C2M comment discussion

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IEEE P802.3ck Task Force
April 29, 2020

Agenda

Provide background to help resolve comments.

Comments 137 -- part 1
Eye opening data capture

Cl 120G	*SC* 120G.4.2	*P* 232	*L* 37	# 137

Dawe, Piers — Mellanox

Comment Type **TR** *Comment Status* **D**

This is incomplete: "Capture the signal according the method defined in 162.9.3.1.1", because it throws away the noise and jitter in the signal. This method could be used to find the pulse response, DFE tap weights and sampling phase, but...

SuggestedRemedy

Make it clear that the signal that is used in step e "Compute the receiver input signal yrx(k) by applying the effect of the DFE" is captured acording to 120E but with a different observation filter. Actually, there is one measurement, and the measured signal is processed (e.g. averaged) to obtain the signal of 162.9.3.1.1.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

It is intended that the eye opening measurement includes the effect of noise at the transmitter output.

162.9.3.1.1 references 85.8.3.3.4 "Waveform acquisition" which includes the following statement:
"Averaging multiple waveform captures is recommended."

The methodology further limits the number of samples to the length of the test pattern.

In order to retain the reference to 162.9.3.1.1, one or more exceptions would have to be added for it to be appropriate.

Since this eye opening methodology uses the methods in 120E.4.2 to derive EH, EW, and VEC, it makes sense to use the same or similar capture method.

In order to use the methodology from 120E, some changes are required. Rather than referring to 120E, it is better to include the capture method in 120G.

Procedure step e) is not clear regarding to which signal the effect of the DFE should be applied.

Change item a) in the procedure by removing the reference to 162.x.x.x and adding the capture method from item 1) in 120E.4.2 and change the minimum number of samples to a minimum of 32 instead 3 per symbol and noting "Interpolation of the captured waveform may be used to achieve this."

For reference item 1) from 120E.4.2 is shown here:
"a) Capture the PRBS13Q using a clock recovery unit with a corner frequency of 4 MHz and slope of 20 dB/decade. The capture includes a minimum of 3 samples per symbol, or equivalent. Collect sufficient samples equivalent to at least 1.2 million PAM4 symbols to allow for construction of a normalized cumulative distribution function (CDF) to a probability of 10–5 without extrapolation."

In step e).
Change:
"applying the effect of the DFE using"
To:
"applying the effect of the DFE to y2(k) using"

For task force discussion.

From 802.3ck D1.1, 120G.4.2, 162.9.3.1.1

Perform the following step once:

a) Capture the signal according the method defined in 162.9.3.1.1, with the exception that the test system has a low-pass response equivalent to the specified receiver noise filter with associated parameters in Table 120G–9 in place of the low-pass response specified in 162.9.3, to give $y_1(k)$.

Perform the following five steps for each valid combination of g_{DC} and g_{DC2} as specified in Table 120G–9:

b) Compute the response $y_2(k)$ by applying the effect of the continuous time filter to $y_1(k)$ using the associated parameters in Table 120G–9.

c) Compute the linear fit pulse response $p_2(k)$ using the method defined in 162.9.3.1.1 with parameter M the same as for step a), D_p equal to 3, and N_p equal to 200.

d) Compute the DFE sampling phase t_s and tap weights $b(n)$ for $p_2(k)$ according to the methodology in 93A.1.6 using the associated parameters in Table 120G–9.

e) Compute the receiver input signal $y_{rx}(k)$ by applying the effect of the ~~DFE~~ [DFE to $y_2(k)$] using the sampling phase t_s and tap weights $b(n)$ determined in the previous step.

f) Compute the variance of the noise at the output of the receive equalizer σ_N^2 based on the one-sided spectral density η_0, provided in Table 120G–9, referred to the receiver noise filter input per Equation (93A–35).

162.9.3.1.1 Linear fit to the measured waveform

The following procedure is used to determine the linear fit pulse response, linear fit error, and normalized transmitter coefficient values.

Set the transmitter under test to transmit the PRBS13Q test pattern (defined in 120.5.11.2.1). For each configuration of the transmit equalizer, capture at least one complete cycle of the test pattern at TP2, as specified in 85.8.3.3.4. The clock recovery unit (CRU) used in the measurement has a corner frequency of 4 MHz and a slope of 20 dB/decade.

From 802.3-2018...

85.8.3.3.4 Waveform acquisition

The transmitter under test repetitively transmits the specified test pattern. The waveform shall be captured with an effective sample rate that is M times the signaling rate of the transmitter under test. The value of M shall be an integer not less than 7. Averaging multiple waveform captures is recommended.

120E.4.2 Eye width and eye height measurement method

Eye diagrams in 200GAUI-4 and 400GAUI-8 chip-to-module are measured using a reference receiver. The reference receiver includes a fourth-order Bessel-Thomson low-pass filter response with 33 GHz 3 dB bandwidth, and a selectable continuous time linear equalizer (CTLE) to measure eye height and width. The pattern used for output eye diagram measurements is PRBS13Q. Unless specified otherwise the probabilities are relative to the number of PAM4 symbols measured. The following procedure should be used to obtain the eye height and eye width parameters, as illustrated by Figure 120E–13:

1) Capture the PRBS13Q using a clock recovery unit with a corner frequency of 4 MHz and slope of 20 dB/decade. The capture includes a minimum of 3 samples per symbol, or equivalent. Collect sufficient samples equivalent to at least 1.2 million PAM4 symbols to allow for construction of a normalized cumulative distribution function (CDF) to a probability of 10^{-5} without extrapolation.

