

RENESAS PRESS CONFERENCE 2023

NOVEMBER 7, 2023

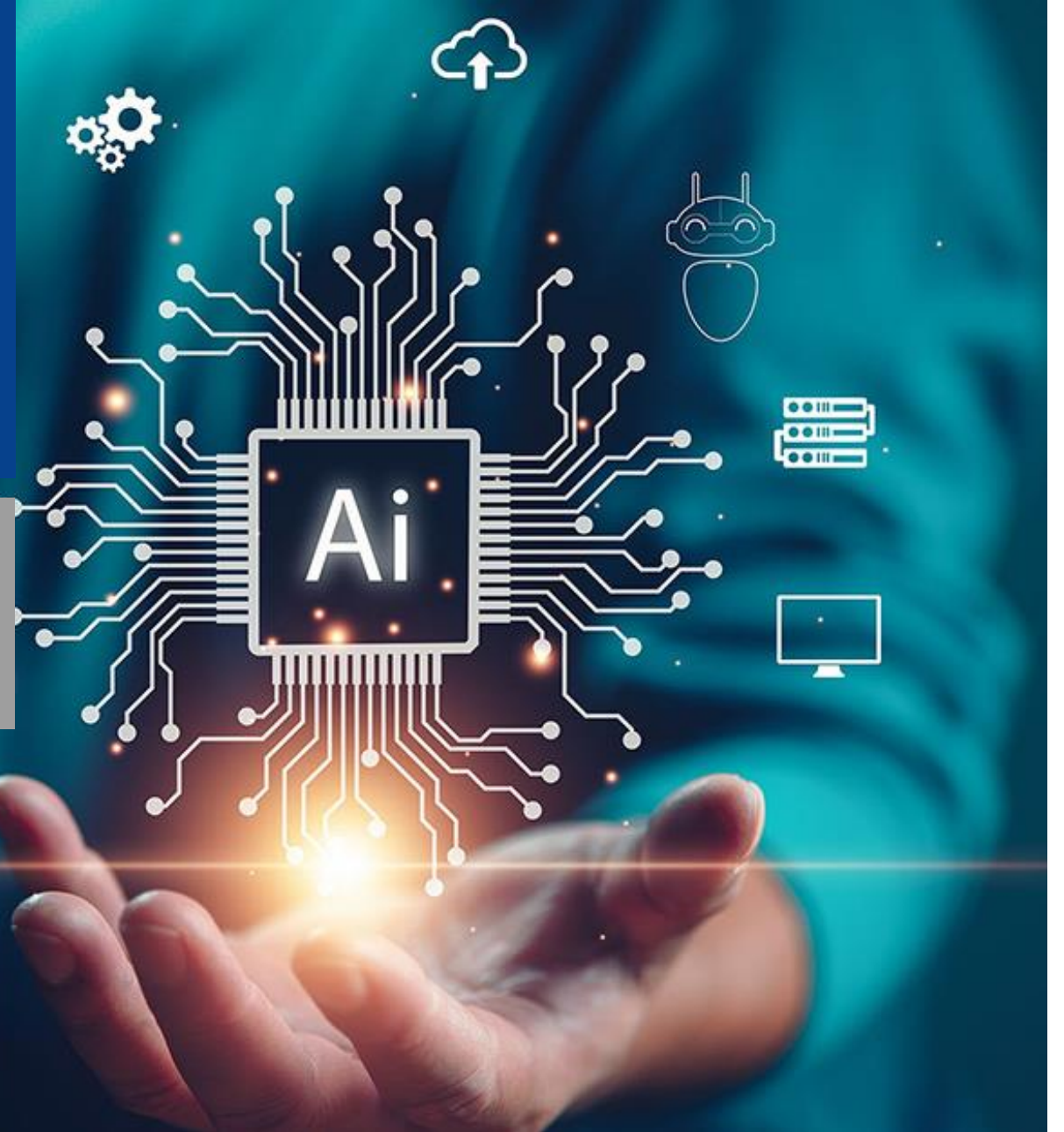
AGENDA

Time	Topic	Spokesperson
8:35 – 8:55 PT 17:35 – 17:55 CET	Renesas' AI roadmap & product announcement for IoT/Industrial markets	Sailesh Chittipeddi Executive Vice President and General Manager, Embedded Processing, Digital Power and Signal Chain Solutions Group (EPSG)
8:55 – 9:15 PT 17:55 – 18:15 CET	Next-generation automotive MCU/SoC roadmap	Vivek Bhan Senior Vice President and Co-General Manager, High Performance Computing, Analog and power Solutions Group (HPCSG)
9:15 – 9:30 PT 18:15 – 18:30 CET	Q&A	

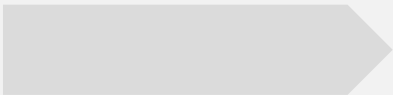
ARTIFICIAL INTELLIGENCE

DISRUPTING IOT FROM INFRA TO EDGE

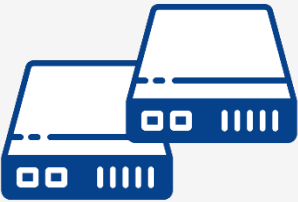
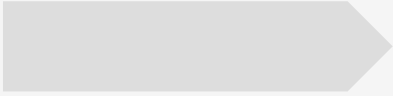
DR. SAILESH CHITTIPEDDI
EXECUTIVE VICE PRESIDENT & GENERAL MANAGER
EMBEDDED PROCESSING, DIGITAL POWER & SIGNAL CHAIN
SOLUTIONS GROUP



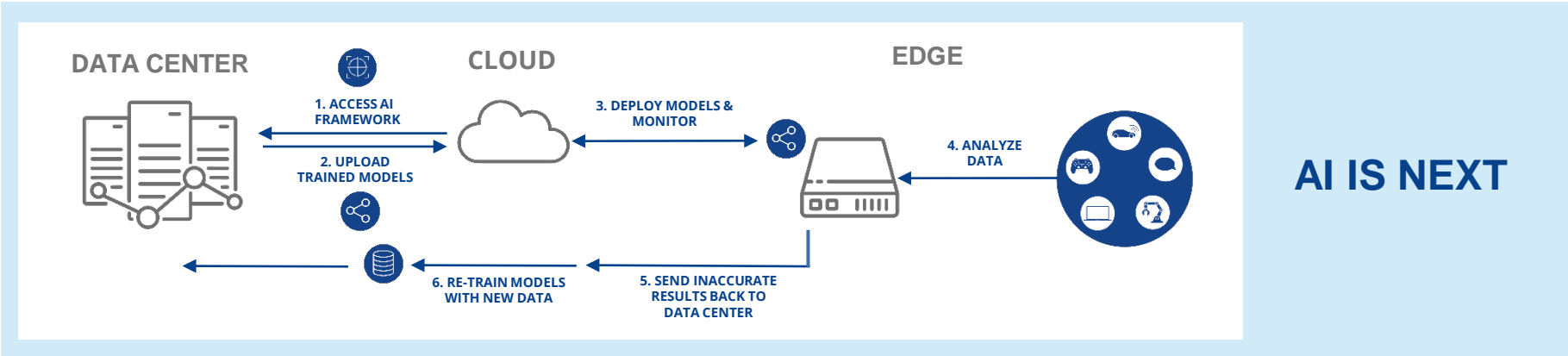
MOVE FROM CENTRALIZED TO DE-CENTRALIZED SYSTEMS



COMPUTING



STORAGE



GENERATIVE V/S PREDICTIVE AI

	GENERATIVE AI	PREDICTIVE AI (EDGE)
GOAL	Generate new content Will move to edge in 5+ years	Analyze data to make predictions and business decisions
INPUT	Digital - text (UNICODE), images (jpg, bmp,...)	Digitized analog sensor inputs from physical world – 6DOF, environmental (gas), audio, image, video
LEARNING TYPE	Supervised with Reinforcement (Human in the loop)	Supervised, Unsupervised, Reinforcement Learning, Federated Learning
PRIMARY MODELS	Transformers	Convolutional Neural Networks, Random Trees/Forests, k-Means, Clustering, SVM, RNN/LSTM, and Micro-transformers 😊
MEMORY REQUIREMENTS	~100s of GB	~kB to ~10 GB
HARDWARE	GPU/TPU in Cloud	Wide variety including MCU, MPU, NPU, FPGA

A DATA EXPLOSION



85%
CAGR
(2017-2025)

ENDPOINT DATA
CREATION
GROWTH

TOTAL DATA
GENERATED BY
IOT DEVICES

80
ZETTA BYTES
(IN 2025)

90%

ENTERPRISE
DATA IS NEVER
USED

A PERFECT ALIGNMENT OF STARS

TECHNOLOGY CONVERGENCE

IOT, AI, 5G maturing roughly at the same time

NEW DESIGN MINDSET

AI transforms data to actionable insights



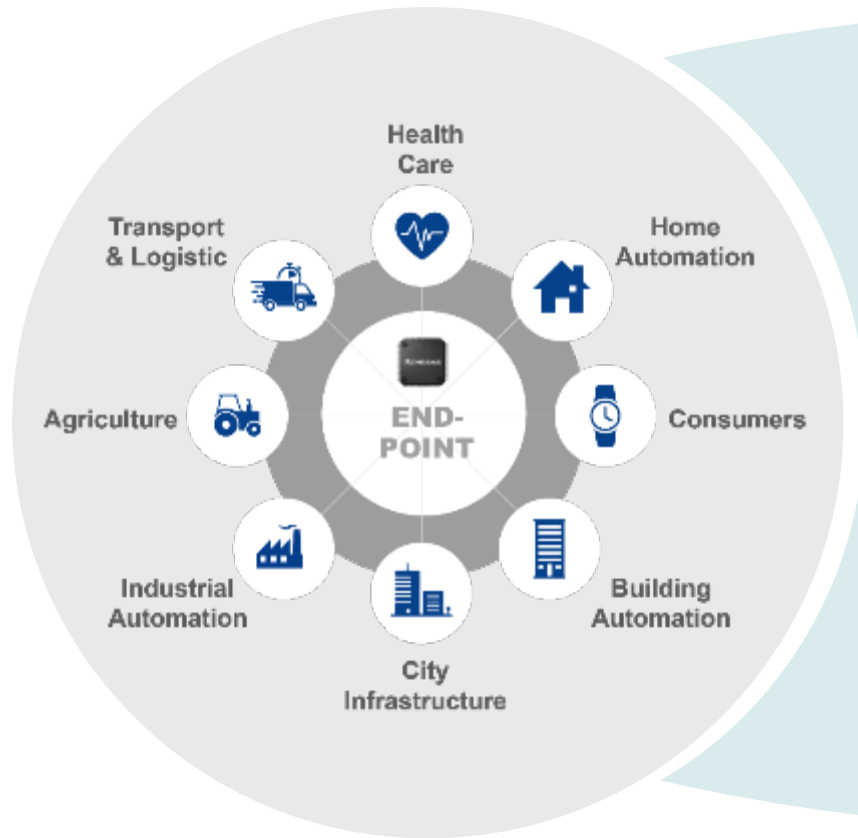
DECENTRALIZED INTELLIGENCE

Tremendous benefits of a distributed intelligence model

DATA EXPLOSION

Endpoint data creation to grow at 85% CAGR (2017-2025)

