Application and Technical Feasibility to Support Bidirectional 10&40 km Optical PHY for 50GbE

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Supporters

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Background

- During IEEE 802 July plenary meeting，”Bidirectional 50Gb/s optical access PHYs call for interest” is discussed from 5G Mobile network application perspective as:
  - In the past, the IEEE 802.3 Ethernet Working Group has standardized bidirectional optical PHYs running at 100Mb/s and 1Gb/s over one single mode fiber, that are intended for optical access applications. Presently, the bidirectional 10 Gb/s and 25 Gb/s Optical Access PHYs Study Group has started. In the near future, due to the high bandwidth requirement of 5G mobile networks, bidirectional links running at 50 Gb/s will be needed. This Call for Interest is to assess the support for the formation of a study group to explore the development of 50Gb/s bidirectional optical access PHYs.

Motivation

- From Minutes of IEEE 802.3 Ethernet Working Group Plenary at San Diego ,

IEEE 802.3 Bidirectional 50 Gb/s optical access PHYs call for interest – Xinyuan Wang

Please see http://ieee802.org/3/minutes/jul18/0718_bidi_50_close_report.pdf.

Mr. Wang presented the results of the consensus meeting.

MOTION #25

Move that the IEEE 802.3 Working Group request the formation of a Study Group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for Bidirectional 10 Gb/s, 25 Gb/s and 50 Gb/s Optical Access PHYs Study Group.

