MathWorks
AUTOMOTIVE CONFERENCE 2022
North America

Software-defined vehicles: developing service-oriented applications with Simulink

Luigi Milia, MathWorks

Shwetha Bhadravathi Patil, MathWorks

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Agenda

- Software-defined vehicles and new architectures (SOA)
- MathWorks solutions for SOA
- Conclusions and key takeaways

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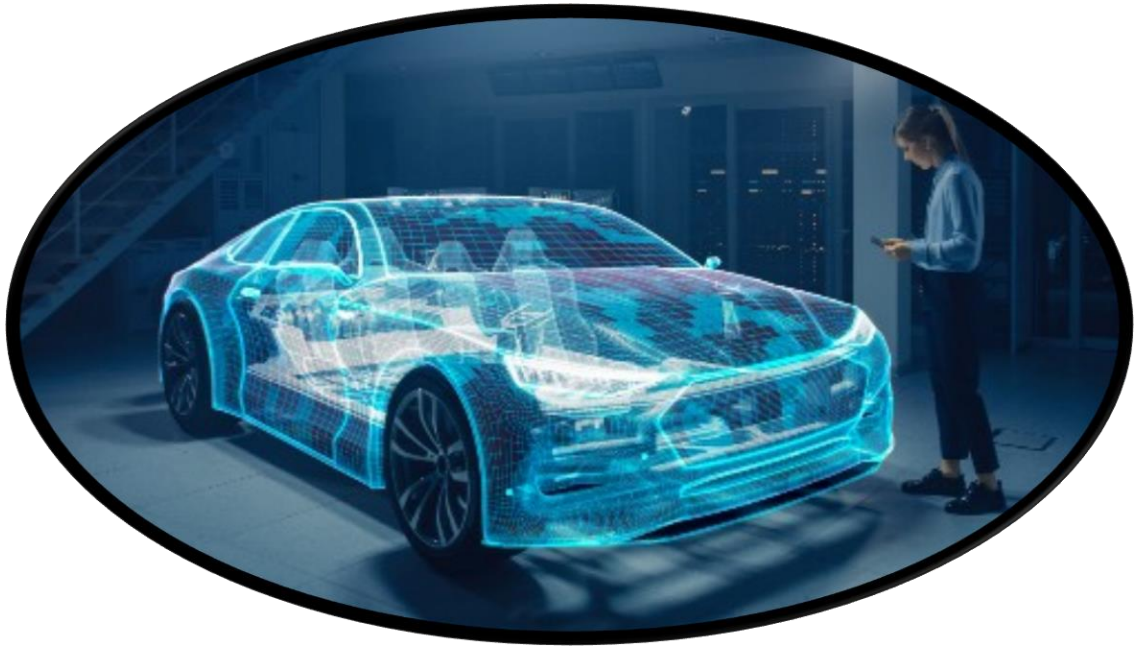
Software-defined vehicles



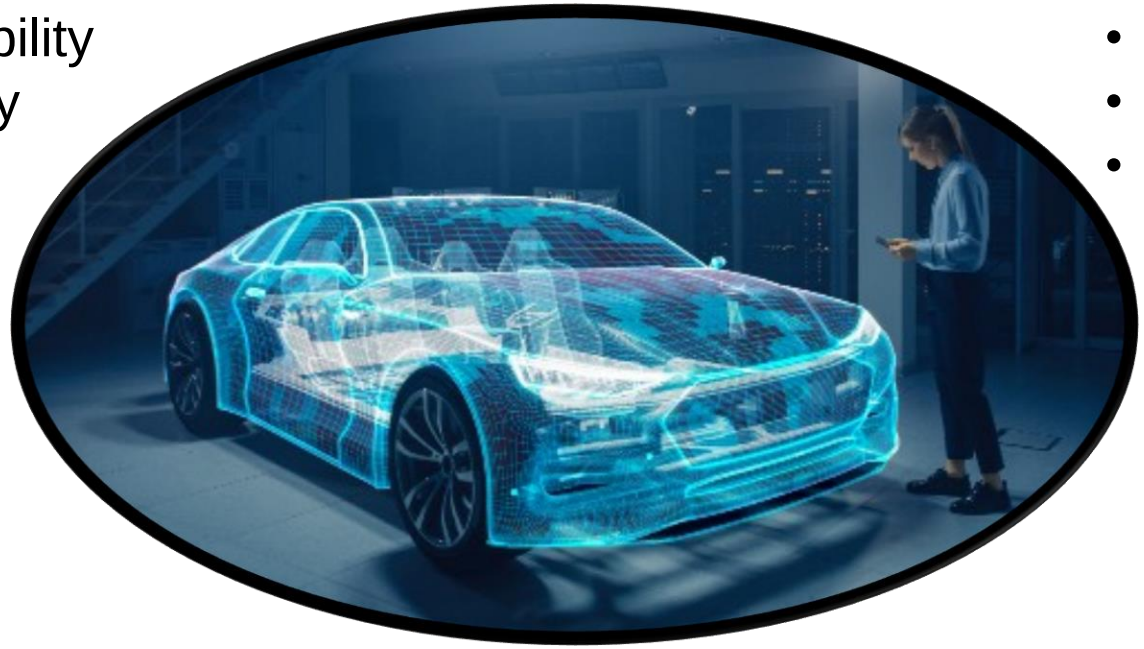
Brand-distinctive features and main value for the customer will come from Software

