TP3

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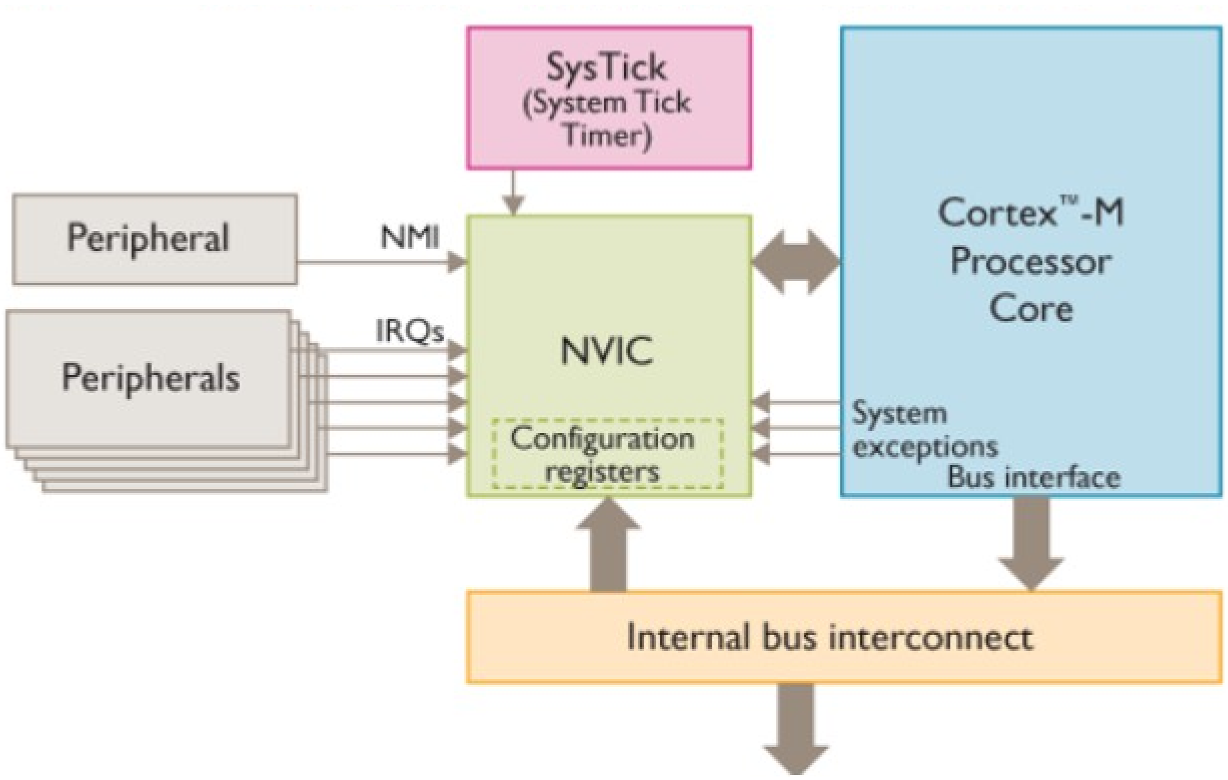
TP3

- Objectif
  - Comprendre la différence entre l'attente active de périphériques (polling) et la gestion de périphériques par interruptions
- La périphérique est le USER BUTTON disponible sur la carte
  - Gestion avec interruption: on génère une interruption matérielle a chaque « click » du bouton
  - Gestion en polling: on boucle tant qu’on a un « click » du bouton

