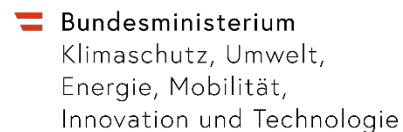


Application of FLEDGE at Neuman Aluminium: An Industrial Use Case

Sebastian Kropatschek, Thorsten Steuer



Austrian Center for Digital Production

Neuman Aluminium

Application Scenario

Architecture Variants

Roadmap

Mapping Vision to Architecture

Application of Fledge

Transaction Manager

State Management

Demo

Learnings

Feedback Develop and Debug FLEDGE Plug-Ins

1

Digital Engineering

- Merge Design & Manuf.
- Data Driven Design
- Digital Twin Fidelity
- „Wear-aware“ CAM

2

Adaptive Manufacturing & Smart Factories

- Reconfigurability
- Process Adaptability
- Predictability
- Shop Floor OS

3

Process-Based Manufacturing Orchestration

- Orchestration & Data
- Process based PLM
- Deployability (HMI)
- Data Contextualisation

4

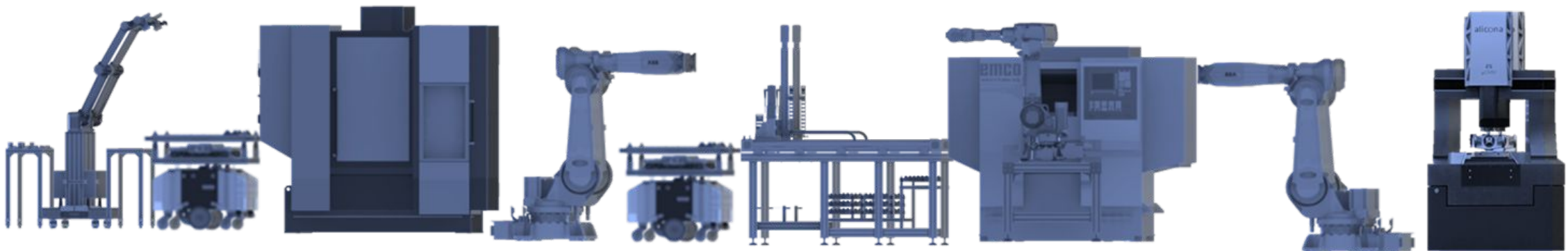
Data Integration and Analytics for Digital Production

- Interoperability
- Advanced Analytics (AI)
- PMV based Analytics
- Knowledge Graphs

5

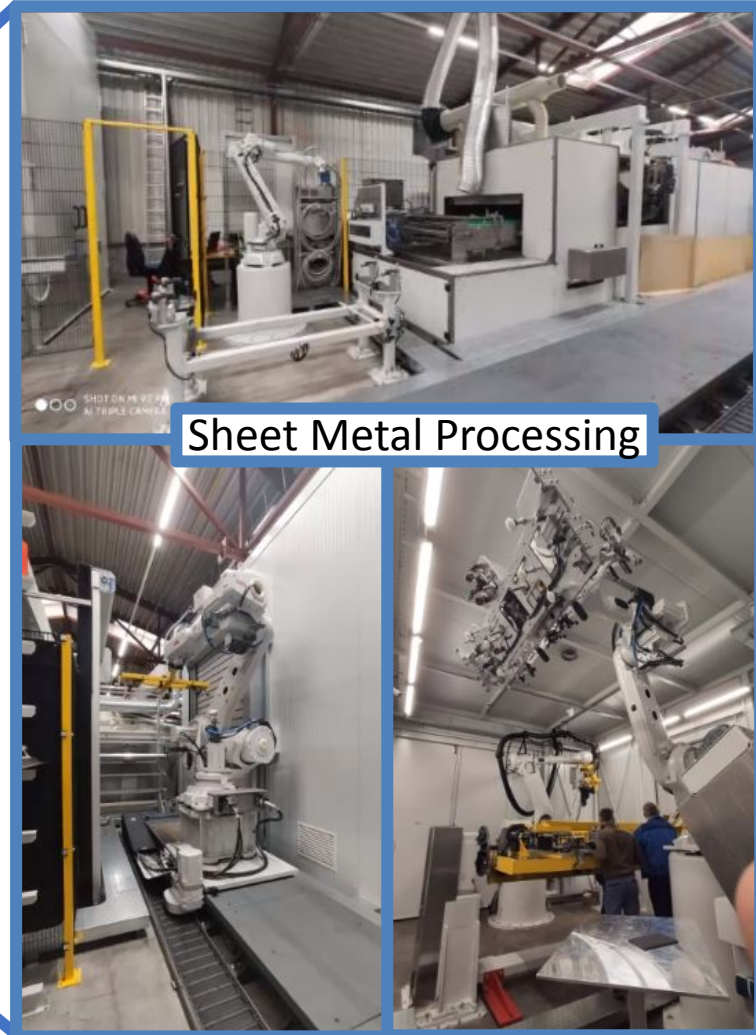
Sustainable Production Systems

- Flexible Safety
- Fail-safe Manufacturing
- Circular Economy
- Production as a Service



