Potential Benefits of Multicore Fibre for Datacenter Applications

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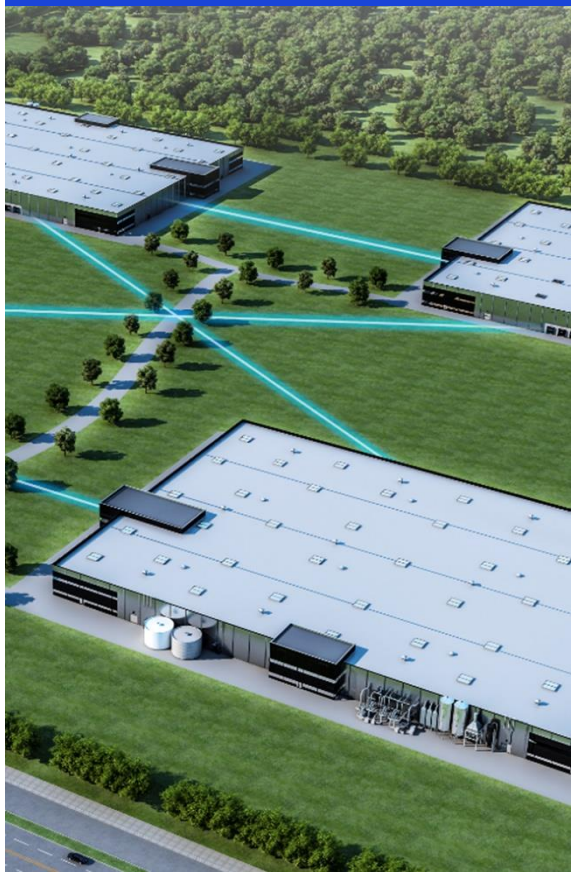
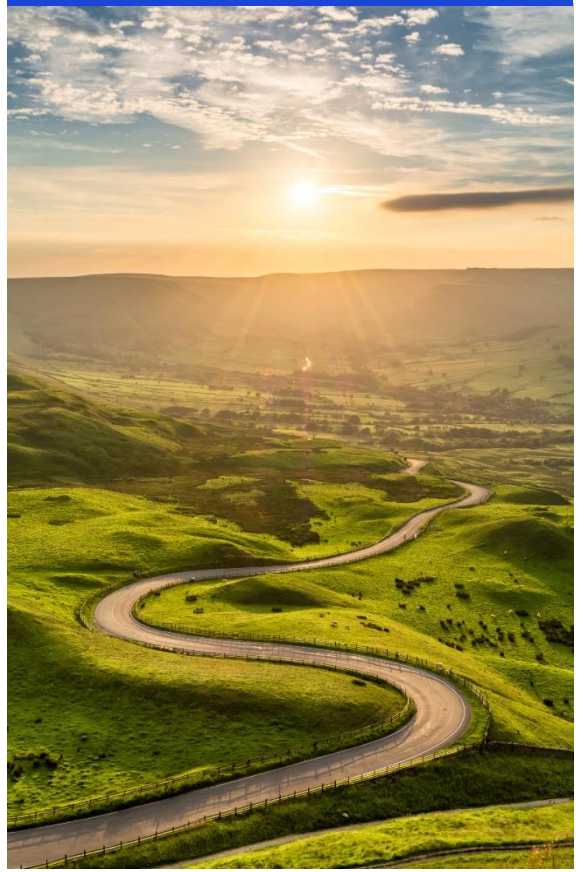
From the data center to the ocean, dense fiber optic cable innovations are needed to serve increased bandwidth requirements

