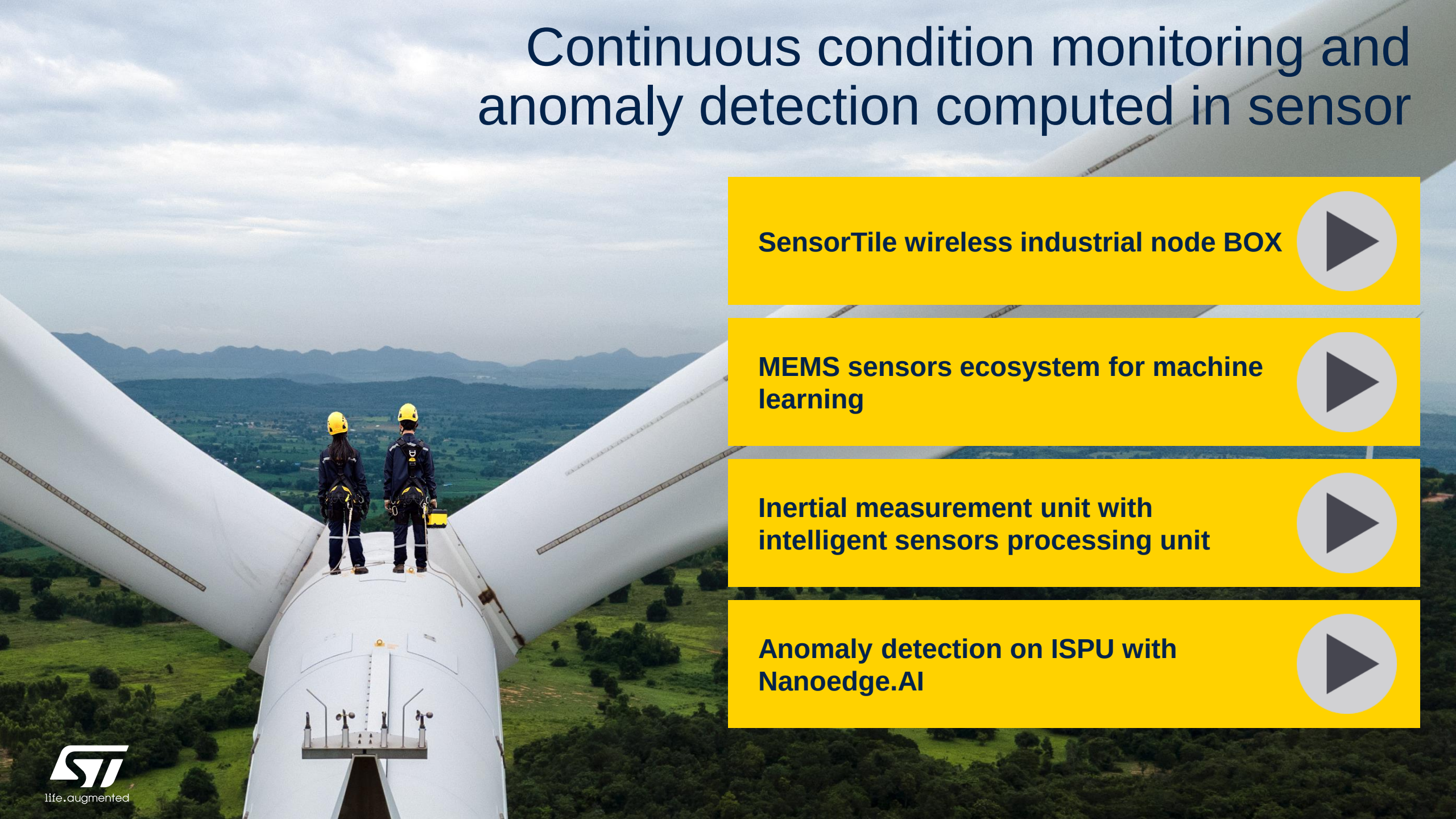
Continuous condition monitoring and anomaly detection computed in sensor



