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Predictive Maintenance with ST sensors

STMicroelectronics

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MEMS Marketing manager

From condition monitoring to predictive maintenance

A solid path, step by step

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Authorized Partner

Data logging from **one or multiple nodes**

Sensing, sampling rate, preprocessing, FFT

Anomaly detection (what, how, where) and **classification**

AI and Machine Learning

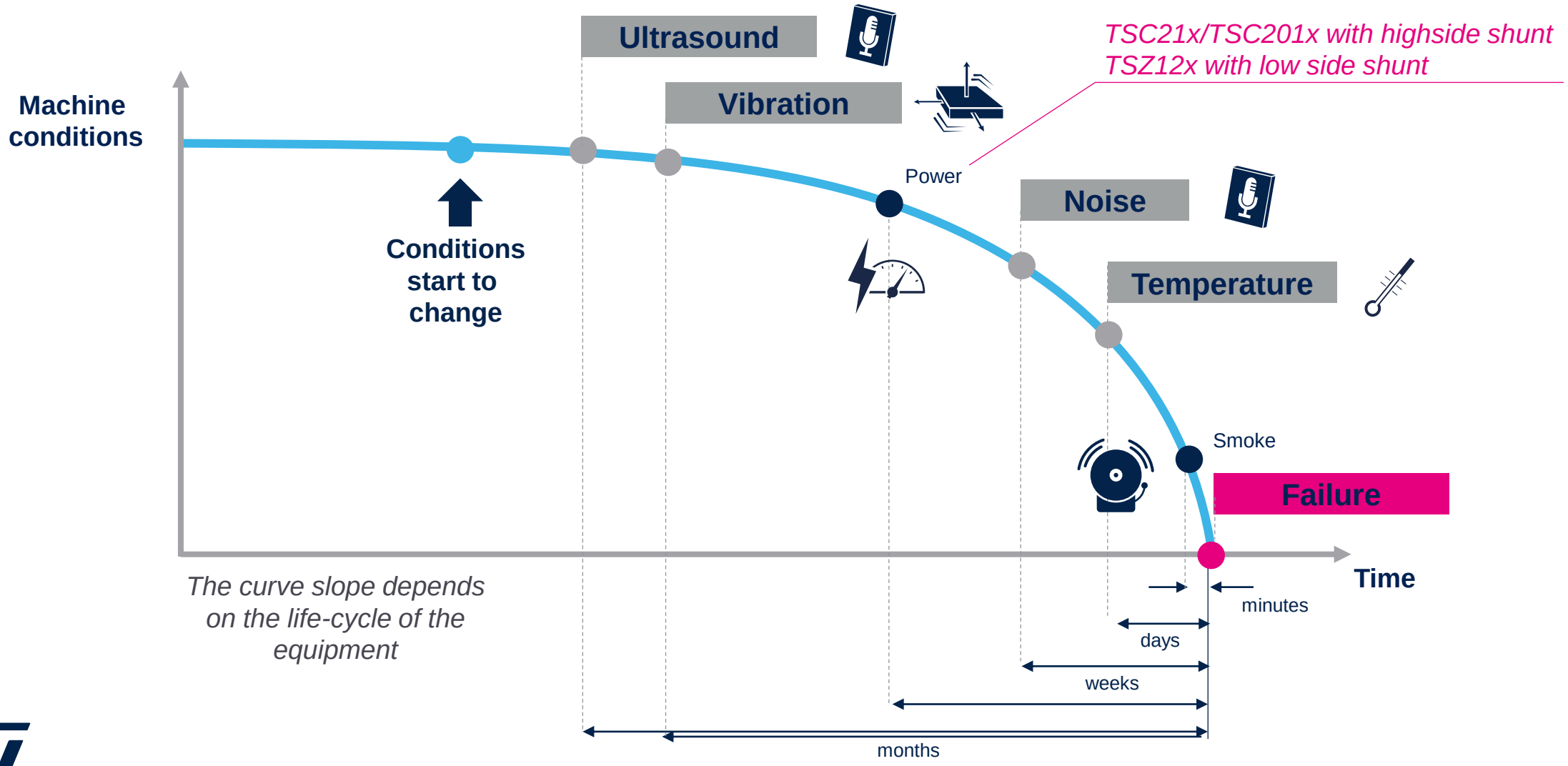
Evaluation of the remaining life of an equipment based on the **BIG DATA**

