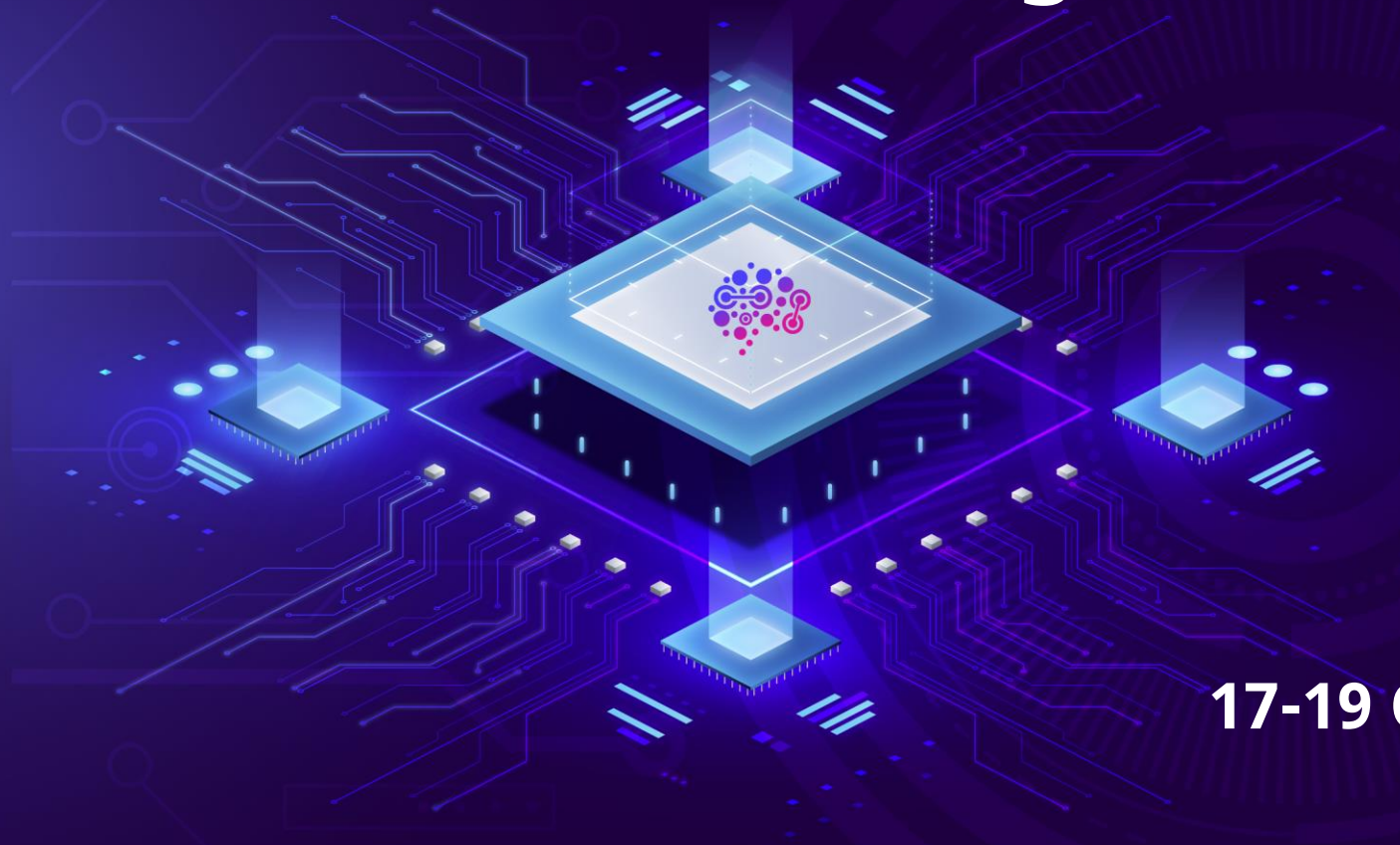
European Conference on EDGE AI Technologies and Applications - EEAI



Advancing emerging edge AI technologies and driving next generation intelligent applications.

17-19 October 2023, Athens, Greece

European Conference on EDGE AI Technologies and Applications - EEAI

Connectivity and Cognitive Communication for Future Shared Mobility

Gerald Fritz-Mayer, TTTech Auto AG, Austria

17-19 October 2023 Athens, Greece

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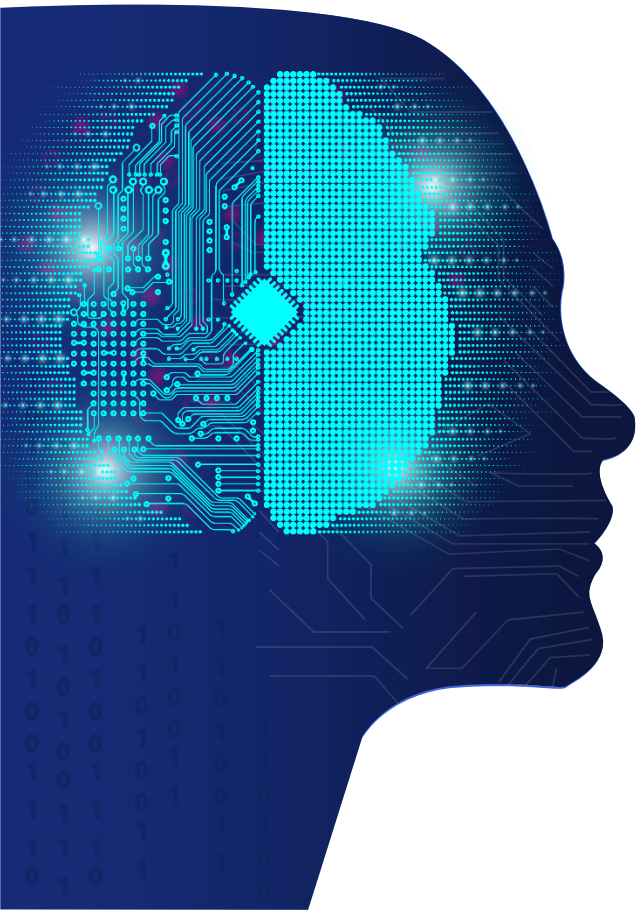
Presentation Outline



- Introduction
- State-of-the-art
- Research Goal
- Methodology
- Design and Implementation
- Experimental Results
- Future Research
- Conclusion

