






Optical Ethernet in Automotive

A Reality

Optical Automotive Communication Systems

	Speed (Mbps)	Application	Year
D²B	5	Digital audio	1998
	25, 150	Infotainment	2001-2008
	10	Safety-critical	2001
	400	Infotainment	2004
	10	SRS	2006
	100	Industrial networks	1992

Optical Communication is well established in the automotive field

The MOST story... Lessons Learnt

- **Success:** > 200 mio. nodes > 200 vehicle models
→ POF established as reputable automotive media
- Till 2016 “de facto” proprietary technology
- Value chain was not oriented to optimize cost
“Margin stacking” undermined the value proposition:
 - # Network Interface Controller: 1
 - # FOT suppliers: 2
 - # Header connector suppliers: 3
 - # Harness suppliers: 4



MOST[®]

Gigabit Optical
should be fairly
SPECIFIED to foster
a competitive value
chain

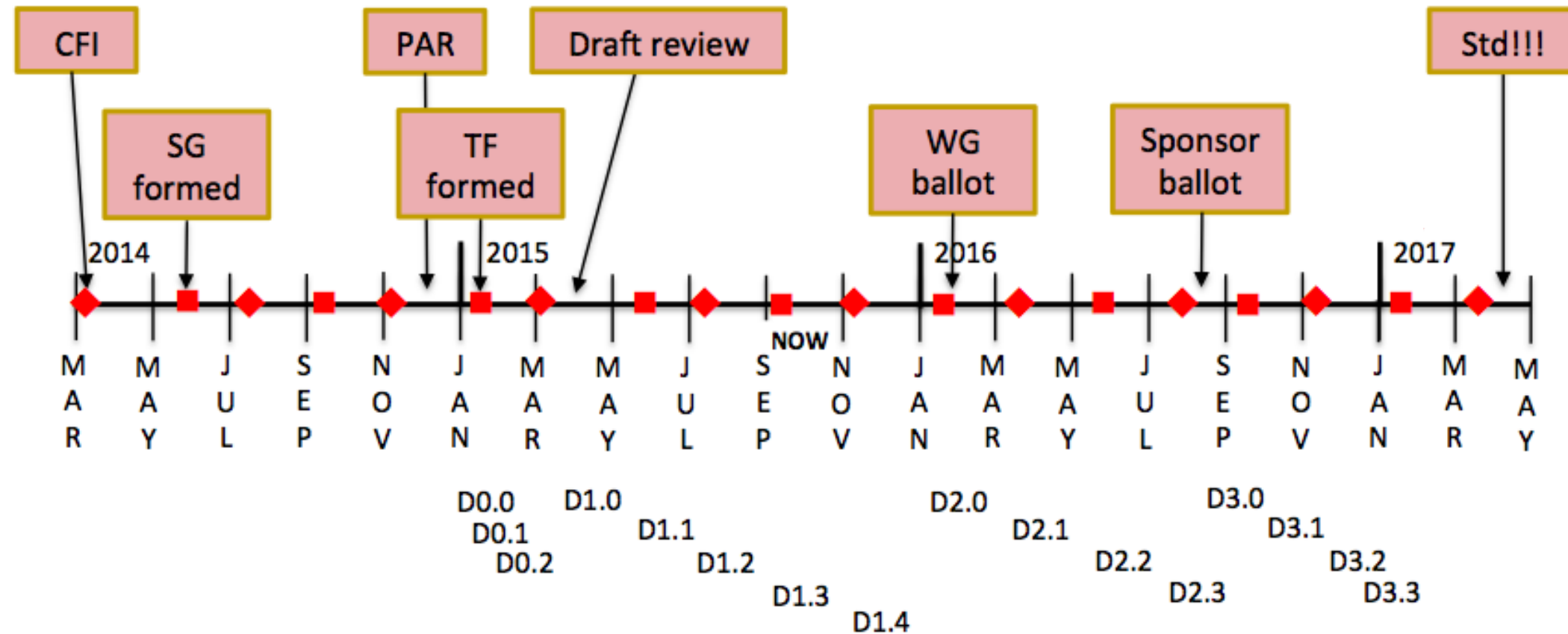
Open specification → **Competitive value chain** → **Cost optimization**



Gigabit POF Standardization



P802.3bv Timeline



Publishing 1Q. 2017

Gigabit POF currently being standardized



ISO TC22 SC31 (WG3)

- Complements IEEE 802.3bv 1000BASE-RHC

ISO TC22 SC32 (WG10)

- Addresses physical harness components (fiber and connectors)

Publishing 1Q. 2019

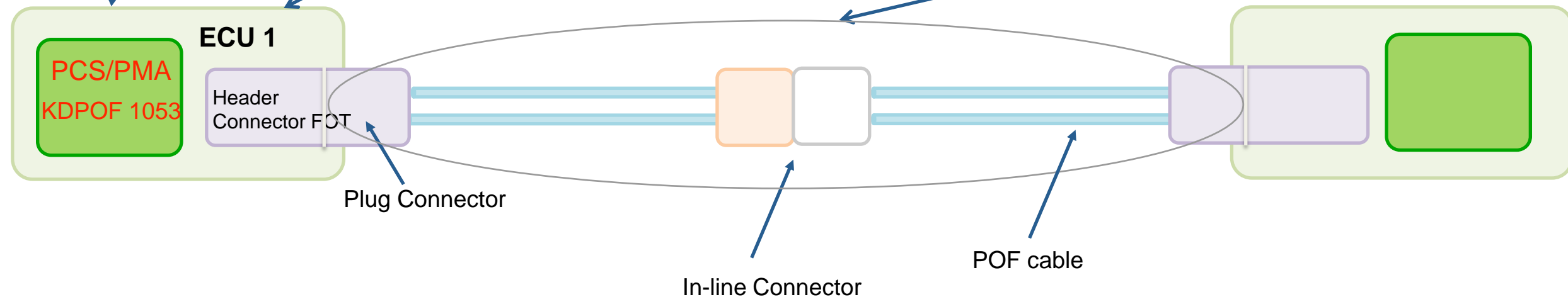
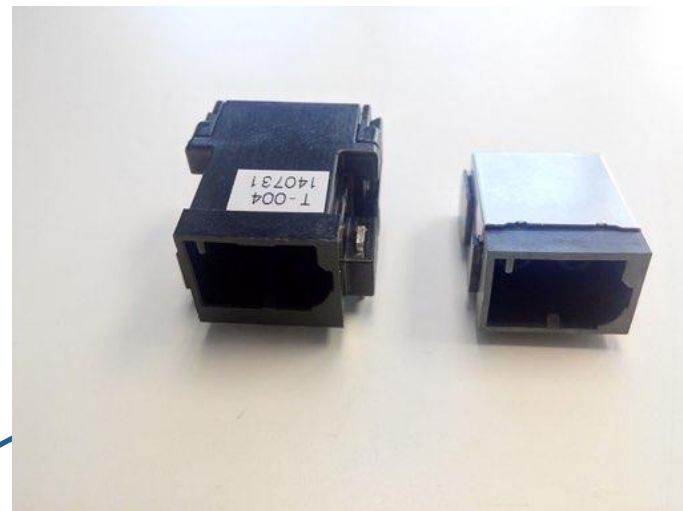
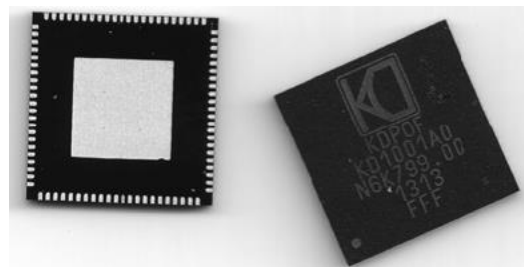


