

Proposal of 8 x 50G NRZ specification for 400GbE 10km PMD

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Introduction

- 50Gb/s NRZ is the best option for 400GbE PMD because of the advantage in the link budget below.

Delta of link budget from 100GBASE LR4 (Preliminary)

	100GBASE LR4	8x50G NRZ	8x50G PAM4	4x100G PAM4	4x100G DMT
MUX/DEMUX ^(a)	-	2.0	2.0	0	0
Coding ^(a)	-	0	5.0	5.0	9+ α
Non-linearity ^(b,c)	-	0	1.0	1.0	0
MPI ^(b)	-	0.3	1.2	1.2	0
Quantization ^(a)	-	0	0.5	0.5	0.5
BW penalty ^(a)	-	1.5	0	1.5	- α

(a) cole_02_0814_smf

(b) xu_3bs_01_0714

(c) zhu_3bs_01a_0514

- 50G NRZ demonstrated fine Rx sensitivity without BER floor problem using 40nm CMOS IC and commercially available 40G optical components (wen_3bs_01_1114).
- This contribution provides loss budget considerations and baseline proposal of 8 x 50G NRZ for 10 km.

Assumptions

- Output power pre-Mux: <math> < 3.3\text{dBm}</math> at $E_r = 6\text{dB}$ (shirao_3bs_01_0914)
- Link loss: 6.4dB for 10 km (kolesar_3bs_01_0514)
- MPI penalty: 0.3dB for NRZ (zhu_3bs_01a_0514)
- TDP: 2.3dB for 10km (cole_01a_1014_smf)
- 8:1 Mux/Demux insertion loss: 3dB each (cole_01a_1014_smf)
- Wavelength allocation: 8 wavelength with blue band extension of 100GBASE LR4. 10 nm gap between L3 and L4
- Evaluated Rx sensitivity at $\text{BER} = 1\text{e-}3$ (wen_3bs_01_1114):

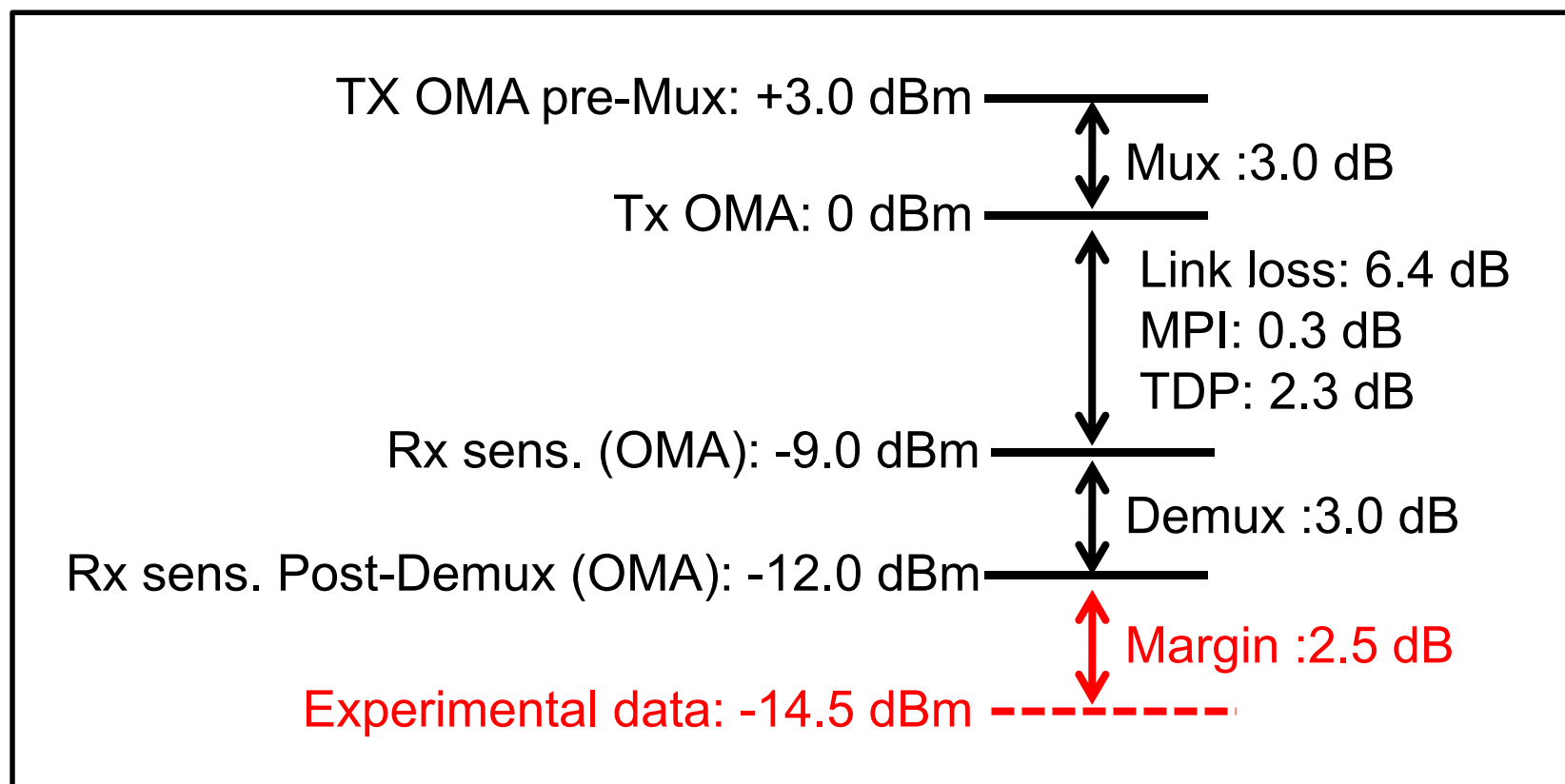
-16.6dBm in average power at $E_r = 9.6\text{dB}$



