



life.augmented

Bringing AI to the Edge

Markus Mayr

Product Marketing Manager MCU/MPU/AI

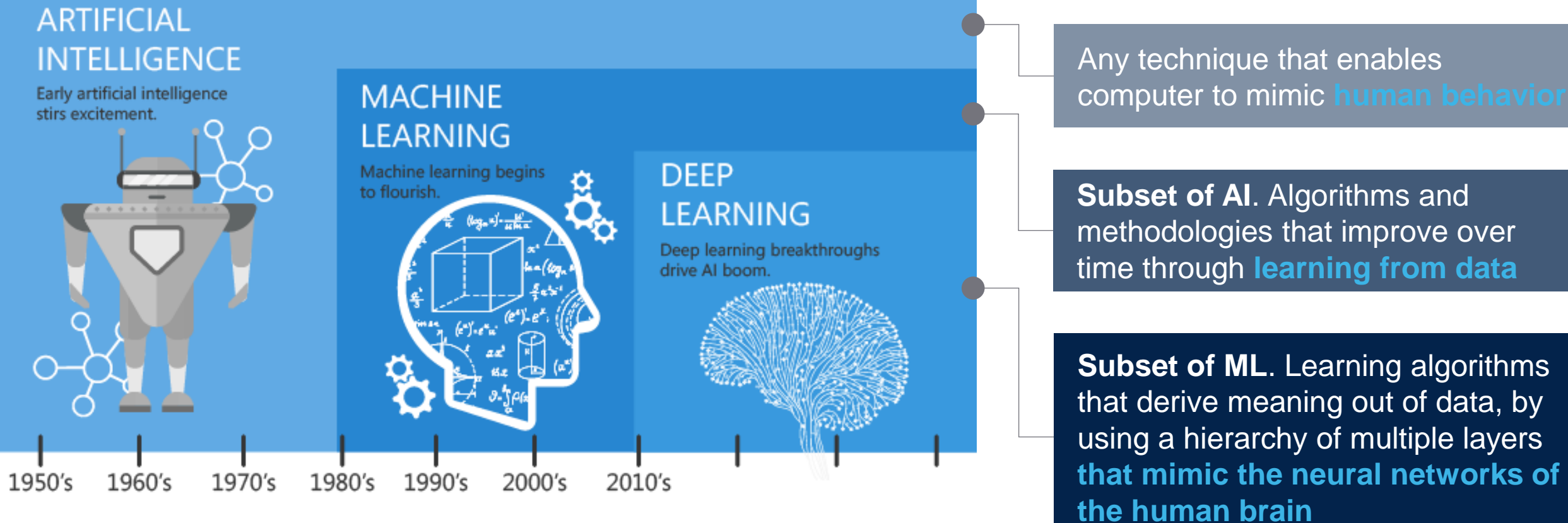
July 2020

STM32 
Cube.AI



What is AI?

