

400GBASE-DR4-2 Baseline Proposal

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Overview/Background

- **This is not a nomenclature presentation.** For the purpose of this presentation 400GBASE-DR4-2 nomenclature is being used.
- **Objective of Interest:** Define a physical layer specification that supports 400 Gb/s operation over 4 pairs of SMF with lengths up to at least 2 km
- Intent is to build from existing 100G/L standards, in particular 400GBASE-DR4 and 100GBASE-FR1
- Update/reconciliation of specs will be applied where appropriate
 - Example: *TDECQ-10log(Ceq)* spec replaced with *Transmitter over/under-shoot*
 - Editors discretion requested for further reconciliation as appropriate

Proposed Transmitter Specifications

Description	400GBASE-DR4-2	Unit
Signaling rate, each lane (Range)	53.125 ± 100 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5	nm
Side-mode suppression ratio (SMSR), (min)	30	dB
Average launch power, each lane (max)	4	dBm
Average launch power, each lane (min)	-3.1	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(max)	4.2	dBm
Outer Optical Modulation Amplitude (OMA _{outer}), each lane(min) for TDECQ < 1.4dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	-0.1 -1.5+TDECQ	dBm
Transmitter and dispersion eye closure (TDECQ), each lane (max)	3.4	dB
TECQ (max)	3.4	dB
TDECQ - TECQ (max)	2.5	dB
Average launch power of OFF transmitter, each lane (max)	-15	dBm
Extinction ratio, each lane, (min)	3.5	dB
Transmitter transition time (max)	17	ps
Transmitter over/under-shoot (max)	22	%
RIN _x OMA (max)	-136	dB/Hz
Optical return loss tolerance (max)	21.4	dB
Transmitter reflectance (max)	-26	dB

Proposed Receiver Specifications

Description	400GBASE-DR4-2	Unit
Signaling rate, each lane (Range)	53.125 ± 100 ppm	GBd
Modulation Format	PAM4	
Lane wavelengths (range)	1304.5 to 1317.5 nm	nm
Damage threshold, each lane	5	dBm
Average receive power, each lane (max)	4	dBm
Average receive power, each lane (min)	-7.1	dBm
Receive power, each lane (OMA _{outer}) (max)	4.2	dBm
Receiver reflectance (max)	-26	dBm
Receiver sensitivity (OMA _{outer}), each lane (max) for TDECQ < 1.4dB for 1.4 dB ≤ TDECQ ≤ 3.4 dB	-4.5 -5.9+TECQ	dBm
Stressed receiver sensitivity (OMA _{outer}), each lane (max) [†]	-2.5	dBm
Conditions of stressed receiver sensitivity test:		
SECQ [†]	3.4	dBm
OMA _{outer} of each aggressor lane	4.2	dBm

Proposed Link Budget

Description	400GBASE-DR4-2	Unit
Power budget (for max TDECQ)	7.8	dB
Operating distance	2000	m
Channel insertion loss	4	dB
Maximum discrete reflectance	See Table	dB
Allocation for penalties (for max TDECQ)	3.8	dB
Additional insertion loss allowed	0	dB

Number of discrete reflectances above -55dB	400GBASE-DR4-2	Unit
1	-25	dB
2	-31	dB
4	-35	dB
6	-38	dB
8	-40	dB
10	-41	dB

Recommendation

- Adopt “400GBASE-DR4-2” as the baseline proposal to satisfy the objective to “define a physical layer specification that supports 400 Gb/s operation over 4 pairs of SMF with lengths up to at least 2 km”.

Thank You

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 $\sim 3\text{ps/m} \sim 6\text{ns}$ for 2km
- Bent fiber can be considerably higher (up to $\sim 45\text{ps/m}$), 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