100GE 10km SMF PMD

IEEE 802.3ba Task Force

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Outline

- Status
- Architecture
- LAN WDM Baseline (-10nm) Grid
- 10km Baseline Grid Link and Power Budget

The following appendices have NOT been reviewed by the presentation co-authors (other then the lead author) and supporters, so their co-authorship and support does not necessarily apply to any of the appendices

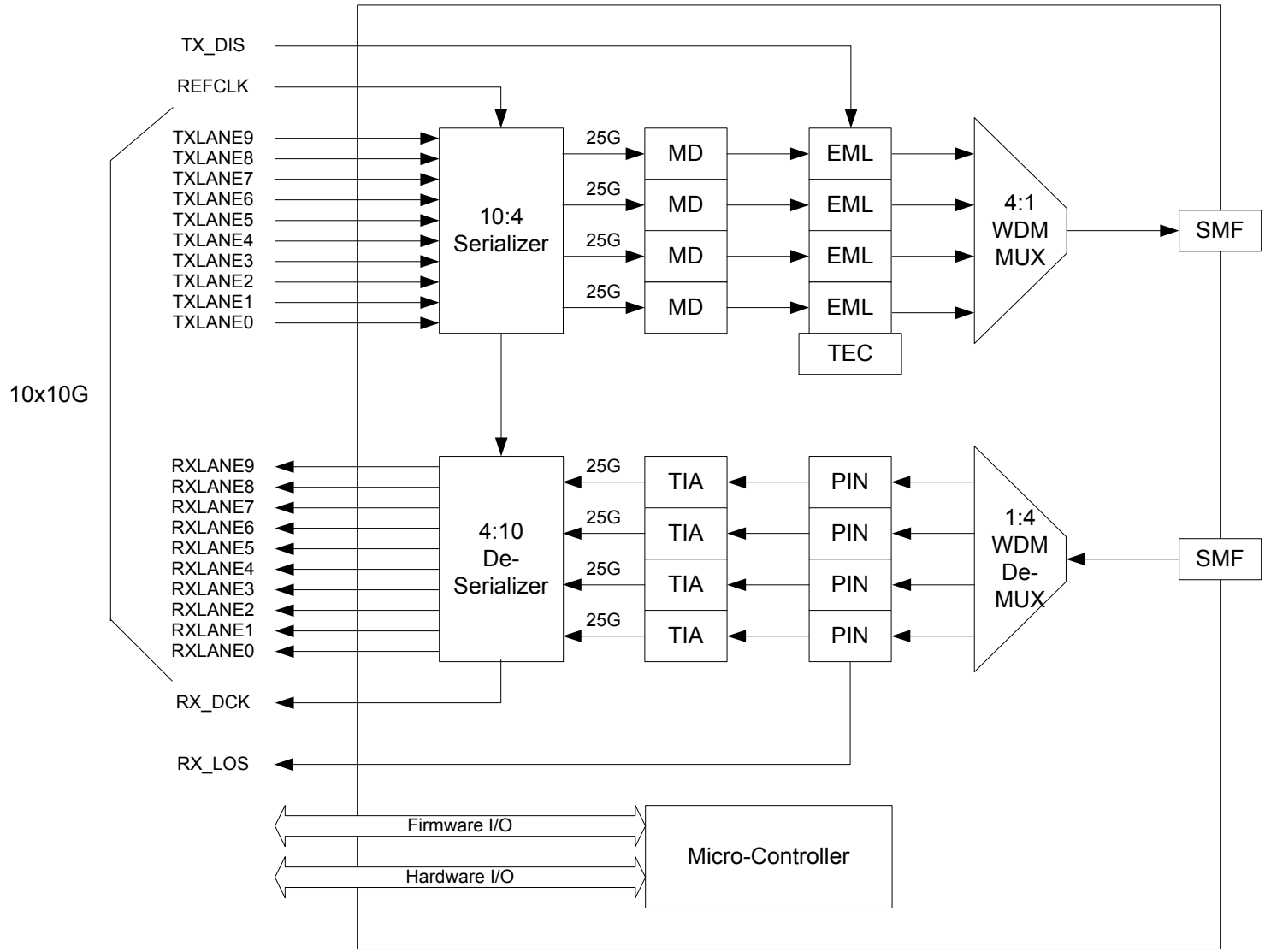
- Appendix 1: LAN WDM Reference (0nm) Grid
- 10km Reference Grid Link and Power Budget
- Appendix 2: LAN WDM -5nm Grid
- 10km -5nm Grid Link and Power Budget
- Appendix 3: LAN WDM -15nm Grid
- 10km -15nm Grid Link and Power Budget

