AUTOSAR Introduction

July 2018

AUTOSAR Web Team

Topics

> AUTOSAR Introduction

> Approaches and standards

> Developing the Adaptive Platform

> Achievements, plans, organization

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Topics

> AUTOSAR Introduction

> Approaches and standards

> Developing the Adaptive Platform

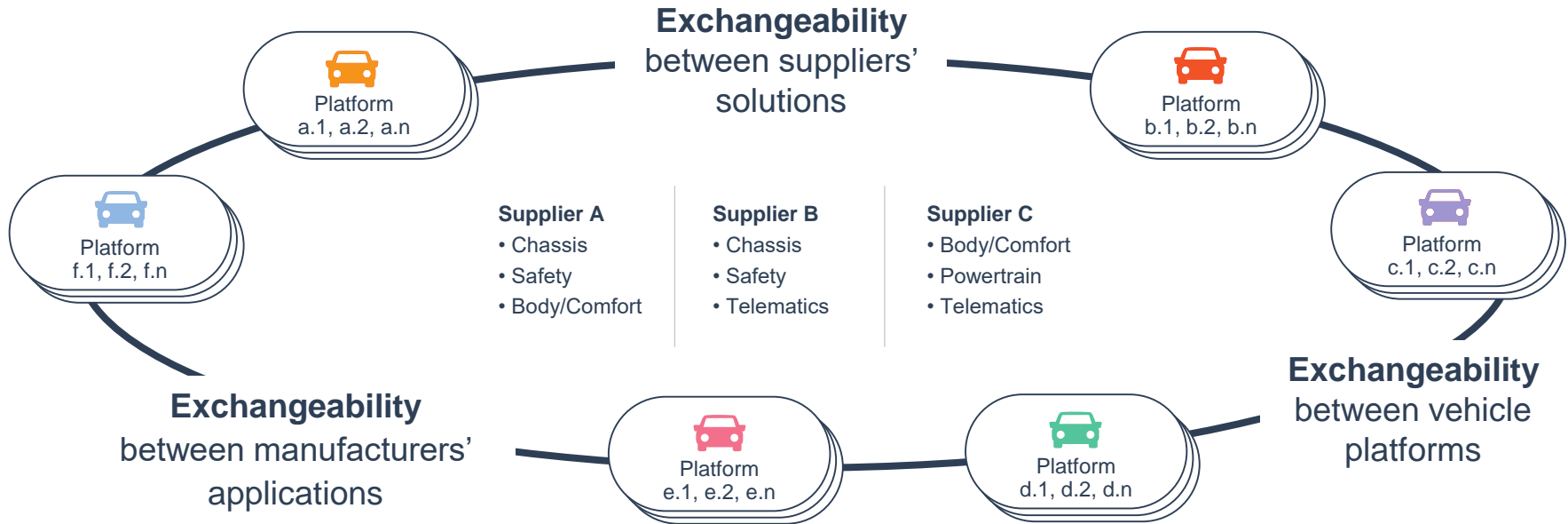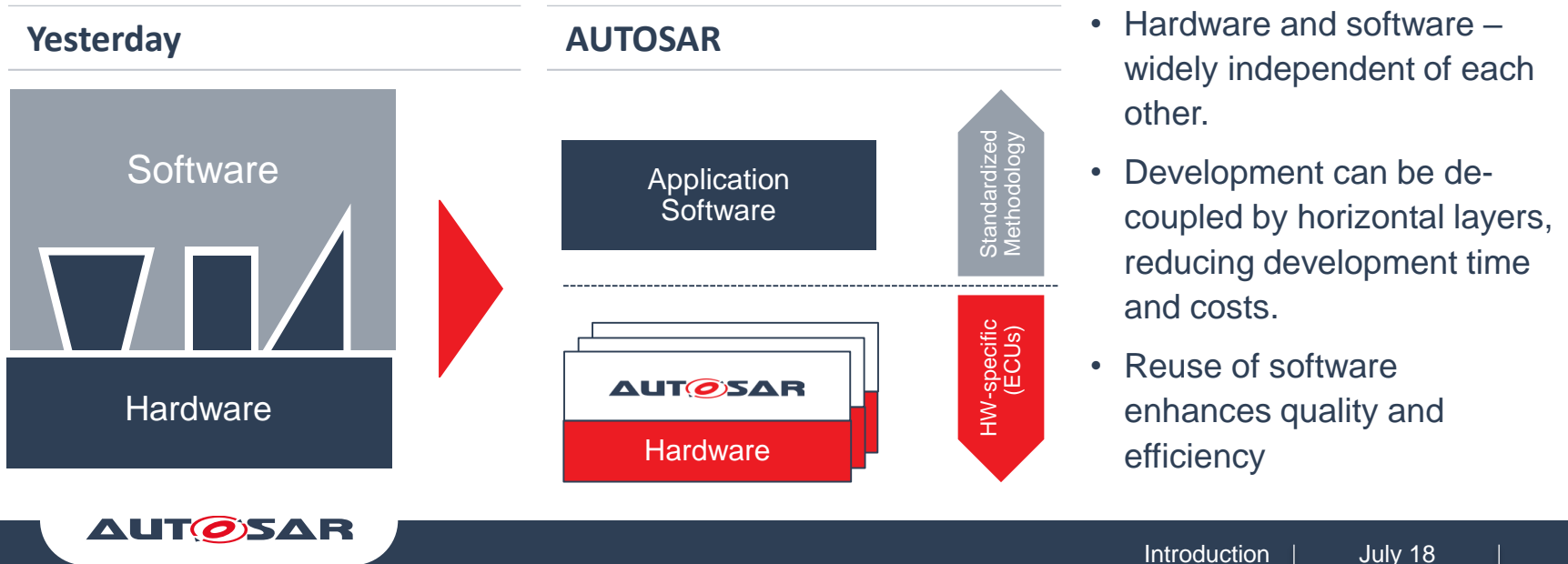> Achievements, plans, organization

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AUTOSAR Vision

AUTOSAR aims to improve complexity management of integrated E/E architectures through increased reuse and exchangeability of SW modules between OEMs and suppliers.

Exchangeability between suppliers' solutions

Exchangeability between manufacturers' applications

Exchangeability between vehicle platforms

Platform a.1, a.2, a.n

Platform f.1, f.2, f.n

Platform b.1, b.2, b.n

Platform c.1, c.2, c.n

Platform e.1, e.2, e.n

Platform d.1, d.2, d.n

Supplier A
• Chassis
• Safety
• Body/Comfort

Supplier B
• Chassis
• Safety
• Telematics

Supplier C
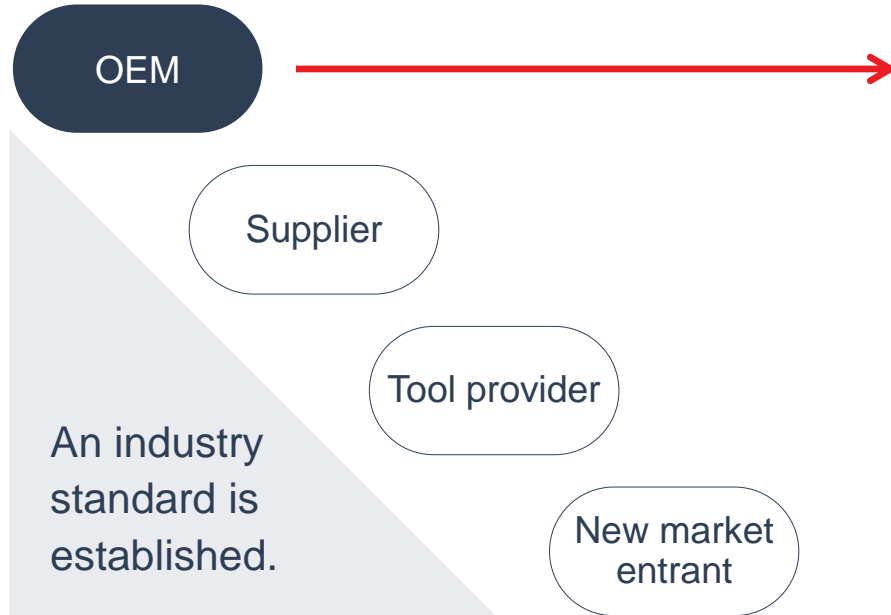• Body/Comfort
• Powertrain
• Telematics

Aims and benefits of using AUTOSAR

AUTOSAR aims to standardize the software architecture of **E**lectronic **C**ontrol **U**nits (**ECUs**). AUTOSAR paves the way for innovative electronic systems that further improve performance, safety and environmental friendliness.
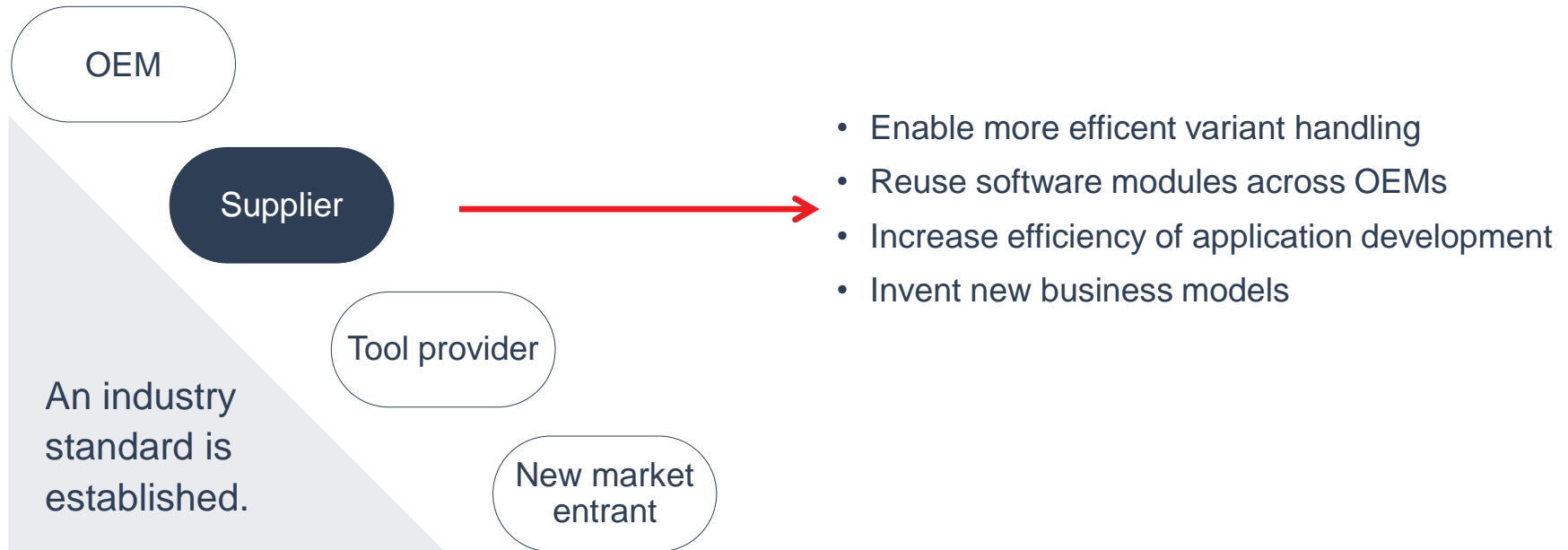
Yesterday

Software

Hardware

AUTOSAR

Application Software

Hardware

Standardized Methodology

HW-specific (ECUs)

- Hardware and software – widely independent of each other.

- Development can be de-coupled by horizontal layers, reducing development time and costs.

