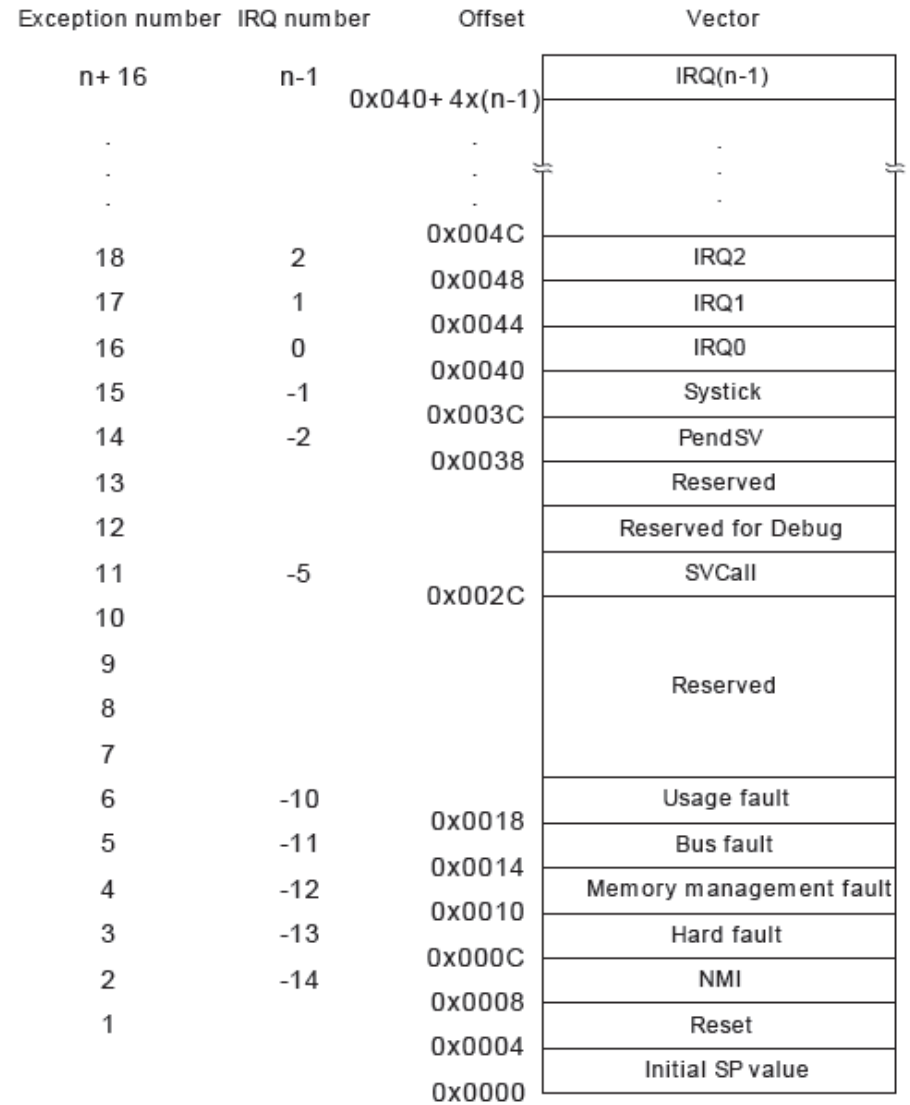
EFM32 Series 0: Interrupts and Energy Modes

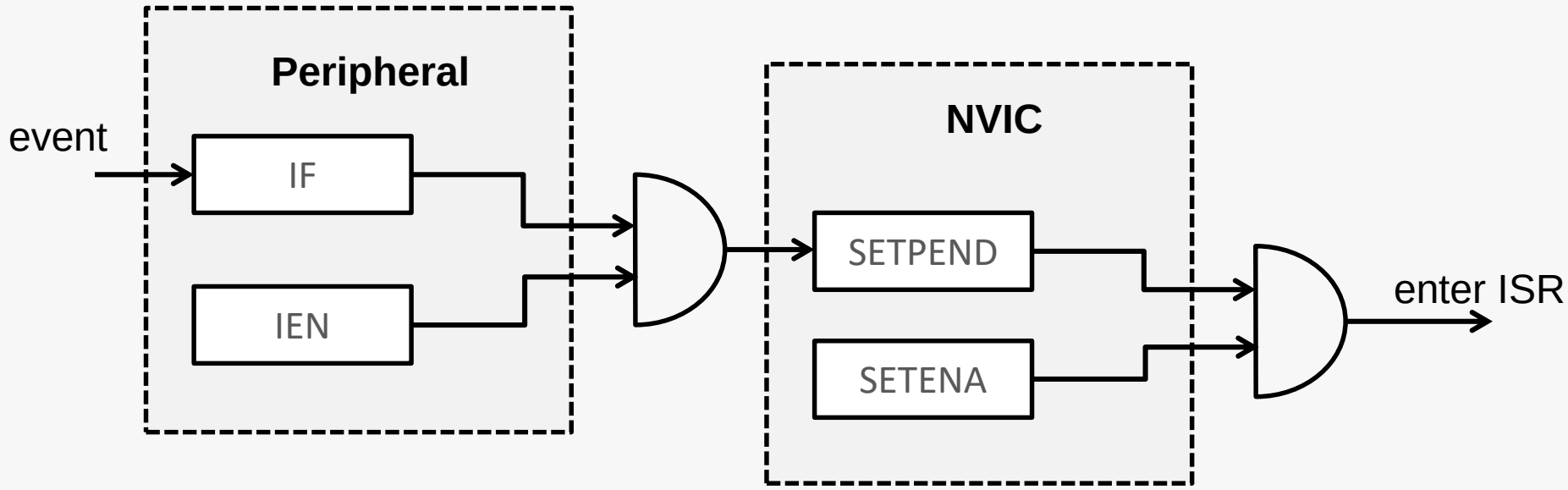
Interrupts

IRQ	Source
0	DMA
1	GPIO_EVEN
2	TIMER0
3	USART0_RX
4	USART0_TX
5	USB
7	ADC0
8	DAC0
9	I2C0
10	I2C1
11	GPIO_ODD
...	....