Advanced data processing with AI and combining with Big Data

Condition Based Monitoring

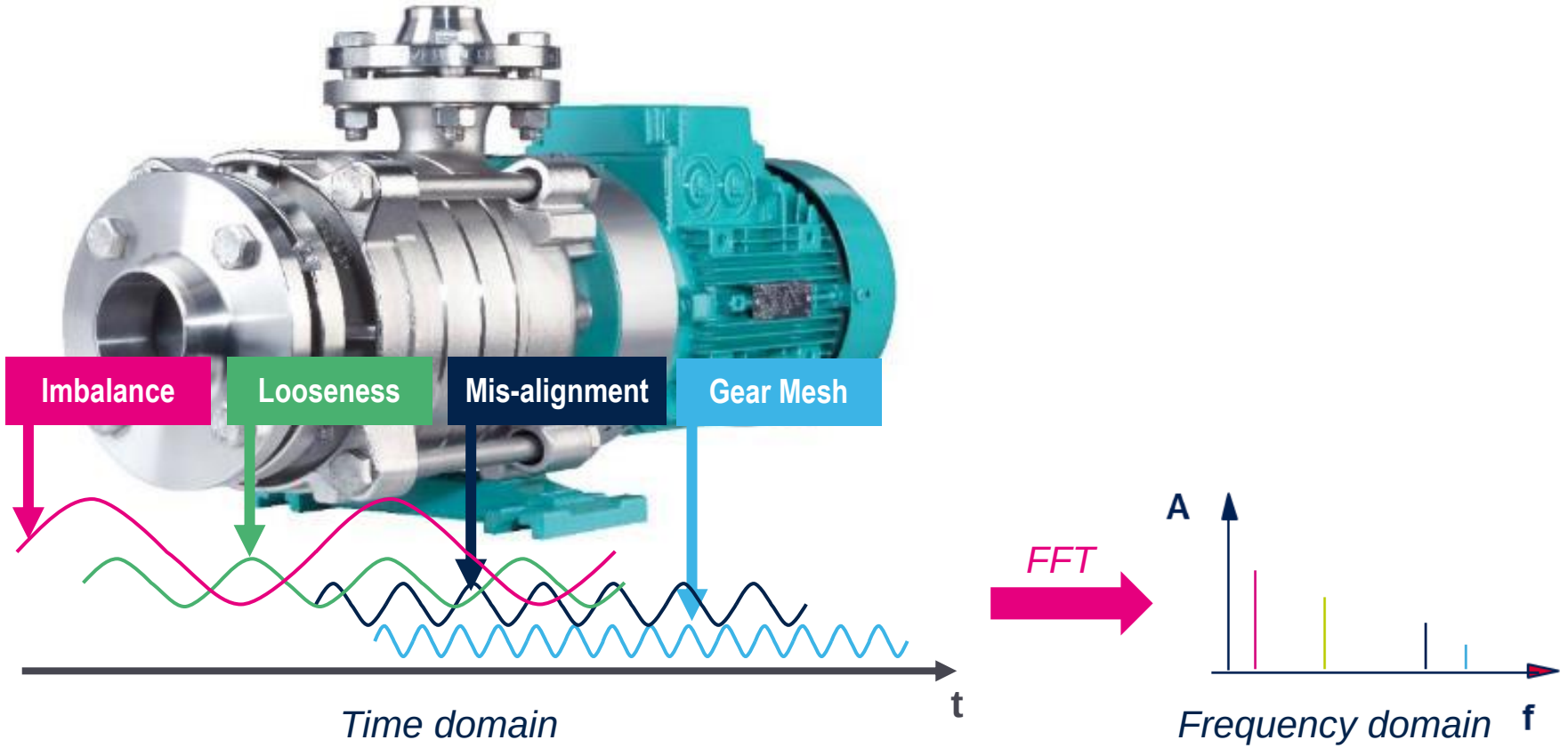
Predictive Maintenance

Sensors for Predictive Maintenance



Example of condition monitoring

Any parameter deviation is an indicator of potential failure



Functions to enable monitoring

- Vibration capture
- Processing
- Secure connections
- Connectivity

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ST key sensor components for predictive maintenance

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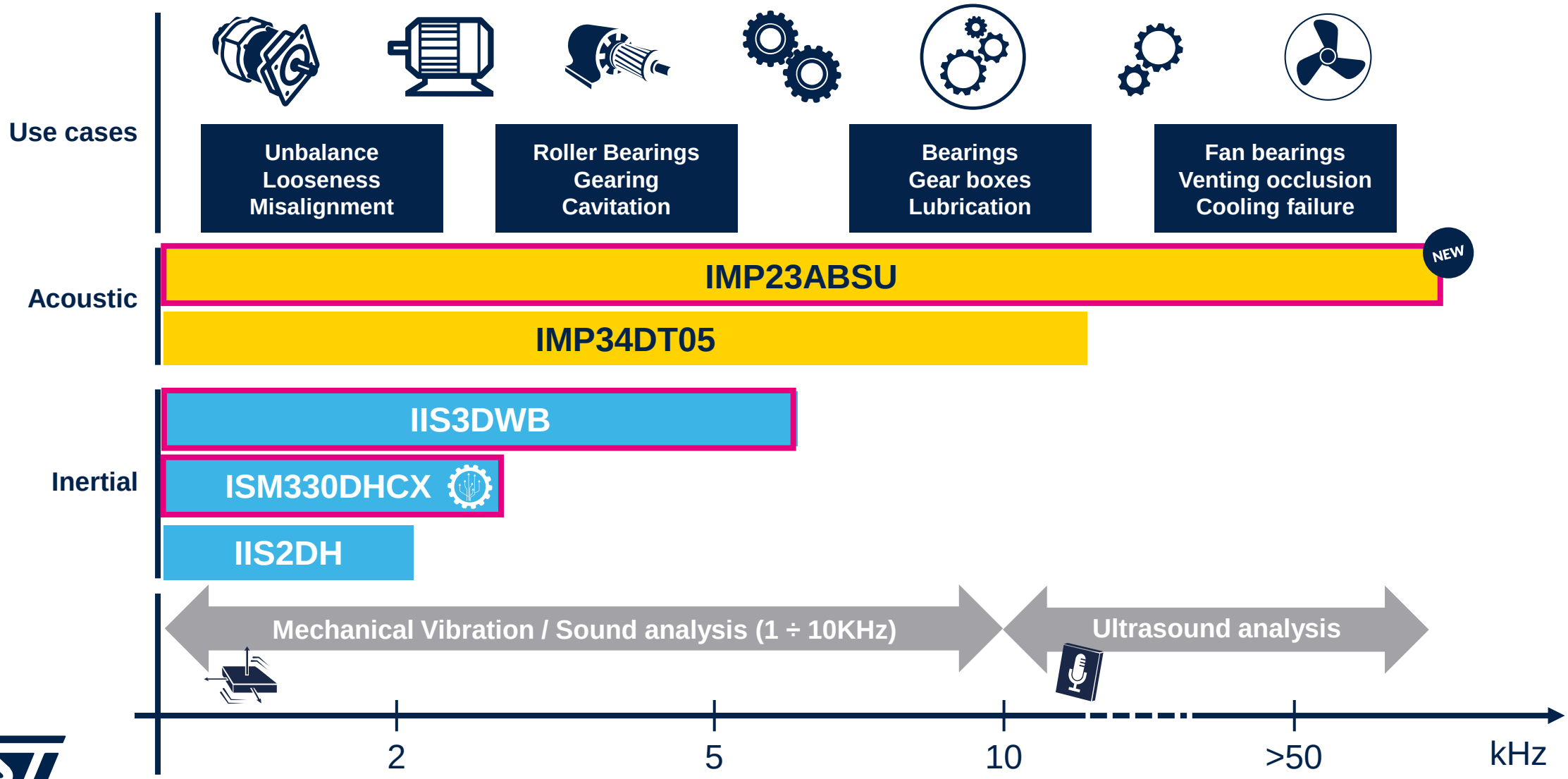
Industrial sensors for vibration analysis sensors and defects over bandwidth

