802.3ds 200Gbps/lane 1060nm Proposal

from 802.3df to beyond 802.3ds

Y. Sun, R. Shubochkin, D. Knight, D. Braganza, J. George,
K. Balemarthy, F. Marques

Lightera

March 11th, 2026

Supporter

Jose Castro (Panduit)
Matthew Peters (Lumentum)
Jeffery Maki (HPE)
Chris Cole (Coherent)
David Lewis (Speciphy / Lumentum)
Mike Dudek (Marvell)

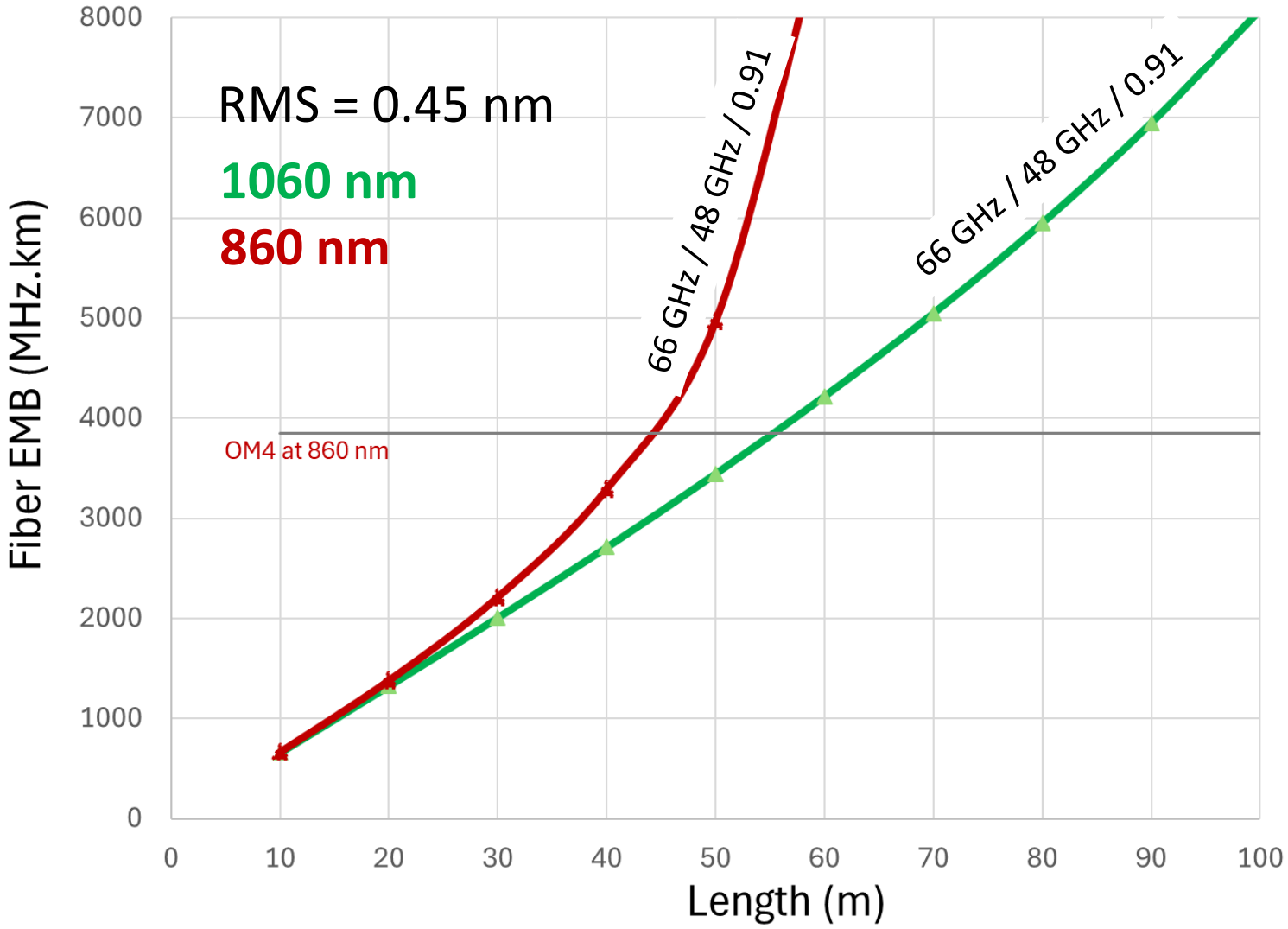
IEEEP802.3 ds Baseline Proposal on 1060 nm Transmitter and Fiber Types

