FROM VEHICLE CENTRIC TO **PEOPLE** CENTRIC

HOW THIS TREND IS CHANGING VEHICLES E/E ARCHITECTURES

G.Smethurst , BMW Research
03.11.2021

BMW GROUP THE NEXT 100 YEARS

Rolls-Royce Motor Cars Limited

SINCE THE FIRST ETHERNET&IP@AUTOMOTIVE TECHNOLOGY IN 2011 THE WORLD CHANGED – WHAT ABOUT E/E ARCHITECTURES?

E/E in 2011…

- Transition phase from application-specific bus to domain architecture
- Focus on: Processing power, Infotainment, connectivity to CE-devices and to the cloud
- ~10 Mio lines of codes
- Increased number of SOPs per year

E/E in 2021…

- Maturity of domain architecture
- Powerful Integration platforms
- Ethernet and legacy coexist
- Focus on: diversity of powertrains, automated driving
- Deep integration of CE in the vehicle
- Data analytics
- Remote-SW-Update.
- >100Mio lines of code
- Many SOPs per year

THE TRANSITION FROM DOMAIN TO ZONAL ARCHITECTURES: A ROBUST AND POWERFUL NETWORK IS KEY FOR MODERN CARS

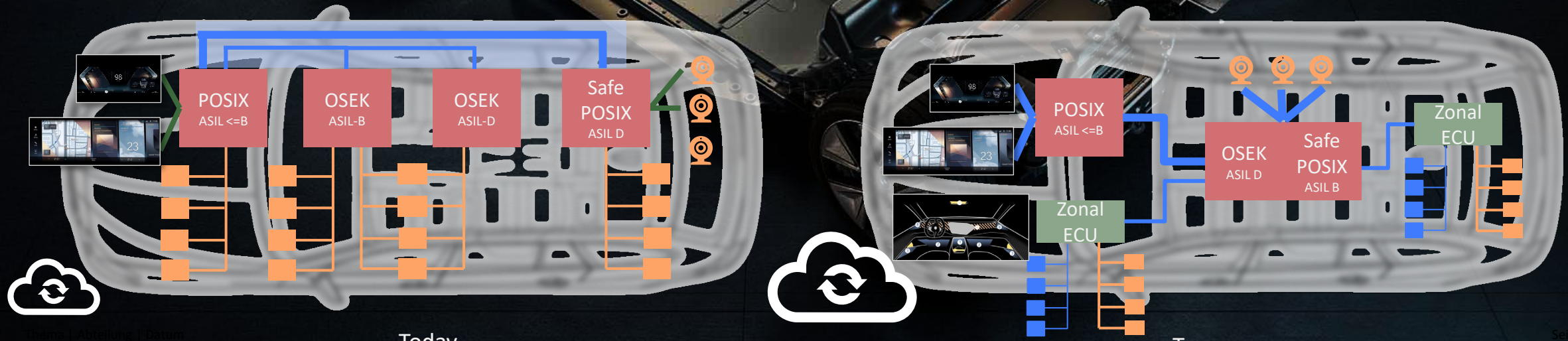
Domain ECUs (Cockpit, Body, PT, ADAS)

- Different bus technologies connected through gateways.
- High maintenance before and after the SOP.

