

OPTICAL TECHNOLOGIES

FROM POF-SOLUTIONS TO NEXT GENERATION, CHALLENGES

Robert Rodenkirchen

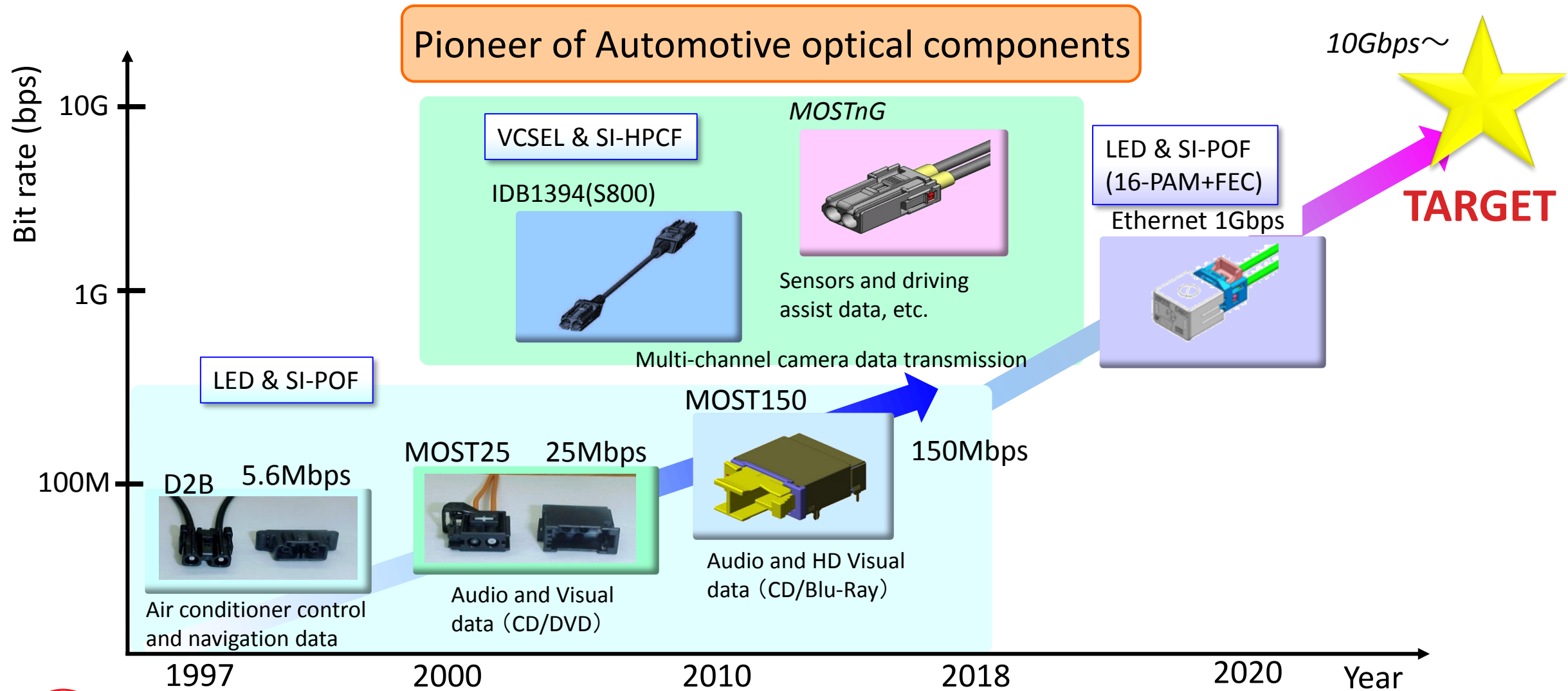
IEEE 802.3 Multi-Gigabit Automotive Optical PHYS
(OMEGA) Study Group
Geneva, Switzerland, January 2020



- 1 General Overview of Automotive Optical Technology
- 2 Optical Solutions Today on the Street
- 3 Addressing Next Generation Technology needs
- 4 R&D activities on NG Optical Technology
- 5 Summary



