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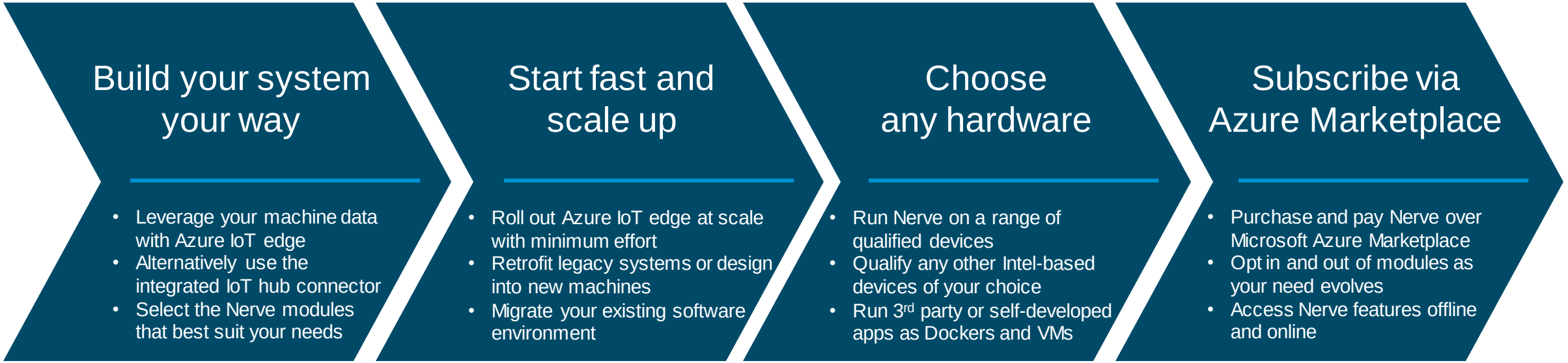
industrial
nerve
Azure IP Co-sell prioritized
Industry priority scenario:
Building More Agile Factories

Introducing Nerve

Nerve is an industrial edge computing platform that connects seamlessly with Azure



Choose the Nerve modules that fit your needs

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Use Nerve modules individually or in combination

Edge Hosting

Azure IoT Edge on managed OS included by default to run side-by-side with other industrial workloads

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Data Services

Access machine data to share with workloads and send to Azure

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Remote Services

Remotely connect to workloads and devices from wherever you are

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Soft PLC

Run machine control workloads on standard industrial hardware

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Nerve and Microsoft Azure

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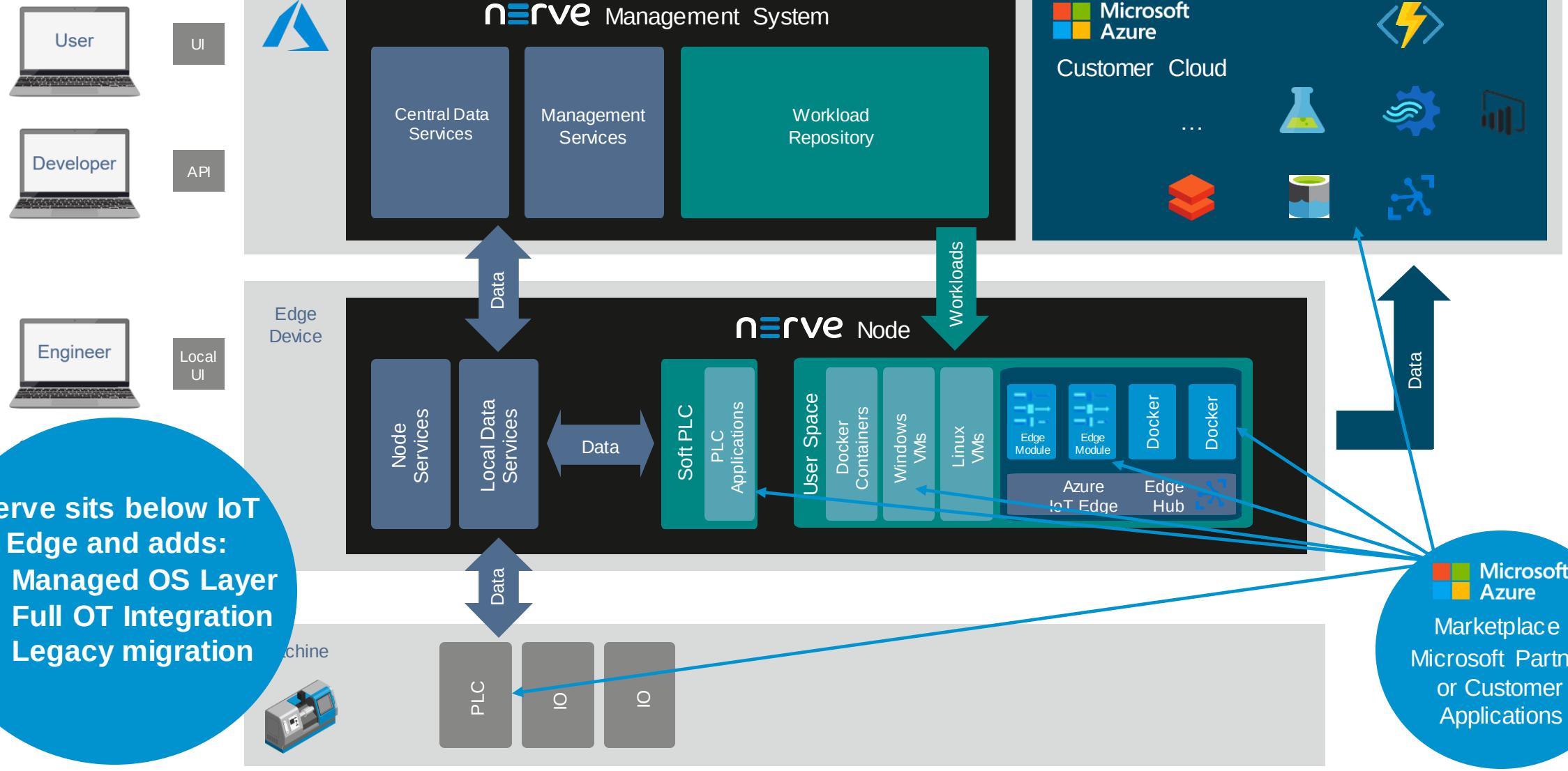
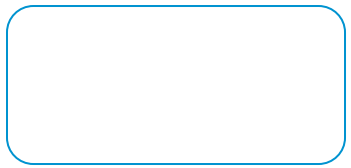


Nerve: Three ways to grow Azure business



Develop customers from IT only to IT + OT

Azure plant & grow: Consumption driving machines add up with each year

No-barrier entry for cloud refuseniks: Convert when they are ready

Nerve Benefits

Reduce Service Cost

50%

Replace site visits with remote access features

Remotely view nodes, log data and update software

Increase Machine Revenue

€ 5000 per machine, per year

Use data-driven applications to offer new services

Host 3rd party and open-source applications

Reduce Hardware Cost

65%

Combine multiple IPC functions on a single IPC

Utilize virtualization and container support

Reduce TCO vs Open-Source

€ 600k savings per year

Enjoy commercially supported and tested features

Hosting and maintenance included

Speed up Time To Market

1.5 years development time saved

Get started fast then scale to meet future needs

Use readily packaged and validated software

Save on Development Effort

50%

Implement new software in a matter of hours or days

Build on pre-integrated Data Gateway and Soft PLC

Cost savings assumptions are based on projections from existing Nerve use cases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NERVE
SYSTEM

Nerve
System Overview

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Node Software

- Edge Hosting
- Data Services
- Remote Services
- Soft PLC

Any Hardware

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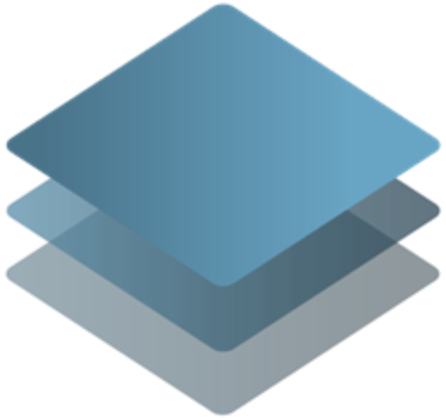
Management System

- Data Services
- Remote Services
- Workload Management

On-prem or Azure

Nerve
System Elements

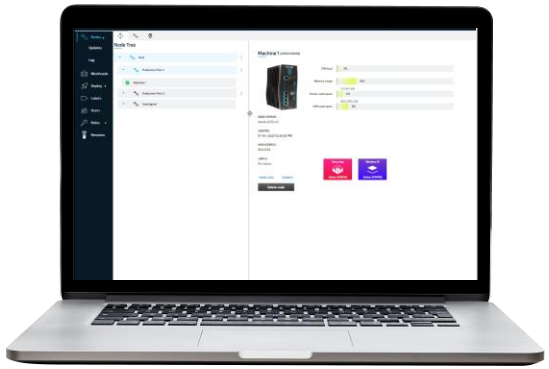


Nerve
Node Software

Device software

Qualified
Nerve Device

Intel Atom, i5, i7 devices



Nerve
Management System

Azure hosted or on-premises

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NERVE FEATURES

Features Overview

Edge Hosting

- Run IoT Edge modules
- Virtual machine management
- Docker container management
- Integrated software repository
- Zero configuration deployment
- Centralled Logging

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Data Services

- Azure IoT Hub connector
- Graphically configurable Data Gateway
- Multi-protocol Data Gateway (OPC UA, S7, MQTT, etc.)
- Built-in Time-series database
- Data buffering for offline operation
- Built-in Visualization

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Remote Services

- Remote tunnel (VPN-like)
- Zero configuration access
- Accessing external devices
- Remote shell access
- Client-less RDP and VNC viewer
- Local acknowledgment for remote access

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Soft PLC

- CODESYS Soft PLC
- Fieldbus connectivity
- High speed connection to an influxDB
- 61131-3 applications as workloads
- Support of retain variables

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Every Nerve module also includes a set of Nerve base features.

Edge Hosting

Virtual Machine management

Nerve Nodes support multiple Virtual Machines as workloads. Applications and operating systems can be migrated into Nerve without requiring any modifications. Virtual Machines can be created on a Node, then pushed to the Workload Repository in the Management System and distributed to all nodes worldwide.

Docker container management

Nerve Nodes support Docker containers as workloads. Docker containers on connected nodes can be managed centrally from the Management System or locally at the edge. Docker containers can be pulled from your private registry or from Docker Hub. Nerve allows to apply persistent configuration files that include specific settings.

Integrated software repository

Nerve integrates a workload repository with built-in version management. The workload repository holds all applications which can be distributed to the Nerve Nodes worldwide. Workload versions can be marked as released and a released workload cannot be modified. This ensures clarity about which exact configuration of a workload is deployed.

Zero configuration deployment

When workloads are created, they are fully encapsulated with all the parameters needed for installation. Service personnel are not required to modify any network, remote-service or resource reservation settings. This ensures that software deployment is straightforward for service personnel.

Centralized Logging

Nerve provides logging services based on the well-known KIBANA system. All system events, node events and applications are logged centrally. Pre-configured dashboards allow users to get started quickly without prior experience of using KIBANA. Nerve provides the infrastructure to log the messages and errors of applications. When applications are configured to log into a Linux Syslog service, Nerve ensures that all logs can be accessed centrally.

Data Services

Graphically configurable Data Gateway

The Nerve Data Gateway can be configured to read data from different sources and forward it to data sinks. It is flexibly configurable for multiple sources and sinks. The data gateway is optimized for high performance and permits short cycle times of down to 1 millisecond. It is graphically configurable for best usability.

