C2M and CR signal specification

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D1.2 comments: 411, 315, 211, 316, 212, 412, 213, 404, 416, 405, 400, 401, 308

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
  - With crosstalk. 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 Amplitude. 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 Amplitude 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 412

- 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
  - D1.1 comment 569, D1.2 editor's notes "The required equalization range and resolution in the transmitter output waveform specification need confirmation"

Draft 1.2 related comments

These comments follow up on D1.1 comments on next slide

411 Wasteful and unnecessary diagnostic specs, some not measurable

315 EECQ for receive compliance

211 Jitter measurement difficulties

316 EECQ for receive compliance

212 Jitter measurement difficulties

412 Crosstalk in measurement and its calibration

213 Jitter measurement difficulties

404 Jitter measurement difficulties...

416 We probably don't need a separate RLM spec

405 SNR_ISI is a component of eye opening

400 Replace SNDR spec with a VEC-like, TDECQ-like spec

401 Jitter measurement difficulties

308 Replace output jitter and SNDR with VEO and VEC

Draft 1.1 related comments

The se comments were not addressed

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