Further test results for 400GBASE-LR4

Yu Xu
Jialong Shuai
Xinyuan Wang

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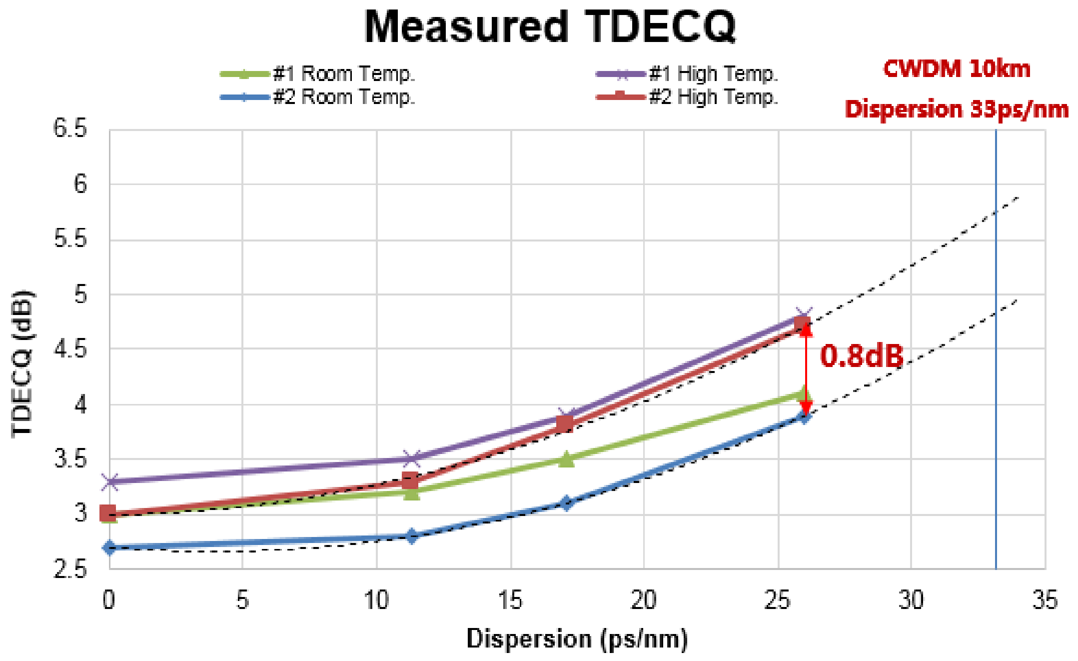
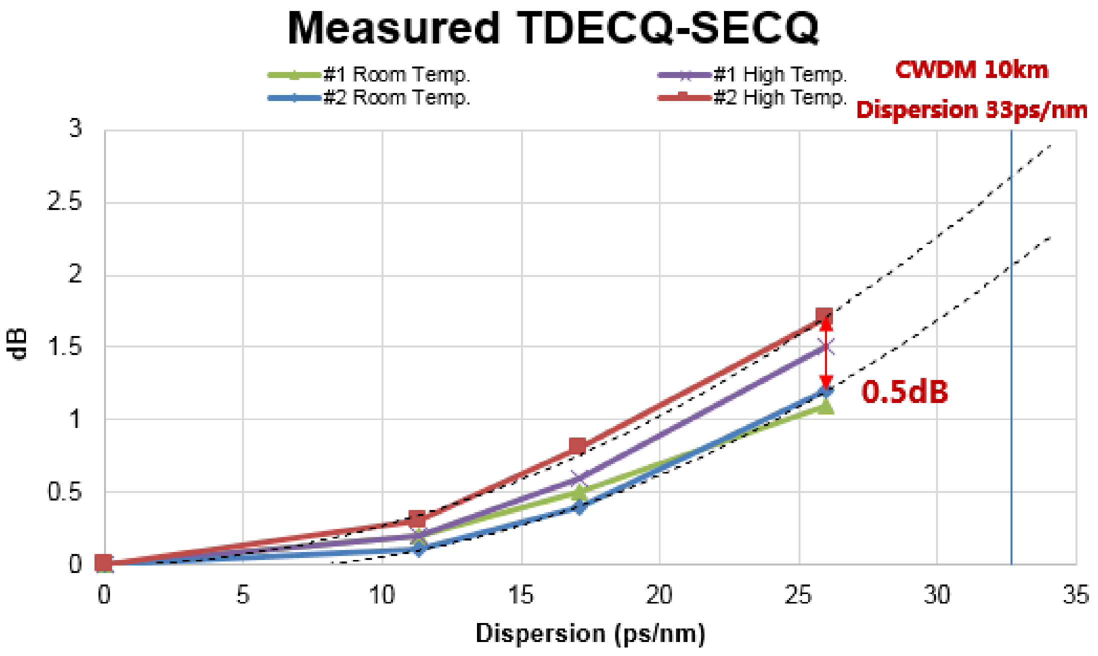
EML Transmitter at High Temperature

