

2019 Nuvoton Industrial IoT/ Smart Home Applications Seminar and Product Launch

Agenda

Time	Session
13:30 ~ 14:00	Registration
14:00 ~ 14:20	Nuvoton Technology Corp. Global Market Development Strategies and Vision
14:20 ~ 15:30	Industrial Control App (NuMicro® NUC980 ; NuMicro® M480)
	Low-Power App (NuMicro® M251 ; NuMicro® ML51)
	IoT Security App (NuMicro® M2351)
15:30 ~ 16:15	Tea break
16:15 ~ 17:30	Smart Home App (NuMicro® MS51 ; NuMicro® M031 ; NuMicro® M487)
	Development Platform: Tools and Environment
	IoT & Graphics Interface Development Platform
17:30 ~ 17:40	Q&A / Lucky draw

Company Profile

Nuvoton Technology Corporation

www.nuvoton.com

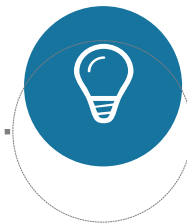


Our Brand Name

nuvoTon
新唐科技



NUVO pronounced like “**nouveau**” (**new 新**) in French +
TON the Chinese pronunciation of “**Tang (唐)**” as in Tang
Dynasty



Named after “**New Tang (新唐)**” to relate to Tang Dynasty’s
great achievements in international cultural exchange,
economy, trade and technology innovations.



“Being an indispensable partner to industry leaders”
and create a brand new Tang Dynasty in the IC industry.

About Nuvoton



Established on July 1st, 2008 as a spin-off of Winbond Electronics' Logic business group.

- Multinational R&D and technical support team with approximate 1,500 employees worldwide.
- The best R&D with exceeded 700 patents, files at least 30 patent applications every year.
- Over 20% of revenue is reinvested to R&D, launching more than 30 new products every year.
- Long-term trustworthy partnership and relationship with customers



Capital

NTD 2,075 Million (USD 70 Million)



IPO Date

September 27th, 2010 (TSE:4919)



Vision

Joy of Innovation

International Team

Nuvoton Technology Corp.(HQ)

- **Location** : Hsinchu Science Park, Taiwan
- HQ team dedicates to worldwide operation, and integrates the resources of R&D, marketing, manufacturing, sales and related information from each site.

Nuvoton Tech. Israel Ltd.(NTIL)

- **Location** : Herzlia, Israel
- NTIL team is well positioned to system innovation capability, responsible for computer and consumer products development.

Nuvoton Tech. India Private (NTID)

- **Location** : Bangalore, Karnataka, India
- NTID team is committed to providing comprehensive service and technical support to customers in India.

Nuvoton Tech. Corp. America (NTCA)

- **Location** : San Jose. CA,U.S.A.
- NTCA team utilizes the remarkable analog technology to develop consumer/industrial products and provides marketing and technical support to U.S. regions.

Nuvoton Elect. Tech. (NTSH)

Nuvoton Elect. Tech. (NTSZ)

Nuvoton Elect. Tech. (NTHK)

- **Location** : Shanghai (SH)/ Shenzhen(SZ) / Hong Kong(HK)
- China team is in charge of the local sales and technology support, fulfilling customers' demand and timely product service.

Business Groups

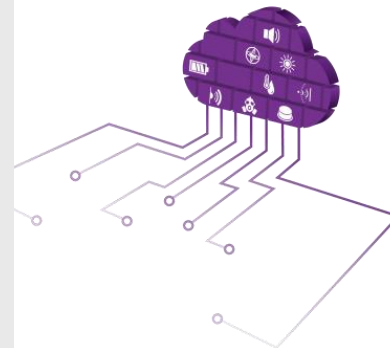
Microcontroller Application

- Arm® Cortex®-M23
- Arm® Cortex®-M4
- Arm® Cortex®-M0
- Arm9™
- 8051



Cloud Security

- Super I/O
- Embedded Controller
- TPM*
- BMC**
- Hardware Monitor IC
- Power Switch IC
- Voltage Level Shift IC
- Gate Driver IC



Audio

- Arm® Cortex® -M Audio SoC
- Consumer Speech
- MaxxAudio Audio Enhancement IC
- Audio Amplifier
- Audio CODEC
- Audio Converter



Manufacturing

- High Voltage and UHV Process
- Power Management Process
- Embedded Memory Process
- Logic Mixed Signal Process
- Mask ROM Process
- Customized Process

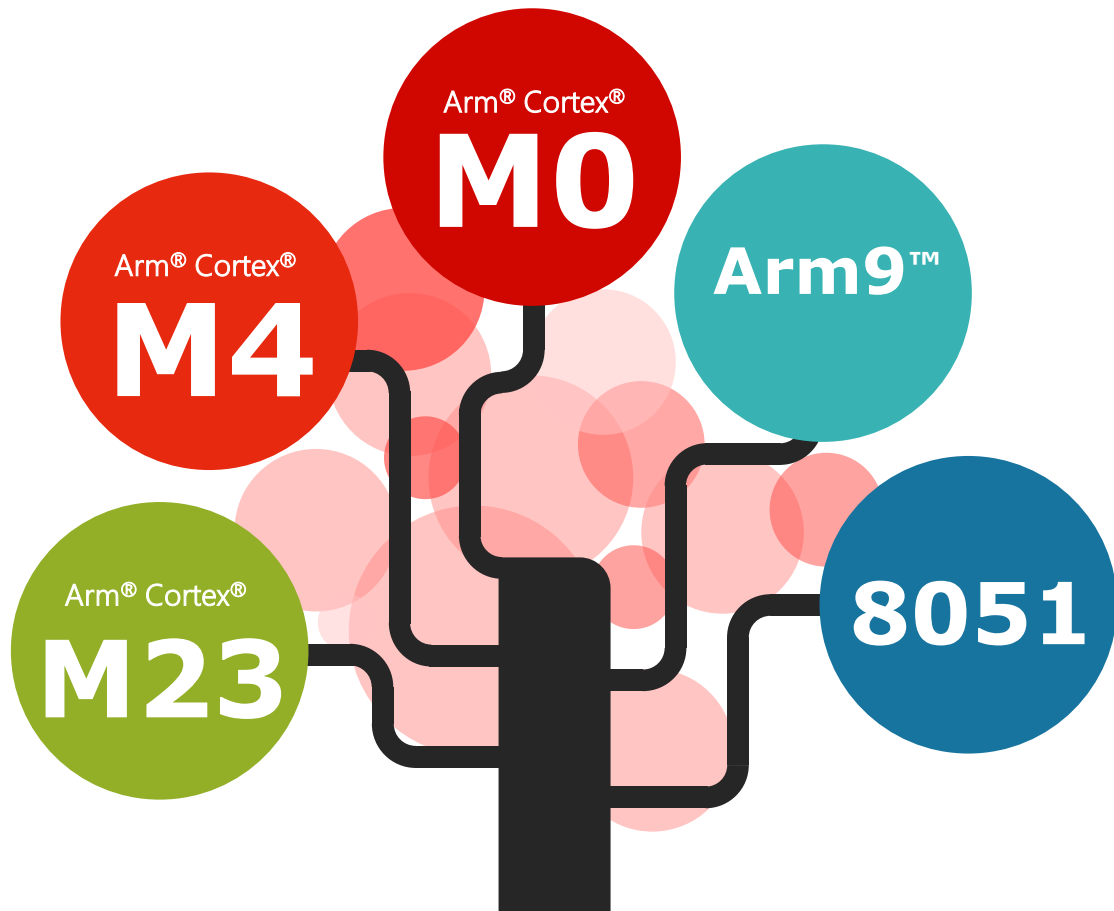
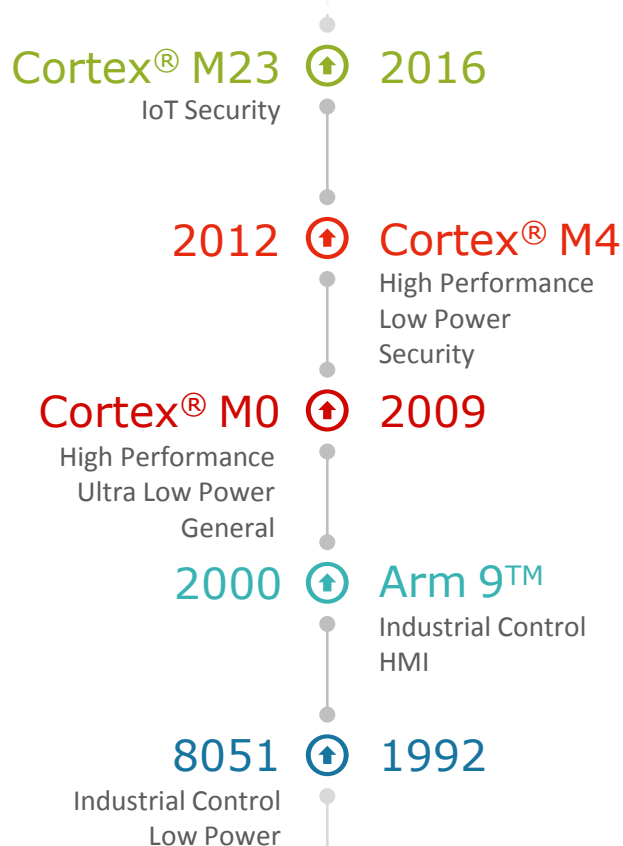
* **TPM**: Trusted Platform Module

** **BMC**: Baseboard Management Controller

Global Market Development Strategies and Prospect

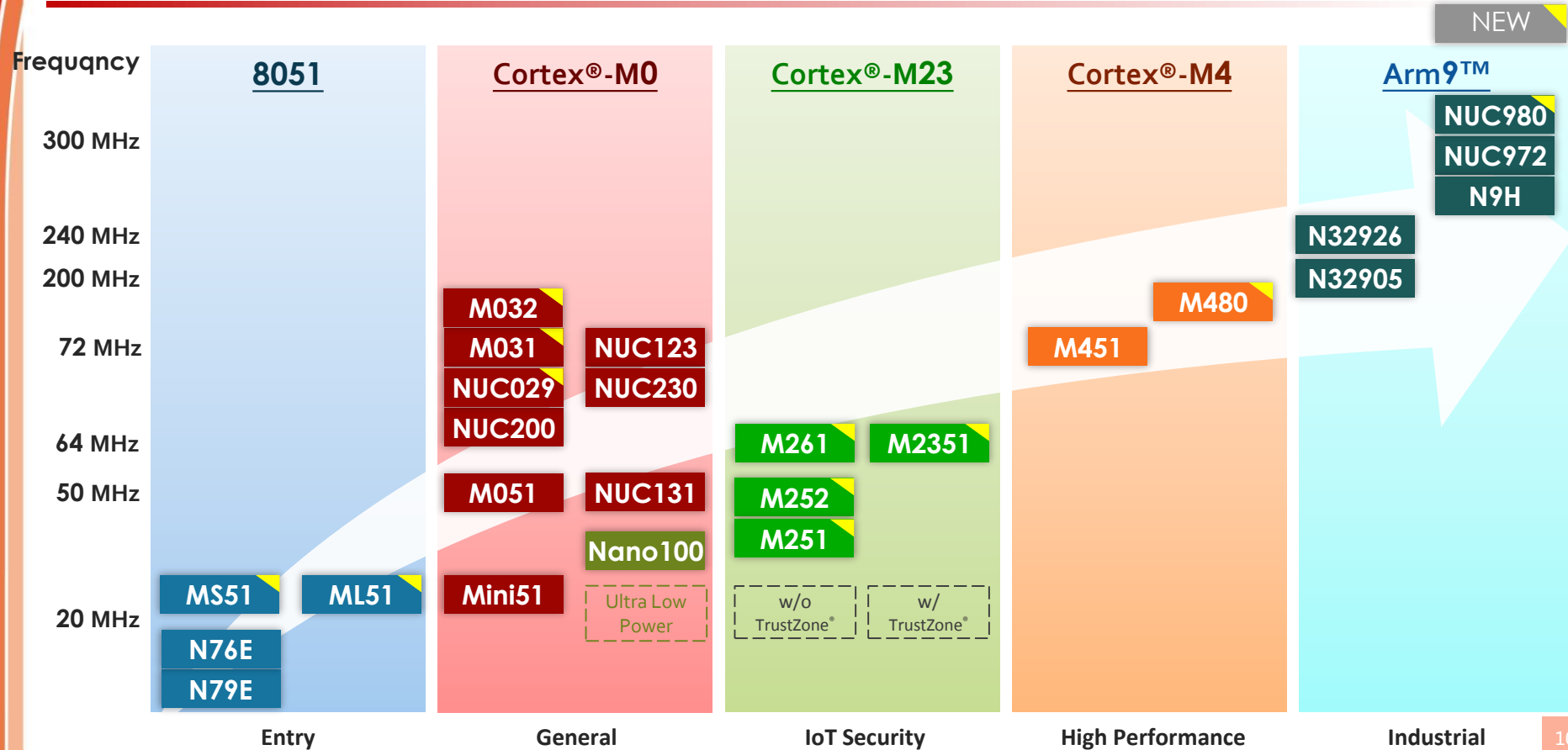
NuMicro® Development Path

Joy of innovation
nuvoTon

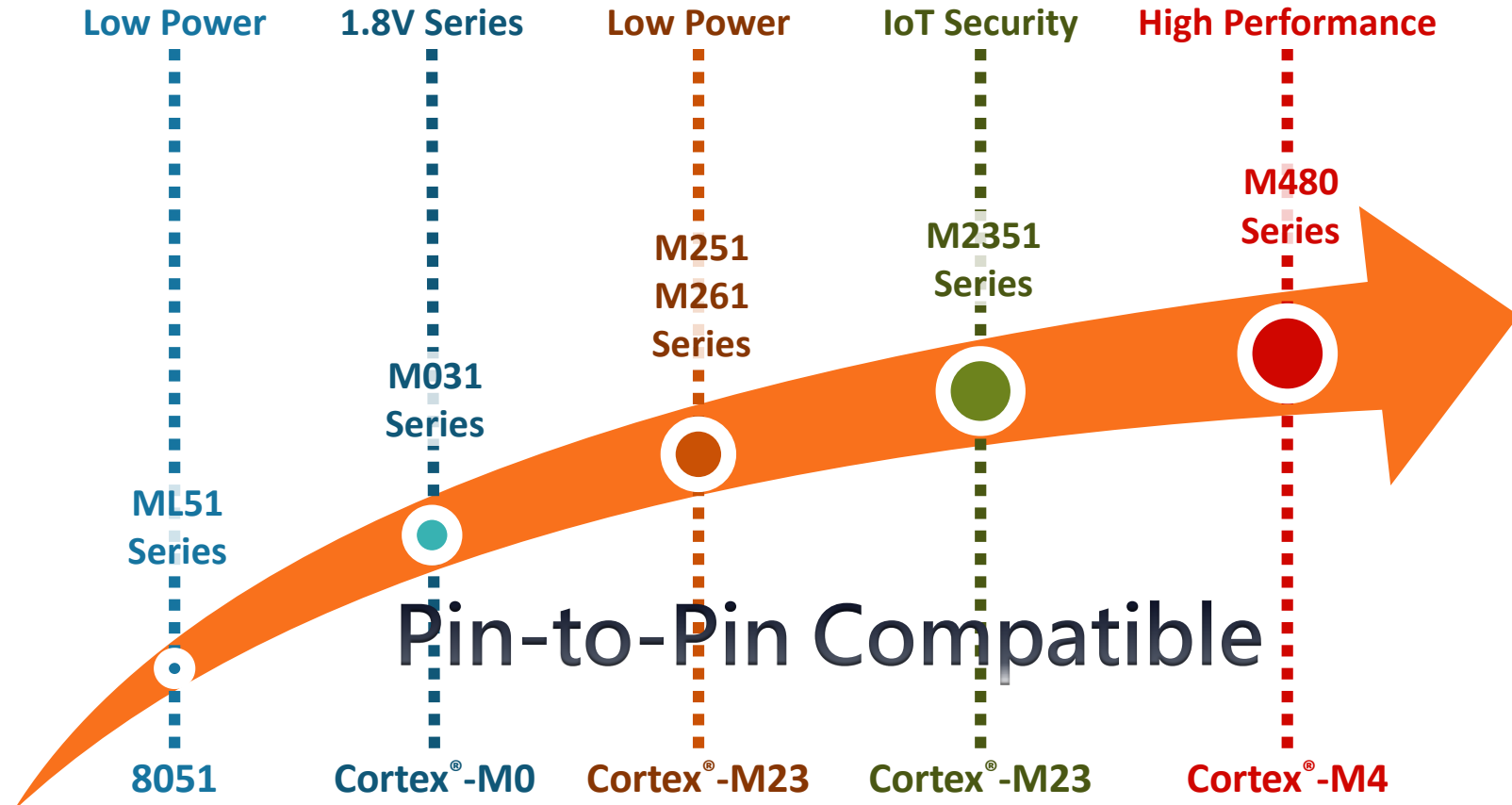


NuMicro® Product Portfolio

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2019 Brand New MCU Platform



Comprehensive Environment and Platform



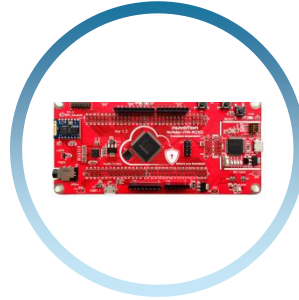
• Multiple Development IDE

- GNU GCC based NuEclipse on Windows or Linux
- Keil MDK
- IAR EWARM



• Brand New Programming Platform - Nu-Link2

- Fast programming
- ISP via multiple I/F
- ETM
- USB bridge
- SPI / I2C Monitoring



• NuMicro IoT and HMI Development Platform

- Incl. sensor node, gateway, cloud database connection
- Cloud service: Arm Pelion, Amazon AWS IoT, Alibaba Cloud
- Comprehensive emWin GUI library



• Easy-to-use Development Tool

- PinConfig: Graphical I/O setting
- PinView: Real-time I/O monitoring



• MP Tool - NuLink-Gang

- One-to-four independent programming



Launch More Than 100 New Products

– Applied to Each Field

Industrial Control App

- **NuMicro® NUC980**: IIoT microprocessor with KGD DDR for reducing the complexity of PCB design
- **NuMicro® M480**: High performance with dual USB OTG and Ethernet MAC

Low-Power App

- **NuMicro® ML51**: Dynamic power consumption down to 80 uA/MHz, standby mode under 1 µA
- **NuMicro® M251**: Low-power, wide operating voltage and active UART in standby mode, eligible for battery application.

IoT Security App

- **NuMicro® M2351**: The 1st Arm® Platform Security Architecture (PSA) Level 1 certified Arm® Cortex-M23 microcontroller around the world.

Smart Home App

- **NuMicro® MS51**: 12-bit ADC with up to 15 channels for accurately multi-data sampling.
- **NuMicro® M031**: 2 MSPS high-speed ADC and high-speed 144 MHz PWM

Global Market Reach

- More than 50 workshops in Korea, Taiwan, China, India, USA and Europe.
- Expo in Germany, USA and Japan.



