

KDPOF Product Use case in Automotive

Dec, 2020



Agenda

- ***Automotive Wire line connectivity need to Evolve to Ethernet***
- ***Advantage of POF link***
- ***KDPOF use case***
- ***KDPOF value chain and proposal***
- ***KDPOF use case***



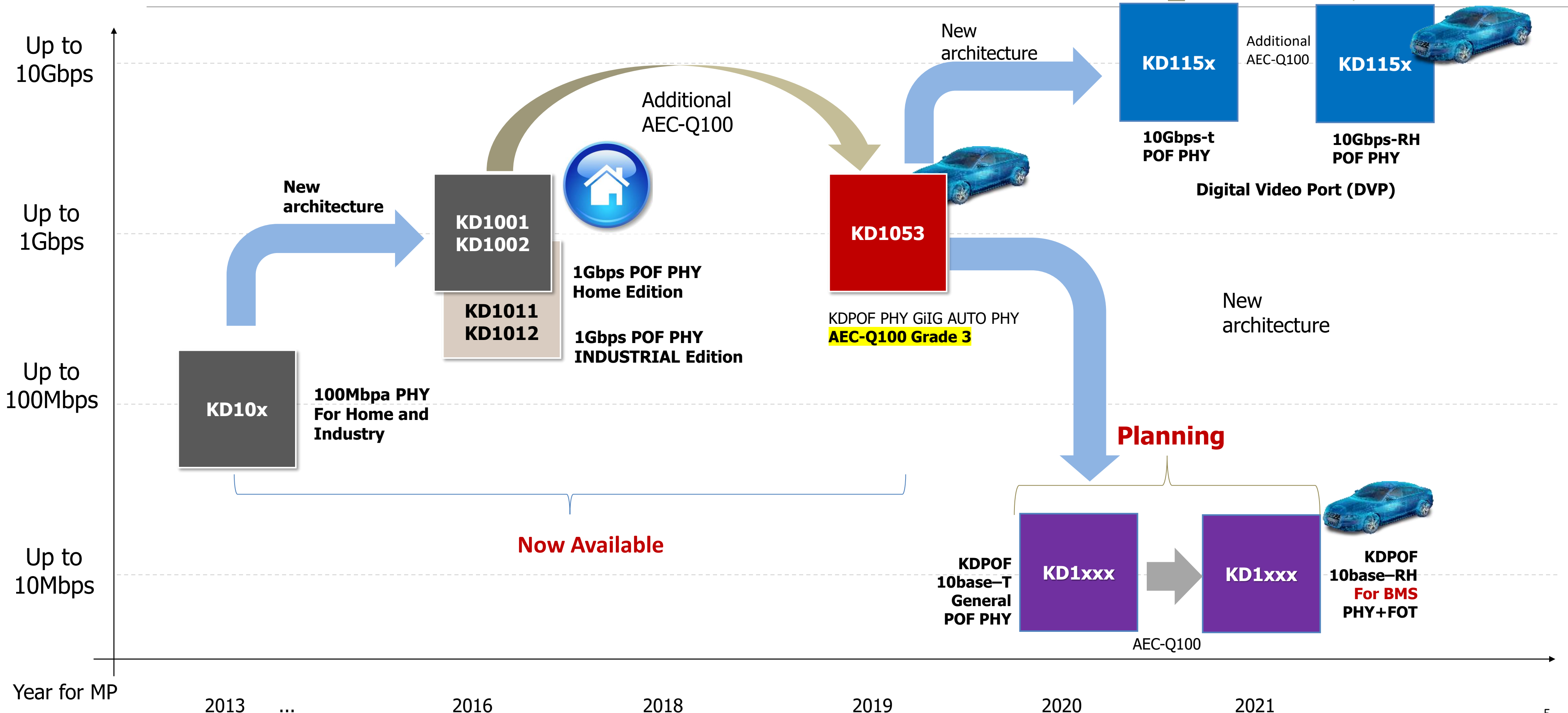


KDPOF use case
Battery Management
Smart Antenna
Digital Side Mirror
Display Steering wheel

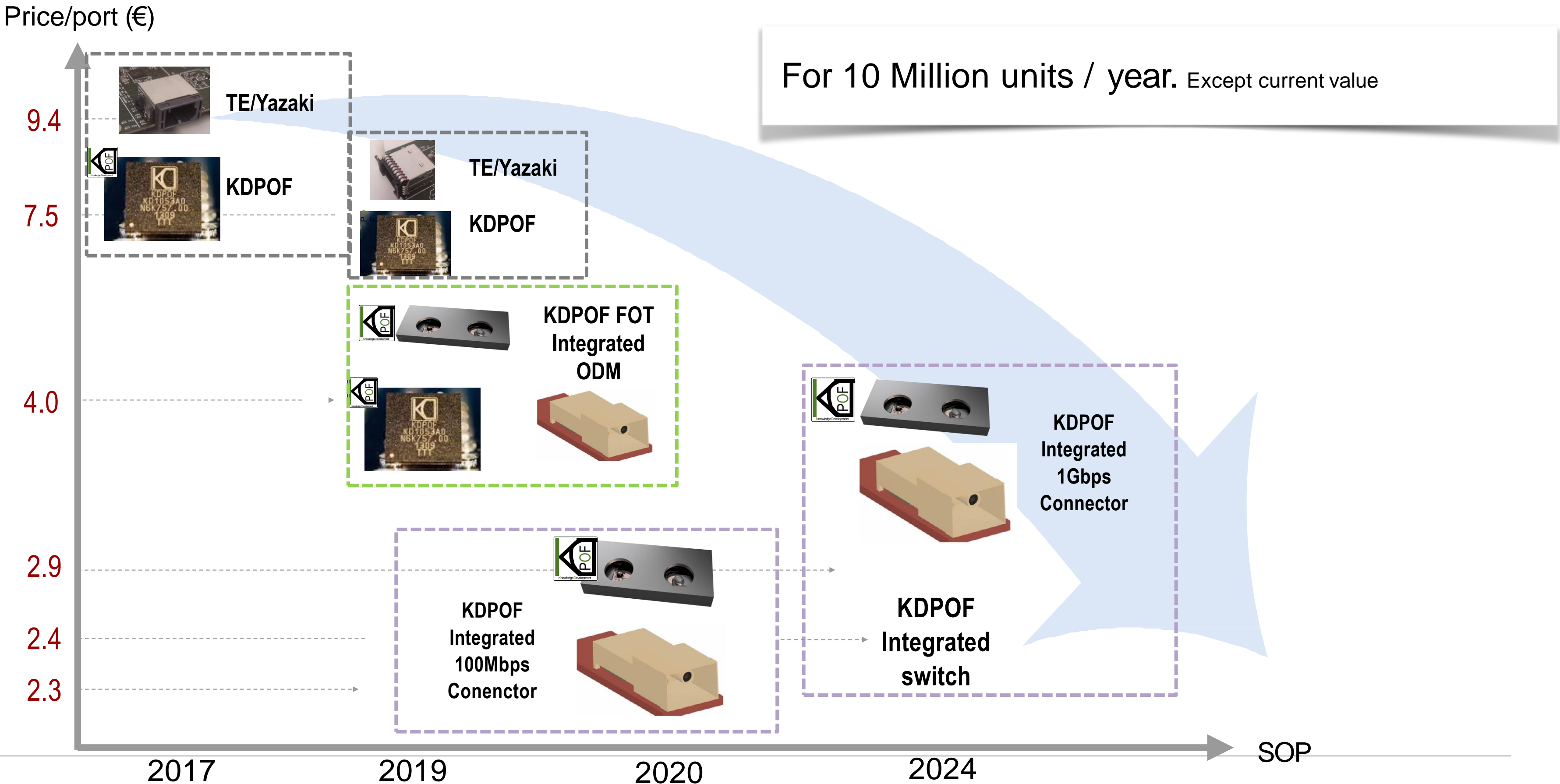
KDPOF Value proposition

- **Low cost than STP – Saving cost**
- **EMC problems free – Saving time and schedule for Qualify test**
- **Galvanic isolation from Legacy copper – 12V Electronic Circuit and passenger Safety from High voltage when car crash**
- **Very reliable** cable, compared with GOF, COAX and copper based STP
- **Low weight – Saving energy(Fuel or Battery)and contribute Efficiency of Engine/Motors**
- **Predictable** and **competitive price** compared with copper in big volumes
- **Good bending** performance – Flexibly in cable train design
- **Availability** of MP stage - 1Gb/s and 100Mb/s product available, multi-Gig is on roadmap
- POF device like cable and Terminals are already **automotive qualified** media
- New POF and IEEE standard will operate from **-40°C to 105°C(125°C/new PCS cable)**
- **Seamless integration** on harness manufacturing and installation.
- **Future Proven:** Already developing MultiGiga solution.

KDPOF Next generation Silicon roadmap



Cost reduction roadmap



Harness cost Comparison View - 1 Gb/s

POF wirings 1000BASE-RH(Fiber)

- PCB FOT 1.7 -> 2.1 €
- PCB Optical connector 0.50 €
- PHY 1.60 €
- Fibre connector 0.20 €
- Fibre /m 0.17 €
- Fibre in-line connector 0.40 €

TOTAL: 2 m+1 inline

8.74 -> 9.54 €

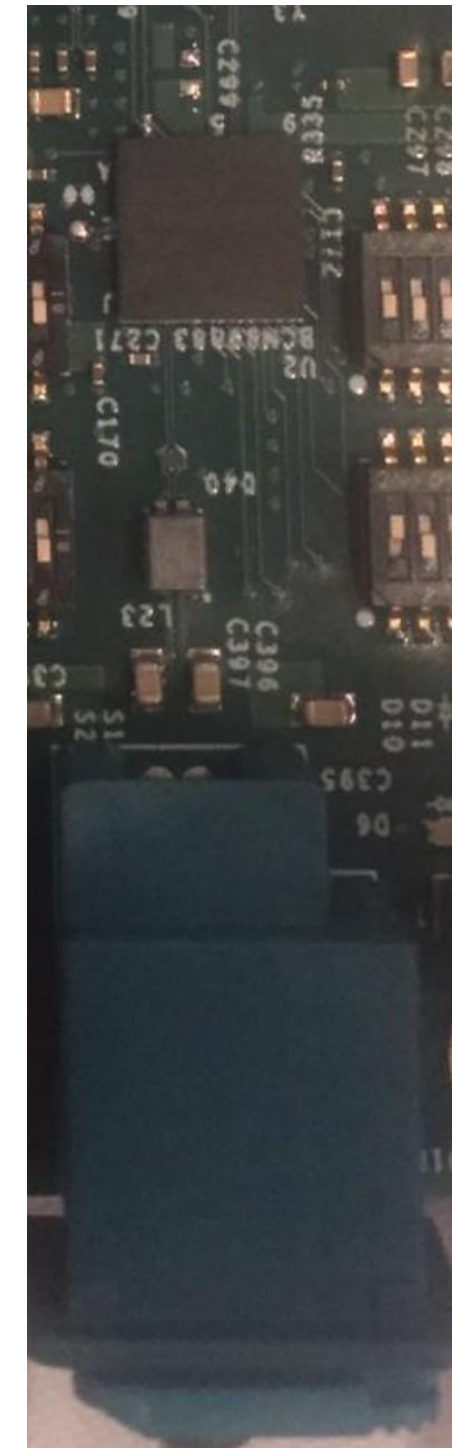
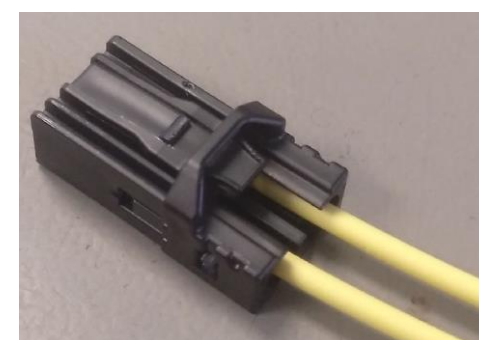
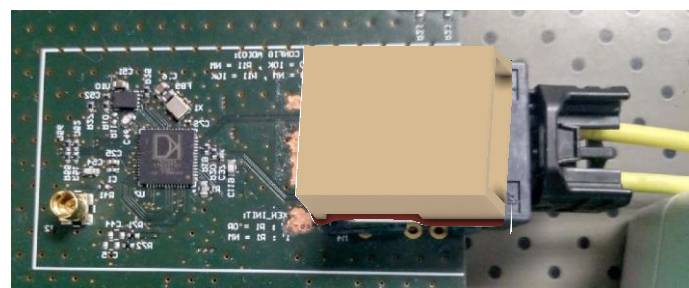
PCB
Header

Rosenberger H-MTD 1000BASE-T1(Copper)

- PCB-Header 0.45 €
- PHY & CMC & ESD 2.80 €
- Wire connector 0.69 €
- Wire /m 0.33 €
- Inline connector 1.45 €