M: X. Wang S: D. Ofelt

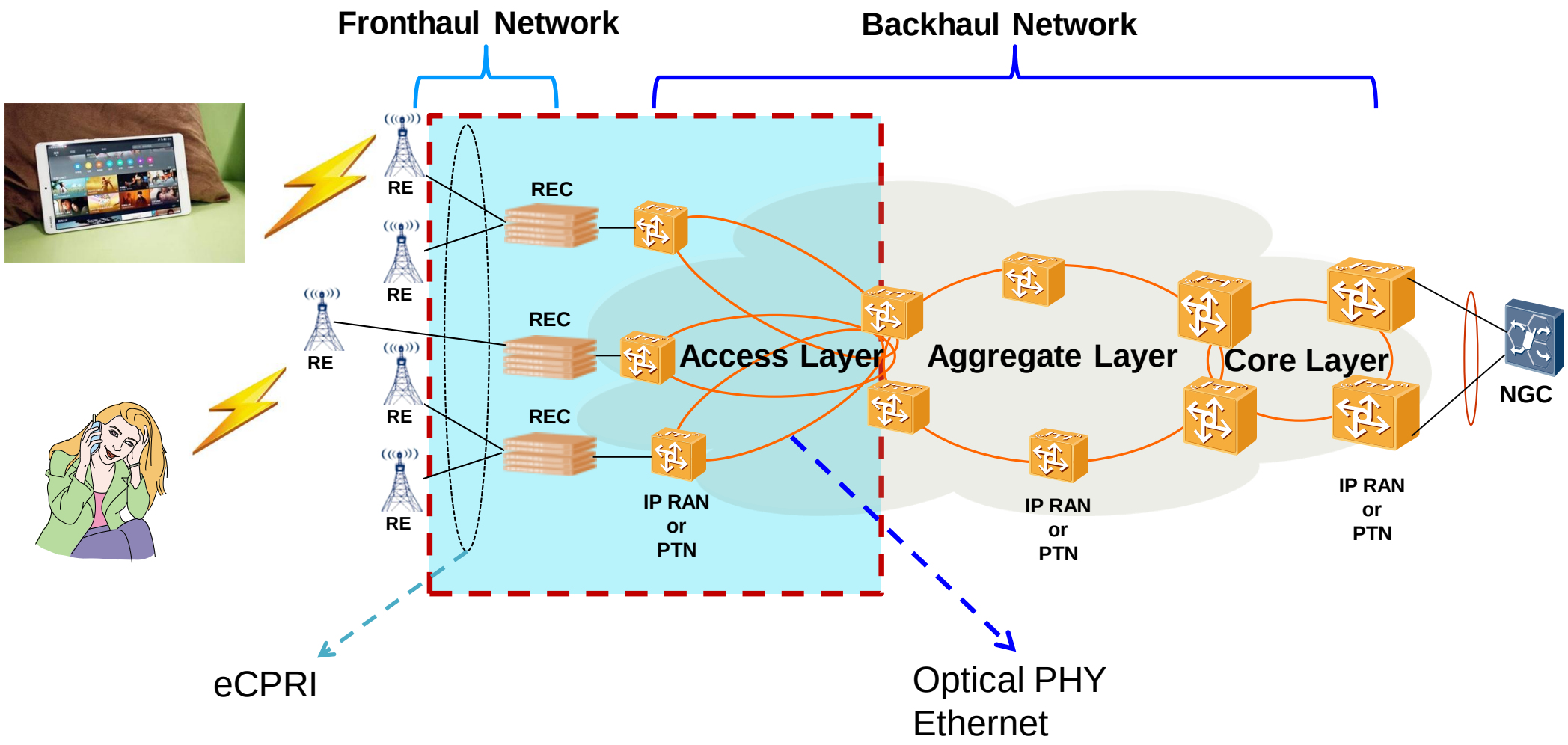
> 50%

Y: 68, N: 0, A: 8

Passed 12-Jul 2018, 5:37 pm

- To support consensus on reach objective for 50GbE BiDi PHYs , this presentation will share test data and analysis from technical feasibility perspective

Application of Mobile Fronthaul and Backhaul



- Potential growing diversity in bandwidth requirements, driven by specific network needs caused by emerging 5G applications. There are network operators who could use 50GbE bidirectional optics for their particular needs

Fiber Reach in 5G Mobile Network for 50GbE BiDi PHYs

- **For Fronthaul,** latency from REC to RE limit the acceptable fiber length, 10km to 20km is observated in centralized RAN (C-RAN).See: https://www.exfo.com/en/resources/blog/preparing-transport-network-for-5g/