Siemens S7 connectivity

The Data Gateway can be configured to read from Siemens S7 PLC's (S7-300/400/1200/1500)

OPC UA Client and Server

The Data Gateway also include sophisticated OPC UA server and client functionality. Both, client and server are freely configurable at runtime and support encryption and authentication using certificates or username/password. You can use the OPC US server to create a digital twin of your machine encapsulating all the data gathered from sensors and PLC.

MQTT support

The Data Gateway support MQTT as input and output protocol, again with certificate and username/password-based security features. The data is formatted in JSON and includes exact timestamping information.

Fieldbus connectivity in combination with the Soft PLC

You can use the Soft PLC module (licensed separately from the Data Service module) to read and write data from Profinet (Master and Slave support), EtherCAT and Modbus. This feature is especially useful for accurate, high speed data ingestion of up to 10kHz sample rate.

Buffering for Offline Operation

The gateway can buffer incoming data during offline periods to later forward it to the central database. A timeout ensures that the local databases don't overflow during longer offline periods.

Remote Services

Remote tunnel (VPN-like)

Remote tunneling can be used to connect to a shell, a web-UI or an FTP server running in workloads or even on external devices in a node's network. The Nerve Connection Manager must be installed locally on a PC to use remote tunnel access. It automatically opens when starting remote tunnel access to a Nerve node. The Connection Manager is available for Windows and Debian based Linux operating systems like Ubuntu.

Zero configuration access

Remote access can be configured when creating a workload in the Nerve Management System. Remote access to the workload is then available whenever it is deployed to a node. No additional configuration is necessary.

Accessing external devices (Edge node as jump host)

Remote viewing in Nerve does not only cover access to workloads and nodes. Users can easily configure external sources for remote access, like a Windows PC running an RDP server or a device with ssh access. Nerve offers a secure hub for remote access to all devices in the machine or production network.

Remote shell access

Nerve integrates a remote shell access directly from within the browser for workloads and external devices. Alternatively, the remote tunnel feature can be used to bring the ssh connection or console port to a PC.

Client-less RDP and VNC viewer

The remote access features (screen viewing, shell access, remote tunneling) are all available directly from within a browser, fully integrated in the Management System. Nerve permits remote access to the screens of Virtual Machines even if they do not have a VNC or RDP server running themselves. This feature is only available for Virtual Machines running on Nerve nodes. External devices still require a VNC or RDP server activated to access them.

Local acknowledgment for remote access

Nerve can be configured to require local acknowledgment for remote access. If activated, a user needs to accept a request for remote access on the node. This ensures that no one sees or interferes with production.

Soft PLC

CODESYS Soft PLC

The integrated CODESYS soft PLC (Version 3.5) is fully managed and applications can be distributed to nodes via the Nerve Management System. The CODESYS soft PLC runs down to 1ms cycle time, taking advantage of the computational power of Intel CPUs.

Fieldbus Support

The Soft PLC supports multiple fieldbus protocols. It can act as an EtherCAT master, PROFINET master and PROFINET device. Nerve supports a dedicated, high speed network port for the fieldbus connections from CODESYS.

High speed connection to influxDB

Nerve provides a connector from the CODESYS soft PLC directly to an influxDB Time-Series Database, optimized for high throughput. Using an Intel Atom class CPU, more than 10,000 samples per second can be pushed into the database.

61131-3 applications as workloads

Nerve Nodes support CODESYS 61131-3 applications as workloads. 61131-3 applications can be programed and tested using the CODESYS IDE on a Nerve Node, then a workload can be created and distributed to other nodes. Nerve can be configured to require local acknowledgment for modification of 61131-3 applications. Where the integrated CODESYS soft PLC is being used to control machine movements or critical operations, administrators can require that modifications are only made when a local user actively permits the change.

Retain variable support

The CODESYS Soft PLC includes retain variable support. Nerve provides a library to help users with this feature.

Nerve
Base Features

Device Management

The Nerve Management System provides a central point for managing all connected nodes. Users can manage nodes, update firmware, monitor device status and deploy and manage workloads. It is available as a hosted service run by TTTech Industrial, or for on-premise installation.

Built-in security

Nerve includes a wealth of features to ensure that the system always operates securely and keeps production data secure. All connections are secured using TLS. Nerve is regularly penetration tested. Software processes are according to IEC62443.

User and Rights Management

Nerve includes a Role-Based Access System to control the access for individual users to certain features of the Management System. Users can be managed through the built-in user and rights management system or connected to LDAP/active directory.

Offline and local operation

Nerve Nodes offer full functionality even when not connected to the Management System for whatever reason. When a node comes online, the Management System syncs to the node and recognizes any modifications made while it was disconnected.

API

Nerve can be managed through an API for automating repetitive tasks or for connecting the Nerve Management System to other systems.

Software Updates

Nerve platform software and all the applications can be updated remotely. The read-only file system ensures integrity of the platform software.

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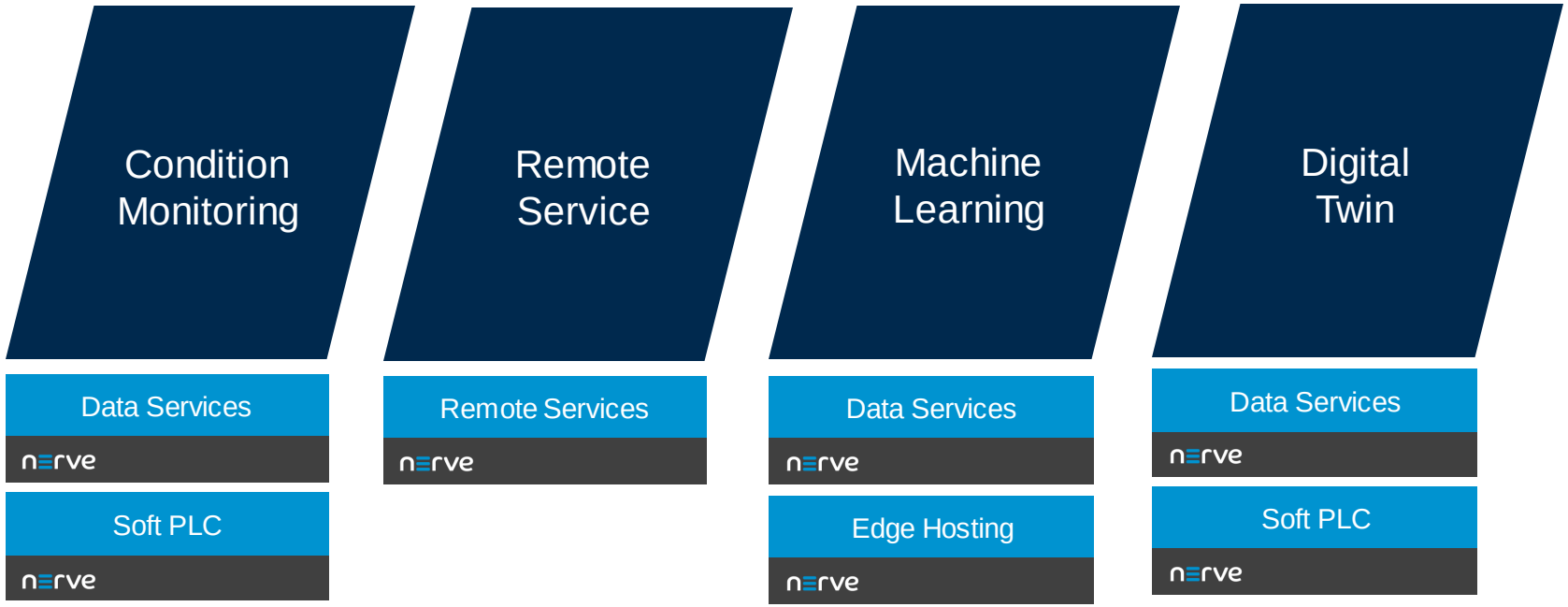
INDUSTRIAL IOT USE CASES

Use Cases Overview

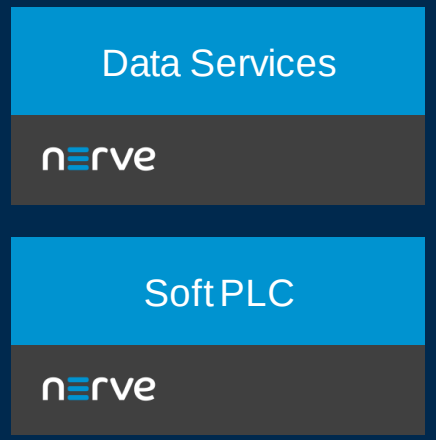


Condition Monitoring

Condition monitoring keeps track of key indicators for machine performance (vibration, temperature etc.) in order to identify any changes which may be indicative of a developing fault. Nerve provides a rich set of functions to implement a condition monitoring and predictive maintenance solution.

- Read sensor data via fieldbuses (Profinet, EtherCAT) using the Soft PLC module
- Read data from PLCs or other sources (S7, Modbus, OPC UA) using the integrated Data Gateway and store it in a local database
- Optionally, run algorithms on the data using NodeRed or Python based containers created by the Nerve SDK
- Use the integrated Grafana visualization tool to display the data locally and create alarms using rules

Use these Nerve modules for condition monitoring:



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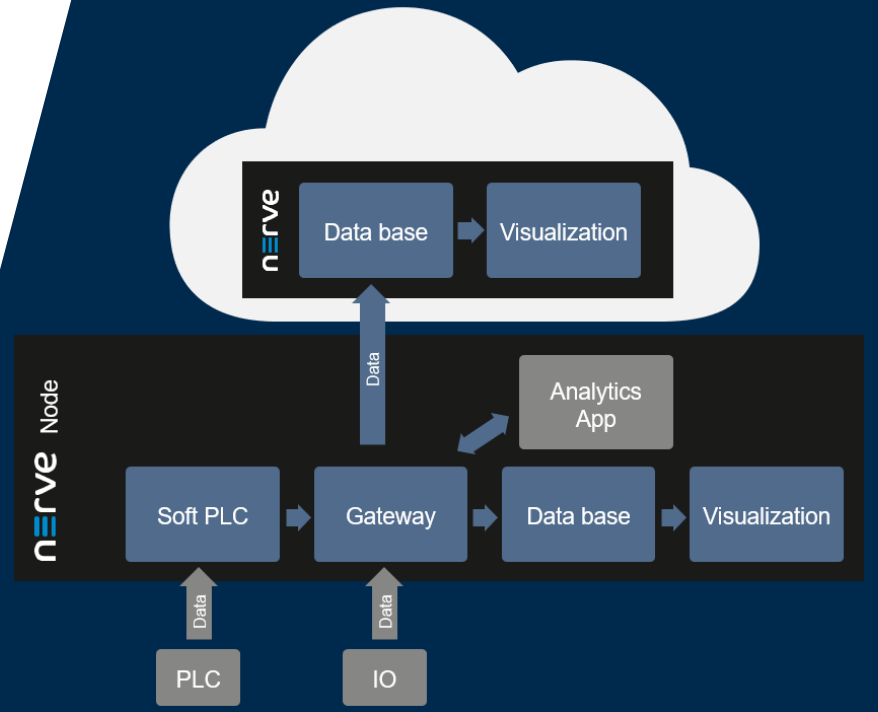

Remote Service

Remote Service includes all service and maintenance work that is carried out on machines and production lines without the service technician being on site. Nerve integrates a full featured remote service subsystem and allows software updates online and offline.

