

Draft Project Documentation

**IEEE 802.3 Beyond 400 Gb/s Ethernet Study Group
Aug 2021 Electronic Session**

**Study Group Discussion of
dambrosia_b400g_01_210819
Work in progress – not adopted**

19 Aug 2021 Electronic Meeting

Introduction

- IEEE 802.3 Beyond 400 Gb/s Ethernet Objectives Landscape (see next page)
- Project Elevator Pitch –
 - This project will consider the need of a broad range of physical layer specifications simultaneously to develop the architecture to support the next generation of Ethernet applications, in both MAC rates and lane signaling rates. This will enable a “building block” technologies approach to address multiple rates and media for an industry that has a growing acceptance of multi-lane infrastructures.
- Project # - IEEE P802.3df
- Proposed **draft** documentation embedded in this presentation
 - Project Authorization Request (PAR)
 - Criteria for Standards Development (CSD)

IEEE 802.3 Beyond 400 Gb/s Ethernet Physical Layer Objectives Landscape (as of 8/12/21)

Ethernet Rate	Assumed Signaling Rate	AUI	BP	Cu Cable	MMF 50m	MMF 100m	SMF 500m	SMF 2km	SMF 10km	SMF 40km
200 Gb/s	200 Gb/s	Over 1 lane		pending			Over 1 Pair	Over 1 Pair		
400 Gb/s	200 Gb/s	Over 2 lanes		pending			Over 2 Pair			
800 Gb/s	100 Gb/s	Over 8 lanes	Over 8 lanes	Over 8 pairs						
	200 Gb/s	Over 4 lanes		pending			Over 4 pairs	1) Over 4 pairs 2) Over 4 λ 's		
	TBD								Over single SMF in each direction	Over single SMF in each direction
1.6 Tb/s	100 Gb/s	Over 16 lanes								
	200 Gb/s	Over 8 lanes		pending			Over 8 pairs	Over 8 pairs		

IEEE 802.3 Major PAR form questions

The PAR form is completed on-line in through the myProject system. Many of the PAR question are proforma and are automatically complete by selecting a IEEE 802.3 amendment project. These items include Standards Committee and the Working Group officers. This slideset therefore provides the major items from the PAR form to assist in consensus building leading up to approving a completed draft PAR form.

All acronyms shall be spelled out at first use.

The following are the Major PAR responses
for the IEEE P802.3^{df} draft PAR

To add a continuation slide: CTRL-M -> right click new slide -> Layout -> select 'Continued' layout

PAR item 2.1 – Project title

Project title: Standard for Ethernet Amendment:
Media Access Control Parameters, Physical Layers and Management Parameters for 200 Gb/s, 400 Gb/s, 800 Gb/s and 1.6 Tb/s Operation

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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 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 Standards Association Ballot:

Sep 2024

Help text: Enter the date the draft standard is planned to be submitted to IEEE-SA for Initial Standards Association Ballot.

4.3 Projected Completion Date for Submittal to RevCom:

Sep 2025

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 Standards Association Ballot for the ballot process.** Cutoff dates for submitting draft standards to RevCom can be found in the yearly calendar located: <http://standards.ieee.org/about/sasb/meetings.html>.

PAR item 5.1 – Project participation

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

150

Help text: This includes Working Group members, additional non-voting participants.

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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:

Option 1

Define Ethernet Media Access Control (MAC) parameters and physical layer specifications for copper, multi-mode fiber, and single-mode fiber media; management parameters for the transfer of Ethernet format frames at 800 Gb/s and 1.6 Tb/s; and define derivative physical layer specifications to address 200 Gb/s and 400 Gb/s Ethernet.

Option 2

For 800 Gb/s and 1.6 Tb/s Ethernet, define Ethernet Media Access Control (MAC) parameters; physical layer specifications for copper, multi-mode fiber, and single-mode fiber media; and management parameters for the transfer of Ethernet format frames at 800 Gb/s and 1.6 Tb/s.

For 200 Gb/s and 400 Gb/s Ethernet, define derivative physical layer specifications for copper, multi-mode fiber and management parameters for the transfer of Ethernet format frames at 200 Gb/s and 400 Gb/s.

Further work needed.

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:

Yes?

5.3.1 If yes, please explain:

Add references to IEEE P802.3ck, IEEE P802.3db?

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.

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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.

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PAR item 5.5 – Project need

5.5 Need for the Project:

The project is necessary to provide solutions to meet the growing bandwidth needs for computing and network interconnect application areas, such as cloud-scale data centers, internet exchanges, co-location services, content delivery networks, wireless infrastructure, service provider and operator networks, and video distribution infrastructure.

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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:

Stakeholders include users and producers of systems and components for high-bandwidth applications, such as cloud-scale data centers, internet exchanges, co-location services, content delivery networks, wireless infrastructure, service provider and operator networks, and video distribution infrastructure.

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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.

PAR item 7.1 – Similar scope

7.1 Are there other standards or projects with a similar scope? (Yes or No)?

Yes

If yes, please explain:

There are no other IEEE standards or projects with a completely similar scope.

There are two other industry efforts outside of IEEE 802 that may partially overlap the 800 Gb/s Ethernet portion of the scope of the proposed project -

- The Ethernet Technology Consortium released D1.0 of “800 G Specification” on 10 March 2020, which defined **an 800G MAC** and physical coding sub-layer (PCS).
- The IEEE 802.3 Working Group received a liaison from the Optical Internetworking Forum (OIF), which communicated the start of the “800G Coherent Project.” The project includes a campus objective that would define fixed wavelength unamplified 2-10km links that would support Ethernet clients up to 800G aggregate bandwidth, which may address some of the application spaces that the proposed project would address. The OIF 800G Coherent Project does not define 800 Gb/s Ethernet nor any of the respective attachment unit interfaces.