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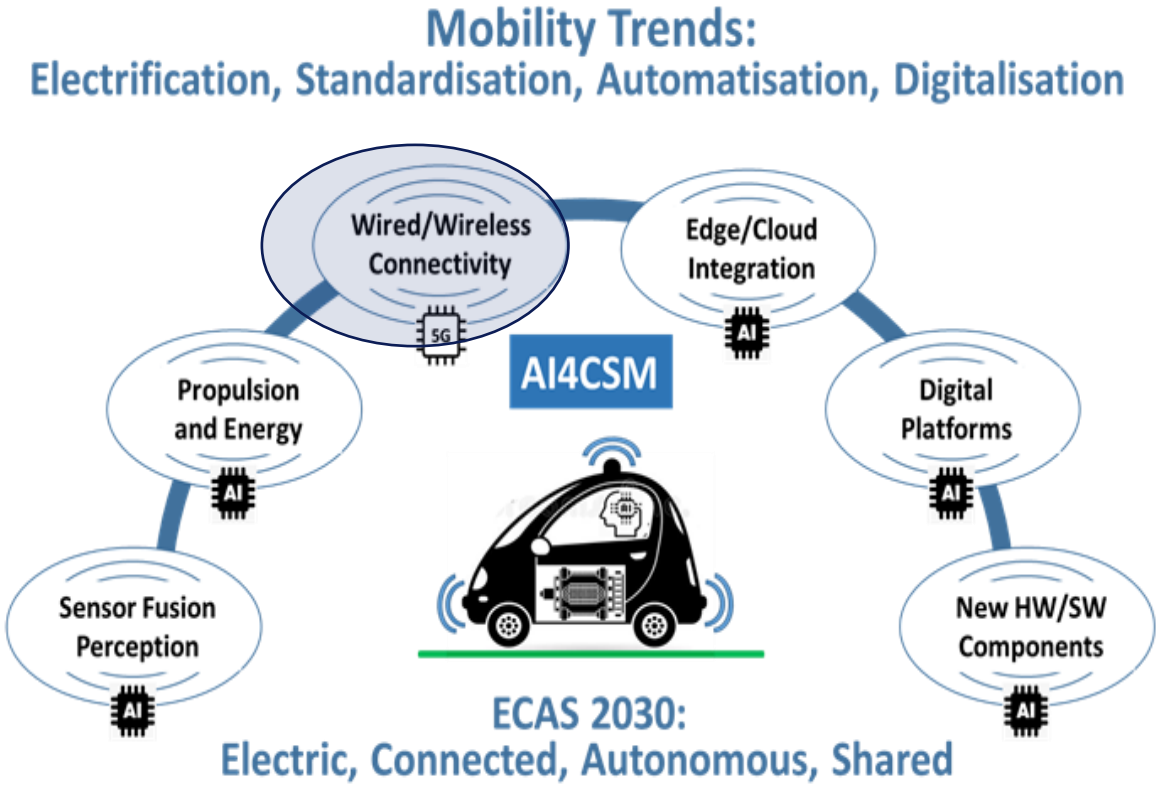
Introduction

- **Scope -** the communication techniques that enable AI-enabled methods to access data from the edge (e.g. cars, infrastructure) and the cloud (e.g. city-model).

- **Goal -** fulfil fast, reliable, low-latency data connection

- **Demonstrators:**

1. Design of *communication architectures* for smart connected mobility
2. Prototype and validate a *novel 5G 28GHz mmW* low latency, large bandwidth *communication technology*



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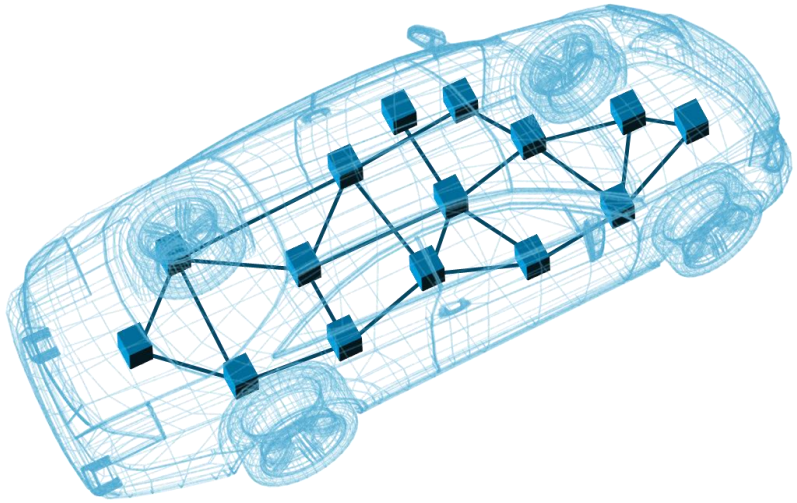
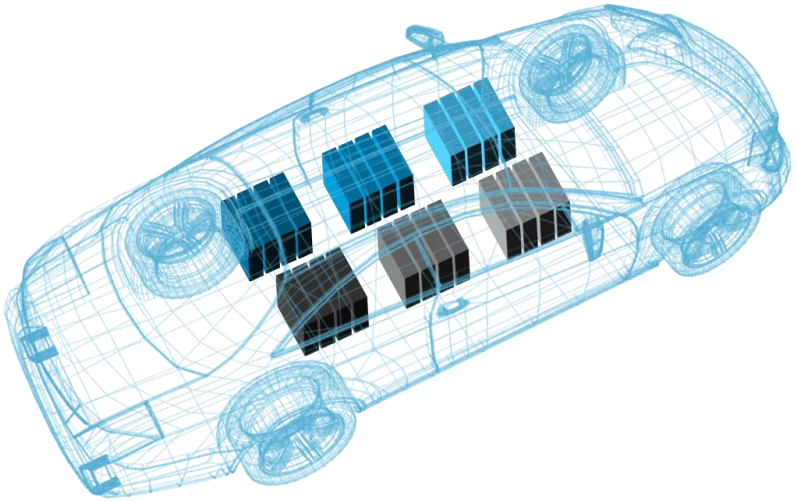
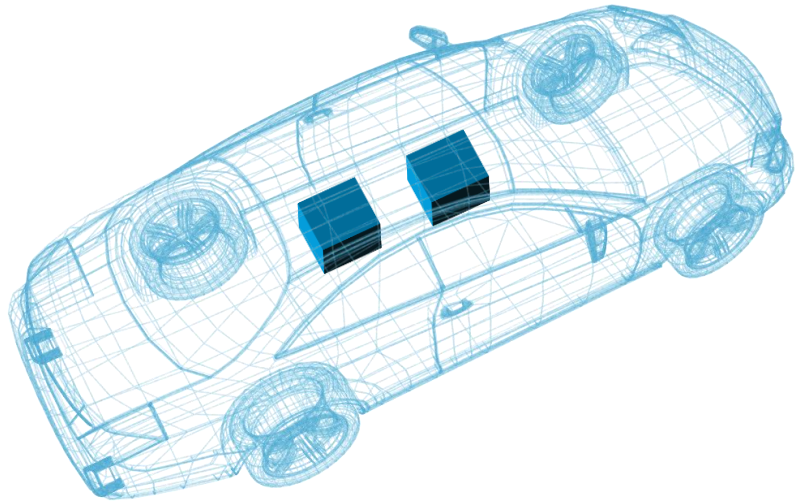
State-of-the-art







