Cl **120** *SC* **120.5.11.2.3** *P* **202** *L* **18** # r01-32

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

Following up D3.0 comment 109: this SSPRQ is not suitable for use in TDECQ or stressed receiver calibration because measurements with this pattern do not give the correct (post FEC) penalty. Neither dawe_3bs_01a_0317 nor anslow_01_0417_smf show a suitable pattern. See associated comment against 121.8.5.3, 122, 124.

SuggestedRemedy

Change the first seed in Table 120-2 to one for which a minimally compliant transmitter with 0.4 dB baseline wander penalty after FEC with a random payload measures as minimally compliant (i.e. also 0.4 dB baseline wander penalty) on a pre-FEC BER basis with SSPRQ. This will be a pattern between the red and light brown curves in dawe_3bs_01a_0317 slide 6.

Response *Response Status* **U**

REJECT.

A similar proposal was made in i-109 which was rejected. No consensus has been reached on changes to this pattern in the ad hoc calls.

After further discussion there is still no consensus for a change to the draft.

[Editor's note added after comment resolution completed.
The response to comment i-109 is:
The current SSPRQ pattern was adopted for use in the TDECQ test (after presentation of its baseline wander characteristics) by comment 50 against D1.3. A straw poll was taken in association with that comment: Do you support adopting the SSPRQ pattern for TDECQ and SRS calibration in Clauses 122 and 123? Yes 41 No 2 .
Comments i-130, i-133, and i-145 proposed to change the first seed in Table 120-2 but these comments were not accepted.
]

Cl **120D** *SC* **120D.3.1.1** *P* **353** *L* **24** # r01-36

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **A**

Transmitter Output residual ISI SNR_ISI (max) 38 dB is too high - probably can't measure the IC through the test fixture and cables.

SuggestedRemedy

Start by checking whether Gaussian assumptions are tripping us up.

Response *Response Status* **U**

ACCEPT IN PRINCIPLE.

See response to comment #r01-22

[Editor's note added after comment resolution completed.
The response to comment r01-22 is:
In Table 120D-1:
Change the minimum SNR_ISI value from 38 to 34.8 dB.
Change the minimum SNDR from 31 to 31.5 dB.
Change Linear fit pulse peak (min) from 0.736*Vf to 0.76*Vf

In Table 120D-8:
Change Av and Afe values from 0.45 to 0.44

Add another NOTE at the end of 120D.3.1.7:
NOTE 2--The observed SNR_ISI can be significantly influenced by the measurement setup, e.g. reflections in cables and connectors. High-precision measurement and careful calibration of the setup are recommended.
]

Cl **120D** *SC* **120D.3.1.1** *P* **357** *L* **29** # r01-22

RAN, ADEE Intel

Comment Type **GR** *Comment Status* **A**

(page 353 according to footer in CMP document)

Current SNR_ISI value of 38 dB is too high to be the minimum requirement (although stated as maximum - this is the subject of another comment).

In measurements performed with state-of-the-art scope and an instrument-grade pattern generator, connected by a short instrument-grade cable, the best SNR_ISI achieved was 39.3 dB, and that was with equalization off. This is only 1.3 dB better than the current minimum. This may be an "ISI floor" of the scope, cables, etc., or actual ISI in the transmitter.

Using a packaged transmitter with a supplied evaluation board, high-performance connectors, with short cables to the same scope, resulted in only 36.9 dB at room temperature and without equalization.

With maximum equalization, the pulse peak will be 60% of the unequalized peak, while the ISI can be assumed to be roughly the same. This will result in a degradation of 4.4 dB in SNR_ISI, so the instrument-grade transmitter will actually have SNR_ISI of only 34.9 dB.

For the channels targeted by the C2C specification, and with a CTLE+DFE equivalent assumed in the receiver, operating at the maximum Tx equalization state is unlikely (as this would reduce the signal and exacerbate the effects of TX ISI, crosstalk and other noises). The COM analysis of contributed channels resulted in Tx equalization much lower than the maximum. Therefore, it is reasonable not to judge the transmitter by this state. More likely, the Tx equalization will reduce the peak by up to 2 dB relative to the unequalized pulse.

To achieve technical feasibility with a broad market potential, the standard should allow some margin for manufacturing variability and temperature dependence. The specification should be such that an instrument-grade transmitter will have a margin of ~2 dB.

