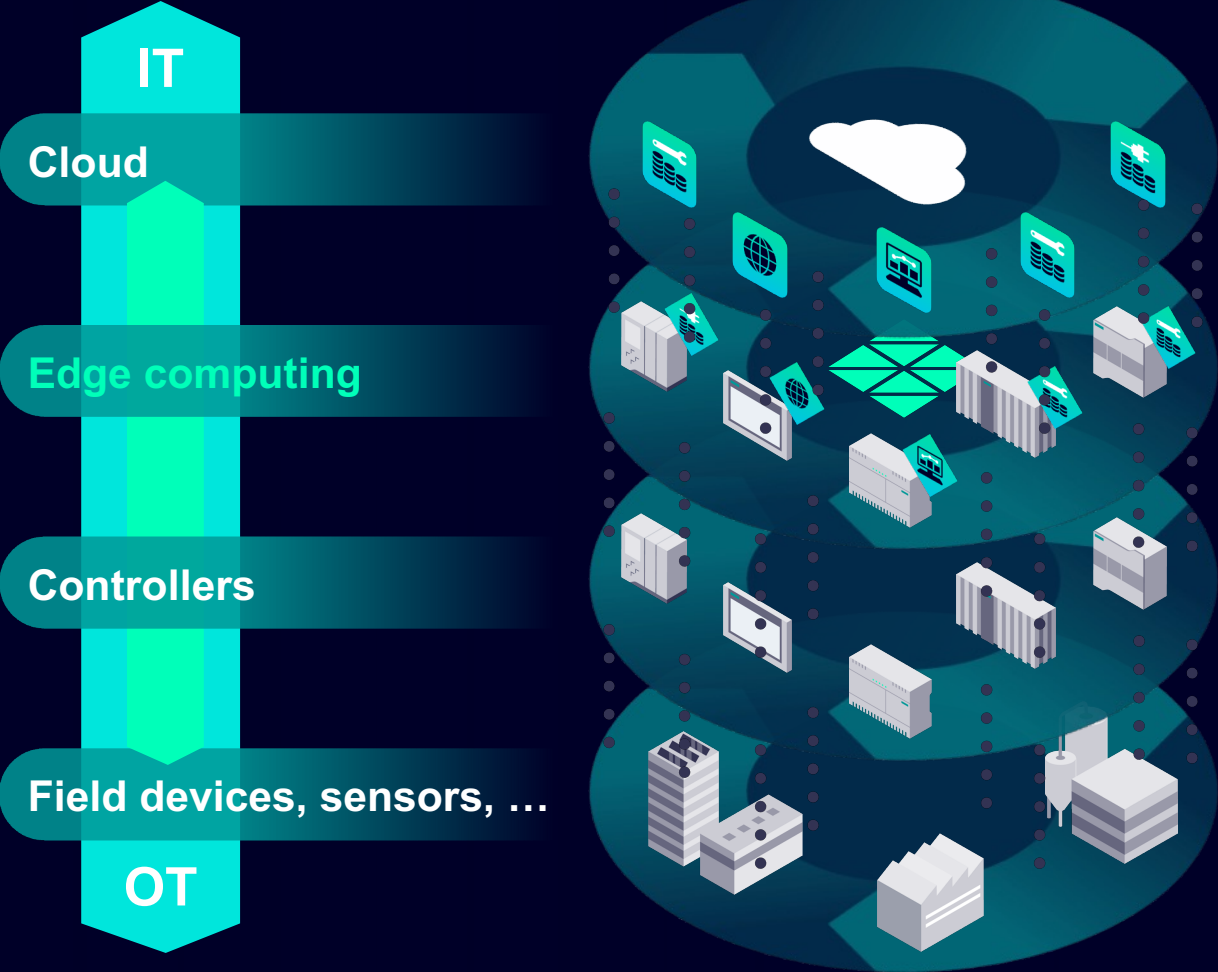




# OpenLab – Technical Workshop Connectivity and Edge

Dr. Christian Kern

# Industrial Edge



Decentral computing & storage with device runtime, apps and central management

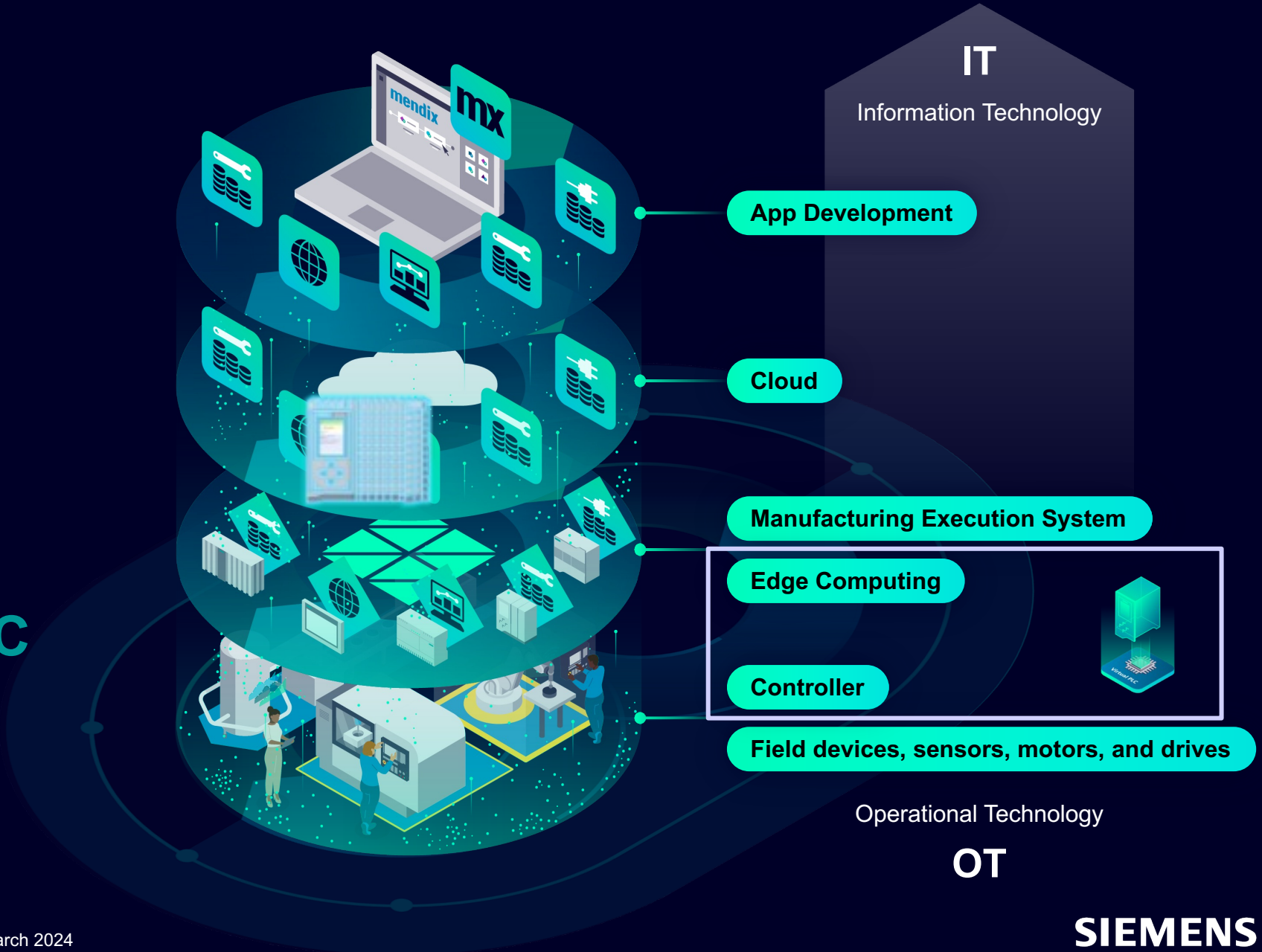
# Virtual PLC

Data intelligence for data-driven decision making

## Bringing together OT and IT

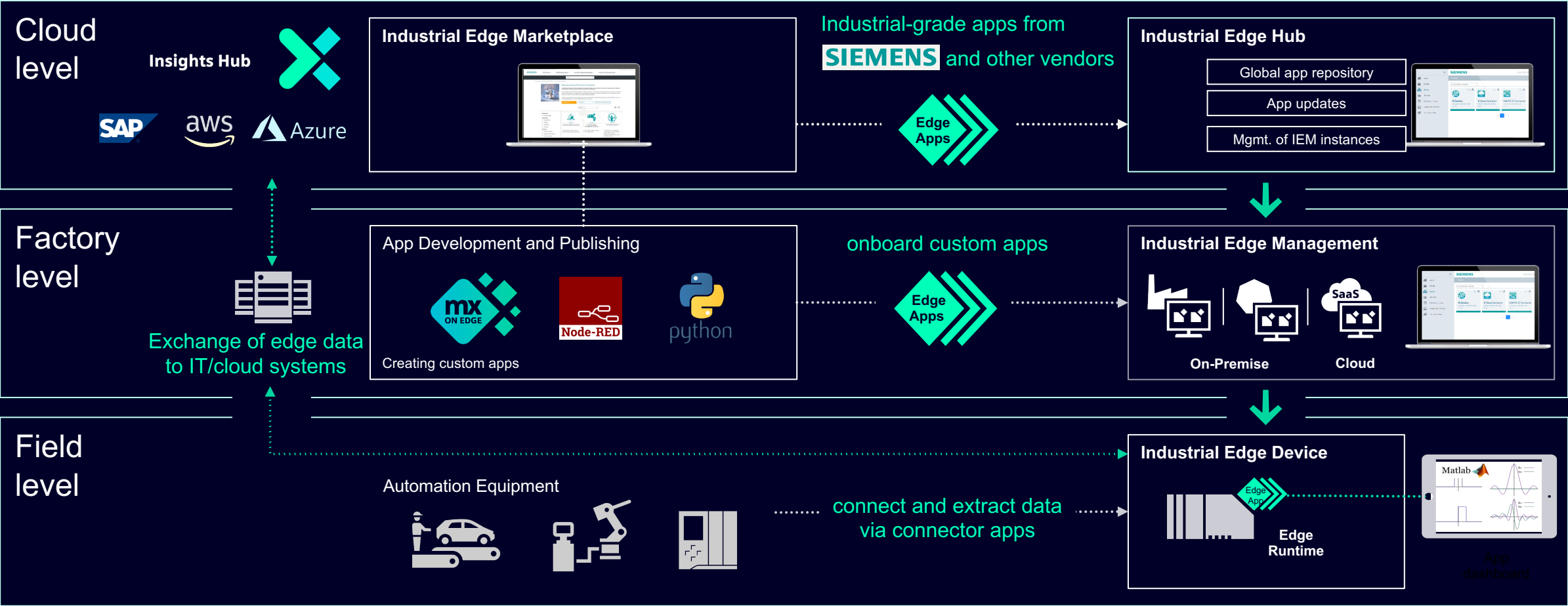
## From Sensor to Edge to Cloud

## A new virtual S7 PLC App at SIEMENS Industrial Edge





# Industrial Edge Blueprint Architecture



# Selected industrial-grade applications from Industrial Edge Ecosystem

Everything centrally manageable for highest scalability

**Shopfloor to cloud connectivity, local data acquisition and pre-processing**



The illustration shows a factory floor with a laptop in the foreground displaying a 'Cloud Connectivity' icon. In the background, there is a factory machine connected to a cloud icon, with data lines indicating connectivity and data flow.

**Central App & Device Management; Bring your own Apps to shopfloor (e.g., with Mendix)**



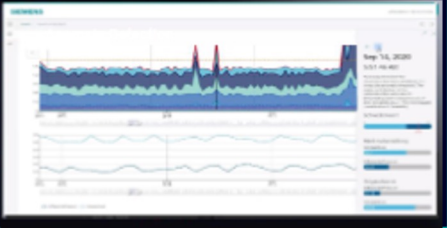
The illustration features a laptop on the left with 'Low code' written on its screen. To the right, a factory floor is shown with a cloud icon and a circular arrow indicating a process or management cycle.