AI Development Timeline and Some Definitions



AI Applications



Face/Voice recognition

Autonomous driving

Stock market trading strategy

Disease symptom detection

Predictive maintenance

Handwriting recognition

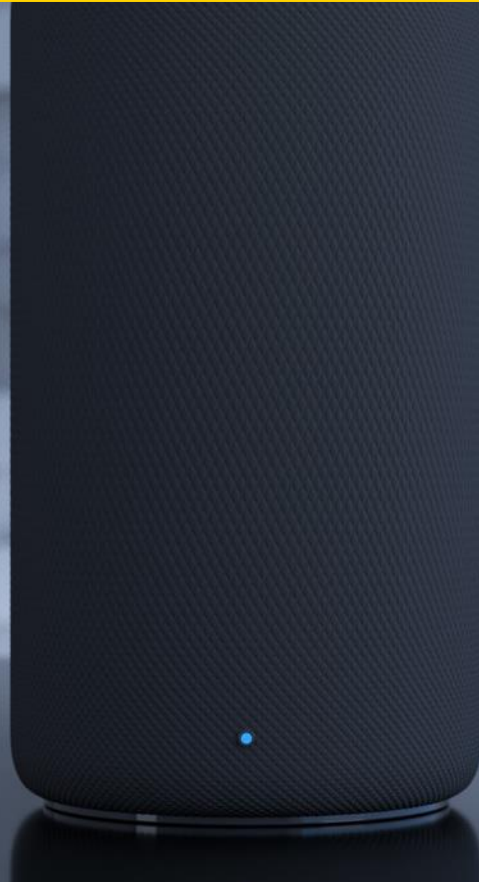
Content distribution

Fraud credit card transaction

Translation engines

Shopping suggestions

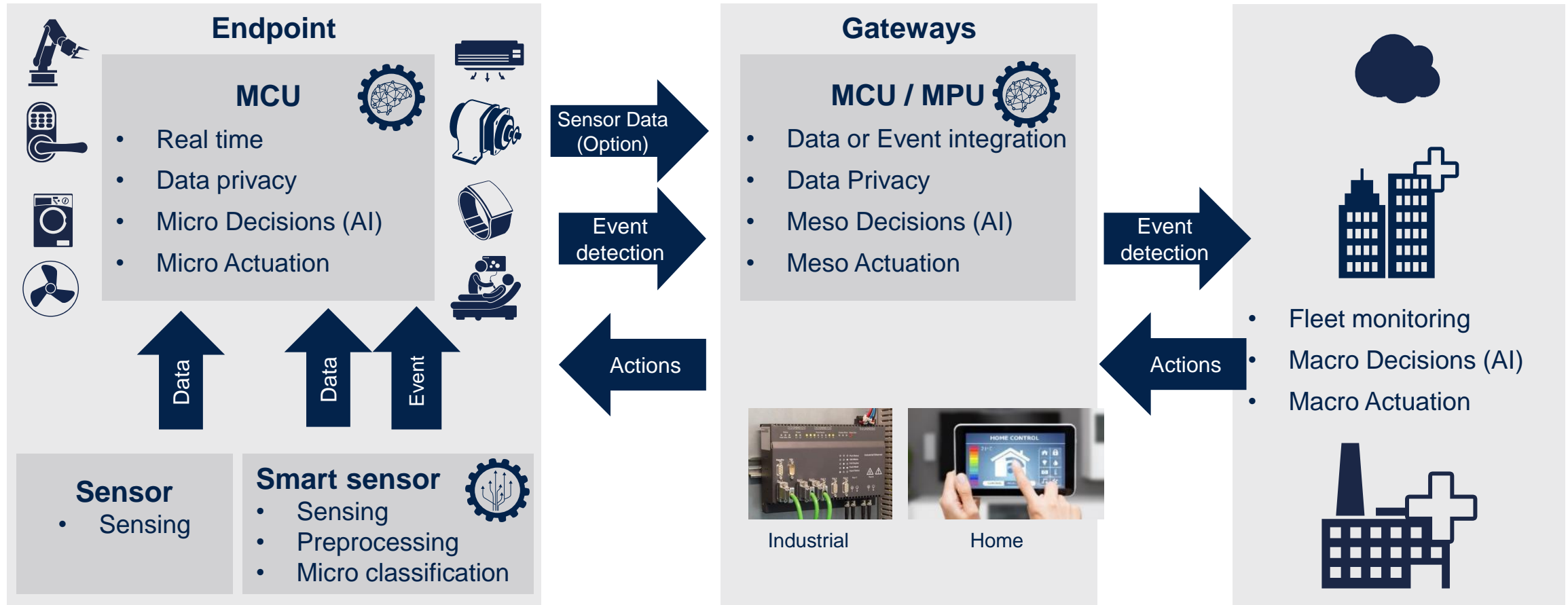
AI from the Cloud to the Edge



Distributed AI from Edge to Cloud

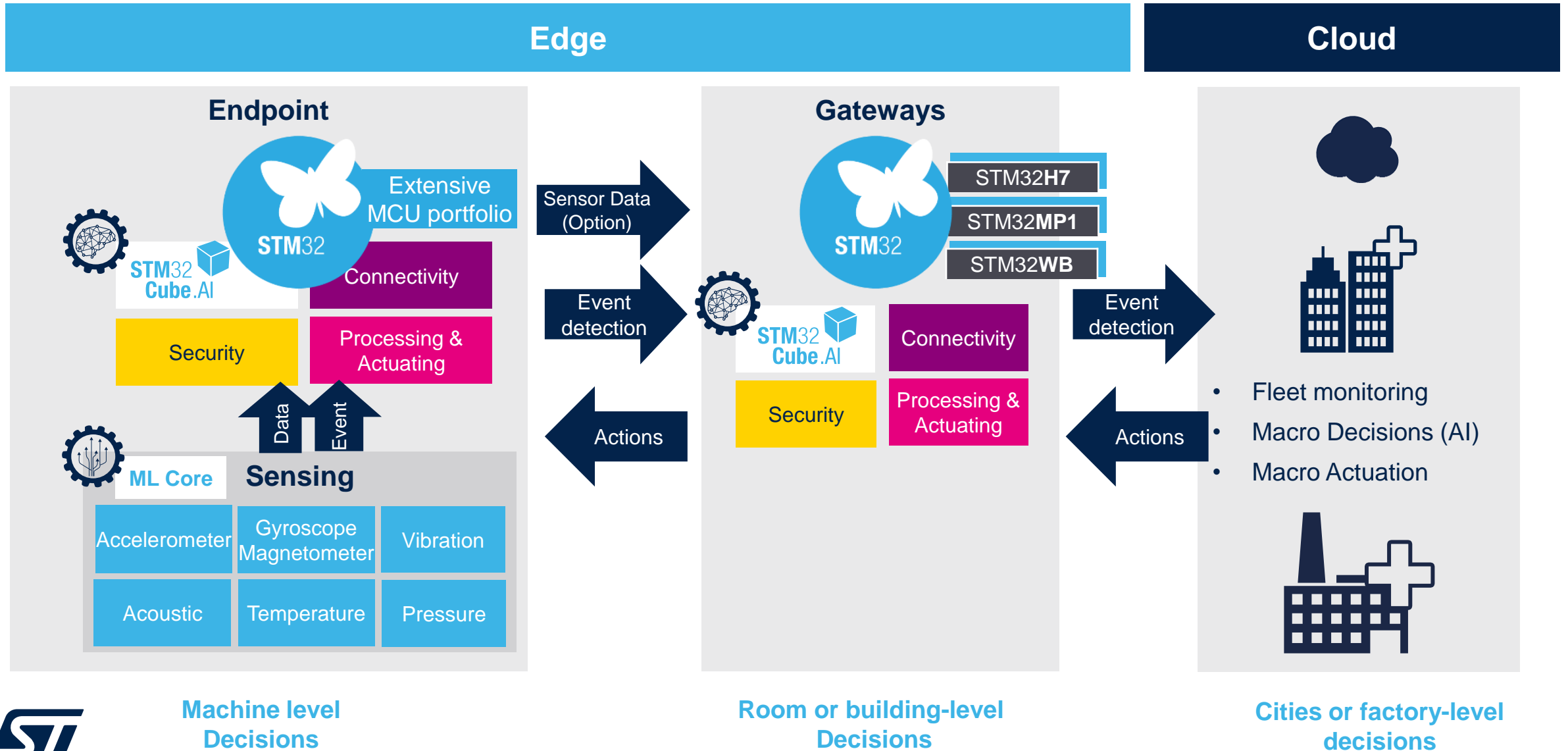
Edge

Cloud





Distributed AI from Edge to Cloud



Neural Networks on STM32

Simple, fast, optimized

STM32 
Cube.AI

The key steps behind Neural Networks



Neural Network (NN) Model Creation



Operating Mode

Capture data



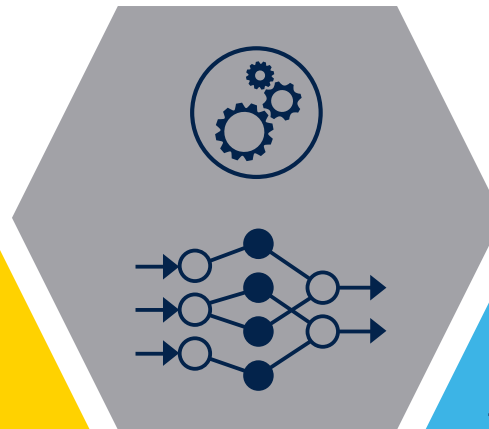
1

2



Clean, label data
Build NN topology

Train NN Model



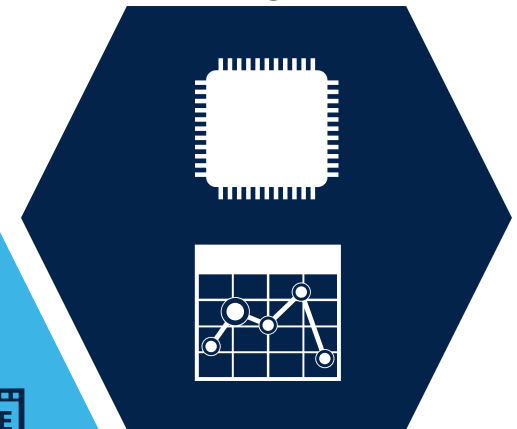
3

4



Convert NN into
optimized code for MCU

Process & analyze new
data using trained NN



5

STM32CubeMX extension AI conversion tool

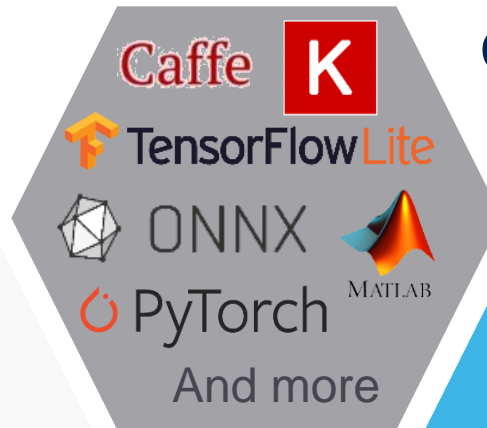
Input your framework-dependent, pre-trained Neural Network into the **STM32Cube.AI** conversion tool

