AUTOSAR Adaptive Software Framework for NXP's S32 Platform

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Solution Manager – Car infrastructure Automotive Software

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SECURE CONNECTIONS FOR A SMARTER WORLD

Agenda

- Introduction to Adaptive AUTOSAR
- NXP's Approach to AUTOSAR Adaptive Platform
- Elektobit's Adaptive AUTOSAR Solution for NXP Platform
- Q&A

Vehicle Architectures

Safe and Secure Mobility the semi value per car – today's standard car at $380

Autonomy

- Different sensor types
- Data fusion:
  - Safe Processing with
  - Integrated AI capabilities
- Fail operation
- Big Data

Electrification

- Power Efficiency
- Battery Management
- Electrification Levels
  Hybrid, full electric…
- Broad range of solution
- Need for standardization

Connectivity

- V2X, 5G, Digital Radio
- Prognostic Health Management
- OTA Update Management
- Analytics (edge to cloud)
- Software-centric solutions
- System security

Major Changes in Network Topology and E2E Architectures

Mega Trends Force Vehicle Architecture Transformation

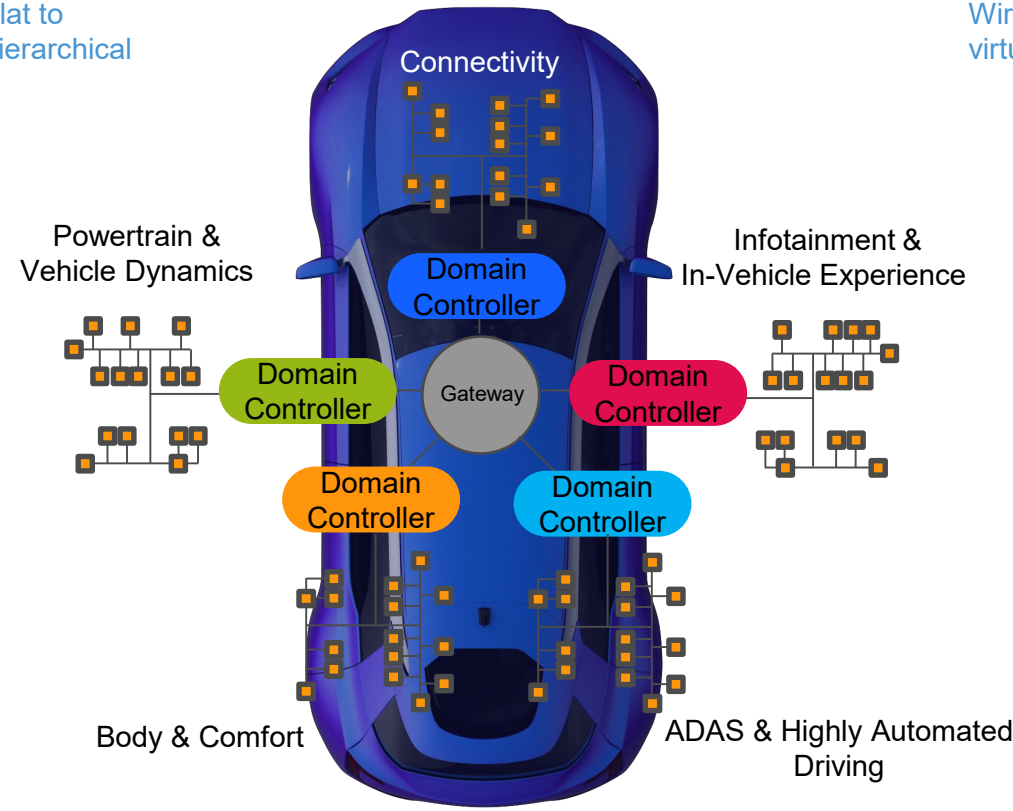
Today: Flat

Low bandwidth, flat network
One MCU per application

Unfit for future mobility

Flat to hierarchical

Tomorrow: Domains

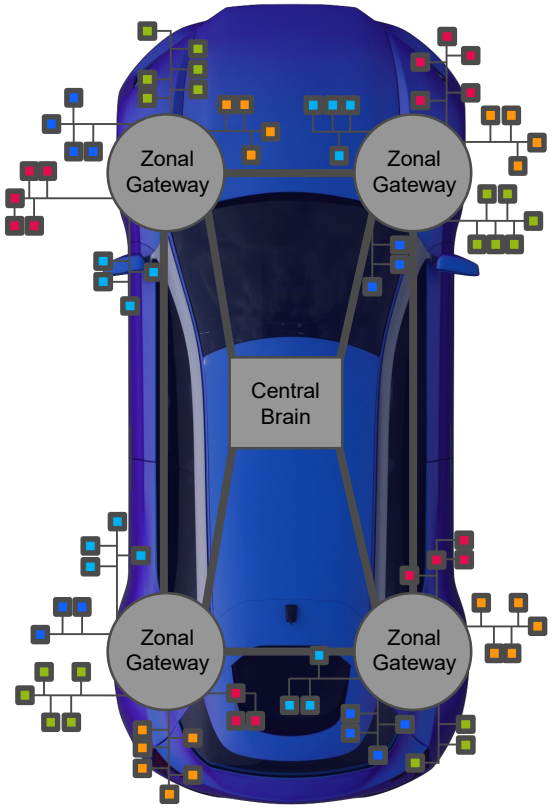


High bandwidth network
Gateway key to communication between domains

Step to autonomous car

Wires go virtual

After Tomorrow: Zones



Domains virtualized by SW – enabling high flexibility
Easy enable/disable or update functions

Step to user-defined car

Vehicle Architectures

Mega Trends: Embedded Software become Software semi value per car – today's standard car at $380

Technology Trends

Autonomy

Electrification

Connectivity

E/E Implication

- ECU Platform
- Topology
- Communication

- OSEK/VDX
- Signal Comm
- Static configuration

- Rich Operating Systems (e.g. Linux)
- Service Oriented Architecture
- Dynamic configuration