- Reuse of software enhances quality and efficiency

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Exploitation of the standard provides significant benefits

OEM

Supplier

Tool provider

New market entrant
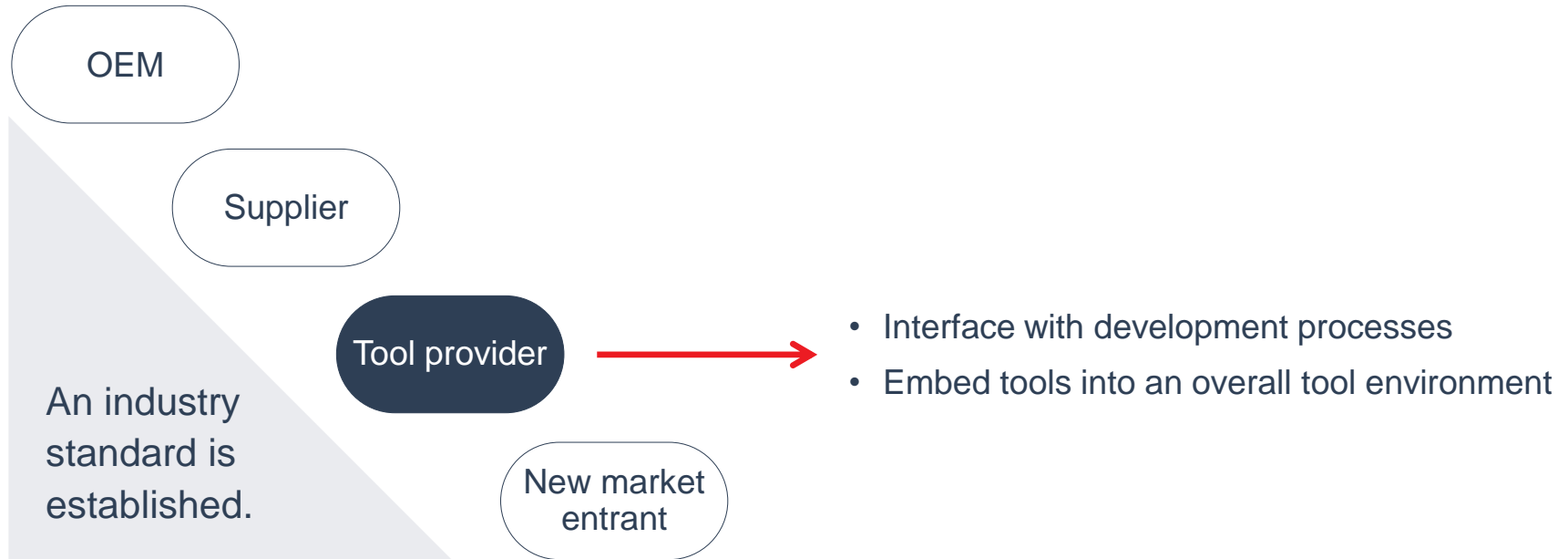
An industry standard is established.

- Establish development distribution among suppliers
- Compete on innovative functions with increased design flexibility
- Simplify software and system integration
- Reduce overall software development costs

Exploitation of the standard provides significant benefits

OEM

Supplier

Tool provider

New market entrant

An industry standard is established.

- Enable more efficent variant handling
- Reuse software modules across OEMs
- Increase efficiency of application development
- Invent new business models

Exploitation of the standard provides significant benefits

OEM

Supplier

Tool provider

An industry standard is established.

New market entrant

- Interface with development processes
- Embed tools into an overall tool environment

Exploitation of the standard provides significant benefits

OEM

Supplier

Tool provider

An industry standard is established.

New market entrant

- Enable new business models by means of standardized interfaces
- Easily understand how automotive software is developed

AUTOSAR – Core Partners and Partners

9 Core Partners

BMW Group · BMW · MINI
BOSCH
Continental
Ford
DAIMLER
PSA GROUPE
GM
TOYOTA
VOLKSWAGEN AG

53 Premium Partners

General OEM
VOLVO TRUCKS · HONDA The Power of Dreams · TATA MOTORS · HYUNDAI · VOLVO · RENAULT · NISSAN · Great Wall

Generic Tier 1
Autoliv · assystem · HELLA · dSPACE · DENSO · JTEKT · LEAR CORPORATION · DELPHI · Panasonic · ZF · NEC · ThyssenKrupp · CNH INDUSTRIAL · Valeo

Standard Software
Mentor Graphics · EB · intel · MathWorks · KPIT · eSOL · VECTOR · SCSK · SOFT · LUXOFT

Tools and Services
ALTRAN · ETRI · itk · L&T Technology Services · cea · Deloitte. · Green Hills SOFTWARE · TATA ELXSI LIMITED · LG Electronics · iav · ETAS · DASSAULT SYSTEMES · sodius · ARC CORE · Fraunhofer · SOFT

Semiconductors
Infineon · RENESAS · ST life.augmented · NXP

38 Development Partners

ANSYS · Advanced Telematic · PRQA · avelabs · BASICWORX · E.S.R.LABS · INCHRON · rti · eJad · Timing Architects · PROVE & RUN · WaferSpace · BASELABS · itemis · silicon gears · ihp · easycore · OFFIS · REACH · SPIRENT · GLIWA · FPT Fpt Software · C & S · OPENSYNERGY · Freetech · IP Camp · IncQueryLabs · EVIDENCE · LAUTERBACH · osb · TTTech · SYMTA VISION · ixia · excelfore · nordsys · NCES · VALIDAS · seneos · AVIN SYSTEMS · PopcornSAR

127 Associate Partners
21 Attendees

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Top-level goals of AUTOSAR – 9 Project Objectives

PO 1

Transferability of software

PO 2

Scalability to different vehicle and platform variants

PO 3

Broad variety of functional domains

PO 4

Definition of an open architecture for automotive software

PO 5

Development of dependable systems

PO 6

Sustainable utilization of natural resources
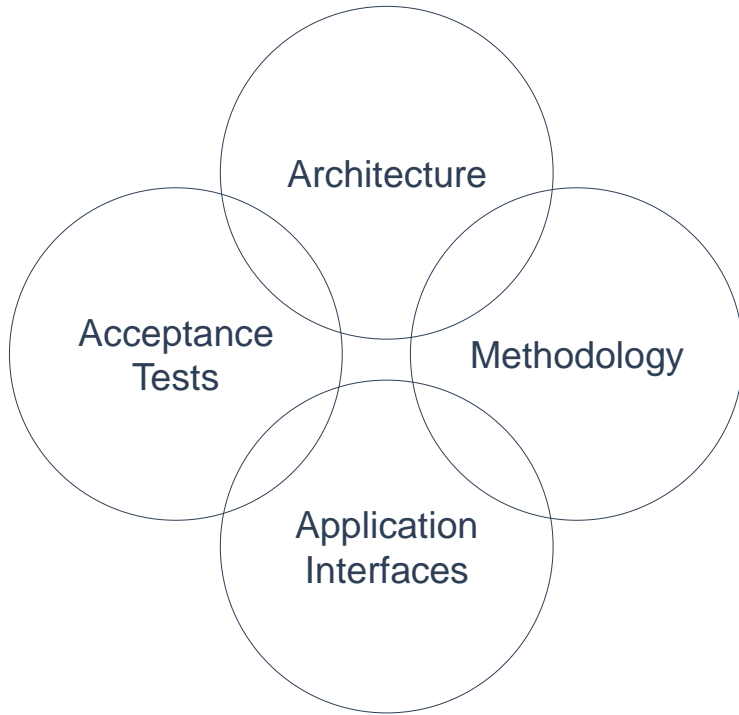
PO 7

Collaboration between various partners
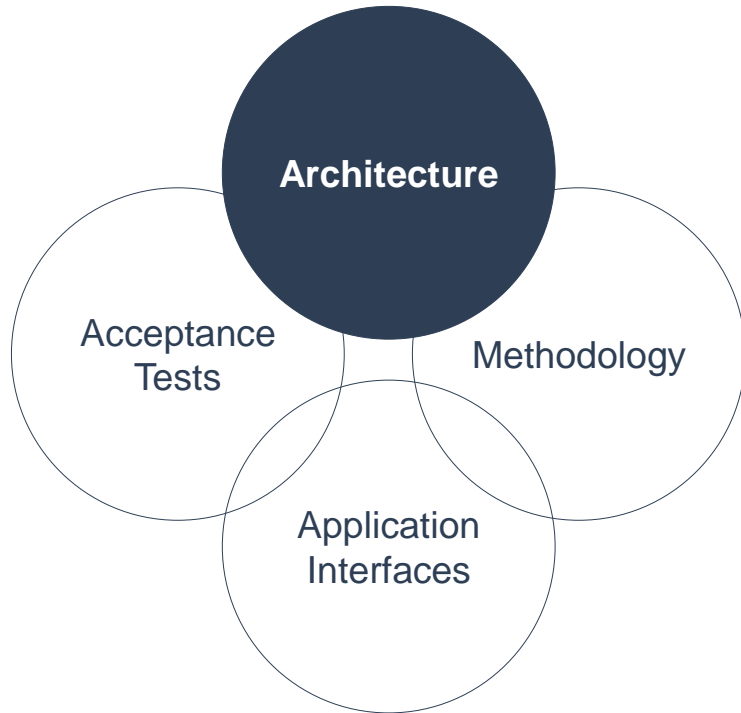
PO 8

Standardization of basic software functionality of automotive ECUs

PO 9

Support of applicable international automotive standards and technologies

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Main working topics

Architecture

Acceptance Tests

Methodology

Application Interfaces

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Main working topics

Architecture

Acceptance Tests

Methodology

Application Interfaces

Software architectures including a complete basic software stack for ECUs – the so called AUTOSAR Basic Software – as an integration platform for hardware independent software applications.

Main working topics

Architecture

Acceptance Tests

Methodology

Application Interfaces
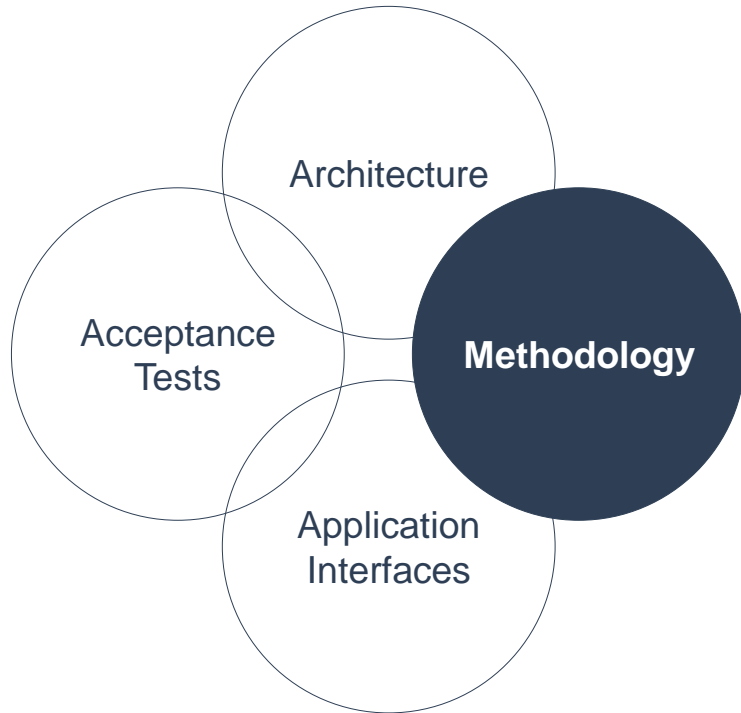
Defines exchange formats and description templates to enable a seamless configuration process of the basic software stack and the integration of application software in ECUs. It includes even the methodology how to use this framework.