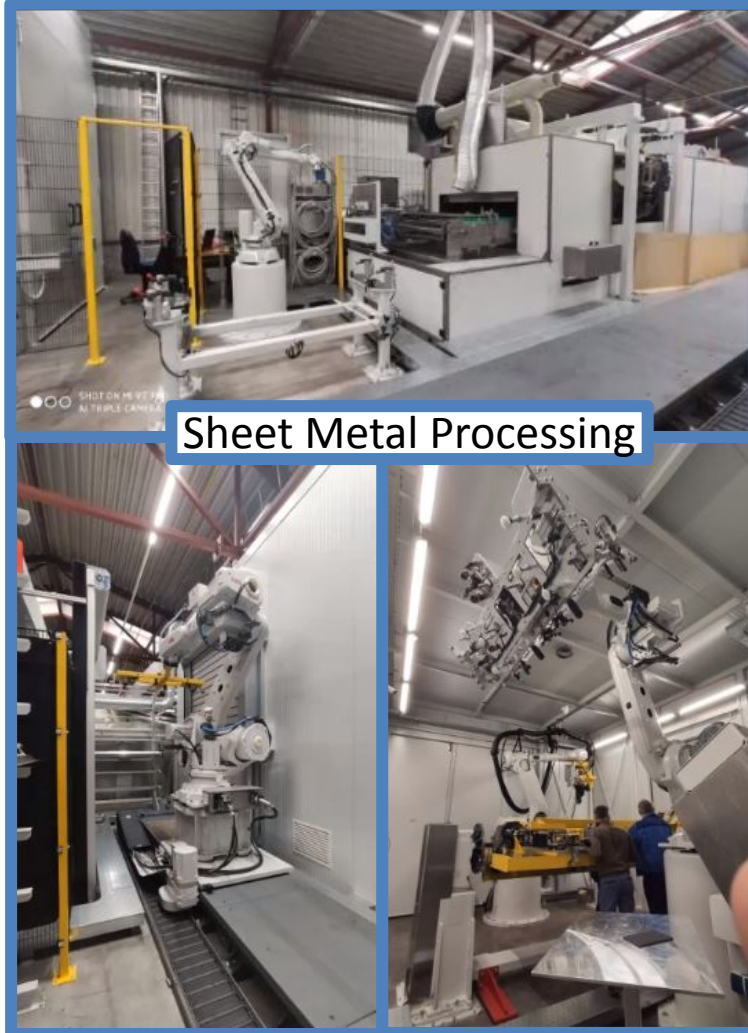


The Neuman Aluminium Group is your global partner for high-quality aluminium solutions.



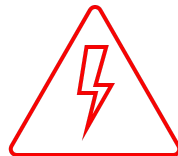
FACTS

1	10	+3000	+200	100%	570
family company	locations	employees	years of experience	enthusiasm	€ million in sales



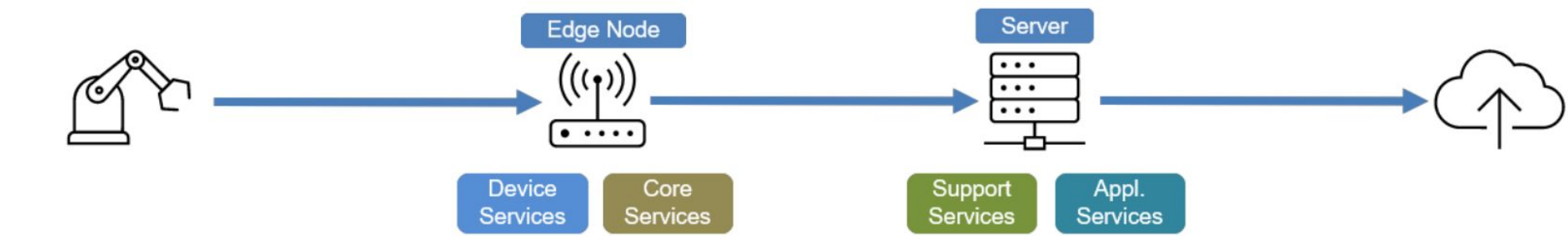
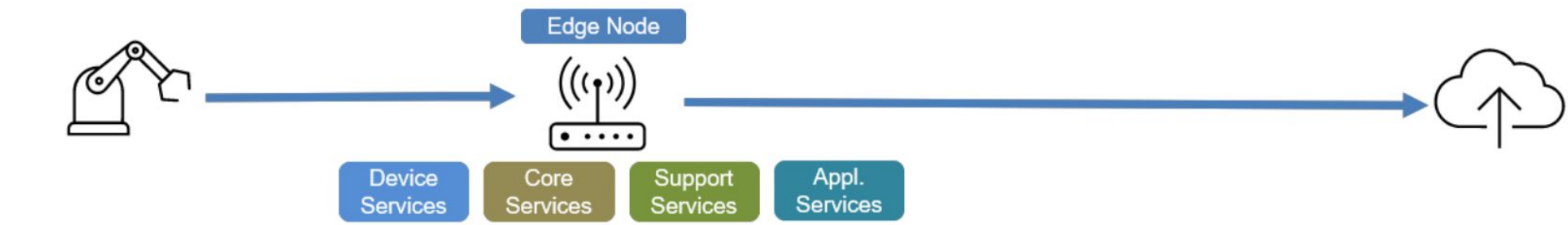
Scenario:

- Multiple Production Facilities in Europe
- Controlled by a Centralized MES
- MES Submits a Production Order to a Facility
- Machine Processes the Order and Notifies MES of Current Production Status
- MES Sends Data to a Subsequent Machine
- Once the Connection to the MES is Lost, Production will Continue as long new Input is Required



The centralized nature of the system creates a critical dependency on the network connection!

Architecture Variants



Roadmap for connected Production Systems (Neuman)



AUSTRIAN CENTER FOR
DIGITAL PRODUCTION

Open-source software stack to deliver device, core, application and supporting services for production equipment.

Self-healing, scalable, up-gradable, flexible, platform independent and offline capable edge devices.

Knowledge or/and ML driven smart edge devices to semi-autonomously control machine, forward data and adjust production equipment.

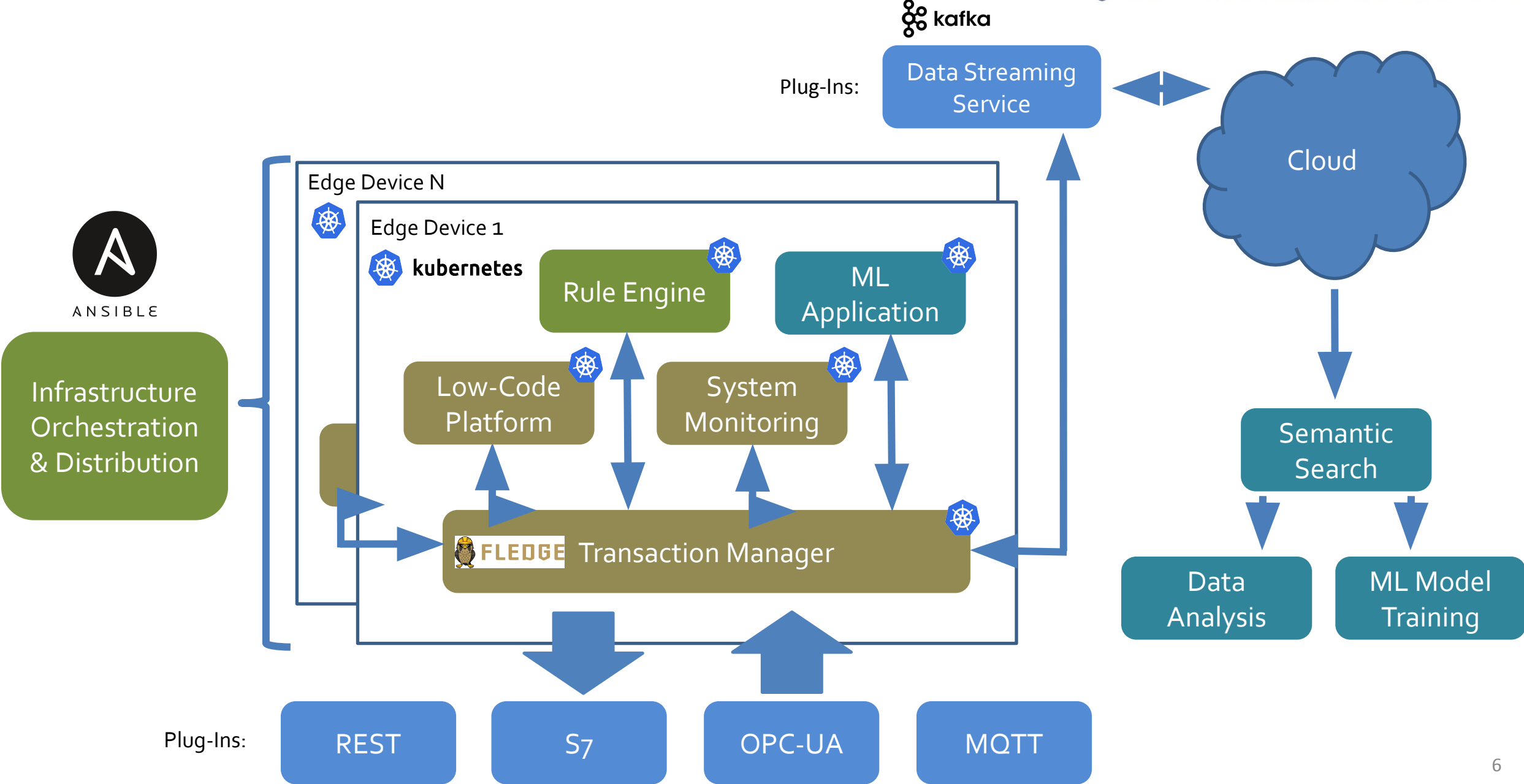
Towards the Representation of Cross-Domain Quality Knowledge for Efficient Data Analytics

