

The Nuvoton logo, featuring the tagline "Joy of innovation" in a small, white, sans-serif font above the word "nuvoTon" in a larger, white, sans-serif font. The logo is set against a large, vibrant red circle. The background of the entire slide is a photograph of a modern, multi-story building with a curved, glass facade, reflecting the sky and surrounding environment. The building is set against a clear blue sky. A large, white, curved line sweeps across the bottom right of the slide, partially obscuring the building image.

Joy of innovation
nuvoTon

NuMaker IoT Platforms

Innovative applications built with
Nuvoton NuMicro[®] series MCU and MPU

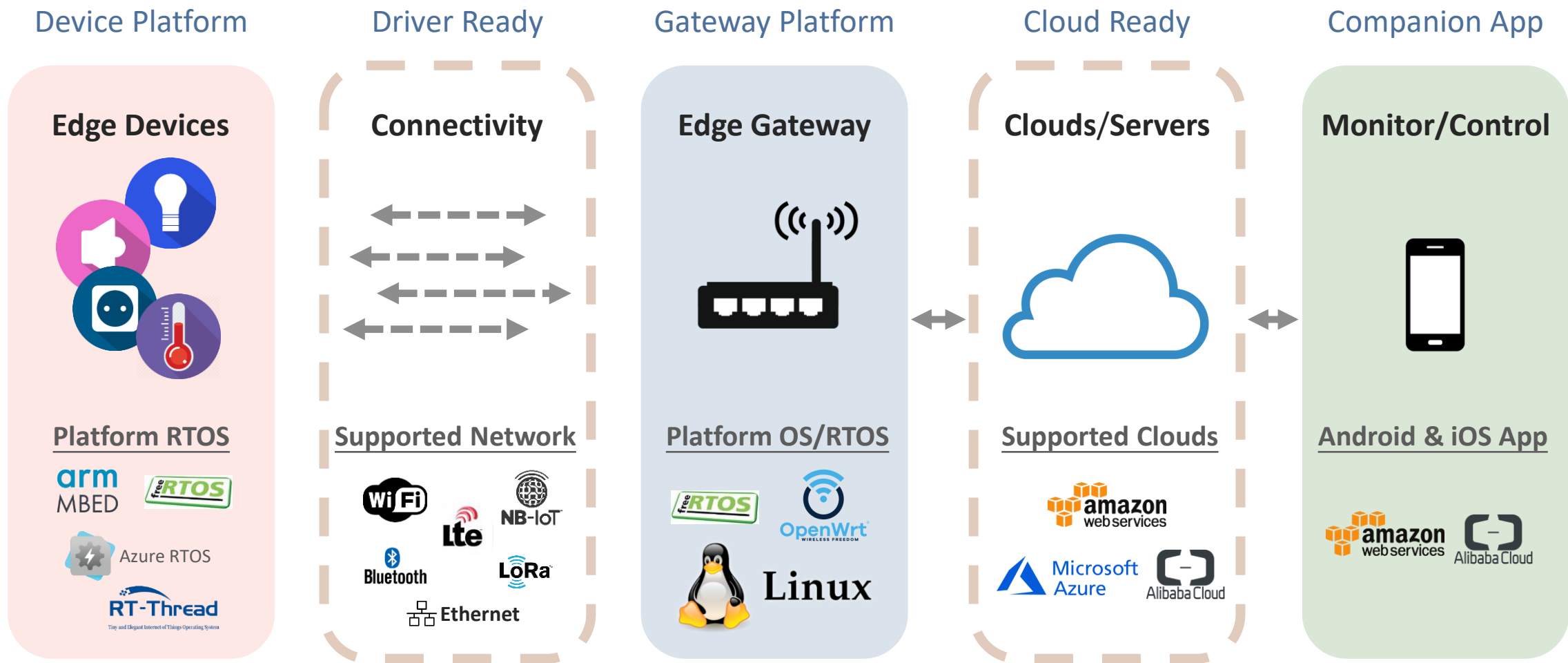
SalesSupport@nuvoton.com

2024-11-20

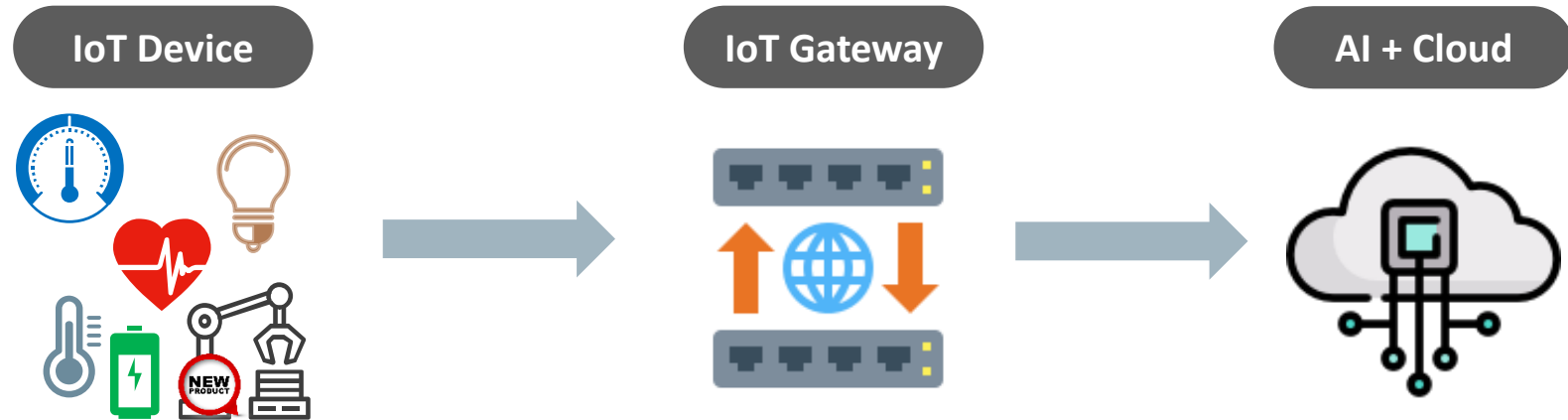
Download the file:

https://www.nuvoton.com/iot_startup

| Nuvoton Provides One-Stop IoT Solution



Nuvoton IoT Platforms



	IoT Device	IoT Gateway	AI + Cloud
Nuvoton Platforms	<div><div>NEW PRODUCT</div><div>NuMaker-IoT-M467 (Cortex-M4) NuMaker-IoT-M487 (Cortex-M4) NuMaker-LoRaD-M252 (Cortex-M23)</div></div>	<div><div>NEW PRODUCT</div><div>NuMaker-IoT-MA35D1-A1 (Dual Cortex-A35)</div><div><div>NEW PRODUCT</div><div>NuMaker-IoT-MA35D0-A1 (Dual Cortex-A35)</div></div><div><div>NEW PRODUCT</div><div>NuMaker-IIoT-NUC980G2 / G1 (ARM9)</div></div><div><div>NEW PRODUCT</div><div>NuMaker-IoT-M467 (Cortex-M4)</div></div></div>	Amazon Web Service Microsoft Azure Alibaba Cloud

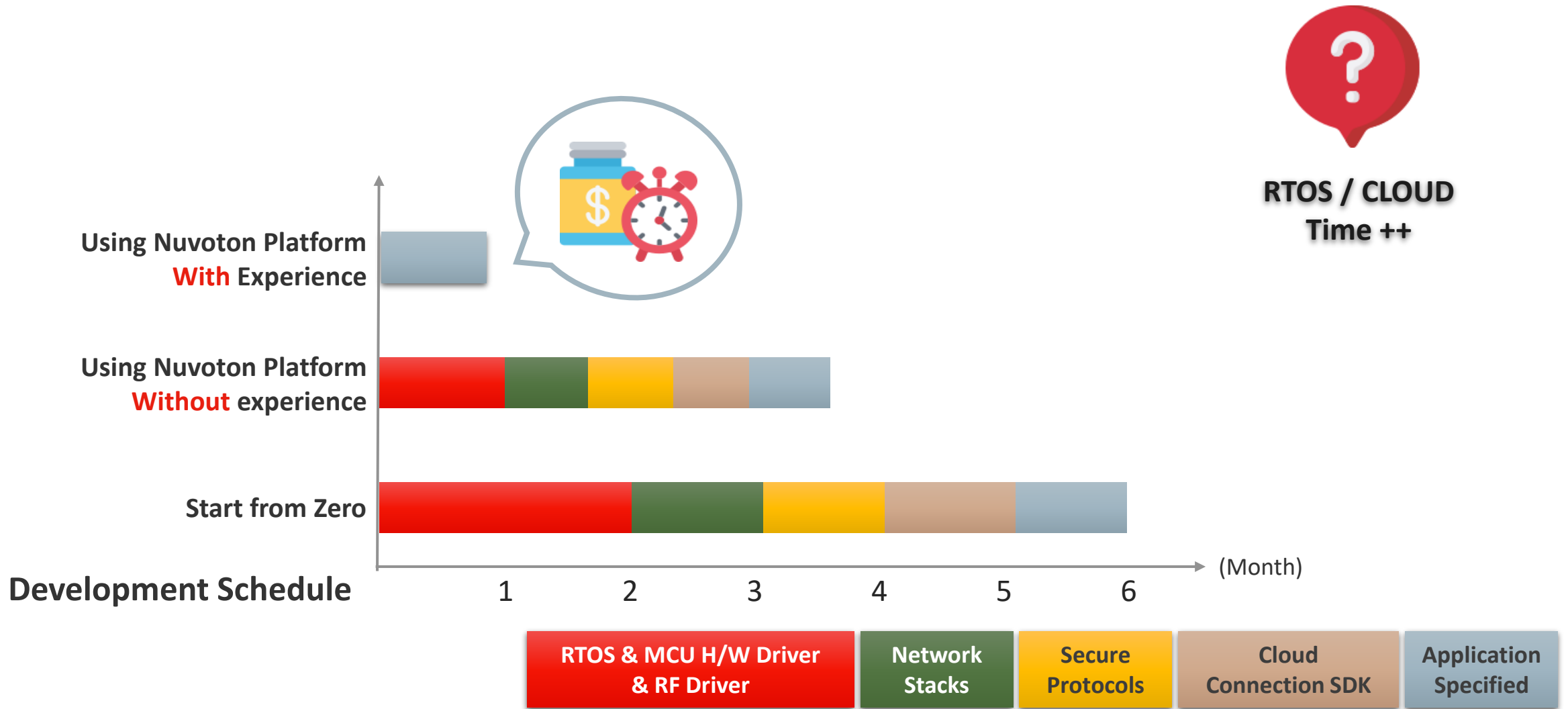
Connectivity

- Supports Ethernet, Wi-Fi, Bluetooth, 4G LTE, NB-IoT, LoRa, etc.
- Supports MQTT, CoAP, HTTP, TLS, Web Server, AWS, etc.

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.
	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.
IoT Gateway Platforms	Industrial IoT High Performance Computing Gateway Platform	 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-NUC980G1	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.

| Solution for your IIoT Platform



| Customer Attribute Capabilities

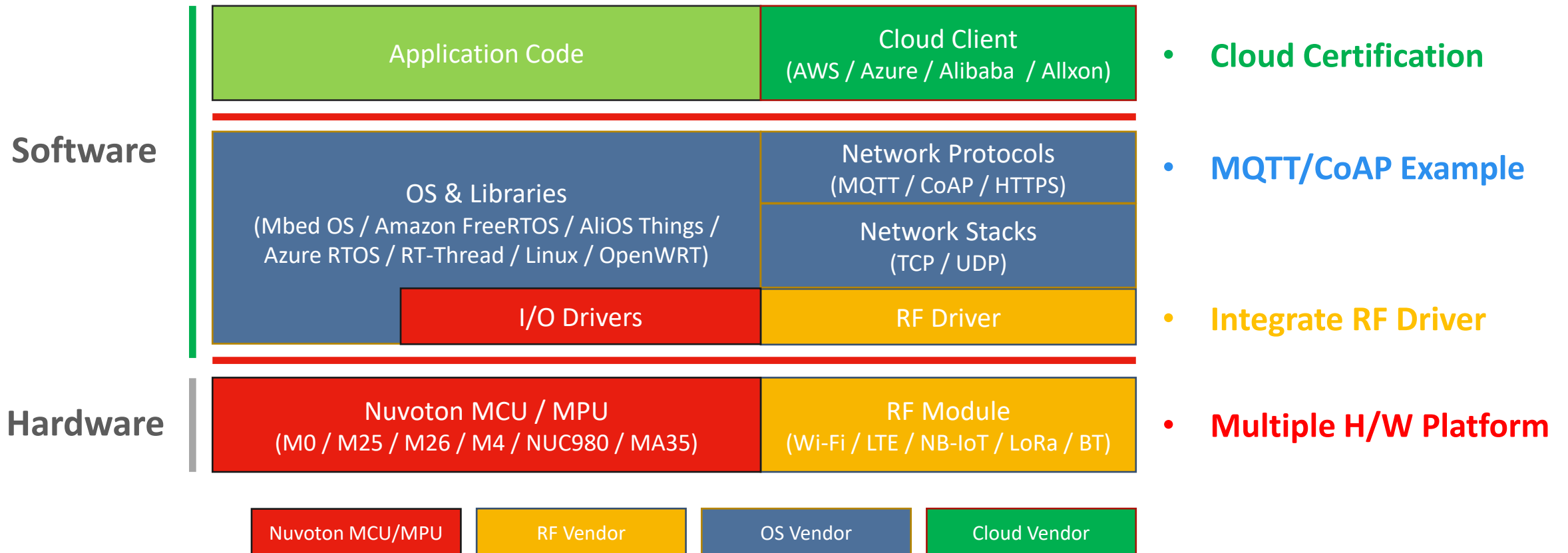


Core & OS	8051 / M0 / M23 / M4 MCU No OS, use BSP only	M4 / M23 MCU RTOS with network stack	ARM9 / A35 MPU Linux with full network stack or RTOS with network stack
Network	No or simple non-IP network Lower data rate	Ethernet, Wi-Fi (UART), 4G LTE (UART), NB-IoT (UART) Lower data rate	Ethernet, Wi-Fi (USB/SDIO), 4G LTE (USB/UART), NB-IoT (USB/UART), ... Higher data rate
GUI	No or segmented LCD	with emWin or LVGL	with emWin, LVGL, Altia, or Qt
R&D Engineers	1 or 2	3 to 5	> 10
Applications	Simple Smart Devices	Home Appliances, Smart Devices...	Industrial, Smart Grid, Smart Building, Smart City, ...
Nuvoton Platforms	 NuMaker-IoT-M467 NuMaker-IoT-M487 NuMaker-LoRaD-M252	 NuMaker-IIoT-NUC980G2 / G1  NuMaker-IoT-M467 NuMaker-IoT-M487	 NuMaker-IoT-MA35D1-A1  NuMaker-IoT-MA35D0-A1  NuMaker-IIoT-NUC980G2 / G1

Nuvoton IoT Platforms

(NuMaker **M0/M25/M26/M4/NUC980/MA35** series platforms)

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



| IoT Device Platforms

Platforms

NuMaker-IoT-M467



- Arm® Cortex®-M4
- Runs at 200 MHz
- 1 MB Flash Memory
- 512 KB SRAM
- FreeRTOS, Mbed OS, RT-Thread, Zephyr
- IoT node device for Sensor Fusion
- Gateway for Energy monitor, Charging, Communication, etc.

