NuMaker IoT Platforms

Innovative applications built with
Nuvoton NuMicro® series MCU and MPU

SalesSupport@nuvoton.com

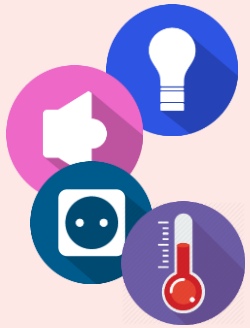
2024-02-20

Download the file:
https://www.nuvoton.com/iot_startup

Nuvoton Provides One-Stop IoT Solution

Device Platform | Driver Ready | Gateway Platform | Cloud Ready | Companion App

Edge Devices



Platform RTOS

arm MBED

FreeRTOS

Azure RTOS

RT-Thread

Tiny and Elegant Internet of Things Operating System

Connectivity

Supported Network

Wi Fi

Lte

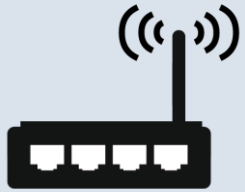
NB-IoT

Bluetooth

LoRa

Ethernet

Edge Gateway



Platform OS/RTOS

FreeRTOS

OpenWrt

WIRELESS FREEDOM

Linux

Clouds/Servers

Supported Clouds

amazon web services

Microsoft Azure

Alibaba Cloud

Monitor/Control

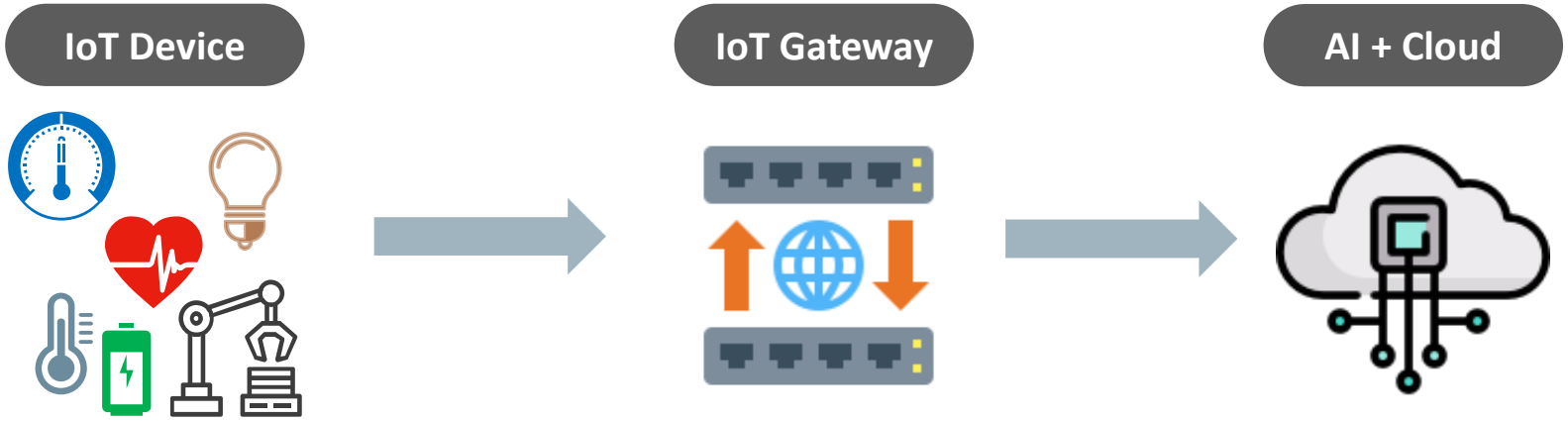
Android & iOS App

amazon web services

Alibaba Cloud

nuvoTon

Nuvoton IoT Platforms



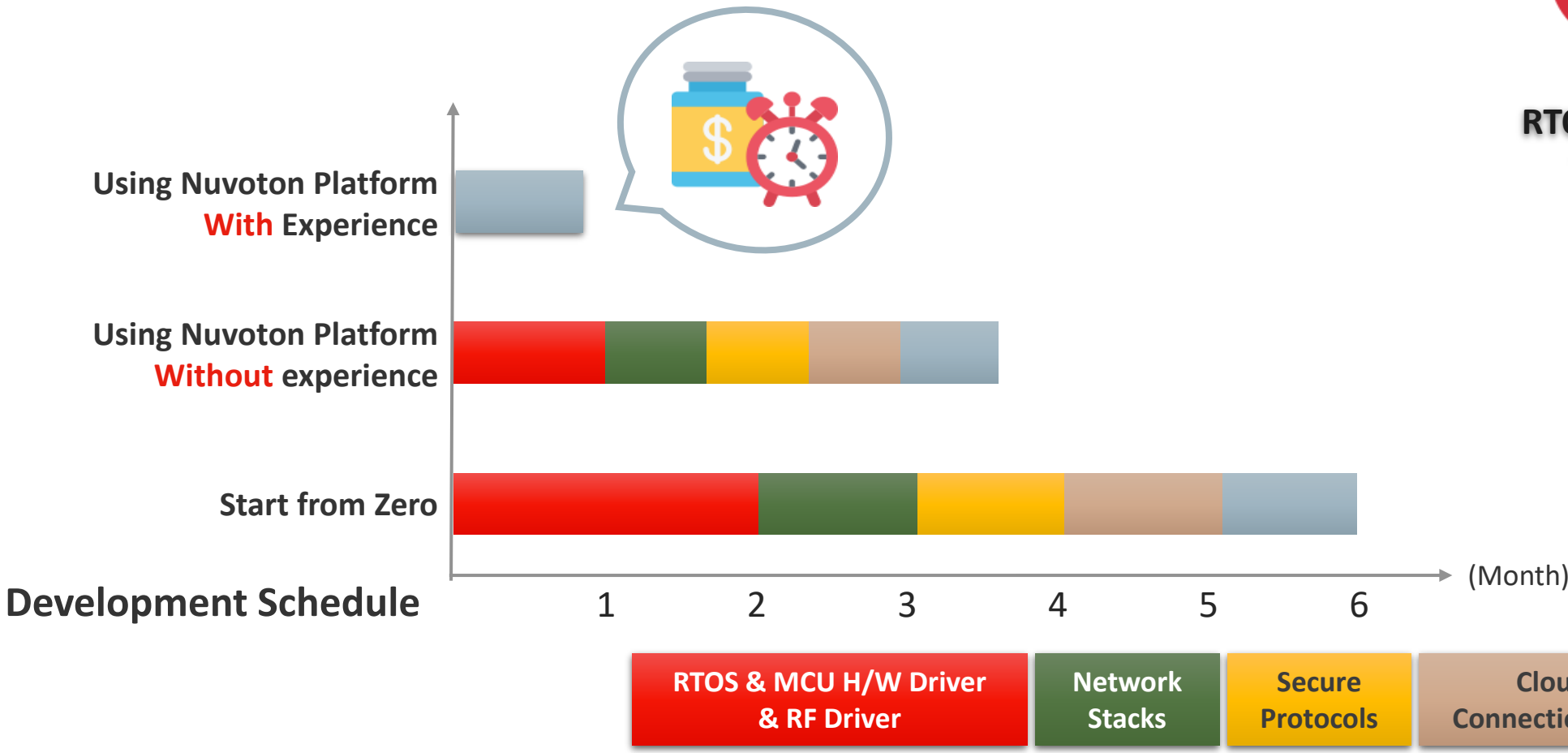
	IoT Device	IoT Gateway	AI + Cloud
Nuvoton Platforms	**NuMaker-IoT-M467 (Cortex-M4)** NuMaker-IoT-M487 (Cortex-M4) NuMaker-IoT-M2354 (Cortex-M23) NuMaker-LoRaD-M252 (Cortex-M23) NuStamp-ACK-M031LE (Cortex-M0)	**NuMaker-IoT-MA35D1-A1 (Dual Cortex-A35)** **NuMaker-IIoT-NUC980G2 (ARM9)** NuMaker-IIoT-NUC980 (ARM9) NuMaker-RTU-NUC980 (ARM9) NuMaker-IoT-M467 (Cortex-M4)	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.
	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	NuMaker-IoT-MA35D1-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.

Solution for your IIoT Platform

RTOS / CLOUD
Time ++



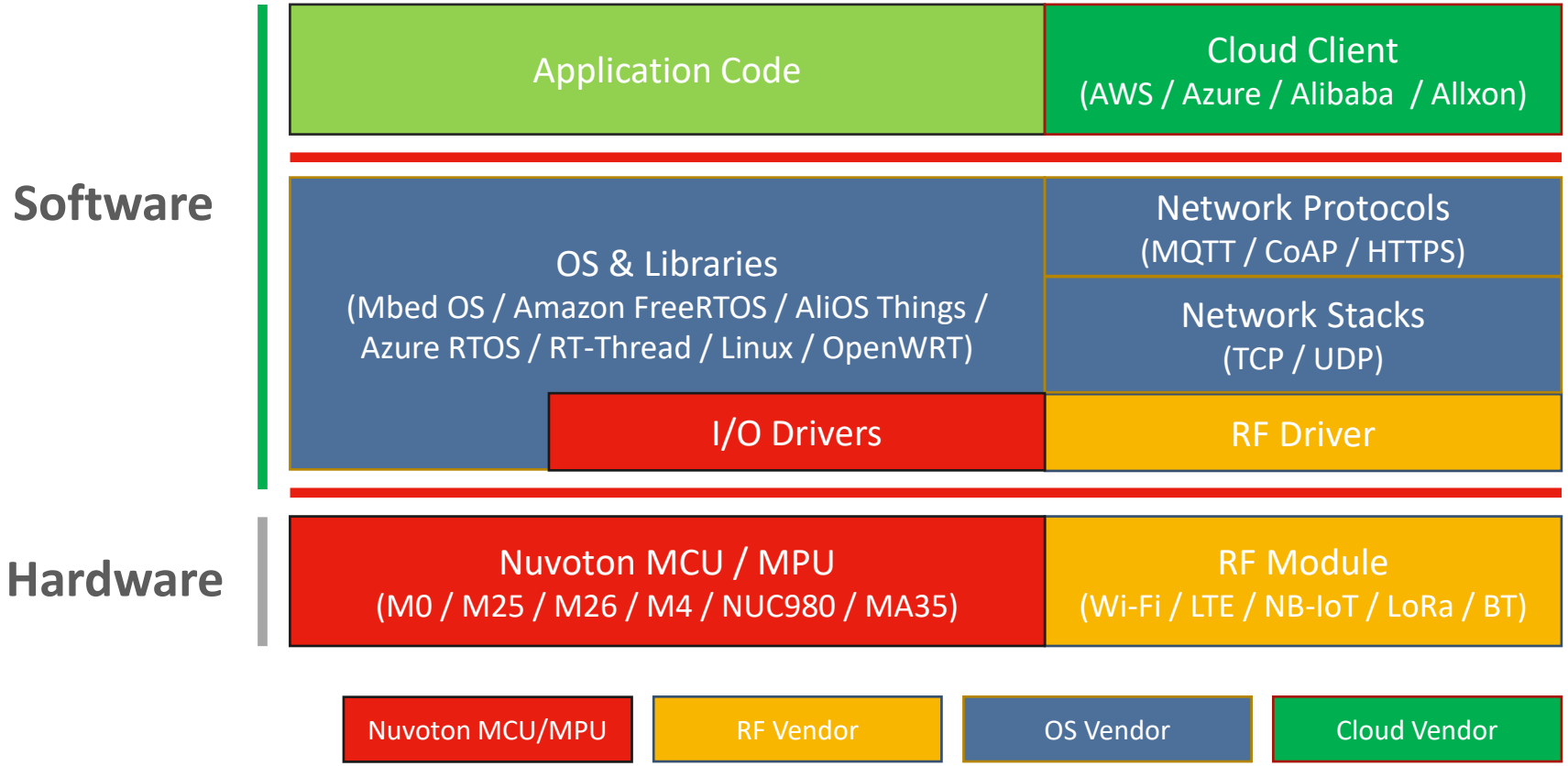
Customer Attribute Capabilities

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** (exclude M2354), **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	NEW PRODUCT **NuMaker-IoT-M467** **NuMaker-IoT-M487** **NuMaker-IoT-M2354** **NuStamp-ACK-M031LE** **NuMaker-LoRaD-M252**	NEW PRODUCT **NuMaker-IIoT-NUC980G2** **NuMaker-IIoT-NUC980** **NuMaker-RTU-NUC980** NEW PRODUCT **NuMaker-IoT-M467** **NuMaker-IoT-M487** **NuMaker-IoT-M2354**	NEW PRODUCT **NuMaker-IoT-MA35D1-A1** NEW PRODUCT **NuMaker-IIoT-NUC980G2** **NuMaker-IIoT-NUC980** **NuMaker-RTU-NUC980**

