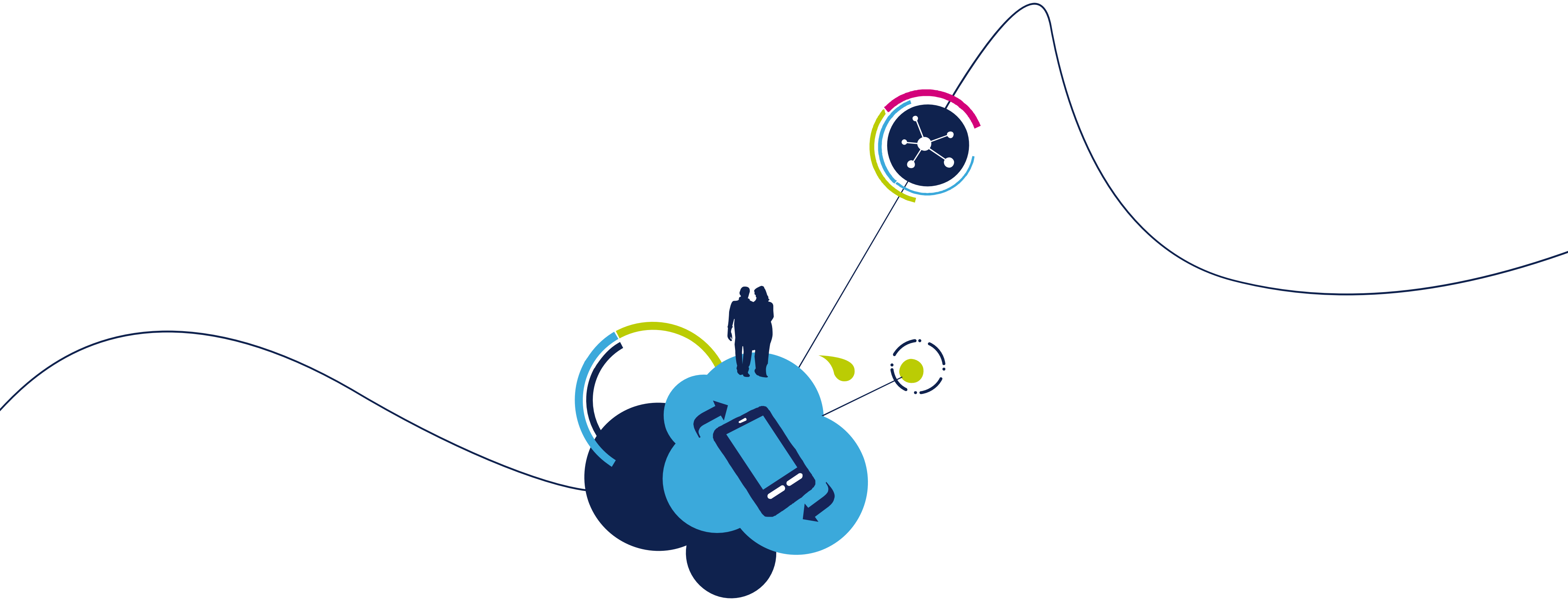


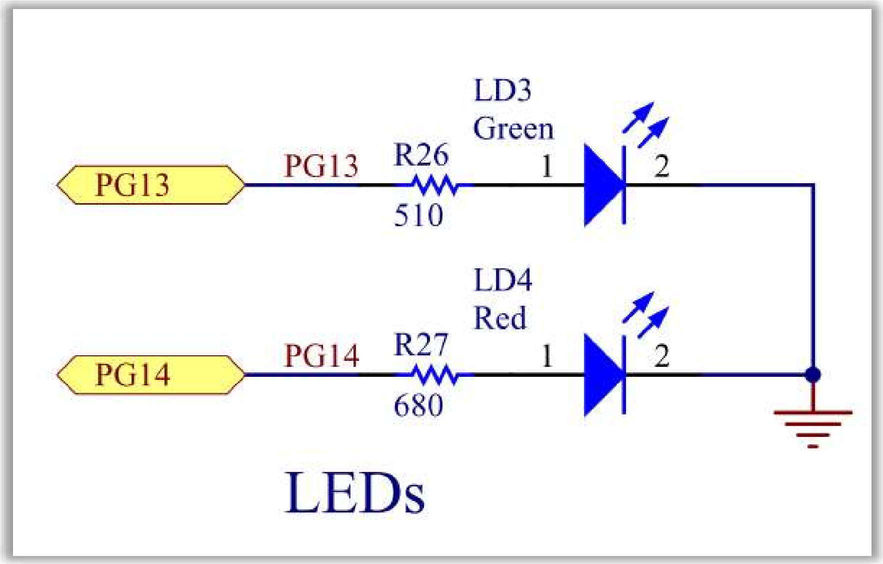
1.1.2 EXTI lab

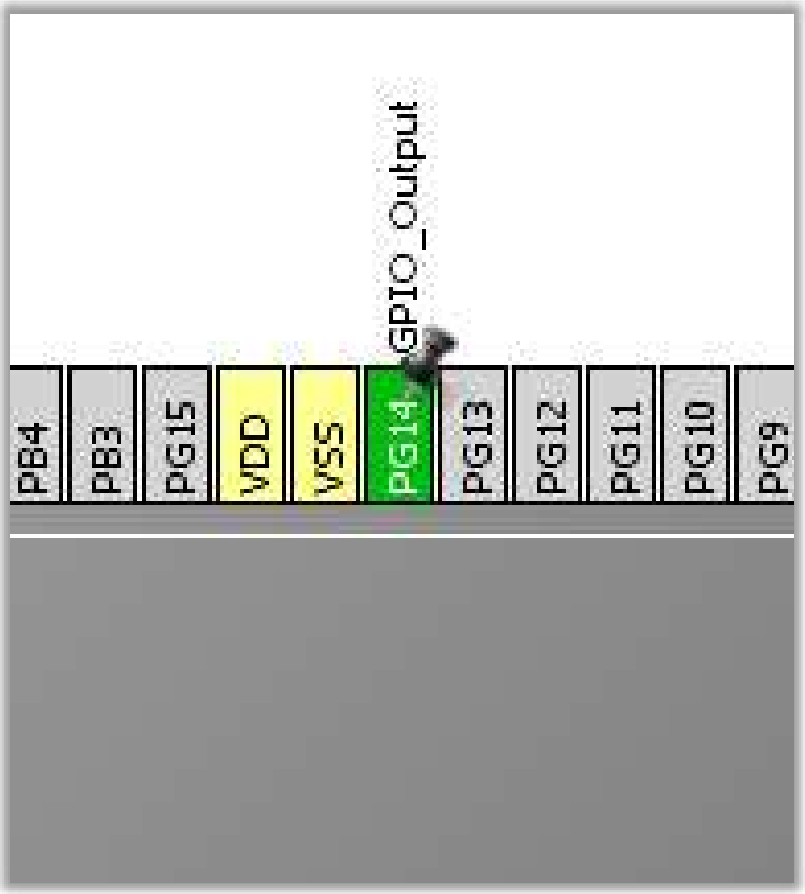
1.1.2 Configure EXTI to turn on LED

- Objective
  - Learn how to setup input pin with EXTI in CubeMX
  - How to Generate Code in CubeMX and use HAL functions
- Goal
  - Configure GPIO and EXTI pin in CubeMX and Generate Code
  - Add into project Callback function and function which turn on led
  - Verify the correct functionality by pressing button which turns on LED

1.1.2 Configure EXTI to turn on LED

- Create project in CubeMX
  - Menu > File > New Project
  - Select STM32F4 > STM32F429/439 > LQFP144 > STM32F439ZITx
- Configure LED pin as GPIO_Output
- Configure Button pin as GPIO_EXTIX





