AGENDA

- Results Recap
- Share Gains in MCU & MPU
- Secular Growth Opportunities
  - Embedded Processing + Analog, Power & Connectivity
  - Embedded Processing + Ethernet PHY for Industrial Markets
- The AI Opportunity
  - AIoT Artificial Intelligence in the AI landscape
  - AI in the Industrial landscape
  - AI in the infrastructure landscape
- X- SG Collaboration to drive growth
- UX improvements to combine the best of SW and HW
- Summary

AIoT: Artificial Intelligence of Things
FINANCIALS AT A GLANCE

Total

Revenue
(oku yen)
9,000

GM
65%

53%
CAGR

33%
(excl. Dialog)

2020 2021 2022

Revenue
(oku yen)

5,000

GM
60%

37%
(excl. Dialog)

37%
CAGR

29%
(excl. Dialog)

55%

0 1,000 2,000 3,000 4,000

Revenue
(oku yen)

Industrial

Infrastructure

IoT

37%
(excl. Dialog)

50%

32%
CAGR

79%
CAGR

1 USD = 100 JPY

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MARKET SHARE GAIN IN MCU FOR INDUSTRIAL/IOT APPLICATIONS

Graphs created by Renesas based on Gartner Research. Calculations performed by Renesas Source: Gartner®. Market Share: Semiconductors by End Market, Worldwide, 2022, Andrew Norwood et al. 31 March 2023, MCU = Total Microcontroller(16bit & 32bit.), excluding Automotive. GARTNER is a registered trademark and service mark of Gartner, Inc. and/or its affiliates in the U.S. and internationally and is used herein with permission. All rights reserved. Gartner does not endorse any vendor, product or service depicted in its research publications, and does not advise technology users to select only those vendors with the highest ratings or other designation. Gartner research publications consist of the opinions of Gartner's research organization and should not be construed as statements of fact. Gartner disclaims all warranties, expressed or implied, with respect to this research, including any warranties of merchantability or fitness for a particular purpose.
MARKET SHARE GAIN ON MPU FOR INDUSTRIAL/IoT APPLICATIONS

General purpose and Industrial automation

- 2021: 9.1%
- 2022: 10.7%

AI

- 2021: 0.0%
- 2022: 1.2%

2026 target share

Source: Renesas estimation
SAM EXPANSION BY ATTACHING A&P, CONNECTIVITY

2022 Revenue

- IoT & Consumer: 44%
- Industrial: 41%
- Infrastructure: 15%

1,900 oku yen

Connectivity + A&P potential SAM

- Industrial
- Infrastructure
- IoT & Consumer

Connectivity attach potential
A&P attach potential

0 500 1,000 1,500 2,000 2,500

Industrial
Infrastructure
IoT & Consumer

(oku yen)

3,800 oku yen (per year)

Source: Renesas estimation 1 USD=100 JPY

MCU

154 oku yen

MPU

Industrial
Infrastructure
IoT & Consumer

(oku yen)

90 oku yen (per year)
SAM EXPANSION INDUSTRIAL: MPU + ETHERNET PHY

**Industrial Ethernet PHY IC SAM**

- Industrial Ethernet PHY SAM
- Existing Smart Factory SAM

<table>
<thead>
<tr>
<th>Year</th>
<th>Industrial Ethernet PHY SAM (oku yen)</th>
<th>Existing Smart Factory SAM (oku yen)</th>
<th>CAGR</th>
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<tr>
<td>2023</td>
<td>2000</td>
<td>2000</td>
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<tr>
<td>2024</td>
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<td>2029</td>
<td>14000</td>
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<tr>
<td>2030</td>
<td>16000</td>
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</table>

**Renesas Industrial Ethernet PHY IC Growth Plan**

- 100M
- 1G
- T1L

<table>
<thead>
<tr>
<th>Year</th>
<th>100M (oku yen)</th>
<th>1G (oku yen)</th>
<th>T1L (oku yen)</th>
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<tr>
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<td>100M</td>
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<td>2030</td>
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**Notes:**

- *1: Source: Techinsights (Nov 2022)  1 USD=100 JPY

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ADDITIONAL GROWTH ACCELERATED BY AI ADOPTION

Enabling Intelligence From The Cloud To The End-Point Sustainably

AI at the core
- Timing
- Power
- Memory Interface

AI at the edge
- Timing
- Power
- Memory Interface
- RF

AI at the endpoint
- MCU/MPU/e-AI
- Power
- Connectivity
- AMS & CMIC

Sustainability
- MCU
- Ultra-Low Power
- Power
- Connectivity
- Environmental Sensors
AI:
TRANSFORMATIONAL GROWTH AT END-POINT, EDGE AND CORE
**AIoT @END POINT: EXPLOSIVE MARKET GROWTH**

**Why endpoint intelligence?**

- Real-time response
- Security & Data privacy
- Efficiency & Low power
- Low cost