Nuvoton IoT Platforms

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

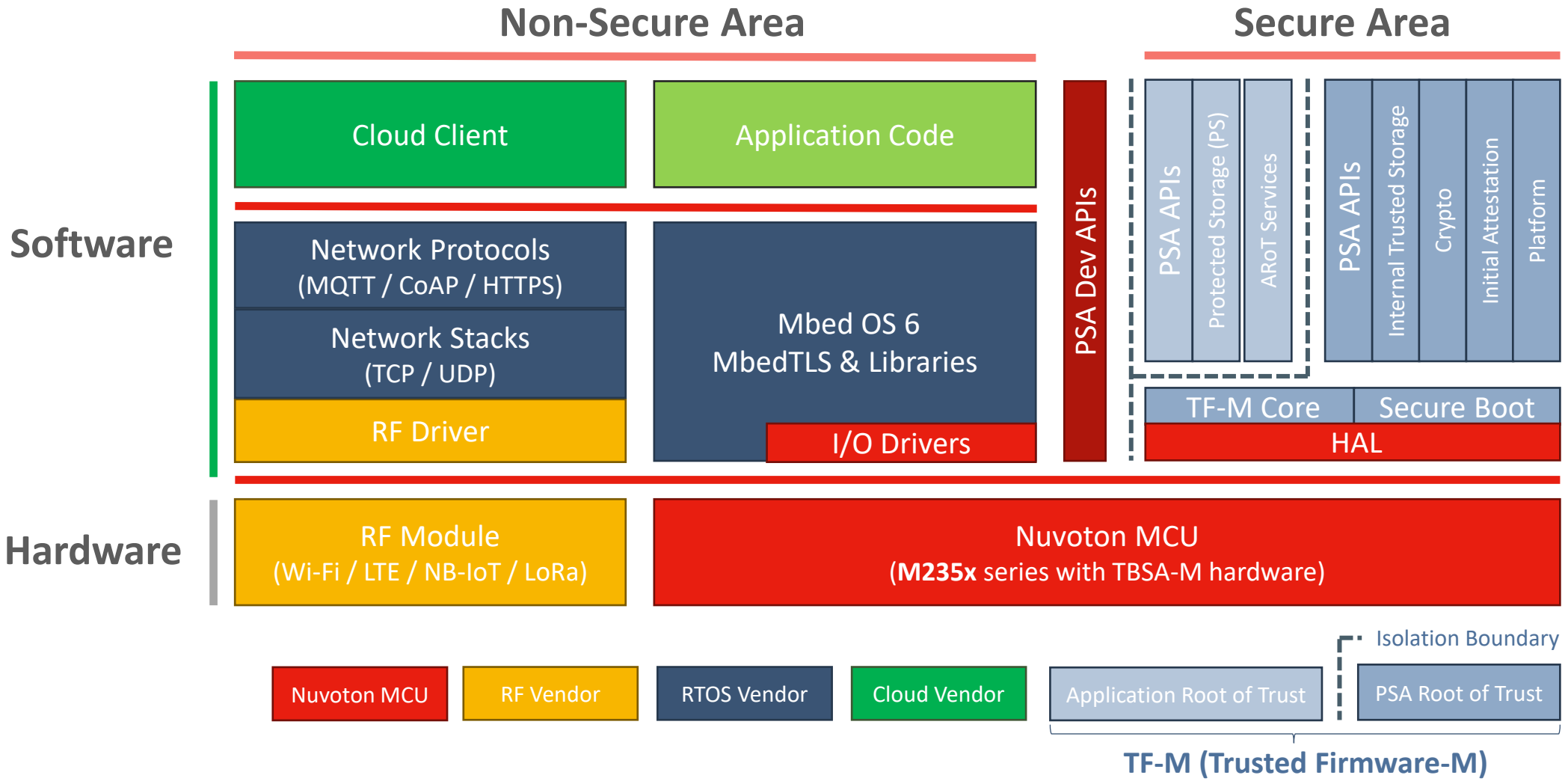
- Integrate MCU/OS/Network Protocols/RF Driver/Application Demos
- Customer can focus on application development.



- Cloud Certification
- MQTT/CoAP Example
- Integrate RF Driver
- Multiple H/W Platform

Nuvoton IoT Platforms with TF-M

(NuMaker **M235x** series platforms)

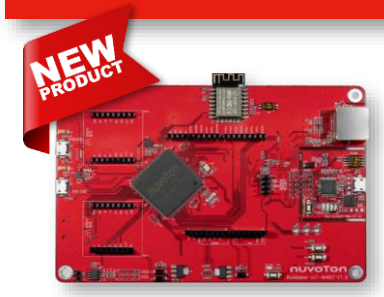


IoT Device Platforms

Platforms

IoT General Platform

NuMaker-IoT-M467



- Arm® Cortex®-M4 core
- Runs at 200 MHz
- 1024 KB 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 core
- 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**

IoT Security Platform

NuMaker-IoT-M2354

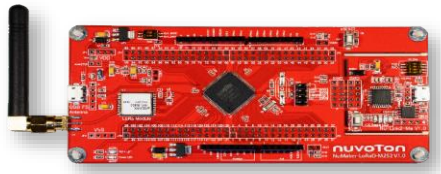
- Arm® Cortex®-M23 core
- Runs at 96 MHz
- 1024 KB Flash Memory
- 256 KB SRAM

- Free RTOS, Mbed OS, RT-Thread

- **IoT node**
- **TrustZone®**
- **PSA® Certified**

LoRa Device Platform

NuMaker-LoRaD-M252



- Arm® Cortex®-M23 core
- Runs at 48 MHz
- 256 KB Flash Memory
- 32 KB SRAM

- Mbed OS

- **LoRa node**

Amazon ACK Platform

NuStamp-ACK-M031LE

- Arm® Cortex®-M0 core
- Runs at 48 MHz
- 128 KB Flash Memory
- 16 KB SRAM

- **Alexa Sensor node with Amazon Alexa Connect Kit (ACK)**

IoT Gateway Platforms

Platforms

NuMaker-IoT-MA35D1-A1

NEW PRODUCT

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

- Linux, OpenWRT, FreeRTOS, RT-Thread

- **Ethernet Gateway**
- **Wireless Gateway**
- **Edge Computing**

NuMaker-IIoT-NUC980G2

NEW PRODUCT

- Arm® ARM926 core
- Runs at 300 MHz
- DDR 128 MB
- 1 Gb SPI-NAND Flash

- Linux, OpenWRT, FreeRTOS, RT-Thread

- **Ethernet Gateway**
- **Wireless Gateway**

NuMaker-IIoT-NUC980

- Arm® ARM926 core
- Runs at 300 MHz
- DDR 64 MB
- 1 Gb SPI-NAND Flash

- Linux, OpenWRT, FreeRTOS, RT-Thread

- **Ethernet Gateway**
- **Wireless Gateway**

NuMaker-RTU-NUC980 (Chili)

- Arm® ARM926 core
- Runs at 300 MHz
- 64 MB DDR2 in LQFP64
- 256 Mb SPI NOR Flash

- Linux, OpenWRT, FreeRTOS, RT-Thread

- **CAN 2.0B/RS485 to Eth**
- **Ethernet Gateway**
- **Gateway in small size**
- **Remote terminal unit**

NuMaker-IoT-M467

NEW PRODUCT

- Arm® Cortex®-M4 core
- Runs at 200 MHz
- 1024 KB Flash Memory
- 512 KB SRAM
- Crypto accelerators

- FreeRTOS, Mbed OS, RT-Thread, Zephyr

- **Ethernet Gateway**
- **Remote Controller**
- **Serial to Ethernet**

Connectivity Ecosystems Support

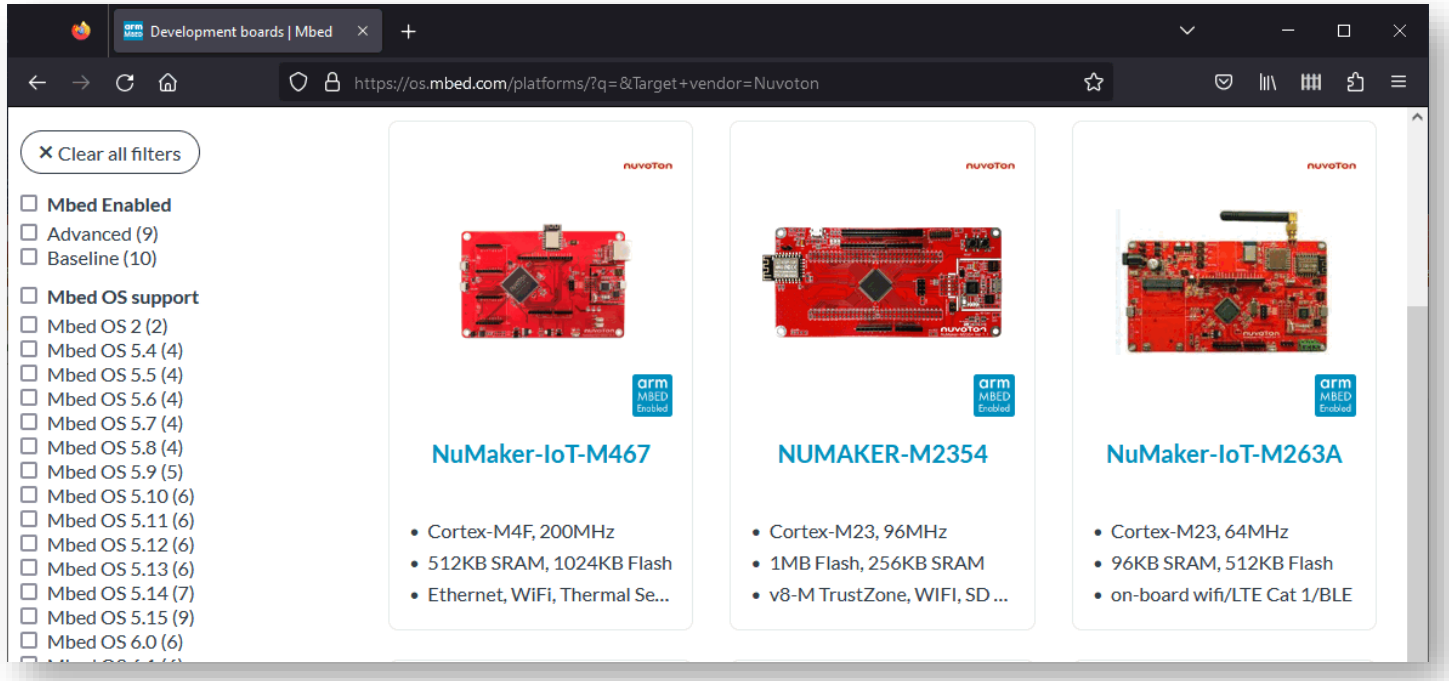
NuMaker Board	OS / RTOS	IP *3				Non-IP *3	Clouds		
		Ethernet	Wi-Fi	NB-IoT Cat-M1	LTE	LoRa (Device)	Amazon AWS	Alibaba Cloud	Microsoft Azure
NEW NuMaker-IoT-MA35D1-A1	Linux / OpenWRT	●	●	●	●		●	●	
	RT-Thread	●						●	●
NEW NuMaker-IIoT-NUC980G2 NuMaker-IIoT-NUC980	Linux / OpenWRT	●	●	●	●		●	●	
	FreeRTOS	●							
	RT-Thread	●						●	●
NuMaker-RTU-NUC980 (Chili)	Linux / OpenWRT	●	●	●	●		●	●	
	FreeRTOS	●							
	RT-Thread	●						●	●
NuMaker-IoT-M487	Mbed OS	●	●	●	●	●*5	●	●	●
	Amazon FreeRTOS	●	●	●			●		
	FreeRTOS	●							
	AliOS Things	●	●					●	
	RT-Thread	●	●					●	●
	Azure RTOS		●						●
NEW NuMaker-IoT-M467	Mbed OS	●	●	●	●	●*5	●		●
	Amazon FreeRTOS	●					●		
	FreeRTOS	●							
	RT-Thread	●	●					●	●
	Zephyr	●	●	●			●		●
NuMaker-IoT-M2354	Mbed OS*1		●	●	●	●	●	●	●
	RT-Thread		●					●	●
	FreeRTOS		●			●			
NuMaker-LoRaD-M252	Mbed OS/Non-OS*2					●			
NuStamp-ACK-M031LE	Non-OS		●				●*4		

*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

Arm Mbed OS Certified Platforms

Mbed OS Certified Boards

- NuMaker-IoT-M467
- NuMaker-IoT-M487
- NuMaker-PFM-M487
- NuMaker-IoT-M2354
- NuMaker-PFM-M2351
- NuMaker-IoT-M263A
- NuMaker-LoRaD-M252 …

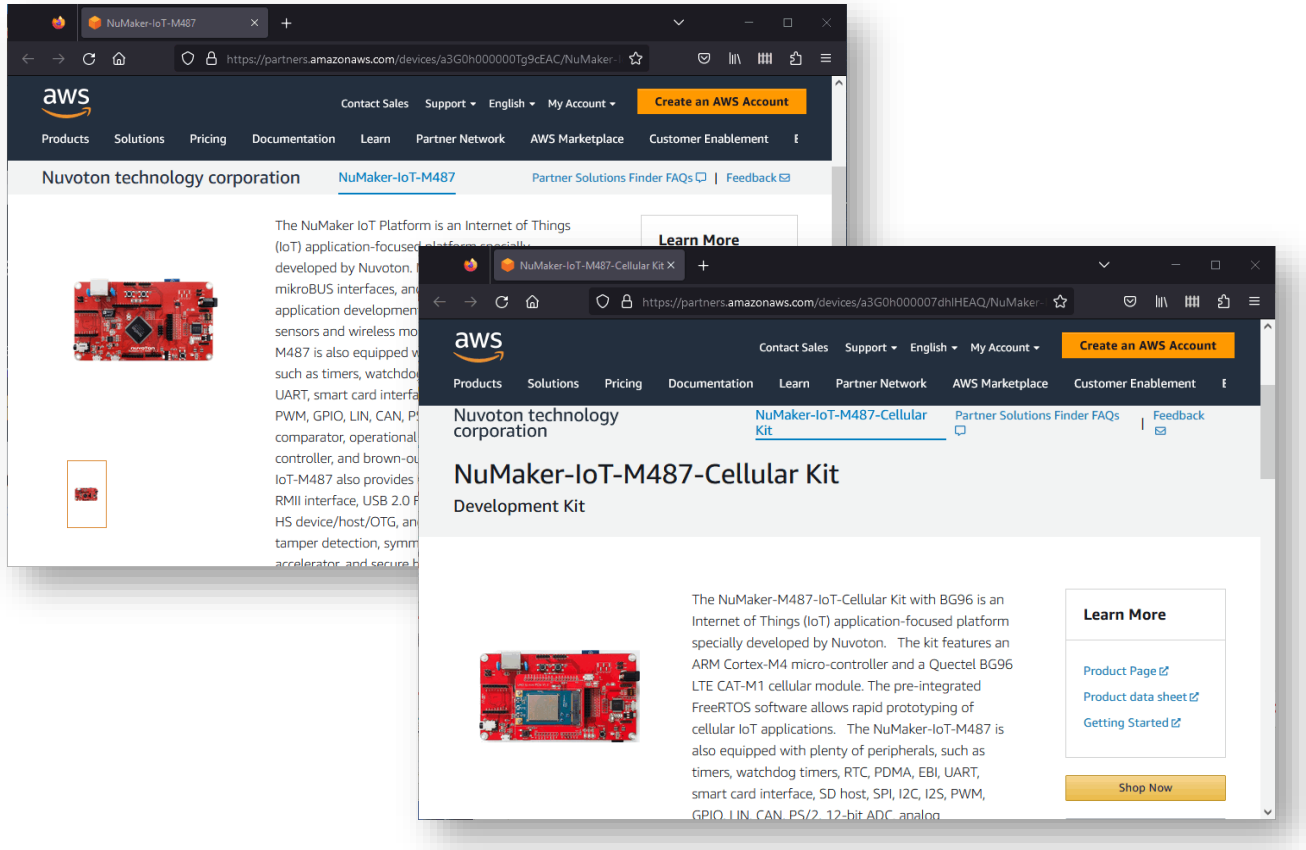


https://os.mbed.com/platforms/?q=&Board+vendor=Nuvoton

AWS Certified Platforms

AWS Certified Boards

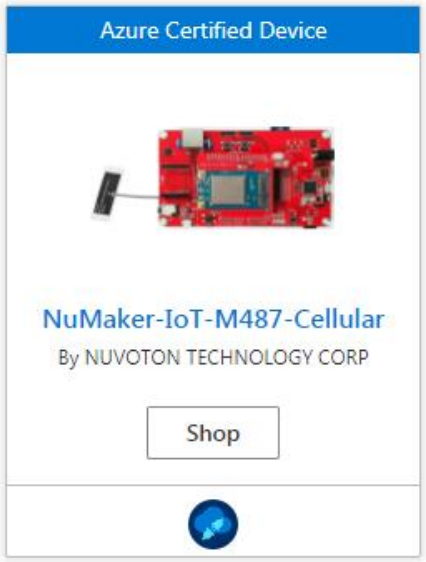
- NuMaker-IoT-M487
- NuMaker-IoT-M487 Cellular Kit

