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Proposal to include optical fiber objective in Multi-gig Automotive Ethernet

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Summary

Propose to include an optical fiber PHY objective in Multi-Gig Ethernet to support emerging high bandwidth, long length & weight reduction use cases

Broad market potential

- Automotive networking is evolving rapidly with multiple use cases for bandwidth ≥ 1 Gb/s
- Related applications requiring link lengths ≥ 15 m
- Glass fiber media option would complement twisted pair in emerging applications

Benefits

- Optical fiber complements copper interconnect by providing exceptional bandwidth, light weight, low power consumption, electromagnetic immunity, and harsh environment resistance

Technical Feasibility

- Optical fiber technologies are mature and widely used in other applications where they have achieved low cost have proven reliability. e.g. 10GBASE-SR technology can be adapted to an automotive PHY

Automotive use cases could benefit from an optical fiber option

- Use cases From CFI Multi-Gig Automotive Ethernet PHY CFI_01_1116.pdf

CFI Multi-Gig Automotive Ethernet PHY

Why Multi-Gig in Addition to 1000BASE-T1/-RH and 100BASE-T1?

- ▶ Use Cases
 - Sharing camera data
 - 4K and 8K shared display data
 - Connectivity: LTE 4G/5G, transport of 802.11ac
 - Connecting 1000BASE-T1/-RH switches
 - Diagnosis (port mirroring of multiple 1000BASE-T1/-RH links)



CFI Multi-Gig Automotive Ethernet PHY

Use Cases

- ▶ Cameras
 - 4K Cameras at 60 fps - 6 to 8 Gbps
 - Short propagation delay (< 20 ms) doesn't allow for compression
- ▶ Data Sharing
 - Aggregation of multiple 1 Gbps links requires xGbps links
- ▶ Displays
 - 4K/8K displays will start appearing in vehicles
- ▶ Data Recorder
 - Significant amount of raw data may need to be saved to reconstruct incidents

- Uncompressed camera/video data rates reach and exceed 10 Gb/s, e.g. zinner_NGAUTO_01a_0217.pdf
- Commercial vehicle applications may require lengths up to 40 m: matheus_buntz_10SPE_01_0916.pdf (10 Mbps Single Pair Ethernet SG)

| | Mandatory | Additional/optional |
|-------------------------|-----------------------------------|--|
| Physical Medium | Unshielded, unjacketed TP cabling | If possible, CAN cable (i.e. PVC insulation) |
| Max. link length | 15 m for passenger vehicles | 40 m for commercial vehicles |

- OEM survey indicated that 50% of respondents expressed interest in 10 Gb/s and 50% said they would consider optical cable
Wienckowski_3NGAUTO_01a_0117.pdf

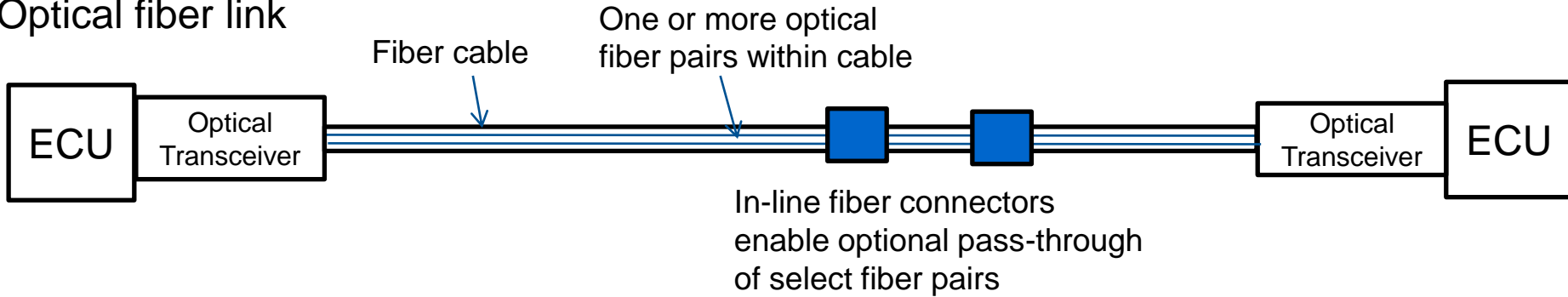
Benefits of optical fiber link

- Optical fiber links provide compelling features that complement copper interconnects
- Reach
- Light weight
- Low power consumption
- Thin cross-section
- Low latency
- Electromagnetic immunity
- Harsh environment compatibility

