

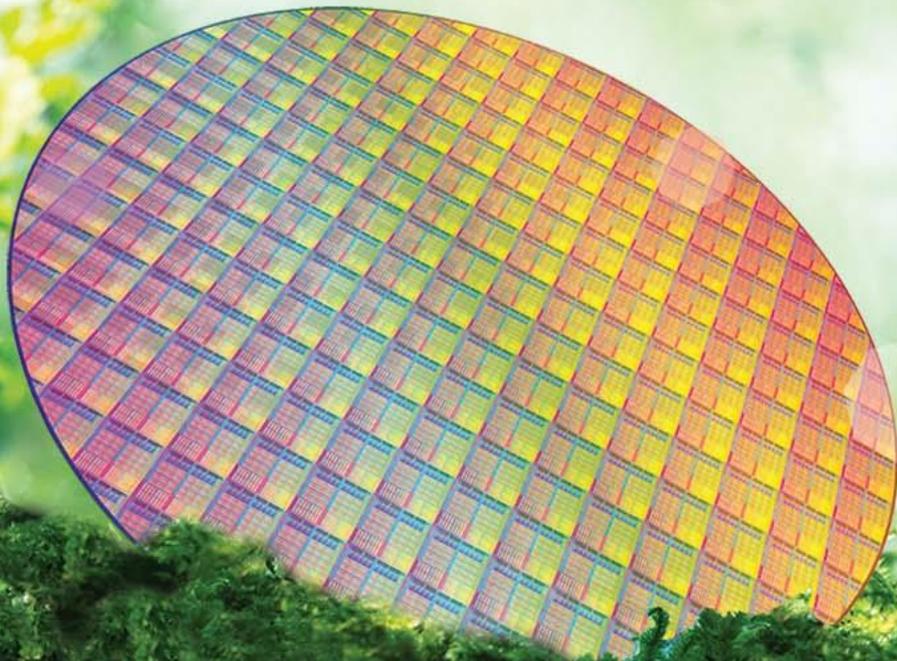
Nuvoton Technology Introduction

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 **Over 3,700 worldwide**

Capital **NT\$4,198 million**

Date of Establishment **2008/7/1**

Date of IPO **2010/9/27 (TSE:4919)**

Chairman **Yuan-Mou Su**

President **Hsin-Lung Yang**

Headquarters **Hsinchu Science Park, Taiwan**

Main Shareholder **Winbond holds 51.2% share**



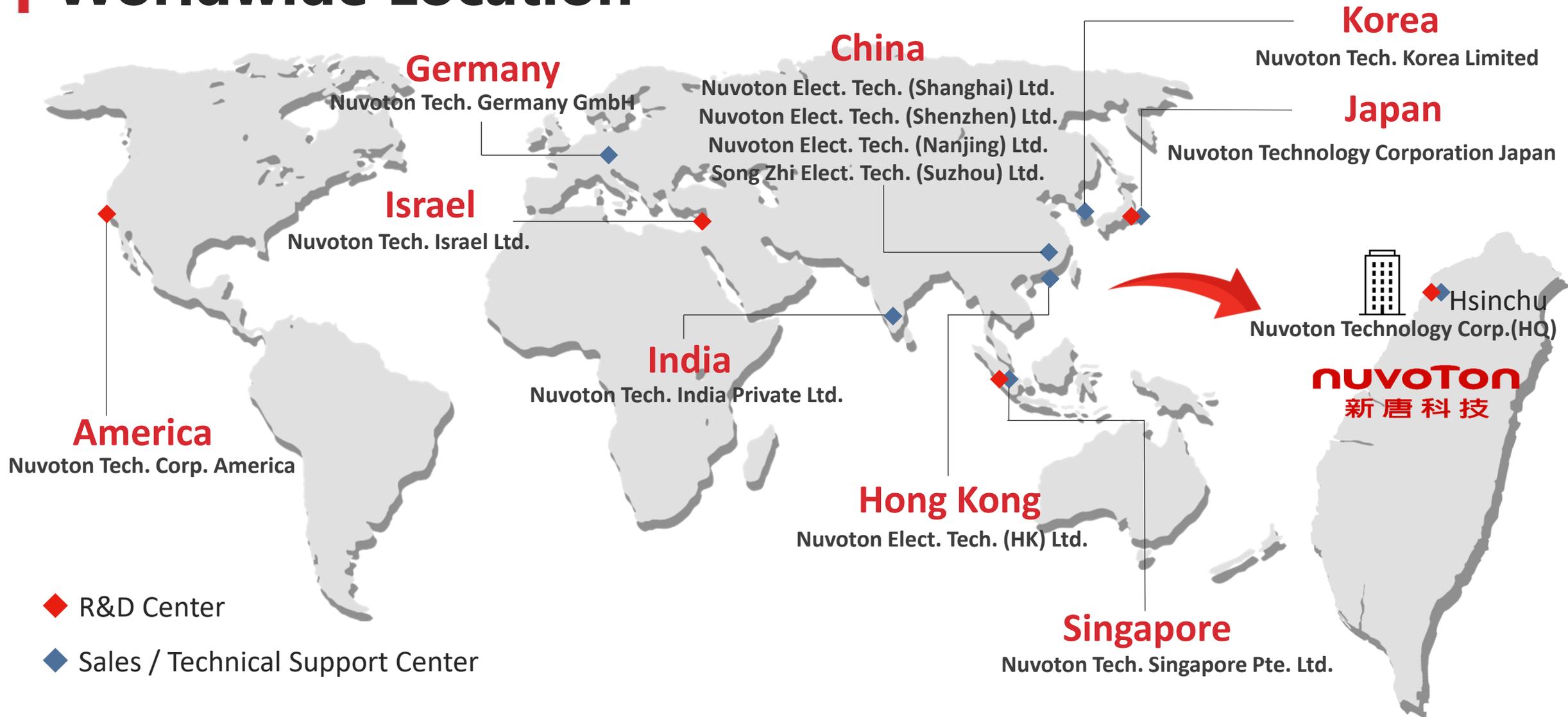
Zhubei Building*



Headquarters

*Photo by Jeffrey Cheng

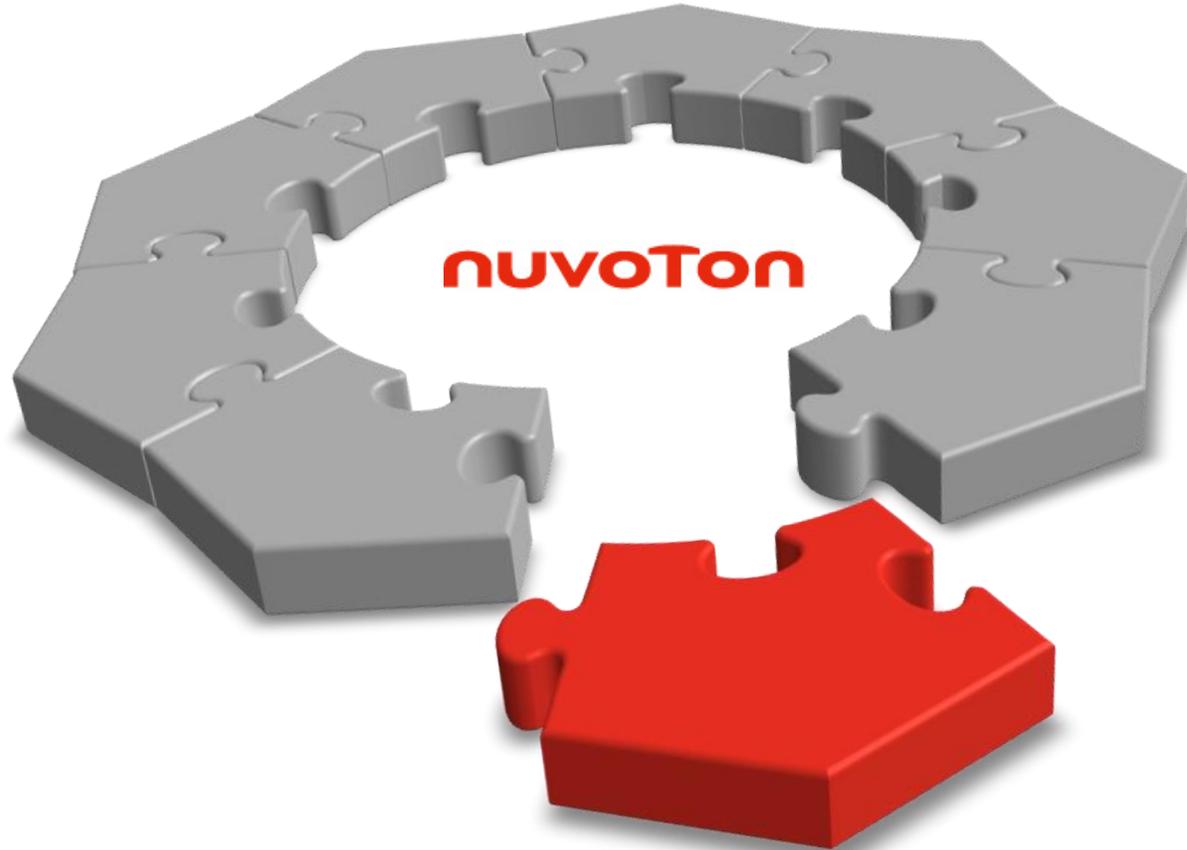