NuMaker-IoT-M487



- Arm® Cortex®-M4
- Runs at 192 MHz
- 512 KB Flash Memory
- 160 KB SRAM
- FreeRTOS, Mbed OS, RT-Thread, Azure RTOS
- IoT node device for Sensor Fusion
- Ethernet Gateway

NuMaker-LoRaD-M252

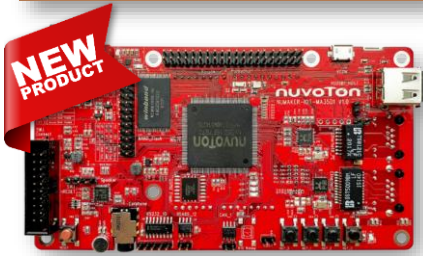


- Arm® Cortex®-M23
- Runs at 48 MHz
- 256 KB Flash Memory
- 32 KB SRAM
- Mbed OS
- LoRa Node

| IoT Gateway Platforms

Platforms

NuMaker-IoT-MA35D1-A1



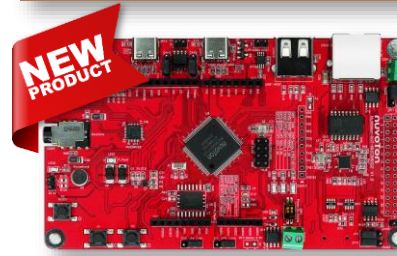
- Dual Arm® Cortex®-A35 + Arm® Cortex®-M4
- Runs at 800 MHz
- 128 MB DDR (↑ 512 MB)
- 512 MB SPI-NAND Flash + 1 GB NAND Flash
- 10/100 Ethernet + 10/100/1000 Ethernet
- CAN bus
- Linux, OpenWRT, FreeRTOS, RT-Thread
- **Ethernet Gateway**
- **Wireless Gateway**
- **Edge Computing**

NuMaker-IoT-MA35D0-A1



- Dual Arm® Cortex®-A35
- Runs at 650 MHz
- 256 MB DDR
- 512 MB SPI-NAND Flash + 1 GB NAND Flash
- 10/100 Ethernet x2
- CAN bus
- Linux, OpenWRT
- FreeRTOS, RT-Thread
- **Ethernet Gateway**
- **Wireless Gateway**
- **Edge Computing**

NuMaker-IIoT-NUC980G2 / G1



- Arm® ARM926
- Runs at 300 MHz
- 128 MB DDR (G2) 64 MB DDR (G1)
- 128 MB SPI-NAND Flash
- 10/100 Ethernet
- CAN bus
- Linux, OpenWRT, FreeRTOS, RT-Thread
- **Ethernet Gateway**
- **Wireless Gateway**

NuMaker-IoT-M467



- Arm® Cortex®-M4
- Runs at 200 MHz
- 1 MB Flash Memory
- 512 KB SRAM
- Crypto accelerators
- 10/100 Ethernet
- FreeRTOS, Mbed OS, RT-Thread, Zephyr
- **Ethernet Gateway**
- **Remote Controller**
- **Serial to Ethernet**

Connectivity Ecosystems Support

NuMaker Board	OS / RTOS	IP ^{*2}				Non-IP ^{*2}	Clouds		
		Ethernet	Wi-Fi	NB-IoT Cat-M1	LTE	LoRa (Device)	Amazon AWS	Alibaba Cloud	Microsoft Azure
<div>NEW PRODUCT</div> <div>NEW PRODUCT</div> NuMaker-IoT-MA35D1-A1 NuMaker-IoT-MA35D0-A1	Linux / OpenWRT	●	●	●	●		●	●	
	FreeRTOS	●							
	RT-Thread	●						●	●
<div>NEW PRODUCT</div> <div>NEW PRODUCT</div> NuMaker-IIoT-NUC980G2 NuMaker-IIoT-NUC980G1 NuMaker-RTU-NUC980 (Chili)	Linux / OpenWRT	●	●	●	●		●	●	
	FreeRTOS	●							
	RT-Thread	●						●	●
<div>NEW PRODUCT</div> NuMaker-IoT-M467	Mbed OS	●	●	●	●	● ^{*3}	●		●
	Amazon FreeRTOS	●					●		
	FreeRTOS	●							
	RT-Thread	●	●					●	●
	Zephyr	●	●	●			●		●
NuMaker-IoT-M487	Mbed OS	●	●	●	●	● ^{*3}	●	●	●
	Amazon FreeRTOS	●	●	●			●		
	FreeRTOS	●							
	AliOS Things	●	●					●	
	RT-Thread	●	●					●	●
	Azure RTOS		●						●
NuMaker-LoRaD-M252	Mbed OS/Non-OS ^{*1}					●			

*1 NuLoRaNode is non-OS version.

*3 Require an external LoRa module

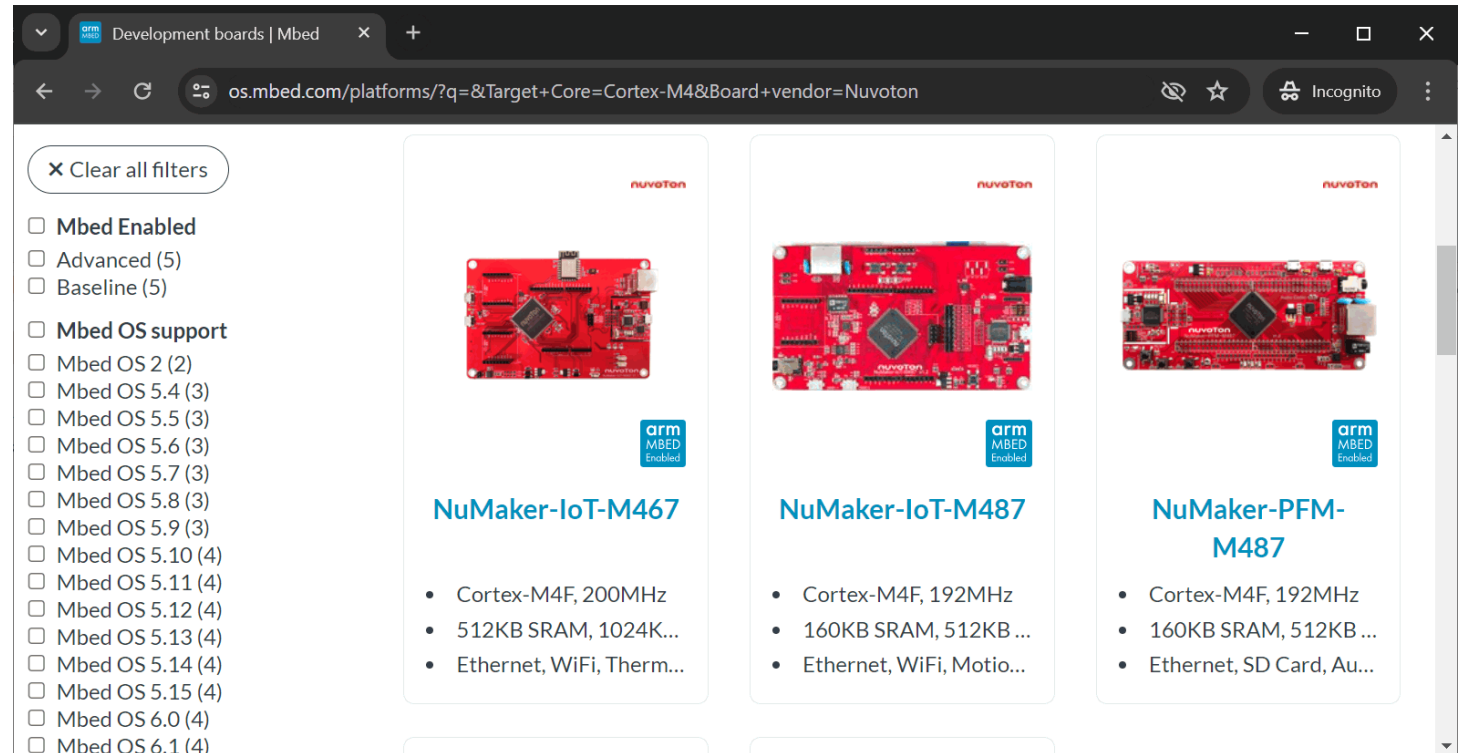
*2 Refer [supported components](#) for detail.

| Arm Mbed OS Certified Platforms

Mbed OS Certified Boards

- NuMaker-IoT-M467
- NuMaker-IoT-M487
- NuMaker-LoRaD-M252

And many more ...

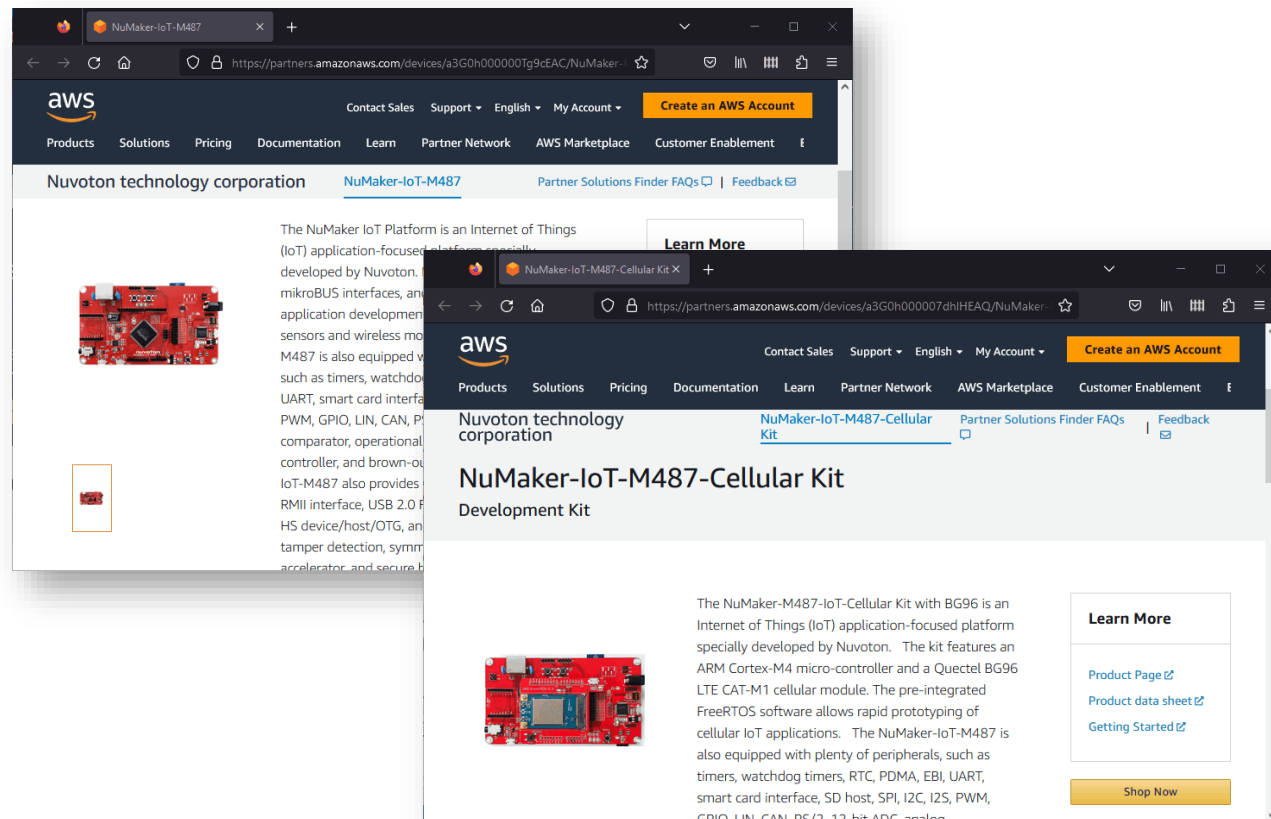


<https://os.mbed.com/platforms/?q=&Board+vendor=Nuvoton>

| AWS Certified Platforms

AWS Certified Boards

- NuMaker-IoT-M487
- NuMaker-IoT-M487 Cellular Kit



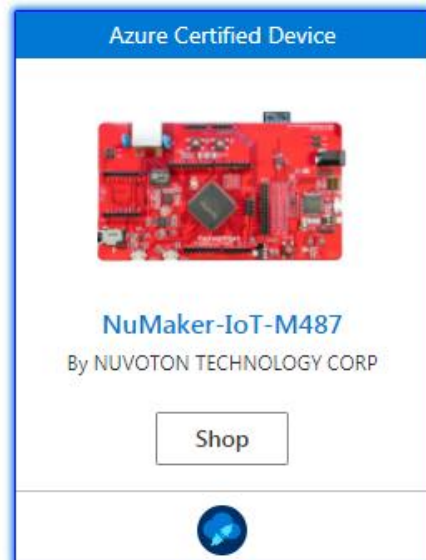
<https://devices.amazonaws.com/search?kw=nuvoton&page=1&sv=freertos>

Azure IoT Certified Device Platform

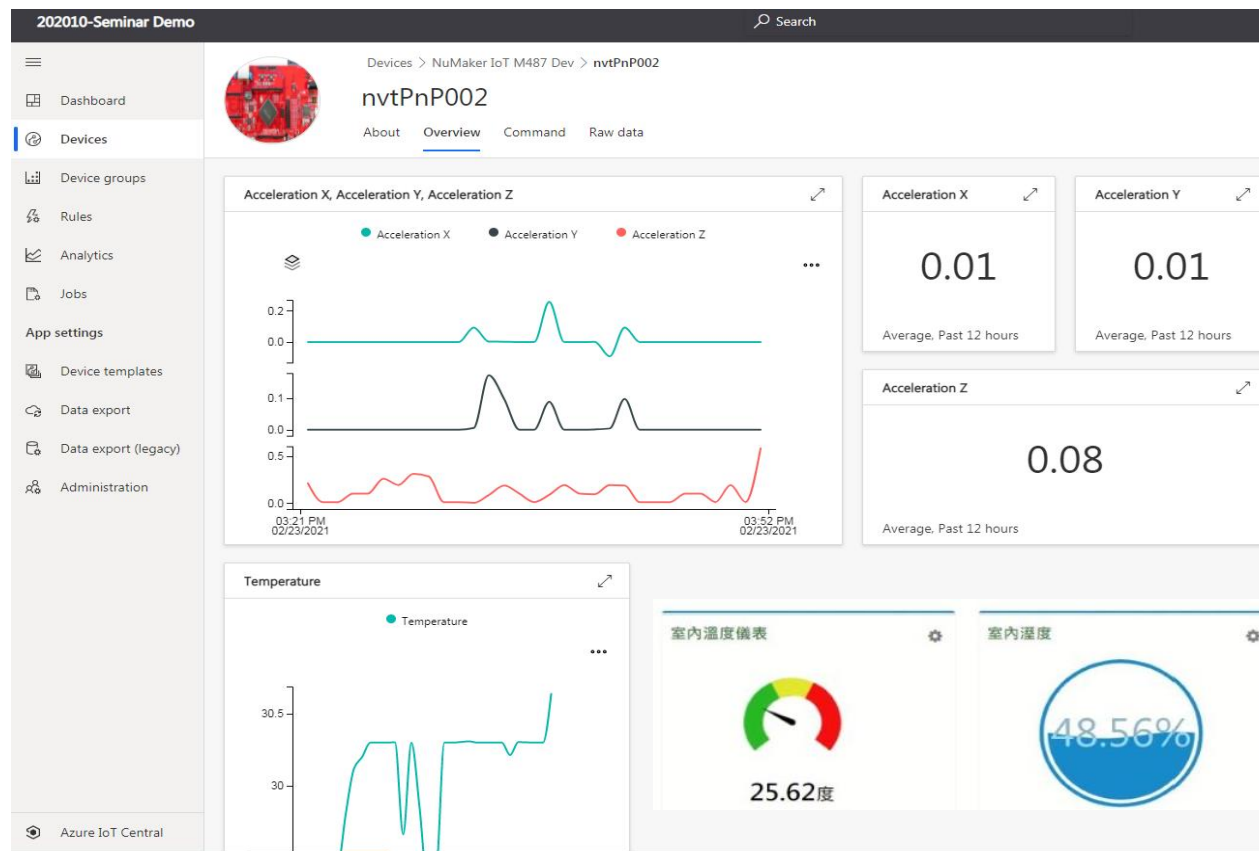
Nuvoton M487 Series. With Microsoft Azure IoT Plug and Play certification.

Easy to use [Azure IoT Central](#) – Digital Dashboard. SI use “no-code” to setup a device management system

Customer can easily reach out the Azure IoT Cloud service by EVB or Module.



