Demonstrator of high bandwidth sensor network for zonal architectures

IEEE SA Ethernet & IP Technology Day
19. / 20.09.2023, São Paulo - Brazil

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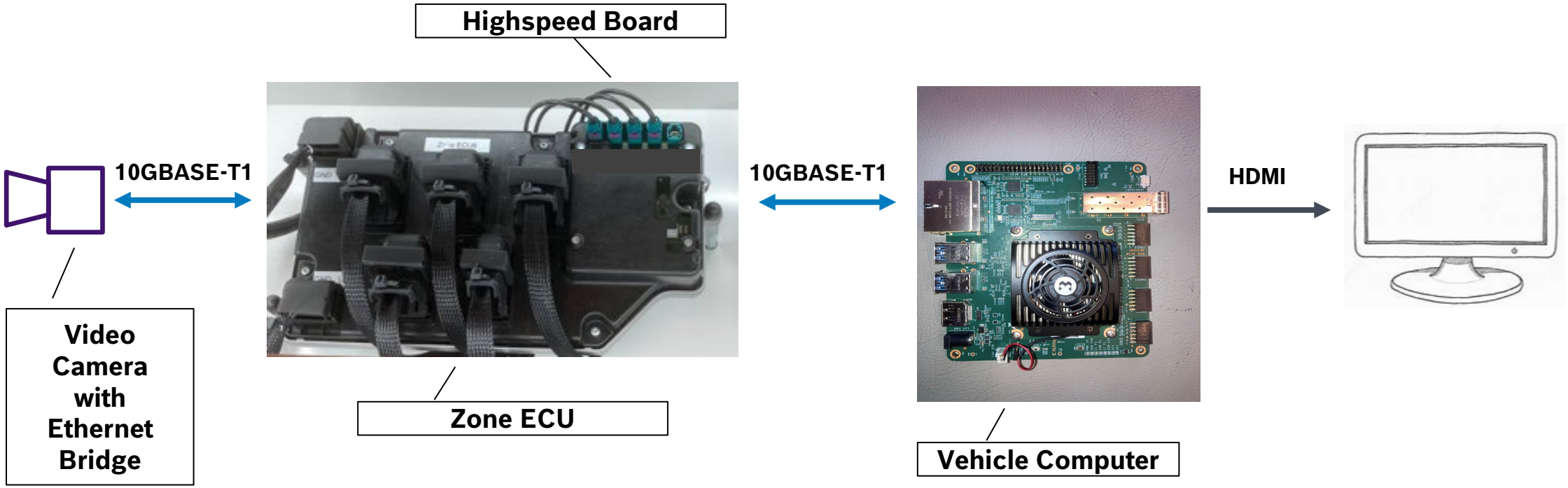
01

