

F5G USE CASES FOR INDUSTRIAL AUTOMATION

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OVERVIEW

- Transformation of Industrial Automation
- Exemplary use case:
 - Vision Inspection for quality assurance
- Testbed for industrial communications
- Initial experimental investigations
- Distributed Intelligence
- Conclusions and Outlook

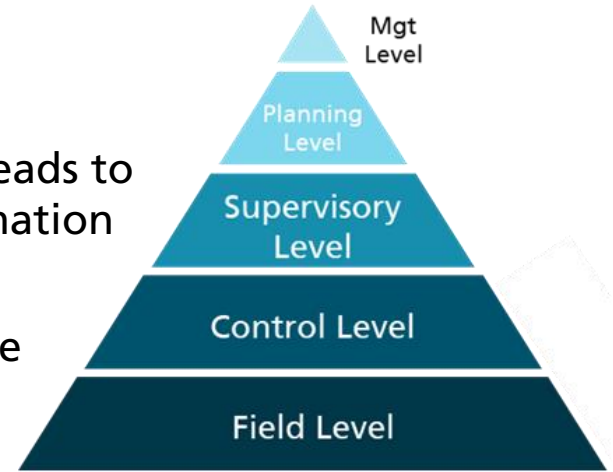


Simon Tschöke, Christoph Hübner,
Moritz Chemnitz, Paul Chojecki,
Frederic Lynker, Marc Emmelmann,
Pooyan Safari, Behnam Shariati

Twin-Transition of the Manufacturing Industry

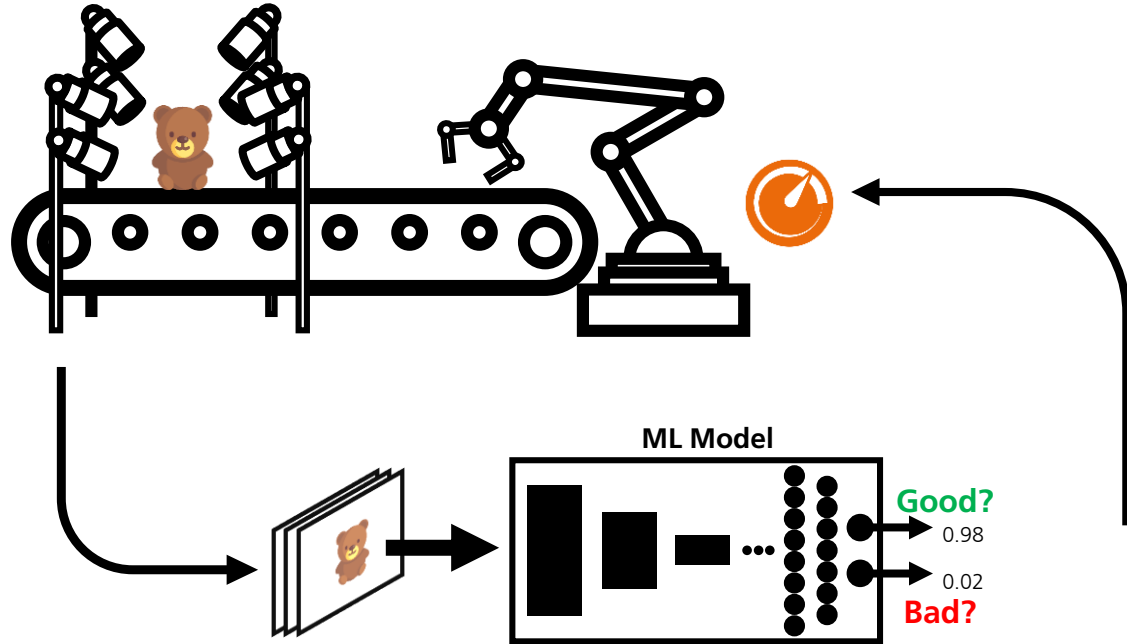
Digital Transformation and Green Transition

