electronica 2022

TECHNOLOGY UPDATES AT ELECTRONICA

RENESAS ELECTRONICS CORPORATION

NOVEMBER 16

AGENDA

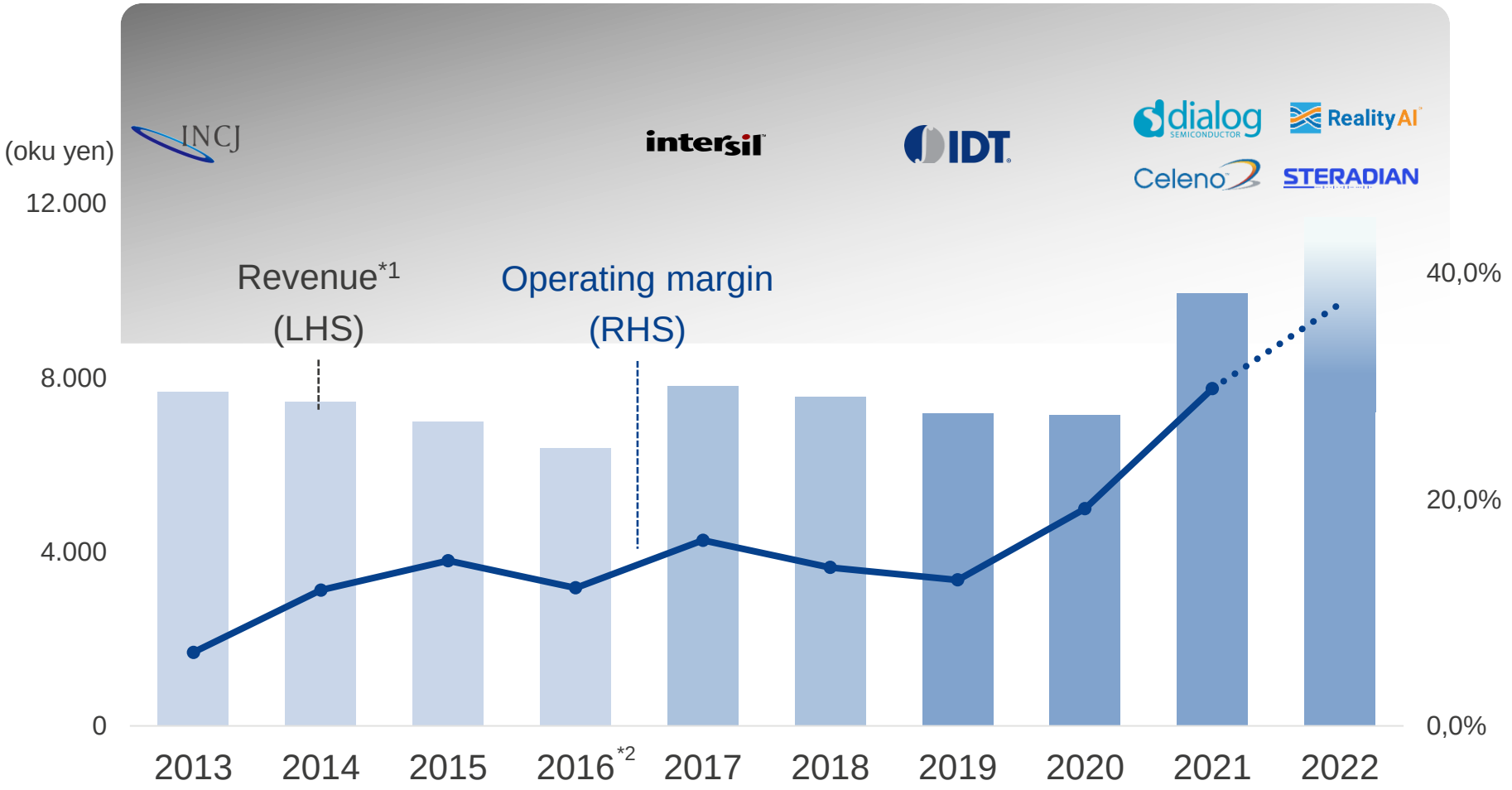
Time	Topic	Spokesperson
11:00 – 11:20	Renesas' IoT connectivity solutions & technology announcements	**Sailesh Chittipeddi**, Executive Vice President and General Manager of IoT and Infrastructure Business Unit (IIBU)
11:20 – 11:30	IIBU Q&A	
11:30 – 11:40	Renesas' automotive business strategy update	**Takeshi Kataoka**, Senior Vice President and General Manager, Automotive Solution Business Unit (ABU)
11:40 – 11:50	ADAS and EV strategy update & new product announcement	**Vivek Bhan**, Senior Vice President and Deputy General Manager of Automotive Solution Business Unit (ABU) & Head of Analog, Mixed Signal & Power Business
11:50 – 12:00	ABU Q&A	
12:00 – 13:00	Lunch & refreshments	

IOT & CONNECTIVITY TECHNOLOGY UPDATES

SAILESH CHITTIPEDDI
EXECUTIVE VICE PREISIDENT & GENERAL MANAGER
IOT AND INFRASTRUCTURE BUSINESS UNIT (IIBU)

RENESAS

OUR GLOBAL JOURNEY



Revenue

+17.7% CAGR

2019 – 2021

Operating margin

+16.9 pts

2019 – 2021

Market cap

3.2X *3

2019 – 2022 YTD

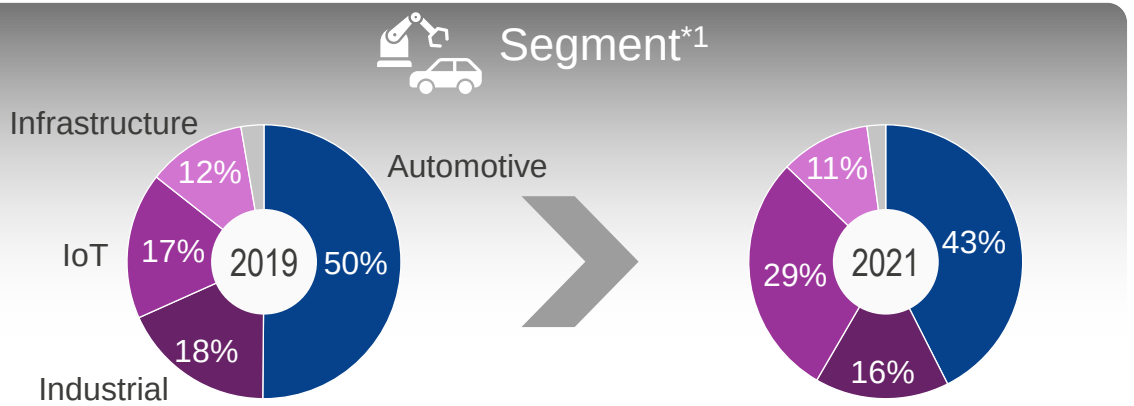
*1: JGAAP/Non-GAAP in 2013 to 2017, IFRS/Non-GAAP in 2018 and on. Revenue of Intersil consolidated from March 2017, IDT from April 2019, Dialog from September 2021, Celeno from January 2022
*2: Fiscal year changed in 2016. 2015 indicates April 2015 to March 2016, and 2016 indicates January to December 2016 *3: 2019/1/4 – 2022/9/22

RENESAS AS A GLOBAL LEADER

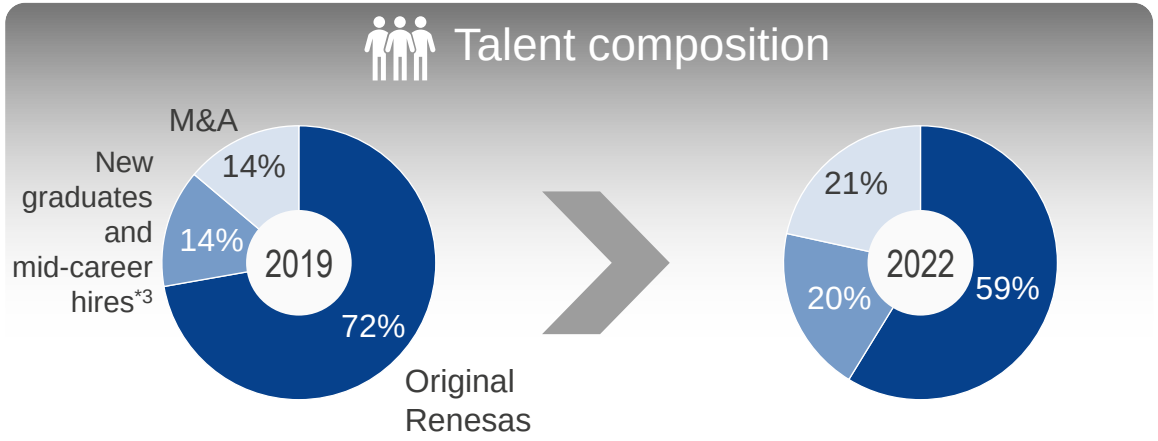
Product*1

Geography*2

Segment*1



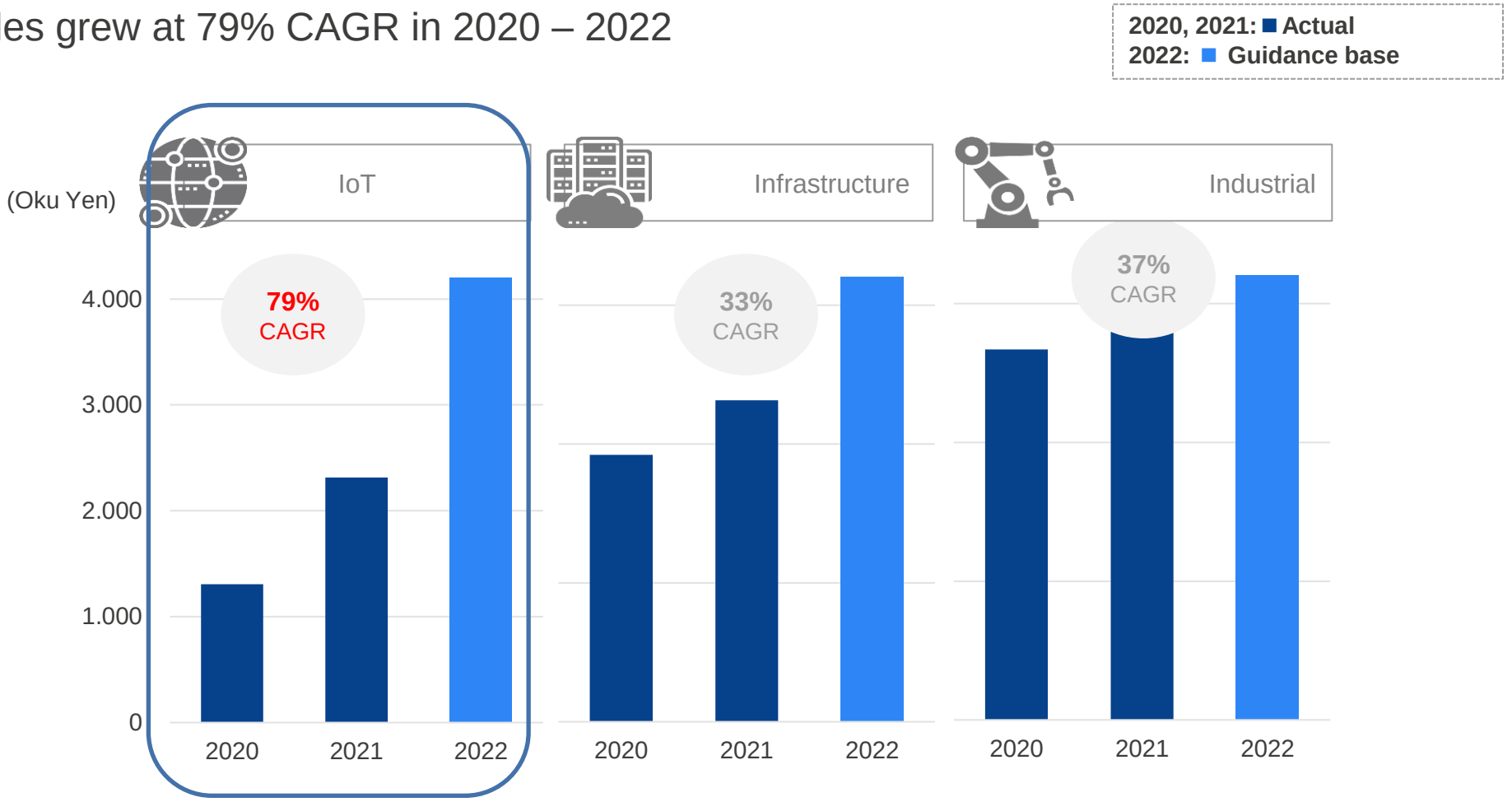
Talent composition



*1: Revenue, Including proforma-based IDT in 2019, Including proforma-based Dialog, excluding Celeno in 2021 *2: R&D headcount *3: New graduates and mid-career hires since 2016

