Future Mobility Approaches and Required Developments for On-board Networks and ADAS Computers

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Eco-Mobility 2018, Vienna Austria, 2018-11-12&13

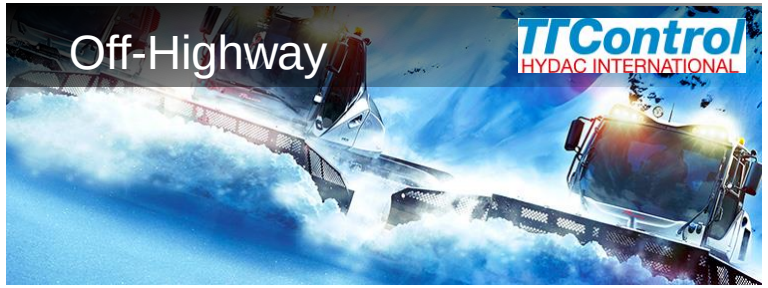
TTTech Group

Company Introduction

Eco-Mobility 2018, Vienna Austria, 2018-11-12&13

Our markets and key benefits

Markets



Focus on safe and robust networking and controls

3CAR Auto Drive SYS2WHEEL

PRYSTINE CPSwarm ACHILES

Key benefits with TTTech

- TTTech is the technology leader in robust networked safety controls
- TTTech is the innovator of Deterministic Ethernet and the driving force behind the IEEE TSN standard
- TTTech transfers proven aerospace network technology to mass markets like automotive and manufacturing
- TTTech runs multiple EC & nationally funded projects in the field like PRYSTINE, CPSwarm, AutoDrive, Achiles, Sys2Wheel etc., cooperating with many European Partners.
- TTTech has successfully cooperated in more than 50 EC/nationally funded projects related to the field.

Boeing 787

NASA Orion MPCV

zFAS: A TTTech Success Story

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- zFAS, the world's first street-legal Level-3 AD Solution, was co-developed between AUDI and TTTech.
- zFAS uses numerous technology components from TTTech and multiple other vendors (>15 suppliers, >35 APPs)
- TTTech technology covers Platform Framework, SW Integration as well as robust and safe deterministic networking.
- zFAS scales across 25 different car models of the VW Group

It started with Infineon ….
Working in partner networks and eco systems

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June 2018
TTTech Auto AG is established

March 2016
Partnership for ASIL-D safety solutions in automated driving

April 2017
MotionWise debuts in the all new Audi A8

January 2017
Partnership to offer MotionWise and Renesas R-Car based platform

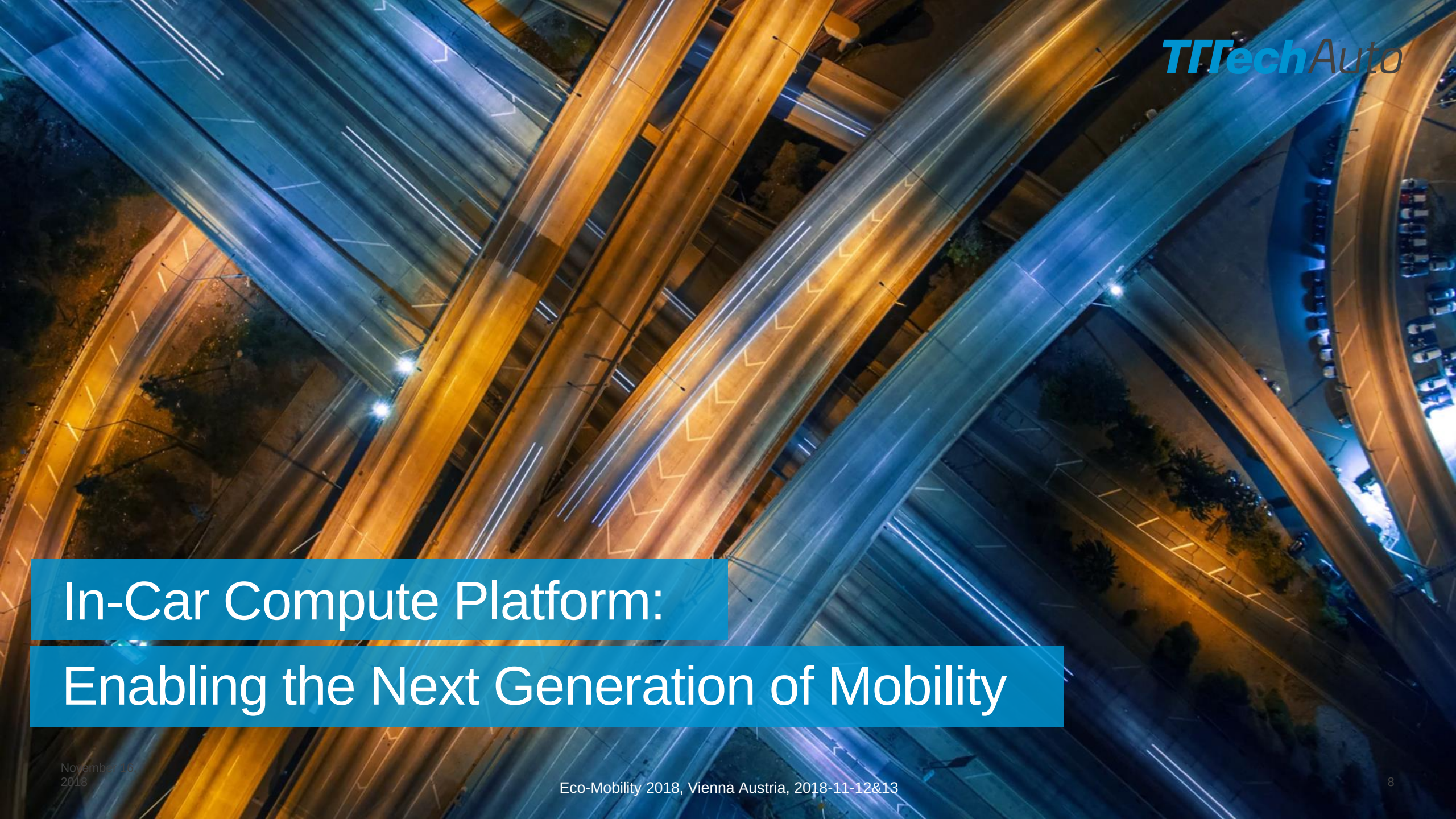
September 2017
Strategic partnership for developing technologies for automated driving