n ECU: n functions

DISTRIBUTED
E/E ARCHITECTURE

5-7 domains: n functions

DOMAIN
E/E ARCHITECTURE

2 ECUs: n functions

CENTRALIZED
E/E ARCHITECTURE

YESTERDAY & TODAY | 2020 – 2025 | 2025 +

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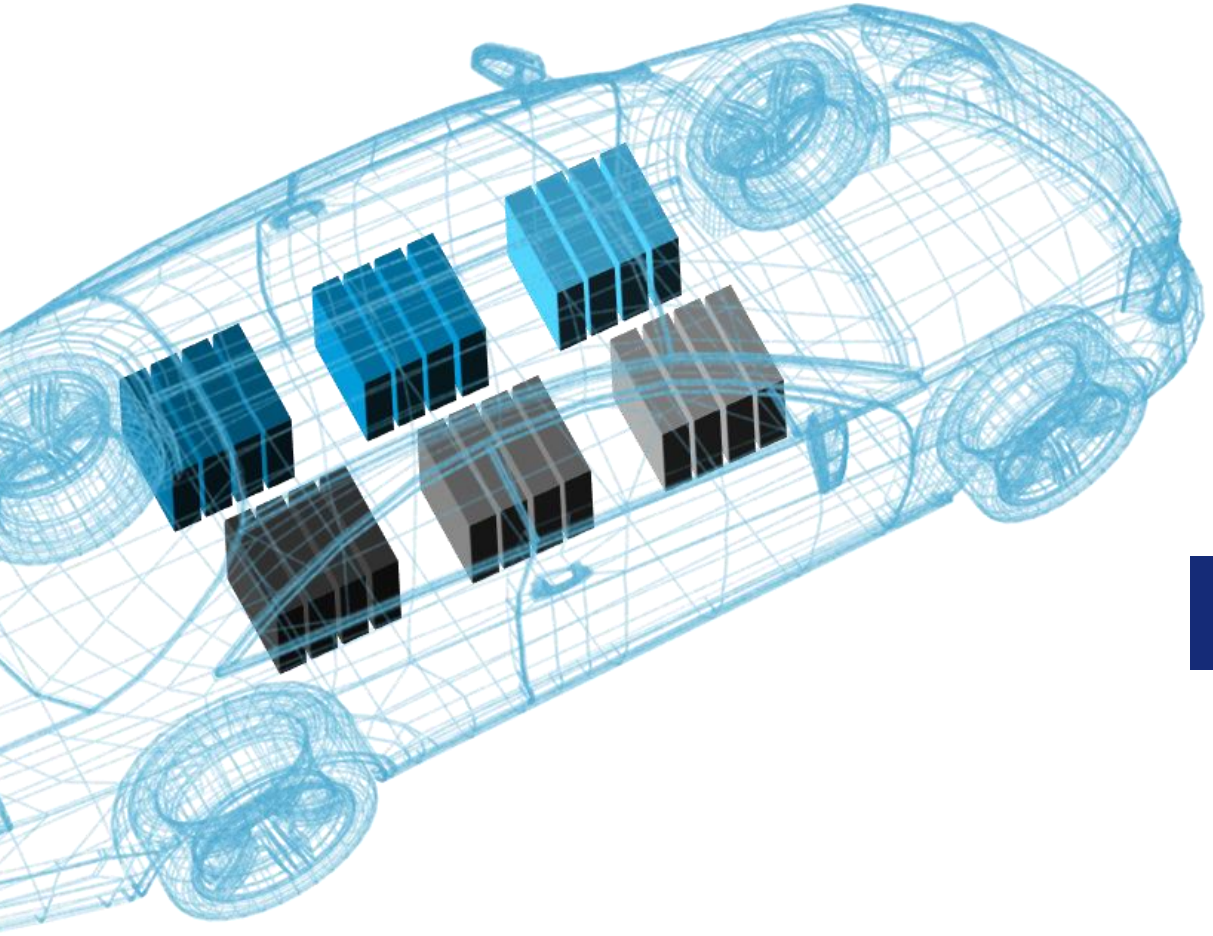
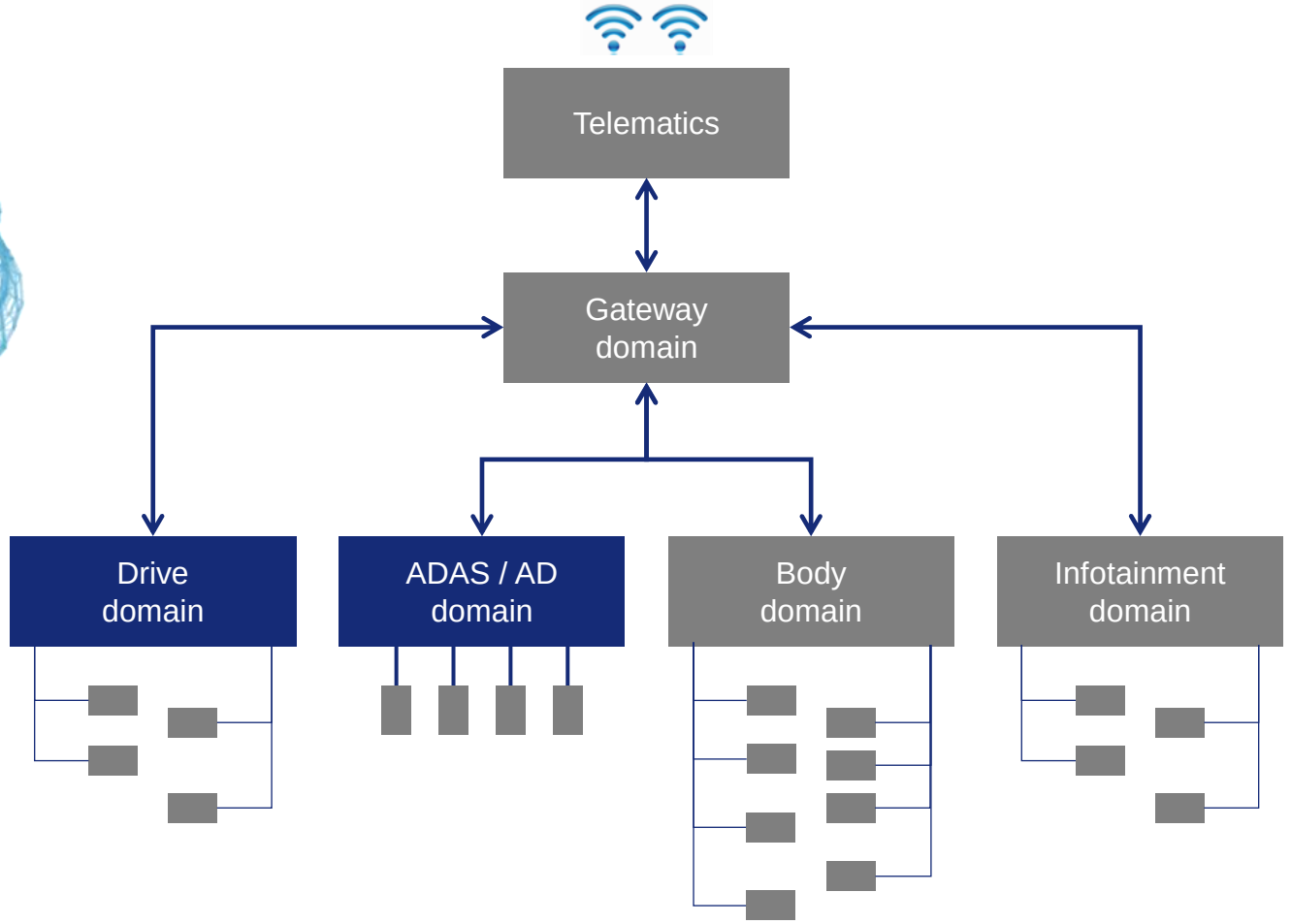
Domain based vehicle architecture

