

IEEE P802.3ct Task Force: 100 Gb/s and 400 Gb/s over DWDM Systems

Closing Report

John D'Ambrosia

Futurewei, U.S. Subsidiary of Huawei

Waikoloa Village, HI, USA

Nov 14, 2019

IEEE P802.3ct Task Force Project information

Task Force Organization

- John D'Ambrosia, Chair, IEEE P802.3cn Task Force
- Editorial Team
 - Tom Issenhuth – Chief Editor, 400 GbE Optical PHY Clause
 - Pete Anslow – Supporting Clauses
 - Peter Stassar – 100 GbE Optical PHY Clause
 - Steve Trowbridge - 100 GbE PCS/FEC/PMA Extender Clauses
 - John DeAndrea - 400 GbE PCS/PMA Clauses
- Task force web and reflector information
 - Reflector: <http://www.ieee802.org/3/ct/reflector.html>
 - Home page: <http://www.ieee802.org/3/ct/index.html>
- Project Documentation –
 - PAR : http://www.ieee802.org/3/ct/P802_3ct_PAR.pdf
 - CSD: <https://mentor.ieee.org/802-ec/dcn/18/ec-18-0249-00-ACSD-p802-3ct.pdf>
 - Objectives: http://www.ieee802.org/3/ct/3ct_Objectives_190212.pdf
 - Timeline: http://www.ieee802.org/3/ct/timeline_3ct_190119.pdf (NEEDS REVIEW)
 - Private Area: <http://www.ieee802.org/3/ct/private/index.html>
 - **Note: The draft, and any other content, is posted for your review only, and neither the content nor access information should be copied or redistributed to others in violation of document copyrights**
- Ad Hoc page: <http://www.ieee802.org/3/ct/public/adhoc/index.html>

IEEE P802.3ct Task Force Activities this week

Met Wed / Thurs this week

Major items discussed, decisions made and actions

Responded to 1 comment submitted by IEEE 802.11 against modified IEEE P802.3ct PAR

Reviewed 59 comments submitted against Draft 1.0 (100 GbE objective only)

Includes all submitted comments plus 1 comment from floor based on presentation submission

Heard 4 technical presentations related to 400 GbE Objective

Formed EVM Methodology Ad hoc, Will meet at 12/5 Interim Teleconference Meeting

Considered liaisons from

OIF – deferred response until January 2020 meeting (Will cc: ITU-T)

ITU – Proposed Liaison to forward D1.1

Current status

100 GbE:

Task Force Comment review D 1.1 Start: 04 Dec, Close 03 Jan

Technical work to resolve D1.1 TBDs and work towards technically complete draft

400 GbE:

Resolve 75 GHz / 100 GHz grid spacing

Baselines (Tx/Rx parameters, EVM methodology) needed to generate D1.0

Pending approval of modified P802.3ct and new P802.3cw PARs

WG Motion

Move that the IEEE 802.3 Working Group approve:

➤ IEEE P802.3ct Project Documentation Modification

- Objectives - http://www.ieee802.org/3/ct/ProjDoc/3ct_Objectives_190911.pdf
- PAR – <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0149-01-00EC-ieee-p802-3ct-draft-par-response.pdf>
- CSD - <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0147-00-00EC-ieee-p802-3ct-draft-csd.pdf>

➤ IEEE P802.3cw Project Documentation

- Objectives - http://www.ieee802.org/3/ct/ProjDoc/3cw_Objectives_190911.pdf
- PAR – <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0150-00-00EC-ieee-p802-3cw-draft-par-response.pdf>
- CSD - <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0148-00-00EC-ieee-p802-3cw-draft-csd.pdf>

M: John D'Ambrosia

S: Tom Issenhuth

Technical (>75%)

Results: Y: x N: x A: x

Motion:

WG Motion

Move that the IEEE 802.3 Working Group approve

➤ IEEE_802d3_to_ITU_3ct_1119

with editorial license granted to the Chair (or his appointed agent) as a liaison communication from the IEEE 802.3 Working Group to ITU-T SG15.

Technical($\geq 75\%$)

M: D'Ambrosia

S: Trowbridge

Results Y: x N:x A:x

Next Meetings

- **Interim Teleconference Meetings**
 - 05-Dec-2019, 10:00am to 12:00pm ET – EVM Methodology Ad hoc will be meeting
 - 12-Dec-2019, 10:00am to 12:00pm ET
 - 19-Dec-2019, 10:00am to 12:00pm ET
 - 09-Jan-2020, 10:00am to 12:00pm ET
- **Next F2F meeting – Jan 2020 Interim, Geneva, Switzerland**

Questions?

Thank you!

