IEEE 802.3 100 Gb/s per lane optical PHYs Study Group

Closing Report to 802.3 Working Group

Vancouver, BC, Canada
March 14th, 2019

Presented by: David Lewis, Lumentum

100G Lambda Study Group
Project information

Task Force Organization

Mark Nowell, Cisco, Chair

Kenneth Jackson, Sumitomo Electric, Recording Secretary

Gary Nicholl, Cisco, Editor-in-Chief (in waiting)

Study Group web and reflector information

Reflector information: http://www.ieee802.org/3/100G_OPTX/reflector.html

Home page: http://www.ieee802.org/3/100G_OPTX/index.html

Project Documentation

PAR: http://www.ieee802.org/3/100G_OPTX/P802_3cu_PAR_Detail.pdf

CSD: http://www.ieee802.org/3/100G_OPTX/CSD_responses_Approved_by_SG_Jan_2019.pdf

Objectives: http://www.ieee802.org/3/100G_OPTX/Objectives_Approved_by_SG_Jan_2019.pdf

Items for today

- Approval of Study Group's documentation:
  - Objectives
  - CSD Responses
  - PAR

100G Lambda Study Group Progress this week

- Received feedback from other WGs on CSD and PAR
- Modified Study Group's documentation for today's approval
- Consensus building on technical presentations

P802.3cu Objectives

Objectives:
http://www.ieee802.org/3/100G_OPTX/Objectives_Approved_by_SG_Jan_2019.pdf

Adopted Jan 2019

Core Objectives Adopted: Y/N/A 42/0/1

PMD Objectives Adopted: Y/N/A 36/1/3

P802.3cu Objectives

- Support a MAC data rate of 100 Gb/s
- Support a MAC data rate of 400 Gb/s
- 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
- Provide appropriate support for OTN
- Support a BER of better than or equal to 10-12 at the MAC/PLS service interface (or the frame loss ratio equivalent) for 100 Gb/s operation
- Support a BER of better than or equal to 10-13 at the MAC/PLS service interface (or the frame loss ratio equivalent) for 400 Gb/s operation
- Define a single-wavelength 100 Gb/s PHY for operation over SMF with lengths up to at least 2 km
- Define a single-wavelength 100 Gb/s PHY for operation over SMF with lengths up to at least 10 km
- Define a four-wavelength 400 Gb/s PHY for operation over SMF with lengths up to at least 2 km
- Define a four-wavelength 400 Gb/s PHY for operation over SMF with lengths up to at least 10 km

WG Motion

Move that 802.3 approve the IEEE P802.3cu objectives, as per page 5 of 0319_100g_optx_close_report.pdf

M: David Lewis

S: Gary Nicholl

Technical (≥ 75%)

Y: N: A:

P802.3cu Criteria for Standards Development

http://www.ieee802.org/3/100G_OPTX/CSD_responses_Approved_by_SG_Jan_2019.pdf

Adopted by Study Group:

Originally Jan 2019 Y/N/A: 39/0/1

IEEE 802.3 Criteria for Standards Development (CSD)

The IEEE 802 Criteria for Standards Development (CSD) are defined in Clause 14 of the IEEE 802 LAN/MAN Standards Committee (LMSC) Operations Manual. The criteria include project process requirements ("Managed Objects") and 5 Criteria (5C) requirements. The 5C are supplemented by subclause 7.2 'Five Criteria' of the 'Operating Rules of IEEE Project 802 Working Group 802.3, CSMA/CD LANs'.

The following are the CSD Responses in relation to the IEEE P802.3**cu** PAR

Items required by the IEEE 802 CSD are shown in Black text and supplementary items required by IEEE 802.3 are shown in **blue** text.

Managed Objects

Describe the plan for developing a definition of managed objects. The plan shall specify one of the following:

a) The definitions will be part of this project.
b) The definitions will be part of a different project and provide the plan for that project or anticipated future project.
c) The definitions will not be developed and explain why such definitions are not needed.

The definition of protocol independent managed objects, to be included in Clause 30 of IEEE Std 802.3, will be part of this project.

