802.3dj D1.0
Comment Resolution - Electrical track

Adee Ran, Cisco

Introduction

- This slide package was assembled by the 802.3dj electrical editorial team to provide background and detailed resolutions to aid in comment resolution.
- Acknowledgement to Howard Heck, Adam Healey, Chris Diminico, Mike Dudek, Matt Brown, and Kent Lusted for reviewing and contributing to this work.
- Text in red indicates editors' explanation of the comments. Italics indicate an editor's observation which might be subjective.
- The responses to the comments may point to the slides for reference but the comment report is the official record.

Cross-Clause topics

Bessel-Thomson measurement filter bandwidth [15 comments, 178/179/176D/176E]

In agenda

Cl 178 SC 178.9.2 P275 L48 # 60

Mellitz, Richard Samtec

Comment Type TR *Comment Status* X

The Bessel-Thomson filter should track fr. Between 0.5 fb and 0.6 fb have been shown in presenations.

SuggestedRemedy

change TBD to 67GHz

Proposed Response *Response Status* O

Cl 178 SC 178.9.2 P275 L48 # 230

Li, Mike Intel

Comment Type TR *Comment Status* X

3dB BW is TBD

SuggestedRemedy

Change it to 65 GHz.
Rational, considering the common and cost effective 1.85mm connector BW, and associated ~7% measurement error, give rise to this number.

Proposed Response *Response Status* O

Cl 179 SC 179.9.4 P309 L23 # 225

Noujeim, Leesa Google

Comment Type T *Comment Status* X

Adopted baseline https://www.ieee802.org/3/dj/public/24_01/ran_3dj_01a_2401.pdf has BT filter bandwidth as TBD but D1.0 has 40GHz. 3dB bandwidth of 40GHz is insufficient for 200Gbps/lane PAM4

SuggestedRemedy

Increase to 65GHz, consistent with test equipment capabilities and demonstrated channel rolloff eg in https://www.ieee802.org/3/dj/public/23_11/weaver_3dj_01_2311.pdf and https://www.ieee802.org/3/dj/public/24_01/benartsi_3dj_01_2401.pdf OR change to TBD

Proposed Response *Response Status* O

Comment #60 is against 178.9.2 (Transmitter characteristics) and suggests **67 GHz**.
Comment #32 proposes a similar bandwidth for receiver test calibration (178.9.3.3).
The reasoning for both is that "The Bessel-Thomson filter should track fr".
Comments #131 and #133 against 176E suggest **58.4375 GHz** with similar reasoning based on different assumed f_r.

Note that there has never been a requirement to have the bandwidth of the measurement B-T filter equal to the COM f_r parameter (part of the Rx model).
(4 comments)

Comment #230 and comment #245 suggest **65 GHz** with reasoning based on connector availability.
Note that the B-T filter is implemented in the test equipment and the cost of other setup components is likely less significant.
(2 comments)

Comment #225 highlights an error in D1.0 - the value 40 GHz appears once although it has not been part of the baseline (and thus has not been adopted).
The proposed value here and in #217 is **65 GHz** based on "test equipment capabilities and demonstrated channel rolloff".
Comments #124 and #388 also address the same issue but suggest changing to **TBD**.
(4 comments)

Comments #399, #410, #412, #422, #425 suggest the value **62 GHz**.
(5 comments)

Summary: The suggested values are 58.4375, 62, 65, and 67 GHz.

Editorial team proposal: use a BW of **X** GHz for signal measurements in 178, 179, 176D, 176E. Replace all TBDs and the "40 GHz" that wasn't adopted. Proposed value for **X** is 65.

ERL (14 comments, 178/179/179B)

In agenda

Cl 178 SC 178.9.2.2 P 278 L 26 # 29

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

scale ERL parameter form 0.3ck

SuggestedRemedy

in table 163-7 change TBD's as follows
Tr 0.005 ns
βx 0 GHz
ρx 0.618
N 400 UI

Proposed Response *Response Status* **O**

There are several similar comments:

- #29 against 178.9.2.2 (KR Tx/Rx ERL) with N=400 (x2 of 802.3ck)
- #28 against 178.9.2.1.2 (KR test fixture ERL) with N=400 (x2 of 802.3ck)
- #43 against 178.10.3 (KR channel ERL) with N=7000 (x2 of 802.3ck)
- #48 against 179.9.4.8 (CR Tx/Rx ERL) with N=1600 (x2 of 802.3ck)
- #51 against 179.11.3 (CR cable assembly ERL) with N=4500 (**same as** 802.3ck)
- #58 against 179B.4.2 (Mated test fixtures ERL) with N=1600 (**x4** of 802.3ck), tw=1, DER0=2e-5

All propose values for ERL parameters, dividing T_r by 2 and multiplying N by as noted above, relative to the values in 802.3ck (100G).

Additional comments #237, #238, #239, #240 (Tr, beta_x, rho_x, N for KR Tx/Rx ERL, respectively) suggest some of the ERL parameters with the same values as above:

Other comments

- #241 proposes 44 for N_bx for KR Tx/Rx ERL
- #231 and #244 propose -3 dB for min dERL (KR Tx/Rx)
- #252 proposes 11 dB for min ERL (KR channel)

The justification provided for ERL parameters is very basic but may be sufficient.
(are the values of N in consensus?)
No comments address ERL parameters in Annex 176D (C2C component and channel) and 176E (C2M host and module) which are mostly TBD.

