IEEE 802.3ap

Proposal for 10Gbps Serial Backplane PHY using Unified Signaling

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* Vitesse supports the switchable Cd tap in the transmitter in order to support legacy NRZ receivers. All other issues related to signal and channel models still requires further study and Vitesse will await the outcome of the signal- and channel ad-hoc committees

Objectives

- Propose a new PMD sublayer for 10Gbps Serial link across proposed channel using Unified signaling
- The proposal allows flexibility in the implementation.
- The proposal provides an optimal solution with balanced equalization between TX and RX

Agenda

- Overview
- Channel Training
- TX specifications
- RX specifications
- Channel Model
- Conclusion

Layer Model

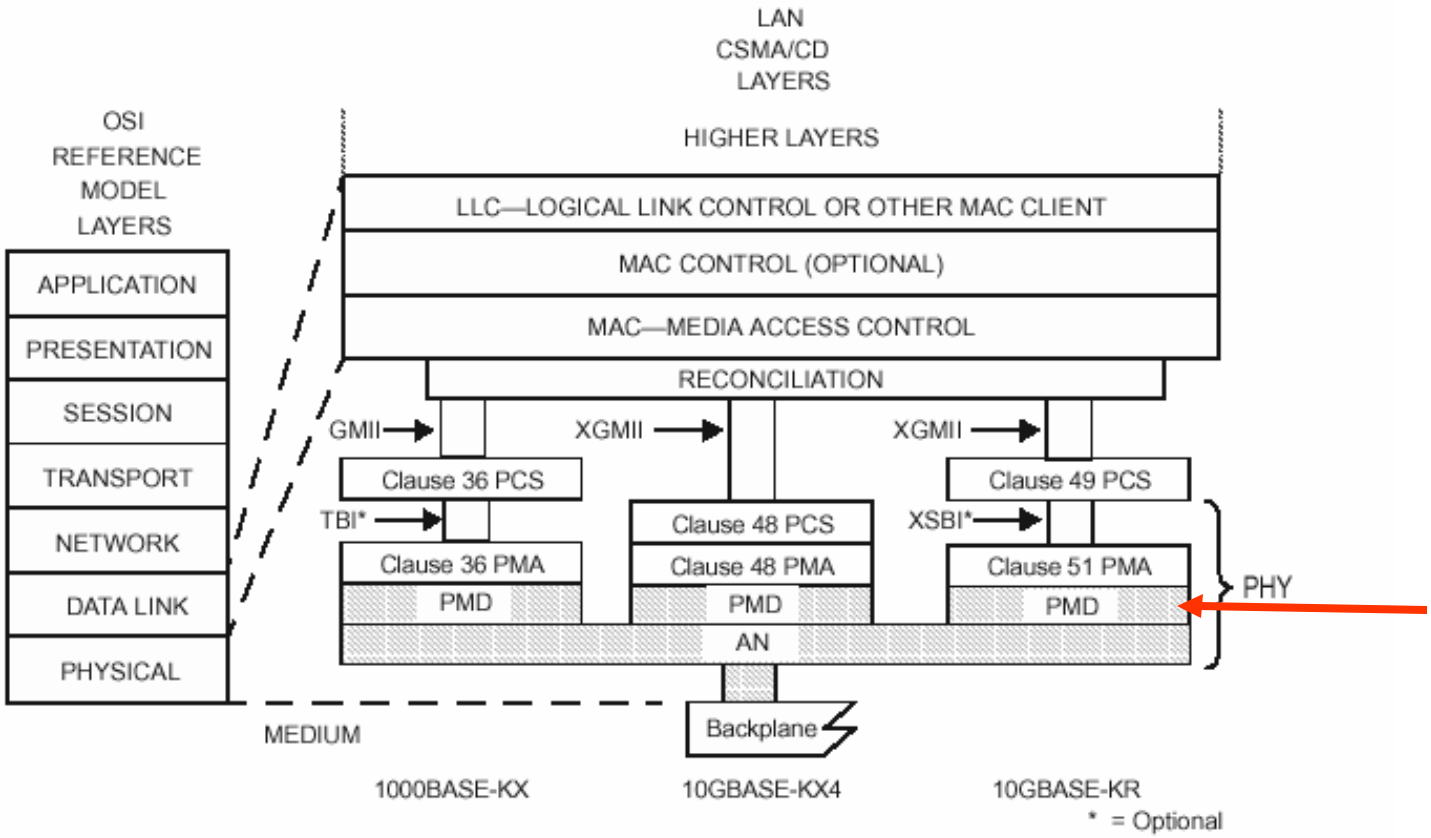
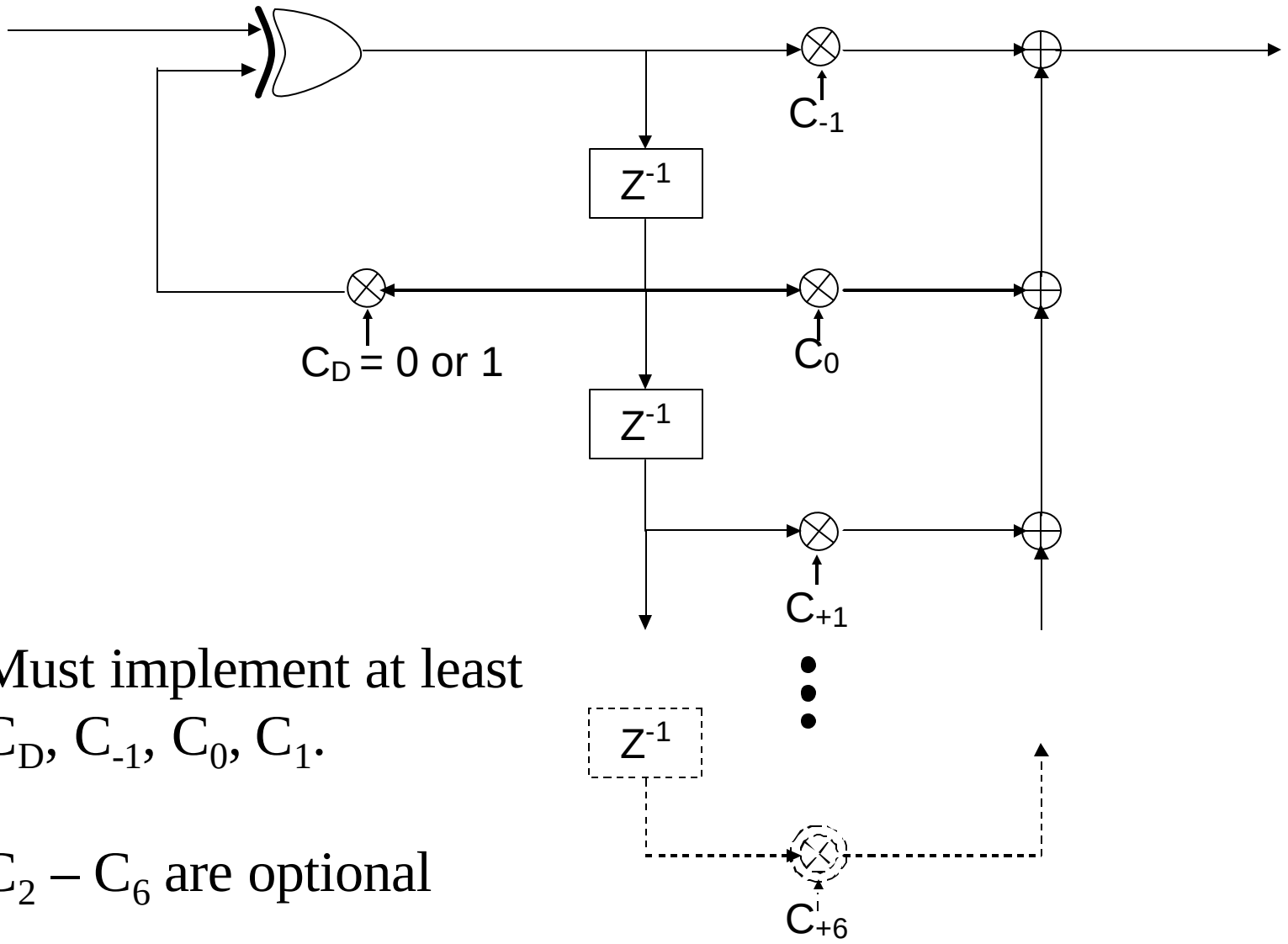


