Preliminary CFI presentation

October 2018

Objective of the call

- Consensus building around the Automotive Optical Multi Gig CFI preparation

- Expected output of the meeting
  - Meet people interested in this CFI
  - Understand background
  - Discuss about requirements, objectives, calendar, etc
  - Decide next calls schedule

- NOT expected output of the meeting
  - Decide the technical solution
  - Have today the CFI PPT ready

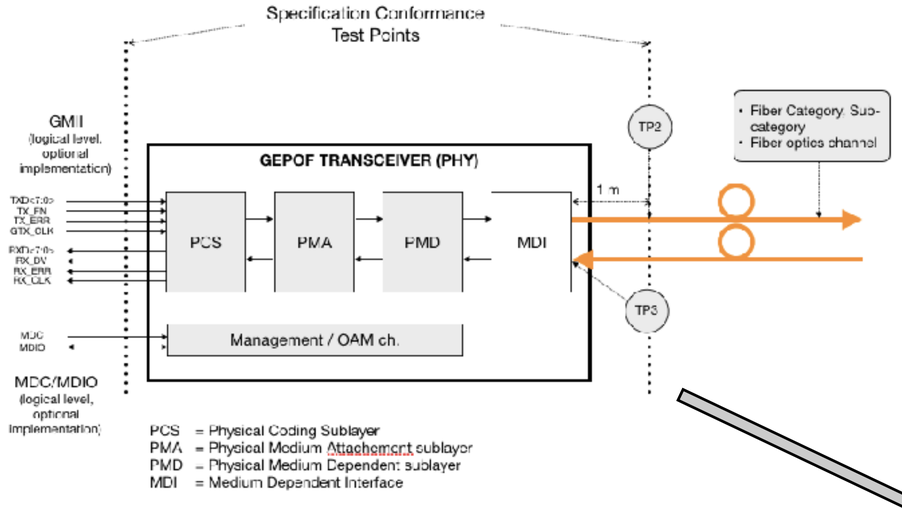
Introduction to optical in Automotive

Optical Communications in automotive

	Speed (Mbps)	Application	Year
D2B	12	Digital audio	1992
MOST	25, 150	Infotainment	2001-2008
Byteflight	10	Safety-critical	2001
Firewire	400	Infotainment	2004

Optical communications are well established in automotive

Gigabit POF: Standardization



IEEE

1000BASE-RH

- PHY definition
  - PCS, PMA & PMD
  - Optical performance

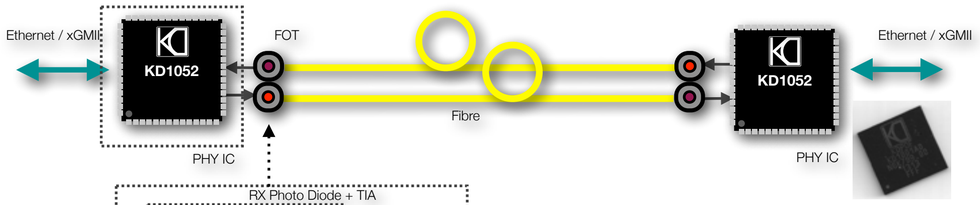
- 1 Gbps
- 15 meters up to 4 in line connectors
- 40 meters
- Automotive qualified POF and light source

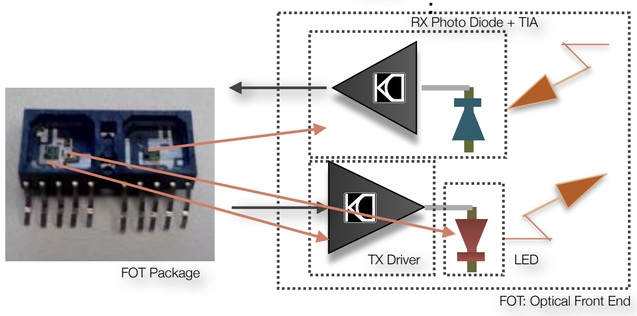
ISO International Organization for Standardization