PMD Type	200 GBASE-xxR1 400 GBASE-xxR2 800 GBASE-xxR4 1.6 TBASE-xxR8			Unit
Signaling rate, each lane	106.25 ± 50 ppm			GBd
Modulation format	PAM4			
Center wavelength	1060 (TBD)			nm
RMS spectral width	0.45 (TBD)			nm
Encircled flex	≥ 86% at 19 µm TBD ≤30% at 4.5 µm TBD			
Fiber Type	OML3	OML4	OML5 ?	
Nomical core diameter	TBD			µm
Operating distance	0.5 to 30	0.5 to 50	0.5 to TBD	m
Effective modal bandwidth	≥ 2010 TBD	≥ 3420 TBD	TBD	MHz.km
Zero dispersion wavelgnth (λ0)	1297 ≤ λ0 ≤1328 TBD			nm
Chromatic dispersion slope (max) (S0)	$-142/(840(1-(\lambda_0/840)^4))$ TBD			ps/nm^2km
All other TxRx and fiber parameters	same as .3df or TBD			

1060nm fiber EMB is based on

- Fiber 3dBo BW as 66GHz
- Fiber 3dBe BW as 48GHz
- Fiber 3dBe BW / Nyquist Freq = 0.91

Fiber EMB vs Reach @ 212Gbps/lane



At the same reach
- 1060 nm needs less EMB

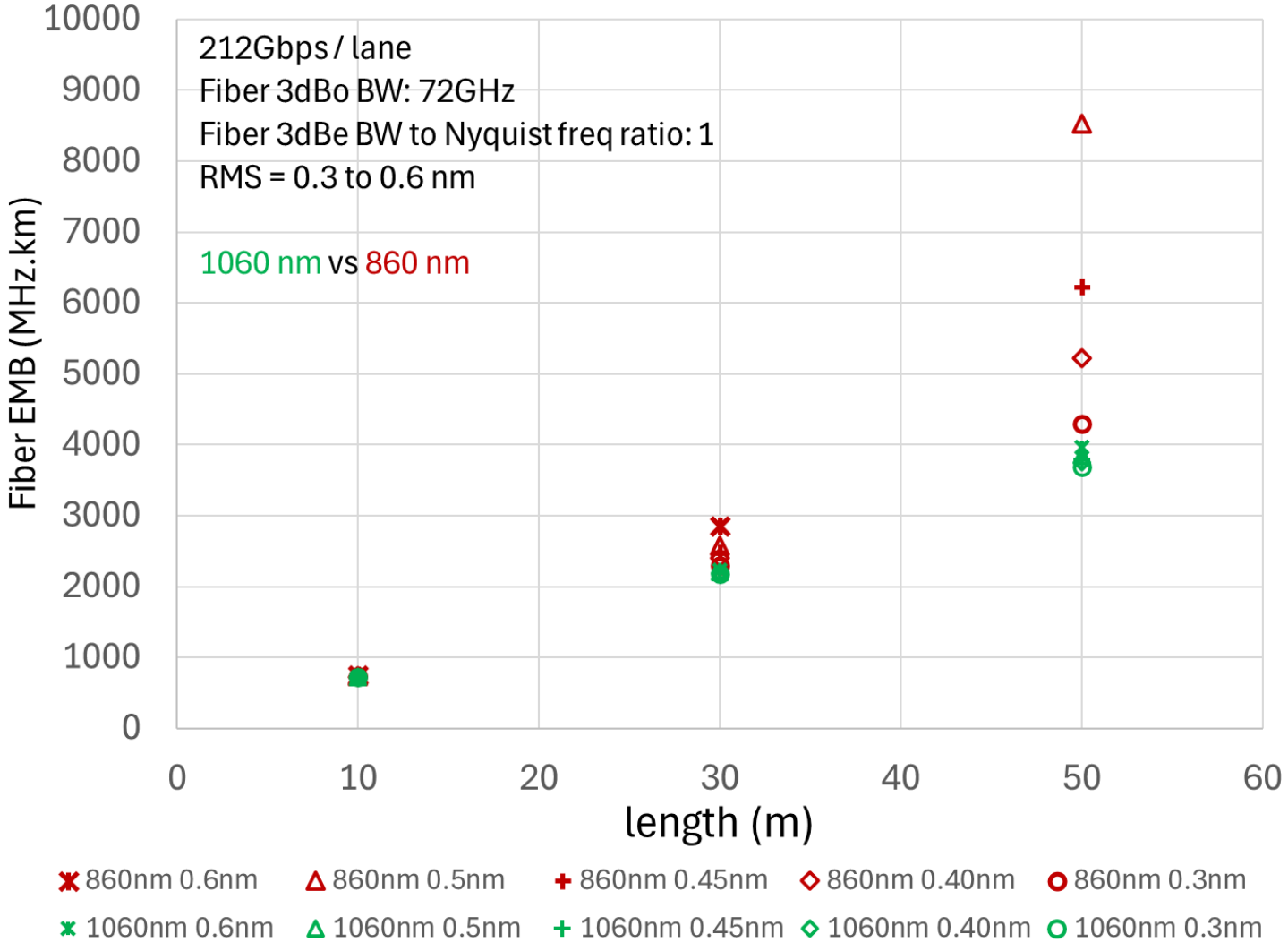
At the same EMB
- 1060 nm can reach longer

