



life.augmented



Distributed Intelligence: Sensing Solutions with Machine Learning Capabilities

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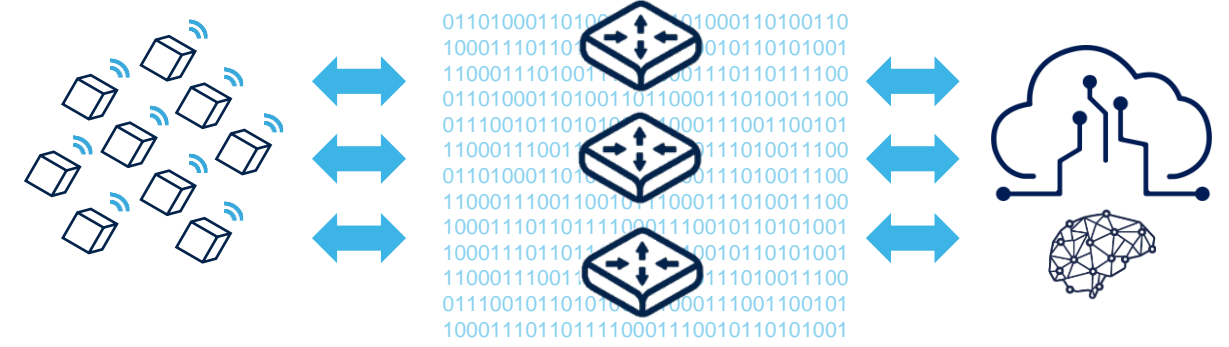
Smart System Challenges: the Move to Edge Computing

CLOUD COMPUTING

Collect and Send Data

Protocol Translation and Device Management

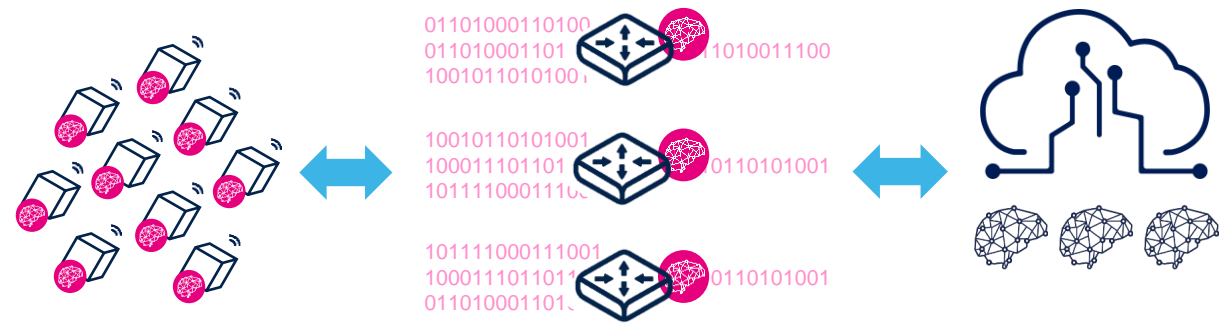
Big Data and Heavy computation



Time-sensitive applications are limited by remote cloud

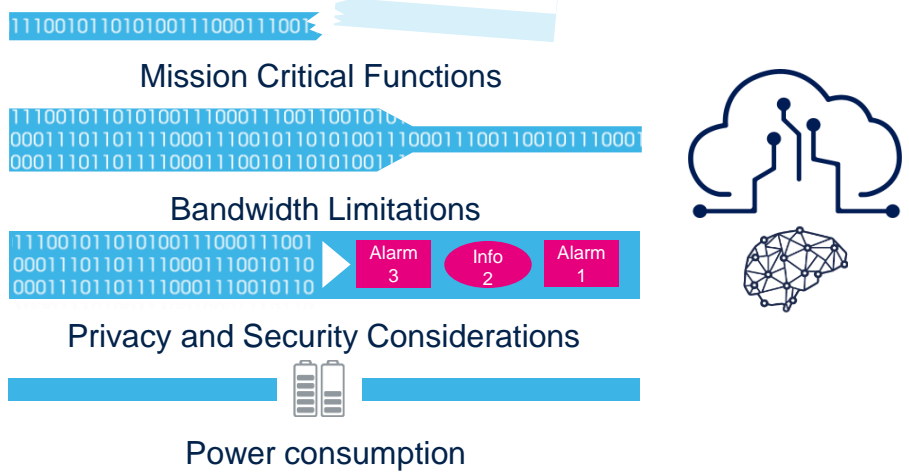
EDGE COMPUTING

Time-sensitive applications should be locally processed



Collect, Process And Send Data Local Processing of Data Optimized computation and Advanced Analysis


Opportunity: move computation down to Sensor Nodes with local processing for real-time elaboration and best power efficiency





Artificial Intelligence and STMicroelectronics

- Thanks to STM32Cube.AI, you can map and run pre-trained **Artificial Neural Networks** (ANN) using the broad STM32 microcontroller portfolio.
- Advanced sensors contain a Finite State Machine (FSM), a Machine Learning Core (MLC) and advanced digital functions to run custom algorithms on the IMU and share the workload from the main processor enabling system functionality while in ultra-low power state.