NEW DESIGN MINDSET



AI/ML Pillars



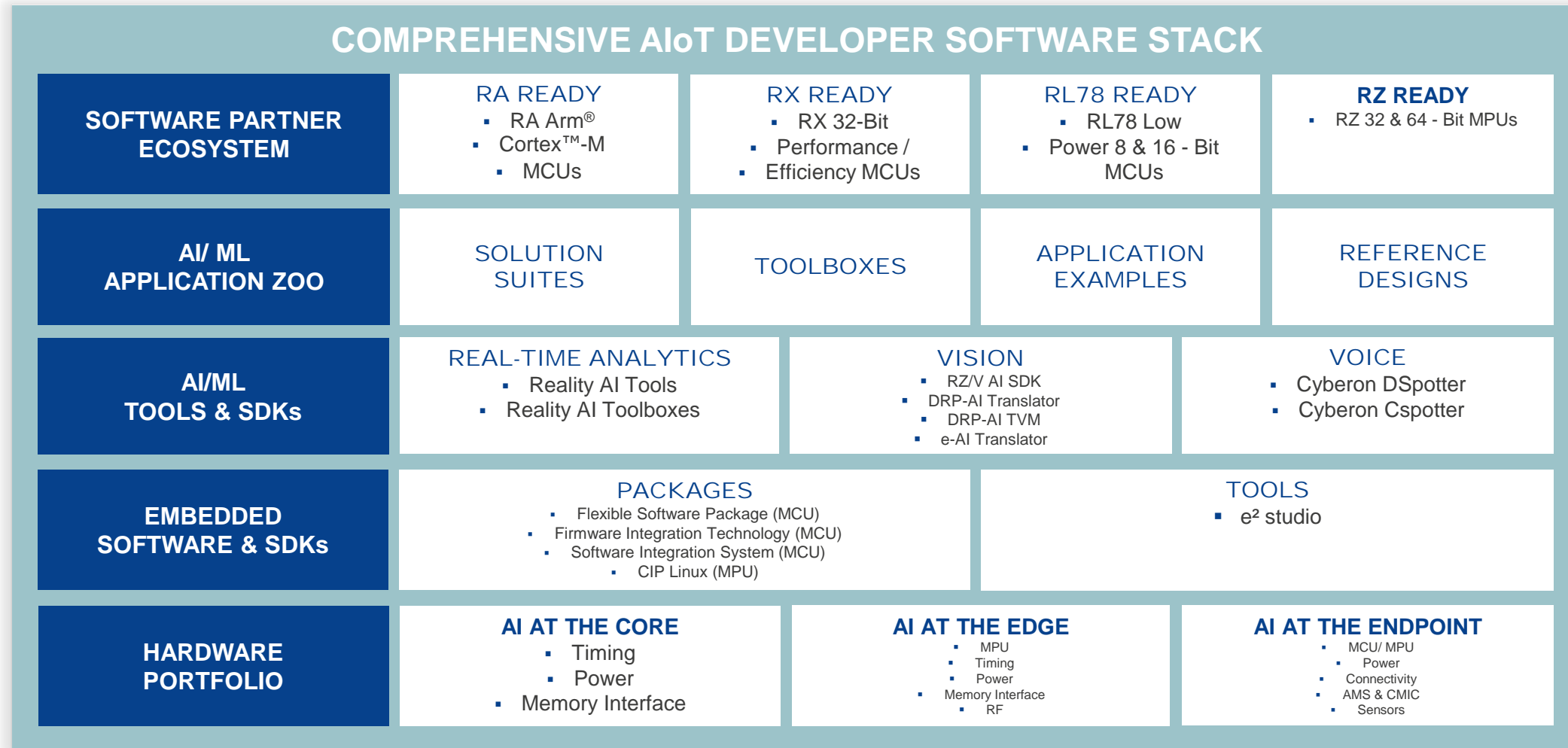
KEY TECHNOLOGIES

- Sensor Fusion
- Motor Control
- HMI
- Wireless Communication
- Capacitive Touch
- Cloud Connectivity
- Functional Safety
- Robotics
- IoT Security

AI/ ML can solve-for or enhance aspects of IOT systems related to maintenance, effectiveness, liability, personalization, service, safety, security, and more