Sebastian Kropatschek¹, Thorsten Steuer¹, Elmar Kiesling^{1,2}, Kristof Meixner^{4,5}, Thomas Frühwirth¹, Patrik Sommer³, Daniel Schachinger³, Stefan Biffl^{1,5}
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⁴Christian Doppler Laboratory for Security and Quality Improvement in the Production System Lifecycle
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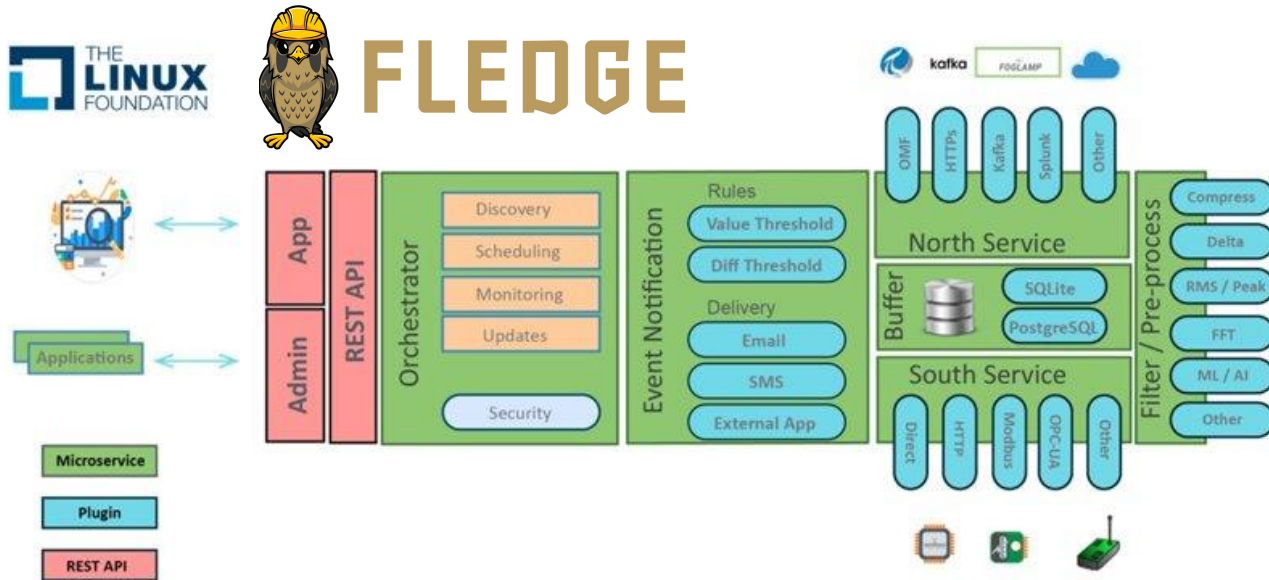
Cross-Domain Quality Knowledge (CQPK) engi- and domain experts collaborate to identify and domain experts collaborate to identify major issues. Industry 4.0 production assess for analysis, making it difficult to resolve data analysis typically do production process, a key challenge. (Impact product qual- cause data analysis, outline an production processes, and address an ideally, ment

In particular, analysts often lack the necessary domain knowledge and rely on the knowledge provided by experts to identify relevant data, understand the semantics of the majority of cause-effect hypotheses. Consequently, resolving communication, data integration, or process challenges. To address this, we propose using a domain model to integrate the perspectives of data analysts and improve the data analytical process. This requires the data analyst in the manufacturing process to have requirements for an application model of cross-domain data analysis. (i) Int- view of potential (ii) Int-

