100GBASE-SR2 MMF baseline proposal - update

P802.3cd, Fort Worth, Texas

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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.

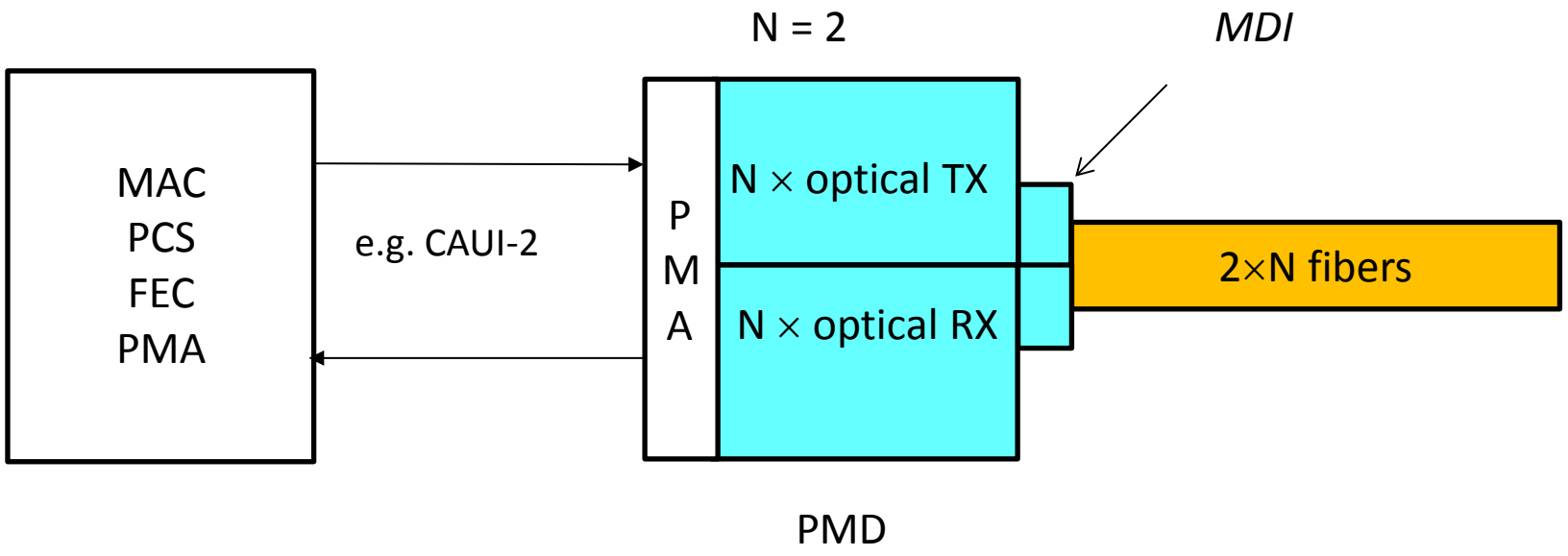
Baselines adopted
based on 1 fibre and 4 fibres per direction