Automatic and fast generation of an STM32-optimized library

STM32Cube.AI offers interoperability with state-of-the-art Deep Learning design frameworks

Any framework that can export models in **ONNX** open format can be imported

Train NN Model



Convert NN into optimized code for MCU



Process & analyze new data using trained NN

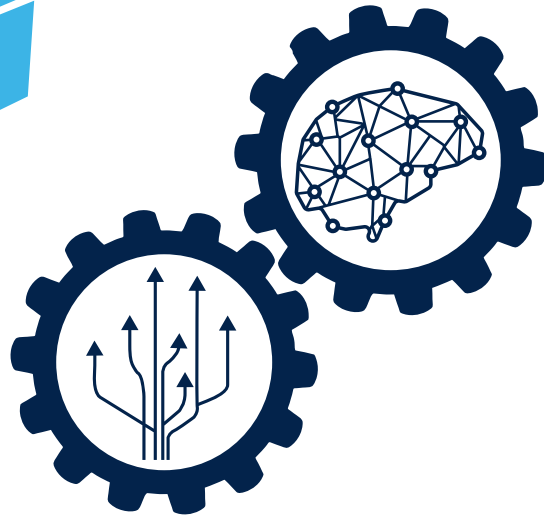


STM32 solutions for AI

More than just the STM32Cube.AI

An extensive toolbox to support easy creation of your AI application

STM32
Cube.AI



- 4 AI extension for STM32CubeMX to map **pre-trained Neural Networks**



1 2

Software examples for Quick prototyping Audio, Motion and Vision Function packs On **ST development Hardware**



1 2 3 4

STM32 **Community** with dedicated Neural Networks topic



1 2 3 4

Trainings, hands on, MOOCs and partners **videos**



1 2 3 4

STM32 AI Partner Program with dedicated Partners providing **Machine or Deep Learning engineering services**



ST AI-authorized Partners

ST life.augmented

Products ▾ Search... Search

Contact Us English ▾

Products Applications Solutions Tools & Software About ST Sample & Buy Support & Community Login

STM32 solutions for Artificial Neural Networks

Overview 5 Steps to AI Resources Featured Content Webinars

Resources

- Function Pack
- Videos
- Wiki
- STM32 MCU Wiki
- Dev Kit
- Mobile App
- Community
- Find a Partner
- Presentation

Find a partner

Products and Services

- ☐ Cloud
- ☐ Embedded Software
- ☐ Software Dev Tools
- ☐ Components & Modules
- ☐ Engineering Services
- ☐ Training
- ☐ Hardware Dev Tools

STM32CubeAI

Country of operation ▾

RESET

Partner Search

Total results:

20 ▾ partners per page



Bluewind

Bluewind, an independent engineering company, provides innovative product design solutions in the fields of Electronics, Energy Efficiency, and Connected Devices. The R&D task force consists of 20+ experienced engineers... [Show more >](#)



Cartesiam

Cartesiam is an expert in Artificial Intelligence at the Edge. We are an ISV expert in mathematics, AI and signal processing on microcontrollers. Cartesiam, invented NanoEdge™, a revolutionary technology enabling Machin... [Show more >](#)



