Towards an 800G-LR4 IMDD Specification Consensus - July 2023 update

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Introduction

- This presentation is a status update on the 800GBASE-LR4 proposed specs in rodes_3dj_01_2305
- This presentation reviews the specs that have consensus among the authors, and outlines the specs with work that is underway
- We propose this specification as a baseline for 800GBASE-LR4 with further refinements based on contributions from the Task Force

Status Report

List of specs we have consensus on:

- Wavelength grid based on LWDM4
- Operating Distance 10km
- Use of Type 2 FEC based on patra_3dj_01b_2303
- Optical link budget= 6.3dB
- Tx and Rx specs achievable without APDs or SOAs:
  - Tx OMAmin @ maxTDECQ= 4.4dBm
  - SRS = -3dBm
- TDECQ max= 3.9dB
- Stronger receiver equalizer than 100G/Lane LR. rodes_3dj_01_2305
- Additional penalty allocations:
  - DGD=0.7 dB kuschnerov_3df_01b_221012
  - MPI = 0.4 dB kuschnerov_3df_02a_221012
  - FWM = 0 dB liu_3dj_01_2303, johnson_3dj_01a_230206
- Consider Statistical Approach for worst case chromatic dispersion (CDq) liu_3dj_optx_01_230427

Status Report

Specs with work underway and more consensus is needed:

- Current effort in ITU-T SG15 Q5 and IEC 86A WG1 to gather data from fiber vendors to support statistical model of chromatic dispersion.
  - Interim values for CDq are proposed in liu_3dj_01_2307, pending more detailed calculation from ITU-T
  - Are CDq limits for power budget and TDECQ compliance testing the same? Or additional allocation is needed?
- TDECQ reference equalizer
  - Is an FFE-only reference receiver enough to equalize CDq limits?
  - If not, should we include DFE or MLSE in the receiver? Stojanovic_3dj_01_2307
- Exact pre-FEC BER for optical PMD is pending further analysis from the task force

Even the specs with consensus are subject to change if needed based on new analysis and measurement data from the task force

Transmit Characteristics

Description	800G-LR4 proposal	Unit
Signaling rate, each lane (range)	113.4375	GBd
Modulation format	PAM4	
Lane wavelengths (range)	1294.6 to 1296.6 1299.1 to 1301.1 1303.6 to 1305.6 1308.1 to 1310.1	nm
Side-mode suppression ratio (SMSR), (min)	30	dB
Total average launch power (max)	11.5	dBm
Average launch power, each lane (max)	5.5	dBm
Average launch power, each lane (min)	-0.9	dBm
Outer Optical Modulation Amplitude (OMAouter), each lane (max)	5.7	dBm
Outer Optical Modulation Amplitude (OMAouter), each lane (min) for TDECQ <1.4 dB for 1.4 dB ≤ TDECQ ≤ 3.9 dB	 1.9 0.5+TDECQ	 dBm dBm
Difference in launch power between any two lanes	3	dB
Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane (max) *	3.9	dB
Transmitter eye closure for PAM4 (TECQ), each lane (max)	3.2	dB
|TDECQ-TECQ| (max)	2.5	dB
Over/under-shoot (max)	22	%
Transmitter power excursion (max)	3.1	
Extinction ratio, each lane (min)	3.5	dB
Transmitter transition time (max)	13	ps
Average launch power of OFF transmitter, each lane (max)	-16	dBm
$RIN_{15.6}OMA$ (max)	-139	dB/Hz
Optical return loss tolerance (max)	15.6	dB
Transmitter reflectance (max)	-26	dB

