

# PASSION FOR INNOVATION R&D, CORE TECHNOLOGY STRATEGY

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SHINICHI YOSHIOKA  
SENIOR VICE PRESIDENT,  
CHIEF TECHNOLOGY OFFICER  
RENESAS ELECTRONICS CORPORATION

# AGENDA

- Directions of Renesas Innovation :  
“Semiconductor Intrinsic” & “User Experience (UX)”
  
- Strategy of Renesas Core Technologies for Innovation

# WHY SW FIRST?

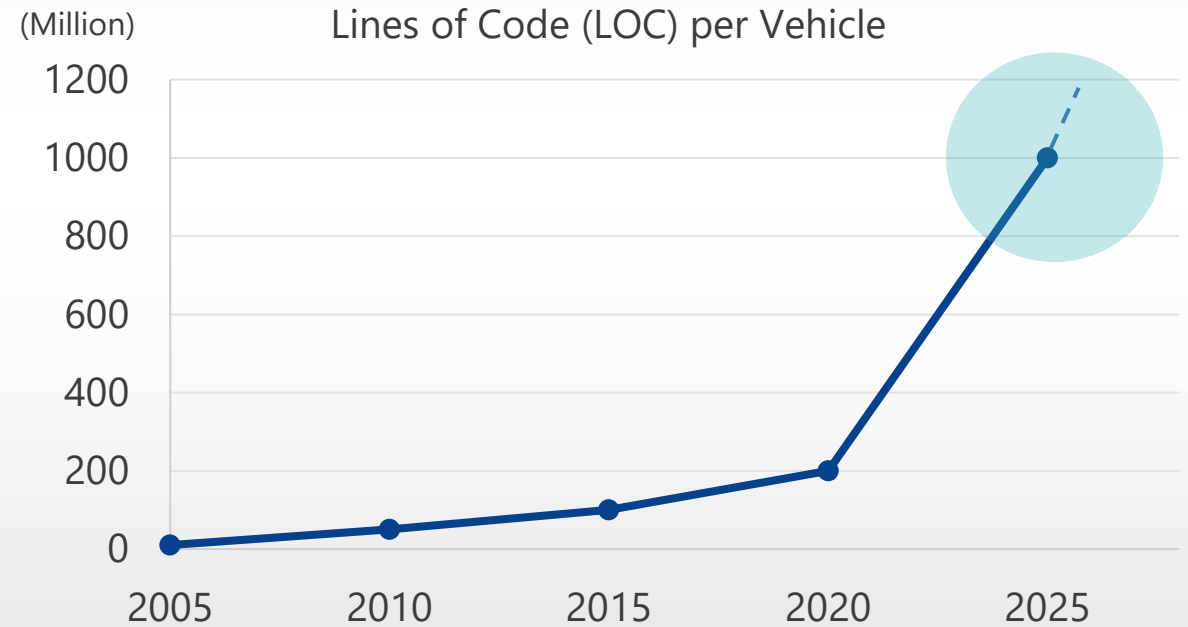
- Value Proposition: HW → SW/Services
- Inevitable SW Explosion



Development Trend: **Software First**

Full autonomous driving system will reach one billion lines of code

- Linux 5.11 ~20 million
- Android ~35 million
- Google Chrome ~35 million
- Windows 7 ~ 40million
- Mac OS X ~ 100 million



