Cl **FM** *SC* **FM** *P* **2** *L* **7** # 125

Ghiasi, Ali — Ghiasi Quantum LLC

Comment Type **ER** *Comment Status* **D**

Missing keywords

SuggestedRemedy

Suggest adding 200GBASE-R, 400GBASE-R, and PAM4

Proposed Response *Response Status* **W**

[Editor's note: Clause and Subclause changed from Abstract to FM]

Cl **00** *SC* **0** *P* **185** *L* **30** # 5

Ran, Adee — Intel

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

The PMA service interface uses the enumerated tx_sym and rx_sym which take values zero, one, two, three or zero and one (116.3.3.1.1 and 116.3.3.2.1). But the physical instantiations of this interface (annexes 120B to 120E) do not define how these values are mapped to electrical signals.

Compare to e.g.121.5.2 which includes the statement "The highest optical power level in each signal stream shall correspond to tx_symbol = three and the lowest shall correspond to tx_symbol = zero."

SuggestedRemedy

Define the required mapping in 120.1.4 (which discusses the physical instantiations)

Add to item b) 2): 'In NRZ modulation, the highest differential voltage level shall correspond to the tx_symbol or rx_symbol value "one" and the lowest level shall correspond to the tx_symbol or rx_symbol value "zero".'

Add to item b) 3): 'In PAM4 modulation, the highest differential voltage level shall correspond to the tx_symbol or rx_symbol value "three" and the lowest level shall correspond to the tx_symbol or rx_symbol value "zero".'

Additionally (or alternatively) add similar statements in every AUI annex as appropriate.

Proposed Response *Response Status* **O**

Cl **00** *SC* **0** *P* **218** *L* **6** # 87

Welch, Brian — Luxtera Inc.

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

SIGNAL_DETECT Fail level set to <= -30 dBm, higher than the -20 dBm for 400G-DR4.

SuggestedRemedy

Suggest Revising to <= - 20 dBm.

Proposed Response *Response Status* **O**

Cl **00** *SC* **0** *P* **220** *L* **34** # 88

Welch, Brian — Luxtera Inc.

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

Average launch power of OFF transmitter, each lane (max) set to -30 dBm, vs. -20 dBm for 400GBase-DR4

SuggestedRemedy

Suggest revising to -20 dBm.

Proposed Response *Response Status* **O**

Cl **1** *SC* **1.4.72h** *P* **34** *L* **33** # 31

Hidaka, Yasuo — Fujitsu Lab of America

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

200/400GMII Extender is defined as a mechanism for communication with future PHYs that utilize a PCS sublayer other than that defined in Clause 119. Although it is important to prepare for future extension in some aspect, this definition of 200/400GMII Extender is far beyond such preparation. It is very strange to exclude current use by restricting it only for future PHY/PCS for many reasons. (1) It cannot be technically complete for unknown future compatibility issues until we define the future PHY/PCS. (2) There is no point to define IEEE standard that nobody can rely on it. (3) There is no need to do it now. When we define the future PHY/PCS, we can define it in a better way by resolving all the unknown compatibility issues. (4) The definition quoting future must be changed in the future, when we define the future PHY/PCS. It is not good to change the definition from the consistency.

On the other hand, although I have carefully reviewed the whole specification, I do not see any serious technical problems to use 200/400GMII Extender in Clause 118 with the current PHYs and Clause 119 PCS.

SuggestedRemedy

Change the definition of 200 GMII Extender to:
The 200 Gb/s Media Independent Interface Extender extends the reach of the 200GMII and consists of two 200GXS sublayers with a 200GAUI-n between them. (See IEEE Std 802.3, Clause 118.)

Change the definition of 400GMII Extender to:
The 400 Gb/s Media Independent Interface Extender extends the reach of the 400GMII and consists of two 400GXS sublayers with a 400GAUI-n between them. (See IEEE Std 802.3, Clause 118.)

Otherwise, remove Clause 118 and postpone it for a future project that will be used.

Proposed Response *Response Status* **O**

Cl **1** *SC* **1.472i** *P* **34** *L* **36** # 161

D'Ambrosia, John — Futurewei, Subsidiary

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

Definition of 200GXS Text essentially says that the functionality of the 200GXS is similar in functionality to the 200GBASE-R PCS and IT may be configured as itself, which doesn't communicate the true intent. It should communication that it can be configured as either the 200GXS or the 200GBASE-R PCS

The 200 Gb/s Extender Sublayer (200GXS) is part of the 200GMII Extender. Infunctionality, it is almost identical to the 200GBASE-R PCS Sublayer defined in Clause 119, but it may be configured as a 200GXS through different optional management registers. (See IEEE Std 802.3, Clause 118.)

SuggestedRemedy

Change definition to -
The 200 Gb/s Extender Sublayer (200GXS) is part of the 200GMII Extender. Infunctionality, it is almost identical to the 200GBASE-R PCS Sublayer defined in Clause 119. It may be configured as either a 200GXS or the 200GBASE-R PCS through different optional management registers. (See IEEE Std 802.3, Clause 118.)

Proposed Response *Response Status* **O**

Cl **1** *SC* **1.472i** *P* **34** *L* **38** # 155

D'Ambrosia, John — Futurewei, Subsidiary

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

The body of the standard introduces DTE 200GXS and PHY 200GXS (and used throughout the rest of the standard), but neither of these terms are defined.

SuggestedRemedy

There are two options -
1. Modify the definition of 200GXS to include the definition of these two terms, based on their location in the stack.
2. Create new definitions in 1.4 for each term.
Option 1 makes the most sense to the commenter in terms of gathering relevant information together, but i recognize that this doesn't allow easy location of these terms.

Proposed Response *Response Status* **O**

Cl **1** *SC* **1.472r** *P* **35** *L* **20** # 156

D'Ambrosia, John — Futurewei, Subsidiary

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

The body of the standard introduces DTE 400GXS and PHY 400GXS (and used throughout the rest of the standard), but neither of these terms are defined.

SuggestedRemedy

There are two options -
1. Modify the definition of 400GXS to include the definition of these two terms, based on their location in the stack.
2. Create new definitions in 1.4 for each term.
Option 1 makes the most sense to the commenter in terms of gathering relevant information together, but i recognize that this doesn't allow easy location of these terms.

Proposed Response *Response Status* **O**

Cl **1** *SC* **1.472r** *P* **35** *L* **20** # 154

D'Ambrosia, John — Futurewei, Subsidiary

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

Definition of 400GXS Text essentially says that the functionality of the 400GXS is similar in functionality to the 400GBASE-R PCS and IT may be configured as itself, which doesn't communicate the true intent. It should communication that it can be configured as either the 400GXS or the 400GBASE-R PCS

1.4.72r 400GXS: The 400 Gb/s Extender Sublayer (400GXS) is part of the 400GMII Extender. In functionality, it is almost identical to the 400GBASE-R PCS Sublayer defined in Clause 119, but it may be configured as a 400GXS through different optional management registers. (See IEEE Std 802.3, Clause 118.)

SuggestedRemedy

Change definition to -
The 400 Gb/s Extender Sublayer (400GXS) is part of the 400GMII Extender. In functionality, it is almost identical to the 400GBASE-R PCS Sublayer defined in Clause 119. It may be configured as either a 400GXS or the 400GBASE-R PCS through different optional management registers. (See IEEE Std 802.3, Clause 118.)

Proposed Response *Response Status* **O**

Cl **30** *SC* **30** *P* **41** *L* **21** # 136

Slavick, Jeff — Broadcom Limited

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

aRSFECIndicationEnable and aRSFECIndicationAbility are missing references to clause 119

SuggestedRemedy

Add references to clause 119 to the definitions of those two management objects

Proposed Response *Response Status* **O**

Cl **45** *SC* **45.2.1** *P* **43** *L* **44** # 122

Dudek, Mike — Cavium

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

A comment is being made to clause 120 to make JP03B also controlable on a per lane basis.

SuggestedRemedy

Assuming that comment is accepted additional appropriate registers for JP03B should be added here.

Proposed Response *Response Status* **O**

Cl **45** *SC* **45.2.1.4** *P* **45** *L* **25** # 83

Anslow, Pete — Ciena

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

In Table 45-6, "operating as 400 Gb/s" should be "operating at 400 Gb/s"
Also, "operating as 200 Gb/s" should be "operating at 200 Gb/s"

SuggestedRemedy

In Table 45-6, change "operating as 400 Gb/s" to "operating at 400 Gb/s"
Also, change "operating as 200 Gb/s" to "operating at 200 Gb/s"

Proposed Response *Response Status* **O**

Cl **45** *SC* **45.2.1.124** *P* **63** *L* **1** # 138

Slavick, Jeff — Broadcom Limited

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

Control register 1.1501 has more then just PRBS patterns.

SuggestedRemedy

Remove the word PRBS from the name of the register and the title of Table 45-93.

Proposed Response *Response Status* **O**

Cl **45** *SC* **45.2.1.124** *P* **63** *L* **41** # 137

Slavick, Jeff — Broadcom Limited

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

To support test operation of "Lane under test shall transmit pattern X, while other lanes are sending PRBS13Q, PRBS31Q or mission data" the definition for 1.1501 bit 3 (tx_gen) needs to be amended. Since to transmit the test pattern it has to be set, but the only way to send mission would be to not enable any pattern on the other lanes. Additionally the tx_gen enable allows for more then just PRBS to be sent.

SuggestedRemedy

Change: "Register 1.1501, bit 3 enables PRBS generation in the transmit direction. Register 1.1501, bit 2 enables PRBS checking in the transmit direction. Register 1.1501, bit 1 enables PRBS generation in the receive direction. Register 1.1501, bit 0 enables PRBS checking in the receive direction. If neither of the bits 7 and 6 are asserted then bits 3:0 have no effect."
to: "Register 1.1501, bit 3 allows for pattern generation to be sent in the transmit direction. Register 1.1501, bit 2 enables PRBS checking in the transmit direction. Register 1.1501, bit 1 allows for pattern generation to be sent in the receive direction. Register 1.1501, bit 0 enables PRBS checking in the receive direction."

Proposed Response *Response Status* **O**

Cl **45** *SC* **45.2.3.47h** *P* **73** *L* **41** # 80

Anslow, Pete — Ciena

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

"PCS FEC lane 0" should be "PCS lane 0"

SuggestedRemedy

Change "PCS FEC lane 0" to "PCS lane 0"

Proposed Response *Response Status* **O**

Cl **116** *SC* **116.1.2** *P* **107** *L* **3** # 7

Ran, Adee — Intel

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

This list specify the interfaces for which the width cannot be chosen "for implementation convenience".

All items except item a refer to physically instantiated interfaces; for these, it makes sense to specify the width. But item a refers to 200GMII and 400GMII and "logical interconnection points" and sets their widths as 64 bits.

The high-speed nGMIIs are assumed to be logical interfaces and not expected to be implemented physically (at least not in an obsevable way). Furthermore, even internal to an implementation, 200G with 64-bit bus width requires more than 2.5 Gtransfers/second and 400G requires more than 5 GT/s. This is not really feasible with today's technology and it is much more likely that implementations will use much larger bus widths such as 256 or 512 bits.

200GMII and 400GMII are interfaces for which "implementations may choose other data-path widths for implementation convenience", therfore they are not exceptions and should not be listed.

SuggestedRemedy

Delete item a from the list.

Alternatively, reword it to clarify that multiple-word implementations of 200GMII and 400GMII are possible.

Proposed Response *Response Status* **O**

Cl **118** *SC* **118.1.2** *P* **130** *L* **15** # 29

Hidaka, Yasuo — Fujitsu Lab of America

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

Comment #255 to D2.0 said that 200GXS and 400GXS are different from 200GBASE-R PCS and 400GBASE-R PCS regarding to IS_SIGNAL.indication. The response to the comment was accept in principle, but suitable text to describe the precise difference is requested. Here is revised changes.

SuggestedRemedy

Change the paragraph of 118.1.2 to:

The 200GXS is identical in function to the 200GBASE-R PCS in Clause 119 excepting the functions described in 118.2 and 118.2a and the 400GXS is identical in function to the 400GBASE-R PCS in Clause 119 excepting the functions described in 118.2 and 118.2a.

Add the following sub clause 118.2a before 118.3:

118.2a IS_SIGNAL.indication

A PHY 200GXS or PHY 400GXS sublayer generates the IS_SIGNAL.indication primitive to the next higher sublayer always with a value of OK.

A DTE 200GXS or DTE 400GXS sublayer monitors the IS_SIGNAL.indication primitive presented by the lower sublayer and behaves in the same way as the 200GBASE-R PCS or 400GBASE-R PCS in Clause 119.

Add a diagram to illustrate the direction of IS_SIGNAL.indication that is an output from PHY XS and an input to DTE XS or 200/400GBASE-R PCS.

Proposed Response *Response Status* **O**

Cl **118** *SC* **118.2.2** *P* **131** *L* **50** # 120

Dudek, Mike — Cavium

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

two returns that shouldn't be there.

SuggestedRemedy

remove them

Proposed Response *Response Status* **O**

Cl **118** *SC* **118.2.2** *P* **131** *L* **50** # 30

Hidaka, Yasuo — Fujitsu Lab of America

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

There is unnecessary new line and extra line space.

SuggestedRemedy

Remove the new line and extra line space.