TOTAL: 2m+1 inline

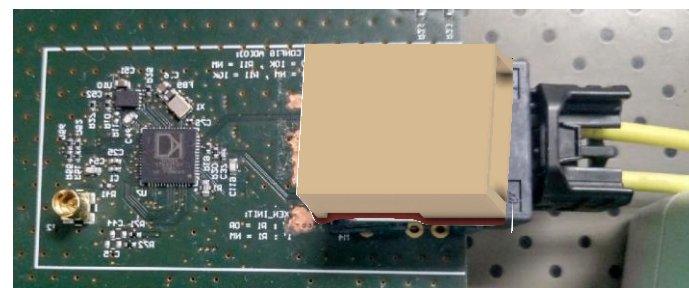
9.99 €



Harness cost Comparison View – 100mb/s

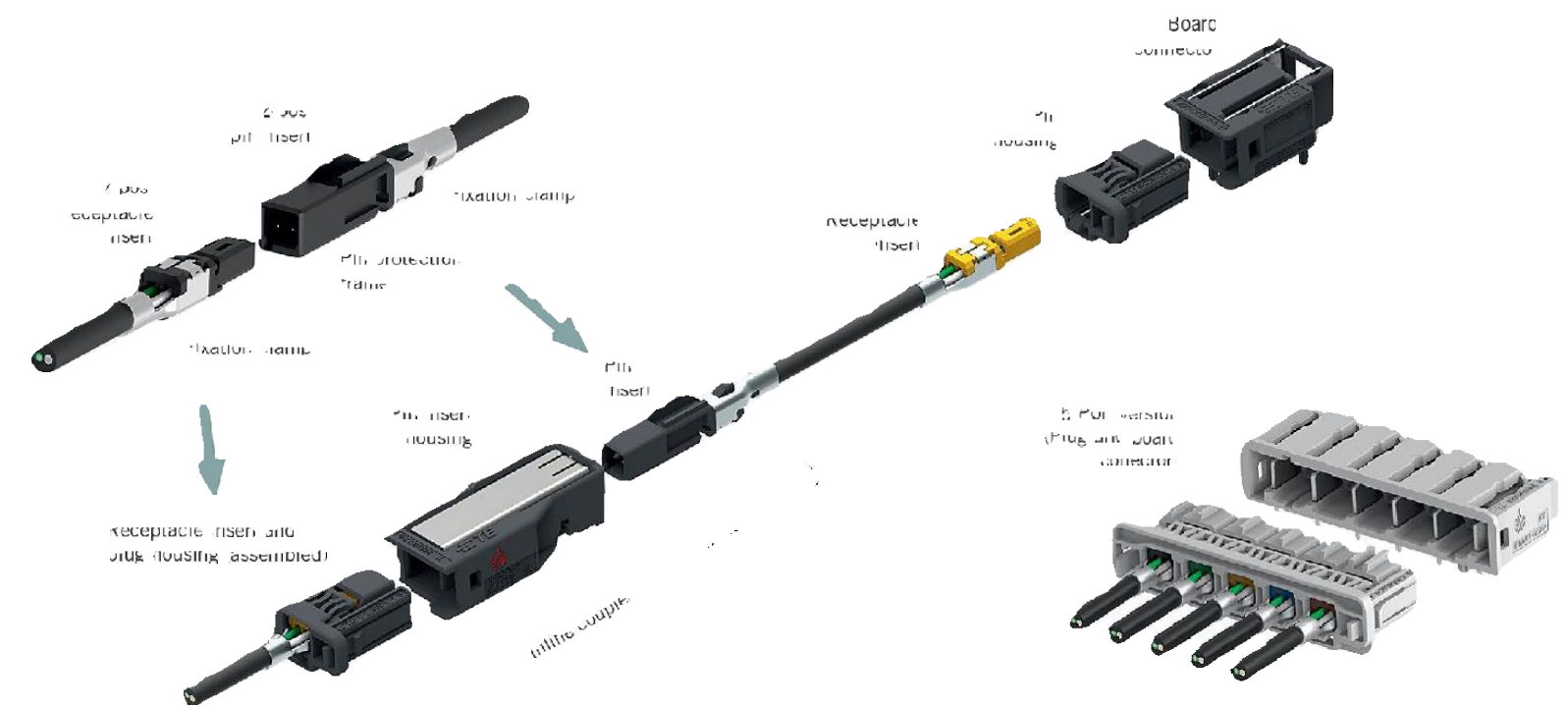
Yazaki POF wirings 100BASE-RH

• PCB FOT	2.1 €	PCB Header
• PCB Optical connector	0.50 €	
• PHY	0 €	
• Fibre connector	0.20 €	
• Fibre /m	0.17 €	
• Fibre in-line connector	0.40 €	
TOTAL: 2 m+1 inline	6.34 €	



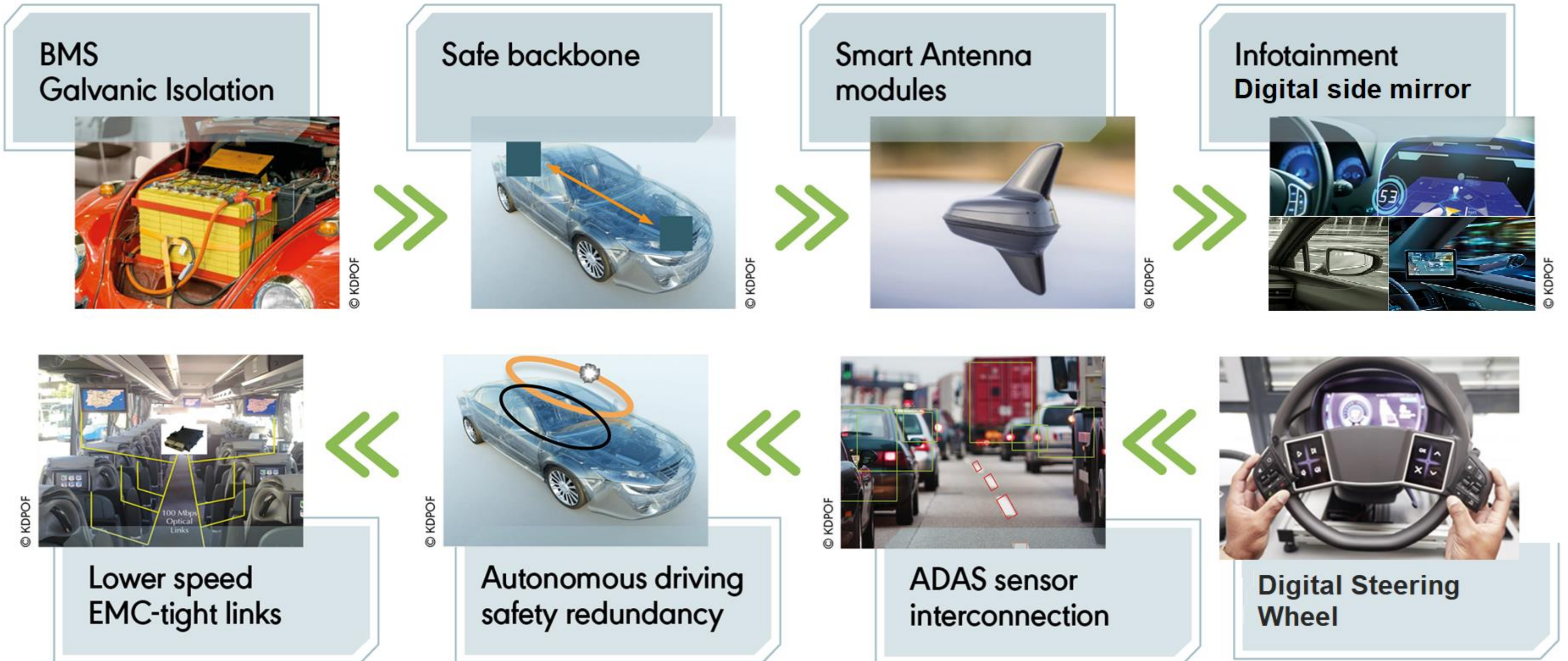
Rosenberger JTP 100BASE-T1

• PCB-Header	0.30 €
• PHY & CMC & ESD	2.30 €
• Wire connector	0.45 €
• Wire /m	0.12 €
• Inline connector	0.95 €
TOTAL: 2m+1 inline	7.29 €

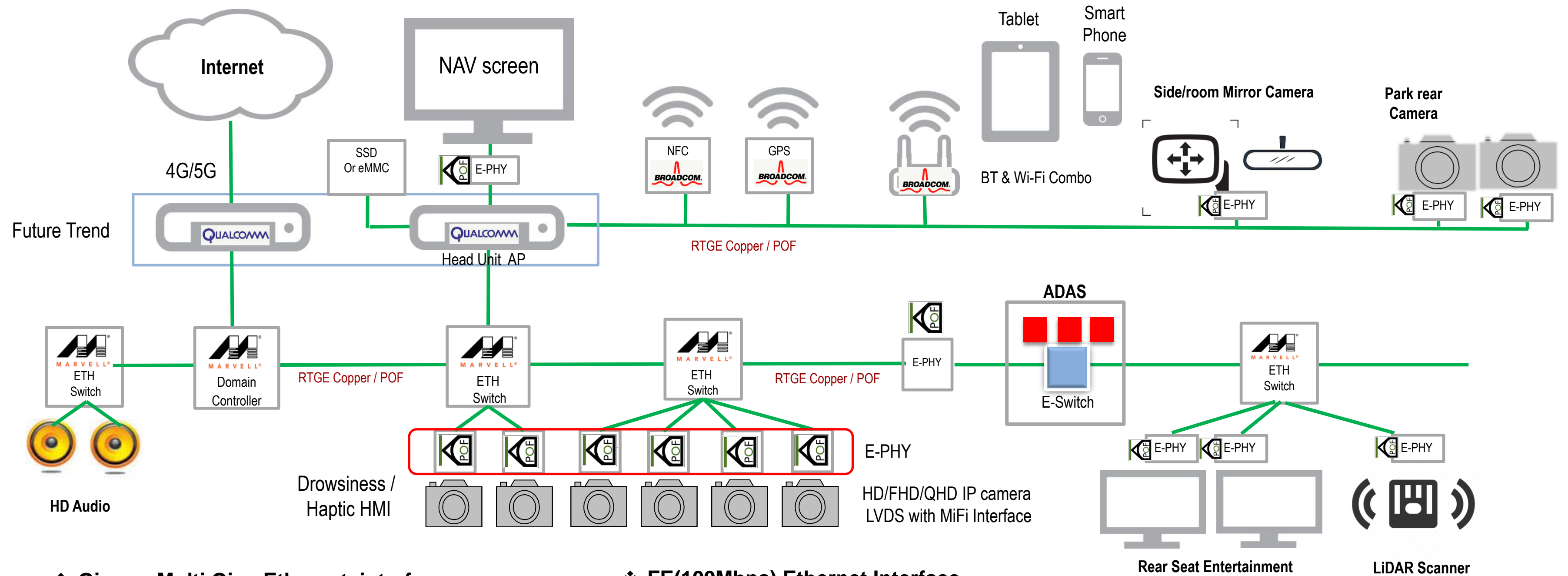


* Above price is based on same Volume and demand Conditions

Use Cases: 1Gbps and 100Mbps POF PHY



POF Use Cases: Ethernet in Automotive



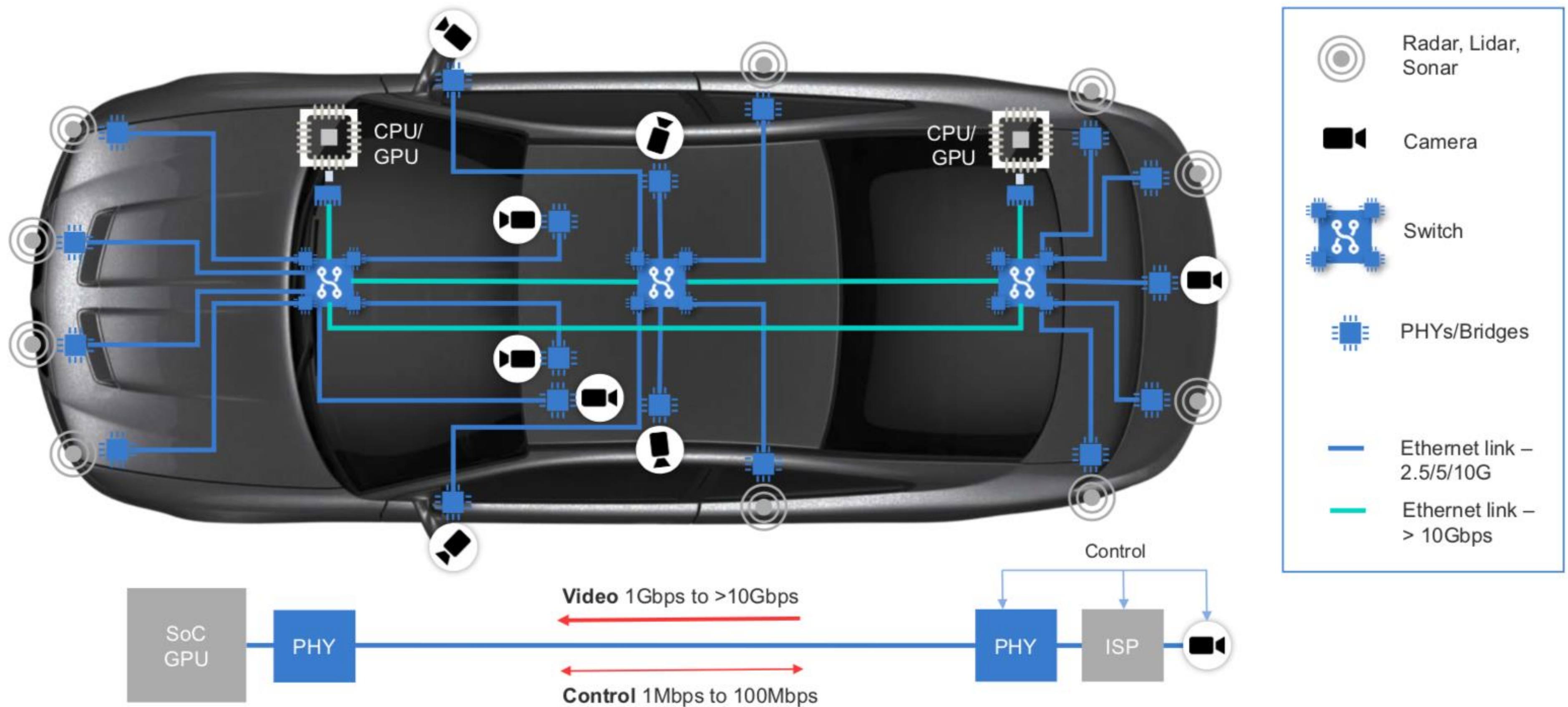
❖ Giga or Multi Giga Ethernet interface :

- Head unit to NAV screen
- GE Switch to FHD Cameras
- IP based HD Audio
- GE switch to Rear Seat Entertain Screen
- 4G/5G interface : TMC(Smart Antenna)
- WiFi/BT Combo Backhaul
- Lidar, Room Mirror/Side mirror backhaul

