

100GBASE-SR2 MMF baseline proposal

P802.3cd, Whistler, BC

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- Baseline proposals for retimed two-lane 100Gb/s PAM4 PMD
 - Physical layer specifications which support link distances of at least 100 m on MMF
 - FEC supported (RS-544) or similar to enable 100 m reach
 - Two-lane short wavelength based PMD for 100GBASE-SR2
 - Compatible with 50GBASE-SR and 200GBASE-SR4 proposals in [king_3cd_01_0516](#), identical optical lane specifications
 - Leverages an evolution of 25G NRZ optics, CDAUI-8 50 Gb/s electrical interfaces, and some of the PAM4 metrics developed in 802.3bs
- Architecture, parameters and specifications for optical interfaces follow.

Adopted MMF Objectives

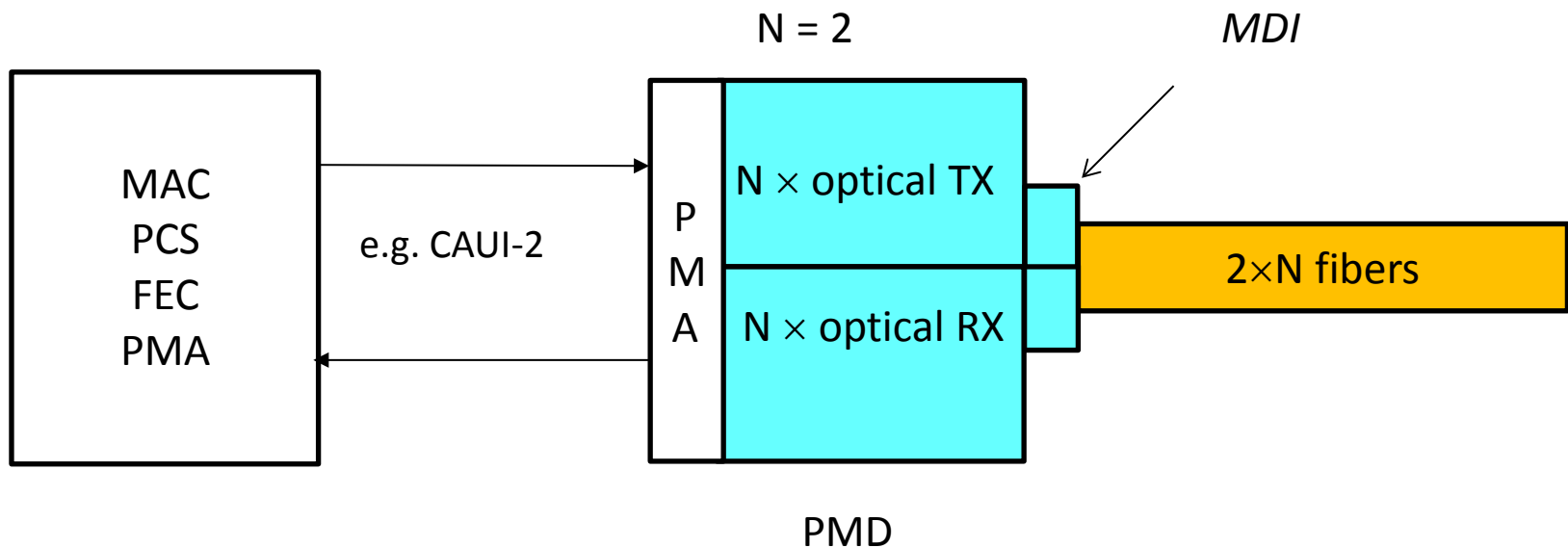
- Define a single-lane 50 Gb/s PHY for operation over MMF with lengths up to at least 100 m.
- **Define a two-lane 100 Gb/s PHY for operation over MMF with lengths up to at least 100 m.**
- Define a 200 Gb/s PHY for operation over MMF with lengths up to at least 100 m.

