Cl **00** *SC* *P* *L* # **2**

Dallesasse, John Emcore Corporation

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

Per the vote in the November, 2004 meeting, the group needs to: ""...demonstrate a 10-12 BER over the rated distance on a specified channel (TBD) and show interoperability between PMD's of at least three vendors for 10GBASE-LRM to support technical feasibility prior to sponsor ballot."" This has not been done. The precedent established in IEEE 802.3ae can be synopsized by an excerpt from Jonathan Thatcher's comment regarding this topic that was submitted during 802.3ae balloting: ""...Feasibility means that technology must be demonstrated with reports and working models; proven technolgy; reasonable testing and with confidence in reliability..."" The presentations made to the 802.3ae Task Force in October and November of 2001 set a reasonable bar for the 802.3aq Task Force. The work of the 802.3aq task force on this subject should also contain confirmation that equalizer adaptation times ensure link stability under conditions typical for standard office environments, such as those called out in GR-63-CORE or IEC 61300-2-1, 2nd Edition, 2003-01.

Suggested Remedy

An adaptation of Thatcher's suggested remedy applies here as well: Demonstrate the technical feasibility of the technology specified in Clause 68 while ensuring the attainment of the other 4 criteria. Or, change the requirements/specifications such that this goal can be achieved.

Response *Response Status* **U**

REJECT.
Out of scope. Comment does not point out any deficiencies in Draft 2.0.
(TF has passed a motion that interop test is necessary prior to Sponsor Ballot)

Cl **00** *SC* *P* *L* # **6**

George, John

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

The parameters in clause 68 create a specification that will enable compliant transceivers to support a certain percentage of single installed multimode fibers - known as fiber coverage. In past IEEE optical PMDs where coverage was relaxed to less than 100% (99%) the coverage was calculated for bi-directional links. 10GBASE-LRM requires two fibers on which to operate a bi-directional link and the end user is concerned with link coverage. For example, if the 95% fiber coverage being proposed is adopted it will result in a dangerously low 90% link coverage which is unacceptable for a PMD that will be used primarily in backbone applications.

Suggested Remedy

SuggestedRemedy: For all modeling and affected parameters in clause 68, adjust values to assure an agreed upon bi-directional link coverage. For example, to achieve 95% link coverage requires 97.5% fiber coverage (0.975^2=0.95), and 99% link coverage requires 99.5% fiber coverage.

Response *Response Status* **U**

REJECT.
Motion to accept in principle
Stating that no changes required to document.
Moved: Mike Dudek
Seconded: Paul Kolesar

Vote to call question:
For: 23
Against: 11
Abstain: 1

Vote on motion
For: 9
Against: 23
Abstain: 4

Motion to reject
No specific remedy suggested.

Moved: Nick Weiner
Seconded: Jan Peeters Weem

Motion to call question:
For: 32
Against: 2
Abstain: 0

Vote on Motion:
For: 27
Against: 7

Abstain: 2
Motion passes.

Cl **01** *SC* **1.4** *P* **4** *L* **30** # **23**

Dawe, Piers Agilent

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

What's encircled flux? I couldn't find a definition either in P802.3am or P802.3aq

Suggested Remedy

Add a definition for encircled flux.

Response *Response Status* **U**

ACCEPT IN PRINCIPLE. Encircled flux: The integral of encircled energy from zero (fiber center) to r, where r varies from zero to 36 um (for 62.5 um fiber) or 29 um (for 50 um fiber), normalized to have unity peak value (at 36 or 29 um), so the units of measure are arbitrary but have dimension optical power (as a function of radius).

Note to editor: rs initalics.

Cl **68** *SC* **5** *P* **17** *L* **10** # **115**

Cobb, Terry Commscope

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

Table 68-2. The maximum operating range for 50 um fibers with 500/500 and 400/400 MHz-km modal bandwidths has not been substantiated.

Suggested Remedy

Use actual range limits based on necessary analysis and experiments using worst case models.

Response *Response Status* **U**

REJECT.
Specific remedy not suggested.

Cl **68** *SC* **6.6** *P* **23** *L* **46** # **116**

Lindsay, Tom ClariPhy Communicati

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

Another comment proposes changing the signal strength measurement from OMA to RF signal power where, in general, a stronger signal will improve the SNR at a slicer input. Although that proposal analyses the signal in a manner that is relevant to an EDC system, there still may be concern that the signal is highly distorted and could cause an implementation penalty cliff. Therefore, we may still need a separate cap on distortion. The current TWDP method is based on same-OMA scaling, and can incorrectly cause changes in signal strength to appear as a change in penalty.