- As potential relaxed latency requirement for fronthaul, extend reach is possible as for large scale Geographical area:

Table 1A Split E and splits I_D, II_D, I_U Latency classes for CoS 'High'

Latency Class	Maximum One-way Frame Delay Performance (see section Error! Reference source not found.)	Use case
High25	25 µs	Ultra-low latency performance
High100	100 µs	For full E-UTRA or NR performance
High200	200 µs	For installations where the lengths of fiber links are in the 40 km range
High500	500 µs	Large latency installations

http://www.ieee802.org/1/files/public/docs2018/cm-mustala-eCPRI-update-0718.pdf

- **For Backhaul**, from huang_ecdc_01_0716 of China Mobile, 10GbE with 10km and 40km reach is most popular deployed

Present status and forecast

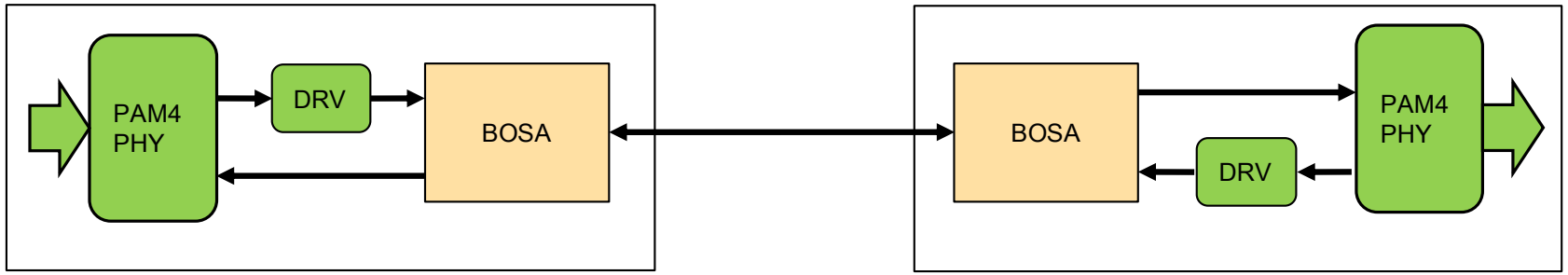
• According to our survey, long distance module is a mandatory requirement for us