Should be 32 in preparation for the linear fit.

Comments 137 -- part 2
Eye opening data capture

Proposed changes as follows:

The eye opening parameters eye height, eye width, and vertical eye closure are measured with the effect of a reference receiver which includes receiver input referred noise, a continuous-time filter as defined in 93A.1.4.3, a receiver noise filter as defined in 93A.1.4.1, and a decision-feedback equalizer as defined in 93A.1.6, using the parameters specified in Table 120G–9. The pattern used for output eye diagram measurements is PRBS13Q. Unless specified otherwise the probabilities are relative to the number of PAM4 symbols measured. The following procedure should be used to obtain the eye height eye width, and vertical eye closure parameters, as illustrated by Figure 120E–13:

a) ~~Capture the signal according the method defined in 162.9.3.1.1, with the exception that the test system has a low-pass response equivalent to the specified receiver noise filter with associated parameters in Table 120G–9 in place of the low-pass response specified in 162.9.3, to give y1(k).~~ Capture the PRBS13Q signal $y_1(k)$ with the effect of low-pass response equivalent to the specified receiver noise filter with associated parameters in Table 120G–9, and using a clock recovery unit with a corner frequency of 4 MHz and slope of 20 dB/decade. The capture includes a minimum of 3 samples per symbol, or equivalent. Collect sufficient samples equivalent to at least 1.2 million PAM4 symbols to allow for construction of a normalized cumulative distribution function (CDF) to a probability of 10^{-5} without extrapolation.

Comments 10157, 114, 10143, 111, 112, 143
CTF gain, part 1

CTF gain range

Cl **120G** *SC* **120G.4.2** *P* **232** *L* **19** # 10157

Dawe, Piers Mellanox

Comment Type **TR** *Comment Status* **D**

[Comment resubmitted from Draft 1.0. Subcl. 120G.4.2 - Pg 225 - ln 44]

This allows combinations such as gDC=-3, gDC2=-3 that should not happen, receivers don't need to design for, and waste time in the "for each valid combination of gDC and gDC2" measurement procedure.

SuggestedRemedy

Limit the combinations:

gDC2	gDC
0 or 1	3 to 14
2	6 to 14
3	9 to 14

Cl **120G** *SC* **120G.4.2** *P* **232** *L* **15** # 114

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type **TR** *Comment Status* **X**

Is not necessary to allow all combination of gDC and gDC2

SuggestedRemedy

Move gDC and gDC2 into a new table with 3 columns for TP1a, TP4, and TP5 per ghiasi_3ck_01_0320

CTLE Gains

- CTLE tap weights allowed at TP1a, TP4, TP5
  - Reduces # of CTLE setting to 24 for TP1a and less at TP4/TP5.

CTLE HF (dB)	CTLE LF (dB)	TP1a	TP5	TP4
2	0, 1	✓	✓	✓
3	0, 1	✓	✓	✓
4	0, 1	✓	✓	✓
4	1, 2	✓	✓	✓
5	1, 2	✓	✓	✓
6	1, 2	✓	✓	-
7	1, 2	✓	✓	-
8	2, 3	✓	✓	-
9	2, 3	✓	✓	-
10	2, 3	✓	✓	-
11	2, 3	✓	-	-
12	3	✓	-	-
13	3	✓	-	-

A. Ghiasi IEEE 802.3ck Task Force 14

http://www.ieee802.org/3/ck/public/20_03/ghiasi_3ck_01_0320.pdf

Cl **120G** *SC* **120G.4.2** *P* **232** *L* **15** # 10158

Dawe, Piers Mellanox

Comment Type **TR** *Comment Status* **D** *(IR)*

[Comment resubmitted from Draft 1.0. Subcl. 120G.4.2 - Pg 225 - ln 40]

These look like the CTLE limits for TP1a and TP4 far end.

SuggestedRemedy

Where are the limits for TP4 near end?

Proposed Response *Response Status* **W**

PROPOSED REJECT.

[The proposed change in the comment does not contain sufficient detail to understand the specific changes that satisfy the commenter.]

It is assumed that the comment is referring to the continuous-time filter (CTF) parameters in Table 120G-9.

There is no issue stated in the comment nor any proposed changes in the suggested remedy.

The CTF parameters specified in this Table 120G-9 are for either case.

See comment #114.

Cl **120G** *SC* **120G.4.2** *P* **232** *L* **15** # 143

Dawe, Piers Mellanox

Comment Type **TR** *Comment Status* **D**

The allowed CTLE settings for TP4 near end are not the same as for TP1a and TP4 far end, and as Ali and I have proposed, should not be simple min/max limits anyway.

SuggestedRemedy

Replace with tables from Ali or me. Also see D1.0 comment 157

Proposed Response *Response Status* **W**

PROPOSED REJECT.

See comments #10157 and #114.

Comments 10157, 114, 10143
CTF gain, part 2

CTF gain range

Cl **120G** *SC* **120G.3.4.1.1** *P* **231** *L* **16** # 111

Ghiasi, Ali — Ghiasi Quantum/Inphi

Comment Type **TR** *Comment Status* **D**

CTLE setting for max loss is TBD

SuggestedRemedy

add table of supported CTLE per ghiasi_3ck_01_0320 where includes min g_DC and g_DC_HP, min g_DC=10 dB and min g_DC_HP=2 dB

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

A presentation related to this comment is anticipated at the March meeting.