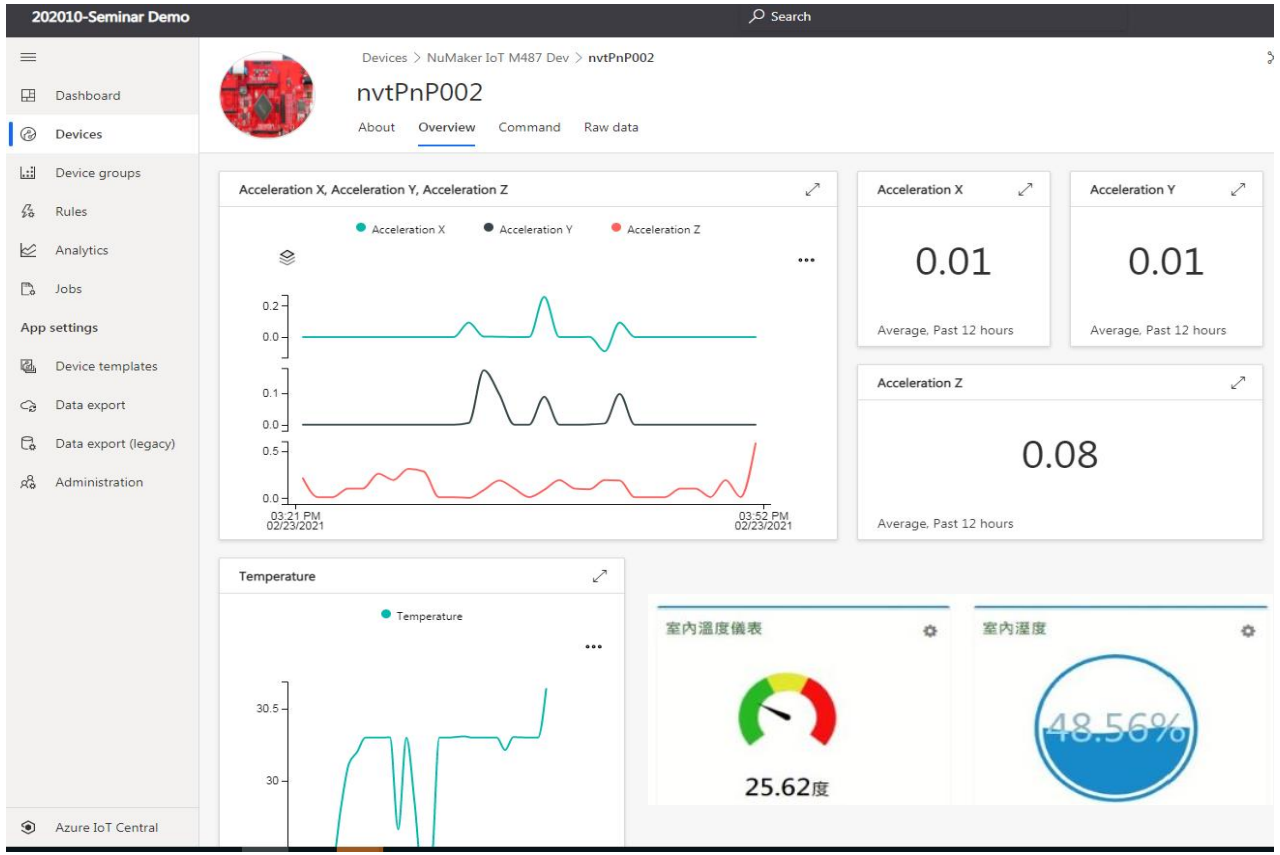


https://devices.amazonaws.com/search?kw=nuvoton&page=1&sv=freertos

Azure IoT Certified Device Platform

Nuvoton M487 Series. With Microsoft Azure IoT Plug and Play certification.
Easy to use Azure IoT Central – Digital Dash Board. SI use “no-code” to setup a device management system
Customer can easily to reach out the Azure IoT Cloud service by EVB or Module. Key promotion features.





Microsoft Azure Certified Device

Azure Certified Device IoT Play 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**

BSP & SDK:
- Nuvoton
- GitHub (Worldwide)
- GitLab (China)
- Gitee (China)

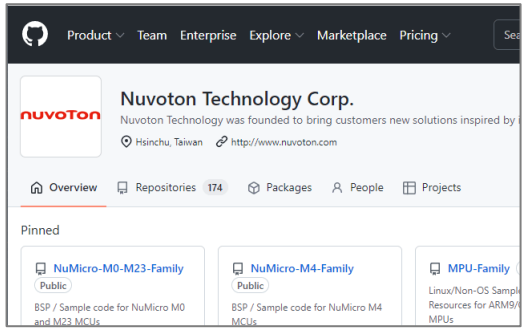
OS & Examples:
- Nuvoton
- Linux
- RT-Thread (China)

Promotion & Tutorial Videos:
- YouTube
- Bilibili (China)

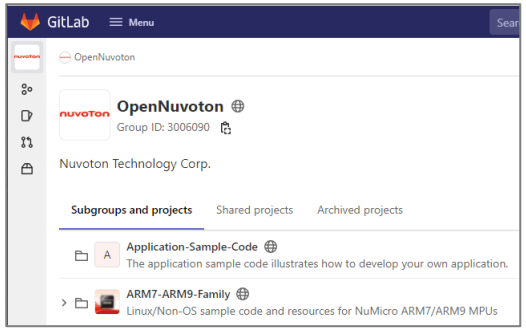
Supporting:
- NuForum
- 21ic (China)新唐MCU技术论坛
- Online Chat
- **Sales Support e-mail**

Technical Supporting Websites

BSP / SDK / Open Source / Examples



GitHub



GitLab

Gitee (China)

RTOS

RT-Thread (China)

Online Video

YouTube

Bilibili (China)

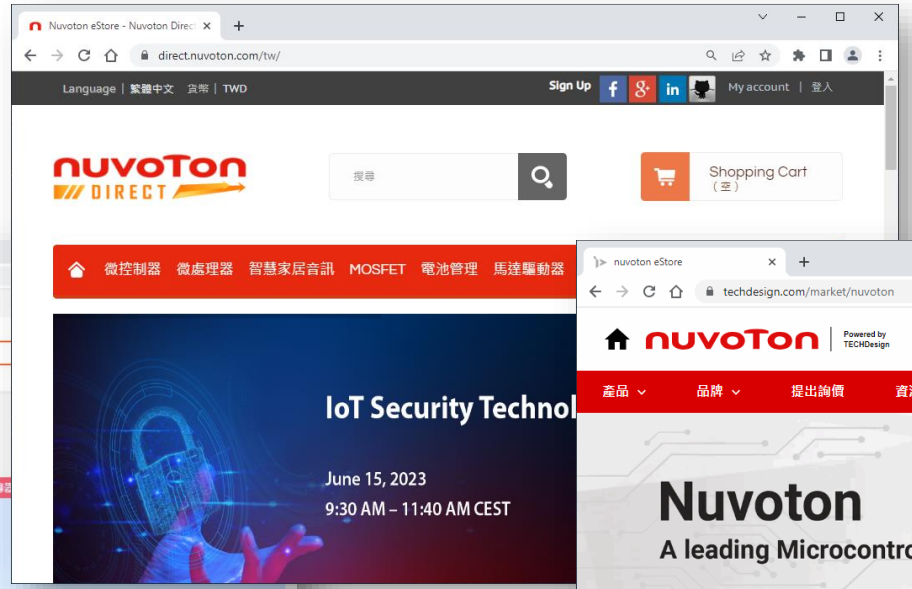
Forums

NuForum

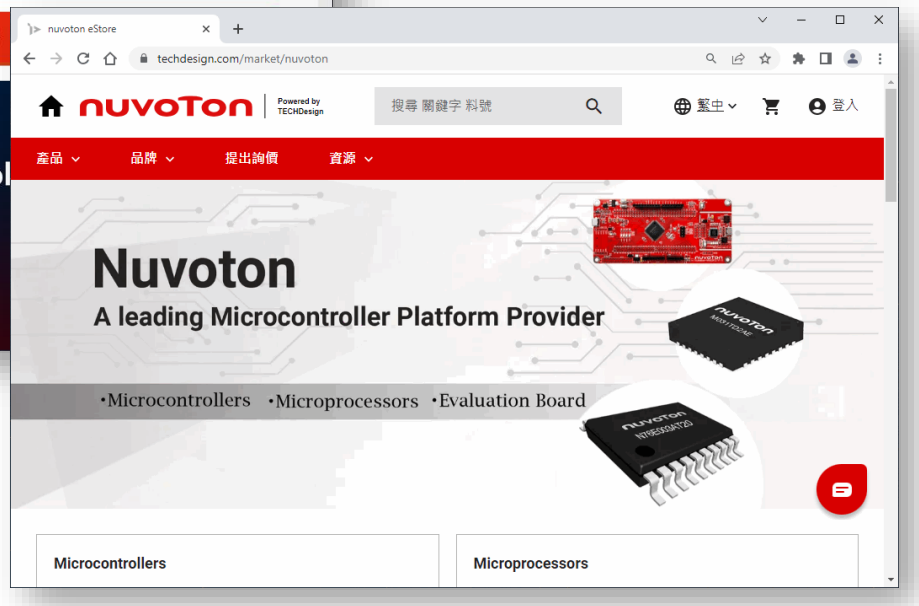
21ic Forum (China)

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

Contact information: SalesSupport@nuvoton.com

NuMicro® Digital Platform

Official Website

www.nuvoton.com

Online Store

direct.nuvoton.com

nuvoton.tmall.com

www.techdesign.com/market/nuvoton

Forum

forum.nuvoton.com

www.nuvoton-MCU.com

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

Social Media

www.facebook.com/NuvotonNuMicro

@Nuvoton Technology Corporation

@NuvotonMCU

Source Code Download

github.com/OpenNuvoton

gitlab.com/OpenNuvoton

gitee.com/OpenNuvoton

Successful Stories

On NuMaker IoT Platforms

Industrial IoT High Performance Computing Gateway

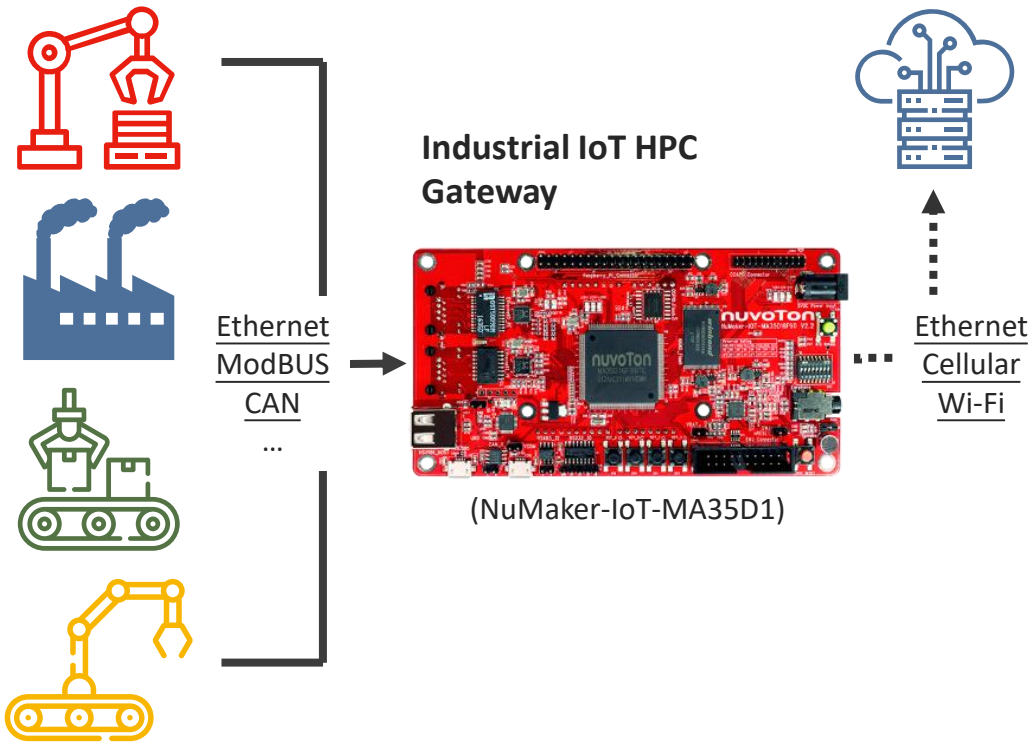
Collects, analyzes, and transfers data between devices and cloud applications for enhanced system performance.

