RISC-V

TECHNOLOGICAL INITIATIVES WITHIN RENESAS ELECTRONICS CORPORATION

2022.1.15
Vice President Kimiharu Eto
MCU Product Development Division
IoT and Infrastructure Business Unit
Renesas Electronics Corporation

AGENDA

- About Renesas
- Our Observations
- RISC-V Announcement
- Embedded Computing in industrial, infrastructure and IoT
- Selection of the RISC-V Core
- Eco System and Renesas
- Summary

About Renesas

WHO WE ARE

Renesas Electronics Corporation is a global semiconductor company delivering trusted embedded design innovation with complete semiconductor solutions that enable billions of connected, intelligent devices to enhance the way people work and live.

A global leader in microcontrollers, analog, power, and SoC products, Renesas provides comprehensive solutions for a broad range of automotive, industrial, infrastructure, and IoT applications that help shape a limitless future.

Headquarters
Tokyo, Japan

Approx. 21,000
employees *

Operating in
30+ countries

715.7 billion yen
revenue in 2020

Approx. 20,000
patents & pending applications

SoC: System-on-a-chip * Consolidated, as of September 30, 2021

OUR PURPOSE

To Make Our Lives Easier

by complementing human capabilities

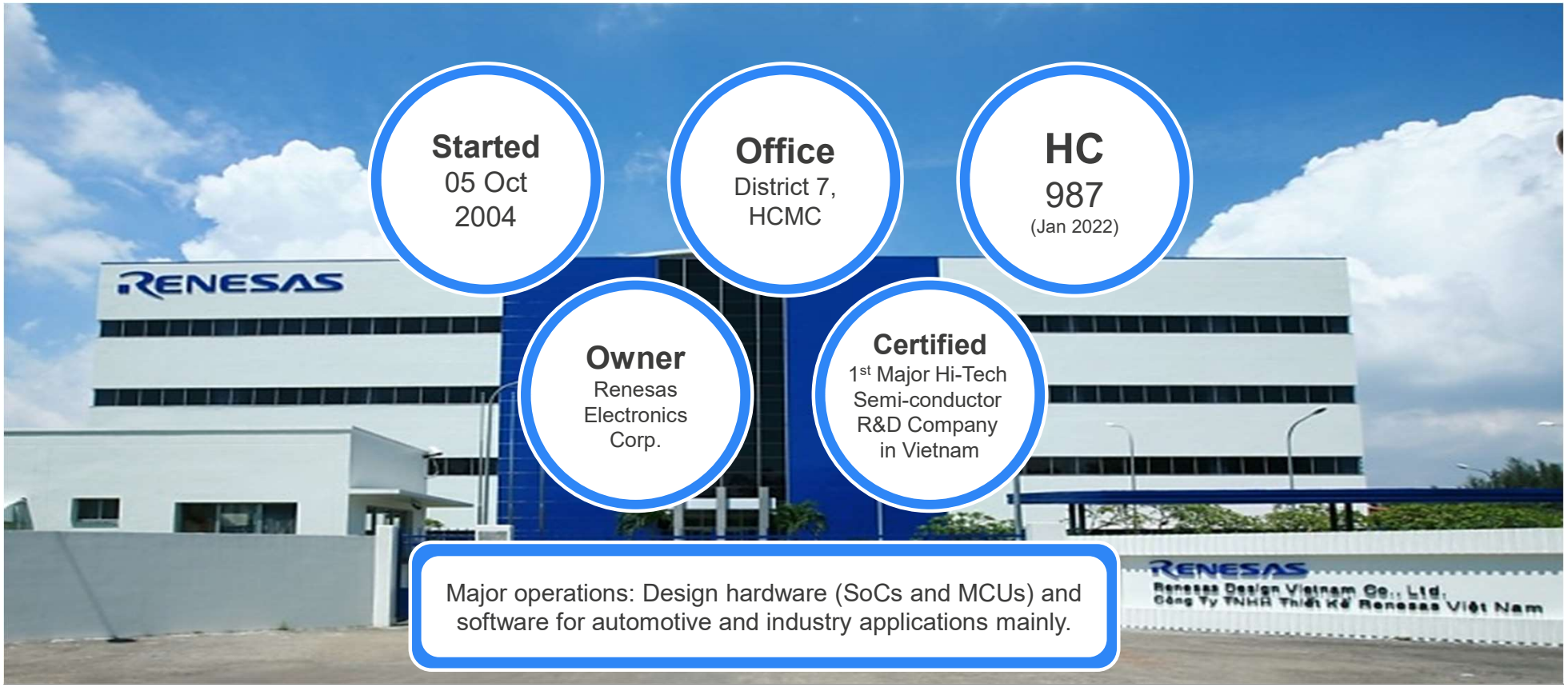
SOLUTION OFFERINGS

Our mission is to develop a safer, healthier, greener, and smarter world by providing intelligence to our four focus growth segments: Automotive, Industrial, Infrastructure, and IoT that are all vital to our daily lives, meaning our products and solutions are embedded everywhere.

