Gregor Nitsche

- Senior researcher at German Aerospace Center (DLR)
  (Deutsches Zentrum für Luft- und Raumfahrt e.V)
- Team-Lead of the Monitoring and Diagnosis Team
  at Institute of Systems Engineering for Future Mobility

- Research topics:
  - formal specification, verification, and runtime validation
  - extra-functional (performance) properties
  - development and integration of runtime monitors
  - embedded and distributed microelectronic and embedded systems
  - SDV-Architectures (Mixed-critical HW/SW systems)

- UP2DATE4SDV Project-Coordinator (HORIZON-RIA / CINEA)

UP2DATE4SDV: Enabling safe & secure modular UPdates, UPgrades and DynAmic Task reallocation and Execution for Software-Defined Vehicles

https://linkedin.com/company/up2date4sdv

Gregor Nitsche (DLR), 26.01.2026

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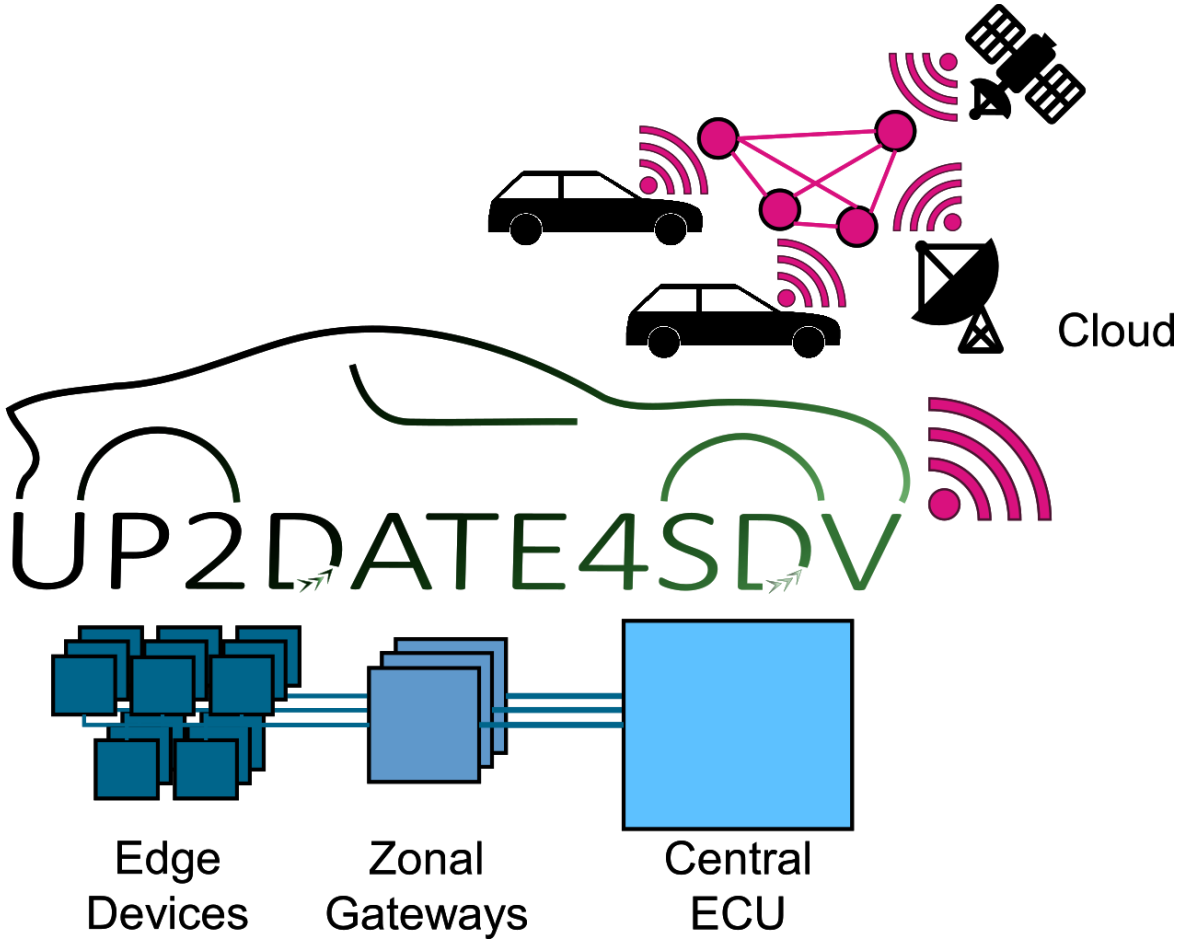
UP2DATE4SDV

Motivation: SD-CCAM-V



- Cooperative autonomous cars
- Communicating infrastructure
- Flexible vehicle functions
  - Personalization
  - Geo-regional adaptation
  - Longevity
  - Safety and security
- Cost-efficiency
- Shorter innovation cycles