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

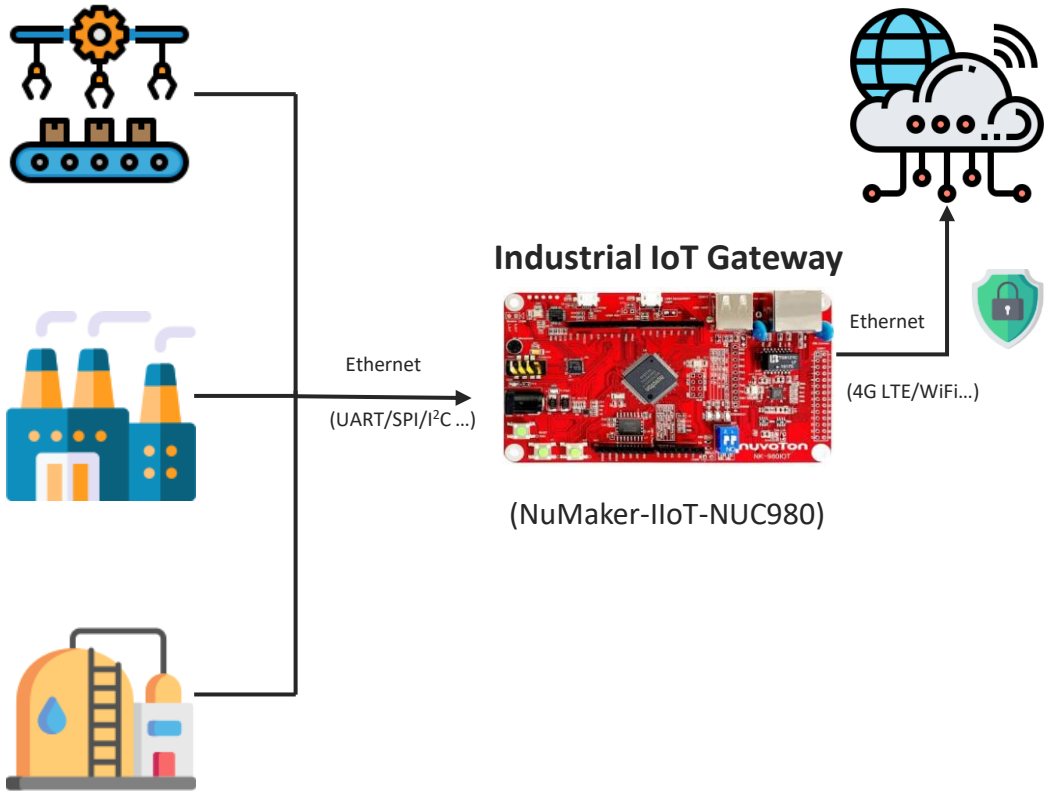
IoT gateway is a bridge to pass raw data through the network to reach a central server for further processing.

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



Remote Control Monitoring and Management

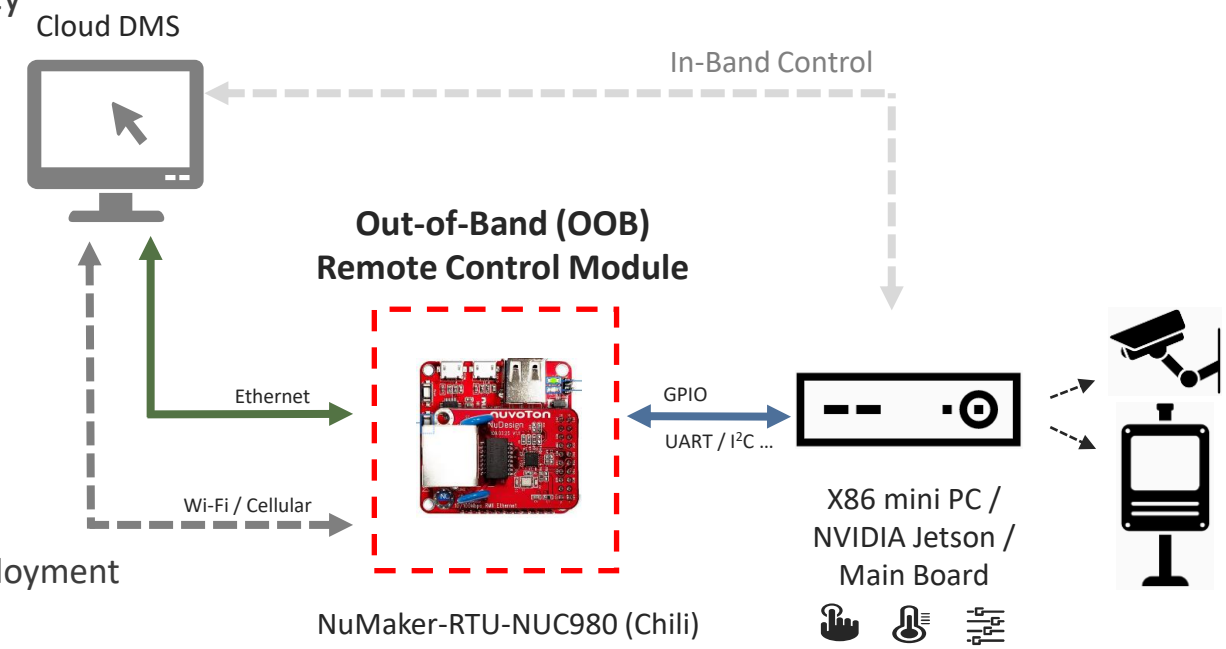
The out-of-band (OOB) remote device management of Nuvoton NUC980 is a complete solution with Cloud DMS.

Application Key Requirements

- Secure communication through multiple network connectivity
- SaaS platform for easy and quick deployment

NuMaker-RTU-NUC980 Platform Features

- **Hardware**
  - ARM9, 300 MHz, MCP 64M or 128M Bytes DDR
  - UART, I²C, SPI, PWM, GPIO, USB for expansion
- **Software**
  - **Buildroot** to customized BSP or ready-to-use BSP image
  - **Linux OS/OpenWRT** and SDK are ready for easy programming
  - TCP, UDP, **HTTP(S)**, **MQTT**, **CoAP**, etc. network protocols.
  - **TLS** 1.2 encryption for secure network communication
  - SaaS reference platform is ready for easy customization and deployment
- **Clouds**
  - Client references to AWS, Microsoft Azure, and Ali Cloud, etc.
  - Complete SaaS platform solution with **Allxon**.
- **Network**
  - Ethernet, Wi-Fi, 4G LTE, and NB-IoT, etc.



Energy Gateway for Solar PV and BMS

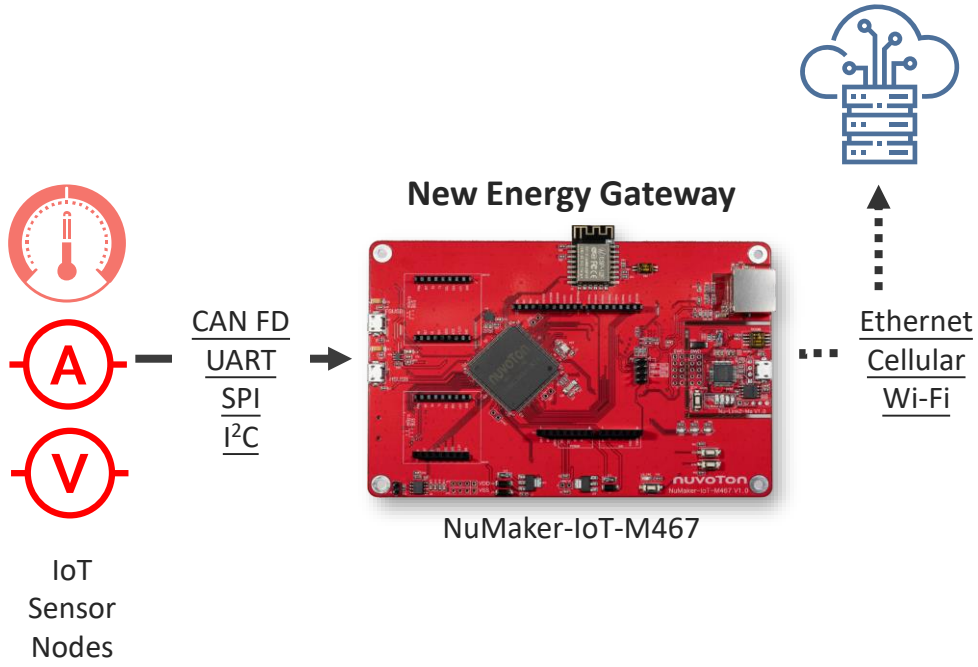
New energy gateway monitors and manages energy sources and loads for optimized energy consumption.

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, I^2C, 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

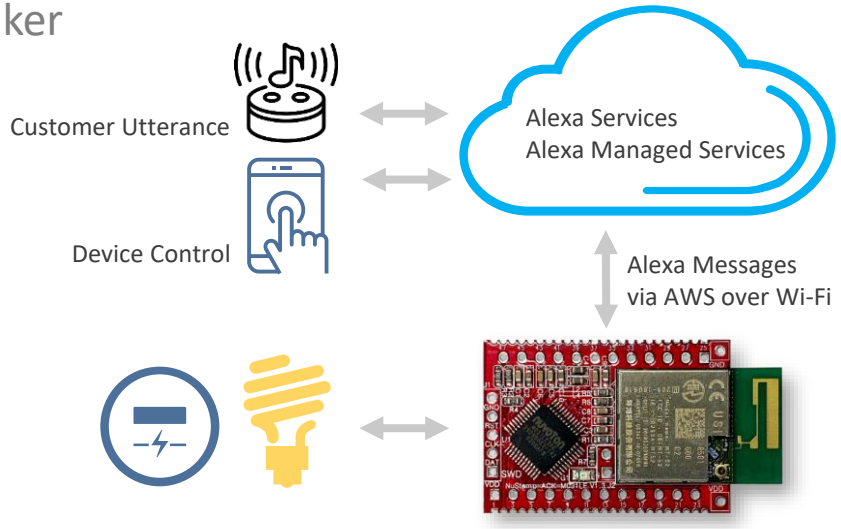
* Looking for another modules that use other Semtech chips, such as SX1262, etc. Please contact nuvoton@reyax.com

Voice Control Home Appliances

Compliant with Amazon Alexa to work with Amazon Echo smart speaker

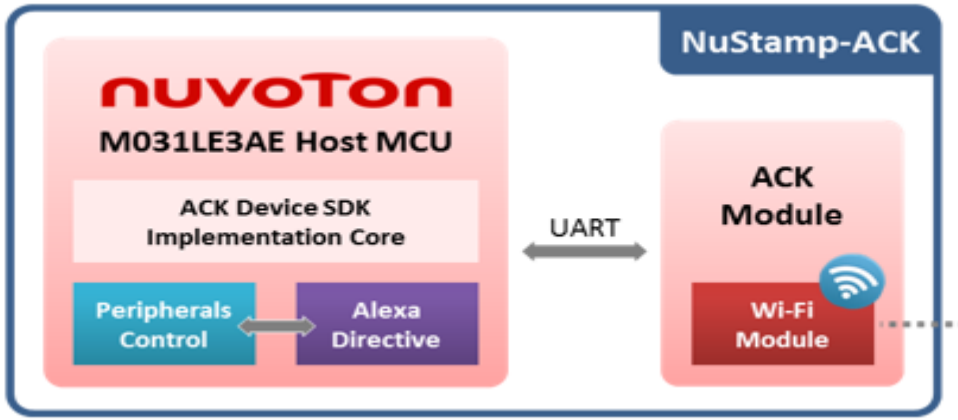
Application Key Requirements

- Easy to integrate into AWS Alexa service
- Easy to control and design the product



NuStamp-ACK-M031LE Features

- **Hardware**
  - NuMicro M031LE, Cortex-M0 core, 72MHz
  - UART, SPI, USB, SDIO, PWM, ADC, DAC, ACMP, I^2C, etc.
- **Software**
  - BSP for all MCU interface drivers and examples
  - Reference of control via UART interface on NuStamp module.
- **Cloud**
  - Connecting AWS Alexa service is ready.
- **Network**
  - Wi-Fi

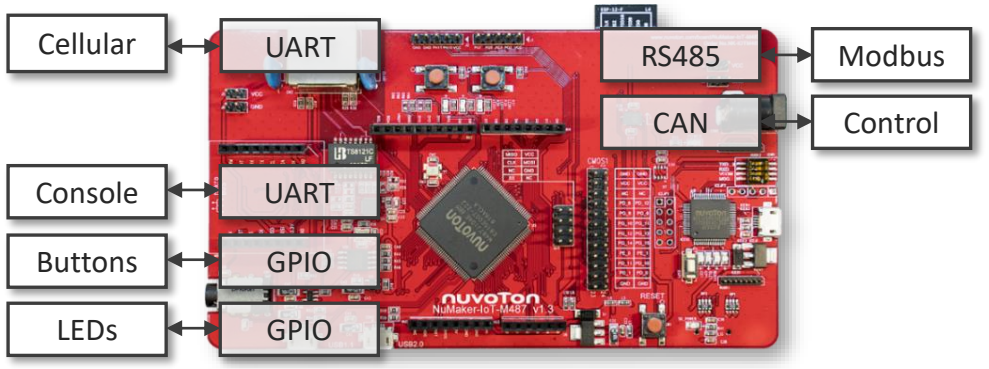


Protocol Conversion

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)	3rd open source*1	Need integration
Mbed Solution	M4	Mbed MQTT	3rd open source*2	Ready solution
Zephyr Solution	M467	Zephyr MQTT	Zephyr Modbus	Need integration

