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Implementation of event-driven Industrial IoT-Systems with Azure IoT Edge and NATS.io

Bertram Holzer
Hans Fleischmann
Schaeffler Technologies AG

Agenda

1 **IT@Schaeffler-Framework**

2 NATS.io Messaging System

3 Open Platform Communications Unified Architecture

4 Gateway Development

5 Workshop Results

6 Digital Production System

Connectivity and integration are the foundation of Smart Factories

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Why

All relevant use cases for a Smart Factory require **access to current and high-quality data**, whether it is transparency about system states, prediction of problems and potential solutions, analytics, machine learning or **autonomous production**.

What

- Standardization of edge **hardware** to a clearly defined, manageable number of alternatives → Equipment
- Delivery of data in standard formats via standard **protocols** → Gateways
- A unified, secure and scalable data **distribution platform** to connect many agents → Messaging System

Architecture

How

- The requirements for IT infrastructure need to be clarified
- The required solution components and infrastructure need to be assigned to Product Owners who provide
  - Documentation on the features and ‘unique selling points’ of their products
  - Operating models incl. roles and responsibilities
  - Dates for availability of the production-ready versions

Operating Model

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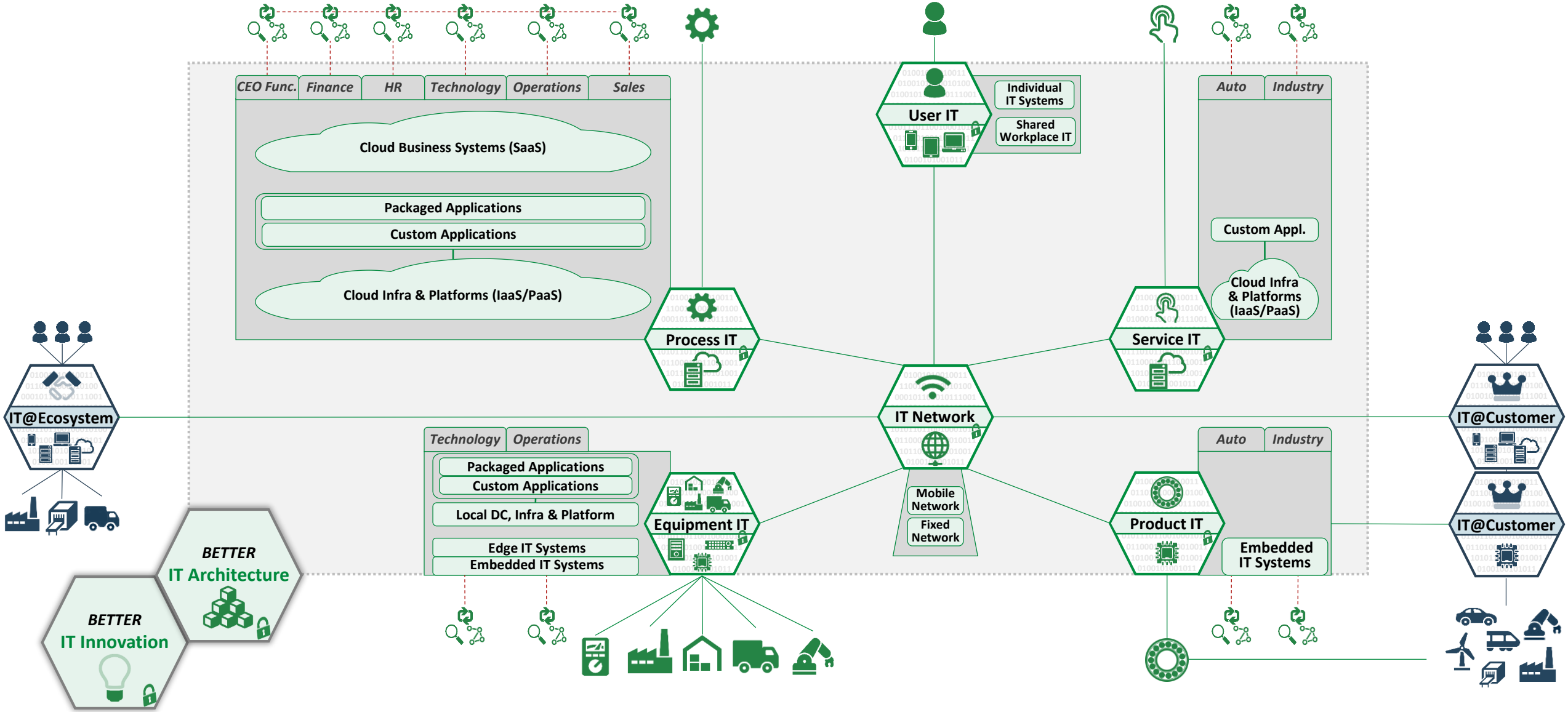
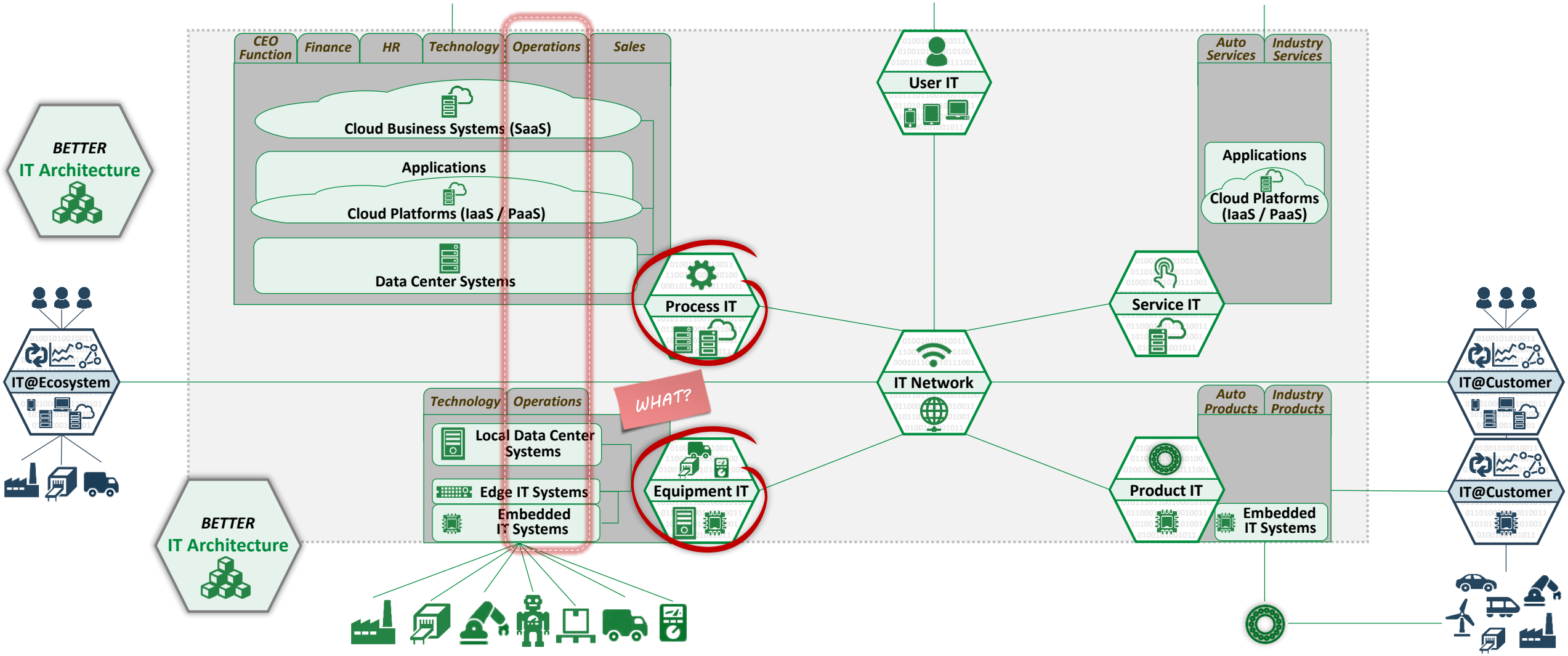
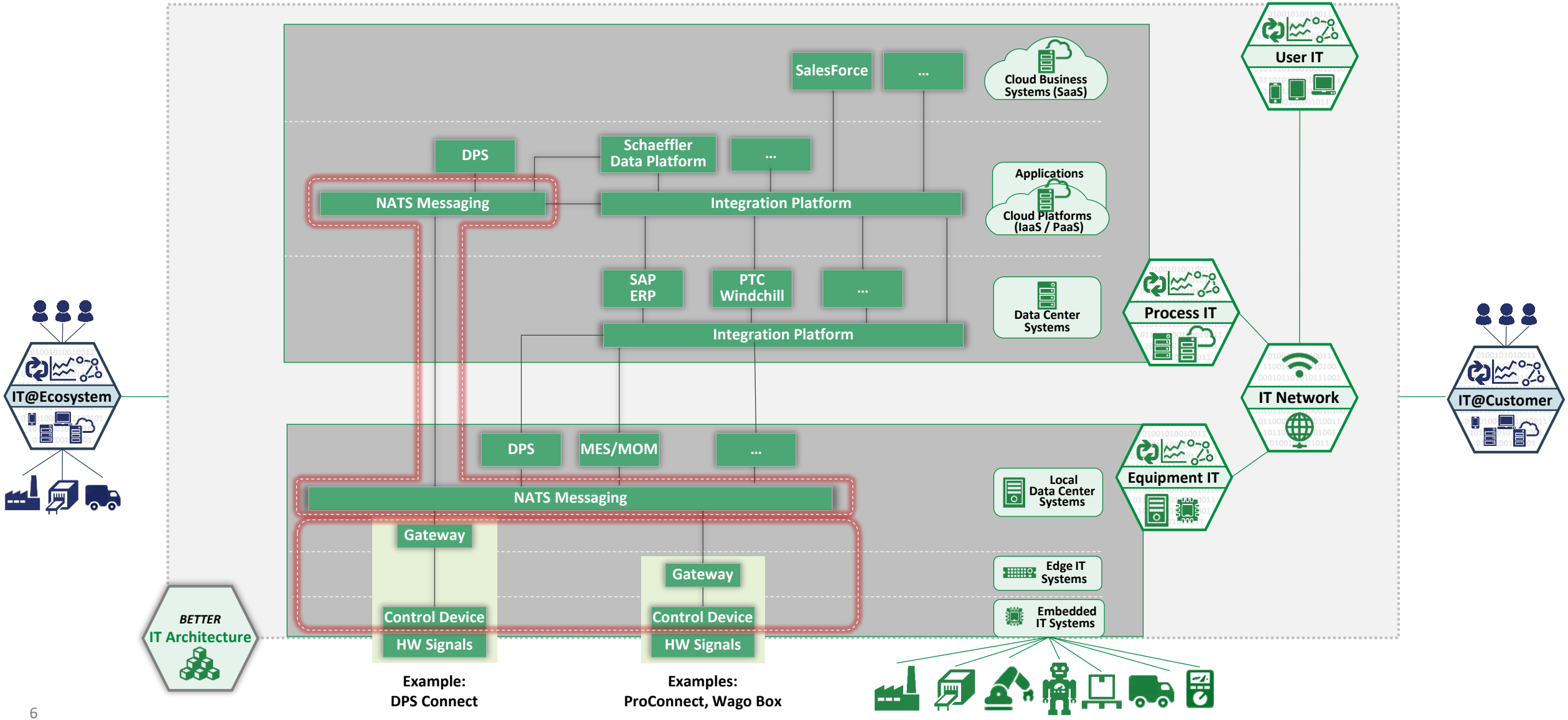
Better IT Architecture – System Deployments across distributed Cloud and Edge Environments



