INTRODUCING AUTOMOTIVE ETHERNET
A PROJECT MANAGER’S ACCOUNT

5TH ETHERNET&IP@AUTOMOTIVE TECHNOLOGY DAY, OCTOBER 2015
### OVERVIEW.

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>2008</td>
<td>Flash, diagnostics and private link</td>
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<tr>
<td>2013</td>
<td>Transmission of video data (camera)</td>
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<tr>
<td>2015</td>
<td>System bus for infotainment and driver assistance</td>
</tr>
<tr>
<td>2018</td>
<td>Ethernet as communication backbone</td>
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</tbody>
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1. Early developments
2. Introducing Ethernet as system bus (November 2011 – April 2015)
3. Outlook
OVERVIEW.

1. Early developments
2. Introducing Ethernet as system bus (November 2011–April 2015)
3. Outlook

- 2008: Flash, diagnostics and private link
- 2013: Transmission of video data (camera)
- 2015: System bus for infotainment and driver assistance
- 2018: Ethernet as communication backbone

Karsten Wittmack, BMW AG, 5th Ethernet&IP@Automotive Technology Day 2015.
FIRST USE CASES – FLASH&DIAGNOSTICS, HU—RSE.

Flash update and diagnostics (series 2008)

Data link between HU and RSE (series 2008)

Cost savings

100Base Tx Ethernet unshielded

Use Cases

Limited useability

100Base Tx Ethernet shielded

Cost savings

Use Cases
THE BREAKTHROUGH: COST EFFICIENT SOLUTION WITH BROADR-REACH (OABR) ETHERNET (100BASE-T1).

New PHY technology allows for the use of unshielded cables (independent from the software stack, 2008 result)

Pilot Use Case: P2P links between cameras and surround view ECU, decision March 2010, SOP July 2013
POINT-TO-POINT LINKS FOR CAMERA SYSTEM.

Proved functionality
✓ EMC performance
✓ Suitable components (CMC)
✓ Simple design rules
✓ Basic Tooling
✓ Embedded software stack

Specific for camera use case
• Support of small package
• Quality and timing impact of compression
• Processor load for high streaming data rates (e.g. 70 Mbit/s per MJPEG-Video, 4 times at ECU
• More complex control of the image compression (e.g. Control of Encoder-Resources)
## DECISION REQUIREMENTS FOR EXTENDED USE.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Status November 2011</th>
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<tbody>
<tr>
<td>1. Technology technically sound</td>
<td>• Pilot proved technology, use of IT solutions and created Tier1/2 partners</td>
</tr>
<tr>
<td>2. Re-use of standard IT approaches possible</td>
<td>• confirmed technology and test methodologies</td>
</tr>
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<td>3. Multi-sourcing possible</td>
<td>• NXP announced sourcing on 1st Ethernet&amp;IP@Automotive Techday@BMW</td>
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<tr>
<td>4. Other OEMs interested</td>
<td>• OPEN ALLIANCE was founded to support industry wide use</td>
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<td>5. Suitable Tier 1/2 partners exist</td>
<td>• Integration of Ethernet interface was started</td>
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<tr>
<td></td>
<td>• 1st discussions regarding standardizing Gbps Ethernet at IEEE</td>
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</tbody>
</table>
Since then, all Ethernet deployment decisions within BMW are based on functional and economic requirements (like for all other IVN technologies).

By November 2011 BMW decided to use 100BASE-T1 Ethernet extensively in infotainment and driver assist domains targeting the new 7-series with SOP July 2015.
OVERVIEW.

1. Early developments

2. Introducing Ethernet as system bus
   (November 2011–April 2015)

3. Outlook
THE 2015 TARGET SYSTEM.

- HU, Head Unit
- RSE, Rear Seat Entertainment
- IAM, Intelligent Antenna Module
- GW, Gateway
- DAS, Driver Assist System
- TSR, Traffic Sign Recognition
- Rview, Rear View
- SVS, Surround View System
- CAM, Camera
To ensure smooth introduction of Ethernet on such a large scale BMW established an “Intensivteam Ethernet” responsible for addressing all related aspects.
THE CHALLENGES.

Initial focus:
- AUTOSAR Ethernet-Stack
- Communication-Database
- Knowledge-Transfer

But, test-set grew with the maturity of the implementation
Change of emphasis of tests over time, generally from lower to higher OSI layer
The industry profits from:

- A proof of concept
- Training of suppliers
- Available harness manufacturing and testing methods
- Increased level of quality in all implementations
  - Ethernet stacks available with several suppliers
  - AUTOSAR Ethernet-Stack available with several suppliers
- Availability of suitable tooling
- Standardization of ECU-Test-Specification (OPEN Alliance TC 8)
- Build up of test houses
- Price drop for and emergence of competing solutions
STATUS OCTOBER 2015.

- More car manufacturers have 100BASE-T1 in production (JLR, Volkswagen, Audi, Porsche, Shanghai GM)
- More have requested for quotes
- This Ethernet&IP@Automotive Techday shows an interop demo between three semiconductor and four cable/connector vendors
- Market forecast of 260 Million ports in 2021 (Strategy Analytics)
- Various major events covered the topic: 3 Nikkei conferences, 5 Ethernet&IP@Automotive Technology Days, 1 Automotive Ethernet Congress ....
- OPEN Alliance with ~270 Members
- IEEE 802.3 with 5 related projects, +QoS in IEEE 802.1
OVERVIEW.

1. Early developments
   - Flash, diagnostics and private link
   - Transmission of video data (camera)
   - System bus for infotainment and driver assistance

2. Introducing Ethernet as system bus (November 2011–April 2015)
   - Ethernet & IP
     - Antrieb
     - Fahrwerk
     - Komfort
     - I.K.

3. Outlook
   - Ethernet as communication backbone
ETHERNET IS ESSENTIAL FOR THE E/E ARCHITECTURE.

Connection tester to ECU is IP. Fast flash updates use OBD Ethernet. Connect via IP with devices, applications, and infrastructure (C2X).

Diagnosis/ Update.
Connection tester to ECU is IP. Fast flash updates use OBD Ethernet.

Ethernet/ IP

Communications backbone.
Connects functions and domains inside the vehicle.

Car in the Cloud.
Connect via IP with devices, applications, and infrastructure (C2X).
THE FUTURE OF E/E ARCHITECTURE.

Big Data and the Cloud are the basis for automotive innovations.

Mastering complexity.

Back End. Information off the cloud.

Fail operational and redundancy.

Connectivity.

Remote software updates.

IP-Backbone

Big Data. Enhanced and usable.
SUMMARY

- BMW introduced Automotive Ethernet because of a functional need
- The discovery of OPEN Alliance BroadR Reach (OABR)/100BASE-T1 made it a cost efficient solution
- The pilot shown 2013 emphasized the PHY layer enabling
- With BMW having introduced OABR as a system bus now in 2015 the industry has a proof of concept and a completed eco-system
- The industry is ready for broad roll out
FURTHER READING

★★★★★ Where REAL automotive innovation is happening
By rogermud on June 29, 2015

★★★★★ A must have
By Aege Diver on March 4, 2015

★★★★★ Recommended
By S. Sonck Thiebaut on December 29, 2014

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THANK YOU FOR YOUR ATTENTION.

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