| C/ 138   | SC 138.7.1   | P 272   | L17  | # i-119  | C/ 138                     |                               | 138.8.5.1                                    | P 276   | L 38   | # r01-73  |
|--|--|---|--|--|----------------------------|-------------------------------|--|---|--|---|
| Dawe, Piers  | JG   | Mellanox Tec  | hnologies  |  | Dawe, Pier                 | s J G                         |  | Mellanox Tec  | hnologies  |   |
| Comment T  | ype TR   | Comment Status R  |  | TDECQ limit  | Comment                    | Туре                          | TR   | Comment Status R  |  | TDECQ precursor taps                                |
| receiver   | front-ends that sho<br>gnalling rate) witho  | is very high, given that the<br>buld not be worse can do<br>ut the FFE.   |  |  | TDEC<br>signific<br>Furthe | Q FFE<br>antly b<br>r refinir | settings indi<br>etter than 1<br>ig the TDEC | ossible minimally complian<br>icates that 2 pre, 2 post (m.<br>pre, 3 post (making it the s<br>CQ search rules will avoid i<br>tion, and in TDECQ testing | aking the curs<br>second tap), fo<br>nefficiency bot | or the third tap) is never<br>or compliant signals. |
| This nee   | eds more study. W  | e should be able to use in  | nformation from  | 302.3bm.   | Suggested                  |                               |  |   |  |   |
| Response<br>REJEC <sup>-</sup>   |  | Response Status U   |  |  | Chang                      | e "Tap                        | 1, tap 2, or                                 | tap 3, has" to "Tap 1 or tap<br>erent TDECQ limit there co  | 2 has". There  | e is a separate comment<br>lifferent conclusion.    |
| No obor  | an to document ou  | agostod   |  |  | Response                   |                               |  | Response Status U   |  |   |
| The issu   |  | ggested.<br>ECQ limit of 4.9 dB has no<br>quality metric to be higher   |  |  | REJEC                      | CT.                           |  |   |  |   |
| specifica  |  |   |  |  |                            |                               | osal was m<br>ne Task For                    | ade against draft 3.0 (comi<br>.ce.   | ments i-107 i-1                                      | 117 and i120) which was                             |
| C/ 138   | SC 138.7.1   | P 273   | L 22   | # r01-70   |                            | mood re                       |  | o to limit the main ten to to   | n 1 ton 2 or t                                       | on 2  |
| Dawe, Piers  | JG   | Mellanox Tec  | hnologies  |  |                            |                               |  | is to limit the main tap to ta<br>/cd/public/Mar18/dawe_3co   |  |   |
| Comment T  | ype TR   | Comment Status R  |  | TDECQ limit  | Task F                     | orce.                         | •  |   |  |   |
| receiver<br>same si  | front-ends that sho<br>gnalling rate) witho  | is very high, given that the<br>buld not be worse, can do<br>ut the FFE. D.30 comme<br>ECQ spec limit can be "ga  | 100GBASE-SR<br>nt 119.   | 4 (PAM2, almost the  |                            |                               | consensus<br>n to i-117 wa                   | to make the proposed cha<br>as:   | nge.   |   |
| SuggestedR   |  |   |  | mont (10).   |                            |                               | RINCIPLE.                                    |   |  |   |
| Compar   | e a minimally comp   | bliant 100GBASE-SR4 tra   |  | the TDECQ limit  |                            |                               |  | /cd/public/Jan18/king_3cd_  | _03_0118.pdf \                                       | with editorial license                              |
| Response   | •••••••  | Response Status U   | 0  |  |                            |                               |  |   |  |   |
| ,<br>REJEC <sup>-</sup>  |  |   |  |  |                            |                               |  |   |  |   |
| No spec  | cific change to docu   | ment suggested.   |  |  |                            |                               |  |   |  |   |
| precede<br>in SMF<br>To date<br>wavefor<br>impleme<br>Measure<br>See:<br>http://ww | ence for this kind of<br>specifications.<br>no contribution has<br>m that passes TDE<br>entation.<br>ed data has been p<br>ww.ieee802.org/3/ci | used by a TDECQ limit of<br>transmitter quality metric<br>been made that demons<br>CQ but cannot be decode<br>resented to the task force<br>d/public/Jan18/king_3cd_<br>d/public/adhoc/archive/ch | to be higher in N<br>strates the proble<br>ed by a reasonal<br>supporting the o<br>02_0118.pdf | MF specifications than<br>m, for example, a<br>ble receiver<br>current specifications. |                            |                               |  |   |  |   |