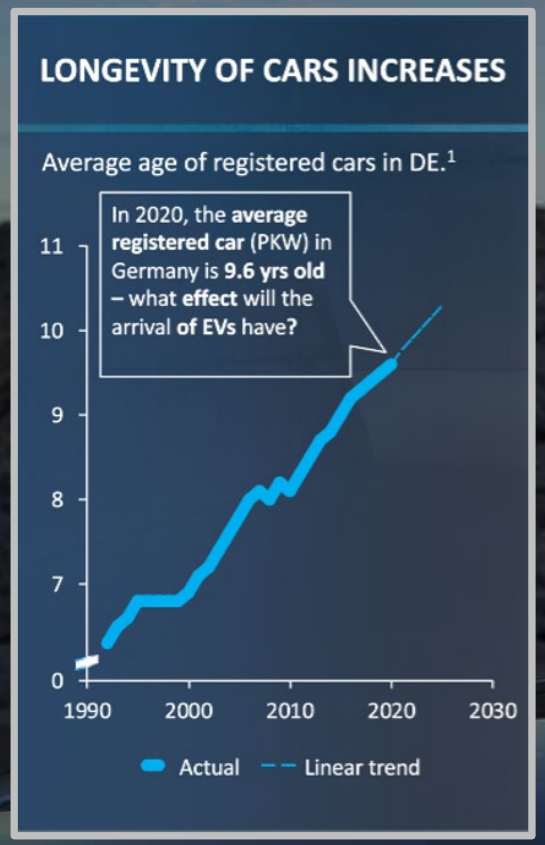
Transition to a Zonal Architecture

- Zonal enables increased wiring harness modularity and places new needs on communication.
- Scalability of Ethernet Switches reduce the effort for gateways development and maintenance.
- SOA-SOME/IP and PDU Tunneling as main communication concepts over Ethernet.
- Scaling of the Ethernet Network with 10BASET1S.
- Improved network performance with MACSec.

