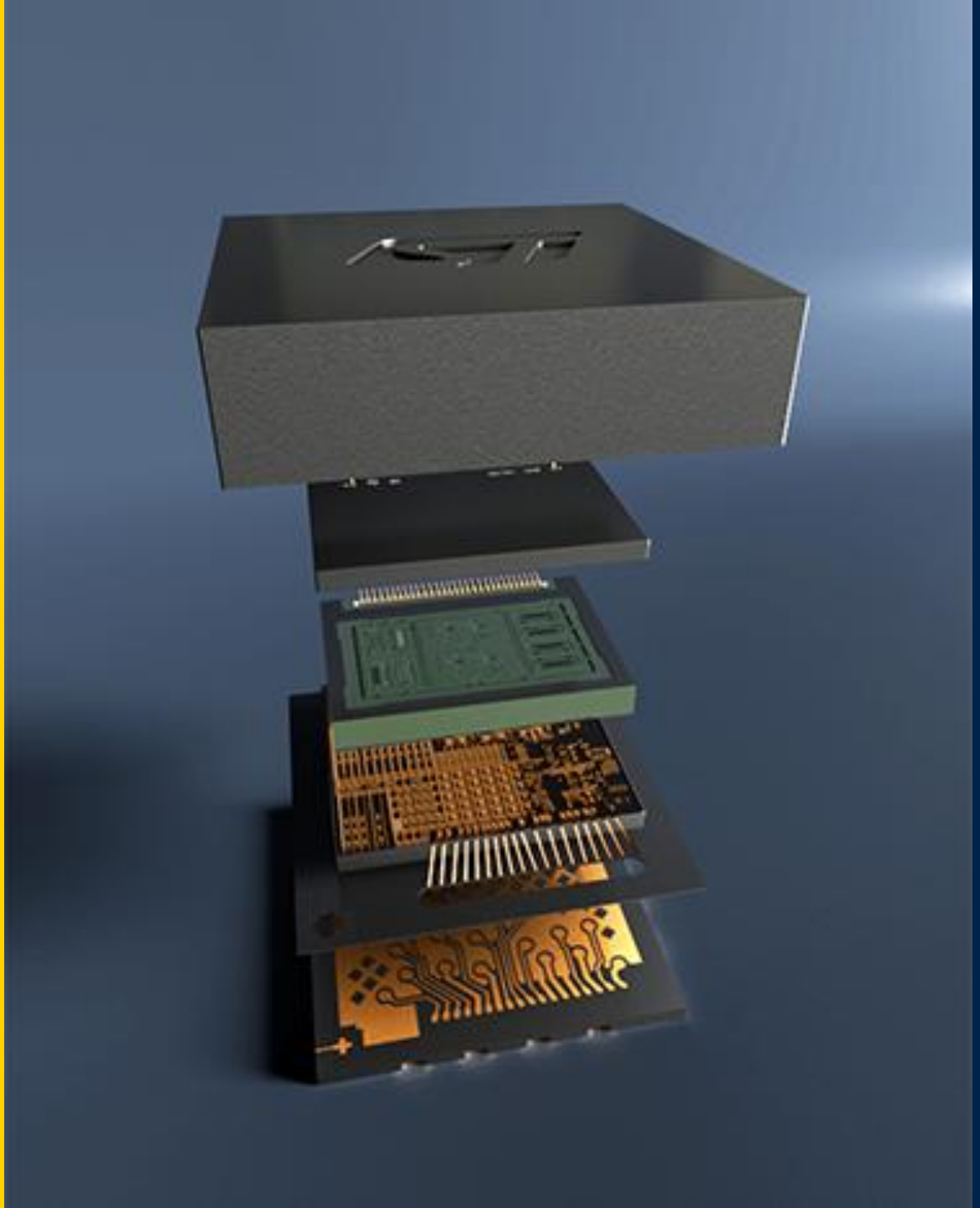
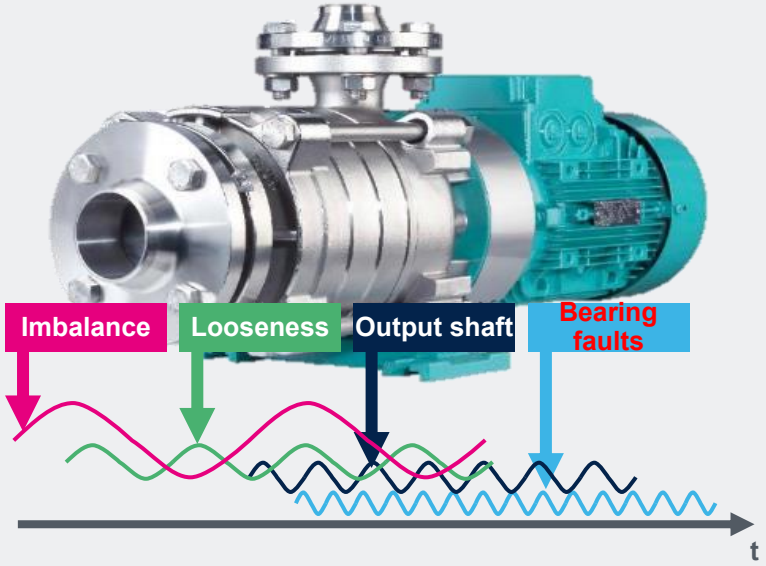