1.1.2 Configure EXTI to turn on LED

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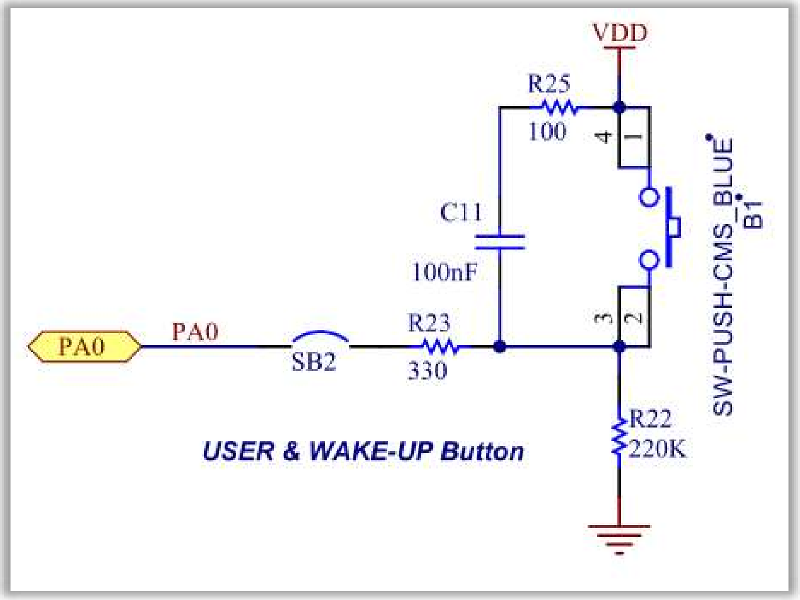
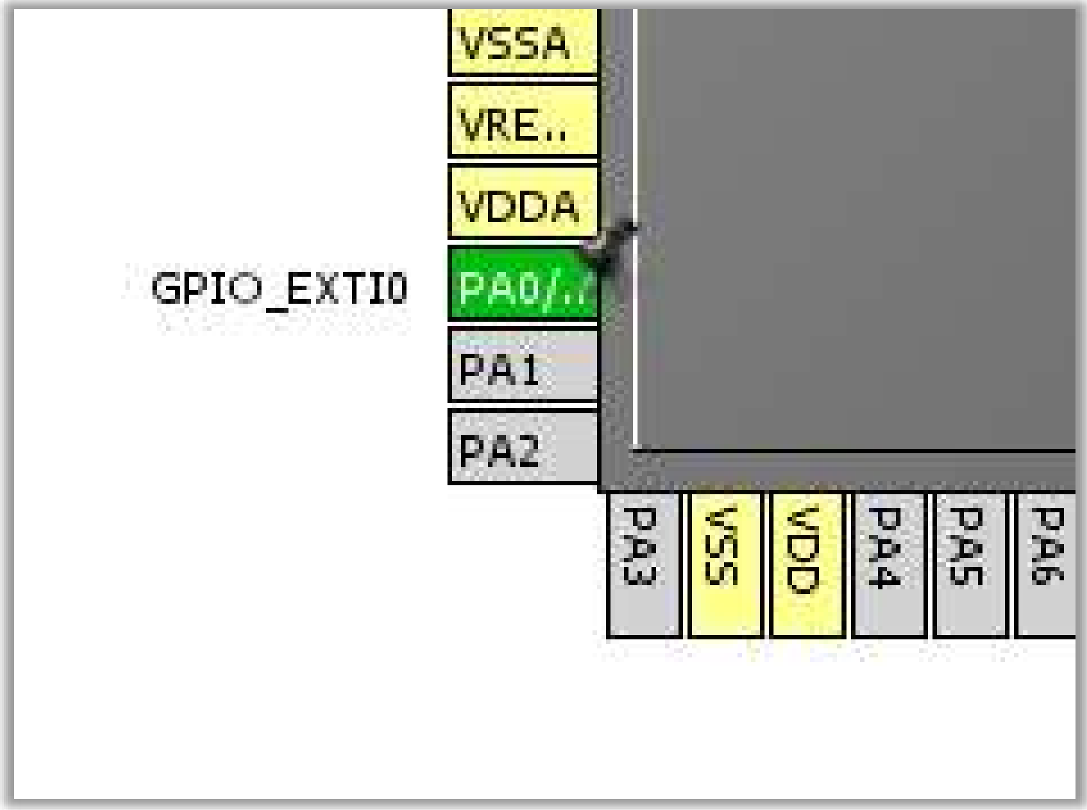
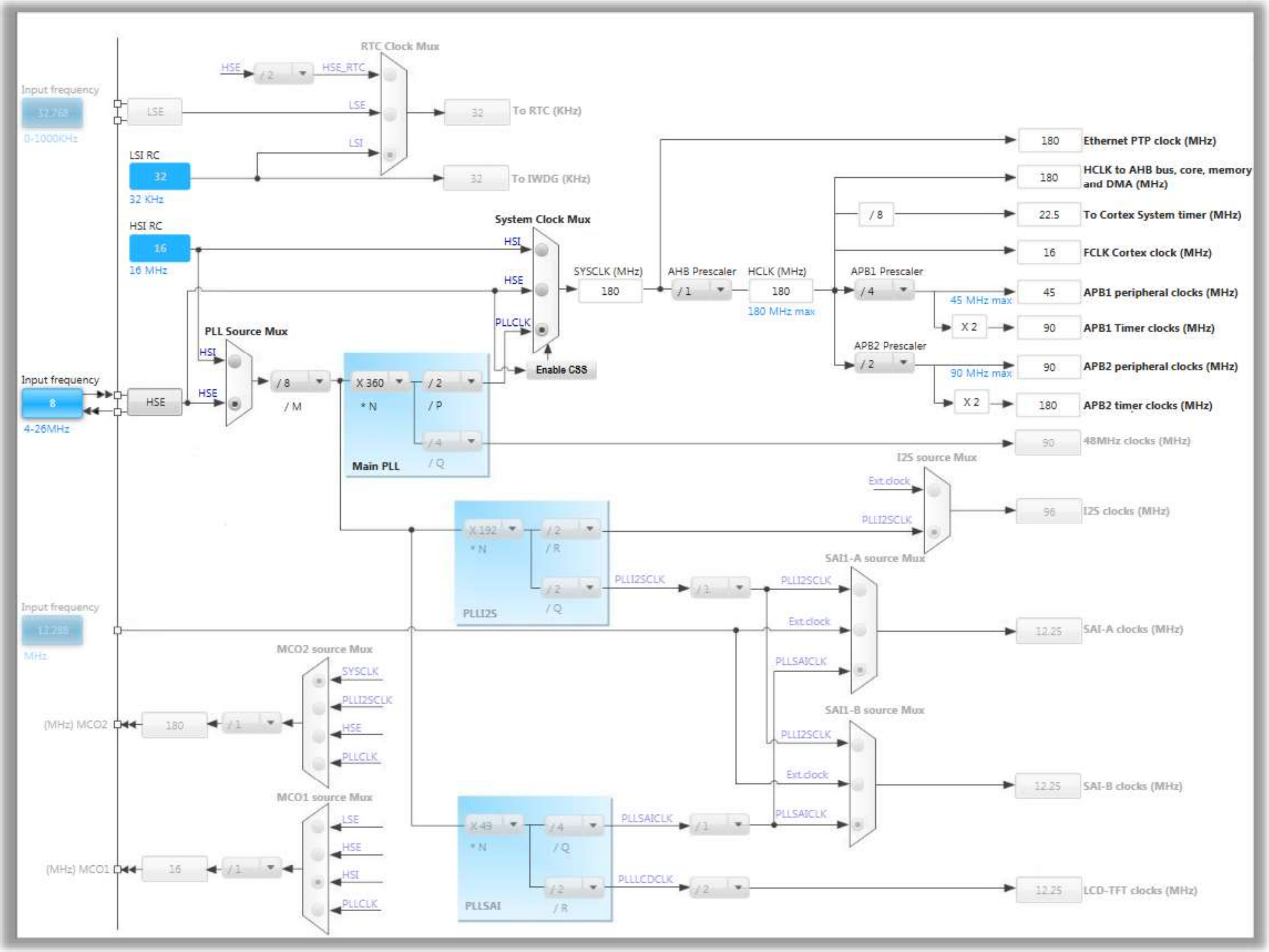