Imagimob

Imagimob is a global leader in artificial intelligence products for STM32. Based in Stockholm, Sweden, the company has been serving customers within the automotive, manufacturing, healthcare and lifestyle industries sin... [Show more >](#)



inventhys

Inventhys is a fast-growing, end-to-end IoT development services company. Our engineers design hardware, embedded

Boards & Function Packs

Simple, fast, optimized

STM32 
Cube.AI

STM32 AI examples and reference designs

Audio scene classification (ASC)



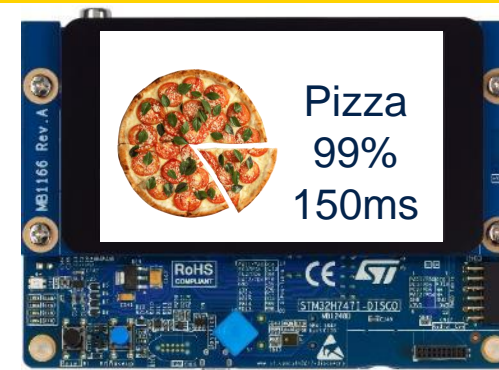
Audio example in FP-AI-SENSING1 package

Human activity recognition (HAR)



Motion example in FP-AI-SENSING1 package

Food Recognition



Vision example in FP-AI-VISION1 package

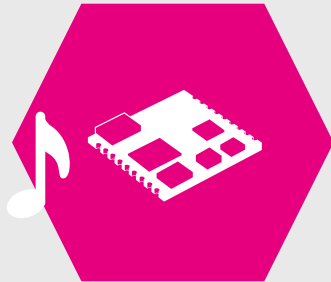
Image Classification & Object Detection



Computer Vision Application in X-LINUX-AI-CV Package for STM32MP1

Audio scene classification (ASC)

Audio example in FP-AI-SENSING1 package



Audio Data capture



Labelling controlled
by smartphone application

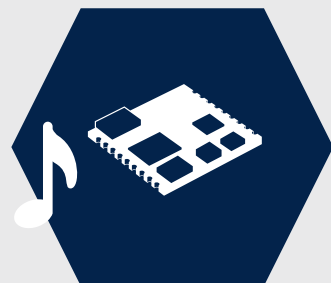


Data stored on the device
SD card for future learning

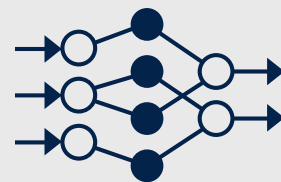


3 classes

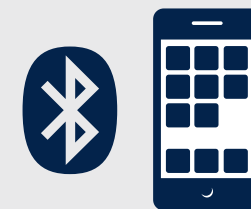
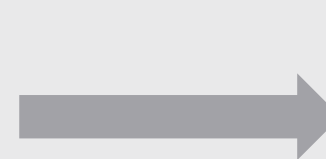
Indoor, Outdoor, In-vehicle
labelling