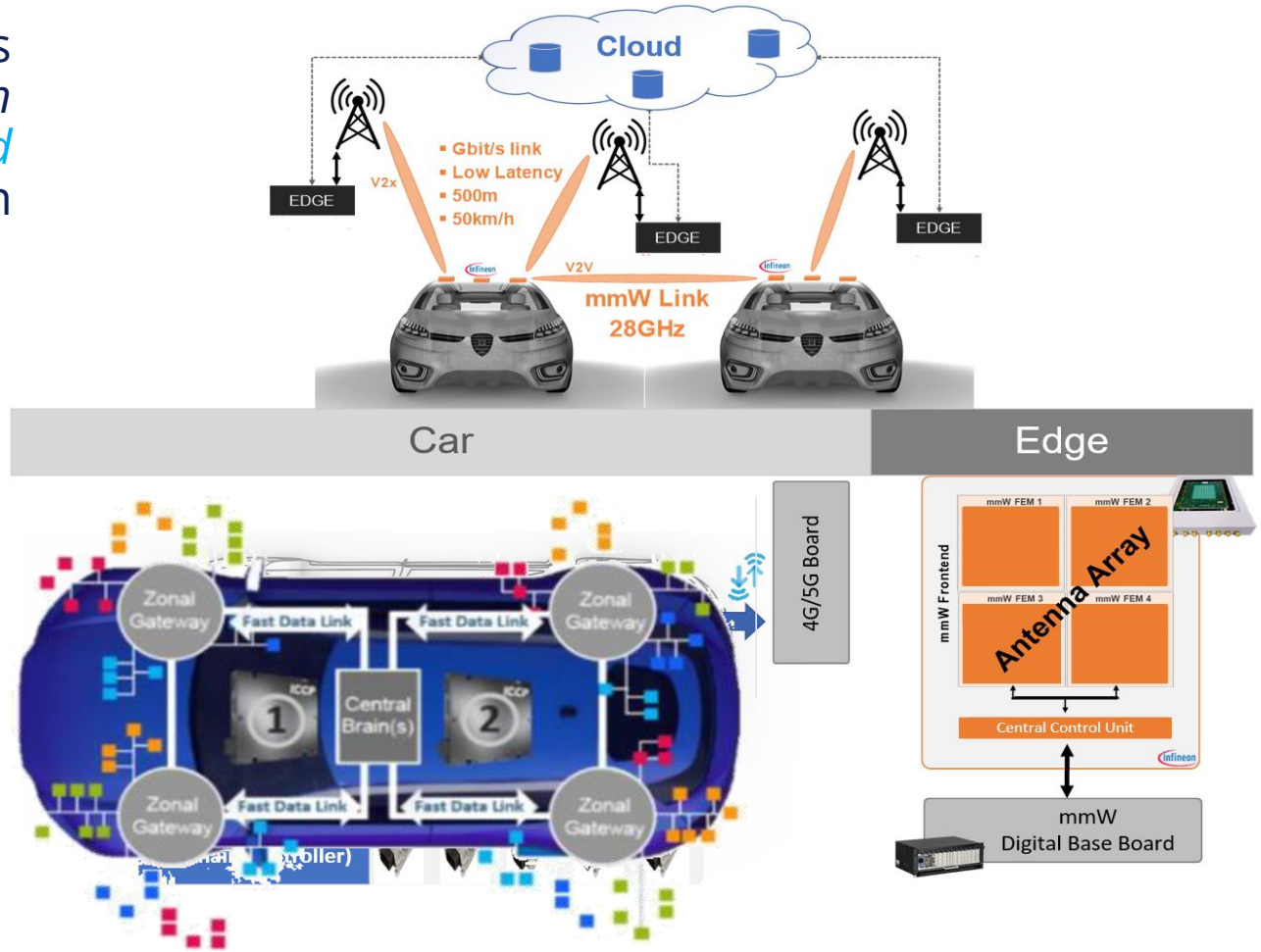




Research Goal

Research Topics:

Secure external communication, with high data rates and bandwidth, the *cloud fusion of edge perception* results into the digital twin as well as *fast and reliable wireless communication channels* based on 28 GHz mmW technology.



Innovation:

- Communication System Architecture
- Robust low latency technology
- AI-enabling communication tech.

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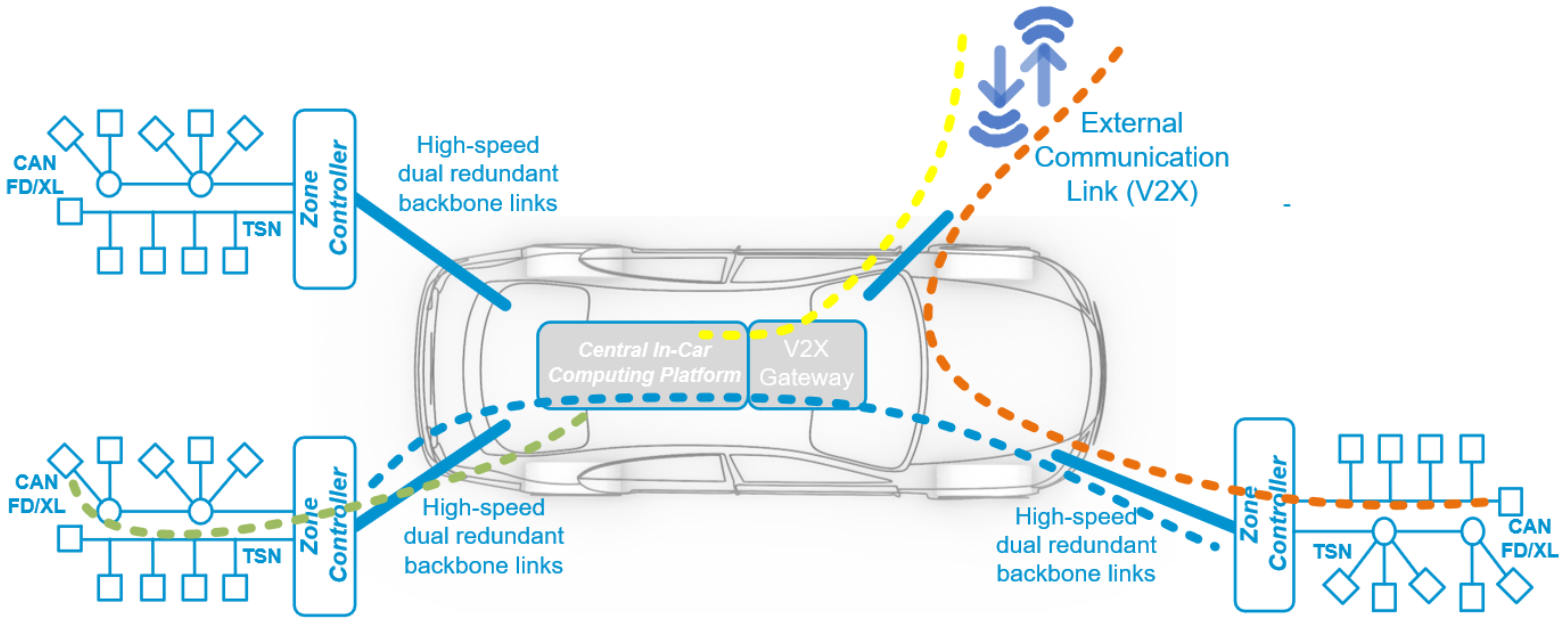
Methodology



