Enabling ILT Presets for Optical PMDs
(Addressing comments 377)

Ali Ghiasi - Ghiasi Quantum/Marvell

IEEE 802.3dj Plenary Meeting

Madrid, Spain

July 28, 2025

Supporter

- ❑ **Marco Mazzini – Cisco**
- ❑ **Roberto Rodes – Coherent**
- ❑ **Ahmad El-Chayeb – Keysight Technologies**

Overview

❑ **Benefit of enabling ILT Presets for optics**

❑ **Overshoot is crude and doesn't result in optimum BER**

❑ **Pro and cons of method to mitigate block BER**

❑ **Current clause 178B ILT**

❑ **Propose clause 178B ILT enabling Presets for optics**

❑ **Summary.**

Benefit of Enabling Presets for Optics

❑ **Sometime transmitter with TX FIR settings resulting in TDECQ>3.4 dB produces better block BER**

– With increasing overshoot waveform non-linearity increases and TDECQ not incorporating effects of compression and ENOB will not show actual penalty is increasing

- Also enabling 1 TDFE will mitigate the need for higher overshoot
- Adding a separate linearity test by using linear pulse fit is another option

❑ **Optionally enable OLT Presets ghiasi_3dj_01_2311 O1 and allow TDECQ for non-default presets to have + 1 dB excursion**

– Receiver starts with default setting "Preset1" then cycle through Preset2 to Preset6

- Preset1 is compliant to TDECQ≤3.4 dB and Functional Receiver or just compliant to Block TDECQ
- Preset 2-6 only only need to pass with Functional Receiver

– ILT receiver picks the best Preset or goes back to default Preset1.

TDECQ Decreases with Increasing Overshoot

❑ **But increasing overshoot and non-linearity may also introduce block errors**

- [rodes_3cu_adhoc_030520_v2](#) show effect of overshoot and TDECQ
- It is not unusual to see some transmitter with >3.4 dB TDECQ with less overshoot to perform better with 200G DSP receiver that have DFE and optional MLSE
- Presets allow to have non-default setting with less overshoot and more linear waveform than may result in better block BER
- Preset can also be used for different optimization for short/long links with higher CD.
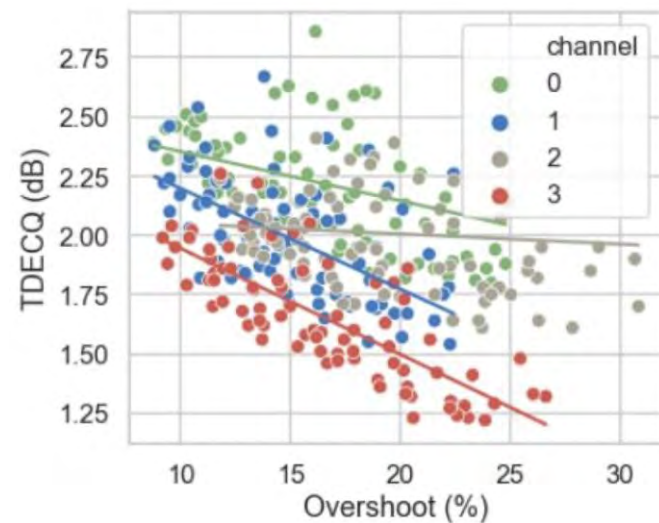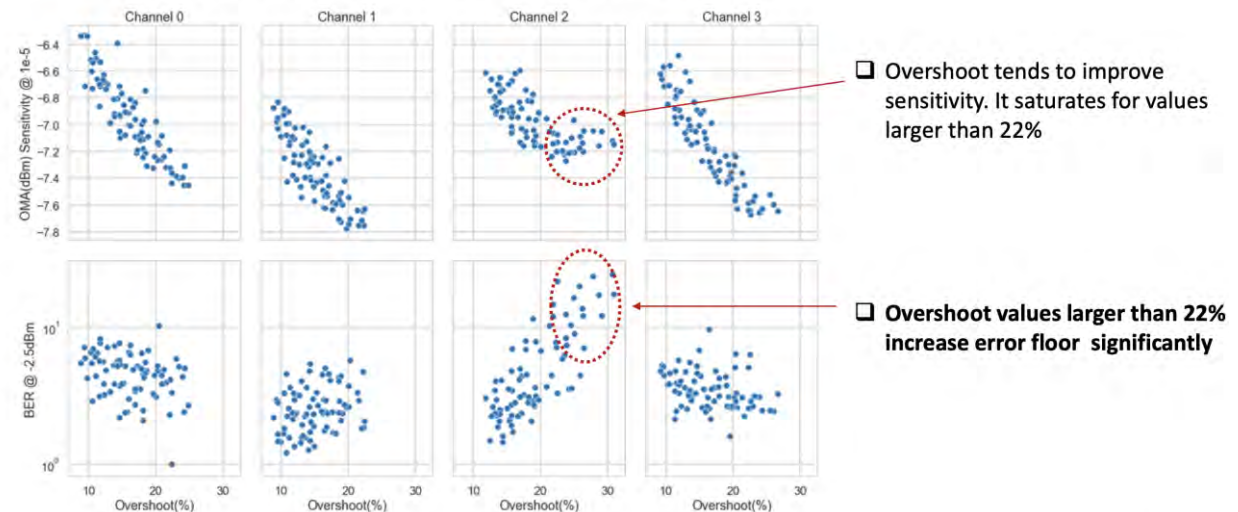
Pro and Cons of Various Method to Mitigate Block Errors