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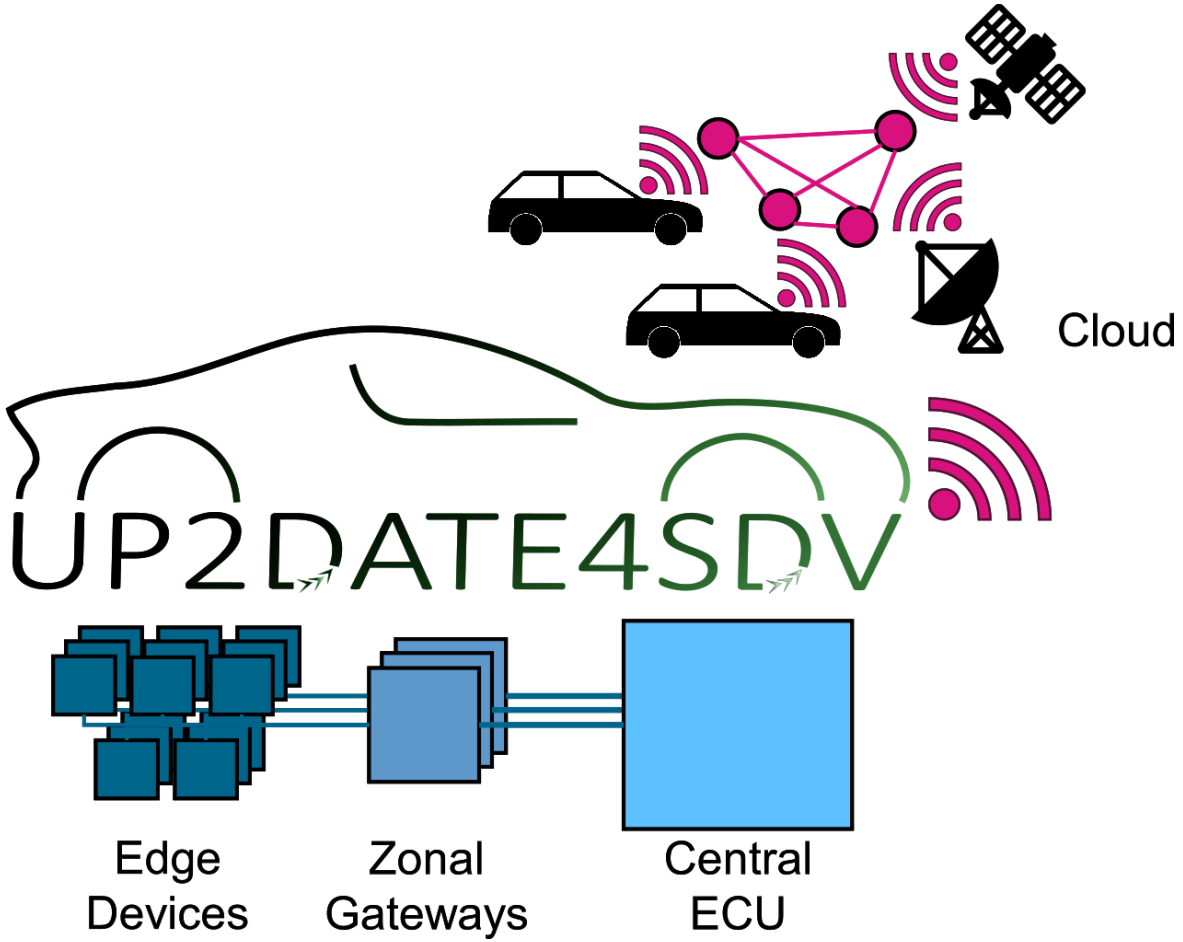
SDV-Trends:



- More-Centralized E/E-Architectures & mixed-critical SW & AI Integration
- Vehicle-to-Cloud Integration & Communication
- Software-Driven Engineering Processes
- Dev-/Ops-Management with Monitoring & OTA Updates

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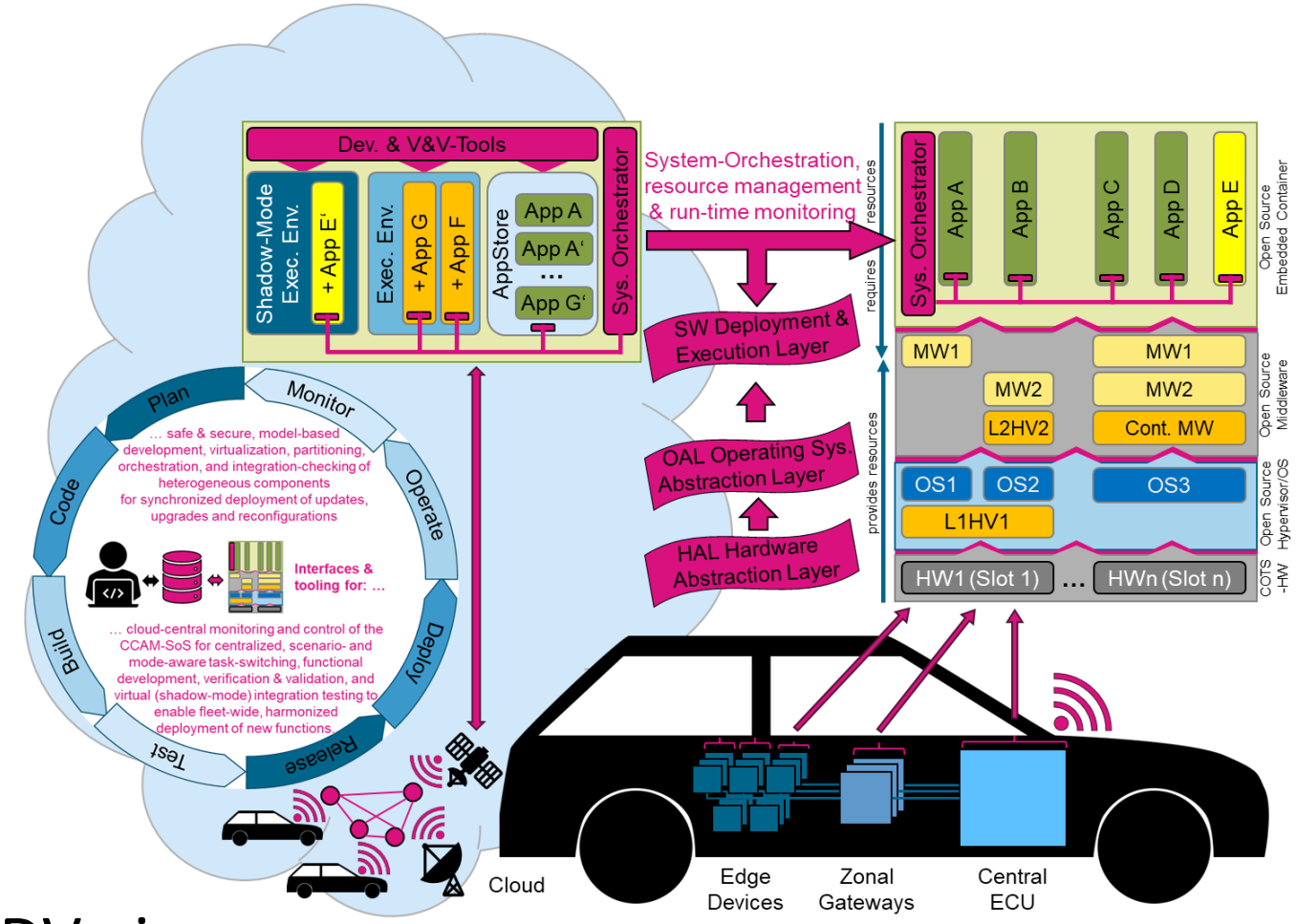
Goal



"UP2DATE4SDV aims

… to develop a **comprehensive ecosystem** for seamless and efficient **software-updates**, **hardware-upgrades**, and **situation-dependent reconfigurations** of software-defined CCAM vehicles"

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Challenges

C1: **Composition** of heterogeneous local and remote components considering timing and resources for a dynamically evolving system

