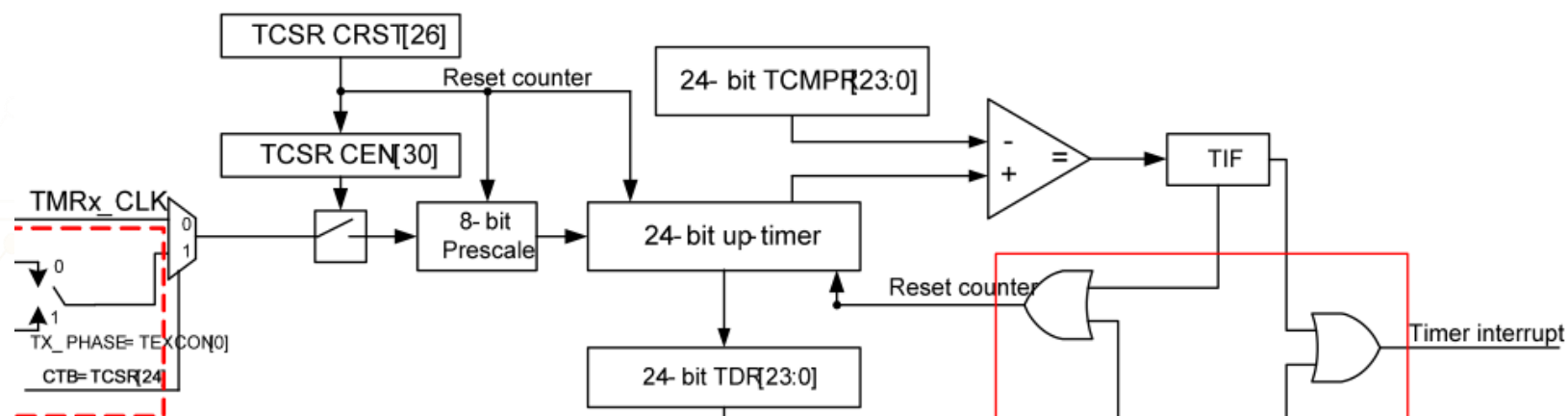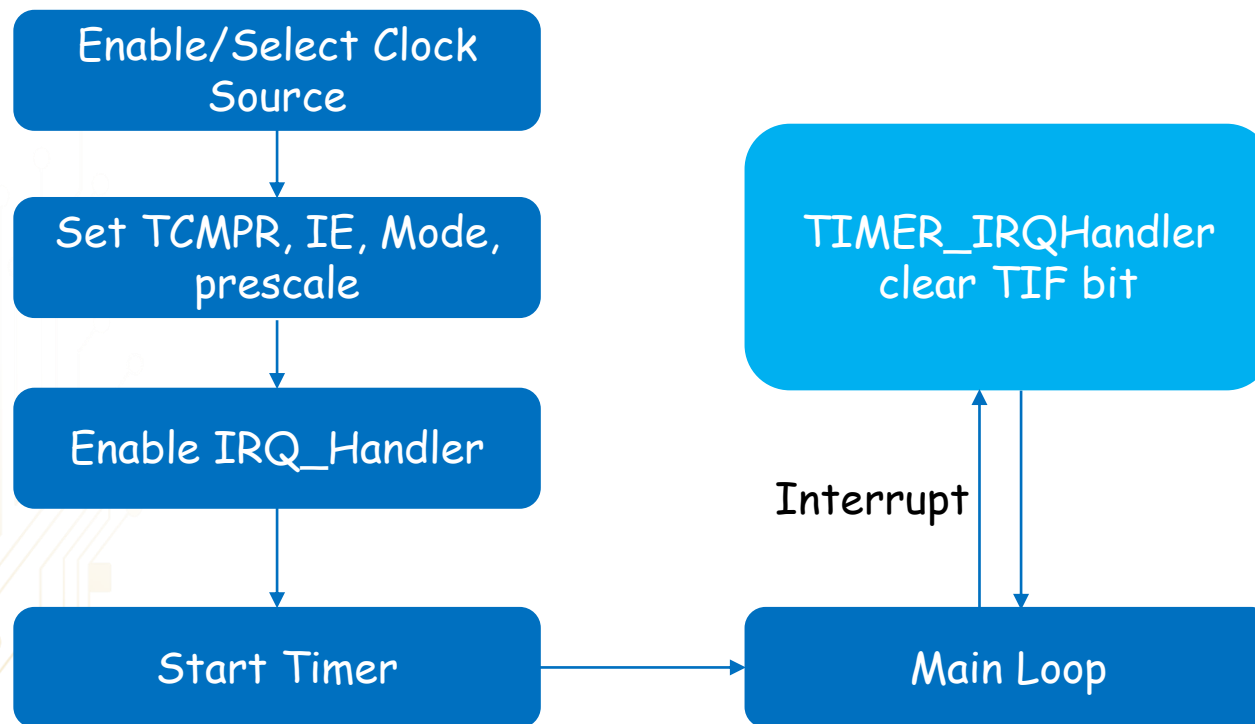# 微處理機系統與介面技術

## *LAB 4 – TIMER*

# Timer

- NUC140 has 4 sets of 32-bit timers(TIMER0~TIMER3)
- Timer mode:
  - One-Shot mode
  - Periodic mode
  - Continuous mode

