Thoughts on 100Gb/s per lane AUI Objectives

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Introduction

This presentation captures some initial thoughts on objective language for the AUI interfaces for the 100 Gb/s per lane Electrical “100GEL” Study Group.

This presentation should be treated as a work in progress to initiate discussion and solicit feedback, and should not be treated as a complete or final proposal.

Background

An AUI is defined within the context of an existing PHY

Existing AUIs were all defined within the context of a PHY project (see backup slides)

However in the case of this project, the primary application for the AUI (at least C2M) is likely for use with existing PHYs based on existing 100Gb/s optical PMDs.

How do we deal with this when it comes to objectives ?

Note, with objectives there needs to be a balance between having enough just detail to support a reasonable response to the PAR and CSD, but not so much detail that we limit the technical solution space when (if) we get into TF.

Existing AUI definitions

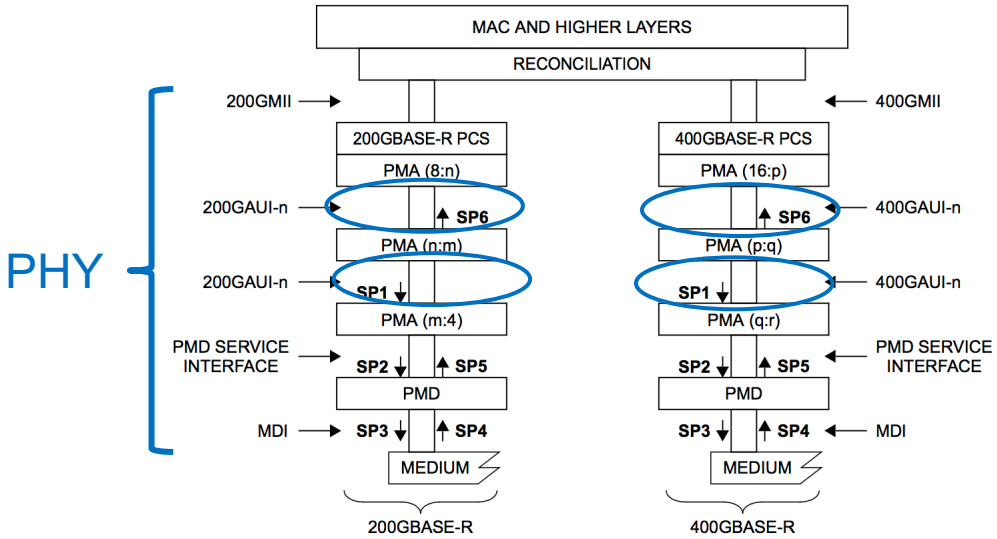
An AUI is essentially defined as:

“An optional physical instantiation of the PMA service interface (when the PMA service interface is between two adjacent PMA sub-layers”

Here is an example wording from 802.bs (Clause 116):

“The PMA service interface, which, when physically implemented as 200GAUI-8 (200Gb/s eight-lane Attachment Unit Interface) or 400GAUI-8 (400 Gb/s eight-lane Attachment Unit Interface) at an observable interconnection port, uses an 8-lane data path as specified in Annex 120B, Annex 120C, Annex 120D, or Annex 120E”

Existing AUI definitions (in pictures from Clause 116)



200GAUI-n = 200 Gb/s ATTACHMENT UNIT INTERFACE
200GMII = 200 Gb/s MEDIA INDEPENDENT INTERFACE
400GAUI-n = 400 Gb/s ATTACHMENT UNIT INTERFACE
400GMII = 400 Gb/s MEDIA INDEPENDENT INTERFACE
MAC = MEDIA ACCESS CONTROL
MDI = MEDIUM DEPENDENT INTERFACE
PCS = PHYSICAL CODING SUBLAYER
PMA = PHYSICAL MEDIUM ATTACHMENT
PMD = PHYSICAL MEDIUM DEPENDENT
n = 8 or 4
m = 8 or 4
p = 16 or 8
q = 16 or 8
r = 16, 8, or 4

Figure 116–5—200GBASE-R and 400GBASE-R Skew points for multiple 200GAUI-n or 400GAUI-n

- An AUI is always defined within the context of a PHY
- An AUI is always between two PMA sub-layers, and is an optional physical instantiation of the PMA service interface (i.e. the interface above the PMA sub-layer)
- Which AUIs can be used with a specific PHY Type (i.e. PMD) is defined in the “Physical Layer Clause” table of every PMD.