February 2018
ZF starts MotionWise integration into ZF ProAI platform

April 2018
BMW contracts TTTech to play vital part in their development of an automated driving platform

March 2018
SAIC Motor Corporation and TTTech sign joint venture contract

April 2018
Integration of RT-RK Automotive in CEE



In-Car Compute Platform:

Enabling the Next Generation of Mobility

Safety is the top-most priority in autonomous driving

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Autonomous driving on levels 3-5 causes a paradigm shift and requires fail-operational functionality

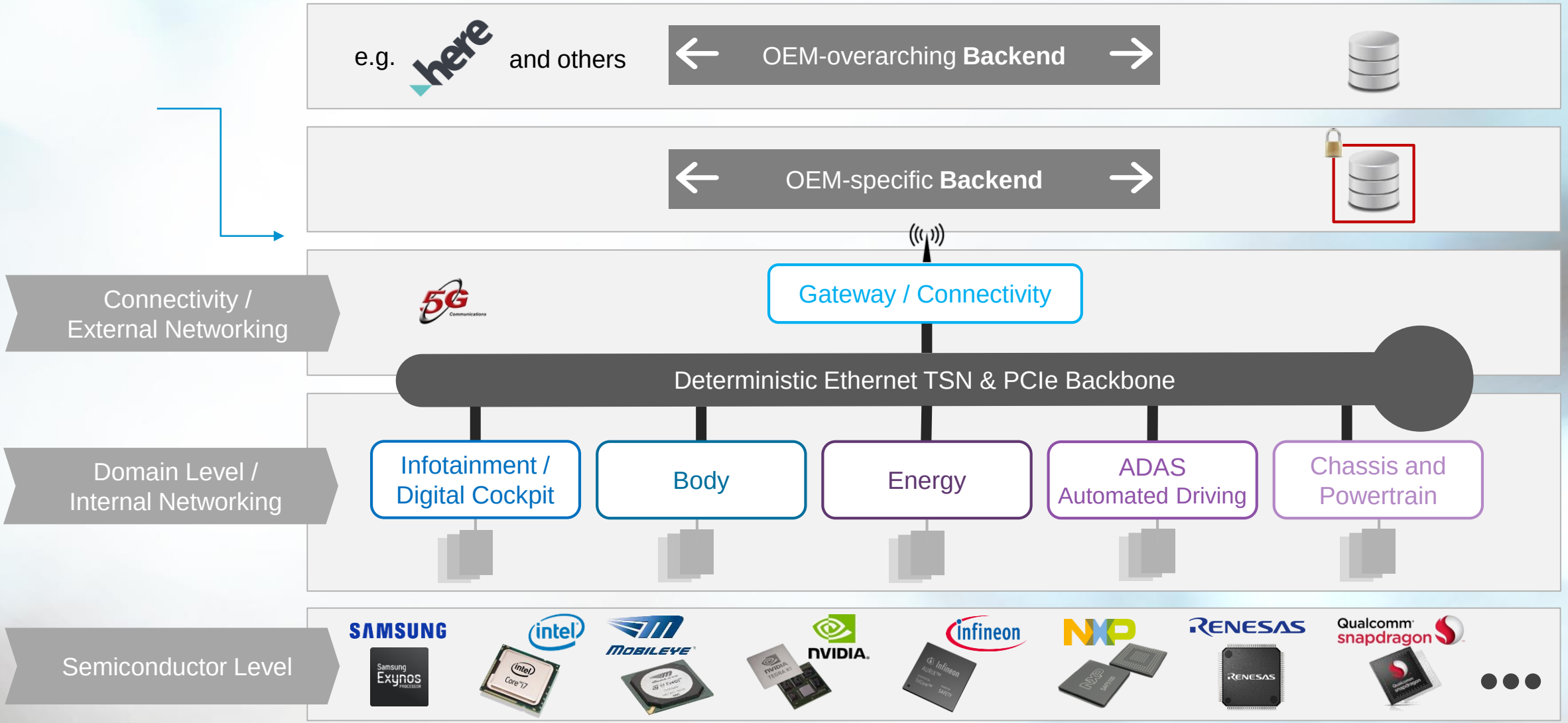
Guaranteed safety of the vehicle demands close interaction of all automotive domains

6 Domains:

- Gateway / Connectivity
- Infotainment / Digital Cockpit
- Body
- Energy
- ADAS Automated Driving
- Chassis and Powertrain

Automotive Domain End-to-End architecture

Complex SoCs are the key enabler and driver

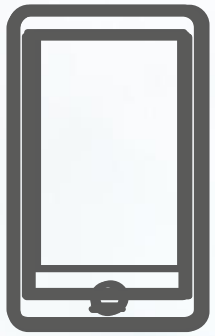


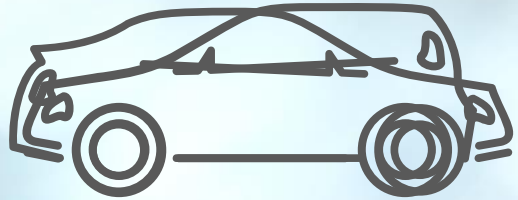
Future E/E architectures must be more flexible and prepared for updates

Mismatch of E/E and SW/HW upgrade cycles

- The cars and their E/E architecture follows an update cycle of about 5 – 7 years.
- Functional SW updates have a much shorter update cycle of about ½ a year – 1 year.
- **SoC upgrades are somewhere in between (2 – 3 years), depending on the type of hardware.**

Software and hardware / SoC upgradability needed





But the domain concept has some limitations as well

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6 domains…

…imply 6 times development cost

…imply 6 times basic software functions (operating systems, diagnostics, tools, etc.)

…imply 6 times sources of software and hardware faults

…imply 6 times maintenance cost

…imply 6 times over the air updates

…imply 6 times integration efforts

…imply 6 times safety and security efforts

But the domain concept has some limitations as well

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domains…

…imply 5 times development cost

…imply 5 times basic software functions (operating systems, diagnostics, tools, etc.)

…imply 5 times sources of software and hardware faults

…imply 5 times maintenance cost

…imply 5 times over the air updates

…imply 5 times integration efforts

…imply 5 times safety and security efforts

But the domain concept has some limitations as well

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domains…

…imply 4 times development cost

…imply 4 times basic software functions (operating systems, diagnostics, tools, etc.)

…imply 4 times sources of software and hardware faults

…imply 4 times maintenance cost

…imply 4 times over the air updates

…imply 4 times integration efforts

…imply 4 times safety and security efforts

But the domain concept has some limitations as well

domains…

…imply 3 times development cost

…imply 3 times basic software functions (operating systems, diagnostics, tools, etc.)