			
Automotive	Industrial	Infrastructure	IoT
Highly reliable **vehicle control**, safe and secure **autonomous driving** and Eco-friendly **electric vehicles**	Lean, flexible and smart **industry**	Robust **infrastructure**, enabling safety and efficiency	Comfortable, safe and healthy lifestyles through **IoT**

INNOVATIONS FROM VIETNAM

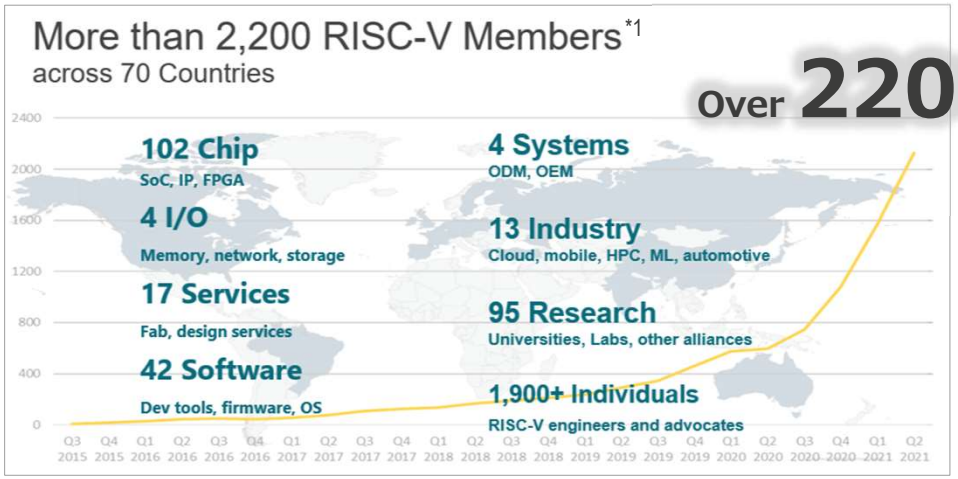
RENESAS DESIGN VIETNAM CO., LTD. (“RVC”)



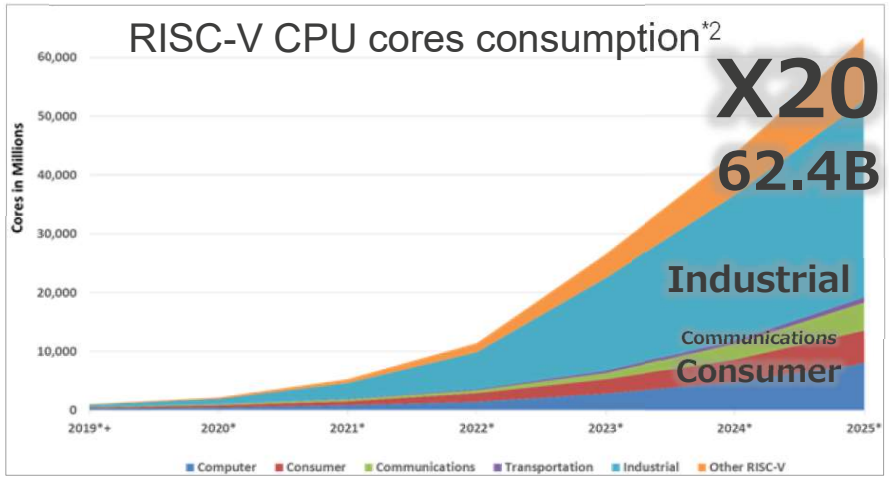
Our Observations

RISC-V ECOSYSTEM RISING FAST: RENESAS ON THE WAY

- RISC-V foundation membership growing fast



- Chip market forecast of $62.4B RISC-V CPUs in the market by 2025, 26% of it in industrial area*2
  - Computer, consumer, communication, transportation, industrial markets foresee average 146.2% CAGR in 2018-25



*1 Source: RISC-V Foundation, *2 Source: Semico Research Corp

RISC-V Announcement

RISC-V ANNOUNCEMENT

RENESAS BIG IDEAS FOR EVERY SPACE

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PRODUCTS APPLICATIONS DESIGN & SUPPORT BUY & SAMPLE ABOUT

About Renesas > Press Room > News > Renesas Selects Andes RISC-V 32-Bit CPU Cores for its First RISC-V Implementation of ASSPs

Renesas Selects Andes RISC-V 32-Bit CPU Cores for its First RISC-V Implementation of ASSPs

October 1, 2020

Renesas Selects Andes RISC-V 32-Bit CPU Cores for ASSPs

TOKYO, Japan — Renesas Electronics Corporation (TSE:6723), a premier supplier of advanced semiconductor solutions, today announced a technology IP cooperation with Andes Technology, an advanced supplier of RISC-V based embedded CPU cores and associated SoC development environment. Renesas selected the AndesCore™ IP 32-bit RISC-V CPU cores to embed into its new application-specific standard products that will begin customer sampling in the second half of 2021.

"We are thrilled that Renesas, a top-tier global MCU provider has designed Andes RISC-V cores into their pre-programmed application-specific standard products. Renesas and Andes share the same vision to welcome the era of RISC-V being the mainstream CPU instruction set architecture (ISA) for system-on-chips (SoC)," **said Frankwell Lin, President of Andes Technology Corp**. "Not only does this represent a milestone for Andes, but it marks the arrival of the open-source RISC-V ISA as a mainstream computing engine. Renesas customers will benefit from a modern ISA constructed for the needs of 21st century computing."

"The scalable range of performance, selectable safety features, and customization options provided by the Andes RISC-V core IP enables Renesas to provide innovative solutions for future application-specific standard products," **said Sailesh Chittipeddi, Executive Vice President, General Manager of Renesas' IoT and Infrastructure Business Unit**. "Customers looking for cost-effective alternative paths for existing or emerging applications will benefit from the reduced time to market and lower development costs."