AUIs and PMD Clauses

It is the PMD clauses that define which optional AUIs can be used for a given PMD, e.g. Clause 122 shown on the right.

If we define a new AUI as part of a new project and want to use it for legacy PMDs, then we need open those clauses and update the “physical layer clauses” table.

Table 122–1—Physical Layer clauses associated with the 200GBASE-FR4, 200GBASE-LR4, 400GBASE-FR8, and 400GBASE-LR8 PMDs

Associated clause	200GBASE-FR4, 200GBASE-LR4	400GBASE-FR8, 400GBASE-LR8
117—RS	Required	Required
117—200GMII[a]	Optional	Not applicable
117—400GMII[a]	Not applicable	Optional
118—200GMII Extender	Optional	Not applicable
118—400GMII Extender	Not applicable	Optional
119—PCS for 200GBASE-R	Required	Not applicable
119—PCS for 400GBASE-R	Not applicable	Required
120—PMA for 200GBASE-R	Required	Not applicable
120—PMA for 400GBASE-R	Not applicable	Required
120B—Chip-to-chip 200GAUI-8	Optional	Not applicable
120B—Chip-to-chip 400GAUI-16	Not applicable	Optional
120C—Chip-to-module 200GAUI-8	Optional	Not applicable
120C—Chip-to-module 400GAUI-16	Not applicable	Optional
120D—Chip-to-chip 200GAUI-4	Optional	Not applicable
120D—Chip-to-chip 400GAUI-8	Not applicable	Optional
120E—Chip-to-module 200GAUI-4	Optional	Not applicable
120E—Chip-to-module 400GAUI-8	Not applicable	Optional
78—Energy Efficient Ethernet	Optional	Optional

[a]200GMII and 400GMII are optional interfaces. However, if the appropriate interface is not implemented, a conforming implementation must behave functionally as though the RS and 200GMII or 400GMII were present.

Potential Objective format

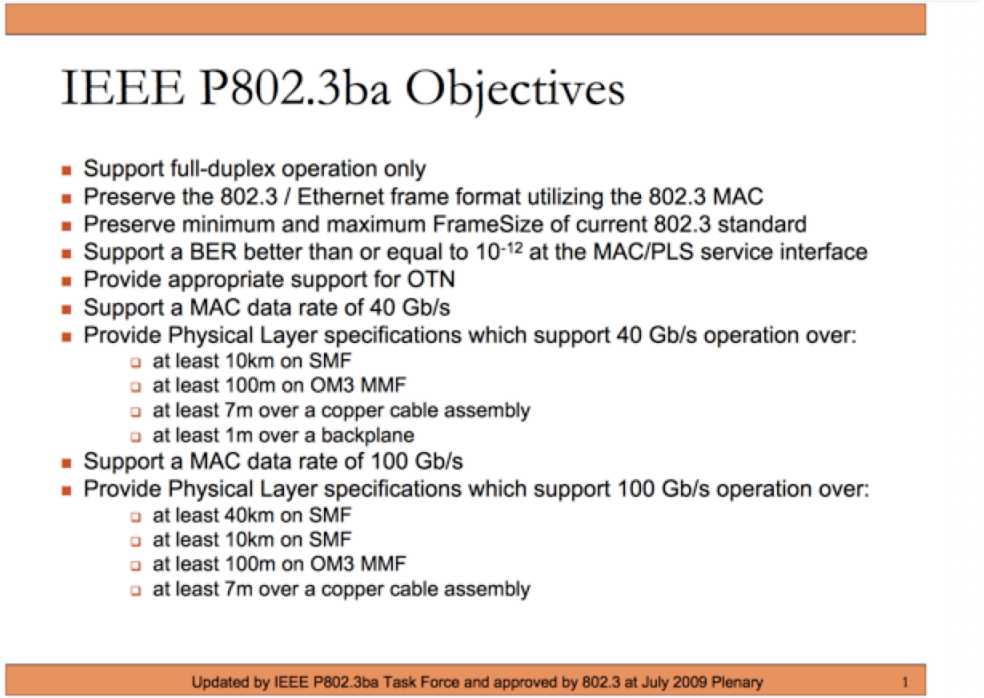
- Define a single-lane 100 Gb/s Attachment User interface (AUI) for chip-to-module applications, compatible with existing PMDs based on 100 Gb/s per lane optical signaling
- Define a single-lane 100 Gb/s Attachment User interface (AUI) for chip-to-chip applications

