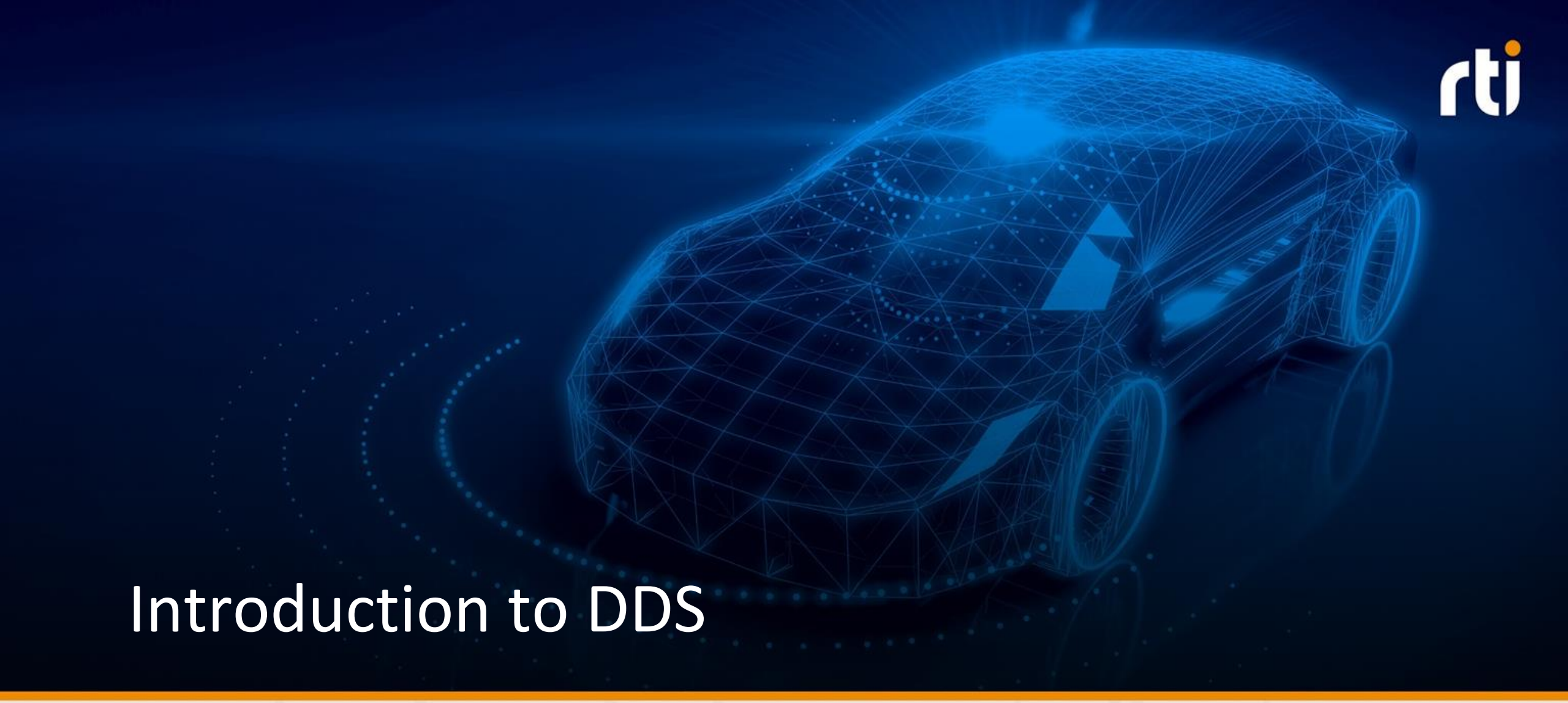


Introduction to DDS

RTI APAC Team

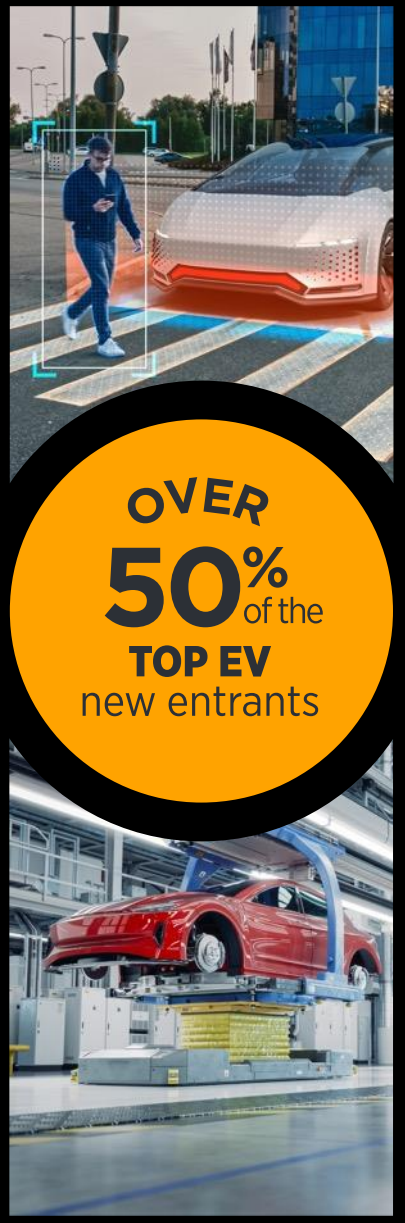
Your Trusted Technology Partner

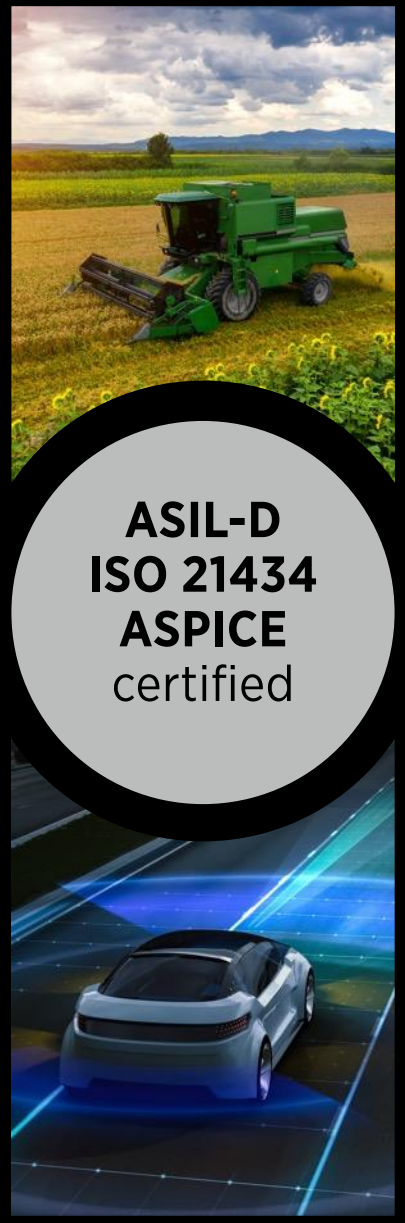
Agenda

- Introduction
- History of SOME/IP & DDS
- Why DDS in Automotive/AUTOSAR?
- Key Architectural features
- Existing using of DDS in actual projects
- History of DDS in AUTOSAR

rti

CONNEXT DRIVE





ONE
PLATFORM
Simulation to Production

TRUSTED BY 25 OEMs

OVER 1 MILLION VEHICLES on the Road

OVER 50% of the TOP EV new entrants

ASIL-D
ISO 21434
ASPICE
certified

rti

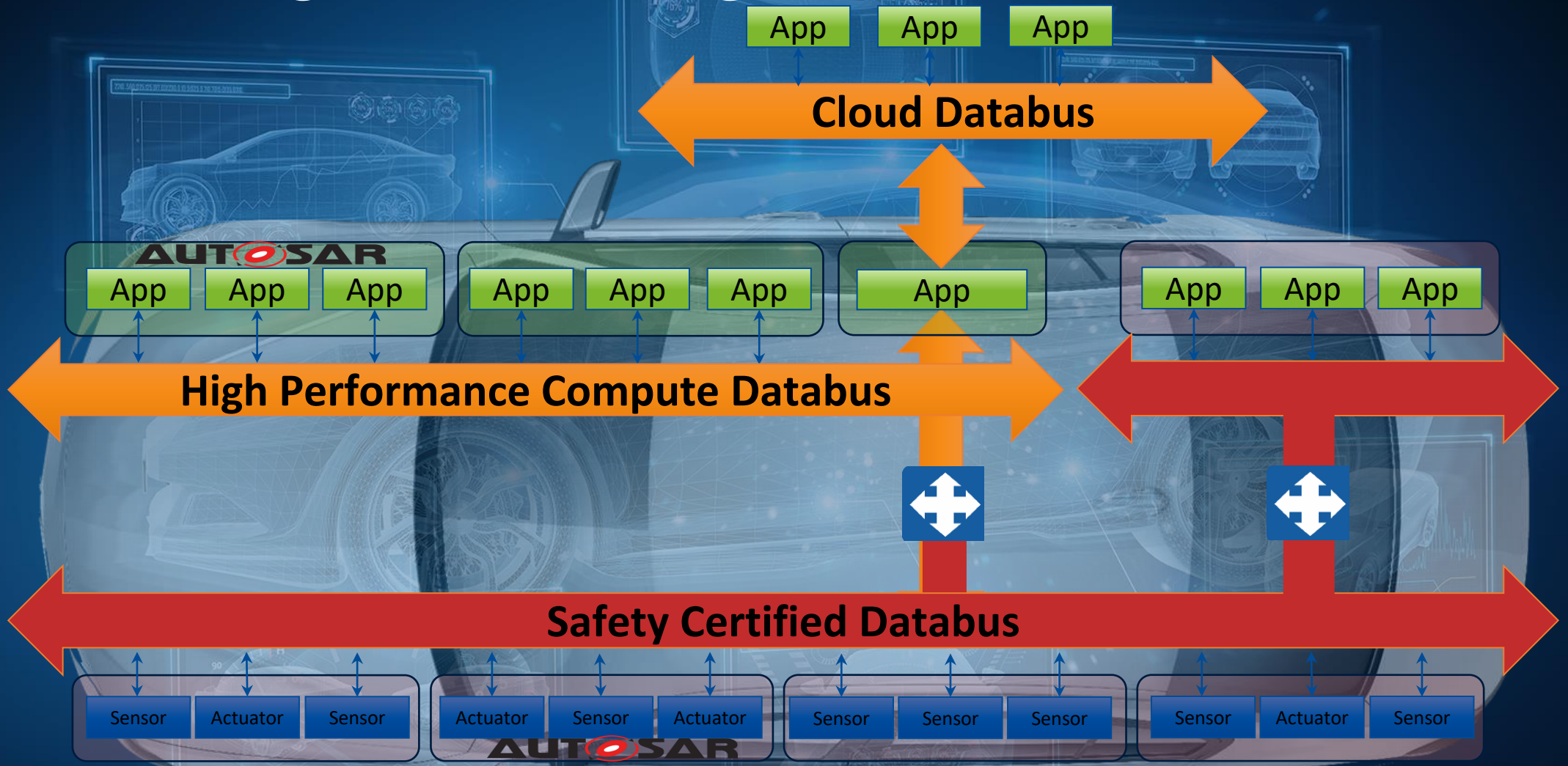
CONNEXT DRIVE®

The First Complete Automotive-Grade Connectivity Solution for AV Development

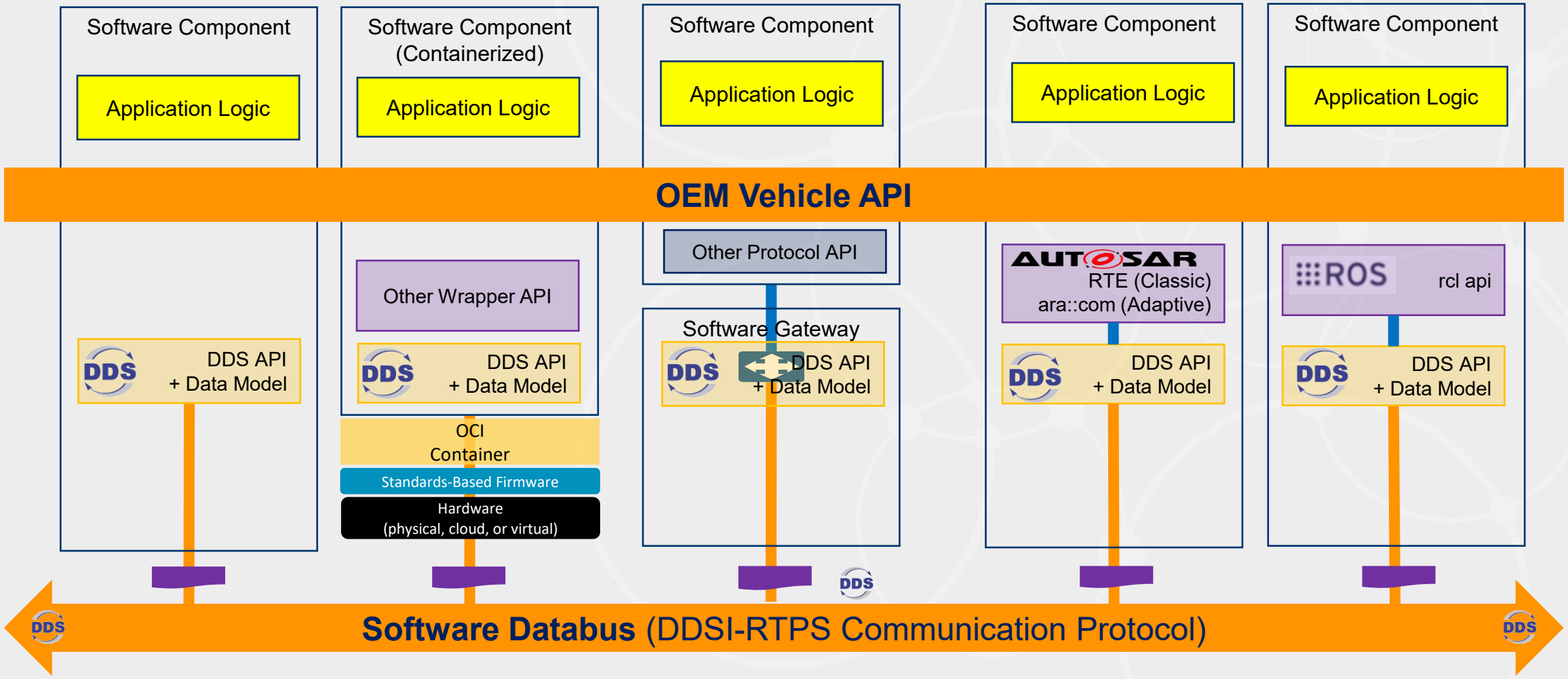
- ISO 26262 ASIL D (SEooC)
- Proven-in-use with production vehicle on the road today
- AUTOSAR Classic/Adaptive Integration Toolkits
- Comprehensive Tool Suite
- Complete ECU to Cloud Framework

www.rti.com/drive

Enabling SdV Design with RTI



Designing a next-gen vehicle platform



High speed, real-time, across platforms

History of SOME/IP & DDS

Understanding the history of the 2 technologies

Background & History

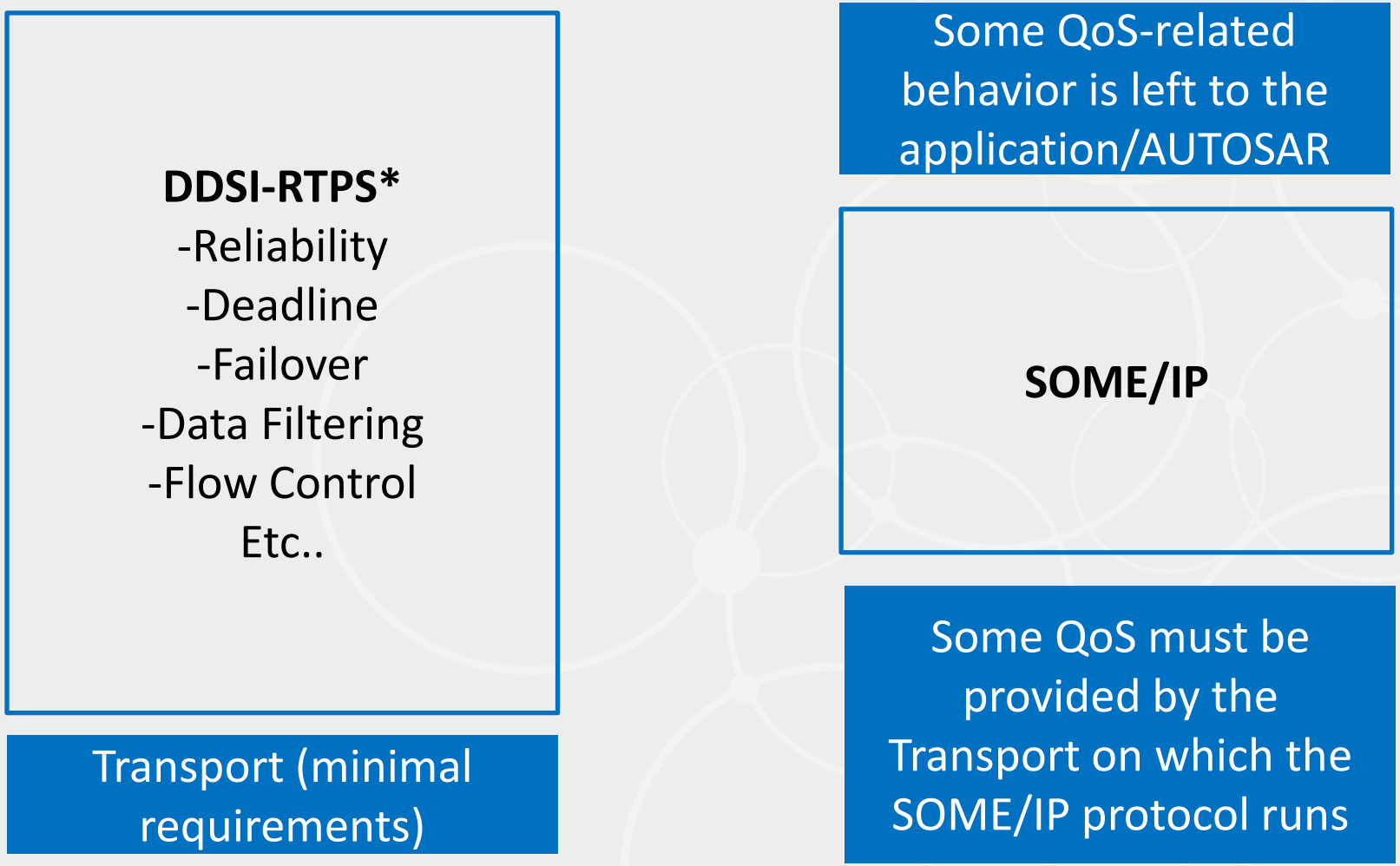
SOME/IP

- Developed by BMW based on experience in Infotainment and in-car networks
- Part of AUTOSAR specification
- Service Oriented
- Developed for
  - Automotive Ethernet
  - Larger data sets/messages than existing automotive standards
  - Large and small hardware ECU