- Reduction of energy consumption and carbon footprint
- The digital transformation of manufacturing processes leads to convergence of Operational Technology (OT) and Information Technology (IT)
 - Field Level: Physical manufacturing equipment on the factory shop floor (motors, actuators, video cameras and other sensors)
 - Control Level: Receives sensor and monitoring information from 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)
 - **Trend** is towards virtualization of control functions (virtual PLC) running in edge cloud environments



Vision Inspection for Quality Assurance

- Industrial-grade video cameras monitor produced objects
- The video streams are processed by AI-assisted video analytics to assess the quality of the produced parts
- automatic quality control measures are taken on the factory shop floor, such as e.g. controlling robotic actors to handle defect parts.

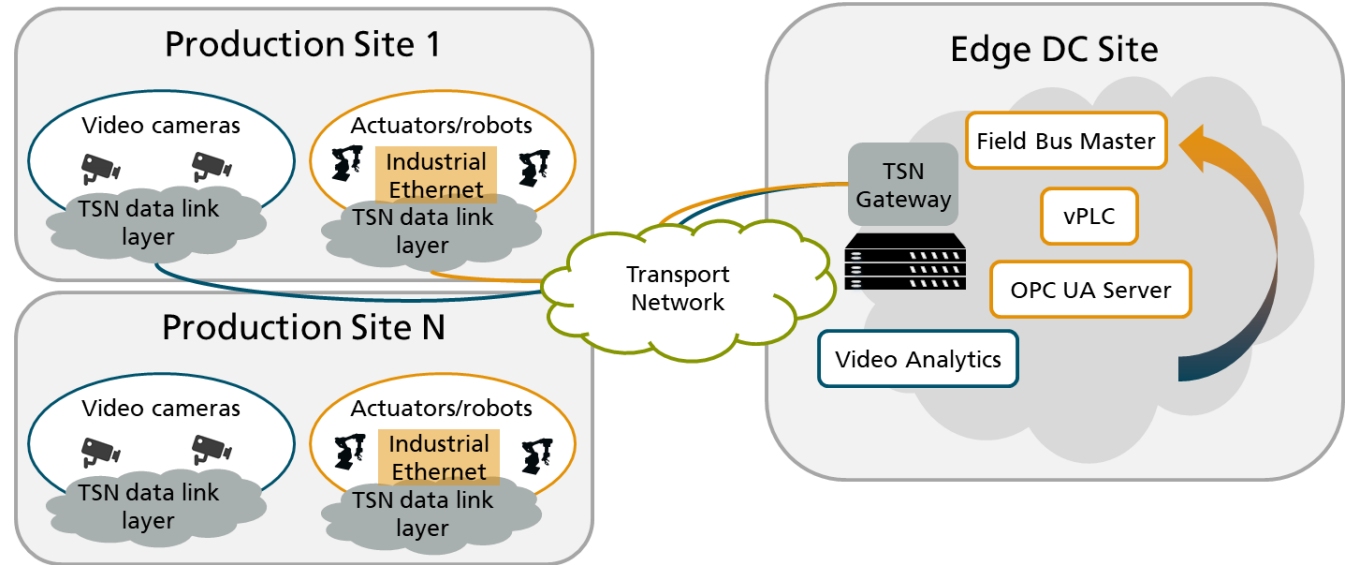


ETSI ISG F5G Use Case

Cloud-based visual inspection for automatic quality assessment in production*

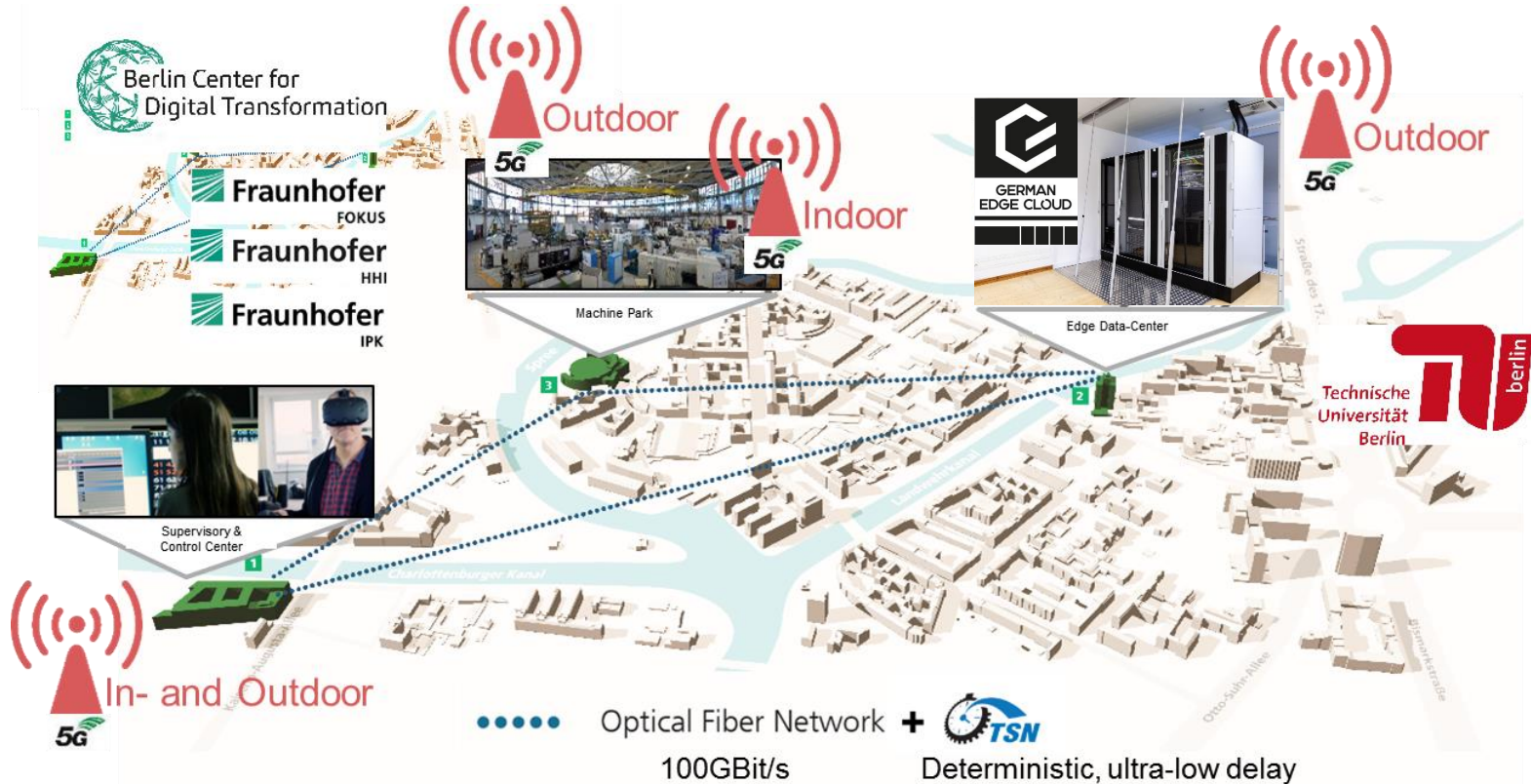
Typical vision inspection applications require **maximum cycle times of 5-10 ms**, while some very time-critical vision inspection scenarios may even require **2 ms or less**.