Comment ID r01-73

| C/ 139 SC ·  | 139.7.5.4  | P 301  | L <b>1</b>   | # r01-76                                     | C/ 138   | SC 13   | 8.7.1                          | P 270   | L <b>22</b>   | # r02-40   |
|--|--|--|--|--|--|---|--------------------------------|---|---|--|
| Dawe, Piers J G  |  | Mellanox Tecl  | hnologies  |  | Dawe, Pier   | 's J G  |                                | Mellanox Tec  | nnologies   |  |
| Comment Type   | TR   | Comment Status R   |  | TDECQ precursor taps                         | Comment  | Туре 1  | ſR                             | Comment Status R  |   | TDECQ limit  |
| TDECQ FFE s<br>significantly be<br>Further refinin   | settings indicetter than 1 p<br>g the TDEC<br>g and operat | ssible minimally compliant<br>cates that 2 pre, 2 post (ma<br>ore, 3 post (making it the s<br>Q search rules will avoid ir<br>on, and in TDECQ testing | aking the curso<br>econd tap), for<br>nefficiency both | r the third tap) is never compliant signals. | transm<br>(PAM2<br>2.5 wit   | litter, and<br>2, almost th<br>h represent<br>precise tap | receive<br>he sam<br>ntative   | B still has not been justified, g<br>r front-ends that should not b<br>e signalling rate) without the<br>drive. The high limit in the dr<br>ps) than needed for the MMF | e worse, can do<br>FFE. king_3cd_<br>aft would requir | 0 100GBASE-SR4<br>_02_0118 showed 1 to<br>e a better equalizer (e.g. |
|  | •  | ap 3, has" to "Tap 1 or tap  | 2 has" Do the  | same in 140 7 5 1                            | Suggested  | Remedy  |                                |   |   |  |
| because the T  | DECQ limit   | is similar. There is a separate could lead to a different  | arate comment  |  |  |   |                                | AM4 MMF transmitters do, an<br>hitter, and set the TDECQ lim  |   |  |
| Response   |  | Response Status U  |  |  | Response   |   |                                | Response Status U   |   |  |
| REJECT.  |  |  |  |  | REJEC  | CT.   |                                |   |   |  |
| See response   | to comment   | r01-73.  |  |  | No spe   | ecific chan   | iges to                        | the draft proposed.   |   |  |
| [ Editor's note  | added after  | comment resolution comp  | leted:   |  | See al   | so respon   | se to co                       | omment r02-39.  |   |  |
| For reference,   | the response   | e to comment r01-73 is co  | opied here:  |  | [  |   |                                |   |   |  |
| REJECT.  |  |  |  |  |  | erence, th  |                                | r comment resolution compleonse to r02-39 is:   | eted.   |  |
| A similar properties of the similar properties of the second seco |  | de against draft 3.0 (comr<br>æ.   | nents i-107 i-11                                       | I7 and i120) which was                       | No specific change to the draft proposed.<br>This is a duplicate of comment r01-69 against draft 3.1.<br>There is no support to consider one of the options from the remedy. |   |                                |   |   |  |
| http://www.iee<br>Task Force.  | e802.org/3/0   | to limit the main tap to tap<br>d/public/Mar18/dawe_3cd<br>o make the proposed chai  | _01a_0318.pd   |  | Measu<br>See: h<br>http://v  | ired data h<br>ttp://www.<br>www.ieee8                    | has bee<br>ieee802<br>302.org/ | n presented to the task force<br>2.org/3/cd/public/Jan18/king_<br>3/cd/public/adhoc/archive/ch<br>3/cd/public/May18/king_3cd_   | supporting the 3cd_02_0118.p ang_011018_3cd           | df .   |
| The resolution   | i to i-117 wa  | S:   |  |  | 1  |   |                                |   |   |  |
| ACCEPT IN P  | RINCIPLE.  |  |  |  |  |   |                                |   |   |  |

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 r02-40

| C/ 138 SC 138.8.5   |  | L 41                                | # <u>r02-48</u>         | C/ 139   |           | 139.7.5.4   | P 298   | L <b>5</b>      | # r02-53                |
|---|--|-------------------------------------|-------------------------|--|-----------|-------------|---|-----------------|-------------------------|
| Dawe, Piers J G   | Mellanox Tec   | nnologies                           |                         | Dawe, Pier   | sJG       |             | Mellanox Teo  | cnnologies      |                         |
| Comment Type TR   | Comment Status R   |                                     | TDECQ precursor taps    | Comment  | Туре      | TR          | Comment Status R  |                 | TDECQ precursor taps    |
| For some equalizer a<br>(sun_3cd_042518_ad<br>D3.1 comment 73.<br>SuggestedRemedy | rchitectures, precursors are mu<br>Ihoc).  | uch more expe                       | nsive than post-cursors | 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 |           |             |   |                 |                         |
| When we have decid<br>improvement made ir   | ed what range of MMF signals<br>h king_3cd_03_0118: change "   |                                     | -                       | will avo   | oid inef  |             | th in product receiver desig  |                 |                         |
|   | tap 2 has".<br>There is a separate comment for SMF because the different TDECQ limit there could lead to |                                     |                         |  |           |             |   |                 |                         |
| a different conclusion  |  |                                     |                         | 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   |           |             |   |                 |                         |
| Response  | Response Status U  |                                     |                         |  |           |             |   |                 |                         |
| REJECT.   |  |                                     |                         |  |           | conclusion. |   |                 |                         |
| Allowing just one pre-  | cursor in the reference EQ me  | ans the transm                      | nitted signal, when     | Response   |           |             | Response Status U   |                 |                         |
| propagated through a  | worst case channel, cannot have ver without suffering higher TD  | ave a significar                    |                         | REJEC  | CT.       |             |   |                 |                         |
| An electrical channel<br>dispersion effects of                                    | typically can guarantee that, he<br>he optical channel in combinat<br>lence has been provided to sho     | owever the chro<br>ion with laser p |                         | propag   | ated th   | irough a w  | rsor in the reference EQ me<br>orst case channel, cannot h<br>without suffering higher TE | ave a significa | nt amount of pre-cursor |
|   |  |                                     |                         | An elec  | ctrical o | channel typ | ically can guarantee that, h  | owever the dis  | persion effects of the  |