DDS

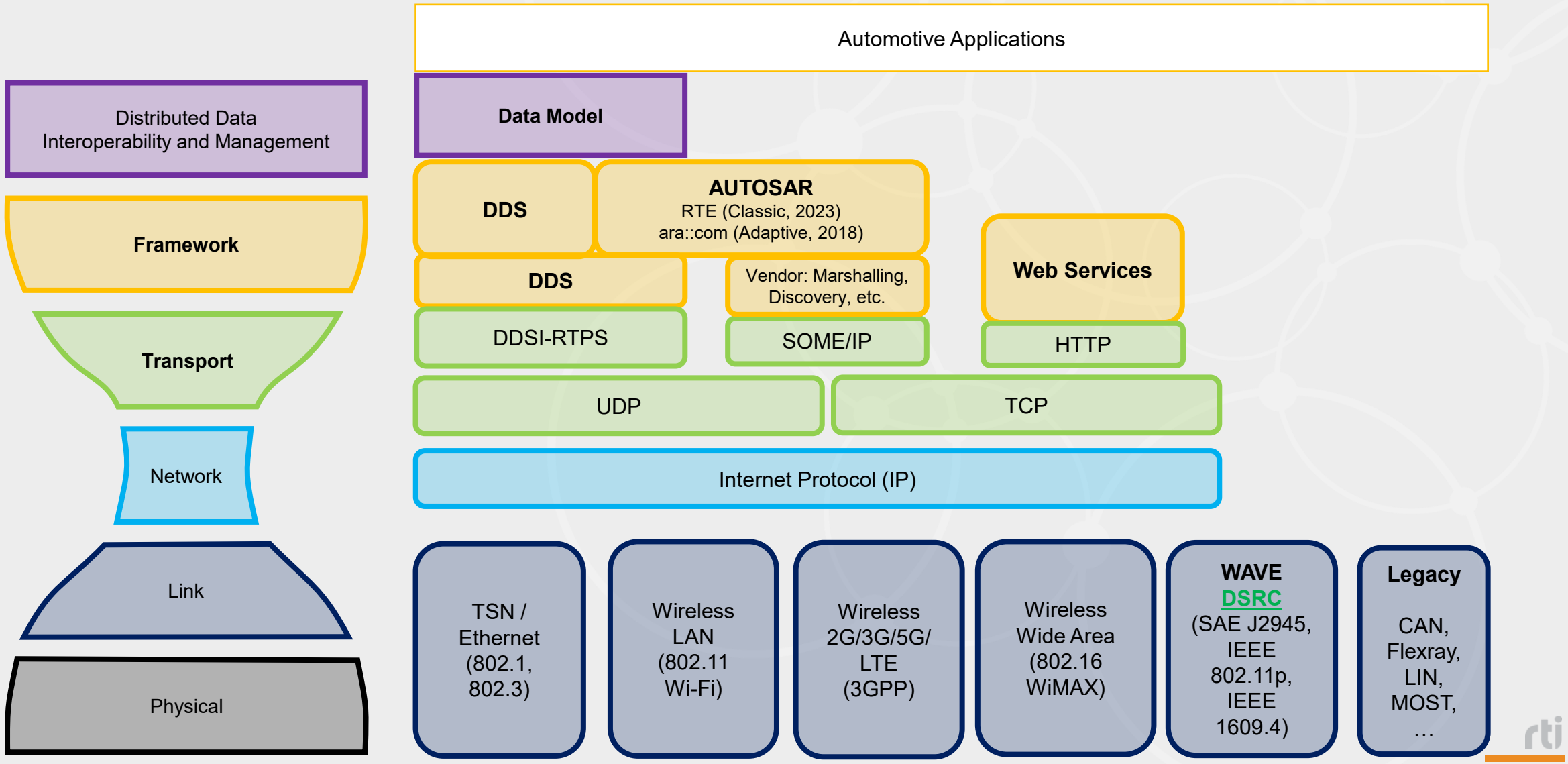
- Early adopters: U.S. Navy, NASA launch control, and mobile robotics
- Specification managed by OMG (Object Management Group)
- Data Oriented
- Developed for
  - Highly available applications
  - Robust operation, no servers or brokers, can operate under a wide range of network conditions
  - High performance, and highly scalable applications

Transport and IP Stack Comparisons



*DDSI-RTPS is the wire protocol for DDS

Where does it live on the Communication Stack?



SOME/IP and DDS comparison

	Industries	Standards	Interoperability
DDS	**Automotive** Transportation Healthcare Energy Oil & Gas Aerospace & Defense	OMG OBJECT MANAGEMENT GROUP **Wire protocol**, APIs, IDL, XML, Security, RPC, TSN …	Rich ecosystem of vendors, tools, services, components, platforms, and standards
SOME/IP	**Automotive**	AUTOSAR **Wire protocol** Modeling	AUTOSAR vendors, tools and services

Key Architectural Differences (Partial)

	Communication	QoS	Type-Definition	Serialization	Security
	Data-Oriented	**Reliability** Durability Timing Buffering Resources …	Handled by DDS Middleware	Handled by DDS Middleware	Handled by DDS Middleware
SOME/IP	Service-Oriented	**Reliability** (UDP or TCP)	Handled by AUTOSAR Platform	Handled by AUTOSAR Platform	Handled by AUTOSAR Platform

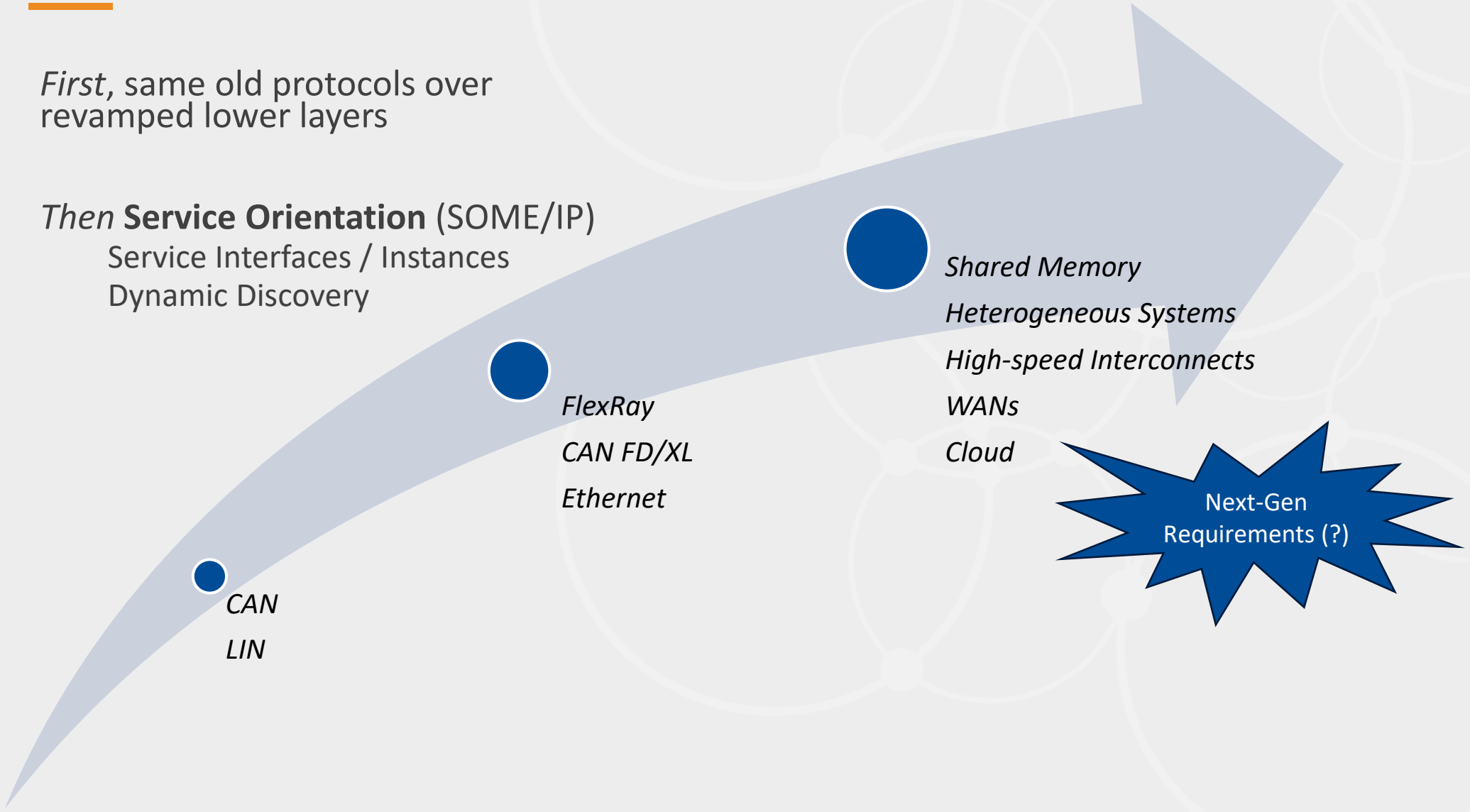
Evolution of Communications in Automotive

First, same old protocols over revamped lower layers

Then **Service Orientation** (SOME/IP)

Service Interfaces / Instances

Dynamic Discovery



Benefits of Data-oriented Communication

- Evolution of Signal-based communication
- Software-defined QoS policies
- Choice between static and dynamic configuration
- Compatible with Service-oriented Communication

Why DDS in Automotive?

Introduction to data-oriented communication

DDS to AUTOSAR CP Concept mapping

DDS Concepts	AUTOSAR Concepts	Role
Application	SW-C	Modular, reusable unit of software that encapsulates a specific set of functionality
DataWriter	Sender-Port	Element within a software component that is responsible for sending data
DataReader	Receive-Port	Element within a software component that is responsible for receiving data
Virtual Data Bus	Virtual Function Bus	Abstracts the underlying communication mechanisms
DDS Middleware	RTE	Serves as an intermediary layer between the application software components and the underlying hardware, providing a standardized interface between application and underlying platform
Topic	System Signal	Logical symbol that specifies how data flows between software components

(*) Note: This is not an exact mapping but just to demonstrate conceptual ideas based on their roles in their respective systems

What is a DDS Topic?

- Like a radio channel frequency (e.g. FM 90.5MHz)
- Just a logical concept to help dynamically establish logical connections between data sender and receiver
- Conceptually similar to **System Signal** in AUTOSAR CP
- Topic information is sent during discovery
- Decouples application (Don’t have to care about endpoint information)

DDS Topics

DDS Databus

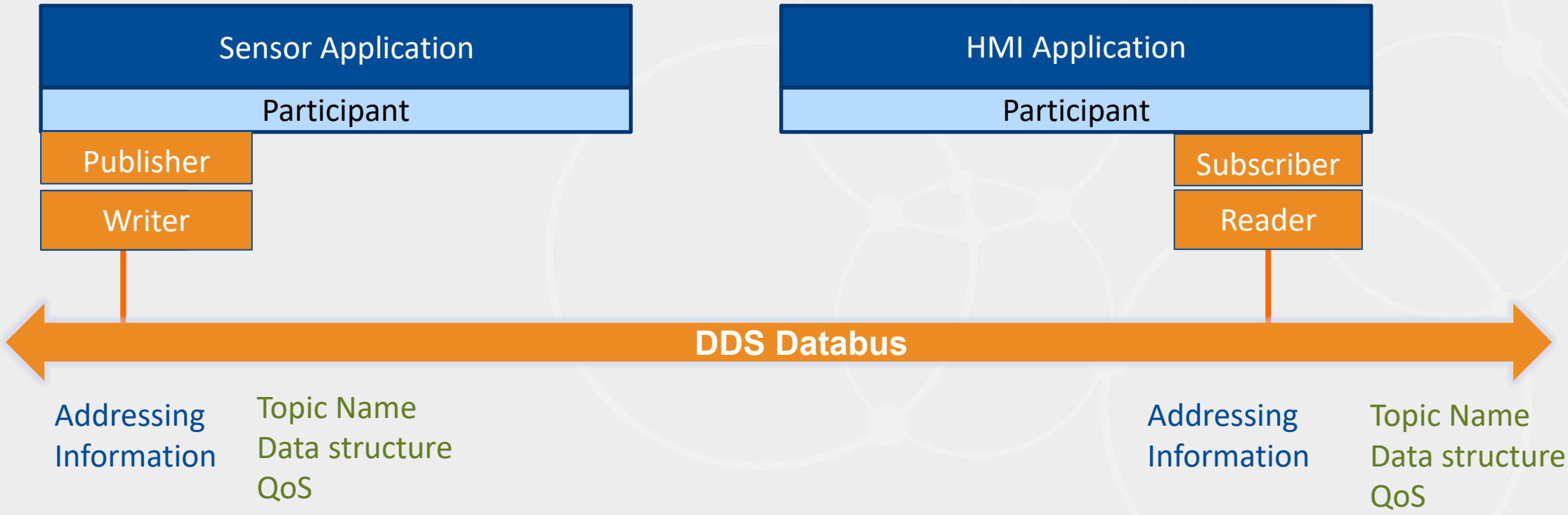
BATTERY_TEMPERATURE

LOGGER_STATUS

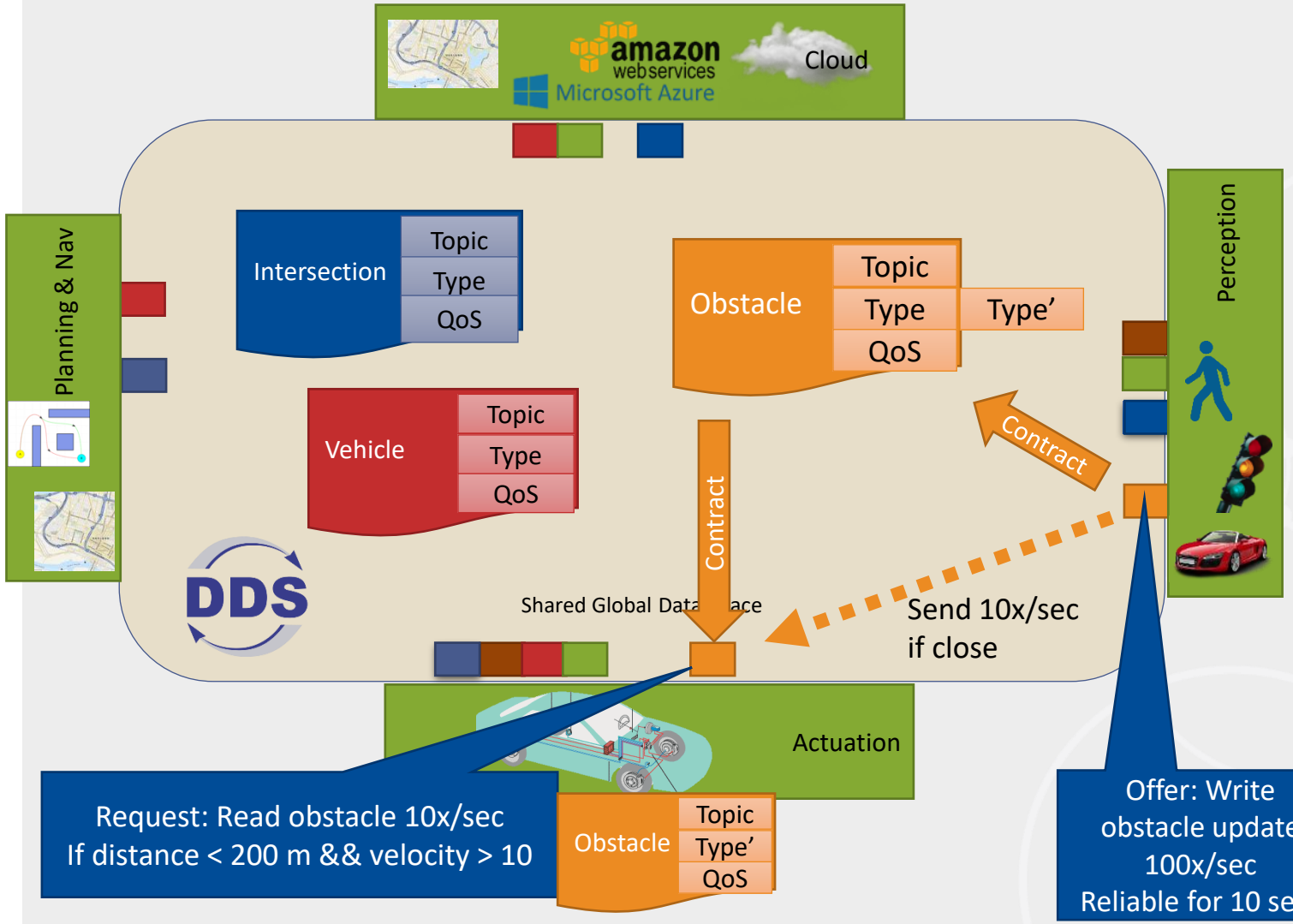
START_STOP_COMMAND

Dynamic Discovery: Virtual Databus

- (Phase 1) **Participant Discovery** exchanges addressing information *(Multicast)*
- (Phase 2) **End Point Discovery** matches *topic name*, *structured data type* and *QoS (Unicast)*