SensorTile wireless industrial node BOX

MEMS sensors ecosystem for machine learning

Inertial measurement unit with intelligent sensors processing unit

Anomaly detection on ISPU with Nanoedge.AI

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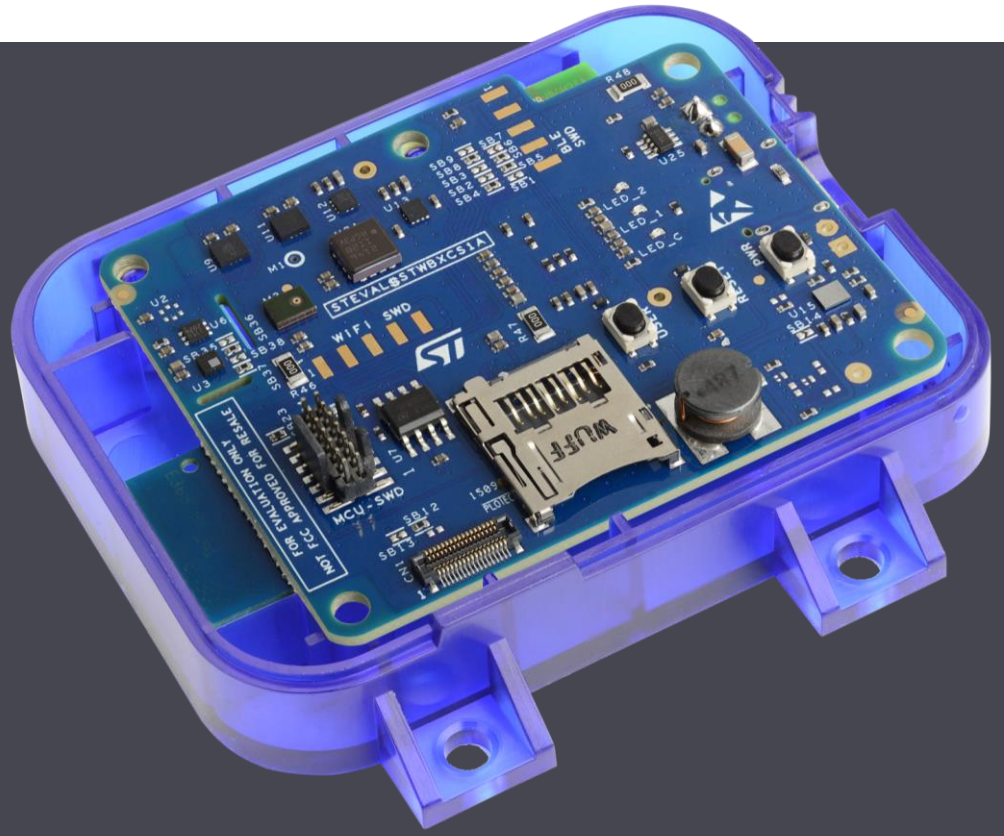
STWIN.box: SensorTile wireless industrial node



STEVAL-STWINBX1

- Main board
- Battery + plastic case for field testing
- STLINK adapter + cable for programming
- DIL24 adapter + flex cable

Develop industrial monitoring applications using motion, ultrasound, temperature, and pressure sensors