RENESAS BIG IDEAS FOR EVERY SPACE

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About Renesas > Press Room > News > Renesas and SiFive Partner to Jointly-Develop Next-Generation High-End RISC-V Solutions for Automotive Applications

Renesas and SiFive Partner to Jointly-Develop Next-Generation High-End RISC-V Solutions for Automotive Applications

SiFive to License Industry-Leading RISC-V Core IP Portfolio to Renesas

April 21, 2021

Partnership for Jointly Developing Next-Gen Automotive RISC-V Solutions

TOKYO, Japan, and SAN MATEO, Calif. – Renesas Electronics Corporation (TSE:6723), a premier supplier of advanced semiconductor solutions, and SiFive, Inc., the industry leader in RISC-V processors and silicon solutions, today announced a strategic partnership to jointly develop next-generation, high-end RISC-V solutions for automotive applications. The partnership will also include SiFive licensing the use of their RISC-V core IP portfolio to Renesas.

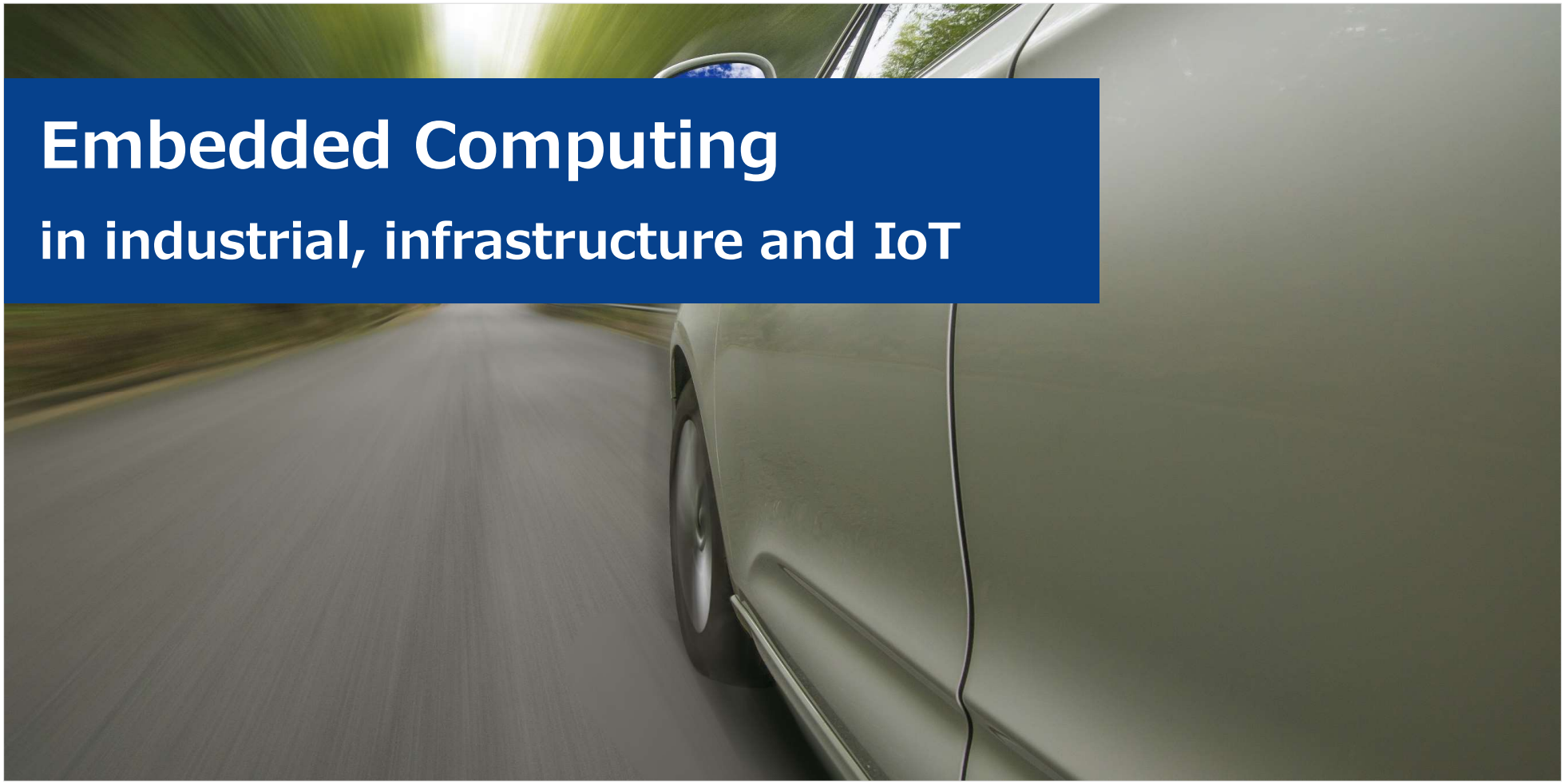
"RISC-V is an important element in providing additional capabilities and options for new and existing customers," **said Takeshi Kataoka, Senior Vice President, General Manager of Automotive Solution Business Unit at Renesas.** "We are very excited to work with SiFive as their lead partner to develop next-generation semiconductor solutions through the collaboration of our accumulated expertise in the automotive field, and SiFive's high-end RISC-V technologies."

