Observations to the current baselines of 2km optical PMDs and proposal to update

Guangcan Mi
Huawei

Supporter

- Haifeng Liu, HG Genuine

Introduction

- 802.3dj adopted baselines for all 200G/lane optical PMDs, except for the newly added objective 800GBASE-FR4-500. The group has demonstrated great team work and spirits of compromise.
- The baselines provide the group with a good starting point, with the team knowing there will be technical debate to come regarding particular numbers.
- This contribution shares our observation to the baselines, specifically for 2km PMDs in welch_3dj_04_2311.pdf , and our proposal of updates.

Topic one: SER limit for TDECQ/TECQ

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	SER limit	
500m spec	4.8e-4	KP4 limitation, reference to clause 91/119， aligning with other earlier generations of optical spec, but may not be suitable for 800GE/1.6TE
2km spec	4e-3	Arbitrary number, no reference, unclear of reasoning.
10km spec	9.6e-3	KP4 + Inner FEC limitation, reference to the on-going logical work, related to the adopted FEC baseline. he_3dj_01a_2311.pdf

Things to consider

1. Technically relevant to other clauses/ technical aspects, so the readers and new comers could understand the standard
   - An example: before 802.3df added the note on the realtion between P_avg – OMA, I asked 5 different colleagues, no one can be certain of how exactly the numbers are correlated in 50G-PAM4 and 100G-PAM4 specs
2. Helps the industry to build cost-effective and robust products:
   - Simplify, not complicate the manufacturing—yes, I will play the manufacturing card again
   - Optoelectrical chips comes with artifacts, and manufacture process introduces flaws. It is no news to sort best, better and ok components and modules for different applications

Topic one: SER limit for TDECQ/TECQ

BER Threshold and Latency for Different FEC Schemes

Rate	Rate per lane	RS-FEC codeword interleaving	PCS latency (incl. Outer FEC) (ns)	Inner FEC latency (ns)	CI depth	CI latency (ns)	Total Latency (ns)	AUI DER0 per PHY	AUI Measured BER per PHY	AUI error extension probability	Available random BER for optics.
100GE	100G	2	139.4	NA			139.4		2E-5	0.75	2.40E-04
200GE	100G	2	88.2	NA			88.2		2E-5	0.75	2.40E-04
	200G	4	139.4	NA (FECo mode)			139.4	2.67E-5	2E-5	0	2.60E-04
									4E-5	0.75	2.35E-04
			139.4	15	Bypass	0	154.4		2E-5	0	3.65E-03
									4E-5	0.75	3.50E-03
			139.4	15	12-way	280	434.4		2E-5	0	5.00E-03
									4E-5	0.75	4.90E-03
400GE	100G	2	62.6	NA			62.6		2E-5	0.75	2.40E-04
	200G	4	88.2	NA (FECo mode)			88.2	2.67E-5	2E-5	0	2.60E-04
									4E-5	0.75	2.35E-04
			88.2	15	Bypass	0	103.2		2E-5	0	3.65E-03
									4E-5	0.75	3.50E-03
			88.2	15	12-way	140	243.2		2E-5	0	5.00E-03
									4E-5	0.75	4.90E-03
800GE	100G	4	62.6	NA			62.6		2E-5	0.75	2.40E-04
	200G	4	62.6	NA (FECo mode)			62.6	2.67E-5	2E-5	0	2.50E-04
									4E-5	0.75	2.25E-04
			62.6	15	Bypass	0	77.6		2E-5	0	3.55E-03
									4E-5	0.75	3.40E-03
			62.6	15	12-way	56	133.6		2E-5	0	5.00E-03
									4E-5	0.75	4.80E-03
1.6TE	200G	4	49.8	NA (FECo mode)			49.8	2.67E-5	2E-5	0	2.50E-04
									4E-5	0.75	2.25E-04
			49.8	15	Bypass	0	64.8		2E-5	0	3.55E-03
									4E-5	0.75	3.40E-03
			49.8	15	12-way	25.6	90.4		2E-5	0	5.00E-03
									4E-5	0.75	4.80E-03

he_3dj_01a_2311.pdf

1. In he_3dj_01a_2311.pdf, a thorough summary on FEC performance was presented to this group.
2. It shows for 800GE/1.6TE,
   - the allocated BER for optical PMD is influenced by AUI
   - the Inner FEC has two possible BER limits