- Remotely access all devices in your machine using an integrated Tunnel (supports any Ethernet based protocol)
- Directly display a remote desktop (VNC and RDP) in your browser without the need for installing additional software
- Access devices inside the machine, use the Edge Node as jump host
- Collect logs centrally for all your devices
- Choose between continuously online or being online only during remote maintenance
- Keep your edge software and applications up to date

Use these Nerve modules for machine learning:

Remote Services

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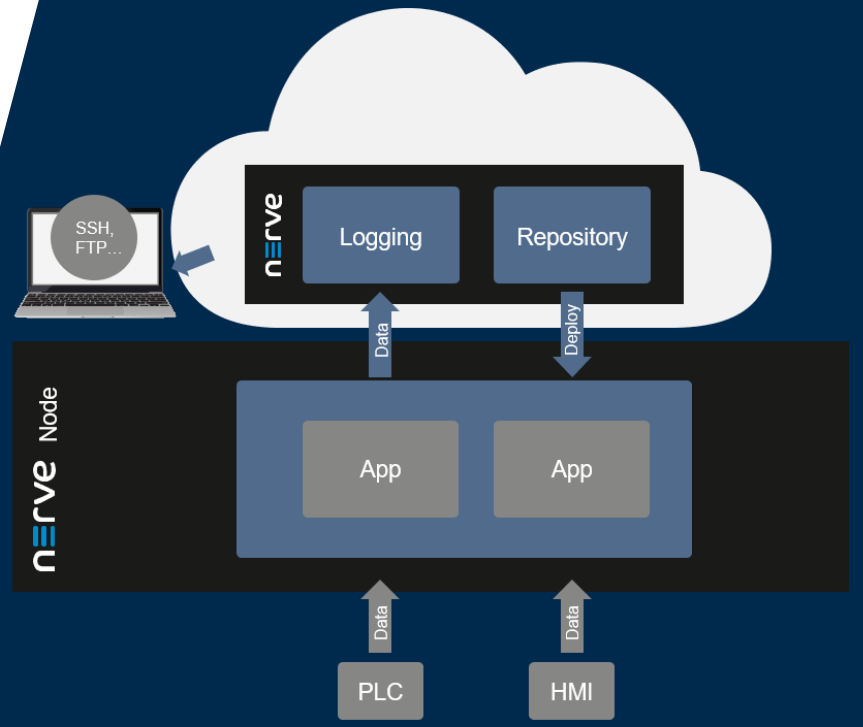
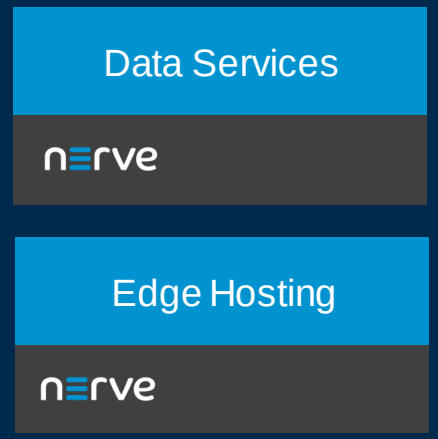


Machine Learning

Machine Learning algorithms build a model based on sample data, known as training data, in order to make predictions or decisions without being explicitly programmed to do so. Nerve can be used as a platform for collecting data to feed training models as well as a distribution method for deployment of Machine Learning algorithms and custom code.

- Use Nerve Data Services to collect training data
- Create and train your models using your preferred Machine Learning toolkit
- Deploy models and configurations using Nerve and integrates into a DevOps flow using the API
- Connect your trained models to live data using the Data Services SDK
- Visualize results using the built-in Grafana dashboards

Use these Nerve modules for machine as a service:



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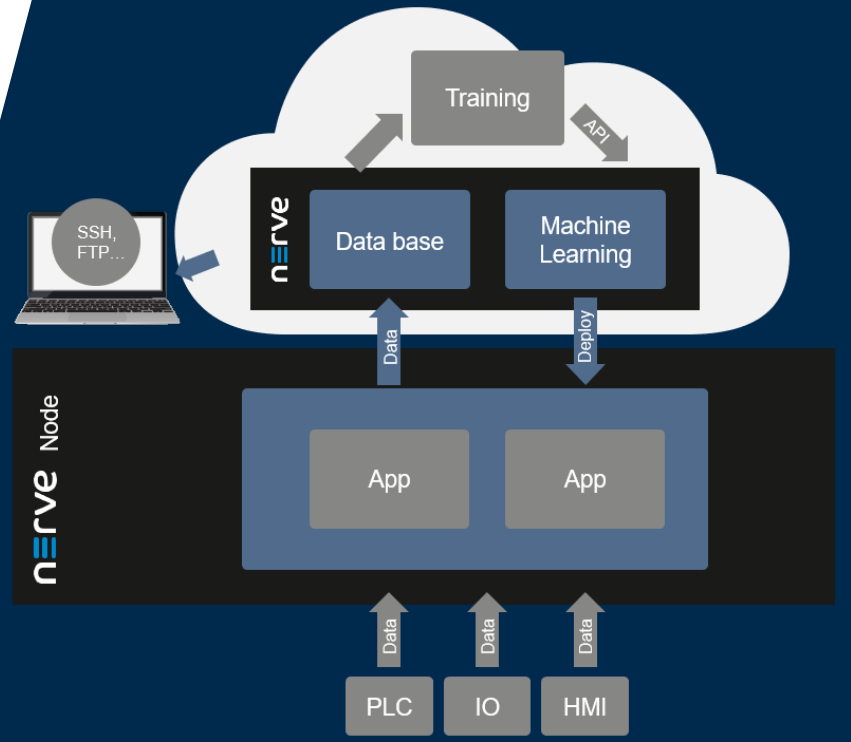
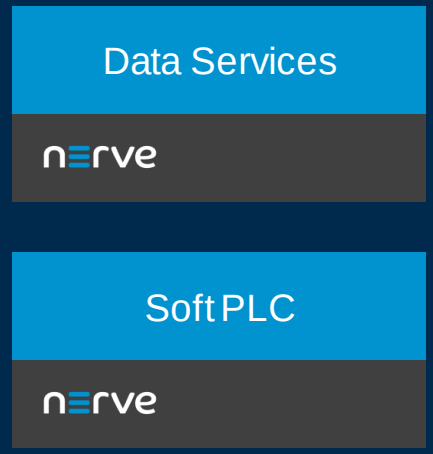


Digital Twin

A digital twin is a representation of a physical object, process or service. The twin can be a digital replica of an object in the physical world such as a CNC mill or a turbine. Nerve provides secure access to machine data which acts as the foundation for a digital twin.

- Collect data from the machine and model them in OPC UA for higher level services
- Read sensors using fieldbuses (Profinet, EtherCAT) using the integrated Soft PLC
- Secure your data using OPC UA security features

Use these Nerve modules for digital twin:



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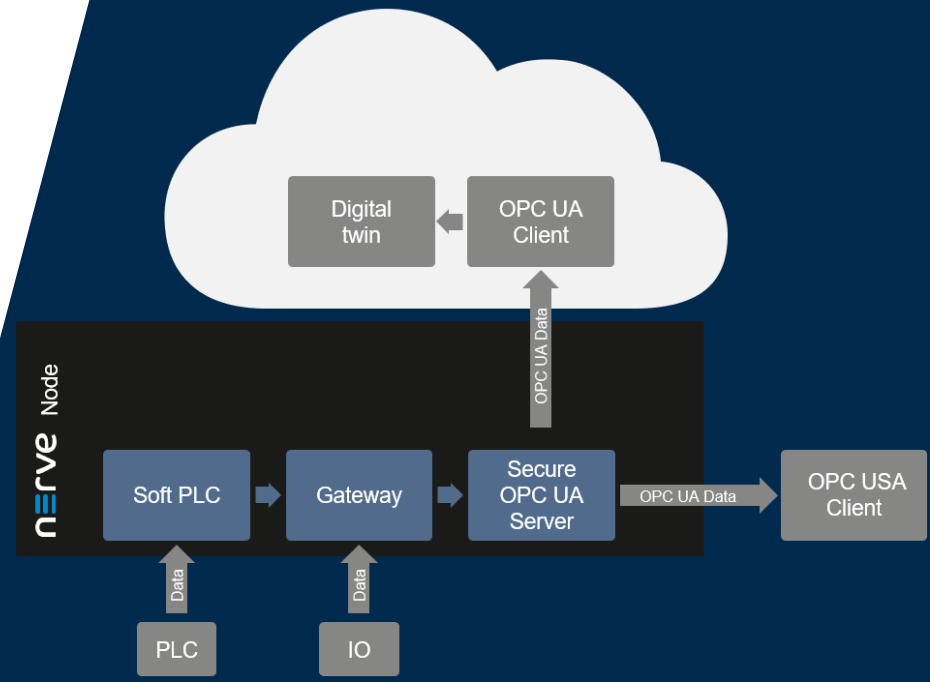

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CUSTOMER CASE STUDIES

Customer Case Studies Overview

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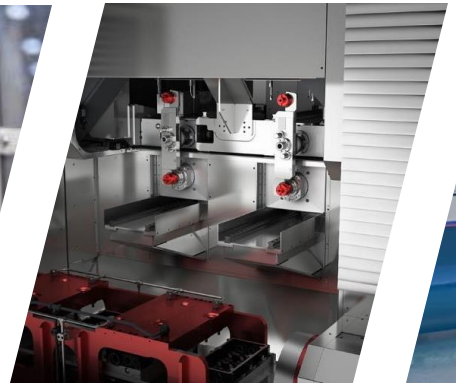
FELSS

