40GBASE-LR4 Specification Proposal

IEEE 802.3ba Task Force

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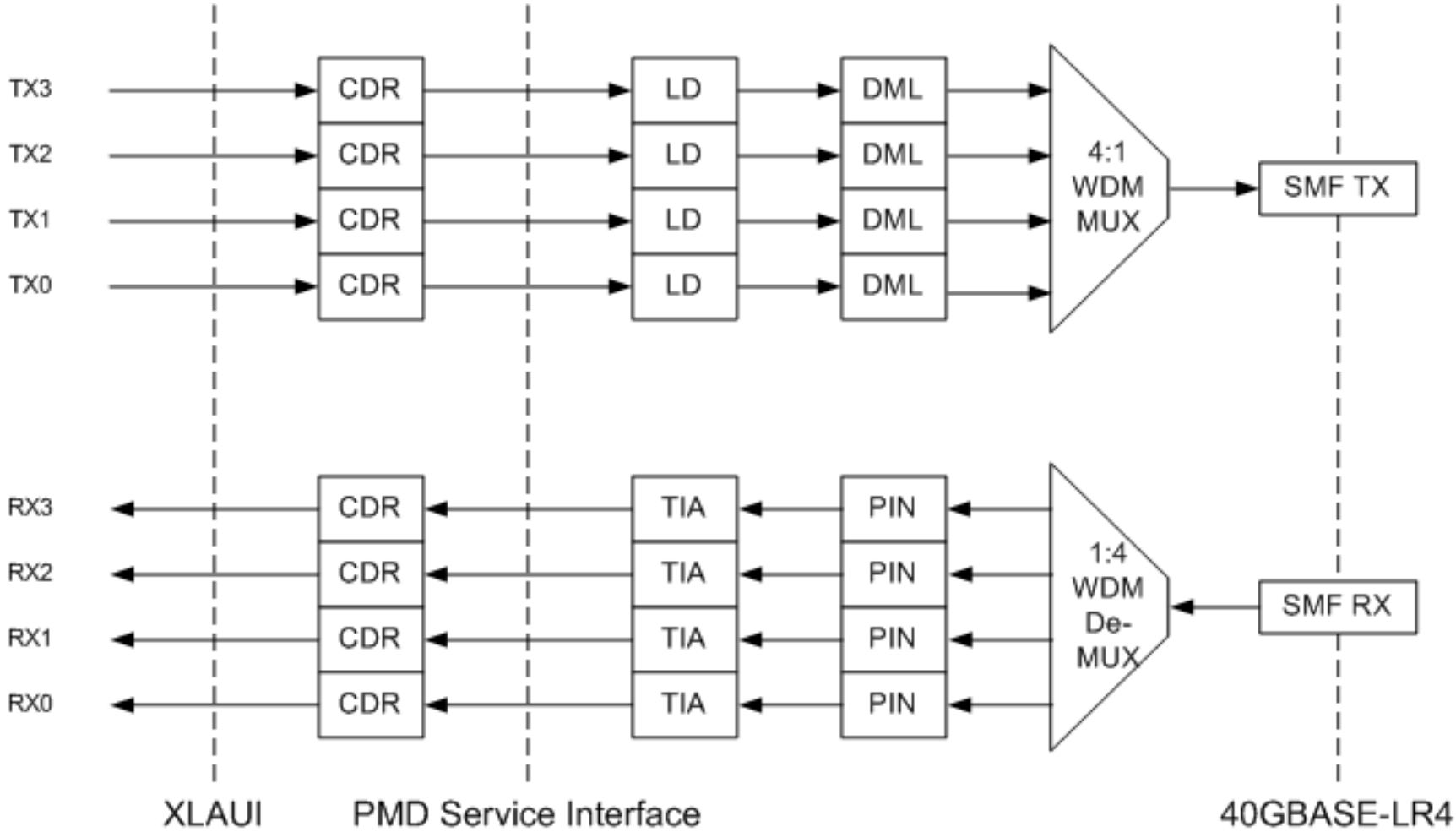
Introduction

- The 40GBASE-LR4 proposal closely follows 10GBASE-LR 802.3ae specification to provide maximum re-use of existing technology, development, and test infrastructure.
- The major changes from 10GBASE-LR are:
  - update to link power budget to account for improvement in DFB technology (speed,)
  - update to TP2 and TP3 power levels to account for CWDM Mux and DeMux losses.
- The change from cole_03_0708 is 0.5dB increase in TP2 power range.
- All numbers should be viewed as subject to change/refinement as a result of detailed review and discussion by 802.3ba participants.
- Support of this presentation is for a baseline for the 40GBASE 10km SMF PMD objective, but does not necessarily imply exact agreement with every specification number.