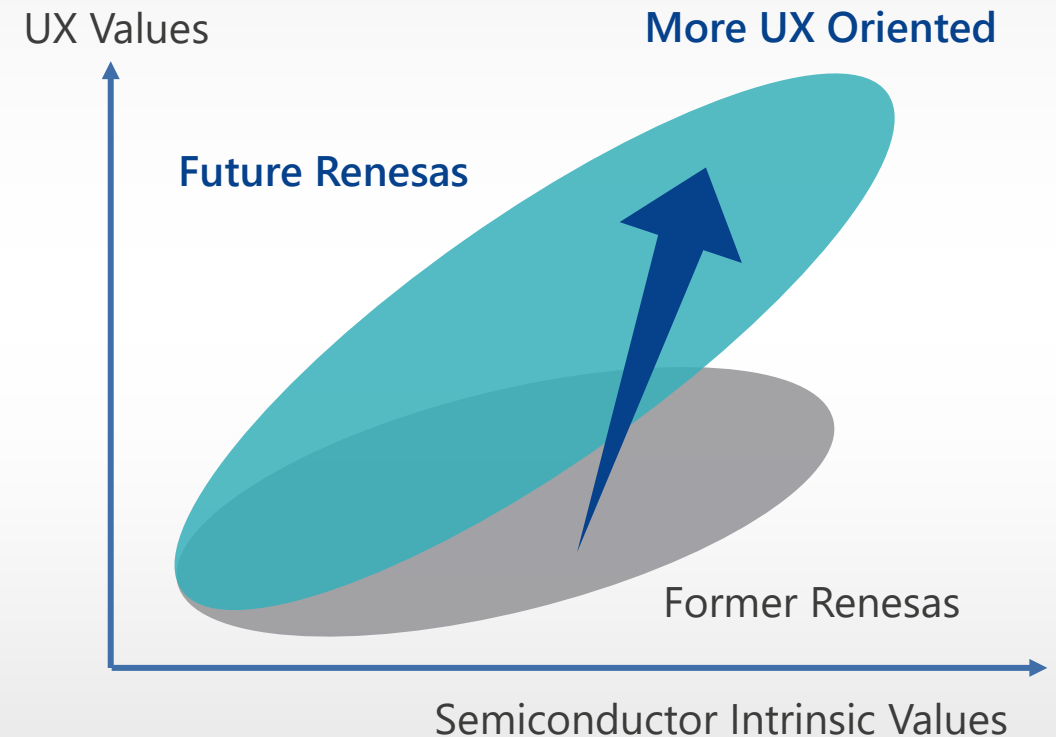
Source: VW, informationisbeautiful.net, openhub.net, gist.github.com

# INNOVATION : TWO DIRECTIONS

## SEMICONDUCTOR INTRINSIC AND USER EXPERIENCE

- Two Directions: “**Semiconductor Intrinsic**” & “**User Experience (UX)**”
- UX Technologies: **Solutions for SW Explosion of Customers**

Semiconductor Intrinsic Values	UX Values
<ul style="list-style-type: none"><li>▪ Performance</li><li>▪ Functionalities</li><li>▪ Process Technology</li><li>▪ Energy Efficiency</li><li>▪ Root of Trust</li></ul>	<ul style="list-style-type: none"><li>▪ Easy to Use SW Development Environment</li><li>▪ SW Reusability/Compatibility</li><li>▪ Rich Eco System for Scaling</li><li>▪ Time to Market</li><li>▪ Agile *CI/CD</li></ul>



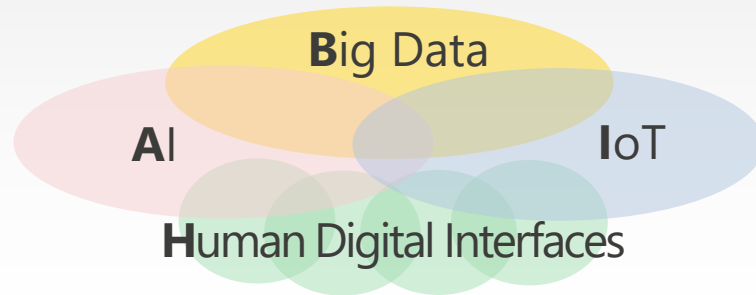
\*CI/CD: Continuous Integration and Continuous Delivery

# PARADIGM SHIFT

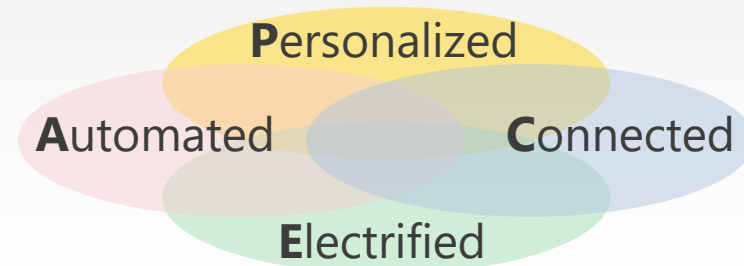
NECESSITATE FOUR CORE TECHNOLOGIES

## GLOBAL PARADIGM SHIFT

Industrial/Infrastructure – DX



Automotive – PACE



## RENESAS CORE TECHNOLOGIES

AI



for Intelligence

- Automated
- Big Data

Safety & Security



for Robustness

- Automated
- Connected/IoT
- Personalized

Digital & Analog & Power Synergy



for System First

- Connected/IoT
- Electrified
- Human Digital IFs

Cloud Native



for Scalability

- Connected/IoT
- Big Data
- Personalized

# ARTIFICIAL INTELLIGENCE

## PURSUIT FOR ADVANCED COMPUTING

### Semiconductor Intrinsic Technology

- **Performance (Higher TOPS)**
  - 60TOPS ASIL-D SoC for AD/ADAS
- **Energy efficiency (Higher TOPS/W)**
  - >10TOPS/W
- **Multiple Network & Multimodal**
  - Dynamically Reconfigurable Processor (DRP)