Mapping Vision to Architecture



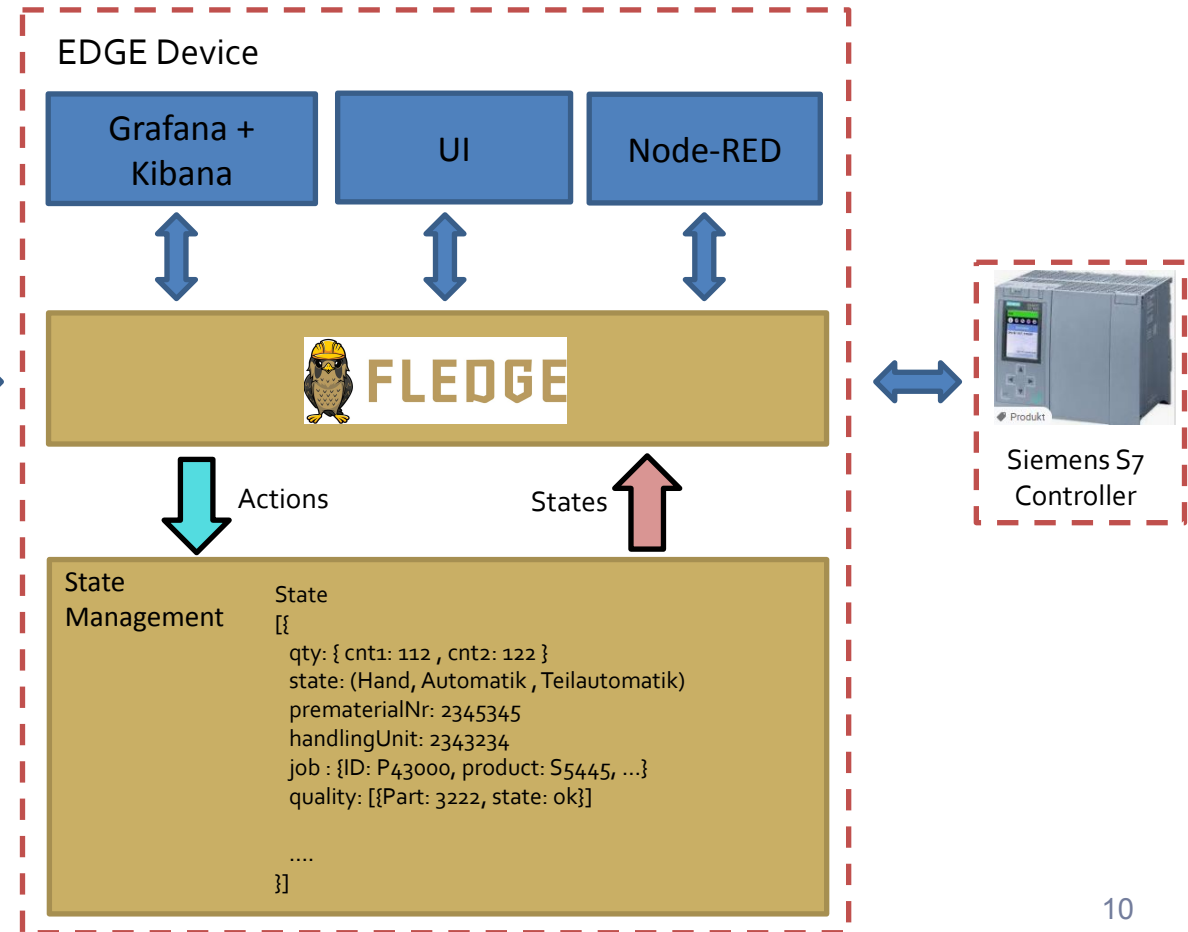
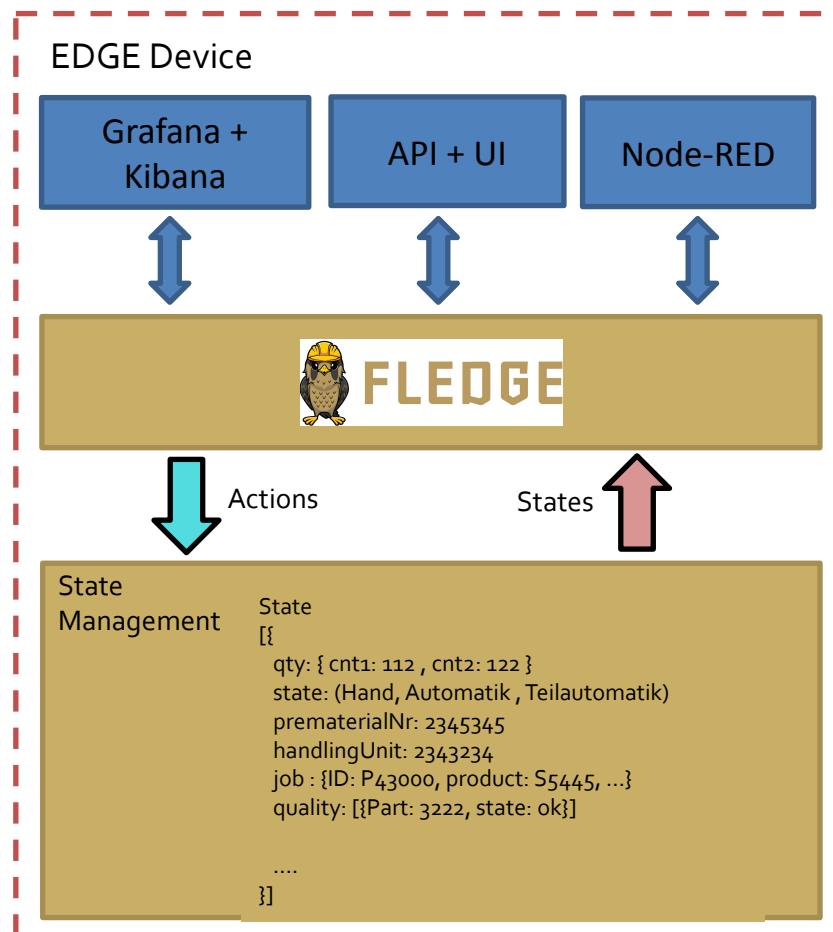
Fledge as Transaction Manager