For task force review.

Cl **120G** *SC* **120G.3.4.1.1** *P* **231** *L* **23** # 112

Ghiasi, Ali — Ghiasi Quantum/Inphi

Comment Type **TR** *Comment Status* **D**

CTLE setting for min loss is TBD

SuggestedRemedy

add table of supported CTLE per ghiasi_3ck_01_0320 where includes min g_DC and g_DC_HP, min g_DC=4 dB and min g_DC_HP=1 dB

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

A presentation related to this comment is anticipated at the March meeting.

For task force review.

CTF gain step size

Cl **120G** *SC* **120G.4.2** *P* **232** *L* **19** # 10143

Dawe, Piers — Mellanox

Comment Type **T** *Comment Status* **D**

[Comment resubmitted from Draft 1.0. Subcl. 120G.4.2 - Pg 225 - ln 46]

Are 1 dB steps for gDC2 fine enough?

SuggestedRemedy

Change to 1/2 dB?

Comments 10157, 114, 10143, 111, 112, 143
CTF gain, part 3

120G.4.2 Eye opening measurement method

The eye opening parameters eye height, eye width, and vertical eye closure are measured with the effect of a reference receiver which includes receiver input referred noise, a continuous-time filter as defined in 93A.1.4.3, a receiver noise filter as defined in 93A.1.4.1, and a decision-feedback equalizer as defined in 93A.1.6, using the parameters specified in Table 120G–9.

Table 120G–9—Eye opening reference receiver parameter values

Parameter	Symbol	Value	Units
Receiver 3 dB bandwidth	f_r	$0.75 \times f_b$	GHz
Continuous time filter, DC gain Minimum value Maximum value Step size	g_{DC}	 –14 –3 1	 dB dB dB
Continuous time filter, DC gain 2 Minimum value Maximum value Step size	g_{DC2}	 –3 0 1	 dB dB dB
Continuous time filter, zero frequency for $g_{DC} = 0$	f_z	12.58	GHz
Continuous time filter, pole frequencies	f_{p1} f_{p2}	20 28	GHz GHz
Continuous time filter, low-frequency pole/zero	f_{LF}	f_b / 40	GHz
Decision feedback equalizer (DFE) length	N_b	4	UI
Normalized DFE coefficient magnitude limit $n = 1$ $n = 2$ to N_b	$b_{max}(n)$	 TBD TBD	—
One-sided noise spectral density	η_0	TBD	V^2/GHz

Perform the following step once:

a) Capture the signal according the method defined in 162.9.3.1.1, with the exception that the test system has a low-pass response equivalent to the specified receiver noise filter with associated parameters in Table 120G–9 in place of the low-pass response specified in 162.9.3, to give $y_1(k)$.

Perform the following five steps for each valid combination of g_{DC} and g_{DC2} as specified in Table 120G–9:

b) Compute the response $y_2(k)$ by applying the effect of the continuous time filter to $y_1(k)$ using the associated parameters in Table 120G–9.

c) Compute the linear fit pulse response $p_2(k)$ using the method defined in 162.9.3.1.1 with parameter M the same as for step a), D_p equal to 3, and N_p equal to 200.

d) Compute the DFE sampling phase t_s and tap weights $b(n)$ for $p_2(k)$ according to the methodology in 93A.1.6 using the associated parameters in Table 120G–9.

e) Compute the receiver input signal $y_{rx}(k)$ by applying the effect of the DFE using the sampling phase t_s and tap weights $b(n)$ determined in the previous step.

f) Compute the variance of the noise at the output of the receive equalizer σ_N^2 based on the one-sided spectral density η_0, provided in Table 120G–9, referred to the receiver noise filter input per Equation (93A–35).

g) Compute an eye diagram from $y_{rx}(k)$, including the effect of Gaussian noise with variance calculated in the previous step.

h) From the eye diagram, compute the eye height, eye width, and vertical eye closure from the eye diagram using the methodologies in 120E.4.2 and 120E.4.3.

Within the set of combinations of g_{DC} and g_{DC2} with eye height meeting the target requirement, for the combination resulting in the smallest vertical eye closure, the eye height, eye width, and vertical eye closure are used as the measured values.

Comments 10157, 114, 10143, 111, 112, 143
CTF gain, part 4

SUMMARY OF COMMENTS

114 (Ali Ghiasi): CTF range for TP1a, TP4, TP4
143 (Piers Dawe): CTF range for TP4
10157 (Piers Dawe): CTF range for TP1a?
10143 (Piers Dawe): CTF step size
10158 (Piers Dawe): CTF range for TP4
111 (Ali Ghiasi): CTF range for TP1, max loss
112 (Ali Ghiasi): CTF range for TP1, min loss

TP1a = host output
TP1 = module input stressed signal
TP4 = module output (far-end and near-end)
TP4a = host input stressed signal

The comments address the following:
#1 reduce CTF range for TP1a
#2 define CTF range for TP4 near-end (different from TP1a and TP4 far-end)
#3 define CTF range for TP4 far-end (different from TP1a and TP4 near-end)
#4 define CTF range for TP1 (different values for max. loss and min. loss)
#5 reduce CTF step size

Comments 10157, 114, 10143, 111, 112, 143
CTF gain, part 5

```
TP1a Consensus proposal:
gDC2 | gDC
 0:  | -2 to -9
-1:  | -2 to -12
-2:  | -4 to -12
-3:  | -8 to -13
```

