

MATLAB EXPO 2021

使用Simulink设计和部署面向服务的架构

龚小平, MathWorks



内容

- 软件定义汽车时代的行业挑战
- Simulink开发面向服务的架构(SOA)
- Simulink对SOA行业标准的支持
 - Simulink对AUTOSAR Adaptive的支持
 - Simulink对数据分发服务 (DDS)的支持
- 总结及如何获取更多相关信息

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软件时代来临

From the news...



**Adds 3,000 New Tech Jobs to Boost
Virtual Testing and Software Expertise**



**Boss Warns the Troops: We Don't
Want to End Up Like Nokia**



**DAIMLER to Cut Out Suppliers
to Fund Software Hiring Spree**

Continental  and Amazon Web Services Create
Platform for Automotive Software



BOSCH Consolidates All Automotive Software
And Electronics Into New Division

<https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2020/nov/1109-techjobs.html>
<https://www.bloomberg.com/news/articles/2020-11-06/vw-s-boss-warns-the-troops-we-don-t-want-to-end-up-like-nokia>
<https://www.ft.com/content/6173af2c-2ea8-4e90-876a-5cc189e3342b>
<https://www.continental.com/en/press/press-releases/20210415-continental-and-amazon-web-services-251210>
<https://www.forbes.com/sites/samabuelsamid/2020/07/21/bosch-consolidates-all-automotive-software-and-electronics-into-new-division/?sh=46032fb81320>

汽车行业趋势

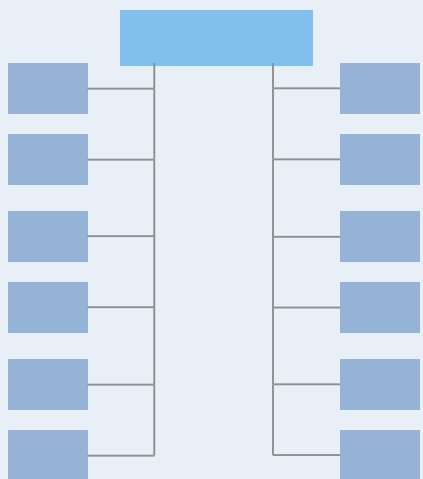


软件定义汽车

关键赋能因素:

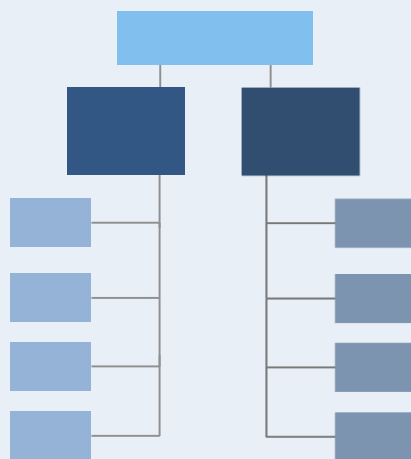
1. 算力向高性能车载计算机集中
2. 新的电子电气和软件架构设计理念

电子电气架构进化



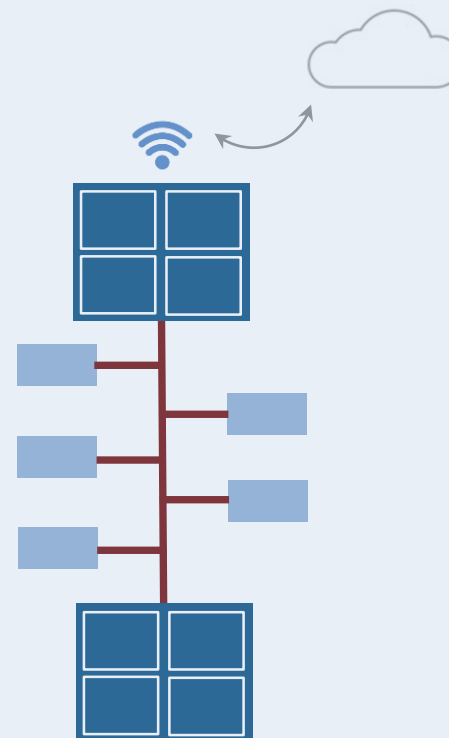
- ~100 ECUs
- 1个功能对应1个 ECU
- 繁复的线束

分布



- 域控制器
- 多核 ECUs
- 网关和网络

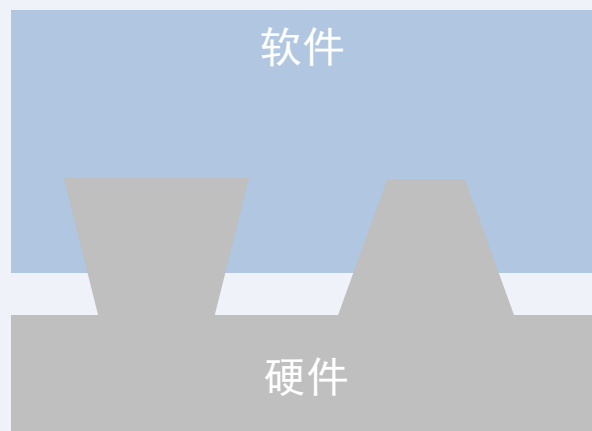
集中



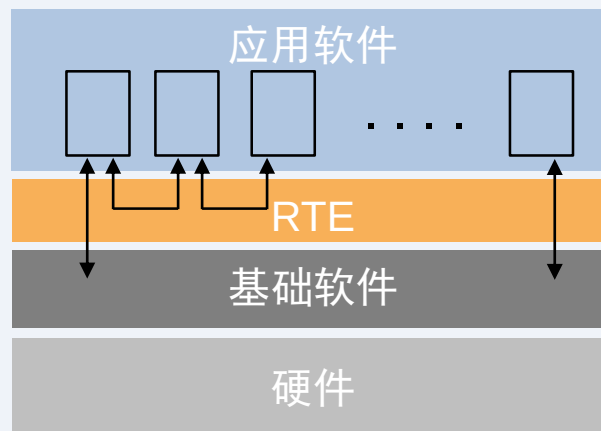
- 车辆/区域控制器
- 多核异构（CPU/GPU/FPGA）
- 高速以太网

高性能高连接

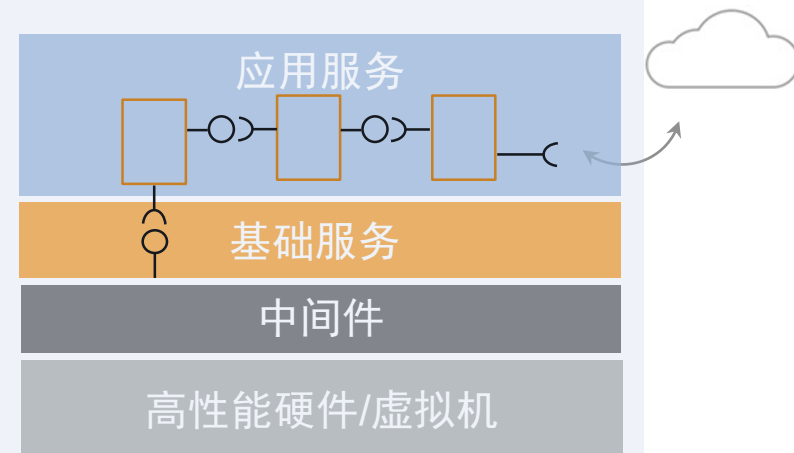
软件架构演变



- 软硬件高度耦合
- 没有标准 APIs
- 软件复用程度低



- 静态软件组件分配
- 基于信号通讯
- 硬件抽象
- 整体升级



- 动态服务发现
- 面向服务的通讯
- 更高级别的硬件抽象
- 选择性升级(OTA)

软硬耦合

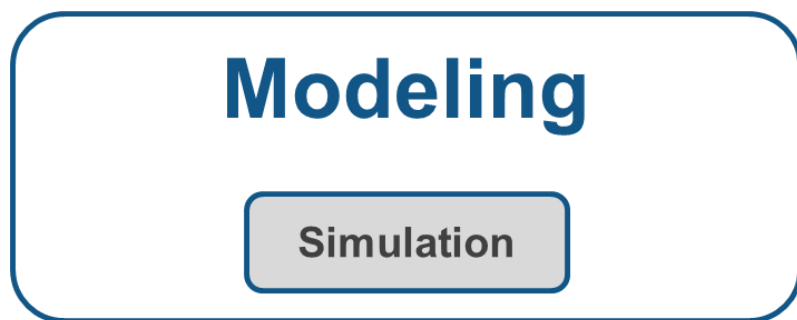
基于组件

面向服务

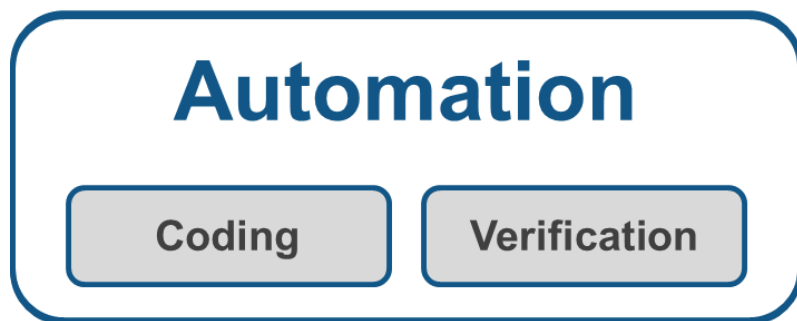
关键挑战

- 面向服务的应用对于汽车行业仍是个新事物
- 已有架构和面向服务的架构将长期共存
- 知识经验、工作流程和软件资产的重用

解决方案 – 面向SOA的基于模型设计



+



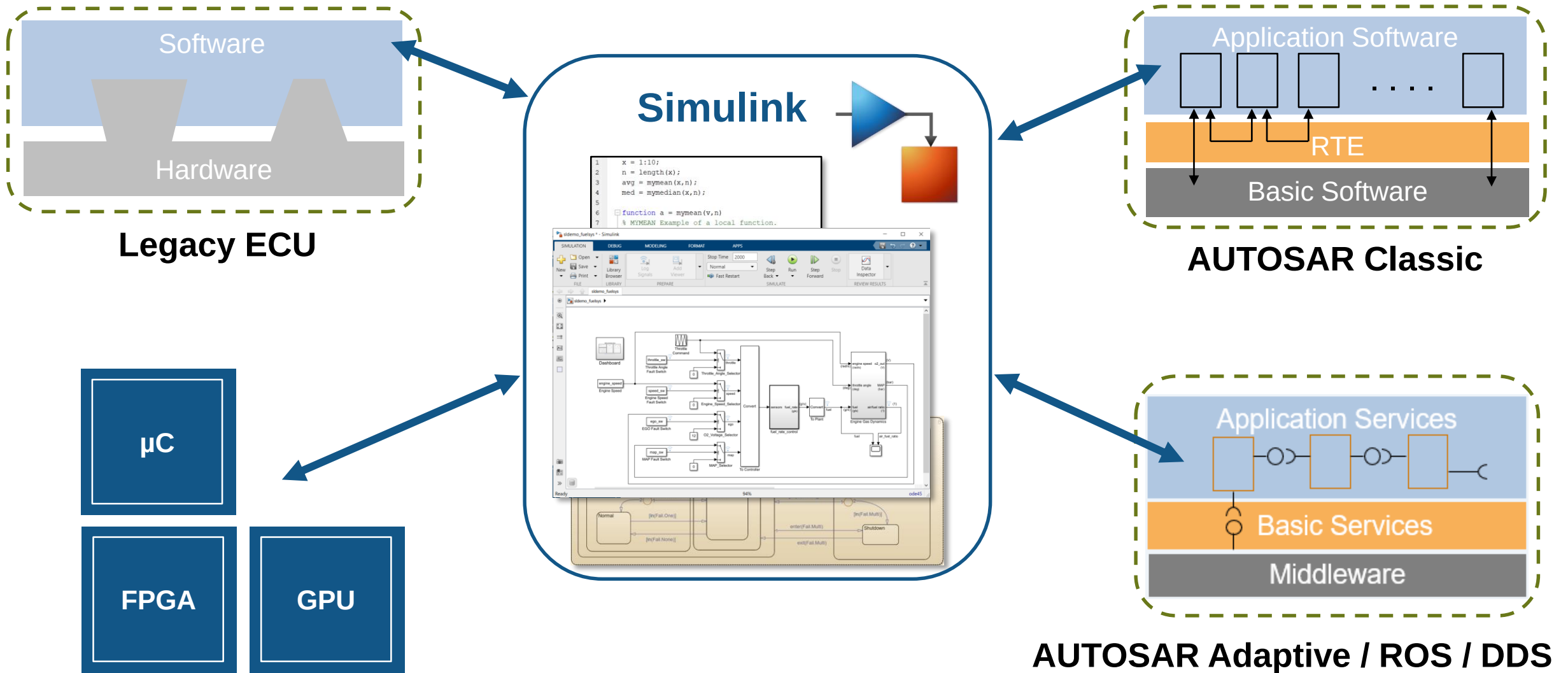
设计和仿真SOA应用

- 图形化的直观协同软件架构设计环境
- Simulink提供语义支持建模和仿真SOA应用

加强自动代码生成和验证支持

- 行业标准支持
- 异构目标硬件平台
- 集成人工智能算法

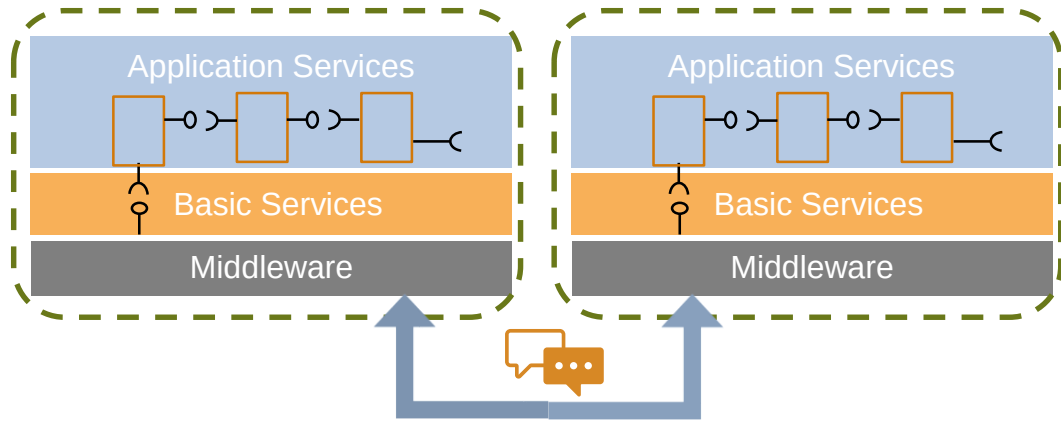
关键概念 – 以算法为中心



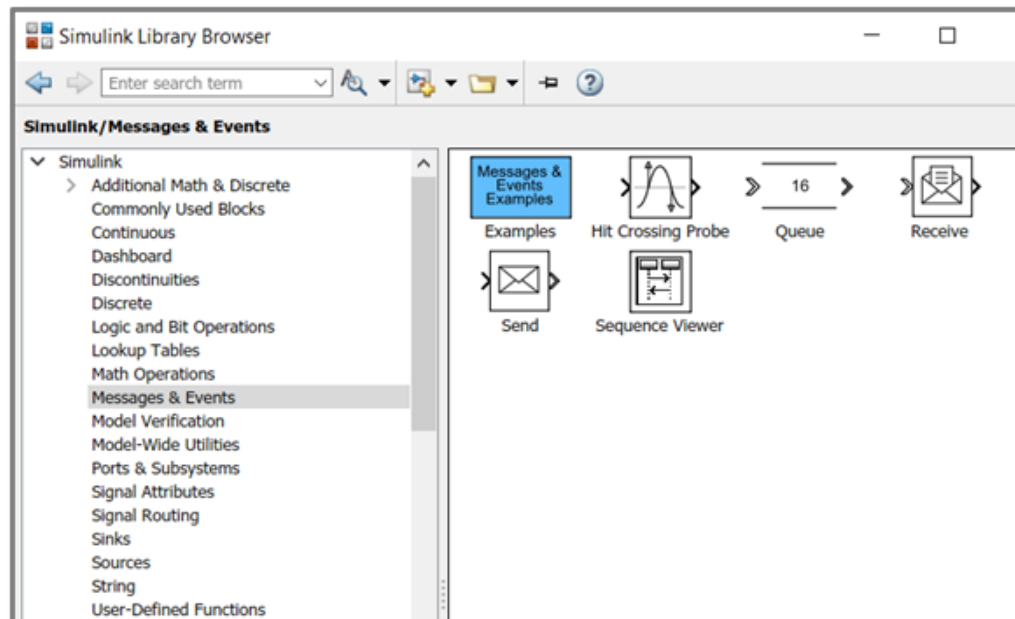
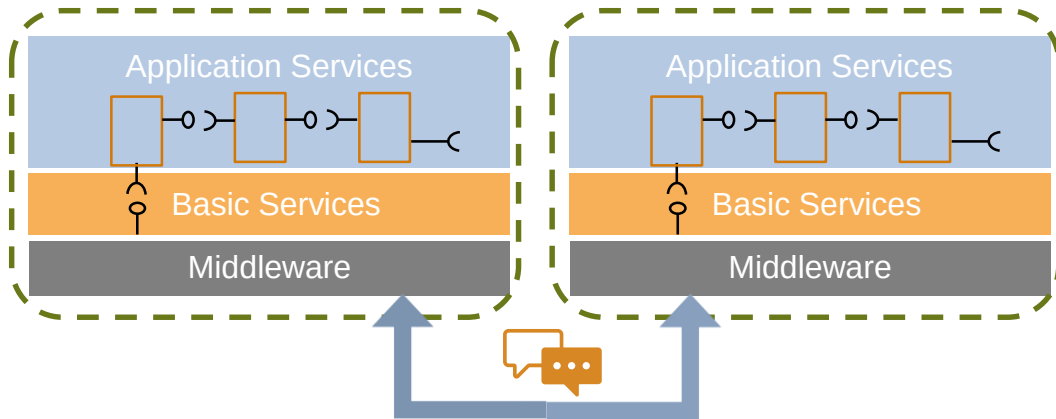
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- 总结及如何获取更多相关信息

