Examining BMW’s Open Architecture For Telematic Applications
Challenges and Opportunities

Hans-Ulrich Michel
Project Manager Information, Communication and Telematics

BMW Group
Examining BMW's Open Architecture
For Telematic Applications
Challenges and Opportunities

1. Introduction: The “Starting Point”

2. Challenges and Opportunities

3. Open Platform and Standardization Activities

4. BMW Research – Exemplary Applications
The “Starting Point”:
The importance of automobile electronics
The Importance of Automotive Electronics

- Percentage of Production Costs: 20-35%
  Increase 10-15% p.a.
Challenges and Opportunities:
What are the challenges and opportunities for the future?
**The Main Challenge:**
Major increase in System Complexity

**ECU architecture: BMW luxury segment**

<table>
<thead>
<tr>
<th>Number ECU´s</th>
<th>16-24</th>
<th>33-70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Networking</td>
<td>PT-CAN (500 kBd)</td>
<td>PT-CAN (500 kBd)</td>
</tr>
<tr>
<td></td>
<td>I/K-BUS (9.6 kBd)</td>
<td>K-CAN (100 kBd)</td>
</tr>
<tr>
<td></td>
<td>P-BUS (9.6 kBd)</td>
<td>K-CAN-P (100 kBd)</td>
</tr>
</tbody>
</table>

**Driving Forces Networking:**
- Increasing number of ECU´s
- Multi-usage of sensor signals
- Diagnostics
- Hierarchical and functional overlapping of app´s
The Main Challenge:
Major increase in System Complexity
The Main Challenge: Major increase in System Complexity

Service & Interaction Functionality

Diagram describing the integration of different communication services and their interactions, including Messages, GSM-Cards, Phone Numbers, Addresses, Calendar, Broker, and Navigator.
The Main Challenge: Major increase in System Complexity

- ECU architecture: BMW luxury segment
- Number of ECUs: 10.24
- Increased networking: PT-CAN (500 Mbps), LIN-BUS (10 Mbps), P-BUS (10 Mbps)

Driving Forces Networking:
- Increasing number of ECUs
- Multiplexing of sensor signals
- Diagnostics
- Hierarchical and functional overlapping of apps

ECUs & Busses
Communicating Devices
Software complexity
The Main Challenge:
Major increase in System Complexity

Problem:
System complexity makes development cycles longer and less predictable

Solution:
To be successful it’s important to design a vehicle architecture that enables time- and cost-efficient integration of new functionality and devices. To reduce implementation risks and to achieve easy interoperability between subsystems it’s necessary to create Open Standards.
Open Platform:
Open Platform and Standardization Activities
Open Platform Design: Functions are software-modules in an application space on a system platform using standardized API´s. Integration of external devices via MOST.

Integrated HMI, but all functions (App´s) running on different devices.

Stand alone devices
## Important Standardization Activities for the Automotive Industry

<table>
<thead>
<tr>
<th>MOST Cooperation</th>
<th>OSEK/VDX</th>
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<tbody>
<tr>
<td>Media Oriented Systems Transport</td>
<td>Open systems and the corresponding interfaces for automotive electronics</td>
</tr>
<tr>
<td>Open Services Gateway Initiative</td>
<td>Automotive Multimedia Interface Collaboration</td>
</tr>
</tbody>
</table>
Important Standardization Activities for the Automotive Industry

• Car Networking Standardization
• ECU Abstraction as a set of Function Blocks
• Media Independent Object Model and Transport Protocol
Important Standardization Activities for the Automotive Industry

To be used as a software platform for Communication Gateways
Benefits of an OSGi enabled Platform for Car Manufacturers

• Reduce Overall Dependencies
  • Platform Vendor Independence
  • Service Provider Independence
  • Network Independence

• Security Infrastructure

• Standardized Hardware Abstraction (HW-SW Separation)
• Standard Platform APIs and Basic Libraries