…imply 3 times sources of software and hardware faults

…imply 3 times maintenance cost

…imply 3 times over the air updates

…imply 3 times integration efforts

…imply 3 times safety and security efforts

But the domain concept has some limitations as well

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domains…

…imply 2 times development cost

…imply 2 times basic software functions (operating systems, diagnostics, tools, etc.)

…imply 2 times sources of software and hardware faults

…imply 2 times maintenance cost

…imply 2 times over the air updates

…imply 2 times integration efforts

…imply 2 times safety and security efforts

The goal of the In-Car Compute Platform (ICCP)

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1 domain…

…implies 1 time development cost

…implies 1 time basic software functions (operating systems, diagnostics, tools, etc.)

…implies 1 time sources of software and hardware faults

…implies 1 time maintenance cost

…implies 1 time over the air updates

…implies 1 time integration efforts

…implies 1 time safety and security efforts

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Data center key technologies

- Server consolidation
- Isolated applications (hypervisors / dockers)
- Improved availability, fail-over and automated recovery schemes
- Load balancing and upgradability
- Reduced energy consumption through ultra-high integration
- Deeply integrated end-to-end security

The data center concept and its translation to automotive

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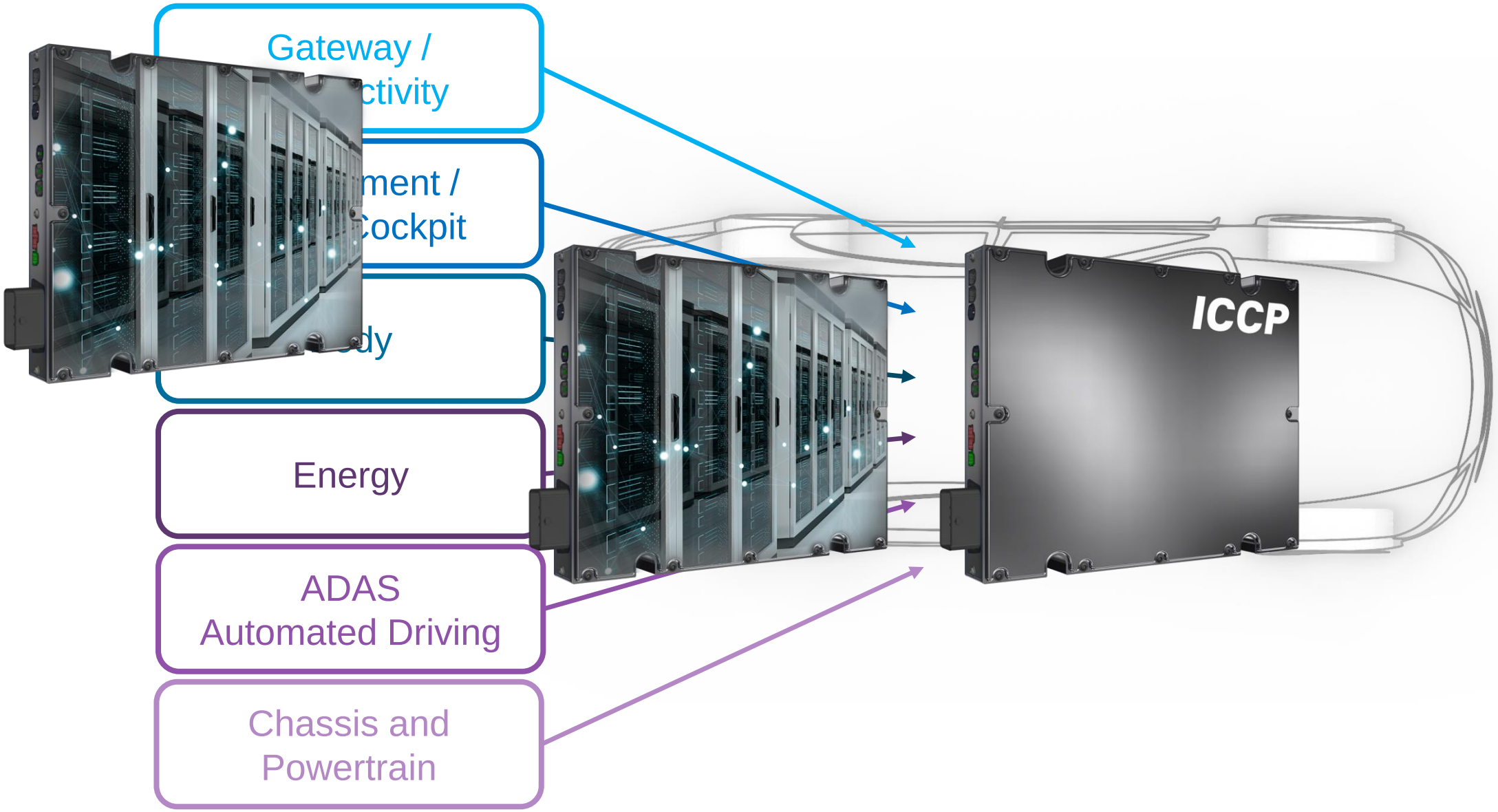
Key technology principles from the data center domain apply to automotive, but they are not complete:

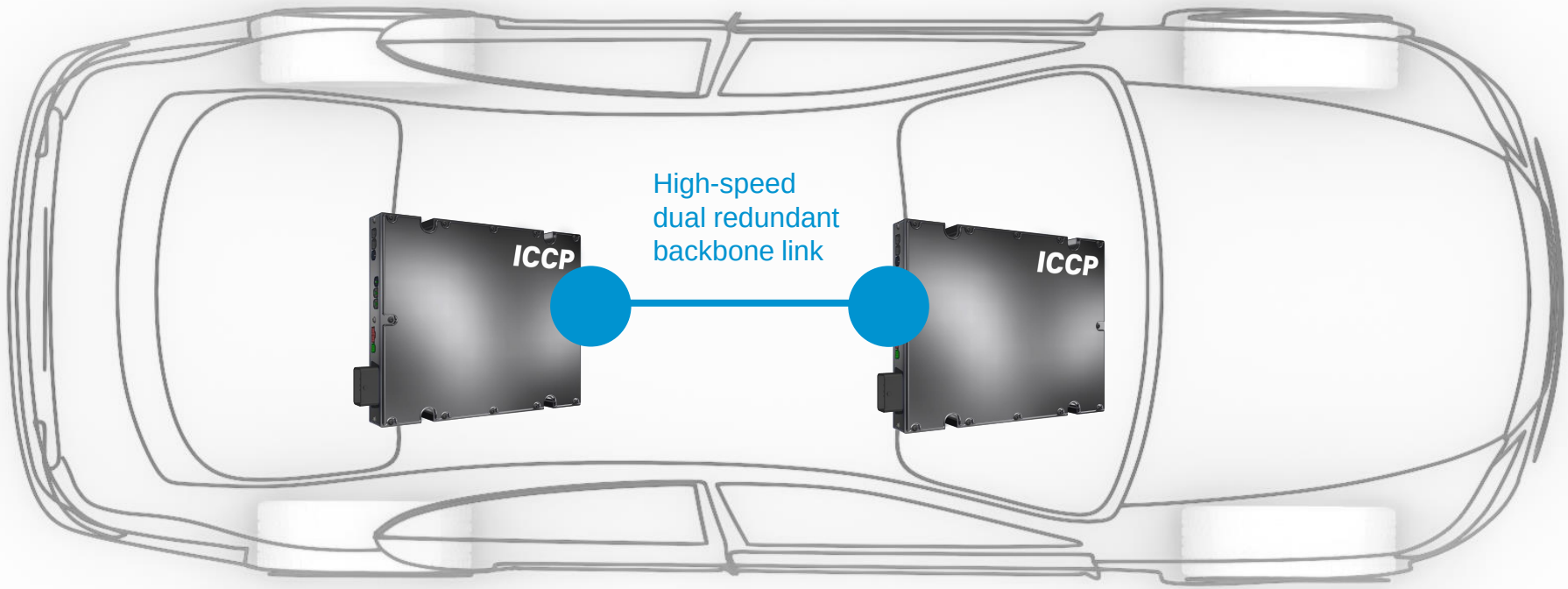
Data centers do not have as stringent safety and hard real-time requirements as the automotive industry.

In addition security needs to be added in automotive …

Domain consolidation via In-Car Compute Platform (ICCP)

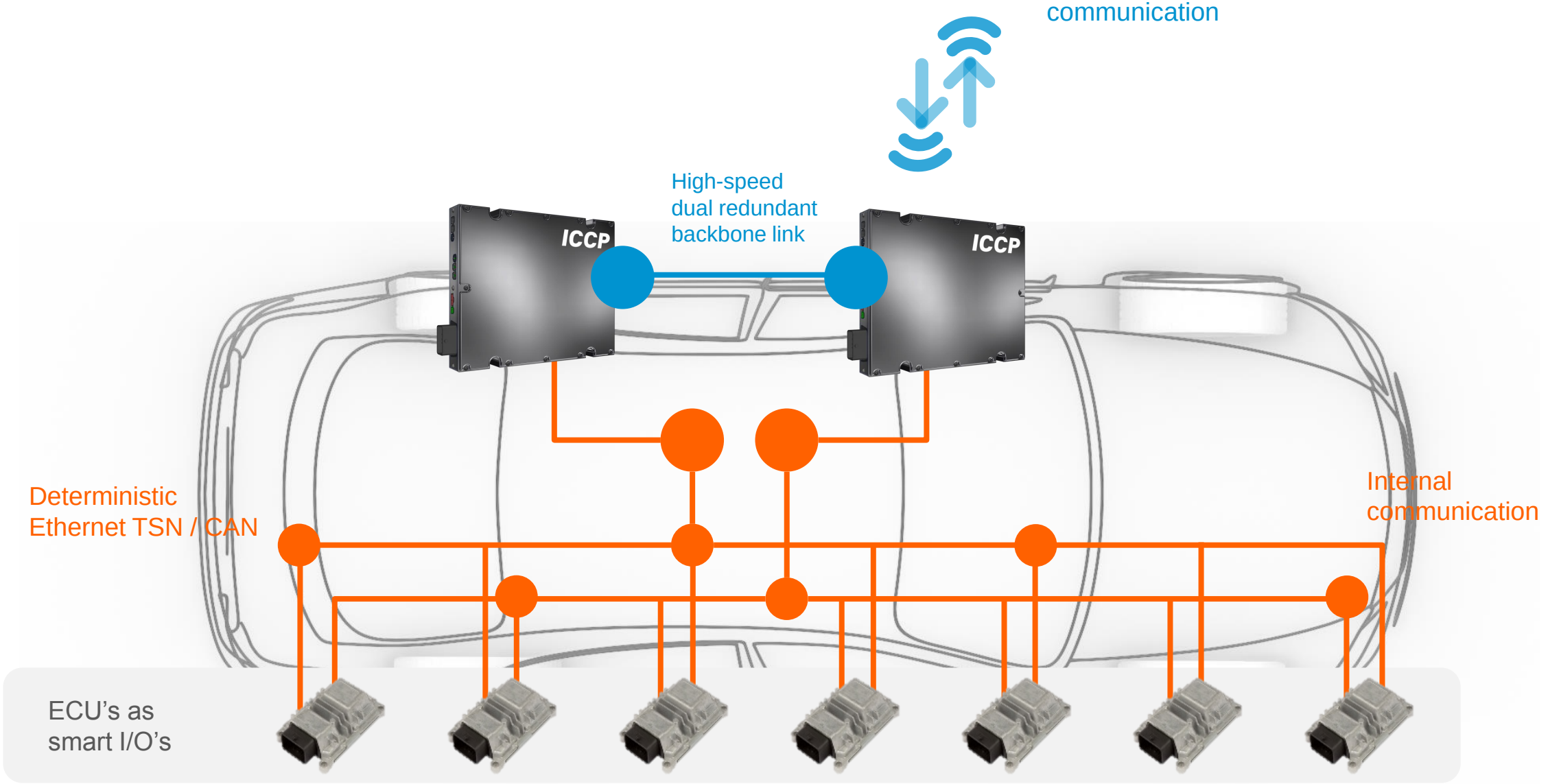


Domain consolidation via In-Car Compute Platform (ICCP)