Worldwide Location



◆ 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

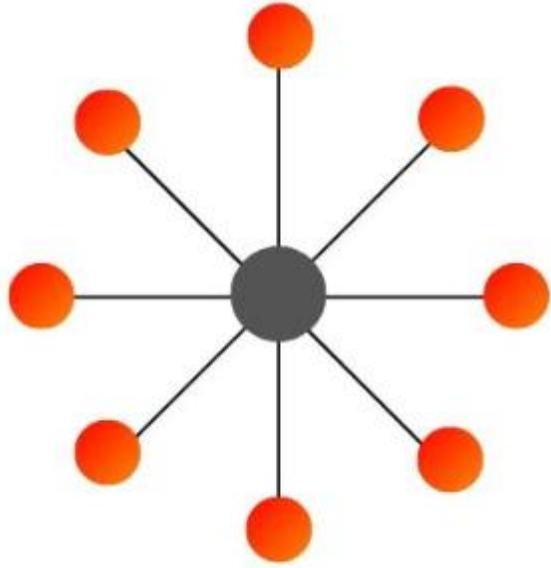
Business Groups

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

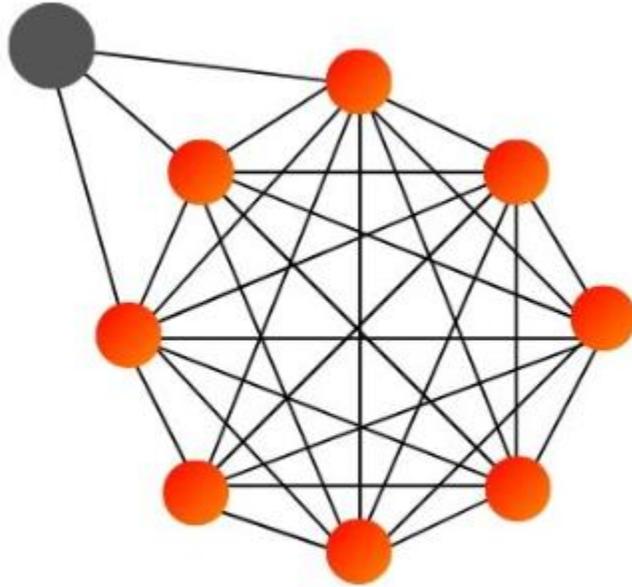
NuMicro[®] IoT Platform



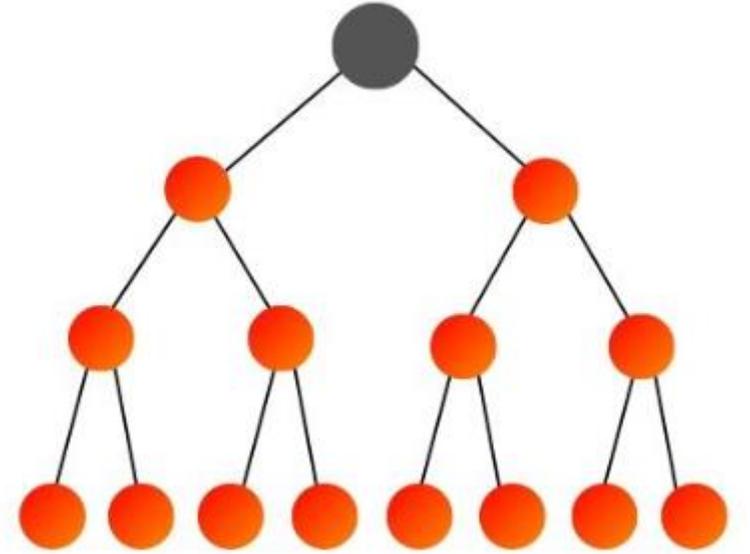
| Mesh Network



Star Topology



Mesh Topology



Partial-Mesh Network

Nuvoton Provides One-Stop IoT Solution

Device Platform

Edge Devices

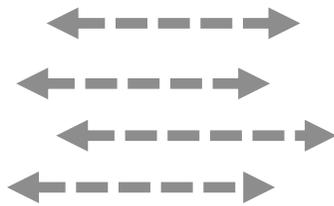


Platform RTOS

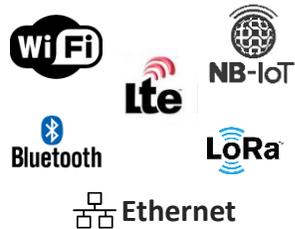