IT@Schaeffler - Context



IT Architecture – Context Production IT – Equipment IT Integration



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SPACE SHORTCUTS
DevOps team delegates

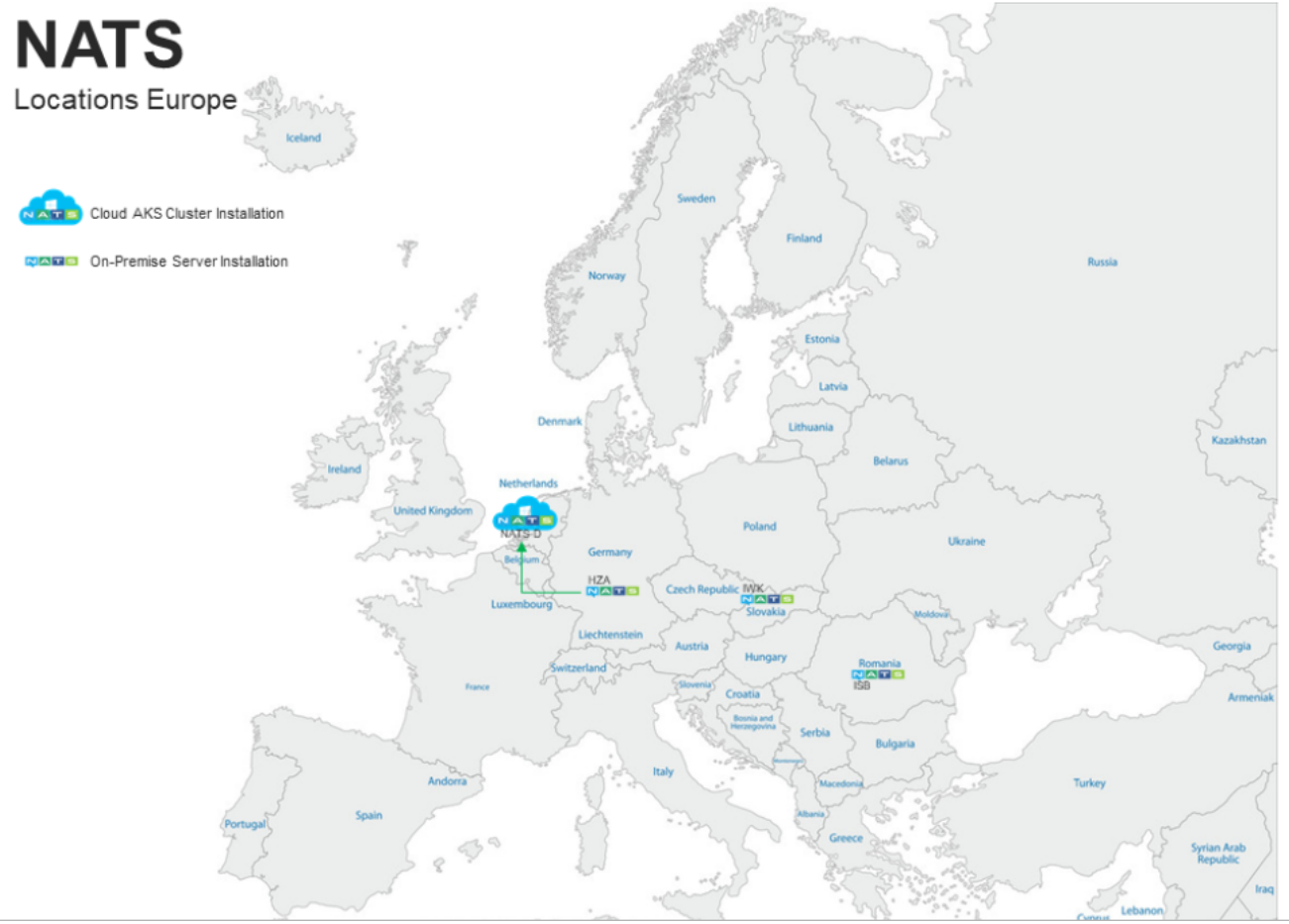
PAGE TREE
- DevOps team delegates
- Documentation
  - Server and Infrastructure
  - MicroServices
  - Documentation Files
  - Build & Release Documentati...
  - Monitoring & Logging
  - Azure Cloud
  - Containerized Environment
  - Export / Import of Locations ...
  - Export of Email Adresses for J...
  - **NATS**
    - NATS Worldwide Rollout Ta...
    - NATS Account Server and L...
    - Nats and PLS Exporter Bind...
    - NATS Cloud Cluster
    - Nats Cluster HZA
    - NATS Concepts
    - NATS Configuration
- Processes
- Public meeting notes

Space tools

NATS

Created by Matthias Wutke, last modified on May 29, 2019

This page contains all topics regarding NATS and NATS-Streaming in relation to development, operations and monitoring/logging.



Contents

Additional Documentation

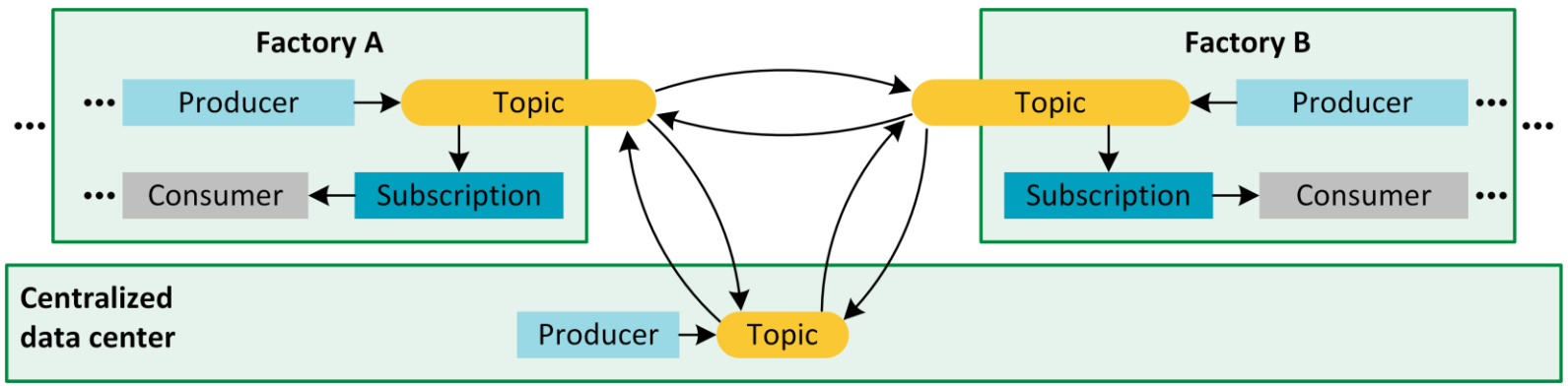
- **NATS on Github**
- **NATS Homepage**
- **Docker NATS-Streaming**
- **Docker NATS-Server**
- **Docker NATS-Prometheus-Exporter**