Proposed Response *Response Status* **O**

Cl **118** *SC* **118.2.2** *P* **131** *L* **53** # 139

Slavick, Jeff — Broadcom Limited

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

Only the DTE XS has the variable rx_local_degraded

SuggestedRemedy

Remove "or rx_local_degraded" from the definition of adjacent_pcs_local_degraded

Proposed Response *Response Status* **O**

Cl **118** *SC* **118.5.7** *P* **141** *L* **48** # 32

Hidaka, Yasuo — Fujitsu Lab of America

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

M2 is mandatory only when the options MD and PHYXS are supported.

SuggestedRemedy

Add "N/A []" in the support column of M2.

Proposed Response *Response Status* **O**

Cl **118** *SC* **118.5.7** *P* **141** *L* **51** # 33

Hidaka, Yasuo — Fujitsu Lab of America

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

M3 is mandatory only when the options MD and DTEXS are supported.

SuggestedRemedy

Add "N/A []" in the support column of M3.

Proposed Response *Response Status* **O**

Cl **119** *SC* **119.2.4.1** *P* **149** *L* **1** # 90

Trowbridge, Steve — Nokia

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

The OTN mapping reference point needs to include both the stream of 66B blocks and the FEC_degrade_SER and rx_local_degrade information

SuggestedRemedy

Change "The stream of 66-bit blocks generated by this process is used as the reference signal for mapping to OTN." to "The stream of 66-bit blocks generated by this process, together with the FEC_degrade_SER and rx_local_degrade is used as the reference signal for mapping to OTN."

Proposed Response *Response Status* **O**

Cl **119** *SC* **119.2.4.4** *P* **151** *L* **50** # 140

Slavick, Jeff — Broadcom Limited

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

The Clause 119 PCS does not forward a XS degraded signal. Clause 118 PHY XS also does not send a degrade indication across the AUI to the DTE XS.

SuggestedRemedy

Presentation to be provided with changes

Proposed Response *Response Status* **O**

Cl **119** *SC* **119.2.4.4** *P* **154** *L* **18** # 85

Anslow, Pete — Ciena

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

The spreadsheet that was used to calculate the hex values in http://www.ieee802.org/3/bs/public/16_05/anslow_3bs_03_0516.pdf for inclusion in Table 119-1 had an error that resulted in UP2, UM3, UM4, UM5 not being the inverse of UP1, UM0, UM1, UM2 as they are for the 400GbE markers.
The performance of the markers in D2.1 with AM0 changed to correct this error is expected to be reviewed in http://www.ieee802.org/3/bs/public/adhoc/logic/oct27_16/anslow_01_1016_logic.pdf

SuggestedRemedy

Change AM0 for 200 Gb/s Ethernet to be:
0x9A, 0x4A, 0x26, 0x05, 0x65, 0xB5, 0xD9, 0xD6, 0xB3, 0xC0, 0x8C, 0x29, 0x4C, 0x3F, 0x73

Proposed Response *Response Status* **O**

Cl **119** *SC* **119.2.6.2.4** *P* **168** *L* **42** # 141

Slavick, Jeff — Broadcom Limited

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

The amps_counter is counting the interval of AM insertions. So "separate the ends of", is that inclusive or exclusive of the codeword containing the AM block?

SuggestedRemedy

Change: "amp_counter
This counter counts the i FEC codewords that separate the ends of two consecutive normal alignment marker payload sequences (where i is 4096 for the 200GBASE-R PCS, and 8192 for the
400GBASE-R PCS)."
to "amp_counter
This counter counts the interval of i FEC codewords containing normal alignment marker payload sequences (where i is 4096 for the 200GBASE-R PCS, and 8192 for the 400GBASE-R PCS)."

Proposed Response *Response Status* **O**

Cl **119** *SC* **119.2.6.3** *P* **169** *L* **13** # 142

Slavick, Jeff — Broadcom Limited

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

The opening paragraph talks about how AM lock is achieved, then how things lose lock, and then the last sentence says, oh by the way when you got lock, also do this. So the flow of the paragraph could be improved.

SuggestedRemedy

Move the last sentence to precede the sentence starting with "Once in lock".

Proposed Response *Response Status* **O**

Cl **119** *SC* **119.2.6.3** *P* **170** *L* **3** # 143

Slavick, Jeff — Broadcom Limited

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

Should me make all the FSMs look the same? The maintence request version has the A transition going to the GOOD_AM state rather then the COUNT_2 state?

SuggestedRemedy

Delete amp_bad_count <= 0 from 2_GOOD
Move the A transition to go from 2_GOOD -> GOOD_AM

Proposed Response *Response Status* **O**

Cl **119** *SC* **119.2.6.3** *P* **170** *L* **10** # 163

Brown, Matt — Applied Micro

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

In Figure 119-12, conditions for some transitions are missing.

SuggestedRemedy

For the transition COUNT_NEXT to COMP_2ND use "amp_counter_done * amp_valid".
For the transition COMP_2ND to 2_GOOD use "amp_match".
For the transition from SLIP to GET_BLOCK use "UCT".

Proposed Response *Response Status* **W**

[Editor's note: This comment was sent after the close of the comment period]

Cl **119** *SC* **119.3.1** *P* **175** *L* **1** # 25

Lapierre, Dominic — EXFO

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

MDIO status variable PCS FEC High SER (clause 45.2.3.47k.4, register/bit number 3.801.2) is missing from table 119-5.

SuggestedRemedy

Add the PCS FEC High SER status variable to table 119-5, in a similar way that 802.3cd defines it in clause 134.6.5.

Proposed Response *Response Status* **O**

Cl **119A** *SC* **119A** *P* **318** *L* **6** # 82

Anslow, Pete — Ciena

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

The example codewords in Annex 119A include the AMs.
The 200G AMs were changed in D2.1, but Tables 119A-1, 119A-3 and 119A-4 have not been updated to reflect the changes.

SuggestedRemedy

Update Tables 119A-1, 119A-3 and 119A-4 to reflect the latest AMs.
Note, another comment proposes to further change AM0 for 200G.

Proposed Response *Response Status* **O**

Cl **119A** *SC* **119A** *P* **318** *L* **6** # 56

Dillard, John — Microsemi

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

Since the alignment markers changed for 200g, tables 119A-1 and 119A-3 require updating.

SuggestedRemedy

I will plan to provide supporting material

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.1.3** *P* **183** *L* **46** # 109

Nowell, Mark — Cisco

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

Since the definintion of the 200GBASE-R and 400G-BASE-R PMAs are unique compared to PMAs at other rates in that they are defined to support both PAM4 and NRZ based PMDs, be clear in the summary list of this fact.

SuggestedRemedy

Modify from:
j) Perform PAM4 encoding and decoding for 200GBASE-R PMAs where the number of physical lanes is 4, and for 400GBASE-R PMAs where the number of physical lanes is 4 or 8.

to:
j) Perform PAM4 encoding and decoding for 200GBASE-R PMAs where the number of physical lanes is 4, and for 400GBASE-R PMAs where the number of physical lanes is 4 or 8. For 400GBASE-R PMAs where the number of physical lanes is 16, no PAM4 encoding or decoding is required.

or similar...

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.1.1** *P* **196** *L* **22** # 144

Slavick, Jeff — Broadcom Limited

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

Do we really want to restrict (and I doubt implmentations do this) error counting to "isolated single bit errors". I believe the current implmentations are able to count all bits, and don't always create single bit errors. I think we want to allow for all errors to be counted along with the ability to reduce a burst error to be a single increment.

SuggestedRemedy

In 120.5.11.1.1, 120.5.11.2.4
Change: "The checker shall increment the test-pattern error counter by one for each incoming bit error in the PRBS31 pattern for isolated single bit errors. Implementations should be capable of counting at least one error whenever one or more errors occur in a sliding 1000-bit window."
To: "The checker shall increment the test-pattern error counter by one for each incoming error in the PRBS31 pattern. Implementations should be capabable of counting at least one error whenever one or more errors occur in a sliding 100-bit window"

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.1.1** *P* **196** *L* **22** # 34

Hidaka, Yasuo — Fujitsu Lab of America

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

The description of the error counter is not clear for burst errors.
Also, we should revise non-exact error counting by the sliding 1000-bit window, because it was introduced in the past when the target BER was rather low such as < 1E-12 and a DFE was not commonly used.

Now, the target BER before RS-FEC is rather high such as < 2.4E-4.
Also, use of the sliding window will miss significant degradation of BER due to error propagation of DFE that is now commonly used in electrical interfaces.
Hardware to measure the exact error count without a sliding window is a few hundred cells and consumes less than 1mW.

This is related to comment #430 to D2.0. This comment is a revised change to the text.

SuggestedRemedy

Change the text "The checker shall increment the test-pattern error counter by one for each incoming bit error in the PRBS31 pattern for isolated single bit errors. Implementations should be capable of counting at least one error whenever one or more errors occur in a sliding 1000-bit window." to either of the following options:

Option A:
The checker shall increment the test-pattern error counter by one for each bit error in the PRBS31 pattern. A burst error is exactly counted as multiple errors.

Option B:
The checker shall increment the test-pattern error counter by one for each error in the PRBS31 pattern. If a DFE is not used, a burst error that is multiple errors within 100 bits may be counted as one error.

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.1.3** *P* **197** *L* **13** # 97

Dawe, Piers — Mellanox

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

In this draft, square wave is proposed for RIN measurement. But we can't use square wave because it isn't PAM4. CDRs, CRUs and any linearity control circuits may fail because two of the expected PAM4 levels are missing, CRUs with the special low PAM4 bandwidth (3 MHz nominal) won't hold lock properly because square wave has an unusually low transition density.

SuggestedRemedy

When the RIN spec has been adjusted, remove this section and associated MDIO registers.

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2** *P* **197** *L* **37** # 114

Dudek, Mike — Cavium

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

JP03B is used for the measurement of EOJ. With the pattern enabled on all the lanes at the same time crosstalk will affect the measured value degrading the result. If the other lanes have a non-synchronous pattern then crosstalk will be averaged and the correct value of EOJ will be obtained.

SuggestedRemedy

Add JP03B to the list of patterns that can be enabled on a lane-by-lane basis. Add control registers to clause 45 (separate comment submitted). Make similar changes to 120.5.11.2.2 that were made to 120.5.11.2.1 (for JP03A) in this draft.

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2.1** *P* **197** *L* **43** # 99

Dawe, Piers — Mellanox

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

Should not use such unrepresentative patterns when more normal ones we use anyway will do the job.

SuggestedRemedy

When the jitter measurement methods have been improved, remove JP03A and JP03B test pattern generator and registers.

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2.3** *P* **198** *L* **40** # 37

Hidaka, Yasuo — Fujitsu Lab of America

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

Unlike PRBS31Q, PRBS13Q does not specify the seed for each lane or the minimum offset between PRBS13Q on different lanes. The Autocorrelation function of PRBS13Q has a strong peak at an offset of 452 symbols with correlation coefficient of 0.4. Lack of specification of seed for each lane or the minimum offset between lanes may result in strong correlation between test patterns on different lanes that is not desired for measurement accurately. It is also discouraged to reuse 4 seeds in Table 94-11 by adding 4 more seeds, because they will make the offset between Lane 1 and 2 only 827 symbols that is not sufficient to separate the strong peak between lanes. Autocorrelation function of PRBS13Q is almost flat for an offset between 470 symbols and 7720 symbols.

SuggestedRemedy

Add the following statement to the second paragraph in 120.5.11.2.3:

To avoid correlated crosstalk, it is highly recommended that the PRBS13Q pattern is generated from different seeds for each lane so that the PRBS13Q pattern has a minimum offset of 940 symbols between any lane and any other lane.

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2.4** *P* **199** *L* **35** # 35

Hidaka, Yasuo — Fujitsu Lab of America

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

The description of the error counter is not clear for burst errors.
Also, we should revise non-exact error counting by the sliding 1000-bit window, because it was introduced in the past when the target BER was rather low such as < 1E-12 and a DFE was not commonly used.

Now, the target BER before RS-FEC is rather high such as < 2.4E-4.
Also, use of the sliding window will miss significant degradation of BER due to error propagation of DFE that is now commonly used in electrical interfaces.
Hardware to measure the exact error count without a sliding window is a few hundred cells and consumes less than 1mW.

This is related to comment #301 to D2.0. Although #301 was rejected, #301 refers to #430 which was accepted in principle. This comment is a revised change to the text.

SuggestedRemedy

Change the text "The checker shall increment the test-pattern error counter by one for each incoming bit error in the PRBS31 pattern for isolated single bit errors. Implementations should be capable of counting at least one error whenever one or more errors occur in a sliding 1000-bit window." to either of the following options:

Option A:
The checker shall increment the test-pattern error counter by one for each bit error in the PRBS31 pattern. A burst error is exactly counted as multiple errors.

Option B:
The checker shall increment the test-pattern error counter by one for each error in the PRBS31 pattern. If a DFE is not used, a burst error that is multiple errors within 100 bits may be counted as one error.

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2.5** *P* **200** *L* **43** # 152

Wertheim, Oded — Mellanox Technologie

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

The current SSPRQ test pattern is too stressful for transmitter (TDECQ) or stressed receiver testing.

SuggestedRemedy

The shortened test pattern structure of sections of PRBS31 is convenient from implementation perspective, we may modify the start values of the segments to produce the right penalty.