Gigabit POF Ecosystem

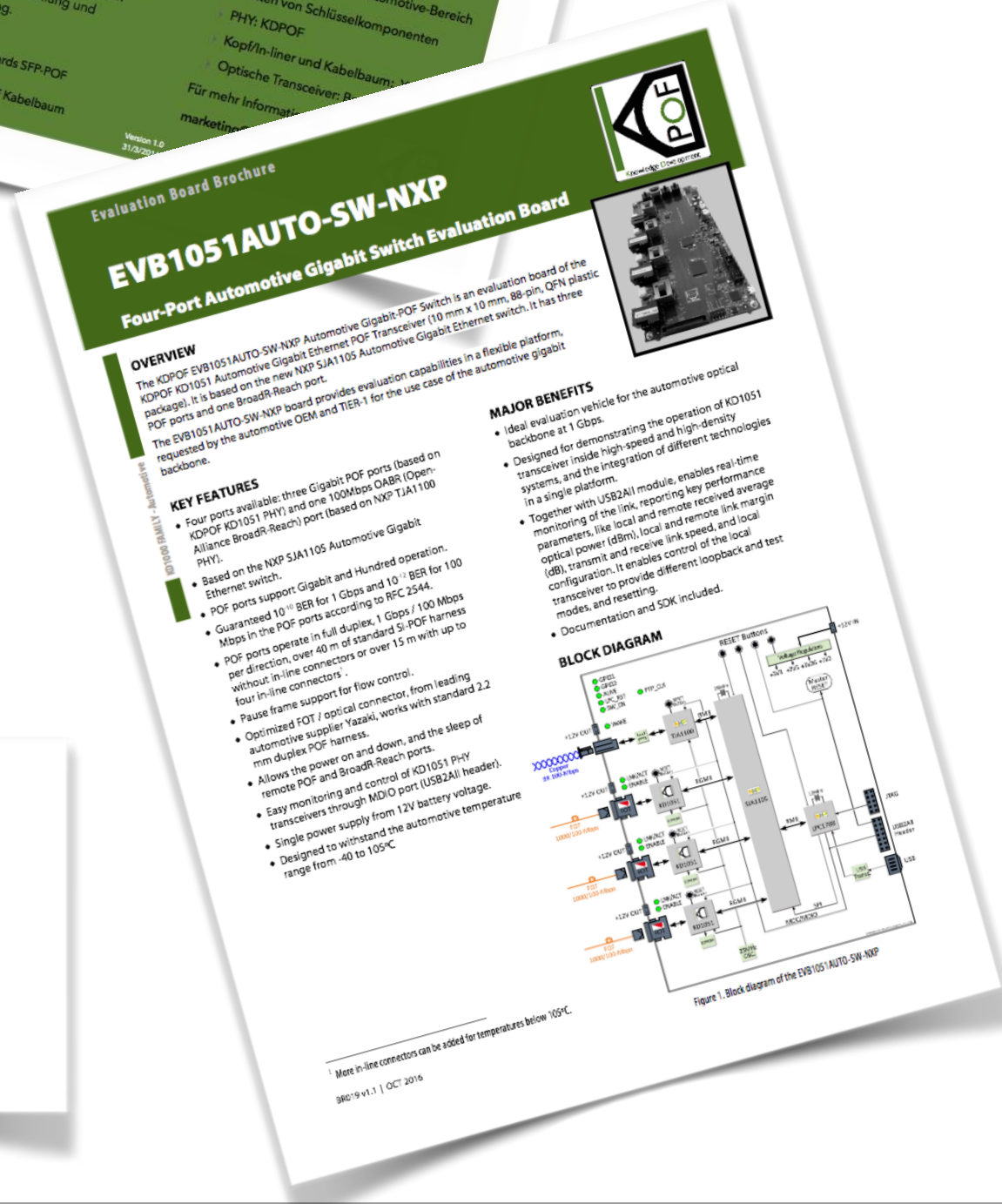
PCS/PMA

FOT (PMD, MDI)