Data rate per vision inspection station:
1 Gb/s – 20 Gb/s

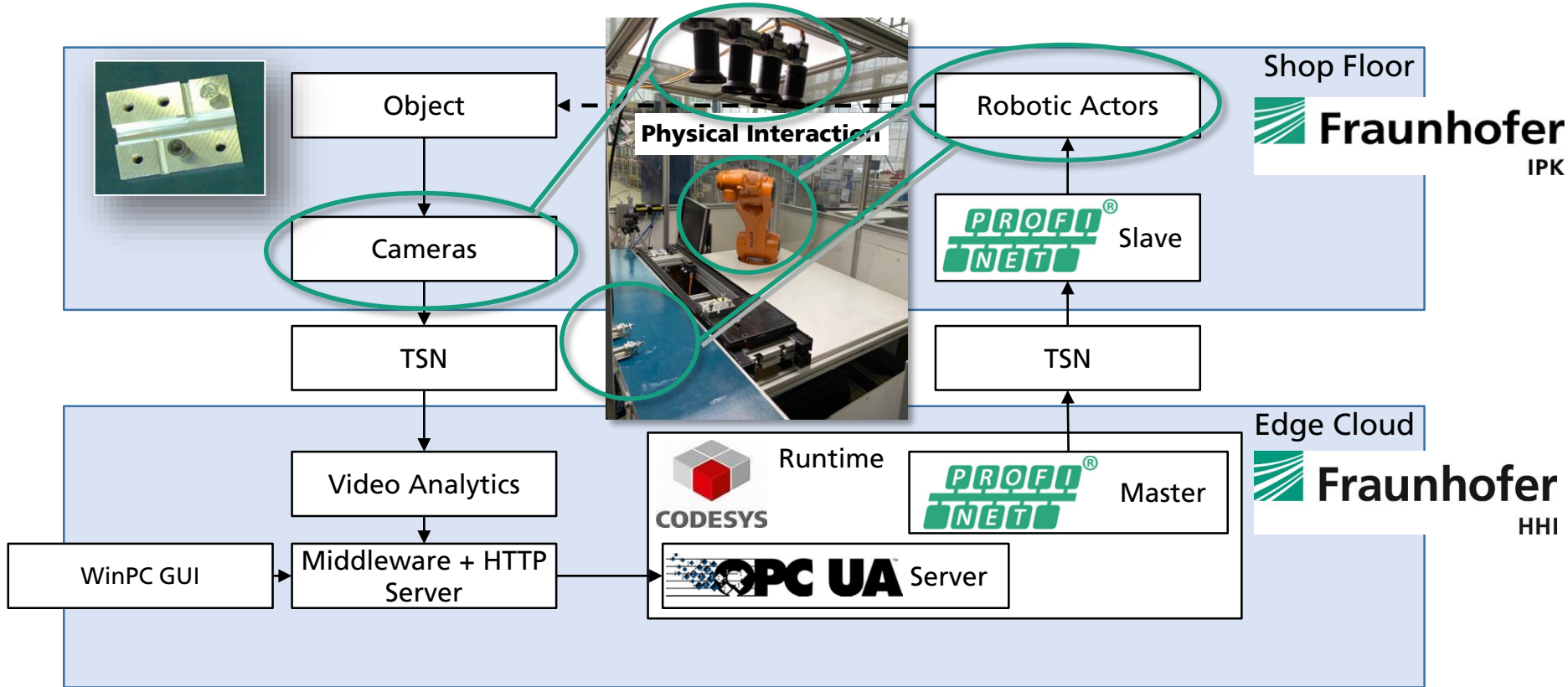


* ETSI GR F5G 008, V1.1.1, "F5G Use Cases Release #2", June 2022.