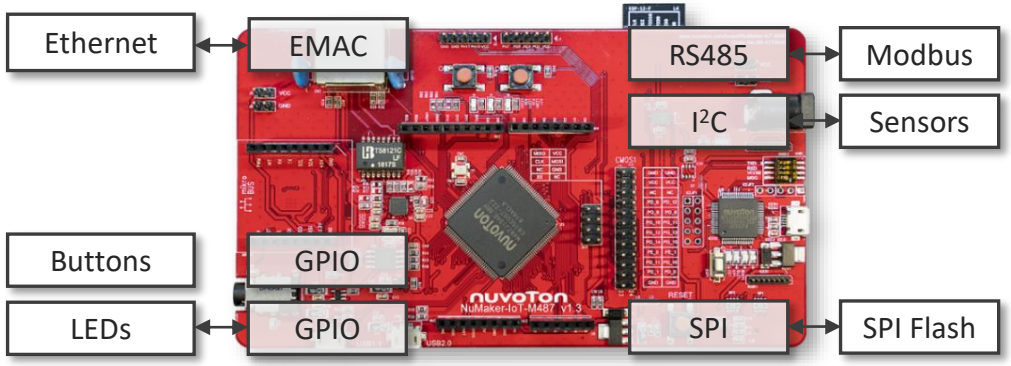
*1 Open source https://github.com/debevv/nanoMODBUS
*2 Open source FreeModbus

Code
https://os.mbed.com/teams/Nuvoton/code/NuMaker-mbed-modbus-sample/

NuForum Application Notes
http://forum.nuvoton.com/viewtopic.php?f=33&t=11140
http://forum.nuvoton.com/viewtopic.php?f=19&t=8587

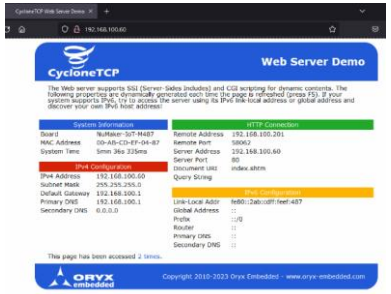
Lite Web Server

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
http://forum.nuvoton.com/viewtopic.php?f=33&t=11188

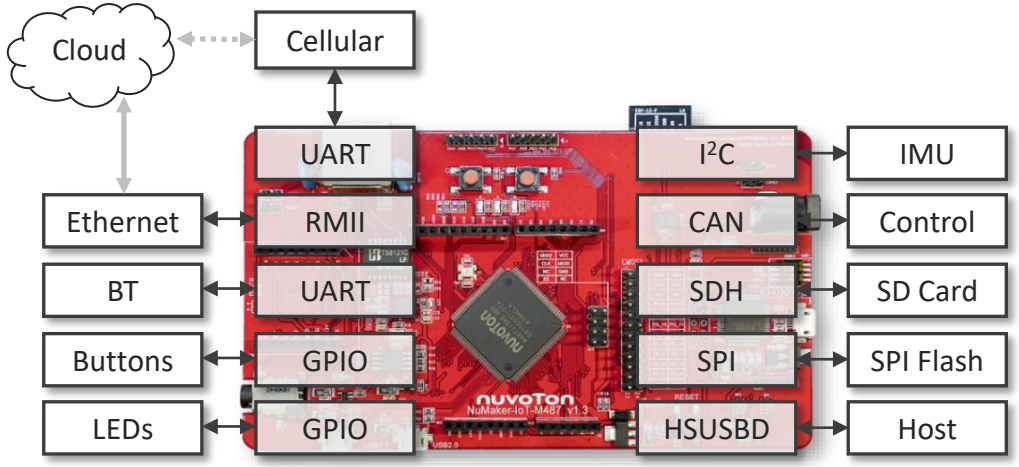
FreeRTOS + CyClone TCP
http://forum.nuvoton.com/viewtopic.php?f=33&t=11193

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.



OTA (Over-the-air firmware update) with AWS IoT on Nuvoton's Mbed Enabled boards. Supported 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
http://forum.nuvoton.com/viewtopic.php?t=11125

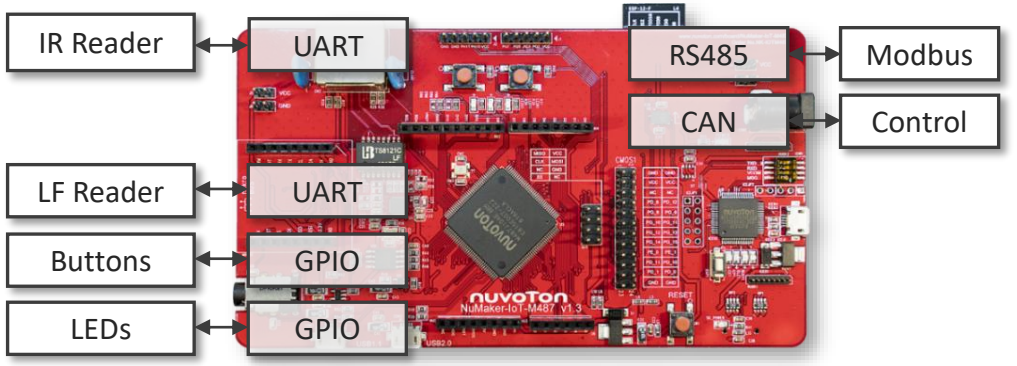
NuMaker M487 Platform Features

- 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

Smart Rack

The Rack Reader converts IR / LF / NFC into RS-486 / RS-232 / CANbus, 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/

NuForum application note
http://forum.nuvoton.com/viewtopic.php?f=33&t=11140
http://forum.nuvoton.com/viewtopic.php?t=8587

Key Features of NuMicro® MPU/MCU on NuMaker IoT Platforms

 | Photo by Jeffery Cheng

List of NuMicro® MPU and MCU

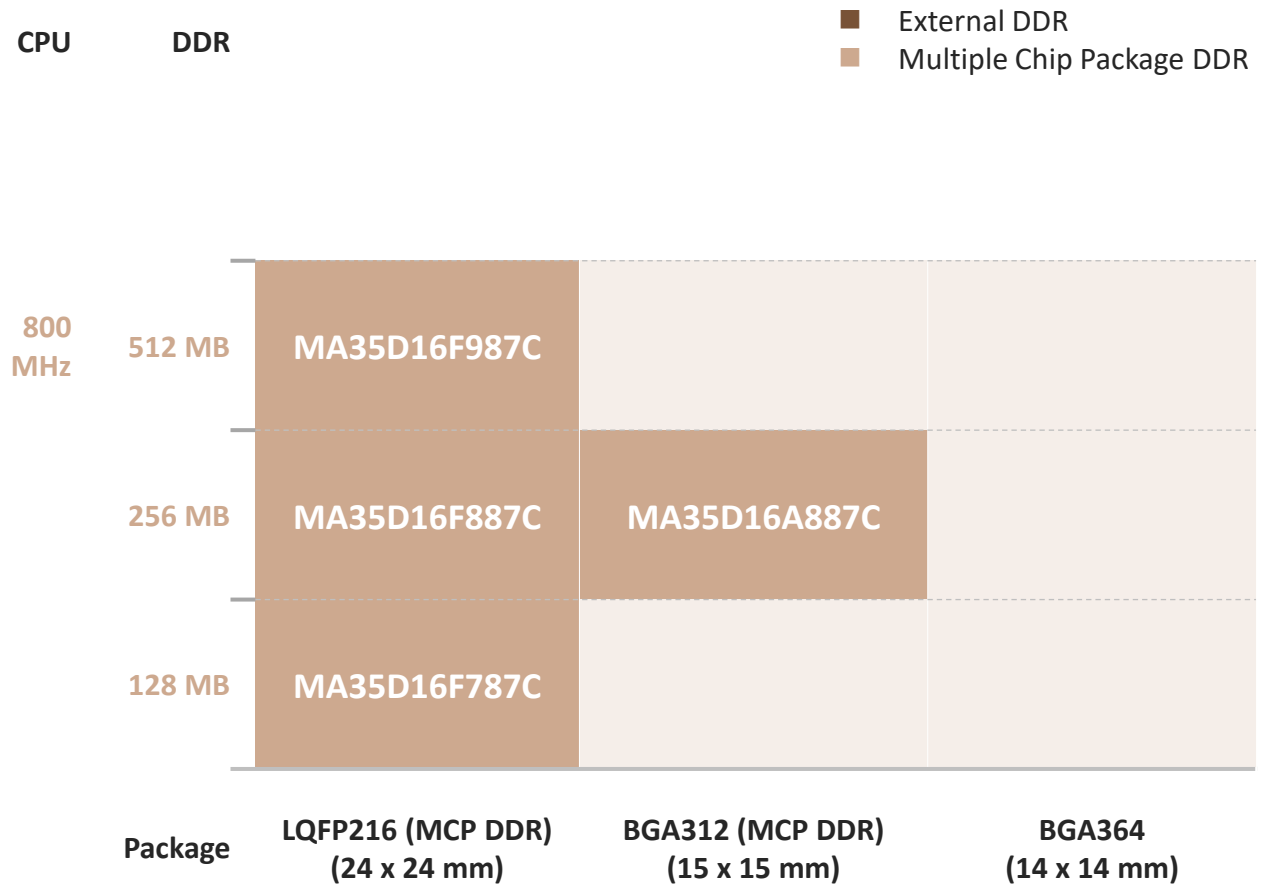
NuMicro® MPU

- MA35D1 Series
- NUC980 Series

NuMicro® MCU

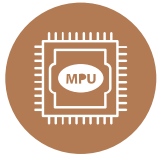
- M460 Series
- M480 Series
- M2354 Series
- M252 Series
- M031/M032 Series

NuMicro® MA35D1 Series MPU



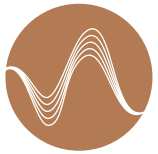
- **Dual 64-bit Arm Cortex-A35 high-performance cores running up to 800 MHz**
- **One Arm Cortex-M4 real-time core running up to 180 MHz**
- **LQFP and BGA package parts with stacking a DDR3L SDRAM up to 512 MB**
- Trusted Secure Island (TSI) an isolated secure hardware unit, which performs all the operations of the cryptographic accelerators
- **Display**
  - LCD display I/F the resolution up to 1080P
  - 2D GFx
  - H.264 decoder up to 1920x1080@45fps
  - 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

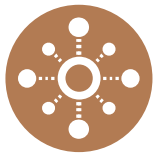


Analog

- 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

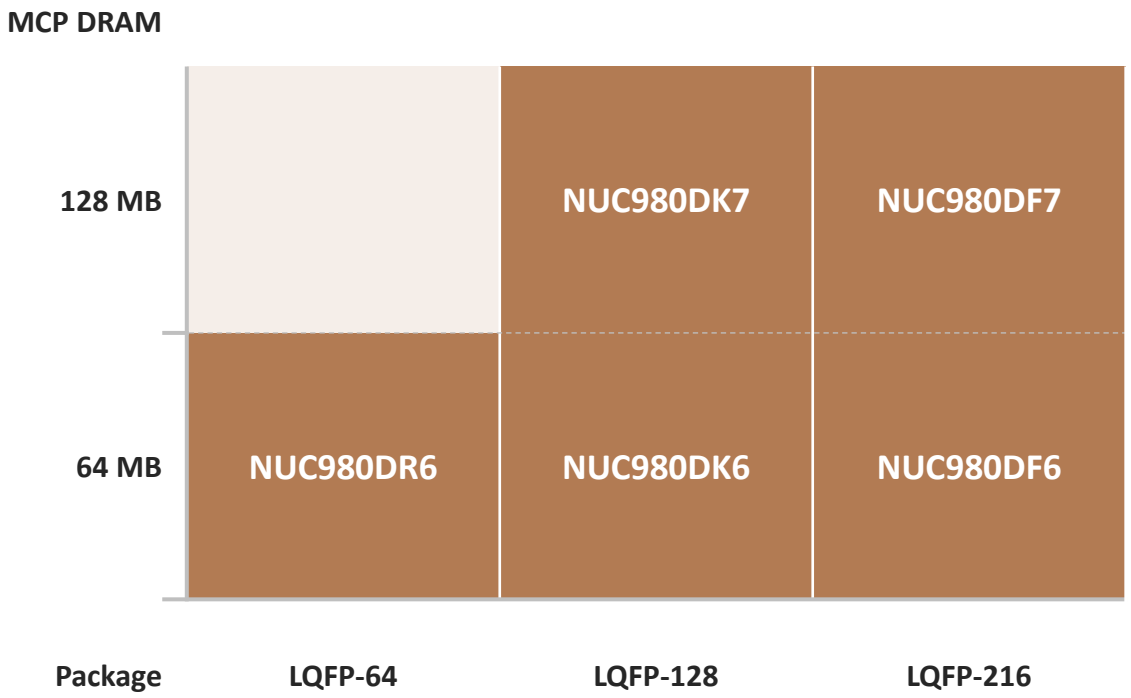
- 4 sets of PDMA
- 2 sets of 10/100/1000 Mbps Ethernet
- 1 set of USB HS Host, 1 set of USB HS Host/Device dual role
- 1 set of SDIO3.0 and 1 set of SDIO2.0
- 4 sets of CAN FD
- 2 sets of QSPI
- 2 sets of I^2S
- 4 sets of SPI/I^2S
- 17 sets of UART
- 6 sets of I^2C
- Up to 150x GPIO (LQFP216)
- 18-channel 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