Coexistence

A WG proposing a wireless project shall demonstrate coexistence through the preparation of a Coexistence Assurance (CA) document unless it is not applicable.

a) Will the WG create a CA document as part of the WG balloting process as described in Clause 13?

b) If not, explain why the CA document is not applicable

- A CA document is not applicable because the proposed project is not a wireless project.

Broad Market Potential

Each proposed IEEE 802 LMSC standard shall have broad market potential. At a minimum, address the following areas:

a) Broad sets of applicability.

b) Multiple vendors and numerous users.

Ethernet is widely deployed in telecom client interconnects and in switch-to-switch applications in hyperscale and enterprise data centers where these 100 Gb/s and 400 Gb/s interconnects are expected to be widely utilized.

The opportunity to have common 100 Gb/s per wavelength technology building blocks across all required SMF reaches in these applications enables solutions with reduced component count, increased density, and lower costs.

Alignment of optical interface signaling rates with the anticipated transition on electrical interface SERDES signaling rates being defined in the IEEE P802.3ck project will be required to support cost effective solutions for all SMF reaches

90 participants attended the “100 Gb/s Per Lane Optical PHYs for 2 km and 10 km for 100 GbE and 400 GbE” Call-For-Interest consensus presentation. 80 participants voted in favor of forming a Study Group. At least 55 individuals affiliated with at least 43 companies indicated that they would support the standardization process. It is anticipated that there will be sufficient participation to complete the standardization process including individuals affiliated from end-users, equipment manufacturers and component suppliers.

Compatibility

Each proposed IEEE 802 LMSC standard should be in conformance with IEEE Std 802, IEEE 802.1AC, and IEEE 802.1Q. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with IEEE 802.1 WG prior to submitting a PAR to the Sponsor.

a) Will the proposed standard comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?

b) If the answer to a) is "no", supply the response from the IEEE 802.1 WG.

c) Compatibility with IEEE Std 802.3

d) Conformance with the IEEE Std 802.3 MAC

As an amendment to IEEE Std 802.3, the proposed project shall comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q.

As was the case in previous IEEE Std 802.3 amendments, new physical layers will be defined for 100 Gb/s and 400 Gb/s operation.

As an amendment to IEEE Std 802.3, the proposed project will conform to the full- duplex operating mode of the IEEE 802.3 MAC.

By utilizing the existing IEEE Std 802.3 MAC protocol, this proposed amendment will maintain maximum compatibility with the installed base of Ethernet nodes.

Distinct Identity

Each proposed IEEE 802 LMSC standard shall provide evidence of a distinct identity. Identify standards and standards projects with similar scopes and for each one describe why the proposed project is substantially different.

Substantially different from other IEEE 802.3 specifications / solutions.

IEEE P802.3bs and P802.3cd projects defined PHYs based on 100 Gb/s per optical lane over 500 m of SMF. The proposed 100 Gb/s and 400 Gb/s PHYs are focused on longer reaches of 2 km and 10 km which are not currently defined in IEEE Std 802.3.

The proposed amendment to the existing IEEE 802.3 standard will be formatted as a collection of new clauses and modifications to existing clauses, making it easy for the reader to select the relevant specification.

Technical Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence that the project is technically feasible within the time frame of the project. At a minimum, address the following items to demonstrate technical feasibility:

a) Demonstrated system feasibility.
b) Proven similar technology via testing, modeling, simulation, etc.
c) Confidence in reliability.

IEEE 802.3 has already established 100 Gb/s and 400 Gb/s MAC specifications suitable for 100 Gb/s per wavelength PHY operation in IEEE Std 802.3bs-2017 and IEEE Std 802.3cd-2018.

The principle of supporting different PMD types from a common MAC specification has been amply demonstrated in IEEE 802.3.

The proposed project will build on the array of Ethernet component and system design experience, and the broad knowledge base of Ethernet network operation.

Component vendors have presented data on the feasibility of the necessary components for 100 Gb/s and 400 Gb/s solutions. Supporting material, which either leverages existing technologies or employs new technologies, has been provided.

