Clause 162 Comments

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CR Cable Assembly COM

Topic	Comments
Channel variables	124, 125, 126, 127, 128, 129, 217, 218, 219, 221, 230
eta0	69, 78, 11161
PN skew	204
Reference DFE	Minimum tap limits - 247 Span - 248 RSS limit - 240, 250
Package transmission line model	150, 265

COM

Cable Assembly COM: Channel Variables

C#	SubClause	Description
124	162.11.7.1.1	Channel: Change “host (transmitter or receiver)” to “host receiver” on p. 162.
125	162.11.7.1.2	Change "S^(HOSP)" to "S^(HOSPR)" in Equation (162-13) and in p. 162 text.
126	162.11.7.1.2	Change "S^(HOSP)" to "S^(HOSPR)" in Equation (162-14) and in p. 162 text.
127	162.11.7.1.2	Change "S^(HOSPT)" to "S^(HOTxSP)" in Equation (162-13) and in p. 162 text.
128	162.11.7.1.2	Change "S^(HOSPT)" to "S^(HOTxSP)" in Equation (162-14) and in p. 162 text.
129	162.11.7.1.1	Remove extraneous “or” on p. 162.
217	162.11.7.1.1	S(HOSPT) definition: Change to "is the host transmitter PCB signal path"
218	162.11.7.1.1	S(HOSPR) definition: Change to "is the host receiver PCB signal path"
219	162.11.7.1.1	Change S(HSPT) to S(HOSPR) on p. 161.
220	162.11.7.1.1	Change S(HSPT) to S(HOSPR) on p. 154, 162, 163.
221	162.11.7.1.1	Change S(HSTxP) to S(HOSPT) on p. 162, line 49.
230	162.11.7.1.1	Change wording of S(HOSPT) and S(HOSPR) definitions on p. 162

CA COM Channel

Comments:

124	125	126	127
128	129	217	218
219	220	221	230

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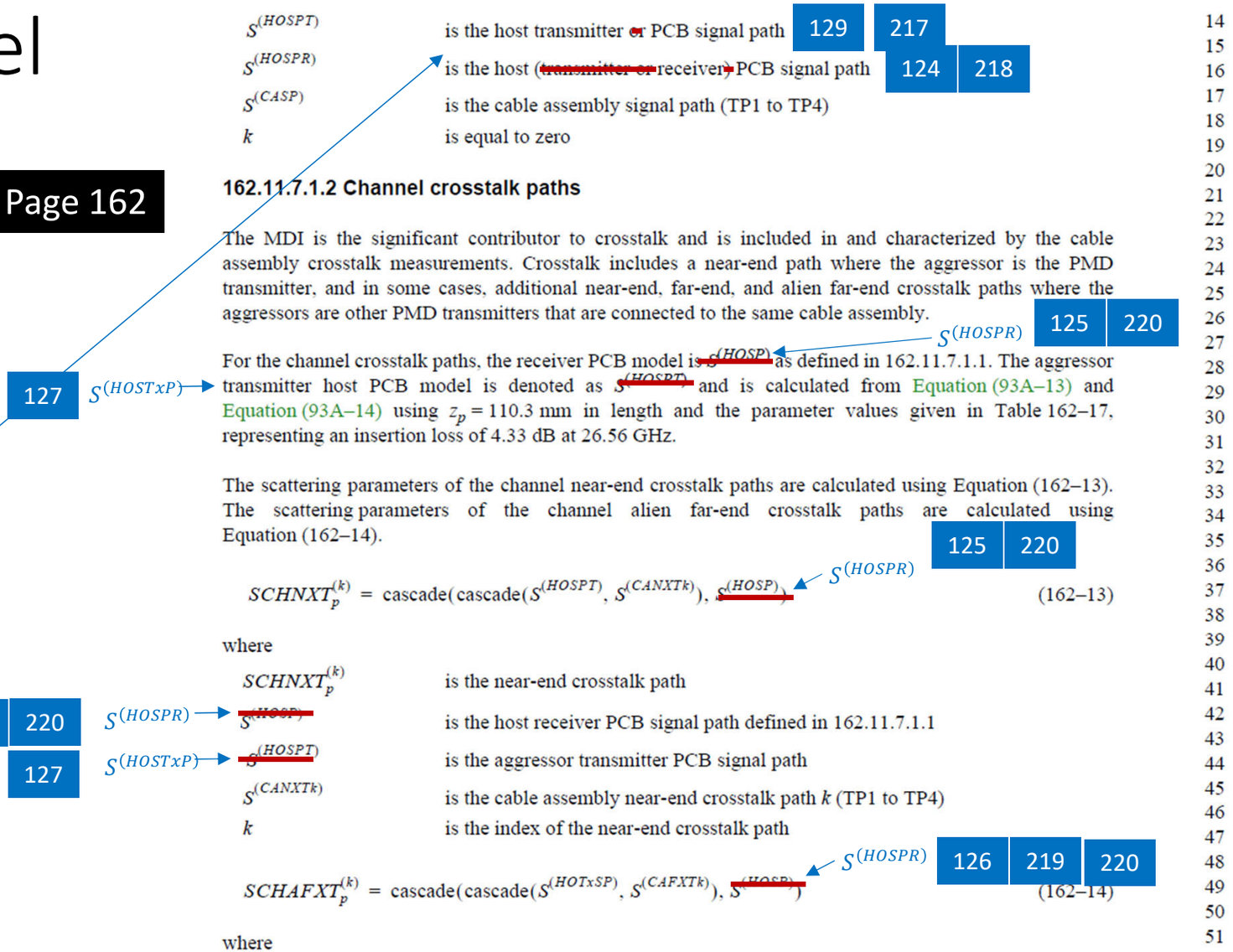
230

transmitter's host PCB signal path
receiver's host PCB signal path



$S^{(HOSPT)}$ is the host transmitter ~~or~~ PCB signal path — 129 217

$S^{(HOSPR)}$ is the host (~~transmitter or~~ receiver) PCB signal path — 124 218

$S^{(CASP)}$ is the cable assembly signal path (TP1 to TP4)

k is equal to zero

162.11.7.1.2 Channel crosstalk paths

The MDI is the significant contributor to crosstalk and is included in and characterized by the cable assembly crosstalk measurements. Crosstalk includes a near-end path where the aggressor is the PMD transmitter, and in some cases, additional near-end, far-end, and alien far-end crosstalk paths where the aggressors are other PMD transmitters that are connected to the same cable assembly.

