
F5G USE CASES FOR INDUSTRIAL AUTOMATION

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Digital Transformation of Industrial Automation

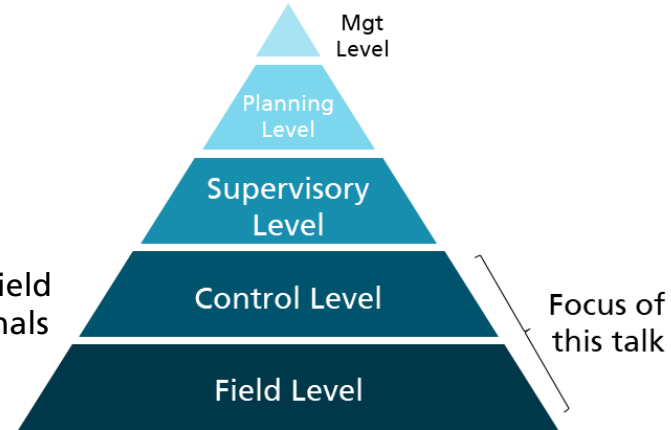
The Role of Edge Clouds

■ Field Level

- physical manufacturing equipment on the factory shop floor such as motors, actuators, video cameras and other sensors.

■ Control Level

- receives sensor and monitoring information from the devices in the Field Level. Based on that information, decisions are taken and control signals for the devices in the Field Level are generated, e.g. by using Programmable Logic Controllers (PLC).



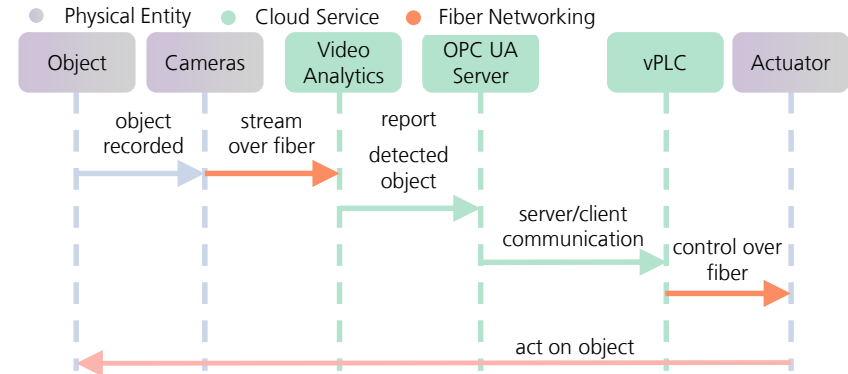
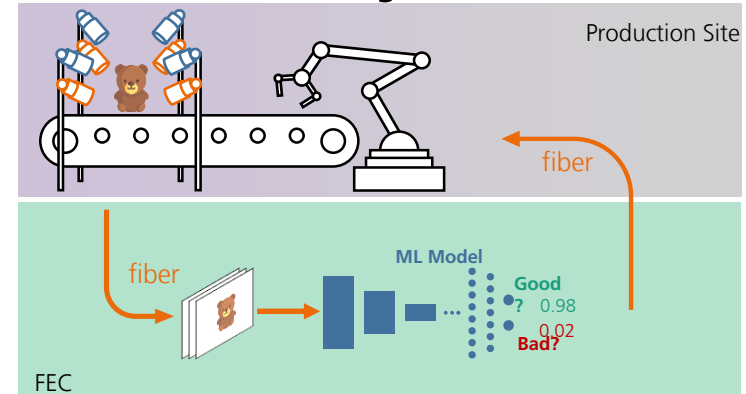
- The current trend is towards virtualization of control functions in the form of virtual PLCs (vPLC) running in edge cloud environments.

- vPLCs alleviates the need for costly and often proprietary solutions for local PLCs on the shop floor, where cooling, power consumption, space and environmental effects are critical issues.

