# 100GBASE-SR2 MMF baseline proposal

P802.3cd, Whistler, BC

21st May 2016

Jonathan King, Finisar

# Supporters

# Contents

- Adopted MMF objectives
- 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

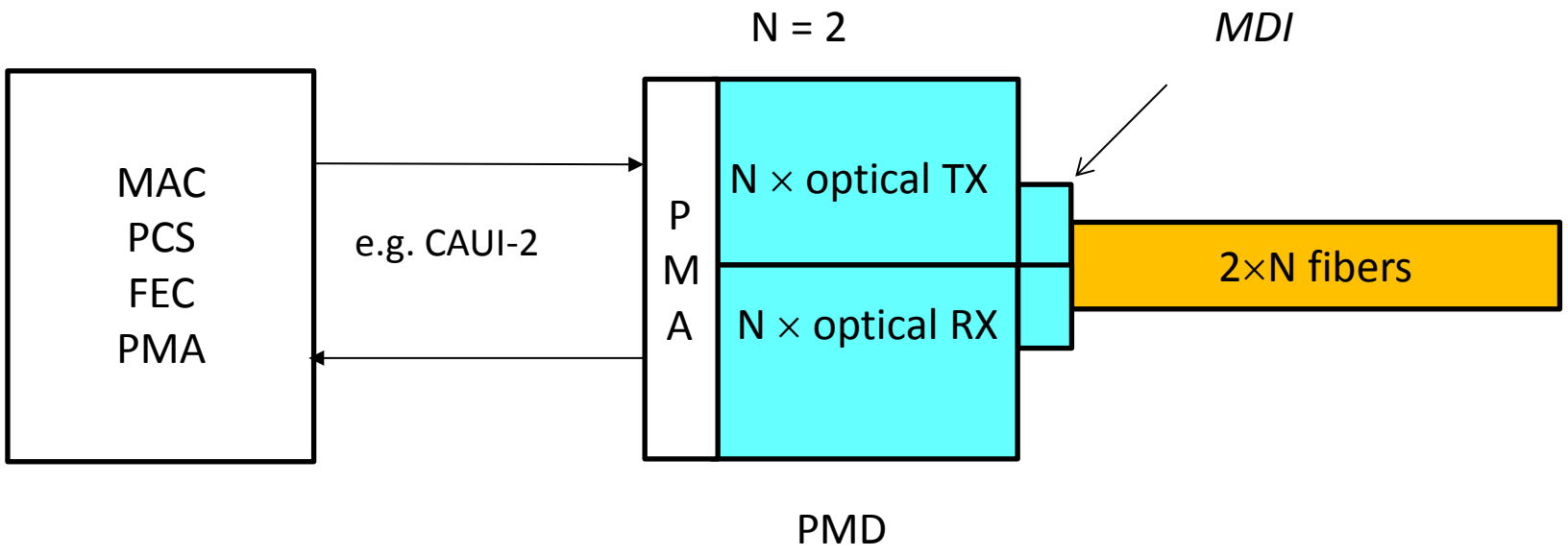
- Define a single-lane 50 Gb/s PHY for operation over MMF with lengths up to at least 100 m.
- **Define a two-lane 100 Gb/s PHY for operation over MMF with lengths up to at least 100 m.**
- Define a 200 Gb/s PHY for operation over MMF with lengths up to at least 100 m.

# Motivation

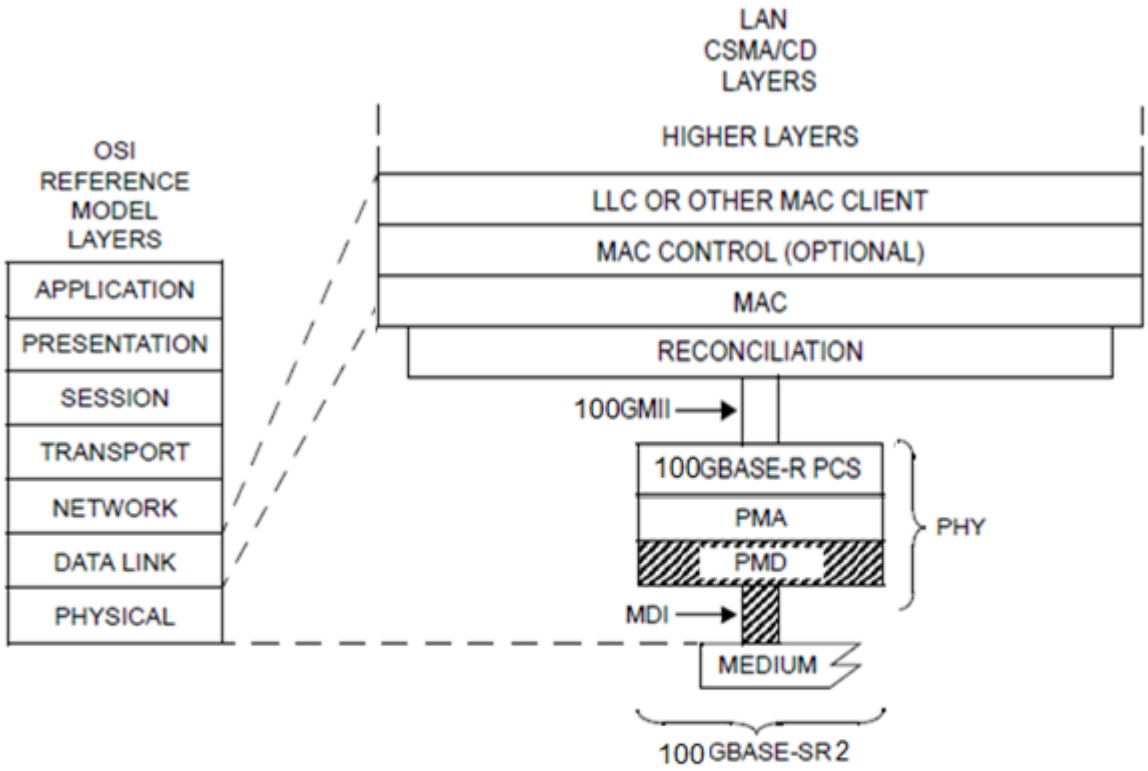
- Single-lane and four-lane links using PAM4 modulation at 26.5625 GBd/lane have been proposed for 50GBASE-SR and 200GBASE-SR4
- This proposal is for a two-lane variant (i.e. two fibres per direction), re-using the same 26.5625 GBd/lane PAM4 optical lane specifications.
  - Utilize low cost, high performance 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 $2.4 \times 10^{-4}$ 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 | |
|---|---|---|
| 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<br>≤ 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 $2.4 \times 10^{-4}$ |
| Re ity ($OMA_{outer}$), each lane (max)[ab] | -7 *TBC* | dBm at $2.4 \times 10^{-4}$ |
| 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 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 !