125 220 $S^{(HOSPR)}$

For the channel crosstalk paths, the receiver PCB model is ~~$S^{(HOSP)}$~~ as defined in 162.11.7.1.1. The aggressor transmitter host PCB model is denoted as ~~$S^{(HOSPT)}$~~ and is calculated from Equation (93A–13) and Equation (93A–14) using z_p = 110.3 mm in length and the parameter values given in Table 162–17, representing an insertion loss of 4.33 dB at 26.56 GHz.

127 $S^{(HOSTxP)}$

The scattering parameters of the channel near-end crosstalk paths are calculated using Equation (162–13). The scattering parameters of the channel alien far-end crosstalk paths are calculated using Equation (162–14).

125 220 $S^{(HOSPR)}$

$$SCHNXT_p^{(k)} = \text{cascade}(\text{cascade}(S^{(HOSPT)}, S^{(CANXTk)}), S^{(HOSP)}) \quad (162\text{–}13)$$

where

$SCHNXT_p^{(k)}$ is the near-end crosstalk path

125 220 $S^{(HOSPR)}$ ~~$S^{(HOSP)}$~~ is the host receiver PCB signal path defined in 162.11.7.1.1

127 $S^{(HOSTxP)}$ ~~$S^{(HOSPT)}$~~ is the aggressor transmitter PCB signal path

$S^{(CANXTk)}$ is the cable assembly near-end crosstalk path k (TP1 to TP4)

k is the index of the near-end crosstalk path

$S^{(HOSPR)}$ 126 219 220

$$SCHAFXT_p^{(k)} = \text{cascade}(\text{cascade}(S^{(HOTxSP)}, S^{(CAFXTk)}), S^{(HOSP)}) \quad (162\text{–}14)$$

where

CA COM Channel (2)

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The scattering parameters of the test channel are measured at the test references as illustrated in Figure 110–3b using the cable assembly test fixtures specified in Annex 162B.1.

The insertion loss at 26.56 GHz of the signal path between the test references in Figure 110–3b is within the limits in Table 162–13.

The COM is calculated using the method and parameters of 162.11.7 with the following considerations:

a) The channel signal path is $SCHS_p$ = cascade($S^{(CTSP)}$, $S^{(HOSP)}$), where cascade() is defined in 93A.1.2.1, $S^{(HOSP)}$ is defined in 162.11.7.1.1, and $S^{(CTSP)}$ is the measured channel between the test references in Figure 110–3b.

b) The COM parameters are as modified by Table 162–13.

$S^{(HOSPR)}$ 220

D1.2 Page 161

The scattering parameters of the channel signal path from TP0 to TP5 are calculated using Equation (162–12). The transmitter and receiver PCB signal paths are denoted as $S^{(HOSTxP)}$ and $S^{(HOSP)}$, and are calculated using Equation (162–12) and Equation (162–11), respectively. The PCB transmission line scattering parameters are denoted as $S^{(l)}$ and are calculated from Equation (93A–13) and Equation (93A–14) using z_p =110.3 mm in length and the parameter values given in Table 162–17, representing an insertion loss of 4.33 dB at

$S^{(HOSPR)}$ 219

D1.2 Page 163

$S^{(HOSPR)}$ 126

$S^{(HOSP)}$ is the host receiver PCB signal path defined in 162.11.7.1.1

$S^{(HOSPT)}$ is the aggressor transmitter PCB signal path

127 $S^{(HOSTxP)}$ → $S^{(CAFXTk)}$ is the cable assembly far-end crosstalk path k (TP1 to TP4)

k is the index of the alien far-end crosstalk path

CA COM: η_0 (C# 69, 78, 11161)

- 07/19 Baseline: 8.20e-9 V^2/GHz
- 01/20 Change: 1.0e-8 V^2/GHz (Straw poll #10 & #11)
- 07/20 proposals:

C#	Proposed value	Referenced presentations
69	9e-9	lim_3ck_01a_1119 mellitz_3ck_03a_1119
78	8.37e-9	champion_3ck_adhoc_01_031120
11161	1e-9	

- Proposed response:

  Reject. The current value was adopted based on results of straw polls #10 & 11 at the 01/2020 interim meeting. The comment provides evidence that some channels fail COM. However, having an interoperable link requires both pass cables and receivers, and both need to be addressed.

C #204 PN Skew

- Proposed response: Reject
- Refer to the response to comment #206.
  - Same proposal for CL163.

Cl **162** *SC* **162.11.7** *P* **159** *L* **34** # **204**

Ghiasi, Ali — Ghiasi Quantum/Inphi

Comment Type **TR** *Comment Status* **D** *COM*

COM receiver reference model does not excite common mode and model is fully symmetrical between P/N. Unless COM reference model has common mode excitation only differential aspect of the S4P exercised.

SuggestedRemedy

Non-idealities in COM can be introduced by following:
-Termination mismatch P/N 3%
- Package P +/- 10%
-Package N +/- 10%
But the total RLM should still be 95%.

Proposed Response *Response Status* **W**

PROPOSED REJECT

The proposed remedy does not provide a clear change to the draft.

