IEEE 802.3
Call For Interest

Automotive Optical Multi Gig
Broader scope: Optical-Copper hybrid links
November 2019

Consensus presentation

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Objective of this meeting

- To measure the interest of making broader the scope of the OMEGA study group to consider:
  - Optional hybrid optical / copper links for asymmetric rate use cases like cameras and displays

- In this meeting, we don’t need to:
  - Choose any technical solution
  - Fully explore the problem
  - Debate strengths and weaknesses of solutions
  - Choose any one solution
  - Create PAR or five criteria
  - Create a standard or specification

- Anyone on the room may speak & vote

- RESPECT… give it, get it

Supporters by affiliation

OEMs

Zhang Tao —SAIC MOTOR Passenger Vehicle Co.
Hideki Goto - TMC
Takashi Yasuda - TMC
Takumi Nomura - Honda R&D
Doarte Goncalves - PSA
Samuel Sigfridsson - Volvo Cars
Jerker Fors - Volvo Cars

Automotive component suppliers (TIER-1 / TIER-2)

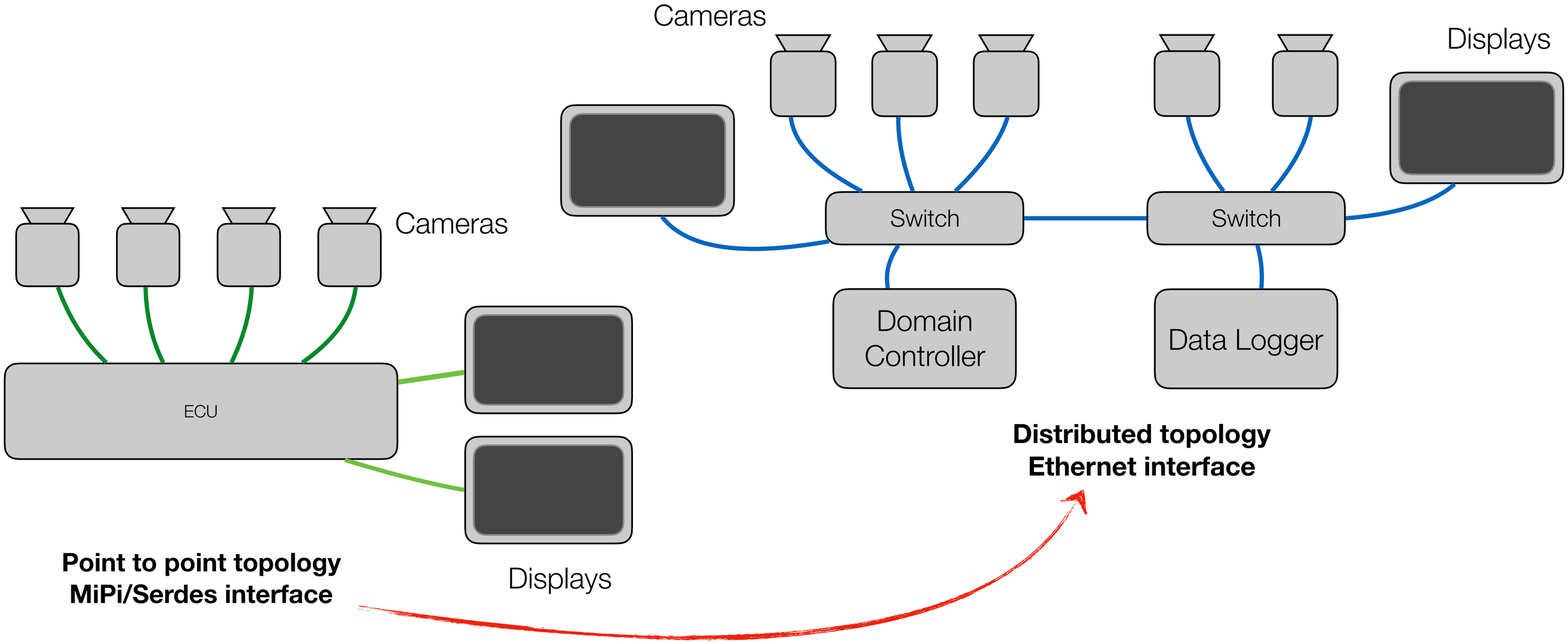
Hayato Yuki - Sumitomo Electric
Kenichi Okajima - Hamamatsu Photonics
Takayuki Shimizu - Hamamatsu Photonics
Masaya Kato - Hamamatsu Photonics
Naoyuki Nakada - Toyoda Gosei
Oki Sugihara - Utsunomiya University
Tomohiro Kikuta - Adamant Namiki Precision Jewel
Yasuhiro Hyakutake - Adamant Namiki Precision Jewel
Kazuya Takayama - Nitto Denko
Tadashi Takahashi - Nitto Denko
Manabu Kagami - NiTech
Yoshihiro Tsukamoto - Mitsubishi Chemical
Masayuki Iwase - FURUKAWA ELECTRIC
Masato Shiino - FURUKAWA ELECTRIC
Wang Xuehuan—Huawei Technologies Co. Ltd
Zhang Xingxin —Huawei Technologies Co. Ltd
Janey Cheng –Luxshare Precision Industry Co., Ltd
Vito Chen - Luxshare Precision Industry Co., Ltd
Ryder Hu –Luxshare Precision Industry Co., Ltd
Mike Gao –Luxshare Precision Industry Co., Ltd
Chen Qun —Hangzhou Yodosmart Automotive Technology Co.,Ltd.