Driver Ready

Connectivity

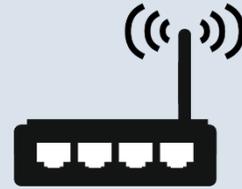


Supported Network



Gateway Platform

Edge Gateway



Platform OS/RTOS



Cloud Ready

Clouds/Servers



Supported Clouds



Companion App

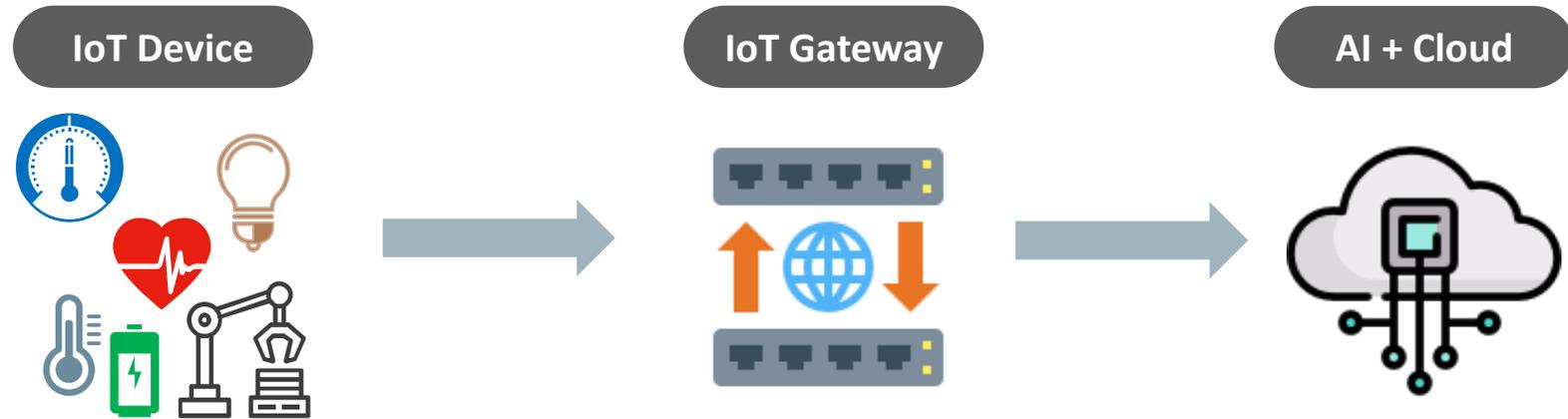
Monitor/Control



Android & iOS App



Nuvoton IoT Platforms



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

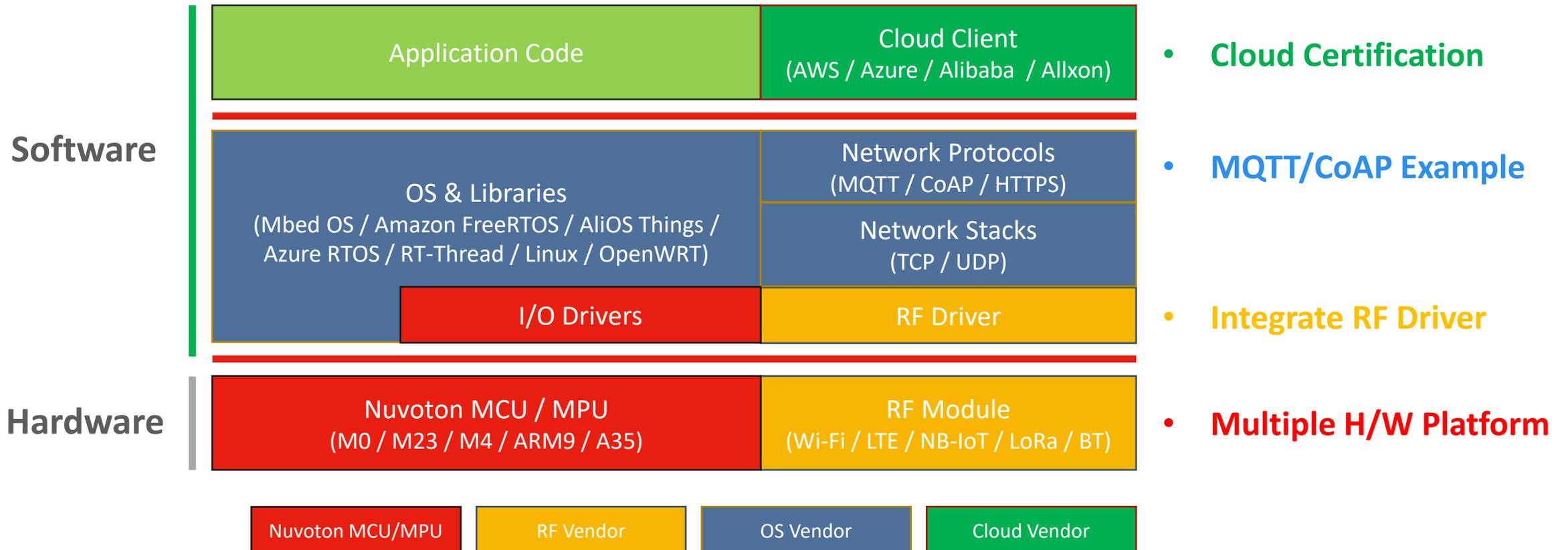
Nuvoton 2024 IoT Platforms