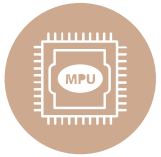
Industrial Control IoT



- **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

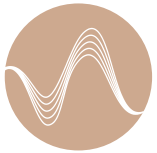
NuMicro® NUC980 Series Features

Industrial Control IoT



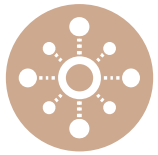
System

- 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



Analog

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



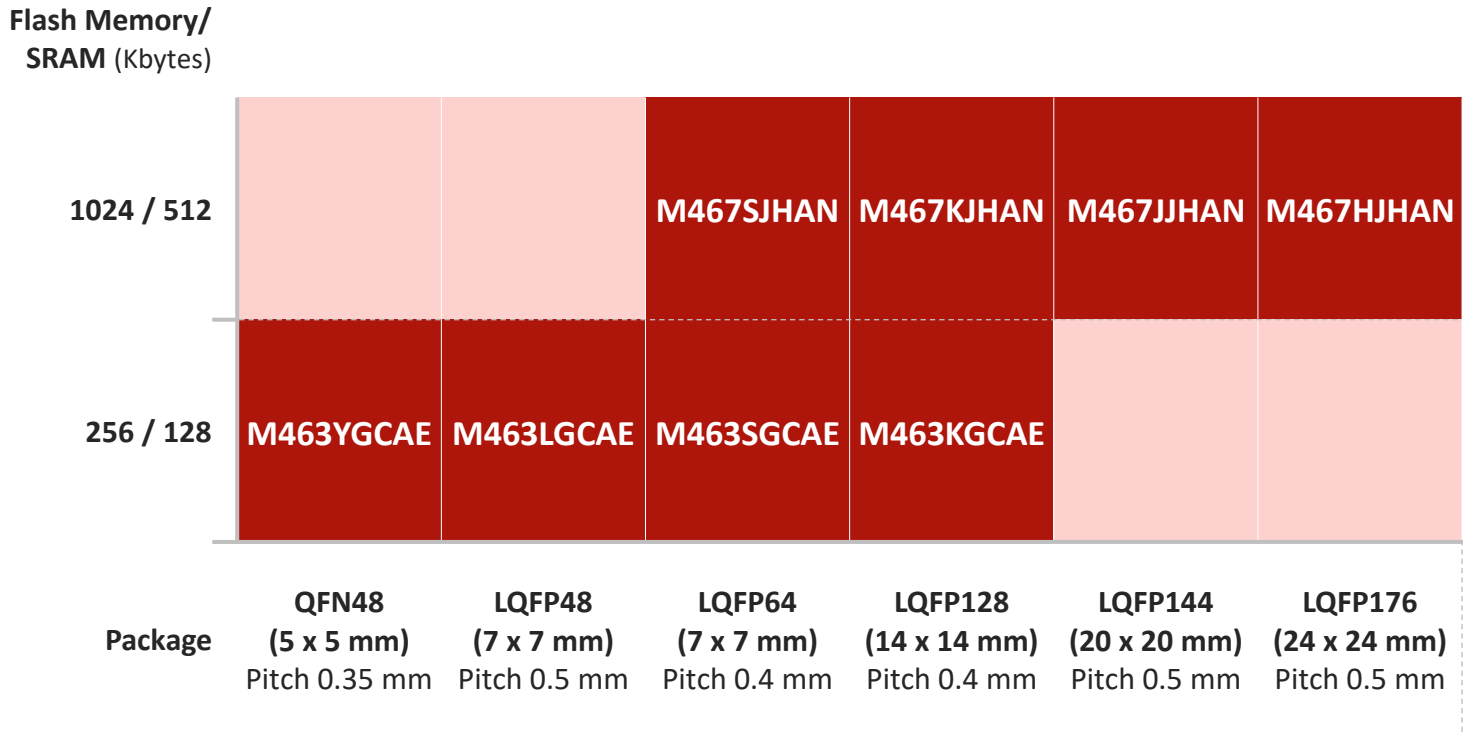
Peripherals

- 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 I^2C
- 1 set of I^2S
- Up to 2 sets of SPI
- 1 set of Quad SPI
- Up to 10 sets of UART/RS485

Security

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

NuMicro® M460 Series MCU



- **Arm® Cortex®-M4F core with build-in DSP**
- **Runs up to 200 MHz**
- **Operating Temperature:** -40°C to +85°C/105°C

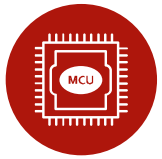
Sub Series:

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

Features:

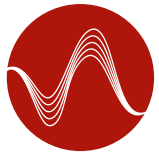
- Secure Boot
- Key Store
- Audio PLL
- eXecute-Only-Memory (XOM)

NuMicro® M460 Series Features



System

- Arm® Cortex®-M4F core with build-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
- 8 KB Loader ROM (LDROM)
- Dual PDMA, each with 16 channels
- Programmable Audio PLL

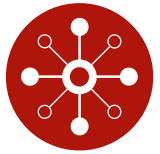


Analog

- 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 ACMP

Security

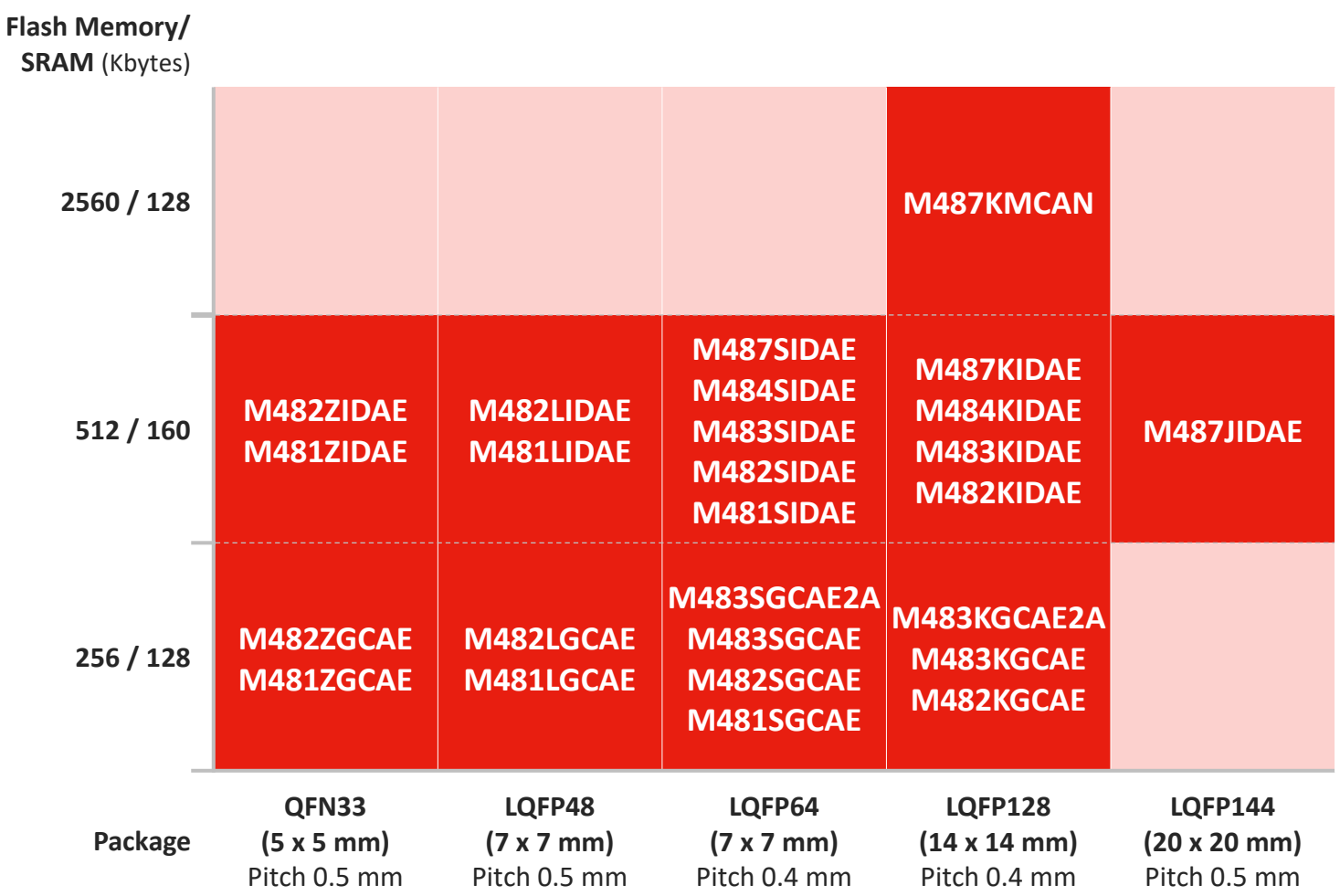
- Crypto Engine
  - AES256, ECC571, SHA512, HMAC512, RSA4096, SM2
- True Random Number Generator (TRNG)
- Key Store to protect key
- Secure Boot
- 3 KB One Time Programming (OTP) ROM
- eXecute-Only-Memory (XOM)



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 HyperBus Interface
- 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 I^2C
- Up to 4 sets of SPI/I^2S + 2 sets of QSPI
- Up to 2 sets of I^2S
- 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



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

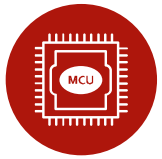
Sub Series:

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

Features:

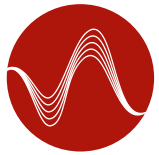
- Secure Boot
- External Bus Interface (EBI, i80)

NuMicro® M480 Series Features



System

- Arm® Cortex®-M4F core with build-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

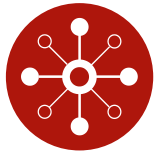


Analog

- 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

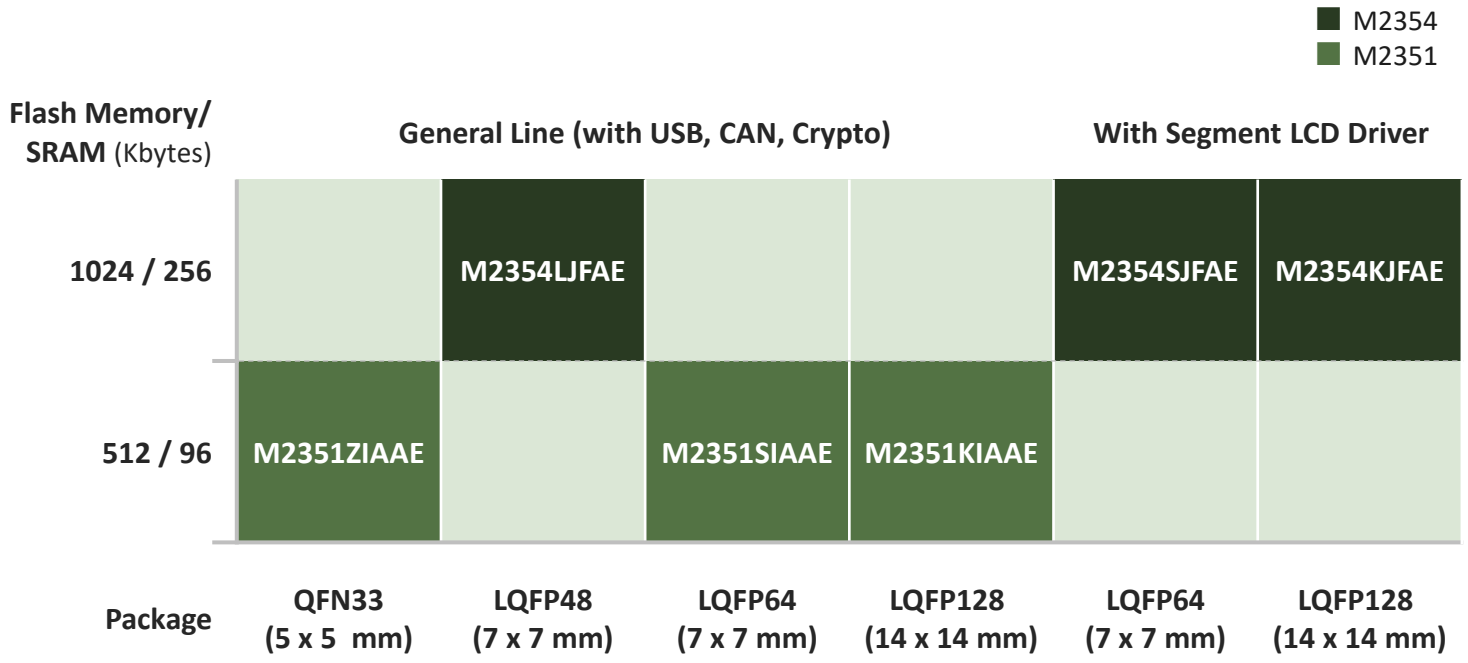
- Crypto Engine
  - AES256, ECC571, SHA512, HMAC512
- Random Number Generator (RNG)
- Secure Boot
- 8 KB Key Protection ROM (KPROM)
- 3 KB One Time Programming (OTP) ROM
- 4 KB Security Protection ROM (SPROM)
- eXecute-Only-Memory (XOM)



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 I^2C
- Up to 4 sets of SPI/I^2S
- Up to 2 sets of Quad SPI
- 1 set of I^2S
- 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® M2351/M2354 Series MCU



- **Arm® Cortex®-M23 core** (with TrustZone)
- Crystal-less USB 2.0 FS OTG
- RTC independent power source (V_{BAT})
- Supports up to 6 tamper pins in MCU system level

M2351 Series

- Runs up to 64 MHz
- 512 KB Flash Memory, 96 KB SRAM
- AES/SHA/DES/3DES/ECC/CRC
- TRNG, PRNG
- Secure Boot, Secure FOTA

M2354 Series

- Runs up to 96 MHz
- 1024 KB Flash Memory, 256 KB SRAM
- AES/RSA/ECC/SHA/CRC
- TRNG, PRNG
- Secure Boot, Secure FOTA, Key Storage

NuMicro® M23 Security MCU Features

Secure Boot, Secure Connectivity, Secure Storage

M2354
M2351
M261/M262/M263

Secure Boot

- Key Generation
- Secure Boot as Root-of-Trust
- Anti-Clone
- Secure Debug

Secure Connectivity

- Mbed RTOS SSL/TLS/DTLS Libraries
- FOTA Update
- Product Lifecycle Management

psacertified™ level one

psacertified™ level two

psacertified™ functional API

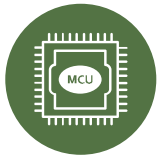
Secure Storage

- Key/ Certificate Provisioning
- Active Shield for Key Store
- SCA/ DPA Mitigation (AES, RSA, ECC)
- Fault Injection Mitigation (Clock, Voltage)

psacertified™
Level 3 Ready

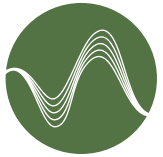
NuMicro® M2354 Series Features

Ultra Low-Power + MCU Enhanced Security



System

- Arm® Cortex®-M23 core with TrustZone supported
- Runs up to 96 MHz
- 1024 KB Flash Memory, 256 KB SRAM
- Operating voltage: 1.7V~3.6V
- Power Consumption 89.3 µA/MHz (LDO), 39.6 µA/MHz (DC-DC)
- 1.5 µA @ 25°C/3.3V stand-by power-down + RTC on, RAM Retention on
- < 0.5 µA @ 25°C/3.3V deep power-down, RTC off, LVR on
- High immunity: EFT 4.4 kV, ESD HBM +/--2 kV
- Operating temperature: -40°C ~ +105°C
- Voltage Adjustable Interface (VAI)
- Up to 8-channel PDMA



