

# Nuvoton Technology Introduction

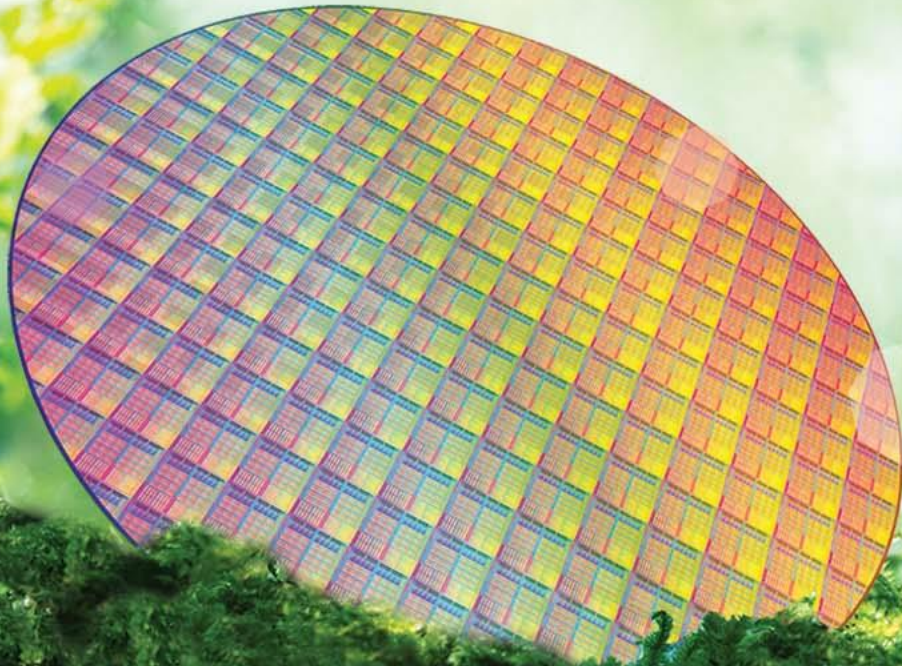
Joy of innovation  
**nuvoTon**



## Vision Statement

以綠色半導體技術豐富人類生活的隱形冠軍

Be a hidden champion in providing sustainable semiconductors to enrich human life.





# | Nuvoton at a Glance

Number of employees	<b>Over 3,700 worldwide</b>
Capital	NT\$4,198 million
Date of Establishment	<b>2008/7/1</b>
Date of IPO	2010/9/27 (TSE:4919)
Chairman	<b>Yuan-Mou Su</b>
President	Hsin-Lung Yang
Headquarters	<b>Hsinchu Science Park, Taiwan</b>
Main Shareholder	Winbond holds 51.2% share