Suggested Remedy

Some options (combinations are possible): 1. Impose non-idealities into the EDC emulator used with the TWDP code to represent real equalizers. Examples are finite EQ lengths or intentional timing error, which also presumes finite length. 2. Determine penalty via loss in SNR at the slicer input compared to a matched filter bound as determined by the signal at the channel input, including the transmitter. 3. Rely only on the Tx RF signal power metric until it is justified that an implementation penalty cliff exists.

Response *Response Status* **U**

REJECT.
Suggested remedy does not give specific change to document.

Cl **68** *SC* **68.5** *P* **17** *L* **10** # **160**

Kolesar, Paul Systimax

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

In Table 68-2, the maximum operating range for 50 um fibers with 500/500 and 400/400 MHz-km modal bandwidths have not been substantiated by simulation or experimental data. The properties of populations of these fibers are substantially different from 62.5 um and OM3 fibers so that they must be analyzed independently for each 50 um fiber type. For example, all specifications for operation on 62.5 and OM3 fibers were based on analysis with fibers having no less than 500 MHz-km bandwidth at 1300 nm. In addition the installed base of 50 um fibers with 500/500 bandwidth has a distinctly different bandwidth distribution than that of 62.5 um fibers.

Suggested Remedy

Perform necessary analysis and experiments to determine actual range limits. To that end, the Task 1 Channel Modeling ad-hoc group have been developing ""worst case"" fiber models for 50 um fibers of similar sort to that of the 108-fiber model developed for 62.5 um fibers. This work must be brought to completion and the results applied to determine actual operating ranges on the 500/500 and 400/400 MHz-km grades of 50 um fiber. Monte Carlo models or, preferably, actual fiber data will also be required to analyze statistical distributions and the dual launch approach.

Response *Response Status* **U**

REJECT.
Specific change to document not suggested.

Cl **68** *SC* **68.5** *P* **17** *L* **78** # **165**

Abbott, John Corning Incorporated

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

The long standing philosophy in 802.3 is to employ worst case design values to ensure a robust system. The LRM specifications need to balance requirements for (a) worst case design (i.e. failure rate of less than 1%); (b) functional objectives (i.e. 300m & BER<10^-12), and (c) low cost/complexity (i.e. PIE-D = 5dB). The ISI parameters in Table 68-4 for the comprehensive stressed receiver test are not consistent with a 1% duplex link failure rate based on Monte Carlo modeling with the Gen67YY data set; nor are they consistent with a 1% single channel failure rate based on calculations using actual 98-99 fiber DMD data. Hence the link length will need to be reduced so that (a)-(b)-(c) are all met.

Suggested Remedy

The specific suggested remedy based on simulation results and actual fiber DMD data is to reduce the length 15% to 255m in table 68-2 p.17 lines 7-9 for 62.5.um fiber. The required change in target length needs to be finalized by 802.3aq once the complexity (c) is finalized.

Response *Response Status* **U**

REJECT.
See comment 158.

Motion to accept in principle.
See comment 158; Beyond this, further change not required.
Moved: David Law
Seconded: Mike Dudek.

Motion to amend
See comment 158; Also change 62.5um and 500/500 50um 300m operating range upper limits to 220m in Table 68-2.
Moved: Paul Kolesar
Seconded: Steve Swanson
For: 7
Against: 23
Abstain: 2
Motion to amend fails

Motion to amend
Reject with same explanation.
Moved: Piers Dawe
Seconded: Jonathan King
For: 22
Against: 6
Abstain: 3

Motion becomes:

Motion to reject.
See comment 158; Beyond this, further change not required.
Moved: David Law
Seconded: Mike Dudek.

For: 30
Against: 4
Abstain: 2

Cl **68** *SC* **68.5** *P* **18** *L* **9** # **166**

Abbott, John Corning Incorporated

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

The center wavelength range of the laser in table 68-3 is 1260-1355nm. A calculation has been done to determine the impact on failure rate as the laser wavelength is shifted from 1300 to 1355nm. A similar calculation was done by TIA during the development of the OM3 product (see Pepeljugoski et al., JLT vol.21 No.5 May 2003 p.1273 figure 17); in that case the failure rate increased by 0.3% as the wavelength shifted 5nm off of 850nm. Calculations based on the Gen67YY Monte Carlo set indicate that shifting from 1300 to 1355nm increases the failure rate between .75%(PIE-D=5) and 1.5%(PIE-D=4) depending on PIE-D required. Hence the target length will need to be reduced slightly.

Suggested Remedy

The specific suggested remedy based on simulation results is to reduce the LRM length by 10% to 270m in table 68-2 p.17 lines 7-9 for 62.5.um fiber. The calculation of the required change in target length needs to be verified by the 802.3aq LRM task force. The calculation will need to be repeated and the target length will change if there are adjustments in the required complexity (c) [PIE-D implicit in comprehensive stressed receiver test] and target % failure rate [coverage of installed base]. A similar effect is expected with OM3 fiber.

