

THE ECLIPSE ARROWHEAD FRAMEWORK ACROSS DOMAINS

Eclipse IoT Day Grenoble 2023

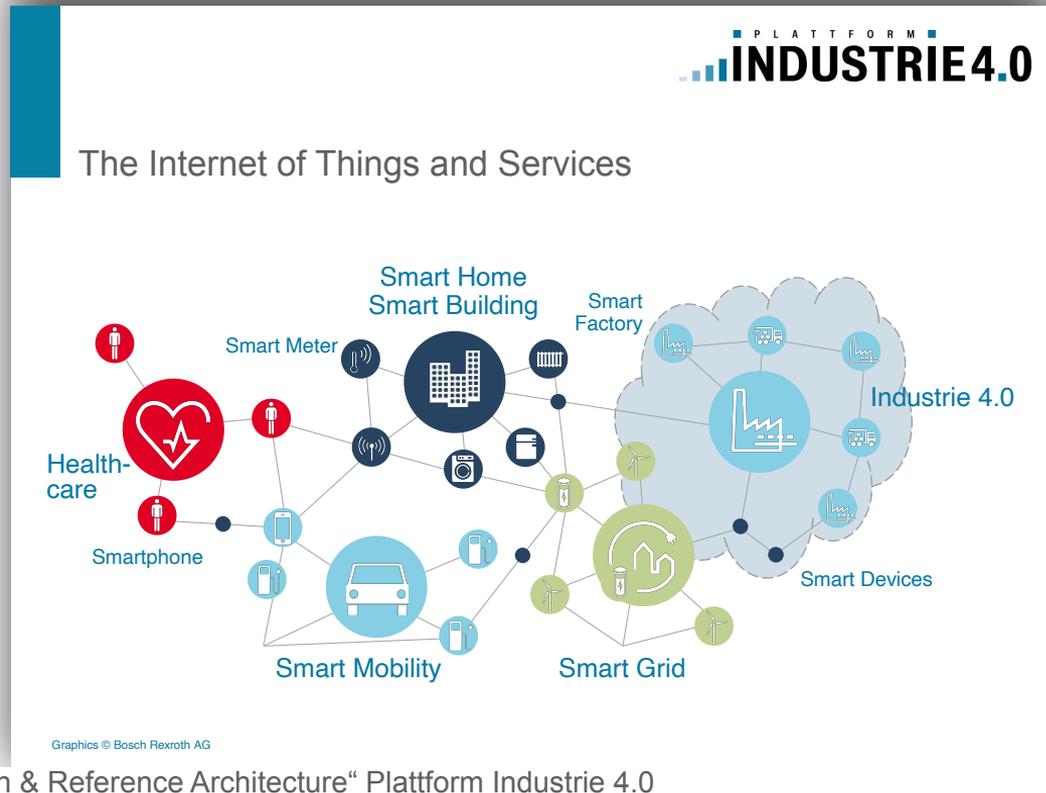
Thursday, January 19, 2023

Jan van Deventer

The presentation's outline

- Background
 - The forth Industrial Revolution, a reference architecture and an IoT framework
- Smart cities with focus on distributed energy (smart grids)
- Manufacturing example (physical and digital twins, AI at the edge)
- Vehicle application: safety critical systems, autonomous snowblower(s)

The Reference Architectural Model for Industrie 4.0 (RAMI 4.0): An Introduction

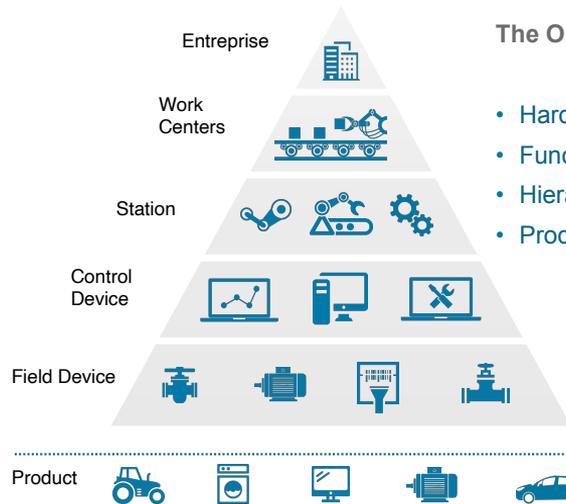


Dr. Karsten Schweichart
Leader(act.) AG1 „Standardization & Reference Architecture“ Plattform Industrie 4.0

The Revolution

PLATTFORM INDUSTRIE 4.0

Axis 1 – Hierarchy: The Factory



The Old World: Industrie 3.0

- Hardware-based structure
- Functions are bound to hardware
- Hierarchy-based communication
- Product is isolated

Graphics © Anna Salari, designed by freepik

PLATTFORM INDUSTRIE 4.0

Axis 1 – Hierarchy: The Factory

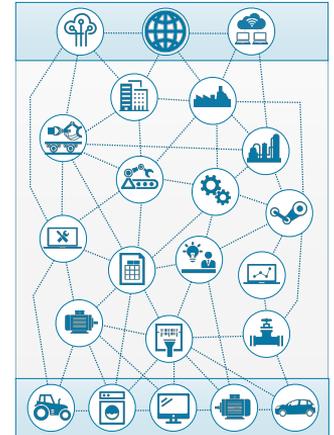
The New World: Industrie 4.0

- Flexible systems and machines
- Functions are distributed throughout the network
- Participants interact across hierarchy levels
- Communication among all participants
- Product is part of the network

Connected World

Smart Factory

Smart Products

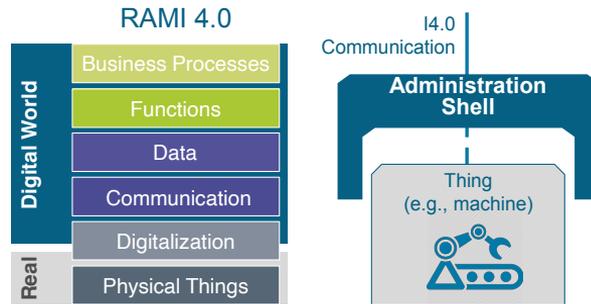


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The Interface to Connectivity

PLATTFORM
INDUSTRIE 4.0

The Industrie 4.0 Component



- The connection takes place over the I4.0 communication
- The administration shell forms the digital part
- The Thing forms the real part