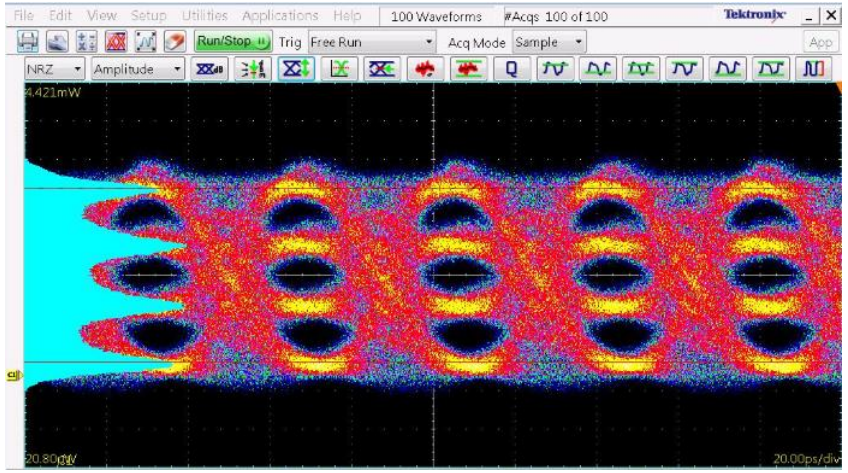
Statistics for 10GE & 100GE Modules used in PTN, as of June, 2016				
Transmission Distance	**<2km**	**10km**	**40km**	**80km**
10GE distribution	0.28%	44.46%	44.05%	11.20%
100GE distribution (more than 15K modules)	0	56.43%	34.59%	8.97%

Possible Wavelength for 50GbE BiDi Optical PHY

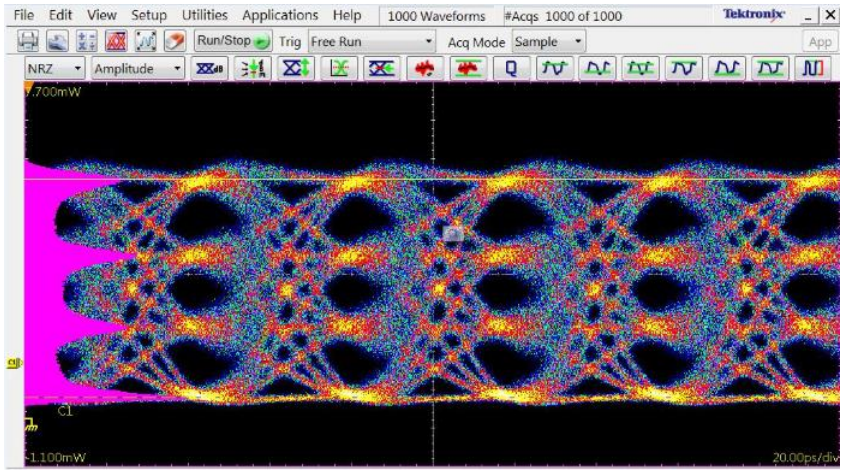
- Possible Wavelength for 10km fiber reach:
  - Wider spaced 1270nm/1330nm offer better technical and economic feasibility in support of short fiber reach scenario
- Possible Wavelength for 40km fiber reach:
  - 1290nm/1315nm with lower dispersion and high output power to improve yield is suggested for extend fiber reach applications, such as 40km