Inside the Data Center

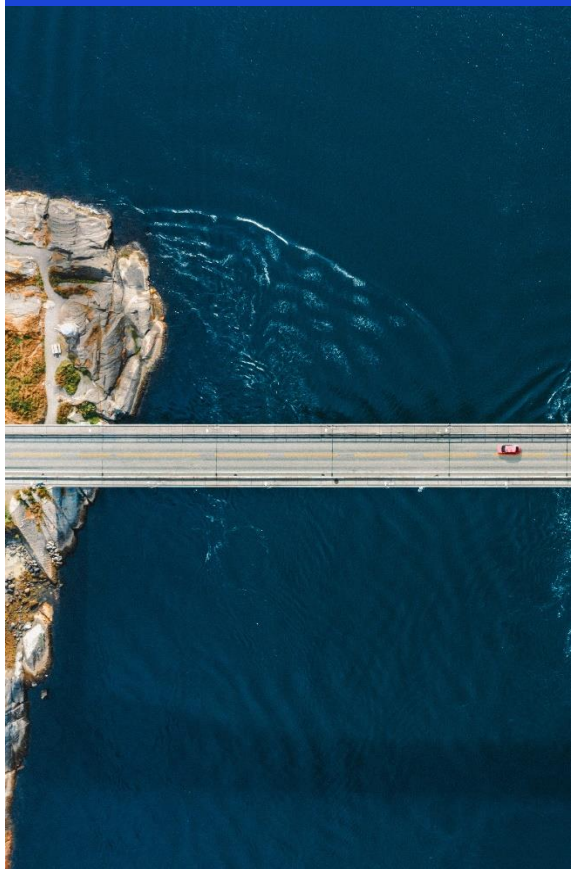
Data Center Interconnects



Terrestrial Core Networks



Subsea Networks



Evolution of fiber density in data centers

Cloud: Single-digit Enterprise growth pre-Gen AI

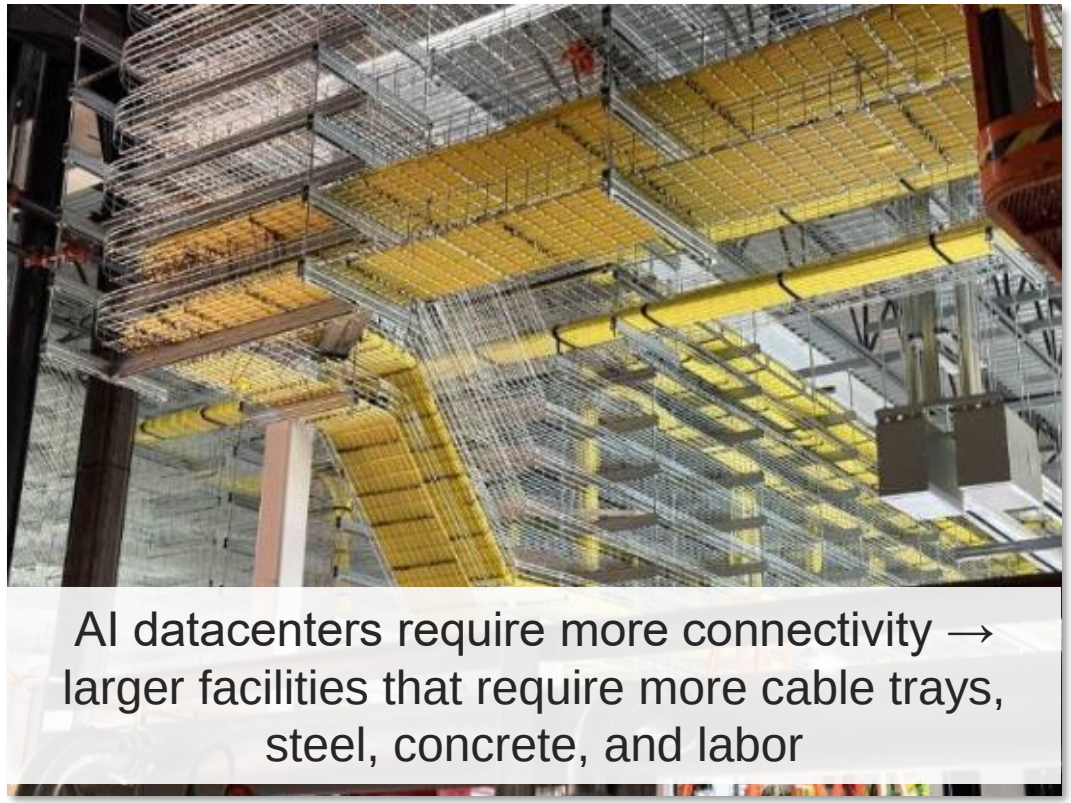
32 GPU Node: 4x more fiber than Cloud

72 GPU Node: 4x more fiber than 32 GPU node (16x more than cloud)

Continued scale-up & scale-out of AI networks creates density, installation, & sustainability problems that MCF solutions can address

Increasing cable volume and complex connections are driving increased costs, longer installation times, and delaying AI compute