Includes Wi-Fi, Bluetooth, NFC, serial interface, SPI/I²C/USART

Application software support

- **High-speed data logging function pack**
- **STBLESensor mobile phone app**

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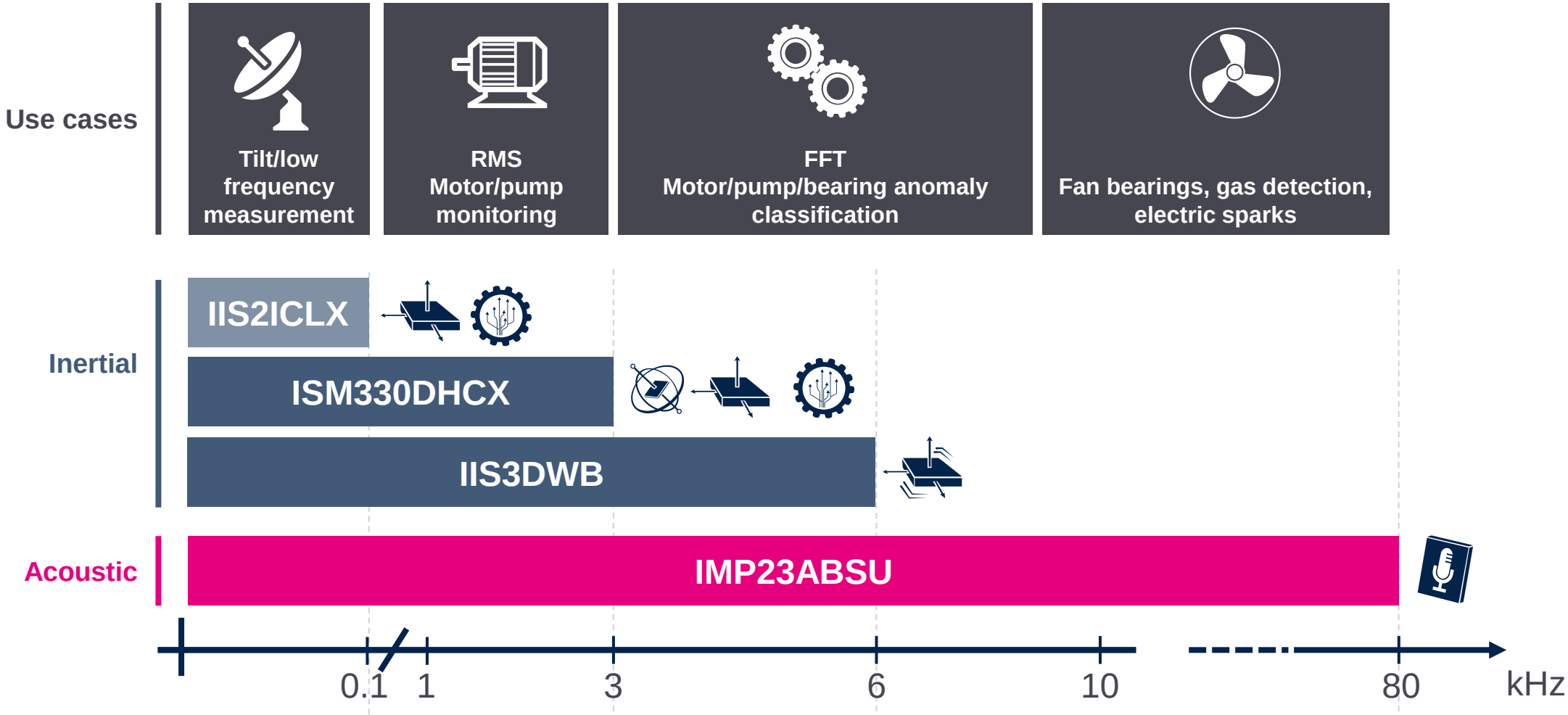
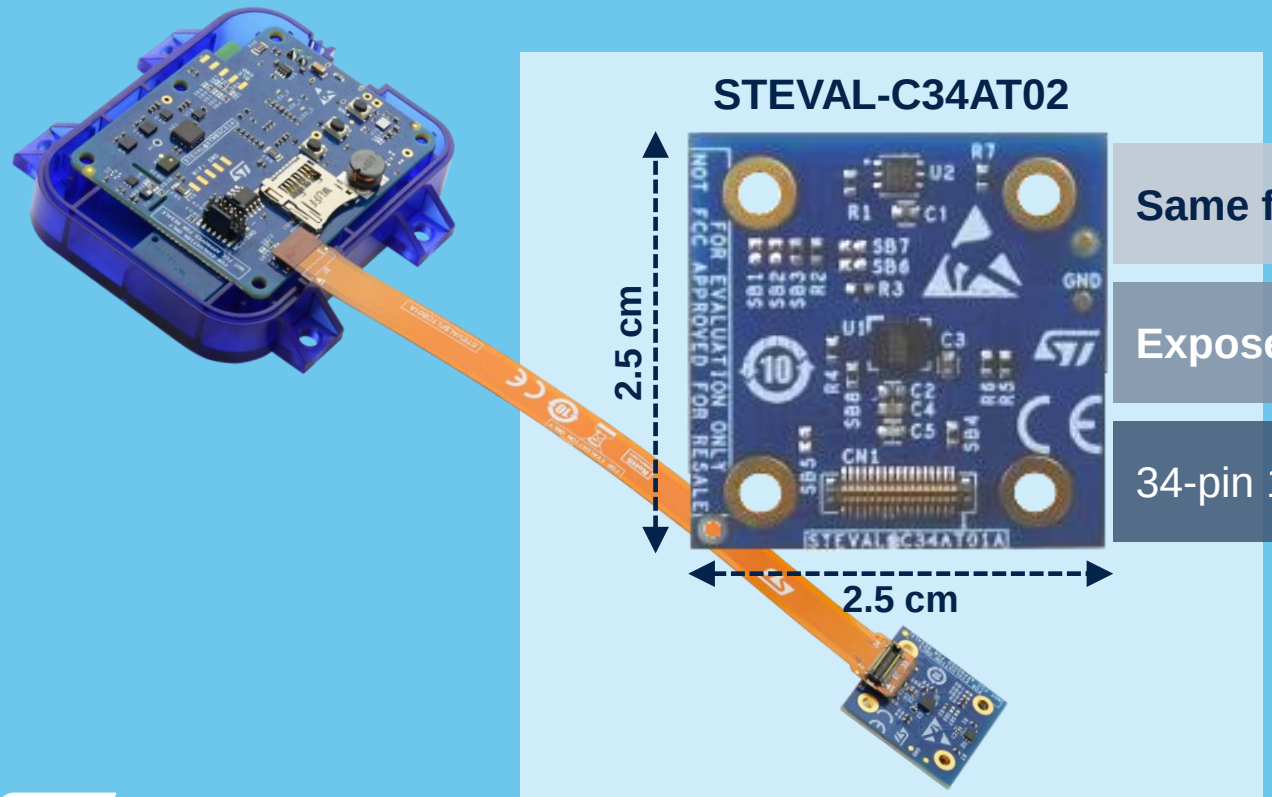
Ultrasound and motion/vibration sensing