For IoT・Infrastructure — **For Automotive**

2020 — OCT — **2021** — APR — **2022**

Embedded Computing

in industrial, infrastructure and IoT



BIG IDEAS FOR EVERY SPACE RENESAS

EXPANDING AI SOLUTIONS

RENESAS RA
RENESAS RZ
RENESAS RL78
RENESAS RX

Sensor & sound

Failure prediction

Abnormality detection in factory equipment
Remote performance monitoring
Gas sensing & AI tool chain

Voice

Command recognition

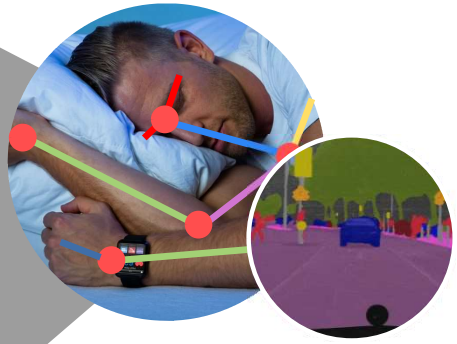
Voice & vision UI
Voice / command recognition for appliances

Image

Image classification
Object recognition

Face authentication
Crowd monitoring
Smart shopping carts
Visual inspection in factories

Vision



Robotics
Human behavior / Activity recognition

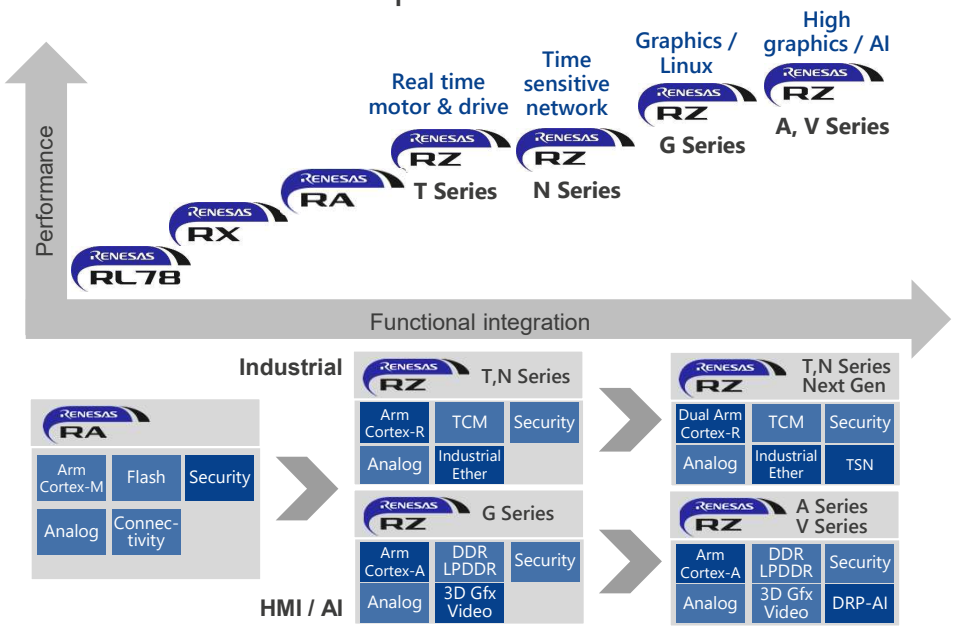
Nursing-care support to avoid danger
Behavioral analysis in sports
Suspicious person detection

EMBEDDED COMPUTING PORTFOLIO

Embedded compute

MCU / MPU

Scalable lineup for MCUs and MPUs



New Product

RZ/V2L new entry class AI MPU

- Unparalleled comprehensive 64bit MPU portfolio to enable AI applications
- Power efficiency by build-in AI accelerator

New Solution

AI MPU ecosystem

- Big improvement of UX – 30+ AI solutions being introduced by eco-system partners
- More partners employing RZ/V series to enrich their AI solution offerings

New Product

RZ/Txx & RZ/Nxx to enable TSN & FuSa*

- RZ/Txx to power 3x real-time control performance for robotics.
- RZ/Nxx to offer backward compatibility to enable TSN for existing factories

* TSN : Time Sensitive Network
FuSa : Functional Safety

RENESAS DIFFERENTIATION

NO.1 MCU SUPPLIER IN THE WORLD*1

RENESAS RL78	RENESAS RX	RENESAS RA	Renesas Synergy™	RENESAS RE
Low Power	**Performance**	**Security**	**Platform**	**E- Harvesting**
Low Cost	Industry Leading Performance	Top Security Implementation	Complete SW&HW Solution	Energy Harvesting IP included
Tiny Footprint	Motor control	Flexible SW Packages & Ecosystem	Cloud-Integrated	Renesas Patent Process Technology
Broadest Portfolio	Industrial Interfaces	Enhanced Cap-Touch	Short Time to market	Ultra Low Power

*1 Source: Gartner, "Market Share: Semiconductors by End Market, Worldwide, 2020", Andrew Norwood et al., Mar 31, 2021, Total Microcontroller

RL78: REJUVENATING 16-BIT MCU MARKET

Targeting at upgrade path for 8 bit MCU

Market Size ~ **$3.5B**[*1]