Response *Response Status* **U**

REJECT.

Motion to reject with the explanation:
TP2 group has recommended that we choose or create TP2 stressors that are approximately 0.07dB greater than TP3 stressors and enter into TWDP code. However no changes to Draft 2.0.
Moved: David Law
Seconded: Norm Swenson
Passed without opposition

Cl **68** *SC* **68.5.1** *P* **18** *L* # **167**

Weiner, Nick Phyworks

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

Transmit signal rise and fall times: For all analysis leading to the development of the clause and receiver tests in particular, transmit signal rise and fall times of 47ps has been assumed. For link behaviour as predicted by the analyses, this rise and fall time needs to be achieved. New transmitter parameter suggested, togeher with test pattern and measurement method subclause.

Suggested Remedy

New row for Table 68-3 (transmit characteristics): ""Signal rise time and fall time (20 % to 80 %)"" ""max"" ""47"" ""ps"". New row for Table 68-5 (test patterns): ""Transmit signal rise and fall times"" ""Square, ten ONEs and ten ZEROs"" ""68.6.X"" New subclause (after 68.6.5): 68.6.X Transmitted signal rise and fall time The transmitted signal rise and fall times are measured between 20 % of the OMA above the mean logic ZERO value and 20 % of the OMA below the mean logic ONE value.

Response *Response Status* **U**

REJECT.
TWDP ensure adequate tx performance. This test not needed.

Cl **68** *SC* **68.5.1** *P* **18** *L* **28** # **173**

Dawe, Piers Agilent

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

The eye mask coordinates might need minor tweaking when we know more about the range of acceptable transmitters from the TP2 study. I do not wish to adjust them now but I am logging this comment to put the issue on the living list.

Suggested Remedy

When the TP2 study is complete and TWDP is settled, review the eye mask coordinates for consistency (should be a little bit easier than TWDP), and make small changes if necessary.

Response *Response Status* **U**

REJECT.
Specific remedy not proposed.

Cl **68** *SC* **68.5.1** *P* **18** *L* **30** # **174**

Dawe, Piers Agilent

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

The TWDP limit must be revised to agree with what cost-effective transmitters can do. It is not obvious that the stressors need be included in TWDP at all, and their inclusion may (dis)favour specific transmitters against equivalently useful transmitters according to the choices made in defining the three stressors. This is another comment that we may not be able to close for a while. Note that TWDP is the best thing we have; we do need a relevant test of transmitter quality, and eye mask is not relevant enough. 'Just get rid of TWDP' is not a practical option.

Suggested Remedy

Investigate the usefulness of a 'TWP' metric without emulated fibers. If this doesn't work, consider whether the relevant criterion is the worst of the three cases, the worst difference to PIE-D or PIE(n,m) of the Gaussian reference transmitter with those cases, the mean of the three cases, the mean of the three differences, or what. Choose a new and suitable limit.

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68** *SC* **68.5.2** *P* **19** *L* **31** # **200**

CUNNINGHAM, DAVID AGILENT TECHNOLO

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

The three sets of ISI parameters need to be replaced by new ones. At the end of the last two meetings it was generally agreed that they were approximate placeholders. In addition, the methodology used to select the ISI stressors is flawed because it does not take into account the purpose of project 10GBASE-LRM per the approved PAR (see text from PAR). The purpose of 10GBASE-LRM dictates a reasonable balance between the following: Support of FDDI-Grade fiber and lower-cost smaller form factor transceivers per the 10GBASE-LRM PAR parts 14. The stress test stressors should not be based on PIE_D values of worst-case link scenarios. Rather to allow lower cost, lower power implementations, the stressors should be back-off from the worst-case PIE_D values. This approach would mimic the proven methodology used by Gigabit Ethernet in the original development of SRS conformance tests for Ethernet. The objectives for the stress test should be: a) With reasonable confidence disallow poor EDC implementations (e.g.: insufficiently long FFE section, very noisy optical-equalizer combinations). b) Ensure that a compliant receiver can recover valid but highly stressed signals. In common with Gigabit Ethernet the LRM stress signals should not be worst-case stress signals.

Suggested Remedy

I believe that new stressors are to be proposed for the comment review meeting. If they are closer to 4 dBo PIE_D equivalent than 4.5 dBo PIE_D equivalent I am likely to support them.

Response *Response Status* **U**

REJECT.
No specific remedy suggested.

Cl **68** *SC* **68.5.2** *P* **19** *L* **41** # **205**

Dawe, Piers Agilent

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

Rise time for simple stressed receiver test needs to be appropriately related to comprehensive stressed test tap weights. We will need to consider the metric for comparison, the desired deliberate offset, implications of noise loading and of difference in signal levels. We should pick a new rise time that is easier for the receiver than the comprehensive stressed receiver sensitivity spec by an amount to cover experimental tolerances.