❖ FE(100Mbps) Ethernet Interface

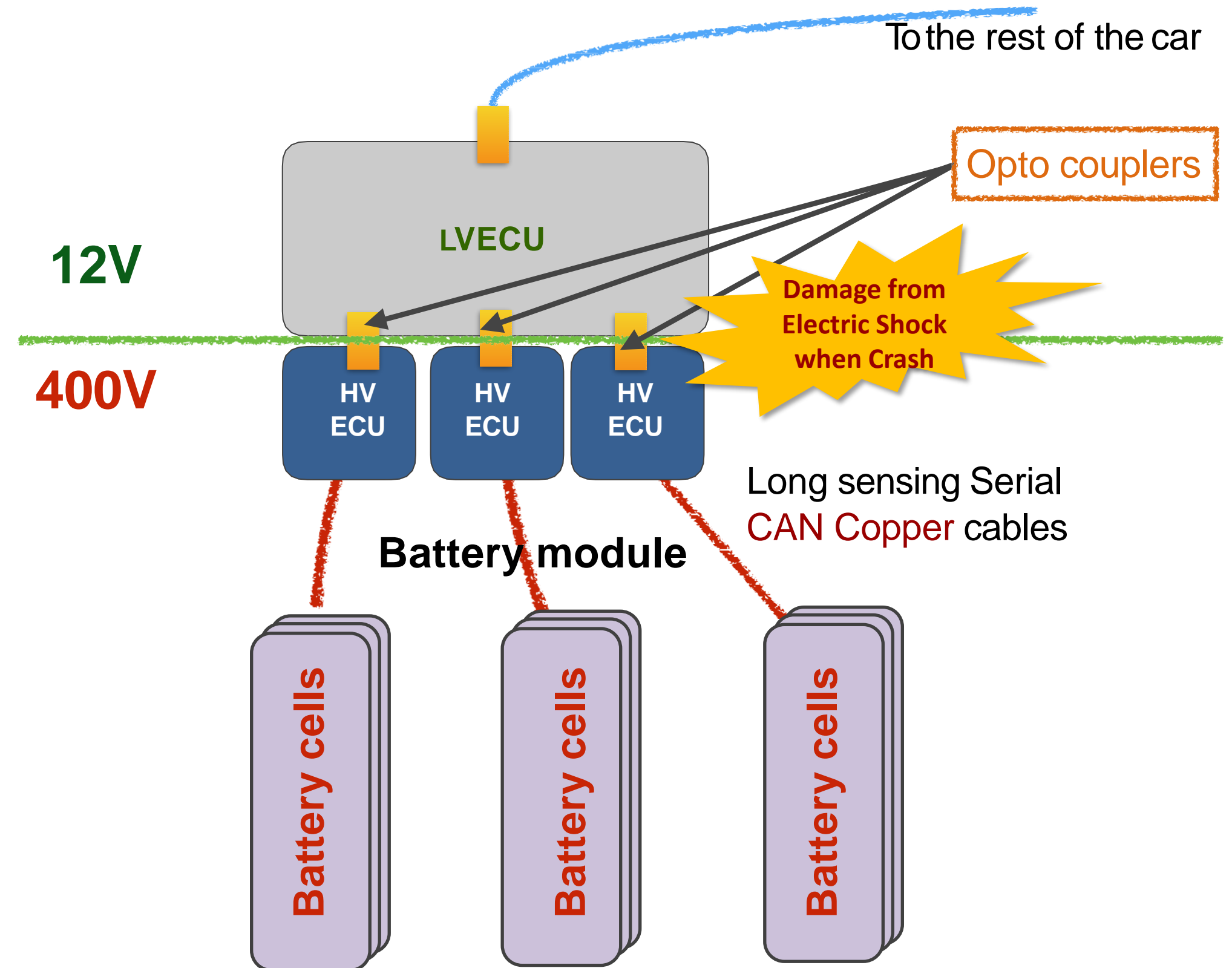
- CAN replacement
- ECUs for controller
- Smart Sensor (IP based)

Use Cases: 1~10Gbps multi gigabit PHY



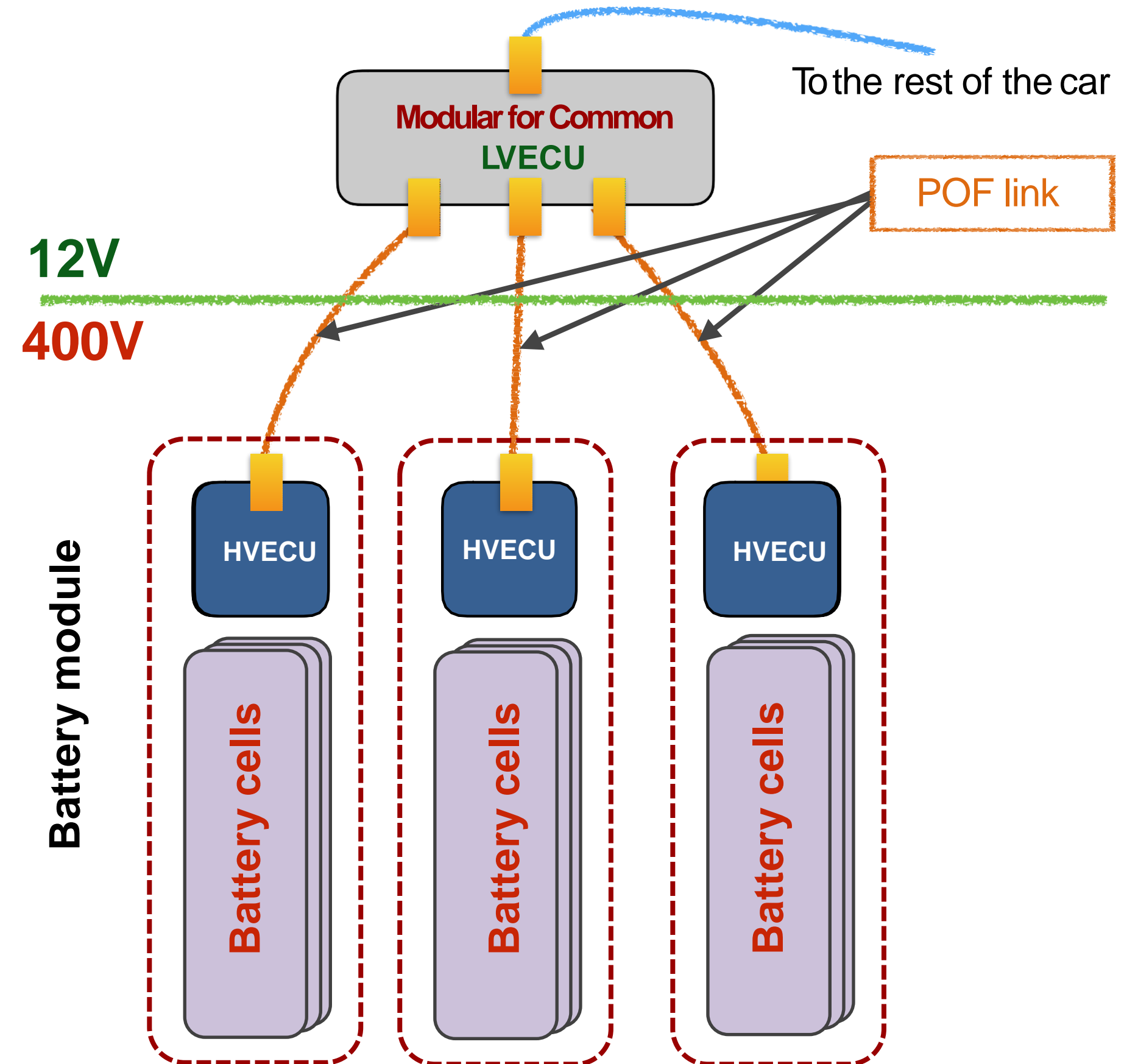
1. BMS link (Why Legacy BMS control line Needs to **Evolve** ?)

- Current BMS adapted **opto-couplers** in the same ECU to Isolate the HV zone b/w LV zone.
- CAN based single point ECU in legacy BMS has the below limitations
 - ✓ **Long Reach b/w LVECU and battery cells**
 - Multiple jointed cables;
 - Noisy environment from Copper cable;
 - Inaccurate temperature and voltage measure
 - ✓ **Lack of flexibility of LVECU Design:**
 - When add or reduce battery cells per EV Car Model, dedicate LVECU needs to be designed and qualified.
 - It can waste budget and efforts in R&D and Qualifying
 - ✓ **CAN link**
 - CAN speed has limited over Mbps speed
 - Need 50~70Mbps to comply new demand
 - ✓ **Need separate LVECUs for each battery control line design:**
 - No modularity design
 - Modular for standard form factor is recommended



1. BMS link (Propose POF based BMS Design of Daimler EQC Edition...)

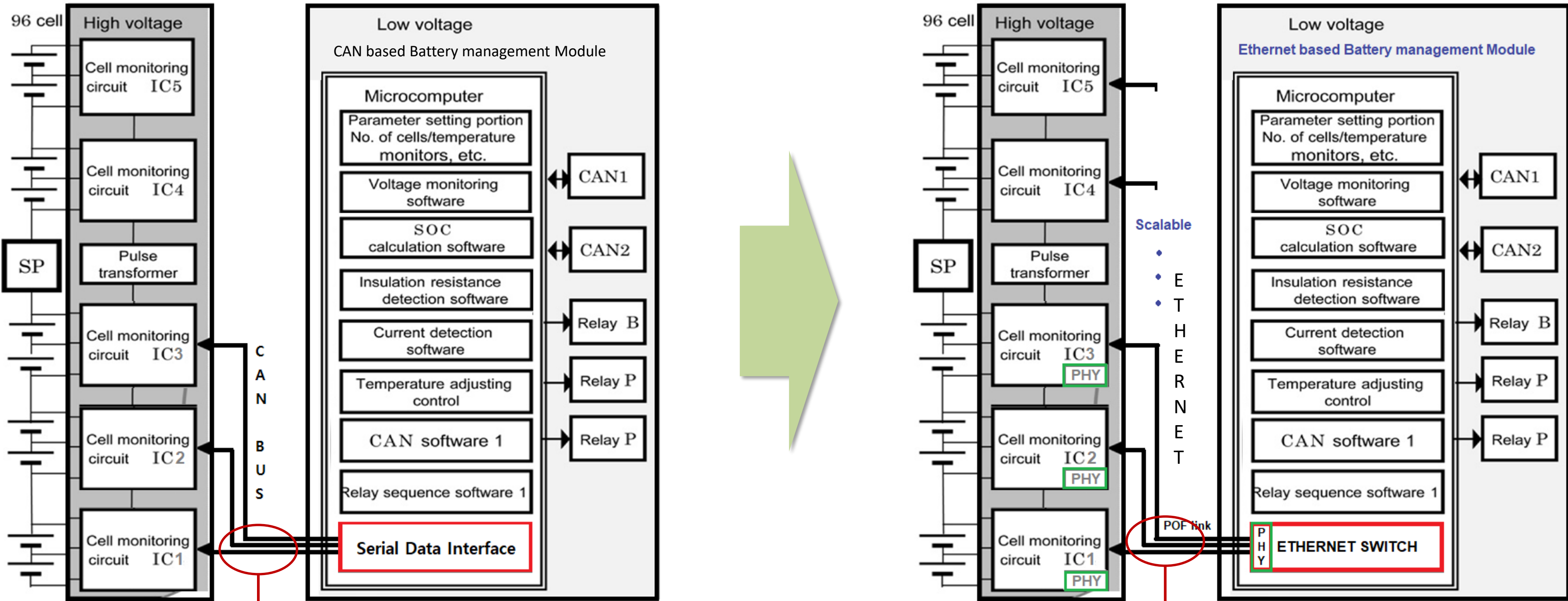
- Flexibility of LVECU configurations with same ECUs
 - ✓ Multiple battery modules can be supported with the same hardware
- Perfect galvanic isolation b/w 400V & 12V regions
 - ✓ No need Opto-Transformer or Blocker for HV isolation
 - ✓ When Car crash, minimize LV ECU damage from HV shock - since there is no direct connection b/w 400V and LVECU.
- Allows neighbor monitoring of battery cells:
 - ✓ Local temperature
 - ✓ Each cell voltage and current balance check
- Noise block
 - ✓ Avoid the noise propagation b/w the high current areas to the rest of the car
- Ethernet ecosystem
 - ✓ Ethernet is the preferred link technology to interconnect all the parts of the car



1. BMS link (New Concept BMS Design – CAN to ETH Connectivity)

Recommend Control bus design for LV Battery management Module from Serial CAN to POF based Ethernet link

- ✓ Easy growth of Cell monitoring circuit from Common Universal BMS design.
- ✓ Provide Perfect galvanic isolation even Car Crash for Low voltage electronic circuit from High voltage