IIS3DWB10IS

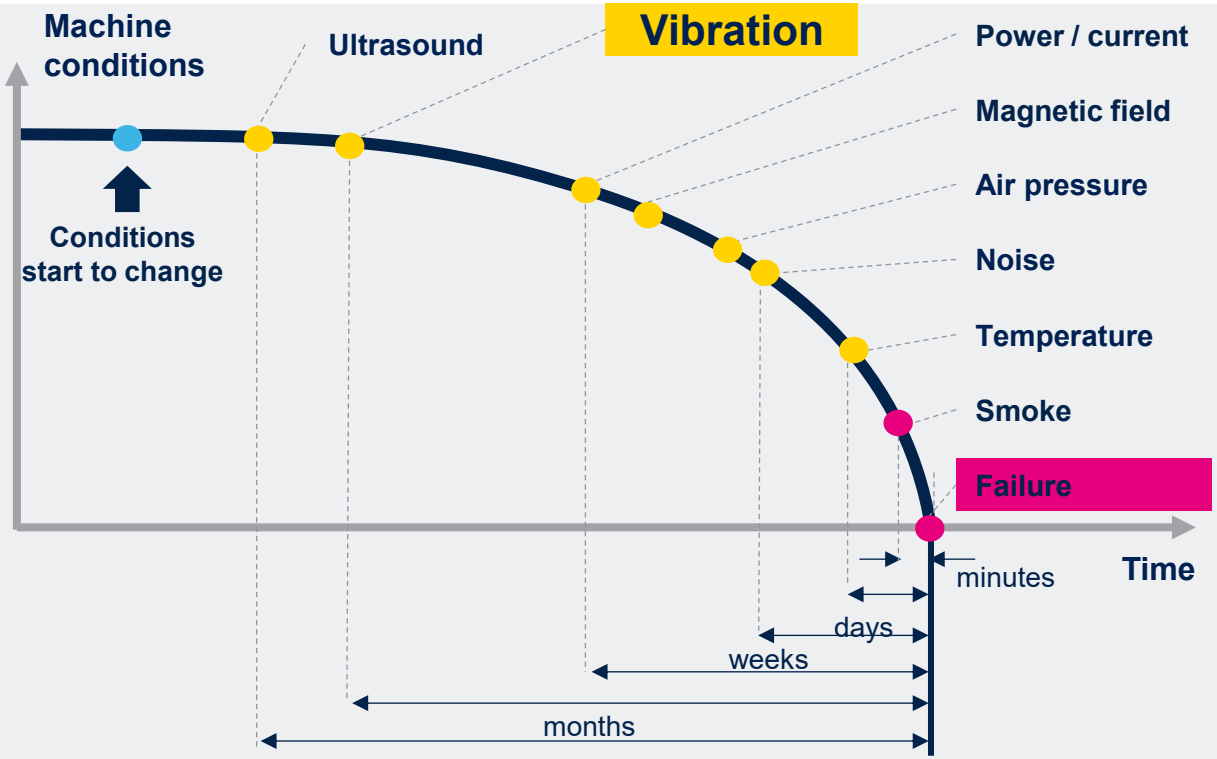
MEMS alternative to piezosensors, built for condition monitoring