Suggested Remedy

Considering all the above, choose a new rise time that is a little easier for the receiver than the comprehensive stressed receiver sensitivity spec.

Response *Response Status* **U**

REJECT.
Specific remedy has not been suggested.

Cl **68** *SC* **68.5.2** *P* **20** *L* **7** # **213**

Thompson, Geoff

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

The receiver max input should be able to tolerate the max transmitter output likely to be encountered (plus margin) and be stated as such.

Suggested Remedy

Change the text that reads:
"f The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having a power level equal to the average receive power (max) plus at least 1 dB."

To:
"f The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having a power level equal to the average transmit power (max) of any 802.3 optical transmitter plus at least 1 dB."

Response *Response Status* **U**

REJECT.
The present value covers existing 802.3 multimode PMDs. Not possible to anticipate future standards.

Cl **68** *SC* **68.52** *P* **17** *L* **20** # **215**

George, John

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

Statement must be normative.

Suggested Remedy

Receivers will have to tolerate dynamically changing impulse response shapes and PIE-D with changes in polarization and fiber shaking. This has been shown is balemarthy_1_0105, king_1_1104, and meadowcroft_1_0105. Thus, the statement should clearly be identified as normative by removing the words "Also, for information".

Response *Response Status* **U**

REJECT.
See proposed response to comment 1.

Motion to accept this response:
Moved: Jonathan King
Seconded: Piers Dawe

For: 21
Against: 6
Abstain: 3

Cl **68** *SC* **68.6** *P* **18** *L* **15** # **216**

Swenson, Norman ClariPhy Communicati

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

Table 68-3: Min OMA and Max OMA are not appropriate for specifying a transmit power when predistorion is permitted in the transmit waveform.

Suggested Remedy

A new measure of transmitted power needs to be defined in terms of the standard deviation of the transmitted power. It is this value that is directly related to the matched filter bound, which is currently used as a figure of merit for the TWDP test.

Response *Response Status* **U**

REJECT.
Detailed change to document not suggested.

Cl **68** *SC* **68.6.1** *P* **20** *L* **45** # **231**

Dawe, Piers Agilent

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

Did we come to a conclusion on 511 bits vs. 512 bits? Is the following correct?

Suggested Remedy

Change 'is also acceptable' to 'has the advantage of balance but can cause triggering and aliasing problems'.

Response *Response Status* **U**

REJECT.
Not consensus within Task Force on the advantage of 512 bit code.

Cl **68** *SC* **68.6.10** *P* **32** *L* **3** # **245**

Dawe, Piers Agilent

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

The contents of table 68-12, and the labels in figure 68-12, will need revision as we change and renormalise the stressors.

Suggested Remedy

Follow other comments.

Response *Response Status* **U**

REJECT.
Can not be accepted at present.

Cl **68** *SC* **68.6.2** *P* **17** *L* **40** # **251**

Swenson, Norman ClariPhy Communicati

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

OMA, as it is used in Clause 68, should be the difference between steady state ""on"" power of the transmitter and steady state ""off"" power of the transmitter. The measurement method proposed does not guarantee that this is the value measured, particularly if there is ringing or precompensation.

Suggested Remedy

Change the TWDP algorithm to compute OMA from the measured waveform.

Response *Response Status* **U**

REJECT.
Specific changes not suggested.
For: 15
Against: 3

Cl **68** *SC* **68.6.2** *P* **17** *L* **45** # **255**

Dawe, Piers Agilent

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

This definition of signal amplitude leads to measurement inconsistencies. Tying down the square wave pattern more precisely would lead to arbitrariness in our measurement. In 802.3ae these didn't matter because OMA was primarily used as an intermediate token in a calculation of something else - an error in OMA cancels itself out by subtraction. For LRM, we need a more precise measure of signal amplitude for TWDP. If we are to consider or allow transmitter pre-emphasis, we need a definition of signal amplitude that represents a pre-emphasised signal fairly. However, we could create a new one for TWDP use and stick with OMA for general use.

Suggested Remedy

The histogram-at-crossing-times method is, I believe, more reproducible for non-equalised signals and fairer for equalised ones, both at TP2. But it may not be very reproducible for pre-emphasised signals, and it's not good at TP3 after a difficult fiber. I don't have a wholly satisfactory remedy at present; this TR may hang around until we have done more work to prove out the TWDP method.

Response *Response Status* **U**

REJECT.

Motion to reject comments:
255, 297, 293, 391, 393, 428, 174, 281, 294,, 299, 304, 302

No consensus to make change.

Moved: Tom Lindsay
Seconded: Sudeep Bhoja

Passed without opposition.

