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Proposal to revert-back flexibility in TDECQ Definition

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Definition of TDECQ Draft 3.2

- To pass a Transmitter, TDECQ measurement uses 5 Taps, where 5 taps can be configured in three ways

Tap Set	Tap-1	Tap-2	Tap-3	Tap-4	Tap-5
No Pre Tap Set	Main	Post1	Post 2	Post 3	Post 4
One Pre Tap Set	Pre 1	Main	Post1	Post 2	Post 3
Two Pre Tap Set	Pre 2	Pre 1	Main	Post1	Post 2

At any given Data rate note, the optical transmitter has been the most difficult part to make and is generally the costliest part due to highest yield issues. The flexibility provided by choosing three combinations of taps was key to producing high yield low cost transceivers. However, at meeting, the last combination was removed which led to this work/simulations. Previous argument was that Fiber Dispersion is the only source of pre-cursor ISI. Simulations do not support this assumption.

Information needed to restrict Tap set

- Statistical information on multiple type of optical modulators, e.g. EML, Silicon Photonics with associated interconnect between the CDR, Electrical amplifier etc
- Temp variation for various combinations

There are limited set of optical modulators and statistical analysis from multiple type of optical modulators from multiple vendors is prohibitive before the standard needs to close.

Due to limited time, we are presenting simulated data representing expected temp and process variations.

The Simulated Model



For 56Gbaud, every detail needs to be modeled. Every time there is a mode conversion, there is possibility of pre-cursor distortion. As the signal propagates, there are multiple points where the mode conversion could be happening and thus leading to variation in pre-cursor. Also the traveling amplifier and modulators will have varying pre-cursor due to various laws of physics they are built on. Modular designs provide flexibility and early time to market but introduce pre-cursor ISI.

Fair comparison between two tap sets

- Since transmitter can also correct for pre-cursor, we considered fix pre-correction of 2nd pre tap while considering 5 tap equalizer with one pre and three post taps.

Simulated Results over temp



Condition	Be _{eff} (GHz)	Ceq (dB)	-2pre	-1pre	Main	+1post	+2post	+3post	TDECQ (dB)
Room Temp Calibration Pre-cursor	29.1	0.9	≡ 0.0301 FIXED	- 0.0866	1.1954	-0.0872	-0.0749	0.0232	1.82
High Temp 1 pre/ 3 post tap set Equivalent	22.6	1.6	≡ 0.0327 FIXED	- 0.2302	1.4004	-0.1823	-0.0249	0.0043	3.75
High Temp 2 Pre / 2 Post tap set Equivalent	22.6	1.4	0.0764 adaptive	- 0.2129	1.3507	-0.2016	-0.0126	---	2.84

Degradation in TDECQ = (3.75-1.82) = 0.91dB

Simulated Results with 2nd pre fixed for High temp



Condition	Be _{eff} (GHz)	Ceq (dB)	-2pre	-1pre	Main	+1post	+2post	+3post	TDECQ
Room Temp Calibration Pre-cursor	29.1	0.9	≅0.0301 FIXED	-0.0866	1.1954	-0.0872	-0.0749	0.0232	1.82
2 nd Pre Fixed corresponding to High temp	29.1	0.6	≅0.08 FIXED	-0.0857	1.1420	-0.0877	-0.0717	0.0233	2.36
High Temp 2 Pre / 2 Post tap set Equivalent	22.6	1.4	0.0764 adaptive	-0.2129	1.3507	-0.2016	-0.0126	---	2.84

Degradation at room temp = 2.36 – 1.82 = 0.54dB

Simulated Results with 2nd pre fixed for average of room temp and high temp



Condition	Be _{eff} (GHz)	Ceq (dB)	-2pre	-1pre	Main	+1post	+2post	+3post	TDECQ
Room Temp Calibration Pre-cursor	29.1	0.9	≡ 0.0301 FIXED	- 0.0866	1.1954	-0.0872	-0.0749	0.0232	1.82
Pre-fix at an average value	29.1	0.6	≡ 0.055 FIXED	- 0.0889	1.1686	-0.0846	-0.0734	0.0228	2.03
	22.6	1.4	≡ 0.055 FIXED	- 0.2256	1.3711	-0.1872	-0.0206	0.0029	3.15
High Temp 2 Pre / 2 Post tap set Equivalent	22.6	1.4	0.0764 adaptive	- 0.2129	1.3507	-0.2016	-0.0126	---	2.84

Adaptive Tap Set

Degradation at room temp = 2.03 – 1.82 = 0.21dB
 Degradation at high temp = 3.14-2.84 = 0.3dB

Conclusions

- Transmitters quality is heavily debated in the standards using TDECQ . This is due to difficulty in making low cost, good quality transmitters.
- The flexibility provided till recently by choosing any of the three sets taps was assumed by many component providers
- We demonstrated that 2nd pre needs to be adapted as compared to have it fixed for robust field operation.
- The use of -2pre cursor taps for 50GBASE-FR, 50GBASE-LR, 100GBASE-FR and 100GBASE-LR provides an existing design that can be easily leveraged

Proposal: Reinstate original reference equalizer text from Draft 3.2

Change ' Tap 1 or tap 2 has the largest magnitude tap coefficient'

To: 'Tap 1, tap 2 or tap 3 has the largest magnitude tap coefficient'