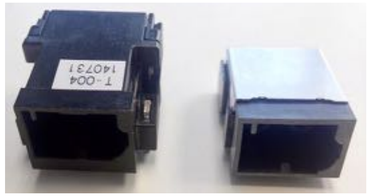
- Wake up and sleep
- Interfaces
- Compliance
- Interoperability
- Harness

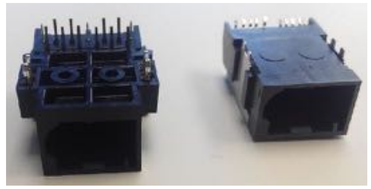
- Connectors
  - Small form factor
  - MOST-150 type

Gigabit POF: Zoom into components



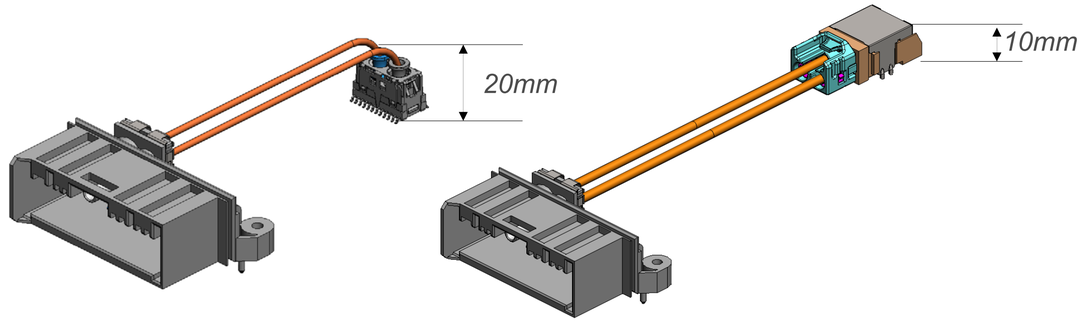






Connector housing

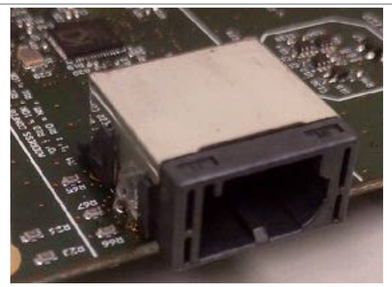
Header connector portfolio to accommodate any board and interconnection topology



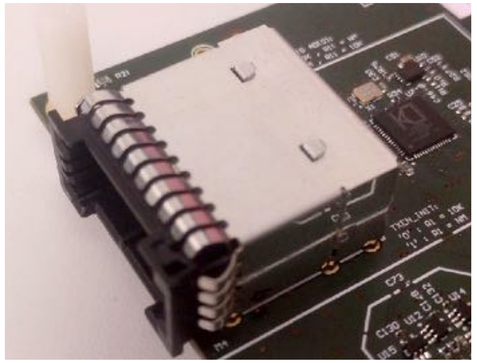
Feature & Advantages

Connector types

- Small form factor connector



- MOST-150 style connector



- Sky-looker connector

USE CASES

Use Cases

BMS
Galvanic Isolation

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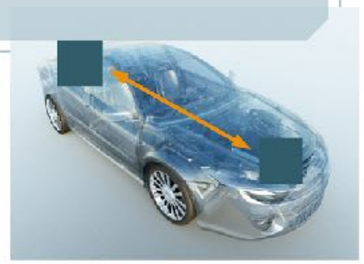
Backbone



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Smart Antenna modules

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Infotainment

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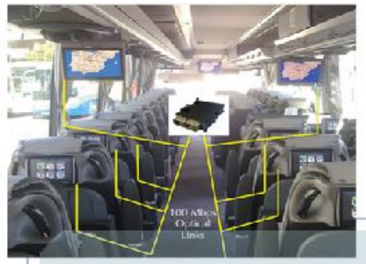

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100 Mbps links
EMC-tight

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Autonomous driving
safety redundancy

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ADAS camera
interconnection

Where is used today ?

- (Show OEMs brand names with their permission)
- (Show TIER-1/2 brand names with their permission)
- Applications used:
  - Battery Management Systems
  - Network backbone
  - Smart Antenna link
  - ADAS safety redundant links
  - Infotainment

Multi Gigabit

GM / NGAUTO Poll

Surveys – OEM Responses

Cable Types – Should different speeds use the same cable or is it okay if they're different?