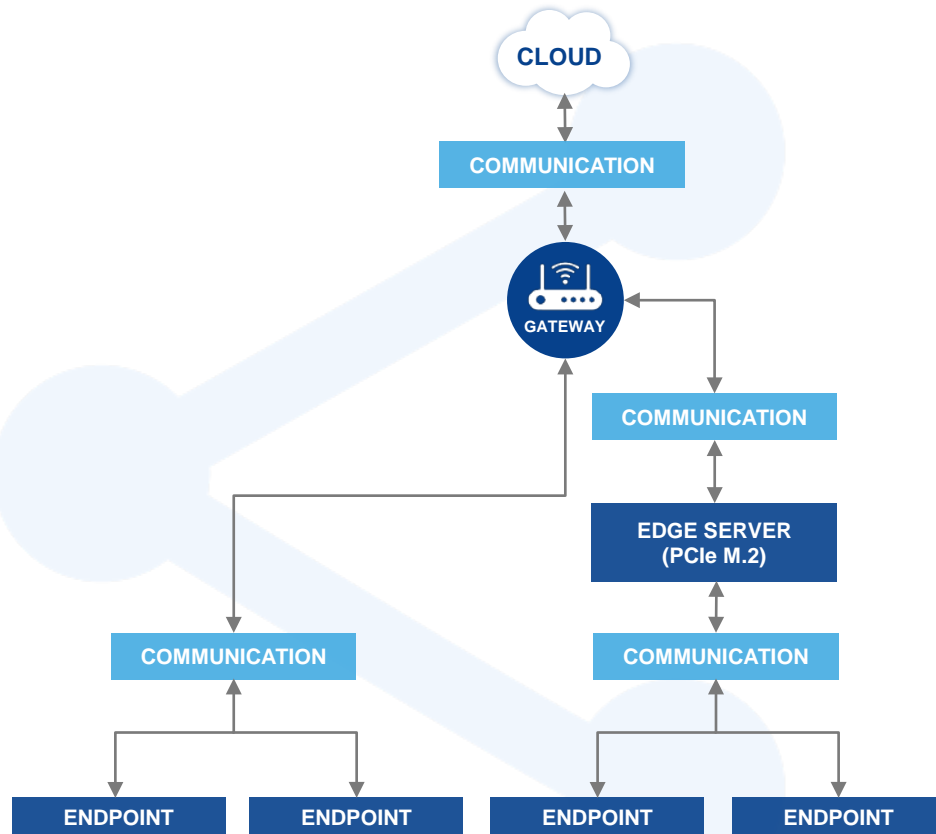
AI@RENESAS

ENABLING INTELLIGENCE FROM THE CLOUD TO THE END-POINT SUSTAINABLY

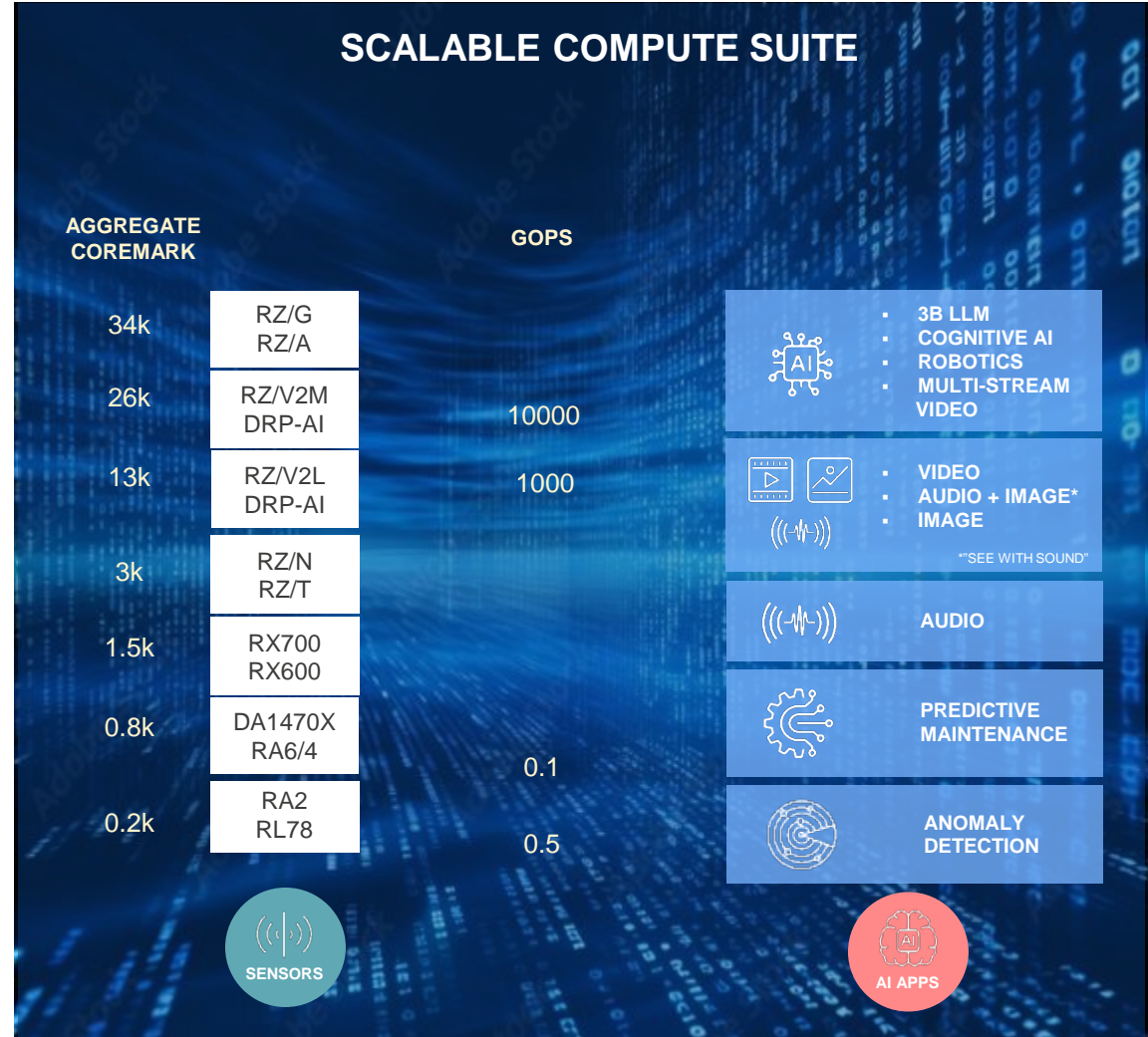


SCALABLE COMPUTE OFFERINGS

END TO END ARCHITECTURE



SCALABLE COMPUTE SUITE



AI@RENESAS

ENABLING INTELLIGENCE FROM THE CLOUD TO THE END-POINT SUSTAINABLY

BROAD PARTNER ECOSYSTEM







RENESAS RA8 SERIES AND RA8M1 GROUP INTRODUCTION

RENESAS ELECTRONICS CORPORATION
NOVEMBER 2023



RENESAS MCU PRODUCT OFFERING

- Meeting various customer needs with multi-architecture CPU product lineup.

8/16bit MCU		32bit MCU	
Renesas Core		Arm® Core	RISC-V® Core
 <p>Low Power</p> <p>Features: Ultra-low energy Low pin count lineup available</p> <p>Max operating frequency: 20~32MHz</p> <p>Application General purpose, Sensor, Motor Control LCD Display control Bluetooth® Low Energy Sub-GHz Security</p>	 <p>Power Efficiency</p> <p>Features: Superior power efficiency High-capacity flash memories Broad lineup</p> <p>Max operating frequency: 32~240MHz</p> <p>Application General purpose, Security, Motor control Capacitive touch key, LCD Display control Cloud connectivity Industrial network</p>	 <p>Arm® Ecosystem</p> <p>Features: High efficiency Advanced security Flexible Software Package</p> <p>Max operating frequency: 48~480MHz</p> <p>Application LCD Display control Network, Wireless Capacitive touch key Security Motor Control</p>	 <p>ASSP</p> <p>Features: Andes RISC-V 32bit CPU Application specific turnkey solution 1st: Motor control 2nd : Voice recognition</p> <p>Max operating frequency: 32MHz</p> <p>Application Refrigerator compressor, fan, pump control Voice command</p>

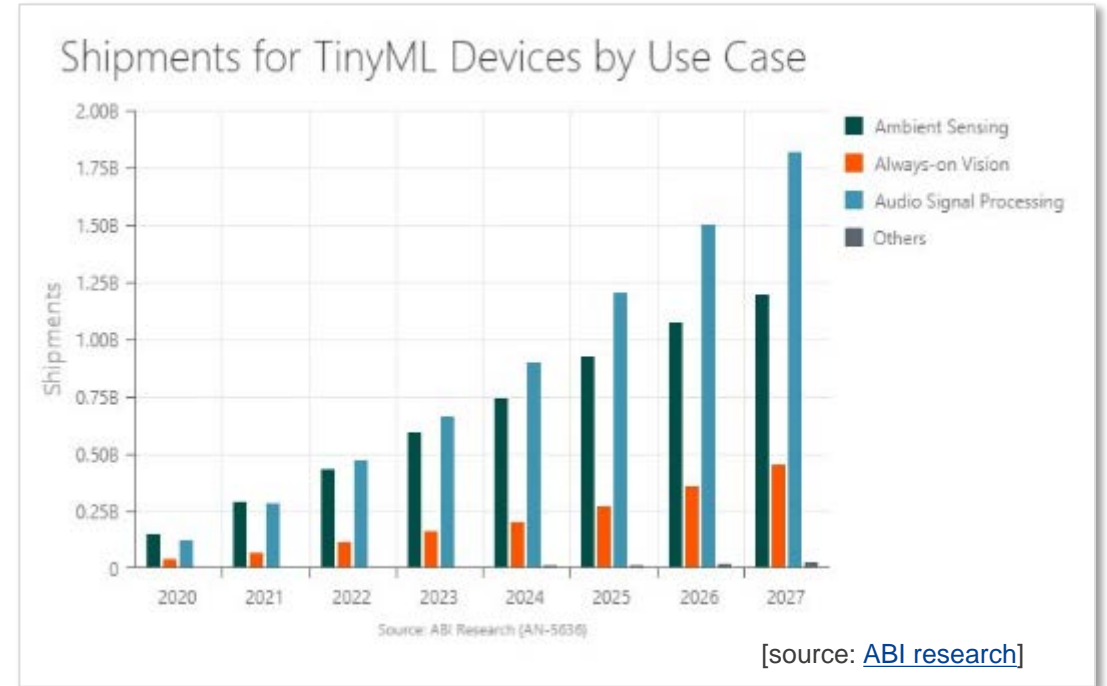
MARKET TRENDS DRIVE DEMAND FOR HIGHER PERFORMANCE MCUs

TRENDS IN THE HIGH PERFORMANCE AND AI MARKETS

- Increased demand for AI on Edge devices drives need for higher performance and ML acceleration
- Increased need for compute capabilities on Edge devices (motor control, drone navigation, robotic arms) requires higher performance and DSP capabilities
- Higher performance MCU-based solutions extend prior investment and avoid having to switch to an MPU
- Advanced security for protection of data at rest or in motion

WHY AI ON THE EDGE?

- Drivers for Edge AI (autonomous operation of end point devices)
 - Lower Latency
 - Lower Power Consumption
 - Lower Bandwidth Requirements
 - Lower Cost
 - Better Security



INCREASED COMPUTE CAPABILITY AT THE EDGE AND INCREASING AVAILABILITY OF "TINY" ML MODELS FUEL AI CAPABILITY IN EDGE PRODUCTS

INDUSTRY'S FIRST MCU WITH NEW ARM CORTEX-M85 CORE!

THE NEW RA8 MCUs ...

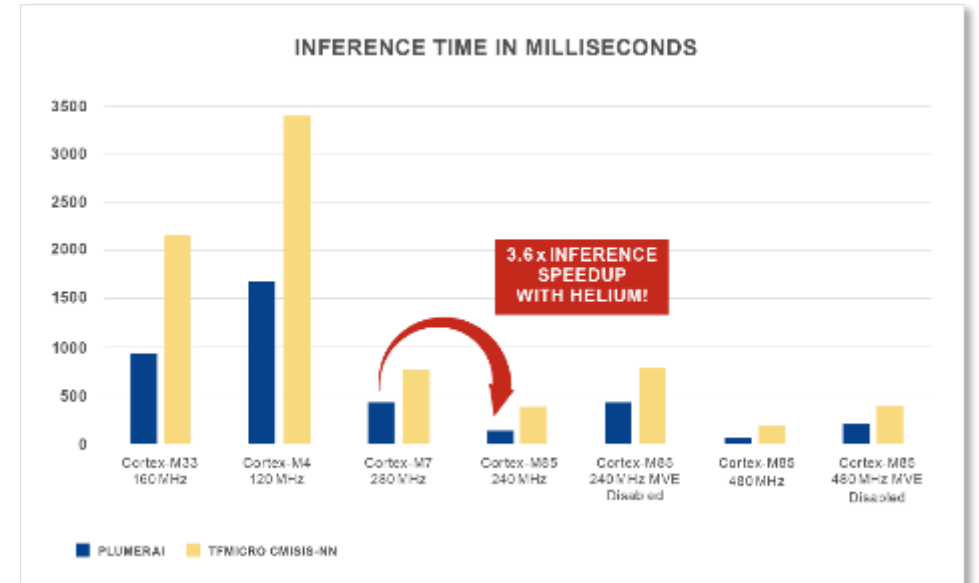
- Bridge the gap between MCUs and MPUs
- Enable compute-intensive applications with the lower power consumption and ease of use of an MCU



- First MCU with Cortex-M85 Core Delivering over **6.39 COREMARKS/MHz**
- Latest Arm v8.1-M Architecture with **HELIUM** accelerates DSP & AI/ML tasks
- Unprecedented **4x DSP/ML & 30% HIGHER SCALAR** Performance over Cortex-M7
- ADVANCED SECURITY** with TrustZone and PACBTI



	CORTEX-M7	CORTEX-M85
ARCHITECTURE	ARM V7-M	ARM V8.1-M
TRUSTZONE	NOT SUPPORTED	SUPPORTED
HELIUM (MVE)	NOT SUPPORTED	SUPPORTED
HW FLOATING POINT	SCALAR DP/SP	SCALAR HP/SP/DP VECTOR HP/SP
MACS PER CYCLE	1 32bit x 32bit	2 32bit x 32bit
COREMARKS/MHz	5.29	6.39



DEMONSTRATED PERFORMANCE UPLIFT WITH HELIUM

TARGET APPLICATIONS

RA8x1 ARE GENERAL PURPOSE MCUs AND FIND APPLICATION ACROSS BROAD MARKETS

INDUSTRIAL APPLICATIONS

- PLC
- Motor Control
- Power Inverters
- Industrial HMI
- Robotics
- Predictive Maintenance Applications



CONSUMER PRODUCTS

- Smart Appliances
- White Goods
- Security Cameras
- Robotic Vacuum Cleaners
- Exercise Equipment with Display



SMART HOME AND BUILDING AUTOMATION

- HVAC
- Safety and Access
- Security Panels
- Smart Thermostats
- Lighting Control
- Home: Hubs/Gateways