Voice of Customers

- Shorten TAT by \*CI/CD testing
- Support for Multi-Framework

\*IR: Intermediate Representation, \*CI/CD: Continuous Integration and Continuous Delivery

### Solution for User Experience

- **SW Development Environment**
  - Simulators (Trade Off: Speed and Precision)
- **AI Compiler**
  - \*IR Technology to manage diversities
- **Network Evaluation Environment**

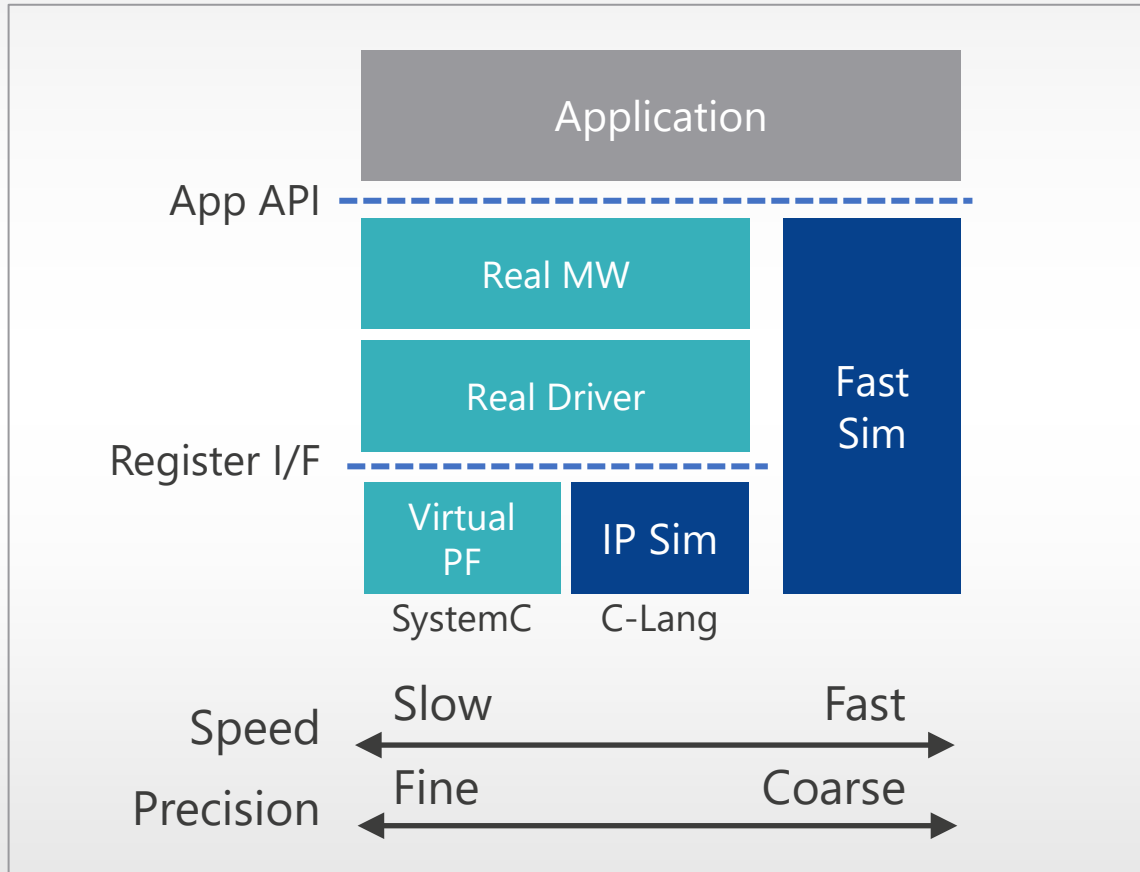
# ARTIFICIAL INTELLIGENCE

## IDEA FOR CHALLENGE

Partners  
 Collaboration w/Partners  
