

International Workshop on Embedded Artificial Intelligence Devices, Systems, and Industrial Applications (EAI)

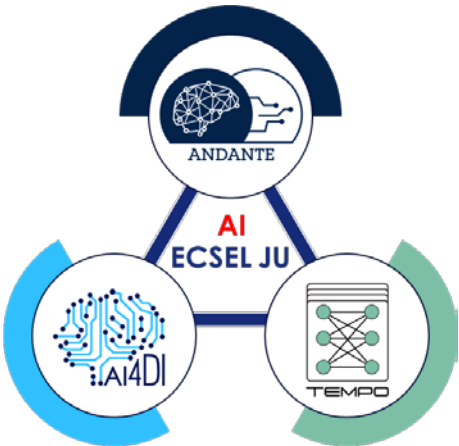


Milan, Italy 19 September 2022

International Workshop on Embedded Artificial Intelligence Devices, Systems, and Industrial Applications (EAI)

Artificial Intelligence: the impact in the semiconductor world

Sara Loi - STMicroelectronics



19 September 2022 Milan, Italy

Presentation Outline



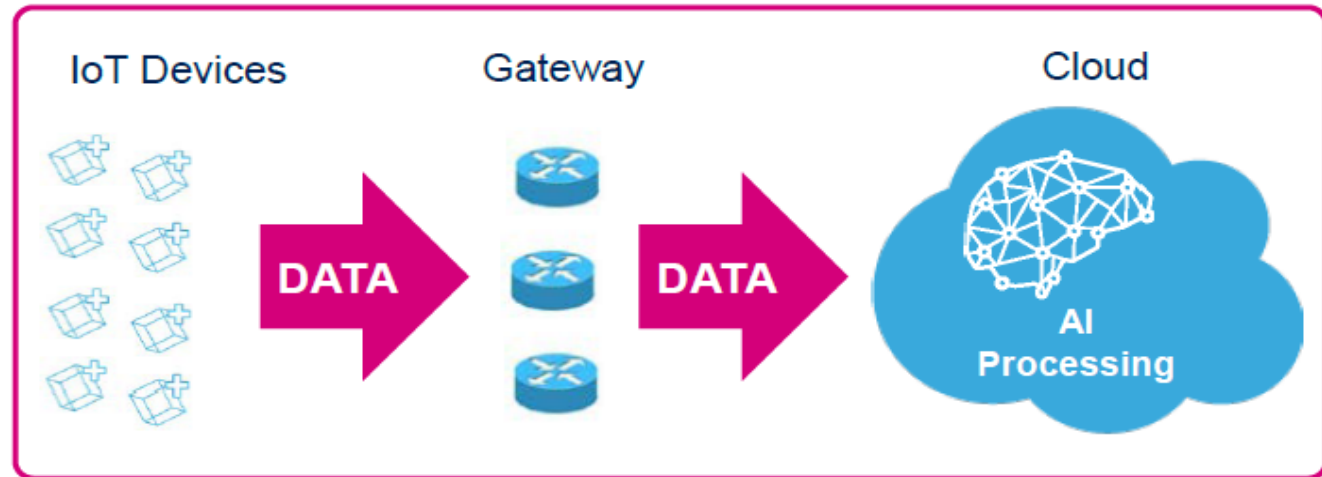
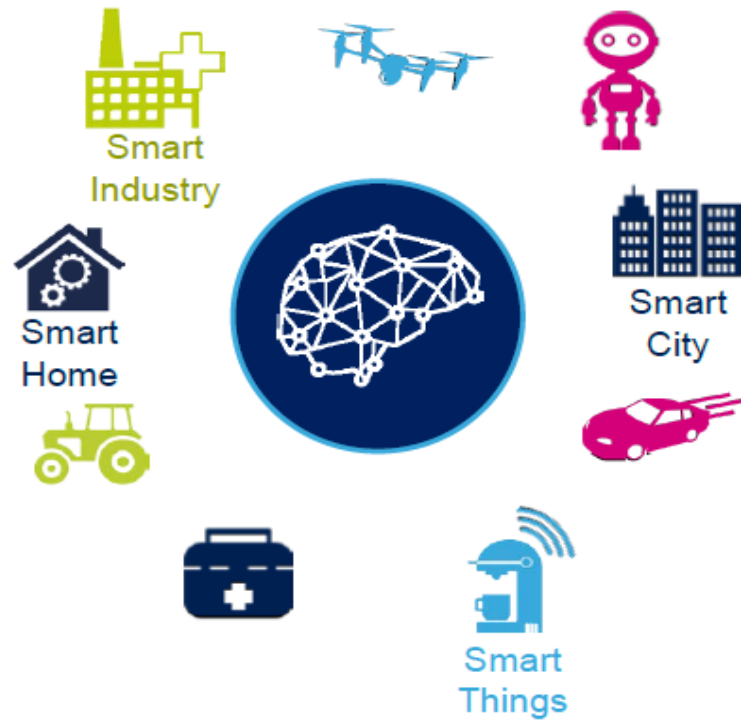
- AI opportunities and challenges
- Applications enabled
- AI for decision making in factory/building
- AI in semiconductor manufacturing