| 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 | NuStamp-ACK-M031LE | 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 NEW | NuMaker-IoT-MA35D1-A1 NuMaker-IoT-MA35D0-A1 | The high performance gateway platform running Linux, supports rich network protocols, data encryptions, and OpenWRT to build the control interface. |
| | Industrial IoT Gateway Platform | NuMaker-IIoT-NUC980G2 NuMaker-IIoT-NUC980 NuMaker-RTU-NUC980 | 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

NEW

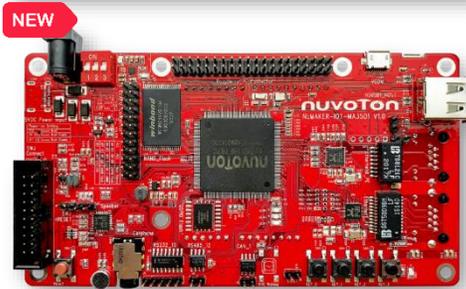
| NuMaker Board | OS / RTOS | IP ^{*3} | | | | Non-IP ^{*3} | Clouds | | |
|--|-----------------|------------------|-------|---------------|-----|----------------------|------------|---------------|-----------------|
| | | Ethernet | Wi-Fi | NB-IoT Cat-M1 | LTE | LoRa (Device) | Amazon AWS | Alibaba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

*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



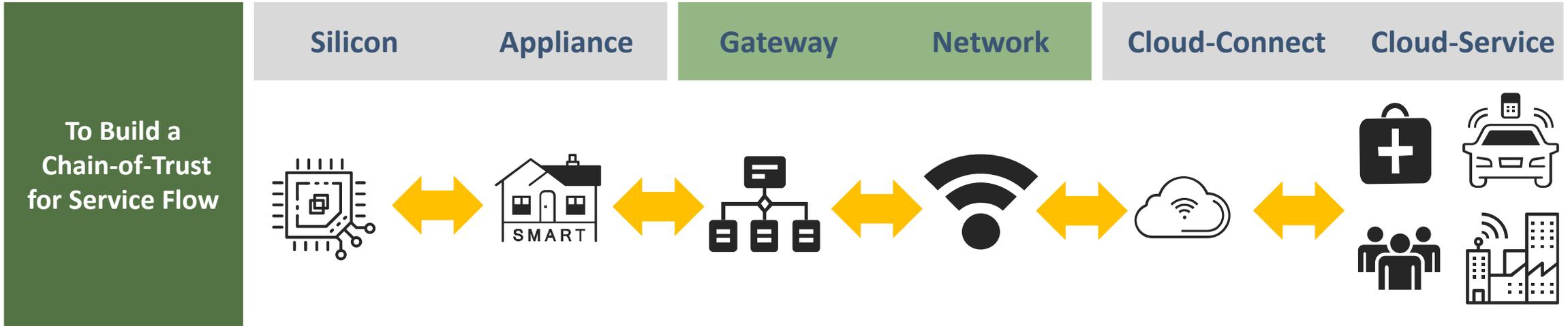
- Arm® Cortex®-M4 core
- Runs at 200 MHz
- 1024 KB Flash Memory
- 512 KB SRAM
- Crypto accelerators
- **Ethernet Gateway**
- **Remote Controller**
- **Serial to Ethernet**