→ Convergence of OT and IT

Edge/Cloud-based Visual Inspection for Quality Assessment of Products

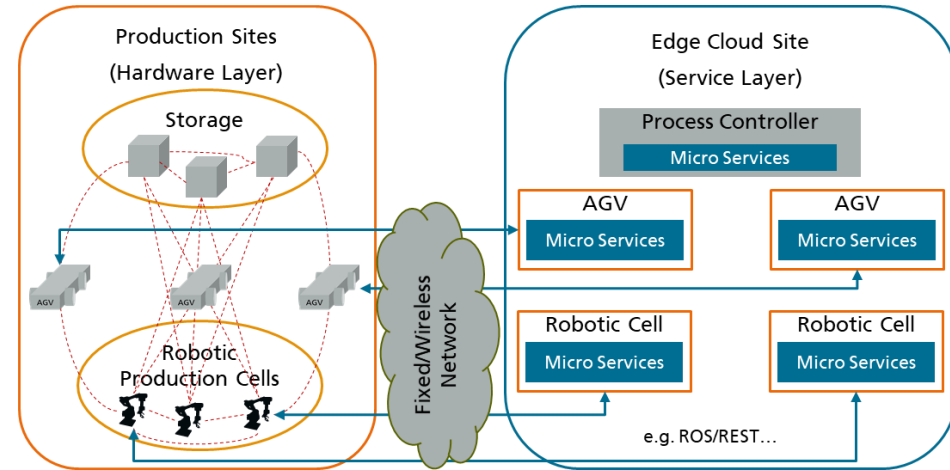
- Industrial-grade video cameras monitor produced objects and video streams are processed by AI-assisted video analytics on edge cloud to assess their quality.
- Automatic quality control measures are taken on the factory shop floor, such as e.g. controlling robotic actors to handle defect parts.
- The number of cameras per vision inspection station ranges from one to four.
- The upstream aggregated data rate per vision inspection station ranges from 1 Gb/s to 20 Gb/s.
- The data rates are asymmetric, since the downstream control signals have a comparably negligible data rate.



[ref] P. Safari, et al., "Edge Cloud based Visual Inspection for Automatic Quality Assurance in Production," in Proc. CSNDSP 2022.

Edge/Cloud-based Control of Automated Guided Vehicles

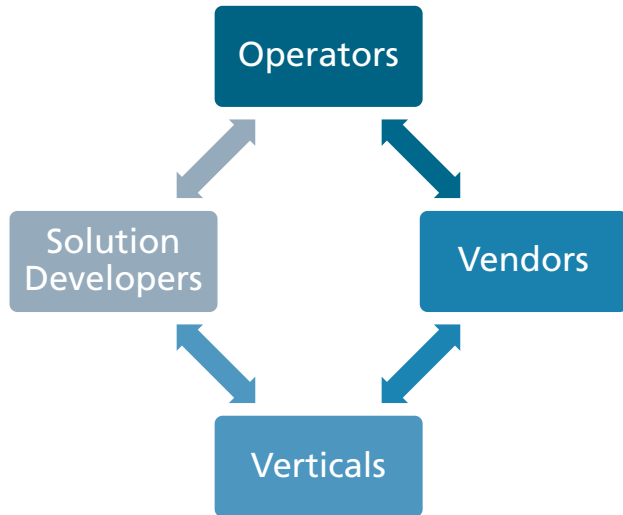
- AGVs perform transportation of goods to and between robotic production cells.
- AGVs and robotic cells provide individual sets of microservices, which are hosted on an edge cloud.
- The navigation of the AGVs is performed on the edge cloud by a guidance control system.
- The end-to-end roundtrip latency between AGV → edge data centre → AGV needs to be less than 30 ms including processing.
- The data rate for control messages is about 400 kbit/s per AGV, while transmission of video from the AGV to the cloud may require 10 Mbit/s or greater.