Reference: whelan_3NGAUTO_01b_0117.pdf

Technical feasibility

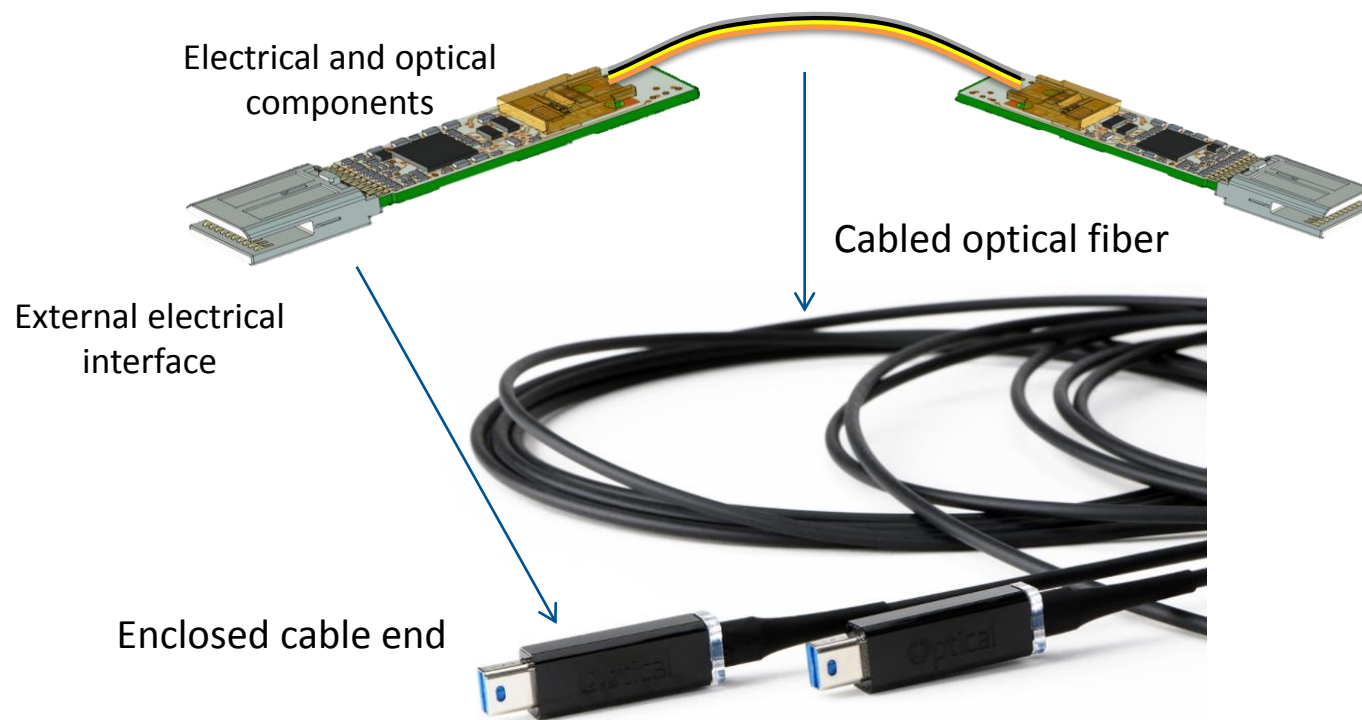
Optical fiber link



| Component | Status | Technology | Examples |
|---------------------|-----------|--------------------------|--|
| Optical transceiver | Available | VCSEL | 10GBASE-SR, or 10G SRL version |
| Fiber | Available | Multimode fiber | OM2, OM3, OM4 |
| Cable | Available | Environmentally hardened | Fiber drop cable, Aerospace cable |
| Connector | Available | Environmentally hardened | Assembly suggested, see next slide as an example |

Active optical cable configuration encapsulates optical links

- Transceiver is permanently fixed to fiber cable
 - Compatible with proven transceiver technologies
- Active cable provides electrical interface to external devices
- Optical and electronic components can be environmentally isolated in sealed environment



Objective proposal

- Add the following multi-gig objective

“Define the performance characteristics of a link segment and a PHY to support 10 Gb/s operation over this link segment supporting up to four inline connectors using

- copper cabling with lengths up to at least 15m
- optical fiber cabling with lengths up to at least 40m”

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Thank You!