IIoT Sensor
u-sense vibration

Smart and easy Retrofit for Machine Condition Monitoring

Joachim Franz Kastner
Program Management Sensors

Agenda

1. Industrial IoT – Role and target of IIoT sensors
2. IIoT Sensor Program
3. Machine condition monitoring by vibration analysis
4. IIoT sensor solution u-sense vibration
5. Sales Info

Industrial Internet of Things

The Industrial Internet of Things (IIoT)

- Interconnect industrial physical objects (“the industrial world”) with the network
- Including sensors and actuators
- Collect, exchange and analyse data
- Generate value based on data, information, knowledge
- Create new business models

Benefits of Industrial IoT

User value is source of the IIoT value chain

- **Efficiency (OEE)**
- **Costs**
- **Flexibility**
- **Resilience**
- **Quality**
- **User experience**

Industrial IoT Strategy

Benefits of Industrial IoT sensors

Problem

Machine failure
→ Unplanned production stop costs
Classic solution:
Preventative maintenance
→ High maintenance costs

Solution

Condition monitoring by sensors
→ Avoid product stop costs
→ Reduce maintenance cost
→ **Resilience, OEE**

Benefits of Industrial IoT sensors

Early risk detection

Condition monitoring and predictive algorithms can detect critical trends before failure occurs.

Automatic alarms and communication

Alarms are triggered immediately to initiate risk handling.
Necessary personnel are automatically informed and information is available at a glance.

Diagnosis

IIoT sensors provide a continuous database of measured values for malfunction diagnosis.

Process optimization

Process efficiency can be increased through the continuous measurement data base and analysis.

Save time and resources

Routine checks are done automatically.
Maintenance tasks can be initiated and planned earlier and more efficiently.

Documentation

All measured values and events are stored and documented for internal or legal requirements.

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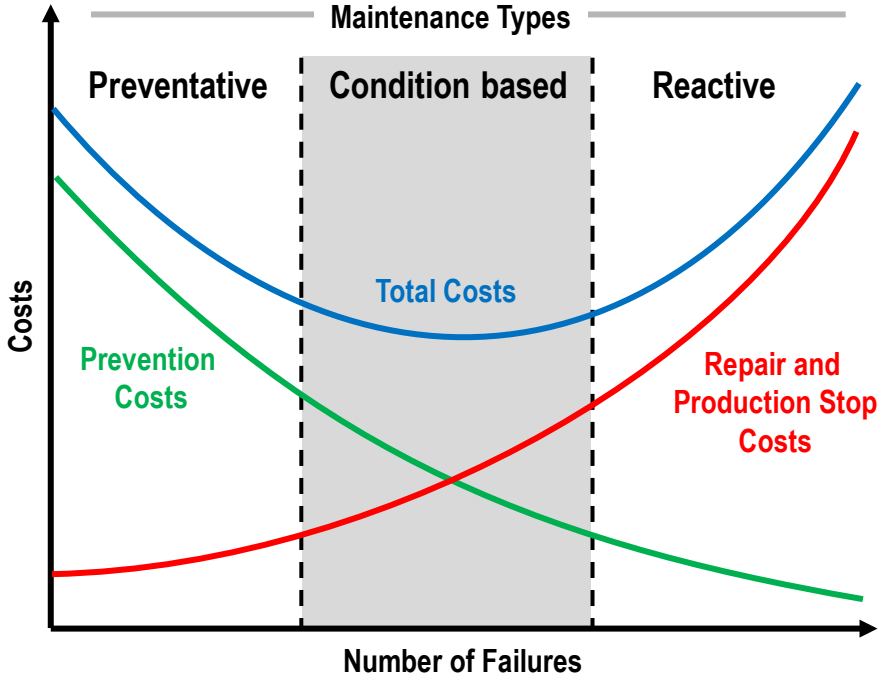
Sensor Program - Key Use Case

Efficiency and Resilience of assets and processes

- Optimize maintenance
- Avoid unplanned production stop
- Reduce risk
- New business models