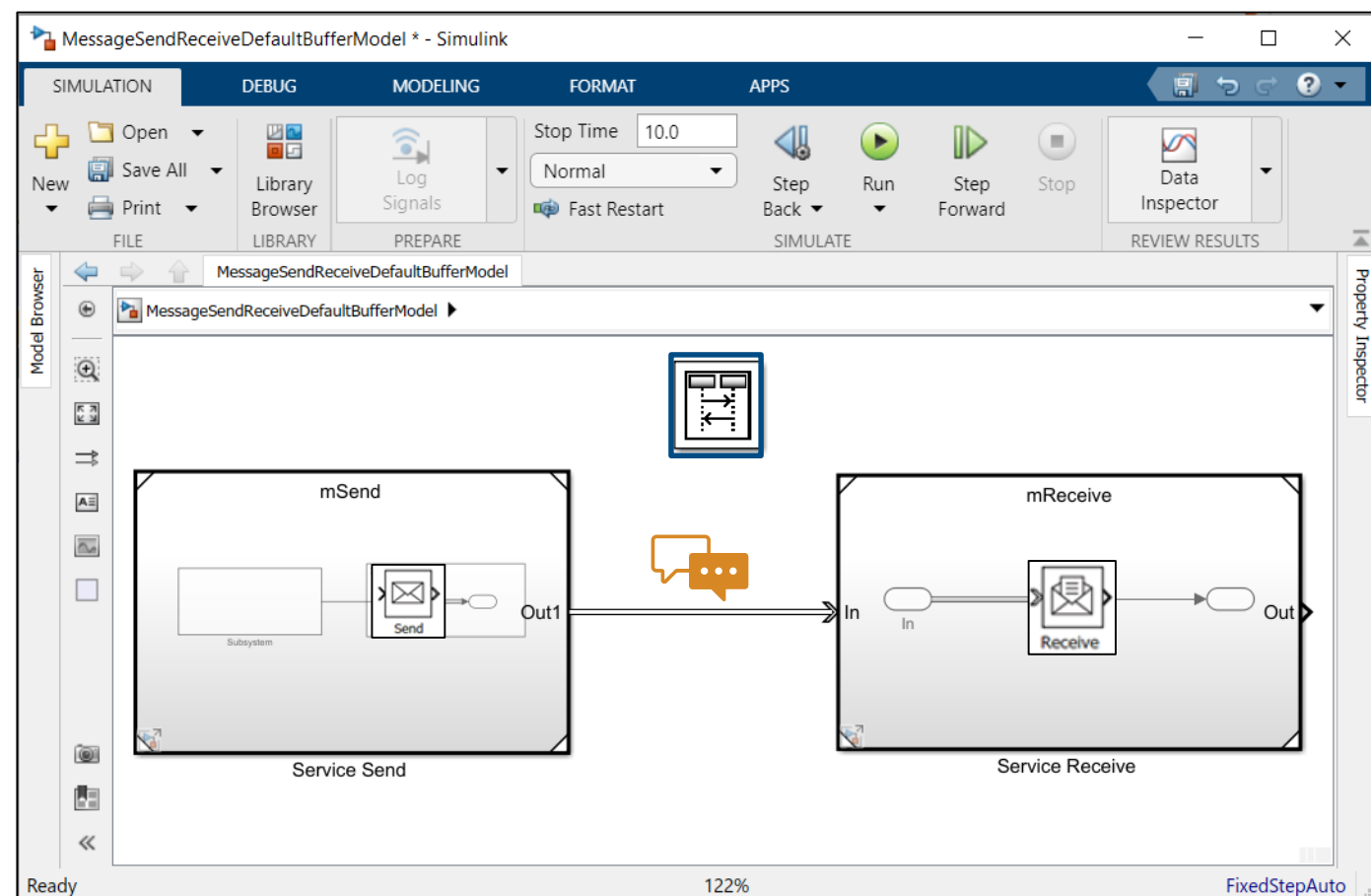
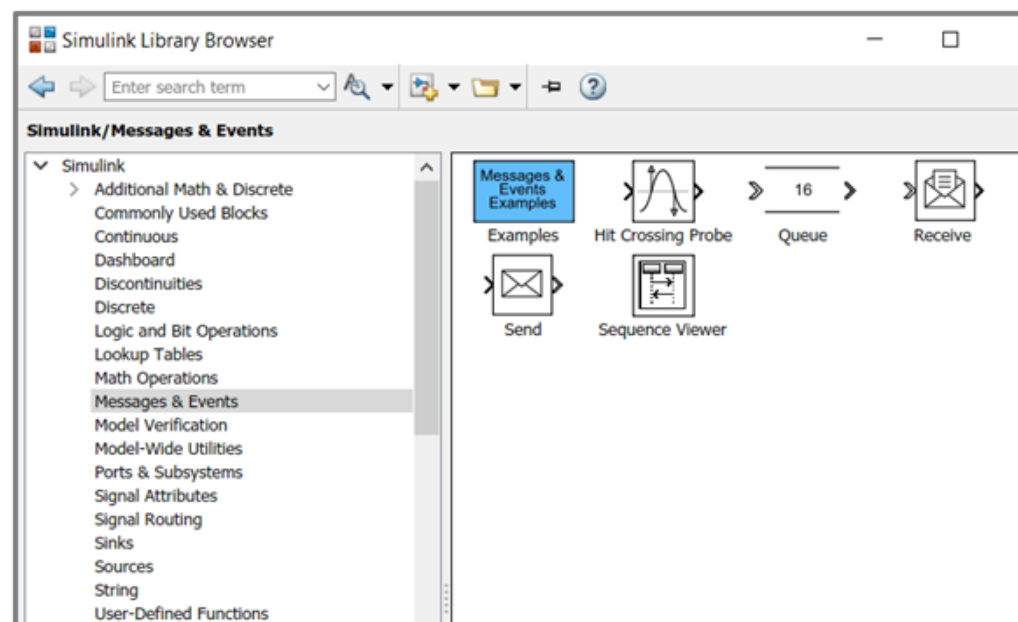
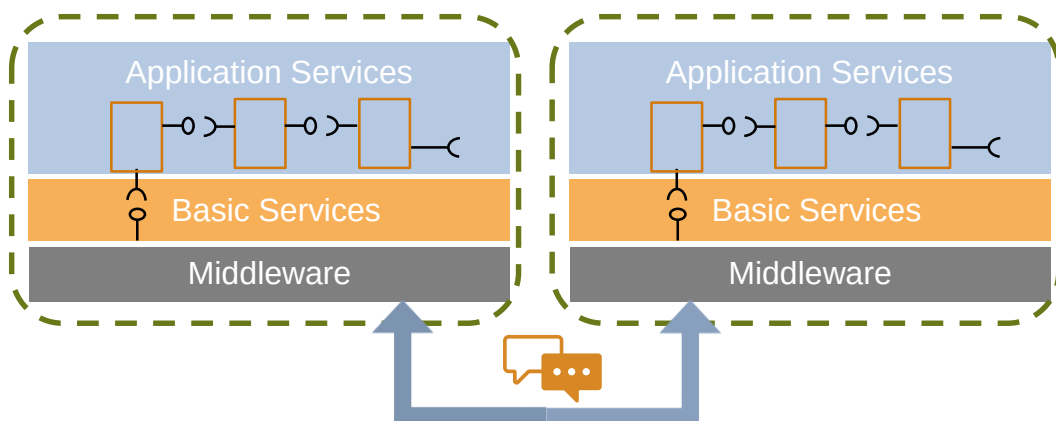
面向服务的通讯建模支持 – Simulink Messages



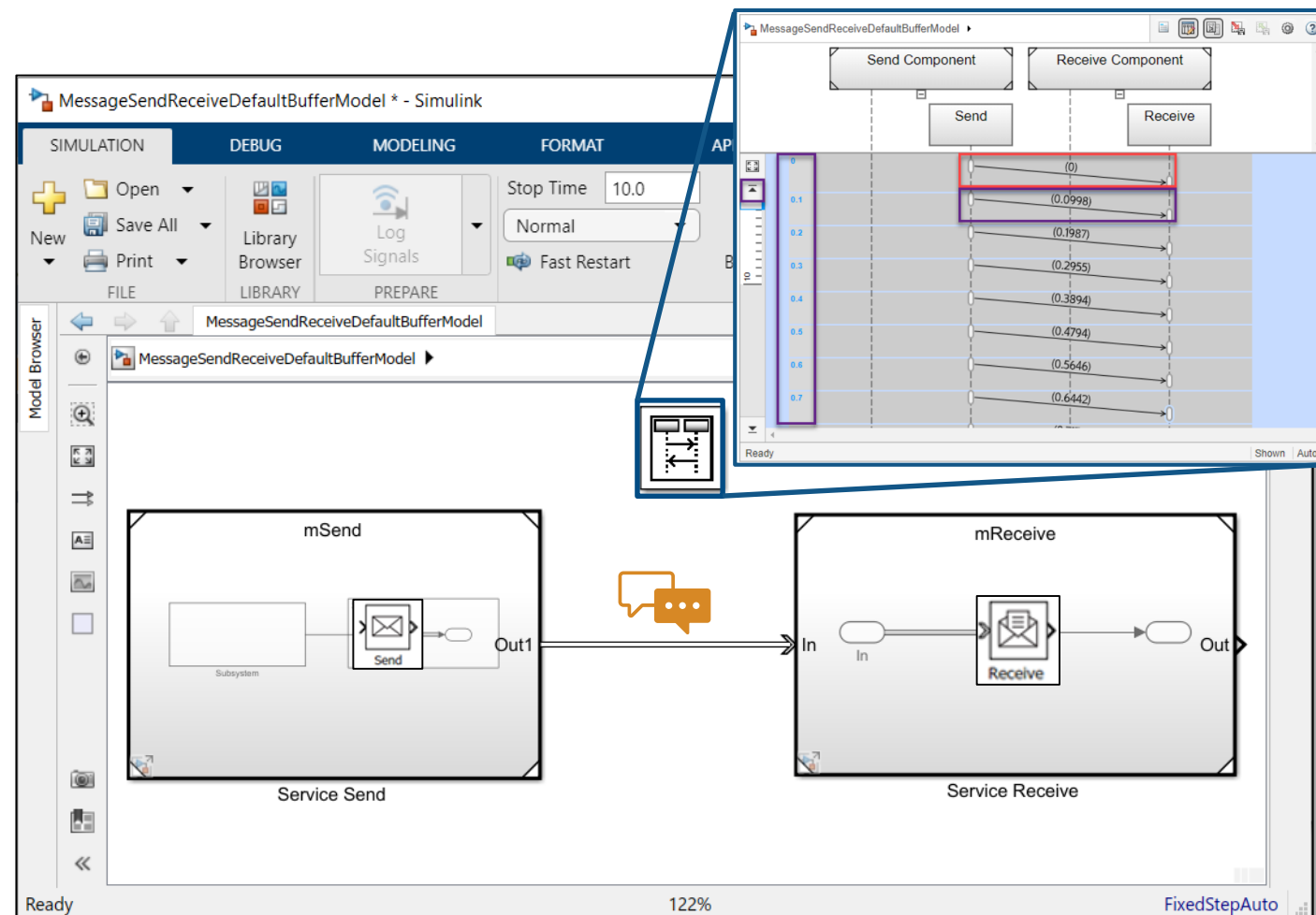
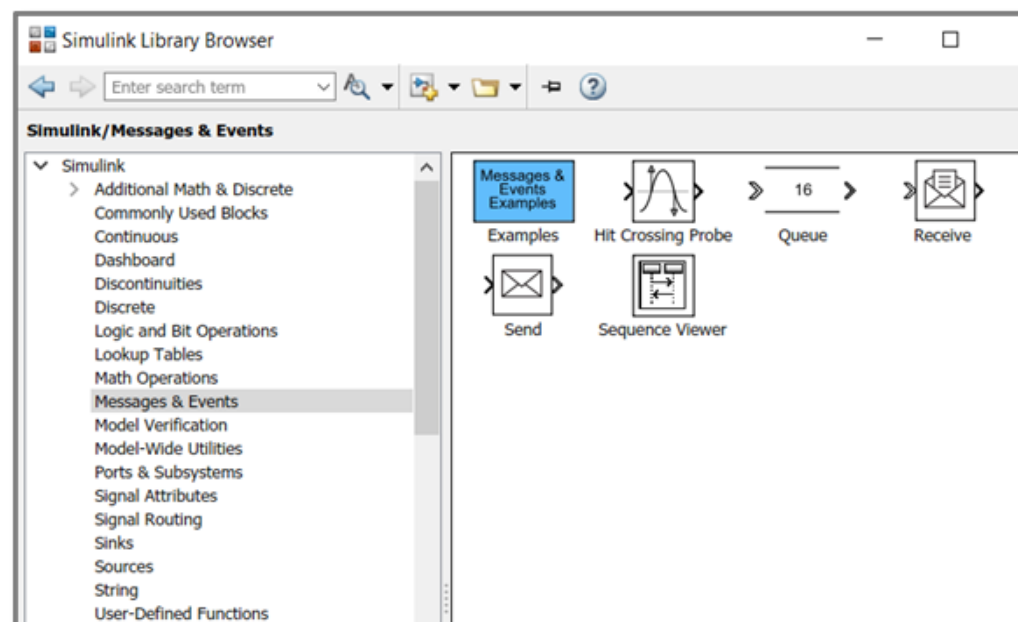
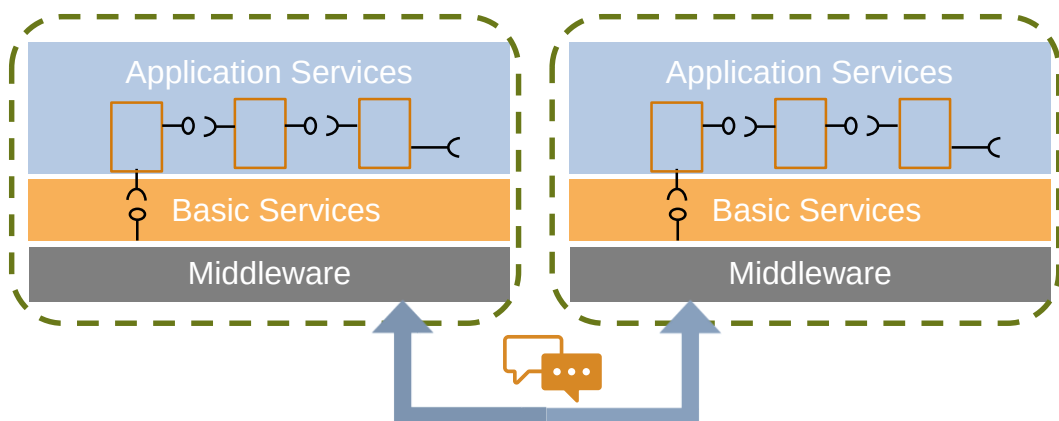
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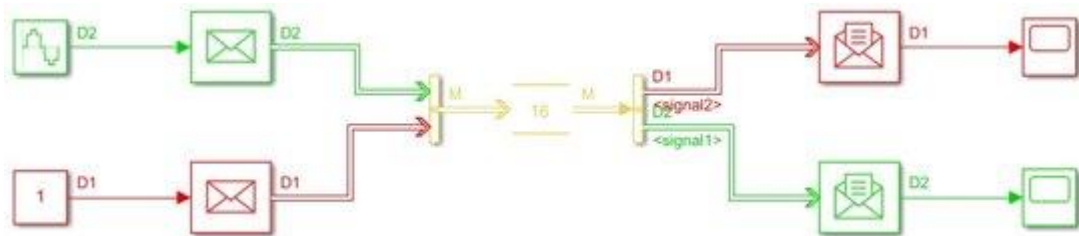
面向服务的通讯建模支持 – Simulink Messages