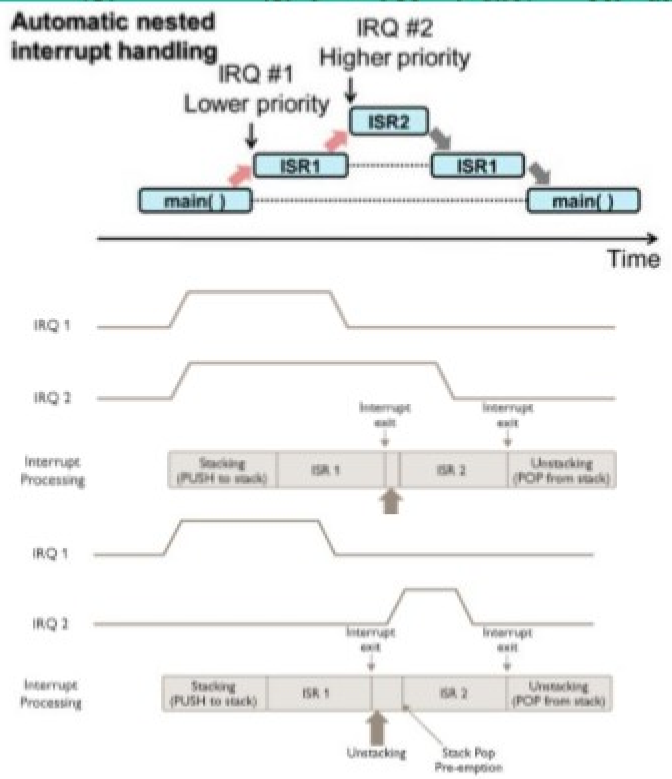
Nested Vector Interrupt Controller NVIC

- Up to 81 interrupts (depends on the STM32 device type)
- Programmable priority level of 0-15
  - A higher level corresponds to a lower priority, so level 0 is the highest interrupt priority
- Dynamic reprioritization of interrupts
- Grouping of priority values into group priority and sub-priority fields Interrupt tail-chaining
- An external Non-maskable interrupt (NMI)

Nested Vector Interrupt Controller NVIC



Nested Vector Interrupt Controller NVIC



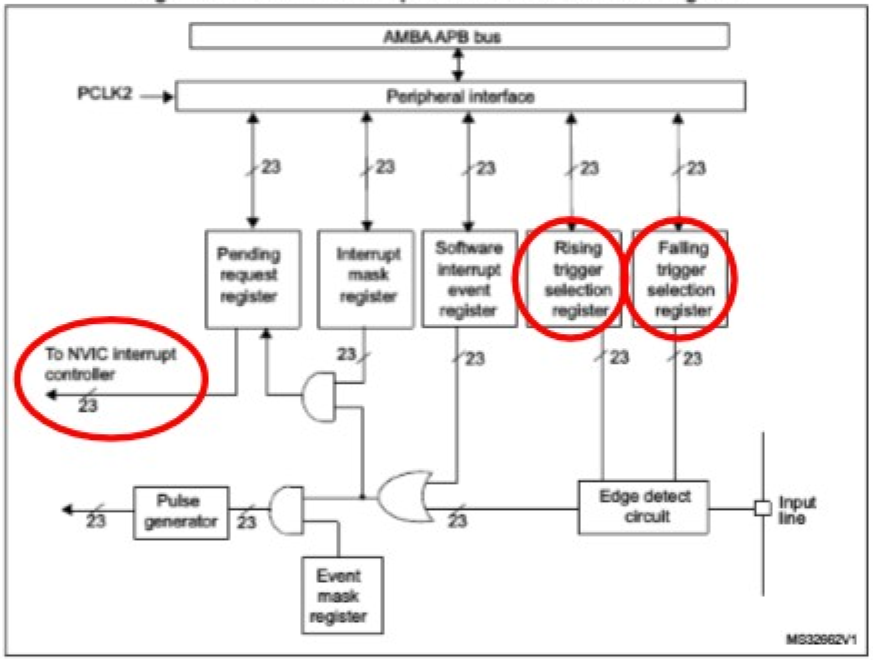
- Nested Interrupt: If a interrupt request (IRQ) with higher priority is raised, it is served first

- Tail chaining: for nested ISR does not restore all saved registers from the stack.
- Stack pop pre-emption: If another exception occurs during the unstacking process of an exception, the processor abandons the stack Pop