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.

| C/ 001      | SC 1            | <i>P</i> 1                     | L1 | # <u>r</u> 03-6 |
|-------------|-----------------|--------------------------------|----|-----------------|
| Rannow, R K |                 | IEEE/SELF                      |    |                 |
| Comment Typ | oe GR           | Comment Status R               |    |                 |
| Various u   | ses of undefine | ed, and non-standard acronyms. |    |                 |

SuggestedRemedy

Response

Response Status U

REJECT.

This comment does not apply to the substantive changes between IEEE P802.3cd D3.2 and D3.3 or the unsatisfied negative comments from the previous ballots. Hence it is not within the scope of the recirculation ballot. (out of scope)

The commenter has not indicated which of the acronyms are undefined or non-standard. Nor has the commenter provided a suggested remedy.

Comment ID r03-6

| CI 138 SC 138  | .8.10  | P 275                 | L <b>45</b>   | # r03-24   |   | SC 138.7.1   | P <b>270</b>   | L <b>22</b>  | # r03-27   |
|--|--|-----------------------|---|--|---|--|--|--|--|
| Dawe, Piers J G  |  | Mellanox Tec          | hnologies   |  | Dawe, Piers J   | G  | Mellanox Tech  | inologies  |  |
| Comment Type T   | <b>R</b> Co  | mment Status R        |   | RIN limit  | Comment Typ   | e TR   | Comment Status R   |  | TDECQ limi   |
| In practice, the re<br>well as from RIN.<br>well to allow the S<br>RIN.<br>SuggestedRemedy<br>Change "should b<br>characteristics in<br>as appropriate.<br>Response<br>REJECT. | Although th<br>Although th<br>SRS to use th<br>De no greate<br>Table 138-8<br><i>Res</i> | experience noise from | on for these in the<br>of noise from all (<br>(max) specified fo<br>B/Hz) to "-127 dE | mode partition noise as<br>budget, it would be as<br>causes, not just from<br>or the transmit<br>b/Hz" or "-126 dB/Hz" | A TDECC<br>transmitte<br>(PAM2, al<br>2.5 dB wit<br>chang_01<br>although i<br>The high i<br>than need<br>SuggestedRe.<br>Consider<br>and comp<br>according<br>Response<br>REJECT.<br>PAM4 trai<br>in king_3o<br>draft 3.3 T<br>The same<br>138 reflec<br>equalizer. | e limit of 4.5 d<br>r, and receive<br>most the san<br>h representa<br>1018_3cd_0 <sup>-</sup><br>nuch of this v<br>imit in the dra<br>led for the SM<br><i>medy</i><br>what actual F<br>are a minima<br>ly, e.g. 4.0 df<br>nsmitters for<br>cd_03_0518 a<br>DECQ limit of<br>e reference re<br>ts the higher | B still has not been justified, g<br>er front-ends that should not b<br>he signalling rate) without the l<br>tive drive, and king_3cd_03_0<br>1_adhoc-v2 showed 2.1 to 3.1<br>vas with PRBS15.<br>aft would require a better equa<br>IF PMDs. D.30 comment 119<br>PAM4 MMF transmitters do (m<br>Illy compliant 100GBASE-SR4 | e worse, can do<br>FFE. king_3cd_<br>518 shows bette<br>dB, the lower er<br>lizer (e.g. more<br>, D3.1 comment<br>ore evidence like<br>transmitter, and<br>values up to 4.0<br>lide 9), which su<br>duct variability v<br>139, and 140. T<br>or MMF, not a c | me fibres and<br>100GBASE-SR4<br>02_0118 showed 1 to<br>er than 3.7 dB.<br>nd with threshold adjust,<br>precise tap settings)<br>t 70, D3.2 comment 40<br>e king_3cd_03_0518),<br>d set the TDECQ limit<br>dB have been shown,<br>upports the P802.3cd<br>with larger sample sizes.<br>The higher TDECQ for<br>different reference |
|  |  |                       |   |  | [Editor's r   | ote added af   | ter comment resolution comple  | eted.  |  |
|  |  |                       |   |  |   |  |  |  |  |
|  |  |                       |   |  | http://www  | v.ieee802.org  | for the cited presentations and<br>/3/cd/public/May18/king_3cd_<br>/3/cd/public/May18/dawe_3cd   | 03_0518.pdf  |  |
|  |  |                       |   |  |   |  |  |  |  |