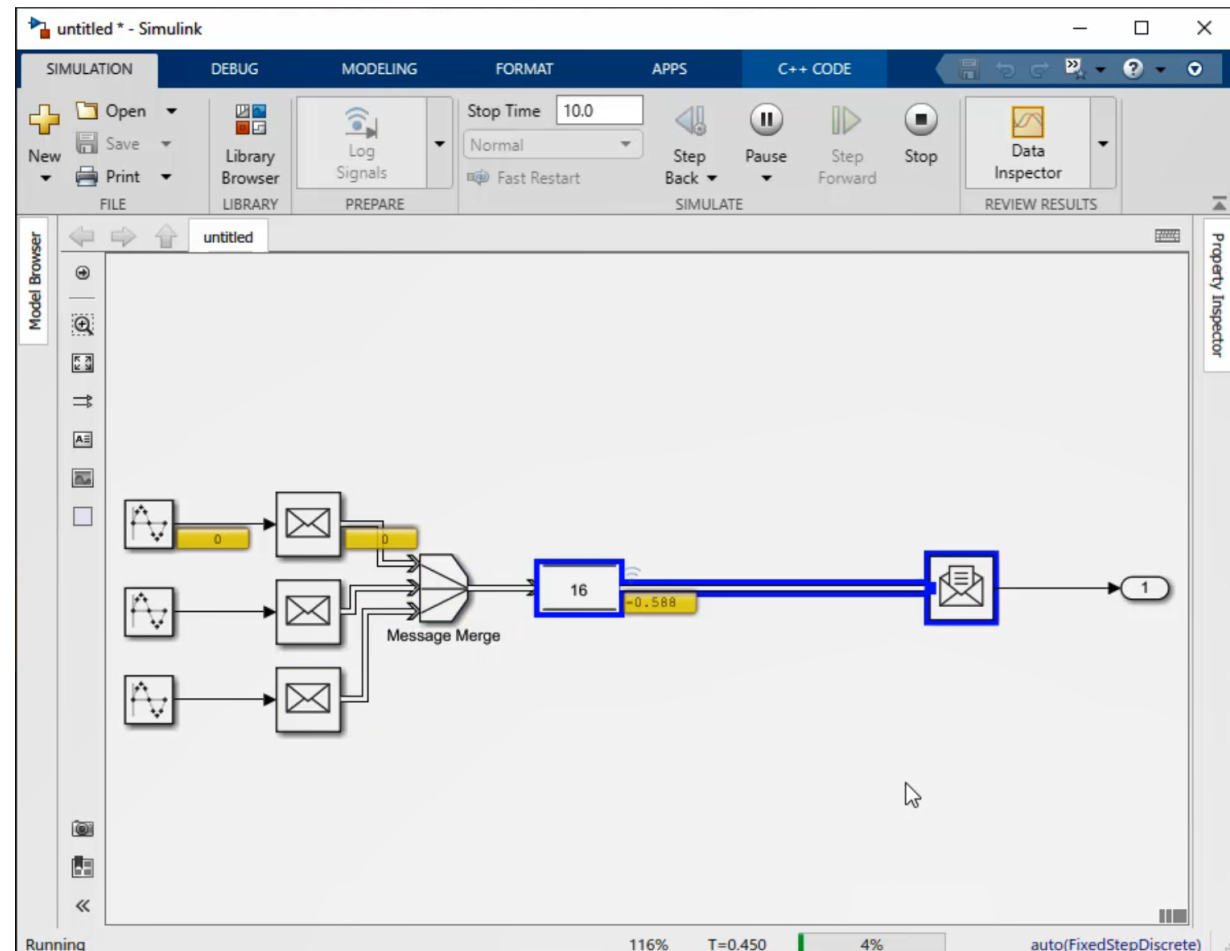
使用消息发送和接收模块建模面向服务的通讯

消息建模的新功能

- 消息线可以合并为非虚拟或虚拟总线
- 将多个消息线合并为一个消息线



R2020b



R2021a

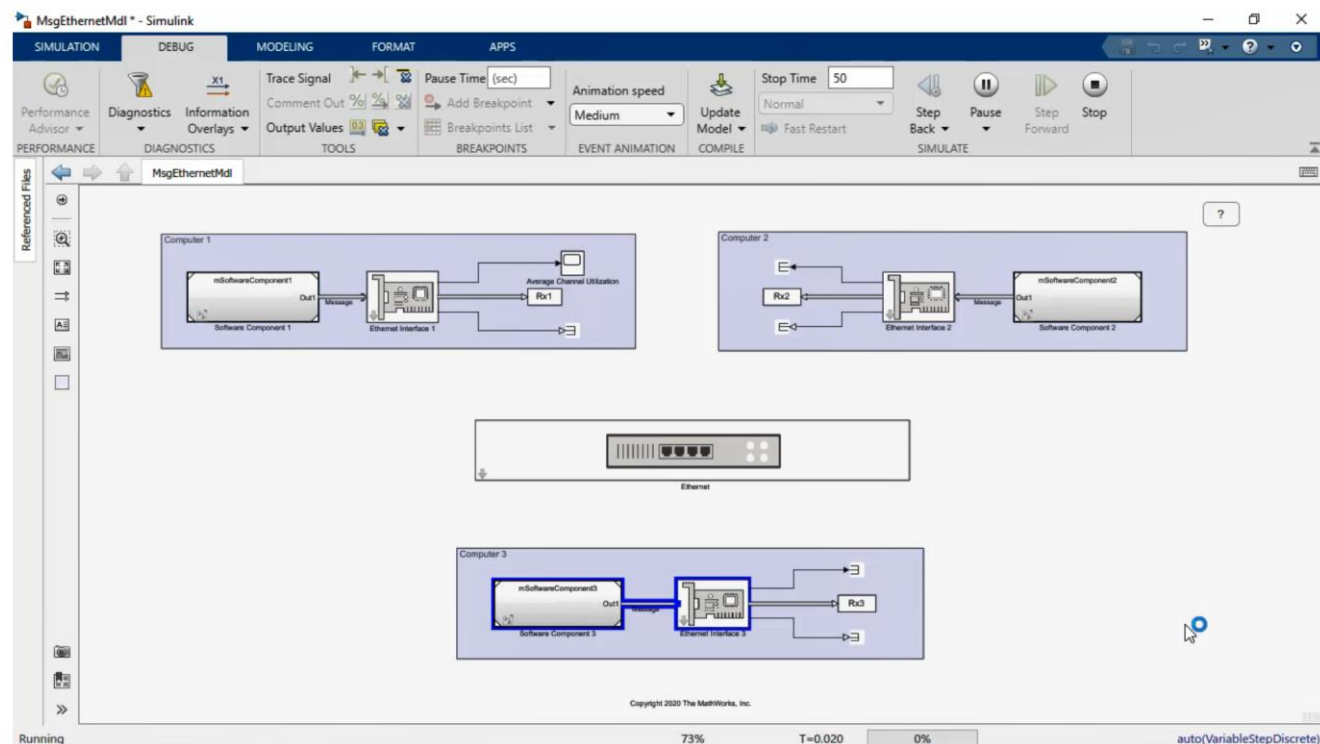
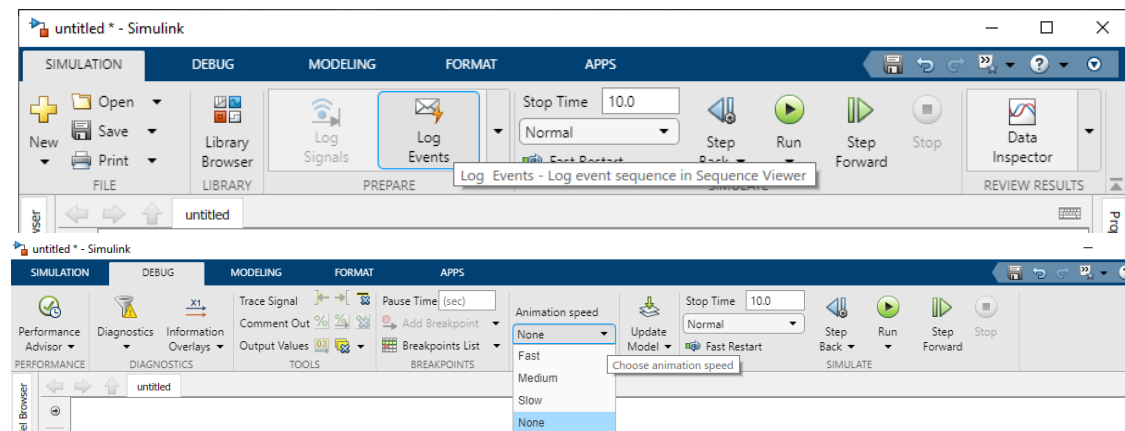
理解复杂系统 – 基于事件的记录和动画

- 查看模型中涉及到以下模块的事件

- Function-Call 子系统
- Simulink 消息
- Simulink 函数

- 用于

- 事件记录
- 事件动画
- 时序观测工具



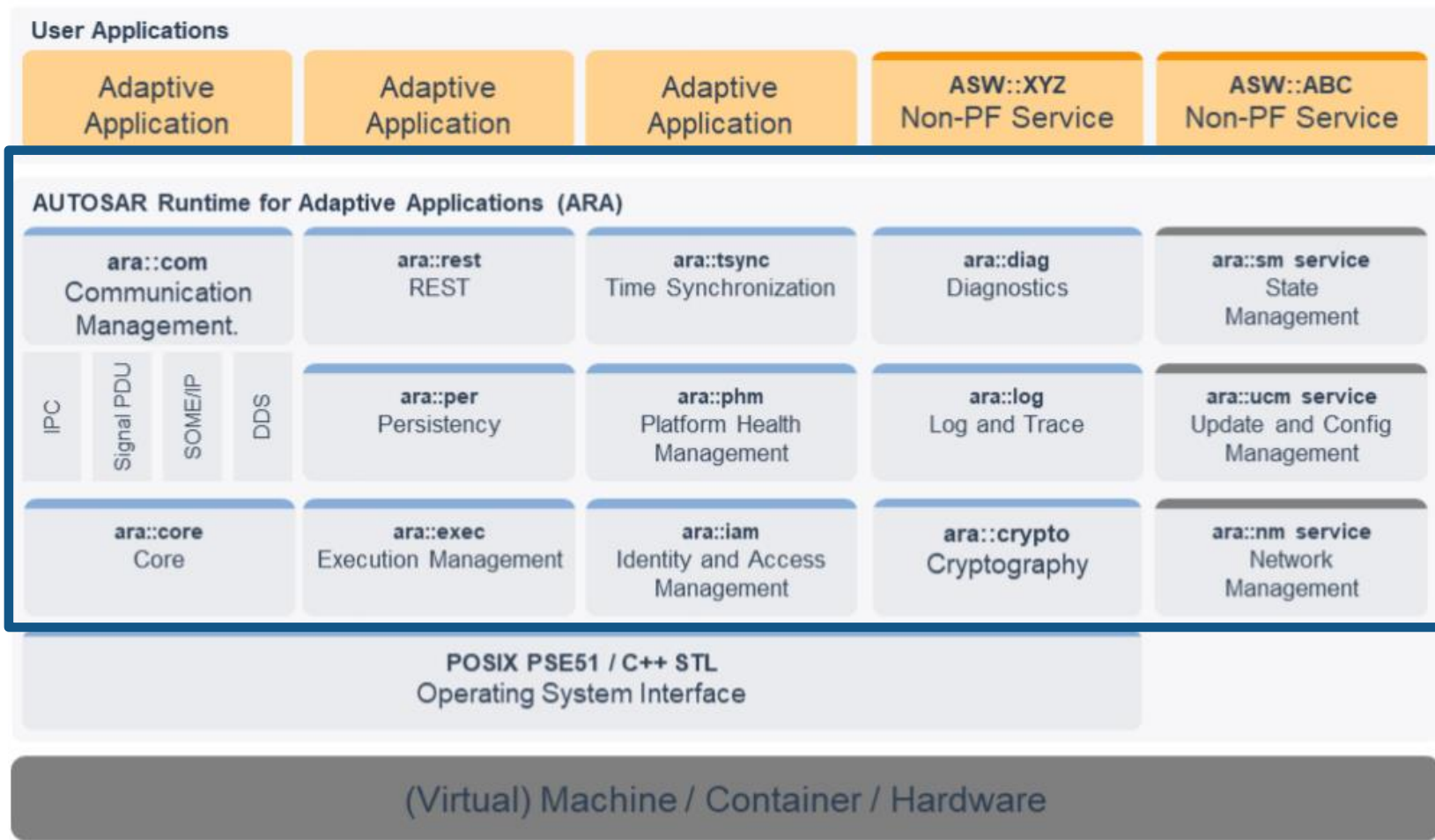
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AUTOSAR Adaptive 概述

AUTOSAR Adaptive

- 服务和接口(ARA)