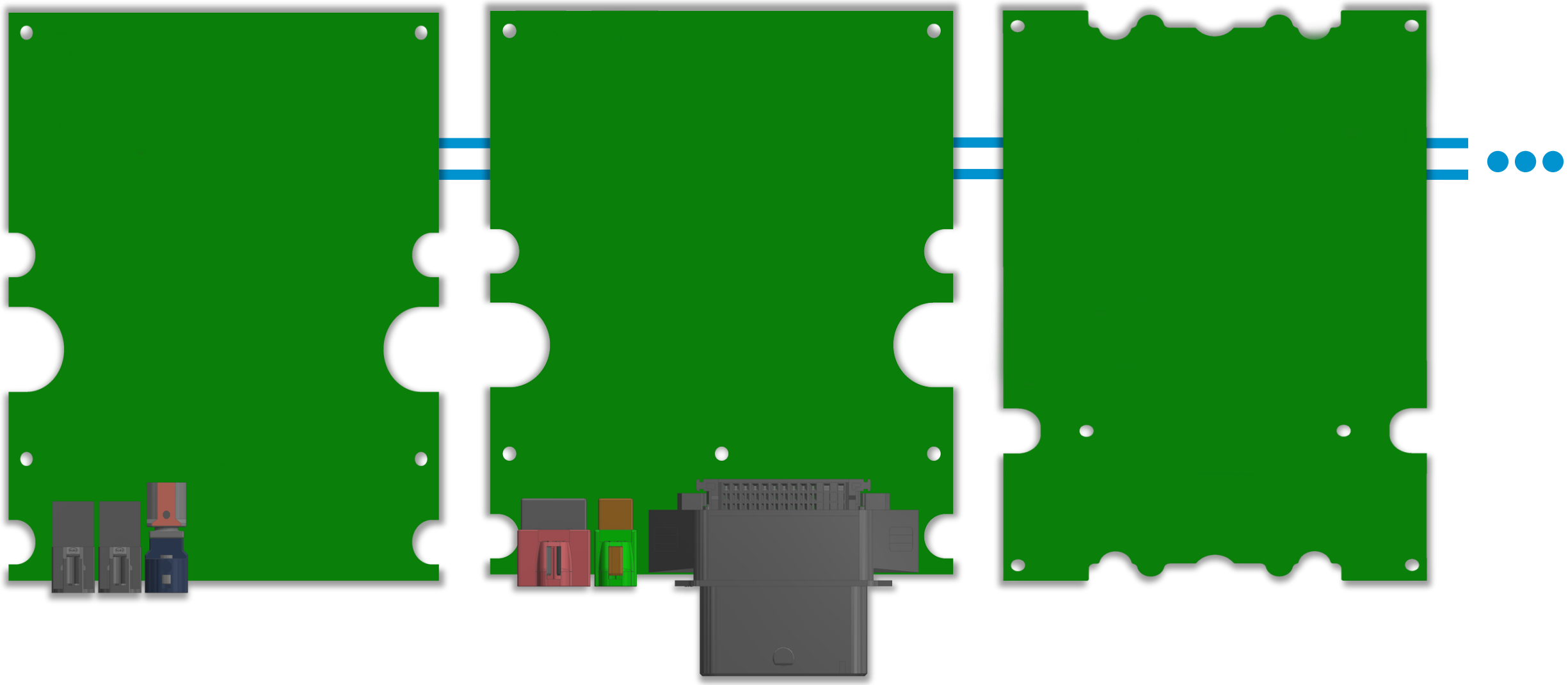
Dual redundant deployment for fail-operational functionality