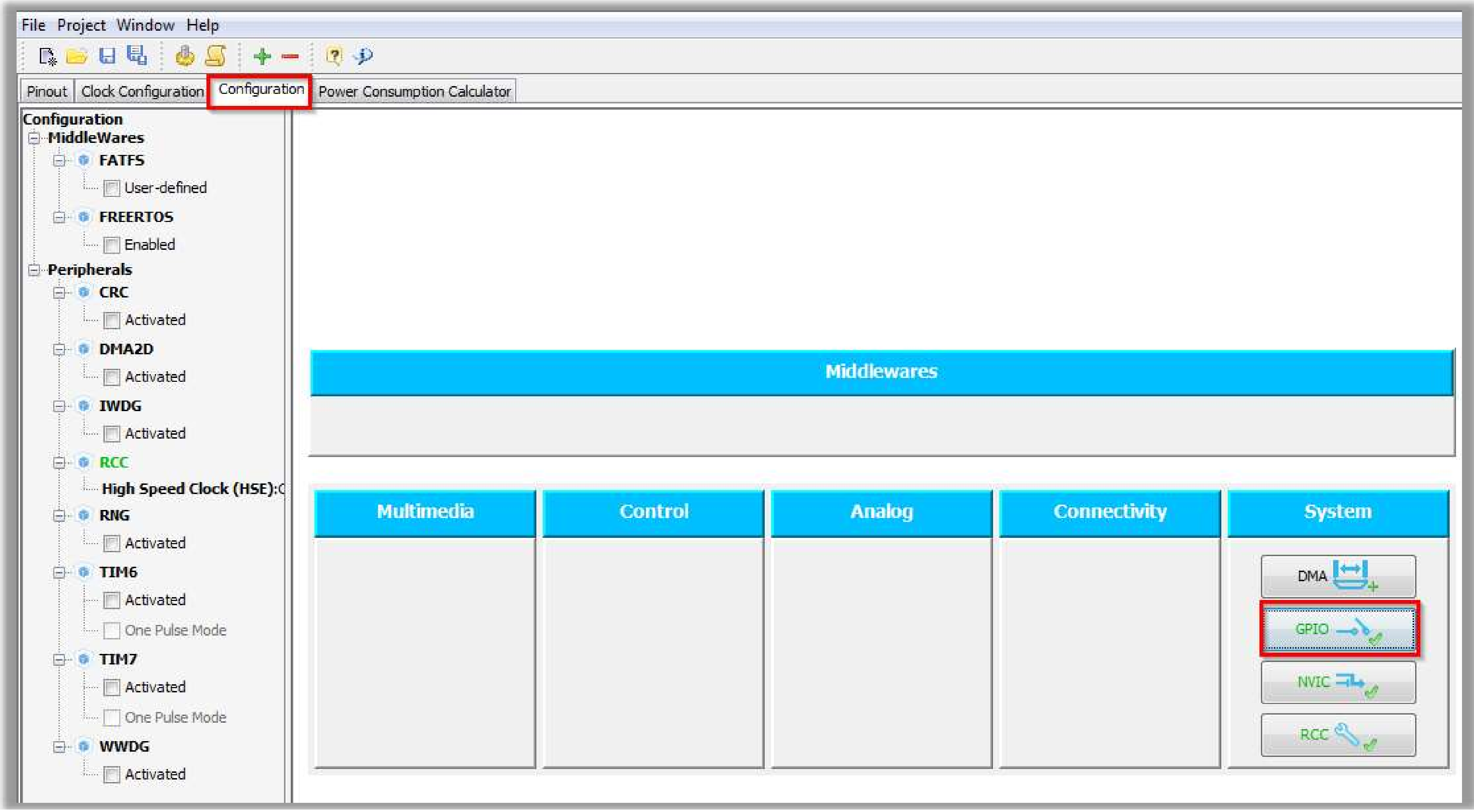
1.1.2 Configure EXTI to turn on LED

- In order to run on maximum frequency, setup clock system
- Details in lab 0



1.1.2 Configure EXTI to turn on LED

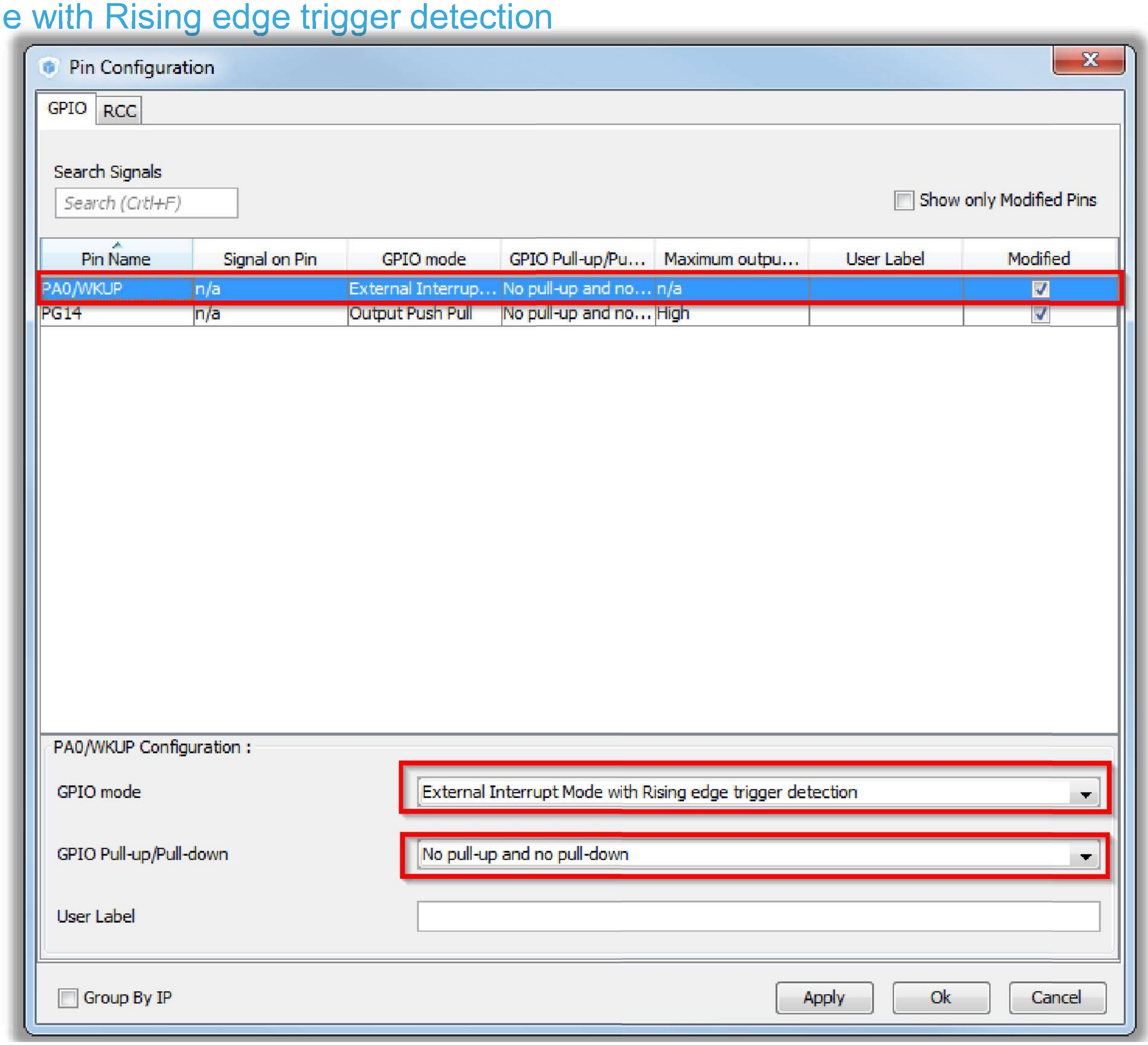
- GPIO Configuration
  - TAB>Configuration>System>GPIO



Configuration
- MiddleWares
  - FATFS
    - ☐ User-defined
  - FREERTOS
    - ☐ Enabled
- Peripherals
  - CRC
    - ☐ Activated
  - DMA2D
    - ☐ Activated
  - IWDG
    - ☐ Activated
  - RCC
    - High Speed Clock (HSE):C
  - RNG
    - ☐ Activated
  - TIM6
    - ☐ Activated
    - ☐ One Pulse Mode
  - TIM7
    - ☐ Activated
    - ☐ One Pulse Mode
  - WWDG
    - ☐ Activated

