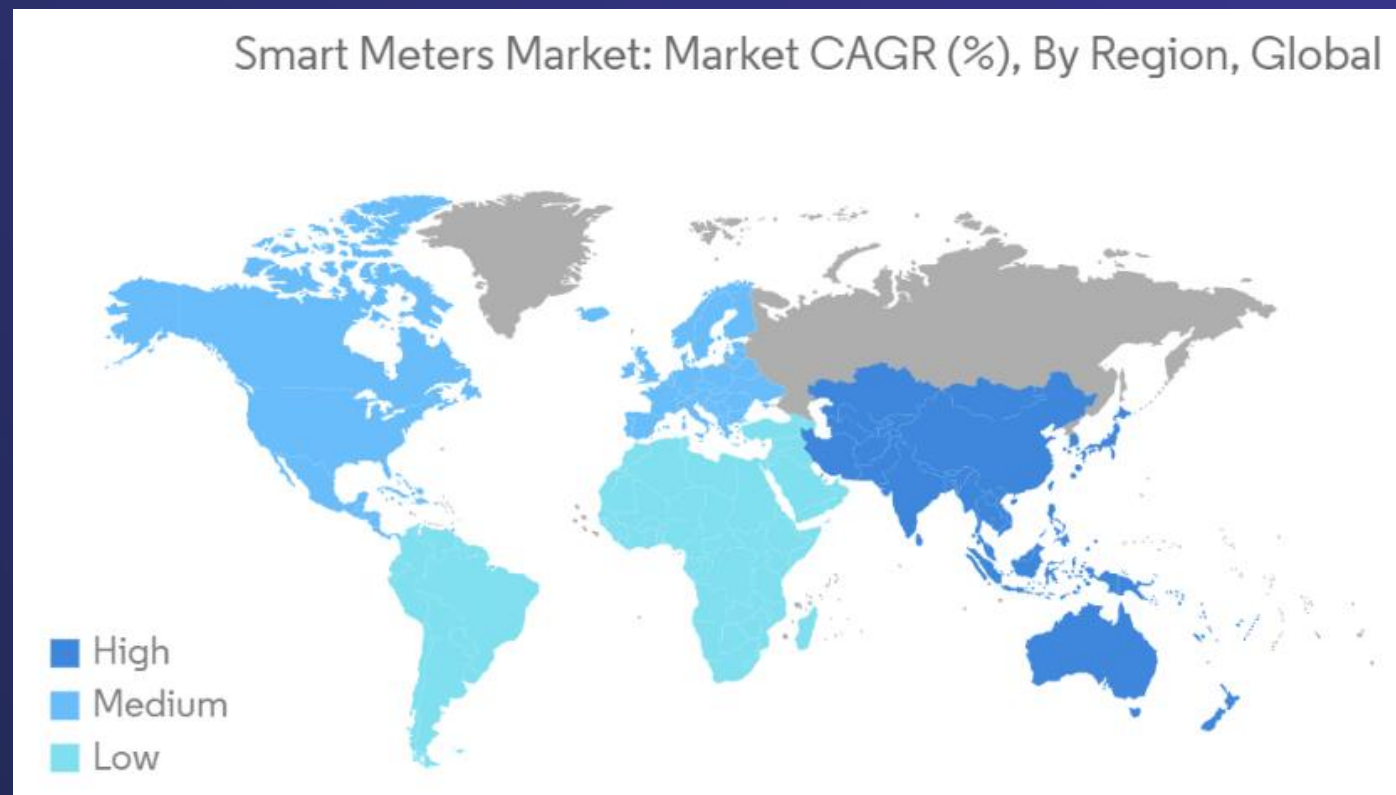
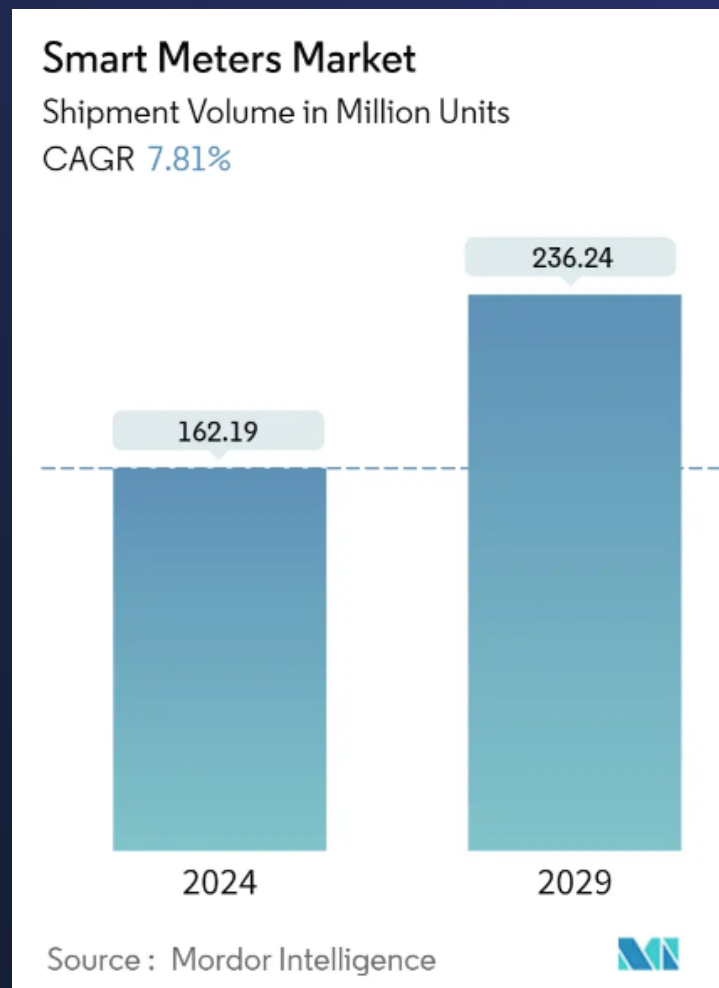