Demonstrator Overview

Demonstrator Overview
Video data transport via Ethernet



02

High Speed communication board

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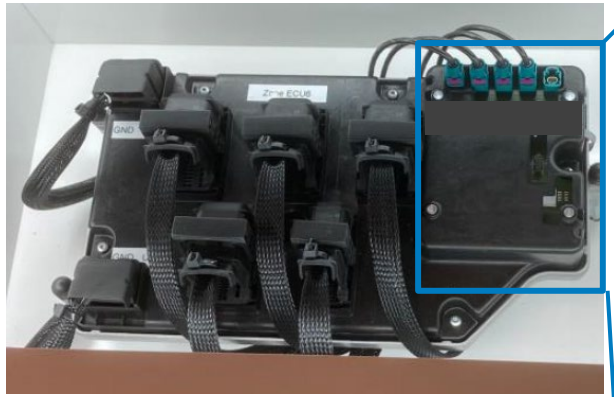
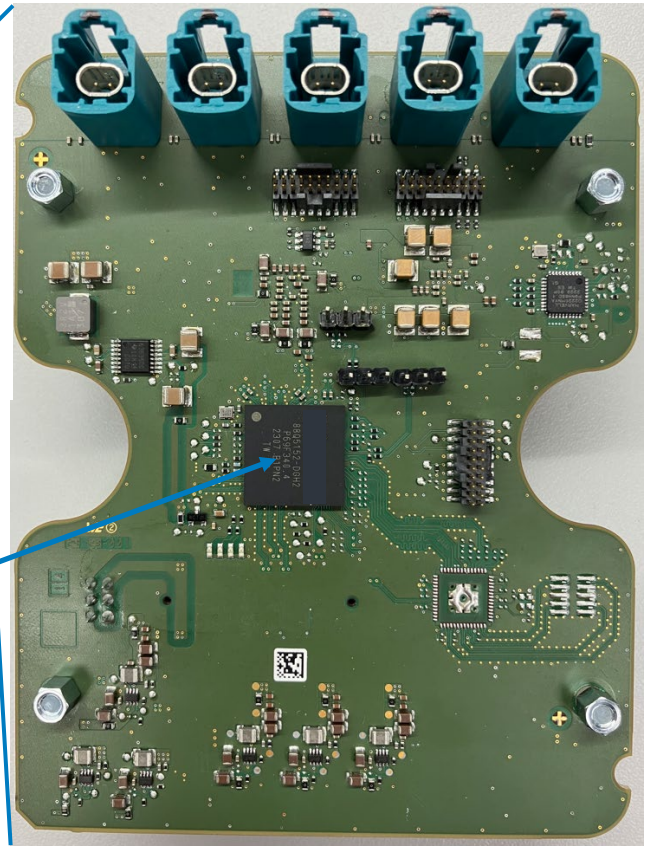
10 Gb/s Ethernet Communication Board
Multivendor capability



