8802-3/802.3 REVISION REQUEST 1107

DATE: 6th March, 2003
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REQUESTED REVISION:
STANDARD: IEEE Std. 802.3ae-2002
CLAUSE NUMBER: 52.9.1.2 and 49.2.8
CLAUSE TITLE: Square wave pattern definition

PROPOSED REVISION TEXT:

(Old text stricken-through, new text underlined)

52.9.1.2 Square wave pattern definition
A pattern consisting of four ~~to eleven~~ consecutive ones followed by an equal run of zeros may be used as a square wave. These patterns have fundamental frequencies between approximately ~~452~~ 1244 MHz (10GBASEW) and 1289 MHz (10GBASE-R).

Similarly for the PCS section:

49.2.8 Test pattern generators
....
When square wave pattern is selected, the PCS will send a repeatingp attern of n 1's followed by n 0's where n is 4. ~~may be any number between 4 and 11 inclusive. The value of n is an implementation choice.~~

RATIONALE FOR REVISION:

The text of the IEEE 802.3ae and of D5.0 (both 2002)

52.9.1.2 Square wave pattern definition
A pattern consisting of four to eleven consecutive ones followed by an equal run of zeros may be used as a square wave. These patterns have fundamental frequencies between approximately 452 MHz (10GBASEW) and 1289 MHz (10GBASE-R).

Corresponding text is in the section 49.2.8, describing the implementation of the PCS pattern generator:

49.2.8 Test pattern generators
....
When square wave pattern is selected, the PCS will send a repeating pattern of n 1's followed by n 0's where n may be any number between 4 and 11 inclusive. The value of n is an implementation choice.

The problem

The definition of the square-wave pattern as of now causes problems due to the fact that different frequency square waves give different OMA results (variability from now on).

Definition: Let the number of consecutive ones (followed by an equal run of zeros) be called NrOfConsBits .

Consider results of an OMA measurements of a high quality signal (externally modulated laser), at 9.953Gb/s fundamental, with two different sampling oscilloscope modules [unit1 is an 80C02 - a high quality, OC-192-targeted optical module for a sampling oscilloscope; unit2 is an 80C05 - a discontinued module targeted at OC-768, rather than at OC192. Both modules have their OC-192 ORR enabled, both ORRs pass the ORR response specified by the IEEE802.3ae (but not with the same margin).]

Table 1: OMA vs. frequency of the square-wave pattern

Pattern-*NrOfConsBits*	unit1 OMA [uW]	unit1 Err re. four consec.	unit2 OMA [uW]	unit2 Err re. four consec.
4	528.4	0.0%	538.8	0.0%
5	527.6	0.2%	548	-1.7%
6	537.7	-1.8%	555.3	-3.1%
7	528.2	0.0%	555.3	-3.1%
8	533.2	-0.9%	560.1	-4.0%
9	538.4	-1.9%	567.6	-5.3%
10	534.6	-1.2%	562.3	-4.4%
11	542.5	-2.7%	562.1	-4.3%
PkPk err over *f* of square-wave:		**2.8%**		**5.3%**

The magnitude of the problem

It is safe to assume that many transmitters on the market exhibit significantly more pronounced long-term aberrations than a instrument-grade, externally modulated laser source used for the experiments in the table above. While such signal sources are not available to me, it is safe to suggest that the variability of the OMA result over the transmitters in the field will be correspondingly larger.

The impact of the problem

While the variability in itself doesn’t shut down the production of IEEE802.3ae modules, it significantly contributes to uncertainty of the result, and to the growth of needed manufacturing margins - which is directly in contrast with the goal of low-cost manufacturing.

Any supplier-customer relationship in the market is compromised by the fact that OMA can be measured differently at each location.

This situation is made worse by the easy interchangeability of the optics in the shape of the XFP modules, which facilitate moving an optical module between different PCS' interfaces. Here a differences in OMA-based measurement results are likely enlarged due to the fact that different manufacturers can use different (frequency) square wave pattern.

Standard consideration

There is no clear reason for the NrOfConsBits range given in the standard, and there's little in the archives that I can find to clarify the issue.

From the little I found, it appears that possibly the arbitrariness of the NrOfConsBits being 'four to eleven' is really a misunderstanding and was not meant to be in the standard to begin with - see Appendix A.

In effect this change provides text that is the intent at D3.2 and others before 4.x (again see Appendix A below.). This also better matches the rest of the industry (e.g. FibreChannel). Value other than 'four' would alleviate most of the issue just as well as the hereby proposed 'four'; however a pattern built on 'four consecutive ...' has these advantages over others:

- Easy to trigger on, no PLL problems, can use existing OCR with not even a cabling change on the T&M equipment

- The result is close in value to that of an PRBS eye amplitude

IMPACT ON EXISTING NETWORKS:

According to my information (unfortunately not publishable publicly), two of the most used (PCS) chips on the market have NrOfConsBits programmability built-in such that the number of consecutive pulses is settable (to 4 and some other numbers).

Conclusion

The compatibility of systems is jeopardized by the variability of the OMA measurements due to the problem described (the frequency of the square-wave pattern is not tightly defined.) It is important to correct this before 10GbE gains reputation for lack of compatibility.