Analog

- Dual voltage regulator available for DC-DC converter or LDO.
- Multi-system operation modes
- 1.2V / 0.9V core voltage
- Up to 16-channel 12-bit 3.76 Msps ADC
- 2 sets of ACMP
- 2 sets of 12-bit 1 Msps DAC

Peripherals

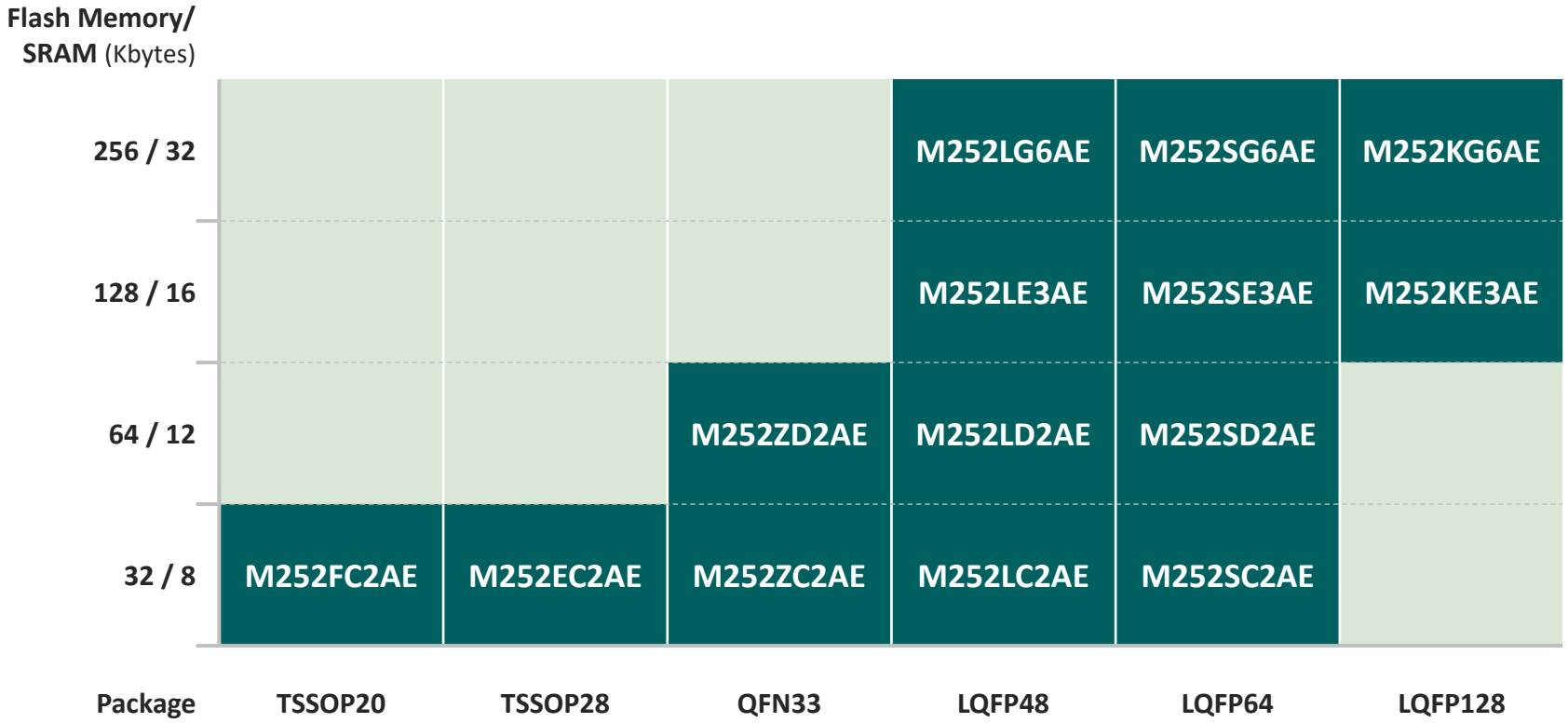
- Crystal-less USB 2.0 FS OTG
- 1 set of CAN 2.0B
- 6 sets of LPUART
- 1 set of SDHC 2.0
- Up to 24-channel PWM
- 16/8-bits External Bus Interface (EBI)
- Segment LCD driver
  - LQFP64: 8x13
  - LQFP128: 8x40
- RTC independent power source (V_{BAT})

Security

- Up to 4 regions XOM (eXecute-Only Memory)
- Crypto
  - AES/RSA/ECC/SHA/CRC
  - TRNG, PRNG
- Supports up to 6 tamper pins in MCU system level
- Secure Boot, Secure FOTA, Key Storage

NuMicro® M252 Series MCU

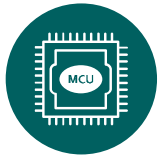
Low Power USB



- **Arm® Cortex®-M23 core** (without TrustZone)
- **Runs up to 48 MHz**
- **Operating voltage:** 1.8V ~ 5.5V
- 138 µA/MHz normal mode
- 2 µA 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 µA/MHz normal mode
- 2 µA 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

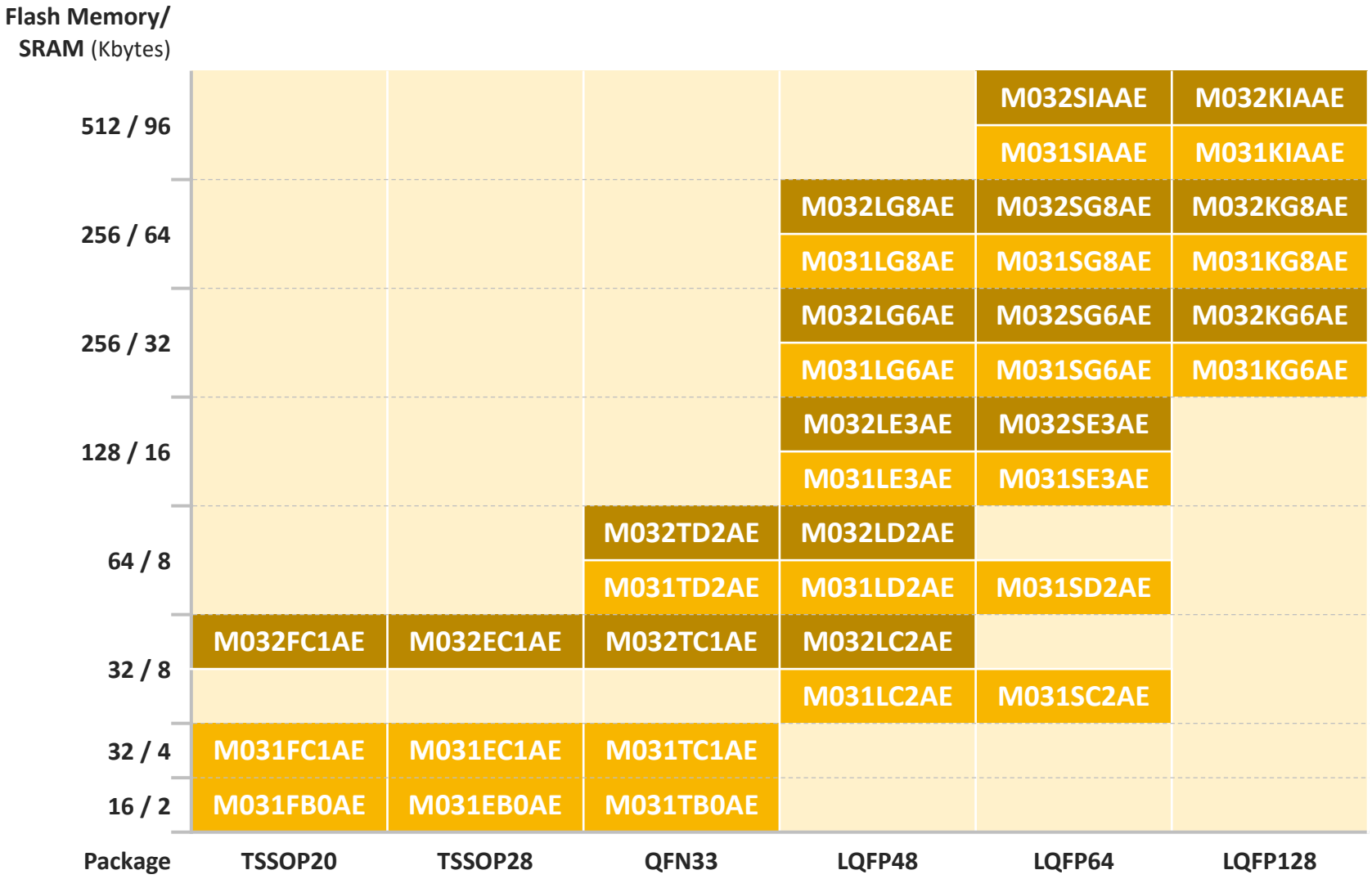
- 3 sets of USCI (UART, I^2C, SPI)
- Up to 24-channel PWM
- Patented “PSIO” (Programmable Serial I/O) supports various serial communication protocols emulation
- Crystal-less USB 2.0 FS Device
- RTC independent power source (V_{BAT})

Highlight

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

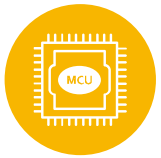
*USCI: Universal Serial Control Interface Controller

NuMicro® M031/M032 Series MCU



- **Arm® Cortex®-M0 core**
- **Runs up to 72 MHz**
- Up to 512 KB Flash Memory, 96 KB SRAM
- HIRC with ±2 % precision from -40°C to +105°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: 1.8 V ~ 3.6 V
- Operating temperature: -40°C ~ +105 °C
- Hardware divider
- High immunity: EFT 4.4 kV, ESD HBM 6 kV
- HIRC with ±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 I^2C, 1 set of I^2S
- 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

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	Y	Linux v5	Y	Y	-	-	Y*4	Y	LR	L	L	L	-	-	
NuMaker-IIoT-NUC980	Y	Linux v5	Y	Y	-	-	Y	Y	LR	L	L	L	-	-	
NuMaker-IIoT-NUC980G2	Y	Linux v5	Y	Y	-	-	Y	Y	LR	L	L	L	-	-	
NuMaker-RTU-NUC980 (Chili)	Y	Linux v5	Y	Y	-	-	Y	Y	LR	L	L	L	-	-	
NuMaker-IoT-M467	Y	Non-OS	Y	Y	Y	-	Y*4	-	NMR	MR	M	M	-	-	
NuMaker-IoT-M487	Y	Non-OS	Y	Y	Y	Y	Y	-	NMAR*5	MAR	M	MA	-	-	
NuMaker-IoT-M2354	Y	Non-OS	Y	Y	Y	-	Y	-	-	MR	M	M	-	-	
NuMaker-LoRaD-M252	-	Non-OS	Y	Y	Y	-	-	-	-	-	-	-	NM	-	Contact us for detail.
NuStamp-ACK-M031LE	Y	Non-OS	Y	Y	-*3	-	-	-	-	N	-	-	-	-	

*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
  - **YouTube** 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

M263 + Mbed OS

Core	Board	Topic (Chinese) (Playlist URL)	
M23	NuMaker-IoT-M263A	三分鐘讓你了解如何運行 Mbed OS (1)	
		在 Mbed OS 控制 LED 與按鍵 (2)	
		在 Mbed OS 上使用 Wi-Fi (3)	
		在 Mbed OS 上使用 NB-IoT 和 LTE (4)	
		在 Mbed OS 連接 Pelion 雲端 (5)	
		在 Mbed OS 使用 SD 卡 (6)	
		在 Mbed OS 上使用環境感測器 (7)	

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/DS2xId3pvSW5FenVB	https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m480 Or refer to the next two slide
M23	NuMaker-M2354	上手指南 https://www.rt-thread.org/document/site//#/rt-thread-version/rt-thread-standard/tutorial/quick-start/numaker-m2354/quick-start 开发实践指南 (在线电子书) https://docs.qq.com/doc/DS2tVSnJWdW5ZYkdV	https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m2354 Or refer to the next three slide
M0	NuMaker-M032KI	上手指南 https://www.rt-thread.org/document/site//#/rt-thread-version/rt-thread-standard/tutorial/quick-start/numaker-m032ki/quick-start	https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m031 Or refer to the next four 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-M263A NuMaker-IoT-M2354	Mbed OS	Wi-Fi	UART	ESP8266/ESP-12F (Espressif)
		Cellular	UART	EC21/EC25 for LTE (Quectel) BG96 for NB-IoT/Cat-M1 (Quectel)
				SIM7020 for NB-IoT (SIMCom)
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-NUC980 NuMaker-IIoT-NUC980G2 NuMaker-RTU-NUC980	Linux	Ethernet	RMII	IC Plus	IP101GR
				Realtek	RTL8201FI-VC-CG
		Wi-Fi	SDIO	AMPAK	AP6212 (2.4G), AP6256 (2.4G/5G)
			USB	Realtek	RTL8188EUS (2,4G), RTL8189EU (2.4G) RTL8822BU (2.4G/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

- For more supported components, please contact us.