Popular Labels

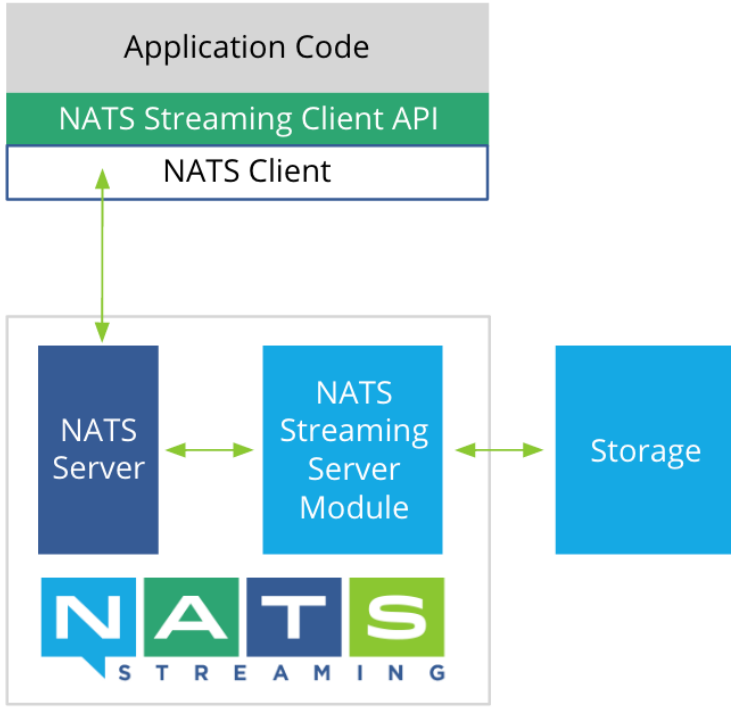
acceptance account ad add agent aks apppool azure backend **build** check

Basic NATS concepts

NATS: Coupling of various NATS clusters with the geo-replication concept



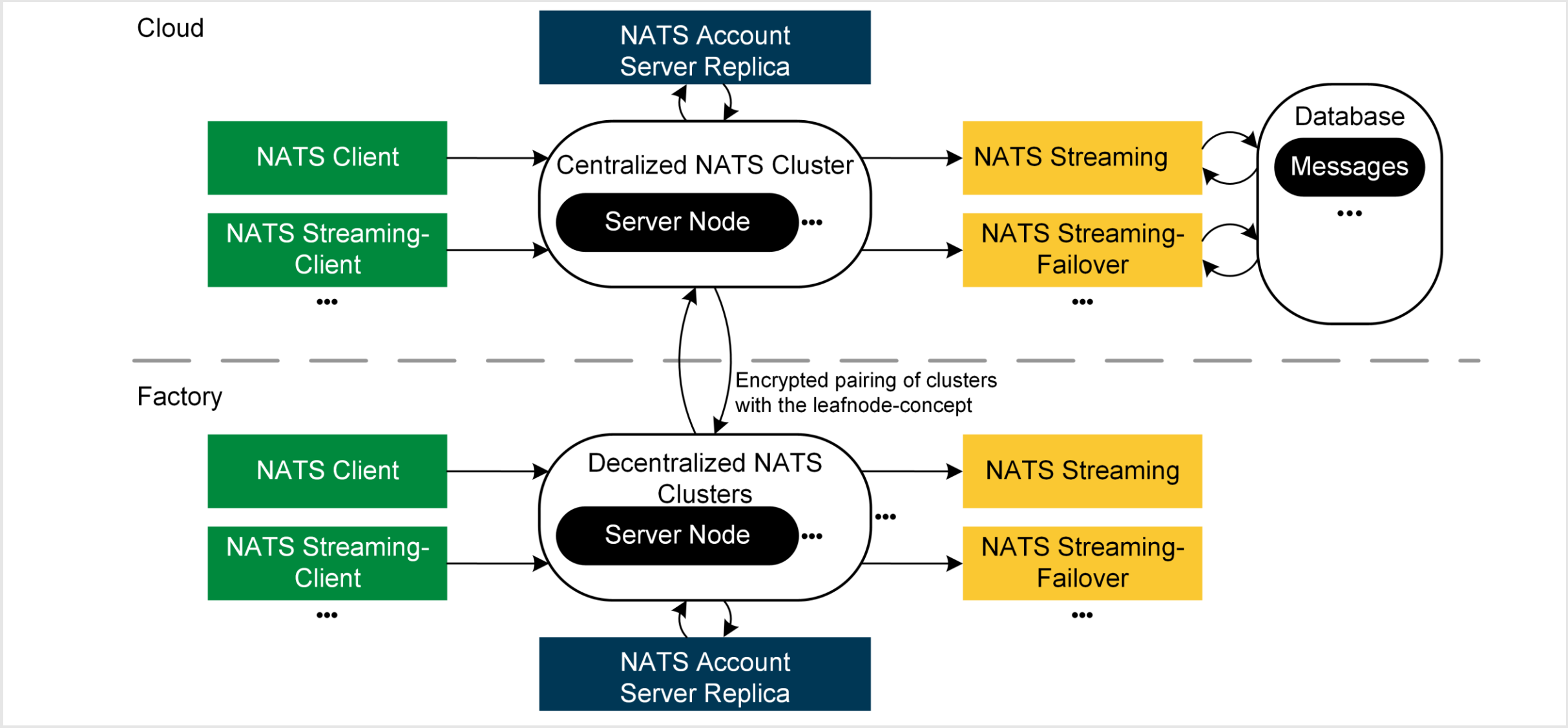
Integration of a NATS Client in your application



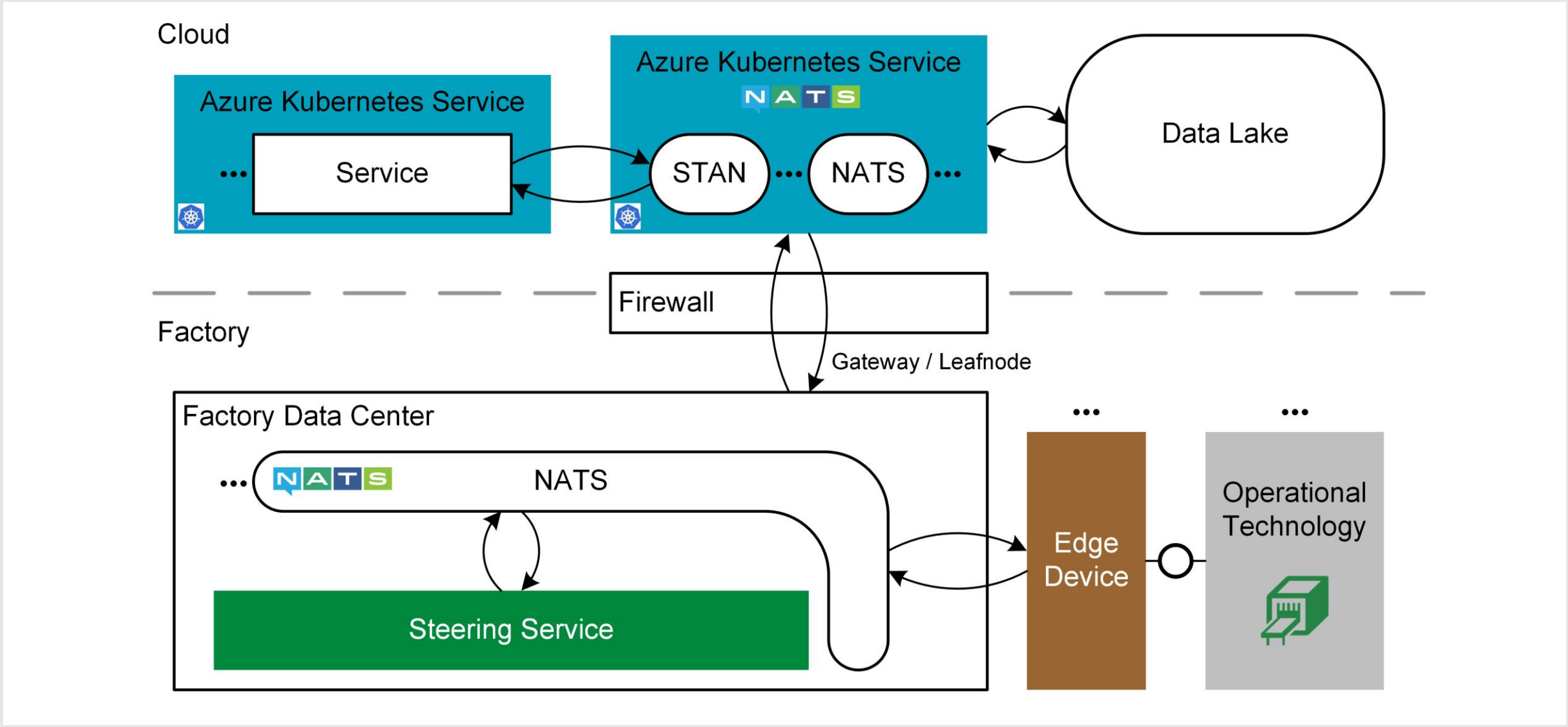
Why NATS.io?