 Renesas

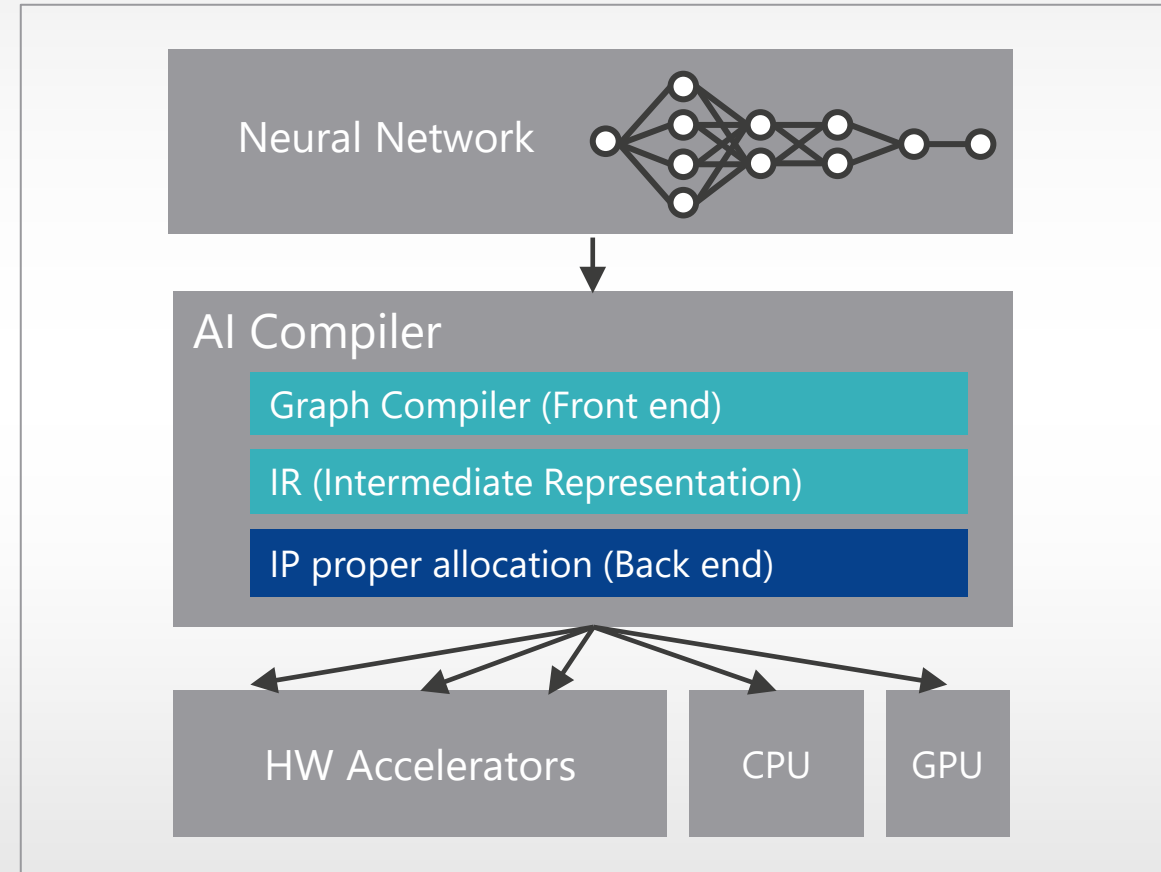
### SW Development Environment

Simulators (Realtime ~ Precise) per SW Layer



### AI Compiler

From Neural Network Graph to HW Resources



# SAFETY & SECURITY

## PURSUIT FOR ROBUSTNESS

### Semiconductor Intrinsic Technology

- **Higher Reliability**
- **Mechanisms for Functional Safety**
  - ECC on Memory, Lock-Step Dual Core, etc.
- **Mechanisms for Security**
  - Hardware Security Module, Secure ROM/eFuse, Memory Protection, etc.



