Bosch multi domain strategy for IVI-systems based on GENIVI

Genivi All Member Meeting, April 17-19, 2018, Munich
Andree Zahir, SVP at Robert Bosch Car Multimedia GmbH

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Agenda

1. Company overview Bosch Car Multimedia GmbH

2. Business & technical challenges

3. Solution strategy based on open technology

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Bosch Car Multimedia GmbH

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RB Multi Domain Strategy
Car Multimedia − Overview

Total Bosch sales (2017): € 78 billion
Total Bosch Mobility Solutions Sales (2017): € 48 billion
Total Car Multimedia sales in 2017: € 2.6 billion

400,500 Bosch associates worldwide, thereof >7,000 CM

Multiple products & services in following business units:

➔ **Connected Information Solutions 1**
   connected navigation & infotainment systems, information displays, connectivity units, coach entertainment

➔ **Connected Information Solutions 2**
   analog and digital instrument clusters, head-up displays

➔ **Manufacturing Services**
   contract manufacturing

➔ **Bosch Softec**
   embedded and cloud based SW solutions for connected services

➔ **ADIT**
   joint venture w/ Denso for the development of IVI (SW) platform

Customers include all major global automotive manufacturers

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RB Multi Domain Strategy
Car Multimedia − Linux/GENIVI relation

▶ Active charter member of Genivi Alliance, board member since 2012

▶ Genivi systems in market since 2012, in total more than 20 million units delivered

▶ Well established SW partner network, part of the GENIVI community

▶ Integration of many 3rd Party components in to
our SW-Stack for different customer projects

▶ Working in global, large scale IVI projects:
Up to one complex project ensemble covering 6 vehicle brands
with more than 400 SOPs, approx. 500 variants and levels

▶ Meanwhile 100% of Bosch Head Units and Connectivity Units based on Linux

Excerpt of partner network

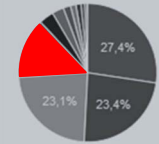|	
Collabora	Arkamys
GreenHills	Cinemo
Global Logic	Here
Mentor	Microsoft
	Neusoft
Intel X86	Nuance
NXP Freescale	Obigo
Qualcomm	Red Bend
Renesas	SKPlanet

Example of benefit

Reengineering of Bluetooth subsystem to Genivi compliance enabled 2nd source

Linux has become the de-facto standard in the IVI market, differentiation rather in SW-layers above

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IVI related OSS − excerpt of Bosch driven contributions

Genivi	Apertis	IoT Backend solutions
▶ Wayland-IVI Extension >90% of contributions by ADIT in 2017 ▶ Diagnostic Log and Trace ADIT is maintainer of DLT ▶ Audio Manager >60.000 changes by ADIT in 2017 ▶ Audio Manager Plugins 100% of contributions by ADIT in 2017	▶ Add-on Software a set of services to orchestrate execution and interaction of add-on software processes ▶ Sensor & Actuator access a framework for more than CAN data ▶ Inter-Domain Communication gateway to deeper embedded area ▶ Integrated collaborative B&I infrastructure streamlined deployment of recurring updates	▶ Hawkbit a back-end framework for rolling out software updates to edge devices ▶ Leshan an OMA LightWeight M2M Device Management solution ▶ Ditto turn physical devices into web services and orchestrate them
▶ and more to ▶ Kernel.org ▶ Apertis.org	▶ and more to ▶ Gnome ▶ Debian ▶ Upstream OSS Projects	▶ and more to Eclipse Foundation **Organization Contribution Activity:** Commits on this project by supporting organization over the last three months. [Unaffiliated] 27,4% Eurotech [Contributor] Robert Bosch GmbH IBM 23,1% 23,4% Sierra Wireless 1/2 ▼

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GoKid Announcement

Works with **GENIVI**®

Meet GoKid outside @ the showcase

▶ **mySPIN** is Bosch's smartphone integration platform to bring app content and services in a safe and secure way to the vehicles screen

▶ As of today, >50 app partners around the globe have integraded the mySPIN.SDK (triggers "Car Mode" and allows whitelisting)

▶ **GoKid** is a comprehensive carpool solution app for schools, teams and active families, helping parents carpool with families they know and trust – <u>and the latest partner in the mySPIN App Network!</u>

Example how GENIVI technology enables new technologies and new biz models

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Business & technical challenges

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RB Multi Domain Strategy
General trends and challenges

