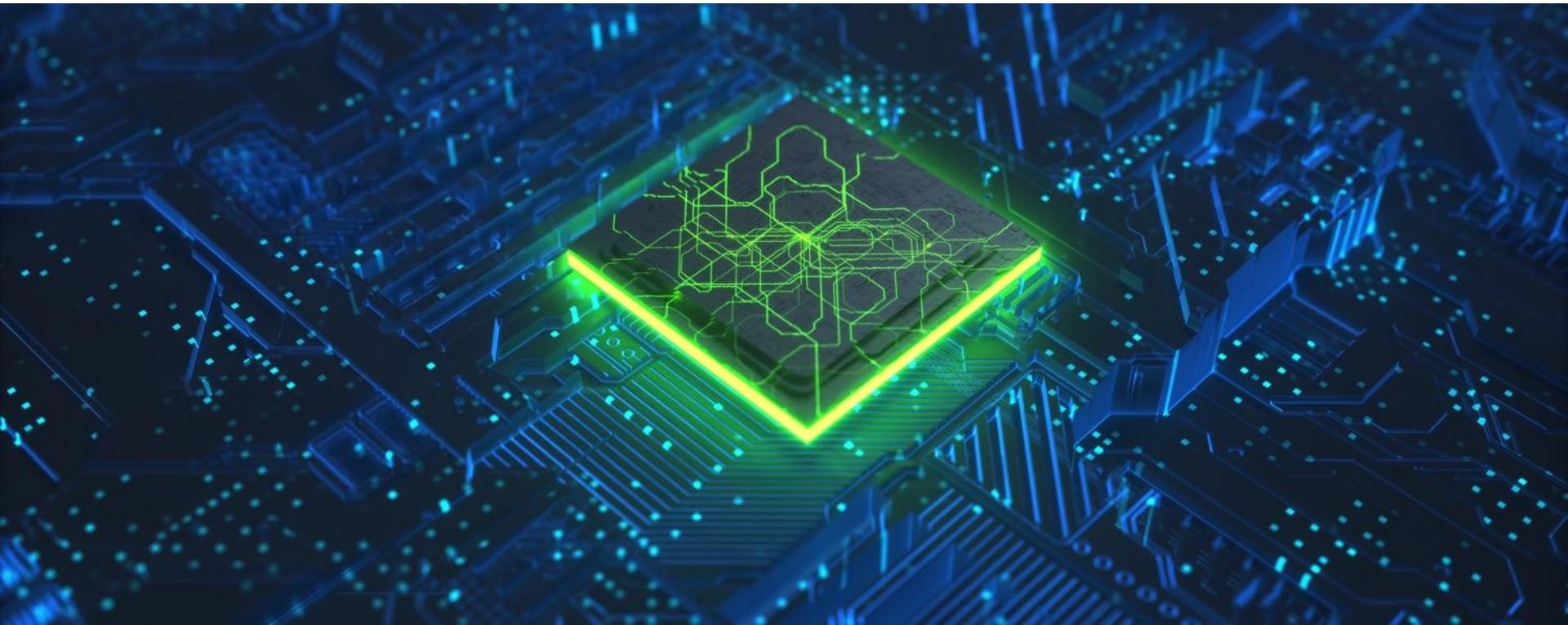


# Unleash the Power of Vision AI: Accelerate Edge AI Solutions with the Renesas RZ/V MPUs

December 2024



# / Agenda & Speakers

- Intro – Keaton Andersen
- Renesas MPU Overview – Jason
- RZBoard V2L Tria Applications – Lucas
- IoTConnect Overview – Keaton
- VisionAI Use Case using the RZBoard V2L + IoTConnect Quick Start – Steven Detloff
- Q&A + Resources - All



Keaton Andersen  
Sr Manager, Customer Solutions  
Avnet



Jason Acevedo  
Senior Digital FAE  
Renesas



Lucas Keller  
Embedded Software Engineer  
Avnet Tria



Steven Dettloff  
IoT Solutions Manager  
Avnet

# Broad and Scalable Product Portfolio

Microcontrollers & Microprocessors	Analog and Power Devices	SoC
<p><b>Arm® Core</b></p> <p> Advanced 32-bit MCUs Arm ecosystem, Advanced security, Intelligent IoT</p> <p> High-End 32/64-bit MPUs High-resolution HMI, Industrial network &amp; real-time control</p> <p> Renesas Synergy™ platform based 32-bit MCUs Qualified software and tools</p> <p><b>Renesas Core</b></p> <p> High Power Efficiently 32-bit MCUs Motor control, Capacitive touch, Functional safety, GUI</p> <p> Ultra-Low Energy 8/16-bit MCUs Bluetooth® Low Energy, SubGHz, LoRa®-based Solutions Automotive actuators &amp; sensors, Low-end ECUs</p> <p> 40nm/28nm process Automotive 32-bit MCUs Rich functional safety and embedded security features</p>	<ul style="list-style-type: none"> <li>▪ Analog products</li> <li>▪ Clocks &amp; Timing</li> <li>▪ Interface &amp; Connectivity</li> <li>▪ Memory &amp; Logic</li> <li>▪ Power &amp; Power management</li> <li>▪ Programmable Mixed-signal, ASIC, &amp; IP products</li> <li>▪ RF products</li> <li>▪ Sensor products</li> <li>▪ Space &amp; Harsh environment</li> </ul> <hr/> <ul style="list-style-type: none"> <li>▪ ASICs</li> <li>▪ Battery Management</li> <li>▪ Clocks &amp; Timing</li> <li>▪ Power Devices</li> <li>▪ Power Management</li> <li>▪ Sensors</li> <li>▪ Video &amp; Display</li> </ul>	<p> Factory automation</p> <p> Automotive computing</p>

# RZ MPU Target Application

## GP-MPU

HMI & IOT EDGE  
(LINUX, ANDROID)



### RZ/G Series

Multimedia /3D Graphics + Linux

#### HMI (RTOS)



Microsoft Azure

### RZ/A Series

2D Graphics + RTOS

## AI-MPU

VISION AI  
(APPLIANCE, SECURITY,  
POS, ROBOT)



### RZ/V Series

AI accelerator + Linux



## IA (Industrial) MPU

INDUSTRIAL NETWORK  
(REMOTE I/O, SENSOR, PLC  
WITH ETHERNET)



### RZ/N Series

Multi-protocol Industrial Ethernet +  
5ports GMAC with Switch & Redundancy

## SERVO & MOTOR DRIVE



### RZ/T Series

Real-time control+  
Multi-protocol Industrial Ethernet

GP MPU : RZ/G, RZ/A targeting HMI & IOT Edge by superior graphic performance & Linux/RTOS support

AI MPU : RZ/V targeting Vision AI application by unique AI accelerator & Linux support

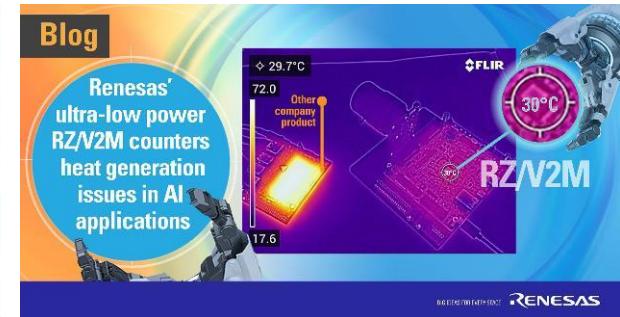
IA MPU : RZ/N, RZ/T targeting Industrial network & Motor by Multi-protocol support

