



OpreX™ Asset Management

Wireless Solution for the Industrial IoT

Sushi Sensor

Driving Equipment Monitoring DX Enabling Smarter Maintenance and Maximized Profitability

For asset-intensive companies, maintaining equipment health and ensuring stable revenue are essential. At the same time, optimizing maintenance costs and maximizing profitability require more efficient equipment monitoring.

Current Issues

- Insufficient digitization of equipment condition data, which forms the foundation of DX
- Many sites still rely on manual inspection rounds by personnel
- Inconsistent inspection frequency and accuracy, leading to unexpected failures
- Unplanned downtime resulting in reduced profitability

Challenges

- Digitization of equipment monitoring to reduce reliance on manual work
- Implementation of anomaly detection initiatives to prevent failures
- Improved maintenance efficiency, balancing cost reduction and stable operation

Yokogawa's Solution

By combining long-established sensing technologies and deep domain knowledge gained from field operations with IoT, Yokogawa offers Sushi Sensor.

- Automated, wireless monitoring through continuous acquisition of equipment condition data
- Early detection of signs of anomalies and support for predictive maintenance
- Establishment of a scalable sensing and sensemaking foundation as the first step of DX

Value Delivered by Sushi Sensor

- Reduced operational risk by preventing unexpected failures
- Lower total maintenance costs through more planned and efficient maintenance
- Enhanced profitability through stable operation and improved productivity



Industrial Wireless IoT Solution **Sushi Sensor**

Creating New Value Through Sensing and Sensemaking

Sushi Sensor goes beyond the collection of equipment data by contributing to value creation through data accumulation and analysis. It is a comprehensive monitoring solution that supports the process from sensing to data analysis and condition assessment.

DX Approach with Sushi Sensor



Benefits



Management

- Optimization of total maintenance costs, including operations
- Data-driven planning for equipment investment and replacement
- Reduced operational risk through stable equipment operation
- Reduced energy costs through equipment health management



On-site

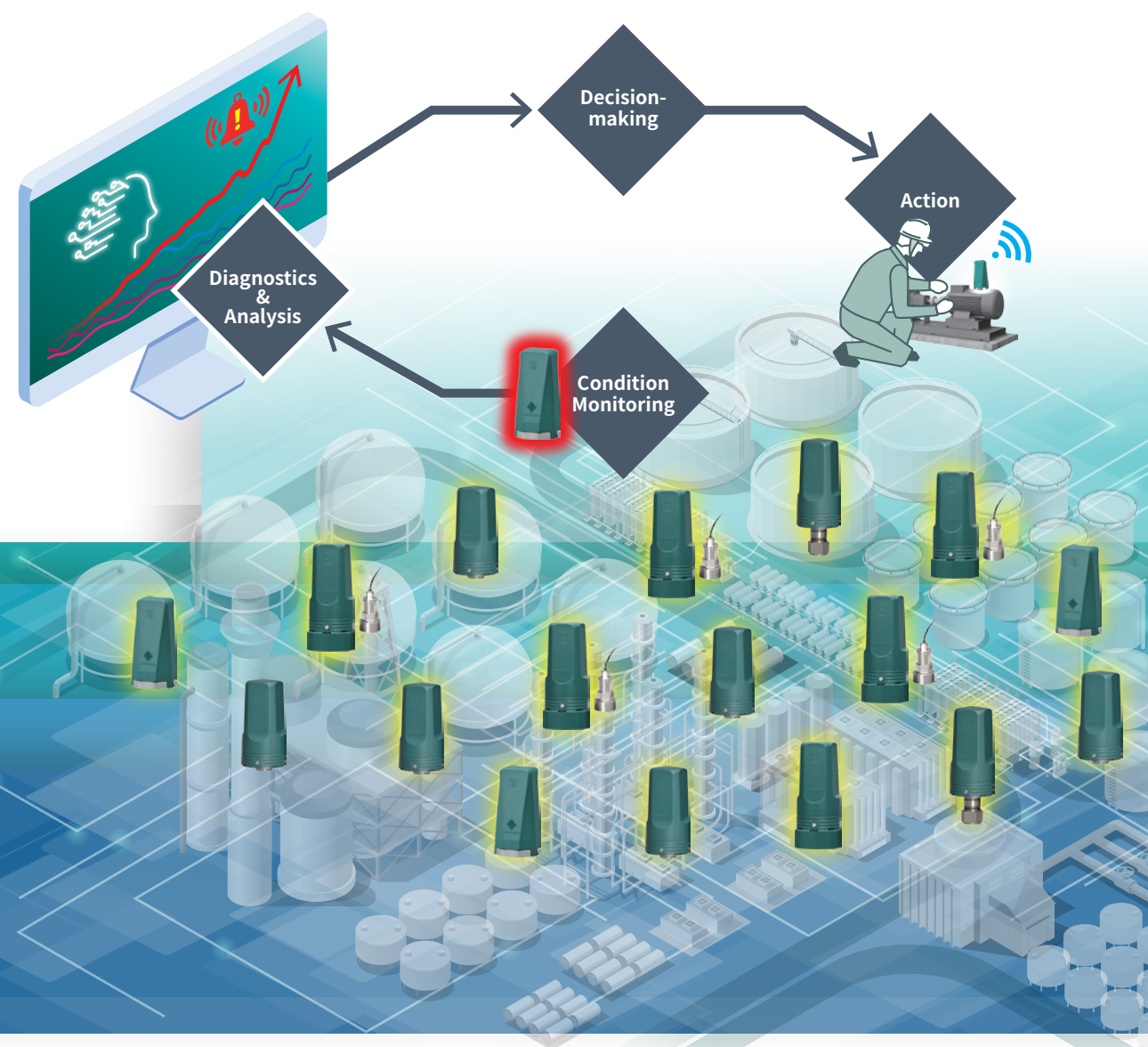
- Reduced equipment monitoring costs
- Automated data collection from equipment, including hazardous locations
- Standardization of equipment monitoring through visualization and quantification of equipment conditions
- Early detection of signs of anomalies to avoid unplanned shutdowns