**Each object needs its own administration shell
that allows its integration into Industrie 4.0**

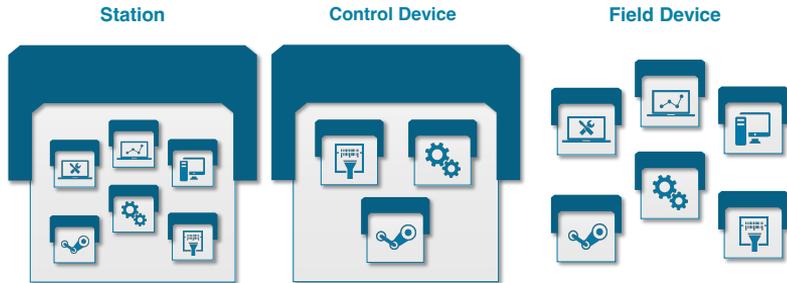
Graphics RAMI 4.0 © Plattform Industrie 4.0 and ZVEI, Administration Shell © ZVEI SG Modelle und Standards, Pictograph © Anna Salari, designed by freepik

Architectural Paradigms

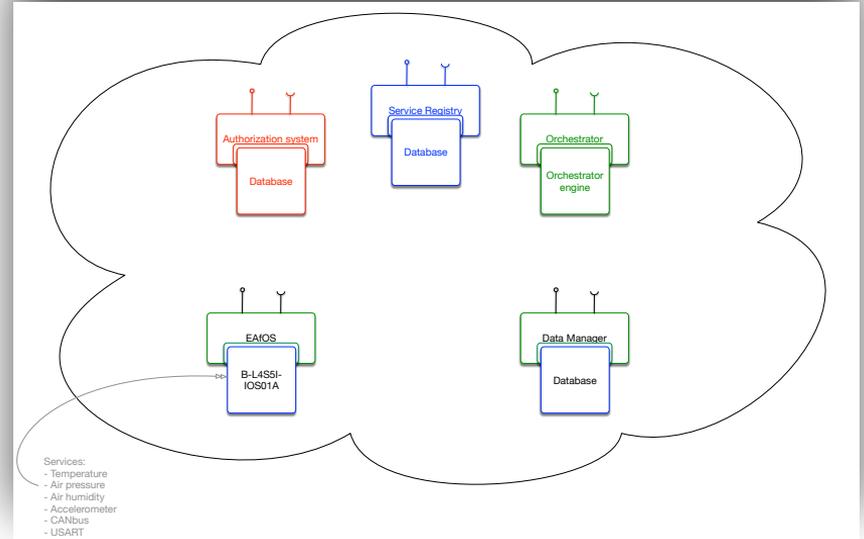
PLATTFORM
INDUSTRIE4.0

The Roles and Responsibilities of the Administration Shell

- Each physical thing has its own administration shell.
- Several assets can form a thematic unit with a common administration shell, several thematic units ...



Graphics © Anna Salari, designed by freepik, Administration Shell © ZVEI SG Modelle und Standards



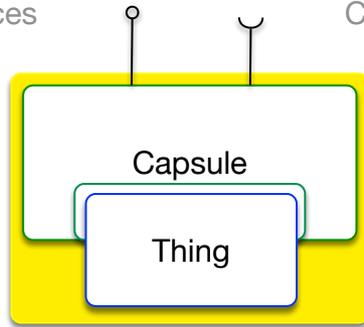
Hierarchy (Russian dolls)
versus
Local Cloud

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A Generic Arrowhead System

Producing services

Consuming services



Interface between the Thing and the Internet

- Sensor
- Actuator
- Algorithm
- Database
- Human machine interface
- PLC

- base URI
- Certificate
- Private key
- Awareness of other systems
- Authorization to provide services

The Eclipse Arrowhead

The image shows a composite of two screenshots. On the left is the Eclipse Arrowhead website, featuring a dark blue header with the Arrowhead logo and navigation links: NEWS, ECOSYSTEM, TECHNOLOGY, ROADMAP, DOWNLOADS, GIT, CONTACT. Below the header, the page title is 'Home / Eclipse Arrowhead™'. The main content area has the heading 'Eclipse Arrowhead™' and a sub-heading 'A framework and implementation platform for SoS, IoT and OT integration'. The text describes the platform as a framework for building automation and digitalisation solutions, based on microservice and micro system architecture. It mentions support for Industry 4.0 architectures like Ram4.0 and various interoperability protocols. On the right is a screenshot of the Eclipse Arrowhead YouTube channel page, showing the channel name, subscriber count (116), and a video thumbnail titled 'Eclipse Arrowhead te' with 573 views.

NEWS ECOSYSTEM TECHNOLOGY ROADMAP DOWNLOADS GIT CONTACT

ARROWHEAD

Home / Eclipse Arrowhead™

Eclipse Arrowhead™

A framework and implementation platform for SoS, IoT and OT integration

Eclipse Arrowhead is a framework and implementation platform to build automation and digitalisation solutions. The basis is an microservice and micro system architecture utilising service oriented architecture principles. The implementation platform includes an engineering process and associated tools and core microsystems. Well proven core microsystem, libraries and template code for application systems, support for model based engineering using SysML and UML are available open source.

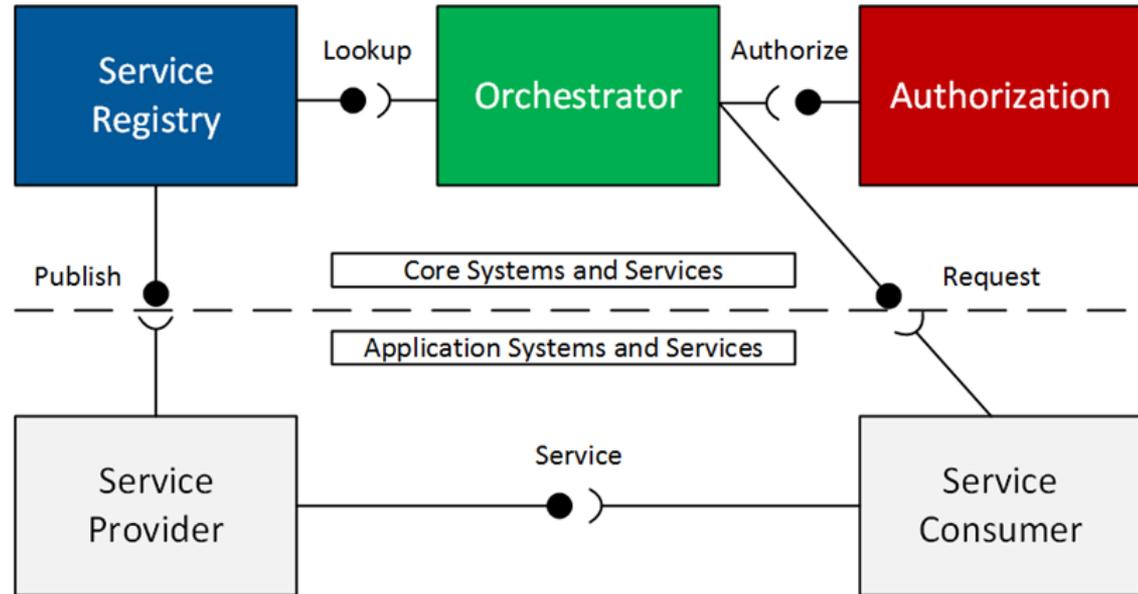
The framework and implementation platform is well suited to design, implement and deploy Automation and digitalisation solution meeting Industry 4.0 architectures like Ram4.0. Usage in highly heterogeneous environments is highly supported thanks to a wide range of interoperability support as autonomous protocol translators, adaptors for many legacy and IT technologies like e.g. OPC-UA, Modbus TCP, Z-wave, IO-link, Web of Things.

