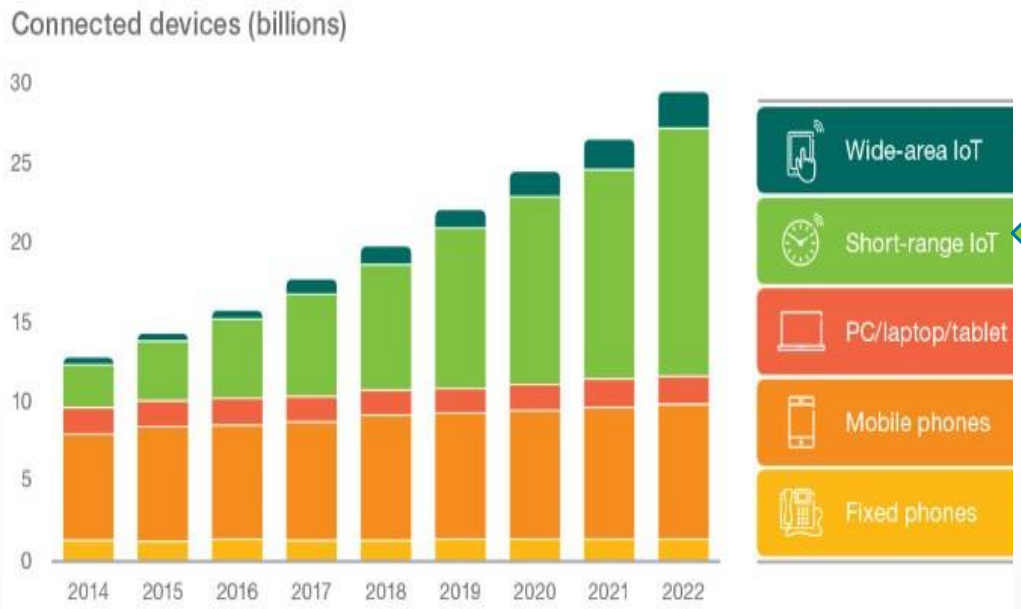
Enabling AI on Low Power Endpoint Devices

Tim Saxe

Growth in resource constrained devices

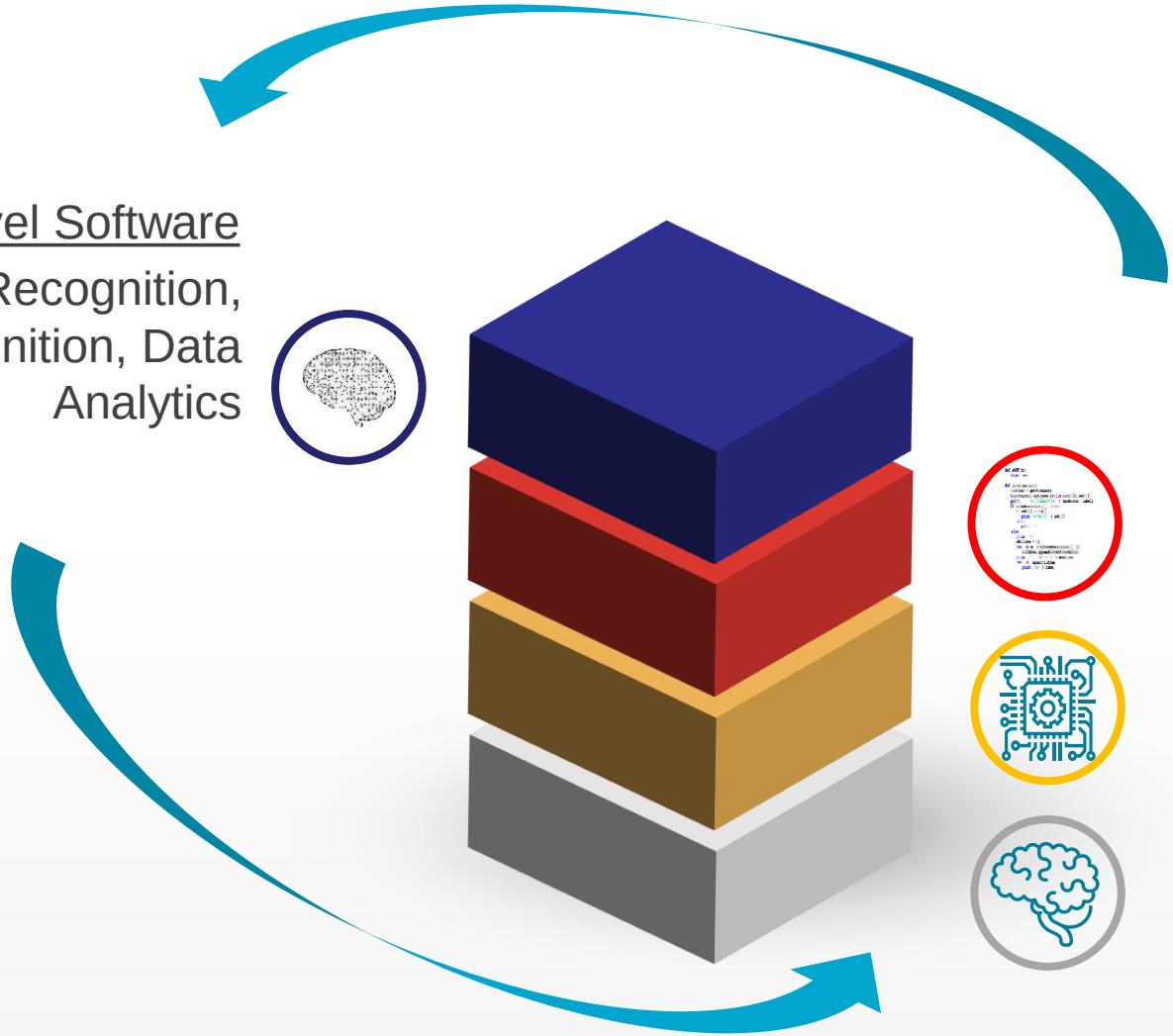


"Within the wide-area IoT segment, two distinct sub-segments with different requirements have emerged: massive and critical applications.