➢ Condition based maintenance of mechanic and electric equipment



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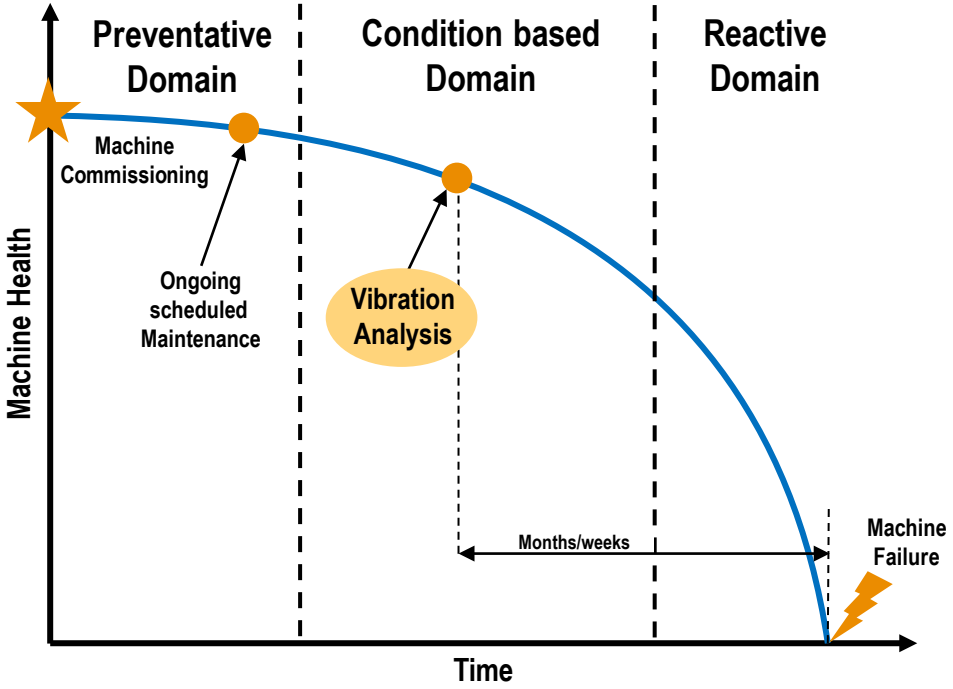
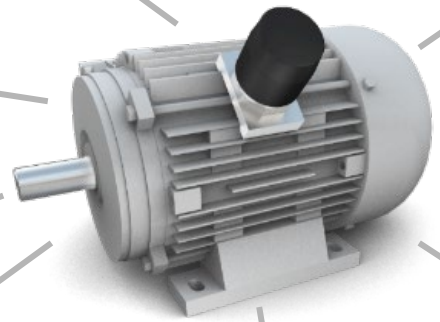
Machine Condition Monitoring with IIoT Vibration Sensors

Predict approaching failure in time by vibration analysis



Condition Monitoring of E-motors and rotating Equipment

Mechanical failure modes for vibration analysis



- Changes of the balancing condition
- Wear or damage to bearings
- Disturbances of the flow in hydroelectric machines
- Changes in alignment
- Operational disturbances
- Mechanical loosening
- Damage to gears and clutches
- Friction
- Cracks in critical components

ISO 13373-1 Condition Monitoring and Diagnostics of Machines

Signal domains

Broadband analysis

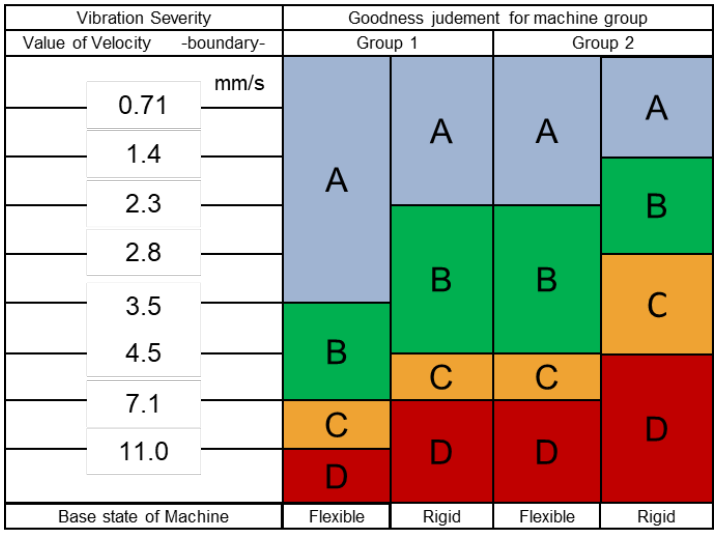
- ISO 20816-1, ISO 10816-3
- Effective velocity v.rms
- Skewness, kurtosis, crest factor

