Do we need Data Distribution Service (DDS) and service-oriented architecture for automotive applications?

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Flow of presentation...

• Future needs of architecture platforms
  • Computation and performance demands on processor
  • Bandwidth demands on communication

• AUTOSAR Adaptive
  • Service Oriented Architecture

• Network bindings for ara::com
  • SOME/IP
  • DDS
  • IPC

• Conclusion
Future of automotive...

**Feature Requirements**
- Highly automated driving
- Back-end connectivity
- V2X
- Electric vehicles

**Growing demand on**
- Computation
- Bandwidth requirements
- Software quality
- Remote software updates

**Standard architecture**
- Enabling integration of different manufacturers’ software, in-house software development
Trends in E/E Architectures

- New types of in vehicle computers are required to fulfill the needs of
  - Performance,
  - Flexibility and
  - Connectivity

- But
  - Backwards compatibility with existing solutions,
  - Fulfillment of increasing requirements for safety and security is a must as well.

Slide from: T. Scharnhorst, AUTOSAR spokesperson, AUTOSAR Adaptive Platform – Progress on the Software Framework for Intelligent, Safe and Secure Mobility
## Future of mobility... Software driven

### New Requirements
- Integration with off-Board Software Systems
- Secure Software Upgrades, Updates
- Central control centers to process customer/environment inputs and conditions
- Integration of in-Vehicle Software Systems: Central Control, Smart Actuators and localized Sensor/Actuator Control with Security & Safety
- Scalable power/thermal technologies to efficiently run central computing centers

### Capabilities and Technologies
- Service-based communication
- Connectivity to Industrial Internet with security framework
- In-Vehicle Large Scale Software Integrations making use of new ECU HW technologies using modern SW languages
- ECU Classifications: Central Compute, Integrated Control Units, I/O control Units
- In-Vehicle High Speed Communication
- ECU Hardware, Compute technologies, heterogeneous systems (Many-core, GPU, FPGA, Accelerators, etc.)
- Evolutionary/Revolutionary E/E Architecture to enable all of the above

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*Industrial IoT Connext Conference 2018: Rick Flores*
What is SOA?

- Service oriented architecture defines a ‘server’ which is the provider for a service/data and a ‘client’ that subscribes to the desired service/data

- SOA has been used for years in the IT industry for distributed systems
  - Players from IoT world such as Google, Amazon, pave the path to digitalization

- Applications are loosely coupled and communicate over a service bus as middleware
Signal vs SOA

Main reasons of adoption:

• Flexibility, scalability and reusability of code
• Partial updates of the system can be performed
• “Soft” migration scenarios are also possible
AUTOSAR Adaptive

• The standard contains interfaces required for developing automotive ECUs running on state-of-the-art multicore microprocessors.

• With the Adaptive Platform, communication between software functionalities is no longer conducted in cyclic bursts, but is service-oriented.

• Lower-level communication is no longer based on CAN or other classic automotive bus systems, which use dedicated protocols, but on Ethernet.
Middleware: SOME/IP

SOME/IP dynamically creates the connection between the service provider and service consumer at runtime – and not at system design time.

- Serialization
- RPC
- Service Discovery
- Publish/Subscribe
- Segmentation of UDP messages

Designed to fit devices of different size, and different OS.
Middleware: DDS

- DDS (Data Distribution Service) targets the broader Industrial IoT domain.
- It is a family of open standards published by the Object Management Group (OMG).
- Was specifically designed for distributed real-time systems, and is used in many industries including transportation, energy, medical systems, industrial automation, aerospace and defense, etc.
- Uses Real Time Publish Subscribe (RTPS)
- Offers Quality of Service (QoS) mechanisms
- DDS was introduced as the network binding for ara::com

Reference: https://omg.org
How to evaluate SOME/IP vs DDS as network binding for ara::com?

**Performance based evaluation**
- End-to-end latency, throughput, jitter, CPU & memory usage

**Functional evaluation**
- Based on Quality of services (QoS) such as reliability, deadline, priority, ownership, content filters, etc., from DDS

**Other factors:**
- Cloud connectivity
- Compatibility with legacy systems
- System design capability (toolchain and processes)
### Sample use cases for performance based evaluation

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<td>(10Gbps)</td>
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Ref: Giancarlo Vasta, Lucia Lo Bello, TechDay 2018
Integration of platforms

SOME/IP Use cases include:
Communication between Classic and Adaptive
Signal to Service translation
Legacy systems

DDS Use cases include:
Cloud connectivity
Non-AUTOSAR applications
More robust Quality of Service mechanisms
Applications for automated driving, V2X demand high computation and bandwidth

Moving towards Ethernet and SOA, moving towards Adaptive AUTOSAR

SOME/IP and DDS as middleware for Adaptive AUTOSAR

Evaluation of SOME/IP and DDS can be based on performance, quality of service requirements, applicability.

DDS seems promising but we need experimental data to evaluate

- Suitable for ADAS applications
- Also need to measure overhead of CPU and memory usage
Future Work

Quantitative and qualitative analyses with SOME/IP and DDS over ara::com

Network layer must be integrated with DDS QoS policies to enforce and synchronize time-based guarantees

Analyze the integration of DDS Ethernet-TSN to enable traffic shaping, priority scheduling, etc., based on application’s QoS requirements
Questions?
Acknowledgments

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