IOT, INDUSTRIAL AND INFRA BU FINANCIAL TRENDS AT A GLANCE

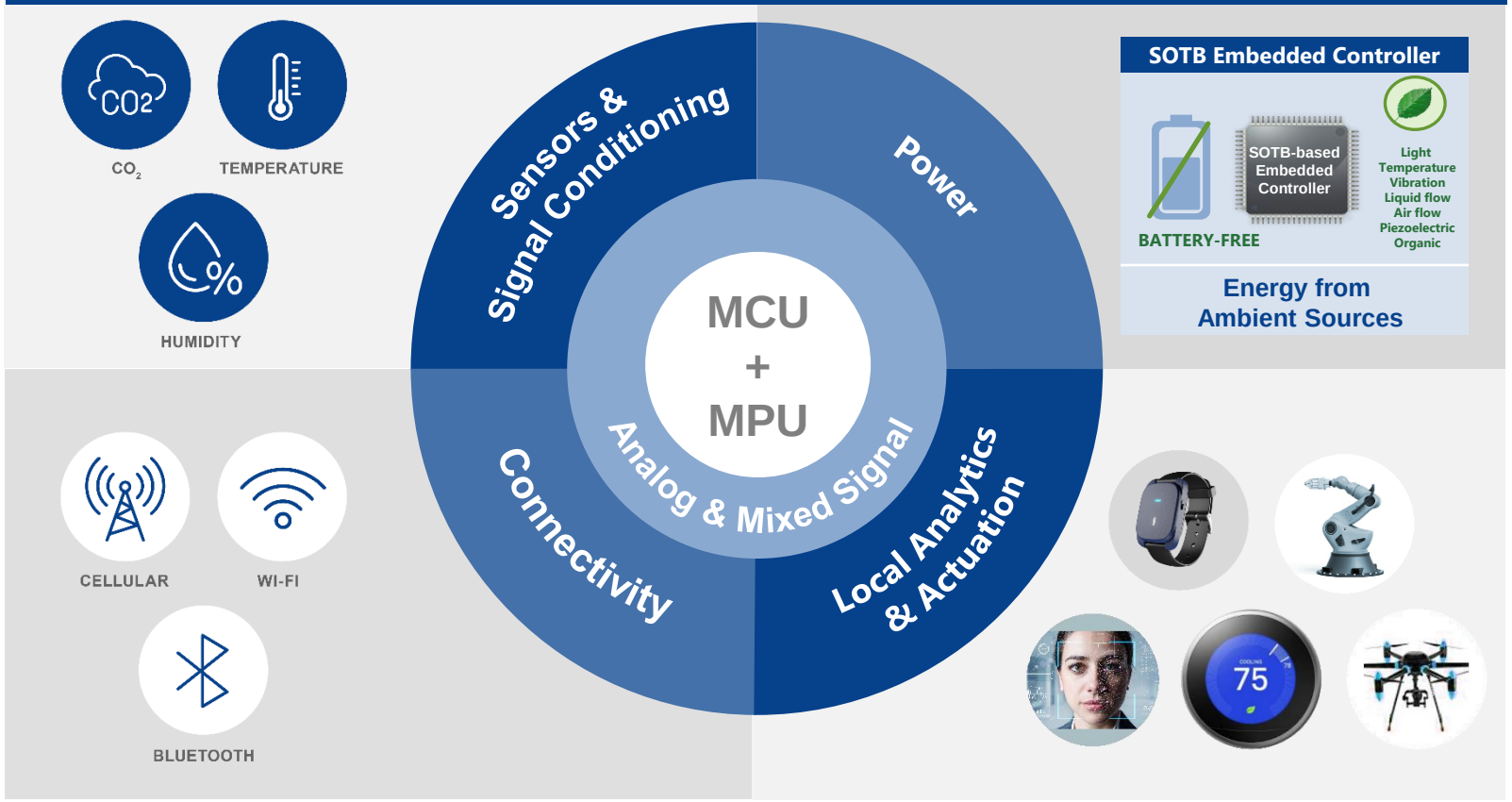
- IoT sales grew at 79% CAGR in 2020 – 2022



MCU + ANALOG / POWER SOLUTIONS

DIVERSIFIED SYSTEM SOLUTIONS FOR OUR CUSTOMERS

TRADITIONAL ELEMENTS FOR DIFFERENTIATION



SYSTEM DIFFERENTIATION

Interfaces & e-AI

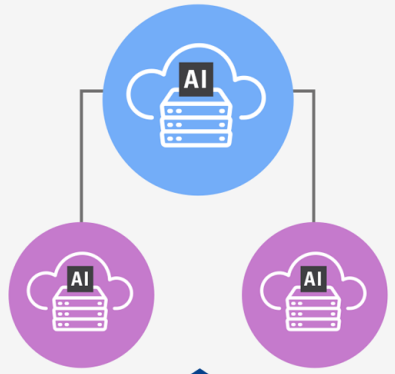
Software Tool Chain Ecosystem

Security

CONVERGENCE OF AI, IOT AND 5G

EVOLUTION OF THE CONNECTED INTELLIGENT EDGE

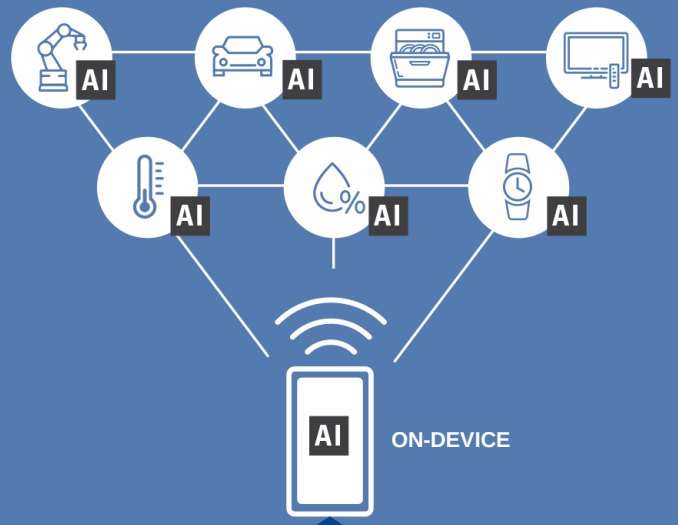
Processing data closer to devices at the edge derives new System values (e.g., lower latency, enhanced privacy)



CLOUD

EDGE CLOUD

NETWORKS (PUBLIC AND PRIVATE)