Lowest System Power
Down to 45.5uA/MHz, Snooze mode

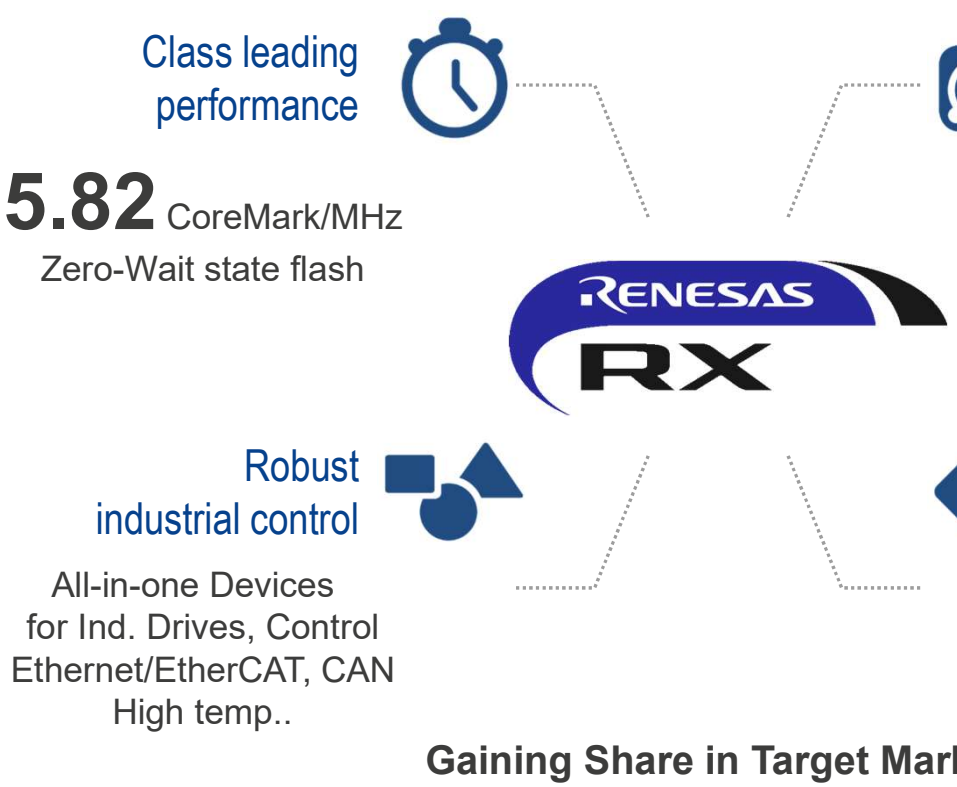
Broad Scalability
1000+ Devices with complete choice

Intelligent & Cost Optimized
1%On-Chip-Oscillator, Temp sensor, LVD, POR

Roadmap to Address New Applications
Lowest pincount, Power, Secuirty , Touch

*1: Source: Gartner, "Market Share: Semiconductors by End Market, Worldwide, 2020", Andrew Norwood et al., Mar 31, 2021, Vendor Revenue basis, Total Microcontroller 8-bit excluding Automotive

RX: PERFORMANCE MARKET LEADER



Gaining Share in Target Markets

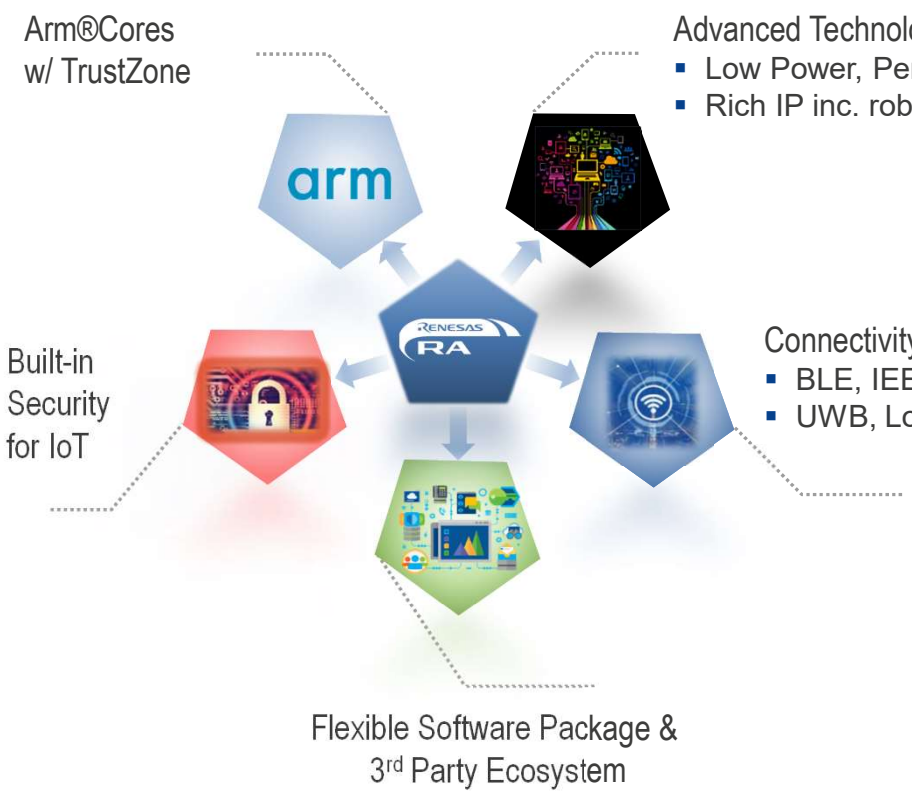
RX700
High Performance
Up to 300MHz

RX600
Advanced
Up to 160MHz

RX200
Low power high performance
Up to 80MHz

RX100
Low power entry level
Up to 32MHz

RA: LEADING THE IOT REVOLUTION



Comprehensive Roadmap
100s of devices & extensive application coverage

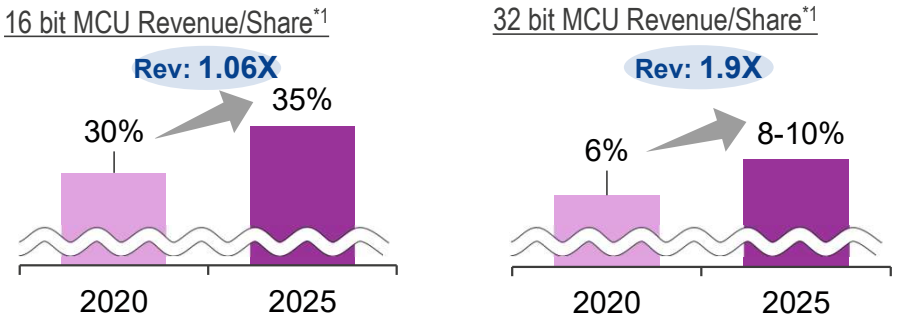
Winning Every Socket
record speed of new wins with funnel crossing $2B