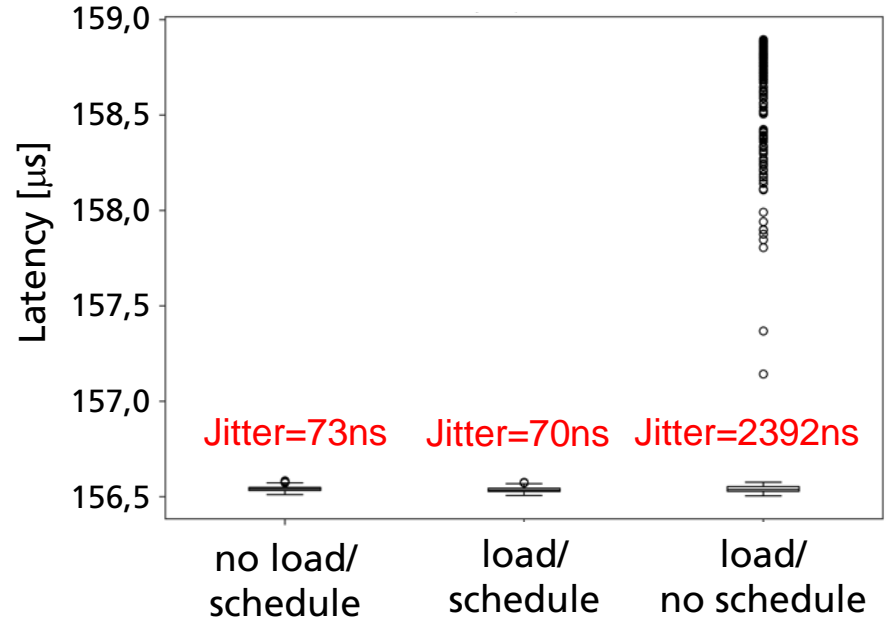
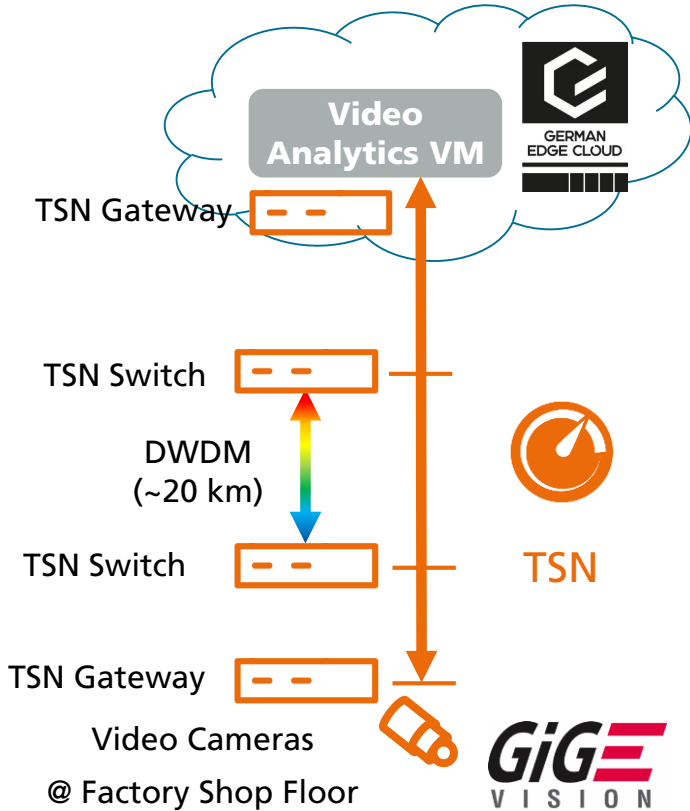
Urban Area Testbed for Industrial Communications



