Transitioning to Automotive Ethernet – 10 Mbps to 10 Gbps and beyond

Mike Jones, Bernd Sostawa
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Overview

- Brief Introduction to Microchip Automotive
- Service Orientated Architecture (SoA)
- Example of Zonal System Architecture
- Case Study
  - Service-orientated communication – Sensor cluster example
  - Migration to 10BASE-T1S technology
Microchip Overview

- Leading Total Systems Solutions provider:
  - Microcontrollers, Digital Signal Controllers and Microprocessors
  - Mixed-Signal, Analog, Interface and Security
  - Clock and Timing
  - Wireless and Wired Connectivity
  - FPGA
  - Memory

- ~ $6 Billion revenue run rate
- ~19,000 employees
- HQ near Phoenix, AZ
Microchip in Automotive

- Top 10 worldwide automotive semiconductor supplier
- 25+ years proven track record delivering global solutions
Automotive Connectivity
Proven Track Record

- >1 Billion CAN & LIN devices shipped
- >600 Million total shipped
  - MOST INICs
  - Ethernet ports
  - USB media boxes deployed

>1.7 billion devices shipped to more than 220 car models
Service Oriented Architecture (SoA)

- Zonal ECUs with centralized computing
- Any service can be accessed anywhere in vehicle (SDN)
- Increases the need for Ethernet in-vehicle networking

- Ubiquitous Ethernet network 1 Mbps to 10 Gbps
Benefits of ‘All-Ethernet’ IVN

- High bandwidth data transfer
- Reduction in need for gateways
- Seamless connectivity cloud to device
- Reduction of software development
- Flexibility and scalability
- Faster time-to-market

• Lower overall cost of ownership
Example Zonal System Solution

Centralized Computing Platform

SoCs

PCIe Gen 4 Switch

Multi-Gig Ethernet Switch

Redundant Switching Network

Zonal ECU Ethernet Switch

10/100/1000T1

10BASE-T1 Sensor Cluster

10G+

1G+

100/1000T1

USB/PCIe - Ethernet

Telematics

10/100/1000T1

10/100T1

Infotainment

10/100T1

Body

100/1000T1

100/1000T1

Radar & LIDARs

10/100/1000T1

USB/PCIe - Ethernet

10/100/1000T1

10/100T1

10BASE-T1 Sensor Cluster

10G+

1G+

100/1000T1

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10/100T1

Infotainment

10/100T1

Body

100/1000T1

Radar & LIDARs

10/100/1000T1

10/100T1

10BASE-T1 Sensor Cluster

10G+

1G+
Service-oriented Communication, Sensor Cluster Example
Today, there are multiple sensor clusters in a car

- Seat
- Bumper
- Door
- Gearbox
- Etc.
A sensor cluster today is part of a fixed application defined during the car’s design.

On PCs, tablets or smartphones new applications can be added during entire device life cycle.

Why don’t we see this in cars today?
“Classic” Sensor Cluster

- Each sensor cluster uses heterogeneous point-to-point connections
  - PWM
  - Analog
  - Etc.

- A seamless delivery of the sensor cluster data to other ECUs or the cloud is not possible
Sensor Cluster with 10BASE-T1S

- Sensor cluster data is available in multiple ECUs and can be forwarded to the cloud.
Service-oriented Communication

- Sensor cluster acts as server offering services
- Applications on different ECUs subscribe for required data
  - Temperature
  - Speed
  - Position
  - Etc.
All-Ethernet Vehicle

- Common security mechanisms in all network speeds
- Common time base in all nodes
  - Sensor synchronisation
  - Cruise recording
- Supports all common network architectures
  - Zonal
  - Domain
- Service-oriented communication
  - Common protocols
  - No gateways needed (switching)
How to migrate?

- Identify existing or new applications
- Simulate system based on
- Optimize communication to take full advantage of Ethernet
- Implement
Simulation Configuration

- Imported AUTOSAR XML file with CAN cluster
  - ECUs
  - Messages
  - Timing
- Manually added Sensor Cluster
- AUTOSAR PDU Optimization (Container PDUs)
- Optional 10BASE-T1S features
  - Burst
  - Multiple PLCA IDs
  - Etc.
Simulation Result

- Timeline

Imported CAN ECUs

Messages from imported CAN ECUs

Sensor Cluster

SOME/IP messages
Simulation Result

- Bandwidth
- Avg. Jitter
- Max. Jitter
- Queue Size

<table>
<thead>
<tr>
<th>Node: ECU 012</th>
<th>Bandwidth (Bit/s)</th>
<th>Avg. Jitter (%)</th>
<th>Max Jitter (%)</th>
<th>Avg Jitter</th>
<th>Max Jitter</th>
<th>Max Queue Size</th>
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<tr>
<td>106.379</td>
<td>0.05 (0.13..0.01)</td>
<td>0.11 (0.42..0.01)</td>
<td>0.0172 (0.04..0.01)</td>
<td>0.0342 (0.08..0.01)</td>
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<td>0.02 (0.02..0.02)</td>
<td>0.0084 (0.01..0.01)</td>
<td>0.0204 (0.02..0.02)</td>
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<td>Node: ECU 035</td>
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<td>0.09 (0.54..0.00)</td>
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<td>0.0265 (0.11..0.02)</td>
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<td>0.14 (0.28..0.02)</td>
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<td>0.31 (0.31..0.31)</td>
<td>0.0106 (0.01..0.01)</td>
<td>0.0310 (0.03..0.03)</td>
<td>1</td>
</tr>
</tbody>
</table>

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Thank You!