Massive IoT connections are characterized by high connection volumes and small data traffic volumes, low cost devices and low energy consumption."

https://www.ericsson.com/en/mobility-report/internet-of-things-forecast

Silicon is Necessary but not Sufficient: Need Full-Stack



High-Level Software

Speech Recognition, Image Recognition, Data Analytics

System Software

Embedded SW, HAL

SoC

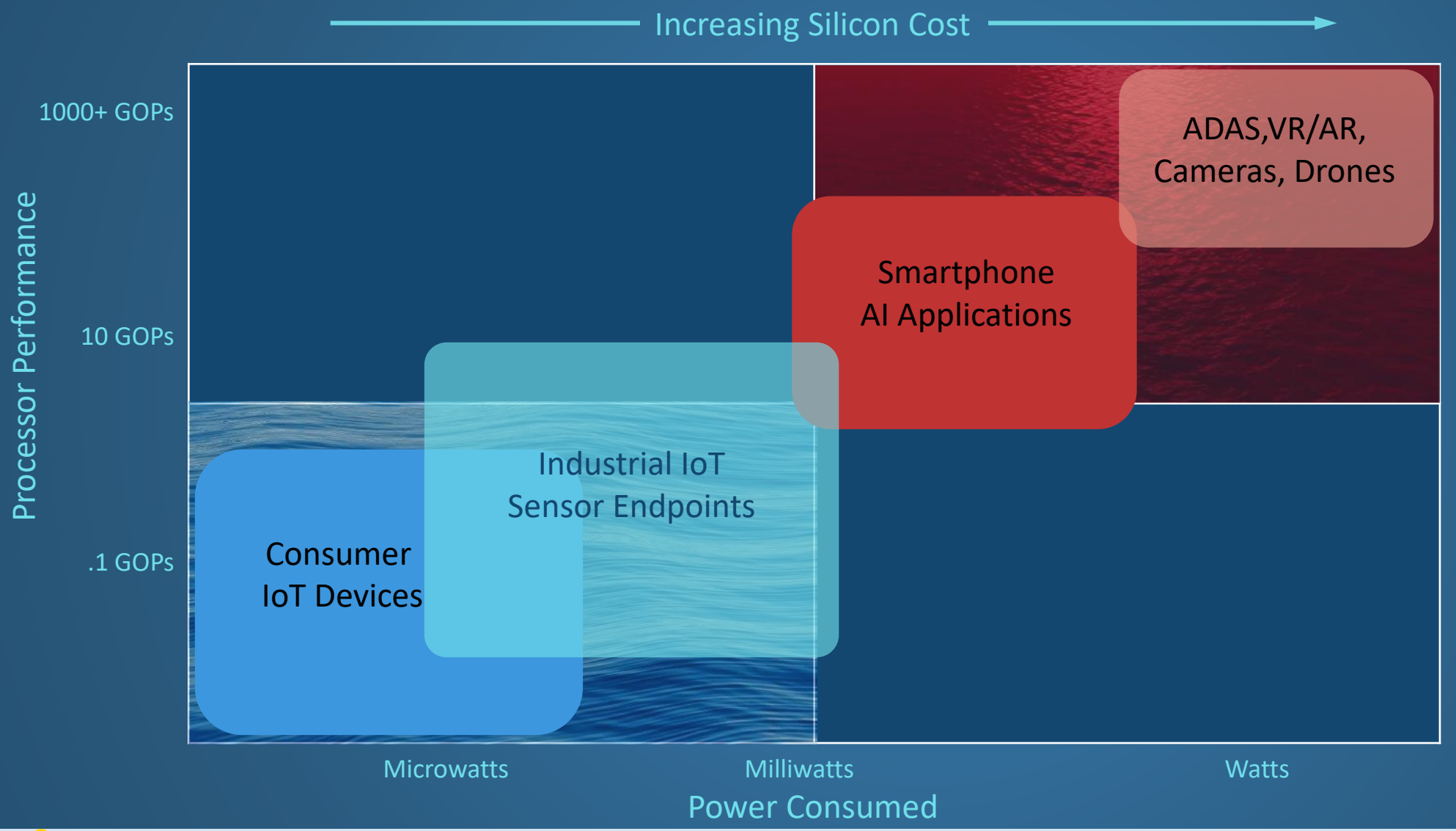
Processor cores and peripherals

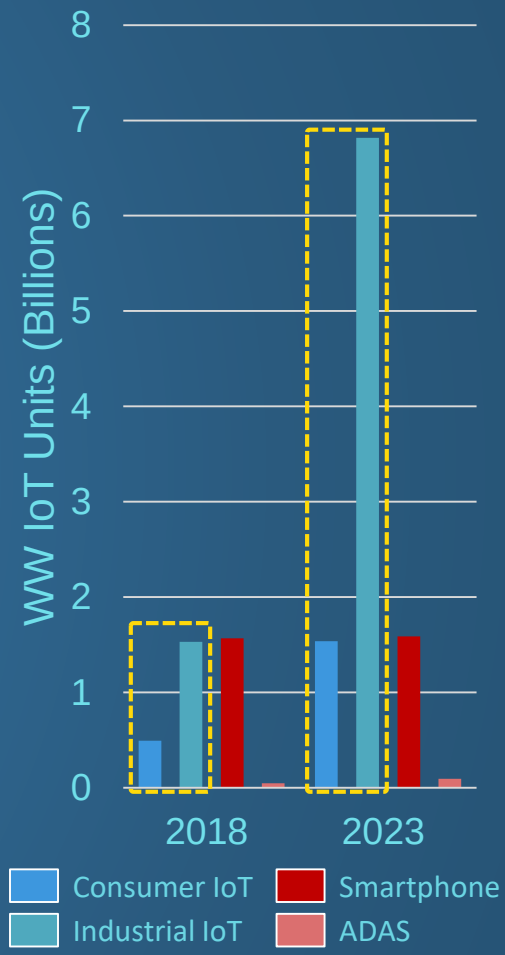
Programmable H/W IP

Neural Networks, eFPGA


SensiML™
MAKING SENSOR DATA SENSIBLE
Further Democratizing IoT

Endpoint and Edge AI: Platform Segments

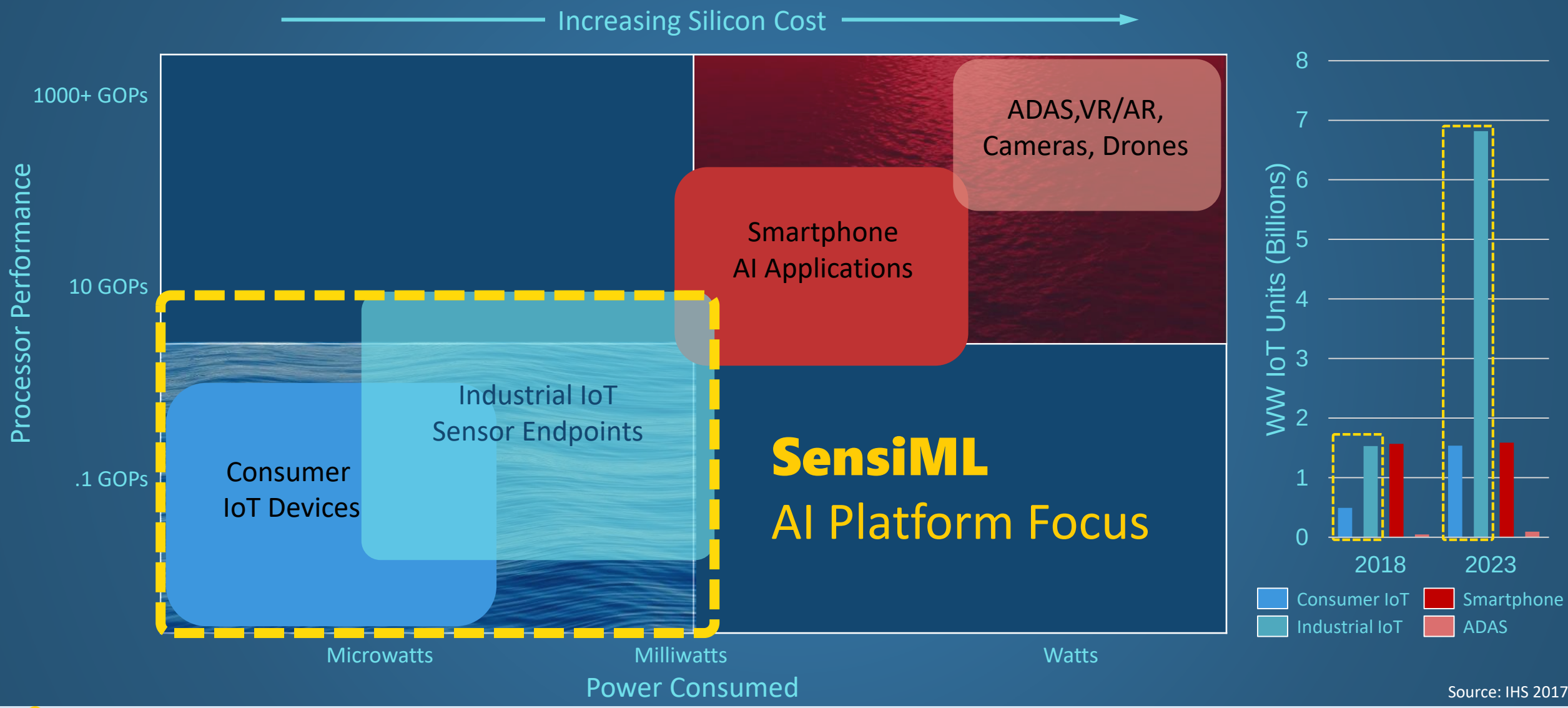




Source: IHS 2017

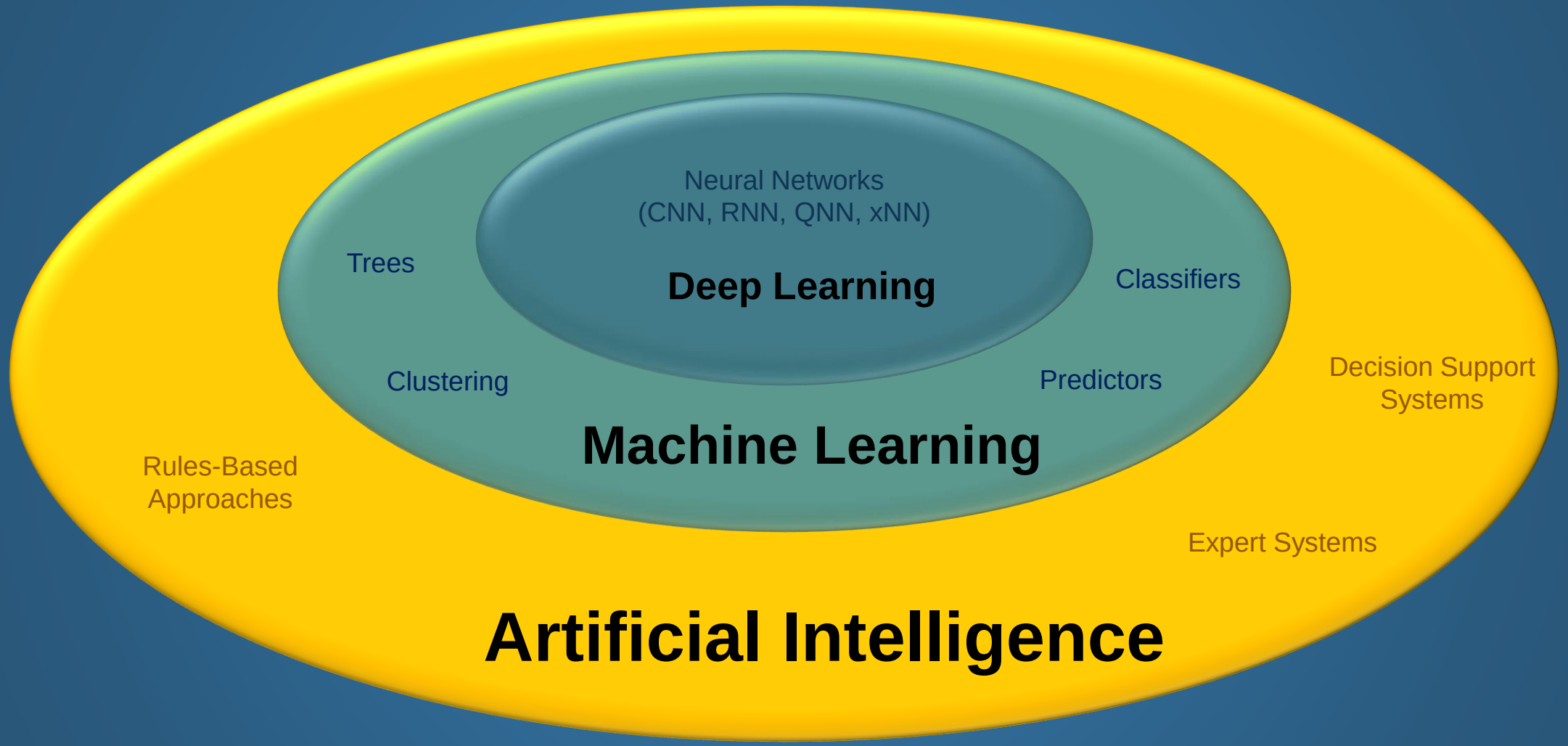
SensiML™