1.1.2 Configure EXTI to turn on LED

- GPIO(Pin) Configuration
  - Select External Interrupt Mode with Rising edge trigger detection
  - No pull-up or pull-down
  - PG14 can be let in default settings
  - Button OK



Pin Name	Signal on Pin	GPIO mode	GPIO Pull-up/Pu...	Maximum outpu...	User Label	Modified
PA0/WKUP	n/a	External Interrup...	No pull-up and no...	n/a		☑
PG14	n/a	Output Push Pull	No pull-up and no...	High		☑

PA0/WKUP Configuration :

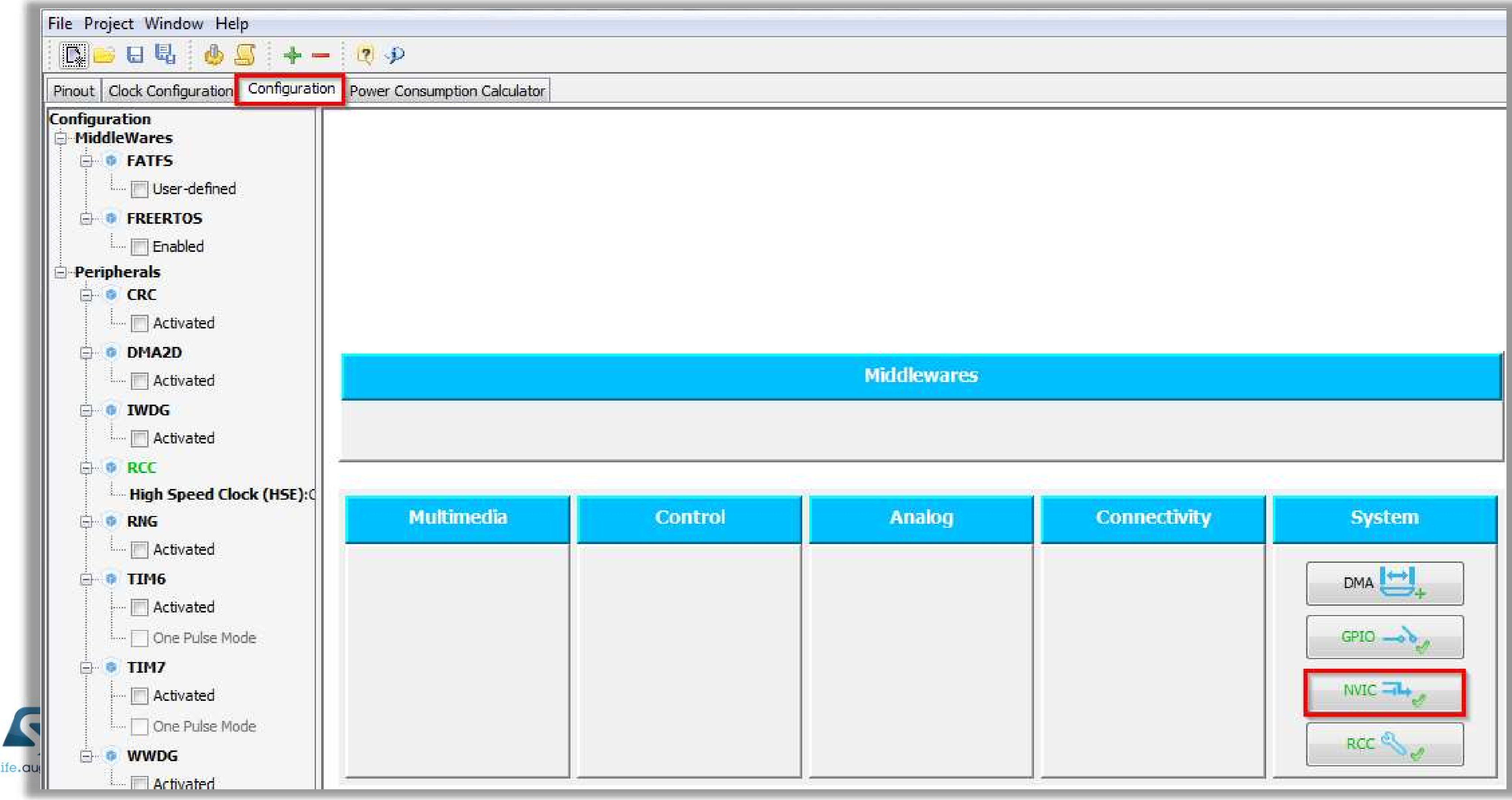
GPIO mode: External Interrupt Mode with Rising edge trigger detection

GPIO Pull-up/Pull-down: No pull-up and no pull-down

User Label:

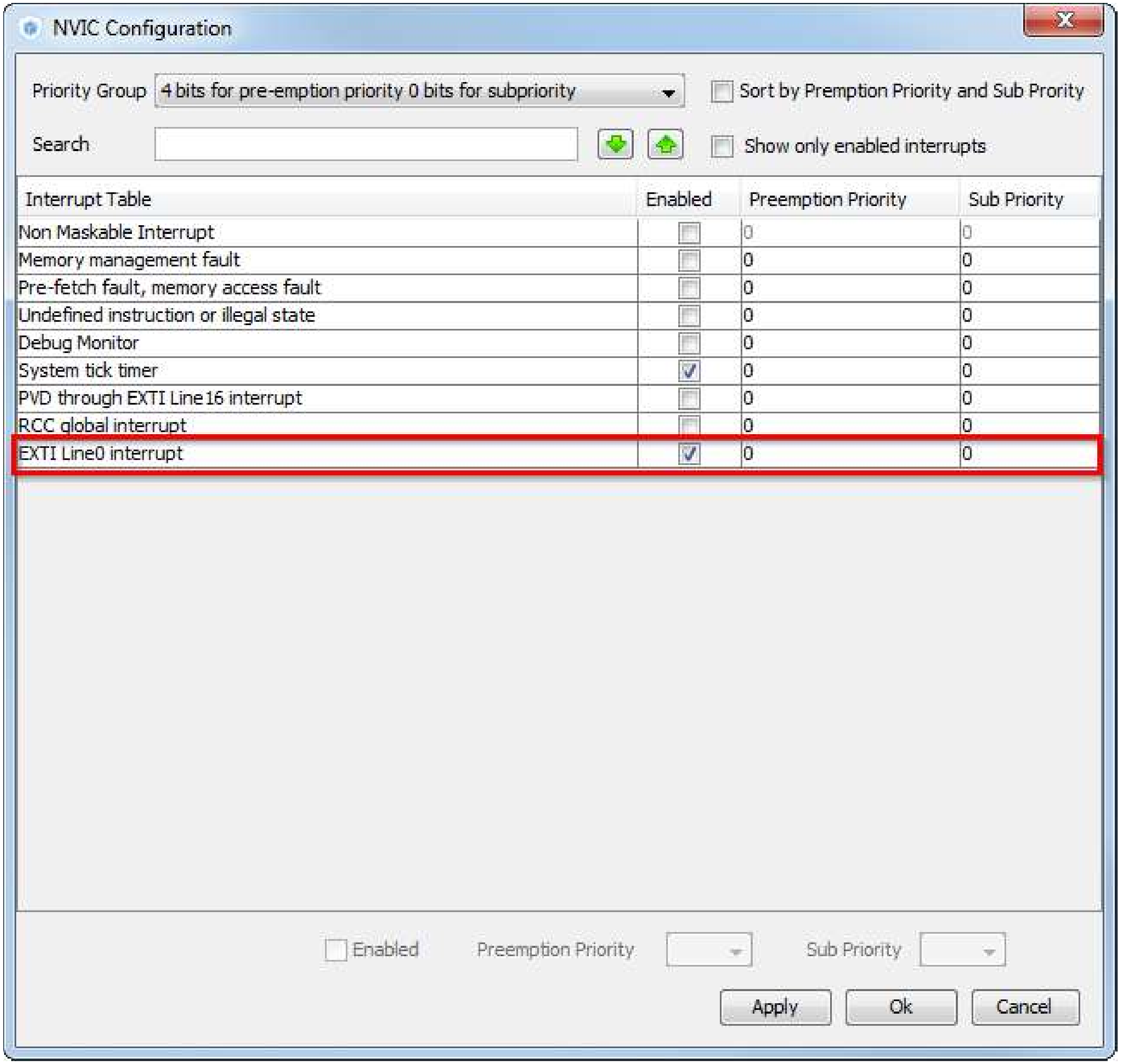
1.1.2 Configure EXTI to turn on LED

- NVIC Configuration
  - We need to enable interrupts for EXTI
  - TAB>Configuration>System>NVIC