-14.5dBm in OMA

Loss budget consideration (10km)

- Margin of 2.5dB between this proposal and experimental data (wen_3bs_01_1114).
- 8 x 50G NRZ is robust and realistic option for 400GbE 10km PMD



Wavelength assignment

- 8 wavelength with blue band extension of LAN-WDM allocation. A 10 nm gap between L3 and L4 enables use of dual 4-lane TOSA/ROSA with external optical Mux/Demux for early adopters.

Lane	Center frequency	Center wavelength	Wavelength range
L ₀	235.6 THz	1272.46 nm	1271.41 to 1273.51 nm
L ₁	234.8 THz	1276.80 nm	1275.75 to 1277.85 nm
L ₂	234 THz	1281.16 nm	1280.11 to 1282.21 nm
L ₃	233.2 THz	1285.56 nm	1284.51 to 1286.61 nm
L ₄	231.4 THz	1295.56 nm	1294.51 to 1296.61 nm
L ₅	230.6 THz	1300.05 nm	1299.00 to 1301.10 nm
L ₆	229.8 THz	1304.58 nm	1303.53 to 1305.63 nm
L ₇	229 THz	1309.14 nm	1308.09 to 1310.19 nm



10nm gap

Link power budget

Parameter	400GbE 10km	Unit
Power budget (for maximum TDP)	9.0	dB
Operation distance	10	km
Channel insertion loss	6.4	dB
MPI penalty	0.3	dB
Maximum discrete reflectance	-26	dB
Allocation for penalties (for maximum TDP)	2.3	dB

Transmit characteristics

Description	400GbE 10km	Unit
Signaling rate, each lane	55.9375 (BCH FEC)	GBd
Lane wavelengths	1271.41 to 1273.51 1275.75 to 1277.85 1280.11 to 1282.21 1284.51 to 1286.61 1294.51 to 1296.61 1299.00 to 1301.10 1303.53 to 1305.63 1308.09 to 1310.19	nm
Side-mode suppression ratio (SMSR), min	30	dB
Optical Modulation Amplitude (OMA), each lane (min)	0	dBm
Launch power in OMA minus TDP, each lane (min)	-2.3	dBm
TDP, each lane (max)	2.3	dB
Extinction ratio (min)	6	dB
RIN20 OMA	TBD	dB/Hz
Optical return loss tolerance (max)	20	dB
Transmitter reflectance (max)	-12	dB

Receive characteristics

Description	400GbE 10km	Unit
Signaling rate, each lane	55.9375 (BCH FEC)	GBd
Operation BER	1E-3	
Lane wavelengths	1271.41 to 1273.51 1275.75 to 1277.85 1280.11 to 1282.21 1284.51 to 1286.61 1294.51 to 1296.61 1299.00 to 1301.10 1303.53 to 1305.63 1308.09 to 1310.19	nm
Receiver reflectance (max)	-26	dB
Receiver sensitivity (OMA), each lane (max)	-9.0	dB

Thank you