C2: **Updateability** of any part (HW, SW, app, node, either local/remote)

C3: Enable synchronized updates for overall **system consistency**

C4: Preserve **safety & security** (SASE) in a dynamically evolving system

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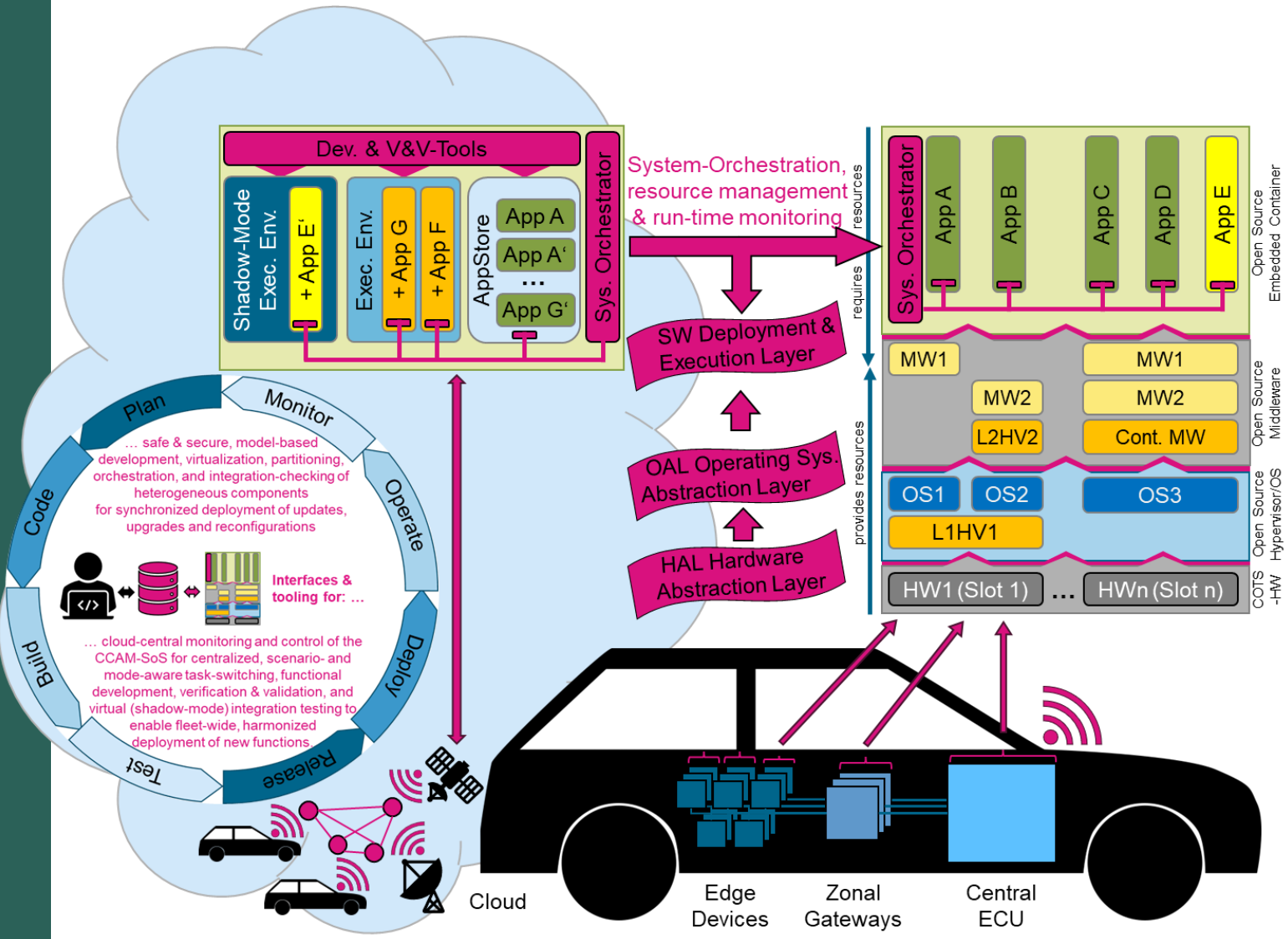
Objectives



O1: **reconfigurable cloud connected zonal vehicle architecture blueprint** (exploiting and building on a unified HAL)

O2: **resource composable SW deployment, execution & communication reference layer** (exploiting and building on a unified OAL)

O3: **dynamic update, orchestration & reconfiguration plane**

O4: **harmonized and simplified development, integration & validation processes** (framework for SDV applications)