DE



IN

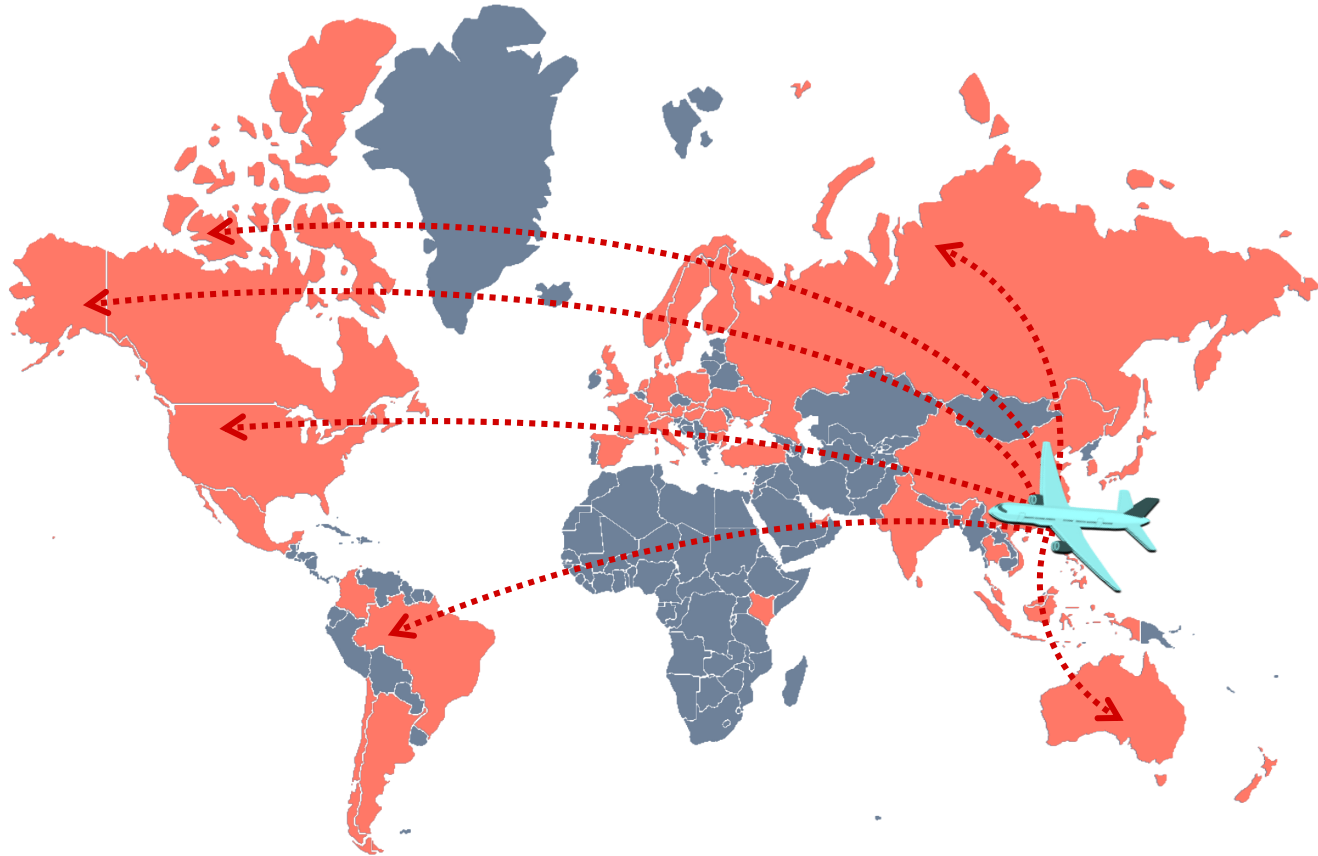


JP



KR

Over 48 Countries



Industrial IoT/ Smart Home Applications Seminar and Product Launch

Brilliant On-Site Solutions

Industrial Control App	Low-power App	IoT Security App	Smart Home App
<ol style="list-style-type: none"> 1. Smart Figure Identification 2. Industrial Remote Control (DTU/RTU) 3. DALI 2nd Gen Lighting Control 4. UPnP Industrial Monitoring Development Platform 5. NB-IoT Development Platform 6. IoT-integrated Development Platform 7. Interactive HMI 8. Battery Management System 	<ol style="list-style-type: none"> 1. Electronic Shelf Label (ESL) 2. Smart Door Lock 	<ol style="list-style-type: none"> 1. Personal Identity Authentication by USB FIDO Key 2. Secure IoT Door Lock from Collaborative Development 3. M2351 for Arm Pelion IoT Management System 	<ol style="list-style-type: none"> 1. Wireless Power & Data Transmission – Blender Temperature Monitoring 2. Smart Toilet Seat 3. PM2.5 Laser Detection Module 4. Interactive Smart Outlet 5. Keyword Spotting – Machine Learning 6. OLED Animation – GIF Decode (LZW)

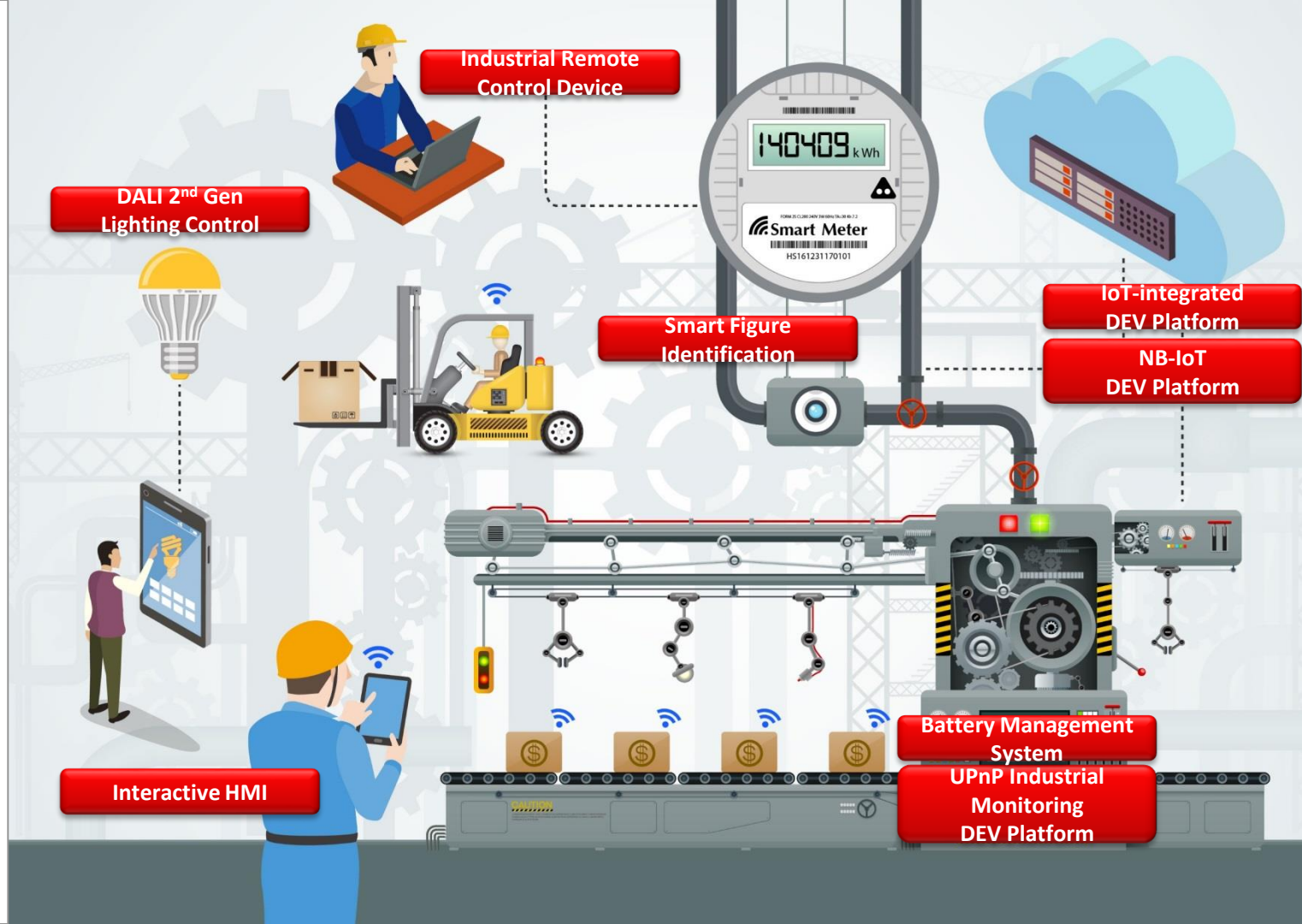
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Industrial Control Application

NuMicro[®] NUC980 / NuMicro[®] M480

- **Smart Figure Identification**
 - **M480 Series**
- Industrial Remote Control Device (DTU/RTU)
 - NUC980 Series
- DALI 2nd Gen Lighting Control
 - NDA102



Smart Figure Identification

• Features of Solution

- Capture QVGA image with CMOS sensor and identify the figure with neural algorithm of machine learning.
- After identifying the figure from water meter upload the digital data to center.
- The identification can be done within half second by high performance Cortex-M4F based NuMicro M481 running up to 192 MHz.

• Introduction of Solution

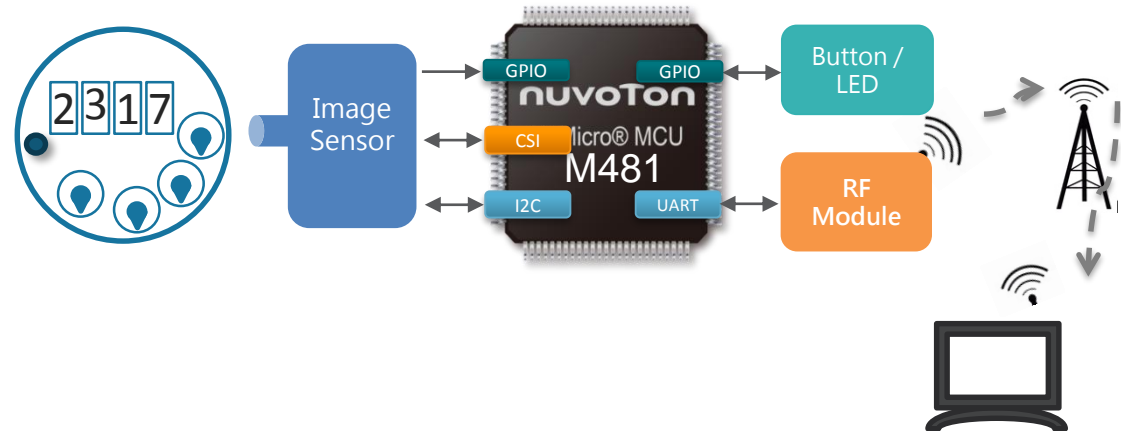
- Use CMOS sensor interface of M481 for image thresholding or DSP for convolution

1	1	1	0	0
0	1	1	1	0
0	0	1	1	1
0	0	1	1	0
0	1	1	0	0

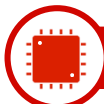
Image

4		

Convolved
Feature



M480 Dual ADC Series Features



System

- Arm® Cortex®-M4F
- Operating frequency: 192 MHz
- 256 KB Flash support 4 configurable XOM regions for code protection
- 128/64 KB SRAM
- Secure Boot for program integrity
- Built-in 48 MHz RC OSC (X-less USB)
- AES-256 / TRNG
- Dynamic power: 130 μ A/MHz
- RTC (V_{BAT}) < 700 μ A



Peripheral

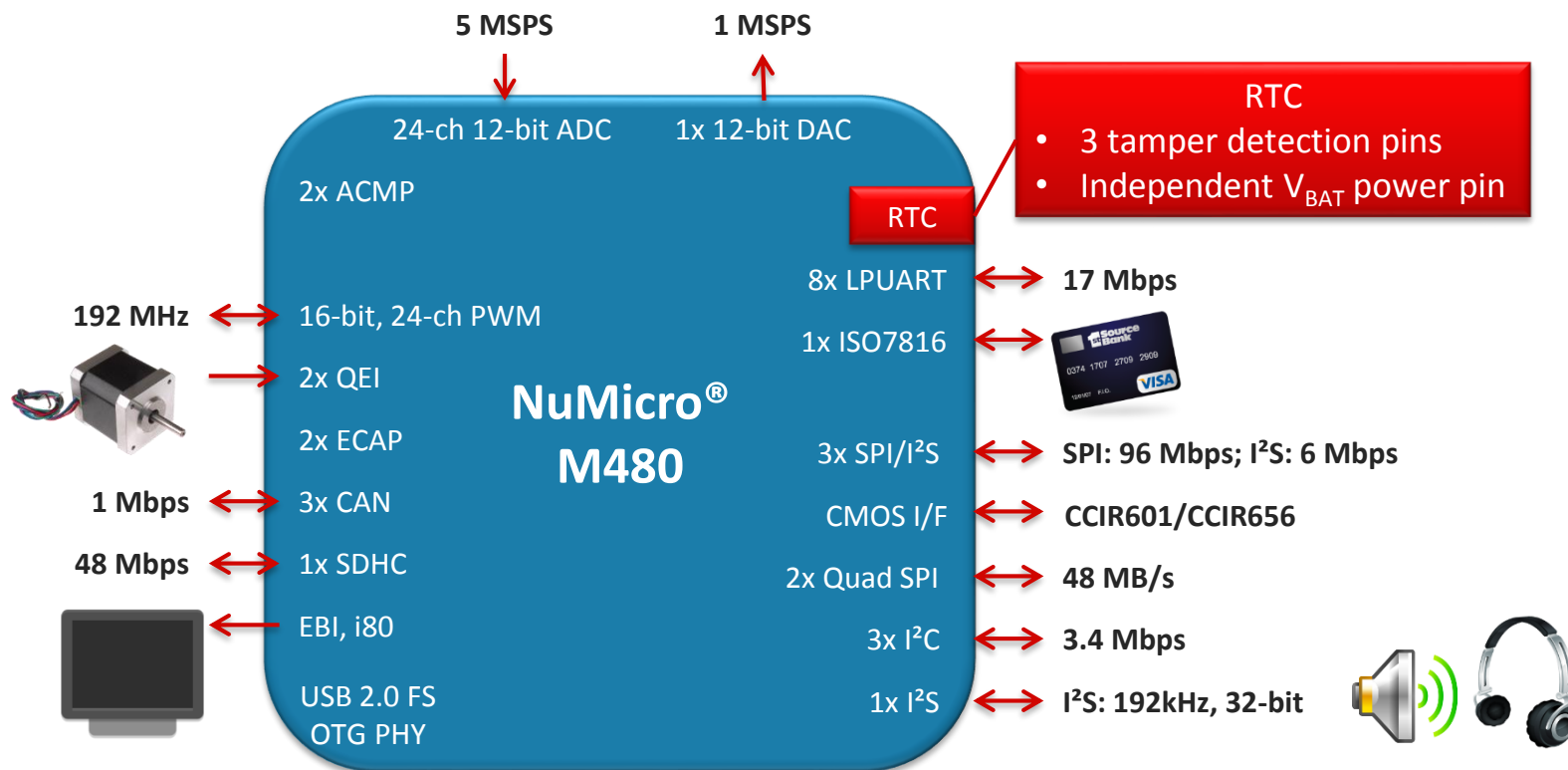
- CMOS sensor interface supports CCIR601, CCIR656 and 1-bit luminance output
- 8x low-power UARTs support one-wire mode
- 2x Quad-SPI
- 3x CAN 2.0B
- 2x QEI
- USB 2.0 full speed OTG supports X-less in device mode
- EBI supports Intel 8080 mode



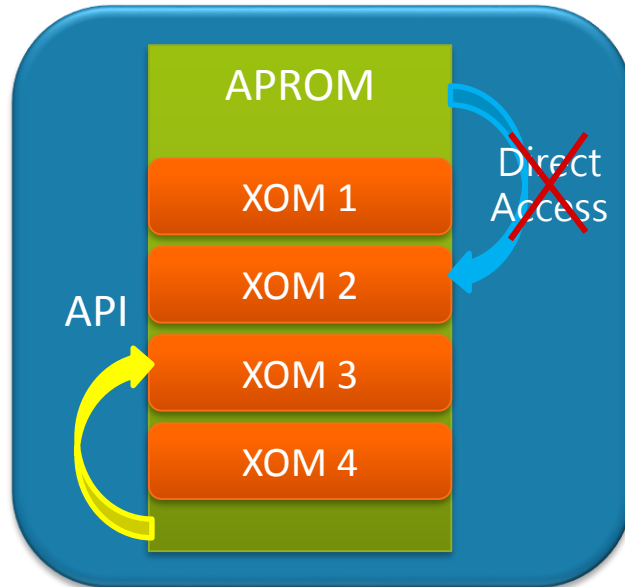
Analog

- Dual 12-bit 5 MSPS SAR ADC support simultaneous sampling.
- 1x 12-bit 1 MSPS DAC
- 2x comparator
- 1.8V – 3.6 V Voltage Adjustable Interface (VAI)

M480 New Series Function Diagram



XOM (eXecute-Only-Memory)



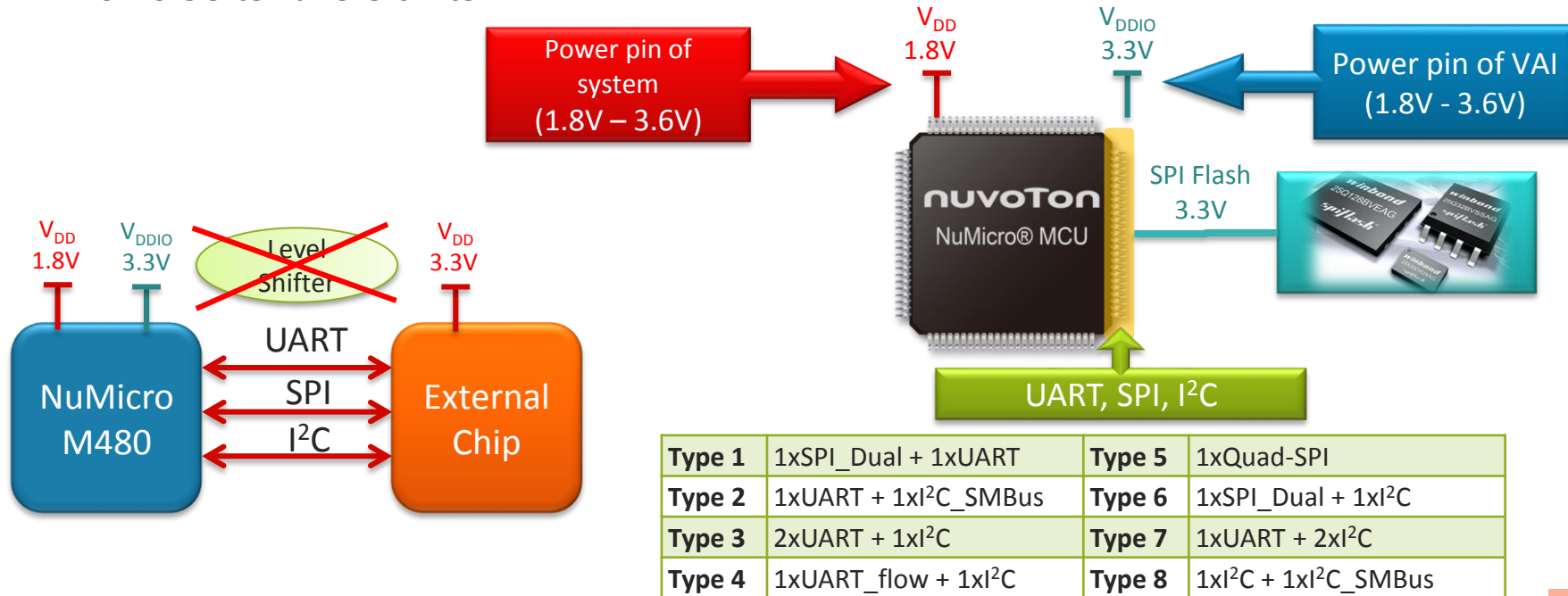
- eXecute-Only-Memory (XOM) is a firmware protection technique to help prevent 3rd parties from stealing or reverse engineering firmware.
- Data inside XOM region cannot be accessed directly.



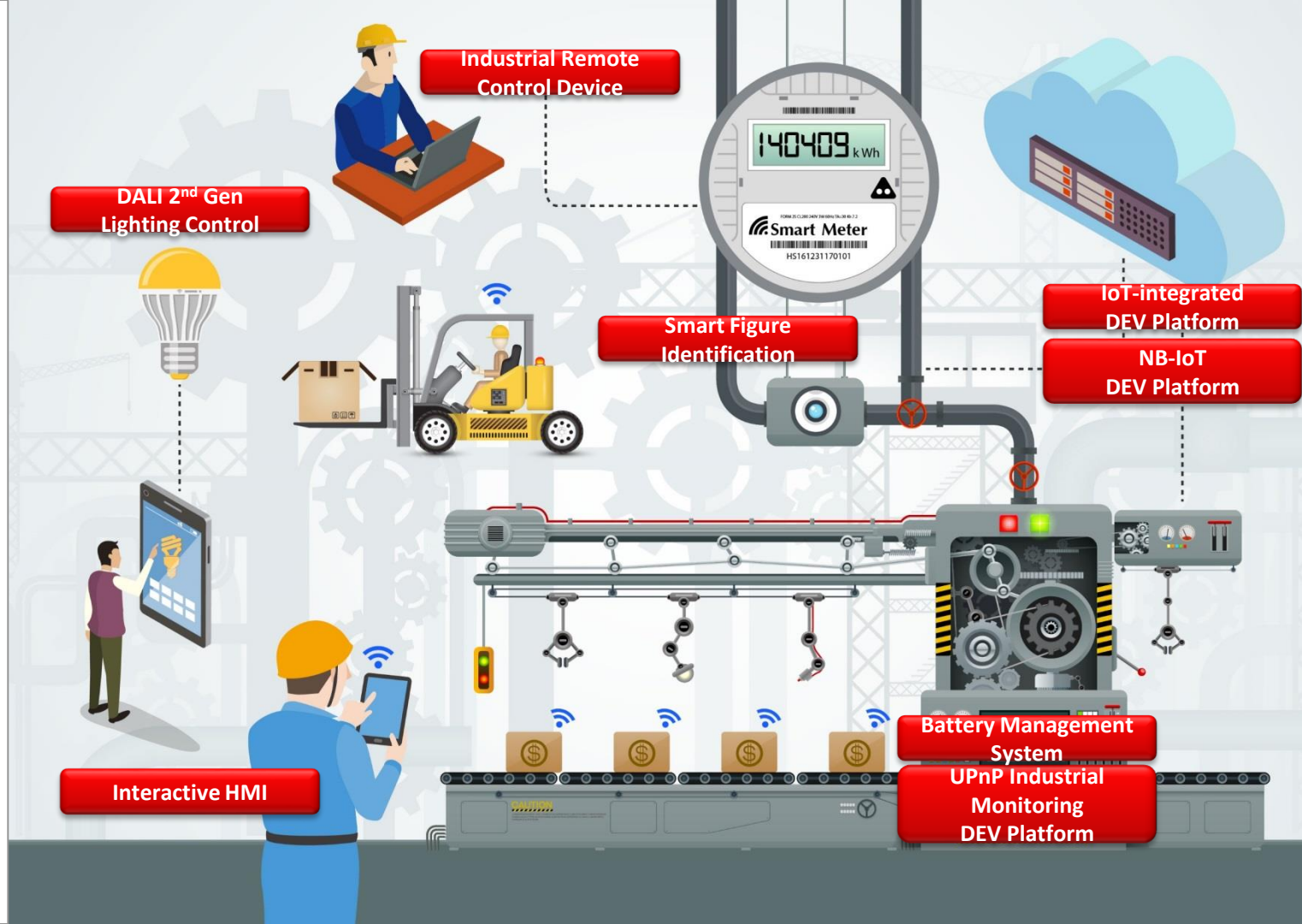
Effectively protect your intellectual property