Both unprecedent to the IMDD community

3. Since we adopted KP4+Inner FEC for 2~10km IMDD specs, it is straight forward to refer to this chart and pick appropriate values, adopt
   - **SER = 9.6e-3 for 2km SMF PMDs**
   - **or**
   - **SER = 6.8e-3 for 2km SMF PMDs if decide to adopt CI bypass**

Topic two: Turn point of TDECQ/SECQ-OMA relation

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	Turn point X	
500m spec	0.9dB	Changed from 802.3df
2km spec	0.9dB	Suggest to align the specs for 200G/lane FECi specs, may need more data to finalize.
10km spec	1.4dB	Same as 802.3df

What does the turn point X mean:

- For Tx performance degradation up until TDECQ=X, the Rx could close the link with the same RS and Tx output power.
- For Tx performance degradation beyond X, performance penalty and CD penalty comes in play, the Rx requires relaxation on RS to close the link, and the Tx output power should increase along.

Why change it:

All the reasons said in topic one.

Topic Three: Output power in OMA of PSM 2km PMDs

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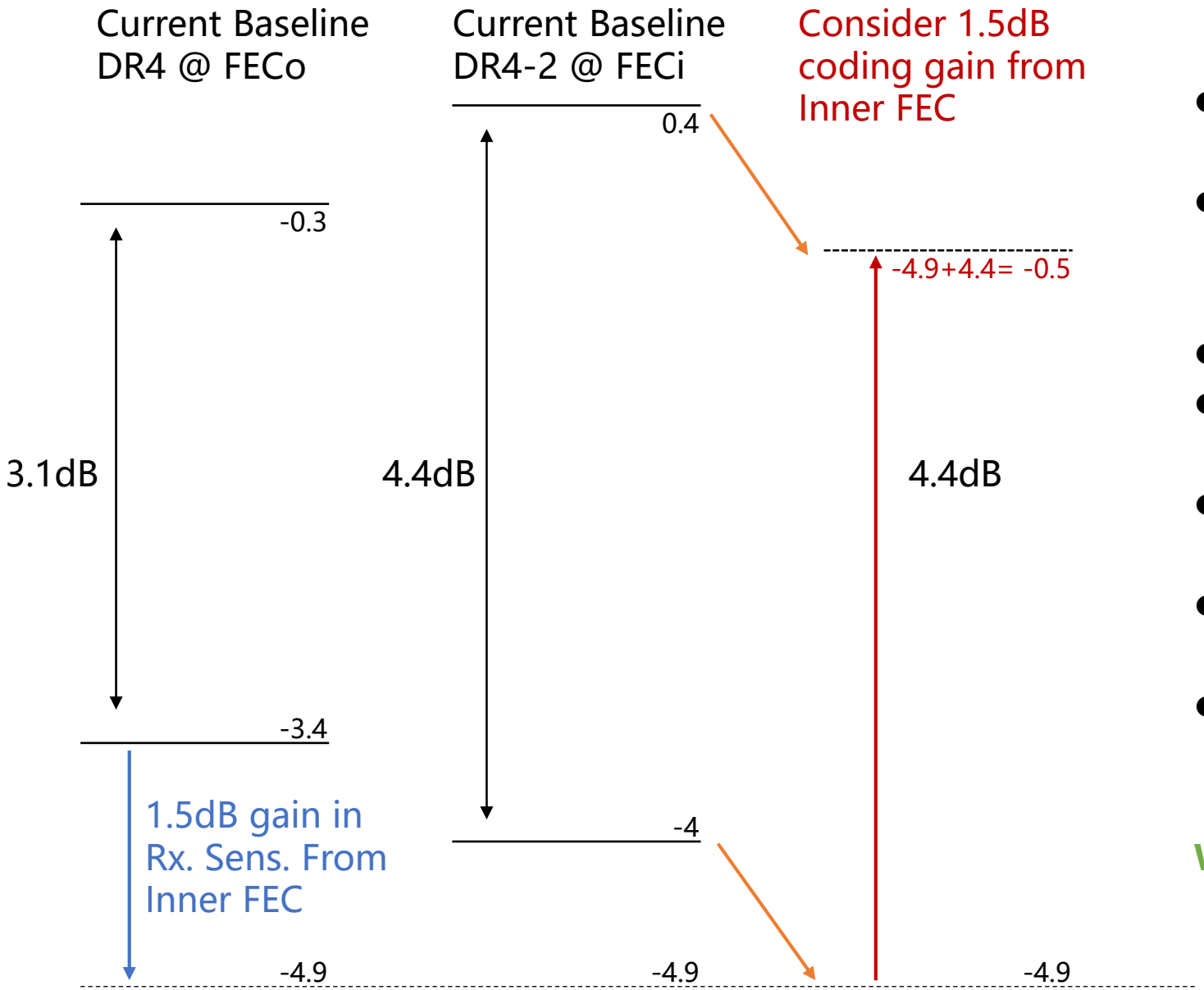
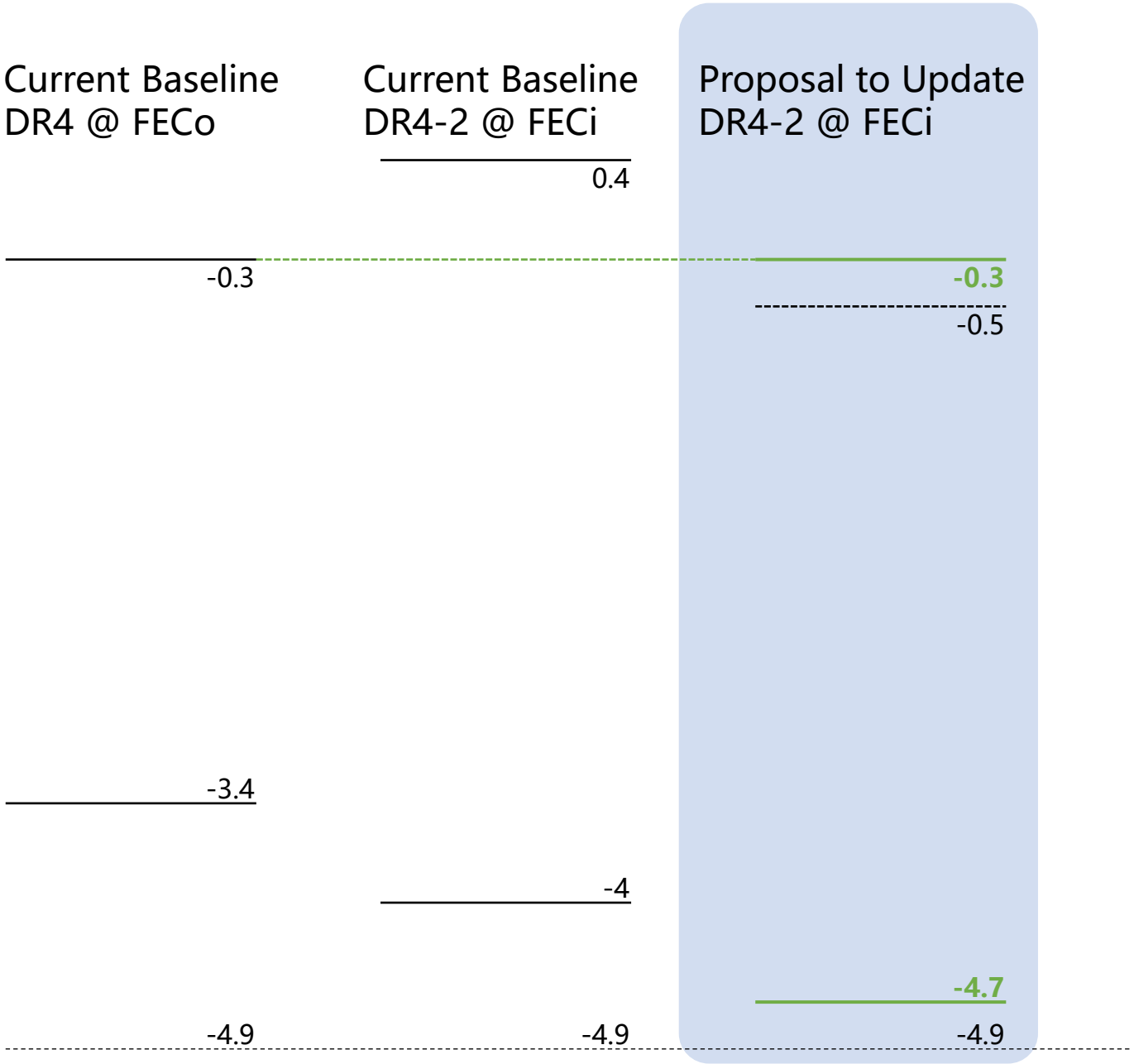