# What is the RZ/V Series

(\*1) DRP-AI : Dynamically Reconfigurable Processor for AI

## RZ/V series features

- MPU family for **embedded Vision AI applications**
- Integrates Renesas original **AI accelerator DRP-AI(\*1)** to deliver up to **80TOPS**
- Delivers **AI power efficiency** up to **10TOPS/W**
- Provides AI performance **scalability** for wide range of applications



[RZ/V Embedded AI MPU | Renesas](https://www.renesas.com/blogs/farewell-heat-countermeasure-rzv2m-brings-innovation-ai-products)

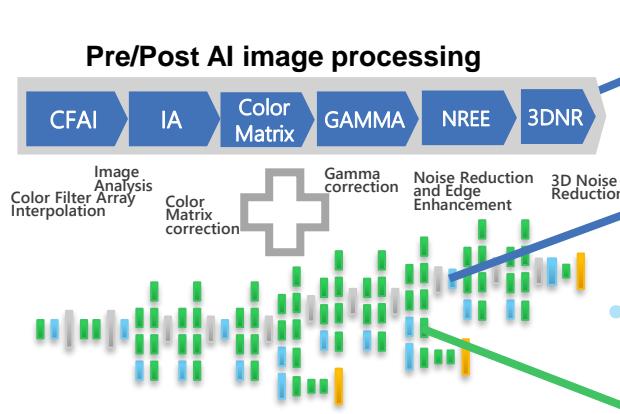
<https://www.renesas.com/blogs/farewell-heat-countermeasure-rzv2m-brings-innovation-ai-products>

# DRP-AI

# DRP-AI Accelerator for Neural Networks

**DRP and AI-MAC combination is perfect for inference**

- DRP-AI integrates “AI-MAC unit” for AI inference
- DRP is to increase effective performance (vs. peak performance) thanks to configurable processors
- Provide future proof flexibility by DRP reconfigurability



**Example of Neural network structure**

## Pre/Post processing

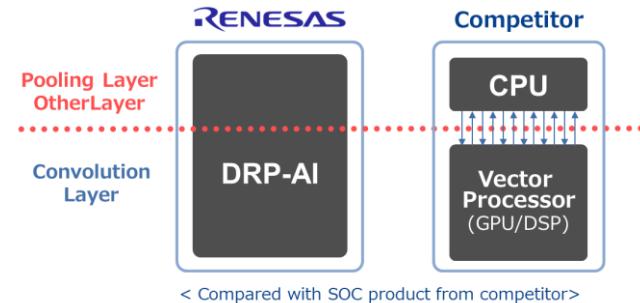
DRP flexibly process pre/post image processing according to AI model as one processing together with AI processing

## Pooling and Other Layer

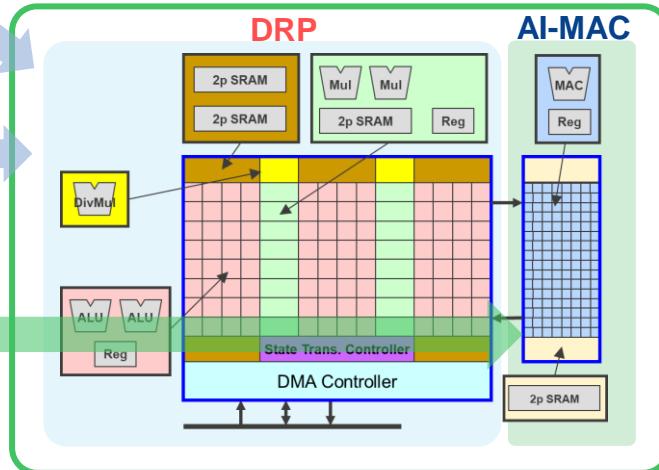
DRP flexibly process operations other than multiply-accumulate or new operations which will come in future

## Convolution Layer

AI-MAC efficiently process MAC operation since this layer is occupied by them

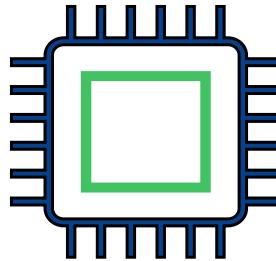


## DRP-AI

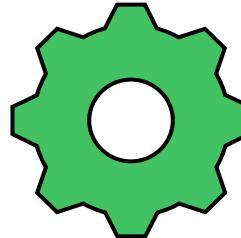


# DRP-AI Features

- DRP-AI realizes high power efficiency with hardware and software.
- DRP-AI Translator optimizes AI network for DRP-AI.  
You can get the **higher power efficiency**, and **low power consumption**.