Software-defined vehicles

demand

Customer expectations

- Clean and Safe mobility
- Digital Life continuity



Technology & Innovation

- Electrification
- Autonomy
- Connectivity

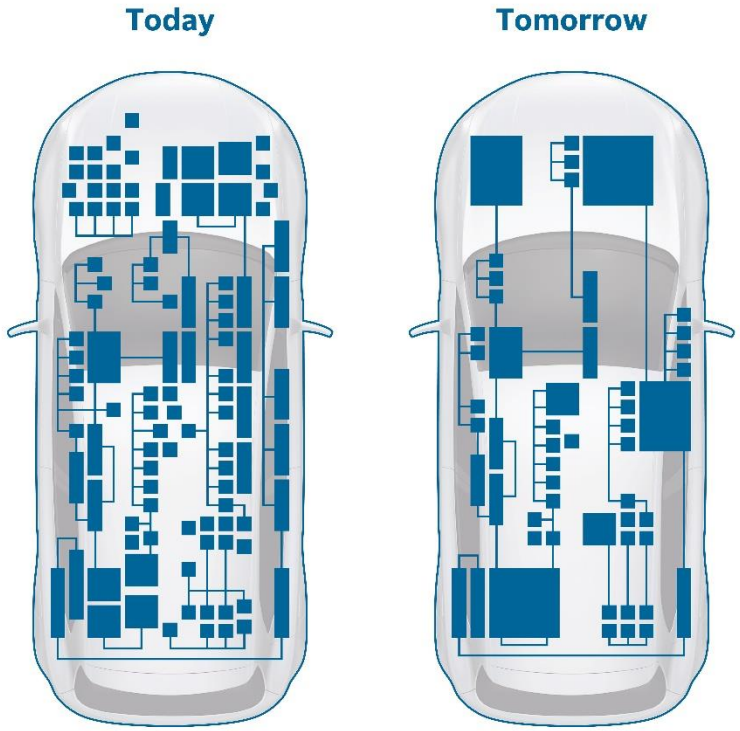
monetize

invest

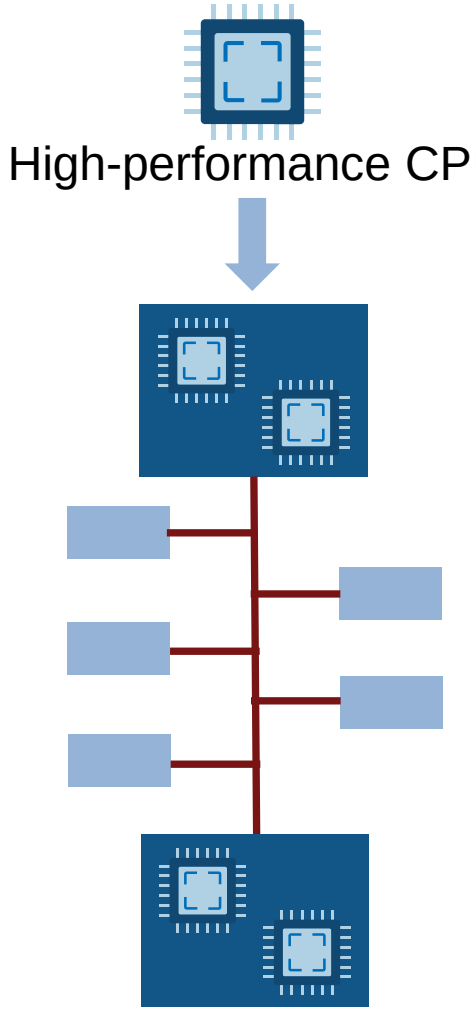
Business opportunity

- App stores, SW features on demand
- SW services subscription plans

Centralization of computing and SOA



Consolidation and centralization of computing

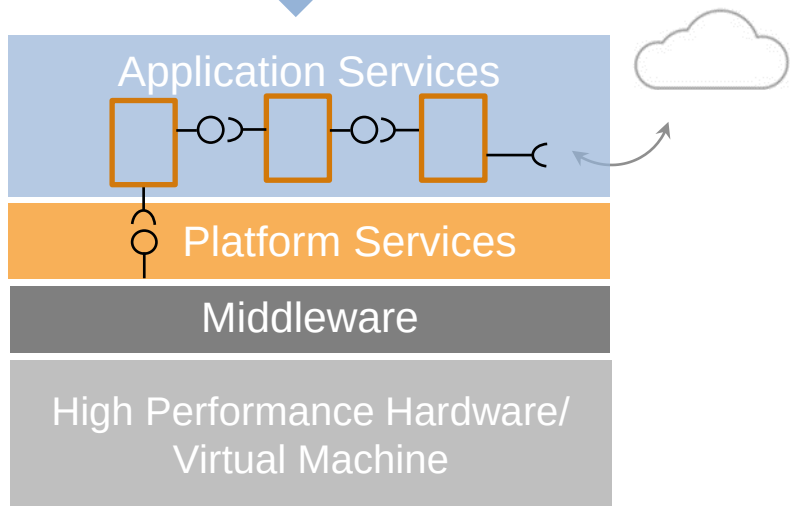


High-performance CPU/GPU

New E/E zonal architectures

SW updates

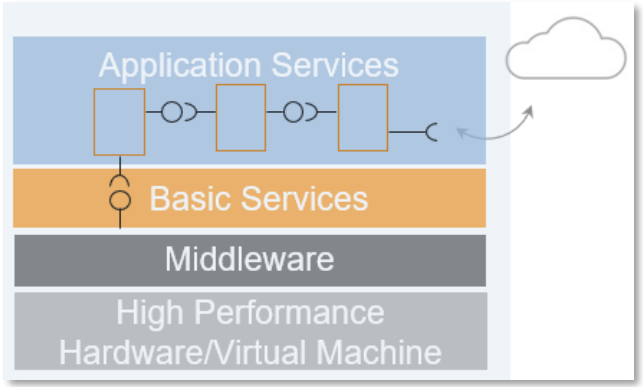
- Frequent
- Selective
- Over-the-air



Higher HW abstraction:
Service-oriented architectures

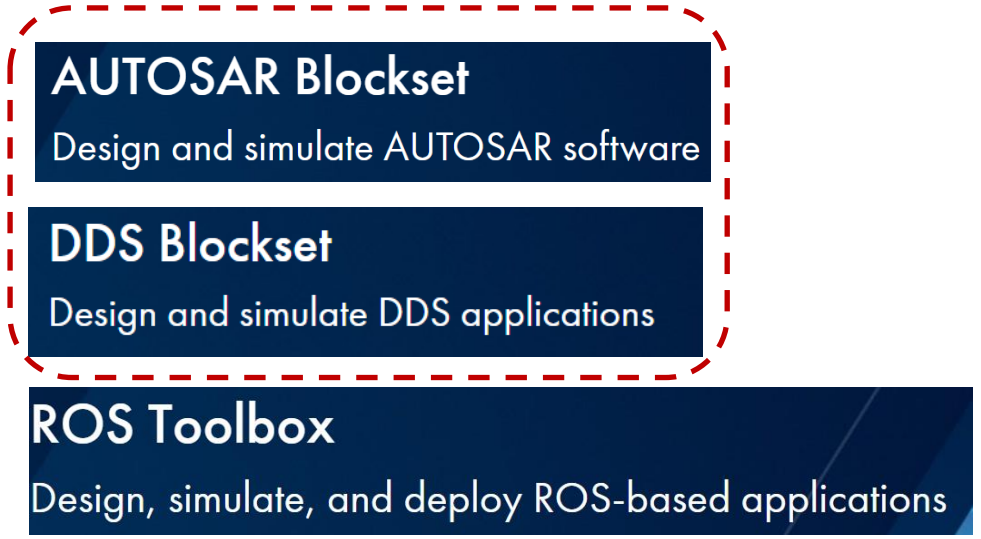
SOA – What's it all about?