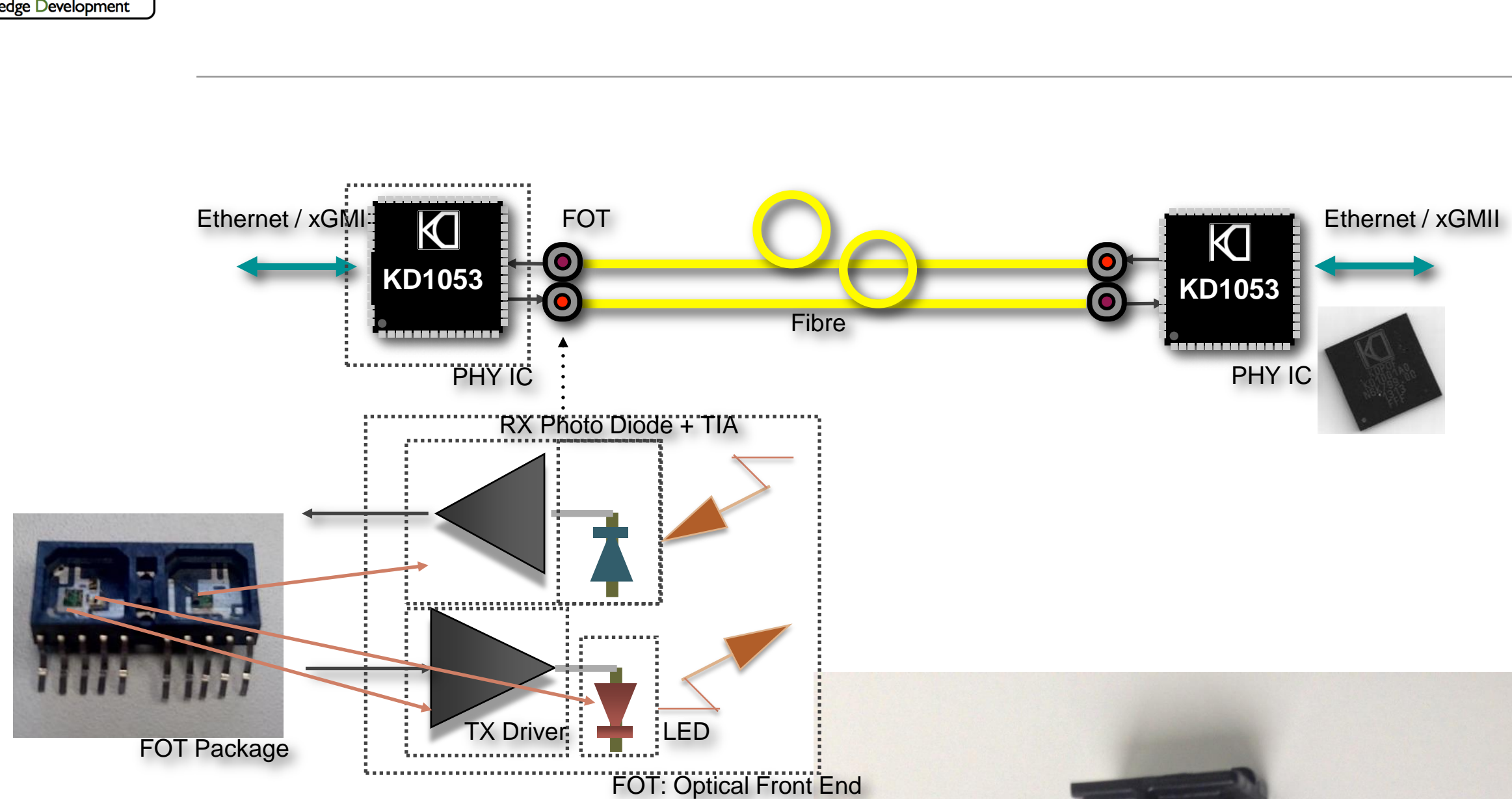
Cable harness



Kit and evaluation boards (switch, MC) available



Gigabit POF Zoom into components



SMD Type

Footprint:
SMD alignment
Pitch 1.27mm × 10

Connector size:
23mm(W) × 10mm(H) × 23mm(D)

THD Type

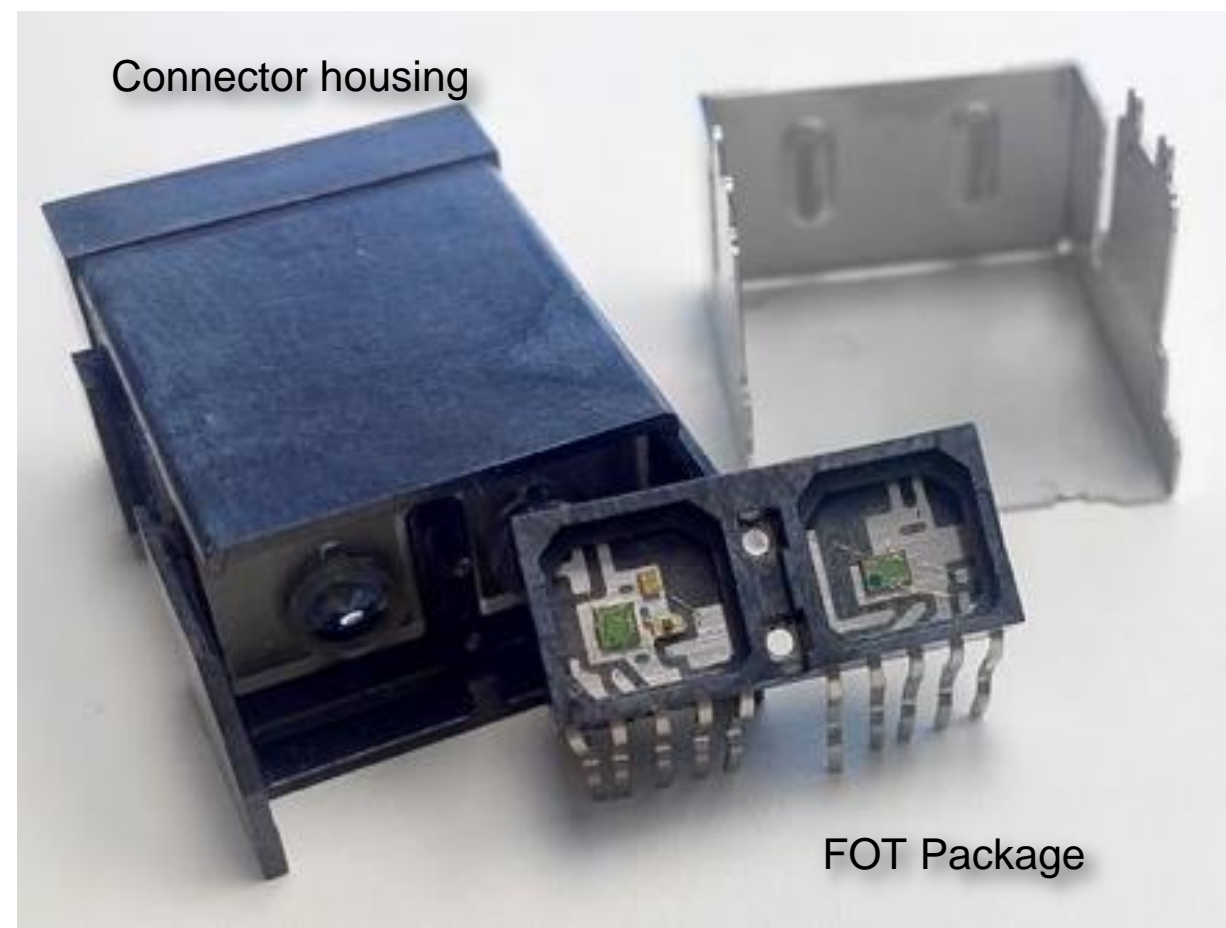
Footprint:
Zigzag alignment
Pitch 2.54mm × (6+4)

Connector size:
15mm(W) × 10mm(H) × 20mm(D)

The SMD connector Interface is completely the same as that of the THD.

