A Proposal to Split the IEEE 802.3cz PAR

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Motivation for this contribution

- Four different PMDs have been proposed in IEEE 802.3cz

  - A solution based on OM3 laser optimized multimode optical fiber operating at 980nm
    - Technically complete
    - Meets all objectives
    - Addresses all CSD responses
    - 980nm has proven reliability advantages

  - A solution based on OM3 laser optimized multimode optical fiber operating over a 850 to 980nm wavelength range
    - It is believed that a single transmitter specification cannot be used due to reliability concerns
      - 980nm VCSEL can have a > 7mA bias current and still meet reliability requirements
      - 850nm VCSEL must have a < 5mA bias current to marginally meet reliability requirements
    - Results in a 2.5dB reduction in link budget that must be compensated for

  - A solution based on OM3 laser optimized multimode optical fiber operating at 1300nm
    - Is not proposed to support all objectives
    - Lacks distinct identity – same data rate and same link length as 980nm proposal
    - Proponents of OM3 at 1300nm claim better reliability than 980nm but no data has been presented to support this claim
    - Is on a different timeline for a technically complete draft

  - A solution based on Graded-Index Plastic Optical Fiber
    - Does not address all of our objectives
    - Does not meet our commitments to IEEE 802 in our CSD responses
    - Is on a different timeline for a technically complete draft

Motivation for this contribution (cont.)

- At the November 8, 2021 802.3 Opening Plenary, the current status of P802.3cz was reported
  - D1.2 in preparation, December 7, 2021 target for availability
  - Still deadlocked on PMD baseline
  - Exploring possibilities for breaking deadlock (e.g., revise Objectives and/or CSD, "PAR split")

- This contribution explores what the documentation might look like for a PAR split
  - Proposed modifications to IEEE 802.3cz Objectives and new IEEE 802.3dh Objectives
  - Proposed modifications to IEEE 802.3cz PAR and a new IEEE 802.3dh PAR
  - Proposed modifications to IEEE 802.3cz CSD responses and new IEEE 802.3dh CSD responses

Intent

- It is believed that the 980nm OM3 proposal has been properly vetted in the TF and is ready to move to WG ballot

- This contribution is intended to be a strawman proposal and is open to review and comment by all
  - It only addresses a PAR split to address GIPOF separately
  - It does not address 850-980nm broadband solutions
  - It does not address 1300nm solutions

- It is believed that all of the other proposal have shortcomings
  - Each has specific issues in addressing CSD requirements for Broad Market Potential, Technical Feasibility, Economic Feasibility and Distinct Identity

Proposed Objectives

IEEE 802.3cz modified objectives

- 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~~ **using graded-index glass optical fiber**

- 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~~ **using graded-index glass optical fiber**

- 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~~ **using graded-index glass optical fiber**

- 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~~ **using graded-index glass optical fiber**

- 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 **40 m** ~~15 m on at least one type of automotive optical cabling~~ **using graded-index glass optical fiber**

IEEE 802.3dh proposed objectives

- 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 **15** m **using graded-index plastic optical fiber**

- 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 **15** m **using graded-index plastic optical fiber**

- 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 **15** m **using graded-index plastic optical fiber**

- 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 **15** m **using graded-index plastic optical fiber**

- ~~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~~ **using graded-index plastic optical fiber**

Proposed CSD Responses - BMP

IEEE 802.3cz Broad Market Potential

- **Each proposed IEEE 802 LMSC standard shall have broad market potential. At a minimum, address the following areas:**
    - **Broad sets of applicability.**
    - **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 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 the PHYs expected to be defined by this project.

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Highlighted text indicates concerns that need to be addressed

Proposed CSD Responses – Distinct Identity

IEEE 802.3cz 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.

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Proposed CSD Responses – Technical Feasibility

IEEE 802.3cz 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:**
  - **Demonstrated system feasibility.**
  - **Proven similar technology via testing, modeling, simulation, etc.**
  - **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

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Proposed CSD Responses – Economic Feasibility

IEEE 802.3cz 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:**
  - **Balanced costs (infrastructure versus attached stations).**
  - **Known cost factors.**
  - **Consideration of installation costs.**
  - **Consideration of operational costs (e.g., energy consumption).**
  - **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.

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IEEE 802.3cz PAR modifications

P802.3cz

Submitter Email: (automatically completed)
Type of Project: Amendment to IEEE Standard 802.3-2018
Project Request Type: Modify / Amendment
PAR Request Date:
PAR Approval Date:
PAR Expiration Date:
PAR Status: ~~Active~~ **Draft**
Root PAR: P802.3-2018
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 Ethernet **using graded-index glass optical fiber** for application in the automotive environment
3.1 Working Group: Ethernet Working Group(C/LM/802.3 WG)
3.1.1 Contact Information for Working Group Chair:
Name: David Law
Email Address: (automatically completed)
3.1.2 Contact Information for Working Group Vice Chair:
Name: Adam Healey
Email Address: (automatically completed)
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: (automatically completed)
3.2.2 Contact Information for Standards Committee Vice Chair:
Name: James Gilb
Email Address: (automatically completed)
3.2.3 Contact Information for Standards Representative:
Name: James Gilb
Email Address: (automatically completed)

P802.3dh

Submitter Email: (automatically completed)
Type of Project: Amendment to IEEE Standard 802.3-2018
Project Request Type: Initiation / Amendment
PAR Request Date
PAR Approval Date:
PAR Expiration Date:
PAR Status:
Root Project: 802.3-2020
1.1 Project Number: P802.3**dh**
1.2 Type of Document: Standard
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3.1 Working Group: Ethernet Working Group(C/LM/802.3 WG)
3.1.1 Contact Information for Working Group Chair:
Name: David Law
Email Address: (automatically completed)
3.1.2 Contact Information for Working Group Vice Chair:
Name: Adam Healey
Email Address: (automatically completed)
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: (automatically completed)
3.2.2 Contact Information for Standards Committee Vice Chair:
Name: James Gilb
Email Address: (automatically completed)
3.2.3 Contact Information for Standards Representative:
Name: James Gilb
Email Address: (automatically completed)

IEEE 802.3cz PAR modifications (cont.)

P802.3cz

4.1 Type of Ballot: Individual

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

4.3 Projected Completion Date for Submittal to RevCom: June 2023

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

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.

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

P802.3dh

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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.

5.3 Is the completion of this standard contingent upon the completion of another standard? Yes; IEC 60793-2-40 has been proposed for early revision to address automotive applications. Wavelength of operation will be considered as well as bandwidth and attenuation specifications and mechanical properties.

5.4 Purpose: This document will not include a purpose clause

IEEE 802.3cz PAR modifications (cont.)

P802.3cz

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.

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.

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7.3 **IEC 60793-2-40 "Optical fibres – Part 2-40: Product specifications – Sectional specification for category A4 multimode fibres**

Thanks for your attention