Voltage Adjustable Interface (VAI)

- 6 pins support second voltage level by providing V_{DDIO} voltage (1.8V - 3.6V)
- Multi-function pin supports UART / SPI / I²C
- No more external level shifter



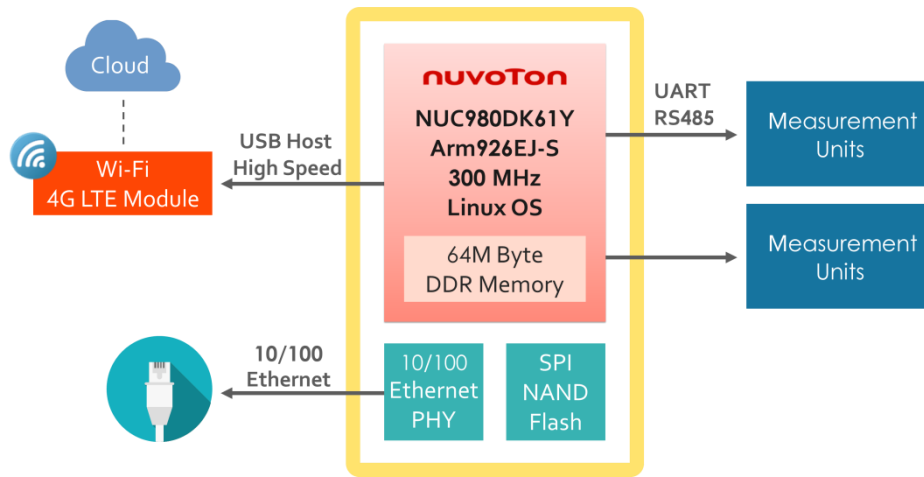
- Smart Figure Identification
 - M480 Series
- Industrial Remote Control Device (DTU/RTU)
 - NUC980 Series
- DALI 2nd Gen Lighting Control
 - NDA102



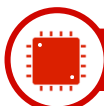
Industrial Remote Control Device (DTU/RTU)

• Features

- Support 4G/LTE via USB
- 10x UART/RS-485 for multiple measurement devices
- Support AWS, Google cloud and Alibaba cloud in Linux OS 4.4
- Dual fast Ethernet for WAN and LAN
- Industrial grade operating temperature
- Small PCB size, around 50mm x 50mm



NUC980 Series Features



System

- Arm® ARM926EJ-S™
- Operating Frequency: 300 MHz
- Boot up from SPI NAND and SD card
- Internal DDR up to 128 MB
- Support Linux OS 4.4, FreeRTOS and Non-OS
- Industrial grade: -40°C - 85°C



Peripheral

- 6x full speed USB host
- 2x high speed USB host
- 2x fast Ethernet MAC
- 2x SDIO/ SD Card
- 4x CAN Bus
- 10x UART /RS485
- 2x CMOS sensor I/F
- 4x I²C



Crypto

- RSA-2048
- ECC-512
- SHA-512
- AES-256
- Pseudo Random Number Generator

Internal DDR Memory to Save BOM Cost

- High PCB layout cost
- Difficult to pass EMI
- High PCBA cost

- Low PCB layout cost
- Easy to pass EMI
- 8.9% PCBA cost drop

- High PCB cost
- High SMT cost
- Difficult to debug

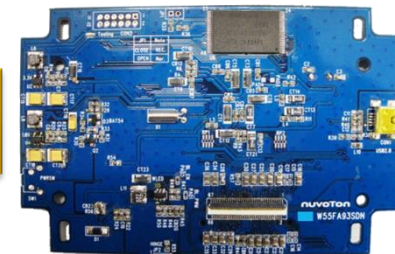


Front
side

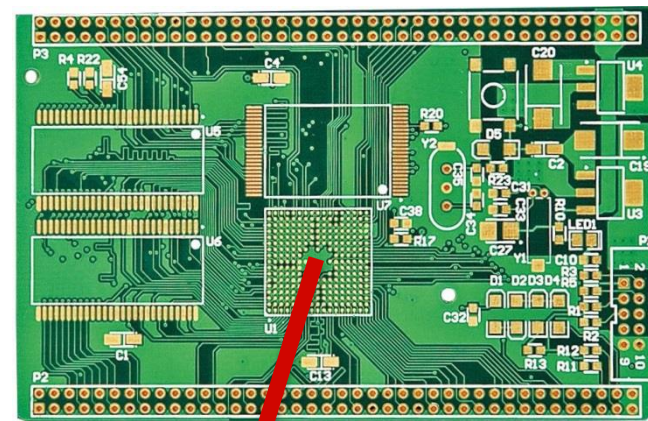


Back
side

LQFP-216 (4 layers PCB)



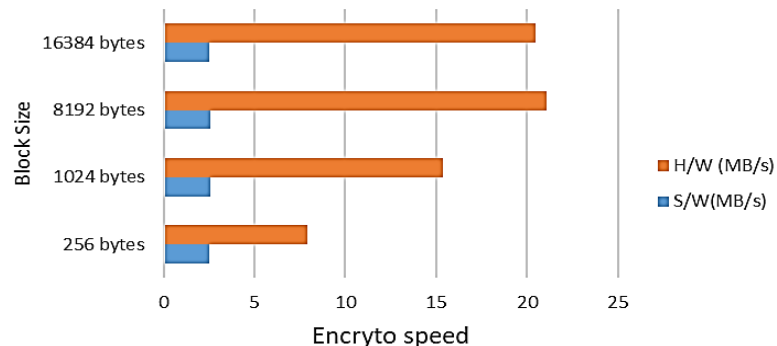
LQFP-128 MCP (2 layers PCB)



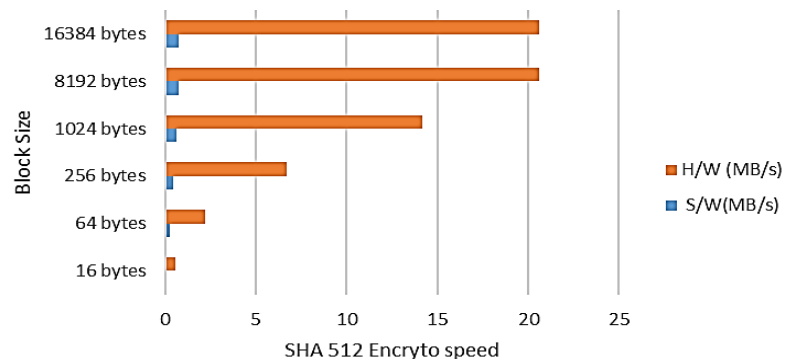
BGA (6-8 layers PCB)

NUC980 Hardware Crypto Engine

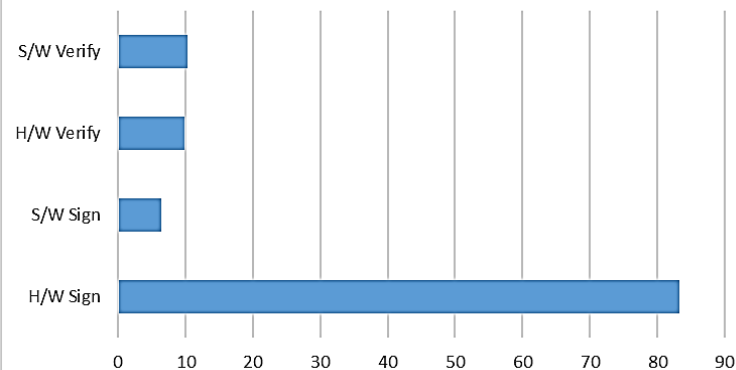
NUC980 Crypto AES-256-CB



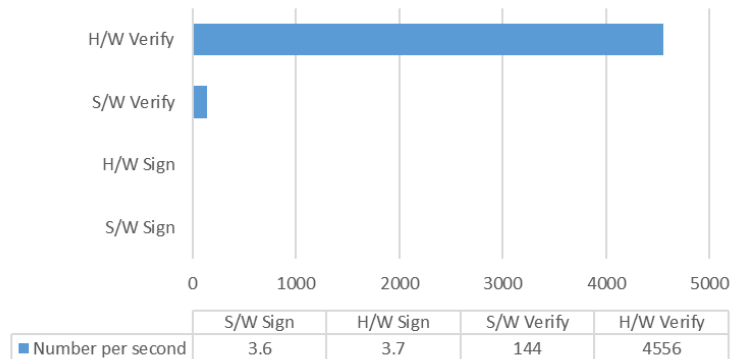
NUC980 SHA-512



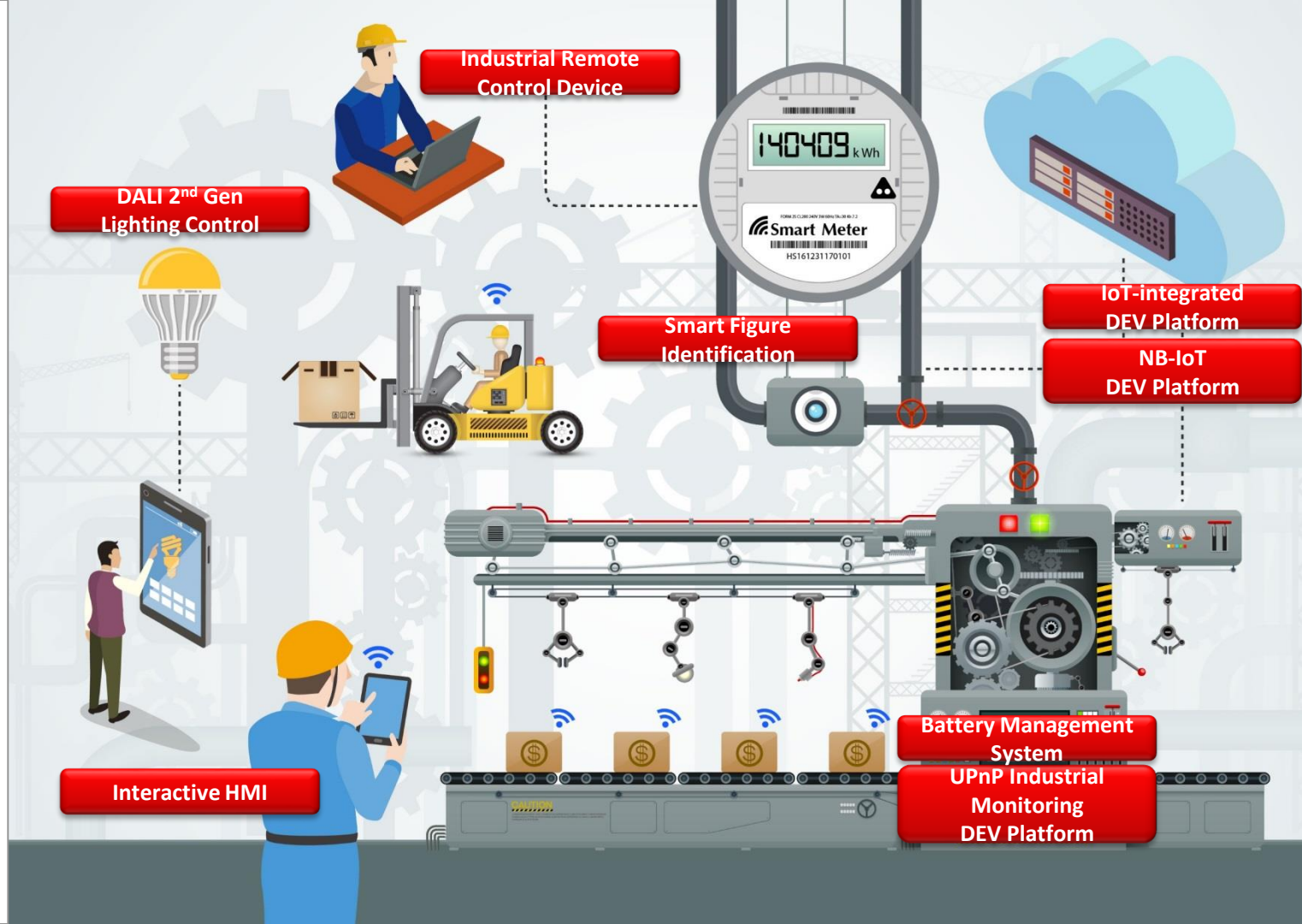
ECC- P-384 Number per second



RSA-2048 Number per second



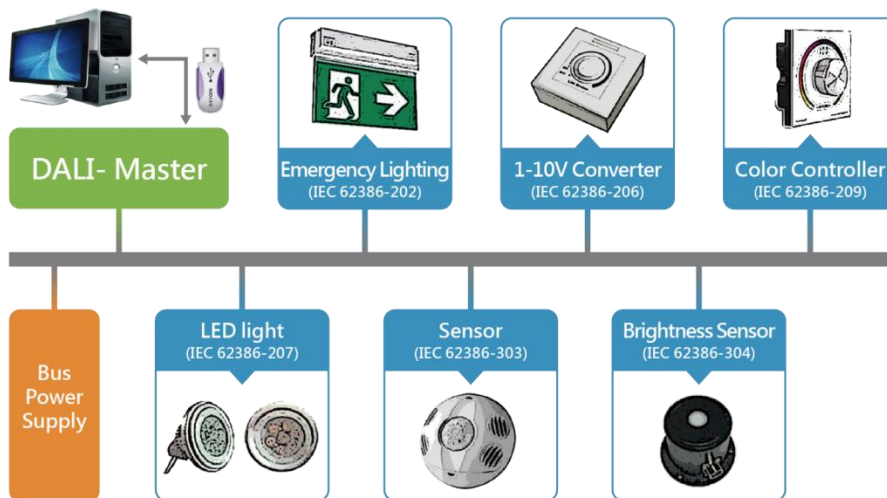
- Smart Figure Identification
 - M480 Series
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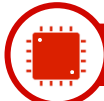
DALI 2nd Gen Lighting Control System

- **Features of Solution**

- Compliant with each protocol (102+20x, 103+30x) of DALI 2nd Gen.
- Only 3 – 6 months of product development schedule
- Comprehensive testing environment to help customer grant DALI 2nd Gen certification
- Multiple Masters interaction mode
- Bus conflict detection and recovery



NDA102 Features



System

- Arm® Cortex®-M0
- Operating frequency: 48 MHz
- 29.5 KB Flash / 4 KB SRAM
- Hardware divider
- Library compliant with DALI 2nd Gen protocol
- Comprehensive development solution including schematic, Gerber file and software



Peripheral

- 2x USCI supports configurable UART / SPI / I²C
- 16-bit, 48 MHz PWM makes lighting control more delicate
- Capture interface is applicable in controlling DALI signal



Analog

- 12-bit ADC supports 2-ch sample and hold
- Programmable Gain Amplifier (PGA)
- 2x comparator

Low-power Application

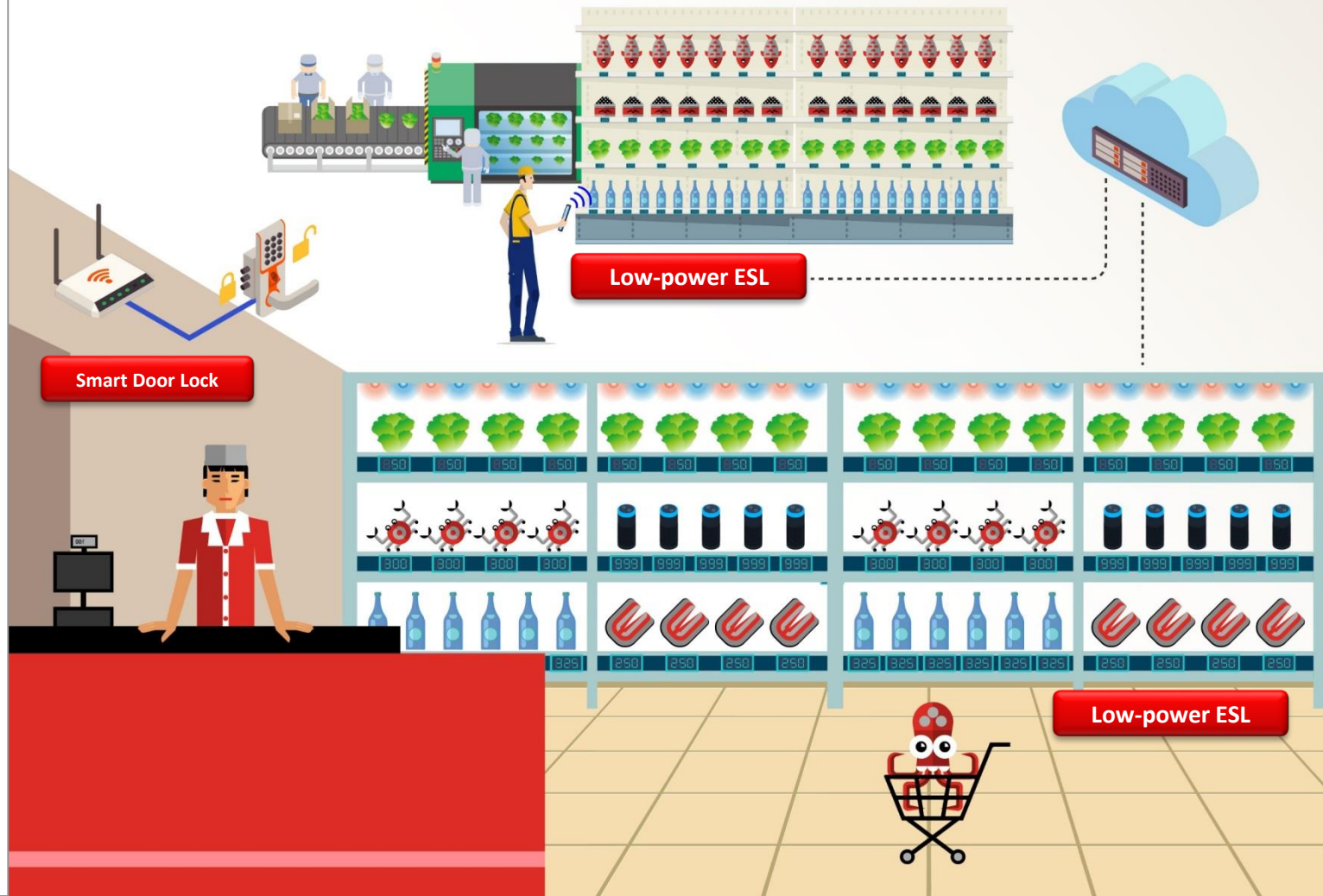
NuMicro[®] M251 ; NuMicro[®] ML51

- **Electronic Shelf Label (ESL)**

- **ML51 Series**

- **Smart Door Lock**

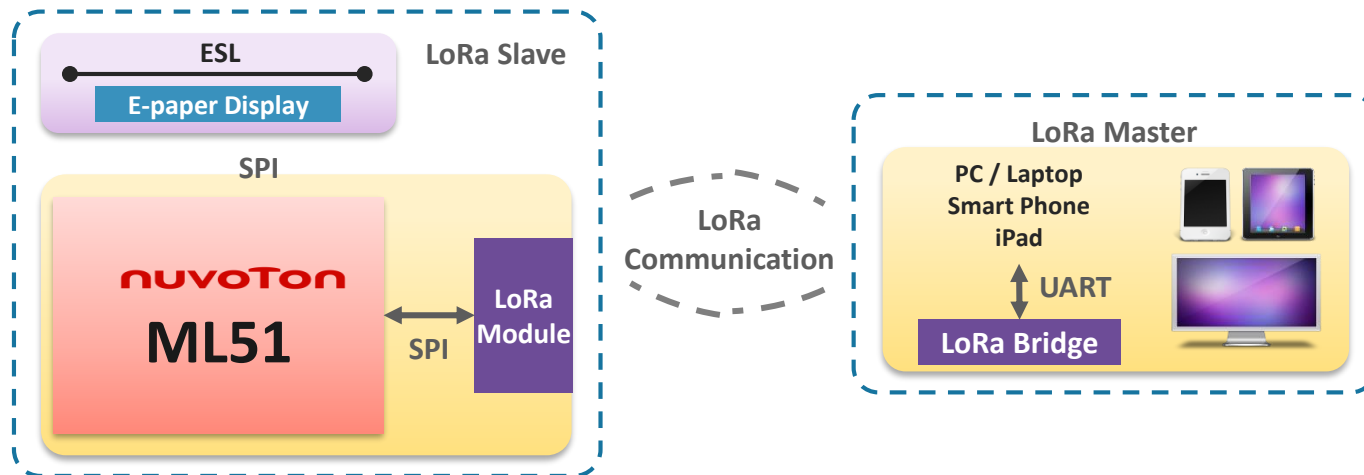
- **M251/M252 Series**



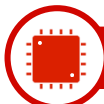
Electronic Shelf Label (ESL) Solution

- **Features of Solution**

- Stay in power-down mode with low-power consumption for up to 3 years battery longevity.
- Content update via LoRa
- RAM retention in power-down mode for keeping display content



ML51 Series Features



System

- 1T 8051
- Operating frequency: 24 MHz
- Operating voltage: 1.8V - 5.5V
- 128 bytes Secure Protection ROM for algorithm protection
- Normal Run: 80 μ A/MHz + 400 μ A
- Low-power Run: <15 μ A
- Power-down: <1 μ A
- Wakeup time: 10 μ s
- High noise immunity: EFT 4.4 kV, ESD HBM 8 kV