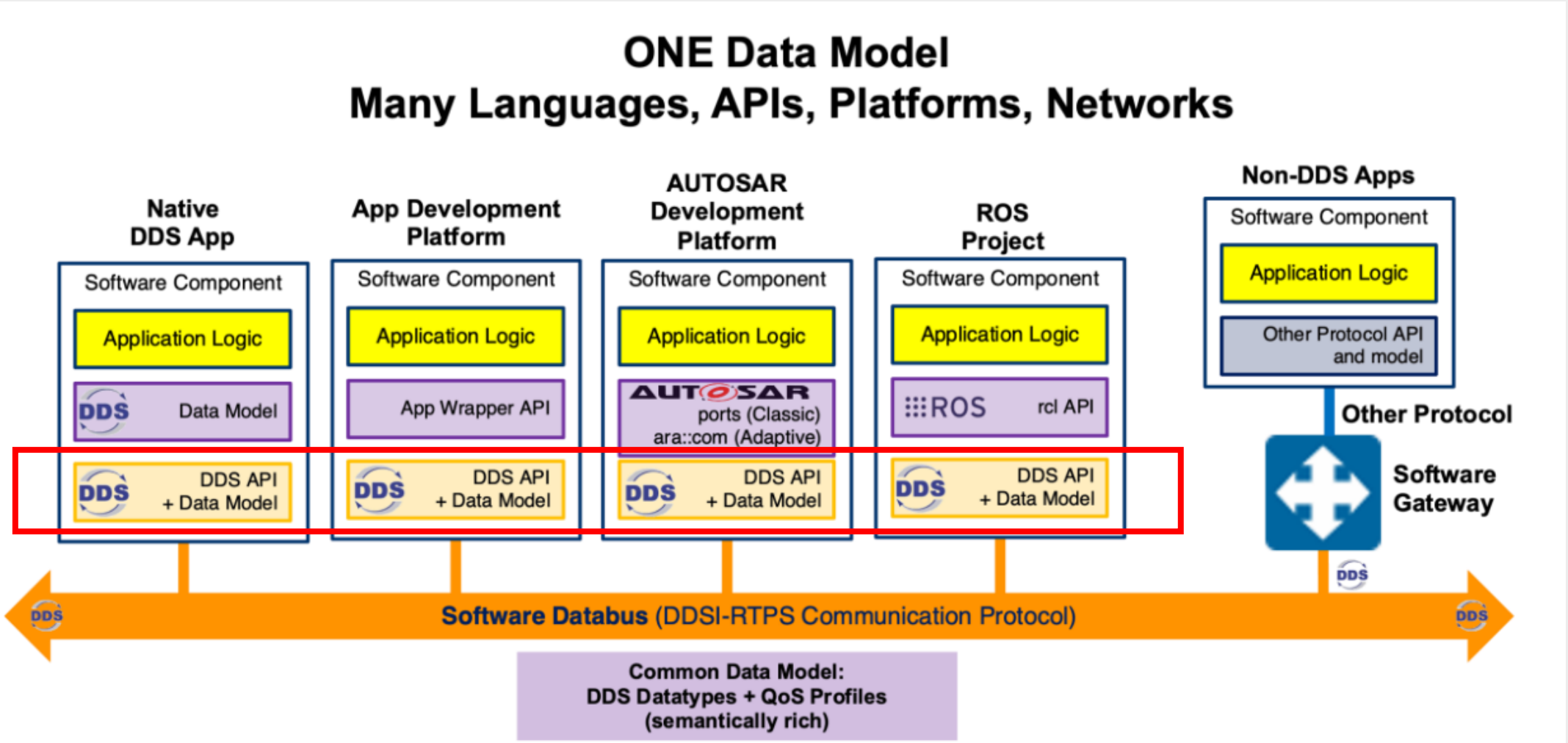


Data Centric Software Integration

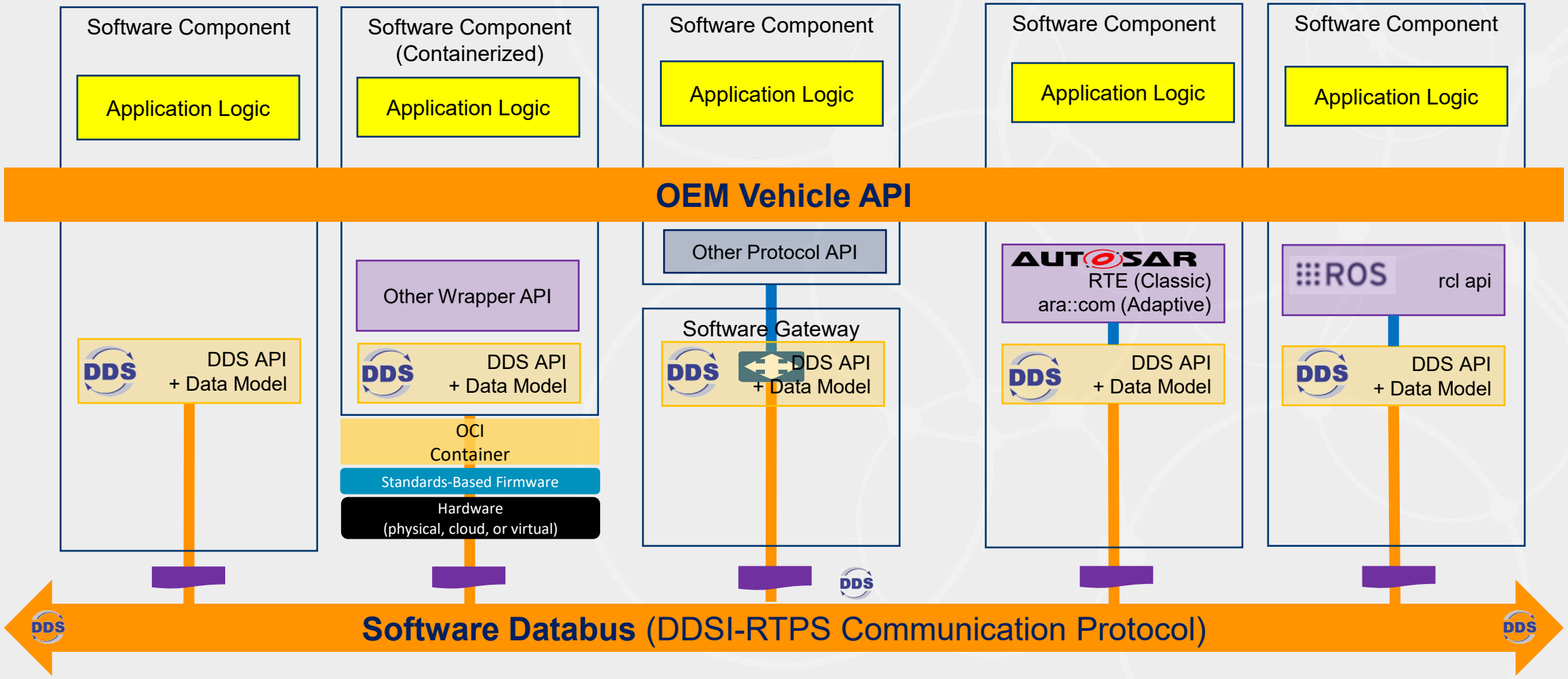


- Global Data Space
  - Automatic discovery
  - Read & write data in any OS, language, transport
  - Type-aware matching
  - Direct peer-to-peer comms
  - Redundant sources/sinks/nets
- No Servers!
- QoS control
  - Timing, Reliability, Liveliness, Redundancy, Ordering, Filtering, Security

#1 Heterogenous Systems Integration

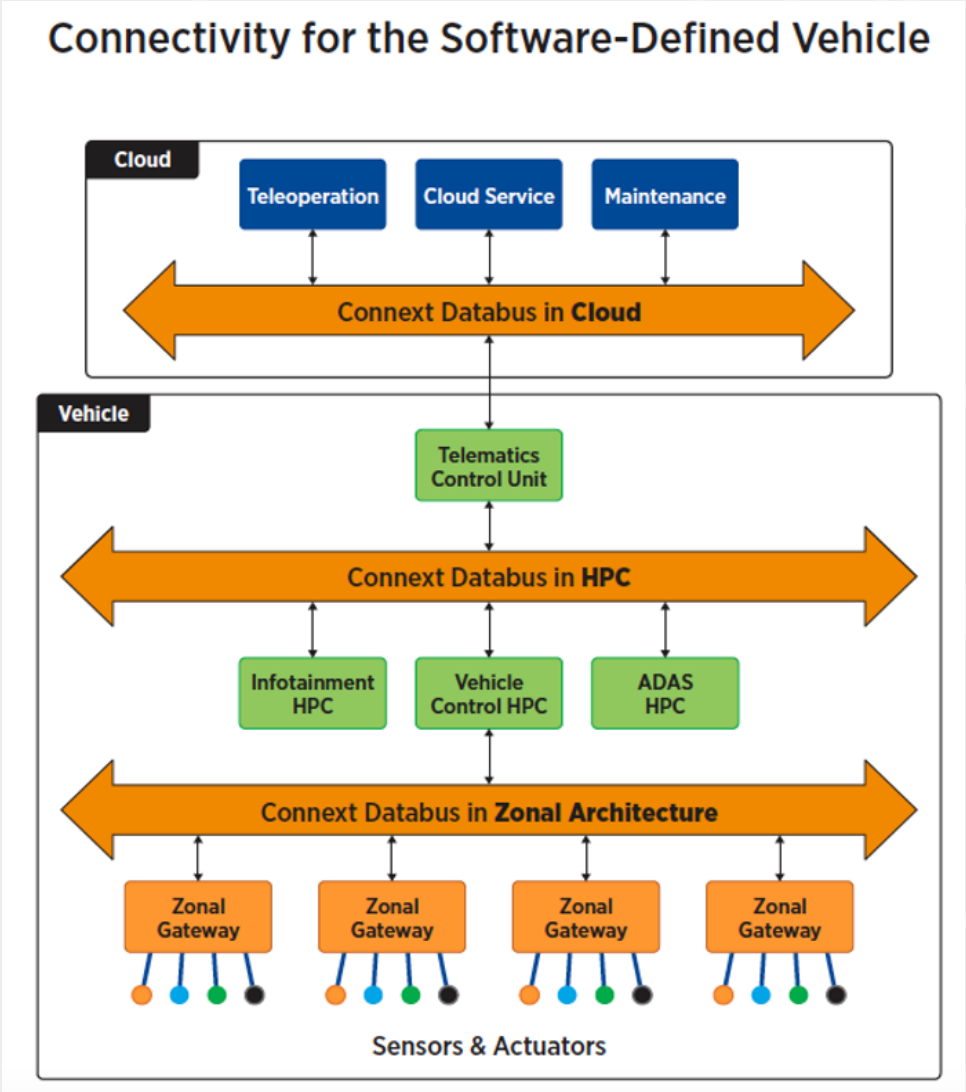


Designing a next-gen vehicle platform



High speed, real-time, across platforms

Multi-Layered Databus in Automotive



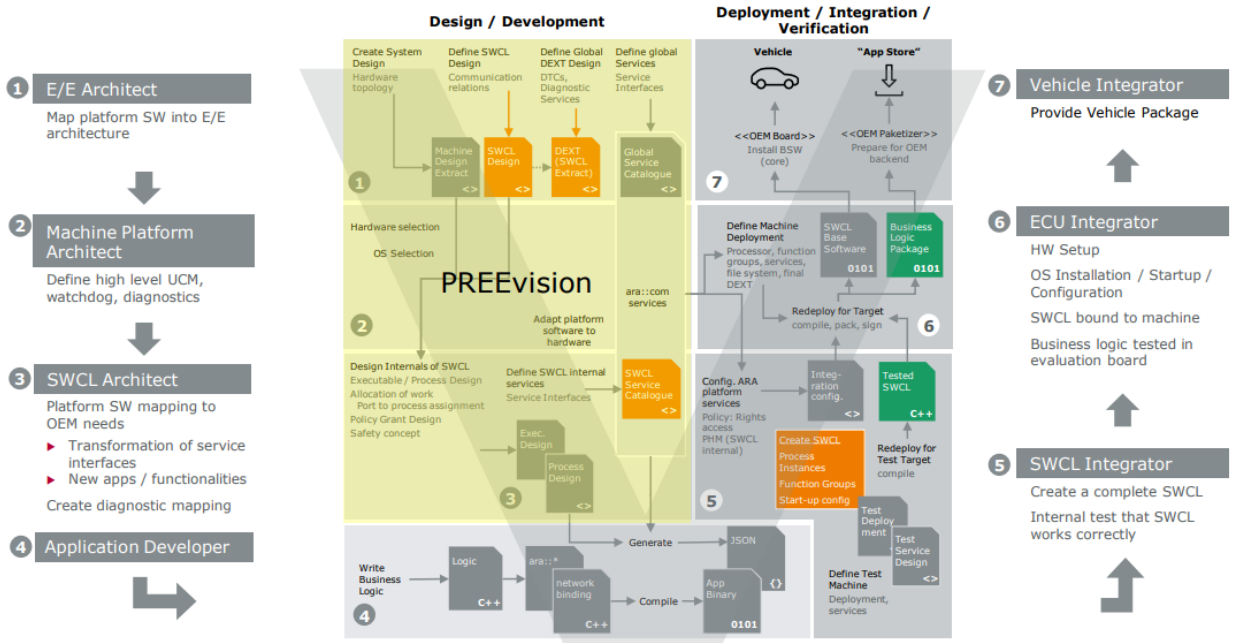
Workflow Comparision: AUTOSAR vs DDS

DDS workflow enables fast iteration for new and uncertain features

"Comprehensiveness"

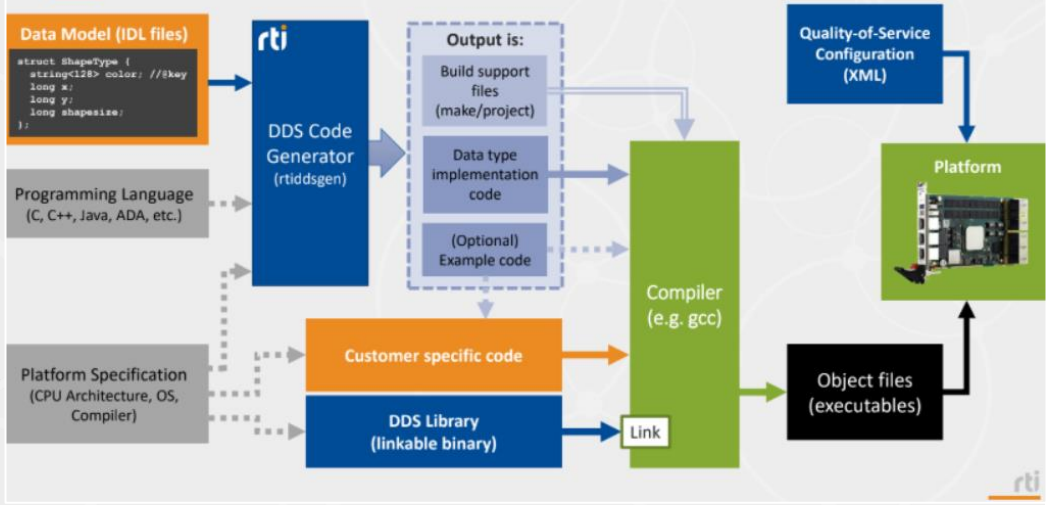
"Speed"

AUTOSAR Adaptive workflow



Requires detailed and complete specification

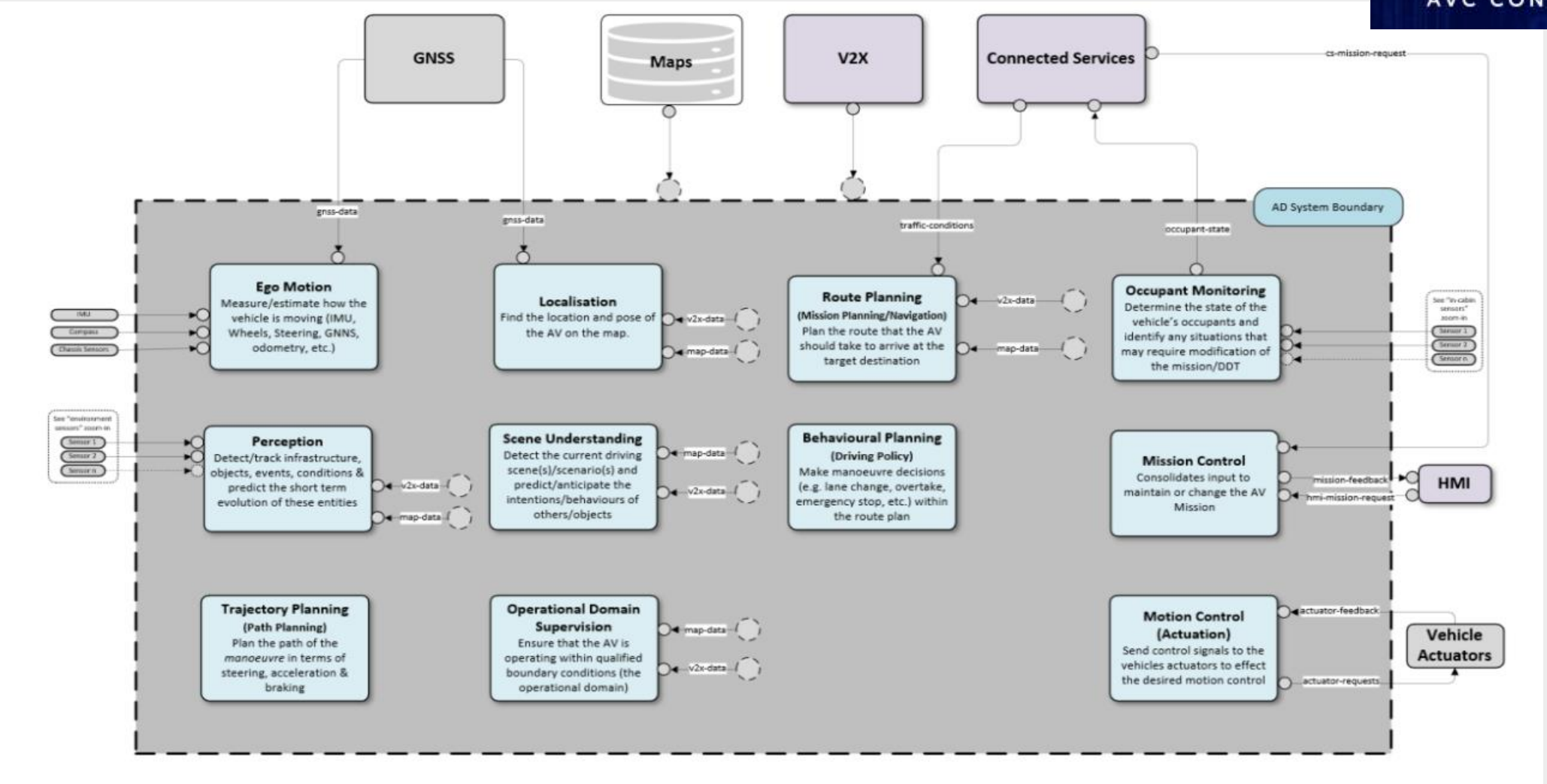
RTI Connext Pro DDS Development Workflow



Only requires interface & QoS Specification

Source:
https://cdn.vector.com/cms/content/events/2020/Webinars20/Vector_Webinar_PREEvision_AUTOSAR_Adaptive.pdf