Voice of Customers

### Certification Support for International Standard

- ISO 26262 / IEC 61508 for safety
- ISO 21434 / IEC 62443 for security

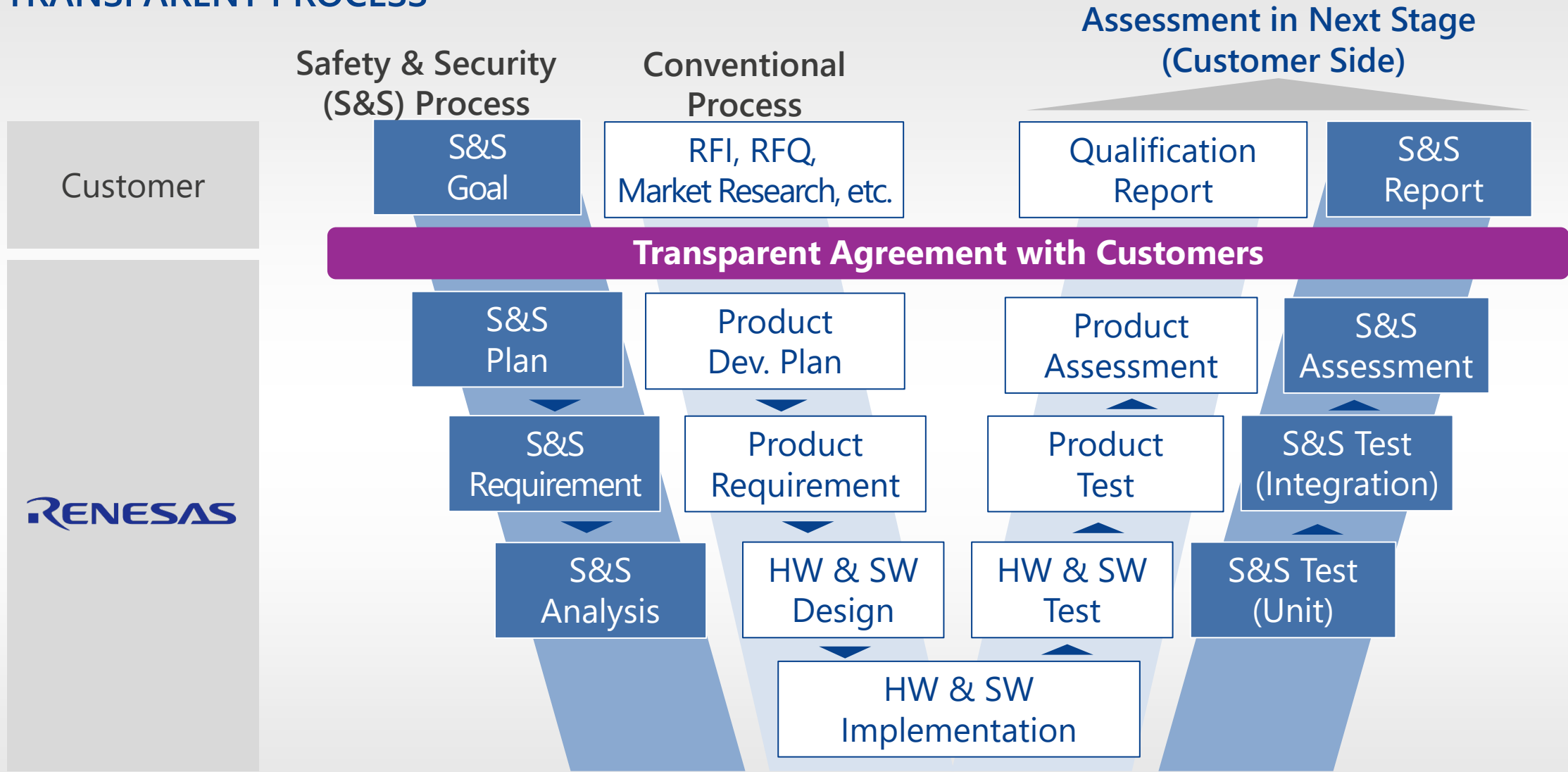
### Solution for User Experience

- **Assessment Support for ISO/IEC standards**
  - Verification Tool (Fault Metrics Calc.)
  - Threat Analysis Report, etc.
- **Product Security Incident Response Team (PSIRT)**
  - Proactive Management for potential security vulnerabilities in Renesas products by monitoring inside and outside incident information