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2.5** *P* **200** *L* **45** # 86

Anslow, Pete — Ciena

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

The PRBS31 generator that was used to generate the sequence in http://www.ieee802.org/3/bs/public/adhoc/logic/apr28_16/anslow_01_0416_logic.pdf was an different to that used by the PRBS31 generator referenced from 120.5.11.2.5.
Unlike the generator used for anslow_01_0416_logic the generator shown in Figure 49-9 does not output the seed as the first 31 bits of the sequence and it has an inverter at the output.
The characteristics of the SSPRQ test sequence created with the changes in the Suggested remedy are expected to be reviewed in http://www.ieee802.org/3/bs/public/adhoc/logic/oct27_16/anslow_02_1016_logic.pdf

SuggestedRemedy

In the heading of Table 120-2, change "Start" to "Seed".
Change the paragraph below the table from:
"The start value is a 31 bit hexadecimal value sent MSB first that represents the first 31 bits of each section, continuing the PRBS31 sequence for the indicated length of bits as if produced by the shift register implementation shown in Figure 49-9." to:
"Each section of PRBS31 is generated as if produced by the shift register implementation shown in Figure 49-9 and the seed is a 31-bit hexadecimal value used to preset S30 through S0 (S30 is set to the MSB and S0 is set to the LSB) prior to the generation of the PRBS31 sequence for the indicated length of bits."

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2.5** *P* **200** *L* **47** # 94

Dawe, Piers — Mellanox

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

This SSPRQ is not suitable for use in TDECQ or stressed receiver calibration because measurements with this pattern do not give the correct penalty.

SuggestedRemedy

Either adjust SSPRQ to a pattern that gives the correct penalty, e.g. by changing the first start sequence in Table 120-2, or remove SSPRQ (using PRBS13Q for TDECQ and stressed receiver calibration).

Proposed Response *Response Status* **O**

Cl **120** *SC* **120.5.11.2.6** *P* **201** *L* **20** # 164

Brown, Matt — Applied Micro

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

The SSPRQ pattern is a complex pattern comprised of a set of independently generated bit pattern segments followed by conversion to PAM4 symbols, gray coding, and precoding. As such, there is ample opportunity for the description to be incorrectly interpreted. There is ample opportunity to misinterpret the specification and implement an incorrect pattern.

SuggestedRemedy

Provide a copy of the entire PAM4 either within the P802.3bs document or in a file on the IEEE web site in a location that is perpetually accessible.

Proposed Response *Response Status* **W**

[Editor's note: This comment was sent after the close of the comment period]

Cl **120** *SC* **120.5.11.2.6** *P* **201** *L* **28** # 153

Wertheim, Oded — Mellanox Technologie

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

A square test pattern is not suitable test pattern for a PAM4 receiver. It doesn't include all the PAM4 symbols / transitions that a CDR or tuning implementation may assume.

SuggestedRemedy

Remove the square test pattern from clause 120.

Proposed Response *Response Status* **O**

Cl **120A** *SC* **120A.2** *P* **328** *L* **8** # 8

Ran, Adee — Intel

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

(This comment is against an unchanged portion of the draft)

The PMA on the top left should be 8:8 if it connects to 200GAUI-8 and the one on the right should be 16:16 if it connects to 400GAUI-16.

SuggestedRemedy

Change top PMAs from PMA(8:4) to PMA(8:8) and from PMA(16:8) to PMA(16:16).

Proposed Response *Response Status* **O**

Cl **120A** *SC* **120A.2** *P* **328** *L* **12** # 111

Dudek, Mike — Cavium

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

There is a problem with figure 120A-4. The PMA's immediately below the PCS have the wrong ratios.

SuggestedRemedy

Change the ratio for the top PMA for 200G to 8:8 and that for the top PMA for 400G to 16:16

Proposed Response *Response Status* **O**

Cl **120B** *SC* **120B.1** *P* **332** *L* **7** # 9

Ran, Adee Intel

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

(This comment is against an unchanged portion of the draft)

It is better to use different names for different things. The version of 200GAUI-8 defined here is different from the one defined in 120C, but but are labeled (200GAUI-8). Same goes for 400GAUI-16, 200GAUI-4 and 400GAUI-8.

In 802.3by the abbreviations C2C and C2M were defined for chip-to-chip and chip-to-module. They can be used to differentiate the labels.

This can also be applied to abbreviate text in the annex, e.g. "200GAUI-8 chip-to-chip" in figure 120B-1, if desired.

In addition, in some places "200GAUI-4" appears unqualified (e.g. P333 L34) while in other places a qualifier such as "chip-to-chip" is appended (e.g. P333 L44). Although the type can be implied from the clause, using the qualifiers "C2C" or "C2M" in all places can improve readability and consistency.

SuggestedRemedy

In the title of annex 120B, change "(200GAUI-8)" to "(200GAUI-8 C2C)" and "(400GAUI-16)" to "(400GAUI-16 C2C)".

Similarly in 120C add "C2M", in 120D add "C2C", and in 120E add "C2M".

Consider using the abbreviations to qualify the AUIs across the text of the annexes too.

Proposed Response *Response Status* **O**

Cl **120b** *SC* **120b.1** *P* **332** *L* **26** # 157

D'Ambrosia, John Futurewei, Subsidiary

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

Fig 120B-1 and 120B-2 include terms 200GBASE-R PCS and 400GBASE-R PCS, respectively. However, these terms are not defined below. It is noted that in both of these diagrams, layers are defined that are not general, and rate specific.

SuggestedRemedy

Include terms 200GBASE-R PCS and 400GBASE-R PCS in terminology below respective diagram.
200GBASE-R PCS - 200 Gb/s BASE-R PCS
400GBASE-R PCS - 400 Gb/s BASE-R PCS

Proposed Response *Response Status* **O**

Cl **120B** *SC* **120B.1** *P* **333** *L* **34** # 10

Ran, Adee Intel

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

(This comment is against an unchanged portion of the draft)

The paragraphs starting in lines 34 and 41 contain a lot of information about loosely related topics (definition of link, loss budget, NRZ modulation, AC coupling, recommendation about -3 dB point) and have lots of common text. This is complete, but difficult to read. It would be easier to read if they are edited to "factor out" the common text.

Also, the first sentence of the third paragraph (L48) seems to fit better into the previous paragraphs.

Suggest reordering for clarity.

Also applies to similar text in 120D.1.

SuggestedRemedy

Replace the three paragraphs in this page with the following text:

"The 200GAUI-8 bidirectional link is described in terms of a 200GAUI-8 transmitter, a 200GAUI-8 channel, and a 200GAUI-8 receiver. The 400GAUI-16 bidirectional link is described in terms of a 400GAUI-16 transmitter, a 400GAUI-16 channel, and a 400GAUI-16 receiver.

Figure 120B–3 depicts a typical 200GAUI-8 application. Figure 120B–4 depicts a typical 400GAUI-16 application.

Equation (83D–1) (illustrated in Figure 83D–3) summarizes the informative differential insertion loss budget associated with the chip-to-chip application.

The 200GAUI-8 chip-to-chip interface comprises independent data paths in each direction, with each data path containing eight differential lanes. The 400GAUI-16 chip-to-chip interface comprises independent data paths in each direction, with each data path containing sixteen differential lanes.

The lanes on each data path are AC-coupled. The low-frequency 3 dB cutoff of the AC-coupling should be less than 100 kHz.

The 200GAUI-8 or 400GAUI-16 transmitter and receiver communicate using NRZ signaling on each lane with a nominal signaling rate of 26.5625 GBd.

The 200GAUI-8 or 400GAUI-16 transmitter on each end of the link is adjusted to an appropriate setting based on channel knowledge. If implemented, the transmitter equalization feedback mechanism described in 83D.3.3.2 may be used to identify an appropriate setting. The adaptive or adjustable receiver perform the remainder of the equalization."

Apply corresponding change in 120D.1 replacing "NRZ" with "PAM4".

Consider changing 120C and 120E in a similar way.

Proposed Response *Response Status* **O**

Cl **120B** *SC* **120B.3.1** *P* **335** *L* **4** # 11

Ran, Adee Intel

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

(This comment is against an unchanged portion of the draft)

In 802.3by we identified a "hole" in the loss budget due to the fact that transmitter that barely meets the existing specs represents a long transition time which was not accounted for in COM. As a result, the specification for the transmitter parameter "Linear fit pulse peak" in the PMD was changed from 0.71*v_f to 0.75*v_f (see 111.8.2). It was claimed that there is margin in existing transmitters to meet this specification. In addition, an exception was added in the receiver tolerance test to account for the measured transimition time of the transmitter (list item c in 111.8.3.1).

Unfortunately, probably due to lack of attention, these changes were not applied to 25GAUI C2C (109A.3.1 refers to 83D.3.1, which has uses the same specification method but with the old value, and there is no exception in the receiver tolerance test). This enables a loss deficit in annex 109A.

It would be preferable not to have this hole in 120B. It seems that it was already fixed in 120D.

For the transmitter, this is a simple matter of adding one more exception. Based on 111.8.2, it is expected that transmitters can meet this specification.

For the receiver, the exception in 120D.3.2.1 item c can be added with minor modifications.

SuggestedRemedy

In 120B.3.1, add to the list of exceptions:
- The value of linear fit pulse peak (min) in Table 83D-1 is 0.75 × v_f.

In 120B.3.2, add to the list of exceptions:
- The transmitter device package model S(tp) is omitted from Equation (93A–3) in the calculation of
COM. The filtered voltage transfer function H(k)(f) calculated in Equation (93A–19) uses the filter
Ht(f) defined by Equation (93A–46), where \beta is 2, Tr is calculated as Tr = 1.09 × Trm – 4.32 ps, and Trm is the measured 20% to 80% transition time of the signal at TP0a. Trm is measured using the method in 86A.5.3.3, with the exception that the observation filter bandwidth is 33 GHz instead of
12 GHz. Trm is measured with the transmit equalizer turned off (i.e., Local_eq_cm1 and Local_eq_c1 both equal to 0, see 83D.3.1.1).

Proposed Response *Response Status* **O**

Cl **120c** *SC* **120c.1** *P* **339** *L* **26** # 158

D'Ambrosia, John — Futurewei, Subsidiary

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

Fig 120C-1 include terms 200GBASE-R PCS and 400GBASE-R PCS, respectively. However, these terms are not defined below diagram. It is noted that in both of these diagrams, layers are defined that are not general, and rate specific.

SuggestedRemedy

Include terms 200GBASE-R PCS and 400GBASE-R PCS in terminology below diagram.
200GBASE-R PCS - 200 Gb/s BASE-R PCS
400GBASE-R PCS - 400 Gb/s BASE-R PCS

Proposed Response *Response Status* **O**

Cl **120C** *SC* **120C.3.2** *P* **341** *L* **29** # 84

Anslow, Pete — Ciena

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

Comment #48 against D2.0 changed (in 120C.3.2 and 120C.4) "as specified in 109B.3.2.1 for a PHY that includes an RS-FEC sublayer" to "as specified in 109B.3.2.1".
But 109B.3.2.1 defines two different test methods. One "For a PHY that includes an RS-FEC sublayer" and the other "For a PHY that does not include an RS-FEC sublayer". Since the PHYs in the P802.3bs draft do not include an RS-FEC sublayer (the FEC is in the PCS layer), the effect of the change made by comment #48 is to select the method appropriate to a PHY without FEC.

SuggestedRemedy

Change this text in 120C.3.2 and 120C.4 back to how it was in D2.0 "as specified in 109B.3.2.1 for a PHY that includes an RS-FEC sublayer"

Proposed Response *Response Status* **O**

Cl **120C** *SC* **120C.3.2** *P* **341** *L* **29** # 115

Dudek, Mike — Cavium

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

Clause 109B.3.2.1 contains two specifications one for a PHY that includes an Clause 109B.3.2.1 RS-FEC sublayer (clause 108) and one for a PHY that does not Clause 109B.3.2.1 provides two different methods to measure the module eye opening. One when the Phy includes an RS-FEC sublayer (Clause 108) and another for a Phy that does not include an RS-FEC sublayer. Technically 200G and 400G do not include an RS-FEC sublayer as the FEC is part of the PCS layer. The change to delete the words "for a PHY that includes an RS-FEC sublayer" will cause the wrong specification to be used. I also had trouble finding the justification for the change in the D2.0 comment data base.

SuggestedRemedy

Revert back to the wording in draft 2.0 or better add "using the method described in 109B.3.2.1.2" Make the same change in 120C.4 on page 342 line 16.

Proposed Response *Response Status* **O**

Cl **120C** *SC* **120C.5.3** *P* **344** *L* **13** # 59

Ran, Adee — Intel

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

"Adaptive equalizer" is not relevant for a host. A host vendor should not mark this item. This feature is characteristic of a module, specifically the module input. Therefore it should be part of the "module input" table.

Also applies to 120E.5.3.

SuggestedRemedy

Move item ADE from 120C.5.3 to 120C.5.4.4 (Module input).
Move item ADE from 120E.5.3 to 120E.5.4.4 (Module input).

Proposed Response *Response Status* **O**

Cl **120C** *SC* **120C.5.4.3** *P* **346** *L* **8** # 12

Ran, Adee Intel

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

Host input does not include an item for the modified BER requirement.

Compare to Module input, item RM2.

SuggestedRemedy

Add item RH2: "Host stressed input test BER requirement"; 120C.3.3; "Meet BER requirement of 120C.1.1"; M

Proposed Response *Response Status* **O**

Cl **120d** *SC* **120d.1** *P* **348** *L* **26** # 159

D'Ambrosia, John Futurewei, Subsidiary

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

Fig 120D-1 and 120D-2 include terms 200GBASE-R PCS and 400GBASE-R PCS, respectively. However, these terms are not defined below. It is noted that in both of these diagrams, layers are defined that are not general, and rate specific.