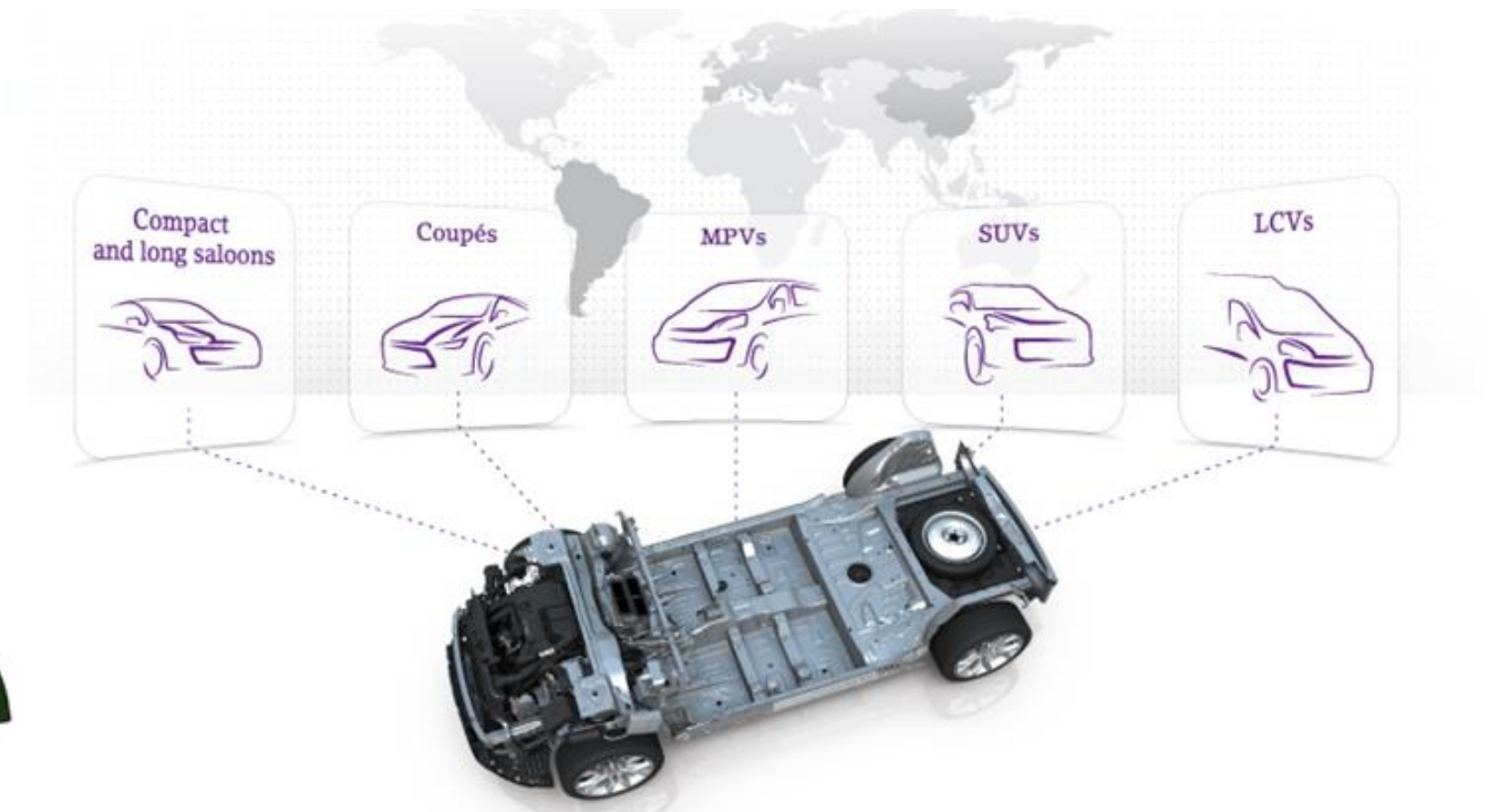
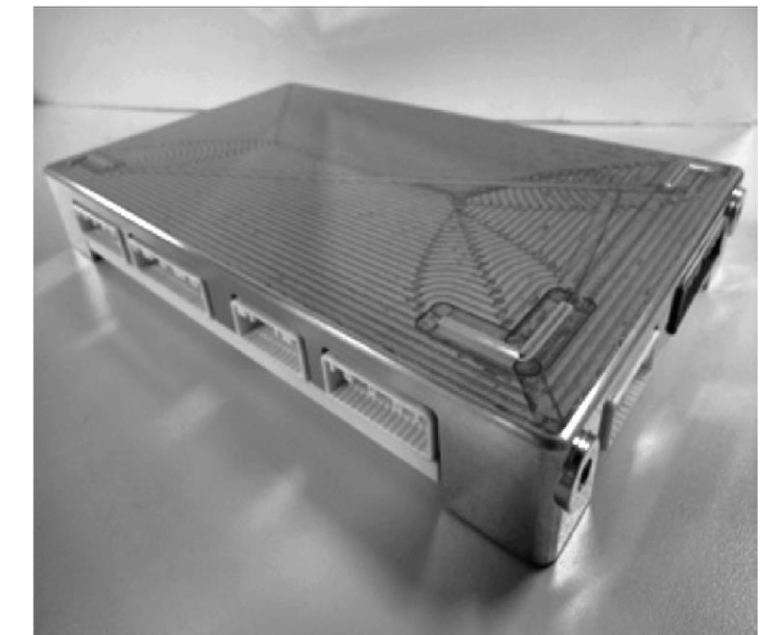
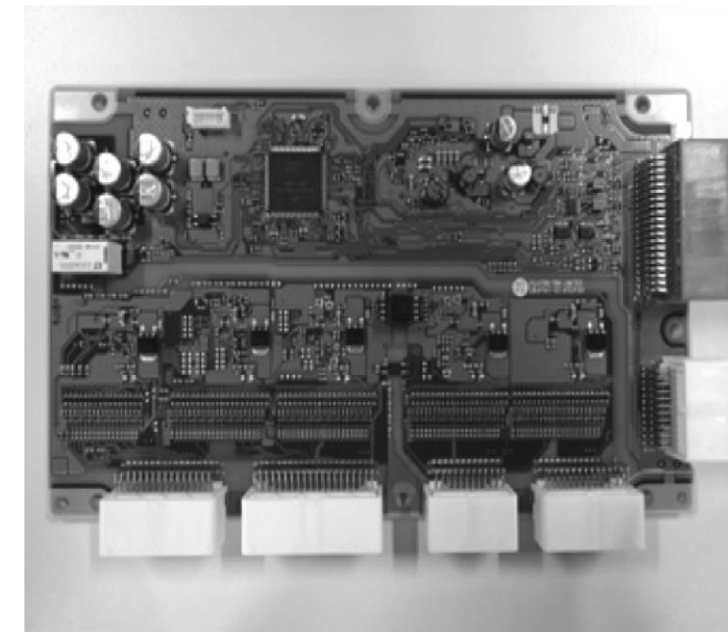


Need to use Separate Photo Isolator for Galvanic Isolation design

No Need to use Separate Photo Isolator for Galvanic Isolation design

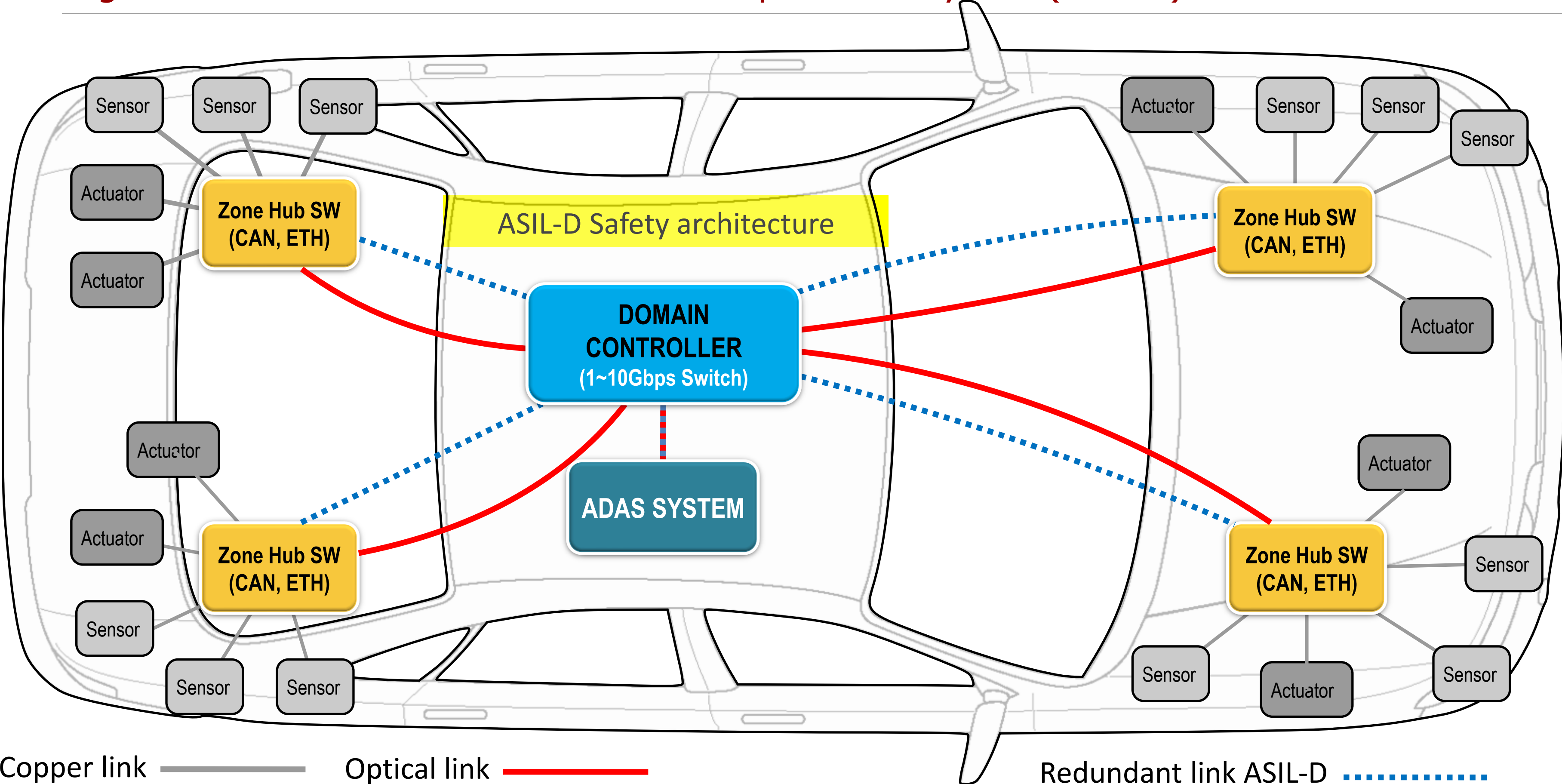
1. BMS link (Motivation to adapt POF link for BMS – Daimler case)

1. Automotive **ASIL-D Design** Compliance
2. Aiming **Universal scalable BMS design like Modular design**
3. Protect Human and LVECU from HV(400V) when Car Crash
4. Design Flexibility in BMS per EV model
 - No need to design individual BMS per EV
5. Provide perfect Galvanic Isolation via POF cable
 - No need Opto-transformer for HV / LV ECU.
6. IEEE Ethernet Ecosystem demand in BMS
 - CAN limitation of speed in CAN
7. Best EMI/EMC characteristic



2. Ethernet backbone (Coexist with legacy Copper)

Design model to reduce Wire harness and improve Safety level(ASIL-D)



2. Ethernet backbone (POF Products)



1. POF enabled GE Switch

- AVB supported
- POF PHY Connector embedded
- WAN 1G/10G Fiber, LAN POF 4/8 port
- Automotive regulation AEC-Q100 qualified



2. POF enabled ECU(Media converter)

- Copper Cable from Antenna to ECU generate Noise
- Recommended to use Expensive Shield STP cable
- Copper based Electrical communication links will reduce antenna reception sensitivity
- **Some New plastic /crystal roofs does not shield antenna from car noise**



3. Smart Shark Fin antenna - POF application

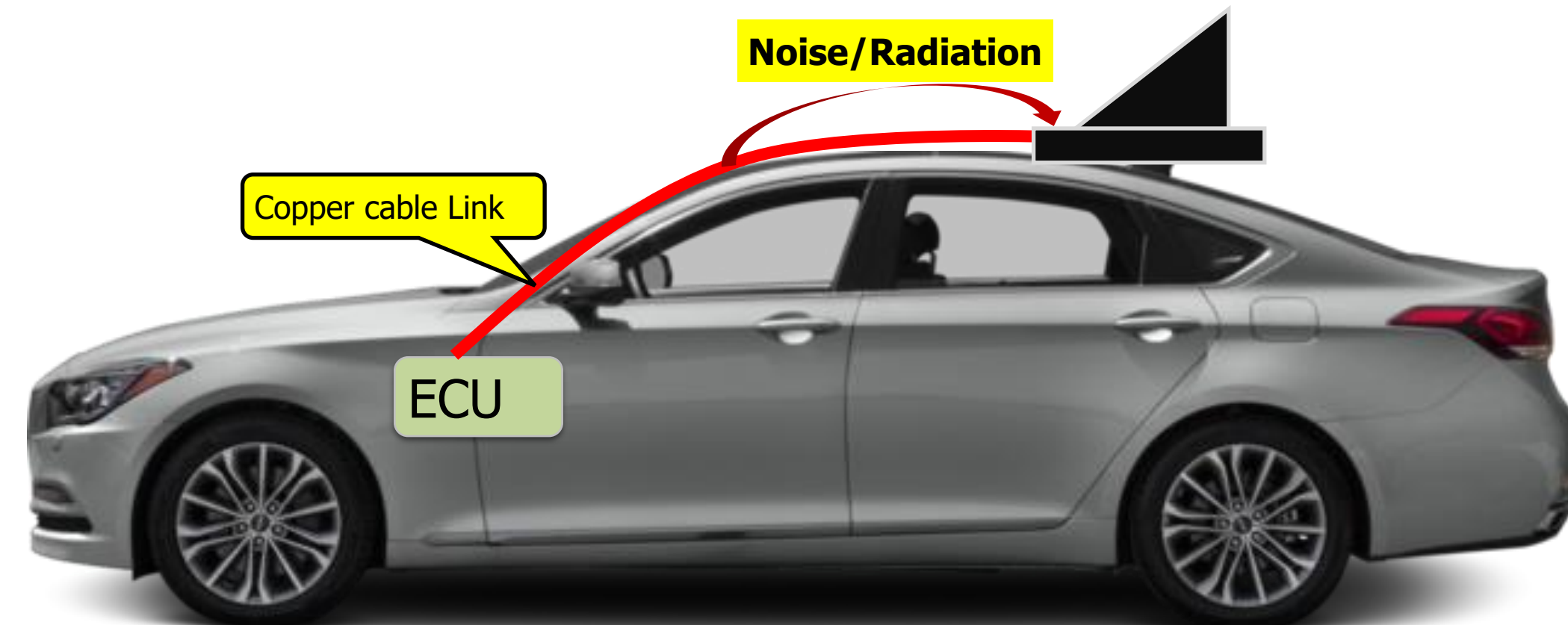
Arguments for current Shark Spin Antenna