Adaptive Platform

AUTOSAR

NXP

AUTOSAR Adaptive – Motivation

Another Platform for Different Applications

Real time requirements

Safety criticality

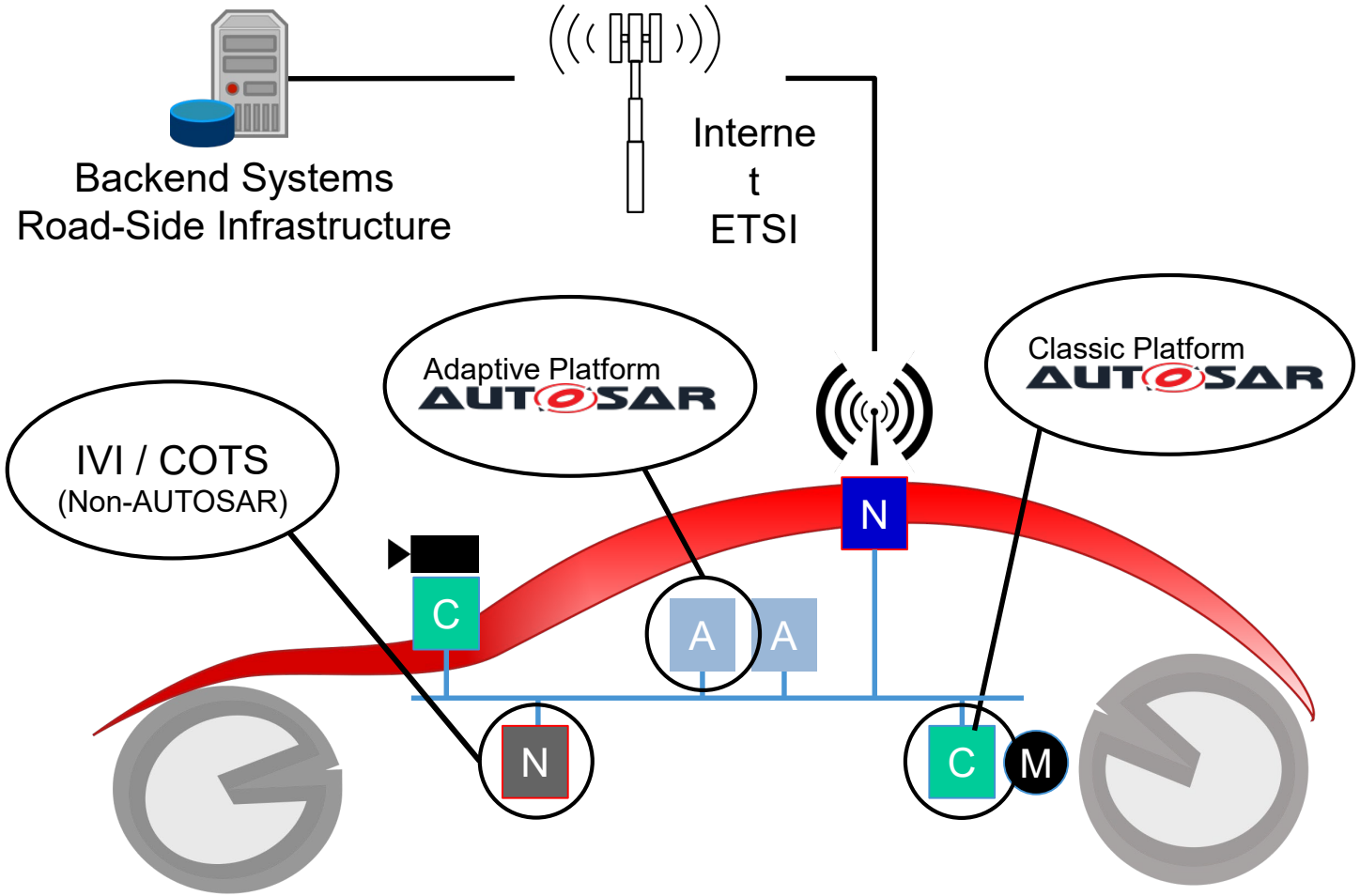
Computing power

Real time Requirements	High, in the range of micro-sec	Mid, in the range of milli-sec	Low, in the range of sec
Safety Criticality	High, up to ASIL-D	High, at least ASIL-B	Low, QM
Computing power	Low, ~ 1000 DMIPs	High, > 20.000 DMIPs	High, ~ 10.000 DMIPs

Source: AUTOSAR
AUTOSAR_EXP_PlatformDesign

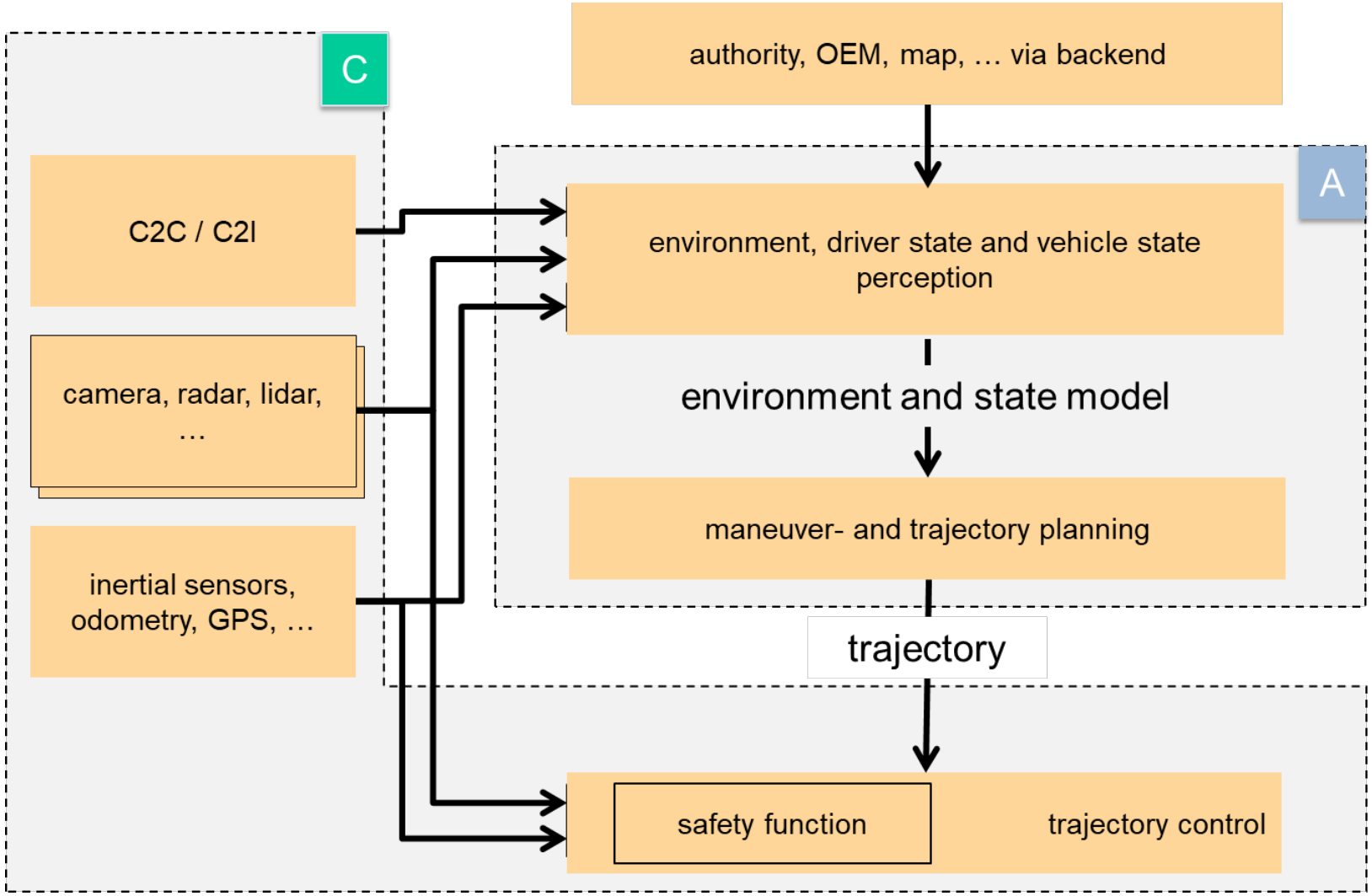
Adaptive Platform – Comprehensive System Design

Integration of Classic-, Adaptive- and Non-AUTOSAR ECUs



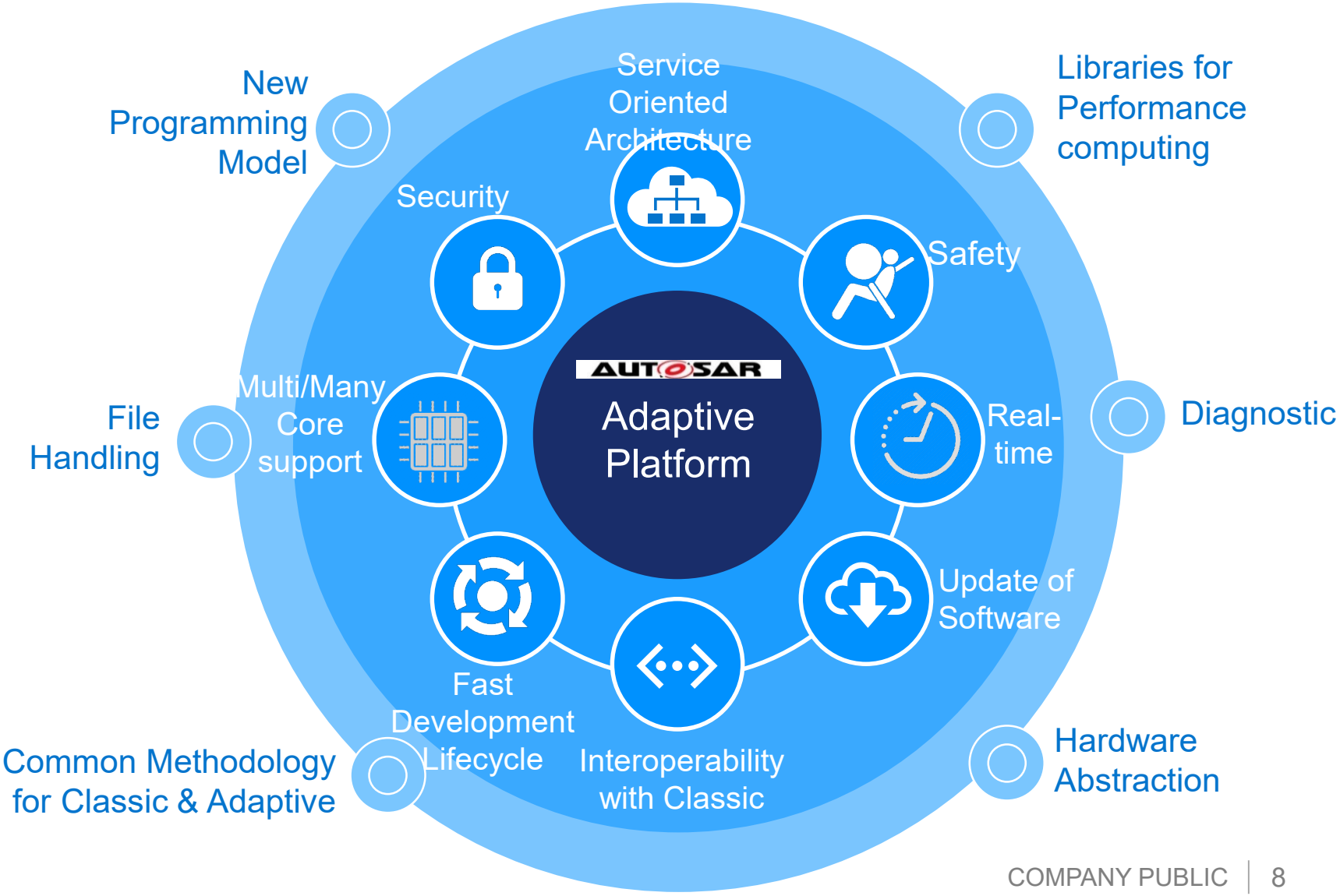
Source: AUTOSAR
AUTOSAR_AdaptivePlatformFor_EXP_TechnicalOverview