- With SOA, applications are standalone processes that provide and/or require services distributed across the vehicle computing platform and the cloud



- SOA provides flexibility to add, remove, or update applications without impacting the entire, typically large, software system

- SOA is used by multiple industrial standards:
  - AUTOSAR Adaptive Platform
  - DDS (Data Distribution Services)
  - ROS (Robot Operating System)



Key Challenges

- Service-oriented architectures require a **change of mindset**
  - Shift from time-driven to event-driven execution
- **Centralize, re-architect** existing applications and partition in processes and services
  - e.g. Centralize energy management and path planning
- **Reuse of existing expertise**, workflows and software assets (don’t start from scratch)
  - Migrate software components from AUTOSAR Classic to AUTOSAR Adaptive

MathWorks is collaborating with OEMs and Suppliers to address these challenges

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  - Simulink for SOA
  - Simulink for AUTOSAR Adaptive
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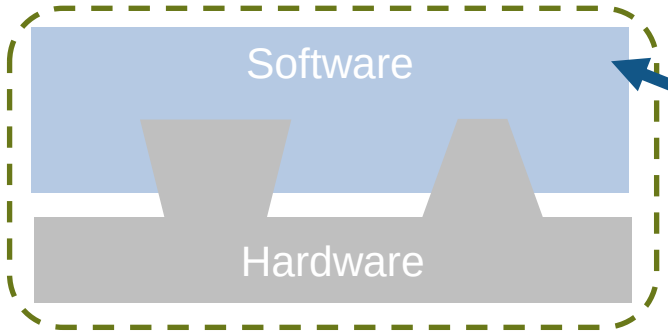
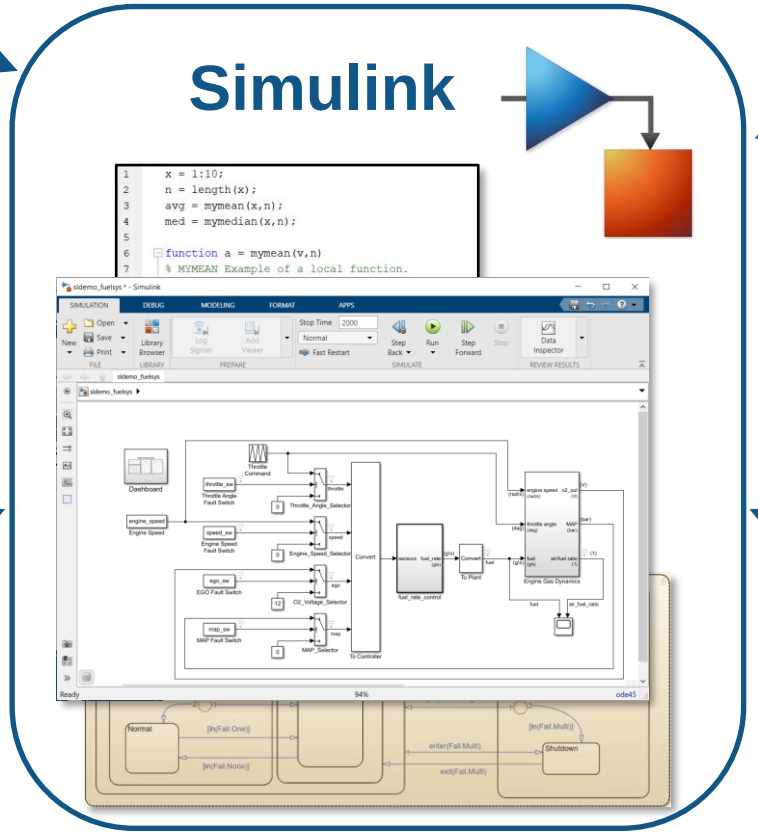
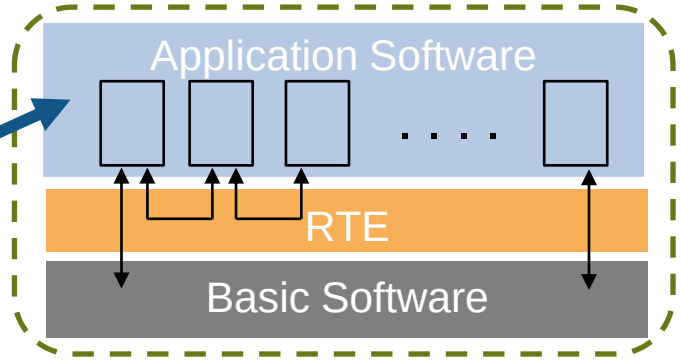
Simulink: deploy software to different targets and standards

