Cl **138** *SC* **138.8.5** *P* **39** *L* **38** # 1

Dawe, Piers Mellanox

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

The 0.1 dB allocation for both modal noise and mode partition noise is too little. See dawe_3cm_adhoc_01_101118, castro_3cm_01_1118, pepeljugoski_1_1104 and castro_3cm_01_0119: we need 0.1 to 0.2 dB for MN (castro_3cm_01_0119 said 0.23 to 0.45 dB) as well as 0.1 dB for MPN. D2.0 comments 38 and 38 against 150.7.3 recommended increasing the power budget for 400GBASE-SR4.2 by 0.2 dB; these were "satisfied" by increasing it by 0.3 dB. However, the same issue for 400GBASE-SR8 has not been fixed yet, and the total penalties should be kept below 4.6 dB, which is unreasonably high already. The adjustment should be done in the same way as before for 100GBASE-SR4 with a formula, so as not to penalise good transmitters.
With this remedy, a 400GBASE-SR8 module used in breakout mode as 200GBASE-SR4, 100GBASE-SR2 or 50GBASE-SR remains interoperable with and compliant to those specs.

SuggestedRemedy

This is a simpler implementation of D2.0 comment 6:
Add an exception in 138.8.5 as follows:
For the calculation of TDECQ (but not SECQ) for 400GBASE-SR8, Equation (138-1) is used in place of Equation (121-11).
R=sqrt(sigmaG^2 + sigmaS^2 - M^2) (138-1)
where M = 0.0065Pave

Response *Response Status* **U**

REJECT.
This comment is similar to comments #39 against D1.0, #4 against D1.1, #1 against D1.2 and #6 against D2.0, which were rejected. Note that comment #6 against D2.0 is an unsatisfied negative comment.
It is highly desirable to keep the per lane specifications for 400GBASE-SR8 identical to the other PMDs in Clause 138 and changing the TDECQ definition for 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4 is out of scope for this project.

Cl **138** *SC* **138.8.5.1** *P* **39** *L* **45** # 4

Dawe, Piers Mellanox

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

As explained in D2.0 comment 9, equalizing a signal after an 11.2 GHz BT4 filter with a 5-tap FFE needs at least one precursor unless the signal is carefully pre-distorted. If it is, and a fourth post-cursor is needed, the same transmitter seen after a fast channel, e.g. a short fibre, can be difficult to receive (outside the TDECQ spec limit and/or receive power too low) because the 5-tap FFE can't correct the fourth post-cursor and the (now -ve) first precursor at the same time.
The fast channel can have less mode partition noise but more modal noise, but the problem remains.

Possible remedies include:
(a) Ensure there is at least one precursor (tap 2 or 3 is the largest), or
(b) Add ~0.4 dB to TDECQ if tap 1 is the largest, or
(c) Defining MMF TDECQ with fast and slow channels, in the same spirit as SMF with high and low dispersion, noting that if tap 2 or 3 is the largest it can be assumed that TDECQ(fast) < TDECQ(slow), so no need to determine it.
An implementer who doesn't like option c, if adopted, can comply by following options a or b. If he doesn't like b he can follow a. In practice, it seems that TDECQ uses at least one precursor for reasonable MMF transmitters, so there is no extra cost to a competent / responsible transmitter implementer, but the receiver needs protection from inferior transmitters that could appear in the future.
With this remedy, a 400GBASE-SR8 module used in breakout mode as 200GBASE-SR4, 100GBASE-SR2 or 50GBASE-SR remains interoperable with and compliant to those specs.

SuggestedRemedy

To ensure that the 400GBASE-SR8 transmitter is good enough for the intended range of channel bandwidths, either:
(a) Change the fourth sentence in 138.8.5.1 from "Tap 1, tap 2, or tap 3, has the largest magnitude tap coefficient, which is constrained to be at least 0.8." to
"For 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4, tap 1, tap 2, or tap 3, has the largest magnitude tap coefficient, which is constrained to be at least 0.8. For 400GBASE-SR8, tap 2, or tap 3 has the largest magnitude tap coefficient, which is constrained to be at least 0.8."; or
(b) In 138.8.5, add another exception: "For 400GBASE-SR8, if tap 1 has the largest magnitude tap coefficient, TDECQ is 1.1 x the value given by Eq. (121-12). The TDECQ value with tap 2 having the largest magnitude tap coefficient may be used instead."; or
(c) Change the third exception in 138.8.5 to:
TDECQ is defined for two measurement conditions for 400GBASE-SR8, and for one measurement condition for 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4. In the high bandwidth case, which applies to 400GBASE-SR8, the combination of the O/E converter and the oscilloscope used to measure the optical waveform is as in 121.8.5.1. In the low bandwidth case, it has a 3 dB bandwidth of 11.2 GHz with a fourth-order Bessel-Thomson response to at least 1.5 x 22.4 GHz and at frequencies above 1.5 x 22.4 GHz the response should not exceed -24 dB. Compensation may be made for any deviation from an ideal fourth-order Bessel-Thomson response. For 400GBASE-SR8, TDECQ is the higher of the results from the two bandwidth cases. If tap 2 or tap 3 has the largest magnitude tap