Adaptive Platform – Architecture Logical View



Source: AUTOSAR
AUTOSAR_EXP_PlatformDesign

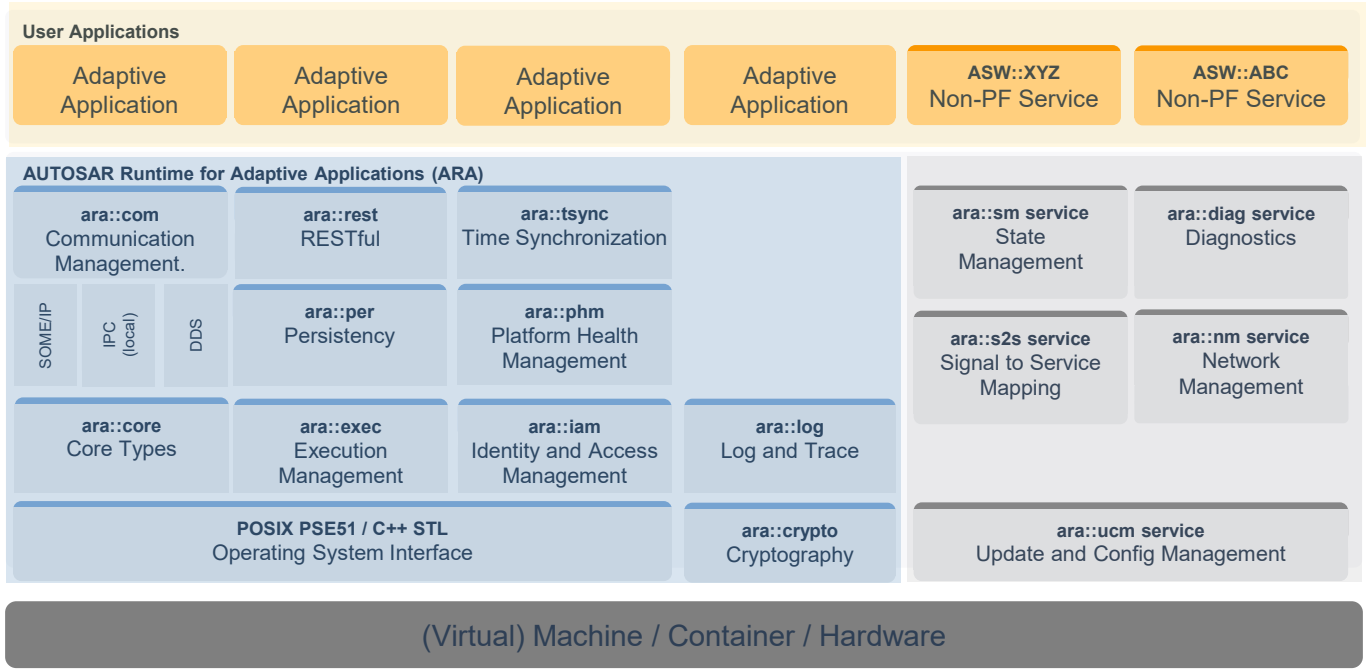
Adaptive Platform – Main Requirements

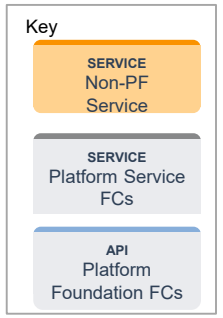


Adaptive Platform – Functional Clusters

AP Foundation

- Fundamental functionalities for AP
- Locally used by one AP instance
- Comparable BSW to CP





Application

- AAs run on top of ARA
- PSE51 API restricted

AP Services

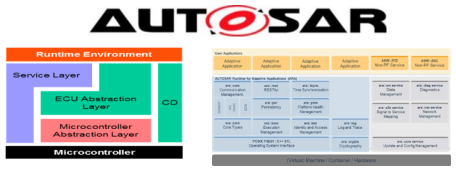
- Standard services of AP
- Locally and/or remotely accessible by different AP instances

AUTOSAR Runtime for Adaptive Applications = Σ of all Functional Cluster APIs / Services

API or Service Interface of a Functional Cluster.
- Programming language specific API for a Functional Cluster as specified in SWS
- The first programming language supported by the Adaptive Platform will be C++

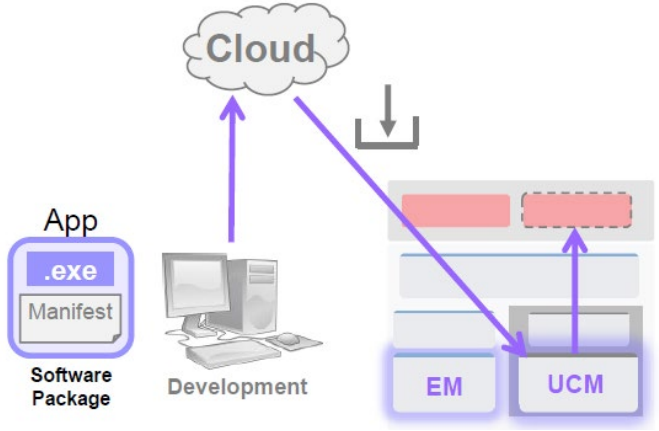
Source: AUTOSAR
AUTOSAR_EXP_PlatformDesign

Adaptive Platform – Key Aspects

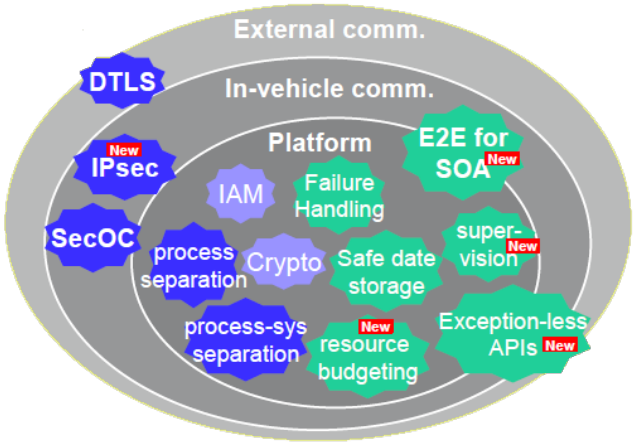


Connected

Dynamic & Updatable



Safe & Secure



Source: AUTOSAR , Alan Belferrag
Adaptive AUTOSAR presentation at 11th AUTOSAR Open Conference