Cl **163** *SC* **163.10** *P* **184** *L* **14** # **206**

Ghiasi, Ali — Ghiasi Quantum/Inphi

Comment Type **TR** *Comment Status* **R** *COM parameter*

COM receiver reference model does not excite common mode and model is fully symmetrical between P/N. Unless COM reference model has common mode excitation only differential aspect of the S4P exercised.

SuggestedRemedy

Non-idealities in COM can be introduced by following:
-Termination mismatch P/N 3%
- Package P +/- 10%
-Package N +/- 10%
But the total RLM should still be 95%.

Response *Response Status* **C**

REJECT

COM mode impairment is indeed not fully considered in COM. However the suggested remedy does not provide clear information to implement.

There is no consensus to implement the suggested remedy at this time. More empirical evidence and consensus building is required.

C #247 Reference DFE minimum tap limits

- Add minimum DFE tap weight limits & update AN93A.1:
  - bmin(1)=+0.3
  - bmin(2)=+0.05
  - bmin(>2)=-0.03
- References:

  kasapi_3ck_01_1119

  heck_3ck_01_0919

  heck_3ck_adhoc_01_061720
- Proposed response: Accept.

Cl **162** *SC* **162.11.7** *P* **160** *L* **48** # **247**

Dawe, Piers — Nvidia

Comment Type **TR** *Comment Status* **D** *CA COM*

It isn't reasonable to expect a real receiver to provide a DFE tap strength of -0.85. Therefore, the channel should not be specified as if the receiver can do that. Further, there is an advantage in knowing that the sign of a tap can't change.
kasapi_3ck_01_1119 slide 7 shows the first DFE tap >0.42 for the critical channels. Another analysis showed the same for 27 backplane channels. Slide 6 of heck_3ck_01_0919 (107 channels) shows that the DFE taps are 2 and 3 are always strongly positive, and no taps <-0.045, yet the draft would allow such untypical/hypothetical channels.
We wanted to check that low loss channels would not do something surprising before adopting sensible limits that don't burden real channels. See new Heck presentation.
Remember that channels that go a little outside a tap weight pay a very small increase in COM for the excess ISI noise that they cause (see another comment), so the limits for the smaller taps should be set a bit tighter than the worst channel we want to pass.
Cable channels are smoother than backplane channels but can have higher loss:

SuggestedRemedy

Add minimum tap weight limits:
Tap 1: min +0.3
Tap 2: min +0.05
All other taps: min -0.03 (tighter than for KR).
Turn the existing "Normalized DFE coefficient magnitude limit"s into "Normalized DFE coefficient limit"s.
Update definition of COM in 93A.1.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

Referenced presentation is here:
http://www.ieee802.org/3/ck/public/adhoc/jun17_20/heck_3ck_adhoc_01_061720.pdf

C #248 Reference DFE Tail

- Proposes: Remove tap positions 25-40.
- Proposed response: Reject
- Refer to the response to C#262
  - Identical proposal for CL163

Cl **162** *SC* **162.11.7** *P* **161** *L* **4** # **248**

Dawe, Piers — Nvidia

Comment Type **TR** *Comment Status* **D** *CA COM*

The analysis that led to the equalizer length choice needs to be revisited with the new COM.

SuggestedRemedy

If there is a significant improvement with the latest COM, remove positions 25-40 and define positions 13-24 as the tail, with 2 or 3 floating groups of 3 taps and an RSS limit.

Proposed Response *Response Status* **W**

PROPOSED REJECT

The task force adopted the reference equalizer based upon review of data for an extensive set of contributed channels. Commenter is encouraged to present analysis to support the suggested remedy.

Cl **163** *SC* **163.10** *P* **185** *L* **33** # **262**

Dawe, Piers — Nvidia

Comment Type **TR** *Comment Status* **R** *COM parameter*

The analysis that led to the equalizer length choice needs to be revisited with the new COM.

SuggestedRemedy

If there is a significant improvement with the latest COM, remove positions 25-40 and define positions 13-24 as the tail, with 2 or 3 floating groups of 3 taps and an RSS limit.

Response *Response Status* **C**

REJECT

This comment does not provide sufficient evidence the suggested remedy will not disqualify channels the task force has agreed to pass.

C #249 Reference DFE Tail RSS

- Proposes: Apply a DFE RSS to tap positions 13-24
- Proposed response: Reject
- Refer to the response to C#263
  - Identical proposal for CL163

Cl **162** *SC* **162.11.7** *P* **161** *L* **6** # 249

Dawe, Piers — Nvidia

Comment Type **TR** *Comment Status* **D** *CA COM*

The spec allows a channel to have its COM calculated with 9 taps in the range 13 to 24 clipped at +/-0.05 - which means that the channel's pulse response could be a little worse than +/-0.05 for these taps. That's a very bad channel! We don't need to provide all the receiver power and complexity to cope with it.

SuggestedRemedy

Use another DFE root-sum-of-squares limit for positions 13-24.

Proposed Response *Response Status* **W**

PROPOSED REJECT

The task force adopted the floating tap RSS limit based upon review of data for an extensive set of contributed channels. The comment proposes to change the limit if certain conditions are met. Without supporting data, the task force cannot verify whether those conditions are met. The commenter is encouraged to provide analysis to support the suggested remedy.

Cl **163** *SC* **163.10** *P* **185** *L* **34** # 263

Dawe, Piers — Nvidia

Comment Type **TR** *Comment Status* **R** *COM parameter*

The spec allows a channel to have its COM calculated with 9 taps in the range 13 to 24 clipped at +/-0.05 - which means that the channel's pulse response could be a little worse than +/-0.05 for these taps. That's a very bad channel! We don't need to provide all the receiver power and complexity to cope with it.

SuggestedRemedy

Use another DFE root-sum-of-squares limit for positions 13-24.

Response *Response Status* **C**

REJECT

The suggested remedy does not provide clear information to implement. Sufficient evidence has not been provided to justify the proposed change. More empirical evidence and consensus building is required.