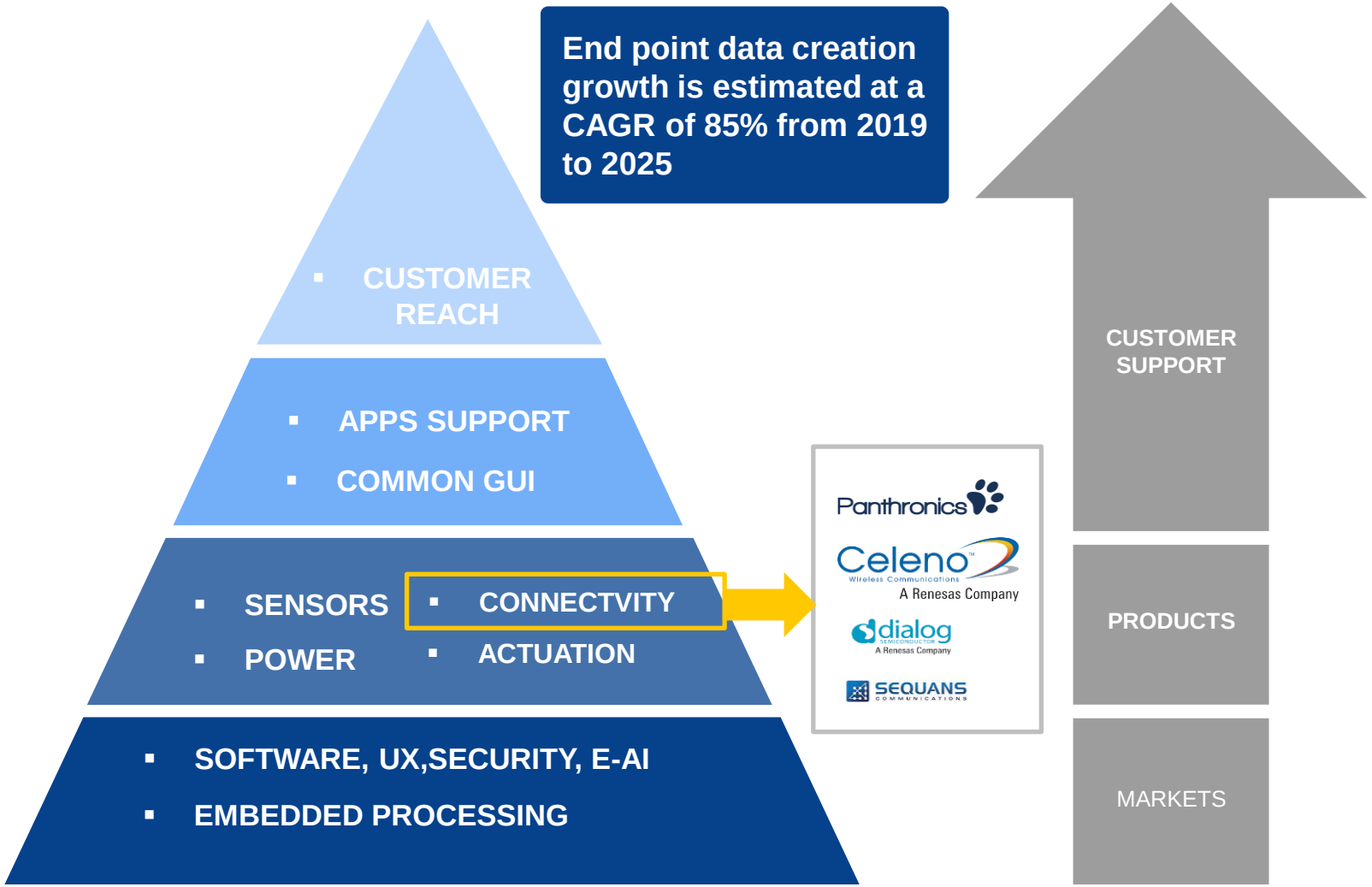


5G

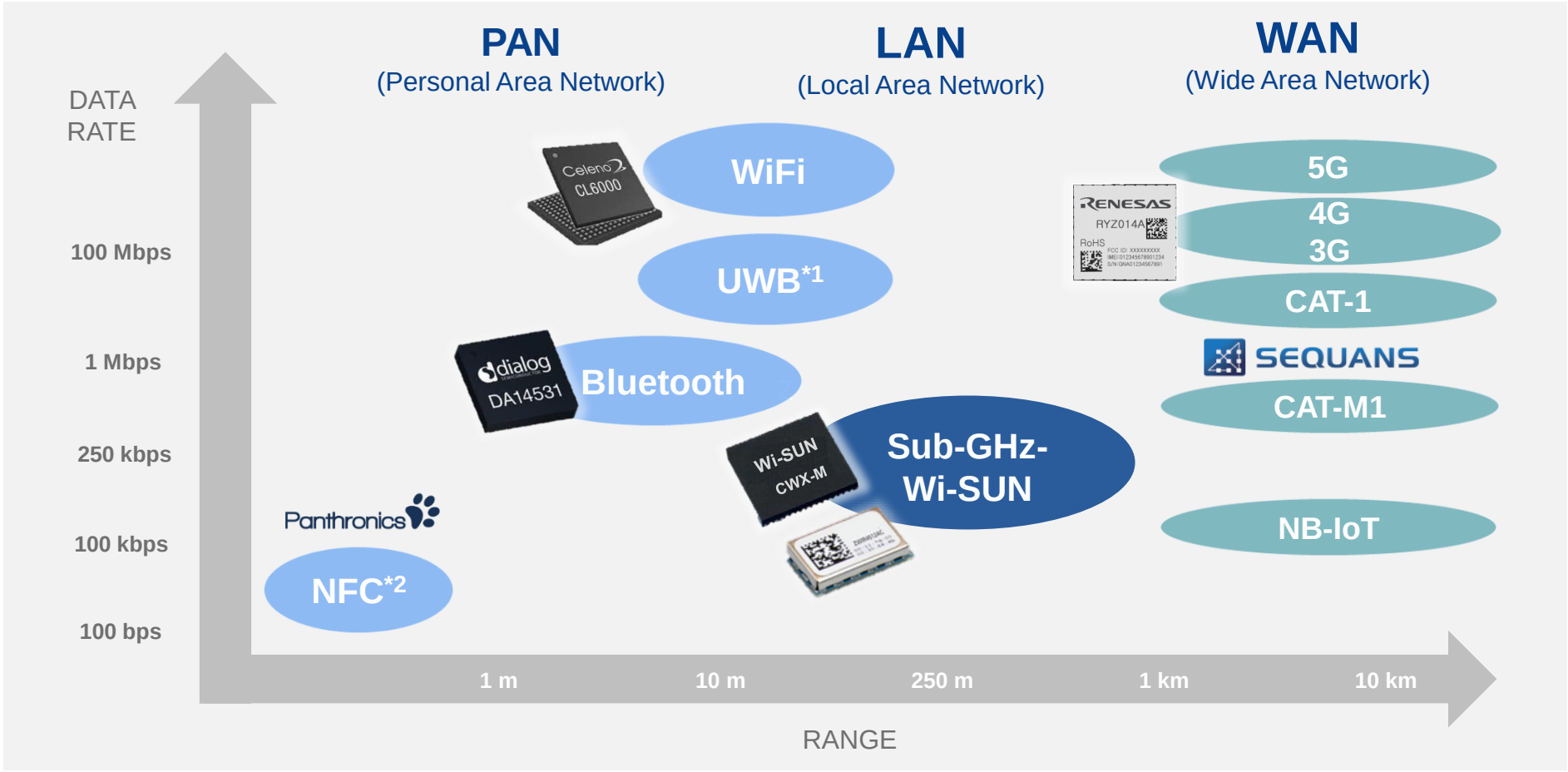
PAST	TODAY	TODAY
Cloud-centric AI	**Partially-distributed AI**	**Fully-distributed AI**
AI training and Inference in the central cloud	Power-efficient on-device AI inference	With constant on-device learning

RENESAS

MOVING INTELLIGENCE FROM CORE TO END POINT SUSTAINABLY



RENESAS WIRELESS CONNECTIVITY:
ENABLING SEAMLESS CLOUD ENABLEMENT



SHORT RANGE

LONG RANGE

CELLULAR

30+ NEW

WINNING COMBOS WITH CONNECTED PORTFOLIO

*1: UWB: Ultra Wide Band *2: NFC: Near Field Communication

IIBU ANNOUNCEMENT – 1

NEW WI-FI 6/6E CONNECTIVITY SOLUTION

WI-FI STATE OF THE INDUSTRY AND WI-FI 7 OUTLOOK

Renesas Wi-Fi chipset opportunity by application in 2022

SMART HOME | ACCESS POINTS | CONSUMER VIDEO | INDUSTRIAL | AUTOMOTIVE

In 2022 – **4.4B** new devices expected to be shipped, reaching a total of **18B** devices in use[1]

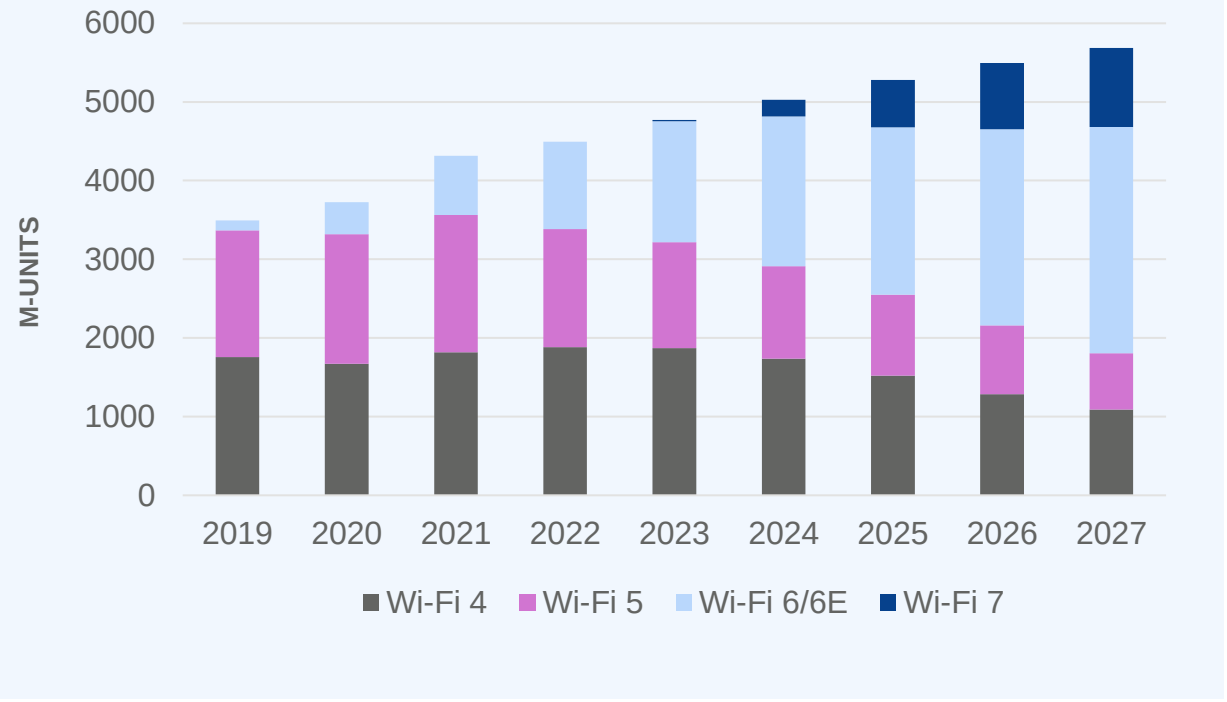
- Out of which over **2.5B** devices will be Wi-Fi 6 (58% in 2022, from 43% in 2021) [2]
- **350M** devices will be Wi-Fi 6E[1]
- **58M** Wi-Fi 6E access points[1]

Wi-Fi 7 is expected to launch in 2024

- **1B+** Wi-Fi 7 devices are expected to ship in 2027
- 140M Wi-Fi 7 AP in 2027, counting 25% of all AP devices shipped
- 856M Wi-Fi 7 Devices in 2027, counting 17% of all devices shipped

(source: IDC, wireless connectivity forecast, 2020 and Renesas)

Wi-Fi market by standard



Source: TSR, Wireless Connectivity Market, 202

NEW WI-FI BLUETOOTH COMBO DEVICE FOR HIGH THROUGHPUT APPLICATIONS

Synergy Effect of Celeno Acquisition

COVERAGE AND PERFORMANCE

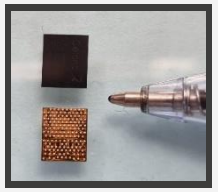
- 2x2 antennas, 160 MHz bandwidth for 2.4 Gbps
- 2.4 GHz, 5 GHz and 6 GHz bands
- Station, Peer to Peer and Soft AP modes
- Multi-user modes for higher performance in dense deployments

SUPPORTED MODES

- BLE 5.2 Audio
- BLE 2Mbps
- BT classic

SYNERGIES

- Pre-integrated, pre-tested with RZ 32bit/64bit MPU portfolio



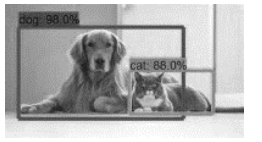
RENESAS RZ

SECURITY

- WEP 64/128, WPA, WPA2, WPA3, WPA3 Enterprise, AES, TKIP

POWER

- Single 3.3v supply with internal PMU



MACHINE VISION ENDPOINTS

HMI

EDGE IIOT GW

INDUSTRIAL AUTOMATION

SURVEILLANCE

GAMING CONSOLES

MULTIMEDIA

RENESAS

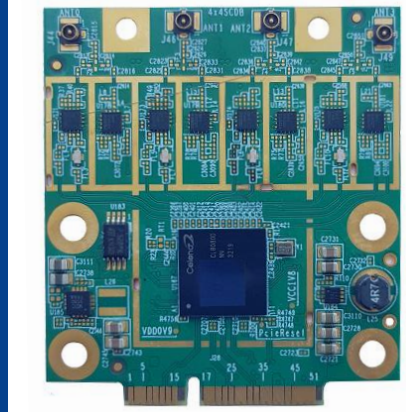
WI-FI FAMILY FOR ACCESS POINTS AND PREMIUM DEVICES

COVERAGE AND PERFORMANCE

- Up To 6gbps Of Throughput, 4x4+4x4 And 160mhz Bandwidth
- 2.4ghz, 5ghz And 6ghz Bands
- Ap, Station And Peer To Peer Modes
- Multi-user Modes For Higher Performance In Dense Deployments

COST EFFECTIVE, SIMPLIFIED ARCHITECTURE

- Two transceivers in one IC
- Using a single mPCIe bus
- Ideal for entry-level 2x2+2x2 solution as well as Triband and Quadband nodes



SECURITY

- WEP 64/128, WPA, WPA2, WPA3, WPA3 Enterprise, AES, TKIP

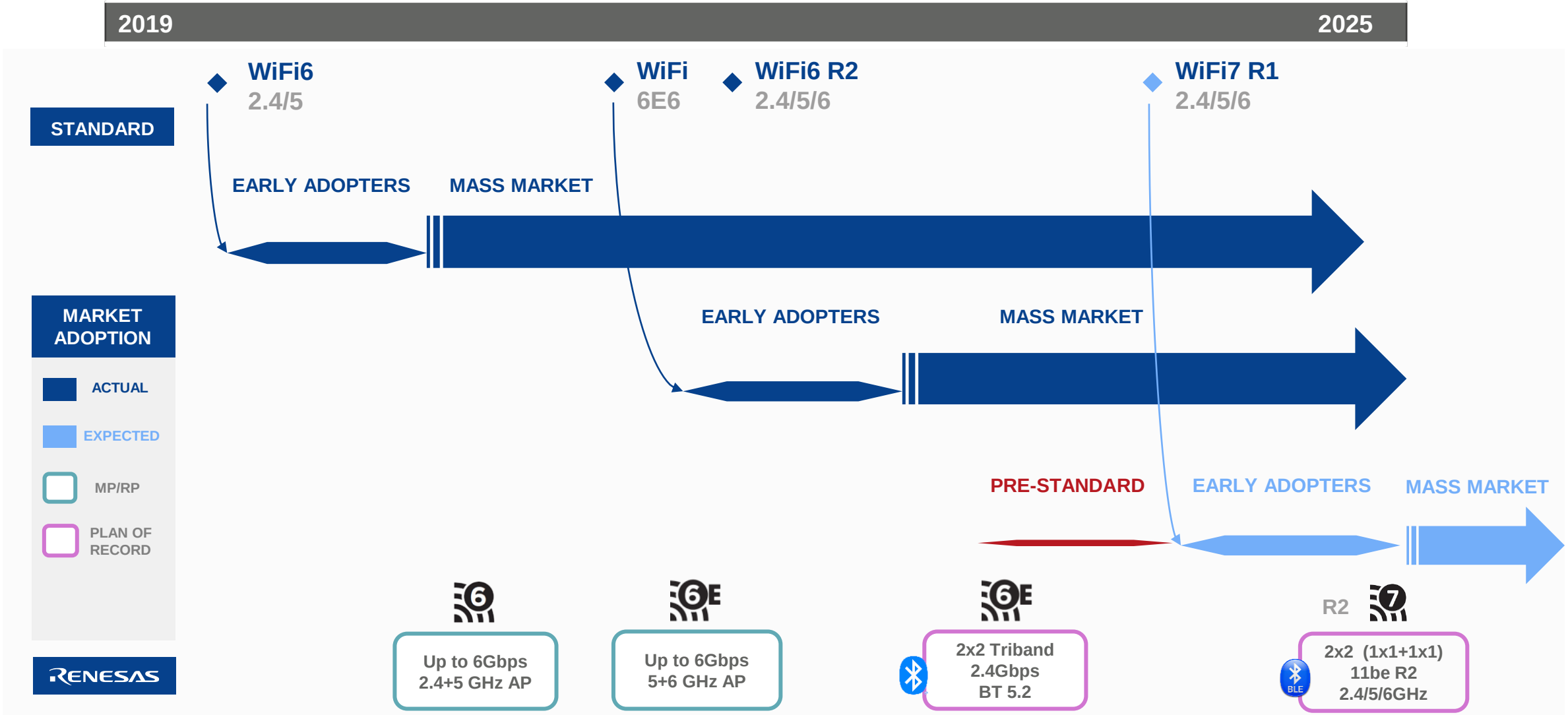
REDUCED POWER

- ~30% less power due to effective architecture – condensed two transceivers in a single IC