**Production performance and resource/energy consumption analytics**



The illustration depicts a factory floor with a laptop in the foreground showing 'OEE' (Overall Equipment Effectiveness) analytics. The laptop screen displays a line graph and a bar chart. In the background, there are factory machines and several floating icons representing different metrics like '24h', 'checkmark', and 'diamond'.

**Detect anomalies based on data patterns (torques, currents and voltages, temperature, ...)**



The screenshot shows a Siemens software interface with a line graph displaying data patterns. A red vertical bar highlights a specific point on the graph, indicating an anomaly. The interface includes various data points and a legend.

**AI supported quality prediction or process optimization (Predictive Services)**



The illustration shows a factory floor with a laptop in the foreground displaying 'AI' (Artificial Intelligence) icons. A magnifying glass is positioned over a data point on the laptop screen, symbolizing quality prediction or process optimization.

**Virtualized automation landscapes HMI and PLC software (limited sales release)**



The illustration features a 3D isometric view of a virtualized automation landscape. It includes a blue cube with a plus sign and a 'Virtual PLC' icon on a base, representing the virtualized software environment.

# Industrial Apps for Industry: More than just an App

## Security by Default

e.g. continuous vulnerability monitoring & fixes, Virus scan, DPGA



## Privacy by Default

According to General Data Protection Reg.<sup>1</sup>

<sup>1</sup>Regulation (EU) 2016/679



## Compliance by Default

e.g. Open Software clearing, Export control clarifications



**SIEMENS**  
**Industrial Apps**  
for Industrial Edge and Insights Hub

## For Industrial users

- UX and APIs for operators, service & shopfloor IT
- Seamless integration with OT Systems
- Continuous improvements



## Global support

Global presales & after sales support e.g. Getting Started Services



## Industrial quality & warranty

- For all apps: ISO9001
- App specific: e.g. ISO50001



# The app Industrial Information Hub (IIH) is the new central data management hub on the bridging data from automation to IT



## Collect Data from OT

Flexible integration of own, 3<sup>rd</sup> Party and Siemens: >90% of all devices in the industry



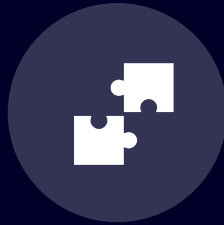
## Configure Easy

One Configurator for everything



## Integrate Data

Data pre-processing, historic capture, live access and cloud sync.



## Access Data

State of the art access via GraphQL, REST, OPC UA



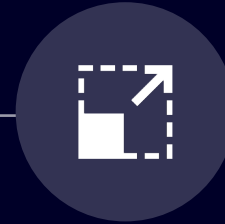
## Map OT and IT

Use any OPC UA companion spec to upgrade a brown field machine to the latest standard



