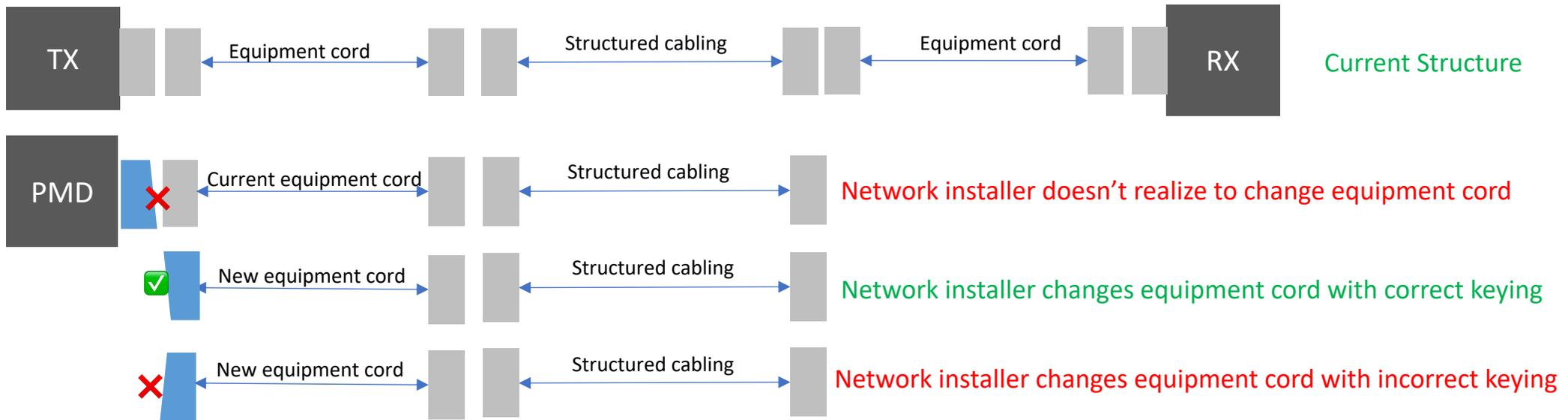
- Enterprise networks are dominated by MMF installation
- 802.3db specifications of 100 Gb/s, 200 Gb/s and 400 Gb/s are expected to be deployed in Enterprise networks
- Cisco estimates that they have sold MPO-12 based MMF module products to more than 7000 customers
- More than 20M¹ modules have already been deployed in networks with flat MPO-12 MMF connectors.
- If P802.3db specification remains with the MDI as APC for MPO-12 connectors this requires cable plant equipment cord replacement and creates compatibility issue with Structured Cabling.