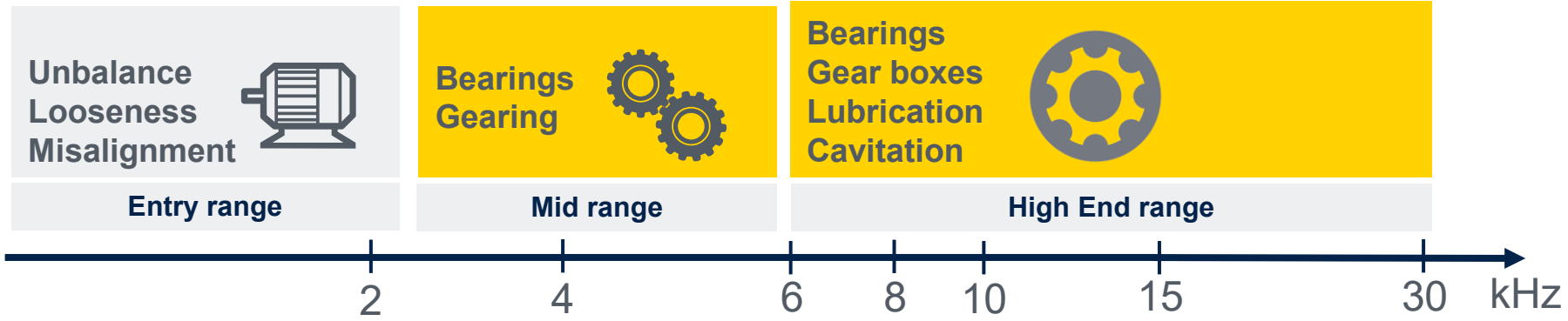
Smart manufacturing: condition monitoring and vibrations



Vibrations

- Displacement
- Speed
- Acceleration
- Angular speed
- Torque
- Acoustic noise





Vibration as a primary sign of machine health

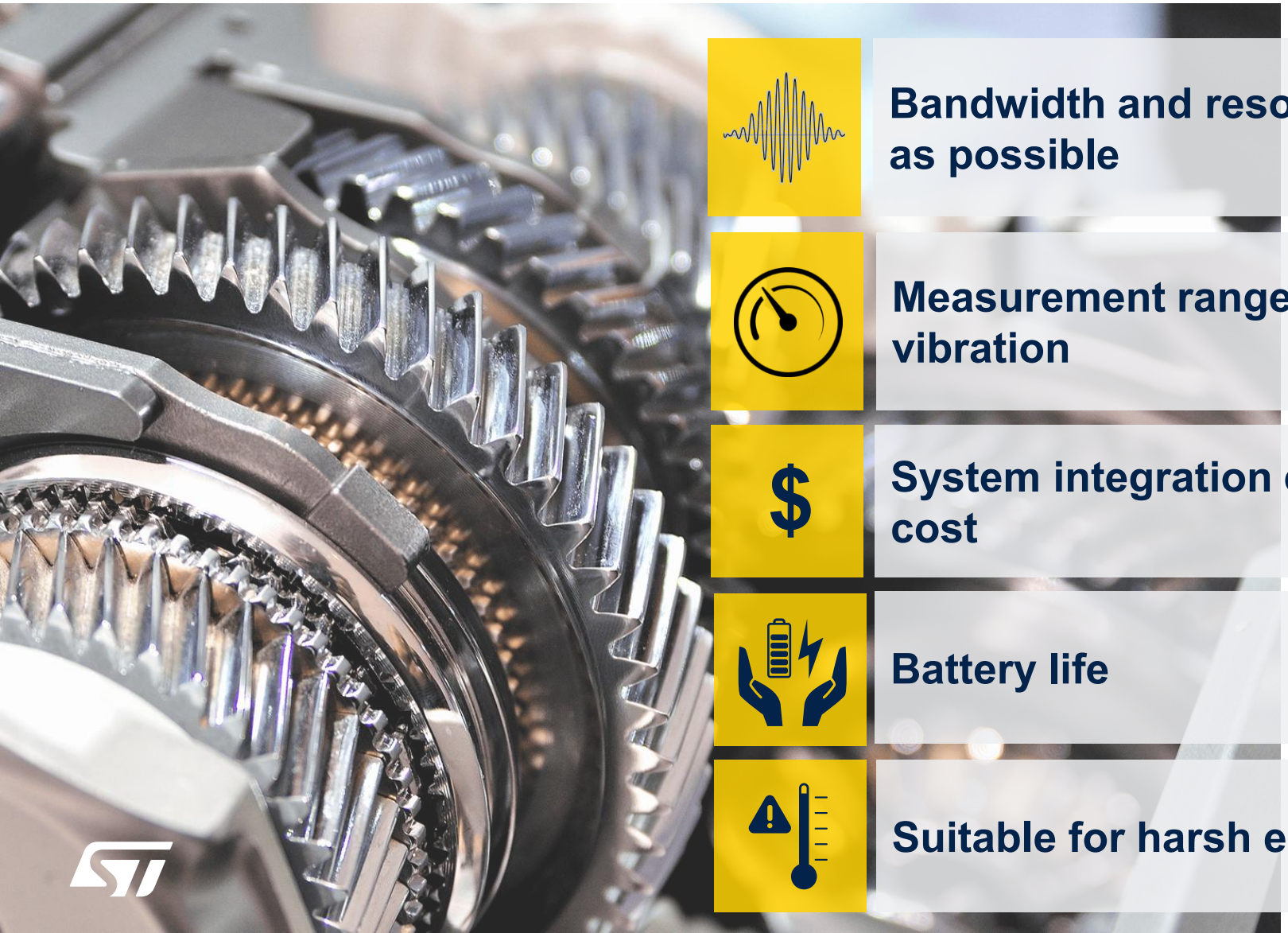
Bearing defects appear in vibration as:

- Characteristic fault frequencies
- High-frequency signatures, modulations and harmonics

How to detect in early-stage defects?

Use a real-time, high-bandwidth, low-noise sensor for continuous monitoring.

Challenges for sensors in bearing applications



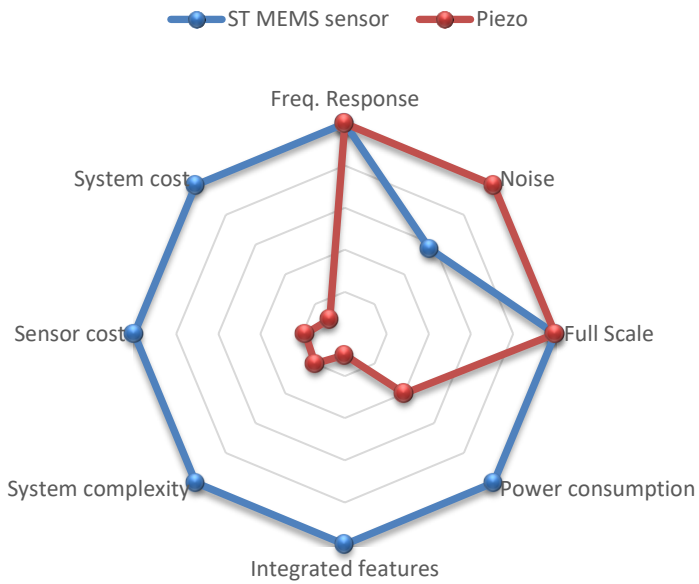
- **Bandwidth and resolution to catch wearing as early as possible**
- **Measurement range due to potentially intense vibration**
- **System integration complexity and overall system cost**
- **Battery life**
- **Suitable for harsh environment**