Main working topics

Architecture

Acceptance Tests

Methodology

Application Interfaces
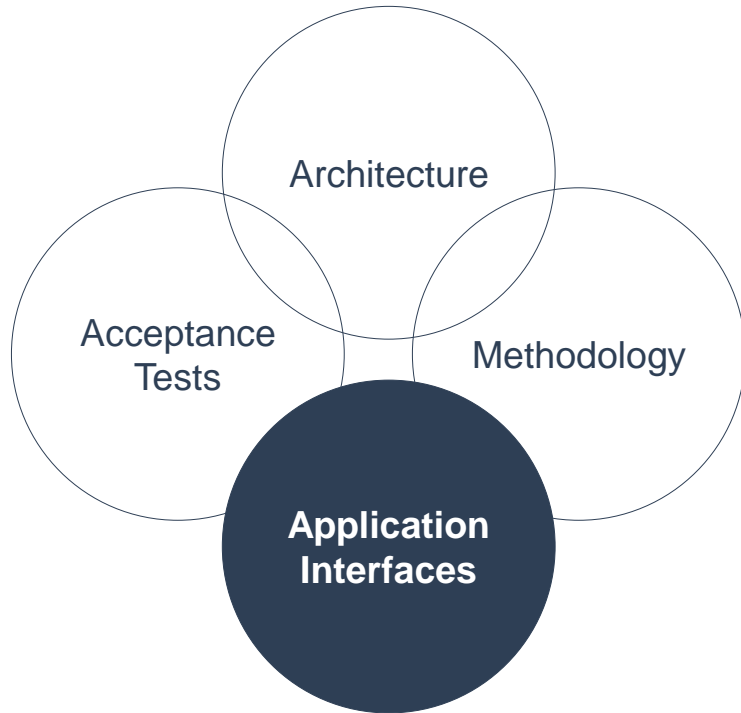
Specification of interfaces of typical automotive applications from all domains in terms of syntax and semantics, which should serve as a standard for application software.

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Main working topics

Architecture

Acceptance Tests

Methodology

Application Interfaces
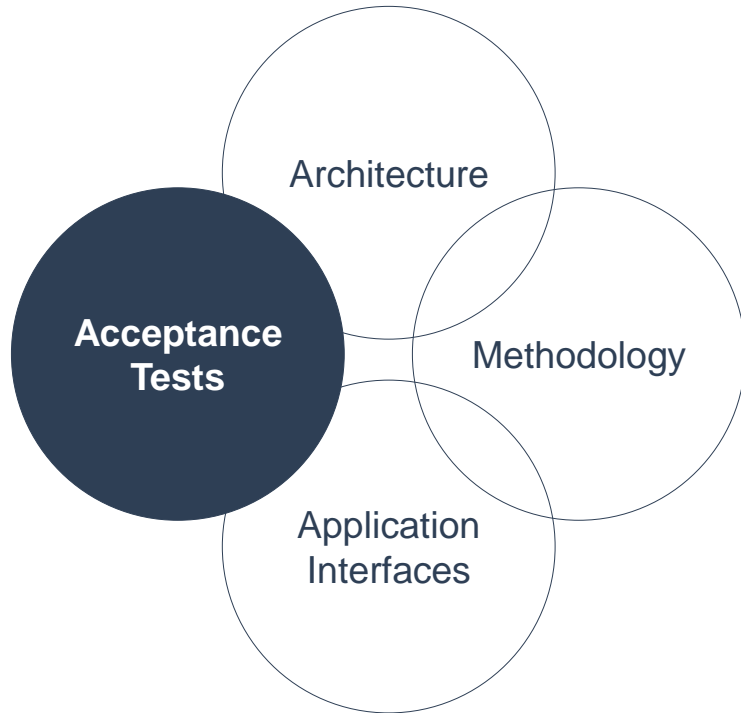
Specification of test cases intending to validate the behavior of an AUTOSAR implementation with AUTOSAR application software components or within one vehicle network.

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Topics

> AUTOSAR Introduction

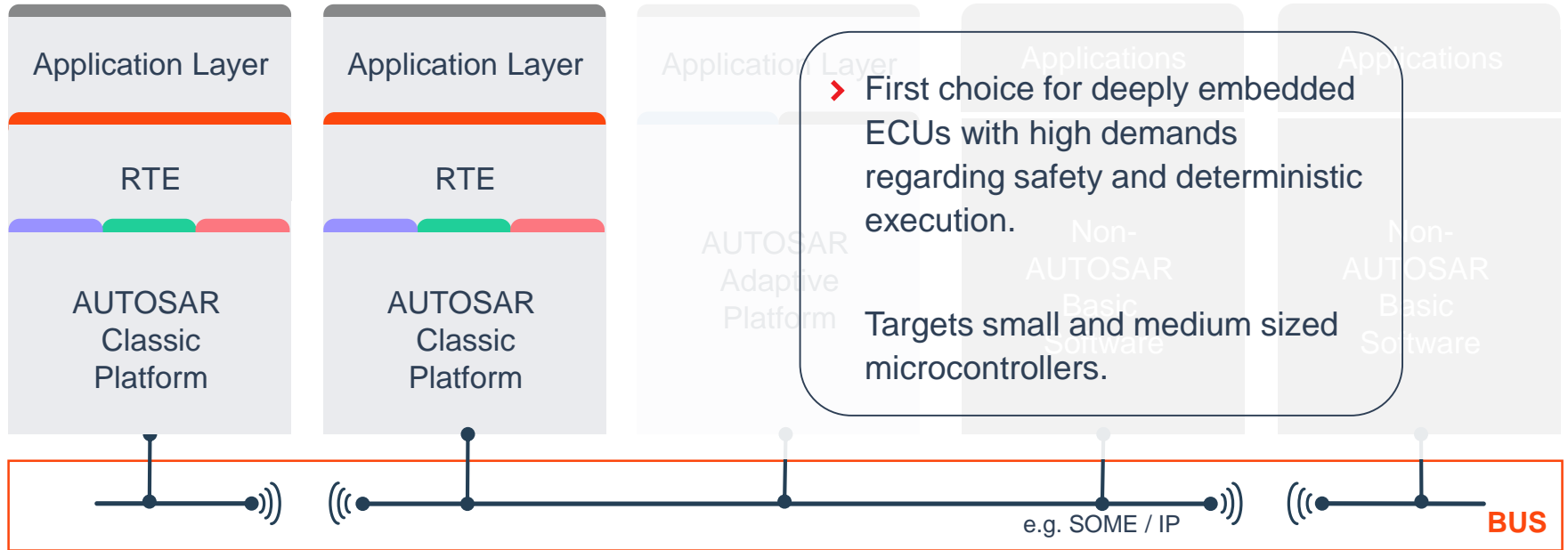> Approaches and standards

> Developing the Adaptive Platform

> Achievements, plans, organization

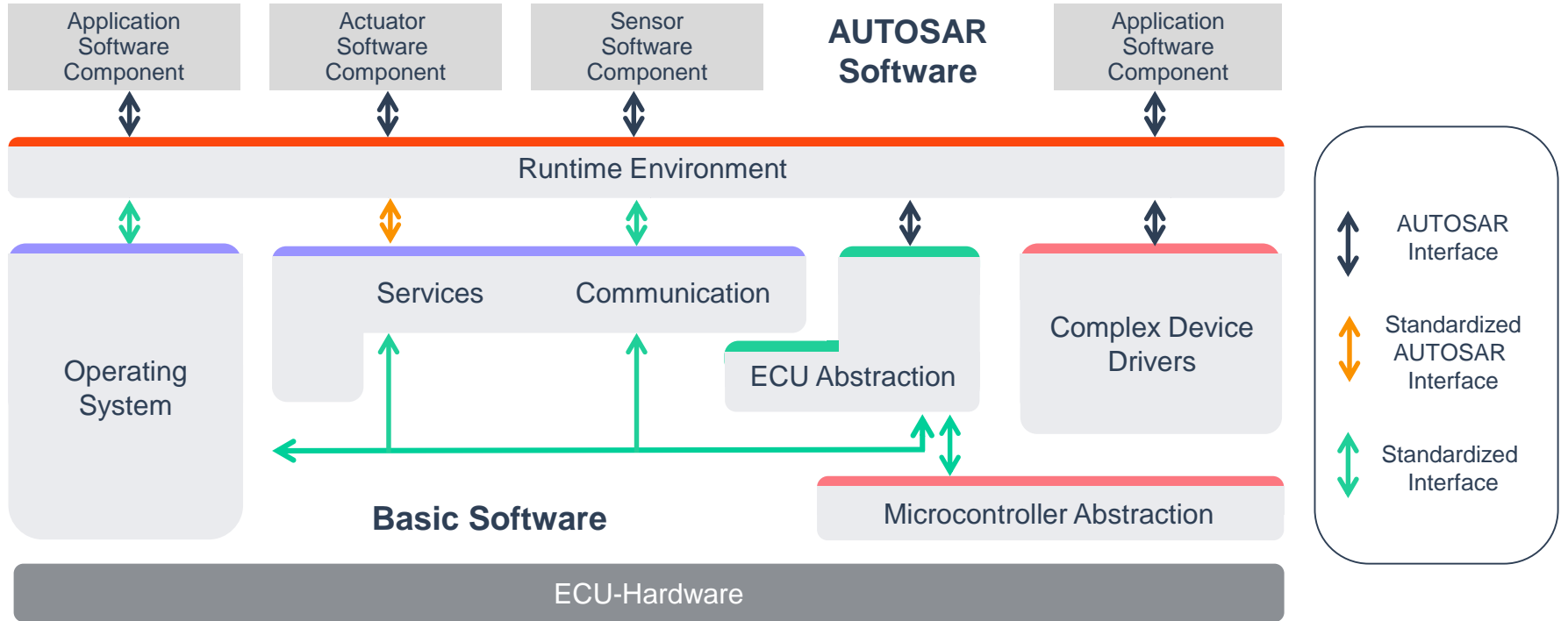# AUTOSAR standardizes two software platforms – Classic and Adaptive

Application Layer	Application Layer	Application Layer	Applications	Applications
RTE	RTE			
AUTOSAR Classic Platform	AUTOSAR Classic Platform	AUTOSAR Adaptive Platform	Non-AUTOSAR Basic Software	Non-AUTOSAR Basic Software

e.g. SOME / IP

BUS
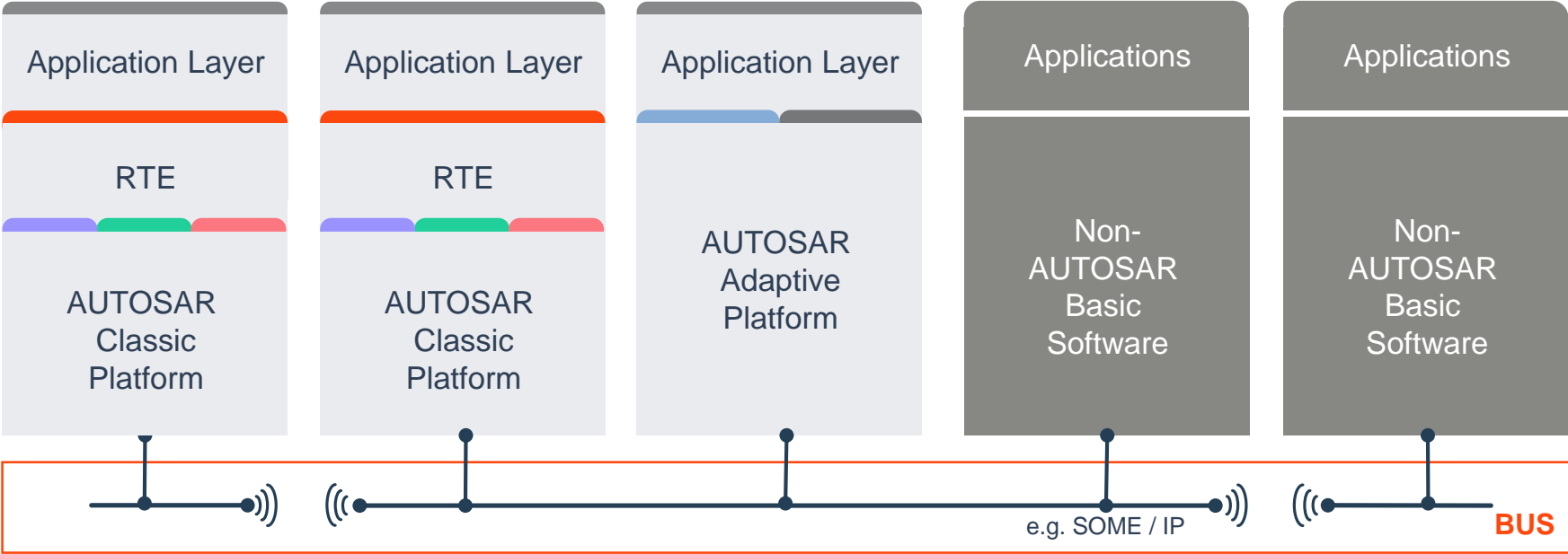
Common Bus Interface Specification

© AUTOSAR

AUTOSAR Classic Platform is worldwide on the road

Application Layer — **RTE** — **AUTOSAR Classic Platform**

Application Layer — **RTE** — **AUTOSAR Classic Platform**

Application Layer — AUTOSAR Adaptive Platform

Applications — Non-AUTOSAR Basic Software

Applications — Non-AUTOSAR Basic Software

> First choice for deeply embedded ECUs with high demands regarding safety and deterministic execution.
>
> Targets small and medium sized microcontrollers.