Endpoint and Edge AI: Platform Segments

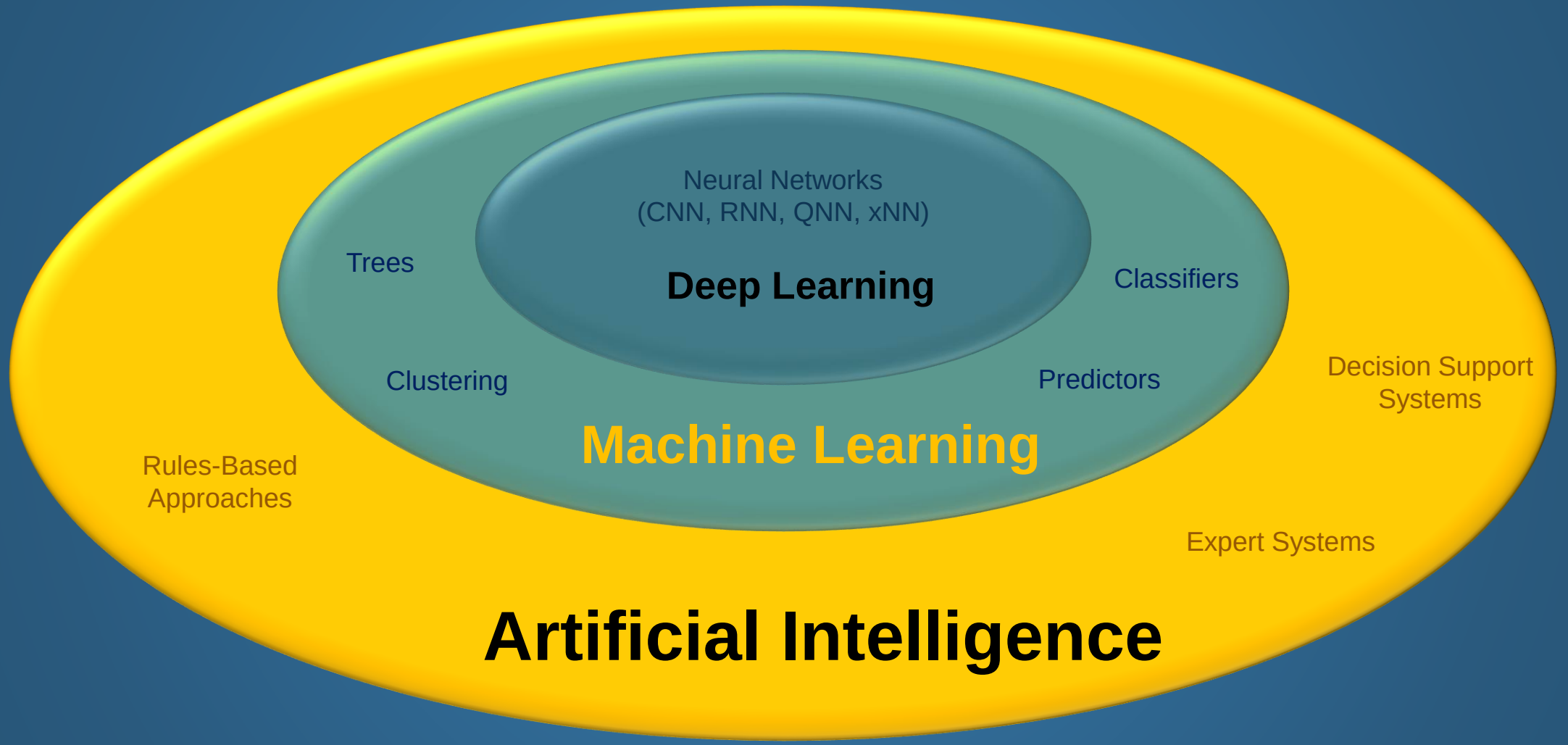


Source: IHS 2017

A High-Level Taxonomy of AI



A High-Level Taxonomy of AI



Which AI method best fits the application?

Tiny ML

Time Series Sensor Data

Feature Selection

$f_1(x)$

$f_2(x)$

$f_3(x)$

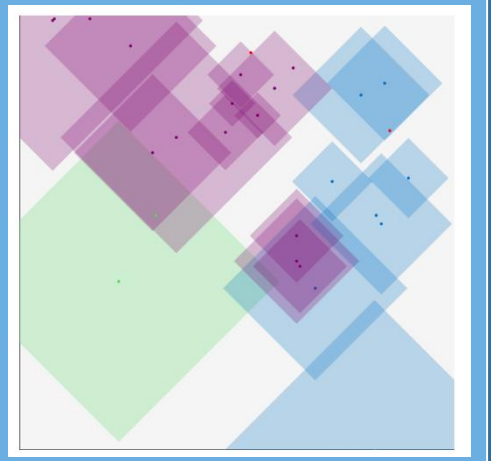
.

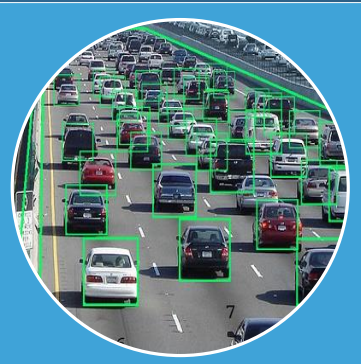
.

.

