IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group Report

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OFS

Teleconference

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IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group Report information

- Study Group Organization
  - Robert Lingle, Jr., Chair
  - Mabud Choudhury, Recording Secretary
- Study Group Charter
  - Move that the IEEE 802.3 Ethernet Working Group authorizes the formation of a study group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for "Lower cost, short reach, optical PHYs using 100 Gb/s wavelengths."
- Study Group web and reflector information

  Send **100 Gb/s Wavelength Short Reach PHYs** reflector messages to:

  stds-802-3-100GSR@listserv.ieee.org

  Study Group web page URL:

  http://www.ieee802.org/3/100GSR/index.html

IEEE 802.3 100 Gb/s Wavelength Short Reach PHYs Study Group

Pre-submitted documents – completed PAR, CSD, and OBJ

PAR: https://mentor.ieee.org/802-ec/dcn/20/ec-20-0014-00-00EC-ieee-p802-3db-draft-par-response.pdf

CSD: https://mentor.ieee.org/802-ec/dcn/20/ec-20-0015-00-00EC-ieee-p802-3db-draft-csd-response.pdf

OBJ: http://www.ieee802.org/3/100GSR/Objectives_Approved_by_100GSR_SG_Jan_2020.pdf

All documents were pre-submitted on 15 February 2020

Draft Objectives (1 of 2)

1. Support a MAC data rate of 100 Gb/s, 200 Gb/s and 400 Gb/s
2. Support full-duplex operation only
3. Preserve the Ethernet frame format utilizing the Ethernet MAC
4. Preserve minimum and maximum FrameSize of current IEEE 802.3 standard
5. Provide appropriate support for OTN
6. 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
7. 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 and 400 Gb/s operation

Draft Objectives (2 of 2)

8. Define a physical layer specification that supports 100 Gb/s operation over 1 pair of MMF with lengths up to at least 50 m
9. Define a physical layer specification that supports 200 Gb/s operation over 2 pairs of MMF with lengths up to at least 50 m
10. Define a physical layer specification that supports 400 Gb/s operation over 4 pairs of MMF with lengths up to at least 50 m

WG Motion

Move that the IEEE 802.3 Working Group approve the IEEE P802.3db objectives

http://www.ieee802.org/3/100GSR/Objectives_Approved_by_100GSR_SG_Jan_2020.pdf

M: Kent Lusted

S: James Young

Y: N: A: (Technical ≥75%)

P802.3db Draft PAR (1 of 4)

Submitter Email: david_law@ieee.org
Type of Project: Amendment to IEEE Standard 802.3-2018
PAR Request Date: 20-Jan-2020
PAR Approval Date:
PAR Expiration Date:
Status: Unapproved PAR, PAR for an Amendment to an existing IEEE Standard

1.1 Project Number: P802.3db
1.2 Type of Document: Standard
1.3 Life Cycle: Full Use

2.1 Title: Standard for Ethernet
Amendment: Physical Layer Specifications and Management Parameters for 100 Gb/s, 200 Gb/s, and 400 Gb/s Operation over Optical Fiber using 100 Gb/s Signaling

P802.3db Draft PAR (2 of 4)

3.1 Working Group: Ethernet Working Group (C/LM/WG802.3)

Contact Information for Working Group Chair

Name: David Law

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Contact Information for Working Group ice-Chair

Name: Adam Healey

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3.2 Sponsoring Society and Committee: IEEE Computer Society/LAN/MAN Standards Committee (C/LM)

Contact Information for Sponsor Chair

Name: Paul Nikolich

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Contact Information for Standards Representative

Name: James Gilb

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P802.3db Draft PAR (3 of 4)

4.1 Type of Ballot: Individual

4.2 Expected Date of submission of draft to the IEEE-SA for Initial Sponsor Ballot: 11/2021

4.3 Projected Completion Date for Submittal to RevCom

Note: Usual minimum time between initial sponsor ballot and submission to Revcom is 6 months.: 05/2022

5.1 Approximate number of people expected to be actively involved in the development of this project: 30

5.2.a. 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.

5.2.b. Scope of the project: This project specifies additions to and appropriate modifications of IEEE Std 802.3 and adds Physical Layer specifications and management parameters for 100 Gb/s, 200 Gb/s, and 400 Gb/s Ethernet optical interfaces for server attachment and other intra-data center applications using 100 Gb/s signaling over optical fiber.

P802.3db Draft PAR (4 of 4)

5.3 Is the completion of this standard dependent upon the completion of another standard: No

5.4 Purpose: This document will not include a purpose clause.

5.5 Need for the Project: Rapid growth of server, network, and internet traffic is driving the need for higher data rates, higher density, lower 1 cost fiber optic solutions, including the shortest links in the data center such as server-attachment. To address these needs, advances in technology now enable the specification of 100 Gb/s, 200 Gb/s, and 400 Gb/s Physical Layer types operating over optical interconnects using 100 Gb/s signaling. IEEE Std 802.3 does not currently define operation over multimode fiber using 100 Gb/s signaling.