Frame Error Rate Prediction for Vehicular Communication using AI

Safe and Secure Redundant Communication Link

Communication and Identity Management

Connectivity Technologies for Safety AD Software Platform

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Research Approach

Cloud

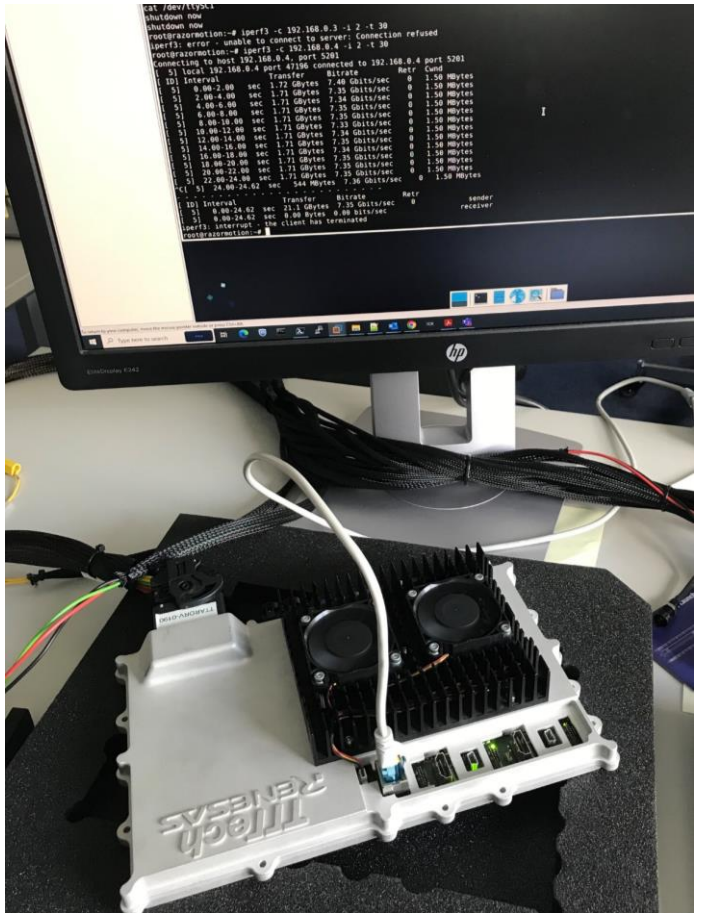
- Develop and validate **enhanced infrastructure mobility platform services** ensuring non-stop supervision of vehicle conditions.

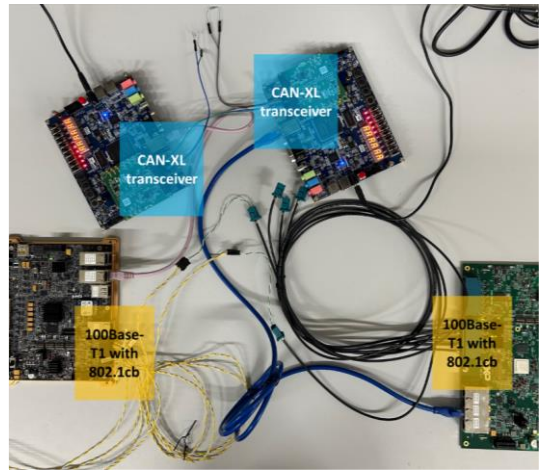
Connectivity

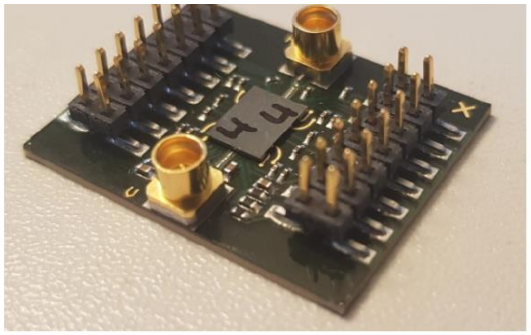
- Prototype and validate **a novel 5G 28GHz mmW** low latency, large bandwidth communication **technology**
- Design of communication architectures for smart connected mobility

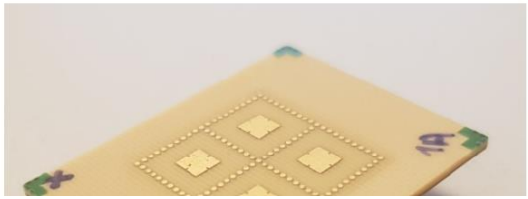
Edge

- Investigate and identify connectivity and **interoperability challenges between devices and systems**
- Design and evaluate the edge nodes









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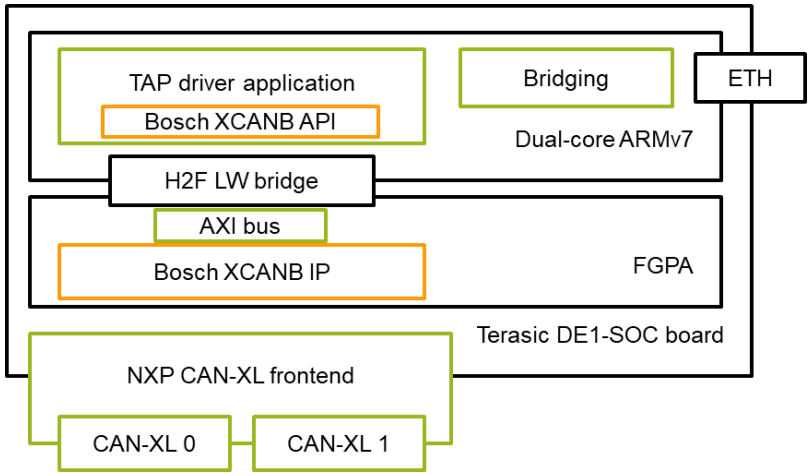
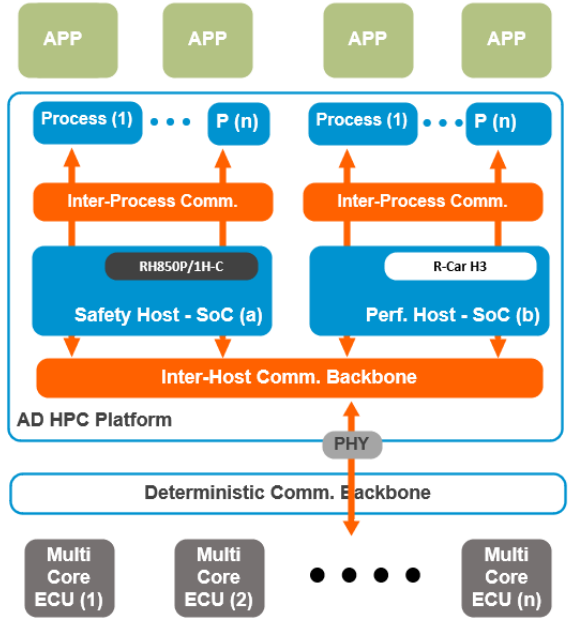
Design and Implementation – Comm. Platform