Presentation Outline



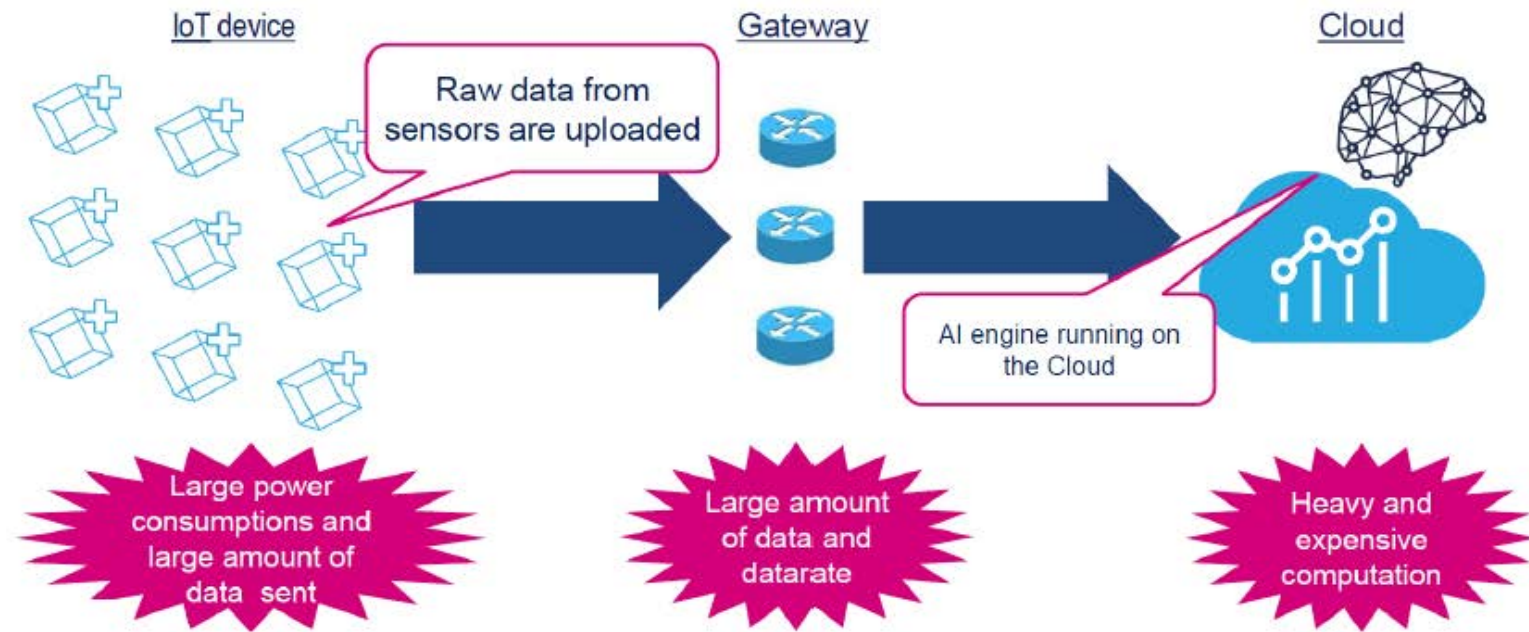
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AI opportunities



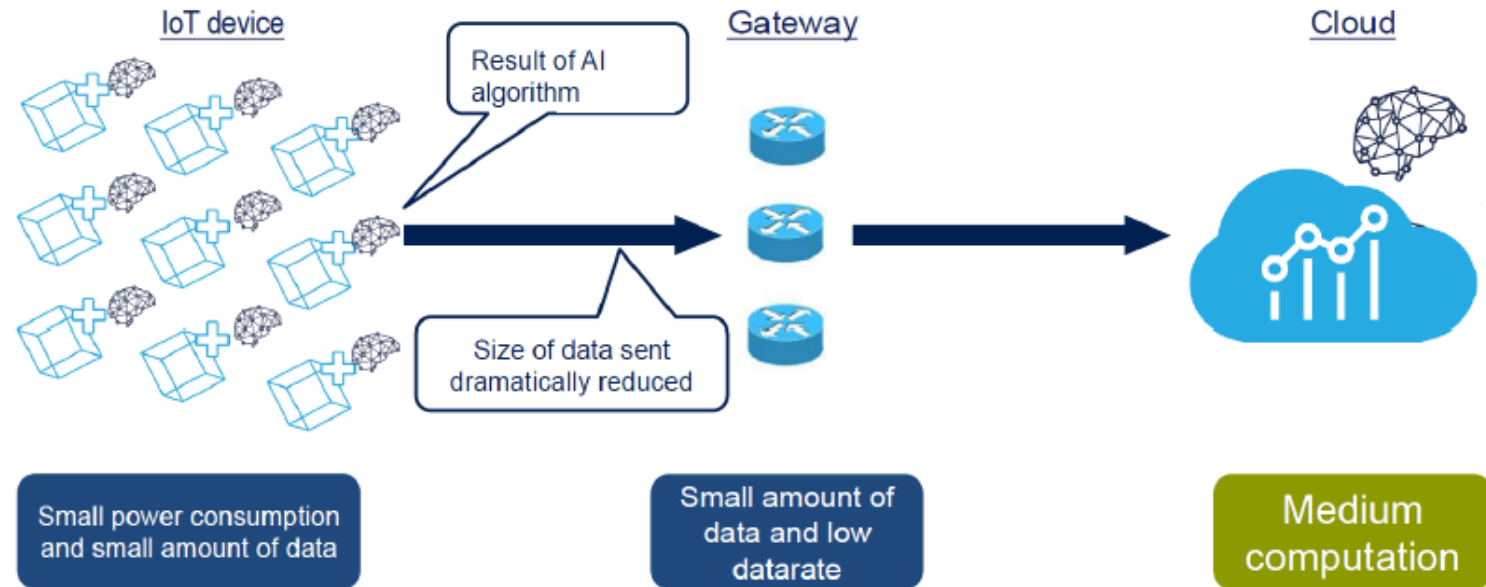
...and challenges: centralized approach

- ↓ Scalability
- ↑ Latency
- ↑ Bandwidth
- ↓ Node intelligence
- ↓ Privacy
- ↓ Security
- ↓ Energy Saving