Thanks

Backup

802.3ba Objectives (Original 40G/100G project)

In this case there were no AUI objectives (even though we defined XLAUI and CAUI as part of the project)



IEEE P802.3ba Objectives

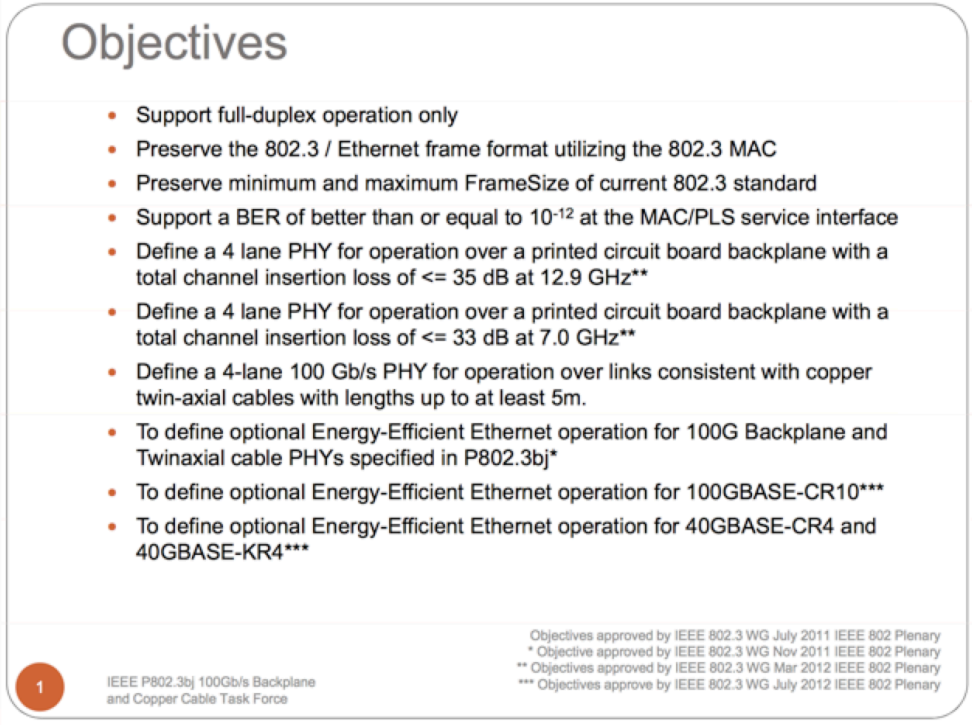
- Support full-duplex operation only
- Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC
- Preserve minimum and maximum FrameSize of current 802.3 standard
- Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface
- Provide appropriate support for OTN
- Support a MAC data rate of 40 Gb/s
- Provide Physical Layer specifications which support 40 Gb/s operation over:
  - at least 10km on SMF
  - at least 100m on OM3 MMF
  - at least 7m over a copper cable assembly
  - at least 1m over a backplane
- Support a MAC data rate of 100 Gb/s
- Provide Physical Layer specifications which support 100 Gb/s operation over:
  - at least 40km on SMF
  - at least 10km on SMF
  - at least 100m on OM3 MMF
  - at least 7m over a copper cable assembly

Updated by IEEE P802.3ba Task Force and approved by 802.3 at July 2009 Plenary 1

http://www.ieee802.org/3/ba/PAR/P802.3ba_Objectives_0709.pdf

802.3bj (100G backplane and copper cable)