SuggestedRemedy

Include terms 200GBASE-R PCS and 400GBASE-R PCS in terminology below respective diagram.
200GBASE-R PCS - 200 Gb/s BASE-R PCS
400GBASE-R PCS - 400 Gb/s BASE-R PCS

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **350** *L* **42** # 3

Ran, Adee Intel

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

(This comment is against an unchanged portion of the draft)

"A 200GAUI-4 or a 400GAUI-8 chip-to-chip transmitter shall meet the specifications given in Table 120D–1 if measured at TP0a."

"if measured" can be read as a condition, but the transmitter characteristics are normative whether or not they are actually measured.

The specifications are already defined at TP0a in Table 120D–1, so there is no need to add "if measured at TP0a"

Also applies to 120D.3.2 (TP5), 120E.3.1 (TP1a), 120E.3.2 (TP4), 120E.3.3 ("appropriate test point"), and 120E.3.4 ("appropriate test point"). In all these cases, the referenced table defines the test point.

SuggestedRemedy

Delete the "if measured at x" part of the sentence in all occurences.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **19** # 43

Hidaka, Yasuo Fujitsu Lab of America

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

In Table 120D-1, the reference for the steady state voltage vf (max) and (min) is 94.3.12.5.3. However, clause 94.3.12.5.3 refers to the linear fit procedure in 94.3.12.5.2 that does not include exceptions described in 120D.1.3. The reference should be made to 120D.3.1.4 which referes to the linear fit procedure in 120D.3.1.2 (it must be corrected to 120D.3.1.3).

SuggestedRemedy

Change the reference for the steady state voltage vf (max) and (min) in Table 120D-1 from 94.3.12.5.3 to 120D.3.1.4.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **19** # 4

Ran, Adee Intel

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

The steady state voltage and linear fit pulse peak parameters have a refererence to 94.3.12.5.3. These parameters have a new measurement procedure in 120D.3.1.4.

SuggestedRemedy

Change the references to point to 120D.3.1.4 for the parameters: Steady state voltage vf (max), Steady state voltage vf (min), and Linear fit pulse peak (min).

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **19** # 106

Healey, Adam Broadcom Ltd.

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

In Table 120D-1, the references for steady state voltage vf (max), steady state voltage vf (min), and linear fit pulse peak (min) should be the newly created subclause 120D.3.1.4.

SuggestedRemedy

Update the references per the comment.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **21** # 41

Hidaka, Yasuo Fujitsu Lab of America

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

The Value of Np, 13 in D2.0 was changed to 200 in D2.1.
A larger Np value increases the steady-state voltage vf, because a longer fitted pulse will capture more long-term ISI.
On the other hand, peak of the fitted pulse does not change.
As a result, the ratio of the linear fit pulse peak to the steady-state voltage vf is reduced.

In order to avoid changing the requirement for Tx due to the Np value change, we should adjust the values of vf and the ratio of the linear fit pulse peak to the steady voltage vf.
According to my simulation, vf was increased by 4.3279% for 30mm package and by 1.7706% for 12mm package when I changed Np from 13 to 200.
The ratio of the linear fit pulse peak to the steady-state voltage vf was reduced by 4.1471% for 30mm package and by 1.7393% for 12mm package when I changed Np from 13 to 200..

SuggestedRemedy

Change the Steady state voltage vf (max)
from 0.6 to 0.611

Change the Steady state voltage vf (min)
from 0.4 to 0.417

Change the value of Linear fit pulse peak (min)
from "0.736 x vf" to "0.705 x vf".

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **21** # 44

Hidaka, Yasuo — Fujitsu Lab of America

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

In Table 120D-1, the reference for the linear fit pulse peak (min) is 94.3.12.5.3. However, clause 94.3.12.5.3 refers to the linear fit procedure in 94.3.12.5.2 and includes a contradictory description for the linear fit pulse peak. The reference should be made to 120D.3.1.4 which refers to the linear fit procedure in 120D.3.1.2 (that must be corrected to 120D.3.1.3).

SuggestedRemedy

Change the reference for the linear fit pulse peak (min) in Table 120D-1 from 94.3.12.5.3 to 120D.3.1.4.

Alternatively, the reference may be directly to 120D.3.1.3, because 120D.3.1.4 merely point to 120D.3.1.2 (that must be corrected to 120D.3.1.3).

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **24** # 107

Healey, Adam — Broadcom Ltd.

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

In Table 120D-1, the reference for signal-to-noise-and-distortion ratio (min) should be the newly created subclause 120D.3.1.6.

SuggestedRemedy

Update the reference per the comment.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **31** # 108

Healey, Adam — Broadcom Ltd.

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

Footnote (b) in Table 120D-1 states that "the state of the transmit equalizer is controlled by management interface." It is unclear what the purpose of this note is. 120D.3.1.5 (which is referenced by the parameters of interest) includes the statement that "the 200GAUI-4 or 400GAUI-8 transmit output is manipulated via management."

SuggestedRemedy

Remove the note.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1** *P* **351** *L* **32** # 116

Dudek, Mike — Cavium

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

Crosstalk from other lanes in a real system does not affect Even-odd jitter, however with the use of the JP03B pattern on all lanes as implied by 94.3.12.6.2 the measured Even-odd jitter will be affected by crosstalk which could either increase it or decrease it. An asynchromous pattern should be used on the other lanes. I have made other comments to add the controls to clauses 120 and 45 to provide per lane enablement of the JP03B pattern.

SuggestedRemedy

change footnote c from "As an exception to 94.3.12.6.2, the clock recovery unit (CRU) used in the jitter measurement has a corner frequency of 4 MHz and a slope of 20 dB/decade." to "As exceptions to 94.3.12.6.2, the clock recovery unit (CRU) used in the jitter measurement has a corner frequency of 4 MHz and a slope of 20 dB/decade, and transmitters on lanes not under test transmit PRBS13Q, PRBS31Q or a valid 200GBASE-R or 400GBASE-R signal."

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.1** *P* **350** *L* **51** # 100

Dawe, Piers — Mellanox

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

Should not use such an unrepresentative pattern for just one spec measurement.

SuggestedRemedy

Measure J4 Jitter and Jrms with PRBS13Q as discussed on the electrical ad hoc. Remove the JP03A test pattern generator and registers.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.1** *P* **350** *L* **51** # 38

Hidaka, Yasuo — Fujitsu Lab of America

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

There has been discussion on jitter measurement using PRBS13Q such as comment #131 to D2.0 by Piers.
This is my recommendation to measure jitter using PRBS13Q.

SuggestedRemedy

Measure jitter on each of 12 specific transitions in PRBS13Q in order to exclude DDJ
- Get a horizontal histogram for each of specific transitions.
  - Each specific transition may be replaced with a similar specific transition.
  - Each histogram should include at least 10^5 hits.
- Derive JRMS and J4 from the histogram using the method in 120D.3.1.1
- JRMS and J4 should meet the specification at each specific transition.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.1** *P* **351** *L* **24** # 93

Mellitz, Richard — Samtec

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

Since Np has been set to 200, there is no way of limiting the ISI of transmitter/package.

SuggestedRemedy

Add a table entry, ISI_SNR max, of 32.3 dB as suggested in mellitz_3bs_01_0916_adhoc.
This the amount of ISI that is compehened in the COM computation.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.1** *P* **351** *L* **28** # 101

Dawe, Piers — Mellanox

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

Should not use such an unrepresentative pattern for just one spec item.
Should not rely on Clause 94.

SuggestedRemedy

Measure EOJ with PRBS13Q as discussed on the electrical ad hoc.
Remove the JP03A test pattern generator and registers.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.1** *P* **351** *L* **28** # 40

Hidaka, Yasuo — Fujitsu Lab of America

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

Test pattern for EOJ has been once changed from JP03B to PRBS13Q, but changed back to JP03B due to some problem.
There has been still discussion to use PRBS13Q for EOJ measurement such as comment #565 to D2.0 by Piers.
This is my recommendation to measure EOJ using PRBS13Q.

SuggestedRemedy

For each of 12 specific transitions in PRBS13Q.
- Measure 2 cycles of PRBS13Q test pattern
- Get a first horizontal histogram for the specific transition in the first PRBS13Q
- Let T1 be the mean time of the first histogram
- Get a second horizontal histogram for the specific transition in the second PRBS13Q
- Let T2 be the mean time of the second histogram
- Calculate EOJ as abs(T2 - T1 - 8191 UI)
- Each histogram should include at least 10^5 hits.
- EOJ should meet the specification at each specific transition.
- Each specific transition may be replaced with a similar transition as long as the same transition in PRBS13Q is measured for T1 and T2

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.1** *P* **351** *L* **40** # 145

Li, Mike — Intel

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

All but 1e-4 of the jitter distribution can be confusing and ambiguous.

SuggestedRemedy

Change it to “jitter distribution with its probability density function (pdf) at and above 1e-4”

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.1** *P* **351** *L* **42** # 39

Hidaka, Yasuo — Fujitsu Lab of America

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

J4 in D2.0 was changed to J5 in D2.1. Then, we can reduce the number of samples in the histogram from 10^6 to 10^5.

SuggestedRemedy

Change "at least 10^6 hits" to "at least 10^5 hits".

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.3** *P* **351** *L* **50** # 112

Dudek, Mike — Cavium

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

If there is assymetry normalization may not be enough to align the levels to the specified values.

SuggestedRemedy

change "normalized" to "normalized and offset adjusted".

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.3** *P* **352** *L* **38** # 147

Li, Mike — Intel

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

“ES is defined to be (ES1 + ES2)/2” is wrong

SuggestedRemedy

Change it to “ES is defined to be (|ES1| + ES2)/2”

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.4** *P* **352** *L* **41** # 117

Dudek, Mike — Cavium

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

The change in the Np value from 13 to 200 removes almost all reflections or other linear distortions from the measurement of sigma e. Package reflections (or other transmitter degradations) that occur in time after the end of the DFE assumed in the Rx will degrade system performance but will no longer be measured. Some method of ensuring that transmitters do not have larger imperfections than those in the COM reference transmitter is required to ensure inter-operability.

SuggestedRemedy

Revert Np back to 13 and make TxSNR in COM larger than TxSNDR to account for the sigma e created by the COM package, or create an additional control method and specifications for these effects.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.4** *P* **352** *L* **46** # 42

Hidaka, Yasuo — Fujitsu Lab of America

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

It is written as the linear fit procedure in 120D.3.1.2, but 120D.3.1.2 does not describe the linear fit procedure. 120D.3.1.2 describes Transmitter linearity. The linear fit procedure is described in 120D.3.1.3.

SuggestedRemedy

Change the reference to 120D.3.1.2 with a reference to 120D.3.1.3.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.1.6** *P* **354** *L* **20** # 36

Hidaka, Yasuo
Fujitsu Lab of America

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

When the waveform is captured, averaging multiple waveform captures was recommended in clause 85.8.3.3.4 that is referred from clause 94.3.12.5.2 that is referred from 120D.3.1.3 that is referred from 120D.3.1.6. Since averaging removed uncorrelated noise, it is not recommended to use averaging when capturing waveform for SNDR measurement.

However, such restriction of not to use averaging would mandate use of a realtime scope and exclude an option to use a sampling scope.

Alternatively, we may permit to use averaging, if we send PRBS13Q on the lanes not under test.

PRBS13Q on different lanes should be uncorrelated as much as possible.
However, PRBS13Q on different lanes are synchronous because the pattern length is same.
Therefore, averating will not remove their effect of crosstalk.

SuggestedRemedy

Change the first and second paragraphs of 120D.3.1.6 to:

Signal-to-noise and distortion ratio (SNDR) is measured at the transmitter output using the following method, with transmitters on all lanes enabled, with identical transmit equalizer settings.

Capture at least one complete cycle of the PRBS13Q test pattern (120.5.11.2.3) at TP0a per 85.8.3.3.4 excepting that averaging multiple waveform captures is not recommended.
If averaging is used, although it is not recommended, send PRBS13Q on the lanes not under test.
Otherwise, send PRBS31Q or a valid 200GBASE-R or 400GBASE-R signal on the lanes not under test.

Compute the linear fit to the captured waveform and the linear fit pulse response, p(k), and error, e(k), according to 120D.3.1.3. Denote the standard deviation of e(k) as σe.

Also specify the minimum offset of 940 symbols between PRBS13Q patterns between any lane and any other lanes in Clause 120.5.11.2.3.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.2.1** *P* **352** *L* **1** # 146

Li, Mike
Intel

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

Vmid definition only uses V0 and V3, yet is used as the reference for calculating level separation mismatch involving V1 and V2, therefore is a biased Vimd and can cause inaccurate and biased estimation.

SuggestedRemedy

Change Vmid to Vmid = (1/4)* (V0+V1+V2+V3)

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.2.1** *P* **355** *L* **19** # 118

Dudek, Mike
Cavium

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

With the change of Np from 13 to 200 in draft 2.1 the effect of reflections in the test system will not be captured and any reflections in the test system will over-stress the receiver.

SuggestedRemedy

Change "the measured value of SNDR" to "the measured value of SNDR with Np=13 in the waveform fit".

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.2.1** *P* **355** *L* **21** # 13

Ran, Adee
Intel

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

J4 and JRMS appear as equation parameters, so should be in italic font in the text as well as in the equation.

SuggestedRemedy

Set J4 and JRMS in italics in the text.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.2.1** *P* **355** *L* **21** # 121

Dudek, Mike — Cavium

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

It would read better if the order of sigma RJ and ADD were reversed so that the equations were in order.

SuggestedRemedy

swap the order.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.2.1** *P* **355** *L* **22** # 14

Ran, Adee — Intel

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

Q4 is not defined anywhere; the "note" is not a definition. It is not clear to the reader where this number comes from.