Ready Ecosystem
100s of technology solution blocks covering AI, Security, HMI, Safety Cloud, REF, Sensing & much more

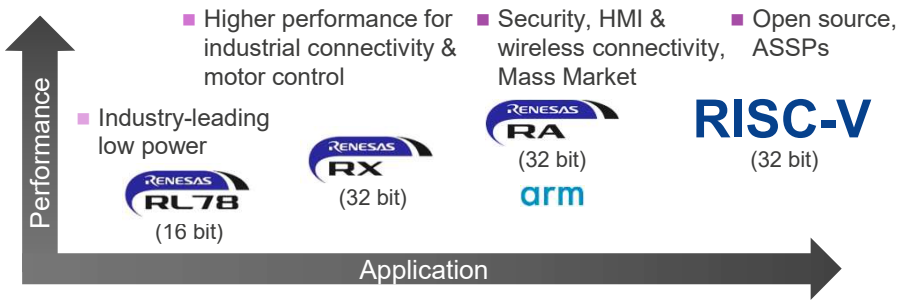
RA2	RA4	RA6
Cortex®-M23 48MHz	Cortex®-M4 & M33 48 ~ 100MHz	Cortex®-M4 & M33 100 ~ 200MHz

PRODUCT OFFERING EXPANSION

Growing MCU Market Share



Product Offering Expansion

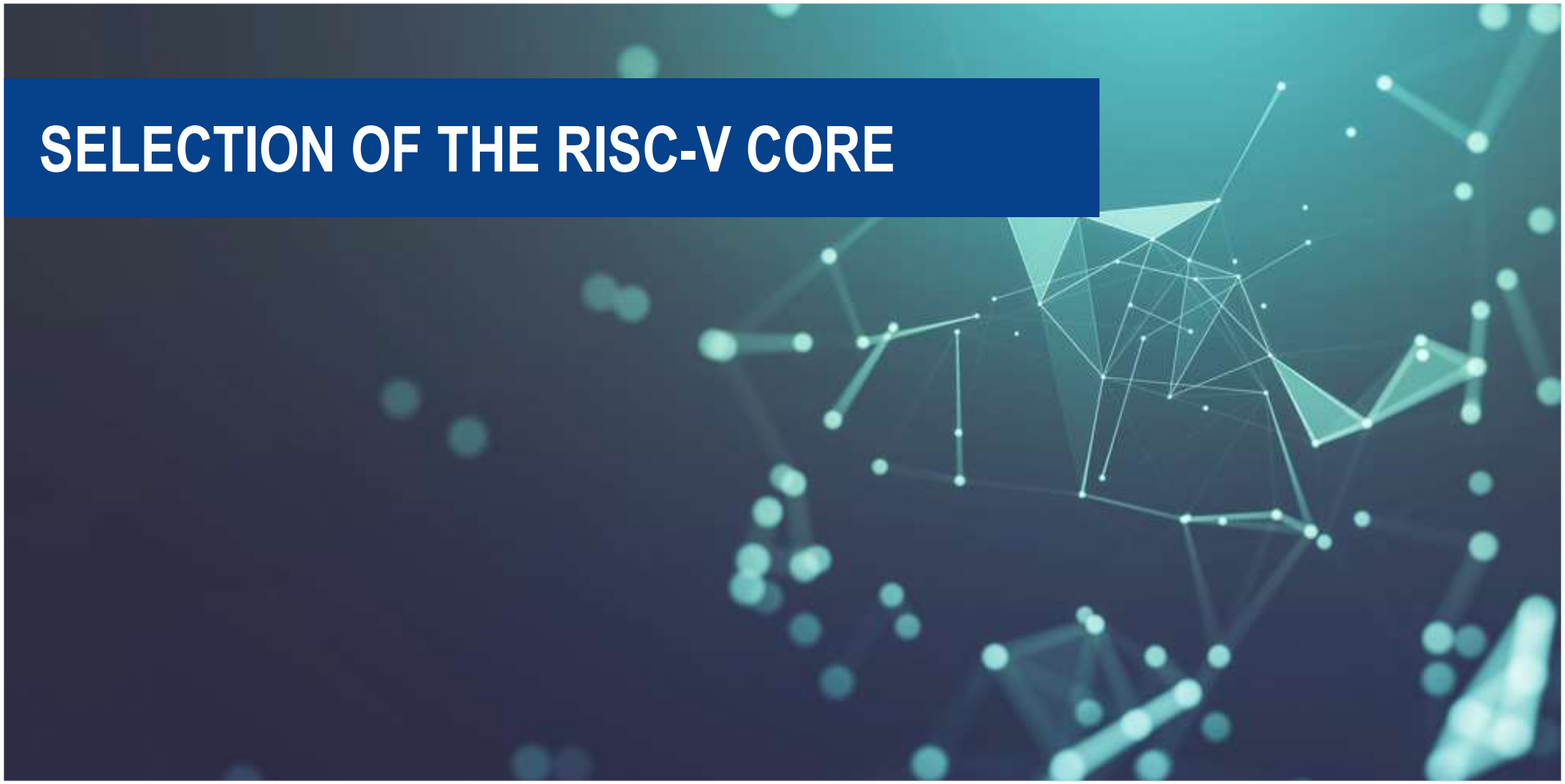


RISC-V initiative

Focuses on application specific segments which required a complete system solution approach, targeting market launch in 2022.