C# 250 Ref DFE Tail

- Proposes: Tighter DFE RSS requirement
- Proposed response: Reject
- Refer to the response to C#264
  - Identical proposal for CL163

Cl **162** *SC* **162.11.7** *P* **185** *L* **36** # **250**

Dawe, Piers — Nvidia

Comment Type **TR** *Comment Status* **D** *CA COM*

As the effect of exceeding the DFE floating tap tail root-sum-of-squares limit increases parabolically as the channel exceeds the limit, the limit must be set a little lower than the worst channel we wish to allow to have an effect at the right point. OAch4 with COM 2.75 gave an unconstrained RSS_tail of 0.022, but CR channels should be smoother than OAch4. Setting the limit 0.01 lower than that might affect its COM by 0.1 dB (vs. no limit) which seems like a gentle effect. However, it seems that the latest COM gives a more optimistic result anyway; this channel may not need the tail taps at all.

SuggestedRemedy

If there is no improvement with the latest COM AND the via capacitances in 162.11.7.1.1 fully represent the tail pulse response of the hosts, change the DFE floating tap tail root-sum-of-squares limit to 0.012.
If the tail pulse response of the hosts is not all in this COM calculation, the COM equalizer should differ to the KR one, for the same silicon.
If there is a small improvement with the latest COM or the tail pulse response of the hosts is not all in this COM calculation, further reduce the limit accordingly.
If there is a significant improvement, remove taps 25-40 and apply a tail tap RSS limit to positions 13-24.

Proposed Response *Response Status* **W**

PROPOSED REJECT

The task force adopted the floating tap RSS limit based upon review of data for an extensive set of contributed channels. The comment proposes to change the limit if certain conditions are met. Without supporting data, the task force cannot verify whether those conditions are met. The commenter is encouraged to provide analysis to support the suggested remedy.

Cl **163** *SC* **163.10** *P* **185** *L* **36** # **264**

Dawe, Piers — Nvidia

Comment Type **TR** *Comment Status* **R** *COM parameter*

As the effect of exceeding the DFE floating tap tail root-sum-of-squares limit increases parabolically as the channel exceeds the limit, the limit must be set a little lower than the worst channel we wish to allow to have an effect at the right point. OAch4 with COM 2.75 gave an unconstrained RSS_tail of 0.022. Setting the limit 0.01 lower than that might affect its COM by 0.1 dB (vs. no limit) which seems like a gentle effect. However, it seems that the latest COM gives a more optimistic result anyway; this channel may not need the tail taps at all.

SuggestedRemedy

If there is no improvement with the latest COM, change the DFE floating tap tail root-sum-of-squares limit to 0.012.
If there is a small improvement with the latest COM, further reduce the limit accordingly.
If there is a significant improvement with the latest COM, remove taps 25-40 and apply a tail tap RSS limit to positions 13-24.

Response *Response Status* **C**

REJECT

The simulations to make the determinations in the suggested remedy are not available.

There is no consensus to implement the suggested remedy at this time. More empirical evidence and consensus building is required.

C#150 Package transmission line model

- Proposes: Specify 100G models in CL162.
  - Differ from existing models in AN93A.
- Proposed response:

  Accept in principle.
  Implement with editorial license.

Cl 162 *SC* 162.11.7 *P* 159 *L* 20 # 150

Ran, Adee Intel

Comment Type T *Comment Status* D *COM*

(cross-clause)

The transmission line parameters in the package model in COM have been the same since 802.3, and are hard-coded in Table 93A–3.

In the COM spreadsheets used in this project there are somewhat different values for these parameters (presented in http://www.ieee802.org/3/ck/public/19_01/benartsi_3ck_01_0119.pdf, but not explicitly adopted into any of the drafts).

Validation of a proposed package model has been presented at the same meeting (http://www.ieee802.org/3/ck/public/19_01/heck_3ck_01_0119.pdf), but with the old TL parameters. So it is not clear if the modified parameters are in consensus.

SuggestedRemedy

If there is consensus that the parameters should change, then a new table should be created for the new values and used in 162,163, and 120F, and possibly a provision should be made in Annex 93A to use differnt parameters if supplied.

Otherwise, the COM spreadsheets should rever to use the existing values (out of scope of the editorial team...)

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

Pending task force discussion.

Implement with editorial license.

The referenced presentations are here:
http://www.ieee802.org/3/ck/public/19_01/benartsi_3ck_01_0119.pdf
http://www.ieee802.org/3/ck/public/19_01/heck_3ck_01_0119.pdf

C#265 COM Pkg

- Proposes: Fix issue type and add definition for the 2nd transmission line segment that represents the vertical structure (l2, zp2).

- Proposed response:

  Accept in principle.
  Implement with editorial license.

Cl 93A *SC* 93A.1.2.4 *P* 198 *L* 53 # 265

Dawe, Piers Nvidia

Comment Type T *Comment Status* D *COM parameter*

Typos in 93A. Eq 93A–16a has S(rp) on both sides. S(l2) has appeared from nowhere. Table 93A-1, COM parameters, says "See 93A.1.2" for zp2 yet it's not here.

SuggestedRemedy

Should the rp on the right be rd?
Explain what zp2 represents. Maybe modify 93A.1.2.3 to say that S(l2) is derived from zp2 in the same way that S(l) is derived from zp. (z is a bad choice for a length anyway, it looks too much like an impedance.)

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

Implement the suggested remedy with editorial license.

RX & TX Characteristics

CR TX & Logic

Topic	Comments
linear fit	255
Vf(min) CC	141, 165
Jitter CC	140*, 168
ACCM	203, 55
EQ control	256
Swing	257
TX RL	137, 138, 139
Logic	60, 66

C# 255 Linear Fit Pulse

- Proposes: Define Nv and set it to 40, consistent with span of the reference DFE.
- Background:
  - CL85 defines Nw as the equalizer length
  - CL136 defines Nv as the equalizer length
  - CL162 uses Nv without definition and has it set to 200.
- Proposed response: Accept in principle.