• Scalability of Application (Client / Server)

• Dynamic Service Deployment

• Specification of API´s for Automotive Requirements (R3)

• Rapid Application Development

• Faster Time-To-Market of the Complete Infrastructure (through standardized SP-Interaction)
Benefits of an OSGi enabled Platform for Car Manufacturers

• Component Model
Benefits of an OSGi enabled Platform for Car Manufacturers

• Component Model
Benefits of an OSGi enabled Platform for Car Manufacturers

• Component Model

Navigation Application

1. Navigation UI
2. Route Guidance
3. Route Calculation
4. Utils
5. System
6. Map Service
7. Positioning API
8. Messaging Service
9. LB-Advertising

OSGi Framework

LB-Advertising Application
Benefits of an OSGi enabled Platform for Car Manufacturers

• Component Model

⇒ Easier and Quicker Application Development and Deployment!
BMW Research:
Some Exemplary Applications
BMW Research - EU-Project
End-to-End Architecture for Service Delivery

OSGi Client

 invokeService [uh, bh, sid]

 [result]

 Vodafone

BillService [uh, bh, sid]

 BMW Service Provider

Authorize [uh, sid]

Authorize [uh, sid]

Top Drive BMW Customer Data

Propagate user id/services data

A1-A2: authenticate exactly one time
B1-B4: authorize and use service n-times

uh: user handle
sid: service identifier
bh: billing handle
Parking Application

System Architecture
Parking Application System Architecture
Parking Application
Component View

Parking Bundles
Shared Bundles
System/Base Bundles

Parking Application
Parking UI
Parking Information Service
Electronic Ticket Service
Route Guidance
Route Calculation
Map Service
Positioning API
Communication Service
System / Utils / HMI

OSGi Framework
**1. Travel Plan at Home**
- (with parking lot reservation)

**2. Travel by car**
- Download travel data / route
- Onboard-route guidance
- Route calculation off-board

**3. Walking to destination**
- Use PDA with map / walking route to go from parking lot destination
  (Java / native app? -> look and feel)
Seamless Navigation Application
High Level Navigation Requirements

1. Ability to navigate to a target
2. The navigation user should have to input the target and way points only once.
3. Ability to synchronize destination and way points in order to fulfill req.2.
4. Ability of all navigation devices (CCC and PDAs) to cooperate while navigating (e.g. avoid multiple position or route calculation, simultaneous audio output etc.).
5. Master awareness => „the better is the master“ strategy, the CCC will be the master for the most operations, but a better performing PDA can become a master for e.g. route calculation => master negotiation protocol.
6. Seamless navigation continuation after leaving the car.
7. Ability to update the map
Seamless Navigation Application

Component View

Navigation Bundles
  - Shared Bundles
  - System/Base Bundles

Navigation Application

- Navigation UI
- Navigation Information Synch Service (PDA)
- Navigation Master Negotiation Service
- Route Guidance
- Route Calculation
- Map Service
- Positioning API
- Communication Service
- System / Utils / HMI

OSGi Framework
Personal Information Assistant Application

General Requirements

• Synchronization of Personal Data. Home PC / PDA / Vehicle / Server
  • Vcard (Address, Phone)
  • Tasks
  • Memo
  • Email
• Possible Additional Feature
  • Vcar-Profile with Car-Personalization Data
Personal Information Assistant Application
Component View

PIA Application

- PIA UI
- Calendaring Service
- E-mail Service
- Contacts Service
- Synchronization Service
- User Authentication Service
- User Admin Service
- Communication Service
- System / Utils / HMI

OSGi Framework

PIA Bundles
Shared Bundles
System/Base Bundles
Conclusion

To be successful it is important to design a vehicle architecture that enables time- and cost-efficient integration of new functionality and devices.

To develop Standard API’s for the interaction of subsystems is essential.

OSGi™ is an important standardization activity for the automotive industry that enables the implementation of an open platform design.