SYNERGIES

- Pre-integrated, pre-tested with RZ 32bit/64bit MPU portfolio

WI-FI STANDARD OUTLOOK AND RENESAS ROADMAP

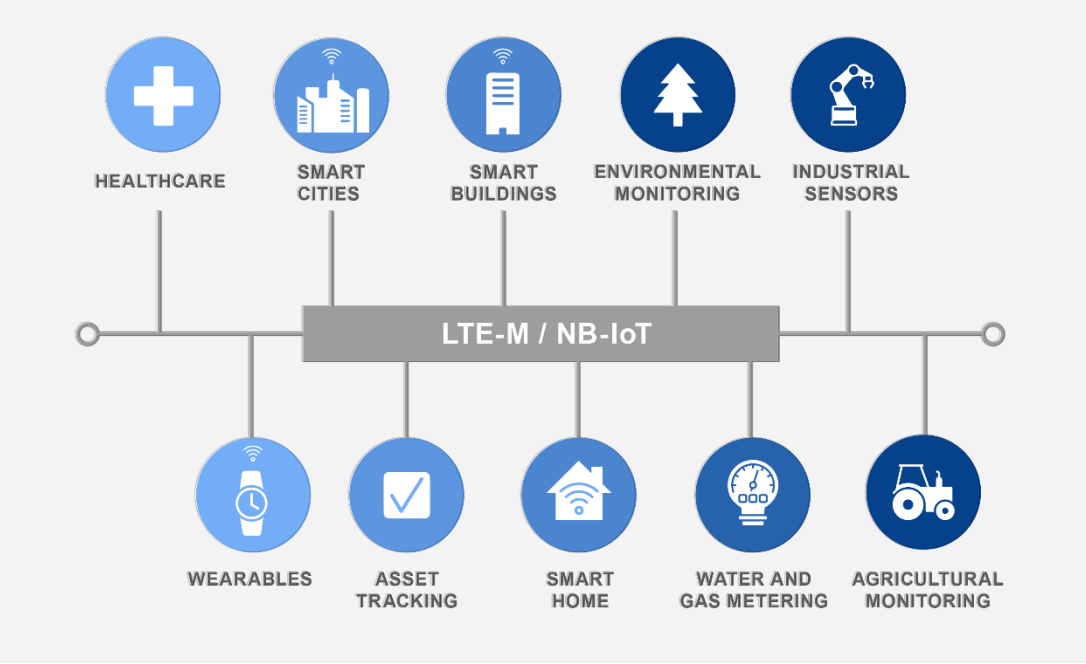


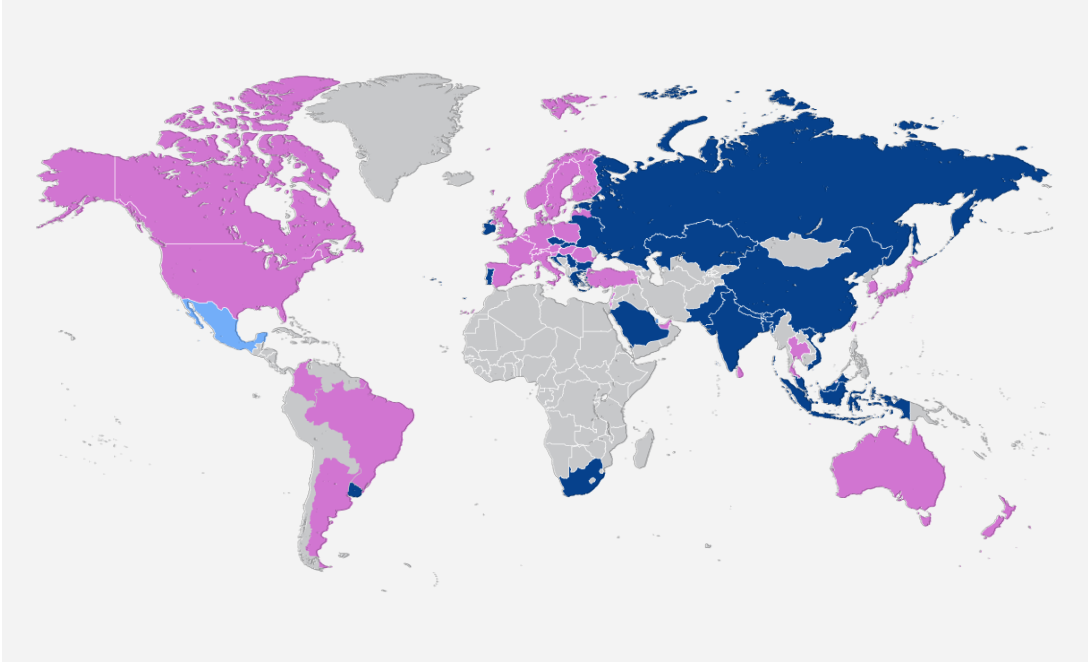
IIBU ANNOUNCEMENT – 2

2ND GENERATION CAT-M1 MODULE WITH NB IOT

MARKET LANDSCAPE FOR CAT-M1 AND NB-IOT

- Cat-M1 & NB-IoT cover almost 75% of the world population*.
- It is estimated that by 2024** there will be ~ 200 million Cat-M1/NB-IoT devices in the field.
- Both Cat-M1 and NB-IoT to be adopted in many IoT segments





* GSMA coverage map
* *Renesas estimates

NEW SECOND-GENERATION RYZ024A WIRELESS MODULE

REDUCED COST

- **60% PCB** reduction
- **Lower** manufacturing cost

WIDE POWER RANGE

- **2.2V to 5.5V** operation
- No **DC-DC converter** for **USB charger**

POWER SAVINGS

- World's lowest **PSM** (**1µA**)
- Industry lowest **eDRX**
  - 48µA@81.92s
  - 3µA@43min
- **Battery friendly** transmit power

COVERAGE

- **Native +23dBm** PA ensures **coverage at cell edge** and **deep indoor** environments

FC GCF KDDI verizon PTCRB IC NTT docomo AT&T

Global Certification and Carrier coverage

LONGEVITY

- Trusted long-term availability in line with Renesas portfolio

ESSENTIAL IPR

- **Full coverage** against 3GPP IPR including customers ability to enforce locally [1]

SECURITY & TRUST

- **Native** Secure Enclave that can be EAL5+ PP084 common criteria certified
- **100% ownership** with no trusted 3rd party IP

[1] *Offering EIPR must accompany ability to enforce. Some companies have no local employees as they are contractors which means customers cannot enforce EIPR protection in the USA.*

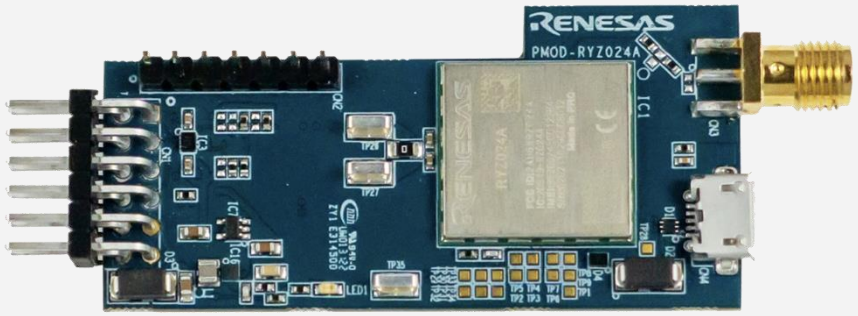
RYZ024A WIRELESS MODULE (PMOD)
ADDING CELLULAR IOT CONNECTIVITY TO ANY RENESAS MCU KIT

PMOD Out-of-Box guide

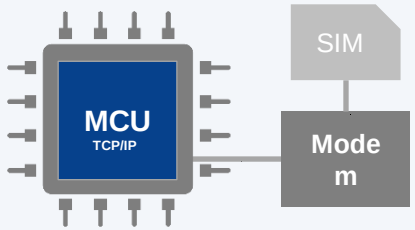
- Small form factor PMOD with mounted RYZ024A
- Quick start guide
- Sample program for RA/RX Family of MCUs

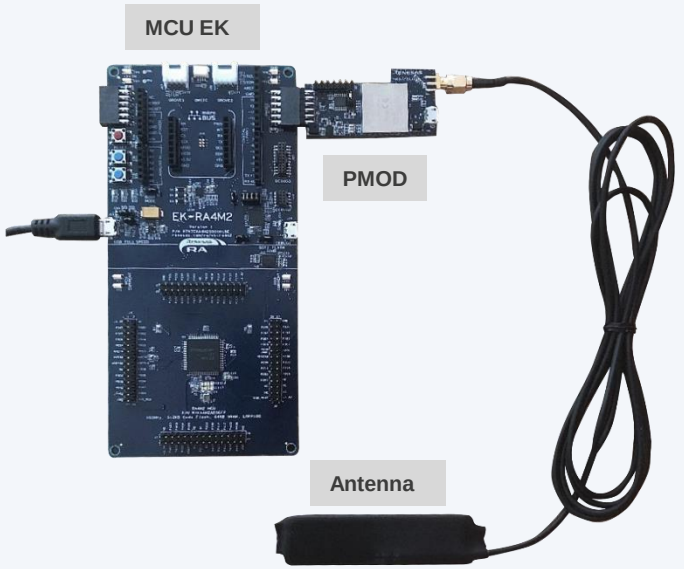
Usage and operations

- Connect RYZ024A PMOD to a Renesas RA, RX or cloud connectivity kit
- Send commands to the module via SPI or UART
- Sending data through AT commands



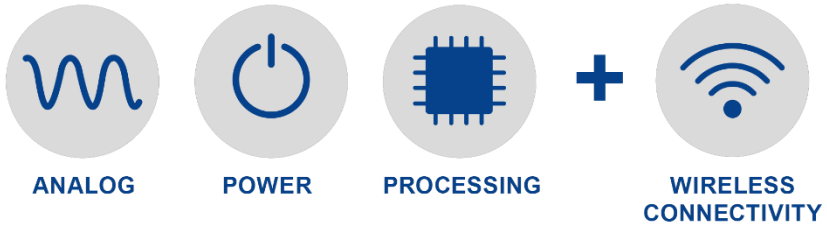
TCP/IP stack
in MCU



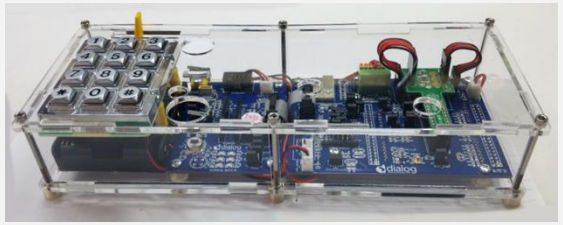


WINNING COMBINATIONS

WIRELESS CONNECTIVITY ADDS FOURTH DIMENSION TO RENESAS SOLUTIONS

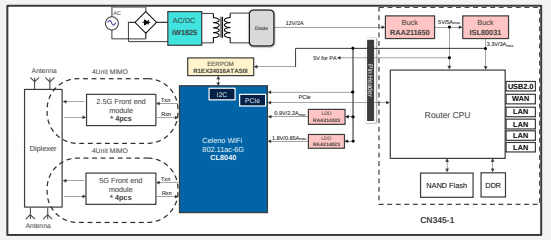


- Wireless Connectivity strengthens our Winning Combinations by enabling end-to-end solutions for a wide breadth of new applications.
- Renesas can accelerate customer designs with reference block diagrams, schematics, and production ready proof of concepts.