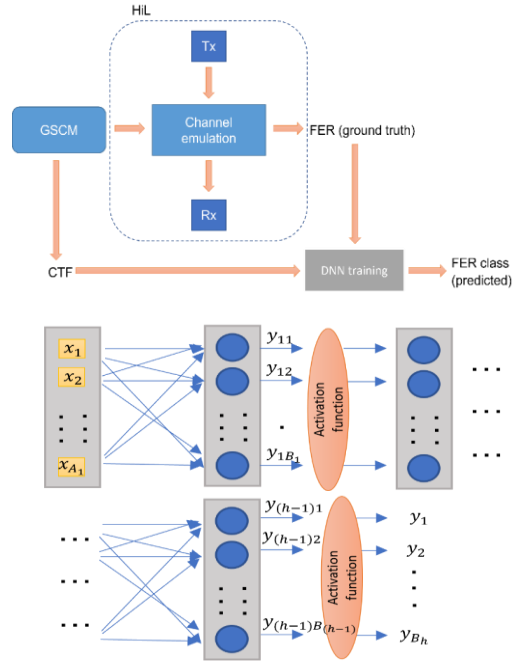
Safe and Secure communication – redundant zonal link



Communication Architecture for the in-car computing platform



Frame Error Rate Prediction for Vehicular Communication using AI



ZONAL Communication | Central In-Car Communication | Wireless Edge-Cloud Comm.

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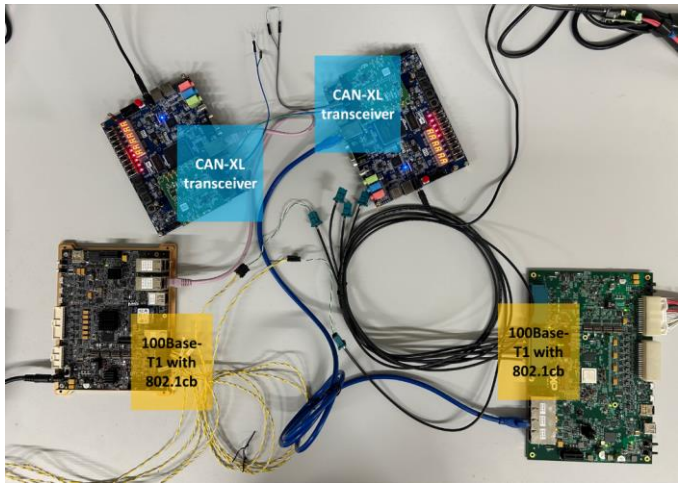
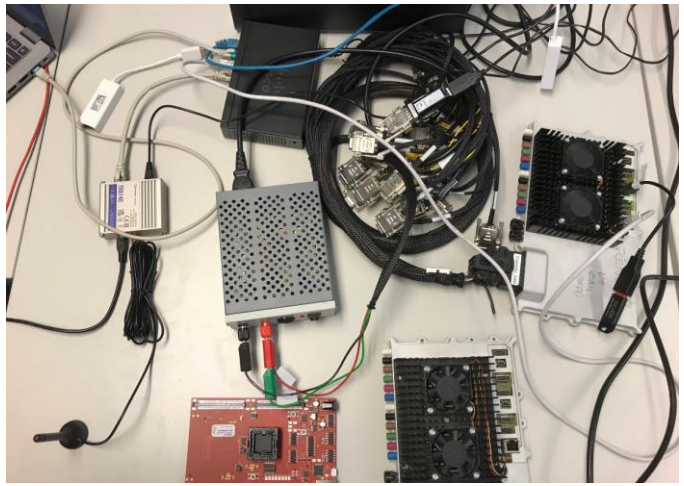
Experimental Results - wireless data transmission

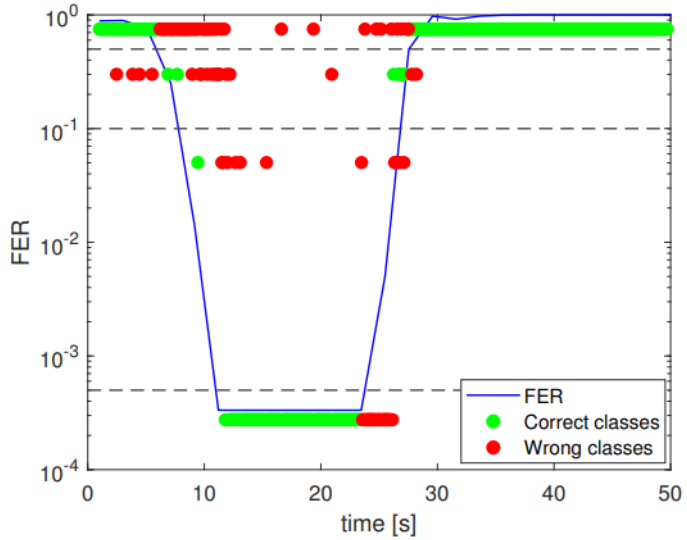
Safe and Secure communication – redundant zonal link



Communication Architecture for the in-car computing platform



Frame Error Rate Prediction for Vehicular Communication using AI



ZONAL Communication | Central In-Car Communication | Wireless Edge-Cloud Comm.

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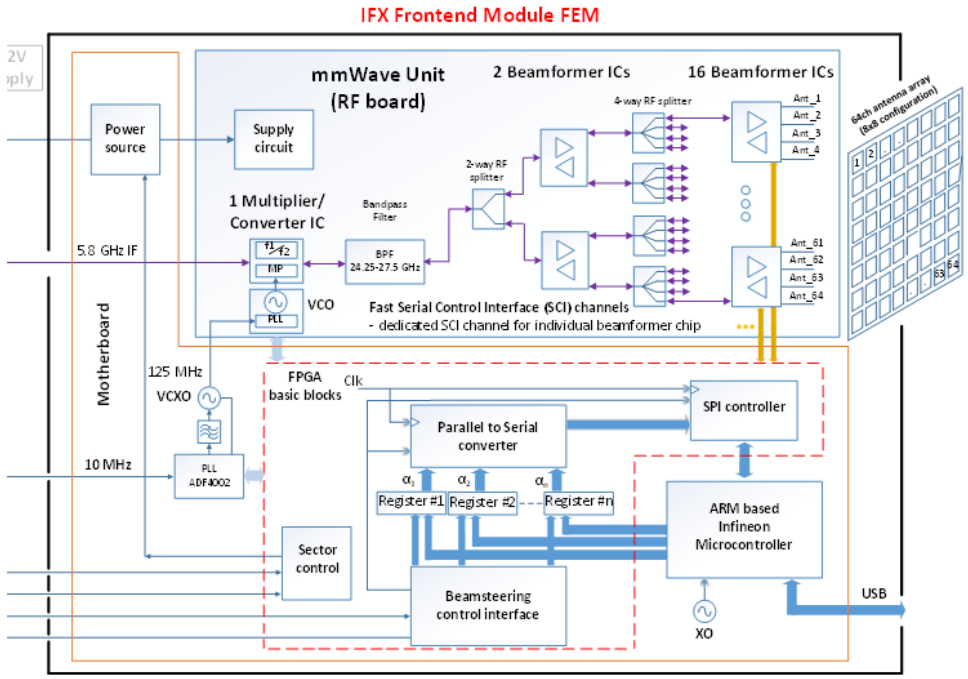
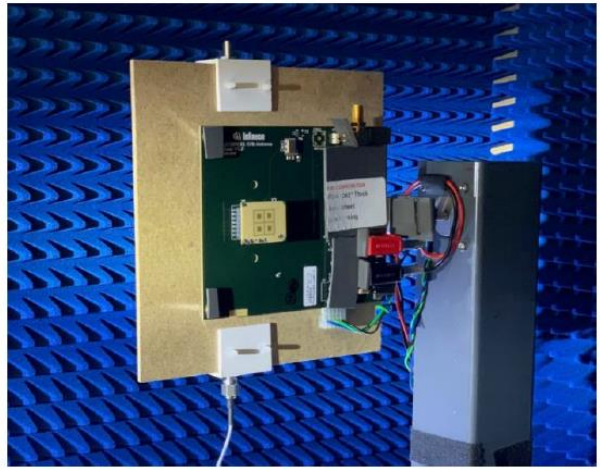
Design & Implementation - wireless data transmission