- Data Services
- Soft PLC
- Edge Hosting

FILL



- Data Services
- Soft PLC
- Edge Hosting

ANDRITZ

- Edge Hosting
- Remote Services

Hydrogen energy storage

- Data Services
- Soft PLC
- Edge Hosting

Food processing

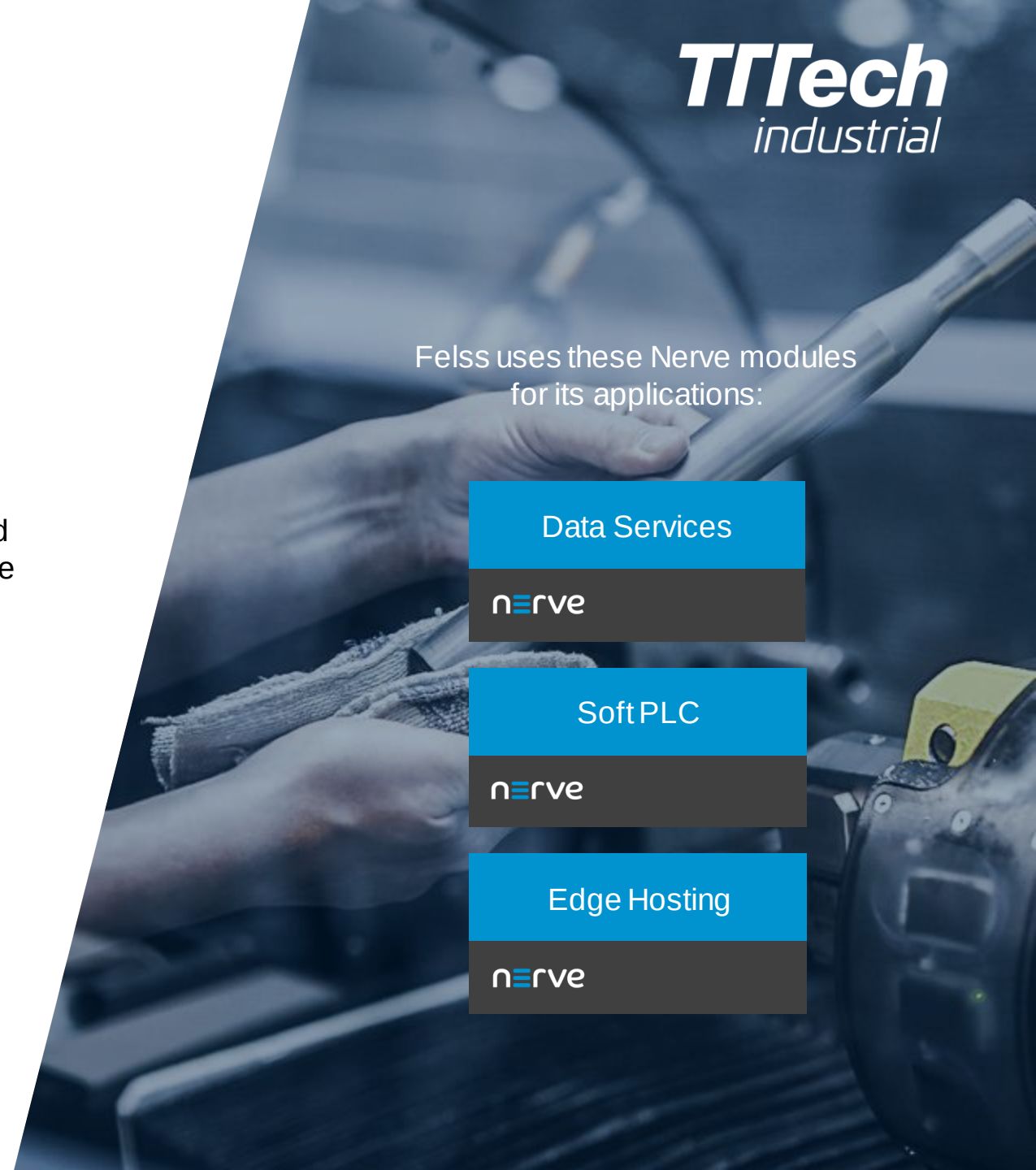
- Data Services
- Edge Hosting

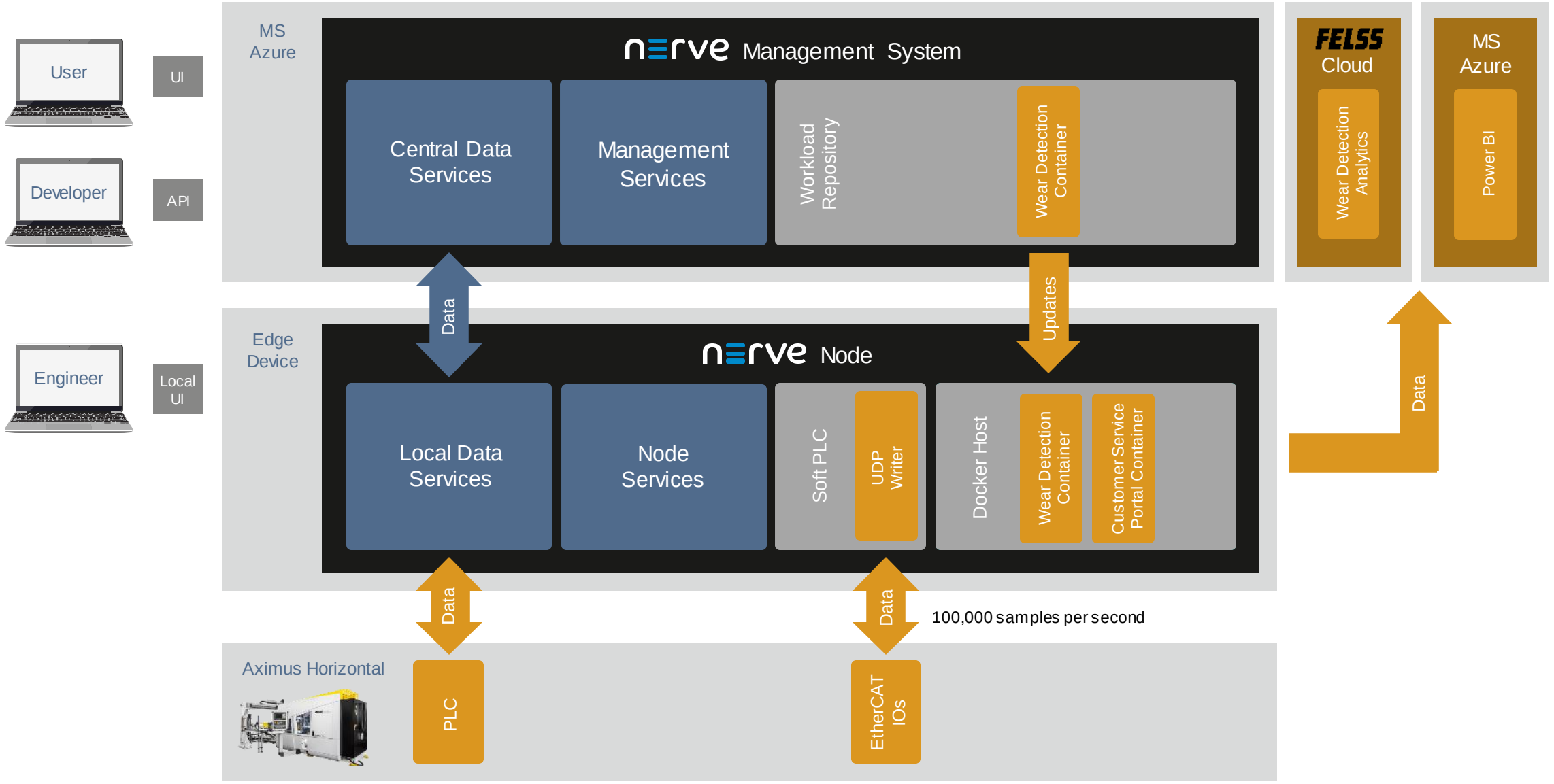
Case Study: Felss Smart Services

FELSS

Felss is a machine builder, specializing in cold forming of metal pipes and materials for automotive manufacturing. By integrating the Nerve software platform into their machines, Felss is now able to:

- Offer its customers secure data connectivity on the machine, in the factory, and to the cloud
- Develop and deploy smart services such as Felss “wear detection software”
- Easily install new applications and software updates to ensure that Felss customers always receive the highest levels of service

