

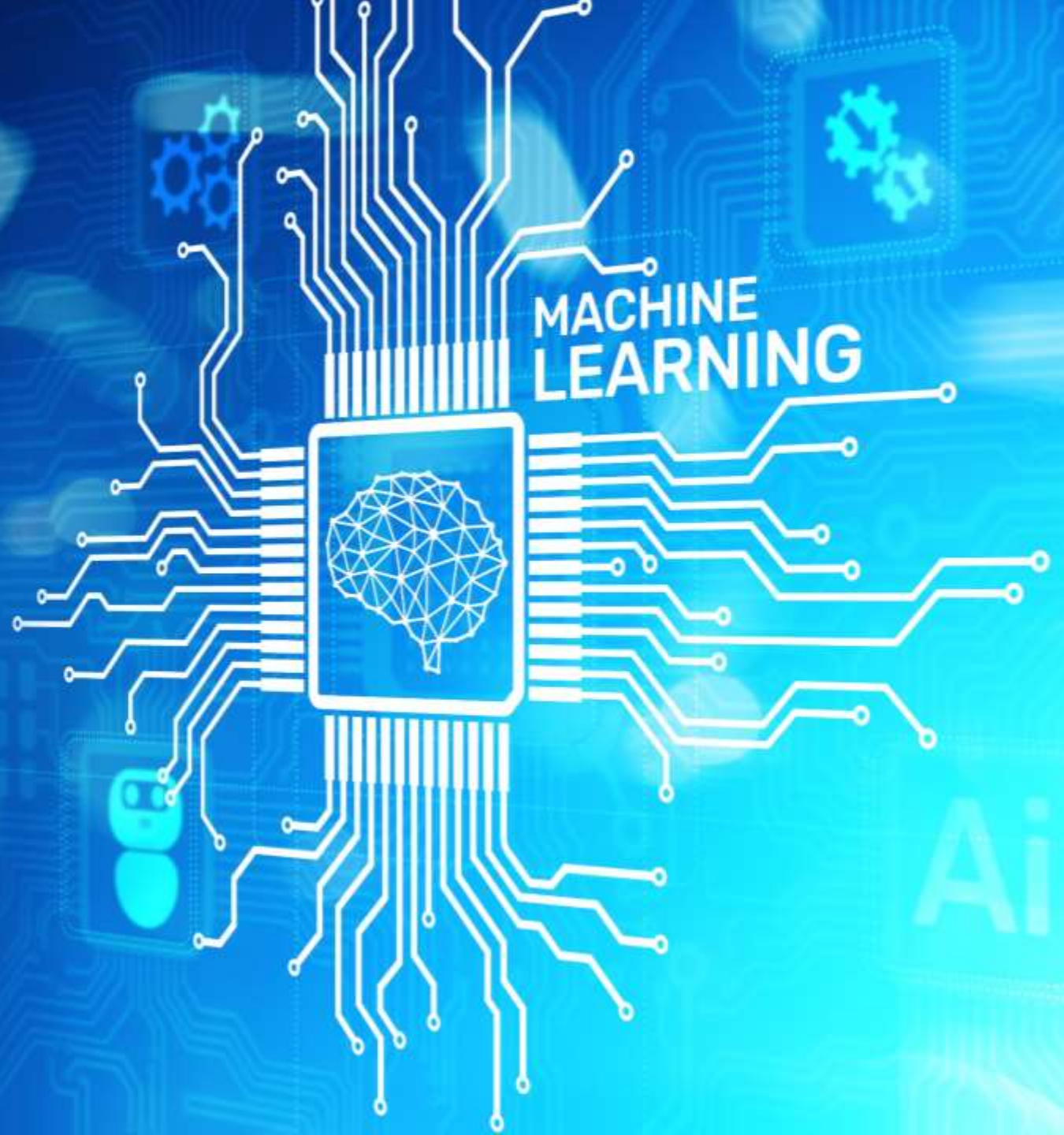
新能源應用方案

BMS 與車載電池管理

Jenny Wang 王榆甄



嵌入式 AI
啟動未來的智慧電網



Smart Grids Architecture

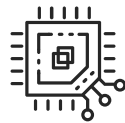


Power Generation

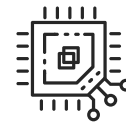
Transmission / distribution

Energy Storage

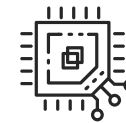
Electrical Vehicles



- NUC980
- MA35D1
- M467
- NADC24

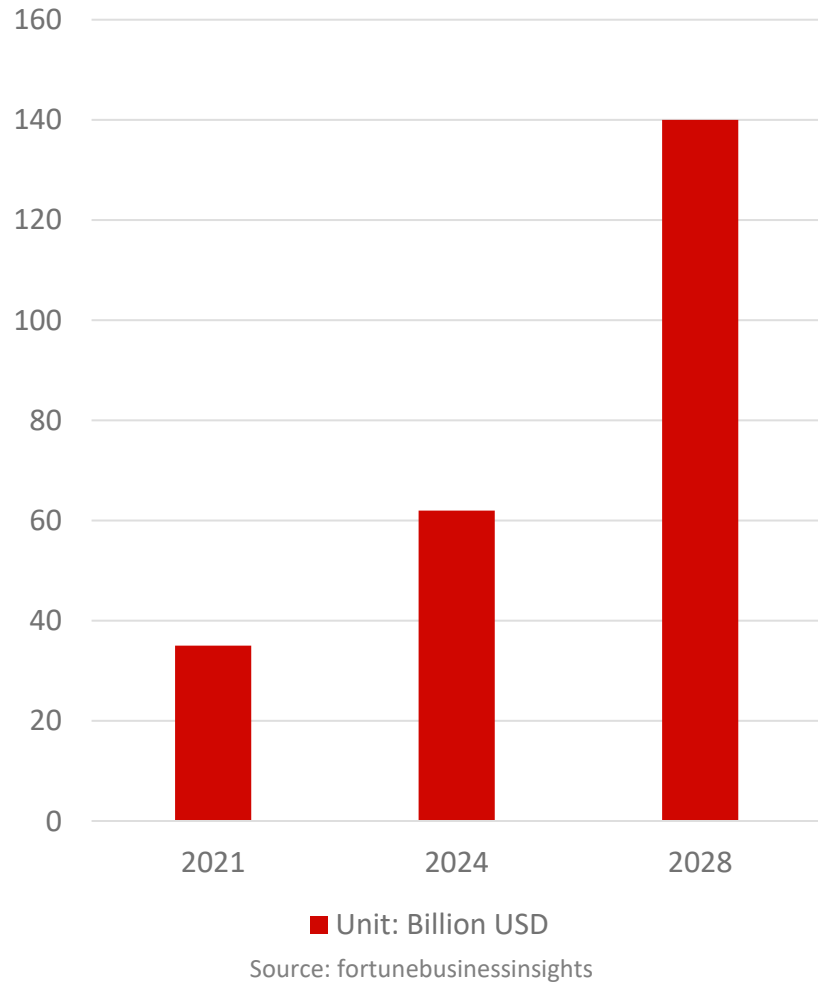


- M467
- M2L31
- KA495xxA



- M467
- M2L31
- KA84917UA
- KA84950UA

The global smart grid market



The global smart grid market is projected to grow from \$35.07 billion in 2021 to \$140.53 billion in 2028 at a CAGR of 21.9% in forecast period.

Rise in number of AI and EVs

- To improved energy efficiency to the use of smart grids.

Supportive Government Policies and Regulations

- Improved efficiency of fault detection and self-healing.
- Increased the security solutions with threat and response.