OFFICE AUTOMATION

- Barcode Fingerprint Scanners
- Scanners
- Office Equipment with display
- QR Code readers

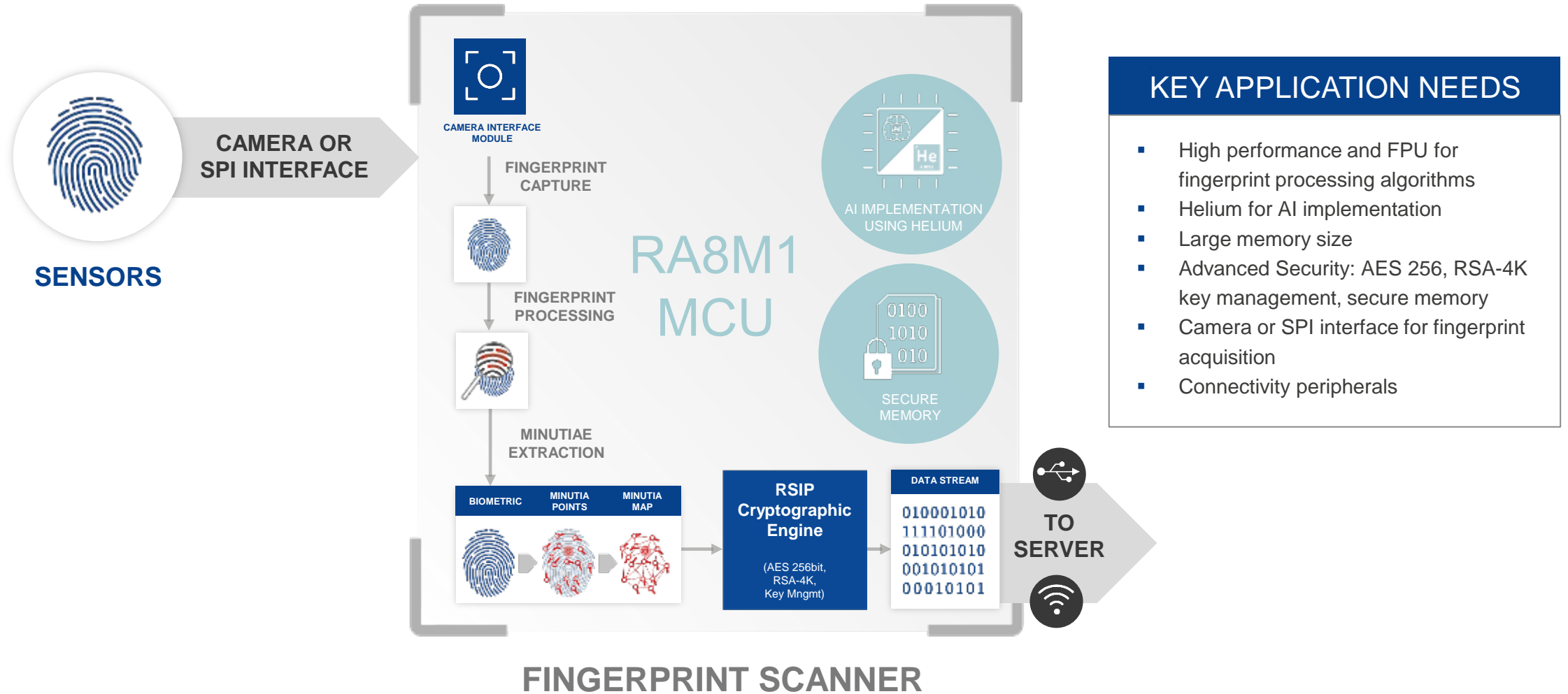


HEALTHCARE

- Patient Monitors
- Infusion pumps
- CPAP Machines
- Respirators
- Hospital beds



RA8M1 APPLICATION EXAMPLE: FINGERPRINT SCANNER BY MANTRA



SUMMARY & KEY TAKEAWAYS

- The convergence of AI & IoT is a megatrend that cannot be ignored
- With explosive growth in endpoint data creation a decentralized intelligence architecture will unlock tremendous potential
- Decentralization of intelligence has very real benefits & implications
- Renesas with its comprehensive offering of hardware, software, tools & ecosystem provides all the building blocks for you to unleash your creativity



RA8 Series

- **Industry's first 32-bit MCUs based on the new Arm[®] Cortex[®]-M85 core**
- Arm Helium technology provides up to **4x DSP and ML performance improvement** vs. Cortex M7-based MCU
- **Significant increase in performance (>6.3 CoreMark/MHz)**, bridging the gap between MCUs and MPUs
- Renesas remains committed to advancing AI/ML innovations by addressing rigorous demands of today's endpoint solutions, encompassing performance, latency, real-time response and power.

RENESAS' NEXT GEN AUTOMOTIVE DIGITAL PRODUCT ROADMAP

NOVEMBER 7, 2023

VIVEK BHAN

SENIOR VICE PRESIDENT, CO-GENERAL MANAGER OF
HIGH PERFORMANCE COMPUTING, ANALOG AND
POWER SOLUTIONS GROUP
RENESAS ELECTRONICS CORPORATION



AGENDA

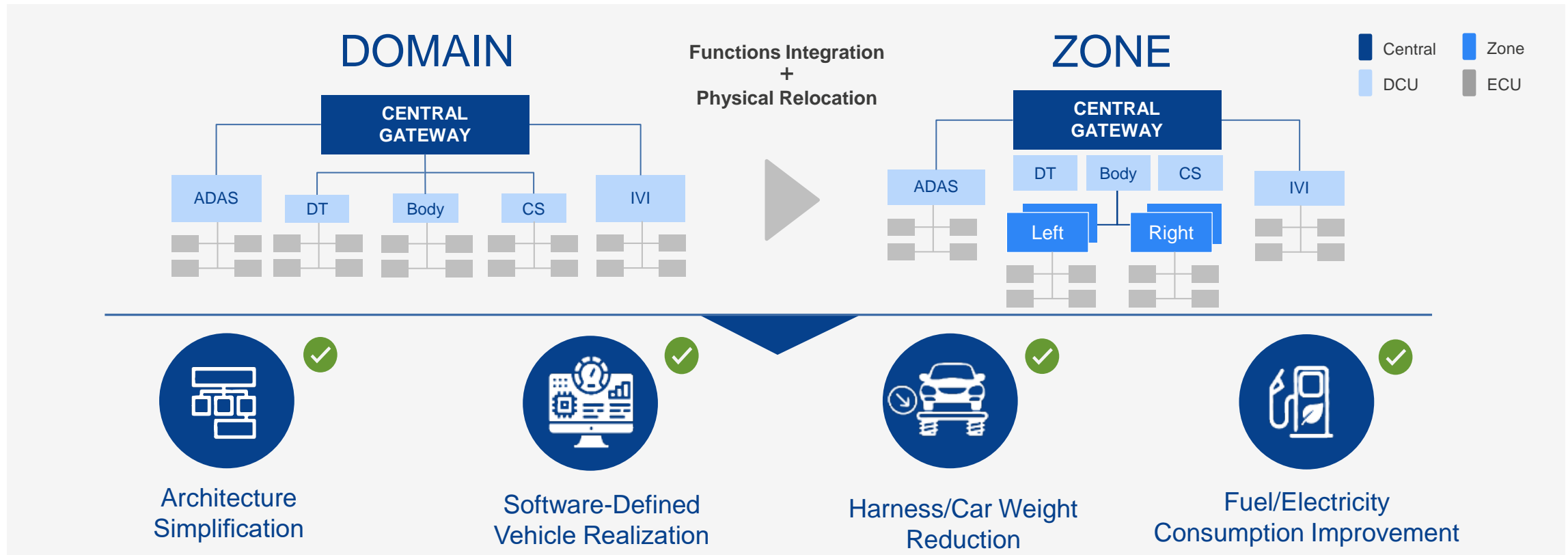
- R-Car Generation 5 (Gen 5) introduction
- R-Car Gen 5 SoC products
- R-Car Gen 5 MCU products

R-CAR GEN 5 INTRODUCTION



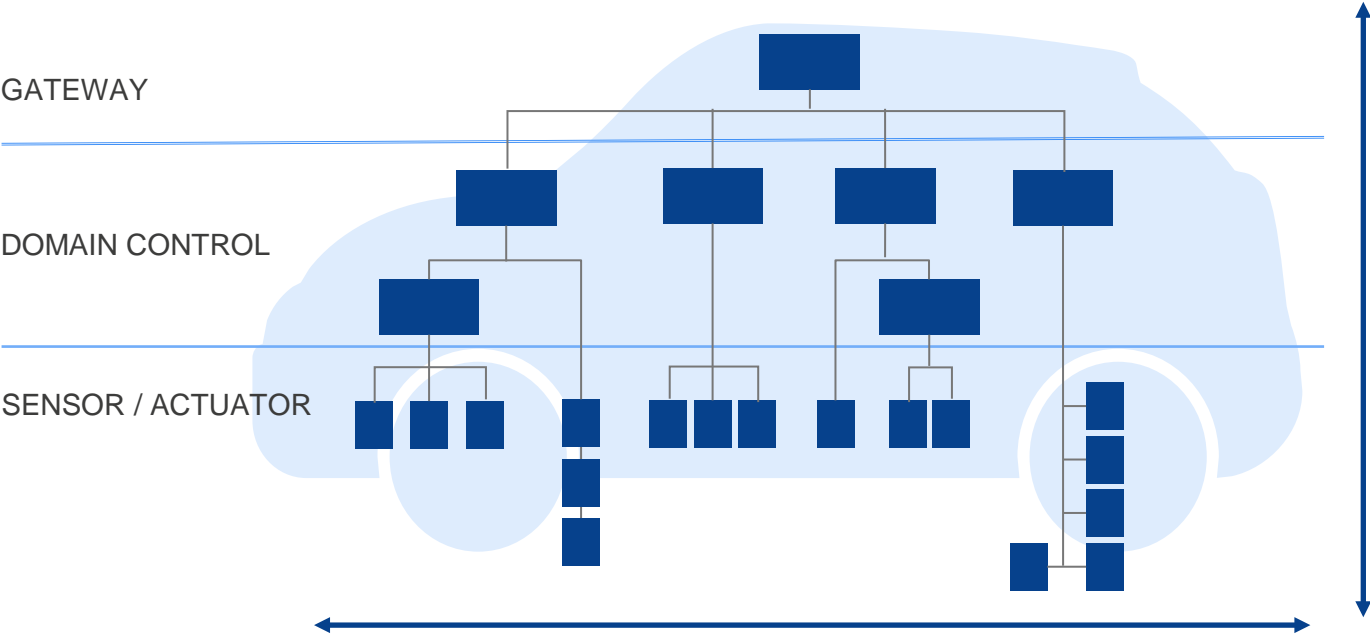
MARKET SHIFT TO CENTRALIZED E/E ARCHITECTURE