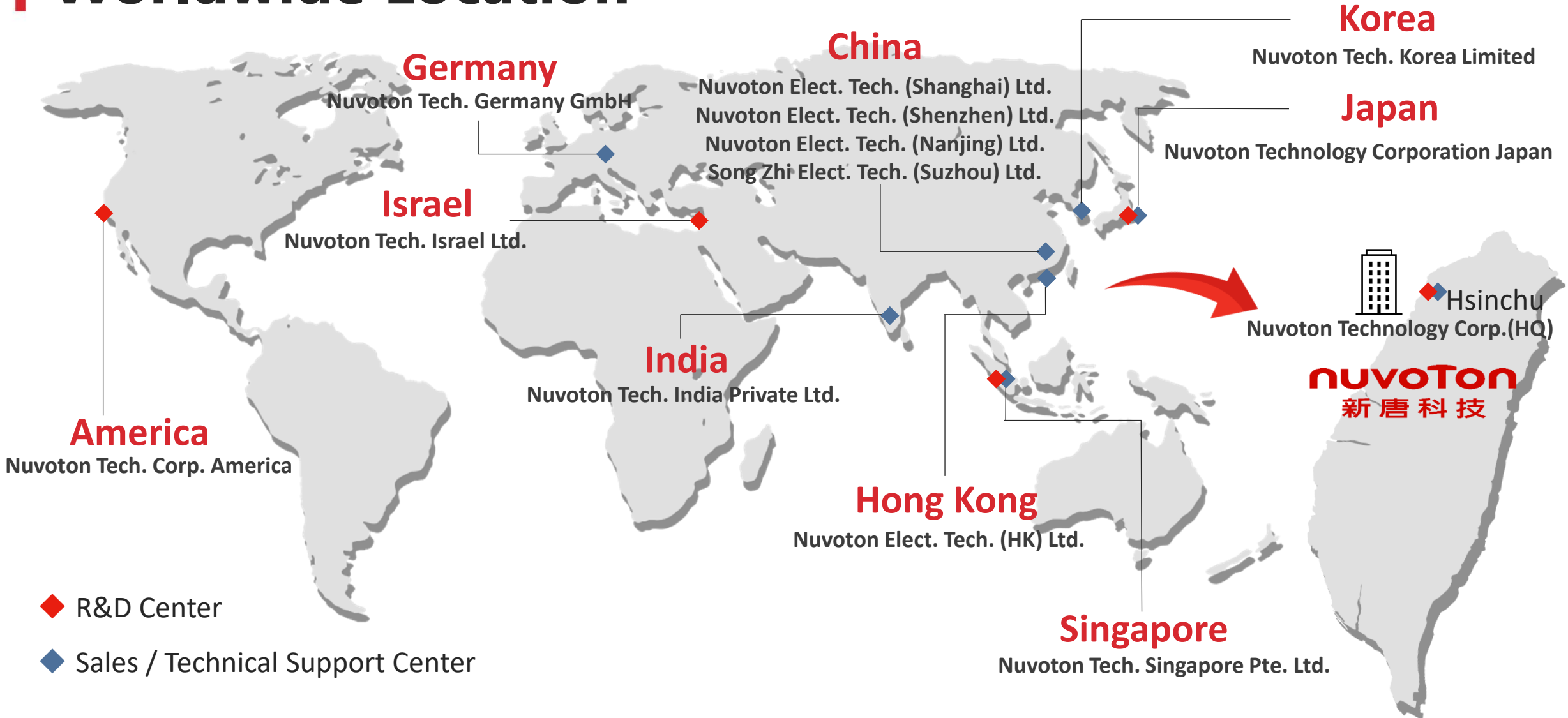
Zhubei Building\*

Headquarters



\*Photo by Jeffrey Cheng

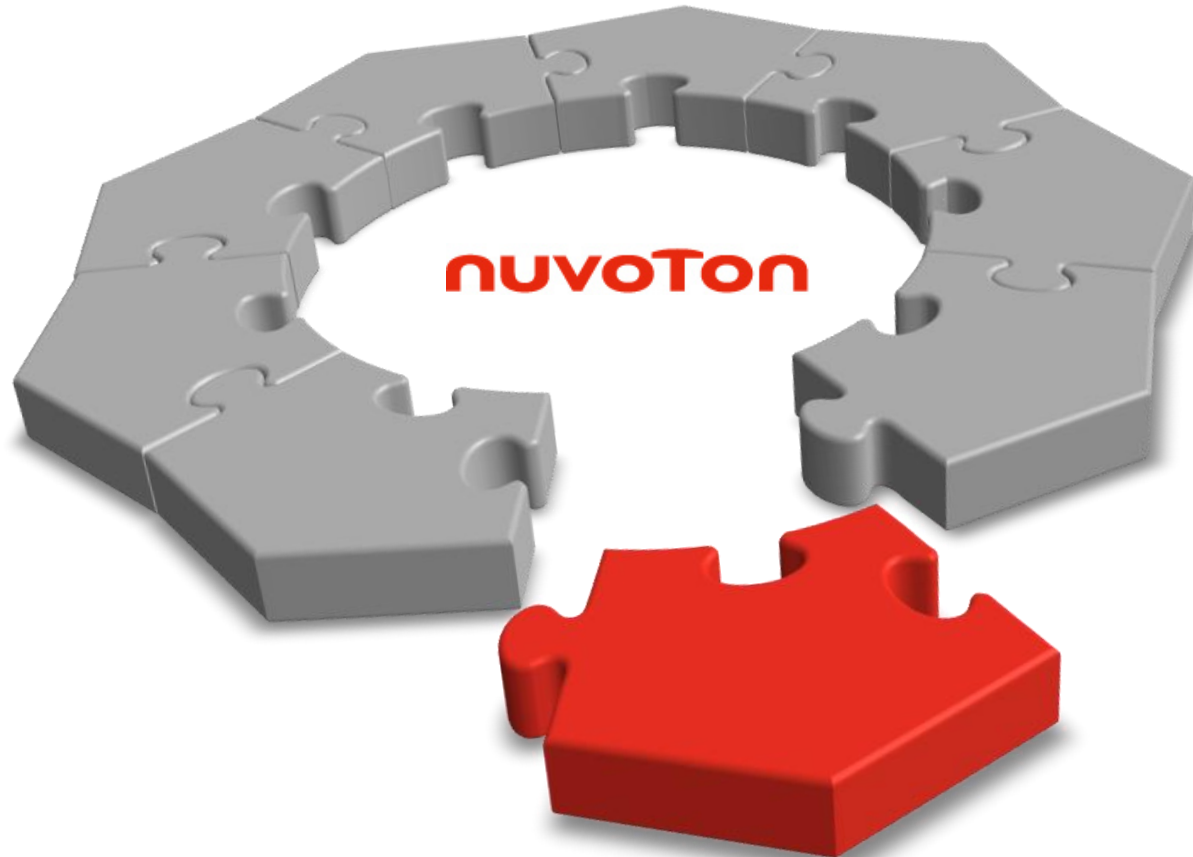
# | Worldwide Location



◆ R&D Center

◆ Sales / Technical Support Center

# | Company Performance











**Leading  
Position**

Worldwide **Top 10**  
Supplier of General  
purpose MCU

Worldwide **Top 1**  
Supplier of TPM/EC for  
commercial PC

Worldwide **Top 1**  
Supplier of MOSFET for  
smartphone

# | Business Groups

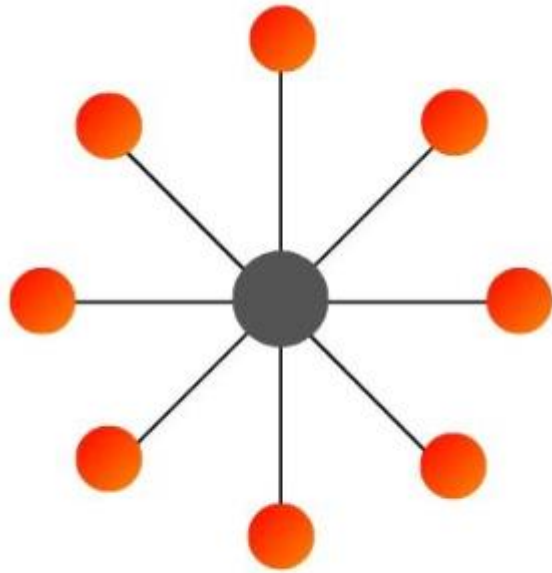
 <b>Microcontroller &amp; Audio</b> <u><b>MCU and MPU Platform</b></u> <ul style="list-style-type: none"><li>• NuMicro® MCU &amp; MPU</li><li>• Audio Component &amp; SoCs</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• Low-power with Analog Integration</li><li>• Low-power Mixed Mode Design</li><li>• IoT Security</li><li>• Eco-system Platform</li></ul>	 <b>Cloud Security</b> <u><b>Computing Security</b></u> <ul style="list-style-type: none"><li>• Secure Embedded Controller and Super I/O</li><li>• Trust Platform Module (TPM)</li><li>• Server Baseboard Management Controller (BMC)</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• Security</li><li>• System Integration / Protection</li><li>• Mixed Mode ASIC</li></ul>	 <b>Foundry</b> <u><b>Foundry Service</b></u> <ul style="list-style-type: none"><li>• 30 years of operations</li><li>• Highly efficient fab focused on high voltage and customized power process</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• BCD Process</li><li>• UHV Process</li><li>• HVIC Process</li></ul>	 <b>Component</b> <u><b>Power Component</b></u> <ul style="list-style-type: none"><li>• CSP MOSFET</li><li>• RF-GaN</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• Ultra Low Impedance</li><li>• Small Size</li><li>• High Efficiency</li></ul>
 <b>Visual Sensing</b> <u><b>Spatial Sensing Solution</b></u> <ul style="list-style-type: none"><li>• Image Sensor (3D TOF)</li><li>• DSP (HMI Display, Audio)</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• High Quality Image, Depth and Sound</li><li>• Enhanced Graphic Processing</li><li>• Software Platform</li></ul>	 <b>Battery &amp; Analog Solutions</b> <u><b>Analog IC's for Battery / Power Application</b></u> <ul style="list-style-type: none"><li>• Battery Monitoring IC</li><li>• Motor Driver IC</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• Analog Design</li><li>• SOI (Silicon on Insulator) Process</li></ul>	 <b>IoT with Security</b> <u><b>MCU &amp; Communication / Interface IC's</b></u> <ul style="list-style-type: none"><li>• Motor &amp; Power Control MCU</li><li>• High Speed IF</li><li>• NFC Tag IC</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• Low Power, Security</li><li>• High Speed Analog</li><li>• System Knowledge</li></ul>	 <b>Laser &amp; GaN</b> <u><b>Laser &amp; GaN Component</b></u> <ul style="list-style-type: none"><li>• High Power Laser Diode</li><li>• GaN Foundry</li></ul> <u><b>Core Technology</b></u> <ul style="list-style-type: none"><li>• High Power and High Reliability Laser Diode</li><li>• Epitaxial and full process service for GaN Power device</li></ul>