Comment ID r03-27

| C/         138         SC         138.8.5.1         P 274         L 1         # r03-31           Dawe, Piers J G         Mellanox Technologies         Mellanox Technologi | C/ 138         SC 138.8.5.1         P 273         L 45         # [r03-32]           Dawe, Piers J G         Mellanox Technologies   |  |  |  |  |  |
|--|---|--|--|--|--|--|
| Comment Type       TR       Comment Status       R       TDECQ main tap magnitude         TDECQ for MMF is measured through a specially low bandwidth, so for the same extreme transmitter emphasis, the reference equalizer's largest magnitude tap coefficient is larger (0.87 vs. 0.8 in dawe_3cd_01b_0518) than for SMF. Further, the survey results for MMF (green points, slide 3, dawe_3cd_01b_0518) are all to the right of +0.5 dB. So the spec can be made more realistic, which makes building the SRS tester easier as well as removing unnecessary design space from the receiver.         SuggestedRemedy       (Just for Clause 138) in "the largest magnitude tap coefficient, which is constrained to be at least 0.8", change 0.8 to 1.         Response       Response Status       U   | Comment Type       TR       Comment Status       R       TDECQ precursor tap         For some equalizer architectures, precursors are much more expensive than post-cursors (sun_3cd_042518_adhoc).       D3.1 comment 73, D3.2 comments 7, 8, 48, 53.         SuggestedRemedy       When we have decided what range of MMF signals are useful and allowed, review the value of the second precursor considering chromatic and modal dispersion. If it's small, 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 and dispersion there could lead to a different conclusion. |  |  |  |  |  |
| REJECT.  | Response Response Status U<br>REJECT.   |  |  |  |  |  |
| TDECQ for MMF is measured through a receiver bandwidth which is lower that for SMF because it includes the channel response. TDECQ for SMF PMDs is measured through a worst case chromatic dispersion fibre which accounts for much, if not all, of the difference.  | Repeat of previous comments r02-48 and r02-53. During comment resolution on D3.2 a similar proposal was rejected for 50G PAM4 based PMDs.   |  |  |  |  |  |
| While VCSEL measurements to date have shown slightly higher TDECQ penalties than<br>SMF transmitters due to low bandwidth, this does not reflect low temperature performance<br>or future transmitter and VCSEL driver developments which would have better margins to<br>the TDECQ limit and better yield/lower cost. Increasing the minimum coefficient of the<br>largest magnitude tap will reduce the flexibility for the transmitter design.<br>There is no consensus to implement the proposed changes.  | The response to r02-48 is shown here for reference:<br>"REJECT<br>Allowing just one pre-cursor in the reference EQ means the transmitted signal, when<br>propagated through a worst case channel, cannot have a significant amount of pre-cursor<br>response at the receiver without suffering higher TDECQ penalty.<br>An electrical channel typically can guarantee that, however the chromatic and modal<br>dispersion effects of the optical channel in combination with laser performance may require<br>the extra tap. "  |  |  |  |  |  |

There was no related presentation for MMF PMDs, however there was a presentation on this topic for 50G SMF PMDs.

See: http://www.ieee802.org/3/cd/public/July18/sun\_3cd\_01b\_0718.pdf

Based on straw poll #8 there is no consensus to make the proposed change.

For reference the result of straw poll #8 is provided here:

Straw Poll #8 For 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4, I support constraining the largest magnitude tap coefficient to Tap 1 or tap 2. Yes: 1 No: 16

