Separate specifications and nomenclature for electrical interfaces within xGMII Extenders

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Background

- In ran_3dj_elec_01_230622 it was noted that:
  - The term “AUI” has been used for electrical interfaces, both **within a PHY** and **within an xGMII Extender**.
  - For PHYs defined in P802.3dj, the use of xGMII Extenders is more likely than before.
  - Electrical interfaces within an xGMII Extender can be allocated a much higher BER than those within a PHY.
- It was suggested that different nomenclature be used for these two cases. Some options were proposed.

Problem statement

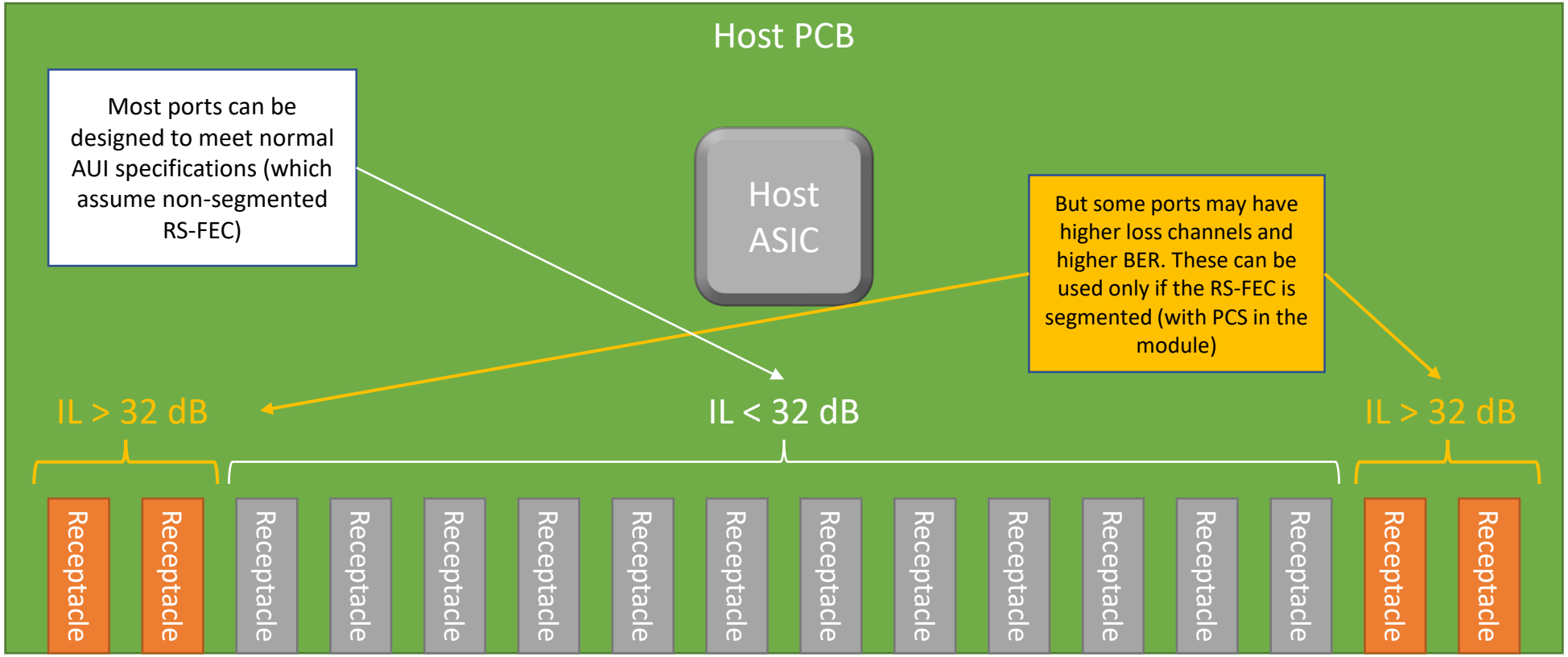
- The term “AUI” has most commonly been used in recent projects (3bm, 3bs, 3cd, 3ck) as the name of the electrical interfaces:
  - Between adjacent PMAs within a (Type 1) PHY
  - Between adjacent PMAs within an xGMII Extender
- For 200G and 400G PHYs, the term “AUI” was used agnostically to represent either use case, because so far, electrical characteristics and channel specifications have been identical.
- With 200G/lane signaling and the rise of “Type 3” PHYs, is it time to consider distinct specifications and nomenclature?