Intelligent sensor processing unit (ISPU) and temperature expansion

Add-on with 6-axis + ISPU (ISM330ISN) and temperature (STTS22H) sensors



- **Same form factor as STEVAL-C34KAT1**
- **Exposed pad on bottom side for thermal coupling**
- 34-pin 15 cm length flex cable included

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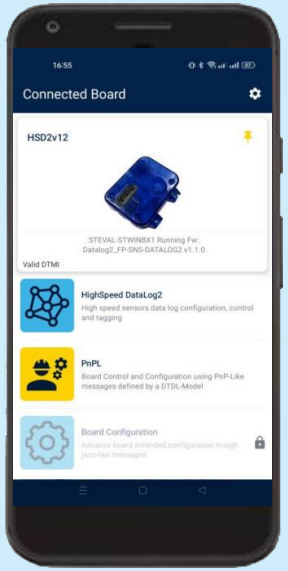
Ecosystem and demo flow

ST BLE Sensor app



STEVAL-STWINBX1 with FP-SNS-DATALOG2 firmware

FP-SNS-DATALOG2 hsdatalog_GUI.py

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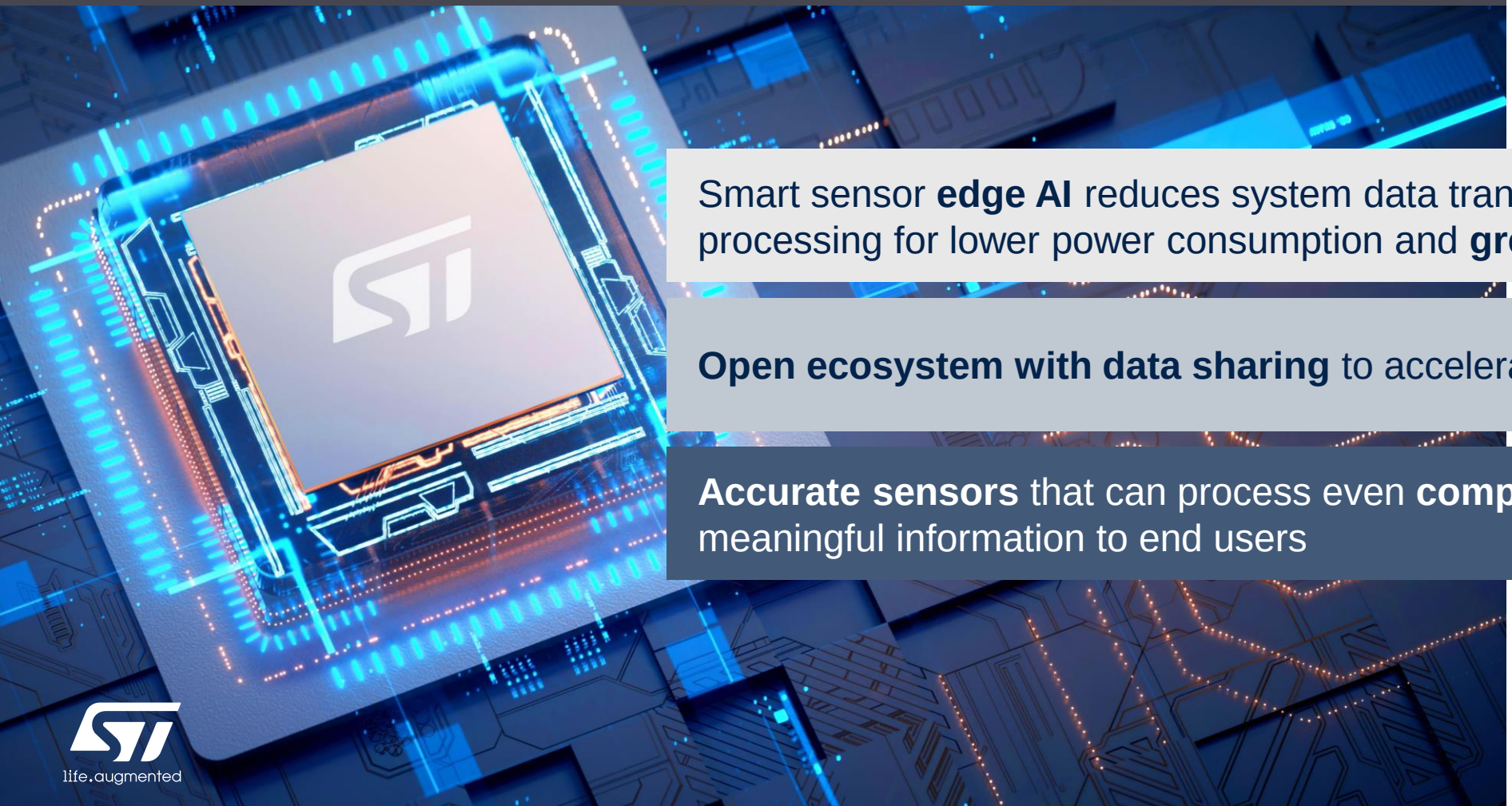
MEMS sensors ecosystem for machine learning