Editorial team proposal:

- Accept the suggested remedies of comments 28, 29, 43, 48, 51, 58, 241, 244, 252
- Refer 237, 238, 239, 240 to #29
- Use the suggested values from clause 178 and 179 to fill in TBDs for annex 176D and annex 176E respectively, except for the value of N and minimum ERL/dERL which will stay TBD.

ERL Tfx (5 comments, 179/176E)

In agenda

Cl 179 SC 179.9.4.8 P315 L35 # 227

Noujeim, Leesa Google

Comment Type T *Comment Status* X

Practical test fixtures may have discontinuities close to 0.2ns from the host-facing connection (mating interface). If the intent is to remove the test fixture discontinuities from the ERL calculations, we should adjust the 0.2ns

SuggestedRemedy

Change text to "...Tfx equal to twice the delay between the test fixture connector and the test fixture host -facing connection minus 0.2ns or as needed to remove test-fixture discontinuities from the ERL result"

Proposed Response *Response Status* O

The comment suggests that the value 0.2 ns may not be correct.

There are several similar comments:
- #227 against 179.9.4.8 (CR host transmitter ERL)
- #218 against 179.11.3 (CR cable assembly ERL)
- #219 against 179.9.5.5 (CR host receiver ERL)
- #220 against 176E.3.3.3 (C2M Host output ERL)
- #221 against 176E.3.4.2 (C2M Module output ERL)

Effect of the suggested change:

179.9.4.8 Transmitter effective return loss (ERL)

The ERL of the transmitter at TP2 is defined by the procedure in 93A.5 using the values in Table 179–9 and Table 179–15, and with the value of T_{fx} equal to twice the delay between the test fixture connector and the test fixture host-facing connection minus 0.2 ns or as needed to remove test-fixture discontinuities from the ERL result"

For module: "module-facing"
For cable assembly: "cable facing"

Note that the 0.2 in the existing text is a reduction from "twice the delay between the test fixture connector and the test fixture host-facing connection".
This means the measurement is time gated to remove reflections from the whole text fixture except for a length equivalent 0.1 ns (assuming "twice" has precedence over "minus").
0.1 ns is approximately 17 mm, so for hosts, the time-domain response starts at 17 mm before the HCB's card end, and likely includes the pad and via. Using different values may cause the via to be excluded, which may affect the ERL result.
For modules and cable assemblies, the MCB has a receptacle, which may require different time gating, but the proposal would leave Tfx open for interpretation and creates ambiguity.

Editorial team proposal: REJECT #218, #622, #227, #219, #620.
- For host ERL, the existing specification of Tfx is appropriate.
- For module and cable assembly ERL, the proposal is not specific enough.

COM (minimum/target value) [13 comments, 178/179/179A/176D]

In agenda

Cl 178 SC 178.10 P284 L11 # 250

Li, Mike Intel

Comment Type **TR** *Comment Status* **X**

COM(min) is TBD

SuggestedRemedy

Repalced both with 3 dB, see lim_3dj_01_2405

Proposed Response *Response Status* **O**

This comment and multiple others suggest using 3 dB as the minimum COM for channels

- 178.10 channel: #33, #250, #402, #253
- 179.11 cable assembly: #50, #413
- 176D.4 channel: #430
- 179A.7 TP0d-TP5d: #57

3 dB is also suggested for Rx test channel calibration:
178.9.3.3: #249, #400
179.9.5.3: #49, #411
176D.3.4.4: #427

The referenced presentation, https://www.ieee802.org/3/dj/public/24_05/lim_3dj_01_2405.pdf, does not include a rationale for the proposed value of COM

The minimum COM should be based on expected implementation penalty with respect to the new reference receiver, for which many parameters are TBD. Specifically, the presentations https://www.ieee802.org/3/dj/public/24_05/healey_3dj_01b_2405.pdf and https://www.ieee802.org/3/dj/public/24_05/shakiba_3dj_02_2405.pdf are relevant in this context.

However, the same value is proposed in several comments, so it may be in consensus and enable moving forward.

Editorial team proposal: Use the value **X** for minimum COM for channels and for test setup calibration in KR/CR/C2C.
Proposed value for X is 3 dB.

Reference impedance for specifications [2 comments, 178/179]

In agenda

Cl **178** *SC* **178.9.1** *P* **275** *L* **39** # 395

Kocsis, Sam — Amphenol

Comment Type **T** *Comment Status* **X**

The reference impedance should match the system impedance, Rd as defined in COM spreadsheets.

SuggestedRemedy

92-ohm, TBD, or straw poll based on proposed values presented in Task Force contributions

Proposed Response *Response Status* **O**

2 comments (#395, #387) about the reference impedance for specifications suggest that it should match the system impedance, and that 46 Ohm (92 Ohm differential) is a possible value.

The reference impedance for specifications (not R_0) affects ERL and other RL results (S-parameter values depend on the reference impedance), and if test equipment is matched to this impedance it will also affect time-domain measurements (R_peak, SNR_ISI).
Designs may take this into consideration, and it would be preferable if these specs do not penalize components matched to the "system impedance" (assumed impedance of the other system components). ⇒ see next slide.

178.9 Electrical characteristics

178.9.1 Reference impedance

The reference impedance for differential specifications is 100 Ω. The reference impedance for common-mode specifications is 25 Ω.