ICCP within the E/E architecture

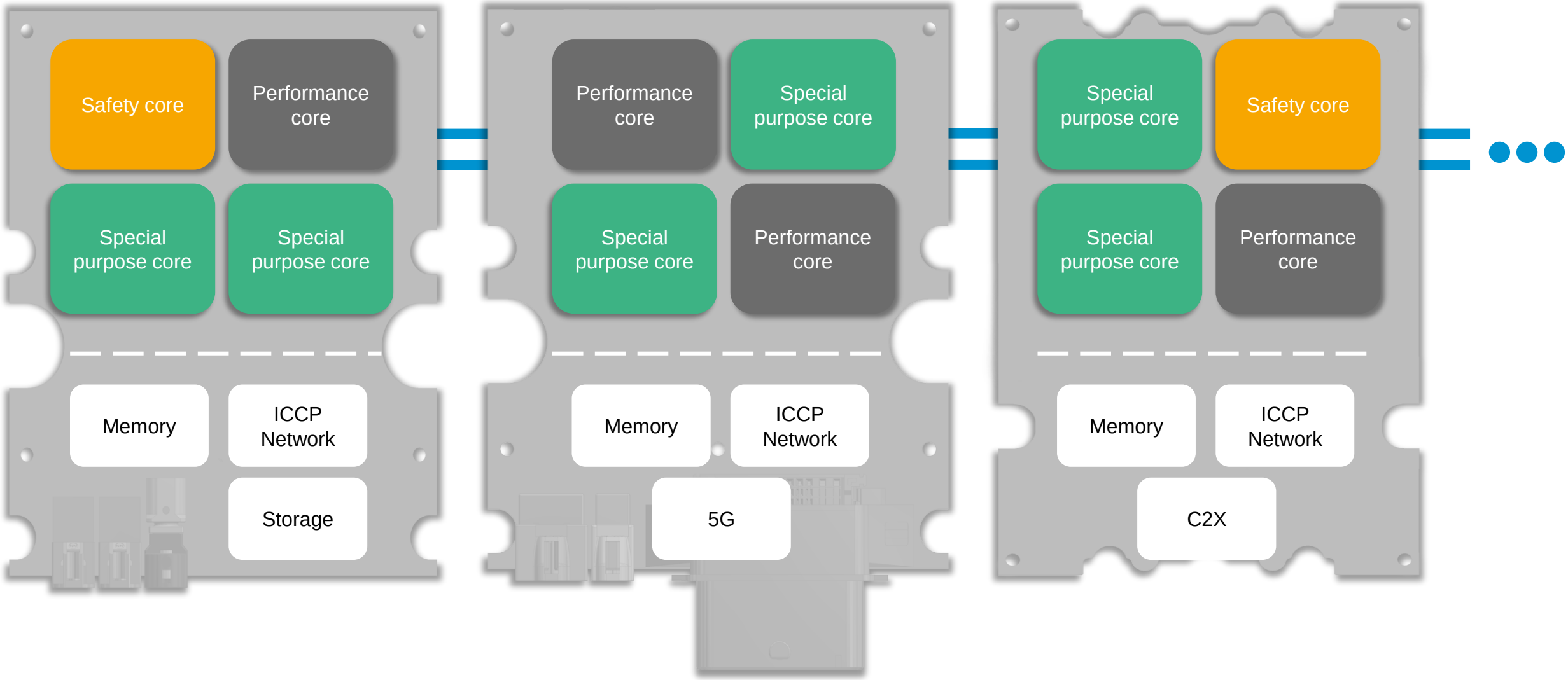


The Platform Concept

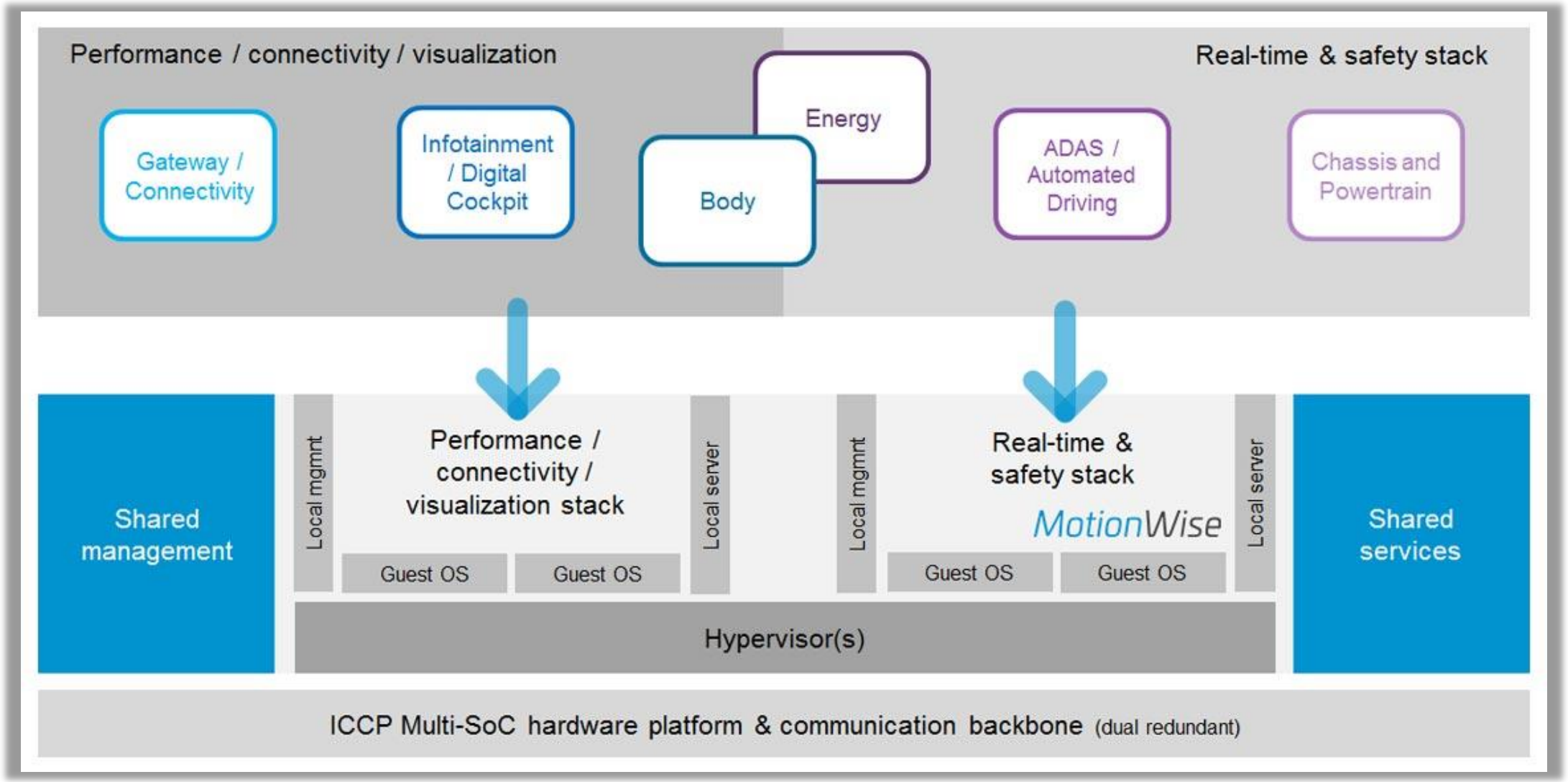
Modular and connected hardware resources within the ICCP



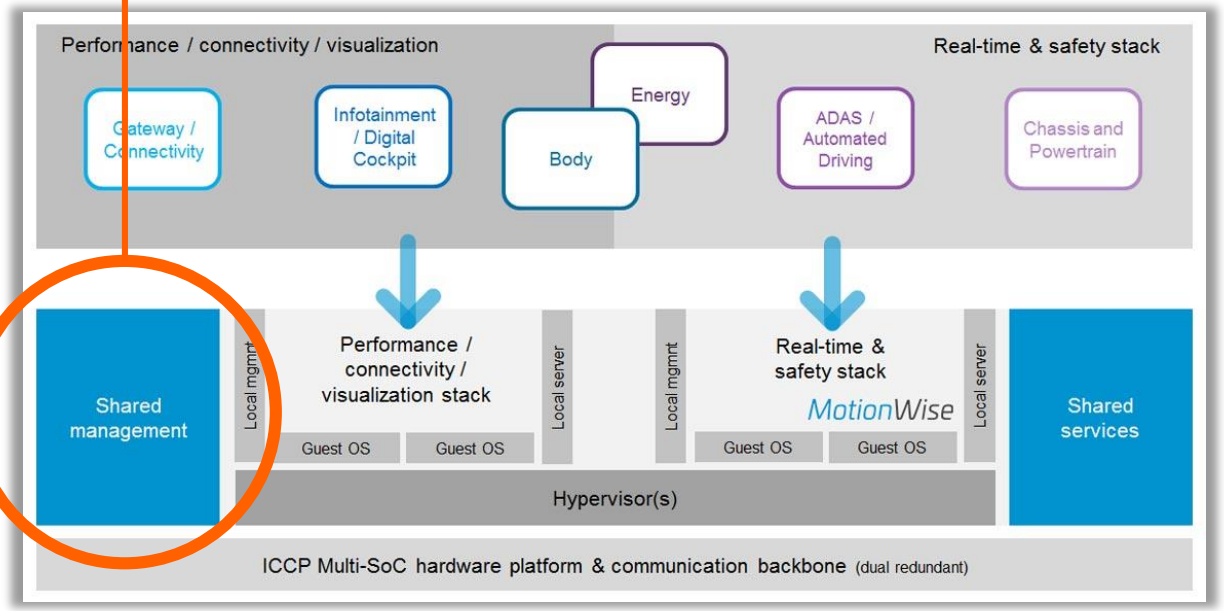
Modular and connected hardware resources within the ICCP