Peripheral

- 4x UART
 - Support 9600 baud rate in low-power run mode
- 2x I²C / 2x SPI
- 4-ch DMA supports UART, SPI and ISO-7816 interface
- 12-ch, 16-bit PWM supports dead zone control, complimentary output and hardware brake
- GPIOs support external interrupt and de-bounce
- GPIOs provide high current driving capability (24mA) for driving LED directly




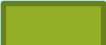




Analog

- 12-bit 500 kSPS SAR ADC supports continuous scan mode
- Comparator
- Built-in 5 levels of internal voltage reference: 1.5V / 2V / 2.5V / 3V / 4V

4 Power Modes to Enhance Battery Life

Normal Run







HIRC/HXT

	Clock	Power
CPU		
Peripheral		
SRAM		

80 μ A/MHz + 400 μ A

Low Power Run

LIRC/LXT

	Clock	Power
CPU		
Peripheral		
SRAM		







15 μ A

Low-power Run Mode

- Support PDMA
- Internal 38.4 kHz RC OSC ($\pm 10\%$)
- Active UART at 9600 baud rate







Low Power Idle

LIRC/LXT

	Clock	Power
CPU		
Peripheral		
SRAM		

13 μ A

Power-down

	Clock	Power
CPU		
Peripheral		
SRAM		

0.8 μ A @3.3V

Power-down mode

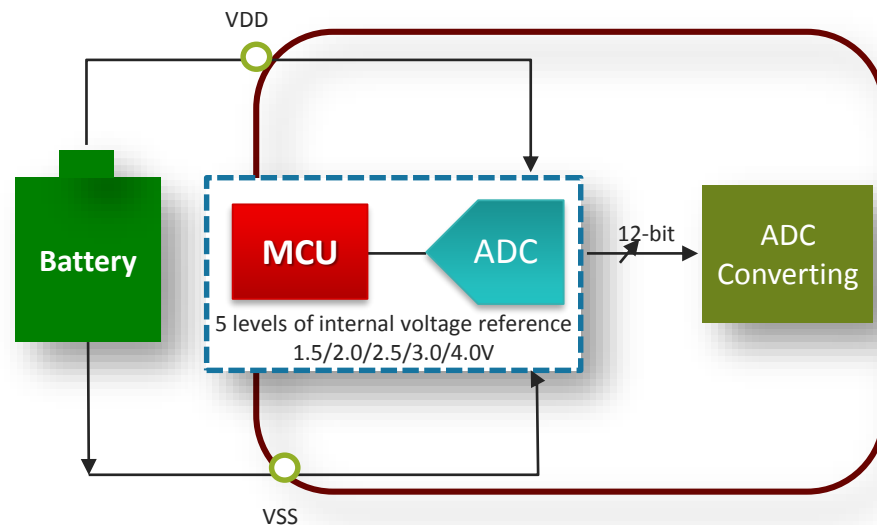
- Wakeup time: 10 μ s

Longer Battery Life with ML51

- Multiple wakeup sources: WKT, WDT, ACMP, GPIO
- If the average power consumption of ML51 is around 5 μA
- Built-in 5 levels of internal voltage reference to keep ADC accuracy during voltage drop

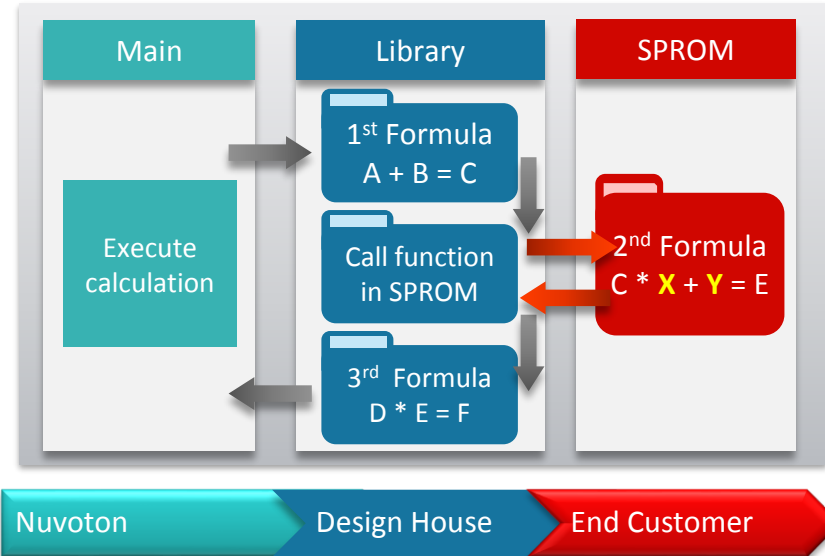
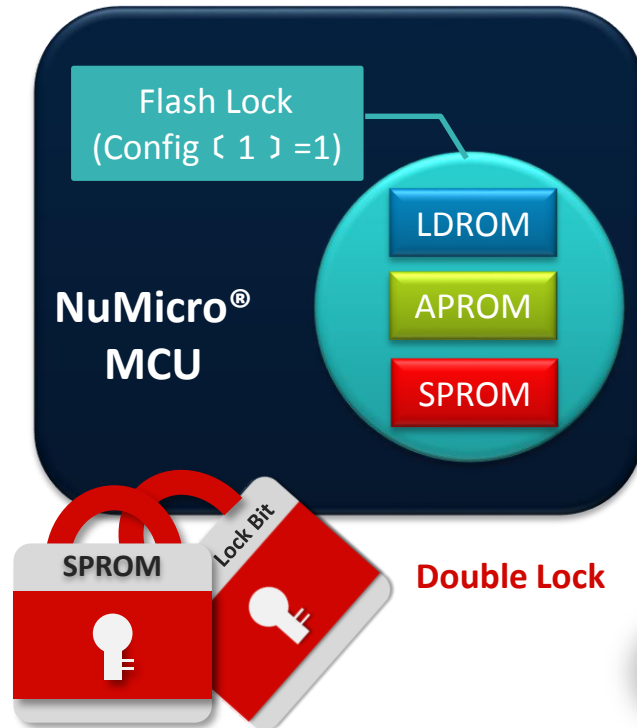


	Lithium	CR2032
Capacity	200mAh	225mAh
Voltage	3.7V	3V
Longevity	4.6 Years	5.1 Years



SPROM – Secure Your Great Idea

Lock your program inside SPROM



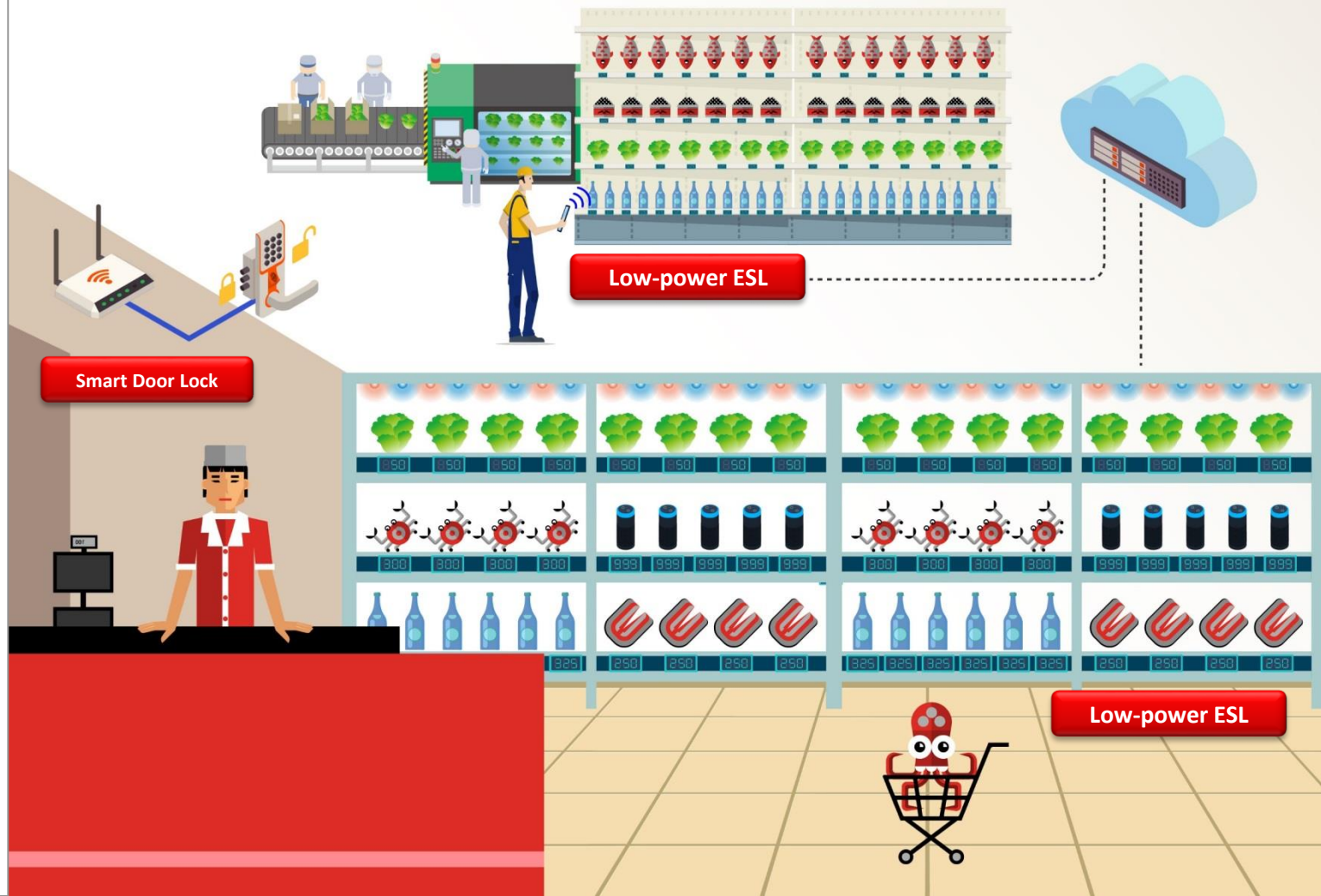
Effectively protect your intellectual property

- Electronic Shelf Label (ESL)

- ML51 Series

- Smart Door Lock

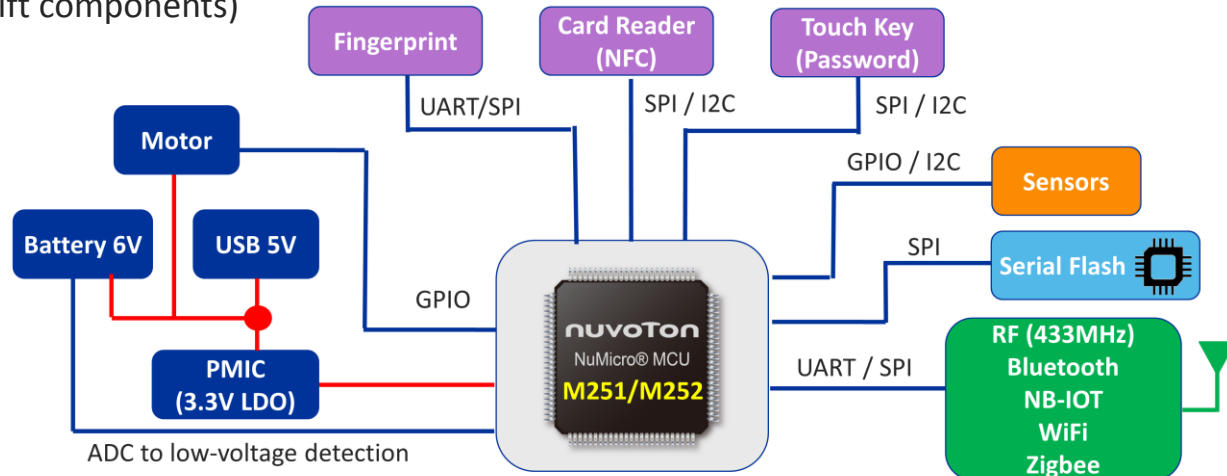
- M251/M252 Series



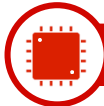
Smart Door Lock

• Nuvoton Solution Features

- **Supports comprehensive battery voltage:** 1.8 ~ 5.5V wide operating voltage
- **Realize long operating time:** Low current consumption in different power modes, such as 138 $\mu\text{A}/\text{MHz}$ @ normal run mode, 2.5 μA @ power-down mode (RTC on), 1.5 μA power-down mode (RTC off), Support Standalone RTC power (VBAT) domain, fast wake-up by multi-pin interrupt.
- **Capable to connect diverse external communication and sensing modules:** Built-in rich peripherals (UART x3, QSPI x1, SPI/I²S x1, I²C x2, USCI x3, PWM x24) , support 2nd VDDIO (VAI, save level-shift components)



M251/M252 Series Features



System

- Arm® Cortex®-M23, up to 48 MHz, Armv8-M architecture
- Operating voltage 1.8 ~ 5.5V
- 16~256 KB Flash / 8~32 KB SRAM
- 1-region configurable eXecute-Only Memory (XOM)
- Built-in hardware divider
- 138 μ A/MHz (Normal run mode)
- 60 μ A/MHz (Idle mode)
- 2.5 μ A (Power down with RTC)
- 1.5 μ A (Power down without RTC)



Peripheral

- Up to 8-ch Programmable Serial I/O (PSIO)
- Up to 24-ch PWM
- USB 2.0 FS Device (X-less)
- USCI x3 (UART, I2C, SPI)
- 1 set of External Bus Interface (EBI)
- 8-ch PDMA



Analog

- Up to 16-channels 880 kSPS 12-bit ADC
- Analog comparator (ACMP) x2
- Support 12bit DAC x1
- OPA x1
- Standalone RTC Power V_{BAT} domain
- Voltage Adjustable Interface (VAI), up to 6 pins for supporting 2nd VDDIO voltage (1.65V - 5.5V)



Smart Door Lock



Keyboard/Mouse



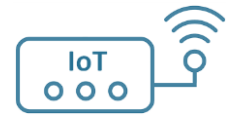
Medical Device



ESL

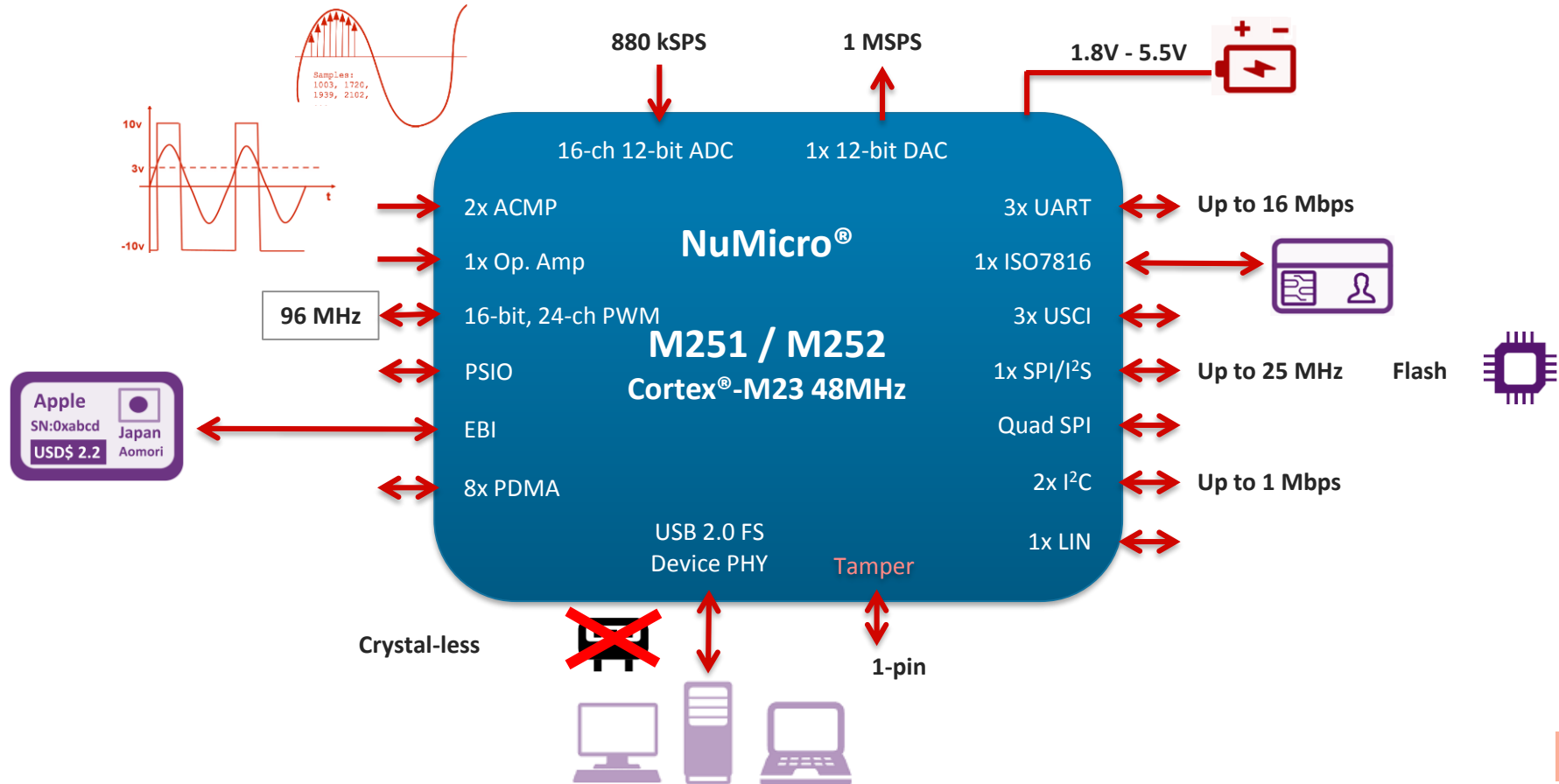


Positioning



IoT Node

M251/M252 Series Function Diagram

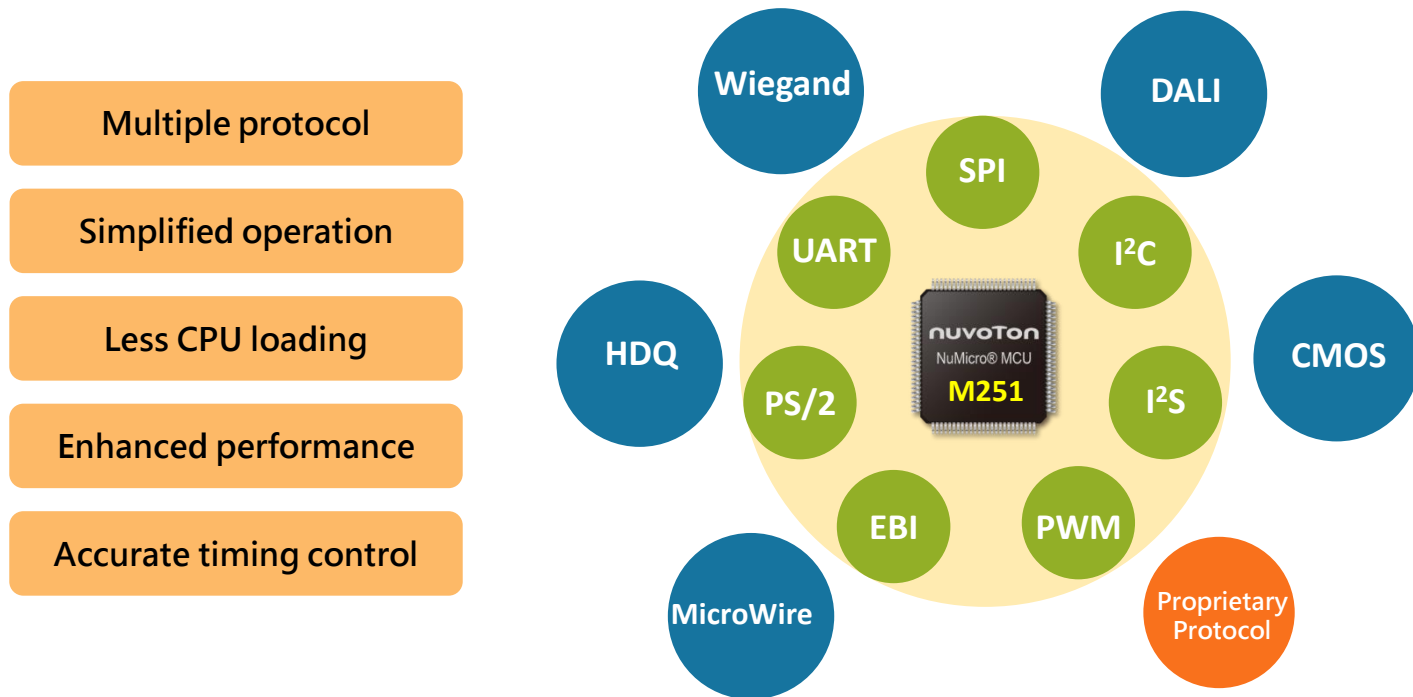


PSIO – Waveform Generator

Nuvoton
Patented

Joy of innovation
nuvoTon

- PSIO (Programmable Serial I/O) can be used to generate arbitrary waveform combination for general or **specific** serial communication protocol.