*1: Estimated by Renesas

SELECTION OF THE RISC-V CORE



CPU CORE SELECTION

Option 1: Open Source (Permissive License)

Pros

- Pros: Flexible, Low cost, avaYilable

Cons

- Unknown quality/compatibility, Lack of support, dependency on original source (updates, bug fixes, etc.),

USE

Option 2: Commercial

For early adaptation

Pros

- Support available, Better quality, Roadmap, compatible with commercial tools

Cons

- Cost (License, Royalties), lack of flexibility

BUY

Option 3: Internal Development

Continue to Investigate

Pros

- Most flexible, full control, possibility to differentiate at the Micro-architecture level, full support, known quality

Cons

- High dev't Cost, long term commitment

Develop

Option 4: Collaboration Platform

Pros

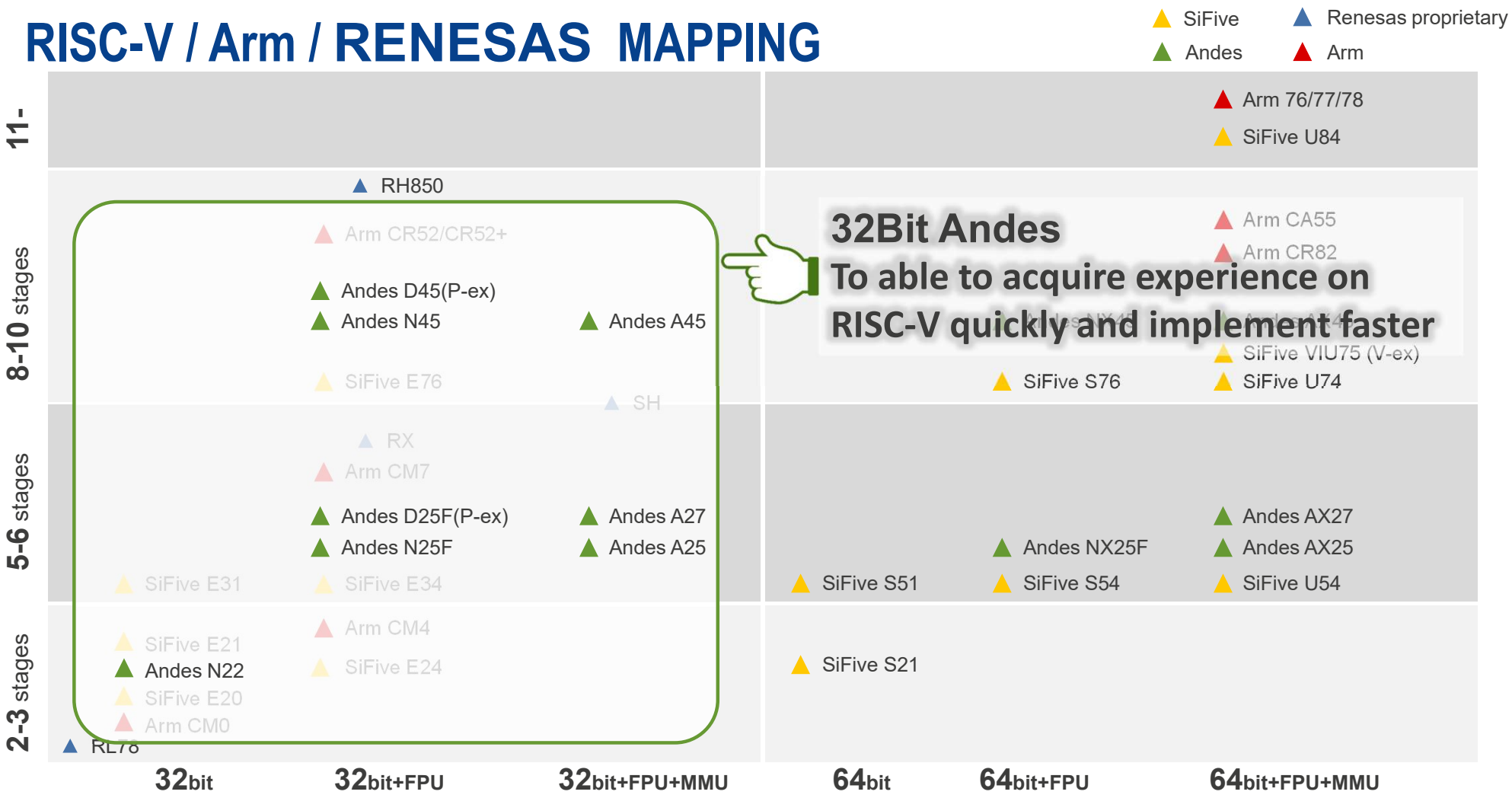
- Some flexibility, some control, low cost, better quality, cost sharing (low), collaborate with industry leaders, opportunity to steer RISC-V opensource direction, insight into competition

Cons

- lack of differentiation

Collaborate

RISC-V / Arm / RENESAS MAPPING



RISC-V ISA AND ANDES ORIGINAL INSTRUCTION

RV32I MC

BASE

Name	Type
RV32I	32bit Integer
RV32E	32bit Embedded
RV64I	64bit Integer
RV128I	32bit Integer

Extensions

Name	Standard Unprivileged Extension
M	Integer Multiplication and Division M
A	Atomics A
F	Single-Precision Floating-Point F
D	Double-Precision Floating-Point D
Q	Quad-Precision Floating-Point Q D
L	Decimal Floating-Point L
C	16-bit Compressed Instructions C