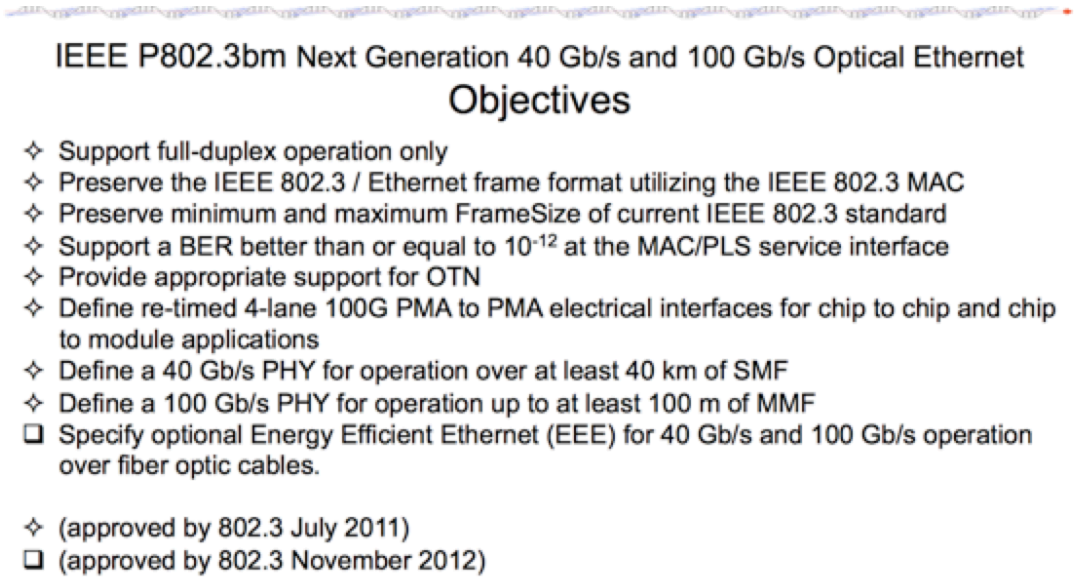
I don’t believe this project defined any AUIs ?



http://www.ieee802.org/3/bj/objectives_0712.pdf

802.3bm (40G and 100G Fiber optics)

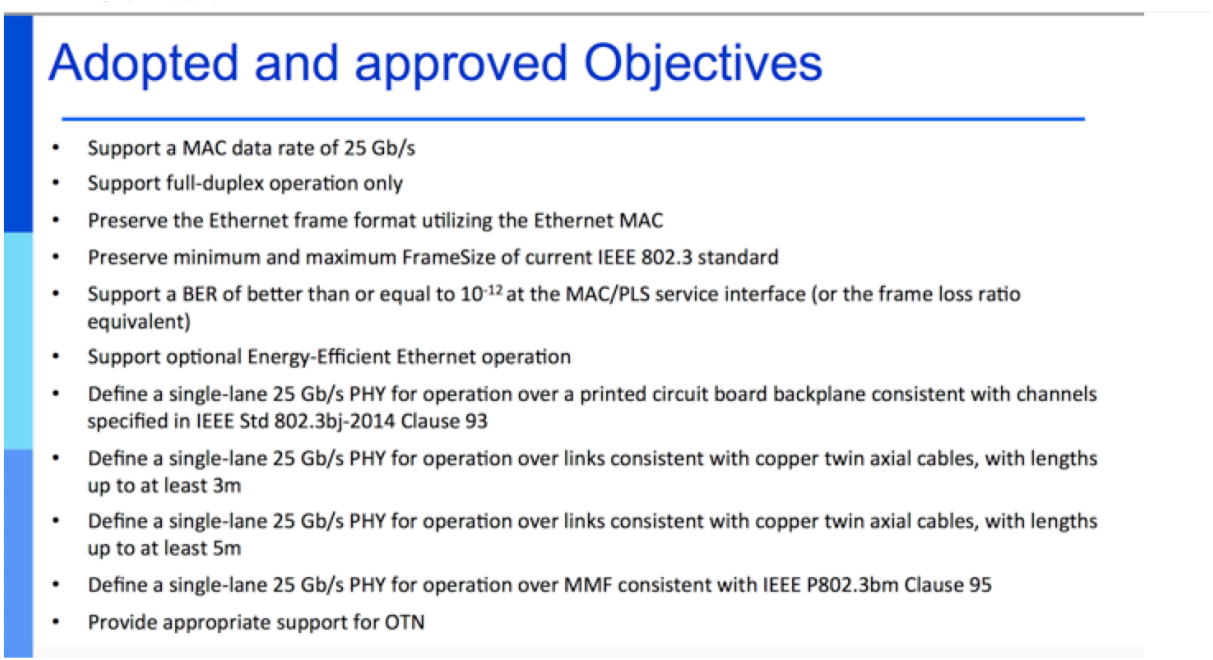
In this case we did define a C2C and C2M AUI objective. Although not called out as part of the objective we did eventually define the AUI's so that they could be used with the PHYs in the original 802.3ba project as well as the new PHYs defined as the 802.3bm project. This was done by defining the AUIs to operate to the same BER specification as the 802.3ba AUIs.