ICCP consolidated software architecture



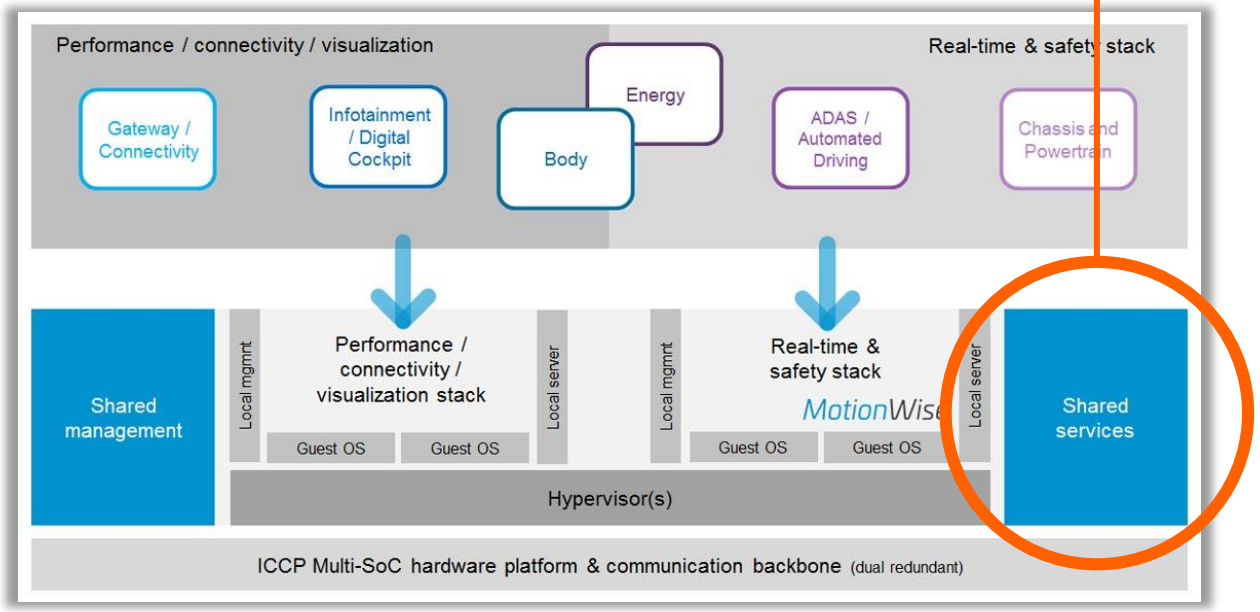
ICCP consolidated software architecture



Shared management

- Safe & secure (re)configuration
- Safe & secure SW updates
- Safe & secure load balancing
- Safe & secure orchestration

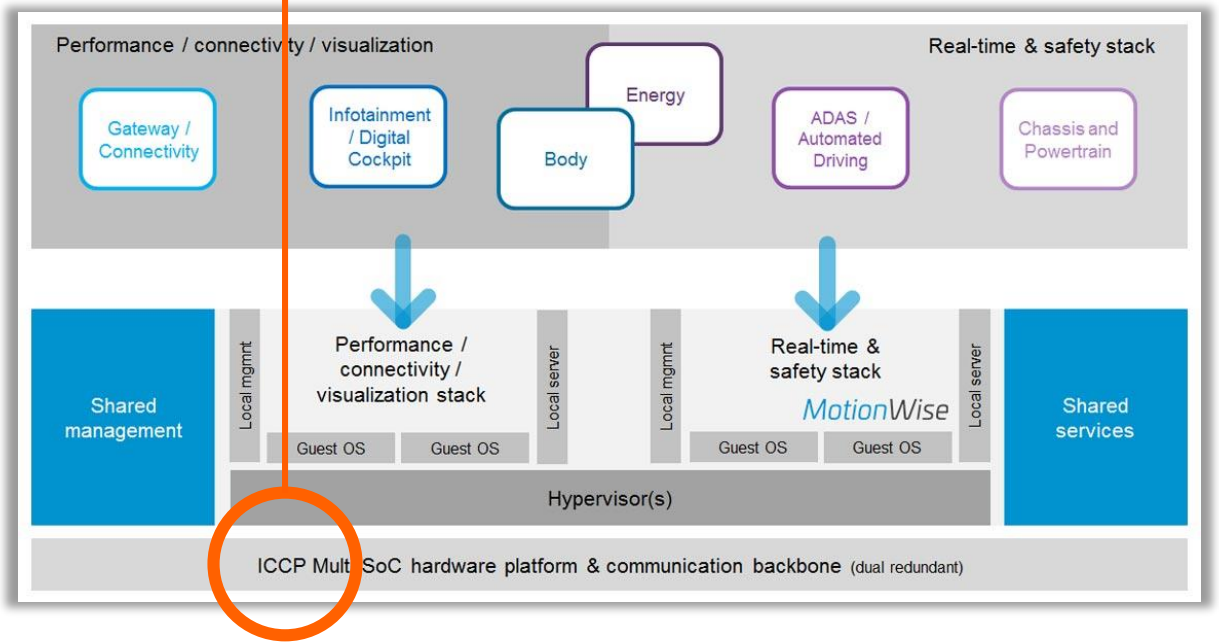
ICCP consolidated software architecture



Shared services

- Safe & secure diagnosis
- Safe & secure monitoring / logging
- Energy management
- Automotive-customized intrusion detection system

ICCP consolidated software architecture



Communication backbone

- Deterministic data delivery
- High-speed automotive-grade communication
- Advanced traffic policing for hard real-time communication and mixed-criticality systems (e.g., babbling idiot isolation)
- Built-in automotive-grade security
- Redundant communication channels for availability w/ zero fail-over time

MotionWise safety software platform

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MotionWise Core

Scheduling Services

Time Triggered Scheduling
Event Triggered Scheduling
Hybrid Scheduling
HW Engine Scheduling
Computation Chains
Execution Manager (Adaptive Platform)

Communication Services

Communication API
- Flexible RTE
- ara::com (Adaptive Platform)

Middleware
- Buffer Handling
- Backbone Communication
  - Deterministic Ethernet
  - PCIe
- Service Based Communication
- SOME/IP