Embedded audio
pre-processing



NN & example
dataset provided

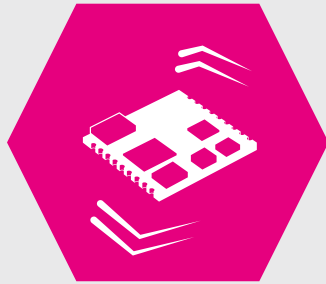


Inference result
displayed on mobile app





Human activity recognition (HAR) Motion example in FP-AI-SENSING1 package



Motion Data Capture



Labelling controlled
by smartphone application

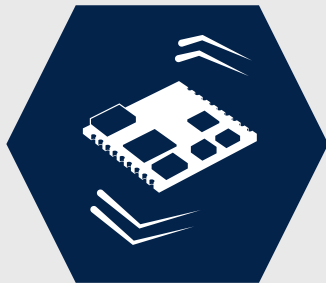


Data stored on the device
SD card for future **learning**

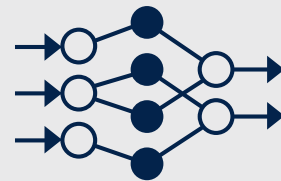


Examples of 5 classes

Stationary, walking, running,
biking, driving **labelling**

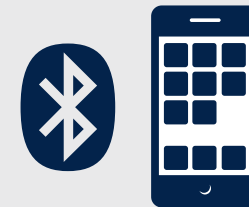


Embedded motion
pre-processing



NN & example
dataset provided

Inferences running
on the microcontroller



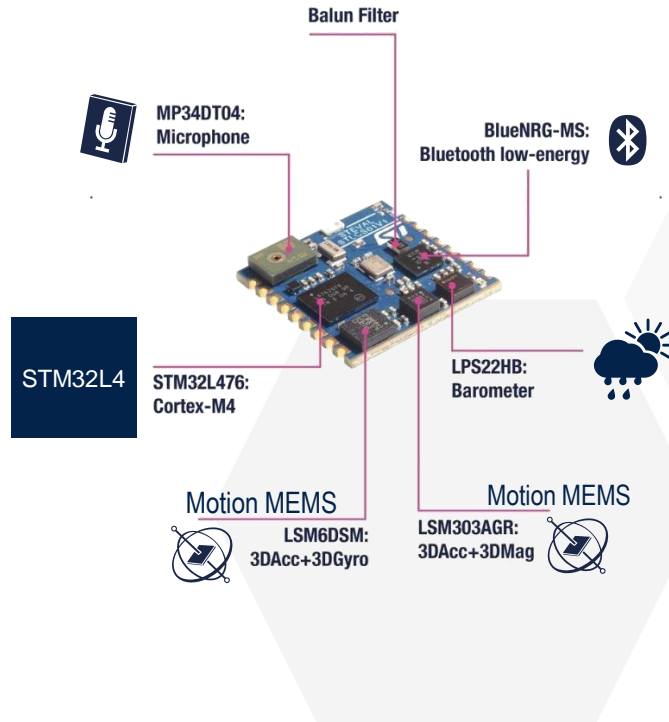
Inference result
displayed on mobile app



Example form-factor hardware to capture and process data

SensorTile

Capture data

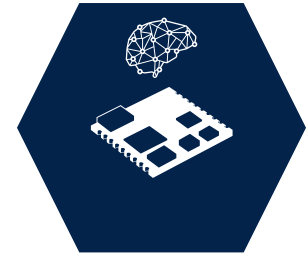


SensorTile.Box



Microsoft IoT
Services ready
Microsoft
Azure

Process & analyze
new data using
trained NN



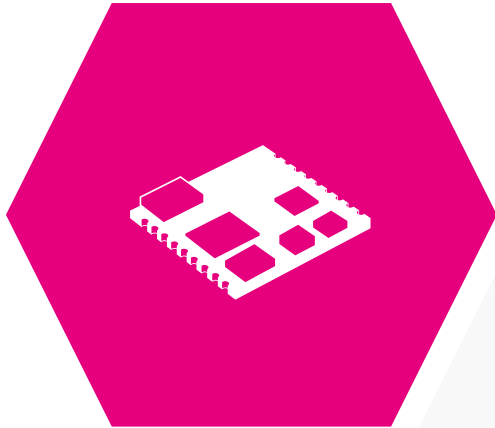
More advanced, high-accuracy and low-power sensors

- First Inertial module with Machine Learning capabilities.
- Motion (accelerometer and gyroscope, magnetometer) and slow motion (inclinometer)
- Altitude (pressure), environment (pressure, temperature, humidity, compass) and sound (sound and ultrasound analog microphone)
- Microsoft IoT services ready to make available on a web dashboard the result of the embedded processing