Applicable Industries

Oil & Gas | Chemicals | Steel | Mining | Ceramics | Pulp & Paper | Batteries | Power | Petrochemicals |
Railways | Non-ferrous Metals | Food & Beverage | Pharmaceuticals | Lifeline Utilities |
Electrical & Electronics | Automotive | Renewable Energy | and more

Smart Equipment Monitoring

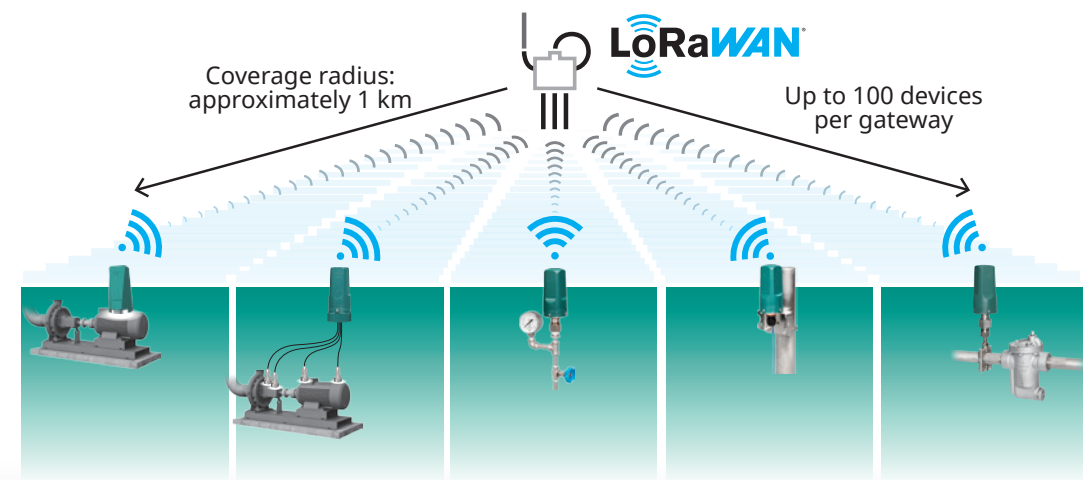
Smart Equipment Condition Monitoring



Long-range Wireless Communication with LoRaWAN®

Enabling Wide-area Monitoring

- Adoption of LoRaWAN® wireless communication enables wide-area coverage with a radius of approximately 1 km from a gateway.
*Communication distance may vary depending on the installation environment.
- A star network topology does not require repeaters and allows easy addition of sensors.
- A single gateway can connect to approximately 100 Sushi Sensor devices.
The number of connectable devices may vary depending on configuration settings such as the update interval and transmitted data volume.



Features of LoRaWAN®

- An open standard specified by the LoRa Alliance, with participation from over 500 IoT-related companies worldwide
- Operates in license free sub-GHz ISM bands defined by regional regulations (e.g., around 920 MHz in Japan), enabling long distance communication over several kilometers under line-of-sight conditions
- High resistance to noise, providing stable and reliable communication
- A globally adopted and proven wireless communication technology

Simple Diagnostics for Early Detection of Equipment Anomalies

Sushu Sensor is primarily designed for simple diagnostics.

Simple diagnostics is a process in which early signs of anomalies are detected through trend monitoring of equipment conditions, and equipment requiring detailed diagnostics is screened. Continuous condition monitoring through periodic measurements at configurable update intervals. This approach reduces inspection workload on site, helps avoid missing early signs of abnormality, and enables prompt response.