From piezoelectric accelerometers to advanced ST MEMS for bearings

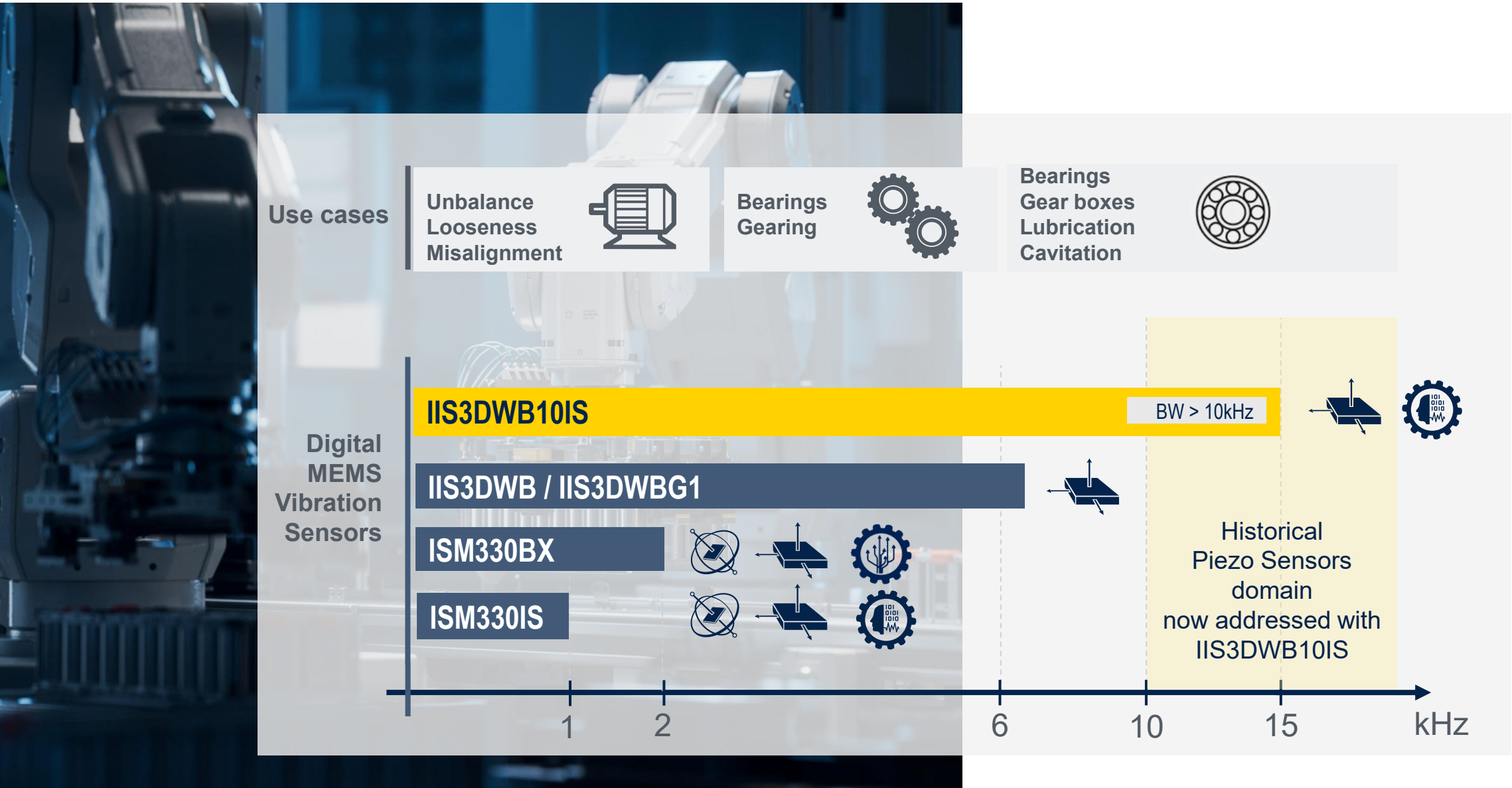
Enhancing piezo performances with ST MEMS sensor

Key sensor performances	ST MEMS sensor **bandwidth >10kHz and 35** $\frac{\mu g}{\sqrt{Hz}}$ **noise**
Integrated features and system complexity	**3-axis digital** with **intelligent processing** in compact (4.5x4.5x1.5) package
$ Sensor and system cost	**Cost-effective** and drives quite significant savings also in **overall system costs**
Power consumption	Intrinsic **low power** consumption and **in the edge processing**