Figure 69–1—Architectural positioning of Backplane Ethernet

Overview

- Use Existing Clause 51 and 49 for PMA and PCS layer
- Define Transmitter characteristics
  - Based on TX mask, output amplitude, jitter, etc
- Define basic TX equalizer Architecture
- Adopt a Normative Channel Model
- Defined receiver characteristics
  - Jitter tolerance, return loss, etc.
  - Require operation with compliant TX over normative channel.
  - Allows implementation flexibility in RX
    - NRZ with Equalization
    - DuoBinary
    - Hybrid Architectures
- TX Equalization can be controlled by RX.
  - Inc/Dec control over TX Equalizer taps.
    - Allow the RX to choose optimal TX equalization for RX technology.
    - Efficient TX and RX implementations

Required Transmit Linear Equalizer Architecture



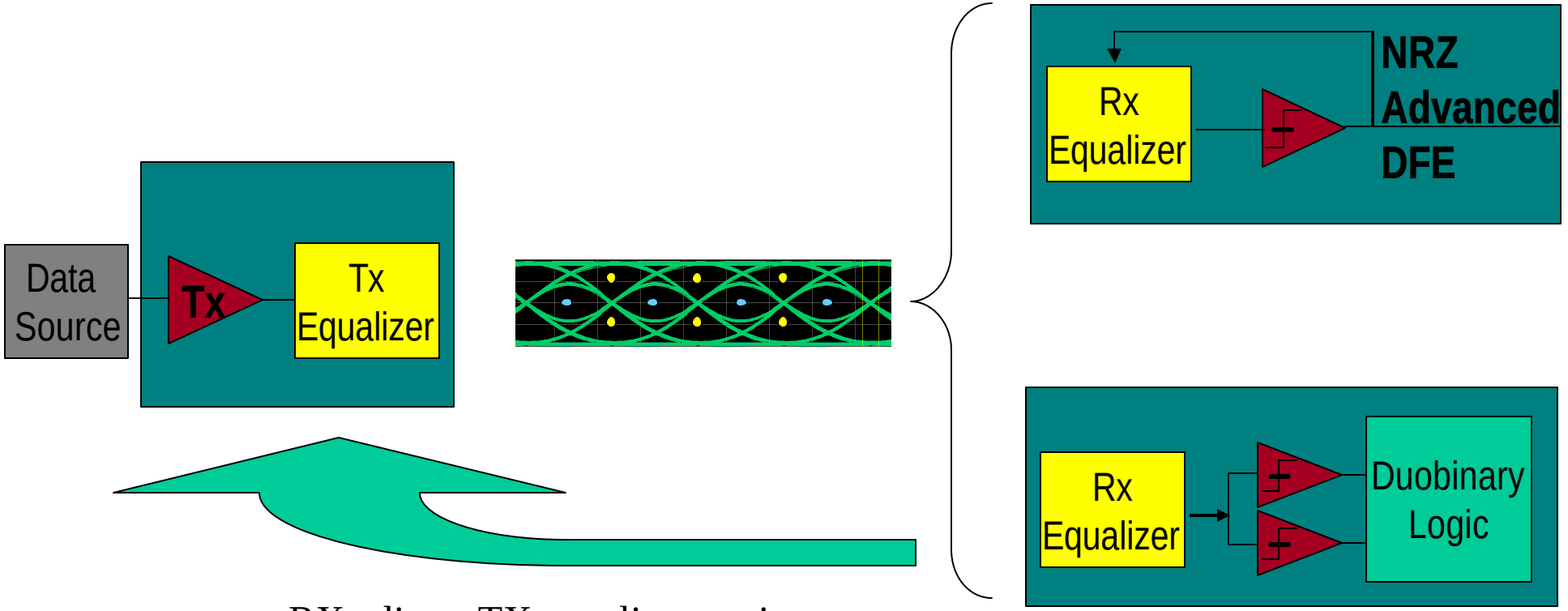
Must implement at least C_D, C_{-1}, C_0, C_1.