#2 AD/ADAS



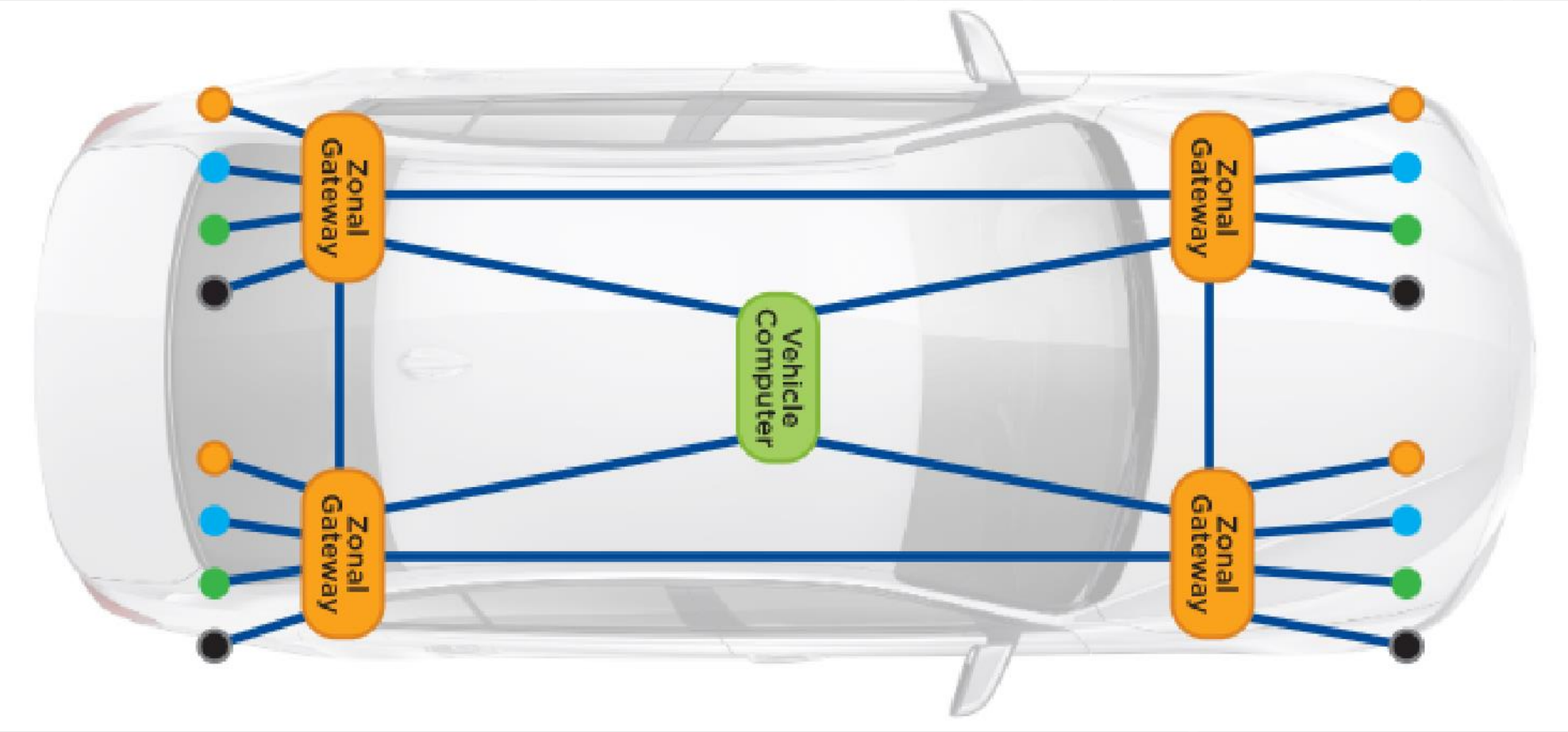
https://avcc.org/announces-tr005/

Distribute High Bandwidth Data Efficiently

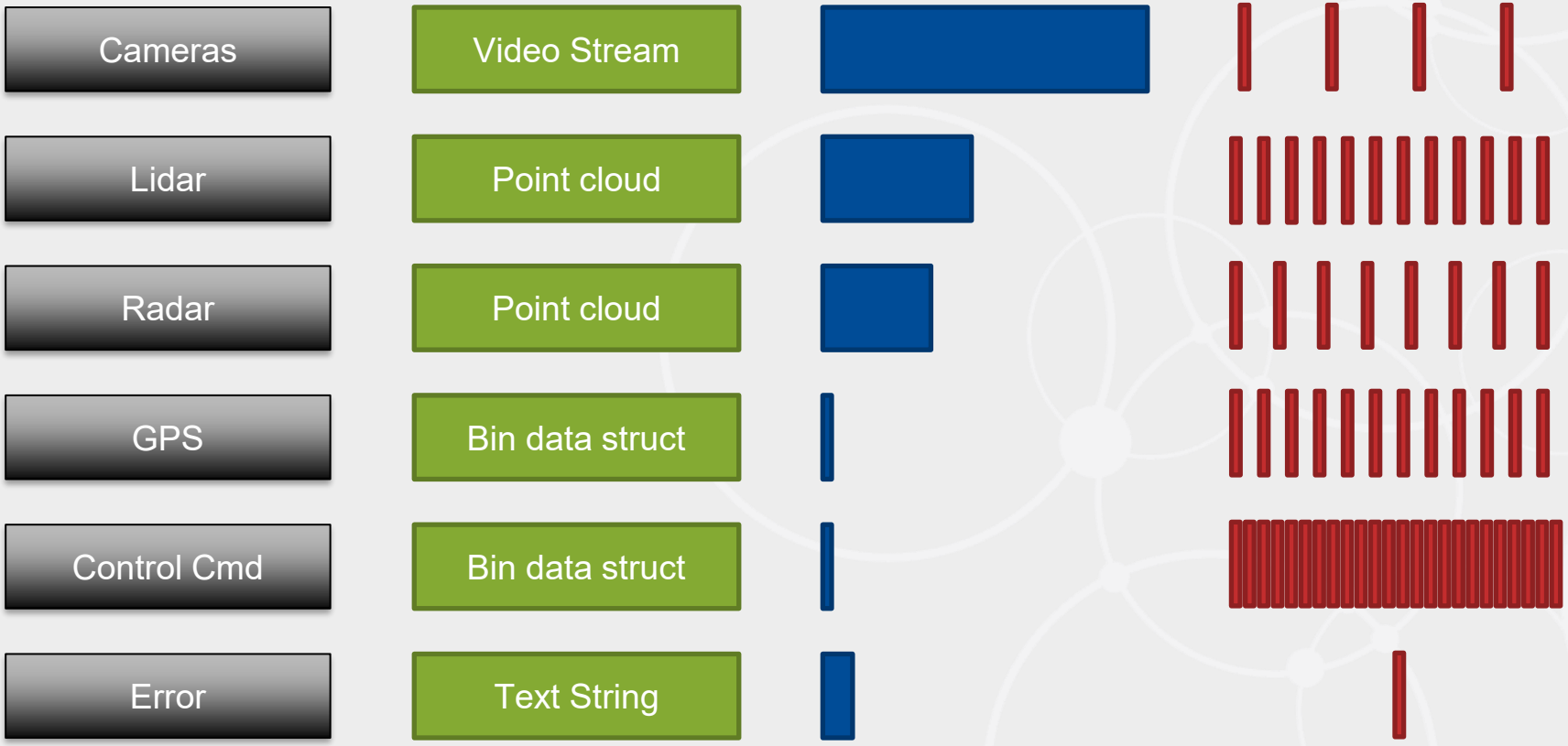
Certified to ASIL-B

RTI FlatData™ and **Zero Copy** shared memory transport dramatically reduce latency and overhead

#3 Data Distribution for Zonal Architecture

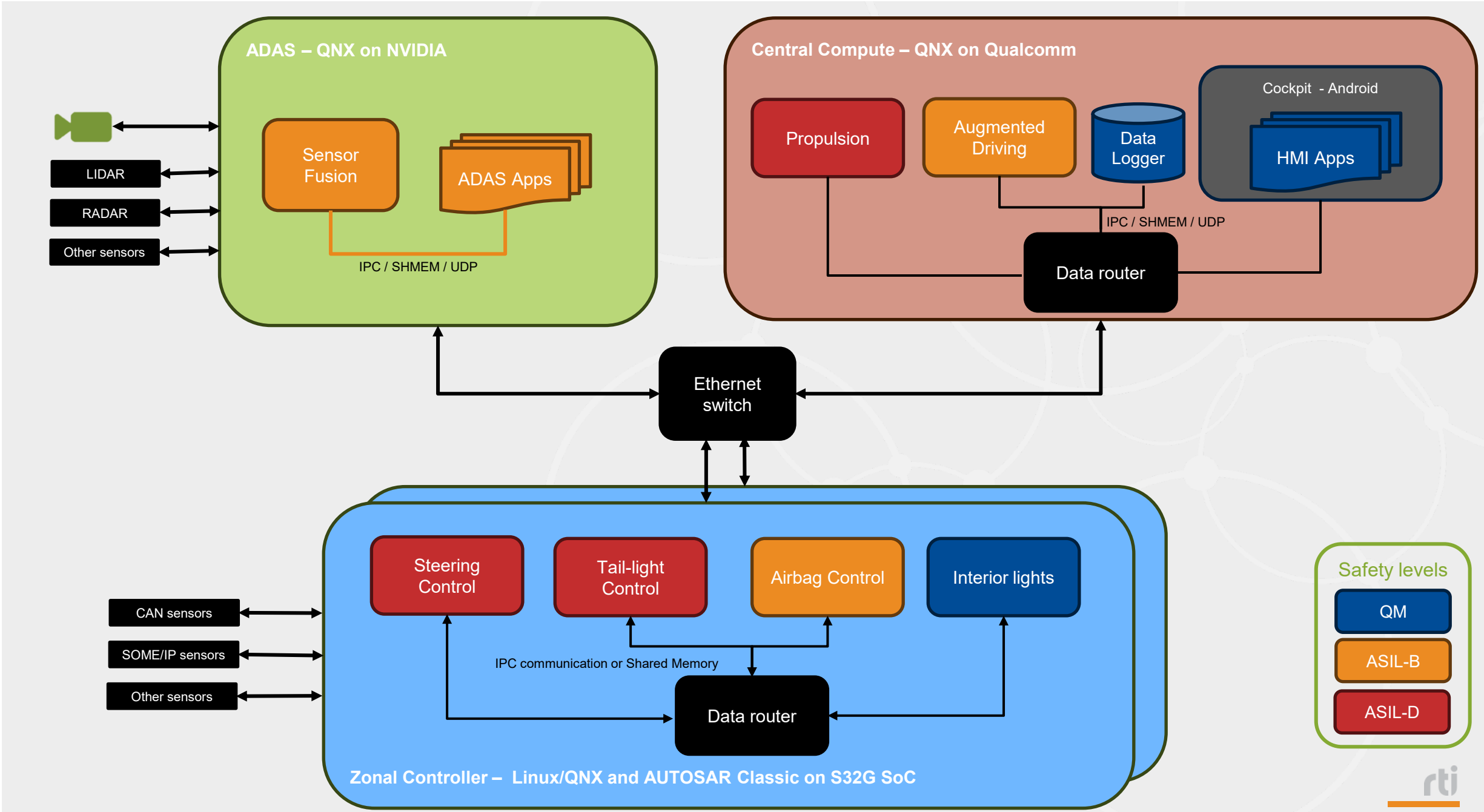


QoS simplifies complex dataflows

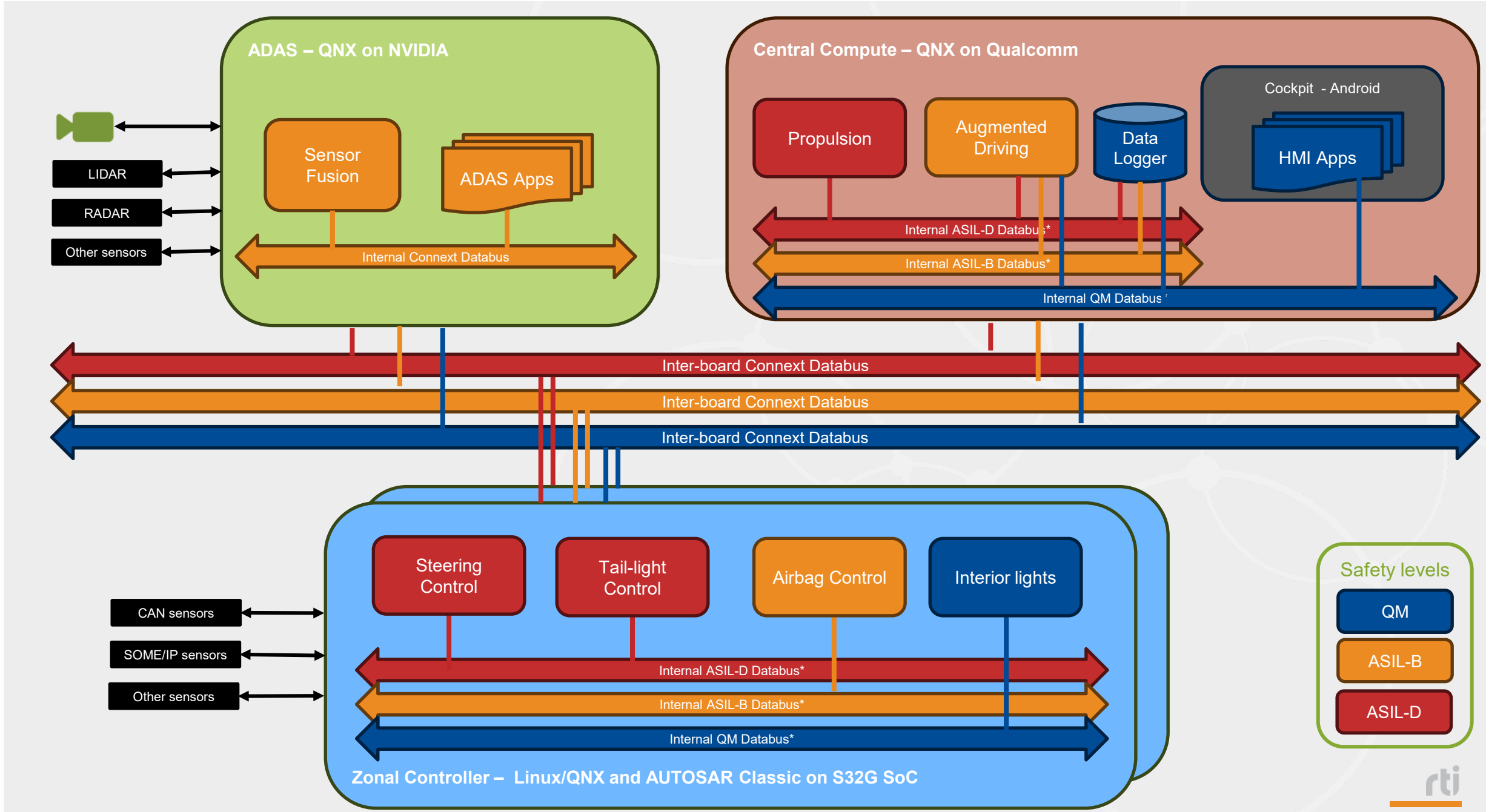


- Many different dataflows
  - Volume
  - Frequency
  - Latency
  - Reliability
  - Destination
- Multiple hardware and software solutions
  - IPC
  - Shared Memory
  - UDP
  - Middleware

What if you could use a single solution for all your data flows?

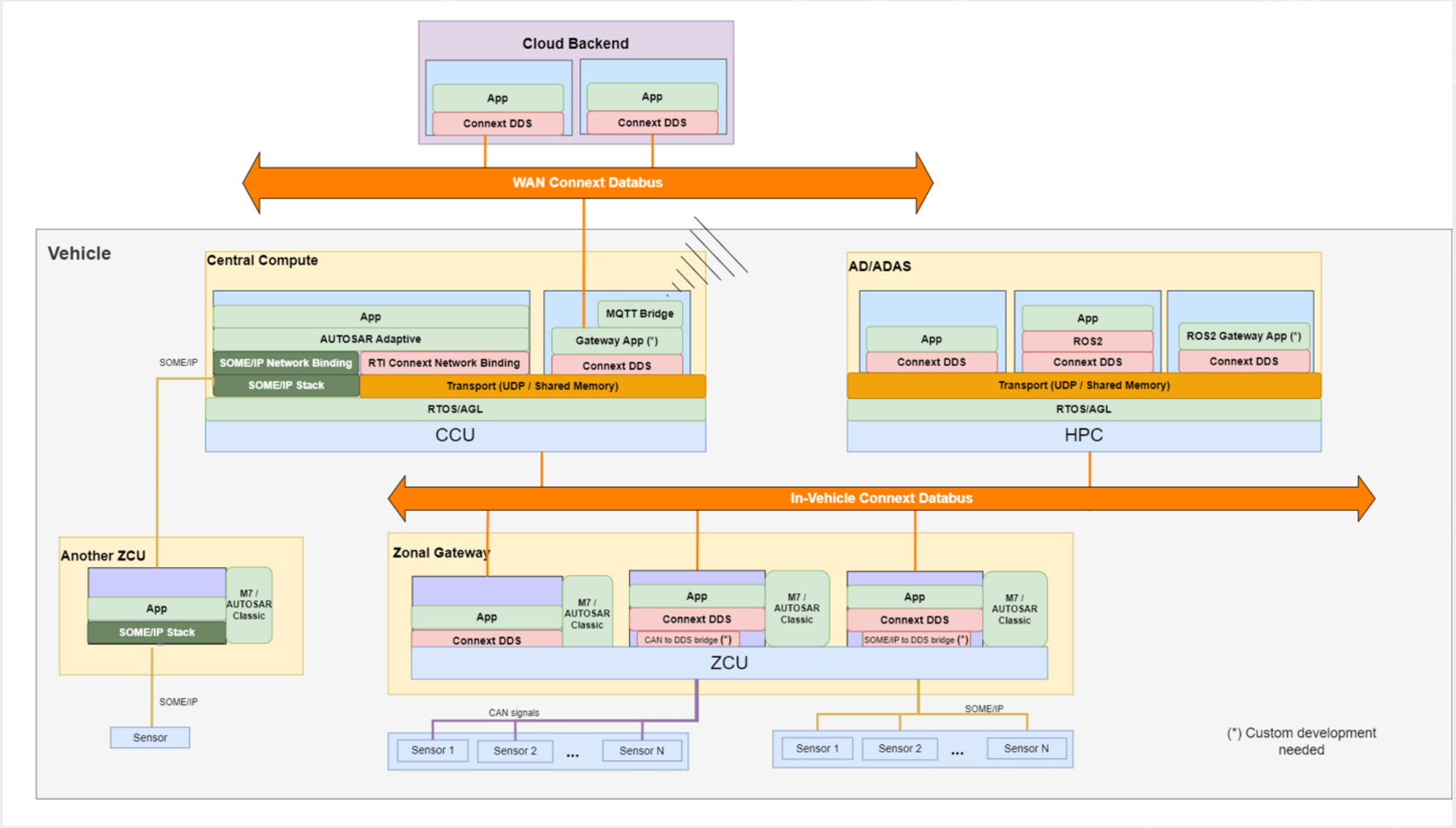


*Databuses represent software-level abstractions to provide isolation, and they could be composed of multiple transports (shared memory, UDP, ...)