- Fast, scalable
- Easy to use
- Runs on Linux and Windows Operating Systems
- Lightweight
- Queue groups
- Provides persisting over NATS Streaming (STAN)
- Auto-Discovery automatically exchanges server topology
- Clients can failover to new servers that weren't originally configured
- NATS server clusters dynamically adjust to new or removed servers
- Rolling updates possible
- ….
- https://www.cncf.io/wp-content/uploads/2019/09/NATS-CNCF-Webinar-Sep-2019.pdf

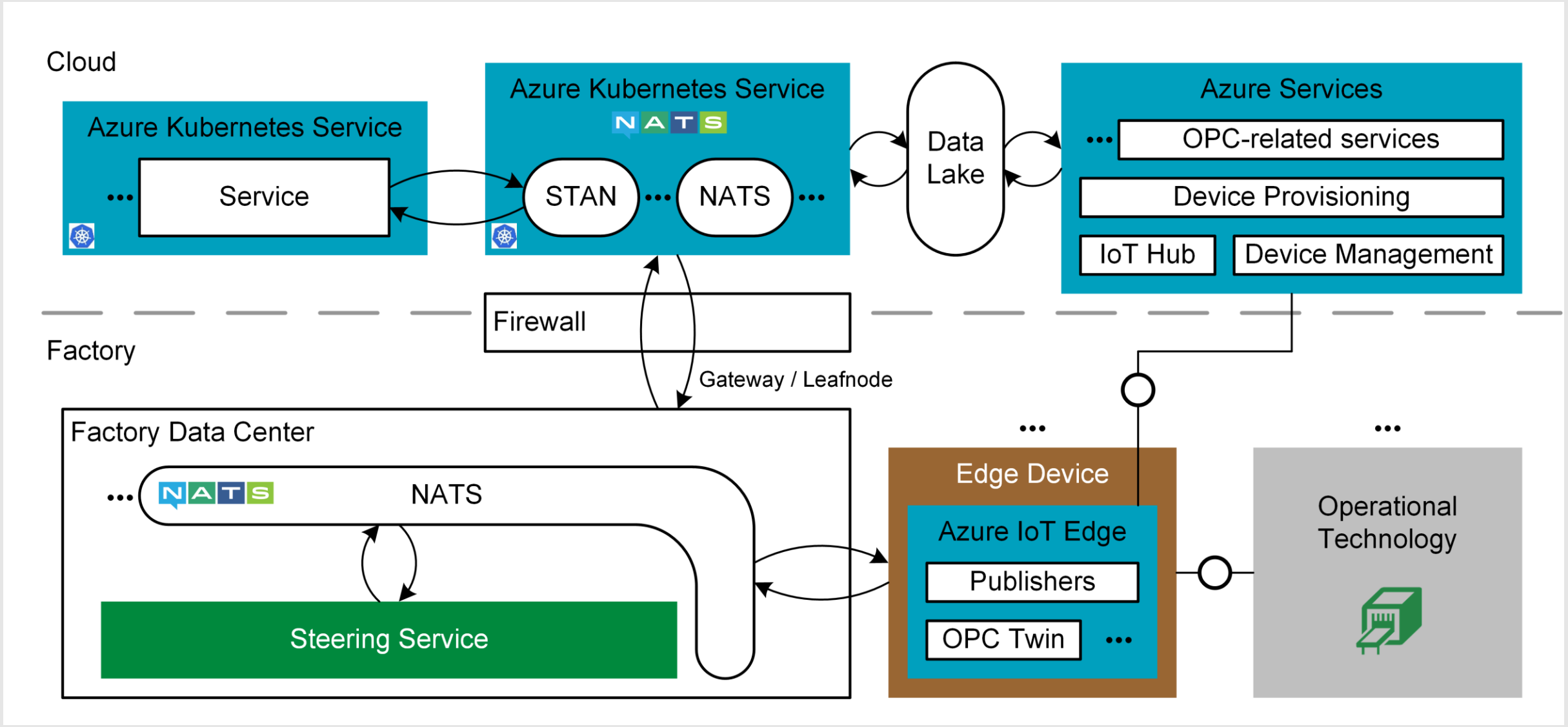
Alignment of centralized and decentralized NATS Clusters



Current NATS Deployment



IoT Hub with NATS – using IoT Hub and IoT Edge for the management of devices



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Schaeffler Herzogenaurach,
Bearing Assembly Line

Asset Administration Shell – Realisation of a Digital Twin

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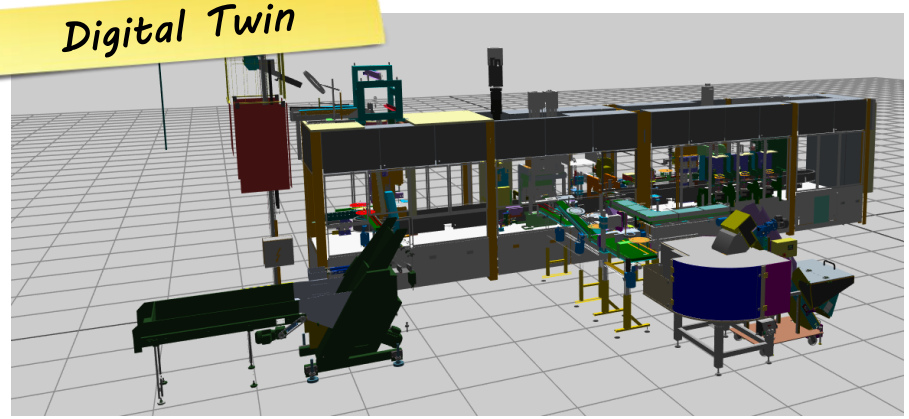
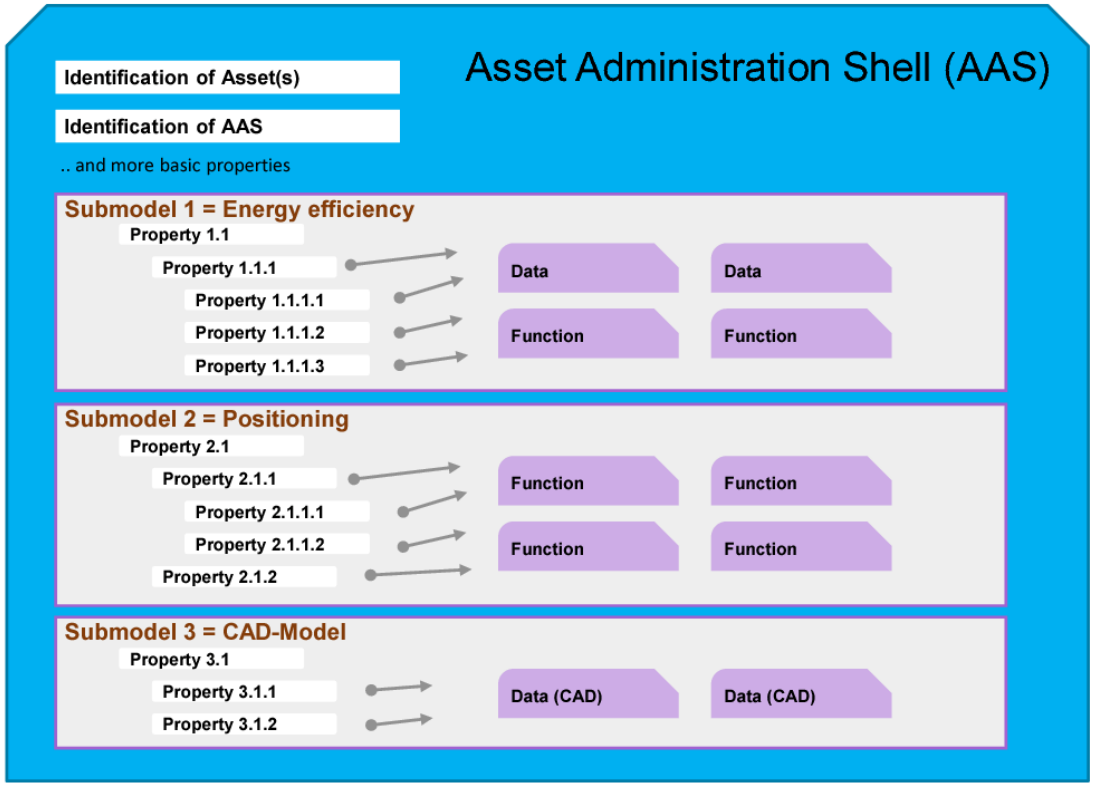
Digital Twin