1. All in one Antenna

- 3G/4G/5G Mobile antenna(1.8, 2.4Ghz)
- WiFi/BT Antenna (2.4 ,5.2Ghz)
- GPS/GNSS Antenna(1176 ~ 1575Mhz)
- V2V/V2X Antenna(5.9Ghz)

2. Background of POF study for Smart Antenna

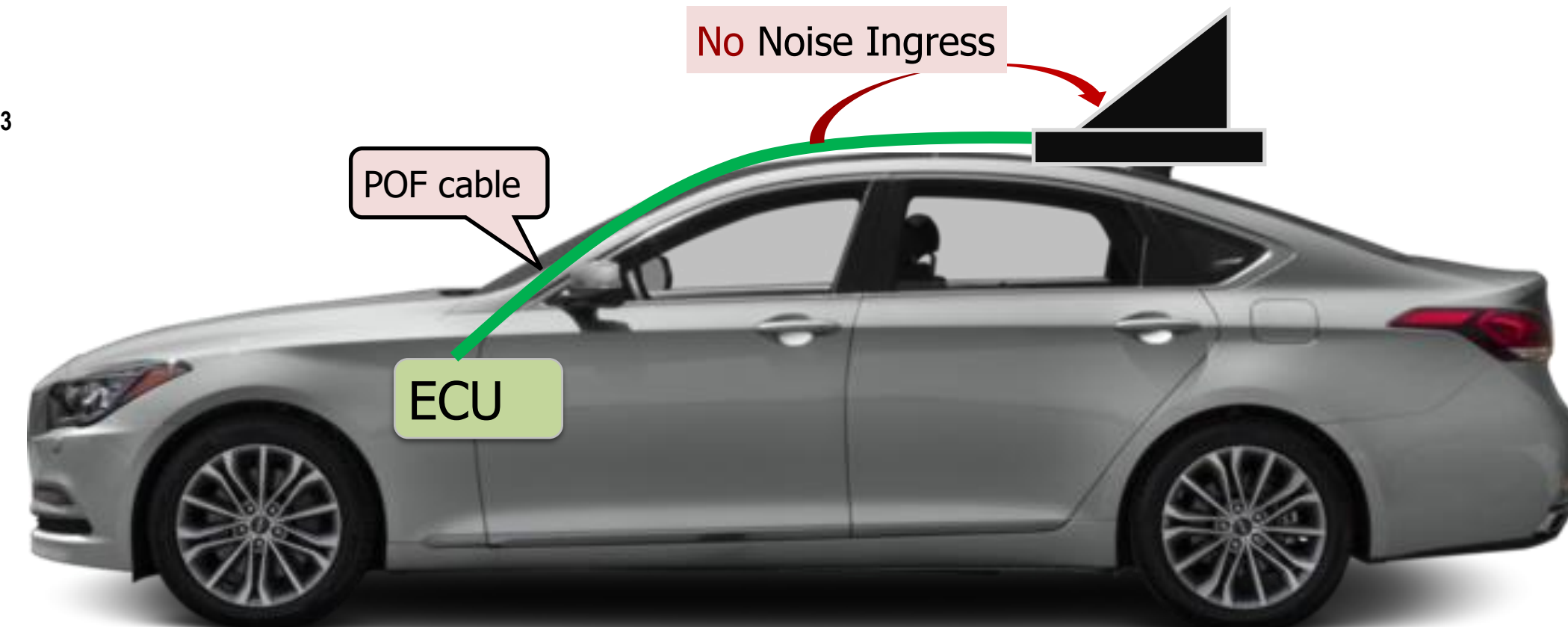
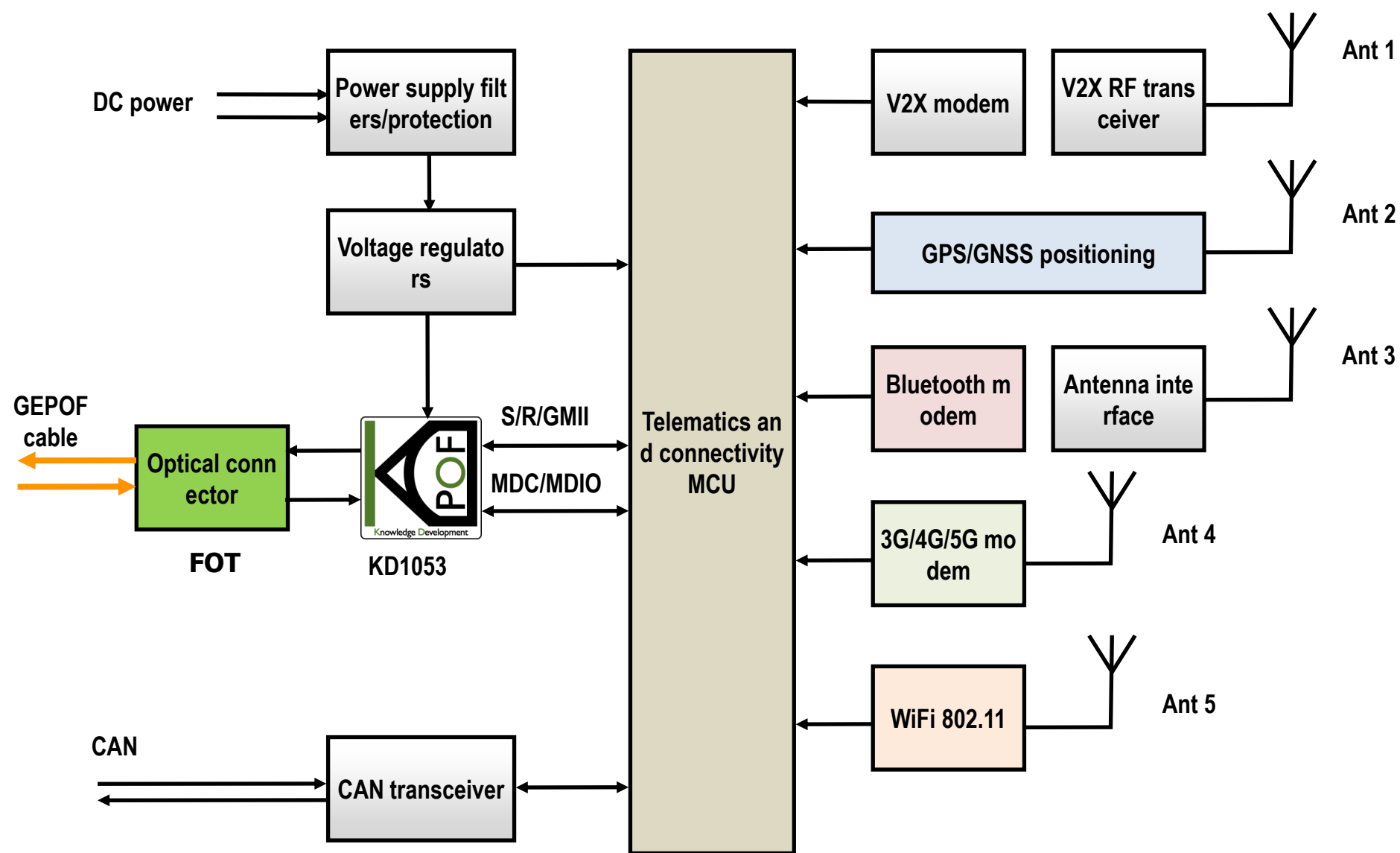
- Copper Cable from Antenna to ECU generate Noise
- Recommended to use Expensive Shield STP cable
- Copper based Electrical communication links will reduce antenna reception sensitivity
- **Some New plastic /crystal roofs does not shield antenna from car noise**



3. Smart Shark Fin antenna - POF application

POF can be a solution for issue

- POF(Optic Fiber) cable does not interfere smart antenna receivers
- To minimize Noise ingress from cable Zero EMC POF is considerable
- Guarantee optical link enhance antenna performance



4. Digital Side Mirror(Lexus ES, Audi etron)

https://www.youtube.com/watch?v=MSruk_75Rss

<https://www.youtube.com/watch?v=aGFtyXkeyyo>



[Products]

1. POF enabled Video recorder or Monitor
2. POF Hybrid cable for remote power
3. IP camera POF PHY/Connector embedded

5. Touching panel Steering and Rear Seat panel

• How it works

- ✓ The concept is pretty simple: The virtual buttons on the touch displays perform exactly the same functions as you might find on a wheel that uses physical buttons.
- ✓ You can adjust the volume, make and answer calls, listen to messages, and cycle through the menu system on the instrument display in front of you, all by tapping away at the screens.
- ✓ The buttons are very clearly labeled: unlike Legacy buttons, which can be a bit fiddly and confusing. There are piezoelectric motors under the panels to provide haptic feedback, so you receive a confirmation 'nudge' every time you push the button successfully.
- ✓ There's even the option to customize the button layout: you can ditch the volume buttons and replace them with shortcuts for navigation, car settings, or mobile phone functions—all by dragging and dropping icons from the car's main dash-mounted touch display.