- ▶ Complexity growths
  - ▶ Functional scope
  - ▶ Internally distributed composed functions
  - ▶ Externally connected functions & protocols
  - ▶ update rate and granularity

- ▶ Capabilities need to rise
  - ▶ Technical resources & tools
  - ▶ Organizational structure & processes
  - ▶ Collaboration Models & ecosystems
  - ▶ Business Models

- ▶ Aspiring system structure driving quality attributes
  - – Security (maintained over lifetime)
    - – holistic, layered, secure by design & least privilege principle
  - – Flexibility (within consistent structure)
    - – deployment across product-lines and integration-level
    - – scalability and customization of technologies
  - – Manageability

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RB Multi Domain Strategy
Capabilities creates opportunities
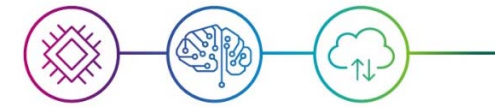
MOORE´S LAW

NIELSEN'S LAW

COMPUTING POWER
New technologies
continue to increase
computing power

NETWORK
Tactile internet,
latency, reliability,
availability,
security

CONNECTED WORLD
Estimated
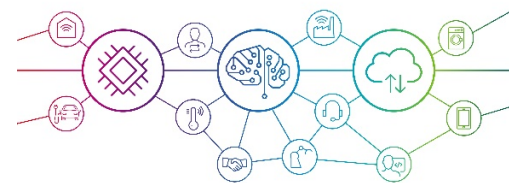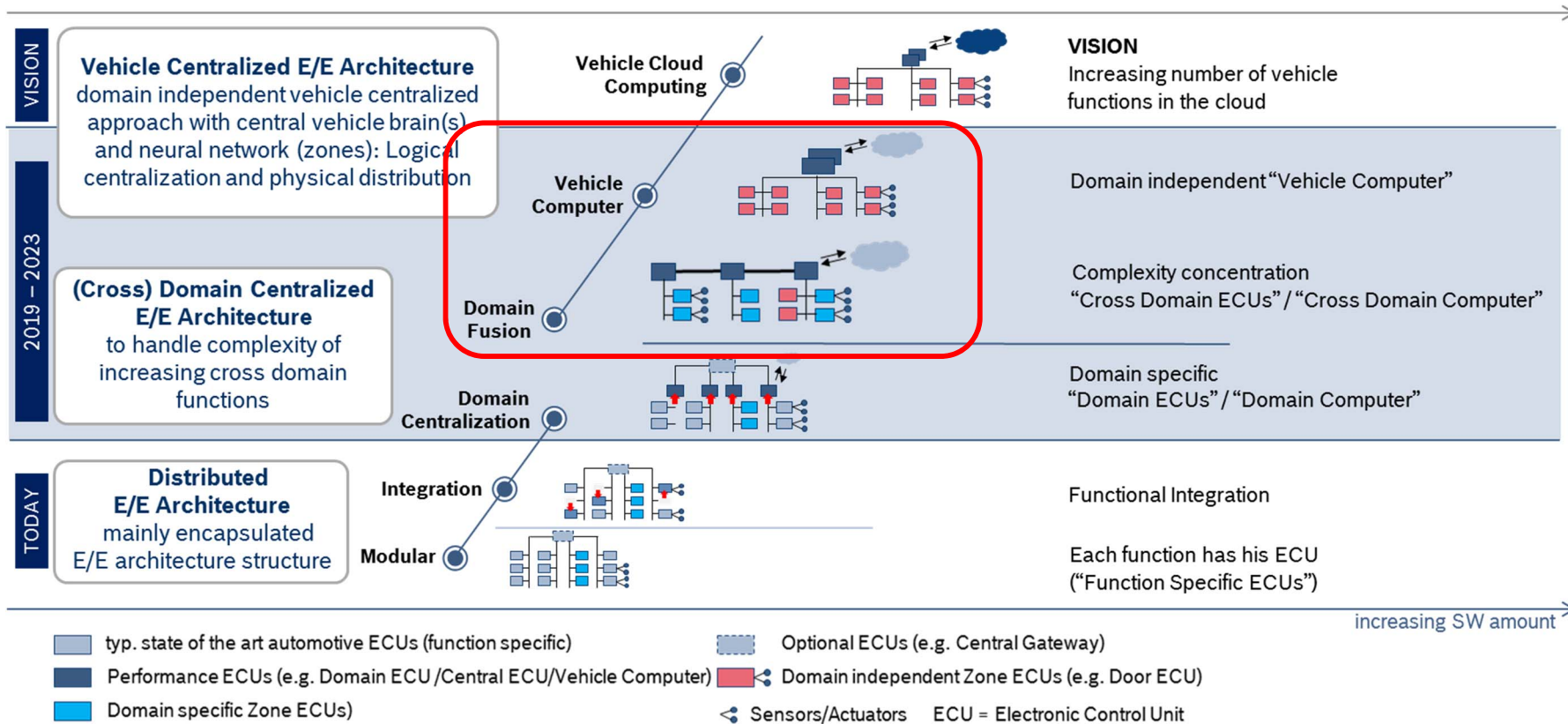20 bn.
connected devices
until 2020