50GbE BiDi B2B Test Scenarios





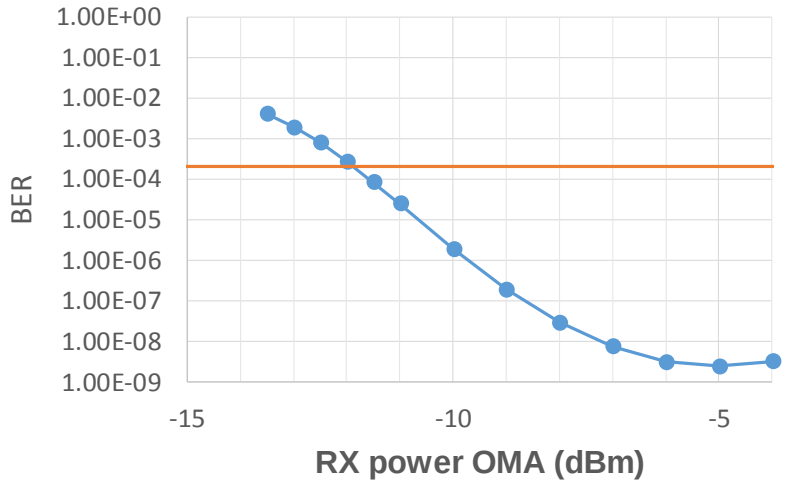
50GbE BiDi 10km Tx eye diagrams

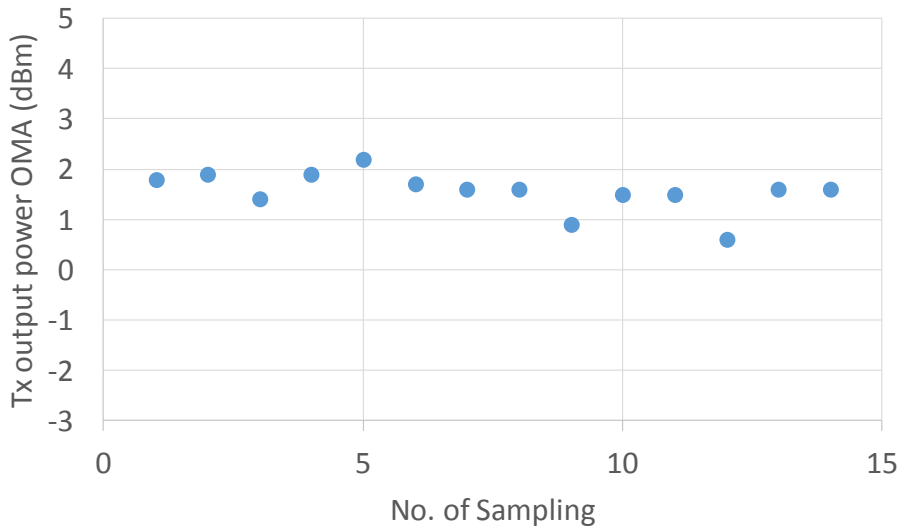


50GbE BiDi 40km Tx eye diagrams

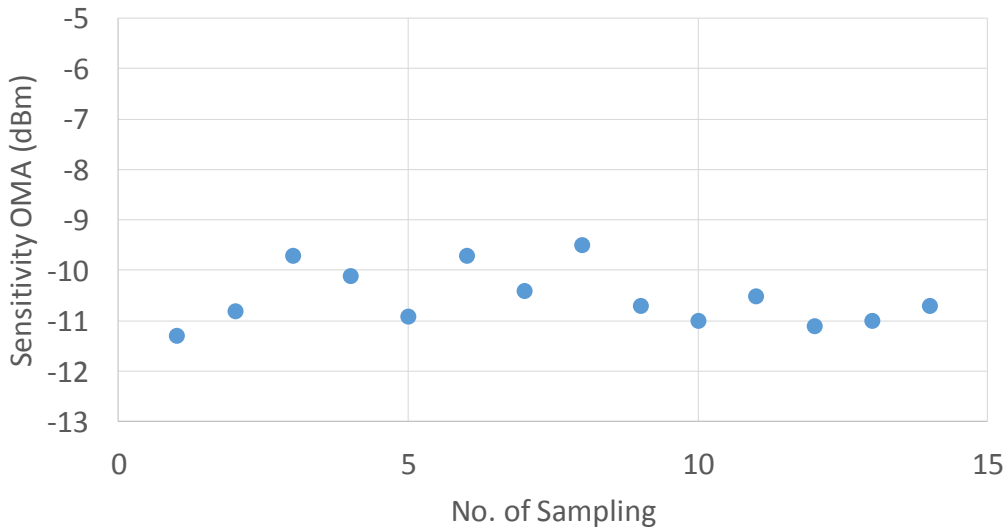
50GbE BiDi 10km B2B Test Results

- Test Scenarios:
  - BER Curve tested
  - Room temperature
  - PRBS Length: one line test (~PRBS31)
  - Wavelength: 1270nm/1330nm
  - Launch power in OMA each lane: ~+1.5dBm
  - Signaling rate lane: 26.5625Gbaud