Smart Grids Architecture

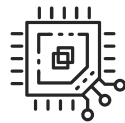


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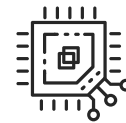
Transmission / distribution

Energy Storage

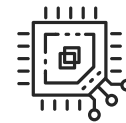
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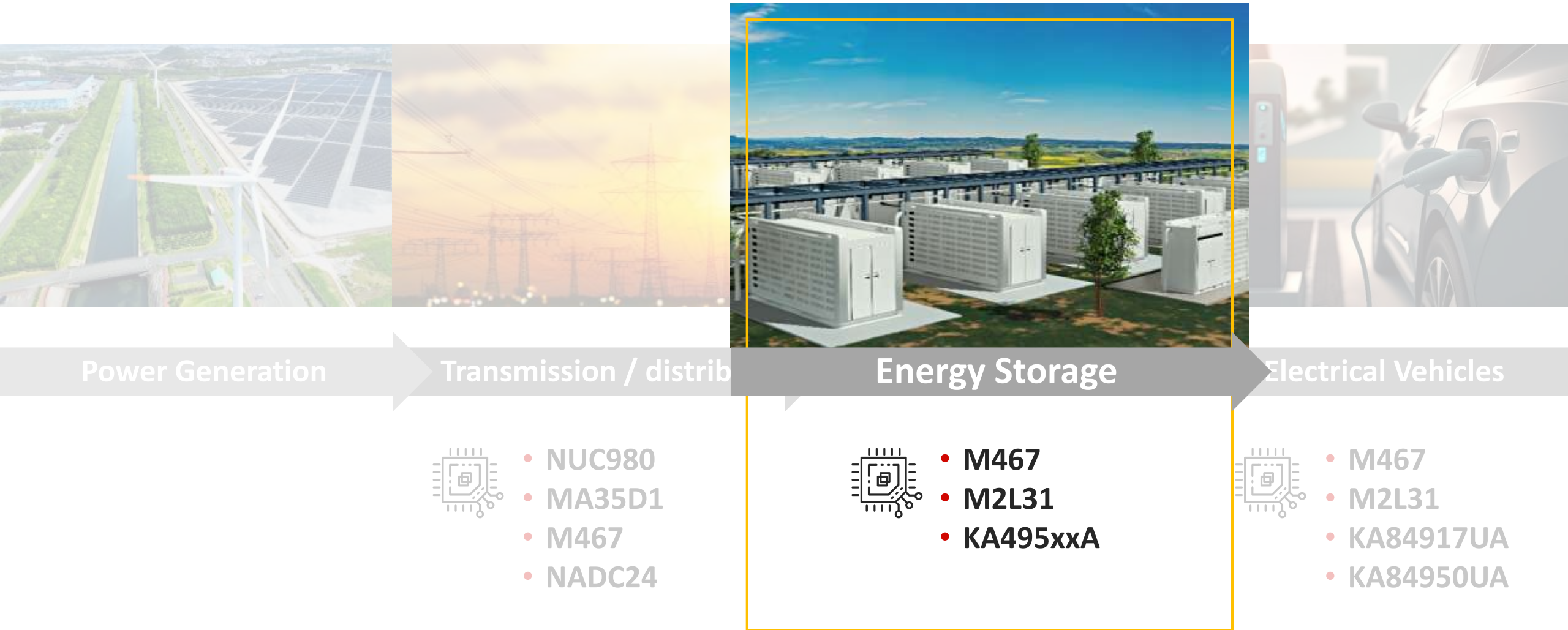


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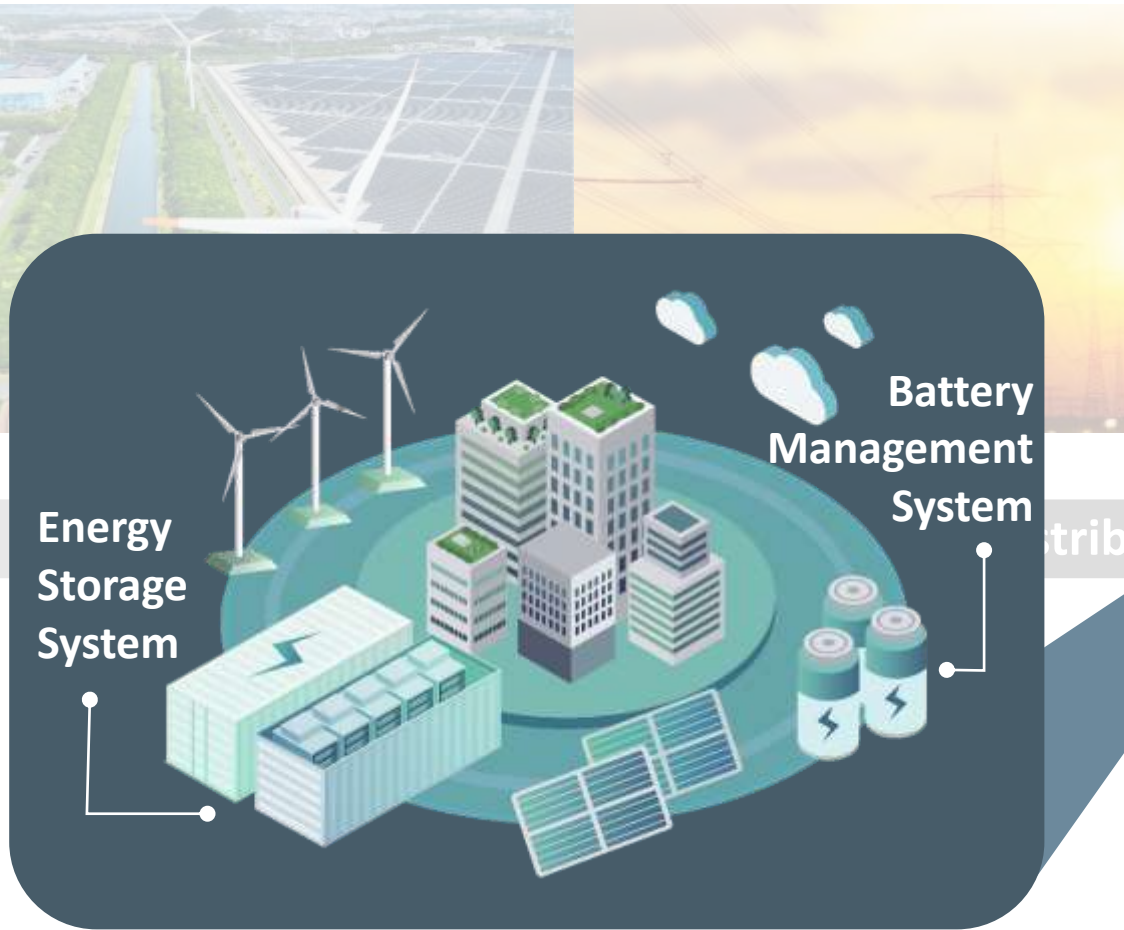


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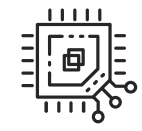
Energy Storage System Architecture