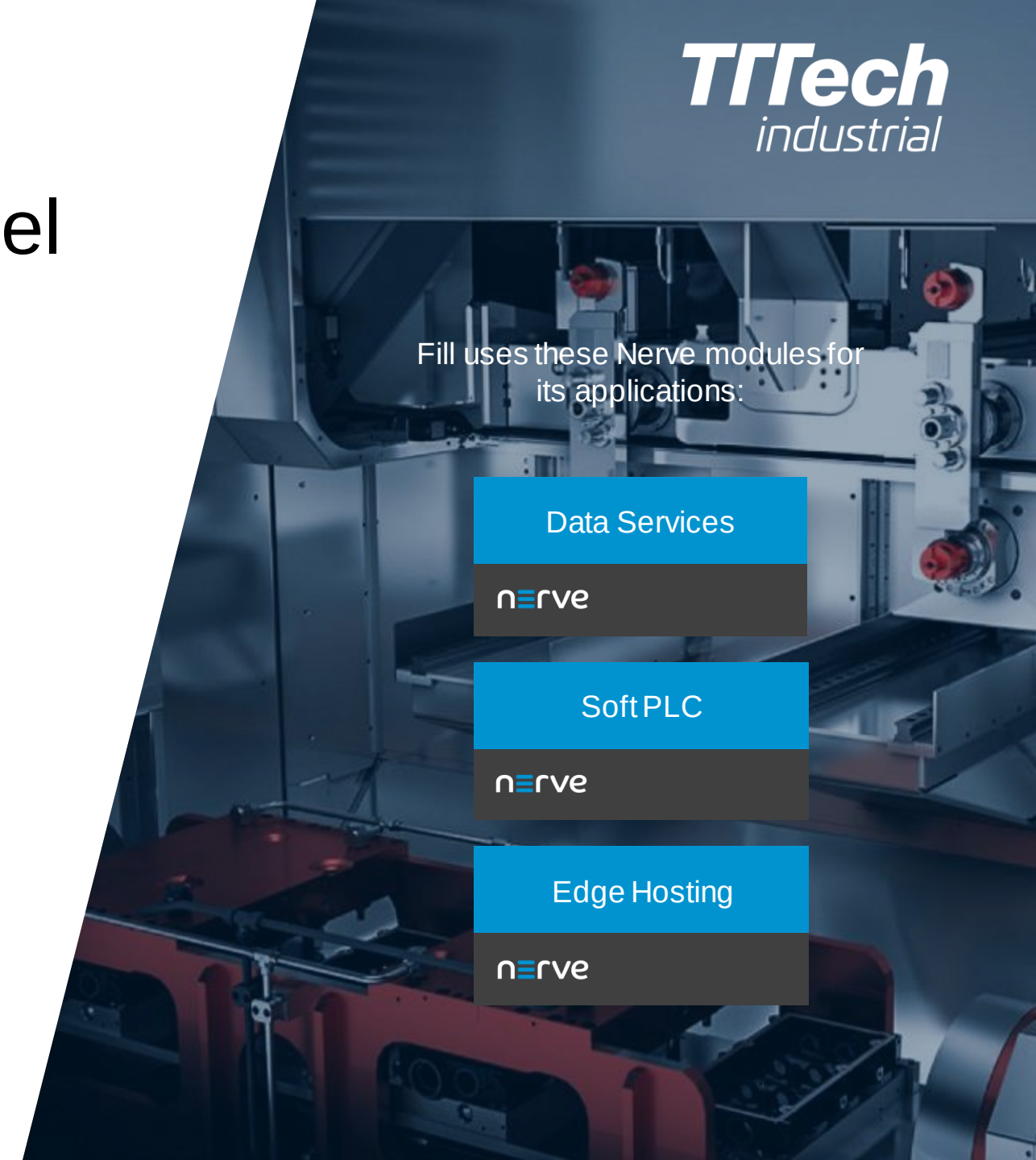


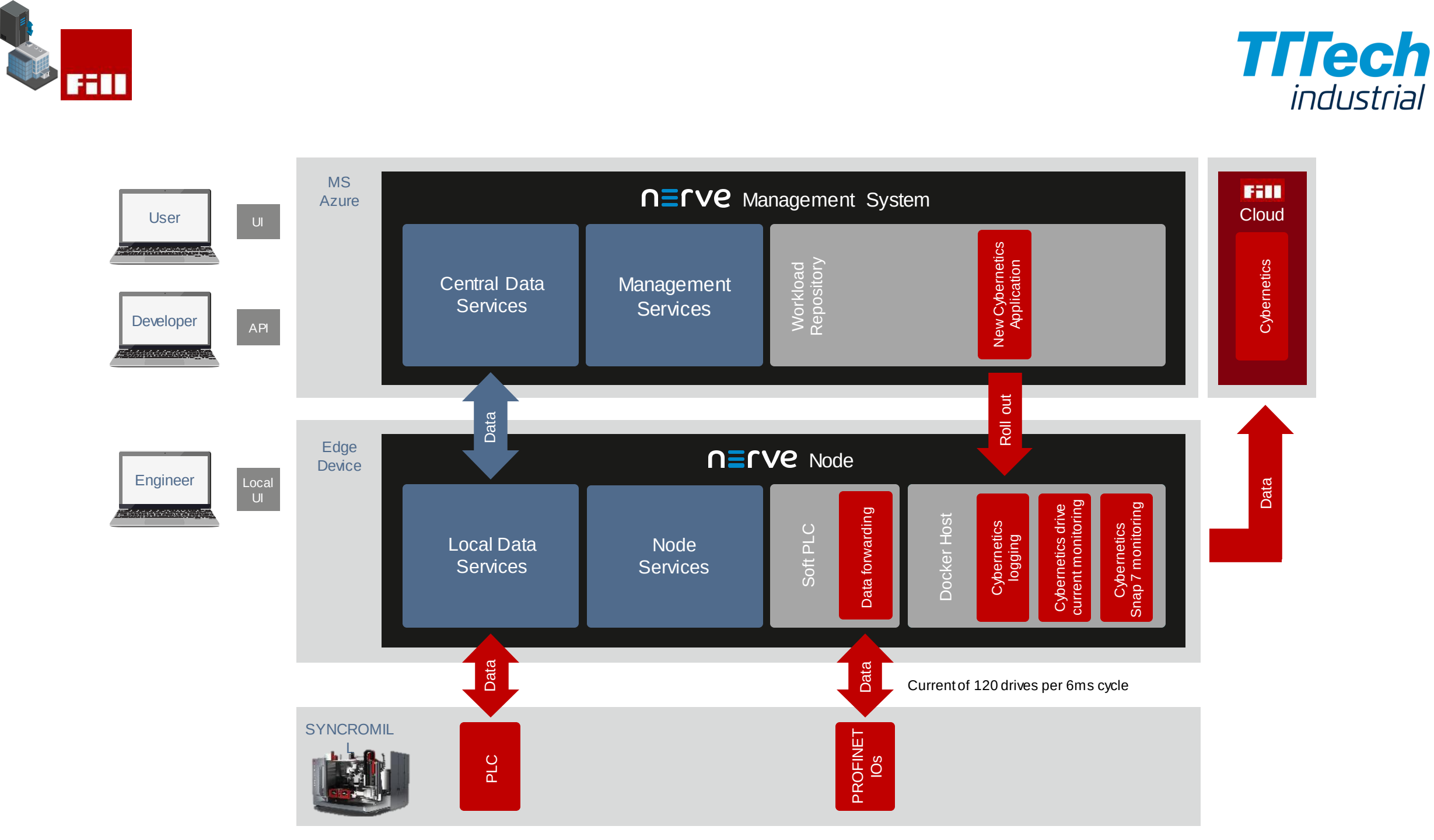

User
UI
Developer
API
Engineer
Local UI
MS Azure
nerve Management System
Central Data Services
Management Services
Workload Repository
Wear Detection Container
FELSS Cloud
Wear Detection Analytics
MS Azure
Power BI
Data
Updates
Edge Device
nerve Node
Local Data Services
Node Services
Soft PLC
UDP Writer
Docker Host
Wear Detection Container
Customer Service Portal Container
Data
Data
Data
100,000 samples per second
Aximus Horizontal
PLC
EtherCAT IOs

Case Study: Fill
New Service Business Model

Fill is a leading international machine and plant engineering company headquartered in Austria. By integrating Nerve into their predictive maintenance solution “Cybernetics”, Fill is now able to:

- Quickly and easily transfer real-time data from machines to Cybernetics, without affecting the performance of the control system
- Run analytics applications at the edge of the network, in order to process data before it reaches a server or cloud instance
- Offer new IIoT services to their customers for new and already installed machines

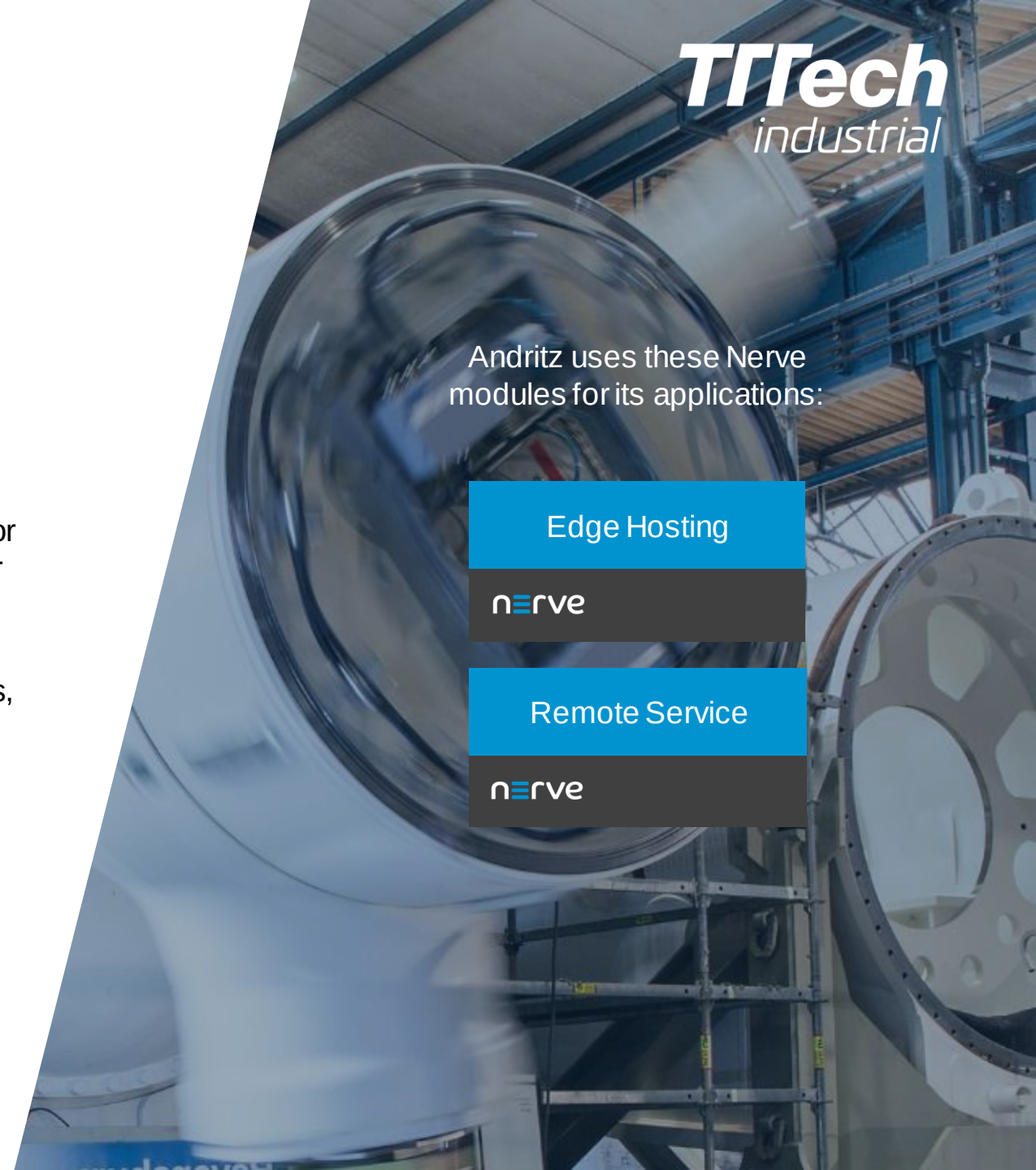


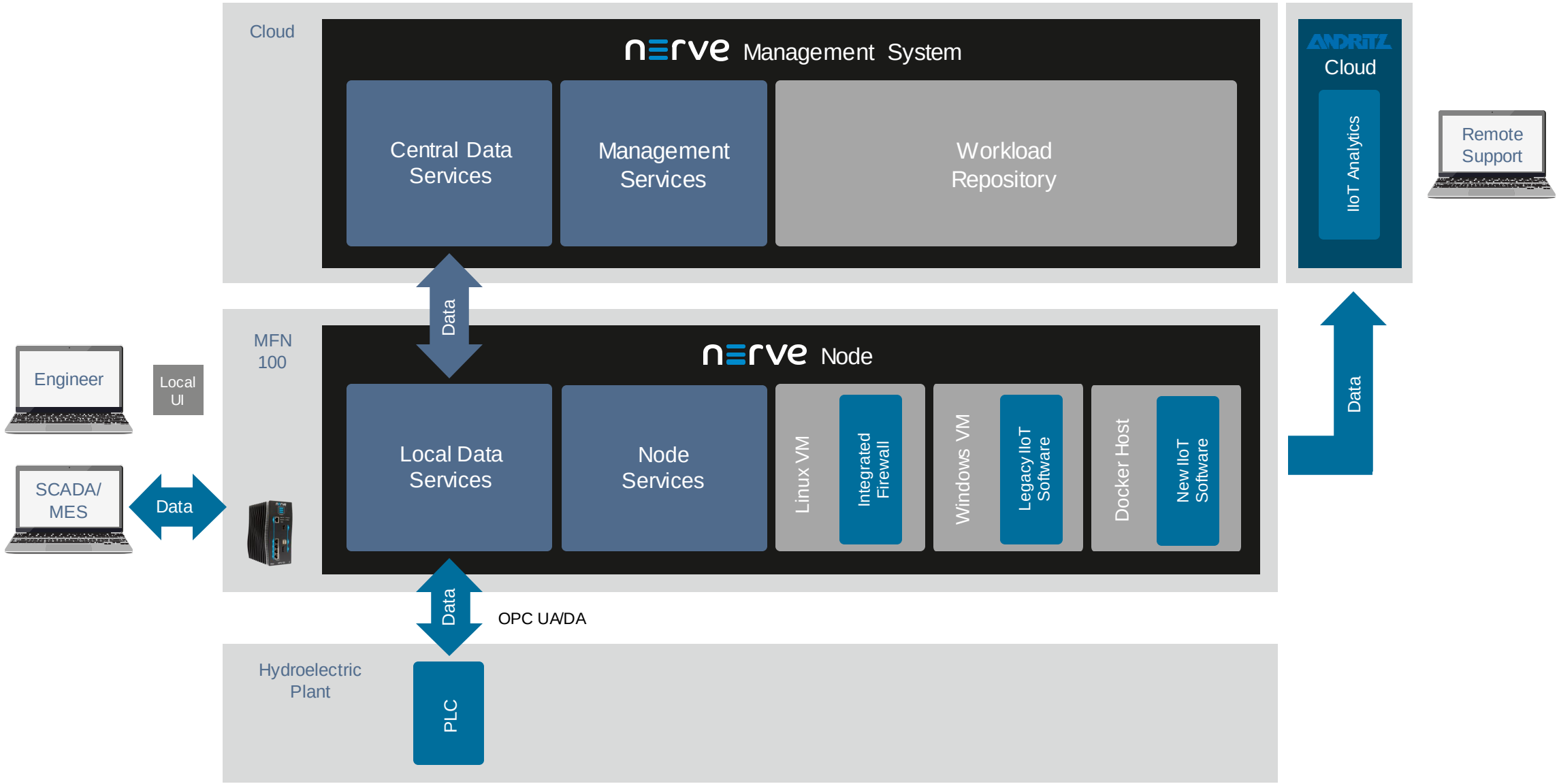

MS Azure
nerve Management System
Central Data Services
Management Services
Workload Repository
New Cybernetics Application
Cloud
Cybernetics
User
UI
Developer
API
Engineer
Local UI
Data
Roll out
Edge Device
nerve Node
Local Data Services
Node Services
Soft PLC
Data forwarding
Docker Host
Cybernetics logging
Cybernetics drive current monitoring
Cybernetics Snap 7 monitoring
Data
Data
Data
Current of 120 drives per 6ms cycle
SYNCROMIL
PLC
PROFINET IOs

Case Study: Andritz Hardware Cost Reduction

Andritz is a globally leading supplier of plants, equipment, and services for hydropower stations. By integrating the Nerve software platform into their hydroelectric power turbines, Andritz is now able to:

- Run multiple applications on one MFN 100, resulting in reduced costs, simplified system integration, and easier device management
- Migrate their legacy operating system as a VM and host Windows-based IIoT software, without needing to modify it
- Host a Cisco ASAv Firewall as a virtual machine to control all incoming and outgoing connections and to protect the system from unauthorized access/malware

