Technical Feasibility to Support 200GE 40km Objective

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Background and Motivation

- In "wang_b10k_01_1117":
  - Analysis on technical feasibility of 40km objective in 50/200/400GbE from enhanced EML/APD/FEC
- In straw poll #2 of Nov meeting, showing need more information on 40km of 200/400GbE with 50Gbps PAM4 approach

Straw Poll #2

- I believe a PAM4 approach, based on 50 Gb/s PAM4, targeting 40km would be technical feasible at
- Results

• 50 Gb/s	Yes	56	No	0	Need more info	6
• 200 Gb/s	Yes	41	No	1	Need more info	17
• 400 Gb/s	Yes	24	No	3	Need more info	34

- This contribution further addresses technical feasibility considerations from enhanced EML/APD side for PHYs/PMDs with up to 40km reach addressing objectives for 200GbE

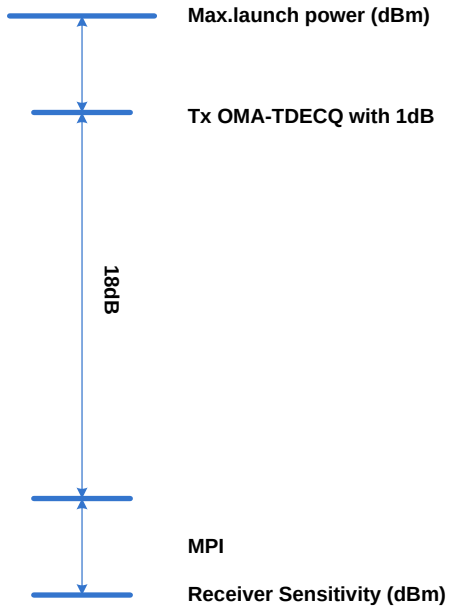
Assumption for 40km Reach Link Characteristics

- Refer to 802.3ba 100GBASE-ER4, suggest 40km reach link budget consistence with following table to enable new 40km standard defined product to be easy plug and play to upgraded current 100GE 40km link

Table 88–14—Fiber optic cabling (channel) characteristics

Description	100GBASE–LR4	100GBASE–ER4		Unit
Operating distance (max)	10	30	40	km
Channel insertion loss[a, b] (max)	6.3	18	18	dB
Channel insertion loss (min)	0	0		dB
Positive dispersion[b] (max)	9.5	28	36	ps/nm
Negative dispersion[b] (min)	–28.5	–85	–114	ps/nm
DGD_max[c]	8	10.3	10.3	ps
Optical return loss (min)	21	21	21	dB

[a]These channel insertion loss values include cable, connectors, and splices.
[b]Over the wavelength range 1294.53 nm to 1310.19 nm
[c]Differential Group Delay (DGD) is the time difference at reception between the fractions of a pulse that were transmitted in the two principal states of polarization of an optical signal. DGD_max is the maximum differential group delay that the system must tolerate.



- So, proposed 40km objective is actually 30km transmission with 3dB extra margin, which could be used for a 40km engineer transmission, without extra margin
- Comparing with 100GBASE-ER4, the link budget should consider extra value for TDECQ and MPI because of PAM4 modulation format