❏ **Some may have given up on TDECQ because some compliant transmitters may fail block BER and in some cases transmitters with higher TDECQ may have better block BER**

- TDECQ is doing what it should do but can be enhanced and any other test will have it's own limitation
    - Mazzini OIF 2024.449.02 raised issue is due to bandlimited RJ that affect certain blocks unproportionally
    - chayeb_3dj_01_2505 raised issue with weird tap settings affecting certain DSP Timing Recover (TR) but TDECQ doesn't incorporate a TR
    - TDECQ doesn't include any compression or ENOB effects and given overshoot drives TDECQ lower while making signal more non-linear may degrade BER of DSP receiver!

3 Key Issues Issues	J3U/JRMS	Phase noise measurement	Linearity Test/Reduce Overshoot	Limiting Weird Taps	Adding DFE	Hardware Functional RX	Block/Enhanced TDECQ	Adding ILT Presets
Mazzini Raised Issue Passing TDECQ but failing Block BER	No	No	No	No	No	Yes	Yes	No
Chayeb Raised Issue Passing TDECQ fail block BER	No	No	No	Yes	No	Maybe	No	No
TDECQ>3.4 dB has Better block BER	No	No	Yes	No	Maybe	Maybe	No	Yes

Current Clause 178B ILT

❑ **Current copper E1 and optics O1 ILT capabilities**

Table 178B–2—Control field structure for E1 interfaces

Bit(s)	Name	Description
15:14	Reserved	Transmit as 0, ignore on receipt
13:11	Initial condition request	13 12 11 1 1 1 = Reserved 1 0 1 = Preset 6 0 1 1 = Preset 5 0 0 1 = Preset 4 1 1 0 = Preset 3 1 0 0 = Preset 2 0 1 0 = Preset 1 0 0 0 = Individual coefficient control
10	Continue training	1 = Continue training 0 = Switch to data when training is completed
9:8	Modulation and precoding request	9 8 1 1 = PAM4 with precoding 1 0 = PAM4 without precoding 0 1 = Reserved 0 0 = PAM2
7	Reserved	Transmit as 0, ignore on receipt
6:5	Training pattern request	6 5 1 1 = free-running PRBS31 1 0 = Reserved 0 1 = free-running PRBS13 0 0 = synchronous PRBS13
4:2	Coefficient select	4 3 2 1 0 0 = Reserved 1 0 1 = $c(-3)$ 1 1 0 = $c(-2)$ 1 1 1 = $c(-1)$ 0 0 0 = $c(0)$ 0 0 1 = $c(1)$ 0 1 x = Reserved
1:0	Coefficient request	1 0 1 1 = No equalization 1 0 = Decrement 0 1 = Increment 0 0 = Hold