  Add text to define Nv (consistent with 136.9.3) and set Nv=40.

Cl **162** *SC* **162.9.3.1.1** *P* **150** *L* **15** # 255

Dawe, Piers — Nvidia

Comment Type **T** *Comment Status* **D** *Tx electrical*

Back in Clause 85, the DFE has 14 taps (Nb), the linear fit pulse length Np is 8 and the equalizer length Nw is 7. So the SNDR measurement doesn't forgive reflections in the transmitted waveform that the DFE can't equalise. Here, we have a DFE with up to 40 UI, Np is 200, Nv is 200? Or do we still use Nw of 7 from Clause 85?

SuggestedRemedy

Is Nv meant to be Nw?
I wonder if 200 (for something) is far too long.

Proposed Response *Response Status* **W**

PROPOSED REJECT

The linear fit pulse method is based upon the method specified in CL136 for 50G PAM signaling, which used Np=200.

Vf(min) C#141, #165

- Proposes: Replace reference to 136.9.3.1.2 with wording taken from that subclause.
  - Eliminates one level of sub-referencing
- Proposed response:

  Accept in principle.

Cl **120F** *SC* **120F.3.1** *P* **205** *L* **20** # 59

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **D** *TX vfmin*

Vf(min) should align with Av in COM table 120F-6 since Nv=200

SuggestedRemedy

Replace TBD for Vf(min) with V(fmin)=0.413

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

Comment #59 proposes 0.413.
Comment #165 proposes 0.4.

For task force discussion.

Cl **162** *SC* **162.9.3.1.2** *P* **151** *L* **10** # 141

Ran, Adee Intel

Comment Type **E** *Comment Status* **D** *Tx electrical*

"The steady-state voltage vf is defined in 136.9.3.1.2, and is determined using Nv=200"

The definition in 136.9.3.1.2 is concise, and includes yet another reference to clause 85. The value of Nv is significantly different. It would help readers if we reduce the depth of references.

SuggestedRemedy

Change this sentence to the following (in a separate paragraph):

"The steady-state voltage vf is defined to be the sum of the linear fit pulse response p(1) through p(M×Nv) divided by M
(refer to 85.8.3.3 step 3)" where Nv=200 is the length of the pulse response in UI."

Proposed Response *Response Status* **W**

PROPOSED ACCEPT

Cl **120F** *SC* **120F.3.1** *P* **205** *L* **20** # 165

Ran, Adee Intel

Comment Type **T** *Comment Status* **D**

(cross clause)
Addressing Vf (min) in C2C which is TBD.

The minimum allowed value should be 0.4 as in C163.

C162 has a lower value 0.387, possibly due to measurement with Nv=13 in clause 136. As the measurement in C162 is done with Nv=200, it isn't clear why the value should be lower than in C163. If there is a reason, a footnote or informative NOTE would be helpful to avoid confusion.

SuggestedRemedy

Change TBD to 0.4.

Consider changing the value in Table 162–9 to 0.4, or adding a note with explanation of the different value.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

Resolve comment using the response to comment #59.

C# 140 Jitter (CC)

- Proposes: Overhaul of jitter description
  - Also applies to 163 and 120F.

Cl **162** *SC* **162.9.3** *P* **148** *L* **45** # **140**

Ran, Adee — Intel

Comment Type **T** *Comment Status* **D** *Tx electrical*

(Cross-clause)
Footnote d of table 162-9 states "J3u, JRMS, and even-odd jitter measurements are made with a single transmit equalizer setting selected to compensate for the loss of the host channel".

This is a significant change compared to the method of 120D.3.1.8 (referenced for two of the jitter parameters), which states that "The J4u, JRMS, and Even-odd jitter specifications shall be met regardless of the transmit equalization setting".

Furthermore, 162.9.3.3 defines J3u jitter with a reference to 120D.3.1.8.1 (which implies being required at all equalization settings) without mention of the exception in the footnote.

Furthermore, "selected to compensate for the loss" can be interpreted in different ways.

Similar text exists in clause 136 and has caused confusion about jitter measurement requirements.

Applies also to clause 163 (which has similar footnote and J3u subclause) and to annex 120F (which simply refers to annex 120D).

SuggestedRemedy

1. Change title of 162.9.3.3 from "J3u jitter" to "Output jitter".
2. Change 162.9.3.3 to include the following:
"Output jitter is characterized by three parameters, J3u, JRMS, and Even-odd jitter. These parameters are calculated from measurements with a single transmit equalizer setting to compensate for the loss of the transmitter package and host channel. The equalizer setting is chosen to minimize any or all of the jitter parameters.

J3u and JRMS are calculated from a jitter measurement specified in 120D.3.1.8.1. J3u is defined as the time interval that includes all but 10^–3 of fJ(t), from the 0.05th to the 99.95th percentile of fJ(t) .

Even-odd jitter is calculated from a jitter measurement as specified in 120D.3.1.8.2."
3. Change the references from 120D.3.1.8 to 162.9.3.3 in the table and in the PICS (TC12).
4. Delete footnote d.

In clause 163, apply similar changes to the table, referring to 162.9.3.3.

In Annex 120F, apply similar changes including a new subclause, but change "host channel" to "test fixture", and omit the definition of J3u.

- Proposed Response:

  Accept in principle.
  Implement with editorial license.

C#168 Jitter (CC)

- Proposes: Either
  - Implement response to C#140 OR
  - Add footnote to state that jitter measurements are made with a single TX EQ setting.
- Proposed response:

  Accept in principle.

Cl **120F** *SC* **120F.3.1** *P* **205** *L* **29** # 168

Ran, Adee Intel

Comment Type **T** *Comment Status* **D**

Jitter specifications refer to 120D.3.1.8 which expliciitly states that they hold at any equalization setting. But this is not feasible and not important.