Azure Certified Device IoT Plug and Play



<https://devicecatalog.azure.com/devices?searchTerm=Nuvoton>

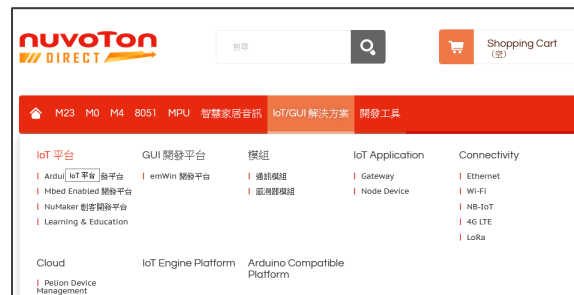
Platform Service

Online e-Store

<https://direct.nuvoton.com>



Select a Platform



Purchase a Platform



Resources on Board page

<https://www.nuvoton.com>



Connect to official board page

Resources

Development Tools

Documents

BSP & SDK

OS & Examples

Promotion & Tutorial Videos

Supporting

Nuvoton
GitHub (Worldwide)
GitLab (China)
Gitee (China)

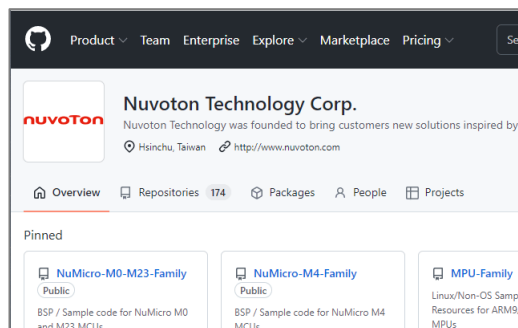
Nuvoton
Linux
RT-Thread (China)

YouTube
Bilibili (China)

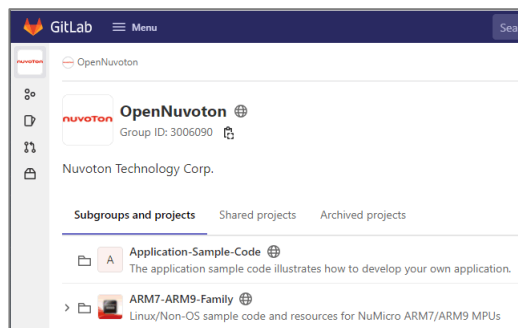
NuForum
21ic (China) 新唐MCU技术论坛
Online Chat
Sales Support e-mail

Technical Supporting Websites

BSP / SDK / Open Source / Examples



GitHub



GitLab



Gitee (China)

RTOS



RT-Thread (China)

Online Video



YouTube



Bilibili (China)

Forums



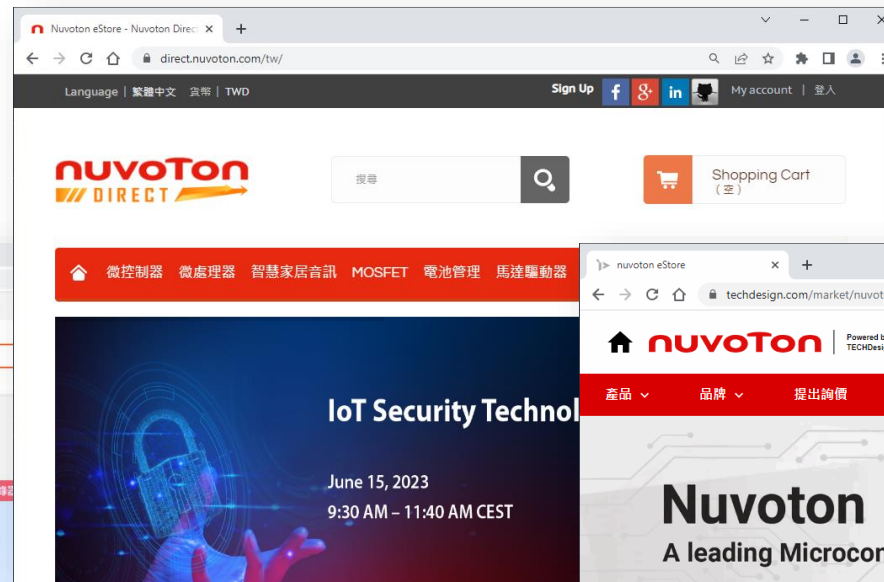
NuForum



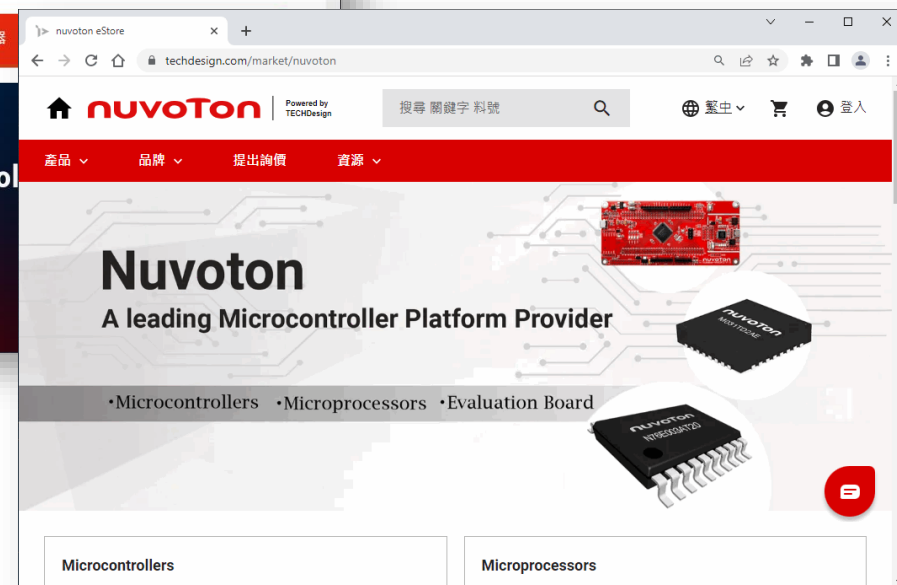
21ic Forum (China)

Online Board Purchase Information

Nuvoton Direct <https://direct.nuvoton.com>



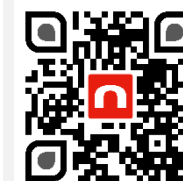
T-mall 天猫新唐旗舰店 <https://nuvoton.tmall.com>



Tech Design <https://www.techdesign.com/market/nuvoton>

NuMicro[®] Digital Platform

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nuvoTon
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Online Store



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Forum



NuForum

forum.nuvoton.com

Social Media



facebook

www.facebook.com/NuvotonNuMicro

Source Code Download



GitHub

github.com/OpenNuvoton



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www.nuvoton-MCU.com



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GitLab

gitlab.com/OpenNuvoton



TECHDesign

www.techdesign.com/market/nuvoton



21ic 中国电子网

bbs.21ic.com/iclist-187-1.html



X

@NuvotonMCU



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gitee.com/OpenNuvoton

Successful Stories

On NuMaker IoT Platforms

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Industrial IoT High Performance Computing Gateway

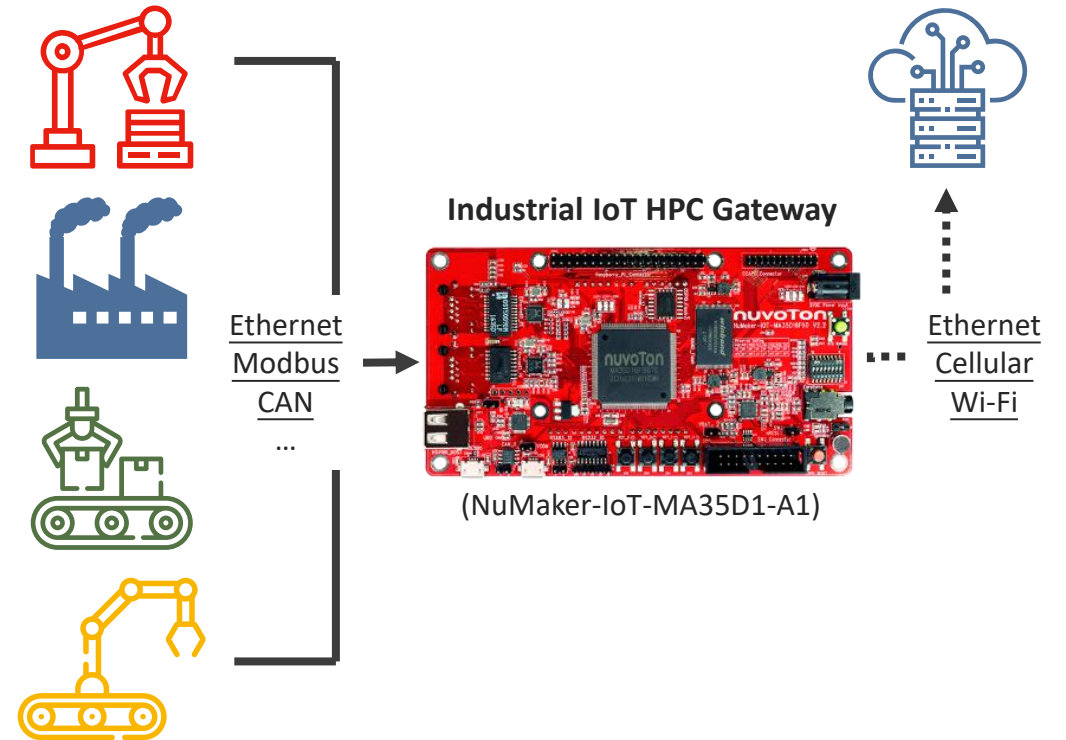
Collects, analyzes, and transfers data between devices and cloud applications for enhanced system performance.

Application Key Requirements

- High computation power for AI inference to response devices.
- Bridging traditional industrial networks to Internet by secure communication through multiple network connectivity
- Remote configuration and web style management

NuMaker-IoT-MA35D1-A1 Platform Features

- **Hardware**
 - Dual Cortex-A35 and Cortex-M4 cores.
 - Up to 800 MHz, stacking up to 512M Bytes DDR
 - UART/RS485, CAN, GPIO, USB, and Arduino interface for expansion
- **Software**
 - Buildroot and Yocto to customized BSP
 - **Linux v5.10/OpenWRT** and RTOS are ready for easy programming
 - TCP, UDP, **HTTP(S)**, **MQTT**, **CoAP**, etc. network protocols.
 - **TLS** encryption for secure network communication
- **Network**
 - **Giga Ethernet, Wi-Fi, 4G/LTE, NB-IoT, LoRa, BLE, sub-1G**, etc.



Industrial IoT Gateway

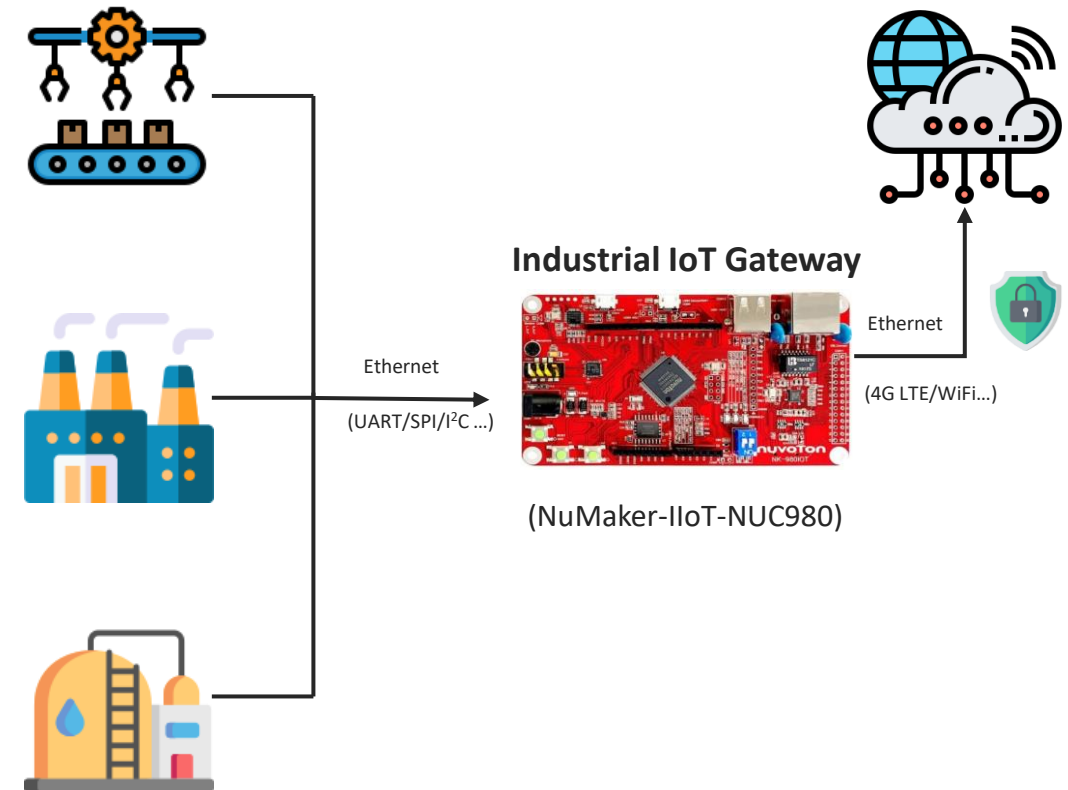
IoT gateway is a bridge to pass raw data through the network to reach a central server for further processing.

Application Key Requirements

- Bridging traditional industrial networks to Internet by secure communication through multiple network connectivity
- Remote configuration and web style management

NuMaker-IIoT-NUC980 Platform Features

- **Hardware**
 - ARM9, 300 MHz, MCP 64M or 128M Bytes DDR
 - UART, I²C, SPI, PWM, GPIO, USB, and Arduino interface for expansion
- **Software**
 - **Buildroot** for Linux to customized BSP or ready-to-use BSP image
 - **Linux/OpenWRT, FreeRTOS, and RT-Thread** multiple OS/RTOS.
 - TCP, UDP, **HTTP(S), MQTT, CoAP**, etc. network protocols.
 - **TLS 1.2** encryption for secure network communication
- **Clouds**
 - Client references to AWS, Azure, Arm Pelion, and Ali Cloud, etc.
- **Network**
 - **Ethernet, Wi-Fi, 4G LTE, NB-IoT, LoRa, BLE, sub-1G**, etc.
- Reference design is ready for easy customization



Energy Gateway for Solar PV and BMS

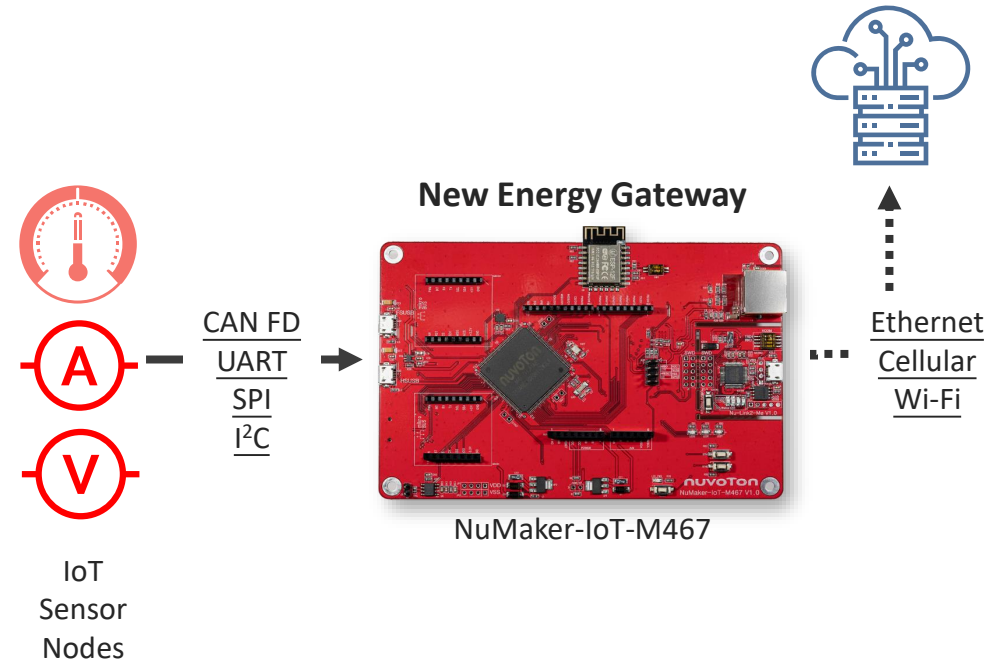
New energy gateway monitors and manages energy sources and loads for optimized energy consumption.