Comment ID r03-32

| C/ 139   | SC 139.7                            | .5.4   | P <b>299</b>  | L <b>5</b>       | # r03-37                  | C/ 138  | SC      | 138.7.2   |                                 | P 271                     | L17               | # <u>r04-11</u>   |  |
|--|-------------------------------------|--|---|------------------|---------------------------|---|---------|---|---------------------------------|---------------------------|-------------------|---|--|
| Dawe, Pie  | ers J G                             |  | Mellanox Tec  | hnologies        |                           | Dawe, Pier  | rs J G  |   |                                 | Mellanox Teo              | chnologies        |   |  |
| Commen   | t Type TR                           | С  | omment Status R   |                  | TDECQ precursor taps      | Comment   | Туре    | TR  | Comme                           | nt 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 (but not yet including chromatic dispersion). 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, D3.2 comment 53.  SuggestedRemedy Review the value of the second precursor considering chromatic dispersion. If it's small, |                                     |  |   |                  |                           | Even after the recent improvement to the transmitter spec, the penalty after equalization I before modal noise, at 4.5 dB on top of the 4.8 dB PAM4 penalty = 9.3 dB, is far higher th for any other optical Ethernet PMD type. Tiny amounts of modal noise will cause an additional penalty, magnified up by the "Pcross effect". There is only 0.1 dB in the budge for both mode partition noise and modal noise, which is about the same as in 100GBASE SR4 (max TDEC 4.3 dB << 9.3). This is too small unless these noises are much smaller this time. The effect of modal noise and mode partition noise and word partition noise with a very high TDECQ transmitter (D.30 comment 119, D3.1 comment 70, D3.2 comment 40, D3.0 comment 110, D3.1 comment 71, D3.2 comment 26) is higher than with a more moderate penalty after equalization or without equalization as in 100GBASE-SR4. |         |   |                                 |                           |                   |   |  |
| contir<br>to "Ta   | nue the improv<br>ap 1 or tap 2 h   | ap 1, tap 2, or tap 3, has"<br>DECQ a little if appropriate. | 100GBASE-SR4 takes this "Pcross" effect into account inside TDEC. Limiting TDECQ-<br>10log10(Ceq) helps, but more improvement is needed.<br>SuggestedRemedy |                  |                           |   |         |   |                                 |                           |                   |   |  |
|  | e is a separate<br>different conclu |  | t for MMF because the   | different TDE    | CQ limit there could lead | 00  |         | ,   | and max TD                      | ECQ-10loa10(Ce            | a) from 4.5 dB to | 4.2 dB.   |  |
| Response   |                                     |  | esponse Status U  |                  |                           | Reduce max TDECQ and max TDECQ-10log10(Ceq) from 4.5 dB to 4.2 dB,<br>Increase TDECQ-OMAouter min from -5.9 to -5.6 dBm,<br>and increase the allocation for mode partition noise and modal noise in the budget from 0.1   |         |   |                                 |                           |                   |   |  |
| REJE   | ECT.                                |  |   |                  |                           | dB to (   | 0.4 dB; | and/or  |                                 |                           |                   | -   |  |
|  | vidence has be<br>pecific.          | een show   | n that there is a problen   | n with the curre | ent draft. The remedy is  | Adjust the definition of TDECQ for MMF to take these noises into account.<br>The SECQ in SRS should be the combination of Tx TDECQ and these other penalties<br>4.5, so no change), and the SRS OMA should be the lowest OMA that can be received   |         |   |                                 |                           |                   |   |  |
|  |                                     |  | tation was reviewed and<br>/public/July18/sun_3cd_  |                  | f                         | below (receiver should not be tested outside its operating range): change SRS OMA 3.4 to -3.3 (but see another comment pointing out that the power levels have slipped should be corrected).<br>The budget table stays the same.  |         |   |                                 |                           |                   |   |  |
| Base   | d on straw pol                      | ls 6 and 7   | 7 there is no consensus   | to make the p    | roposed changes.          | Response  | -       |   |                                 | e Status U                |                   |   |  |
| For re   | eference the re                     | esults to s  | straw polls are shown he  | ere:             |                           | ,<br>REJE(  | CT.     |   |                                 |                           |                   |   |  |
|  |                                     | l support  | constraining the largest  | t magnitude ta   | p coefficient to Tap 1 or | Preser<br>review  |         | <http: td="" wv<=""><td>ww.ieee802.c</td><td>org/3/cd/public/S</td><td>ept18/dawe_3cd_</td><td>_01b_0918.pdf&gt; was</td></http:> | ww.ieee802.c                    | org/3/cd/public/S         | ept18/dawe_3cd_   | _01b_0918.pdf> was                                      |  |
| Yes:<br>No: 1  | 4<br>9                              |  |   |                  |                           | for NR  | Z. Insu | ifficient ev  |                                 | been provided to          |                   | ificantly less than 0.1 dB<br>enalty is large enough to |  |
|  | •                                   | I support  | constraining the largest  | t magnitude ta   | p coefficient to Tap 1 or |   |         |   | revious analy<br>g/3/aq/public/ | ysis:<br>/nov04/pepeljugc | oski_1_1104.pdf   |   |  |
| No: 1  |                                     |  |   |                  |                           | There   | was no  | support   | to make a ch                    | ange.                     |                   |   |  |
|  |                                     |  |   |                  |                           | Also, s   | see res | ponse to  | r04-12.                         |                           |                   |   |  |
|  |                                     |  |   |                  |                           |   |         |   |                                 |                           |                   |   |  |

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 r04-11

| C/ 138      | SC 138.7.1 | P 270         | L 22     | # <u>r</u> 04-12 |
|-------------|------------|---------------|----------|------------------|
| Dawe, Piers | JG         | Mellanox Tech | nologies |                  |