1.1.2 Configure EXTI to turn on LED

- NVIC Configuration
  - Enable interrupt for EXTI Line0
  - Button OK



NVIC Configuration

Priority Group: 4 bits for pre-emption priority 0 bits for subpriority

□ Sort by Premption Priority and Sub Prority

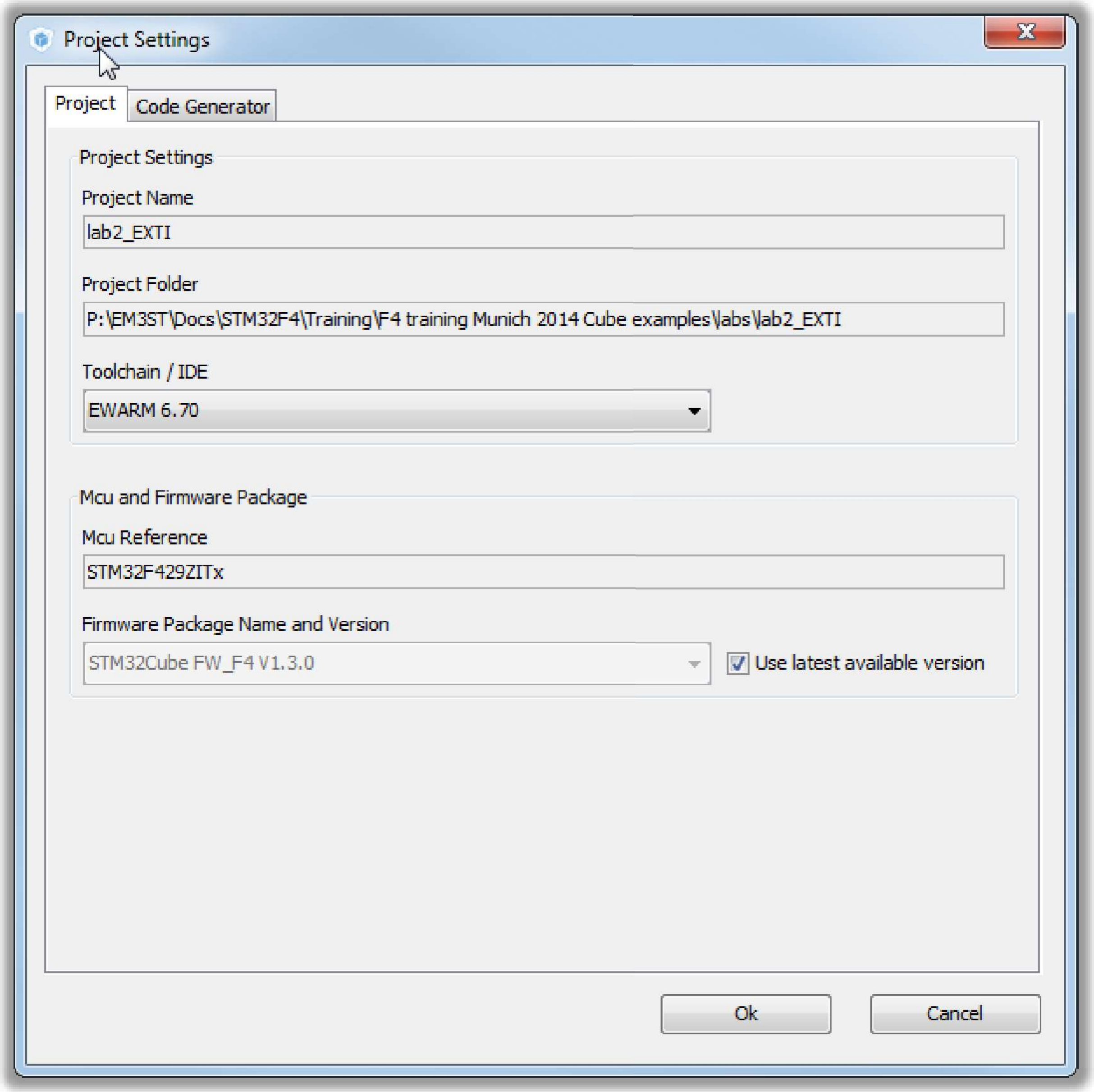
Search:

□ Show only enabled interrupts

Interrupt Table	Enabled	Preemption Priority	Sub Priority
Non Maskable Interrupt	□	0	0
Memory management fault	□	0	0
Pre-fetch fault, memory access fault	□	0	0
Undefined instruction or illegal state	□	0	0
Debug Monitor	□	0	0
System tick timer	☑	0	0
PVD through EXTI Line16 interrupt	□	0	0
RCC global interrupt	□	0	0
EXTI Line0 interrupt	☑	0	0

1.1.2 Configure EXTI to turn on LED

- Now we set the project details for generation
  - Menu > Project > Project Settings
  - Set the project name
  - Project location
  - Type of toolchain
- Now we can Generate Code
  - Menu > Project > Generate Code



Project Settings

Project Name: lab2_EXTI

Project Folder: P:\EM3ST\Docs\STM32F4\Training\F4 training Munich 2014 Cube examples\labs\lab2_EXTI

