40GBASE-LR4 Specification Proposal

IEEE 802.3ba Task Force

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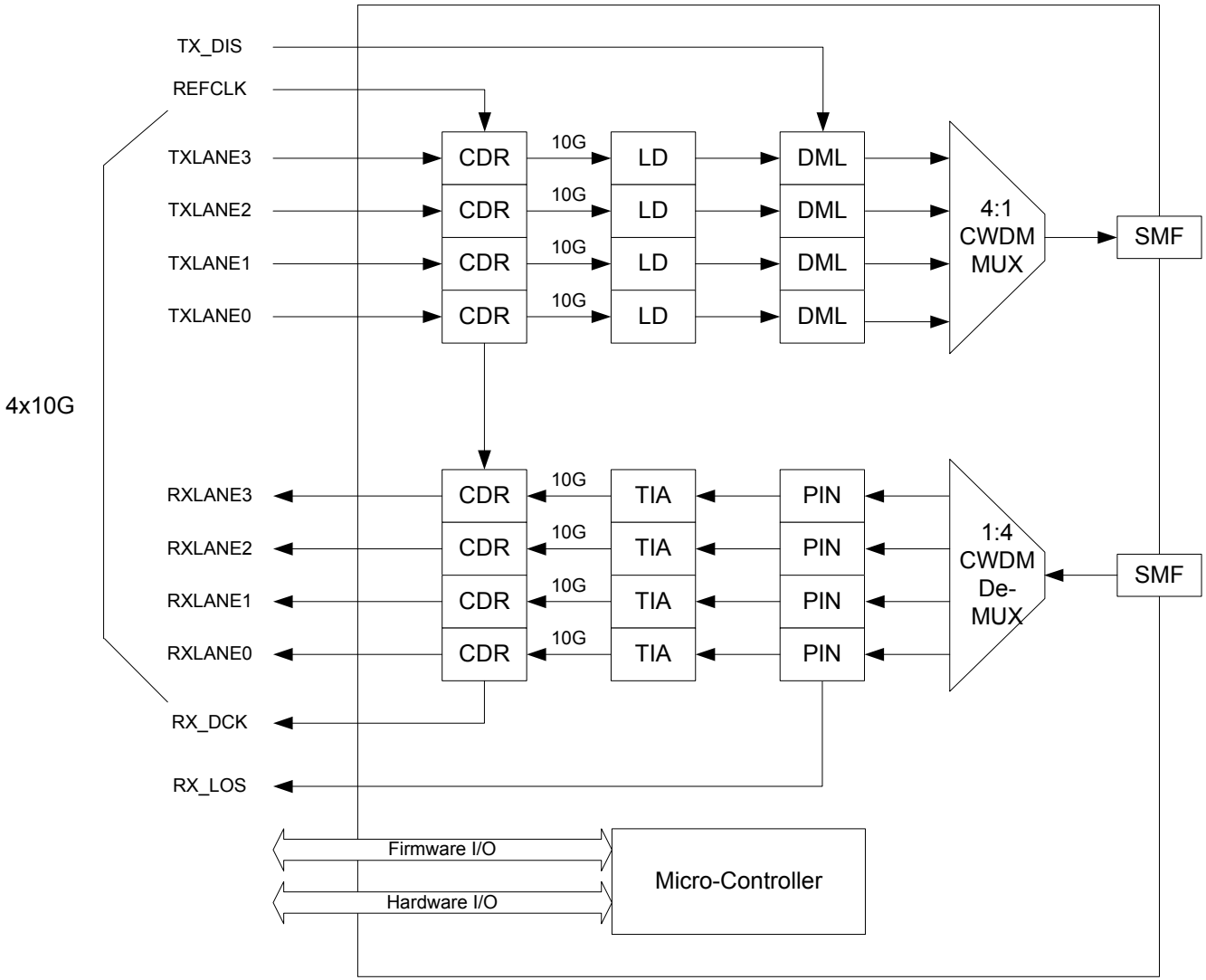
Introduction

- This Specification 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.
- 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 40GE 10km SMF PMD objective, but does not necessarily imply exact agreement with every specification number.

Example 10km 1310nm DML 4x10G Implementation



This block diagram is informative only. The specification proposal applies to the optical interface.

For example, the CDR location inside the block is not a requirement of the specification. An alternate block diagram, with no re-timing inside is equally acceptable, if optical specifications are met.

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)	8.0	dBm
Average launch power per lane (max)	2.0	dBm
Average launch power per lane (min)[b]	-6.8	dBm
Optical Modulation Amplitude (OMA) - TDP, per lane (min)	-4.8	dBm
Optical Modulation Amplitude (OMA), per lane (min)	-3.8	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)[c]	-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 (Not shown is OMA, per lane (min) + TDP (max) = -2.5dBm)

[c] RIN is scaled by 10*log(10/4) to maintain SNR out of transmitter

[d] -12dB transmitter reflectance helps relax RX reflection spec

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]	2.0	dBm
Average receive power, per lane (min)[b]	-13.5	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	100GBASE-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.