IEEE P802.3ct PROJECT SPLIT

Summary of Project Documents

➤ IEEE P802.3ct Project Documentation Modification

- Objectives - http://www.ieee802.org/3/ct/ProjDoc/3ct_Objectives_190911.pdf
- PAR – <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0149-01-00EC-ieee-p802-3ct-draft-par-response.pdf>
- CSD - <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0147-00-00EC-ieee-p802-3ct-draft-csd.pdf>

➤ IEEE P802.3cw Project Documentation

- Objectives - http://www.ieee802.org/3/ct/ProjDoc/3cw_Objectives_190911.pdf
- PAR – <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0150-00-00EC-ieee-p802-3cw-draft-par-response.pdf>
- CSD - <https://mentor.ieee.org/802-ec/dcn/19/ec-19-0148-00-00EC-ieee-p802-3cw-draft-csd.pdf>

IEEE P802.3ct (mod) Adopted 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

100 Gb/s Ethernet

Support a MAC data rate of 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 100 Gb/s

Provide a physical layer specification supporting 100 Gb/s operation on a single wavelength capable of at least 80 km over a DWDM system.

~~***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 on a single wavelength capable of at least 80 km over a DWDM system.**~~

IEEE P802.3cw Adopted 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

~~100 Gb/s Ethernet~~

~~Support a MAC data rate of 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 100 Gb/s~~

~~Provide a physical layer specification supporting 100 Gb/s operation on a single wavelength capable of at least 80 km over a DWDM system.~~

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 on a single wavelength capable of at least 80 km over a DWDM system.

IEEE P802.3ct PAR / CSD MODIFICATIONS

PAR item 2.1 – Project title

Project title: Standard for Ethernet Amendment:

Single PAR: Physical Layers and Management Parameters for 100 Gb/s and ~~400 Gb/s~~
Operation over DWDM (dense wavelength division multiplexing) systems

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:

Date ~~Jul 2020~~ **Nov 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:

Date ~~Feb 2021~~ **Aug 2021**

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:

Define physical layer specifications and management parameters for the transfer of Ethernet format frames at 100 Gb/s ~~and 400 Gb/s~~ at reaches greater than 10 km over DWDM systems.

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:

Optical solutions targeting greater than 10 km over a DWDM system will address the bandwidth growth and reach requirements of Cable/MSO (multiple system operator) distribution networks, **and** mobile backhaul networks, ~~and interconnect for distributed data centers~~ where reaches greater than 10 km are required, or where fiber availability drives the need for multiple instances of Ethernet over a DWDM system.

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 mobile backhaul networks, cable/multi-service operator (MSO) distribution networks, ~~data center interconnect networks~~, and any other networks needing **100 Gb/s operation at** reaches in excess of 10 km over DWDM systems.

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.

Other PAR Items

- 5.1 Approximate number of people expected to be actively involved in the development of this project: 80
- 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
- 7.2 Joint Development Is it the intent to develop this document jointly with another organization?: No

PAR Item 7.1 (1 of 2)

7.1 Are there other standards or projects with a similar scope?:

Yes.

While there are no other IEEE standards or projects with a similar scope, the IEEE 802.3 Working Group has received ~~a liaison~~ from ~~two organizations~~ indicating that the ~~respective groups have related efforts underway~~. ITU-T Study Group 15 ~~has~~ **that** communicated that it is revising Recommendation ITU-T G.698.2 to include multi-vendor interoperable 100 Gb/s single channel optical interfaces that operate over a DWDM system for approximately 80 km distances. ~~The Optical Internetworking Forum (OIF) has communicated that it is developing the 400ZR Implementation Agreement (IA), which is targeted at (passive) single channel and (amplified) short reach DWDM (dense wavelength division multiplexing) / DCI (data center interconnect) pluggable modules with distances supported from 80-120 km. The effort will support 400 Gb/s Ethernet via the 400GAUI-8 interface that is defined by IEEE 802.3.~~ Stakeholders have expressed the desire for this project, as it will define physical layer specifications and Protocol Implementation Conformance Statements (PICS) for 100 Gb/s ~~and 400 Gb/s~~ Ethernet operation over DWDM systems that are consistent and completely integrated with existing IEEE 802.3 Ethernet specifications.

PAR Item 7.1 (2 of 2)

- Sponsor Organization: ITU-T SG15 ~~and OIF~~
- Project/Standard Number: Recommendation ITU-T G.698.2 ~~and OIF 400ZR Implementation Agreement~~
- Project/Standard Date: **Approval date of 29th Nov 2018**
- Project/Standard Title: Recommendation ITU-T G.698.2 Amplified multichannel dense wavelength division multiplexing applications with single channel optical interfaces ~~and OIF 400ZR Implementation Agreement~~

PAR Form 8.1

- 8.1 Additional Explanatory Notes:

It became apparent to the IEEE 802.3 Working Group that the market demands and the state of technology for 100 GbE and 400 GbE over DWDM systems are different, and that a faster timeline for the 100GbE portion of the IEEE P802.3ct project could be achievable. As a result the 400 Gb/s Operation over DWDM

Systems portion of the project has been removed from the IEEE P802.3ct PAR and placed in the new IEEE P802.3cw amendment PAR.