GENERAL OVERVIEW OF AUTOMOTIVE OPTICAL TECHNOLOGY



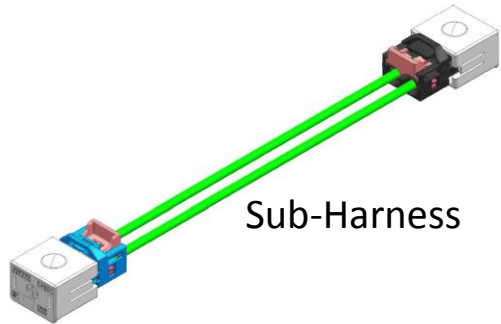
Optical Solutions Today on the Street

- Millions of vehicles running with optical solutions today (for almost 20 Years)
- Components, EDS and Manufacturing experience on today`s solution
- Numerous challenges in the field of optical technology solved regarding
 - Assembly process:
 - Quality assuring Assembly Processes
 - Solutions for Bending Protection
 - Measures to ensure dust protection
 - Etc.
 - Design:
 - Lens design (improved crosstalk attenuation, reduced insertion Loss)
 - Optical Header Design (with relaxed requirements on temperature resistance)
 - Combining PHY and FOT in one single chip (better EMC Performance, reduction on Header Size)



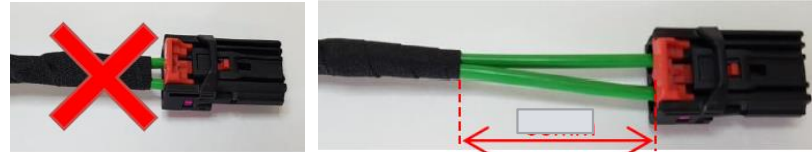
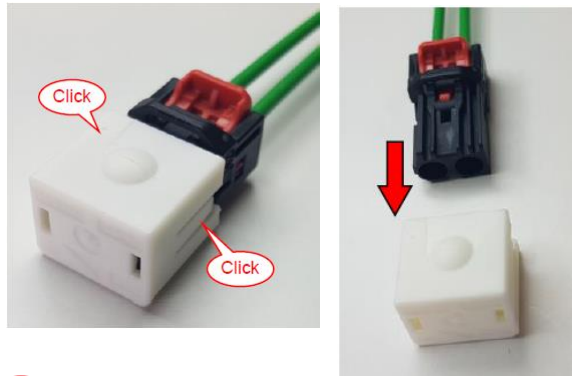
NUMEROUS CHALLENGES SOLVED ON ASSEMBLY PROCESS

Handling Instructions for correct Assembly and Storage of Optical Fiber Components (Sub-Harnesses) elaborated. To be considered during entire life cycle beginning from Production, stocking and shipment over OEM assembly up to final customer



Dust protection during

- Stocking
- Shipment
- Assembly at Customer Facilities



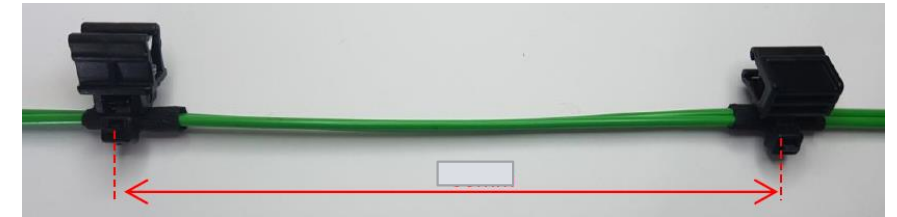
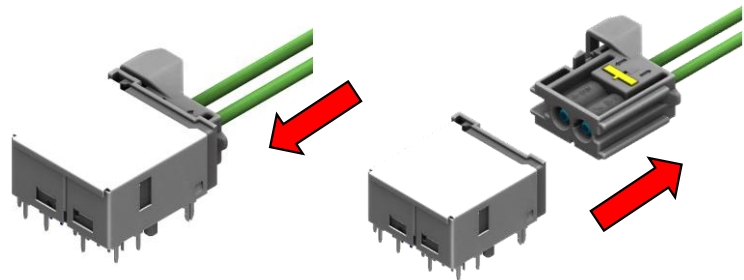
Min. distance between tape and connector must be respected to avoid unlocking of the ferrule.