Application Key Requirements

- Real time monitoring and load management
- Secure communication connectivity

NuMaker-IoT-M467 Platform Features

- **Hardware**
 - Cortex-M4 core, 200MHz
 - Secure Boot, Key Store, TRNG, and Crypto Engine for enhanced security
 - **CAN FD, UART/RS485, SPI, USB, SDIO, PWM, ADC, DAC, ACMP, I²C, etc.**
- **Software**
 - Support **Mbed OS, FreeRTOS, Zephyr, RT-Thread** RTOS.
 - TCP, UDP, **HTTP(S), MQTT, CoAP**, etc. network protocols
 - **TLS** encryption for secure network communication
- **Clouds**
 - Client references to AWS, Azure, Arm Pelion, Ali Cloud, and Allxon, etc.
- **Network**
 - **Ethernet, Wi-Fi, 4G LTE, NB-IoT, etc.**



LoRa Sensor Node

Long range, low rate, and low power for sub 1G wireless solution

Application Key Requirements

- Low power for LoRaWAN or proprietary LoRa network
- Various interfaces for different sensors

NuMaker-LoRaD-M252 Platform Features

- **Hardware**
 - Cortex-M23 core, 48MHz
 - UART/RS485, SPI, I²C, PWM, 12-bit ADC, USB FS Device, etc.
 - RYLR890/400 LoRa module on board
- **Software**
 - Supports Mbed OS as well as non-OS BSP
 - Supports LoRaWAN v1.0.2, v1.0.3, and v1.1.0.
 - Supports LoRaWAN Class A / C
 - Compatible with Helium Network

Board Name	Order Number	RF Module / Chip	Frequency Bands
LoRaD-M252-H	NK-LDHM252	RYLR890 / SX1276	900~ MHz
LoRaD-M252-M	NK-LDMM252	RYLR890 / SX1276	800~ MHz
LoRaD-M252-L	NK-LDLM252	RYLR400 / SX1276	400~ MHz



Channel Plan	Common Name	Board Name
EU863-870	EU868	LoRaD-M252-M
US902-928	US915	LoRaD-M252-H
EU433	EU433	LoRaD-M252-L
AU915-928	AU915	LoRaD-M252-H
CN470-510	CN470	LoRaD-M252-L
AS923-1	AS923	LoRaD-M252-H
KR920-923	KR920	LoRaD-M252-H
IN865-867	IN865	LoRaD-M252-M

* Looking for modules that use other Semtech chips, such as SX1262, etc. Please contact nuvoton@reyax.com

Protocol Conversion

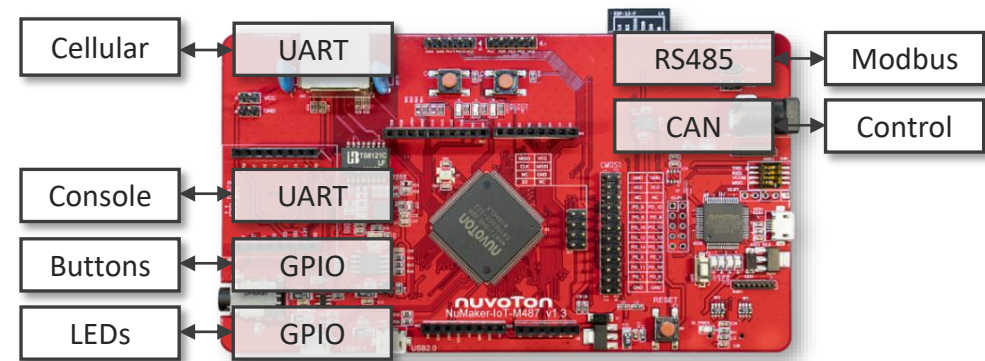
Modbus / MQTT IIOT Gateway

The entry IoT gateway converts Modbus RTU into MQTT protocol, then to public cloud platform.

Using a Cortex-M4 MCU with RTOS, it supports cellular communication, such as GPRS, 3G, 4G, etc. to connect to server or public clouds. TLS also integrated for secure connections.

NuMaker M483 Platform Features

- 192 MHz Arm® Cortex®-M4F with DSP and floating-point unit to accelerate calculation.
- Up to 6 UART (RS-485 capable) for Modbus connections.
- Integrated RTOS, network protocols.



Environment Type	MCU/MPU	MQTT	Modbus	Mark
Linux Solution	NUC980	MQTT library	Modbus library	Ready solution
FreeRTOS Solution	M4	BSP (FreeRTOS+lwIP)	3 rd open source* ¹	Need integration
Mbed Solution	M4	Mbed MQTT	3 rd open source* ²	Ready solution
Zephyr Solution	M467	Zephyr MQTT	Zephyr Modbus	Need integration

*1 Open source <https://github.com/debevv/nanoMODBUS>

*2 Open source FreeModbus

Code

<https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-Modbus-sample/>

Application Notes @ NuForum

<https://forum.nuvoton.com/zh/application-platform/iot-platform/12757>

<https://forum.nuvoton.com/zh/mcu-nudeveloper-ecosystem/bsp-example-code/12722>

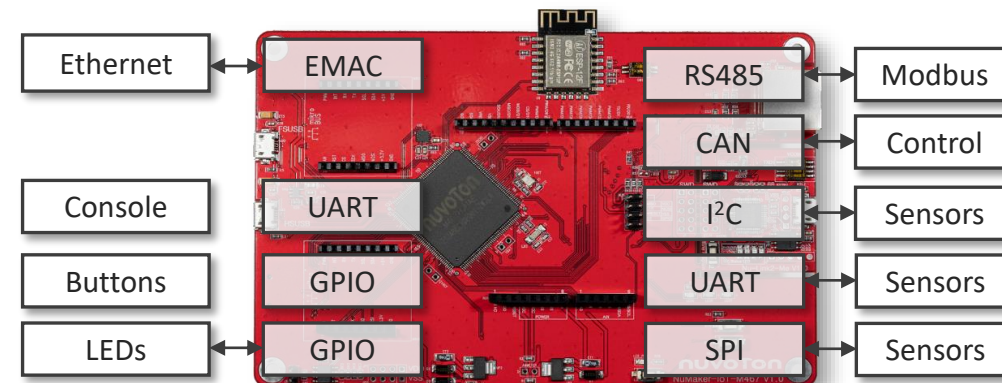
Protocol Conversion

Modbus TCP

Modbus TCP is a very commonly used network protocol in industry. The M467 development board has built-in Ethernet, and with RTOS and network protocol stack, it is very easy to build a conversion between Modbus TCP and other interfaces, include ADC, I²C, CAN, PWM, SPI, etc.

NuMaker M467 Platform Features

- 200 MHz Arm[®] Cortex[®]-M4F with DSP and floating-point unit to accelerate calculation.
- 10/100 Ethernet on board
- Up to 10 UART (RS-485 capable) for Modbus RTU connections.
- Integrated RTOS, network protocols.



MCU	RTOS	Network Stack	Modbus TCP
M467	FreeRTOS	LwIP	Server (Slave)
	FreeRTOS	CycloneTCP	Client & Server (Master & Slave)

Examples @ NuForum

<https://forum.nuvoton.com/zh/mcu-nudeveloper-ecosystem/bsp-example-code/12722>

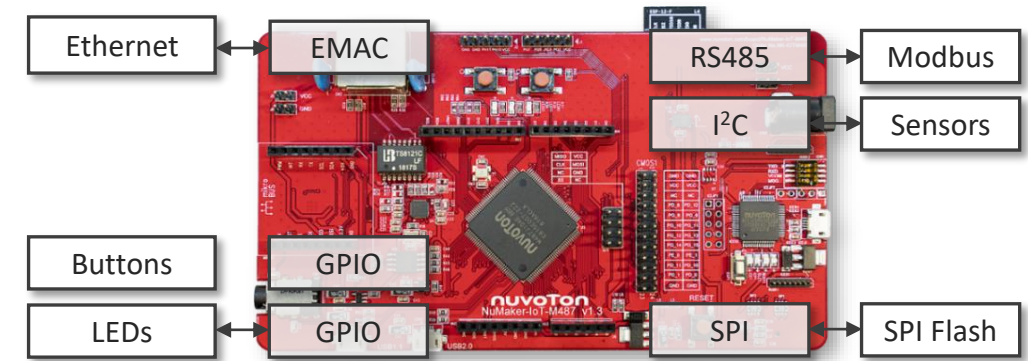
<https://forum.nuvoton.com/zh/application-platform/iot-platform/12754>

Lite Web Server

The Cortex-M4 MCU with RTOS to support web server in Mbed OS and FreeRTOS environment. Customer can easily to use the example code to build up a web server onto our NuMaker-IoT-M467 or NuMaker-IoT-M487 EVB to show a web-based dashboard.

NuMaker M487 Platform Features

- 192 MHz Arm® Cortex®-M4F with DSP and floating-point unit to accelerate calculation.
- Up to 6 UART (RS485 capable) for Modbus connections.
- Integrated RTOS, network protocols (httpd, etc.).
- Support TLS.



Mbed OS

<https://forum.nuvoton.com/zh/application-platform/iot-platform/12741>

FreeRTOS + CyCloneTCP

<https://forum.nuvoton.com/zh/application-platform/iot-platform/12745>

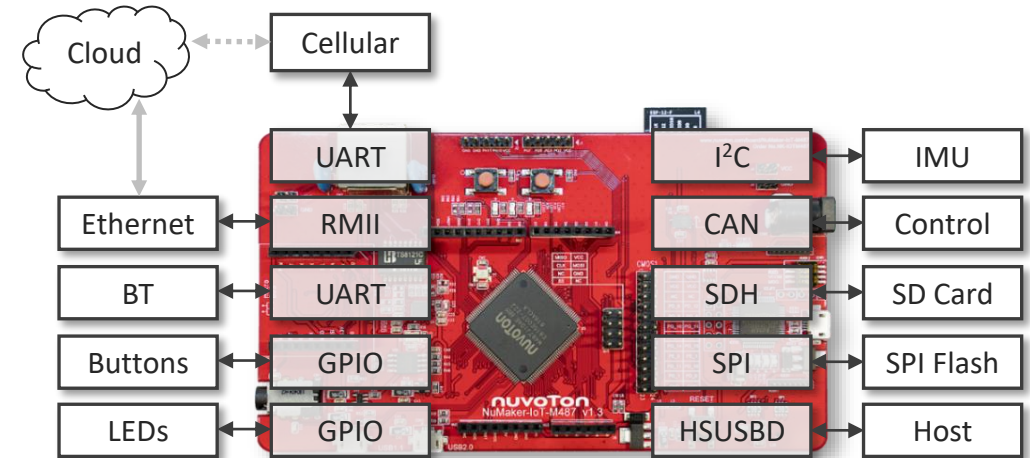
Cloud Battery Management System With OTA (Over-the-air) Firmware Update

The BMS management system is consist of a hardware system for battery status detection, includes voltage, current, temperature, charging, health etc., and network connection to cloud, such as AWS, for remote monitoring. Also need over-the-air (OTA) firmware update through cloud to add features or fix bugs and malicious code.

NuMaker-IoT-M487 platform supports Mbed OS, and easily connect to AWS IoT core service with OTA feature through Ethernet, Wi-Fi, or Cellular networks. The richer peripheral interfaces, include ADC, I²C, CAN, PWM, SPI, etc., for several sensors to measure battery status.

NuMaker M487 Platform Features

- 192 MHz Arm[®] Cortex[®]-M4F with DSP and floating-point unit to accelerate calculation.
- Complete interfaces, such as CAN, ADC, I²C, etc. for sensors and detectors for battery management system



Over-The-Air firmware update with AWS IoT on supported Nuvoton's Mbed Enabled boards are,

- NuMaker-IoT-M487, use Wi-Fi, store firmware to SPI Flash
- NuMaker-PFM-M487, use Ethernet, store firmware to SPI Flash
- NuMaker-M2354, use Wi-Fi, store firmware to MicroSD card

Code @ GitHub

<https://github.com/OpenNuvoton/NuMaker-mbed-AWS-IoT-CSDK-OTA-example>

Application note @ NuForum

<https://forum.nuvoton.com/zh/application-platform/iot-platform/11125>

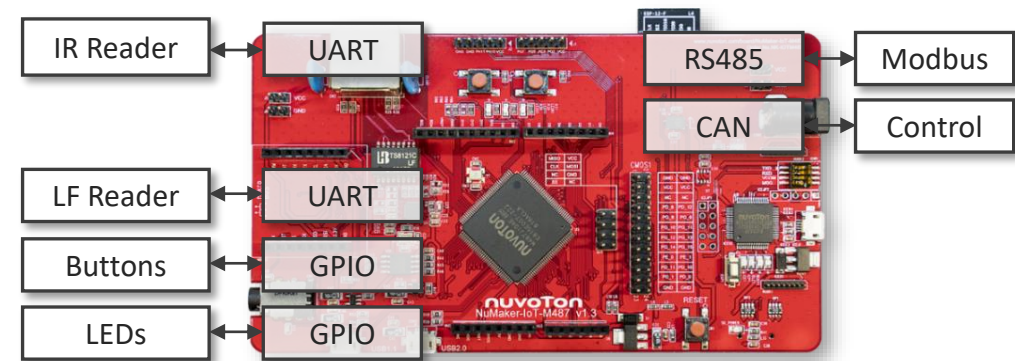
| Smart Rack

The Rack Reader converts IR / LF / NFC into RS-485 / RS-232 / CAN bus, then to public cloud platform.

Using a Cortex-M4 MCU with RTOS, it supports IR / NFC / RFID reader to connect to server or public clouds. TLS encryption also integrated for data security.

NuMaker M483 Platform Features

- 192 MHz Arm® Cortex®-M4F with DSP and floating-point unit to accelerate calculation.
- Up to 6 UART (RS-485 capable) for Modbus connections.
- Integrated RTOS, network protocols.



Code

<https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-Modbus-sample/>

Application note @ NuForum

<https://forum.nuvoton.com/zh/application-platform/iot-platform/12695>

Key Features of NuMicro[®] MPU/MCU

on NuMaker IoT Platforms

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| List of NuMicro® MPU and MCU

NuMicro® MPU

- MA35D1 Series
- NUC980 Series

NuMicro® MCU

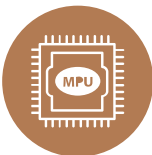
- M460 Series
- M480 Series
- M252 Series

NuMicro[®] MA35D1 Series MPU

CPU	DDR		External DDR	Multiple Chip Package DDR
800 MHz	(External)			MA35D16A087C
800 MHz	512 MB	MA35D16F987C		
	256 MB	MA35D16F887C	MA35D16A887C	
	128 MB	MA35D16F787C		
Package		LQFP216 (MCP DDR) (24 x 24 mm)	BGA312 (MCP DDR) (15 x 15 mm)	BGA364 (14 x 14 mm)

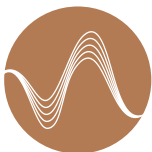
- **Dual 64-bit Arm[®] Cortex[®]-A35** high-performance cores running up to 800 MHz
- **One Arm[®] Cortex[®]-M4** real-time core running up to 180 MHz
- **LQFP and BGA package parts with stacking a DDR3L SDRAM up to 512 MB**
- **Trusted Secure Island (TSI)** an isolated secure hardware unit, which performs all the operations of the cryptographic accelerators
- **Display**
 - LCD display I/F the resolution up to 1080P
 - 2D Graphic Engine
 - H.264 decoder up to 1920 x 1080 @45 fps
 - JPEG decoder
- **High-speed connectivity**
 - 2 sets of 10/100/1000 Mbps Ethernet
 - 1 set of SDIO3.0, 1 set of SDIO2.0
 - 1 set of USB HS Host
 - 1 set of USB HS Host/Device dual role
 - 4 sets of CAN FD

NuMicro[®] MA35D1 Series Features



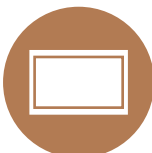
System

- Dual 64-bit/32-bit Arm Cortex-A35 high-performance cores running up to 800 MHz
- One Arm Cortex-M4 real-time core running up to 180 MHz
- Supports discrete power supply and PMIC solutions
- Operating temperature (Tj): -40°C ~ +105°C
- Offering LQFP and BGA package parts with stacking a DDR3L SDRAM up to 512 MB



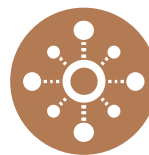
Analog

- 1 set of 12-bit 4.7 Msps EADC with 8 input channels or 4 differential input pairs
- 1 set of 12-bit 500 ksps ADC with 8 input channels, supports 4/5-wire resistive touch



Display and Video

- LCD RGB I/F display with the resolution up to 1080P@60 fps
- Integrated a 2D Graphic Engine
- JPEG decoder, picture size up to 16368 x 16368
- H.264 decoder supports baseline, main profile, high profile, and resolution up to 1920 x 1080 @45 fps
- 2 sets of CCIR601, CCIR656 Camera Interface, resolution up to 3M pixels