COM R_d parameter
[8 comments, 178/179/176D/176E]

In agenda

Cl 178 SC 178.10.1 P285 L40 # 396

Kocsis, Sam Amphenol

Comment Type T *Comment Status* X

Rd(t) = "TBD"

SuggestedRemedy

Change "TBD" to "92-ohm" to match majority of contributions to the Task Force, and better align with Zc definition in package

Proposed Response *Response Status* O

This comment and 3 similar ones (#396, #397, #391, #392) are about the R_d parameter, which is used as the terminations (Tx and Rx) in the COM pulse response calculation.
The value in the suggested remedy seems to be differential, and would become 46 Ohm single ended.

Other comments suggest different values:
- #255, #256: 46.25 Ohm
- #141, #137: 50 Ohm

The value of R_d affects the reference ERL (and thus dERL) and the reflections within the reference package (and thus COM and dR_peak).

*ERL is also affected by the **reference impedance for measurements** (which is now, effectively, 50 Ohm single-ended - see previous slide) so these specifications are closely tied with each other.*

Note that if R_d is different from the termination used in time-domain measurements (e.g. scope) then A_v, A_fe and A_ne need to change to create the minimum compliant v_f when measured on a scope. Additionally, Tx output specifications may need to be changed.

Editorial team proposal:
- Change Rd (both t and r) from TBD to **X Ohm** in COM device parameters tables (Table 178–12, Table 179–15, Table 176D).
- Change the reference impedance statements (178A.1.3, 178.9.1, 179.9.3, 179.11.1, and 176D.3.2) to define a reference **single-ended** impedance of **X Ohm** for all specifications, e.g., insertion loss, return loss, and ERL.Add a similar statement in 176E.

Proposed value for X: 46 Ohm.

If X is different from 50 Ohm, add a NOTE that s-parameter measurements may be made with a different impedance and converted mathematically to that reference. Add an editor's note that output waveform measurements on 50 Ohm scopes need to be addressed.

If the reference impedance is different from R_d, add an editor's note after each COM parameter table, noting that the values of A_v, A_ne and A_fe need confirmation.

COM R_0 parameter
[9 comments, 178/179/176D/176E]

In agenda

Cl 178 SC 178.10.1 P285 L38 # 35

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

(Table 178–12): Computation can be independent of R0. Add a note to explain. S parameter can utilize any R0. For computation purposes s-parameters are converted to 50 ohms which is the native impedance for the most common test equipment.

SuggestedRemedy

Change R0 for TBD to 50 ohms and add a note indicating the imported s-parameter are to be converted into 50 ohm reference before computation.

Proposed Response *Response Status* **O**

2 comments (#35, #52) suggests that R_0 should not affect COM result.

7 comments (#254, #403, #414, #141, #431, #136, #438) suggest the value 50 Ohm for R_0, as used in previous projects.

Note that the reference impedance for specifications is stated explicitly in 178.9.1, 179.9.3, 179.11.1, and 176D.3.2 (see previous slide), and does not refer to R_0.

178A.1.3 already defines the reference impedance for s-parameters (effectively 50 Ohm single ended), so the R_0 parameter in COM tables may be redundant.

178A.1.3 Measurement of the channel under test

The S-parameters for each signal path are measured between the test points specified by the clause or annex that utilizes this calculation. It is recommended that the scattering parameters be measured with a uniform frequency step from a start frequency no greater than 10 MHz (TBC) to a stop frequency of at least TBD GHz. The measurement frequency step corresponds to the time span of the pulse response derived from the S-parameters (see 178A.1.6). The frequency step should be chosen to be small enough so that all significant components of the pulse response are included.

The reference impedance for the measurement of differential-mode S-parameters is 100 Ω.

Editorial team proposal: Remove the R_0 parameter from all COM tables

COM Tx FFE
[10 comments, 178/179/176D/176E]

In agenda

Cl 178 SC 178.10.1 P286 L18 # 37

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

Presentations so for have not shown the need for Tx FFE. Change to no TXFFE until further data is provided.
Rx noise may suggest a need for the TXFFE which would improve performance. It's not clear from a channel perspective that the TX FFE is not a zero sum gain compared to the Rx noise loss of COM. Until Rx FFE noise is better defined zero out TxFFE.

SuggestedRemedy

Change TBDs for c(-3),c(-2),c(-1), and c(1) to zero. Set C(0) tp 1.

Proposed Response *Response Status* **O**

The comment suggests that COM should use no Tx equalization.

There are several other comments on the same topic

- #142 against 176D and #138 against 176E suggest -0.3:0.02:0 for c(-1) , 0:0.02:0.14 for c(-2), -0.14:0.02:0.14 for c(1), and no c(-3)

- #258 against 178 suggests no c(-3)
- #259 against 178 suggests 0:0.02:0.16 for c(-2)
- #260 against 178 suggests -0.4:0.02:0 for c(-1)
- #261 against 178 suggests 0.54 for c(0)
- #262 against 178 suggests -0.2:0.02:0 for c(1)

- #405 against 178 and #416 against 179 suggest matching the ranges with the Tx characteristics table (which has different values from the two sets above)

The values proposed by multiple comments do not indicate consensus in this area.

The contributions so far are not sufficient evidence for not needing a Tx FFE as suggested in the comment. The chosen Tx FFE values ("no equalization") in analysis presented so far is due to the unlimited Rx FFE coefficients used in the analysis, but these limits are still TBD.
The possible inclusion of an ADC model (with dynamic-range-dependent quantization noise), presented in https://www.ieee802.org/3/dj/public/24_05/healey_3dj_01b_2405.pdf, may change the chosen Tx FFE.