Benefits of 1060 nm is more obvious at
- longer reach

Nyquist freq. = 53.125 GHz

Notation on chart:
3dBo BW / 3dBe BW / Fiber 3dBe BW to Nyquist freq. ratio

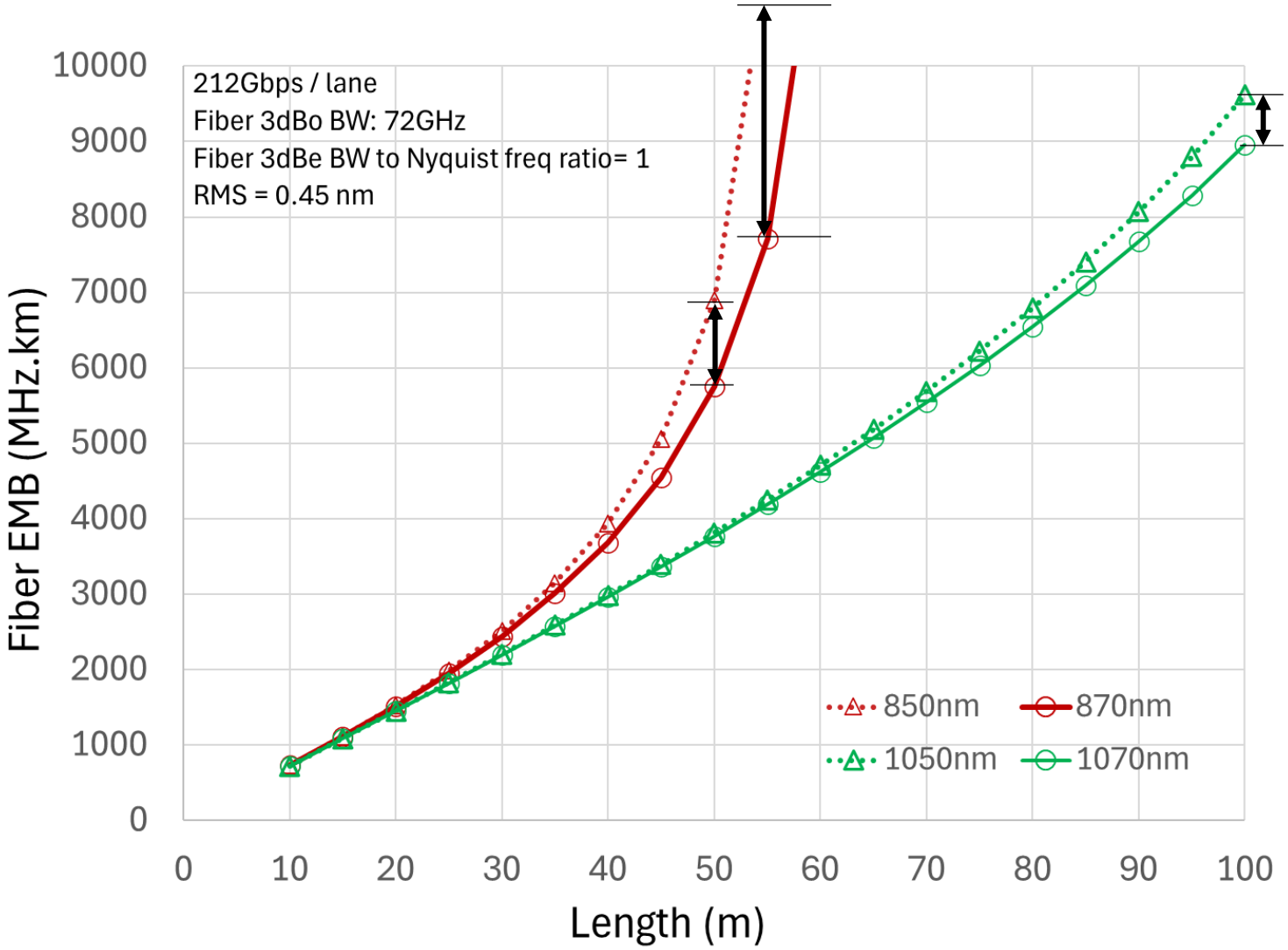
Fiber EMB vs Reach @ 212Gbps/lane – RMS Sensitivity