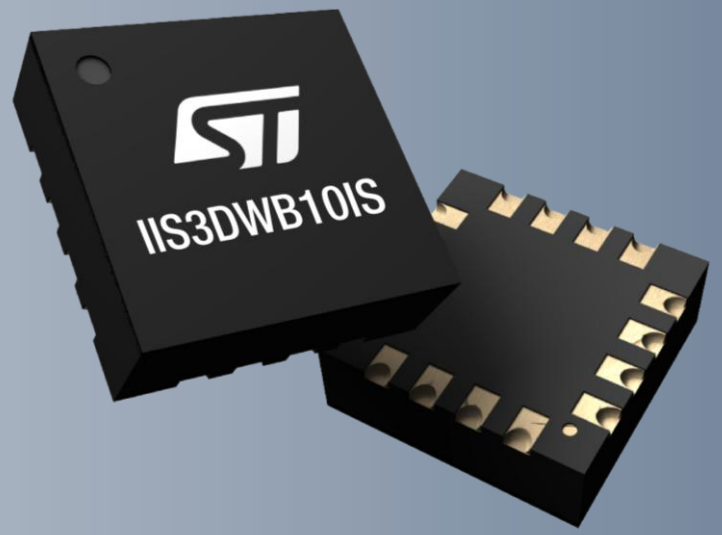
MEMS sensor vs PIEZO: key indicators for vibration monitoring



MEMS vibration sensors for industrial applications



Attributes



Unprecedented vibration sensing capabilities

Ultra-wide bandwidth and **dynamic range** make the sensing of any vibration for condition monitoring possible

Decision making in the edge with ISPU 2.0

ISPU 2.0 with HW accelerators to process at the edge, in real time vibration data with any customer defined algorithms

Suitable for harsh environments and Long-term availability

Operate up to **125˚C** and guaranteed for **long-term availability**

Key features

Intelligent MEMS vibration sensor – 3-axis – High BW

Key applications:

Vibration monitoring for industrial applications with **embedded real time calculation** of complex features (FFT, RMS, Envelope, ..) or AI algorithms

- **12 to 15KHz Bandwidth*** with flat frequency response & anti-aliasing
- Selectable FS: **±50 / ±100 / ±200 g**
- Low power: **1.9 mA (1-axis), 4.1 mA (3-axis)**
- **External clock input** for data synchro
- **Embedded ISPU 2.0**
- **Multiple operating modes** (continuous, Burst)
- Temperature range **up to 125ºC**
- LGA-16 4.5x4.5x1.5mm with wettable flanks

Samples & Tools available

* 15KHz for x and y-axis, 12KHz for z-axis (typ. values)

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The ISPU 2.0 powering IIS3DWB10IS

ISPU: powering the intelligence of the new generation vibration sensor

Key applications:

embedded real time calculation of complex features (FFT, RMS, Envelope, etc) or **AI algorithms**

Real time processing of data of the ultra high bandwidth sensor

Fully programmable in C code

New ISPU Core architecture **with HW accelerators** makes possible real time FFT, RMS, filtering or even AI algorithm in the sensor

- Key Parameters:
  - **32-bit RISC** Harvard architecture, with minimal floating-point unit (FPU)
  - **Embedded hardware accelerators** (like square root, for loop, memory indexing, multiply-cumulate).
  - Clock frequency: **40 MHz / 40 MIPS / 40 MFLOPS**
  - Memory RAM: **32kB Program + 56kB Data RAM**, with full re-allocation
  - **FIFO 2048x80 bits**

ISPU: intelligent sensor processing unit

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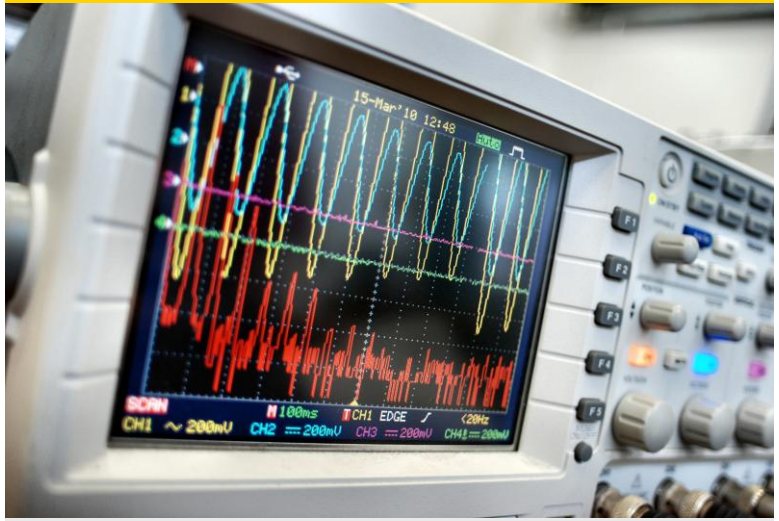
IIS3DWB10IS applications

