Improving 200G MMF Link Margin by enabling Presets (comments 74, 75, 80, 81, 83, 84, 89, and 90)

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Supporters

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Overview

- **Potential benefits of ILT for optics**
- **Current E1 and O1 ILT frames**
- **Enabling ILT for 200G MMF**
- **Summary.**

Potential OLT Knobs One May Adjust

- **OLT baseline with 4 pages will have sufficient space that future projects may choose to control various type of optical parameters to improve optical link performance and/or reach – not part of current proposed baseline**
  - Preset in classical ILT only used for FFE adjustment
    - Adjusting transmit FFE taps autonomously (pre-emphasis) or Overshoot – important for VCSELs
  - OMA control – maybe not as important for VCSELs
  - Inner/Output Eye Adjustment - important for VCSELs
  - MZM compression – NA for VCSELs
  - EA modulators asymmetrical compression – NA for VCSELs
  - CD penalty on links > 2km on outer wavelengths L0 and L3 – NA for VCSELs
- **Some of the above controls may impact baseline TDECQ which doesn't always produce the best BER, as long as adjustment are not disruptive the receiver MMSE will select best operating Preset**
  - The key is to make sure Presets are glitch-less where receiver can cycle through the Preset without link flap.

How to Configure the Presets

- **Need to enable the DME bits to enable Presets and decide if support of Presets is optional or mandatory – if optional then it defats the purpose**
  - AUI and CR/KR have enabled 6 Presets with 2 reserves
  - In DS proposing to enable 3 presets – additional presets can be enabled for OMA adjustment if required
- **How one may configure the Presets**
  - Following Preset configuration allow for overshoot adjustment, OMA, and inner/outer eyes if required or Preset table can be simplified to fewer settings:
    - Preset 1 – Default optimized for 60% of the maximum reach with maximum 22.5% overshoot/undershoot
    - Preset 2 – Optimized for B2B reach with maximum 15% overshoot/undershoot
    - Preset 3 – Optimized for max reach with maximum 30% overshoot/undershoot
    - Preset 4 – Reserved
    - Preset 5 – Reserved
    - Preset 6 – Reserved
    - Preset 7 – Reserved
    - Preset 8 – Reserved

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 Presets for Optical O1 PMDs

- **AUI and KR/CR already support Presets and enabling optional Presets for O1 PMDs is straight forward as shown below but we may want to call it O2.**

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 = Reserved 1 1 0 = Reserved 1 0 0 = Reserved 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	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

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

200G MMF TDECQ

- **Proposed limit for classic TDECQ = 4.4 dB**
  - In order to allow classic TDECQ to go as high as 4.4 dB the non-equalizable distortion must be limited
  - Proposed to add TDECQ(k) = TDECQ – 10log10(Ceq) = 3.4 dB to limit non-equalizable distortion
    - For background on limiting non-equalizable distortion see https://www.ieee802.org/3/db/public/May22/dawe_3db_01_051922.pdf
- **TDECQ must be met for all 3 Presets.**

Summary

- **Enabling ILT O1 PMDs Presets is straight forward**
  - Proposal enables 3 Presets
    - Default optimized for a reach of 60% with 22.5% overshoot/undershoot*
    - A settings optimized for B2B with 15% overshoot/undershoot*
    - A settings optimized for maximum reach with 30% overshoot/undershoot*
  - Overshoot/undershoot are measured with TECQ test pattern at a hit ratio of 1E-4
- **Presets can also be enabled for OMA and inner-outer eye adjustment if necessary!**

Back up