| Energy Storage System Architecture



trib **Energy Storage** Electrical Vehicles

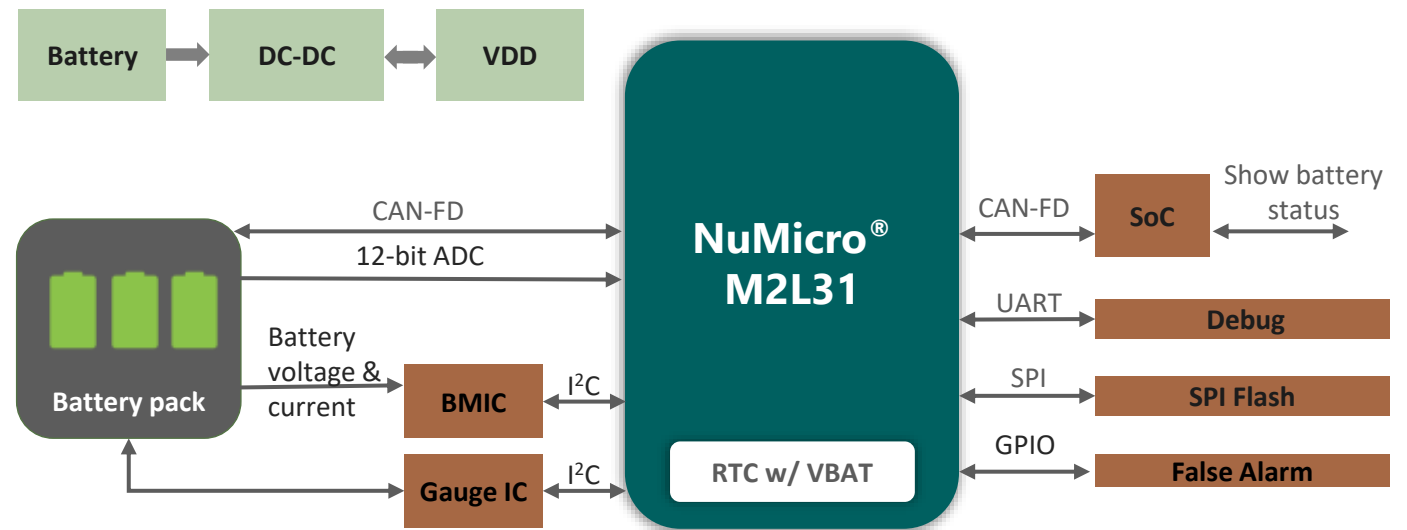


- M467
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- KA495xxA

Battery Management System

Features

- Supports **512 KB ReRAM** and 168 KB SRAM
- Built-in **Dual bank** and **Secure boot**
- 2 sets of **CAN FD** interface, up to 5 Mbps transmission rate
- Supports up to 24-ch 12-bit 3.6 MSPS ADC
- Built-in RTC with independent V_{BAT} pin to record time event
- Supports **0.3 μA** power consumption in Deep Power-down
- Supports IEC-60730 STL



M2L31 Series

Latest Low Power Mainstream Microcontroller

Low power Consumption

60 $\mu\text{A}/\text{MHz}$ @ normal run mode
2 μA @ Power down with RAM
300 nA @ deep power down mode
Independent **Low Power Domain**



Advanced Memory Structure

512 KB **ReRAM Dual bank** OTA
168 KB SRAM for RTOS



Advanced Connectivity

USB 2.0 **Type-C PD 3.1** Controller
USB2.0 FS with **OTG**
Up to 2 sets of **CAN FD**



User Interface

EBI interface
16-ch Capacitive touch



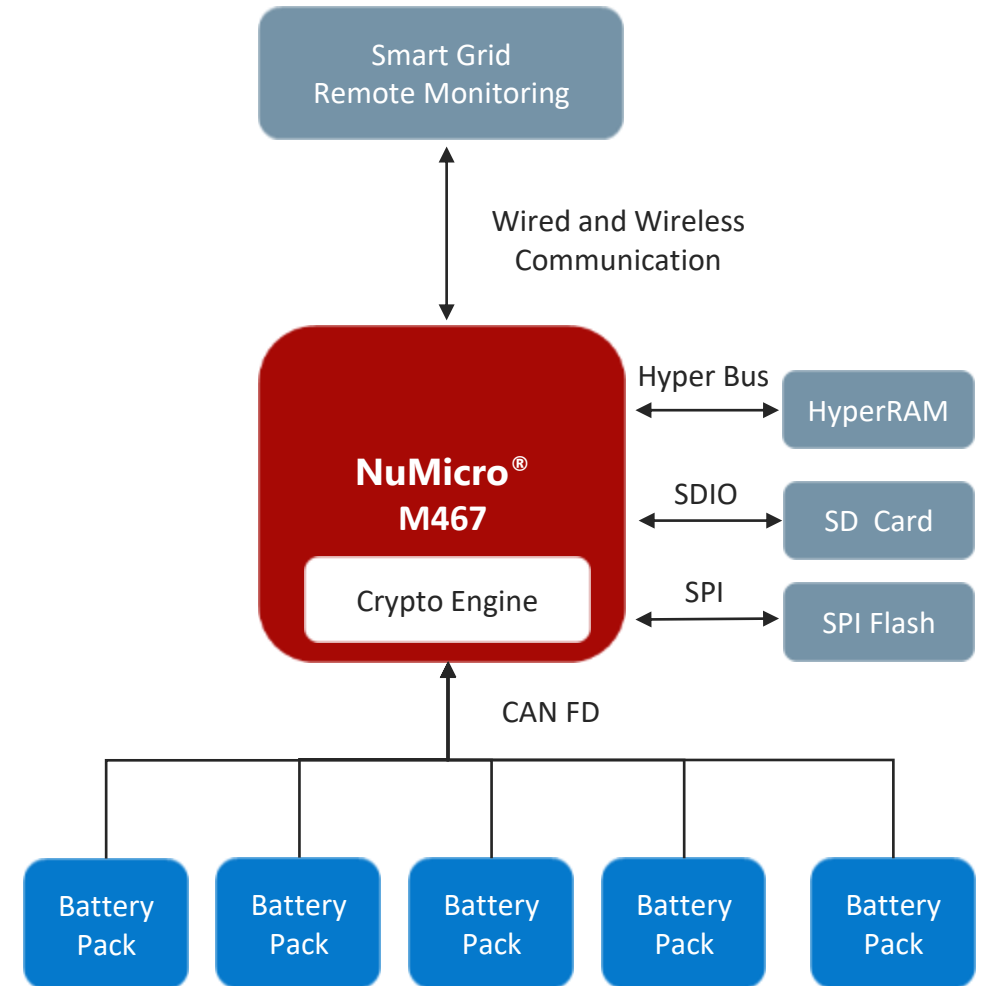
High Density Memory and Low Power Series

- Up to 72 MHz Arm[®] Cortex[®]-M23
- Operating Voltage: 1.71V to 3.6V
- Operating Temperature: -40°C to 105°C

Energy Storage System

Features

- 200 MHz Cortex-M4
- 1 MB Flash (dual bank), 512 KB SRAM
- Secure Boot
- Ethernet 10/100M
- 4x CAN FD
- Crypto Engine, Key Store, TRNG