*Databuses represent software-level abstractions to provide isolation, and they could be composed of multiple transports (shared memory, UDP, …)

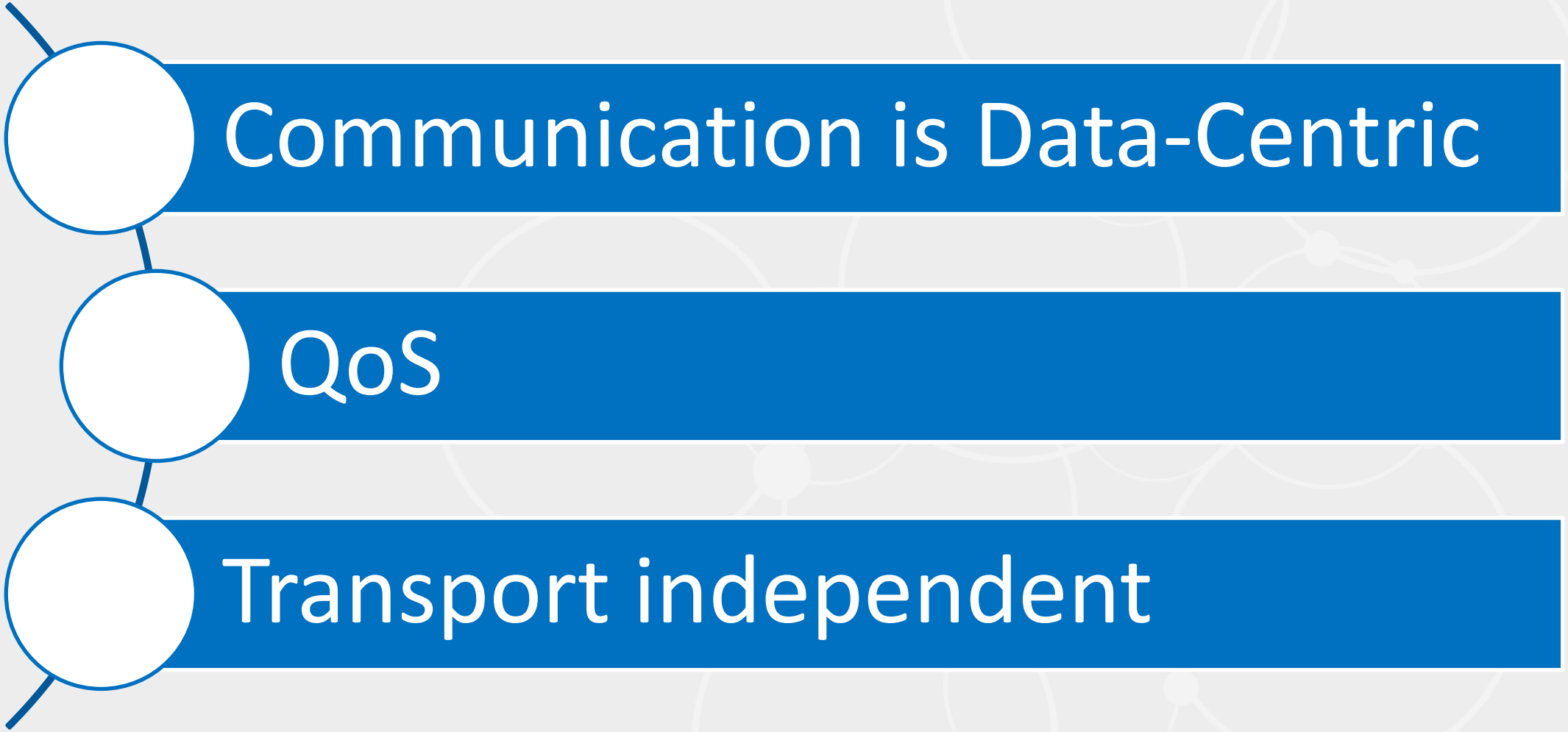
Example next-gen vehicle architecture



Key architectural features of DDS

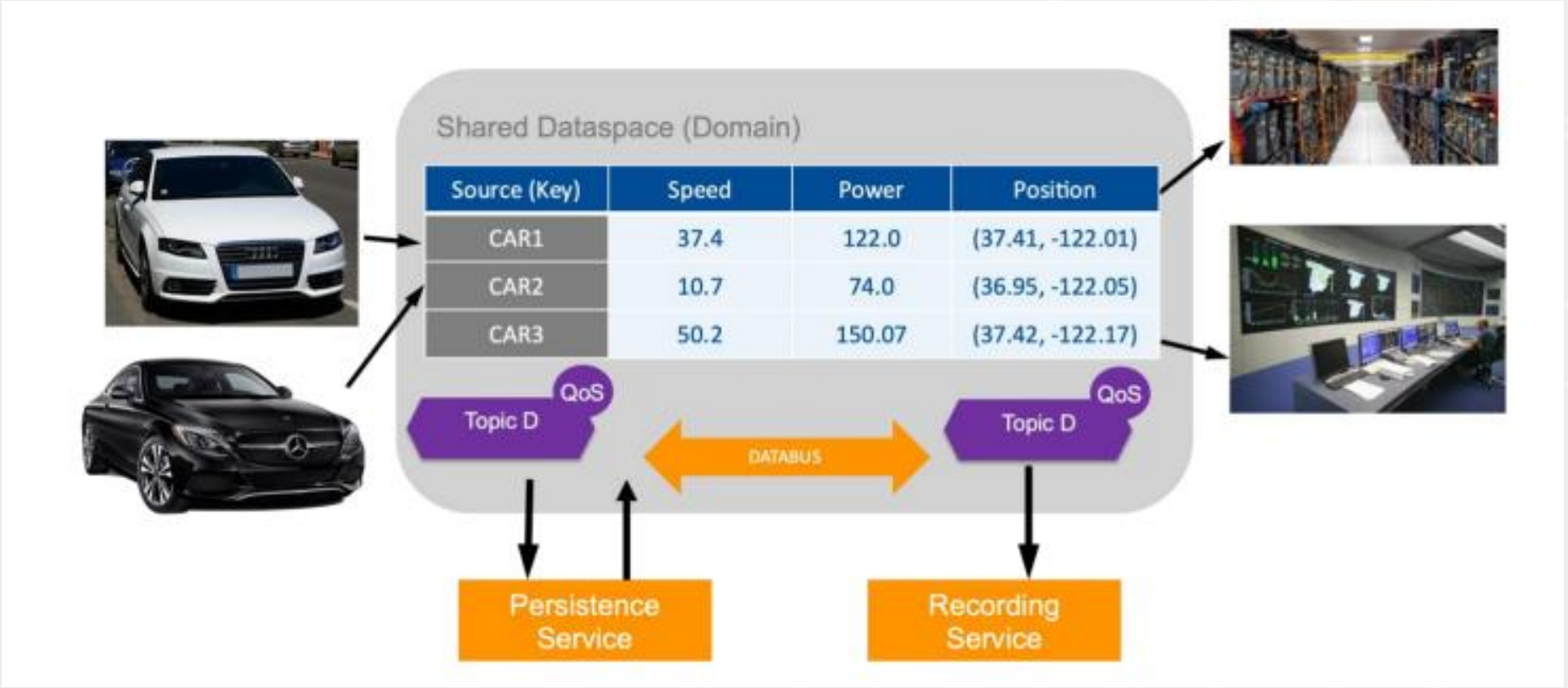
What makes DDS unique

3 Key architectural features

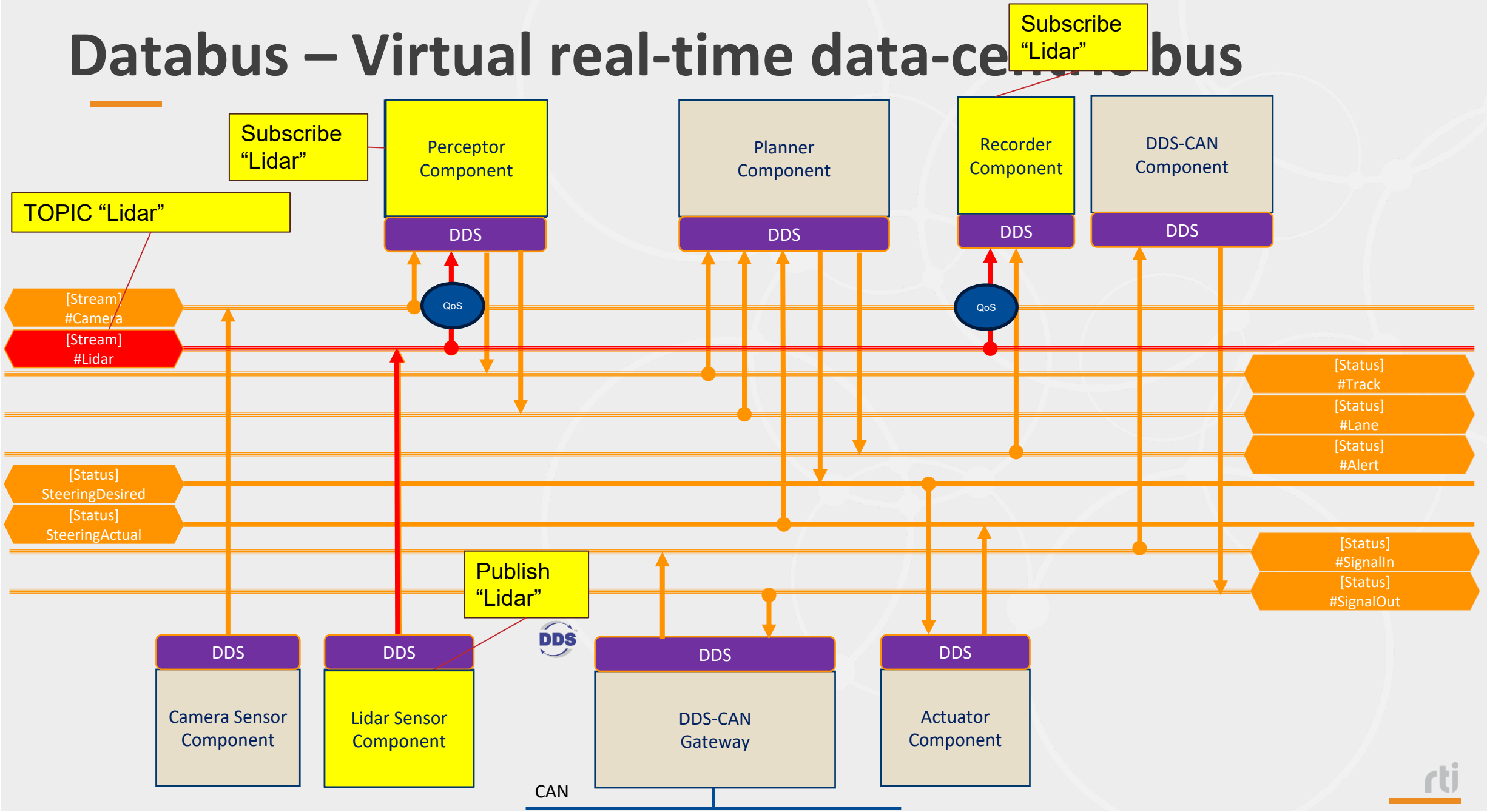


Communication is Data-Centric

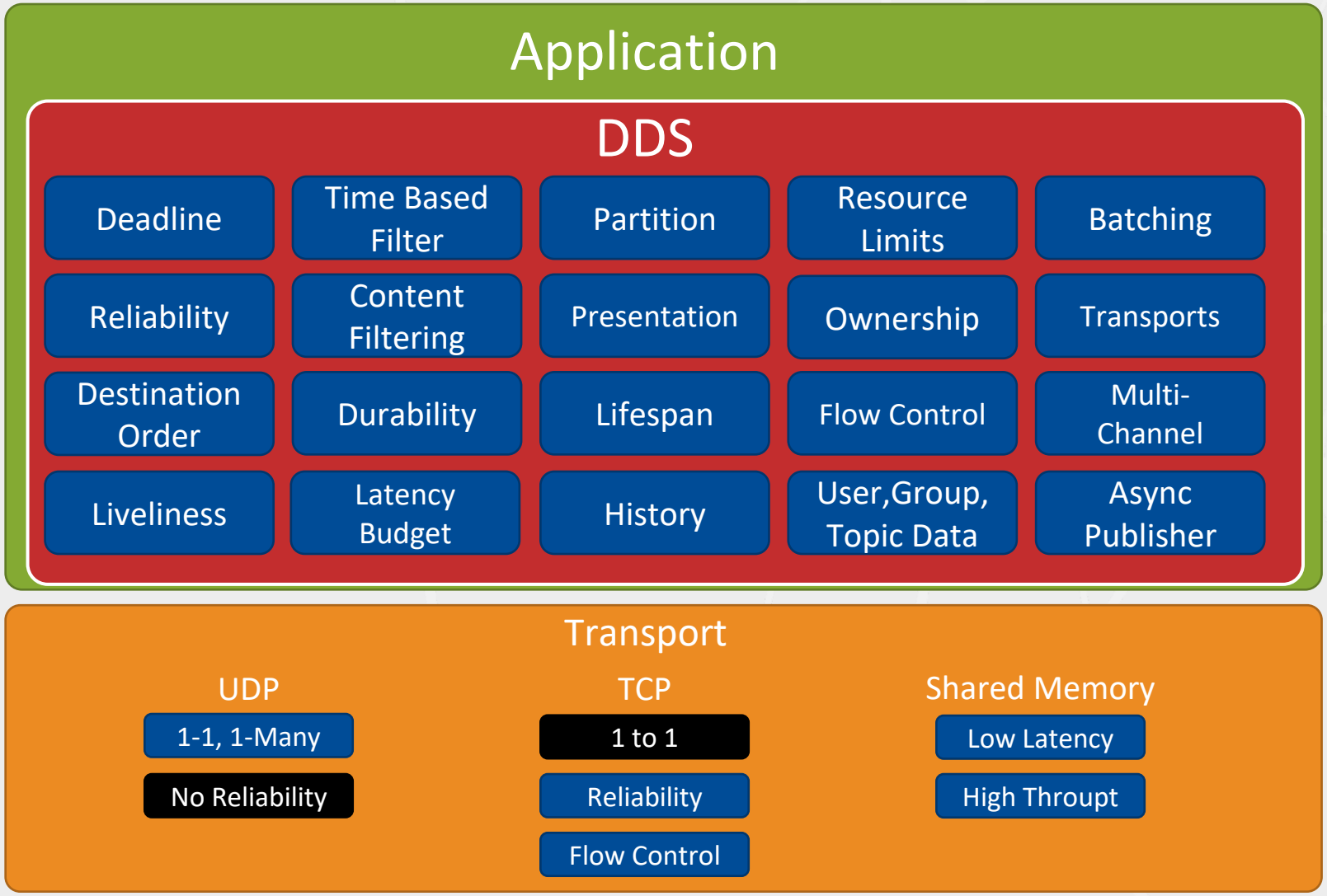
Data centric architecture *refers to a system in which data is the primary and permanent asset, whereas applications change.*



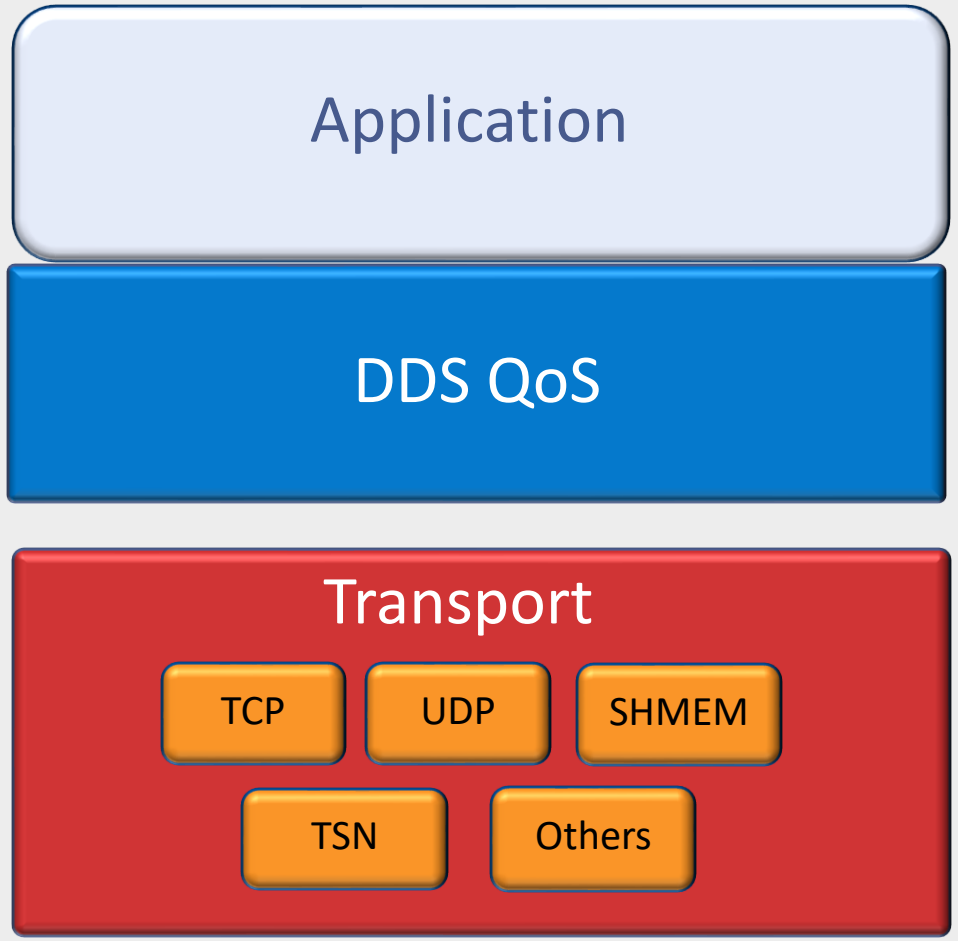
Databus – Virtual real-time data-centric bus



Quality of Service: DDS



DDS is transport independent

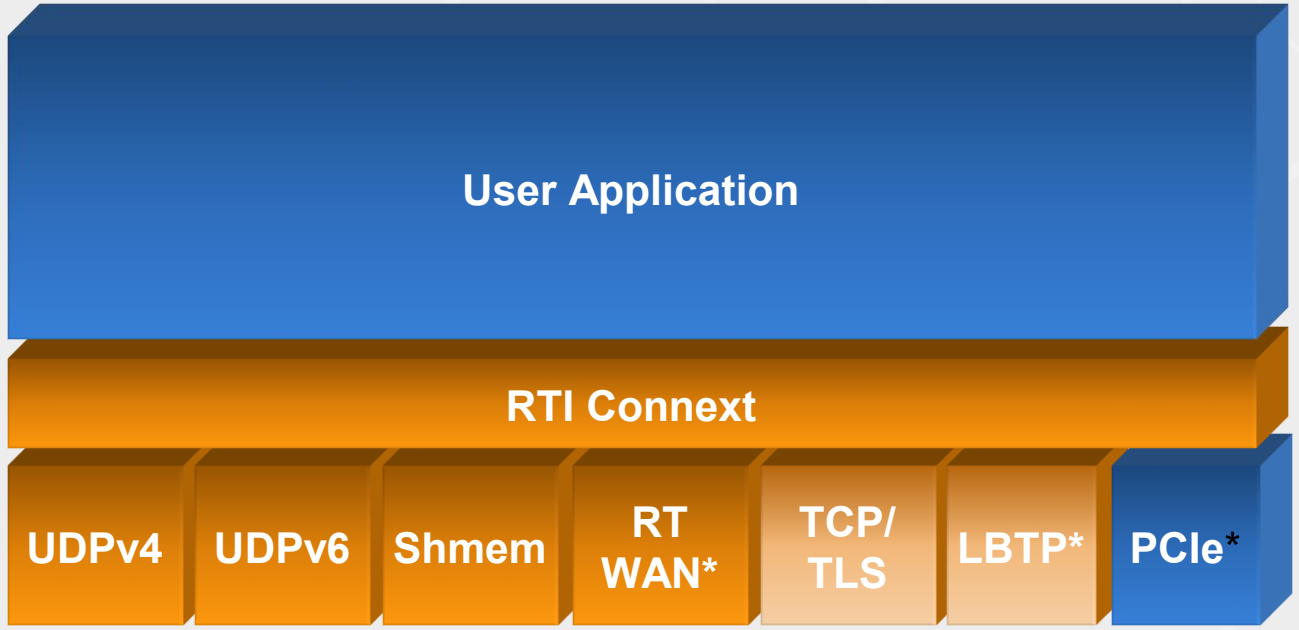


DDS Runs Anywhere

- LAN
- WAN
- 4G/5G
- Satellite
- Limited Bandwidth radio
- On-Device
- Cloud
- Containers
- TSN