C_2 – C_6 are optional

Configurable TX equalizer

- C_{-1},C_0,C_1 required
  - Minimum Range
  - Minimum Granularity
- C_d required
  - Single bit 0 or 1
- C_2 – C_6 are optional
- Controlled through Link Initialization Protocol or Management Interface

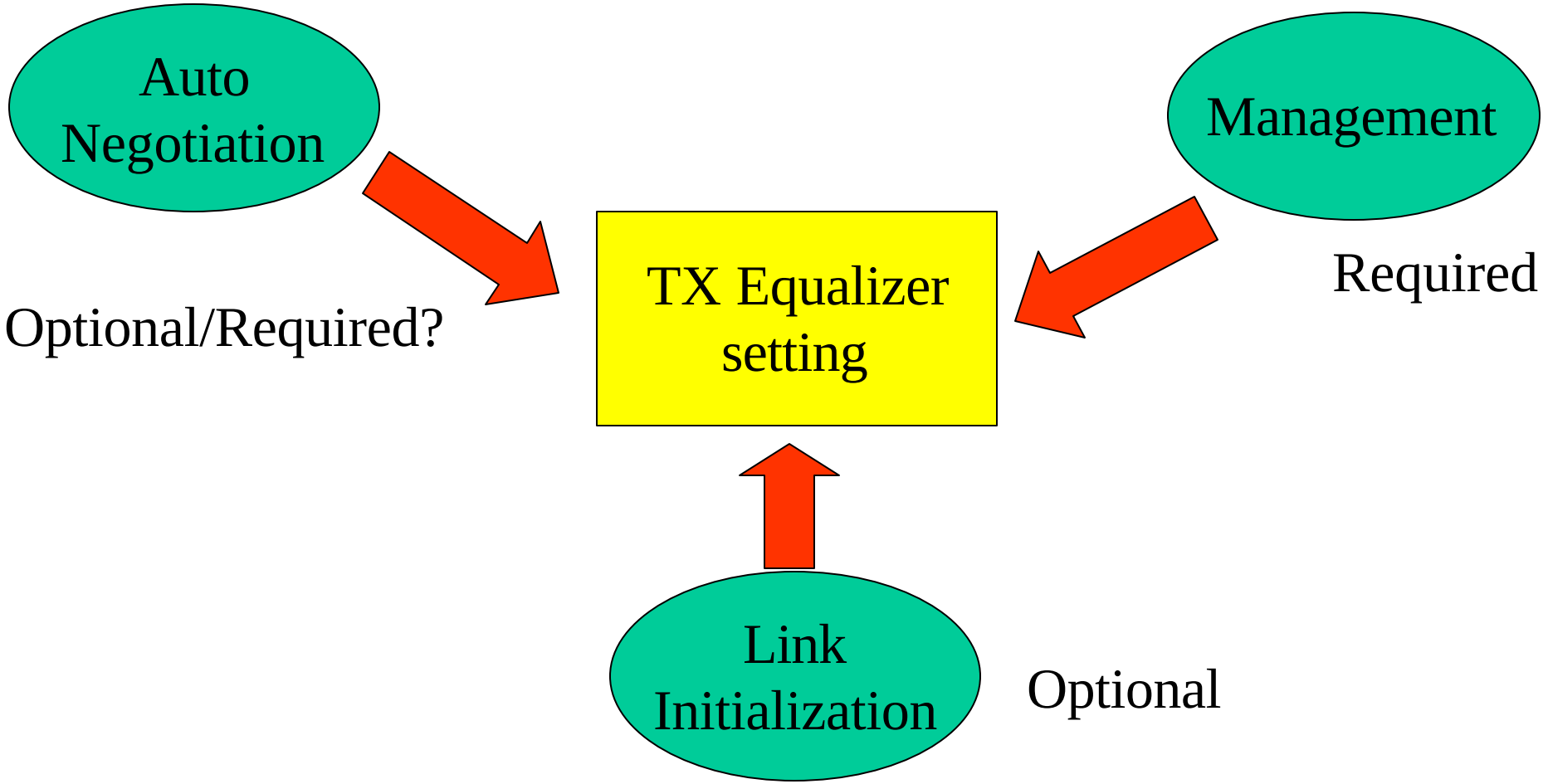
Same TX Signal Optimally Filtered for RX