IoT Security Application

NuMicro[®] M2351

- Personal Identity Authentication by USB FIDO Key
- Secure IoT Door Lock from Collaborative Development
 - M2351 Series



Secure Fingerprint IoT
Door Lock

Personal Identity
Authentication by USB
FIDO Key

Secure IoT Device
Management

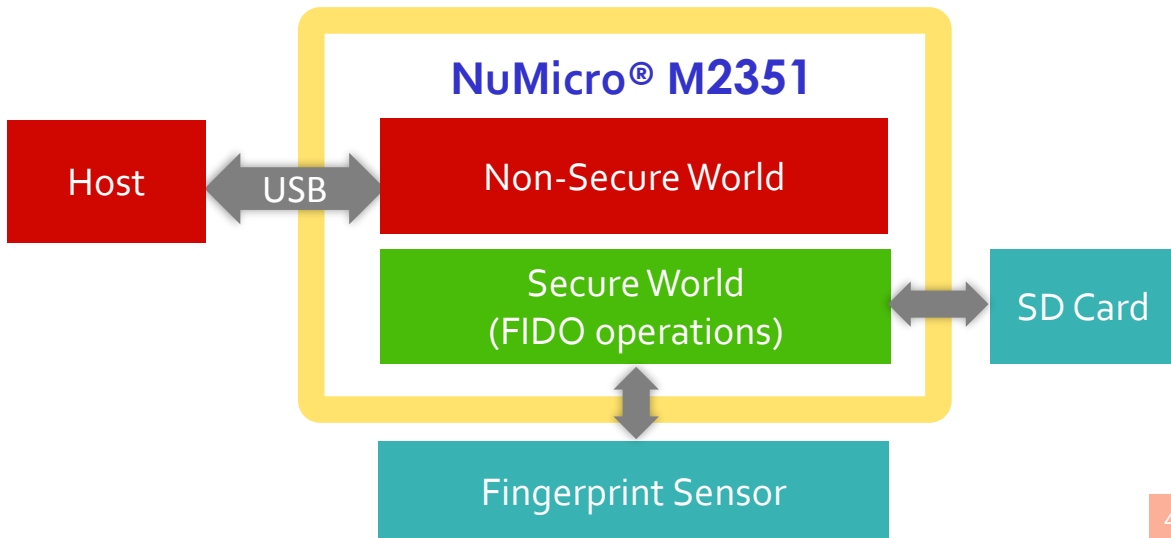
Personal Identity Authentication by USB FIDO Key

- **Features of Solution**

- The solution combines NuMicro® M2351 microcontroller and SunASIC® fingerprint sensor as hardware foundation, supporting Universal 2nd Factor (U2F) protocol by FIDO libraries. Easily to be adopted in crypto currency transaction, PC/laptop or mobile phone for user identity authentication

- **Introduction of Solution**

- USB 2.0 full speed
- SD card, ISO-7816 card supported
- Fast fingerprint identification < 1 second
- USB drivers
 - HID protocol
 - Storage class
 - Biometric class



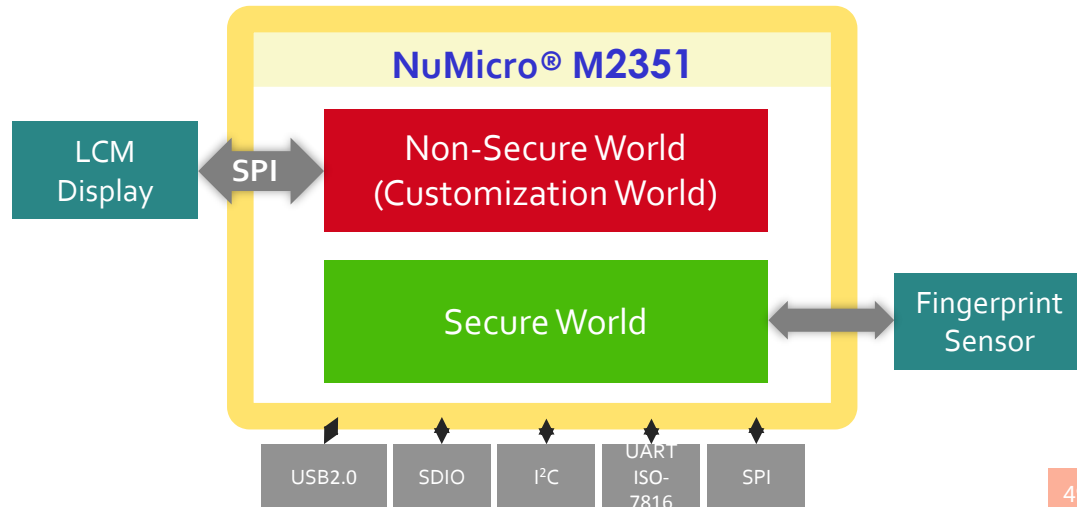
Secure IoT Door Lock from Collaborative Development Joy of innovation **nuvoTon**

- **Features of Solution**

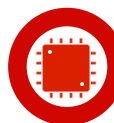
- Collaborative Secure Software Development by TrustZone® for Arm®v8-M
 - Fingerprint recognition algorithm can be stored in Secure World
 - Application developer (E.g. LCD user interface) can use Non-Secure World for final product development, the NSC (Non-Secure Callable) APIs provide communication between both worlds.

- **Introduction of Solution**

- The fingerprint recognition algorithm are stored inside XOM against attack.
- Non-secure world provides another space for application developer to add extra functionalities, like Bluetooth, Wi-Fi or NFC.



M2351 Features



System

- Arm® Cortex® -M23 core
- Operation up to 64 MHz
- 256 KB Flash / 96 KB SRAM
- First MCU with both Arm® PSA Certified Level 1 and PSA Functional API Certified



Security

- TrustZone® for Armv8-M
- XOM (Execute-Only-Memory)
- Secure Bootloader
- Secure OTA firmware update
- H/W Crypto Accelerator
- Flash lock bits security
- Tamper detection pins



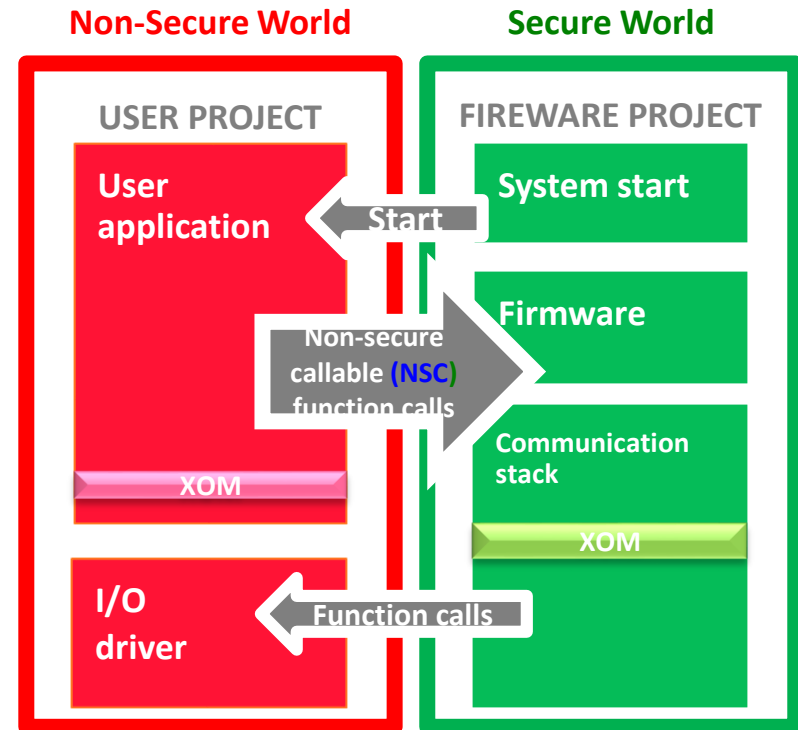
Low-power

- Multiple Power Modes
- Normal Run Mode
 - 97 μ A/ MHz (LDO)
 - 45 μ A/ MHz (DC-DC)
- Standby Power-down Mode (SPD) : 2.8 μ A
- Deep Power-down Mode (DPD) : < 2 μ A

Synergy for MCU System Development by M2351

- **Building a system with Secure and Non-secure projects**

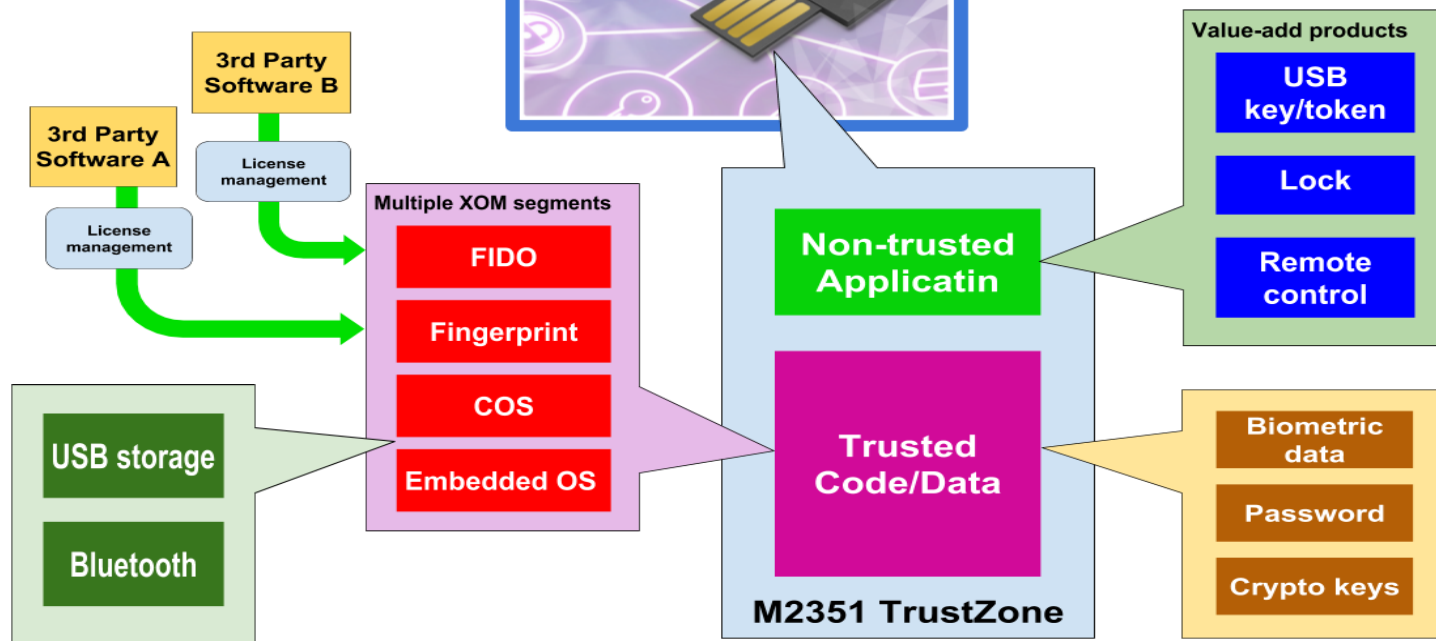
- Non-secure project cannot access Secure World resources
- Secure project can access everything
- Secure and Non-Secure projects may be implemented with independent time scheduling
- XOM (eXecute-Only Memory)



Leading Position for Software IP Protection

**A New Architecture
and Ecosystem for
Personal Security**

**Nuvoton Technology
新唐科技**



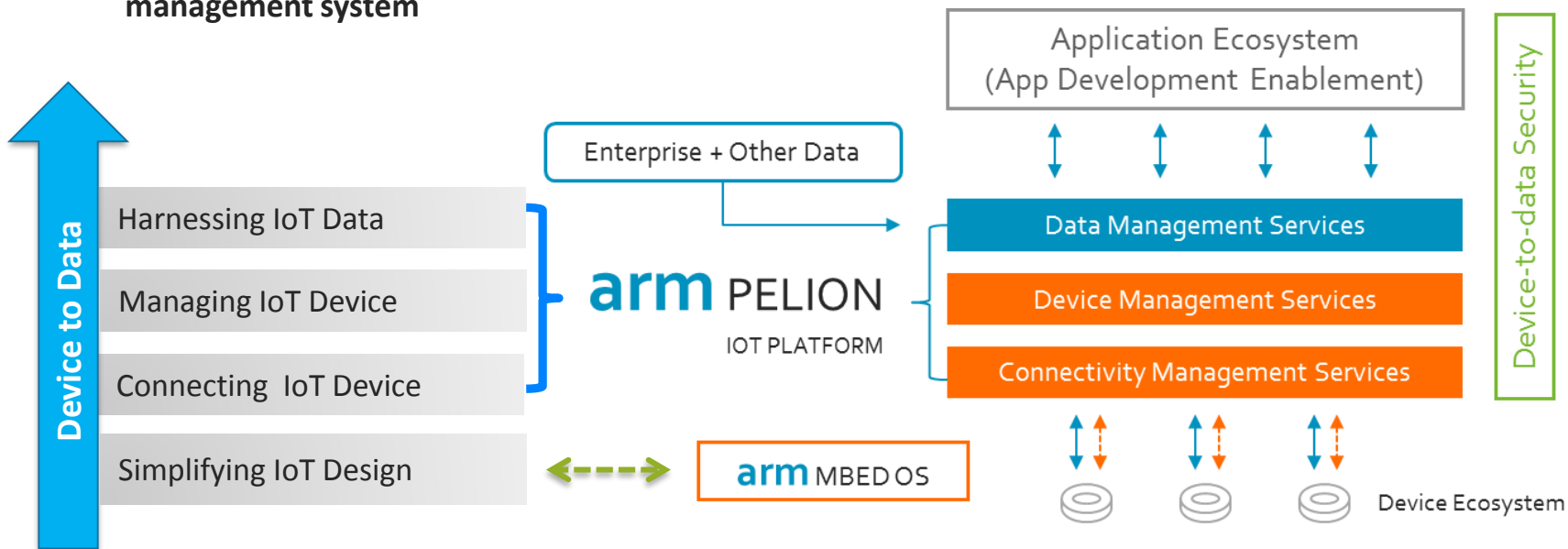
PSA (Platform Security Architecture) Certified

- **Introduction to PSA Certified™**
 - PSA Certified provides a simple and comprehensive approach to security testing. It comprises two elements: a multi-level, security robustness scheme (Levels 1, 2 and 3) and a developer focused API test suite.
- **Advantages of PSA Certified™**
 - PSA Certified enables device makers to achieve the security required for their use case through these three progressive levels of security assurance, each requiring increasingly rigorous hardware and software evaluation, which are assigned by analyzing the use case threat vectors



M2351 for Arm Pelion IoT Management System

- NuMicro® M2351 :
Cortex®-M23 CPU based and Arm® Platform Security Architecture (PSA) Certified Level 1
- NuMaker PFM-M2351 development board : Mbed Enabled
- From Arm® Mbed OS to Arm® Pelion IoT Platform : to realize a secure and convenient IoT device management system



Agenda

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13:30 ~ 14:00	Registration
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14:20 ~ 15:30	Industrial Control App (NuMicro® NUC980 ; NuMicro® M480)
	Low-Power App (NuMicro® M251 ; NuMicro® ML51)
	IoT Security App (NuMicro® M2351)
15:30 ~ 16:15	Tea break
16:15 ~ 17:30	Smart Home App (NuMicro® MS51 ; NuMicro® M031 ; NuMicro® M487)
	Development Platform: Tools and Environment
	IoT & Graphics Interface Development Platform
17:30 ~ 17:40	Q&A / Lucky draw

Nuvoton Direct Promotion

Joy of innovation
nuvoton



NuMaker-M031SD

NuMaker-M031TB

NuMaker-M032SE

NuTiny-ML51EB9AE

NuMaker-M031TC

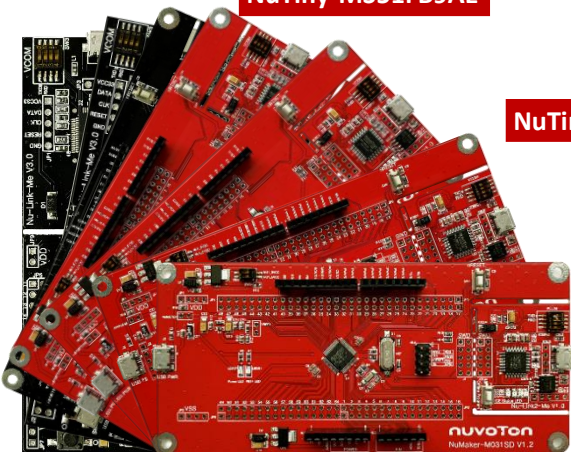
NuTiny-MS51FB9AE

NuMaker-MI51PC

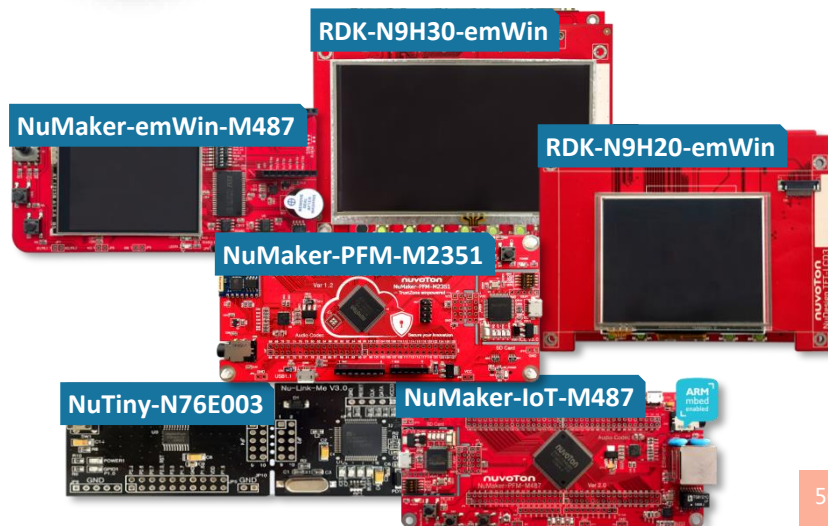
NuTiny-NUC029SG

NuTiny-NUC029SE

NuTiny-NUC029SD



<https://direct.nuvoton.com/roadshow/>



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Smart Home Application

NuMicro® MS51 ; NuMicro® M031 ; NuMicro® M487

- **Wireless Power & Data Transmission**

- **MS51 Series**

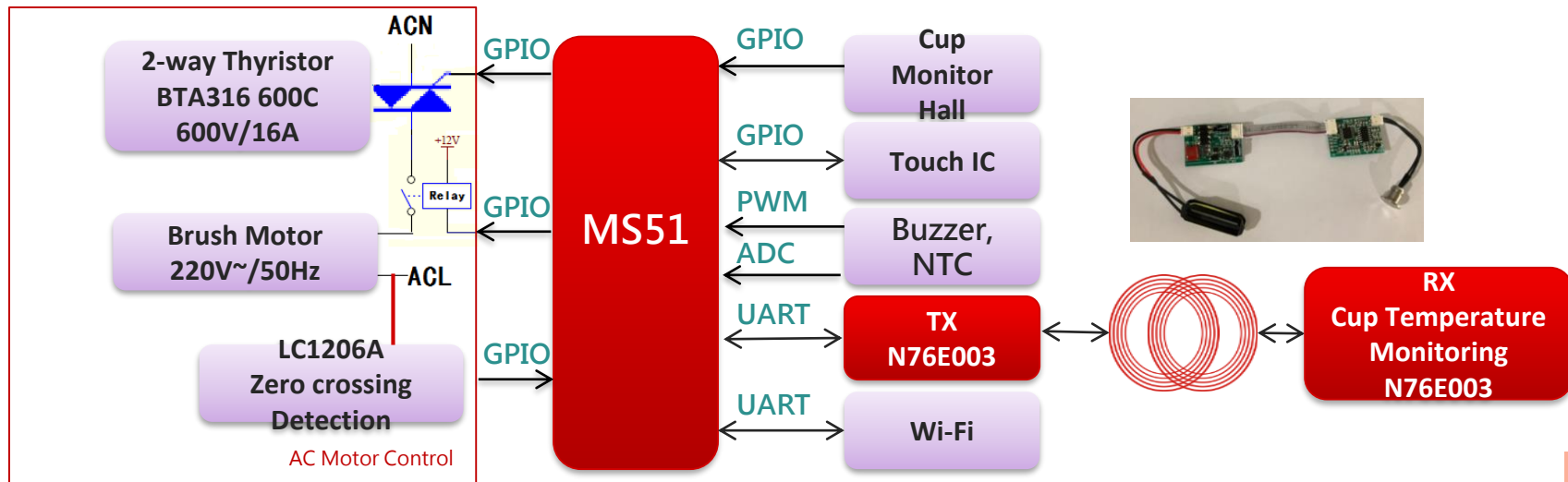
- Smart Toilet Seat
 - NUC029 Series
- PM2.5 Laser Detection Module
 - M031/M032 Series
- Interactive Power Outlet
- Keyword spotting – Machine Learning
 - M480 Series



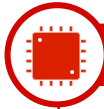
Wireless Power & Data Transmission

– Blender Temperature Monitoring

- **Features of Solution**
 - Wireless-powered and bi-directional data transmission
 - Base can monitor the temperature of cup without wire connection
 - Can be extended to the product control or communication with waterproof or dustproof



MS51 Series Features



System

- 1T 8051
- Operating frequency: 24 MHz
- Up to 32 KB Flash
- Up to 2 KB SRAM
- 128 bytes Secure Protection ROM for algorithm protection
- High noise immunity: EFT 4.4 kV, ESD HBM 8 kV



Peripheral

- Up to 5 sets of UART for connecting multiple sensors
- 6-ch, 16-bit PWM supports dead zone control and complimentary output
- GPIOs provide high current driving capability (24mA) for driving LED directly
- Pin-to-pin compatible with N76E003



Analog

- 15-ch, 12-bit SAR ADC supports continuous scan mode
- Built-in bandgap for measuring V_{DD} voltage ($\pm 1\%$ accuracy)

N76E003 vs. MS51

	N76E003	MS51*
Flash (KB)	18	16
SRAM (B)	256 + 768	256 + 1K
SPROM(B)	-	128
Max CPU Speed (MHz)	16	24
HIRC (MHz)	16	16/24
LIRC (KHz)	10	10
UART/SPI/I ² C	2/1/1	2/1/1
GPIO	18	18
16-bit Timer	4	4
16-bit PWM	6	6
WDT	V	V
ADC (Max Sample Rate)	8-ch, 12-bit (380 kSPS)	8-ch, 12-bit (500 kSPS)
PDMA	---	---
Internal voltage reference	---	---
IO sink current	15 mA	24 mA
Power down current	6 μ A	5 μ A
Voltage	2.4V to 5.5V	2.4V to 5.5V
Package	QFN20/ TSSOP20/ SOP20	QFN20/ TSSOP20/ SOP20

Six Enhancements

- **System Speed**
 - 16 MHz \rightarrow 24 MHz
- **Enhanced ADC**
 - Support continuous scan mode
 - Up to 500 kSPS
- **SRAM size**
 - 768 bytes \rightarrow 1024 bytes
- **SPROM**
 - 128 bytes for algorithm protection
- **Better power consumption**
 - 6 μ A \rightarrow 5 μ A
- **I/O Sink Current**
 - 15 mA \rightarrow 24 mA

- Wireless Power & Data Transmission
 - MS51 Series
- **Smart Toilet Seat**
 - **NUC029 Series**
- PM2.5 Laser Detection Module
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- Keyword spotting – Machine Learning
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Smart Bathroom - Smart Toilet Seat

• Features of Solution

• Plenty peripherals:

Connect lot of external modules to implement automatic lighting, cover control, cleaning, drying, flushing, deodorizing and speaker...etc.