No twist during Taping

Spot Tapes



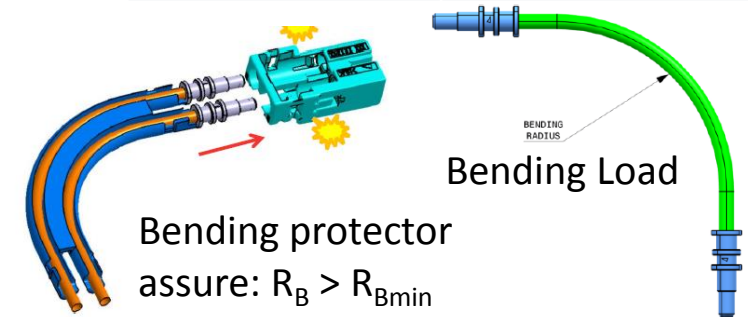
Plug Assembly Force	Plug Pull out force
<75 N	>67 N



Minimum distance between Clips and between Clip and End of Tape has to be respected.



R_B /mm	Atten. Loss/dB
25 mm	0.10 dB
10 mm	1.37 dB



Optical Solutions Today on the Street

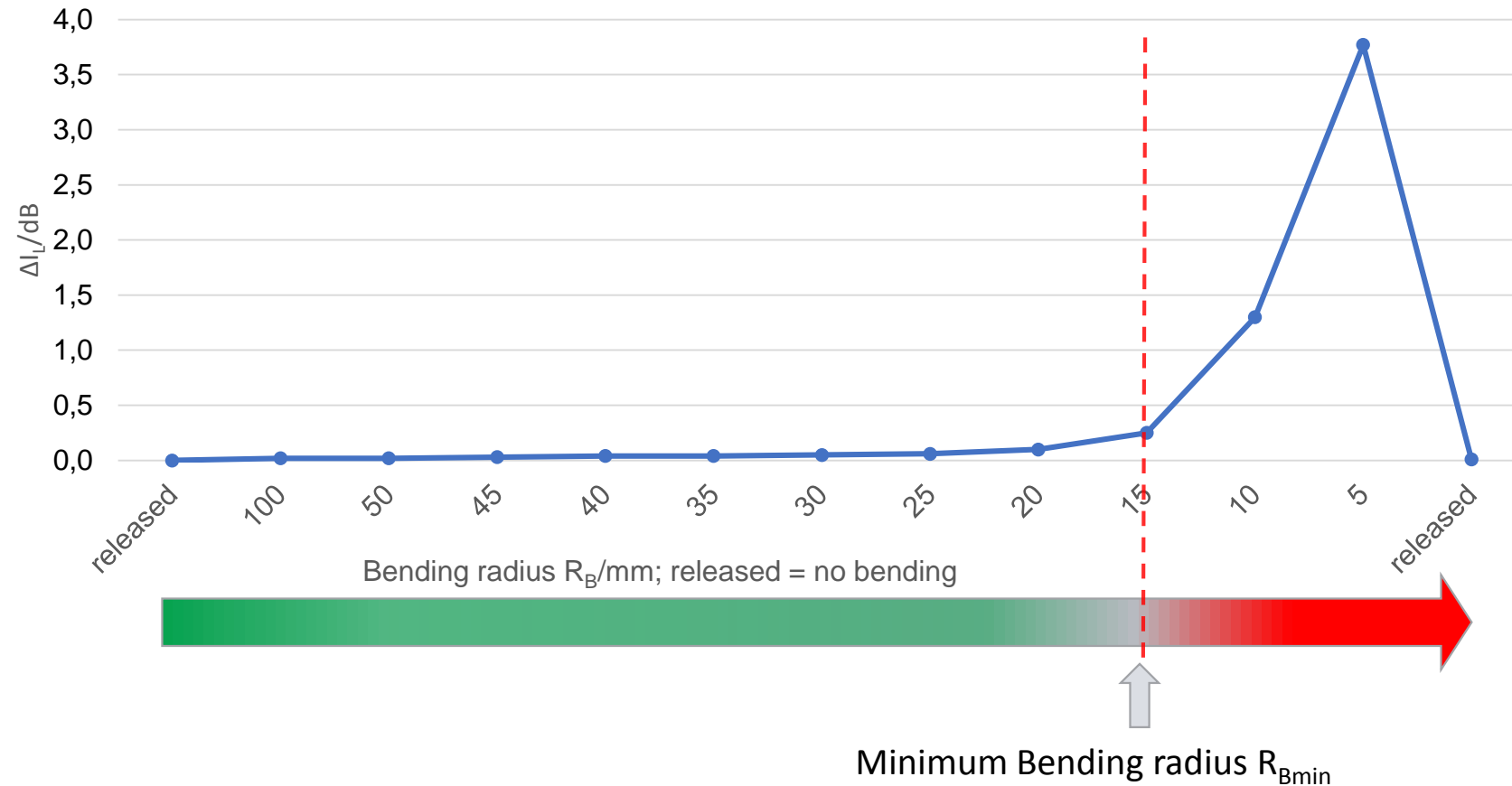
BENDING LOAD EFFECTS – CURRENT SI-POF TECHNOLOGY