RX adjusts TX equalizer settings
For optimum signal performance

Receiver may be implemented using
Variety of methods

TX Equalizer Settings can be set Many ways



Link Initialization Protocol

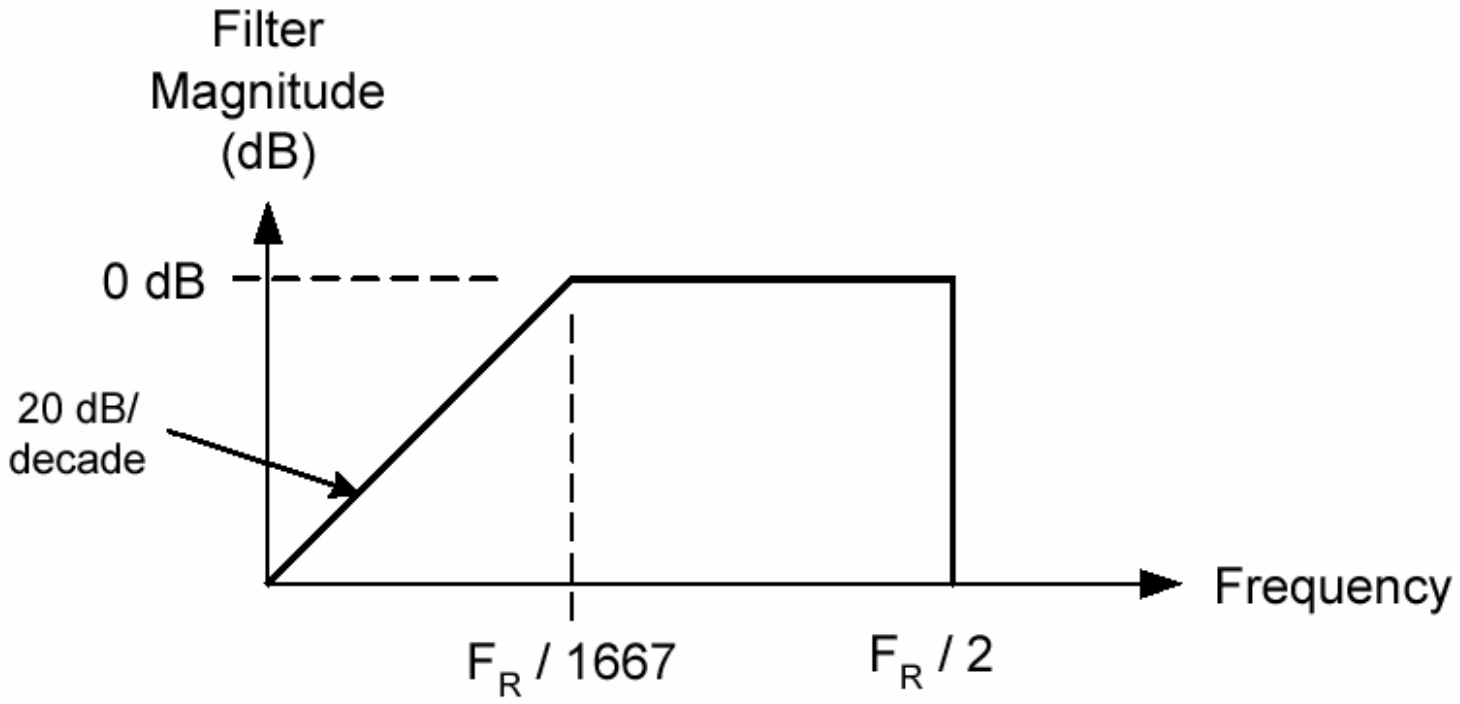
- Support Rob Brink's proposal for LIP.