e.g. SOME / IP

BUS

Common Bus Interface Specification

© AUTOSAR

Software architecture of AUTOSAR Classic Platform

AUTOSAR Software

Application Software Component • Actuator Software Component • Sensor Software Component • Application Software Component

Runtime Environment

Basic Software

Operating System • Services • Communication • ECU Abstraction • Complex Device Drivers • Microcontroller Abstraction

ECU-Hardware

AUTOSAR Interface

Standardized AUTOSAR Interface

Standardized Interface

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Basic approach

Virtual Integration	Introduction of HW Attributes	ECU Configuration
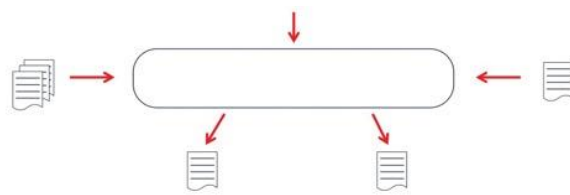
Basic approach

Virtual Integration >

Independent of hardware

SW-C Descriptions

Application Layer

Virtual Functional Bus

Basic approach

Holistic view of the entire system, both software and hardware

ECU
Descriptions

Tools supporting development of
software components

System
Constraint
Description

ECU
Descriptions
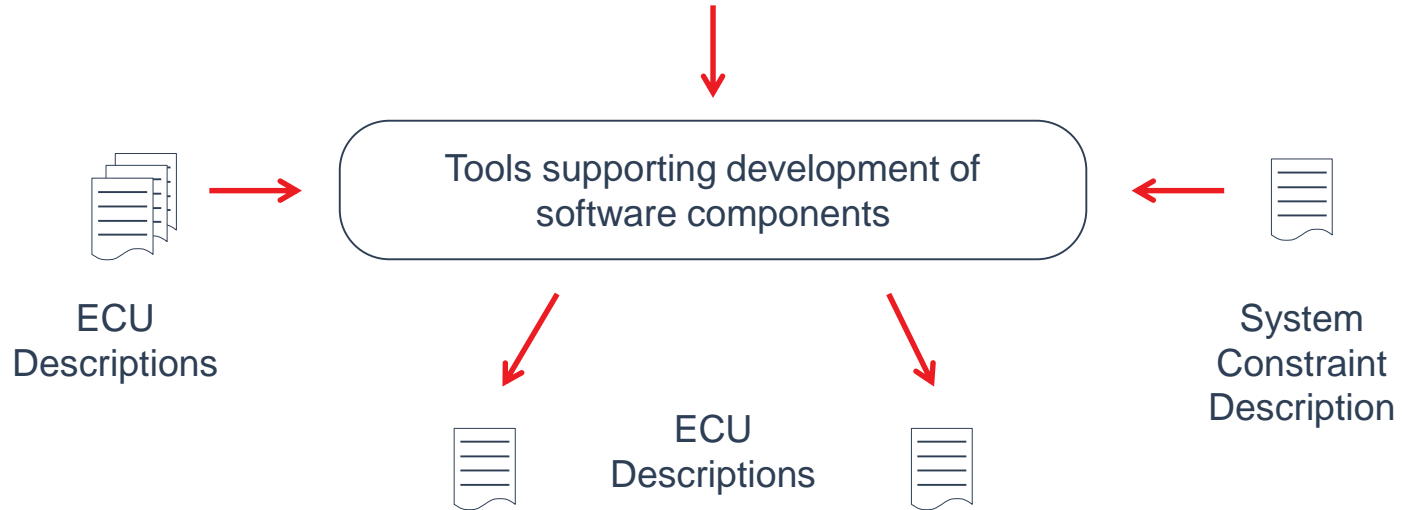
Basic approach

ECU Configuration

- Run-Time Environment
- Separation of system into its ECU plus common infrastructure

System
Descriptions

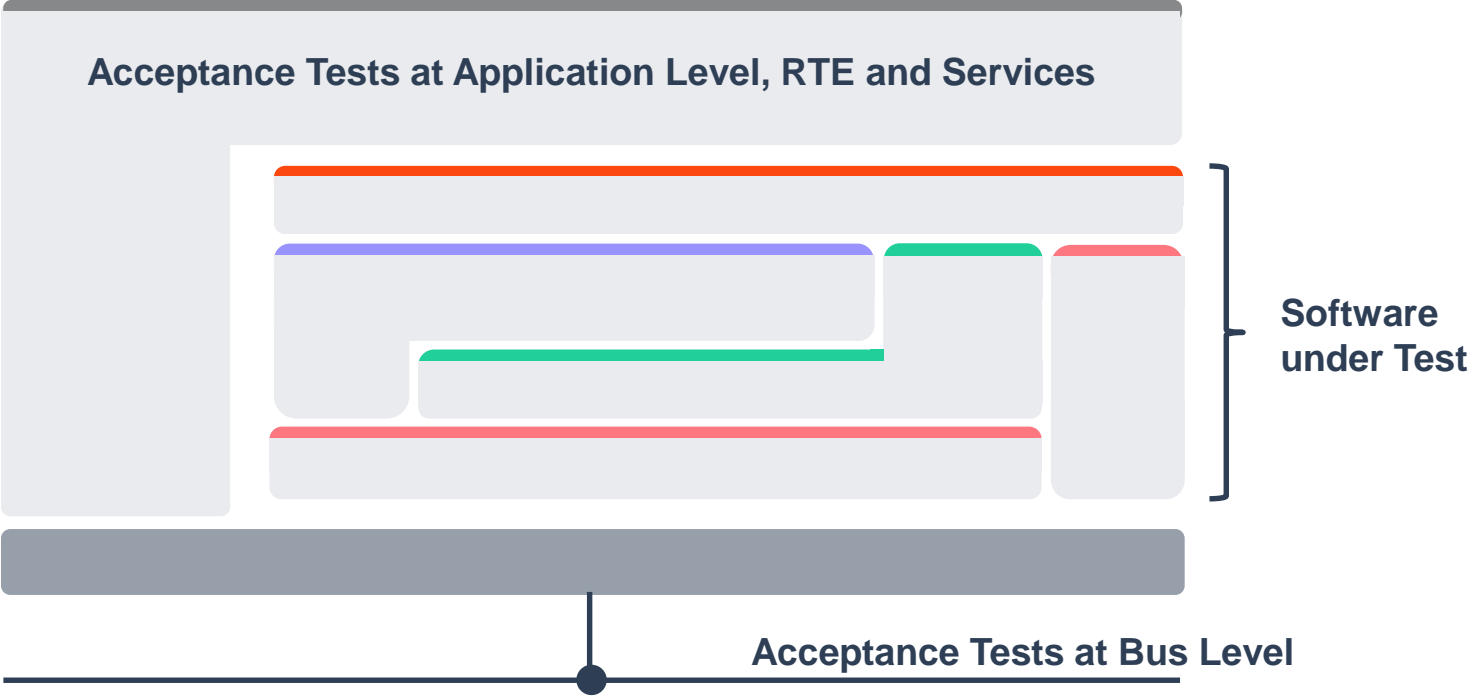| ECU I		ECU II	ECU n
SW-C 1	SW-C 2	SW-C 3	SW-C n
RTE		RTE	RTE
BSW		BSW	BSW

...

Gateway

Flex Ray

CAN
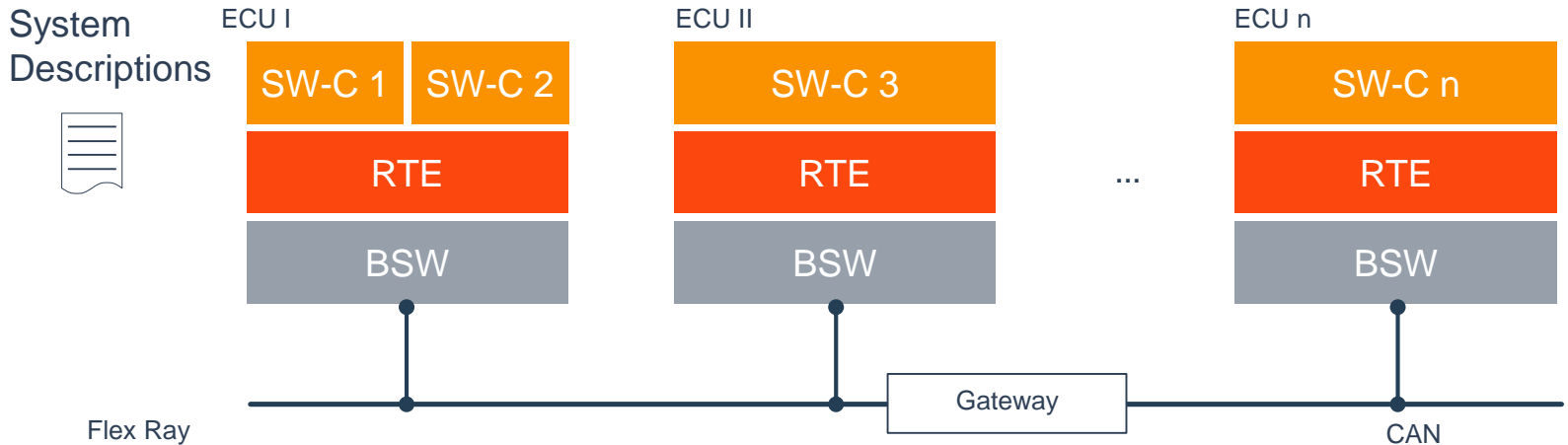
© AUTOSAR

AUTOSAR Classic Platform
Layered Software Architecture

Application Layer
Runtime Environment

Services Layer		Complex Drivers
ECU Abstraction Layer		
Microcontroller Abstraction Layer		

Microcontroller
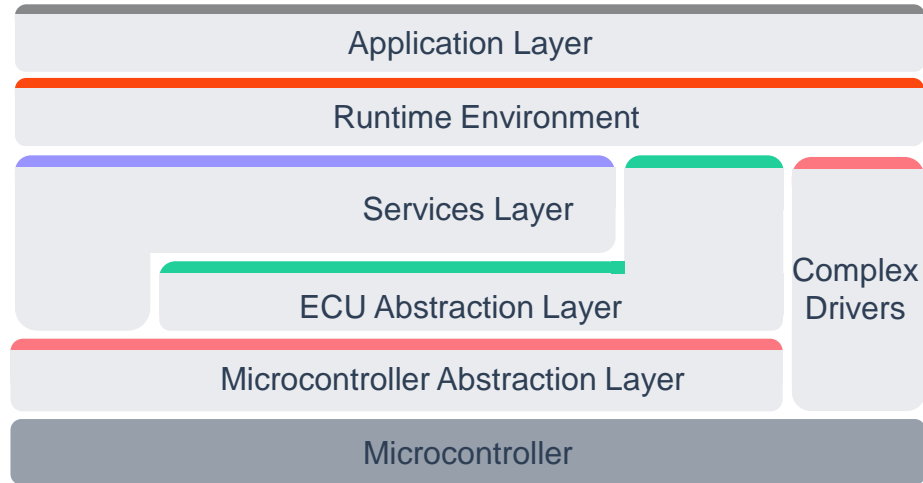
> HW and SW applications are decoupled from each other.