O5: **Safety & Security** (SASE) from O1, O2 & O3

O6: Demonstration on **CCAM relevant Use Cases**

O7: **cooperation with CCAM & SDV Initiatives**

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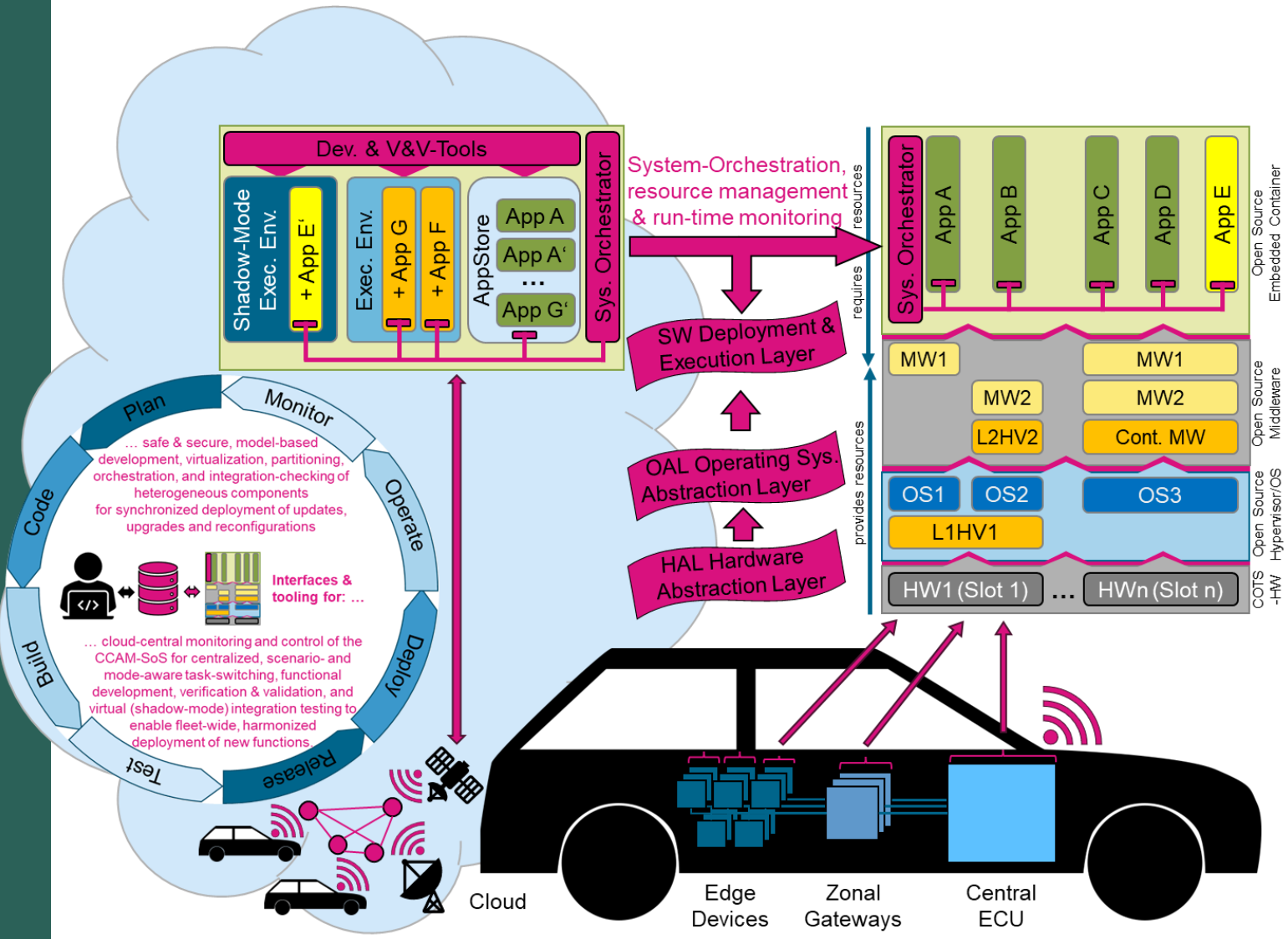
Key Results



R1: **Interface- & Service-Definitions** in 3 orthogonal dimensions (HAL/OAL/ORP)

R2: **Reference Implementation** of a **reconfigurable zonal HW architecture**

R3: **Reference Implementation** of a **resource composable SW deployment & execution layer**

R4: **Proof-of-Concept Implementation** of a **dynamic orchestration & reconfiguration plane**

R6: **Integration into DevOps based** continuous **validation & verification** processes and tools

R5: **Safety & Security Pattern supporting certification**

R7: **Demonstrator for CCAM based collective and adaptive perception**

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Status

- MS1 (M6 / Sept. 2025):
  Definition of Demonstrators & Requirements

- MS2 (M9 / Dec. 2025):
  Work-Package-Requirements for
  -> Hardware & Hardware-Abstraction Layer
  -> OS, MW & OS Abstraction Layer
  -> Orchestration & Reconfiguration Plane

- Show-Case-1 implemented:
  First HW/SW-Tests exchanging SW-Modules on Research-Demonstrator: TuringPi w. CM4 + L4Re + ROS2 + Autoware running in a Carla-Simulation

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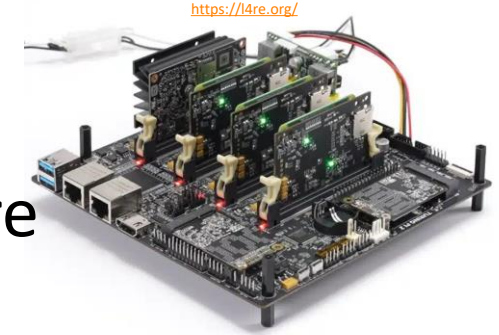
https://docs.ros.org/en/foxy/_static/favicon.ico

https://l4re.org/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Outlook

- MS4 (M15 / Sept. 2026):
  Show-Case-2: SW-Updates on Research-Demonstrator:

  -> criticality-aware platform orchestration
  -> health-dependend SW relocation
  -> resource-limit aware, secure deployment
  -> resource monitoring for virtual & physical HW

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L4Re
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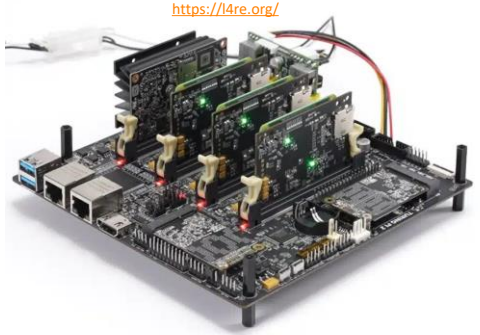
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Thank you!

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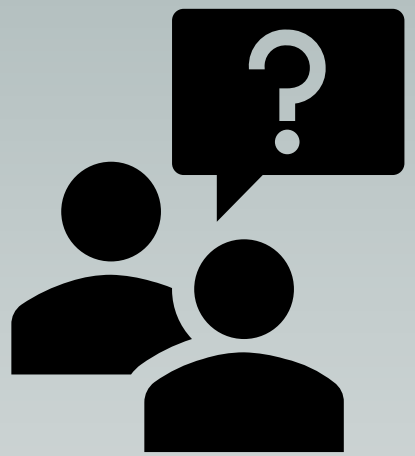

Gregor Nitsche

+49 441 770507-354
gregor.nitsche@dlr.de
https://DLR.de

German Aerospace Center (DLR)
Deutsches Zentrum für Luft- und Raumfahrt e. V.
Institute of Systems Engineering for Future Mobility (SE)
Escherweg 2 | 26121 Oldenburg

THANK YOU

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Q&A EXTENSION

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Overview

Project number:	**101203060**	**Starting Date:**	**1 July 2025**
Call:	**HORIZON-CL5-2024-D6-01**	**End Date:**	**30 June 2028**
Topic:	**HORIZON-CL5-2024-D6-01-01**	**Duration:**	**36 Months**
Type of action:	**Type of action: HORIZON-RIA**	**Total Cost:**	**5 999 076,90 €**
Service:	**Service: CINEA/C/03**	**Total PM:**	**677.50**
Consortium:	**14 partners:** **DLR, IKL, BSC, ZSC, TAAT,** **AVL, ST, NEO, KK, CON,** **6 (EU) countries:** **Germany, Austria, France,** **Italy, Romania, Spain, (Turkey)**	**WPs:**	**7**
		Milestones:	**7**
		Deliverables:	**38**
Website:	**https://up2date4sdv.eu**	**LinkedIn**	**https://linkedin.com/company/up2date4sdv**