Bearing Assembly Line

PLATTFORM INDUSTRIE 4.0

Access to information and functions



Strict, standardized data format

Realtime data

Various, supplementary and proprietary data formats

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Open Platform Communications Unified Architecture

PLATTFORM INDUSTRIE 4.0

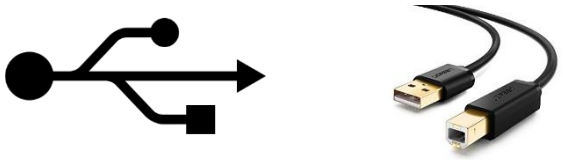
OPC UA™

“USB for automation components”

- Information centric architecture
  - M2M-Communication
  - Information modeling
- OPC UA is
  - Platform independent
  - Standardized in IEC 62541

Communication

Information Models



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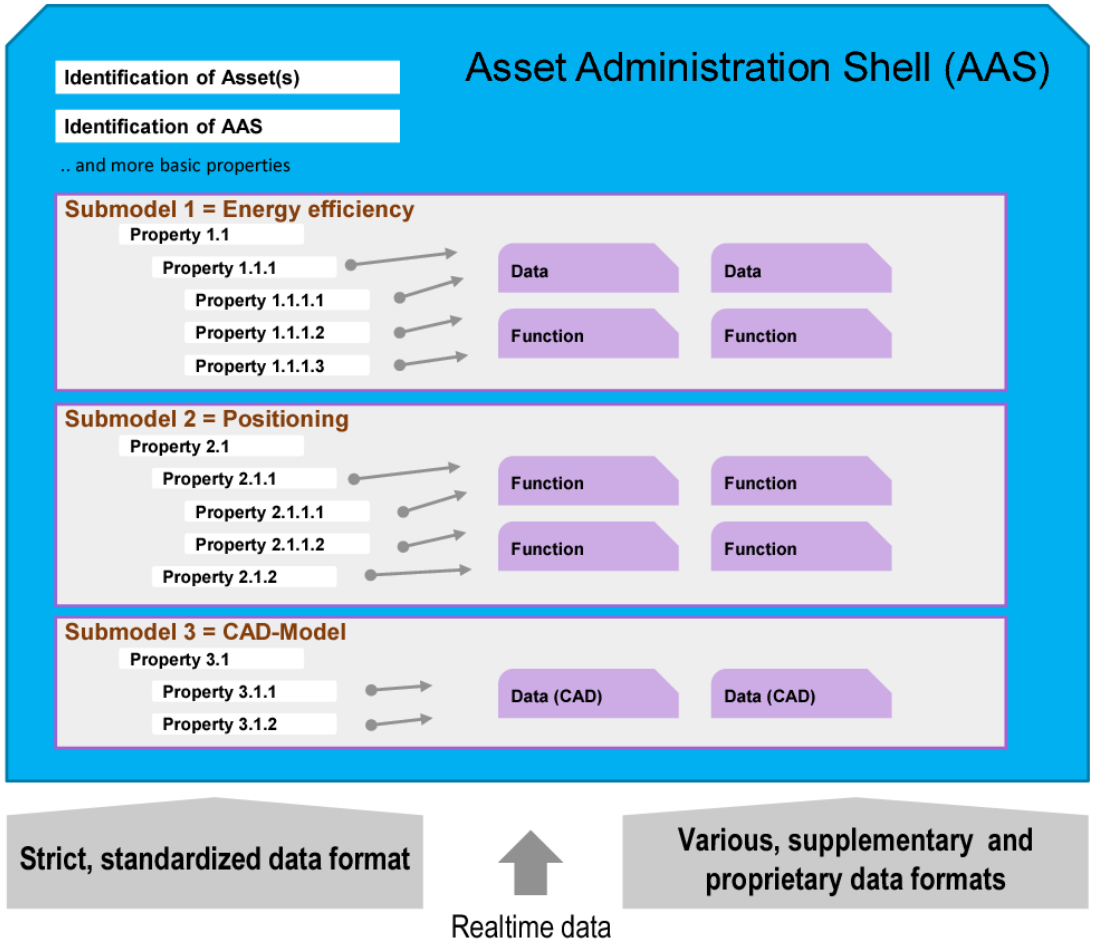


Azure IIoT: Industry leading OPC UA Support

The Industrial Interoperability Standard

Microsoft is a member of the OPC Foundation since 1996
Microsoft supports OPC UA on Azure since 2016

Interoperability

Vendor, Platform and OS Independent

Open Source on GitHub (Many Microsoft contributions)

Discoverable Services Oriented Architecture (SOA) independent of the transport method

Owned by a Non-Profit (OPC Foundation)

50M installed base and exponential growth

Data Modelling

Rich data modeling preserves source context

Vendors can extend the data model of each product (Companion Specification)

Maps to field bus protocols, e.g. BACNet | PLCopen | MTConnect | …

Security

Secure Design from group-up

Based on **open security standards**

Authentication | Encryption

Evolves as security technologies evolve

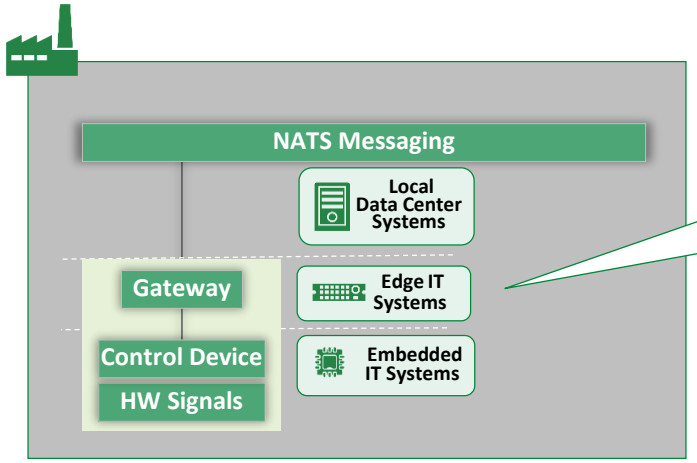
Vendors/Users can choose level of security