RA4L1的表计应用解析

瑞萨电子嵌入式处理产品事业部
业务开发中心
2025年3月

电表全球市场概览

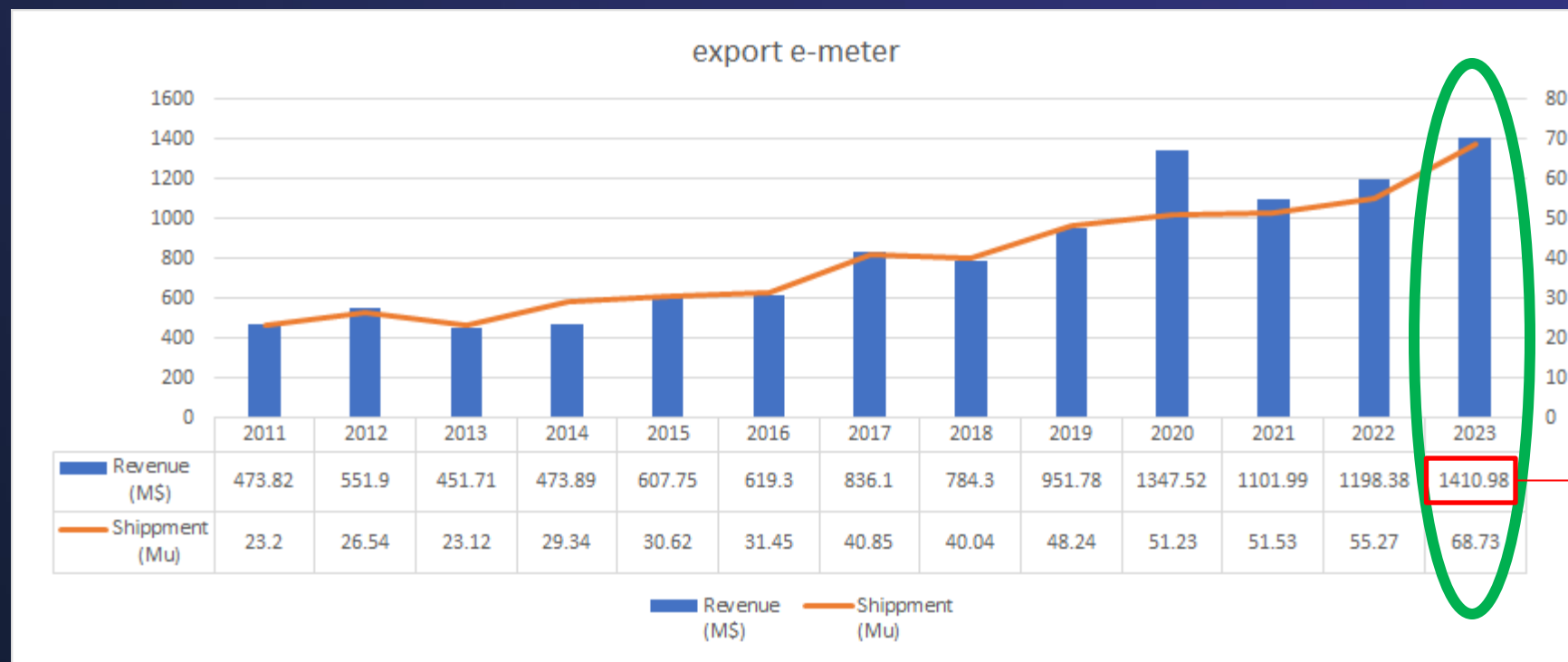


增速迅猛区域

第一梯队：中国，印度，东南亚，澳洲

第二梯队：欧洲，北美

中国电表出口：保持平稳增长

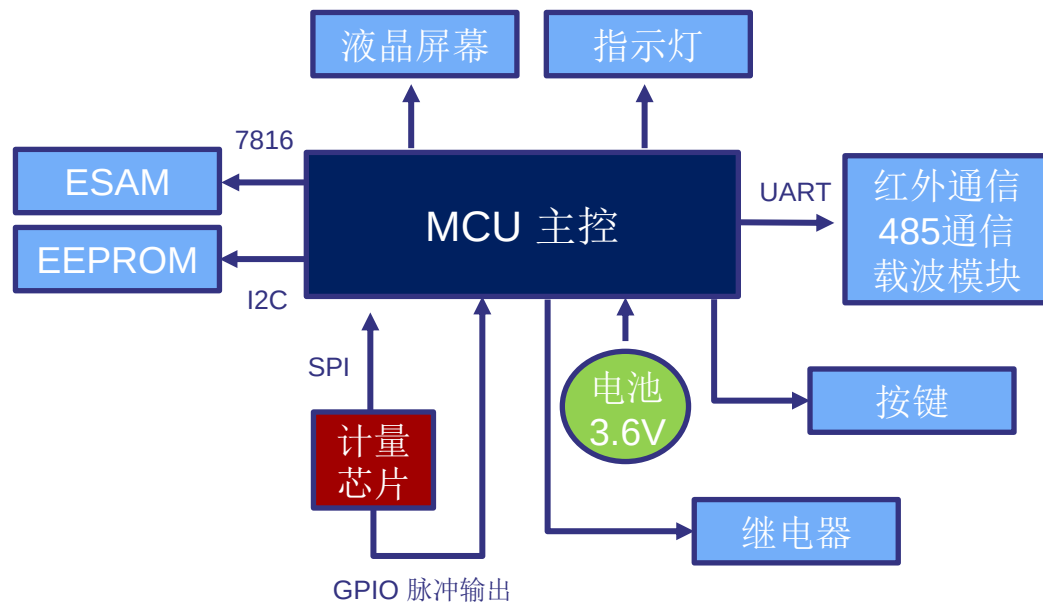


连续6年保持增长
2023年
3ph表: 760M\$, YoY=15%
1ph表: 580M\$, YoY=23%

2023年出口电表：将近7000万只

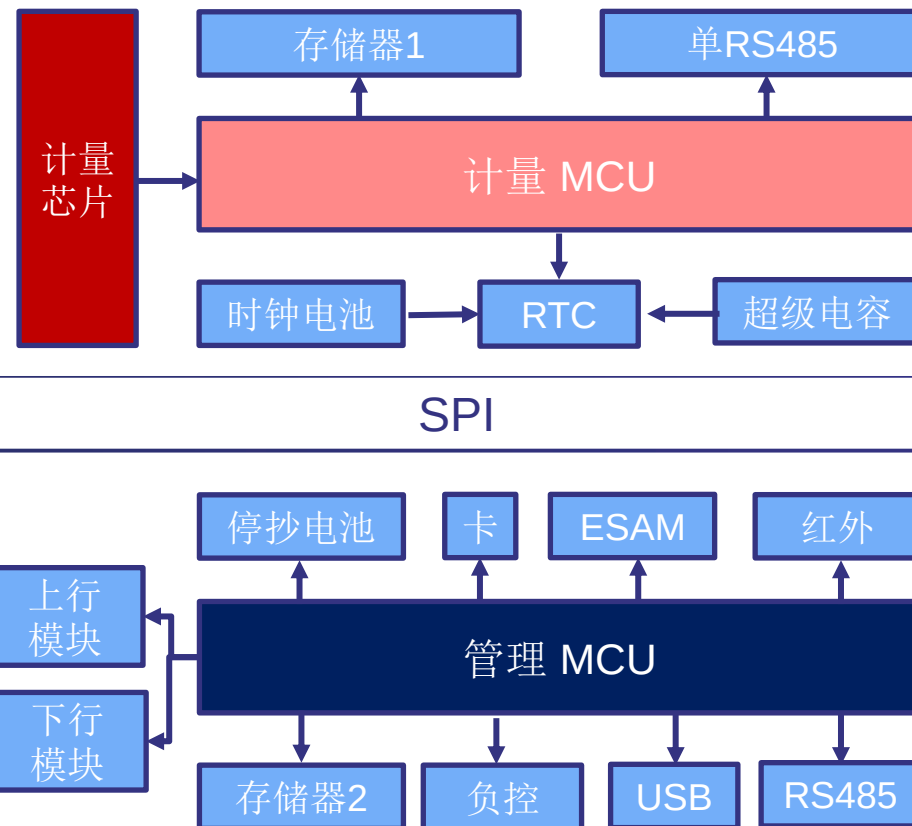
电表的分离架构

当前主流智能表

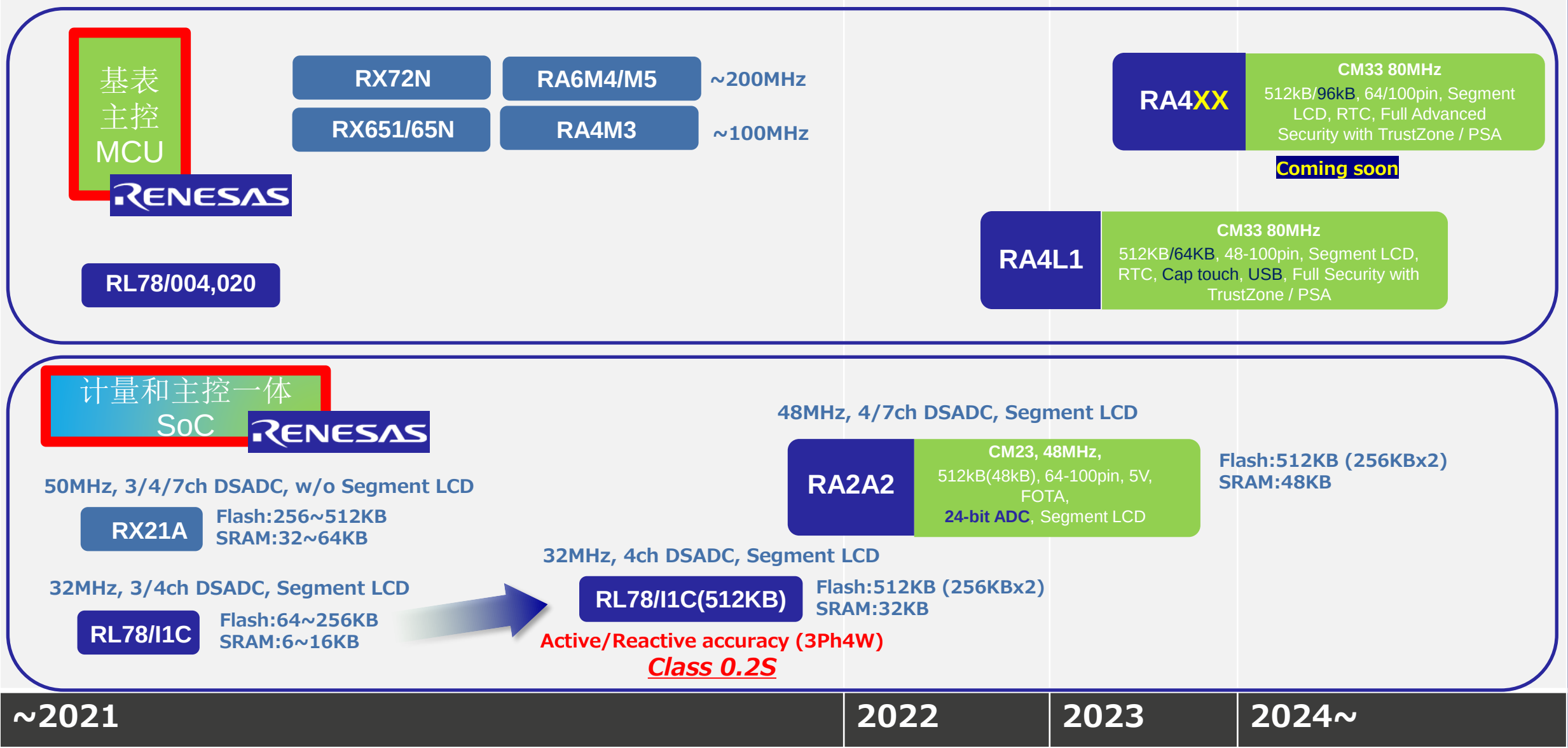


IR46 双芯智能表