- Take current Rx. Sens. in DR4@FECo specification as anchor point
- In welch_3dj_01b_2311, 1.5dB gain in Rx. Sens. was assumed from using Inner FEC. Following this assumption
- PSM could have nominal Rx. Sens. of -4.9dB
- The Tx OMA_min for DR4-2 could reach as low as -0.6dB as shown in the left chart.
- The current adopted baseline has Tx OMA_min of 0.3dB.
- **Not exploiting the coding gain of Inner FEC.**
- As commented in mi_3dj_01b_2311, lower Tx OMA spec allows lower power consumption

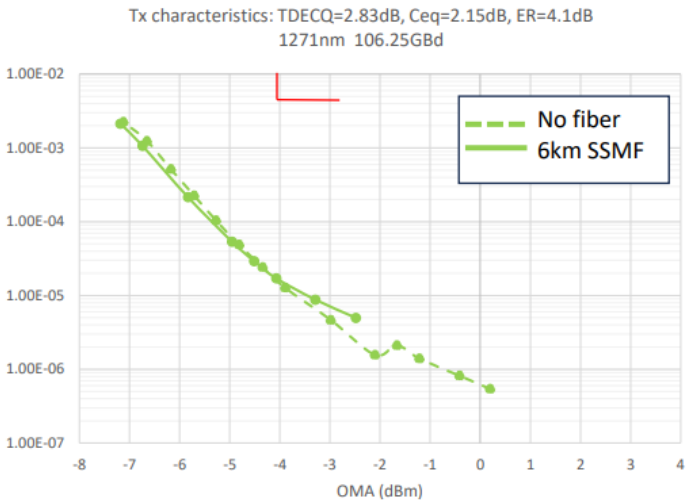
What about lower the Tx OMA_min of DR4-2

Proposal to Update the DR4-2 baseline



- ✓ Propose to lower the Tx OMA_min and align with that of DR4, green lines in the left chart
- ✓ Staying within the coding gain capability of Inner FEC.
- ✓ Requiring -4.7dB of Rx Sens.
  - ✓ Experiment data presented in rodes_3dj_01a_2311 showed promising result of Rx. Sens.
  - ✓ Acquire further data to verify this proposal would be next step.

From rodes_3dj_01a_2311



Summay

- Three observations were made regarding the adopted baselines for 2km optical PMDs
  - Misalignment of the SER limit of 2km PMDs with other optical PMD, adopted FEC baseline and logical layer discussion
  - Misalignment of the turn point X in TDECQ/SECQ-OMA relation with other optical PMDs
  - Overly conservative Tx OMA and Rx Sens. for PSM 2km PMDs.
- Suggest to
  - Change the SER limit to either 9.6e-3(reflecting Inner FEC) or 6.8e-3 (reflecting Inner FEC with bypass CI)
  - Change the turn point X to 1.4dB
  - Change the OMA and RS of PSM 2km PMDs as shown in P11.