Etherne t
Legac y
SerDe
Cloud: SW Update, backend processing

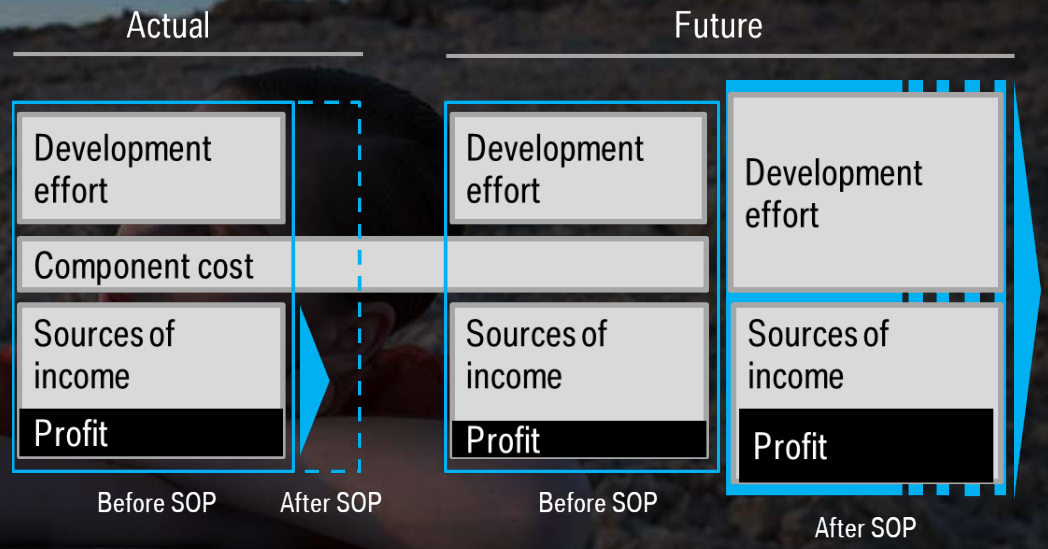


CHANGING VEHICLE OWNERSHIP AND USAGE MODELS CREATE NEW CHALLENGES FOR THE AUTOMOTIVE INDUSTRY – „ALWAYS FRESH“



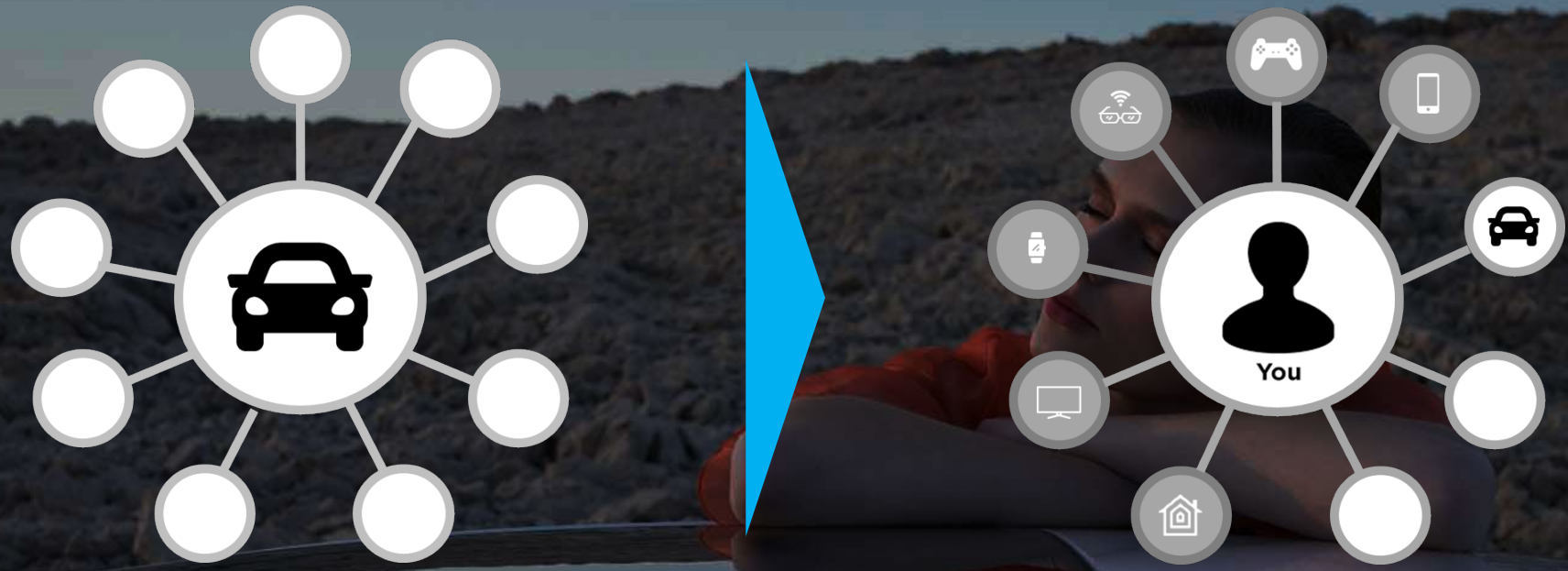
In 2020 the average age of registered cars in Germany was 9,6 yrs old. In 2010 it was 8, and in 2000 it was less than 7.

- Customers will expect that a vehicle is kept fresh & up to date throughout it´s extended lifetime.
- Residual value will depend on vehicle functionality at point of re-sale.



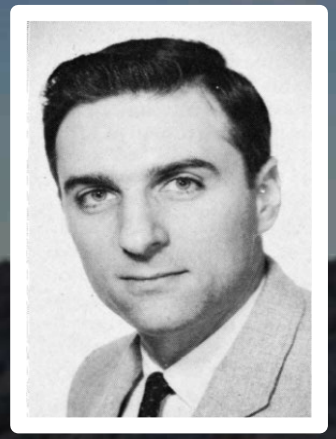
In future the costs and revenues after SOP will become significantly more important.

CHANGING VEHICLE OWNERSHIP AND USAGE MODELS CREATE NEW CHALLENGES FOR THE AUTOMOTIVE INDUSTRY – PEOPLE CENTRIC



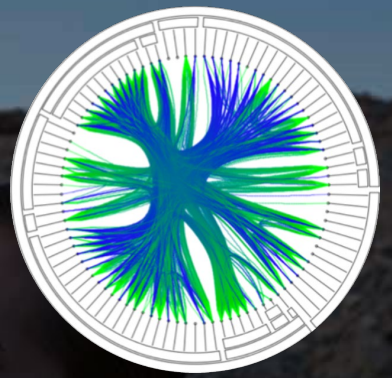
as “yet another” connected device within a customers digital life, the vehicle needs to integrate seamlessly