Cl **68** *SC* **68.6.5** *P* **22** *L* **49** # **273**

Dawe, Piers Agilent

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

The appropriate hit ratio was calculated for a non-equalising link. At some point before the end of the project we should confirm or change it as appropriate for our non-equalising situation. I don't expect that any change would be a big deal in practice, so it's not top priority.

Suggested Remedy

Review the hit ratio; change if appropriate.

Response *Response Status* **U**

REJECT.
Specific remedy not suggested.

Cl **68** *SC* **68.6.5** *P* **23** *L* **14** # **276**

CUNNINGHAM, DAVID AGILENT TECHNOLO

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

The eye mask of Figure 68-6 with co-ordinates from Table 68-3 was arbitrarily relaxed from that of 10GBASE-LR. No clearly articulated case has been presented that justifies the current co-ordinate selection. The eye mask may need change.

Suggested Remedy

Justify the current co-ordinates or show that another set is required.

Response *Response Status* **U**

REJECT.
Precise change not specified.

Cl **68** *SC* **68.6.6** *P* **23** *L* **45** # **278**

CUNNINGHAM, DAVID AGILENT TECHNOLO

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

TWDP as described in 68.6.6 and specified in Table 68-3, page 18, line 30 needs to be recalculated. There are a few reasons for this as follows: 1) For very long DFE equalizers the correctly normalized TWDP can be shown to be: TWDP = PIE_D - 5log(<P(f)/N(f)>g) + 5log(<P(f)/N(f)>a) (in dBo) where PIE_D is per Bhoja_1_0704 for the NRZ reference case, P(f) is the power spectrum of pre-distorted NRZ with random data, N(f) is the power spectrum of the reference NRZ with random data, < >g represents the geometric mean and < >a represents the arithmetic mean. To get the equation for TWDP in this form I have used an approximation by using PIE_D as the first term - but this a very good approximation and does not affect my argument. The current method of calculating TWDP does not properly account for the last term in this equation. The last term represents the increased transmit power for the waveform under test relative to the NRZ reference waveform. When this term is taken into account it becomes clear that TWDP is approximately constant and equal to PIE_D independent of the waveform. However, non-symmetric pre-distortion is generally damaging as it introduces a line spectrum that can be associated with wasted un-equalised power and jitter. 2) The channels used for estimating TWDP are not yet agreed within 10GBASE-LRM and are expected to change.

Suggested Remedy

Correct the TWDP method so that it properly normalises the transmit power for waveforms under test relative to the NRZ reference. My comment on making the OMA a more fair representation is relevant to this issue. If that is accepted then I believe it will fix this issue too. Track the agreed test channels within 10GBASE-LRM and calculate TWDP with the most current channels.

Response *Response Status* **U**

REJECT.
No consensus for change.

Cl **68** *SC* **68.6.6** *P* **23** *L* **47** # **279**

Dawe, Piers Agilent

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

As Intel have shown, there might be transmitter defects that are not caught by our suite of eye mask, TWDP, SNR and random jitter. This is another comment that will have to stay open 'just in case'.

Suggested Remedy

If there are likely and serious defects not screened for, decide what to do; e.g. give a warning, do nothing, modify a test, add a new test.

Response *Response Status* **U**

REJECT.
No specific remedy suggested.

Cl **68** *SC* **68.6.6** *P* **23** *L* **51** # **281**

Dawe, Piers Agilent

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

I'm not convinced that TWDP needs to include a set of emulated fibers; they may skew the test towards transmitters that perform relatively well with these specific cases, rather than well over a wide range of fibers. And if we can do without the emulated fibers, things get a bit simpler.

Suggested Remedy

Investigate whether TWDP really needs or benefits from the set of emulated fibers. If not, rename it 'TWP', change 'with standard emulated multimode fibers and receiver' to 'with a standard receiver'. Change 68.6.6.1 p 24 line 22 'This algorithm analyses the waveform in combination with each of three emulated channels, equivalent to those given in Table 68-4 for the comprehensive stressed receiver specifications, and with an emulated reference receiver equalizer.' to 'This algorithm analyses the waveform with an emulated reference receiver equalizer.'. Delete this sentence: 'The TWDP measurement is the largest of the three penalty results.' Change the algorithm (p 24 lines 48-54, p25 lines 1 2 18-24 p26 lines 23-25) and Annex 68A to match.

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68** *SC* **68.6.6.1** *P* **24** *L* **18** # **285**

Dawe, Piers Agilent

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

We need to give the reader the information needed to get from a captured waveform at e.g. 7 samples/UI to a processable one. How is the interpolation to be done? Is an oversampling rate of 16 a requirement? Would 8 work? Would 32 be better? Would an odd number work? (I believe not). How is the alignment done? We'll try to bring partial information on these subject to the meeting. I expect we will be able then to start writing text along the lines of 'Measurement at 7 samples/UI would give a measurement-related error about x dB (sign?), 8 or 10 samples/UI would... Interpolation methods Y and Z may have consequences A and B. A timestep of 1/c UI for the calculation is OK/bad; an even number of c is required.' Notice that there's an alignment in 40.6.1.2.4.