The market demands solutions to address E/E Architecture's shift to Centralized/Zonal Architecture

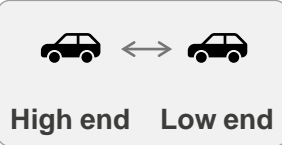


DCU: Domain Control Unit, ECU: Electronic Control Unit, DT: Drivetrain (Powertrain), CS: Chassis, IVI: In-Vehicle Infotainment,

RENESAS VALUE IN E/E ARCHITECTURE



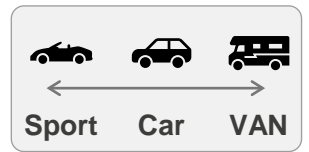
1 PERFORMANCE SCALING



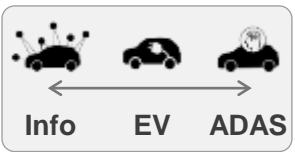
Across car grade

- High performance SoC
- World's leading cross domain 32bit MCU
- Best in class 16bit MCU

2 SW / IP COMMONALITY



Across car model



Across application



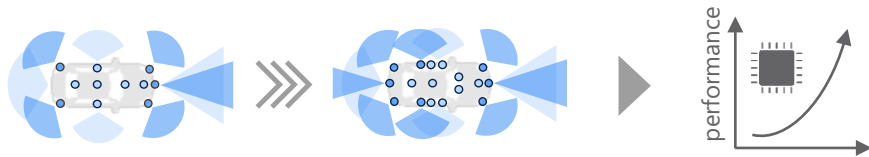
Across generation

- High SW reusability / portability
 - Fast Time to Market
 - Low Development Cost
- 

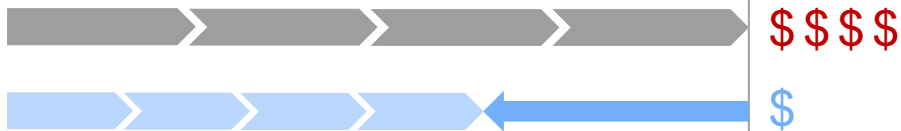
MARKET TRENDS AND CUSTOMER PAIN POINTS

Customer pain points

Increase Compute with Flexibility



Reduced Development Cost And Tat

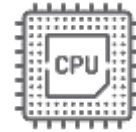


Upgradability



Renesas Initiatives

Chiplet Architecture



- Open Compute solutions deployed with industry-standard chiplets
- Modular HW and systems to meet OEM bespoke processing needs

Re-Use of Software



- Common SW framework across MCUs & SoCs
- 100% portability and re-usability across generations: cloud-based AI solutions

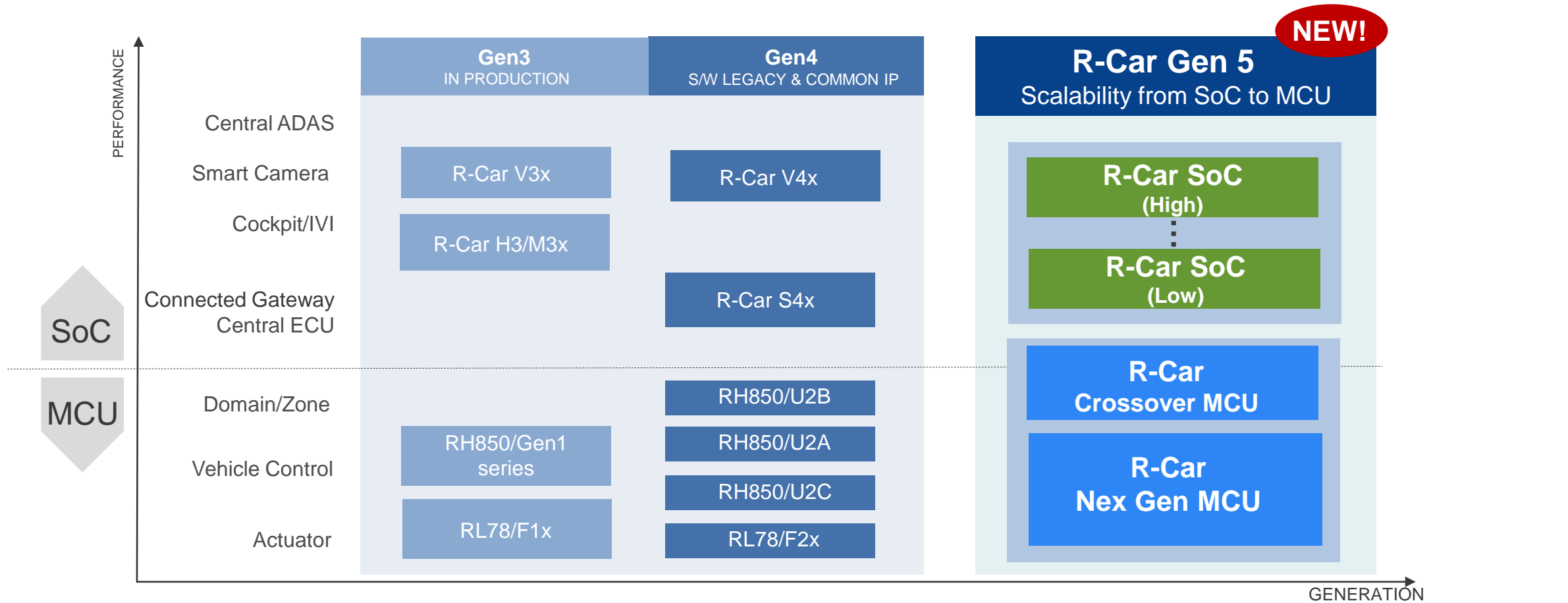
Shift Left + Cloud Initiatives



- Cloud based SW development for pre and post deployment
- Shift left – Software first approach for OTA ready solutions

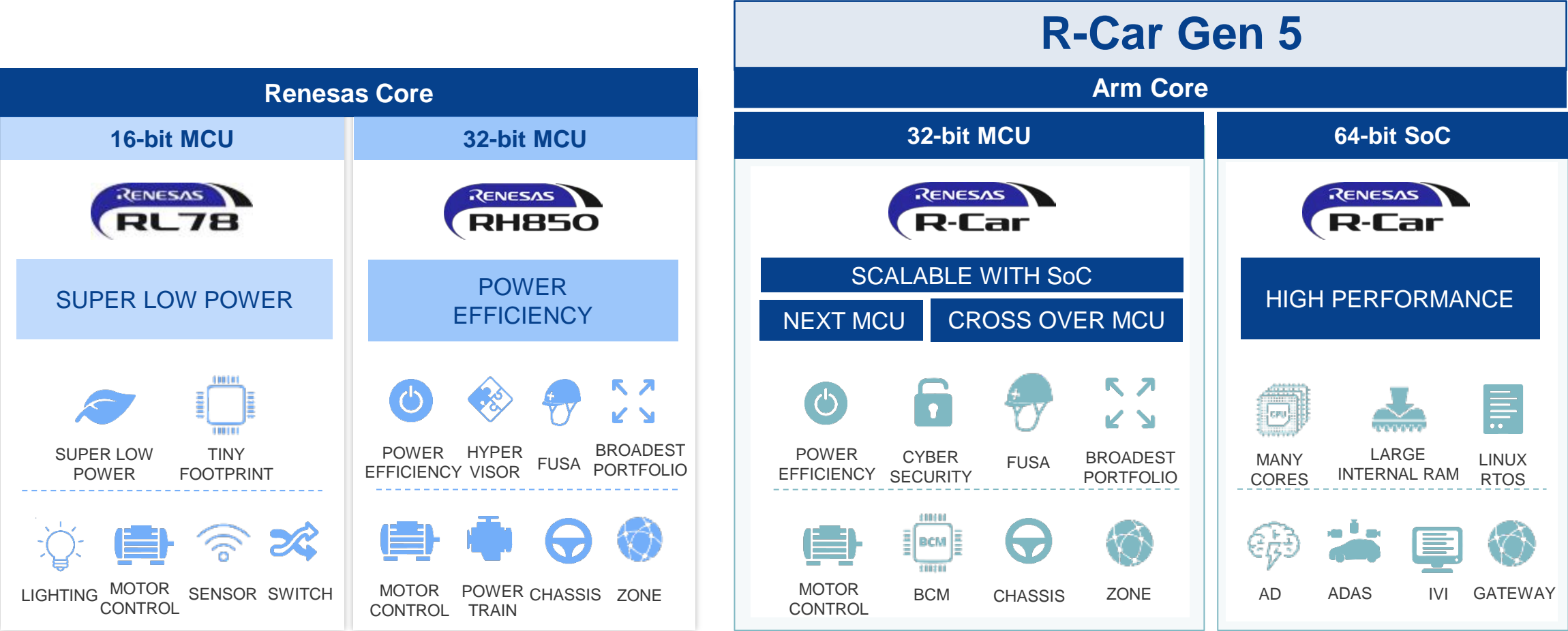
R-Car GEN 5 PRODUCT FAMILY – PERFORMANCE & SCALABILITY FOR THE NEXT DECADE

A versatile Arm-based platform offers scalability and flexibility, while allowing for the reuse of software assets across different products and generations.