Fledge...

- ... is open source.
- ... delivers data to different cloud services.
- ... collects data from any sensor.
- ... aggregates, combines and organizes data.
- ... transforms and filters data.
- ... buffers data & resends after connection is reestablished.
- ... is highly performant and resource efficient.

Current Project Status



New Fledge South S7 Plug-In

The plug-in is used to read data from a Siemens S7 PLC.

Features:

- Read Various PLC Data Types
- Arrays
- Objects/ Structs (UDTs)
- Array of Objects
- Optimized Reading of Data as Blocks

- Output:
 - JSON Object /
 - Escaped String
 - Flat Variable List

New Fledge North S7 Plug-In

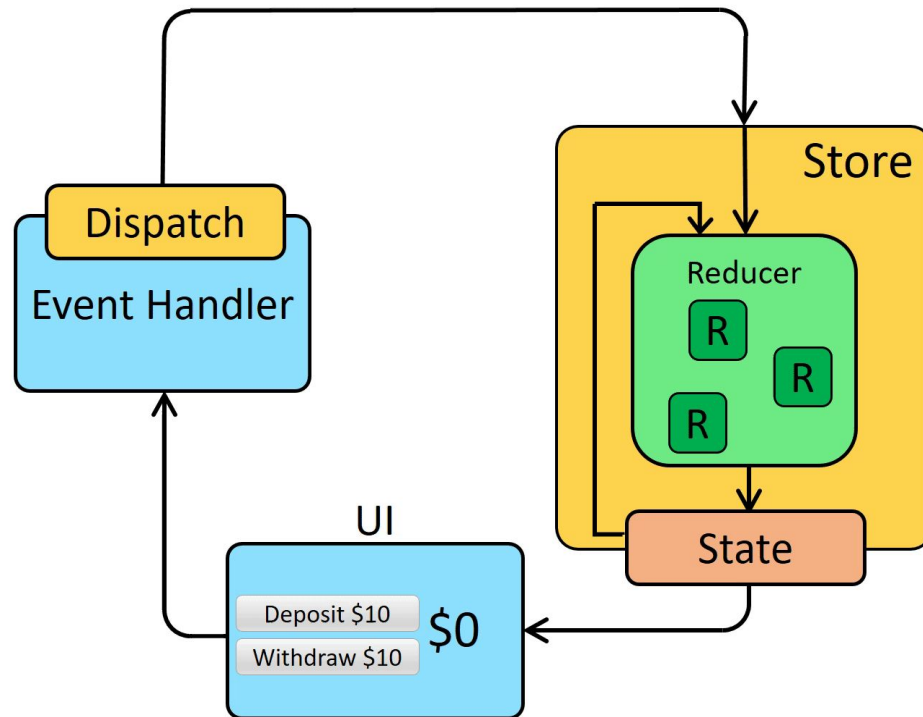
The plug-in is used to write data to a Siemens S7 PLC

Features:

- Write Various PLC Data Types
- Verification: Write + Read
- Add Static Datapoint to Asset
- Limited Bool Support because of Snap7 -Python Library

Redux Data Flow

State Management



Redux Principles:

- **Single Source of Truth:** The state of your whole application is stored in an object tree within a single store.
- **State is Read-only:** The only way to change the state is to emit an action, an object describing what happened.
- **Changes are made with pure functions:** A reducer is a central place where state modification takes place. Reducer is a function which takes state and action as arguments, and returns a newly updated state.

New Fledge Rule Plug-In

The rule is used to detect if a data point is different from its previously received value within an asset.