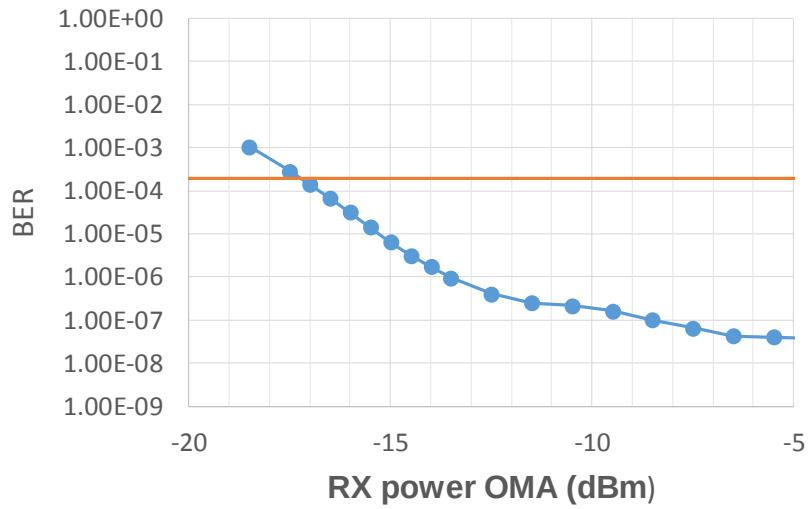
Tx output power tested

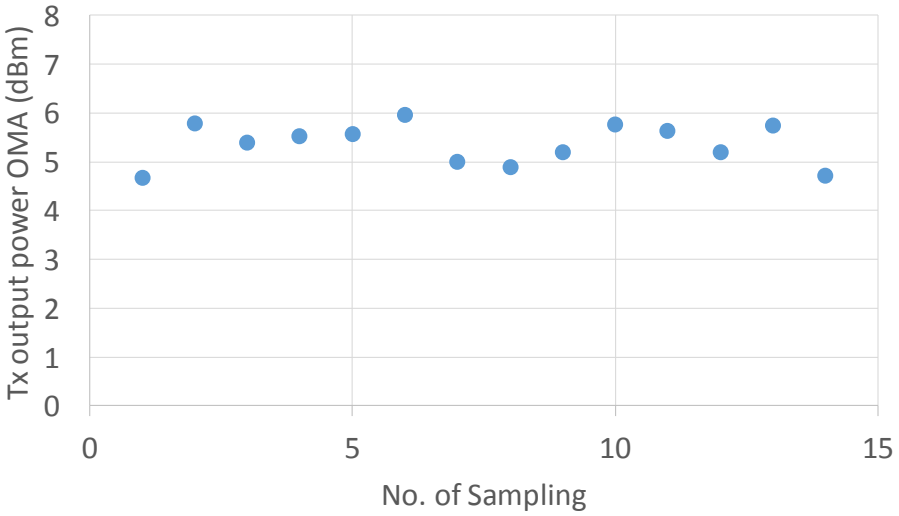


Rx sensitivity tested

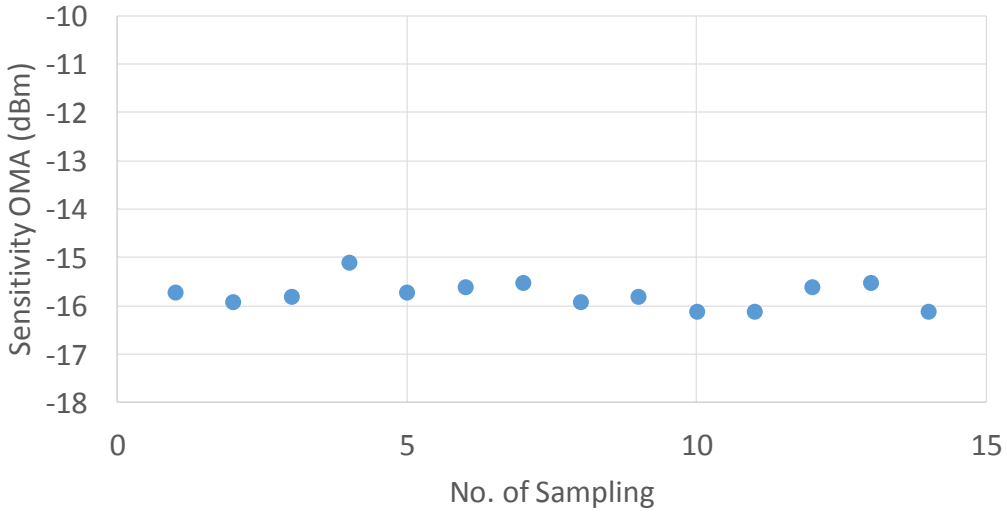
50GbE BiDi 40km B2B Test Results

- Test Scenarios:
  - BER Curve tested
  - Room temperature
  - PRBS Length: one line test (~PRBS31)
  - Wavelength: 1290nm/1315nm
  - Launch power in OMA each lane: ~+5dBm
  - Signaling rate lane: 26.5625Gbaud





Tx output power tested



Rx sensitivity tested

Optical Margin of 50GbE BIDI 10/40km Link Budget, tested

Description (Outer Eye)	10km Reach	30/40km Reach	Unit
Tx OMA_{outer}, tested	0.5	5.0	dBm
Reach	10	30/40	km
SECQ tested Tx	2	1.8	dB
Insertion loss	6.3	18	dB
CD penalty assumption	0.2	0.5	dB
MPI	0.5	0.5	dB
TDECQ assumed	2	2.3	dB
Receiver sensitivity OMA required @ SECQ = 1.4dB	-7.1	-14.4	dBm
Receiver sensitivity tested value @ SECQ = 2.0dB	-9.5	-15.0	dBm
Receiver sensitivity calculated from tested value @ SECQ = 1.4dB	-10.1	-15.4	dBm
Optical Margin	3	1	dB

- This table is just to verify the feasibility, not for specification suggestion. In real product, those numbers could be relaxed for yield.

Summary

- Based on the study and further potential improvement, we would like to recommend the following objectives for 50GbE Bidirectional Optical PHYs
  - Support bidirectional transmission over a single strand of single mode fiber
  - Define single lane 50 Gb/s PHYs for operation over at least 10 km
  - Define single lane 50 Gb/s PHYs for operation over at least 40 km


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
спасибо
dank je
tapadh leat
obrigado
dziękuję
bedankt
hvala
mauruuru
sukriya
kop khun krap
go raibh maith agat
arigatō
dakujem
terima kasih
grazie
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malondo
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