ADDRESSING THE CHALLENGES OF „ALWAYS FRESH“ AND PEOPLE CENTRICITY

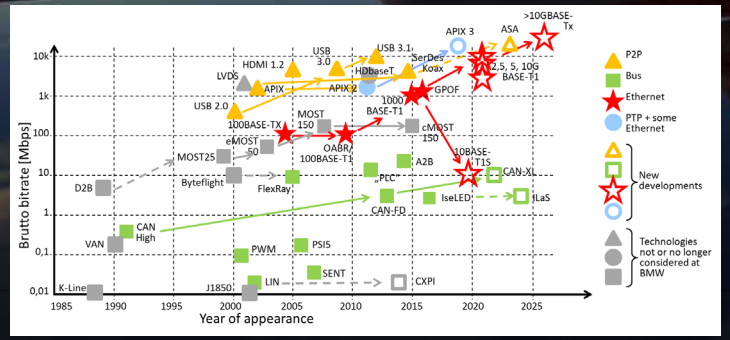


> “Organizations which design systems ... are constrained to produce designs which are copies of the communication structures of these organizations”

Melvin Conway, Computer scientist, 1967



The complexities of highly integrated systems must be understood and managed if they are to be maintained for an extended period of time with acceptable effort



The architecture must be designed to be updated. The architecture must be simplified, particularly where frequent updates are anticipated. Technical discontinuity must be avoided if time to market is to be minimized.

ADDRESSING THE CHALLENGES OF „ALWAYS FRESH“ AND PEOPLE CENTRICITY: PROCESS

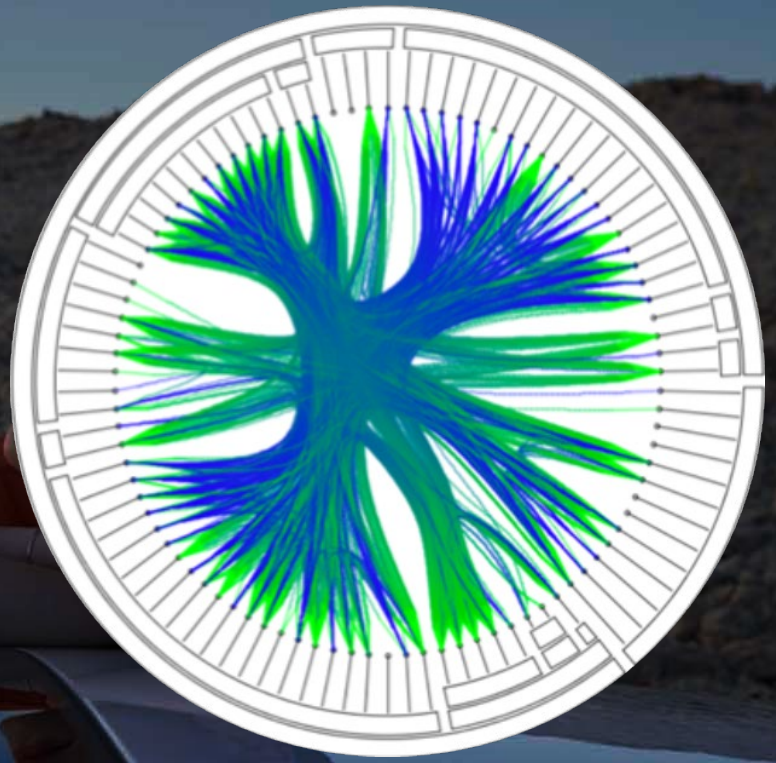
94 Vehicle Functions…

… of which only 9 had no dependencies to other vehicle functions

… the remaining 85 functions had

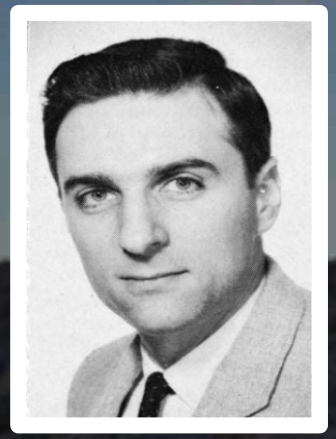
1451 dependencies to each other

… of which 58% were unknown to the function experts.