Summary of proposals:

TP1a = host output

TP4 = module output

gDC2	TP1a gDC						TP4 far-end	TP4 near-end
	D1.1	dawe comment #10157	ghiasi presentation	OIF	discussion compromise	Other	ghiasi #114	ghiasi #114
0	-3 to -14	-3 to -14	-2 to -4	-3 to -12	-2 to -6	?	-2 to -4	-2 to -4
-1	-3 to -14	-3 to -14	-2 to -7	-3 to -12	-2 to -9	?	-2 to -7	-2 to -5
-2	-3 to -14	-6 to -14	-4 to -11	-6 to -12	-4 to -11	?	-4 to -10	-4 to -5
-3	-3 to -14	-9 to -14	-8 to -13	-9 to -11	-8 to -13	?	-8 to -10	--
# of combos 1 dB step	12x4 = 48	12*2+9+6 = 39	3+6+8+6 = 23	10*2+7+3 = 30	5+8+8+6 = 27	x+x+x+x = y	19	9
# of combos 0.5 dB step	96	78	46	60	54	2*y	38	18

TP1 same as TP1a?
TP4a same as TP4?

Comments 10157, 10143, 114
CTF gain, part 6

120G.3.4.1.1 Module stressed input test procedure

The module stressed input test is summarized in Figure 120G–12. The stressed signal is applied at TP1 and is calibrated at TP1a. A reference CRU with a corner frequency of 4 MHz and slope of 20 dB/decade is used to calibrate the stressed signal using a PRBS13Q pattern.

Eye height vertical eye closure are measured according to the method described in 120G.4.2.

Possible Consensus? Discussion starting with Ali… • • • • •

Two levels of frequency-dependent attenuation are used for the module stressed input test: high-loss and low-loss.

For the high-loss case, frequency-dependent attenuation is added such that the loss at 26.56 GHz from the output of the pattern generator to TP1a is TBD dB. The TBD dB loss represents TBD dB channel loss with an additional allowance for host transmitter package loss. Eye height and VEC are then measured at TP1a based on the measurement methodology given in 120E.4.2 and vertical eye closure is measured according to 120E.4.3. Random jitter and the pattern generator output levels are adjusted (without exceeding the differential peak-to-peak input voltage tolerance specification as shown in Figure 120G–7) to result in the eye height for all three eyes and eye width for the smallest eye given in Figure 120G–8 using the reference receiver with the setting that maximizes the product of eye height and eye width. This CTLE ~~setting has to be greater than or equal to TBD dB.~~ This CTF setting has to be greater than or equal to 10 dB for gDC and 2 dB for gDC2.

For the low-loss case, discrete frequency-dependent attenuation is removed such that from the output of the pattern generator to TP1a comprises the mated HCB/MCB pair as described in 120G.4.3. Eye height and eye width at TP1a are then adjusted in the same way as described for the high-loss case except that the restriction the CTF setting has to be greater than or equal to 4 dB for gDC and 1 dB for gDC2. that the CTL~~E setting has to be greater than or equal to TBD dB does not apply. In both cases~~, the input VEC is less than TBD dB.

The pattern is then changed to Pattern 5, Pattern 3, or a valid 100GBASE-R, 200GBASE-R, or 400GBASE-R signal for the input test, which is conducted by inserting the module into the MCB. Patterns 3 and 5 are described in Table 124–9.

Comments 72, 71 -- part 1
Channel Insertion Loss and COM

Cl **120G** *SC* **120G.1** *P* **218** *L* **48** # 72

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **D**

The equation is only reccomended. The way 120G-1 is anotated before the graph is anotated suggest that that it is required for performance.

SuggestedRemedy

Add section titled 120G.1.2 Informative COM based on sun_3ck_01a_0120.pdf slide 29 and 30

Proposed Response *Response Status* **W**

PROPOSED REJECT.

Contrary to the comment, the suggested remedy is proposing to add an additional informative constraint on the channel using COM with reference to a previously reviewed presentation.

The comment provide no justification for the proposed changes in the suggested remedy.

Cl 120G *SC* 120G.1 *P* 218 *L* 48 # 71

Mellitz, Richard Samtec

Comment Type TR *Comment Status* D

The equation is only reccomended. The way 120G-1 is anotated before the graph is anotated suggest that that it is required for performance.

SuggestedRemedy

Add section titled 120G.1.1 Informative IL

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

Equation 120G-1 is introduced in previous paragraphs as follows:
"The recommended insertion loss budget is characterized by Equation (120G-1) and illustrated in Figure 120G-5."

The Figure with the graph of the equation has the following title:
"Figure 120G-5-Recommended channel insertion loss"

The related text clarifies that the equation is a recommended specification.

However, it would be beneficial to package up the channel specification in a channel subclause similar to 120F.4 "Channel characteristics".

Move the informative channel specifications to a new subclause "120G.4 Channel characteristics".

Also, see related comment #72.