Typically, navigation requires 16 CPU Cores, 32 GB RAM and 200 GB HD per AGV. For additional services such as object detection and localization an additional GPU is required.

Enable Twin Transition through Ubiquitous Fiber Connectivity

F5G OpenLab



F5G Alliance

Ecosystem Development
Raise and Verify Use-cases
Participate in Trade Shows

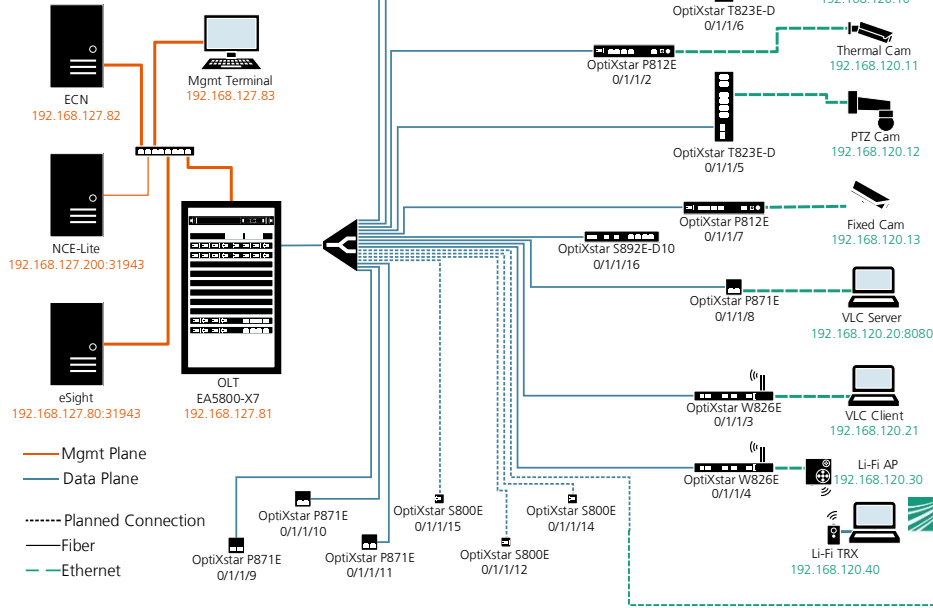
F5G OpenLab – Development and Demonstrations

Investigates Use-cases, Demonstrate F5G Technologies,
Showcase F5G PoCs

ETSI ISG F5G – F5G Standards Development

Generation Definition, Use-case Documentation, Architecture Definition, E2E Management