## Scalability

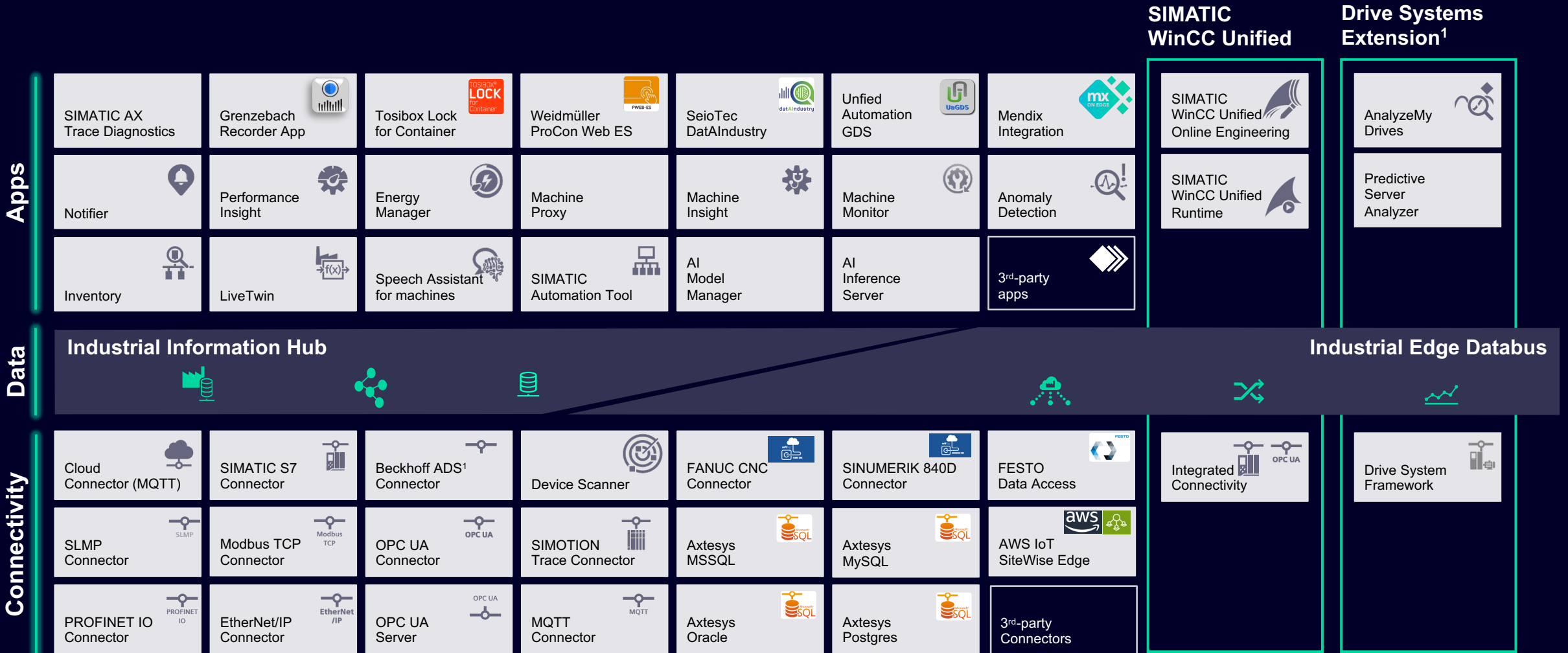
**Scale-out** by distributing Model between Nodes or **Scale-up** from constrained Devices to Cloud





# Connectivity<sup>1</sup> is the foundation for all Industrial Edge Apps

Extensive app portfolio that can combine to valuable end to end use cases



<sup>1</sup> Estimations based on available connectivity to all major vendors in the automation market

Note: as of IE Marketplace (August 2023)

# Factory Automation Control

Virtual PLC



**The world  
loves  
IT ...**

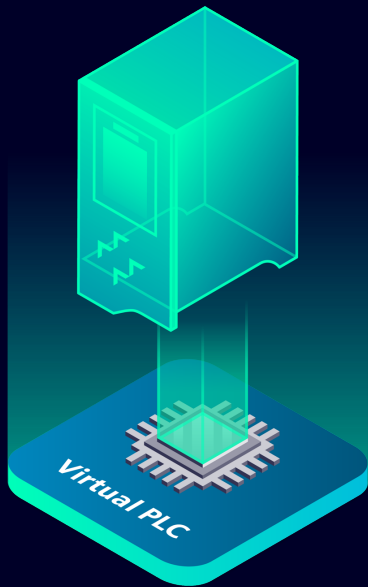
**... and  
runs  
on OT**

# SIMATIC S7-1500V

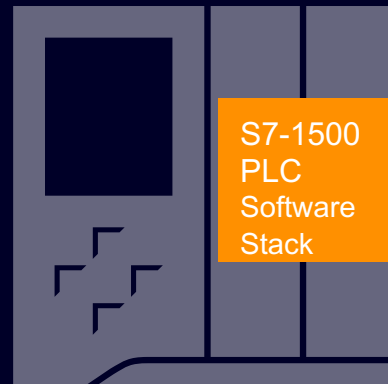
Virtual controller – the basic idea ... we bring SIMATIC on the Industrial Edge!