Adaptive Platform – Strategy

Specifications

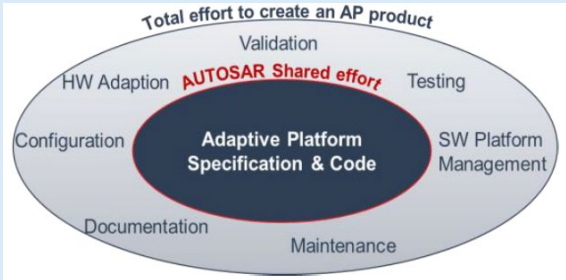
Identify needs & use-cases

Concepts, Features, Requirements

Reference Code

Specification validation

Training/dissemination of AP



Attracting environment for coders

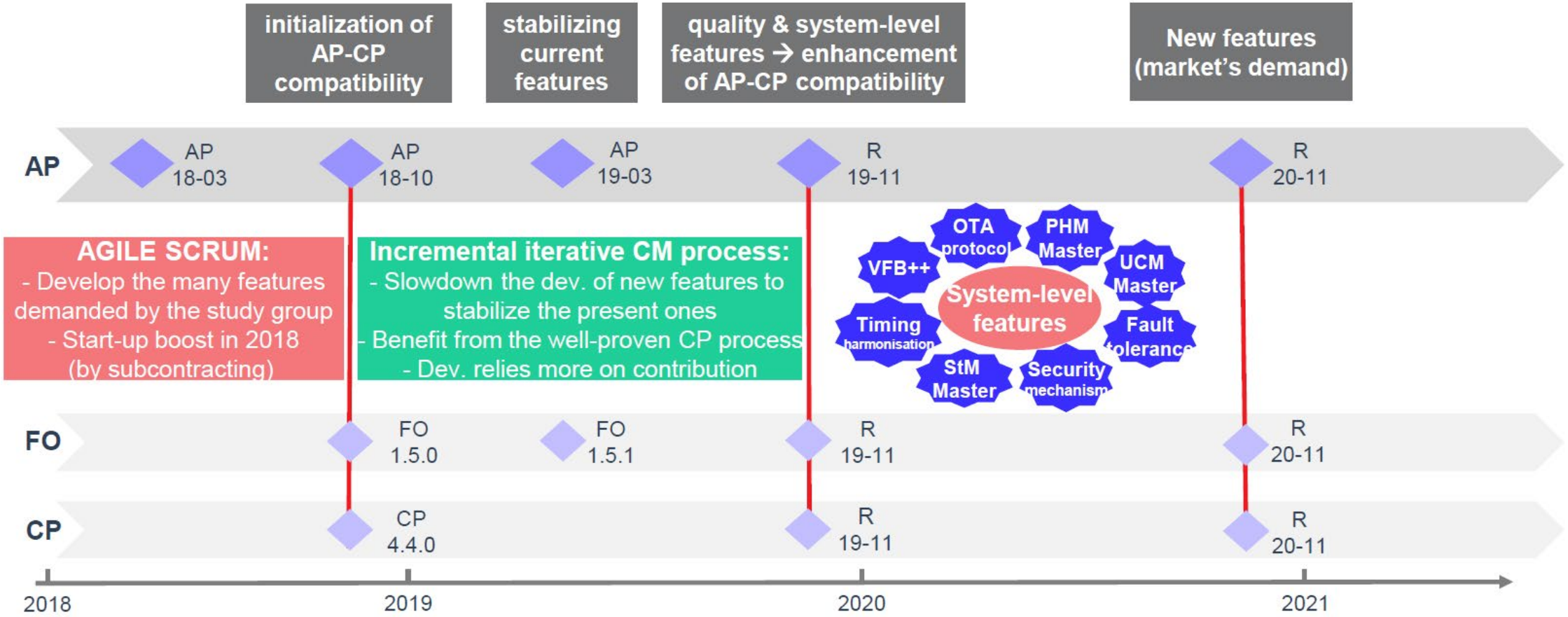
Platform Demonstrator

Highlights specific features

Prove interoperability

Showcase

Adaptive Platform – Roadmap



Source: AUTOSAR , Alan Belferrag
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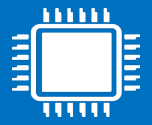
NXP's Approach to AUTOSAR Adaptive Platform

Auto Processors Tomorrow – Domain Architecture Requirements



Performance

Optimized for domain control

Real-time

Scalable

Arm

Arm top to bottom

Arm Cortex-A, -R, and -M cores

Safe

ASIL D

Secure

Powerful hardware security engine (HSE)

Firmware upgradable public key encryption

No side channel attacks

OTA

Across most nodes

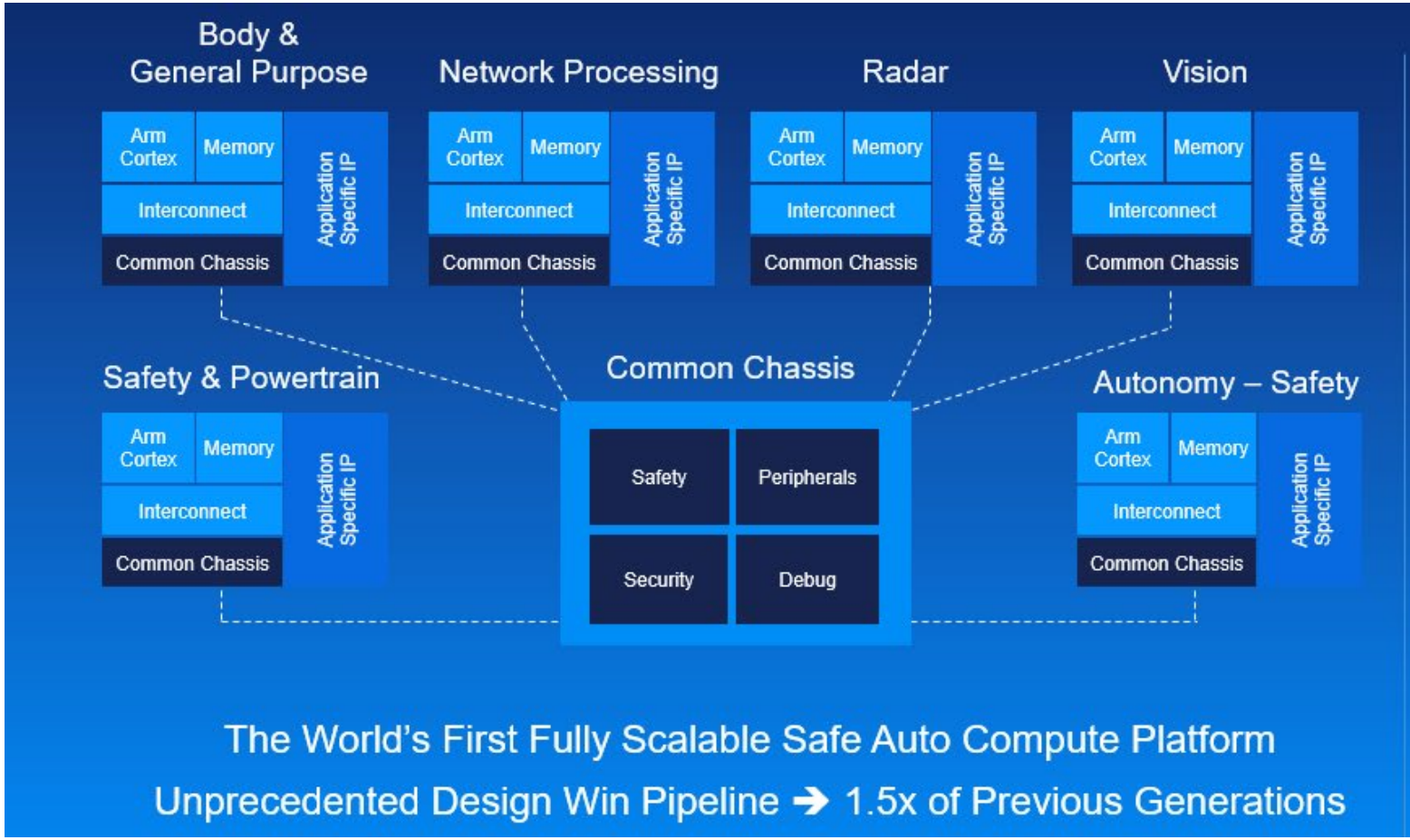
Scalable encrypted external NVM

Wide memory range, read while write

SW Reuse

Massive software Re-use within and across application domains

Auto Processors Tomorrow – NXP's Unique S32 Platform



Reduces SW R&D[1] by 35%

Unified HW with identical SW environment

10x the Performance[2]

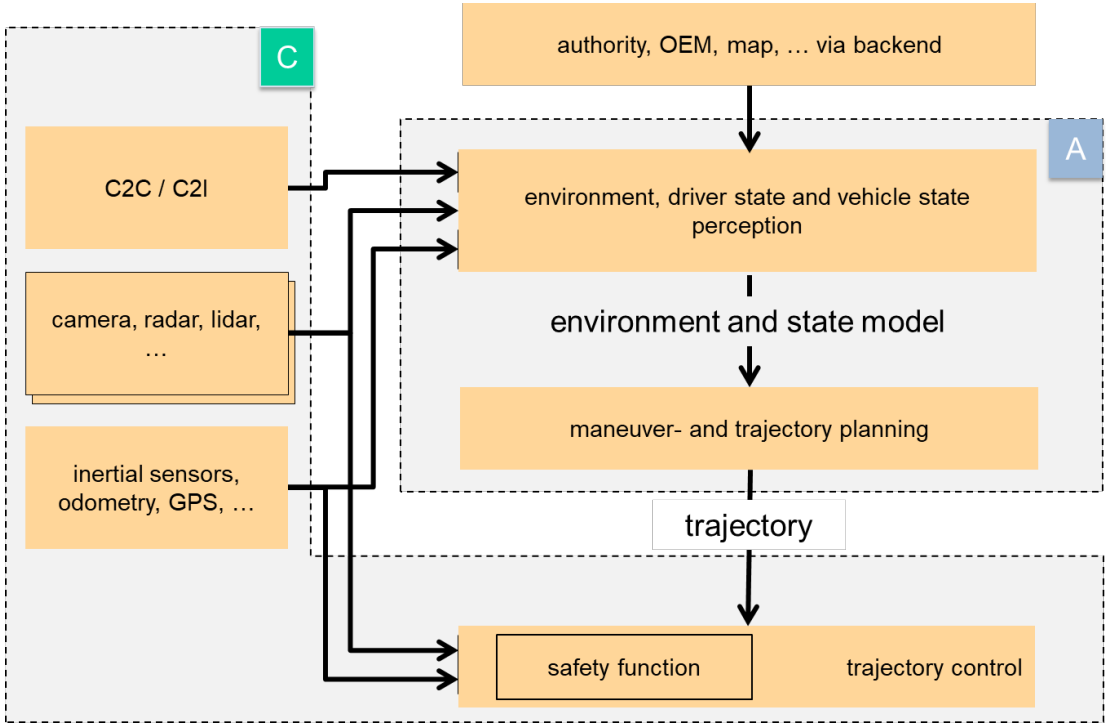
Multiple real time OS
ADAS AI accelerators