Editorial team proposal:

- #37: REJECT, there is no consensus to make the proposed changes. Further analysis of the required range of Tx FFE in conjunction with the reference Rx and consensus building is encouraged.
- #138, #142, #258, #259, #260, #261, #262, #405, #416: REJECT resolve using the response to comment #37.

COM f_r parameter
[9 comments, 178/179/176D/176E]

In agenda

Cl 178 SC 178.10.1 P286 L12 # 36

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

T(able 178–13) Presentations so far have used fr of 0.5, 0.55, 0.58, and 0.6. 67 Ghz limits on test equipment and cabling/connector modal physics suggest at least a 9 dB loss is required for good measurements at 67 GHz. Set fr to 0.6 or lower to achieve this.

SuggestedRemedy

change TBD to 0.6.

Proposed Response *Response Status* **O**

Comment #36 suggests that the values 0.5, 0.55. 0.58 and 0.6 are candidates, and suggests 0.6.
The suggested relationship between f_r and measurement bandwidth has not been established.

Several values are suggested in various comments:

- #36, #53: 0.6
- #404, #415, #432, #439: 0.58 (no rationale)
- #137, #141: 0.55 (no rationale)
- #257: 0.5 (refers to lim_3dj_01_2405, but no rationale in this presentation)

Previous reference receivers used the value 0.75, but several past contributions suggest that a lower value would both be more realistic and yield better COM results.
No comment suggests that there should be a difference between interfaces.

With not-too-different values proposed in several comments, it may be possible to reach consensus and enable moving forward.

Editorial team proposal:
Use f_r = **X***f_b as reference receiver bandwidth for all electrical interfaces (Table 178-13, Table 179-16, Table 176D-6, and Table 176E–7).
Proposed value of X: 0.55

COM Rx FFE length parameters [9 comments, 178/179/176D/176E]

In agenda

Cl 178 SC 178.10.1 P287 L13 # 275
Li, Mike Intel
Comment Type TR Comment Status X
Nfix TBD
SuggestedRemedy
Replace it w 24,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L16 # 277
Li, Mike Intel
Comment Type TR Comment Status X
Nf TBD
SuggestedRemedy
Replace it w 5,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L13 # 274
Li, Mike Intel
Comment Type TR Comment Status X
dw TBD
SuggestedRemedy
Replace it w 6,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L17 # 278
Li, Mike Intel
Comment Type TR Comment Status X
Namx TBD
SuggestedRemedy
Replace it w 60,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L15 # 276
Li, Mike Intel
Comment Type TR Comment Status X
Ng TBD
SuggestedRemedy
Replace it w 4,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

5 separate comments against COM Rx FFE length parameters in clause 178:
- d_w (#274)
- N_fix (#275)
- N_g (#276)
- N_f (#277)
- N_max (#278)

Comments #42 (178) and #54 (179) suggest multiple choices for many parameters (not a specific proposal).

Comment #140 proposed Rx FFE parameters for 176E reference receiver, and #144 proposes the same parameters for C2C COM reference receiver.

Comments #504 (176D), #70 (179), #71 (178), and #72 (176E) propose values for some of these parameters along with many others.

Additional proposals for these parameters are included in consensus presentations, see https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf and https://www.ieee802.org/3/dj/public/24_06/lusted_3dj_01_2406.pdf (a?).

Editorial team proposal:
Use d_w=5 (as proposed in /lusted_3dj_07_2405), N_fix=14, N_g=2, N_f=4, and N_max=50 (as proposed in /lusted_3dj_01_2406 (a?)) to replace TBDs in Table 176D–7 and Table 176E–7.
Add editor's notes similar to that in slide 4 of lusted_3dj_07_2405 and slide 5 of /lusted_3dj_01_2406 (a?) to denote that these values need further analysis.
Keep these values TBD in clauses 178 and 179.

COM Rx FFE coefficient limits [14 comments, 178/179/176D/176E]

In agenda

Cl 178	SC 178.10.1	P287	L18	# 279
Li, Mike		Intel		
Comment Type TR		Comment Status X		
Wamx(j) TBD				
SuggestedRemedy				
Replace it w 0.7, see lim_3dj_01_2405, slide 5				
Proposed Response		Response Status O		

The referenced presentation, lim_3dj_01_2405, does not include an explanation of the proposed value.

4 separate comments against COM Rx FFE coefficient limits in clause 178:
- Wmax: 0.7 (#279) and Wmin: -0.7 (#280)
- bmax : 0.85 (#281) and bmin: 0.3 (#282)
- Floating tap min/max (#283 and #284)

For bmax, comment #140 (176E) and #144 (176D) propose 0.75 (but also d_w)

Comments #42 (178) and #54 (179) suggest multiple choices for many parameters (not a specific proposal).

Comments #504 (176D), #70 (179), #71 (178), and #72 (176E) propose values for some of these parameters along with many others.
The presentation https://www.ieee802.org/3/dj/public/24_05/heck_3dj_01b_2405.pdf was provided in support of #504. Slides 25-26 include proposed values for these parameters (per index).