Q(3.8906) is 5e-5; is this intended to represent probability of 1e-4?

Way back in 48B.3.1.3.1 I found:

"For each BER_n, determine the associated Qn from the inverse normal cumulative probability distribution, adjusted for transition density, e.g., Q = 3.94 for BER = 1e-5, and Q = 5.77 for BER = 1e-9, where transition density is assumed to be 0.5"

These Q values correspond to 4e-5 and 4e-9 respectively; the BER is divided by half of the transition density, or 0.25. But in 120D.3.2.1 the "BER" is divided by 2. I'm confused...

It would be preferable to define Q4 using the inverse complementary error function (already defined in clause 92) with the appropriate argument, either in the text or in another equation, and explain the argument's relation to the 1e-4 probabilty measured.

SuggestedRemedy

Assuming the value is correct, add an equation:
Q4=sqrt(2)*erfc^-1(2*10^-4/(transition density factor))
Where erfc^-1 is the inverse of the complementary error function erfc(x) defined by Equation (92–14).
And explain why the "transntion density factor" in the argument is taken as 2 instead of 0.25 as in 48B. (If the number is incorrect, modify accordingly)

Alternatively use erfcinv instead of Q^-1

Move the note after the equation.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.2.2** *P* **356** *L* **15** # 16

Ran, Adee — Intel

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

What does "be at least 3 dB" mean? Should it be "should be", "shall be"?

What happens if the COM is below 3 dB? This may happen since the added jitter is higher than A_DD even at high frequencies which are not filtered in measurement (if the transmitter and channels are minimally compliant then even with no noise added COM will be 3 dB).

Is there a reason for testing tolerance to a sinusoidal with PtP of 0.05 UI when in COM A_DD is 0.02 (corresponding to PtP of 0.04)?

SuggestedRemedy

Preferably change the maximum peak-to-peak amplitude to 0.04 UI.

If jitter is kept higher than 2*A_DD, remove the requirement for COM, since it might not be possible to meet it. And if possible explain in the text why the test is defined with this high amplitude.

Fix the "be".

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.3.2.2** *P* **356** *L* **33** # 15

Ran, Adee — Intel

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

"jitter amplitude" is confusing, since amplitude of a sinusoidal is half of the peak-to-peak. The values here should be the peak-to-peak.

Compare to Table 111–7.

SuggestedRemedy

Change ""Jitter amplitude" to "Peak-to-peak jitter amplitude".

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.4** *P* **357** *L* **30** # 17
Ran, Adee Intel

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

Mixed font size in the "value" column.

SuggestedRemedy

Set all cells to 9 point font.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.4** *P* **357** *L* **31** # 60
Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

Several numbers in the "value" column seem to have a larger font than the rest.

SuggestedRemedy

Use consistent font for numbers.

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.4** *P* **357** *L* **33** # 61
Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

The parameter with symbol C_b in Table 120D–7 seems to correspond to "Single-ended package capacitance at package-to-board interface" in Table 93A–1, which has the symbol C_p. Unless this is a new parameter definition (which I can't find), it should have the same symbol and the same name as in Table 93A–1.

SuggestedRemedy

Change parameter symbol from C_b to C_p and change the corresponding name to "Single-ended package capacitance at package-to-board interface".

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.4** *P* **357** *L* **34** # 18
Ran, Adee Intel

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

"ohms" should use the capital Omega sign (per style manual)

SuggestedRemedy

Change to Ohm sign (Hexadecimal 2126) or capital Omega (Hexadecimal 03A9).

Proposed Response *Response Status* **O**

Cl **120D** *SC* **120D.4** *P* **358** *L* **9** # 91
Mellitz, Richard Samtec

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

The is no equation reference for fz1,fz2,fp1,fp2. It is closely related to eq. 93A–22. One could deduce the meaing. However we should be more expeicit.

SuggestedRemedy

Add equation proposed for COM in mellitz_3bs_01_0815_elect.pdf or explicity specified in Healey_02_0115.pdf

Proposed Response *Response Status* **O**

Cl **120e** *SC* **120e.1** *P* **362** *L* **26** # 160
D'Ambrosia, John Futurewei, Subsidiary

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

Fig 120E-1 include terms 200GBASE-R PCS and 400GBASE-R PCS, respectively. However, these terms are not defined below diagram. It is noted that in both of these diagrams, layers are defined that are not general, and rate specific.

SuggestedRemedy

Include terms 200GBASE-R PCS and 400GBASE-R PCS in terminology below diagram.
200GBASE-R PCS - 200 Gb/s BASE-R PCS
400GBASE-R PCS - 400 Gb/s BASE-R PCS

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.1** *P* **365** *L* **21** # 135

Ghiasi, Ali — Ghiasi Quantum LLC

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

Based simulation to show feasibility 200GAUI-4/400GAUI-8 C2M were base on hypotitical connector haivng ~1/3 the connector crosstalk specified in 120E.4.1
http://www.ieee802.org/3/bs/public/adhoc/elect/24Aug_15/dallaire_01_082415_elect.pdf

SuggestedRemedy

Need to verify if current eye width and eye height are feasible with QSFP28 like connector having ~3x the crosstalk. Attach presentation provide background
http://www.ieee802.org/3/bs/public/16_09/ghiasi_3bs_01_0916.pdf

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.1** *P* **365** *L* **50** # 62

Ran, Adee — Intel

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

(Comment is against an unchanged portion of the draft)

What does the "A" in "eye height A" stand for?

SuggestedRemedy

Clarify, or delete the "A".

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.1.2** *P* **366** *L* **43** # 148

Li, Mike — Intel

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

900 mv is not consistent with that in Table 120E-1

SuggestedRemedy

Change it to be 880 mv to be consistent with Table 120E-1

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.1.5** *P* **367** *L* **8** # 63

Ran, Adee — Intel

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

(Comment is against an unchanged portion of the draft)

The average reader should be familiar with the concept of transition time, but here it is redefined in a confusing way. The transition times are defined to apply to only specific transitions; "PAM4 edges" is unclear ("edge" usually refers to the zero-crossing on the signal, as in the next paragraph); and "isolated edge" is not defined at all. Punctuation of the sentence is also unclear.

Also, 0% and 100% are not well defined (only "may be estimated", and "in this case").

SuggestedRemedy

Change the first paragraph to read:

"In this annex, transition times are specified for transitions between three consecutive "zero" symbols and three consecutive "three" symbols, or vice versa. The specified times are between the crossings of 20% and 80% levels of the signal."

In the second paragraph, change "In this case, the 0% level and the 100% level may be estimated as" to "The 0% level and the 100% level are defined as".

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.1.5** *P* **367** *L* **16** # 149

Li, Mike — Intel

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

Filter definition unclear and inconsistent

SuggestedRemedy

Change “The waveform is observed through a 33 GHz low-pass filter response (such as a Bessel-Thomson response).” To
“The waveform is observed through a low-pass filter response with a 3 dB bandwidth of 33 GHz (such as a Bessel-Thomson response).” to be clear and complete and consistent (e.g., with Line 14, page 366)

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.1.7** *P* **369** *L* **49** # 150

Li, Mike Intel

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

Figure caption for Figure 120E-9 inconsistent with section tile and table 120E-2

SuggestedRemedy

Change “Selectable continuous time linear equalizer (CTLE) characteristic” to “Reference continuous time linear equalizer (CTLE) characteristic”

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.2** *P* **370** *L* **16** # 19

Ran, Adee Intel

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

Module differential output voltage (max) is specified as 900 mV. This value seems extremely and unnecessarily high for PAM4 signaling, and using it may be waste of electrical power in the module transmitter. Nevertheless the specified host input tolerance is also 900 mV.

Since there is no de-emphasis in the module output, long runs will reach the launch voltage at the host input. The reference CTLE attenuates up to 9 dB at DC, which would still leave over 300 mV peak voltage with the maximum module output. Such high voltages may cause saturation of the host receiver which is detrimental for PAM4 detection.

To avoid saturation with the maximum module output the host would likely have to apply additional flat attenuation to the signal; this causes adds complexity and possibly increases noise in the receiver.

On the other hand, the minimum far-end eye height (after reference equalization) is specified as only 30 mV. Currently there is no connection between the minimum eye height and the differential output voltage, so a module with a 30 mV far-end eye height and a high diffferential output voltage (that requires attenuation in the host) would be compliant. A host that attenuates the signal to maintain linearity will have a smaller than expected eye height.

Assuming the host receiver may also function as a PAM4 electrical PMD (such as the ones being defined in 802.3cd) which operate over more lossy channels, the host receiver will also have to detect PAM4 with much lower incoming amplitudes. These PMDs typically use transmitter equalization to de-emphasize the low-frequency content of the signal and thus don't need attenuation at the receiver (in fact they usually need positive gain). The large difference of expected amplitudes between these two cases adds complexity to the receiver design.

Since a module is pluggable we cannot assume proprietary soltutions to reduce the module output voltage.

A possible remedy is to state the near-end and far-end eye height parameters relative to the differential output voltage, in order to prevent having a combination of small eye height with a large peak voltage.

This problem may also apply in the other direction, dhost output to module input (although the module does not have to double as a CR receiver).

SuggestedRemedy

Add a specification fot maximum far-end module output differential voltage to be no more than 5 times the far-end eye height (so that the peak-to-peak of the host input is up to 10 times the eye height - equivalent to ~30% eye opening).

In addition it will be good to reduce the maximum module output differential voltage to 450

mV (900 mV differantial PtP).

Change the host receiver tolerance (Table 120E–4) and crosstalk generator in host stressed input test (120E.3.3.2.1) parameters accordingly.

Optionally add a way to control the module output voltage with an MDIO register.

If desired, change the host output and module input specifications accordingly.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.2** *P* **370** *L* **16** # 6

Ran, Adee Intel

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

Module differential output voltage (max) is specified in Table 120E–3 as 900 mV. Using the definition in the reference (120E.3.1.2) means that the peak-to-peak is 1800 mV. In comparison, the Host output is specified 880 mV peak-to-peak (Table 120E–1).

Host input tolerance (Table 120E–4) is also specified as 900 mV, but that is peak-to-peak.

I assume the intent is that host output, host input tolerance, and module output use the same definition and at least the latter two use the exact same value.

SuggestedRemedy

In Table 120E–3, change "Differential output voltage (max)" to "Differential peak-to-peak output voltage (max)", as in Table 120E–1.

Consider changing both module output and host input tolerance values from 900 to 880 to match hos output.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.3.2** *P* **371** *L* **47** # 64

Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

Reference to the procedure in 83E.3.3.2.1 is obsolete - there is a specific procedure for this annex in 120E.3.3.2.1.

SuggestedRemedy

Change reference to 120E.3.3.2.1.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.3.2** *P* **373** *L* **11** # 113

Dudek, Mike Cavium

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

The Eye height is ambiguous.

SuggestedRemedy

Change to "Far-end Eye height.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.3.2.1** *P* **373** *L* **46** # 119

Dudek, Mike Cavium

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

It is unlikely that it will be possible to create an input signal that has exactly equal eye height and eye width on all three eyes, but the test procedure implies this is required. If the individual levels of the pattern generator output are adjusted rather than the overall amplitude it should be possible to achieve the same eye height, but it is very likely that the middle eye width will be larger than the outer two.

SuggestedRemedy

Change "Random jitter and the pattern generator output amplitude are adjusted (without exceeding the differential pk-pk input voltage tolerance specification as shown in Table 120E–4) to result in the eye height and eye width given in Table 120E–5 using the reference receiverwith the setting of the CTLE that maximizes the product of eye height and eye width." to ""Random jitter and the pattern generator output levels are adjusted (without exceeding the differential pk-pk input voltage tolerance specification as shown in Table 120E–4) to result in the eye height for all three eyes and eye width for the smallest eye given in Table 120E–5 using the reference receiver with the setting of the CTLE that maximizes the product of eye height and eye width."

Make the equivalent change to the Module input test calibration.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.3.2.1** *P* **373** *L* **51** # 65

Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

This subclause describes the host stressed input test procedure in great detail, but I don't see where any requirement for the BER or SER of the host under test. There should be a "shall" statement, and also a corresponding PICS item (this is addressed in another comment).

If the test is conducted using pattern 5 or any valid PCS output pattern, then there is no way to check the BER before unscrambling; Therefore a requirement can reasonably be defined in terms of symbol error ratio (after processing by the PCS FEC).

Alternatively, if the test is conducted using pattern 3 (PRBS31Q) then the pattern is not a valid PCS sequence and the requirement can reasonably be defined in terms of BER at a PMA pattern checker.

The suggested remedy handles both options.

SuggestedRemedy

Append the following paragraphs at the end of this subclause:

"If the test is performed with pattern 3, the host bit errors are counted using the host's PMA test pattern checker (see 120.5.11.1.1). If the test is performed with pattern 5 or a valid 200GBASE-R/400GBASE-R signal, the host bit errors are counted using the host's PCS Reed-Solomon decoder error counters (see 119.2.5.3), with every symbol error considered as a single bit error. The number of received bits may be estimated based on the test time.

The host BER under the stressed input test conditions shall meet the requirements of 120E.1.1."

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.4** *P* **374** *L* **13** # 20

Ran, Adee Intel

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

In Table 120E–7, "Differential pk-pk input voltage tolerance" value is minimum 900 mV, while the host output is specified in Table 120E–1 with a maximum of only 880 mV.

In previous similar clauses these specs were aligned.