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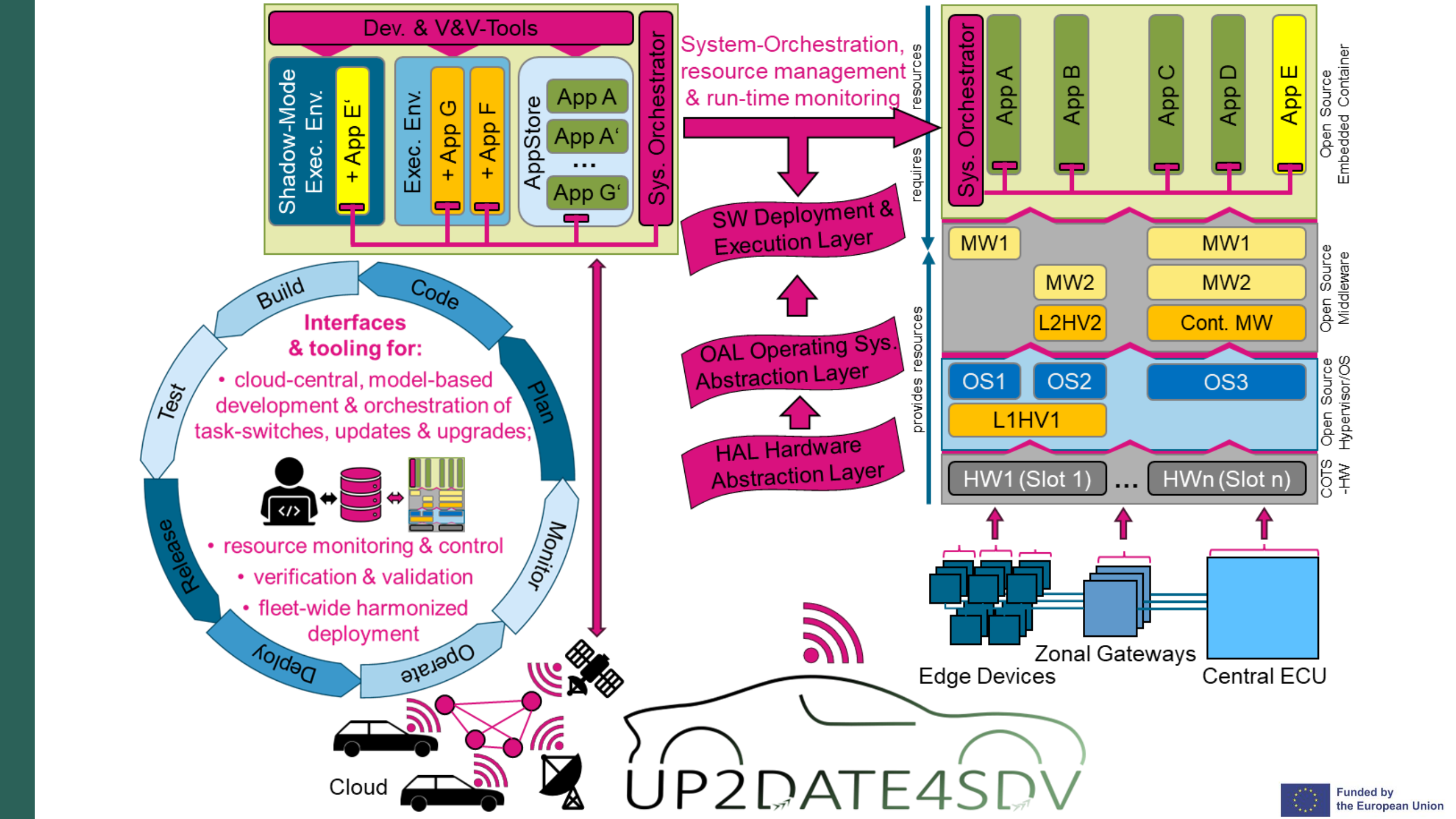
Dev. & V&V-Tools
Shadow-Mode Exec. Env.
+ App E'
Exec. Env.
+ App G
+ App F
AppStore
App A
App A'
...
App G'
Sys. Orchestrator
System-Orchestration, resource management & run-time monitoring
resources
requires
provides resources
SW Deployment & Execution Layer
OAL Operating Sys. Abstraction Layer
HAL Hardware Abstraction Layer
Sys. Orchestrator
App A
App B
App C
App D
App E
Open Source Embedded Container
MW1
MW2
L2HV2
MW1
MW2
Cont. MW
Open Source Middleware
OS1
OS2
OS3
L1HV1
Open Source Hypervisor/OS
HW1 (Slot 1)
...
HWn (Slot n)
COTS -HW
Build
Code
Plan
Monitor
Operate
Deploy
Release
Test
Interfaces & tooling for:
• cloud-central, model-based development & orchestration of task-switches, updates & upgrades;
• resource monitoring & control
• verification & validation
• fleet-wide harmonized deployment
Edge Devices
Zonal Gateways
Central ECU
Cloud
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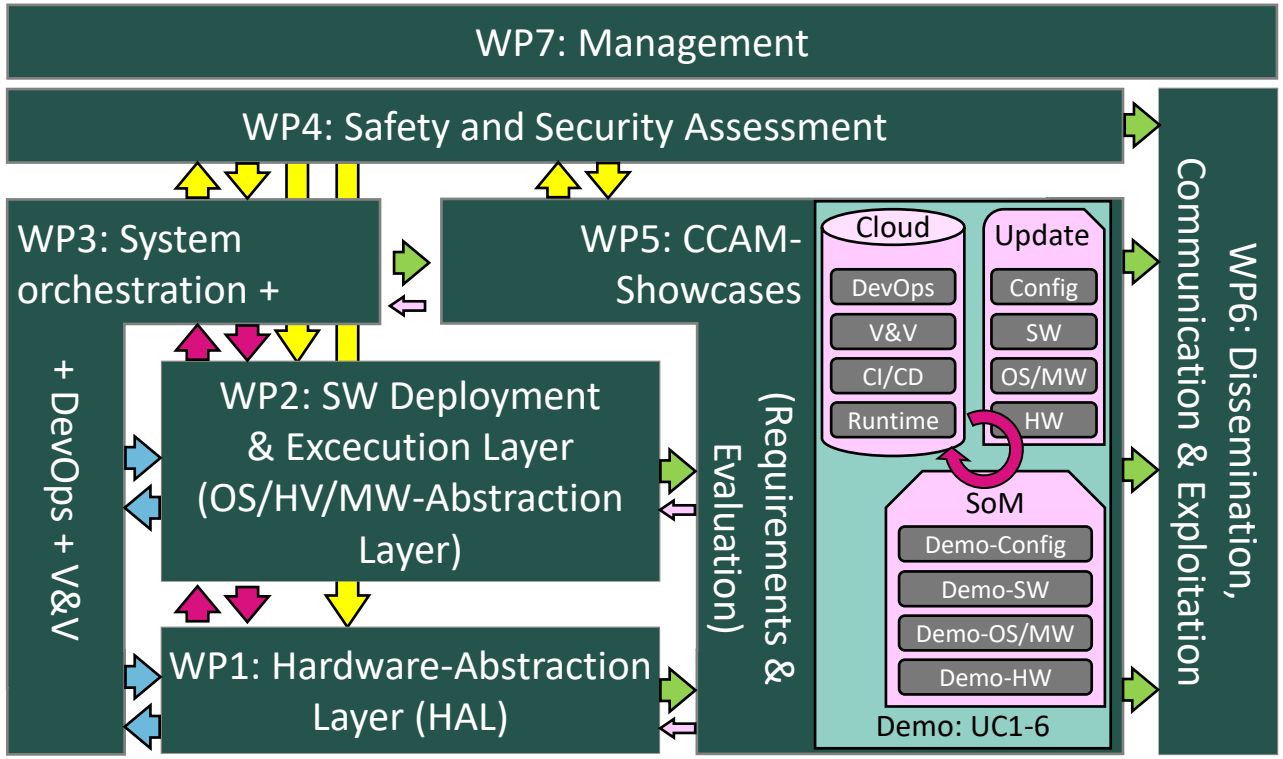
Structure