Other

Li Wei — China Academy of Information and Telecommunication Technology
Zhang Haifeng — Shanghai E-Planet Technologies Co., Ltd.
Takeo Masuda - OITDA/PETRA

Market Drivers
Automotive Cameras / Displays

- There are two topologies for the camera/displays connectivity in the automotive industry:



Market Drivers
Automotive Cameras / Displays

- Camera traffic is the main contributor to the total transport data rate in the car
- Asymmetric data-rate is an intrinsic characteristic of this application

Case one-Automotive Camera

Image Quality vs Bandwidth

30 FPS	Hres	Vres	Fps	12bit	14bit	16bit 96dB	20bit 120dB	24bit 140dB	32bit 180dB
720p	1280	720	30	0.41	0.48	0.55	0.69	0.83	1.11
1080p	1920	1080	30	0.93	1.09	1.24	1.56	1.87	2.49
2k	2560	1440	30	1.66	1.94	2.21	2.76	3.32	4.42
3k	2896	1876	30	2.44	2.85	3.26	4.07	4.89	6.52
4k	3840	2160	30	3.73	4.35	4.98	6.22	7.46	9.95
8k	7680	4320	30	14.93	17.42	19.91	24.88	29.86	39.81

60FPS	Hres	Vres	Fps	12bit	14bit	16bit 96dB	20bit 120dB	24bit 140dB	32bit 180dB
720p	1280	720	60	0.83	0.97	1.11	1.38	1.66	2.21
1080p	1920	1080	60	1.87	2.18	2.49	3.11	3.73	4.98
2k	2560	1440	60	3.32	3.87	4.42	5.53	6.64	8.85
3k	2896	1876	60	4.89	5.70	6.52	8.15	9.78	13.04
4k	3840	2160	60	7.46	8.71	9.95	12.44	14.93	19.91
8k	7680	4320	60	29.86	34.84	39.81	49.77	59.72	79.63

Note：The data rates are in the unit of Gbps, and include 20% protocol overhead

Image quality is determined by three key parameters resolution, dynamic range and frame rate

HUAWEI TECHNOLOGIES CO., LTD.