~~Item 7.1 Project/Standard date: Recommendation ITU-T G.698.2 consent date of 19th Oct 2018~~
~~Item 7.1 Project/Standard date: OIF 400ZR Implementation Agreement project start date 3rd Nov 2016~~

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 P802.3ct 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 100 GbE ~~and 400 GbE~~. Optical solutions targeting 80 km over DWDM systems will address the bandwidth growth and reach requirements of Cable/MSO distribution networks **and**, mobile backhaul networks ~~and interconnect for distributed data centers~~ where reaches in excess of 40 km are required or where fiber availability drives the need for multiple instances of Ethernet over a DWDM system.*
- *This project will provide upgrade paths for existing application areas that need greater bandwidth at the reaches specified. Applications over 80 km over DWDM systems migrating from 10 Gb/s do not have an upgrade path.*
- ***A** ~~Two~~ calls-for-interest for “Beyond 10 km Optical PHYs” (for ~~50 GbE / 200 GbE / 400 GbE and then separately~~ for 100 GbE) had ~~103 & 124~~ participants respectively. ~~In each CFI,~~ **A** approximately 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 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 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.](#)

- While there are no other IEEE standards or projects with a similar scope, the IEEE 802.3 Working Group has received liaisons from ~~two organizations indicating that the respective groups have related efforts underway.~~ ITU-T Study Group 15 ~~has~~ **that** communicated that it is revising Recommendation ITU-T G.698.2 to include multi-vendor interoperable 100 Gb/s single channel optical interfaces that operate over a DWDM system for approximately 80 km distances. ~~The Optical Internetworking Forum (OIF) has communicated that it is developing the 400ZR Implementation Agreement (IA), which is targeted at (passive) single channel and (amplified) short-reach DWDM (dense wavelength division multiplexing) / DCI (data center interconnect) pluggable modules with distances supported from 80-120 km. The effort will support 400 Gb/s Ethernet via the 400GAUI-8 interface that is defined by IEEE 802.3.~~
Stakeholders have expressed the desire for this project, as it will define physical layer specifications and Protocol Implementation Conformance Statements (PICS) for 100 Gb/s ~~and 400 Gb/s~~ Ethernet operation over DWDM systems that are consistent and completely integrated with existing IEEE 802.3 Ethernet specifications.
- There is no IEEE 802.3 standard or project developing a standard that supports point-to-point Ethernet over an 80km DWDM system at a data rate of 100 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 100 Gb/s and 400 Gb/s coherent detection solutions for metro and long-haul networks. Subcomponents or design experience from these can be leveraged for the proposed Physical Layer specifications.
 - The experience gained from the wide deployment of optical coherent detection solutions at single wavelength 100 Gb/s and higher over DWDM systems with much longer reaches than 80 km provides confidence in feasibility of 80 km solutions over a DWDM system.
 - 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 optical coherent detection solutions targeting reaches much longer than 80 km at 100 Gb/s and above that are expected to be cost reduced for 80 km reaches over DWDM systems.
 - 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.

IEEE P802.3cw PAR / CSD (MODIFICATIONS TO EXISTING P802.3ct PAR /CSD)

PAR item 2.1 – Project title

Project title: Standard for Ethernet Amendment:

Single PAR: Physical Layers and Management Parameters for ~~100 Gb/s and 400 Gb/s~~
Operation over DWDM (dense wavelength division multiplexing) systems

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:

Date ~~July 2020~~ **July 2021**

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:

Date ~~Feb 2024~~ **Feb 2022**

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:

Define physical layer specifications and management parameters for the transfer of Ethernet format frames at ~~100 Gb/s and~~ 400 Gb/s at reaches greater than 10 km over DWDM systems.

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:

Optical solutions targeting greater than 10 km over a DWDM system will address the bandwidth growth and reach requirements of ~~Cable/MSO (multiple system operator) distribution networks, mobile backhaul networks, and~~ interconnect for distributed data centers where reaches greater than 10 km are required, or where fiber availability drives the need for multiple instances of Ethernet over a DWDM system.

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 ~~mobile backhaul networks, cable/multi-service operator (MSO) distribution networks,~~ data center interconnect networks, and any other networks needing **400 Gb/s operation at** reaches in excess of 10 km over DWDM systems.

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.