- Requirements
- Integration & Communication of Results
- safety and security assessment
- update-, upgrade-, and reconfiguration-processes
- cloud-based MBSE-components

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Key Results

- R1: **Interface- & Service-Definitions** in 3 orthogonal dimensions (HAL/OAL/ORP)
- R2: **Reference Implementation** of a **reconfigurable zonal HW architecture** for software-defined CCAM vehicles
- R3: **Reference Implementation** of a **resource composable SW deployment & execution layer** for software-defined CCAM vehicles
- R4: **Proof-of-Concept Implementation** of a **dynamic orchestration & reconfiguration plane** for software-defined CCAM vehicles
- R6: **Integration into DevOps based** continuous **validation & verification** processes and tools
- R5: **Safety & Security Pattern supporting certification**
- R6: **Demonstrator for CCAM based collective and adaptive perception**

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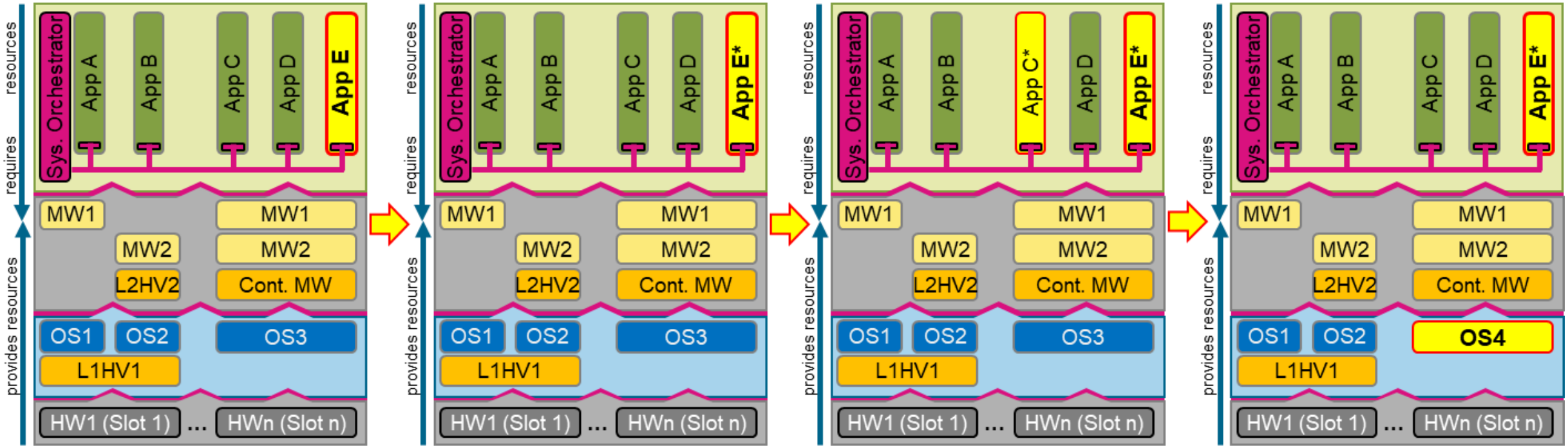
UseCase Examples



- **Scenario (1)** Isolated application update E*: within resources; no change of interfaces required
- **Scenario (2)** Dependent application update E*: within resources, change of interfaces can be required
- **Scenario (3)** Demanding update: App E* requires more resources → change of platform config. (to unlock resources)