Eclipse Arrowhead

Eclipse Arrowhead Technology

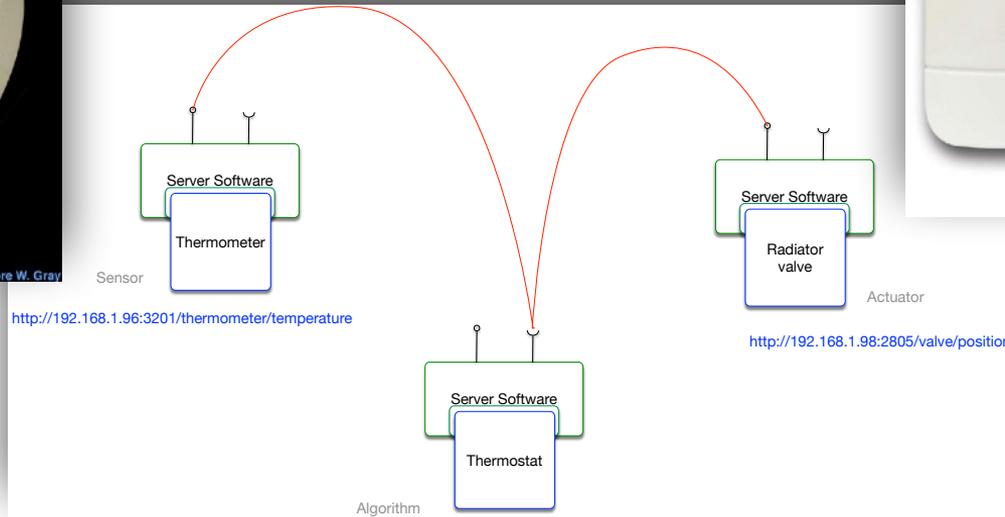
The Local Cloud

- Loose coupling
- Late binding
- Manageability
- Authentication
- Authorization
- Low latency
- Data ownership
- Privacy
- ...