Example 10km 1310nm DML 4x10G Implementation



CWDM Baseline Grid

- ITU G.694.2 specification
- Exact wavelengths: 1271, 1291, 1311, 1331 nm
- Shorthand wavelengths: 1270, 1290, 1310, 1330 nm
- TX and RX wavelength range: 13 nm
- G.652 A&B 10km SMF worst dispersion and fiber loss
  - Max positive dispersion (1337.5nm) = 33ps/nm
  - Max negative dispersion (1264.5nm) = -59ps/nm
  - Max Loss (1337.5nm) = 4.3dB
  - Max Loss (1264.5nm) = 4.7dB

40GBASE-LR4 lane assignments

Lane	Center wavelengths	Wavelength ranges
L_0	1271 nm	1264.5 – 1277.5 nm
L_1	1291 nm	1284.5 – 1297.5 nm
L_2	1311 nm	1304.5 – 1317.5 nm
L_3	1331 nm	1324.5 – 1337.5 nm

40GBASE-LR4 transmit characteristics

Description	40GBASE-LR4	Unit
Signaling speed per lane	10.3125 ±100 ppm	GBd
Lane wavelengths (range)	1264.5 – 1277.5 1284.5 – 1297.5 1304.5 – 1317.5 1324.5 – 1337.5	nm
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} [a]	TBD	
Side Mode Suppression Ratio (SMSR), (min)	30	dB
Total average launch power (max)	8.3	dBm
Average launch power per lane (max)	2.3	dBm
Average launch power per lane (min)[b]	-7.0	dBm
Optical Modulation Amplitude (OMA) - TDP, per lane (min)	-4.8	dBm
Optical Modulation Amplitude (OMA), per lane (min) [c]	-4.0	dBm
Transmitter and dispersion penalty (max)	2.3	dB
Average launch power of OFF transmitter, per lane (max)	-30	dBm
Extinction Ratio (min)	3.5	dB
RIN_{12} OMA (max)	-128	dB/Hz
Optical Return Loss Tolerance (max)	12	dB
Transmitter Reflectance (max) [d]	-12	dB

[a] Tx eye mask spec to be specified as per eye mask methodology discussions

[b] Informative, average launch power (min) and is not the principle indicator of signal strength.

[c] Even if the TDP < 0.8dB, the OMA (min) must exceed this value.

[d] Transmitter reflectance is defined looking into the transmitter.

40GBASE-LR4 receive characteristics

Description	40GBASE-LR4	Unit
Signaling speed per lane	10.3125 ±100ppm	GBd
Lane wavelengths (range)	1264.5 – 1277.5 1284.5 – 1297.5 1304.5 – 1317.5 1324.5 – 1337.5	nm
Average receive power, per lane (max) [a]	2.3	dBm
Average receive power, per lane (min) [b]	-13.7	dBm
Receive sensitivity (OMA), per lane (max)	-11.5	dBm
Return loss (min)[c]	-26	dB
Stressed receive sensitivity (OMA), per lane (max) [d]	-9.9	dBm
Vertical eye closure penalty, per lane [f]	1.6	dB
Receive electrical 3 dB upper cutoff frequency, per lane (max)	12.3	GHz

[a] The receiver shall tolerate, without damage, the Average Receive Power (max) plus 1 dB

[b] Informative, equals min Tx OMA with infinite ER and max channel insertion loss

[c] Prevents excess coherent interference due to Tx Rx reflectance

[d] Measured with conformance test signal at TP3 for BER = 10^{-12}

[f] Informative. Penalty for testing stressed receiver sensitivity

40GBASE-LR4 link power budget

Description	40GBASE-LR4	Unit
Power budget	9.0	dB
Operating distance	10	km
Channel insertion loss [a]	6.7	dB
Maximum Discrete Reflectance (max)	-26	dB
Allocation for penalties (TDP (max)) [b]	2.3 [c]	dB
Additional insertion loss allowed	0.0	dB

[a] Channel insertion loss includes fiber and connector losses for worst case wavelength lane

[b] Dispersion and other penalties for worst case wavelength lane

[c] Assumes Ts = 40ps, 1.6dB ISI Penalty, 0.7dB other penalties.