- Uncooled transmitters are tested with different chromatic dispersion in 1328nm, compared to the proposed spec in lewis_3cu_adhoc_061919_v2 :
  - The TDECQ is excessively high at 10km positive dispersion
  - The penalty introduced by high temperature is expected to be about 0.5dB
  - Optimization for best TDECQ will increase SECQ by at least 0.2dB





SiP Transmitter at Room Temperature

- In mazzini_3cu_adhoc_070319 and mazzini_3cu_adhoc_082119, a cooled SiP transmitter at a CWDM wavelength was tested with 10km worst case negative chromatic dispersion at room temperature, compared to the proposed spec in lewis_3cu_adhoc_061919_v2 :
  - The TDECQ value is 3.49dB with only 0.41dB margin
  - Tx OMA - TDECQ fails to meet the proposed spec due to insufficient optical launching power.
  - An additional penalty is expected to be introduced at high temperature;

	Measurement (BOL in lab)	Proposed Spec (EOL)	Margin
TX OMA (dBm)	2.23*	>0.5	
TDECQ – SECQ (dB)	2.03	--	
TDECQ (dB)	3.49	<3.9	0.41
TX OMA-TDECQ (dBm)	-1.26	>-0.9	-0.36

*TX AOP = 0dBm ER = 10.5dB

Appendix

AOP at TP2 = 0dBm

ER = 10.5dB

2019/7/4 (周四) 1:19

Marco Mazzini (mmazzini) <00000e5c2535a1ca-dmarc-request@ieee.org>

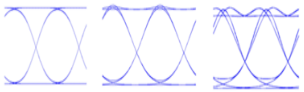
Re: [802.3_100G-OPTX] P802.3cu Task Force ad hoc meeting

收件人 STDS-802-3-100G-OPTX@LISTSERV.IEEE.ORG

转发该邮件的时间为 2019/7/4 11:03。

Hi Mike,
thank you for your question.

I think in this experiment it's just chromatic dispersion which tends to spread the impulse frequences and get the eye crossing points compressed towards the bottom.
I put below an example of an NRZ eye behavior for at 10Gb/s under chromatic dispersion, starting with 50% crossing points in back-to-back (left to right: BTB, 400 and 800ps/nm).