Long-term stable operation with battery-powered design

Battery-powered design: easy installation without power wiring

- Enables flexible installation with minimal on-site work

Maintenance-friendly design: easy battery replacement on site

- Battery replacement is possible without removing the sensor from the equipment.
- Reduced maintenance workload

Product configuration

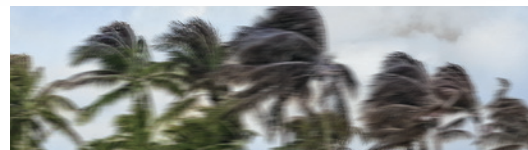
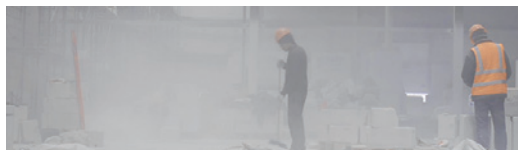
- Wireless Communication Module (XS110A): Battery sold separately
- Integrated Wireless Vibration Sensor (XS770A): Battery built-in

Long battery life: reduced replacement frequency

Estimated battery life: 4 to 10 years* (Update interval: 1 hour)

*Battery life may vary depending on ambient temperature, update interval, and communication conditions.

- Supports stable long-term operation with fewer battery replacements
- Battery status can be checked from the host system and smartphone



Environmentally Robust Hardware

Reliable sensing even in harsh environments

- Intrinsically Safe Design for Use in Hazardous Areas
Designed for use in hazardous areas
Integrated Wireless Vibration Sensors support Zone 2 (Division 2); other models support Zone 1 (Division 1)
- Dustproof and waterproof
Stable sensing under harsh conditions such as rain and dust
- Long-term reliability
Continuous equipment monitoring supported by stable operation over extended periods

Wireless Vibration Monitoring

Visualizing Equipment
Conditions Using Vibration Data



Integrated Wireless Vibration Sensor XS770A

Detects Early Signs of Equipment Anomalies through Simple Diagnostics

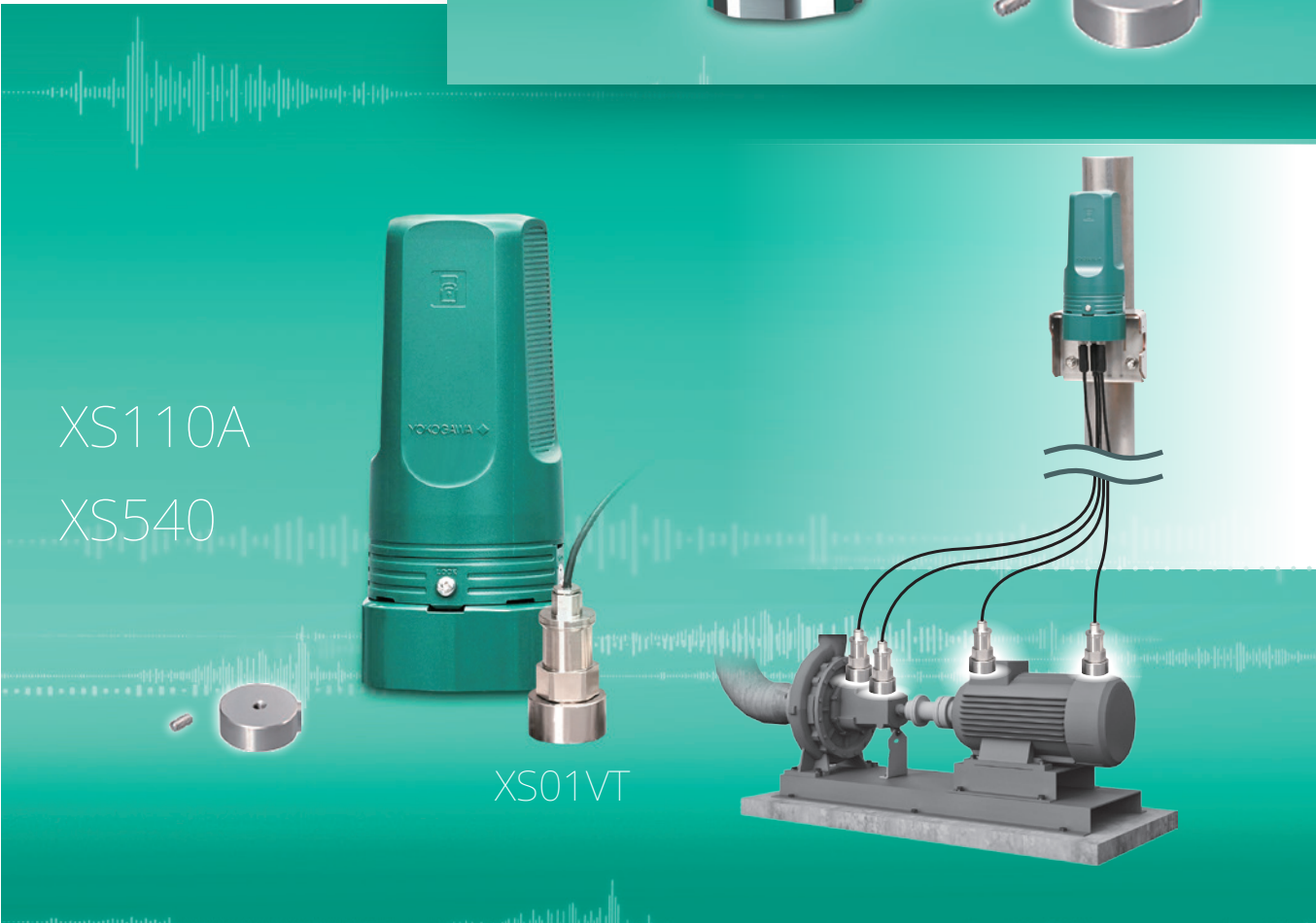
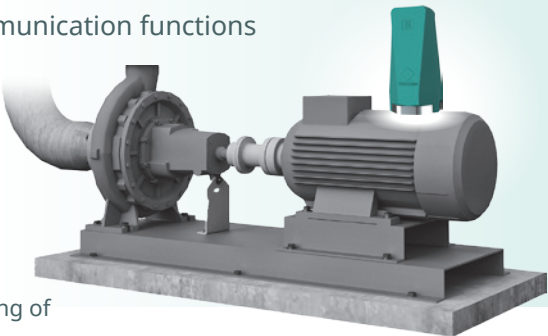
Integrated design combining sensing and wireless communication functions