Smart Door Lock Proof of Concept

Asset Tracking Data Logger



Wi-Fi 6 Router Block Diagram

SUMMARY

Transformed into an AIoT Powerhouse

Embedded Processing Leadership

Edge & End-Point AI

Analog & Mixed Signal

Power

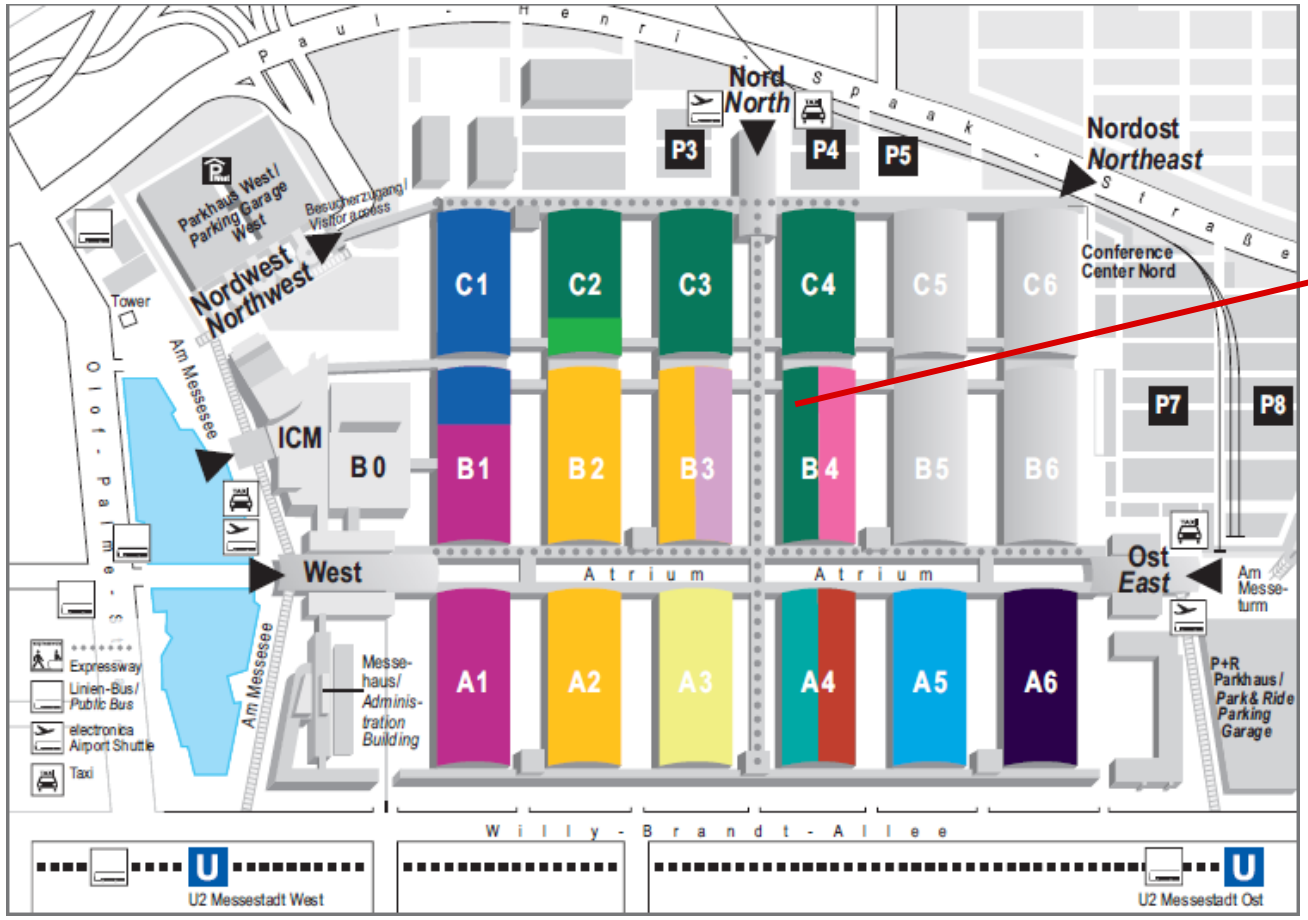
Winning Combinations

New Connectivity Solutions

Wi-Fi 6/6E Combo Solutions

Dual-Mode Cat-M1+NB IoT Wireless Module

COME SEE OUR DEMOS AT HALL B4, BOOTH 179



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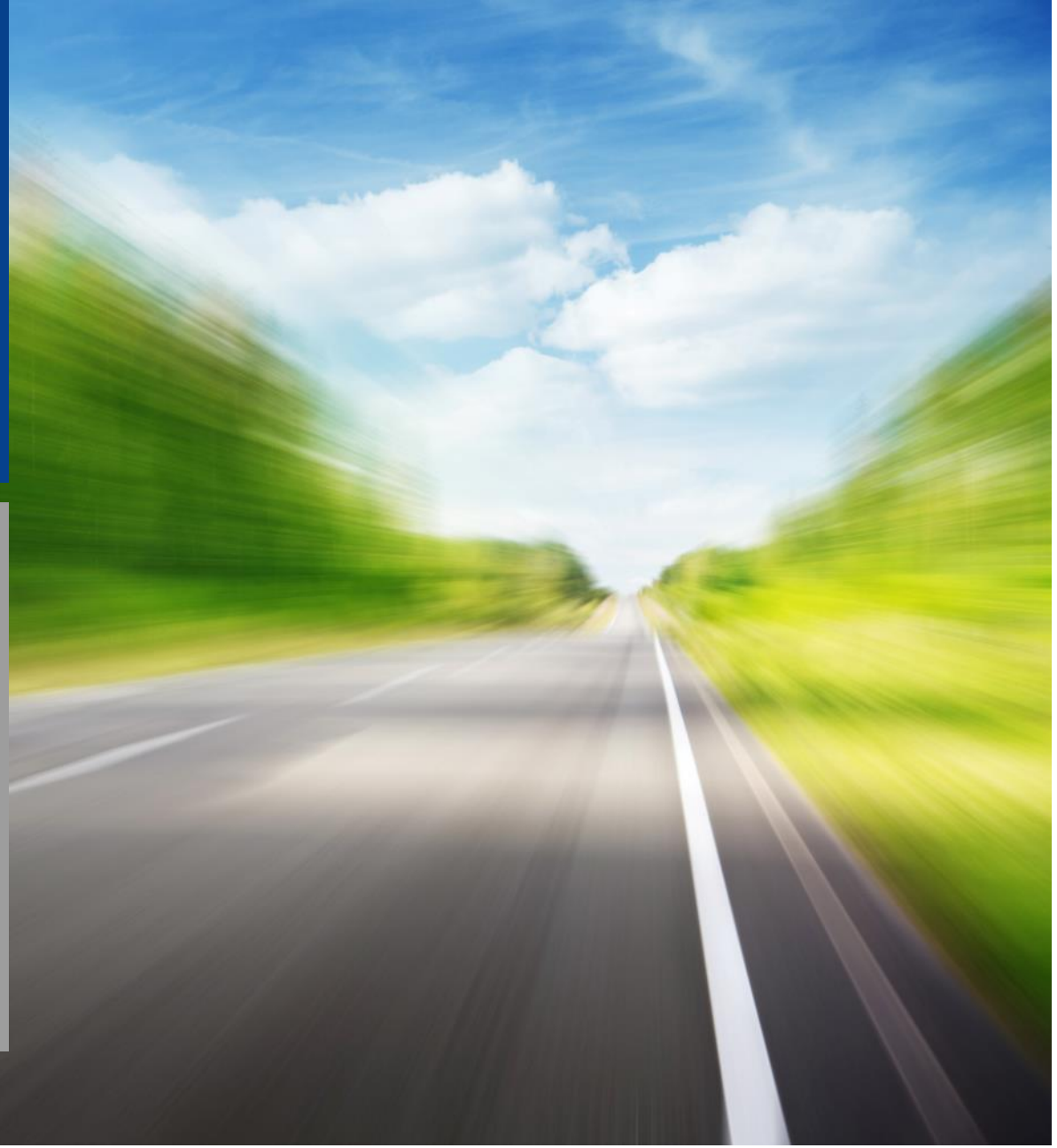
VISION AND STRATEGY OF RENESAS AUTOMOTIVE BUSINESS