¹ LightCounting Ethernet Transceiver Forecast, March 2022

Enterprise vs Cloud Data Center

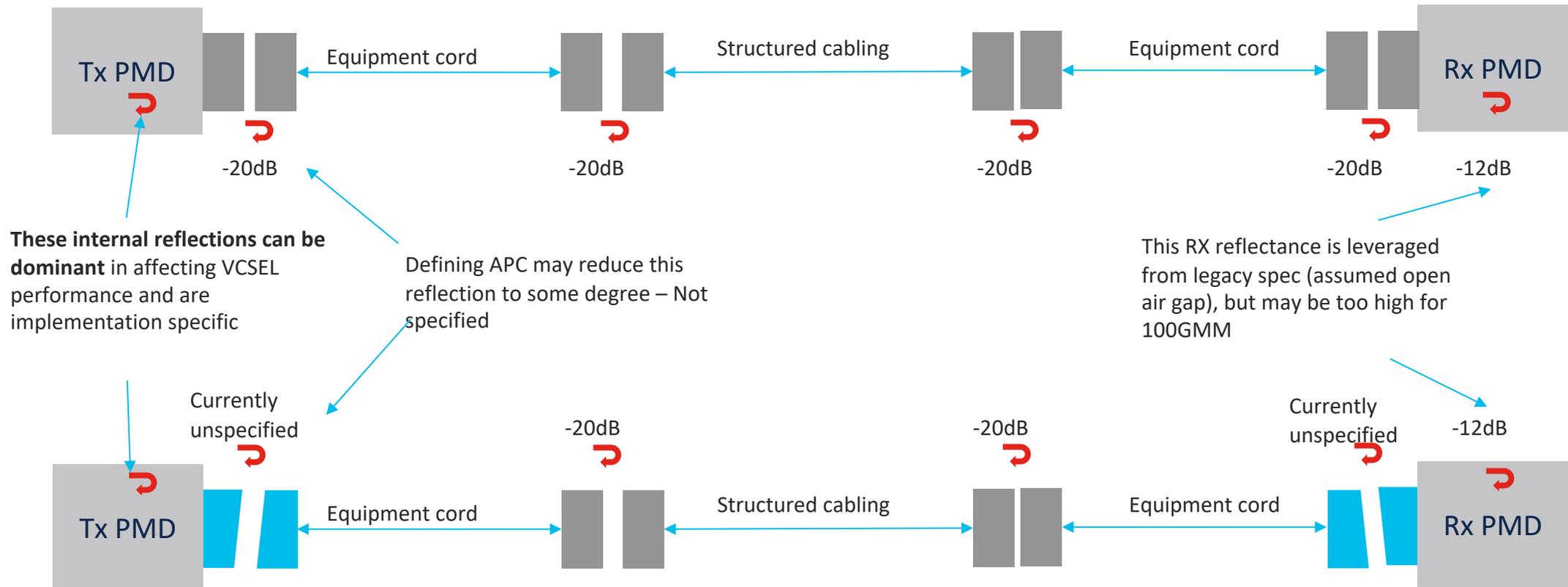
- The adoption of APC MDI's for MPO-16 400GBASE-SR8 has occurred only in limited Cloud Data Center deployments to our knowledge
 - But being DC, this can be significant volumes
- Cloud data center deployments are generally more homogeneous reducing installation variants
- History has shown that the lifetime adoption of a certain interface can be dominated by cloud DC in the early adoption phase but then becomes dominated by the broader industry adoption over time
- Enterprise deployments (1000's of network operators) are likely less homogenous
 - Significant value in maintaining installed base. e.g. success of MMF BiDi
 - Greater risk of deployment issues when mixing APC-based and PC-based modules within a network deployment

Deployment Risks



- Additional cost of replacing equipment cords
- Confusion around needing specific equipment cords for specific PMDs
- Incorrect mismatch of PC and APC results in out of spec fiber plant (air gap). Unclear if damage risk exists or not
- Risk of large product returns expected to fiber installer or module manufacturer

Optical Return Loss Consideration



Optical Return Loss Consideration

- No reduction in any technical specifications since single lane specifications are based on LC connector with PC
- The optical return loss from the maximum discrete reflectance is defined less than -20dB
- MPO-12 connectors with flat interface MUST and CAN meet -20dB reflectance requirement. There is no return loss grade lower than -20dB defined for multimode connectors as of today.
- The impact of Multipath Interference (MPI) penalty of MMF due to MDI connector is insignificant considering the VCSEL short coherent length. Changing MPO-12 MDI to angled interface does NOT improve worst case RX optical return loss performance which is dominated by the PD and internal module design.

Summary

- Little technical benefit to switch to APC from PC
- Large installed base of MPO-12 PC based infrastructure. But deployment of APC infrastructure exists in few (but large) deployments – however this is mostly MPO-16 with some MPO-12
- Change is disruptive to the current structured cabling.
- Using the same MDI as for 40GBASE-SR4, 100GBASE-SR4 and 200GBASE-SR4 enables easy upgrade and broad market potential for 400GBASE-VR4 and 400GBASE-SR4 which is a known and prevalent use case
- No completed standards exist for APC based MMF connectors for IEEE to reference.

Proposal

- Comment I-33 proposes change to 167.10.3.3 to adopt PC based MDI for MPO-12 connector consistent with previous specifications.
- Advantages:
 - Aligns P802.3db specifications with dominant installation practices.
 - Specifies an existing industry connector specification
 - Consistent with all previous 802.3 MMF specifications
- Disadvantage:
 - Fails to provide any reference to the APC adoption which is real within some large volume deployments at some data centers

Proposal (2)

- Change 167.10.3.3 to adopt PC based MDI for MPO-12 connector as the normative MDI AND include an informative specification to an APC MDI for MPO-12 with explanative notes included to explain the requirement to match the module MDI with the equipment cord connector.
- Advantage:
 - Same as before plus...
 - Provides the acknowledgement of APC adoption while providing more detailed information on the deployment risks to a user
 - Provides a spec for procurement teams to reference their choices
- Disadvantages:
 - Unclear on whether the incomplete APC specification can be referenced