Spectral analysis

- e.g. discrete spectral components

Special spectral analysis

- e.g. envelope analysis



Group 1: 300kW – 50MW, Group 2: 15kW – 300MW

ISO 13373-1 Condition Monitoring and Diagnostics of Machines

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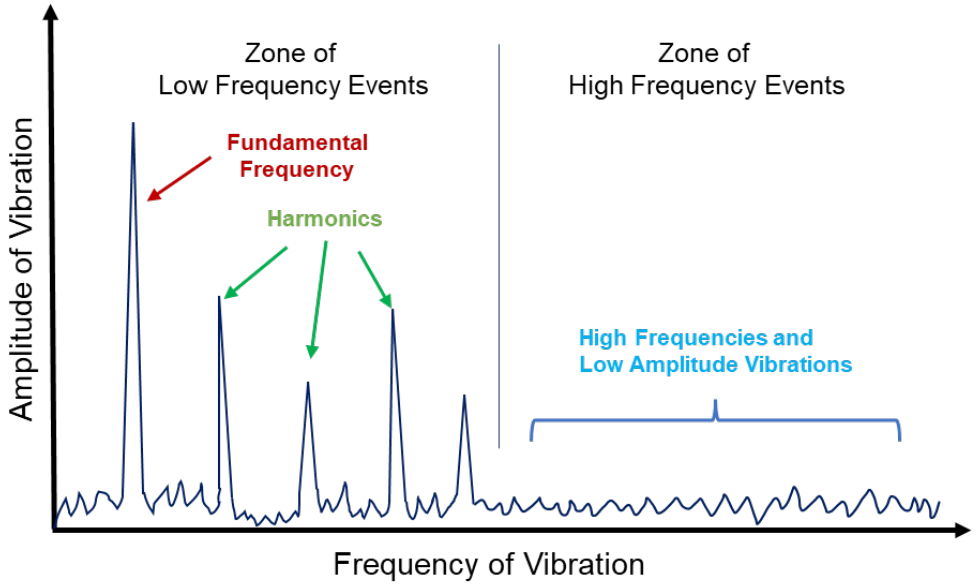

Low Frequency Events: Caused by Imbalance, Misalignment, Looseness
High Frequency Events: Early Signs of Bearing Failures