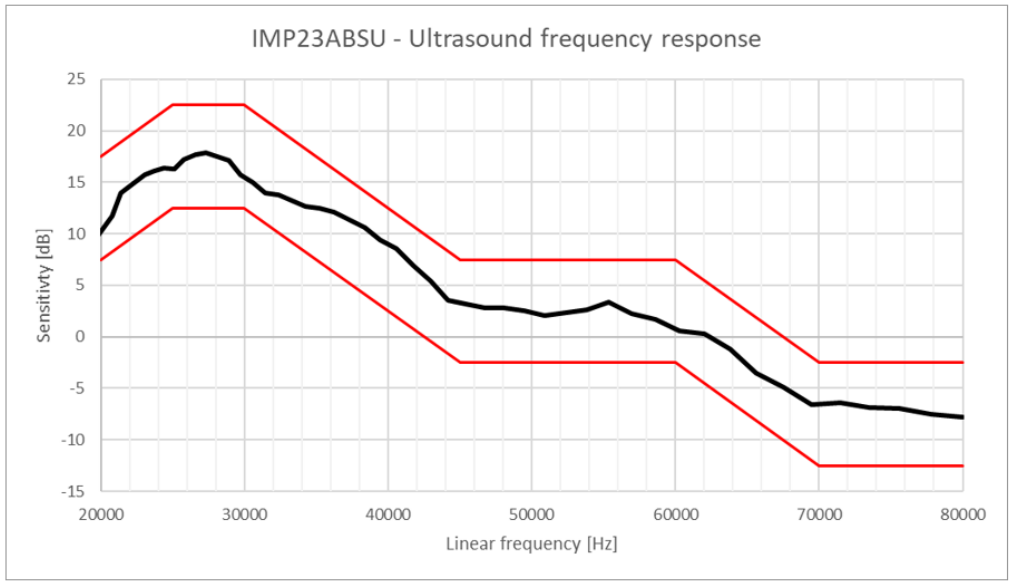


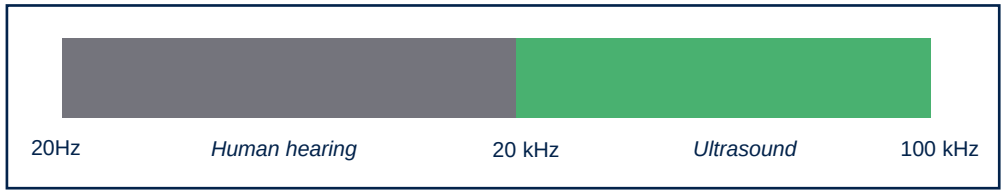
IMP23ABSU
High-performance analog microphone up to 80kHz

Key Features

- High Acoustic Overload Point of 130 dBSPL
- Nominal sensitivity -38dBV ±1dB @ 94 dBSPL
- 64 dB SNR
- Up to 80kHz of ultrasound frequency response
- -40 to 85 deg temperature range

Package: RHLGA metal cap
3.6 x 2.6 x 1mm





”Acoustic sound within the human hearing range.
***Most background noise** in plants and other industrial facilities, including turbines, motors, and compressors, falls within this frequency range ” **

”Acoustic sound beyond the human hearing range.
*Very few background noise will occur on this area**. Leaking gas produces acoustical sound within this range**”*
**) Reference* AZOsensors.com*