Observations

- Sensor to ECU direction
  - ➢ 4k is on the way, maybe not very soon, but very possible in the near 3-5 years
  - ➢ 20~32bit/pixel @60FPS might be needed for high level autonomous driving features/functions
- ECU to Sensor direction
  - ➢ Control
  - ➢ OTA upgrade
- Power supply
  - ➢ Power on wire for space saving
  - ➢ Hybrid channel maybe a good option, fiber for forward, cooper for backward & power

Suggestions

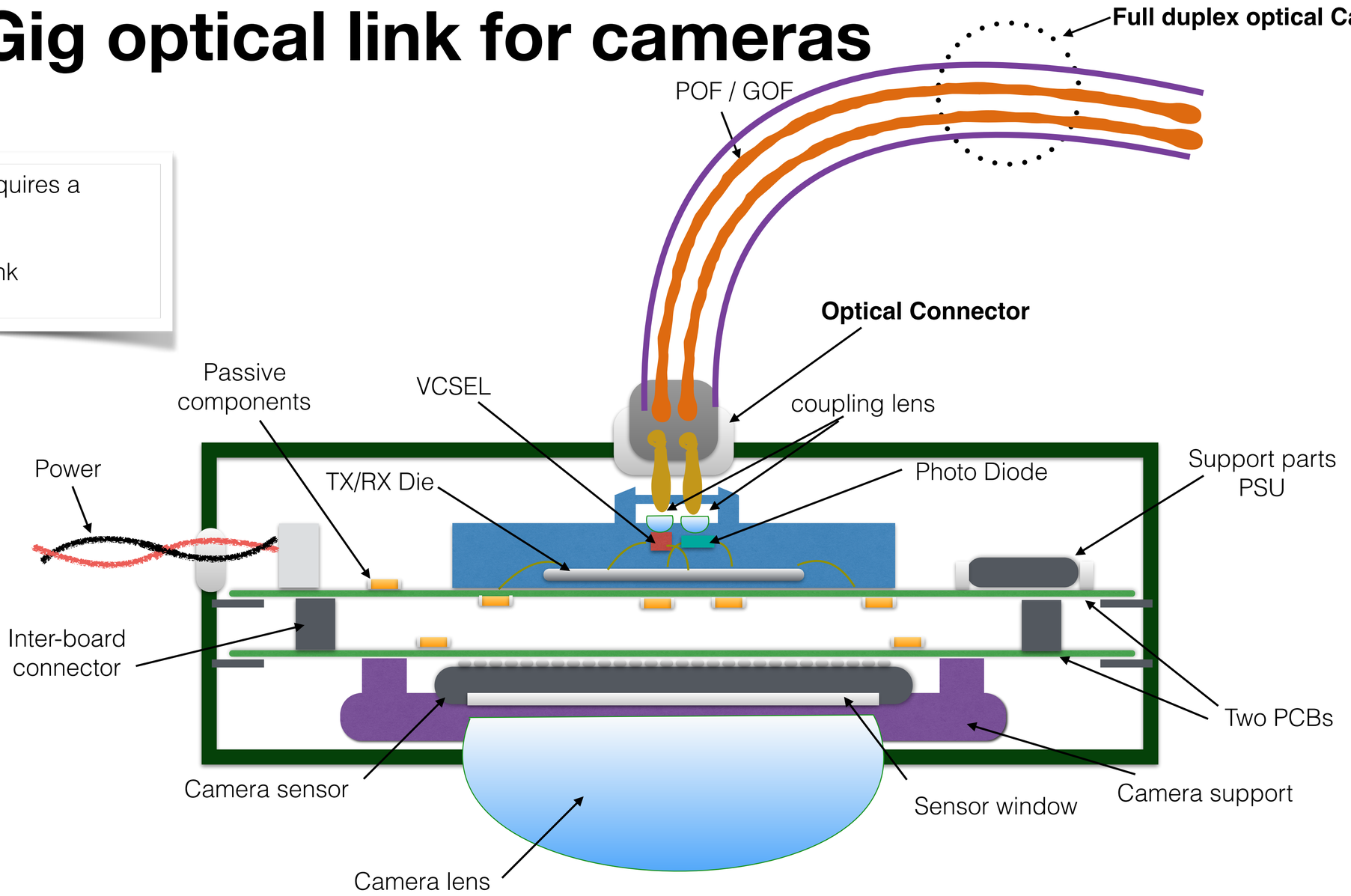
- Asymmetric rate, ≥10Gbps for high data rate direction, approximately 100Mbps for low data rate direction

X HUAWEI

Multi-Gig optical link for cameras

Camera application requires a special approach:

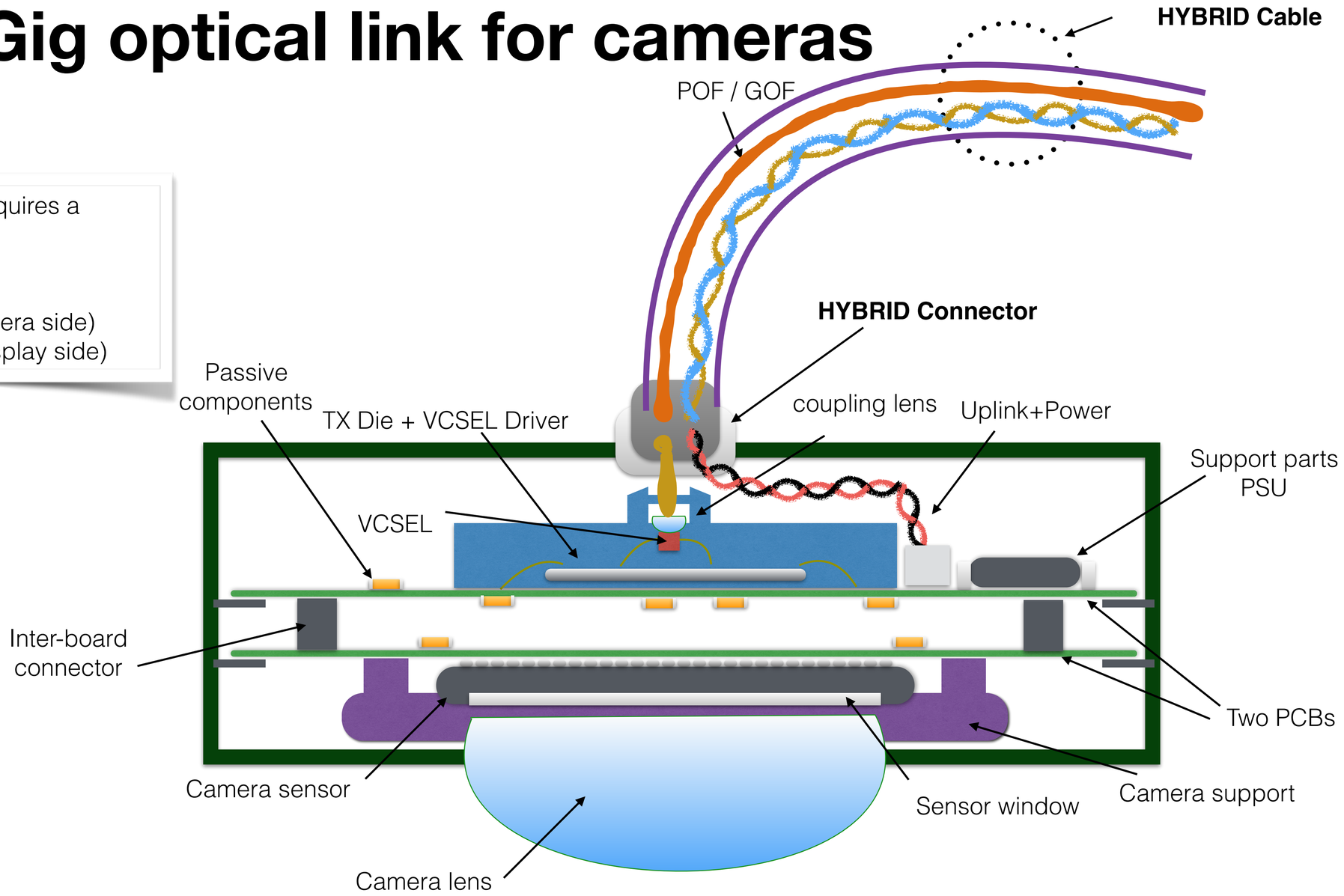
- Full duplex optical link



Multi-Gig optical link for cameras

Camera application requires a special approach:

- Hybrid link
- Tx IC + VCSEL (camera side)
- Rx IC + PD (ECU/display side)