Vogelsang and Fuhrmann. "Why feature dependencies challenge the requirements engineering of automotive systems: An empirical study." *RE,* 2013.

ADDRESSING THE CHALLENGES OF „ALWAYS FRESH“ AND PEOPLE CENTRICITY



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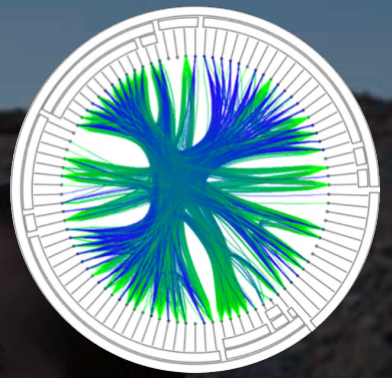

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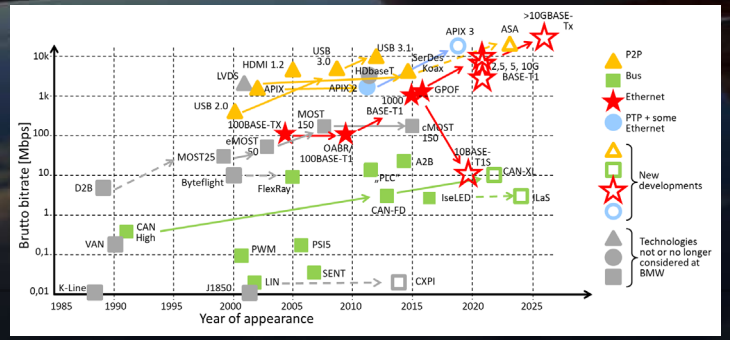

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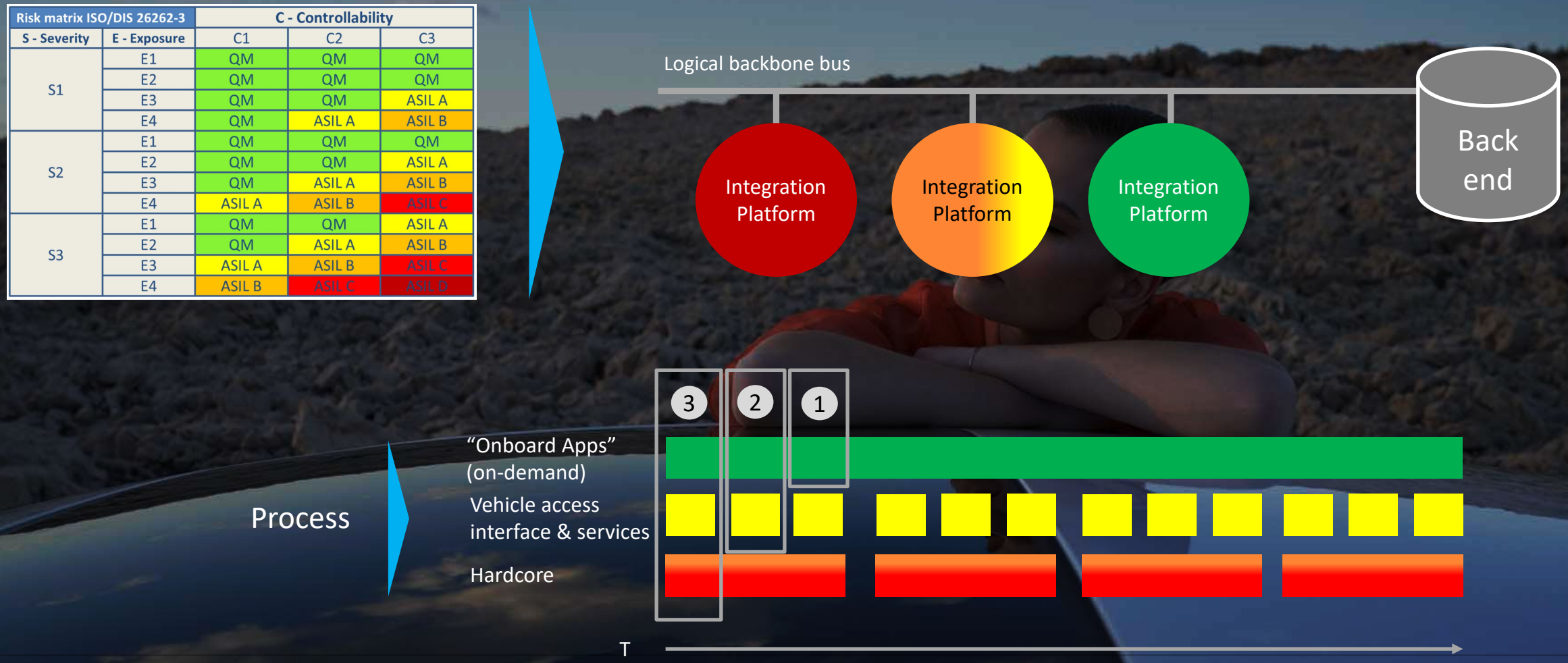
ADDRESSING THE CHALLENGES OF „ALWAYS FRESH“ AND PEOPLE CENTRICITY: ARCHITECTURE ➔ BACK TO BASICS