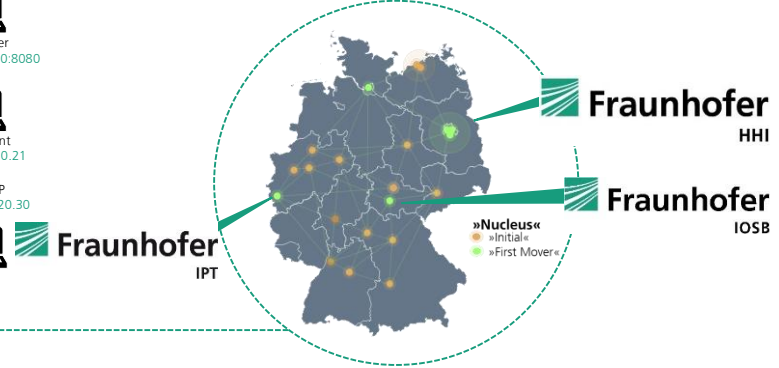
F5G OpenLab



Manufacturing Sites

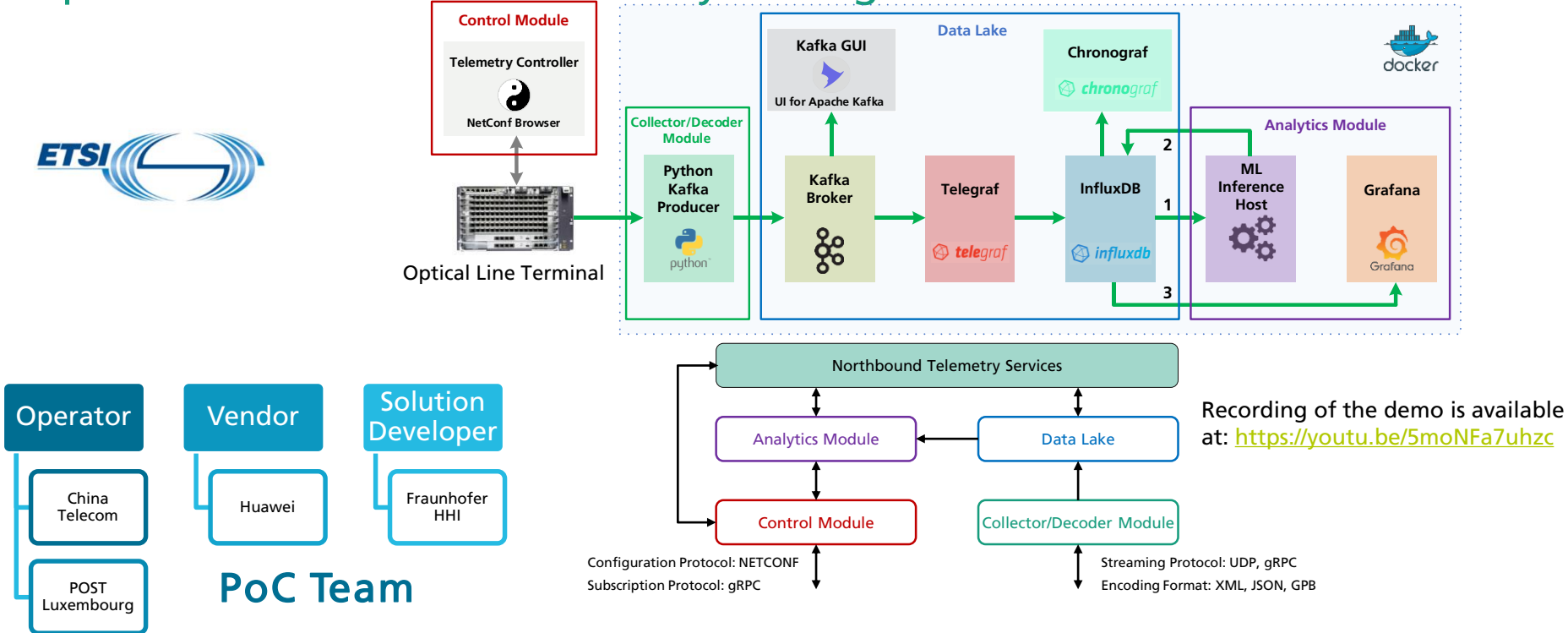


Fraunhofer Edge Cloud (FEC)



F5G PoC: Precise Traffic Monitoring for Analysis and Prediction

Implementation of F5G Telemetry Management Platform



[ref] M. Balanici, et al., "Demonstration of a Real-Time ML Pipeline for Traffic Forecasting in AI-Assisted F5G Optical Access Networks," in Proc. ECOC 2022.

Conclusions and Outlook

- Use cases for industrial automation pose very challenging requirements on the communication infrastructure
 - Time sensitive, cyclic communication with low latency and jitter
 - Potentially high bandwidth, data Privacy, security and reliability
- F5G OpenLab offers a unique opportunity to operators, vendors, and technology developers to test and validate their solutions.
- We carried out the first successful PoC demonstration together with POST Luxembourg, China Telecom, and Huawei.
- PoC demonstration of more use cases are in preparation.
 - Edge/Cloud-based visual inspection for quality assessment of products
 - Edge/Cloud-based control of automated guided vehicles

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WE PUT SCIENCE INTO ACTION.

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