Driver Characteristics Table

Parameter	Value	units
Baud rate tolerance	10.3125GBd +/- 100ppm	GBd
Diff. Amplitude (1) maximum minimum	1200 800	mVp-p mVp-p
Common-Mode Voltage	TBD	V
Diff. Output Return Loss minimum	Figure	dB
Output Template	Figure	V
Transition Time min Measured between 20% and 80%	24	ps
Output Jitter (2) Random Deterministic Total	 .15 0.15 0.3	 UIp-p UIp-p UIp-p

(1) Measured at Peak of the Output Waveform
(2) With TX Jitter Filter Applied

TX Jitter Filter



Note: F_R is bit rate

TX Mask

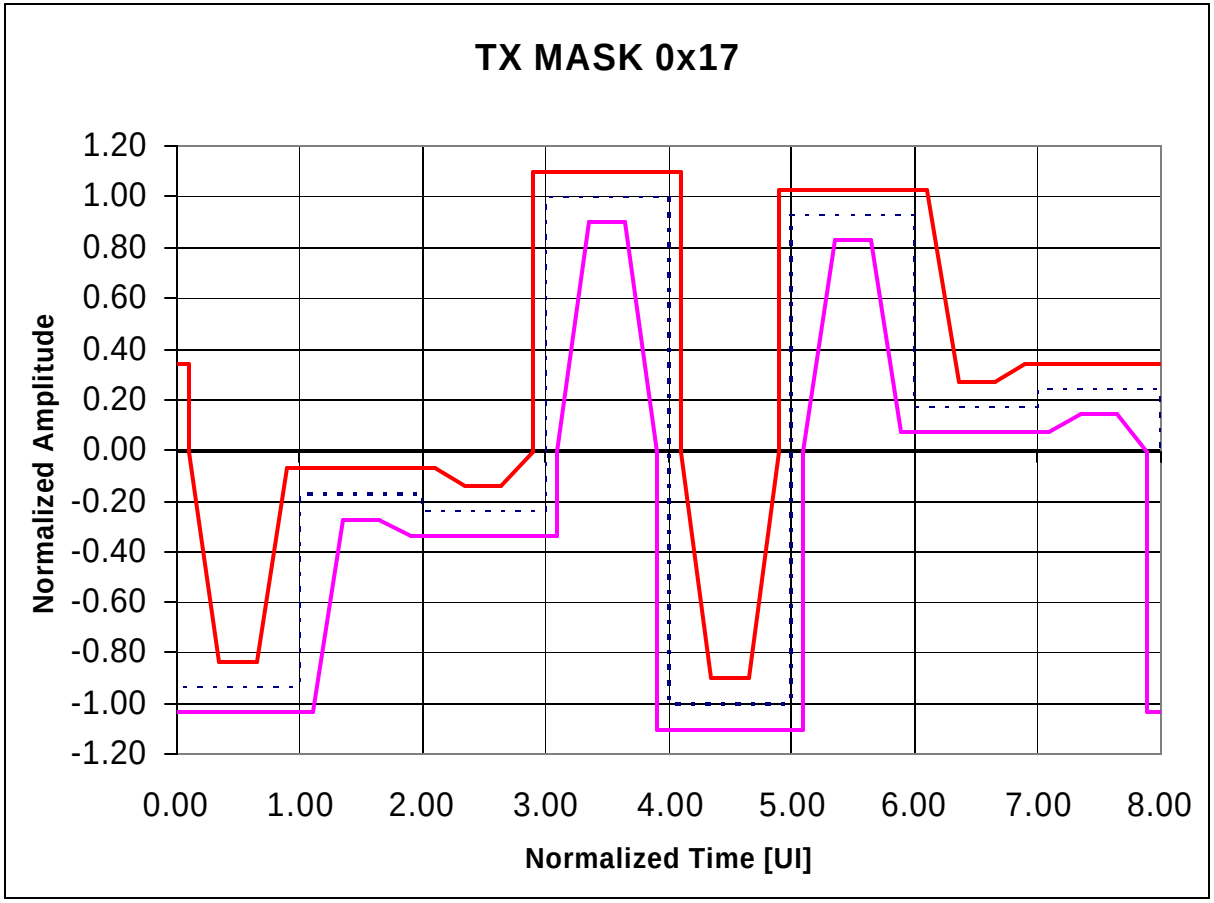
- We must specify a Mask
  - Metric to measure TX compliance to standard
  - Could be 1 mask with multiple thresholds, or multiple masks.
- Ensures the TX equalizer(s) has sufficient granularity, and range.
- Provides the RX a basis for what to expect and must receive through a compliant channel