Risk matrix ISO/DIS 26262-3		C - Controllability		
S - Severity	E - Exposure	C1	C2	C3
S1	E1	QM	QM	QM
	E2	QM	QM	QM
	E3	QM	QM	ASIL A
	E4	QM	ASIL A	ASIL B
S2	E1	QM	QM	QM
	E2	QM	QM	ASIL A
	E3	QM	ASIL A	ASIL B
	E4	ASIL A	ASIL B	ASIL C
S3	E1	QM	QM	ASIL A
	E2	QM	ASIL A	ASIL B
	E3	ASIL A	ASIL B	ASIL C
	E4	ASIL B	ASIL C	ASIL D



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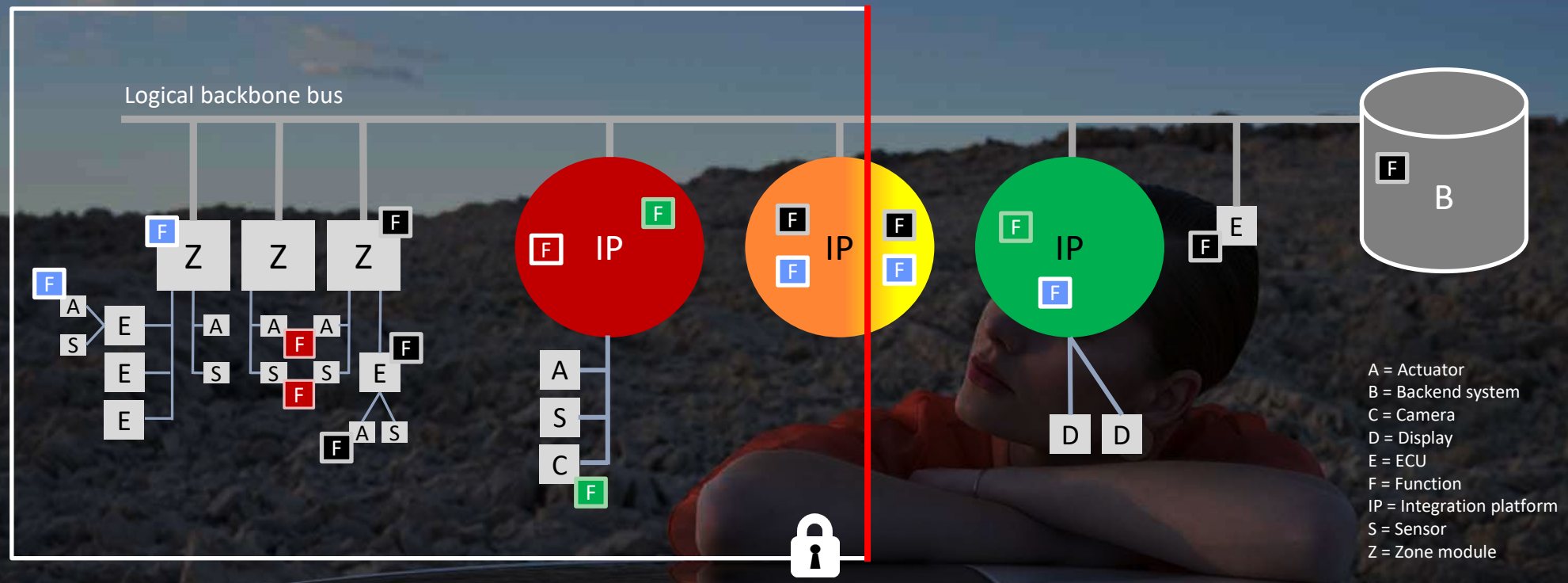