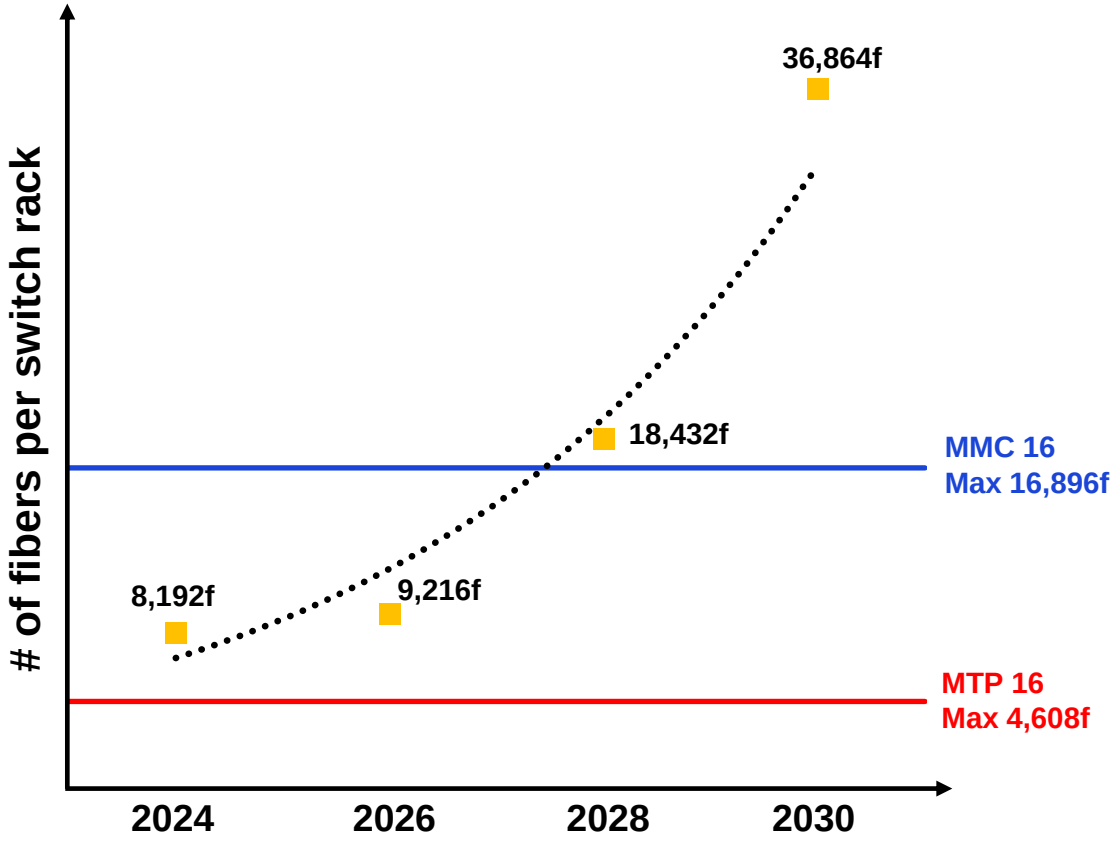
Step change in infrastructure requirements



AI datacenters require more connectivity → larger facilities that require more cable trays, steel, concrete, and labor

Source: xAI (DC Overhead Cabling)

High-density solutions will be required

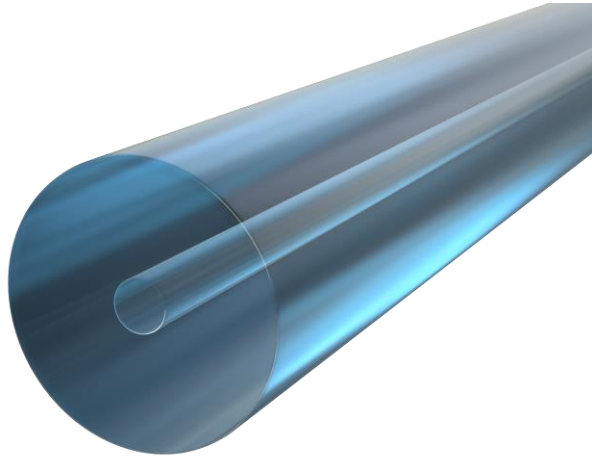


AI data centers require over 10 times more fiber, compared to traditional data centers.