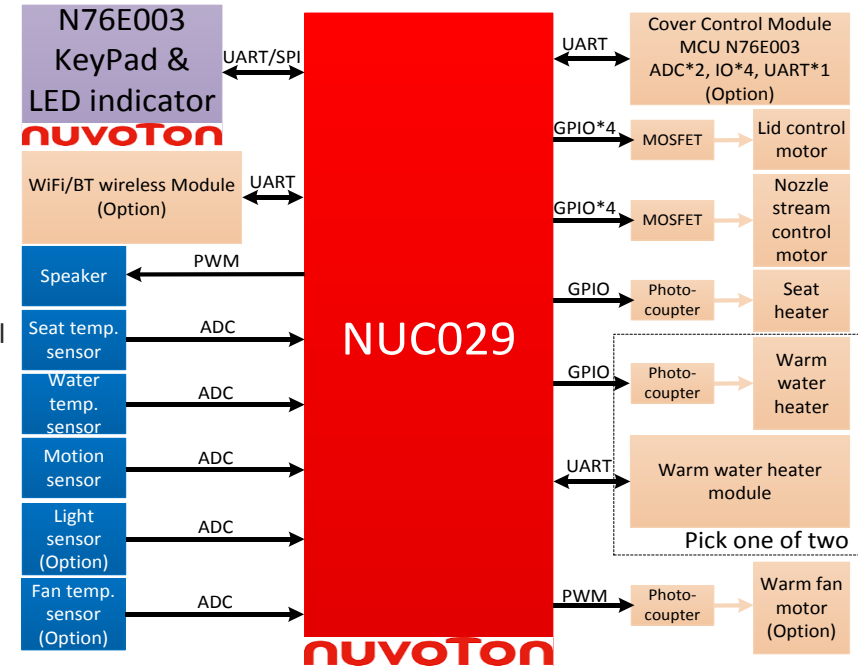
• Smart control to provide comfortable experience:

Through precise of multi-channel ADCs detection to control water volume, water temperature, toilet seat temperature, motor safety management

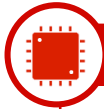
• Flexible display mode:

Support button scanning, Segment LCD or TFT LCD.

• Support to assort wireless controller for easy control.



NUC029 Series Features



System

- Arm® Cortex® -M0
- Operating frequency: 72 MHz
- 16 KB - 256 KB Flash
- 2 KB - 20 KB SRAM
- Support Width working voltage 2.5 ~ 5.5 V
- Support Hardware Divider
- Robust noise immunity EFT 4.4 kV and strong ESD HBM 7 kV)



Peripherals

- Support variety of peripherals, such as USCI, UART, SPI, I2C, I2S, LIN. (USCI can be set to UART/SPI/I2C)
- Up to 8 set UART, 5 set SPI, 5 set I2C
- Up to 12-ch 16-bit 144 MHz PWM
- Support 16/8 bit EBI
- Support 9-ch PDMA
- Support USB 2.0 FS Device (Crystal-less)



Analog

- Up to 20-ch 12-bit 1 MSPS SAR ADC
- Build-in analog comparator x 4
- Integrated with power-on Reset, Brown-out Reset and Low voltage reset
- Support VAI(Voltage Adjustable Interface) to support the 2nd I/O voltage from 1.65V ~ 5.5V



robot



headset



Treadmill



Meter

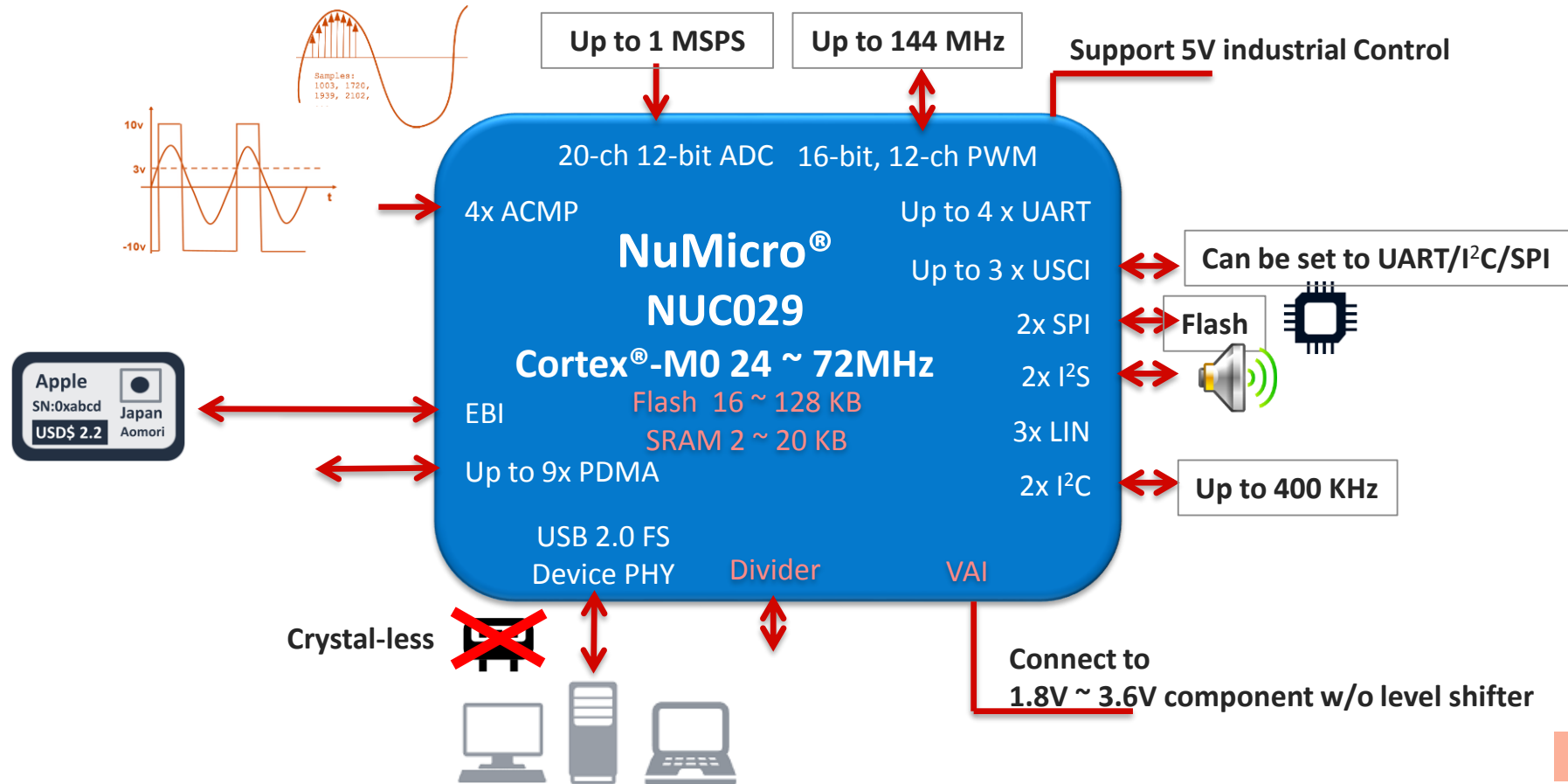


washing machine



Water Purifier

NUC029 Series Function Diagram

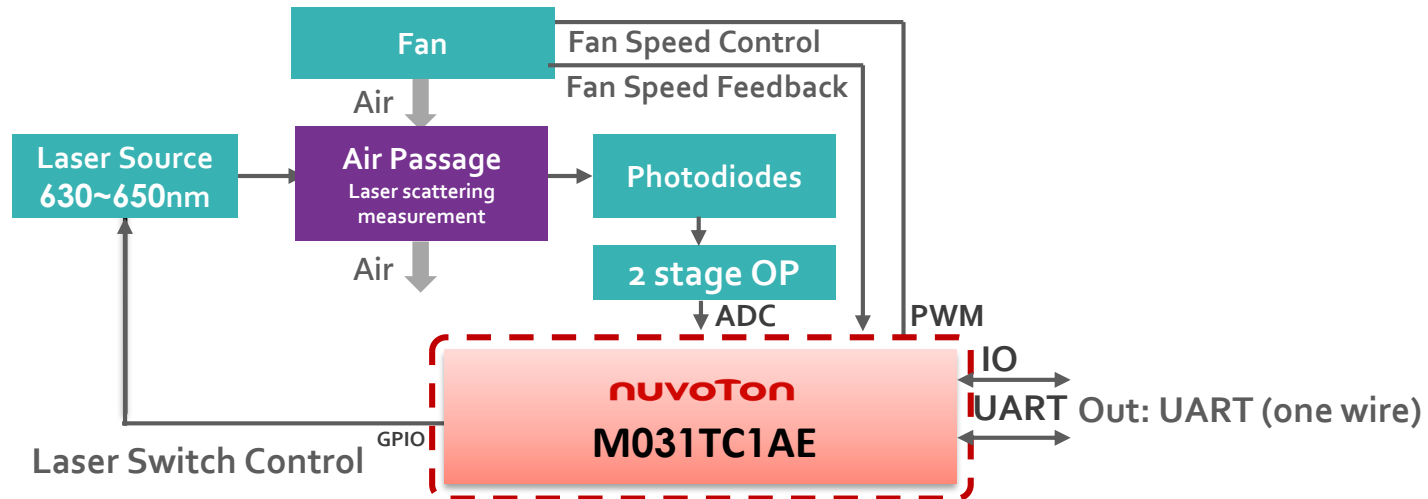


- Wireless Power & Data Transmission
 - MS51 Series
- Smart Toilet Seat
 - NUC029 Series
- **PM2.5 Laser Detection Module**
 - **M031/M032 Series**
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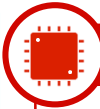


PM2.5 Laser Detection Module

- Features of Solution**
 - High speed 2 MSPS 12-bit ADC: enhance sampling speed and measurement accuracy to fast & accurate catch qualitative and quantitative value of PM 2.5.
 - Support 5V input, compatible with 3.3V/5V interface, simplify module platform.
 - Speed up algorithm calculation and reduce division operation time by Hardware Divider.
 - Easy to expand the module by plenty peripherals, it can fast apply at air purifiers, automotive air purifiers, air conditioners, fresh air equipment, air quality monitoring, environmental monitoring and handheld air quality testing equipment, etc.



M031 / M032 Series Features



System

- Arm® Cortex® -M0
- Operating frequency: 72 MHz
- 16 ~ 512 KB Flash / 2 ~ 96 KB SRAM
- Support Dual Bank OTA
- 512 Bytes - 2048 Bytes SPROM (Security Protection ROM)
- Low operate voltage 1.8~3.6V
- Operating temperate -40 ~ 105 °C
- Built-in Hardware Divider
- Support IEC-60730



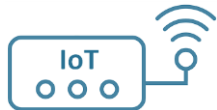
Peripherals

- Support Variety high performance peripherals, such as
 - Up to 2 sets USCI(USCI can be set to UART/SPI/I2C)
 - Up to 8 sets 6 MHz UART
 - Up to 2 sets 24 MHz SPI
 - Up to 4 sets I²C and 1 set I²S
- 1-wire UART communication function
- Up to 24-channels 16-bit 144MHz PWM
- Support 16/8 bit EBI and up to 9-ch PDMA
- Support USB 2.0 FS Device (Crystal-less)



Analog

- Up to 16-ch 12-bit 2 MSPS SAR ADC
- Build-in analog comparator x 2
- Integrated with power-on Reset, Brown-out Reset and Low voltage reset
- RTC with Calendar and Alarm



Connector



Laser rangefinder



Mini printer



Meter

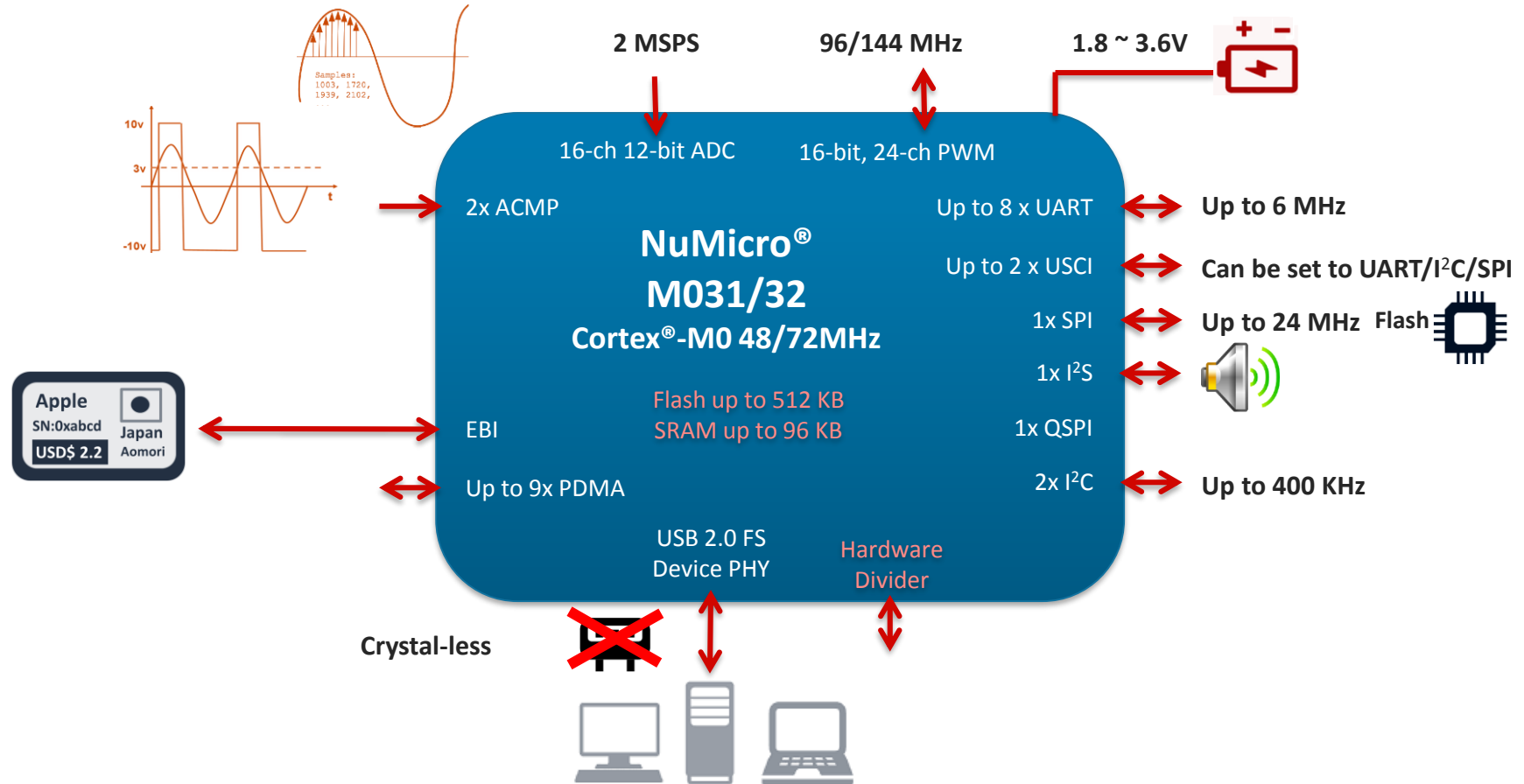


Wireless charger



Pysiotherapy

M031/M032 Series Function Diagram



M031 / M032 Series Enhanced Points

Item	Competitor	NuMicro® M031	Benefit
Operation voltage	2.4V - 3.6V	1.8V - 3.6V	W/O LDO if Battery source
GPIO (e.g. LQFP48)	39	42	More GPIO at same package
ADC Channel & Sample rate	1 MSPS	2 MSPS	<ul style="list-style-type: none"> - Higher speed accurate sampling. - More ADC at same package
Peripherals (e.g. 256 KB)	Up to 6 set UART	Up to 8 set UART	<ul style="list-style-type: none"> - More UART for external module. - Support one-wire UART Communication for mechanical limitation
PDMA	Max. 5-ch	Max. 9-ch	- More PDMA for User application
Package options	Few package options	TSSOP20 – LQFP128	- More package selection

- Wireless Power & Data Transmission
 - MS51 Series
- Smart Toilet Seat
 - NUC029 Series
- PM2.5 Laser Detection Module
 - M031/M032 Series
- **Interactive Power Outlet**
- **Keyword spotting – Machine Learning**
 - M480 Series



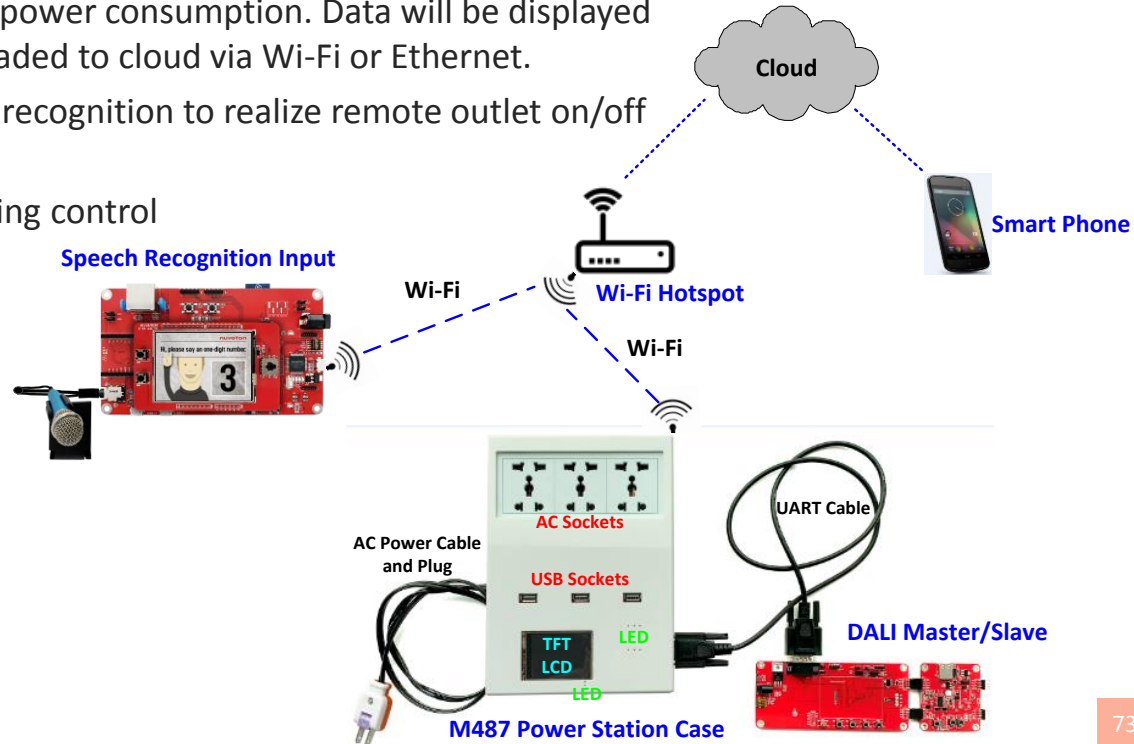
Interactive Smart Outlet

• Features of Solution

- Real-time monitors current and power consumption. Data will be displayed on the QVGA TFT-LCD and uploaded to cloud via Wi-Fi or Ethernet.
- Combined with voice command recognition to realize remote outlet on/off control.
- Work with DALI for remote lighting control

• Introduction of Solution

- The Graphic User Interface, displayed on the TFT-LCD, can be easily modified with emWin library provided by Nuvoton.
- The hardware crypto engine of M487 supports TLS protocol for data transmission.