5. Legacy Steering Wheel Harness



CAN protocol to control
: Limited in band with of Video data

POF Ethernet aggregated
POF Ethernet can be solution for simplicity of Wire

6. Legacy Rear Seat Control need to innovation

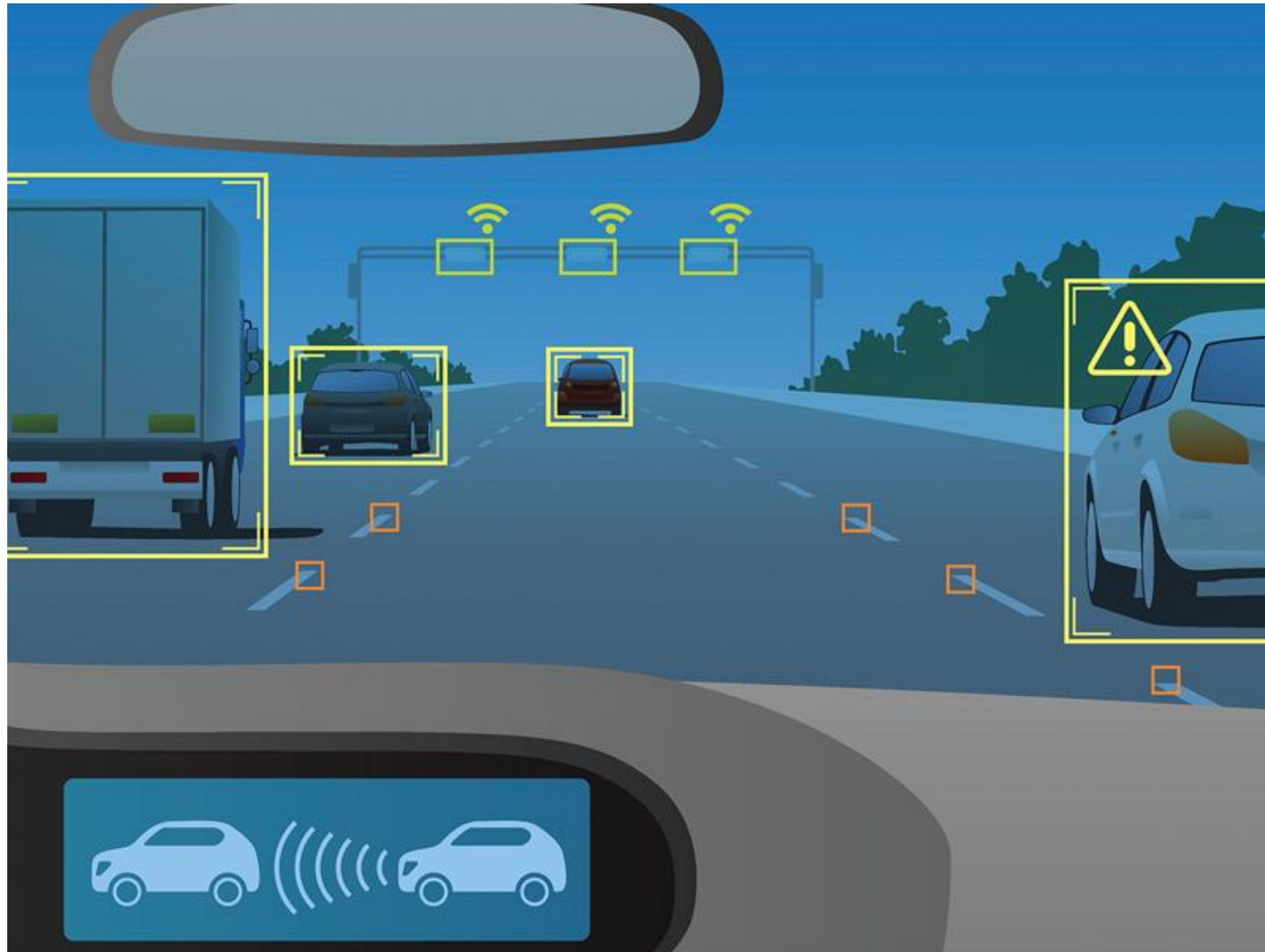


CAN protocol to control
: Limited in band with of Video data



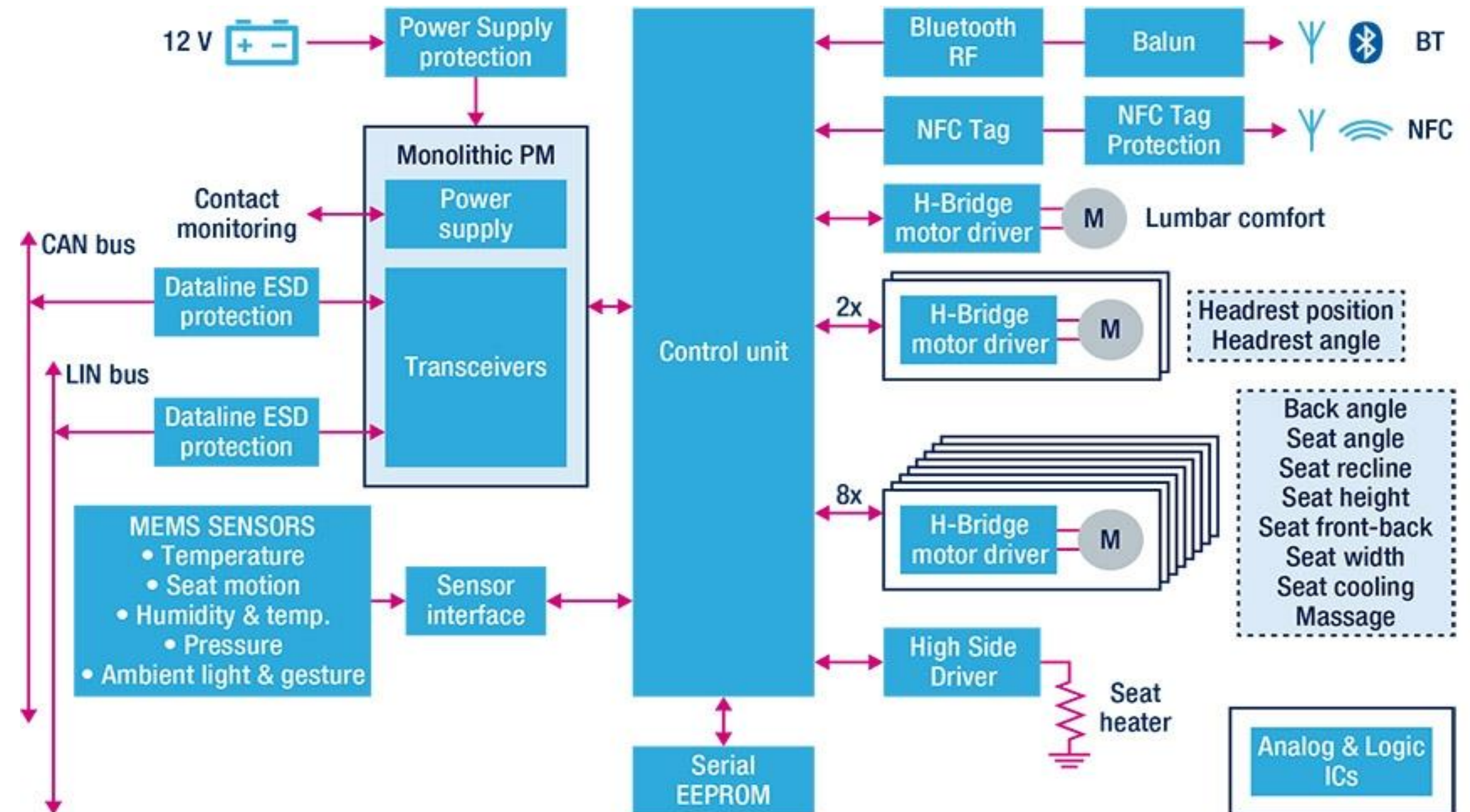
POF Ethernet aggregated
POF Ethernet can be solution for simplicity of Wire
Ex: [lexus-ls500-rear-seats-controls](#)

POF 링크응용 – Autonomous Lidar Scanner



6. New trend Rear Seat control pad diagram

- Even car seating cannot escape innovation: Extremely complex mechanical and electronic systems are fitted in Premium cars to ensure driver and passenger comfort.
- Seat control offers the possibility to fine tune a large number of position settings – backrest angle, seat height or width, to mention a few – or the ability to control seating temperature using dedicated cooling/heating devices. All the seat adjustments can be stored and retrieved at will.
- The challenge is make sure that all the loads – including a range of electric motors – used to finely tune seat morphology are efficiently and reliably driven and controlled.
- Our range of low-ohmic, fully protected high-side drivers, available in a variety of combinations including H-bridges arrangement for motors, SP C5 32-bit automotive-grade microcontrollers, power management ICs and system basis chips (SBC) can help design effective solutions for seat control.



Key Components to develop for POF connectivity

1. POF Connectors

- PCB header(for Automotive and Home)
- In-line connector to join
- Built-in Connector for IPCAM/Monitor

TE Electric



Yazaki

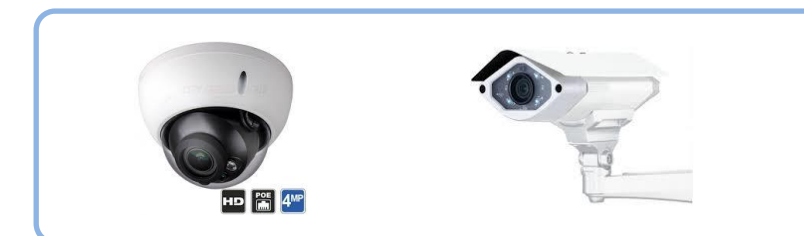


Low POF connector/ MEMs type



2. POF enabled IPCAM

- For Automotive
- For Home and Retail



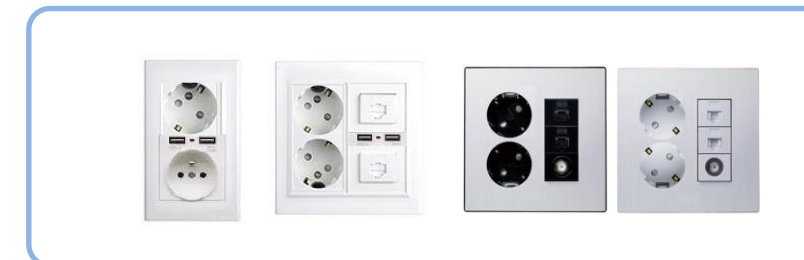
3. POF Enabled GE Switch(4,8,16 port)

- FE POFSW, GE POFSW
- POE type POF Switch over POF



4. Media converter

- Network Interface Converter
- SFP module type
- Outlet type



5. POF Cable (3rd vendor)

- SI-POF(100Mbps ~ 1Gbps)
- GI-POF(1Gbps ~ 10Gbps)
- Hybrid Cable (POF + 24 AWG copper)



Business Phase

Stage 1 : Key POF Component

POF PCB Header

- MEMS type low cost

POF Inline connector

- Automotive edition
- Train/Industrial Edition
- Home Edition

POF Hybrid cable

Stage2 : Simple Module Device

POF Ethernet Switch

- Auto edition
- Train/Industrial Edition
- Home edition

Cameras

- POF Enabled Camera/(Auto)
- POF enabled Camera/(home)

Stage3 : System/ Platform

Driving Vehicle Recording System

Lidar system

BMS system

TMU(Smart Antenna)



POF key Components

POF connector

POF camera

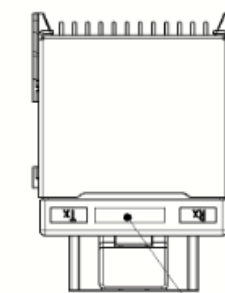
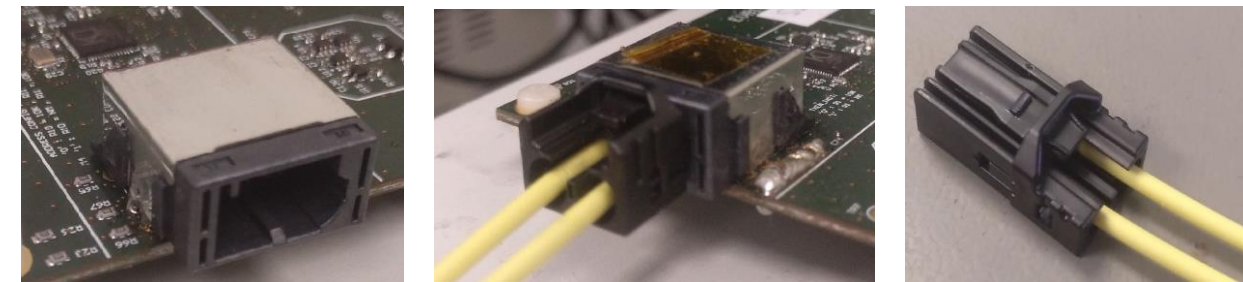
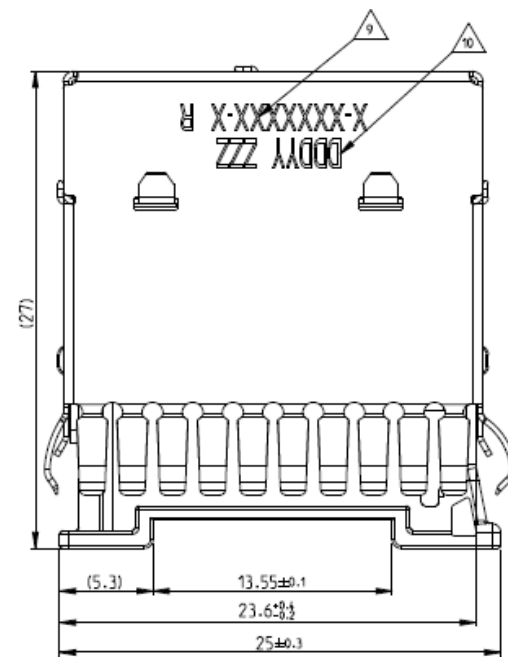
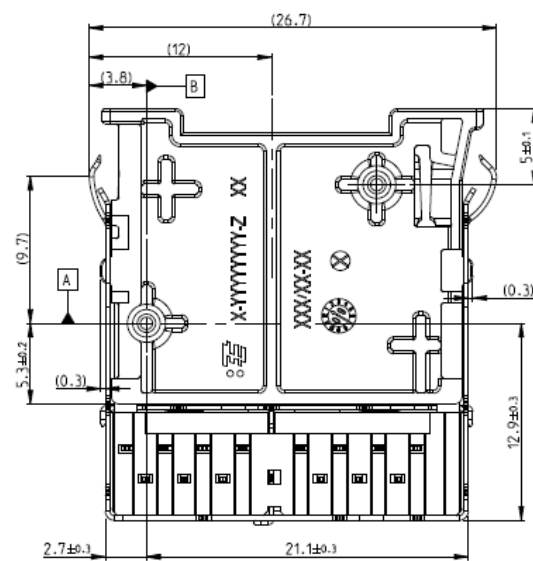
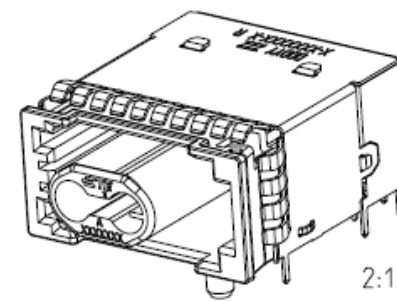
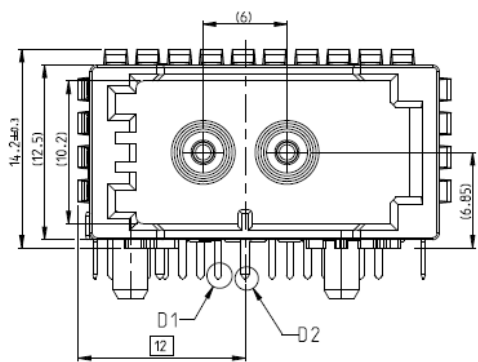
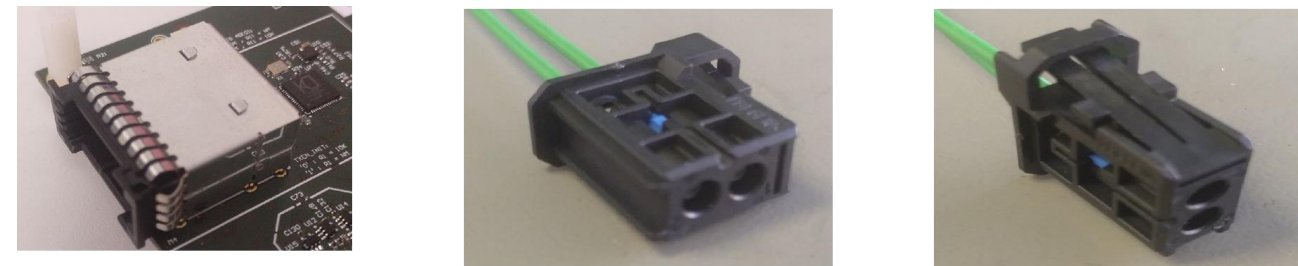
POF Switch & ECU

POF Hybrid cable

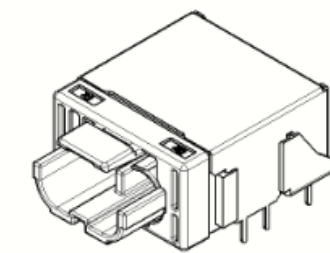
POF Connector

MOST 150 GOF MICRO PIGTAIL

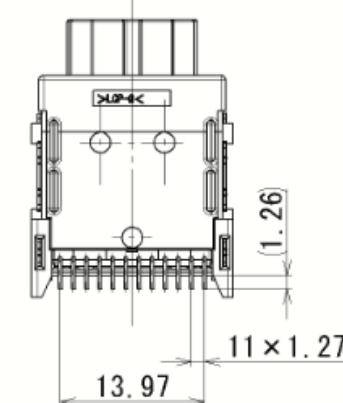
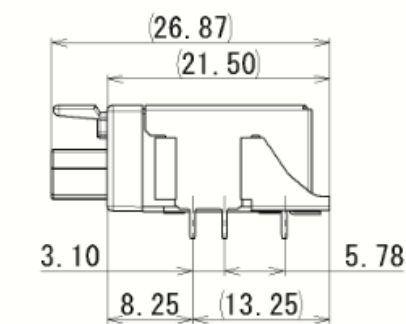
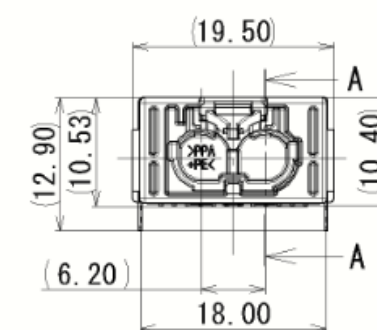
FULLY SHIELDED AVAGO AFBR-1150/2150 (Available now)



ENGRAVE PART IDENTIFICATION HERE.