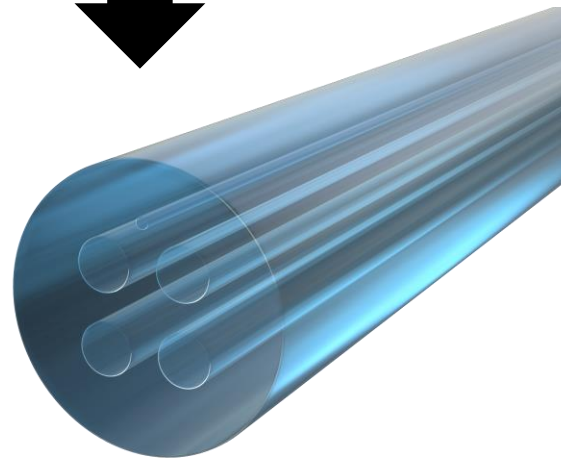
10x more fiber

Outside the data center, long-haul networks need to connect regional data center hubs to each other – and ultimately to you!

Inside the data center, AI requires innovative high-density solutions that fit more fiber into the same space.



Single-core optical fiber



4-core Multicore optical fiber (MCF)

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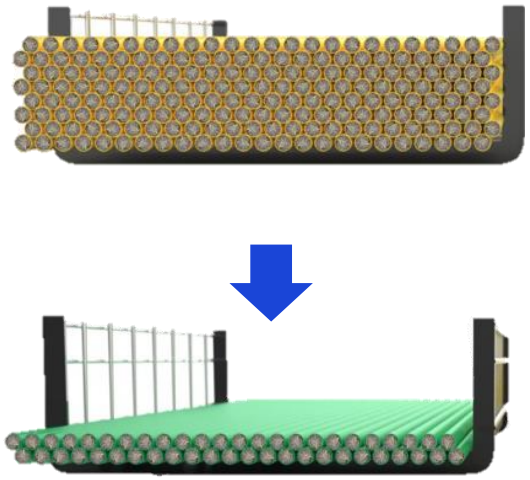
Inside the data center MCF enables scalable, high-density solutions with significant material reduction & deployment efficiency

