Regarding Comment I-73 on D3.0

Contribution to IEEE 802.3cy

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Introduction

- Comment I-73 (TR) on D3.0, page 94, line 48, states:
  - Change "jitter relative to an unjittered reference shall be less than 0.4 ps" to "jitter relative to an unjittered reference shall be less than 0.4 ps, when measured with bandwidth from 1MHz to 100MHz, and less than 1ps when measured with bandwidth from 10kHz to 1MHz."

- There has been some off-line discussion about what the appropriate limit values to use in this text

- This presentation suggests minor updates to the text proposal, based on further considerations in off-line discussions

Proposed Changes

- Based on off-line discussions we suggest to replace the text "jitter relative to an unjittered reference shall be less than 0.4 ps" on page 94, line 48, AND on page 95, line 14, with
  - "jitter relative to an unjittered reference shall be less than 0.4 ps, when measured from 1MHz to 100MHz, and less than 0.8ps when measured from 10kHz to 1MHz."

- We also propose to clarify the filtering to use in the jitter measurements:
  - On page 95, at the end of the paragraph ending at line 8, add the following:

  "For the jitter calculations it is recommended to use a bandpass filter with the frequency response of Equation (165-XXX) for the 10kHz to 1MHz band and Equation (165-YYY) for the 1MHz to 100MHz band, where the values are f_L = 10kHz and f_C = 1MHz.

  $$G(f) = \frac{f}{f - j \times f_L}\left(1 - \frac{f}{f - j \times f_C e^{-j\pi f T}}\right) \qquad \text{(165-XXX)}$$

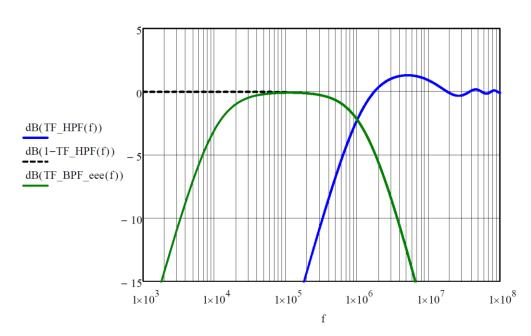 $$G(f) = \frac{f}{f - j \times f_C e^{-j\pi f T}} \qquad \text{(165-YYY)"}$$
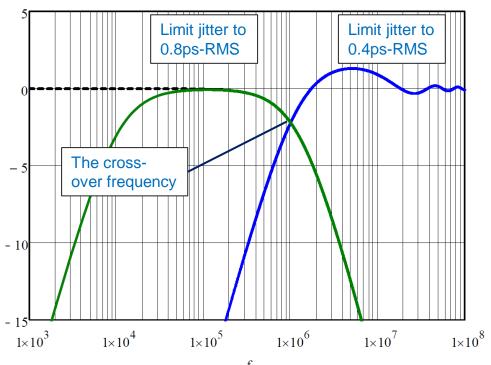
Explanation of Proposed Bandpass Filter

- The bandpass filter is based on High-pass Function in 94.3.12.6.1

$$G(f) = \frac{f}{f - \mathrm{j} \times f_n e^{(-j2\pi fT)}}$$

HP

LP

$$G_L(f) = \frac{f}{f - j \times f_C}\left(1 - \frac{f}{f - j \times f_H e^{-j\pi fT}}\right)$$

dB(TF_HPF(f))

dB(1−TF_HPF(f))

dB(TF_BPF_eee(f))

Explanation of Proposed Limits

- The 1MHz crossover frequency is a compromise between CDR jitter tracking performance, echo noise, etc. The 1MHz value is intended to be a conservative number that will help with interoperability between different PHY implementations

- The 0.8ps jitter limit in the lower band is a compromise between analog complexity and CDR performance (SNR on long cables and EEE robustness)

Proposed Resolution of Comment I-73

Add the highlighted text

On Page 94:

The transmitter timing jitter is measured by capturing the TX_TCLK_879 waveform in both MASTER and SLAVE configurations while in test mode 1 using the transmitter test configuration 2 shown in Figure 165–26. When in test mode 1 and the link is up and the two PHYs have established link (link_status is set to OK), the RMS value of the MASTER TX_TCLK_879 jitter relative to an unjittered reference shall be less than 0.4 ps, when measured from 1MHz to 100MHz, and less than 0.8ps when measured from 10kHz to 1MHz. The peak-to-peak value of the MASTER TX_TCLK_879 jitter relative to an unjittered reference shall be less than 4 ps.

On Page 95:

TX_TCLK_879 jitter shall be measured over an interval of 0.4 ms ± 10%. The band-pass bandwidth of the capturing device shall be 200 MHz (this is equivalent to phase noise integration of the clock over a bandwidth of at least 100 MHz from the carrier frequency). The unjittered reference is a constant clock frequency extracted from each record of captured TX_TCLK_879. The unjittered reference is based on linear regression of frequency and phase that produces minimum time interval error. For the jitter calculations it is recommended to use a bandpass filter with the frequency response of Equation (165-XXX) for the 10kHz to 1MHz band and Equation (165-YYY) for the 1MHz to 100MHz band, where the values are $f_L = 10kHz$ and $f_C = 1MHz$.

$$G_L(f) = \frac{f}{f - j \times f_L}\left(1 - \frac{f}{f - j \times f_C e^{-j\pi fT}}\right) \qquad \text{(165-XXX)}$$

$$G_H(f) = \frac{f}{f - j \times f_C e^{-j\pi fT}} \qquad \text{(165-YYY)"}$$

165.5.3.3.1 Transmit MDI random jitter in MASTER mode

In addition to jitter measurement for transmit clock, MDI jitter is measured when in test mode 2 with the square wave pattern (see Table 165–13) and using test configuration 3 as shown in Figure 165–25. The RMS value of the MDI output jitter relative to an unjittered reference shall be less than 0.4 ps, when measured from 1MHz to 100MHz, and less than 0.8ps when measured from 10kHz to 1MHz. The peak-to-peak value of the MDI output jitter relative to an unjittered reference shall be less than 4 ps. Jitter shall be measured

Summary

- New text was proposed for comment I-73 on D3.0, based on offline discussion

- We propose to adopt the text changes on slide 6 as a resolution to comment I-73