A wide range allowed for FFE coefficients, combined with not accounting for quantization noise, effectively assumes a high-resolution ADC and causes the Tx FFE coefficients not to be utilized in COM optimization. This implies that receivers do not need Tx equalization. The penalties of real receivers having more limited FFE equalization, which would some Tx equalization, have not been analyzed.
Further analysis in this area is encouraged.

However, if consensus can be achieved, having numbers instead of TBDs is a step forward.

Editorial team proposal:
REJECT #279-#284, #140, #144, and #504, due to lack of consensus. REJECT #42 and #54 due to lack of specific proposals.
Alternatively:
Use the proposed values of w_max, w_min, b_max, b_min in comments 279-282 to replace TBDs in Table 178–13, Table 179–15, Table 176D–7, and Table 176E–7.
Add editor's notes similar to that in slide 4 of https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf to denote that these values need further analysis.

COM CTLE parameters [6 comments, 178/176D/176E]

In agenda

Cl 178 SC 178.10.1 P286 L32 # 263

Li, Mike Intel

Comment Type TR *Comment Status* X

g1 inherited from 802.3ck, no simod support, not approproaite

SuggestedRemedy

Replace them w
-15 :0, 1 (min, max, step)
see lim_3dj_01_2405, slide 5

Proposed Response *Response Status* O

Cl 176D SC 176D.4.1 P606 L33 # 433

Li, Tobey MediaTek

Comment Type TR *Comment Status* X

Zero 2 frequency and pole 3 frequency of Continuous time filter are inconsistent with Table 178–13

SuggestedRemedy

Replace zero 2 frequency with fb/80
Change pole 3 frequency from "fb" to "fb/80"

Proposed Response *Response Status* O

Cl 176E SC 176E.5.2 P634 L34 # 440

Li, Tobey MediaTek

Comment Type TR *Comment Status* X

Pole & zero frequency values of continuous time filter are TBD

SuggestedRemedy

Replace zero 1 frequency, fz1, with fb/2.5 GHz
Replace zero 2 frequency, fz2, with fb/80 GHz
Replace pole 1 frequency, fp1, with fb/2.5 GHz
Replace pole 2 frequency, fp2, with fb GHz
Replace pole 3 frequency, fp3, with fb/80 GHz

Proposed Response *Response Status* O

4 separate comments against COM CTLE parameters in Table 178-13 (non-TBD):

- g1: -15:1:0 (#263) (-15 instead of -20)
- g2: -5:1:0 (#264) (-5 instead of -6)
- fz1, fz2: fb/4.233, fb/80 (#265) (fb/4.233 instead of fb/2.5)
- fp1, fp2, fp3: fb/1.8973, fb/2.6562, fb/80 (#266) (fb/1.8973 instead of fb/2.5 and fb/2.6562 instead of fb)

The referenced presentation https://www.ieee802.org/3/dj/public/24_05/lim_3dj_01_2405.pdf does not include a rationale for the proposed changes (highlighted) to the existing values of these COM parameters, nor clarifies why they should be made different from those of clause 179.

Comment #433 suggests changes in Table 176D–6 (C2C) to align it with Table 178-13 (KR)

- Suggests fz2 = fb/80 (replacing TBD)
- Suggests fp3 = fb/80

Comment #440 suggests CTLE parameters for the C2M reference receiver in Table 176E–7 (all currently TBD) that are aligned with the COM parameters of clause 178 and 179.

In addition, the editorial team noticed that Table 176D-7 includes the parameter fLF which is not defined in Annex 176A (it is replaced by fp3 and fp1).

Editorial team proposal:

- Use the identical CTLE parameters from Table 178-13 and Table 179-16, without change, in C2C (Table 176D-6) and C2M (Table 176E–7)
- Align fp1, fz1, fp2, fz2, fp3 in all tables
- Remove fLF from Table 176D-7

(AIP #433, AIP #440, REJECT #263-#266)

COM T_r parameter
[6 comments, 178/179/176D/176E]

In agenda

Cl **179** SC **179.10.1** P **286** L **50** # 39

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

scale Tr from .3ck. Understand that this is not the Tr at TP0d.

SuggestedRemedy

set Tr to 0.00375 ns

Proposed Response *Response Status* **O**

This comment suggests that the transition time T_r used in COM should be scaled down from the value 7.5 ps used in 802.3ck, resulting in 3.75 ps; and states that “this is not the Tr at TP0d”.

Other comments (#268, #407, #418, #435, #441) suggest the value 4 ps instead.

Note that T_r (modeled prior to the device termination) contributes to the transition time at TP0d (after the device termination), and will therefore affect Tx specifications at TP0v (specifically, the reference R_peak). The sensitivity of these specifications to the suggested values has not been addressed by any contributions. Further analysis in this area is encouraged.

However, having numbers instead of TBDs is a step forward, if consensus can be achieved.

Editorial team proposal:

- Change T_r from TBD to **X** ps in Table 178–13, Table 179–15, Table 176D–7, and Table 176E–7.
- Add editor's notes similar to that in slide 4 of https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf to denote that this value needs further analysis.

Proposed value of X: 4

SNDR/SCMR/SNR_TX
[6 comments, 178/179]

In agenda

Cl 179 SC 179.9.4.1.1 P312 L42 # 45

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

SNDR reduces with loss and used that way for equation 178A–18.

SuggestedRemedy

Insert a subsection e) Loss correction factor for fitted pulse measurements. See presentation

Proposed Response *Response Status* **O**

Cl 179 SC 179.9.4.6 P315 L17 # 47

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

SNDR reduces with loss and used that way for equation 178A–18.