Motivation

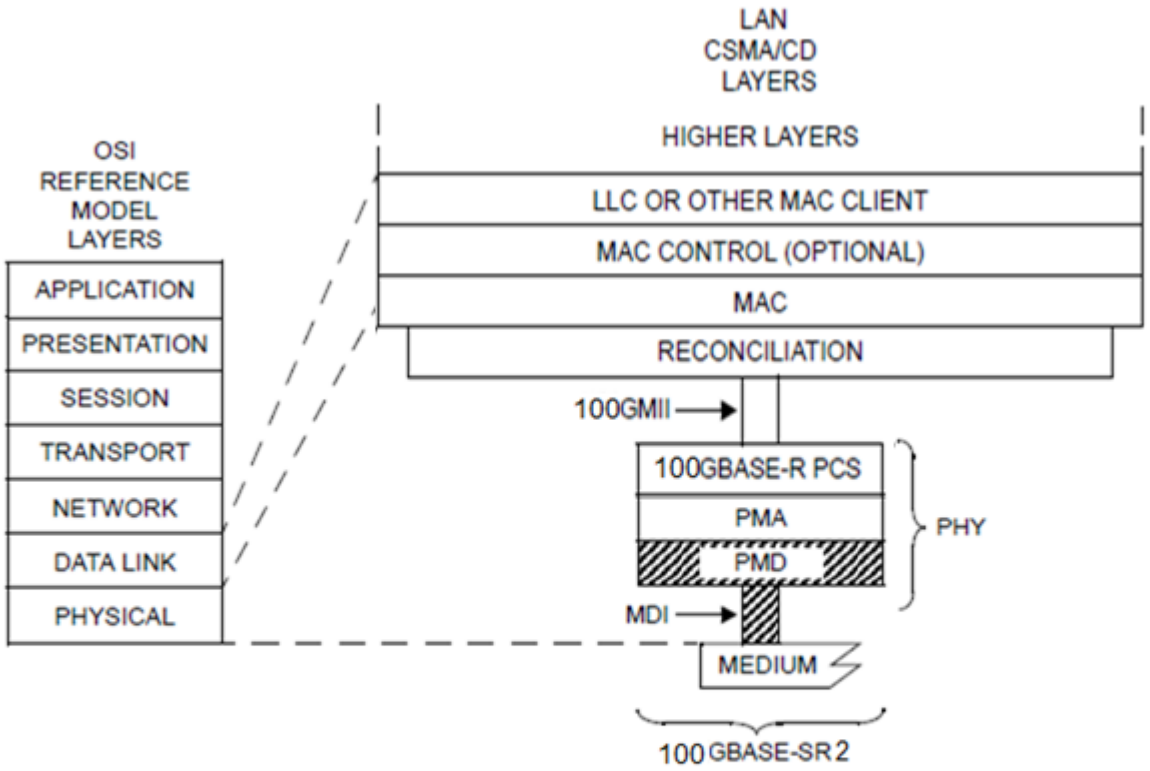
- Baselines for 1x and 4x lane links using 26.5625 GBd/lane PAM4 modulation adopted for 50GBASE-SR and 200GBASE-SR4
- This proposal is a 2 lane variant (2 fibres per direction), with the same 26.5625 GBd/lane PAM4 optical per lane spec's
  - Low cost, high performance MMF compatible optics and electronics
    - Similar 28 Gb/s NRZ optics technology (based on uncooled 850 nm VCSELs) used in 25G, 100G, 400G Ethernet, and 32G Fibre Channel
- Why 2 fibres (and not 2 wavelengths)? See *kipp_3cd_01a_0516*
  - Configurability: Multi-fibre modules support multiple configurations of 50/100/200G, leading to higher volumes and lower cost; WDM ports can't be broken out
  - Parallels the 100GBASE-CR2 proposals in 802.3cd – same host electrical port can support optics or copper links, with similar high-level functionality
  - No mux demux loss to further stress the PAM4 power budget
  - Consensus on per lane optical specs for baseline
  - Low hanging fruit for Ethernet

Proposal

- Two optical fibres per direction for 100GBASE-SR2
- 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-SR2: 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	
Signaling rate, each lane, (range)	26.5625 ± 10[illegible]	[illegible]
Modulation format		
Center wavelength (range)	[illegible]60	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 (O[illegible] [illegible]ane (max)[a]	+3	dBm
Optical Modulation Amp[illegible] [illegible]outer), each lane (min)[ab]	-4 *TBC*	dBm
Launch power in [illegible]us TDECQ (min)[a]	-5 *TBC*	dBm
Transmi[illegible] [illegible]ion eye closure (TDECQ), each lane (max)[a]	4 *TBC*	dB
A[illegible] [illegible] power of OFF transmitter, each lane (max)	-30	dBm
Extl[illegible]ion ratio (min)[a]	3	dB
Encircled Flux	≥ 86% at 19 µm ≤ 30% at 4.5 µm	

Same as 50GBASE-SR and 200GBASE-SR4

[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	PAM	
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	-12	dB
Stressed receive (OMA_{outer}), each lane (max)[a]	-3 *TBC*	dBm at 2.4×10^{-4}
Re ity (OMA_{outer}), each lane (max)[ab]	-7 *TBC*	dBm at 2.4×10^{-4}
Conditions of stressed receiver sensitivity test		
Stressed eye closure (SECQ), lane under test[a]	4 *TBC*	dB
OMA of each aggressor lane	+3	dBm

Same as 50GBASE-SR and 200GBASE-SR4

[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	OM	nit
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 TDE	4.1 *TBC*		dB
Additional insertion loss allo	0.1	0	dB

Same as 50GBASE-SR and 200GBASE-SR4

Concluding remarks

- A 100GBASE-SR2 baseline is proposed for a two-lane 100G PMD, based on 50 Gb/s PAM4 with two fibres per direction
- Represents a straightforward augmentation of the 50G PAM4 per lane family of MMF PHYs
  - Same per lane optical spec's as 50GBASE-SR and 200GBASE-SR4
  - Same reach (100 m on OM4) achievable with RS-544 FEC
- Configurability: supports breakout ratios at 1:2, 1:4
- Parallels the 100GBASE-CR2 proposals in 802.3cd – same host electrical port can support MMF optics or copper links, with similar high-level functionality

Q & A

Thanks !