Hardware: DRP-AI



Software

DRP-AI  
Translator

# Performance and Scalability

# Next Gen RZ/V2H AI Performance demonstration

Renesas RZ/V2H

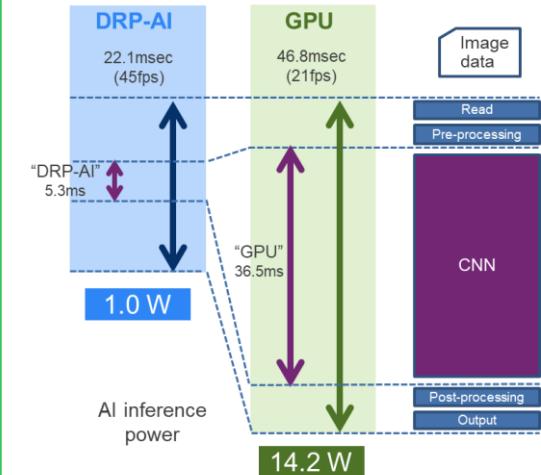
vs. GPU



Next Gen RZ/V

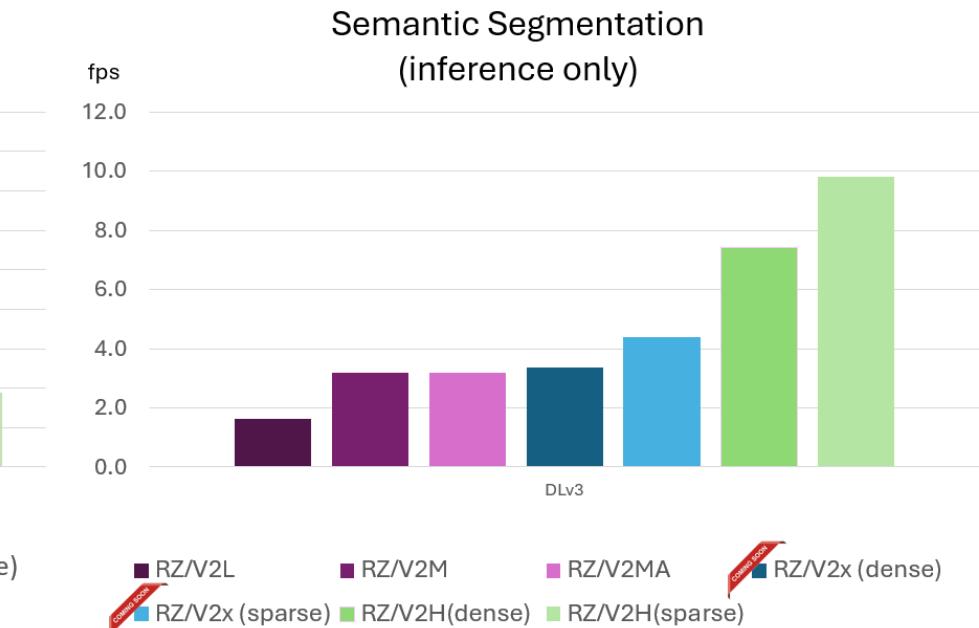
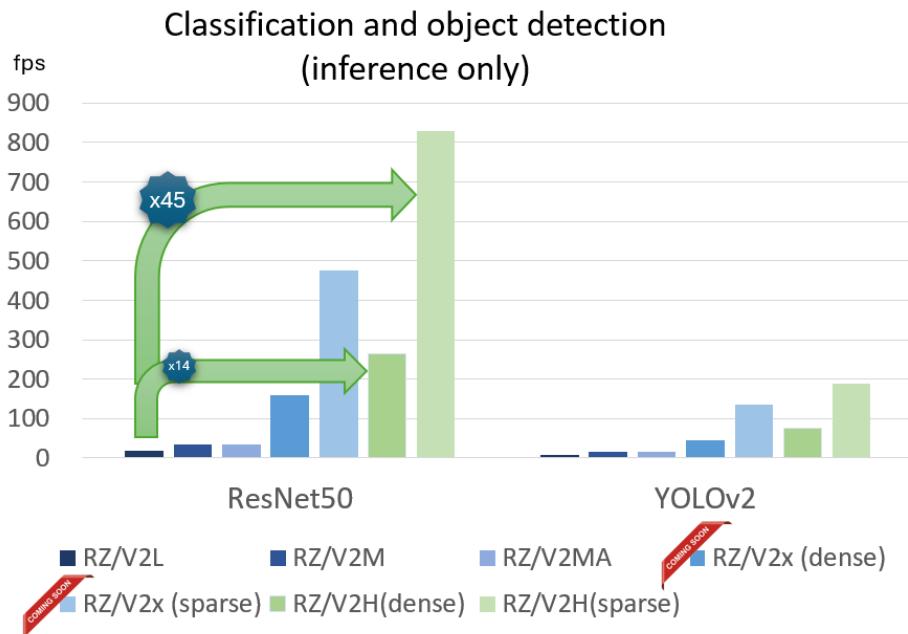
2 core 1.0GHz CPU

6 core 1.9GHz CPU



# RZ/V series AI Performance Scalability

- 14x Performance between RZ/V2L & RZ/V2H for Classification (ResNet50) even non-Pruning (Dense)
- 45x Performance range with Pruning (Sparse Model, ResNet50)



# Scalability AI Performance Line Up

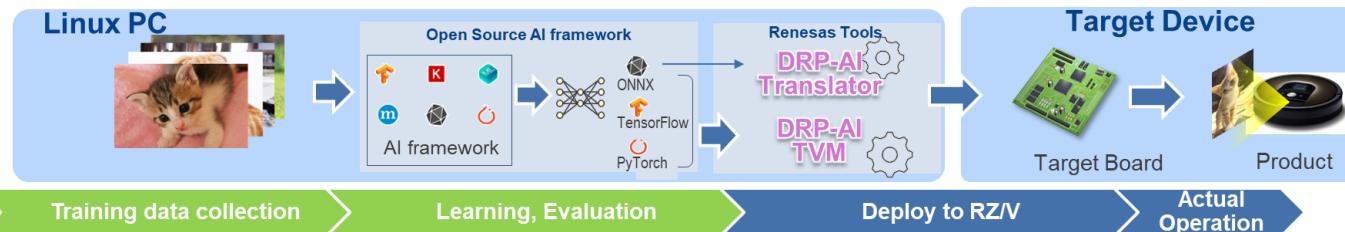
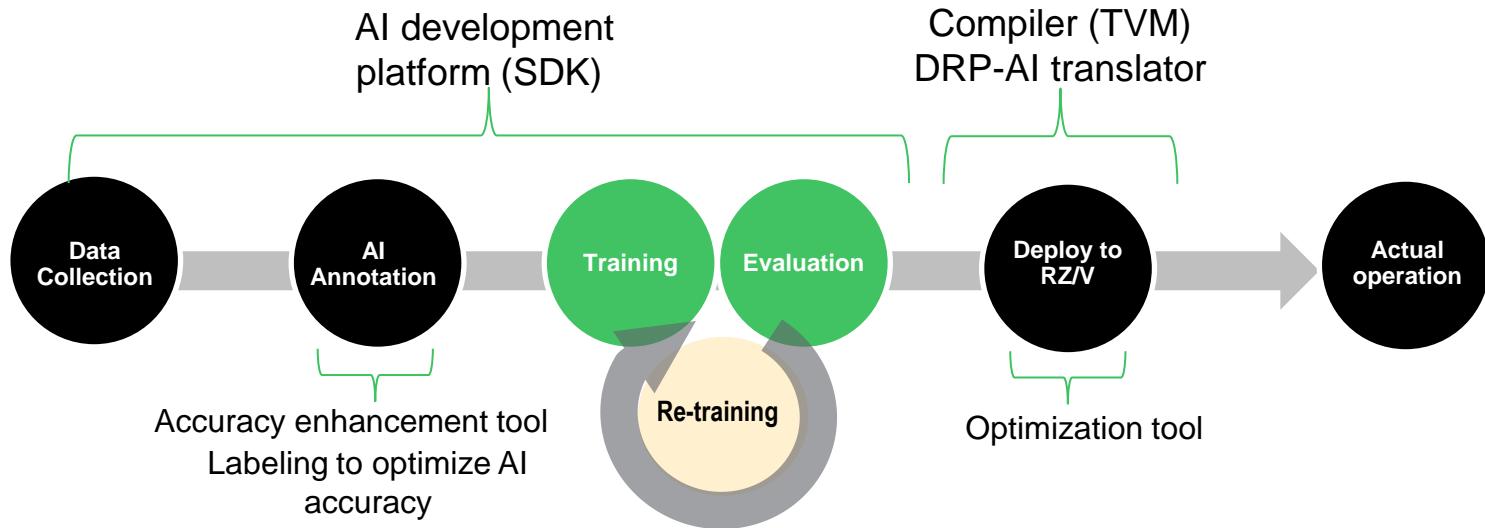
One MPU Platform covers entire performance requirement

AI MPU Product	AI Performance	ISP	Major Feature
<b>High performance</b> <b>RZ/V2H</b>	Mass Production	80TOPS	         
			         
<b>Cost performance</b> <b>RZ/V2x (Preliminary)</b>	Coming Soon	15TOPS	         
			        
<b>RZ/V2M</b>	Mass Production	0.7TOPS	       
<b>RZ/V2MA</b>	Mass Production		   
<b>RZ/V2L</b>	Mass Production	0.4TOPS	      

# AI Model Development Flow

# RZ/V AI Development & Deployment Flow

AI partners cover the end-to-end design flow



# DRP-AI Tool Chain

RZ/V2L, RZ/V2M, RZ/V2MA

FP16 Dense

<sup>1</sup> PyTorch, the PyTorch logo and any related marks are trademarks of Facebook, Inc. (<https://pytorch.org/>)