© AUTOSAR

AUTOSAR Classic Platform
Acceptance Test Architecture

Acceptance Tests at Application Level, RTE and Services

Software under Test

Acceptance Tests at Bus Level

Game changer for AUTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.

> Highly automated driving

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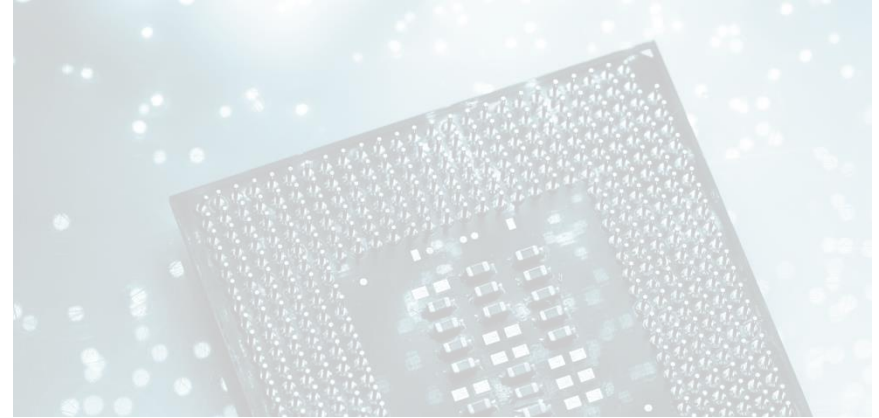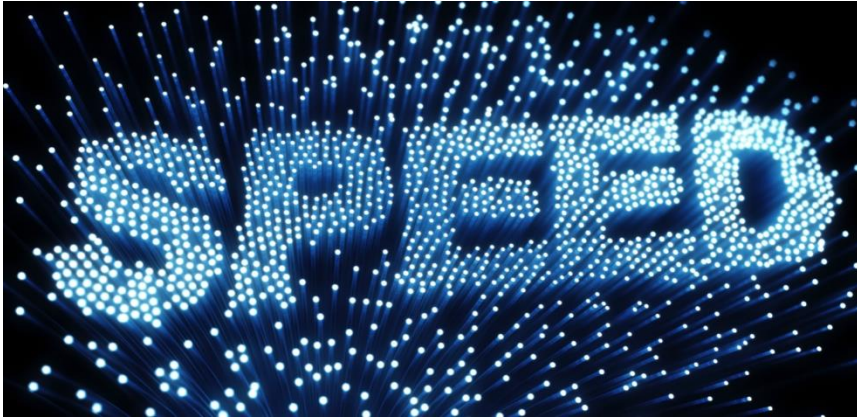
Game changer for AUTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.

> Car-2-X applications
> Internet of Things and cloud services

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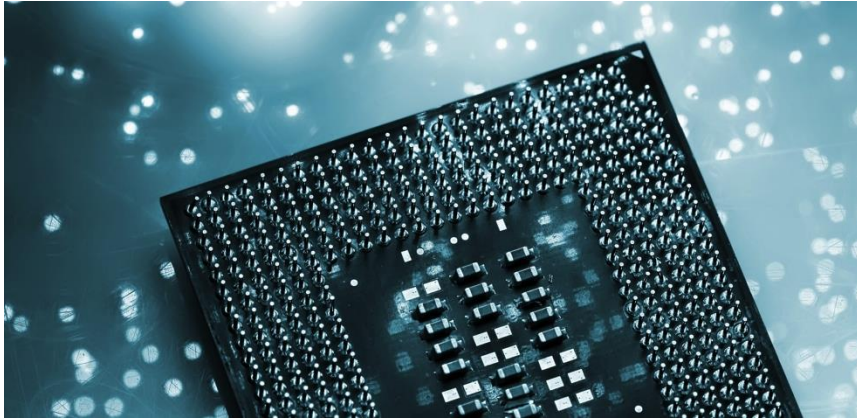# Game changer for AUTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.
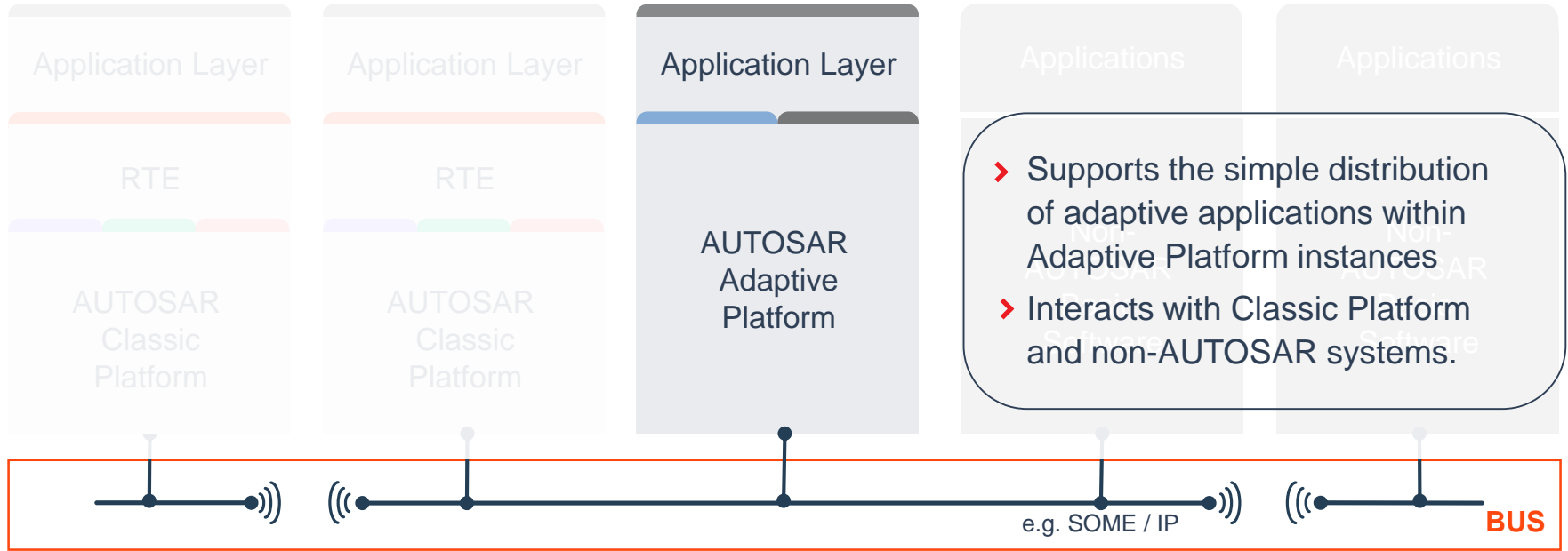

> Increasing data rates

Game changer for AUTOSAR – selected main drivers

Main drivers for new automotive software systems have been determined.

> New processor technologies

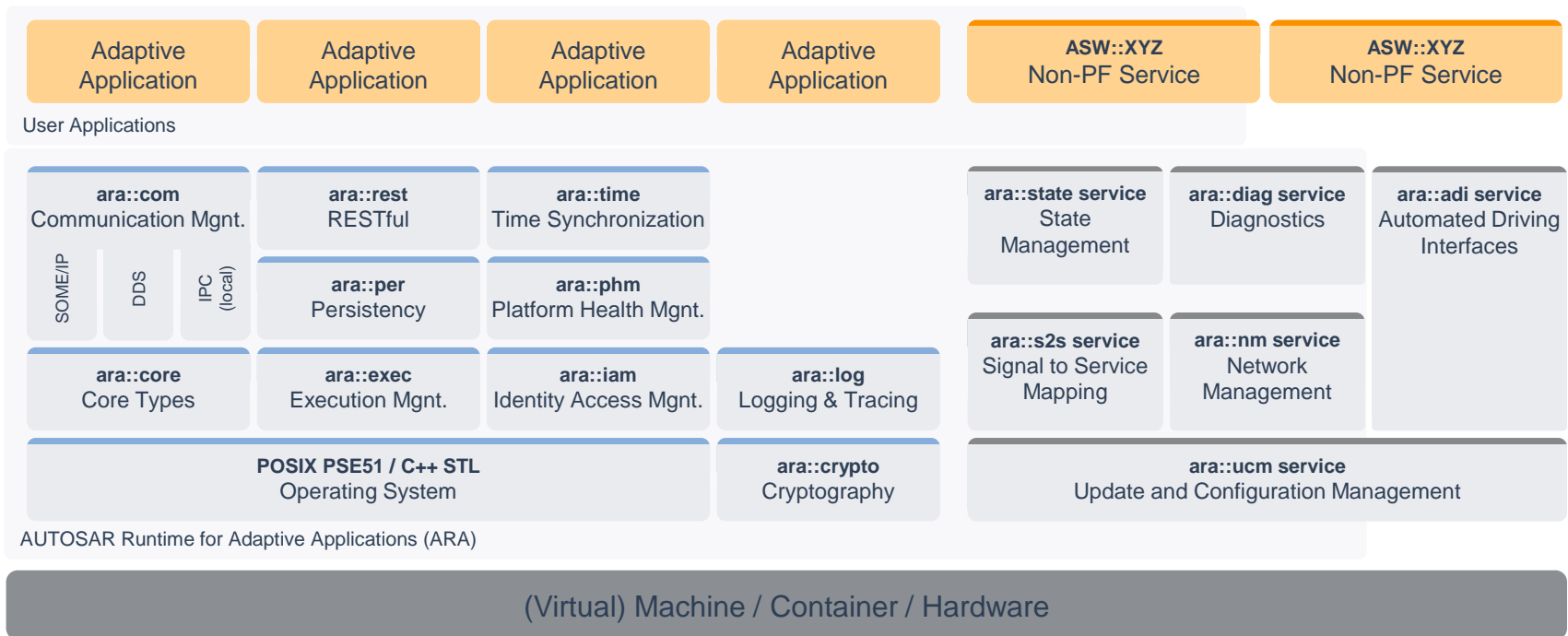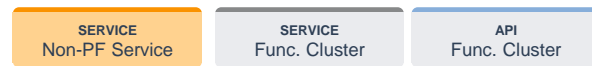© AUTOSAR

AUTOSAR Adaptive Platform for realizing future drivers

Application Layer

Application Layer

Application Layer

Applications

Applications

RTE

RTE

AUTOSAR
Adaptive
Platform

Non-
AUTOSAR

Non-
AUTOSAR

AUTOSAR
Classic
Platform

AUTOSAR
Classic
Platform

> Supports the simple distribution of adaptive applications within Adaptive Platform instances
> Interacts with Classic Platform and non-AUTOSAR systems.

e.g. SOME / IP

BUS

Common Bus Interface Specification

© AUTOSAR

AUTOSAR Adaptive Platform
Logical view

Adaptive Application	Adaptive Application	Adaptive Application	Adaptive Application	ASW::XYZ Non-PF Service	ASW::XYZ Non-PF Service

User Applications

ara::com Communication Mgnt.	**ara::rest** RESTful	**ara::time** Time Synchronization		**ara::state service** State Management	**ara::diag service** Diagnostics	**ara::adi service** Automated Driving Interfaces
SOME/IP · DDS · IPC (local)	**ara::per** Persistency	**ara::phm** Platform Health Mgnt.				
ara::core Core Types	**ara::exec** Execution Mgnt.	**ara::iam** Identity Access Mgnt.	**ara::log** Logging & Tracing	**ara::s2s service** Signal to Service Mapping	**ara::nm service** Network Management	
POSIX PSE51 / C++ STL Operating System			**ara::crypto** Cryptography	**ara::ucm service** Update and Configuration Management		

AUTOSAR Runtime for Adaptive Applications (ARA)

(Virtual) Machine / Container / Hardware

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Classic Platform vs. Adaptive Platform
Technical characteristics

AUTOSAR **Classic Platform**	AUTOSAR **Adaptive Platform**
Based on OSEK	Based on POSIX
Execution of code directly from ROM	App. is loaded from persistent memory into RAM
Same address space for all applications (MPU support for safety)	Each application has its own (virtual) address space (MMU support)
Optimized for signal-based communication (CAN, FlexRay)	Service-oriented communication
Fixed task configuration	Support of multiple (dynamic) scheduling strategies
Specification	Specification and code