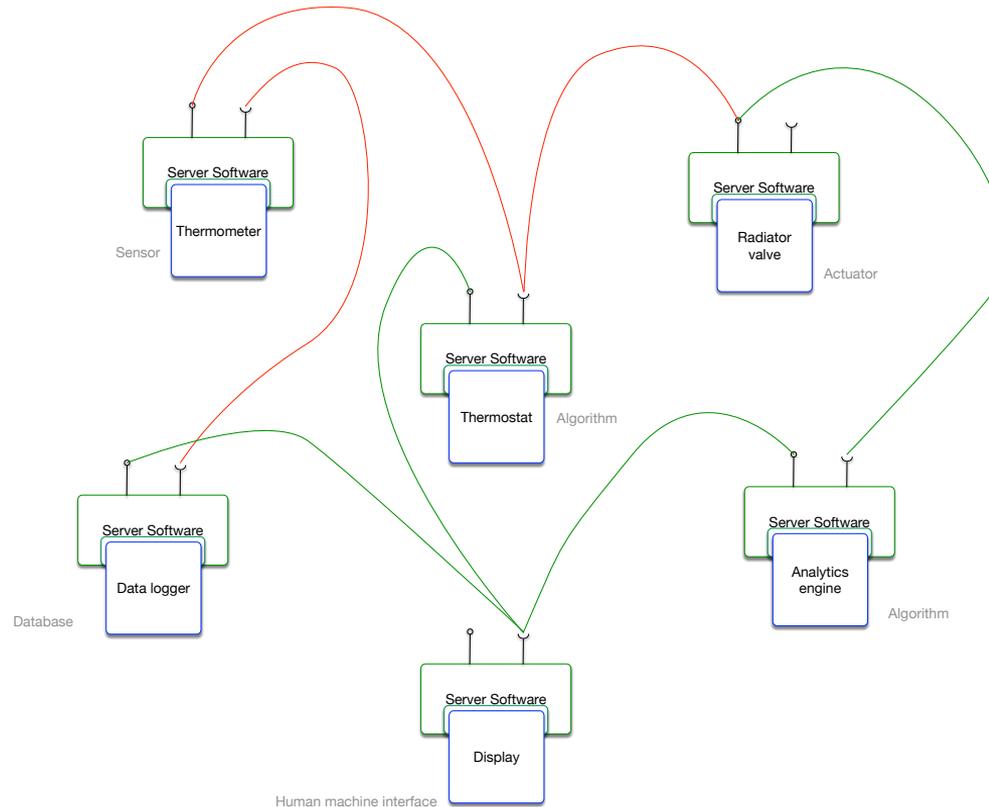


Smart Grids: Evolution & Complexity

- The common household thermostat

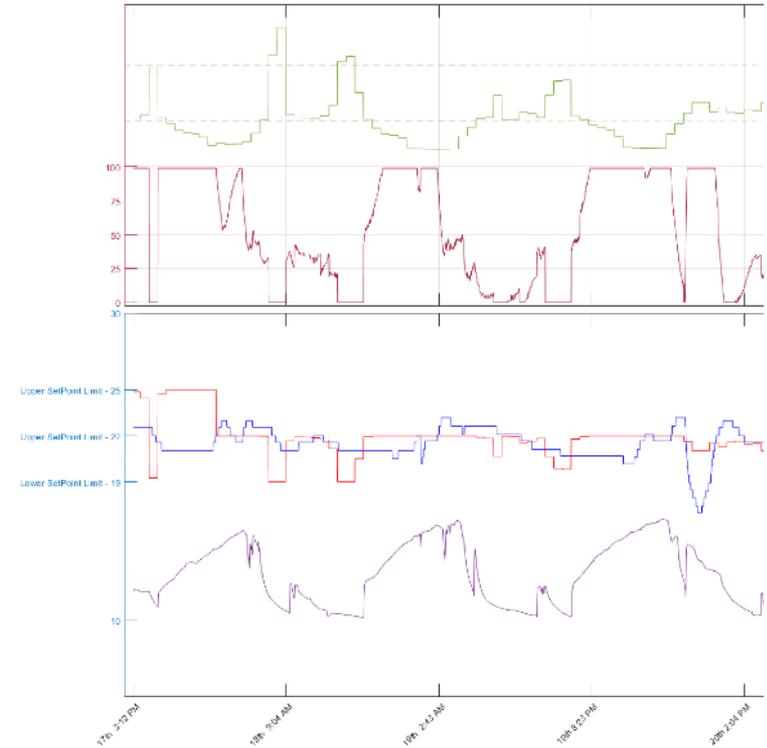
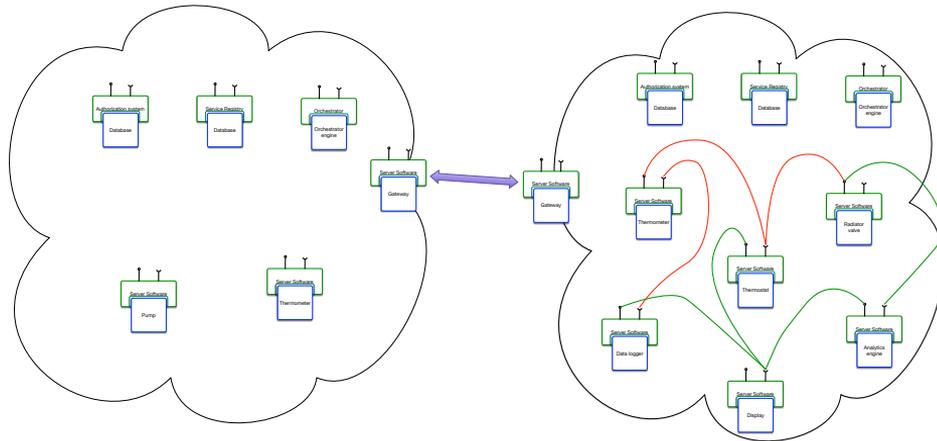
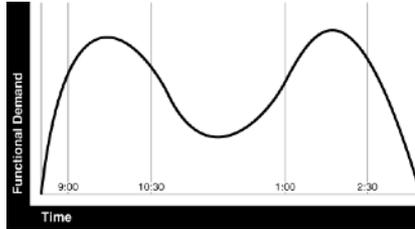


