IEEE 802.3cz – A Review of PMD Options

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Current Status in IEEE 802.3cz

- **Three different PMDs have been proposed in IEEE 802.3cz**
  - One based on OM3 laser optimized multimode Optical Fiber operating at 980nm
  - One based on Graded-Index Plastic Optical Fiber operating at 850nm
  - One based on SiP operating at 1310nm on Multimode Optical Fiber
- Significant contributions have been presented supporting OM3 at 980nm
  - A complete baseline proposal has been developed addressing all objectives and CSDs
- **There appears to be no opposition to including OM3/980 in IEEE 802.3cz but concern that it is the ONLY option**
  - **But it is the best option considering all factors**
- **The proposed PMDs on GIPOF at 850nm and SiP at 1310nm on OM3**
  - **Do not address all of our objectives**
  - **Do not meet our commitments to IEEE 802 in our CSD responses**
- **There is some opposition to 980nm but…**
  - It has been demonstrated that 980nm VCSELs are more reliable for this application
  - 980nm has been considered by IEEE in the past; the primary reason it has not been included is the installed base of 850nm products
    - Automotive has no installed base
  - All VCSEL manufacturers can cost effectively manufacture 980nm VCSELs if 980nm is selected
  - There are advantages for the VCSEL and the fiber at 980nm

IEEE 802.3 approved 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
- 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
- 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
- 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
- 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

A Review of the Relevant CSDs

- **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**
- **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**
- **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**
- **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.

A comparison of the proposed PMDs

- OM3 laser optimized multimode Optical Fiber operating at 980nm meets all of the objectives and CSDs
  - 2.5, 5, 10, 25 and 50G supporting 40m and 4 in-line connectors

- Graded-Index Plastic Optical operating at 850nm has been proposed but falls short on both objectives and CSDs
  - 2.5, 5, 10G and 25G proposed supporting 15m
  - Number of in-line connectors depends on data rate and connector loss allocation
  - Cost is unknown but is believed to be higher than OM3 with less capability (shorter distance)

- Multimode Optical Fiber operating at 1310nm on SiP has been proposed but falls short on both objectives and CSDs
  - 10 and 25G proposed supporting 40m and 4 in-line connectors
  - Cost is unknown but is believed to be higher than OM3 for the same capability (same distance but violates distinct identity)

Number of PMDs

- Most IEEE standards have *one and only one* PMD targeted at each application space
  - Unless there is good rationale for including multiple PMDs, e.g., significant cost differences or differences in supportable link lengths

- If we include all proposed 802.3cz PMDs, we will have
  - 2 supporting 2.5G
  - 2 supporting 5G
  - 3 supporting 10G
  - 3 supporting 25G
  - 1 supporting 50G

- Or 11 port types total

- What is the rationale for supporting multiple PMDs for a single data rate/link length?

PMD analysis

- *If at all possible, IEEE 802.3cz should only develop one PMD per data rate that satisfies all of the objectives*
- Multiple solutions addressing the same application space fragments the market
  - Target reach is similar for all objectives
  - Only difference is the data rate

CSD \ PMD	OM3/980nm	GIPOF/850nm	SiP/1310nm
Broad Market Potential			
Distinct Identity			
Technical Feasibility			
Economic Feasibility			
Shortcomings	None	Cost W/C Laser EMB Mode coupling Connectors	Complexity W/C Laser EMB Unknown costs Distinct identity

Summary

- It is recommended that we select a PMD based on a 980 nm VCSEL & OM3
  - OM3 fiber readily available for 20+ years from multiple vendors
  - Many round-robin tests of EMB, and VCSEL characterization
  - 980nm readily available from multiple vendors
  - 980nm yields best reliability and lowest cost

- A4i GI-POF fiber
  - Has not been characterized thoroughly, no round-robins, fiber is not available
  - Bandwidth based on OFL and not EMB
  - Significant mode coupling could lead to even shorter links
  - Cannot support 50G
  - The worst-case short-length performance with VCSELs is unknown

- SiP
  - Complex design even for multimode fiber
  - Bandwidth based on OFL and not EMB
  - Has not been characterized thoroughly, no round-robins
  - Costs unknown

Thanks for your attention