**AI chip TAM**

<table>
<thead>
<tr>
<th>Year</th>
<th>MPU</th>
<th>MCU</th>
<th>FPGA</th>
<th>DSP</th>
<th>Others</th>
<th>SAM</th>
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<td>2026</td>
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</tbody>
</table>

(oku yen)

**CAGR**

- 53% MCU
- 45% MPU

**Source:** Renesas estimation

1 USD = 100 JPY

DSP: Digital Signal Processing
SCALABLE EMBEDDED PROCESSOR SOLUTIONS
BY AI APPLICATION TYPE

<table>
<thead>
<tr>
<th>Memory</th>
<th>Performance</th>
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<tbody>
<tr>
<td>Optical number recognition</td>
<td>Classification</td>
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<tr>
<td>Object detection</td>
<td>Voice recognition</td>
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<tr>
<td>Signal processing</td>
<td>RZ/G (Embedded AI MPU (Hardware acceleration))</td>
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<tr>
<td>Anomaly detection</td>
<td>Pose estimation</td>
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<tr>
<td>RL78</td>
<td>Object detection (Mobilenet SSD)</td>
</tr>
<tr>
<td>RX, RA</td>
<td>Classification (ResNet50)</td>
</tr>
<tr>
<td>RZ/A, RZ/T</td>
<td>Object detection (YOLOv2)</td>
</tr>
</tbody>
</table>
AI OPPORTUNITY @EDGE: INDUSTRIAL AUTOMATION MARKET

- Predictive maintenance
- Real-time monitoring of process conditions
- Preventive quality control
- Machine inspection
- Machine vision
- Data pre-processing – edge computing

Use cases driving market potential

Source: Renesas estimation  1 USD=100 JPY
AI OPPORTUNITY FOR INFRASTRUCTURE: MEMORY & TIMING

Now

Memory DIMM
- RCD
- PMIC
- DB
- Hub
- DRAM
- Clock Gen
- Peripheral Clock Gen
- Oscillator

Memory DIMM
- RCD
- PMIC
- TS
- DRAM

Mother board

PCIe slots

AI SAM expansion

AIC
- CXL memory expansion
- PMIC
- Hub
- DRAM

Memory DIMM
- CXL memory expansion
- PMIC
- Hub
- DRAM

AI/NW accelerators
- Oscillator
- Clock buffer
- Clock Gen

EDSFF
- CXL memory expansion
- PMIC
- Hub
- DRAM

BMC
AI OPPORTUNITY FOR INFRASTRUCTURE: SAM EXPANSION OPPORTUNITY

Source: Renesas estimation 1 USD=100 JPY

- Baseline DIMM
- AI + additional memory + CXL
- Baseline Timing
- AI + New Timing

Source: Renesas estimation 1 USD=100 JPY
AI OPPORTUNITY FOR INFRASTRUCTURE: PERFORMANCE DIGITAL POWER BY PLATFORM & GENERATION

VR13HC Server
In Production

- 12V E-Fuse
  - Multiphase
  - Digital PoL
  - Analog PoL
  - CPU
  - DDR4

VR14 Birchstream
Production 2H 2024

- 48V E-Fuse
  - Multiphase
  - DDR5 VR on DIMM
  - Digital PoL
  - Analog PoL
  - 48V-12V On-board module

Next Gen AI
In design

- 48V E-Fuse
  - Multiphase
  - Digital PoL
  - Analog PoL
  - 48V IBC
  - AI SoC

Renesas content Renesas opportunity
DATA CENTER PERFORMANCE DIGITAL POWER SAM EXPANSION OPPORTUNITY

Source: Renesas estimation 1 USD=100 JPY
DIGITAL MULTIPHASE MIGRATION IN AUTOMOTIVE

- **Today**
  - Distributed architecture
  - Distributed low power MCU’s
  - No application for multiphase

- **Tomorrow**
  - Centralized architecture

- **Future**
  - Zone architecture
  - Software-Defined Vehicle
  - High compute/High Security

High power multiphase needed

- Digital control & Telemetry
- Performance-based technology
- Readiness & Quality
- Capacity, manufacturing & supply
TIMING CONTENTS INCREASE IN AUTOMOTIVE

Today
- Distributed architecture
  - Distributed low power MCU’s
  - No application for multiphase

Tomorrow
- Centralized architecture

Future
- Zone architecture
  - Software-Defined Vehicle
  - High compute/High Security

Contents per vehicle
- ~1 clock
- ~2 clocks
- >4 clocks
UX ENHANCEMENT

- Development kits
- Embedded SW (Flexible software package)
- Tool chains (e² Studio)
- Configurable mixed-signal tools
- Integrating AI training models
FINANCIAL MODEL

- Grow @SAM++
- GM ≈60%
- OM 30-35%
SUMMARY

Market share gain for MCU and MPU, using attach as a growth opportunity

Exponential data growth, pervasive AI

Integrating AI elements into industrial infrastructure, and IoT

UX enhancement & SG collaboration
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