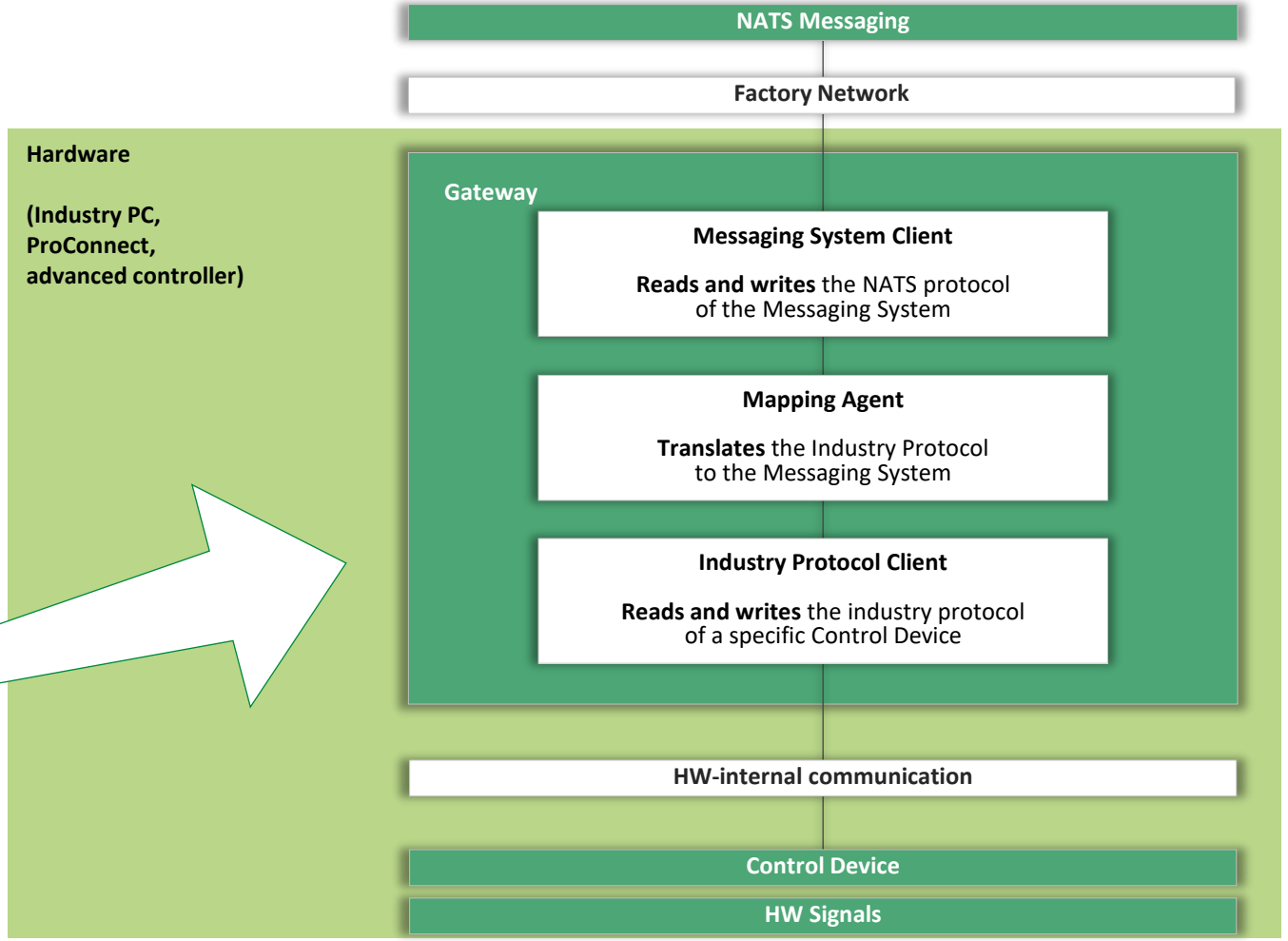
Easily acceptable by IT departments

github.com/Azure?q=OPC

Agenda

Gateways act as translators from specific industry protocols to the Messaging System





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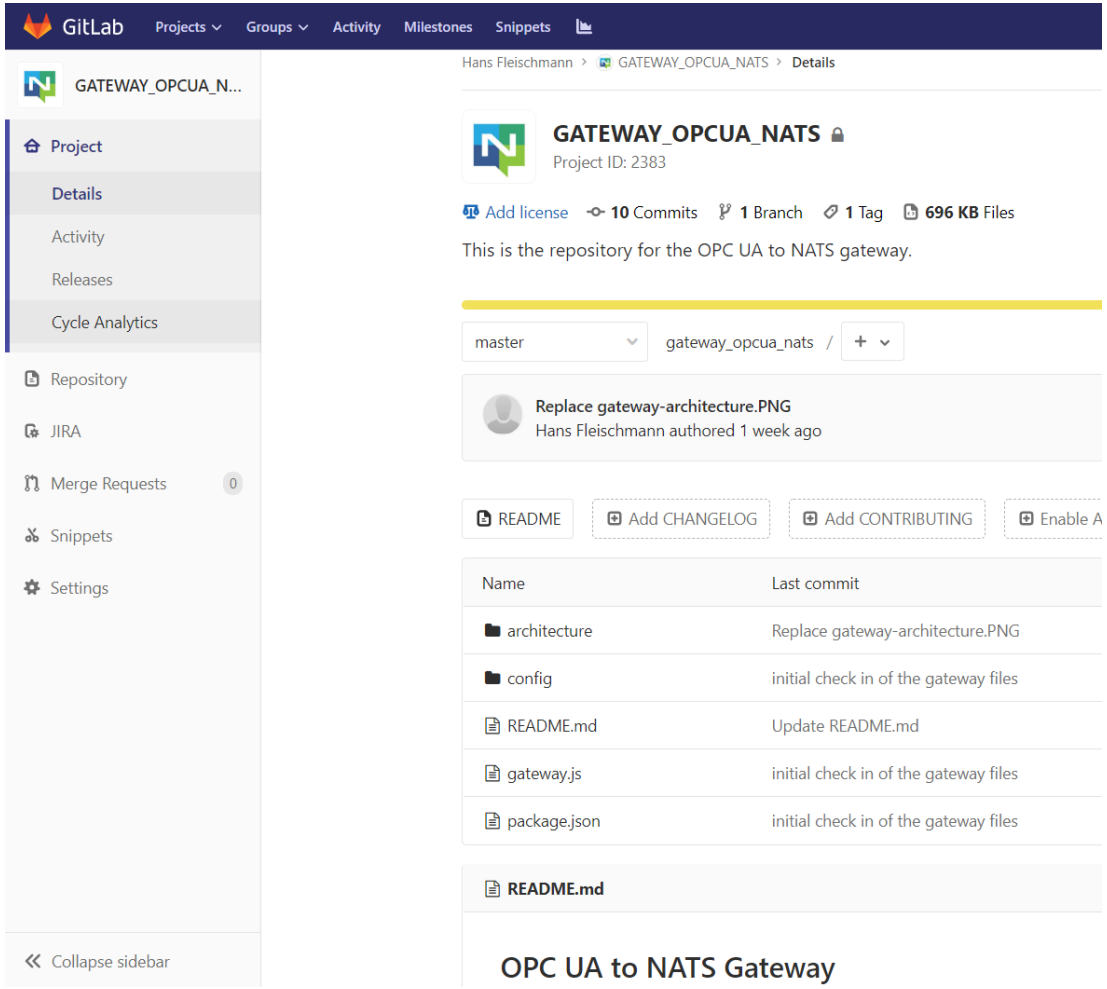

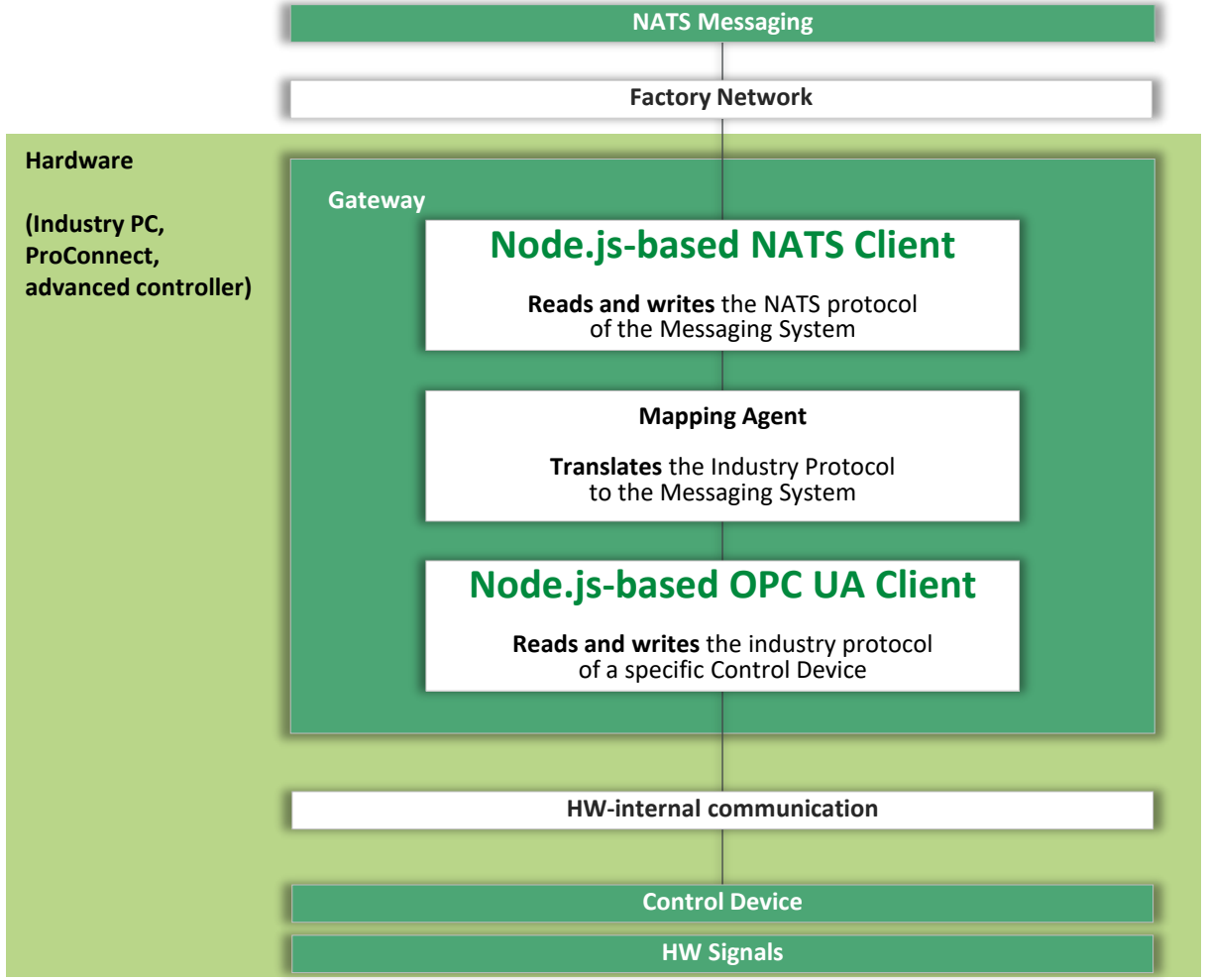

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Build solutions on your terms

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Applications that **Solve Business Problems**, services for **Specific Use Cases**
Data-driven identification of behavior models of automated production plants