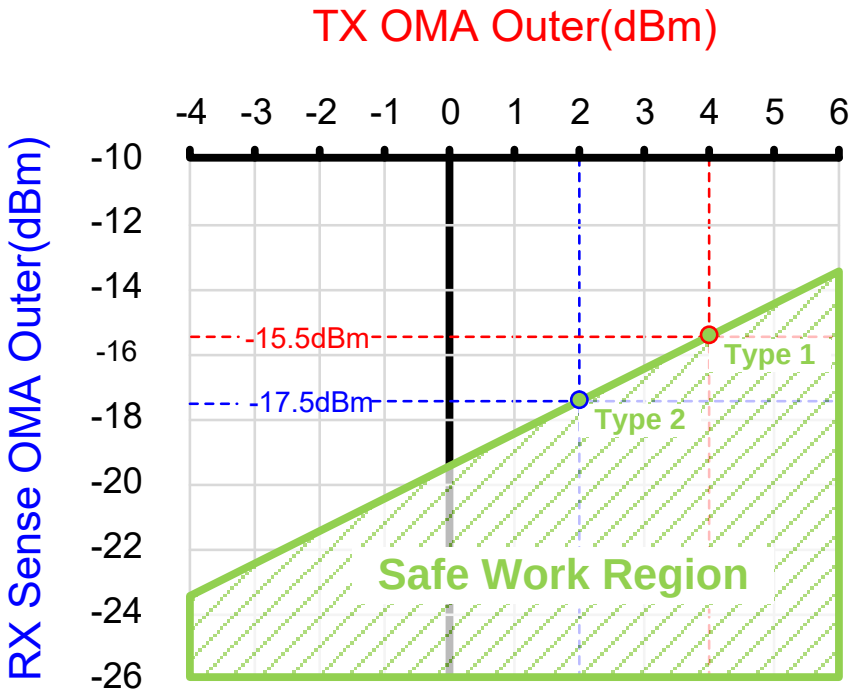
Technical Approach for 200GE 40km Reach Link Budget

- In the previous presentations, NTT, Lumentum and also Huawei had presented the test result of NX50G PAM4 on BER, transmitter output power, dispersion penalty, oMux/oDemux loss, sensitivity of APD-based ROSA, fiber dispersion and so on.
  - http://www.ieee802.org/3/B10K/public/17_09/lewis_b10k_01_0917.pdf
  - http://www.ieee802.org/3/B10K/public/17_09/yu_b10k_01_0917.pdf
  - http://www.ieee802.org/3/ad_hoc/ngrates/public/calls/17_0502/sone_nea_01a_170502.pdf
  - http://www.ieee802.org/3/ad_hoc/ngrates/public/calls/17_0502/yu_nea_01_170502.pdf
- Based on these test data, for 200GE 40km with 4X50G PAM4, the proposed link budget to support technical feasibility:

	Type 1	Type 2	Type 3
Tx OMA-TDECQ (dBm)	3	1	1
Fiber + Connector Loss (dB)	18	18	18
MPI (dB)	0.5	0.5	0.5
Receiver Sensitivity(dBm)	-15.5 @ 2.4e-4	-17.5 @ 2.4e-4	-17.5 @ ~1e-3
FEC Gain dB	3.2	3.2	4.5~5.2

Further Analysis of Type 1 and Type 2 in 200GE 40km

Potential Parameter for TX/RX



	TX_OMA_Outer (dBm)	
	Min	Max
Vendor 1	4.5	6.6
Vendor 2	6.2	7.1
Vendor 3	5.8	
Vendor 4	5.5	8.4
Vendor 5	4.0	7.0

	RX_OMA_Outer (dBm)	
	Min	Max
Vendor 1	-15.5	-18
Vendor 2	-16.6	-16.8
Vendor 3	-16.4	-17
Vendor 4	-17.1	
Vendor 5	-16.9	-17.5

- Data of Vendor 1 to 4 are from "wang_b10k_01d_1117". Data of Vendor 5 is latest test result. Different vendor from TX can interoperate with different vendor in RX.
- According to the test results, most of the commercial components could satisfy the SAFE work region between Type 1 and Type 2
- The whole thoughts would be reusing the mature 200GE LR4 components, to take new market with the lowest new research cost.

Summary

- This presentation only focus on the 200GbE analyze, and shows one of the solution's technical feasibility for 40km transmission
- Objective for Beyond 10 km PHY of 200GbE can be met with following:
  - Provide physical layer specifications which support 200 Gb/s operation over at least 40km of SMF
- 400GbE with 40km reach based on 8X50Gbps PAM4 analyze are still on going and it would include optical component performance, electrical FEC ability and also the tradeoff to support an objective with 40km reach


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
спасибо
obrigado
dziękuję
bedankt
merci
go raibh maith agat
mochchakkeram
tapadh leat
sukriya
kop khun krap
arigatō
dakujem
terima kasih
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