Toolchain / IDE: EWARM 6.70

Mcu and Firmware Package

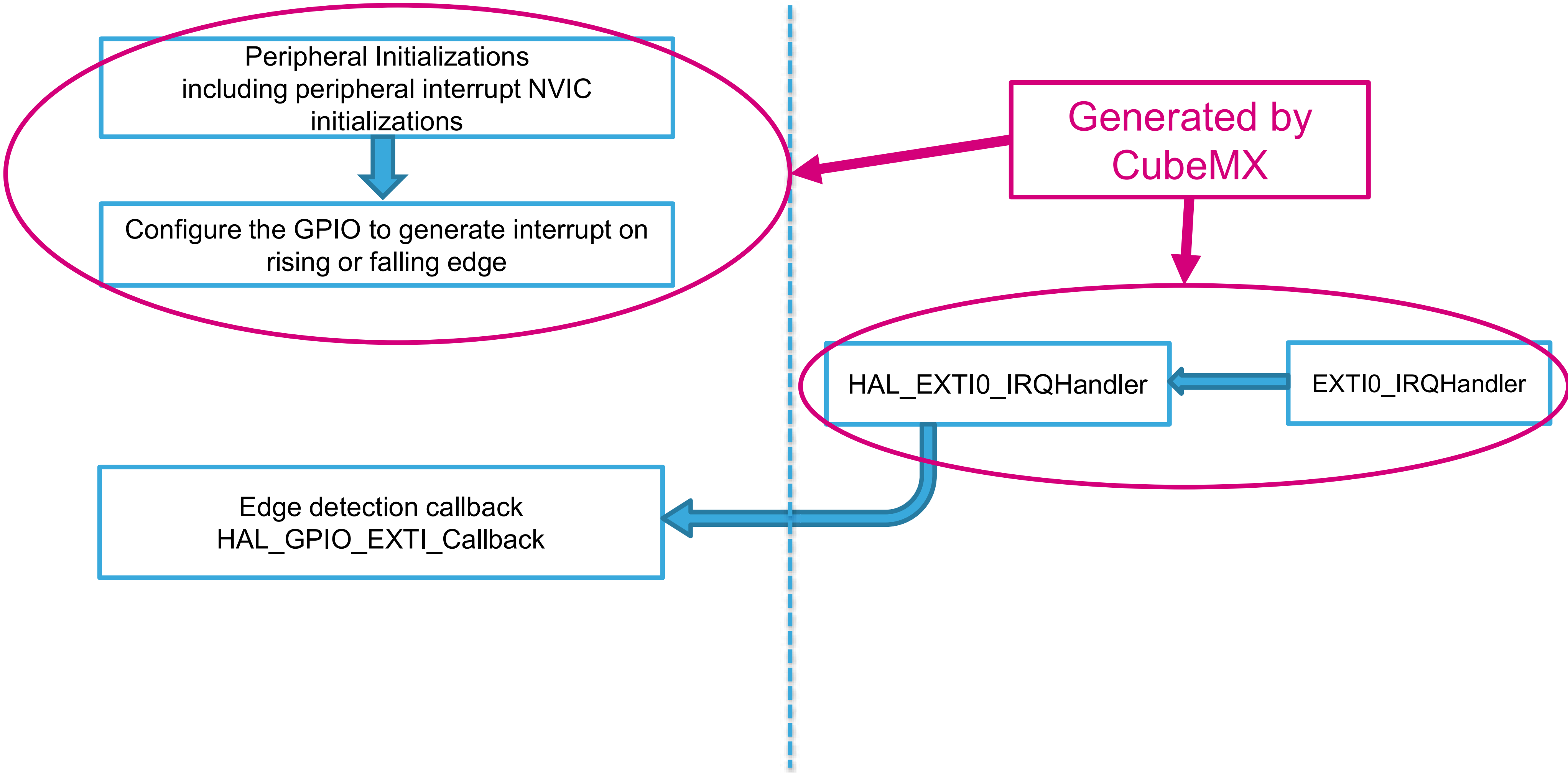
Mcu Reference: STM32F429ZITx

Firmware Package Name and Version: STM32Cube FW_F4 V1.3.0

☑ Use latest available version

1.1.2 Configure EXTI to turn on LED

HAL Library work flow 1



Peripheral Initializations including peripheral interrupt NVIC initializations

Configure the GPIO to generate interrupt on rising or falling edge

Generated by CubeMX

HAL_EXTI0_IRQHandler

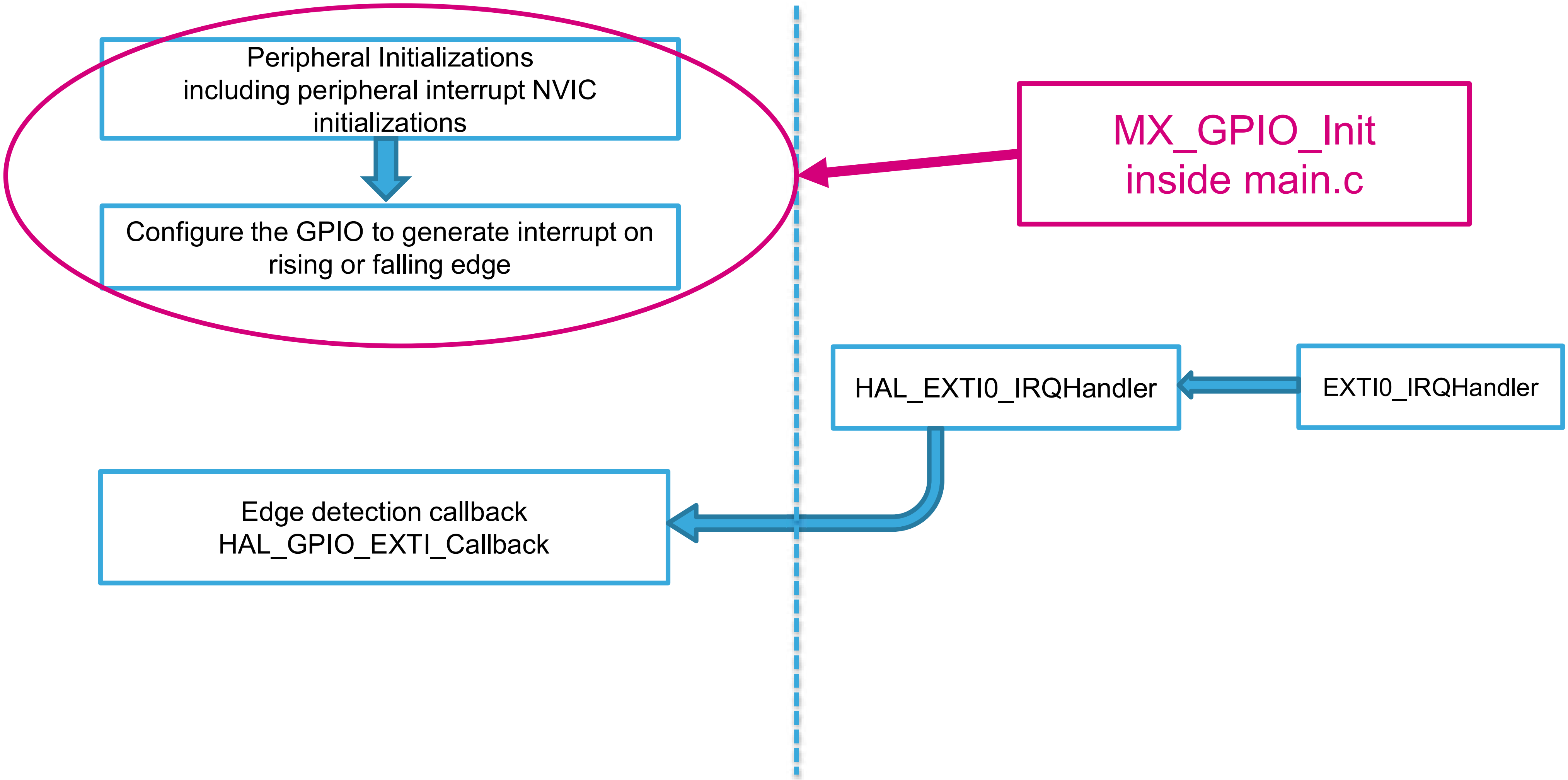
EXTI0_IRQHandler

Edge detection callback HAL_GPIO_EXTI_Callback

life.augmented

1.1.2 Configure EXTI to turn on LED

HAL Library work flow 2



Peripheral Initializations including peripheral interrupt NVIC initializations

Configure the GPIO to generate interrupt on rising or falling edge

MX_GPIO_Init inside main.c

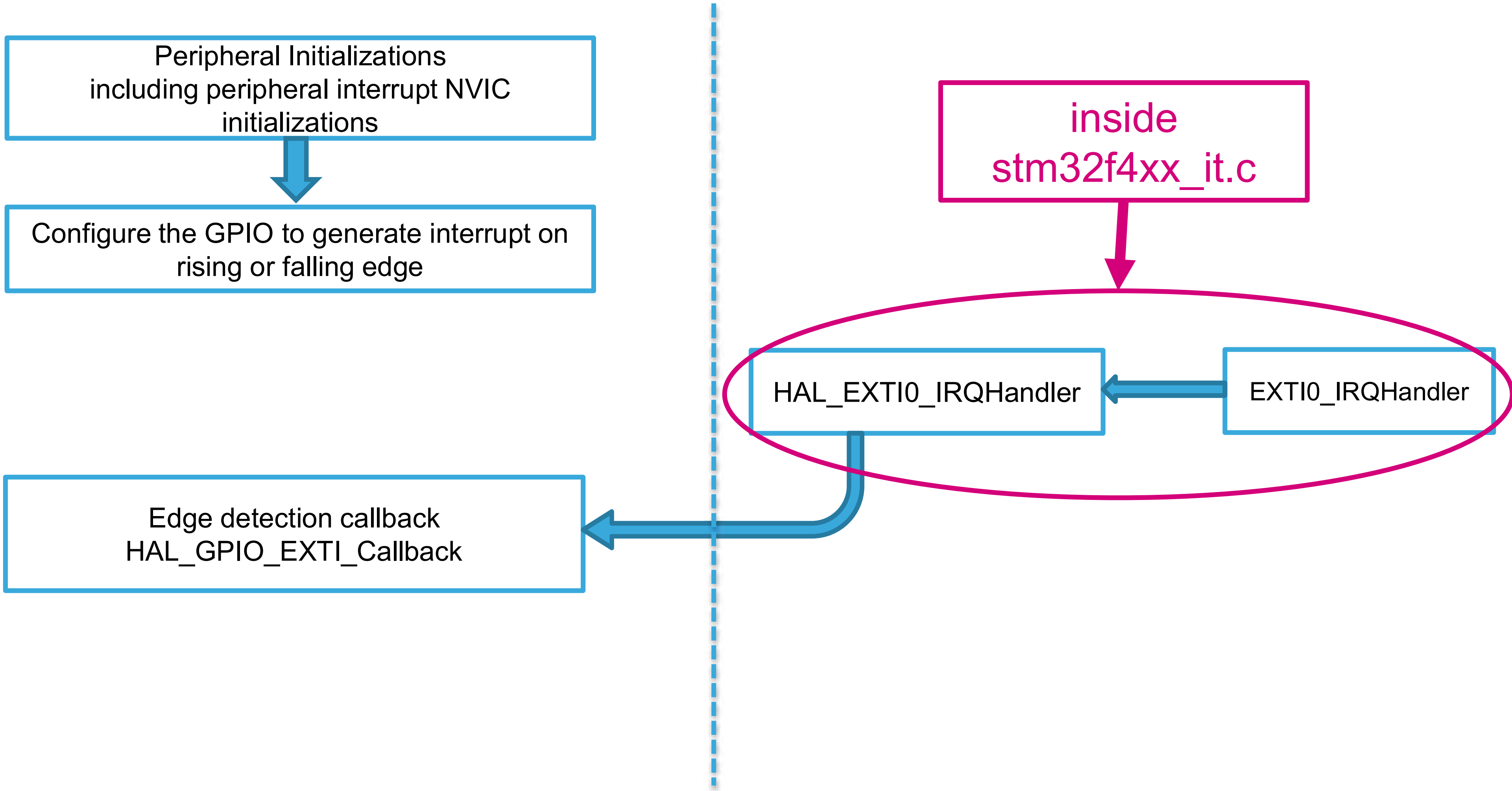
HAL_EXTI0_IRQHandler

EXTI0_IRQHandler

Edge detection callback HAL_GPIO_EXTI_Callback

1.1.2 Configure EXTI to turn on LED

HAL Library working flow 3



Peripheral Initializations including peripheral interrupt NVIC initializations