5.6 Stakeholders for the Standard: Users and producers of systems and components for servers and accelerators, network storage, networking systems, enterprise and cloud-scale data centers, service providers, and high-performance computing.

Intellectual Property

6.1.a. Is the Sponsor aware of any copyright permissions needed for this project?: No

6.1.b. Is the Sponsor aware of possible registration activity related to this project?: No

7.1 Are there other standards or projects with a similar scope?: No

7.2 Joint Development

Is it the intent to develop this document jointly with another organization?: No

8.1 Additional Explanatory Notes:

WG Motion

Move that the IEEE 802.3 Working Group approve the IEEE P802.3db 100 Gb/s Wavelength Short Reach PHYs PAR https://mentor.ieee.org/802-ec/dcn/20/ec-20-0014-00-00EC-ieee-p802-3db-draft-par-response.pdf

M: Flavio Marques

S: David Piehler

Y: N: A: (Technical ≥75%)

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.

- Broad Sets of Applicability:
  - Electrical signaling data rates on both switches and server network interface cards are expected to move to 100 Gb/s per lane in the next few years.
  - The trends of increasing switch radix and decreasing server count-per-rack combine to favor architectures connecting servers to switches across multiple racks, requiring longer reaches over optical fiber (tens of meters) than can be supported by passive copper cables (< 2 m), for 100 Gb/s lanes.
  - Short reach, lower cost optical modules using 100 Gb/s signaling can serve as low cost interconnects between servers and switches over tens of meters in cloud data centers, AI/machine learning clusters, high-performance computing applications, and in large enterprise and carrier data centers. Implementations could be developed to support breakout topologies.
  - Short reach, lower cost optical modules using 100 Gb/s signaling can also serve as low cost interconnects for a significant portion of switch-to-switch links in cloud data centers.
- Multiple vendors and numerous users:
  - 55 individuals affiliated with 38 companies were supporters for “Lower cost, short reach, optical PHYs using 100 Gb/s wavelengths” Call For Interest (CFI), including cloud and enterprise end-users. 65 participants attended the CFI consensus presentation. 55 participants voted in favor of forming a Study Group. 22 individuals from 18 companies indicated participation in this project.
  - It is anticipated that there will be sufficient participation to effectively complete the standardization process including representatives 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(, 200 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.

- The proposed amendment will be the first IEEE 802.3 standard defining operation over multimode fiber using 100 Gb/s signaling.

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, 200 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 principle of building equipment that supports IEEE 802.3 networks operating at different Ethernet rates has been amply demonstrated by a broad set of product offerings.
- The proposed project will build on the array of Ethernet component and system design experience, and the broad knowledge base of Ethernet network operation
  - Vertical Cavity Surface Emitting Laser (VCSEL)-MMF links using 50 Gb/s (25 GBd PAM4) signaling were developed in IEEE P802.3cd and IEEE P802.3cm, and specifications for 400 Gb/s over parallel MMF were developed.
  - Individuals affiliated with component vendors have presented simulations and data demonstrating the feasibility of 100 Gb/s (50 GBd PAM4) signaling VCSEL-based multimode links.
- The reliability of Ethernet components and systems can be projected 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. Re-use of common technologies from prior Ethernet projects will allow economies of scale to reduce cost.
- In consideration of installation costs, the project is expected to use proven and familiar optical fiber media types.
- The historical low cost and low power advantages associated with VCSEL-MMF links are expected to be preserved when increasing the optical lane rate from 50 to 100 Gb/s
- Higher speed 100 Gb/s signaling over MMF will leads to reduced lane counts, reduced fiber and component counts, reduced complexity, and lower cost than previously standardized PMDs based on
  50 Gb/s signaling.
- Use of transceivers developed for this project will promote re-use of the installed base of MMF cabling.
- Network design, installation and maintenance costs are minimized by preserving network architecture, management, and software.

WG Motion

Move that the IEEE 802.3 Working Group approve the IEEE P802.3db 100 Gb/s Wavelength Short Reach PHYs CSD “Managed Objects”, “Coexistence”, “Broad Market Potential”, “Compatibility”, “Distinct Identity”, “Technical Feasibility”, and “Economic Feasibility” responses, as per https://mentor.ieee.org/802-ec/dcn/20/ec-20-0015-00-00EC-ieee-p802-3db-draft-csd-response.pdf with modifications as detailed on slide 18 of 0520_100GSR_report.pdf .

M: Ray Nering

S: Mike Dudek

Y: N: A: (Technical ≥75%)

Questions?

Thank you!