SuggestedRemedy

change
The transmitter SNDR is defined by the measurement method described in 120D.3.1.6
to
The transmitter SNDR is defined by the measurement method described in 120D.3.1.6 plus a power loss factor defined in xxxx

Proposed Response *Response Status* **O**

If the proposal is adopted, implementing this proposal would preferably done with broad editorial license.

Other comments (shown on subsequent slides) are based on this proposed change.

The following presentation was reviewed by the task force at the May interim meeting:
https://www.ieee802.org/3/dj/public/24_05/mellitz_3dj_02_2405.pdf
The presentation suggested effectively changing the definition of the "signal" component of SNDR as shown in the excerpts below.
The motivation is that this way the SNDR measurement at different losses between the source and the measurement point yield consistent results.

The presentation suggests a specific way of writing this definition as a correction factor "So we don't change prior standards", but this can be done specifically for the clauses in this project without affecting other standards.

Comment #47 seems to suggests essentially the same change.

- For the "S" in SNDR use the power variance of the signal at the measurement point as follows which is the in time and frequency domain
  - $\sigma_P^2 = \sum_1^{\mathrm{M}(N_p - Dp - 1)} p(n)^2$
  - Instead of p_{max}
- Consider SNDR as a ratio of signal power variance to noise power variance
  - Perhaps: SNDR should be $10 * log_{10}\left(\frac{\sigma_P^2}{\sigma_e^2 + \sigma_n^2}\right)$

SNDR/SCMR/SNR_TX [6 comments, 178/179]

In agenda

Cl 178 SC 178.9.2 P276 L34 # 27

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

adjust SNDR with loss correction factor which is about 1 dB basd on prior assumptions

SuggestedRemedy

change SNDR to 33.5 dB.

Cl 178 SC 178.10.2 P287 L5 # 41

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

SNR_TX can be SNDR when loss correction is employed

SuggestedRemedy

Change TBD to 33.5 dB

Proposed Response *Response Status* **O**

Cl 178 SC 178.9.2.6 P279 L22 # 31

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

adjust SCMR with loss correction factor

SuggestedRemedy

add + loss correction factor to equation 178-1

Proposed Response *Response Status* **O**

- #27 suggests setting the minimum SNDR in clause 178 to 33.5 dB based on the expected improvement from the new definition.
- #41 suggests using the same value for SNR_TX.
- #31 suggests that the correction factor (essentially the new numerator) be applied to SCMR in clause 178.
- #270 suggests 33 dB for SNDR in clause 178 (not related to the proposed redefinition of SNDR).

Editorial team proposal:
For #45:

- Change the definitions of SNDR in 179.9.4.6 and SCMR in 178.9.2.6 to use a numerator based on the suggested equations in https://www.ieee802.org/3/dj/public/24_05/mellitz_3dj_02_2405.pdf slides 12 and 13, with editorial license.
- Change SNDR (min) to **X** in transmitter characteristics in 178, 179, and 176D.
- Change SNR_TX in COM tables to **X**.

Suggested value for **X**: 33.5 dB.

#47, #31, #27, #41, #270: resolve using the response to #45.

Jitter
[X comments, 178/179/176D/176E]

In agenda

Cl 178 SC 178.9.2 P276 L38 # 236

Li, Mike Intel

Comment Type TR *Comment Status* X

Output jitter (max) TBD

SuggestedRemedy

reapcle TBDs with:
Jrms : 0.023 UI
J2.7u03: 0.102 UI
J2.7u: 0.110 UI
Even--odd jitter, pk-pk: 0.025 UI
See lim_3dj_01_2403a, lim_3dj_01_2405, and [1], [2], [3]

Proposed Response *Response Status* O

Cl 179 SC 179.9.4.7 P310 L25 # 204

Ran, Adee Cisco

Comment Type TR *Comment Status* X

Jitter specification is TBD.

Based on https://www.ieee802.org/3/dj/public/adhoc/electrical/24_0104/calvin_3dj_elec_01a_240104.pdf, the jitter measurement methodology of existing clauses 162, 163, and 120G (specifically using the two edges R03/F30) is feasible for measurements with a loss 30 dB. It is expected that the same method can be used for higher losses as long as the scope can maintain CDR lock.

This methodology should be used for all electrical interfaces, with adequate adjustments.

SuggestedRemedy

A detailed proposal will be provided.

Proposed Response *Response Status* O

- #236 refers to the following presentations: https://www.ieee802.org/3/dj/public/24_03/lim_3dj_01a_2403.pdf, https://www.ieee802.org/3/dj/public/24_05/lim_3dj_01_2405.pdf
- #204 refers to https://www.ieee802.org/3/dj/public/adhoc/electrical/24_0104/calvin_3dj_elec_01a_240104.pdf and the detailed proposal mentioned is https://www.ieee802.org/3/dj/public/24_05/ran_3dj_03_2405.pdf.
- #271 and #272 suggest A_DD=0.02 UI and sigma_RJ=0.01 UI.

Both #236 and #204 (in ran_3dj_03_2405) suggest using jitter specifications based on the dual-Dirac model with parameters in #271 and #272. As a result, both proposals have approximately the same JRMS. EOJ is also similar.

The main difference is that comment #236 suggests using a new parameter J2.7u, while #204 (in ran_3dj_03_2405) suggests using J3u and J6u, measured only on the R03/F30 edges.

