Baseline Proposal for 800 GbE over Eight Pairs of MMF for 50 and 100 m Reaches

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IEEE P802.3df 200 Gb/s, 400 Gb/s, 800 Gb/s and 1.6 Tb/s Ethernet Task Force
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Adopted Physical Layer Objectives

Spotlight

Ethernet Rate	Assumed Signaling Rate	AUI	BP	Cu Cable	MMF 50m	MMF 100m	SMF 500m	SMF 2km	SMF 10km	SMF 40km
200 Gb/s	200 Gb/s	Over 1 lane		Over 1 pair			Over 1 Pair	Over 1 Pair		
400 Gb/s	200 Gb/s	Over 2 lanes		Over 2 pairs			Over 2 Pair			
800 Gb/s	100 Gb/s	Over 8 lanes	Over 8 lanes	Over 8 pairs	Over 8 pairs	Over 8 pairs	Over 8 pairs	Over 8 pairs		
	200 Gb/s	Over 4 lanes		Over 4 pairs			Over 4 pairs	1) Over 4 pairs 2) Over 4 λ's		
	TBD								Over single SMF in each direction	Over single SMF in each direction
1.6 Tb/s	100 Gb/s	Over 16 lanes								
	200 Gb/s	Over 8 lanes		Over 8 pairs			Over 8 pairs	Over 8 pairs		

Technology Reuse

Leverage existing or work-in-progress 100 Gb/s per lane (e.g. 3cu, 3ck, 3db) to higher lane counts

Develop 200 Gb/s per lane electrical signaling for 1/2/4/8 lane variants of AUIs and electrical PMDs

Develop 200 Gb/s per optical fiber for 1/2/4/8 fiber based optical PMDs and 4 lambda WDM optical PMD

Potential for either direct detect and / or coherent signaling technology

Making it all work together

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Objectives

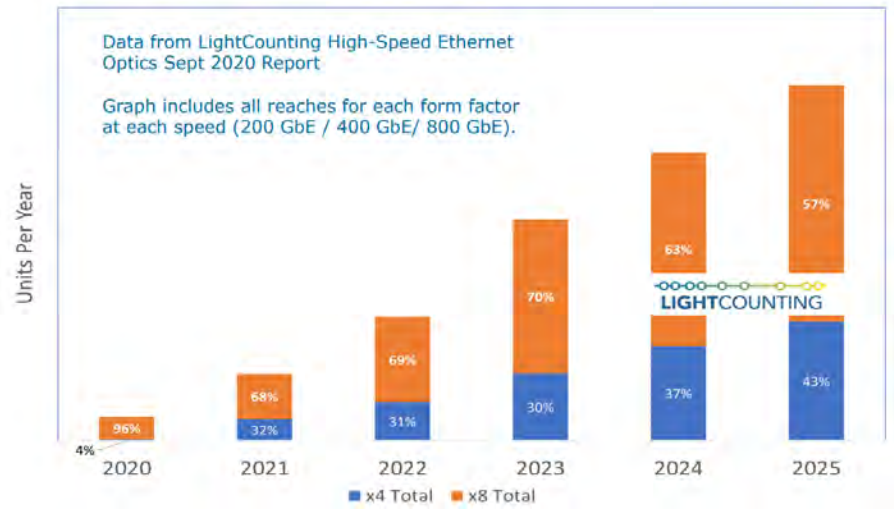
Define a physical layer specification to support 800 Gb/s operation

1. Over 8 pairs of multimode fiber with reach up to at least 50 m

2. Over 8 pairs of multimode fiber with reach up to at least 100 m

800G MMF Links

- 100G VCSEL-based multimode fiber optical links will be in high volume over the next five years for multiple short reach applications
- Advantages of multimode links include ease of alignment, dust tolerance, and low cost for reach up to 100 m
- Applications include fiber-to-the-server/GPU, AI/ML, and large enterprise and cloud networks
- P802.3db defines 100G VCSEL-based 1, 2, and 4 pair multimode fiber links
- 8 fiber pair links are finding growing acceptance
  - 400GBASE-SR8 defined in P802.3cm is a 8 fiber pair multimode link that has found wide use in hyperscale DC
  - 800GBASE-VR8 and 800GBASE-SR8 (a) will build on the fiber infrastructure, and (b) enable breakout cabling, e.g., 800GBASE-SR8 can function as a dual 400GBASE-SR4



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100G per Lane Multimode Links

- P802.3db is currently at Draft 3.0 and defines 1, 2, and 4 lane PMDs for OM4 50 and 100 m reach
  - 53.125 GBd PAM4 and KP4 FEC
  - VR and SR links are defined to be interoperable for reach up to OM4 50 m
  - Center wavelength of light source
    VR 842 – 948 nm
    SR 844 – 863 nm

Table 167–6—Operating range

PMD type	Required operating range[a]
100GBASE-VR1 200GBASE-VR2 400GBASE-VR4	0.5 m to 30 m for OM3
	0.5 m to 50 m for OM4
	0.5 m to 50 m for OM5
100GBASE-SR1 200GBASE-SR2 400GBASE-SR4	0.5 m to 60 m for OM3
	0.5 m to 100 m for OM4
	0.5 m to 100 m for OM5

[a]The RS-FEC correction function may not be bypassed for any operating distance.

