CTLE Enhancements for 25G-AUI

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Opening Remarks

- The intent of this presentation is to kick-off some discussions on potential enhancements to the 25G-AUI C2M specification, in order to support an adaptive approach to the setting of the CTLE parameters.

- Having said that, 802.3by D1.0 is still a technically complete document with regard to the 25G-AUI definition for the C2M interface (CL109), as the current proposal is based on a single lane of the CAUI-4 C2M specification defined in 802.3bm (already shipping in the field)

- In order to maintain the aggressive 802.3by schedule, the recommendation is that while now is a good time to start such discussions, any actual changes/modifications to the document should be held off until the D2.0 balloting cycle.
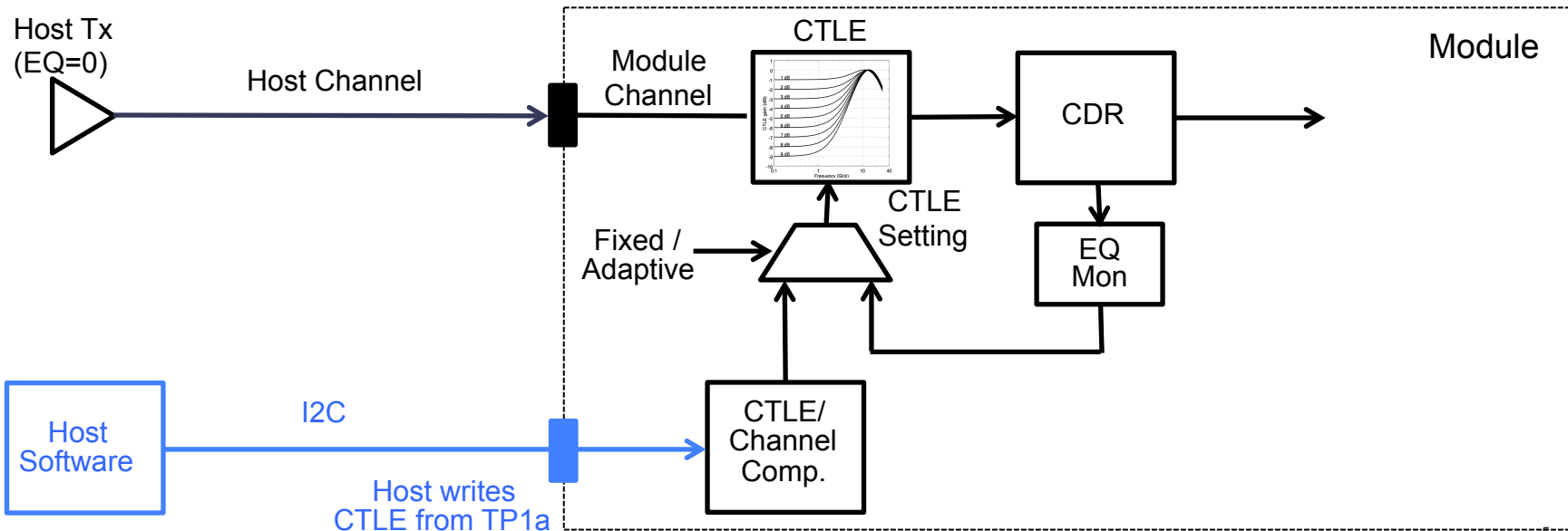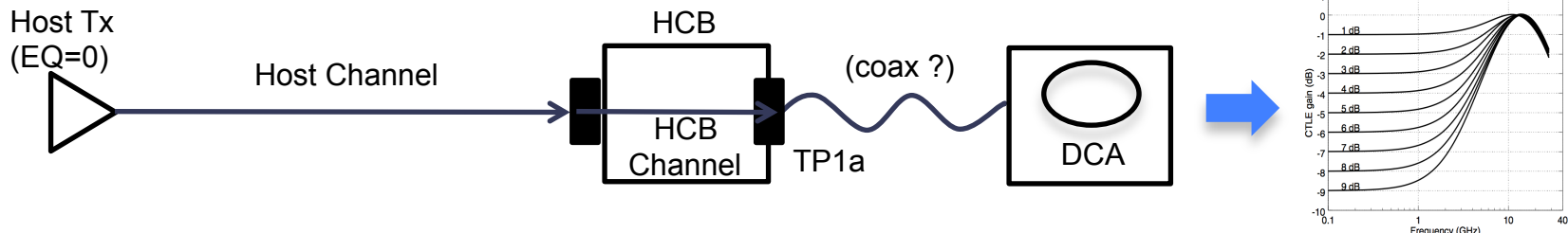
Background

- Topic first brought up in a comment against D0.1 from Jeff Maki.