Suggested Remedy

Remove the sentence at line 18 'effective sample rate of at least 7 samples per unit interval is required.', insert a new paragraph (to be written) at line 27.

Response *Response Status* **U**

REJECT.
No specific remedy suggested.

Cl **68** *SC* **68.6.6.2** *P* **24** *L* **30** # **293**

Swenson, Norman ClariPhy Communicati

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

The TWDP algorithm scales the OMA of the measured waveform to 1 and sets the noise spectral density accordingly. A matched filter bound for a rectangular pulse with OMA 1 is used as a reference point for determining TWDP. This penalizes waveforms with larger OMAs and less predistortion in a manner that does not accurately predict link performance.

Suggested Remedy

Change the TWDP algorithm to accurately measure the matched filter bound of the transmitted waveform and compare that to the effective SNR at the slicer of the reference equalizer. Define limits that will ensure link closure with a compliant channel and receiver.

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68** *SC* **68.6.6.2** *P* **24** *L* **42** # **297**

Dawe, Piers Agilent

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

re 'OMA and steady-state ZERO power must also be specified.': I don't think this is viable as it stands. The assumed steady-state ZERO power matters remarkably little but the assumed OMA is too important.

Suggested Remedy

Make the program calculate the things it needs, or at least explain clearly how they can be found with adequate accuracy. OMA may not be the right (robust, accurate, fair) metric.

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68** *SC* **68.6.6.2** *P* **24** *L* **47** # **298**

Dawe, Piers Agilent

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

Is an oversampling rate of 16 a requirement?

Suggested Remedy

Decide and make clear.

Response *Response Status* **U**

REJECT.
16 is not a firm requirement, but it works, and consistency should help. The commenter is encouraged to propose a specific alternative if it is needed.

Cl **68** *SC* **68.6.6.2** *P* **24** *L* **52** # **299**

Dawe, Piers Agilent

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

It's a nuisance that the test cases are arranged in columns here while they are in rows in table 68-4.

Suggested Remedy

FiberResp = [...
0.000000 0.072727 0.145455 0.218182
a b c d
e f g h
I j k l];
Delays = FiberResp(1,:); need to check if that should be FiberResp(1,:)';
(in STEP 1)
Pcoefs = FiberResp(i+1,:); need to check if that should be FiberResp(i+1,:)';

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68** *SC* **68.6.6.2** *P* **24** *L* **52** # **300**

Dawe, Piers Agilent

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

The emulated fiber tap weights are wrong.

Suggested Remedy

Revise them following table 68-4.

Response *Response Status* **U**

REJECT. .
No specific remedy suggested.

Cl **68** *SC* **68.6.6.2** *P* **25** *L* **29** # **303**

Dawe, Piers Agilent

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

The functions butter and freqs are toolbox functions (extra cost, probably not readily portable). As the details of the anti-aliasing filter are not supposed to matter, can we replace this with something simpler? It's easy to avoid butter, if one knows that a = 1 123.14 7581.8 273450 4931300 and b = 0 0 0 0 4931300. Not sure how to get rid of freqs. Can we just write down a filter in a form like 1+cos(f/f0)^4 ?

Suggested Remedy

Replace toolbox functions with 'plain vanilla' code, changing the filter type if it helps.

Response *Response Status* **U**

REJECT.
Specific remedy not provided.

Cl **68** *SC* **68.6.9.1** *P* **28** *L* **11** # **333**

Kolesar, Paul Systimax

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

The comprehensive stressed receiver sensitivity test insufficiently tests the capability of the receiver. Experimental reports from more than one laboratory (e.g. Balemarthy_1_0105) have shown that waveform changes induced by variations in singlemode polarization state cause variations up to 2.5 dB in PIE-D. The ability of the receiver to track such changes is untested, although the ability to support such waveform changes is required in clause 68.5.2. While arguments have been put forth that these waveform variations happen at speeds well below the feedback loop time constants of EDC chips, there are other aspects besides speed of adjustment that determine the ability of the equalizer to faithfully track such changes without inducing bit errors. For examples, the chips ability to hold accurate clock recovery, correctly adjust its coefficients (tracking accuracy), and have sufficient headroom in its adjustment range are not established only by the speed of its feedback loop. These aspects can be checked in aggregate by a test that induces variation in the received waveform that emulate changes induced by mechanical perturbation observed experimentally.