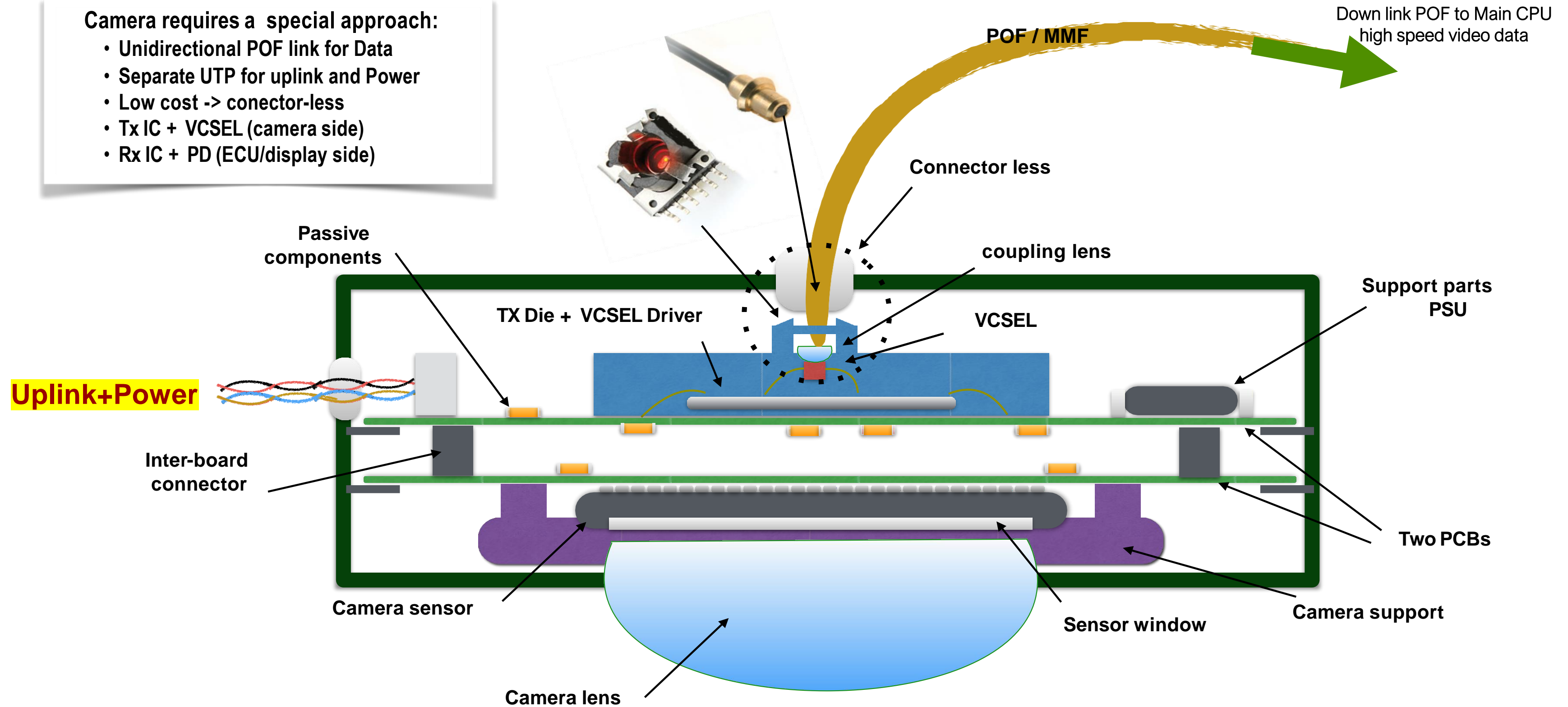
ISOMETRIC VIEW



POF Camera module concept – **Separate Power cable**

Camera requires a special approach:

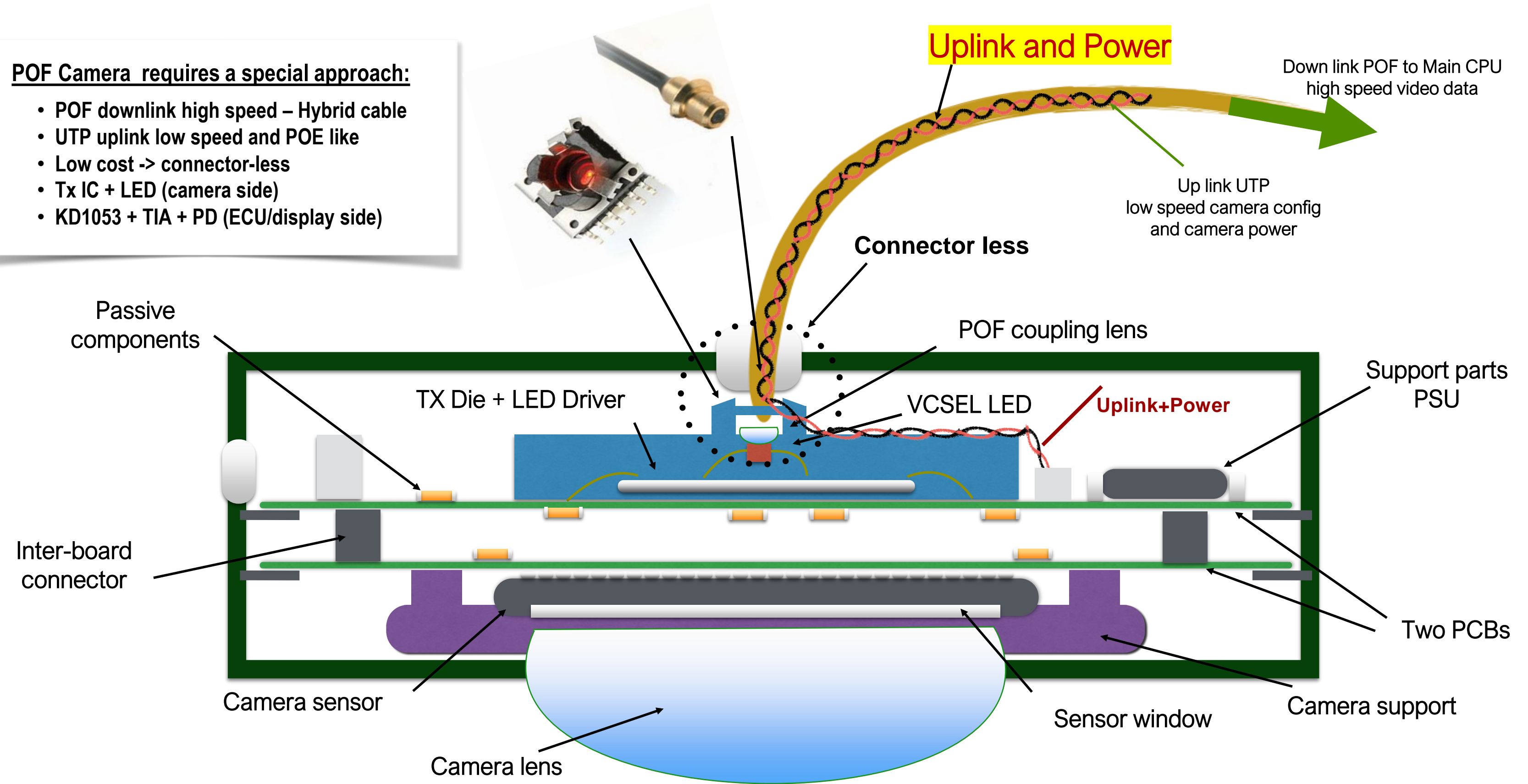
- Unidirectional POF link for Data
- Separate UTP for uplink and Power
- Low cost -> connector-less
- Tx IC + VCSEL (camera side)
- Rx IC + PD (ECU/display side)



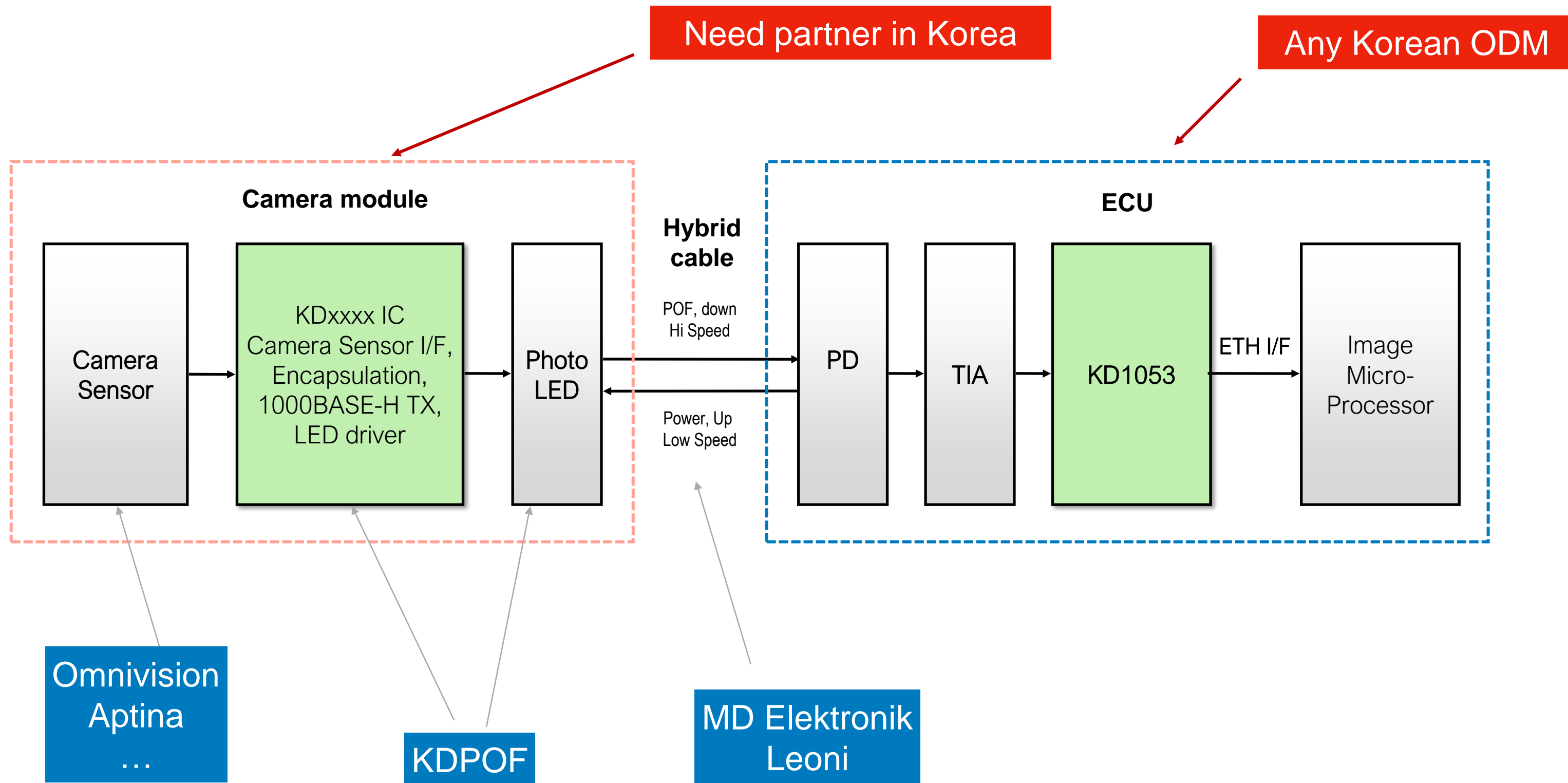
POF Camera module concept – Hybrid cable

POF Camera requires a special approach:

- POF downlink high speed – Hybrid cable
- UTP uplink low speed and POE like
- Low cost -> connector-less
- Tx IC + LED (camera side)
- KD1053 + TIA + PD (ECU/display side)