At the same reach

- Fiber EMB is less sensitive to RMS variation at 1060 nm
- Advantage of 1060 nm is more obvious at longer reach

Fiber EMB vs Reach @ 212Gbps/lane – Spectral Sensitivity

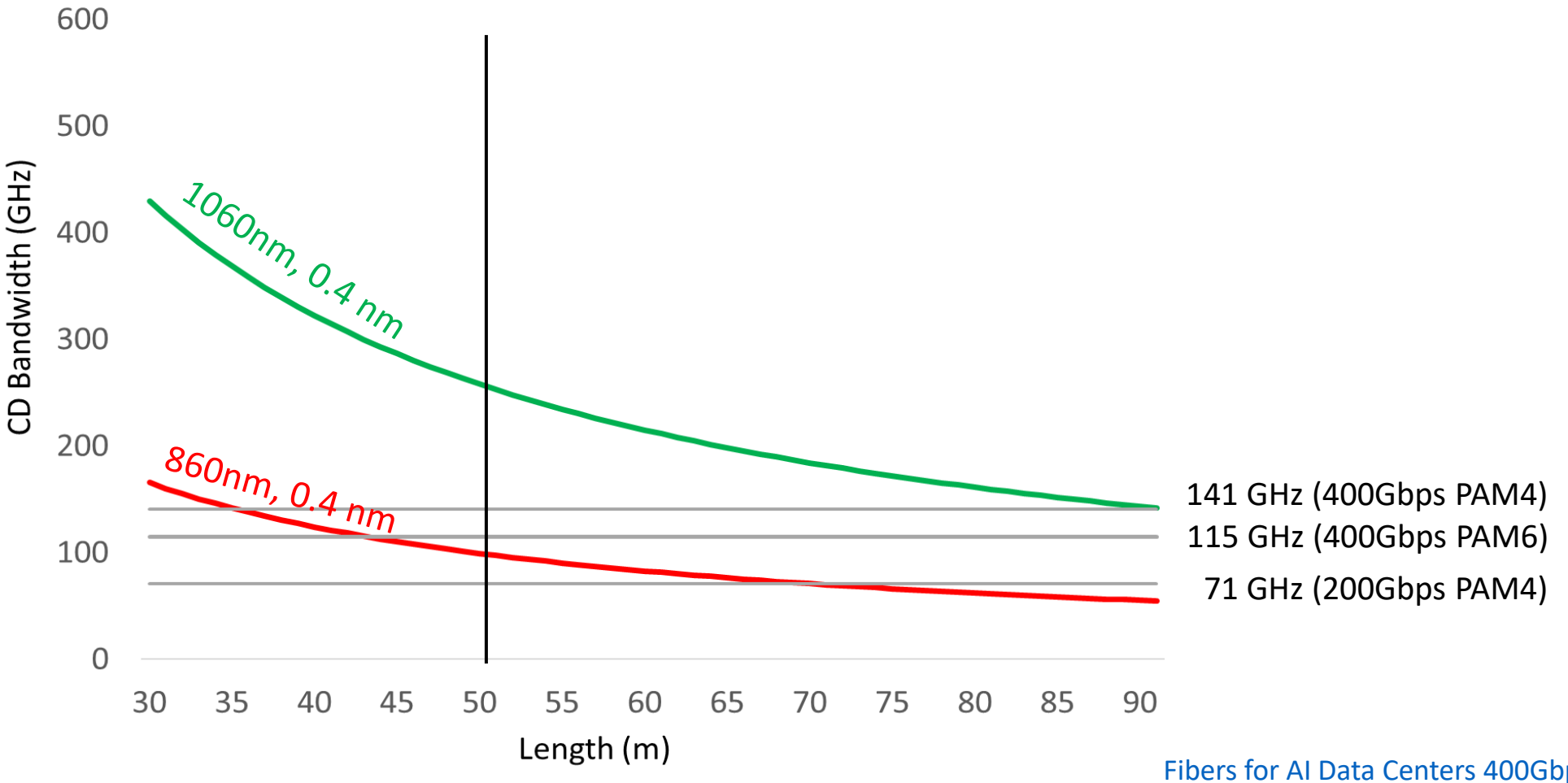


At the same reach

- Fiber EMB is less sensitive to spectral drift at 1060 nm band
- Advantage of 1060 nm band is more obvious at longer reach