Distributed approach: AI@ the Edge/Node

- ↑ Scalability
- ↓ Latency
- ↓ Bandwidth
- ↑ Node Intelligence
- ↑ Privacy
- ↑ Security
- ↑ Energy Saving
- ↑ Data Value



Key steps behind neural networks



Neural Network (NN) Model Creation



Operating Mode

Capture data



1

2

Clean, label Data
Build NN topology



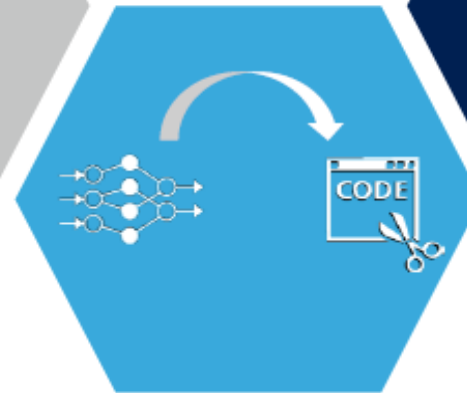
Train NN Model



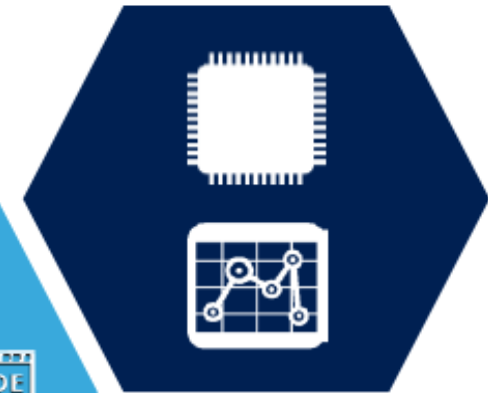
3

4

Convert NN into
optimized code for MCU



Process & analyze new
data using trained NN



5

Presentation Outline



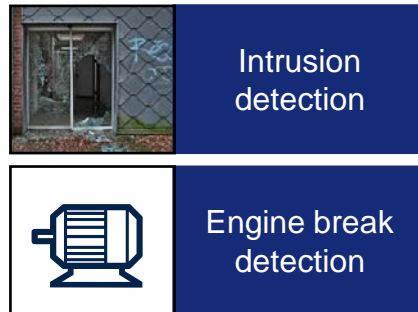
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Applications enabled

SOUND BASED

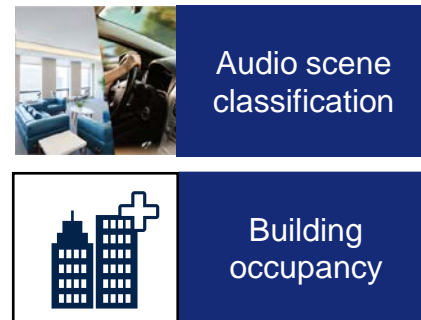
Sound event classification

- Home alarms
- Machine anomaly



Context awareness

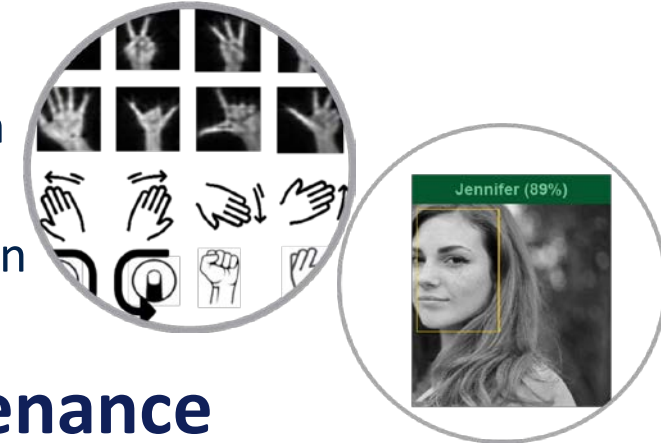
- Vehicular environment
- Factory activity
- Human presence detection