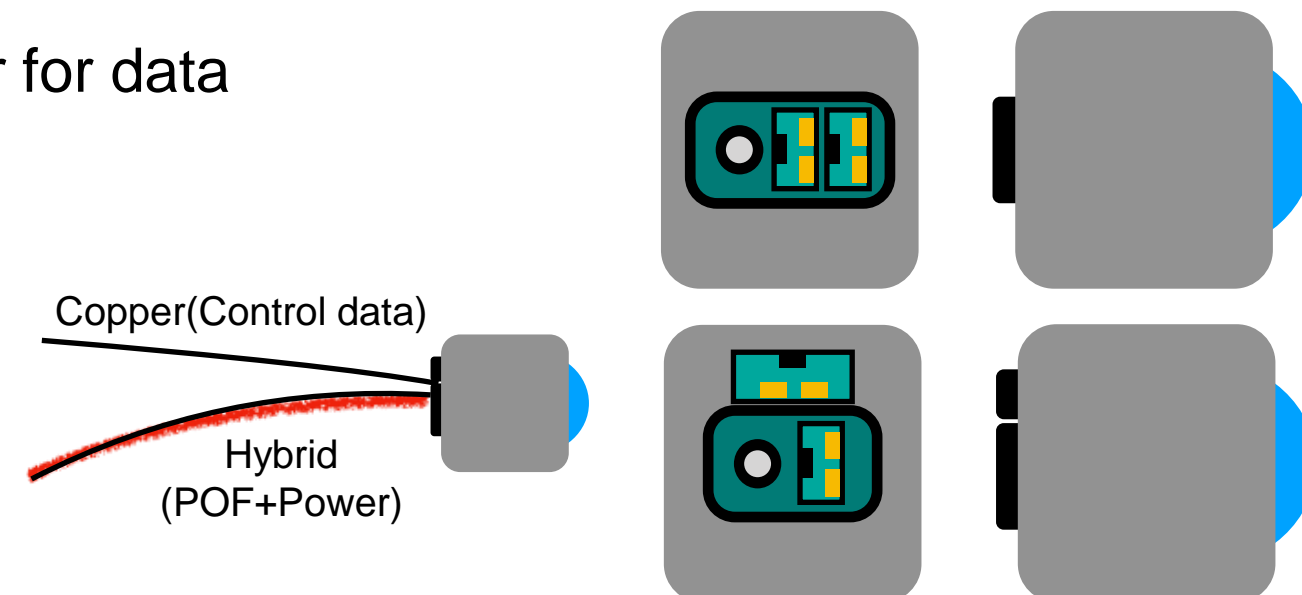
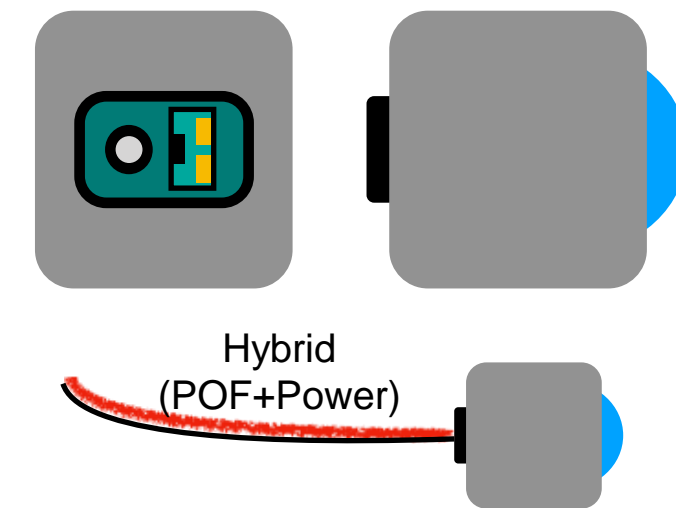
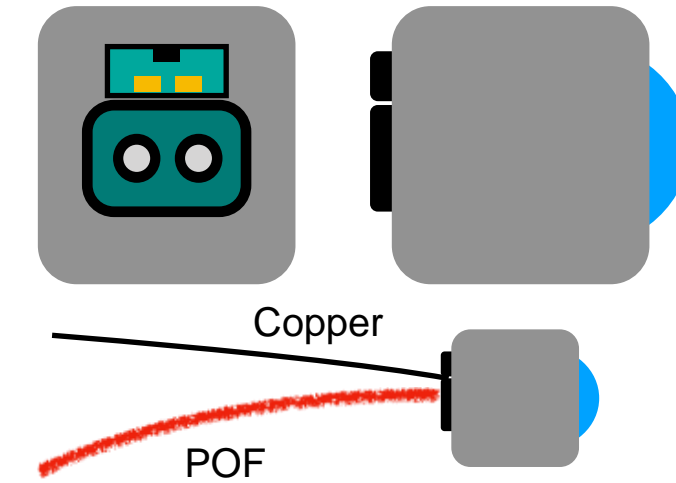


Camera module block diagram



Camera connector options

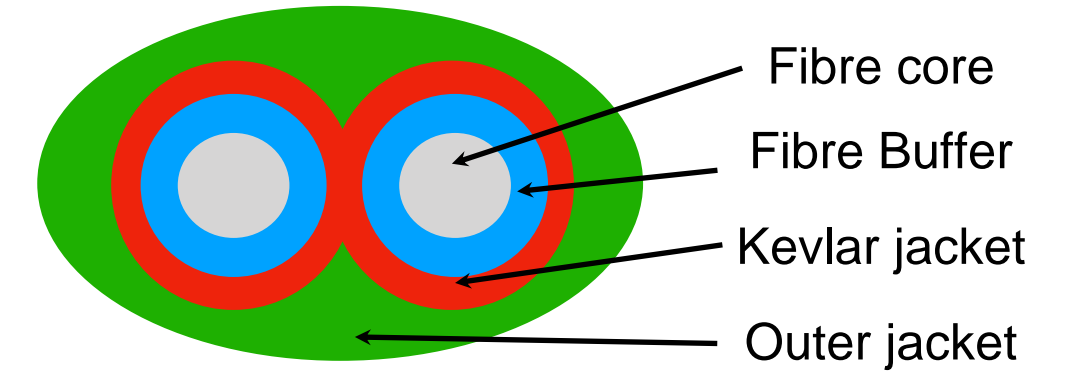
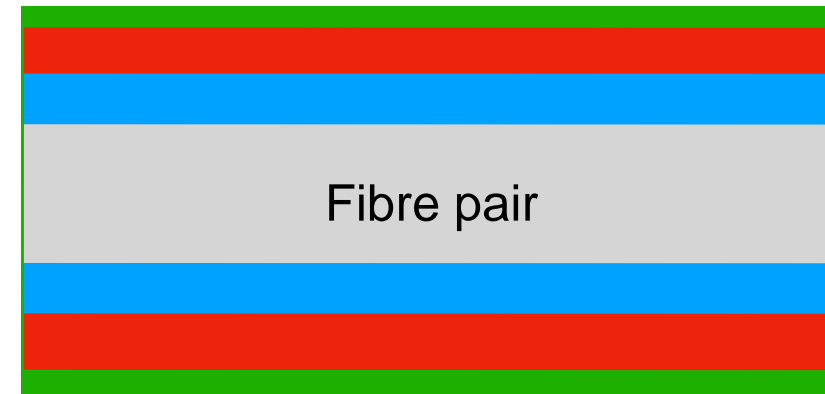
- ❖ Dual(Two way) POF cable + 1 pair of copper for power(UTP)
 - Products
 - ✓ Unlimited power
 - ✓ Independent connector between power and optical possible
 - ✓ Reuse full duplex connector. Single connector qualification. Reuse power connector
 - ✓ Power might be provided locally
 - Considerations:
 - ✓ Two connectors – One for POF and One for Power
- ❖ Single(One way) POF cable + 1 pair of copper for power & data in same bundle
 - Products
 - ✓ Minimum amount of wires
 - ✓ Compact and simple connector
 - Considerations:
 - ✓ Size of coils for power filter
 - ✓ Limited amount of power (1W for unregulated supply)
 - ✓ New connector qualification
 - ✓ Power has to be provided from ECU
- ❖ Single(One way) POF cable + 1 pair of copper for power + 1 copper for data
 - Products
 - ✓ Unlimited power for Power consuming device
 - ✓ Power might be provided locally
 - Considerations:
 - ✓ Complexity of connector
 - ✓ 3 wires / cable
 - ✓ New connector qualification



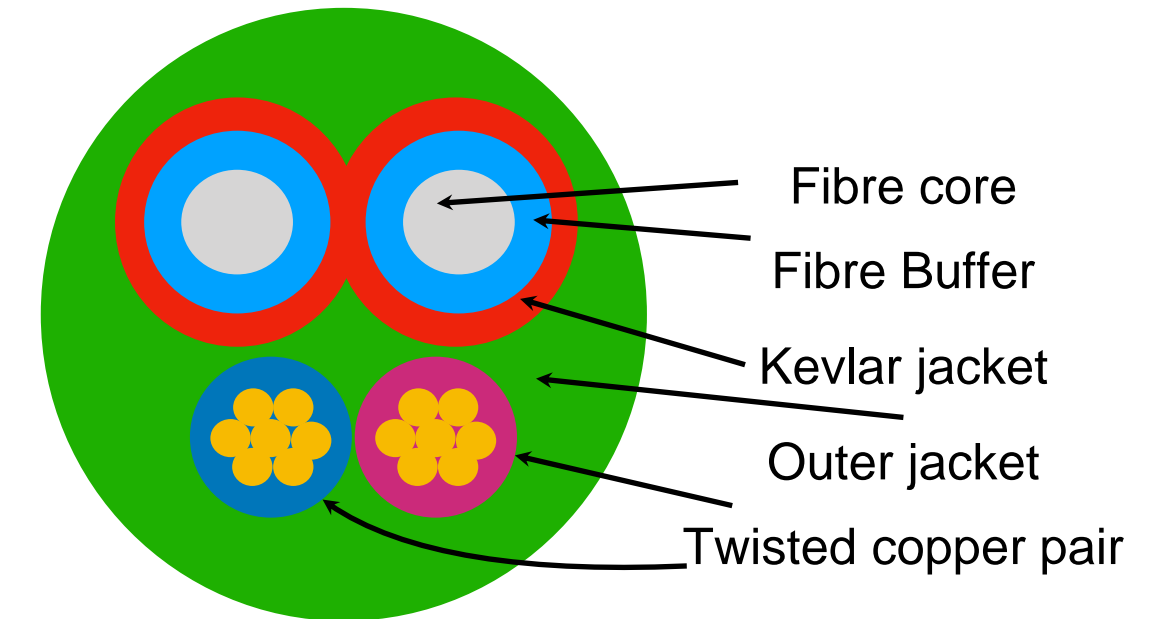
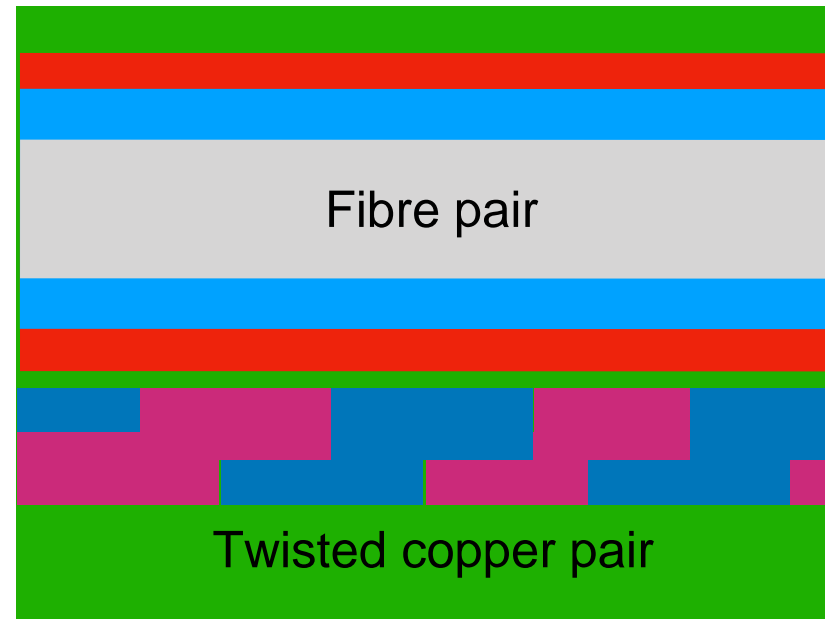
POF/Hybrid Cable options

❖ Mechanical Strength is provided by:

- Kevlar jacket
- Copper protection

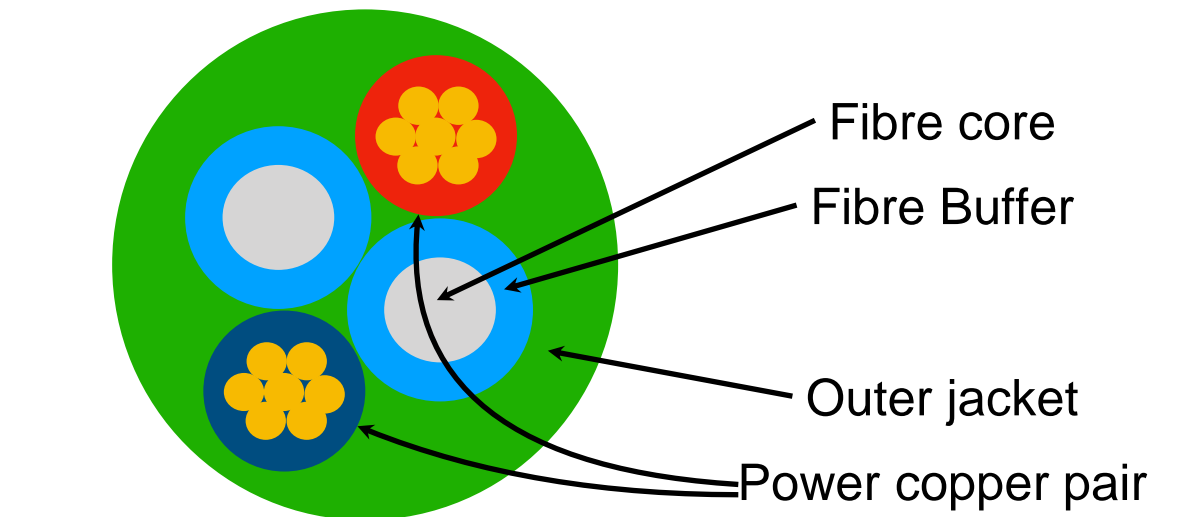
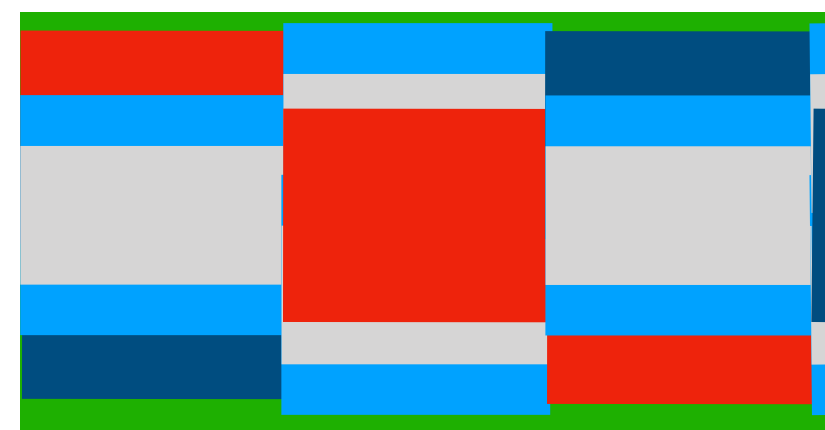


❖ Cables might be optical or hybrid



❖ Hybrid cables might be with:

- Data cables - Very twisted
- Power cables - Soft twisting
- Power cables might provide mechanical strength



Soft twisting

Q&A



Joshua Moon
KDPOF Korea Distributor
joshua@rss.or.kr
+82-10-3894-4877