Measured Parameters

- Vibration (velocity and acceleration) in X-, Y-, and Z-axes, and 3-axis composite
- Surface temperature

Benefits

- Easy installation enabled by an integrated structure combining wireless communication and sensing
- Optimized for continuous and trend condition monitoring of rotating equipment such as pumps and motors



4ch Wireless Vibration Sensor XS540 + XS110A + XS01VT

Supports Detailed Diagnostics in Addition to Simple Diagnostics

Consists of the XS540 Vibration Measurement Module, XS110A Wireless Communication Module, and XS01VT Vibration Pickups

Measured Parameters

- Z-axis vibration (velocity and acceleration)
- Surface temperature
- Up to 4 channels

Benefits

- High installation flexibility enabled by a separated structure for wireless communication and measurement functions
- Applicable to confined spaces, as well as locations where wireless communication is difficult, such as metal-enclosed equipment
- Effective for detailed diagnostics of bearings and gearboxes, in addition to pumps and motors
- Supports identification of fault locations and causes for equipment where early signs of anomalies have been detected

Support for Detailed Diagnostics

Narrowing Down Potential Fault Locations (Multi-channel Measurement)

- Helps narrow down potential fault locations using vibration data from multiple points
- Supports decision-making for detailed diagnostics of equipment with early signs of anomalies

Support Fault Cause Analysis (Wide Frequency Bandwidth)

- Acquires wide-band vibration data from low to high frequencies
- Supports identification of fault causes related to bearings, gears, and similar components
- Time-domain waveform data can be utilized for detailed diagnostics such as FFT analysis



Bearing Anomaly Detection Support (Crest Factor)

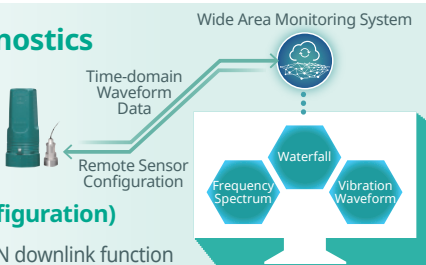
- Transfers crest factor (CF)* to the host system
- Supports detection of early-stage signs of anomalies by capturing impulsive changes in vibration

* Crest factor is an effective indicator for detecting early damage in bearings and gearboxes.



Remote Utilization of Data Required for Detailed Diagnostics

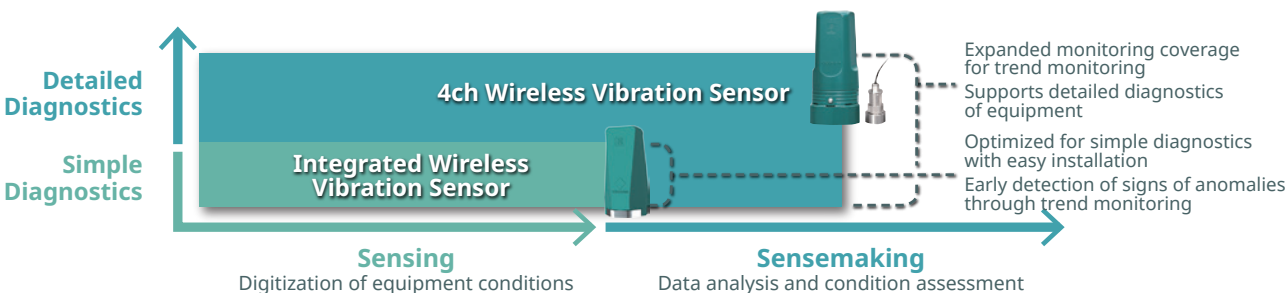
- Transfers acquired time-domain waveform data to host systems
- FFT analysis can be performed using cloud-based host systems (optional)
- Supports remote investigation and assessment of fault locations and causes