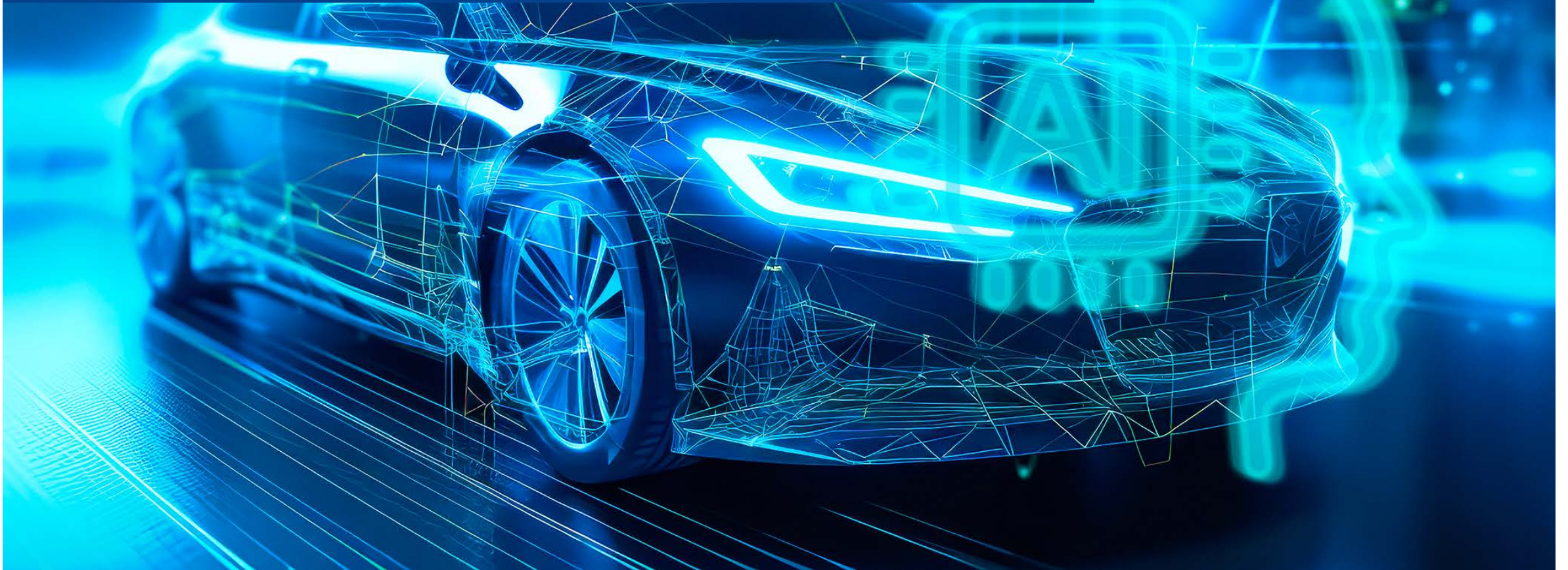


RENESAS' ENTIRE AUTOMOTIVE EMBEDDED PROCESSORS

Renesas provides for the various needs of our customers with a rich lineup of automotive MCUs and SoCs.

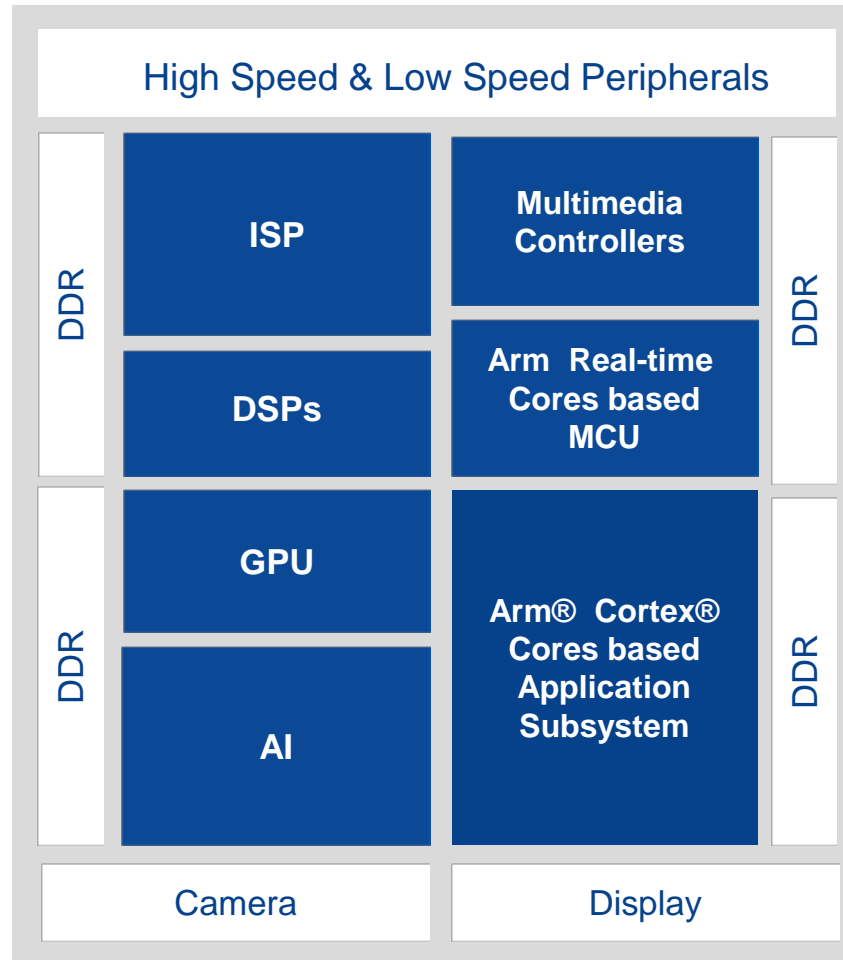


R-CAR GEN 5 SoC



R-CAR GEN5 SoC – ARCHITECTED FOR THE SOFTWARE DEFINED VEHICLE (SDV)

Chiplet Architecture



FUTURE PROOF

Designed with bleeding edge process technology

EFFICIENCY

Designed to meet Power requirements of Evs

SYSTEM OPTIMATION

Integrate Renesas industry leading Analog/Power and computing solutions

HIGH PERFORMANCE EDGE AI COMPUTE

- Highly efficient AI Solution
- Support for future extensions

CLOUD NATIVE SDV SOLUTION

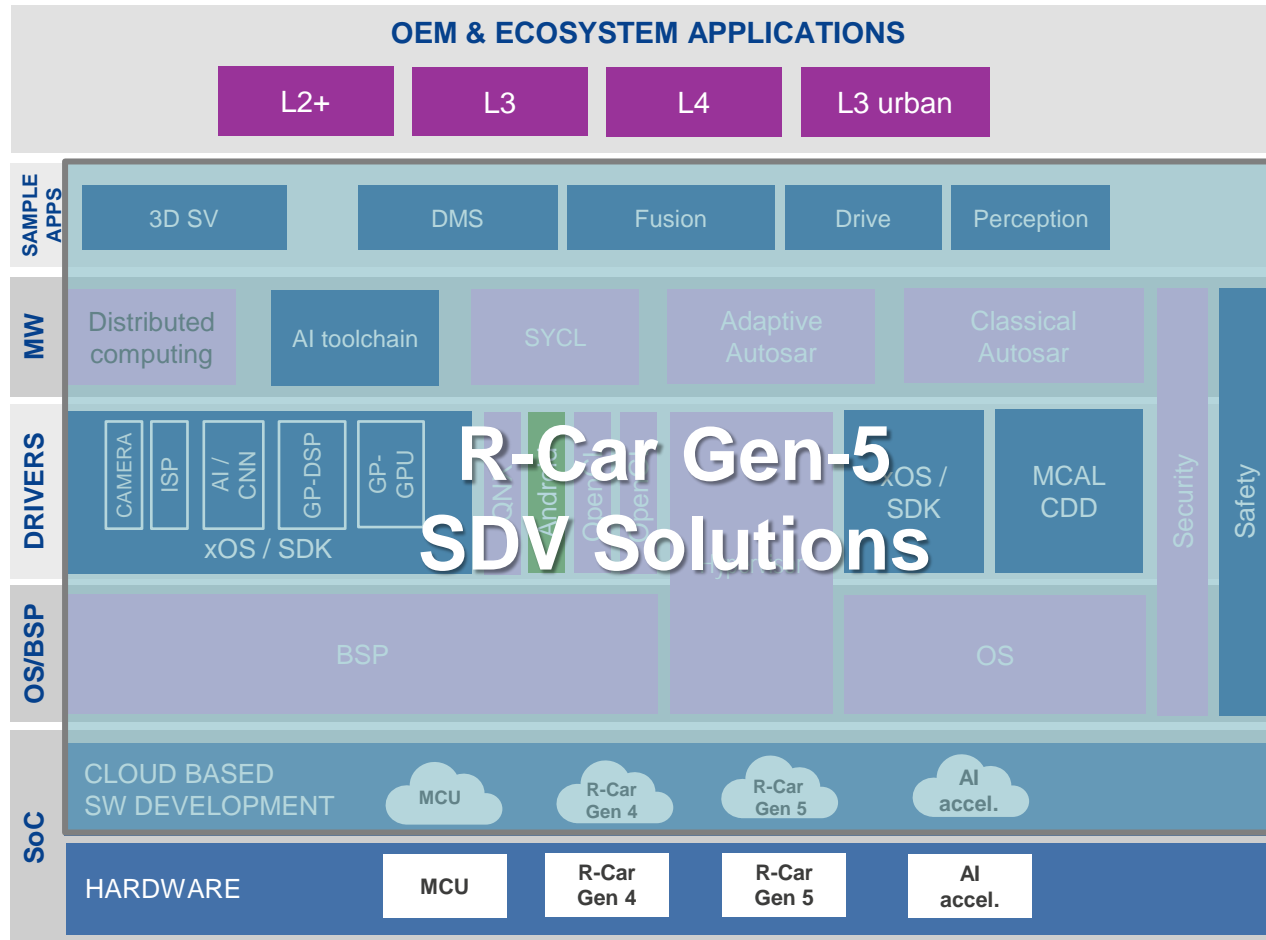
- Cloud and “shift left” enablement
- Support for OTA ready solutions

FLEXIBILITY

- Open compute platforms with modularity
- SW reusability with MCUs and R-Car solutions

ISP: Image Signal Processor, DSP: Digital Signal Processor, GPU: Graphic Processor Unit, DDR: Memory Interfaces, OTA: Over the Air, SDV: Software Defined Vehicle

R-CAR GEN 5 SDV ENABLING PLATFORM



R-Car Gen 5 Software Defined Vehicle(SDV) Solutions

- «Shift Left» enabled Software solutions – multi-generation & product family support
- Pre-integrated and validated including partners' solutions
- Cloud based development enabling OTA and upgradability post-deployment