<sup>2</sup> TensorFlow, the TensorFlow logo and any related marks are trademarks of Google Inc. (<https://www.tensorflow.org/>)

INT8 Dense

RZ/V2H & RZ/V2x

INT8 Sparse



Pruning

Retraining



# Getting Started

# Ready to deploy AI Applications

Quick and easy solutions to develop AI enabled products

- ✓ You will find the AI applications you need on your next project
- ✓ Provides easy-to-use AI Applications for the 7 market segments with pre-trained AI model
- ✓ AI applications are free to use and does not require any AI expertise

*Agriculture*



*Healthcare*



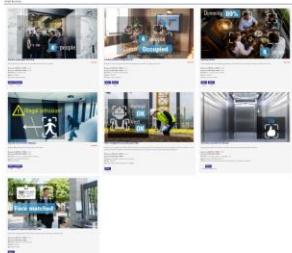
*Smart Home*



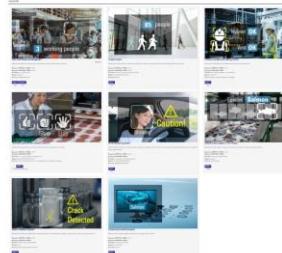
*Smart City*



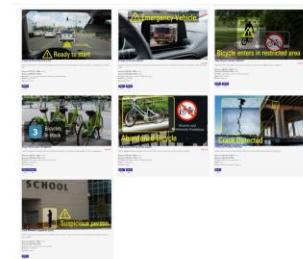
*Smart Building*



*Industrial*



*Retail*



# /RZBOARD V2L

## System overview



Compact embedded system SBC optimized for AI/ML applications. This is ideal for software development and evaluation of the RZ/V2L processor family. The Pi like form factor allows use of hardware components like display, camera and HAT boards. Well suited for Edge AI applications requiring powerful ARM processor, plus dedicated AI accelerator and strong expansion capabilities.

### Processor (RZ/V2L)

- Dual-core Arm Cortex-A55 @1.2GHz + Arm Cortex-M33
- DRP-AI Accelerator, 3D GPU, H.264 Enc/Dec

### Memory and Storage

- 2GB DDR4, 32 GB eMMC, microSD slot, 16 MB QSPI

### Connectivity Features

- Gigabit Ethernet
- Wi-Fi (802.11ac) and Bluetooth 5
- USB (2x type-A, 1x OTG microUSB)
- CANFD (includes CAN transceiver)

### Video and Audio

- MIPI DSI and HDMI display interfaces
- MIPI CSI camera interface
- 3.5mm stereo audio jack

### Power

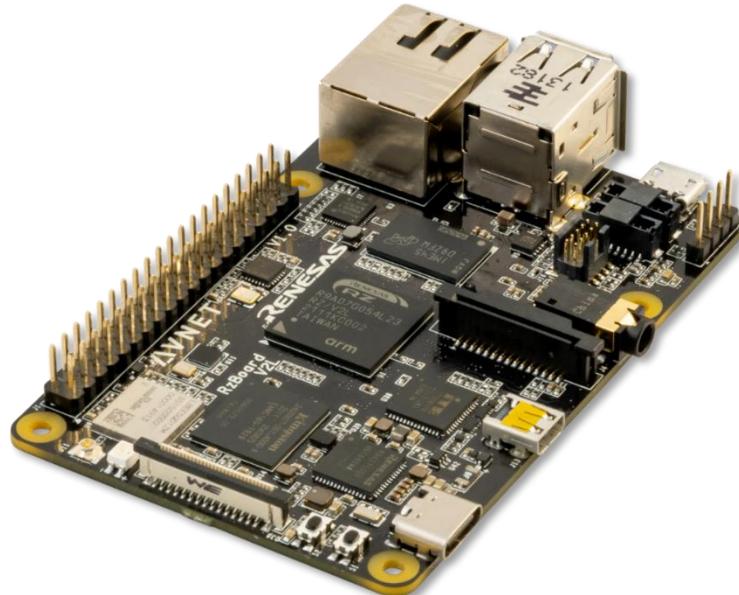
- Single 5V/3A USB Type-C power supply

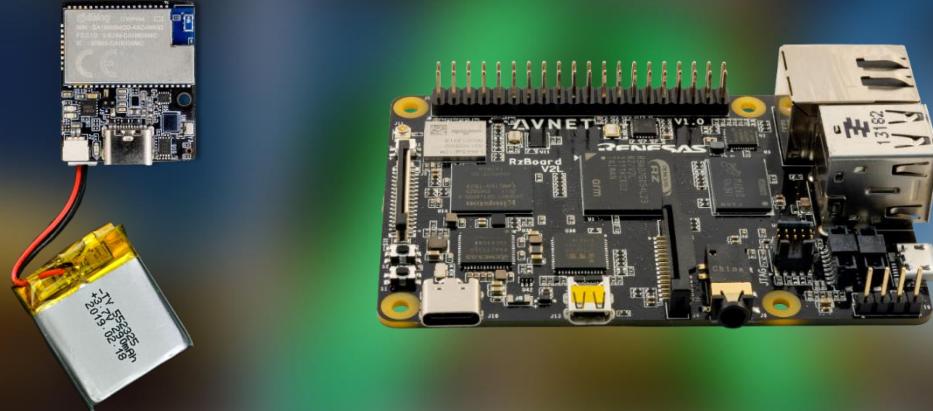
### Software

- [Civil Infrastructure Platform](#) (CIP) Linux kernel with 10-year support

### Form Factor

- Raspberry Pi HAT compatible (85mm x 56.5mm dimensions)





# TRIA SBCs, Development Kits, and SOMs

(Renesas RZ and RA based Platforms)

# ONE OF THE LARGEST GLOBAL SOM/COM MANUFACTURERS

Computer-on-Modules are widely accepted across all vertical markets



COM+HPC

COM+Express



From simple **LOW POWER** modules to **COMPLEX EDGE-BASED** artificial Intelligence solutions, we work with our customers to understand the challenge and provide the perfect compute solution. Our modules are available in standard pre-designed formats, or can be customized to accommodate specific requirements.

\***SINGLE-BOARD COMPUTER**



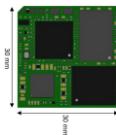
\***SYSTEM-ON-MODULE**



SoMs are commonly used in applications where space, power efficiency, and weight demands are critical, such as IoT devices, industrial equipment, and custom electronics.