Roadmap for Industrial BMIC

Battery Voltage V.S Applications

2021

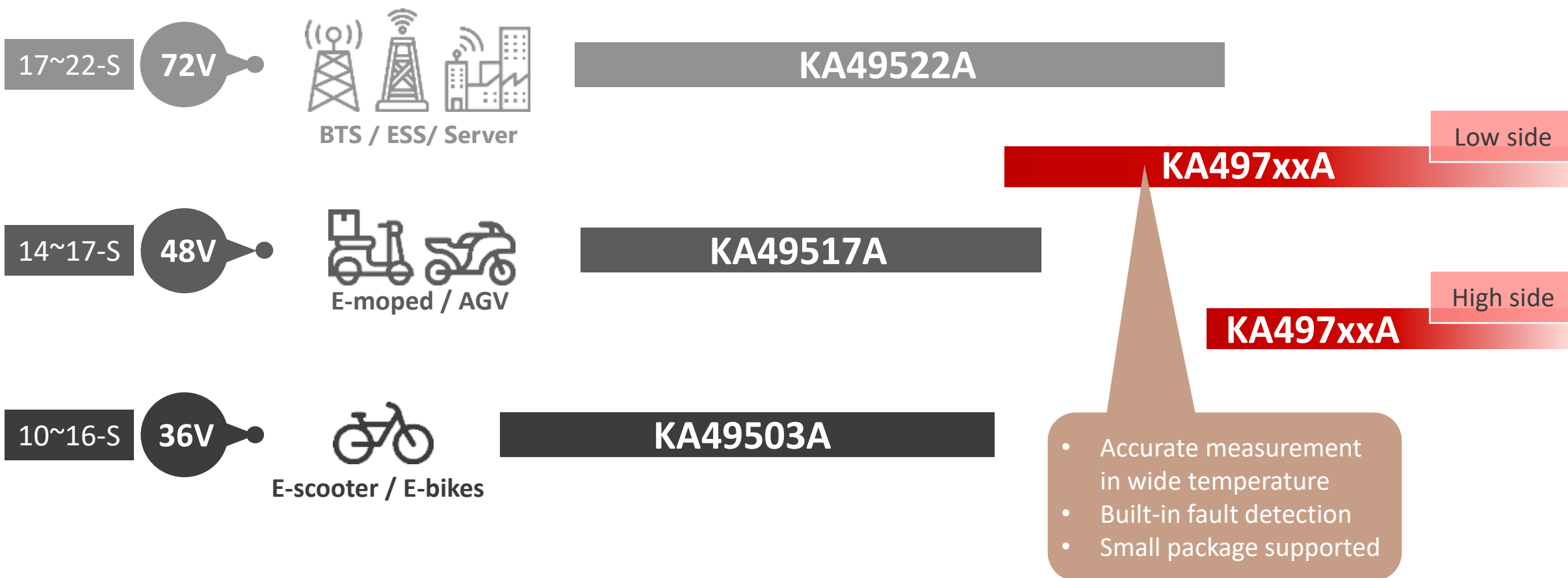
2022

2023

2024

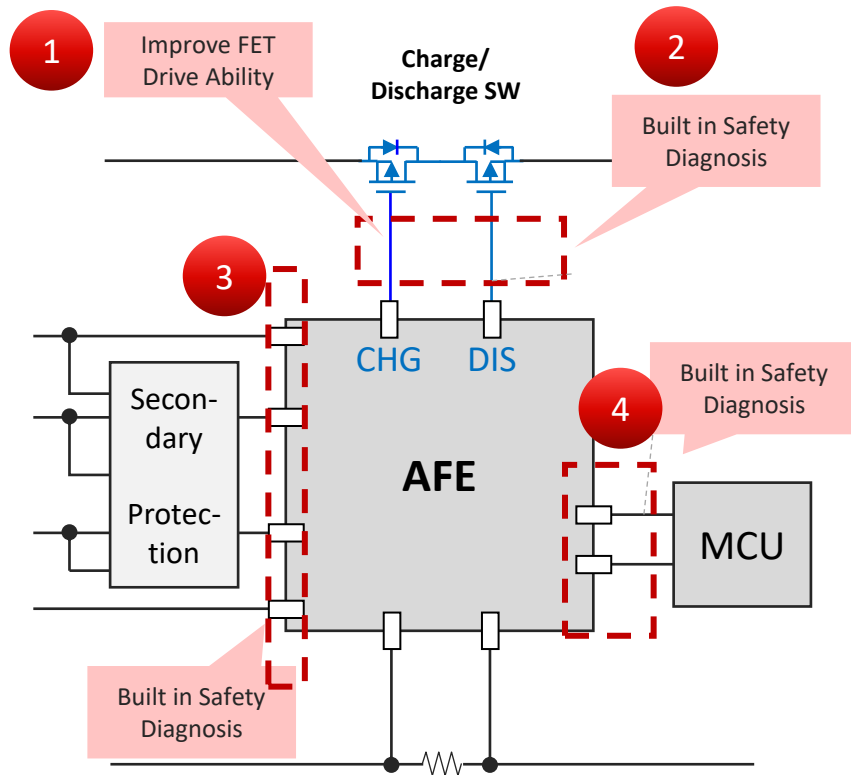
2025

2026



BMIC Features

Built-in fault detection



Specification	KA495/97xx	Competitor
Charger Detection	✓	✓
Load Detection	✓	✓
Small Current Detection	✓	✓
FET Driver Fault detection	1 ✓	Secondary Protection only
FET Driver Status monitor	2 ✓	External circuit
Current Measurement ADC diagnostic check function	3 ✓	External circuit
MCU fault diagnostic check (MCU supply reset)	4 ✓	-

Built-in safety diagnosis function

Smart Grids Architecture

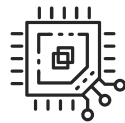


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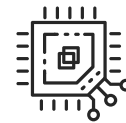
Transmission / distribution

Energy Storage

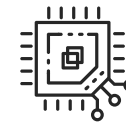
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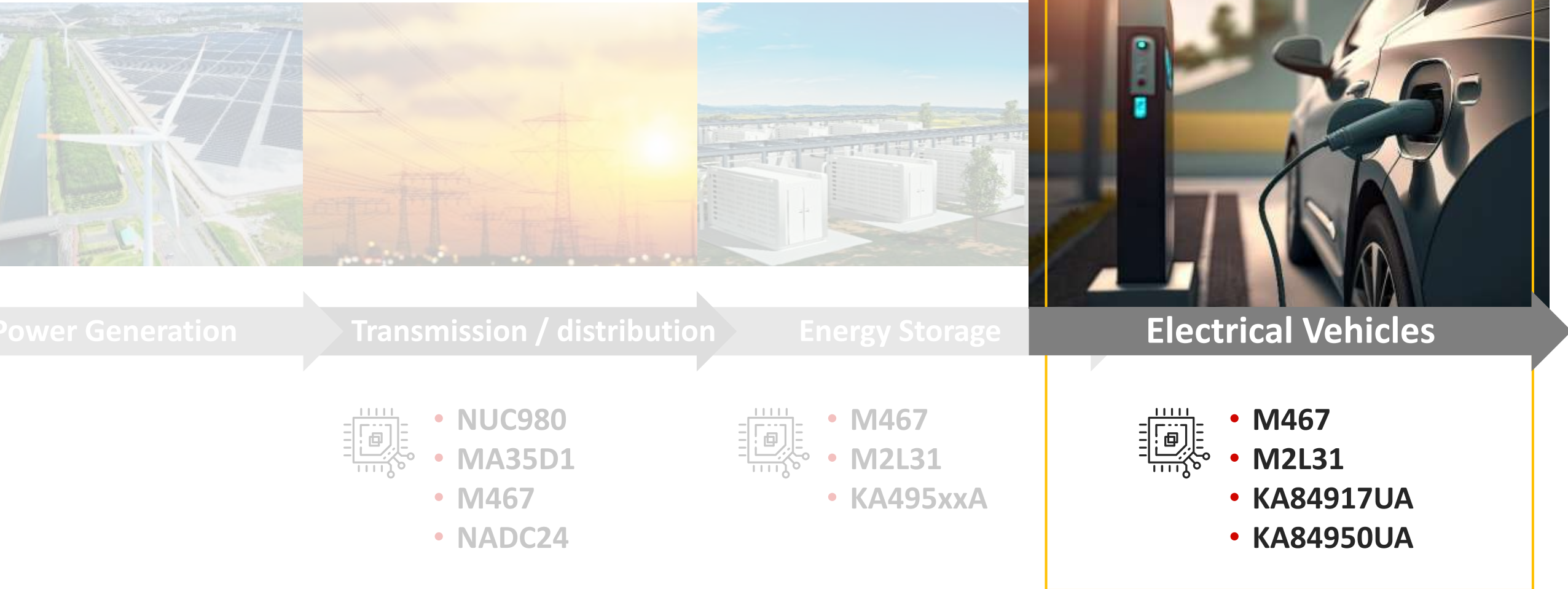


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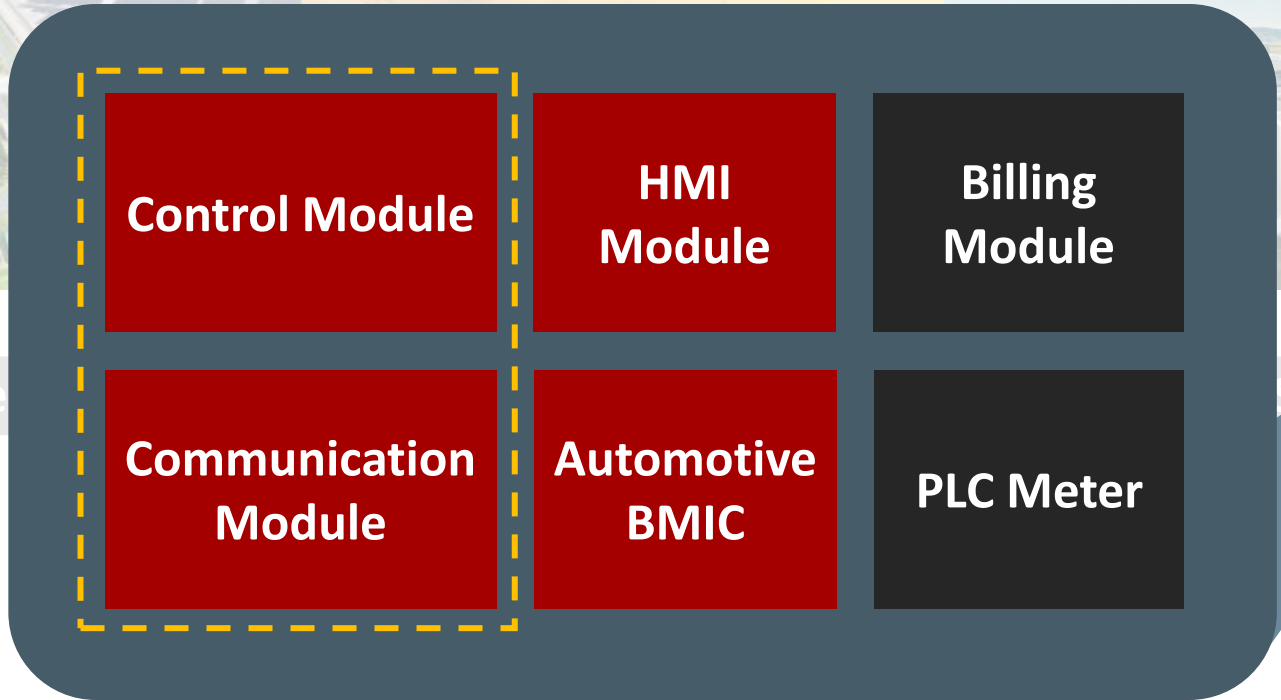