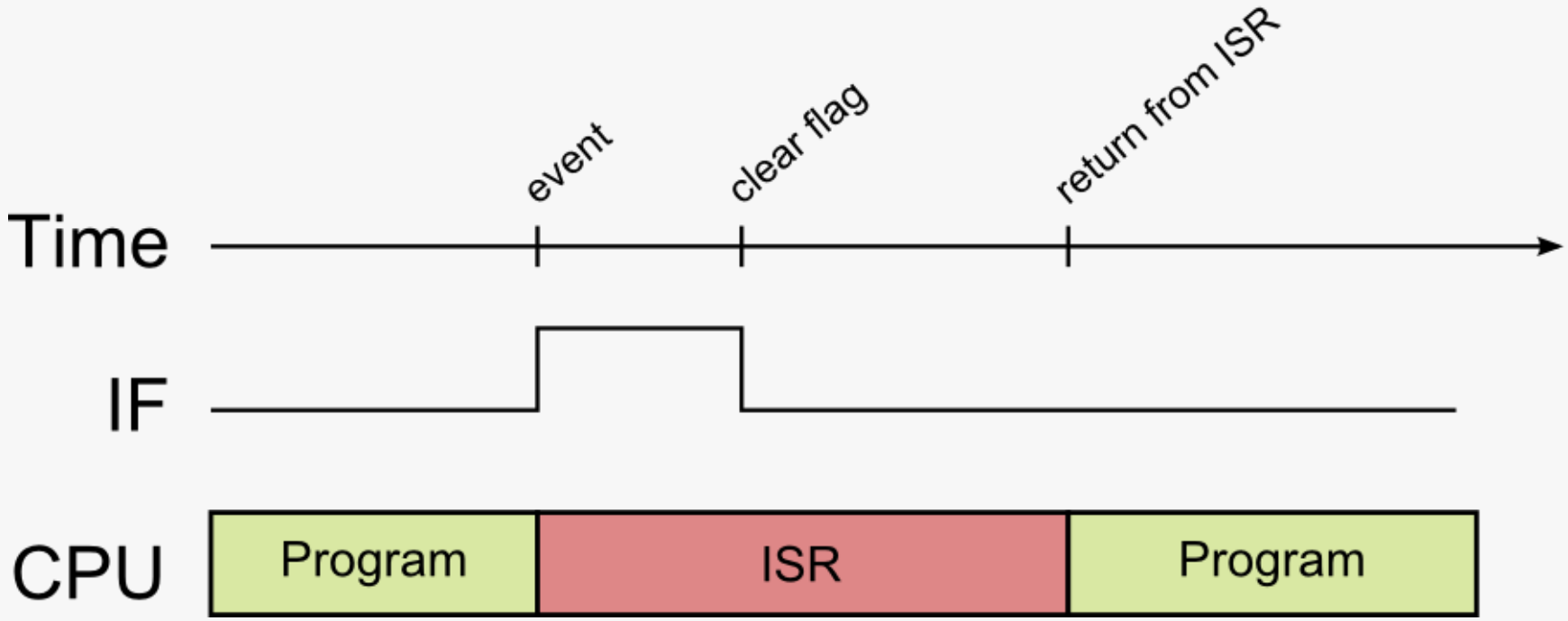
Figure 2.2. Vector table



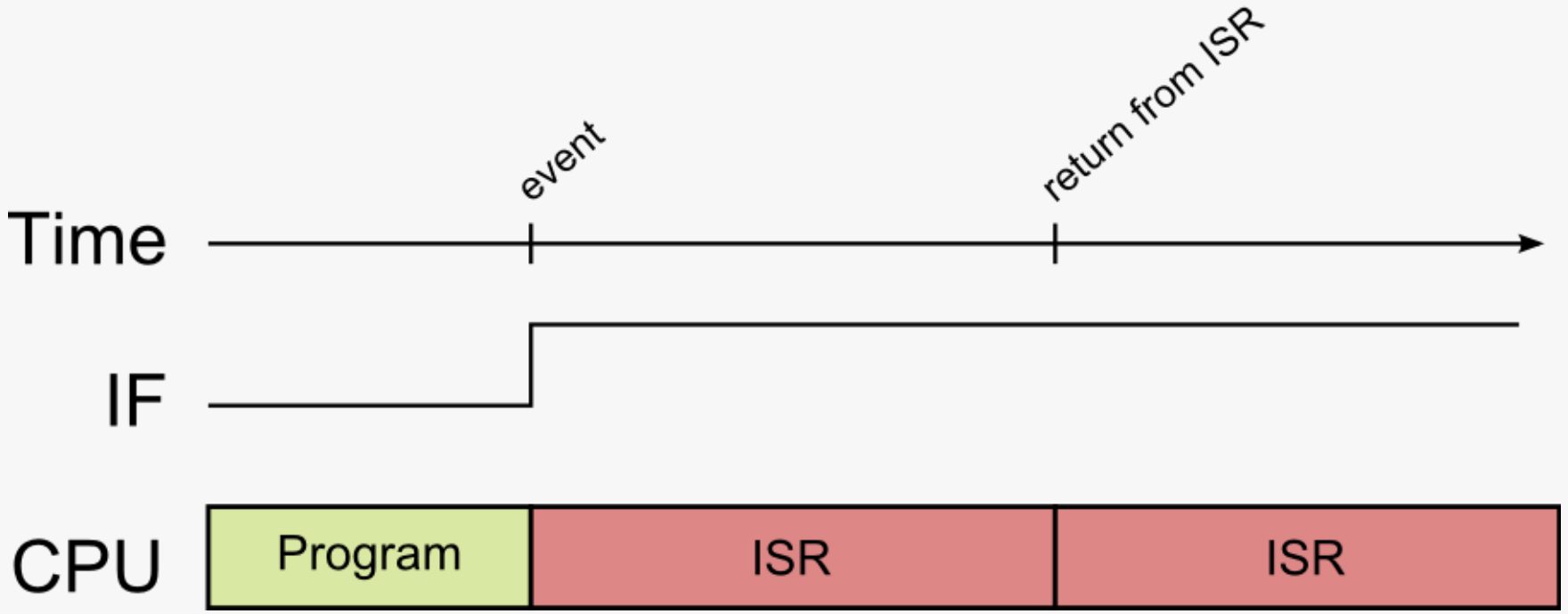
Interrupt Activation



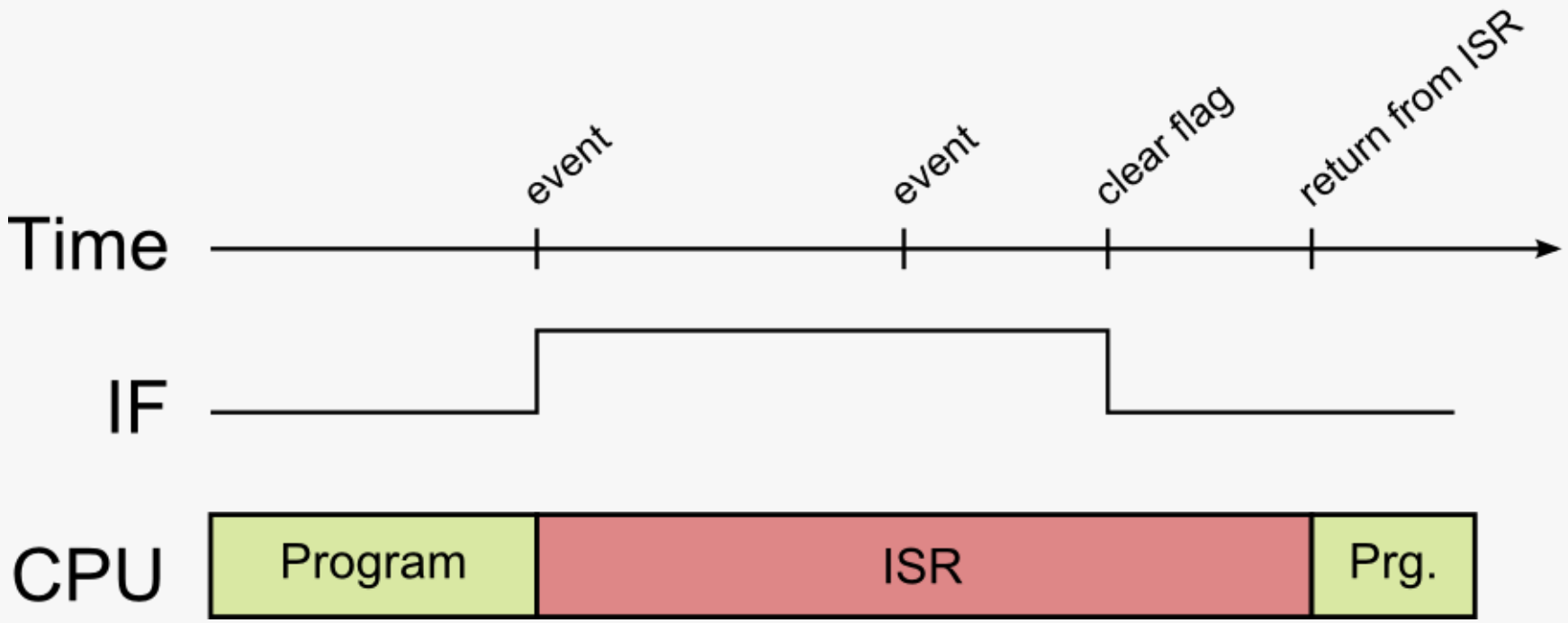
Clearing Interrupt Flag



Clearing Interrupt Flag



Clearing Interrupt Flag



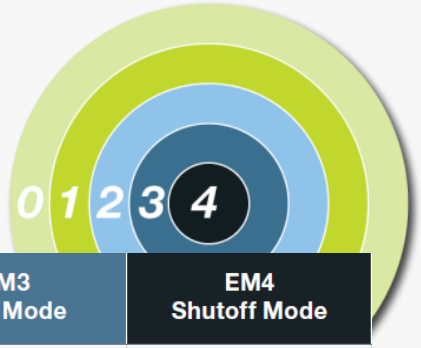
Interrupt Example

```
void enableTimerInterrupts(void)
{
    /* Interrupt flags can be OR'ed together */
    uint32_t enabledFlags = TIMER_IEN_OF | TIMER_IEN_CC0;

    /* Make TIMER2 generate IRQs */
    TIMER_IntEnable(TIMER2, enabledFlags);

    /* Enable interrupts on IRQ events from TIMER2 */
    NVIC_EnableIRQ(TIMER2_IRQn);
}
```

Interrupt Example Continued

```
void TIMER2_IRQHandler(void)
{
    uint32_t flags = TIMER2_IntGet();

    TIMER2_IntClear(flags);

    if ( flags & TIMER_IF_OF ) {
        /* Overflow event occured */
    }

    if ( flags & TIMER_IF_CC0 ) {
        /* CC0 event occured */
    }
}
```