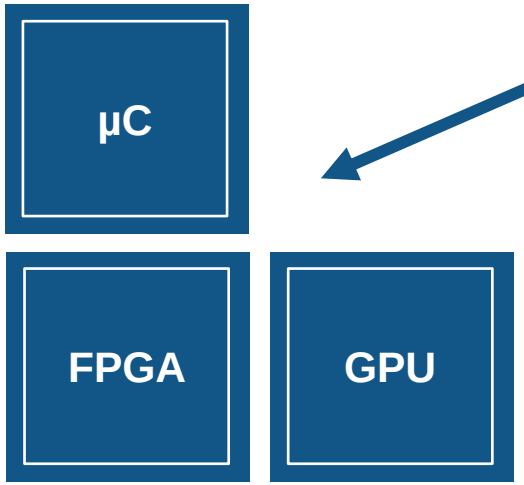


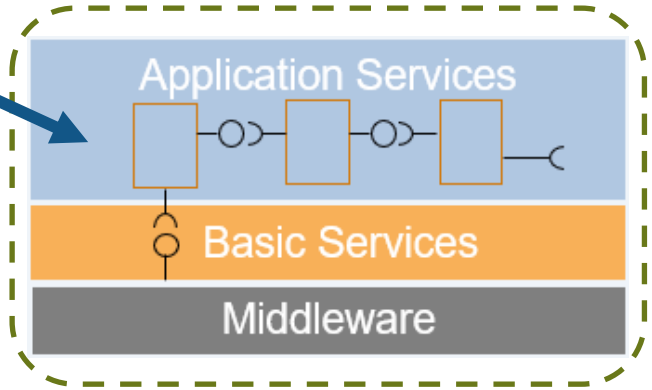
Legacy ECU





AUTOSAR Classic

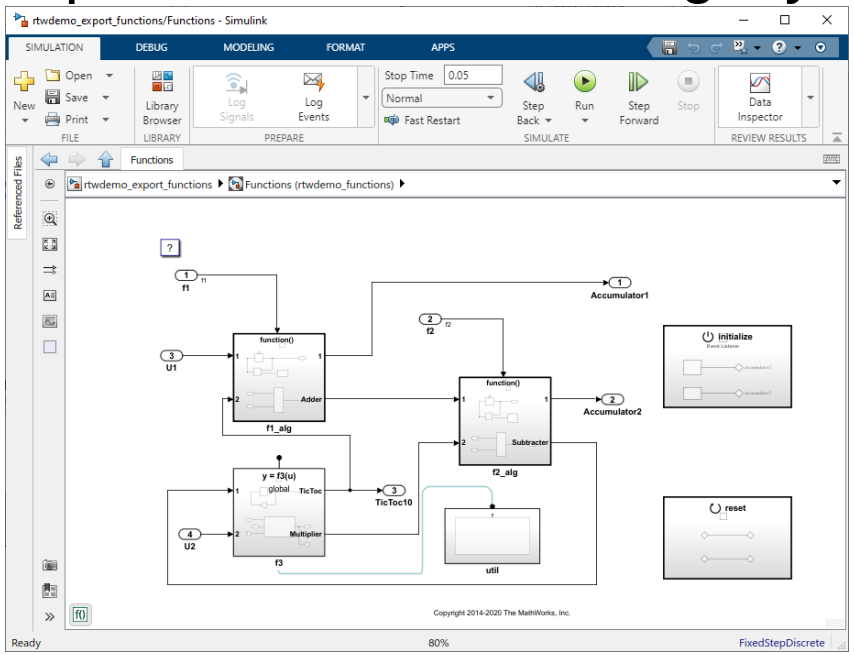




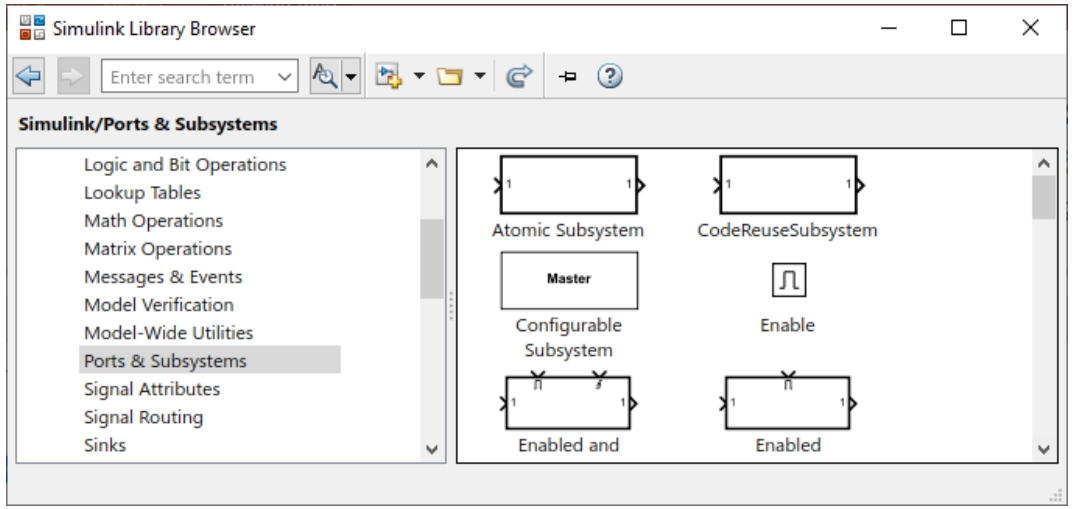
AUTOSAR Adaptive / ROS / DDS

Simulink Supports Exporting Callable Functions Well

- Export Function Modeling style

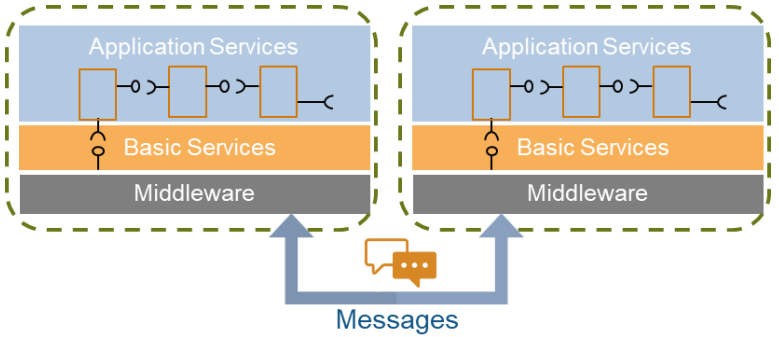