Peripherals

- 4 sets of PDMA
- 2 sets of 10/100/1000 Mbps Ethernet
- 1 set of USB HS Host, 1 set of USB HS Host/Device dual role
- 1 set of SDIO3.0 and 1 set of SDIO2.0
- 4 sets of CAN FD
- 2 sets of Quad SPI
- 2 sets of I²S
- 4 sets of SPI/I²S
- 17 sets of UART
- 6 sets of I²C
- Up to 150x GPIO (LQFP216)
- 18-channel 28-bit Enhanced PWM (EPWM)
- 12-channel 32-bit Timer PWM (Timer PWM)
- 3 sets of QEI
- 3 sets of Enhanced Capture
- RTC with V_{BAT}



Security

- TrustZone
- Secure Boot
- Trusted Secure Island (TSI) an isolated secure hardware unit, which performs all the operations of the cryptographic accelerators
 - Crypto Engine: AES256, SHA512, ECC, RSA4096, SM2/3/4
 - True Random Number Generator (TRNG)
 - 8 Kbits One Time Programmable (OTP) memory with Key Store to protect key

NuMicro[®] NUC980 Series MPU

Industrial Control IoT

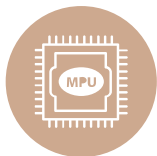
MCP DRAM

	128 MB		
		NUC980DK7	NUC980DF7
	64 MB		
	NUC980DR6	NUC980DK6	NUC980DF6
Package	LQFP-64	LQFP-128	LQFP-216

- **ARM926EJ-S MPU core**
- **Runs up to 300 MHz**
- **MCP DRAM: 64/128 MB DDR Memory**
- **Peripherals**
 - Up to 2 sets of USB 2.0 HS Host/Device
 - Up to 2 sets of SD Card/SDIO
 - Up to 2 sets of 10/100 Mbps Ethernet
 - Up to 4 sets of CAN 2.0B
 - Up to 10 sets of UART/RS485
- **Crypto engine:**
RSA2048, ECC256, AES256, SHA512, HMAC512
- **Operating system**
 - Embedded Linux
 - OpenWRT
 - FreeRTOS/RT-Thread
- **Operating temperature: -40°C ~ +85°C**

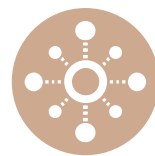
| NuMicro[®] NUC980 Series Features

Industrial Control IoT



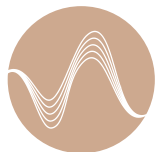
System

- Arm[®] ARM926EJ-S core
- Runs up to 300 MHz
- MCP DRAM
 - 64/128 MB DDR Memory
- Operating voltage: 3.0V ~ 3.6V
- Dual PDMA, each with 10 channels
- Up to ± 4 kV ESD HBM
- Operating temperature: -40°C ~ +85°C



Peripherals

- Up to 2 sets of USB 2.0 HS Host/Device
- Up to 2 sets of SD Card/SDIO
- Up to 2 sets of 10/100 Mbps Ethernet
- Up to 4 sets of CAN 2.0B
- Up to 4 sets of I²C
- 1 set of I²S
- Up to 2 sets of SPI
- 1 set of Quad SPI
- Up to 10 sets of UART/RS485



Analog

- Up to 8-channel 12-bit 200 ksps ADC
 - One internal channels for band-gap V_{BG} input
 - External V_{REF} pin



Security

- Crypto Engine
 - RSA2048, ECC256, AES256, SHA512, HMAC512
- Pseudo Random Number Generator (PRNG)

NuMicro[®] M460 Series MCU

Flash/SRAM
(Kbytes)

[*]: up to 125°C

1024 / 512

256 / 128

		M467SJHAN M467S2JHAE	M467KJHAN M467K2JHAE	M467JJHAN M467J2JHAE	M467HJHAN M467H2JHAE
M463YGCAE	M463LGCAE M463L2GCAC ^[*]	M463SGCAE M463S2GCAC ^[*]	M463KGCAE M463K2GCAC ^[*]		

Package	QFN48 (5 x 5 mm) Pitch 0.35 mm	LQFP48 (7 x 7 mm) Pitch 0.5 mm	LQFP64 (7 x 7 mm) Pitch 0.4 mm	LQFP128 (14 x 14 mm) Pitch 0.4 mm	LQFP144 (20 x 20 mm) Pitch 0.5 mm	LQFP176 (24 x 24 mm) Pitch 0.5 mm
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- Arm[®] Cortex[®]-M4F core with built-in DSP
- Runs up to 200 MHz
- Operating voltage:
1.7V to 3.6V
- Operating temperature:
-40°C to +85°C/105°C/125°C

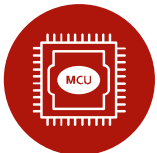
Sub Series:

- M467: Ethernet + Crypto + CAN FD + USB HS OTG + USB FS OTG
- M463: AES + CAN FD + USB HS OTG

Features:

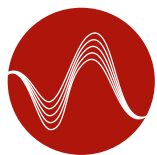
- Hardware Secure Boot
- Hardware Crypto Engine
- Hardware Key Store
- Programmable Audio PLL
- Up to 4 sets of CAN FD

| NuMicro® M460 Series Features



System

- Arm® Cortex®-M4F core with built-in DSP
- Runs up to **200 MHz**
- Up to **1024 KB Flash Memory**
 - **Dual Bank for FOTA**
- Up to **512 KB SRAM**, 64 KB with parity check
- Operating voltage: 1.7V ~ 3.6V
- Operating temperature: -40°C ~ +85°C/105°C/125°C
- 8 KB Loader ROM (LDRROM)
- **Dual PDMA, each with 16 channels**
- **Programmable Audio PLL**



Analog

- **Up to 3 sets of 12-bit 5 Msps ADC, up to 28-channel**
- Up to 2-channel of 12-bit 1 Msps DAC
- Up to 4 sets of analog comparator



Security

- **Crypto Engine**
 - AES256, ECC571, SHA512, HMAC512, **RSA4096**, SM2
- True Random Number Generator (TRNG)
- **Hardware Key Store to protect key**
- **Hardware Secure Boot**
- 3 KB One Time Programming (OTP) ROM
- eXecute-Only-Memory (XOM)



Peripherals

- 12-channel 16-bit Enhanced 200 MHz PWM (EPWM)
- 12-channel 16-bit Basic 200 MHz PWM (BPWM)
- **10/100 Mbps Ethernet MAC**
- **1 set of SPIM + 16 KB Cache (XIP)**
- **1 set of USB HS (480 Mbps) OTG with on-chip PHY**
- 1 set of Crystal-less USB FS (12 Mbps) OTG with on-chip PHY
- **Up to 4 sets of CAN FD**
- Up to 10 sets of UART + up to 3 sets of ISO 7816-3
- Up to 5 sets of I²C
- Up to 4 sets of SPI/I²S + 2 sets of Quad SPI
- Up to 2 sets of I²S
- Up to 2 sets of SDIO
- 1 set of PSIO
- **1 set of USCI**
- 1 set of 6x8 KPI
- **1 set of Camera Interface**
- **4 sets of Enhanced QEI**
- 4 sets of Enhanced Capture
- **External Bus Interface (EBI, i80)**
- RTC with V_{BAT}
- Up to 146x GPIO (LQFP176)

NuMicro[®] M480 Series MCU

Flash Memory/
SRAM (Kbytes)

2560 / 128				M487KMCAN	
512 / 160	M482ZIDAE M481ZIDAE	M485YIDAE M482LIDAE M481LIDAE	M487SIDAE M484SIDAE M483SIDAE M482SIDAE M481SIDAE	M487KIDAE M484KIDAE M483KIDAE M482KIDAE	M487JIDAE
256 / 128	M482ZGCAE M481ZGCAE	M482LGCAE M481LGCAE	M483SGCAE2A M483SGCAE M482SGCAE M481SGCAE	M483KGCAE2A M483KGCAE M482KGCAE	
封装	QFN33 (5 x 5 mm) Pitch 0.5 mm	LQFP48 (7 x 7 mm) Pitch 0.5 mm QFN48 (5 x 5 mm) Pitch 0.35 mm	LQFP64 (7 x 7 mm) Pitch 0.4 mm	LQFP128 (14 x 14 mm) Pitch 0.4 mm	LQFP144 (20 x 20 mm) Pitch 0.5 mm

- Arm[®] Cortex[®]-M4F core with built-in DSP
- Runs up to 192 MHz
- Operating voltage:
1.8V ~ 3.6V

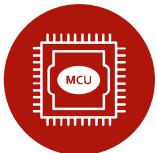
Sub Series:

- M487: Ethernet + Crypto + CAN + USB HS/FS OTG
- M485: Crypto
- M484: USB HS OTG
- M483: CAN + USB HS OTG
- M482: USB FS OTG
- M481: Base Line

Features:

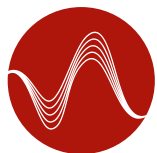
- Hardware Secure Boot
- Hardware Crypto Engine
- Up to 3 set CAN 2.0B
- External Bus Interface (EBI, i80)

| NuMicro® M480 Series Features



System

- Arm® Cortex®-M4F core with built-in DSP
- Runs up to **192 MHz**
- Up to **2.5 MB Flash Memory**
- Up to **160 KB SRAM**, 32 KB with parity check
- Operating voltage: 1.8V ~ 3.6V
- Operating temperature: -40°C ~ +105°C
- 4 KB Loader ROM (LDROM)
- **16-channel PDMA**



Analog

- **Up to 2 sets of 12-bit 5 Msps ADC, up to 24-channel**
- Up to 2-channel of 12-bit 1 Msps DAC
- Up to 2 sets of ACMP
- Up to 3 sets of OPA



Security

- **Crypto Engine**
 - AES256, ECC571, SHA512, HMAC512
- **Random Number Generator (RNG)**
- **Hardware Secure Boot**
- 8 KB Key Protection ROM (KPROM)
- 3 KB One Time Programming (OTP) ROM
- 4 KB Security Protection ROM (SPROM)
- **eXecute-Only-Memory (XOM)**



Peripherals

- 12-channel 16-bit Enhanced 192 MHz PWM (EPWM)
- 12-channel 16-bit Basic 192 MHz PWM (BPWM)
- 10/100 Mbps **Ethernet MAC**
- **1 set of SPIM + 32 KB Cache (XIP)**
- **1 set of USB HS (480 Mbps) OTG with on-chip PHY**
- **1 set of Crystal-less USB FS (12 Mbps) OTG with on-chip PHY**
- **Up to 3 sets of CAN 2.0B**
- Up to 8 sets of UART
- Up to 3 sets of ISO 7816-3
- Up to 3 sets of I²C
- Up to 4 sets of SPI/I²S
- Up to 2 sets of Quad SPI
- 1 set of I²S
- Up to 2 sets of SDIO
- **Up to 2 sets of USCI**
- 1 set of Camera Interface
- **2 sets of QEI**
- 2 sets of Enhanced Capture
- **External Bus Interface (EBI, i80)**
- RTC
- Up to 114x GPIO (LQFP144)

NuMicro[®] M252 Series MCU

Low Power USB

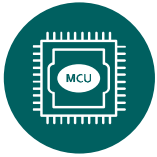
Flash Memory/
SRAM (Kbytes)

256 / 32				M252LG6AE	M252SG6AE	M252KG6AE
128 / 16				M252LE3AE	M252SE3AE	M252KE3AE
64 / 12			M252ZD2AE	M252LD2AE	M252SD2AE	
32 / 8	M252FC2AE	M252EC2AE	M252ZC2AE	M252LC2AE	M252SC2AE	
Package	TSSOP20	TSSOP28	QFN33	LQFP48	LQFP64	LQFP128

- **Arm[®] Cortex[®]-M23 core**
(without TrustZone)
- **Runs up to 48 MHz**
- **Operating voltage:**
1.8V ~ 5.5V
- 138 μ A/MHz normal mode
- 2 μ A power-down + RTC on
- Crystal-less USB 2.0 FS Device

| NuMicro[®] M251/M252 Series Features

Low Power



System

- ARM[®] Cortex[®]-M23 core (without TrustZone)
- Runs up to 48 MHz
- 32 KB ~ 256 KB Flash Memory, 8 KB ~ 32 KB SRAM
- Operating voltage: 1.8V ~ 5.5V
- 138 μ A/MHz normal mode
- 2 μ A power-down + RTC on
- Operating temperature: -40°C ~ +105°C
- Multiple Frequency HIRC: 4, 48 MHz
- 1.8V ~ 5.5V Voltage Adjustable Interface (VAI)
- 8-channel PDMA



Analog

- Up to 16-channel 12-bit 1 Msps ADC
- 2 sets of ACMP
- 1 set of 12-bit DAC
- 1 set of OPA



Peripherals

- 3 sets of USCI (UART, I²C, SPI)
- Up to 24-channel PWM
- Patented “PSIO” (Programmable Serial I/O) supports various serial communication protocols emulation
- Crystal-less USB 2.0 FS Device
- RTC independent power source (V_{BAT})

Highlight

- Supports 1.8V ~ 5.5V Serial Interface can connect with device with different voltage



*USCI: Universal Serial Control Interface Controller

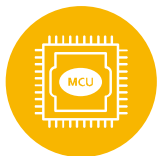
NuMicro® M031/M032 Series MCU

Flash Memory/
SRAM (Kbytes)

512 / 96					M032SIAAE	M032KIAAE
					M031SIAAE	M031KIAAE
256 / 64				M032LG8AE	M032SG8AE	M032KG8AE
				M031LG8AE	M031SG8AE	M031KG8AE
256 / 32				M032LG6AE	M032SG6AE	M032KG6AE
				M031LG6AE	M031SG6AE	M031KG6AE
128 / 16				M032LE3AE	M032SE3AE	
				M031LE3AE	M031SE3AE	
64 / 8			M032TD2AE	M032LD2AE		
			M031TD2AE	M031LD2AE	M031SD2AE	
32 / 8	M032FC1AE	M032EC1AE	M032TC1AE	M032LC2AE		
				M031LC2AE	M031SC2AE	
32 / 4	M031FC1AE	M031EC1AE	M031TC1AE			
16 / 2	M031FB0AE	M031EB0AE	M031TB0AE			
Package	TSSOP20	TSSOP28	QFN33	LQFP48	LQFP64	LQFP128

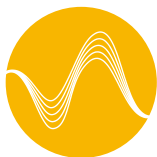
- **Arm® Cortex®-M0 core**
- **Runs up to 72 MHz**
- Up to 512 KB Flash Memory, 96 KB SRAM
- HIRC with $\pm 2\%$ precision from -40°C to $+105^{\circ}\text{C}$
- **High immunity:**
EFT 4.4 kV, ESD HBM 6 kV
- 16-channel 12-bit 1.8V
2 Msps ADC
- Up to 24-channel 16-bit
PWM, up to 144 MHz

| NuMicro[®] M031/M032 Series Features



System

- 32-bit Arm[®] Cortex[®]-M0 core
- Runs up to 72 MHz
- 16 KB ~ 512 KB Flash Memory, 2 KB ~ 96 KB SRAM
- Operating voltage: 1.8V ~ 3.6V
- Operating temperature: -40°C ~ +105°C
- Hardware divider
- High immunity: EFT 4.4 kV, ESD HBM 6 kV
- HIRC with $\pm 2\%$ precision from -40°C to +105°C
- Dual-bank Over-The-Air (OTA) firmware update
- Supports IEC-60730 STL



Analog

- 16-channel 12-bit 1.8V 2 Msps ADC
- 2 sets of ACMP



Peripherals

- Crystal-less USB 2.0 FS Device
- 8 sets of 6 MHz UART with 1-wire mode
- 2 sets of 24 MHz SPI
- 2 sets of I²C, 1 set of I²S
- 2 sets of USCI
- Up to 24-channel 16-bit PWM, up to 144 MHz
- RTC for calendar and alarm



Security

- Up to 2048 bytes Security Protection ROM (SPROM)

NuMicro[®] IoT Resources

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| Nuvoton IoT Resource

- IoT Resource Table
 - Reference webpages for Boards, RTOS, and Network
- Training Materials
 - Videos, Quick Start
- Supported Communication Components/Modules
- Reference for supported Clouds
- Forum, FAQ and more.