Motivation

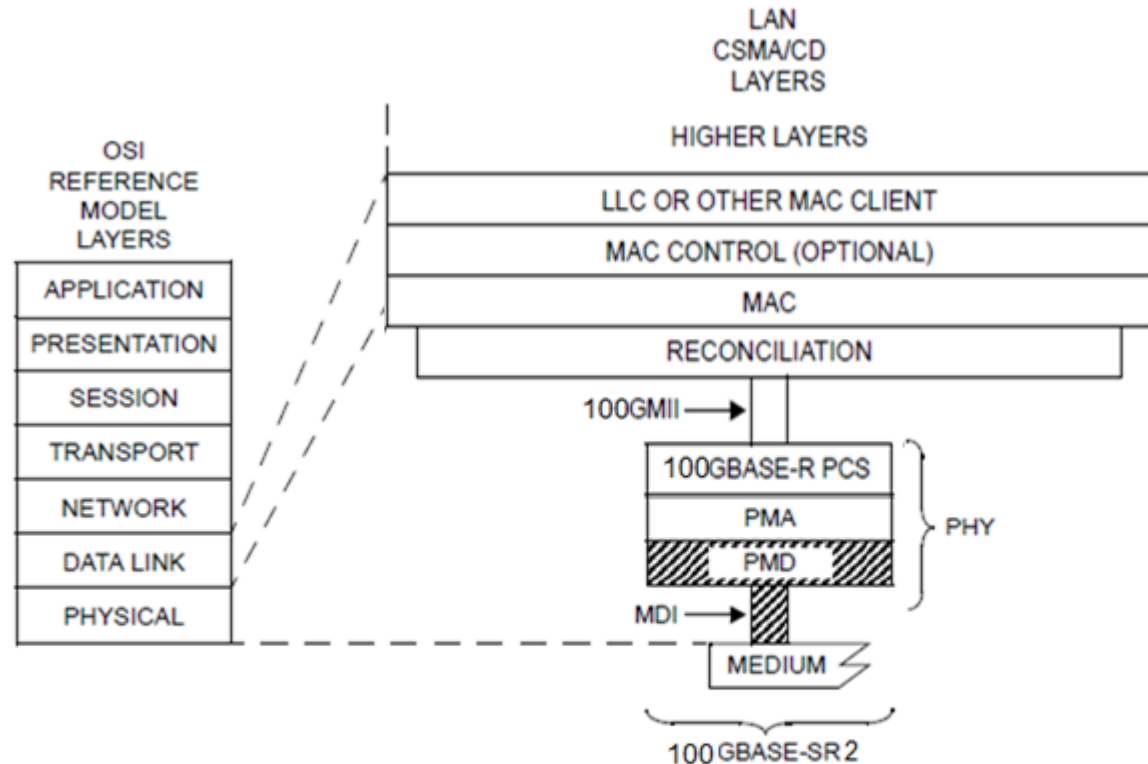
- Single-lane and four-lane links using PAM4 modulation at 26.5625 GBd/lane have been proposed for 50GBASE-SR and 200GBASE-SR4
- This proposal is for a two-lane variant (i.e. two fibres per direction), re-using the same 26.5625 GBd/lane PAM4 optical lane specifications.
 - Utilize low cost, high performance MMF compatible optics and electronics
 - Similar 28 Gb/s NRZ optics technology used in 25G, 100G, 400G Ethernet, and 32G Fibre Channel
 - Uses existing viable semiconductor technologies and uncooled 850nm VCSELs
 - FEC-supported retimed interface enables a lowest power, lowest cost, 100 m solution today

Proposal

- Two optical lanes per direction for 100GBASE-SR
- Each lane @ 26.5625 GBd PAM4 over 100 m OM4 fiber.
 - Exact signaling rate is determined by project's choice of FEC.
- 850 nm sources and receivers
 - Assumes target BER (prior to error correction) around 2.4×10^{-4} and random error statistics