Table 178B–3—Control field structure for O1 interfaces

Bit(s)	Name	Description
15:11	Reserved	Transmit as 0, ignore on receipt
10	Continue training	1 = Continue training 0 = Switch to data when training is completed
9:8	Modulation and precoding request	9 8 1 1 = PAM4 with precoding 1 0 = PAM4 without precoding 0 1 = Reserved 0 0 = PAM2
7	Reserved	Transmit as 0, ignore on receipt
6:5	Training pattern request	6 5 1 1 = free-running PRBS31 1 0 = Reserved 0 1 = free-running PRBS13 0 0 = synchronous PRBS13
4:0	Reserved	Transmit as 0, ignore on receipt

Enabling Preset for Optical O1 PMDs

❑ **ILT already supports Presets and enabling optional Presets for O1 PMDs is straight forward as shown below:**

Table 178B-3 Control field O1 supporting optional Presets

Bit(s)	Name	Description
15:14	Reserved	Transmit as 0, ignore on receipt
13:11	Initial condition request (new item to support Preset)	13 12 11 1 1 1 = Reserved 1 0 1 = Preset 6 1 1 0 = Preset 5 1 0 0 = Preset 4 0 1 1 = Preset 3 0 1 0 = Preset 2 0 0 1 = Preset 1 0 0 0 = Reserved
10	Continue training	1 = Continue training 0 = Switch to data when training is completed
9:8	Modulation and precoding request	9 8 1 1 = PAM4 with precoding 1 0 = PAM4 without precoding 0 1 = Reserved 0 0 = PAM2
7	Preset Supported (needed only if support of Preset is Optional)	0 = Preset not supported 1 = Preset supported
6:5	Training pattern request	6 5 1 1 = free-running PRBS31 1 0 = Reserved 0 1 = free-running PRBS13 0 0 = synchronous PRBS13
4:0	Reserved	Transmit as 0, ignore on receipt

Table 178B-5 Status field O1 supporting Presets

Bit(s)	Name	Description
15	Receiver ready	1 = Training is complete and the receiver is ready for data 0 = Request for training to continue
14	ILT	Transmit as 1
13:12	Training pattern status	13 12 1 1 = free-running PRBS31 1 0 = Reserved 0 1 = free-running PRBS13 0 0 = synchronous PRBS13
11:10	Modulation and precoding status	9 8 1 1 = PAM4 with precoding 1 0 = PAM4 without precoding 0 1 = Reserved 0 0 = PAM2
9	Receiver frame lock	1 = Frame boundaries identified 0 = Frame boundaries not identified
8	Initial condition status (new item to support Preset)	1 = Updated 0 = Not updated
7	Parity	Even parity bit
6:0	Reserved	Transmit as 0, ignore on receipt

Summary

❑ **Current TDECQ reference receiver doesn't incorporate effects such as compression and ADC ENOB, and there is no penalty for degradation due to non-linearities**

– With TDECQ improving with increasing overshoot often drives link to lower TDECQ which may not result optimum block BER

❑ **Enabling ILT O1 PMDs Presets is straight forward and control field 7 is used to advertise optional Presets**

– With Presets enabled for O1 Preset1 is compliant to TDECQ≤3.4 dB and Functional Receiver or just compliant to Block TDECQ

  • Preset 2-6 only need to pass with Functional Receiver

  • ILT receiver picks the best Preset or goes back to default Preset1

– It is up to manufacture how to program Preset 2-6 and for what effects

  • Presets for DR optics may include different pre-emphasis settings, inner/outer eye adjustment , etc.

  • Preset for FR4/LR optics may may include different pre-emphasis settings, +/- chirp adjustment, etc.

Thank you