Component technology for 100 Gb/s optical serial rates, are already either under development for other Ethernet projects (IEEE P802.3bs & P802.3cd) or working implementations have been demonstrated.

The reliability of Ethernet components and systems has been established in the target environments with a high degree of confidence.

Economic Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence of economic feasibility. Demonstrate, as far as can reasonably be estimated, the economic feasibility of the proposed project for its intended applications. Among the areas that may be addressed in the cost for performance analysis are the following:

a) Balanced costs (infrastructure versus attached stations).
b) Known cost factors.
c) Consideration of installation costs.
d) Consideration of operational costs (e.g., energy consumption).
e) Other areas, as appropriate.

The cost factors for Ethernet components and systems are well known and the 100 Gb/s and 400 Gb/s Ethernet interfaces will maintain a favorable cost balance for the targeted switch-to-switch applications

Reasonable cost for the resulting performance will be achieved in this project as established by prior experience in the development of:

Ethernet optical specifications based on 100 Gb/s per wavelength PMDs including 400GBASE-DR4 and 100GBASE-DR.

Industry optical specifications for 2 km and 10 km SMF reaches at 100 Gb/s and 400 Gb/s.

Alignment of electrical and optical interface widths.

In consideration of installation costs, the project is expected to use proven and familiar media consistent with industry deployments, namely single-mode fiber.

Network design, installation and maintenance costs are minimized by preserving network architecture, management, and software.

100 Gb/s per wavelength PMDs reduce the number of optical transmit/receive components by up to 4 times compared to 25 Gb/s and 50 Gb/s per wavelength solutions leading to lowered overall network power consumption. For 100 Gb/s the elimination of the optical mux/demux components further reduces cost and power consumption of these PMDs.

WG Motion

Move that the IEEE 802.3 Working Group approve the IEEE P802.3cu “100 Gb/s per lane optical PHYs” CSD “Managed Objects”, “Coexistence”, “Broad Market Potential”, “Compatibility”, “Distinct Identity”, “Technical Feasibility”, and “Economic Feasibility” responses, as per 0319_100g_optx_close_report.pdf

M: David Lewis

S: Gary Nicholl

Technical (≥ 75%)

Y: N: A:

IEEE P802.3cu PAR

Jan 2019: Study Group adopted PAR and submitted for approval ahead of March plenary (Y/N/A 22:0:0)

http://www.ieee802.org/3/100G_OPTX/P802_3cu_PAR_Detail.pdf

Based on feedback from other Working Groups, a couple of changes were made and updated version was adopted this week (Y/N/A 42/0/0):

http://www.ieee802.org/3/100G_OPTX/P802_3cu_PAR_Detail_updated0319.pdf

Changes highlighted in following slides. (additions/~~deletions~~)

PAR item 2.1 – Project title

Project title: Standard for Ethernet Amendment:

Amendment: Physical Layers and Management Parameters for 100 Gb/s and 400 Gb/s Operation over Single-Mode Fiber at 100 Gb/s per wavelength

Help text: The title of the base standard is uneditable. Please enter the amendment title in the text box. The title should be sufficiently unambiguous, understandable by a NesCom member not from the society that submitted the PAR. All acronyms shall be spelled out in the title.

PAR item 4.2 and 4.3 Project dates

4.2 Expected Date of submission of draft to the IEEE-SA for Initial Sponsor Ballot:

~~04~~ 03/2020

Help text: Additional communication and input from other organizations or other IEEE Standards Sponsors should be encouraged through participation in the working group or the invitation pool prior to Sponsor Ballot.

4.3 Projected Completion Date for Submittal to RevCom:

10/2020

Help text: Enter the date the draft standard is planned to be submitted to RevCom for processing (not to exceed four years from the date of PAR submission). **It is suggested to allow at least six months after Initial Sponsor Ballot for the ballot process.** Cutoff dates for submitting draft standards to RevCom are generally in February, May, August, and October. Check the appropriate calendars for the specific dates as the draft matures. Use a best guess estimate for the PAR.