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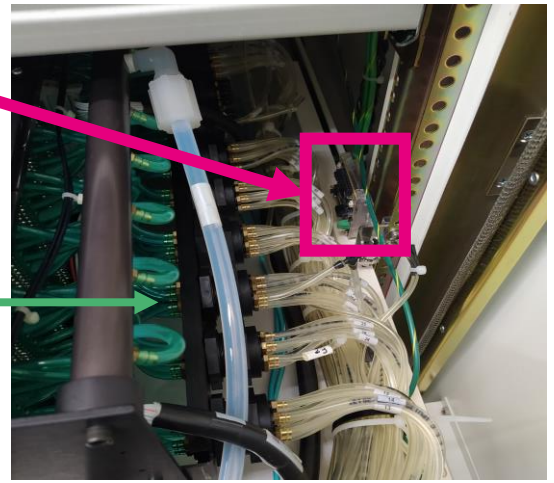
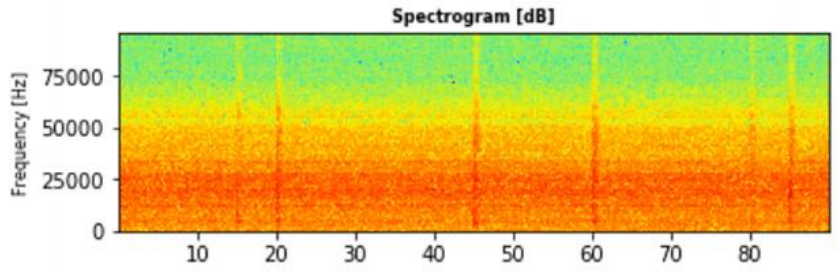
Ultrasound microphone for air and gas leakages

- **N2 or air leaks are common on tools with large number of pneumatic valves**
- **Gas leak detectors are widely used in chemical industries** where the presence of chemical fumes can impact the well-functioning of valves. Monitoring the condition of every valve is very challenging.
- Gas leak detectors with ultra-sound microphones are a “non-intrusive” monitoring method

STWIN

Pneumatic valves rack





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IIS3DWB
Ultra wide bandwidth vibration sensor

Key Features

- 3-axis accelerometer/vibration sensor
- ±2/±4/±8/±16g full scale
- Bandwidth 6.3 kHz (-3dB)
- 26.7kHz ODR SPI interface
- 3kbyte of FIFO
- Noise density 75 µg/√Hz (60 single-axis mode)
- Operating temperature -40 to 105 degrees

Package: 2.5x3x0.83 mm

LONGEVITY 10 YEARS COMMITMENT

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ISM330DHCX
6-axis IMU with Machine Learning Core

Best-in-class accuracy 6-axis IMU with Machine Learning Core

- **High accuracy, stability and linearity over temperature and time**
  - Axel Noise Density 60 µg/√Hz (typ) – ODR up to 6.6kHz
  - Gyro Offset vs T ±0.005 dps/°C (typ)
  - Gyro Bias Instability 3°/hr (typ)
  - Rate Noise Density 5 mdps/√Hz (typ)
- **Programmability & digital features**
  - Programmable Machine Learning Core & Finite State Machines to integrate AI
  - 9 kB Embedded FIFO
  - Sensor Hub
- **Configurability**
  - Angular rate range: from ±125dps up to ±4000 dps
  - Axel Full Scale: from ±2g up to ±16g
  - Low power and high-performance modes
- **Extended operating temperature range from -40 to +105 °C**

LGA 14L
2.5 x 3 x 0.86 mm

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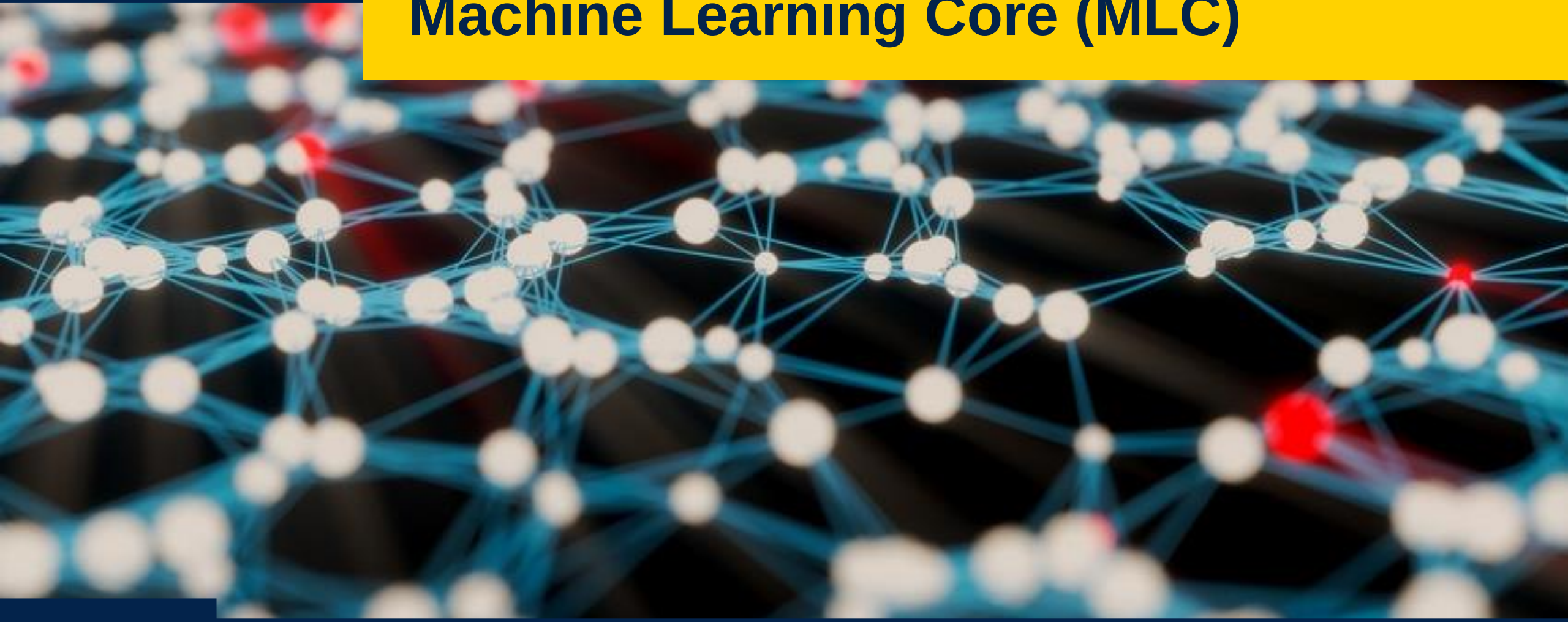
ST sensors with Machine Learning Core (MLC)



