Baseline Proposals for 800GE Over Eight Fiber Pairs for 500m and 2km

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Disclaimers and Assumptions

- **This is not a nomenclature presentation**. For the purpose of this presentation the following nomenclature is being used:
  - Eight lanes over 500m of parallel SMF = 800G-DR8
  - Eight lanes over 2km of parallel SMF = 800G-DR8+
- It is expected that the task force will adopt different nomenclature for the 2km reach objective
- **This is not an FEC presentation**. It is assumed (and recommended) that the per lane speeds and FEC coding gain are consistent with prior 100G/L standards.

Objectives of Interest

- Define a physical layer specification that supports 800 Gb/s operation:
  - Over 8 pairs of SMF with lengths up to at least 500 m
  - Over 8 pairs of SMF with lengths up to at least 2 km

Background

- Intent is to build from existing 100G/L standards, in particular:
  - 800G-DR8 (500m) : 400GBASE-DR4 and 100GBASE-DR
  - 800G-DR8+ (2km): 100GBASE-FR1

- Reasons for doing so:
  - Leverage industry development in existing 100G/L products, which already includes “2x400G-DR4/DR4+” optical modules (800G total throughput)
  - Enable breakout to existing 400G and 100G solutions/standards

- Update/reconciliation of specs will be applied where appropriate
  - Example: *TDECQ-10log(Ceq)* spec replaced with *Transmitter over/under-shoot*

Proposed Transmitter Specifications

Description	800G-DR8	800G-DR8(+)	Unit
Signaling rate, each lane (Range)	53.125 ± 100 ppm	53.125 ± 100 ppm	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	1304.5 to 1317.5	nm
Side-mode suppression ratio (SMSR), (min)	30	30	db
Average launch power, each lane (max)	4	4	dBm
Average launch power, each lane (min)	-2.9	-3.1	dBm
Outer Optical Modulation Amplitude (OMA_{outer}), each lane(max)	4.2	4.2	dBm
Outer Optical Modulation Amplitude (OMA_{outer}), each lane(min) for TDECQ < 1.4dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	 -0.8 -2.2+TDECQ	 -0.1 -1.5+TDECQ	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	3.4	3.4	dB
TECQ (max)	3.4	3.4	dB
| TDECQ - TECQ| (max)	2.5	2.5	dB
Average launch power of OFF transmitter, each lane (max)	-15	-15	dBm
Extinction ratio, each lane, (min)	3.5	3.5	dB
Transmitter transition time (max)	17	17	ps
Transmitter over/under-shoot (max)	22	22	%
Transmitter peak-to-peak power (max)	5	5	dBm
RIN_x OMA (max)	-136	-136	dB/Hz
Optical return loss tolerance (max)	21.4	21.4	dB
Transmitter reflectance (max)	-26	-26	dB

Proposed Receiver Specifications

Description	800G-DR8	800G-DR8(+)	Unit
Signaling rate, each lane (Range)	53.125 ± 100 ppm	53.125 ± 100 ppm	GBd
Modulation Format	PAM4	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5 nm	1304.5 to 1317.5 nm	nm
Damage threshold, each lane	5	5	dBm
Average receive power, each lane (max)	4	4	dBm
Average receive power, each lane (min)	-5.9	-7.1	dBm
Receive power, each lane (OMA_{outer}) (max)	4.2	4.2	dBm
Receiver reflectance (max)	-26	-26	dBm
Receiver sensitivity (OMA_{outer}), each lane (max) for TDECQ < 1.4dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	 -3.9 -5.3+TECQ	 -4.5 -5.9+TECQ	dBm
Stressed receiver sensitivity (OMA_{outer}), each lane (max)[†]	-1.9	-2.5	dBm
Conditions of stressed receiver sensitivity test:			
SECQ[†]	3.4	3.4	dBm
OMA_{outer} of each aggressor lane	4.2	4.2	dBm

Proposed Link Budget

Description	800G-DR8	800G-DR8(+)	Unit
Power budget (for max TDECQ) for extinction ratio ≥ 4.5 dB for extinction ratio < 4.5 dB	 6.4 6.5	 7.7 7.8	dB
Operating distance	500	2000	m
Channel insertion loss	3	4	dB
Maximum discrete reflectance	See Table	See Table	dB
Allocation for penalties (for max TDECQ) for extinction ratio ≥ 4.5 dB for extinction ratio < 4.5 dB	 3.4 3.5	 3.7 3.8	dB
Additional insertion loss allowed	0	0	dB

Number of discrete reflectances above -55dB	800G-DR8	800G-DR8(+)	Unit
1	-25	-25	dB
2	-31	-31	dB
4	-35	-35	dB
6	-38	-38	dB
8	-40	-40	dB
10	-41	-41	dB

Skew Considerations for 2km

From 400GE

	Maximum Skew (ns)	Maximum Skew Variation (ns)	Location
SP1	29	0.2	PMA
SP2	43	0.4	PMD Service Interface
SP3	54	0.6	MDI
SP4	134	3.4	MDI
SP5	145	3.6	PMD Service Interface
SP6	160	3.8	PMA
PCS	180	4	At PCS Receive

Max fiber skew = 80 ns

- Skew values in parallel fiber generally depend on how it is bent.
- Skew for unbent fiber usual low ~ 3ps/m ~ 6ns for 2km
- Bent fiber can be considerably higher (up to ~ 45 ps/m), however that would only be expected to occur over a short net effective length out of a 2km span.
- Up to 40 ps/m total effective skew could be accommodated while still meeting 80ns total skew budget
- Note: Above data was collected for 12f ribbons, 16f ribbons as would be required for 800G-DR8+ warrant further investigation and modeling.

Motivations for 500m **AND** 2km

- Market exists for both 500m and 2km reaches:
  - For different network tiers (with 500m generally being used for lower tiers)
  - For different datacenters sizes (with 500m used for smaller datacenters)
  - For different cost optimizations (500m generally being used in more cost sensitive links)
  - Predominant losses/reaches are usually less than 3dB, so standardizing for only 4+ dB would be a poor economic choice
- Optics supply base benefits from having close “companion” standards/solutions.
  - Optics have “long tails”, such that the margin required to manage worst case performance is often considerable
  - Ability to yield/bin optical modules into different reach classes mitigates this effect, allowing for more aggressive designs with better power, cost, capacity, etc.

Other Consideration

- Nowell_3df_01_220118 asked if there was interest to codify “400G-DR4+” into this project.

- Proposal for “800G-DR8+” could easily be adapted to this application if the task force so desires.

- Currently 400G-DR4+ is used extensively by webscale DC operators, who manage their own specifications (always some variant of 4x100G-FR1). Adoption by smaller DC operators and other markets likely streamlined with targeted IEEE spec.

Recommendations

- Adopt both “800G-DR8” and “800G-DR8+” as baselines to satisfy the eight lane 500m and 2km objectives.

- Leverage existing 100G/L standards where possible/reasonable to maximize technology re-use and breakout compatibility.

Thank You