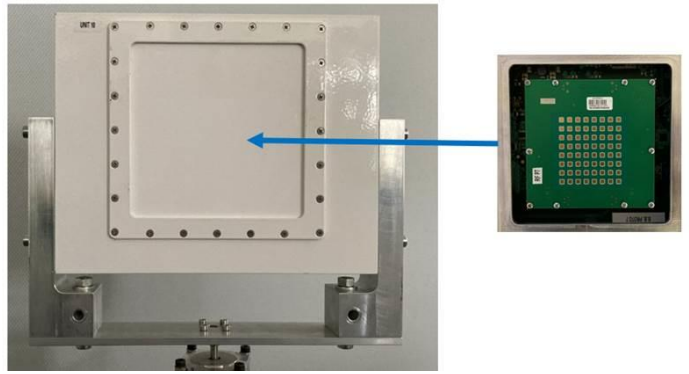
Frontend Module Design with individual beamforming functionality



The transmission was tested in an antenna chamber to validate the performance of IC together with the antenna.



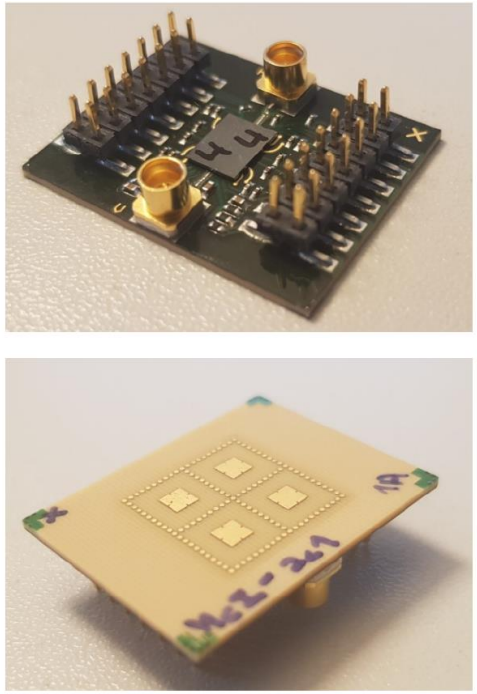
Transmission Test Setup



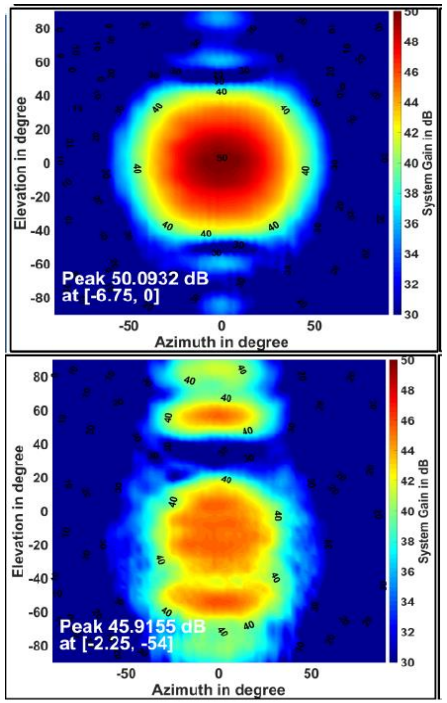
Antenna Array Design

Experimental Results - wireless data transmission

- 5G Front-End for a novel low latency connectivity platform operating at 28GHz in the milli-meter wave band



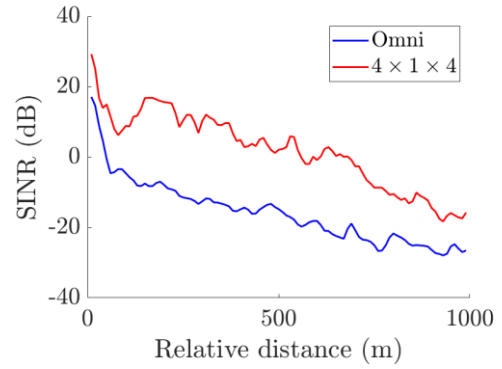
Module with chip and antenna array integrated.

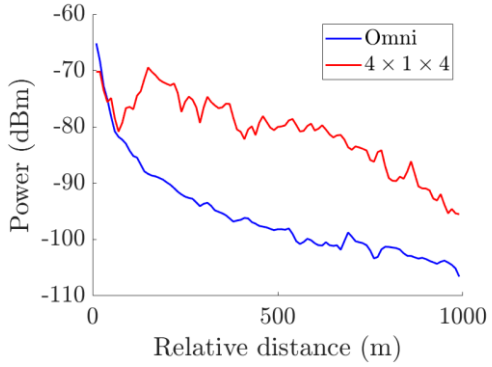


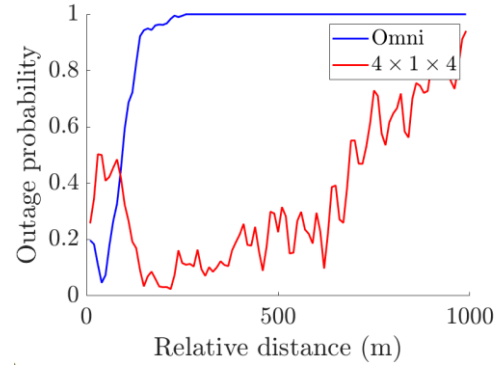
Beam scanning of the antenna covering the right hemisphere.