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- KA84950UA

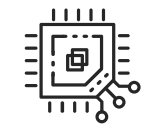
Electrical Vehicles and EV Chargers



Electrical Vehicles and EV Chargers



Electrical Vehicles



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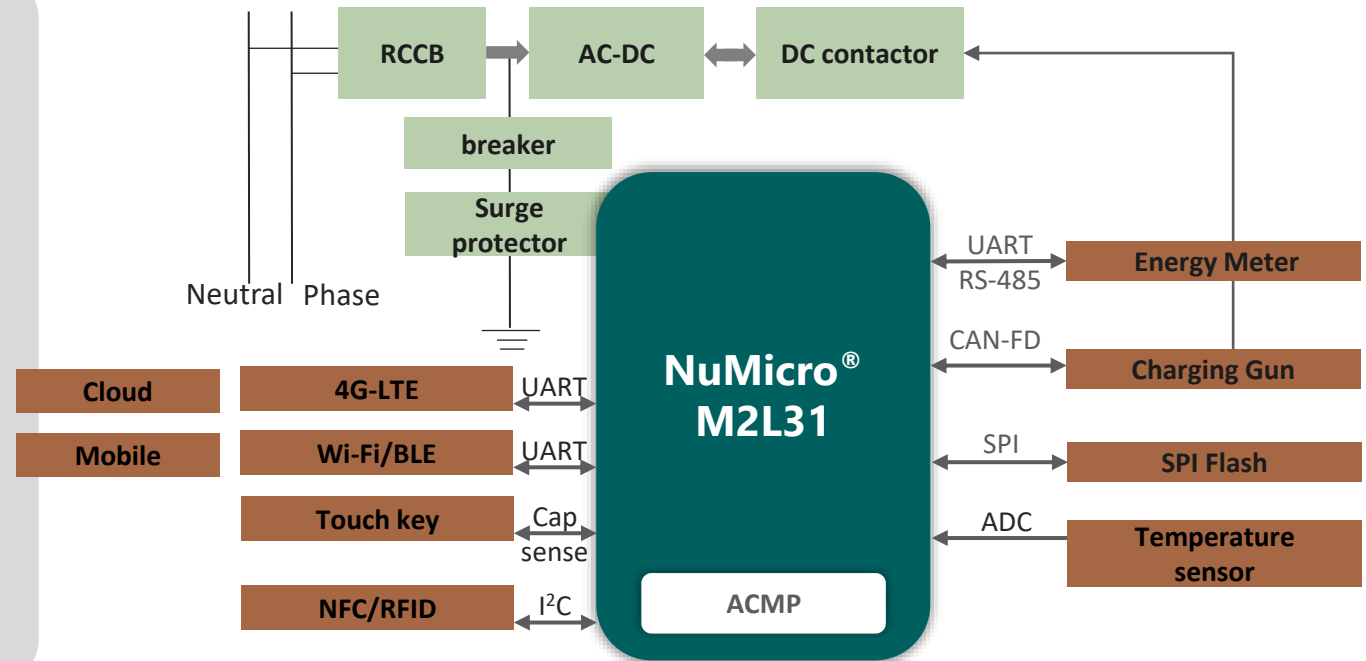
Nuvoton Solution

Outsourcing

AC type EV Charging Pile

Features

- 512 KB ROM with **dual bank** controls for read-while-write (RWW)
- **Secure Boot** to increase chip security
- Supports **2x CAN-FD** to communicate with charging gun
- Up to **8x UART** to connect with 4G LTE, Wi-Fi, BT, NFC, RFID
- Up to **3x ACMP** for signal detection and protection
- Supports up to **16-ch Capacitive touch**



剩餘電流動作斷路器: Residual Current Circuit Breaker
接觸器: Contactor
浪湧保護器: Surge protector

Advanced Features for M2L31 Series



ReRAM

Faster Rewrite speed
Supports “Word” & “Word line”
programming
Low Power consumption



Security

Crypto engines
Secure boot
Write protection
Hardware pin lock



Ultra-Low-Power

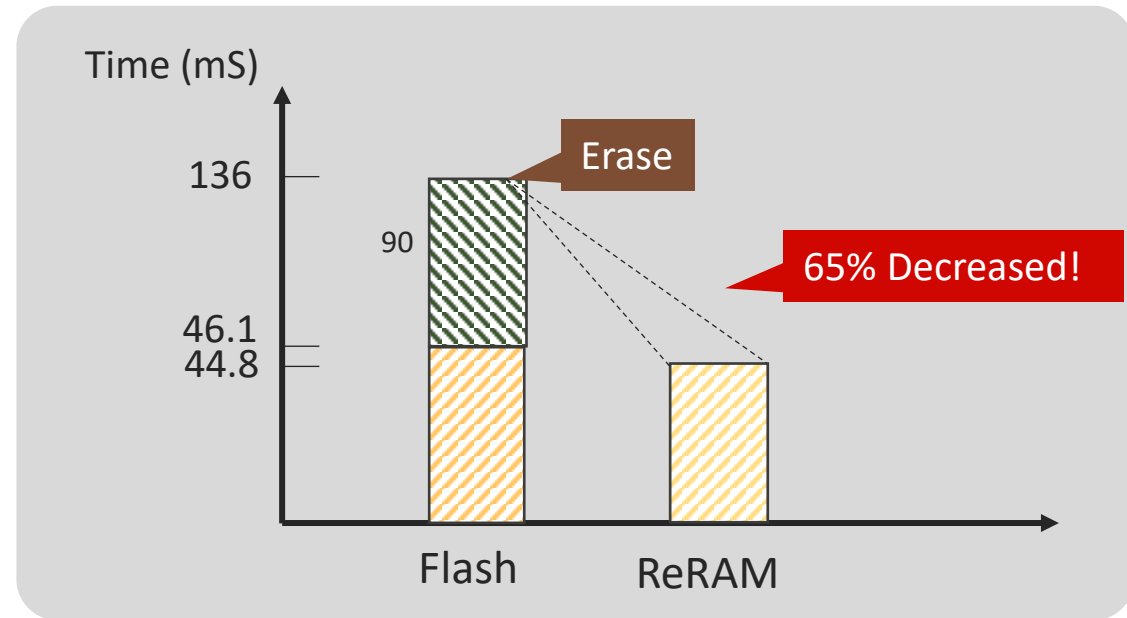
SIX Low Power modes
Independent Low Power domain
60 μ A/MHz in Normal run mode
0.5 μ A in deep Power down mode

Advanced Features for M2L31 Series



ReRAM

No need Page erase
Faster reprogram speed than Flash



Program by one page (4 KB)