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u-sense vibration

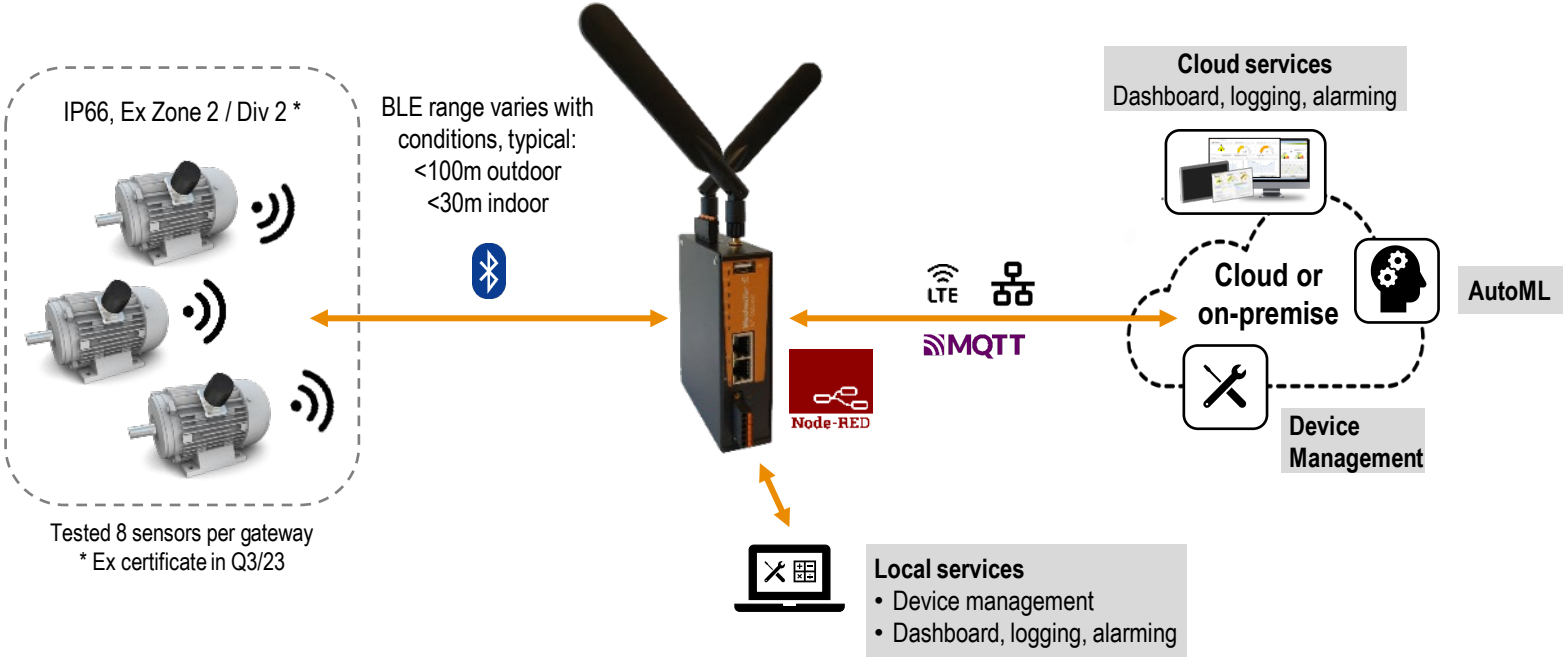
System components

Additional portfolio

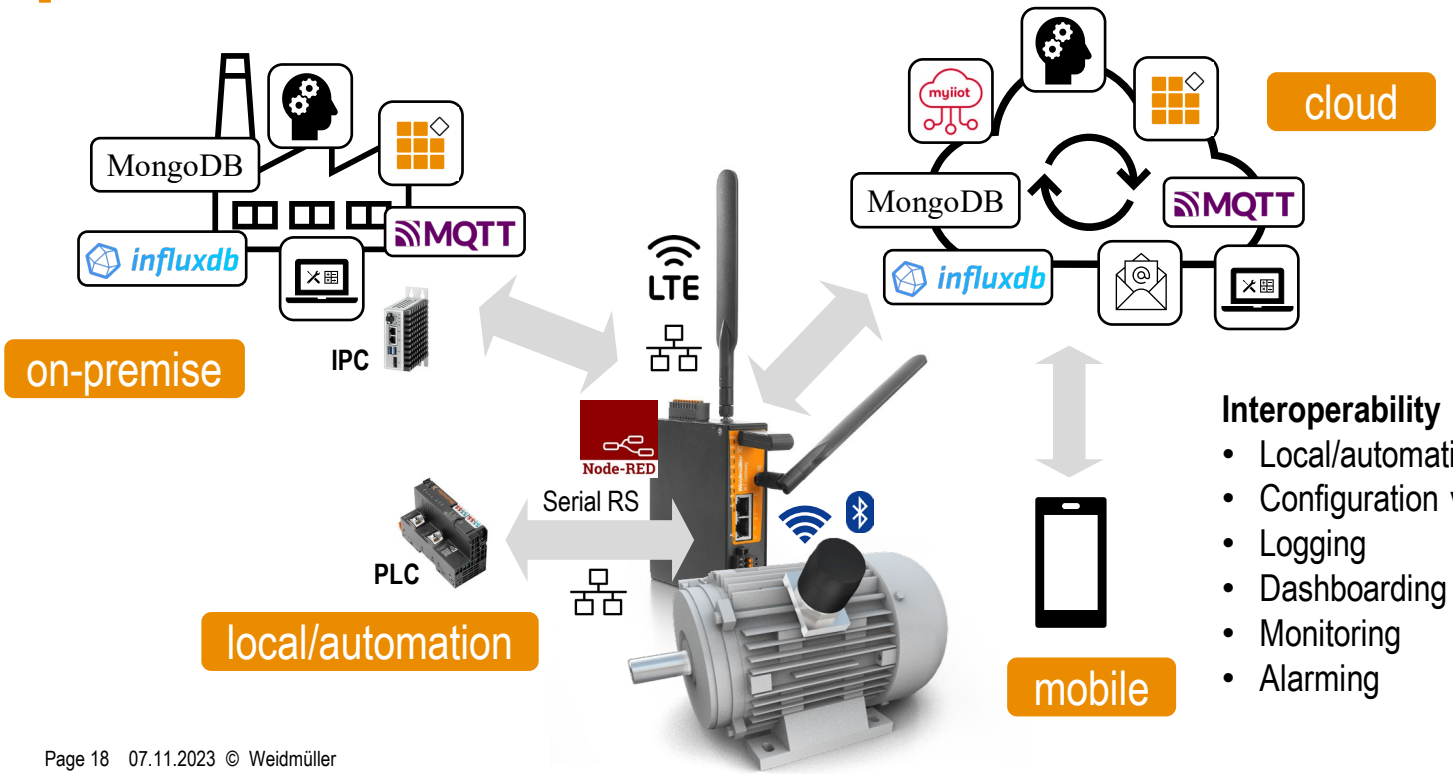
FieldPower IoT box (LAN/ LTE)	
Spare battery kit sensor	
Starter-Kit	

u-sense vibration

System architecture



u-sense vibration – Smart Sensor for Machine Monitoring
Featuring: Data Interoperability and Multi-Connectivity



Interoperability & Multi-Connectivity

- Local/automation, on-premise, into cloud
- Configuration via web interface
- Logging
- Dashboarding
- Monitoring
- Alarming

u-sense vibration

Tool for vibration condition monitoring

Broadband analysis (ISO 10816-3)

- 3-axis acceleration in band 10…1000 Hz
- Velocity rms, skewness, kurtosis, crest factor