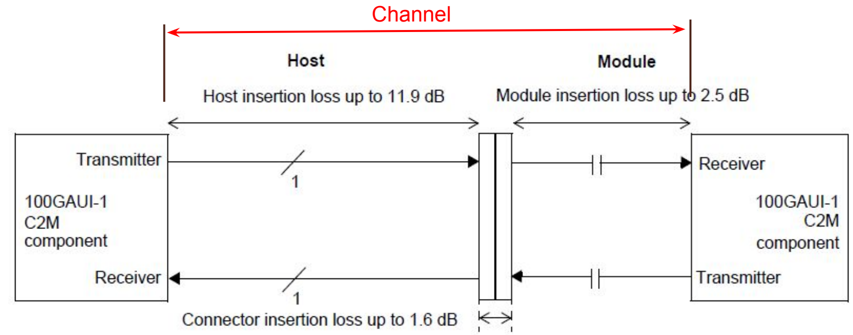

Figure 120G–2—100GAUI-1 C2M insertion loss budget at 25.56 GHz

Comment #72
Assuming that intent is to add an informative COM specification for the channel from host device output to module device input.

The 100GAUI-1 C2M link is described in terms of a host 100GAUI-1 C2M component, a 100GAUI-1 C2M channel with associated insertion loss, and a module 100GAUI-1 C2M component. Figure 120G–2 depicts a typical 100GAUI-1 C2M application and summarizes the differential insertion loss budget associated with the C2M application. The supported insertion loss budget is characterized by Equation (120G–1) and illustrated in Figure 120G–5. The 100GAUI-1 C2M interface comprises independent data paths in each direction. Each data path contains one differential lane using PAM4 signaling, where the highest differential level corresponds to the symbol three and the lowest level corresponds to the symbol zero. Each lane is AC-coupled within the module.

The 200GAUI-2 C2M link is described in terms of a host 200GAUI-2 C2M component, a 200GAUI-2 C2M channel with associated insertion loss, and a module 200GAUI-2 C2M component. Figure 120G–3 depicts a typical 200GAUI-2 C2M application and summarizes the differential insertion loss budget associated with the C2M application. The supported insertion loss budget is characterized by Equation (120G–1) and illustrated in Figure 120G–5. The 200GAUI-2 C2M interface comprises independent data paths in each direction. Each data path contains two differential lanes using PAM4 signaling, where the highest differential level corresponds to the symbol three and the lowest level corresponds to the symbol zero. Each lane is AC-coupled within the module.

The 400GAUI-4 C2M link is described in terms of a host 400GAUI-4 C2M component, a 400GAUI-4 C2M channel with associated insertion loss, and a module 400GAUI-4 C2M component. Figure 120G–4 depicts a typical 400GAUI-4 C2M application and summarizes the differential insertion loss budget associated with the C2M application. The recommended insertion loss budget is characterized by Equation (120G–1) and illustrated in Figure 120G–5. The 400GAUI-4 C2M interface comprises independent data paths in each direction. Each data path contains four differential lanes using PAM4 signaling, where the highest differential level corresponds to the symbol three and the lowest level corresponds to the symbol zero. Each lane is AC-coupled within the module.

Comments 72, 71 -- part 2
Channel Insertion Loss and COM

New proposed response to Comment #71:

For the 100GAUI-1 and 200GAUI-2 descriptions, Equation 120G-1 is introduced as follows: "The supported insertion loss budget is characterized by Equation (120G-1) and illustrated in Figure 120G-5."

For the 400GAUI-4 description, Equation 120G-1 is introduced as follows: "The recommended insertion loss budget is characterized by Equation (120G-1) and illustrated in Figure 120G-5."

In two places…
Change: “The supported insertion loss budget”
To: “The recommended insertion loss budget”

Note that the three referenced paragraphs are being merged together per the response to closed comment #91.

As the comment recommends, it would be beneficial to package up the channel specification in a channel subclause similar to 120F.4 "Channel characteristics".

Move the informative channel specifications to a new subclause "120G.4 Channel characteristics".

Implement with editorial license.

Comment 92
Post-FEC BER

Cl **120G** *SC* **120G.1.1** *P* **219** *L* **26** # 92

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type **TR** *Comment Status* **D**

The bit error ratio (BER) not clear if this is pre or post .

SuggestedRemedy

The pre-FEC bit error ratio (BER) provided that the error statistics are sufficiently random when processed ...

Proposed Response *Response Status* **W**

PROPOSED REJECT.

To address the comment, the leading portion of the sentence (see below) defines the BER as being measured after being processed by the PMA and, by exclusion, not an FEC; thus without error correction.
"The bit error ratio (BER) when processed according to Clause 135 for 100GAUI-1 C2M or Clause 120 for 200GAUI-2 or 400GAUI-4 C2M."

The proposal in the suggested remedy goes beyond the concerns raised in the comment. The processing by a particular FEC is only relevant when defining an entire PHY. The BER specifications for PMDs that might be associated with this interface include allocation for errors, including worst case burst errors, for this interface.

Concerns relating to the errors bursts was addressed in the response to D1.0 comment #202.
http://www.ieee802.org/3/ck/comments/8023ck_D10_final_closedcomments_200128.pdf

No further specification is required.

120G.1.1 Bit error ratio

The bit error ratio (BER) when processed according to Clause 135 for 100GAUI-1 C2M or Clause 120 for 200GAUI-2 or 400GAUI-4 C2M shall be less than 10^{-5}.

Afterthought...
It might be helpful to change the wording to: "processed by the PMA according to"

Draft 1.0, Comment #202...

