Discussion of Merge Request 4.13_1 (sigma_X2)

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Introduction

- IEEE Std. 802.3 and amendments normatively specify Channel Operating Margin (COM) via equations and methods in Annex 93A and Annex 178A
  - This is the COM specification
- COM code is available via IEEE SA Open Source "802-COM" website
  - The COM code is an example implementation of the COM equations and methods in the specification text

Background

- The σ_X^2 term was removed from the TX output noise PSD equation by IEEE P802.3dj D1.3 comment #511.
- The IEEE 802.dj Annex 178A text was changed to remove σ_X^2
- However, the V4.13 COM reference code does not reflect the change.
  - σ_X^2 term remains in the code

IEEE 802.3dj D1.3

178A.1.7.3 Transmitter output noise

For a given sampling time $t_s^{(0)}$, the power spectral density of the sampled transmitter noise at the input to the receiver discrete-time equalizer is defined by Equation (178A–18).

$$S_{tn}(\theta) = \sigma_X^2 10^{-SNR_{TX}/10} \left|\mathrm{DFT}[h_{tn}(n)]\right|^2 / f_b \qquad \text{(178A–18)}$$

D1.3 Comment 511

Cl 178A	*SC* 178A.1.7.3	*P*756	*L*12	# 511

Li, Mike — Intel

Comment Type TR *Comment Status* A *COM Tx noise*

Including sigma_x^2 in EQ (178A-18) is incorrect. It will make the TX noise modualtion depedent which is wrong.

SuggestedRemedy

Remove the sigma_x^2 in EQ (178A-18)

Response *Response Status* C

ACCEPT IN PRINCIPLE.
Implement the suggested remedy with editorial license.
Note that this change brings the COM model for transmitter noise into closer alignment with the measurement of SNDR defined in 179.9.4.5.1.

D2.4

178A.1.7.3 Transmitter output noise

For a given sampling time $t_s^{(0)}$, the power spectral density of the sampled transmitter noise at the input to the receiver discrete-time equalizer is defined by Equation (178A–19).

$$S_{tn}(\theta) = 10^{-SNR_{TX}/10} \left|\mathrm{DFT}[h_{tn}(n)]\right|^2 / f_b \qquad \text{(178A–19)}$$

Problem Statement

- There is a discrepancy between the written specification text and the COM code implementation
- Any result using the current COM reference code does not reflect the equation as written in the current IEEE P802.3dj draft (D2.4)
- Impact: Implementing a change to the equation can reduce the COM result by up to ~0.5 dB and has effects on SNDR limits, etc.

Cl **178A** *SC* **178A.1.7.3** *P* **854** *L* **20** # 39

Mellitz, Richard — Samtec

Comment Type **TR** *Comment Status* **R** *COM (E)*

Equation 179A-19 for S_tn computation omits the modulation term (signa_X²), assuming transmitter noise behavior is independent of modulation. This was implemented as are result of comment 511 on d1.3. This is acceptable for low-radix designs with minimal crosstalk, where SNDR remains high regardless of modulation. However, in high-radix designs with significant crosstalk and modal conversion, transmitter noise becomes modulation-dependent. Ignoring signa_X² under these conditions misrepresents performance and introduces a ~0.4 dB COM penalty.

SuggestedRemedy

Include signa_X^2 in the S_tn computation as in suggested in slide 7 of https://www.ieee802.org/3/dj/public/24_01/healey_3dj_01_2401.pdf

Response *Response Status* **C**

REJECT.
This comment does not apply to the substantive changes between IEEE P802.3dj D2.2 and D2.3 or the unsatisfied negative comments from previous drafts. Hence it is not within the scope of the recirculation ballot.

The CRG has reviewed slides 3-6 in <https://www.ieee802.org/3/dj/public/26_01/ran_3dj_01b_2601.pdf>.

A change to the transmitter noise model should not be done without a corresponding change to the SNDR limits (and/or definition) in order to maintain the intended relationship. The suggested remedy does not propose such a change to the SNDR definition and this risks creating a disconnect between what is required for a compliant transmitter and how such a transmitter is modeled to compute Channel Operating Margin (COM).

There is no consensus to make the suggested change.

Recommended Path Forward

- Rich provided COM code merge Request 4.13_1 that includes:
  - Code to implement D2.4 equation 178A-19.
  - A switch to enable the new code.
    - 1 = Use D1.3 equation 178A-18
    - 0 = Use D2.4 equation 178A-18. (Default)
- The merge request allows participants to assess the impact of the change and build consensus towards resolving the discrepancy in the SA ballot cycle.
- Contributions for the March plenary are encouraged.
  - Comparison of results between the two equation forms
  - Analysis and recommended changes to other parts of the IEEE P802.3dj draft specification, if applicable

Thanks!