IoT Resource Table

Board	Web	BSP	UM *1	GS *2	Mbed OS	Amazon FreeRTOS	RT- Thread	Linux	Eth	Wi- Fi	4G LTE	NB- IoT	LoRa	BT	Remark
NuMaker-IoT-MA35D1-A1	<u>Y</u>	<u>Linux v5</u>	<u>Y</u>	<u>Y</u>	-	-	Y*4	<u>Y</u>	LR	L	L	L	-	-	
NuMaker-IoT-MA35D0-A1	<u>Y</u>	<u>Linux v5</u>	<u>Y</u>	<u>Y</u>	-	-	Y*4	<u>Y</u>	LR	L	L	L	-	-	
NuMaker-IIoT-NUC980G1	<u>Y</u>	<u>Linux v5</u>	<u>Y</u>	<u>Y</u>	-	-	<u>Y</u>	<u>Y</u>	LR	L	L	L	-	-	
NuMaker-IIoT-NUC980G2	<u>Y</u>	<u>Linux v5</u>	<u>Y</u>	<u>Y</u>	-	-	<u>Y</u>	<u>Y</u>	LR	L	L	L	-	-	
NuMaker-RTU-NUC980 (Chili)	<u>Y</u>	<u>Linux v5</u>	<u>Y</u>	<u>Y</u>	-	-	<u>Y</u>	<u>Y</u>	LR	L	L	L	-	-	
NuMaker-IoT-M467	<u>Y</u>	<u>Non-OS</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	-	Y*4	-	NMR	MR	M	M	-	-	
NuMaker-IoT-M487	<u>Y</u>	<u>Non-OS</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	-	NMAR*5	MAR	M	MA	-	-	
NuMaker-LoRaD-M252	-	<u>Non-OS</u>	<u>Y</u>	<u>Y</u>	<u>Y</u>	-	-	-	-	-	-	-	NM	-	Contact us for detail.

*1 User Manual

*2 Gerber & Schematics

*3 Dash (-) is not available (N/A).

*4 Support in RT-Thread Studio, no URL.

*5 Support on specified OS/RTOS

N: Non-OS, M: Mbed OS, A: A:FreeRTOS, R: RT-Thread, L: Linux

| Training Materials

- Online Media
 - **YouTub**e Channel <https://www.youtube.com/user/NuMicro>
 - **Bilibili** Channel <https://space.bilibili.com/544360881>
- Tutorial Videos
 - NuMaker-IIoT-NUC980 + Linux
 - NuMaker-IoT-M487 + Mbed OS
 - NuMaker-IoT-M487 + AliOS Things
 - NuMaker-IoT-M467 + Mbed OS
- RT-Thread Quick Start

Training Videos

M487 + Mbed OS or AliOS Things

Core	Board	Topic (Chinese) (Playlist URL)	Topic (English) (Playlist URL)
M4	NuMaker-IoT-M487	Step by Step 讓你了解如何運行 Mbed OS (1)	Get Started with Mbed OS (1)
		在 Mbed OS 完成按鍵控制 LED 開關功能 (2)	Control LED and Buttons on Mbed OS (2)
		在 Mbed OS 上使用 Wi-Fi (3)	Use Wi-Fi on Mbed OS (3)
		在 Mbed OS 上使用 NB-IoT/LTE (4)	Use NB-IoT or 4G LTE on Mbed OS (4)
		在 Mbed OS 連接 Pelion 雲端 (5)	Connect to Pelion DM on Mbed OS (5)
		在 Mbed OS 上使用 Ethernet (6)	Use Ethernet on Mbed OS (6)
		在 Mbed OS 使用溫度感測器 (7)	Control Temperature sensor on Mbed OS (7)
		在 Mbed OS 使用 SD 卡 (8)	Use SD Card on Mbed OS (8)
		在 Mbed OS 做錄放音 (9)	Record and Play audio on Mbed OS (9)
		在 Mbed OS 連接 AWS IoT 雲端 (10)	Connect to AWS IoT service (10)
		在 Mbed OS 連接 Microsoft Azure (11)	Connect to Azure IoT Hub service (11)
		在 AliOS Things 完成按鍵控制 LED 開關功能 (1)	
		在 AliOS Things 使用九軸感測器 (2)	
		在 AliOS Things 使用乙太網路連接阿里雲 (3)	
		在 AliOS Things 使用Wi-Fi連接阿里雲 (4)	

| Training Videos

M467 + Mbed OS

Core	Board	Topic (Chinese)	Topic (English)
M4	NuMaker-IoT-M467		Use Mbed Studio to develop applications on NuMaker-IoT-M467 platform

Training Videos

NUC980 + Linux

Core	Board	Topic (Chinese) (Playlist URL)	Topic (English) (Playlist URL)
ARM9	NuMaker-IIoT-NUC980	如何安裝 NuMaker NUC980 IIoT開發環境 (1)	Install Development Environment (1)
		學習透過 GPIO 控制 LED (2)	Control GPIO (2)
		學習透過 Ethernet 連網 (3)	Use Ethernet (3)
		如何使用 LTE 與 NB-IoT (4)	Use LTE and NB-IoT (4)
		連接 Amazon 物聯網服務 (5)	Connect to AWS (5)

Core	Board	Topic (Chinese) (Playlist URL)	Topic (English) (Playlist URL)
ARM9	NuMaker-RTU-NUC980 (Chili)	10分鐘快速學會在新唐NUC980 上使用嵌入式Linux OS	Nuvoton Chili board with Linux OS, featured in it's compact size, rapid in development
		新唐 Chili Board - 快速、小型、立即上手的 Linux 平台	
		新唐 Chili Board – 開發板與平台介紹	
		新唐 Chili Board (1) – 下載、編譯與燒錄教學	
		新唐 Chili Board (2) – 遠端監控與資料存取實例操作	

RT-Thread Quick Start Guide

CPU Core	Board	Guide	Supported Driver List
ARM9	NK-980IOT	上手指南 https://www.rt-thread.org/document/site/rt-thread-version/rt-thread-standard/tutorial/quick-start/nk-980iot/quick-start 开发实践指南 (在线电子书) https://docs.qq.com/doc/DS1FqdHlHVvpJWWRp	https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/nuc980 Or refer to the next slide
M4	NuMaker-PFM-M487	上手指南 https://www.rt-thread.org/document/site/rt-thread-version/rt-thread-standard/tutorial/quick-start/numaker-pfm-m487/quick-start 开发实践指南 (在线电子书) https://docs.qq.com/doc/DS2xld3pvSW5FenVB	https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m480 Or refer to the next two slide

| Supported Communication Components (MCU)

Platform	RTOS	Type	Interface	Chip or Module Part Number (Vendor)
NuMaker-IoT-M487 NuMaker-IoT-M467	Mbed OS RT-Thread	Ethernet	RMII	IP101GR (IC Plus), RTL8201FI (Realtek)
		Wi-Fi	UART	ESP8266/ESP-12F (Espressif)
NuMaker-IoT-M487 NuMaker-IoT-M467	Mbed OS	Cellular	UART	EC21/EC25 for LTE (Quectel), BG96 for NB-IoT/Cat-M1 (Quectel)
				SIM7020 for NB-IoT (SIMCom)
NuMaker-IoT-M487	Amazon FreeRTOS	Ethernet	RMII	IP101GR (IC Plus)
		Wi-Fi	UART	ESP8266/ESP-12F (Espressif)
		Cellular	UART	BG96 for NB-IoT/Cat-M1 (Quectel)
NuMaker-IoT-M252	Mbed OS	LoRa	SPI	RYLR890 / RYLR400 (Reyax) (Semtech SX1276 inside)

- For more supported components, please [contact us](#).

| Supported Communication Components (MPU)

Platform	OS/RTOS	Type	Interface	Vendor	Chip / Module Part Number
NuMaker-IIoT-NUC980G2 NuMaker-IIoT-NUC980G1	Linux	Ethernet	RMII	IC Plus	IP101GR
				Realtek	RTL8201FI-VC-CG
				Microchip	SMSC8742Ai (LAN8742)
				DAVICOM	DM9161AEP
				Motorcomm	YT8512C/YT8512H, SZ18201
				JLSemi	JL1101
				RPCOM	RPC8201F
				CoreChips	SR8201F
		Wi-Fi	SDIO	AMPAK	AP6212 (2.4G), AP6256 (2.4G/5G)
			USB	Realtek	RTL8188EUS (2,4G), RTL8189EU (2.4G) RTL8822BU (2.4G/5G), RTL8852BU (5G)
		Cellular	USB	Quectel	EC20/EC21/EC25 (LTE), BG96 (NB-IoT/Cat-M1)
				SIMCOM	SIM7600 (LTE)
		LoRa	SPI	Semtech	SX1301 (RAK2247, RAK2246, Gemtek)
	RT-Thread	Ethernet	RMII	IC Plus	IP101GR
		Wi-Fi	UART	Espressif	ESP8266
		Cellular	UART	Fibocom	MC615 (4G/LTE)
	FreeRTOS	Ethernet	RMII	IC Plus	IP101GR

| Supported Communication Components (MPU)

Platform	OS/RTOS	Type	Interface	Vendor	Chip / Module Part Number
NuMaker-IoT-MA35D1-A1 NuMaker-IoT-MA35D0-A1	Linux	Ethernet	RMII	IC Plus	IP101GR
				Realtek	RTL8201FI-VC-CG
			RGMII*1	Realtek	RTL8211FDI-CG
				Motorcomm	YT8531H
		Wi-Fi	SDIO	AMPAK	2.4G: AP6212 2.4G/5G: AP6203BM, AP6256, AP6275S
			USB	Realtek	2.4G: RTL8188EUS, RTL8189EU 2.4G/5G: RTL8822BU
		Cellular	USB	Quectel	EC20 (4G/LTE)
				SIMCom	SIM7600 (4G/LTE)

*1 NuMaker-IoT-MA35D1-A1 only

*2 For more supported components, please refer the [AVL](#) in [design resource page](#) or [contact us](#).

Cloud Client References

NuMaker Board	OS / RTOS	Clouds		
		Amazon AWS	Alibaba Cloud	Microsoft Azure
NuMaker-IIoT-NUC980G2 NuMaker-IIoT-NUC980G1	Linux	1 & 5		
	RT-Thread		2	2
NuMaker-IoT-M487	Mbed OS	<u>4</u> & 5		4 & 5
	Amazon FreeRTOS	3		
	AliOS Things			
	RT-Thread		2	2
	Azure RTOS			6
NuMaker-IoT-M467	Mbed OS	<u>4</u>		4
	RT-Thread		2	2

Click the underlined text to open the URL

1. Download the [NUC980 Linux BSP](#). In Documents folder, refer the chapter 3 & 4 of **NUC980 NK-980IoT User Manual** file.
2. Refer these examples, [Azure IoT SDK](#) and [Ali IoT SDK](#) on RT-Thread site.
3. Refer the [document](#) on AWS document site.
4. Refer the Mbed OS examples for [AWS](#) and [Azure](#).
5. Nuvoton also published tutorial videos on YouTube in [English](#) and [Chinese](#).
6. Please [Contact us](#) for more information

Network Protocols on NuMaker Platforms

Platform	Tool	OS/RTOS	TCP/IP Stack	SSL/TLS	Protocols / Applications									
					HTTP client	HTTP server	MQTT client	MQTT broker	CoAP client	SNMP agent	SNTP client	FTP client	WebSocket client/server	SSH c/s
NuMaker-IoT-MA35D1-A1 NuMaker-IoT-MA35D0-A1	Buildroot, Yocoto	Linux	Linux	OpenSSL	S	S	S	Y	S	Y	Y	S	Y	Y
	Keil	RT-Thread	lwIP	MbedTLS	S	Y	S		S					
NuMaker-IoT-NUC980G2 NuMaker-IoT-NUC980G1	Buildroot	Linux	Linux	OpenSSL	S	S	S	Y	S	Y	Y	S	Y	Y
	Keil	RT-Thread	lwIP	MbedTLS	S	Y	S		S					
	Keil	FreeRTOS	lwIP	MbedTLS		Y	Y			Y ^{*3}				
NuMaker-IoT-M467 NuMaker-IoT-M487	Keil	RT-Thread	lwIP	MbedTLS	S	Y	S		S					
	Mbed Tools	Mbed OS	lwIP	MbedTLS	S	Y	S		S	Y ^{*3}				
	Keil, IAR, GCC	FreeRTOS	lwIP	MbedTLS		Y	Y			Y ^{*3}				
	Keil	FreeRTOS	CyCloneTCP	CyCloneSSL	S	S	S		S	Y ^{*4}	Y	S	S	Y
NuMaker-IoT-M487	Keil	Amazon FreeRTOS	TCP Plus	MbedTLS	S		S							
	Keil	Azure RTOS	NetX	NetX Secure	Y					Y ^{*4}		Y		
NuMaker-IoT-M467	Keil	Zephyr	Zephyr	MbedTLS	S	Y	S		S		Y		Y	

*1 Y means support. Nuvoton, RTOS, or 3rd party have provided libraries and examples.

*2 S means contain Y and also support TLS for secure connections.

*3 Support SNMPv2 only

*4 Support both SNMPv2 and SNMPv3

| Web Server (httpd) Functions Comparison

Platform	OS/RTOS (+TCP/IP Stack)	GET/POST	Virtual Hosing	Security			Dynamic Content		
				TLS	Basic	Digest	SSI	CGI	FCGI
NuMaker-IoT-MA35D1-A1 NuMaker-IoT-MA35D0-A1	Linux* ²	Y* ¹	Y	Y	Y	Y	Y	Y	Y
	RT-Thread	Y							
NuMaker-IoT-NUC980G2 NuMaker-IoT-NUC980G1	Linux	Y	Y	Y	Y	Y	Y	Y	Y
	RT-Thread	Y							
	FreeRTOS + lwIP	Y							
NuMaker-IoT-M467 NuMaker-IoT-M487	RT-Thread	Y							
	Mbed OS	Y							
	FreeRTOS + lwIP	Y							
	FreeRTOS + CyCloneTCP	Y		Y			Y	Y	
NuMaker-IoT-M487	Amazon FreeRTOS								
	Azure RTOS								
NuMaker-IoT-M467	Zephyr	Y							

*1 Y means support. Nuvoton or RTOS have provides libraries and examples.

*2 Apache Web Server, lighttpd, and nginx can be used as web server on the platform. Please refer to related documents for more functions.

