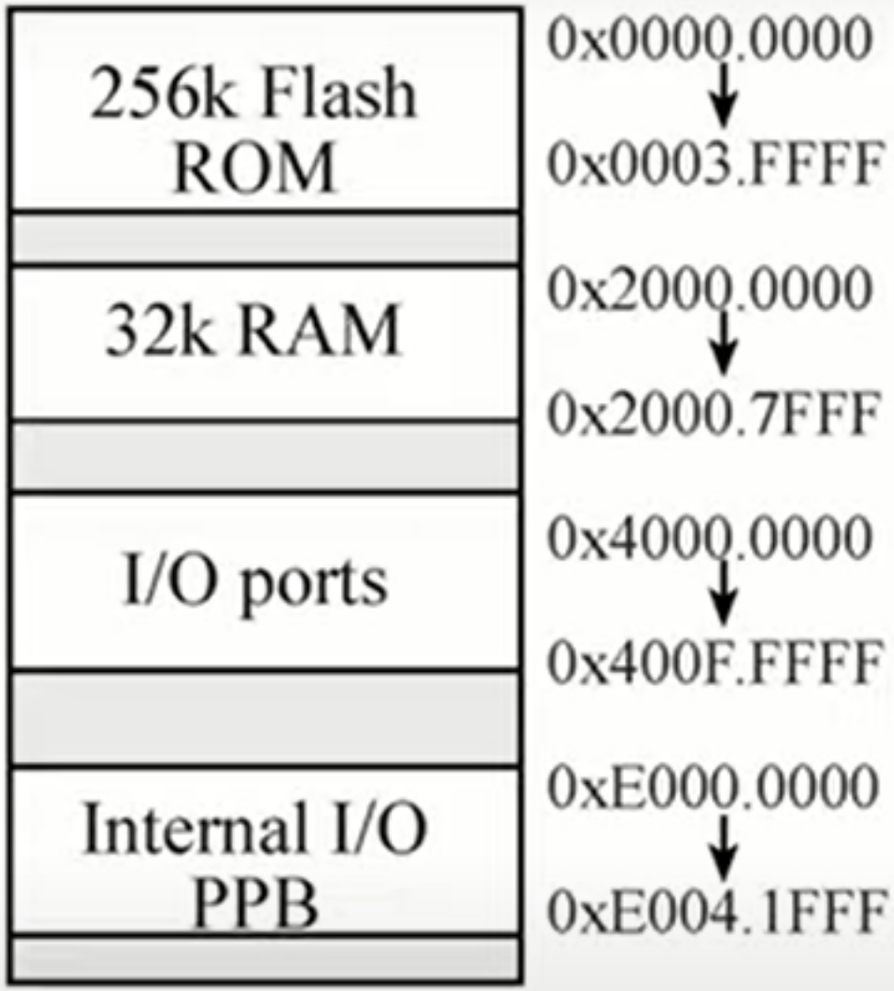
SysTick Timer

- Timer/Counter operation
  - 24-bit counter *decrements* at bus clock frequency
    - With 80 MHz bus clock, decrements every 12.5 ns
  - Counting is from $n \rightarrow 0$

ARM Memory-map



TI TM4C123
Microcontroller

SysTick Timer

Address	31-24	23-17	16	15-3	2	1	0	Name
SE000E010	0	0	COUNT	0	CLK_SRC	INTEN	ENABLE	NVIC_ST_CTRL_R
SE000E014	0	24-bit RELOAD value						NVIC_ST_RELOAD_R
SE000E018	0	24-bit CURRENT value of SysTick counter						NVIC_ST_CURRENT_R

- Initialization (4 steps)
  - Step1: Clear ENABLE to stop counter
  - Step2: Specify the RELOAD value
  - Step3: Clear the counter via NVIC_ST_CURRENT_R
  - Step4: Set NVIC_ST_CTRL_R
    - CLK_SRC = 1 (bus clock is the only option)
    - INTEN = 0 for no interrupts
    - ENABLE = 1 to enable

SysTick Timer Registers

```
#define NVIC_ST_CTRL_R(*((volatile uint32_t *)0xE000E010))

#define NVIC_ST_RELOAD_R(*((volatile uint32_t *)0xE000E014))

#define NVIC_ST_CURRENT_R(*((volatile uint32_t *)0xE000E018))
```

SysTick Timer Example

```
void SysTick_Init(void){
 NVIC_ST_CTRL_R = 0; // 1) disable SysTick during setup
 NVIC_ST_RELOAD_R = 0x00FFFFFF; // 2) maximum reload value
 NVIC_ST_CURRENT_R = 0; // 3) any write to CURRENT clears it
 NVIC_ST_CTRL_R = 0x00000005; // 4) enable SysTick with core clock
}

// The delay parameter is in units of the 80 MHz core clock(12.5 ns)
void SysTick_Wait(uint32_t delay){
  NVIC_ST_RELOAD_R = delay-1;  // number of counts
  NVIC_ST_CURRENT_R = 0;       // any value written to CURRENT clears
  while((NVIC_ST_CTRL_R&0x00010000)==0){ // wait for flag
  }
}
// Call this routine to wait for delay*10ms
void SysTick_Wait10ms(uint32_t delay){
 unsigned long i;
 for(i=0; i<delay; i++){
   SysTick_Wait(800000); // wait 10ms
}
```

SysTick Timer

24-bit Countdown Timer

```
SysTick_Init
; disable SysTick during setup
    LDR R1, =NVIC_ST_CTRL_R
    MOV R0, #0                  ; Clear Enable
    STR R0, [R1]
; set reload to maximum reload value
    LDR R1, =NVIC_ST_RELOAD_R
    LDR R0, =0x00FFFFFF;        ; Specify RELOAD value
    STR R0, [R1]                ; reload at maximum
; writing any value to CURRENT clears it
    LDR R1, =NVIC_ST_CURRENT_R
    MOV R0, #0
    STR R0, [R1]                ; clear counter
; enable SysTick with core clock
    LDR R1, =NVIC_ST_CTRL_R
    MOV R0, #0x0005     ; Enable but no interrupts (later)
    STR R0, [R1]        ; ENABLE and CLK_SRC bits set
    BX  LR
```