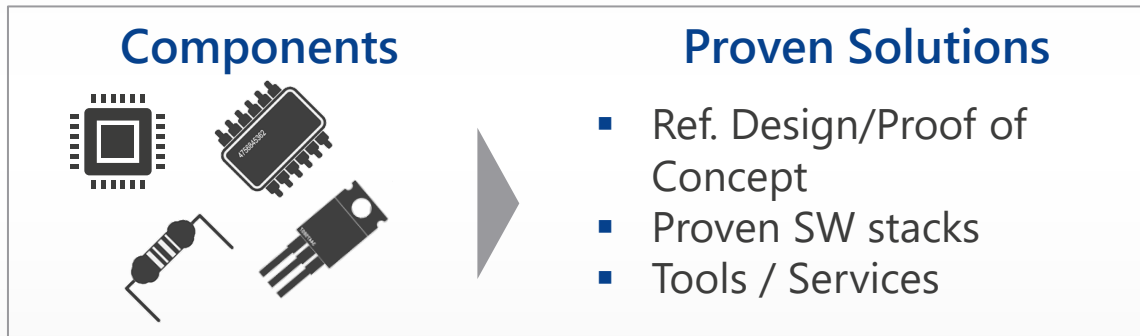
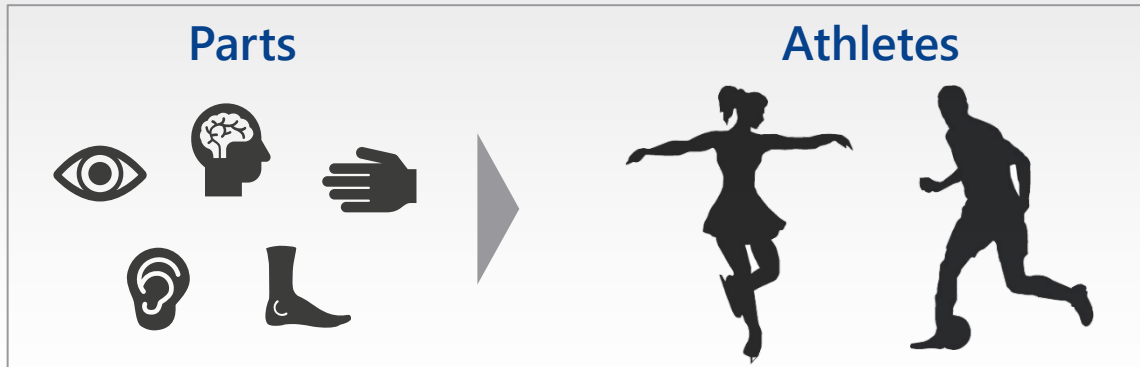
# SAFETY & SECURITY

## TRANSPARENT PROCESS



# DIGITAL & ANALOG & POWER SYNERGY

## PURSUIT FOR SYSTEM FIRST



Voice of Customers

**Business Values** : Shorten TAT, Reduced BOM Cost, Time to Market, etc.

**Engineering Values** : Secured System, Fault Tolerance, Power Efficiency, Precision, etc.

## Solution for User Experience

### ▪ Winning Combination Solutions

- Optimizing Combination of Digital, Analog and Power
- Additional Values per Customer Application

# DIGITAL & ANALOG & POWER SYNERGY

## IDEA FOR CHALLENGE

Motor Control

Radar/Lidar

Battery mgmt.

Wireless

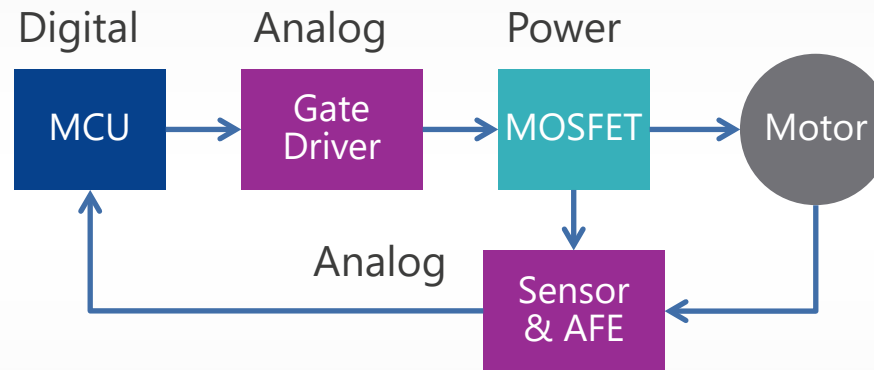
Data Center

Example

### Intrinsic Technologies

- Processor
- Peripheral (Timer, A/D)
- Gate driver
- Power device
- Position/Current sensing
- S/W: FOC, Trapezoidal
- MBD

### System Integration



**Motor Control Software** for Electromagnetics, Kinetics, Inverter, Thermal Calib., etc.



**Model-Based Design** for Early Development

### Promising Market



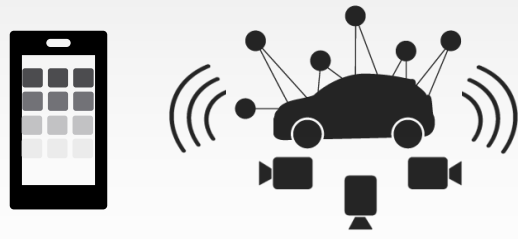
# CLOUD NATIVE

## PURSUIT FOR SCALABILITY OF CUSTOMER SYSTEMS

### Embedded



### Service Oriented



Updatable, Scalable, Secured, etc.

