STM32 Ecosystem workshop

T.O.M.A.S Team

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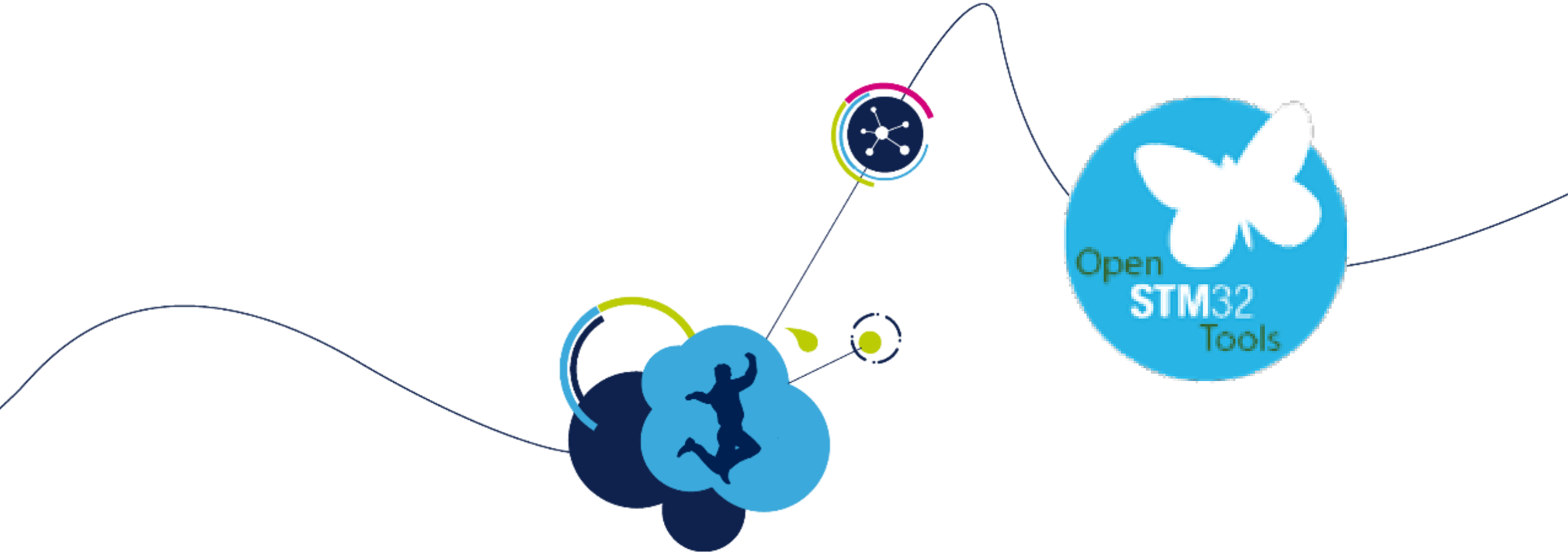
Goal of this part

- ✓ Practice a bit with STMStudio – monitoring variables and creating expressions
- ❑ Practice a bit with printf implementation using SWO channel and STLink Utility application
- ❑ Practice a bit with printf implementation using USART and any terminal application

In our next task we will use a PC applications to monitor data sent by Nucleo board over STLink v2.1:

- asynchronously using USART2 interface -> monitor on any terminal application
- synchronously, using SWO interface -> monitor on STLink Utility application



