Volkswagen goes Adaptive

Adaptive AUTOSAR as SW Framework
for the new electric vehicle platform

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1. Motivation – Why is there a need for change?
2. Introduction – Basic approach, assumptions & challenges
3. Central architectural concepts
4. Roadmap Adaptive AUTOSAR
5. Conclusion

Current way of thinking: Vehicle separated from customers’ daily digital experience

New way of thinking: Vehicle integrated in customer digital experience
Motivation

„Digital World“ stands for innovation and being up to date
→ The Vehicle becomes an integral part of this digital world

The smart vehicle consistently increases its performance via updates and upgrades after sales

A new approach is required to enable continuous innovation
Assumptions and Challenges

Key Parameters

- Power Train
- Chassis
- Body
- ADAS
- Infotainment
...  

- Power Train
- Chassis
- Body
- ADAS
- Infotainment
- Auto. Driving
- Digitalization
...  

Criteria

- Distributed Functional Architecture
  - not appropriate for update- and upgradability

E/E-Architecture

- Centralized Functional Architecture
  - Application Server with Basic System Services

Technische Entwicklung
Elektrik/Elektronik
Architectural Pattern for Automotive Networks

Central Gateway Architecture

- Vehicle functions are distributed
  - High scalability
  - Distributed functions are limited by the network capabilities

Domain Controller Architecture

- Integration of software into domain-specific ECUs
  - Increased flexibility
  - Cross domain functionalities over different Domain Controller (DC)
  - Limited scalability (DC always required)

Amount of software

Software complexity
A new approach to enable updatability & upgradability

Centralized functional architecture with decoupling of application software and I/O functions
- Reduce overall system complexity and dependencies between applications

Efficient & fast development of customer functions
- Provide basic services required by several customer functions
- Make use of service-oriented communication
Service-oriented architecture as key to digitalization

Enables Volkswagen to reduce complexity & improve updateability, upgradeability, reusability and portability by:

- dividing applications in single, self-contained software components
- minimizing functional dependencies between software components

Achieved by:
- Service-oriented communication
- dynamic binding using service discovery and publish/subscribe
- Data representation primarily based on REST (Representational State Transfer) → uniform interfaces, stateless, separation of concerns, ...
- Forward- and backward-compatibility of interfaces
Interface compatibility

To enable continuous updates and upgrades, the compatibility of interfaces is required.

Depending on the use cases this can be achieved with:

- SOME/IP including a TLV (Tag-Length-Value) extension
- ViWi (Volkswagen infotainment Webservice interface) based on JSON

Forward compatibility:
An receiver is able to ignore additional elements provided by an updated interface.

Backward compatibility:
An updated receiver is able to receive and process only a subset of the required elements provided by an interface.
Communication Server

Central architectural component to encapsulate signal-based communication from service-oriented communication

- (Bus)signals on sensor-actuator level and legacy partition
- Services interfaces for service-oriented communication (application/basic services)

ICAS

Legacy partition

Applications

Basic Services

Communication Server

Router (Signal/PDU)

Service-oriented communication

Communication Server

Signal-based communication
Common SW-Framework based on Adaptive AUTOSAR

- Customer functions/basic services can be developed independently of ICAS and operating system
- Common methodology and exchange formats
- Common update and communication protocols
Roadmap basic software for partitions with Adaptive AUTOSAR

- POSIX Operating System
  - Execution Management
    - Initiate / Terminate of function
    - Restart of functions
    - User Management
  - Communication/Middleware
    - Ethernet incl. SOME/IP
  - Memory Management
    - File system access
    - Safe Key/Value Storage
  - Diagnostics
    - Logging and Tracing (DLT)
    - Diagnostics protocols
  - Methodology & Templates
    - SWC Description
    - Manifest
    - Signal-oriented communication to service-oriented communication

- Safety & Platform Health Management
  - E2E Protection
  - Watch dog

- SW-Updates & SW-Configuration Management
  - Partitioning concept
  - Interface for partition switch in Bootloader + SW reset
  - Installation routine

- Memory Management
  - Updates by SW-Configuration Management

- Security
  - Encryption
  - Authentication
  - Certificates
  - Crypto Hardware

- SW-Updates & SW-Configuration Management
  - Packet mechanisms
  - SW transfer onto ECU

- Execution Management
  - Updates by Security

- Architecture

- Methodology & Templates

- Diagnostics

- Execution Management
  - Resource Management
  - Updates by SW-Configuration

- Memory Management
  - Updates by SW-Configuration Management

Later Releases

- HW Acceleration (OpenCL)

- Vehicle API

- Further Language Bindings

- Redundancy mechanisms

- Startup Checks
Conclusion

Volkswagen is going to introduce a centralized architecture with focus on updataability and upgradability of customer functions.

In-Car Application Servers (ICAS) are using Adaptive AUTOSAR as SW-Framework.

Volkswagen & Vector will jointly promote the Adaptive AUTOSAR standard to be used in ICAS ECUs.
Thank you very much for your attention