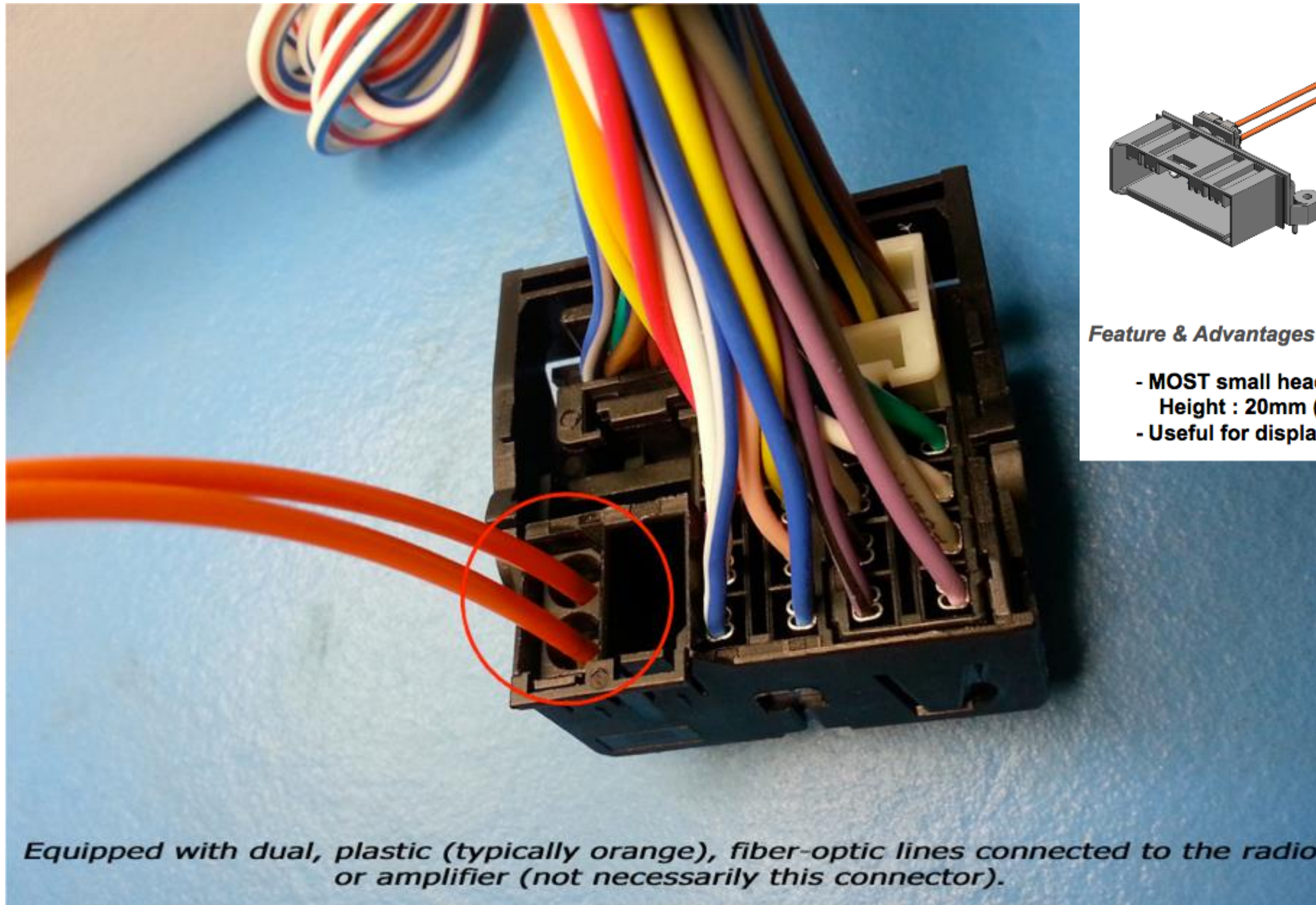
Specifications of basic properties:

- Application Temp.: -40 to 105[deg.C]
- Storage condition: -40 to 105[deg.C]
- Soldering condition: Flow / Reflow soldering (Peak Temp.: 260[deg.C])

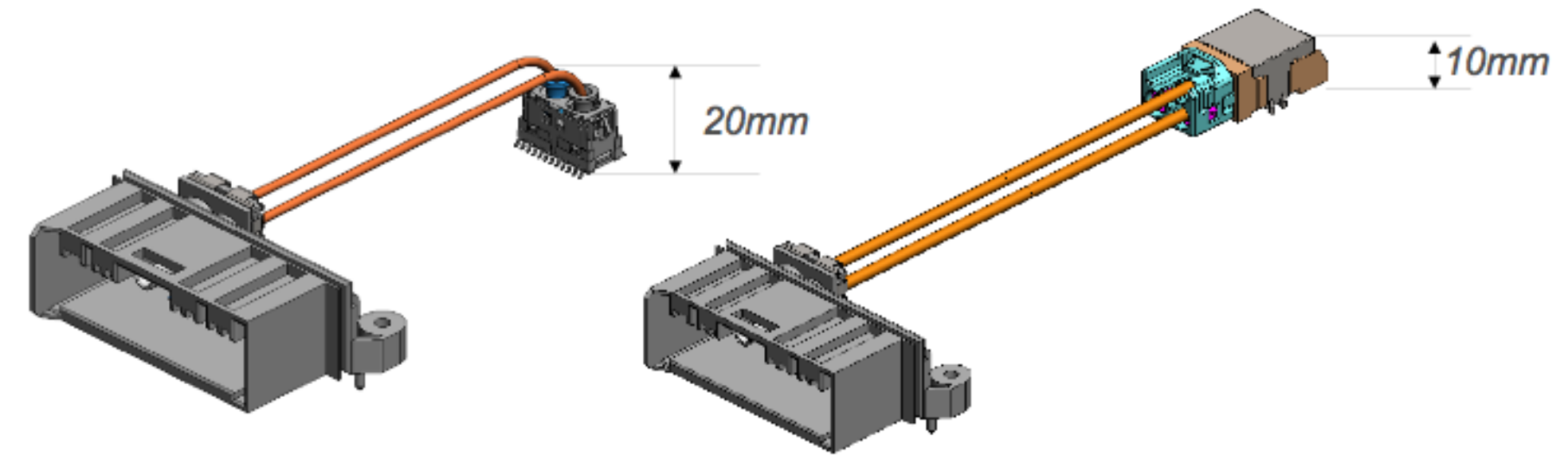


Header connector portfolio to accommodate any board and interconnection topology

Gigabit POF Seamless hybrid connector integration



Equipped with dual, plastic (typically orange), fiber-optic lines connected to the radio or amplifier (not necessarily this connector).