At the bottom line, the proposal is to specify minimum SNR_ISI as 4 dB below the best measured value with an instrument-grade unequalized transmitter, or 35.3 dB.

The current value was set by comment i-69 which states: "the RSS sum of the SNDR and SNRisi should equal the RSS sum of the TxSNR used in COM plus the SNRisi produced by the COM package". The normalized RSS of the current values of SNDR and SNR_ISI is 0.03, or 30.2 dB below the signal; to keep it the same with SNR_ISI of 35.3 dB, the required SNDR should be slightly increased to 31.8 dB.

SuggestedRemedy

Change the minimum SNR_ISI value from 38 to 35.3 dB.

Change the minimum SNDR from 31 to 31.8 dB.

In 120D.3.1.7, change "The SNR_ISI specification shall be met for all transmit equalization settings" to "The SNR_ISI is measured with Local_eq_cm1 and Local_eq_c1 set to zero".

Add another NOTE at the end of 120D.3.1.7:
NOTE 2--The observed SNR_ISI can be significantly influenced by the measurement setup, e.g. reflections in cables and connectors. High-precision measurement and careful calibration of the setup are recommended.

Response *Response Status* **U**

ACCEPT IN PRINCIPLE.

In Table 120D-1:
Change the minimum SNR_ISI value from 38 to 34.8 dB.
Change the minimum SNDR from 31 to 31.5 dB.
Change Linear fit pulse peak (min) from 0.736*Vf to 0.76*Vf

In Table 120D-8:
Change Av and Afe values from 0.45 to 0.44

Add another NOTE at the end of 120D.3.1.7:
NOTE 2--The observed SNR_ISI can be significantly influenced by the measurement setup, e.g. reflections in cables and connectors. High-precision measurement and careful calibration of the setup are recommended.

Cl **120D** *SC* **120D.3.1.7** *P* **356** *L* **23** # i-158

Hidaka, Yasuo Fujitsu Laboratories of

Comment Type **TR** *Comment Status* **R**

Optimization of two parameters of the second-order CTLE as described in 93A.1.4.3 with parameters in Table 120D-8 is not required for the loss of package and test fixture.
The CTLE defined for chip-to-module interface in 120E.3.1.7 should be sufficient.

This is re-submission of comment #33 for D2.2.

SuggestedRemedy

Change
"SNR_ISI is defined by Equation (120D-8) computed from p_max and ISI_cursors after these have been re-calculated with the continuous time filter described in 93A.1.4.3 using the parameters in Table 120D-7 applied and optimized for maximum SNR_ISI."
to
"SNR_ISI is defined by Equation (120D-8) computed from p_max and ISI_cursors after these have been re-calculated with the selectable continuous time linear equalizer (CTLE) which is described in 120E.3.1.7 by Equation (120E-2) with coefficients in Table 120E-2 and illustrated in Figure 120E-9 applied and optimized for maximum SNR_ISI."

Response *Response Status* **U**

REJECT.
No consensus for a change at this time.

[Editor's note added after comment resolution completed. The consensus view was that the current measurement method is adequate and there is no need to simplfy it.]

Cl **120D** *SC* **120D.3.1.8** *P* **358** *L* **46** # r01-41

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

I doubt that the low frequency RL at 14.25 dB is significant for signal integrity compared with the 8.7 dB at 6 GHz. This RL is much tighter than CEI-56G-MR at low (and high) frequency but looser between 4 and 9 GHz.

SuggestedRemedy

Change 14.25 - f to 12 -0.625f

Response *Response Status* **U**

REJECT.
No consensus to make a change at this time, but further investigation is encouraged.

[Editor's note added after comment resolution completed. The consensus view was that further investigation of the effect of Return Loss at low frequencies should take place, but no change to the equation can be justified at this time.]

Cl **120D** *SC* **120D.4** *P* **360** *L* **4** # i-73

Dudek, Michael — Cavium

Comment Type **TR** *Comment Status* **R**

Simulations presented in the 802.3cd task force have shown that the value of COM for 20dB channels varies significantly based on the values of Zc and Rd and that the presently used values do not provide the worst case result. No single set of values is the worst case for all channels. Some channels are showing 0.5dB less COM than the worst case package for that channel. (See http://grouper.ieee.org/groups/802/3/cd/public/adhoc/archive/hidaka_020117_3cd_adhoc.pdf and further as yet unpublished work)

SuggestedRemedy

Change the COM specification for the channel to 3.5dB here while leaving the COM calibration target for the receiver interference tolerance test at 3.0dB.