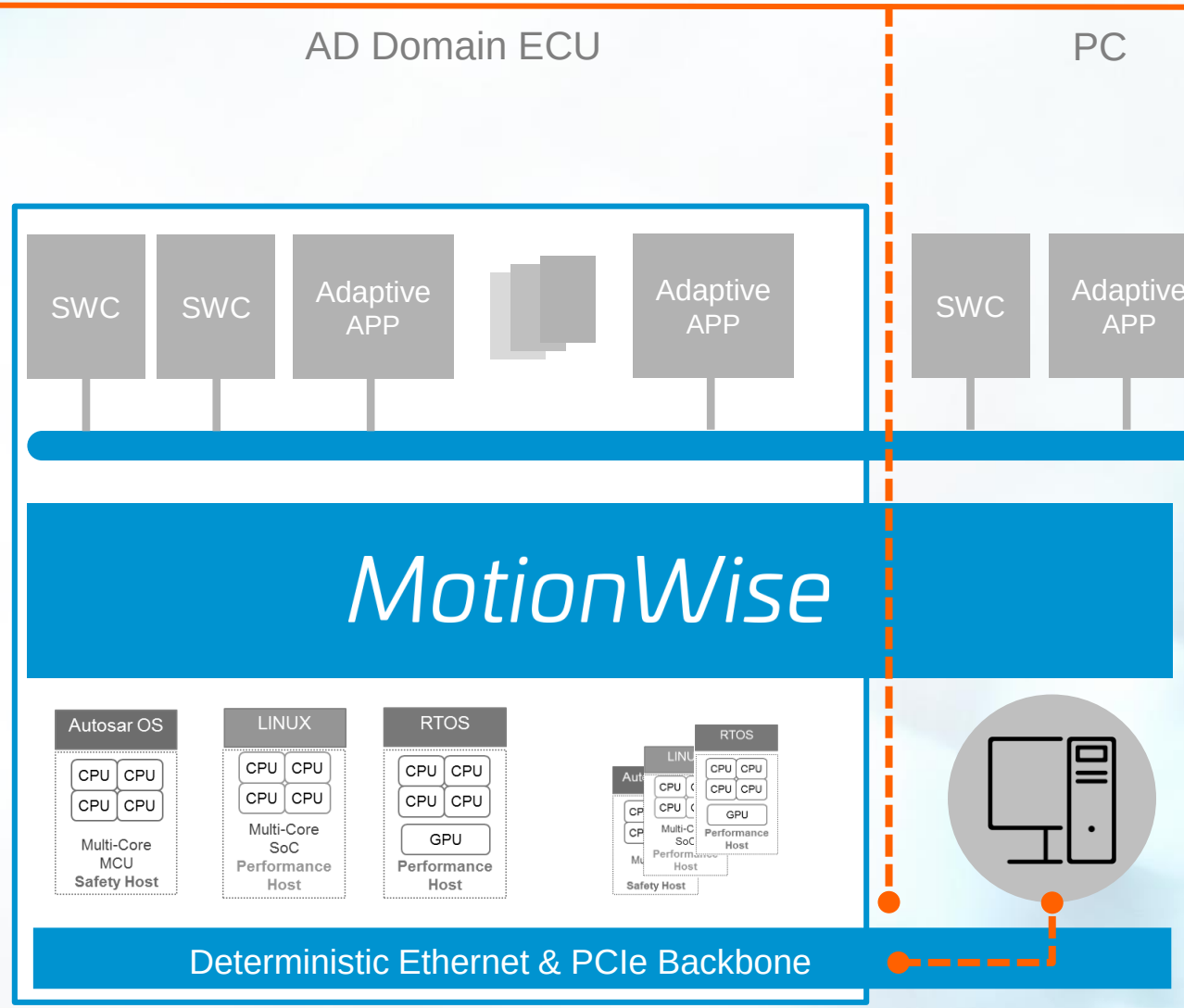
Vehicle Communication
- CAN
- Ethernet (SOME/IP)

Time Services

Time Synchronization
Global Time
Time Conversions

Safety and Health Monitoring

Task Monitoring
Host Monitoring
Time Synchronization Monitoring
Computation Chain Monitoring
E2E Data/Communication Protection
Error Handler Framework
BIST Framework



MotionWise Extensions

Automotive Services

ECU Life Cycle Management
Diagnostics Framework
Calibration
Persistency

Development Services

Logging
Tracing / Profiling
SW Update

Support Services

Blackbox Recorder
Sensor Framework

Tool Suite

MotionWise Creator

System Definition Verifier
MotionWise Core Creation

MotionWise SDK

Software In the Loop
Remote Access Library
Profiling Framework
Schedule Visualization
Capture & Replay
Application Integration Tooling
SW Update Tool
Build Framework

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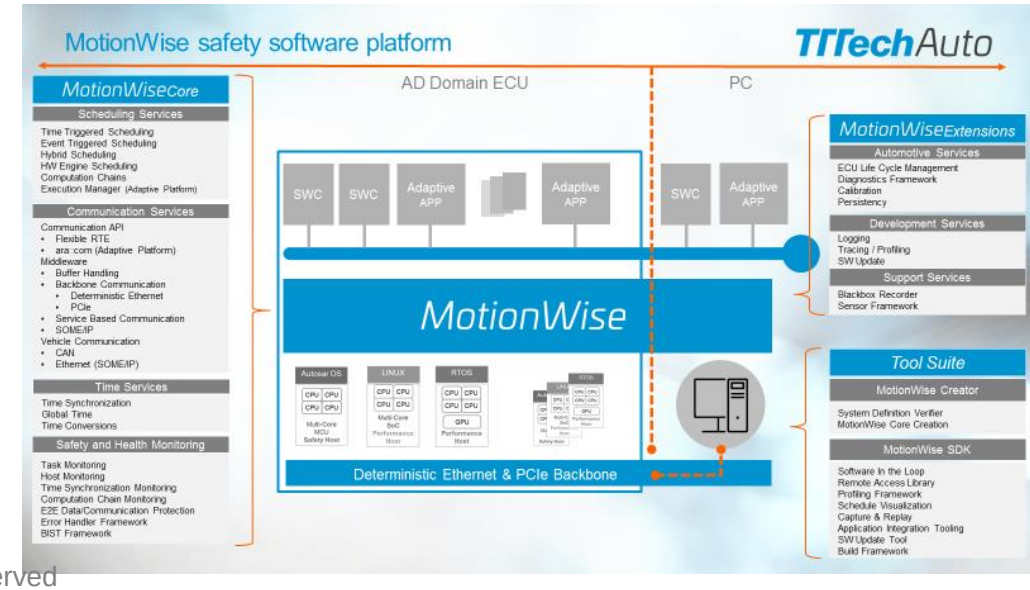
Safety documentation delivered

- 350 documents
- 40.000 pages
- approx. 350 lbs printout
- approx. 13.8ft high paper stack



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