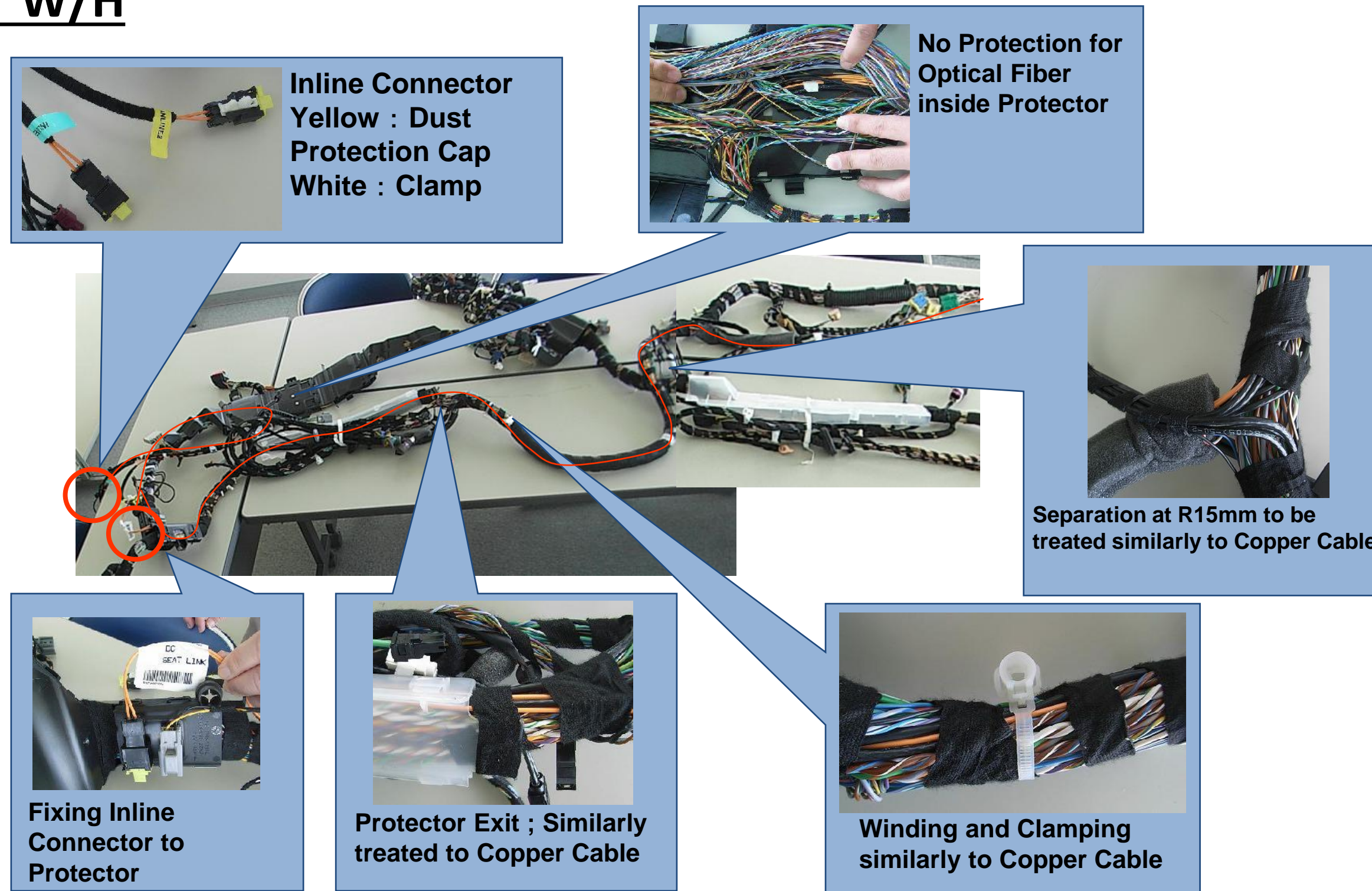
Feature & Advantages

- MOST small header connector can be used as SMD-Pigtail
Height : 20mm (standard component) vs. 10mm (small component)
- Useful for display unit Interface, such as strongly requested thinner devices

Seamless integration of POF in hybrid electrical/optical connectors

Harness and Assembly process

Floor W/H



Inline Connector
Yellow : Dust Protection Cap
White : Clamp

No Protection for Optical Fiber inside Protector

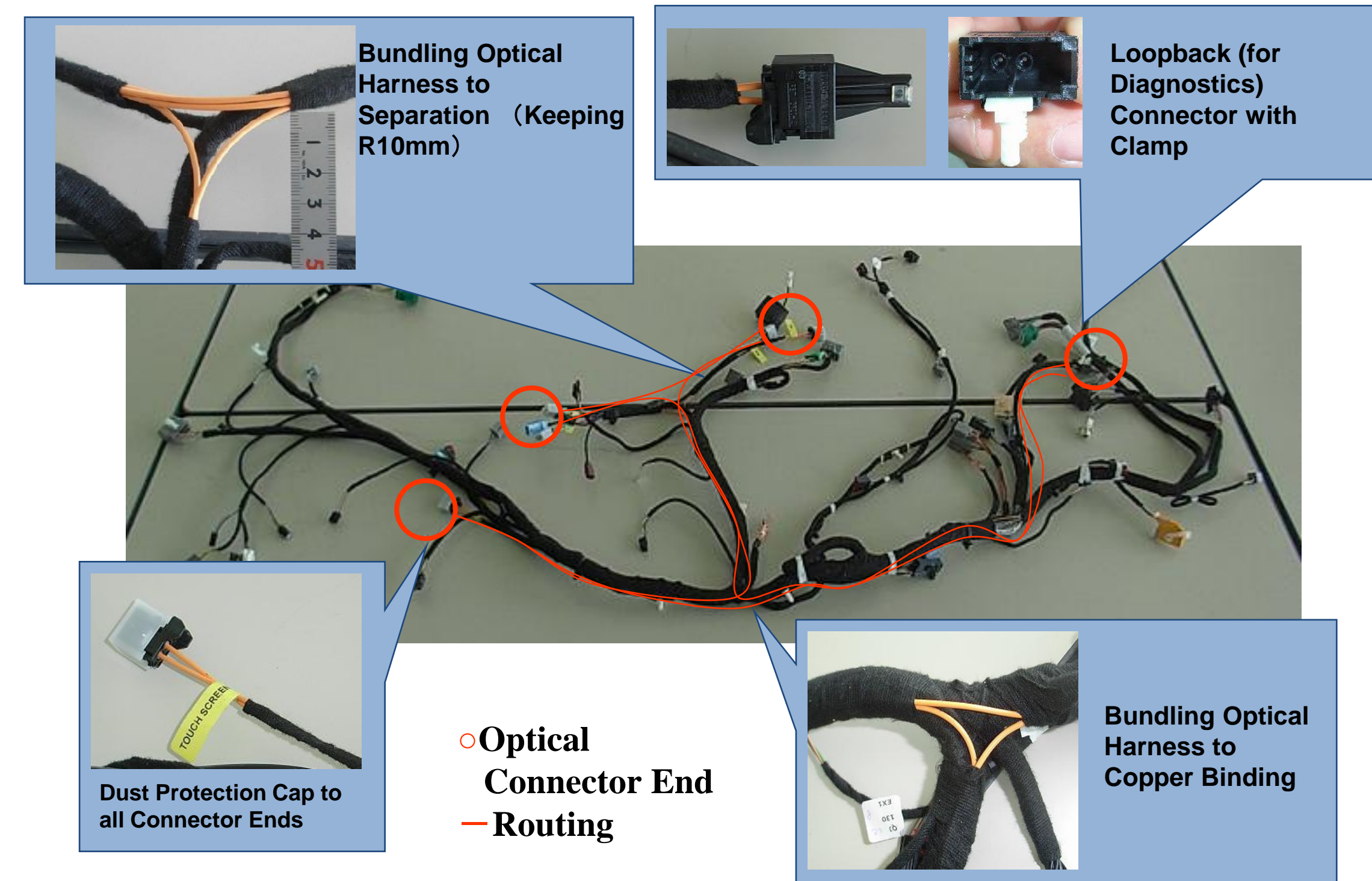
Separation at R15mm to be treated similarly to Copper Cable

Winding and Clamping similarly to Copper Cable

Protector Exit ; Similarly treated to Copper Cable

Fixing Inline Connector to Protector

Instrument Panel W/H



Bundling Optical Harness to Separation (Keeping R10mm)