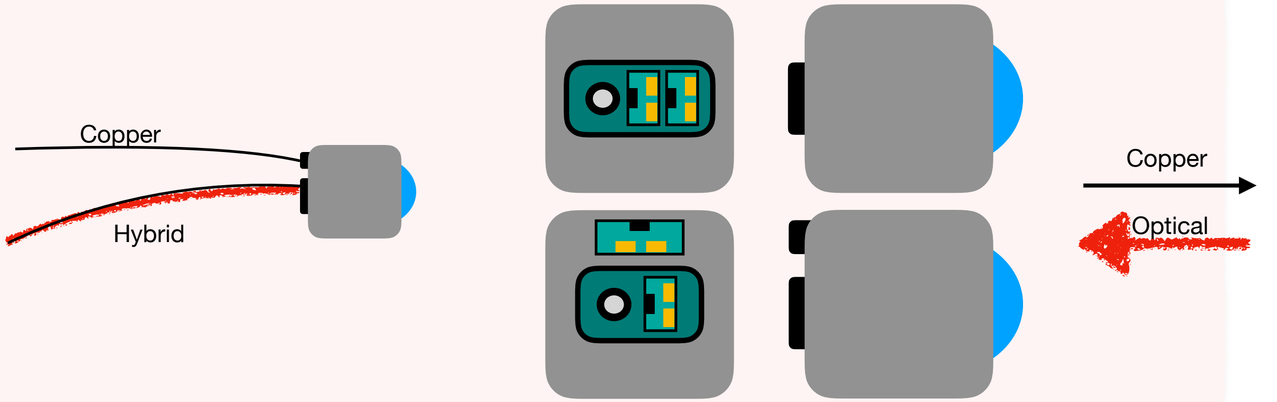


Camera connector options

- **Dual optical + 1 copper for power**
  - Pros:
    - Power not limited by connectivity
    - Same or separated cable structures for power and optical connectivity
    - Reuse symmetric rate full duplex connector. Single connector qualification. Reuse power connector
    - Power might be provided locally
  - Cons:
    - Two connectors

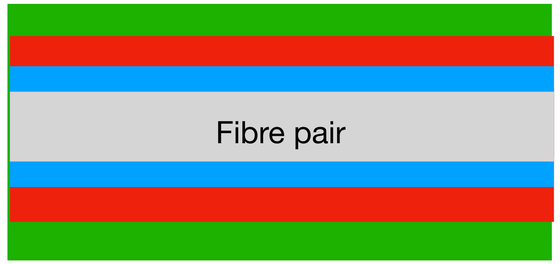
- **Single optical + 1 copper for power & data (PoDL)**
  - Pros:
    - Minimum amount of wires
    - Compact connector
    - Power provided by ECU. It might be regulated (<3W)
  - Cons:
    - Limited amount of power for unregulated power (<1W)
    - Different connector of the one used backbone case; extra qualification
    - Power has to be provided from ECU. Complexity of ECU
    - PoDL filters in camera.

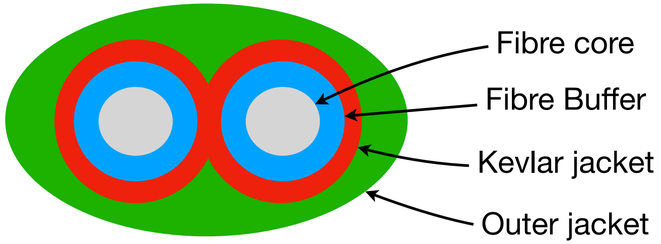
- **Single optical + 1 copper for power + 1 copper for data**
  - Pros:
    - Power not limited by connectivity
    - Power might be provided locally
  - Cons:
    - Complexity of connector
    - Complex wiring
    - Different connector of the one used backbone case; extra qualification