## S7-1500V

- **virtual SIMATIC S7-1500 PLC**
- Hardware independence
- TIA Portal compatible
- App Management over IT/Edge



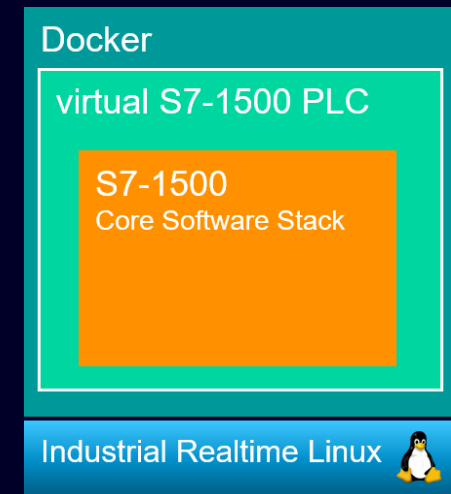
## S7-1500 PLC



## virtual SIMATIC PLC

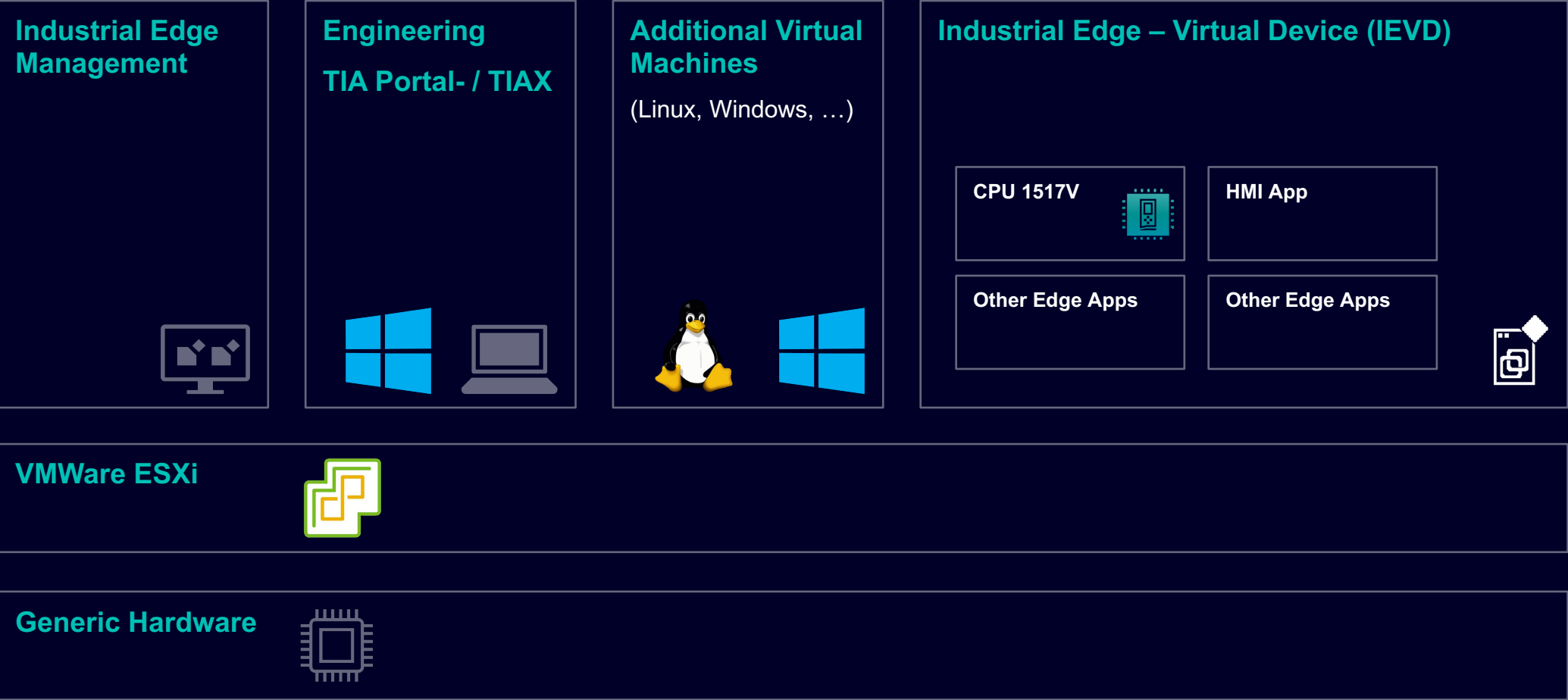
@SIEMENS Edge Runtime

### Edge App



# SIMATIC S7-1500V

## Big picture virtual Edge Device





# CERN OpenLab

Collaboration Device Management

## Siemens Technology Mission

We accelerate

**CUSTOMER**

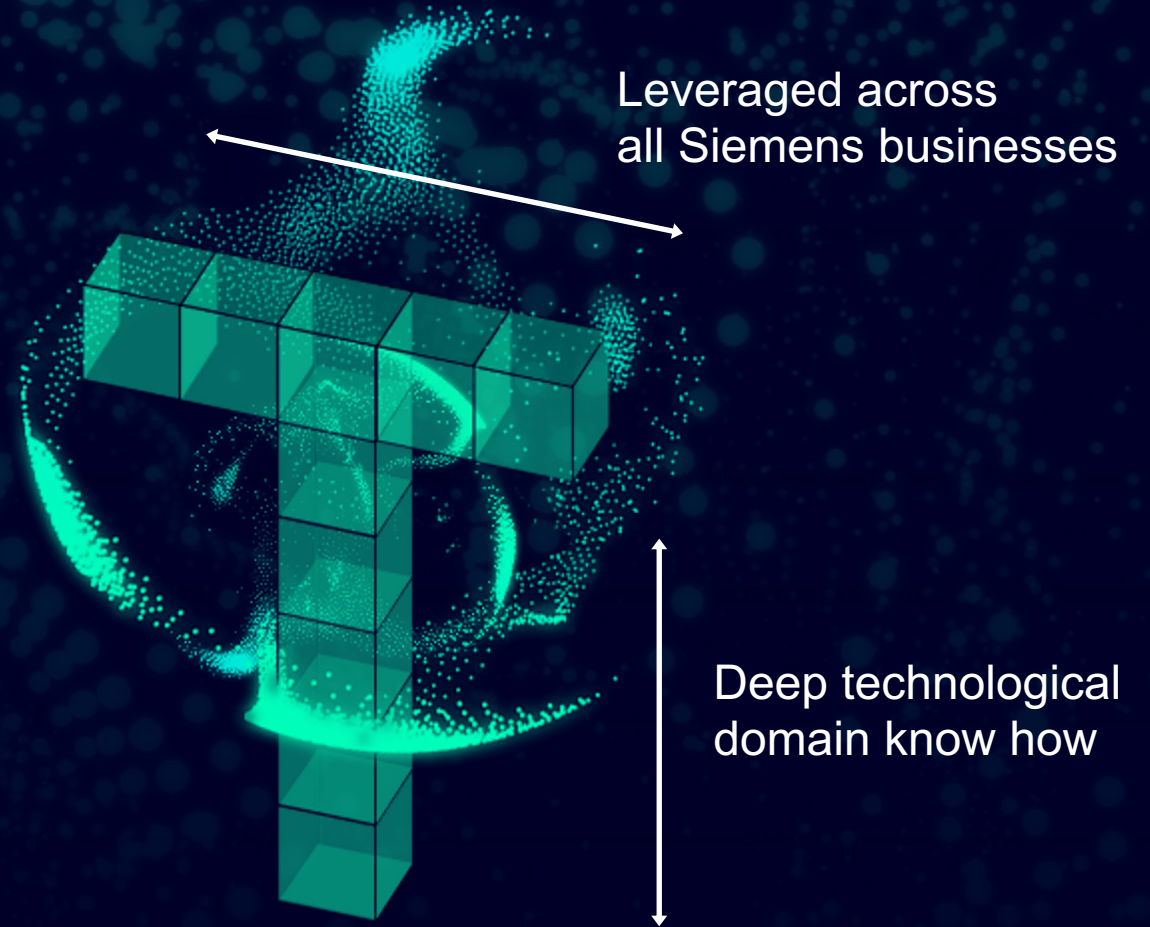
success and Siemens' growth

by **LEADING** the

development of

**TOMORROW'S**

technologies, together.





# Facts and figures on Research and Development

## Siemens group and Siemens Technology

### Research and Development at Siemens



€ 4.9 bn

Expenditures for R&D



42,500