Influence of Bending Load on Optical Attenuation in case of current SI-POF Technology

$$\Delta I_L = f(R_B)$$

Plastic Optical Fibre

Increase of Insertion Loss ΔI_L versus Bending Radius R_B

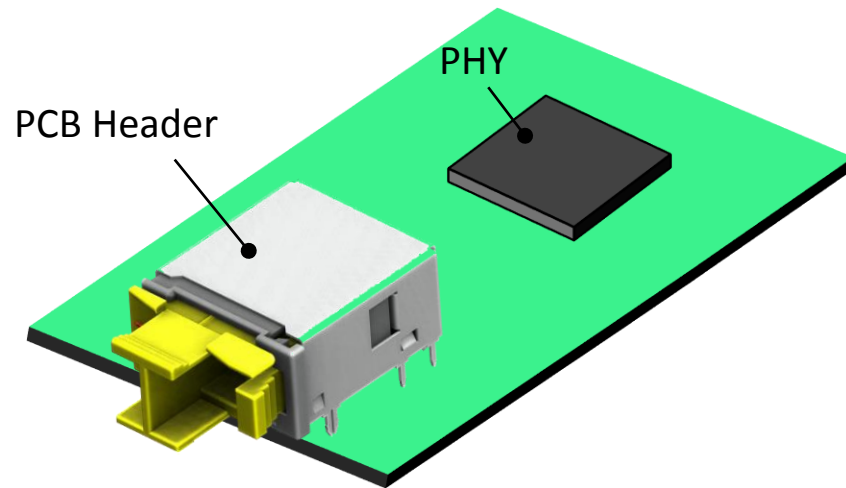


Sharp Increase of attenuation
 If bending radius $R_B < R_{Bmin}$
 $R_{Bmin} = 15 \text{ mm} !$



