Architecture Transformation towards IoT Ecosystems
Enabling Data-Driven Development for Software-Defined Vehicles

Automotive Software Factory | September 22nd, 2021
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Architecture Transformation towards IoT Ecosystems

Content

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Vehicle Architecture Transformation
Vehicle Architecture Transformation
Changing Stakeholder Requirements

Addressing Stakeholder Needs
› Continuous Evolution (Digital Lifecycle)
› V2X & Cloud Integration
› Time2Market
› Integration of 3rd party SW
› Safety, Security & Privacy

Impact to Architecture
› Decoupling Hardware from Software & Services
› Compute Centralization
› Separate I/O from Compute
› Cloud / IoT Integration
› Platform & Interface Standardization

Drivers, Differentiators & Portfolio
› Driven by customer experience
› Software as main differentiator, innovation driver & asset
› Ability to provide solutions and integrate across IoT stack
› Scalable platforms and re-usable building blocks
Vehicle Architecture Transformation

Complexity & functional growth with current approach reaching its limits

Up2now

Patchwork architecture

› Up to ~100 ECUs, limited computing power
› Functionality isolated in ECUs
› Lots of wires
› Limited cloud-based functionality

User expectation: pleasure, safety and convenience

Going forward

Function-defined architecture

› Few High-Performance Computers and Zone Control, significant computing power
› Functions defined by SW (HW abstraction)
› ~50% reduction of wires
› Always connected

User expectation: smart IoT device

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**Vehicle Architecture Transformation**

**Trust-based Collaboration & Partnership Models**

**Hardware and function coupling – Software treated like hardware**

<table>
<thead>
<tr>
<th>Tier1 → OEM</th>
<th>Function development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier2 → Tier1</td>
<td>Middleware ECU integration</td>
</tr>
<tr>
<td>Tier1</td>
<td>Hardware development</td>
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<table>
<thead>
<tr>
<th>Function development stops at SOP¹</th>
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<tbody>
<tr>
<td>Middleware maintenance</td>
</tr>
<tr>
<td>Hardware production</td>
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<tr>
<td>Spare part delivery, garage maintenance services</td>
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**Software-defined vehicle needs a software platform partner throughout vehicle lifecycle**

<table>
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<th>OEM</th>
<th>Function development</th>
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<tr>
<td>SW supplier</td>
<td>Middleware ECU integration</td>
</tr>
<tr>
<td>HW supplier</td>
<td>Hardware development</td>
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<table>
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<th>New functions and services</th>
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<tr>
<td>Middleware adaptation including security and safety support</td>
</tr>
<tr>
<td>Maintenance and lifetime security and safety support</td>
</tr>
<tr>
<td>Hardware production: Updates/changes possible</td>
</tr>
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<td>Spare part delivery, garage maintenance services</td>
</tr>
</tbody>
</table>

1 SOP: Start of production, 2 EOP: End of production, 3 EOL: End of life

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Vehicle Architecture Transformation
From domain to function & service orientation

Going forward
Function-defined & Service-oriented

Up2now
Domain-oriented

Interior Cockpit / HMI  Body & Comfort  ADAS / AD  Safety / Motion  ...

Appl.  Appl.  Appl.  Appl.  ...
SW / OS  SW / OS  SW / OS  SW / OS  ...
HW  HW  HW  HW  ...
...
...
...
...

Vertical Integration
full solution/stack that OEM can leverage

Horizontal Integration
synergies, reuse and maturity/quality

From domain to function & service orientation
Software Defined Vehicle
Key elements of the Software Defined Vehicle

Continental Automotive Edge Framework – our full-stack IoT solution

Scalable Compute Platform

Cloud / On Premise

Digital Twin
Predictive Maintenance

Cloud Services

Automotive SW Platform

Platform Services

Middleware
Edge Enabler
Simulation & Validation Services

Continental HPC Platform

Data Center

Cloud / On Premise

Sensors
Zones / ECUs
Actuators

Vehicle Infrastructure

Note: Size of the boxes does not reflect the size or complexity of the software.
Key elements of the Software Defined Vehicle Development Kits – enabling efficient product development

- **Harmonize** development and integration of distributed services & applications
- **Provide** a platform solution, clear interfaces & development environment
- **Enable** seamless development of service-oriented IoT ecosystem architectures

HPC = High-Performance Computer; SCP = Scalable Compute Platform; ZCU = Zone Control Unit
Key elements of the Software Defined Vehicles
Automotive DevOps in High Performance Computing

Continental Cooperation Portal
Continental Software Factory
Continental HPC Platform(s)

code
build
test
release
deploy
operate
monitor

plan

DEVELOPMENT
BUILD, TEST & INTEGRATION
DELIVERY
OPERATION

GitHub
JIRA
Confluence
禅道
sonar
qube
Plant UML

Jenkins
python
ansible
EMU
MySQL
Gradle
Gratana
LINUX

docker
VirtualBox
docker
VirtualBox

kube
AWS
Azure
neo4j

TensorFlow
Terraform
kubernetes
maven

kibana
Development for the Software Defined Vehicle
Collaborative Development and CI/CD

Cooperation Challenges
Collaborative Development and CI/CD
Mastering Cooperation Challenges

- Feature Requests
- Bug Reports
- Software

Continental Software Factory
- Continuous Integration / Test / Delivery
- Embedded Hardware
- In House Resources
- Cloud Resources
- Software Delivery
- KPI Reports

External Software Factories
- Developer & Manager
- OEM
- Tier 1 A
- Tier 1 B
- 3rd party

In-House Resources

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Currently, the primarily used **applications** in the **CCP** are Artifactory and Jira.
Data Driven Development
Data Driven Development during R&D

Use Case: Robustness validation of ADAS/AD functions

Drive vehicle, collect data

Data acquisition

Update Software

Real world

Datalake: Vehicle test data (> 1 mio km)

Analyze and upload data

Optimize Algorithm

Validate with test data

Virtual world

Deployment

Model training

Test optimized algorithm

Cloud Server

Embedded Target

Similar to Target

ADAS: Advanced Driver Assistance System, AD: Automated Driving
Data Driven Development
Evolution towards **Data Driven Ecosystem**

1. **Update Software**
   - Drive vehicle, collect data
   - **Silent testing**

2. **Data acquisition**
   - **Data Selection & Aggregation**

3. **Analyze and upload data**
   - **3G**

4. **Optimize Algorithm**
   - Model training
   - Simulation
   - Validation

5. **Test optimized algorithm**
   - **Cloud Server**

6. **Validate with test data**
   - Similar to Target

**Data Factory:** Vehicle test data (> 10 mio km)

**REAL WORLD**

**VIRTUAL WORLD**