R&D employees

### Inventions and patents – Securing our future



4,480

Inventions



2,520

Patent applications



16

Research and Innovation  
Ecosystems

### Global research collaborations

### Technology



2,100

Employees worldwide



1,700

Researchers

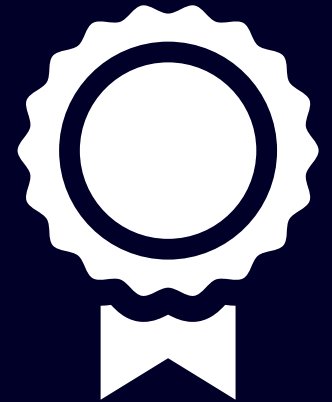


430

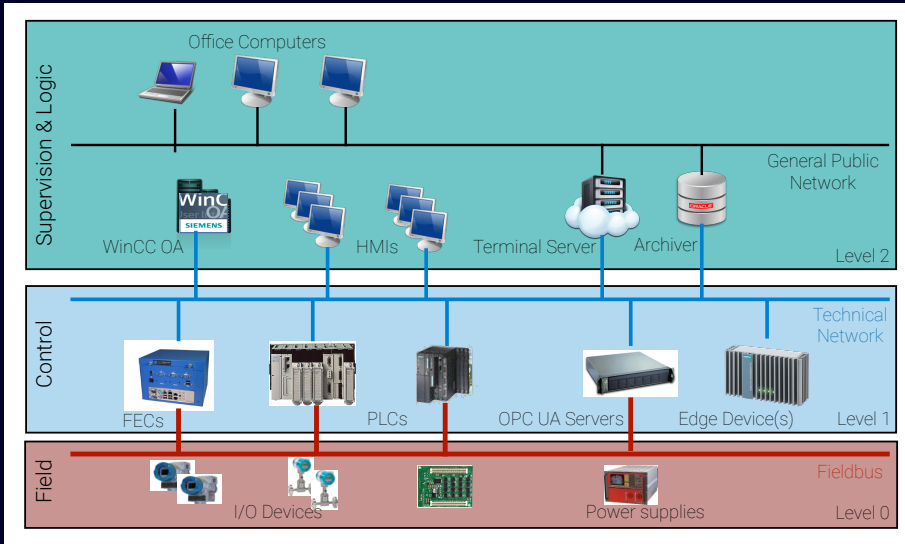
Patent experts

## Goals in OpenLab

- **Evaluate SW/HW in Real-World Context:** Test our software/hardware in an open, industrial environment beyond standard industrial settings.
- **Identify & Align:** Map CERN's challenges to Siemens' technological strengths.
- **Co-create & Innovate:** Partner with CERN to create solutions that bridge these gaps.
- **Feedback & Improve:** Implement co-developed innovations into Siemens' products.