Home: the scalable local cloud



Open Source & Cybersecured Smart Grid

- Energy savings & End user comfort



Manufacturing

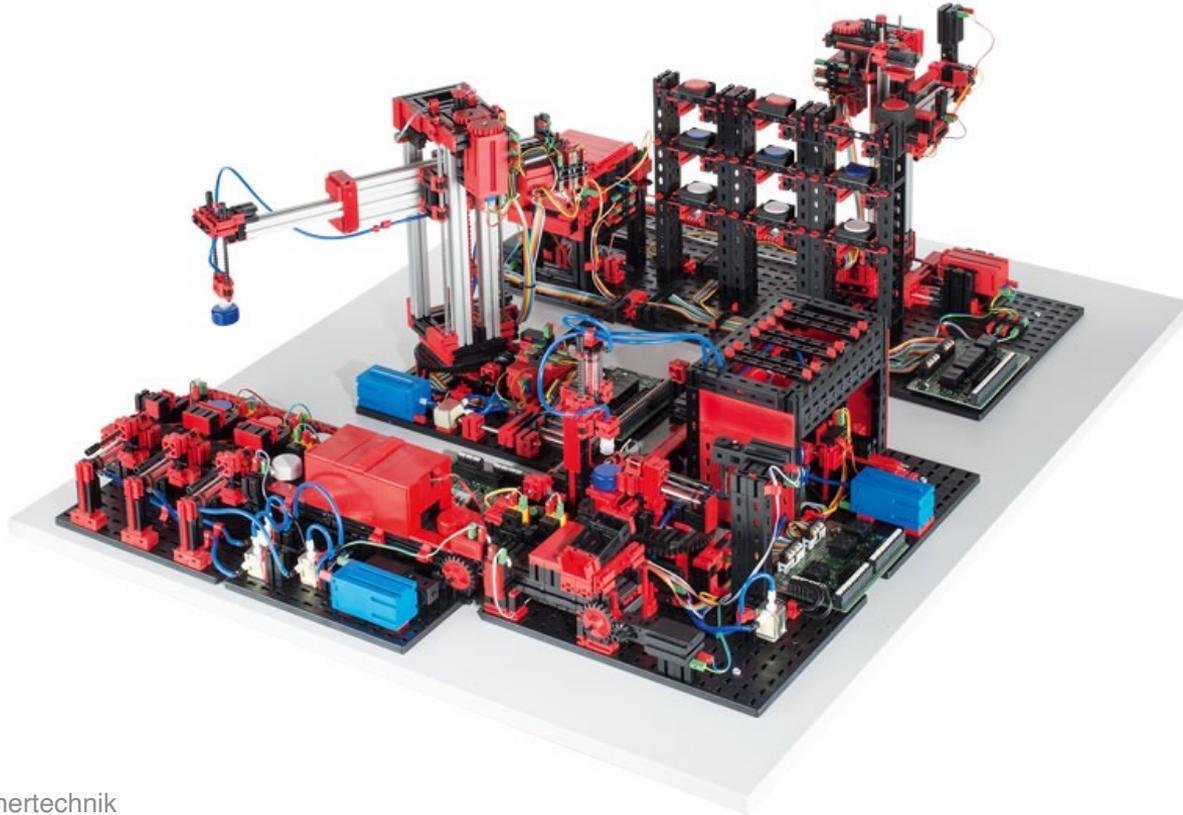
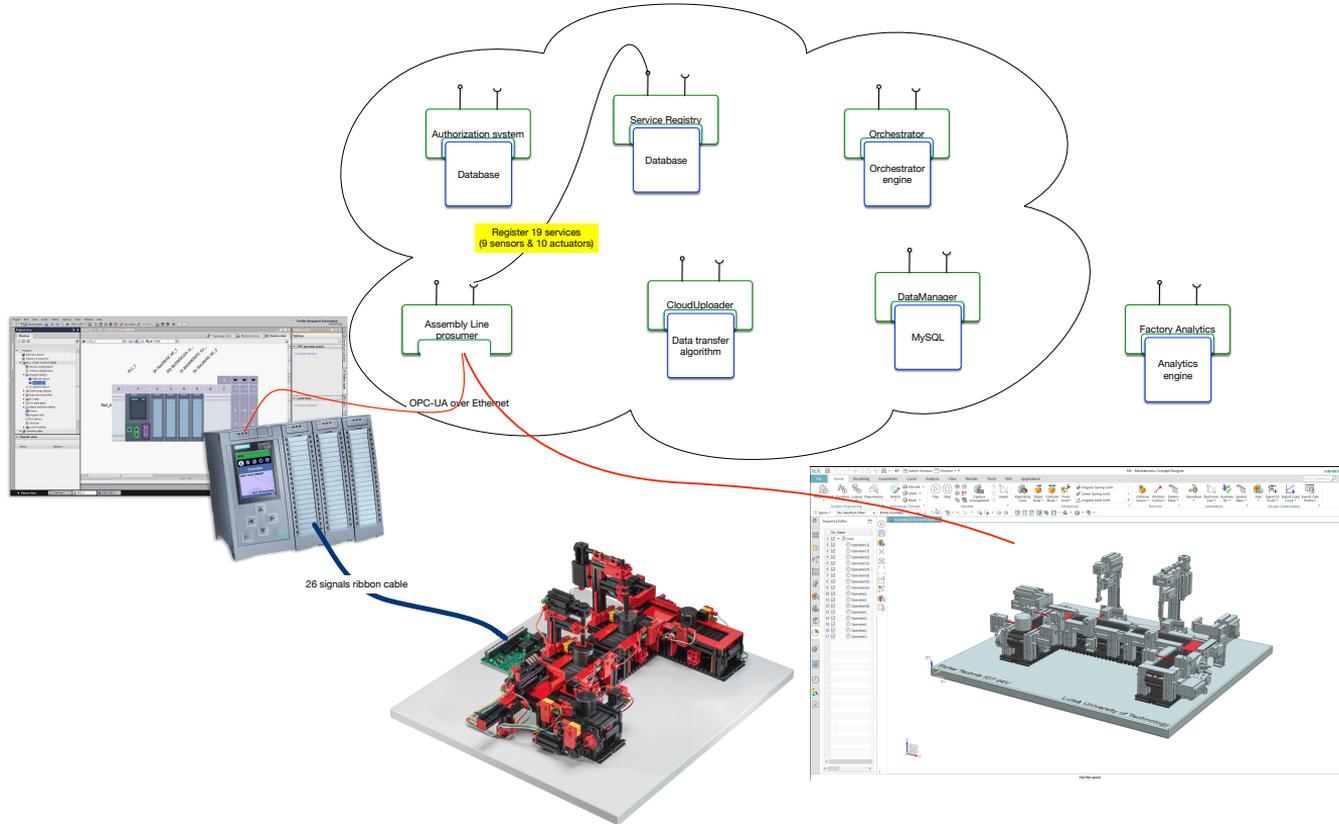
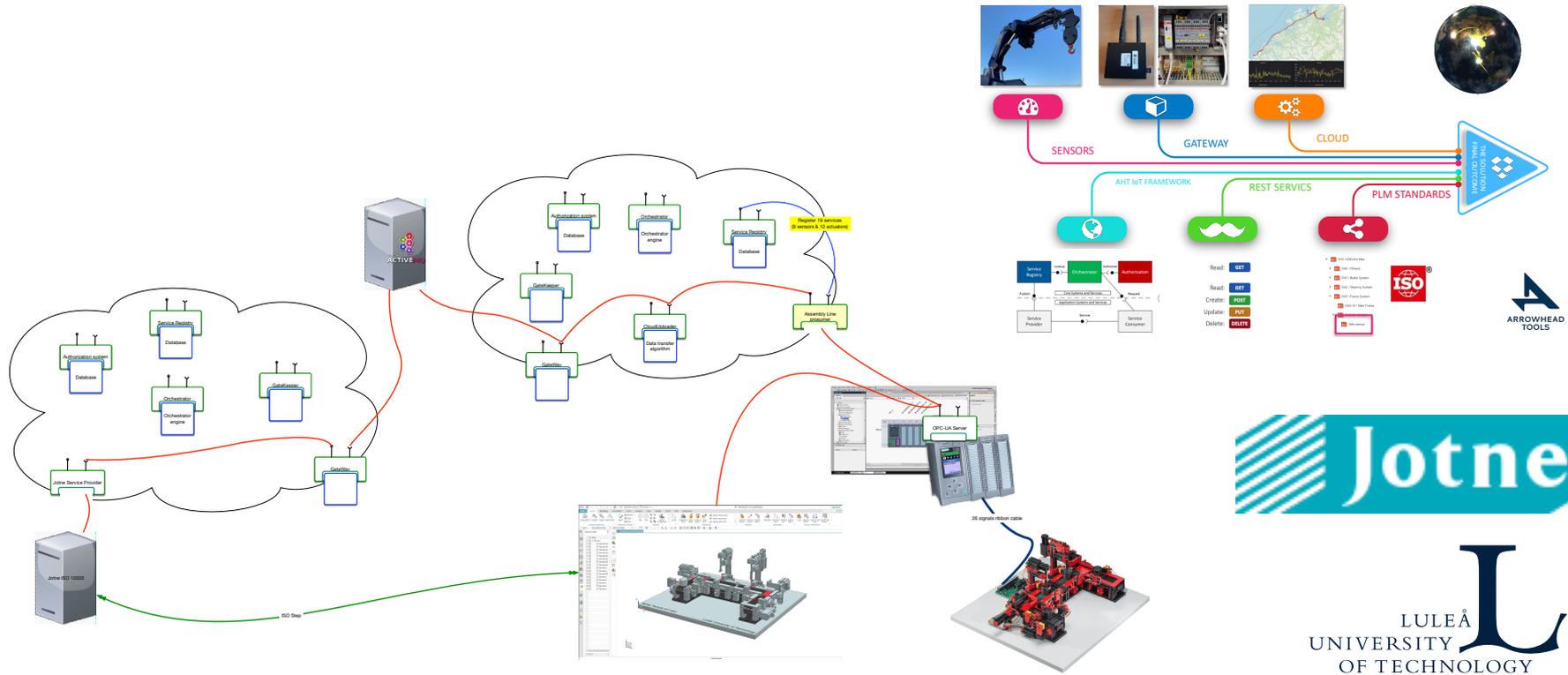