Features:

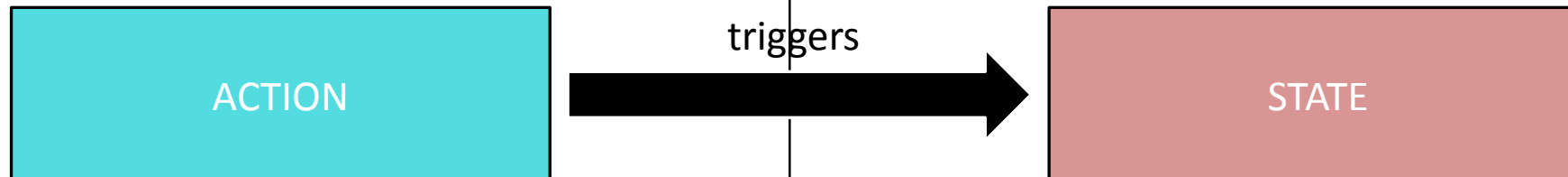
- Configurable to Monitor Multiple Assets
- Can be Configured to Rename Data Points

New Fledge Notification Plug-In

The notification is used to create a new asset based on data previously received from the rule plugin and the assets already collected by Fledge.

Features:

- Configurable Asset Name to Create
- Can be Configured to Choose which Assets and Data Points Should be Used to Create the New Asset.
- Can be Configured to Rename Data Points
- Can be Configured to Authenticate against the FLEDGE REST API.



Developed by ACDP

- Transaction Manager
 - **fledge-south-s7-python**
<https://github.com/kropatschek/fledge-south-s7-python.git>
 - **fledge-north-s7-python** <https://github.com/kropatschek/fledge-north-s7-python>
 - **fledge-north-opcuaclient** <https://github.com/kropatschek/fledge-north-opcuaclient>
- State Management
 - **fledge-rule-delta**
<https://github.com/kropatschek/fledge-rule-delta.git>
 - **fledge-notify-customasset**
<https://github.com/kropatschek/fledge-notify-customasset.git>

Provided Plug-Ins by FLEDGE

South

- fledge-south-http** <https://github.com/fledge-iot/fledge-south-http.git>
- fledge-south-opcua** <https://github.com/fledge-iot/fledge-south-opcua.git>
- fledge-south-modbus tcp <https://github.com/fledge-iot/fledge-south-modbus-tcp.git>
- fledge-south-mqtt <https://github.com/fledge-iot/fledge-south-mqtt.git>

North

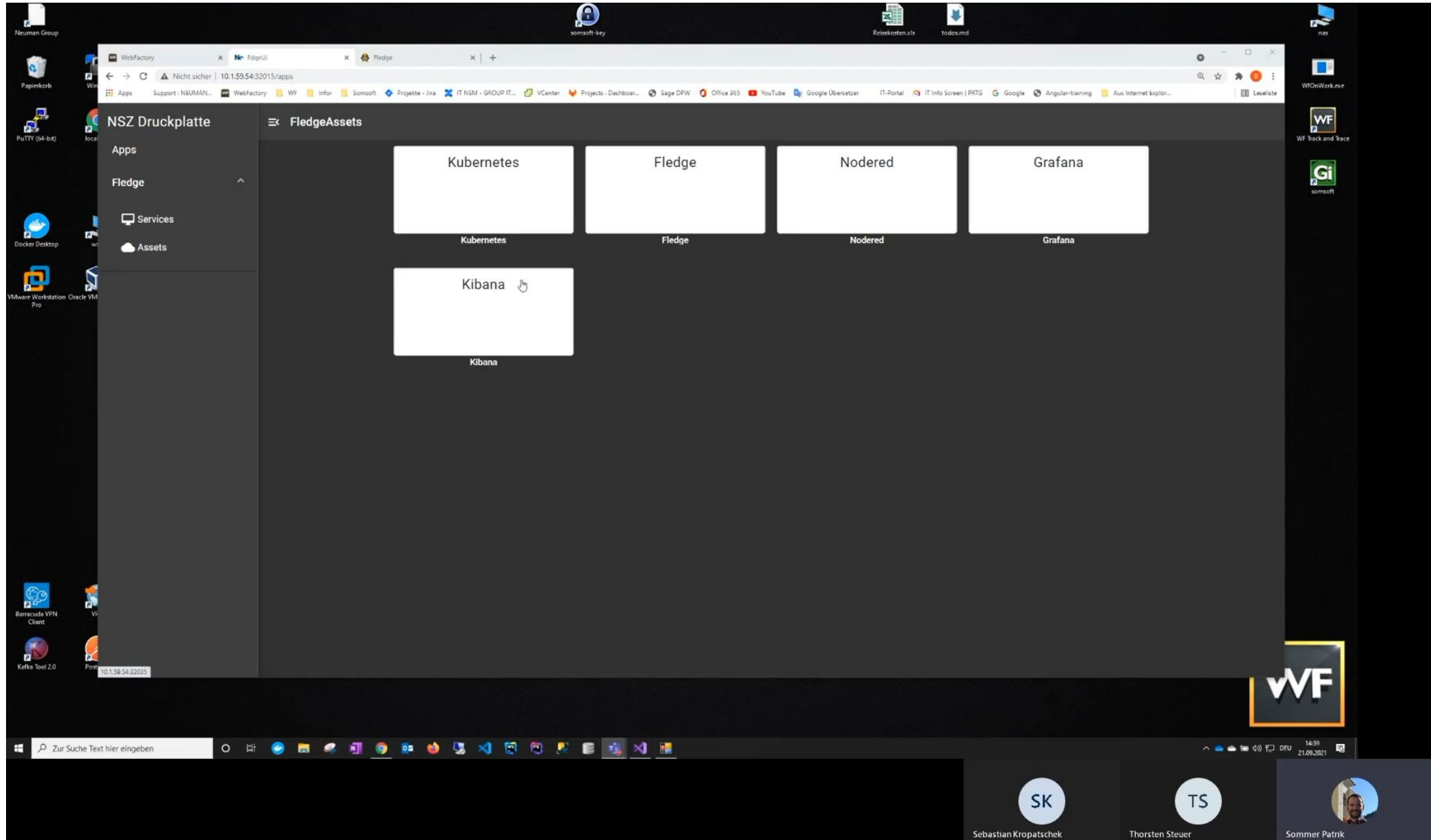
- fledge-north-kafka** <https://github.com/fledge-iot/fledge-north-kafka.git>
- fledge-north-opcua** <https://github.com/fledge-iot/fledge-north-opcua.git>
- fledge-north-http-c** <https://github.com/fledge-iot/fledge-north-http-c.git>
- fledge-north-http <https://github.com/fledge-iot/fledge-north-http.git>