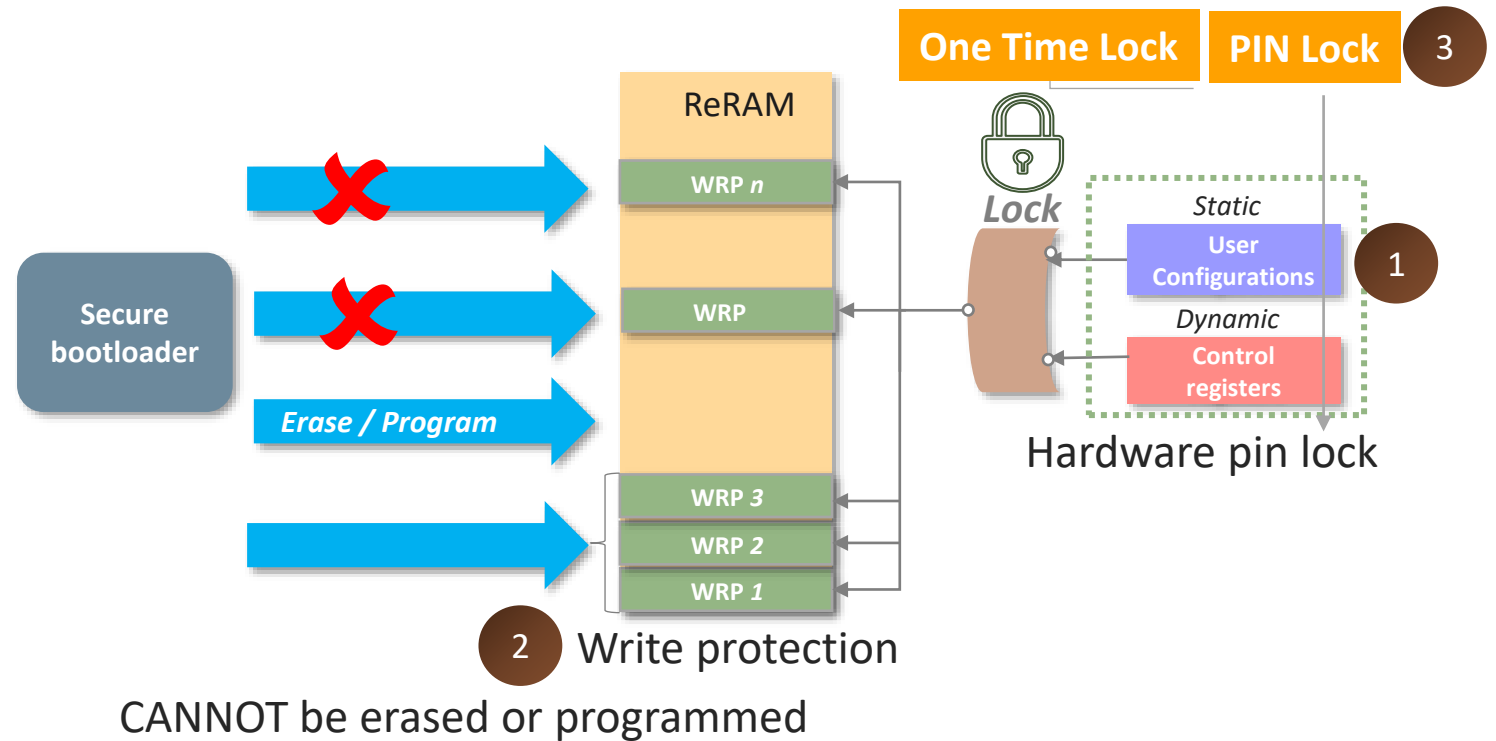
1 word = 4 byte
1 page = 1024 word
 $1024/64 \times 2.8\text{ms} = 44.8\text{ mS}$

Advanced Features for M2L31 Series



Security

Enable by Control registers or User Configuration
The entire ReRAM can be divided into minimum 8k unit.
DUAL protection mechanism