Connectivity and **Data Processing** modules

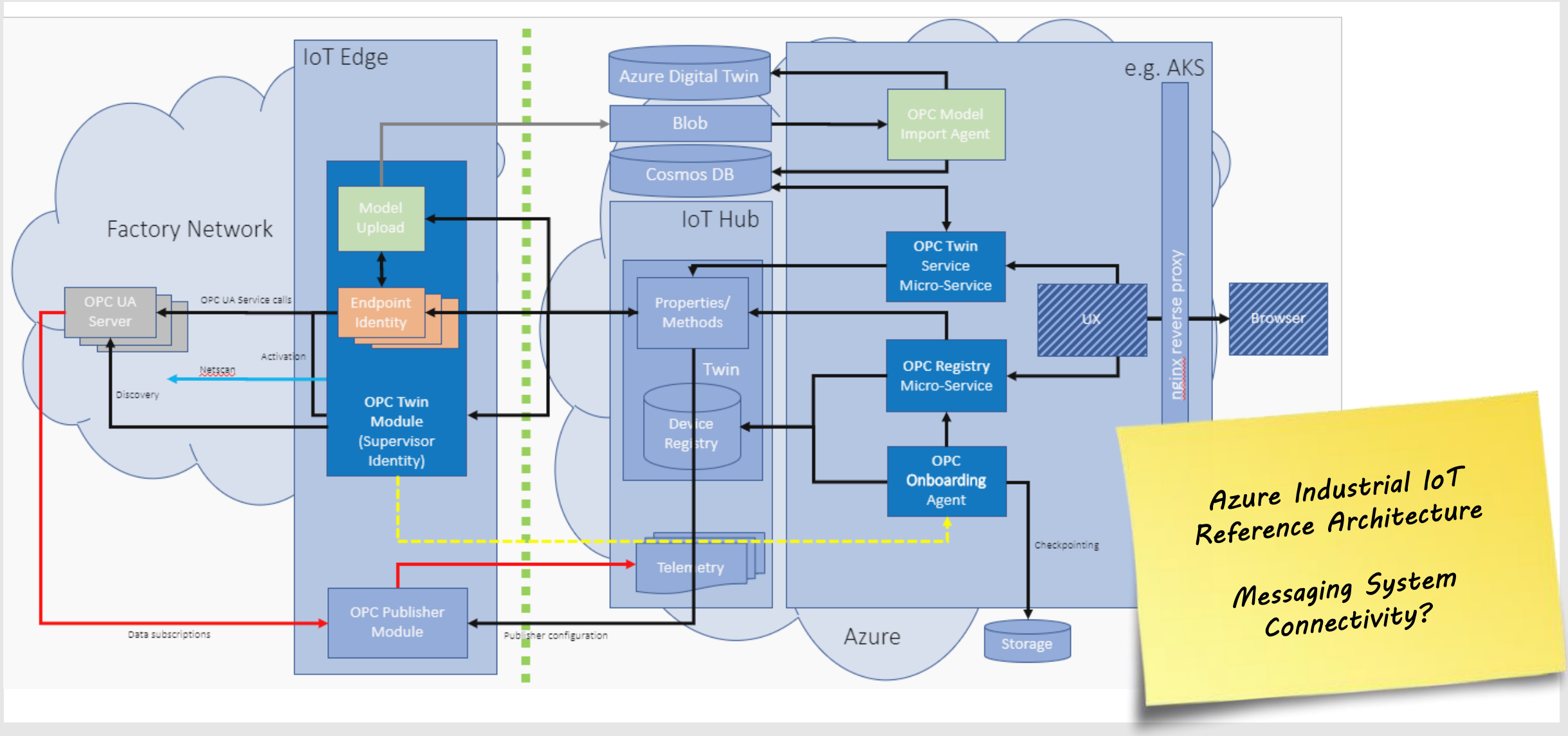
Microsoft Azure

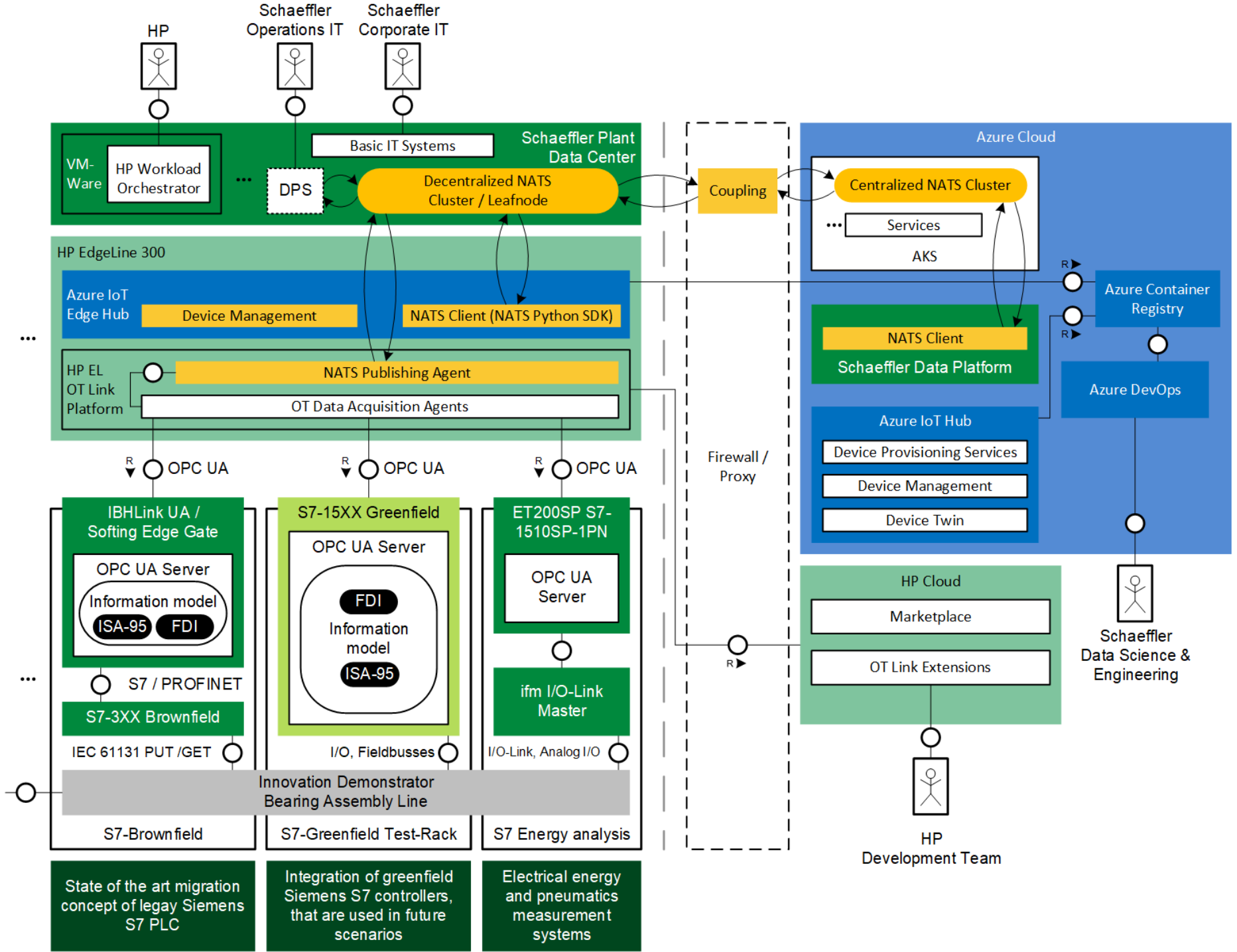
Scalable Services for Manufacturing Interoperability and Data Modeling
Open Industrial IoT **Reference Platform** based on **Industrial Standards (OPC UA)**

Scalable, **Managed** Services for **Common Patterns (PaaS)**
IoT Edge, IoT Hub, Stream Analytics, Data Lake, Azure Functions, AzureML, …

Globally Available Edge/Private/Public Cloud **Infrastructure (IaaS)**
Kubernetes Service, KeyVault, Azure Active Directory, Resource Manager, Azure Portal, …