See also Appendix A below.

Please attach supporting material, if any	
Submit to:- Bob Grow, Chair IEEE 802.3	
E-Mail: Bob.Grow@intel.com	
+------- For official 802.3 use -----------+	
| REV REQ NUMBER: 1107 |	
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For information about this Revision Request see -	
http://www.ieee802.org/3/maint/requests/revision_history.html#REQ1107	

Appendix A.

This is an attempt to backtrack the committee's thinking while deciding on the measurement method for OMA, in particular on the pattern to be used.
Quotes from the standard or the Comments are marked by a vertical side-bar.

1.1. Draft 2.0 Comments - Introduction of the OMA method

From the P802.3ae Draft 2.0 Comments:

> # 887 Cl 52 SC 52.7 P L
>
> Comment Type T
>
> There are no specifications on how OMA should be measured.
>
> SuggestedRemedy
>
> Insert a subclause after 52.7.3 describing OMA measurements.
>
> 52.7.xx Optical modulation amplitude (OMA) test procedure
>
> ==========
>
> OMA is the difference in optical power for the nominal "1" and "0" levels of the optical signal. OMA shall be measured for a node transmitting a repeating "00001111" pattern corresponding to a 1.25 GHz (10GBASE-EW) or 1.29 GHz (10GBASE-ER) square wave.
>
> ……..
>
> Proposed Response
>
> ACCEPT IN PRINCIPLE. OMA measurement technique is required and should be specified here. Methodology for OMA measurement should be coordinated with commenter #454 (Mike Dudek).
>
> Comment Status A
>
> Response Status C
>
> OMA
>
> Ohlen, Peter Optillion

And one more:

> And :
>
> # 454 Cl 52 SC 52.7.3 P 372 L 6
>
> Comment Type T
>
> OMA measurement method is required instead of Extinction ratio

Comment Status A

OMA

Mike Dudek, Mike T Dudek Cielo Communications

…… While supplying the optical transmitter with 1000MHz square wave, use the following procedure to measure optical modulation amplitude. …

From there on there's little re. OMA square wave in the Comments database all the way up to D3.1, but in Comments on D3.1 the '4 to 11' is noted:

1.2. Draft 3.1 Comments: a Comment on '4 to 11'

This Comment re. D3.1 mentions the frequency of the square-wave:

154 Cl 49 SC 49.2.8 P 418 L 41

Comment Type T

"When square wave pattern is selected, the PCS will send a repeating pattern of n 1's followed by n 0's where n may be any number between 4 and 11"Is n programmable? or implementation dependent? We should not leave this open.

Suggested Remedy

Specify the value of n.

Response

ACCEPT IN PRINCIPLE. n is implementation dependent because the PHY people only needed a square wave and the exact frequency was not critical.

Should we add "The value of n is an implementation chioce."?

Comment Status A

Response Status C

Gaither, Justin Xilinx, Rocketchips Div

Note that at this point in time, the OMA was still measured on a ""00001111" pattern" in section 52.9.4 (see 1.3).

1.3. Draft 3.2 still has both definitions - '4 to 11' and '4', but its comments reconciles the two

to quote:

"52.9.5 Optical modulation amplitude (OMA) test procedure"

OMA is the difference in optical power for the nominal "1" and "0" levels of the optical signal, … in Figure 52–15. OMA should be measured for a node transmitting a repeating "00001111" pattern corresponding to a 1.25 GHz (10GBASE-W) or 1.29 GHz (10GBASE-R) square wave.

And:

52.9.1 Test patterns

…. . For a few optical measurements, a pattern which is not data like, such as a square wave, is specified. A pattern consisting of four to eleven consecutive 1s followed by an equal run of 0s may be used as a square wave. These patterns have fundamental frequencies between approximately 452 MHz (10GBASE-W) and 1289 MHz (10GBASE-R).

But these two were reconciled into one as follows:

1.4. P802.3ae Draft 3.2 Comments
625 Cl 52 SC 52.9.4 P 451 L 7
Comment Type T
Calls out 00001111 pattern, yet pattern table allows variation up to 11 0's and 1's.
SuggestedRemedy
I believe we only want to refer to the square wave pattern described in clause 52.9.1. Delete all info regarding pattern definition within this section.
Response
ACCEPT.
Comment Status A
Response Status C
Lindsay, Tom StratosLightwave

1.4. Appendix' conclusion

Clearly the original proposal at D2.0 had a fixed square-wave pattern in mind for measuring OMA. Based on the data presented here I don't understand why, and when after D2.0 comments, the '4 to 11' arose. From comments it's obvious that before D3.2 both '4' and '4 to 11' were present, perhaps diluting the attention to the fact that '4 to 11' invites variability of result. This Comment to D3.1:
"n is implementation dependent because the PHY people only needed a square wave and the exact frequency was not critical"
suggests that this range was proposed, and found reasonable by the "PHY people". If this is so, then it would be my conjecture that the point "exact frequency was not critical" should have been understood in a narrower sense than the "use sometimes this and sometimes that" sense of the phrase "4 to 11"