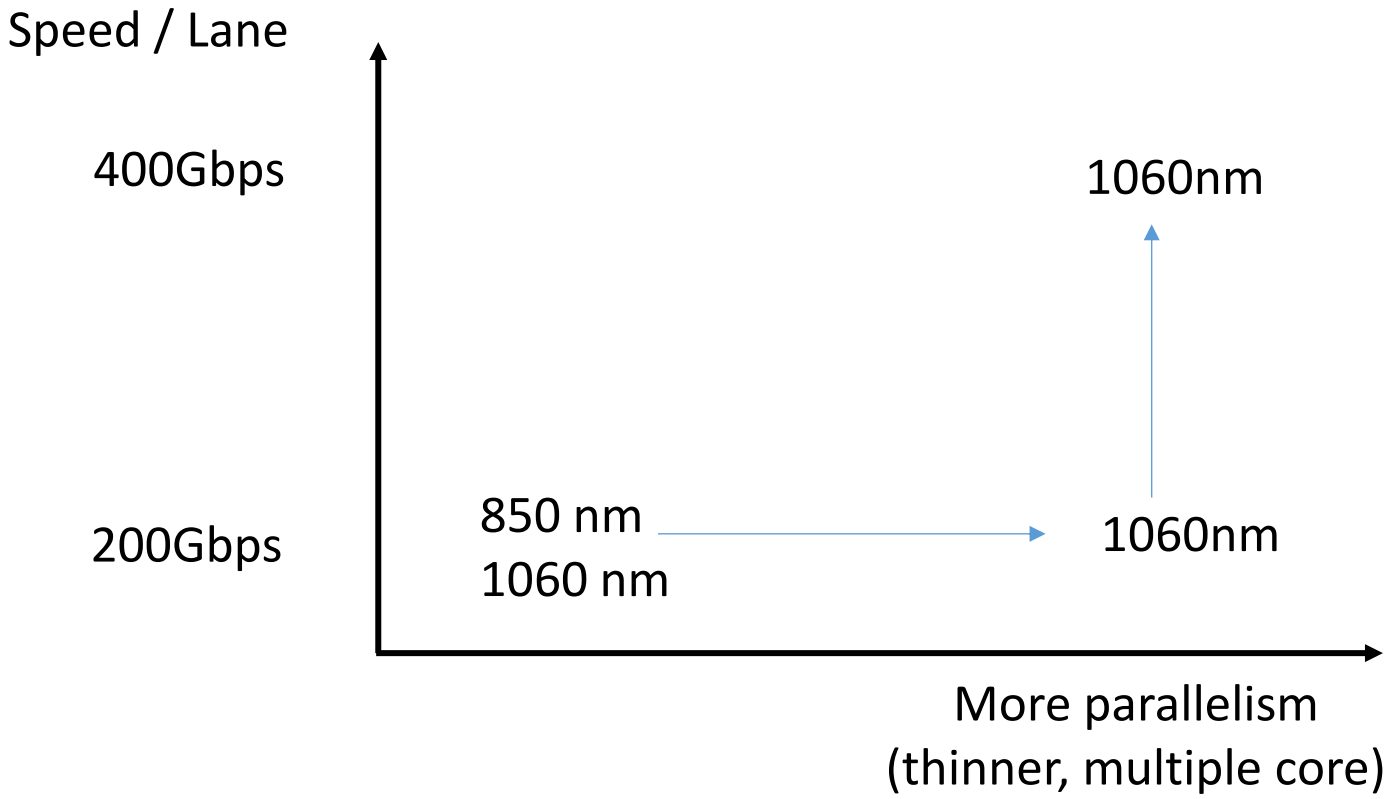
Moving to 400Gb/s/lane, longer reach enabled by 1060 nm

Reach extended by lower chromatic dispersion bandwidth



Fibers for AI Data Centers 400Gbps per Lane Applications,
Fiber for AI Workshop, Feb 24°, 2026

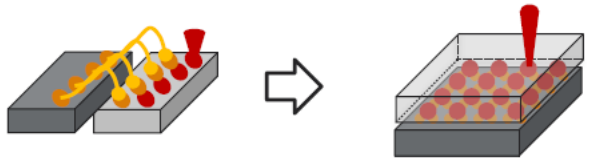
Plausible Roadmap beyond IEEE 802.3ds 200Gbps/lane



- This contribution is focused on 200Gbps/lane signaling for IEEEP802.3ds MMF PMDs/PHYs, also indicating the potential future application for 1060 nm MMF, 1060 nm VCSEL-MMF links.