Response *Response Status* **U**

REJECT.
There was no consensus to make the equivalent change in P802.3cd

Straw Poll
Change the COM specification for the channel to 3.5dB 4
Make no change 9

Cl **120E** *SC* **120E** *P* **365** *L* **1** # i-118

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

Are there discrepancies between CEI-56G-VSR-PAM4 and Annex 120E for which Annex 120E should change?

SuggestedRemedy

?

Response *Response Status* **U**

REJECT.
The comment identifies no issues, and proposes no remedies.

Cl **120E** *SC* **120E.3.1** *P* **369** *L* **19** # i-119

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

The host is allowed to output a signal with large peak-to-peak amplitude but very small EH - in other words, a very bad signal. If the module is exactly like the reference receiver, that would work - but that's not a reasonable "if".

SuggestedRemedy

We may need some other spec to protect the module from unexpected signals.

Response *Response Status* **U**

REJECT.
No remedy provided. The commenter is encouraged to provide a presenation on this subject.

Cl **120E** *SC* **120E.3.2** *P* **376** *L* **5** # r01-42

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

Far-end pre-cursor ratio doesn't seem like the right tool to solve the issue raised in healey_3bs_01a_0317, which seeks to outlaw "transmitter A1" that gives more than 4 dB COM anyway, so the limit for far-end pre-cursor ratio seems too restrictive. The complaint seems to be that even if the eye is open after the software channel, some receivers might struggle after their own package loss.

SuggestedRemedy

If there is an issue, consider increasing the loss in the software channel to moving the "far end" to after a reasonable package loss, and making a small adjustment the FE eye height and width to compensate. Anyway, relax the far-end pre-cursor ratio limit. If a limit remains, consider if there needs to be a minimum as well as a maximum limit.
Review the way this works for a reasonable variety of channels.

Response *Response Status* **U**

REJECT.
The commenter has not provided any evidence to support his assertion that the limit for far-end pre-cursor ratio is more restrictive than necessary.

Cl **121** *SC* **121.8.5.1** *P* **227** *L* **52** # r01-13

RAN, ADEE — Intel

Comment Type **TR** *Comment Status* **R**

(page 224 according to footer in CMP document)

This is a follow-up on i-131 due to changes in 121.8.5.a and 121.8.5.3 which make it more relevant.

The 31-UI offset is now required "so that the symbols on each lane are not correlated within the PMD". But that is incorrect; the symbols are fully correlated, with a constant offset.

The rebuttal of comment i-131 claimed that having crosstalk "locked to the pattern under test" enables it to be "correctly processed by the equalizer". But this makes the crosstalk strongly correlated with the measured signal (even with 31 UI offset) and appear as a high-probablity noise component (due to the short SSPRQ length); where in real life, crosstalk will be totally uncorrelated with the transmitter signal, and likely closer to Gaussian. This results in overly pessimistic accounting of crosstalk.

With TDECQ being tested without averaging (as now added in 121.8.5.3), there seems to be no need for requiring the SSPRQ pattern on all lanes. The statistics of uncorrelated crosstalk will be represented better if the measurement is done with adjacent lanes transmitting a signal with a different period, such as PRBS31Q or PRBS13Q. Since the measurement is not averaged, the statistics can be captured correctly.

In addition for making it a more representative test, controlling SSPRQ per lane and not requiring a 31-UI offset (which does not really help anyway) may reduce complexity in the PMA design.

SuggestedRemedy

Require TDECQ measurement to be performed with SSPRQ transmitted only on the lane under test, with other lanes transmitting PRBS31Q or a valid PCS pattern.

Change SSPRQ generator control to be per-lane (in 120.5.11.2.3 and 45.2.1.124).

Delete the requirement to have at least a 31 UI delay between lanes in 120.5.11.2.3 and in 121.8.5.1, and delete the words "so that the symbols on each lane are not correlated within the PMD" (they are incorrect).

Apply corresponding changes in the TDECQ subclauses of other PMD clauses.

Grant license to the editors to implement the changes correctly across the multiple clauses involved.