Reference Posts

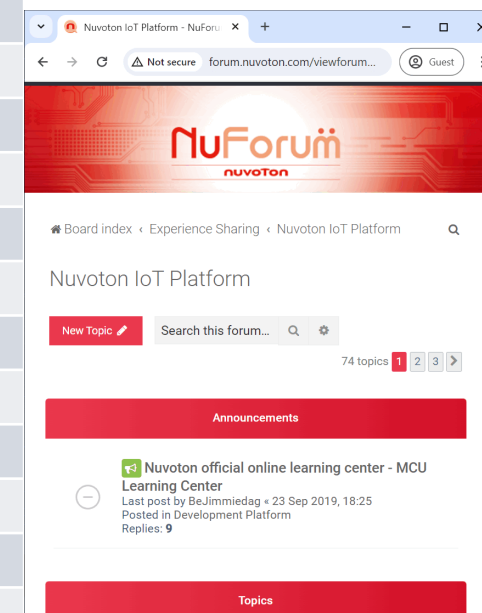
On Forums and Web sites

Joy of innovation
nuvoTon

Reference Posts on Nuvoton's NuForum

IoT Platform board (<https://forum.nuvoton.com/zh/application-platform/iot-platform>) on NuForum

Titles	URL
The OTA on M487 with Mbed OS and AWS IoT	https://forum.nuvoton.com/zh/application-platform/iot-platform/11125
PC Controls RYLR998 via NuMaker Board running pass-through firmware	https://forum.nuvoton.com/zh/application-platform/iot-platform/12691
Control AT Command module on Mbed OS and NuMaker IoT Boards	https://forum.nuvoton.com/zh/application-platform/iot-platform/12694
于 NuMaker-IoT-M487 平台以 AliOS Things 的 MQTT 协议连接阿里云	https://forum.nuvoton.com/zh/application-platform/iot-platform/12695
Build the bridge of Serial and Ethernet	https://forum.nuvoton.com/zh/application-platform/iot-platform/12709
Cellular Communication on Mbed OS and NuMaker IoT Boards	https://forum.nuvoton.com/zh/application-platform/iot-platform/12713
NuMaker boards support Arduino programming environment	https://forum.nuvoton.com/zh/application-platform/iot-platform/12714
Ping-pong test on NuMaker-LoRaD-M252 board	https://forum.nuvoton.com/zh/application-platform/iot-platform/12721
NCT7717U thermal sensor example code on Mbed OS and NuMaker IoT boards	https://forum.nuvoton.com/zh/application-platform/iot-platform/12726
Build a Web Server on a NuMaker IoT board using Mbed OS	https://forum.nuvoton.com/zh/application-platform/iot-platform/12741
Build a Web Server on a NuMaker IoT Board using CyCloneTCP and FreeRTOS	https://forum.nuvoton.com/zh/application-platform/iot-platform/12745
Use NuMicroPy (MicroPython) on NuMaker IoT board	https://forum.nuvoton.com/zh/application-platform/iot-platform/12749
Modbus TCP client/server demo using CycloneTCP and FreeRTOS	https://forum.nuvoton.com/zh/application-platform/iot-platform/12754
Using LwIP to Implement Modbus TCP on NuMaker-IoT-M467	https://forum.nuvoton.com/zh/application-platform/iot-platform/12756
Modbus RTU device on Mbed OS and NuMaker IoT boards	https://forum.nuvoton.com/zh/application-platform/iot-platform/12757
Update Wi-Fi Module Firmware on NuMaker IoT Boards	https://forum.nuvoton.com/zh/application-platform/iot-platform/12766
Virtual COM in FreeRTOS: Simplify Non-OS Example Porting to FreeRTOS	https://forum.nuvoton.com/zh/application-platform/iot-platform/12771
Connect to Azure IoT using Connection String On NuMaker board and Mbed OS	https://forum.nuvoton.com/zh/application-platform/iot-platform/12774



* Please visit the forum for more articles

References and Posts on RT-Thread

- 使用免费 RT-Thread Studio 高效开发新唐 ARM9/M4/M23/M0 平台
 - <https://www.bilibili.com/video/BV1Rt4y1s7Sh/>
- **NUC980 @ RT-Thread**
 - 快速上手指南视频 <https://www.bilibili.com/video/BV1cu411R7uX/>
 - 快速上手指南 [RT-Thread_training_Nuvoton_NUC980_For_RTT-2022-0217.pdf](#)
 - NUC980 模块评测任务大挑战 <https://club.rt-thread.org/ask/article/7012a902031d6a38.html>
 - NUC980 支持 RT-Thread 应用于串口服务器的方案及优势
<https://www.bilibili.com/video/BV1CU4y1Z7uy/>
 - RT-Thread 文档中心的 [NuMaker-IoT-NUC980 上手指南](#)
- **M487 @ RT-Thread**
 - 快速上手指南视频 <https://www.bilibili.com/video/BV1LF411W7Qw/>
 - M487 模块评测任务大挑战 <https://club.rt-thread.org/ask/article/766e6c03c20d5bb0.html>
 - RT-Thread 文档中心的 [NuMaker-IoT-M4787 上手指南](#)
- **M467 @ RT-Thread**
 - RT-Thread 文档中心的 [NuMaker-M467HJ 上手指南](#)

RT-Thread and NUC980

- NUC980 评测文章与范例

<https://club.rt-thread.org/ask/tag/1977.html?type=article>

Titles		Titles	
【开发板评测】Nuvoton 980开发板4G模块MC615 AT命令联网		NK-980IOT 测评之 WDT 、 CRYPTO	
【NK-980IoT评测】USB测试分享		NK-980IOT I2C测试：读取BMP180	
【NK-980IoT评测】EMAC之6:RTT环境中NUC980的EMAC的使用		NK-980IOT测评之4G Module（三）AT Device上网	
NK-980IOT 测评-CRYPTO		NK-980IOT测评之TIMER	
NK-980IOT 测评之 硬件spi0驱动ili9341		NK-980IOT测评之QSPI	
【NK-980IoT评测】EMAC之5：拿到板子操练一下		NK-980IOT测评之EBI	
【NK-980IoT评测】ADC测试分享		NK-980IOT 测评之 I2S 和 SDH	
NK-980IOT测评之RTC（NTP时间同步）		NUC980IOT测评之UART直接用法	
【NK-980IoT评测】RT-Thread ADC应用实践		NK-980IOT测评之YAFF2文件系统移植	
【NK-980IoT评测】EMAC之3：功能模块的使用说明		NK-980IOT测评之SDH测试	
【NK-980IoT评测】EMAC之2：功能模块的硬件介绍		NK-980IOT测评之QSPI NAND flash的读写测试	
【NK-980IoT评测】EMAC之1：理解原理与开发流程		NK-980IOT测评之UFS文件系统使用体验	
【NK-980IoT评测】基于RT-Thread Studio建立工程与烧写固件		NK-980IOT测评之ESP8266 AT测试	
【NK-980评测】SPI功能测试及其LoRa模块驱动		NK-980IOT测评之4G Module（二）PPP拨号	
NK-980IOT 测评之 GPIO		NK-980IOT测评之4G Module（一）硬件介绍	

更多文章請點上方網址參考

| RT-Thread and NUC980

- **NUC980 DIY 项目文章**
<https://club.rt-thread.org/ask/article/4e9c2586e89c4c34.html>

Titles
NUC980 DIY项目大挑战 - EtherCAT实现
(NUC980 开发板 DIY 项目大挑战) WEB服务器远程控制 (更新中)
【NUC980开发板DIY项目大挑战】串口服务器
【NUC980开发板DIY项目大挑战】车间数据采集方案
【NUC980开发板DIY项目大挑战】室内环境采集监测系统
基于NUC980使用RTT与计量芯片HT7017的计量通讯
【NUC980开发板DIY项目大挑战】数据采集网关
【NUC980开发板DIY项目大挑战】环境温湿度采集
【NUC980开发板DIY项目大挑战】数据集中器
【NUC980开发板DIY项目大挑战】Modbus RTU控制器

RT-Thread and M487

- M487 评测文章与范例

<https://club.rt-thread.org/ask/tag/84733250946dea76.html?type=article>

Titles		Titles	
基于RT-Thread的NuMaker-IoT-M487外设评测之TIMER		Numaker-IoT-M487 ECAP 功能评测	
基于RT-Thread的NuMaker-IoT-M487外设评测之ADC		【Numaker-IoT-M487】QEI相关功能评测	
Numaker IoT-M487开发板测试---NAU88L25		Nuvoton M487USCI之UART串口接收	
NuMaker-IoT-M487评测--USBH		【Nuvoton M487试用】GPIO+UART测评	
【开发板评测】Numaker-IoT-M487开发板 PWM测评		【开发板评测】Nuvoton M487 GPIO和UART评测	
[开发板测评]Numaker-IOT-M487的SDH测试		NUMAKER-PFM-M487开发板评测之OLED屏显示驱动	
【Nuvoton M487模块评测】CAN 总线通信功能评测		Nuvoton M487测评之CRYPTO(二) AES	
【开发板评测】Numaker-IoT-M487开发板USBD		NUMAKER-IOT-M487开发板评测之WDT和RTC测试	
【开发板评测】新唐Nu-maker M487 开发板 usb device 移植		【Numaker-IoT-M487】RTC测试	
【开发板评测】Numaker-IoT-M487开发板之emac		【Numaker-IoT-M487】SD接口验证	
【开发板评测】Numaker-IoT-M487开发板之Timer		【开发板评测】Nuvoton M487开发板USPI实现ST775S屏幕驱动	
Numaker-IoT-M487的RTC		【开发板评测】Nuvoton M487开发板wifi模块可用性	
【开发板评测】Nuvoton-IOT-M487开发板SPIM读写W25Q32		【Numaker-IoT-M487】CRYPTO相关功能评测	
Nuvoton M487USCI之USPI通讯		Nuvoton M487测评之CRYPTO(一) Hash	
【开发板评测】Numaker-IoT-M487开发板 之ADC测试		【开发板评测】Nuvoton M487开发板USCI之UI2C	

更多文章請點上方網址參考

I FAQ

- RTOS/OS
 - RT-Thread
 - **Mbed OS**
 - Amazon FreeRTOS
 - Azure RTOS
 - **Linux / OpenWRT**
- Network
 - LoRa
- Clouds
- Common

* Items in **bold** indicate updates

FAQ – RT-Thread

Q	A
NUC980 支持 5G modules? 例如 RG200U.	Most cellular modules have UART and/or USB for host to connect to. NUC980 does support them. However, cellular modules are controlled via AT command. RT-Thread supported modules can be found in the source code (https://github.com/RT-Thread-packages/at_device)
N32905 支持 RT-Thread?	Currently, NUC980 and N9H30 support RT-Thread.
人机界面支持那种 GUI tools?	Because integrate with LVGL, the tools are provided by LVGL.
推荐那个平台使用 LVGL?	Most Nuvoton NuMaker boards that support RT-Thread can use LVGL. https://github.com/RT-Thread/rt-thread/blob/master/bsp/nuvoton/docs/LVGL_Notes.md has the list of LVGL demo on NuMaker boards. You can buy board on Nuvoton online e-store (https://direct.nuvoton.com) to try it.
N9H30 平台支持 LVGL 吗?	We recommended NuMaker-HMI-N9H30 https://www.youtube.com/watch?v=EgTG-3NHHAs
N9H30 和 RT-Thread 支持 FMI/NAND Flash?	The port can be download here (https://github.com/wosayttn/sdk-bsp-nk-n9h30/tree/fminand). It will also be available after RT-Thread v4.1.0 when the port had integrated into RT-Thread mainstream.
NUC977 支持 RT-Thread 吗?	We recommended NuMaker-IIoT-NUC980. Please contact us if you need more information. SalesSupport@nuvoton.com

FAQ – Mbed OS (1/4)

Q	A
Any MQTT examples?	<p>AWS IoT example uses MQTT. You can</p> <ul style="list-style-type: none">• Select NuMaker board in Mbed online compiler, you can create a project based on AWS IoT example.• Or create a new Mbed project using the example URL https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-AWS-IoT-example/• Or refer this tutorial video https://www.youtube.com/watch?v=OWrkJzwueZc (English) or https://www.youtube.com/watch?v=u7QOP5RJOPE (Chinese)
Wi-Fi can't work because firmware version is too old?	<p>Mbed OS 5.1x and later request the new firmware version of ESP8266 Wi-Fi module. The new firmware needs 16Mb Flash in size. Some modules (such as ESP-01, ESP-07, etc.) has 8Mb Flash only, so they can't update to the new firmware. NuMaker-PFM-M2351 and early NuMaker-IoT-M487 (v1.2) have ESP-07 Wi-Fi module on board. NuMaker-IoT-M487 v1.3 and later NuMaker boards changed to ESP-12 module which has 32Mb flash, and Nuvoton also updated the Wi-Fi module firmware during board production.</p> <p>If your NuMaker-IoT-M487 Wi-Fi doesn't work while running Mbed OS, please make sure the board version is v1.3. The v1.3 board is available from July 2019.</p>
Coding guidance to reduce power?	<p>Please refer https://os.mbed.com/docs/mbed-os/latest/apis/power-optimization.html</p>
Can IoT-M487 use Mbed Studio?	<p>Mbed Studio can select IoT-M487 board to build firmware but can't support firmware download and online debug due to Nu-Link limitation.</p>
Does it support FTP Client?	<p>The URL of FTP client example is https://os.mbed.com/users/dkato/ftp-client/ Just import this code to your Mbed project. There are a lot of reference codes contributed on Mbed community. Simply use keyword to search on https://os.mbed.com/</p>

FAQ – Mbed OS (2/4)

Q	A
Does it support TLS 1.3?	MbedTLS in Mbed OS supports SSL/TLS features. MbedTLS supports TLS 1.3 since version 3.0. However, MbedTLS v3.2.1 is still not fully supported TLS 1.3 yet. The API of MbedTLS v2 and v3 are different. Mbed OS v5 use MbedTLS v2.5.x. Mbed OS v6 uses MbedTLS v2.25.0. So Mbed OS does not support TLS 1.3 yet.
Does it support server socket?	<p>It depends.</p> <p>Mbed OS includes lwIP for TCP/IP stack. The maximum server socket can be configured on lwIP. But it takes more SRAM to supports more sockets. The configuration is only workable for the network use lwIP, such as Ethernet.</p> <p>For an Wi-Fi module like ESP8266, it has its own TCP/IP stack, ESP8266 driver based on AT command handler on Mbed OS does not support server socket by default.</p>
Are there any converter examples like UART-to-Ethernet, SPI-to-Ethernet, CAN-to-Ethernet?	<p>Mbed OS defines API for common IO peripherals and supports TCP/IP stack as well. Nuvoton provides a UART-to-Ethernet example on Mbed OS (https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-Serial-to-Ethernet/). You can modify it to use another interface, such as CAN or SPI.</p> <p>The Mbed OS community is very active. If you want to follow CANopen protocol on CAN bus, here is a CANopen example (https://github.com/Alphatronics/mbed-os-example-canopen). You can build your own CANopen-to-Ethernet based on these two examples.</p> <p>Because of Ethernet, suggest Mbed-Enabled M487 board to develop the applications.</p>
How to change UART port or pins for console output?	In mbed-os/targets/targets.json, search the board definition by using MCU name as keyword, then modify usb-uart, usb-uart-tx, and usb-uart-rx to the UART port and pins you want.

FAQ – Mbed OS (3/4)

Q	A
Any examples for cellular connection? Such as NB-IoT, CAT-M1, or LTE.	Nuvoton provides two expansion boards for cellular connections. Quectel BG96 for NB-IoT and CAT-M1, Quectel EC21 for LTE. You can purchase these board here https://direct.nuvoton.com/tw/communication-module/ . These expansion boards can be used on Mbed Enabled NuMaker-IoT series boards. The reference example is https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-Cellular-example/ You can also refer videos https://www.youtube.com/watch?v=O6zKHc1y0Qo (Chinese) or https://www.youtube.com/watch?v=e48y00fu63s (English) By the way, your SIM card need to support NB-IoT or CAT-M1 on BG96 for NB-IoT or CAT-M1 connections. Please contact your system operator.
Any RS485 / Modbus examples?	Please refer the example https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-Modbus-sample/
Any http / https / httpd examples?	httpd for simple web server: https://os.mbed.com/teams/sandbox/code/http-webserver-example/ http/https example: https://os.mbed.com/teams/sandbox/code/http-example/
Support SNMP?	Here is the SNMP v1/v2 sample https://github.com/OpenNuvoton/NuMaker-mbed-SNMP
Support USB Host or USB OTG?	No, Mbed OS 5 and 6 do not support USB host. Only support USB device.
What are the USB device class supported? Does it support USB-DFU?	Mbed OS does not support USB-DFU. Please refer https://os.mbed.com/docs/mbed-os/latest/apis/index.html , USB driver session for the supported USB device classes.

FAQ – Mbed OS (4/4)

Q	A
Encounter difficulties importing a new project from Modbus (https://os.mbed.com/teams/Nuvoton/code/Modbus/). What are the resolution steps?	<p>The majority of Mbed source codes are hosted on os.mbed.com or github.com, serving either as libraries or complete samples. A sample comprises full code importable to create a new project, while a library is solely importable into an existing project, precluding the creation of a new one. The explains the unsuccessful importation of a Modbus library into a new project.</p> <p>Typically, source codes prefixed with “mbed-os-” or “NuMaker-” denote complete samples, while others functions as libraries.</p> <p>Importing the https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-Modbus-sample/ example rather than https://os.mbed.com/teams/Nuvoton/code/Modbus/ library to initiate the creation of a new project.</p>
Mbed Studio shows that the ARM compiler license is about to expire.	Before the license expires, ARM will release a new version of Mbed Studio to include the new license. Please go to the Mbed Studio official website https://os.mbed.com/studio to download the update.
Q	A
End of Life for Mbed	https://os.mbed.com/blog/entry/Important-Update-on-Mbed/ The Mbed OS platform and OS will reach end of life in July 2026. Please visit above URL for more information
How about MbedTLS?	MbedTLS is unaffected by the EOL of Mbed OS. The MbedTLS v3.6.0 support TLS 1.3 by default. The BSP of the Nuvoton MCU which have Ethernet still include the MbedTLS for secure communication.