### Solution for User Experience

- **Cloud IT Technology imported to endpoints**
  - Enable cloud services to run in endpoints smoothly
- **Alliance with influential Cloud IT Partners**
  - Established eco systems enable application SW and services to be developed spontaneously

### Cloud Native Tech. to Enable \*SOA

- Communication (HTTPS, MQTT, ROS2, etc.)
- Microservice (Docker, Kubernetes, etc.)
- Cache Management (Webview Cache, etc.)
- Cloud Based \*IDE (Remote Sim/Debug, etc.)



Voice of Customers

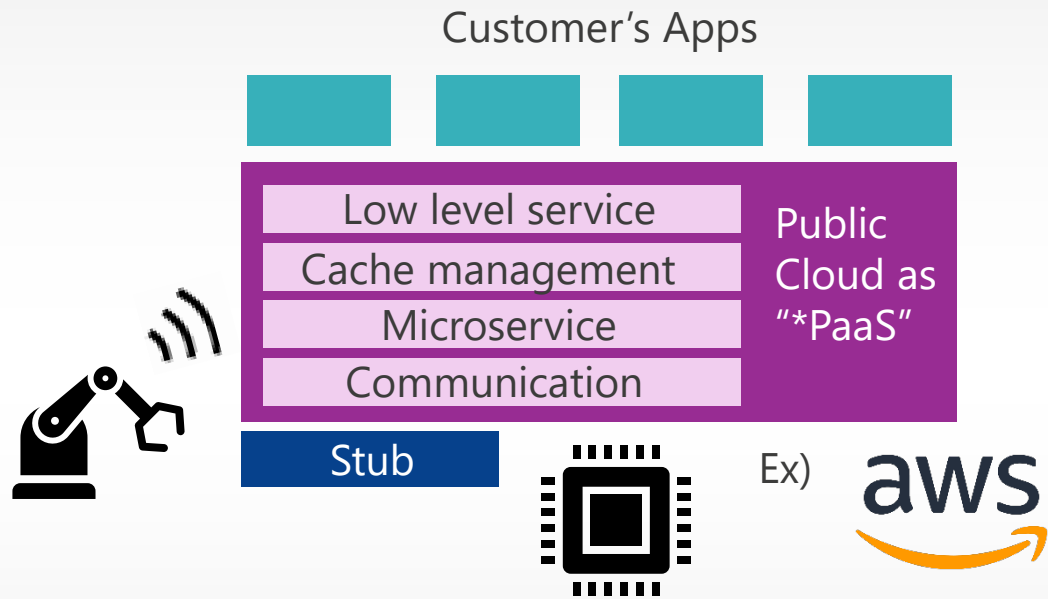
\*SOA : Service Oriented Architecture, \*IDE : Integrated Development Environment

# CLOUD NATIVE

## DEPLOYMENT OF INVOLVING CLOUD TECHNOLOGIES

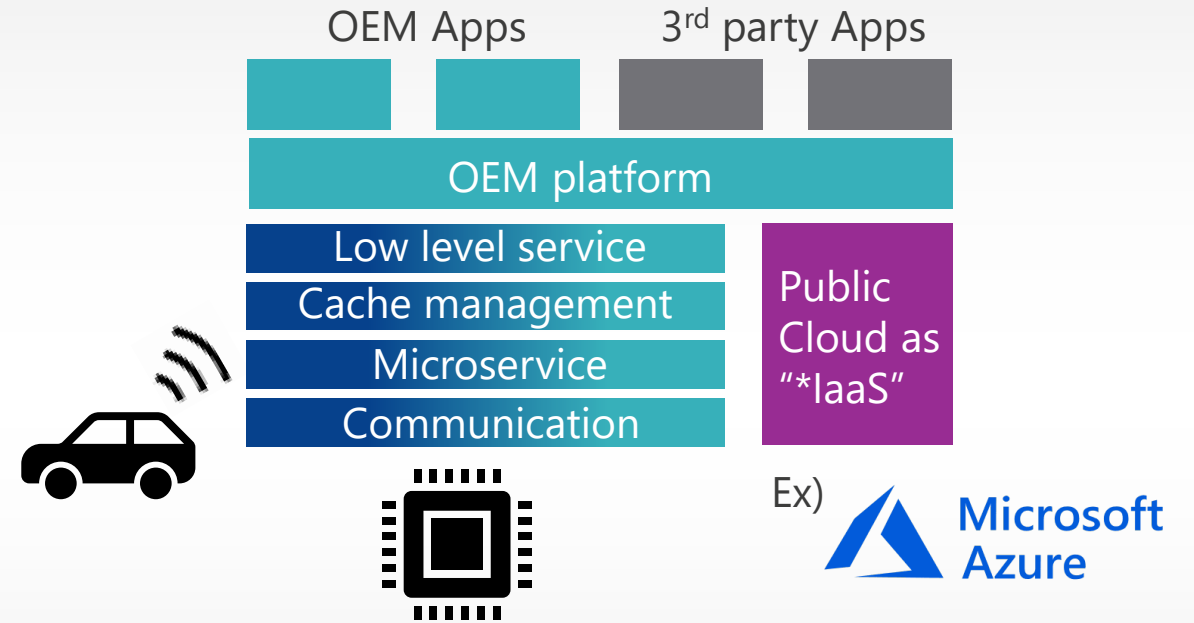
- Others
- Cloud vendor
- Customer
- Renesas