NuMicro[®] 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[®] 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)



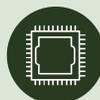
Flash Memory Protection

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

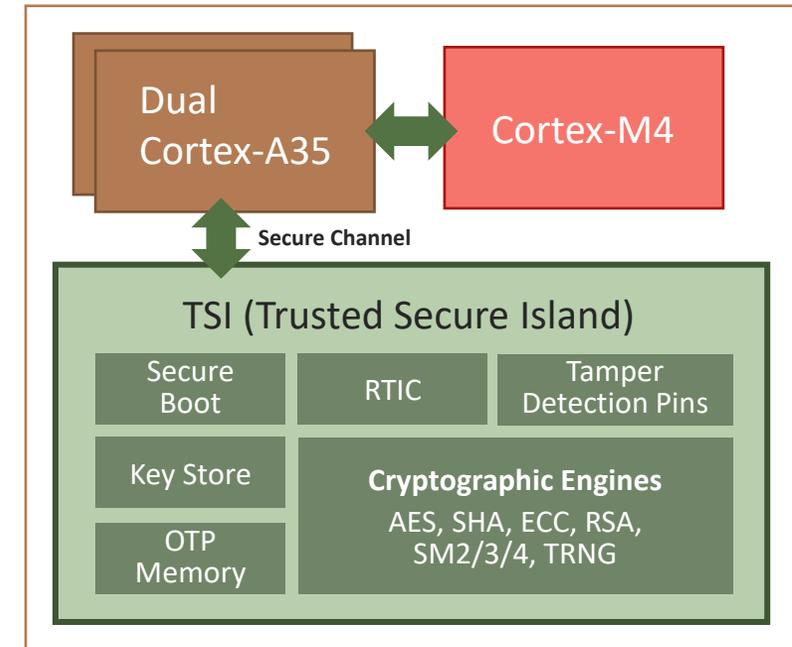


Security Reference Software and Provisioning

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

Advanced Security Features for Cyber Security

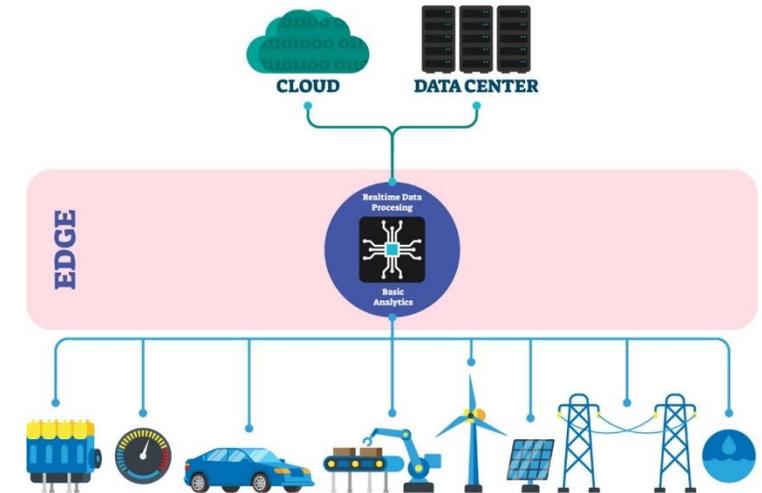
- The Nuvoton TSI is an isolated secure hardware unit where operation is not affected by MA35D1 system.
- Built-in cryptographic accelerators, Key Store, and OTP memory
- Performs all the security operations, including secure boot and tamper pins detection.
- The secure environment and features realize 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