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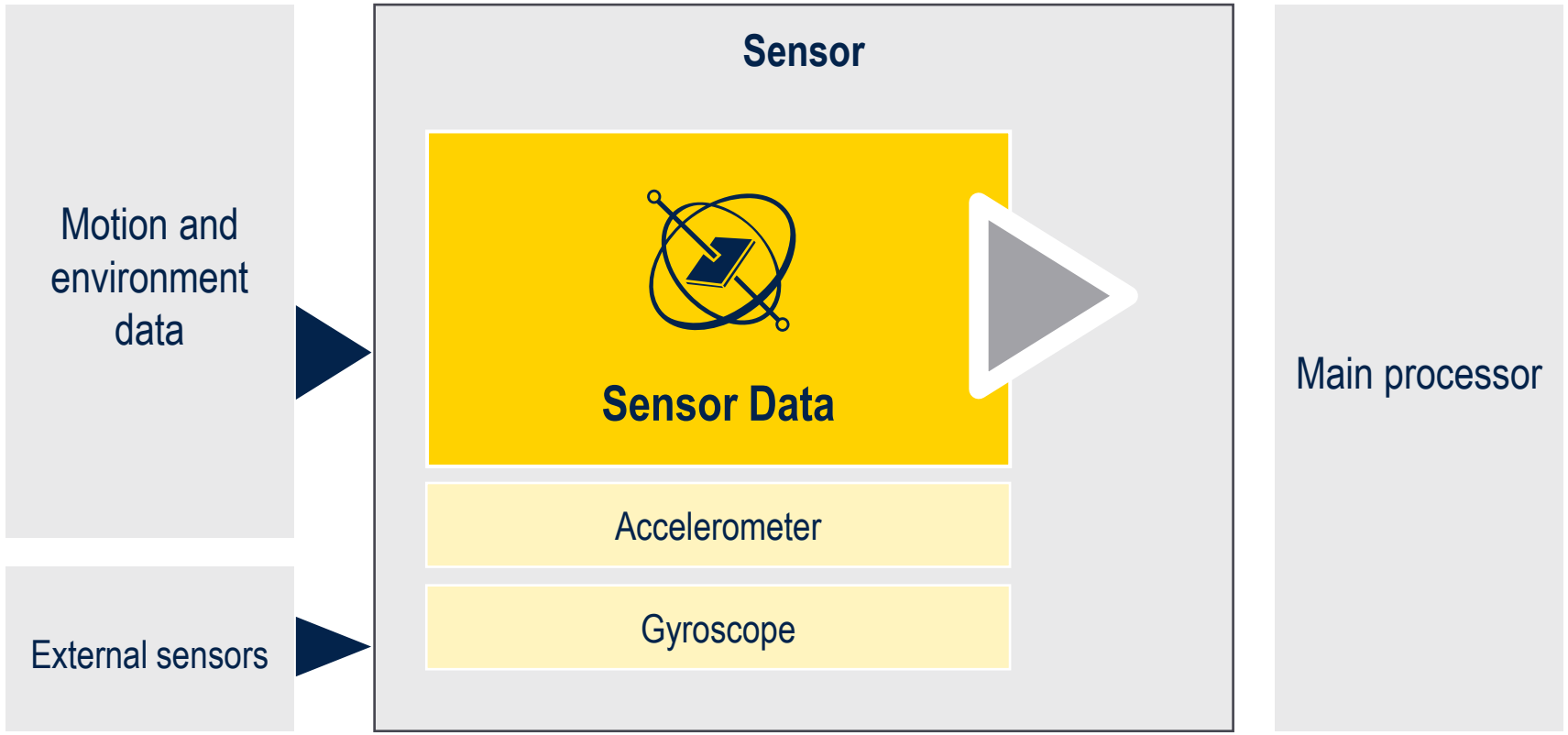
Typical sensor data transfer for main CPU