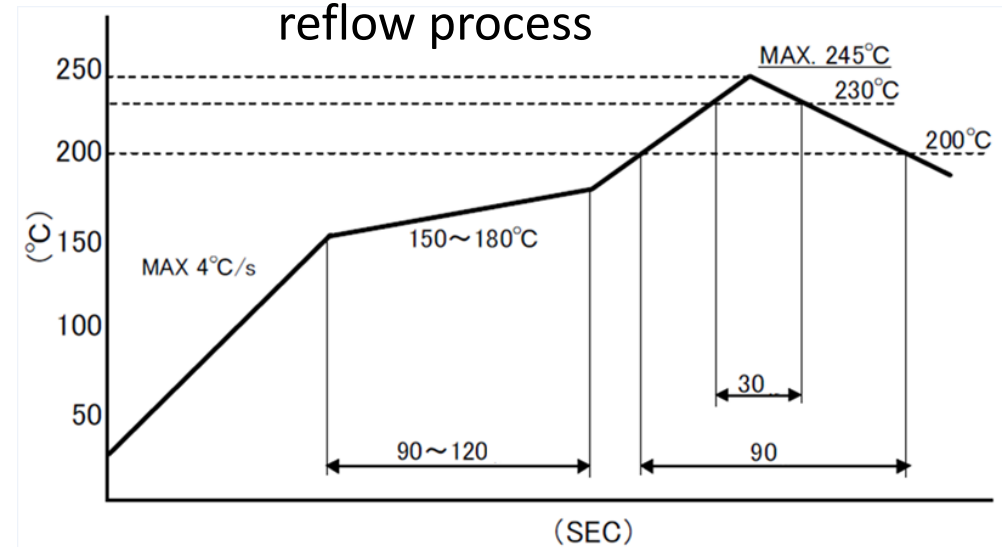
Optical Solutions Today on the Street

Today`s solution for 100 Mbps and 1 Gbps Ethernet



Some examples of improvements already made:

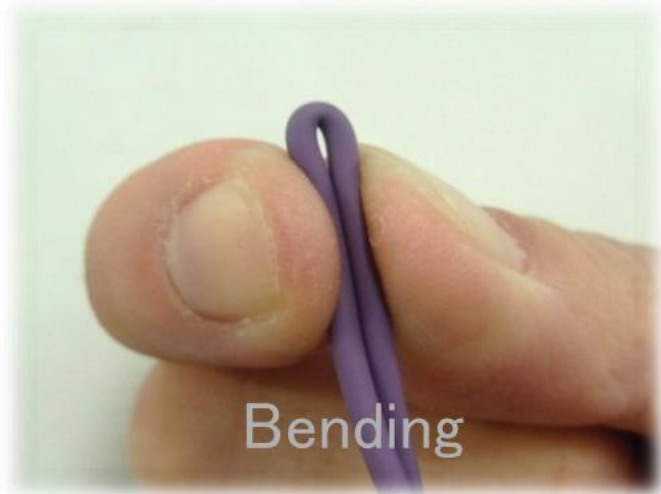
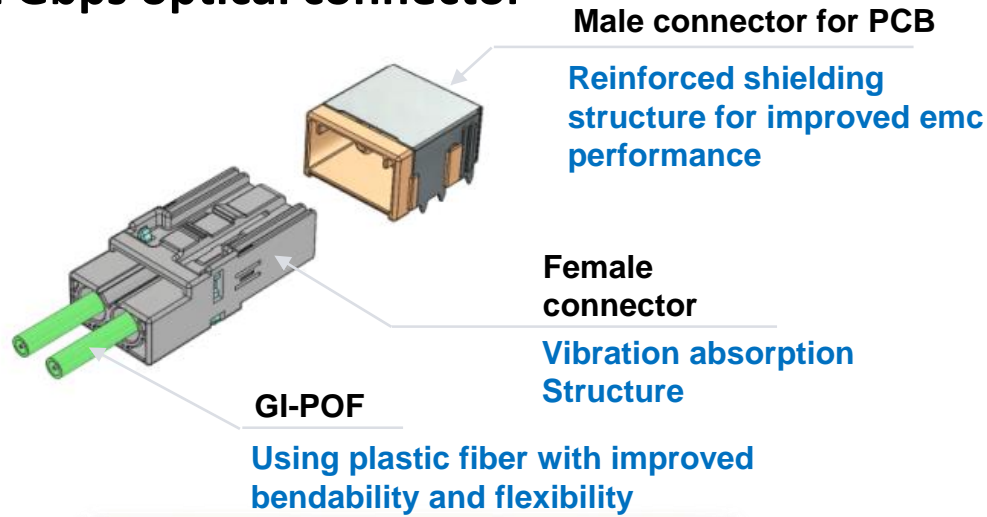
- Thermal load
- Crosstalk Attenuation
- EMC performance
- Optical attenuation
- Optical power budget



- FOT
 - ✓ Available for ambient temperature range of -40 °C to 105 °C
 - ✓ High reliable VCSEL in the market
- Fibre cable
 - ✓ Available for high temperature resistance fiber
 - ✓ Never break against small bending
- Connectors, Headers
 - ✓ Small coupling loss between Header and plug or Plug and inline connector
 - ✓ No damages under the Automotive environments
 - ✓ EMC protection
- Standardization Activity
 - already initiated, but challenging



12 Gbps optical connector



Achievable BER (Bit Error Ratio) <math>< 10^{-12}</math>

Enables the implementation of optical data transmission channels in automotive industry suitable

- for entertainment as well as for safety applications (Transmission of video images from vehicle periphery monitoring system, ADAS, 360 ° surround view, etc.)