Complementary debug tools

Using printf() over SWO and USART2 to send data via USB to PC

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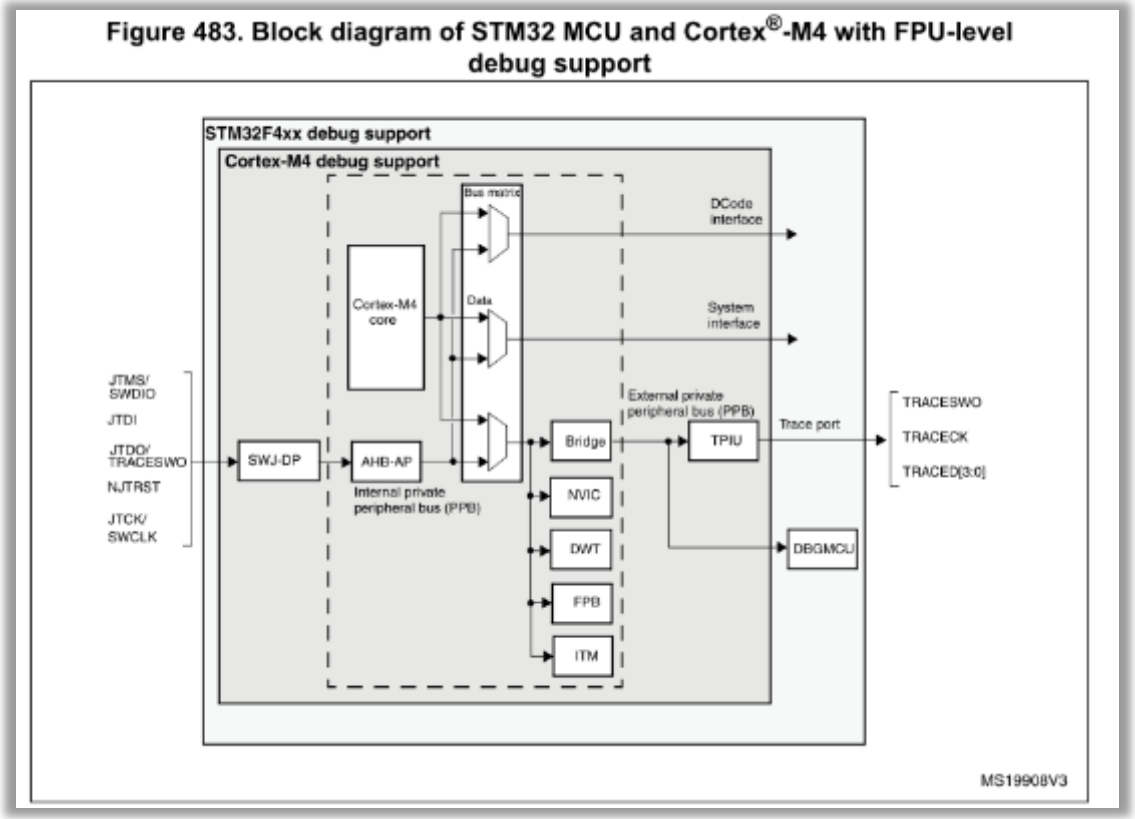
Using SWO

introduction

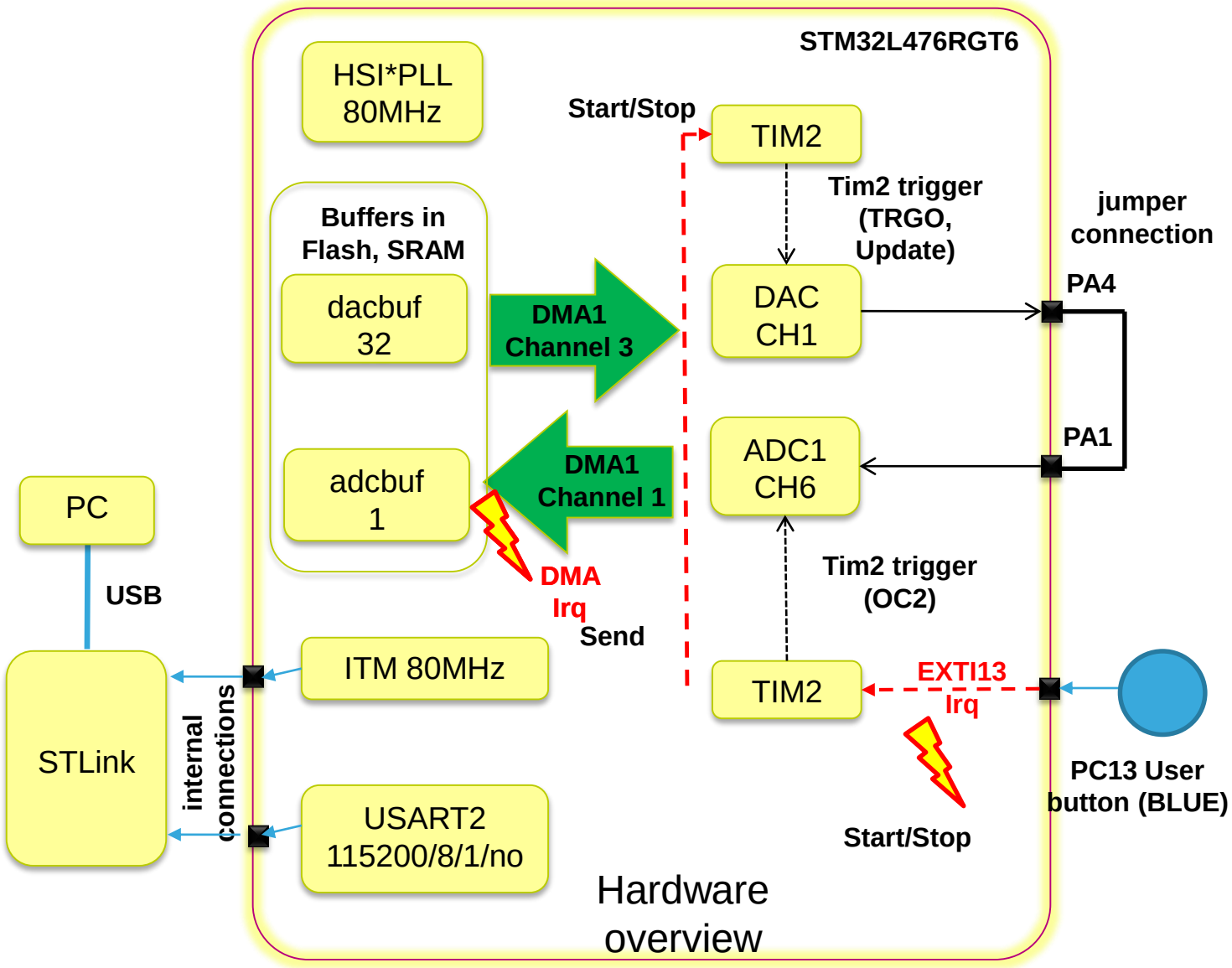
- On most of STM32 (except STM32F0, L0 devices) there is peripheral called Instrumentation Trace Macrocell (**ITM)** (do not mix with Enhanced Trace Macrocell - ETM) available
- This peripheral can be used to send-out data from MCU over Single Wire Output (SWO) pin
- It is possible to redirect **printf()** to use this peripheral
- Most IDEs can display this information during debug
- On 64pins Nucleo boards (NUCLEO_L476RG as well) SWO pin (PB3) is connected to the STLink (SB15 solder bridge is closed) so no additional connection is required to reuse this line