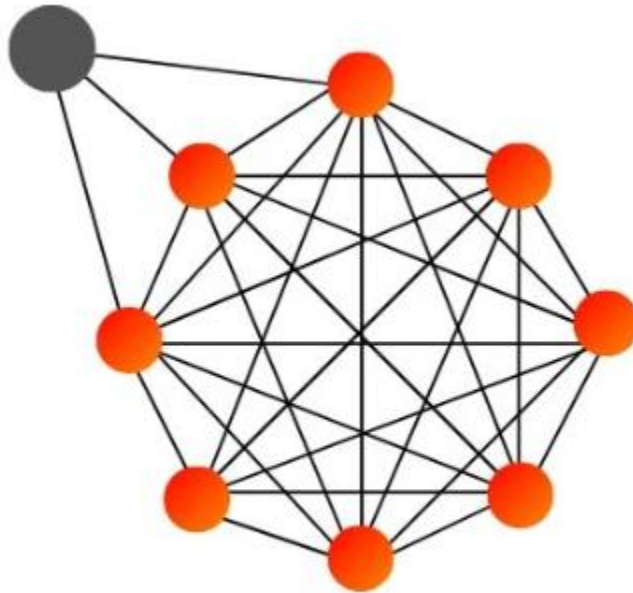
# NuMicro<sup>®</sup> IoT Platform



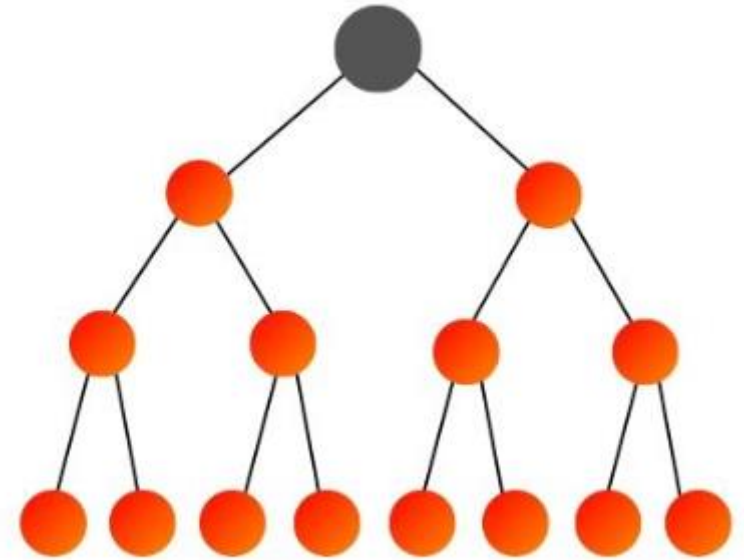
# | Mesh Network



Star Topology



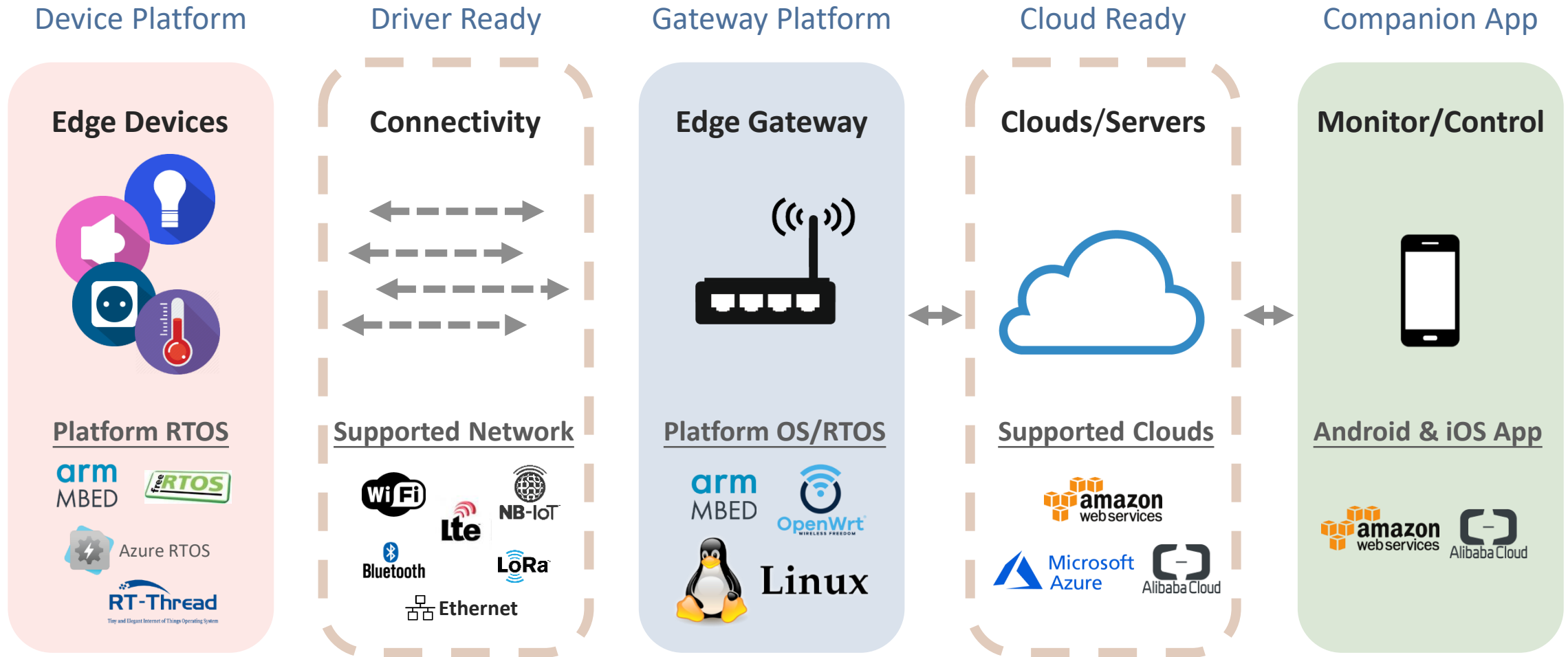
Mesh Topology



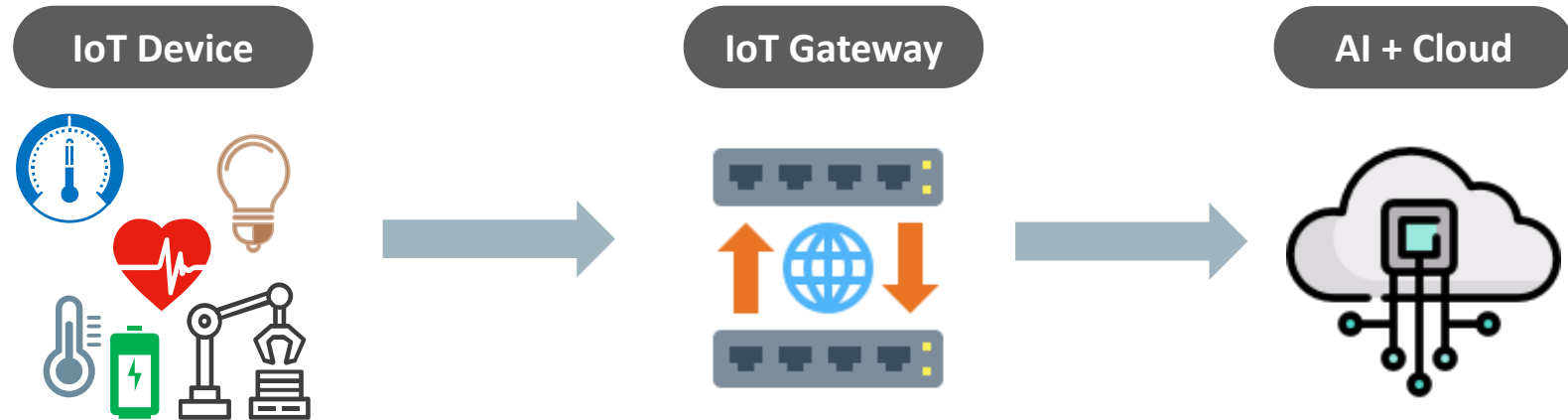
Partial-Mesh Network



# | Nuvoton Provides One-Stop IoT Solution




# Nuvoton IoT Platforms



	IoT Device	IoT Gateway	AI + Cloud
Nuvoton Platforms	<b>NEW</b> <b>NuMaker-IoT-MA35Family (Dual Cortex-A35)</b>		
	NuMaker-IoT-M467 (Cortex-M4) NuMaker-IoT-M487 (Cortex-M4) NuMaker-IoT-M2354 (Cortex-M23) NuMaker-LoRaD-M252 (Cortex-M23) <i>NuStamp-ACK-M031LE</i> (Cortex-M0)	<b>NEW</b> <b>NuMaker-IIoT-NUC980G2 (ARM9)</b> NuMaker-IIoT-NUC980 (ARM9) NuMaker-RTU-NUC980 (ARM9) NuMaker-IoT-M467 (Cortex-M4)	Amazon Web Service Microsoft Azure Alibaba Cloud

