Connected Infotainment Systems
The Internet of Things in the Car

Thomas Kropf
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Outline

➡ Who is “Bosch”?

➡ Connected Infotainment

➡ Current Challenges

➡ Impact on SW Architecture

➡ Conclusion
Outline

➔ Who is “Bosch”?  
➔ Connected Infotainment  
➔ Current Challenges  
➔ Impact on SW Architecture  
➔ Conclusion
### 2014 key figures

<table>
<thead>
<tr>
<th>Bosch Group</th>
<th>48.9 billion euros in sales</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>290,000 associates</td>
</tr>
<tr>
<td></td>
<td>360,000 associates as per April 1.15*</td>
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</tbody>
</table>

**Mobility Solutions**
- One of the world’s largest suppliers of automotive technology

**Industrial Technology**
- Leading in drive and control technology, packaging, and process technology

**Energy and Building Technology**
- Leading manufacturer of security technology
- Global market leader of energie-efficient heating products and hot-water solutions

**Consumer Goods**
- Leading supplier of power tools and accessories
- Leading supplier of household appliances

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*including BSH Hausgeräte GmbH (formerly BSH Bosch und Siemens Hausgeräte GmbH)

and Robert Bosch Automotive Steering GmbH (formerly ZF Lenksysteme GmbH).
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ECSA 2015: Connected Infotainment Systems

Demand for information and entertainment

User

Demand for driver assistance

e.g. Smartphone integration

Infotainment services

Driver assistance

Vehicle

Cloud-based

e.g. Energy management

Intelligence, security

Vehicle-based

Cloud-based

Flexibility, reuse from CE-World

Demand for
driver assistance

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Connected Infotainment – Solution Alternatives

Smartphone enabled apps & services leverage actuality and processing power of CE devices
Services downloaded to the head unit are linked to the vehicle.

Downloaded apps managed by the head-unit
Inspired by Apple & Google
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Demand for information and entertainment

Demand for driver assistance

User

Infotainment services

Functionality, usability, HMI, safety

Vehicle

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Connected Navigation as Data Source for ADAS*

**Electronic Horizon**

- **Speed**
- **Slope**
- **Geometry**

Example: engine ECU

* ADAS = Advanced Driver Assistance Systems

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Country Road Assistant

ACC speed setting with coasting strategy is controlled by navigation information i.e. electronic horizon
Data Quality – Crowd Sourcing Approach

- Aggregation of data from sensors of different quality
- Georeferencing of data in cloud-based map
- Secure, anonymous communication
- Secure download of data
- Quality of service (communication channel)
- Merge of dynamic data with local map
- Safety relevant ADAS functionality
- Local "learning" (early data integration into map)
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Architecture Drivers for Infotainment Platforms

Market Trends
- Various cooperation models between OEM and Tier1/Tierx
- Flexible development cooperations to best utilize specialists for each discipline
- Increasing SW-sharing and -exchange
  (e.g. 3\textsuperscript{rd} party Navi, smartphone integration, ...)
- Platform and Applications independence of Tier 1

Strategic Requirement
- Independence from single suppliers (e.g. QNX, Microsoft, Google)
- Cost reduction, i.e. license fees and maintenance rates

Open Platforms and OSS development are essential to support new business models of SW-sharing and development cooperations
What do you think?

→ How many Lines of Code do we have in a head unit as of 2015?
→ How do we take care that your mobile is working well with the HU?
Infotainment product complexity

Lines Of Code double approx every 2.5 years, 3rd party share grows 5x faster than in-house.
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Wide Scope of Connectivity

- **Safety & Security**
  - Driver Assistance Functions
    - Instrumentation, Warning Gongs, Winker signals, Vision, ADAS
    - Driver Monitoring, Augmented Reality, ASIL B, Field Test
  - Cloud Connectivity
    - Add-On SW (AppStore), IoT, Internet Gateway, HTLM5, Data Structures, Protocols
    - Backend & APIs, continuous change, TTM, Privacy, Attacks

- **Interoperability of Mobile Devices**
  - Multiple Technologies: BT, USB, SD, WiFi, SPI, ...
  - Multiple Regions: USA, EU, China & Japan, ...
  - Multiple Protocols: e.g. SPI – mySPIN, Car Play, Android Auto, Mirror Link
  - Test Cycles Pre-SOP: >100 (30) per Year / Region / Technology (USB)
  - Test Cycles Post-SOP: >250 (100) per Year / Region / Technology (USB)

- **Networking & (OTA) Update in a Distributed Setup**
  - Many supplier / partner
  - Several parallel processing units
    - μP, μC, Audio-Chip, DSP, GPU, multiple SoCs, Big / Little, Multicore, etc.
Multiple data streams and bearers have access to the vehicle head unit.
Hack of connected car raises alarm over driver safety

Video: https://dp8hsntg6do36.cloudfront.net/55ad80d461646d4db7000005/531bc5de-3185-49d1-ae1d-2e4ac580efelow.mp4
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Future Infotainment Domain partitioning

Support Functions

Functional Domains

Automotive Domain

CE Domain

Vehicle Domain
Driver Domain
Comfort Domain
Security & Update-Server (TrustZone)
Connectivity Domain
Consumer Domain

Processor (s)

Safety

Security

SAFETY

DSP cores, GPGPU...

Reception (SDR)
Audio processing
Video Processing
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Connectivity levels in focus – End-2-End

The car is the ultimate [mobile | connected | IoT] device

Vehicle

Backend Systems

Network & Provider

Wireless

Applications (Vehicle part)

CCU – Connectivity Control Unit or Module

Ethernet

Applications (backend part)

IP Routing

WAN Standards (e.g. LTE)

3G

4G

5G

IEEE 802.11p

802.11n

The car is the ultimate [mobile | connected | IoT] device
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Cars are the ultimate IoT devices

Help us tackling the SW (architecture) challenges

http://www.toptal.com/android/is-developing-for-car-infotainment-systems-the-next-big-thing