TAKESHI KATAOKA
SENIOR VICE PRESIDENT AND GENERAL MANAGER

VIVEK BHAN
SENIOR VICE PRESIDENT AND DEPUTY GENERAL MANAGER

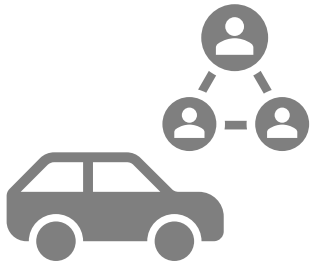
AUTOMOTIVE BUSINESS UNIT
RENESAS ELECTRONICS CORPORATION

MEGATRENDS OF AUTOMOTIVE INDUSTRY

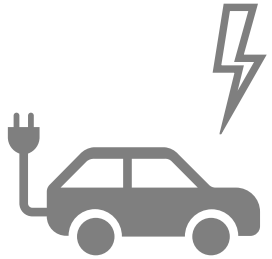
CASE Trend

Connected

Autonomous

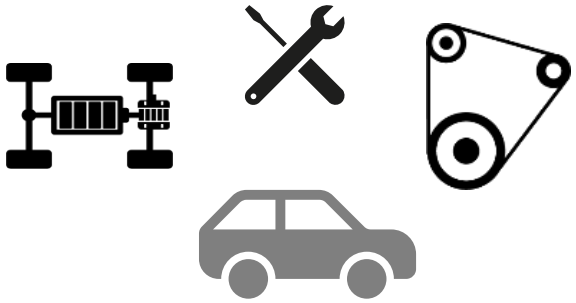


Shared/Service

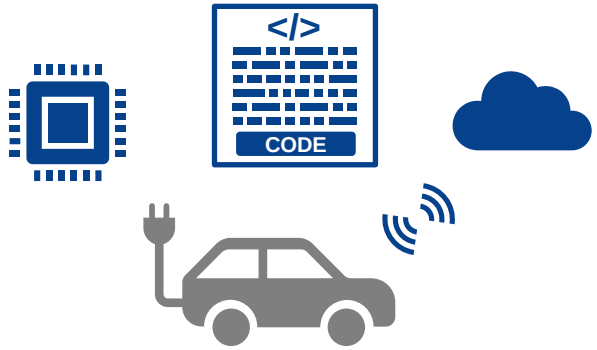


Electrified

Value

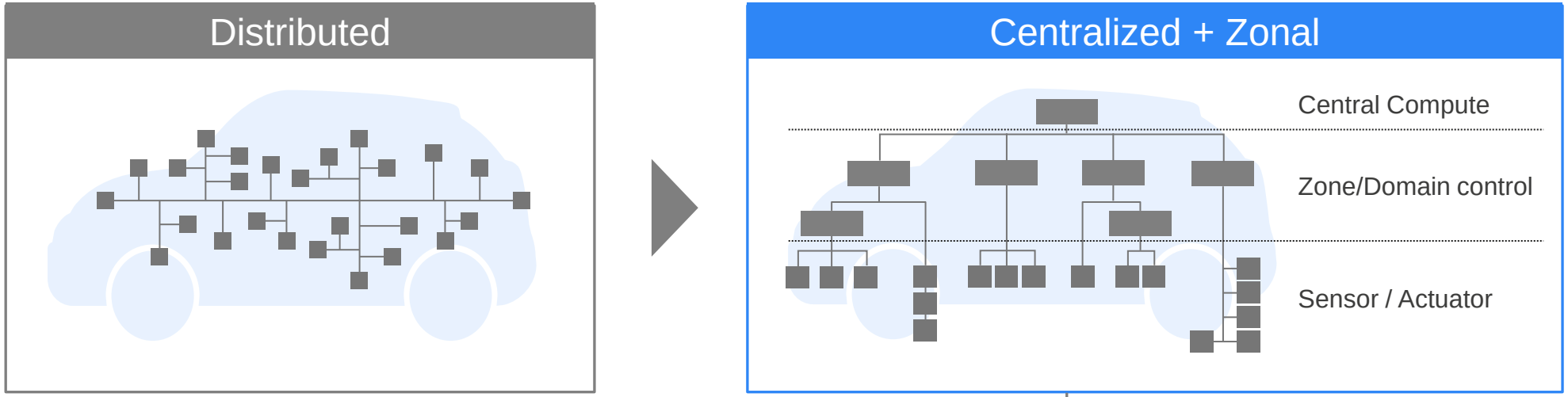


Mechanics oriented



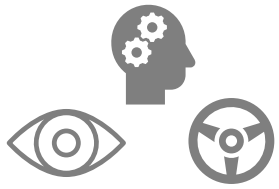
Software defined vehicle

NEEDS FOR E/E ARCHITECTURE EVOLUTION

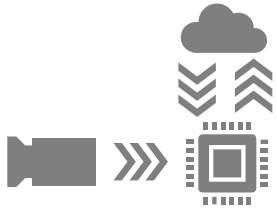


Software Update

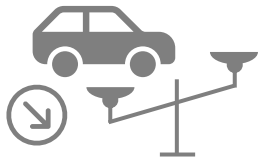
Robust Security



Cooperative Control



Large Data Transmission



Weight Reduction

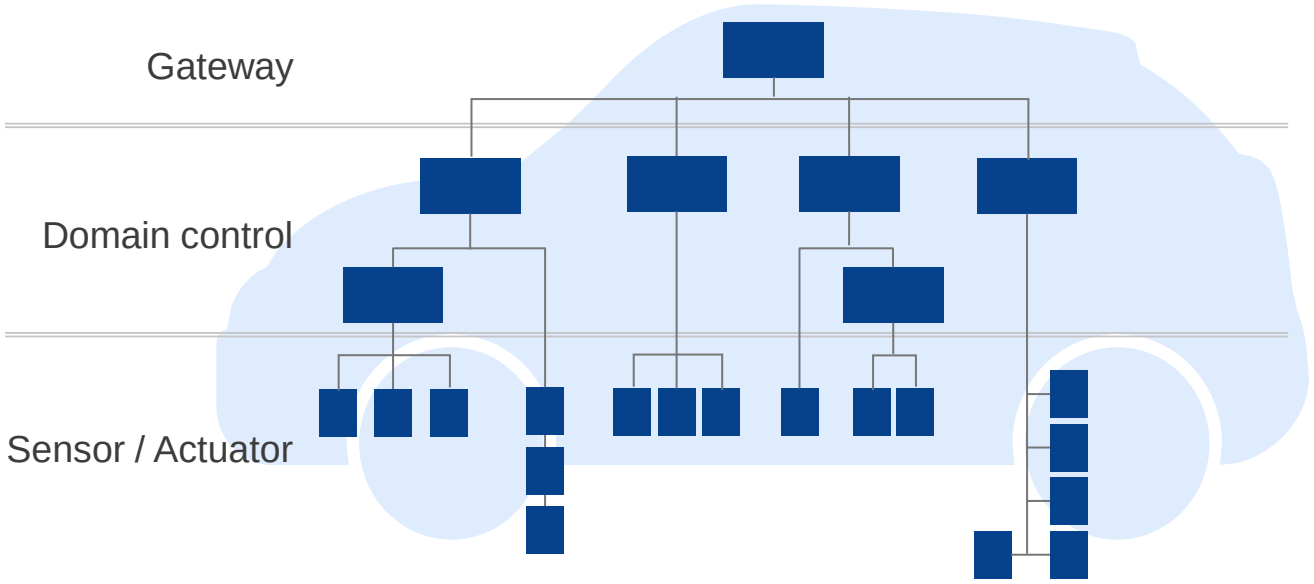
Better Fuel Efficiency

Connected / Service

ADAS

EV

RENESAS VALUE IN E/E ARCHITECTURE



1 Performance Scaling

High end → Low end

Across car grades

High performance SoCs

World's leading cross-domain 32bit MCUs

Best-in-class 16bit MCUs

2 Software / IP Commonality

Sport Car VAN

Across car models

Info EV ADAS

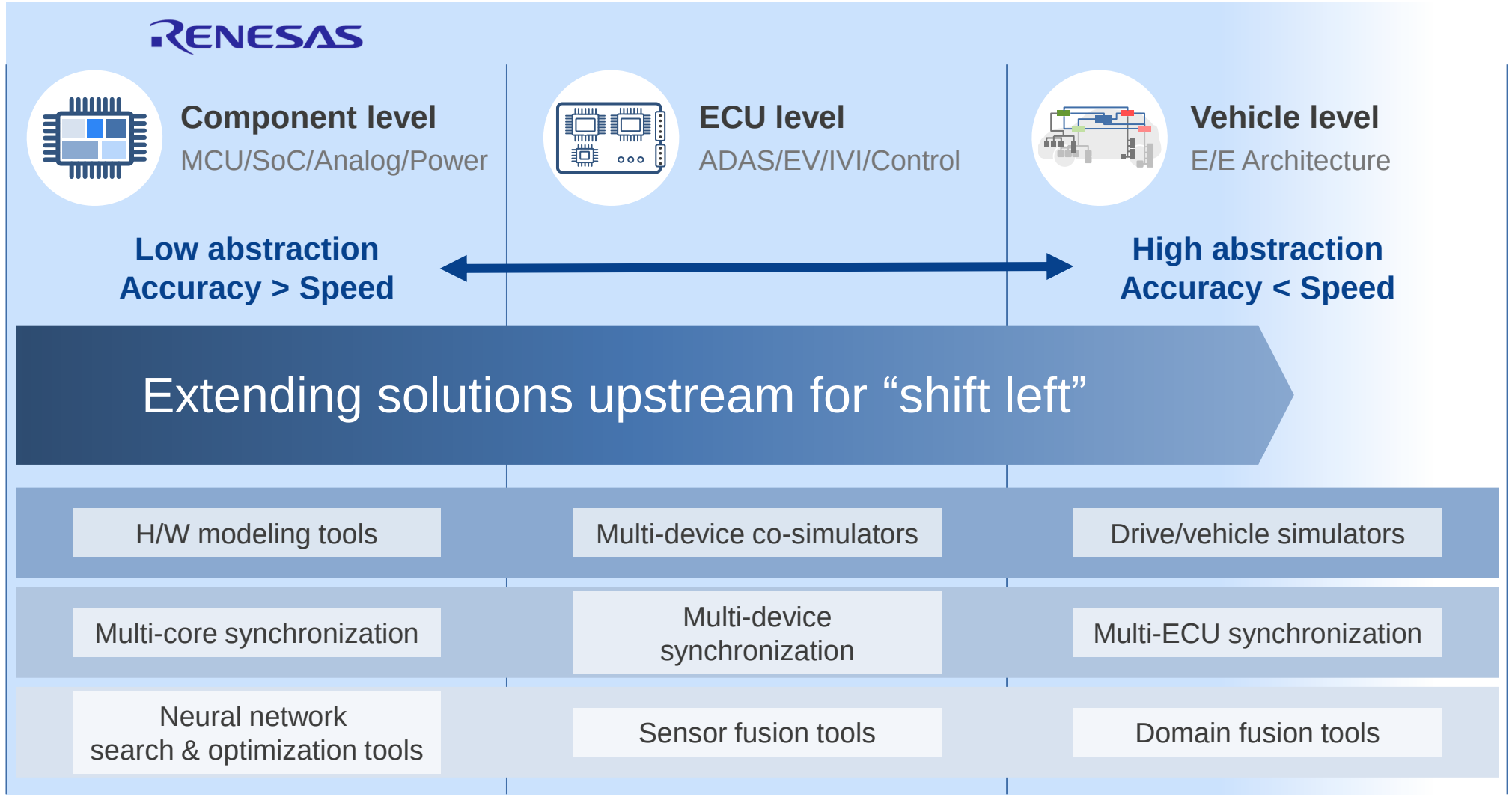
Across applications

Current → New

Across generations

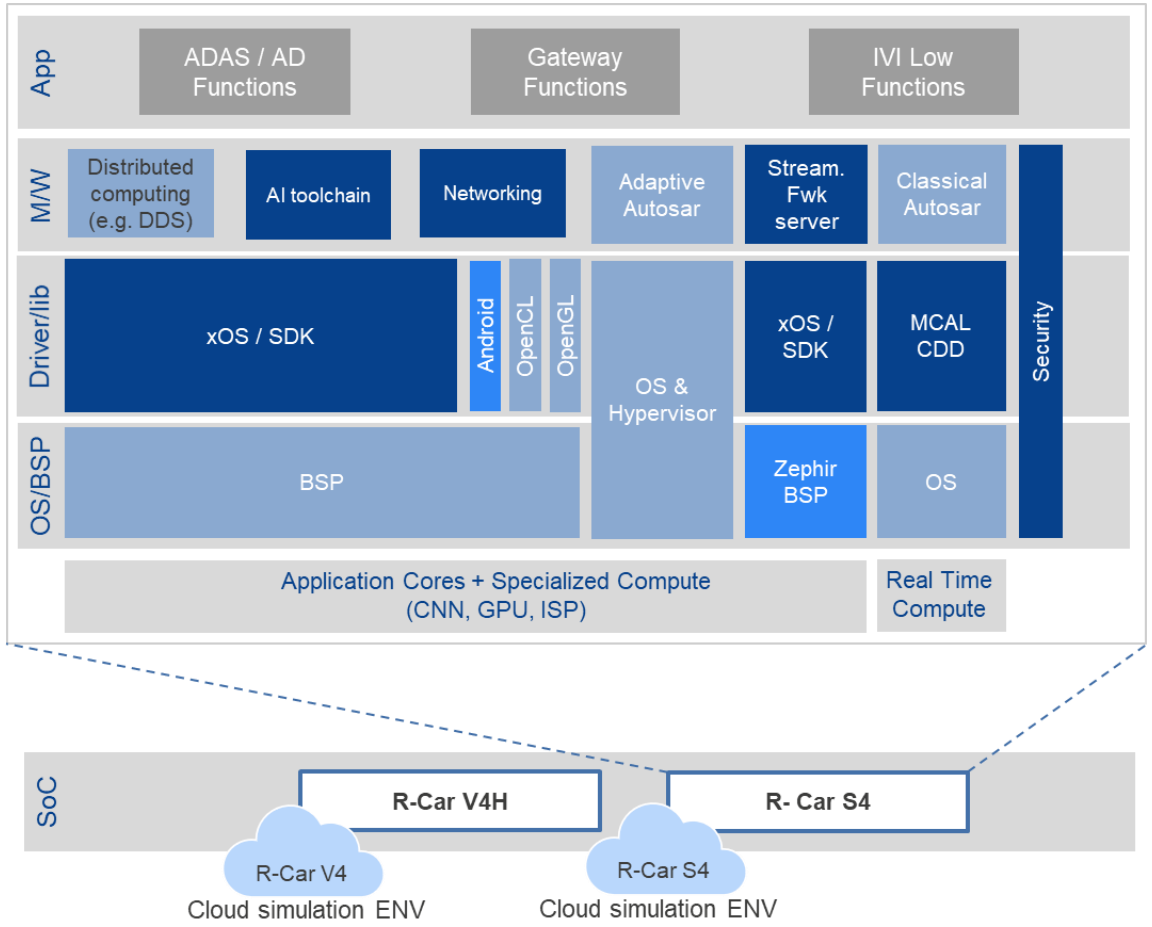
- High Software Reusability / Portability
- Fast Time to Market
- Low Development Cost