# | Nuvoton 2024 IoT Platforms

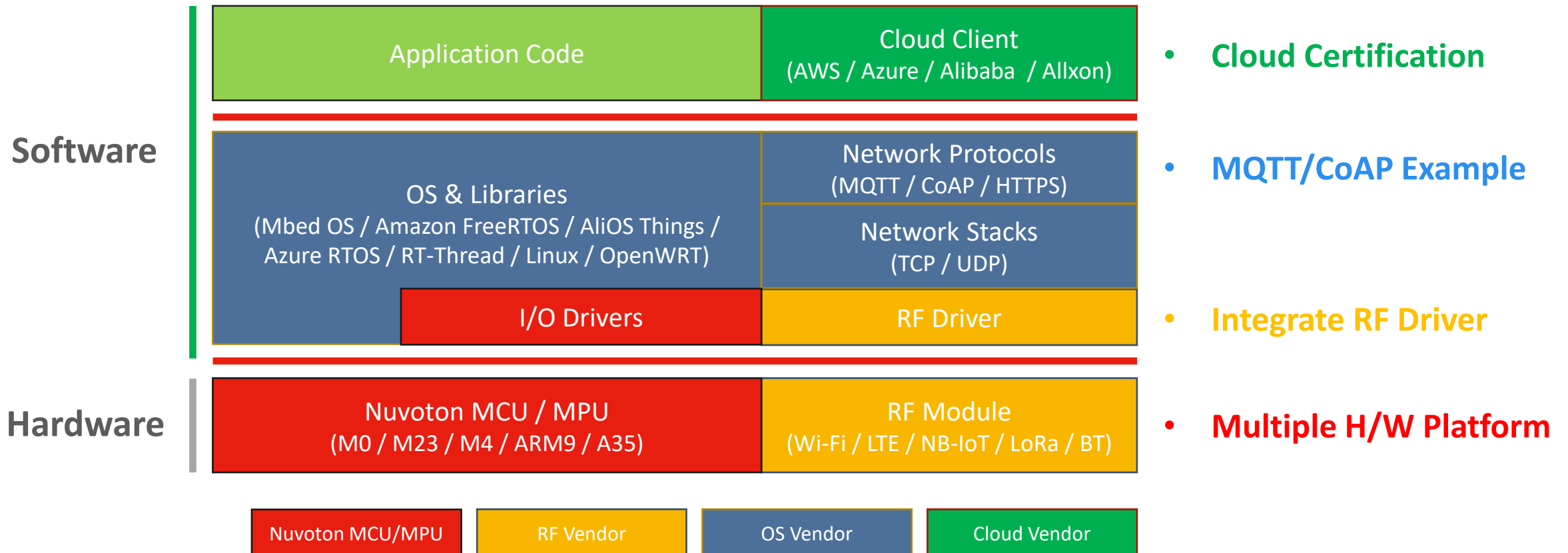
IoT Platforms	Application Platforms	NuMaker Board	Details
IoT Device Platforms	IoT General Platform	NuMaker-IoT-M467 NuMaker-IoT-M487	The platforms are designed for sensor fusion and machine learning device applications. They also support Arm® CMSIS-NN for neural network computations and include Wi-Fi and Ethernet network support.
	IoT Security TF-M Platform	NuMaker-IoT-M2354	The IoT secure platform based on Arm® Cortex®-M23 TrustZone® technology with secure keys management and storage protected by physical tampering shield.
	LoRa Device Platform	NuMaker-LoRaD-M252	The LoRa device development platform is fully compliant with LoRaWAN Class A & C standard and supports 868-915MHz (EU/US) or 433-470MHz (CN) bands.
	Amazon ACK Platform	<b>NuStamp-ACK-M031LE</b>	Amazon approved Alexa Connect Kit (ACK) platform. Easy to implement smart home appliances with Alexa Echo speaker ecosystem.
IoT Gateway Platforms	Industrial IoT High Performance Computing Gateway Platform 	<b>NuMaker-IoT-MA35D1-A1</b> <b>NuMaker-IoT-MA35D0-A1</b>	The <b>high performance</b> gateway platform running Linux, supports rich network protocols, data encryptions, and OpenWRT to build the control interface.
	Industrial IoT Gateway Platform	<b>NuMaker-IIoT-NUC980G2</b> <b>NuMaker-IIoT-NUC980</b> <b>NuMaker-RTU-NUC980</b>	The gateway development platforms running Linux, supports rich network protocols, complete encryption methods, as well as OpenWRT to build the control interface.
	Lite IoT Gateway Platform	NuMaker-IoT-M467	Supports multiple cloud services, such as Amazon Web Service, Alibaba Cloud and Microsoft Azure IoT, etc.



# Nuvoton IoT Platforms

(NuMaker M4/NUC980/MA35 series platforms)

- Integrate MCU/OS/Network Protocols/RF Driver/Application Demos
- Customer can focus on application development.