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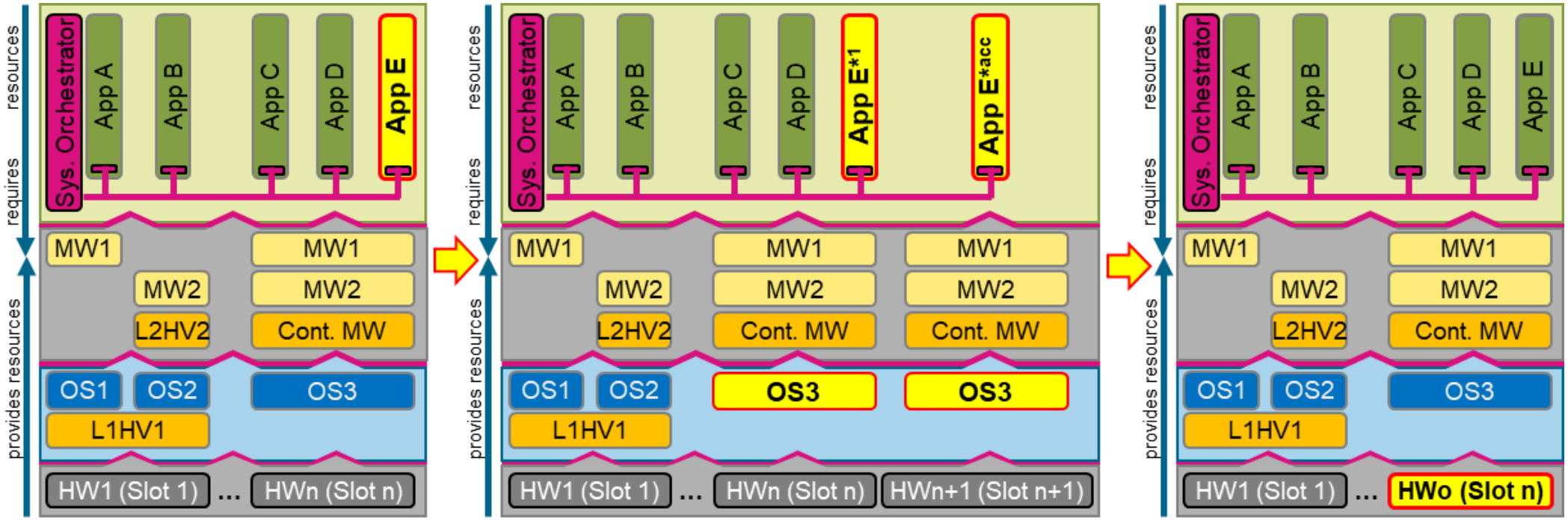
UseCase Examples



- **Scenario (4)** Demanding update: App E* needs more resources → change of platform config. requires new HW (HW Slot n+1)
- **Scenario (6)** Hardware-Upgrade: HWn is not available anymore → Replacement of Hardware HWn with new HW HWo (e.g. ARM-based SoC replaced by RISC-V based SoC)

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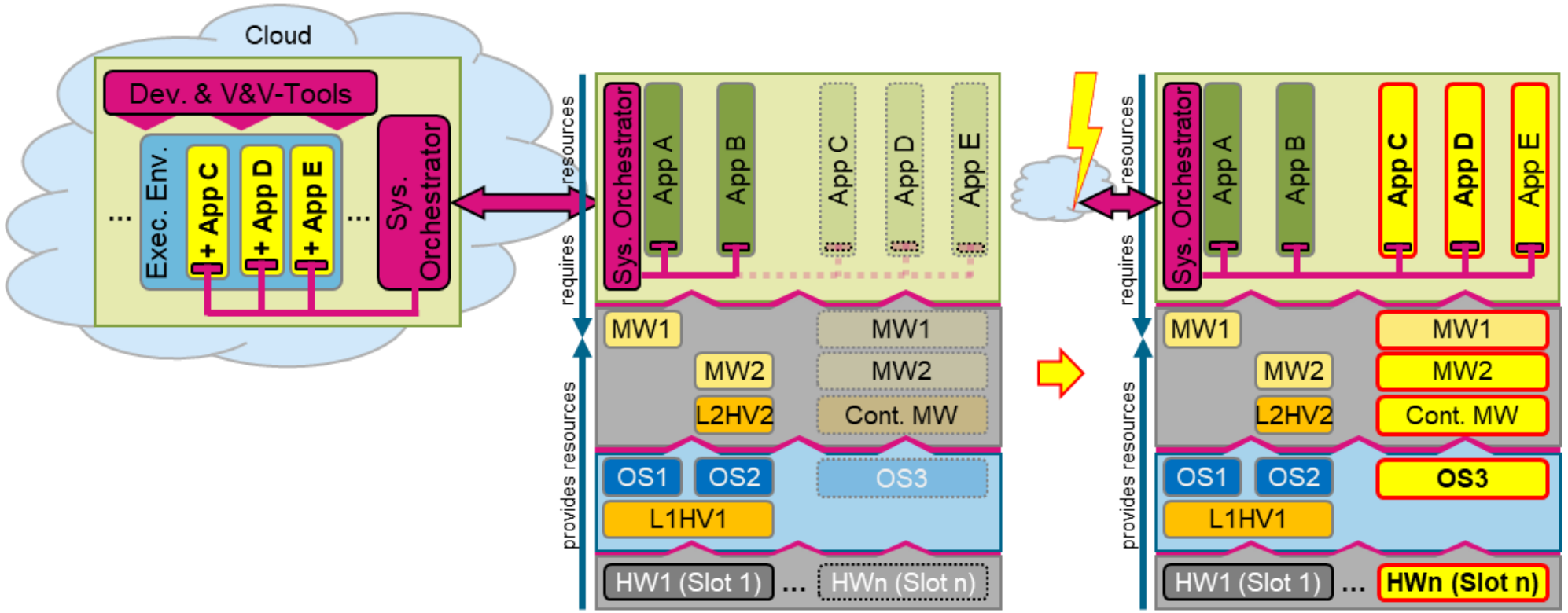

- **Scenario (5)** Scenario-dependent reconfiguration: Switching between pre-defined “modes” at run-time: e.g. between cloud guided driving in the city and full self-driving outside the city depending on stability of the cloud-connection, traffic density, availability of global scenario-data