Goals of this presentation

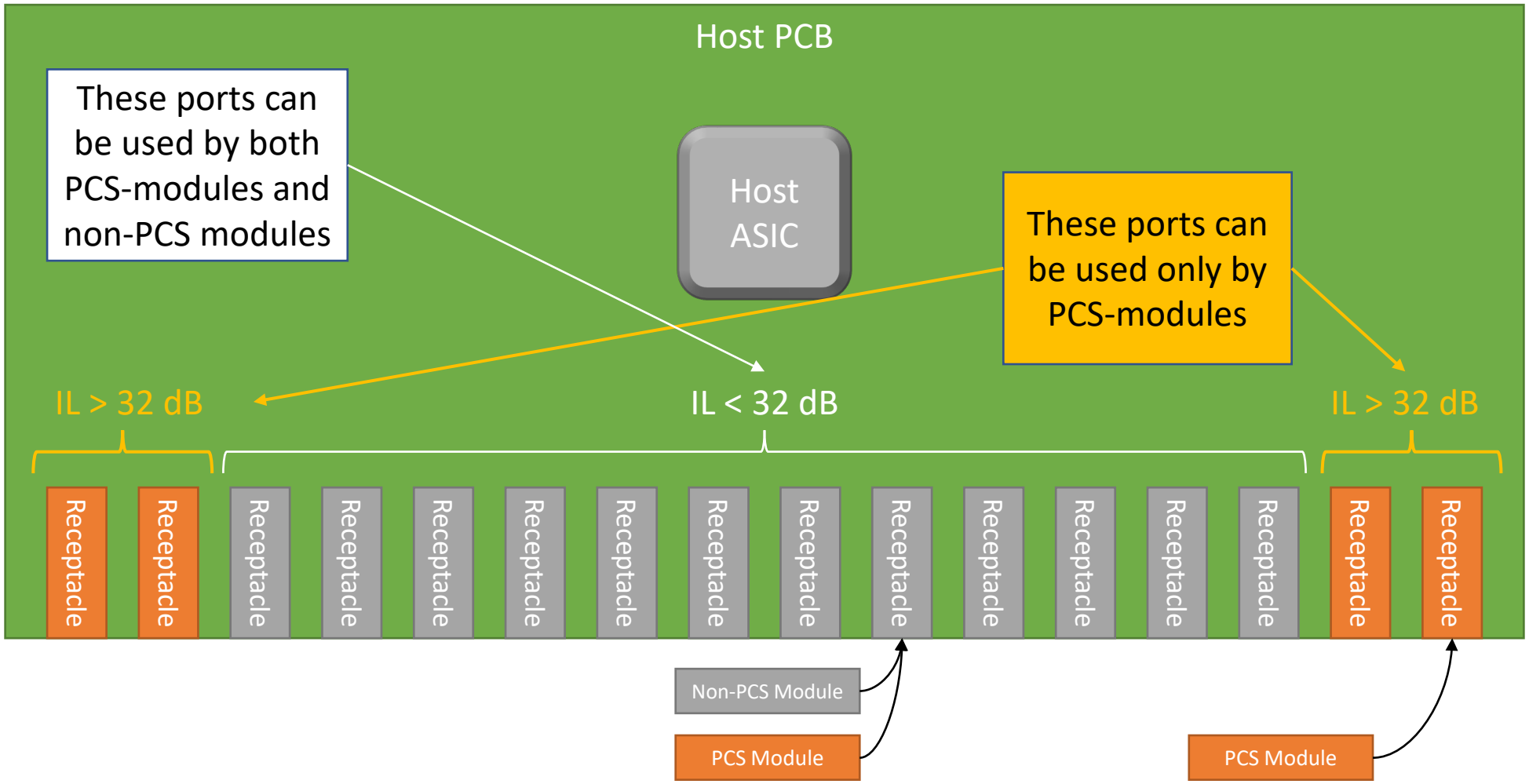
- Introduce the need for a different set of specifications for electrical interfaces within an xGMII Extender
  - The specification details are not addressed
  - The concept is applicable for both C2M and C2C, but examples focus on C2M
- Suggest a separate nomenclature for these interfaces, to distinguish them from interfaces within a PHY (“AUIs”)