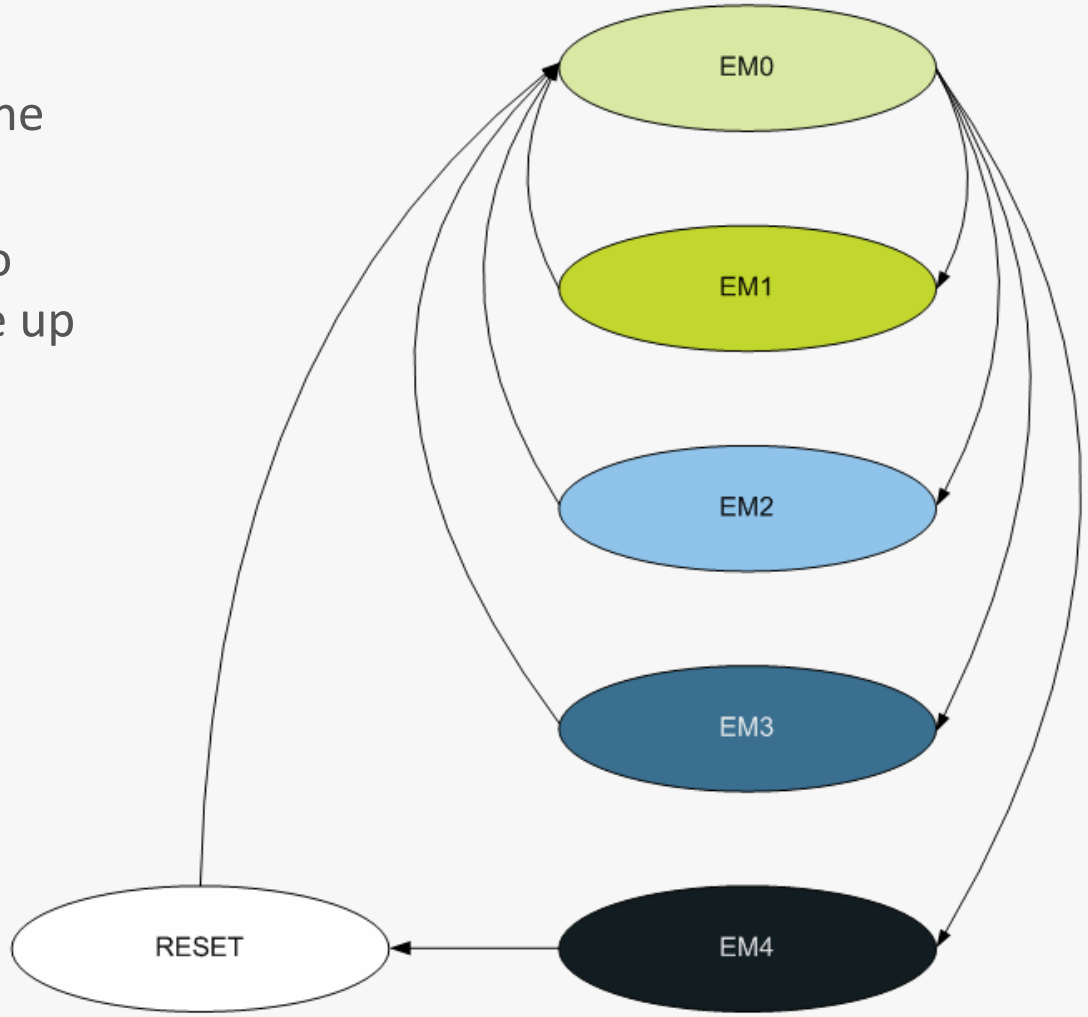
Energy Modes



EFM32 with 3V power supply. Application from memory.	EM0 Run Mode	EM1 Sleep Mode	EM2 Deep Sleep	EM3 Stop Mode	EM4 Shutoff Mode
Current consumption	150 µA/MHz	45 µA/MHz	0.9 µA	0.6 µA	20 nA
Wake-up time	-	0	2 µs	2 µs	160 µs
CPU (Cortex-M3/M0)	On	-	-	-	-
High frequency peripherals	Available	Available	-	-	-
Low frequency peripherals	Available	Available	Available	-	-
Asynchronous peripherals	Available	Available	Available	Available	-
Full CPU and SRAM retention	On	On	On	On	-
Power-on Reset/Brown-out Detector	On	On	On	On	On
Wake-up events	Any	Any	32 kHz peripherals	Async IRQ, I2C slave Analog Comparators Voltage Comparators	Reset, GPIO rising/ falling edge

Enter/Exit Energy Modes

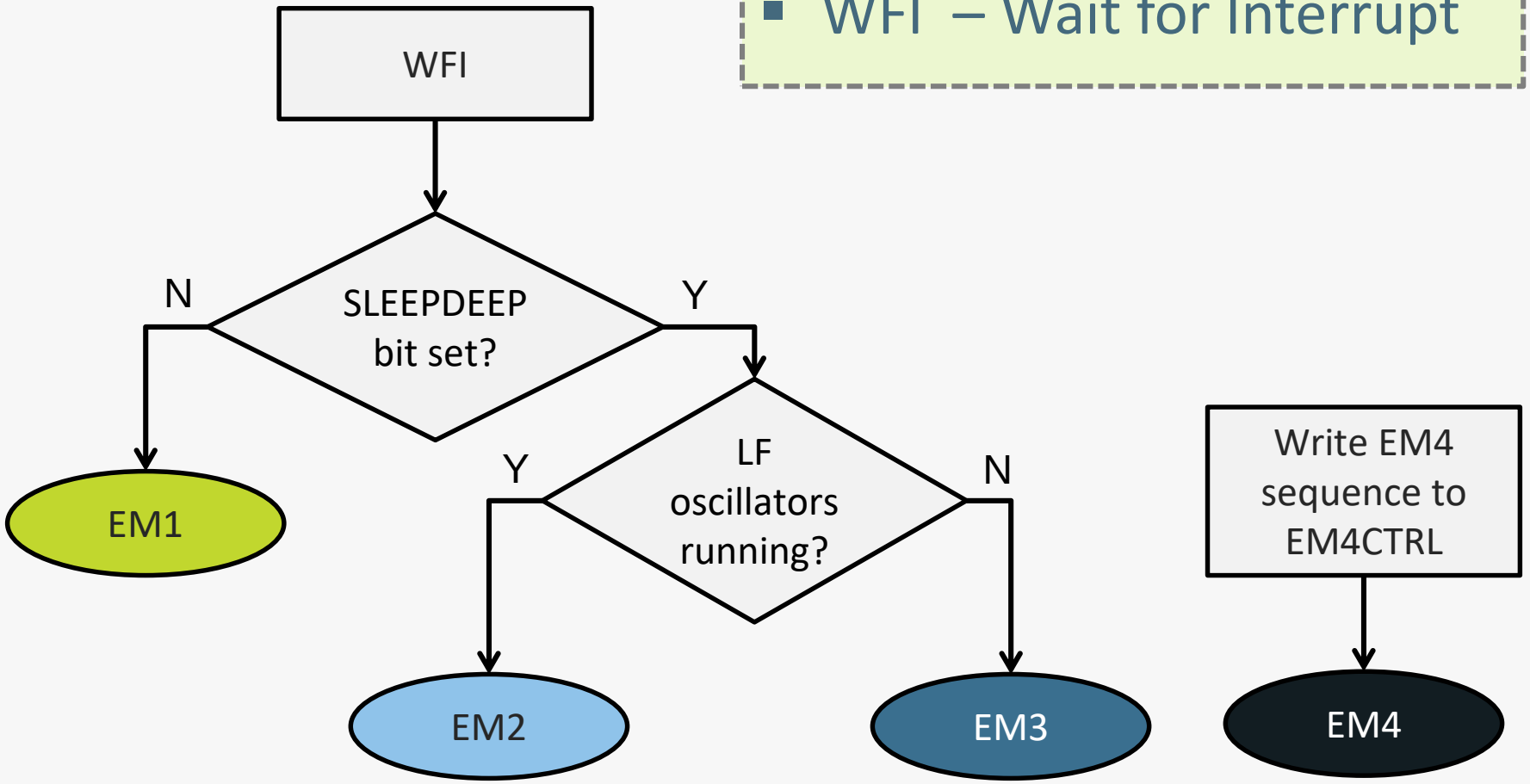
- Enter any low energy mode from software
- Any event wakes up the CPU (enters EM0)
- In EM4 MCU has to go through reset to wake up