Form factor hardware AI IoT node for more connectivity

IoTNode

Capture data



+



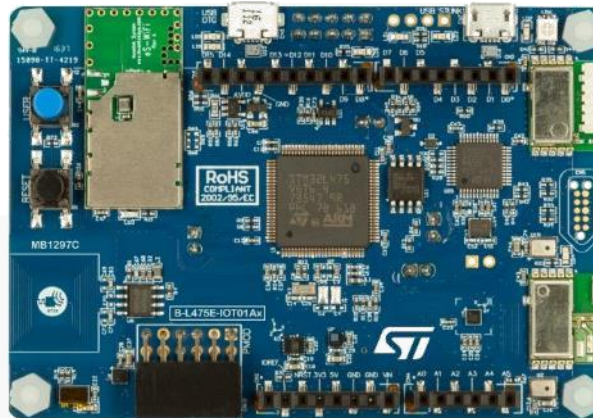
Sub-1GHz



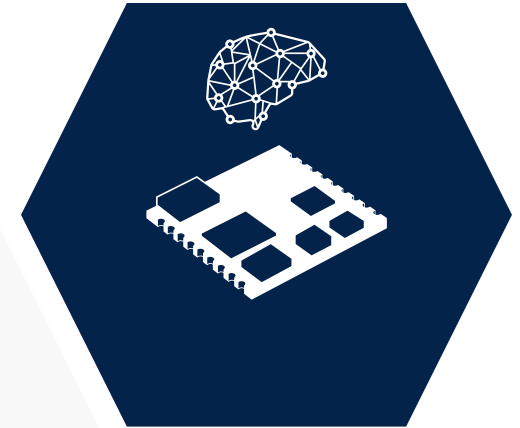
Dynamic NFC Tag



Wi-Fi



Process & analyze new
data using trained NN



More debug capabilities

- Integrated ST-Link/V2.1
- PMOD extension connector
- Arduino Uno extension connectors

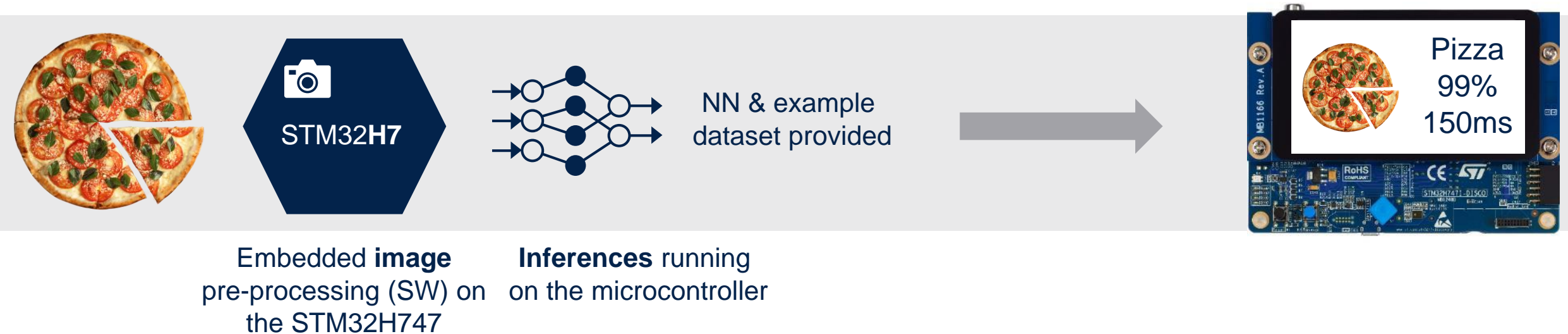
Image classification Vision example in FP-AI-VISION1 package

Enjoy the food classification demo

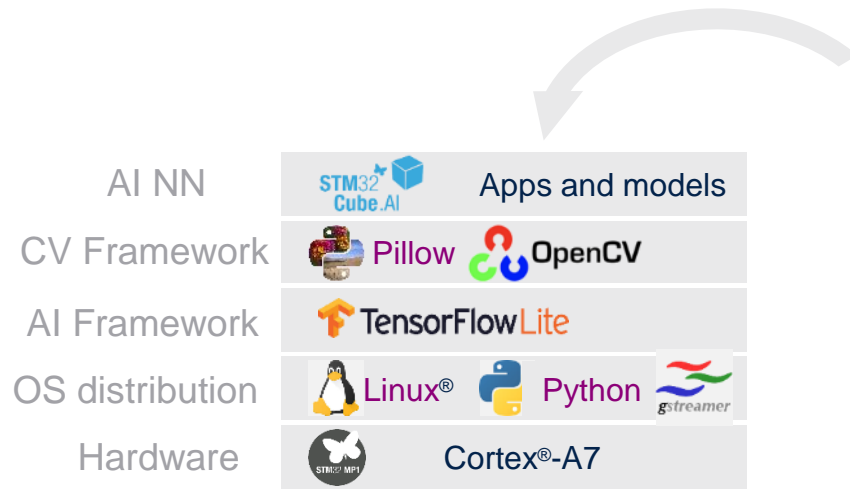
- Default demo based on 18 classes (224x224 RGB pictures)
- Several camera image output size possible