SuggestedRemedy

Change input tolerance minimum value to 880 mV.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.4.1** *P* **374** *L* **40** # 151

Li, Mike Intel

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

Table 120E-8 inconsistent with Table 120E-1

SuggestedRemedy

Change “ESMW (Eye symmetry mask width) = 0.25 UI” to “ESMW (Eye symmetry mask width) = 0.22 UI”
Change “Eye width= 0.25 UI ” to “Eye width = 0.22 UI”
Change “Eye height = 50 mV” to “Eye height = 32 mV”

Proposed Response *Response Status* **W**

[Editor's note: Line changed from "40-45" to "40"]

Cl **120E** *SC* **120E.3.4.1.1** *P* **375** *L* **45** # 131

Ghiasi, Ali Ghiasi Quantum LLC

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

Loss budget is specified at 12.89 GHz not consistent with Fig 120E-3 loss budget definition at 13.28 GHz which is PAM4 signal Nyquist

SuggestedRemedy

Change 12.89 GHz to 13.28 GHz

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.4.1.1** *P* **376** *L* **1** # 132

Ghiasi, Ali — Ghiasi Quantum LLC

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

The pattern generator device has a package but it would be internal to the generator and in many cases I have seen pattern generator having slower rise time due to internal losses than actual SerDes. Please don't suggest to use a broken methdology!

SuggestedRemedy

Change TP1a loss to 10.2 dB. Please define the nominal generator output risetime to account for any package loss, suggested TP0 20-80% risetime is 12.5 ps. If the generator output is faster than 12.5 ps add the requried 4th order Bessel Thomson fitler to slow down the output to 12.5 ps.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.4.1.1** *P* **376** *L* **1** # 66

Ran, Adee — Intel

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

(Comment is against an unchanged portion of the draft)

The first paragraph (starting on P375) describes the procedure at length, and ends by stating the required performance, without a break. It seems too long and should be broken for ease of reading.

SuggestedRemedy

Break the last sentence ("The module... receiver under test shall ...") to a separate paragraph.

Preferably, change the text starting at P375 L54 ("For the high loss case…") and ending at P376 L9 ("as described for the high loss case") to a list of two items, one describing the high-loss case and another describing the low-loss case, or to two level-5 subclauses.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.3.4.1.1** *P* **376** *L* **11** # 67

Ran, Adee — Intel

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

(Comment is against an unchanged portion of the draft)

It is not clear how errors should be detected and counted in this test. The module is not required to count errors internally (and is unlikely to have this capability for anything but test pattern 3), and the test setup does not include a BER checker at the optical output of the module or elsewhere. If such BER checker is assumed, there should be a definition of what it is expected to do - which is not trivial. In addition, there should be some guidance on where this BER checker can be placed.

Specifically, the BER checker should use a bit sequence which depends on the test pattern:

If the test is conducted using pattern 5 or any valid PCS output pattern, then there is no way to check the BER before unscrambling; Therefore a requirement can reasonably be defined in terms of symbol error ratio (after processing by the PCS FEC).

Alternatively, if the test is conducted using pattern 3 (PRBS31Q) then the pattern is not a valid PCS sequence and the requirement can reasonaly be defined in terms of BER at a PMA pattern checker. This may be done inside the module, if implemented, or somewhere else.

The suggested remedy handles both options.

SuggestedRemedy

Add the following text before the last sentence of 120E.3.4.1.1 (i.e. before BER requirements are discussed):

"If the test is performed with pattern 3, the module bit errors may be counted using a PMA test pattern checker (see 120.5.11.1.1) if this option is implemented in the module.

If the test is performed with pattern 5 or a valid 200GBASE-R/400GBASE-R signal, the module bit errors may be counted by placing the module under test into local loopback (see 120.5.9) and feeding the module output into a compliant host or its equivalent, and then using the host's PCS Reed-Solomon decoder error counters (see 119.2.5.3), with every symbol error considered as a single bit error.

Methods of extracting the received bit pattern and counting errors other than the ones described above may be used if they generate equivalent results.

The number of received bits may be estimated based on the test time."

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.4.1** *P* **376** *L* **25** # 92

Mellitz, Richard — Samtec

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

The frequnecy domain electrical specfication for the mated fixture (HDB/MCB) could allow for up to 1 dB difference in COM as decribed in healey_3bs_01_0916. The difference may result in 5mV of VEO undcertianly.

SuggestedRemedy

Add a requreiment that the mated fixture must have a COM within 0.15 dB of that specified in healey_3bs_01_0916 on page 8 of 5.18 dB. A presentation demostrated this will be requested. This will use a new version of the example COM implementation which includes features suggested in healey_3bs_01_0916.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.4.2** *P* **376** *L* **31** # 133

Ghiasi, Ali — Ghiasi Quantum LLC

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

This section is out of sync with the OIF-56G-VSR liason to the IEEE.

SuggestedRemedy

The new OIF document has new figure to show the CDF high and low, Fig 16-6. We need Fig like OIF 16-6. To stay consistant with OIF terminology we could use Fig 16-6 instead of defining UPCDF1 and UPCDF0, just remove all these defintion and instead you can say adjust the CDF-High and CDF-Low from middle eye to upper eye and lower. This will make the procedure more clear and shorter.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.4.2** *P* **377** *L* **25** # 68

Ran, Adee — Intel

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

The procedure in this subclause is referenced in host/module stressed input tests as a method of measuring "eye height" and "eye width". But procedure in this list generates three eye heights (Vupp, Vmid, and Vlow) and three eye widths (Hupp, Hmid, and Hlow). It is not clear which height/width should be used.

Note that for the "eye height" parameters Table 120E–1 and Table 120E–3, which also reference this subclause, there are footnotes stating "All 3 PAM4 eyes at 10^–5 probability". It may be understood that the "3 PAM4 eyes" refers to the measured Vupp, Vmid and Vlow, but it is not stated explicitly.

When calibrating a stressed eye test, I assume the minimum width/height of all 3 eyes should be specified (if the maximum is specified, the other eyes may be completely closed). If that's the case, the procedure should define the "eye height" and "eye width" as the minimum across the three measurements.

Assuming this is done, this definition can replace the table footnotes too.

SuggestedRemedy

Add an item after current item 6 with text: "The eye height is defined as the minimum of Vmid, Vupp, and Vlow".
Add an item after current item 9 with text: "The eye width is defined as the minimum of Hmid, Hupp, and Hlow".

Delete footnote a in Table 120E–1 and Table 120E–3.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.4.2** *P* **378** *L* **20** # 26

Rabinovich, Rick — IXIA

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

Figure 120E-13 does not reflect the text describing the methodology to measure eye-width and eye-height in subclause 120E.4.2. The procedure has gone through multiple edits but the subject figure did not track the terminology included in the text.

SuggestedRemedy

Edit Figure 120E-13 appropriately. Please refer to presentation given at electric adhoc: http://www.ieee802.org/3/bs/public/adhoc/elect/17Oct_16/rabinovich_01_101716_elect.pdf. Plan to update presentation to be given at Plenary Meeting.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.4.2** *P* **379** *L* **3** # 69

Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

According to the style guide, the word "must" should not be used in this place, since it does not indicate an unavoidable situation.

In addition, this is a procedure for measurement of EH/EW parameters. It should always yield values. What are the EH and EW if any of the conditions are not met? If they are they undefined, stressed eye calibration is not well defined.

This eye mask seems to be a minimum requirement for the "symmetrical eye width" (where the latter is twice the minimum of left and right openings relative to TCmid). If that's the case, the minimum should not be a part of the _procedure_; the procedure should yield the symmetrical eye width, and the tables can specify the minimum for that _result_.

Note that in all tables which refer to this procedure, either ESMW and eye width are specified with the same value, or ESMW alone is specified; this means that the important parameter is the symmetrical eye width, and there is no need to calculate the "total" eye widths as currently done in steps 7, 8, and 9.

SuggestedRemedy

Change item 7 to read:
"Calculate the middle eye symmetrical width (Hmid) as the minimum of Tcmid-TL(1e-5) and TR(1e-5)-Tcmid, where TR(1e-5) and TL(1e-5) are the times where MIDCDFR and MIDCDFL, respectively, have a value of 1e-5."

Delete item 10.

Change the text and labels in Figure 120E–14 accordingly (especially, eliminate "must").

Change ESMW in Table 120E–1 and Table 120E–3 to "eye width".

Delete ESMW rows in Table 120E–5, Table 120E–8.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.4.2** *P* **379** *L* **46** # 55

Szczepanek, Andre Inphi

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

The definitions of AVupp, Vupp, AVmid, Vmid, AVlow, & Vlow are redundant and should be removed.

SuggestedRemedy

Remove the definitions of AVupp, Vupp, AVmid, Vmid, AVlow, & Vlow.

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.5.4.3** *P* **383** *L* **54** # 70

Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

There is no PICS item for host receiver performance. RH1, "Host input characteristics", mostly deals with the host input (electrical parameters which should always comply), but does not state the host receiver performance (BER or SER) with stressed input. The BER item in 120E.5.3 is too generic, and does not address the stressed input test conditions either.

Compliance of receiver performance under stressed input test should be separate from input signal compliance.

SuggestedRemedy

Add a PICS item in 120E.5.4.3:
RH2 | Host stressed input test | 120E.3.3.2.1 | Host under test meets the BER requirements | M | Yes [ ]

Proposed Response *Response Status* **O**

Cl **120E** *SC* **120E.5.4.4** *P* **384** *L* **7** # 71

Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

There is no PICS item for module receiver performance. The BER item in 120E.5.3 is too generic, and does not address the stressed input test conditions.

Compliance of receiver performance under stressed input test should be separate from input signal compliance.

SuggestedRemedy

Add a PICS item to 120E.5.4.4:
RM2 | Module stressed input test | 120E.3.4.1.1 | Module under test meets the BER requirements | M | Yes [ ]

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.1.1** *P* **213** *L* **48** # 21

Ran, Adee Intel

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

"The bit error ratio (BER) when processed according to Clause 120 shall be less than 2.4 × 1e–4..."

This sentence does not define the conditions under which the BER is measured. For this requirement to hold, it makes sense to assume that the transmitter and the receiver (both including PMA and PMD) are compliant, and the optical channel is compliant (e.g. according to the fiber types and lengths listed in 121.7). But none of that is listed here.

There is a PICS item associated with this "shall". BER is typically associated with the receiver, so a supplier of a PMD has to commit that the receiver meets the specified BER. It doesn't make senst to commit to meeting it under unspecified conditions.

In electrical PMD clauses, this is solved by having the BER requirement is stated as "link BER". A link is described as including compliant transmitter, channel, and receiver. This way the conditions are specified and every supplier should be able to commit.

SuggestedRemedy

Define the performance in terms of a compliant link. Add a definition of "link" in a separate paragraph following the current paragraph.

Suggested wording:

The bit error ratio (BER) of a link shall be less than 2.4 × 1e-4 (… conclude the existing paragraph).

In this context, a link consists of a compliant transmitter (PMA and PMD), a fiber optic channel meeting the specifications of Table 121–13, and a compliant receiver (PMD and PMA).

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.3.2** *P* **215** *L* **40** # 57

Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

"The Skew at SP4 (the receiver MDI) shall be less than 134 ns and the Skew Variation at SP4 shall be less than 3.4 ns.

If the PMD service interface is physically instantiated so that the Skew at SP5 can be measured, then the Skew at SP5 shall be less than 145 ns and the Skew Variation at SP5 shall be less than 3.6 ns."

Which provider is responsible for meeting the requirements at SP4? Most of the skew and variation at SP4 is caused by the medium. The PMD provider cannot control them.

Having a PICS item for a parameter that is not controllable does not make sense. Such items would probably be checked blindly.

It makes more sense that the skew and variation created by the PMD between SP4 and SP5 should be limited; this is the difference between the values at SP4 and the values at SP5. The skew at SP4 can be provided informatively.

Comment similarly applies to 122.3.2, 123.3.2, 124.3.2.

SuggestedRemedy

Change the quoted paragraphs (L40 to L44) to read

"The Skew at SP4 (the receiver MDI) can be assumed to be less than 134 ns and the Skew Variation at SP4 can be assumed to be less than 3.4 ns.

If the PMD service interface is physically instantiated so that the Skew at SP5 can be measured, then the Skew at SP5 shall be less than the Skew at SP4 plus 11 ns, and the Skew Variation at SP5 shall be less than the Skew Variation at SP4 plus 0.2 ns."

Change PICS accordingly.

Change similarly in the other clauses.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.3.2** *P* **215** *L* **47** # 58

Ran, Adee Intel

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

(Comment is against an unchanged portion of the draft)

The measurement method defined in 86.8.3.1 cannot be applied directly to the PMDs in this project: for the signal at the PMD input or output, the alignment markers are bit-muxed and PAM4 modulated, and identifying the alignment markers must be done after at least an equivalent of a PMA sublayer that recovers and de-muxes two serial bit stream.

The measurement of skew parameters at the PMD may be done in several ways, and can be left to the test implementer, outside the scope of the standard, without affecting interoperability.

Comment similarly applies to 122.3.2, 123.3.2, 124.3.2.

SuggestedRemedy

Delete the sentence "The measurements of Skew and Skew Variation are defined in 86.8.3.1." here and in the other PMD clauses.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.5.4** *P* **217** *L* **40** # 2

Ran, Adee Intel

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

(This comment is against an unchanged portion of the draft)

Several functional specifications subclauses lack MDIO mapping (121.5.4 PMD global signal detect function, 121.5.5 PMD lane-by-lane signal detect function, 121.5.7 PMD global transmit disable function (optional)) unlike other functional specification subclauses.