The platforms are organized by 5 AUTOSAR standards
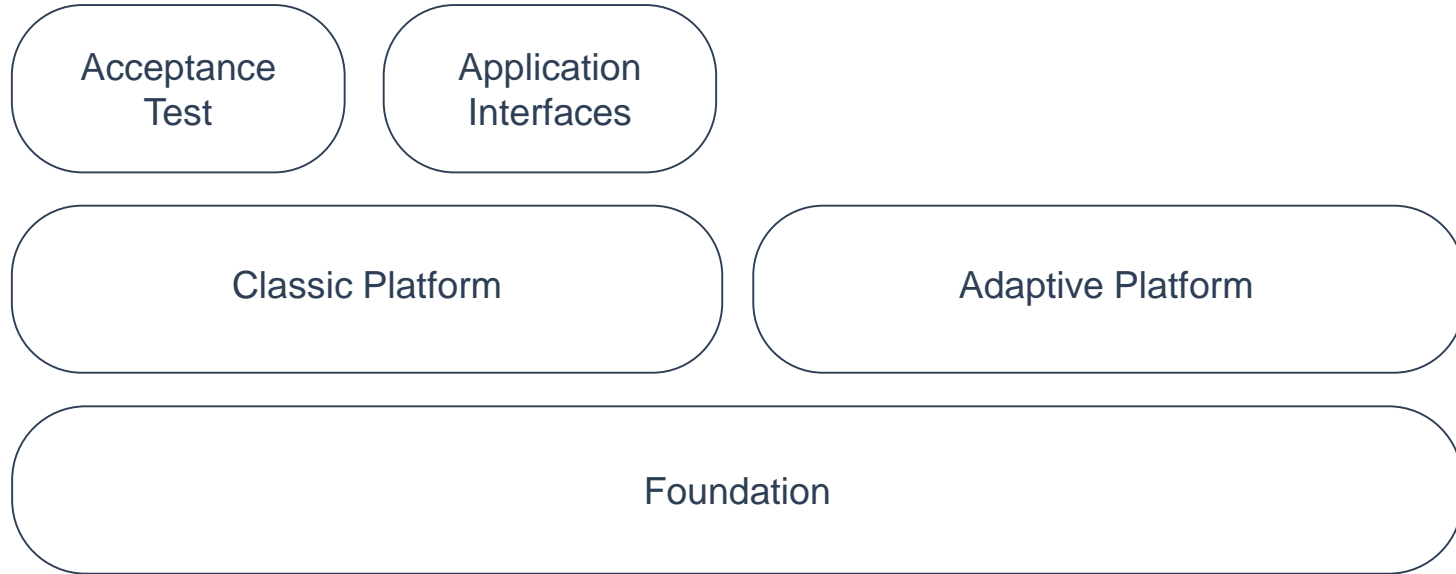
Acceptance Test

Application Interfaces

Classic Platform

Adaptive Platform

Foundation

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Topics

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AUTOSAR Adaptive Platform: Success factors

Market driven feature development

Frontloading of validation

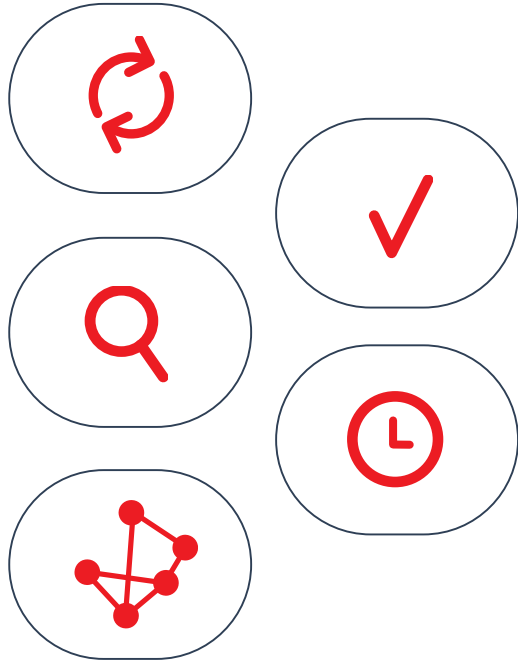Precision and quality of the standard

Early availability of exemplary implementation

Short development cycles

Interoperability and increased quality

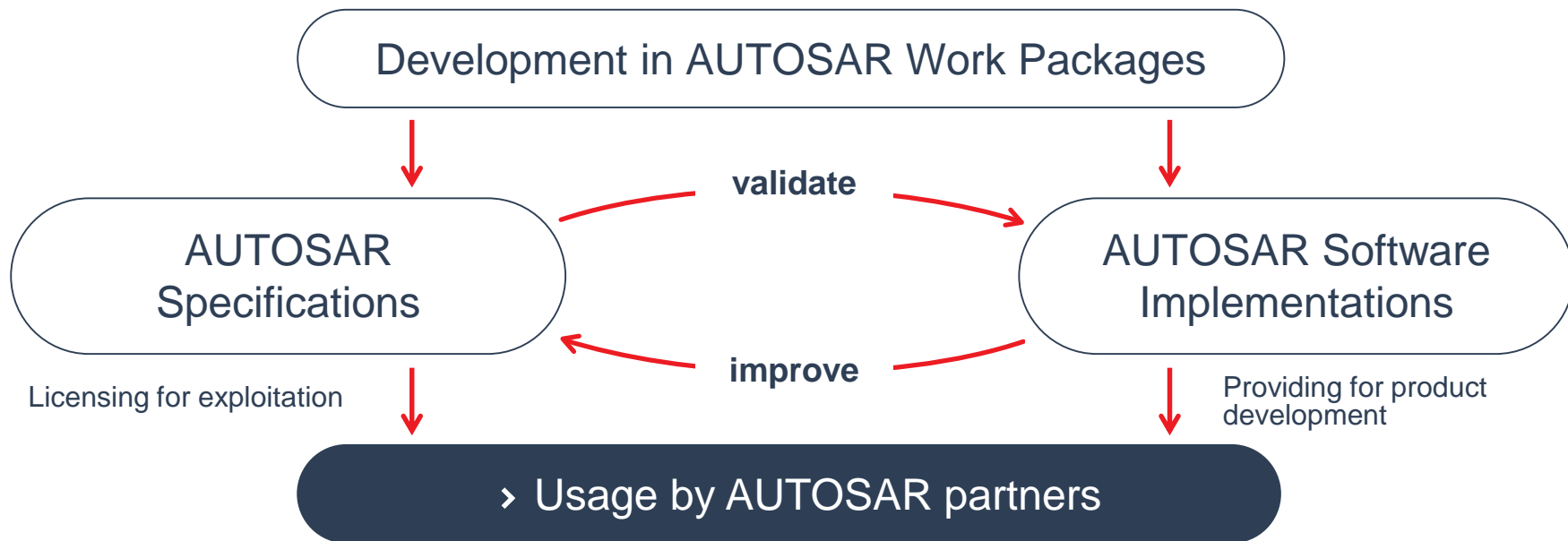# Key factors to make AUTOSAR Adaptive Platform a success

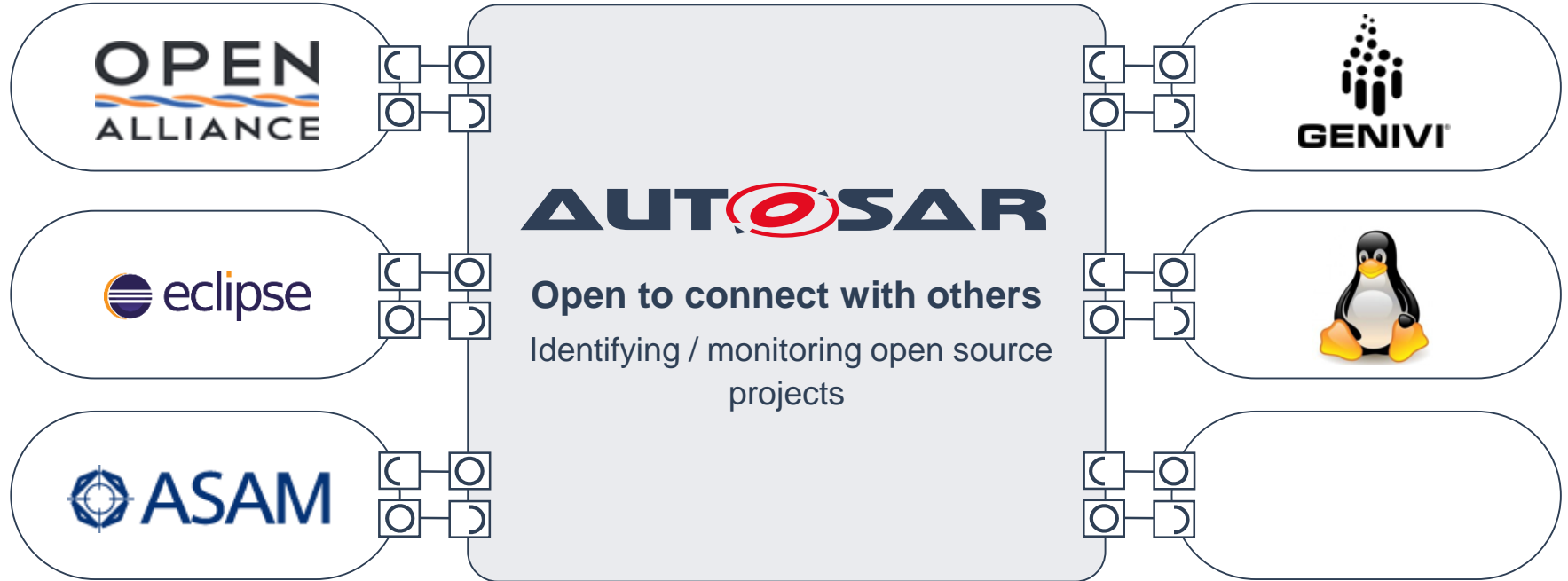

> Collaboration between other standardization bodies

> Joint development of specifications and exemplary software implementations

Joint development of AUTOSAR specifications and exemplary software implementations for the AUTOSAR Adaptive Platform

