

Fiber channel model - evolving considerations for modern data centers

400GPL Ad-hoc

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Supporters

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Fiber Loss Budget

- Hyperscalers are under pressure to deploy networks faster to enable AI capacity time to market
- A current point of friction is fiber connectors
 - Installation of many connectors
 - cleaning / inspection / sign-off of circuits prior to install of network equipment
- An emerging solution:
 - Non-contact dust tolerant connector systems
 - Enable aggregation of more connectors to speed installation (lower spring force)
 - Can be applied to both optical backplanes and trunk connections
- However, non-contact connectors have higher base IL than physical contact
 - Total IL budgets likely need to be adjusted to account for this

Meta Example Fiber Pathways



Meta inter-building fiber pathway

~4M fibers.

Pathway construction is becoming increasingly challenging to scale to support inter-building demand



Meta intra-building fiber trays

Already nearing 100% capacity, future designs may exceed tray capacity

Reference Fiber Link Model (IEEE)

802.3dj

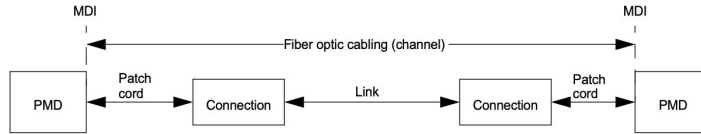
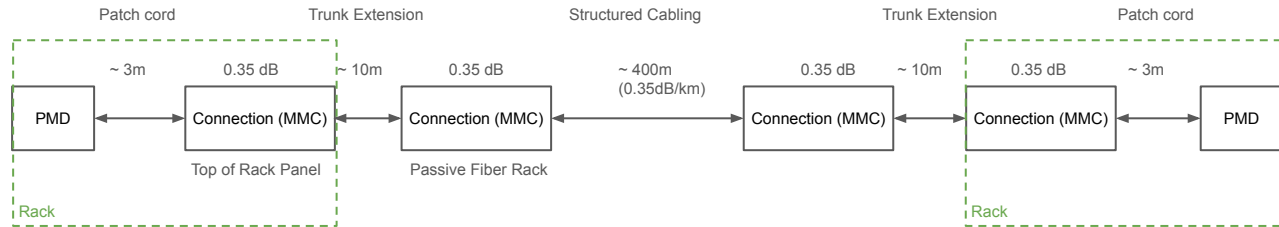


Figure 180-6—Fiber optic cabling model

Total IL: 1.25 dB (0.5 dB per connector + 0.5 dB/km @ 1310 nm)
Design Margin: 1.75 dB (to 3 dB IL tol)

Informative - you can add additional segments provided attenuation, dispersion, reflections and PMD meet overall channel spec.

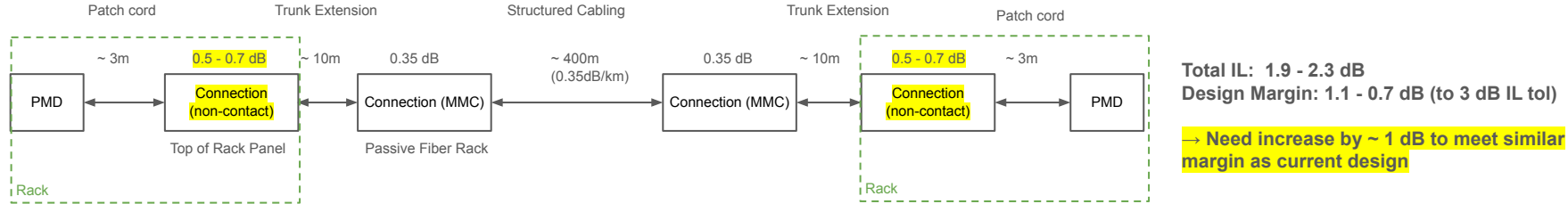
Current Meta example



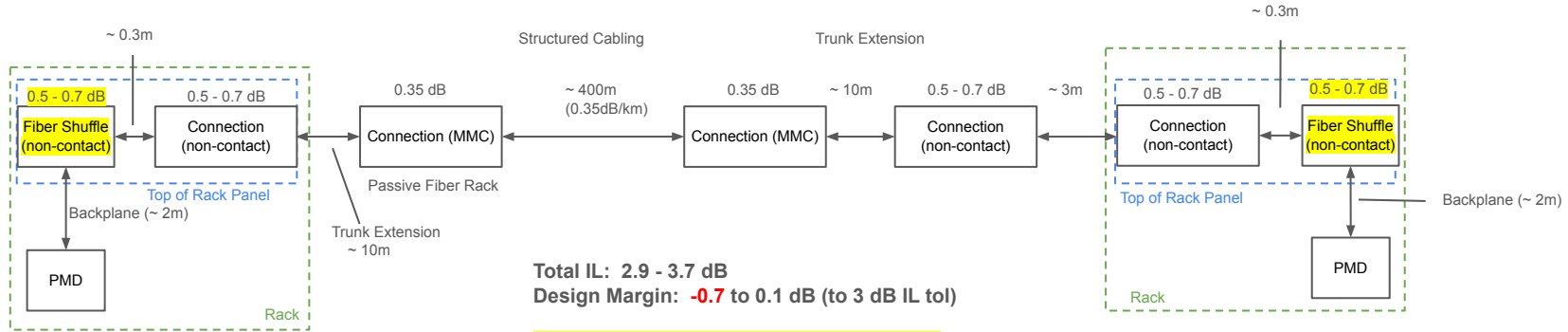
Total IL: 1.6 dB
Design Margin: 1.4 dB (to 3 dB IL tol)

Future Potential Options

Selective use of contamination resistant (e.g. non-contact) connectors



Optical Backplane (more detail on next slide)



Why Optical Backplane?

Introduction of an Optical Backplane into compute and network racks may solve several challenges for integrated photonics modules (NPO / CPO)

We assume use of a blind-mate non-contact dirt resistant optical connector system

Key Benefits



Time consuming fiber installation process is minimized



Failed system level replacement is a fast operation, rather than many hours

- (Supports both ELS and integrated laser solutions)



Enables rapid off-site integration with less optically specialized partners



Exploded View - Meta OBP rack concept
(% Nhan Hoang, Meta)

Missing Elements (Call to Action)



High density blind mate backplane connector systems



Inspection / cleaning solutions friendly to in-situ operation

Improved Fiber Characteristics - Observation

- Current IEEE DR4 (181-9) specs allocate 0.25 dB for 500m (0.5 dB/km) based on outside plant fiber
- For intra-datacenter use, we propose updating this loss spec to 0.35 dB/km (0.175 dB at 500m) to reflect modern intra-DC fiber performance
- Establishing a standardized compliance methodology for link specifications (comprehending innovations in fiber/connectors) would ensure end-user flexibility and interoperability

Conclusions

- For future data center builds, we expect an increase in fiber channel loss
 - More connectors per channel:
 - Construction requires pre-build of fiber infrastructure → termination of fiber runs to enable test and sign off
 - Contamination / dust resistant *aggregation friendly* connectors → higher insertion loss
 - New architectures (optical backplanes)
- Proposal:
 - Extend existing compliance framework to supports higher IL tolerances (propose up to 4 dB) independent of link distance to better align with end-user use-cases
 - Enable comprehension of new fiber and connector types within this framework