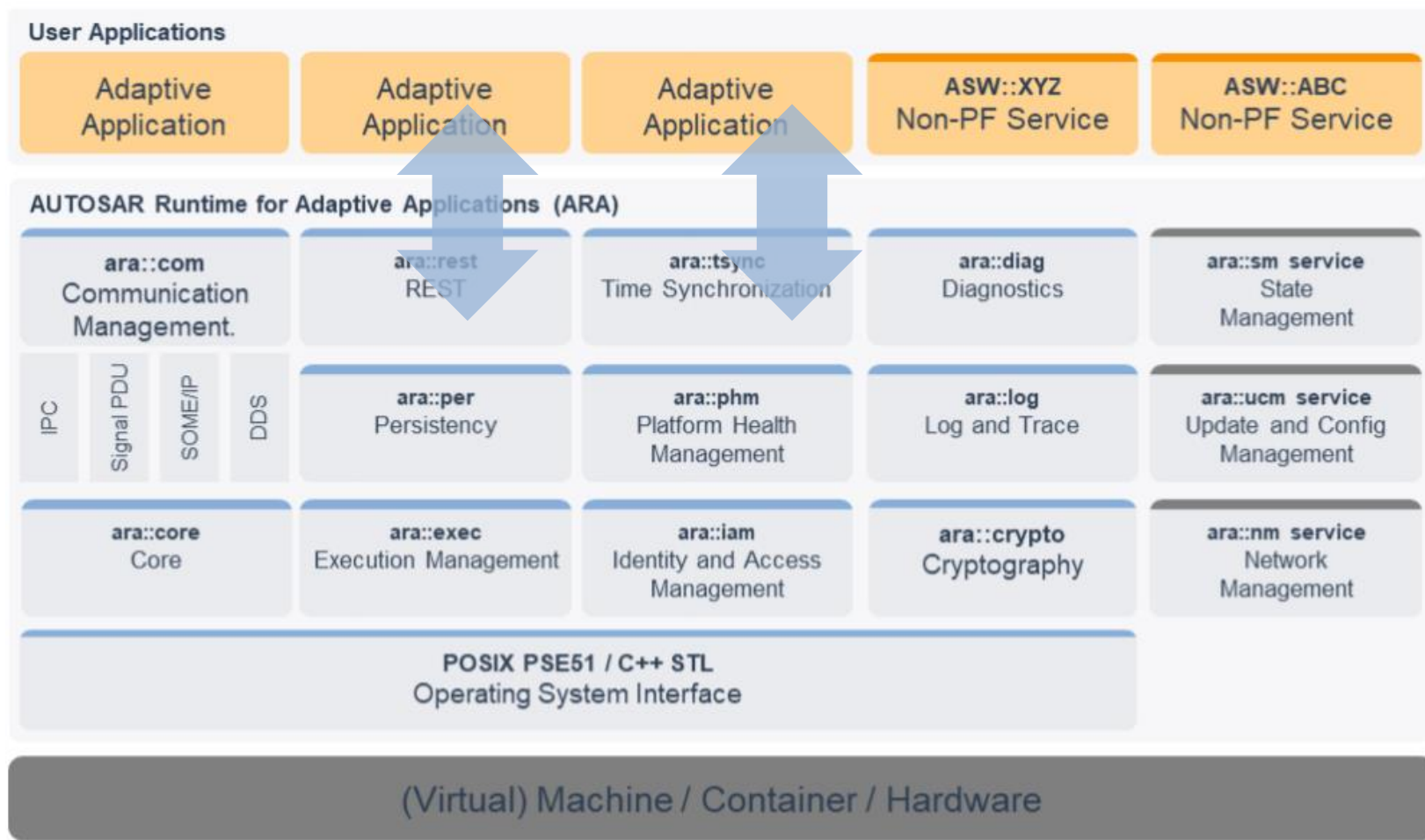


Source: www.autosar.org

AUTOSAR Adaptive 概述

AUTOSAR Adaptive

- 服务和接口(ARA)
- 客户端（应用）和服务器的运行时动态链接

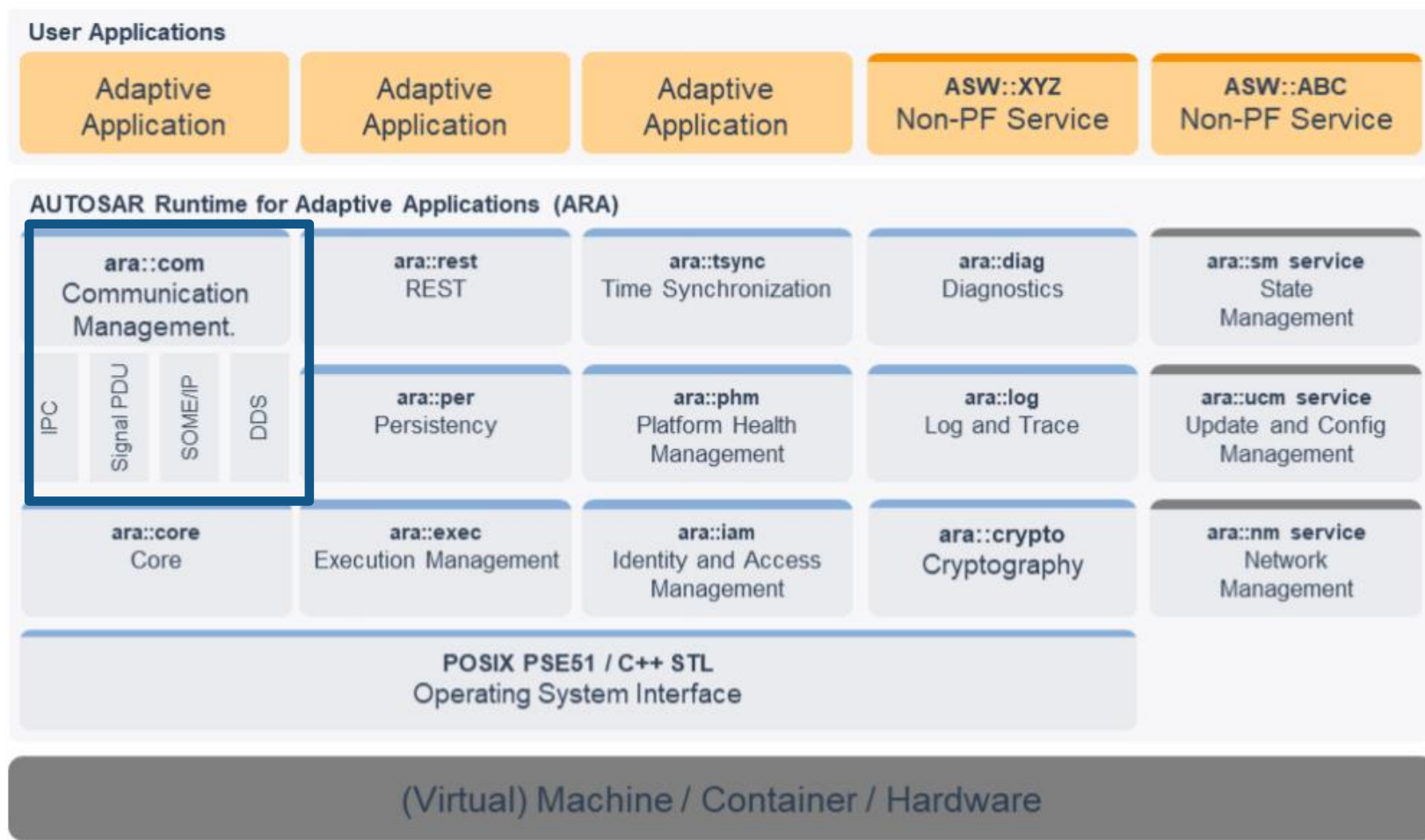


Source: www.autosar.org

AUTOSAR Adaptive 概述

AUTOSAR Adaptive

- 服务和接口(ARA)
- 客户端（应用）和服务器的运行时动态链接
- 通讯中间件：
SOME/IP 和 DDS



Source: www.autosar.org

AUTOSAR Adaptive 支持 – AUTOSAR Blockset

AUTOSAR Adaptive平台实现了汽车行业Adaptive应用的AUTOSAR Runtime

在Simulink中对AUTOSAR Adaptive应用进行建模、仿真、测试和生成代码



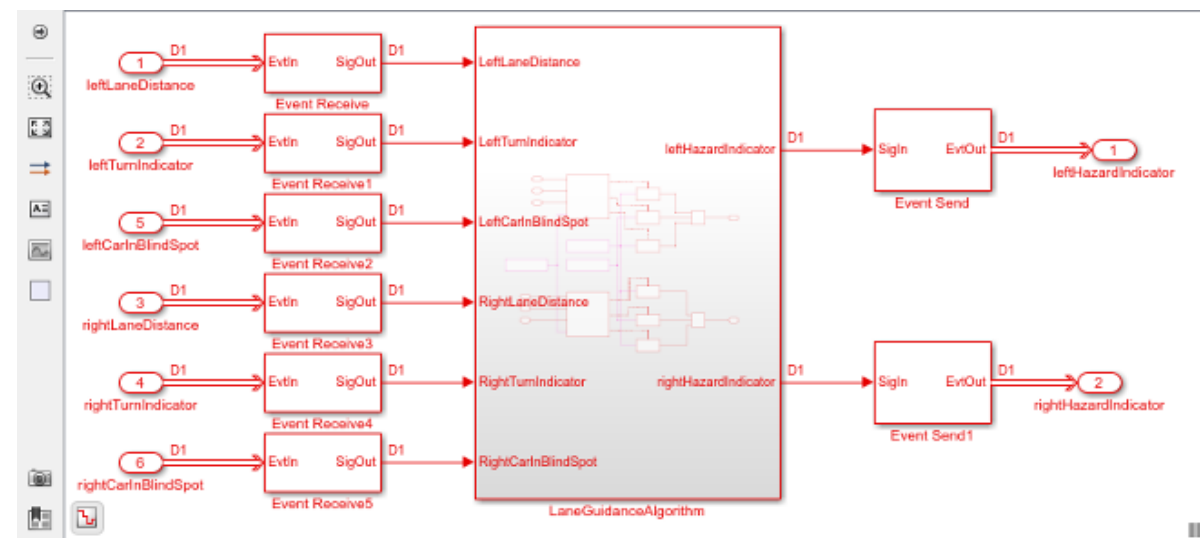
AUTOSAR Blockset

Design and simulate AUTOSAR software

Request a free trial

使用Simulink开发AUTOSAR Adaptive

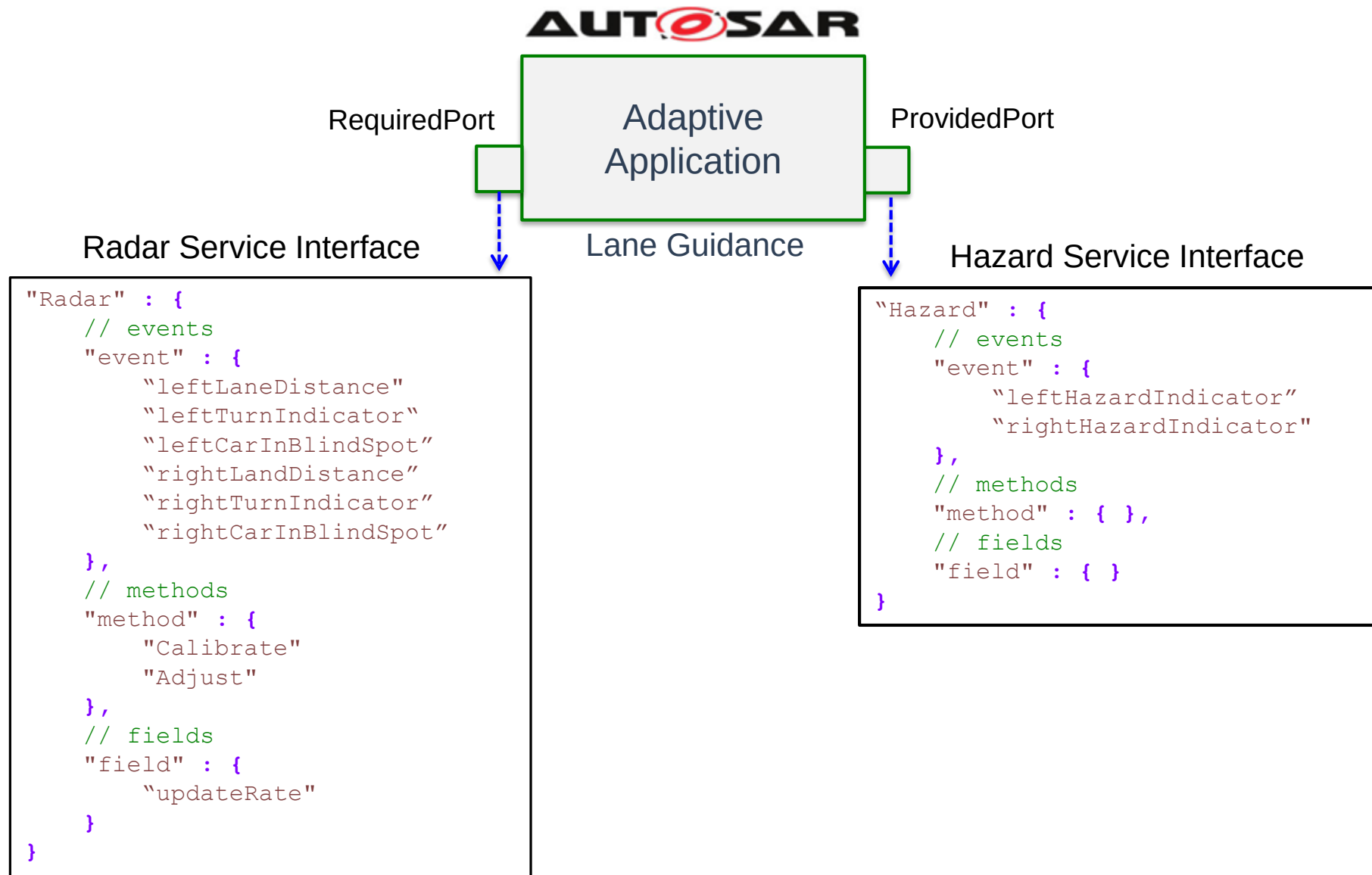
- AUTOSAR Adaptive的服务通讯机制:
 - Events
 - Methods
 - Fields
- Simulink中Events可以采用消息建模及配置生成代码



The screenshot shows the 'AUTOSAR' configuration window with the 'Service Interfaces' section expanded. The 'ProvidedInterface' section is selected, and the 'Events' sub-section is active. The table below lists the configured events.

Name	SwCalibrationAccess	DisplayFormat
leftHazardIndicator	ReadOnly	
rightHazardIndicator	ReadOnly	

AUTOSAR Adaptive 软件架构



AUTOSAR Adaptive 应用建模

AUTOSAR

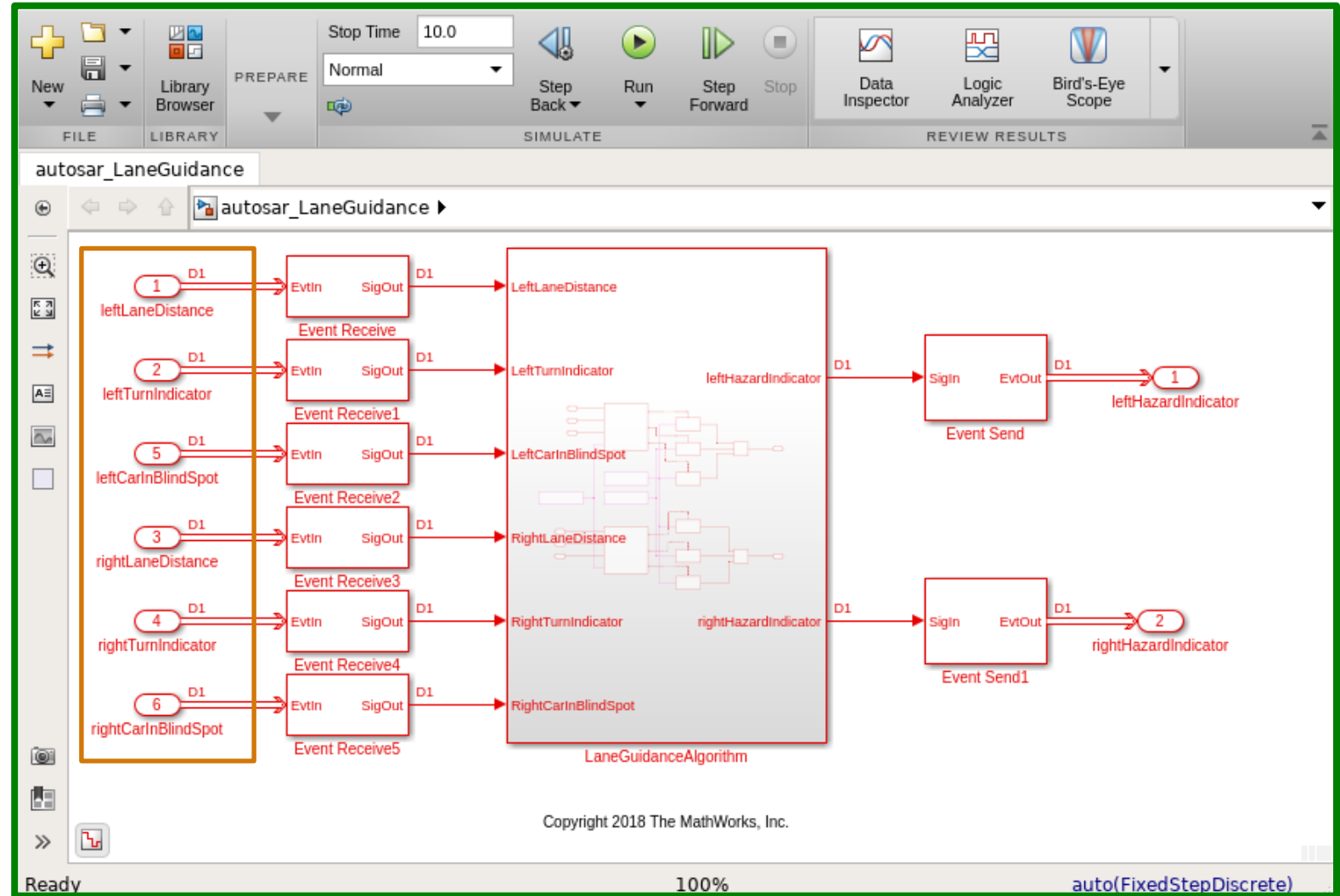
Adaptive
Application

RequiredPort

```

"Radarr" : {
  // events
  "event" : {
    "leftLaneDistance"
    "leftTurnIndicator"
    "leftCarInBlindSpot"
    "rightLandDistance"
    "rightTurnIndicator"
    "rightCarInBlindSpot"
  },
  // methods
  "method" : {
    "Calibrate"
    "Adjust"
  },
  // fields
  "field" : {
    "updateRate"
  }
}

```



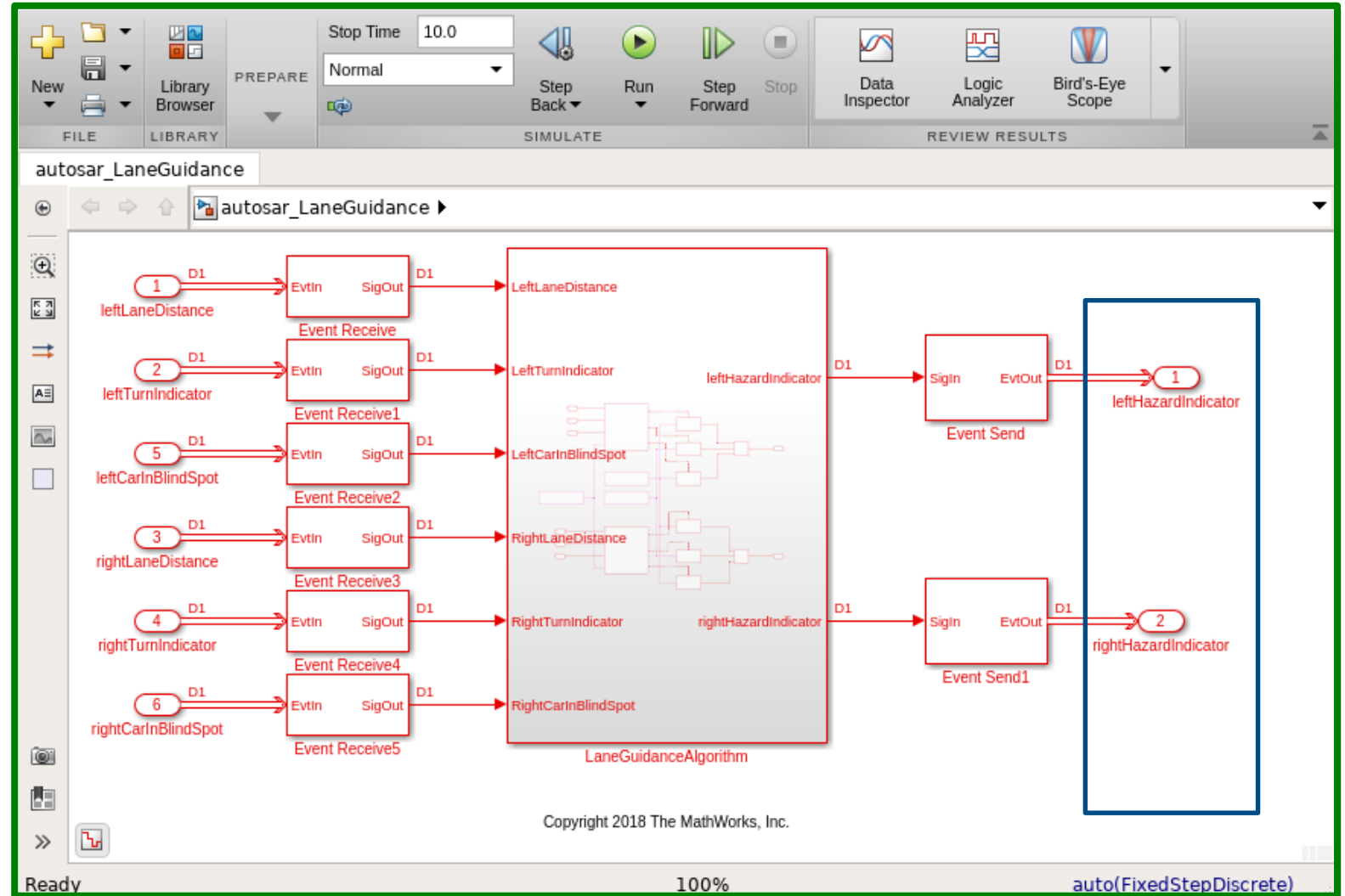
AUTOSAR Adaptive 应用建模

AUTOSAR

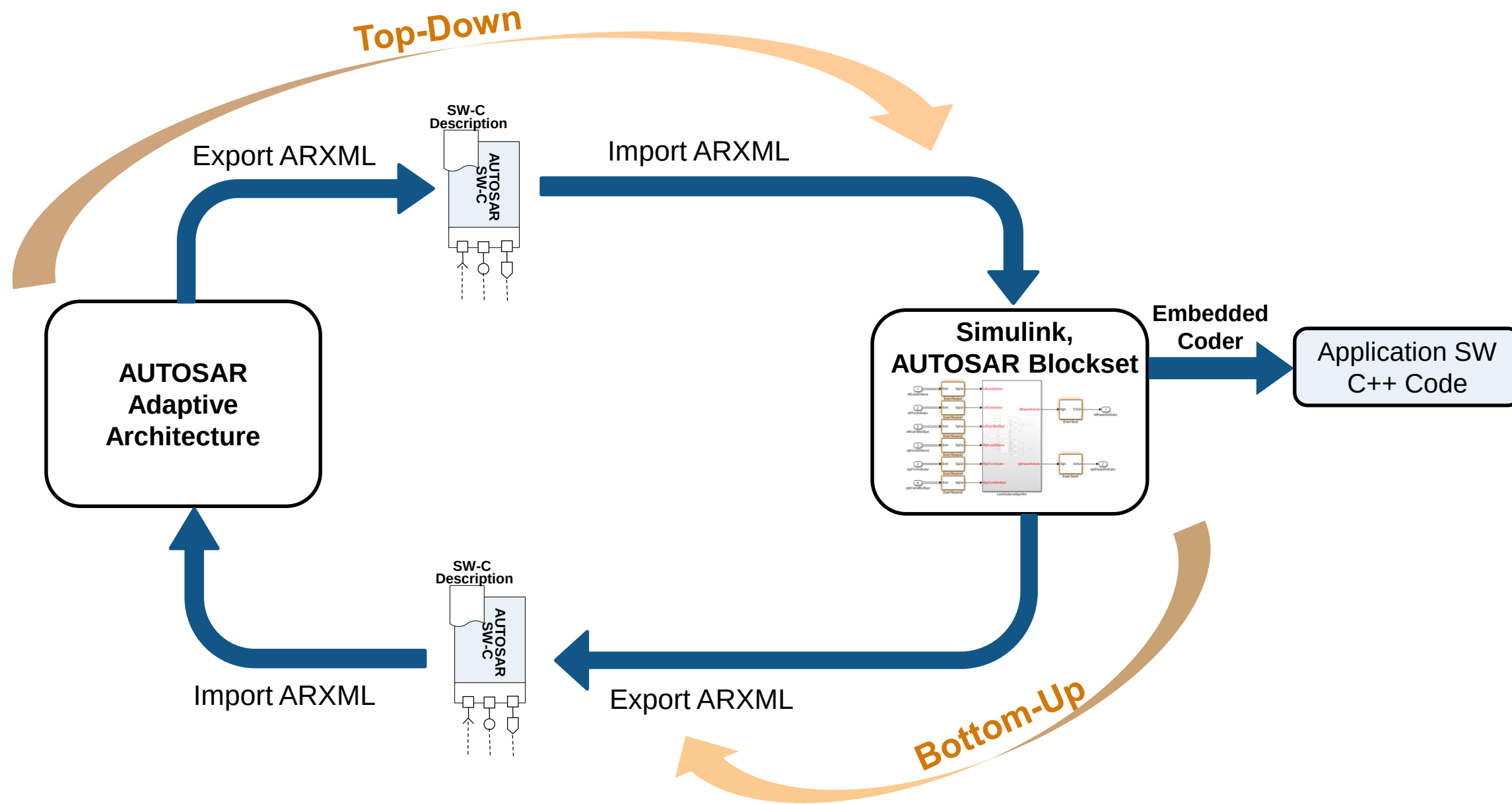
Adaptive
Application

ProvidedPort:

```
"Hazard" : {
  // events
  "event" : {
    "leftHazardIndicator"
    "rightHazardIndicator"
  },
  // methods
  "method" : { },
  // fields
  "field" : { }
}
```