rtwdemo_export_functions

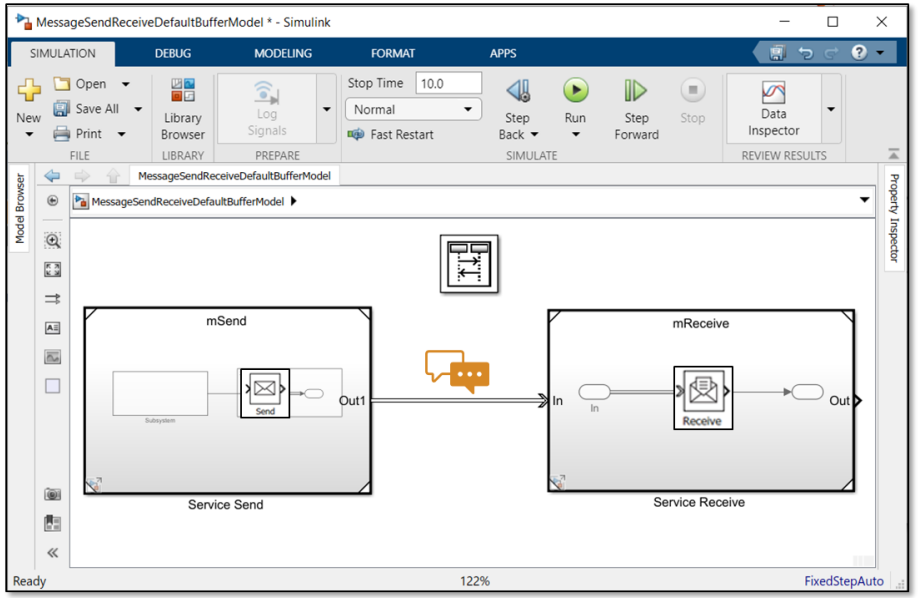


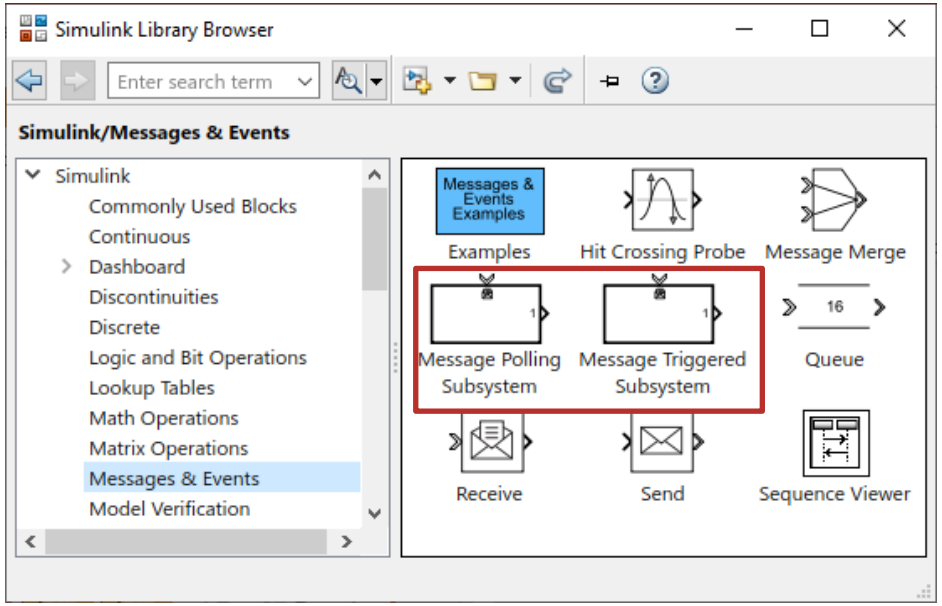
Ports and Subsystems

New Simulink semantics to support SOA



Model service-oriented communication using Simulink messages (Send/Receive)





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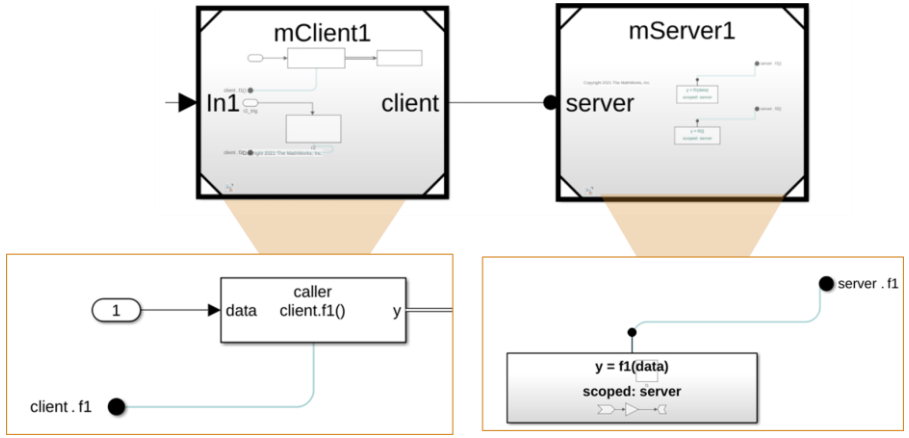