Loopback (for Diagnostics) Connector with Clamp

Separation at R15mm to be treated similarly to Copper Cable

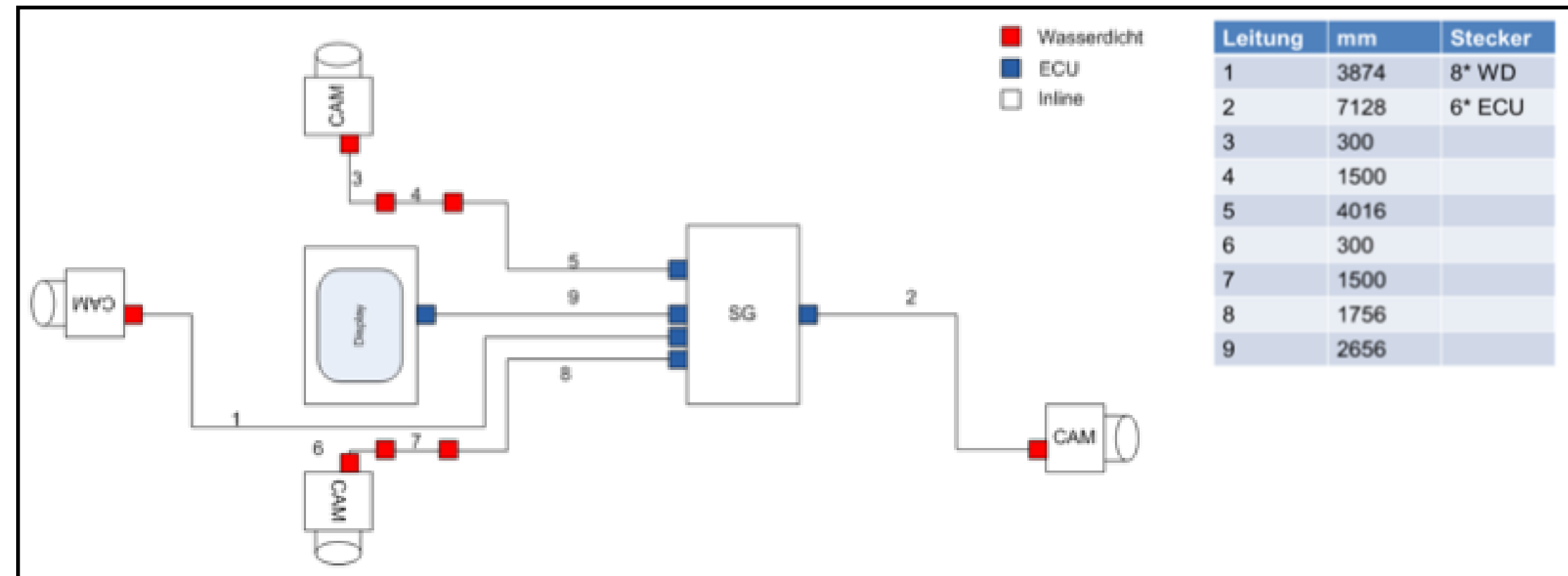
Bundling Optical Harness to Copper Binding

Dust Protection Cap to all Connector Ends

○ Optical Connector End
— Routing

Seamless integration of POF with W/H at manufacturing and installation

Costs are favorable



Reference scenario

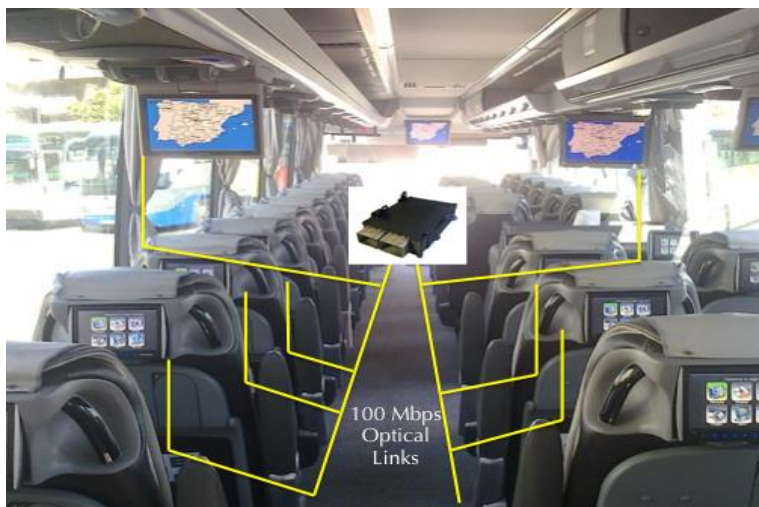
Total length: 23,03 m
Total connectors: 10
Total in-line connectors: 4

Excluding final assembly as well as investment costs

Cable Type	STP (e.g. KROCAR 64995781)	Jacketed TP (e.g. LEONI DACAR 676)	POF (e.g. PM 4Y 1,0/1,51/2,3 Gebauer & Griller)
Total weight of wires [kg]	0,6679	0,2990	0,2303
Estimated Price Savings of cables [%]	as base value	66,3	78,5
Estimated Price Savings of harness [%]	as base value	15,8	23,1

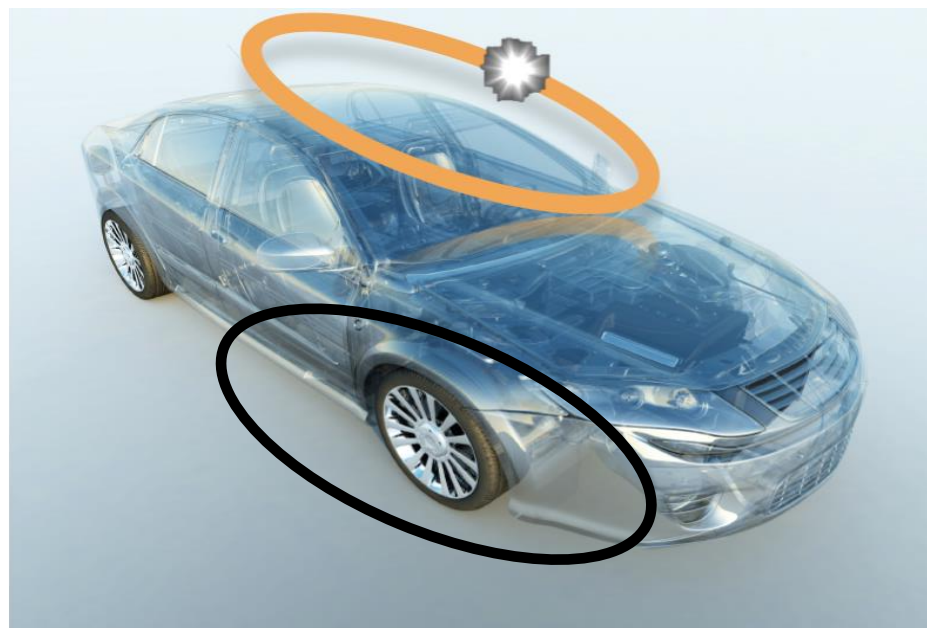
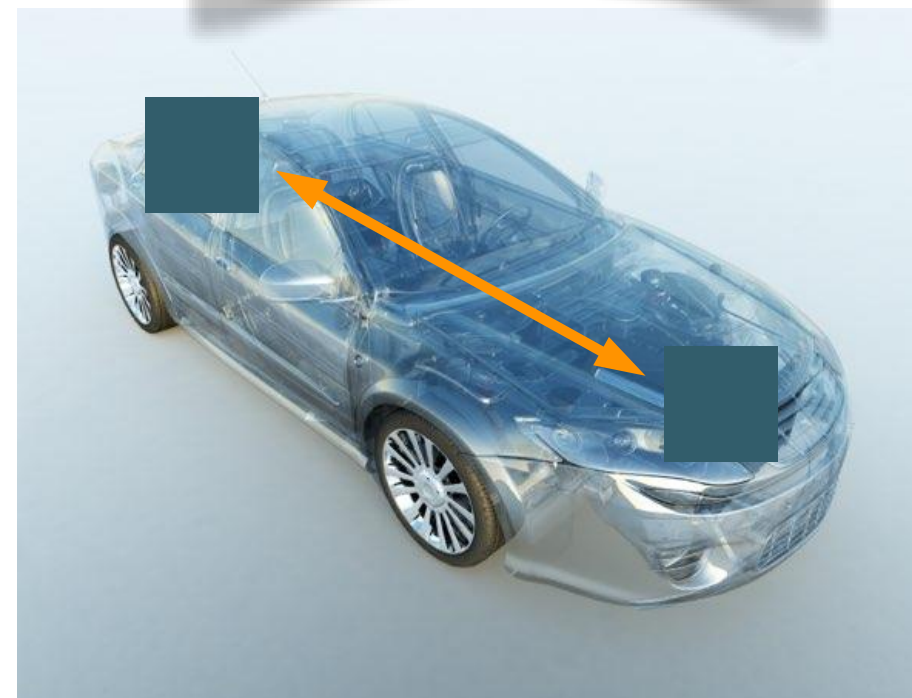
Use cases 1 Gbps / 100 Mbps Optical links