This comment also applies to the corresponding subclauses in clauses 122 , 123 and 124.

SuggestedRemedy

Add MDIO mapping information, as in 121.5.9 to 121.5.11.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.5.8** *P* **218** *L* **48** # 1

Ran, Adee Intel

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

(This comment is against an unchanged portion of the draft)

The wording of the "PMD lane-by-lane transmit disable function" subclause is inconsistent with other similar subclauses:

1. Unlike other optional function, it is not stated as optional in the subclause heading
2. There is no reference to the MDIO subclause.
3. "If the optional PMD_transmit_disable_i function is not implemented in MDIO, an alternative method may be provided to independently disable each transmit lane for testing purposes" - this text does not appear in any other subclause, and is practically redundant (an alternative method may always be provided).

In addition to this inconsistency, it is somewhat unclear if lane-by-lane transmit disable is required for testing purposes. Is it really optional?

This comment also applies to the "PMD lane-by-lane transmit disable function" subclauses in clauses 122 and 124. For clause 123, the comment applies partially (it is stated as optional in the subclause heading).

SuggestedRemedy

If it is an optional feature, apply the following

1. add "(optional)" to the subclause heading (except in clause 123 which has it already)
2. Replace the last paragraph with a paragraph stating the MDIO mapping: "If the MDIO interface is implemented, PMD_transmit_disable_i shall be mapped to the PMD transmit disable i bit as specified in 45.2.1.8". (in clause 123 add the extension register in 45.2.1.14g).

If this feature is required for testing purposes, then remove its marking as optional.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.7.1** *P* **220** *L* **34** # 105

Dawe, Piers Mellanox

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

Th limit for "Average launch power of OFF transmitter, each lane (max)" is not suitable for transmitters that share a laser and may be used in breakout scenarios.

SuggestedRemedy

Change the limit from -30 dBm to -20dBm, same as in 400GBASE-DR4. Note this is still way lower than the average receive power in 200GBASE-DR4 and 6.7 dB below the average receive power in 25GBASE-LR.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.7.1** *P* **220** *L* **36** # 102

Dawe, Piers Mellanox

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

Requiring an extinction ratio of 4.5 dB restricts the range of transmitter technologies but does not appear to benefit the link or the receiver significantly (they are protected by the TDECQ spec). Its effect is to push up cost.

SuggestedRemedy

Reduce the extinction ratio limit to a defensible amount, such as 3 dB.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.7.1** *P* **220** *L* **37** # 96

Dawe, Piers Mellanox

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

The purpose of the RIN spec has changed from something to ensure a good transmitter to something to ensure a good TDECQ measurement. The limit should be adjusted for the intended purpose.

SuggestedRemedy

Correct the RIN limits according to what is necessary for to enable a good TDECQ, all clauses that use TDECQ.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.7.1** *P* **239** *L* **37** # 110

Lewis, David — Lumentum

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

Table 121-6. The value of RIN21.4OMA appears unecessarily low at -142. Other 26.6 GBd PAM-4 PMDs, such as 200GBASE-FR4/-LR4 and 400GBASE-FR8/-LR8 have RINxxOMA values of -136 dB/Hz. Those PMDs have lower receiver sensitivity requirements than 200GBASE-DR4, considering that they have optical demuxes, and yet can tolerate RIN of -136 dB/Hz.

SuggestedRemedy

Change the value of RIN21.4OMA from -142 to -136 dB/Hz.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.7.3** *P* **219** *L* **47** # 134

Ghiasi, Ali — Ghiasi Quantum LLC

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

Current -45 dB RL require APC connector and may not support installed based.

SuggestedRemedy

Standard should allow reducing the number of connectors from 4 as defiend for operation with -45 dB RL to -35 dB with 2 connectors.
Adhoc contribution
http://www.ieee802.org/3/bs/public/adhoc/smf/16_08_16/anslow_01_0816_smf.pdf
inducate to support 2 connector the RL for each connector must be -39 dB. This is close enough to either the MPI budget or trade connector loss as few are used with MPI.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.1** *P* **222** *L* **19** # 98

Dawe, Piers — Mellanox

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

In this draft, square wave is proposed for RIN measurement. But we can't use square wave because it isn't PAM4. CDRs, CRUs and any linearity control circuits may fail because two of the expected PAM4 levels are missing, CRUs with the special low PAM4 bandwidth (3 MHz nominal) won't hold lock properly because square wave has an unusually low transition density.

SuggestedRemedy

If a RIN spec is needed, define it based on PRS13Q. All PAM4 optical clauses. Remove square wave from the draft.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.1** *P* **222** *L* **41** # 50

Le Cheminant, Greg — keysight Technologies

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

Allow SSPRQ pattern 6 as a valid pattern for extinction ratio test. This will allow the extinction ratio measurement to be derived from the same data acquired for the TDECQ test, saving test time and not requring the test process to do a pattern switch

SuggestedRemedy

Add pattern 6 to table 121-10 line 41

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.1** *P* **222** *L* **41** # 49

Le Cheminant, Greg — keysight Technologies

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

Optical modulation amplitude should allow use of SSPRQ (pattern 6) as a valid test pattern in addition to PRBSQ13 (pattern 4). Currently OMA is measured only with pattern 4. TDECQ is measured only with pattern 6. TDECQ requires an OMA value, which forces two patterns to be used. The data acquired for the TDECQ measurement using the SSPRQ pattern can effectively be reused for the OMA measurement if the SSPRQ pattern is docmented as a valid pattern. This will reduce test times as well as not require the test process to be forced to switch test patterns.

SuggestedRemedy

Allow SSPRQ as a valide pattern for OMA measurements. Add pattern 6 to Table 121-10, line 37

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.5.1** *P* **224** *L* **10** # 48

Le Cheminant, Greg — keysight Technologies

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

Figure 121-4 is incomplete. Text was lost in the right side.

SuggestedRemedy

Figure 121-4 should be identical to 122-4 on page 257

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.5.3** *P* **225** *L* **6** # 72

Le Cheminant, Greg keysight Technologies

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

Specify that OMAouter is measured on the equalized signal.

Allow the TDECQ measurement to be more portable. Given the two gain terms of the equalizer, the measurement, as proposed, can be made entirely on the resulting waveform. This also allows the equalizer used for this measurement to be implemented in hardware

SuggestedRemedy

Update the text of line 6 to read: OMAouter is measured according to 121.8.4 on the equalized signal

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.5.3** *P* **225** *L* **8** # 95

Dawe, Piers Mellanox

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

The draft says Pattern 6 (SSPRQ) should be used for TDECQ. But SSPRQ is a short, deliberately stressful pattern and therefore a TDECQ measurement does not give anything like the correct penalty for a range of reasonable transmitters.

SuggestedRemedy

Either adjust SSPRQ to a pattern that gives the correct penalty (e.g. by changing the first start sequence in Table 120-2); or use PRBS13Q for TDECQ (and stressed receiver calibration) with a separate requirement for low frequency performance as appropriate, similar to how the 200GAUI-4 etc. specifications handle this, choosing any limit according to the circumstances of the optical link. Apply to clauses 121, 122, 124.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.5.3** *P* **225** *L* **11** # 79

Le Cheminant, Greg keysight Technologies

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

For cosnsistent results across various implementations, the TDECQ optimizations requires some constraints. MMSE optimization is a standard technique that can be implemented by software algorithms or by actual receiver equalizers. By specifying the optimization criteria, it avoids multiple T&M vendors implementing different optimization techniques, or T&M vendors using optimization techniques that an actual receiver could not achieve

SuggestedRemedy

Section 121.8.5.3 currently has this statement:
The reference equalizer (specified in 121.8.5.4) is used to minimize the value of TDECQ derived from the captured waveform.

Modify to read: The reference equalizer (specified in 121.8.5.4) is applied to the waveform. The equalizer taps are optimized for the minimum mean square error about the symbol levels (Pave - OMA/2), (Pave - OMA/6), (Pave+OMA/6), and (Pave+OMA/2), where the mean square error is calculated over the center 0.1 UI of the eye diagram

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.5.3** *P* **225** *L* **21** # 73

Le Cheminant, Greg keysight Technologies

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

Specifically document which signal average power is derived from, which is the equalized eye diagram

SuggestedRemedy

Modify line 21 to read "The average optical power (Pave) of the equalized eye diagram is determined...."

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.5.3** *P* **226** *L* **24** # 45

King, Jonathan Finisar

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

Equation 121-4 is intended to direct the reader to create a cummulative distribution for values of y>Pth1 and y<Pth1, a few reviewers have commented that it's a bit ambiguous as written.

SuggestedRemedy

Equation 121-4 could be expressed more clearly by describing the value of Cf1(yi) as two expressions, one for yi>Pth1, and one for yi<Pth1.
See example in presentation king_3bs_01_1016_smf

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.8.5.3** *P* **226** *L* **25** # 162

Hanan, Leizerovich MultiPhy

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

Equation 121-4 is intended to direct the reader to create a cummulative distribution of yi. Because the value of C1F in Equation 121-4 is used in calculation BER, it should be complete for all values of yi.
Specifically, for the value yi<Pth1, yi>Pth1 and yi=Pth1.

SuggestedRemedy

Use Either -
CF1(yi) =
| sigma{f(y), from y=Pth1+Dy to yi} for yi>Pth1
| sigma{f(y), from y=yi to Pth1-Dy} for yi<Pth1
| O for yi=Pth1
**Dy is delta y

Or more elegent manner is -
CF1(yi) = sigma{f(y), from y=min(Pth1,yi) to max(Pth1,yi)} - f(Pth1)

Proposed Response *Response Status* **W**

[Editor's note: This comment was sent after the close of the comment period]

Cl **121** *SC* **121.8.5.3** *P* **226** *L* **25** # 74

Le Cheminant, Greg keysight Technologies

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

Equation 121-4 requires some modifications (too complex to be entered in the comment tool)

SuggestedRemedy

Modifications to the equation will be provided in a separate document e-mailed with the comments

Proposed Response *Response Status* **W**

[Editor's note: Attachment is lecheminant_3bs_01_1116.pdf in http://www.ieee802.org/3/bs/comments/P802d3bs_D2p1_attachments.zip]

Cl **121** *SC* **121.8.5.3** *P* **226** *L* **31** # 75

Le Cheminant, Greg keysight Technologies

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

we should call out the actual Gaussian distribution of equation 121-5 and provide a method for estimating it

SuggestedRemedy

Modify line 31 to read "Gth1(yi) is given by Equation (121-5) and can be estimated by (121-6)".

Add new equation 121-5 (too complex for comment tool, provided in seperate contribution)

Original equation 121-5 becomes equation 121-6

Proposed Response *Response Status* **W**

[Editor's note: Attachment is lecheminant_3bs_01_1116.pdf in http://www.ieee802.org/3/bs/comments/P802d3bs_D2p1_attachments.zip]

Cl **121** *SC* **121.8.5.3** *P* **227** *L* **16** # 76

Le Cheminant, Greg keysight Technologies

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

Equation 121-8 needs a term to compensate for the equalizer DC gain

SuggestedRemedy

Modification of the equation provided in a separate contribution (too complex for comment tool)

Proposed Response *Response Status* **W**

[Editor's note: Attachment is lecheminant_3bs_01_1116.pdf in http://www.ieee802.org/3/bs/comments/P802d3bs_D2p1_attachments.zip]

Cl **121** *SC* **121.8.5.3** *P* **227** *L* **24** # 77

Le Cheminant, Greg keysight Technologies

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

Document the equalizer DC gain coefficient (as provided in earlier comment on equation 121-8

SuggestedRemedy

Add text at line 24:

Cdc is a coefficient which compensatesd for the reference equlaizer DC gain when the equalizer has been optimized for minimum TDECQ

The value Cdc can be calculated from the equalizer tap coefficients Ai as shown in equation (new #)

(New equation): (provided in separate contribution)

Proposed Response *Response Status* **W**

[Editor's note: Attachment is lecheminant_3bs_01_1116.pdf in http://www.ieee802.org/3/bs/comments/P802d3bs_D2p1_attachments.zip]

Cl **121** *SC* **121.8.5.4** *P* **227** *L* **27** # 78

Le Cheminant, Greg keysight Technologies

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

T/2 spacing allows the equalizer to reduce the noise, which a T spaced equalizer cannot do. This creates strange behaviors where the TDECQ value can go down as OMA drops relative to the intrinsic noise because the equalizer starts optimizing to reduce noise instead of ISI.

SuggestedRemedy

Change: …is a 5 tap, T/2 spaced, feed-forward equalizer (FFE), where T is the symbol period.
To: is a 5 tap, 1 precursor, T spaced, feed-forward equalizer (FFE), where T is the symbol period.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.11** *P* **233** *L* **15** # 126

Ghiasi, Ali Ghiasi Quantum LLC

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

Table 121-13 uses optical return loss is hanging in the air and should be tight to # of discrete reflectances

SuggestedRemedy

Add note maximum number of discreate reflectace is given by Table 121-15.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.11.3.1** *P* **234** *L* **47** # 127

Ghiasi, Ali Ghiasi Quantum LLC

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

MDI definition of Fig 121-9 is not consistant with definition in CL 95 or PSM4 MSA where the outer 4 fiber are used

SuggestedRemedy

Please define left most 4 fibers for TX and right most fibers as RX, please also align the text wth fibers
MDI Fig 124-5 looks fine so you could just borrow it

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.11.3.2** *P* **234** *L* **46** # 124

Dudek, Mike — Cavium

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

The optical lane assignments for 200GBASE-DR4 shown in figure 121-9 are different from those for 400GBASE-DR4 shown in figure 124-5. They are also different from what was shown in draft 2.0 and I can't find a comment that explained the change and there are no change bars against it.