Notification

- fledge-notify-asset** <https://github.com/fledge-iot/fledge-notify-asset.git>
- fledge-rule-average <https://github.com/fledge-iot/fledge-rule-average.git>
- fledge-rule-simple-expression <https://github.com/fledge-iot/fledge-rule-simple-expression.git>
- fledge-notify-mqtt <https://github.com/fledge-iot/fledge-notify-mqtt.git>

Filter

- fledge-filter-asset** <https://github.com/fledge-iot/fledge-filter-asset>
- fledge-filter-delta <https://github.com/fledge-iot/fledge-filter-delta.git>
- fledge-filter-expression <https://github.com/fledge-iot/fledge-filter-expression.git>
- fledge-filter-change <https://github.com/fledge-iot/fledge-filter-change.git>



The screenshot displays a Windows desktop environment. A web browser window is open, showing a dashboard titled "FledgeAssets". The dashboard features five white tiles arranged in two rows: "Kubernetes", "Fledge", "Nodered", "Grafana" in the top row, and "Kibana" in the bottom row. A sidebar on the left side of the browser window is titled "NSZ Druckplatte" and contains a menu with "Apps", "Fledge", "Services", and "Assets". The Windows taskbar at the bottom includes a search bar with the text "Zur Suche Text hier eingeben" and a system tray showing the time as 14:39 on 21.09.2021. A video conference overlay at the bottom right shows three participants: Sebastian Kropatschek (SK), Thorsten Steuer (TS), and Sommer Patrik.

Performance

- **We tested FLEDGE with sampling rates of 50 ms.**
- FLEDGE is very resource efficient, runs on a Raspberry Pi.

Flexibility

- The current approach supports a variety of architecture concepts.
- The services and plug-ins of FLEDGE can be combined to cover a big variety of use cases.
- Supports multiple protocols south and north.

Extendability

- Plug-Ins can relatively easy be developed after an initial training period.
- Other plug-ins can be used as templates.

Usability

- Documentation provides great support for users.
- **Community is helpful and open to new contributors.**

Open Challenges

- Better open-source tool support for monitoring and orchestration of edge devices.
- Improvement of FLEDGE Documentation for Developers.

Trust open-source and start to adapt
and improve FLEDGE!!!

- Documentation for developers should be extended.
- Logger cannot be stopped manually from the GUI to look at specific error messages.
All Plug-Ins must be stopped sometimes to catch the error message.
- Only single log pages can be viewed and the search only works page wise.
- For debugging North Services Node-RED is a useful tool.
- Debugging North Services can be tricky since sometimes after reconfiguring North Services the Service runs into unpredictable states.
- Cannot set debug level via GUI for python plug-ins.
- There is no option available to clean the log if it is full.
- Importing other fledge configurations is not supported and exporting only the configuration is not supported.
- Increase community for testing FLEDGE or develop more unit tests.
- Provide more sample code for plug-ins.
- It is difficult to overview what classes can be used and how to achieve a certain goal.