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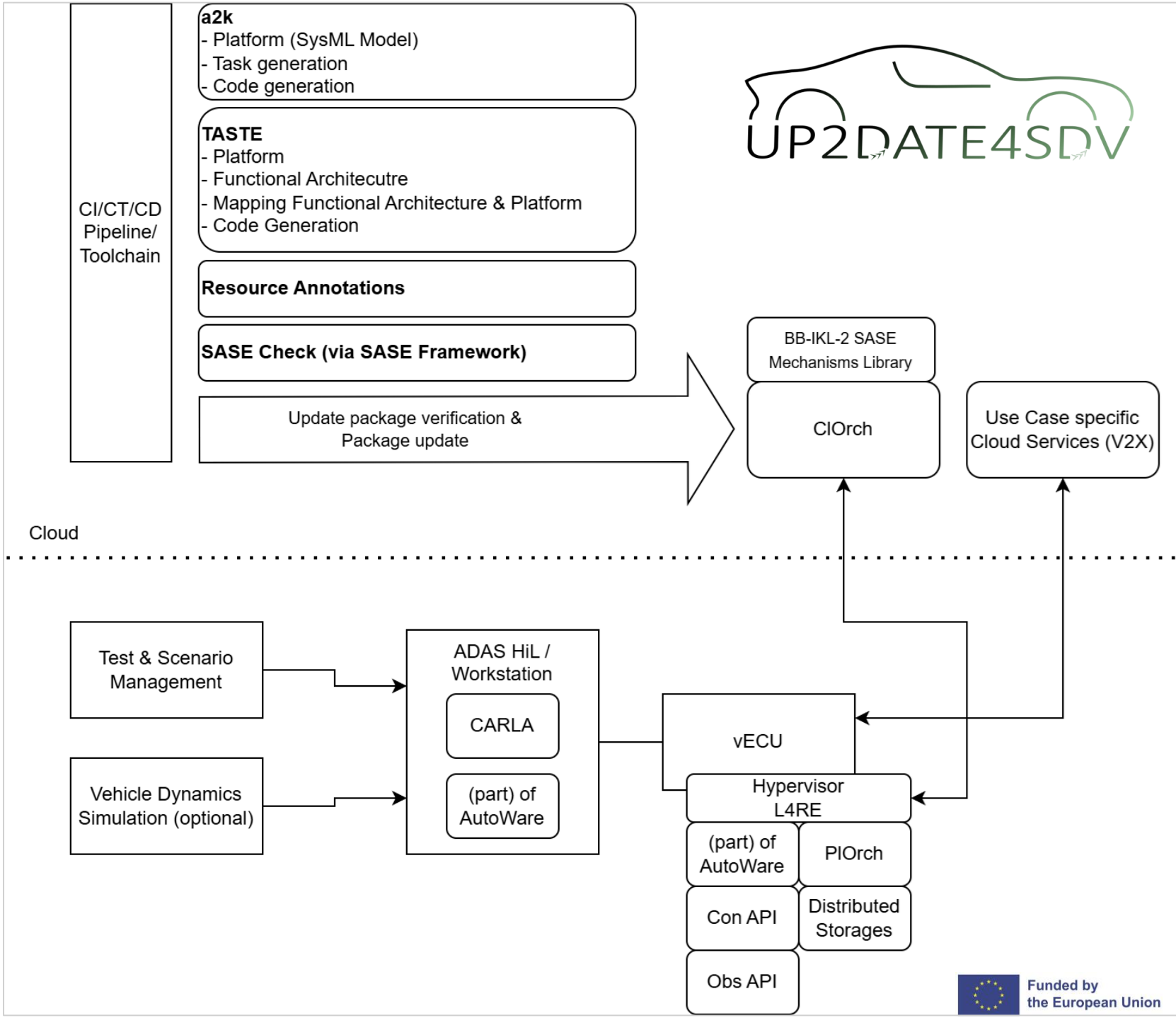
Virtual CCAM Demonstrator



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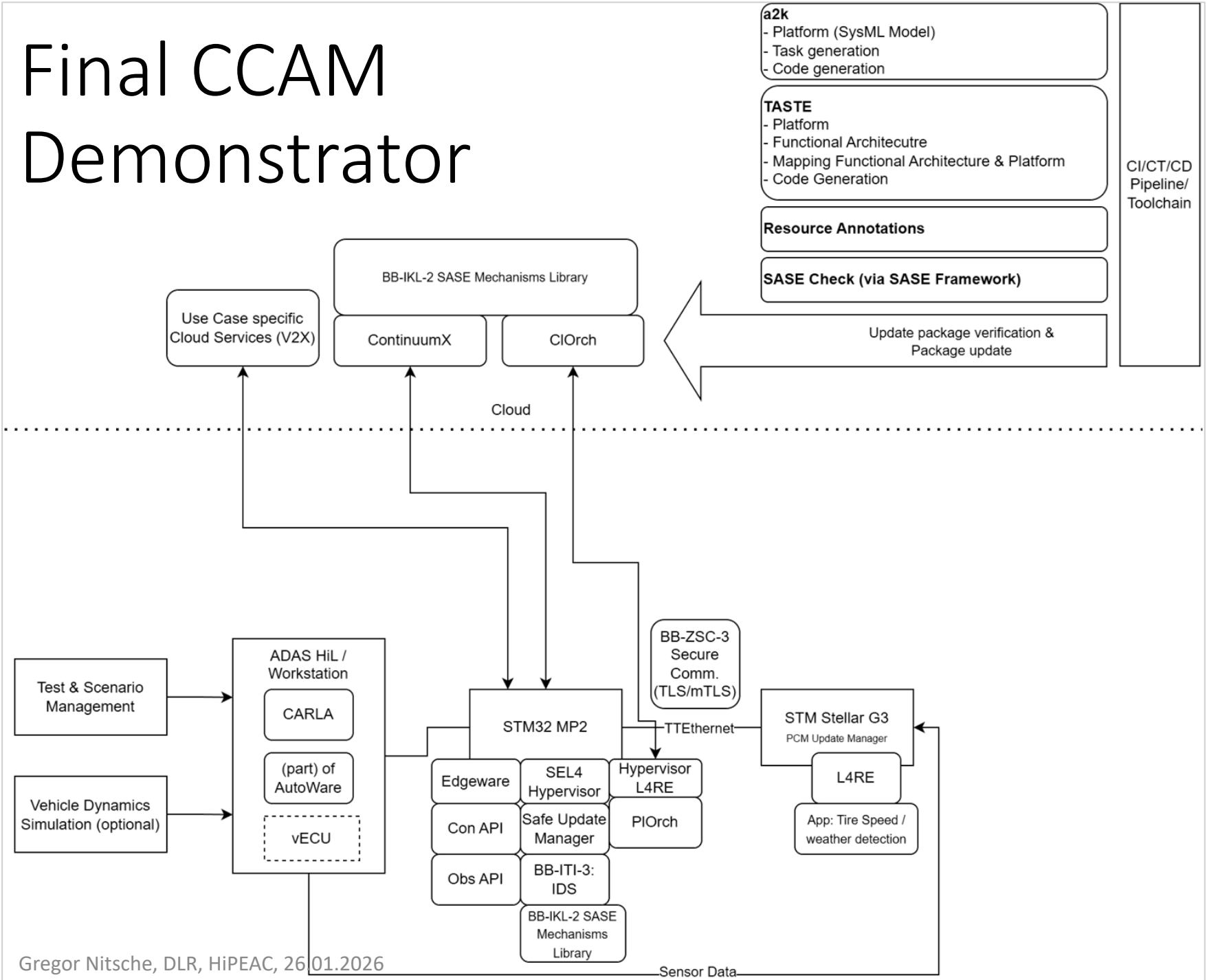
Final CCAM Demonstrator



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