Decoupled from Platform, Transport

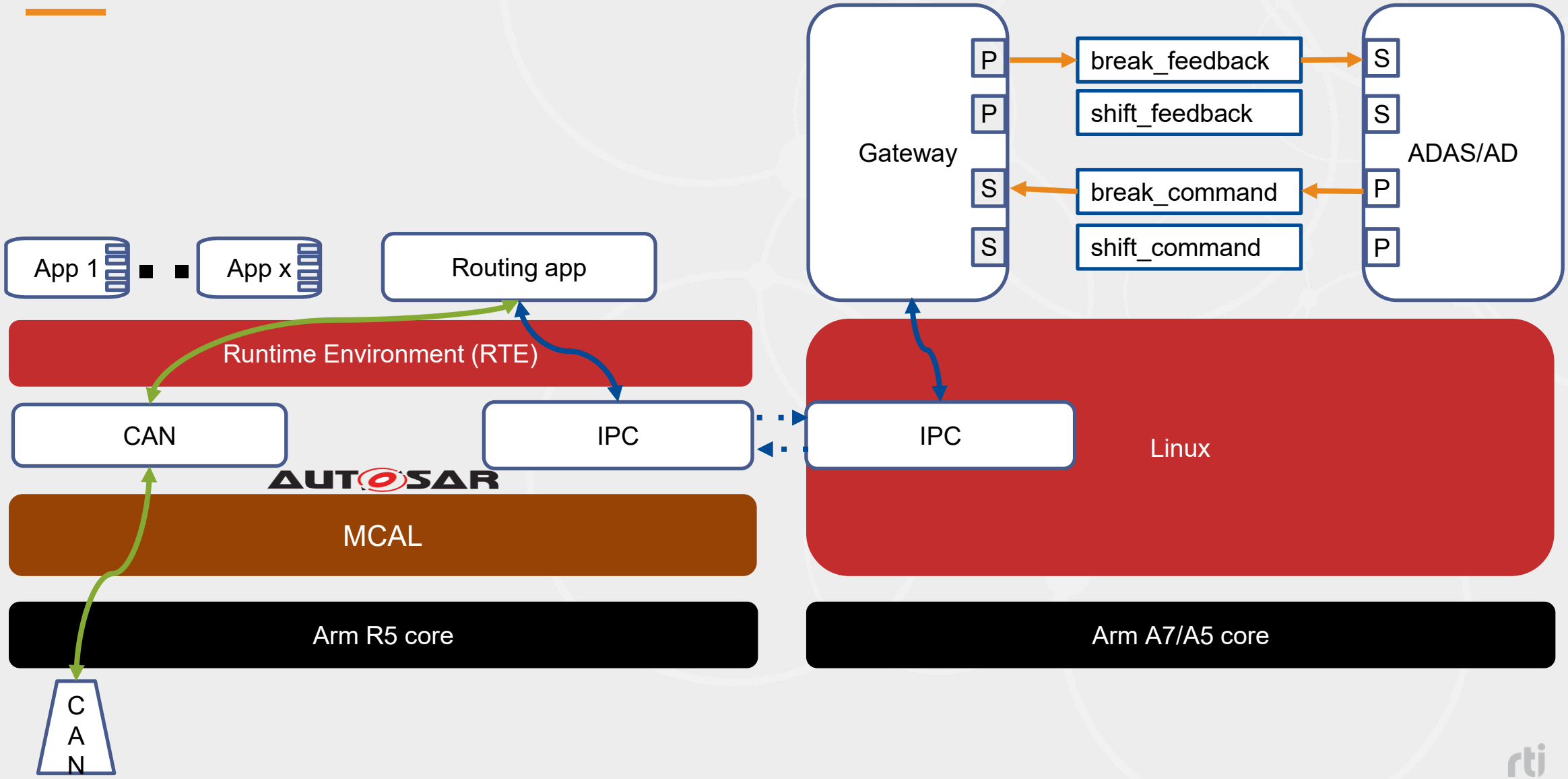
- *Connext* uses "Plugins" to access underlying networks
  - **Builtin Plugins**: UDPv4, UDPv6, Shared memory (shmem)
  - **RTI Transport Plugins**: TCP/TLS, Limited Bandwidth*, Real-Time WAN*
  - **User created plugins**: e.g, PCIe, Zero-Copy, Inter-core IPC



*optional component

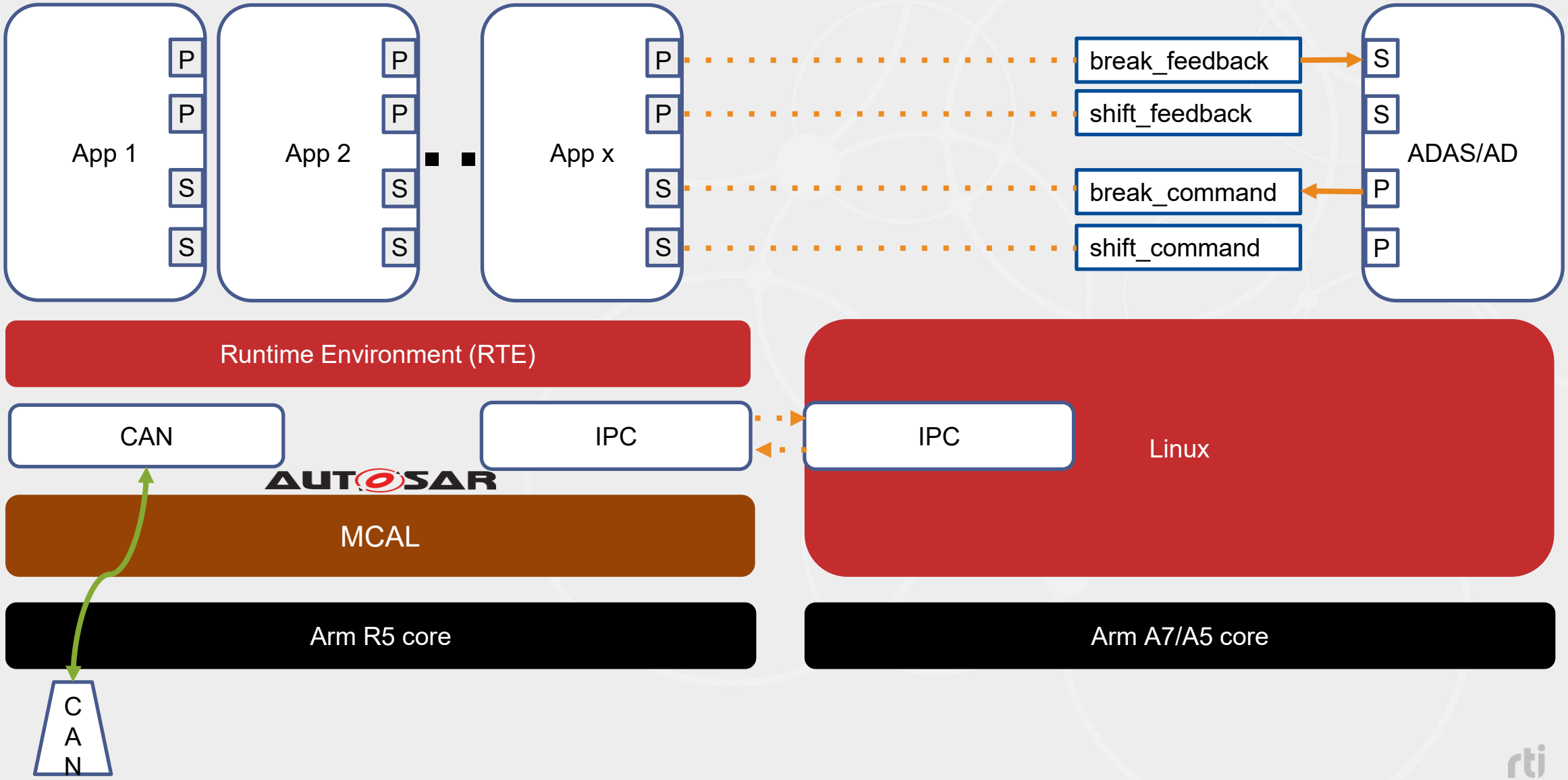
Without DDS

*Demo level only, no product available yet



Example: Inter-Core over DDS

*Demo level only, no product available yet. Available at CES!



Signal to Data in AUTOSAR CP

When did DDS enter the automotive market?

DDS in AUTOSAR CP – WIP

- Specification of Data Distribution Service in Classic Platform (DDS takes the shape of a BSW module).

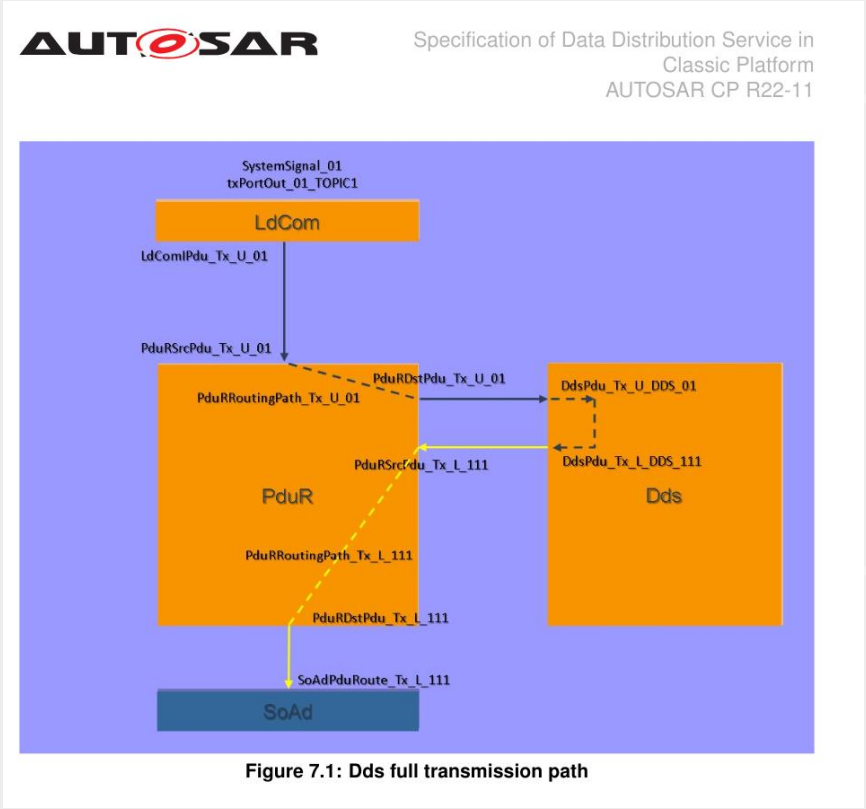
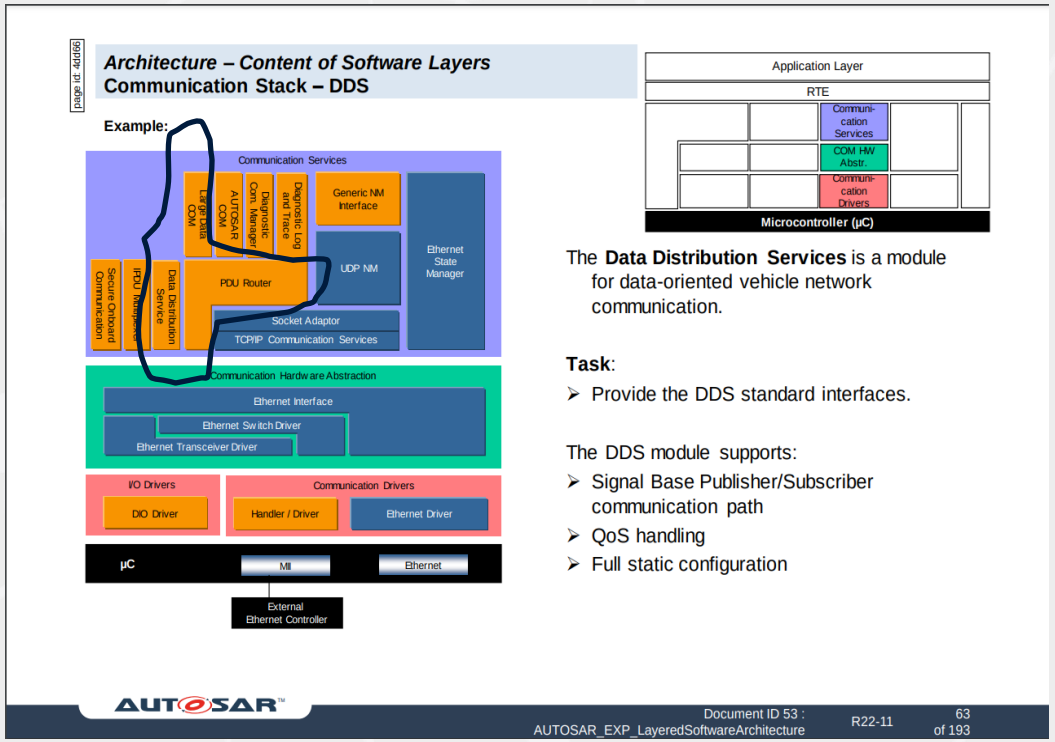


Figure 7.1: Dds full transmission path

https://www.autosar.org/fileadmin/standards/R22-11/CP/AUTOSAR_SWS_ClassicPlatformDataDistributionService.pdf



https://www.autosar.org/fileadmin/standards/R22-11/CP/AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

DDS in AUTOSAR CP

- Product Status: WIP
- Current support for MCU - RTI AUTOSAR CP Integration Toolkit

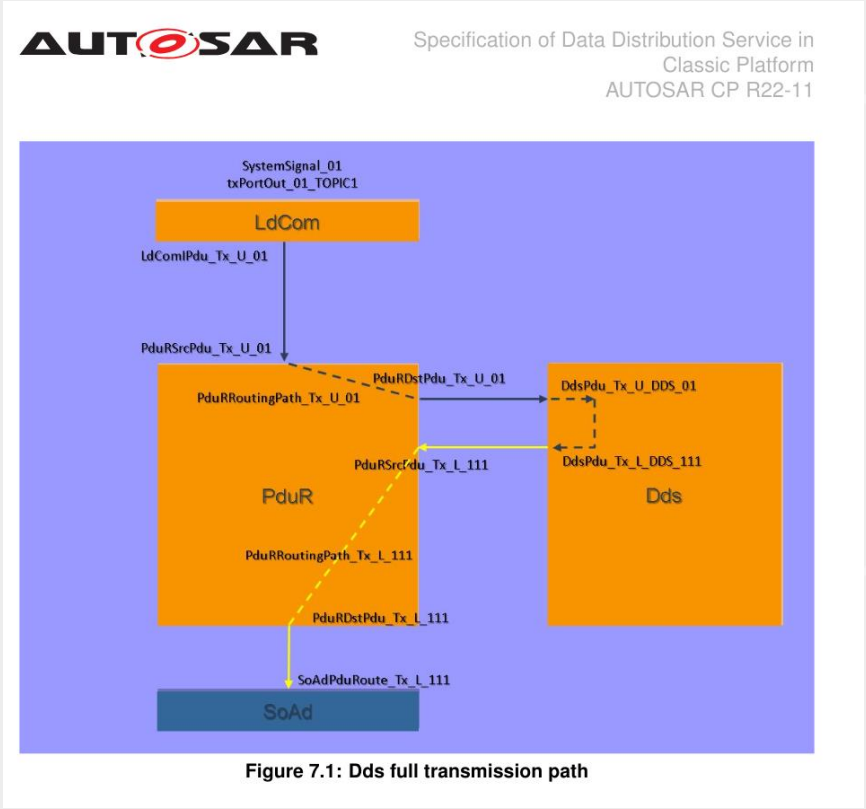
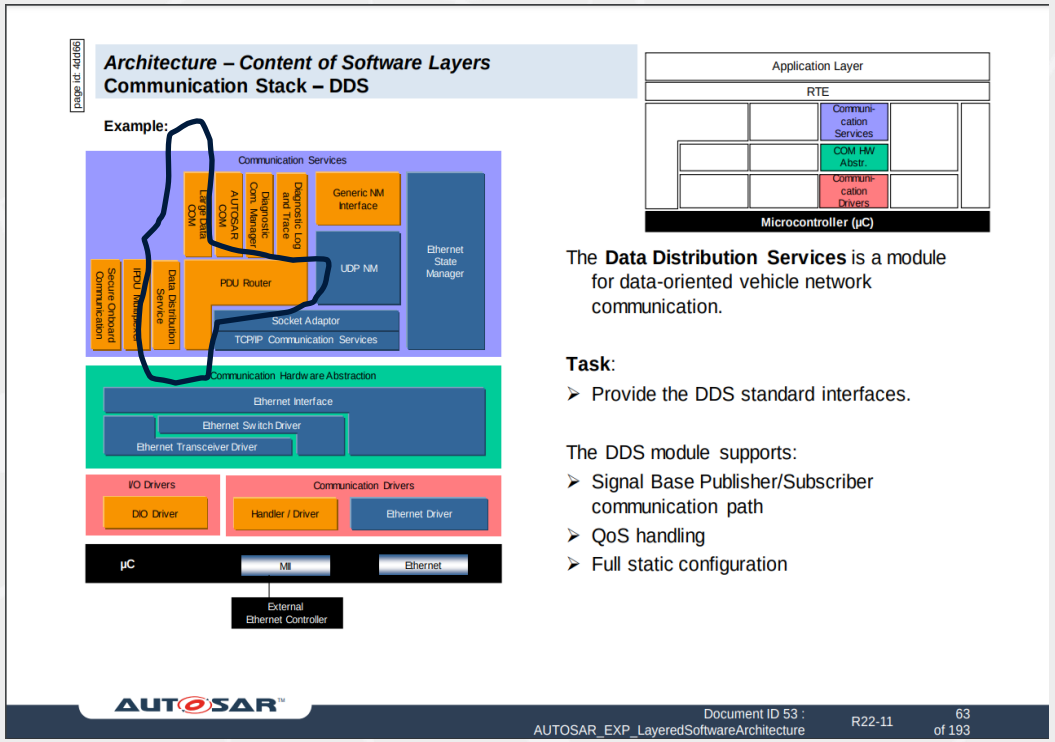