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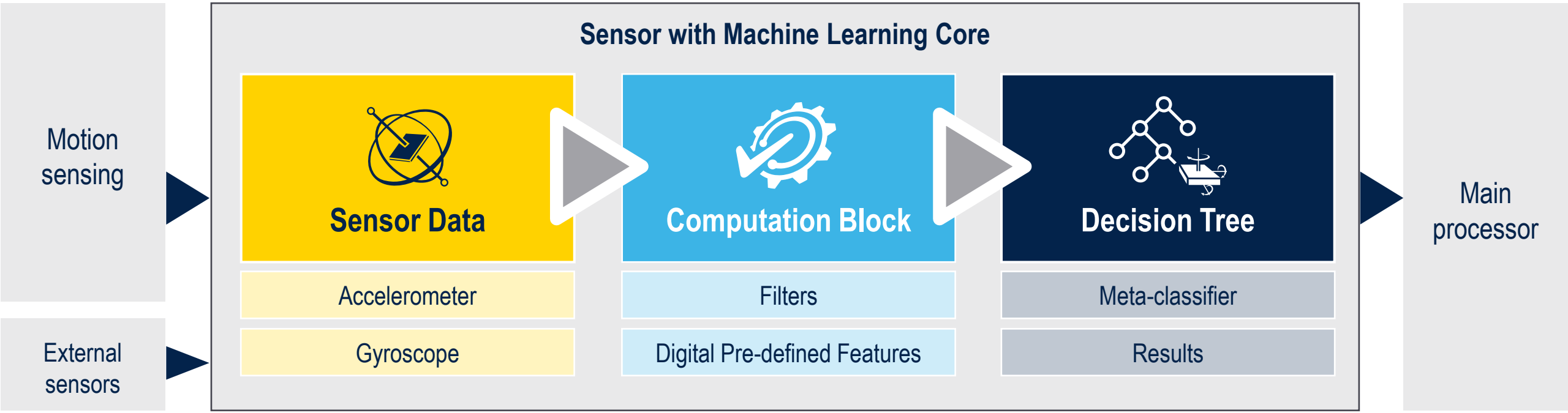
Machine Learning Core

MLC is an in-sensor classification engine based on Decision Tree logic



MLC is able to **increase accuracy** with a **better context detectability**, **offloading the main processor** while the built-in sensors identify motion data

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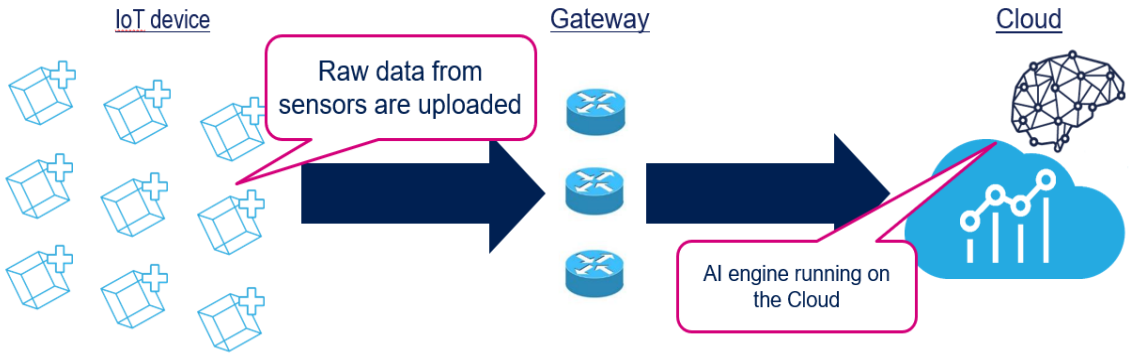
Moving from cloud to edge computing for easier data handling

CLOUD

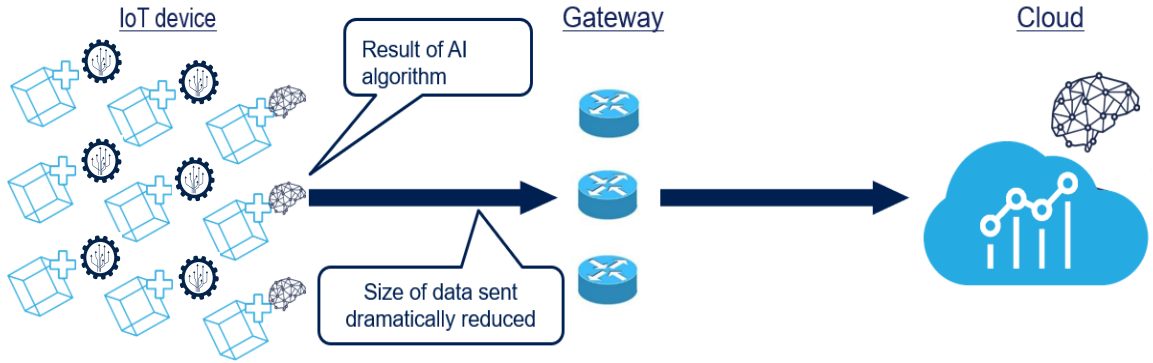


High power consumption & heavy files sent to the cloud

Time-sensitive applications are limited by remote data cloud

- Mission-critical functions
- Bandwidth limitations
- Privacy and security concerns
- Power consumption

EDGE



Low power consumption. Optimized data sent to the cloud

Time-sensitive applications are locally processed

Market needs:
Sensors with local processing (Artificial Intelligence) for real-time elaboration and best power efficiency

Sensors with Machine Learning Core & Finite State Machine

- **LSM6DSOX**
  6-axis IMU for battery powered IOT
- **LSM6DSRX**
  6-axis IMU for VR and trajectory tracking
- **ISM330DHCX**
  6-axis IMU for Industry 4.0
- **ASM330LHHX**
  6-axis IMU for Vehicles
- **IIS2ICLX**
  2-axis Inclinometer and structures monitoring