# Timer Flow Chart

```
Enable/Select Clock
Source
        │
        ▼
Set TCMPR, IE, Mode,
prescale
        │
        ▼
Enable IRQ_Handler
        │
        ▼
Start Timer ──────────────▶ Main Loop
```

TIMER_IRQHandler
clear TIF bit

Interrupt

Main Loop

# Register Description

- TCSR
  - Timer Control Register
  - CEN, IE, MODE, PRESCALE
- TCMPR
  - Timer Compare Register
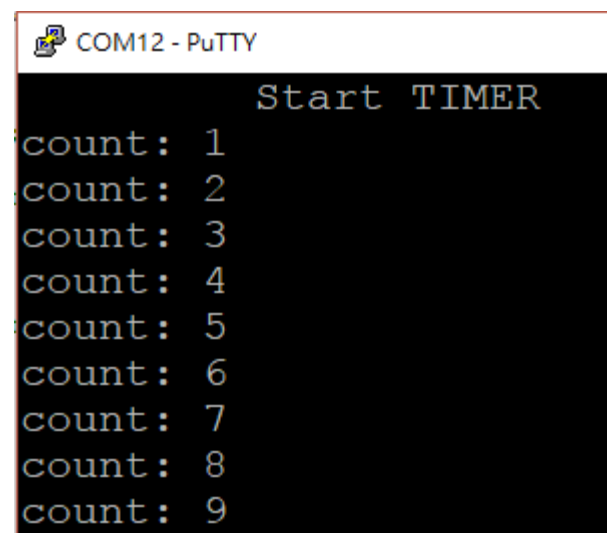- TISR
  - Timer Interrupt Status Register
  - TIF

**Timer Control Register (TCSR)**

| Register | Offset | R/W | Description | Reset Value |
|----------|--------|-----|-------------|-------------|
| TCSR0 | TMR_BA01+0x00 | R/W | Timer0 Control and Status Register | 0x0000_0005 |
| TCSR1 | TMR_BA01+0x20 | R/W | Timer1 Control and Status Register | 0x0000_0005 |
| TCSR2 | TMR_BA23+0x00 | R/W | Timer2 Control and Status Register | 0x0000_0005 |
| TCSR3 | TMR_BA23+0x20 | R/W | Timer3 Control and Status Register | 0x0000_0005 |

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|----|----|----|----|----|----|----|----|
| DBGACK_TMR | CEN | IE | MODE[1:0] | | CRST | CACT | CTB |
| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| Reserved | | | | | | | TDR_EN |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Reserved | | | | | | | |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| PRESCALE[7:0] | | | | | | | |

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# Basic

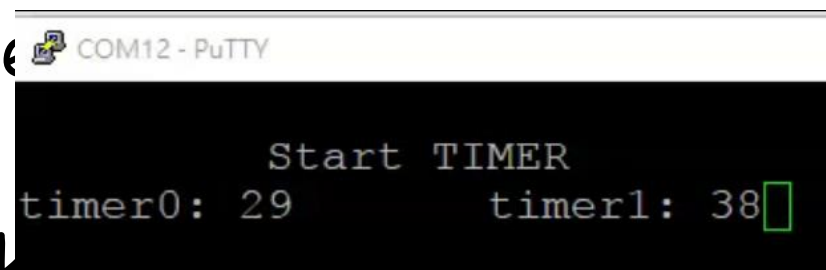- Make a counter(計數器), and print on putty for every second
- Use periodic mode



- Note:
- It is not recommended to print in the IRQ Handler, because it will take too much cycle in the IRQ, but we just for test

# Bonus

- Implement two counter,
  count 2 times per second and 3 times per second

- Use two GPIO to suspend counter
  - Key1 press, suspend counter1
  - Key2 press, suspend counter2

- counter1,2 are independent,
  key1 only affect on counter1 and so do

- Demo影片

- Note: use "\r" let putty see like a clock
  ex. printf("\rXXXXX")

COM12 - PuTTY

Start TIMER
timer0: 29        timer1: 38

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# Tips

- 範例程式: TIMER_PeriodicINT
- 只需要看**TIMER0**的部分就好,要看懂**timer**是如何計數 TCMPR, prescale 是怎麼算出1秒
  ex. Timer clock source = 12MHz , prescale = 0
      TCMPR = 12000000 ➔ 1 interrupt per second
- Remember to clear the timer interrupt flag
- 在計算如何計數前也別忘了要看指定的CLOCK SORCE是哪個唷

```
/* Select Timer 0~3 module clock source */
CLK_SetModuleClock(TMR0_MODULE, CLK_CLKSEL1_TMR0_S_HXT, NULL);
CLK_SetModuleClock(TMR1_MODULE, CLK_CLKSEL1_TMR1_S_HCLK, NULL);
CLK_SetModuleClock(TMR2_MODULE, CLK_CLKSEL1_TMR2_S_HIRC, NULL);
CLK_SetModuleClock(TMR3_MODULE, CLK_CLKSEL1_TMR3_S_HXT, NULL);
```

# Demo

- Place: 創新大樓515 找助教 夏子聰
- Demo Time: (二)(四)下午三點~五點
- Report deadline: 11/18(五)
- Report title format: LABx_ID_Name.pdf

- Demo必須在Report deadline前完成
- Demo前須先上傳程式碼(上傳main所在的.c檔即可)

# Graded

- Basic : 70%
- Bonus : 15%
- Report & Code : 15%

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