Item	Specification
Date Rate	~ 12 Gbps
Operation Temperature range	-40 °C ~ + 105 °C
PCB soldering method	Reflow
PCB connector weight	Under investigation
Power supply voltage	3.3V ±5%
Light source	VCSEL @ $\lambda = 850\text{nm}$



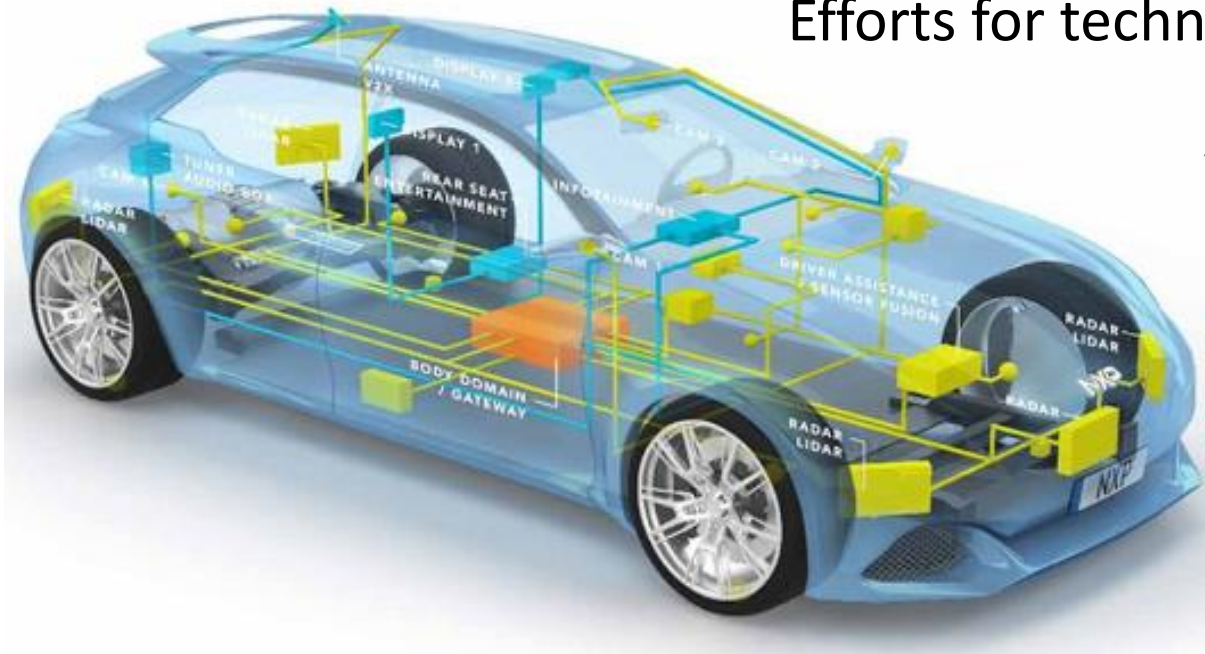
Lots of solutions supporting Next Generation Automotive Optical already exist

Continuous improvement on existing solutions in progress

Efforts for technology harmonization have been initiated

Advantages of optical technology clearly addressed:

- Weight Reduction
- Improved EMC due to
 - Increased EMI (Electromagnetic Immunity)
 - Reduced Electromagnetic Radiation as well
- Increased Electrical Safety (Galvanic Isolation)
- Increased Functional Safety (Redundancy)



**THANK YOU VERY
MUCH FOR YOUR
ATTENTION!**

In case of questions please do not hesitate to contact

Yazaki Europe Group

Name: Robert Rodenkirchen

Phone: +49 (221) 292 88-303

Mobile: +49 (172) 94 20 8 90

Email: robert.rodenkirchen@yazaki-europe.com