10km SMF Status

- Baseline Approach to 10km SMF reach
  - TX: 4x25G MD-EML → LAN WDM Mux
  - RX: 4x25G PIN-TIA ← LAN WDM DeMux
- Technical presentations discussing baseline approach
  - cole_01_1106, cole_01_0307, cole_01_0907, cole_01/02_0108, cole_01/02_0308
  - jiang_01_0507, jiang_01_0907
  - nagarajan_01_1107
  - johnson_01_0108

  Many other presentations discussed 4x25G MD-EML approach, but on a CWDM Grid
- Key Issues analyzed
  - Min receiver sensitivity
  - Transmitter output power
  - DML feasibility
  - Dispersion Penalty
  - Integration approaches

Gen1 10km 1310nm EML PMD



LAN WDM Baseline (-10nm) Grid

- ITU G.694.1 specification
- 800GHz spacing (193.1THz base)
- 4 wavelengths shifted by -10nm from Reference Grid
- Exact wavelength values: 1295.56 1300.05 1304.58 1309.14 nm
- Shorthand wavelength values: 1295, 1300, 1305, 1310 nm
- 2nm window (precise pass-band TBD)
- G.652 A&B 10km SMF worst corner dispersion and fiber loss
  - Max positive dispersion (1310nm) = 9ps/nm
  - Max negative dispersion (1295nm) = -28ps/nm
  - Max Loss (1310nm) = 4.2dB
  - Max Loss (1295nm) = 4.3dB

10km Baseline Grid Power Budget

25G Link Budget 10km SMF TP2 → TP3	LAN WDM EML α = -1.0 λ = 1295nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1310nm ER = 4.5dB
Fiber Loss (G.652 A&B)	4.3 dB	4.2 dB
Connector loss	2.0	2.0
Dispersion Penalty	0.5	0.6
Other Penalties	0.7	0.7
Total budget	7.5 dB	7.5 dB

25G Pwr Budget 10km SMF TP2 → TP3 OMA (Average)	LAN WDM EML α = -1.0 λ = 1295nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1310nm ER = 4.5dB
TX Min	2.3 dBm (1.1)	2.3 dBm (2.5)
TP2 TX Min 2.5dB Mux loss	-0.2	-0.2
Link Budget (dB)	7.5	7.5
TP3 RX Min 2.5dB Demx loss	-7.7	-7.7
RX Min (w/ 1dB xtalk penalty)	-10.2 dBm (-11.4)	-10.2 dBm (-10.0)

- EML chirp range assumption: $-1.0 \leq \alpha \leq 1.0$
- EML λ = 1310nm, chirp α = 1.0: Dispersion Penalty = 0.2, Loss = 4.2dB (not limiting)
- DML λ = 1295nm, chirp α = 3.5: Dispersion Penalty = 0.5, Loss = 4.3dB (equivalent)
- RX overload, max difference in power between wavelengths, other specs TBD

Appendix 1: LAN WDM Reference (0nm) Grid

- ITU G.694.1 specification
- 800GHz spacing (193.1THz base)
- 4 wavelengths selected for minimum dispersion in 1310nm window
- Exact wavelength values: 1305.72, 1310.28, 1314.88, 1319.51 nm
- Shorthand wavelength values: 1305, 1310, 1315, 1320 nm
- 2nm window
- G.652 A&B 10km SMF worst corner dispersion and fiber loss
  - Max Positive Dispersion (1320nm) = 19ps/nm
  - Max Negative Dispersion (1305nm) = -18ps/nm
  - Max Loss (1320nm) = 4.2dB
  - Max Loss (1305nm) = 4.2dB
- Reference Grid is used as basis for comparison of alternate grid proposals

10km Reference Grid Power Budget

25G Link Budget 10km SMF TP2 → TP3	LAN WDM EML α = 1.0 λ = 1320nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1320nm ER = 4.5dB
Fiber Loss (G.652 A&B)	4.2 dB	4.2 dB
Connector loss	2.0	2.0
Dispersion Penalty	0.3	1.3
Other Penalties	0.7	0.7
Total budget	7.2 dB	8.2 dB