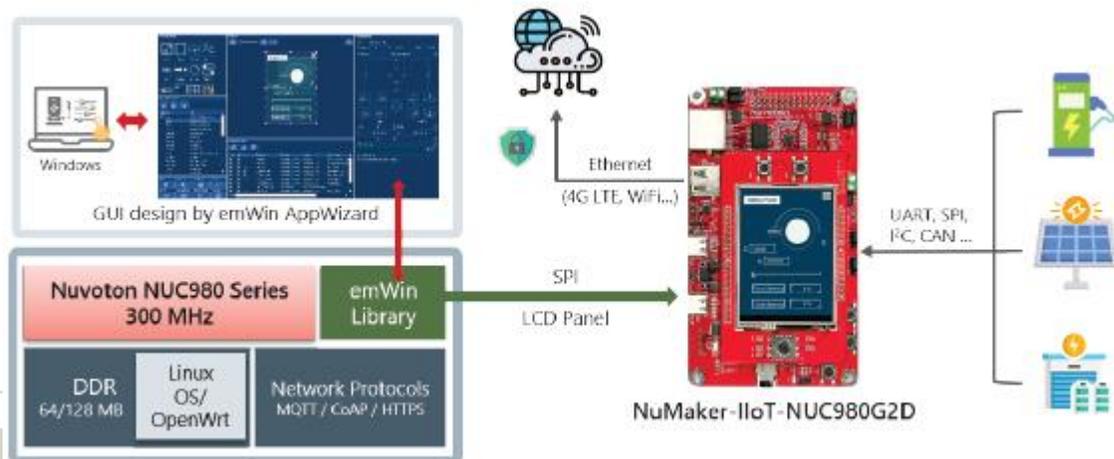
Features

- 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 2 sets of high-speed USB hosts
- Up to 10 sets of UART/RS485 interfaces
- Up to 4 sets of CAN Bus interfaces

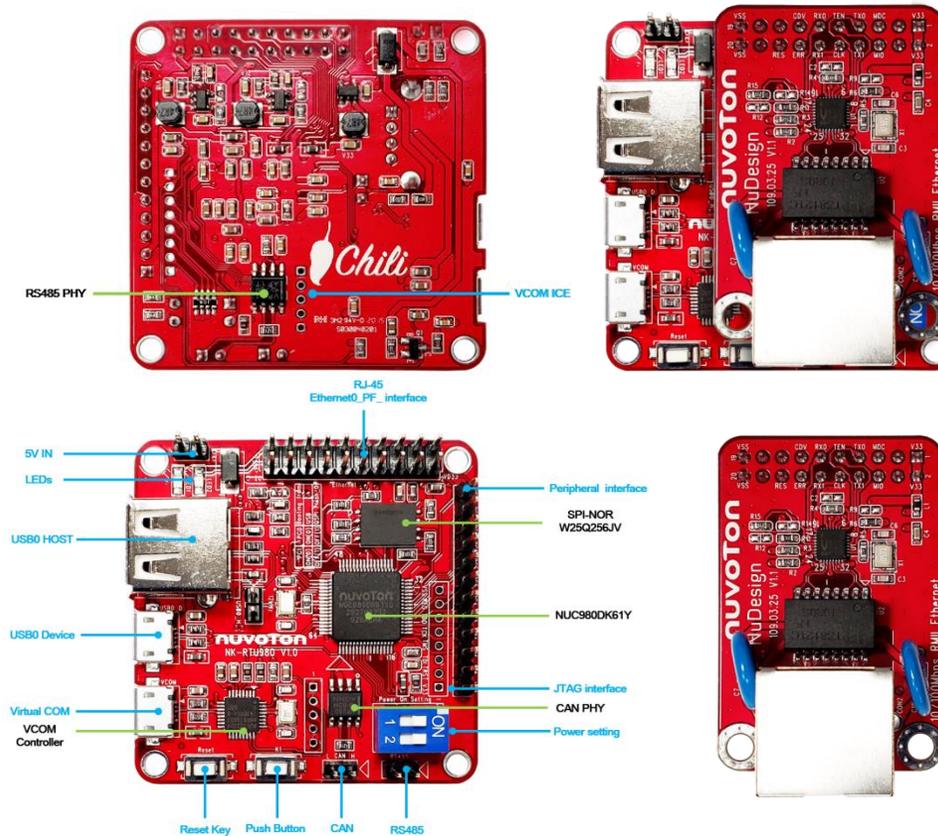


NuMaker-RTU-NUC980(Chili)

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)