CUSTOMER
New services
and
business models

Business models and configurations evolve with moving state-of-the art

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RB Multi Domain Strategy
Clear trend towards major upheaval of EE architectures

VISION

Vehicle Centralized E/E Architecture
domain independent vehicle centralized approach with central vehicle brain(s) and neural network (zones): Logical centralization and physical distribution

2019 – 2023

(Cross) Domain Centralized E/E Architecture
to handle complexity of increasing cross domain functions

TODAY

Distributed E/E Architecture
mainly encapsulated E/E architecture structure

Vehicle Cloud Computing

Vehicle Computer

Domain Fusion

Domain Centralization

Integration

Modular

VISION
Increasing number of vehicle functions in the cloud

Domain independent "Vehicle Computer"

Complexity concentration "Cross Domain ECUs" / "Cross Domain Computer"

Domain specific "Domain ECUs" / "Domain Computer"

Functional Integration

Each function has his ECU ("Function Specific ECUs")

increasing SW amount

- ☐ typ. state of the art automotive ECUs (function specific)
- ☐ Performance ECUs (e.g. Domain ECU /Central ECU/Vehicle Computer)
- ☐ Domain specific Zone ECUs)
- ☐ Optional ECUs (e.g. Central Gateway)
- ☐ Domain independent Zone ECUs (e.g. Door ECU)
- ⊰ Sensors/Actuators   ECU = Electronic Control Unit

Centralization (into computation nodes) & system boundary expansion (into the cloud)

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Instrumentation and Infotainment systems are merging

▶ Support of **holistic vehicle HMI concept**

  ▶ Displaying everything that needs to be displayed

  ▶ Granting function safety for critical elements in primary view-field

  ▶ Multimodality including haptic feedback for more safety and comfort

▶ Solution for **economical vehicle lines**

  ▶ Scalable technology portfolio with flexibility for specialization

▶ Integration framework for **securely connected services**

  ▶ Down to Connectivity Units acting as gateway to critical networks

 ▶ Also for deeply embedded functions, like automated driving use cases

Infotainment products constitute the interface to the user and to external services

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RB Multi Domain Strategy
Changing business / collaboration models

▶ Different business models for infotainment system development get applied, going beyond the classical model (Tier1 develops mainly the complete system)

▶ Advantages of these new and often more complex business models

- Increasing technical complexity of the systems is addressed by system de-composition
- OEMs can assume responsibility on system or sub-system level, e.g. from HMI to system integration
- OEMs are enable to define and implement their software roadmaps independent of Tier1 suppliers
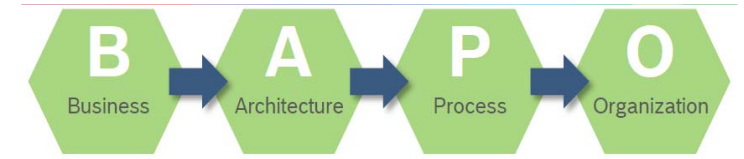
▶ Conclusions