Entering a Low Energy Mode

Sleep instruction

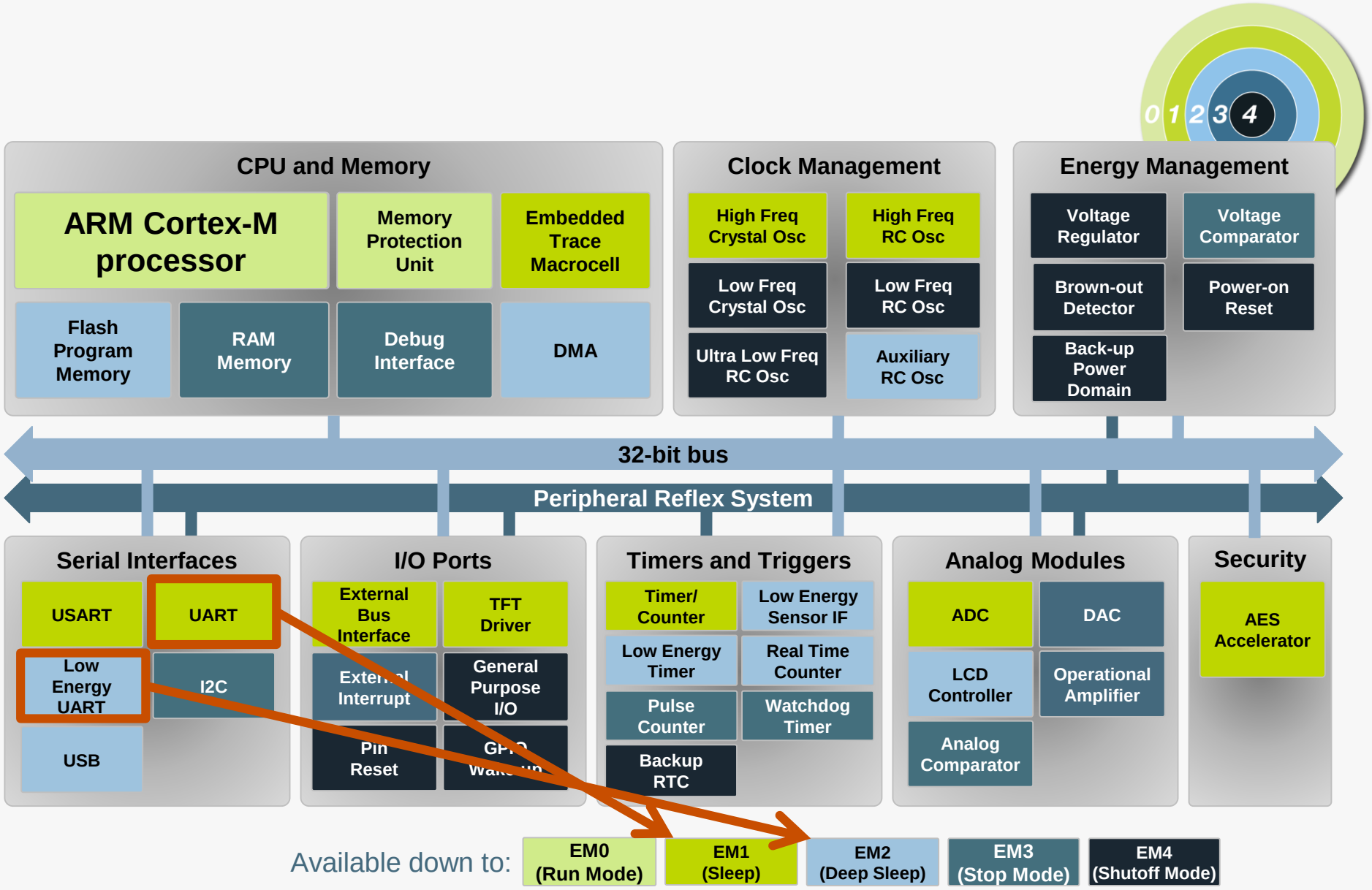
- WFI – Wait for Interrupt



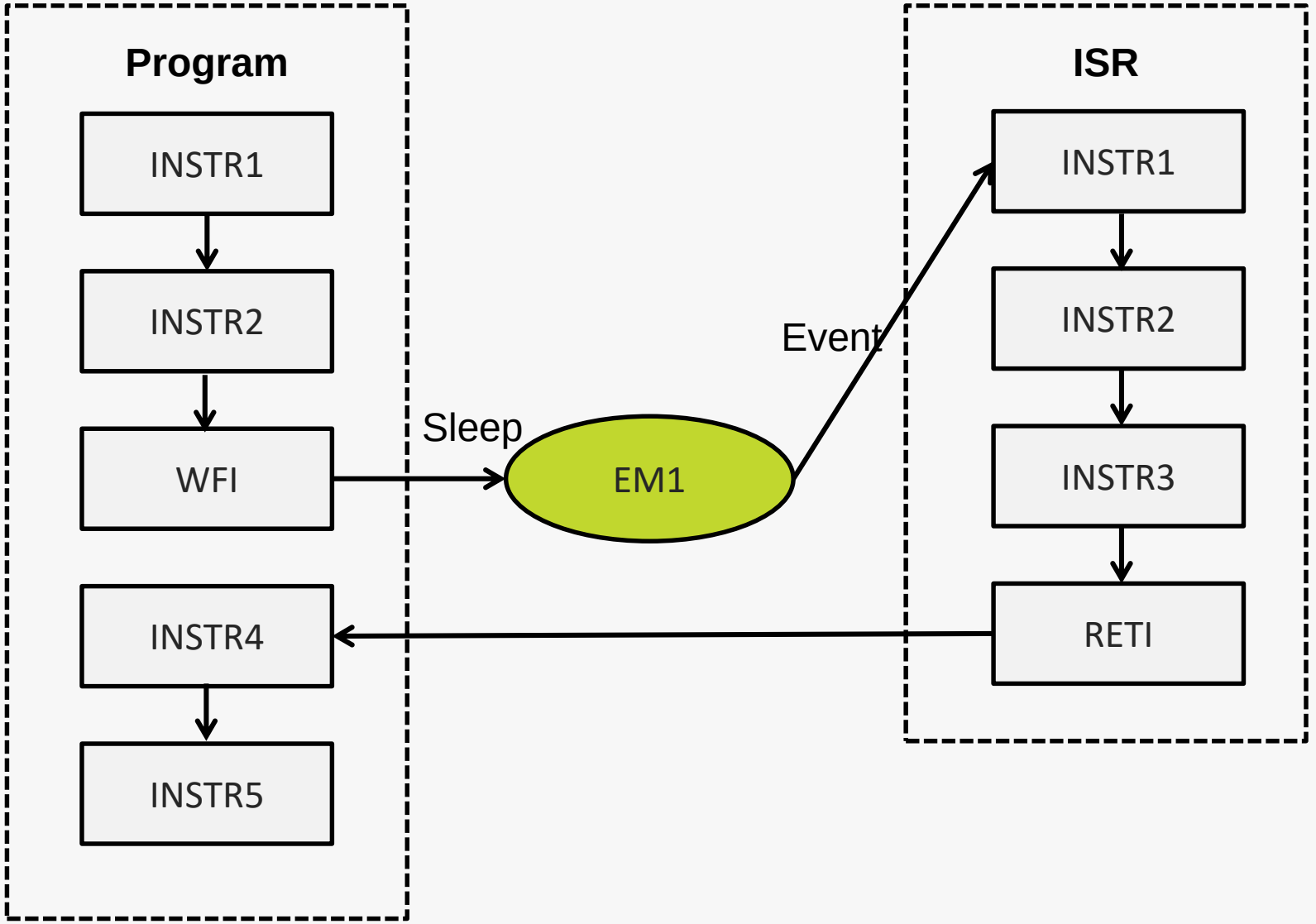
Energy Modes emlib API

```
void EMU_EnterEM1(void);

void EMU_EnterEM2(bool restore);

void EMU_EnterEM3(bool restore);

void EMU_EnterEM4(void);
```