Stakeholders for the proposed project have expressed the desire for this effort to define the MAC parameters, physical layer specifications, and management parameters for 800 Gb/s Ethernet operation (as well as 200 Gb/s, 400 Gb/s, and 1.6 Tb/s Ethernet) that are consistent and completely integrated with existing IEEE 802.3 Ethernet specifications.

Help text: Identify any standard(s) or project(s) of similar scope(s), both within or outside of the IEEE, and explain the need for an additional standard in this area.

For any standard(s) or project(s) of similar scope(s) add ‘Project slide(s)’

To add: CTRL-M -> right click new slide -> Layout -> select ‘Project’ layout

PAR item 8.1 – Additional notes

Additional Explanatory Notes:

Consider adding a comment regarding the schedule issue / dates

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If there is any further information that may assist NesCom in recommending approval for this project, include this information here. The title of any documents referenced in the PAR should be listed here.

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 4.5 ‘Criteria for Standards Development’ of the ‘IEEE 802.3 Ethernet Working Group Operations Manual’.

The following are the CSD Responses in relation to the IEEE P802.3^{df} 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.

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Coexistence

A WG proposing a wireless project shall prepare a Coexistence Assessment (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? (yes/no)**
- b) If not, explain why the CA document is not applicable.**

- No. A CA document is not applicable because the proposed project is not a wireless project.

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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.

- 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.
- Per the IEEE 802.3 2020 Bandwidth Assessment Report, by 2025 the bandwidth requirements of various applications will grow between 2.3 to 55.4 times relative to their 2017 levels. The definition of 800 Gb/s and 1.6 Tb/s Ethernet will address the growing diverse bandwidth requirements and cost considerations for these key application areas: cloud-scale data centers, internet exchanges, co-location services, content-delivery networks, wireless infrastructure, service provider and operator networks, and video distribution infrastructure.
- Presentations have been submitted to the study group that illustrate the market adoption of Ethernet ports addressing multiple rates and medias for use with duplex and parallel infrastructures.
- Evolving needs of computing applications will be enabled by parallel solutions targeting noted high-bandwidth applications.
- There has been wide attendance and participation in the study group by end users, equipment manufacturers and component suppliers. It is anticipated that there will be sufficient participation to effectively complete the standardization process.

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 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/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 compatibility with the installed base of Ethernet nodes.
- The definition of protocol independent managed objects, to be included in Clause 30 of IEEE Std 802.3, will be part of this project.

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 800 Gb/s and 1.6 Tb/s Ethernet, providing an upgrade path for IEEE 802.3 users from lower Ethernet rates, such as 200 Gb/s and 400 Gb/s Ethernet.
- The proposed amendment will define derivative physical layer specifications from those developed for 800 Gb/s and 1.6 Tb/s Ethernet to address copper, multi-mode fiber, and single-mode fiber specifications, based on a reduced number of physical lanes, for 200 Gb/s and 400 Gb/s Ethernet.

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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.**
- The principle of scaling the IEEE 802.3 MAC to higher speeds has been well established by previous work within IEEE.
 - 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.
 - Systems with an aggregate bandwidth of greater than or equal to 400 Gb/s have been demonstrated and deployed in operational networks.
 - The proposed project will build on the array of Ethernet component and system design experience, and the broad knowledge base of Ethernet network operation.
 - Contributions have been made that presented data on the feasibility of higher speed solutions. Proposals, which either leverage existing technologies or employ new technologies, have been provided.
 - The experience gained in the development and deployment of technologies since the start of the development of 40 Gigabit Ethernet and 100 Gigabit Ethernet (IEEE 802.3ba) starting in 2008, is applicable to the development of specifications for components at higher speeds. For example, pulse-amplitude modulation, parallel transmission techniques, forward error correction, and wavelength-division multiplexing can be combined to address 800 Gb/s and 1.6 Tb/s Ethernet, as well as to address reduced lane count solutions for 200 Gb/s and 400 Gb/s Ethernet.
 - Based on prior experience with developing higher speed solutions, the reliability of Ethernet components and systems is understood and 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) Known cost factors.
 - b) Balanced cost factors.
 - c) Consideration of installation costs.
 - d) Consideration of operational costs (e.g., energy consumption).
 - e) Other areas, as appropriate.
- Prior experience scaling IEEE 802.3 indicates the cost distribution between servers, switches, routers, and the infrastructure will remain acceptably balanced for 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/s Ethernet.
 - The cost factors for Ethernet components and systems are well known. The proposed project may introduce new cost factors which can be quantified.
 - The deployment of 800 Gb/s and 1.6 Tb/s Ethernet standards and derivatives at 200 Gb/s and 400 Gb/s will allow economies of scale to reduce cost for all solutions.
 - In consideration of installation costs, the project is expected to use proven and familiar media, including backplane and copper cabling, as well as multimode and single-mode optical fiber cabling.
 - Network design, installation and maintenance costs are minimized by preserving network architecture, management, and software.
 - In consideration of operational costs associated with power consumption, the project will examine alternatives that trade off PMD complexity, power, latency, and implementation constraints.