Response *Response Status* **U**

REJECT.
This comment makes a similar proposal to comment i-131, which was rejected with the response:

"The TDECQ test (and SECQ test) are based on capturing the complete SSPRQ pattern and passing it through a reference equalizer. The measurement is allowed to be made using an equivalent-time sampling oscilloscope. By requiring that all lanes are receiving the SSPRQ pattern, any crosstalk from the other lanes is locked to the pattern under test, captured by the oscilloscope as a distortion of the waveform and correctly processed by the equalizer. Because of the offset between the lanes, the crosstalk will be different for the various occurrences of each symbol type. If the draft is changed to allow PRBS13Q or PRBS31Q on the other lanes, then the crosstalk will no longer be locked to the pattern under test and will appear as noise when captured using an equivalent-time sampling oscilloscope and will not be processed correctly by the reference equalizer since the frequency profile of the crosstalk is lost."

The advantage of retaining the frequency content of the crosstalk when using an equivalent time oscilloscope outweighs any advantage of improved randomness when using a different pattern on the other lanes.

Cl **121** *SC* **121.8.5.3** *P* **225** *L* **9** # i-134

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

This says "...the oscilloscope is set up to capture samples from all symbols in the complete pattern". But with only 1 sample/UI, the record of the high frequency components of the signal would be made up by the instrument and test method, probably inaccurately. For comparison, 120E.4.2, Eye width and eye height measurement method, says "the capture includes a minimum of 3 samples per symbol, or equivalent", but an optical signal is likely to contain more high frequency components than 200GAUI-4, that could be good or bad.

SuggestedRemedy

Add "The capture includes a minimum of seven samples per symbol, or equivalent."

Response *Response Status* **U**

REJECT.
The optical signal is measured through a 0.75 x symbol rate BT4 low pass filter, so frequency content > the symbol rate is increasingly filtered out. The issue is being able to construct an eye diagram, which requires sampling of the signal waveform at many fractional UI through the signal waveform. Since the intent to construct an eye diagram is explicit in the description of the TDECQ measurement method, mandating 7 (or any other number of samples) per symbol just enforces a longer test, not a better one.
The minimum number of samples per UI would probably be different for the two types of scope allowed to be used.

Cl **121** *SC* **121.8.5.3** *P* **226** *L* **8** # r01-48

Dawe, Piers J G — Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

Following up on D3.0 comment 133: the draft says Pattern 6 (SSPRQ) should be used for TDECQ. Today's SSPRQ is more stressful in pre-FEC measurements than the service pattern (long scrambler) with FEC, so today's TDECQ measurement does not give the correct penalty for a range of reasonable and compliant transmitters. Same problem in clauses 122 and 124. See associated comment against 120.5.11.2.3.

SuggestedRemedy

Change the first seed in Table 120-2 to one for which a minimally compliant transmitter with 0.4 dB baseline wander penalty after FEC with a random payload measures as minimally compliant (i.e. also 0.4 dB baseline wander penalty) on a pre-FEC BER basis with SSPRQ. This will be a pattern between the red and light brown curves in dawe_3bs_01a_0317 slide 6.

Response *Response Status* **U**

REJECT.
This topic has been discussed at the SMF Ad Hoc with no consensus being reached for a change.
After further discussion there is still no consensus for a change to the draft.

[Editor's note added after comment resolution completed.
Evidence that no change is needed was given in:
http://www.ieee802.org/3/bs/public/17_05/anslow_3bs_03_0517.pdf
]

Cl **121** *SC* **121.8.5.3** *P* **227** *L* **2** # i-23

RAN, ADEE Intel

Comment Type **TR** *Comment Status* **R**

The sentence "Each element of the cumulative probability function Cf1(yi) is multiplied by a value Gth1(yi), and then summed to calculate an approximation for the partial symbol error ratio (SER) for threshold 1" isn't quite clear.

What is "Each element of the cumulative probability function"? is it each term of the sum? What are the summation limits?

As a service to readers, please write the required calculation required to find the "approximation for the partial symbol error ratio (SER) for threshold 1" in equation form.

I assume the required calculation is

SER_1 = Sigma{y_i=-inf}{y_i=inf}C_f1(y_i)*G_th1(y_i)

SuggestedRemedy

Add a new equation (see comment, correct if necessary).

Replace the sentence "Each element of the cumulative probability function Cf1(yi) is multiplied by a value Gth1(yi), and then summed to calculate an approximation for the partial symbol error ratio (SER) for threshold 1" with a reference to the new equation.