Suggested Remedy

Add a dynamic aspect to the comprehensive stressed receiver sensitivity test. One means of accomplishing this would be to vary the tap weights of the ISI generator of figure 68-10 to emulate experimentally captured waveform changes induced by polarization state variations or multimode fiber shaking. This approach has the advantage of leveraging the measurement configuration of the existing test. The frequency of the variation should be at least 10 Hz, and the amplitude of the tap weight changes within a full cycle should be sufficient to cause an increase of 2.5 dB in PIE-D relative to the three presently defined comprehensive stressed receiver test signals of table 68-6. A possible alternative approach, if it can be shown to impart similar rigor, would be to continuously vary the test signals from the defined pre-cursor to split symmetrical to post-cursor conditions (and back again) at a rate of at least 10 Hz during the comprehensive stressed receive test.

Response *Response Status* **U**

REJECT. See proposed response to comment 1.

Also, to further address specific points raised in the comment:
Commenter> .. The chips ability to hold accurate clock recovery
Editor> This is tested during the separate comprehensive stressed receiver tests.
Commenter> .. Correctly adjust its coefficients (tracking accuracy)
Editor> Correct (and accurate) adjustment of coefficients is verified by the existing comprehensive stressed receiver tests. Tracking ability is the only aspect that would be verified by a dynamic test, and this is easily verified using informal methods.
Commenter>.. Have sufficient headroom in its adjustment range
Editor> This is verified by the existing comprehensive stressed receiver tests.

Motion to accept above response:
Moved Scott Schube
Seconded Jan Peeters Weem

Motion to call the question:
For: 24

Against: 5
Abstain: 4

Vote on motion:
For: 24
Against: 5
Abstain: 5

Cl **68** *SC* **68.8** *P* **34** *L* **4** # **367**

Thompson, Geoff

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

The text:
"Insertion loss measurements of installed multimode fiber cables are made in accordance with ANSI/TIA/EIA-526-14A/Method B or IEC 61280-4-1/Method 1." is ambiguous. I don't know how to do a conformance check on this unless I do both tests. Since this is supposed to be drafted as an international standard the TIA reference should be deleted.

Suggested Remedy

Change the text to read:
"Insertion loss measurements of installed multimode fiber cables are made in accordance with IEC 61280-4-1/Method 1."

Response *Response Status* **U**

ACCEPT IN PRINCIPLE.
Change the text to read:
"Insertion loss measurements of installed multimode fiber cables are made in accordance with IEC 61280-4-1/Method 2"
Method 1 was incorrectly referenced in Draft 2.0.

Cl **68** *SC* **68.9.1** *P* **28** *L* **1** # **369**

George, John

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

The comprehensive stress receiver sensitivity test does not include response variations caused by polarization changes and fiber shaking. Such impairments have been shown to occur in MMFs in balemarthy_1_0105, king_1_1104, and meadowcroft_1_0105.

Suggested Remedy

A dynamic component must be added to the comprehensive stressed receiver sensitivity test. A suggested approach: During the comprehensive stressed receiver sensitivity test, the tap weights of the ISI stressors should be randomly varied at a frequency from 6 to 20 Hz in such a way as to produce PIE-D variations, relative to the statically measured PIE-D, of +/- 1.25 dB for offset launch and +/- 1.75 dB for center launch.

Response *Response Status* **U**

REJECT.
See response to comment 1.

Response agreed by consensus

Cl **68** *SC* **Table 68-2** *P* **17** *L* **7** # **389**

Dallesasse, John Emcore Corporation

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

The operating range of 300 meters has an unspecified statistical success rate. Because the goal of a low-cost module is not consistent with the goal of > 99% link success due to the added cost associated with more complex equalizer architectures, the standard needs to explicitly state the best estimate of link success for a duplex link.

Suggested Remedy

Add a footnote f to Table 68-2: f) The estimated statistical success rate for achieving a BER of less than 10^-12 on 300 meter links is less than 91%. This assumes a single-link success rate of 95% or higher, and may need to be adjusted as final parameters are selected by the group.

Response *Response Status* **U**

ACCEPT IN PRINCIPLE.
See comment 158.

Cl **68** *SC* **Table 68-3** *P* **18** *L* **17** # **391**

Lindsay, Tom ClariPhy Communicati

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

General communication theory tells us that RF signal energy or power is the best measure of signal strength. This especially applies to EDC systems such as LRM, where receivers can approach matched filter bounds. In contrast, OMA is a point-property of selected bits in special square wave patterns – it does not consider signal power of other bits in complex patterns and so is not complete as a characteristic of signal strength for LRM. An example of the problem is pre-emphasis, which can increase SNR via an increase in the RF signal strength, but the gain is not apparent in the use of OMA which ignores the pre-emphasized bits. Further, OMA is difficult to define and measure accurately, especially for waveforms with overshoot, ringing, tilt, etc. Ideally, the signal strength metric should allow a tradeoff between power and penalty (see separate penalty comment) as done with TDP in LR.