SuggestedRemedy

Change the figure back to what was in draft 2.0.

Proposed Response *Response Status* **O**

Cl **121** *SC* **121.12.4.6** *P* **240** *L* **1** # 81

Anslow, Pete — Ciena

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

In the headings for 121.12.4.6, 122.12.4.9, and 124.12.4.6 "MD" should be "MDI"

SuggestedRemedy

In the headings for 121.12.4.6, 122.12.4.9, and 124.12.4.6 change "MD" to "MDI"

Proposed Response *Response Status* **O**

Cl **121** *SC* **122.8.6** *P* **227** *L* **35** # 51

Le Cheminant, Greg — keysight Technologies

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

Assuming pattern 6 is allowed for extinction ratio test, the text in 121.8.6 needs to document this

SuggestedRemedy

change the text at line 35 to read ".....as defined in 120.5.11.2.3 or the SSPRQ pattern as defined in 120.5.11.2.5."

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.1.1** *P* **242** *L* **43** # 22

Ran, Adee — Intel

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

"The bit error ratio (BER) when processed according to Clause 120 shall be less than 2.4 × 1e–4..."

This sentence does not define the conditions under which the BER is measured. For this requirement to hold, it makes sense to assume that the transmitter and the receiver (both including PMA and PMD) are compliant, and the optical channel is compliant (e.g. according to the fiber types and lengths listed in 122.7). But none of that is listed here.

There is a PICS item associated with this "shall". BER is typically associated with the receiver, so a supplier of a PMD has to commit that the receiver meets the specified BER. It doesn't make senst to commit to meeting it under unspecified conditions.

In electrical PMD clauses, this is solved by having the BER requirement is stated as "link BER". A link is described as including compliant transmitter, channel, and receiver. This way the conditions are specified and every supplier should be able to commit.

SuggestedRemedy

Define the performance in terms of a compliant link. Add a definition of "link" in a separate paragraph following the current paragraph.

Suggested wording:

The bit error ratio (BER) of a link shall be less than 2.4 × 1e-4 (… conclude the existing paragraph).

In this context, a link consists of a compliant transmitter (PMA and PMD), a fiber optic channel meeting the specifications of Table 122–17, and a compliant receiver (PMD and PMA).

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.7.1** *P* **250** *L* **35** # 103

Dawe, Piers — Mellanox

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

Requiring an extinction ratio of 4.5 dB restricts the range of transmitter technologies but does not appear to benefit the link or the receiver significantly (they are protected by the TDECQ spec). Its effect is to push up cost.

SuggestedRemedy

Reduce the extinction ratio limit to a defensible amount, such as 3 dB (all 4 PMDs in this clause).

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.7.3** *P* **254** *L* **8** # 27

Swanson, Steve — Corning Incorporated

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

In Table 122-13, the channel insertion loss for 200GBASE-LR4 and 400GBASE-LR8 is specified at 6.3 dB. However 10km x 0.46 dB/km plusthe 2.0 dB allocation for connectors = 6.6 dB.

SuggestedRemedy

Add a footnote tied to Channel Insertion Loss:

bUsing the 0.46 dB/km at 1272.55 nm attenuation for optical fiber cables derived from Appendix I of ITU-T G.695 may not support operation at 10 km for 400GBASE-LR8 at worst case conditions.

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.8.1** *P* **255** *L* **29** # 52

Le Cheminant, Greg — keysight Technologies

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

As per earlier comments, allow SSPQRQ pattern 6 as a valid pattern for OMA and extinction ratio

SuggestedRemedy

Add pattern 6 to table 122-15 line 29 and line 33

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.8.4** *P* **255** *L* **54** # 53

Le Cheminant, Greg — keysight Technologies

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

As per previous comments, SSPRQ should be documented as a valid pattern for OMA test

SuggestedRemedy

change line 54 page 255 to read ".....pattern as defined in 120.5.11.2.3 or SSPRQ pattern as defined in 120.5.11.2.5 with the sum.....".

Note that 121.8.4 makes no reference to patterns for making an OMA measurement. If that is the preferred text, then 122.8.4 should be similar and just drop the reference to the specific PRBSQ13 pattern

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.8.5.1** *P* **256** *L* **44** # 123

Dudek, Mike — Cavium

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

The definition of what pattern is on the other lanes should be included. (SSPRQ with at least 31 UI delay between lanes).

SuggestedRemedy

Copy the appropriate sentences from 121.8.5.1

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.8.6** *P* **258** *L* **17** # 54

Le Cheminant, Greg — keysight Technologies

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

As per earlier comments, SSPRQ should be a valid pattern for extinction ratio measurements

SuggestedRemedy

change line 18 to read ".....pattern as defined in 120.5.11.2.3 or SSPRQ pattern as defined in 120.5.11.2.5 with the sum.....

Proposed Response *Response Status* **O**

Cl **122** *SC* **122.10** *P* **262** *L* **44** # 129

Ghiasi, Ali — Ghiasi Quantum LLC

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

Table 121-13 uses optical return loss is hanging in the air and should be tight to # of discrete reflectances

SuggestedRemedy

Add note maximum number of discreate reflectace is given by Table 122-19.

Proposed Response *Response Status* **W**

[Editor's note: Clause changed from 120 to 122, Subclause changed from 120.1 to 122.10]

Cl **122** *SC* **122.11.1** *P* **263** *L* **24** # 128

Ghiasi, Ali — Ghiasi Quantum LLC

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

The 200Gbase-FR4/LR4 having CL88 LAN-WDM grid could also support 0.44 dB/km fiber

SuggestedRemedy

Suggest keeping current 0.47/0.5 dB for 400G-FR8/LR8 but use 0.44/0.5 dB for 200G-FR4/LR4 per definition in CL88

Proposed Response *Response Status* **O**

Cl **123** *SC* **123.1.1** *P* **271** *L* **52** # 23

Ran, Adee — Intel

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

"The bit error ratio (BER) when processed according to Clause 120 shall be less than 2.4 × 1e–4..."

This sentence does not define the conditions under which the BER is measured. For this requirement to hold, it makes sense to assume that the transmitter and the receiver (both including PMA and PMD) are compliant, and the optical channel is compliant (e.g. according to the fiber types and lengths listed in 123.7). But none of that is listed here.

There is a PICS item associated with this "shall". BER is typically associated with the receiver, so a supplier of a PMD has to commit that the receiver meets the specified BER. It doesn't make senst to commit to meeting it under unspecified conditions.

In electrical PMD clauses, this is solved by having the BER requirement is stated as "link BER". A link is described as including compliant transmitter, channel, and receiver. This way the conditions are specified and every supplier should be able to commit.

SuggestedRemedy

Define the performance in terms of a compliant link. Add a definition of "link" in a separate paragraph following the current paragraph.

Suggested wording:

The bit error ratio (BER) of a link shall be less than 2.4 × 1e-4 (… conclude the existing paragraph).

In this context, a link consists of a compliant transmitter (PMA and PMD), a fiber optic channel meeting the specifications of Table 123–6, and a compliant receiver (PMD and PMA).

Proposed Response *Response Status* **O**

Cl **123** *SC* **123.7** *P* **278** *L* **4** # 28

Swanson, Steve — Corning Incorporated

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

The decision to add wide band multiple mode fiber to the 400GBASE-SR16 PMD is a mistake that will lead at minimum to confusion in the market and is IMHO misleading the reader of the standard to believe that deploying a fiber designed for operation in SWDM systems in a parallel application, will lead to enhanced performance or a viable upgrade path when in fact it will not. It is not clear that 400GBASE-SR16 will reach broad market potential given the fact that the work in 802.3cd will likely obsolete 400GBASE-SR16 in favor of 400GBASE-SR8. In addition, there is no good rationale for deploying 32 wideband fibers in a parallel fiber solution as an upgrade path.

SuggestedRemedy

The suggestion is to reverse our decision in Fort Worth and remove wide band multimode fiber from 400GBASE-SR16 rather than mislead the reader of the standard. A user is always free to use a fiber that meets/exceeds the OM4 specification but if it provides no benefit at higher cost, it should not be recommended.

If this comment is not selected, several changes still must be made:

1. Replace "...type A1a.3 (OM4), or fiber compliant to TIA-492AAAE, according to the specifications defined in Table 123.6" with "...type A1a.4 (OM5)"

2. Replace "The fiber type and operating range shown in Table 123..5 are the same as 100GBASE-SR4 (See Clause 95)." with "The operating range shown in Table 123.5 is the same as 100GBASE-SR4 (See Clause 95).

3. 2.Consistent with Table 122-8 for single-mode fiber, there is no need to add a new row for WBMMF in Table 123-5 since the supportable link length is the same as OM4 and the fiber should only be used as an OM4 equivalent fiber, i.e., a single wavelength solution in this parallel application. Replace Table 123-5 with the following:
Table 123-5 - 400GBASE-SR16 operating range
PMD type Required operating range
400GBASE-SR16 0.5 m to 70 m for OM3
0.5 m to 100 m for OM4 or OM5 operating as OM4 fiber at 850nm

Proposed Response *Response Status* **O**

Cl **123** *SC* **123.7** *P* **278** *L* **5** # 89

Pimpinella, Rick — Panduit

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

Although the new wide band multimode fiber defined in TIA-492-AAAE has the same minimum EMB at 850 nm as OM4, these two fibers do not perform the same when coupled to VCSEL based transceivers. The modification made to the refractive index profile for WBMMF results in a combined modal and chromatic bandwidth which is different from OM4 and consequently, has a different channel reach. The channel reach of WBMMF, and how it relates to OM4 has not been characterized at this time and currently, there is no collaborative effort to do so. In regards to channel reach, these two fibers are not equivalent and must be further studied before specifying in an IEEE application standard. Furthermore, at least one of the fiber manufacturers are still in the process of tuning their WBMMF process. The premature inclusion of WBMMF in 802.3bs will result in customer confusion, particularly when future PMDs are specified that claim a longer reach for WBMMF compared to OM4.

SuggestedRemedy

I strongly suggest we reverse the decision to include WBMMF, which was proposed during the Fort Worth meeting and blindsided several active participants in 802.3.

Proposed Response *Response Status* **W**

[Editor's note: Subclause set to 123.7, Page set to 278, line set to 5]

Cl **124** *SC* **124.1.1** *P* **289** *L* **45** # 24

Ran, Adee Intel

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

"The bit error ratio (BER) when processed according to Clause 120 shall be less than 2.4 × 1e–4..."

This sentence does not define the conditions under which the BER is measured. For this requirement to hold, it makes sense to assume that the transmitter and the receiver (both including PMA and PMD) are compliant, and the optical channel is compliant (e.g. according to the fiber types and lengths listed in 124.7). But none of that is listed here.

There is a PICS item associated with this "shall". BER is typically associated with the receiver, so a supplier of a PMD has to commit that the receiver meets the specified BER. It doesn't make senst to commit to meeting it under unspecified conditions.

In electrical PMD clauses, this is solved by having the BER requirement is stated as "link BER". A link is described as including compliant transmitter, channel, and receiver. This way the conditions are specified and every supplier should be able to commit.

SuggestedRemedy

Define the performance in terms of a compliant link. Add a definition of "link" in a separate paragraph following the current paragraph.

Suggested wording:

The bit error ratio (BER) of a link shall be less than 2.4 × 1e-4 (… conclude the existing paragraph).

In this context, a link consists of a compliant transmitter (PMA and PMD), a fiber optic channel meeting the specifications of Table 124–11, and a compliant receiver (PMD and PMA).

Proposed Response *Response Status* **O**

Cl **124** *SC* **124.7.1** *P* **296** *L* **31** # 104

Dawe, Piers Mellanox

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

Requiring an extinction ratio of 5 dB restricts the range of transmitter technologies but does not appear to benefit the link or the receiver significantly (they are protected by the TDECQ spec). Its effect is to push up cost. Curious that the limit for 400GBASE-DR4 is higher than for 200GBASE-DR4 anyway.

SuggestedRemedy

Reduce the extinction ratio limit to a defensible amount, such as 3 dB.

Proposed Response *Response Status* **O**

Cl **124** *SC* **124.8.1** *P* **298** *L* **40** # 46

Le Cheminant, Greg keysight Technologies

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

As per earlier comments, allow SSPQRQ pattern 6 as a valid pattern for OMA and extinction ratio

SuggestedRemedy

add pattern 6 to lines 40 and 45 page 298

Proposed Response *Response Status* **W**

[Editor's note: Type set to T]

Cl **124** *SC* **124.8.6** *P* **299** *L* **50** # 47

Le Cheminant, Greg keysight Technologies

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

As per earlier comments, SSPRQ should be a valid pattern for extinction ratio measurements

SuggestedRemedy

change line 50 to read ".....pattern as defined in 120.5.11.2.3 or SSPRQ pattern as defined in 120.5.11.2.5 with the sum....."

Proposed Response *Response Status* **W**

[Editor's note: Type set to T]

Cl **124** *SC* **124.10** *P* **302** *L* **45** # 130

Ghiasi, Ali
Ghiasi Quantum LLC

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

Table 124-11 optical return loss is hanging in the air and should be tight to # of discrete reflectances

SuggestedRemedy

Add note maximum number of discreate reflectace is given by Table 122-19.

Proposed Response *Response Status* **W**

[Editor's note: Subclause changed from 124.1 to 124.10]