### Comment Type TR Comment Status R

TDECQ limit of 4.5 dB (on top of the 4.8 dB PAM4 penalty), is extremely high. Technology that can do 100GBASE-SR4 (PAM2, almost the same signalling rate but no equalizer) should do better, king 3cd 02 0118 showed 1 to 2.5 dB with representative drive, and king 3cd 03 0518 shows better than 3.7 dB. chang 011018 3cd 01 adhoc-v2 showed 2.1 to 3.1 dB, the lower end with threshold adjust, although much of this was with PRBS15. king 3cd 02a 0718 slide 12 showed a multi-peaked distribution including some "failing" transmitters, dawe 3cd 01b 0518 slide 8 showed one at 4 dB and a few significantly better. The high limit in the draft requires a better equalizer (e.g. more precise tap and threshold settings) than needed for the SMF PMDs, and we need some more room in the budget for modal noise. D.30 comment 119, D3.1 comment 70, D3.2 comment 40, D3.3 comment 27.

## SugaestedRemedv

Change max TDECQ and max TDECQ-10log10(Ceg) from 4.5 to 4.2 dB. Increase OMAouter-TDECQ in step.

Response

Response Status U

REJECT.

This comment is similar to R03-27.

100GBASE-SR4 does not include receiver equalization, whereas the 100GBASE-SR2 does; therefore the penalty for each cannot be easily compared.

PAM4 transmitters for MMF with measured TDECQ values up to 5 dB have been shown in http://www.ieee802.org/3/cd/public/May18/king 3cd 03 0518.pdf, http://www.ieee802.org/3/cd/public/May18/dawe 3cd 01b 0518.pdf (slide 9), and in http://www.ieee802.org/3/cd/public/July18/king 3cd 02a 0718.pdf (slide 12) which supports the P802.3cd draft 3.4 TDECQ limit of 4.5 dB, taking account of product variability with larger sample sizes.

http://www.ieee802.org/3/cd/public/July18/king 3cd 02a 0718.pdf also shows receiver sensitivity vs estimated SECQ for values up to 4 dB with no indication of problems.

The current TDECQ limit was arrived at as a compromise between transmitter and receiver capabilities.

The URLs for the presentations cited by the commenter and not called out above are: 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/dawe 3cd 01b 0518.pdf

Presentation <http://www.ieee802.org/3/cd/public/Sept18/dawe 3cd 01b 0918.pdf> was reviewed.

There was no support to make a change.

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

| C/ 138 S        | C 138.8.5.1 | P 276            | L <b>29</b> | # r04-13 |
|-----------------|-------------|------------------|-------------|----------|
| Dawe, Piers J ( | G           | Mellanox Tec     | hnologies   |          |
| Comment Type    | e TR        | Comment Status R |             | MMF TX   |

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

Make the MMF spec more consistent with the SMF specs so that a common equalizer IC can be used for both. While SMF TDECQ is measured for both extremes of channel, MMF TDECQ is measured for the slow channel only. That's OK, we can read across to the other case we don't measure, but recognise that a signal after a slow channel will look less emphasised than what the receiver has to tolerate. The reference equalizer's largest magnitude tap coefficient (0.8 for a fast channel) should be set consistently (as from the same transmitter) for the slow channel, dawe 3cd 01b 0518 proposed 0.87. The survey results for MMF (green points, slide 8, dawe\_3cd\_01b\_0518) are all to the right of +0.5 dB (or tap strength about 1.1). So we could tighten up more than this proposal, but this is consistent with the SMF specs and still allows a strongly over-emphasised transmitter. See presentation.

D3.3 comment 31.

## SuggestedRemedy

In "the largest magnitude tap coefficient, which is constrained to be at least 0.8", change 0.8 to 0.85. The SMF clauses can stay with 0.8.

Response Response Status U

REJECT.

VCSEL measurements to date have shown slightly higher TDECQ penalties than SMF transmitters due to low bandwidth, and the use of peaking can help to improve yield and reduce cost especially at process, temperature, and voltage corners.

Increasing the minimum coefficient of the largest magnitude tap will reduce the flexibility for the transmitter design.

Presentation <http://www.jeee802.org/3/cd/public/Sept18/dawe 3cd 01b 0918.pdf> was reviewed.

No support to make a change.