# TRIA - Product Portfolio



## Standard Compute on Modules

Previously MSC / Avnet Embedded products  
Industry standard form-factors, higher volume



## Application Optimized

Previously AES/AAG products  
Proprietary form-factors, low MOQ

## Development Kits

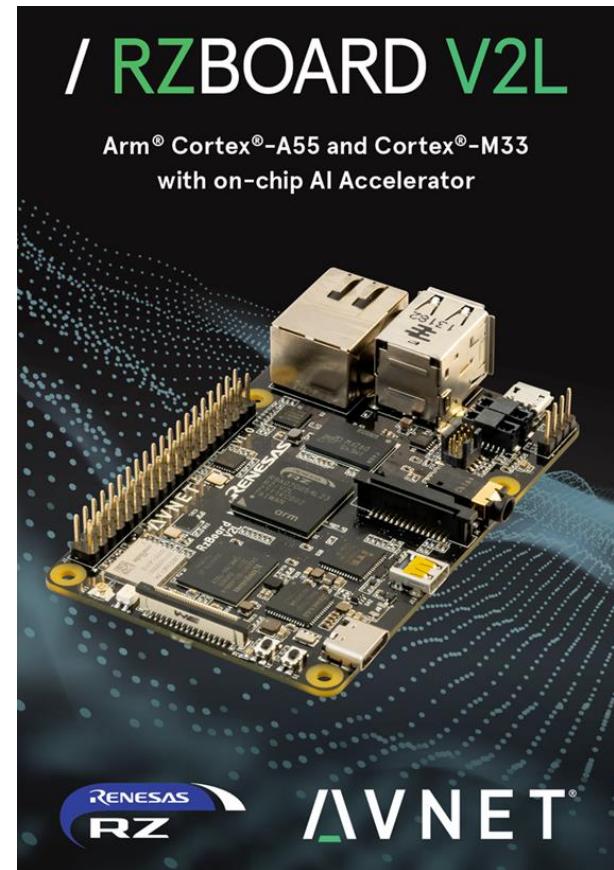
Previously AES/AAG products  
Mass market starting point

# RZBoard V2L

# / RZBOARD V2L

## What is RZBOARD V2L?

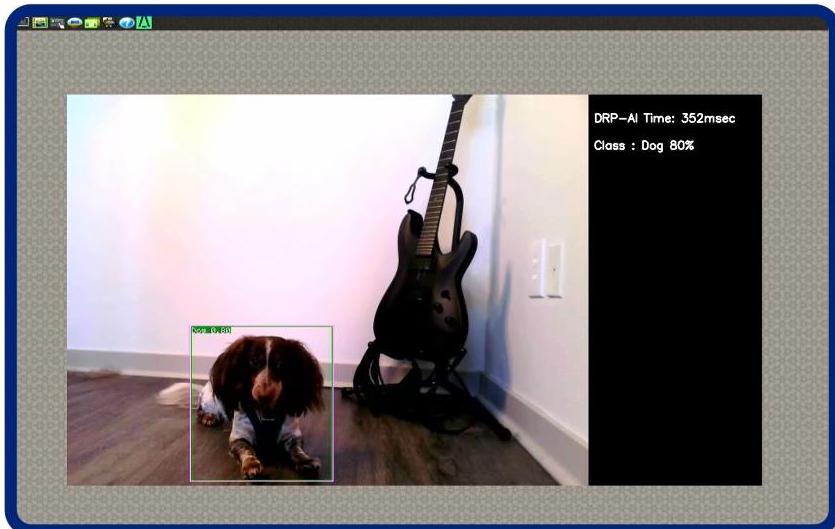
- Avnet-designed development board, engineered in compact Raspberry Pi-4B / MaaXBoard form-factor
- Facilitates development of **Vision-AI** applications based on energy-efficient **Renesas RZ/V2L** SoC
- Efficient on-chip **DRP-AI accelerator** (1 TOPS/W), capable of Tiny YOLOv2 object-detection at 28fps, offloads the Arm A55 processor cores
- On-chip **H.264 Video Encode/Decode** (1920x1080), **3D-GPU** and **Image Scaling Unit**
- Supports versatile hardware expansion options via eco-system of **Click boards**, Pi **HATs** and more...

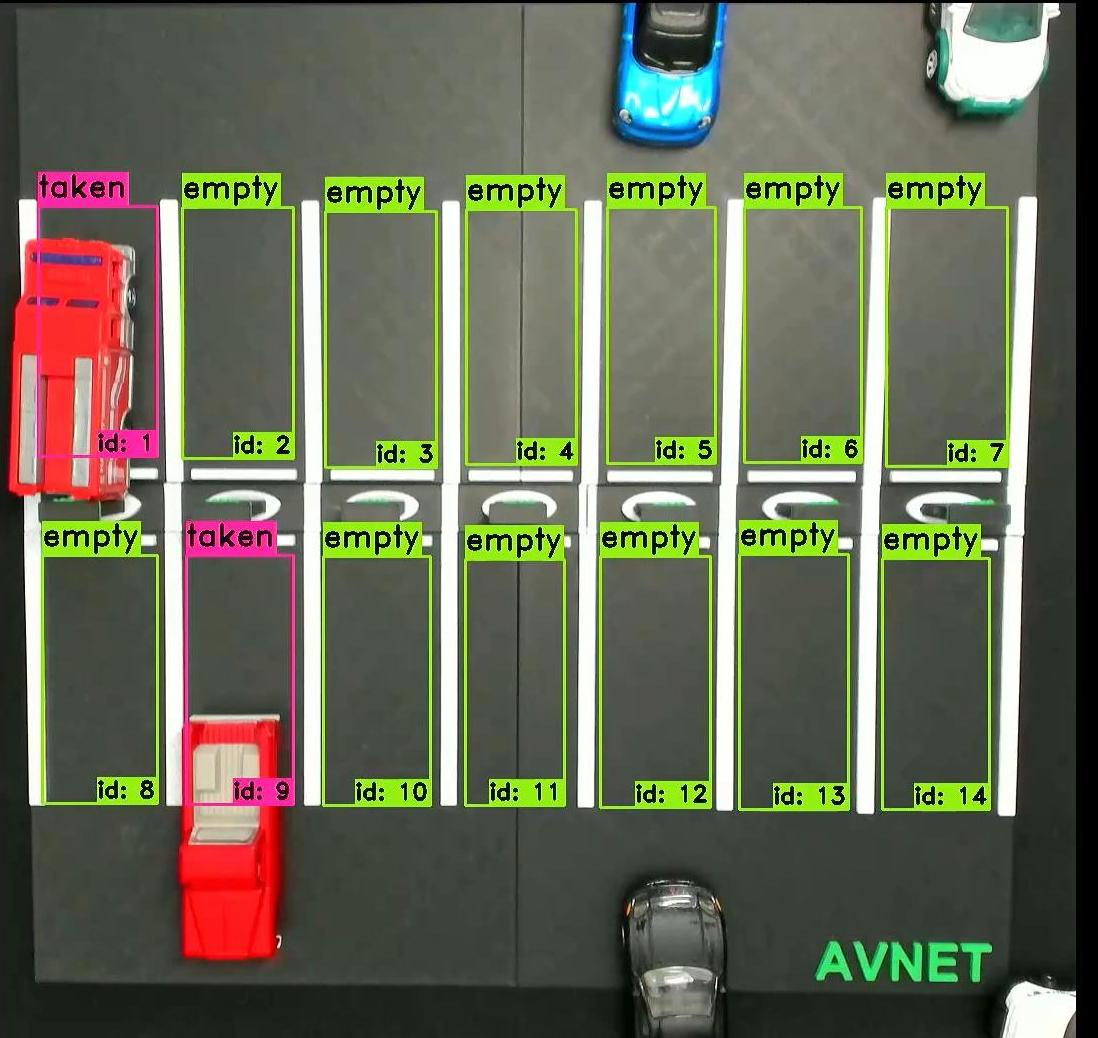


# RZBuddy Smart Dispenser

RZBOARD V2L

- Real-time YOLO
- Web Control & Monitoring
- Linux & FreeRTOS
- Open Source HW & SW