In C162 and C163 there is a footnotw that jitter is measured in a single equalizer setting. Another comment suggests making it more explicit.

SuggestedRemedy

If my other comment does not apply here:
Add a table footnote that "J3u, JRMS, and even-odd jitter measurements are made with a single transmit equalizer setting selected to compensate for the loss of the transmitter package and TP0 to TP0a test fixture" similar to Table 163-5.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

AC Common Mode (#203, #55)

- Proposed response: Reject
- Refer to response to C#28.

Cl 163 SC 163.9.1 P177 L38 # 28

Wu, Mau-Lin Mediatek

Comment Type T *Comment Status* R *common mode noise*

The 'AC common-mode RMS voltage (max.)' is 30 mV, which is the same as that in 802.3cd. By combining this spec with P/N skew mismatch of backplane channel, it will induce crosstalk to differential signal at receiver. From 50G to 100G, it's difficult to improve the P/N skew mismatch to half. Based on that, we shall modify AC common-mode RMS voltage. We shall align this spec to that in C2M (120G).

SuggestedRemedy

Change 30 mV to 17.5 mV.

Response *Response Status* C

REJECT.

Note that comment #205 and #54 request the same change.

The suggested remedy does not provide sufficient evidence that the proposed threshold is feasible and necessary. Further evidence and consensus building is encouraged.

This applies to both KR and C2C.

Cl 162 SC 162.9.3 P148 L24 # 203

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D *AC CM*

30 mV AC common mode has significant amount of penalty given that RLCD ~RLDC or 12 dB depending on the loss of the channel the penalty can be 1-3 mV RMS

SuggestedRemedy

Consider reducing 30 mV RMS to 17.5 mV RMS

Proposed Response *Response Status* W

PROPOSED REJECT

The comment needs to provide supporting analysis to address additional considerations (e.g. design and manufacturing variation).

Resolve using the response to comment #28.

Cl 163 SC 163.9.3 P148 L24 # 55

Mellitz, Richard Samtec

Comment Type TR *Comment Status* D

30 mv of AC common-mode RMS voltage is too severe. Little work has been to justify this.

SuggestedRemedy

Set AC common-mode RMS voltage to TBD. Add a line to the table called AC common-mode deterministic voltage which essentially represents skew.

Proposed Response *Response Status* W

PROPOSED REJECT

[Editor's note: Change subclause from 163.9.3]

Resolve using the response to comment #28.

C# 256 ic_req

- Proposes: Define ic_req and add references.
- Proposed response:

  Accept in principle.
  ic_req is defined in Table 162-7.
  Add reference to it.

Cl **162** *SC* **162.9.3.1.3** *P* **151** *L* **21** # 256

Dawe, Piers Nvidia

Comment Type **T** *Comment Status* **D** *bucket*

"ic_req" appears without explanation. I can see that it may be mapped to an MDIO register, but those registers follow the hardware, they don't define it. The reader doesn't know it's in Figure 136-9 because you haven't told him, and anyway that's too arcane.

SuggestedRemedy

Explain what it is, with appropriate references to 162.8.11 and 136.8.11.something.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

Implement the suggested remedy with editorial license, adding description with reference to the definition in Table 162-7.

TX Swing #257

- Proposes: Reduced swing when TX starts
  - Reduce c(0) for OUT_OF_SYNC &/or NEW_IC preset 1.
  - Reduce starting amplitude for training phase of RITT.
- Note: also applies to CL163.
- Propose response:

  Reject.
  Proposed remedy needs to be complete, including specific proposed values.

Cl **162** *SC* **162.9.3.1.3** *P* **151** *L* **30** # **257**

Dawe, Piers — Nvidia

Comment Type **T** *Comment Status* **D** *Tx electrical*

Starting the transmitter up with maximum swing seems bad for two reasons: it suddenly adds a lot of crosstalk to neighbouring links, before this link has established that the high swing is needed or desirable; and it may stress the linearity of the receiver. It would be better to start at a low to medium swing, and the receiver ask to turn it up if it wishes.

SuggestedRemedy

Reduce c(0) in one or both of OUT_OF_SYNC and NEW_IC preset 1. If necessary, create another row for the traditional neutral at max setting used for testing - but as it seems that may never be useful in practice, maybe we should avoid that.
Also, in 162.9.4.3.4, reduce the starting amplitude for the training phase in RITT (presently 800 mV peak-to-peak differential "on an alternating 0-3 pattern").
Similarly in 163 as appropriate.

Proposed Response *Response Status* **W**

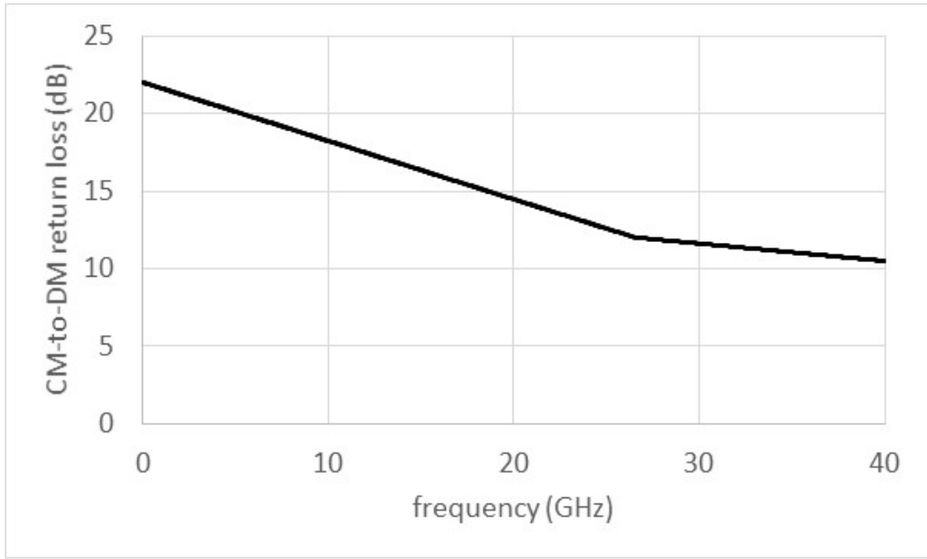
PROPOSED REJECT

The proposed remedy needs to be complete, including specific proposed values.