Development in AUTOSAR Work Packages

AUTOSAR Specifications

validate

AUTOSAR Software Implementations

improve

Licensing for exploitation

Providing for product development

> Usage by AUTOSAR partners

Cooperation with other standards

Open to connect with others

Identifying / monitoring open source projects
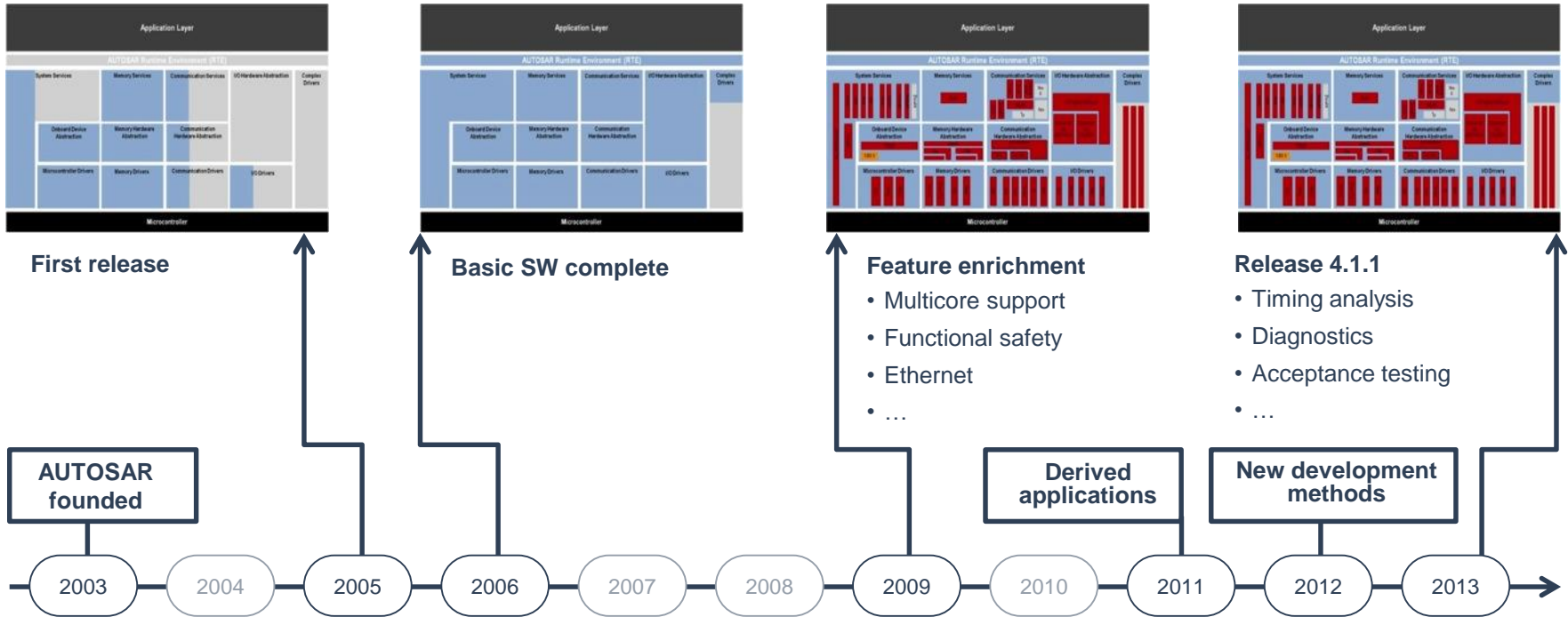
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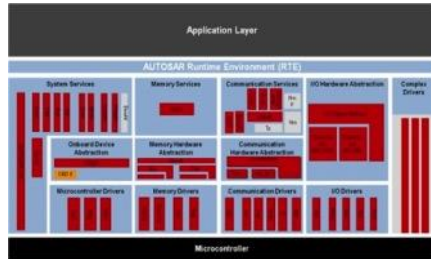
AUTOSAR

AUTOSAR Achievements and Outlook (1/2)
Milestones, just to name a few

First release

Basic SW complete

Feature enrichment
- Multicore support
- Functional safety
- Ethernet
- …

Release 4.1.1
- Timing analysis
- Diagnostics
- Acceptance testing
- …

AUTOSAR founded

Derived applications

New development methods

| 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |

© AUTOSAR

AUTOSAR Achievements and Outlook (2/2)
Milestones, just to name a few

Release 4.2.1

- Large data communication via Ethernet and CAN FD
- Integration of non-AUTOSAR systems
- …

10 years of AUTOSAR
6th OC Nov 13

Release 4.3.0

- Hardware Test Management on Startup and Shutdown
- Crypto Interface
- V2X Support
- Extended Buffer Access for Rapid Prototyping
- SOME/IP Transport Protocol Decentralized Configuration
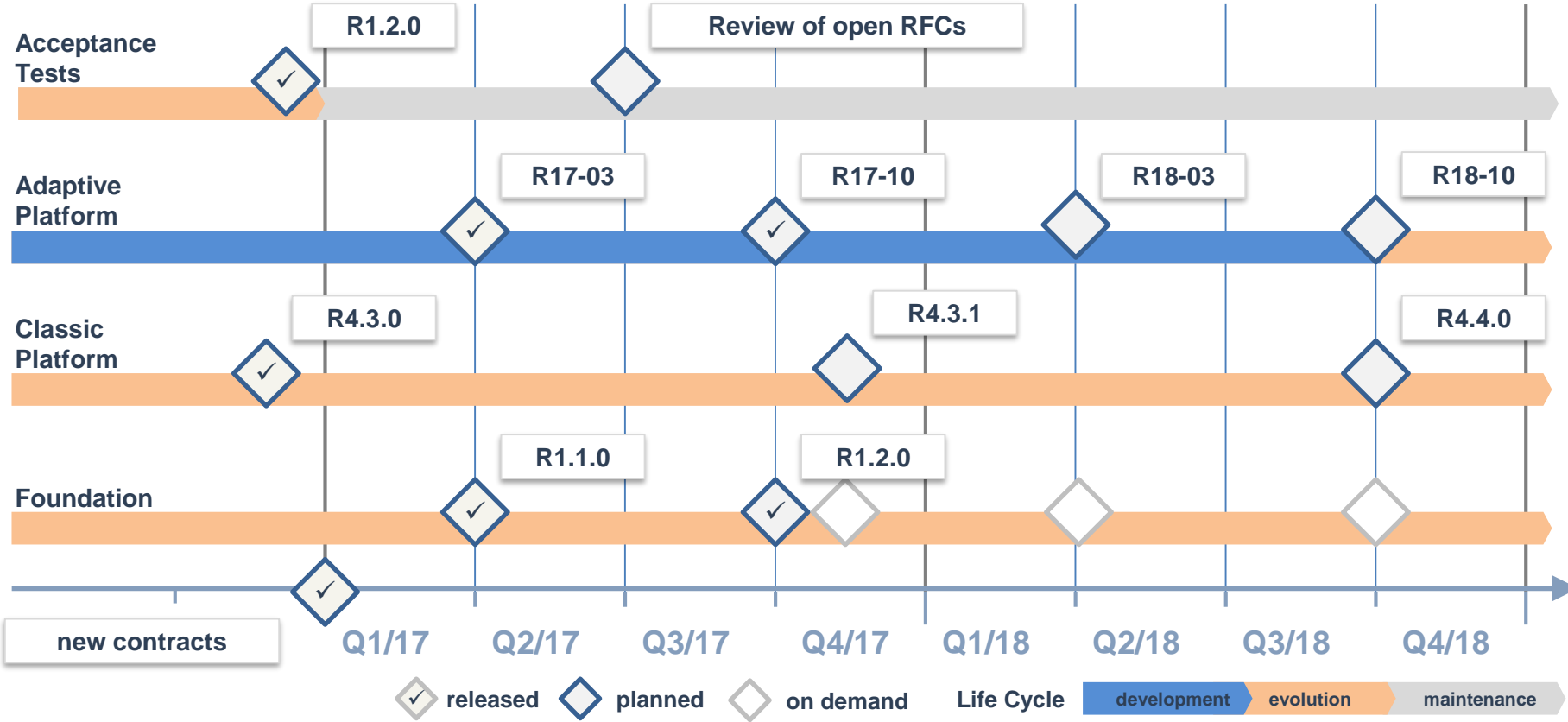
Release 4.3.1

- Quality
- Interface Module for Ethernet and IP testing
- Macro Encapsulation Of Library Calls
- Error Detection and Correction for Communication
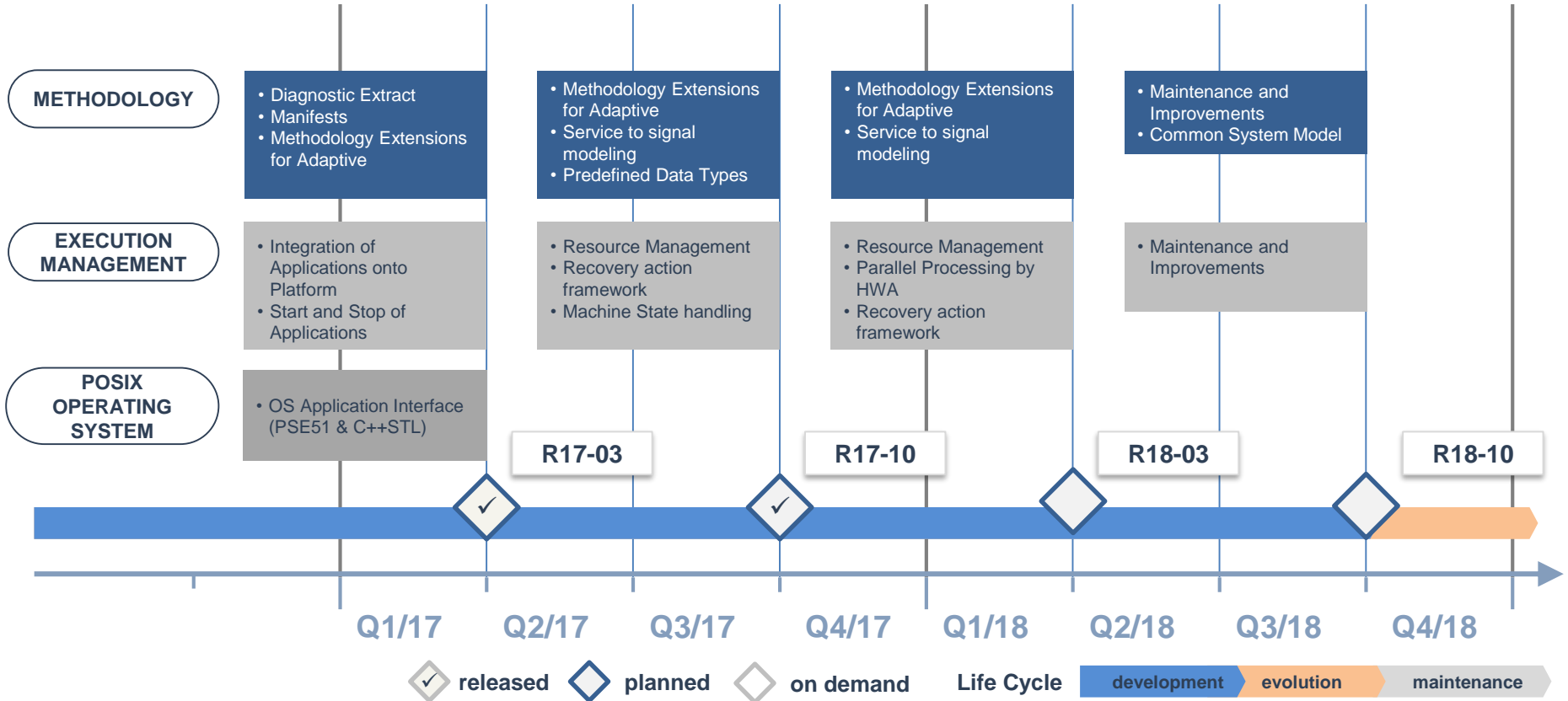
Release 4.4.