RZ Spark - R4

AVNET IOTCONNECT

**SPARK**  
"Smart Parking AI-Driven RZBoard Kit"  
Built on the Avnet RZBoard V2L featuring Renesas' RZ DRP-Accelerator

**Device Tracker** Select Device to Track

**Parking Lot Availability**

Map showing parking lot locations in Denver area:

- Road
- Westminster
- Arvada
- Thornton
- Denver
- Lakewood
- Aurora
- Centennial
- Littleton
- Castle Rock
- Deer Trail
- 25 miles
- 25 km

Map credits: © 2024 TomTom. © 2024 AVNET Corporation. Terms

Product: RZBoard V2L

Source: SPARK Github

Cloud: IoTConnect

IOTCONNECT Solutions Suite

aws

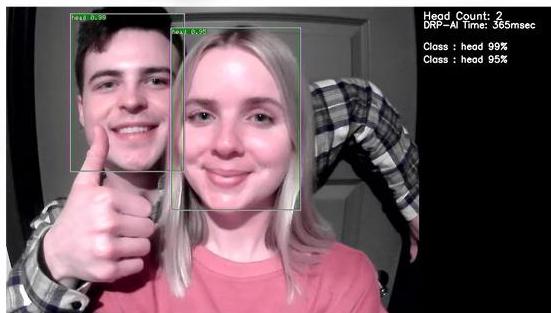
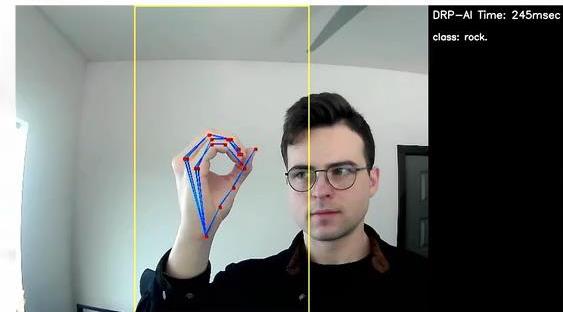
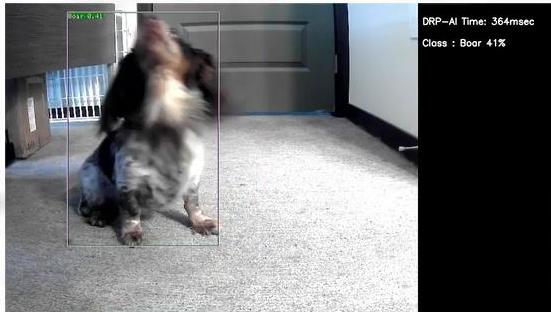
One interface for AWS services

Free Trial Subscription

Watch on YouTube

aggregate them to create one ecosystem for production ready

QR codes for SPARK Github and One interface for AWS services



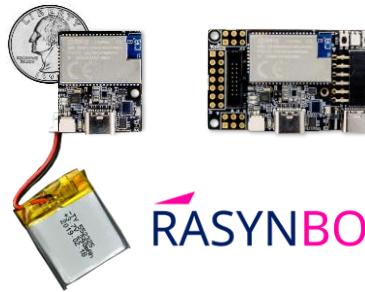
# Board References



## RZBOARD V2L

### RZ/V2L

- **Renesas RZ/V2L Processor**  
2x A55 (1.2GHz), 1x M33 (200MHz)
- **NPU: DRP-AI accelerator**
- **VPU: H264 Enc/Dec (1080p30)**
- **GPU: Arm Mali G31 3D (500MHz)**
- 2GB DDR4
- 32GB eMMC, 16MB QSPI flash
- MicroSD slot
- **MicroHDMI 1080p30 display i/f**
- MIPI-DSI (4L) 1080p30 display i/f
- MIPI-CSI (2L) 1080p30 camera i/f
- 1G Ethernet
- 2x USB 2.0 host, 1x USB 2.0 OTG
- Wi-Fi 802.11ac, BT5, u.FL antenna
- **DA7212 codec, audio jack**
- **1x CAN-FD (incl. transceiver)**
- 40-pin HAT expansion connector
- 5V/3A USB Type C power input
- 85mm x 56mm R-Pi form factor



## RASYNBOARD

### RA6M4, DA16600, NDP120...

- **Renesas RA6M4 M33 (200MHz) w/TZ**
- **Syntiant NDP120 NPU** (always-on neural processing of sensor data)
- TDK 6-axis IMU (**ICM-42671-P**)
- TDK MEMS microphone (**T5838**) PDM output (LP always-on modes)
- **Renesas DA16600 Wi-Fi/BLE module**
- **IO Board USB debug interface**
- IO Board expansion interfaces
- IO Board 2x button switches, RGB LED
- **IO Board SDcard socket**
- Use case examples for custom development
- **AWS IoT certified** [avnet.me/aws-devices](http://avnet.me/aws-devices)

**RENESAS -based**  
**Dev Kit/SBCs and SOMs**



Note New **SM2S-G3E** and **OSM-SF-RZG3L** compute modules are scheduled for 2025



# Avnet IoTConnect

Manage, Secure, Deploy

December 2024



# About Avnet

## Quick facts

- Founded in 1921
- Headquartered in Phoenix, Arizona
- \$AVT listed on the NYSE since 1960
- AVT listed on NASDAQ since 2018
- #163 on FORTUNE 500 (US) in 2022

**15,300**

Employees  
worldwide

**1,925**

Engineers around  
the world

**2.8M+**

Engineering  
community members

**1M+**

Customers in  
140 countries

**250+**

Locations  
globally

**\$23.8B**

Revenue

# Avnet Investments

AVNET

AVNET

CORE SEMI



AN AVNET COMPANY

CLOUD APPLICATION  
DEVELOPMENT



AN AVNET COMPANY

EMBEDDED SOFTWARE  
DESIGN SERVICES



AN AVNET COMPANY

EMBEDDED MODULES  
& BOARDS



DESIGNED BY AVNET

SOLUTIONS DEVELOPMENT:  
ADVANCED APPLICATIONS  
GROUP



## IoT Sales Team

A global specialized IoT team focused on providing unique hardware, software and cloud expertise to OEMs