Additional relevant presentation was reviewed in the May interim meeting: https://www.ieee802.org/3/dj/public/24_05/zivny_3dj_01a_2405.pdf, suggesting changes to the measurement method to potentially improve the precision. Straw Poll #8 was taken after the presentation:

- I would support the approach for the C2M and CR measurement specifications in zivny_3dj_01a_2405
- Results (all): Y: 12, N: 11 , NMI: 22 , A: 36

It appears that there is no clear consensus on adopting the proposed methodology changes. However, it is possible that there is consensus on some of the missing TBDs.

Editorial team proposal:
- For KR+C2C Tx (Tp0v) and CR (TP2), adopt the Jrms, J3u and EOJ values slide 12 of ran_3dj_03_2405, measured only on R03/F30 edges. Add editor's notes that the jitter specification need confirmation.
- Separate discussions about C2M, J6u, and measurement over all 12 edges.

Pulse response linear fit
[5 comments, 178/179/176E]

[X comments, 178/179/176E]

Multiple COM parameters [6 comments, 178/179/176D/176E]

Cl 179 SC 179.11.7 P 332 L 12 # 70

Lusted, Kent — Intel Corporation

Comment Type TR *Comment Status* X

The COM parameter values for the 200GBASE-CR1, 400GBASE-CR2, 800GBASE-CR4 and 1.6TBASE-CR8 PMDs are TBDs

SuggestedRemedy

In table 179-16, Use the COM parameter values from https://www.ieee802.org/3/dj/public/24_01/healey_3dj_01_2401.pdf slide 18, which are:

f_r = 0.58
c(-3) = 0
c(-2) = 0
c(-1) = 0
c(0) = 1
c(1) = 0
A_v = 0.413
A_fe = 0.413
A_ne = 0.45
eta_0 = 6e-9
SNR_TX = 33
sigma_RJ = 0.01
A_DD = 0.02
R_LM = 0.95
d_w = 5
Nfix = 10
N_g = 0
N_f = 0
N_max = 0
b_max(1) = 0.85
b_min(1) = 0

additionally, set MLSE = 0 (not enabled)

Proposed Response *Response Status* O

Comments #70 and #71 propose a large set of COM parameter values together for CR and KR, respectively.
Comment #72 proposes a similar set for C2M and suggests adding a table instead of referring to the parameters of C2C.

The referenced presentation, https://www.ieee802.org/3/dj/public/24_01/healey_3dj_01_2401.pdf, does not provide rationale for the suggested remedies of these comments. Specifically, slide #18 states that the values used are not a baseline proposal.

Comment #504 proposes a set of parameters for C2C, following analysis in https://www.ieee802.org/3/dj/public/24_05/heck_3dj_01b_2405.pdf.
Comments #42 and #54 do not include a specific proposal (but suggest a series of straw polls).

There are multiple other comments that may result in adopting values for some of the proposed parameters. These comments may to be resolved partially by the responses to the other comments.

Note that the presentations cited did not examine the effect of constraining the Rx FFE parameters (Wmin/Wmax), and disabled Tx equalization (c(i)). The assumption that receiver can operate with large Rx FFE coefficient values and without Tx FFE equalization may not be in consensus.

Editorial team proposal:
- REJECT comments #42 and #54 (no actionable remedy within the draft).
- Resolve the other comments after all other electrical comments, to possibly adopt values for parameters that have not been addressed by other comments and may be in consensus.
- Consider adding a COM table in Annex 176E as suggested by comment #72.
- If necessary, add editor's notes similar to that in slide 4 of https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf to denote values that need further analysis.

Annex 176E

Annex 176E, C2M channel ILdd Comments #130, #73

In agenda

Cl 176E SC 176E.2 P615 L33 # 130

Ghiasi, Ali — Ghiasi Quantum/Marvell

Comment Type T *Comment Status* X

Loss budgets are TBD

SuggestedRemedy

See Ghiasi C2M May-24 Contribution for background on the numbers
IIDD=28 dB
Connector with one via = 3 dB
Module IIdd = 3.6 dB
Host IIdd=21.4 dB

Proposed Response *Response Status* O

Cl 176E SC 176E.4.1 P632 L6 # 73

Lusted, Kent — Intel Corporation

Comment Type TR *Comment Status* X

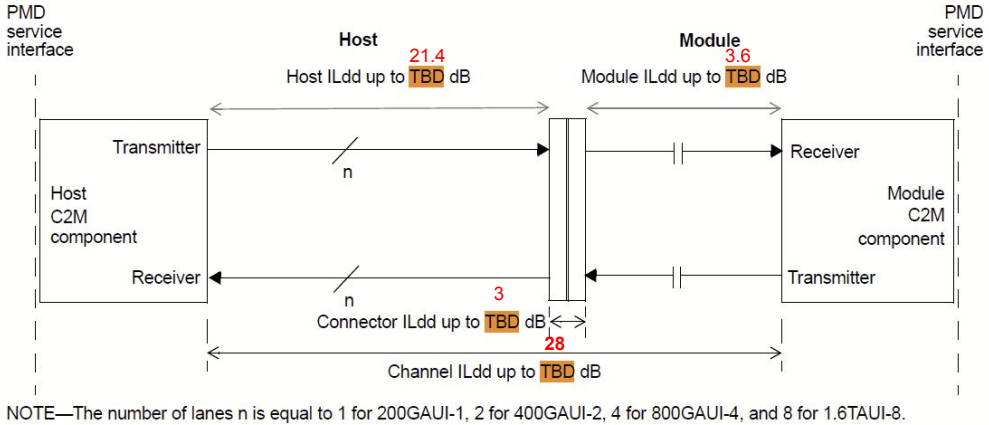
The IL_dd for AUI C2M channel is a TBD

SuggestedRemedy

Set IL_dd = 33 per https://www.ieee802.org/3/dj/public/24_01/lusted_3dj_03_2401.pdf