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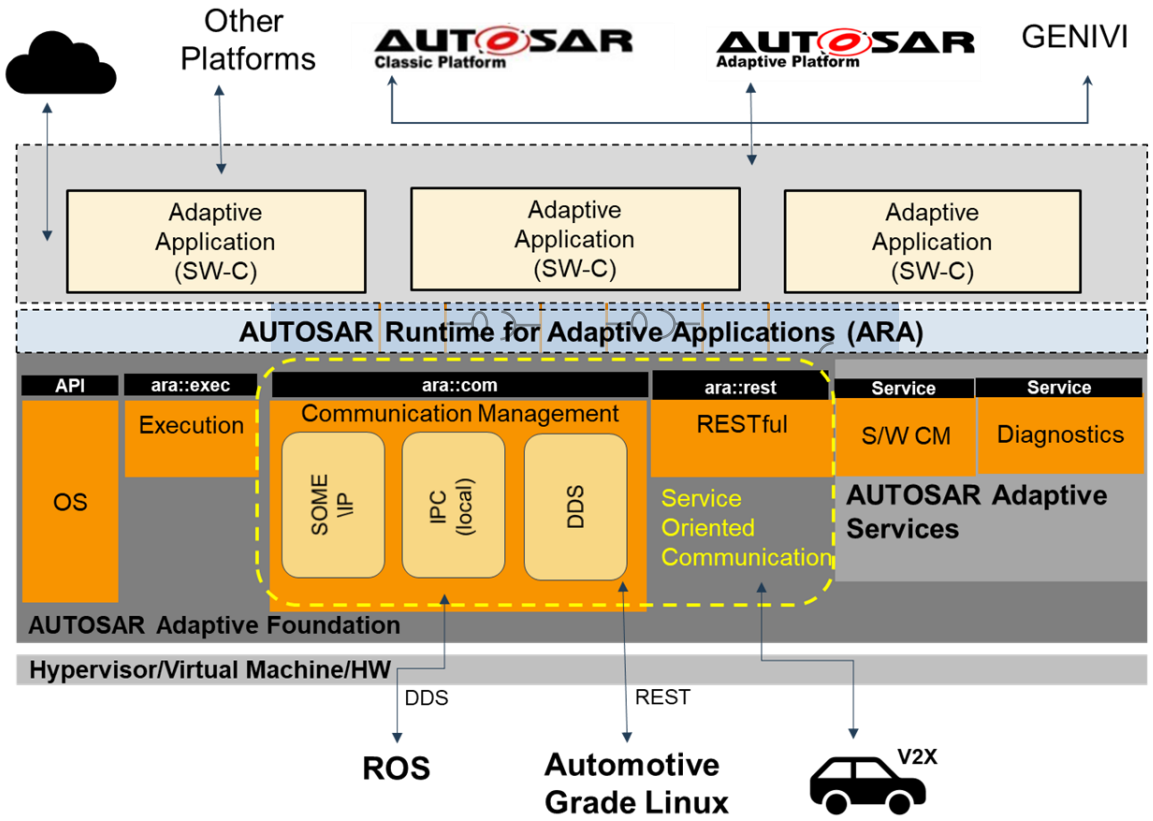
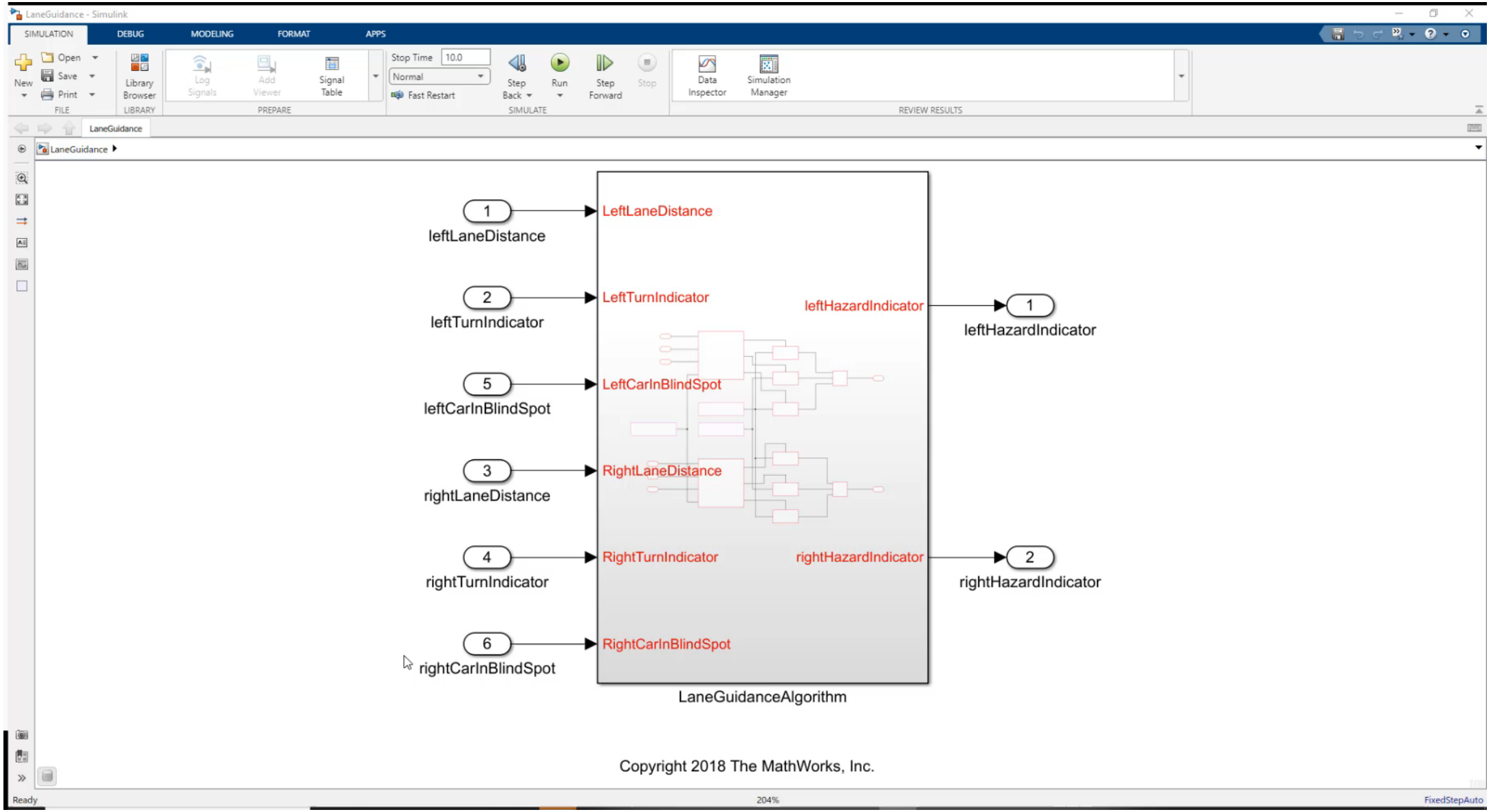
AUTOSAR Adaptive

AUTOSAR Adaptive Platform implements the AUTOSAR Runtime for Adaptive Applications (ARA) for automotive industry.