- Remote Event Communication Manager
- Harmonization of Physcial Units for ASW and BSW Based on ASAM
- Security Policy Manager Module
- AUTOSAR Real Time Interface
- RTE Implementation Plug-Ins
- LIN-Support for LIN slave
- Ethernet Wake on data line
- Formal Model Query and Blueprint Derivation Mechanisms
- Bus-Mirroring
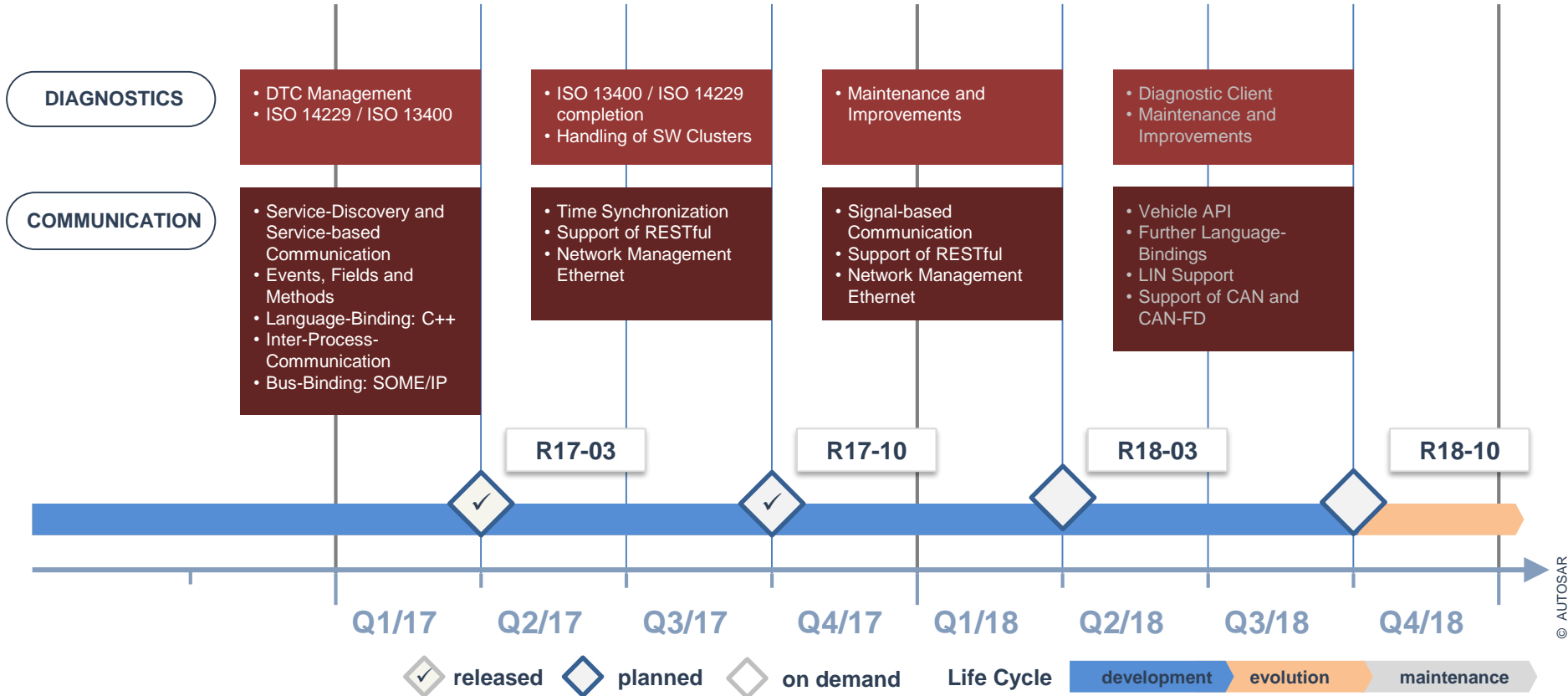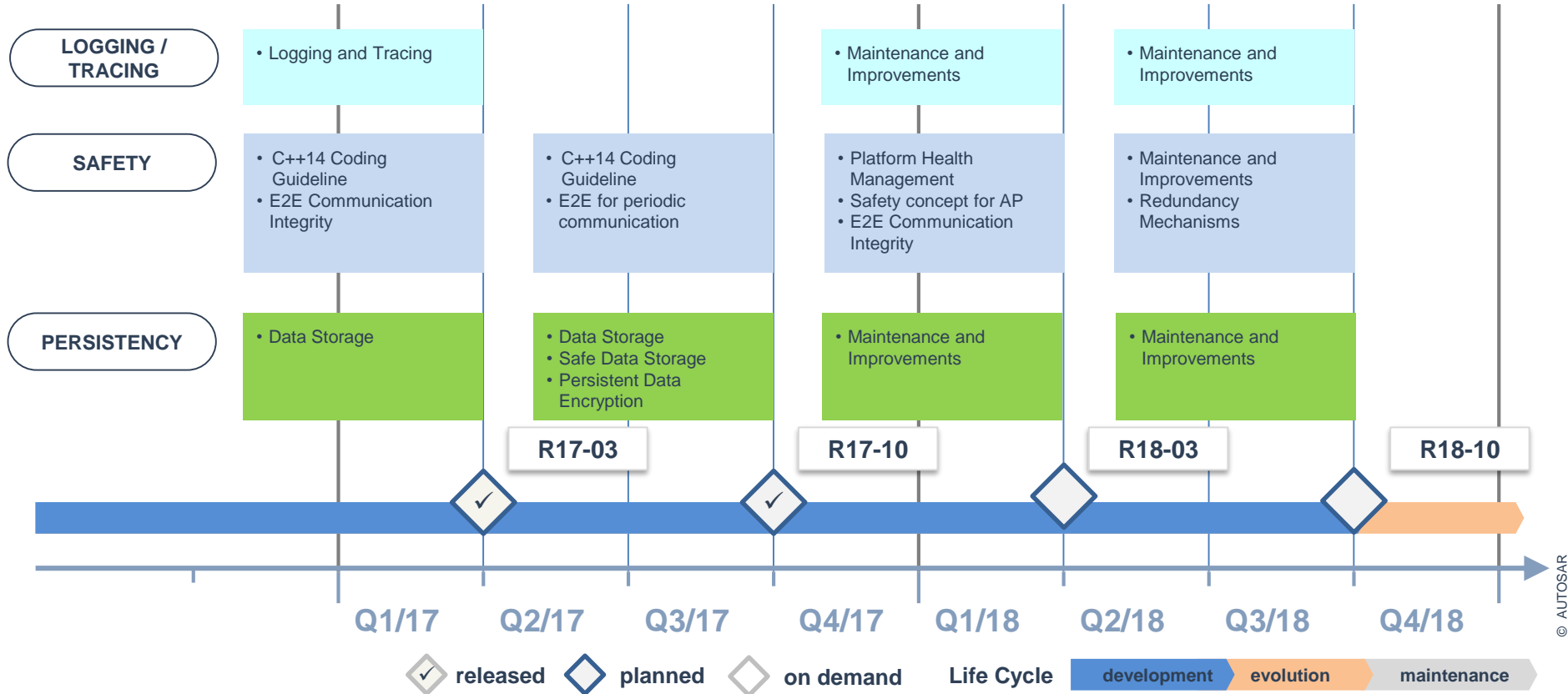- Extended Serialization for Data Structures in SOME/IP with tag/length/value encoding

2013 — 2014 — 2015 — 2016 — 2017 — 2018

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AUTOSAR Platform Roadmap

AUTOSAR Adaptive Platform Roadmap

METHODOLOGY	• Diagnostic Extract • Manifests • Methodology Extensions for Adaptive	• Methodology Extensions for Adaptive • Service to signal modeling • Predefined Data Types	• Methodology Extensions for Adaptive • Service to signal modeling	• Maintenance and Improvements • Common System Model
EXECUTION MANAGEMENT	• Integration of Applications onto Platform • Start and Stop of Applications	• Resource Management • Recovery action framework • Machine State handling	• Resource Management • Parallel Processing by HWA • Recovery action framework	• Maintenance and Improvements
POSIX OPERATING SYSTEM	• OS Application Interface (PSE51 & C++STL)			

R17-03 ✓ **R17-10** ✓ **R18-03** **R18-10**

Q1/17 Q2/17 Q3/17 Q4/17 Q1/18 Q2/18 Q3/18 Q4/18

✓ released   ◇ planned   ◇ on demand   Life Cycle | development | evolution | maintenance

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AUTOSAR Adaptive Platform Roadmap

DIAGNOSTICS	COMMUNICATION

DIAGNOSTICS

- DTC Management
- ISO 14229 / ISO 13400

- ISO 13400 / ISO 14229 completion
- Handling of SW Clusters

- Maintenance and Improvements

- Diagnostic Client
- Maintenance and Improvements

COMMUNICATION

- Service-Discovery and Service-based Communication
- Events, Fields and Methods
- Language-Binding: C++
- Inter-Process-Communication
- Bus-Binding: SOME/IP

- Time Synchronization
- Support of RESTful
- Network Management Ethernet

- Signal-based Communication
- Support of RESTful
- Network Management Ethernet

- Vehicle API
- Further Language-Bindings
- LIN Support
- Support of CAN and CAN-FD

R17-03 ✓
R17-10 ✓
R18-03
R18-10

Q1/17 Q2/17 Q3/17 Q4/17 Q1/18 Q2/18 Q3/18 Q4/18

✓ released   ◇ planned   ◇ on demand   Life Cycle development evolution maintenance

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AUTOSAR Adaptive Platform Roadmap

SECURITY

SOFTWARE CONFIG. MGNT

SECURITY

• Crypto API • Authentication & Certificates • Key Management • Secure Communication	• Crypto API • Authentication & Certificates • Key Management • Secure Communication • Support of trusted platform	• Crypto API • Authentication & Certificates • Key Management • Secure Communication • Support of trusted platform

SOFTWARE CONFIG. MGNT

• Package Management • Installation routine	• Container Support? • Package Download over the air • Package Management • Installation routine • Diagnostic Client

R17-03 ✓

R17-10 ✓

R18-03

R18-10

Q1/17	Q2/17	Q3/17	Q4/17	Q1/18	Q2/18	Q3/18	Q4/18

✓ released   ◇ planned   ◇ on demand   Life Cycle development evolution maintenance

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Field of Applications

Automotive applications

Use-cases related to engine powered, land-based, non-railed vehicles, such vehicles intended for primary transportation purposes.

Original target

Derived application

Use-cases that are neither an Automotive Application nor in a field of use of products or service that falls into the categories of ultra-hazardous activities.

Extended

Ultra-hazardous activities

Aerospace and aviation, nuclear power, chemical and/ or biological reactors, petrochemical, or military (except for military marine transportation vessels).

Excluded

How do we do that?
Evolution of AUTOSAR's Organizational Structure

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Work Group Structure

Legend:
- Lead Work Package
- Work Package
- Feature Team

Project Leader Team

WP-A
Software architecture

- **WP-A-LIB** Libraries
- **WP-A-MCBD** Multicore BSW Distr.
- **WP-A1** VFB and RTE
- **WP-A2** COM Stack
- **WP-A4** Diagnostics
- **WP-A5** MCAL

WP-M
Methodology and Templates

- **WP-M-METH** Methodology
- **WP-M-GST** Generic Structure Template
- **WP-M-SWCT** Software Component Template
- **WP-M-SYST** System Template ECU Configuration
- **WP-M-TIMEX** Timing Extensions
- **WP-M1** Timing Analysis

WP-I
Application Interface

- **WP-I-BODY** Body and Comfort
- **WP-I-ENGINE** Powertrain Engine
- **WP-I-TRSM** Powertrain Transmission
- **WP-I-CHASSIS** Chassis Control
- **WP-I-OCSAFE** Occupant and Pedestrian Safety

Feature Teams (column 1)
- **FT-CM** Communication Mgmt.
- **FT-EMO** Execution Mgmt.
- **FT-DIAG** Adaptive Diagnostics
- **FT-MM** Methodology & Manifests
- **FT-PER** Persistency
- **FT-UCM** Update & Conf Management

Feature Teams (column 2)
- **FT-SAF** Safety
- **FT-SEC** Security
- **FT-DI** Demonstrator Integration
- **FT-ST** System Tests
- **FT-ADI** Automated Driving Interfaces

Cross-standard concerns
- **WP-X-SEC** Security
- **WP-X-SAF** Functional Safety
- **WP-X-VAL** Validation

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User Group Structure

```
                        ┌─────────────────┐
                        │   User Groups   │
                        └─────────────────┘
```

UG-IN	UG-CN	UG-NA	UG-IE
India	China	North America	Improved Exploitation

- Interoperability of exchange artifacts

- Demonstrator development
- System design with 3 AUTOSAR ECUs
- BSW integration, documentation and project closure planned for E2016

- Common Training: OEM-Tier1 Workflows/ Security
- Safety
- Ethernet

- 6 thesis on optimizing the use of AUTOSAR
- Establishment of Adaptive Platform

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Further information on AUTOSAR

For more information on AUTOSAR:

- Working results
- User Experiences
- Exploitation

You are welcome to have a look at AUTOSAR's publications available at the AUTOSAR website www.autosar.org.

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11th AUTOSAR

Open Conference and Networking Reception

Networking Reception		Conference
Tuesday, **November 6th, 2018** 7:00 pm – 10:00 pm	**+**	Wednesday, **November 7th, 2018** All-day

Venue:
The Portman Ritz-Carlton Shanghai
1376 Nanjing Xi Lu, Shanghai 2000-40, China

Further information:
https://www.autosar.org/news-events/

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