COMPUTER VISION ON MCUs

HMI

- Gesture recognition
- Face Recognition
- Emotion Recognition



Predictive maintenance

- Smoke detection
- Product defect detection



Image processing

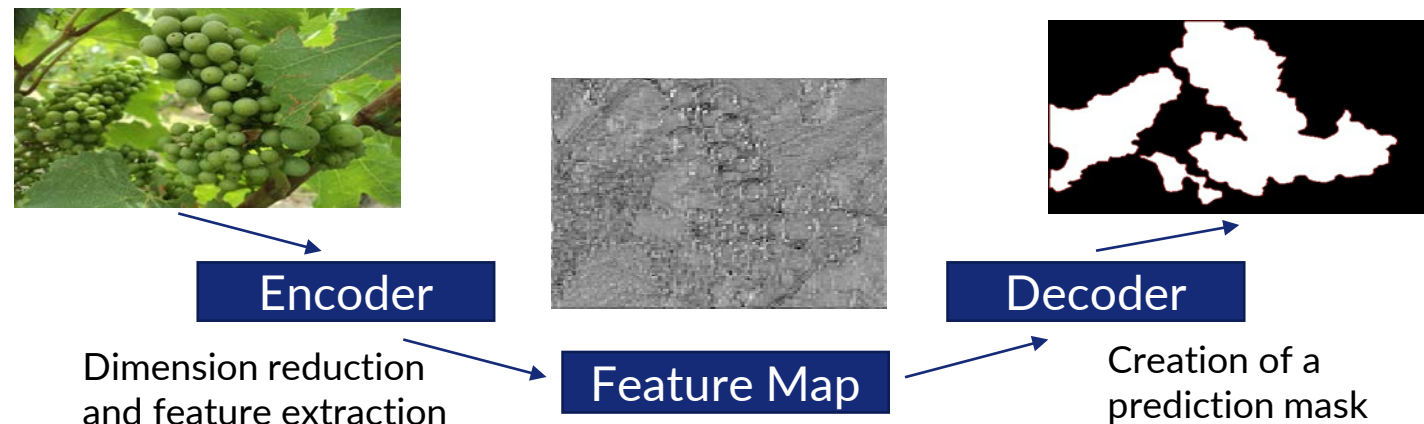
- Characters and digits recognition
- Recognize field pests, disease



Autonomous environment-aware Robot



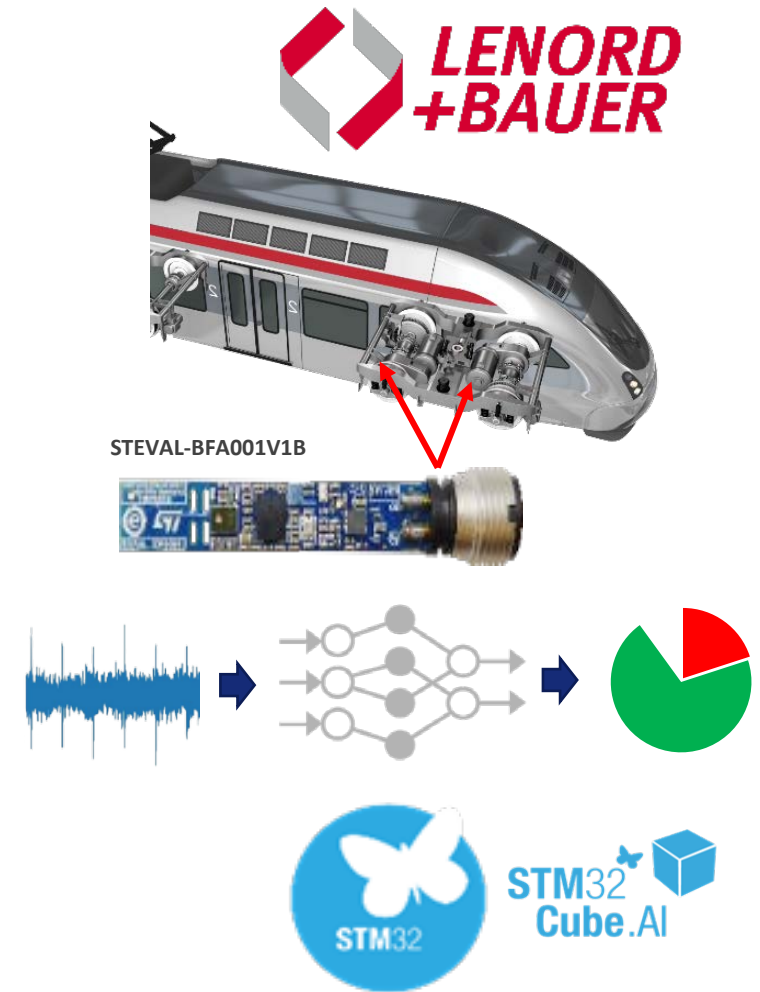
- Integration of cameras to the robot for
 - ✓ Grape/flower detection and counting
 - ✓ Disease detection on leaves/grapes
- AI based monitoring systems to provide guidance and advice



LENORD trains

Predictive Maintenance relying on embedded AI

- Joint project STMicroelectronics – Lenord Bauer
- Accelerometer data to monitor wheels (bearing) vibrations anomalies.
- A NN, running on the MCU of the node, provides alarm in critical conditions