Image source: fischertechnik

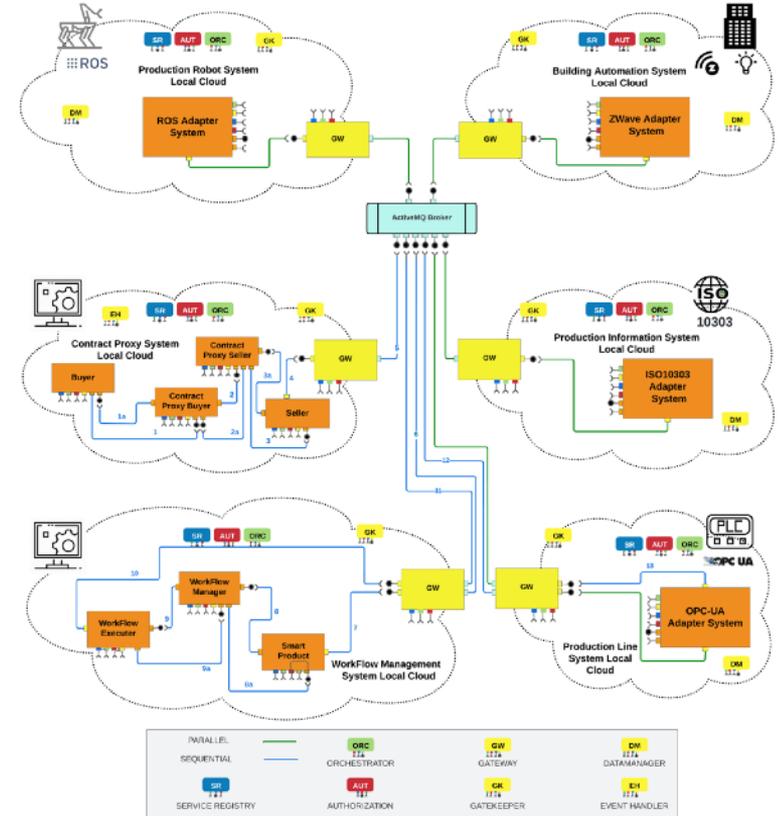
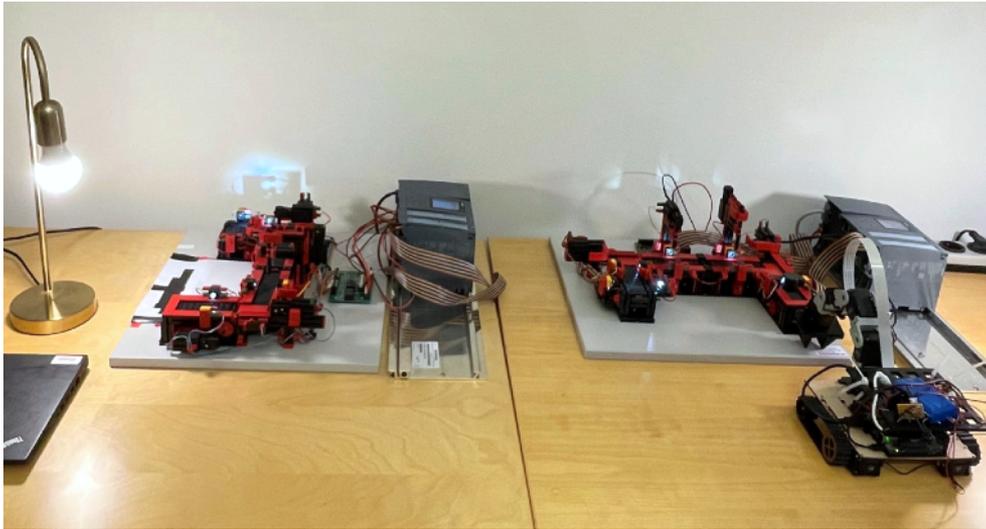
An Indexed Line with OPC UA and Digital Twin