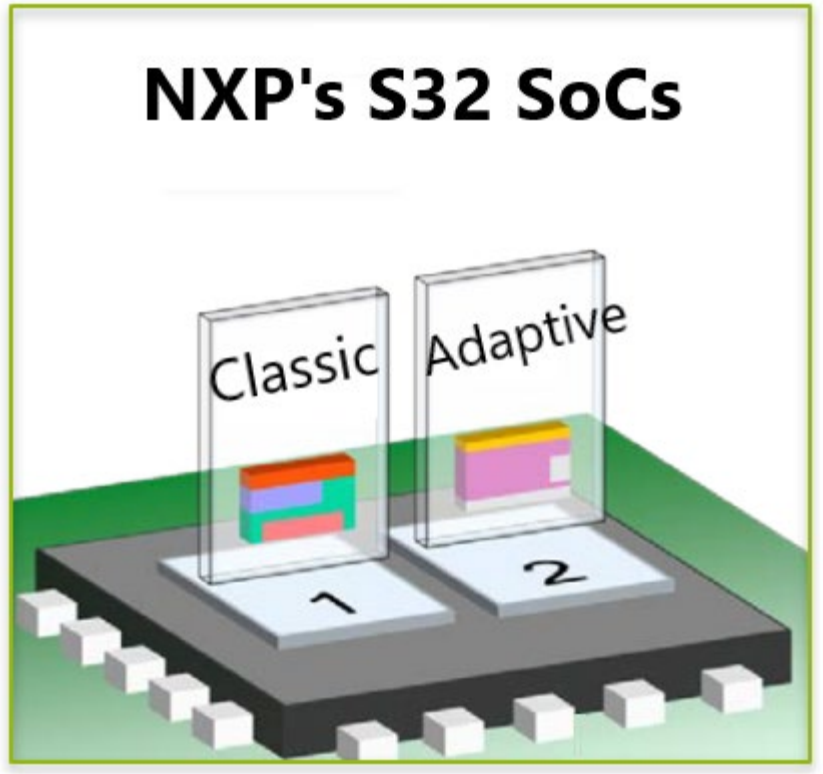
Safe and Secure

4 independent ASIL D paths
HW security engine
Ready for OTA

1. Based on analysis of existing NXP Software code in existing customers' applications
2. Based on publicly available competitor roadmap performance statements versus today's best safe auto platform

Auto Processors Tomorrow – NXP's Unique S32 Platform

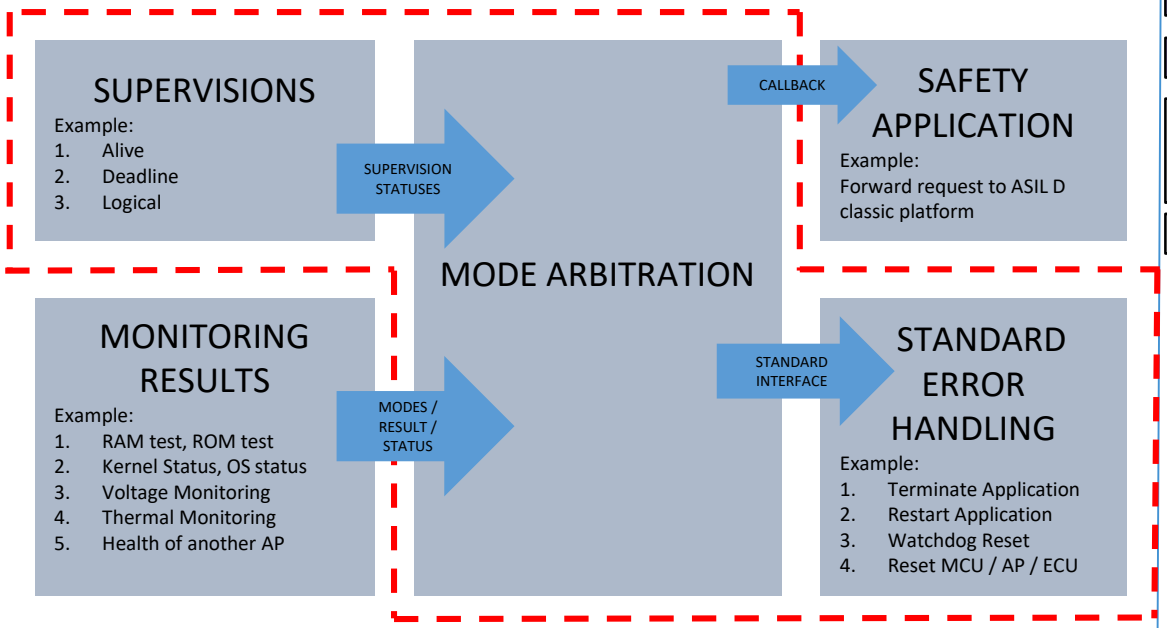




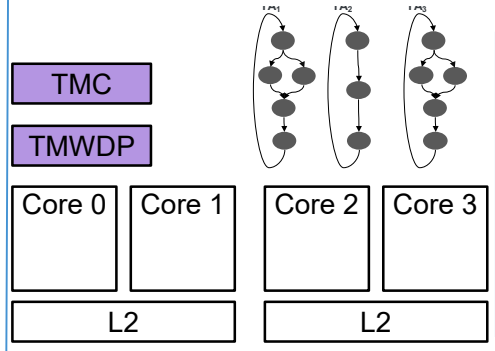
NXP's S32 – Scalable Safe Auto Compute Platform

Auto Processors Tomorrow – NXP's Unique S32 Platform

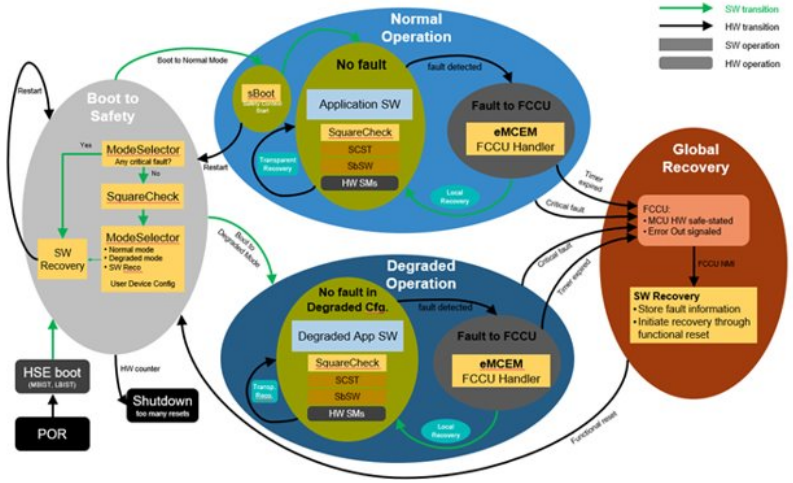
AUTOSAR Adaptive – Platform Health Monitoring



S32 Safety (by Software) Concept



- Enable ASIL B/D by application monitoring
- Detects loss of integrity and data error caused by SW & HW faults
- Time Monitored Comparator (TMC)
  - Detects data and timing errors
- Timed Multi-Watchdog Processor (TMWDP)
  - Operational logical flow errors