- 68.75% of respondents said it is okay to use different cables for different speeds

Is it okay to use optical cable?

- 50% of respondents said they would consider using optical cable

Maximum operating temperature

- 62.5% need 105 C for most or all speeds
- 18.75% need more than 105 C for some or all speeds
- 18.75% say 85 C is sufficient for all speeds

Minimum operating temperature

- 100% agree that -40 C is sufficient
- -55 C is required for storage

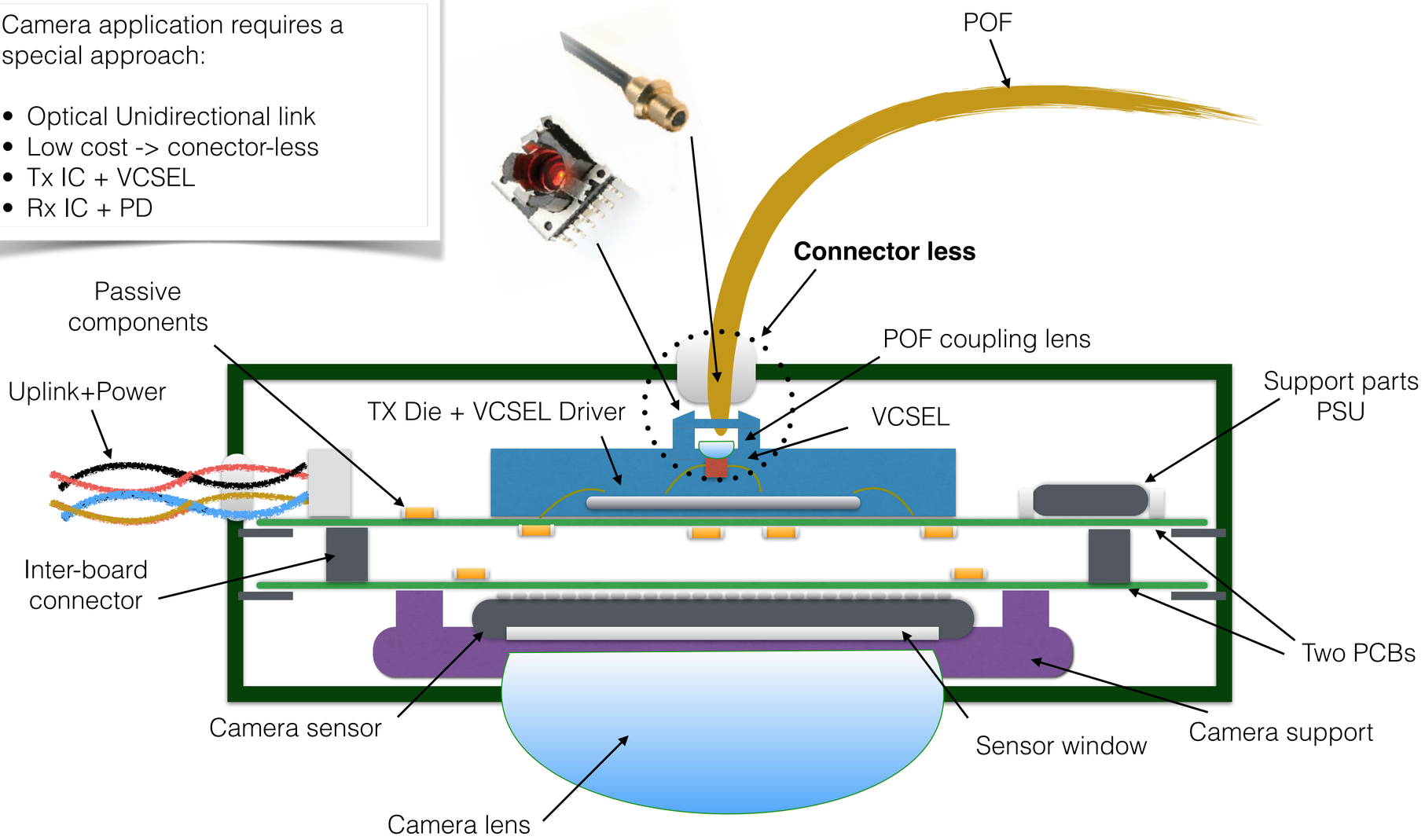
Multi Gigabit applications

- Back-bone
  - Symmetric trafic
  - May be in redundancy configuration for safety systems
  - 1 to 6 links per car
  - Mixed data type (Control, Multimedia, ADAS, Sensors data, video, etc)
  - Aggregation of all data generated in the car
  - Very high speed redundant links with ADAS system
- Camera & Display
  - Very asymmetric trafic
  - 1 to 5 display links per car
  - 1 to 8 camera links per car
  - Raw video data type
  - Would it be managed by MIPI ?
  - Should 802.3 create an asymmetric/hybrid PHY specification? (xx Gbps down / 10 Mbps up) (Optical / Copper)
- Other ?

Multi-Gig optical link for cameras

Camera application requires a special approach:

- Optical Unidirectional link
- Low cost -> conector-less
- Tx IC + VCSEL
- Rx IC + PD



10GBASE-SR

- IEEE Std 802.3 already includes the 10GBASE-SR specification that may be considered as starting point to develop multi-gigabit optical solution for automotive applications.
  - However, is it really good enough for automotive applications?
- Difference between 10GBASE-SR and the Automotive requirements:
  - Temperature range: Tj = -40ºC -> 105ºC/125ºC and 15 years of operation with 0 ppm failures
    - So VCSEL current density needs to be reduced to achieve reliability and target temperature range
    - VCSEL Bandwidth will be highly reduced
    - Relative intensity noise will increase
  - Insertion Loss will be increased due to:
    - 4 inline connectors with much higher estimated losses per connector due to vibrations, aging, dust, etc
  - Cost and power consumption restrictions are different
    - Is it possible to have high yield manufactured components (Connectors, VCSEL, PD, etc) with the new requirements meeting cost needs ?