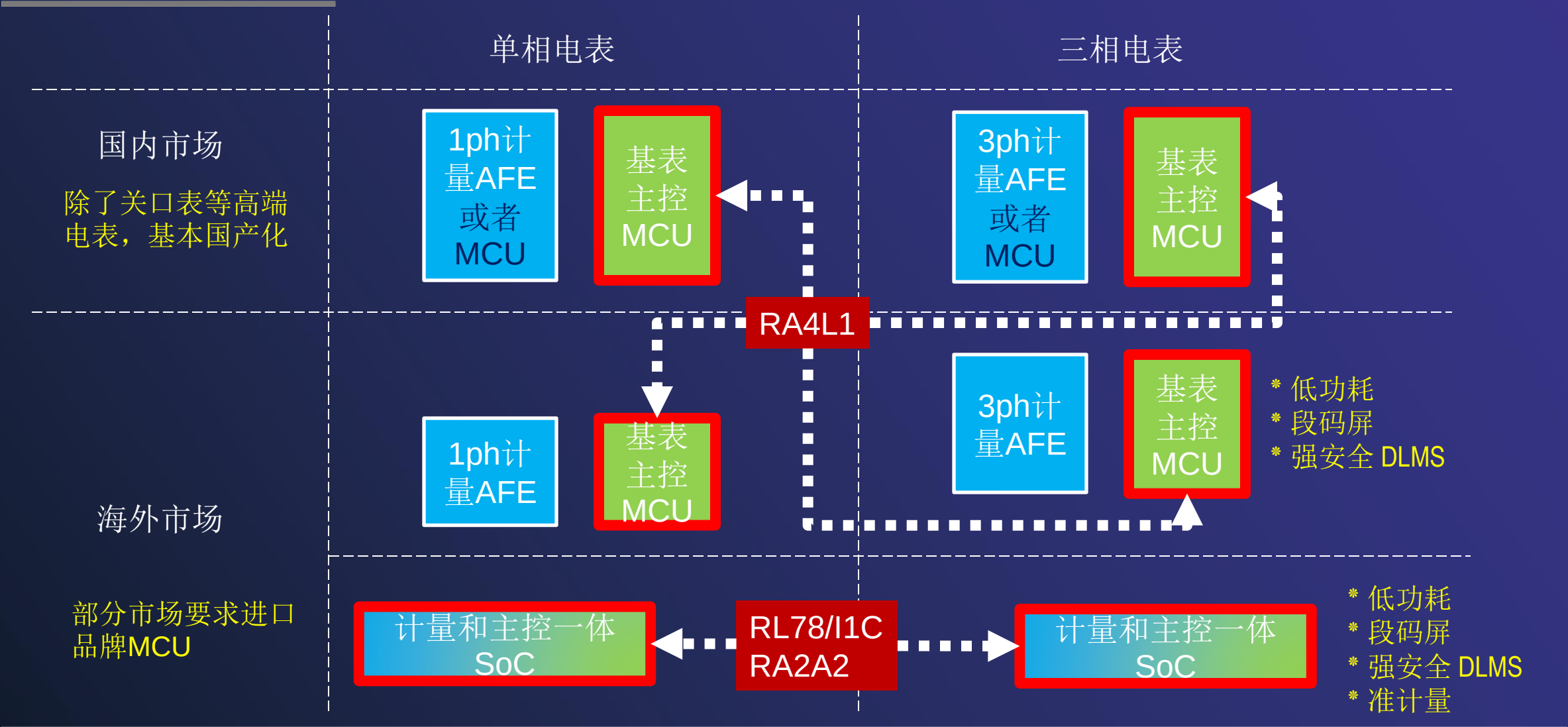
系统电源



瑞萨表计MCU产品路线图



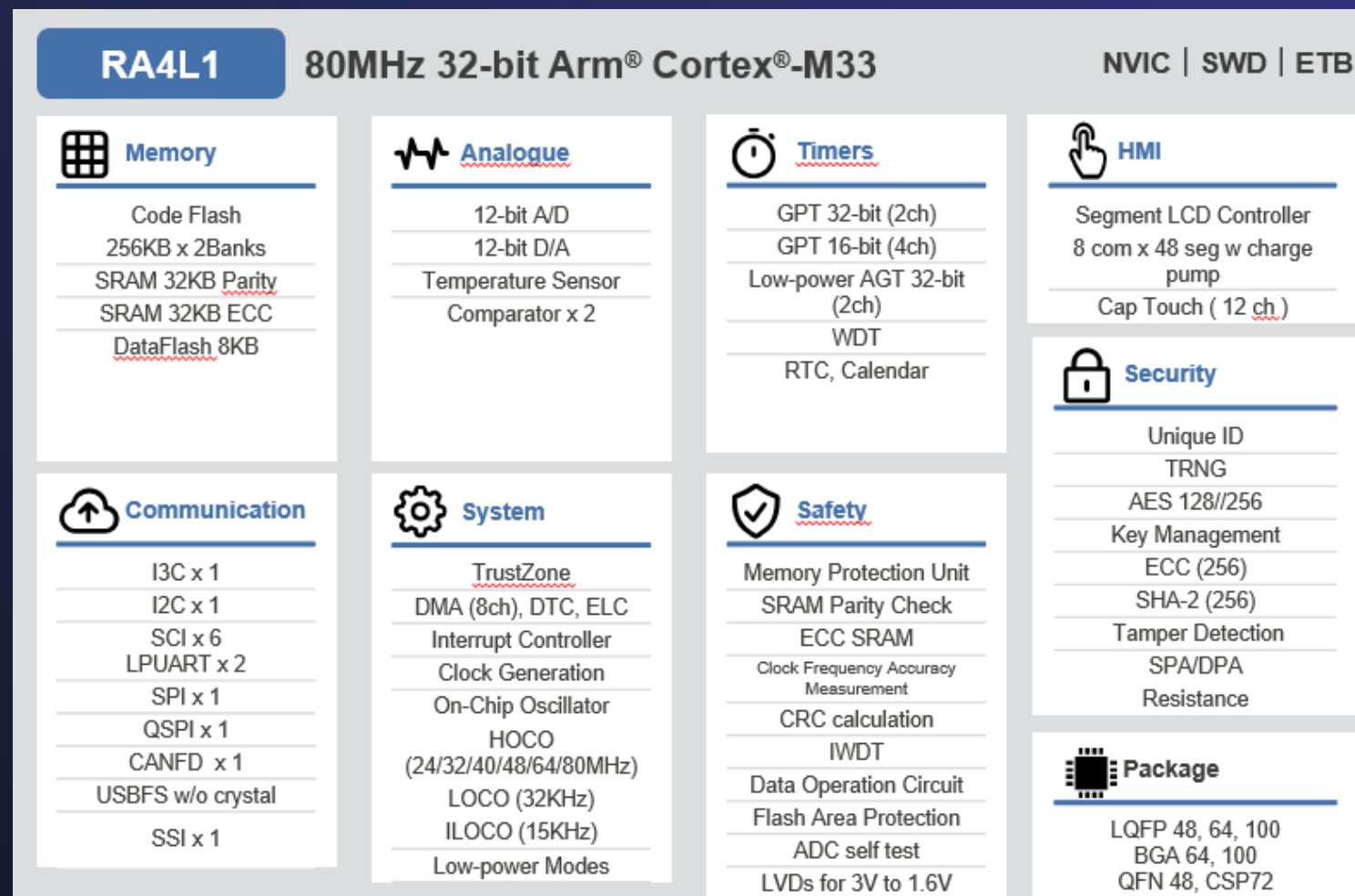
RA4L1在电表三种架构中的位置



RA4L1 特性一览

基表
主控
MCU

RENESAS



产品特点:

- * 低功耗，高算力，64K待机保持SRAM
- * 段码屏接口（带电荷泵）
- * 片上密码学模块可满足DLMS Suit 0, 1
- * 丰富的通信接口，带CAN/USB
- * CM33内核支持TrustZone、PSA认证
- * 1.6~3.6V供电，环温最高125°
- * 82 GPIO/100pin

RA4XX 特性一览



RA4XX

80MHz 32-bit Arm® Cortex®-M33