Full end-to-end optimized software example

- from camera acquisition to image pre-processing before feeding the NN
- Multiple memory mapping possibilities to optimize and test impact on performances
- Retrain this NN with your own dataset
- Quantize your trained network to optimized inference time and memory usage



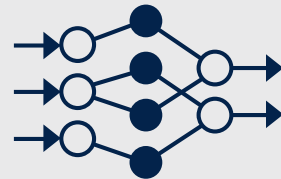
X-LINUX-AI-CV Package for STM32MP1 Computer-Vision Application



Application examples in C/C++ and Python

- Image classification: 1000 objects classified
- Multiple object detection: 90 classes

Includes code for camera acquisition and image pre-processing



AI, CV frameworks
& application
examples provided



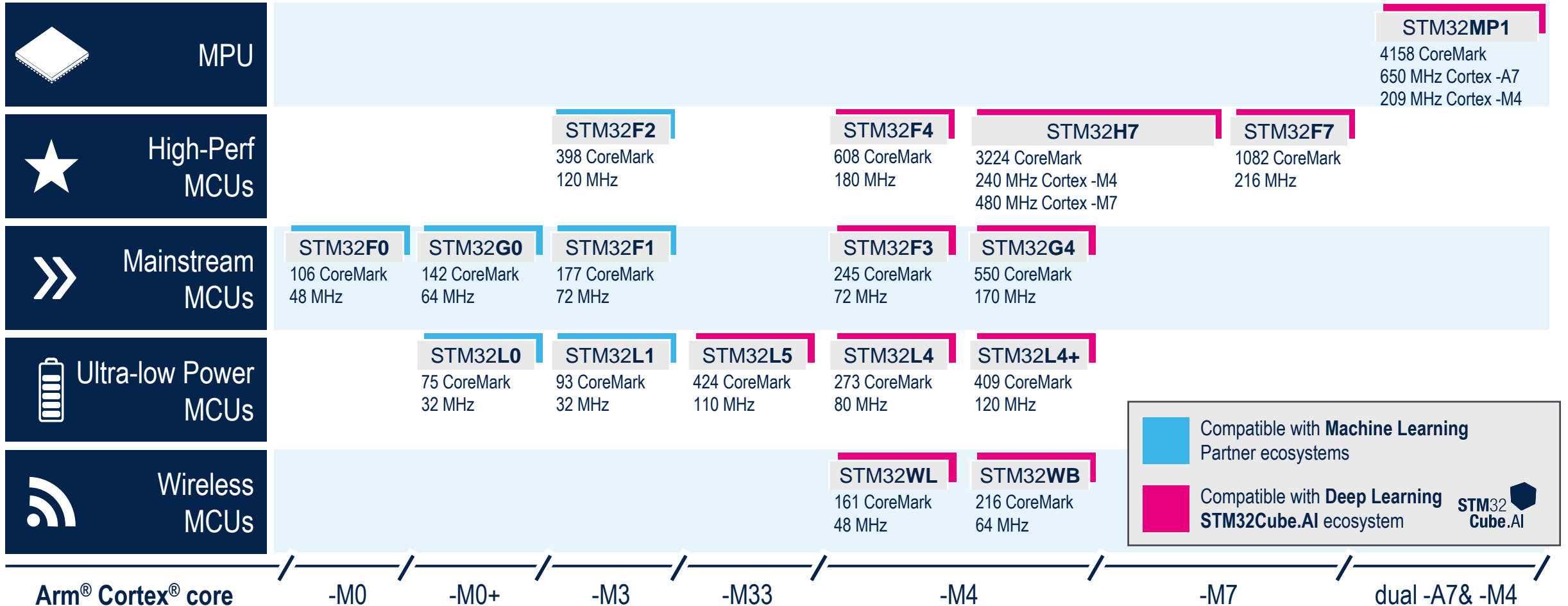
USB camera or
built-in camera
module

Inferences running on the
microprocessor in 80ms
for image classification

Displayed on STM32MP1-DK2,
STM32MP1-EV1 or Avenger96 board

Making AI Accessible Now

Leader in Arm® Cortex®-M 32-bit General Purpose MCUs



For more information



www.st.com/STM32CubeAI



Thank you

© STMicroelectronics - All rights reserved.

ST logo is a trademark or a registered trademark of STMicroelectronics International NV or its affiliates in the EU and/or other countries.

For additional information about ST trademarks, please refer to www.st.com/trademarks.

All other product or service names are the property of their respective owners.



life.augmented