Spectral analysis

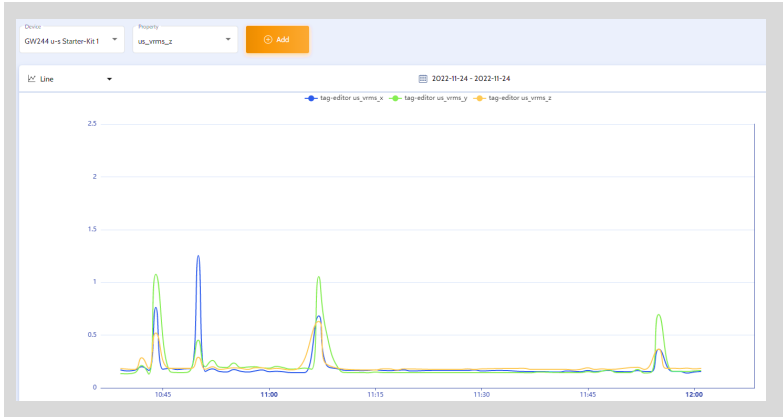
- 3-axis acceleration in band 10…3300 Hz
- Calculate acceleration FFT spectra in sensor
- 2048 bins, resolution ca. 1.6 Hz

Temperature

- Socket temperature

Measurement Interval

- 10s (test mode), 10min, 1h



WM cloud easyConnect with charts of v.rms_x/y/z

u-sense vibration

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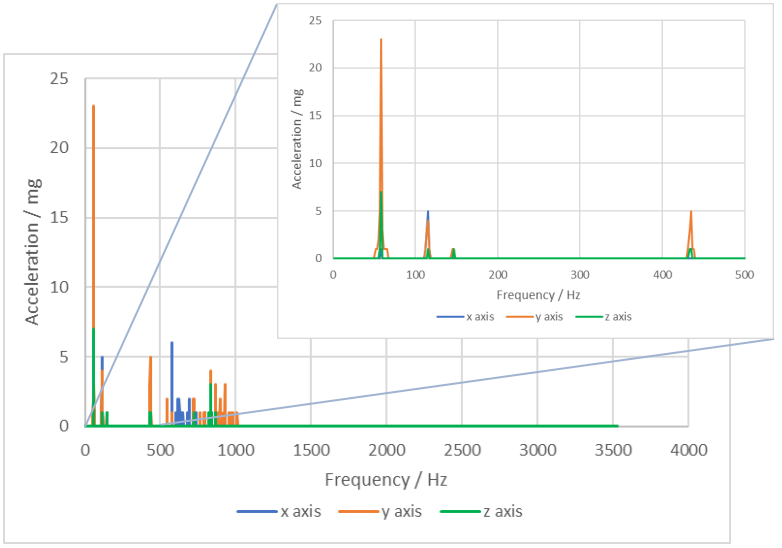