1060 VCSEL Benefits

1060nm VCSEL technical benefits



Metric	850nm	1060nm	Context
Fiber BW *	+	-	Working with fiber manufacturers on best path to 30m and 50m reach at 1060nm
Wall plug efficiency	+	+	Roughly equivalent efficiency, slightly lower voltage at 1060nm.
Emitter BW	-	+	Strained InGaAs active layer design enables 1.3x intrinsic BW, higher differential gain and efficiency
Signal Integrity	-	+	Flip chip integration removes group delay impedance issues known with wire-bonding..
Reliability	-	+	Flip chip and channel sparing takes FIT below 1. Al free active region enable high temp/high power reliability.
Detector technology	-	+	Flip chip detectors - higher speed / better responsivity than wire-bonded equivalent
Density	-	+	2D VCSEL arrays for high density interconnect including channel sparing
Thermal management	-	+	>20C lower laser junction, >20C lower ASIC temperature from flip chip driver/TIA assemblies
Manufacturability	-	+	Flip chip for mass reflow or TCB, also enables high accuracy placement for assembly
Volume	-	+	Builds on largest VCSEL deployments in history, reuses MFG partners, test, assembly supply chain

LUMENTUM

IEEE 802.3 200 Gb/s per Wavelength MMF PHYs Study Group Meeting

Source: muhigana_200gmmf_01b_2509.pdf , "*Proposal for 200Gbps 30m and 50m MM Reach objectives using 1060nm*", IEEE 802.3 200 Gb/s per Wavelength MMF PHYs Study Group Interim Meeting, September 17, 2025

* Fiber BW refers to the modal bandwidth at 1060 nm for a OM3/OM4/OM5 MMF, not for MMF optimized at 1060 nm.

1060 nm MMF Benefits (Fiber Expert Perspective)

Metric	860 nm high BW	1060 nm w. smaller core	Context
Standardization	+	-	Possibly more work within SDOs on 1060 nm due to core diameter and WL changes
Fiber development	+	-	Retuning BW to 1060 nm is trivial, geometry/core size change will require more work
Fiber testing	+	-	1060 nm sources are needed for testing
Fiber attenuation	-	+	Lower at 1060 nm (2.2 dB/km *vs* 0.9 dB/km)
Chromatic dispersion	-	+	2.6x lower at 1060 nm (98 ps/nm*km *vs* 38 ps/nm*km)
Modal BW required	-	+	Lower for 1060 fiber: we can possibly use “OM3 grade” for both 30m and 50m links
Lower grade fiber fallout	-	+	Can use OM3/4 grades of 1060 MMF, only OM4/4+ can be used for the 860 option
Coupling to PD	-	+	1060 is easier to couple to both top illuminated and lensed-substrate illuminated photodiodes which are already at < 20um diameter
Germanium use	-	+	Significantly lower Ge use for smaller core 1060 MMF (up to 75% less Ge)
Future upgrade path	-	+	1060 opens the path to >50 m reach, possibly future 400G applications
Density and SDM	-	+	Opens path to high-density small-clad MMF and MM MCF solutions
Fiber volume	-	+	Much higher volume/yield at 1060 nm due to lower EMB requirements and smaller core size
Fiber cost	-	+	Higher yields and lower Ge consumptions for 1060 nm potentially result in lower fiber cost relative to the cost of 860 nm