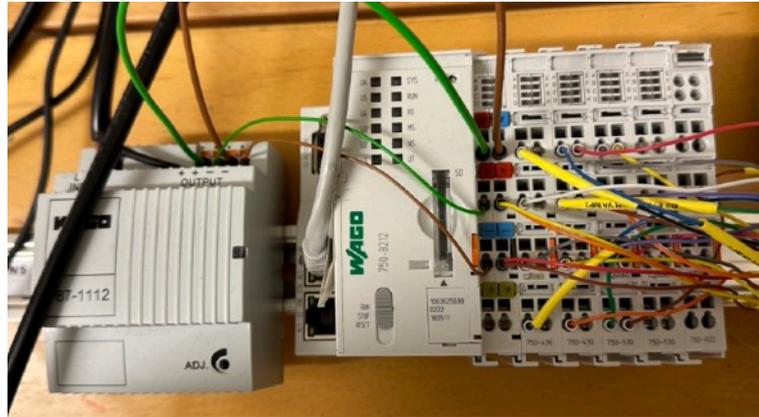
Information Models & ISO 10303 system



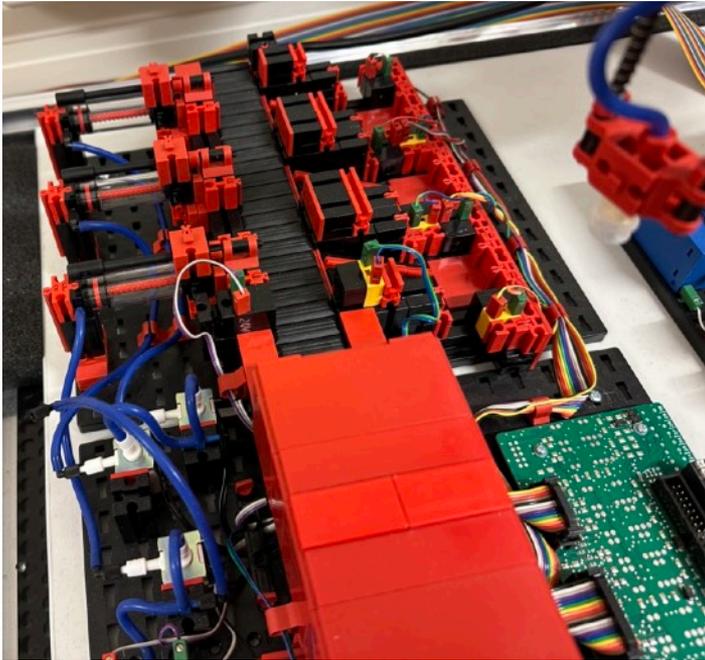
One Size Lot, ROS, and Z-Wave



Interoperable & Protocol Agnostic Systems

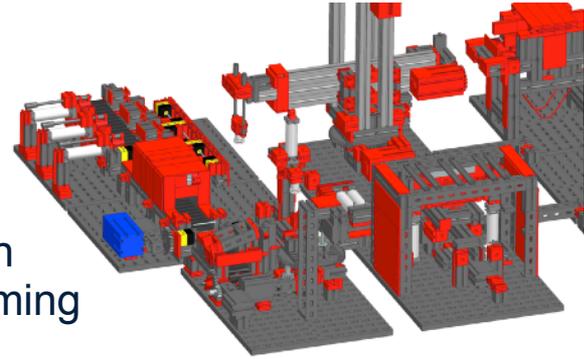


Digital Twins for Different Purposes



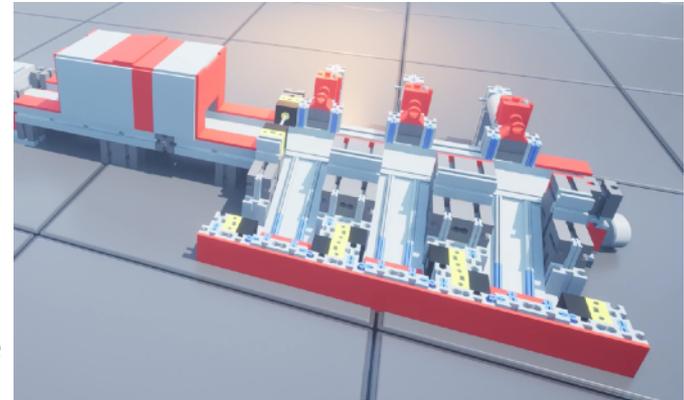
CAD:

- Factory design
- PLC programming
- Operations



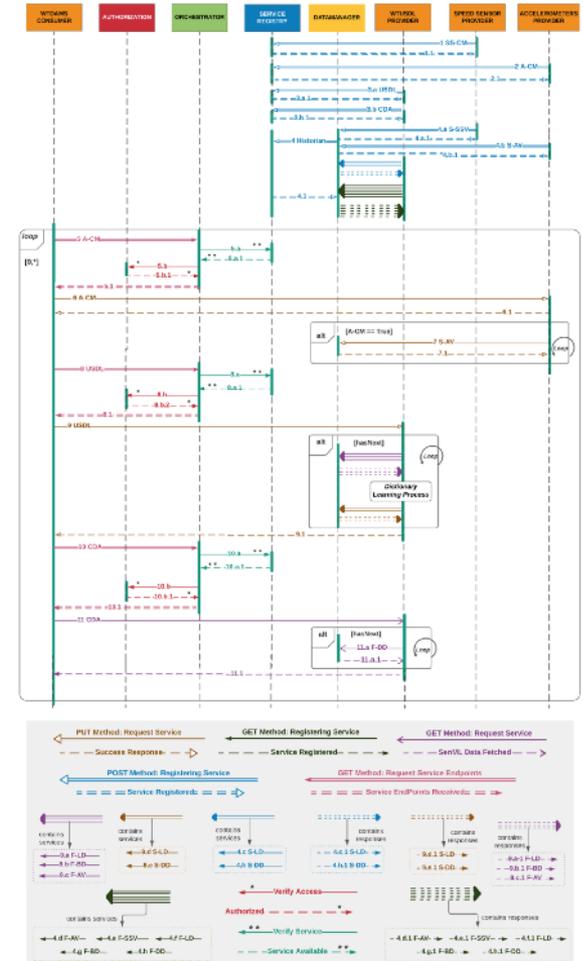
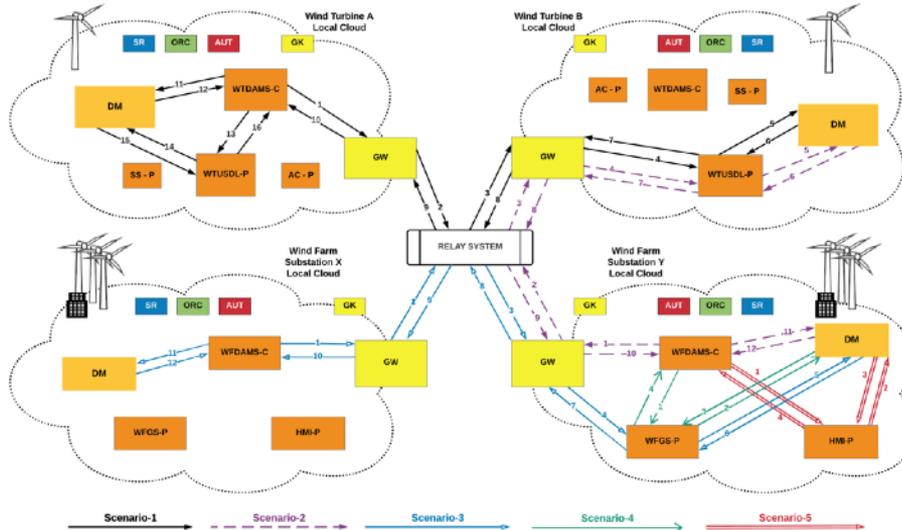
Game engine:

- Training
- Operations
- Maintenance



AI @ the Edge

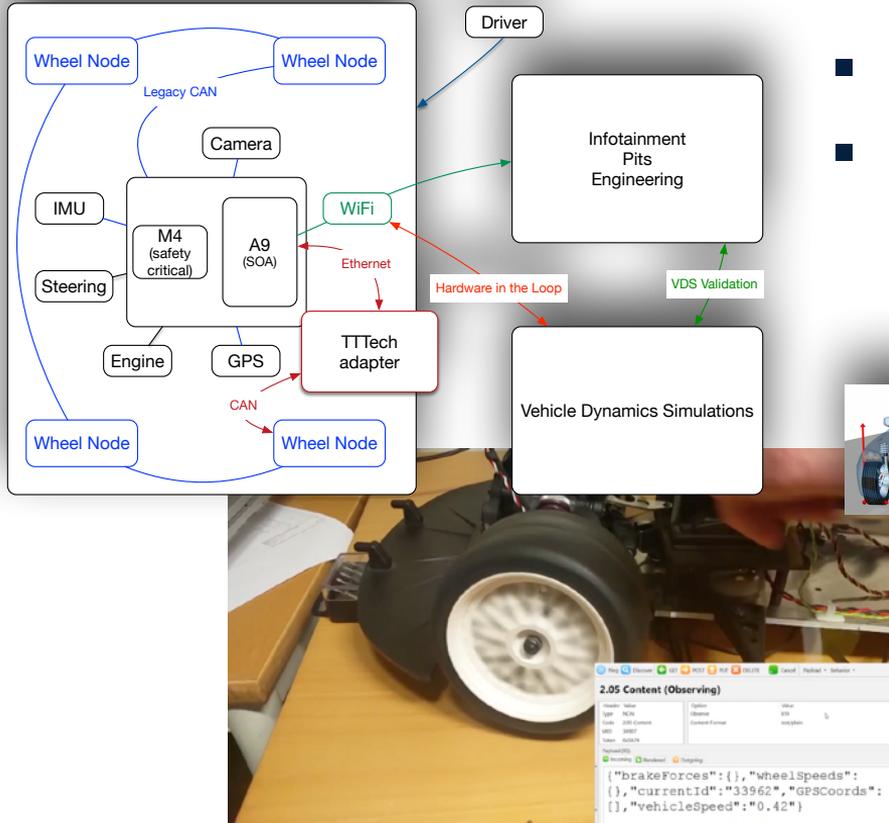
- Detecting ball bearing damage prior to failure in windmill farms
- Confederated learning