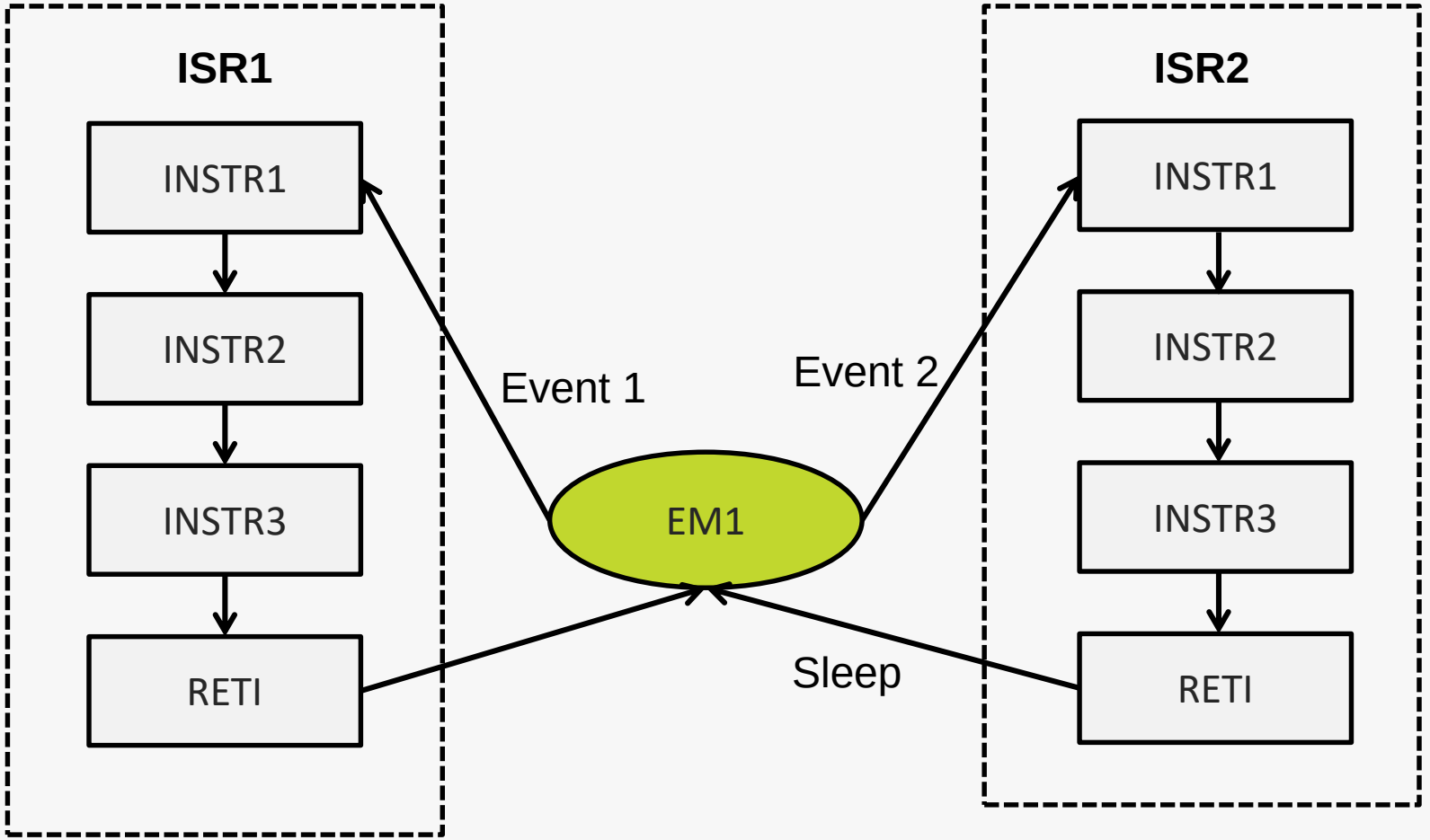
Peripherals and Energy Modes



Program Flow – Sleep and Interrupt



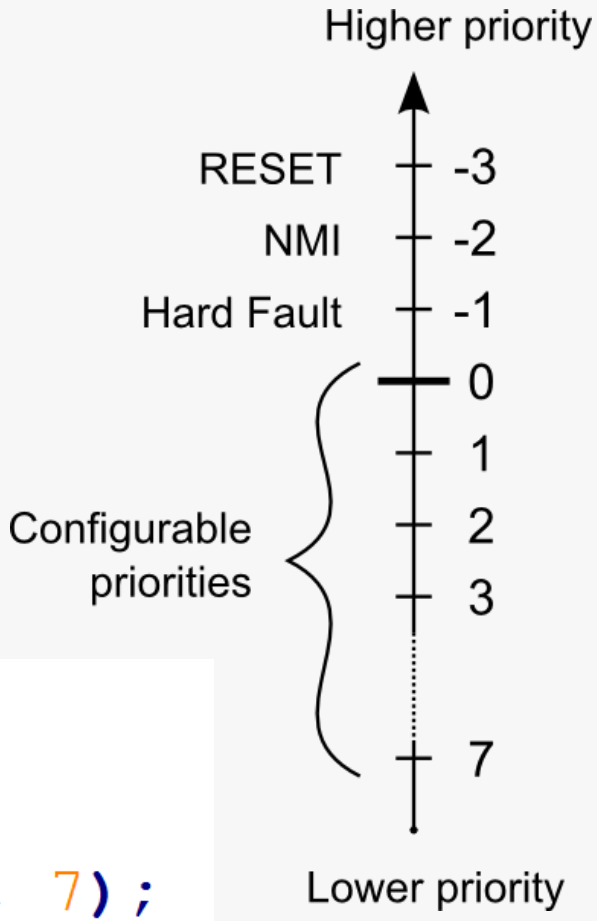
Program Flow Sleep-on-Exit



Note: SLEEPONEXIT bit in SCR must be set!