CM-DM RL C #137 & #138

- Proposes:
  - Determine whether TX CM-DM return loss is needed.
  - If yes: Add subclause (162.9.3.1.5) with equation and text to define what is being specified. Add references to 163 and 120F.
  - If no: eliminate from CL162.
- Proposed response:

  AIP.



$$CDRL(f) = \begin{cases} 22 - {}^{f}\!/_{f_{nyquist}} & 0.01 \le f \le f_{nyquist} \\ 5 - 3\,{}^{f}\!/_{f_{nyquist}} & f_{nyquist} < f \le 40 \end{cases}$$

CM-to-DM RL C#137 & #138

Cl **162** *SC* **162.9.3** *P* **148** *L* **28** # 138

Ran, Adee Intel

Comment Type **T** *Comment Status* **D** *Tx electrical*

(cross-clause)
Clause 162 has a common-mode to differential return loss specification for both Tx and Rx. Clause 163 and annex 120F have this specification only for Rx.

Is this an oversight, or maybe a Tx specification is not required in clause 162 either? (discussion may be required)

SuggestedRemedy

If a C-D RL specification is not required for the Tx, it should be removed from Table 163–5, and the specification (subject of another comment) should be a subclause of 162.9.4 instead of 162.9.3.

If it is required, references to the specification subclause (subject of another comment) should be added in Table 163–5 and in Table 120F–1.

If there is a reason to have a specification for CR but not for KR/C2C, there should be an informative NOTE in clause 162 that explains it. (I don't know of a reason at the time of writing)

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

Cl **162** *SC* **162.9.3** *P* **148** *L* **28** # 137

Ran, Adee Intel

Comment Type **T** *Comment Status* **D**

(cross-clause comment)
Tx common mode to differential mode return loss is currently TBD.

The current reference is to 92.8.3.3 equation 92-2, where the equation for the minimum loss creates a piecewise linear function, with 22 dB at DC, 12 dB at the Nyquist frequency (12.89 GHz), and ~10.5 dB at 19 GHz. This limits the conversion to/from common mode quite well.

There is another C-D RL specification in this draft, in 120F.3.2.2 (Rx specifications), which is based on frequency scaling of the similar specification in clause 93 (equation 93-5 - per the adopted baseline). Equation 93-5 creates a tighter spec than equation 92-2 (except in a small band around 7 GHz) even though mode conversion should be easier to control in KR/C2C channels.

Clause 163 Rx specification refers to 93.8.1.4 - which is a Tx specification and does not include C-D RL at all (obvious error).

It is not clear why C2C, CR, and KR should have different specifications for C-D RL. If there is, it should be explained (informative NOTE would probably help).

The suggested remedy based on frequency scaling of equation 92-2 (which is equivalent to equation 120G–1, but uses f_N as a parameter to simplify the text).

Alternatively, 120F.3.2.2 can be used for all three Rx specifications.

This specification should be in a new subclause that other specifications can refer to. It should also provide some justification to the specification.

SuggestedRemedy

Add a subclause 162.9.3.1.5 with content:
162.9.3.5 PMD Common-mode to differential return loss
Common-mode signal can be generated in the channel by conversion of a differential signal. Common-mode signal propagating from the channel into the transmitter or the receiver can be converted back to a differential signal and result in differential noise propagating toward the receiver. To limit this effect, a minimum common-mode to common-mode return loss is required.

The common-mode to differential mode output return loss of the transmitter shall meet Equation (162–new).

CDRL(f) ≥
22-10*f/f_N, 0.01 ≤ f ≤ f_N
15-3*f/f_N, f_N< f < 40
Where
f_N=26.5625 is the Nyquist frequency in GHz

f is the frequency in GHz
CDRL(f) is the common-mode to differential return loss in dB at frequency f

Refer to the new subclause in Rx specifications: Table 162–12, Table 163–7 , and Table 120F-3.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

Implement with editorial license.

See related 120G comment #174.

CM-to-CM RL C#139

- Proposes:
  - Adopt specification from .bj (2dB) and extend to 40GHz,
  - Add test to describe what is being specified
  - insert appropriate references.
- Note: Also applies to CL163.
- Proposed response:

  AIP

Cl 162 SC 162.9.3 P 148 L 30 # 139

Ran, Adee Intel

Comment Type T *Comment Status* D *Tx electrical*

(cross-clause)
Common-mode to common-mode return loss specification is currently TBD.

The specification in all PMD clauses since 802.3bj is 2 dB flat between 0.2-19 GHz.

This specification has been taken from InfiniBand without further discussion in 802.3bj. It may be difficult to justify specific limits. However, it is reasonable from implementation point of view and there is no evidence that requires modifying it.

It is proposed to extend the frequency range proportionally with the increase in signaling rate, to 40 GHz. This should be done in a new subclause that other specifications can refer to. It should also provide some justification to the specification.

SuggestedRemedy

Add a new subclause 162.9.3.6 with content:

162.9.3.6 Common-mode to common-mode return loss
Common-mode signal can be generated in the channel by conversion of a differential signal. Any common-mode signal returned into the channel can be converted back to a differential signal and result in differential noise into the receiver. To limit this effect, a minimum common-mode to common-mode return loss is required.

The common-mode to common-mode return loss shall be greater than or equal to 2 dB at all frequencies between 0.2 GHz and 40 GHz.