Table 167–9—Illustrative link power budget

Parameter	100GBASE-VR1 200GBASE-VR2 400GBASE-VR4			100GBASE-SR1 200GBASE-SR2 400GBASE-SR4			Unit
	OM3	OM4	OM5	OM3	OM4	OM5	
Effective modal bandwidth at 850 nm[a]	2000	4700		2000	4700		MHz.km
Power budget (for max TDECQ)	6.2			6.4			dB
Operating distance	0.5 to 30	0.5 to 50		0.5 to 60	0.5 to 100		m
Channel insertion loss[b]	1.6	1.7		1.7	1.8		dB
Allocation for penalties[c] (for max TDECQ)	4.5			4.6			dB
Additional insertion loss allowed	0.1	0		0.1	0		dB

[a]Per IEC 60793-2-10, see Table 167–15 for information on effective modal bandwidth at other wavelengths.
[b]The channel insertion loss is calculated using the maximum distance specified in Table 167–6 and cabled optical fiber attenuation of 3.0 dB/km at 850 nm plus an allocation for connection and splice loss given in 167.10.2.2.1.
[c]Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

Transmit and Receive Specifications, P802.3db D3.0

Table 167–7—Transmit characteristics

Description	100GBASE-VR1 200GBASE-VR2 400GBASE-VR4	100GBASE-SR1 200GBASE-SR2 400GBASE-SR4	Unit
Signaling rate, each lane (range)	53.125 ± 100 ppm		GBd
Modulation format	PAM4		—
Center wavelength (range)	842 to 948	844 to 863	nm
RMS spectral width[a] (max)	0.65	0.6	nm
Average launch power, each lane (max)	4		dBm
Average launch power, each lane (min)	–4.6		dBm
Outer Optical Modulation Amplitude (OMA_{outer}), each lane (max)	3.5		dBm
Outer Optical Modulation Amplitude (OMA_{outer}), each lane (min) for max (TECQ, TDECQ) ≤ 1.8 dB for 1.8 < max (TECQ, TDECQ) ≤ 4.4 dB	–2.6 –4.4 + max (TECQ, TDECQ)		dBm dBm
Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane (max)	4.4	4.4	dB
Transmitter eye closure for PAM4 (TECQ), each lane (max)	4.4		dB
Overshoot/undershoot (max)	29		%
Transmitter power excursion, each lane (max)	2.3		dBm
Extinction ratio, each lane (min)	2.5		dB
Transmitter transition time, each lane (max)	17		ps
Average launch power of OFF transmitter, each lane (max)	–30		dBm
$RIN_{12}OMA$ (max)	–132		dB/Hz
Optical return loss tolerance (max)	12		dB
Encircled flux[b]	≥ 86% at 19 μm ≤ 30% at 4.5 μm		—

[a]RMS spectral width is the standard deviation of the spectrum.
[b]If measured into type A1a.2 or type A1a.3, or A1a.4, 50 μm fiber, in accordance with IEC 61280-1-4.

Table 167–8—Receive characteristics

Description	100GBASE-VR1 200GBASE-VR2 400GBASE-VR4	100GBASE-SR1 200GBASE-SR2 400GBASE-SR4	Unit
Signaling rate, each lane (range)	53.125 ± 100 ppm		GBd
Modulation format	PAM4		—
Center wavelength (range)	842 to 948		nm
Damage threshold[a] (min)	5		dBm
Average receive power, each lane (max)	4		dBm
Average receive power, each lane[b] (min)	–6.3	-6.4	dBm
Receive power, each lane (OMA_{outer}) (max)	3.5		dBm
Receiver reflectance (max)	–12		dB
Receiver sensitivity (OMA_{outer}) (max) for TECQ ≤ 1.8 dB for 1.8 < TECQ ≤ 4.4 dB	-4.4 -6.2 + TECQ	-4.6 -6.4 + TECQ	dBm dBm
Stressed receiver sensitivity (OMA_{outer})[c] (max)	-1.8	-2.0	dBm
Conditions of stressed receiver sensitivity test:[d]			
Stressed eye closure for PAM4 (SECQ), lane under test	4.4		dB
OMA_{outer} of each aggressor lane	3.5		dBm

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level on one lane. The receiver does not have to operate correctly at this input power.
[b]Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
[c]Measured with conformance test signal at TP3 (see 167.8.14) for the BER specified in 167.1.1.
[d]These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

800 GbE Multimode Links

- Propose to add 800GBASE-VR8 (50 m reach) and 800GBASE-SR8 (100 m reach) to the content of Clause 167 by adopting the transmit, receive, and power budget specifications therein.
  - Update related text, figures, and tables with editorial license
  - Stay aligned with the latest P802.3db draft
- MDI and lane assignments for eight lane MMF links will be taken up in subsequent meetings.

Straw Poll to Adopt the Proposed Baseline

For 800GBASE-VR8 and 800GASE-SR8 PMDs, align to the corresponding transmit, receive, and power budget specifications in Clause 167 of P802.3db [slide 8 of this presentation, murty_3df_01_220315.pdf].

1. Y
2. N
3. Need more information
4. Abstain

Results 1) 2) 3) 4)

Proposed Motion

For 800GBASE-VR8 and 800GASE-SR8 PMDs, align to the corresponding transmit, receive, and power budget specifications in Clause 167 of P802.3db [slide 8 of this presentation, murty_3df_01_220315.pdf].

- Y
- N
- Abstain

Mover Ramana Murty
Second

Y: N: A: