Cl **136**   *SC* **136.11.7**   *P* **235**   *L* **18**   # i-60

RAN, ADEE   Intel Corporation

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

Package transmission line characteristic impedance is set at 90 Ohm. This is an increase from the default value in Annex 93A which is 78.2 Ohm.

The reason for the relatively low value 78.2 Ohm was that to typical packages (especially large ones with many lanes) have lower impedance to improve their matching to silicon and ball impedances, and to reduce the trace insertion loss. This is not expected to change; most practical packages will not have impedance close to 100 Ohm.

In practice, termination can be adjusted and board design can be optimized to match lower impedance package and improve performance (even if cables are 100 Ohm)

It is suggested to acknowledge the expected lower impedance of practical devices in the reference package and termination parameters: assume packages are 80 Ohm while termination and board are 90 Ohm (imperfect matching).

Also applies in 137.10 (Table 137-5).

SuggestedRemedy

In both Table 136-15, and Table 137-5, change the value of Zc to 80 Ohm and Rd to 45 Ohm.

In 136.11.7.1, add an exception to the parameter values from Table 92-12: Z_c is set to 90 Ohm.

Consider changing the reference impedance for channels from 100 Ohm to 85 Ohm (136.11.1 and 137.10, and COM tables).

Response   *Response Status* **U**

REJECT.

The response to comment i-161 resulted in different changes than the ones in the suggested remedy.

Cl **138**   *SC* **138.8.5**   *P* **274**   *L* **39**   # i-116

Dawe, Piers J G   Mellanox Technologie

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

It seems that it is 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, such as high peak power, high crest factor, or a need to remove emphasis from the signal, contrary to what equalizers are primarily intended to do. Note the receiver is tested for a very slow signal only, not for any of these abusive signals. This is an issue for all the PAM4 optical PMDs, although it may be worse for MMF because of the high TDECQ limit.

SuggestedRemedy

1. To screen for noisy or distorted signals with heavy emphasis
Define TDECQrms = $10*log10(A\_RMS/(s*3*Qt*R))$ where A_RMS is the standard deviation of the measured signal after the 13.28125 GHz filter response, Qt and R are as already in Eq 212-12. s is the standard deviation of a fast clean signal with OMA=2 and without emphasis, observed through the 13.28125 GHz filter response (around 0.7). Set limit for TDECQrms according to what level of dirty-but-emphasised signal we decide is acceptable, add max TDECQrms row to each transmitter table. Alternatively, if the same relative limit is acceptable for all PAM4 optical PMDs, the limit could be here in the TDECQ procedure.
Similarly in clauses 139, 140.
2. To protect the TIA input, consider a peak power spec as in Clause 86.
3. To protect the TIA and any AGC and TIA from unreasonable signals, consider a crest factor spec.
4. To protect the receiver from having to "invert" heavily over-emphasised signals, set a minimum cursor weight.
To protect the equalizer from having to support unnecessary settings for waveforms that can't or shouldn't ever happen, constrain the cursor position - see other comments .

Response   *Response Status* **U**

REJECT.

The need for additonal transmitter specs has not been established, and insufficient evidence has been provided that the proposed remedy fixes the claimed problem.

A contribution is invited 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. A similar proposal to create a TDECQrms spec was suggested in comment #r02-35 against 802.3bs D3.2, which was similarly rejected.

A peak power spec has not been shown to be necessary, and a definition and value has not been provided.
A crest factor limit has not been shown to be necessary, and a definition and value has not been provided.

The need for a limit to cursor weight has not been established.

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general
COMMENT STATUS: D/dispatched A/accepted R/rejected   RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn
SORT ORDER: Comment ID

Comment ID **i-116**   Page 1 of 8
2018-06-05 8:52:01 AM

Cl **138** *SC* **138.7.1** *P* **272** *L* **17** # i-119

Dawe, Piers J G Mellanox Technologie

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

A TDECQ limit of 4.9 seems very high, given that the same fibres and transmitter and receiver front-ends that should not be worse can do 100GBASE-SR4 (PAM2, almost the same signalling rate) without the FFE.

SuggestedRemedy

This needs more study. We should be able to use information from 802.3bm.

Response *Response Status* **U**

REJECT.

No change to document suggested.
The issue caused by a TDECQ limit of 4.9 dB has not been clarified. There is precedence for this kind of transmitter quality metric to be higher in MMF specifications than in SMF specifications.

Cl **138** *SC* **138.7.1** *P* **273** *L* **22** # r01-70

Dawe, Piers J G Mellanox Technologie

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

A TDECQ limit of 4.9 seems very high, given that the same fibres and transmitter, and receiver front-ends that should not be worse, can do 100GBASE-SR4 (PAM2, almost the same signalling rate) without the FFE. D.30 comment 119.
Also, it seems that the TDECQ spec limit can be "gamed" (D3.0 comment 116).

SuggestedRemedy

Compare a minimally compliant 100GBASE-SR4 transmitter and set the TDECQ limit accordingly. Provide a signal quality spec that cannot be "gamed".

Response *Response Status* **U**

REJECT.

No specific change to document suggested.

The issue that might be caused by a TDECQ limit of 4.9 dB has not been clarified. There is precedence for this kind of transmitter quality metric to be higher in MMF specifications than in SMF specifications.
To date no contribution has been made that demonstrates the problem, for example, a waveform that passes TDECQ but cannot be decoded by a reasonable receiver implementation.
Measured data has been presented to the task force supporting the current specifications. See:
http://www.ieee802.org/3/cd/public/Jan18/king_3cd_02_0118.pdf
http://www.ieee802.org/3/cd/public/adhoc/archive/chang_011018_3cd_02_adhoc-v2.pdf

Cl **138** *SC* **138.8.5** *P* **276** *L* **33** # r01-71

Dawe, Piers J G Mellanox Technologie

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

It seems that it is 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, such as high peak power, high crest factor, or a need to remove emphasis from the signal, contrary to what equalizers are primarily intended to do. Note the receiver is tested for a very slow signal only, not for any of these abusive signals. This is an issue for all the PAM4 optical PMDs, although it may be worse for MMF because of the high TDECQ limit and because the signal is measured in a particularly low bandwidth.
D3.0 comment 116.

SuggestedRemedy

1. To screen for noisy or distorted signals with heavy emphasis:
Define TDECQrms = $10*\log10(A\_RMS/(s*3*Qt*R))$ where A_RMS is the standard deviation of the measured signal after the 13.28125 GHz or 11.2 GHz filter response (before the FFE), Qt and R are as already in Eq 212-12. s is the standard deviation of a fast clean signal with OMA=2 and without emphasis, observed through the filter response (0.6254 for 13.28125 GHz, 0.6006 for 11.2 GHz).
Either, set limit for TDECQrms according to what level of dirty-but-emphasised signal we decide is acceptable, add max TDECQrms row to each transmitter table.
Or, if the same relative limit is acceptable for all PAM4 optical PMDs, the limit could be here in the TDECQ procedure. e.g. make the TDECQrms limit the same as the TDECQ limit, say here that both TDECQ and TDECQrms must meet the TDECQ spec.
2. To protect the receiver from having to "invert" heavily over-emphasised signals, set a minimum cursor weight, 0.9.
Similarly in clauses 139, 140.
To protect the equalizer from having to support unnecessary settings for waveforms that can't or shouldn't ever happen, constrain the cursor position - see other comments .

Response *Response Status* **U**

REJECT.

The need for additonal transmitter specs has not been established, and insufficient evidence has been provided that the proposed remedy fixes the claimed problem.

To date no contribution has been made that 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.

A similar proposal to create a TDECQrms spec was suggested in comment #r02-35 against 802.3cd D3.0, which was similarly rejected.

A peak power spec has not been shown to be necessary, and a definition and value has not been provided.

A crest factor limit has not been shown to be necessary, and a definition and value has not

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general
COMMENT STATUS: D/dispatched A/accepted R/rejected   RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn
SORT ORDER: Comment ID

Comment ID **r01-71** Page 2 of 8
2018-06-05 8:52:01 AM

been provided.

The need for a limit to cursor weight has not been established

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Cl **138**   *SC* **138.8.5.1**   *P* **276**   *L* **38**   # r01-73

Dawe, Piers J G   Mellanox Technologie

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

Further investigation of possible minimally compliant MMF signals and their associated TDECQ FFE settings indicates that 2 pre, 2 post (making the cursor the third tap) is never significantly better than 1 pre, 3 post (making it the second tap), for compliant signals. Further refining the TDECQ search rules will avoid inefficiency both in product receiver design, testing and operation, and in TDECQ testing.

SuggestedRemedy

Change "Tap 1, tap 2, or tap 3, has" to "Tap 1 or tap 2 has". There is a separate comment for SMF because the different TDECQ limit there could lead to a different conclusion.

Response   *Response Status*   **U**

REJECT.

A similar proposal was made against draft 3.0 (comments i-107 i-117 and i120) which was reviewed by the Task Force.

The agreed resolution was to limit the main tap to tap 1, tap 2, or tap 3. http://www.ieee802.org/3/cd/public/Mar18/dawe_3cd_01a_0318.pdf was reviewed by the Task Force.
There was no consensus to make the proposed change.

The resolution to i-117 was:

ACCEPT IN PRINCIPLE.
Implement the changes proposed in
http://www.ieee802.org/3/cd/public/Jan18/king_3cd_03_0118.pdf with editorial license

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Cl **139**   *SC* **139.7.5.4**   *P* **301**   *L* **1**   # r01-76

Dawe, Piers J G   Mellanox Technologie

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

Further investigation of possible minimally compliant SMF signals and their associated TDECQ FFE settings indicates that 2 pre, 2 post (making the cursor the third tap) is never significantly better than 1 pre, 3 post (making it the second tap), for compliant signals. Further refining the TDECQ search rules will avoid inefficiency both in product receiver design, testing and operation, and in TDECQ testing.

SuggestedRemedy

Change "Tap 1, tap 2, or tap 3, has" to "Tap 1 or tap 2 has". Do the same in 140.7.5.1 because the TDECQ limit is similar. There is a separate comment for MMF because the different TDECQ limit there could lead to a different conclusion.

Response   *Response Status*   **U**

REJECT.

See response to comment r01-73.

[Editor's note added after comment resolution completed:

For reference, the response to comment r01-73 is copied here:

REJECT.

A similar proposal was made against draft 3.0 (comments i-107 i-117 and i120) which was reviewed by the Task Force.

The agreed resolution was to limit the main tap to tap 1, tap 2, or tap 3. http://www.ieee802.org/3/cd/public/Mar18/dawe_3cd_01a_0318.pdf was reviewed by the Task Force.
There was no consensus to make the proposed change.

The resolution to i-117 was:

ACCEPT IN PRINCIPLE.
Implement the changes proposed in
http://www.ieee802.org/3/cd/public/Jan18/king_3cd_03_0118.pdf with editorial license

]

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general
COMMENT STATUS: D/dispatched A/accepted R/rejected   RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn
SORT ORDER: Comment ID

Comment ID **r01-76**   Page 3 of 8
2018-06-05 8:52:01 AM

Cl **136** *SC* **136.11.4** *P* **232** *L* **28** # r02-15

Dudek, Michael   Cavium

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

None of the cables that have been posted have ERL's as bad as 11dB and a presentation will be made that shows that a cable channel with an ERL as bad as 11dB would cause system problems.

SuggestedRemedy

Change the requirement for ERL of the cables to be 14dB. Also in table 136-16 and PICS CA4

Response *Response Status* **U**

REJECT.

There was no consensus to implement the suggested remedy.

See straw polls #4 and #5 and
http://www.ieee802.org/3/cd/public/May18/ran_3cd_03_0518.pdf

[
Editor's note added after comment resolution completed. For reference, the results of straw polls 4 and 5 are provided:

"Straw poll #4:
For Cable assembly ERL minimum in clause 136, I would support
1. Option b
2. Option c
3. Option d
Chicago rules
Results: #1: 4, #2: 13, #3: 14

Straw Poll #5
For Cable assembly ERL minimum in clause 136, I would support
1. Accepting r02-23
2. Rejecting r02-23
Choose one
Results: #1: 15, #2: 8"
]

Cl **136** *SC* **136.11.8** *P* **233** *L* **7** # r02-30

Ran, Adee   Intel Corporation

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

The COM parameters for clause 136 correspond to very well-matched channel terminations. The device single-ended termination resistance is 50 Ohm, the package model characteristic impedance is 95 Ohm, and the host board impedance (136.11.8.1) is 100 Ohm.

This creates a smooth channel with no reflections outside of the cable, except for the package capacitors (which are within the DFE reach).

In reality things will not be so nice. Actual devices and NICs will have reflections outside of the DFE reach (limited by ERL, not not zero). These reflections are not accounted for in the COM budget - leaving a deficit.

The effect of far-end reflections is not accounted for in the receiver interference tolerance test COM calibration. So receivers may perform well in the test but fail in real life scenarios.

I am planning a presentation with more details of the problem and proposed solutions.

SuggestedRemedy

Upcoming presentation.

Response *Response Status* **U**

REJECT.

There is no consensus to make a change.

Straw poll #11
In order to address the issues presented in
http://www.ieee802.org/3/cd/public/May18/ran_3cd_01a_0518 with respect to clause 136,
to create a guardband in COM, I would support:
1. Adjust the specifications for Tx and/or Rx
2. Adjust the specifications for the cable assembly
3. Adjust the specifications both for the Tx/Rx, and for the cable assembly
4. Make no changes
(Chicago rules)
1: 3, 2: 8, 3: 7, 4: 16

Straw poll #14
In order to address the issues presented in
http://www.ieee802.org/3/cd/public/May18/ran_3cd_01a_0518 with respect to clause 137,
to create a guardband in COM, I would support:
1. Adjust the specifications for the backplane channel
2. Make no changes
1: 2, 2: 19

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general
COMMENT STATUS: D/dispatched A/accepted R/rejected   RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn
SORT ORDER: Comment ID

Comment ID **r02-30**   Page 4 of 8
2018-06-05 8:52:01 AM

Cl **138**   *SC* **138.7.1**   *P* **270**   *L* **22**   # r02-40

Dawe, Piers J G   Mellanox Technologie

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

A TDECQ limit of 4.9 dB still has not been justified, given that the same fibres and transmitter, and receiver front-ends that should not be worse, can do 100GBASE-SR4 (PAM2, almost the same signalling rate) without the FFE. king_3cd_02_0118 showed 1 to 2.5 with representative drive. The high limit in the draft would require a better equalizer (e.g. more precise tap settings) than needed for the MMF PMDs. D.30 comment 119, D3.1 comment 70.

SuggestedRemedy

Consider what actual PAM4 MMF transmitters do, and compare a minimally compliant 100GBASE-SR4 transmitter, and set the TDECQ limit accordingly, e.g. 3.8 dB.

Response   *Response Status* **U**

REJECT.

No specific changes to the draft proposed.

See also response to comment r02-39.

[
Editor's note added after comment resolution completed.
For reference, the response to r02-39 is:
"REJECT.
 No specific change to the draft proposed.
This is a duplicate of comment r01-69 against draft 3.1.
There is no support to consider one of the options from the remedy.
Measured data has been presented to the task force supporting the current specifications.
See: http://www.ieee802.org/3/cd/public/Jan18/king_3cd_02_0118.pdf
http://www.ieee802.org/3/cd/public/adhoc/archive/chang_011018_3cd_01_adhoc-v2.pdf
http://www.ieee802.org/3/cd/public/May18/king_3cd_03_0518.pdf"
]

Cl **138**   *SC* **138.8.5**   *P* **273**   *L* **35**   # r02-46

Dawe, Piers J G   Mellanox Technologie

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

In this draft, it is possible to make a bad MMF transmitter with emphasis (e.g. with a noisy or distorted signal) that even an equalizer better than the reference equalizer won't be able to improve. Note the receiver is tested for a slow signal only, not for such signals. This issue is worse for MMF because of the high TDECQ limit.
On the TDECQ map (see e.g. dawe_041818_3cd_adhoc-v2) we need to stop signals that are too high up the page.
D3.0 comment 116, D3.1 comment 71.

SuggestedRemedy

For a MMF TDECQ limit of 3.8 dB: Either:
1. Limit TDECQ -10*log10(Ceq) to <=4.2 dB for SMF PMDs.
or:
2. Define TDECQrms = 10*log10(A_RMS/(s*3*Qt*R)) where A_RMS is the standard deviation of the measured signal after the 13.28125 GHz filter response (before the FFE), Qt and R are as already in Eq 121-12. s is the standard deviation of a fast clean signal with OMA=2 and without emphasis, observed through the reference Bessel-Thomson filter response but before the reference equalizer (0.6006 for 11.2 GHz).
Limit 3.4 dB for MMF PMDs. This could be added to the transmitter tables.

Response   *Response Status* **U**

ACCEPT IN PRINCIPLE.

See comment response to r02-27 (rise and fall time and limiting the RIN of the transmitter) and r02-9 (on lowering TDECQ limit).

There was no support for adding a limit on TDECQ -10*log10(Ceq) or to define TDECQrms.

[
Editor's note added after comment resolution completed.
For reference, the response to r02-9 is:
"ACCEPT IN PRINCIPLE.
The Task Force reviewed the updated proposal in
http://www.ieee802.org/3/cd/public/May18/king_3cd_01_0518.pdf.
In Table 138-8 change value for "Transmitter and dispersion eye closure (TDECQ), each lane (max)" from 4.9 dB to 4.5 dB and change the parameter name to "Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane (max)".
In Table 138-9:
Change value for "Stressed receiver sensitivity (OMAouter), each lane (max)" from -3 to -3.4 dBm.
Change value for "Stressed eye closure (SECQ), lane under test" from 4.9 dB to 4.5 dB.
Change note d to read "Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 4.5 dB."
In Table 138-10:
Change value for "Power budget (for max TDECQ)" from 6.9 dB to 6.5 dB.
Change value for "Allocation for penalties (for max TDECQ)" from 5 dB to 4.6 dB.

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general
COMMENT STATUS: D/dispatched A/accepted R/rejected   RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn
SORT ORDER: Comment ID

Comment ID **r02-46**   Page 5 of 8
2018-06-05 8:52:01 AM

In 138.8.7 change "Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 4.9 dB" to "Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 4.5 dB"

Change the title for subclause 138.8.5 from "Transmitter and dispersion eye closure - quaternary (TDECQ)" to "Transmitter and dispersion eye closure for PAM4 (TDECQ)"

In Table 139-6 change value for "Transmitter and dispersion eye closure for PAM4 (TDECQ) (max)" from 3.2 dB to 2.8 dB for 50GBASE-FR and from 3.4 dB to 3 dB for 50GBASE-LR.

In Table 139-7:

Change value for "Stressed receiver sensitivity (OMAouter) (max)" from -5.1 to -5.5 dBm for 50GBASE-FR and from -6.4 dBm to -6.8 dBm for 50GBASE-LR.

Change value for "Stressed eye closure for PAM4 (SECQ)" from 3.2 dB to 2.8 dB for 50GBASE-FR and from 3.4 dB to 3 dB for 50GBASE-LR.

Change note c to read "Receiver sensitivity (OMAouter) (max) is informative and is defined for a transmitter with a value of SECQ up to 2.8 dB for 50GBASE-FR and 3 dB for 50GBASE-LR."

In Table 139-8:

Change value for "Power budget (for max TDECQ)" from 7.6 dB to 7.2 dB for 50GBASE-FR and from 10.3 dB to 9.9 dB for 50GBASE-LR.

Change value for "Allocation for penalties (for max TDECQ)" from 3.6 dB to 3.2 dB for 50GBASE-FR and from 4 dB to 3.6 dB for 50GBASE-LR.

In 139.7.8 change "For 50GBASE-FR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 3.2 dB" to "For 50GBASE-FR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 2.8 dB" and change "For 50GBASE-LR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB" to "For 50GBASE-LR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 3 dB".

In Table 140-6 change value for "Transmitter and dispersion eye closure for PAM4 (TDECQ) (max)" from 3.4 dB to 3 dB.

In Table 140-7:

Change value for "Stressed receiver sensitivity (OMAouter) (max)" from -1.9 to -2.3 dBm.

Change value for "Stressed eye closure for PAM4 (SECQ)" from 3.4 dB to 3 dB.

Change note c to read "Receiver sensitivity (OMAouter) (max) is informative and is defined for a transmitter with a value of SECQ up to 3 dB."

In Table 140-8:

Change value for "Power budget (for max TDECQ)" from 6.5 dB to 6.1 dB for ER >= 5 dB and from 6.8 dB to 6.4 dB for ER < 5 dB.

Change value for "Allocation for penalties (for max TDECQ)" to "6.1 minus max channel insertion loss per Table 140-12" for ER >= 5 dB and

to "6.4 minus max channel insertion loss per Table 140-12" for ER < 5 dB.

In 140.7.8 change "a value of SECQ up to 3.4 dB" to "a value of SECQ up to 3 dB".

In 138.8.5, 139.7.5.3 and 140.7.5 change "Pth1, Pth2, and Pth3 are varied from their nominal values by up to ±1% of OMAouter in order to optimize TDECQ." to "Pth1, Pth2, and Pth3 are varied from their nominal values by up to ±1% of OMAouter in order to optimize TDECQ. The same three thresholds are used for both the left and the right histogram."

With editorial license."

For reference, the response to r02-27 is:

"ACCEPT IN PRINCIPLE.

The Task Force reviewed
http://www.ieee802.org/3/cd/public/May18/king_3cd_02a_0518.pdf and
http://www.ieee802.org/3/cd/public/May18/dawe_3cd_01b_0518.pdf.
A straw poll #9 was taken:
I would support to:
1. Introduce Tx rise-and-falltime specifications.
2. Introduce limitations to tap-weights
3. Make no change
Chicago rules.
1: 24
2: 5
3: 5
Make the changes on slides 3 - 7 of
http://www.ieee802.org/3/cd/public/May18/king_3cd_04_0518.pdf in Clauses 138, 139 and
140, with editorial license.
]

Cl **138**   *SC* **138.8.5.1**   *P* **273**   *L* **41**   # r02-48

Dawe, Piers J G   Mellanox Technologie

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

For some equalizer architectures, precursors are much more expensive than post-cursors (sun_3cd_042518_adhoc).
D3.1 comment 73.

SuggestedRemedy

When we have decided what range of MMF signals are useful and allowed, continue the improvement made in king_3cd_03_0118: change "Tap 1, tap 2, or tap 3, has" to "Tap 1 or tap 2 has".
There is a separate comment for SMF because the different TDECQ limit there could lead to a different conclusion.

Response   *Response Status* **U**

REJECT.

Allowing just one pre-cursor in the reference EQ means the transmitted signal, when propagated through a worst case channel, cannot have a significant amount of pre-cursor response at the receiver without suffering higher TDECQ penalty.

An electrical channel typically can guarantee that, however the chromatic and modal dispersion effects of the optical channel in combination with laser performance may require the extra tap. No evidence has been provided to show otherwise.

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general
COMMENT STATUS: D/dispatched A/accepted R/rejected   RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn
SORT ORDER: Comment ID

Comment ID **r02-48**   Page 6 of 8
2018-06-05 8:52:01 AM

Cl **139**　　　*SC* **139.7.5.3**　　　　*P* **297**　　　*L* **52**　　　# r02-52

Dawe, Piers J G　　　　　　　　Mellanox Technologie

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

In this draft, it is possible to make a bad SMF transmitter with emphasis (e.g. with a noisy or distorted signal) that even an equalizer better than the reference equalizer won't be able to improve. Note the receiver is tested for a slow signal only, not for such signals.

On the TDECQ map (see e.g. dawe_041818_3cd_adhoc-v2) we need to stop signals that are too high up the page.

D3.0 comment 116, D3.1 comment 71.

SuggestedRemedy

For a SMF TDECQ limit of 3.2 or 3.4 dB: Either:
1. Limit TDECQ -10*log10(Ceq) to <=2.8 dB for SMF PMDs.
or:
2. Define TDECQrms = 10*log10(A_RMS/(s*3*Qt*R)) where A_RMS is the standard deviation of the measured signal after the 13.28125 GHz filter response (before the FFE), Qt and R are as already in Eq 121-12. s is the standard deviation of a fast clean signal with OMA=2 and without emphasis, observed through the reference Bessel-Thomson filter response but before the reference equalizer (0.6254 for 13.28125 GHz).
Limit 3 dB for SMF PMDs. This could be added to the transmitter tables.

Response　　　　　　*Response Status* **U**

ACCEPT IN PRINCIPLE.

See comment response to r02-27 (rise and fall time) and r02-9 (on lowering TDECQ limit).

There was no support for adding a limit on TDECQ -10*log10(Ceq) or to define TDECQrms.

[
Editor's note added after comment resolution completed.

For reference, the response to r02-9 is:
"ACCEPT IN PRINCIPLE.
The Task Force reviewed the updated proposal in
http://www.ieee802.org/3/cd/public/May18/king_3cd_01_0518.pdf.
In Table 138-8 change value for "Transmitter and dispersion eye closure (TDECQ), each lane (max)" from 4.9 dB to 4.5 dB and change the parameter name to "Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane (max)".
In Table 138-9:
Change value for "Stressed receiver sensitivity (OMAouter), each lane (max)" from -3 to -3.4 dBm.
Change value for "Stressed eye closure (SECQ), lane under test" from 4.9 dB to 4.5 dB.
Change note d to read "Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 4.5 dB."
In Table 138-10:
Change value for "Power budget (for max TDECQ)" from 6.9 dB to 6.5 dB.
Change value for "Allocation for penalties (for max TDECQ)" from 5 dB to 4.6 dB.
In 138.8.7 change "Receiver sensitivity is informative and is defined for a transmitter with a

value of SECQ up to 4.9 dB" to "Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 4.5 dB"
Change the title for subclause 138.8.5 from "Transmitter and dispersion eye closure - quaternary (TDECQ)" to "Transmitter and dispersion eye closure for PAM4 (TDECQ)"
In Table 139-6 change value for "Transmitter and dispersion eye closure for PAM4 (TDECQ) (max)" from 3.2 dB to 2.8 dB for 50GBASE-FR and from 3.4 dB to 3 dB for 50GBASE-LR.
In Table 139-7:
Change value for "Stressed receiver sensitivity (OMAouter) (max)" from -5.1 to -5.5 dBm for 50GBASE-FR and from -6.4 dBm to -6.8 dBm for 50GBASE-LR.
Change value for "Stressed eye closure for PAM4 (SECQ)" from 3.2 dB to 2.8 dB for 50GBASE-FR and from 3.4 dB to 3 dB for 50GBASE-LR.
Change note c to read "Receiver sensitivity (OMAouter) (max) is informative and is defined for a transmitter with a value of SECQ up to 2.8 dB for 50GBASE-FR and 3 dB for 50GBASE-LR."
In Table 139-8:
Change value for "Power budget (for max TDECQ)" from 7.6 dB to 7.2 dB for 50GBASE-FR and from 10.3 dB to 9.9 dB for 50GBASE-LR.
Change value for "Allocation for penalties (for max TDECQ)" from 3.6 dB to 3.2 dB for 50GBASE-FR and from 4 dB to 3.6 dB for 50GBASE-LR.
In 139.7.8 change "For 50GBASE-FR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 3.2 dB" to "For 50GBASE-FR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 2.8 dB" and change "For 50GBASE-LR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB" to "For 50GBASE-LR, receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 3 dB".
In Table 140-6 change value for "Transmitter and dispersion eye closure for PAM4 (TDECQ) (max)" from 3.4 dB to 3 dB.
In Table 140-7:
Change value for "Stressed receiver sensitivity (OMAouter) (max)" from -1.9 to -2.3 dBm.
Change value for "Stressed eye closure for PAM4 (SECQ)" from 3.4 dB to 3 dB.
Change note c to read "Receiver sensitivity (OMAouter) (max) is informative and is defined for a transmitter with a value of SECQ up to 3 dB."
In Table 140-8:
Change value for "Power budget (for max TDECQ)" from 6.5 dB to 6.1 dB for ER >= 5 dB and from 6.8 dB to 6.4 dB for ER < 5 dB.
Change value for "Allocation for penalties (for max TDECQ)" to "6.1 minus max channel insertion loss per Table 140-12" for ER >= 5 dB and
to "6.4 minus max channel insertion loss per Table 140-12" for ER < 5 dB.
In 140.7.8 change "a value of SECQ up to 3.4 dB" to "a value of SECQ up to 3 dB".
In 138.8.5, 139.7.5.3 and 140.7.5 change "Pth1, Pth2, and Pth3 are varied from their nominal values by up to ±1% of OMAouter in order to optimize TDECQ." to "Pth1, Pth2, and Pth3 are varied from their nominal values by up to ±1% of OMAouter in order to optimize TDECQ. The same three thresholds are used for both the left and the right histogram."
With editorial license."

For reference, the response to r02-27 is:
"ACCEPT IN PRINCIPLE.
The Task Force reviewed

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general
COMMENT STATUS: D/dispatched A/accepted R/rejected　　RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn
SORT ORDER: Comment ID

Comment ID **r02-52**　　　Page 7 of 8
2018-06-05 8:52:01 AM

http://www.ieee802.org/3/cd/public/May18/king_3cd_02a_0518.pdf and
http://www.ieee802.org/3/cd/public/May18/dawe_3cd_01b_0518.pdf.
A straw poll #9 was taken:
I would support to:
1. Introduce Tx rise-and-falltime specifications.
2. Introduce limitations to tap-weights
3. Make no change
Chicago rules.
1: 24
2: 5
3: 5
Make the changes on slides 3 - 7 of
http://www.ieee802.org/3/cd/public/May18/king_3cd_04_0518.pdf in Clauses 138, 139 and
140, with editorial license."
]

Cl **139**　　　*SC* **139.7.5.4**　　　　*P* **298**　　　*L* **5**　　　# r02-53

Dawe, Piers J G　　　　　　　Mellanox Technologie

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

For some equalizer architectures, precursors are much more expensive than post-cursors
(sun_3cd_042518_adhoc). Further investigation of possible minimally compliant SMF
signals and their associated TDECQ FFE settings indicates that 2 pre, 2 post (making the
cursor the third tap) is never significantly better than 1 pre, 3 post (making it the second
tap), for compliant signals. See dawe_3cd_01a_0318. Further refining the TDECQ search
rules will avoid inefficiency both in product receiver design, testing and operation, and in
TDECQ testing. D3.1 comment 76.

SuggestedRemedy

Continue the improvement made in king_3cd_03_0118: change "Tap 1, tap 2, or tap 3,
has" to "Tap 1 or tap 2 has". Do the same in 140.7.5.1 because the TDECQ limit is
similar. There is a separate comment for MMF because the different TDECQ limit there
could lead to a different conclusion.

Response　　　　　　　*Response Status*　**U**

REJECT.

Allowing just one pre-cursor in the reference EQ means the transmitted signal, when
propagated through a worst case channel, cannot have a significant amount of pre-cursor
response at the receiver without suffering higher TDECQ penalty.

An electrical channel typically can guarantee that, however the dispersion effects of the
optical channel in combination with chirp may require the extra tap. No evidence has been
provided to show otherwise.

Cl **139**　　　*SC* **139.7.9.1**　　　　*P* **299**　　　*L* **50**　　　# r02-55

Dawe, Piers J G　　　　　　　Mellanox Technologie

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

The choice of "at least half of the dB value of the stressed eye closure" is not consistent
with the transmitter specs.

SuggestedRemedy

When we have decided what range of signals are useful and allowed (for left-side limit, see
other comments), revise this "at least half" to be consistent. Add an "at most" limit
consistent with the right-side Tx limit. Also in 138 and 140.

Response　　　　　　　*Response Status*　**U**

REJECT.

No specific changes to the draft suggested.

TYPE: TR/technical required ER/editorial required GR/general required T/technical E/editorial G/general　　　*Comment ID*　**r02-55**　　　Page 8 of 8
COMMENT STATUS: D/dispatched A/accepted R/rejected　　　RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn　　　2018-06-05 8:52:01 AM
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