Embedding edge AI technology in sensors to collect, process, and send meaningful real-time data



Smart sensor **edge AI** reduces system data transfers and offloads network processing for lower power consumption and **greater sustainability**

Open ecosystem with data sharing to accelerate innovation & development

Accurate sensors that can process even **complex algorithms** and deliver meaningful information to end users

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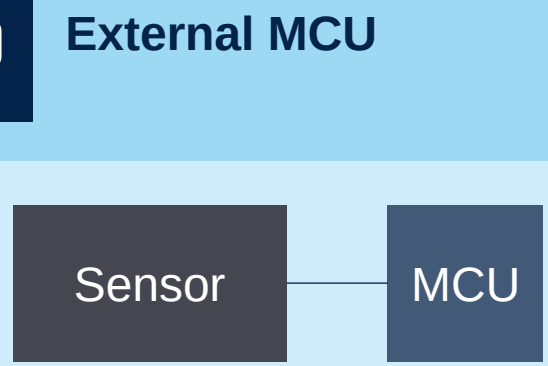
Machine learning and processing sensor data

Optimizing system consumption and reducing latency

External MCU



MCU runs the algorithms
Runs any kind of software

Sensor (MLC/FSM) + MCU

Decision tree and finite state machine
Reconfigured through register settings

Sensor (ISPU) + MCU

Digital signal processing (ISPU)
C-code and AI instruction set

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FSM = finite state machine
ISPU = intelligent sensor processing unit
MLC = machine learning core

In-sensor processing with MLC and FSM

Machine learning core

Data acquisition campaign

Engine matches data patterns with user-defined classes

Understand scenarios based on training data

Activity tracking

Input	Labeled sensor data with features
Logic	Machine learning based logic
Output	Pattern classification using a decision tree

Finite state machine

Series of state parameters with defined transitions

Recognize gestures

Multiple FSM programs in parallel

Gesture recognition

Input	Sensor samples data
Logic	Event-/trigger-based logic using thresholds/timers
Output	Event detection using commands and conditions

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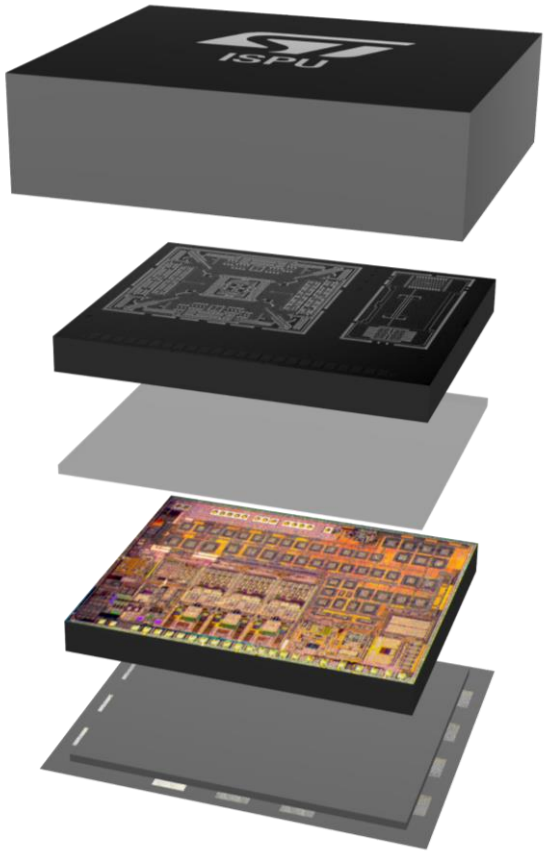
Intelligent sensor processing unit



The ISPU is a fully integrated digital signal processor (DSP) that is optimized for sensor data processing and can run even complex AI algorithms

Ultralow power consumption at system level, thanks to optimized data transfer

High processing capability with AI-enabled programmable core (machine learning and neural network)