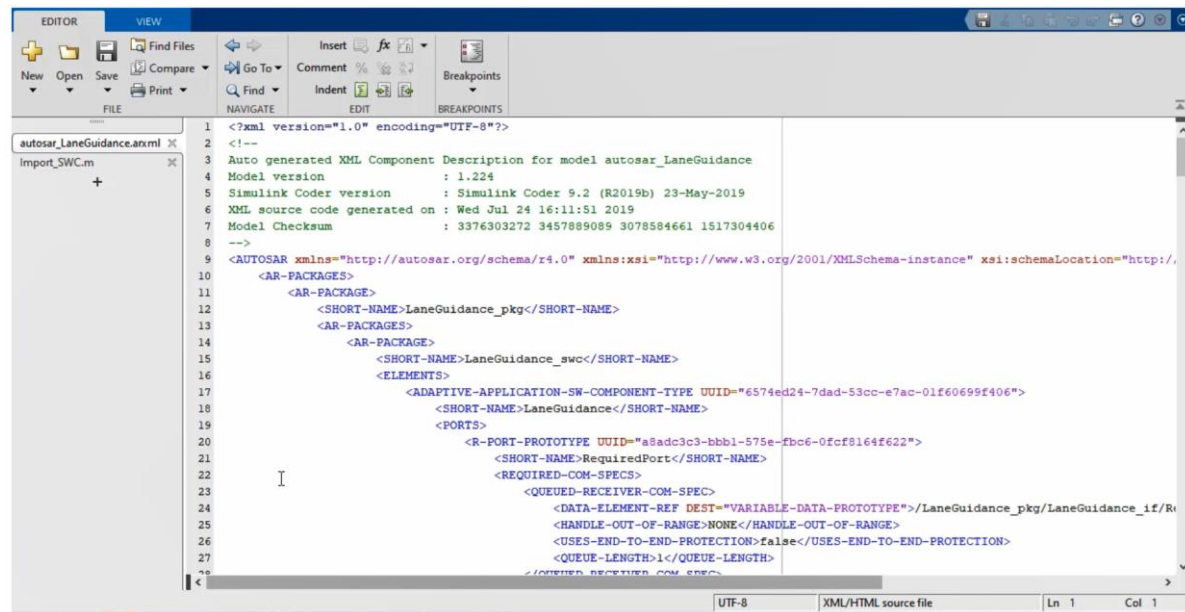


AUTOSAR Adaptive 工作流程



AUTOSAR Adaptive 开发步骤

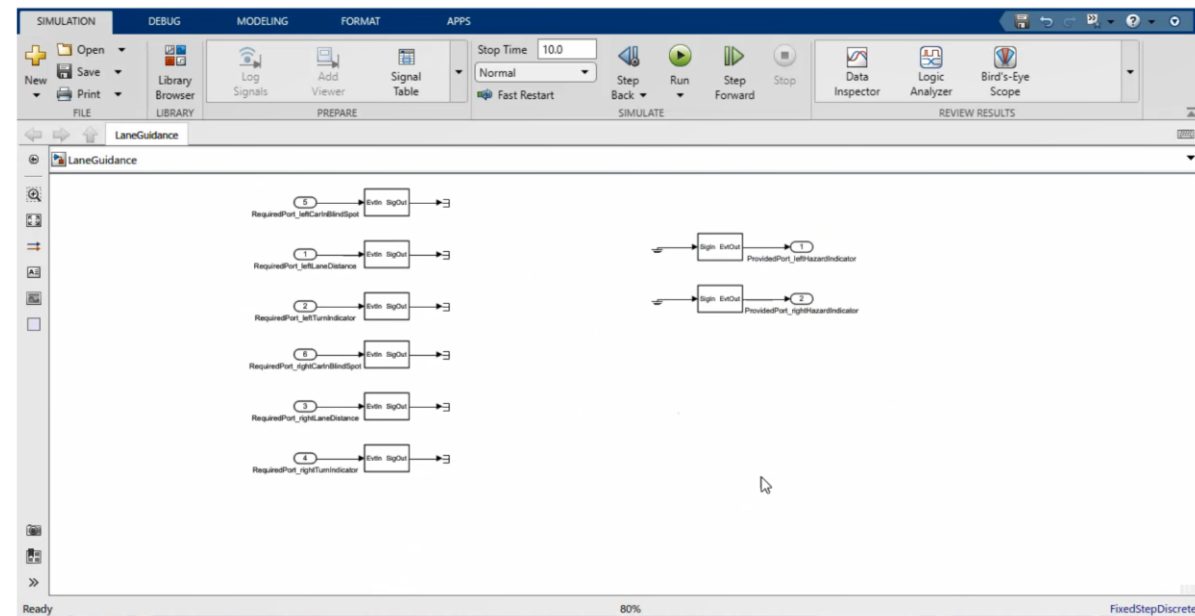
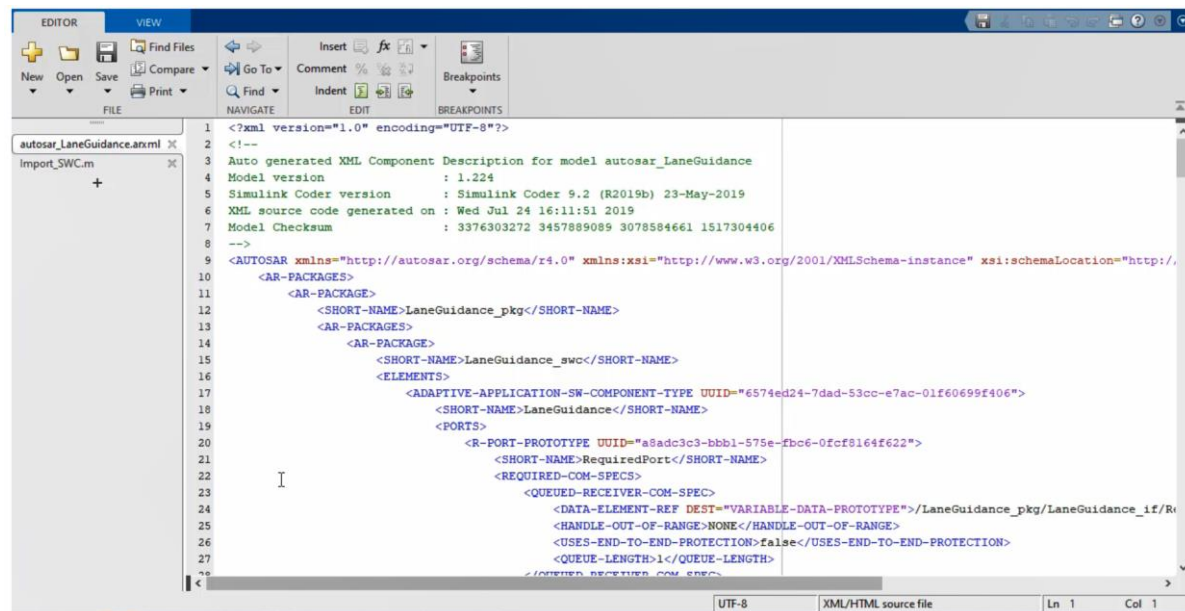
- 导入ARXML创建模型框架



```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <!--
3 Auto generated XML Component Description for model autosar_LaneGuidance
4 Model version : 1.224
5 Simulink Coder version : Simulink Coder 9.2 (R2019b) 23-May-2019
6 XML source code generated on : Wed Jul 24 16:11:51 2019
7 Model Checksum : 3376303272 3457889089 3078584661 1517304406
8 -->
9 <AUTOSAR xmlns="http://autosar.org/schema/r4.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://
10 <AR-PACKAGES>
11 <AR-PACKAGE>
12 <SHORT-NAME>LaneGuidance_pkg</SHORT-NAME>
13 <AR-PACKAGES>
14 <AR-PACKAGE>
15 <SHORT-NAME>LaneGuidance_sw</SHORT-NAME>
16 <ELEMENTS>
17 <ADAPTIVE-APPLICATION-SW-COMPONENT-TYPE UUID="6574ed24-7dad-53cc-e7ac-01f60699f406">
18 <SHORT-NAME>LaneGuidance</SHORT-NAME>
19 <PORTS>
20 <R-PORT-PROTOTYPE UUID="a8adc3c3-bbb1-575e-fbc6-0fcf8164f622">
21 <SHORT-NAME>RequiredPort</SHORT-NAME>
22 <REQUIRED-COM-SPECS>
23 <QUEUED-RECEIVER-COM-SPEC>
24 <DATA-ELEMENT-REF DEST="VARIABLE-DATA-PROTOTYPE"/>LaneGuidance_pkg/LaneGuidance_if/R
25 <HANDLE-OUT-OF-RANGE>NONE</HANDLE-OUT-OF-RANGE>
26 <USES-END-TO-END-PROTECTION>false</USES-END-TO-END-PROTECTION>
27 <QUEUE-LENGTH>1</QUEUE-LENGTH>
28 </QUEUED-RECEIVER-COM-SPEC>
29 </REQUIRED-COM-SPECS>
30 </R-PORT-PROTOTYPE>
31 </PORTS>
32 </ADAPTIVE-APPLICATION-SW-COMPONENT-TYPE>
33 </ELEMENTS>
34 </AR-PACKAGE>
35 </AR-PACKAGES>
36 </AUTOSAR>
```

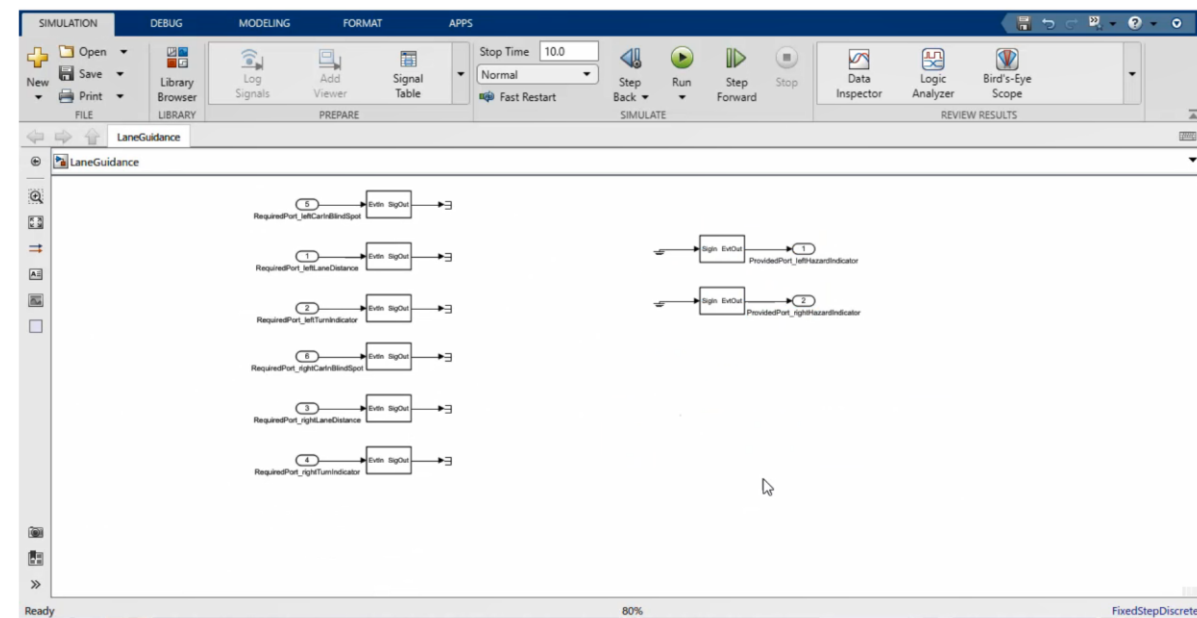
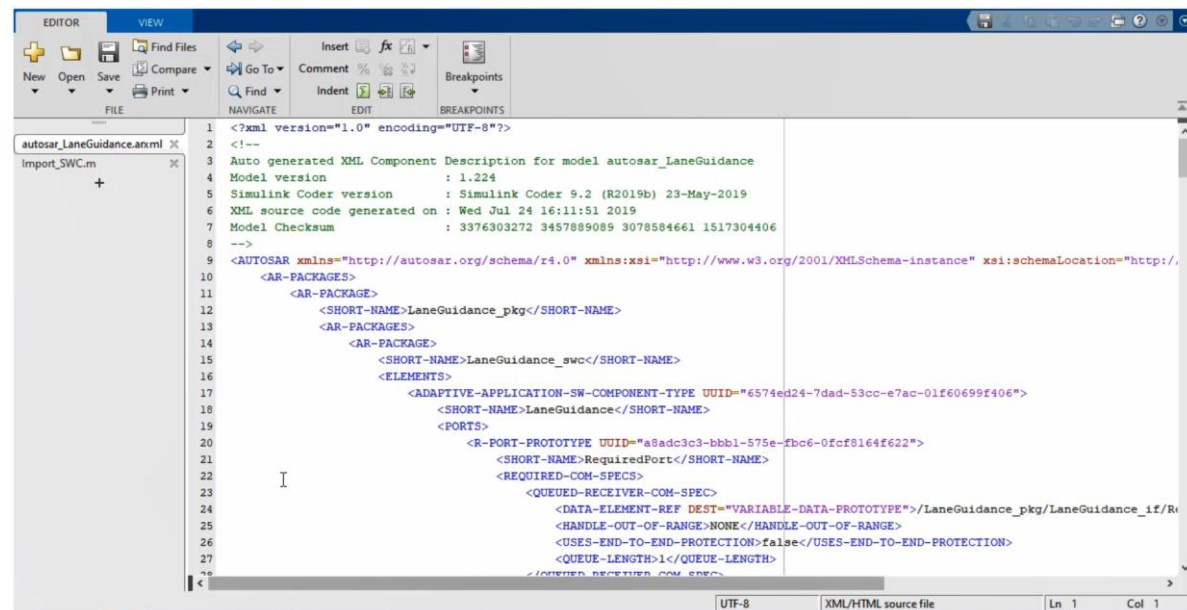
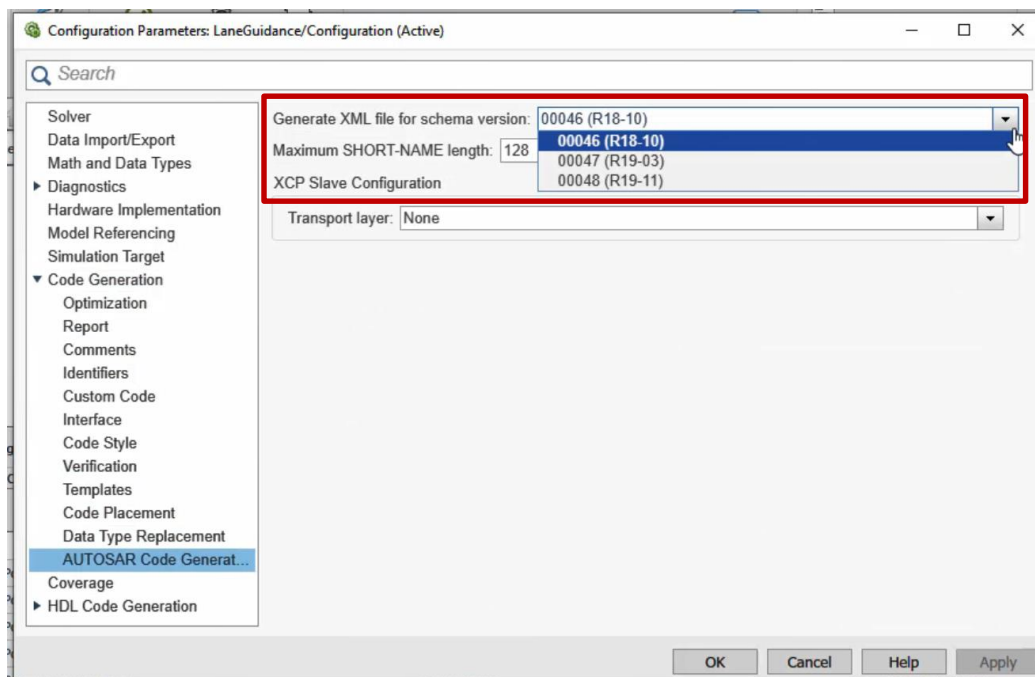
AUTOSAR Adaptive 开发步骤

- 导入ARXML创建模型框架



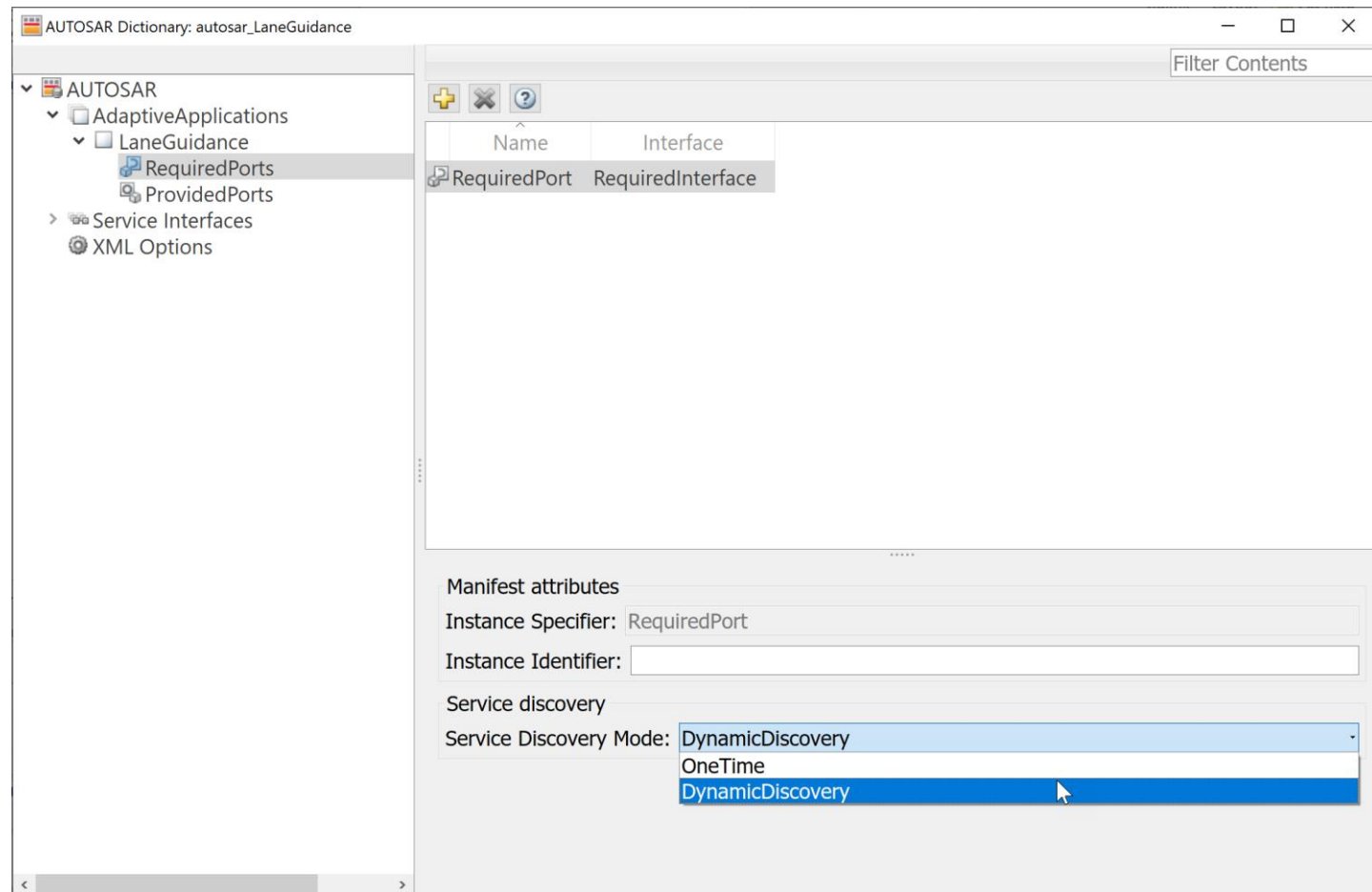
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- 导入ARXML创建模型框架