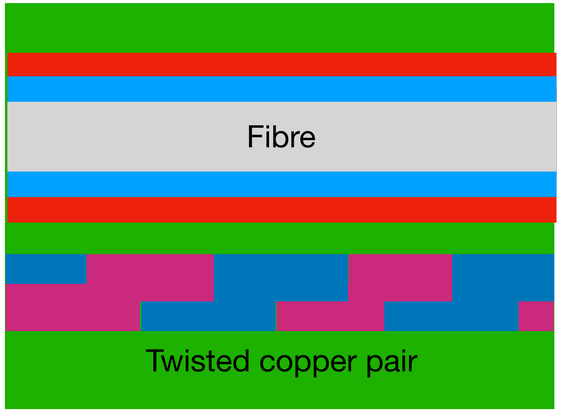


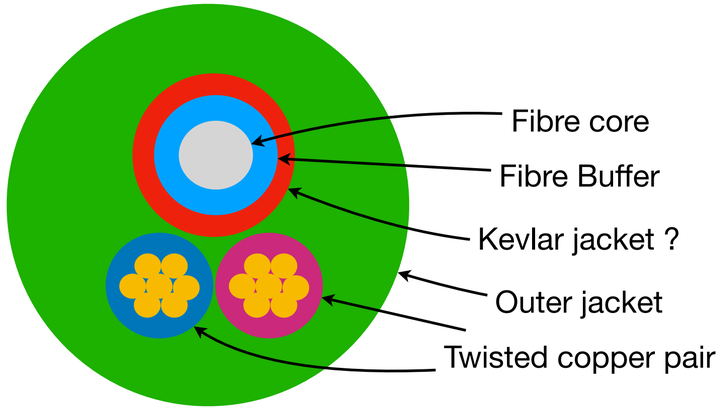
Cable options

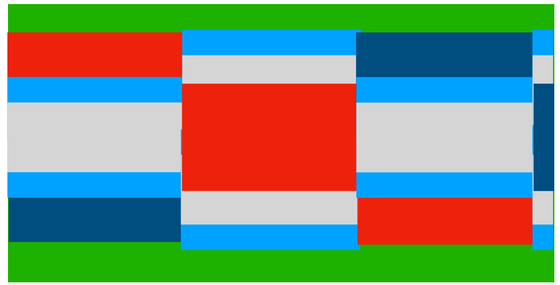
- Mechanical Strength is provided by:
  - Kevlar jacket
  - Copper protection
- Cables might be optical or hybrid
- Hybrid cables might be with:
  - Data cables - Highly twisted
  - Power cables - Soft twisting
    - Power cables might provide mechanical strength