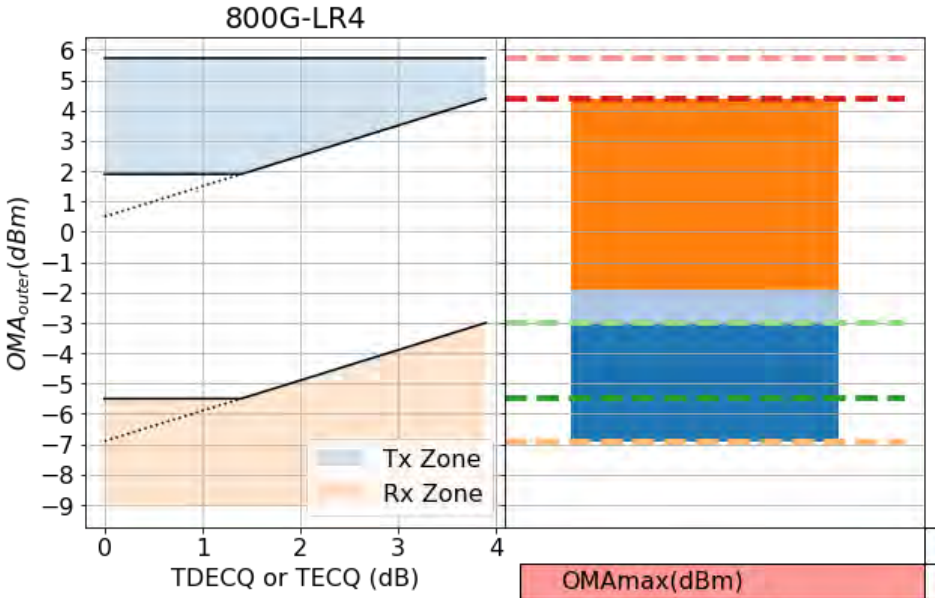
*Measured with a TBD reference equalizer

Receive Characteristics

Description	800G-LR4 proposal	Unit
Signaling rate, each lane (range)	113.4375	GBd
Modulation format	PAM4	
Lane wavelengths (range)	1294.6 to 1296.6 1299.1 to 1301.1 1303.6 to 1305.6 1308.1 to 1310.1	nm
Damage threshold, each lane	6.5	dBm
Average receive power, each lane (max)	5.5	dBm
Average receive power, each lane (min)	-8	dBm
Receive power (OMAouter), each lane (max)	5.7	dBm
Difference in receive power between any two lanes (OMAouter) (max)	3.3	dB
Receiver reflectance (max)	-26	dB
Receiver sensitivity (OMAouter), each lane (max) for TECQ <1.4 dB for 1.4 dB ≤ TECQ ≤ 3.9 dB	 -5.5 -6.9 + TECQ	 dBm dBm
Stressed receiver sensitivity (OMAouter), each lane (max)	-3	dBm
Conditions of stressed receiver sensitivity test:		
Stressed eye closure for PAM4 (SECQ), lane under test *	3.9	dB
OMAouter of each aggressor lane	1.3	dBm

*Measured with a TBD reference equalizer

Tx & Rx specs



	800G-LR4
OMAmax(dBm)	5.7
OMA-TDECQ(dBm)	0.5
OMAmin@TDECQmax(dBm)	4.4
SRS(dBm)	-3.0
Rx Sens (TECQ <= 1.4dB)	-5.5
RSnominal(dBm)	-6.9
OpticalLossBudget	6.3
AdditionalPenalties	1.1
TDECQmax	3.9
PowerBudget	11.3

Link Power Budget

Parameter	800G-LR4 proposal	Unit
Power budget (for maximum TDECQ)	11.3	dB
Operating Distance	10	km
Channel insertion loss	6.3	dB
Maximum discrete reflectance	-35	dB
Allocation for penalties (for maximum TDECQ) *	5	dB

*DGD=0.7dB and MPI= 0.4dB , kuschnerov_3df_01b_221012, kuschnerov_3df_02a_221012

Transmitter compliance channel specifications

Dispersion*		Max mean DGD
Minimum	Maximum	
-19.6ps/nm	+3ps/nm	TBD

* liu_3dj_01_2307

Conclusion

We have presented a status report on the consensus effort to propose an 800GBASE-LR4 baseline

- The consensus baseline proposal has TBD on:
  - Reference equalizer
  - CDq min and max
  - Max mean DGD
  - Pre-FEC BER

We expect further refinement as the task force progresses and more data comes available