PAR item 5.2A – Standard scope

5.2A Scope of the complete standard:

This standard defines Ethernet local area, access and metropolitan area networks. Ethernet is specified at selected speeds of operation; and uses a common media access control (MAC) specification and management information base (MIB). The Carrier Sense Multiple Access with Collision Detection (CSMA/CD) MAC protocol specifies shared medium (half duplex) operation, as well as full duplex operation. Speed specific Media Independent Interfaces (MIIs) provide an architectural and optional implementation interface to selected Physical Layer entities (PHY). The Physical Layer encodes frames for transmission and decodes received frames with the modulation specified for the speed of operation, transmission medium and supported link length. Other specified capabilities include: control and management protocols, and the provision of power over selected twisted pair PHY types.

Help text: If this Amendment will change the scope statement of the complete document (base + Amendment), it can be edited and should be explained in the Additional Explanatory Notes field at the end of the PAR form. If this Amendment will not change the scope statement of the complete document the pre-populated text should be left as is.

PAR item 5.2B – Project scope

5.2B Scope of the Project:

This project is to specify additions to and appropriate modifications of IEEE Std 802.3 to add PHY specifications and Management Parameters for 100 Gb/s and 400 Gb/s Ethernet optical interfaces for reaches up to 10 km based on 100 Gb/s per wavelength optical signaling.

Help text: State what the Amendment is changing or adding.

PAR item 5.3 – Project contingency

5.3 Is the completion of this standard contingent upon the completion of another standard (Yes or No)? If **yes**, please explain below:

No

Help text: Your explanation should include how the standard is dependent upon the completion of another standard. Also, if applicable, why a PAR request is being submitted if the standard currently under development is not yet complete. The title and number of the standard which this project is contingent upon shall be included in the explanation.

PAR item 5.4 – Project purpose

5.4 Will the completed document (base + amendment) contain a purpose clause:

○ Yes ◉ No

Note: IEEE Std 802.3 does not contain a Purpose Clause.

PAR item 5.5 – Project need

5.5 Need for the Project:

The continual growth of bandwidth demand has driven evolution of higher Ethernet speeds, including 100 Gb/s and 400 Gb/s Ethernet. To meet this growth, ongoing advancement in optical technology enables the opportunity to develop higher density or lower cost optical interfaces using 100 Gb/s per wavelength optical signaling with greater than 500 m reach.

Help text: The need for the project details the specific problem that the standard will resolve and the benefit that users will gain by the publication of the standard. The need statement should be brief, no longer than a few sentences.

PAR item 5.6 – Stakeholders

5.6 Stakeholders for the Standard:

Users and producers of systems and components for Ethernet-based networking systems and data centers.

Help text: The stakeholders (e.g., telecom, medical, environmental) for the standard consist of any parties that have an interest in or may be impacted by the development of the standard.

WG Motion

Move that the IEEE 802.3 Working Group approve the IEEE P802.3cu “100 Gb/s per lane optical PHYs” PAR, in http://www.ieee802.org/3/100G_OPTX/P802_3cu_PAR_Detail_updated0319.pdf

M: David Lewis

S: Gary Nicholl

Technical (≥ 75%)

Y: N: A:

WG Motion

Move that the IEEE 802.3 Working Group request the re-chartering of the IEEE 802.3 100 Gb/s per lane optical PHYs Study Group.

M: David Lewis

S: Gary Nicholl

> 50%

Y: N: A:

Future Meetings & Ad hocs

Ad-hoc meeting plans

On-going quasi-bi-weekly meetings, all topics (will cycle) – agendas will be published.

Timeslot TBD

See: http://www.ieee802.org/meeting/index.html

May 2019 Interim

Week of May 20th, 2019. Salt Lake City, UT, USA

July 2019 Plenary

Week of July 15th, 2019. Vienna, Austria

Sept 2019 Interim

Week of Sept 9th, 2019. Indianapolis, IN, USA

Nov 2019 Plenary

Week of Nov 11th, 2019. Waikoloa Village, HI, USA