# CERN Control System



- Heterogenous system.
- Huge deployment of PLCs.
  - 60% of PLCs sourced by Siemens.
  - Rest from vendors like Schneider Electric.
- Main difference to other industries: huge number of devices.
- Also new device classes e.g., 5G / LoraWAN connected sensor/small devices.

Category	Approximate Number
SCADA Applications	850
Industrial PCs	400
Database (Oracle)	10
PLC	1000
OPC UA Servers	200
Front-End Computers	60
Power Supplies	100
Fieldbus devices	1000
I/O device	10 Million

\* Image by CERN

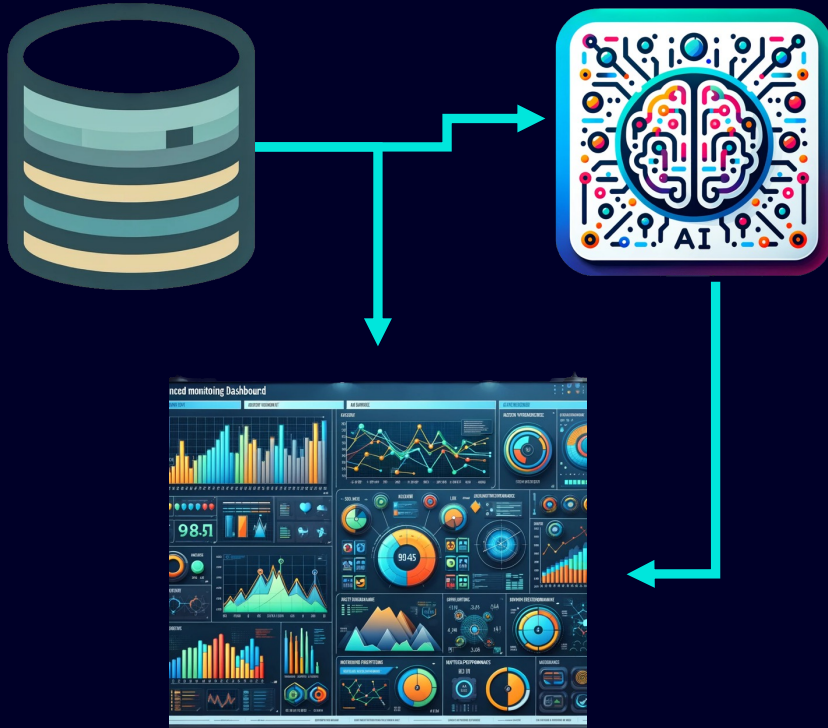
# Pain Points

Scoping revealed two major pain points.

## Ingestion of Monitoring Data

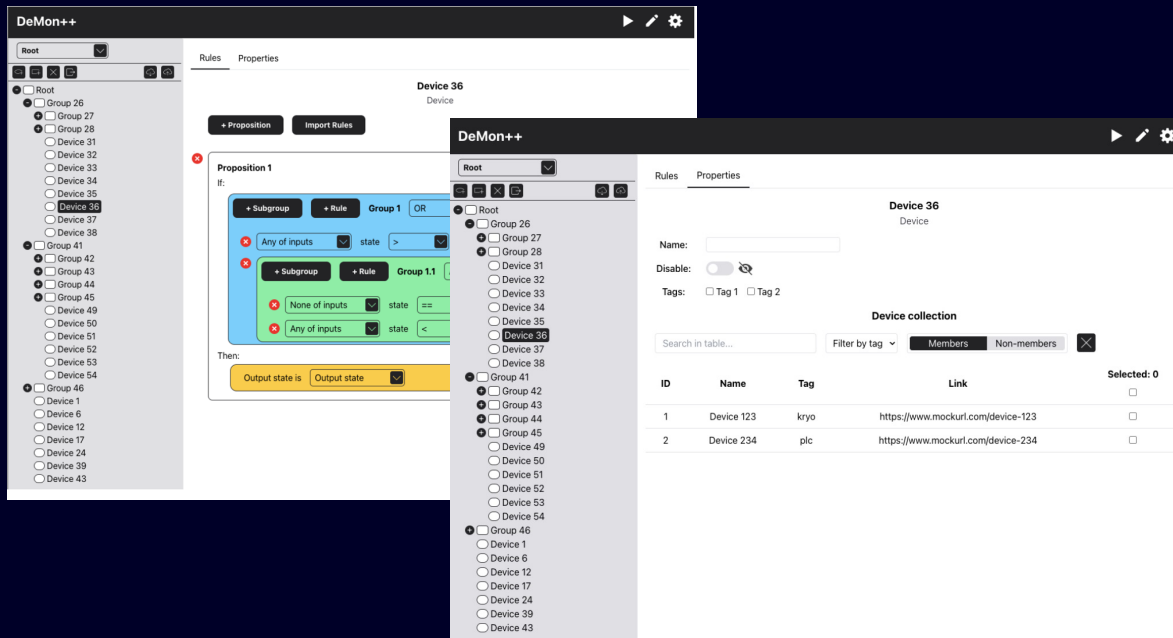


## Processing and Visualization of Data



# Processing and Visualizing Data

- No complete out-of-the-box Siemens solution yet.
- CERN + Siemens Master student developed PoC covering white spots (frontend and backend).