Cl **120F** *SC* **120F.4.1** *P* **201** *L* **46** # 202

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type **TR** *Comment Status* **R** *COM burst penalty*

COM table and analysis does not include penalty due to burst error, current COM code on some weired channel

SuggestedRemedy

http://www.ieee802.org/3/ck/public/19_03/anslow_3ck_01_0319.pdf page has 2 dB of SNR penalty with pre-coding on for tap weights [0.85, 0.05, 0.25, -0.05, 0.15], the Anslow analysis showed that non of the 115 channels would be as bad but how can we gurantee some weired channel will not in the mix that passes 3 dB COM but would fail due to burst error? Assuming there is interest we can bring a proposal in future task force meeting for an analytical burst error estimator that can be added to COM.

Response *Response Status* **C**

REJECT.

[Editor's note: The clause/subclause were changed from 120/120.4.1 to 120F/120F.4.1]

The issue described here has been raised in previous amendments and was resolved by accounting for possible degradation due to correlated errors in the PAM4 electrical interface (AUI-C2C) in PHYs which use these interfaces. The requirements of all PMDs in these PHYs are defined to result in somewhat lower frame loss ratio than the requirement for a full PHY. See 136.1, 137.1, 138.1.1, 139.1.1, 140.1.1. Similar derated requirements are used for the new PMDs defined in clauses 162 and 163.

See also http://www.ieee802.org/3/cd/public/July16/anslow_3cd_01_0716.pdf.

Also, see the response for comment 200.

Commenter has not provided changes to the draft.

From 802.3cd-2018...

140.1.1 Bit error ratio

The bit error ratio (BER) when processed by the PMA (Clause 135) shall be less than 2.4×10^{-4} provided that the error statistics are sufficiently random that this results in a frame loss ratio (see 1.4.275) of less than 9.2×10^{-13} for 64-octet frames with minimum interpacket gap when additionally processed by the FEC (Clause 91) and PCS (Clause 82). For a complete Physical Layer, the frame loss ratio may be degraded to 6.2×10^{-10} for 64-octet frames with minimum interpacket gap due to additional errors from the electrical interfaces.

If the error statistics are not sufficiently random to meet this requirement, then the BER shall be less than that required to give a frame loss ratio of less than 9.2×10^{-13} for 64-octet frames with minimum interpacket gap.

Comment 108, 107
Stressed eye jitter profile

Cl 120G *SC* 120G.3.3.2.1 *P* 227 *L* 52 # 108

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D *jitter profile*

Table reference is TBD

SuggestedRemedy

Replace TBD with table 120F-1

Proposed Response *Response Status* W

PROPOSED REJECT.

The comment is referring to this sentence at the end of page 227:
"Random jitter and bounded uncorrelated
jitter are added such that the output of the pattern generator approximates the output jitter profile given in Table TBD."

The suggested remedy proposes to point to Table 120F-1 which specifies the transmitter electrical characteristics for C2C (not C2M).

It is not clear which parameters in Table 120F-1 specify the output jitter profile.

For task force discussion.

See also comment #107

Host input

Bounded uncorrelated jitter provides a source of bounded high probability jitter uncorrelated with the signal stream. This jitter stress source may not be present in all stressed pattern generators or bit error ratio testers. It can be generated by driving the pattern generator external jitter modulation input with a filtered PRBS pattern. The PRBS pattern length should be between PRBS7 and PRBS9 with a signaling rate approximately 1/10 of the stressed pattern signaling rate (e.g., 5.3125 GBd). The clock source for the PRBS generator is asynchronous to the pattern generator clock source to ensure non-correlation of the jitter. The low-pass filter that operates on the PRBS pattern to generate the bounded uncorrelated jitter should exhibit 20 dB/decade roll-off with a –3 dB corner frequency between 150 MHz and 300 MHz. This value is kept below the upper frequency limit of the pattern generator external modulator input. Random jitter and bounded uncorrelated jitter are added such that the output of the pattern generator approximates the output jitter profile given in Table TBD.

Cl 120G *SC* 120G.3.4.1.1 *P* 230 *L* 14 # 107

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D

Table reference is TBD

SuggestedRemedy

Replace TBD with table 120F-1

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

[Editor's note: The line number was changed from 52 to 14.]

The comment relates to the following sentence.

"Random jitter and bounded uncorrelated jitter are added such that the output of the pattern generator approximates the output jitter profile given in Table TBD."

The suggested remedy proposes to point to Table 120F-1 which specifies the transmitter electrical characteristics for C2C (not C2M).

It is not clear which parameters in Table 120F-1 specify the output jitter profile.

For task force discussion.

See also comment #108.

Module input

on the PRBS pattern to generate the bounded uncorrelated jitter should exhibit 20 dB/decade roll-off with a –3 dB corner frequency between 150 MHz and 300 MHz. This value is kept below the upper frequency limit of the pattern generator external modulator input. Random jitter and bounded uncorrelated jitter are added such that the output of the pattern generator approximates the output jitter profile given in Table TBD. The target pattern generator 20% to 80% transition time at the input to the test channel in the module stressed input test is TBD ps. The effective return loss of the test system as measured at TP1 meets the specification given in Figure 120G.3.1.3.

From Table 120F-1...

Output jitter			
J_{RMS} (max)	120D.3.1.8	0.023	UI
J4u (max)	120D.3.1.8	0.118	UI
Even-odd jitter (max)	120D.3.1.8	0.019	UI

[a]Measurement uses the method described in 93.8.1.3 with the exception that the PRBS13Q test pattern is used.
[b]The state of the transmit equalizer is controlled by management interface.