$f_n(x)$

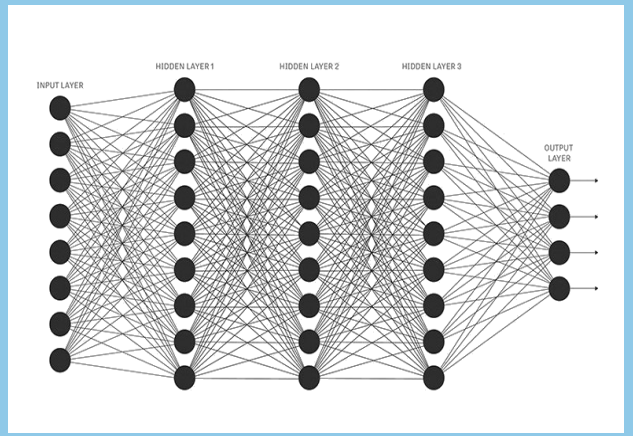
ML Classifier
(kNN, RBF)





Computer Vision

Neural Networks
(xNN)



SensiML™

What resources are available?

Data Science

28k Data Scientists

182k w/ Data Science Skills

versus

Software Development

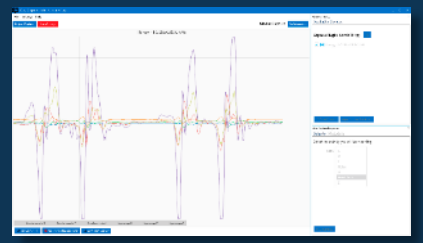
1,625k Developers

SensiML™

Source: US Bureau of Labor Statistics (www.bls.gov)

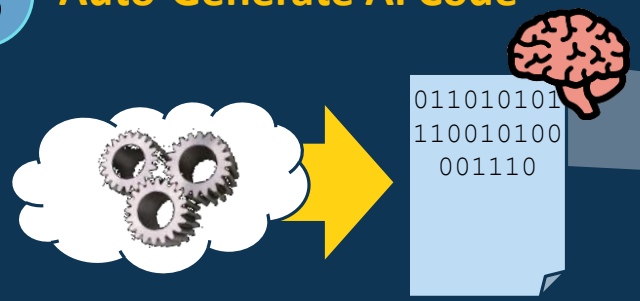
SensiML Makes Building Intelligent Endpoints Practical

1 Collect / Import Sensor Data

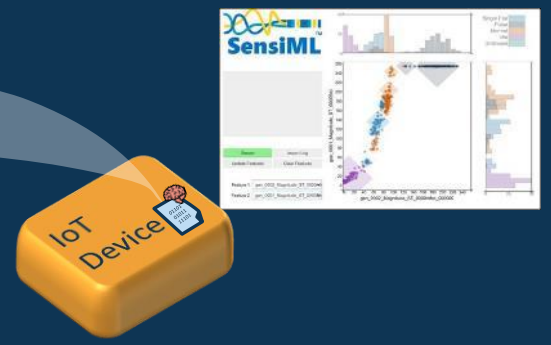


2 Choose Preferred Processor

3 Auto-Generate AI Code



4 Flash to Device and Test



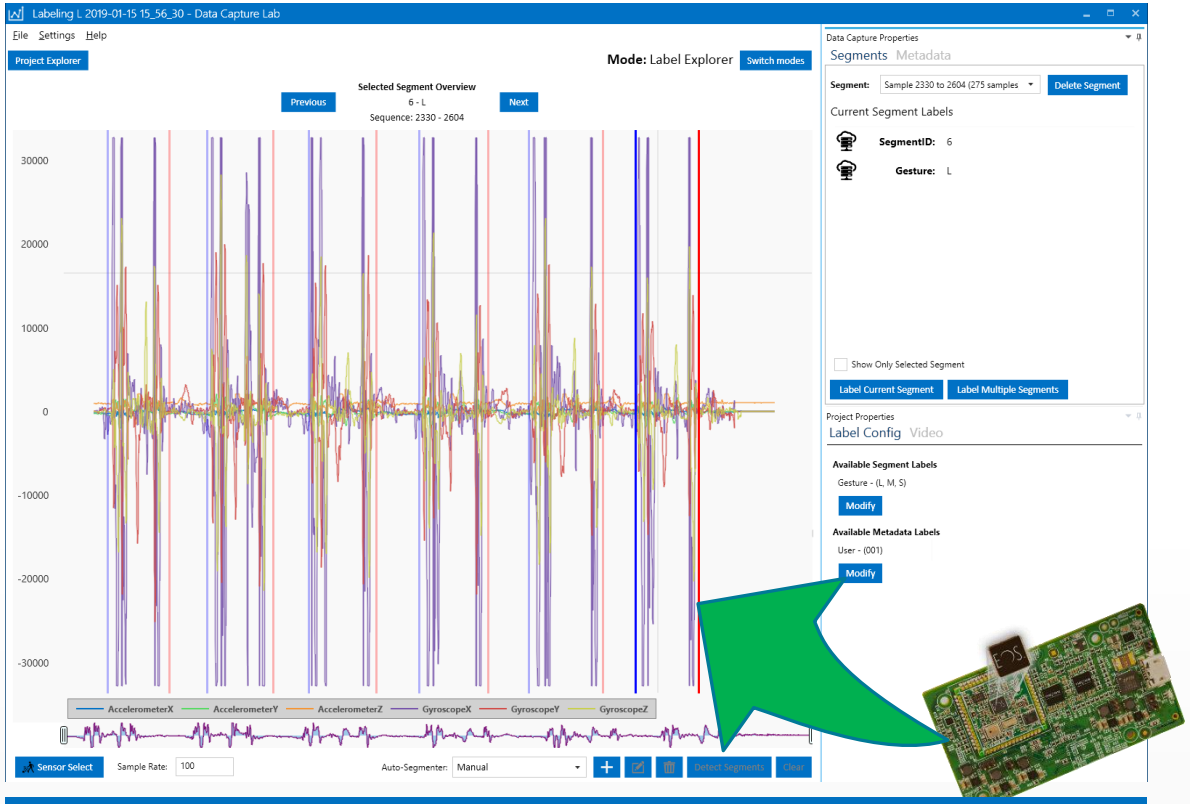
Democratizing the application of AI to Millions of Software Developers and Billions of Endpoint IoT Devices