# Connectivity Ecosystems Support

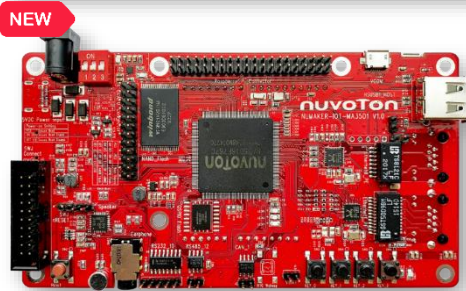
NuMaker Board	OS / RTOS	IP <sup>*3</sup>				Non-IP <sup>*3</sup>	Clouds		
		Ethernet	Wi-Fi	NB-IoT Cat-M1	LTE	LoRa (Device)	Amazon AWS	Alibaba Cloud	Microsoft Azure
NEW NuMaker-IoT-MA35D1-A1 NuMaker-IoT-MA35D0-A1	Linux / OpenWRT	●	●	●	●		●	●	
	RT-Thread	●						●	●
NuMaker-IIoT-NUC980G2 NuMaker-IIoT-NUC980	Linux / OpenWRT	●	●	●	●		●	●	
	FreeRTOS	●							
	RT-Thread	●						●	●
NuMaker-RTU-NUC980 (Chili)	Linux / OpenWRT	●	●	●	●		●	●	
	FreeRTOS	●							
	RT-Thread	●						●	●
NuMaker-IoT-M487	Mbed OS	●	●	●	●	● <sup>*5</sup>	●	●	●
	Amazon FreeRTOS	●	●	●			●		
	FreeRTOS	●							
	AliOS Things	●	●					●	
	RT-Thread	●	●					●	●
	Azure RTOS		●						●
NuMaker-IoT-M467	Mbed OS	●	●	●	●	● <sup>*5</sup>	●		●
	Amazon FreeRTOS	●					●		
	FreeRTOS	●							
	RT-Thread	●	●					●	●
	Zephyr	●	●	●			●		●

- \*1 Support on Mbed Studio
- \*2 Non-OS ver. is NuLoRaNode.
- \*3 Refer [supported components](#) for detail.
- \*4 Alexa Connect Kit (ACK)
- \*5 Require an external LoRa module

# | IoT Platforms

## Platforms

### NuMaker-IoT-MA35D0/1-A1



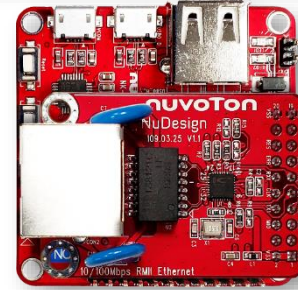
- Dual Arm® Cortex®-A35 + Arm® Cortex®-M4
- Runs at 800 MHz
- 128 MB DDR (up to 512 MB)
- 1 Gb NAND Flash
- Ethernet Gateway
- Wireless Gateway
- Edge Computing

### NuMaker-IIoT-NUC980 NuMaker-IIoT-NUC980G2



- Arm® ARM926 core
- Runs at 300 MHz
- DDR 64 MB / 128 MB(G2)
- 1 Gb SPI-NAND Flash
- Ethernet Gateway
- Wireless Gateway

### NuMaker-RTU-NUC980 "Chili Board"



- Arm® ARM926 core
- Runs at 300 MHz
- 64 MB DDR2 in LQFP64
- 256 Mb SPI NOR Flash
- CAN 2.0B/RS485 to Eth
- Ethernet Gateway
- Gateway in small size
- Remote terminal unit

### NuMaker-IoT-M467



- Arm® Cortex®-M4 core
- Runs at 200 MHz
- 1024 KB Flash Memory
- 512 KB SRAM
- Crypto accelerators
- Ethernet Gateway
- Remote Controller
- Serial to Ethernet

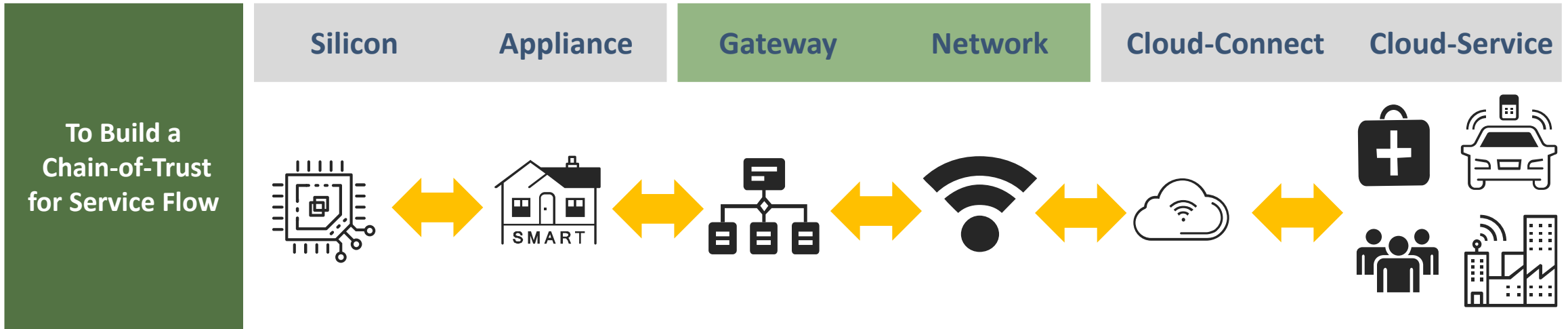


# NuMicro<sup>®</sup> IoT Security Platform



# Why IoT Security Matters

- IoT Services Security Rely on Chain-of-Trust



- IoT Things Security Rely on Silicon Root-of-Trust



# | NuMicro<sup>®</sup> IoT Security Technology

## MCU System Security



### Secure Boot

Secure Bootloader in ROM with Driver APIs



### Device Identification

Unique ID, Customer Unique ID



### Isolation

TrustZone-M, TrustZone-A, Peripheral Privileged Mode, Trusted Secure Island (TSI for MPU)