NodeRED dashboard with acceleration-x/y/z spectra

u-sense vibration

Cyber security elements

Physical access limitation by operator

Secure boot: Only certified software will be executed by sensor

Secure firmware update over the air: Only certified software can be updated

Sensor PIN: PIN required to pair gateway and sensor

BLE security: Communication encrypted and authentified

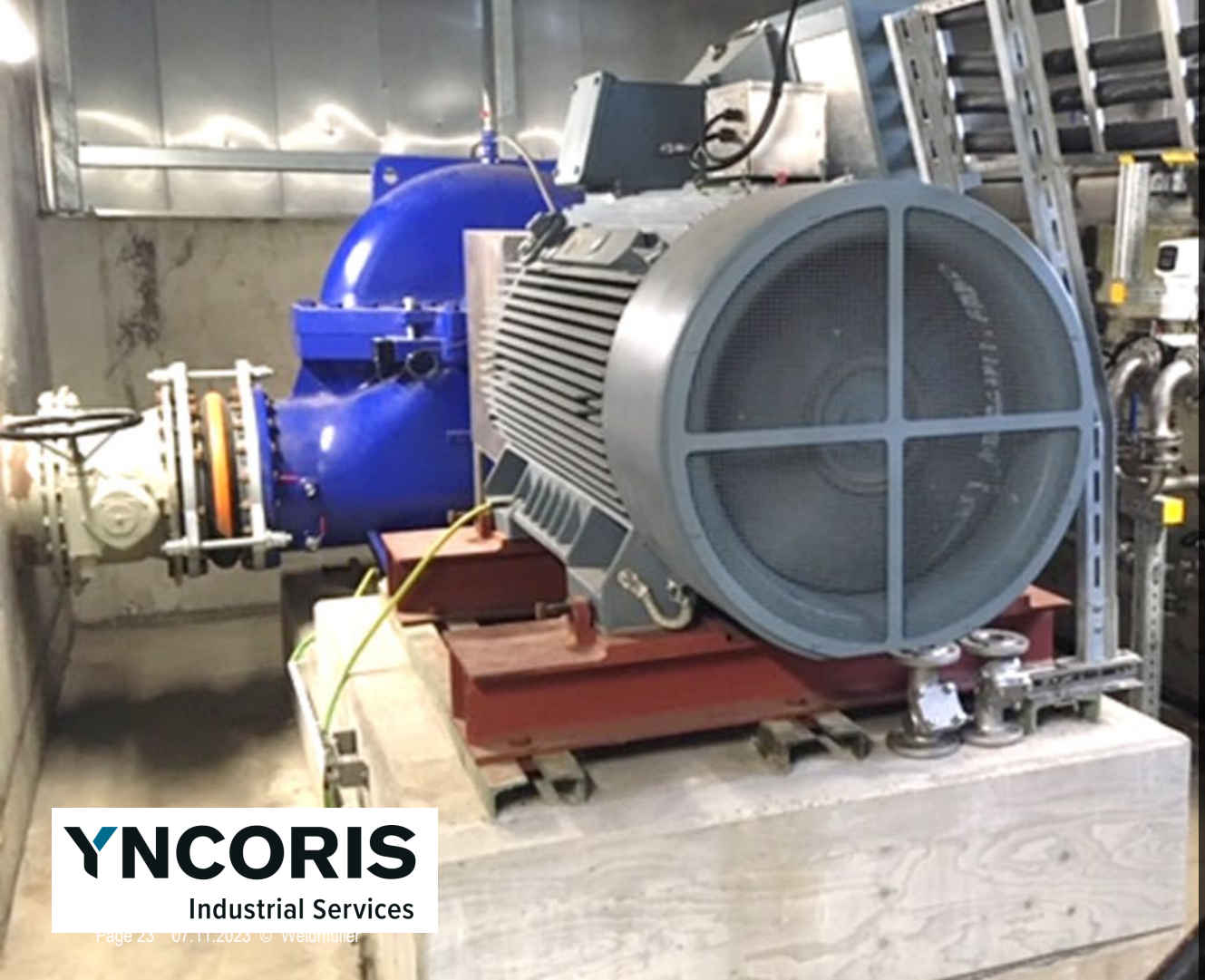
Gateway user rights management (user, password)

Connectivity to cloud services via NodeRED: Security credentials of cloud services

Applications

Vibration based condition monitoring of evenly running machines

- E-motors, pumps, fans, compressors
- HVAC
- Process industry
- Public utility: Water works, sewage plants
- Cooling compressors



Condition monitoring of pumps

YNCORIS | Process | Germany

- Cooling pumps
- u-sense vibration, IoT-GW30, FieldPower box
- Individual customer care, interoperability, customer data sovereignty
- High scalability at other chemical parks and process plants

YNCORIS
Industrial Services

Weidmüller

Waste water treatment plant

YNCORIS | Process | Germany

- Agitators
- u-sense vibration, IoT-GW30, FieldPower box
- Individual customer care, interoperability, customer data sovereignty
- High scalability at other chemical parks and process plants

Weidmüller

Condition monitoring of water pumps

Waterworks | Process | Germany

- Integration in existing measurement and control system
- u-sense vibration, IoT-GW30, FieldPower box
- Openness of IoT system to enable data handling and storage at customer
- 17 water supply companies in Germany of that size