Improved Efficiency of Configuration Tasks (Remote Configuration)

- Enables remote configuration of update intervals and thresholds using the LoRaWAN downlink function
- Minimizes on-site work and improves the operational efficiency of detailed diagnostics

Positioning of Wireless Vibration Sensors (by Application)



Wireless Pressure Monitoring

From Manual Inspection Rounds to Continuous Wireless Monitoring



Wireless Pressure Sensor XS530+XS110A

Continuous condition monitoring of gauge pressure
Available in 2 pressure range options:
5 MPa or 35 MPa

- Consists of the XS530 Pressure Measurement Module and the XS110A Wireless Communication Module

Measured Parameters

- Gauge pressure of gases and liquids

Benefits

- Quantification and improved efficiency of pressure monitoring
- Reduces the workload of manual inspection rounds and enables continuous condition monitoring



Application Examples

Oil Cellar Pressure Monitoring

Challenges

- Need for continuous monitoring of lubrication supply conditions and early detection of anomaly signs
- Need to reduce equipment shutdown risk and ensure stable production line operation

Solution

- Install wireless pressure sensors on the oil cellar to continuously monitor lubrication supply pressure
- Detect anomalies when the pressure falls below predefined thresholds, enabling prompt initial response

Benefits

- Continuous online monitoring of lubrication supply conditions
- Improved equipment health management and reduced risk of unexpected shutdowns



Wireless Temperature Monitoring

Improved Efficiency and Labor Reduction in Equipment Monitoring

Wireless Temperature Sensor XS550+XS110A

Continuous condition monitoring of equipment temperature via thermocouples

- Consists of the XS550 Temperature Measurement Module and the XS110A Wireless Communication Module

Measured Parameters

- Temperature (dual thermocouple inputs)
Supports nine types of thermocouples compliant with IEC 60584

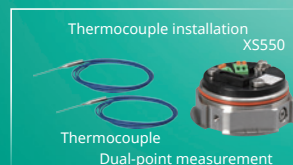
Benefits

- Wide temperature measurement range improves monitoring efficiency
- Reduces the workload of manual inspection rounds and enables remote monitoring



XS110A

XS550



Temperature Monitoring Around LNG Tanks

Challenges

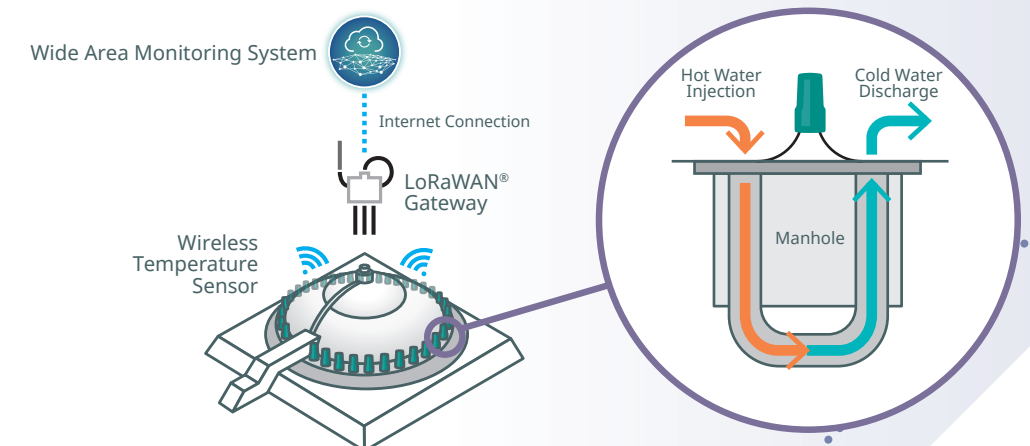
- Need for efficient, wide-area monitoring of temperatures around LNG tanks to prevent tank damage caused by ground freezing
- Need to reduce the workload of manual inspection rounds

Solution

- Replace conventional temperature sensors with wireless temperature sensors to enable remote monitoring
- Battery-powered operation eliminates the need for power wiring and allows flexible expansion of monitoring points

Benefits

- Significant reduction in the workload of manual inspection rounds
- Improved maintenance efficiency while ensuring the integrity of LNG tanks



Wireless Steam Trap Monitoring

Supporting Equipment Health and Energy Efficiency



Wireless Steam Trap Monitoring Device XS822+XS110A

Continuous Wireless Monitoring of Steam Traps

- Consists of the XS822 Steam Trap Monitoring Module and the XS110A Wireless Communication Module
- Can be retrofitted to existing steam piping using a waveguide

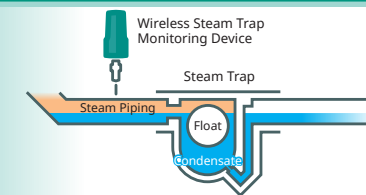
Measured Parameters

- Steam trap condition (Normal / Clogged / Steam Leakage) based on acoustic and surface temperature measurements