Response *Response Status* **U**

REJECT.
The current text is in the context of an example of a linear vector, and the description of element by element multiplication was taken from a maths text book, and seems clear. A contribution with a clear equation describing the element by element multiplication would be helpful.

Cl **121** *SC* **121.8.5.3** *P* **228** *L* **9** # i-140

Dawe, Piers J G Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

It may be possible to make a bad transmitter (e.g. with a noisy or distorted signal), use emphasis to get it to pass the TDECQ test, yet leave a realistic, compliant receiver with an unreasonable challenge.

SuggestedRemedy

Define TDECQrms = 10*log10(C_dc*A_RMS/(s*3*Qt*R)) where A_RMS is the standard deviation of the measured signal after the 19.34 GHz filter response and s is the standard deviation of a fast clean signal with OMA=0.5 and without emphasis, observed through the 19.34 GHz filter response (from memory I believe s is about 0.82). Require that TDECQrms shall not exceed the limit for TDECQ. If we think it's justified, we could allow a slightly higher limit for TDECQrms.

Response *Response Status* **U**

REJECT.
Insufficient evidence of the claimed problem and that the proposed remedy fixes the problem.
The commenter is invited to provide a contribution that demonstrates the problem (a waveform that passes TDECQ but cannot be decoded by a reasonable receiver implementation) and that the proposed additional requirement prevents this issue from occurring.

Cl **121** *SC* **121.8.7** *P* **228** *L* **19** # i-141

Dawe, Piers J G Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

In this draft (following 52.9.6), square wave is proposed for measuring the signal strength in a RIN measurement procedure. Clause 52 is 10GBASE-S/L/E, an NRZ clause. We should not use square wave here because it isn't PAM4; e.g. any transmitter linearity control circuits may fail because two of the expected PAM4 levels are missing. There is no need to use a special unnatural pattern for this. Using a mixed-frequency pattern is much more convenient and gives a slightly more relevant RIN, closer to SNR, anyway.

SuggestedRemedy

If a RIN spec is needed, define it based on PRBS13Q. All PAM4 optical clauses. Remove square wave for PAM4 from the draft.

Response *Response Status* **U**

REJECT.
This is a resubmit of comment #98 to D2.1 which was rejected with the following response: "The use of a square wave to measure RIN was discussed during the resolution of comment #152 against D2.0 with the consensus being to continue to use a square wave. The commenter is invited to provide the details of a measurement method for RIN which uses the PRBS13Q pattern."

Response to this comment is the same as to #98.

Cl **124** *SC* **124.8.9** *P* **302** *L* **31** # r01-55

Dawe, Piers J G
Mellanox Technologie

Comment Type **TR** *Comment Status* **R**

Following up on D3.0 comment 153: if the jitter corner frequency for 26.5625 GBd (NRZ and PAM4) is 4 MHz, the low frequency (sloping) part of the jitter mask should scale with signalling rate, i.e. align if expressed in time vs. frequency, to avoid a need for a poorly specified wander buffer in the 2:1 muxes in a 400GBASE-DR4 module. Compare 87.8.11.4 and 88.8.10: 4 MHz for 10.3125 GBd, 10 MHz for 25.78125 GBd. History: anslow_3bs_04_0316 does not contain reasoning, refers to ghiasi_3bs_01_0316 which does not address wander and buffering.

SuggestedRemedy

Add another exception for the SRS procedure, with a table like Table 121-12 but with the frequencies doubled.
Or, replacing second row after the header row:
80 kHz < f <= 500 kHz 4e5/f
500 kHz < f <= 1 MHz 2e11/f^2
1 MHz < f <= 4 MHz 2e5/f

Response *Response Status* **U**

REJECT.
This issue was already discussed in response to comment i-153 to D3.0 which was:
"The jitter corner frequency was extensively discussed within the Task Force with multiple presentations on the topic. The CRU corner frequency was chosen to be 4 MHz for all interfaces (including 400GBASE-DR4) in the March 2016 TF meeting as recorded in: http://www.ieee802.org/3/bs/public/16_03/anslow_3bs_04_0316.pdf."

The possible need for a buffer was discussed in presentations made leading up to this decision. For example, see:
http://www.ieee802.org/3/bs/public/16_01/ghiasi_3bs_01a_0116.pdf#page=15

There was no consensus to make a change to the draft.