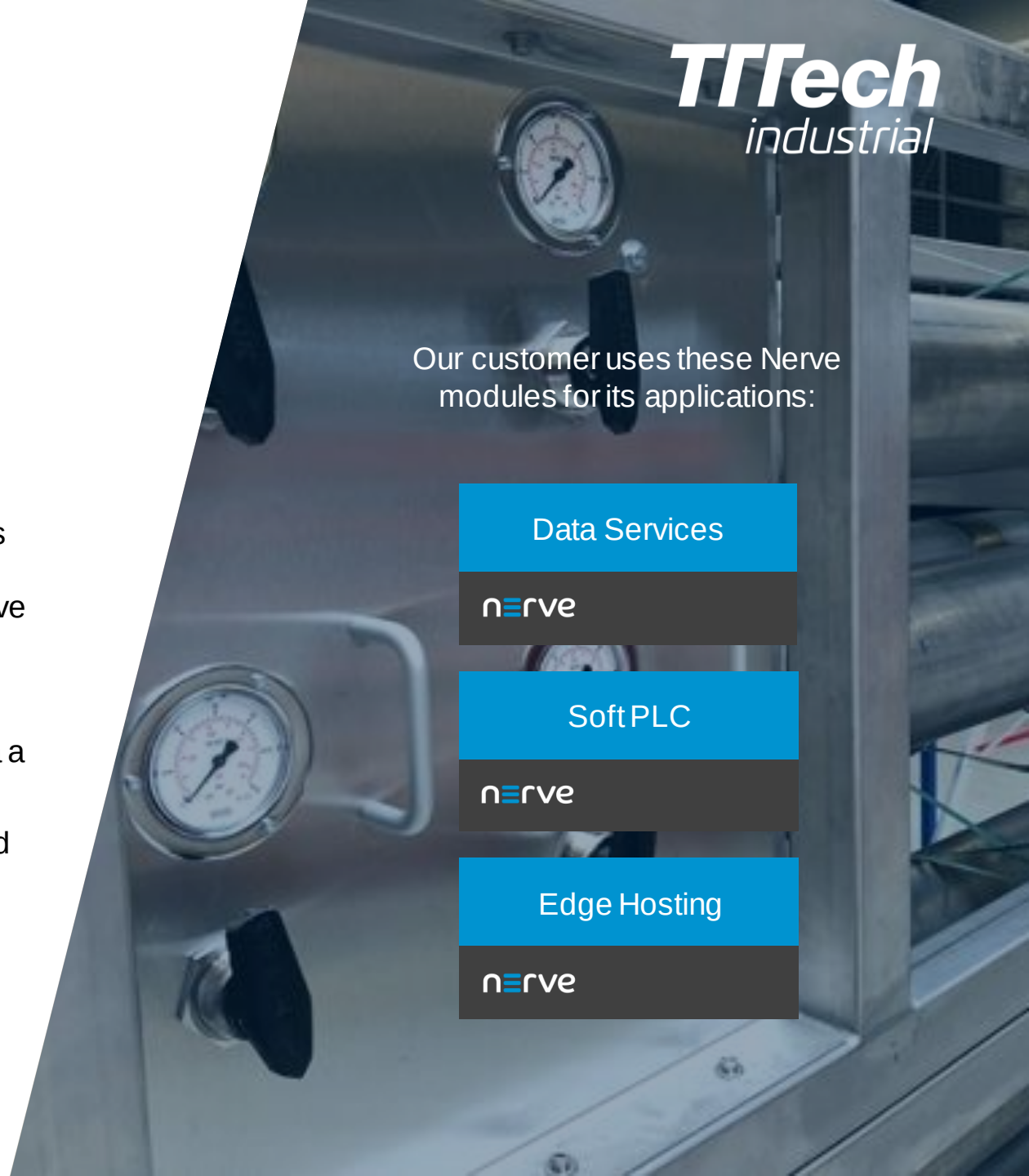



Cloud
nerve Management System
Central Data Services
Management Services
Workload Repository
ANDRITZ Cloud
IIoT Analytics
Remote Support
Data
MFN 100
nerve Node
Local Data Services
Node Services
Linux VM
Integrated Firewall
Windows VM
Legacy IIoT Software
Docker Host
New IIoT Software
Data
Engineer
Local UI
SCADA/ MES
Data
Data
OPC UA/DA
Hydroelectric Plant
PLC

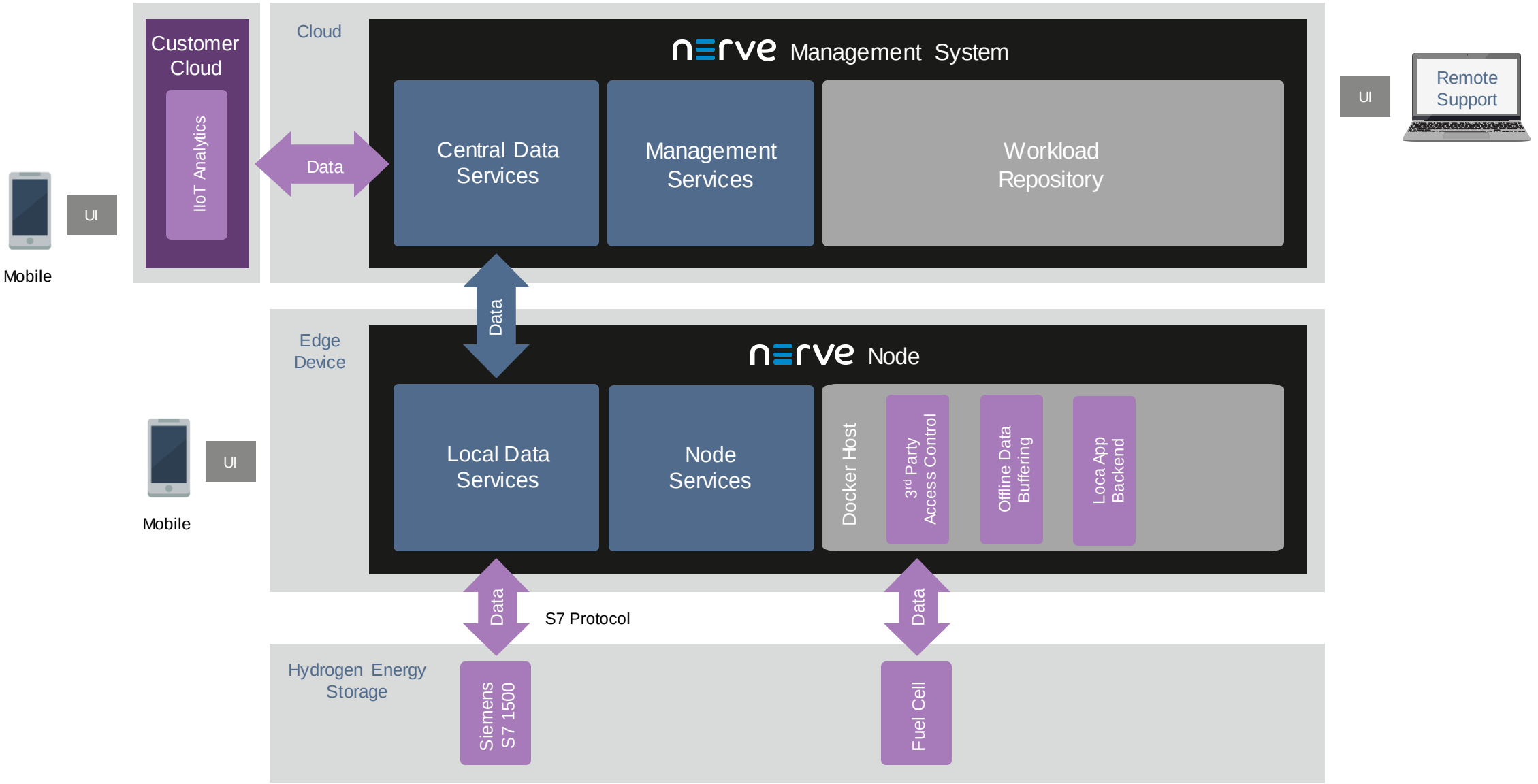
Case Study:
Hydrogen Energy Storage

Our customer is a large multinational that creates energy storage systems using hydrogen electrolytic and fuel cells. They use Nerve together with a Siemens automation system to integrate all electronic functions. With Nerve they are now able to:

- Monitor and control hydrogen energy stores on mobile applications via a connectivity backbone provided by Nerve
- Enable support teams to remotely access the systems to diagnose and correct problems
- Access subsystems of suppliers to maintain and diagnose those subsystems



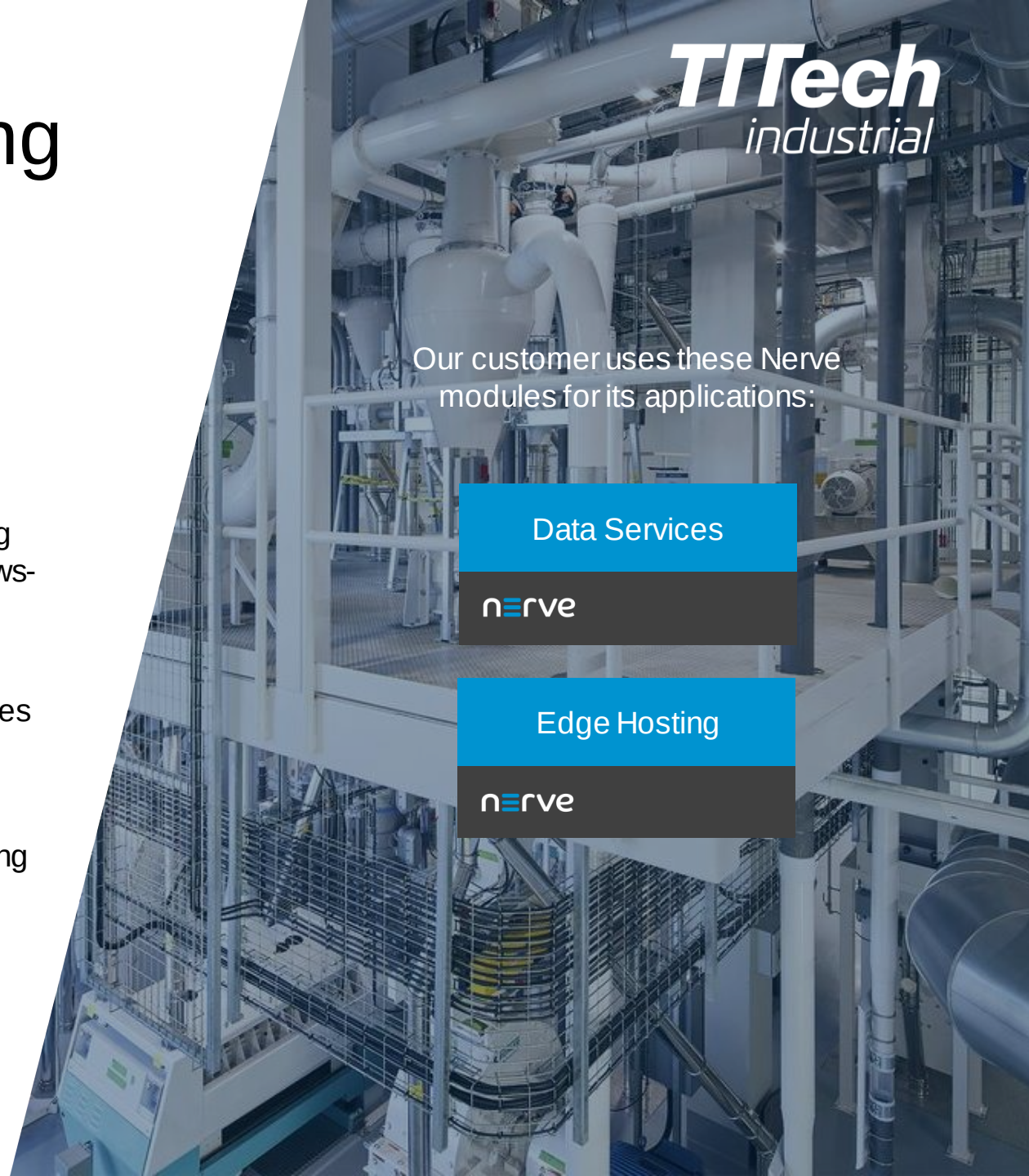
Hydrogen Energy Storage



Case Study: Food Processing Extending Software Lifetime

Our customer is a leading food processing equipment manufacturer. Using Nerve, they are lowering hardware costs by consolidating existing Windows-based software onto a single platform. The customer has been able to:

- Extend software lifetimes by hosting legacy software as virtual machines
- Migrate software from obsolescent hardware to a modern virtualized environment
- Combine up to three virtual machines in one device, drastically reducing hardware costs



Extending Software Lifetime

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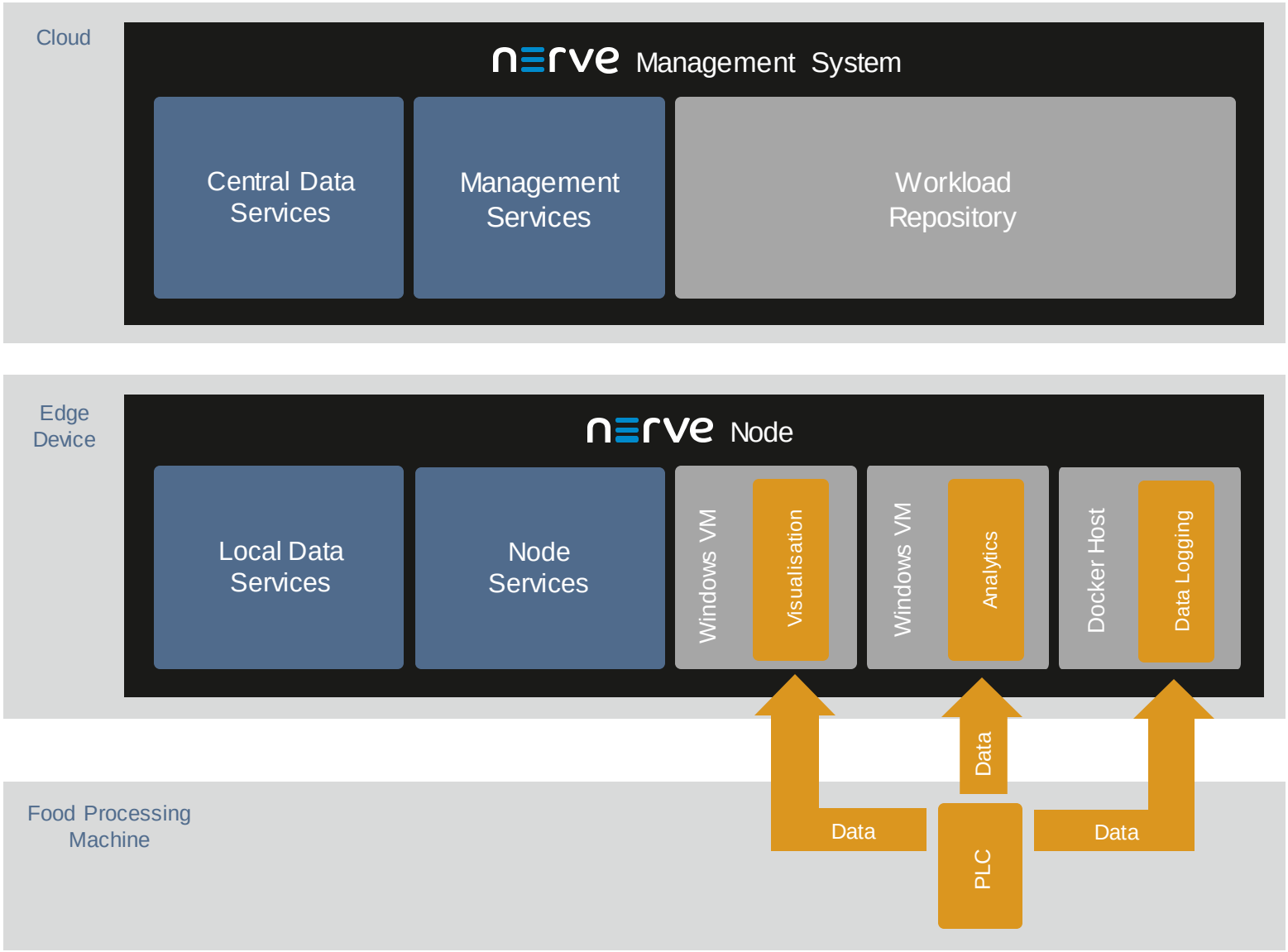

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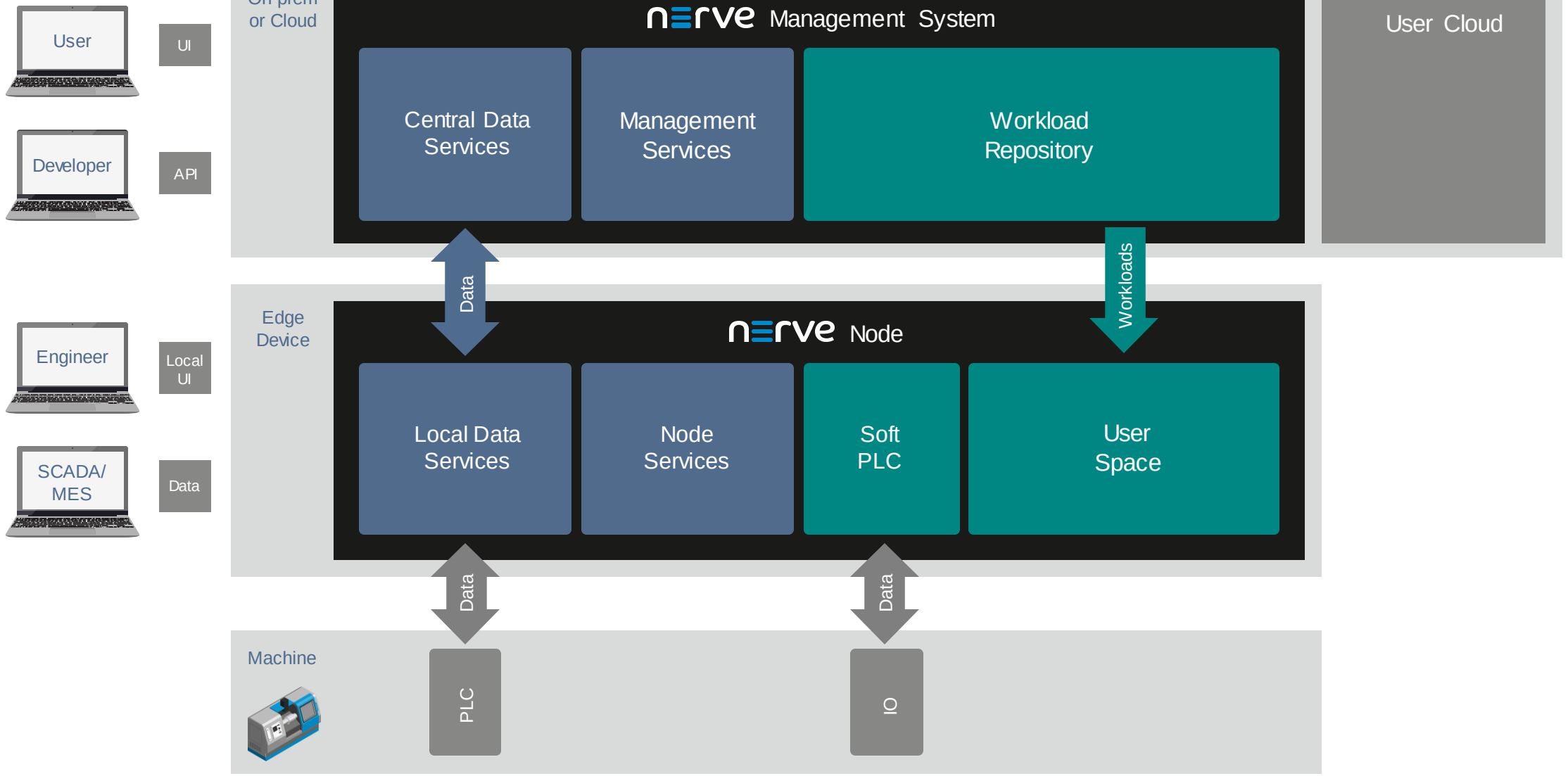
NERVE ARCHITECTURE

Nerve System Architecture



Nerve System Architecture Detail

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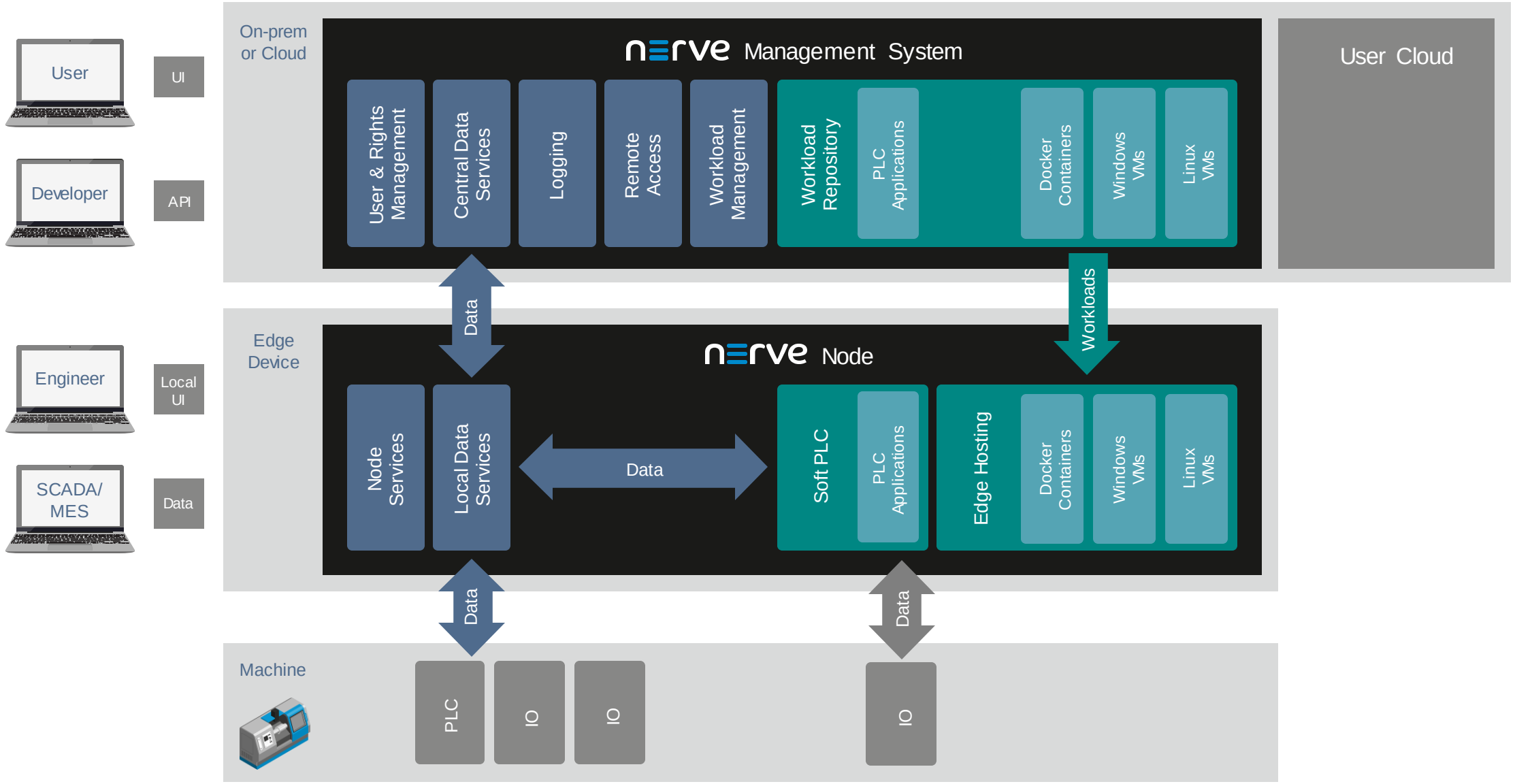