- The classical "OEM/Tier1 only" business model will be more and more replaced by other models with different responsibilities and more stakeholders
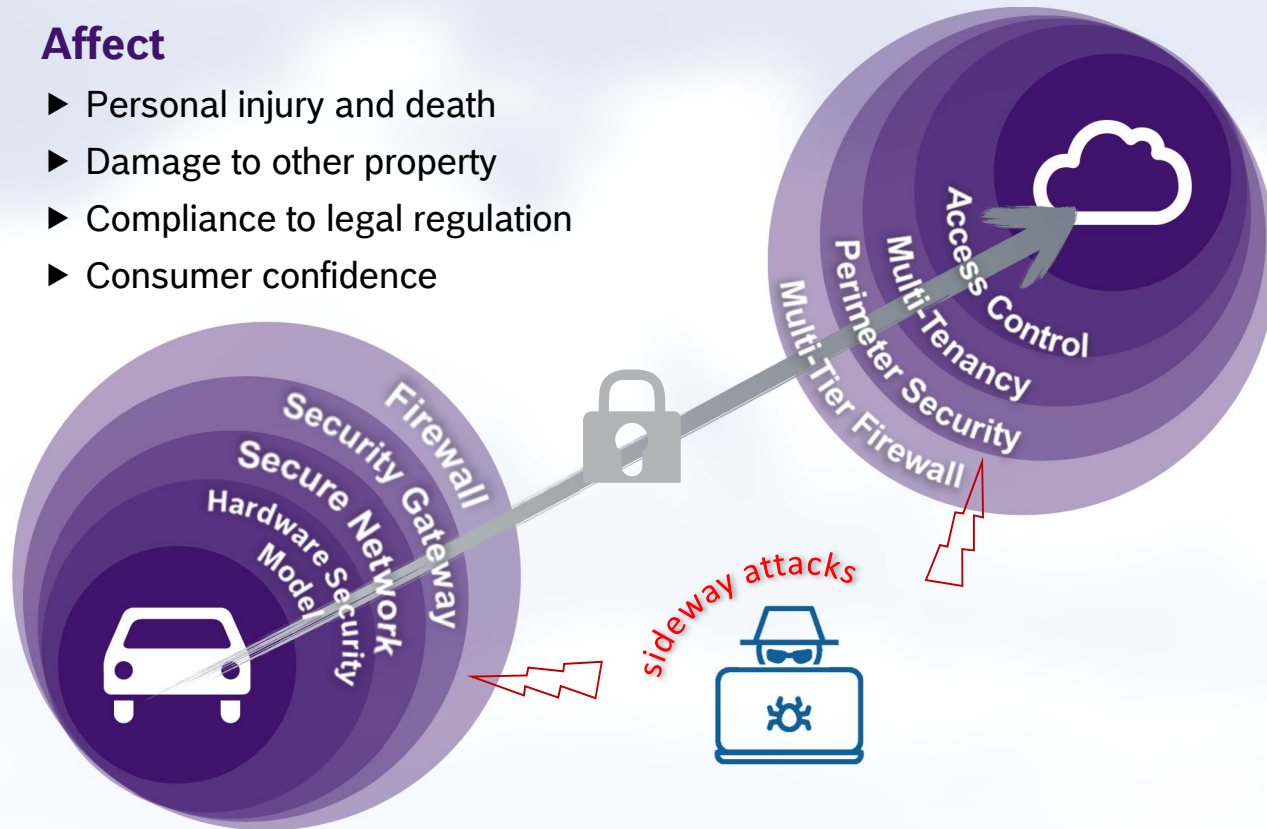- Successfully mastering these new business models will be a key to success for OEMs and Tier1s in future

Engaging in development communities like GENIVI supports to master complex project setups

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RB Multi Domain Strategy
Security & Privacy as major architectural driver

Affect

▶ Personal injury and death

▶ Damage to other property

▶ Compliance to legal regulation

▶ Consumer confidence

Firewall
Security Gateway
Secure Network
Hardware Security
Model

Access Control
Multi-Tenancy
Perimeter Security
Multi-Tier Firewall

sideway attacks

Privacy

▶ Enforcement of well-defined privacy policies

▶ Transparent and user friendly

Security

▶ Measures for all IoT elements, i.e. assets, network, backend

▶ Application- and component-specific defense-in-depth strategy

▶ State-of-the-art technology

Security is a key success factor for connected services and a system architecture driving aspect

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Bosch Car Multimedia strategy based on GENIVI and OSS technology