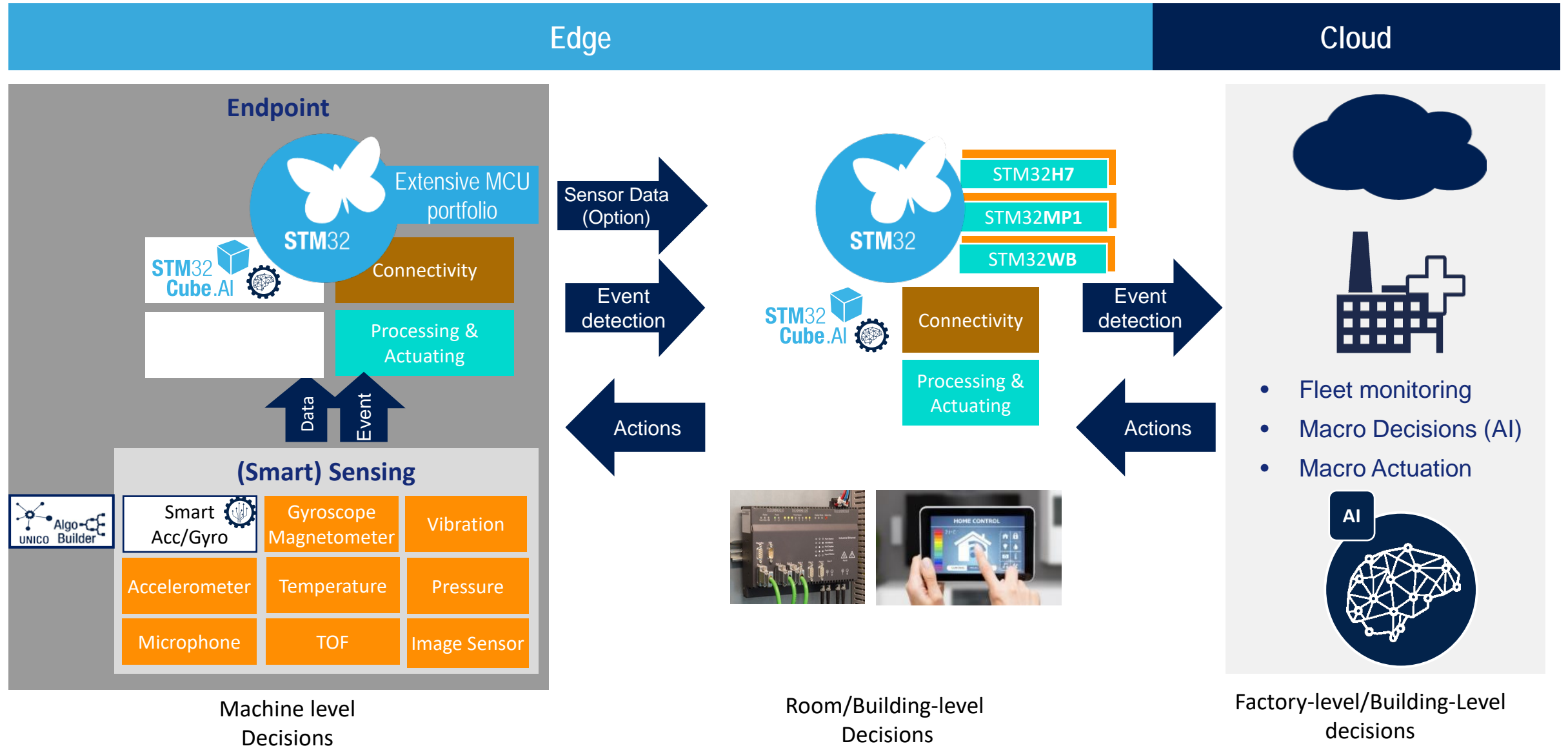


Presentation Outline

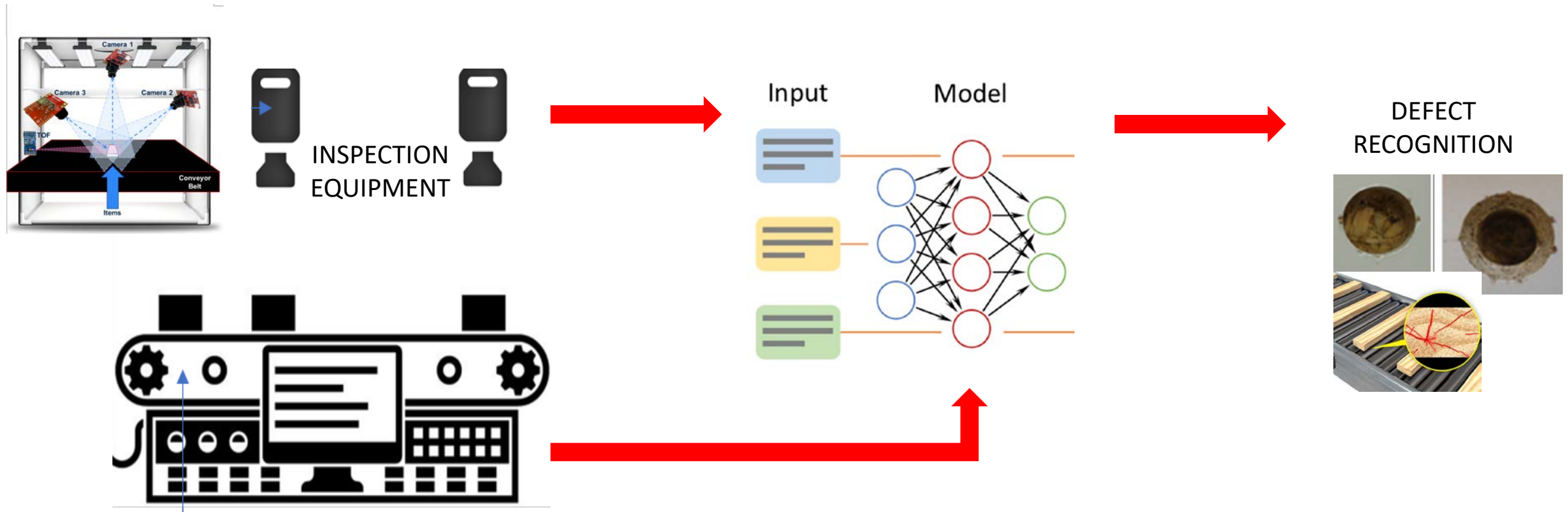


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Distributed AI for factory/building decisions