Automotive Zone ECU with High Speed Ethernet Communication Board

Switch with *2x 10 Gb/s* Vendor A

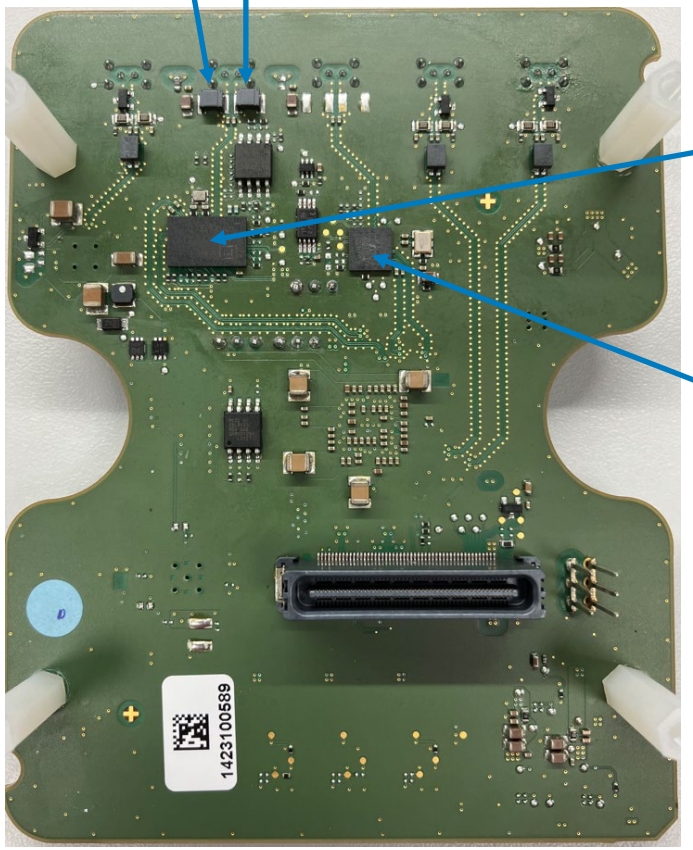


Front View

Inductors for PoDL

10 Gb/s PHY Vendor A

10 Gb/s PHY Vendor B



Backside View

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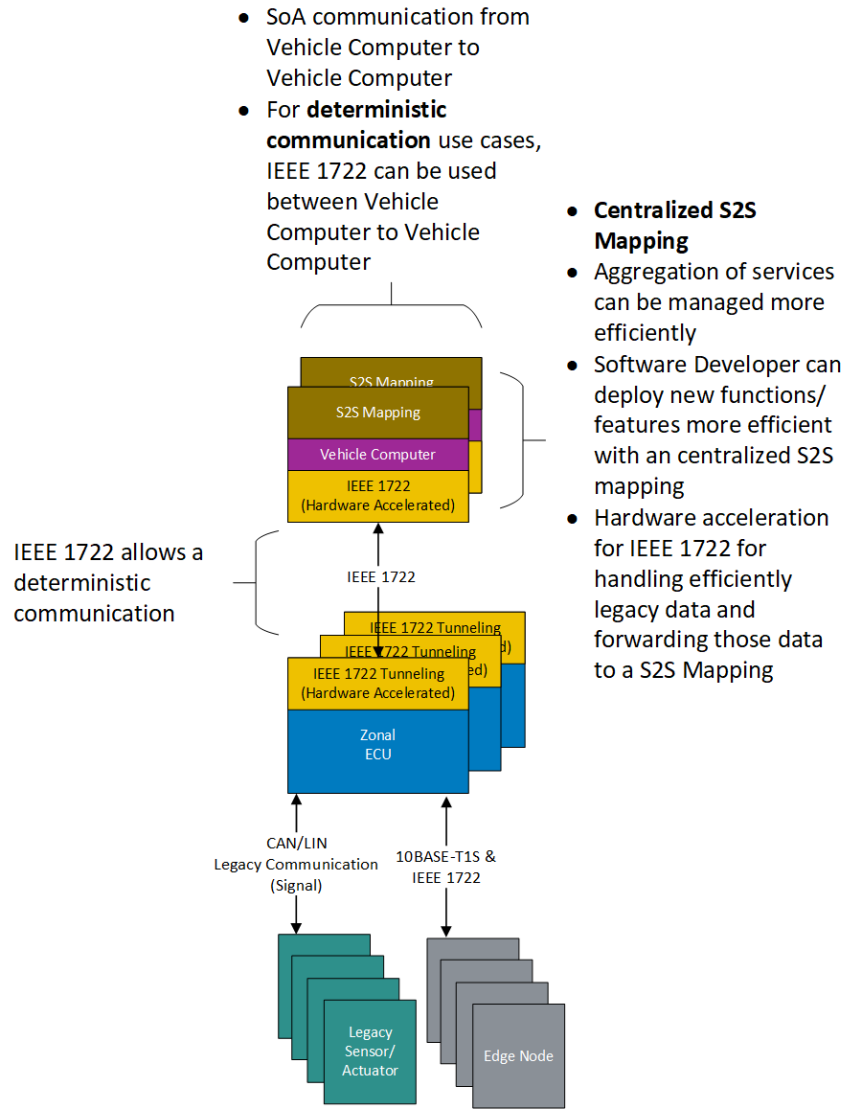
Signal to Service Mapping strategy

Signal to service mapping
Preferred solution

- Signal to Service mapping in **vehicle computers**
- Communication between vehicle computers and Zonal ECUs via IEEE1722 protocols
- Communication between Zonal ECUs and Edge Nodes via IEEE1722 or legacy communication
- Hardware acceleration possible and required for future high speed requirements



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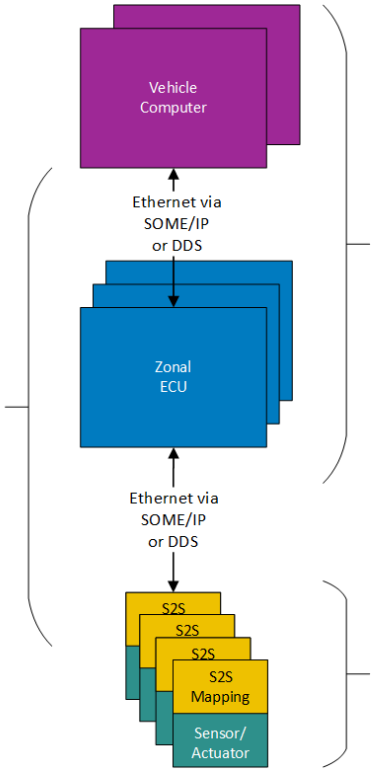
Alternative *Signal to service mapping* concepts
Not preferred solutions