100GBASE-SR: Position in 802.3 architecture



100GMII=100Gb/s MEDIA INDEPENDENT INTERFACE
 LLC = LOGICAL LINK CONTROL
 MAC = MEDIA ACCESS CONTROL
 MDI = MEDIUM DEPENDENT INTERFACE
 PCS = PHYSICAL CODING SUBLAYER

PHY = PHYSICAL LAYER DEVICE
 PMA = PHYSICAL MEDIUM ATTACHMENT
 PMD = PHYSICAL MEDIUM DEPENDENT
 SR = PMD FOR MULTIMODE FIBER

Transmitter characteristics (each lane) at TP2

Description	Value	Unit
Signaling rate, each lane, (range)	26.5625 ± 100	ns
Modulation format		
Center wavelength (range)	1550	nm
RMS spectral width	0.6	nm
Average launch power, each lane (max)	+4	dBm
Average launch power, each lane (min)	-6	dBm
Optical Modulation Amplitude (OMA_{outer}), each lane (max) ^a	+3	dBm
Optical Modulation Amplitude (OMA_{outer}), each lane (min) ^{ab}	-4 <i>TBC</i>	dBm
Launch power in TDECQ (min) ^a	-5 <i>TBC</i>	dBm
Transmitter eye closure (TDECQ), each lane (max) ^a	4 <i>TBC</i>	dB
Average power of OFF transmitter, each lane (max)	-30	dBm
Extinction ratio (min) ^a	3	dB
Encircled Flux	$\geq 86\%$ at $19 \mu\text{m}$ $\leq 30\%$ at $4.5 \mu\text{m}$	

^a OMA_{outer} , and TDECQ are as defined in 802.3bs; the 5 tap T/2 reference is *TBC* for MMF links

^b Even if TDECQ is <1dB, OMA_{outer} must be at least this value

Receiver characteristics (each lane) at TP3

Description	Value	
Signaling rate, each lane, (range)	26.5625 ± 100ppm	
Modulation format	PA	
Center wavelength (range)		nm
Damage threshold (min)	+5	dBm
Average receive power, each lane (max)	+4	dBm
Average receive power, each lane (min)	-7.9	dBm
Receive power, each lane (OMA)	+3	dBm
Receiver reflectance (m ²)	-12	dB
Stressed receiver sensitivity (OMA _{outer}), each lane (max) ^a	-3 <i>TBC</i>	dBm at 2.4 x 10 ⁻⁴
Receiver sensitivity (OMA _{outer}), each lane (max) ^{ab}	-7 <i>TBC</i>	dBm at 2.4 x 10 ⁻⁴
Conditions of stressed receiver sensitivity test		
Stressed eye closure (SECQ), lane under test ^a	4 <i>TBC</i>	dB
OMA of each aggressor lane	+3	dBm

^a OMA_{outer}, and SECQ are as defined in 802.3bs, the 5 tap T/2 reference is *TBC* for MMF links

^b Receiver sensitivity is informative

Illustrative link power budget (each lane)

Parameter	OM3	OM4	Unit
Effective modal bandwidth at 850 nm	2000		MHz.km
Power budget (for max TDECQ)			dB
Operating distance		100	m
Channel insertion loss		1.9	dB
Allocation for penalties (for max TDFC)		4.1 <i>TBC</i>	dB
Additional insertion loss allowed	0.1	0	dB

Same as 50GBASE-SR and 200GBASE-SR4

Concluding remarks

- A baseline proposal for a two-lane 100G PMD, based on 50 Gb/s PAM4 per lane, represents the straightforward augmentation of the 50G PAM4 per lane family of PHYs
- Same reach (100 m on OM4) is achievable with RS-544 support or similar
- Per lane optical spec's will be compatible with 50GBASE-SR and 200GBASE-SR4
 - for example, allows breakout ratios at 1:2, 1:4, 2:4

Q & A

Thanks !