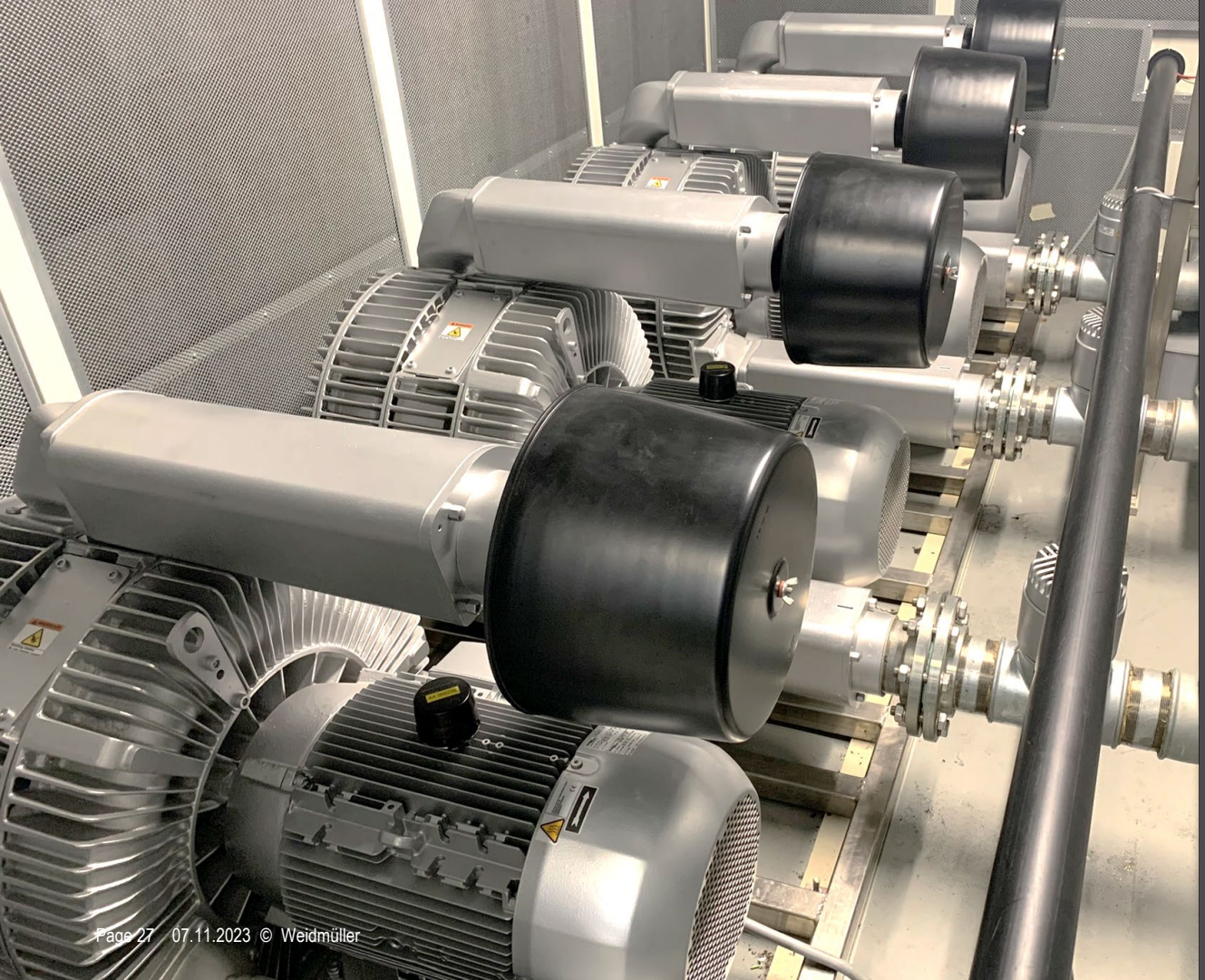
WASSERWERKE WESTFALEN

Weidmüller

Condition monitoring of pumps

Weidmüller | Production | Germany

- Vertical immersion pumps in electroplating facility
- Condition monitoring with u-sense vibration
- Applicable at other industrial immersion pumps



Condition monitoring of compressors

Weidmüller | Production | Germany

- Side channel compressors in electroplating facility
- Condition monitoring with u-sense vibration
- Applicable at other industrial compressors

Weidmüller

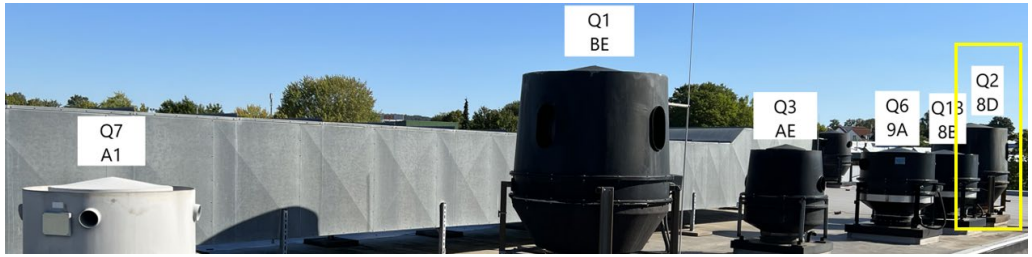
Condition monitoring of roof mounted fans

Weidmüller | Production | Germany

- Industrial fans on the roof of electroplating
- Condition monitoring with u-sense vibration and u-sense energy drives, evaluation by Industrial Analytics
- Applicable at other industrial HVAC

Condition Monitoring of Roof mounted Fans

Detection of Belt Failure



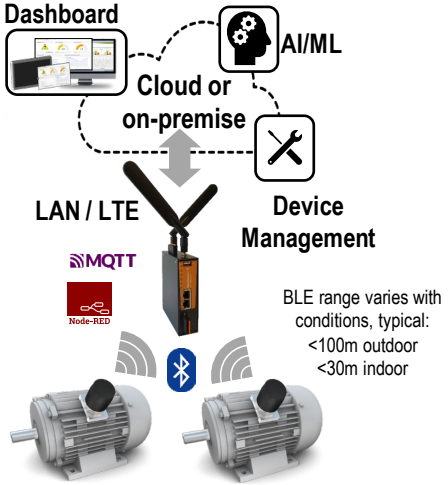
Link

Summary u-sense vibration
IIoT Sensor Solution for Condition Monitoring

System Components

- Wireless sensor (battery, Bluetooth BLE)
- MEMS chip: 3D acceleration, temperature
- Edge vibration analysis in sensor (ISO 10816)
  - Effective velocity v.rms etc.
  - Acceleration vibration spectrum
- Socket temperature
- Measurement/transmission interval 10s/10min/1h
- Battery live c. 3 years (15 - 25°C, interval 1h)
- IP66, Ex Zone 2 / Div 2 (scheduled)