F Remote door unlock

F Face recognition

F Brake by wire

F Seat heating

NEXT STEPS IN PURSUIT OF „ALWAYS FRESH“ AND PEOPLE CENTRICITY

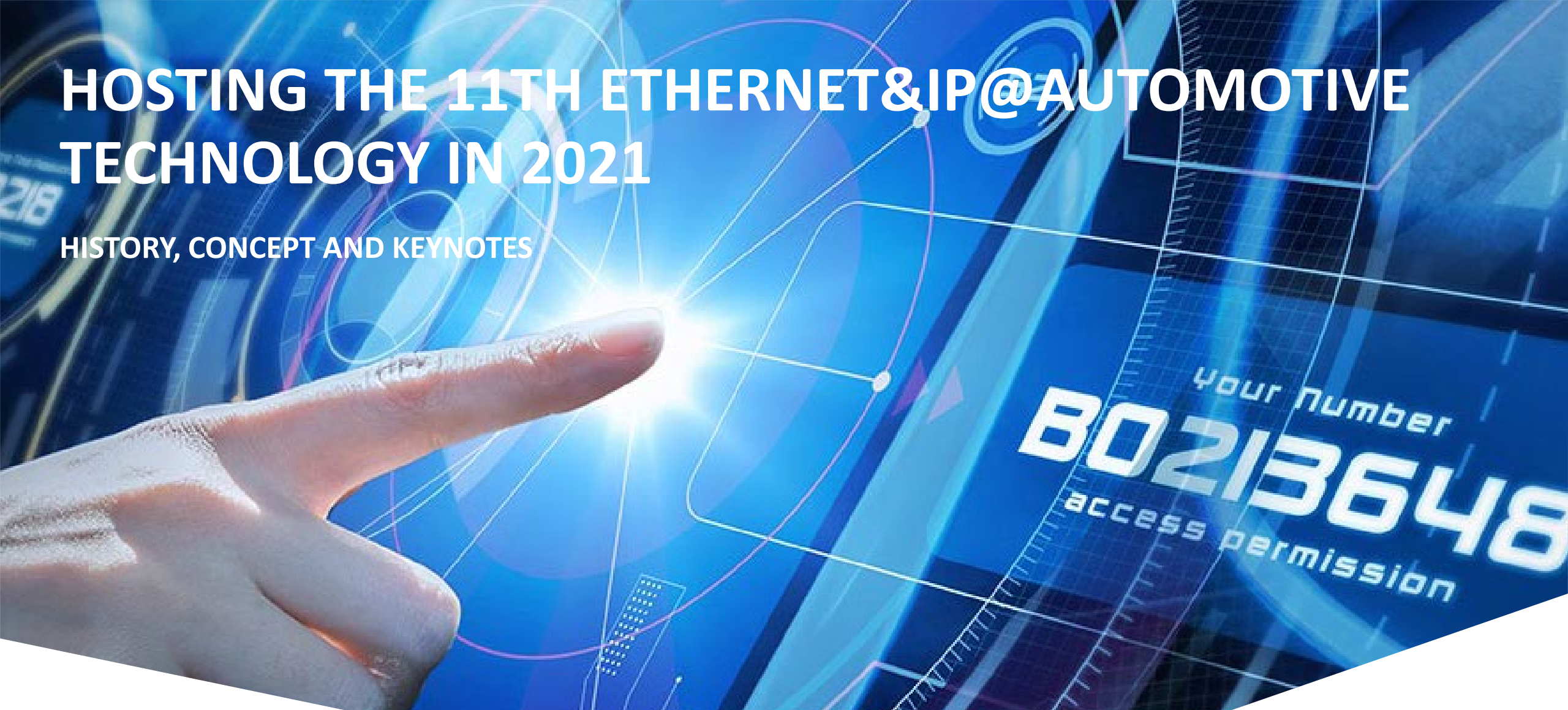
To do

- Further consolidate in-vehicle communication technologies.
  - Fully leverage the potential of Ethernet (e.g. Traffic shaping/classes, security).
  - Extend network to embrace increased bandwidth and asymmetrical requirements (e.g. video (camera / display)
- Logically extend In-Vehicle ethernet backbone to provide seamless end to end connectivity.
- Address Instant-on / energy efficiency for communication technologies.
- Identify an approach to establishing the vehicle device interface
  - What data / services are relevant at the vehicle device interface to support “always fresh” and people centricity
  - How will the interface be described
  - How will the interface be governed


Thank you for
your attention

HOSTING THE 11TH ETHERNET&IP@AUTOMOTIVE TECHNOLOGY IN 2021

HISTORY, CONCEPT AND KEYNOTES



EE-322, 09.8.2021

BMW GROUP THE NEXT 100 YEARS

Rolls-Royce Motor Cars Limited

BMW SCHREIBT BEI AUTOMOTIVE ETHERNET EINE ERFOLGSGESCHICHTE.

- BMW hat 2008 als erster Autohersteller Ethernet als Kommunikationstechnologie im Auto eingeführt.
- Mit der Pionierarbeit zu Automotive Ethernet und seiner Standardisierung, hat BMW nachhaltig die Industrie verändert.
- Heute sind alle anderen Autohersteller BMW gefolgt und nutzen ebenfalls Ethernet in ihren Serienfahrzeugen.

- Am 3. und 4. November 2021 findet im BMW Projekthausstudio eine Fachtagung zu Automotive Ethernet statt.