~~Presumably, "random jitter" refers to "JRMS" and "bounded uncorrelated jitter refers to "J4u" What about even-odd jitter, which is correlated? Perhaps the following change would help...~~

"Random jitter and bounded uncorrelated jitter are added such that the output of the pattern generator approximates the output jitter profile given by J_{RMS} and J4u in Table ~~TBD~~120F-1."

Comment 10063
Host input stressed eye jitter setup

Cl 120G *SC* 120G.3.3.2.1 *P* 228 *L* 39 # 10063

Dudek, Mike Marvell

Host input

Comment Type T *Comment Status* D

[Comment resubmitted from Draft 1.0. Subcl. 120G.3.3.2.1 - Pg 221 - ln 39]

The draft is missing the information for how to set up the stressed receiver input signal.

SuggestedRemedy

Insert the following (modified from 120E.3.3.2.1) " Random jitter and the pattern generator output levels are adjusted (without exceeding the differential pk-pk input voltage tolerance specification as shown in Table 120G-4) to result in the eye height for all three eyes and eye width for the smallest eye given in Table 120G-5 with the setting of the CTLE that maximizes the product of eye height and eye width.
The far-end pre-cursor ISI ratio is measured using the method defined in 120E.3.2.1.2 and it shall meet the
specification in Table 120G-3. Pre-emphasis capability is likely to be required in the pattern generator to
meet this requirement". However consider whether the product of eye height and eye width is the best criteria or whether it would be better to replace "that maximizes the product of eye height and eye width" with "that minimizes the value of vertical eye closure.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

Insert the following, with the selected optimization <optimization criteria>:
"Random jitter and the pattern generator output levels are adjusted (without exceeding the differential peak-to-peak input voltage tolerance specification as shown in Table 120G-4) to result in the eye height for all three eyes and eye width for the smallest eye given in Table 120G-5 with the setting of the CTLE that <optimization criteria>.
The far-end pre-cursor ISI ratio is measured using the method defined in 120E.3.2.1.2 and it meets the specification in Table 120G-3. Pre-emphasis capability is likely to be required in the pattern generator to
meet this requirement".

For <optimization criteria> select from one of the following:
(a) "maximizes the product of eye height and eye width"
(b) "minimizes the value of vertical eye closure"

For task force discussion.

The optimization criteria should be consistent with the module output measurement which is not fully defined yet. But we might assume the method will be the same as for the host output. Based on the response to closed comment 10066, the optimization is based on minimizing VEC.

Cl 120G *SC* 120G.4.2 *P* 233 *L* 6 # 10066

Dudek, Mike Marvell

Comment Type E *Comment Status* A

[Comment resubmitted from Draft 1.0. Subcl. 120G.4.2 - Pg 226 - ln 33]

The paragraph describing what the measured values of Eye height, Eye width and VEC are is difficult to follow.

SuggestedRemedy

Consider replacing this paragraph with "The measured values of eye height, eye width and vertical eye closure are the values obtained with the combination of gDC and gDC2 that produces an eye height above the target value and the minimum value of vertical eye closure.

Response *Response Status* C

ACCEPT IN PRINCIPLE.

There was discussion that the eye width should also be included in this algorithm. However, some analysis and consensus building is required.

Replace the paragraph with:
"The values of eye height, eye width and vertical eye closure are the values obtained with the combination of gDC and gDC2 that produces the minimum value of vertical eye closure where eye height also meets the target value."

Comment 110
Module input test fixture insertion loss

Cl 120G *SC* 120G.3.4.1.1 *P* 231 *L* 9 # 110

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D

loss at TP1a is TBD plus two more TBDs on the same line

Module input

SuggestedRemedy

..TP1a is 19.2 dB. The 19.2 dB loss represents 16 dB channels loss .

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

For task force discussion.

120G.3.4.1.1 Module stressed input test procedure

For the high-loss case, frequency-dependent attenuation is added such that the loss at 26.56 GHz from the output of the pattern generator to TP1a is TBD dB. The TBD dB loss represents TBD dB channel loss with an additional allowance for host transmitter package loss. Eye height and VEC are then measured at TP1a based on the measurement methodology given in 120E.4.2 and vertical eye closure is measured according to 120E.4.3. Random jitter and the pattern generator output levels are adjusted (without exceeding the differential peak-to-peak input voltage tolerance specification as shown in Figure 120G–7) to result in the eye height for all three eyes and eye width for the smallest eye given in Figure 120G–8 using the reference receiver with the setting that maximizes the product of eye height and eye width. This CTLE setting has to be greater than or equal to TBD dB.

Comment 10062
Host input stressed eye jitter setup

Cl 120G *SC* 120G.3.4.1.1 *P* 231 *L* 22 # 10062

Dudek, Mike Marvell

Module input

Comment Type T *Comment Status* D *C2M VEC*

[Comment resubmitted from Draft 1.0. Subcl. 120G.3.4.1.1 - Pg 224 - ln 22]

Multiple presentations have shown that the VEC at TP1a is more critical for end to end performance than just the eye opening.

SuggestedRemedy

Add a VEC min specification to Table 120G-8. Value TBD. Move the sentence on line 22 beginnin with "In both cases" to a separate paragraph (to emphasis that it applies to both the high and low loss cases) and change it to "In both cases, the input VEC is less than TBD dB and greater than the value in table 120G-8

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

Move the sentence to a new paragraph and change to the following:

"In both the low-loss and high-loss cases, the input VEC is less than TBD dB and greater than the value in table 120G-8."