AUTOSAR Adaptive 开发步骤

- 导入ARXML创建模型框架
- 配置服务发现机制

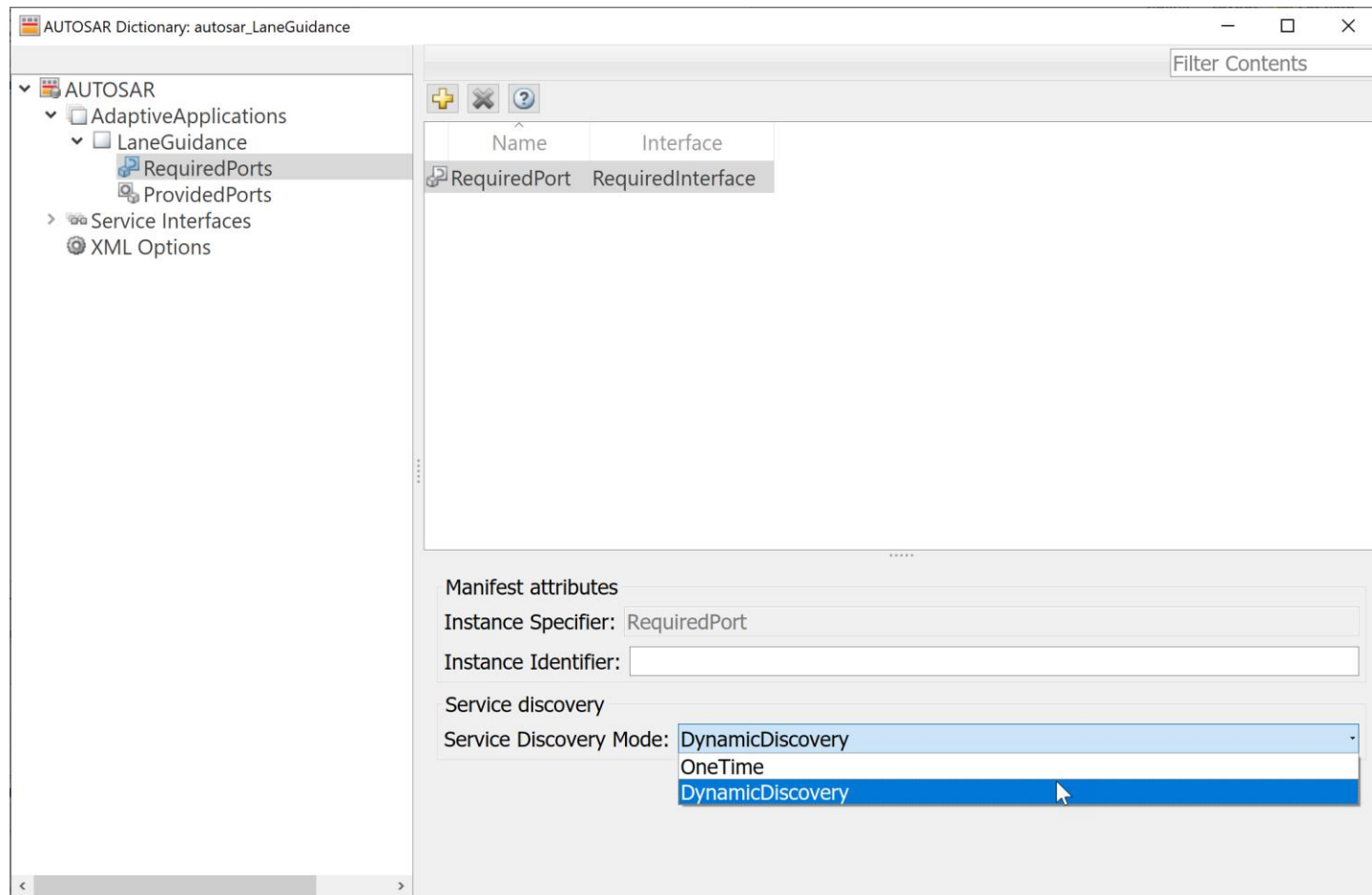


AUTOSAR Adaptive 开发步骤

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- 配置服务发现机制

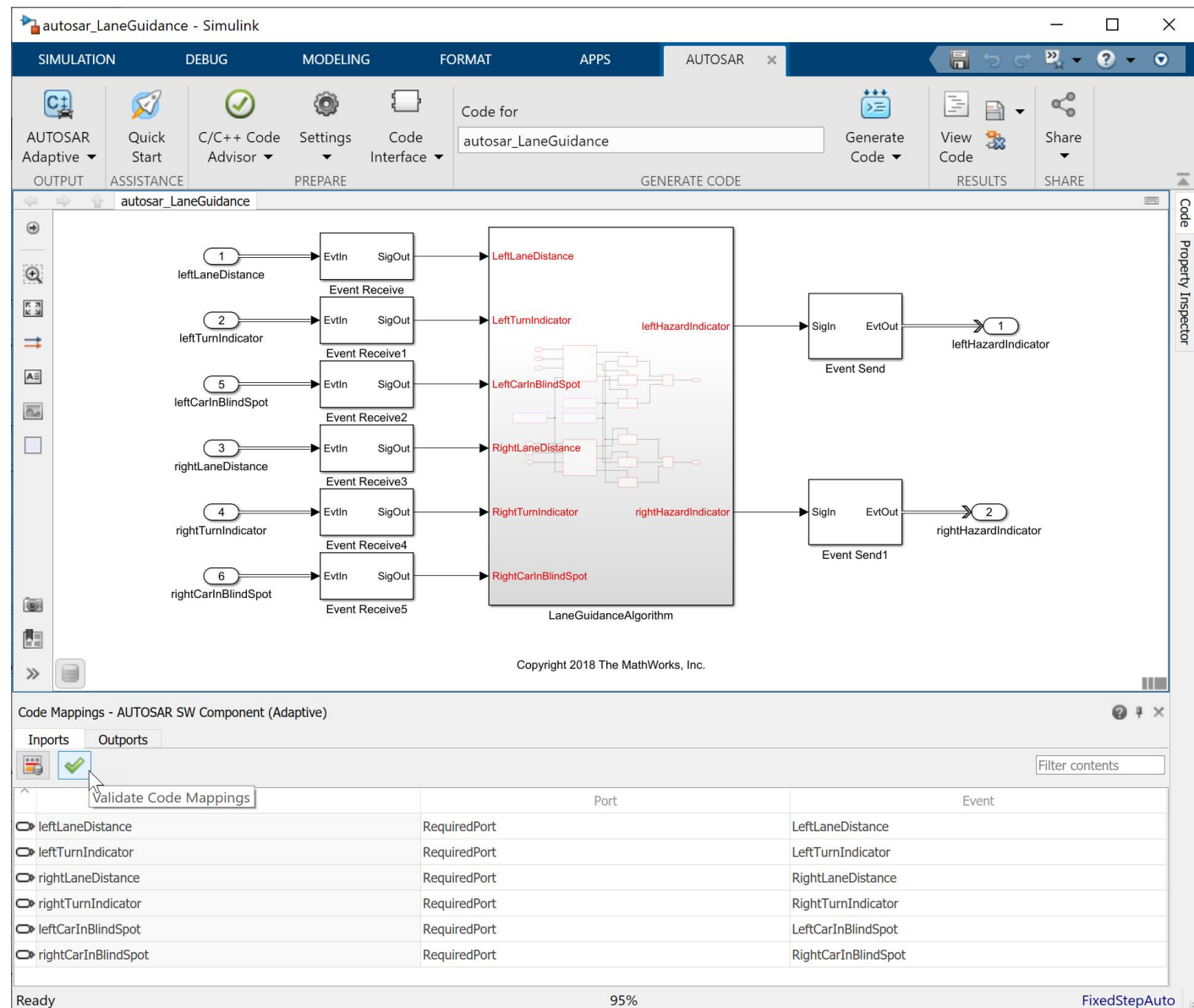
订阅自适应服务

- 只在启动时, 或
- 在其可用时动态发现



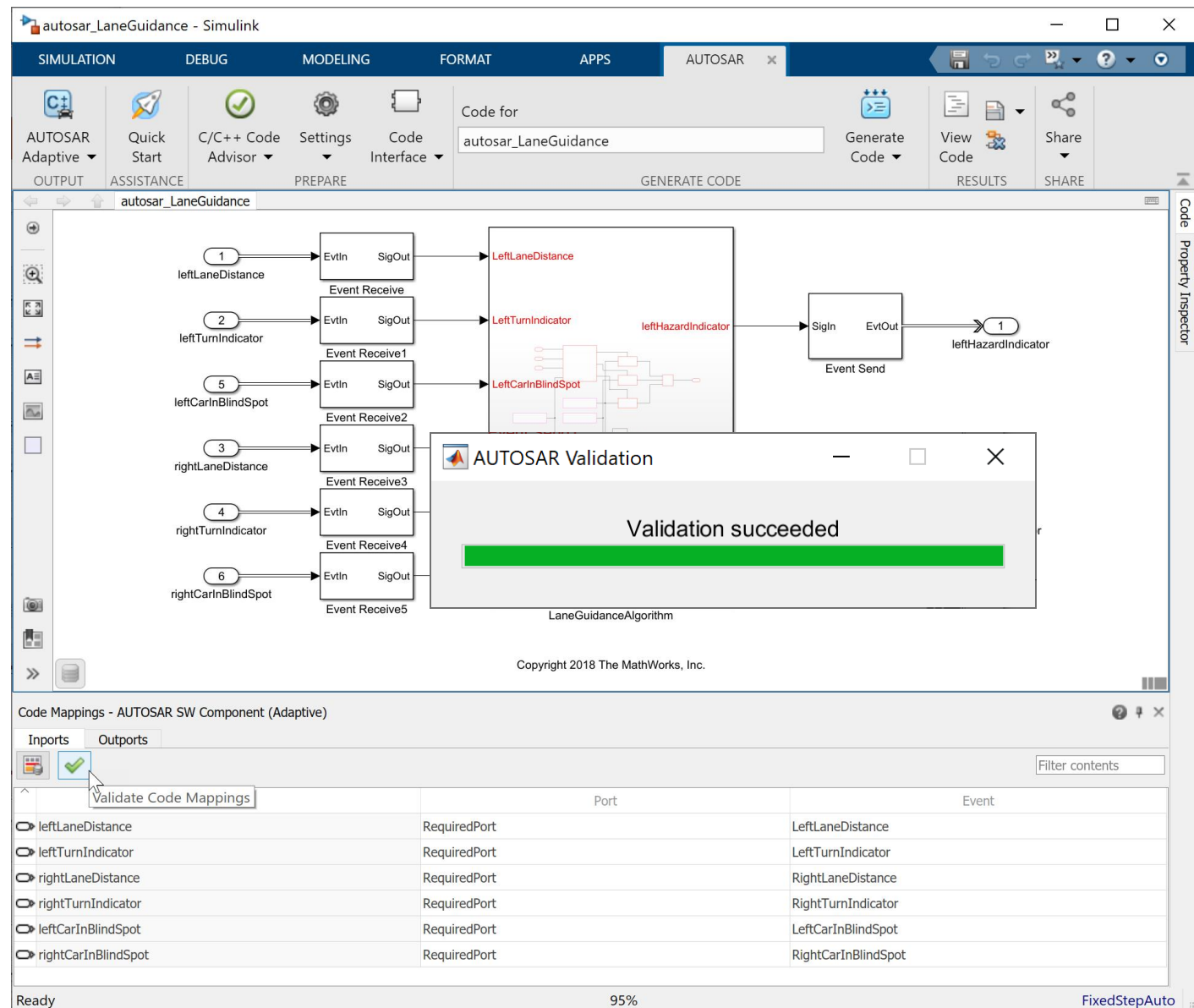
AUTOSAR Adaptive 开发步骤

- 导入ARXML创建模型框架
- 配置服务发现机制
- 确认AUTOSAR属性



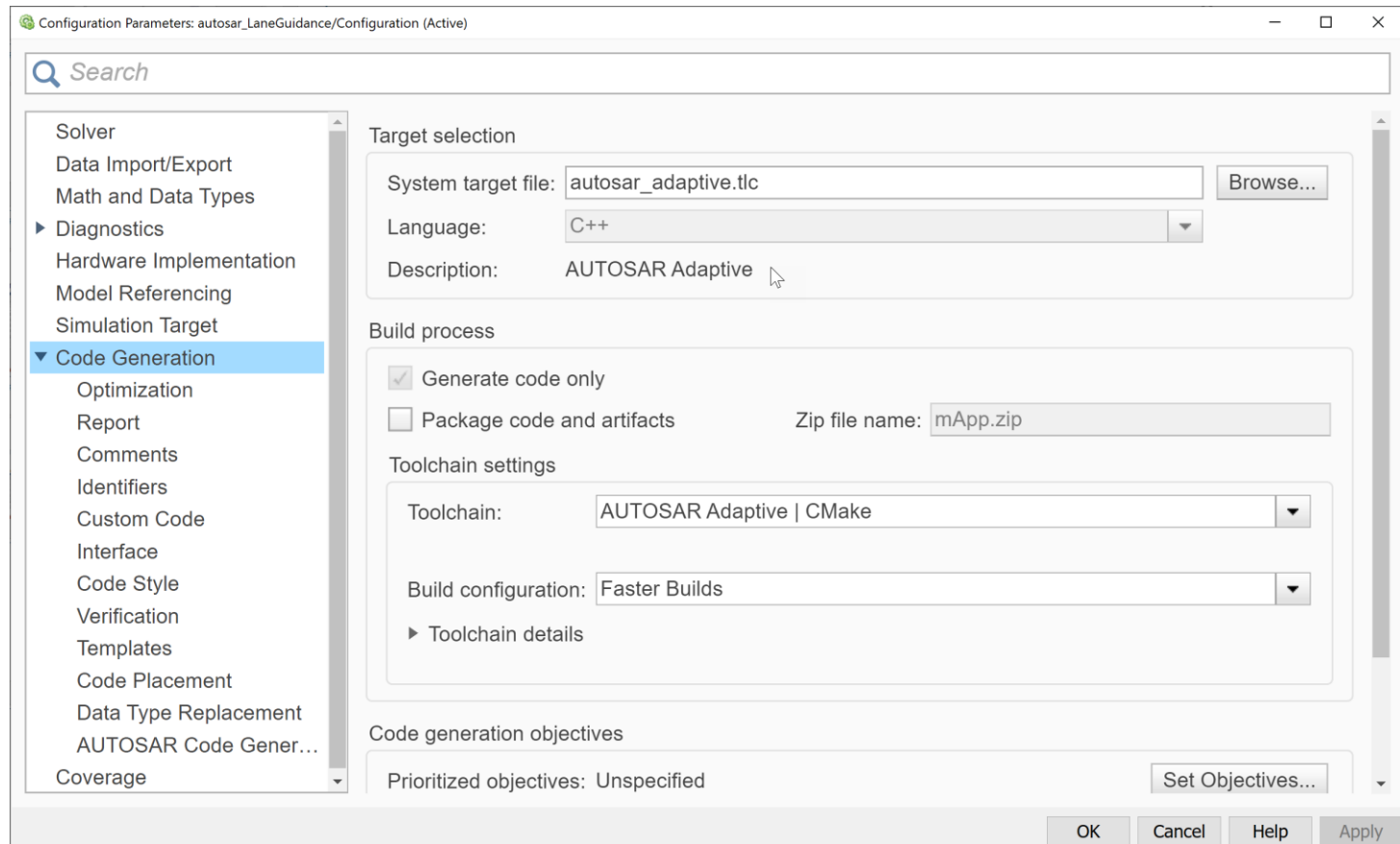
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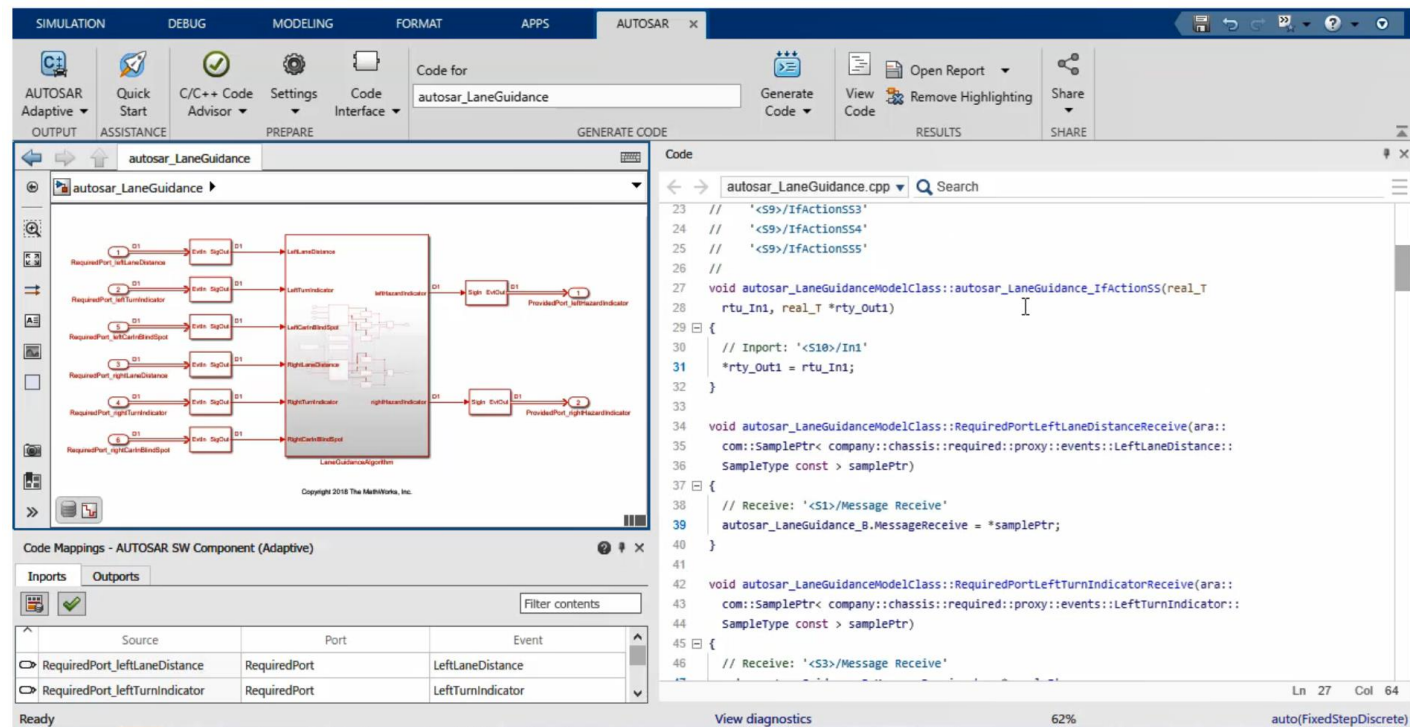
AUTOSAR Adaptive 开发步骤