25G Pwr Budget 10km SMF TP2 → TP3 OMA (Average)	LAN WDM EML α = 1.0 λ = 1320nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1320nm ER = 4.5dB
TX Min	2.0 dBm (0.8)	3.0 dBm (3.2)
TP2 TX Min 2.5dB Mux loss	-0.5	0.5
Link Budget (dB)	7.2	8.2
TP3 RX Min 2.5dB Demx loss	-7.7	-7.7
RX Min (w/ 1dB xtalk penalty)	-10.2 dBm (-11.4)	-10.2 dBm (-10.0)

Appendix 2: LAN WDM -5nm Grid

- ITU G.694.1 specification
- 800GHz spacing (193.1THz base)
- 4 wavelengths shifted by -5nm from Reference Grid
- Exact wavelength values: 1300.62, 1305.15, 1309.71, 1314.3 nm
- Shorthand wavelength values: 1300, 1305, 1310, 1315 nm
- 2nm window
- G.652 A&B 10km SMF worst corner dispersion and fiber loss
  - Max positive dispersion (1315nm) = 14ps/nm
  - Max negative dispersion (1300nm) = -23ps/nm
  - Max Loss (1315nm) = 4.2dB
  - Max Loss (1300nm = 4.3dB

10km -5nm Grid Power Budget

25G Link Budget 10km SMF TP2 → TP3	LAN WDM EML α = -1.0 λ = 1300nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1315nm ER = 4.5dB
Fiber Loss (G.652 A&B)	4.3 dB	4.2 dB
Connector loss	2.0	2.0
Dispersion Penalty	0.4	0.8
Other Penalties	0.7	0.7
Total budget	7.4 dB	7.7 dB

25G Pwr Budget 10km SMF TP2 → TP3 OMA (Average)	LAN WDM EML α = -1.0 λ = 1300nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1315nm ER = 4.5dB
TX Min	2.2 dBm (1.0)	2.5 dBm (2.7)
TP2 TX Min 2.5dB Mux loss	-0.3	0.0
Link Budget (dB)	7.4	7.7
TP3 RX Min 2.5dB Demx loss	-7.7	-7.7
RX Min (w/ 1dB xtalk penalty)	-10.2 dBm (-11.4)	-10.2 dBm (-10.0)

- EML chirp range assumption: $-1.0 \leq \alpha \leq 1.0$
- EML λ = 1315nm, chirp α = 1.0: Dispersion Penalty = 0.3, Loss = 4.2dB

Appendix 3: LAN WDM -15nm Grid

- ITU G.694.1 specification
- 800GHz spacing (193.1THz base)
- 4 wavelengths shifted by -15nm from Reference Grid
- Exact wavelength values: 1290.54, 1295.00, 1299.49, 1304.01 nm
- Shorthand wavelength values: 1290, 1295, 1300, 1305 nm
- 2nm window
- G.652 A&B 10km SMF worst corner dispersion and fiber loss
  - Max positive dispersion (1305nm) = 4.8ps/nm
  - Max negative dispersion (1290nm) = -33.5ps/nm
  - Max Loss (1305nm) = 4.2dB
  - Max Loss (1290nm) = 4.4dB

10km -15nm Grid Power Budget

25G Link Budget 10km SMF TP2 → TP3	LAN WDM EML α = -1.0 λ = 1290nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1290nm ER = 4.5dB
Fiber Loss (G.652 A&B)	4.4 dB	4.4 dB
Connector loss	2.0	2.0
Dispersion Penalty	0.6	0.5
Other Penalties	0.7	0.7
Total budget	7.7 dB	7.6 dB

25G Pwr Budget 10km SMF TP2 → TP3 OMA (Average)	LAN WDM EML α = -1.0 λ = 1290nm ER = 7dB	LAN WDM DML α = 3.5 λ = 1290nm ER = 4.5dB
TX Min	2.5 dBm (1.3)	2.4 dBm (2.6)
TP2 TX Min 2.5dB Mux loss	-0.0	-0.1
Link Budget (dB)	7.7	7.6
TP3 RX Min 2.5dB Demx loss	-7.7	-7.7
RX Min (w/ 1dB xtalk penalty)	-10.2 dBm (-11.4)	-10.2 dBm (-10.0)

- EML chirp range: $-1.0 \leq \alpha \leq 1.0$
- EML λ = 1305nm, α = 1.0: Dispersion Penalty = 0.3, Loss = 4.2dB
- DML λ = 1305nm, α = 3.5: Dispersion Penalty = 0.5, Loss = 4.2dB