FAQ – Amazon FreeRTOS

Q	A
Does it support TLS 1.3?	MbedTLS in Amazon FreeRTOS supports SSL/TLS features. MbedTLS supports TLS 1.3 since version 3.0. However, MbedTLS v3.2.1 is still not fully supported TLS 1.3 yet. The API of MbedTLS v2 and v3 are different. Amazon FreeRTOS uses MbedTLS v2.8.x at this moment. So it does not support TLS 1.3 yet.
CyCloneTCP supports many protocols. Are there any demonstration?	<p>CyCloneTCP designed by Oryx Embedded. Please visit Oryx Embedded site https://www.oryx-embedded.com/download/ then download the Open Source Version. Extract the ZIP file and find all demonstration in demo directory.</p> <p>The CyCloneTCP demo uses FreeRTOS by default. You can use Keil MDK or IAR tool to build the demo code. So far, NuMaker-IoT-M487 and NuMaker-IoT-M467 boards are supported in the demo.</p>

| FAQ – Azure RTOS

Q	A
Where is the port of Azure RTOS on NuMaker board?	<p>The source code can be download here https://github.com/OpenNuvoton/azure-getting-started/tree/nuvoton_azure_rtos/Nuvoton</p> <p>Supported board is <u>NuMaker-IoT-M487</u>.</p> <p>Supported connectivity is <u>Wi-Fi</u>.</p> <p>The README.md has described how to build the RTOS and examples.</p>

FAQ – Linux / OpenWRT

Q	A
What version of Linux kernel supported?	<p>Till Feb. 2023, the supported Linux kernel version are,</p> <ul style="list-style-type: none">• NUC970 : v3.10• NUC980 : v4.4, v5.10• MA35D1 : v5.10
What version of OpenWRT supported?	<p>The OpenWRT 21.02 series focuses on supported targets to Linux kernel v5.4. According to different Linux kernel versions to support specific OpenWRT versions. Nuvoton supports OpenWRT versions are,</p> <ul style="list-style-type: none">• OpenWRT v17.01 on Linux v4.4• OpenWRT v22.03 on Linux v5.10
How to build a new compile environment for NUC980?	<p>Suggest directly cloning the fresh and complete Buildroot repository from https://github.com/OpenNuvoton/NUC970_Buildroot (for Linux kernel v4.4) https://github.com/OpenNuvoton/MA35D1_Buildroot (for Linux kernel v5.10)</p> <p>If any warnings appear while building the environment, they are most likely due to missing related packages. You can simply search for and install the relevant packages online.</p> <p>Since our VMware image already has the necessary packages installed, we won't encounter such errors.</p>

FAQ – LoRa

Q	A
Where is the LoRaWAN device development resources?	<p>Nuvoton provides two versions of LoRaWAN device for <u>NuMaker-LoRaD-M252</u> board</p> <ul style="list-style-type: none">• (Recommended) Mbed OS version, refer the M487+MbedOS training video slides and follow the video “<u>Get Started with Mbed OS</u>” (English) or “<u>Step by Step 讓你了解如何運行 Mbed OS</u>” (Chinese) to create a new project with “<u>NuMaker-LoRaD-M252</u>” platform and “<u>NuMaker mbed OS v6.x LoRaWAN</u>” template.• Non-OS version, https://github.com/OpenNuvoton/NuLoRaNode
Any support for the LoRa module on NuMaker-LoRaD-M252?	Please contact nuvoton@reyax.com for the LoRa module support.
Provide long range peer to peer solutions?	Reyax and Nuvoton jointly provide LoRa module controlled by AT command. The RYLR998 module for 868/915MHz and the RYLR498 module for 423/433/470MHz.
EVK support CN band 470-510 MHz?	Yes, the NuMaker-LoRaD-M252 (NK-LDLM252) EVK support it.
EVK support IN band 865-867 MHz?	Yes, the NuMaker-LoRaD-M252 (NK-LDMM252) EVK support it.
EVK support EU band 867-869 MHz?	Yes, the NuMaker-LoRaD-M252 (NK-LDMM252) EVK support it.
EVK support US band 902-928 MHz?	Yes, the NuMaker-LoRaD-M252 (NK-LDHM252) EVK support it.
EVK support JP/KR/TW band 920-925 MHz?	Yes, the NuMaker-LoRaD-M252 (NK-LDHM252) EVK support it.
How about the power consumption?	On NuMaker-LoRaD-M252, the MCU enter power down mode → 13.2uA Enable Buffered Serial (UART) and waiting receive UART data → 9.71mA

FAQ – Clouds

Q	A
Where to get the cloud connection examples?	Please refer the page “Supported clouds” in this document
How to get Azure certification for my device?	Microsoft has the Azure Certified Device Program https://www.microsoft.com/azure/partners/azure-certified-device . A device pass the program can list on the Azure Device Catalog https://devicecatalog.azure.com . The first certification program “Azure Certification Device” is the baseline. You need a valid Azure Active Directory account and a verified MPN (Microsoft Partner Network) account before applying the certification. Please log in https://certify.azure.com and follow steps in certification document https://learn.microsoft.com/azure/certification/overview to start the certification.
How to get AWS certification for my device?	AWS has the Device Qualification Program https://aws.amazon.com/partners/programs/dqp/ . A device pas the program can list on AWS Partner Device Catalog https://devices.amazonaws.com . You need an APN (AWS Partner Network) account. Log in APN account https://partnercentral.awspartner.com , click Resources, use keyword “device qualification program” to search the guide. Click “AWS Device Qualification Program Guide 20xx” to download it. And follow the instructions in the guide.

FAQ – Common

Q	A
Where to get the Nuvoton IoT information?	Please refer https://www.nuvoton.com/iot_startup
What are the difference between NuMaker-IIoT-NUC980 and NuMaker-IIoT-NUC980G2?	Major features changes are: <ul style="list-style-type: none">• Embedded DDR is 128MBytes.• Two MicroUSB connectors change to USB Type-C connectors.• CAN transceiver on board and add CAN bus connectors.
Install Keil MDK v5.37 (or later versions) to compile example in BSP results in errors. How to solve it? 安裝 Keil MDK v5.37 (或之後的版本) 在編譯 BSP 裡的範例會發生錯誤. 要如何解決?	<p>Starting from Keil MDK v5.37, Arm removed Arm Compiler v5 and only keeps Arm Compiler v6. These two compiler versions have some incompatible usages. Examples in the BSP and some third-party open-source code were developed using Arm Compiler v5. Compiling with Arm Compiler v6 can result in errors. Arm offers a standalone installation of Arm Compiler v5, please follow the instructions on the webpage https://developer.arm.com/documentation/ka005073/latest/ to download and install Arm Compiler v5. If Keil MDK is installed in the directory "C:\Keil_v5", it's recommended to change the installation directory for Arm Compiler v5 to "C:\Keil_v5\ARM\ARMCC". After completion, reopen the example with Keil MDK to compile without errors.</p> <p>從 Keil MDK v5.37 版本起，Arm 移除 Arm Compiler v5, 只留 Arm Compiler v6. 兩個版本編譯器有些用法不相容。BSP 包裡的範例和一些第三方的開源原始碼是用 Arm Compiler v5 開發，使用 Arm Compiler v6 編譯會發生錯誤。Arm 提供 Arm Compiler v5 獨立安裝方式，請按照網頁 https://developer.arm.com/documentation/ka005073/latest/ 的說明，下載和安裝 Arm Compiler v5. 如果 Keil MDK 安裝的目錄是 "C:\Keil_v5", 建議 Arm Compiler v5 的安裝目錄改成 "C:\Keil_v5\ARM\ARMCC". 完成後，重新用 Keil MDK 開啟範例即可編譯無誤。</p>

Appendix

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| Appendix

- Drivers supported in RT-Thread
 - NUC980 series, M480 series, and M460 series.

| NUC980 Supported Drivers in RT-Thread

- Refer the URL <https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/NUC980>

Peripheral	rt_device_class_type	Device name
ADC	RT_Device_Class_Miscellaneous (ADC)	<i>adc</i>
CAN	RT_Device_Class_CAN	<i>can[0-3]</i>
CRYPTO	RT_Device_Class_Miscellaneous (HW Crypto)	<i>hwcrypto</i>
EBI	N/A	<i>N/A</i>
EMAC	RT_Device_Class_NetIf	<i>e[0-1]</i>
GPIO	RT_Device_Class_Miscellaneous (Pin)	<i>gpio</i>
I2C	RT_Device_Class_I2CBUS	<i>i2c[0-3]</i>
I2S	RT_Device_Class_Sound	<i>sound0</i>
PDMA	N/A	<i>N/A</i>
QSPI	RT_Device_Class_SPIBUS	<i>qspi[0]</i>
RTC	RT_Device_Class_RTC	<i>rtc</i>
PWM	RT_Device_Class_Miscellaneous (PWM)	<i>pwm[0-1]</i>
USBH	RT_Device_Class_USBHost	<i>usbh</i>
USBD	RT_Device_Class_USBDevice	<i>usbd</i>
SC (UART function)	RT_Device_Class_Char	<i>scuart[0-1]</i>
SDH	RT_Device_Class_Block	<i>sdh[0-1]</i>
SPI	RT_Device_Class_SPIBUS	<i>spi[0-1]</i>
TIMER	RT_Device_Class_Timer	<i>timer[0-5]</i>
UART	RT_Device_Class_Char	<i>uart[0-9]</i>
WDT	RT_Device_Class_Miscellaneous (Watchdog)	<i>wdt</i>

M480 Supported Drivers in RT-Thread

- Refer the URL <https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m480>

Peripheral	rt_device_class_type	Device name			
BPWM	RT_Device_Class_Miscellaneous (PWM)	<i>bpwm[0-1]</i>	EI	RT_Device_Class_Miscellaneous (Pulse encoder)	<i>qei[0-1]</i>
BPWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	<i>bpwm[0-1]i[0-5]</i>	QSPI	RT_Device_Class_SPIBUS	<i>qspi0</i>
CAN	RT_Device_Class_CAN	<i>can[0-1]</i>	RTC	RT_Device_Class_RTC	<i>rtc</i>
CLK	RT_Device_Class_PM	<i>pm</i>	SC (UART function)	RT_Device_Class_Char	<i>scuart[0-2]</i>
CRC	RT_Device_Class_Miscellaneous (HW Crypto)	<i>hwcrypto</i>	SDH	RT_Device_Class_Block	<i>sdh0</i>
CRYPTO	RT_Device_Class_Miscellaneous (HW Crypto)	<i>hwcrypto</i>	SPI	RT_Device_Class_SPIBUS	<i>spi[0-3]</i>
EADC	RT_Device_Class_Miscellaneous (ADC)	<i>eadc[0-1]</i>	SPI (I2S function)	RT_Device_Class_Sound/RT_Device_Class_Pipe	<i>spii2s[0-3]</i>
EBI	N/A	<i>N/A</i>	TIMER	RT_Device_Class_Timer	<i>timer[0-5]</i>
ECAP	RT_Device_Class_Miscellaneous (Input capture)	<i>ecap[0-1]i[0-2]</i>	TIMER (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	<i>timer[0-5]i0</i>
EMAC	RT_Device_Class_NetIf	<i>e0</i>	TIMER (PWM function)	RT_Device_Class_Miscellaneous (PWM)	<i>tpwm[0-5]</i>
EPWM	RT_Device_Class_Miscellaneous (PWM)	<i>epwm[0-1]</i>	TRNG	RT_Device_Class_Miscellaneous (HW Crypto)	<i>hwcrypto</i>
EPWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	<i>epwm[0-1]i[0-5]</i>	UART	RT_Device_Class_Char	<i>uart[0-5]</i>
FMC	FAL	<i>N/A</i>	USBBD	RT_Device_Class_USBDevice	<i>usb0</i>
GPIO	RT_Device_Class_Miscellaneous (Pin)	<i>gpio</i>	USBH	RT_Device_Class_USBHost	<i>usbh</i>
GPIO	RT_Device_Class_I2CBUS	<i>softi2c0[0-1]</i>	USCI (I2C function)	RT_Device_Class_I2CBUS	<i>ui2c[0-1]</i>
HSOTG	RT_Device_Class_USBHost/RT_Device_Class_USBDevice	<i>N/A</i>	USCI (SPI function)	RT_Device_Class_SPIBUS	<i>uspi[0-1]</i>
HSUSBD	RT_Device_Class_USBDevice	<i>usb0</i>	USCI (UART function)	RT_Device_Class_Char	<i>uuart[0-1]</i>
I2C	RT_Device_Class_I2CBUS	<i>i2c[0-2]</i>	WDT	RT_Device_Class_Miscellaneous (Watchdog)	<i>wdt</i>
I2S	RT_Device_Class_Sound/RT_Device_Class_Pipe	<i>sound0</i>			
PDMA	N/A	<i>N/A</i>			

M460 Supported Drivers in RT-Thread

- Refer the URL <https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m460>

Peripheral	rt_device_class_type	Device name			
BPWM	RT_Device_Class_Miscellaneous (PWM)	<i>bpwm[0-1]</i>	PDMA	N/A	N/A
BPWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	<i>bpwm[0-1]i[0-5]</i>	QSPI	RT_Device_Class_SPIBUS	<i>qspi[0-1]</i>
CANFD	RT_Device_Class_CAN	<i>canfd[0-3]</i>	RTC	RT_Device_Class_RTC	<i>rtc</i>
CCAP	RT_Device_Class_Miscellaneous	<i>ccap0</i>	SC (UART function)	RT_Device_Class_Char	<i>scuart[0-2]</i>
CRC	RT_Device_Class_Miscellaneous (HW Crypto)	<i>hwcrypto</i>	SDH	RT_Device_Class_Block	<i>sdh[0-1]</i>
CRYPTO	RT_Device_Class_Miscellaneous (HW Crypto)	<i>hwcrypto</i>	SDIO	RT_Device_Class_Sdio	<i>sdio[0-1]</i>
DAC	RT_Device_Class_Miscellaneous (DAC)	<i>dac[0-1]</i>	SPI	RT_Device_Class_SPIBUS	<i>spi[0-10]</i>
EADC	RT_Device_Class_Miscellaneous (ADC)	<i>eadc[0-1]</i>	SPI (I2S function)	RT_Device_Class_Sound/RT_Device_Class_Pipe	<i>spii2s[0-10]</i>
EBI	N/A	N/A	TIMER	RT_Device_Class_Timer	<i>timer[0-3]</i>
ECAP	RT_Device_Class_Miscellaneous (Input capture)	<i>ecap[0-1]i[0-2]</i>	TIMER (PWM function)	RT_Device_Class_Miscellaneous (PWM)	<i>tpwm[0-3]</i>
EMAC	RT_Device_Class_Netif	<i>e0</i>	TRNG	RT_Device_Class_Miscellaneous (HW Crypto)	<i>hwcrypto</i>
EPWM	RT_Device_Class_Miscellaneous (PWM)	<i>epwm[0-1]</i>	UART	RT_Device_Class_Char	<i>uart[0-7]</i>
EPWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	<i>epwm[0-1]i[0-5]</i>	USB	RT_Device_Class_USBDevice	<i>usb</i>
EQEI	RT_Device_Class_Miscellaneous (Pulse encoder)	<i>eqei[0-3]</i>	USBH	RT_Device_Class_USBHost	<i>usbh</i>
FMC	FAL	N/A	USCI (I2C function)	RT_Device_Class_I2CBUS	<i>ui2c[0-1]</i>
GPIO	RT_Device_Class_Miscellaneous (Pin)	<i>gpio</i>	USCI (SPI function)	RT_Device_Class_SPIBUS	<i>uspi[0-1]</i>
GPIO	RT_Device_Class_I2CBUS	<i>softi2c0[0-1]</i>	USCI (UART function)	RT_Device_Class_Char	<i>uuart[0-1]</i>
HSOTG	RT_Device_Class_USBHost/RT_Device_Class_USBDevice	N/A	WDT	RT_Device_Class_Miscellaneous (Watchdog)	<i>wdt</i>
HSUSB	RT_Device_Class_USBDevice	<i>usb</i>			
I2C	RT_Device_Class_I2CBUS	<i>i2c[0-4]</i>			
I2S	RT_Device_Class_Sound/RT_Device_Class_Pipe	<i>sound[0, 1]</i>			

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谢谢

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Děkuji

Bedankt

Thank you

Kiitos

Merci

Danke

Grazie

ありがとう

감사합니다

Dziękujemy

Obrigado

Спасибо

Gracias

Teşekkür ederim

Cảm ơn