Neural Networks
on STM32
Simple, fast, optimized

▶ Learn more



INEMO

Machine learning core
6-axis inertial module

▶ Learn more



Our vision

We create the new generation of **sensors** to allow **developers** exploiting their potential by improving the overall system **efficiency**

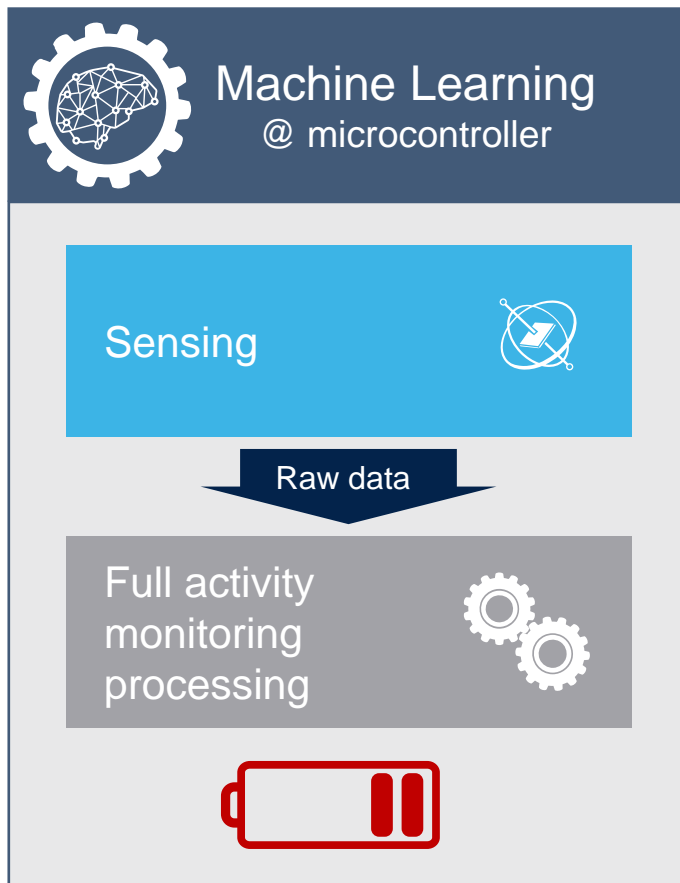
thanks to:

- Reduced power consumption (both sensor and system)
- Increased accuracy (context detectability)
- Real edge computing

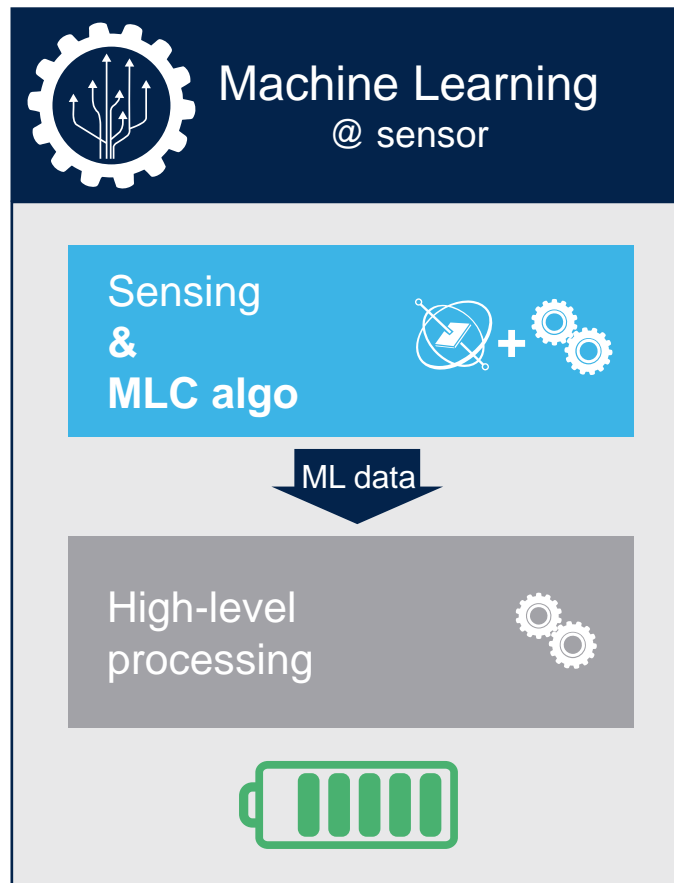
And we do this by leveraging Machine Learning techniques for the world of A.I.