http://www.ieee802.org/3/bm/P8023bm_Objectives_1113.pdf

802.3by (25Gb/s Ethernet)

In this case we had no AUI objectives but the project defined a 25G C2C and C2M AUI



http://www.ieee802.org/3/by/P802_3by_Objectives.pdf

802.3bs (200Gb/’s and 400Gb/s Ethernet)

In this case we had C2C and C2M AUI objectives, there is no mention of loss budget or BER specifications in the objective itself.

Project Objectives

- Support a MAC data rate of 200 Gb/s
- Support a MAC data rate of 400 Gb/s
- Support a BER of better than or equal to 10^{-13} at the MAC/PLS service interface (or the frame loss ratio equivalent)
- Support full-duplex operation only
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Preserve minimum and maximum FrameSize of current Ethernet standard
- Provide appropriate support for OTN
- Provide physical layer specifications which support 200 Gb/s operation over:
  - At least 500 m of 4-lane parallel SMF
  - At least 2 km of SMF
  - At least 10 km of SMF
- Provide physical layer specifications which support 400 Gb/s operation over:
  - At least 100 m of MMF
  - At least 500 m of SMF
  - At least 2 km of SMF
  - At least 10 km of SMF
- Specify optional Energy Efficient Ethernet (EEE) capability
- Support optional Attachment Unit Interfaces for chip-to-chip and chip-to-module applications

http://www.ieee802.org/3/bs/Objectives_16_0317.pdf

802.3cd (50Gb/s, 100Gb/s and 200Gb/s Ethernet)

In this case again there is no mention of an AUI objective, even though we did define several new AUIs as part of the project. In fact in this case some of the new AUIs (eg 100GAUI-4 and 100GAUI-2) only work with the new PHYs defined in this project and not with legacy 100G PHYs defined in ba/bj/bm.

Objectives 1 of 2

- Support full-duplex operation only
- Preserve the Ethernet frame format utilizing the Ethernet MAC
- Preserve minimum and maximum FrameSize of current IEEE 802.3 standard
- Support optional Energy-Efficient Ethernet operation
- Provide appropriate support for OTN
- Support a MAC data rate of 50 Gb/s and 100 Gb/s
- Support a BER of better than or equal to 10^{-12} at the MAC/PLS service interface (or the frame loss ratio equivalent) for 50 Gb/s and 100 Gb/s operation
- Support a MAC data rate of 200 Gb/s
- Support a BER of better than or equal to 10^{-13} at the MAC/PLS service interface (or the frame loss ratio equivalent) for 200 Gb/s operation

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Objectives 2 of 2

50 Gb/s Ethernet PHYs

- Define single-lane 50 Gb/s PHYs for operation over
  - copper twin-axial cables with lengths up to at least 3m.
  - printed circuit board backplane with a total channel insertion loss of <= 30dB at 13.28125 GHz.
  - MMF with lengths up to at least 100m
  - SMF with lengths up to at least 2km
  - SMF with lengths up to at least 10km

100 Gb/s Ethernet PHYs

- Define a two-lane 100 Gb/s PHY for operation over
  - copper twin-axial cables with lengths up to at least 3m.
  - printed circuit board backplane with a total channel insertion loss of <= 30dB at 13.28125 GHz.
  - MMF with lengths up to at least 100m
- Define a single lane 100 Gb/s PHY for operation over duplex SMF with lengths up to at least 500 m, consistent with IEEE P802.3bs Clause 124

200 Gb/s Ethernet PHYs

- Define four-lane 200 Gb/s PHYs for operation over
  - copper twin-axial cables with lengths up to at least 3m.
  - printed circuit board backplane with a total channel insertion loss of <= 30dB at 13.28125 GHz.
- Define 200 Gb/s PHYs for operation over MMF with lengths up to at least 100m

3

http://www.ieee802.org/3/cd/P802d3cd_objectives_v4.pdf