NVIC | SWD | ETB

Memory Code Flash 256KB x 2Banks SRAM 64KB Parity SRAM 32KB ECC (LP Retained SRAM 16KB) DataFlash 8KB	Analogue 12-bit A/D Temperature Sensor (+/- 1 °C typical)	Timers GPT 32-bit (2ch) GPT 16-bit (4ch) Low-power AGT 32-bit (2ch) WDT IWDT RTC (+/- 0.03ppm), Calendar , Vrtc	HMI Segment LCD Controller 8com x 44 seg w charge pump
Communication I2C x 2 SCI x 6 SPI x 3 LPUART x 2 QSPI x 1 ISO7816 CAN FD x 1	System DMA (8ch), DTC, ELC Interrupt Controller Clock Generation On-Chip Oscillator HOCO (TBD) LOCO (32KHz) ILOCO (15KHz) Low-power Modes TrustZone	Safety Memory Protection Unit SRAM Parity Check ECC SRAM Clock Frequency Accuracy Measurement CRC calculation IWDT Data Operation Circuit Flash Area Protection ADC self test LVDs for 3V to 1.6V	Security Unique ID TRNG AES 128//256 Key Management ECC (256/384) SHA-2 (256/384) Tamper Detection SPA/DPA Resistance
			Package LQFP 100 / 64

产品特点:

- * 低功耗，高算力，96KB待机保持SRAM
- * 段码屏接口（带电荷泵）
- * 片上密码学模块可满足DLMS Suit 0, 1, 2
- * 丰富的通信接口
- * Cortex-M33内核支持TrustZone
- * RTC微调步长可精确到 0.03ppm

Coming soon in 2025

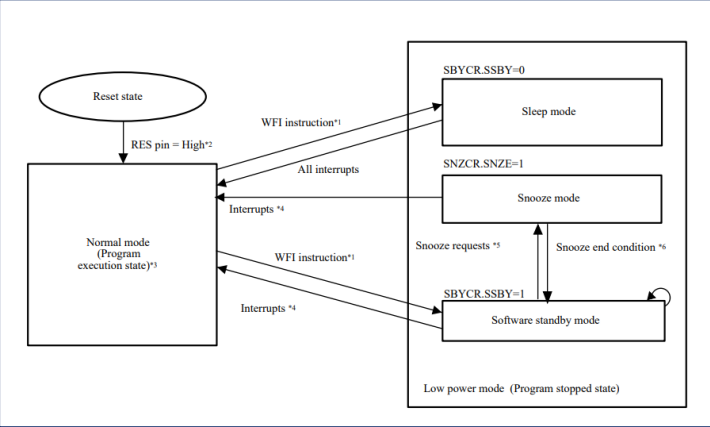
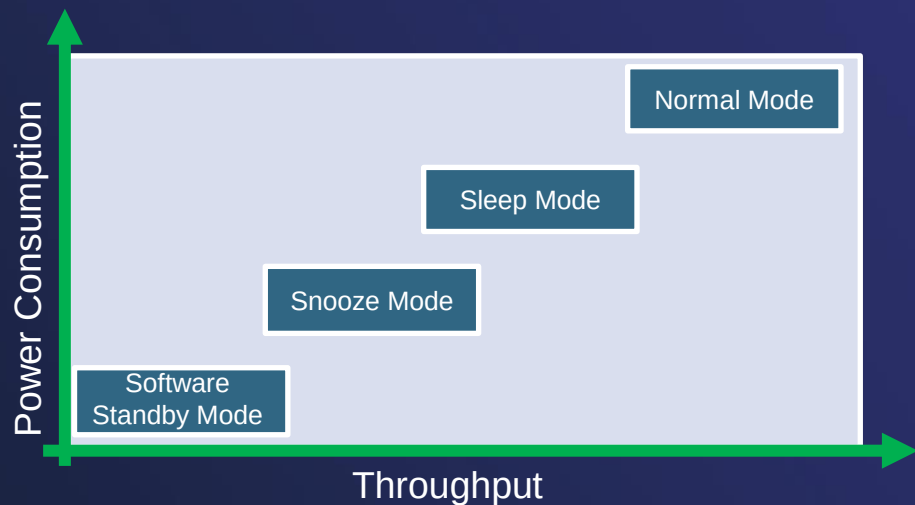
RA4L1 + RA4XX 产品阵列