- Renesas (Proprietary)
- Renesas (Open Source Software)
- Partner Products
- OEM Applications

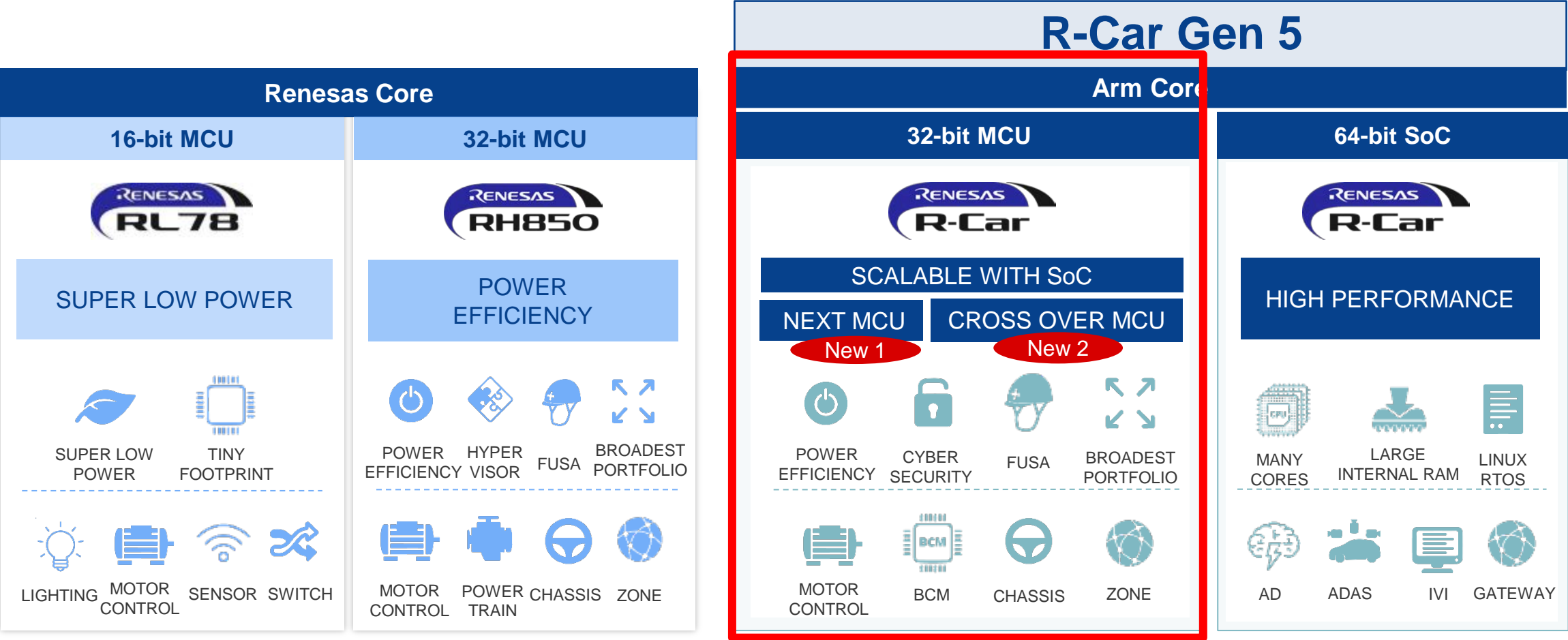
3D SV: 3D Surround View, DMS: Driver Monitoring System, MW: Middle Ware, SDK: Software Development Kit, CDD: Complex Device Driver, BSP: Board Support Package

NEXT GEN MICROCONTROLLERS

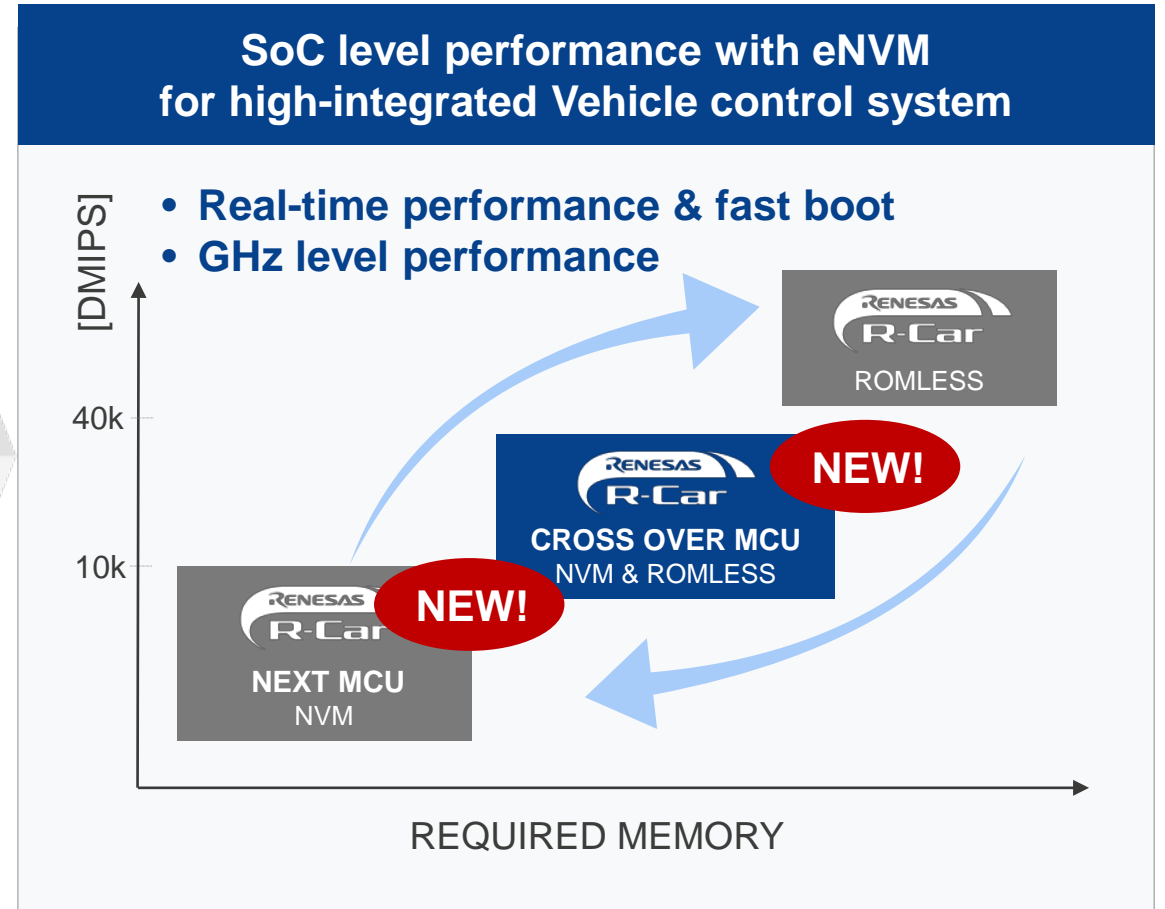
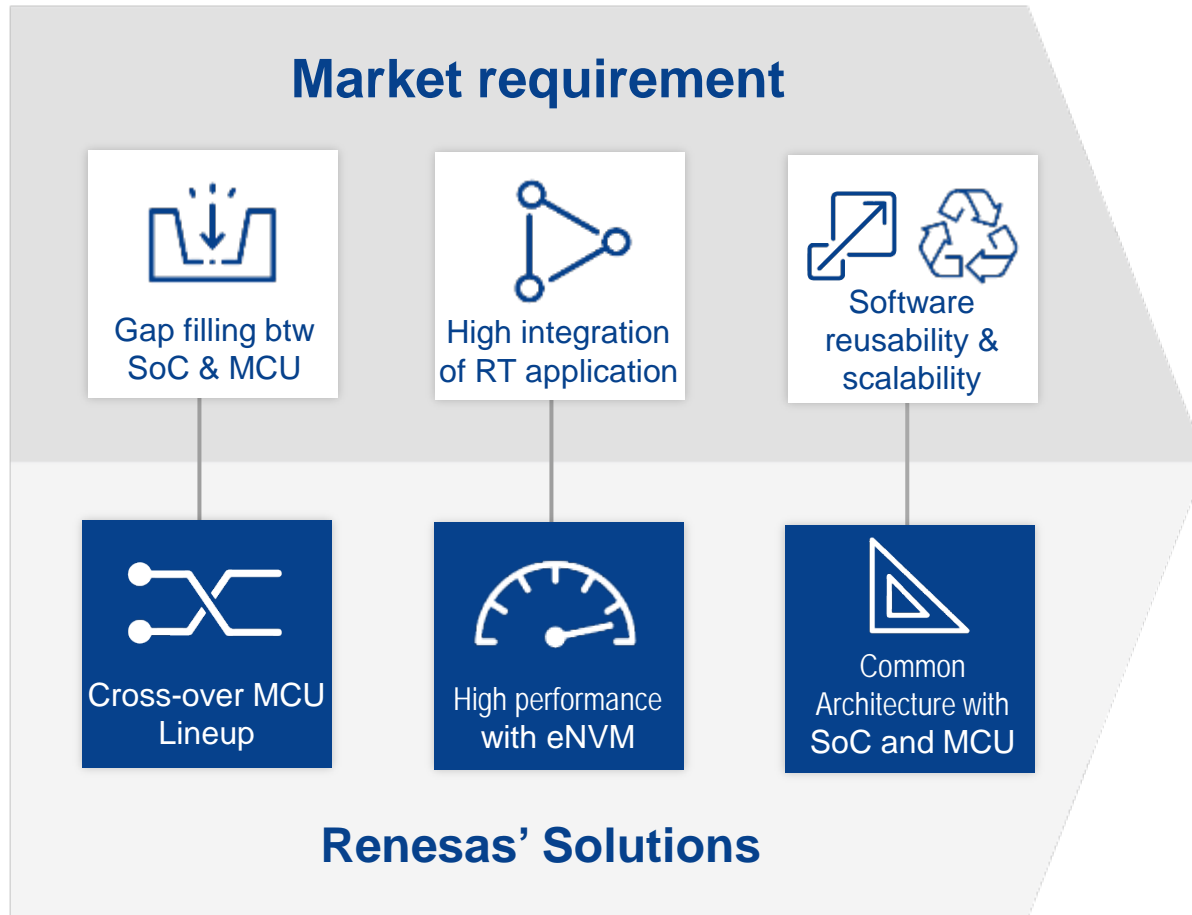