Comment ID r04-13

| C/ 138                                       | SC 138.8.5   | 1 P274  | L <b>2</b>   | # r04-14  |    |
|--|--|---|--|---|----|
| Dawe, Pie                                    | rs J G   | Mellanox Tec  | chnologies   |   |    |
| Comment                                      | Type <b>TR</b>   | Comment Status R  |  | Precurs   | or |
| (sun_3<br>D3.1 c<br>is not<br>with.          | Bcd_042518_ac<br>comment 73, D3<br>naturally biased<br>The argument in<br>deliberately stra          | rchitectures, precursors are milhoc).<br>8.2 comments 7, 8, 48, 53, D3.<br>I to postcursor, nor is the referent<br>the response to comment 32<br>nge transmitted signals that ca                  | 3 comment 32.<br>ence filter the tra<br>was incorrect fo | A direct-mod transmitte<br>Insmitter is assessed<br>Ir MMF. We should not |    |
| Suggested                                    | Remedy   |   |  |   |    |
| to "Ta<br>There                              | p 1 or tap 2 has<br>is a separate c  | ment made in king_3cd_03_0 <sup>-</sup><br>".<br>omment for SMF because the<br>here could lead to a different o   | different TDECC  |   | r. |
| Response                                     |  | Response Status U   |  |   |    |
| REJE   | CT.  |   |  |   |    |
| This c                                       | omment is simi   | ar to several earlier comments  | s including r03-32                                       | 2.  |    |
| The fi                                       | nal response to  | r03-32 was:   |  |   |    |
| simila<br>The re<br>"REJE<br>Allowi<br>propa | at of previous co<br>r proposal was<br>esponse to r02-4<br>CT<br>ng just one pre-<br>gated through a | omments r02-48 and r02-53. D<br>rejected for 50G PAM4 based<br>48 is shown here for reference<br>cursor in the reference EQ me<br>worst case channel, cannot h<br>ver without suffering higher TD | PMDs.<br>::<br>eans the transmit<br>ave a significant    | ted signal, when  |    |
| disper                                       |  | typically can guarantee that, h<br>he optical channel in combinat   |  |   |    |
| this to                                      | pic for 50G SM   | presentation for MMF PMDs,<br>- PMDs.<br>02.org/3/cd/public/July18/sun_   |  | ·   |    |
| Based  | on straw poll #  | 8 there is no consensus to ma   | ke the proposed  | change.   |    |
| For re                                       | ference the res  | ult of straw poll #8 is provided  | here:  |   |    |
| For 50                                       |  | 0GBASE-SR2, and 200GBAS coefficient to Tap 1 or tap 2.  | E-SR4, I suppor  | t constraining the  |    |
|  |  |   | ,  |   |    |

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 r04-14

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Yes: 1 No: 16 "

Presentation <http://www.ieee802.org/3/cd/public/Sept18/dawe\_3cd\_01b\_0918.pdf> was eviewed.

Straw Poll #3

For 50GBASE-SR, 100GBASE-SR2, and 200GBASE-SR4, I support constraining the largest magnitude tap coefficient to Tap 1 or tap 2. Yes: 2, No: 15

There is no consensus to make the change.

Precursor

| C/ 139      | SC 139.7.5.4 | P 299        | L <b>5</b> | # r04-16 |
|-------------|--------------|--------------|------------|----------|
| Dawe, Piers | s J G        | Mellanox Tec | hnologies  |          |

Comment Status R

For some equalizer architectures, precursors are much more expensive than post-cursors (sun\_3cd\_042518\_adhoc). 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 (but not yet including chromatic dispersion). See dawe\_3cd\_01a\_0318. The maximum chromatic dispersion is 3.2 ps/nm for 50GBASE-FR and 16 ps/nm for 50GBASE-LR. Compare 10GBASE-LR which is allowed 48 ps/nm. Scaling for signalling rate gives 7.2 ps/nm, twice as much as 50GBASE-FR. 10GBASE-LR doesn't have a receive equalizer and is not seen as dispersion-challenged. This indicates that it is likely that 50GBASE-FR doesn't need a second precursor, even with a direct mod transmitter. Improving the TDECQ search rules will avoid inefficiency both in product receiver design, testing and operation, and in TDECQ testing. D3.1 comment 76, D3.2 comment 53, D3.3 comment 37.

## SuggestedRemedy

Comment Type

TR

Continue the improvement made in king\_3cd\_03\_0118, as done for 100GBASE-DR: change "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-FR, tap 1 or tap 2, has the largest magnitude tap coefficient, and for 50GBASE-LR, tap 1, tap 2, or tap 3, has the largest magnitude tap coefficient. This coefficient is constrained to be at least 0.8".

There is a separate comment for MMF because the different TDECQ limit, dispersion and TDECQ test method there could lead to a different conclusion.

Response

Response Status U

REJECT.

This comment is similar to r03-47.

The final response to r03-47 is shown here for reference:

"REJECT.

This comment was received after the ballot closed. (late)

This is a similar comment to r02-53 for which the response is shown here for reference:

## "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."

The following presentation was reviewed and discussed.

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

Http://www.ieee802.org/3/cd/public/July18/sun\_3cd\_01b\_0718.pdf

Based on straw polls 6 and 7 there is no consensus to make the proposed changes. For reference the results to straw polls are shown here: Straw Poll #6. For 50GBASE-FR, I support constraining the largest magnitude tap coefficient to Tap 1 or tap 2. Yes: 4 No: 19 Straw Poll #7 For 50GBASE-LR, I support constraining the largest magnitude tap coefficient to Tap 1 or tap 2. Yes: 0 No: 19"

Presentation <a href="http://www.ieee802.org/3/cd/public/Sept18/dawe\_3cd\_01b\_0918.pdf">http://www.ieee802.org/3/cd/public/Sept18/dawe\_3cd\_01b\_0918.pdf</a>> was reviewed.