- A straw poll to gauge consensus on the above is planned.

Possible host design



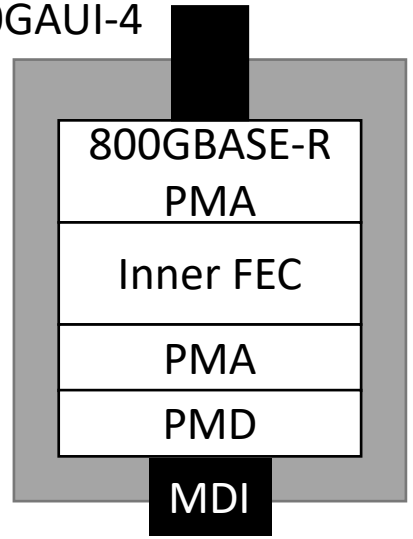
Possible host design (cont.)



Possible module types

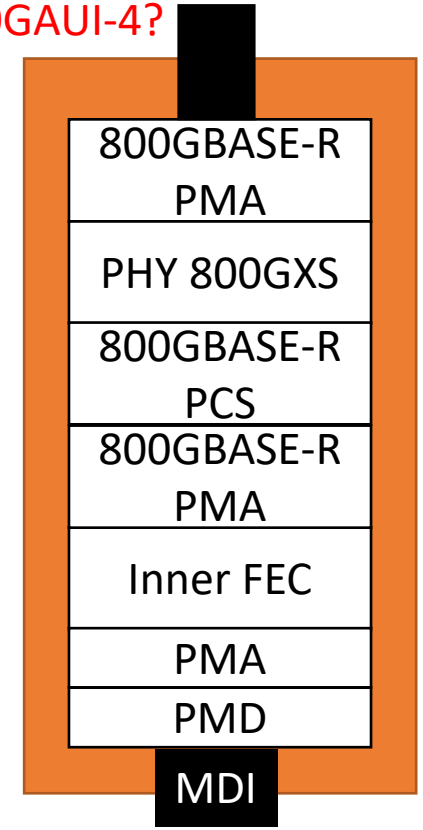
The electrical interfaces have different BER allocations – so they are not the same!

800GAUI-4



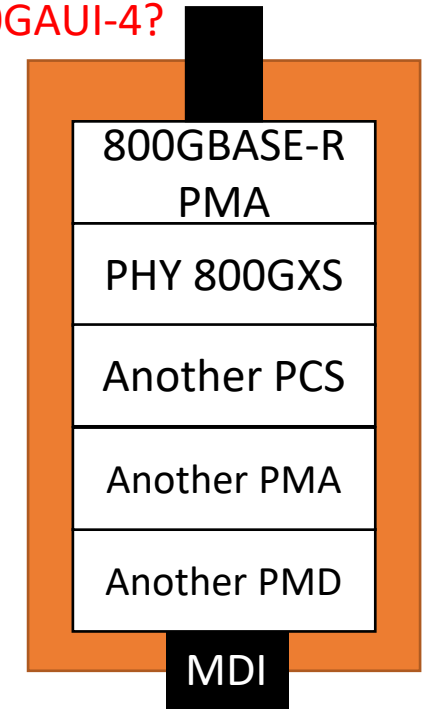
Non-PCS module

800GAUI-4?