Simulation Parameter:

$f_0 = 26\ GHz$
$P_{TX} = 23\ dBm$
$NF_{RX} = 13\ dBm$
$B = 200\ MHz$
$SCS = 60\ kHz$
$Data\ rate\ 10\ Mbps$
$Highway\ LOS/NLOSv$
$100\ pairs$







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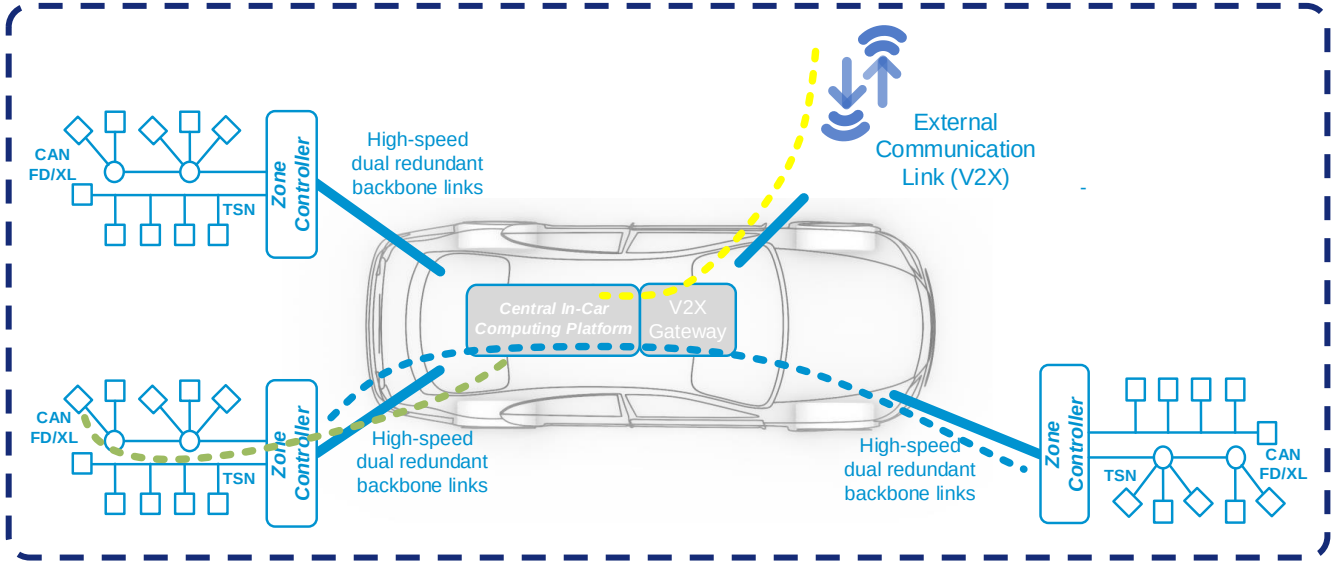
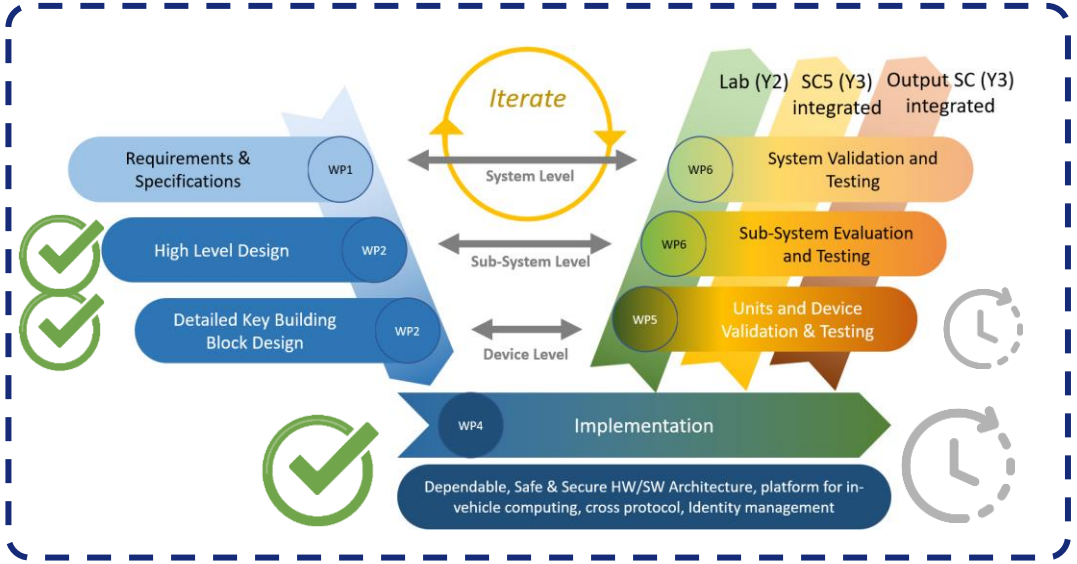
Conclusion & Future Work





Collaborative Effort by

TTTechAuto, infineon, NXP, AIT Austrian Institute of Technology, Fraunhofer HHI, Technische Universität Dresden, ima

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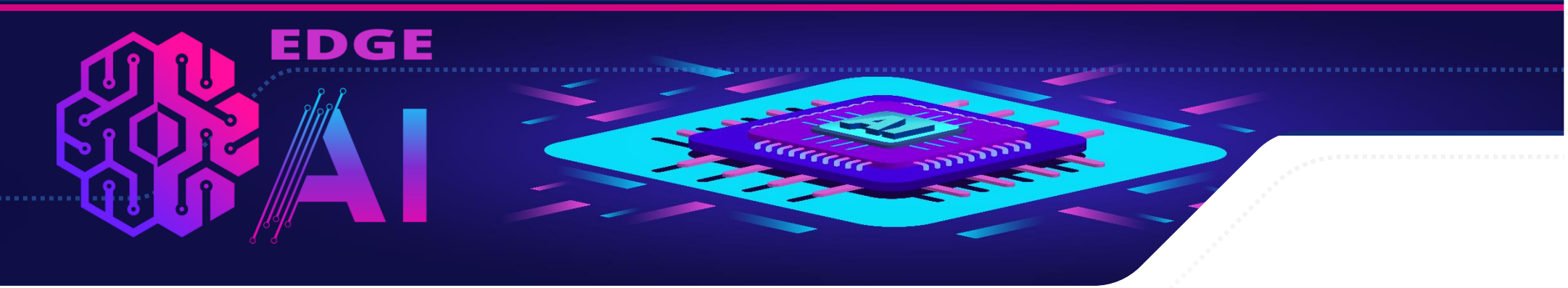
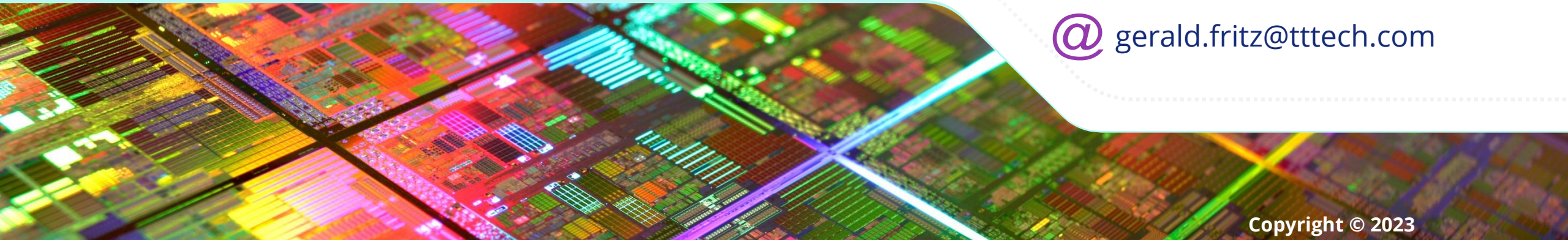


Thank You

For your attention



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