### Industrials (MCU Based)



Customer: Want to **"ADAPT" DX.**  
 Renesas : Deploy Cloud Native SW of IT Vendors.

### Automotive (SoC Based)



Customer: Want to **"BE" SW platformers.**  
 Renesas : Support Development of Cloud Native SW.

\*PaaS: Platform as a Service, \*IaaS: Infrastructure as a Service

# THREE “EASIER” FOR USER EXPERIENCES

## REALIZE AFFINITY OF END POINTS WITH CLOUD TECHNOLOGIES

### **Easier to Differentiate**

Realize expected performance and functions of HWs by providing easier-to-use means for SW

Examples: Drivers (MCAL), Hypervisor, OSAL (OS Abstraction Layer), Middleware, Firmware, etc.

### **Easier to Develop**

Contribute to agile SW development for \*CI/CD through tools evolved by IT/Cloud technologies

Examples: \*IDE, Compiler, Profiler, Debugger, Tools for Accelerators, etc.

### **Easier to Scale**

Enable application & service development to prevail on customer systems by creating rich ecosystem

Examples: Communication Protocols, Microservice, Cache Management, Cloud Based IDE, etc.

\*CI/CD: Continuous Integration and Continuous Delivery, \*IDE : Integrated Development Environment

# SUMMARY

To make our lives easier, Renesas innovation aims:

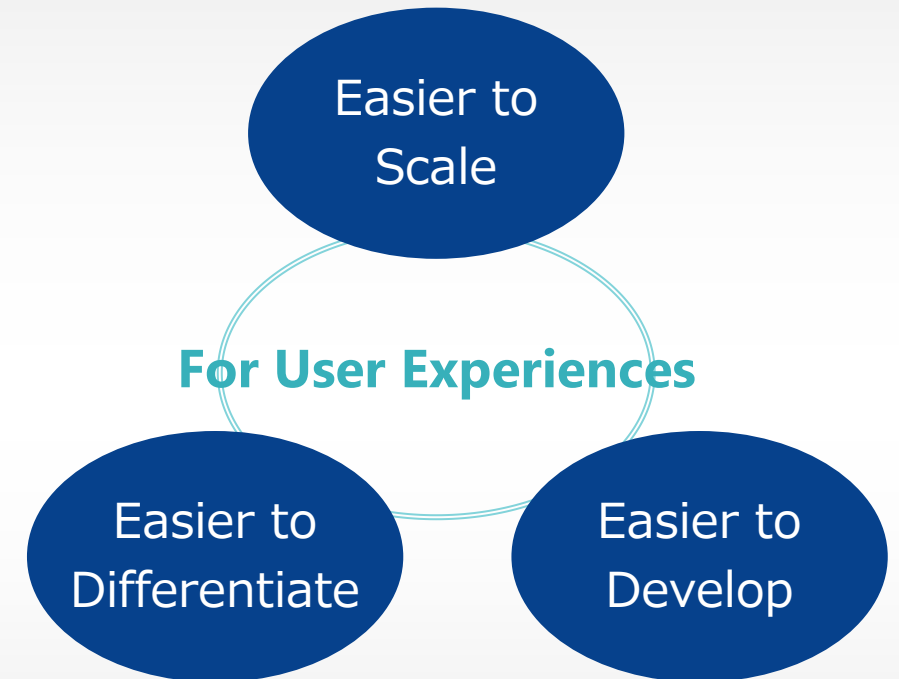
- **Solve Customers' Challenges**

User Experience (UX) innovations focused in addition to Semiconductor Intrinsic ones

- **Four Core Technologies to cope with Paradigm Shifts**

AI, Safety & Security, Digital & Analog & Power Synergy, Cloud Native

## Three "Easier" to improve UX



[Renesas.com](https://www.renesas.com)