- Comment was resolved by fixing an inconsistency found with a PICS statement, but the request for autonomous, adaptive CTLE was not addressed.

CI **109B**   SC **109B.4.4.4**   P **217**   L **40**   # 110

Maki, Jeffery   Juniper Networks

Comment Type   **T**   *Comment Status*   **A**

"As 83E.1.1 with settings associated with Recommended_CTLE_value" is not compatible with mandatory use of Adaptive receiver. 25G-AUI chip to module needs to use autonmous Adaptive reciver.

SuggestedRemedy

Should read "As 83E.1.1 with autonmous adaptive CTLE."

Response   *Response Status*   **C**

ACCEPT IN PRINCIPLE.

[The editor changed the reference "line" to 47.]

The commenter is apparently referring to PICS item RM2.
The reference to 83E.1.1 (which is titled "Bit Error Ratio") in the RM2 value/comment column is likely an error and should be 83E.3.4.1.1. However, 83E.3.4.1.1 does not specify in any way an "autonomous adapative CTLE".

For PICS item RM2.
Change the Value/Comment field to:
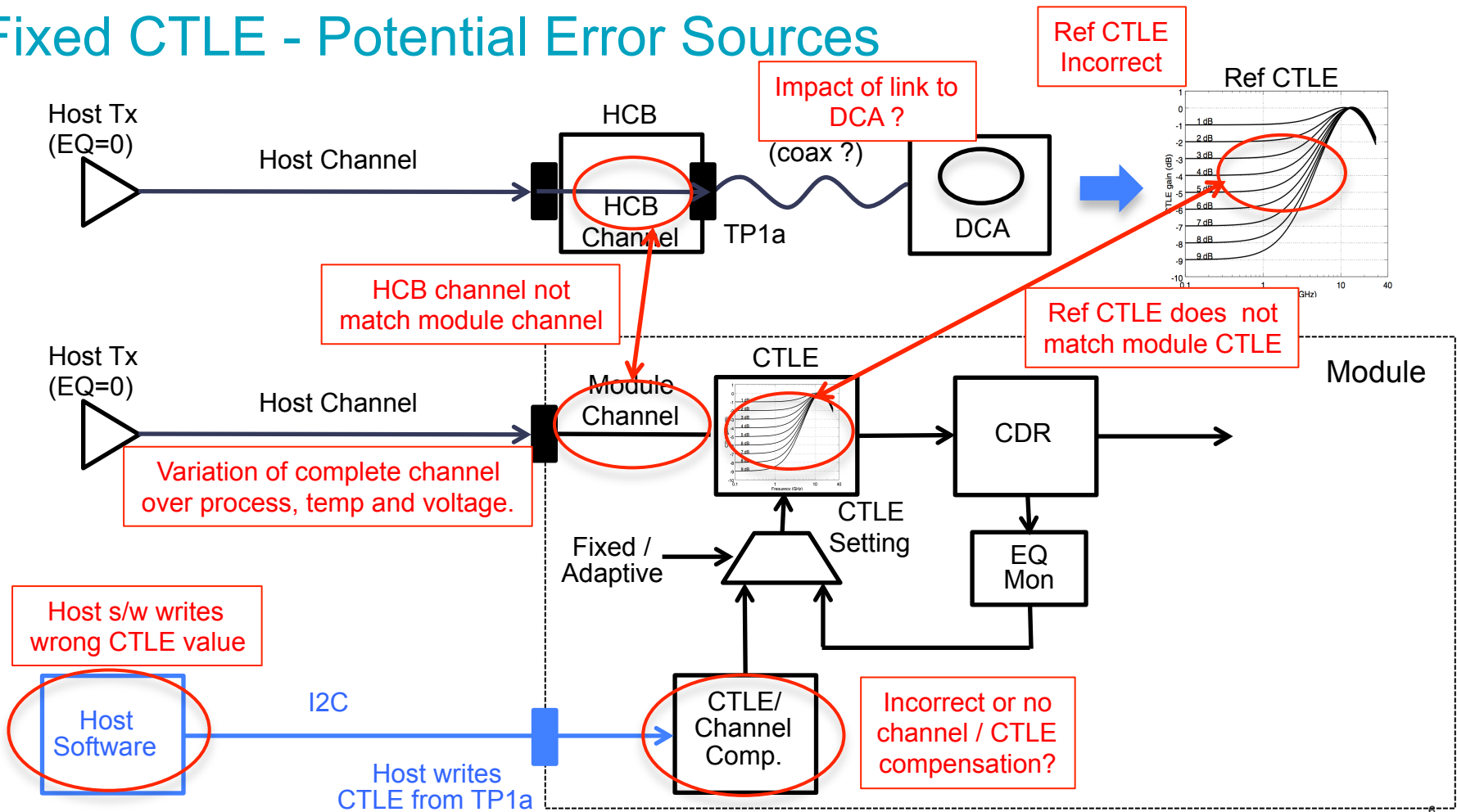"As 83E.3.4.1.1 with settings associated with Recommended_CTLE_value"