## Extensive line card

Semiconductors, IP&E, embedded systems, software and cloud



## Hardware Edge Design

Technology selection and support provided by 800+ Field Application Engineers



## Embedded Software Design

Design, develop, and integrate embedded OS, firmware, and application software



## Cloud and Digital Design

Complete IoT solutions (cloud, apps, data insights) built on IoTConnect



## Supply Chain and Logistics

Supply chain models to address each customer's priorities



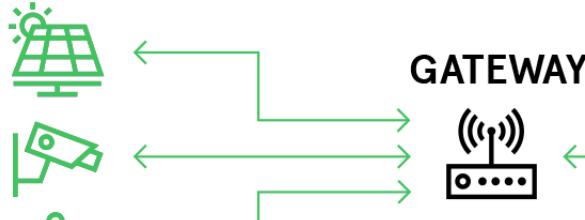
## Lifecycle Management

Digital Managed Services, OTA updates, post sales support

Gives us Unmatched Capabilities

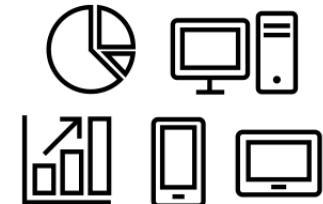
# The IoT Challenge

## DEVICES



## IoT CLOUD PLATFORM

## DASHBOARDS & DECISIONS



## Hardware & Firmware



## Cloud



## Back-End & Experience



IoT solutions require skills across multiple engineering disciplines

# The IoT Challenge

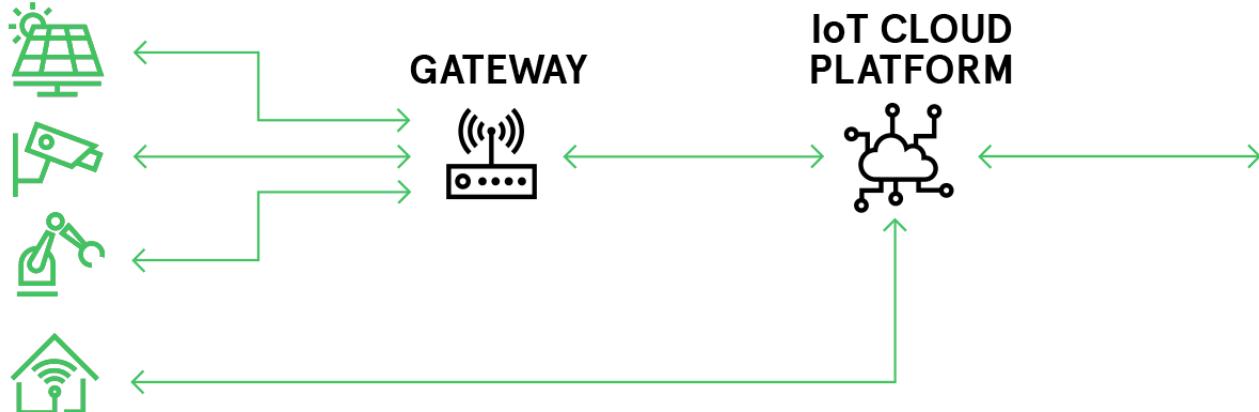
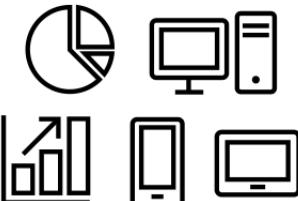
## DEVICES