Proposed Response *Response Status* O

The referenced presentation is https://www.ieee802.org/3/dj/public/24_05/ghiasi_3dj_02a_2405.pdf.
It analyzes specific channels with unspecified module PCB loss and “8 mm CDR” module package.
Several COM parameters used in this presentation have not been adopted.



NOTE—The number of lanes n is equal to 1 for 200GAUI-1, 2 for 400GAUI-2, 4 for 800GAUI-4, and 8 for 1.6TAUI-8.

Figure 176E–2—Components of a 200 Gb/s per lane AUI-C2M interface and insertion loss budget at 53.125 GHz

The referenced presentation https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_03_2405.pdf does not address ILdd.
The comment is against 176E.4.1 (Recommended channel characteristics/Insertion loss), which has an equation for the ILdd limit. The suggested remedy does not address the equation.
The proposed Channel ILdd value is **33 dB.**

Editorial team proposal:
Reject both comments due to the large difference. Continue working toward consensus loss budget for C2M in conjunction with COM parameters.

Annex 176E, Input specs

Annex 178A

Annex 178A, DER0 (1 of 2)
Comments #285, #362

In agenda

Cl 178A SC 178A.1.10.2 P659 L12 # 285

Li, Mike Intel

Comment Type TR *Comment Status* X

DER0 EQ is wrong

SuggestedRemedy

change P(y0)= DER0 to 1-P(y0) =DER0, see slide 3 of lim_3dj_02_2405, see also a marked version in the support data sheet.

Proposed Response *Response Status* O

Cl 178A SC 178A.1.10 P658 L43 # 362

Healey, Adam Broadcom Inc.

Comment Type T *Comment Status* X

The relationship between "detector error ratio", "PAM-L symbol error ratio", and "bit error ratio" is not documented and, as a result, not generally understood. While these quantities are related, they are not interchangeable. Prior assumptions that they are interchangeable has led to errors in the translation between COM results and expected (measured) receiver performance. This new annex gives us an opportunity to clarify the relationship between DER0 and other terms or to replace DER0 with a more generally understood term.

SuggestedRemedy

Slide 5 of <https://www.ieee802.org/3/dj/public/23_11/healey_3dj_01a_2311.pdf> suggest expressions for relationship between detector error ratio and other terms. Either replace "DER0" with a target PAM-4 symbol error ratio (or bit error ratio) and adjust the equations for calculating COM accordingly, or document the relationship between DER0 and the other two terms.

Proposed Response *Response Status* O

It may not be clear that the solution for $y_0 = P^{-1}(DER_0)$ is less than 0 for any $DER_0 < 0.5$

It is specified that the magnitude of the result is used

Expressions like $y_0 = P^{-1}(1-DER_0)$ or $DER_0 = 1-P(y_0)$ are used elsewhere in Annex 178A to make y_0 greater than 0

Although also correct, use of different forms may lead to further confusion

It would be better to add clarity to, and consistently use, an expression to map between a CDF value and the corresponding amplitude value

In addition, there has been confusion about the relationship between DER_0 and PAM-L symbol error ratio (or BER) and it has been suggested that this relationship be clarified

Annex 178A, DER0 (2 of 2) Comments #285, #362

Editorial team proposal:
Implement the changes shown in this slide, with editorial license.

178A.1.10.2 Noise and interference amplitude

The probability distribution function of the noise and interference amplitude is calculated using the procedure defined in 93A.1.7.3 using the sampled time-domain responses and noise variance defined in 178A.1.9. The corresponding cumulative distribution function is defined by Equation (178A–35).

$$P(y) = \int_{-\infty}^{y} p(u)du$$ [Use dummy variable in integrand.] (178A–35)

[Re-write to clarify that the expected result is a positive number.]

The noise and interference amplitude, A_{ni}, is a positive value that satisfies the relationship $P(-A_{ni}) = DER_0$ where DER_0 is the target detector error ratio.

[Add note to clarify the relationship between DER and other error ratio metrics.]

NOTE 2—The target detector error ratio DER_0 is SER_1 x $L/(2L-2)$ where SER_1 is the maximum allowed probability of the initial error in a PAM-L error burst.

[Change Equations (178A–36) and (178A–37), as modified by comments #211, #212, #286, and #287, to use expressions similar to what is used in 178A.1.10.2.]

$$COM_{MLSD} = COM_{DFE} + 20\log_{10}(-P^{-1}(DER_{MLSD})/A_s) - Q \quad (178A–36)$$

$$DER_{MLSD} = \sum_{j=1}^{\infty}\left(\frac{L-1}{L}\right)^{j-1} P_j\left(-A_s\frac{(u_j^T u_j)^{3/2}}{(u_j^T V_j u_j)^{1/2}}\right) \quad (178A–37)$$

Clause xxx, <topic>
Comment #<n>