IEEE 802.3 Multi Gigabit Automotive Optical PHYs Study Group Report

Robert M. (Bob) Grow
RMG Consulting / KDPOF
WG Interim Teleconference, 21 May 2020

IEEE 802.3 Multi Gigabit Automotive Optical PHYs Study Group information

- Study Group Organization
  - Bob Grow, Chair
- Study Group Charter
  - Move that the IEEE 802.3 Working Group request the formation of a Study Group to develop the Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for Multi Gigabit Automotive Optical PHYs.
- Send Multi-Gigabit Automotive Optical PHYs reflector messages to:

  stds-802-3-omega@listserv.ieee.org
- Study Group web page URL:

  http://www.ieee802.org/3/OMEGA/index.html

IEEE 802.3 Multi Gigabit Automotive Optical PHYs Study Group project documents

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

Draft PAR request: <https://mentor.ieee.org/802-ec/dcn/20/ec-20-0010-01-00EC-ieee-p802-3cz-draft-par-response.pdf>

Draft CSD: <https://mentor.ieee.org/802-ec/dcn/20/ec-20-0011-00-00EC-ieee-p802-3cz-draft-csd-response.pdf>

Draft objectives: <http://ieee802.org/3/OMEGA/public/jan_2020/objectives_OMEGA_01a_0120.pdf>

- All documents were pre-submitted on 15 February 2020

Draft Objectives (1 of 3)

1. Preserve the IEEE 802.3/Ethernet frame format at the MAC client service interface
2. Preserve minimum and maximum frame size of the current IEEE 802.3 standard
3. Support full duplex operation only
4. Define optional startup procedure which enables the time from power_on=FALSE to a state capable of transmitting and receiving valid data to be less than 100ms
5. Support data rates of 2.5 Gb/s, 5 Gb/s, 10 Gb/s, 25 Gb/s, and 50 Gb/s at the MAC/PLS service interface
6. Support optional Energy Efficient Ethernet optimized for automotive applications
7. Support operation in automotive environments (e.g., EMC, temperature)
8. Do not preclude meeting FCC and CISPR EMC requirements

Draft Objectives (2 of 3)

9. Define the performance characteristics of an automotive link segment and an optical PHY to support 2.5 Gb/s point-to-point operation over this link segment supporting up to 4 inline connectors for at least 40 m on at least one type of automotive optical cabling.-
10. Define the performance characteristics of an automotive link segment and an optical PHY to support 5 Gb/s point-to-point operation over this link segment supporting up to 4 inline connectors for at least 40 m on at least one type of automotive optical cabling.-
11. Define the performance characteristics of an automotive link segment and an optical PHY to support 10 Gb/s point-to-point operation over this link segment supporting up to 4 inline connectors for at least 40 m on at least one type of automotive optical cabling.-
12. Define the performance characteristics of an automotive link segment and an optical PHY to support 25 Gb/s point-to-point operation over this link segment supporting up to 4 inline connectors for at least 40 m on at least one type of automotive optical cabling.-
13. Define the performance characteristics of an automotive link segment and an optical PHY to support 50 Gb/s point-to-point operation over this link segment supporting up to 2 inline connectors for at least 15 m on at least one type of automotive optical cabling.-

Draft Objectives (3 of 3)

14. Support a Bit Error Ratio better than or equal to 10^{-12} at the MAC/PLS service interface (or the frame loss ratio equivalent)

WG Motion cz1

MOTION

Move that the IEEE 802.3 Working Group approve the IEEE P802.3cz objectives, as per slides 4 through 6 of 0520_OMEGA_report.pdf.

M: Robert Grow

S: Carlos Pardo

Y: N: A: (Technical ≥75%)

(SG approval 15 May 2020 by unanimous consent)

P802.3cz draft PAR changes (1 of 6)

Submitter Email: david_law@ieee.org

Type of Project: Amendment to IEEE Standard 802.3-2018 Project Request Type: Initiation / Amendment

PAR Request Date: 12 Sep 2019

PAR Approval Date:

PAR Expiration Date:

PAR Status: Draft

Root Project: 802.3-2018

1.1 Project Number: P802.3cz

1.2 Type of Document: Standard

1.3 Life Cycle: Full Use

2.1 Project Title: Standard for Ethernet

Amendment: Physical Layer Specifications and Management Parameters for Multi-Gigabit Optical Automotive Ethernet

P802.3cz draft PAR changes (2 of 6)

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

3.1.1 Contact Information for Working Group Chair:

Name: David Law

Email Address: david_law@ieee.org

3.1.2 Contact Information for Working Group Vice Chair:

Name: Adam Healey

Email Address: adam.healey@broadcom.com

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

3.2.1 Contact Information for Standards Committee Chair:

Name: Paul Nikolich

Email Address: p.nikolich@ieee.org

3.2.2 Contact Information for Standards Committee Vice Chair:

Name: James Gilb

Email Address: gilb@ieee.org

P802.3cz draft PAR changes (3 of 6)

3.2.3 Contact Information for Standards Representative:

Name: James Gilb

Email Address: gilb@ieee.org

4.1 Type of Ballot: Individual

4.2 Expected Date of submission of draft to the IEEE SA for Initial Standards Committee Ballot: Mar 2022

4.3 Projected Completion Date for Submittal to RevCom: Oct 2022

5.1 Approximate number of people expected to be actively involved in the development of this project: 40

P802.3cz draft PAR changes (4 of 6)

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: Specify additions to and appropriate modifications of IEEE Std 802.3 to add Physical Layer specifications and management parameters for multi-gigabit optical Ethernet for application in the automotive environment.