coefficient in the low bandwidth case, it may be assumed that the result from the low bandwidth case is higher than the result from the high bandwidth case.

Response *Response Status* **U**

REJECT.
This comment is similar to comments #42 against D1.0, #7 against D1.1, #4 against D1.2 and #9 against D2.0, which were rejected. Note that comment #9 against D2.0 is an unsatisfied negative comment.
It is highly desirable to keep the per lane specifications for 400GBASE-SR8 identical to the other PMDs and changing the constraint on which tap can have the largest magnitude for 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4 is out of scope for this project.
Limiting to at most three post-cursors in the reference equalizer means that the transmitted signal, when propagated through the TDECQ reference response, cannot have a significant amount of fourth post-cursor response at the receiver without suffering higher TDECQ penalty.
Insufficient evidence has been provided to justify a change.

Cl **150** *SC* **150.8.5.1** *P* **59** *L* **28** # 5

Dawe, Piers Mellanox

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

As explained in D2.0 comment 14, equalizing a signal after a 8.96 GHz BT4 filter with a 5-tap FFE needs at least one precursor unless the signal is carefully pre-distorted. If it is, and a fourth post-cursor is needed, the same transmitter seen after a fast channel, e.g. a short fibre, can be difficult to receive (outside the TDECQ spec limit and/or receive power too low) because the 5-tap FFE can't correct the fourth post-cursor and the (now -ve) first precursor at the same time.
The fast channel can have less mode partition noise but more modal noise, but the problem remains.

Possible remedies include:
(a) Ensure there is at least one precursor (tap 2 or 3 is the largest), or
(b) Add ~0.4 dB to TDECQ if tap 1 is the largest, or
(c) Defining MMF TDECQ with fast and slow channels, in the same spirit as SMF with high and low dispersion, noting that if tap 2 or 3 is the largest it can be assumed that TDECQ(fast) < TDECQ(slow), so no need to determine it.
An implementer who doesn't like option c, if adopted, can comply by following options a or b. If he doesn't like b he can follow a. In practice, it seems that TDECQ uses at least one precursor for reasonable MMF transmitters, so there is no extra cost to a competent / responsible transmitter implementer, but the receiver needs protection from inferior transmitters that could appear in the future.

SuggestedRemedy

To ensure that the transmitter is good enough for the intended range of channel bandwidths, either:
(a) Change "Tap 1, tap 2, or tap 3, has" to "Tap 2 or tap 3 has"; or
(b) In 150.8.5, add another exception: "If tap 1 has the largest magnitude tap coefficient, TDECQ is 1.1 x the value given by Eq. (121-12). The TDECQ value with tap 2 having the largest magnitude tap coefficient may be used instead."; or
(c) Change the paragraph at line 15 to:
TDECQ is defined for two measurement conditions. In the high bandwidth case, the combination of the O/E converter and the oscilloscope used to measure the optical waveform is as in 121.8.5.1. In the low bandwidth case, it has a 3 dB bandwidth of 8.96 GHz with a fourth-order Bessel-Thomson response to at least 1.5 x 17.92 GHz and at frequencies above 1.5 x 17.92 GHz the response should not exceed -24 dB. Compensation may be made for any deviation from an ideal fourth-order Bessel-Thomson response. TDECQ is the higher of the results from the two bandwidth cases. If tap 2 or tap 3 has the largest magnitude tap coefficient in the low bandwidth case, it may be assumed that the result from the low bandwidth case is higher than the result from the high bandwidth case.

Response *Response Status* **U**

REJECT.
This comment is similar to comments #48 against D1.0, #14 against D1.1, #9 against D1.2 and #14 against D2.0, which were rejected. Note that comment #14 against D2.0 is an unsatisfied negative comment.
Limiting to at most three post-cursors in the reference equalizer means that the transmitted

signal, when propagated through the TDECQ reference response, cannot have a significant amount of fourth post-cursor response at the receiver without suffering higher TDECQ penalty.
Insufficient evidence has been provided to justify a change.

Cl **138** *SC* **138.8.5** *P* **38** *L* **38** # 2006

Dawe, Piers Mellanox

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

The 0.1 dB allocation for both modal noise and mode partition noise is too little. See dawe_3cm_adhoc_01_101118, castro_3cm_01_1118, pepeljugoski_1_1104 and castro_3cm_01_0119: we need 0.1 to 0.2 dB for MN (castro_3cm_01_0119 says 0.23 to 0.45 dB) as well as 0.1 dB for MPN. The total penalties should be kept below 4.6 dB, which is unreasonably high already. This should be done with a formula, as for 100GBASE-SR4, so as not to penalise good transmitters.
In the remedy, M = 0.0065*Pave may be on the low side: 100GBASE-SR4 has M2 = 0.0175*Pave.

SuggestedRemedy

Add an exception in 138.8.5 as follows:
For 400GBASE-SR8, Equation (138-1) is used in place of Equation (121-11).
R=sqrt(sigmaG^2 + sigmaS^2 - M^2) (138-1)
where M = 0.0065Pave
In 138.8.10 Stressed receiver sensitivity, refer to the new Eq. 138-1 (as above) and say that:
the values of M in Equation (138-1) is set to zero.
(or, leave this section referring to Eq. 121-11 but to avoid confusion, add:
NOTE--The parameter M of Equation (138-1) is not used.)

Response *Response Status* **U**

REJECT.
This comment is similar to comments #39 against D1.0, #4 against D1.1 and #1 against D1.2, which were rejected.
It is highly desirable to keep the per lane specifications for 400GBASE-SR8 identical to the other PMDs in Clause 138 and changing the TDECQ definition for 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4 is out of scope for this project.

Cl **138** *SC* **138.8.5.1** *P* **38** *L* **45** # 2009

Dawe, Piers Mellanox

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

Equalizing a signal after an 11.2 GHz BT4 filter with a 5-tap FFE needs at least one precursor unless the signal is carefully pre-distorted. If it is, and a fourth post-cursor is needed, the same transmitter seen after a fast channel, e.g. a short fibre, can be difficult to receive (outside the TDECQ spec limit) because the 5-tap FFE can't correct the fourth post-cursor and the (now -ve) first precursor at the same time.
The fast channel can have less mode partition noise but more modal noise, but the problem remains.
In practice, it seems that TDECQ uses at least one precursor for real MMF transmitters.
Possible remedies include:
Ensure there is at least one precursor (tap 2 or 3 is the largest), or
Modify TDECQ if tap 1 is the largest by adding an interferer representing the uncorrected precursor that this weird transmitter would have on a short link, or
Defining MMF TDECQ with fast and slow channels, in the same spirit as SMF with high and low dispersion, noting that if tap 2 or 3 is the largest it can be assumed that TDECQ(fast) < TDECQ(slow), so no need to determine it. It should be possible to make a reasonable estimate of TDECQ(fast) from the dataset of a TDECQ(slow) measurement, but it's not likely that one would need to do that, as noted above.

SuggestedRemedy

To ensure that the 400GBASE-SR8 transmitter is not gaming the spec like this:
Change the fourth sentence in 138.8.5.1 as follows: change "Tap 1, tap 2, or tap 3, has the largest magnitude tap coefficient..." to
"For 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4, tap 1, tap 2, or tap 3, has the largest magnitude tap coefficient... For 400GBASE-SR8, tap 2 or tap 3, has the largest magnitude tap coefficient..."
Note another comment relates to the same sentence.

Response *Response Status* **U**

REJECT.
This comment is similar to comments #42 against D1.0, #7 against D1.1 and #4 against D1.2, which were rejected.
It is highly desirable to keep the per lane specifications for 400GBASE-SR8 identical to the other PMDs and changing the constraint on which tap can have the largest magnitude for 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4 is out of scope for this project.
Limiting to at most three post-cursors in the reference equalizer means that the transmitted signal, when propagated through the TDECQ reference response, cannot have a significant amount of fourth post-cursor response at the receiver without suffering higher TDECQ penalty.
Insufficient evidence has been provided to justify a change.