SensiML™

Solution lies in open standards and automation

Foundation of AI is quality data

- SensiML Data Capture Lab
  - Open interface to control data acquisition
  - Open interface to collect data
  - Open source data warehouse to share data
  - Powerful tool for data set management
  - Powerful computer assisted labelling
    - Minimize the drudgery
    - Maximize the insights

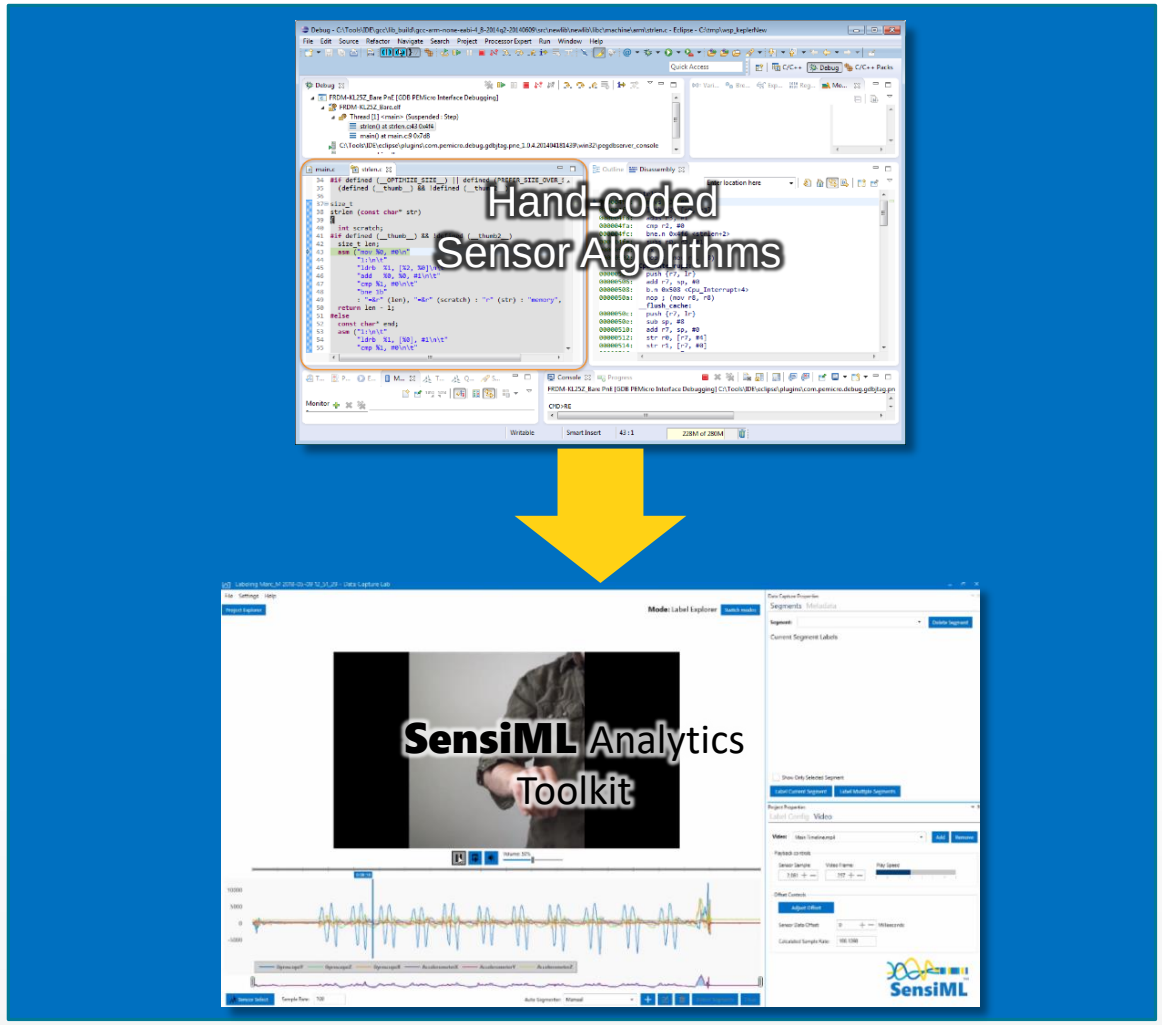


Encompasses 4Cs of Labeling Training Data:
Collection, Cleansing, Collaboration, Curation

…and more automation

Purpose of AI is classification

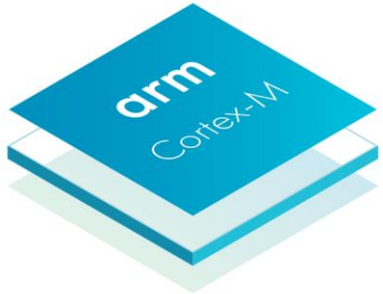
- SensiML Analytic Toolkit
  - Understands the resource limitations of the target device
  - Explores feature extraction/classification algorithm tradeoffs
    - Over 100 feature extractors – optimized for resource constrained devices
    - Multiple algorithms from classical ML to Neural Nets
    - Open interface allows 3rd party additions
  - Eliminates the need for hand-coded algorithms
    - Speeds PoC – days, not weeks
    - Speeds development – weeks, not months



Supported Platforms

QuickLogic - QuickAI Accelerated AI Platforms

ST - STM32 & SensorTile Development Kit



ARM Cortex-M Series Processors

Nordic Semiconductor - nRF52 & Nordic Thingy IoT Sensor Kit

Raspberry Pi 3/3Bs

Arnold Testbed – PULPissimo + eFPGA

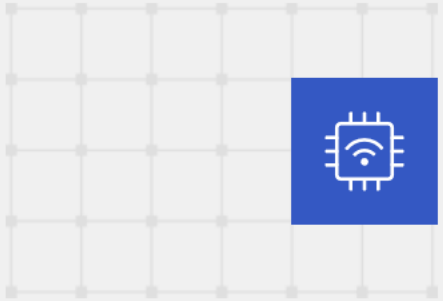
SiFive

Freedom Aware (coming soon)

Templates

Freedom Aware

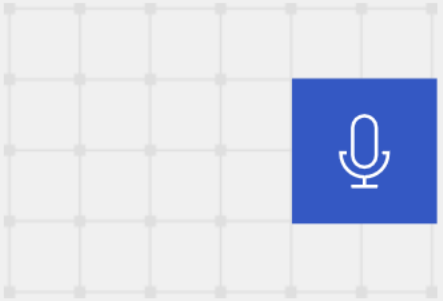
Ultra-low power solutions optimized for consumer and industrial IoT applications.