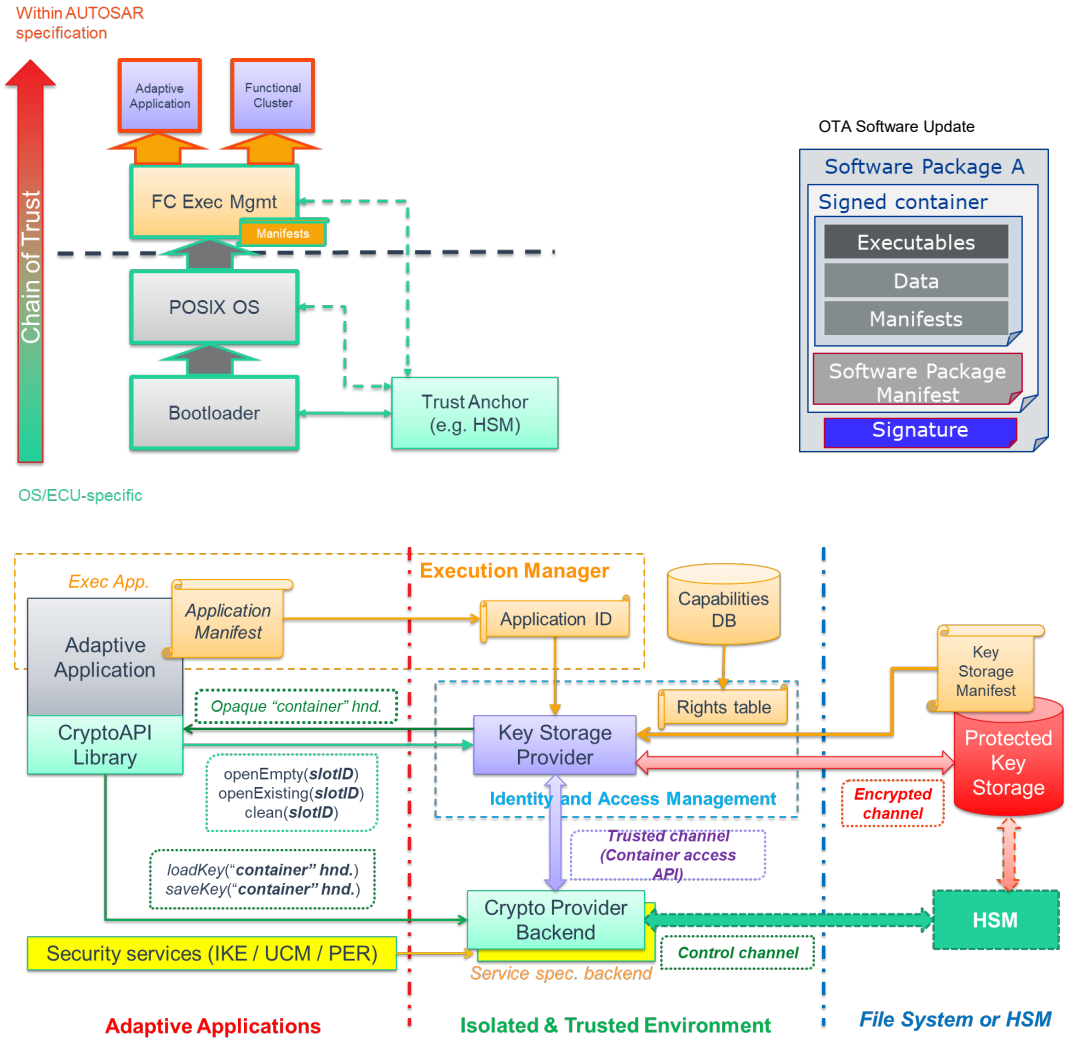


Safety by Software (SbSW) concept: https://community.nxp.com/docs/DOC-343700

NXP's Safety Concept with the patented Safety by Software (SbSW) method, for performance cores, to efficiently enable the AUTOSAR Classic and Adaptive Platform Heath Monitoring & Safety.

Auto Processors Tomorrow – NXP's Unique S32 Platform

AUTOSAR Adaptive - Trusted Platform and the Security Stack



S32 HSE – More than a Cryptographic Engine

Accelerates

Cryptographic operations

Offloads

the app with a dedicated intelligence

Establishes Trust

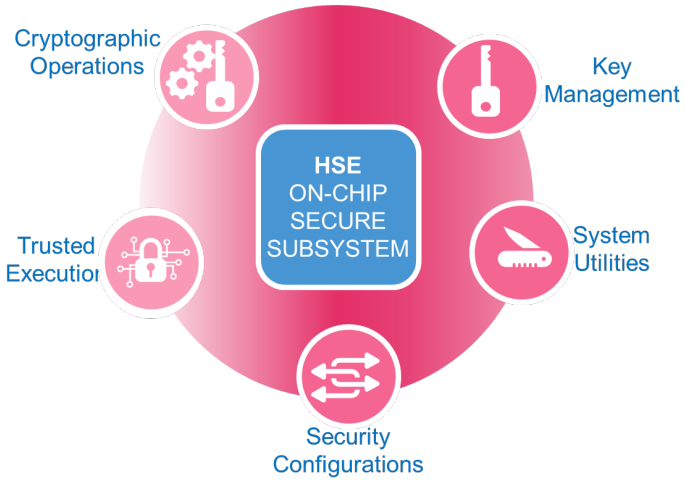
Secure Boot + Root of Trust

Controls

The platform

Easily Integrates

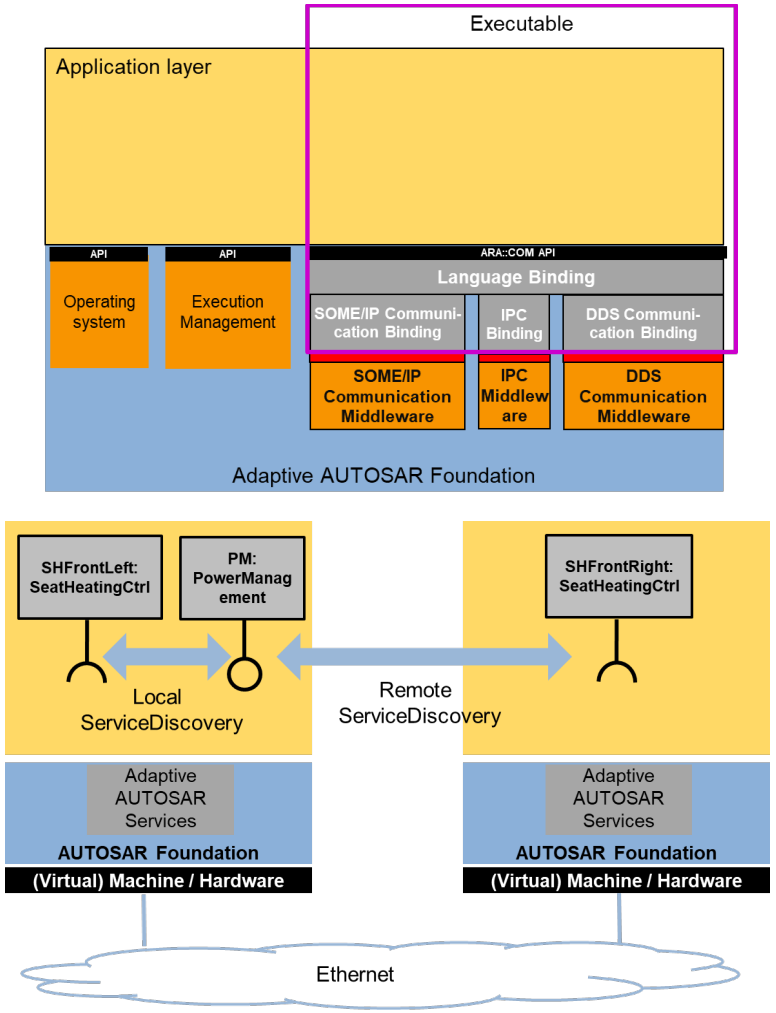
In your design



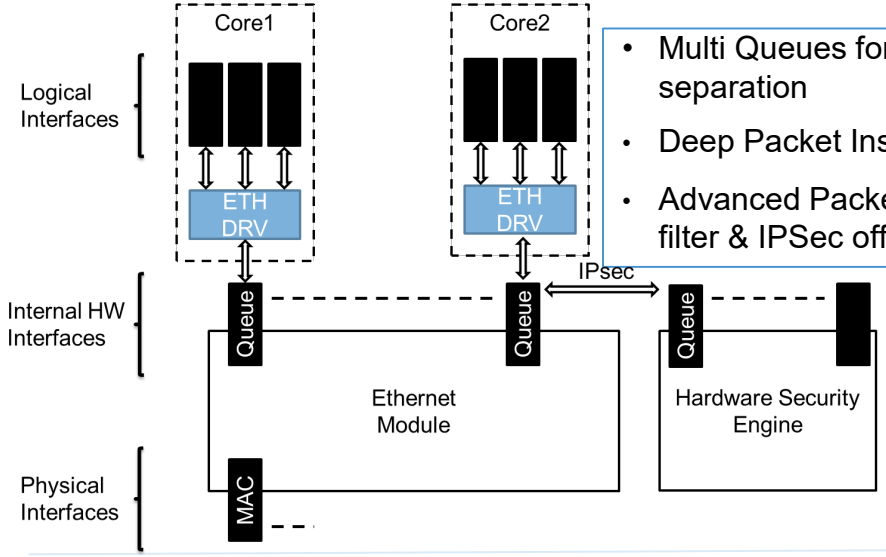
S32 Security Solution: https://community.nxp.com/docs/DOC-343679