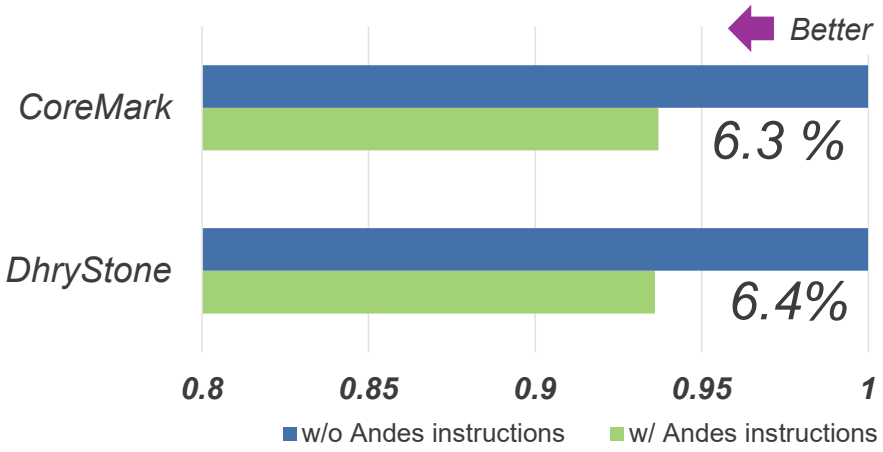
Not all extensions are described

Unique by Andes -Example-

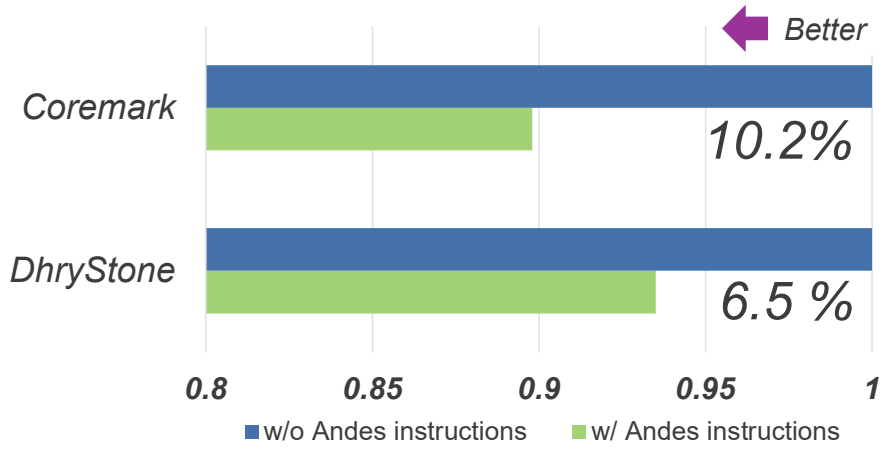
Type	Function
Branch	Conditional Branche by immediate
Bit Manipulations	For Sing extension
Load	Wider Address by dedicated register
String	Judge to finish String instruction

AndeStar™ V5

ANDES ORIGINAL INSTRUCTIONS



Sycle Time Relative Performance



ROM Code Relative Size Comparison

Effectiveness of Andes Defined instructions were confirmed!

ECOSYSTEM AND RENESAS

DEVELOP RISC-V

LEARNING RISC-V

- OPEN SOURCE CORE
  - PULP ETH ZURICH/OPENHW
  - ROCKET UC BERKELEY

PROTOTYPE RISC-V

- SYNOPSYS ASIP DESIGNER
- CHISEL

UTILIZATION OF THE ECOSYSTEM COULD BE AN OPTION

USE, GET USE RISC-V

- SOFTWARE DEVELOPMENT ENVIRONMENT
  - GNU・OPENOCD

- FOR COMING ASSP
  - FACTORY PRE-PROGRAMMED ON-CHIP FIRMWARE
  - GUI FOR PARAMETER SETTING FOR END USER
  - SEGGER & ANDES COMPILER FOR FIRMWARE DEVELOPER

SELECTED BY RISC-V

RENESAS
BIG IDEAS FOR EVERY SPACE

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会社案内 > プレスルーム > ニュース > Dialog Semiconductor Selected as SiFive Preferred Power Management Partner for RISC-V Development Platforms

Dialog Semiconductor Selected as SiFive Preferred Power Management Partner for RISC-V Development Platforms

Dialog's highly efficient, cost effective PMICs, deliver "Exact Fit" power solutions

2021年5月11日

SiFive Preferred Power Management Partner

London, United Kingdom – Dialog Semiconductor plc (XETRA:DLG), a leading provider of battery and power management, Wi-Fi®, Bluetooth® low energy (BLE) and Industrial edge computing solutions, today announced that it has extended its partnership with SiFive, Inc the industry leader in RISC-V processors and silicon solutions. Dialog is SiFive's preferred power management partner for its HiFive Unmatched, a PC form-factor RISC-V Linux Development Platform for the SiFive Freedom U740 RISC-V SoC.

The new HiFive Unmatched platform uses Dialog's highly integrated DA9063 system PMIC which incorporates 6 DC-DC Buck Regulators and 11 LDOs. The device enables the SiFive platform to achieve maximum performance by optimally meeting all power supply requirements. In addition, the DA9063 supports Dynamic Voltage Scaling (DVS) which dramatically reduces the power dissipation and thermal footprint of the platform.

Dialog PMIC was selected to the SiFive RISC-V Linux Development Platform

SUMMARY

FUTURE OF RISC-V IN RENESAS

- Not so many products in the market which use Open Architecture
- RISC-V ASSP will launch in 2022 to be an early adapter
- Ecosystem is the key For further growth of RISC-V

As the No1 MCU Supplier,

Renesas will send you exciting news about RISC-V

www.renesas.com