BMS
Galvanic Isolation



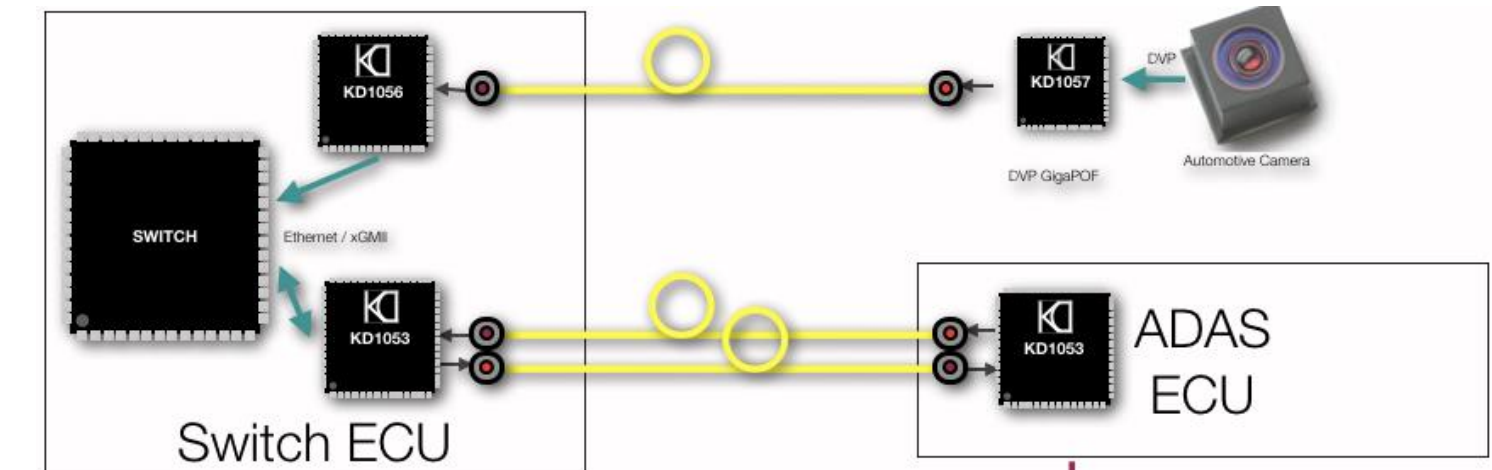
100 Mbps links
EMC-tight

Backbone



Autonomous driving
safety redundancy

Smart Antenna
modules



ADAS cameras
interconnection

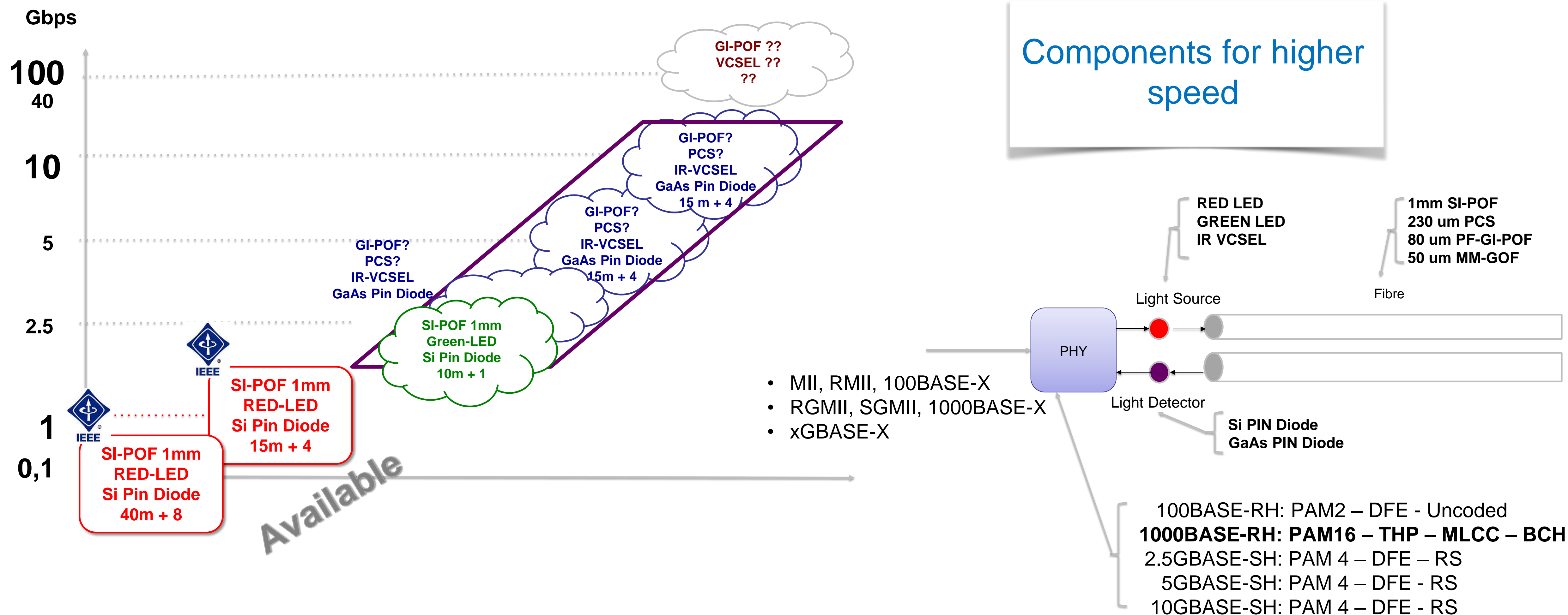


Optical Ethernet is the Future

	100 Mbps	1 Gbps	10 Gbps
	Copper: JTP Optical: SI-POF	Copper: STP? Optical: SI-POF	Copper: STP. Cat 7? Optical: PCS, GI-POF
Cost	Copper beats Optical	Copper loses Optical ✓	Copper loses Optical ✓ ✓
Weight Thickness	Copper ties Optical	Copper loses Optical ✓	Copper loses Optical ✓ ✓
EMC noise/ susceptibility	Copper loses Optical ✓	Copper loses Optical ✓	Copper loses Optical ✓ ✓