Connecting button to interrupt

- Look at the Reference Manual: RM0368* Chapter 10

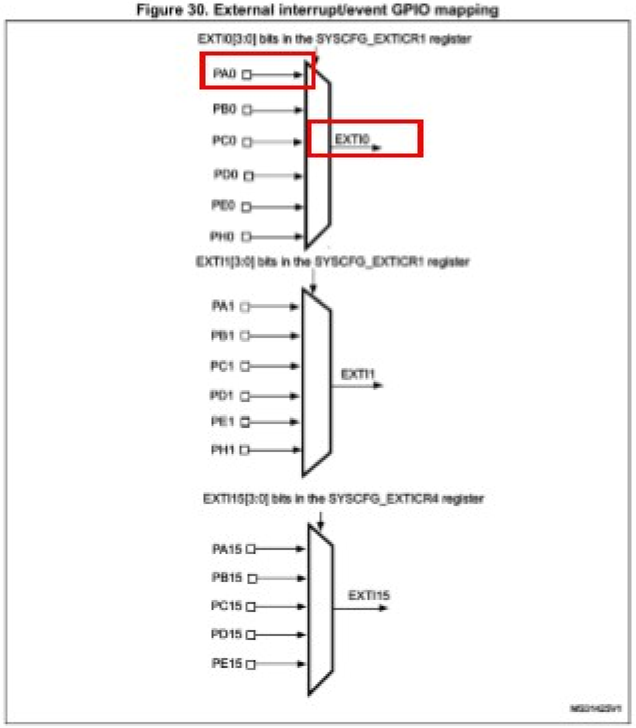
Figure 29. External interrupt/event controller block diagram



*STM32F3_refmanual_DM00043574.pdf

Connecting button to interrupt

Figure 30. External interrupt/event GPIO mapping


EXTI0[3:0] bits in the SYSCFG_EXTICR1 register
PA0
PB0
PC0
PD0
PE0
PH0
EXTI0
EXTI1[3:0] bits in the SYSCFG_EXTICR1 register
PA1
PB1
PC1
PD1
PE1
PH1
EXTI1
EXTI15[3:0] bits in the SYSCFG_EXTICR4 register
PA15
PB15
PC15
PD15
PE15
EXTI15

- There are 16 EXTI lines connected to GPIOs
- All pins with the same pin number are connected on the same EXTI line (eg. Pin_2 Port A and Pin_2 Port C share the same EXTI2)
- EXTI 16 – 22 are reserved for RTC, USB etc…

USER BUTTON

- Look at the file stm32f3_discovery.h
  - It is located in the stm32f3discovery_hal_lib
- It contains two functions to manage the button:
  - void **BSP_PB_Init**(Button_TypeDef Button, ButtonMode_TypeDef ButtonMode);
    - It specifies the way the button is used (Button_Mode)
      - GPIO : polling
      - EXTI : interrupt

USER BUTTON (INTERRUPT)

```
void BSP_PB_Init(Button_TypeDef Button, ButtonMode_TypeDef ButtonMode)
{

  if (ButtonMode == BUTTON_MODE_EXTI)
  {
    /* Configure Button pin as input with External interrupt */
    GPIO_InitStruct.Pin = BUTTON_PIN[Button];  // GPIO_PIN_0
    GPIO_InitStruct.Pull = GPIO_NOPULL;
    GPIO_InitStruct.Speed = GPIO_SPEED_FREQ_HIGH;
    GPIO_InitStruct.Mode = GPIO_MODE_IT_RISING;
    HAL_GPIO_Init(BUTTON_PORT[Button], &GPIO_InitStruct);

    /* Enable and set Button EXTI Interrupt to the lowest priority */
    HAL_NVIC_SetPriority((IRQn_Type)(BUTTON_IRQn[Button]), 0x0F, 0x00);
    HAL_NVIC_EnableIRQ((IRQn_Type)(BUTTON_IRQn[Button]));
  }
}
```

USER BUTTON (Polling)

-
  - uint32_t **BSP_PB_GetState** (Button_TypeDef Button);
    - It returns the state of the button
      - 0 the button is not pressed
      - 1 the button is pressed

Interrupt

- If the button is programmed to be used with interrupt, the ISR is the

```
void EXTI0_IRQHandler(void) {
    …
    LL_EXTI_ClearFlag_0_31 (LL_EXTI_LINE_0);
    /* mandatory function to clear the Interrupt request */
}
```

Exercice 1

- Allumer le LED7 quand on appui sur le bouton. Si on appui une deuxième fois le LED7 s'étaint
  - **Version a)** utiliser l'interruption
  - **Version b)** utiliser le polling (boucle pour tester l'état du bouton

Exercice 2

- Ecrire un programme qui peut faire au même temps:
  - Clignoter le LED4 (freq = 2Hz)
  - Allumer le LED7 quand on appuie sur le bouton. Si on appuie une deuxième fois le LED7 s’éteint

Exercice 3

- Ecrire un programme pour faire
  - Clignoter le LED4 à 2Hz
  - Reconnaitre un double-click du bouton et donc modifier la freq à 10Hz
    - Second click doit arriver avant 1s du premiere click
    - Un deuxième double-click modifier le freq à 2Hz