From low power sensor to low power system

Machine Learning Core (MLC) for real edge computing enables high system flexibility



Power optimization at system level



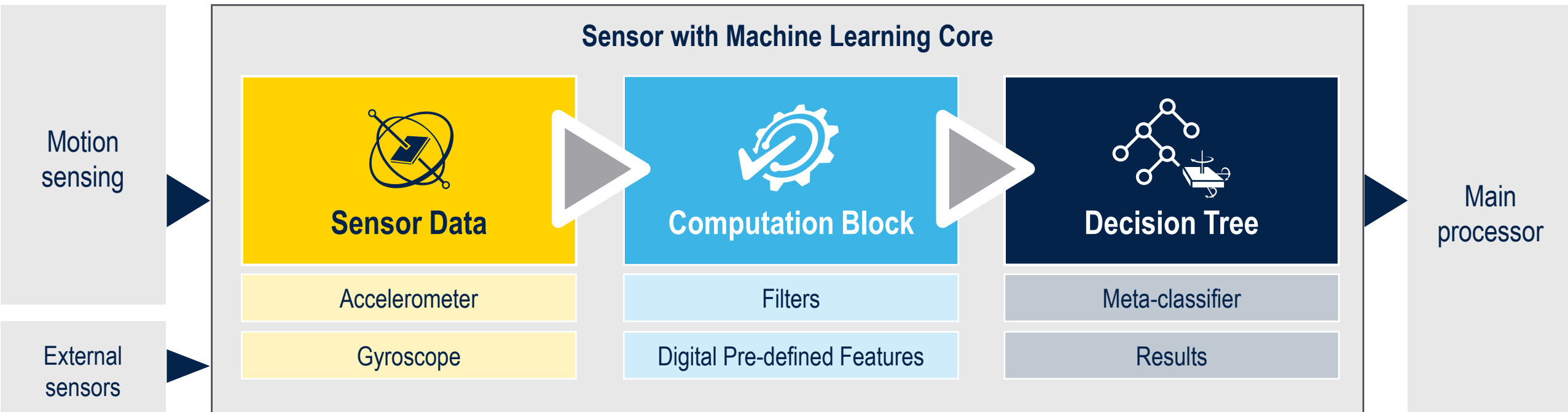
- Higher computation power at sensor level
- Lower power consumption at system level
- Cost optimized solution

This is added value!



Machine Learning Core (MLC) What is it?

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

Decision Tree design with AlgoBuilder and Unico-GUI



Capture data



- Accelerometer
- Gyroscope
- External sensors

AlgoBuilder

Unicleo-GUI



Label data



- Filters
- Features

Unico-GUI



Build decision tree



- Classification
- Results

Unico-GUI



Embed decision tree



- DT implementation

AlgoBuilder



Process new data



- Real time test

Unicleo-GUI



6-Axis IMU with Machine Learning Core

1



Collect Logs for each class

2



Define Features that best characterize the identified classes

3



Machine Learning tools generate program for LSM6DSOX based on Logs and Features

4



Configure the LSM6DSOX, run the application

Detected as ->	Stationary	Walking	Fast Walking	Jogging
Stationary	99.1%	0.9%	0.0%	0.0%
Walking	0.0%	99.4%	0.2%	0.0%
Fast Walking	0.0%	3.7%	95.9%	0.2%
Jogging	0.0%	0.6%	0.7%	98.5%



More intelligence with embedded Machine Learning Core

10 to 1,000 times power saving
with real edge computing

Personal Electronics



LSM6DSOX

Activity
recognition

Gym activity
recognition

Airplane mode
detection

Personal Electronics



LSM6DSRX

Virtual
Reality

Sensor
Fusion

Vehicle
stationary
detection

Industrial IoT



ISM330DHCX

Smart
antennas

Industrial IoT

Dynamic
inclinometers



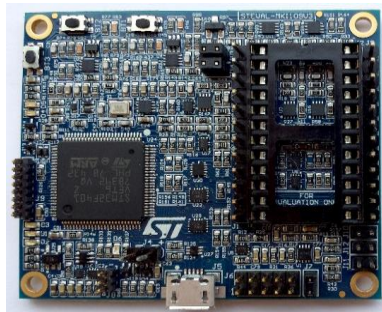
Hardware Evaluation Tools

Hardware:

- SensorTile.box



- Professional MEMS Tool



Software:

- AlgoBuilder



- Unicleo-GUI



- Unico-GUI



Questions?