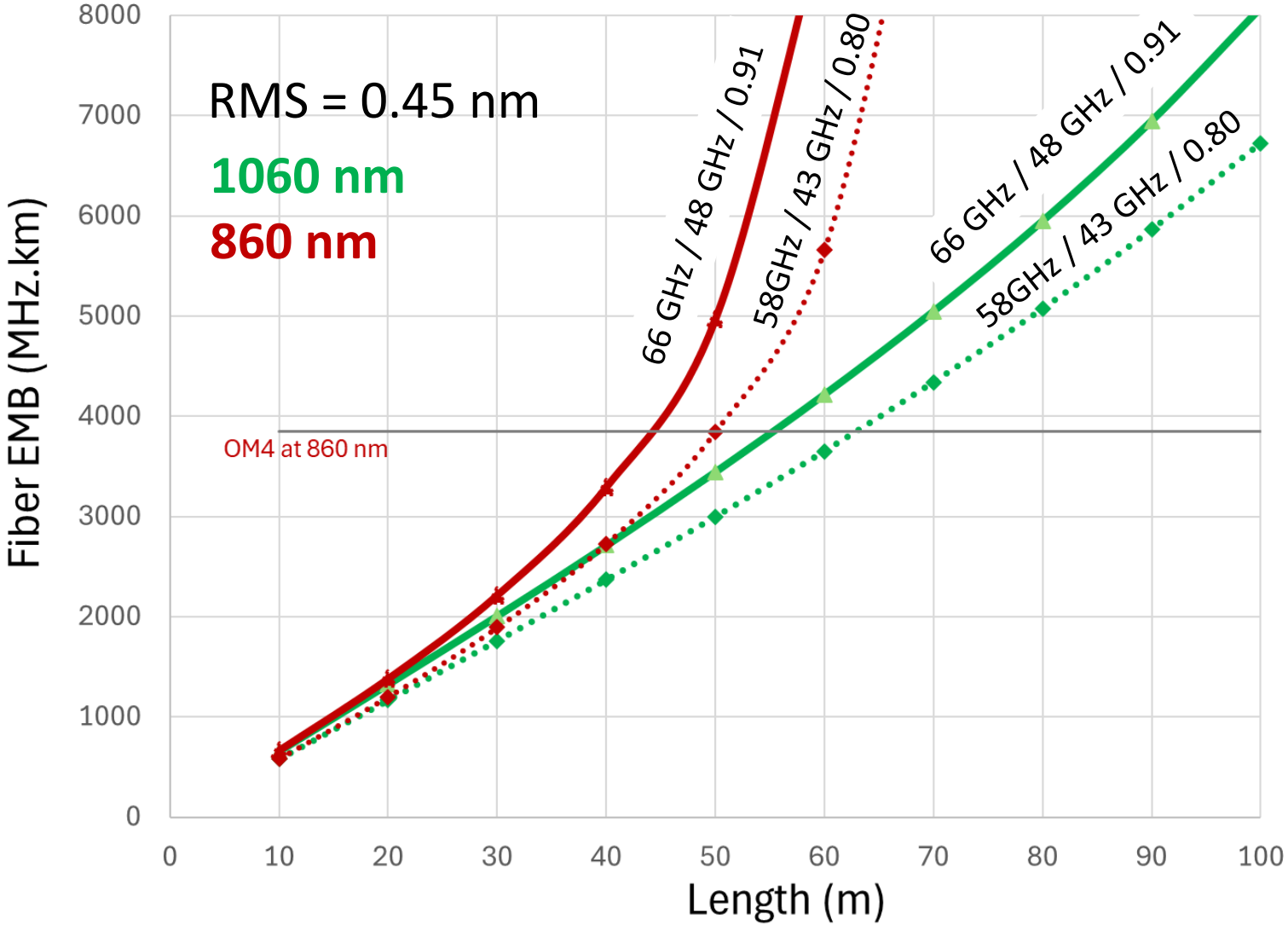
1060 nm VCSELs with a small-core 1060 nm MMF are potentially a higher yield, forward-looking high-reliability approach capable of meeting requirements for high volume AI scale-up applications.

We propose 802.3ds include a 1060 nm PMD and a 1060 nm optimized MMF.

We propose sending a liaison letter from IEEE to IEC requesting standardization of 1060 nm optimized MMFs.

Back up

Fiber EMB vs Reach @ 212Gbps/lane



At the same reach
- 1060 nm needs less EMB

At the same EMB
- 1060 nm can reach longer

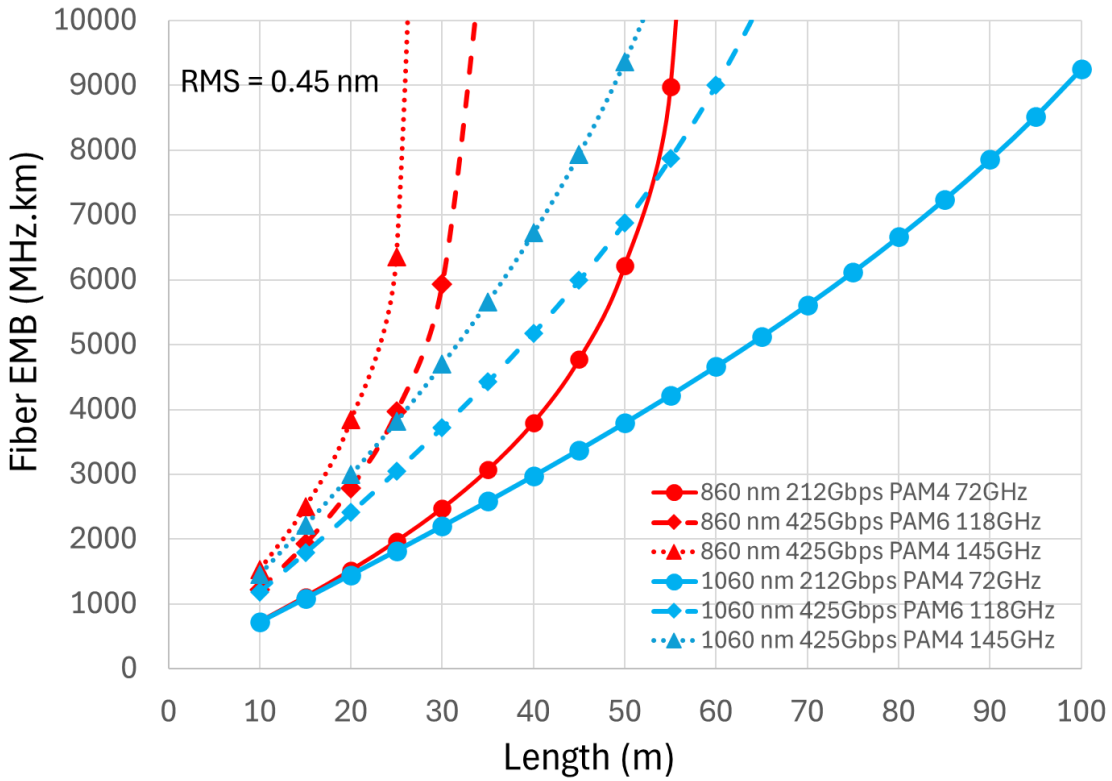
Benefits of 1060 nm is more obvious at
- longer reach