Optical Ethernet is the natural path to higher speed

The future of Optical Multi Gbps Ethernet speed

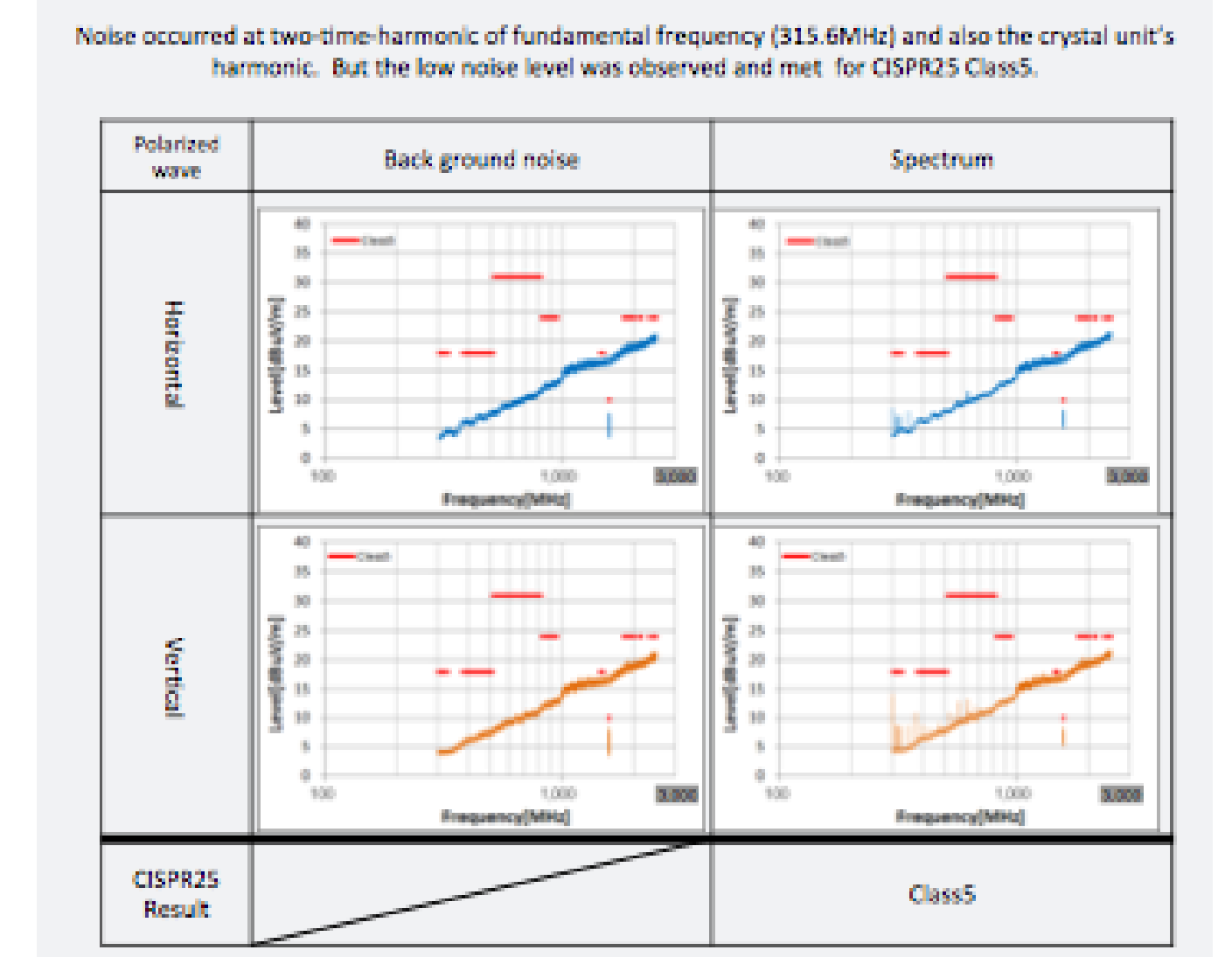




Value Proposition

- **EMC problem free**
 - Yazaki EMC measurements demonstrates EMS/EMI performance
 - Problem free integration, no EMC adoption R&D costs per derivative etc.
- **Galvanic isolation** Advantage for high voltage systems
- **Very reliable** Compared with GOF, COAX and STP
- **Predictable / competitive price** Compared with COAX in big volumes
- **Good bending** Radius down to 10 mm
- **Availability** Early products available
- **Automotive qualified** POF is an approved media
- **Temperature Range** New standard **-40°C to 105°C**
- **Seamless integration** Harness manufacturing and installation
- **Future Proven** Multi-Giga under development

Summary	Test Name	Page	Results		
			OK	NOK	EVENT
EE/EMC tests	• ISO 11452 Radiated immunity	11	X		
	• CISPR-25 Conducted Emissions	15	X		
	• ISO 11452-4 BCI	21	X		
	• ISO 7637-2 Transient Conducted Emissions	25	X		
	• ISO 7637-2 Transient Conducted Immunity	29	X		
	• LV 124 E-10 Interruptions	36	X		
	• ISO 11452-8 Magnetic Field Immunity	40	X		



EMC CISPR-25 class 5



In summary....

Gigabit POF is available and standardized in a solid and competitive Ecosystem

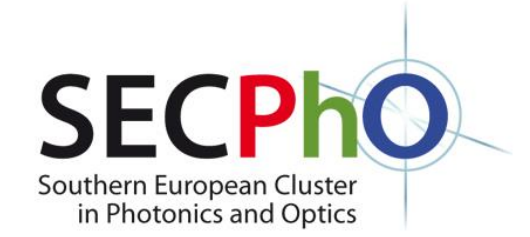
Gigabit POF has a compelling value proposition EMC, COST and SEAMLESS INTEGRATION

Gigabit POF is the first step to an indisputable automotive future-proven MULTI GIGA optical world

... Do you have any reasonable argument

why not to use Gigabit POF?

... Contact César Esteban cesar.esteban@kdpof.com



Thank you

César Esteban FAE
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