IOT / Wearable
Movement tracking & Shock




GNSS, Telematics, VR/AR, Robot
Rotation / Movement

Predictive maintenance & Monitoring
Vibration / Tilt




Infrastructure & Landslide monitoring
Mechanical movement / Tilt

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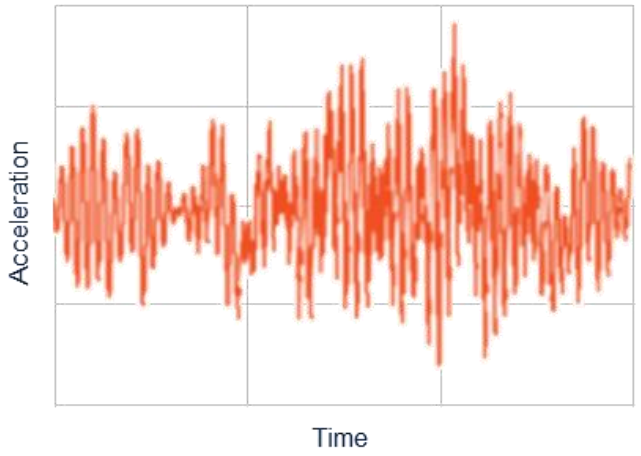
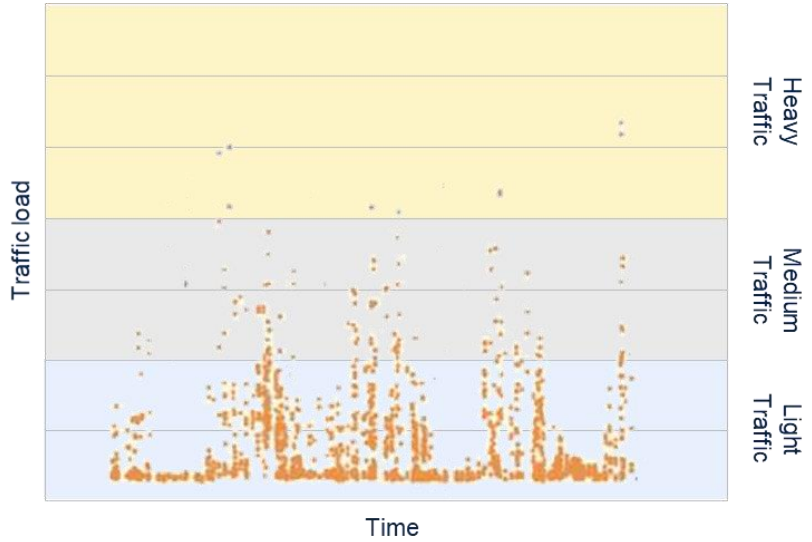
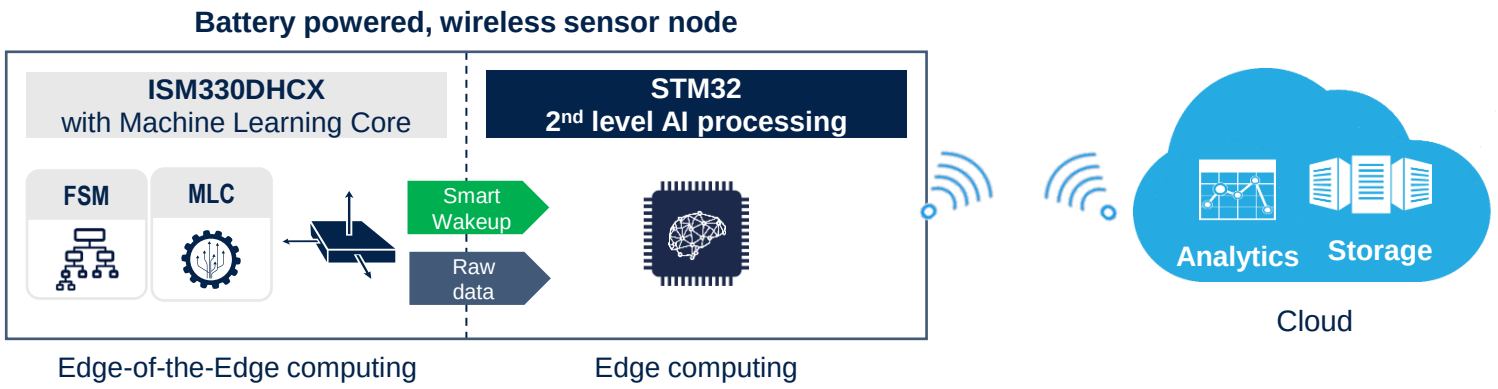
Smart Wake-up for SHM

Machine learning core classifies the traffic load and wakes up 2nd level processing only when relevant conditions are met







STWIN introduction

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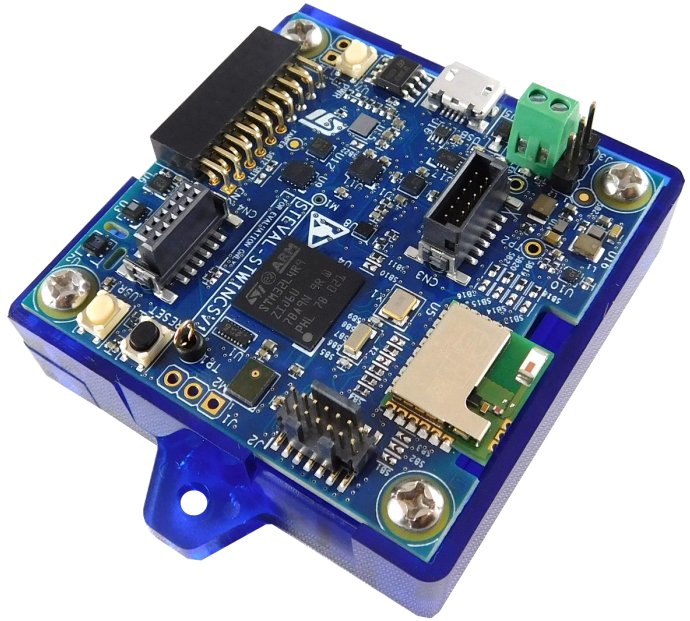
Wireless connectivity is a game changer Here’s why