AI-based quality control for woodwork production process



- An AI based monitoring systems for quality control in production
- Distributed learning mechanism for continuous training

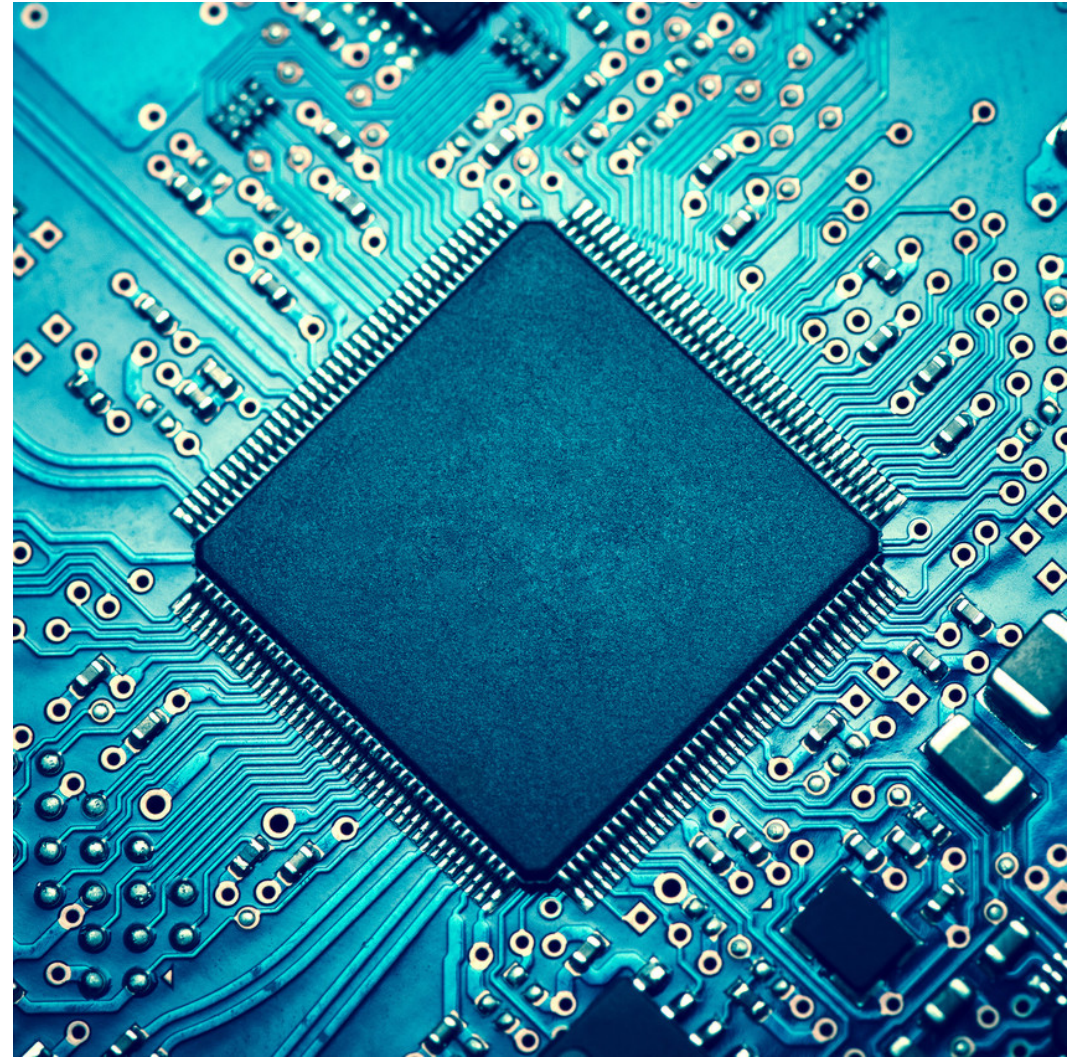
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Data analytics and AI for manufacturing excellence

- Industrialize manufacturing **Data & Analytics capabilities**
- Improve manufacturing **Quality** and **Yield**
- Improve **equipment (& People) productivity** and reduce **manufacturing cost**