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RB Multi Domain Strategy
General platform building blocks
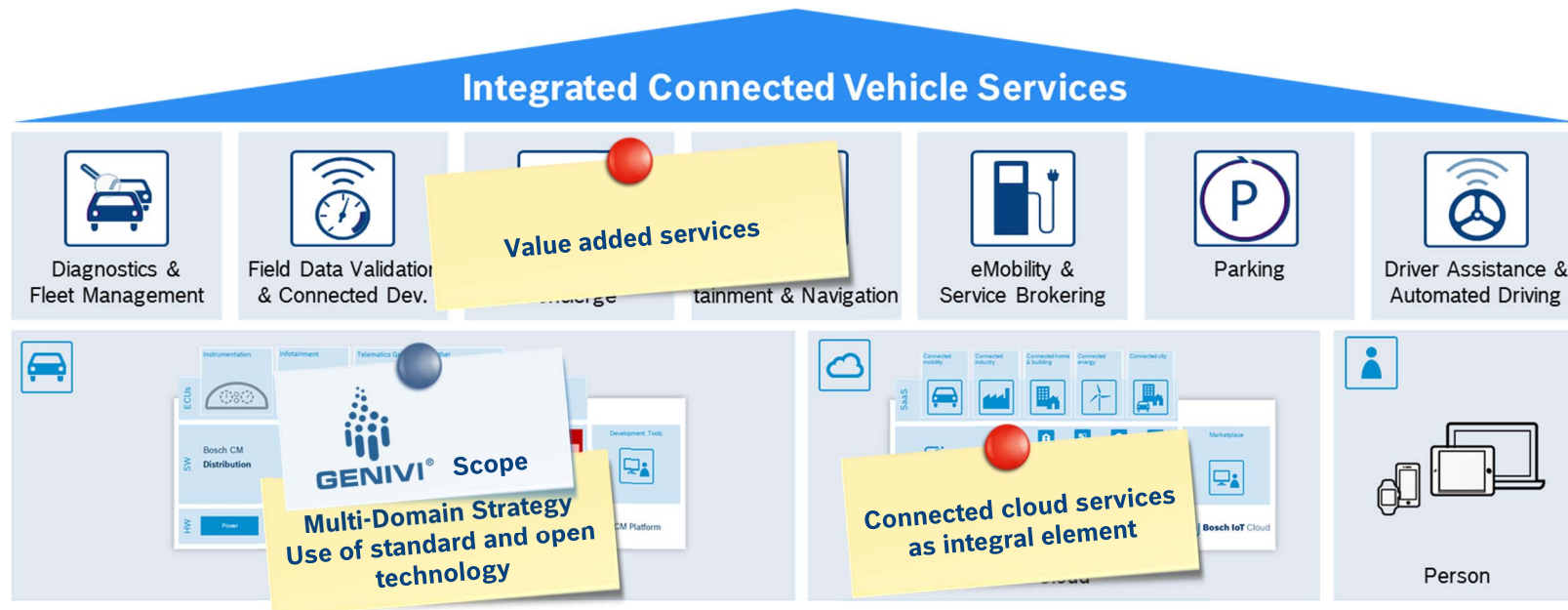
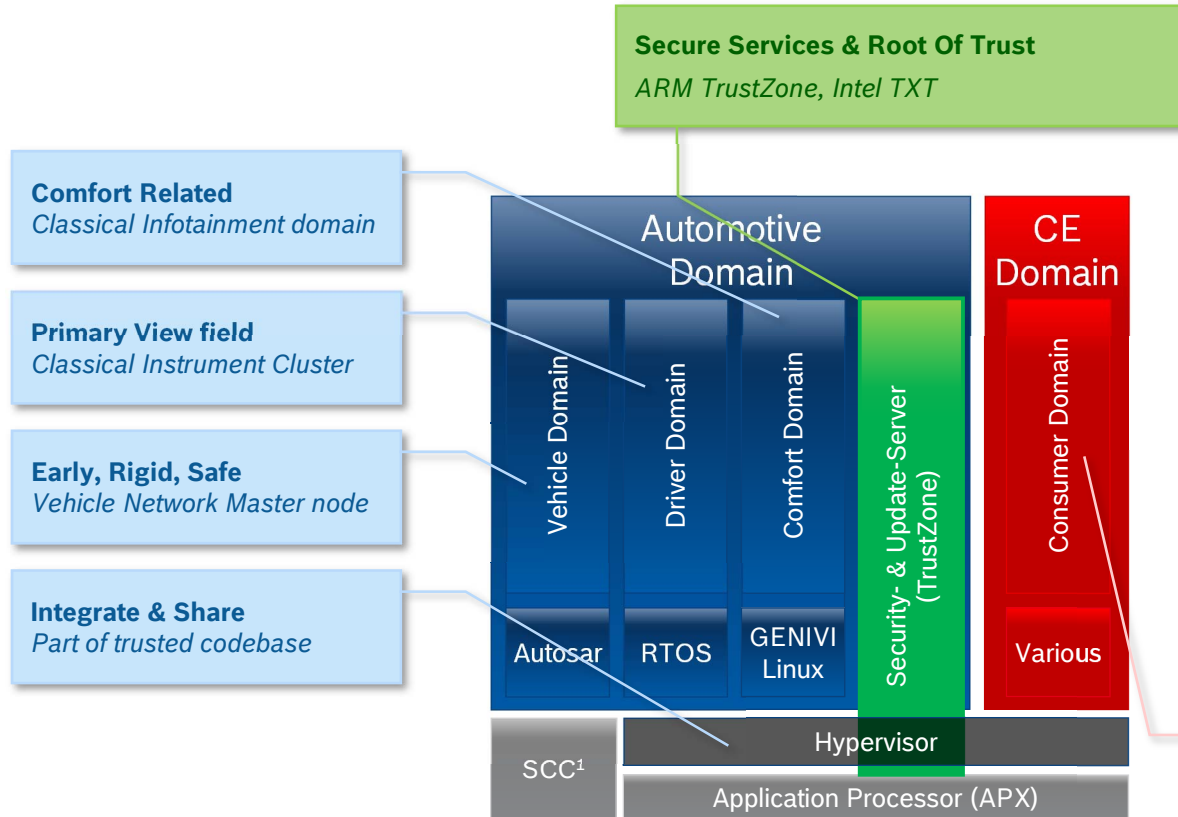▶ Platform spans across all *areas:* in-vehicle but as also cloud and personal devices