Vibration monitoring

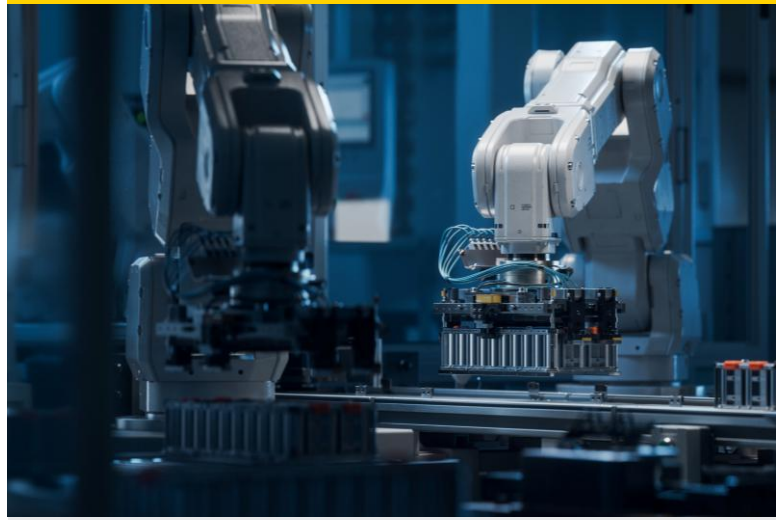
Enable **early detection of mechanical anomalies** with precise vibration sensing for reliable condition monitoring and predictive maintenance.

High-end shock sensor



Capture fast, **high-impact events with high-resolution sensing and ultra-wide bandwidth** for accurate shock detection and analysis.