MCU for IoT

Designed for embedded IoTs, microcontrollers, wearables and more

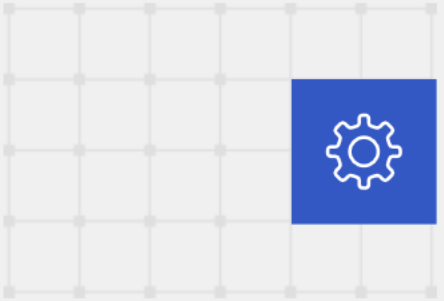
Learn More



Always-On Voice Processor

Optimized for smart devices and more

Learn More



Predictive Maintenance 4.0

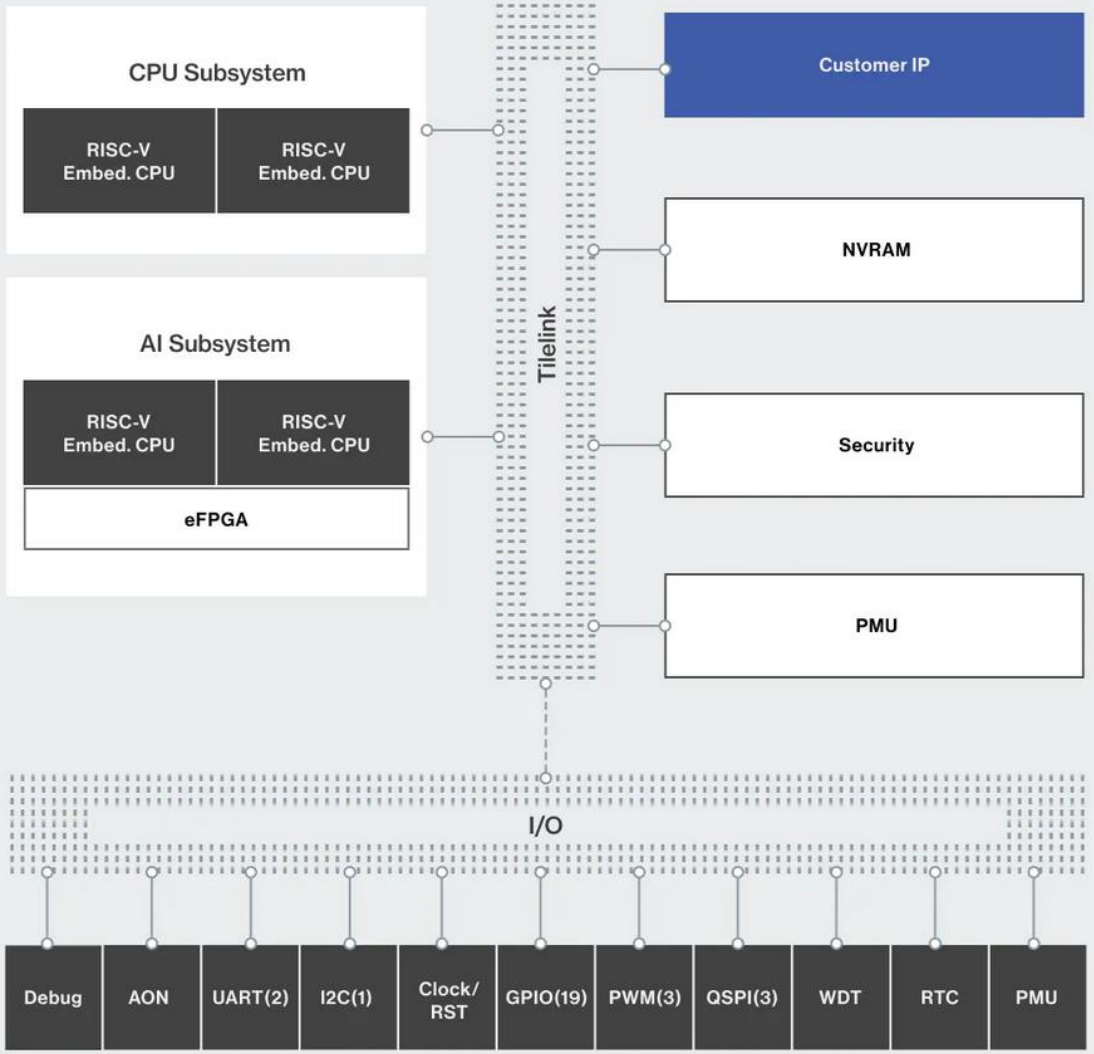
Designed to support digital and analog sensors