PCS module X

800GAUI-4?



PCS module Y

Note: 800G used as an example; 200G, 400G, and 1.6T are similar

How does the BER affect host and module specifications?

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.

120G.5.1 Signal levels

The signal levels are as defined in 120E.3.1.2.

Low-frequency and full-band peak-to-peak AC common-mode voltage, VCM_{LF} and VCM_{FB}, respectively, are defined by the method specified in 162.9.4.4 with the following exceptions:

a) The peak-to-peak AC common-mode voltage is defined as the AC common-mode voltage range measured at TP1a or TP4 that includes all but 10^{-5} of the measured distribution, from 0.000005 to 0.999995 of the cumulative distribution.

b) The condition for transmitter equalization to be turned off does not apply.

120G.3.3.5 Host stressed input tolerance

Host stressed input tolerance is defined by the procedure described in 120G.3.3.5.1 through 120G.3.3.5.3.

The host under test shall meet the BER requirement in 120G.1.1:

— For either the short or long mode.
— With all sinusoidal jitter cases in Table 162–17.
— For any signaling rate in the range given in Table 120G–7.

120G.3.4.3 Module stressed input tolerance

Module stressed input tolerance is defined by the procedure described in 120G.3.4.3.1 through 120G.3.4.3.3.

The module under test shall meet the BER requirement in 120G.1.1:

— For both the high-loss and low-loss cases (see 120G.3.4.3.2), calibrated separately.
— With all sinusoidal jitter cases in Table 162–17.
— For any signaling rate in the range given in Table 120G–9.

Many module and host specifications are dependent on the BER allocated to the interface.

How will different specifications be used

- Non-PCS modules will have a set of specifications (“Module specification A”) that use the allocated BER (e.g., 1e-5)
  - BER allocation and specification methods are still to be determined
- PCS-modules whose interface is an xGMII Extender can have a higher BER (e.g., 1e-4). Their specifications can be loosened using this BER value (“Module specification B”).
- What if a PCS-module can be configured to bypass the PCS (for PHY types where this is applicable)?
  - When bypassed, it has to comply with “Module specification A”
  - When not bypassed, it has to comply with “Module specification B”
- For Hosts:
  - Ports with high loss can meet “Host specification B” and interoperate only with modules that comply with “Module specification B”
  - Ports with lower loss can meet both “Host specification A” and “Host specification B” and interoperate with both types of modules
- Link training and module management will likely be part of the solution…

Nomenclature

- Assuming there are different specifications, we need different nomenclature…
  - So that modules can be advertised correctly (data sheets and management registers)
  - So that host port compatibility can be documented
- Nomenclature for AUIs has been adopted (lusted_3df_01_220111 slide 25).
  - E.g., 400GAUI-2 C2M
  - It is suggested to keep this nomenclature for the AUIs within the PHY (“specification A”) and define a new set of terms for AUIs within an Extender (“specification B”)
- Some nomenclature choices are proposed below.

Nomenclature notes

- The term **AUI** is defined as an interface between a DTE and a PMA (1.4.198 Attachment Unit Interface (AUI), specific to 10 Mb/s Ethernet).
- 10 Gb/s Ethernet has introduced **XAUI** (1.4.87 and clause 47) as the interface between two instances of XGXS
  - This matches the “electrical interface within an Extender” concept
  - Note that the “X” is a roman numeral denoting 10G, and the acronym is defined as “10 Gigabit Attachment Unit Interface”