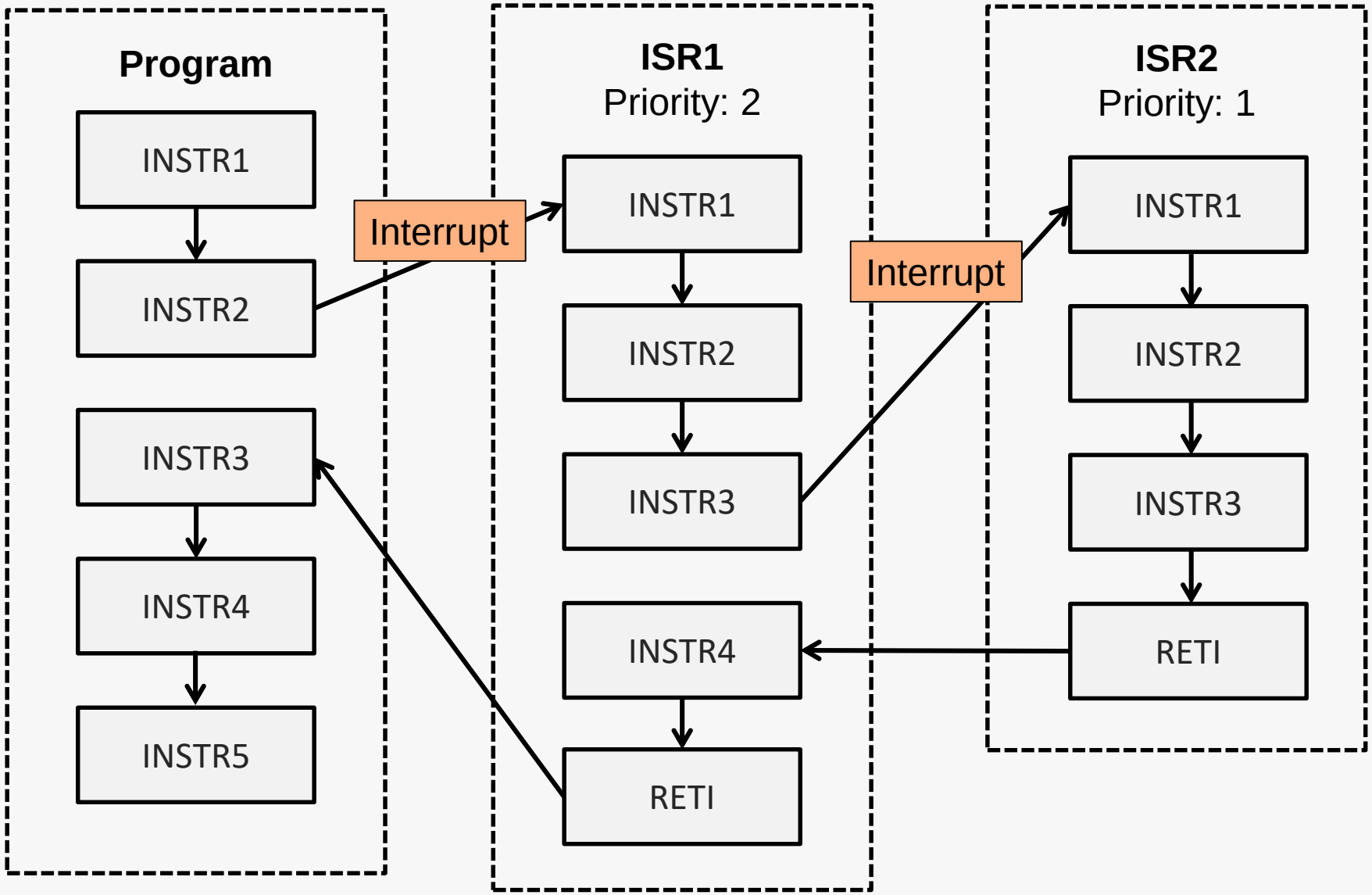
Interrupt Priority

- 3 high-priority interrupts
- 8 configurable levels
- Default level is 0
- Interrupt preemption

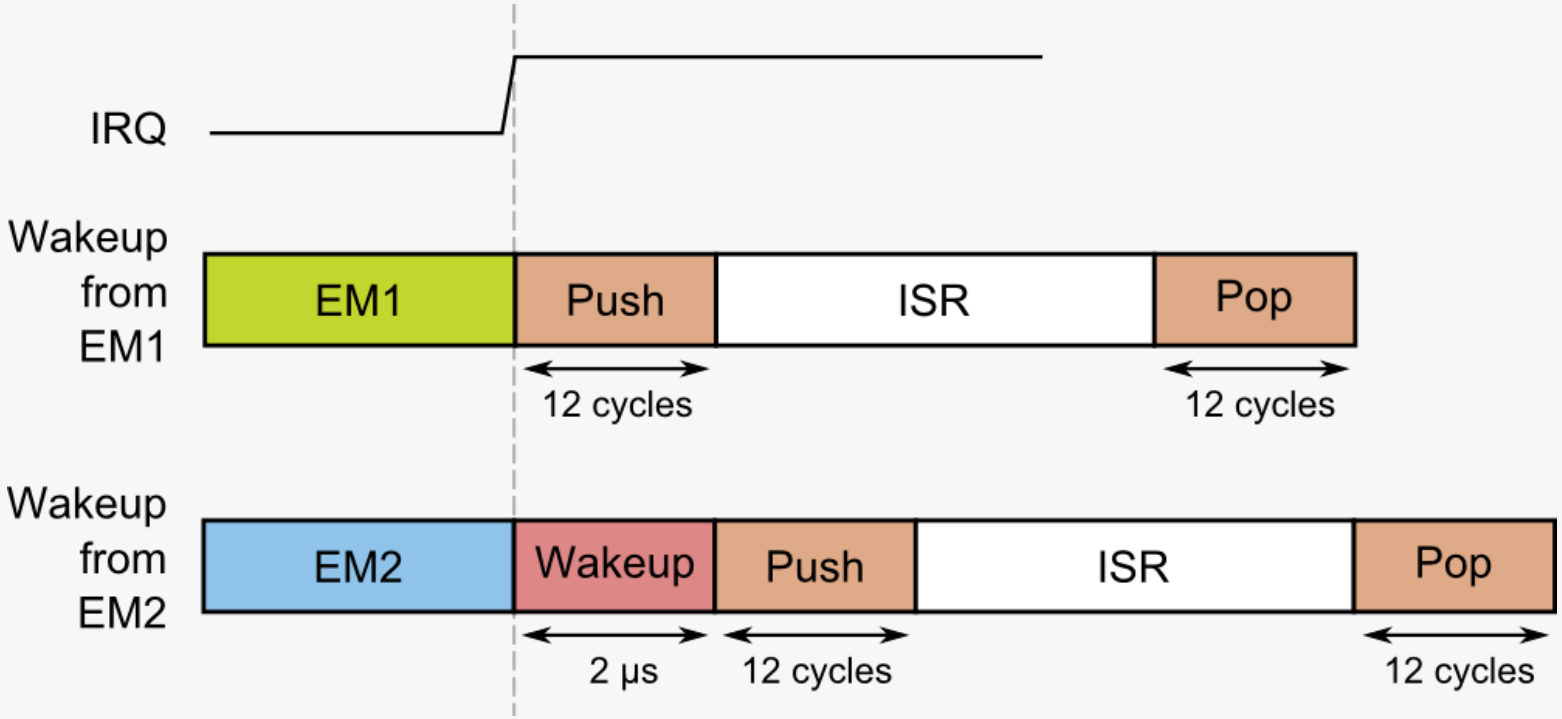



```
/* Set lowest priority
 * for TIMER0 interrupt */
NVIC_SetPriority(TIMER0_IRQn, 7);
```