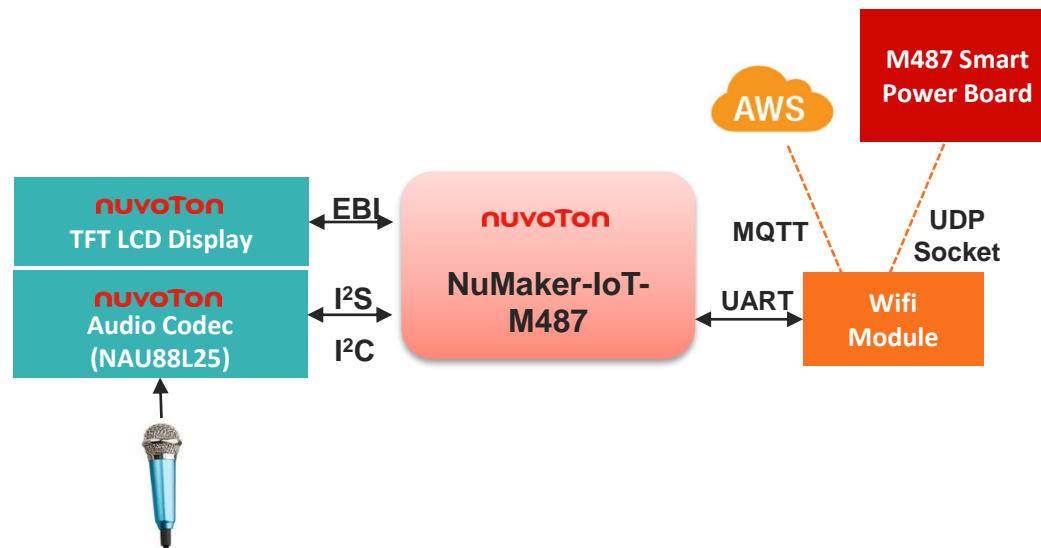
Keyword Spotting – Machine Learning

• Features of Solution

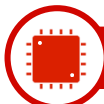
- Implement voice keyword spotting through deep machine learning.
- Voice recognition can be displayed on QVGA TFT-LCD and be used as voice command for remote control.

• Introduction of Solution

- Fast operation of voice recognition with NuMicro M487 running up to 192 MHz
- Multiple cloud connection examples
 - HTTP/MQTT/CoAP
 - TLS
 - LwIP/FreeRTOS+TCP



M480 High Performance Series Features



System

- Arm® Cortex®-M4F
- Operating frequency: 192 MHz
- 512 / 256 KB Flash
- 160/96 KB SRAM
- 4 KB Secure Protection ROM (SPROM) for algorithm protection
- Secure Boot for program integrity
- Hardware crypto engine
- Dynamic power: 175 μ A/MHz



Peripheral

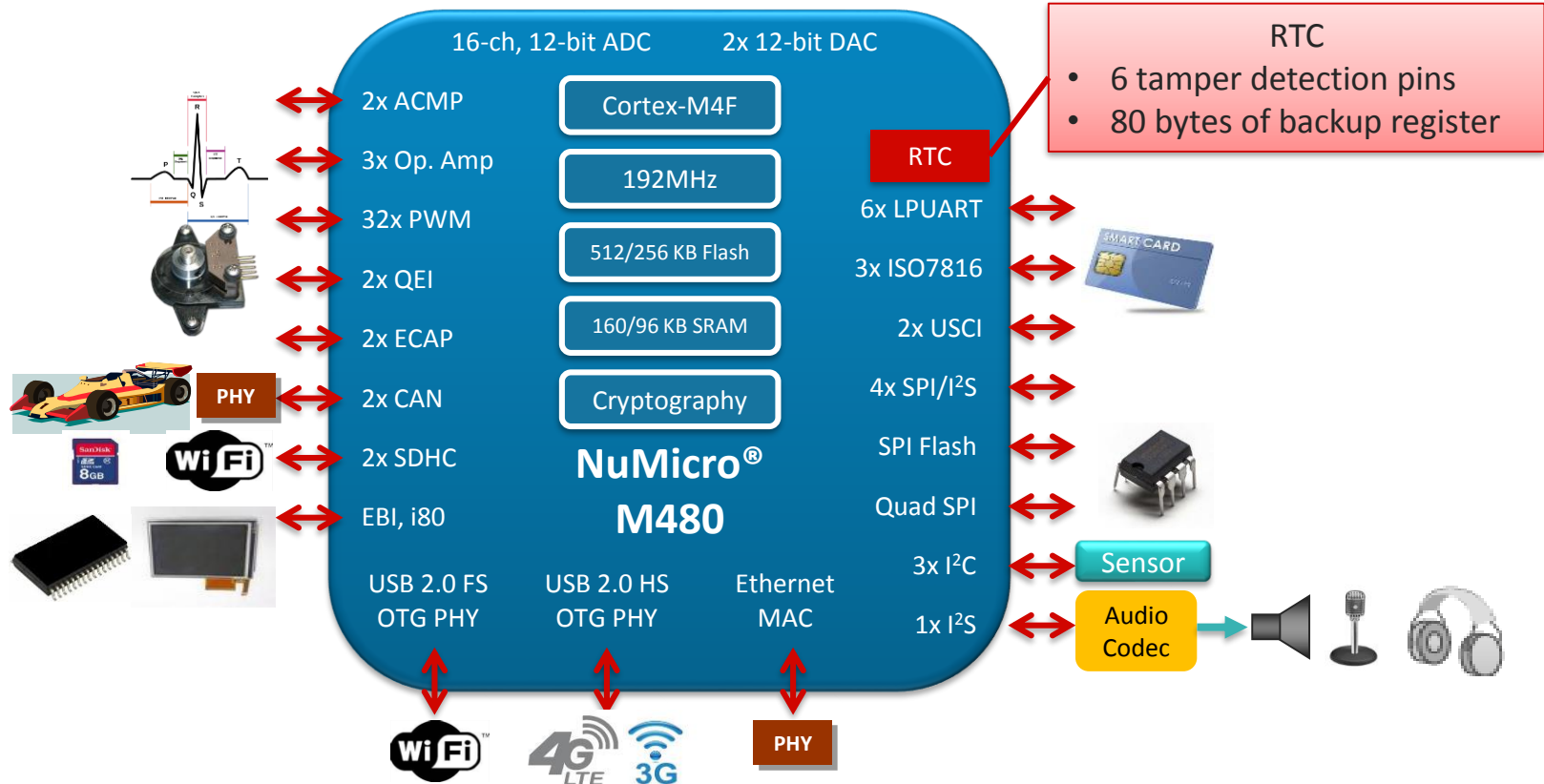
- 1x SPI Flash supports eXecute-In-Place (XIP)
- 1x Quad-SPI
- 2x SD host controller
- 2x USCI support configurable UART / SPI / I2C
- USB HS OTG (on-chip PHY)
- USB FS OTG (on-chip PHY)
- 1x fast Ethernet MAC
- 2x CAN 2.0B
- 2x QEI
- EBI supports Intel 8080 mode



Analog

- **12-bit 5 MSPS SAR ADC**
- 2x 12-bit 1 MSPS DAC
- 2x comparator
- 3x Op. Amplifier
- 1.8V – 3.6V Voltage Adjustable Interface (VAI)

M480 Series Function Diagram



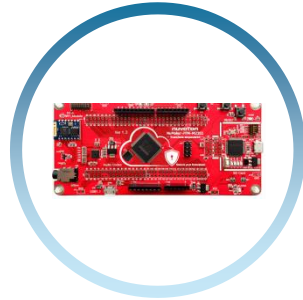
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	IoT & Graphics Interface Development Platform
17:30 ~ 17:40	Q&A / Lucky draw

Development Platform

Tools and Environment

Development Environment and Tools



• Multiple Development IDE

- GNU GCC based NuEclipse on Windows or Linux
- Keil MDK
- IAR EWARM

• Brand New Programming Platform - Nu-Link2

- Fast programming
- ISP via multiple I/F
- ETM
- USB bridge
- SPI / I2C Monitoring

• NuMicro IoT and HMI Development Platform

- Incl. sensor node, gateway, cloud database connection
- Cloud service: Arm Pelion, Amazon AWS IoT, Alibaba Cloud
- Comprehensive emWin GUI library

• Easy-to-use Development Tool

- PinConfig: Graphical I/O setting
- PinView: Real-time I/O monitoring

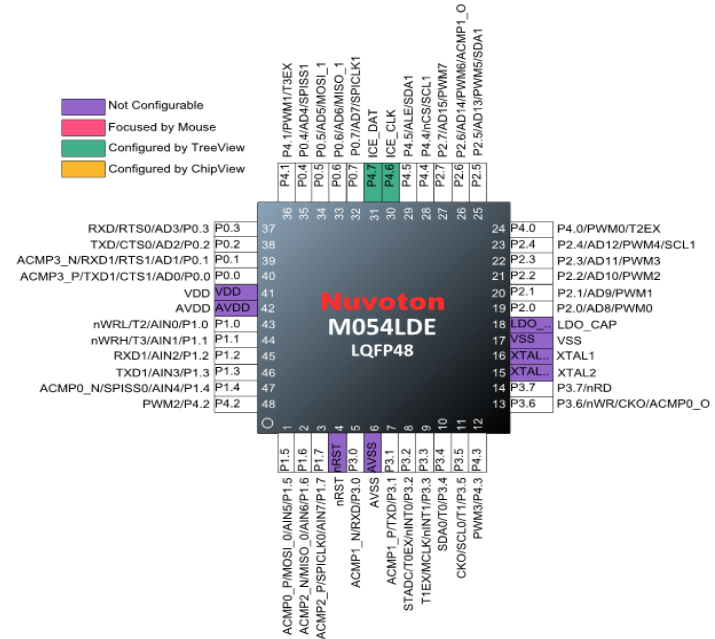
• BSP (Board Supporting Package)

- Comprehensive drivers
- Plentiful peripheral examples
- API compatibility

PinConfig

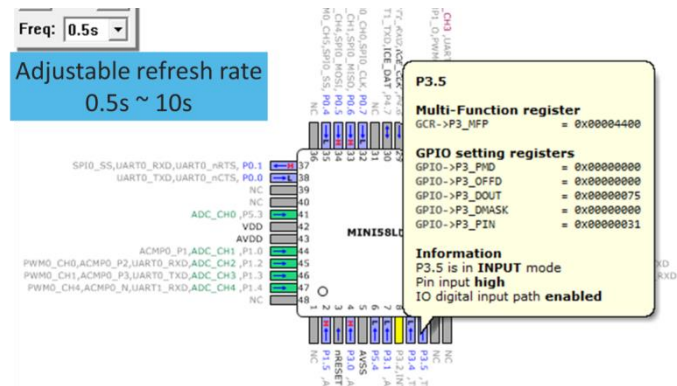
- Tool for pin assignment, initial code generation, and OrCAD/Protel part generation

- Click and Select to configure pin setting
 - Speed up pin assignment process
- Generates GPIO function configuration code (.c file)
 - Speed up program development
- Automatically generates corresponding OrCAD or Protel part
 - Reduce the risk of erroneous hardware schematics

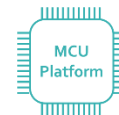


- **Monitors real-time pin status and register settings**

- **Displays selected pin's configuration and highlights invalid settings**
- **Supports two types of PinView**
 - Stand-alone PinView
 - Add-on PinView for Keil μ Vision[®] IDE and IAR Embedded Workbench IDE



Mass Production and Program Upgrade



• Brand New Programming Platform - Nu-Link2

- Fast programming
- ISP via multiple I/F
- ETM
- USB bridge
- SPI / I2C Monitoring

• MP Tool – NuLink-Gang

- One-to-four independent programming
- Auto Programming Machine

• ICP Programming Tool

- Online/offline programming
- Image bound to specific Nu-Link
- Encrypted project file for securing image
- Image serial number

• Customizable Programming Flow

- Nu-Link Command Tool supports up to 16 boards simultaneously.
- Command execution from scripts or vendor GUI to control programming process.

• ISP Programming Tool

- Standard ISP protocol via UART or USB.
- Source code of firmware and application tool.

Nu-Link2

— Multifunction Debug / Programming Platform

• Program

- Use high-speed USB 2.0 to increase the data transmission speed.
- Supports offline programming.
- Supports ISP upgrade via USB, UART, SPI or I²C.

• Debug & Trace

- Breakpoints and single step execution
- ETM (*Embedded Trace Macrocell*)

• USB Bridge

- USB-to-UART, USB-to-SPI, USB-to-I²C, USB-to-CAN,

• Monitor

- Monitors data status on SPI or I²C in real time.



IoT & Graphics Interface Development Platform

IoT Development Platform

Arm Pelion / Amazon Web Service / Alibaba Cloud

Supported Real-Time OS

Arm® Mbed™ OS

- Nuvoton is silicon partner of Arm® Mbed™
- RTOS kernel
- Modular and thread Safety
- Hardware security
- Communication security
- Power management
- Mbed cloud client
- Secure firmware update

arm
MBED
Enabled

Amazon FreeRTOS

- Nuvoton is technology partner of Amazon
- RTOS kernel
- Modular
- Communication security
- Power management
- AWS IoT core connection
- Secure firmware update



AliOS Things

- NuMicro MCU is part of Ali Cloud ecosystem.
- Sensor framework
- Online upgrade
- Secure protection
- Versatile package in package ecosystem

AliOS Things

Supported Cloud Platform

Pelion Device Management

- Secure Connection
- Deploy and Manage Devices
- Securely Remote Update
- Dashboard and API Console



※ Image from <https://cloud.mbed.com>

Amazon Web Service

- AWS IoT Core – Device Connection, Control, and Management
- Alexa – Voice Recognition and Control
- DynamoDB – Fast NoSQL database to store sensor data for analysis
- Lambda – Execute code to integrate and trigger Amazon services

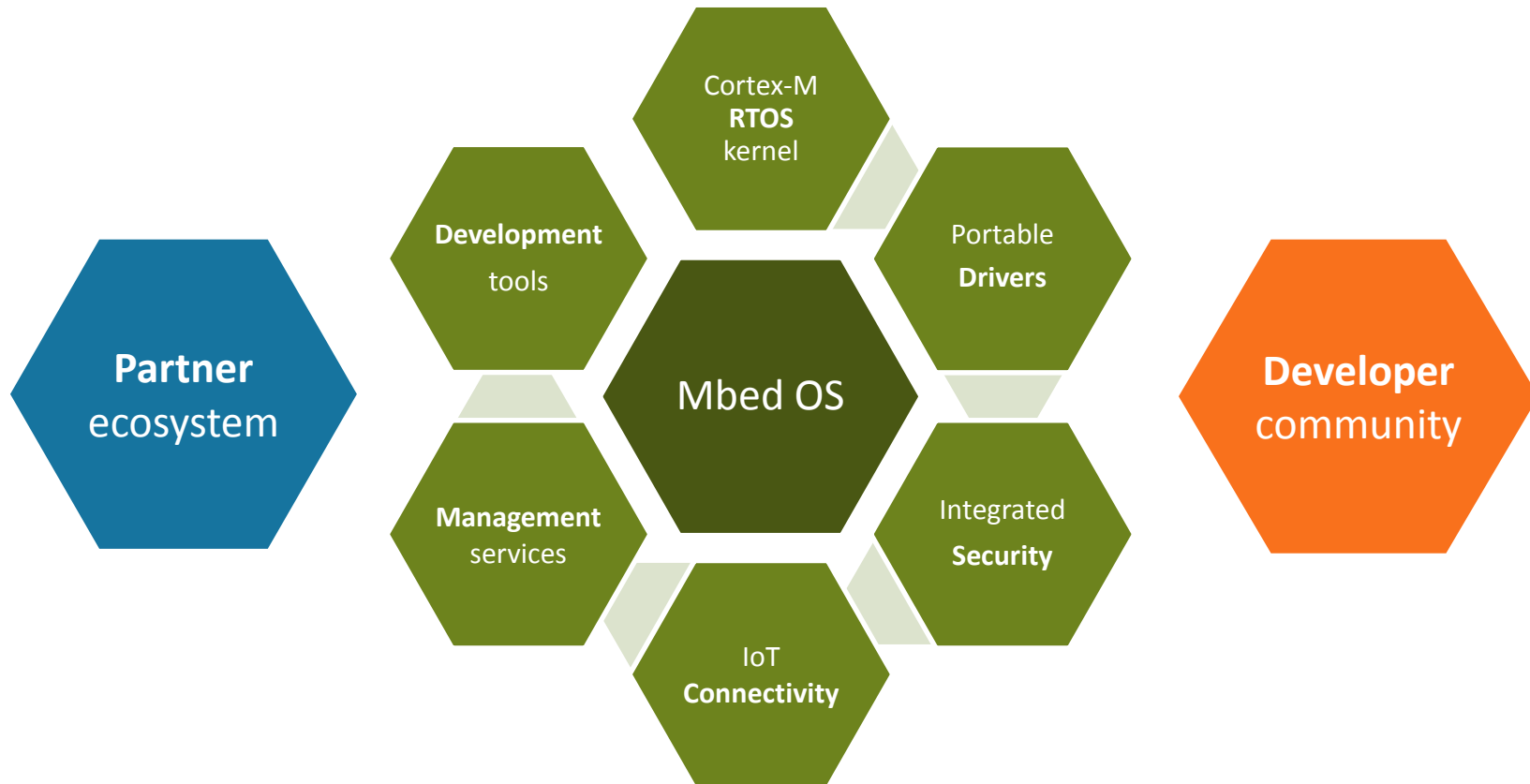


Alibaba Cloud IoT

- Mass connected device
- Multiple device models to simplify the application development
- Multilevel authentication mechanism
- Multiple scenes of device communication
- Data analysis service for data visualization



-1- Arm® Mbed™ OS



-2- Amazon FreeRTOS

FreeRTOS

- Support different architectures and development tools
- Minimal ROM, RAM and processing requirement.
- Scalable, simple, and easy use
- Active forum

Amazon FreeRTOS

- Based on the FreeRTOS kernel
- Include Connectivity, Security, and Over-the-air update, etc. libraries
- Configuration Wizard



-3- AliOS Things









Nuvoton MCU was certified
by AliOS Things

Part of Ali Cloud ecosystem

Value-added Ali Cloud Service



NuMaker IoT Development Platform

NuMaker	IOT-M487	PFM-M487	PFM-NUC472	PFM-M453	PFM-NANO130	PFM-M2351
						
Core	Mbed Certified	Mbed Certified	Mbed Certified	Mbed Certified	Mbed Certified	Mbed Certified
Clock (MHz)						
Flash / SRAM (字节)	512K / 160K	AliOS Things Certified	512K / 64K+1M*1	256K / 32K	AliOS Things Certified	512K / 96K
Full-speed USB	OTG/Host/Device		OTG/Host/Device	OTG/Host/Device		OTG/Host/Device
High-speed USB	OTG/Host/Device	OTG/Host/Device	Device			
Ethernet MAC	√	√	√			
Wi-Fi	√					√
HW Crypto	√	√	√			√
SPI Flash (bytes)	4M*2	256K*2				4M*4
Audio Codec	NAU88L25	NAU88L25	NAU8822L	NAU8822L		NAU88L25
RS232 / RS485 / CAN			1 / 1 / 1	0 / 1 / 1		
Sensors on board	BMX055*5		MPU6500*6	MPU6500*6		
MicroSD Card Slot	√	√	√			√
LED / Button	3 / 2	3 / 2	1*3 / 2	1*3 / 2	3 / 2	2 / 2
NuMaker Brick I2C I/F	√					
Arduino Uno I/F	√	√	√	√	√	√
mikroBus™ I/F	√					
Simulated Image Sensor I/F	√					
NuLink-Me (ICE)	√	√	√	√	√	√

*1 External 1MB SRAM

*2 External SPI Flash

*3 RGB LED

*4 Winbond Secure SPI Flash

*5 9-axis Sensor

*6 6-axis Sensor

HMI Development Platform

emWin GUI Library

HMI Development Platform

NK-N9H20



- Platform P/N: NuMaker emWin N9H20
- MPU: ARM9 @ 200 MHz
- Panel Size: 3.5" (320x240)
- Panel I/F: 8-bit serial RGB



NK-N9H30



- Platform P/N: NuMaker emWin N9H30
- MPU: ARM9 @ 300 MHz
- Panel Size: 5" (800x480)
- Panel I/F: 24-bit RGB



NK-BEDM487D



- Platform P/N: NuMaker emWin M487
- MCU: Cortex-M4 @ 192 MHz
- Panel Size: 2.4" (320x240)
- Panel I/F: EBI



NK-NUC126D



- Platform P/N: NuMaker emWin NUC126
- MCU: Cortex-M0 @ 72 MHz
- Panel Size: 2.4" (320x240)
- Panel I/F: SPI



