C2M and CR signal specification

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Comments 578, 564, 565, 561, 577, 571, 332, 116, 117, 572. Relates to jitter comments: 174, 175, 176, 181, 179, 180. See slide 7

Abstract and introduction

- Apply the well-established and effective reference receiver based specification method to 802.3dj C2M and CR signals, consistent with the COM method for CR cables
- See https://ieee802.org/3/dj/public/24_06/dawe_3dj_01a_2406.pdf
- Increased host loss, particularly in C2M, means the traditional CR measurement method is too far from its KR roots; replace it with an improved C2M method
- Take advantage of learnings from TDECQ
- https://ieee802.org/3/ck/public/20_10/healey_3ck_01a_1020.pdf proposed two histograms for C2M
- https://ieee802.org/3/dj/public/24_05/calvin_3dj_01b_2405.pdf shows the practicality of the C2M eye method with the CTLE, FFE, 1-DFE reference receiver

Combine the quotas as COM does

- In today's CR, a transmitter may trade off its voltage noise vs. its nonlinear distortion because they are both components of SNDR, but not its noise vs. jitter, v_f vs. R_LM, R_peak vs. SNDR... This is wasteful

Item	**Combined in COM?**	**Combine in eye measurement?**
Pulse peak ratio R_peak = v_peak/v_f ~C_eq ~ EQ range. We don't yet know if we need fine TxFIR setting or not		
Level separation mismatch ratio R_LM	No	Yes
SNDR part 1, noise	Yes	Yes
SNDR part2, distortion (but not R_LM)	Yes	Yes
SNR_ISI	Yes	Yes
Jitter:		
J_RMS	Yes	Yes
J3u, J3u_03 (J6u has been proposed)	Yes	*Could be useful if it can be measured*
Even-odd jitter	No?	Yes

Objective of method

- We seek to assess a *signal* for its suitability
  - Not diagnose or infer the properties of a channel and source behind it
  - We look forward (to the receiver) not backward (to the embedded source)

Signal measurement method

- For one setting of the Tx FIR options (considering training handshaking tolerance)
  - A large signal swing for better SNR in the scope measurement
- Measure the PRBS13Q signal using the standard CRU and without averaging
  - Add software transmission line for "far end" measurements
- Process with clean lossy transmission line in software (for far-end measurements) and the COM-like CTLE-FFE-DFE reference receiver
  - Use defined scope noise representing receiver front-end noise, correctly handling noise enhancement according to how the instrumentation works
  - Search for CTLE setting and sampling phase
  - Use COM MMSE method to find FFE and DFE tap weights at best phase
- With these EQ settings, apply the twin histograms as in TDECQ and https://ieee802.org/3/ck/public/20_10/healey_3ck_01a_1020.pdf "this proposal (2 offsets)"
  - Histogram phase and thresholds may be adjusted but kept consistent for left and right, and CTLE-FFE-DFE settings are not changed
- For each histogram, the three sub-eyes are combined to one because we don't care which one makes errors. Compare COM's very simple handling of PAM4 and R_LM
- Each combined histogram must have adequate opening at target BER relative to Eye Height. This is equivalent to COM limit
- Because the receiver noise is given, this ensures that the signal is not too small and not too bad
  - A secondary Eye Height limit may be used if warranted

Discussion

- No need for specs for SNDR, SNR_ISI, Jrms, EOJ, R_LM, vf, Rpeak, although some of them may be part of calibrating the stressed signals for input testing

- Moves away from salami-slicing and micromanaging the designers; frees stranded margin

- Handles crosstalk correctly (in the measurement) as in 120E
  - Comment 572

- To make the method respond better to the tails of the jitter distribution, the Qt in the TDECQ-like noise filling method can be increased
  - This is like choosing the COM margin – a judgement call
- Seek to J3u or similar for now, if we can find how to measure it; this may be measured with a different Tx FIR setting

- Granularity of Tx FIR training is a separate subject, not addressed here
  - Comment 569

Related comments

578 Don't need a separate R_{LM} spec

564 Add a VEC-like, TDECQ-like spec using 179's COM reference receiver in a scope. Delete SNDR, jitter specs and SNR_ISI. Similarly for KR and C2C.

565 Don't need a separate SNR_{ISI} spec

561 Delete the jitter section, add a VEC-like, TDECQ-like spec for CR, for KR and C2C

577 Don't need the SNDR section , add a VEC-like, TDECQ-like spec for CR, for KR and C2C

571 Remove vf (min), Rpeak, SNDR, SNR_ISI, R_{LM} and output jitter. Add a VEC-like, TDECQ-like spec using the COM reference receiver, and eye height. Apply to C2M throughout 176E. Note 120E doesn't have an eye linearity spec

332 Problems measuring jitter; reinstate VEC

116, 117 Replace jitter and SNDR with VEO and VEC, consider adding EW

572 Stressed signal diagrams and crosstalk calibration

Specifically jitter related:

174, 175, 176 Relax J3u03 and J4u03 limits

181, 179, 180 Find another way to measure uncorrelated jitter