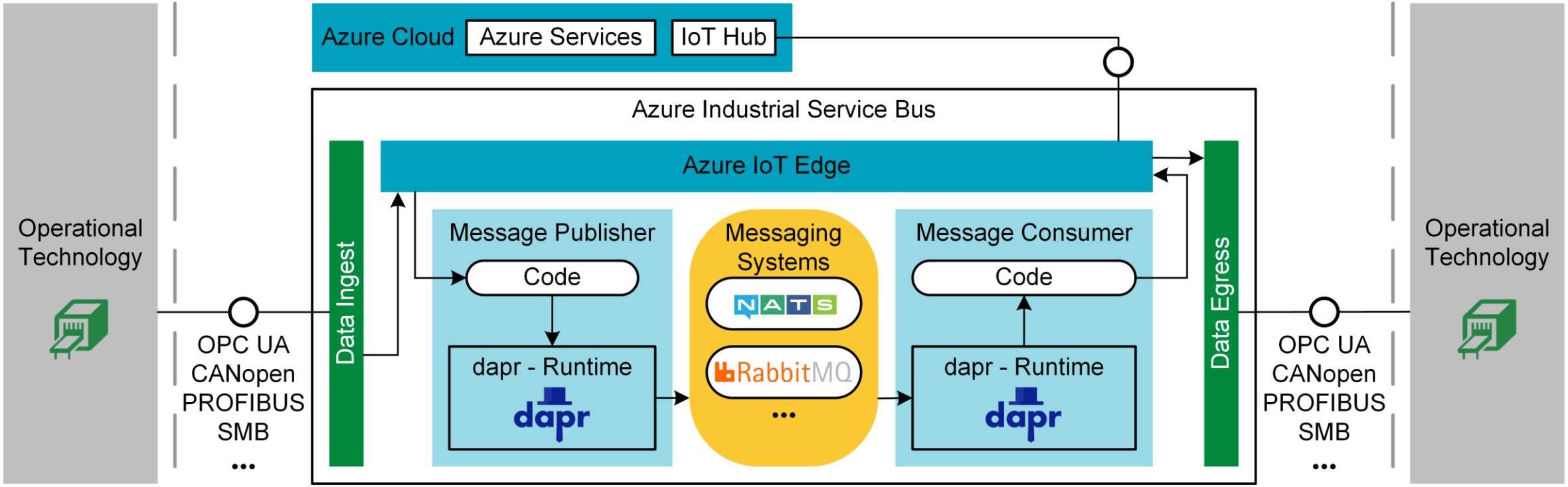
Build solutions on your terms





- Results of the Workshop
- Evaluation of HP EdgeLine and the corresponding OT Link platform
- Device Management was tested successfully

Outlook: Advancement of Azure IoT Edge to an Industrial Service Bus (ISB)



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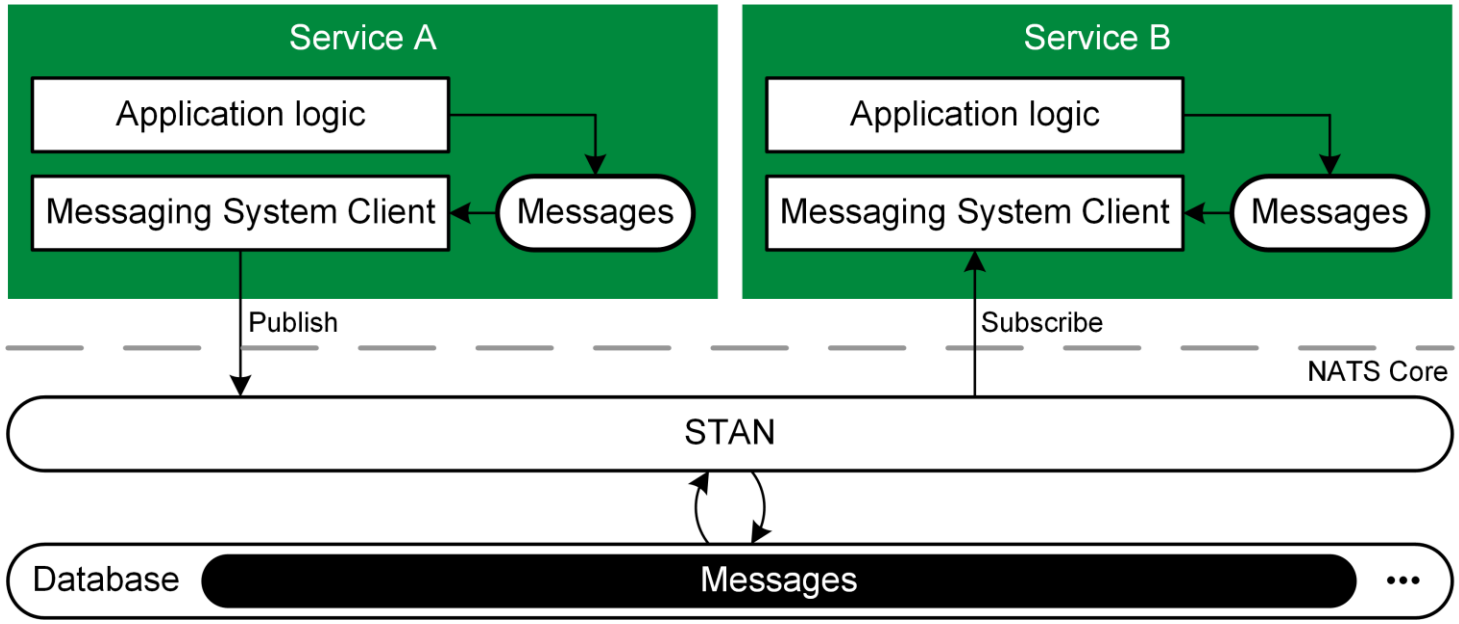
Digital Production System @ Schaeffler

- Implementation of services for custom use cases
- Production systems handle almost similar data -> reuseable compontens

  -> Microservices architecture
- Based on Microservice Messaging Pattern
- Implemented with NATS Streaming



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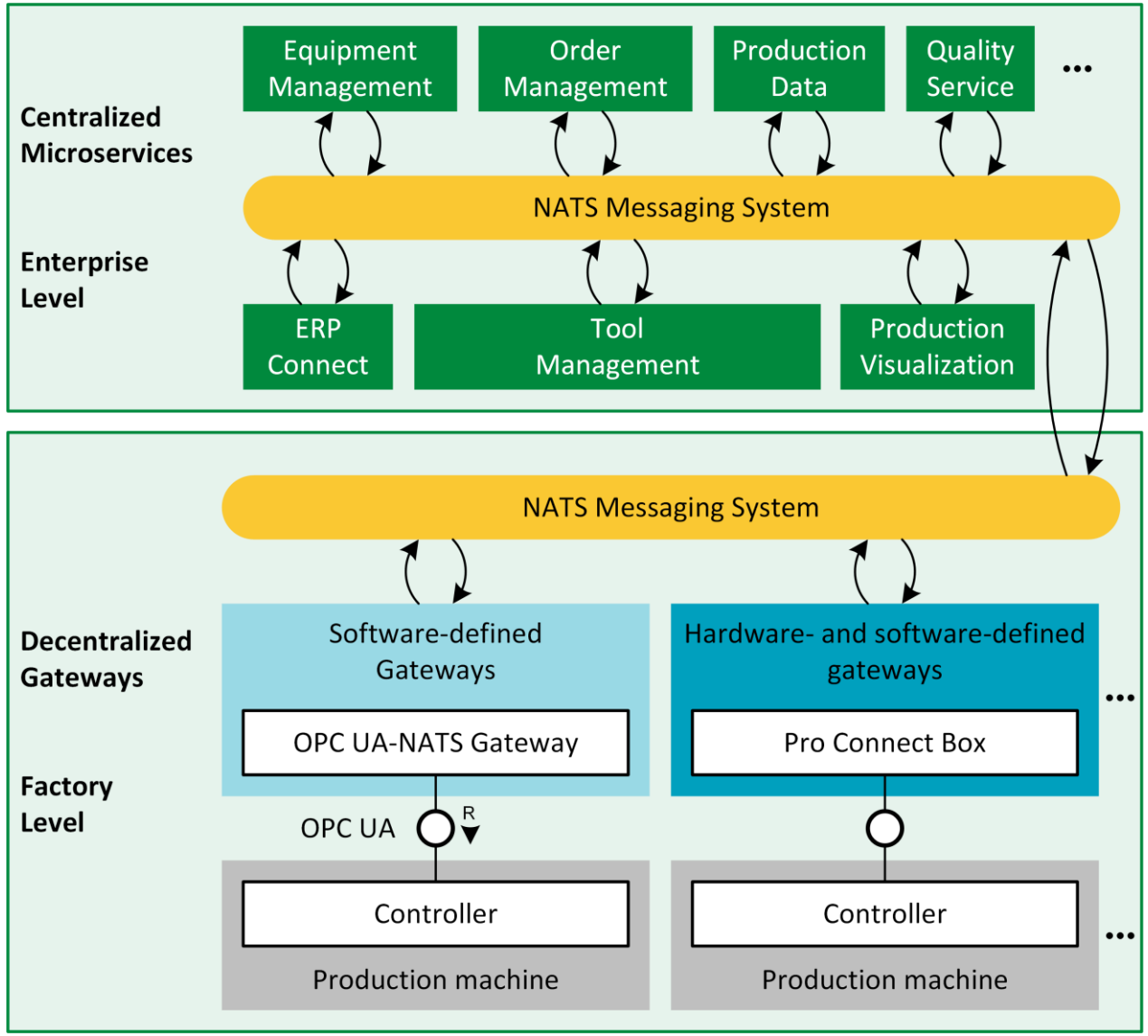
Digital Production System Architecture



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Digital Production System Architecture

NATS.io