Vision Inspection End-to-End Control Loop

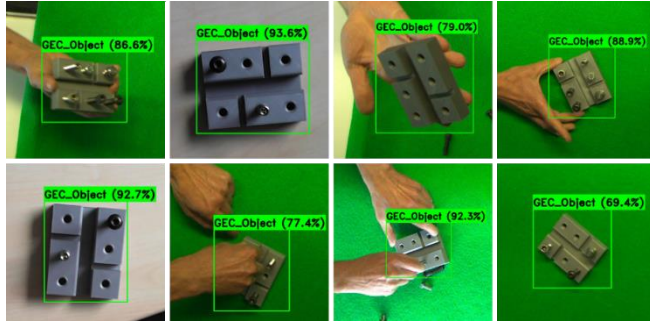


TSN-over-Fiber Latency Measurements - Setup

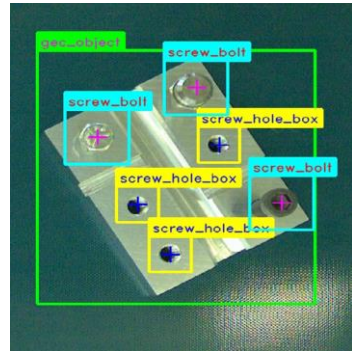


Distributed Intelligence

Distributed ML for Communication-Efficient Privacy-Preserving Training

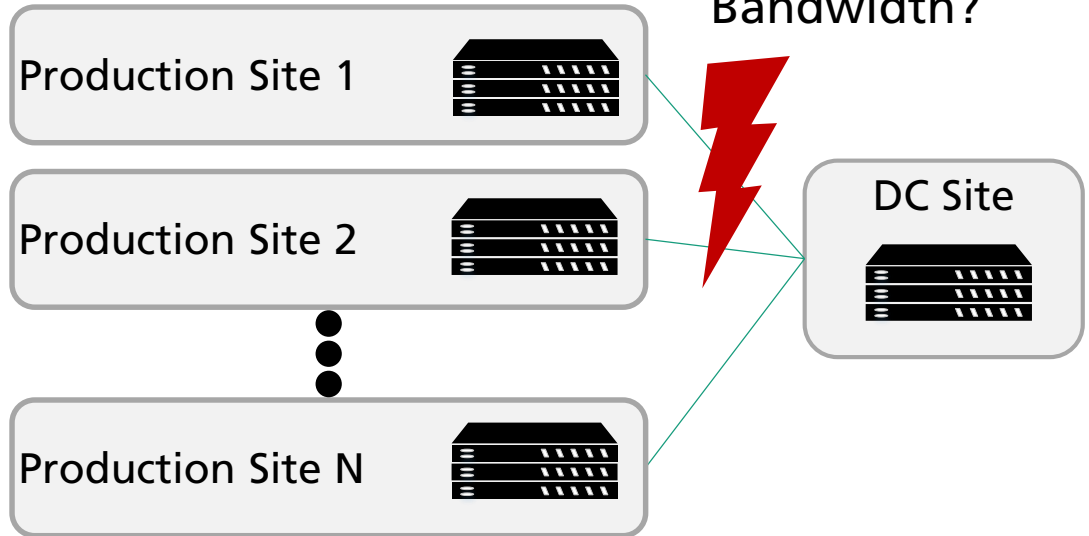


Object
Detection



Object
Verification

On-premises Edge



Distributed Learning Framework - DLFI

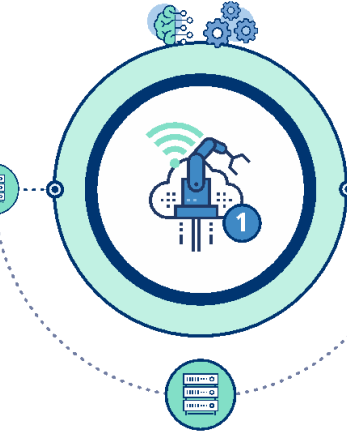
Modular, Pluggable, and Cloud Native

- Comprises Training Coordinator Node (**TCN**) and Edge Contributor Node (**ECN**)
- Reduces the amount of transported data
- Protects the privacy of data owners
- Supports different downstream tasks and GPUs

Edge Contributor Node 2
(Production Site)



Edge Contributor Node 1
(Production Site)



Edge Contributor Node 3
(Production Site)



**Demo @
Fraunhofer
Booth 311**

Training Coordinator Node
(DC Site)



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
- Open Lab for F5G technologies in Berlin
 - First ETSI ISG F5G Proof-of-Concept (PoC) completed in Open Lab*
 - Proof-of-Concepts for more use cases, e.g. cloud-based navigation and control of Automated Guided Vehicles (AGV)

* Demo Zone, Foyer 3rd Floor, Tu2.5: "Demonstration of a Real-Time ML Pipeline for Traffic Forecasting in AI-Assisted F5G Optical Access Networks", Tuesday, 10:15–15:45

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WE PUT SCIENCE INTO ACTION.

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