Features are handled holistically and broken down into composed sub-functions being deployed to the respective environment

▶ In-vehicle platform is based on several domains and used across all product-lines

Products and segments are derived from a consistent basis

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RB Multi Domain Strategy
Car Multimedia domain architecture

Secure Services & Root Of Trust
ARM TrustZone, Intel TXT

Comfort Related
Classical Infotainment domain

Primary View field
Classical Instrument Cluster

Early, Rigid, Safe
Vehicle Network Master node

Integrate & Share
Part of trusted codebase

Automotive Domain

CE Domain

Vehicle Domain

Driver Domain

Comfort Domain

Security- & Update-Server (TrustZone)

Consumer Domain

Autosar

RTOS

GENIVI Linux

Various

SCC[1]

Hypervisor

Application Processor (APX)

Secure Connectivity Services
Landing zone for external content
i.e. based on GOOGLE Android or FOSS Apertis

Security Paradigms

- Strict legal compliance (state-of-the-art measures, data protection)
- Strict isolation of critical components / infrastructure
- Defense-in-depth approach
- Consequent application of least-privilege-principle
- Up-to-date security by fast fixes (i.e. days) in CE domain, updates in automotive domain acc. to automotive procedures

1) SCC could also be integrated in Application Processor

Car multimedia's implementation of the GENIVI domain interaction strategy

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RB Multi Domain Strategy
Key Success factors to master the challenge   - 1 -

Our view: No one 'alone' can master the challenge
                   Proprietary platforms for software integration nodes lose relevance

▶ Follow upstream-first principle

  ▶ IVI-SW Development must be fully aligned with OSS components, frameworks and toolchains

  ▶ Enablement of an ECO system

▶ The infrastructure of IVI-Software (Architecture, Toolchain, Processes) should not contain any proprietary technologies

  ▶ Proprietary cross cutting processes, methods and tools should be harmonized

    – The processes and the tools for software build & integration shall be flexibly adaptable to the OEM needs

    – Related proprietary tooling's must be transferred into mainstream OSS solution

  ▶ Proprietary frameworks and central functions must be replaced completely

    – Own approaches must be contributed to corresponding OSS projects

Go upstream for collaboration and join the GENIVI and OSS contributor community

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RB Multi Domain Strategy
Key Success factors to master the challenge   - 2 -

- ▶ Align solution (Interfaces, Protocols, Tools) with adjacent environments (µP-, OS- und HV-Combinations)
  - ▶ Genivi, Adaptive Autosar, Android, W3C
  - ▶ Deployment variants, inter-domain connection, resource and device sharing

- ▶ Refined with any desired software solution and related 3rd party SW-partner
  - ▶ From the pool of partners of a particular OEM and integrated into their products
  - ▶ Across the complete value chain
    (commercial technology supplier, OSS consultancy service provider, OSS software distributor, contract developer, etc)

- ▶ Share commonality across OEM specific products
  - ▶ Integrated into diverse environments and configurations at different OEMs
  - ▶ and thus via the OEM also into competitor products

GENIVI is the platform to drive this mission

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Q&A

Thank you!   Any questions?

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