Supported Communication Components (MPU)

Platform	OS/RTOS	Type	Interface	Vendor	Chip / Module Part Number
IoT-MA35D1-A1	Linux	Ethernet	RMII	IC Plus	IP101GR
				Realtek	RTL8201FI-VC-CG
			RGMII	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)

- 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-NUC980 NuMaker-IIoT-NUC980G2	Linux	1 & 5		
	RT-Thread		2	2
NuMaker-RTU-NUC980 (Chili)	Linux	1 & 5		
	RT-Thread		2	2
NuMaker-IoT-M487	Mbed OS	4 & 5		4 & 5
	Amazon FreeRTOS	3		
	AliOS Things			
	RT-Thread		2	2
	Azure RTOS			6
NuMaker-IoT-M467	Mbed OS	4		4
	RT-Thread		2	2
NuMaker-IoT-M2354	Mbed OS	4 & 5		4 & 5
	RT-Thread		2	2
NuStamp-ACK-M031LE	Non-OS	6		

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	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-NUC980	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	CyClone TCP	CyClone SSL	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	
NuMaker-IoT-M263A NuMaker-IoT-M2354	Mbed Tools	Mbed OS	Embedded in Wi-Fi module	MbedTLS	S	Y	S		S					

*1 **Y** means support. Nuvoton, RTOS, or 3rd party have provide 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	Linux*2	Y*1	Y	Y	Y	Y	Y	Y	Y
	RT-Thread	Y							
NuMaker-IoT-NUC980G2 NuMaker-IoT-NUC980	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 + CyClone TCP	Y		Y			Y	Y	
NuMaker-IoT-M487	Amazon FreeRTOS								
	Azure RTOS								
NuMaker-IoT-M467	Zephyr	Y							
NuMaker-IoT-M263A NuMaker-IoT-M2354	Mbed OS	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

Reference Posts on Nuvoton's NuForum

IoT Platform board (http://forum.Nuvoton.com/viewtopic.php?f=33) on NuForum

Titles	URL
The OTA on M487 with Mbed OS and AWS IoT	http://forum.nuvoton.com/viewtopic.php?f=33&t=11125
PC Controls RYLR998 via NuMaker Board running pass-through firmware	http://forum.nuvoton.com/viewtopic.php?f=33&t=11136
Control AT Command module on Mbed OS and NuMaker IoT Boards	http://forum.nuvoton.com/viewtopic.php?f=33&t=11139
于 NuMaker-IoT-M487 平台以 AliOS Things 的 MQTT 协议连接阿里云	http://forum.nuvoton.com/viewtopic.php?f=33&t=11140
Build the bridge of Serial and Ethernet	http://forum.nuvoton.com/viewtopic.php?f=33&t=11154
Cellular Communication on Mbed OS and NuMaker IoT Boards	http://forum.nuvoton.com/viewtopic.php?f=33&t=11159
NuMaker boards support Arduino programming environment	http://forum.nuvoton.com/viewtopic.php?f=33&t=11160
Ping-pong test on NuMaker-LoRaD-M252 board	http://forum.nuvoton.com/viewtopic.php?f=33&t=11167
NCT7717U thermal sensor example code on Mbed OS and NuMaker IoT boards	http://forum.nuvoton.com/viewtopic.php?f=33&t=11172
Build a Web Server on a NuMaker IoT board using Mbed OS	http://forum.nuvoton.com/viewtopic.php?f=33&t=11188
Build a Web Server on a NuMaker IoT Board using CyClone TCP and FreeRTOS	http://forum.nuvoton.com/viewtopic.php?f=33&t=11192
Use NuMicroPy (MicroPython) on NuMaker IoT board	http://forum.nuvoton.com/viewtopic.php?f=33&t=11196
Modbus TCP client/server demo using Cyclone TCP and FreeRTOS	http://forum.nuvoton.com/viewtopic.php?f=33&t=11201
Using LwIP to Implement Modbus TCP on NuMaker-IoT-M467	http://forum.nuvoton.com/viewtopic.php?f=33&t=11204
Modbus RTU device on Mbed OS and NuMaker IoT boards	http://forum.nuvoton.com/viewtopic.php?f=33&t=11205

* Posts listed until the end of 2023, continue to increase posts for reference

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 文檔中心的 NuMaker-IIoT-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 文檔中心的 NuMaker-IoT-M4787 上手指南
- **M2354 @ RT-Thread**
  - **快速上手指南视频** https://www.bilibili.com/video/BV1fq4y1379V/
  - RT-Thread 文檔中心的 NuMaker-M2354 上手指南
- **M467 @ RT-Thread**
  - RT-Thread 文檔中心的 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UFFS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UUART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

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RT-Thread and M2354

- **M2354** 评测文章与范例
  https://club.rt-thread.org/ask/tag/e31004a8c5cc30f3.html?type=article

Titles	Titles
【NuMaker-M2354试用】电量芯片SH366006 I2C接口测试验证	【NuMaker-M2354试用】定时器——基本定时功能
【NuMaker-M2354试用】QEI模块测评	【NuMaker-M2354试用】SPI 驱动W25Q128
【NuMaker-M2354试用】USCI测试	【NuMaker-M2354试用】ECAP测试分享
【NuMaker-M2354试用】spi测试分享	【NuMaker-M2354试用】I2c测试分享
【NuMaker-M2354试用】microSD实验	【NuMaker-M2354】UART1测评
【NuMaker-M2354试用】RTC实验	【NuMaker-2354】GPIO测评
【NuMaker-M2354试用】MicroSD 模块测评	【NuMaker-M2354试用】CAN 总线通信功能评测
【NuMaker-M2354试用】使用TRNG生成随机数	【NuMaker-M2354试用】看门狗
【NuMaker-M2354试用】基于rt-thread CAN驱动框架通信评测	【NuMaker-M2354试用】WiFi Module测试分享
【NuMaker-M2354试用】PWM测评	【NuMaker-M2354试用】GPIO+PWM测试分享
【NuMaker-M2354试用】串口——基本收发功能演示	【NuMaker-M2354试用】ADC测试分享
【NuMaker-M2354试用】M2354测评_CRYPTO	【NuMaker-M2354试用】使用RT-Thread的CRYPTO设备(1)
【NuMaker-M2354试用】_adc测试分享	【NuMaker-M2354试用】CAN总线开发与测试分享【硬件篇】
【NuMaker-M2354试用】使用RT-Thread的CRYPTO设备(2)	【NuMaker-M2354试用】+SPI驱动LCD及TOUCH
【NuMaker-M2354试用】定时器——单路PWM	【NuMaker-M2354试用】+开箱及环境搭建

更多文章請點上方網址參考

FAQ

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

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=EqTG-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?	AWS IoT example uses MQTT. You can • 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?	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. 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.
Coding guidance to reduce power?	Please refer https://os.mbed.com/docs/mbed-os/latest/apis/power-optimization.html
Can IoT-M487 use Mbed Studio?	Mbed Studio can select IoT-M487 board to build firmware, but can't support firmware download and online debug due to Nu-Link limitation.
Does it support FTP Client?	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/

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?	It depends. 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. 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.
Are there any converter examples like UART-to-Ethernet, SPI-to-Ethernet, CAN-to-Ethernet?	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. 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. Because of Ethernet, suggest Mbed-Enabled M487 board to develop the applications.
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?	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. Typically, source codes prefixed with “mbed-os-” or “NuMaker-” denote complete samples, while others functions as libraries. 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.

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.
CyClone TCP supports many protocols. Are there any demonstration?	CyClone TCP 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. The CyClone TCP 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.

FAQ – Azure RTOS

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

FAQ – Linux / OpenWRT

Q	A
What version of Linux kernel supported?	Till Feb. 2023, the supported Linux kernel version are, • NUC970 : v3.10 • NUC980 : v4.4, v5.10 • MA35D1 : v5.10
What version of OpenWRT supported?	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, • OpenWRT v17.01 on Linux v4.4 • OpenWRT v22.03 on Linux v5.10
How to build a new compile environment for NUC980?	Suggest directly cloning the fresh and complete Buildroot repository from https://github.com/OpenNuvoton/NUC970_Buildroot 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. Since our VMware image already has the necessary packages installed, we won't encounter such errors.

FAQ – LoRa

Q	A
Where is the LoRaWAN device development resources?	Nuvoton provides two versions of LoRaWAN device for **NuMaker-LoRaD-M252** board • **(Recommended)** Mbed OS version, refer the M487+MbedOS training video slides and follow the video "**Get Started with Mbed OS**" (English) or "**Step by Step 讓你了解如何運行 Mbed OS** " (Chinese) to create a new project with "**NuMaker-LoRaD-M252**" platform and "**NuMaker mbed OS v6.x LoRaWAN**" 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 Certificated 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: • 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?	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. 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。

Appendix

 | Photo by Jeffery Cheng

Appendix

- Drivers supported in RT-Thread
  - NUC980 series, M480 series, M460 series, M2354 series, M032KI 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)	***adc***
CAN	RT_Device_Class_CAN	***can[0-3]***
CRYPTO	RT_Device_Class_Miscellaneous (HW Crypto)	***hwcryto***
EBI	N/A	***N/A***
EMAC	RT_Device_Class_NetIf	***e[0-1]***
GPIO	RT_Device_Class_Miscellaneous (Pin)	***gpio***
I2C	RT_Device_Class_I2CBUS	***i2c[0-3]***
I2S	RT_Device_Class_Sound	***sound0***
PDMA	N/A	***N/A***
QSPI	RT_Device_Class_SPIBUS	***qspi[0]***
RTC	RT_Device_Class_RTC	***rtc***
PWM	RT_Device_Class_Miscellaneous (PWM)	***pwm[0-1]***
USBH	RT_Device_Class_USBHost	***usbh***
USBD	RT_Device_Class_USBDevice	***usbd***
SC (UART function)	RT_Device_Class_Char	***scuart[0-1]***
SDH	RT_Device_Class_Block	***sdh[0-1]***
SPI	RT_Device_Class_SPIBUS	***spi[0-1]***
TIMER	RT_Device_Class_Timer	***timer[0-5]***
UART	RT_Device_Class_Char	***uart[0-9]***
WDT	RT_Device_Class_Miscellaneous (Watchdog)	***wdt***

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

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

M2354 Supported Drivers in RT-Thread

- Refer the URL https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m2354

Peripheral	rt_device_class_type	Device name
BPWM	RT_Device_Class_Miscellaneous (PWM)	***bpwm[0-1]***
BPWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	***bpwm[0-1]i[0-5]***
CAN	RT_Device_Class_CAN	***can0***
CLK	RT_Device_Class_PM	***pm***
CRC	RT_Device_Class_Miscellaneous (HW Crypto)	***hwcryto***
CRYPTO	RT_Device_Class_Miscellaneous (HW Crypto)	***hwcryto***
EADC	RT_Device_Class_Miscellaneous (ADC)	***eadc0***
EBI	N/A	***N/A***
ECAP	RT_Device_Class_Miscellaneous (Input capture)	***ecap[0-1]i[0-2]***
EPWM	RT_Device_Class_Miscellaneous (PWM)	***epwm[0-1]***
EPWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	***epwm[0-1]i[0-5]***
FMC	FAL	***N/A***
GPIO	RT_Device_Class_Miscellaneous (Pin)	***gpio***
GPIO	RT_Device_Class_I2CBUS	***softi2c0[0-1]***
I2C	RT_Device_Class_I2CBUS	***i2c[0-2]***
I2S	RT_Device_Class_Sound/RT_Device_Class_Pipe	***sound0***
PDMA	N/A	***N/A***
QEI	RT_Device_Class_Miscellaneous (Pulse encoder)	***qei[0-1]***
QSPI	RT_Device_Class_SPIBUS	***qspi0***
RTC	RT_Device_Class_RTC	***rtc***
SC (UART function)	RT_Device_Class_Char	***scuart[0-2]***
SDH	RT_Device_Class_Block	***sdh0***
SPI	RT_Device_Class_SPIBUS	***spi[0-3]***
SPI (I2S function)	RT_Device_Class_Sound/RT_Device_Class_Pipe	***spii2s[0-3]***
TIMER	RT_Device_Class_Timer	***timer[0-5]***
TIMER (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	***timer[0-5]i0***
TIMER (PWM function)	RT_Device_Class_Miscellaneous (PWM)	***tpwm[0-5]***
TRNG	RT_Device_Class_Miscellaneous (HW Crypto)	***hwcryto***
UART	RT_Device_Class_Char	***uart[0-5]***
USBD	RT_Device_Class_USBDevice	***usbd***
USBH	RT_Device_Class_USBHost	***usbh***
USCI (I2C function)	RT_Device_Class_I2CBUS	***ui2c[0-1]***
USCI (SPI function)	RT_Device_Class_SPIBUS	***uspi[0-1]***
USCI (UART function)	RT_Device_Class_Char	***uuart[0-1]***
WDT	RT_Device_Class_Miscellaneous (Watchdog)	***wdt***

M032KI Supported Drivers in RT-Thread

- Refer the URL https://github.com/RT-Thread/rt-thread/tree/master/bsp/nuvoton/libraries/m031

Peripheral	rt_device_class_type	Device name
ADC	RT_Device_Class_Miscellaneous (ADC)	***adc0***
BPWM	RT_Device_Class_Miscellaneous (PWM)	***bpwm[0-1]***
BPWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	***bpwm[0-1]i[0-5]***
CLK	RT_Device_Class_PM	***pm***
CRC	RT_Device_Class_Miscellaneous (HW Crypto)	***hwcryto***
EBI	N/A	***N/A***
FMC	FAL	***N/A***
GPIO	RT_Device_Class_Miscellaneous (Pin)	***gpio***
GPIO	RT_Device_Class_I2CBUS	***softi2c0[0-1]***
I2C	RT_Device_Class_I2CBUS	***i2c[0-1]***
PDMA	N/A	***N/A***
PWM	RT_Device_Class_Miscellaneous (PWM)	***pwm[0-1]***
PWM (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	***pwm[0-1]i[0-5]***
QSPI	RT_Device_Class_SPIBUS	***qspi0***
RTC	RT_Device_Class_RTC	***rtc***
SPI	RT_Device_Class_SPIBUS	***spi0***
SPI (I2S function)	RT_Device_Class_Sound/RT_Device_Class_Pipe	***spii2s0***
TIMER	RT_Device_Class_Timer	***timer[0-3]***
TIMER (Capture function)	RT_Device_Class_Miscellaneous (Input capture)	***timer[0-3]i0***
UART	RT_Device_Class_Char	***uart[0-7]***
USBD	RT_Device_Class_USBDevice	***usbd***
USCI (I2C function)	RT_Device_Class_I2CBUS	***ui2c[0-1]***
USCI (SPI function)	RT_Device_Class_SPIBUS	***uspi[0-1]***
USCI (UART function)	RT_Device_Class_Char	***uuart[0-1]***
WDT	RT_Device_Class_Miscellaneous (Watchdog)	***wdt***

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