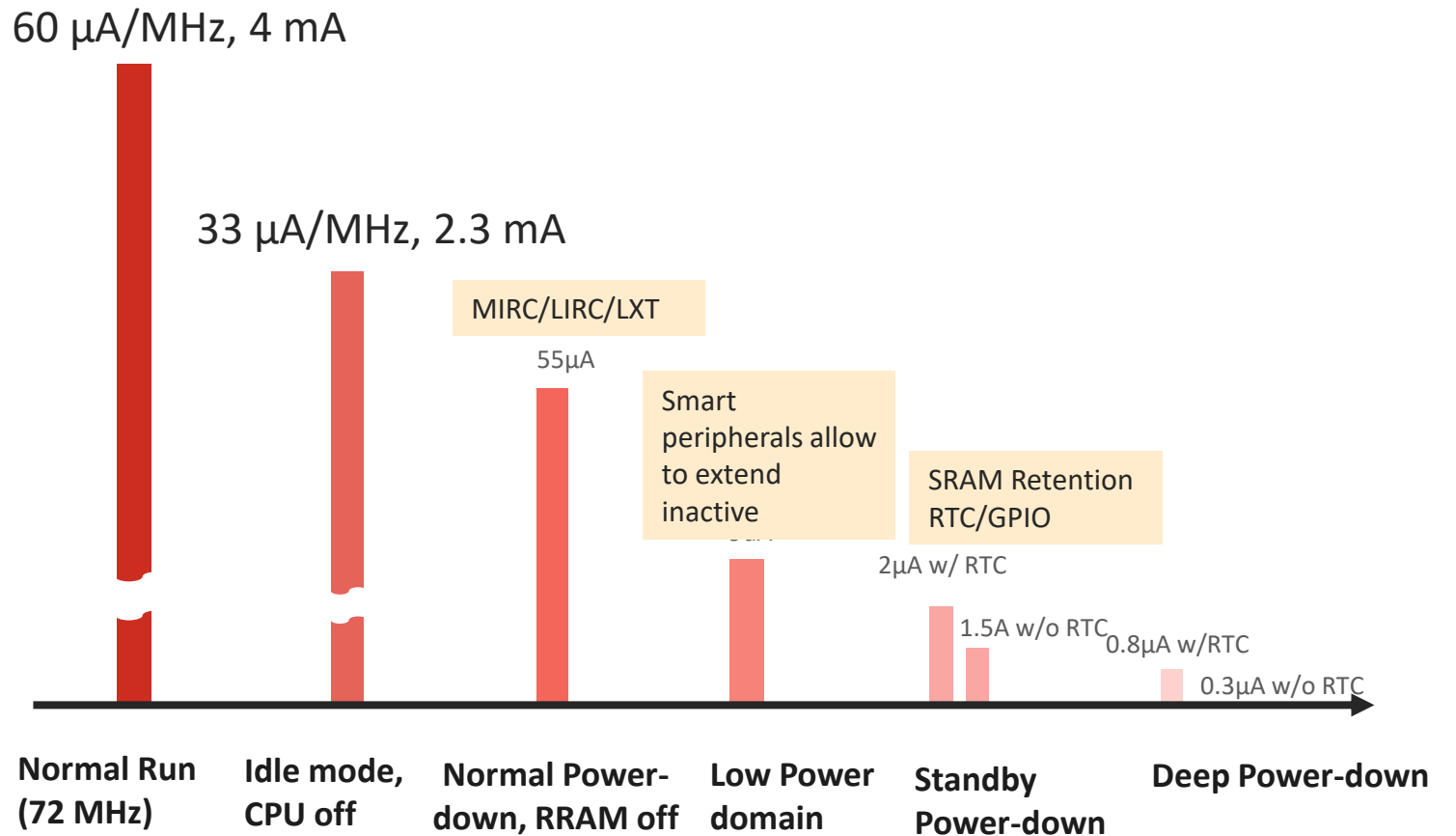


Advanced Features for M2L31 Series

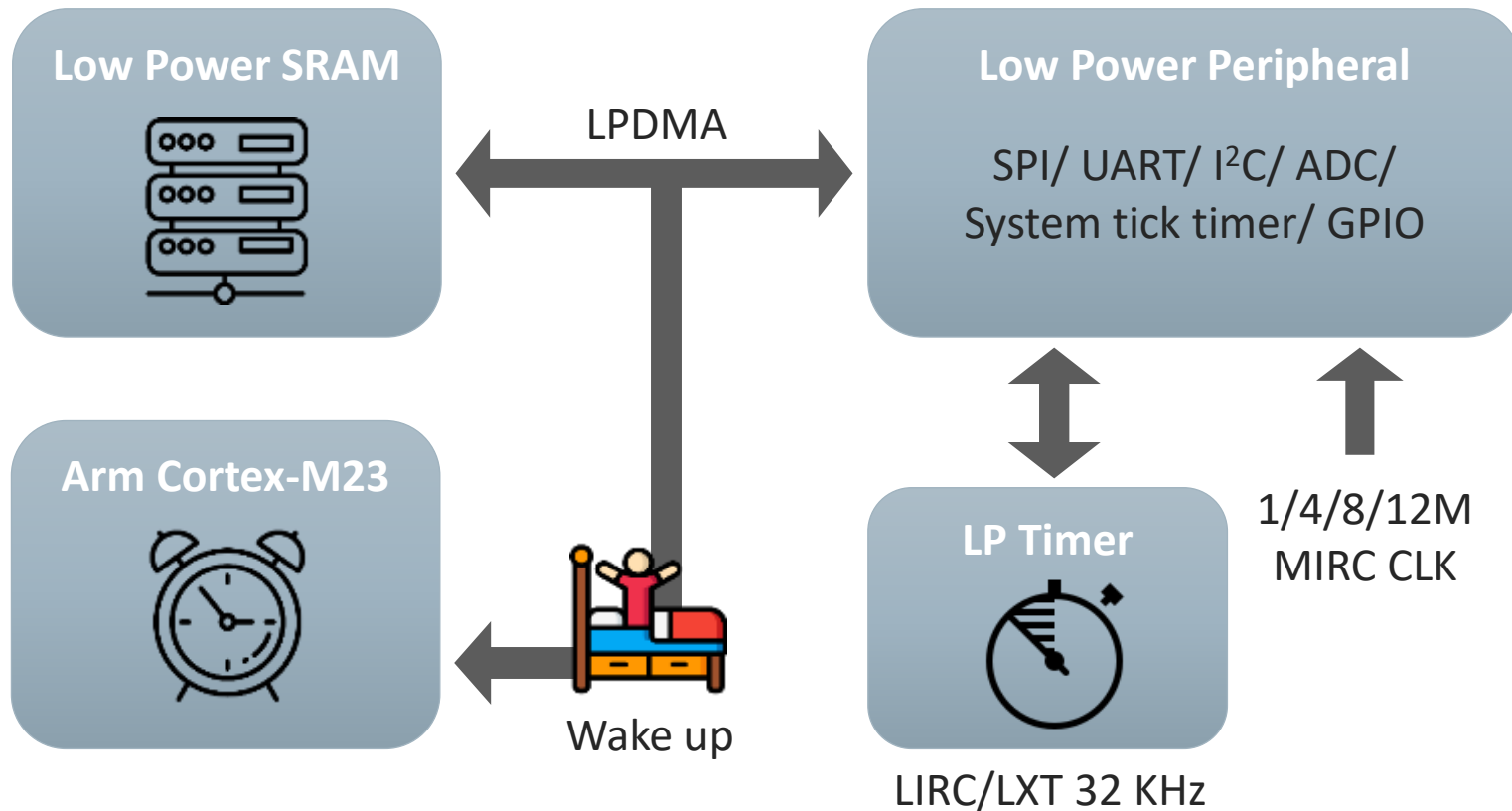


Ultra-Low-Power

SIX Low Power modes
Independent Low Power domain
60 $\mu\text{A}/\text{MHz}$ in Normal run mode
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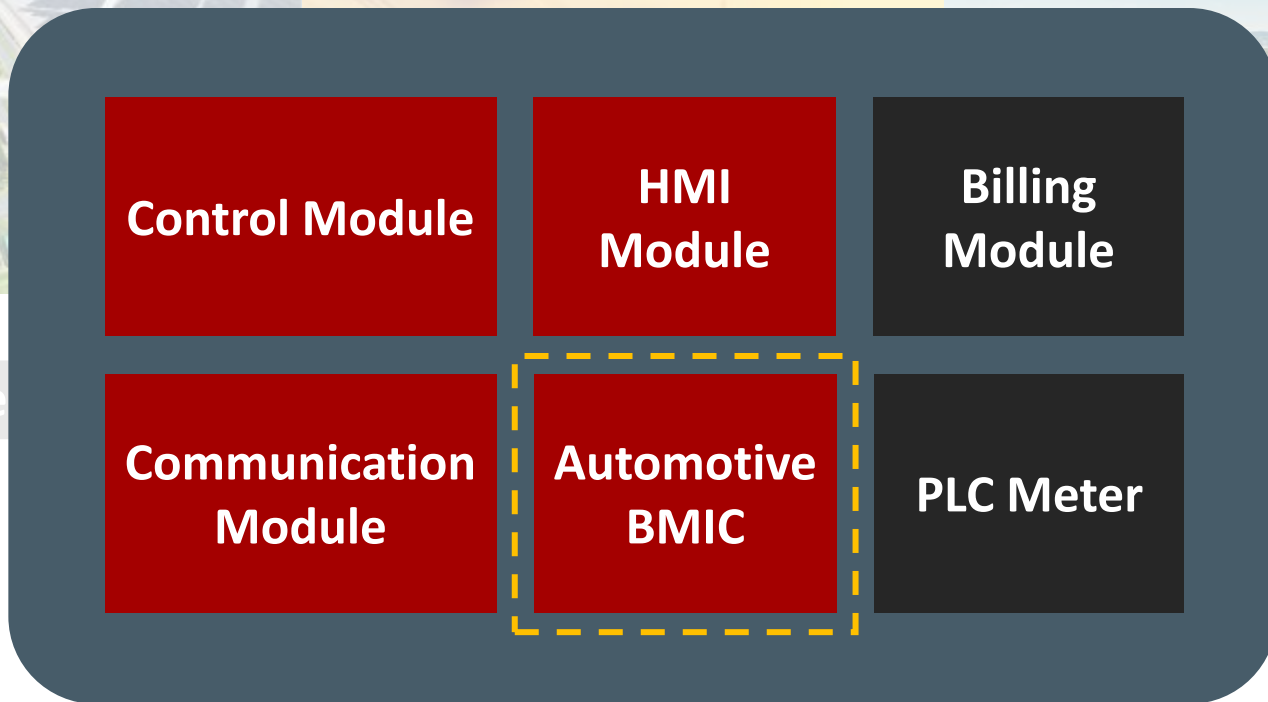


Auto Operation in Low Power Domain

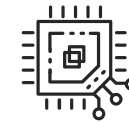


- Low Power Peripherals can be **functional and autonomous** in Power-down mode.
- **ACMP** supports ADC **trigger** and **wake up function**.