Benefits

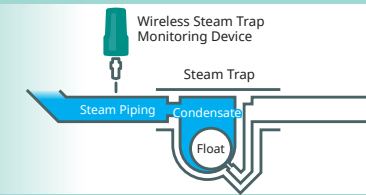
- Visualization of steam trap conditions
- Support for steam loss reduction

Steam Trap Condition Modes Determined by the Wireless Steam Trap Monitoring Device



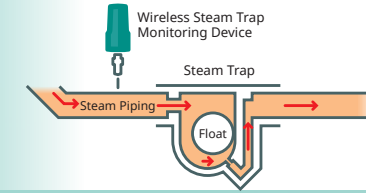
Normal

Condensate is discharged properly



Clogged

Condensate is not discharged, resulting in reduced thermal efficiency and impact on process performance



Steam Leakage

Steam leakage causes energy loss and increased operating costs

Steam Trap Monitoring Solution

Supporting Safety and Reliability of Steam Systems

Challenges

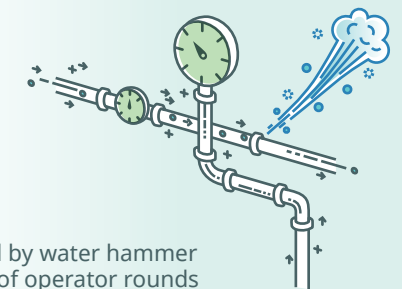
- Continuous monitoring of steam trap conditions and early detection of clogging and steam leakage
- Identification of affected equipment and prompt response when anomalies occur

Solution

- Online monitoring using wireless steam trap monitoring devices
- Condition determination based on temperature and acoustic data (Normal / Clogged / Steam Leakage)
- Retrofit installation on existing steam systems using a waveguide

Benefits

- Prevention of equipment damage: helps avoid piping damage caused by water hammer
- Improved inspection efficiency: significant reduction in the workload of operator rounds
- Enhanced steam system reliability through continuous condition monitoring



Supporting Greenhouse Gas (GHG) Emissions Reduction

Challenges

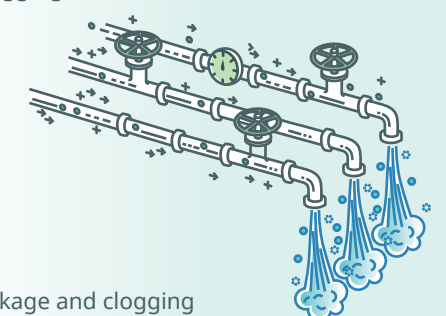
- Early identification of energy losses caused by steam leakage or clogging
- Visualization of steam usage and losses
- Provision of data to continuously verify GHG reduction efforts

Solution

- Online monitoring using wireless steam trap monitoring devices
- Continuous monitoring of steam leakage and clogging conditions
- Retrofit installation on existing steam systems using a waveguide

