IEEE P802.3cn Task Force:
50 Gb/s, 100 Gb/s, 200 Gb/s, and 400 Gb/s over Single-Mode Fiber and DWDM

Potential Splitting of P802.3cn PAR – Project Targeting "40km over SMF" Related Objectives

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Introduction

This presentation proposes project documentation, based on existing IEEE P802.3cn documentation, that would target “40km over SMF” related objectives for 50GbE, 200GbE, and 400GbE

Included -

- Objectives
- PAR
- CSD

Proposed Objectives

- **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**

50 Gb/s Ethernet

- **Support a MAC data rate of 50 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**
- **Provide a physical layer specification which supports 50 Gb/s operation over at least 40 km of SMF**

200 Gb/s Ethernet

- **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**
- **Provide a physical layer specification supporting 200 Gb/s operation over four wavelengths capable of at least 40 km of SMF**

400 Gb/s Ethernet

- **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) for 400 Gb/s**
- **Provide a physical layer specification supporting 400 Gb/s operation over eight wavelengths capable of at least 40 km of SMF**

PAR (1 of 2)

- 2.1 Title: Standard for Ethernet Amendment: Physical Layers and Management Parameters for 50 Gb/s, 200 Gb/s, and 400 Gb/s Operation over Single-Mode Fiber
- 4.2 Expected Date of submission of draft to the IEEE-SA for Initial Sponsor Ballot: 11/2019
- 4.3 Projected Completion Date for Submittal to RevCom: 5/2020
- 5.2.b. Scope of the project: Define physical layer specifications and management parameters for the transfer of Ethernet format frames at 50 Gb/s, 200 Gb/s, and 400 Gb/s at reaches greater than 10 km over single-mode fiber. Make TDECQ (Transmitter and dispersion eye closure for PAM4) related changes to existing 200 Gb/s and 400 Gb/s physical medium dependent sublayers over single-mode fiber.
- 5.5 Need for the Project: Optical solutions targeting greater than 10 km over single-mode fiber will address the bandwidth requirements of mobile backhaul networks fueled by consumer video.
- 5.6 Stakeholders for the Standard: Users and producers of systems and components for mobile backhaul networks and any other networks needing reaches in excess of 10 km over single-mode fiber.

PAR (2 of 2)

- 7.1 Are there other standards or projects with a similar scope?: Yes If Yes please explain: No
- 8.1 Additional Explanatory Notes:
  - It became apparent to the IEEE 802.3 Working Group that the 50 Gb/s, 200 Gb/s, and 400 Gb/s Operation over Single-Mode Fiber portion of the IEEE P802.3cn project, which is an extension of existing IEEE 802.3 specifications, could be developed on a faster timeline than the DWDM portion of the IEEE P802.3cn project. As a result the 100Gb/s and 400 Gb/s Operation over DWDM Systems portion of the project has been removed from the IEEE P802.3cn PAR and placed in the new IEEE P802.3ct amendment PAR.
  - Item 5.2b: PAM4 expands to 4-level pulse amplitude modulation

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**cn** 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 being adopted in new application areas that require longer transmission distances than currently specified by the IEEE 802.3 Ethernet standard for 50 GbE, 200 GbE, and 400 GbE. Optical solutions targeting 40 km over single-mode fiber will address the bandwidth requirements of the access layers of mobile backhaul networks, in particular in China, as forecasted bandwidth data indicates demand fueled by consumer video in excess of other world regions.
- This project will provide upgrade paths for existing application areas that need greater bandwidth at the reaches specified. Applications over 40 km single-mode fiber migrating from 25 GbE to 50 GbE or 100 GbE to 200 GbE / 400 GbE do not have an upgrade path.
- A call-for-interest for “Beyond 10 km Optical PHYs” for 50 GbE / 200 GbE / 400 GbE had 103 participants. ~~A~~pproximately 60 individuals affiliated with at least 39 companies indicated that they would support the standardization process. It is anticipated that there will be sufficient participation to effectively complete the standardization process including individuals 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

e) Managed object definitions compatible with SNMP

- 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 50 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 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.

- There is no IEEE 802.3 standard or project developing a standard that supports point-to-point Ethernet over 40 km of single-mode fiber cabling at a data rate of 50 Gb/s, 200 Gb/s, or 400 Gb/s.

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 building equipment that supports IEEE 802.3 networks operating up to 400 Gb/s 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.
  - The industry already has experience developing 50 Gb/s per wavelength, direct detect solutions for 50 Gb/s, 200 Gb/s and 400 Gb/s Ethernet. Subcomponents or design experience from these can be leveraged for the proposed Physical Layer specifications.
  - The experience gained in the development and deployment of 25 Gb/s and 100 Gb/s optical solutions targeting 40 km is applicable to the development of specifications for components at 50 Gb/s per wavelength targeting 40 km over single-mode fiber. Feasibility data has been presented.
- 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.
- Reasonable cost for the resulting performance will be achieved in this project as established by prior experience in the development of Ethernet direct detect optical specifications ranging from 50 Gb/s to 400 Gb/s based on the 50 Gb/s per wavelength PMDs
- In consideration of installation costs, the project is expected to use proven and familiar media consistent with industry deployments.
- Extended reach optical solutions minimize the need for additional equipment to achieve the target reaches which lowers overall network power consumption.
- Network design, installation and maintenance costs are minimized by preserving network architecture, management, and software.

Thank You!