Electrical Vehicles and EV Chargers



Electrical Vehicles



- M467
- M2L31
- KA84917UA
- KA84950UA

Nuvoton Solution

Outsourcing

Automotive BM-IC Roadmap

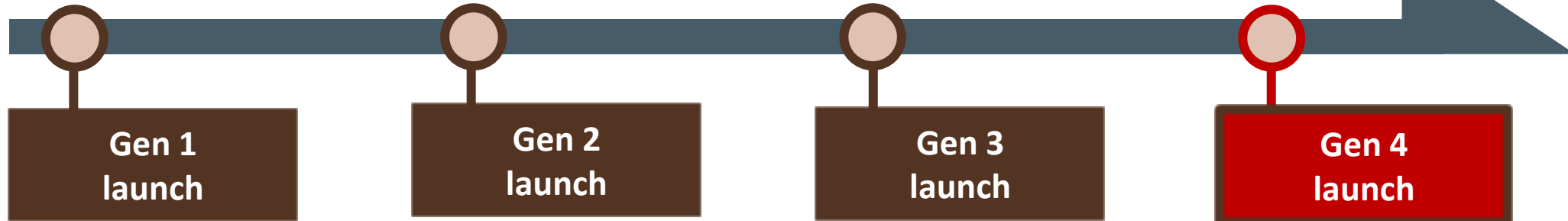
ASIL-D



Released the press on 29th Aug

CY2010

CY2023



BM-IC 25ch
KA84950UA

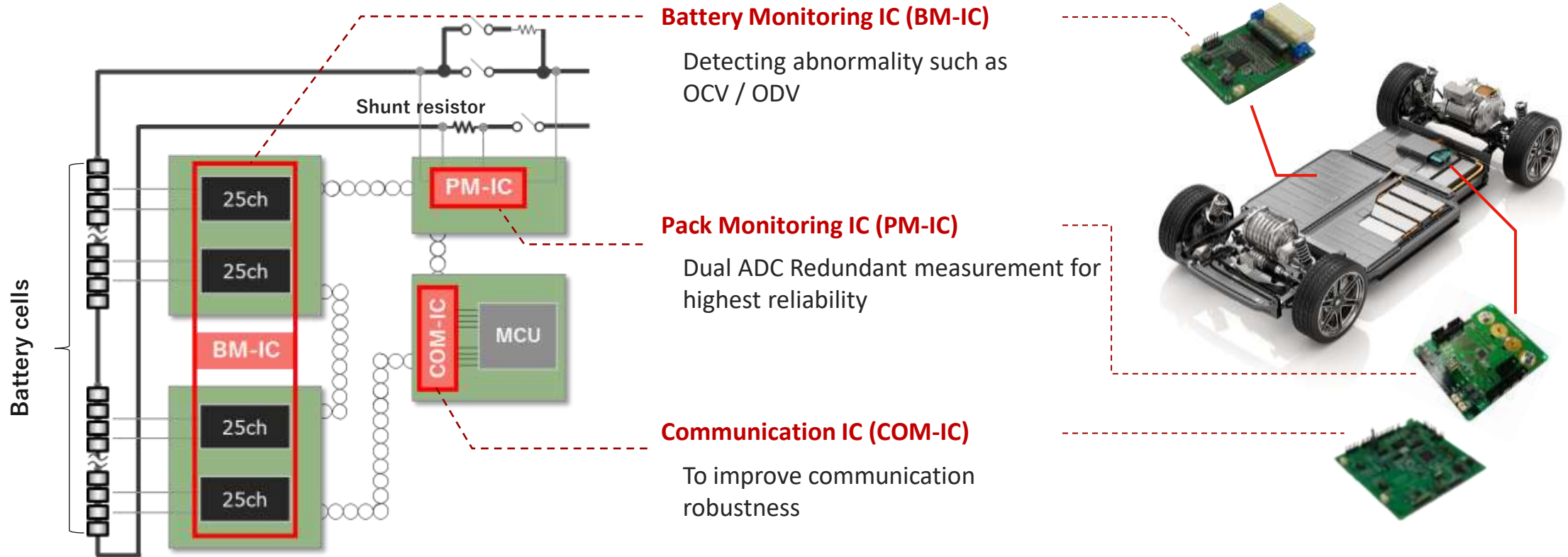
PM-IC
KA84917UA

- $\pm 1.5\text{mV}$ (typ.)
- $\pm 2.5\text{mV}$ (-40~150C)

- $\pm 0.3\%$ @ 2kA range

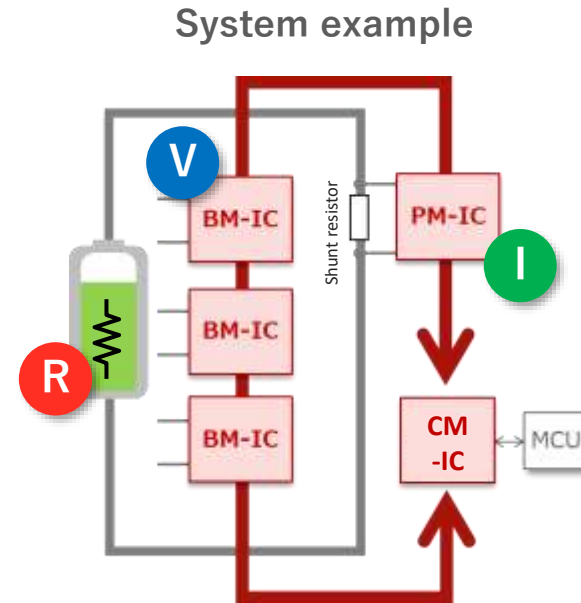
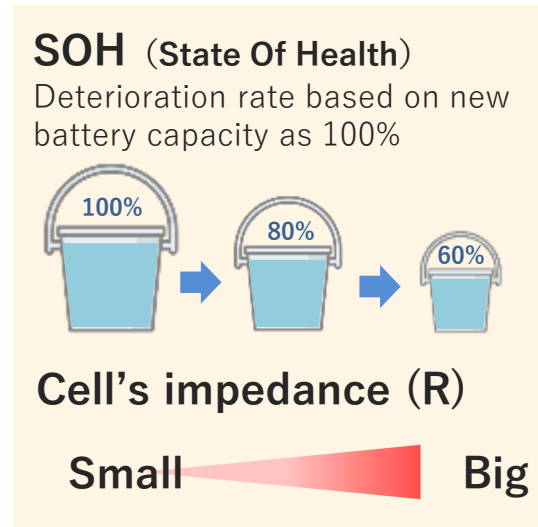
4th Generation of Battery Management Chipsets

Simplifying an BMS that consists of 100 to 200 in-series battery cells



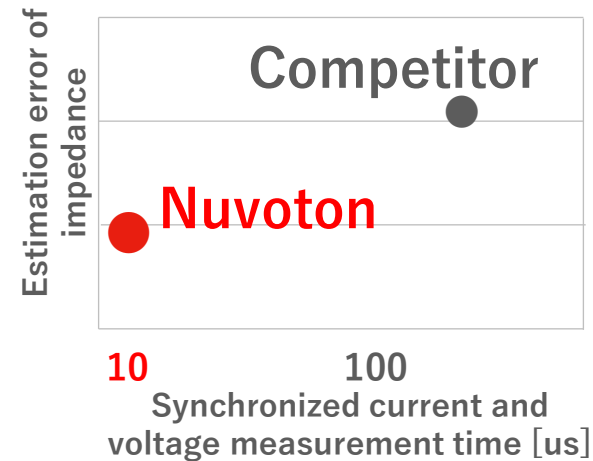
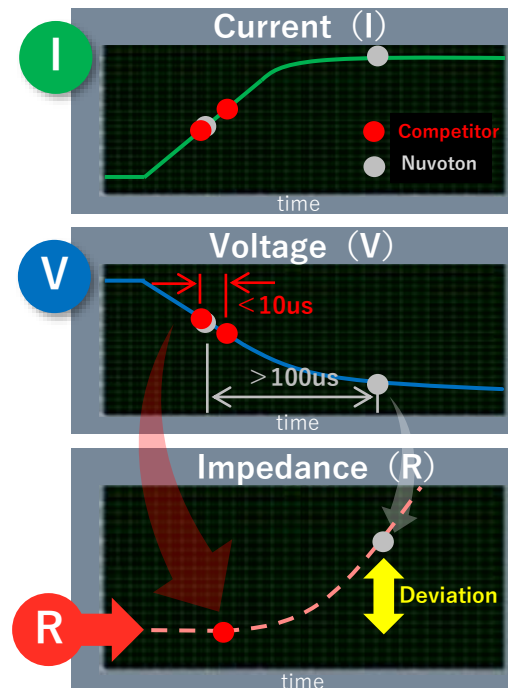
| Estimation of State of Health (1/2)

Calculate the battery impedance from the voltage (V) and current (I) obtained from the battery system



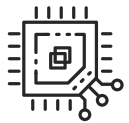
Estimation of State of Health (2/2)

To measure current and voltage values simultaneously within 10us.



Key Takeaways

Transmission / distribution



- NUC980
- MA35D1
- M467
- NADC24

Energy Storage



High-side/Low-side FET control
Built-in fault detection

- KA495xxA



Dual bank
Secure boot
CAN-FD

- ESS-M467
- BMS-M2L31

Electrical Vehicles



ASIL-D certified BM-IC, PM-IC
SOH Quick measurement

- 25-ch KA84950UA
- KA84917UA

AC EV Charging pile



ReRAM
Write Protection
Ultra-Low-Power

- M2L31