UNIFIED DEVELOPMENT ENVIRONMENT

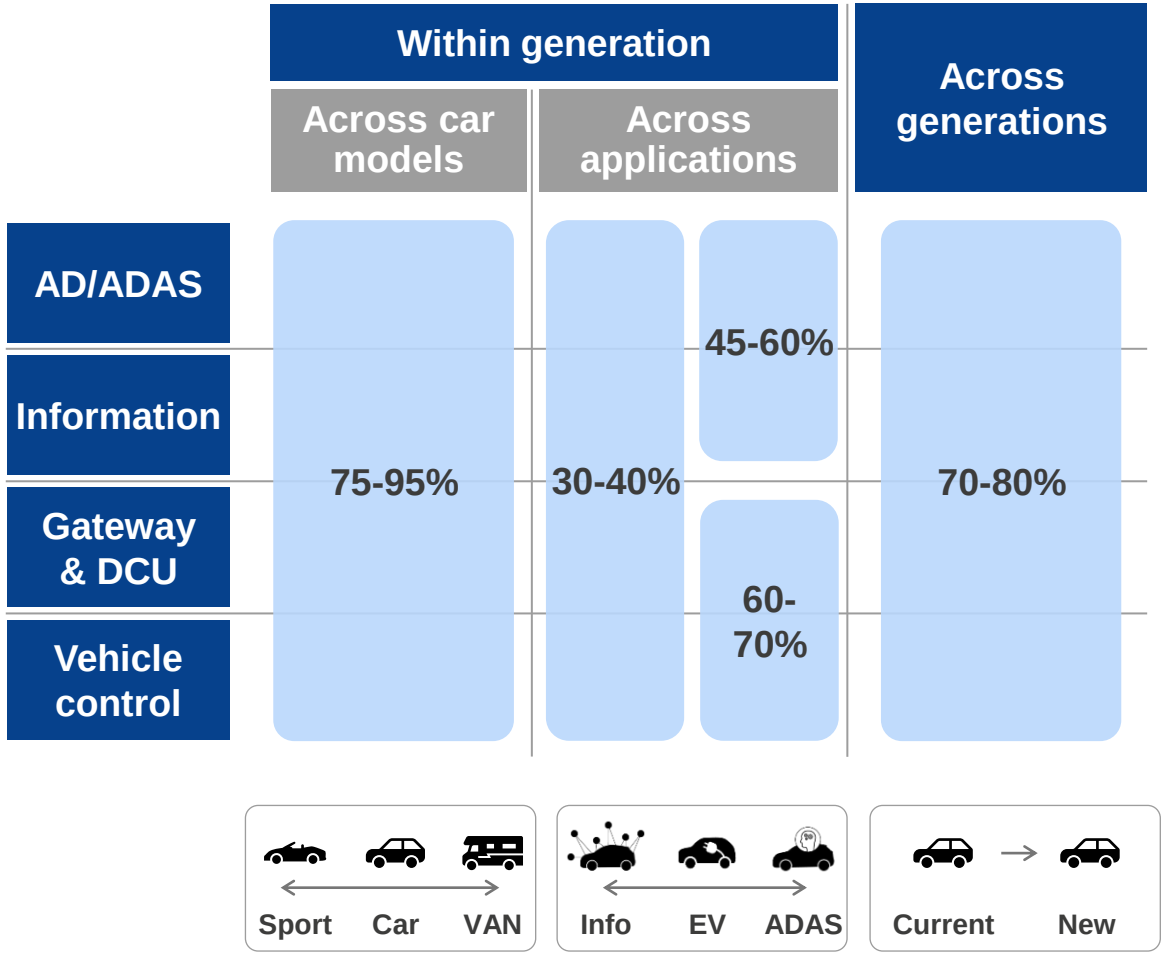


DIFFERENTIATION THROUGH SOFTWARE

Complete Software Stack

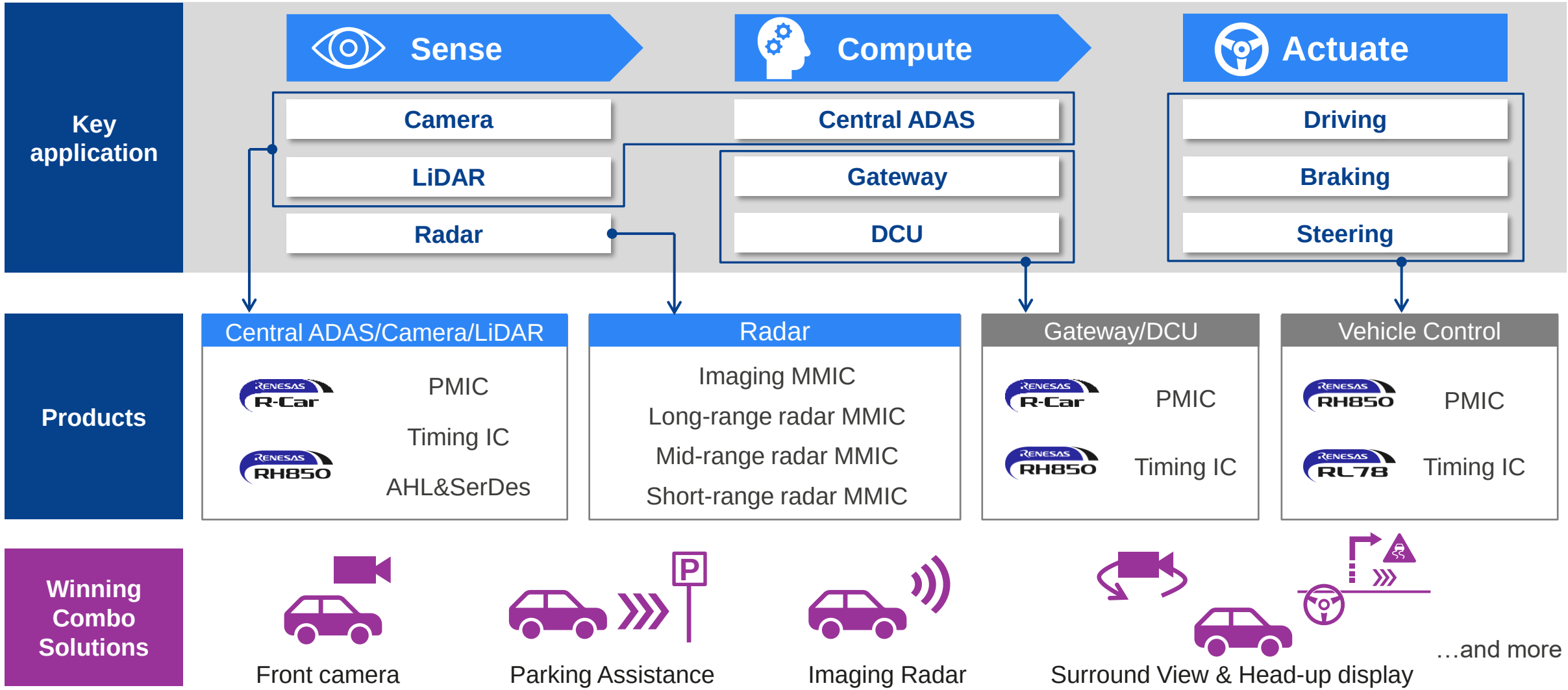


Software & IP Commonality



ADAS/AD

AUTONOMOUS DRIVING: COMPLETE SOLUTIONS

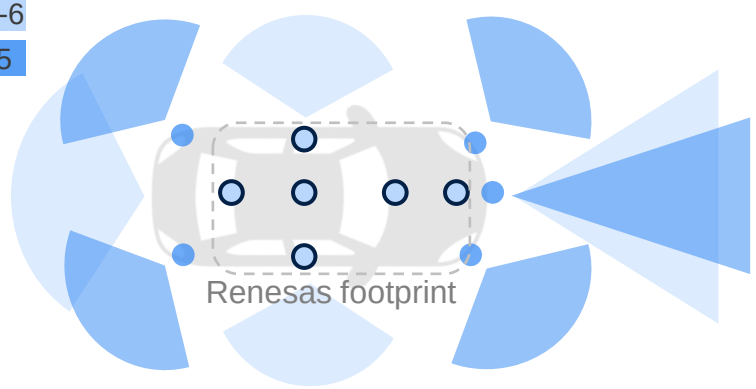


AUTONOMOUS DRIVING: CENTRAL ADAS + CAMERA + RADAR

Existing solution*1 – Central ADAS/Camera

- Best-in-class SoC for camera with low power consumption
- Strong footprint for major Tier1s/OEMs

Camera : 2-6
Radar : 3-5



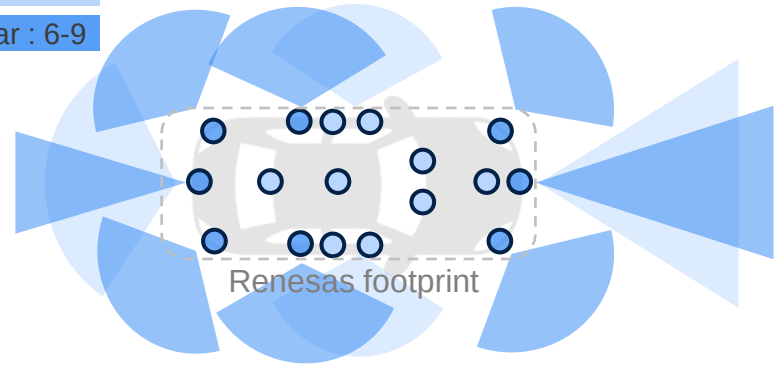
Central ADAS/Camera

SoC
MCU
AHL
PMIC
Timing IC

Next solution*2 – Central ADAS/Camera + Radar

- Best-in-class radar MMIC with advanced 28nm RFCMOS
- Central SoC for Camera/Radar fusion

Camera : 6-9
Radar : 6-9



Central ADAS/Camera

SoC
Higher performance
MCU
AHL & SerDes
PMIC
Timing IC

Radar

Imaging MMIC
LRR MMIC
MRR MMIC
SRR MMIC

*1: Level2 base *2: Level3 base

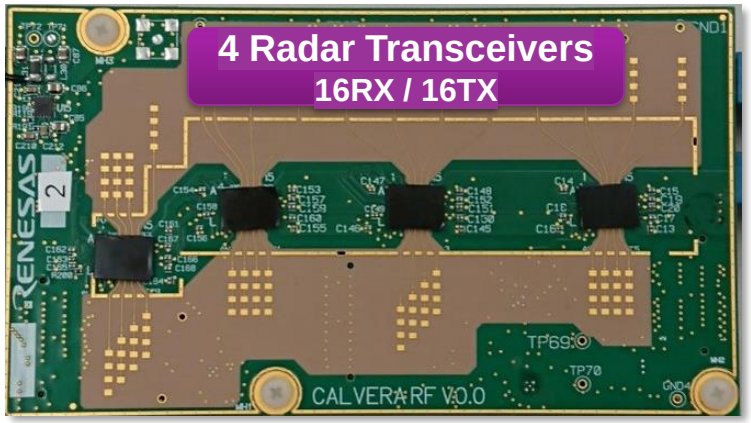
ABU ANNOUNCEMENT

FIRST RAA270205 76-81GHZ RADAR TRANSCEIVER

NEW RADAR TRANSCEIVER – TODAY'S ANNOUNCEMENT

Renesas Introduces First Radar Transceiver through Recent Acquisition of STERADIANSEMI

Leverage Steradian's design assets and expertise to develop our own automotive radar products

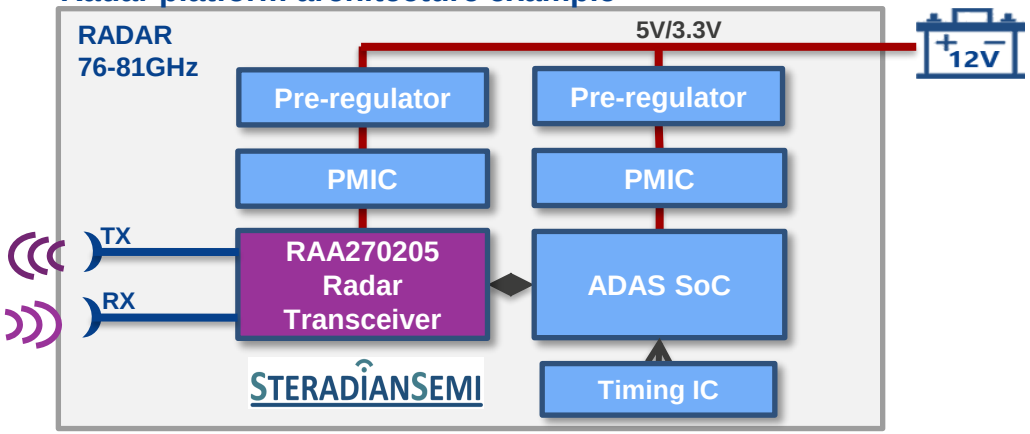


- RAA270205 RFCMOS radar transceiver, 5 GHz bandwidth (76 - 81GHz)
- 4 TX & 4 RX channels per chip, up to 16 MIMO channels
- Range-FFT performed on chip
- Applications: High-resolution 4D radar, imaging radar
- Sample shipment in Q1/2023

Comprehensive Radar Solution

Compelling radar solution that combines the new radar transceiver with Renesas' ADAS SoCs, PMICs, and timing products together with software