Flash/RAM	512kB / 64kB	R7FA4L1BD4CDB	R7FA4L1BD4CFL	R7FA4L1BD4CNE	R7FA4L1BDCBQ	R7FA4L1BD4CFM	R7FA4L1BD4CFP	R7FA4L1BD4CAF
	256KB / 64KB	R7FA4L1BB4CDB	R7FA4L1BB4CFL	R7FA4L1BB4CNE	R7FA4L1BB4CBQ	R7FA4L1BB4CFM	R7FA4L1BB4CFP	R7FA4L1BB4CAF
Pin Count Package Size in mm Pitch in mm Temperature range		72 CSP 3.66 x 4.30 0.4 -40 -> 105° C	48pin LQFP 7x7 0.5 -40 -> 125° C	48pin QFN 7x7 0.5 -40 -> 125° C	64pin BGA 5.5x5.5 0.5 -40 -> 105° C	64pin LQFP 10x10 0.5 -40 -> 125° C	100pin LQFP 14x14 0.5 -40 -> 125° C	100pin BGA 7x7 0.5 -40 -> 105° C

Flash/RAM	512kB / 96kB					RA4XX	RA4XX	
	256KB / 96KB					RA4XX	RA4XX	
Pin Count Package Size in mm Pitch in mm						64pin LQFP 10x10 0.5	100pin LQFP 14x14 0.5	

RA4L1 低功耗模式

多种低功耗模式，灵活可配



Mode of Operation	Core	Flash	SRAM	RTC, AGT, iWDT LVD, LPUART, I2C, I3C, ACMP, LCD	Other Peripherals	IO Pins
Normal	Operating	Selectable	Selectable	Selectable	Selectable	Selectable
Sleep	Stop (retained)	Selectable	Selectable	Selectable	Selectable	Selectable
Snooze Mode*	Stop (retained)	Stop (retained)	Selectable	Selectable	Selectable	Selectable
Software Standby	Stop (retained)	Stop (retained)	Stop (retained)	Selectable	Stop (retained)	Stop (retained)

RA4L1 功耗表现

功耗

RA4L1	High speed Mode (80 MHz)	Middle Speed Mode (8 MHz)	Low Speed Mode (1 MHz)	Sub-Osc Mode (32 kHz)
Normal mode*	13.4 mA	1.79 mA	0.33 mA	8.73 µA
Sleep Mode**	5.63 mA	0.81 mA	0.22 mA	4.26 µA