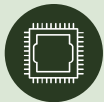
### Flash Memory Protection

Read/Write Protection, eExecute-Only Memory (XOM), Dual-Bank with Bank Swap



### System Anti-Tampering

Tamper Detection Pins, RTC Domain Backup Registers



### Chip-Level Security

Temperature Sensor, Clock Function Monitor, Voltage Glitch Detection

## Crypto Security



### TRNG, Hardware Accelerators, Secure Storage

TRNG, DES/3DES, SHA, AES, RSA, ECC, Power Side-Channel Attack Mitigation for AES/RSA/ECC, Secure Key-Store, China SM2/SM3/SM4

## Product Lifecycle Security



### Product Lifecycle Management

Booting Status Monitor, Lifecycle Management, Firmware Version Counter



### Secure Debug

Debug Authentication (temporarily unlock), Debug Port Management (DPM)

## Software and Service



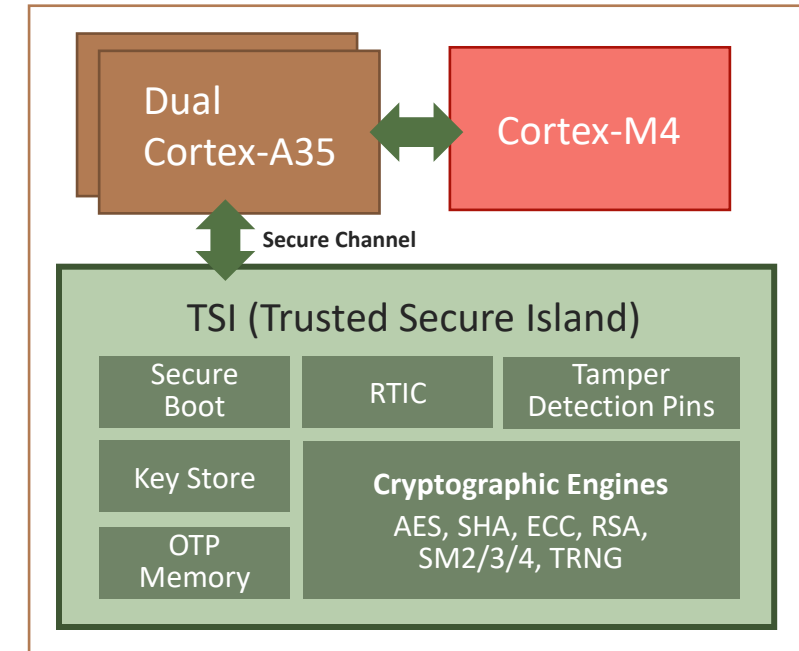
### Security Reference Software and Provisioning

Key Generation Tool, Firmware Image Signing Tool, OTA Update, Key/Certificate Provisioning Service



# Advanced Security Features for Cyber Security

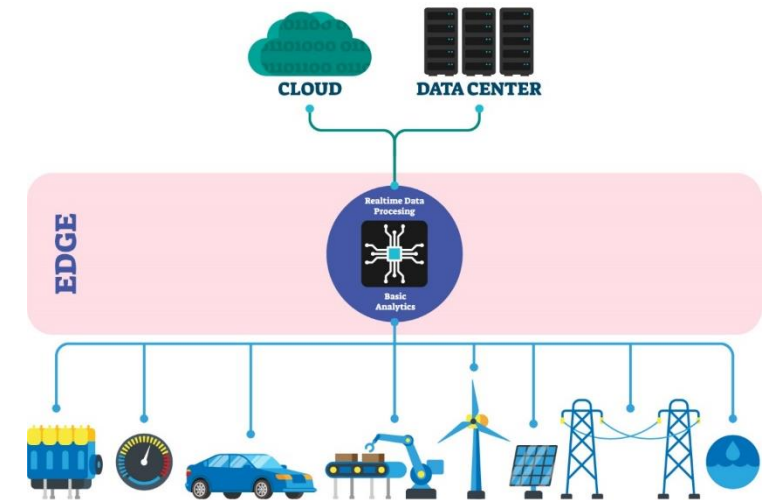
- The Nuvoton TSI is an isolated secure hardware unit where operation is not affected by MA35D1 system.
- Built-in cryptographic accelerators, Key Store, and OTP memory
- Performs all the security operations, including secure boot and tamper pins detection.
- The secure environment and features realize the **Protection, Detection, and Recovery** for IoT products.
- Easily established
  - **Execution Security**
    - TSI, TrustZone, Secure boot, Run-Time Integrity Checker (RTIC)
  - **Communication Security**
    - Hardware cryptographic accelerators
  - **Chip-level Storage Security**
    - Key Store and OTP memory, accessed by the cryptographic engines, without the need of CPU access
  - **System Security**
    - Tamper pins for tamper detection



**The MA35D1 is a trusted system for IoT products' security requirements**

# High Performance and Advanced Security for Edge Gateway

- For increasing the data processing and connection ability, equipped advanced security, high performance cores, PDMA and high-speed connectivity.
- **High Performance and Real-time Processing**
  - Dual 64-bit Arm Cortex-A35 up to 800 MHz
  - Arm Cortex-M4 up to 180 MHz
  - Gigabit Ethernet x2, USB2.0 HS x2, SDIO 3.0, CAN FD x4, UART x17 etc.
- **Advanced Security**
  - TrustZone
  - Nuvoton unique secure hardware - TSI
  - Secure data transfer by TLS encryption
- **Networking**
  - Network protocols -TCP, UDP, HTTP(S), MQTT, CoAP, etc.
  - Ethernet, Wi-Fi, 4G/5G, NB-IoT, LoRa, BLE, sub-1G, etc.
  - Public cloud client references to Azure, AWS, etc.