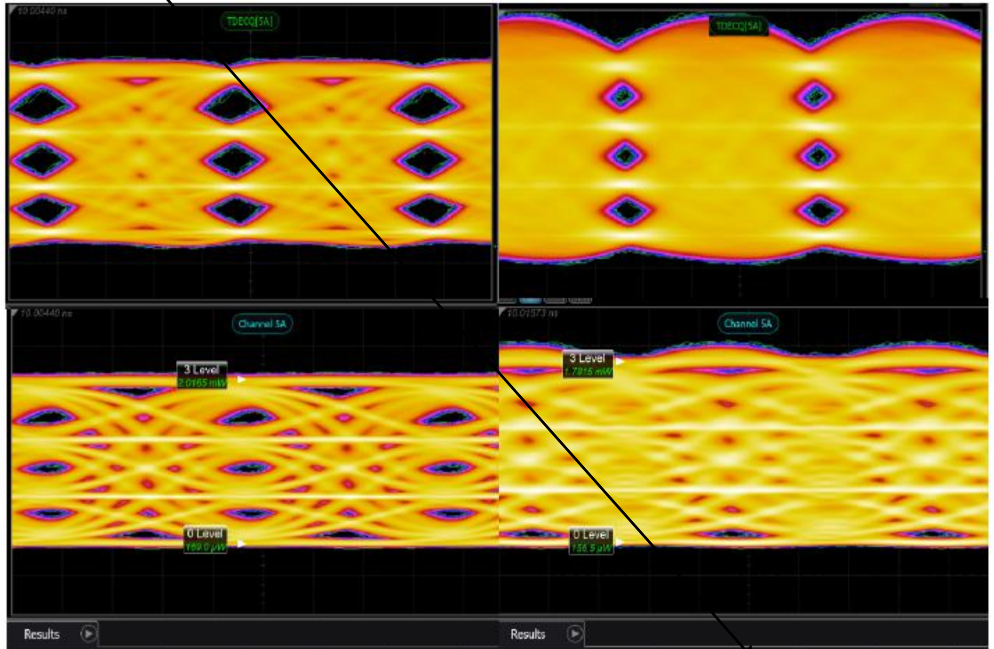
So if we consider a PAM4 eye that would suffer the same kind of distortion that we actually measured over different CD values, having less phase/amplitude margins on the top eye make sense to me.
This penalty is then partially recovered by the equalizer, but is where the bottom compression seem to make good job (I think optimum threshold for the mid-eye should move away from 50%, as well the bottom eye would go more towards the 0 level, so a real receiver, optimization should work better than the reference one).

As reported in slide 4, in the experiment I tried to keep myself always in the same identical input power for the PDFA pre-amplifier to avoid different noise on 2-3 levels (for this I always report 36dB OSNR for all test conditions).
As well I tried to ensure the input power to the fiber to be small enough (having ≈ 0dBm at TP2, I got max -1dBm into fiber when VOA=0, which correspond to the highest fiber loss case) to avoid SPM.
I also avoided to use narrow BW optical filter, which can also cause crossing points to drop too, paying a bit of penalty on overall system noise, but ensuring I wasn't overstressing the system.

Hope this answer your question, please let me know if there's something that I can do to improve for the next experiments in case.

Best regards
Marco

Bottom compression



Measurement		Current	Minimum	Maximum	Count
Outer ER	5A	10.77 dB	10.72 dB	10.80 dB	60
Ceq	F1	0.66 dB	0.66 dB	0.66 dB	60
RLM (802.3 CL_94)	F1	0.872	0.872	0.875	60
TDECQ	F1	1.53 dB	1.51 dB	1.53 dB	10

Measurement		Current	Minimum	Maximum	Count
Outer ER	5A	10.57 dB	10.55 dB	10.58 dB	59
Ceq	F1	1.12 dB	1.12 dB	1.12 dB	59
RLM (802.3 CL_94)	F1	0.927	0.926	0.927	59
TDECQ	F1	3.49 dB	3.29 dB	3.49 dB	10

Source: http://www.ieee802.org/3/cu/public/cu_adhoc/cu_archive/mazzini_3cu_adhoc_070319.pdf

Observation & Thoughts

- The TDECQ measurements for a SiP transmitter with CWDM grid indicate :
  - Small manufacturing margin (0.4dB) even at room temperature;
  - Insufficient power budget to close the 10km fiber transmission (0.36dB gap)
- The TDECQ of EML transmitters at CWDM grid are excessively high at 10km positive dispersion.
- Possible choices for 400GBASE-LR4:
  - Adopting CWDM as a baseline for 6.3dB loss with around 6-7km reach.
  - Adopting LWDM as a baseline for 10km reach.


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