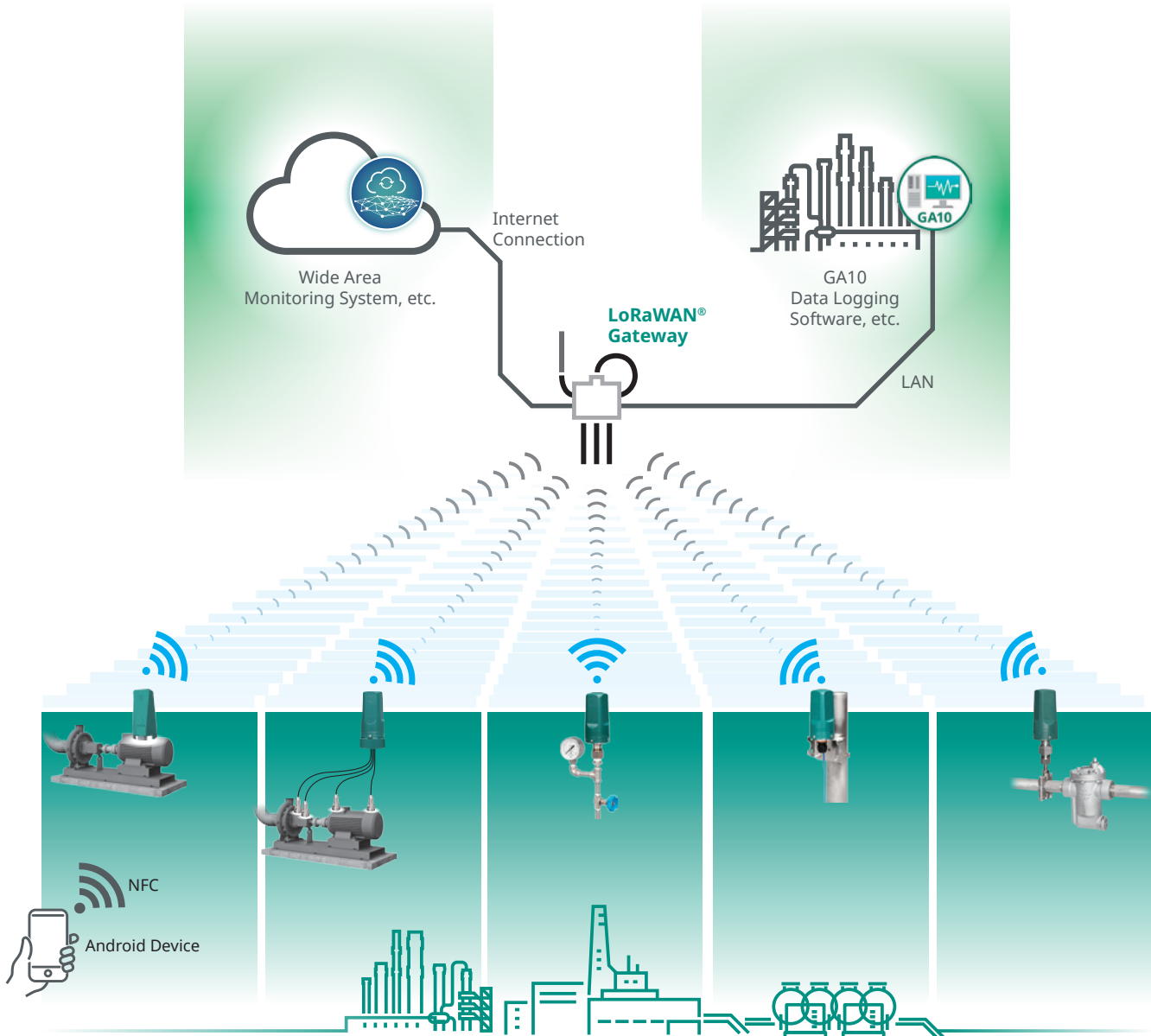
Benefits

- Support for steam loss reduction through early identification of leakage and clogging
- Support for GHG emissions reduction by visualizing steam losses



System Overview

System Configuration



Component	Description
Sushi Sensor	Measures vibration, pressure, and temperature, and detects steam trap conditions
LoRaWAN® Gateway	Receives data from Sushi Sensor and relays it to a cloud server or an on-premises server
Host System	Server that stores data in the cloud or on-premises
PoE Injector	Supplies power to the LoRaWAN gateway
Android Device	Device for running the Sushi Sensor App ¹ and Key Card Editor ² (with NFC functionality)
Option	Magnetic Holder (for Integrated Wireless Vibration Sensor) Screw-mounted magnet holder for sensor installation Magnetic Holder (for 4-Channel Wireless Vibration Sensor) Screw-mounted magnet holder for attaching vibration pickups
	NFC Card
	Vibration Pickup Extension Cable

¹ Android application for configuring Sushi Sensor
² Android application for writing key information to NFC cards

Product Specifications

					
	Integrated Wireless Vibration Sensor	4ch Wireless Vibration Sensor	Wireless Pressure Sensor	Wireless Temperature Sensor	Wireless Steam Trap Monitoring Device
Model	XS770A	XS540+ XS01VT	XS530	XS550	XS822
Sensor Configuration	Integrated type	Separate type (Used in combination with the XS110A Wireless Communication Module)			
Transmitted Data	Velocity (RMS), Acceleration (Peak), Surface Temperature Measurement axes: X, Y, Z, and Overall (3 axis composite)	Velocity (Peak, RMS), Acceleration (Peak, RMS), Time domain waveform, Surface Temperature, Crest Factor Measurement axis: Z axis (1-4 channels)	Gauge pressure	Temperature (2 points)	Steam trap condition (Good (Normal) / Cold (Clogged) / Blow Through (Steam Leakage), Temperature
Measurement Range	Frequency range: 10 Hz to 1 kHz; Surface temperature: -20 to 85°C	Frequency range: 5 Hz to 10 kHz; Surface temperature: -40 to 125°C	Standard: -0.1 to 5 MPa; High pressure: -0.1 to 35 MPa	Thermocouples B, E, J, K, N, R, S, T, C (-200 to 2315 °C)	Maximum steam temperature: 160 °C to 440 °C (Maximum steam temperature varies depending on the selected heat-dissipation accessories (e.g., heatsink).
Update Interval	1 minute to 3 days	Trend monitoring: 2 minutes to 3 days; Time-domain waveform transfer: 1 week to 1 month	1 minute to 3 days	1 minute to 3 days	1 hour to 3 days
Communication Method	LoRaWAN® Class A Regional frequency band depends on country regulations				
Typical Battery Life*1	Approx. 4 years (update interval: 1 hour)	Approx. 10 years (update interval: 1 hour)*2	Approx. 10 years (update interval: 1 hour)		
Battery Type	Built in battery (Model: XS70BT)	Battery sold separately: F9915NR (Tadiran TL 5930/S, 2 pcs) Commercially available batteries may also be procured by the customer			
Dimensions / Weight	97 × 46 × 46 mm; 260 g	42.5×Ø24mm 80g*3	188 × Ø68 mm; ≤ 1 kg	141 × Ø68 mm; ≤ 800 g	237 × Ø68 mm; ≤ 1 kg*4
Explosion Protection	Intrinsically Safe: Ex ic IIB T4 Gc	Intrinsically Safe (certification planned)	XS110A: Intrinsically Safe: Ex ib IIC T4 Gb XS530/XS550/XS822: Intrinsically Safe: Ex ib IIC T4 Gb		
Degrees of Protection	IP66/IP67				

*1 Battery life may be reduced depending on ambient temperature, update interval, and communication quality.
*2 For 1 channel. Battery life varies depending on the number of channels used.
*3 Dimensions and weight of the XS01VT vibration pickup (excluding cable).
*4 Excluding waveguide and heat dissipation accessories.