Radar platform architecture example



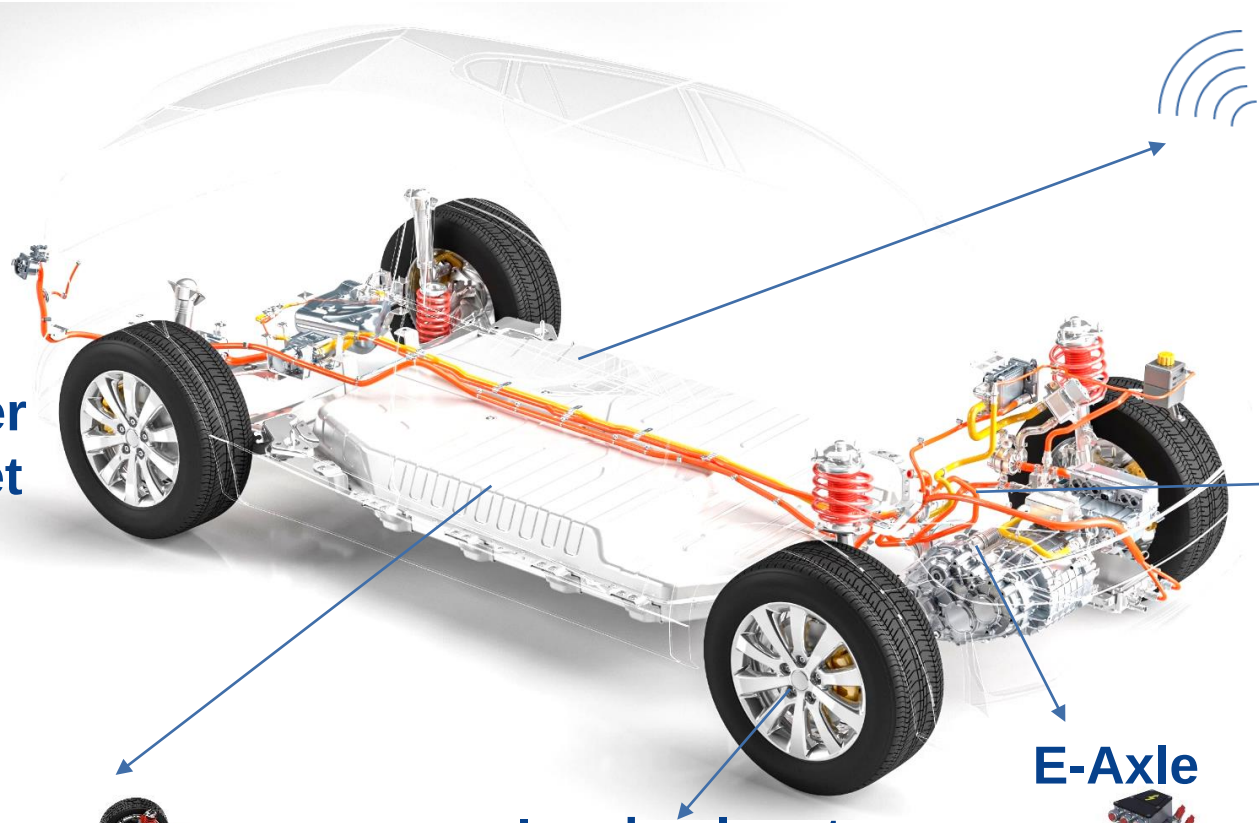
EV

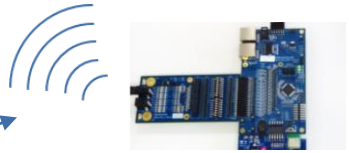
BEV MEGATRENDS

A&P TECHNOLOGY ROADMAP ALIGNED TO EV TRENDS

BMS
Wireless/Distributed

On-board Charger
3-phase AC outlet
22kW





DC/DC, On-board Charger
Smaller size

Skateboard Scalable Platform

In-wheel motor

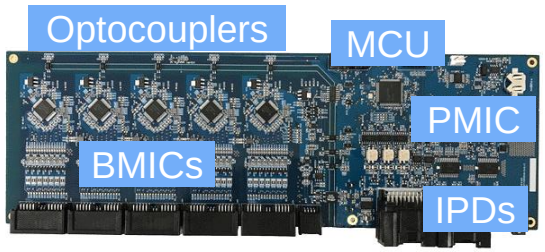
E-Axle

Traction system

RENESAS

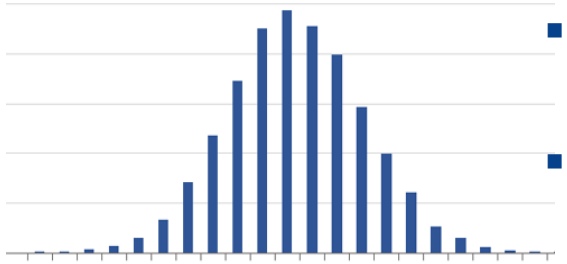
BATTERY MANAGEMENT SOLUTION

System-Level Solution Capability



- ASIL D support
- AUTOSAR driver S/W
- MATLAB simulation & Autocode for SOC/SOH
- System support capability

Industry leading performance

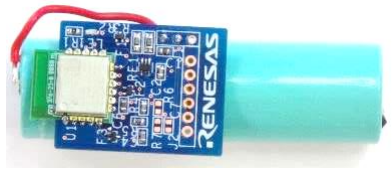


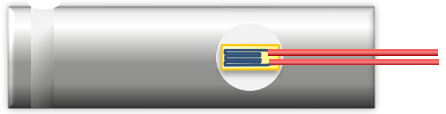
- High accuracy over conditions and lifetime
- Maximize useable capacity of the battery

Scalable Lineup

- RH850/U2A3, A6, A8, A16 (3MB~16MB lineup)
- Pin-compatible scalable 8~16 cell BMICs: RAA271708, 12, 14, 16

Advanced System-Level PoC

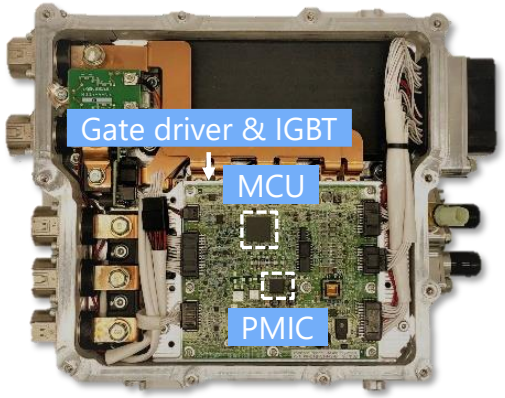




- Wireless BMS proof-of-concept with very low-power BLE
- Battery swelling detection with strain gauge & high-performance sensor AFE

EV SOLUTIONS

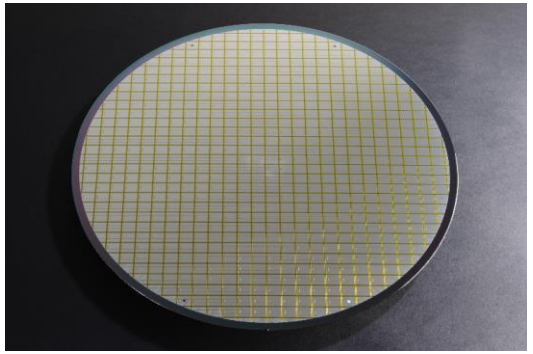
System-Level Solution Capability

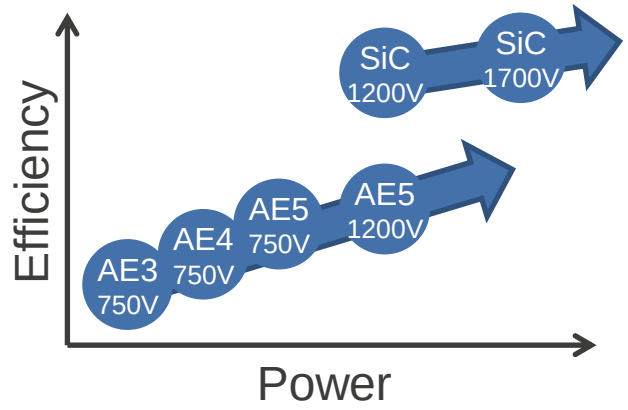


- ASIL C support
- Ready-on-board software
- MATLAB simulation & Autocode ready
- System support capability

High-Performance IGBT

Capacity by 12-inch fab

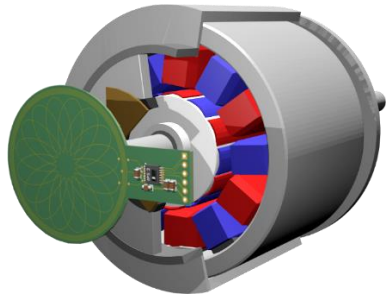




Scalable Gate Driver

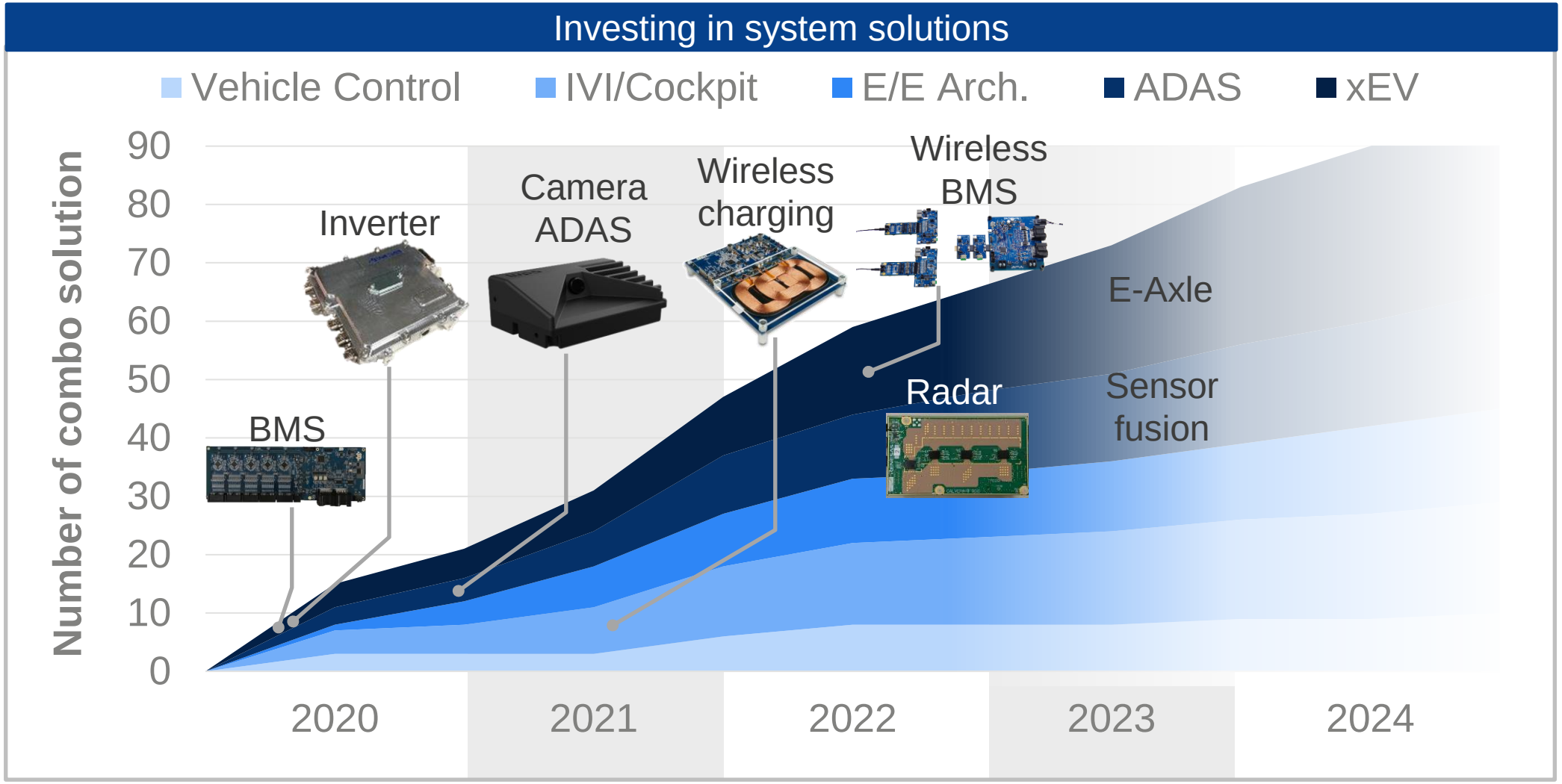
- Scalable function line up
- Integrated Power supply
- Reduced bill-of-material
- Voltage monitoring / feedback

Inductive Position Sensing



- Stator coil on PCB
- System design optimization supported by Renesas design tool
- Up to 100x lighter than traditional approach

WINNING COMBO/SYSTEM REFERENCE DESIGNS



SUMMARY

Renesas strives to achieve a **cleaner**, **safer and more convenient** society by providing innovative automotive semiconductor solutions.

Renesas.com