Robotics

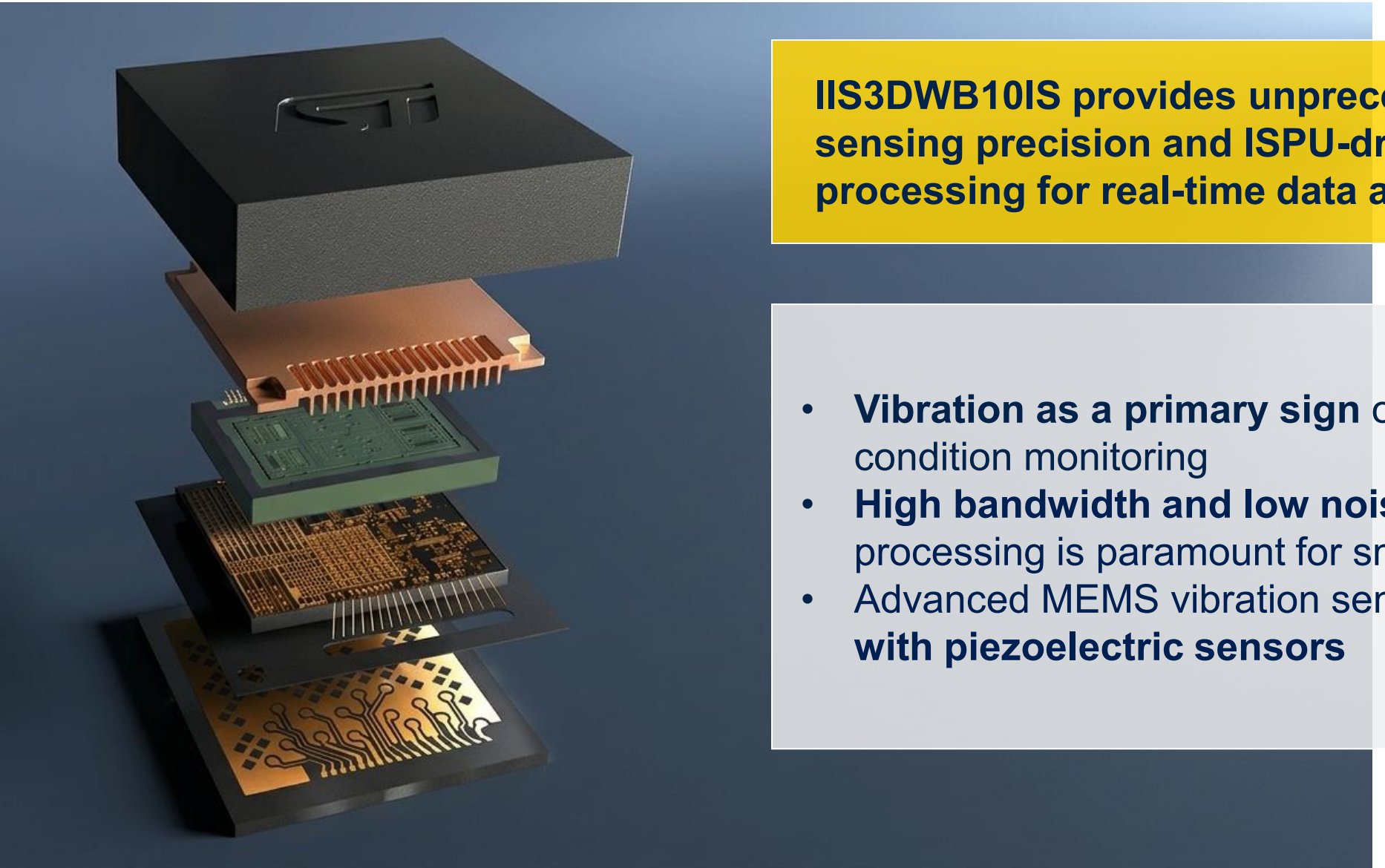


Support **smarter robotic systems with real-time motion insight**, helping improve responsiveness and operational reliability.

IIS3DWB10IS vs competitors

Features	IIS3DWB10IS	Competitor MEMS / Piezo
Sensing	• 3-axis • Digital output • with bandwidth >> 10 kHz and flat frequency response • ultra low noise (<50µg/√Hz) • high dynamic range (full scale up to 200g)	• 1-axis • Analog output • Not flat frequency response • Typically, lower dynamic range
Edge Processing	Embedded ISPU 2.0 for real time calculation of complex features (FFT, RMS, Envelope, etc) or AI algorithms and to adapt sensor configuration to the exact context	No embedded features nor processing being bare analog sensors
Integration, ease of use, cost effectiveness	3-axis digital monolithic sensor with ISPU in a compact 4.5x4.5 mm² package reduces BOM, simplifies electrical and mechanical design, and lowers overall system costs	• Analog outputs require external components for signal conditioning and digital conversion, making system design complex and costly. • Single-axis sensing and lack of embedded processing hinder integration and add rigidity to system design and partitioning. • Piezo sensors typically require calibration, adding further complexity
Software libraries	Libraries for the most important features for vibration monitoring: FFT, filtering, envelope, velocity severity, anomaly detection	n/a (since no embedded processing)
Power consumption	Intrinsically low power sensor, thanks to ISPU enable flexibility and low power operation at system level	• Analog output sensors require external signal conditioning and digital conversion, which increase power consumption. Since all processing is handled by the microcontroller, system-level power optimization is limited
Reliable operation	Reliable operation in a wide temperature range **(up to +125°C)** and stressful mechanical conditions	• In some cases (mainly Piezo) limited to **+85°C** • Piezo are challenging over temperature variation and in case of mechanical shocks

Why use IIS3DWB10IS



IIS3DWB10IS provides unprecedented vibration sensing precision and ISPU-driven in-sensor AI processing for real-time data analysis

- **Vibration as a primary sign** of machine health and condition monitoring
- **High bandwidth and low noise sensor** with processing is paramount for smart industry applications
- Advanced MEMS vibration sensors are now **competing with piezoelectric sensors**

Our technology starts with You

Find out more at www.st.com