Refer to the new subclause in the appropriate row of table 162-9. Set the value to 2 dB.

Refer to the new subclause in Table 163-5 with the same value, and change the row name from "Common-mode return loss (min.)" to "Common-mode to common-mode return loss (min.)".

Add a new row for "Common-mode to common-mode return loss (min.)" with same content in table 120F-1.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

Removing the Tx CM-to-diff RL spec to make it consistent with KR seems appropriate.

C#60 AN Timing

- Proposes: Add item f) with the statement in the suggested remedy.
- Proposed response: Accept.

Cl **162** *SC* **162.8.11** *P* **147** *L* **14** # 60

Lusted, Kent — Intel Corporation

Comment Type **TR** *Comment Status* **D** *Logic*

The currently defined PMD control function does not place a limit on the amount of time that a device is allowed to transition from the Cl 73 Auto-negotiation protocol (i.e. entry into the AN_GOOD_CHECK state in Figure 73-10) to the response of new request from a partner device. This particular condition had a constraint of 50 msec in Clause 92.7.12. Because it was not bounded, it is possible for a device to consume a large amount of time transitioning between these functions.

SuggestedRemedy

Add an item to the list in the subclause that states "the handshake timing shall meet the requirements of 136.8.11.6 except during the first 50 ms following the beginning of the start-up protocol. The beginning of the start-up protocol is defined to be entry into the AN_GOOD_CHECK state in Figure 73–10.".

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

C#66 PMD Control State Machine

- Proposes: Update PMD control state diagram (Figure 136-7) to address situation where a link partner breaks frame lock during training.
  - Would need to introduce new figure in 162
- Refer to http://www.ieee802.org/3/ck/public/20_07/lusted_3ck_01_0720.pdf
- Proposed response: Accept

Cl **162** *SC* **162.8.11** *P* **147** *L* **21** # 66

Lusted, Kent — Intel Corporation

Comment Type **TR** *Comment Status* **D** *Logic*

In the IEEE 802.3cd-2018 project, an updated PMD Control Function (i.e. link training) was defined and specified in Cl 136.8.11.
Among other things, specific changes enabled the link training protocol to support link establishment between two devices without using Cl 73 Auto-Negotiation (i.e. for the customer use case of "forced PHY speed" on the link).

The currently defined state machine in Clause 136.8.11 (Figure 136-7) does not autonomously recover from a partner breaking frame lock during link training (Note: observed when the Clause 73 Auto-Negotiation state machine is not used.) Unless a high-level management agent (i.e. SW or FW) detects the condition, the result could be either a link down (i.e. link never comes up) or a link oscillation (up/down/up/down/etc). One reason is that the signals local_tf_lock and remote_tf_lock are only checked moving from the SEND_TF state to the TRAIN_LOCAL state. Another is that there is no clear indication between the two end points that the link has been restarted (without AN73 present). There are other reasons as well, not listed here.

SuggestedRemedy

Update the PMD control state diagram to account for this situation. Some solutions include, but are not limited to:
- increase the duration of the holdoff_timer to exceed that of the max_wait_timer (>= 12 seconds)
- add monitoring of the local and received frame lock status after the initial frame lock is achieved
- implement an abort signaling mechanism

See presentation to be submitted for TF consideration.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

Pending review of the following presentation:
http://www.ieee802.org/3/ck/public/20_07/lusted_3ck_01_0720.pdf

For task force discussion.

Thanks!

C# 151 Unit Consistency

- Change Cb value from 0.3e-6 nF to 3.0e-5 nF.
  - i.e. don't use leading '0'.
- Proposed response: Accept
- Note: also applies to 163.10 and 120F.4.1

Cl **162** *SC* **162.11.7** *P* **159** *L* **41** # 151

Ran, Adee Intel

Comment Type **E** *Comment Status* **D** *bucket*

(cross clause)
For a consistent notation of the numeric values of capacitances , change text of Cb to 3e-5 nF. Alternatively use exponent of -6 everywhere and set Cd=120e-6, Cb=30e-6, Cp=87e-6

SuggestedRemedy

Per comment. Apply in 162.11.7, in 163.10, and in 120F.4.1.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.

Bucket

Tx c(0): C#144 & #258

- Proposes: Set minimum value for c(0)
- Proposed response: Accept.

Bucket

Cl **162** *SC* **162.9.3.1.5** *P* **152** *L* **19** # **144**

Ran, Adee — Intel

Comment Type **T** *Comment Status* **D** *bucket*

(cross-clause)

There is no requirement in the transmitter characteristics for the range of c(0).

While the maximum is 1 by definition of the measurement method, the minimum is only implied by the minimum value of c(-1) and an assumption that the sum of absolute coefficients is capped at 1 (which may not be true in all implementations).

Even assuming that the sum is not larger than 1, the implied minimum of c(0) is 0.66, while the COM search range assumes 0.54 is possible.

SuggestedRemedy

Add the following paragraph before the NOTE:

Having received sufficient "decrement" requests so that it is at its minimum value, c(0) shall be less than or equal to 0.54.

Add a row in table 162-9: "value at minimum state for c(0) (max.)" with reference to this subclause and value 0.54.

Add similar rows in table 163-5 and table 120F-1.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT

Cl **162** *SC* **162.9.3.1.5** *P* **152** *L* **3** # **258**

Dawe, Piers — Nvidia

Comment Type **T** *Comment Status* **D** *bucket*

There seem to be rules here to ensure that c(-3), c(-2), c(-1) and c(1) can be moved over defined ranges, but not for c(0).

SuggestedRemedy

What is the intention? What should attempting to adjust c(0) be able to achieve and what is out of bounds?
Write down whatever information is missing in Table 162-9 and here. If it isn't missing, put it in in Table 162-9 and cross-reference it from this section.
Adjust Clause 163 consistent with this.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

Resolve using the response to comment #144.