The TBD value might be chosen if the value in Table 120G-8 is also chosen.

For task force discussion.

Table 120G–8—Module stressed input parameters

Parameter	Value
ESMW (Eye symmetry mask width)	TBD UI
Eye width	TBD UI
Applied pk-pk sinusoidal jitter	Table 120G–6
Eye height	TBD mV

For the low-loss case, discrete frequency-dependent attenuation is removed such that from the output of the pattern generator to TP1a comprises the mated HCB/MCB pair as described in 120G.4.3. Eye height and eye width at TP1a are then adjusted in the same way as described for the high-loss case except that the restriction that the CTLE setting has to be greater than or equal to TBD dB does not apply. In both cases, the input VEC is less than TBD dB.

The response should be updated to include adding VEC to Table 120G-8.

Comment 127, 126
Common-Mode Return Loss (CMRL)

Cl 120G *SC* 120G.3.2 *P* 224 *L* 36 # 127

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D

Module ouptut also needs common mode return loss

SuggestedRemedy

RLCC=12-9*f dB, from 10 MHz to 1 GHz
RLCC=3 dB 1 to 53 GHz
See ghiasi_3ck_03_0320

Host output

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

[Editor's note: Since the comment refers to module output the subclause, page, and line were changed to 120G.3.2, 224, and 36, respectively.]

A presentation relating to this comment is anticipated at the March meeting.

For task force discussion.

!!! Below this added 2020/4/6 !!!

!!! Revert subclause/page/line to 120G.3.1/221/28 !!!

It is assumed that the comment was meant to refer to host output rather than module output.

Cl 120G *SC* 120G.3.2 *P* 224 *L* 52 # 126

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* X

Module ouptut also needs common mode return loss

SuggestedRemedy

RLCC=12-9*f dB, from 10 MHz to 1 GHz
RLCC=3 dB 1 to 53 GHz
See ghiasi_3ck_03_0320

Module output

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

A presentation related to this comment is anticipated at the March meeting.

For task force review.

For the host output and module output a new common-mode return loss specification is proposed.

If accepted, add allowance for editorial license.

Comment 119, 125, 124
Common-Mode to Differential Return Loss (CDRL)

CI 120G SC 120G.3.1.2 P 222 L 2 # 119

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D

RLCD return loss can be improved

SuggestedRemedy

RLCD=30-30*f/25.78 dB, from 10 MHz to 12.89 GHz
RLCD=15 dB 12.89 to 53 GHz
See ghiasi_3ck_03_0320

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

[Editor's note: The subclause was changed from 120G.3.4.1 to 120G.3.1.2.]

The comment relates to common-mode to differential return loss" (RLCD) for the host output as specified in Table 120G-1 and 120G.3.1.2.

The comment does not provide a justification for improving the RLCD.

A presentation related to this comment is anticipated at the March meeting.

For task force discussion of the proposed changes.

The reference in Table 120G-1 for RLDC is incorrect. Change "120G.3.1.3" to "120G.3.1.2".

Also, for consistency throughout 802.3ck...

In Table 120G-1 and beneath Equation (120G-2)
Change: "Common to differential mode return loss"
To: "Common-mode to differential return loss"

Host output

CI 120G SC 120G.3.2 P 224 L 52 # 125

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D

RLCD return loss can be improved

SuggestedRemedy

RLCD=30-30*f/25.78 dB, from 10 MHz to 12.89 GHz
RLCD=15 dB 12.89 to 53 GHz
See ghiasi_3ck_03_0320

Proposed Response *Response Status* W

PROPOSED REJECT.

The comment relates to common-mode to differential return loss" (RLCD) for the module output as specified in Table 120G-3 by reference to Equation (120G-2).

The comment does not provide a justification for improving the RLCD.

A presentation related to this comment is anticipated at the March meeting.

For task force discussion of the proposed changes.

The same change is being proposed by comment #119 for Equation (120G-2).

The reference in Table 120G-3 for RLDC is incorrect. Change "120G.3.1.3" to "120G.3.1.2".

Also, for consistency throughout 802.3ck...

In Table 120G-1...
Change: "Common-mode to differential mode return loss"
To: "Common-mode to differential return loss"

Module output

should be AIP

CI 120G SC 120G.3.4 P 229 L 15 # 124

Ghiasi, Ali Ghiasi Quantum/Inphi

Comment Type TR *Comment Status* D

RLCD return loss can be improved

SuggestedRemedy

RLCD=30-30*f/25.78 dB, from 10 MHz to 12.89 GHz
RLCD=15 dB 12.89 to 53 GHz
See ghiasi_3ck_03_0320

Proposed Response *Response Status* W

PROPOSED REJECT.

The comment relates to common-mode to differential return loss" (RLCD) for the module input as specified in Table 120G-7 by reference Equation (120G-2).

The comment does not provide a justification for improving the RLCD.

A presentation related to this comment is anticipated at the March meeting.

The same change is being proposed by comment #119 for Equation (120G-2).

For task force discussion of the proposed changes.

However, reference in Table 120G-7 for RLDC is incorrect. Change "120G.3.1.3" to "120G.3.1.2".

Also, for consistency throughout 802.3ck...

In Table 120G-8...
Change: "Common to differential mode conversion return loss"
To: "Common-mode to differential return loss"

Module input

should be AIP

The proposal is to improve the already specified CDRL.

If no changes to equation are accepted, there are still some text changes that are worth doing to align the naming.