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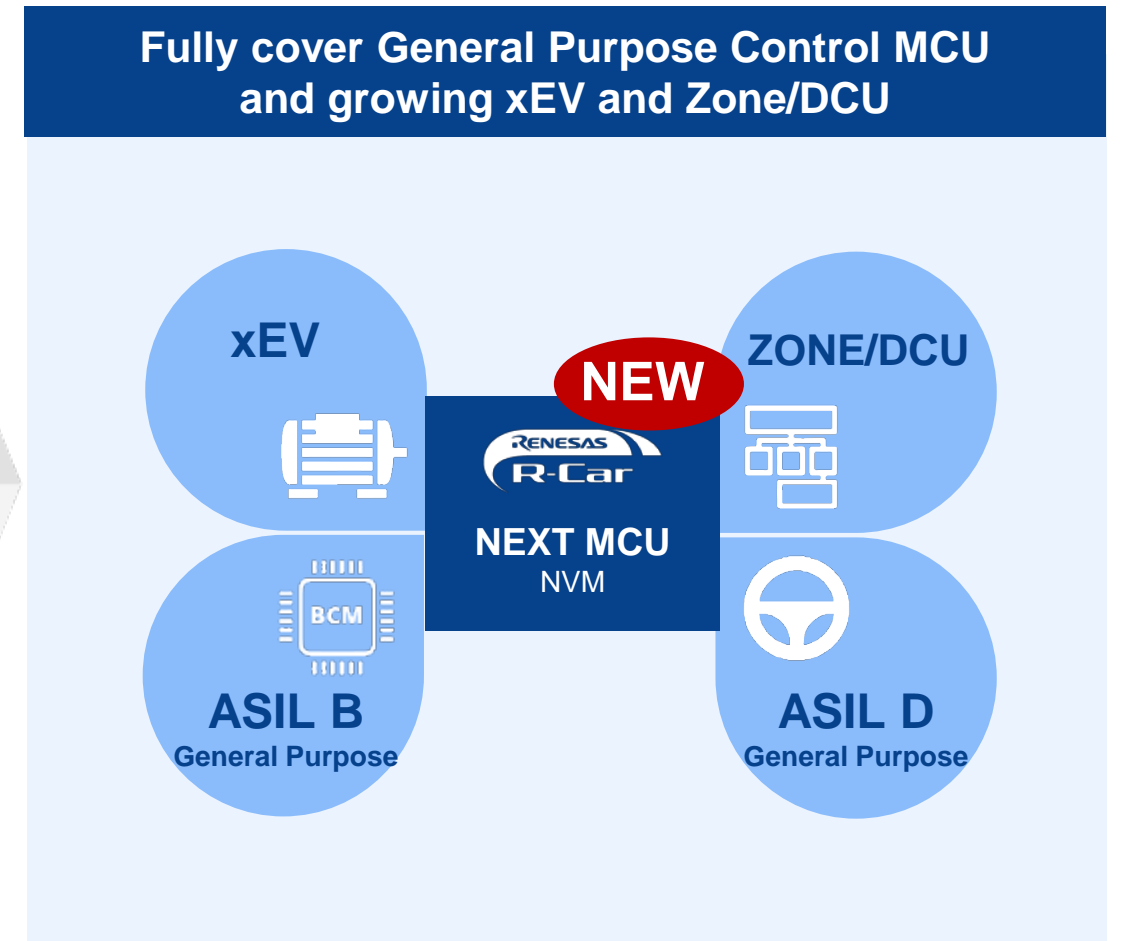
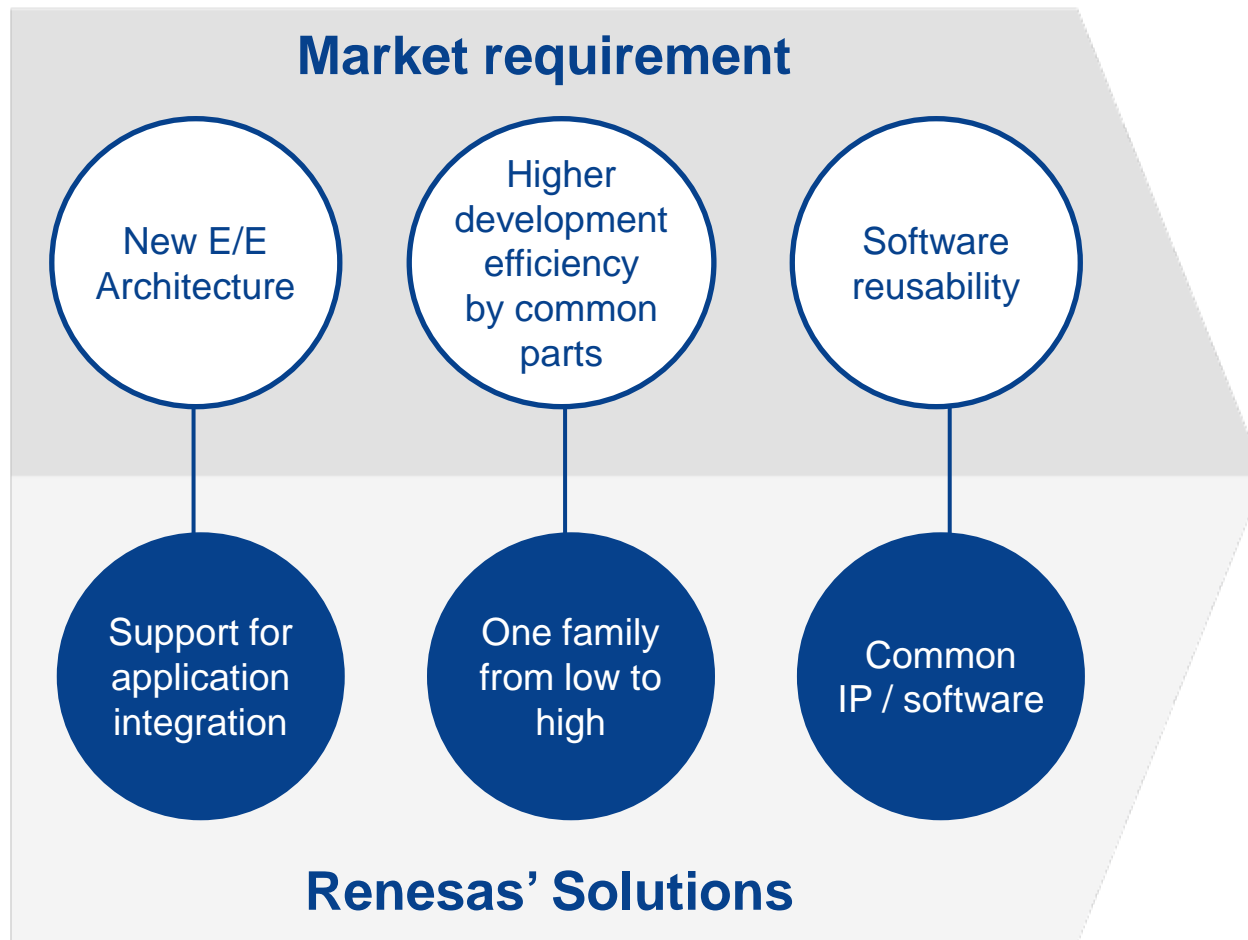


1. CROSSOVER MCU ARM FAMILY - CONCEPT



RT: Real Time, eNVM: embedded Non-Volatile Memory

2. NEXT-GEN MCU ARM FAMILY - CONCEPT



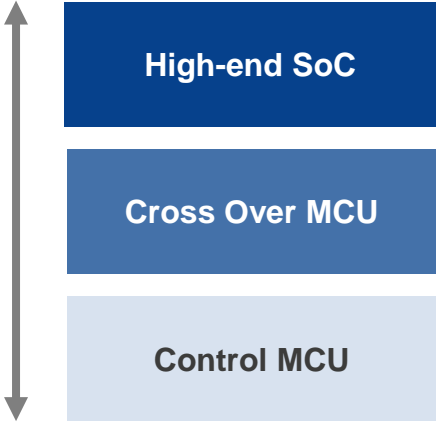
BCM: Body Controller Module, NVM: Non-Volatile Memory, DCU: Domain Controller Unit

SUMMARY OF R-CAR GEN5

Renesas develops R-Car Gen 5 products and SW development environments to enable customers to accelerate development and bring their mobilities to market faster.

SCALABILITY

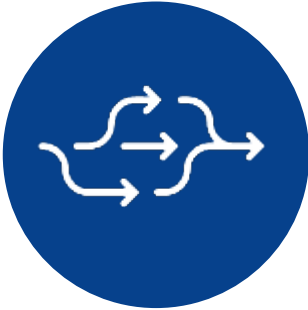
Expanded Arm Core lineup enables customers to reuse, upgrade, and portable software



The diagram illustrates the scalability of R-Car Gen 5. It features three stacked rectangular boxes of varying shades of blue. The top box is dark blue and labeled 'High-end SoC'. The middle box is a medium blue and labeled 'Cross Over MCU'. The bottom box is light blue and labeled 'Control MCU'. To the left of these boxes is a vertical double-headed arrow, indicating the range of software portability and reuse across these different SoC levels.

FLEXIBILITY


R-Car Gen 5 SoC incorporates chiplet technology to customize SoC designs with AI accelerators and other IPs



The icon for flexibility is a dark blue circle containing a white graphic of a central point with three arrows branching out to the right, and three arrows looping back to the center from the right, symbolizing a flexible and customizable design process.

SHIFT LEFT

Software platform enables Shift Left approach for earlier development and supports Software First concept



The diagram compares development timelines. The top part shows a light blue arrow pointing right, labeled 'Before', with a chiplet icon to its left and a grey arrow pointing left towards it. The bottom part shows a dark blue arrow pointing right, labeled 'With R-Car Gen 5', with a computer monitor icon to its left. This visualizes the 'Shift Left' approach where development starts earlier in the process.

THANK YOU !

ANY QUESTIONS?

RENEASAS

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