Configure the GPIO to generate interrupt on rising or falling edge

Edge detection callback HAL_GPIO_EXTI_Callback

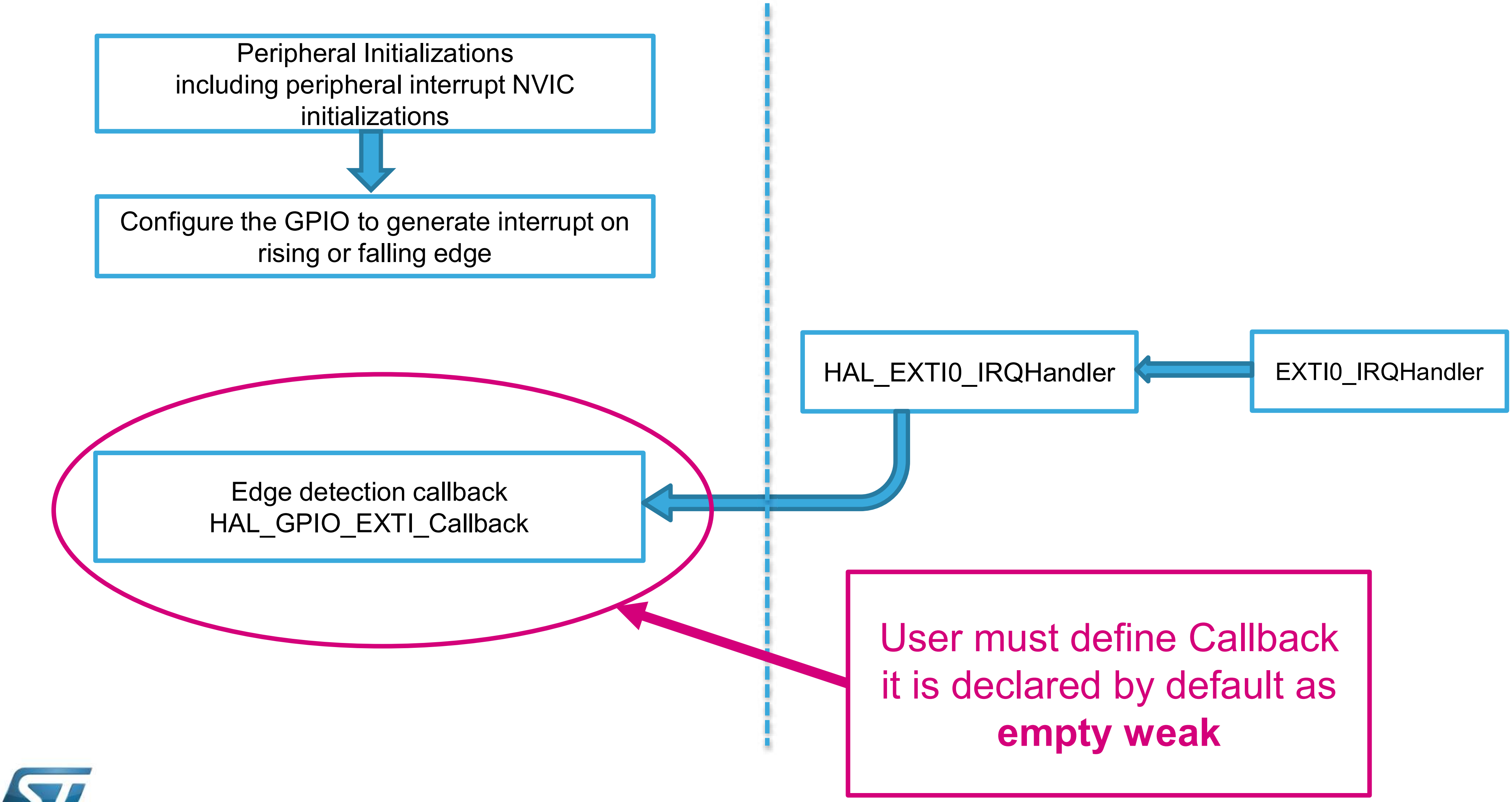
inside stm32f4xx_it.c

HAL_EXTI0_IRQHandler

EXTI0_IRQHandler

1.1.2 Configure EXTI to turn on LED

HAL Library work flow 4



Peripheral Initializations including peripheral interrupt NVIC initializations

Configure the GPIO to generate interrupt on rising or falling edge

HAL_EXTI0_IRQHandler

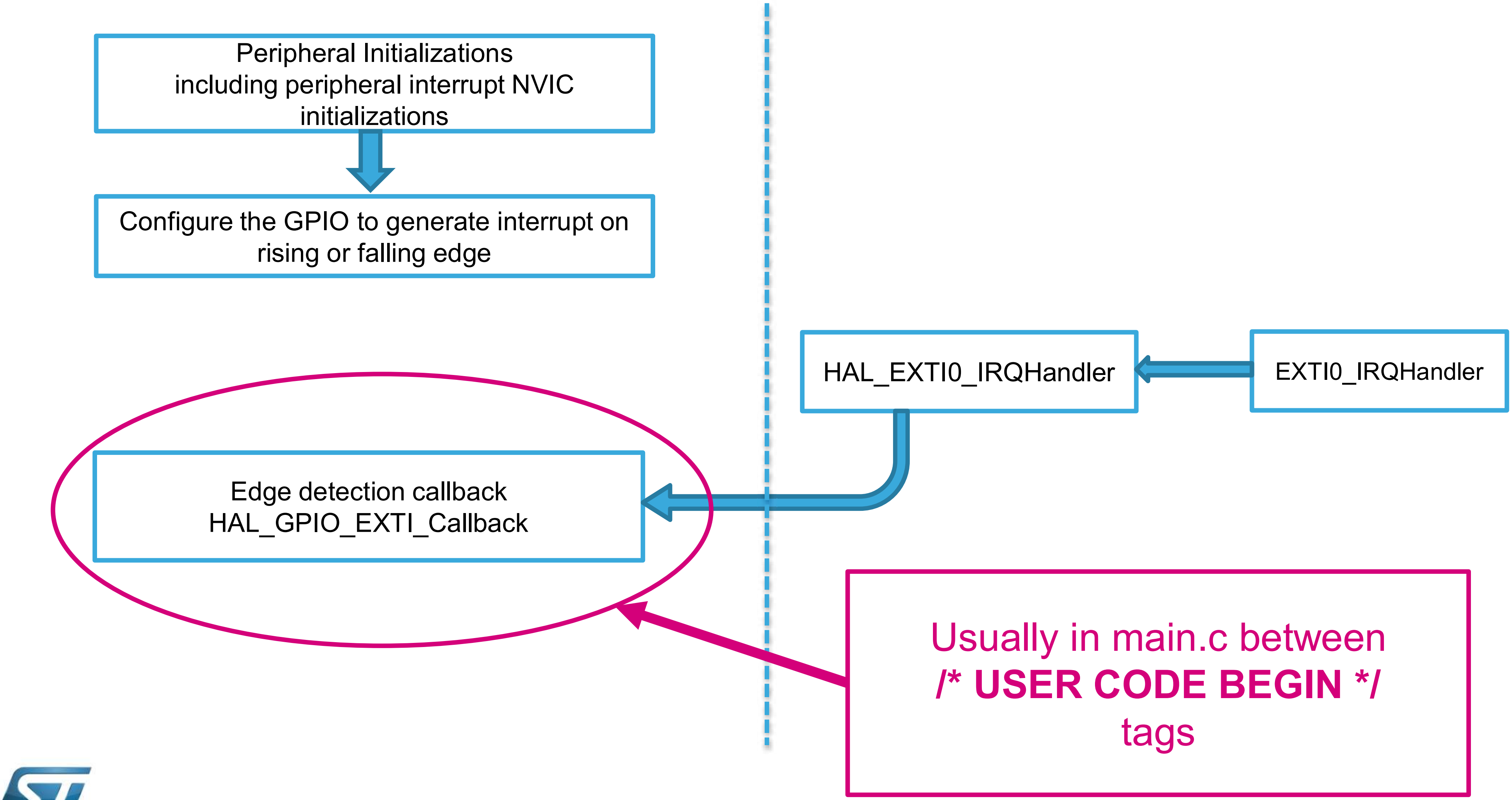
EXTI0_IRQHandler

Edge detection callback HAL_GPIO_EXTI_Callback

User must define Callback it is declared by default as **empty weak**

1.1.2 Configure EXTI to turn on LED

HAL Library work flow 5



Peripheral Initializations including peripheral interrupt NVIC initializations

Configure the GPIO to generate interrupt on rising or falling edge

HAL_EXTI0_IRQHandler

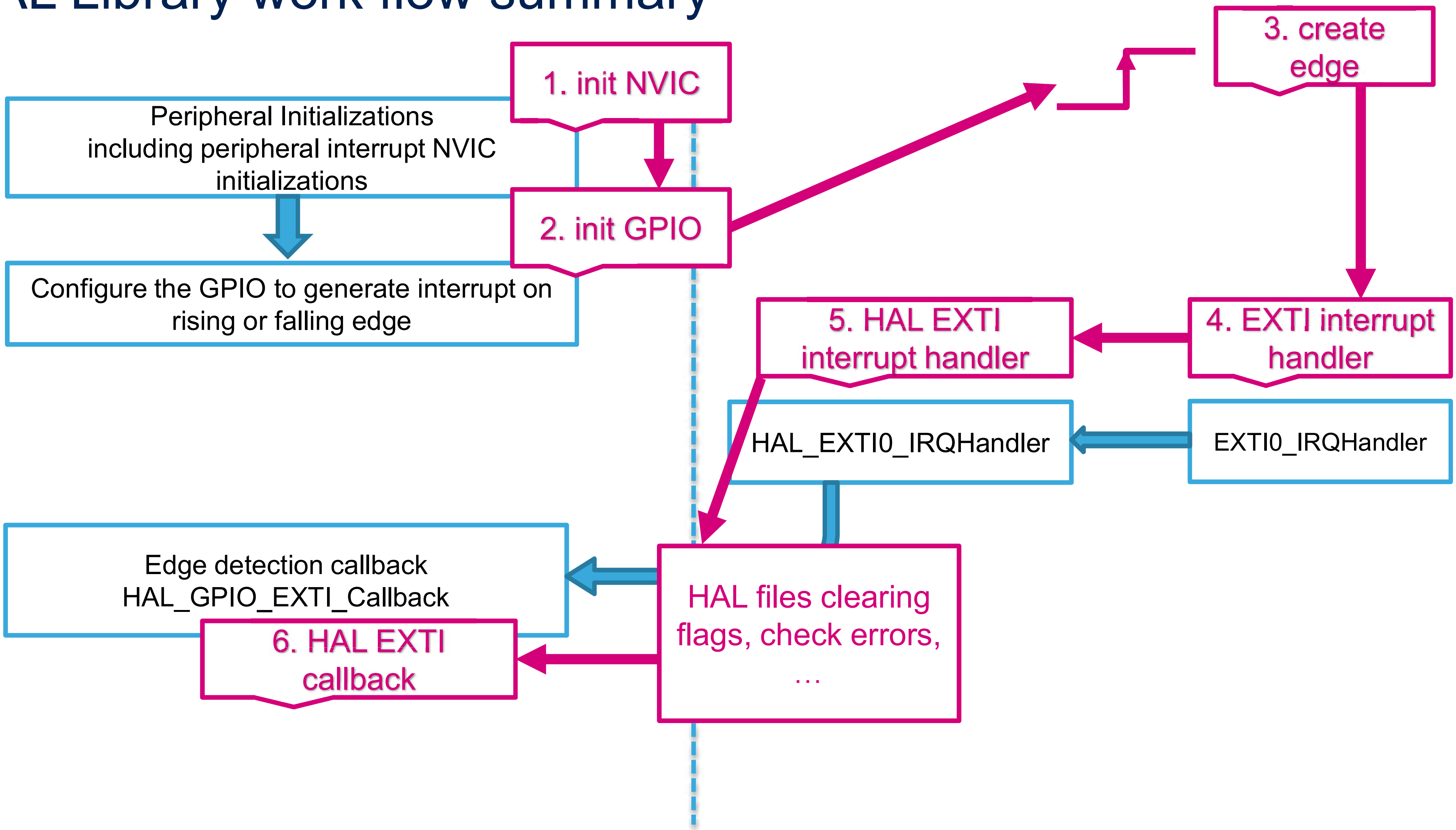
EXTI0_IRQHandler

Edge detection callback HAL_GPIO_EXTI_Callback

Usually in main.c between **/* USER CODE BEGIN */** tags

1.1.2 Configure EXTI to turn on LED

HAL Library work flow summary



1. init NVIC
Peripheral Initializations including peripheral interrupt NVIC initializations
2. init GPIO
Configure the GPIO to generate interrupt on rising or falling edge
3. create edge
4. EXTI interrupt handler
5. HAL EXTI interrupt handler
EXTI0_IRQHandler
HAL_EXTI0_IRQHandler
HAL files clearing flags, check errors, …
Edge detection callback HAL_GPIO_EXTI_Callback
6. HAL EXTI callback

1.1.2 Configure EXTI to turn on LED

- Now we open the project in our IDE
  - The functions we want to put into main.c
  - Between */* USER CODE BEGIN 4 */* and */* USER CODE END 4 */* tags
  - We create function which will handle the EXTI interrupts
- The HAL callback function for EXTI
  - void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
- For LED turn on we need to use this functions
  - *HAL_GPIO_WritePin*

1.1.2 Configure EXTI to turn on LED

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- For LED turn on we need to use this functions
  - *HAL_GPIO_WritePin*

```
/* USER CODE BEGIN 4 */
void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
  if(GPIO_Pin == GPIO_PIN_0) {
    HAL_GPIO_WritePin(GPIOG, GPIO_PIN_14, GPIO_PIN_SET);
  } else {
      __NOP();
  }
}
/* USER CODE END 4 */
```