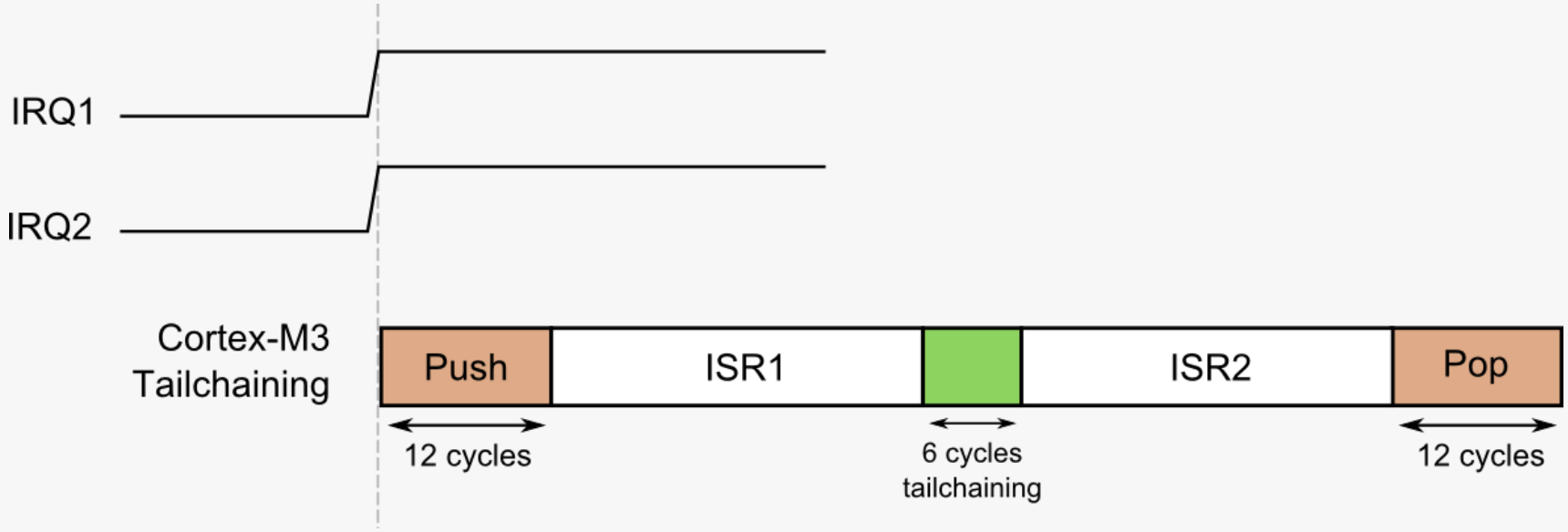
Interrupt Preemption



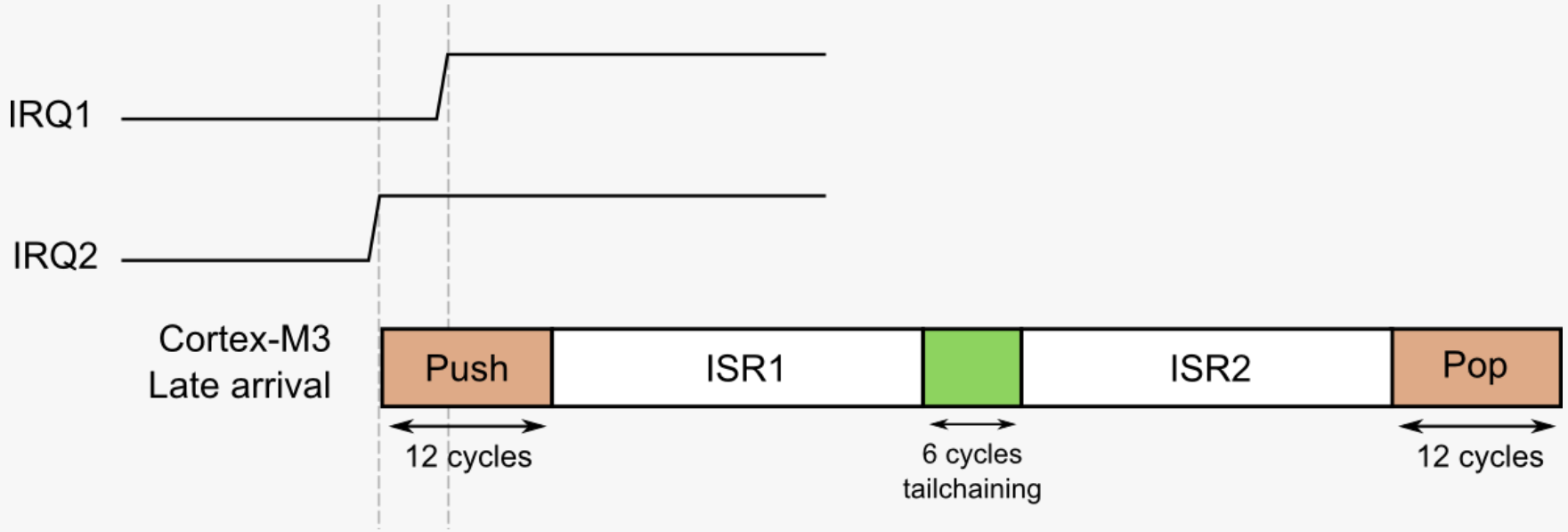
Wakeup Latency



Interrupt Tailchaining



Late Arrival



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Hands-On Lesson:

TM0008 in Simplicity Studio