Density	Deployment Efficiency	Sustainability

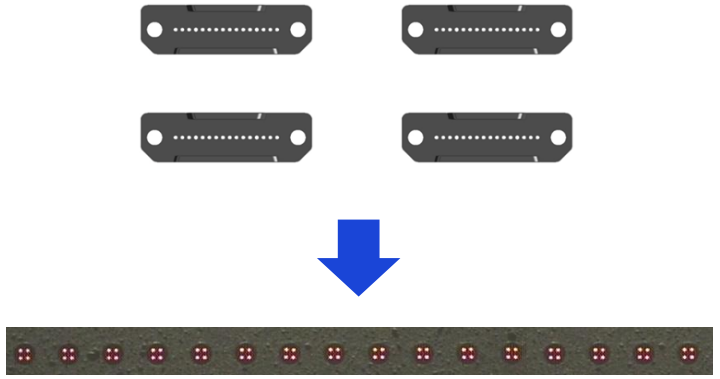
Up to 75% lighter & smaller

Ease civil engineering requirements



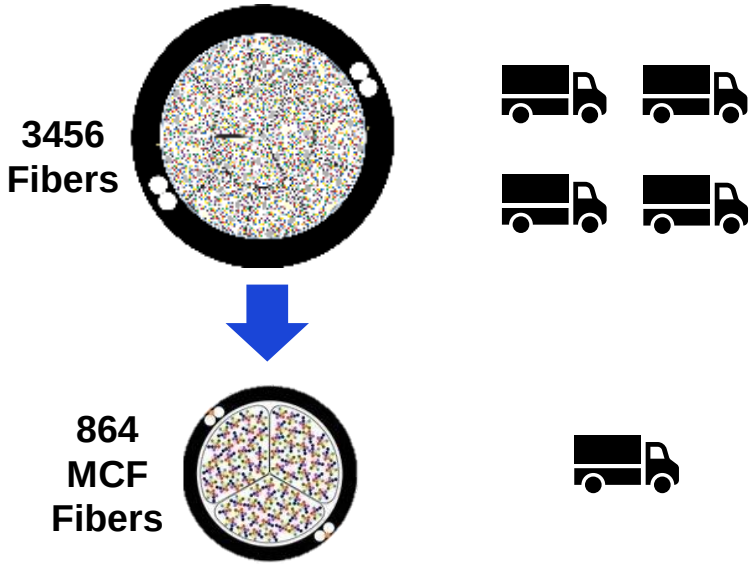
75% fewer connections

Reduce end-to-end link installation time by over 50%



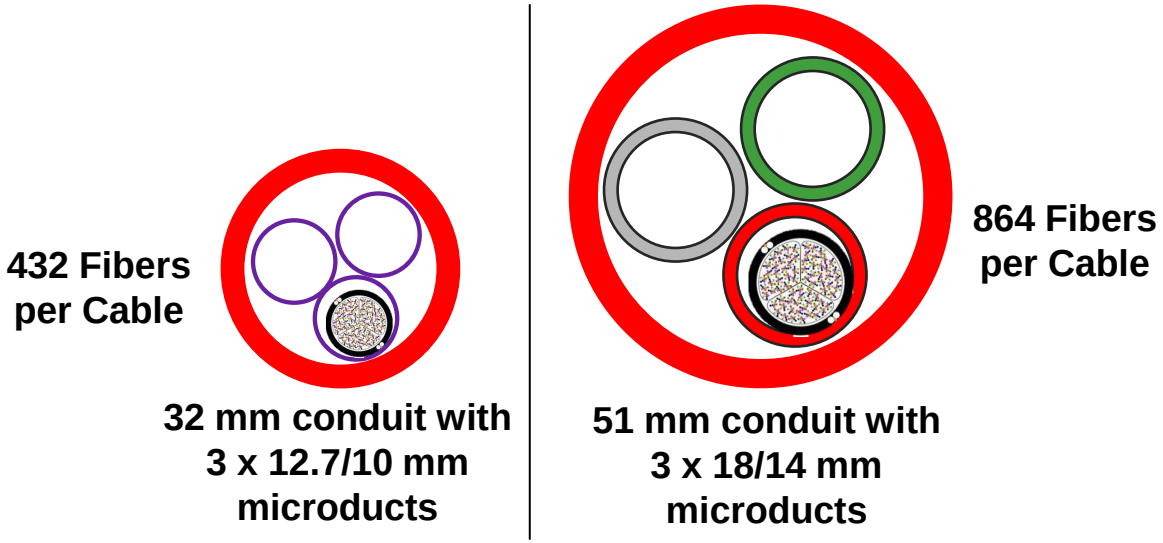
Less material

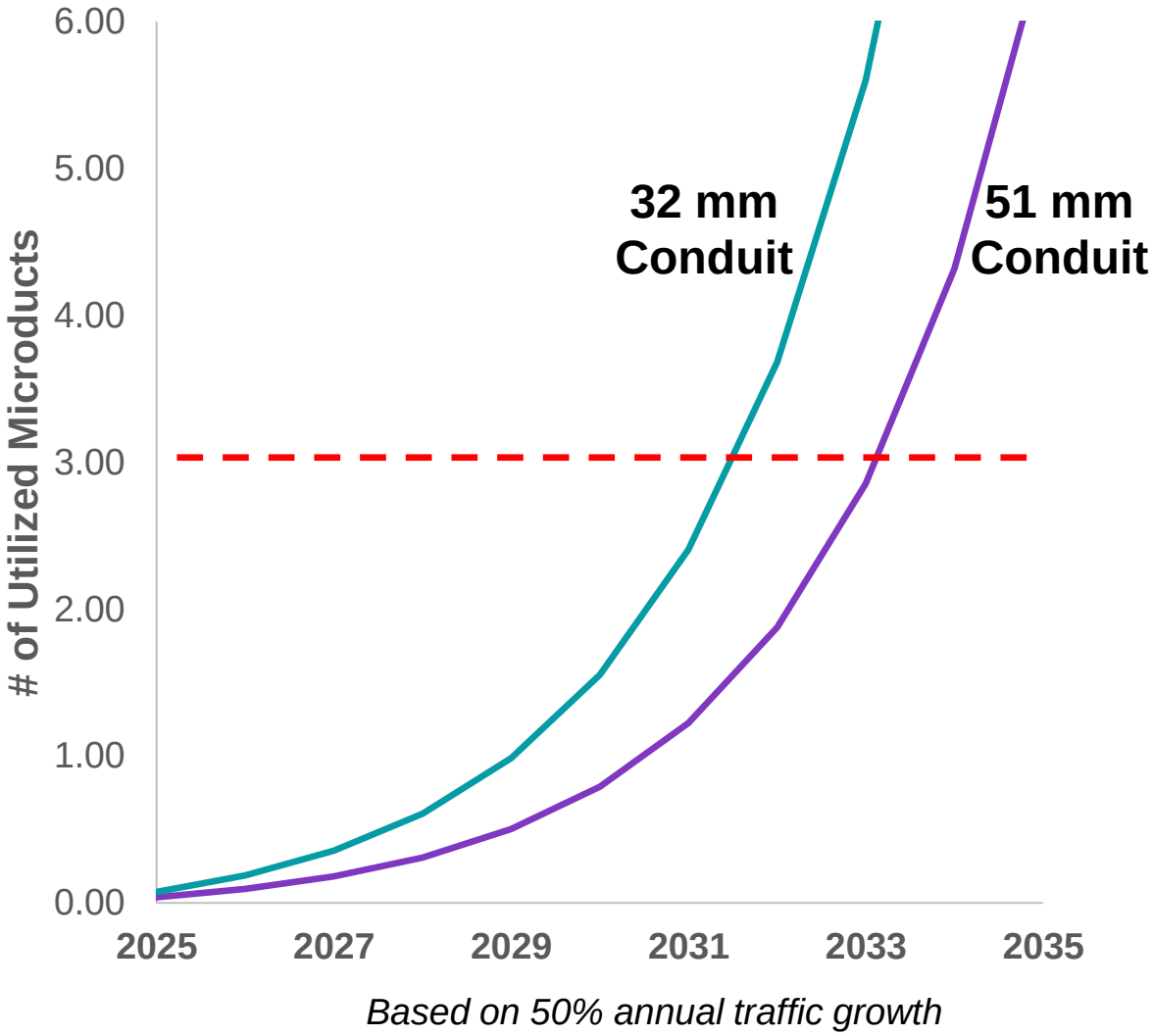
Enhance supply chain resilience and environmental sustainability