DeMon++: A framework for designing  
and implementing Distributed Monitoring  
Systems based on Hierarchical Finite State  
Machines

Master of Science (Tech) Thesis  
University of Turku  
Department of Computing  
Robotics and Autonomous Systems  
2023  
Lorenzo Morelli

Supervisors:  
Prof. Tami Westerlund  
Christian Kern

The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Turnitin OriginalityCheck service.

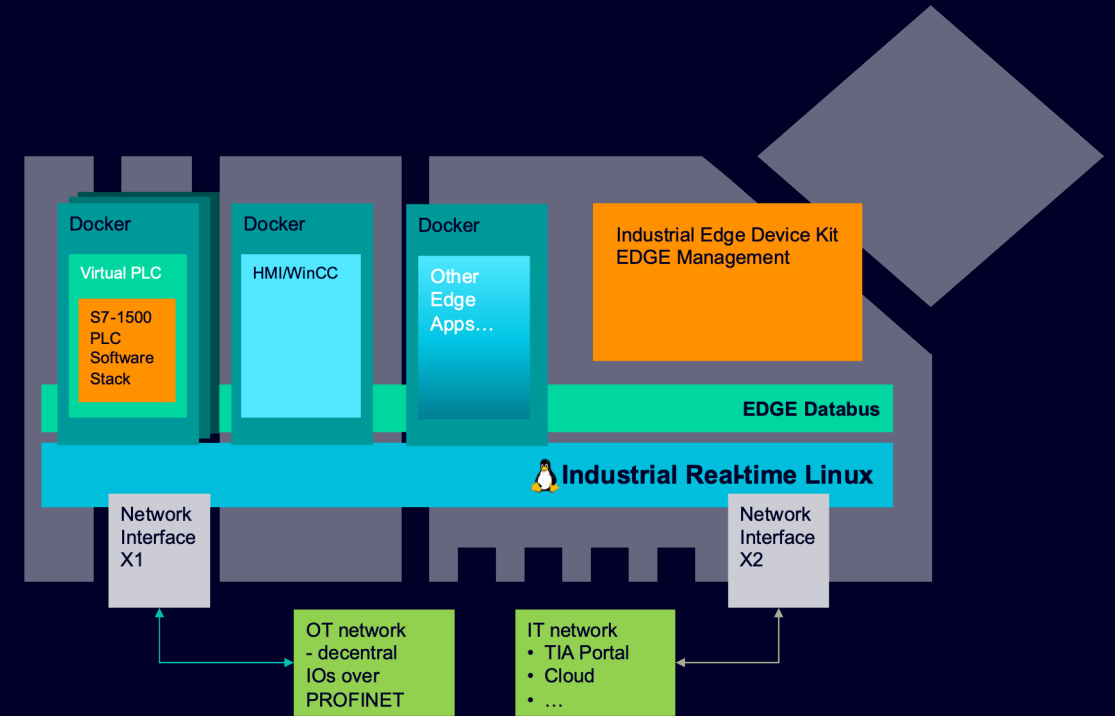
# Co-creation with Industrial Edge

- Machine Insight:
  - Industrial Edge App for the monitoring of PLCs.
  - Evaluated previous year by CERN.
  - Valuable feedback received.
- Collaboration is highly beneficial due to...
  - ...varied nature of CERN's infrastructure.
  - ...e.g., multiple devices vendors and hardware versions.
- Upcoming: co-create on functionality extensions.



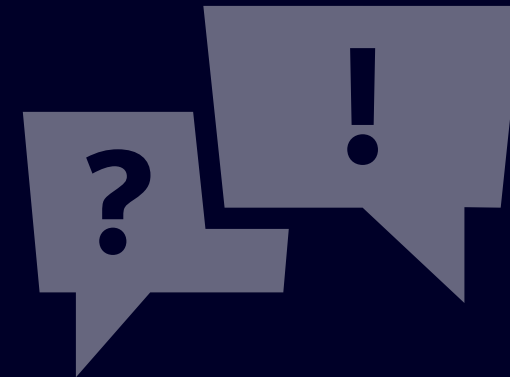
## Evaluation vPLC @ CERN

- We received great customer feedback for the vPLC.
- CERN allows us to evaluate the vPLC...
  - ...transparently and open.
  - ...in a large deployment, with many use-cases.
- Ideal candidate:
  - Massive number of PLCs.
  - Various requirements and control applications.
  - Potentially upcoming new accelerator:
    - Requires more flexible and larger setup.
    - Virtualization of control could be helpful.



## Summary and Outlook

- Previous year: collaboration with CERN on device monitoring.
- This year:
  - Co-creation on device monitoring.
  - Evaluation of the Virtual PLC.
- Next 3-year collaboration in preparation.





# | Contact

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