Initial Proposed TX Mask

Test pattern is 0x17 repeating pattern

Masked based on 3 - tap EQ baseline values from previous data presentation

gaither_01_1104.pdf

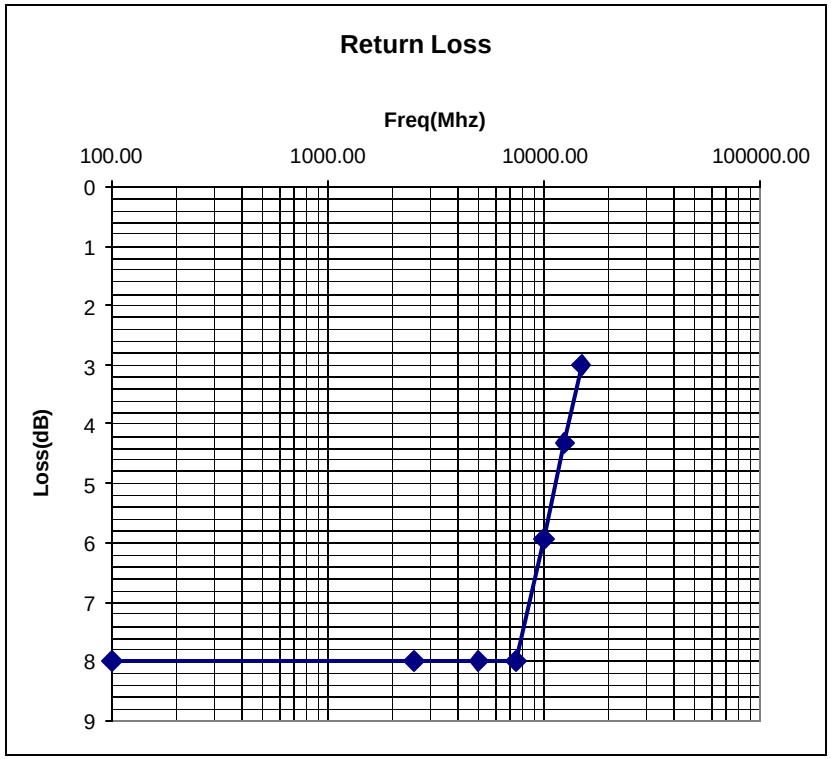


Differential Return Loss

Return Loss(f) = 8
For 100Mhz = f < 7.5 Ghz

$$\text{Return Loss}(f) \geq 8 - 16.6 * \log\left(\frac{f}{7.5\text{Ghz}}\right)$$