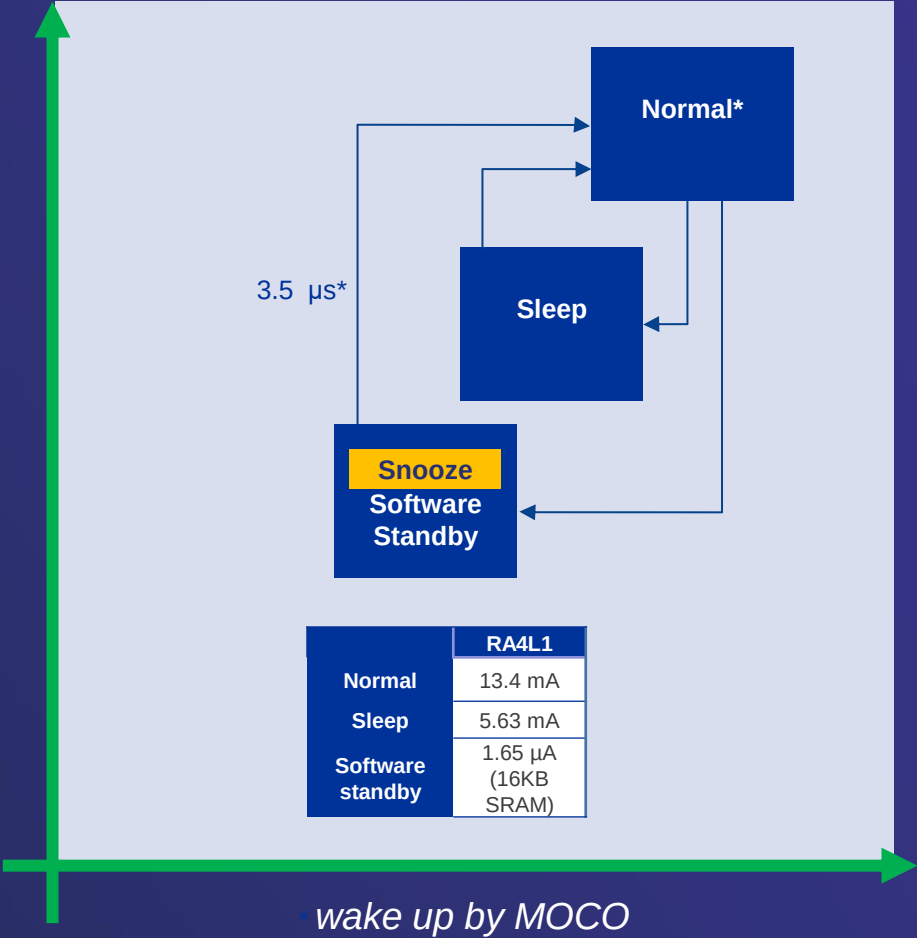
软件待机模式电流

Parameter	TYP	Test Conditions
All SRAMs(0x2000_0000 to 0x2000_FFFF) are on	1.70µA	Ta = 25 Degrees C
Only 16KB SRAM (0x2000_0000 to 0x2000_3FFF) is on	1.65µA	Ta = 25 Degrees C

从待机状态唤醒的时间

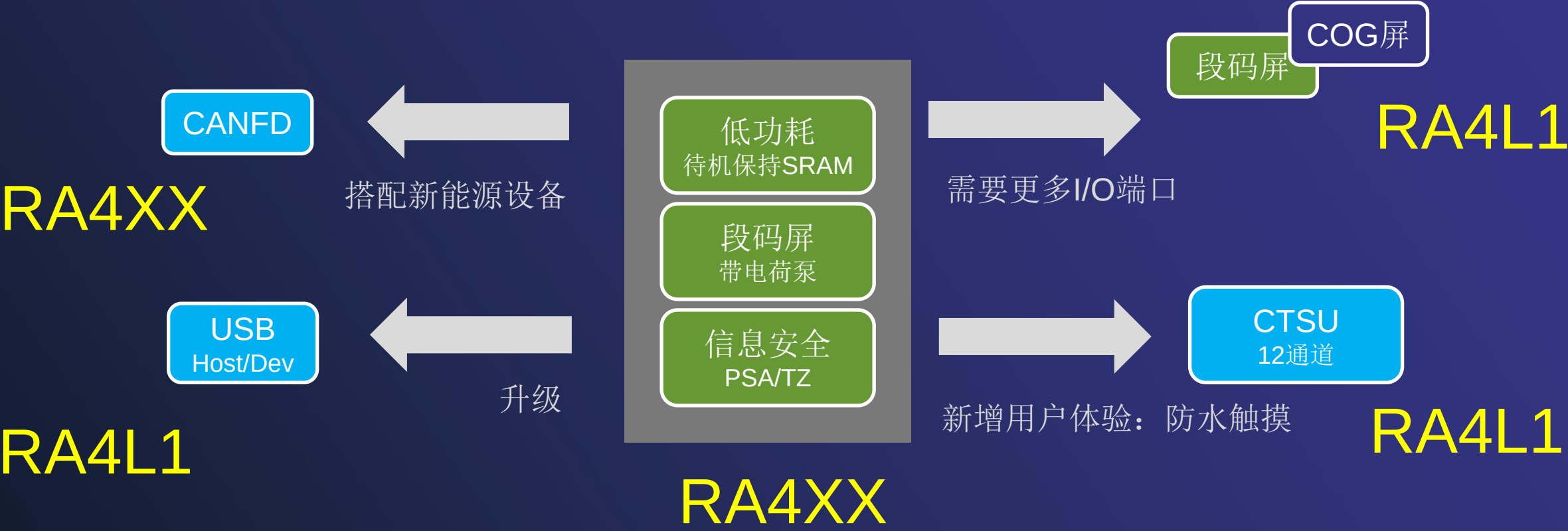
Recovery time	System clock source	Typical value
Software Standby mode	MOSC (20 MHz)	2.1 ms
	HOCO (32 MHz)	13.5 µs
	HOCO (48 MHz)	13.2 µs
	MOCO	3.5 µs

* All peripheral clocks and cache disabled. While (1) code executing from flash
** All peripheral clocks and cache disabled



RA4L1, RA4XX 主要应用

- 具有高安全性，高稳定性要求的 基表主控



更多信息

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