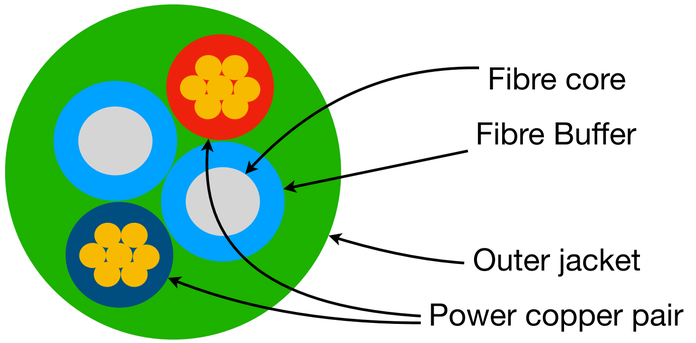






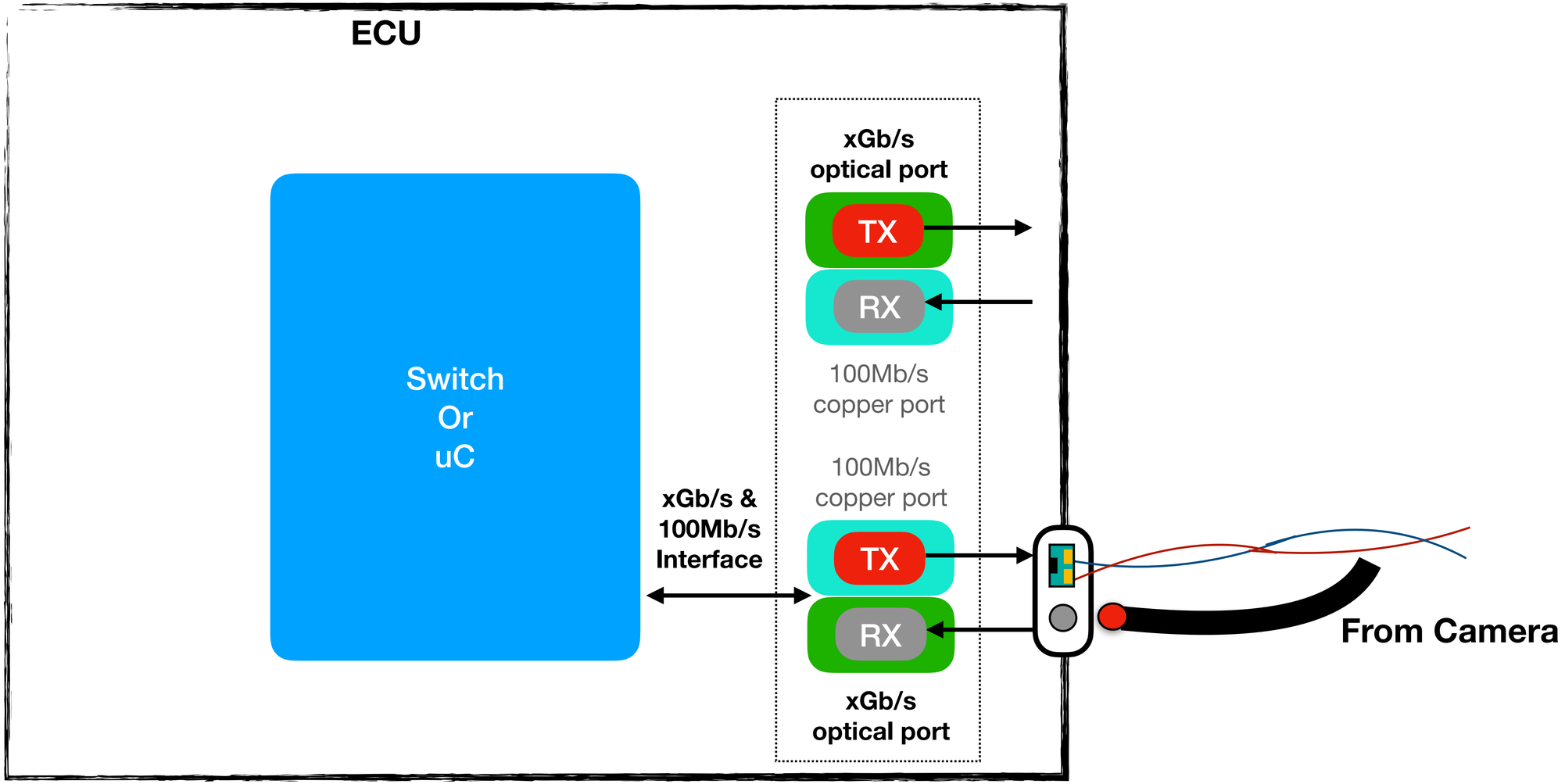


Soft twisting



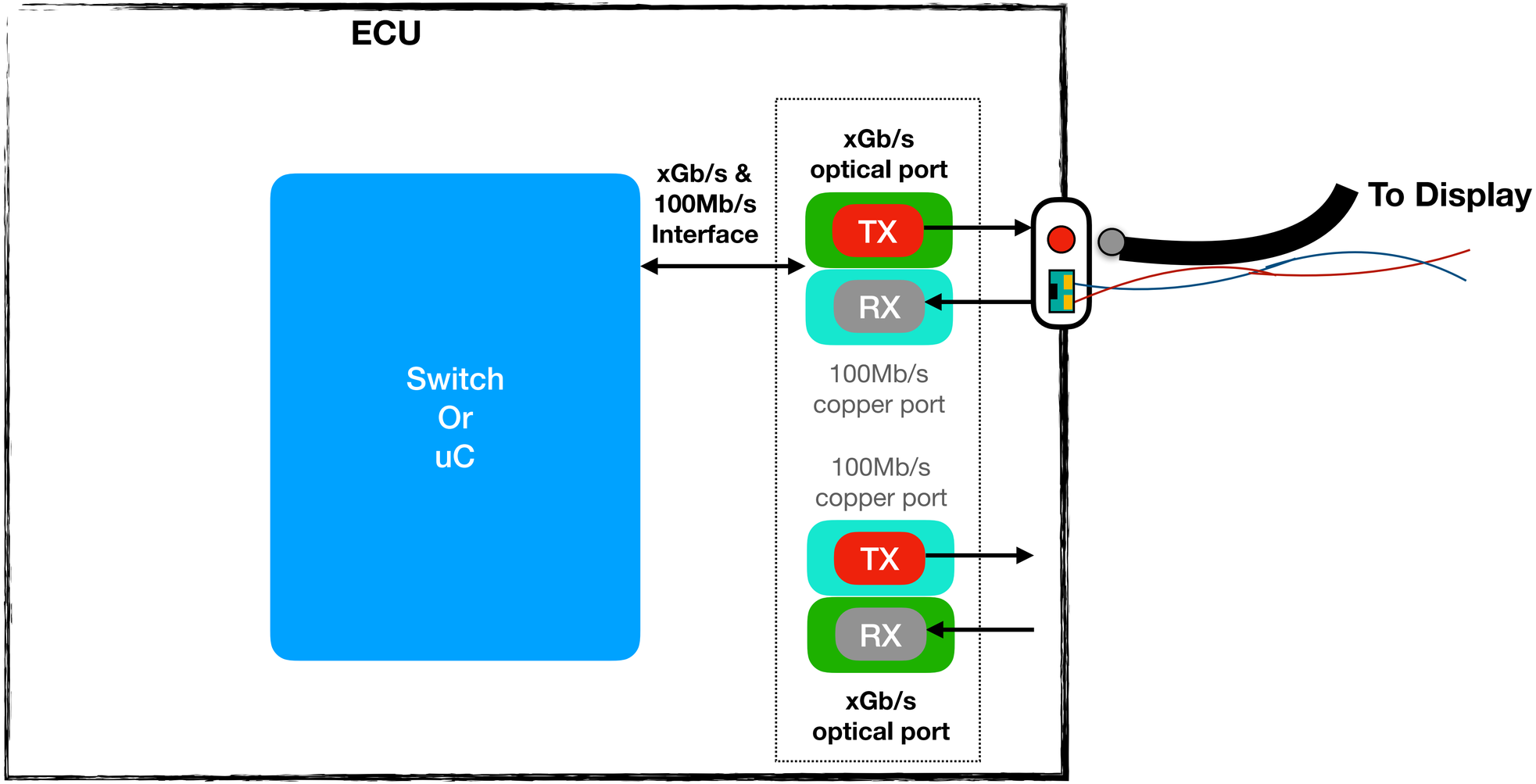
Hybrid PHY

- 1 Camera in a single port
- Low speed channel in copper



Hybrid PHY

- 1 Display in a single port
- Low speed channel in copper



Market potential

- Around 90 M vehicles sold in 2018
  - 70 M cars, 20 M are Commercial Vehicles and Trucks
- Links:
  - By 2030 almost all cars will have at least one back camera high speed
  - Backbone: 1 to 10 links/car
    - 5 + 5 redundant links for full autonomous cars
  - Smart Antenna: 1 link/car
  - Camera/Sensor: 1 to 10 links/car
  - Displays: 1 to 4 links/car
- Mature market will show the foll oximate numbers:
  - 25 M links per year for smart of cars with smart antenna)
  - 70 M links per year for h erage 1 link/car)
  - 150 M links per ye as and other sensors (Average 2 links/car)
  - 100 M links per ye isplays
- Total ports per year can be estimated in 700 M (Average 4 links/car)

- These numbers will overlap with 1 Gb/s links deployment

70% of high speed links are asymmetric data rate

Why now ?

- OMEGA Study Group has started
- First discussions on camera and display use case has being presented
- Some market drivers would like to consider hybrid links

Straw polls

- Should a OMEGA study group make broader its scope to be able to discuss hybrid links?
  - Y: N: A:
  - Room:

Next steps

- Ask 802.3 at Thursday's closing meeting to form study group

- If approved:
  - Request 802 EC to approve the broader scope of the group
  - Discussions on hybrid channel would be during January 2020 IEEE 802.3 meeting

  - If there is enough interest the hybrid links will be included in the objectives and PAR