CAUI-4 C2M CTLE Recap

- The current CAUI-4 C2M specification is based on a CTLE equalization scheme, implemented at the receiving end of the link.

- The settings for the CTLE equalizer are assumed to be fixed over time (for a given channel), and are required to be written into the module by the the host line card.

- This requires that each CAUI-4 lane on a line card (potentially up to 144+ individual lanes) be characterized by measuring at TP1a, determining the optimum CTLE setting using external test equipment and a reference CTLE receiver, the optimum CTLE settings stored on the host card, and then written to individual modules as and when they are plugged in.

- It also requires the optical module to compensate for any difference between it's own CAUI-4 channel and CTLE implementation, and the external reference receiver used to calibrate the host line card.

CAUI-4 CTLE Recap (In pictures!)

Fixed CTLE - Potential Error Sources

Host Tx (EQ=0)

Host Channel

HCB

HCB Channel

TP1a

(coax ?)

DCA

Impact of link to DCA ?

Ref CTLE Incorrect

Ref CTLE

HCB channel not match module channel

Ref CTLE does not match module CTLE

Host Tx (EQ=0)

Host Channel

Module Channel

CTLE

CDR

Variation of complete channel over process, temp and voltage.

Fixed / Adaptive

CTLE Setting

EQ Mon

Module

Host s/w writes wrong CTLE value

Host Software

I2C

Host writes CTLE from TP1a

CTLE/ Channel Comp.

Incorrect or no channel / CTLE compensation?

Fixed CTLE - Potential Error Sources

- Previous slide highlights potential sources of error with fixed CTLE
- A number of us have ran into some of these exact issues during QSFP28 bring-up
- Moving to an adaptive CTLE approach addresses many of these issues and provides a more plug-and-play architecture, but it does come with it's own challenges:
    - Definition of adaptive, one-time-at-startup or continuous ?
    - If continuous what is the minimum update rate ?
    - Requires changes to the compliance test methodology ?
- Many of the details around supporting adaptive CTLE are currently being worked within the various 56G electrical interface projects in both the OIF and 802.3bs Task Force.

Summary

- Based on recent practical experiences with CAUI-4, now is a good time to consider enhancements to the 25G-AUI to support adaptive CTLE.

- This is also well aligned with work underway in defining 56G electrical interfaces in the OIF and IEEE, where adaptive CTLE has been made mandatory.

- However it probably makes sense to hold off on making any changes to the 802.3by document until the D2.0 ballot cycle, at which time all the details for the adaptive CTLE should have been flushed out and be fairly solid.