Auto Processors Tomorrow – NXP's Unique S32 Platform

AUTOSAR Adaptive – Service Oriented Communication

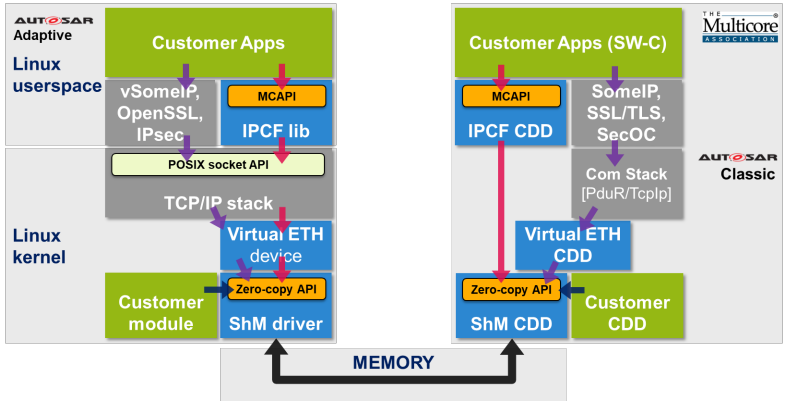


S32 Ethernet Module & IPCF solution



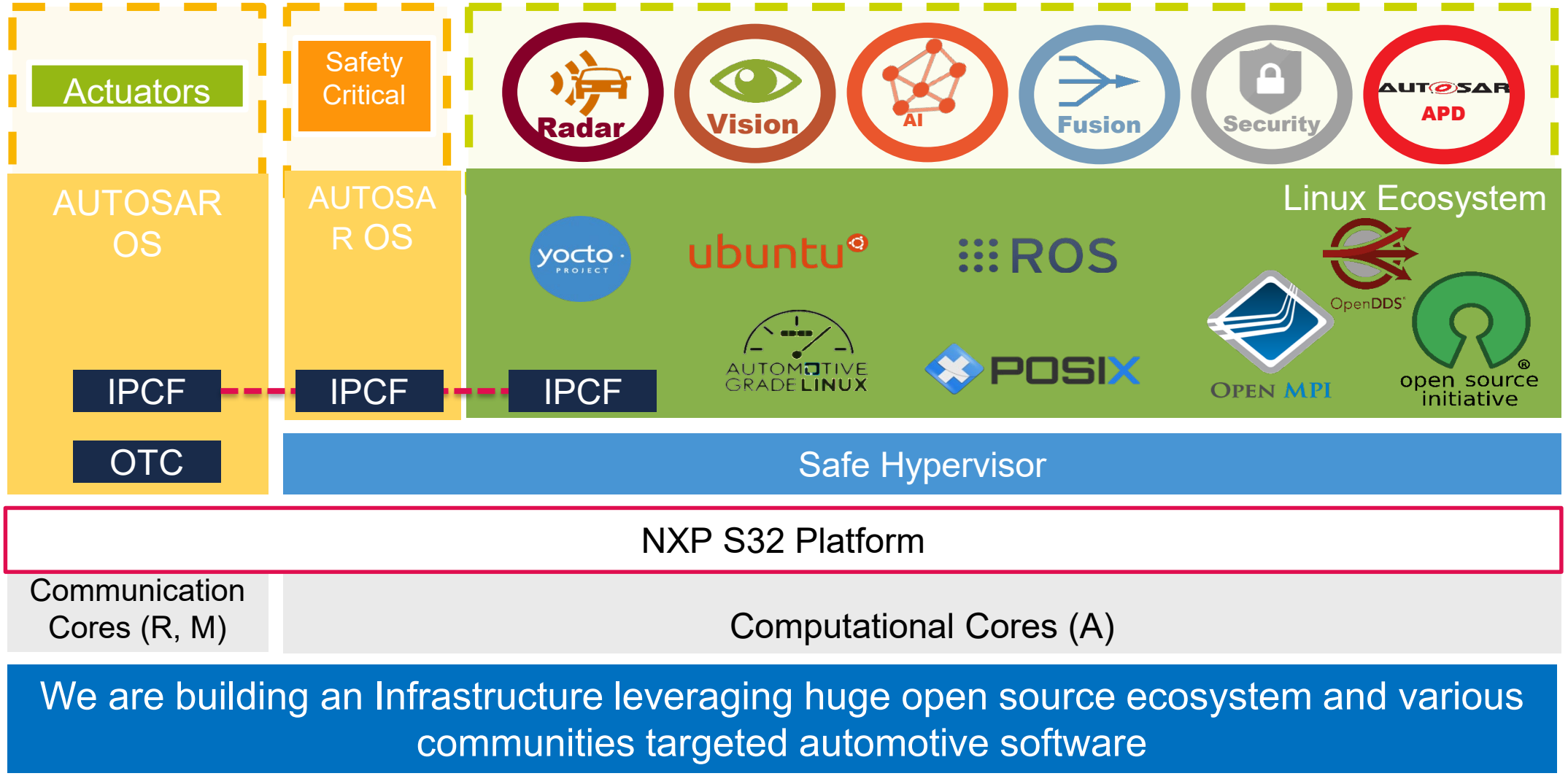
- Multi Queues for Multi-Core or VMs separation
- Deep Packet Inspection (e.g. IDPS)
- Advanced Packet Filtering (e.g.SOME/IP filter & IPSec offload)

- Performance (zero-copy)
- Freedom from interference (ASIL-D)
- MCAPI over Shared Memory (SHM)
- Virtual Eth over SHM and PCIe
- OS/HW agnostic



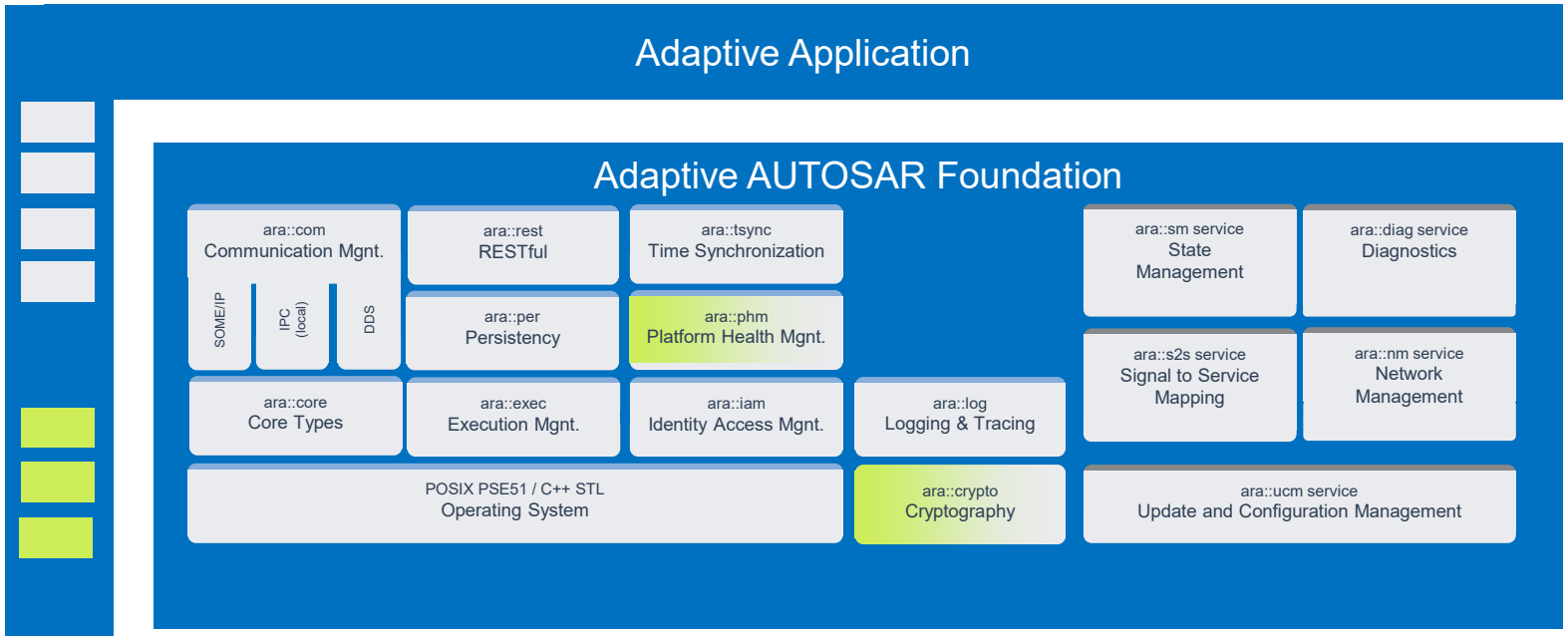
S32 IPCF: https://community.nxp.com/docs/DOC-334836
S32 SoA: https://community.nxp.com/docs/DOC-343674

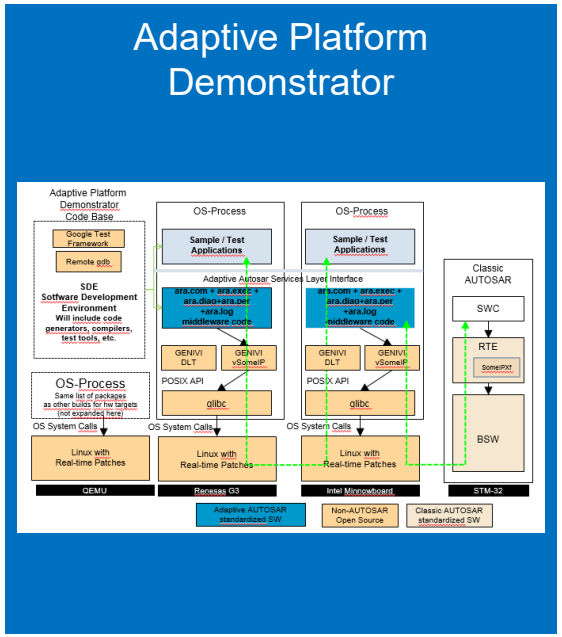
Software Infrastructure for AUTOSAR Adaptive Platform