Overall structure

Use Cases

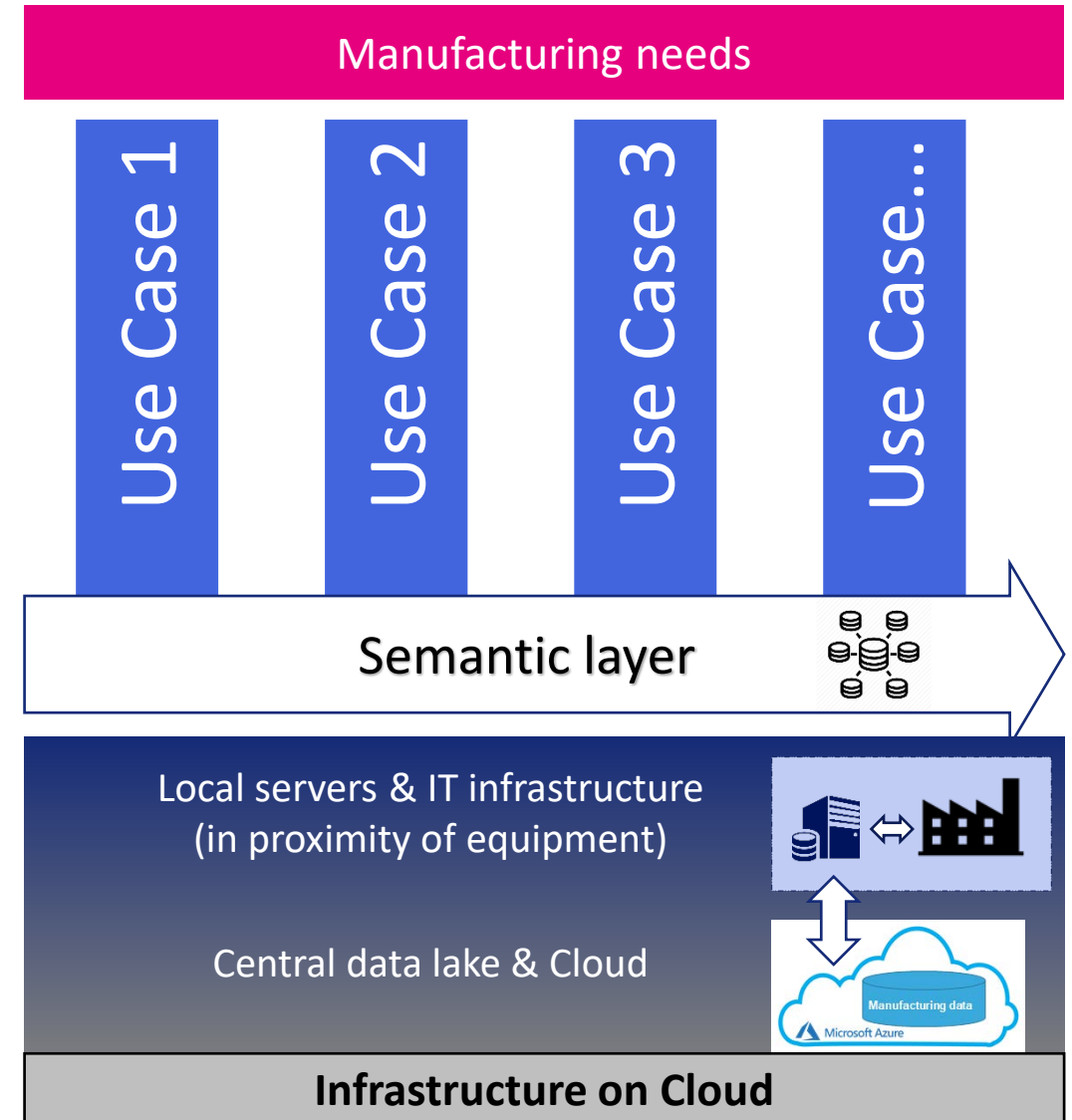
- Develop and deploy use cases
- Review with site experts

Semantic layer

- Provide access to data all over the manufacturing chain

IT infrastructure

- Cloud environment to host Manufacturing Data and local servers in each plant
- Central to exercise (train) and adjust (tune) models and tools