Outside the datacenter traffic growth will exhaust brownfield OSP duct infrastructure

- Legacy conduits will be exhausted before 2031-2033 with standard single-core fibers
- MCF enables 4x capacity in the same duct, extending the useful life of existing conduit infrastructure and delay greenfield investments





Large Scale AI Data Center Challenges

- Modern large AI Data Center Requirements:
  - Large scale with multi-building campus: Fiber connectivity reach > 2km
  - Massive fiber infra-structure:
    - Inside buildings ~ 20M x optical line channel (100Gbps or 200Gbps per channel)
    - Inter-buildings ~ 1M fibers x optical line channel
- Fiber Dispersion: CWDM starts to hit limit << 2km at 400G-PAM4

	4-Core MCF@ 1310nm	PSMF@1310nm	CWDM@ 1271-1330nm
# of optical signal channel per fiber	4	1	4
# of fiber for Ref. TRx 800G-xR4	2	8	2
CD limited transmission @ 100G-PAM4	~10Km	~10km	~6-10km
CD Limited transmission @ 200G-PAM4	~10Km	~10km	~2.5km
CD Limited transmission @ 400G-PAM4	~2-3km	~2-3km	~ 600m

Status of >100 Gbps per Wavelength in IEEE Standards

- IEEE 802.3 has not made any decisions on 400G per lane and are not expected to start the project until sometime in 2026.
  - 100 Gbps per wavelength are being deployed today
  - 200 Gbps per wavelength are expected in the next 2 years (802.3dj expected to be published in 2026

- If MCF is chosen, system vendors may have to take into account penalties associated with crosstalk in their link designs
  - Standardization approaches for measuring crosstalk underway
  - Several proposed methods are being discussed with the goal of consenting on a method
  - Crosstalk for installed links also must be analyzed and measurement methods may be different from fiber to a deployed cable fiber

- Only informative guidance available for Polarization Mode Dispersion (PMD) for short lengths as current specification focuses on long link applications (> 40 kms).
  - MCF cabled fiber PMD needs to be evaluated wrt current protocol to ensure performance