Figure 7.1: Dds full transmission path

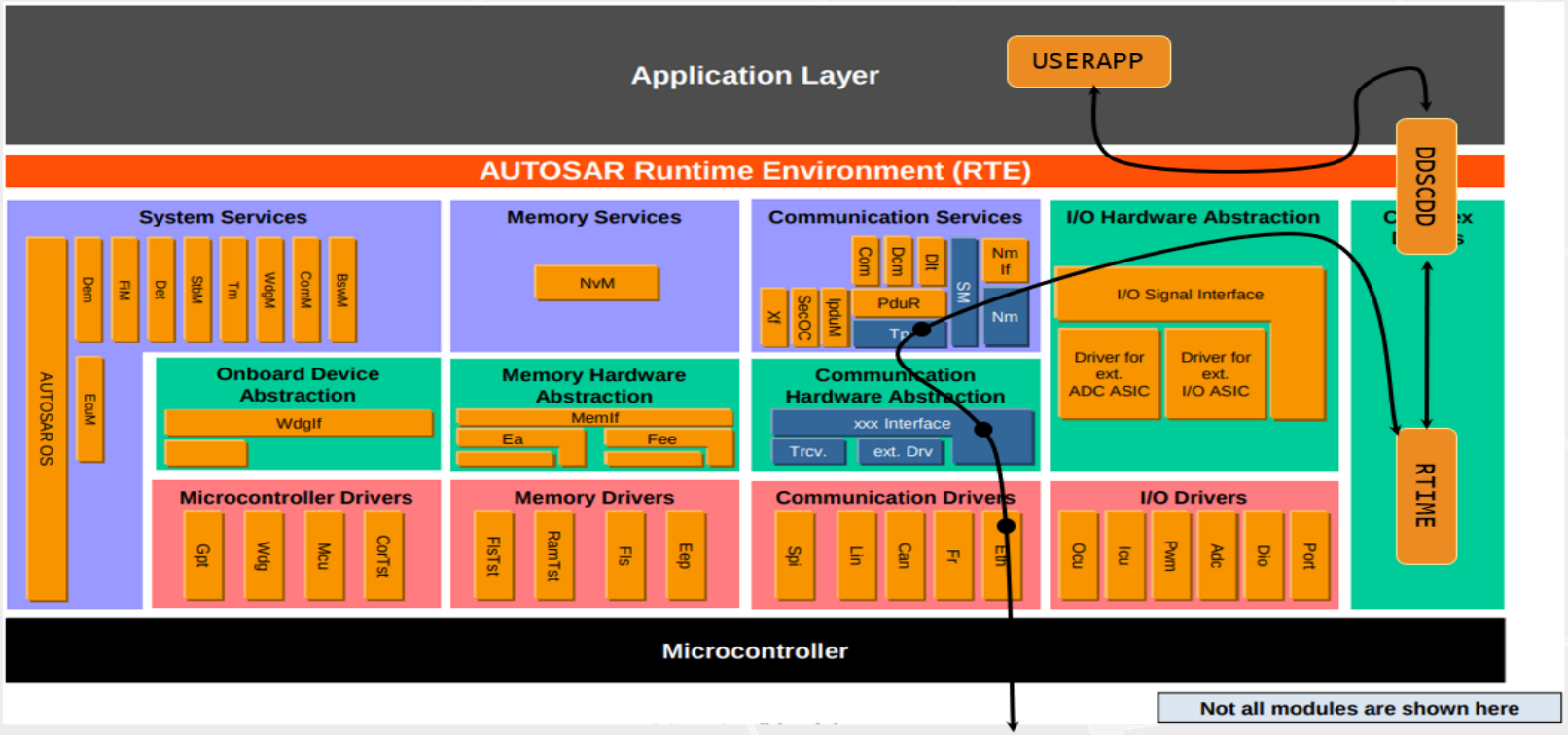


https://www.autosar.org/fileadmin/standards/R22-11/CP/AUTOSAR_SWS_ClassicPlatformDataDistributionService.pdf

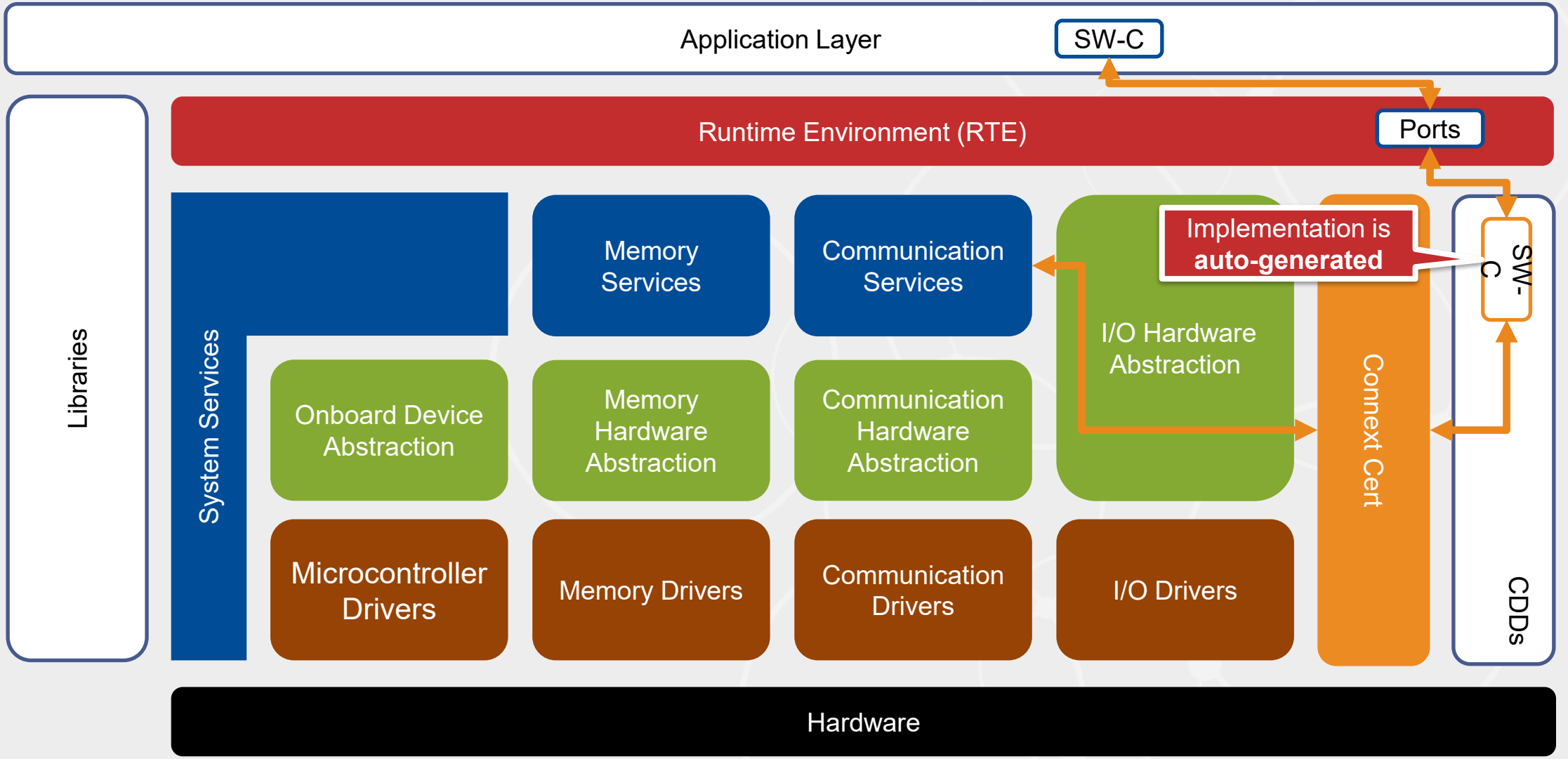
https://www.autosar.org/fileadmin/standards/R22-11/CP/AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

Connext in AUTOSAR CP (Current RTI Solution)

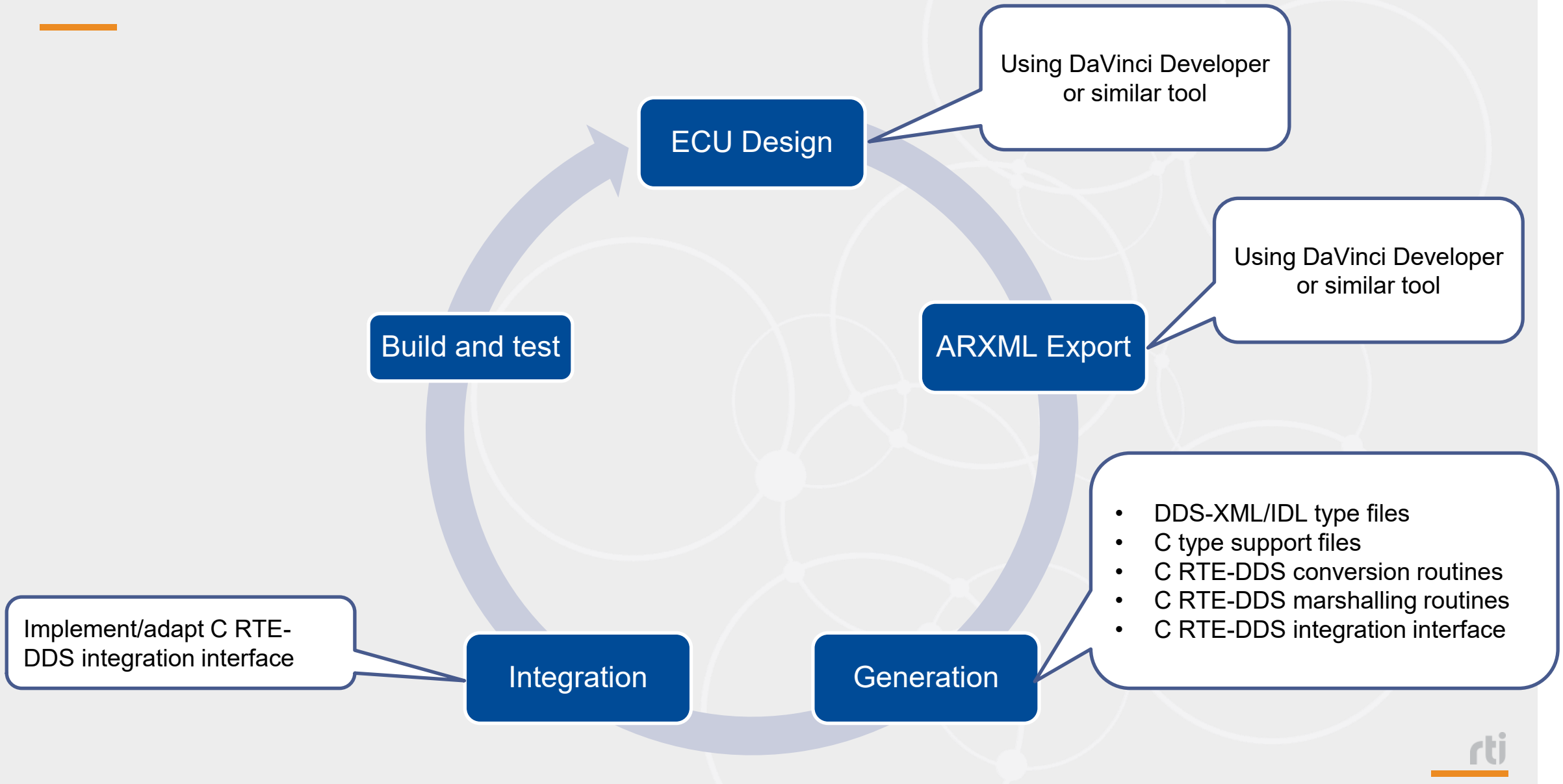
- AUTOSAR Platform Integration Toolkit
  - Leverages a custom CDD that acts as a DDS proxy between RTE and DDS databus.