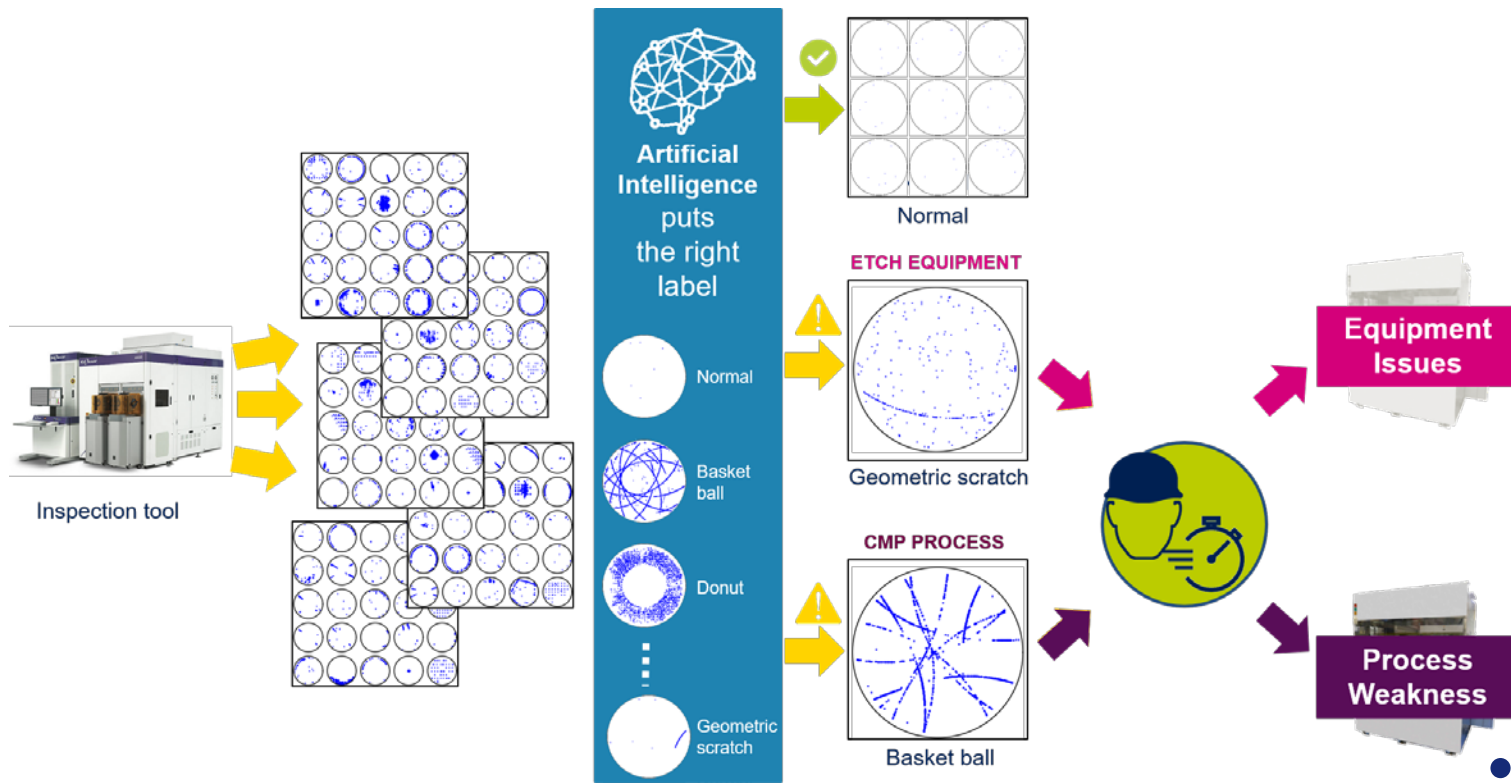
Semantic layer

Semantic

- Contextualize the data to activate interactions between various domains across the whole chain
- Common language, managed interactions
- **Cross sites/transportability** of Use Cases

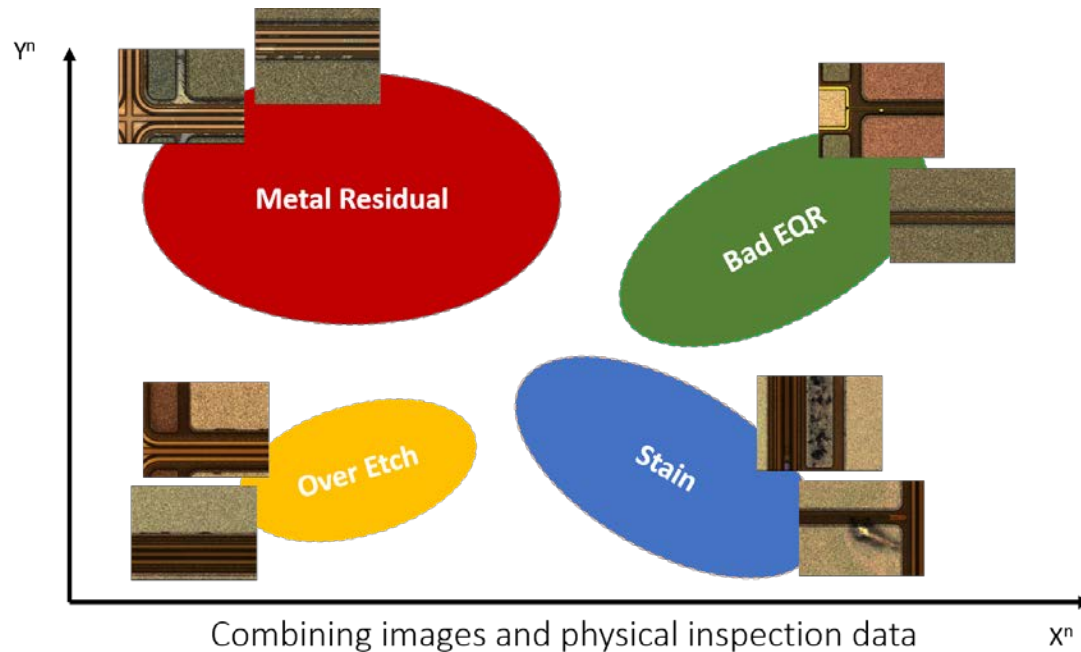


Use case: Automatic Wafer Classification (AWC)



- Solution to autonomously classify **defect patterns** on Wafer Defect Maps (WDMs) in real time.
- Artificial Intelligence (AI) technique:
 - Deep Learning (DL) algorithm
 - specific Convolutional Neural Network (CNN) tailored to handle WDMs
- Solutions integrated in a **quality inspection system**

Use case: Automatic Defect Classification (ADC)

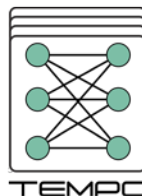


- Solution to autonomously **classify all defects** lying on the wafer in real time
- Artificial Intelligence (AI) technique: a Random Forest algorithm
- *Label to each defect, specifying whether it has impact on device performances or not*

Conclusions

- Advantages of the distributed approach (e.g. bandwidth, power consumption, privacy)
- Several application areas (e.g. winery, predictive maintenance) in IoT
- Support to manage complexity in semiconductor manufacturing (e.g. Automatic Wafer Classification, Automatic Defect Classification)

Event organisers



The Key Digital Technologies Joint Undertaking - the Public-Private Partnership for research, development and innovation – funds projects for assuring world-class expertise in these key enabling technologies, essential for Europe's competitive leadership in the era of the digital economy. KDT JU is the successor to the ECSEL JU programme. www.kdt-ju.europa.eu

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Thank You

For your attention

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