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- 确认AUTOSAR属性
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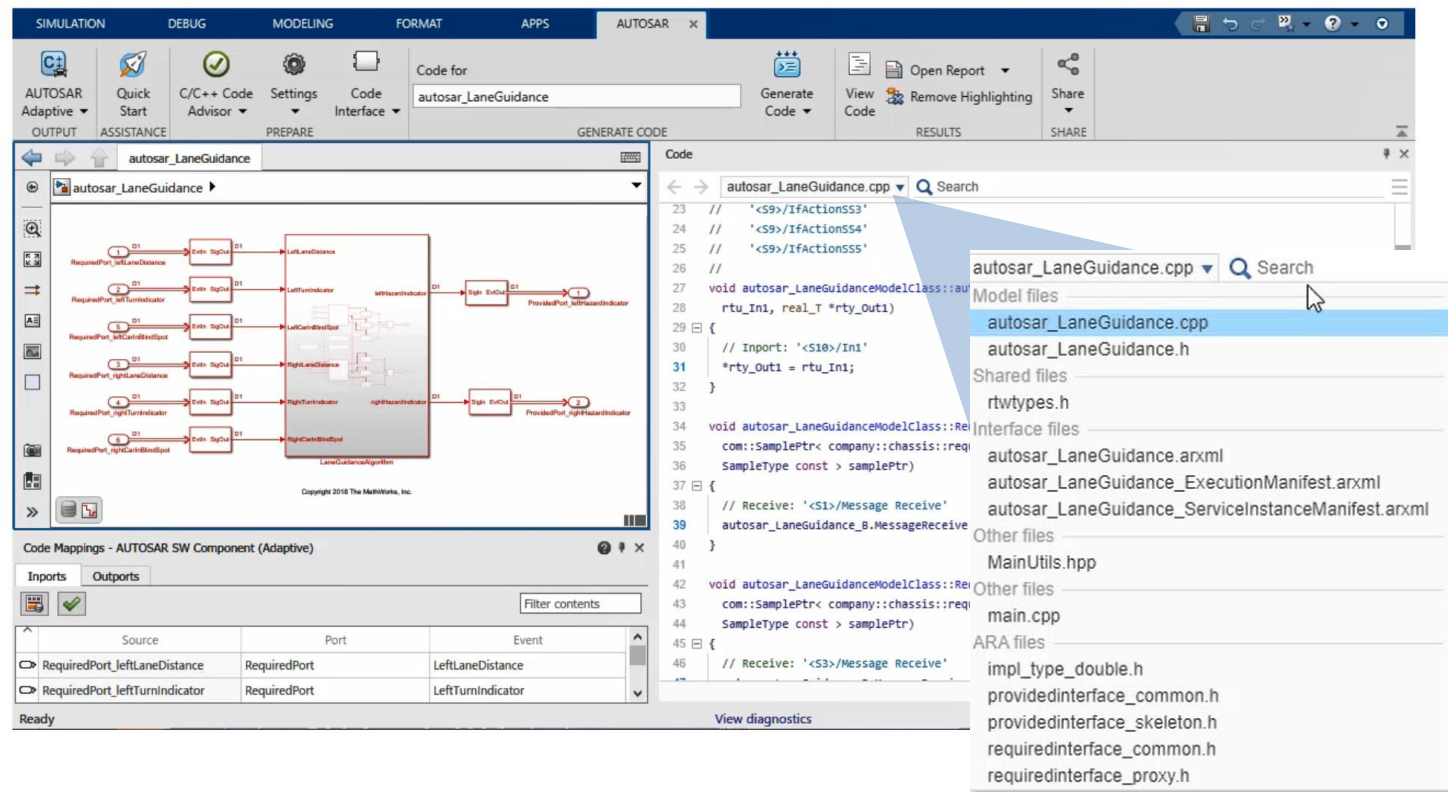
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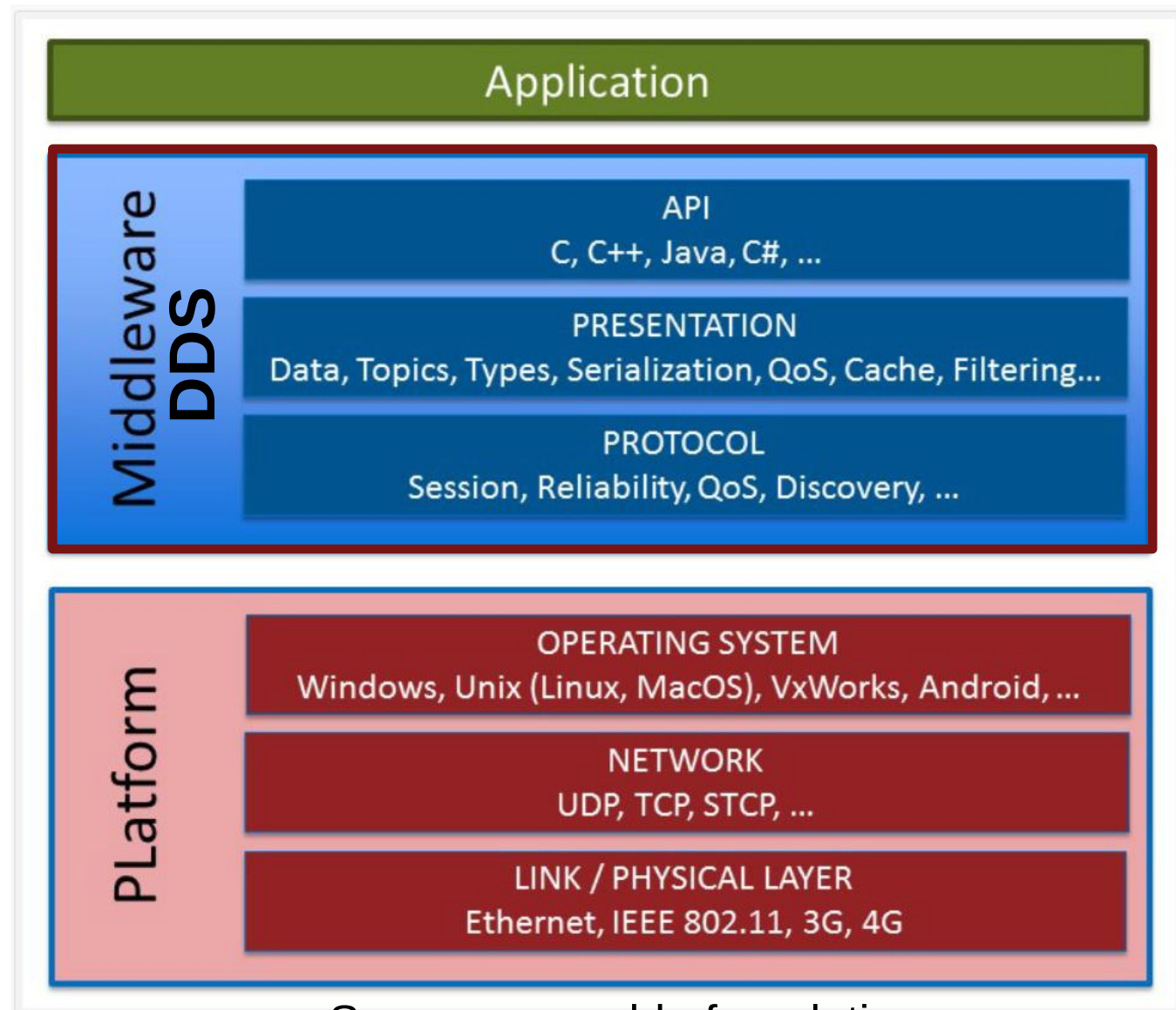
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DDS概述

数据分发服务 (DDS)

- 从网络、数据格式和操作系统的细节中将应用抽象出来
- 数据中心通讯（发布-订阅）
- 服务质量和动态发现



Source: www.dds-foundation.org

DDS支持 – DDS Blockset



数据分发服务(DDS)采用SOA方法论解决实时和嵌入式系统的发布/订阅的通讯问题



DDS面向航空、国防、汽车和机器人等行业的实时数据交换应用需求

R2021a

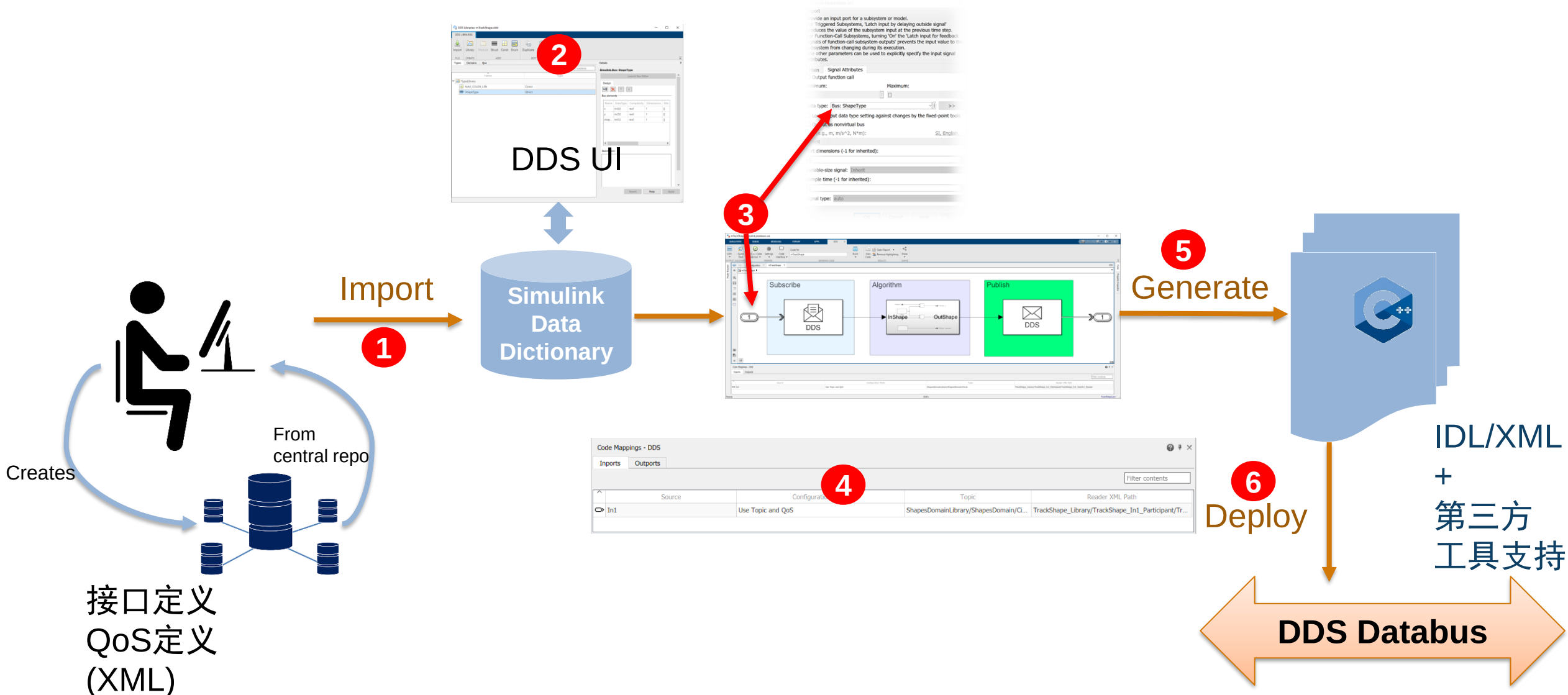
DDS Blockset

Design and simulate DDS applications

[Request a trial](#)