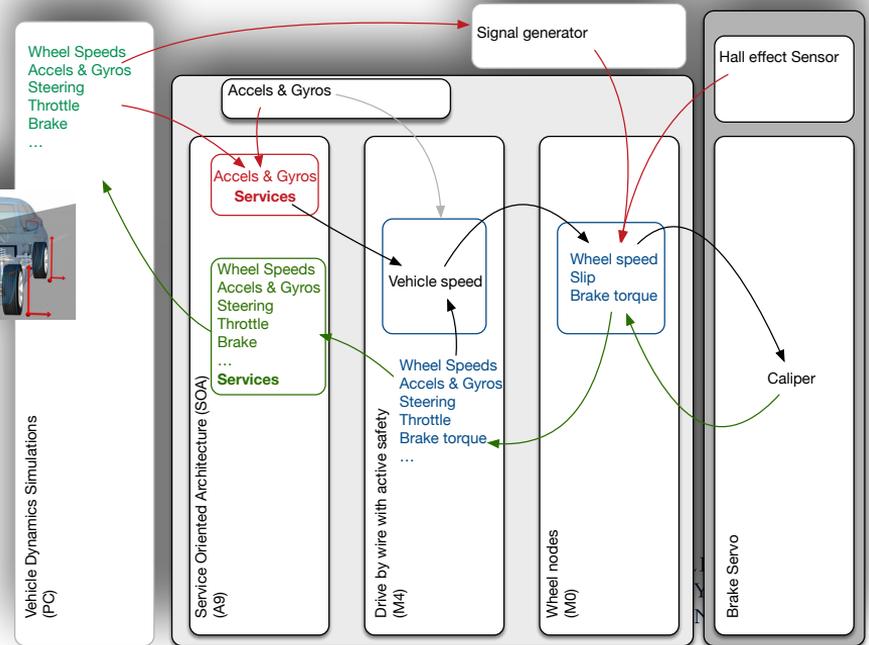
Eclipse Arrowhead on Vehicles



Safety Critical Systems & Services

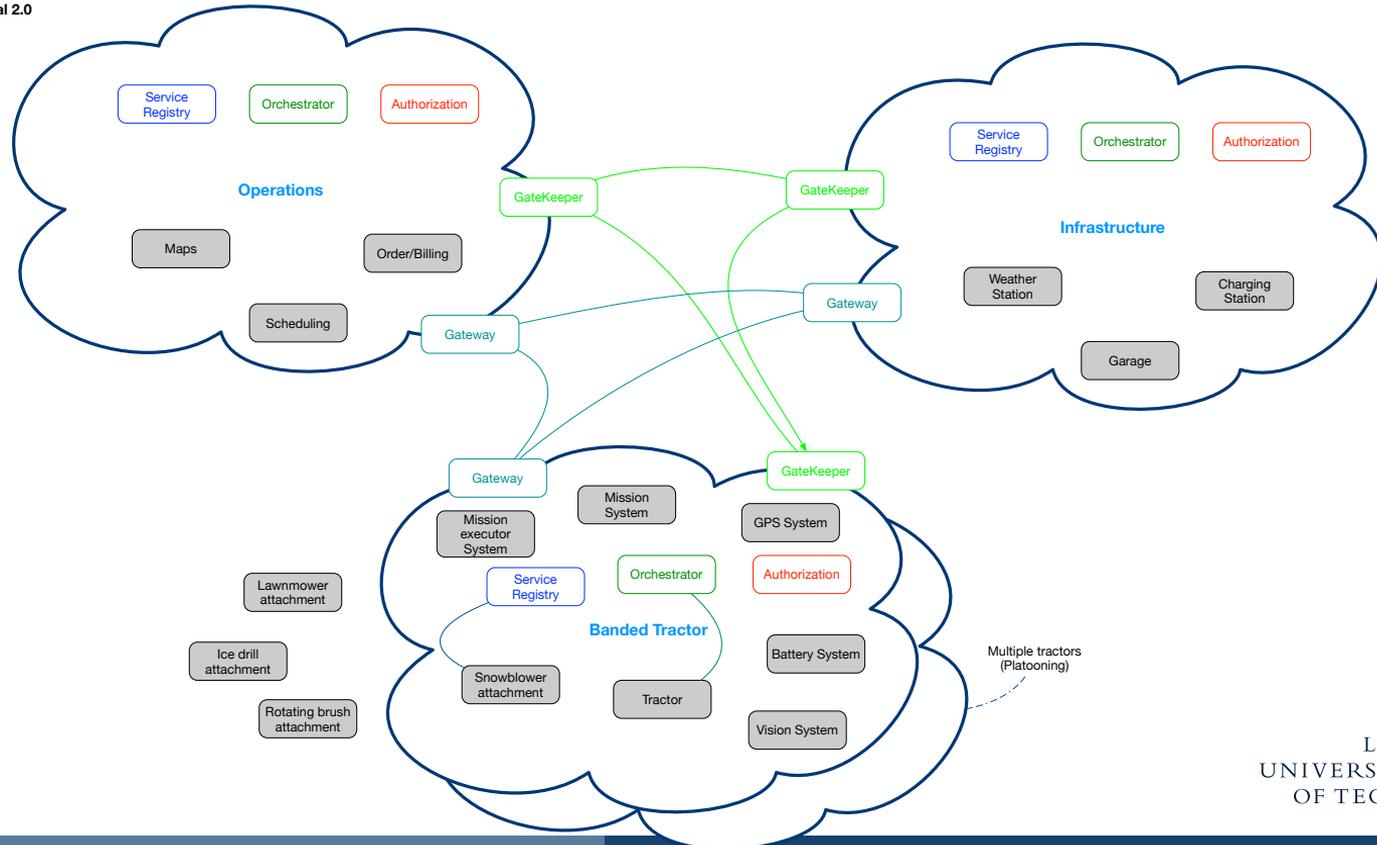


- ABS, Traction Control
- Hardware in the loop



Systems of Systems for Tractors

Snow Removal 2.0



Take Aways

- The Eclipse Arrowhead framework integrates other IoT solutions for a seamless, secure, and unified operation with low latency.
- It is being applied and used to
 - Industry
 - Smart cities
 - Vehicles
- It supports different types of digital twins and AI at the edge.
- There is a commercial ecosystem to support its availability.

Questions





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