Option a)



DDS and SOME/IP does not support deterministic communication

Complex S2S aggregation on Zonal ECU and finally on Vehicle Computer

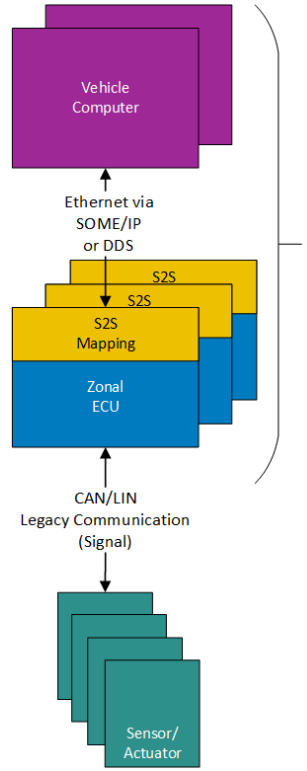
- Sensors/Actuators need to be „intelegent“ for S2S Mapping
- „Intelligence“ cost money

Signal to Service mapping **in sensors** require intelligent sensors and complex S2S aggregation on zonal ECU and vehicle computers => **not preferred**.

Option b)

DDS and SOME/IP does not support deterministic communication

High compute load on the Zonal ECU for S2S Mapping and complex integation effort for defining and realizing services over Zonal ECUs



Complex S2S aggregation on Zonal ECU and finally on Vehicle Computer

Signal to Service mapping **in Zonal ECU** require high compute load on Zonal ECUs and complex S2S aggregation on zonal ECU and on vehicle computers => **not preferred**.

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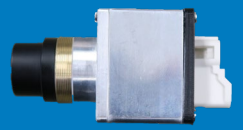
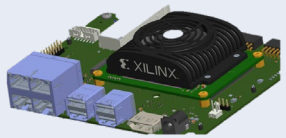
Next steps

Next steps

Sensors / actuators		• Implementation of camera ethernet bridges from other vendors using IEEE-P1722b protocol and common sensor image format • RGGB imager with ~ 8 Gb/s (8 Mpixel, 45 fps, 16 bit/pixel, blanking factor 1.3) (currently in use is a 2 Mpixel format due to Display Port capabilities) • Implementation of gPTP protocol • Imager control via ISP (using I²C over IEEE1722 for imager settings) • Implementation of Energy efficient Ethernet (EEE) • Coaxial link segment including PoC (Power over Coax) • Radar signal via Ethernet via future IEEE-P1722c • Realization of additional function and services (e.g., window lifters, audio, video, lightening,…)
Multi Gb/s Communication board in Zonal ECU		• Implementation of CAN, LIN via IEEE1722-2016 • Implementation of Ethernet I/O link (remote control protocol) • gPTP implementation via PTP hardware clock (phc) • Implementation of Radar via Ethernet and CAN • Unified uplink to central computer with defined quality of service using TSN mechanisms and 25 Gb/s • Additional Zonal ECUs
Central computer (at the moment realized via FPGA)		• Decapsulation of CSI2 from IEEE-P1722b stream • Encapsulation of I²C signals on IEEE-P1722b (directly to camera bridge) • Reception of up to 100 Gb/s from Zonal ECUs • Signal to service mapping (IEEE 1722 => SOME/IP) • Implementation of gPTP protocol in FPGA

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Summary

Explanation of demonstrator
Summary

Video via Automotive Ethernet is possible

- 10GBASE-T1 (10 Gb/s) link is available already from multiple vendors as prototypes
- Interoperability of PHYs and Switch from different vendors is shown
- Video quality via Ethernet comparable to conventional SerDes technologies

Integration of Multi Gb/s Ethernet technology in automotive product

- 10 Gb/s communication board was integrated in typical zonal control unit as a prototype
- Automotive PCB design rules were adapted to Multi Gb/s traffic
- Validation of solution in automotive environment will be done (Expectation: no problems expected)

Benefits:

- Network technology allows multiple listeners
- Aggregation of different data links is possible
- Network technology allows flexible designs