Learn More

Predictive Maintenance 4.0

Template key

- SiFive IP
- Customer IP
- Partner IP



Predictive Maintenance 4.0

Template key

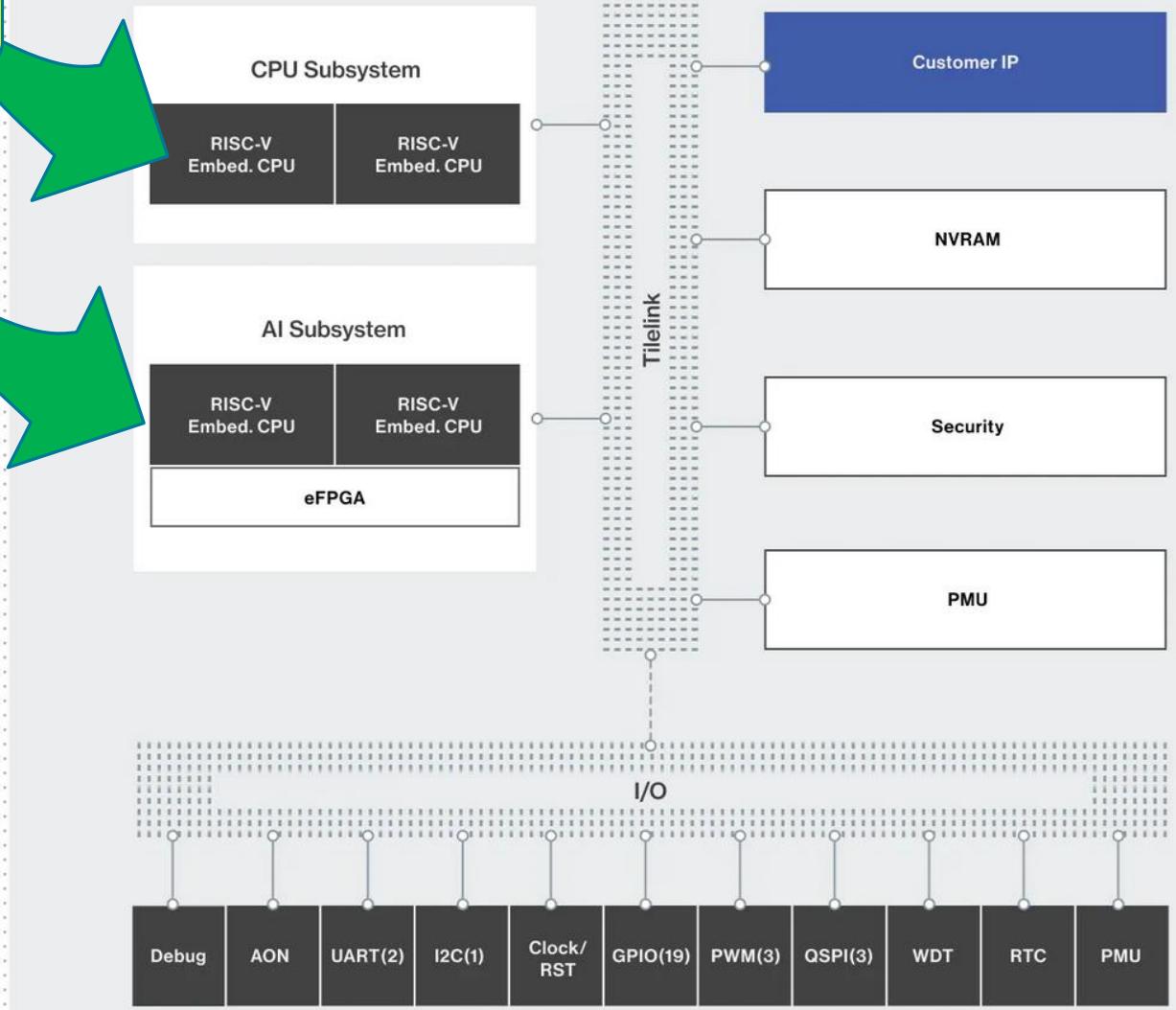
SiFive IP

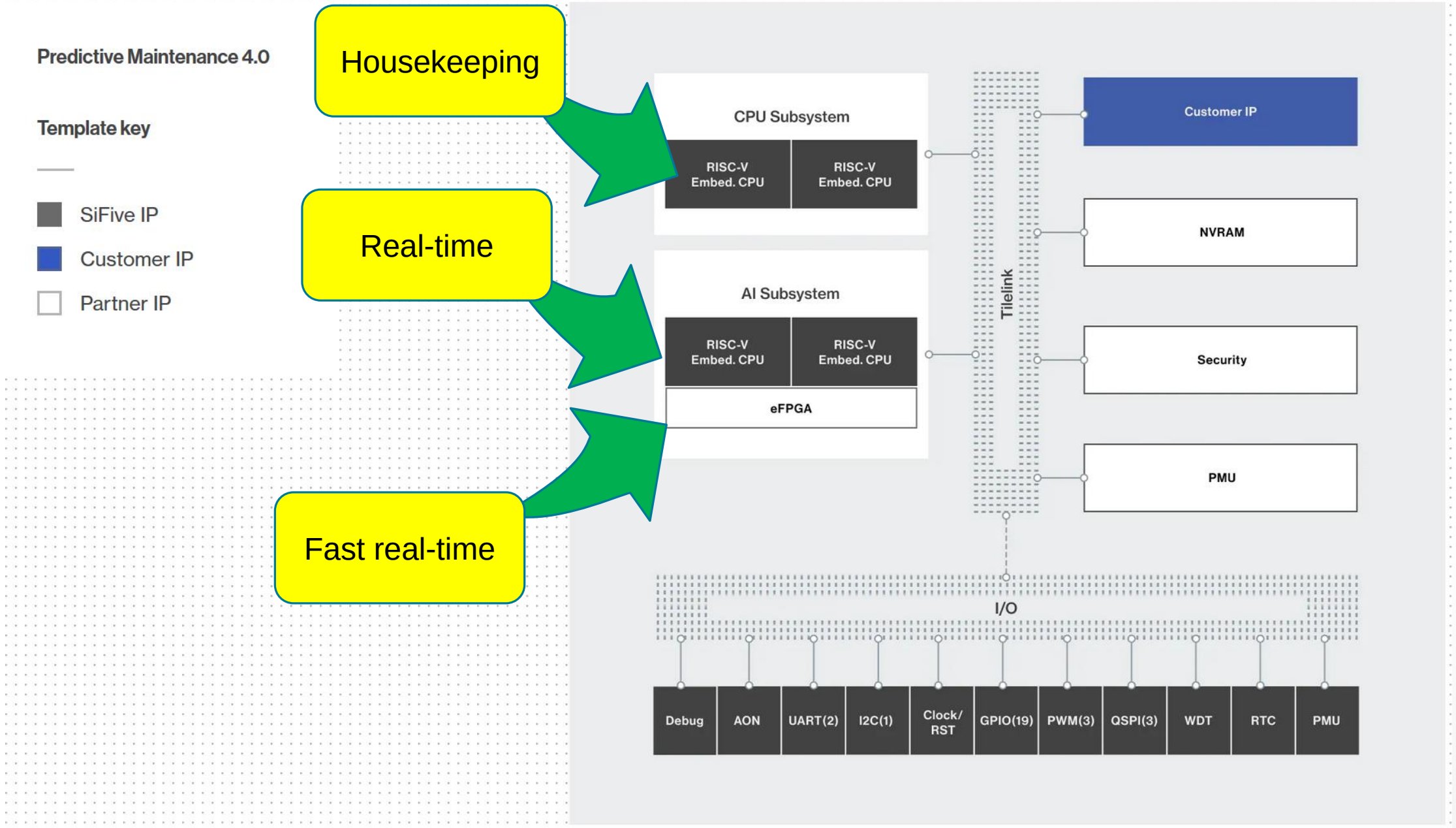
Customer IP

Partner IP

Housekeeping

Real-time





Thank you!