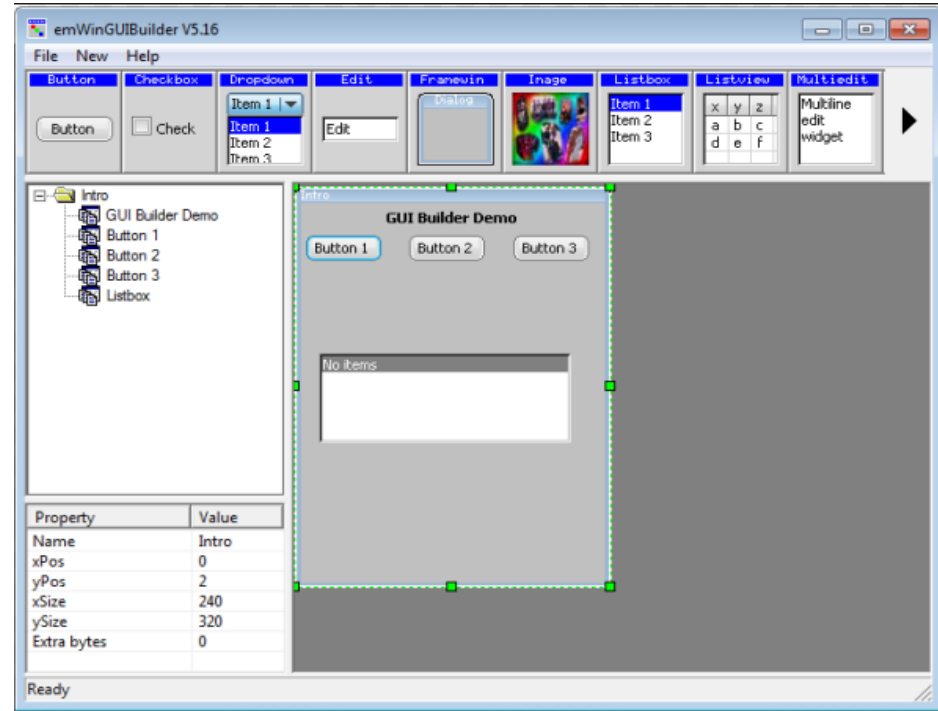
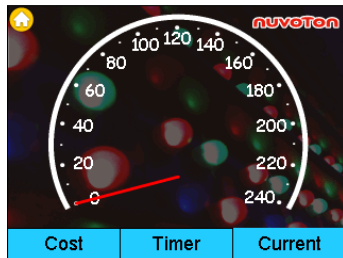
emWin Supported HMI Solution

Resolution	< 320 x 240	< 480 x 272	320 x 240 ~ 800 x 480	800 x 480 ~ 1024 x 768	800 x 480 ~ 1024 x 768
Series	NUC126	M480	N9H20	N9H26	N9H30
Core	Cortex-M0 @ 72MHz	Cortex-M4 @ 192MHz	ARM9 @ 200MHz	ARM9 @ 264MHz	ARM9 @ 300MHz
Panel Interface	SPI / I ² C	SPI / I ² C / i80 (8/16bit)	i80 (8/16bit) / RGB (16/24bit)	i80 (8/16bit) / RGB (16/24bit)	i80 (8/16bit) / RGB (16/24bit)
Color Depth	Mono OLED / 65K TFT	Mono OLED / 65K TFT	65K / 16M TFT	65K / 16M TFT	65K / 16M TFT
Input Type	Button, Ext Touch IC: Res/Cap	Button, Ext Touch IC: Res/Cap	Res Touch (internal ADC) Cap Touch (Ext. Touch IC)	Res Touch (internal ADC) Cap Touch (Ext. Touch IC)	Res Touch (internal ADC) Cap Touch (Ext. Touch IC)
Flash / RAM	128KB/20KB	(1)256KB/96KB (2)512KB/160KB	External Flash RAM: 2MB/ 8MB/ 32MB	External Flash RAM: 16MB/ 32MB	External Flash RAM: 16MB/ 32MB
Video Codec	-	-	MJPEG	MJPEG/H.264	MJPEG
Audio	I ² S	I ² S	Stereo DAC / I ² S	Stereo Codec / I ² S	I ² S

Windows Tool / API / Graphic Library

Tools

- **GUIBuilder Window Manager and Widgets Modules**
- API for line drawing, draw frame, draw circle, etc.
- Bitmap conversion tools in Windows
- Support ISO 8859-1 Font character
- Support black and white, grayscale and color displays
- Support ADC touch screen and mouse



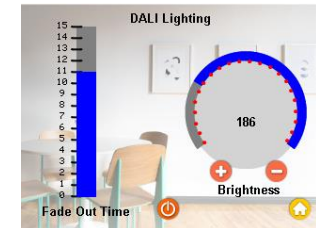
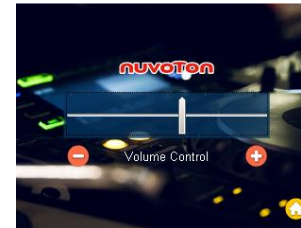
Nuvoton GUI Examples

Nuvoton Widgets

- Dali Control - Brightness & Time
- Smart Plug - Power consumption and expense estimation
- Timer Control
- Music Volume Control



Nuvoton emWin GUI Demo



Summary

New Product Table

NUC980 Series

7
P/N

- 300 MHz ARM926EJ-S
- Internal 128 MB DDR
- HW Crypto Engine
- Boot from SPI NAND, NAND or eMMC
- 6x USB FS Host
- 2x USB HS Host
- 2x Fast Ethernet MAC

M480 Series

47
P/N

- 192 MHz Cortex-M4F
- 512 KB Flash w/ XOM
- 160 KB SRAM
- Secure Boot
- USB HS OTG w/ PHY
- X-less USB
- 2x 12-bit 5 MSPS ADC
- 3x CAN 2.0B
- HW Crypto / Ethernet MAC
- 130 μ A/MHz
- $RTC(V_{BAT}) < 900$ nA

M2351 Series

4
P/N

- 64 MHz Cortex-M23
- **TrustZone**
- 512 KB Flash w/ XOM
- 96 KB SRAM
- Secure Boot
- HW Crypto Engine
- Multiple Power Management Mode
- 45 μ A/MHz (DC-DC)

M261 Series

9
P/N

- 64 MHz Cortex-M23
- 512 KB Flash w/ XOM
- 96 KB SRAM
- Secure Boot
- HW Crypto Engine
- Multiple Power Management mode
- 45 μ A/MHz (DC-DC)

M251/M252 Series

31
P/N

- 48 MHz Cortex-M23
- 256 KB Flash w/ XOM
- 32 KB SRAM
- X-less USB
- Programmable Serial I/O (PSIO)
- HW Multiplier / Divider
- 138 μ A/MHz

M031/M032 Series

31
P/N

- 72 MHz Cortex-M0
- 512 KB Flash
- 96 KB SRAM
- X-less USB
- 12-bit 2 MSPS ADC
- HW Divider

NUC029 Series

12
P/N

- 72 MHz Cortex-M0
- 256 KB Flash
- 20 KB SRAM
- X-less USB
- 12-bit 1 MSPS ADC (20-ch)
- 4x Comparators

ML51/MS51 Series

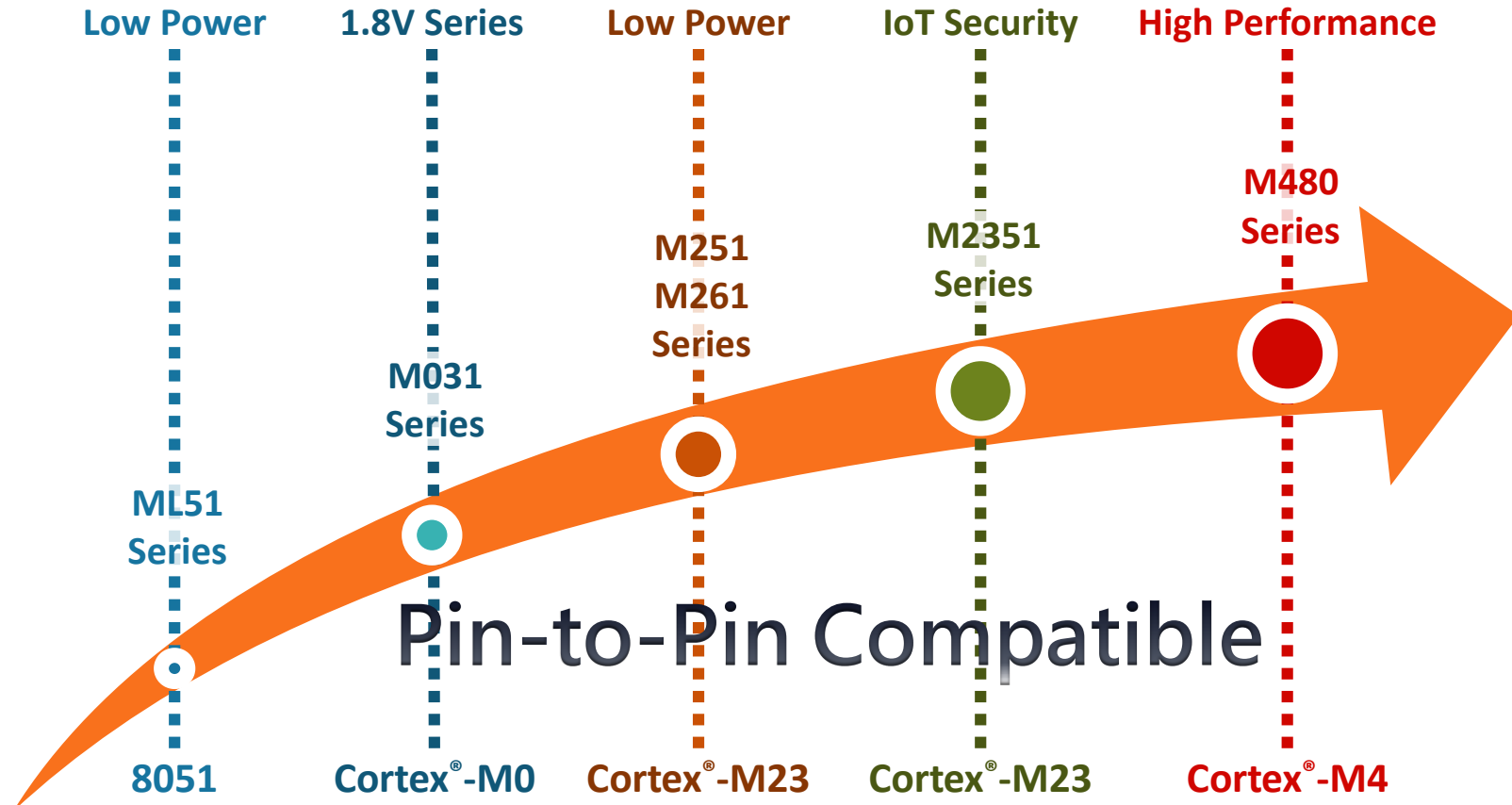
16
P/N

- ML51**
- 24 MHz 1T 8051
 - 128 bytes SPROM
 - 80 μ A/MHz + 400 μ A
 - Active 9600 UART in low power mode
- MS51**
- 24 MHz 1T 8051
 - 128 bytes SPROM
 - GPIO supports up to 24mA driving current

New Product Table

NUC980 Series 7 P/N <ul style="list-style-type: none"> 300 MHz ARM926EJ-S Internal 128 MB DDR HW Crypto Engine Boot from SPI NAND, NAND or eMMC 6x USB FS Host 2x USB HS Host 2x Fast Ethernet MAC Industrial Remote Control Device (DTU/RTU)	M480 Series 47 P/N <ul style="list-style-type: none"> 192 MHz Cortex-M4F 512 KB Flash w/ XOM 160 KB SRAM Secure Boot USB HS OTG w/ PHY X-less USB 2x 12-bit 5 MSPS ADC Smart Number Recognition Intelligent Power Outlet	M2351 Series 4 P/N <ul style="list-style-type: none"> 64 MHz Cortex-M23 TrustZone 512 KB Flash w/ XOM 96 KB SRAM Secure Boot HW Crypto Engine Multiple Power USB FIDO Key for Identity Security Secure IoT Door Lock	M261 Series 9 P/N <ul style="list-style-type: none"> 64 MHz Cortex-M23 512 KB Flash w/ XOM 96 KB SRAM Secure Boot HW Crypto Engine Multiple Power Management mode 45 μA/MHz (DC-DC) Secure IoT Door Lock
M251/M252 Series 31 P/N <ul style="list-style-type: none"> 48 MHz Cortex-M23 256 KB Flash w/ XOM 32 KB SRAM X-less USB Programmable Serial I/O (PSIO) HW Multiplier / Divider 138 μA/MHz Four-in-one Smart Electronic Lock	M031/M032 Series 31 P/N <ul style="list-style-type: none"> 72 MHz Cortex-M0 512 KB Flash 96 KB SRAM X-less USB 12-bit 2 MSPS ADC HW Divider PM2.5 Laser Detection Module	NUC029 Series 12 P/N <ul style="list-style-type: none"> 72 MHz Cortex-M0 256 KB Flash 20 KB SRAM X-less USB 12-bit 1 MSPS ADC (20-ch) 4x Comparators Smart Toilet	ML51/MS51 Series 16 P/N <p>ML51</p> <ul style="list-style-type: none"> 24 MHz 1T 8051 128 bytes SPROM 80 μA/MHz + 100 μA Electronic Shelf Label <p>MS51</p> <ul style="list-style-type: none"> 24 MHz 1T 8051 128 bytes SPROM Wireless Power Supply and Data Transfer

2019 Brand New MCU Platform



NuMicro® Product Portfolio

Joy of innovation
Silverson

	8051	Cortex®-M0	Cortex®-M23 W/O TrustZone®	Cortex®-M23 W. TrustZone®	Cortex®-M4	Arm9™
High Performance Industrial Control					M480 192 MHz core speed	NUC980 Industrial IoT NUC970 KGD SDRAM
IoT Security			M261 Wide Op. Voltage, Low power M251/252 Wide Op. Voltage, Low power	M2351 TrustZone®		
Industrial Control	MS51 High Immunity	NUC120 USB & 5V App M051 5V App Mini51 Entry 32-bit	M031/032 Multi-peripheral and high speed ADC NUC029 High Immunity NUC130 CAN & 5V App		NUC505 Sound Processing M451 5V MCU	
Low Power	ML51 Wide Op. Voltage	Nano100 Low-power & 3V App				

NuMicro® Products

Joy of innovation

diver

8051

M0

M23
w/o TrustZone

M23
w/ TrustZone

M4

Arm9

	Series	Brief intro	Eligible Applications
High Performance Industrial Control	MUC980	Microprocessor focusing on industrial IoT	Industrial IoT
	NUC970	Industrial IoT microprocessor with internal SDRAM	Industrial IoT
	M480	High performance microcontroller: up to 192 MHz operating frequency	Wired/Wireless IoT, Industrial Control, Human Machine Interface (HMI), Ethernet communication
IoT Security	M2351	TrustZone® empowered microcontroller focusing on IoT security	IoT Security applications, Smart Door Lock, FIDO Identification
	M261	Low-power microcontroller focusing on IoT applications	IoT Node Devices, Smart Door Lock, Security Monitoring
	M251/252	Low-power Cortex®-M23 based microcontroller with security function and full speed USB 2.0	IoT Node Devices, Portable Medical Devices, Smart Mobile Payment Reader
Industrial Control	NUC505	Audio-focused microcontroller with internal 24-bit audio codec	Consumer Electronics, Audio-related systems
	M451	5V microcontroller supporting CAN 2.0B and full-speed USB	5V systems, Consumer Electronics, Home Appliances
	M031/032	A 3V microcontroller with plenty peripherals and high-speed ADC application	Industrial Control, High Precision Instrument, Wireless Charger, HMI, IoT Node Devices, Security Systems
	NUC029	5V microcontroller supporting high resistance EFT	Industrial Control, High Precision Instrument, HMI, Motor Control, Communication Systems
	NUC130	5V microcontroller supporting CAN application	Automotive Devices, Security Systems, Communication Systems, Elevators
	NUC120	5V microcontroller supporting full-speed USB 2.0	USB Composite Devices, Gaming Mice/ Keyboards, Industrial Control
	M051	5V microcontroller focusing on industrial applications	Industrial Control, Security/ Alarm Systems, Temperature Sensors, Motors
	Mini51	5V entry-level 32-bit microcontroller	Wireless Charger, Home Appliances, Security/ Alarm, Temperature Sensors
	MS51	1T 8051 microcontroller providing small packages and featuring high-resistance EFT	Industrial Control, LED Lighting Control, Motor Control
Low Power	Nano100	Low-power 3V microcontroller supporting full-speed USB 2.0 and ComSeg LCD	IoT Node Devices, Portable Medical Devices, Smart Mobile Payment Reader
	ML51	Ultra low-power 1T 8051 based microcontroller with enhanced functionalities	IoT Node Devices, Handheld Devices, Sensors, Wireless Modules

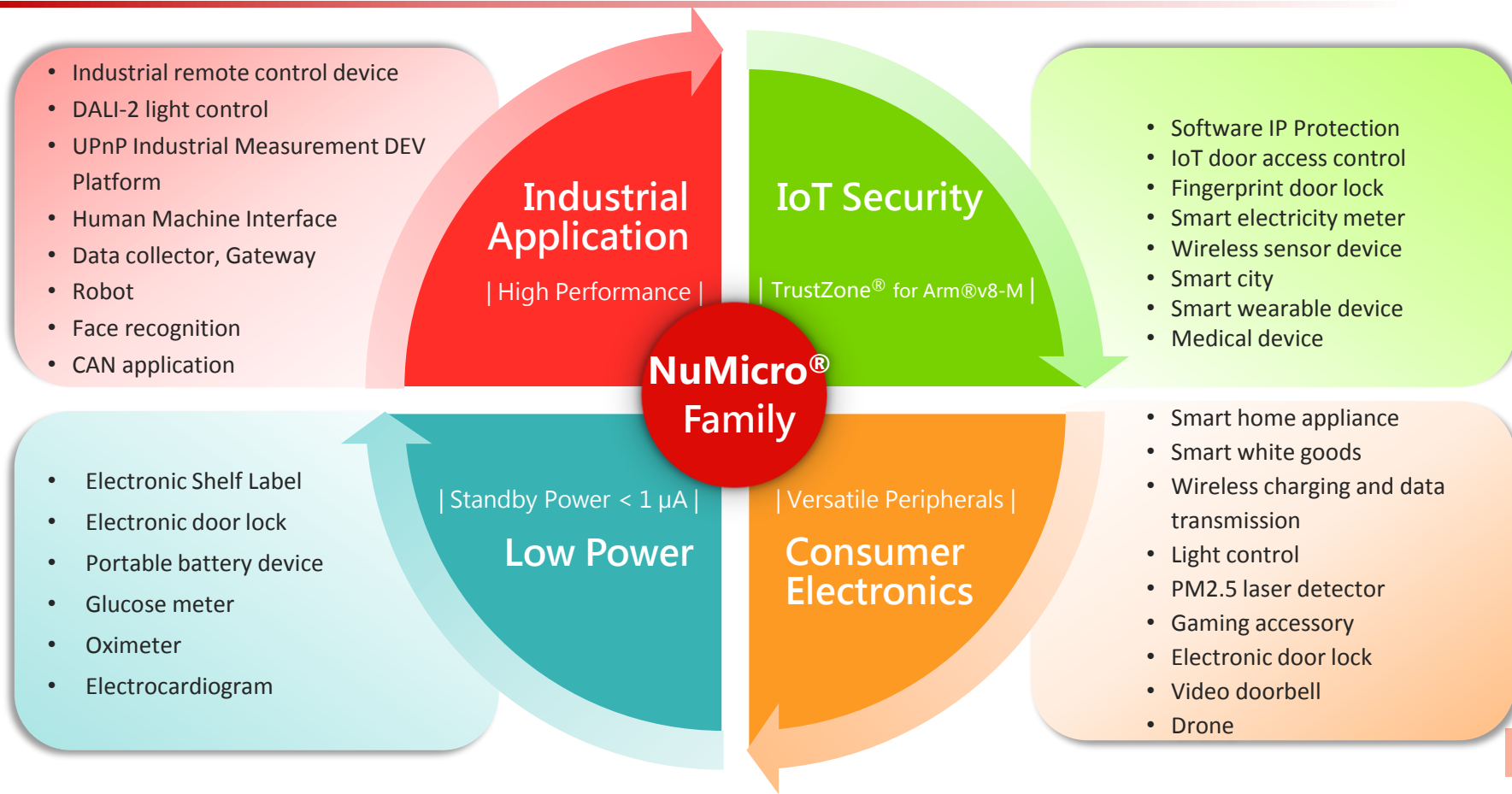
NuMicro® Microcontroller

- Comprehensive low power and high performance MCU/MPU series running up to 300 MHz
- Operating voltage : 1.8V - 3.6V / 2.5V - 5.5V / **1.8V - 5.5V**
- Industrial operating temperature : -40°C - 105°C
- Enhanced code protection techniques
- Rich and versatile peripherals with high system immunity

	CPU (MHz)	Flash	SRAM	Special Feature
8-bit	24	8 KB - 64 KB		Low Power, SPI, I2C, I2S, I2SOP
M0	24 – 72	4 KB - 512 KB		Low Power
M23	64	512 KB		Supports Arm® PSA/ TBSA- Management
M4	72 – 200	40 KB - 2 MB	16 KB - 1 MB	USB OTG, USB Host, Crypto, Ethernet
MPU	200 – 300	Boot from eMMC NAND Flash SPI Flash	Internal SDRAM 2 MB- DDR2 128 MB	UART x 11, USB Host x 2, Ethernet x 2 2D Graphic Engine, JPEG Codec, TFT-LCD, CMOS Sensor, HW Crypto

Over 600 parts
are ready for
selection

NuMicro® MCU Applications



Why Nuvoton?



Online Resource



Nuvoton Website

www.nuvoton.com

Forum

NuForum

- <http://forum.nuvoton.com>



牛卧堂

- <http://www.nuvoton-MCU.com>



21ic 中国电子网

- <http://bbs.21ic.com/iclist-187-1.html>



Media

facebook

- <https://www.facebook.com/NuvotonNuMicro/>



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- ID: nuvoton_mcu



Twitter

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BSP

GitHub

- <https://github.com/OpenNuvoton>



GitLab

- <https://gitlab.com/OpenNuvoton>



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- <https://gitee.com/OpenNuvoton>



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- <https://direct.nuvoton.com>



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- <http://nuvoton.tmall.com/>



TECH DESIGN

- www.techdesign.com/market/nuvoton



Thanks for your Participation!

See you next time...