    - Is it possible to have a low power implementation with improved reliability, and implementable in a car ?
  - OAM channel is needed
  - System needs to be adaptive to cope with:
    - dynamic changes of temperature
    - large parametric variation with manufacturing processes and temperature

Open discussion

Needed speed

- For Camera / Display the industry is already using non-ethernet copper solutions for speeds bellow 10 Gbps
- Automotive camera requires:
  - High resolution (Today 1 -2 Mbpx is used. Future is targeting 4/8 Mbpx)
  - High dynamic range per pixel (See in the dark, no saturation of camera, etc)
  - High frame rate (Fast ADAS reaction)
  - No/minimal compression to avoid loss of information and increase of latency and power consumption
  - 4/8 Mbpx x 24 bppx x 60 fps = 6/12 Gbps
  - Do we need more than 10 Gbps ? 25 Gbps ?
- Backbone:
  - Today backbones are 100 Mbps / 1 Gbps
  - 10 Gbps should be the natural step
  - Is 2.5 or 5 Gbps needed ? May be no PHY price difference with 10 Gbps. May be only power consumption. Does application implementation improves thanks to lower speeds ?
  - Is 25 Gbps, 50 Gbps, 100 Gbps needed ?

Type of fibre

- MMF glass fibre: OM1 to OM5 (50um/125um)
  - Very high volumes
  - High temperature (125ºC)
  - Fragile ?
- GI-POF: (80um/400um)
  - Robust, flexible, larger
- PCS / HCS
  - Robust
  - Low bandwidth (125 ºC)
  - High temperature
  - Low bandwidth ?
- GI-HCS
  - High temperature

- Should we support several fiber types ?
- Should they share the same PMD ?
- Should the OEM decide the fibre or should be decided during the standardization process ?

Cable Requirements

- 15 m + 4 in-line
- 40 m

- Key parameter is the amount of inline connectors.
- Length is less critical

Calendar

- When is needed ?
  - Published Standard
  - SOP

Optical: Best solution for very high speeds in Auto ?

- Is the industry going to require more than 10 Gbps, or even x00 Gbps speeds any time ?
- Is it economically or technically feasible in copper ?
- Would it be optical the most reasonable solution ?

Future meetings

- Best hour ?
- When ?