Nyquist freq. =53.125 GHz

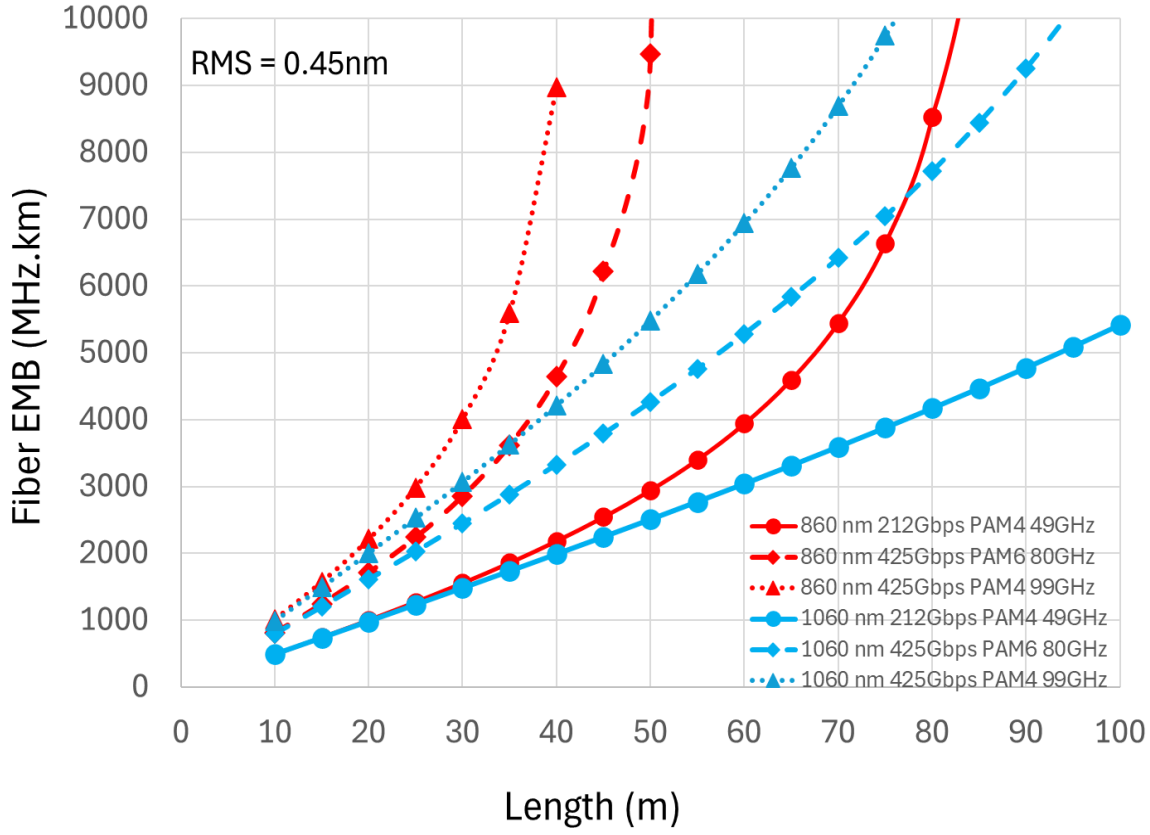
What is possible at 400Gbps/lane?

More divergence on EMB needed between 850 nm and 1060 nm at

- Longer reach
- Higher speed
- Higher 3dBe BW / Nyquist freq ratio



Fiber 3dBe BW / Nyquist Freq. = 1



Fiber 3dBe BW / Nyquist Freq. = 0.68