For 7.5Ghz = f < 15Ghz



RX specification

Bit error ratio

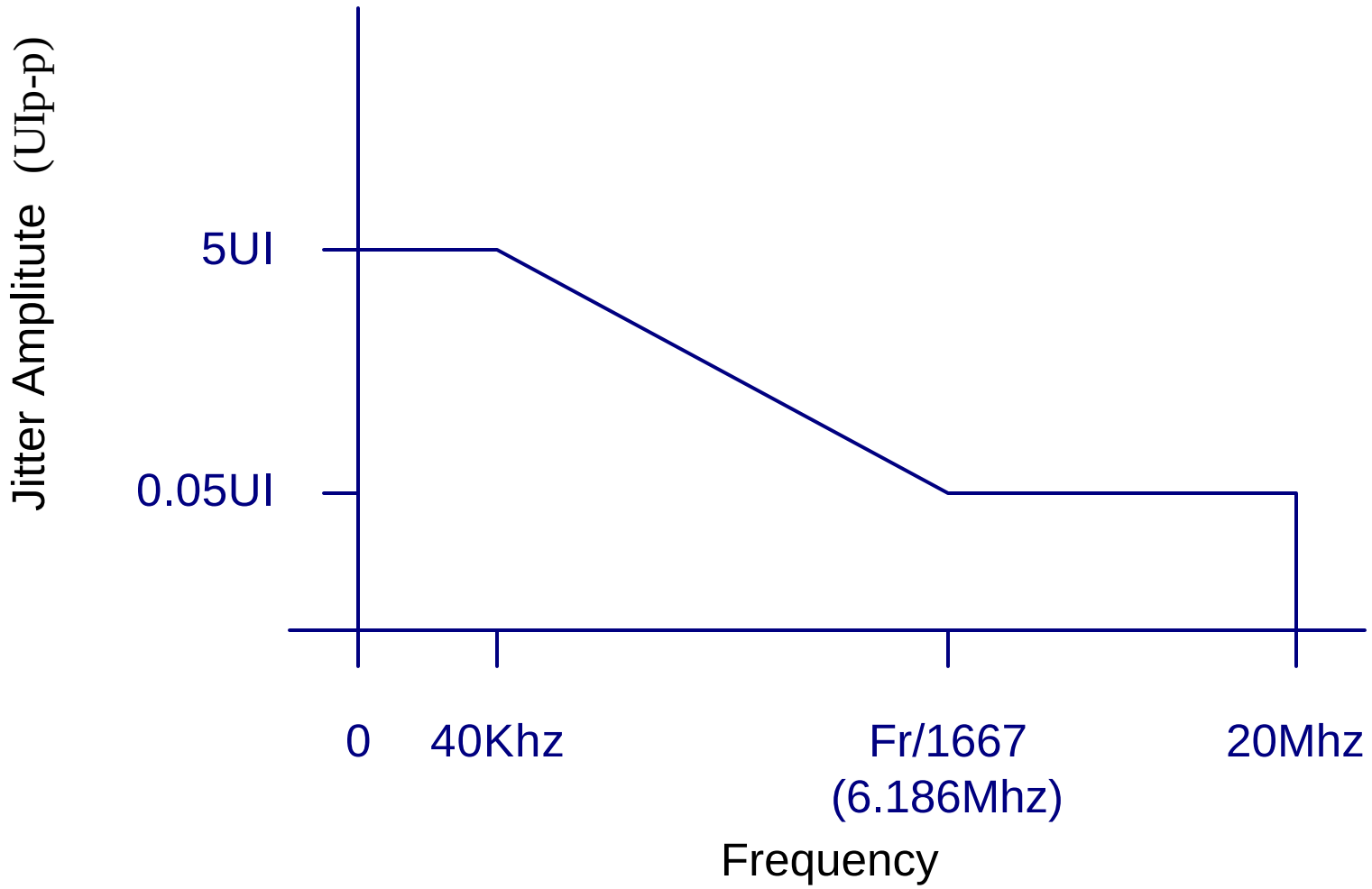
The receiver shall operate with a BER of better than 1E-12 when receiving a compliant transmit signal, as defined in X,through a compliant channel as defined in Y.

Paraphrased from 54.6.4.1 of IEEE802.3ak-2004

RX Characteristics Table

Parameter	Value	units
Baud rate tolerance	10.3125GBd +/- 100ppm	GBd
Diff. Peak Amplitude maximum	1600	mVp-p
Error Rate	10^-12	
Diff. Return Loss minimum	See TX Ret. Loss	dB
Jitter Tolerance	See Figure	UI

RX Sinusoidal Jitter Tolerance



Channel Model

- Adopt a Normative Channel Model
- Work to be developed through the Channel Model Adhoc.

Conclusion

- The proposal meets objective for 10Gbps Serial PMD
- Specified in a manner that is consistent with existing IEEE 802.3 PMD clauses
- Maintains compatibility with other 10Gbps serial electrical standards
- Provides a mechanism for the channel to be optimally equalized.
- Provides Consensus