System Architecture



- Up to 16 sensors per gateway
- Local and remote sensor & gateway control
- Open northbound connectivity

Application & Segments

Vibration based condition monitoring of evenly running machines

Pumps	
Fans	
Compressors	

Segments

- Process industry, chemistry, oil & gas
- Traditional industries, building material, etc.
- Public utility: Energy, water, sewage, heat
- HVAC

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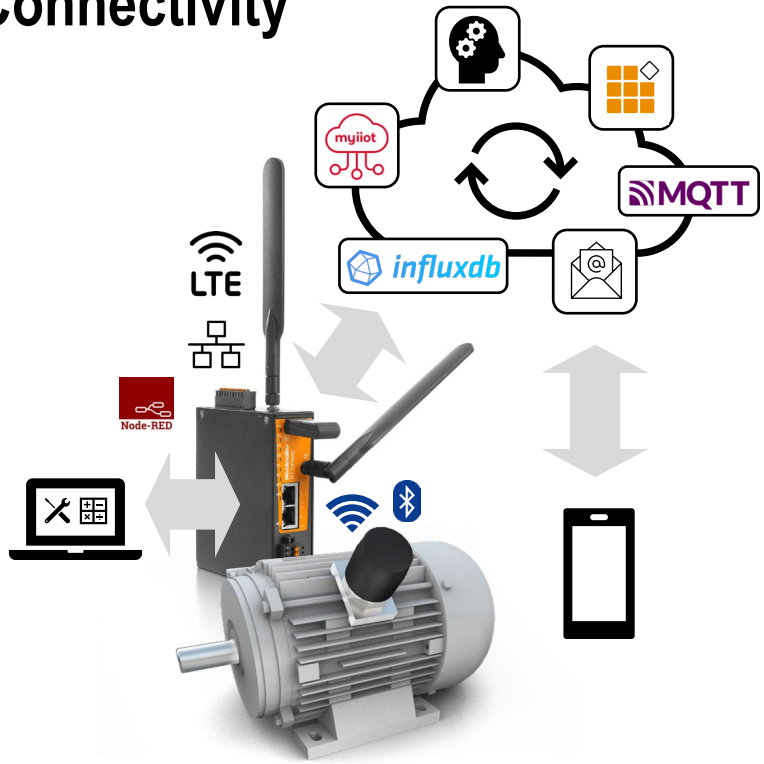
u-sense vibration – Smart Sensor for Machine Monitoring
Featuring: Pilot-Kit for easy getting started

- Test kit for practical experience including
  - Wireless sensor u-sense vibration
  - Gateway GW30LTE with operating system uOS
  - FieldPowerBox including 24V power supply
  - Bluetooth Stick, spare battery, glue adapter
  - special price
- Data interoperability, transparency, multi-connectivity
- Dashboard with live-values, monitoring, alarming
- On-edge, on prem and into the cloud

u-sense vibration – Smart Sensor for Machine Monitoring
Featuring: Interoperability and Multi-Connectivity

- **Machine condition monitoring by vibration analysis and temperature measurement**
- **Easy retrofit by wireless sensor (Bluetooth)**
- **Data uplink by ethernet, serial and LTE**
- **Data interoperability, transparency, multi-connectivity - on edge device, on-premise and into the cloud**
- **Dashboard, logging, monitoring, alarming by email**
- **Cloud connectivity: InfluxDB, MQTT, easyConnect, …**
- **GTI Software: ResMa, Industrial AutoML**



u-sense vibration product portfolio

Portfolio	Type	Article no.
FieldPower IoT box		
FP Box LAN	FP IOT MD01 LAN S2 0000	8000058603
FP Box 4G EU	FP IOT MD01 4EU S1000	8000058270
IoT gateway		
IoT-Gateway LAN	IoT-GW30 LAN	2682620000
IoT-Gateway 4G EU	IoT-GW30-4G-EU	2682630000
USB stick BLE for gateway	US67-USB-STICK-BLE	2874720000
Vibration sensor	US67-V1T-BLE	2751260000
Spare battery kit sensor	US67-BAT-COSL	2757620000
Adapter plate sensor	US67-PLATE64-STD	2811910000
Pilot-Kit	Pilot-Kit u-sense vibration	3008440000

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