P802.3cz draft PAR changes (5 of 6)

5.3 Is the completion of this standard contingent upon the completion of another standard? No

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

5.5 Need for the Project: Applications in automotive industries have begun the transition of legacy automotive networks to Ethernet to support Advanced Driver Assist Systems. This has generated a need for data rates greater than 1 Gb/s in the automotive environment. Optical fiber has been used in automotive applications both for Ethernet and other protocols. This project will complement other 802.3 projects working on specifications for electrical media operation at rates greater than 1 Gb/s in the automotive environment.

The number of cameras in vehicles is increasing as is the camera data rate with movement to higher resolution video. Optical data links are applicable to both the vehicle network backbone as well as connection of selected devices where location or other factors favor using an optical link.

P802.3cz draft PAR changes (6 of 6)

5.6 Stakeholders for the Standard: End-users, vendors, automotive Original Equipment Manufacturers, Tier x suppliers, system integrators, and providers of systems and components (e.g., sensors, actuators, test and measurement equipment, harnesses and harness components, software, silicon, and control units) for automotive applications.

6.1 Intellectual Property

6.1.1 Is the Standards Committee aware of any copyright permissions needed for this project? No

6.1.2 Is the Standards Committee 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 Is it the intent to develop this document jointly with another organization? No

8.1 Additional Explanatory Notes: 5.6 -- Tier x refers to the various levels of suppliers to Original Equipment Manufacturers (e.g., car manufacturer). A Tier 1 supplier for example supplies components or subsystems directly to the OEM.

Motion cz2 (PAR)

MOTION

Approve the proposed IEEE P802.3cz Multi Gigabit Automotive Optical PHYs PAR https://mentor.ieee.org/802-ec/dcn/20/ec-20-0010-01-00EC-ieee-p802-3cz-draft-par-response.pdf with modifications as detailed in Slides 8 through 13 of 0520_OMEGA_report.pdf.

M: Robert Grow

S: Steve Swanson

Y: N: A: (Technical ≥75%)

(SG approval 15 May 2020 by unanimous consent)

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.
  - Rapid growth of automotive Ethernet has placed high demand on the existing set of PHYs defined for the Automotive industry. Quantitative presentations have been made to the 802.3 OMEGA study group indicating significant market opportunity.
  - The increase of EMC issues due to the frequency increase of operation, and the galvanic isolation required in electrical vehicles is enabling the use of optical communications in the Automotive industry. The support of 40m distances makes optical an optimal solution for buses and trucks.
  - Several uses cases within the Automotive industry ~~has~~have been presented in the 802.3 OMEGA Study Group and CFI.
  - Other transport industries may benefit from these PHYs, for example trains, aircrafts, etc.
- Multiple vendors and numerous users.
  - In the CFI and the Study Group more than 40 individuals working for OEMs and TIER-1/2 suppliers have shown their support and interest.
  - More than 90 Million cars are produced world wide annually. Many of them would benefit from Multi Gigabit Ethernet connectivity. More than 700 Million annual ports is the market size addressable by ~~this~~the PHYs expected to be defined by this project.

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 a PHY amendment to IEEE Std 802.3, the proposed project will remain in conformance with IEEE Std 802, IEEE Std 802.1AC, and IEEE Std 802.1Q.
- The proposed amendment will conform to the IEEE 802.3 MAC.
- As with other IEEE 802.3 projects, a number of new PHY types will be defined.

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 that supports optical Ethernet at rates greater than 1 Gb/s for the requirements of automotive applications.
- The project may define multiple PHYs, but will define only a single PHY for each rate, media, and link reach combination.

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 proposed project will build on the array of Ethernet component and system design experience, and the broad knowledge base of Ethernet network operation.
- Full-duplex operation over different optical fibers has been proven in deployments at multi gigabit rates.
- Optical communications is already being successfully used in the automotive industry
- Reliability concerns have been covered by different analysis reported in the Study Group with a high degree of confidence.
- Component vendors, including PHY vendors, fiber vendors and systems vendors have presented data on the feasibility of the necessary components for this project. Proposals which leverage existing technologies have been provided.
- Study group presentations support link budgets that fulfill automotive requirements at acceptable cost.

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.

- Ethernet interfaces in the target data rate range defined by this project will maintain a favorable cost-performance balance.
- The balance of costs between infrastructure and attached stations is not applicable to the automotive environment.
- The cost factors for Ethernet components and systems are well known. The proposed project may introduce new cost factors for automotive applications which can be quantified.
- Prior experience in the development of other physical layer specifications for Ethernet indicates that the specifications developed by this project will result in a reasonable cost for the specified performance.
- The reduction in the number of legacy networks requiring specialized components, expertise, and gateways in the targeted markets will result in a significant drop in both vehicle assembly (installation) and operational costs.
- Overall costs are minimized by introducing Ethernet network architecture, management, and software into the automotive environment.
- Zonal (centralized) architecture, connected car, and autonomous car, will allow consolidation of processing resources similar to what has been seen in enterprise networks.
- The study group presentations support the possibility of technology leveraging of existing optical components for the automotive industry.

Motion cz3 (CSD)

MOTION

Approve the modified IEEE P802.3cz Multi Gigabit Automotive Optical PHYs Task Force 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-20-0011-00-00EC-ieee-p802-3cz-draft-csd-response.pdf with modifications as detailed in Slides 15 through 20 of 0520_OMEGA_report.pdf.

M: Robert Grow

S: Mabud Choudhury

Y: N: A: (Technical ≥75%)

(SG approval 15 May 2020 by unanimous consent)

Thank You!