There was no support to make the change.

Comment ID r04-16

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| C/ 138 SC 138.8.5  | P 273  | L <b>47</b>             | # r05-2                  | http://www.ieee802.org/3/cd/public/May18/dawe_3cd_01b_0518.pdf (slide 9), a http://www.ieee802.org/3/cd/public/July18/king_3cd_02a_0718.pdf (slide 12)  | and in               |
|--|--|-------------------------|--------------------------|---|----------------------|
| Dawe, Piers J G  | Mellanox Tecl  | nnologies               |                          | which supports the P802.3cd draft 3.4 TDECQ limit of 4.5 dB, taking account c   | of product           |
| Comment Type TR  | Comment Status R   |                         |                          | variability with larger sample sizes.<br>http://www.ieee802.org/3/cd/public/July18/king_3cd_02a_0718.pdf also shows   | receiver             |
| is much higher than for<br>http://ieee802.org/3/cm/  | mments, the combination of a<br>SMF, is too high. See<br>public/adhoc/dawe_3cm_adh<br>n measured TDECQ and pe  | noc_01_092718.          | pdf                      | sensitivity vs estimated SECQ for values up to 4 dB with no indication of proble<br>The current TDECQ limit was arrived at as a compromise between transmitter<br>capabilities.<br>The URLs for the presentations cited by the commenter and not called out abo   | ems.<br>and receiver |
| SuggestedRemedy  |  |                         |                          | http://www.ieee802.org/3/cd/public/Jan18/king_3cd_02_0118.pdf<br>http://www.ieee802.org/3/cd/public/adhoc/archive/chang_011018_3cd_01_adh   | oc-v2 ndf            |
| R=sqrt(sigmaG^2 + sigr<br>where M = 0.0075Pave<br>[Note to reader: Pave is<br>In 138.8.10 Stressed reader: | d in place of Equation (121-1<br>naS^2 - M^2) (138-1)<br>already defined in 121.8.5.3<br>ceiver sensitivity, e.g. at page<br>tion (138-1) is set to zero, an | ]<br>e 275 line 46, ins | sert:                    | http://www.ieee802.org/3/cd/public/Aa/16/artifive/chang_011018_odd_01_ada<br>http://www.ieee802.org/3/cd/public/May18/dawe_3cd_01b_0518.pdf<br>Presentation <http: 3="" cd="" dawe_3cd_01b_0914<br="" public="" sept18="" www.ieee802.org="">reviewed.<br/>There was no support to make a change.</http:> |                      |
| Response   | Response Status U  |                         |                          |   |                      |
| REJECT.  |  |                         |                          |   |                      |
| This comment is a resta been recirculated.   | tement of previous comment   | ts (r04-11 and r0       | 04-12) that have already |   |                      |
| http://www.ieee802.org/  | ons were presented to and d<br>3/cd/public/Oct18/king_3cd_<br>3/cd/public/Oct18/dawe_3cd_  | 01_1018.pdf             | task force:              |   |                      |
| There was no support o remedy to the draft.  | ther than from the commente  | er for adopting th      | ne newly proposed        |   |                      |
| The response to comme  | ent r04-11 was:  |                         |                          |   |                      |
| REJECT.<br>Presentation <http: ww<br="">reviewed.</http:>  | w.ieee802.org/3/cd/public/Se   | pt18/dawe_3cd_          | _01b_0918.pdf> was       |   |                      |
| Previous analysis has s<br>for NRZ. Insufficient evi   | hown that the penalty for mo<br>dence has been provided to   |                         |                          |   |                      |
| warrant a change to the<br>See the following for pre<br>http://www.ieee802.org/                            | 5  | ski 1 1104.pdf          |                          |   |                      |
| There was no support to<br>Also, see response to r   | make a change.   |                         |                          |   |                      |
| The response to comme<br>REJECT.   | ent r04-12 (to which r04-11 re   | efers) was:             |                          |   |                      |
| This comment is similar  | to R03-27.<br>ot include receiver equalizat  | ion whereas the         | 100GBASE-SR2 does        |   |                      |
| therefore the penalty for  | each cannot be easily comp   | ared.                   |                          |   |                      |
|  | 1MF with measured TDECQ<br>3/cd/public/May18/king_3cd_   |                         | B have been shown in     |   |                      |
| TYPE: TR/technical required  |  |                         |                          |   | Page 10 of 10        |

COMMENT STATUS: D/dispatched A/accepted R/rejected RESPONSE STATUS: O/open W/written C/closed U/unsatisfied Z/withdrawn SORT ORDER: Comment ID