Other PAR Items

- 5.1 Approximate number of people expected to be actively involved in the development of this project: 80
- 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
- 7.2 Joint Development Is it the intent to develop this document jointly with another organization?: No

PAR Item 7.1 (1 of 2)

7.1 Are there other standards or projects with a similar scope?:

Yes.

While there are no other IEEE standards or projects with a similar scope, the IEEE 802.3 Working Group has received liaisons from two organizations indicating that the respective groups have related efforts underway. ITU-T Study Group 15 has communicated that it is **working on a future revision of Recommendation ITU-T G.698.2 to include 400G application codes for** multi-vendor interoperable 400 Gb/s single channel optical interfaces that operate over a DWDM system for approximately 80 km distances. The Optical Internetworking Forum (OIF) has communicated that it is developing the 400ZR Implementation Agreement (IA), which is targeted at (passive) single channel and (amplified) short-reach DWDM (dense wavelength division multiplexing) / DCI (data center interconnect) pluggable modules with distances supported from 80-120 km. The effort will support 400 Gb/s Ethernet via the 400GAUI-8 interface that is defined by IEEE 802.3. Stakeholders have expressed the desire for this project, as it will define physical layer specifications and Protocol Implementation Conformance Statements (PICS) for ~~100 Gb/s and~~ 400 Gb/s Ethernet operation over DWDM systems that are consistent and completely integrated with existing IEEE 802.3 Ethernet specifications.

PAR Item 7.1 (2 of 2)

- Sponsor Organization: ITU-T SG15 and OIF
- Project/Standard Number: Recommendation ITU-T G.698.2 and OIF 400ZR Implementation Agreement
- Project/Standard Date:
- Project/Standard Title: Recommendation ITU-T G.698.2 Amplified multichannel dense wavelength division multiplexing applications with single channel optical interfaces and OIF 400ZR Implementation Agreement

PAR Form 8.1

- 8.1 Additional Explanatory Notes: Item 7.1 Project/Standard date: Recommendation ITU-T G.698.2 ~~consent date of 19th Oct 2018~~ Work item created 29 Mar 2018. Item 7.1 Project/Standard date: OIF 400ZR Implementation Agreement project start date 3rd Nov 2016

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
P802.3ctw 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 ~~100 GbE and 400 GbE~~. Optical solutions targeting 80 km over DWDM systems will address the bandwidth growth and reach requirements of ~~Cable/MSO distribution networks, mobile backhaul networks and~~ interconnect for distributed data centers where reaches in excess of 40 km are required or where fiber availability drives the need for multiple instances of Ethernet over a DWDM system.*
- *This project will provide upgrade paths for existing application areas that need greater bandwidth at the reaches specified. Applications over 80 km over DWDM systems migrating from 10 Gb/s do not have an upgrade path.*
- ~~Two A~~ *calls-for-interest for “Beyond 10 km Optical PHYs” (for 50 GbE / 200 GbE / 400 GbE and then separately for 100 GbE) had 103 & 124 participants respectively. In each CFI, Approximately 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, a 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 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.

- While there are no other IEEE standards or projects with a similar scope, the IEEE 802.3 Working Group has received liaisons from two organizations indicating that the respective groups have related efforts underway. ITU-T Study Group 15 has communicated that it is **working on a future revision of Recommendation ITU-T G.698.2 to include 400G application codes for** multi-vendor interoperable 400 Gb/s single channel optical interfaces that operate over a DWDM system for approximately 80 km distances. The Optical Internetworking Forum (OIF) has communicated that it is developing the 400ZR Implementation Agreement (IA), which is targeted at (passive) single channel and (amplified) short-reach DWDM (dense wavelength division multiplexing) / DCI (data center interconnect) pluggable modules with distances supported from 80-120 km. The effort will support 400 Gb/s Ethernet via the 400GAUI-8 interface that is defined by IEEE 802.3.

Stakeholders have expressed the desire for this project, as it will define physical layer specifications and Protocol Implementation Conformance Statements (PICS) for ~~100 Gb/s~~ and 400 Gb/s Ethernet operation over DWDM systems that are consistent and completely integrated with existing IEEE 802.3 Ethernet specifications.

- There is no IEEE 802.3 standard or project developing a standard that supports point-to-point Ethernet over an 80km DWDM system at a data rate of ~~100 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 100 Gb/s and 400 Gb/s coherent detection solutions for metro and long-haul networks. Subcomponents or design experience from these can be leveraged for the proposed Physical Layer specifications.
 - The experience gained from the wide deployment of optical coherent detection solutions at single wavelength 100 Gb/s and higher over DWDM systems with much longer reaches than 80 km provides confidence in feasibility of 80 km solutions over a DWDM system.
 - 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 optical coherent detection solutions targeting reaches much longer than 80 km at 100 Gb/s and above that are expected to be cost reduced for 80 km reaches over DWDM systems.
 - 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.