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NERVE
SECURITY

Security according to ISO 62443

Nerve security architecture is designed to meet IEC 62443 SL2/3 goals

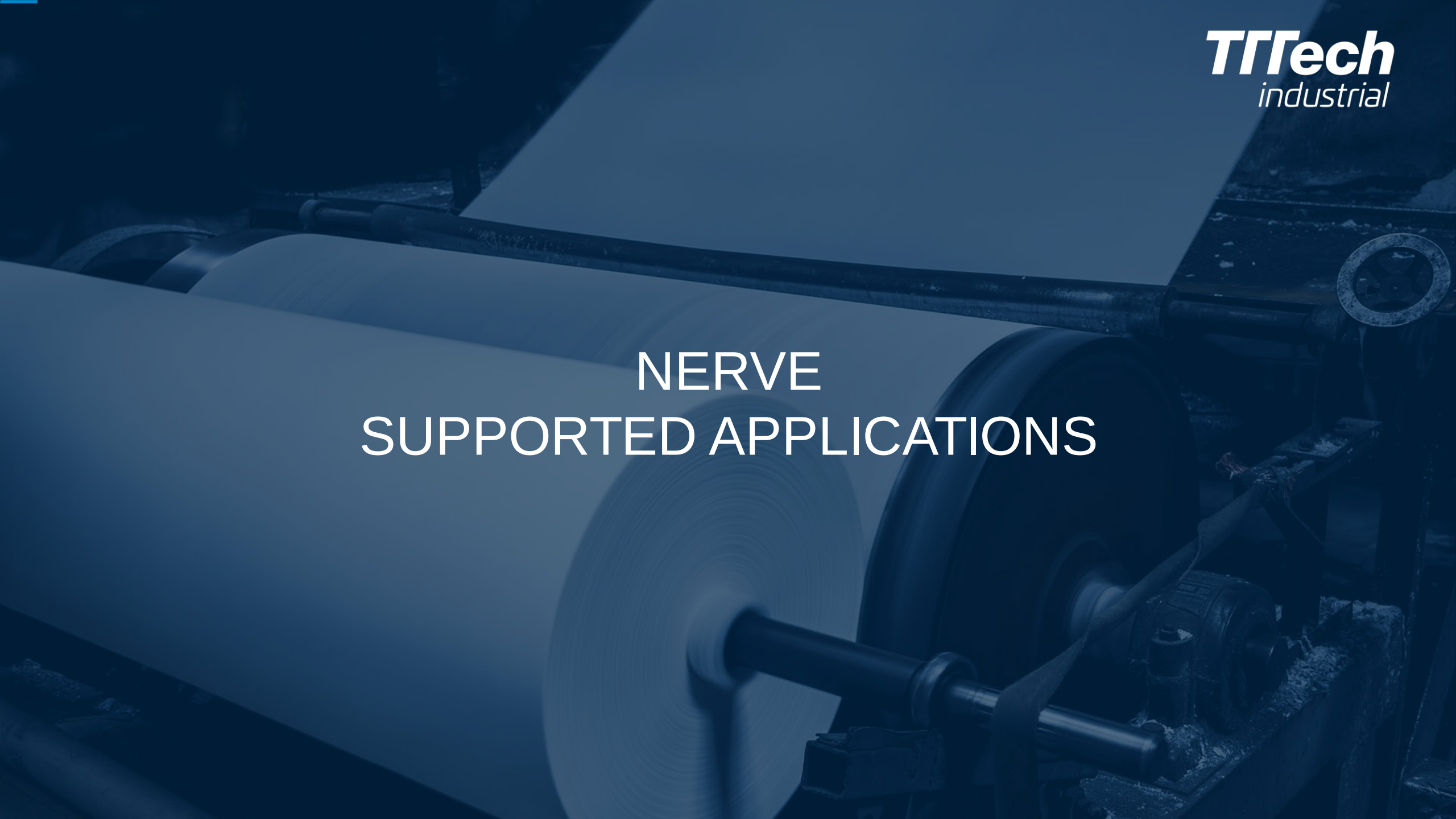
Overview of Nerve security requirements coverage:

- FR1 – Identification and Authentication (of Human Users, Software, Devices): Supported
- FR2 – Use Control: Supported, except physical diagnostics/test interfaces
- FR3 – System Integrity: Supported, except malicious workload code onboarded by authorized user
- FR4 – Data Confidentiality: Supported
- FR5 – Restriction of Data Flow: Supported, except elements of Zone Boundary Protection
- FR6 – Timely Response to Events (audit logging): Supported
- FR7 – Resource Availability: partly supported

Detailed assessment results can be provided on request

Penetration tests are being executed by 3rd party during development

Ongoing development to address full coverage of IEC 62443 SL3 and certification



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NERVE
SUPPORTED APPLICATIONS

crosser

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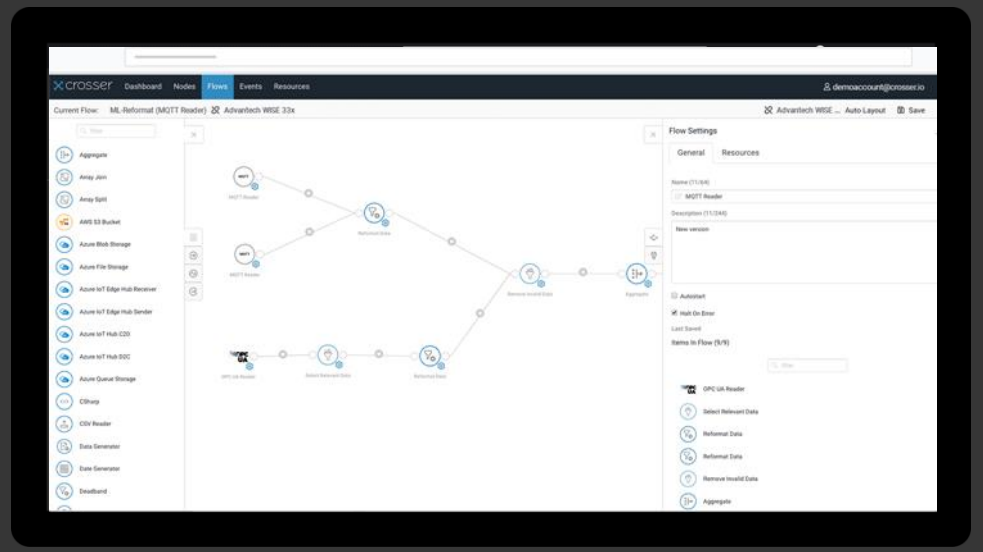
Trial version available as a pre-provisioned workload in Nerve



Powerful streaming analytics and integration software

Crosser runs on Nerve at the edge, as well as on-premise or in the cloud. Crosser enables real-time processing of streaming or batch data from any data source, which can be used for applications such as condition monitoring and predictive maintenance.

- Ready-to-use, and zero-code modules with a highly intuitive user interface
- Commercially supported and centrally managed software with outstanding security features
- High-speed, at source data processing that reduces the need for expensive cloud services

Node-RED

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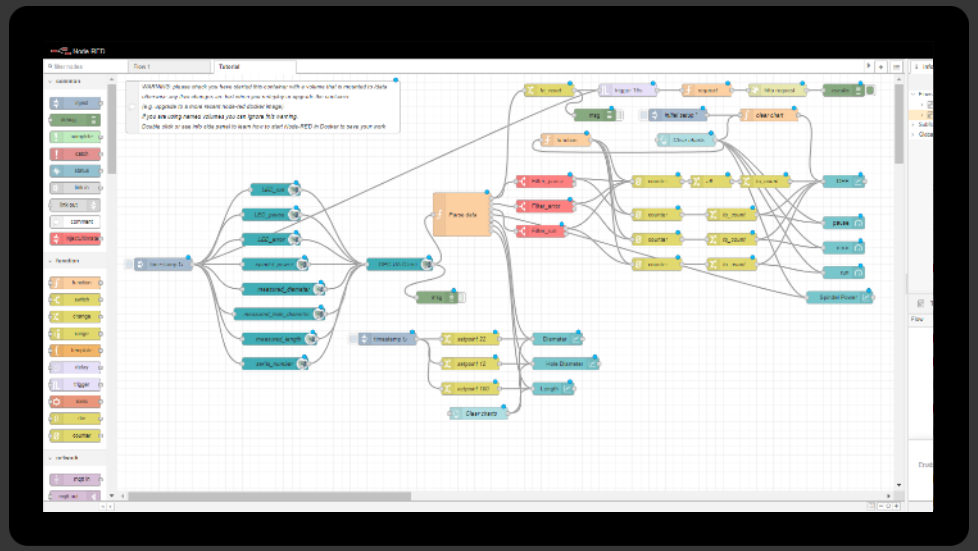
Available as a pre-provisioned workload in Nerve



Browser based, open-source data flow editor

Node-RED provides a browser-based editor that makes it easy to set up flows, with a wide range of nodes in the palette that can be deployed to its runtime in a single-click.

- Open-source data flow editor with large community support
- Drag-and-drop functionality that makes getting started quick and easy
- Processing machine data from any source and sending it to any cloud

NERVE
QUALIFIED DEVICES

Nerve Qualified Devices

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Class 2 Devices

TTTech MFN 100
Intel Atom E3940/50

Siemens Simatic IPC 127E
Intel Atom E3940

SuperServer E100-9AP-IA
Intel Atom E3940

Kontron Kbox A-150- APL
Intel Atom E3950

Kontron Kbox A-250
Intel Atom E3950

Class 3 Devices

Vecow SPC-5600
Intel i5

Siemens Simatic IPC 427E
Intel i5

Class 4 Devices

SuperServer 1019D
Intel Xeon

TTTech MFN 100

MFN 100			
CPU	Intel E3940 4 cores, 4GB RAM		Intel E3950 4 cores, 8GB RAM
Storage	64GB SSD MLC	256GB SSD MLC	512GB SSD MLC
Fieldbus Interfaces	1 x 10/100/1000 Mbit/s RJ45 (PROFINET, EtherCAT, Modbus TCP/IP)		
Ethernet Interfaces	4 x 10/100/1000 Mbit/s RJ45		
USB	2 x USB 2.0 (assignable to virtual machines)		
Output	1 x DisplayPort (assignable to virtual machines)		
Mounting	DIN rail or wall mount		
Power	2 x 24V redundant input Maximum power consumption 33.6W		
Environmental	Intended for use in control cabinets Operational temperature: -40°C to +70 °C IP 40 according to IEC 60529		
Dimensions	(H x W x D) 177.5 x 75 x 141mm		

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