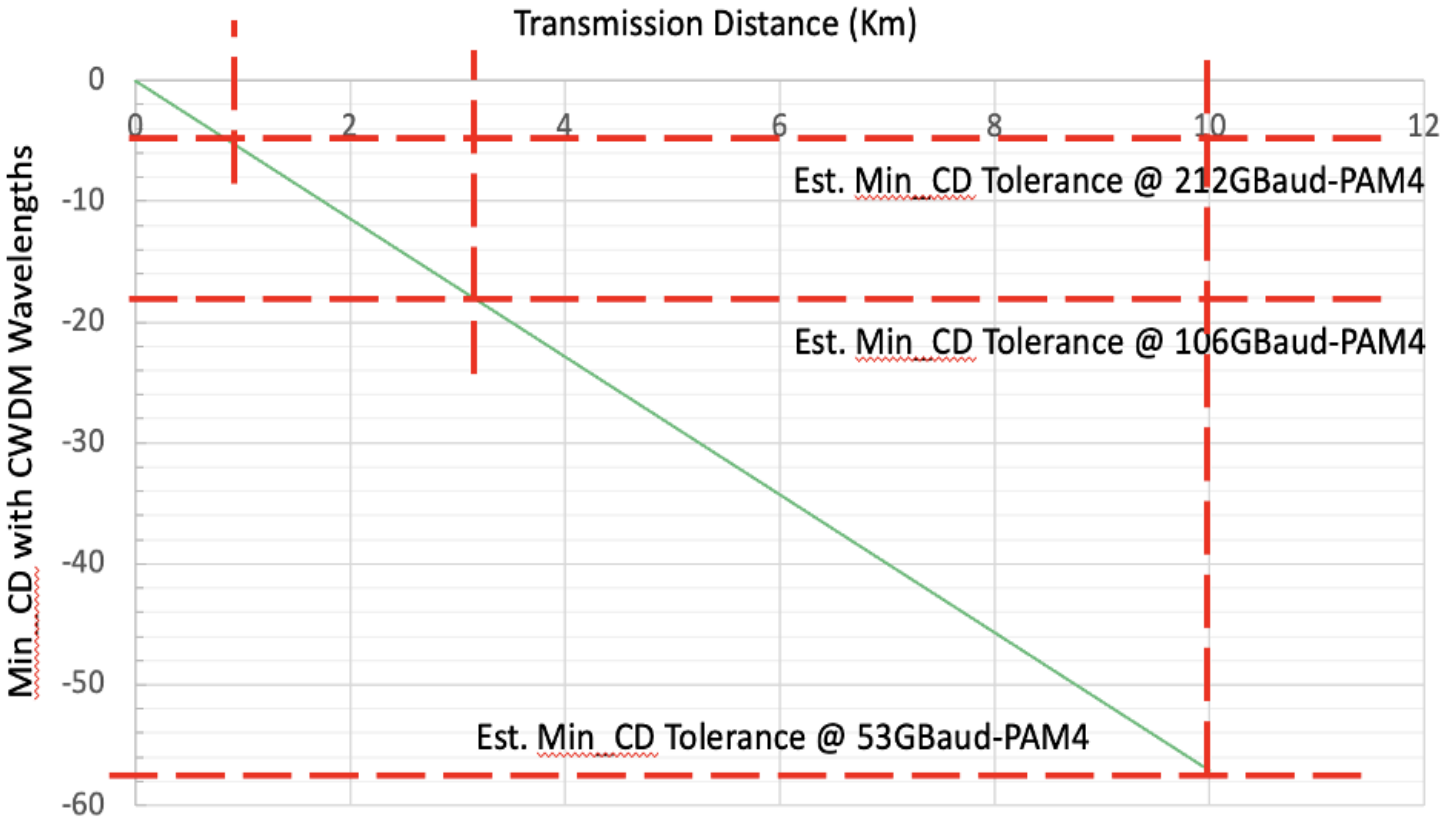
Summary

- AI Datacenters will require more than 10X the amount of fibre compared to traditional datacenters
- MCF enables scalable, high-density solutions with significant material reduction & deployment efficiency
- Use of MCF can enable use of low cost/low power transceivers at 400 Gbps per wavelength at the same fiber density of CWDM systems utilized at lower speeds
- Standardization for MCF is underway and proposals have been made to broaden the scope of this work to address datacenter applications

Backup Slides

CWDM Limit for 200G-PAM4 and 400G-PAM4

- Fiber CD limiting reach for CWDM optics
  - ~10km for 100G-PAM4
  - ~3km for 200G-PAM4
  - <1km for 400G-PAM4



1310nm with MCF for 400G-PAM4

- 1310nm+/-6nm PSM with MCF can support much longer reach
  - ~10km @ 200G-PAM4
  - ~3km for 400G-PAM4