Software Infrastructure for AUTOSAR Adaptive Platform

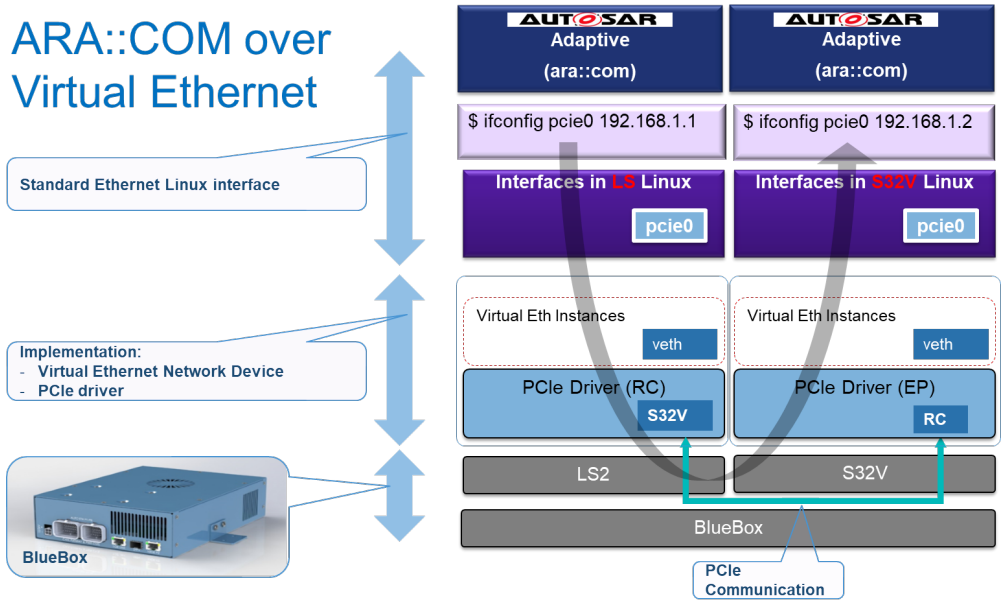
Adaptive AUTOSAR ready to use/build ecosystem





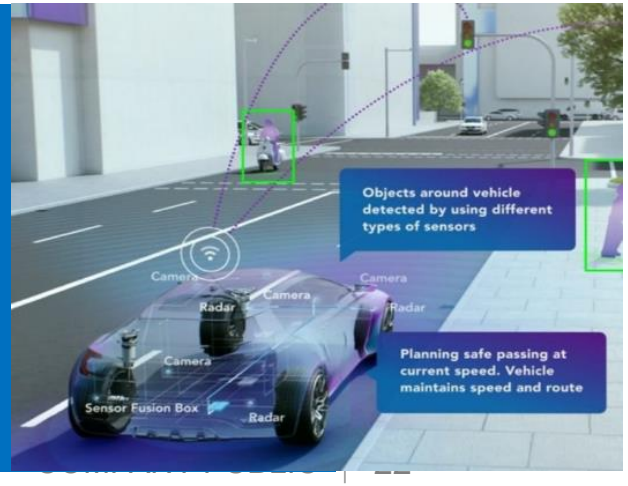
NXP Bluebox: Central Processing Unit For Autonomous Driving

- Highly Optimized Safe Central Compute
  - Various sensor data streams: Radar, Vision, LiDAR, V2X
  - S32V234 automotive vision and sensor fusion processor
  - LS2084A embedded compute processor
  - S32R27 radar microcontroller
- Ease of Development
  - ROS Space
  - Open ROS Space Linux®-based system
  - Programmable in linear C
  - Easily customizable
  - Development environment for mainstream vehicles
  - AUTOSAR Adaptive Ready
- Security
  - CSE and ARM® TrustZone ® technology
- High Performance per Power
  - Up to 90,000 DMIPS at < 40 W
  - Complete situational assessment
  - Supporting classification
  - Object detection and localization
  - Mapping
- Decision Making
  - Global Path Planning
  - Behavior Planning
  - Motion Planning

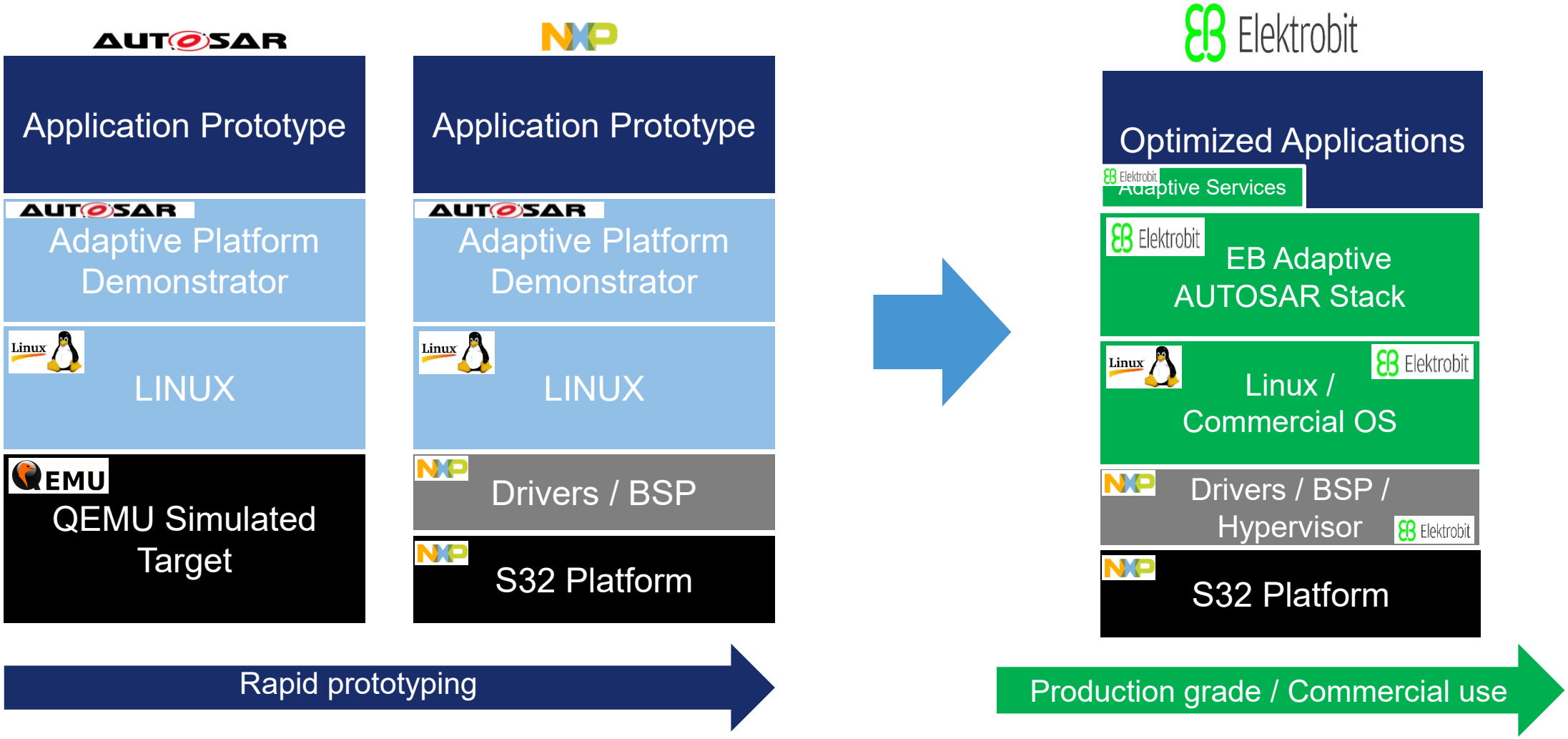


NXP Automated Drive Kit

- Computing: NXP BlueBox 2.0
- Vision: Front Camera Software with MIPI CSI2 Camera
- LiDAR: Selection of Lidars supported
- RADAR
- Inertial Measurement Unit & Integrated GPS
- Operating System
- Middleware: ROS (Robot Operating System)



Software Infrastructure for AUTOSAR Adaptive Platform



Elektrobit's Adaptive AUTOSAR Solution for NXP's Platforms

Placeholder for Elektrobit Presentation

- (TBC if it will be incorporated or need to stay separately)

Q&A

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FOR A SMARTER WORLD