**The MA35D1 is suitable for edge gateway in smart factory and new energy applications, etc.**

# | NUC980 New Energy Gateway

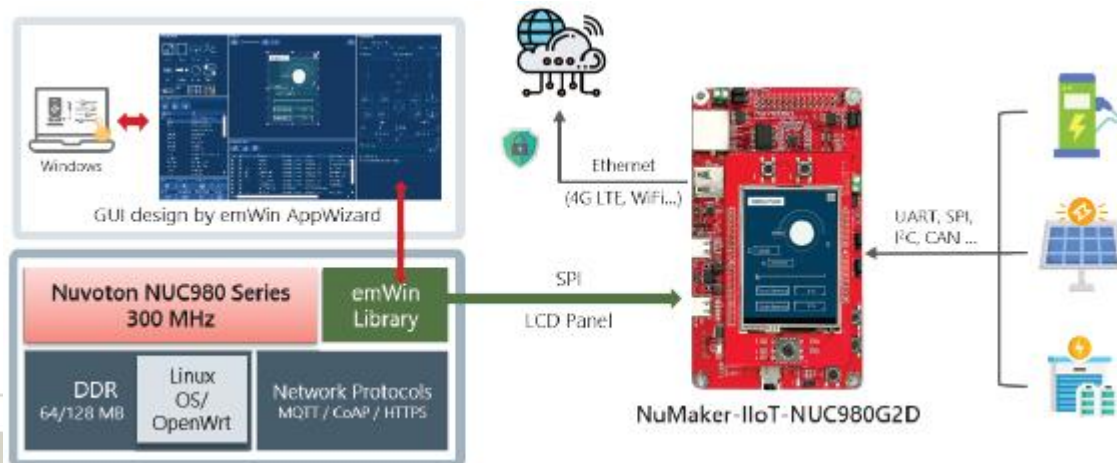
## Features

- Linux OS/OpenWrt + Graphics library (emWin)
- Supports various networking protocols including MQTT, COAP, HTTPD, and HTTPS
- Ethernet or Wi-Fi/4G connectivity to the cloud
- OTA (Over-the-Air) firmware upgrades
- Secure data transmission – TLS 1.2/1.3 (OpenSSL)
- PCB solution requires only 2 to 4 layers of PCB

## Specifications

### NUC980 Series

- LQFP package with built-in 64/128 MB DDR
- SPI NOR/NAND/eMMC/SD/USB boot options
- Up to 2 sets of 10/100 Ethernet interfaces
- Up to 2 sets of high-speed USB hosts
- Up to 10 sets of UART/RS485 interfaces
- Up to 4 sets of CAN Bus interfaces



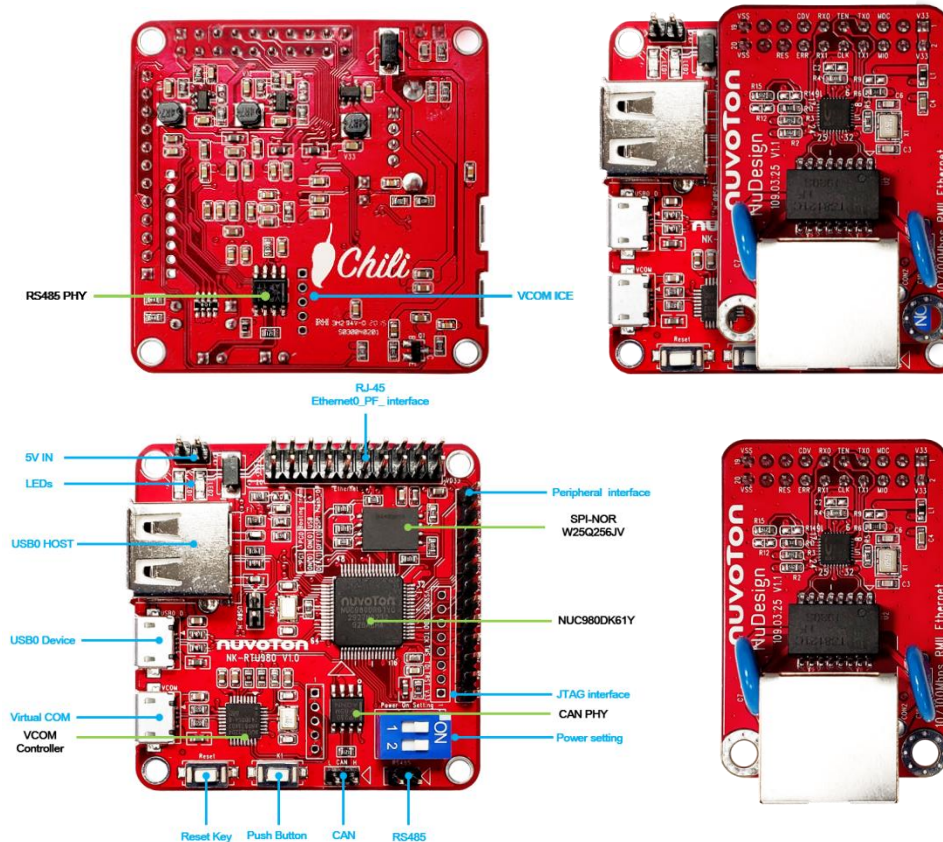


# NuMaker-RTU-NUC980(Chili)

## Key Features

- NUC980DR Series
  - ARM926EJ-S 300 MHz
  - 64M Byte DDR2 in LQFP64 package
- 10/100M Ethernet x 1
- On board USB CDC port
- USB 2.0 HS Host / Device x 1
- CAN Bus x 1
- RS485 x 1
- SPI NOR Flash 32M Byte
- Linux OS and RTOS
- SaaS(Software as a Service) Ready

<http://www.nuvoton.com/chili>



(Reference: NK-RTU980)