Easily programmable in C language or with commercial and open-source AI models

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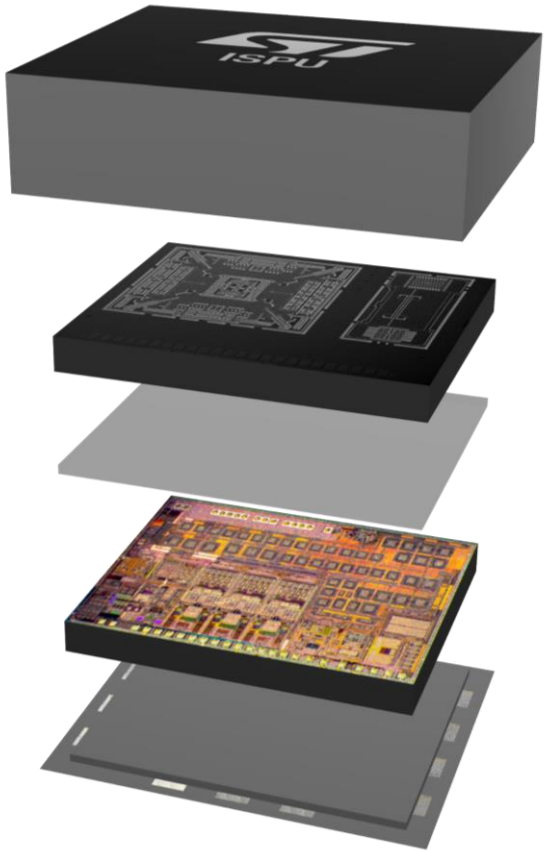
Intelligent sensor processing unit



The ISPU is a fully integrated digital signal processor (DSP) that is optimized for sensor data processing and can run even complex AI algorithms

Small area: enhanced 32-bit RISC Harvard architecture

RAM based: 40 KB (program + execution)

Full precision: Floating-point unit

Binary neural network convolution accelerator

Fast interrupt response: 4 cycles vs 15 (Cortex®)

Frequency/output data rate: 5 MHz/3.33 kHz-10 MHz/6.66 kHz

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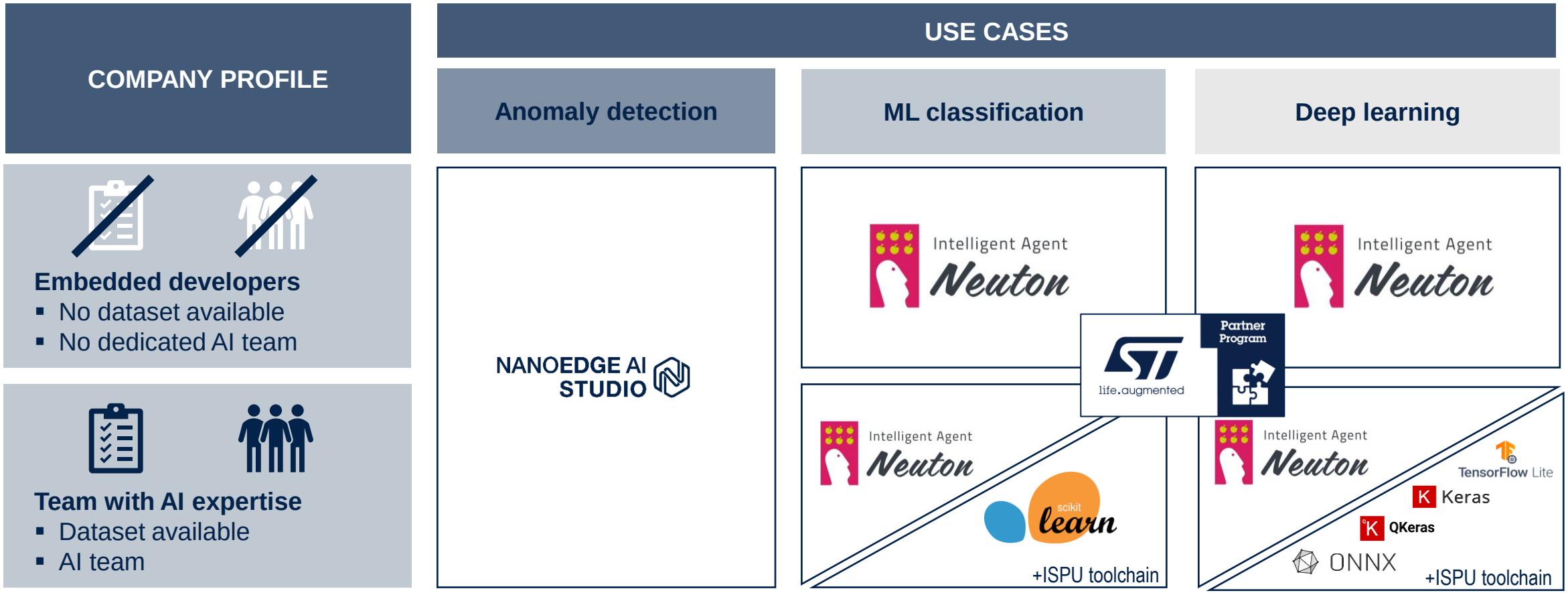
Software development tools for sensors with ISPU