## GATEWAY

## IoT CLOUD PLATFORM

## DASHBOARDS & DECISIONS



Hardware & Firmware

Cloud

Back-End & Experience

← / **IOTCONNECT<sup>®</sup>** →

IoT solutions require skills across multiple engineering disciplines

/IOTCONNECT®

# /IOTCONNECT®

Things



Connected  
Manufacturing



Industrial  
Gateway

# /IOTCONNECT®

Things



Connected  
Manufacturing



Industrial  
Gateway

Business Insights

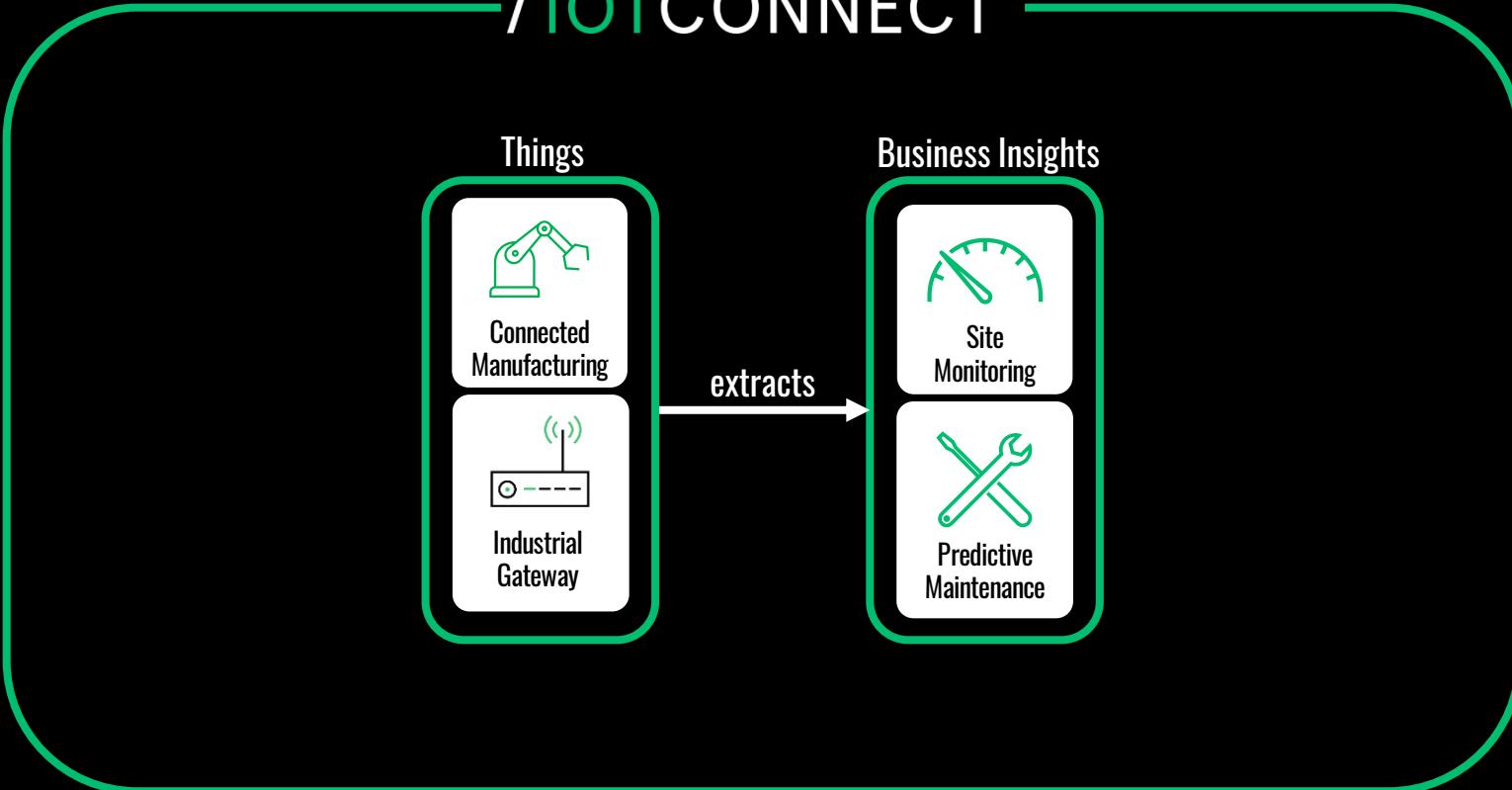


Site  
Monitoring

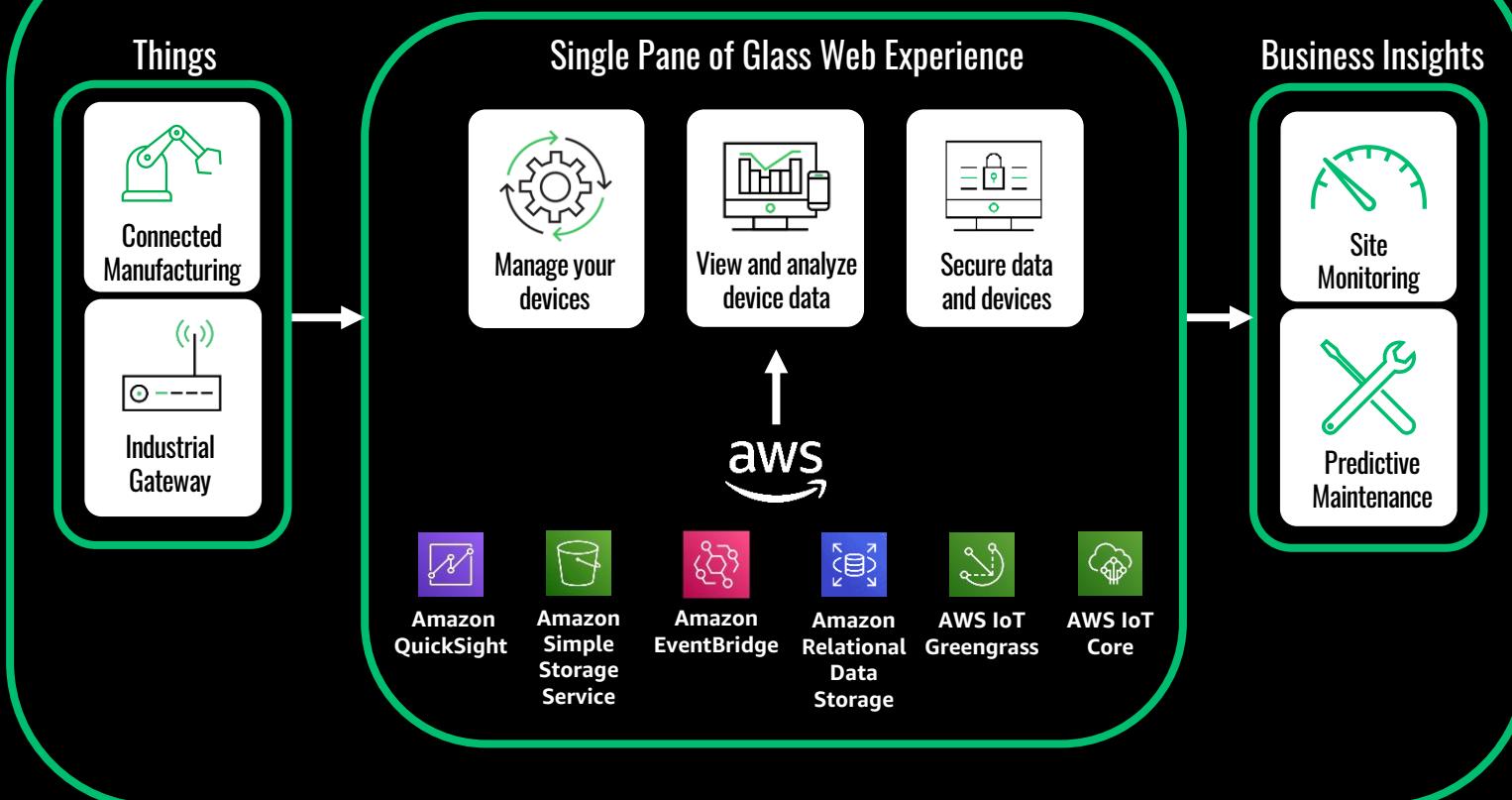


Predictive  
Maintenance

extracts



# /IOTCONNECT®



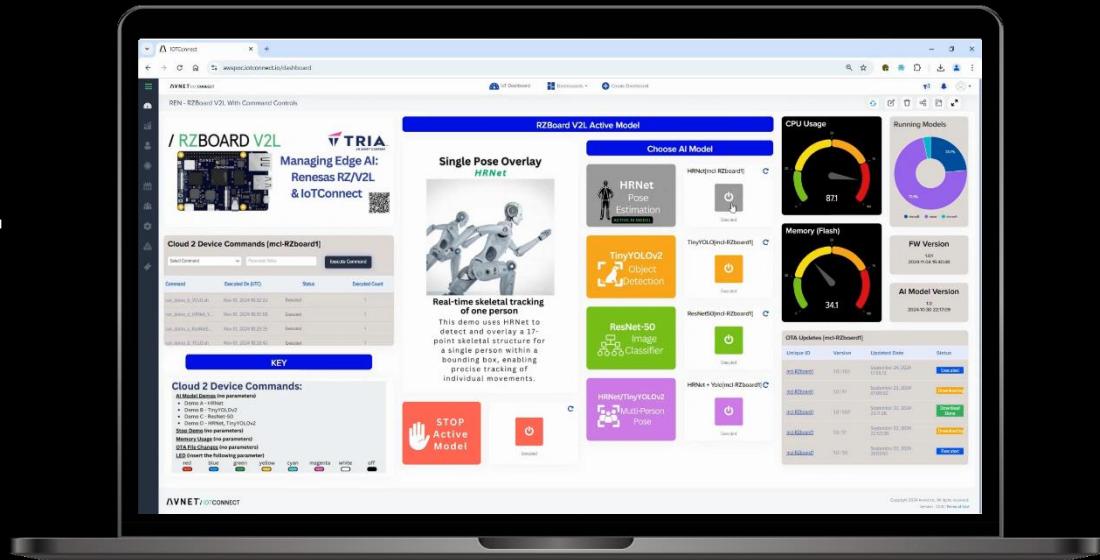
# /IOTCONNECT®

## RZBoard V2L VisionAI Use Case



 **TRIA**  
AN AVNET COMPANY

Tria RZBoard V2L



The screenshot displays the AVNET IoTConnect web interface for managing the RZBoard V2L. The main header reads "AVNET IoTConnect" and "RZBoard V2L With Command Controls". Below the header, there's a section titled "RZBOARD V2L Managing Edge AI: Renesas RZ/V2L & IoTConnect" featuring a QR code. A central image shows a person's skeleton overlaid on a video feed, with the text "Single Pose Overlay HRNet". To the right, a large blue box highlights "Real-time skeletal tracking of one person." It explains that the demo uses HRNet to detect and overlay a 3D joint heatmap and skeleton for a single person within a bounding box, enabling precise tracking of individual movements. On the left, a sidebar lists "Cloud 2 Device Commands" for "mcu-RZboard1". On the right, there are several cards for different AI models: "HRNet(RZBoard)", "TinyYOLOv2 Object Detection", "ResNet-50 Image Classifer", and "HRNet+TinyYOLOv2 Multi-Person Pose". Each card includes a status indicator (e.g., "Enabled", "Disabled") and a control button. At the bottom, there are "STOP Active Model" and "Start" buttons. The dashboard also features a "CPU Usage" gauge (87%), a "Memory (Flash)" gauge (34.1), and sections for "FW Version" (2024.01.16.01.00) and "AI Model Version" (1.0). A "OTA Updates" table lists several entries with columns for "User ID", "Version", "Update Date", and "Status". The footer of the dashboard includes copyright information: "Copyright 2024 Avnet Inc. All rights reserved." and "AVNET/IOTCONNECT".

# Q&A