Suggested Remedy

Modify the TWDP code to calculate signal strength based on the full RF signal power and to be variable depending on a penalty result.

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68** *SC* **Table 68-3** *P* **18** *L* **28** # **392**

Lindsay, Tom ClariPhy Communicati

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

I am not yet convinced that we've really evaluated the range of possibilities of Tx waveforms. As an example, it is known that pre-cursor fiber responses can lead to higher implementation penalties for finite length equalizers, and so the standard might want to encourage (at least not discourage) transmitter pre-compensation for such channels, providing they have small impact to penalties for post-cursor channels. Another concern is that we have not seen data from real transmitters over conditions such as temperature and aging and how they affect link budget penalties. We should also assess VCSEL waveforms.

Suggested Remedy

Study pre-compensation carefully and gather transmitter characteristics over more operating conditions. Modify the eye mask coordinates as appropriate in response to this work. This could also affect 68.6.5.

Response *Response Status* **U**

REJECT.
Specific remedy not suggested.

Cl **68** *SC* **Table 68-3** *P* **18** *L* **30** # **394**

Bhoja, Sudeep Big Bear Networks

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

The 5dB value for the Transmitter Waveform Dispersion Penalty needs to be changed. Previous contributions such as lindsay_3_1104 have shown that TP2 & TP3 tests and limits should be linked. The PIE-D value for 99% coverage based on a 47.1ps reference Tx and Gen67YY fiber model with connectors is 4.5dB. This number is lower than the 5dB currently specified.

Suggested Remedy

Change the 5dB value to 4.5dB

Response *Response Status* **U**

REJECT.
No consensus to change.

Cl **68** *SC* **Table 68-3** *P* **18** *L* **30** # **393**

Lindsay, Tom ClariPhy Communicati

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

The TWDP value should track the TP3 stress levels. However, it has been observed that stress levels for real waveforms can be greater than TP3 stress levels for finite length EQs, even though their infinite length results are equal or better. So, perhaps TWDP should consider finite EQs and/or some margin that forces real Tx waveforms to have tighter results than the TP3 levels. Finite equalizer lengths may also be able to discriminate and encourge the benefits of pre-compensation of Tx waveshaping. This could be helpful for finite EQs in real applications.

Suggested Remedy

This issue requires more study. Possible outcomes are 1. Run TWDP with shorter equalizer(s) and require the penalty results be not greater than the corresponding TP3 stresses with the same shorter EQs. 2. Set TWDP limits to be somewhat more stringent than the TP3 stress levels to ensure interoperability.

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68A** *SC* **6** *P* **19** *L* **44** # **414**

Ghiasi, Ali Broadcom

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

Current jitter tolerance test only at a single frequncy will not detect potential weakness in the receiver. Suggest to use jitter tolerance mask per IEEE 802.3ae Fig 52-4.

Suggested Remedy

Response *Response Status* **U**

ACCEPT IN PRINCIPLE.
See response to comment 222.

Cl **68A** *SC* **68A** *P* **42** *L* **17** # **428**

Dawe, Piers Agilent

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

Need to change the list of inputs when we have worked out how to make the algorithm measure a signal strength.

Suggested Remedy

per comment

Response *Response Status* **U**

REJECT.
See motion recorded in response comment 255.

Cl **68A** *SC* **68A** *P* **42** *L* **20** # **430**

Dawe, Piers Agilent

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

Need to change description of alignment when we have worked out how it's done.

Suggested Remedy

per comment

Response *Response Status* **U**

REJECT.
Specific remedy not suggested

Cl **68A** *SC* **68A** *P* **42** *L* **31** # **433**

Dawe, Piers Agilent

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

Need to change description of anti-aliasing filter to follow changes in 68.6.6.

Suggested Remedy

per comment

Response *Response Status* **U**

REJECT.
Specific remedy not suggested.

Cl **68A** *SC* **68A** *P* **42** *L* **39** # **435**

Dawe, Piers Agilent

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

Out of place? Does this sentence really mean channel input: 'The channel input is a periodic data sequence ... where N is the length of one period (e.g. 511 for PRBS9).'?

Suggested Remedy

If it's the captured waveform, move it to line 17, and say 'The captured waveform x(k)' on line 25. If it's the data sequence, move it to line 20 and say 'The data sequence x(k) used'. If it's the FFE input, to line 33. Avoid the term 'channel input', correct the terminology, put a label {x} or x(k) by the thing it is, to give the reader a clue. It would help to write x(k) = {x(0),x(1)... (if that is the case) to tie these vectors back to figure 68A-1.

Response *Response Status* **U**

REJECT.
Suggested remedy does not appear to the be complete.