Possible nomenclature for interfaces within xMII Extenders

A. Use the string AUI prefixed with data rate and suffixed with width, the letter X (for “eXtender”), and C2C/C2M; for example, 200GAUI-1X C2M
   - Enables other letter suffixes if we define more than one “PHY” AUI
B. Using the string XAUI prefixed with data rate and suffixed with width and C2C/C2M; for example, 200GXAUI-1 C2M
   - X stands for “eXtender”
   - May be pronounced “two hundred Gee Za Wee…”
C. Similar to B, but using the string EUI instead; for example, 200GEUI-1 C2M
   - E stands for “Extender”
   - May be pronounced “two hundred Gee Yoo Ee…”
D. Similar to B, but using the string XSAUI instead; for example, 200GXSAUI-1 C2M
   - XS stands for “eXtender Sublayer”
   - May be pronounced “two hundred Gee Ex Es AUI…”

Nomenclature options

Item	Option A	Option B	Option C	Option D
1-lane electrical interface within a 200GMII Extender	200GAUI-1X C2C 200GAUI-1X C2M	200GXAUI-1 C2C 200GXAUI-1 C2M	200GEUI-1 C2C 200GEUI-1 C2M	200GXSAUI-1 C2C 200GXSAUI-1 C2M
2-lane electrical interface within a 400GMII Extender	400GAUI-2X C2C 400GAUI-2X C2M	400GXAUI-2 C2C 400GXAUI-2 C2M	400GEUI-2 C2C 400GEUI-2 C2M	400GXSAUI-2 C2C 400GXSAUI-2 C2M
4-lane electrical interface within an 800GMII Extender	800GAUI-4X C2C 800GAUI-4X C2M	800GXAUI-4 C2C 800GXAUI-4 C2M	800GEUI-4 C2C 800GEUI-4 C2M	800GXSAUI-4 C2C 800GXSAUI-4 C2M
8-lane electrical interface within a 1.6TMII Extender	1.6TAUI-8X C2C 1.6TAUI-8X C2M	1.6TXAUI-8 C2C 1.6TXAUI-8 C2M	1.6TEUI-8 C2C 1.6TEUI-8 C2M	1.6TXSAUI-8 C2C 1.6TXSAUI-8 C2M

Backup

Existing definitions

- **1.4.198 Attachment Unit Interface (AUI):** In 10 Mb/s CSMA/CD, the interface between the Medium Attachment Unit (MAU) and the data terminal equipment (DTE) within a data station. Note that the AUI carries encoded signals and provides for duplex data transmission. (See IEEE Std 802.3, Clause 7 and Clause 8.)
  - **1.4.394 Medium Attachment Unit (MAU):** A device containing an Attachment Unit Interface (AUI), Physical Medium Attachment (PMA), and Medium Dependent Interface (MDI) that is used to connect a repeater or data terminal equipment (DTE) to a transmission medium.
  - **1.4.279 data terminal equipment (DTE):** Any source or destination of data connected to the local area network.
- **1.4.87 10 Gigabit Attachment Unit Interface (XAUI):** The interface between two 10 Gigabit Extender Sublayers (XGXS) to extend the reach of the XGMII for 10 Gb/s operation. (See IEEE Std 802.3, Clause 47.)
- **1.4.145 400 Gb/s Attachment Unit Interface (400GAUI-n):** A physical instantiation of the PMA service interface to extend the connection between 400 Gb/s capable PMAs over n lanes, used for chip-to-chip or chip-to-module interconnections. For chip-to-module interconnections and for chip-to-chip interconnections, three widths of 400GAUI-n are defined: a sixteen-lane version (400GAUI-16), an eight-lane version (400GAUI-8), and a four-lane version (400GAUI-4). (See IEEE Std 802.3, Annex 120B and Annex 120C for 400GAUI-16, or Annex 120D and Annex 120E for 400GAUI-8, or Annex 120F and Annex 120G for 400GAUI-4.)
  - **1.4.147 400GMII Extender:** The 400 Gb/s Media Independent Interface Extender extends the reach of the 400GMII and consists of two 400GXS sublayers with a 400GAUI-n between them. (See IEEE Std 802.3, Clause 118.)