- Es wird ein Hybridevent mit 88 Teilnehmern im Raum (inklusive 10 Ausstellern) und Lifeübertragung an Onlineteilnehmer (~100).

- BMW hostet das Event, die gesamte Organisation wird von der IEEE durchgeführt.

- BMW hat die Möglichkeit mit einer 20 Minuten Keynote, die Teilnehmer zu begrüßen und zu begeistern (geplant 3.11. 9:00).

MÖGLICHER INHALT (KONFERENZSPRACHE IST ENGLISCH).

Abstract from EE-322 regarding Networking Technologies.

- The actual choice of the architecture might change the length of the wiring, but not the need for communication.
- A robust and powerful communication network is key to the functioning modern cars.
  - Ethernet allows for state of the art security
  - Automotive Ethernet provides the right communication infrastructure that supports various speed grades.
- High Data-rates: Multi-GB enables computer on wheel architectures (Zonal) and personalized cloud-computing services. The big challenge is the physical layer.
- Low Datarates: 10BASE-T1S Ethernet has been developed in order to seamlessly integrate chassis & interiors ECU to the Ethernet network.
  - To be cost efficient, 10BASE-T1S supports a multidrop bus structure.
  - 10BASE-T1S is ready for next generation series introduction (NCAR).

Demonstrator with 10BASET1S System network from EE-322 at the event.

Keynotes from BMW Management does not need to focus on Ethernet only.

- 03.11 at 09:00 pm CET for ~20 minutes.
- Ideas**:** Future of vehicle electronics and architecture (NCAR), succesfull introduction of SP21, new challenges like semiconductor supply-crisis, how this is impacted by changing mobility trends Etc..