Global Deployment & Compliance

Q1. Is Sushi Sensor available in all countries?

A. Sushi Sensor is offered globally; however, availability may vary depending on local regulations and project conditions. General availability information is provided on Yokogawa's official website and in the General Specifications (GS). If the information required for your application is not available in these sources, please contact Yokogawa or a local representative.

Q2. Why do product configurations differ by region?

A. Product configurations differ by region because requirements related to wireless communication regulations, explosion protection, and applicable safety standards vary by country and application. These regulatory and safety requirements define the conditions under which products can be designed and applied.

Q3. What should be confirmed before deployment?

A. Applicable requirements for wireless communication, installation environment, and hazardous area classification (if applicable) should be confirmed. Yokogawa can support confirmation and system design based on your project conditions.

System Configuration & Scalability

Q4. Can I start small and expand later?

A. Yes. Sushi Sensor is designed for scalable deployment. You can start with a limited scope and expand monitoring points as operational needs evolve.

Q5. Can Sushi Sensor be used with both on-premises and cloud systems?

A. Sushi Sensor is designed to support flexible system configurations. Integration options depend on system requirements, regional conditions, and project scope.

Q6. What is the role of Sushi Sensor in diagnostics?

A. Sushi Sensor supports diagnostics by detecting abnormal signs based on deviations from historical trends and by providing triggers for subsequent diagnostic actions. Depending on the sensor configuration and application, Sushi Sensor can also support deeper diagnostic analysis.

Q7. How should I choose between XS770A and XS540/XS110A/XS01VT for wireless vibration monitoring?

A. Sushi Sensor offers different wireless vibration sensors depending on the required depth of equipment monitoring and diagnostic objectives.

XS770A is optimized for simple diagnostics through trend monitoring. It enables easy and rapid deployment and is well suited for monitoring a large number of assets to detect early signs of anomalies and to help prioritize high-risk equipment.

The 4-channel wireless vibration sensor (**XS540/XS110A/XS01VT**) supports both simple diagnostics and diagnostic assistance for deeper analysis. In addition to trend monitoring, it provides support for fault location and fault cause investigation using multi-channel measurement, wide frequency bandwidth, and analysis techniques such as FFT on time-domain waveform data.

Installation & Operation

Q8. What types of equipment are suitable for Sushi Sensor?

A. Sushi Sensor is suitable for a wide range of equipment, particularly assets that are difficult to monitor through manual inspection rounds or are not monitored continuously.

Q9. How should the monitoring frequency (update interval) be determined?

A. The update interval should be determined based on the monitoring objective, asset criticality, and operating conditions. Shorter intervals provide more timely visibility of condition trends, while longer intervals are suitable when monitoring a larger number of assets or less critical equipment.

Q10. What are typical considerations for installation and maintenance?

A. Key considerations include installation space, mounting method, accessibility for maintenance, and wireless communication conditions. Defining these constraints early helps ensure a practical and reliable deployment.

Data, Integration & Support

Q11. What kind of data can be used for condition monitoring?

A. Sushi Sensor supports trend-based condition monitoring by collecting equipment condition data. The collected data can be used to detect early signs of anomalies and to help prioritize assets that may require closer inspection or more detailed diagnostics.

Q12. Can Sushi Sensor be integrated with existing systems?

A. Integration with existing systems is determined on a project-by-project basis. Specific integration methods, interfaces, and responsibilities depend on the target system architecture and project conditions and therefore cannot be predefined in general documentation. Please consult Yokogawa to confirm interface options and integration scope for your project.

Q13. Where can I find information related to compliance requirements?

A. General compliance-related information, including wireless communication regulations, explosion protection, and applicable safety standards, is described in the General Specifications (GS). Because actual requirements may vary depending on the application and project conditions, confirmation at the project level may be required. If further clarification is required, please consult Yokogawa.

Note: The latest information on Sushi Sensor, including product specifications and general availability, is available on Yokogawa's official website and in the General Specifications (GS). Please refer to these sources first. If the required information is not available, or if further clarification is needed for a specific project or region, please contact Yokogawa or a local representative.



Road to smart manufacturing



OpreX™

Through the comprehensive OpreX portfolio of products, services, and solutions, Yokogawa enables operational excellence across the enterprise.



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