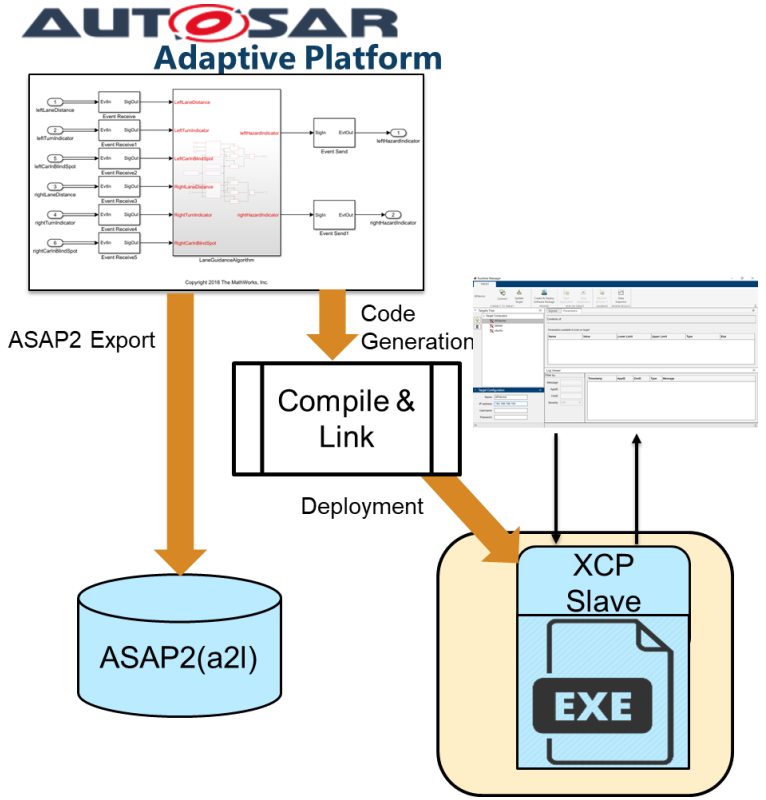


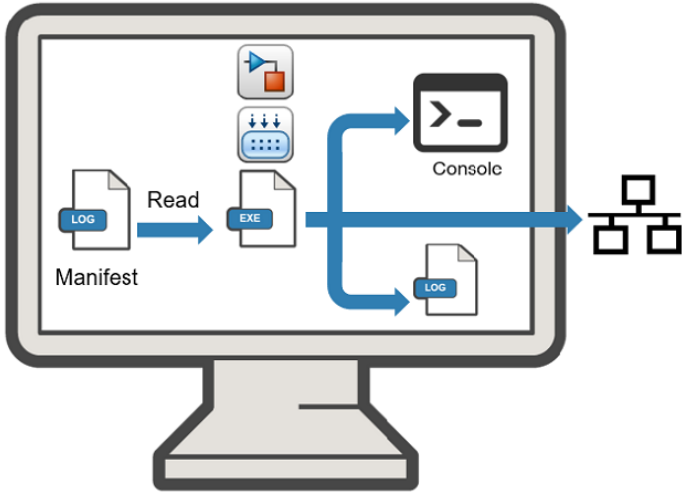
Configure for an AUTOSAR Adaptive application



AUTOSAR Adaptive Deployment

- Create Linux executables for Run-Time Calibration and Measurement
- Run-time logging (ara::log) for adaptive executables
  - Forward event logging information to a console, file, or network, as defined in the AUTOSAR Diagnostic Log and Trace specification





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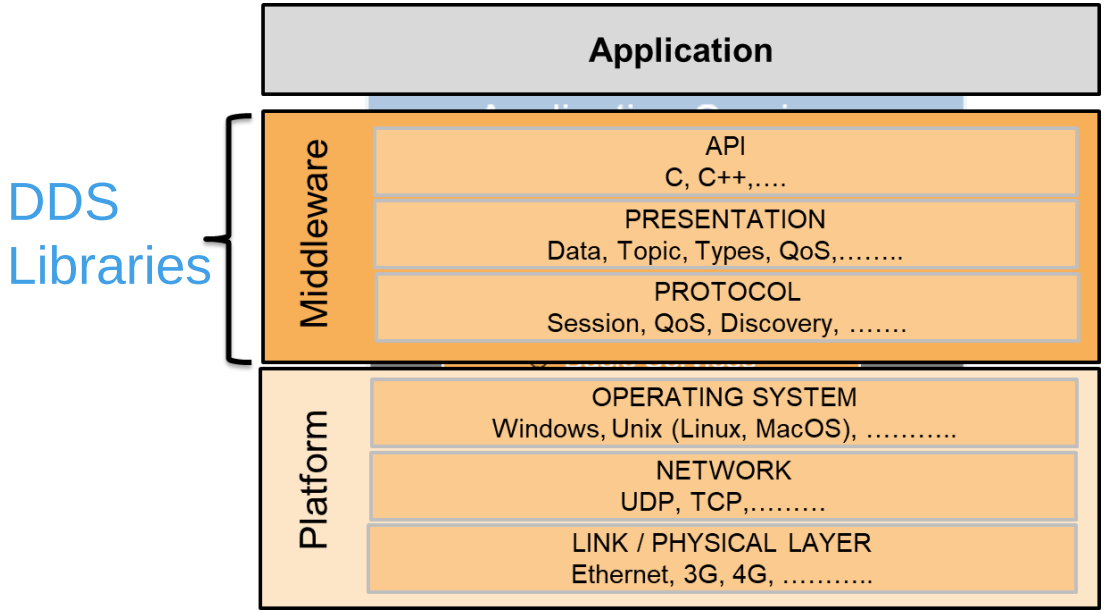
Simulink for DDS

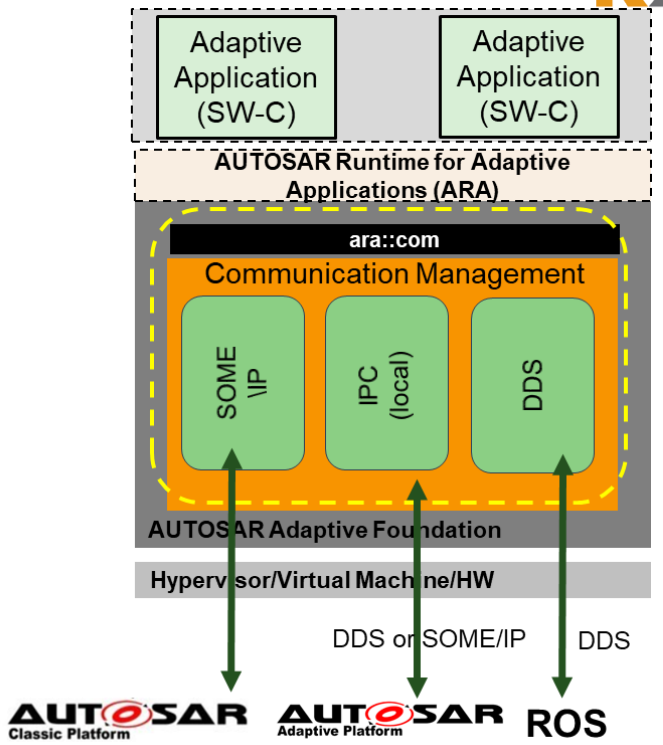
Data Distribution Services (DDS) uses SOA methodology, and directly addresses publish and subscribe communications for real-time and embedded systems.