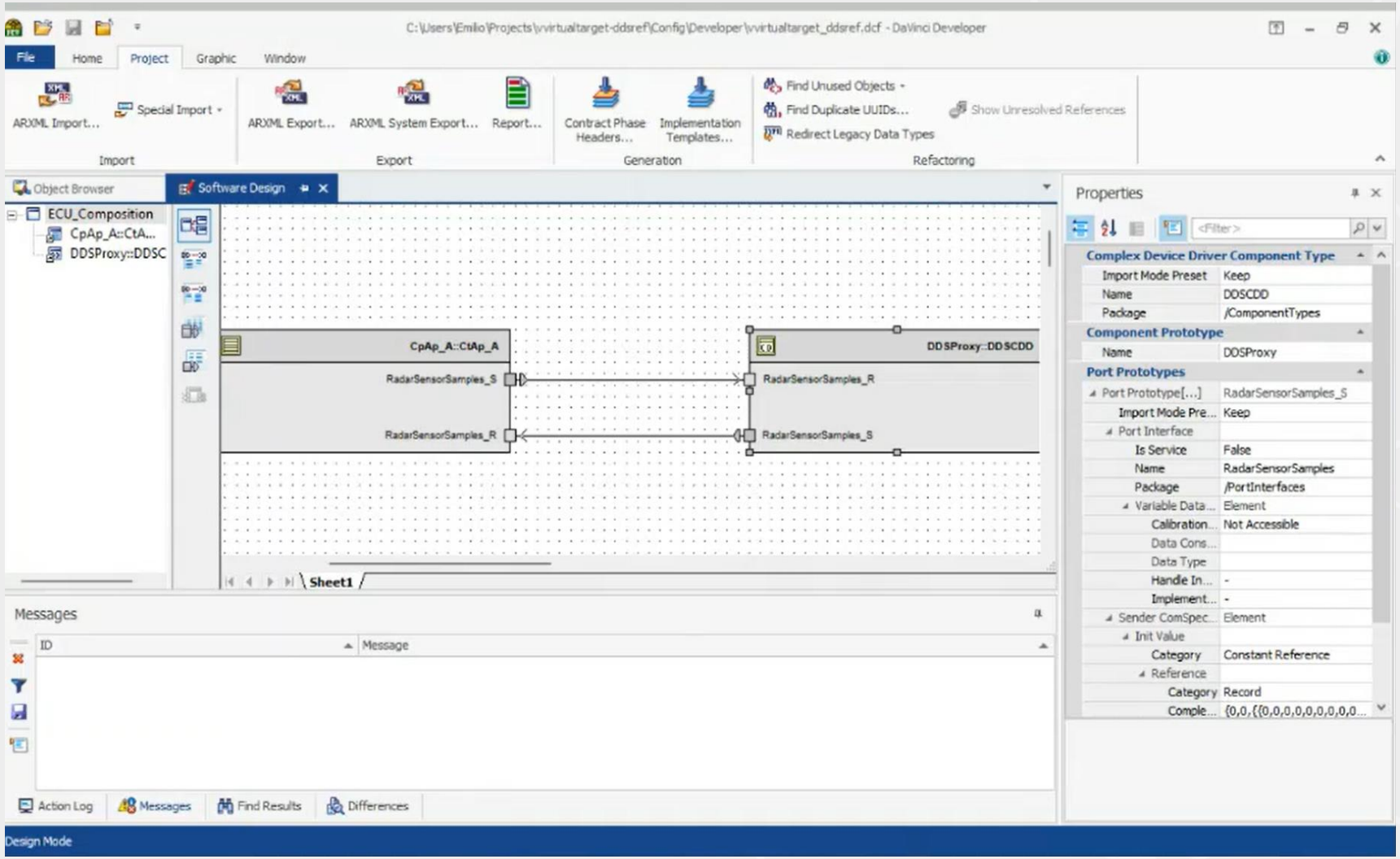
RTI Connext Drive & AUTOSAR CP



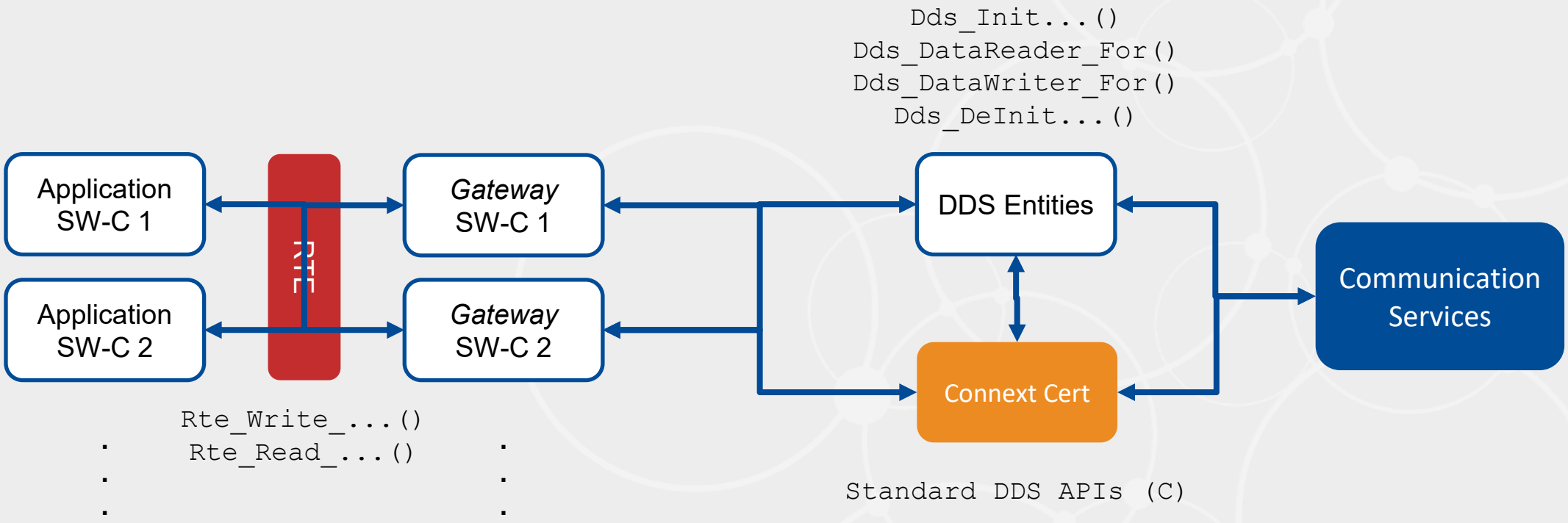
Workflow



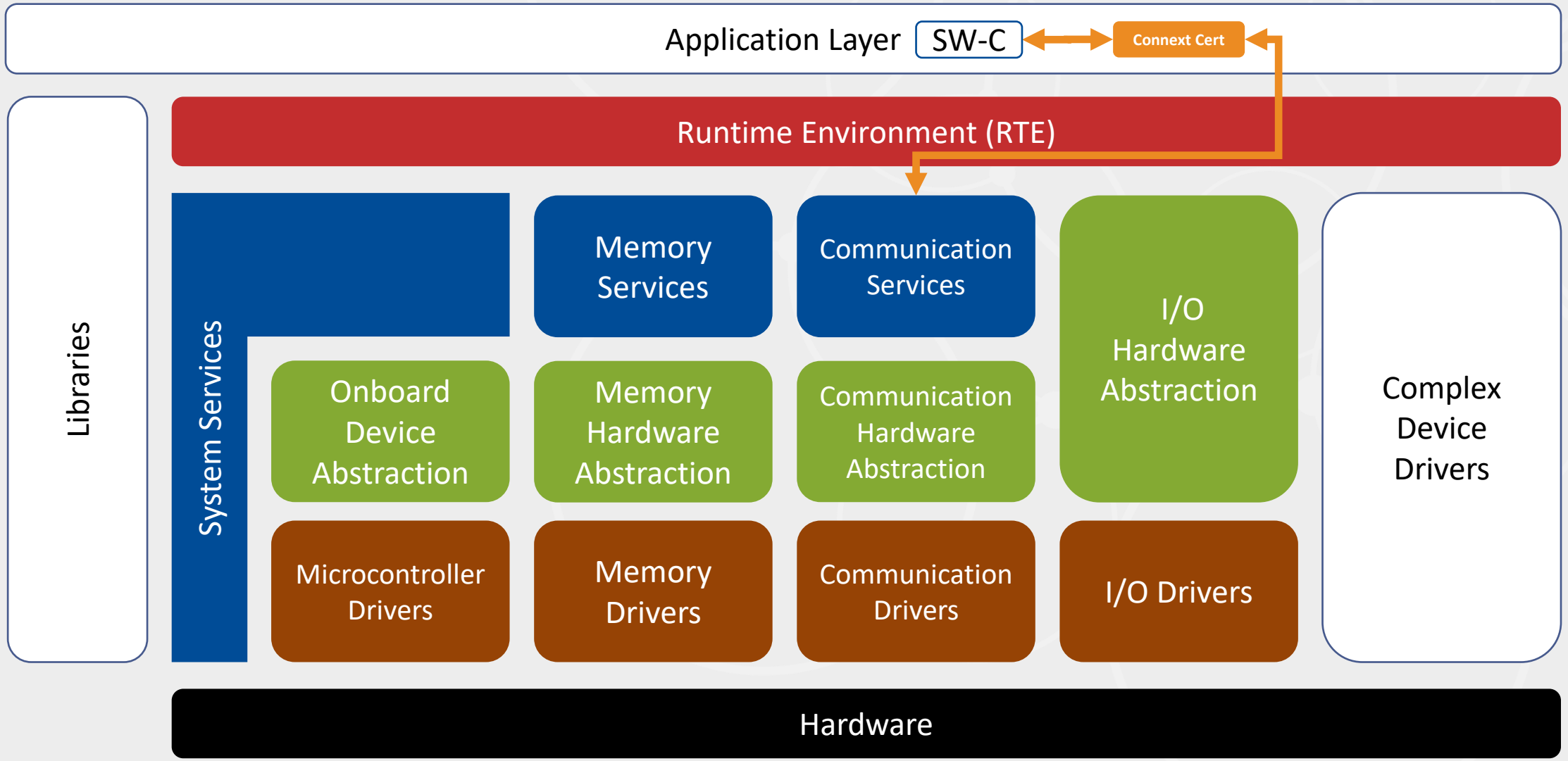
DDS Gateway Design



Functional view

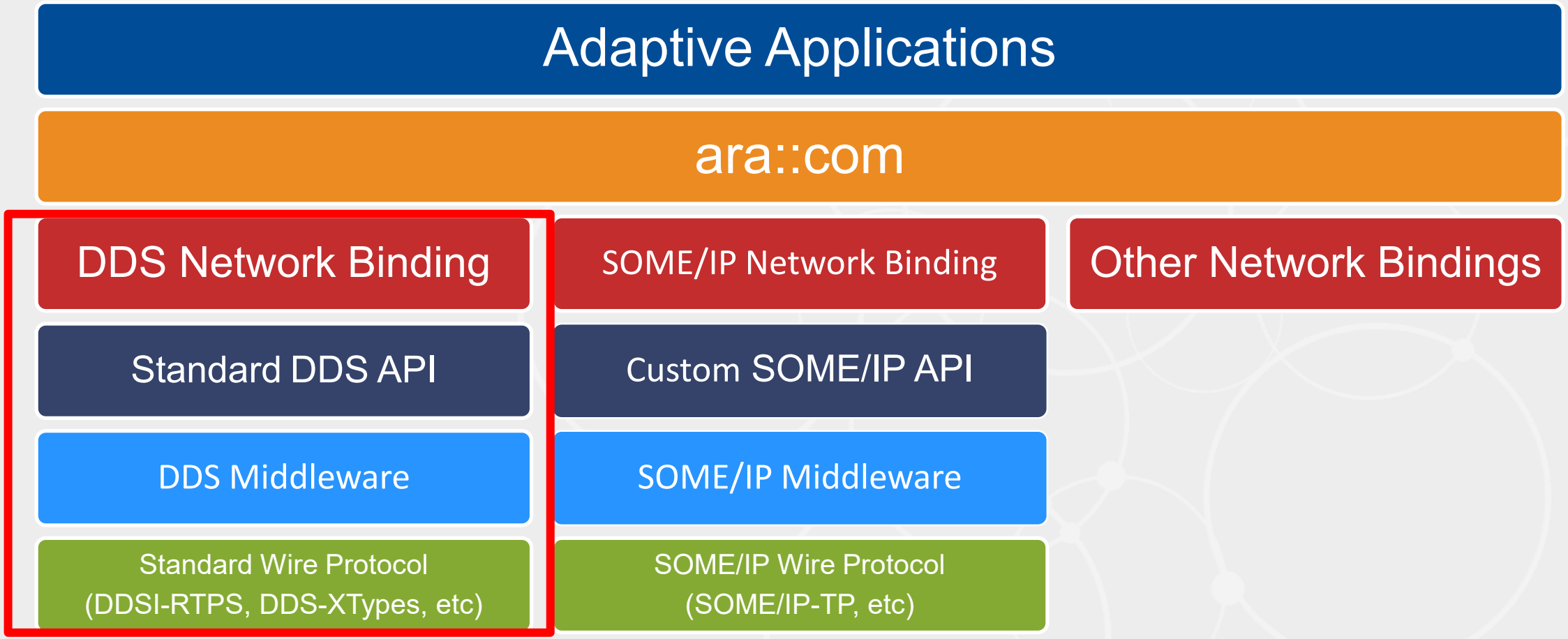


Connext Drive in AUTOSAR Classic (as Library)

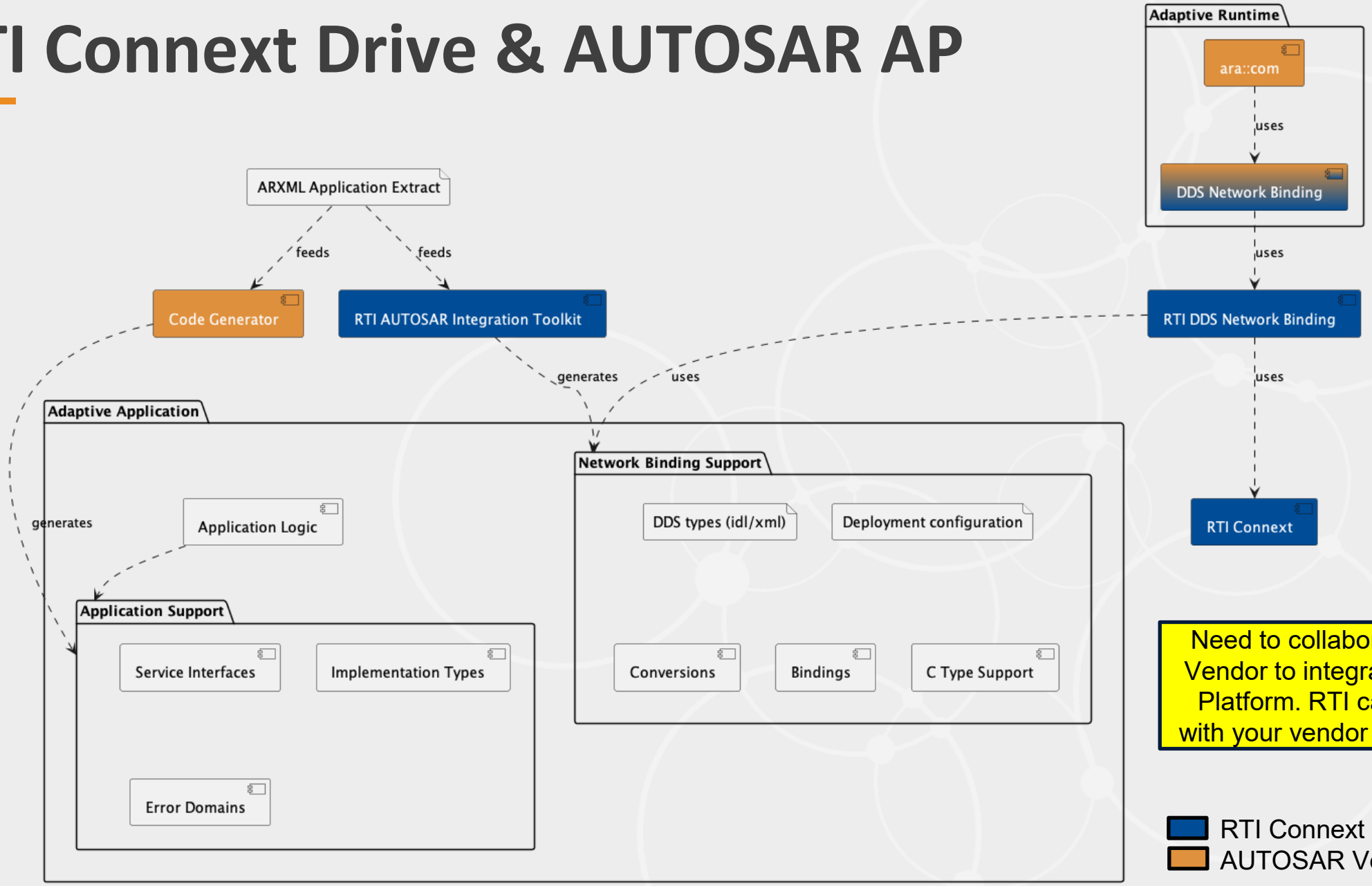


Connext in AUTOSAR AP

RTI has a fully functional component for DDS Network binding meeting AP spec. 22-11



RTI Connext Drive & AUTOSAR AP



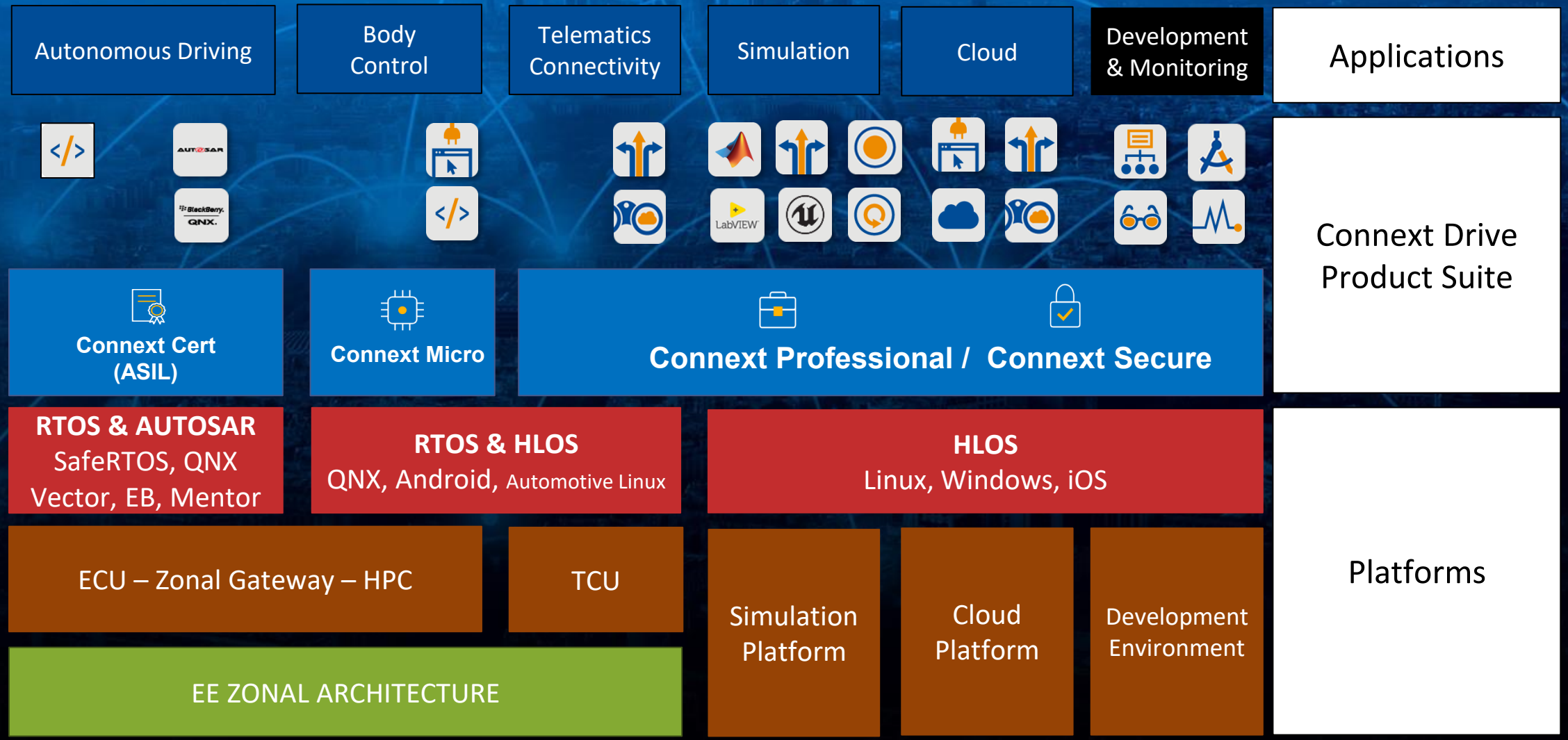
Need to collaborate with Vendor to integrate to AP Platform. RTI can work with your vendor of choice

RTI Connext
AUTOSAR Vendor

Examples of DDS in MP projects

Current project examples

Connext Drive® Architecture Stack



Connext CERT is ISO 26262 ASIL D Certified

- Safety Plan
- Safety Manual
- Software development Plan
- Software Quality Assurance Plan
- Software Configuration Management Plan
- Software Verification Plan
- Software Test Plan
- Tool Qualification Plan
- Software Vulnerability Analysis
- Safety Case

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD Product Service

CERTIFICATE

No. Z10 116089 0001 Rev. 00

Holder of Certificate: Real-Time Innovations, Inc.
232 East Java Drive
94089 CA Sunnyvale
USA

Certification Mark:

Product: Embedded Software

Model(s): Connext DDS Micro Cert

Parameters: Publish-Subscribe Middleware for Real-time Systems
Safety Parameters: ASIL D – ISO 26262

The report RS98088C is a mandatory part of this certificate.
The product complies with the following listed safety requirements only, if the specifications documented in the currently valid revision of this report are met.

Tested according to: ISO 26262-2:2018
ISO 26262-6:2018
ISO 26262-8:2018

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. This certificate is valid until the listed date, unless it is cancelled earlier. All applicable requirements of the testing and certification regulations of TÜV SÜD Group have to be complied. For details see: www.tuvsud.com/ps-cert

Test report no.: RS98088C

Valid until: 2027-03-14

Date, 2022-03-15

(Peter Weiß)

Page 1 of 1
TÜV SÜD Product Service GmbH • Certification Body • Ridlerstraße 65 • 80339 Munich • Germany

TÜV®

Functional safety and cybersecurity

RELATED VENDOR

FAULHABER

RTI Connext Drive receives certifications ASPICE CL1, ISO 21434, and ISO 26262

2024-11-29 · Source: Press release | Translated by AI · 1 min Reading Time ·

RTI has received the process certifications ASPICE CL1, ISO 21434, and ISO 26262 for Connext Drive. Connext Drive is based on the Data Distribution Service standard and provides functional safety and cybersecurity for the development and design of software-defined vehicles.

RTI receives certifications ASPICE CL1, ISO 21434, and ISO 26262.
(Image: Sergey Bitos | Shutterstock)

RTI in Automotive

- RTI is working with **more than half of the top 10** funded vehicles newcomers.
- RTI is growing its traditional market customer base.
- RTI Connext® **is running in multiple production vehicles**.
- RTI has more than 50+ automotive programs.

XPENG chooses RTI Connext Drive® for future E/E architecture

Jan 07, 2025, at 6:03 pm | gasgoo

> RTI, a provider of intelligent system infrastructure software, recently announced that Chinese new energy vehicle maker XPENG had selected RTI Connext Drive® as the core communication technology for ...

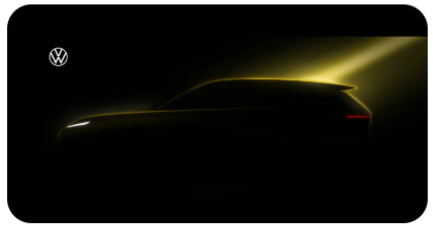
Beijing (Gasgoo)- RTI, a provider of intelligent system infrastructure software, recently announced that Chinese new energy vehicle maker XPENG had selected RTI Connext Drive® as the core communication technology for its next-generation electronic and electrical (E/E) architecture.

Starting with the mass-produced models in 2026, XPENG will adopt Connext Drive to manage data distribution, supporting its mission to introduce smarter, more efficient vehicles with cutting-edge technologies.

XPENG's Vice President, Yu Peng, emphasized the need for a unified communication framework capable of handling the intensive data requirements across their vehicle lineup, from high-end to entry-level models. "RTI Connext Drive is recognized in the industry as a flexible, reliable, and extensively validated middleware. With RTI's leadership in the Data Distribution Service (DDS™) standard and decades of experience in complex system services, this partnership will help XPENG accelerate the development of future vehicles while reducing various risks," he stated.

Connext Drive, based on the DDS standard, provides a software framework capable of real-time data handling, compatible with all enterprise application scenarios. It is independent from platform architecture, possessing complex communication capabilities, and therefore supporting the data foundation for advanced driver assistance systems (ADAS) and autonomous driving features. The platform is agnostic to hardware, offering a robust solution for integrating new technologies without major infrastructure overhauls, allowing XPENG to continuously enhance its vehicles without rewriting software.

VOLKSWAGEN GROUP Group Media Investors Sustainability Career



02/29/2024

Ready for next EV push: Volkswagen enters into agreement with XPENG for

- Major milestone reached: Partners enter into Master Agreement on strategic technical collaboration, bundling their respective strengths to tackle the dynamic Chinese market
- Joint development of intelligent connected vehicles (ICV) will complement the Volkswagen brand portfolio with two models in the mid-size segment for the Chinese market

Volkswagen to roll out new architecture with Xpeng to cut China EV costs

By **Sarah Wu**

April 17, 2024 4:47 PM GMT+8 · Updated 9 months ago

[1/2] A Volkswagen electric ID. Next is debuted at an event ahead of the Shanghai Auto Show, in Shanghai, China April 17, 2023. REUTERS/Aly Song/File Photo Purchase Licensing Rights

Summary Companies

- VW develops new EV architecture with Xpeng
- New architecture to help cut manufacturing costs
- VW seeking to regain market share in China

BEIJING, April 17 (Reuters) - Volkswagen AG (VOWG_p.DE) said on Wednesday it has developed a new architecture for intelligent and electric cars with its Chinese partner Xpeng (9868.HK), which the German automaker said will help it offer more affordable EVs in its biggest market.

Volkswagen plans to use the China Electrical Architecture (CEA) in locally developed VW-branded EVs from 2026, it said.

SECURE IN-VEHICLE COMMUNICATIONS

APTIV

Aptiv Autonomous Mobility is a global technology company that develops safer, greener and more connected solutions enabling the future of mobility. Aptiv selected RTI's connectivity middleware to provide secure, in-vehicle communication for its autonomous vehicles. Connext exchanges and stores data, while providing an open platform to make software module integrations smoother.

rti

UNIFY SIMULATION VENDORS

Audi's hardware-in-the-loop simulation feeds realistic data to components to test hundreds of ECUs.

RTI software enables a modular environment that scales to test entire vehicles and complex scenarios.

ENABLE A SAFE FLYING CAR

VAHANA

Airbus Vahana is developing the first certified, electric, self-piloted vertical take-off and landing (VTOL) passenger aircraft.

RTI Connext addresses diverse systems with the same technology, greatly simplifying design integration and modularity.

rti

WORK IN HARSH ENVIRONMENTS

KOMATSU

Komatsu is the world's largest mining equipment manufacturer.

RTI Connext provides reliable, fast connectivity enabling control, debugging and system health monitoring for continuous mining.

rti

Summary

- Why DDS in automotive?
- Key differences from SOME/IP
- Existing use-cases

Thank you!