STWIN1B: SensorTile Wireless Industrial Node



- Hardware Board
- Battery + plastic case for field testing
- STLink-V3MINI + cable for programming

STWIN1B is available under the sales code: **STEVAL-STWINKT1B**

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www.st.com/stwin

Application software

STM32 Cube

A broad ecosystem of SW tools	
Datalogging	FP-SNS-DATALOG1
Anomaly detection NANOEDGE AI STUDIO	FP-AI-NANOEDG1
Condition Monitoring	FP-IND-PREDMNT1
Focus on microphones	X-CUBE-MEMSMIC1

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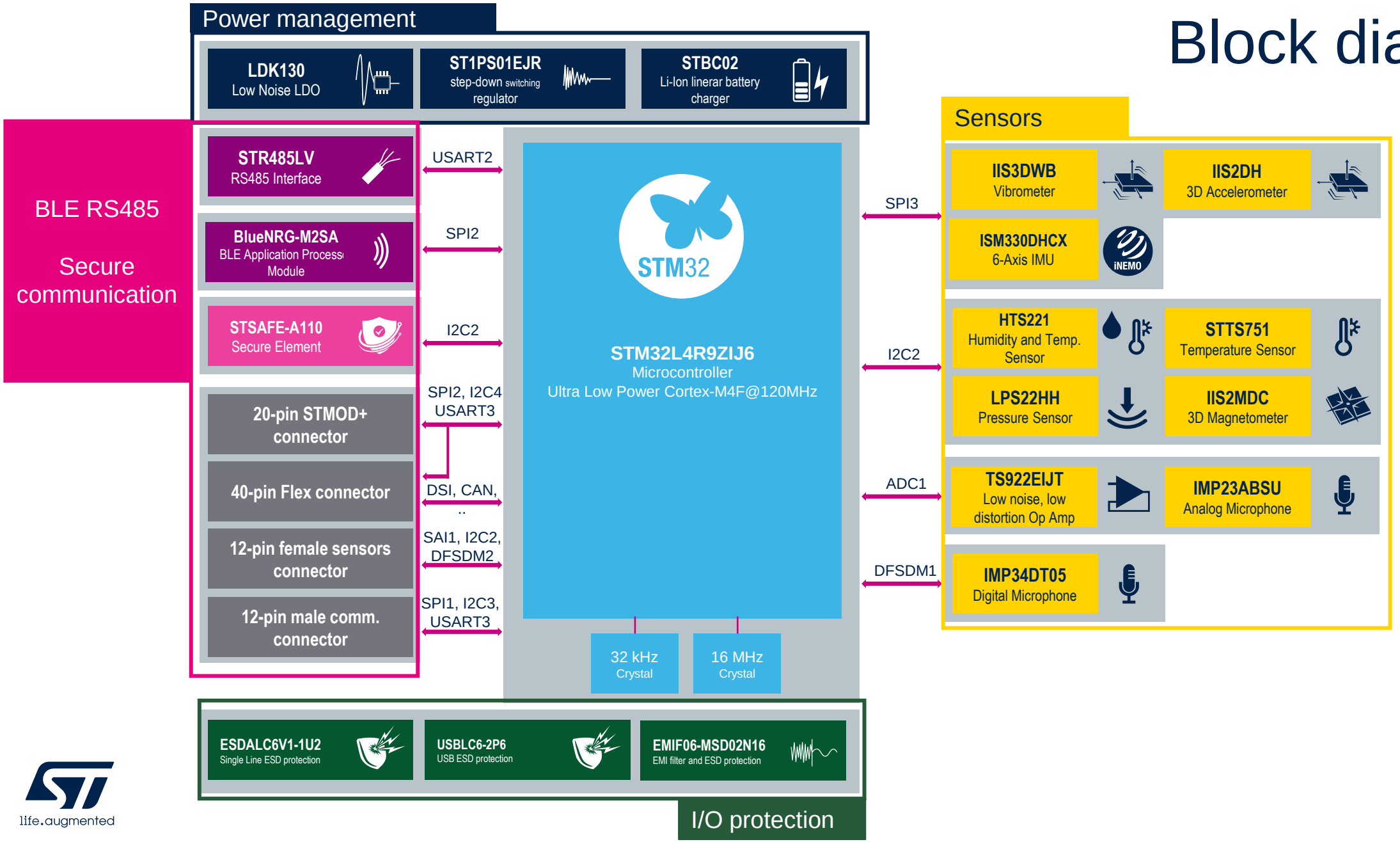
STEVAL-STWINKT1B Block diagram

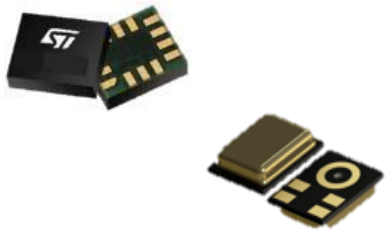


Summary

Predictive Maintenance to Anomaly detection

1

New industry 4.0 way of monitoring assets remotely with industrial sensors emerging



2

IIS3DWB vibration sensor, **IMP23ABSU** ultrasound microphone and **ISM330DHCX** 6-axis IMU sensors are high runner components

3

New **STWIN1B** development kit available with plenty pre-made SW packages for high speed datalogging and anomaly detection

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Our technology starts with You

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