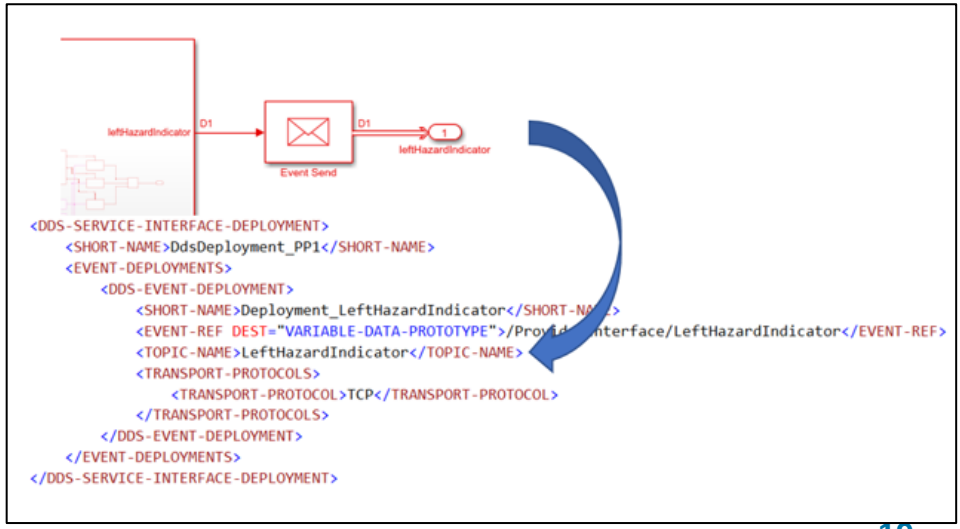
DDS addresses the needs of applications that require real-time data exchange in industries like aerospace and defense, automotive, and robotics.



DDS (Data Distribution Services) is part of AUTOSAR Adaptive Deployment

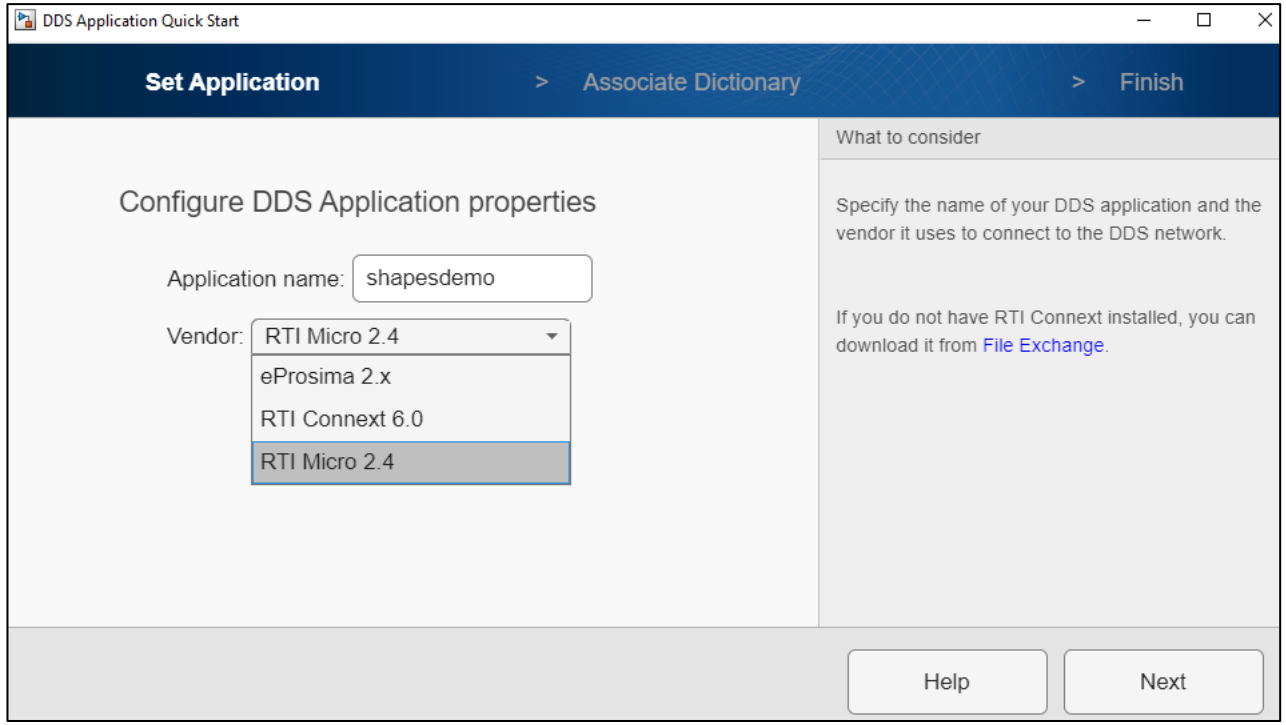
- Supports DDS binding for ara::com enabling communication between adaptive AUTOSAR applications
  - Generated `ServiceInstanceManifest.arxml` contains DDS deployment artifacts





Model DDS application

- Import DDS definitions from XML or create new Definitions
- Define/Modify DDS definitions in DDS Dictionary
- Model application algorithms
- Simulate DDS models including QoS
- Generate DDS executables and deploy on a DDS network



Full integration with third-party DDS stacks including RTI Connext, RTI Micro and eProsima Fast DDS

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Conclusions

Challenges

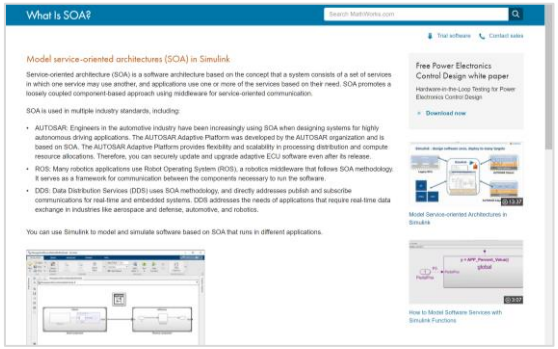
- **Automotive E/E and SW architecture are evolving**, pushed by need for advanced, complex functions
- New, **service-oriented architectures** are required to **master complexity** and enable **frequent updates**

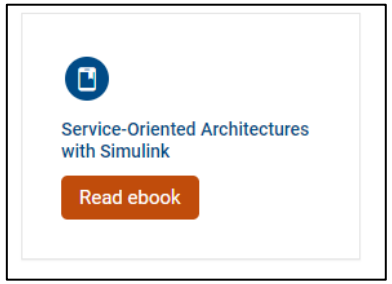
Solutions

- You can **design, simulate and generate** code to deploy service-oriented applications (including AUTOSAR Adaptive and DDS) in **Simulink**
- You can **reuse your existing expertise and models** to mitigate the risk of migration to SOA applications

Resources

- Visit SOA Webpage





AUTOSAR Blockset

DDS Blockset

ROS Toolbox

- Learn more about Designing and deploying interoperable AUTOSAR and non-AUTOSAR applications for heterogeneous automated driving platforms

- Reach out to us

USA

Shwetha Bhadravathi Patil <shwethap@mathworks.com>

Mark Danielsen <mdaniels@mathworks.com>

Europe

Luigi Milia <lmilia@mathworks.com>

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Thank you