ISPU products

For real-time processing and artificial intelligence

- Full scale: ±2000 dps, ±16 g
- Idd 0.59 mA (combo mode)
- Accelerometer noise 70 µg/√Hz
- Gyroscope noise 3.8 mdps/√Hz

MEMS sensor
3-axis accelerometer & 3-axis gyroscope

Sensor hub
to collect data from up to 4 additional external sensors

ISPU core

Standard IMU pinout and footprint: 2.5 x 3 mm²

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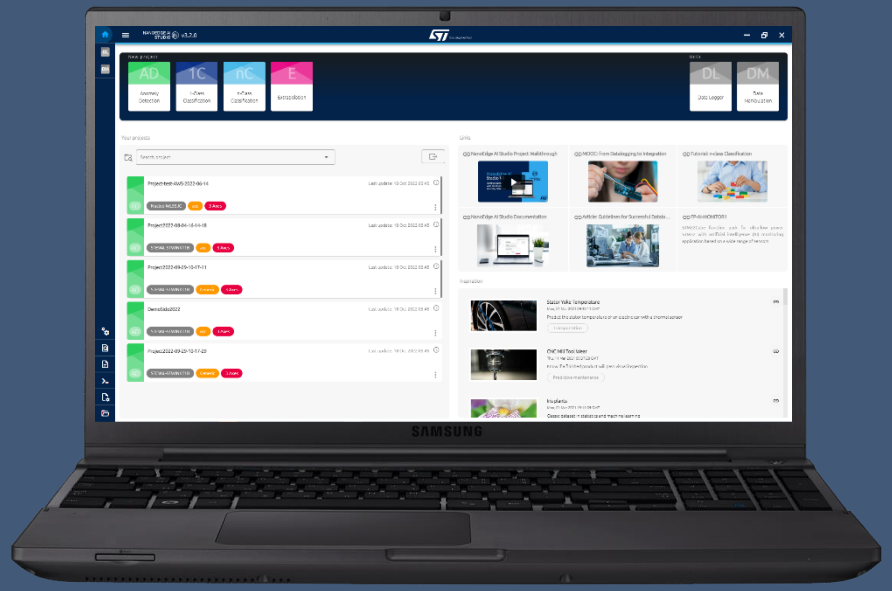
NanoEdge AI Studio V3.2 (and up) optimized for ISPU

On the PC

1 Create the library once



NANOEDGE AI STUDIO

Standalone PC solution (Win/Linux)

Create and embed a self-learning engine

On the ISPU

2 Use the library many times

For anomaly detection, the model is self-trained at the edge.

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Anomaly detection and AI: stepping closer to the signal

Possibility to divide the tasks between the sensor and the MCU