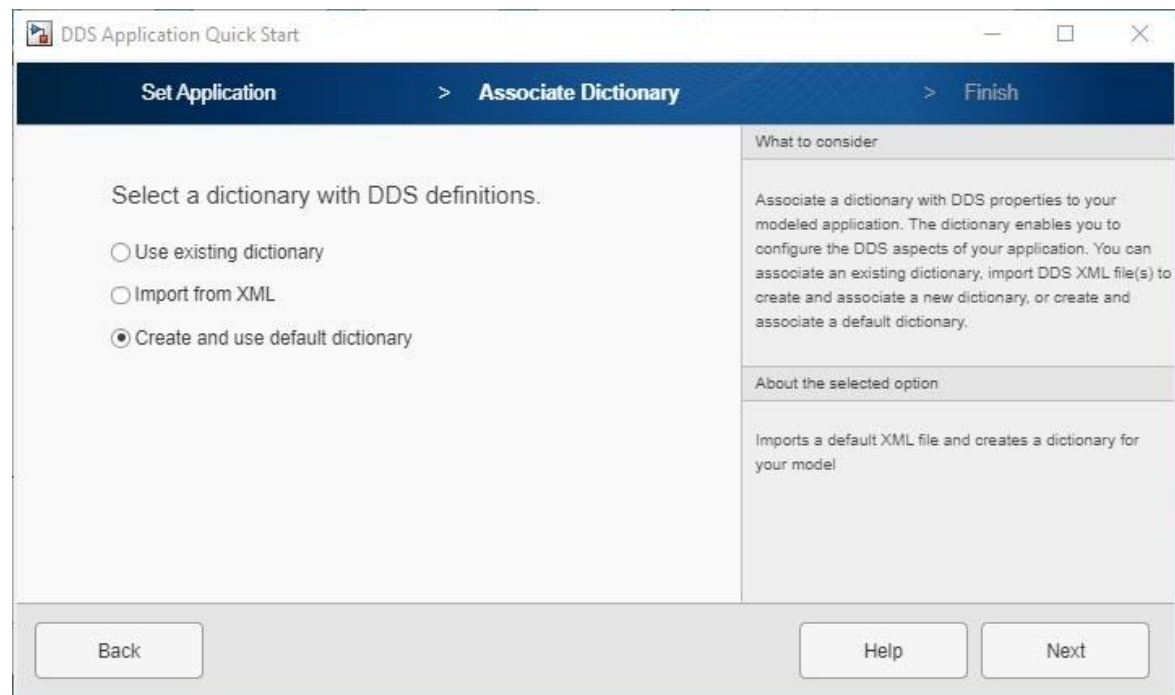


DDS开发流程



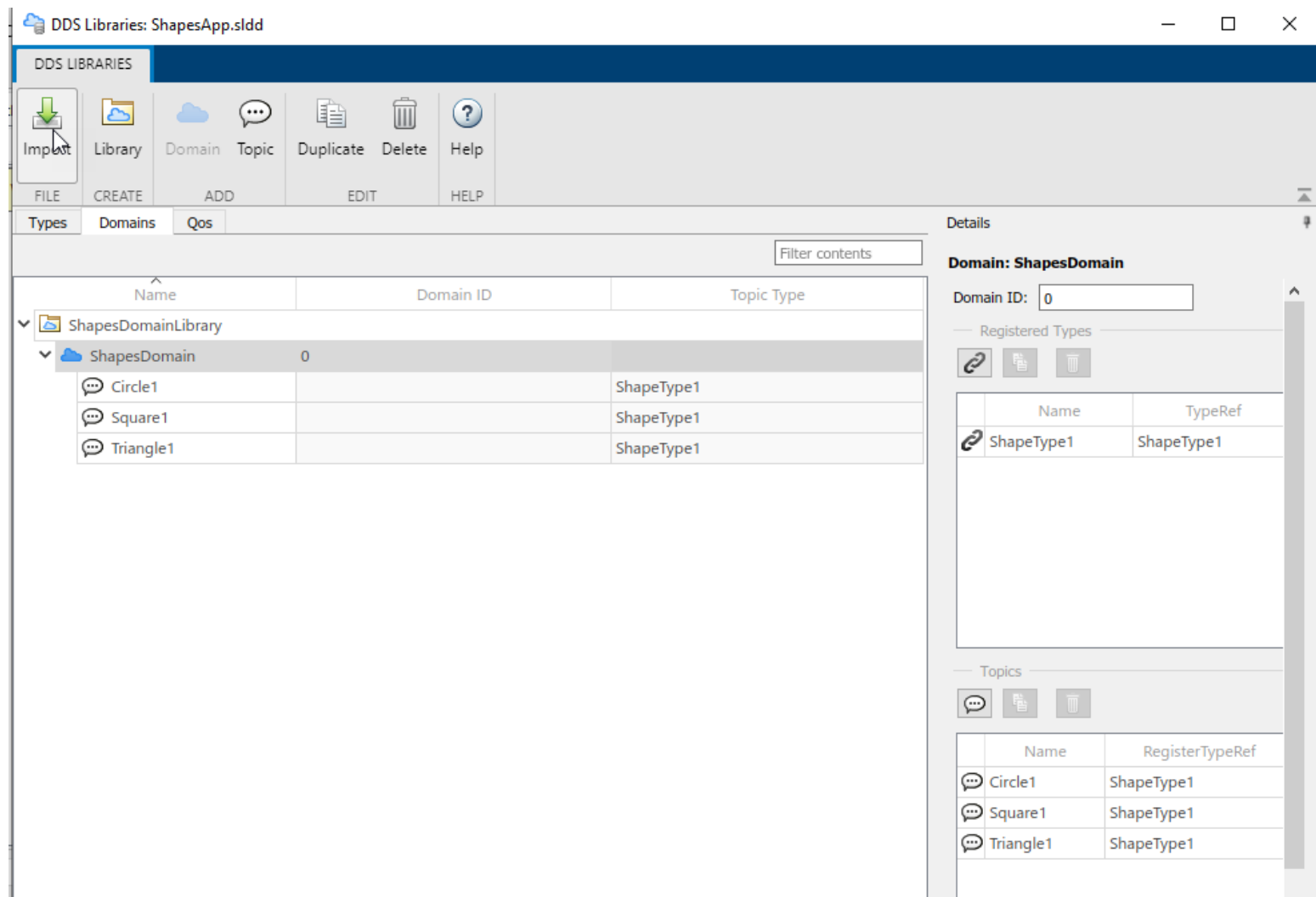
DDS 应用快速上手

- DDS 应用快速上手功能可以
 - 创建默认的DDS定义
 - 从XML文件导入DDS定义
 - 使用在模型中创建好的预定义数据



DDS数据词典

- 导入XML
- 定义/修改
 - 话题类型
 - 域
 - 服务质量策略

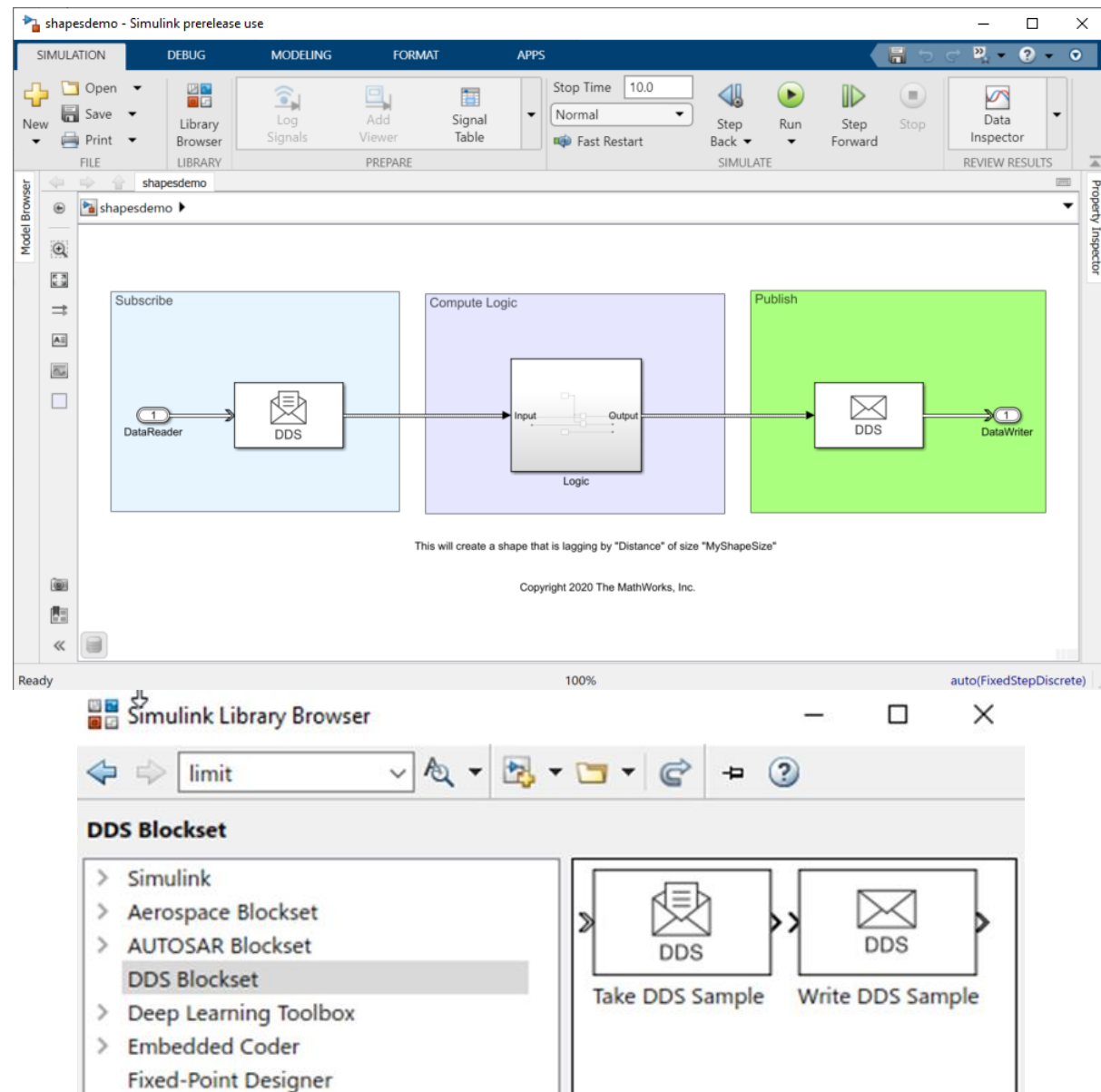


DDS建模模块

使用DDS模块建模发布或订阅机制

DDS Blockset 提供基本模块用于建模DDS应用

- 接收 DDS 采样
- 写入 DDS 采样

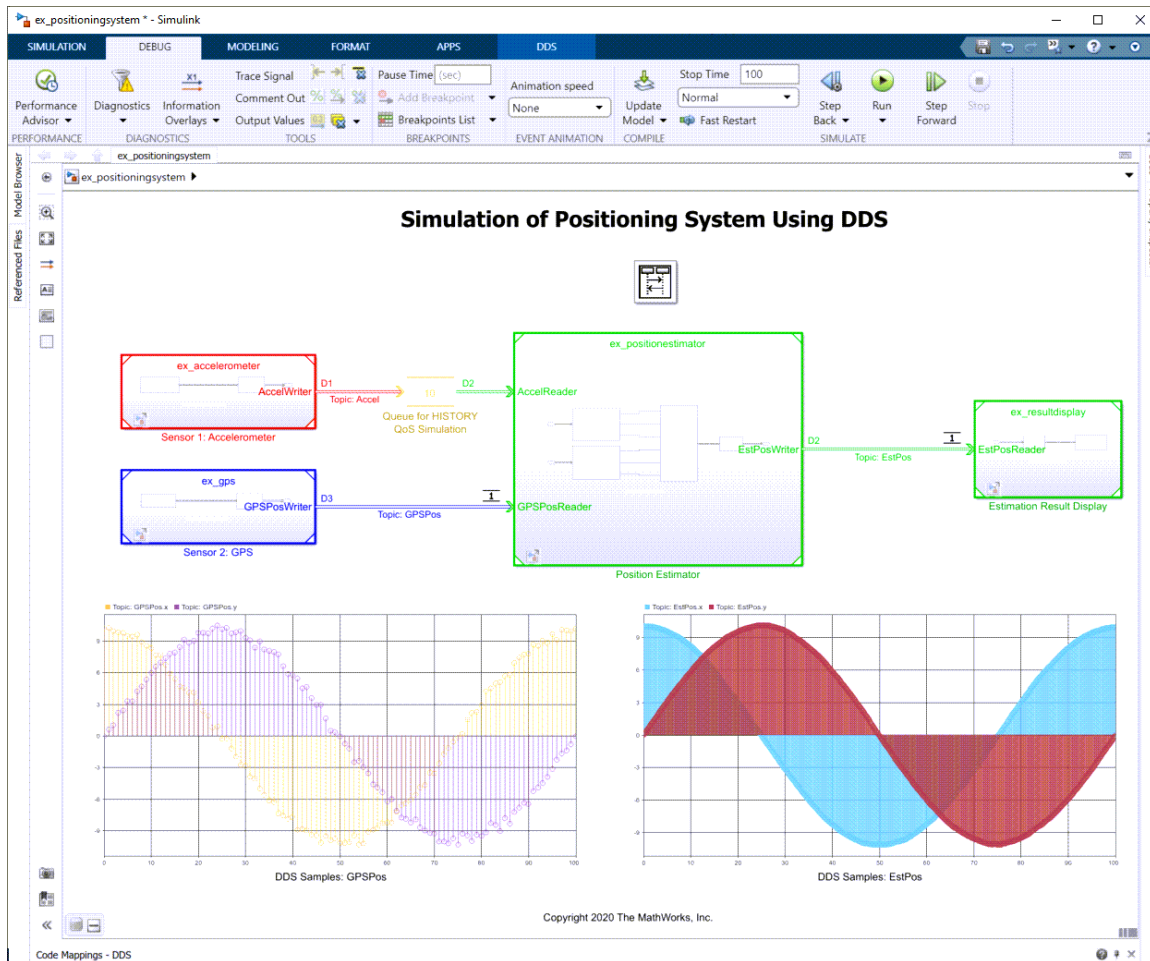


```
>> open_system('shapedemo');
```

DDS应用仿真

仿真DDS Simulink模型及其服务质量

使用Simulink建模和仿真包括历史数据在内的服务质量策略以验证运行时行为



DDS代码生成和部署

生成DDS可执行文件并部署到DDS网络

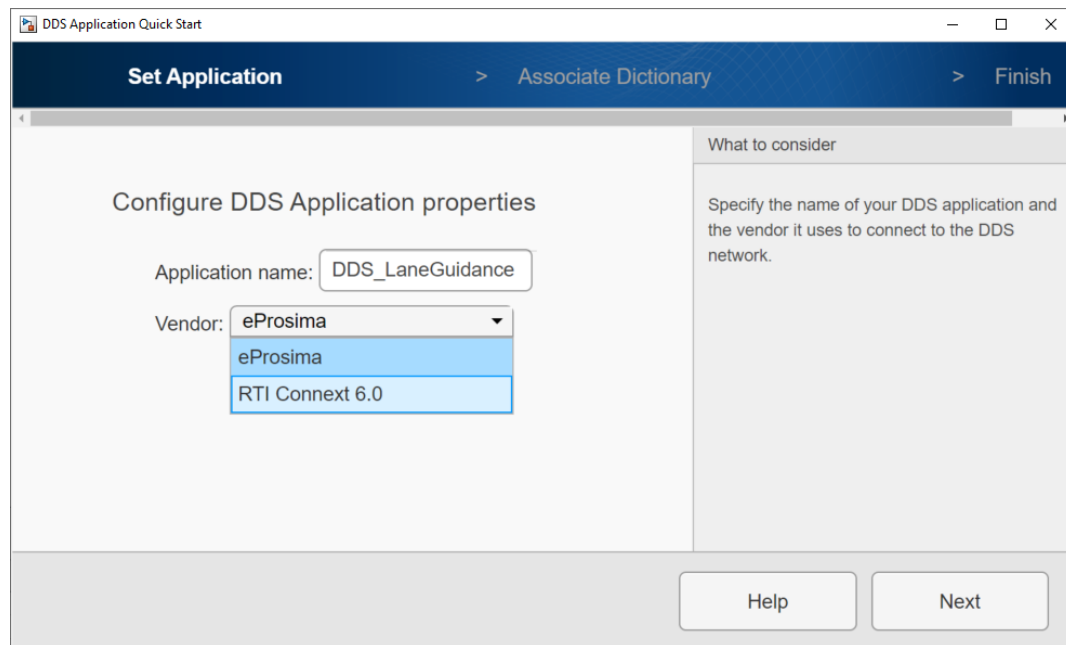
- 使用Embedded coder生成
 - 带DDS API的C++产品级代码
 - 用于部署的XML或IDL文件

```
bool writewithWriter(const PosType* data, std::string participantName, std::string writerName) {
    DDS_DataWriter* writer = getWriter(writerName, participantName);
    PosTypeDataWriter* fooWriter = PosTypeDataWriter_narrow(writer);
    if(!fooWriter) {
        return false;
    }
    const DDS_ReturnCode_t ret = PosTypeDataWriter_write((PosTypeDataWriter*)writer, data);
    return (ret == DDS_ReturnCode_t::DDS_RETCODE_OK);
};

bool createParticipant(std::string participantName) {
    if (participants.find(participantName) == participants.end()) {
        DDS_DomainParticipant* participant =
            DDS_DomainParticipantFactory_create_participant_from_config(
                DDS_TheParticipantFactory, participantName.c_str());
        if(!participant) {
            return false;
        }
        participants[participantName] = participant;
    }
    return true;
};
```

与第三方DDS栈集成

DDS Blockset 与第三方DDS栈 (如RTI Connex and eProsima Fast DDS)完全集成



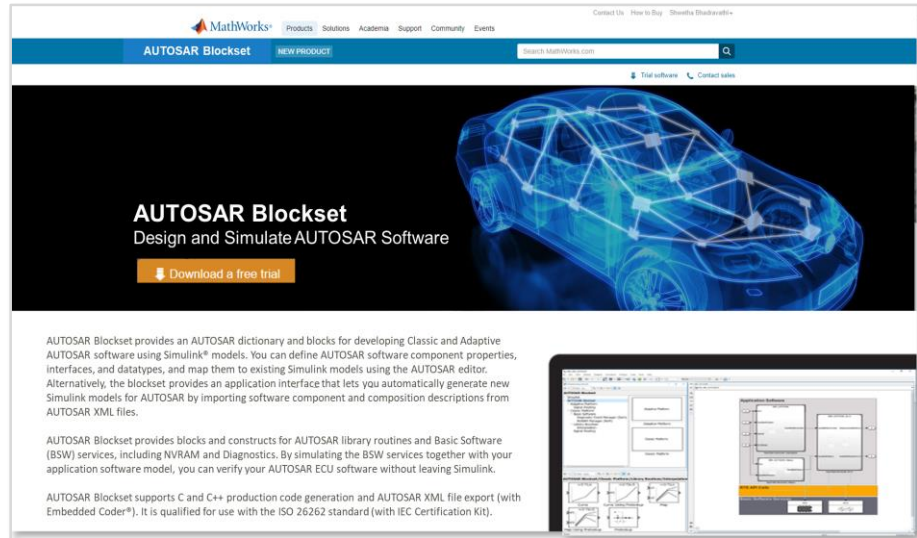
内容

- 软件定义汽车时代的行业挑战
- Simulink开发面向服务的架构(SOA)
- Simulink对SOA行业标准的支持
 - Simulink对AUTOSAR Adaptive的支持
 - Simulink对数据分发服务 (DDS)的支持
- 总结及如何获取更多相关信息

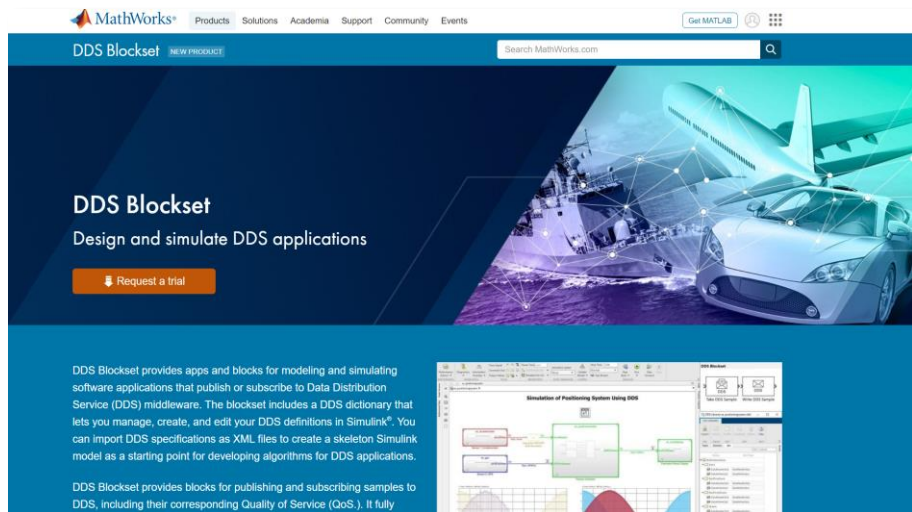
总结

- 高级的功能需求推动了汽车行业电子电气和软件架构的进化
- 软件的复杂管理和频繁升级要求引入了面向服务的架构
- Simulink支持设计、仿真、生成和部署面向服务的应用
- 最大化的复用已有模型和经验有助于降低迁移至SOA应用的风险

更多相关信息 – 产品主页和演示



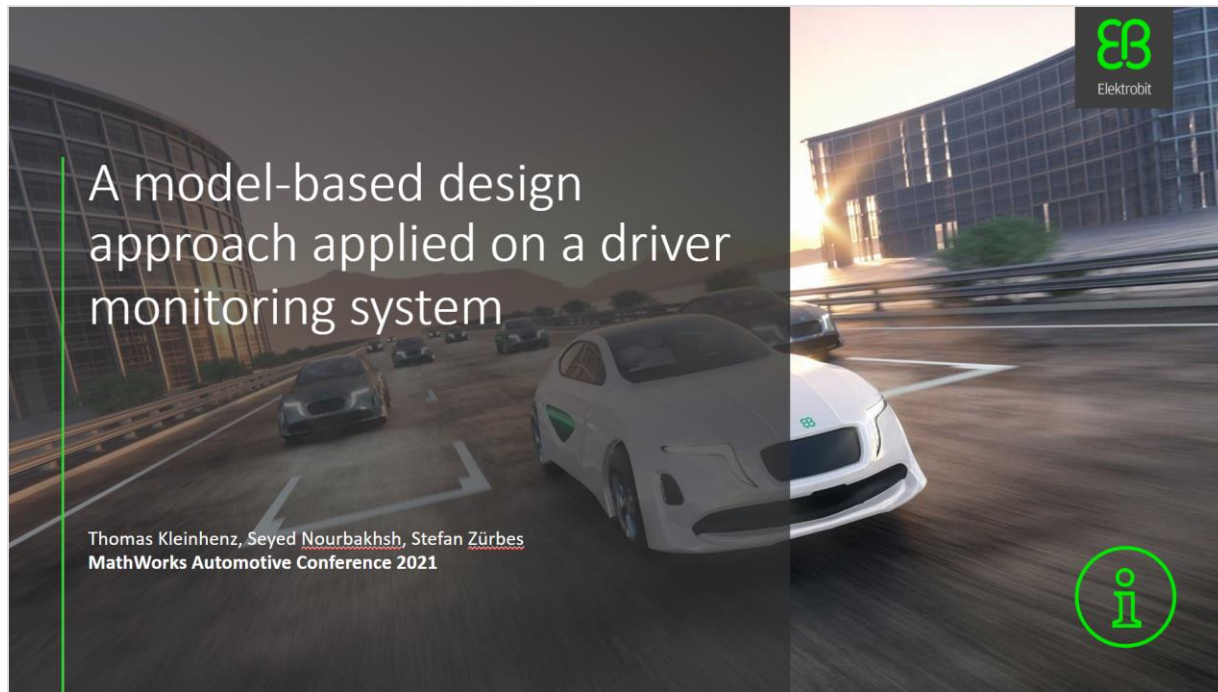
www.mathworks.com/products/autosar.html



www.mathworks.com/products/dds.html



更多相关信息 – 与第三方栈的集成



Elektrobit – A model-based design approach applied on a driver monitoring system (using Adaptive AUTOSAR)

Vector – The evolution of E/E Architecture and the Impact on Future Software Development.



MATLAB EXPO 2021

感谢参会！



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