Cl **150** *SC* **150.8.5** *P* **58** *L* **18** # 2012

Dawe, Piers Mellanox

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

The 0.1 dB allocation for both modal noise and mode partition noise is too little. See dawe_3cm_adhoc_01_101118, castro_3cm_01_1118, pepeljugoski_1_1104 and castro_3cm_01_0119: we need 0.1 to 0.2 dB for MN (castro_3cm_01_0119 says 0.23 to 0.45 dB) as well as 0.2 to 0.4 dB for MPN. The total penalties should be kept below 4.6 dB, which is unreasonably high already. This should be done with a formula, as for 100GBASE-SR4, so as not to penalise good transmitters.
This remedy keeps the 150 m reach for OM5, although the 100 m transmitters have to be slightly better than needed for 100 m on OM4. M = 0.0065*Pave may be on the low side: 100GBASE-SR4 has M2 = 0.0175*Pave.

SuggestedRemedy

Insert:
Equation (150-1) is used in place of Equation (121-11).
R=sqrt(sigmaG^2 + sigmaS^2 - M^2) (150-1)
where M = 0.0065Pave
In 150.8.10 Stressed receiver sensitivity, refer to the new Eq. 150-1 (as above) and say that:
the value of M in Equation (150-1) is set to zero.
(or, leave this section referring to Eq. 121-11 but to avoid confusion, add:
NOTE--The parameter M of Equation (150-1) is not used.)

Reduce the limits for TDECQ and TDECQ-10log10(Ceq), from 4.5 dB to 4.3 dB (0.2 dB lower than the SECQ values, allowing for 0.3 dB MPN penalty with associated Pcross, including the 0.1 dB already in the draft budget).
In the budget table 150-9, the power budget doesn't change, the allocation for penalties for 70 m and 100 m decrease from 4.6 to 4.5 dB and the additional insertion losses for 70 m and 100 m increase by 0.1 dB to 0.4, 0.3 dB.

Response *Response Status* **U**

ACCEPT IN PRINCIPLE.
See response to comment #29. The consensus was that 4.9 dB allocation for total penalties is acceptable for 400GBASE-SR4.2.

Cl **150** *SC* **150.8.5.1** *P* **58** *L* **28** # 2014

Dawe, Piers Mellanox

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

Equalizing a signal after a 9 GHz BT4 filter with a 5-tap FFE needs at least one precursor unless the signal is carefully pre-distorted. If it is, and a fourth post-cursor is needed, the same transmitter seen after a fast channel, e.g. a short fibre, can be difficult to receive (outside the TDECQ spec limit) because the 5-tap FFE can't correct the fourth post-cursor and the (now -ve) first precursor at the same time.
The fast channel can have less mode partition noise but more modal noise, but the problem remains.
In practice, it seems that TDECQ uses at least one precursor for real MMF transmitters.
Possible remedies include:
Ensure there is at least one precursor (tap 2 or 3 is the largest), or
Modify TDECQ if tap 1 is the largest by adding an interferer representing the uncorrected precursor that this weird transmitter would have on a short link, or
Defining MMF TDECQ with fast and slow channels, in the same spirit as SMF with high and low dispersion, noting that if tap 2 or 3 is the largest it can be assumed that TDECQ(fast) < TDECQ(slow), so no need to determine it. It should be possible to make a reasonable estimate of TDECQ(fast) from the dataset of a TDECQ(slow) measurement, but it's not likely that one would need to do that, as noted above.

SuggestedRemedy

To ensure that the transmitter is good enough for the intended range of channel bandwidths, change "Tap 1, tap 2, or tap 3, has" to "Tap 2 or tap 3 has".

Response *Response Status* **U**

REJECT.
This comment is similar to comments #48 against D1.0, #14 against D1.1 and #9 against D1.2, which were rejected.
Limiting to at most three post-cursors in the reference equalizer means that the transmitted signal, when propagated through the TDECQ reference response, cannot have a significant amount of fourth post-cursor response at the receiver without suffering higher TDECQ penalty.
Insufficient evidence has been provided to justify a change.
Straw poll
Should a conditional TDECQ test with SECQ bandwidth be added to the draft?
Y: 4
N: 6

Cl **138** *SC* **138.1** *P* **28** *L* **12** # 2026

Hajduczenia, Marek Charter Communications

Comment Type **ER** *Comment Status* **R** *Bucket*

Lists of PHYs in multiple locations - please avoid enumerating all the PHYs over and over again

SuggestedRemedy

Change repeated enumerations "50GBASE-SR, 100GBASE-SR2, 200GBASE-SR4, and 400GBASE-SR8" indicatign all PMDs to "Clause 138 PMDs" - it is simpler to maintain in the future - multiple locations in the draft

Response *Response Status* **U**

REJECT.
The enumeration of the PMDs avoids ambiguity.