Concept of the system

sending measured data over SWO and USART2 via STLink

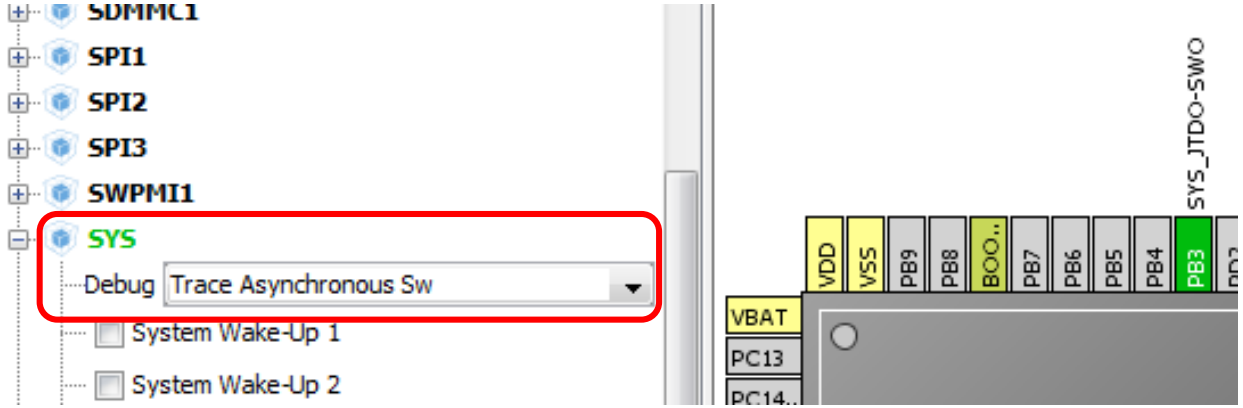
- Use the project from previous part (**L4_DAC_ADC.ioc**)
- Enable SWO line with debug interface (PB3 pin)
- Enable USART2 in asynchronous mode: 115200bps, 8bit data, no parity, 1bit stop
- Modify printf() to use SWO and USART2 as an output channels
- Configure user button (PC13) to start/stop Timer2
- Configure ADC transfer complete callback to send adcbuf[0] using printf



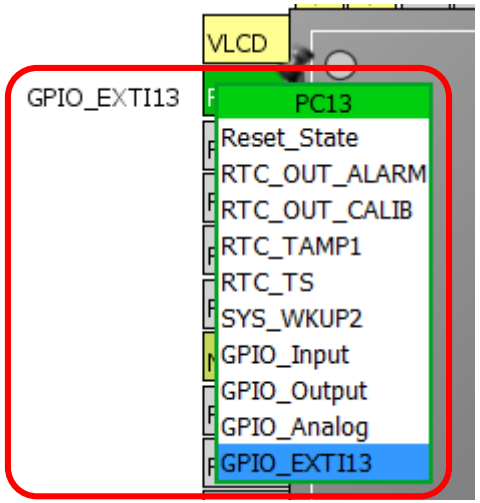
Adding SWO, EXTI13 and USART2

STM32CubeMX – Pinout tab

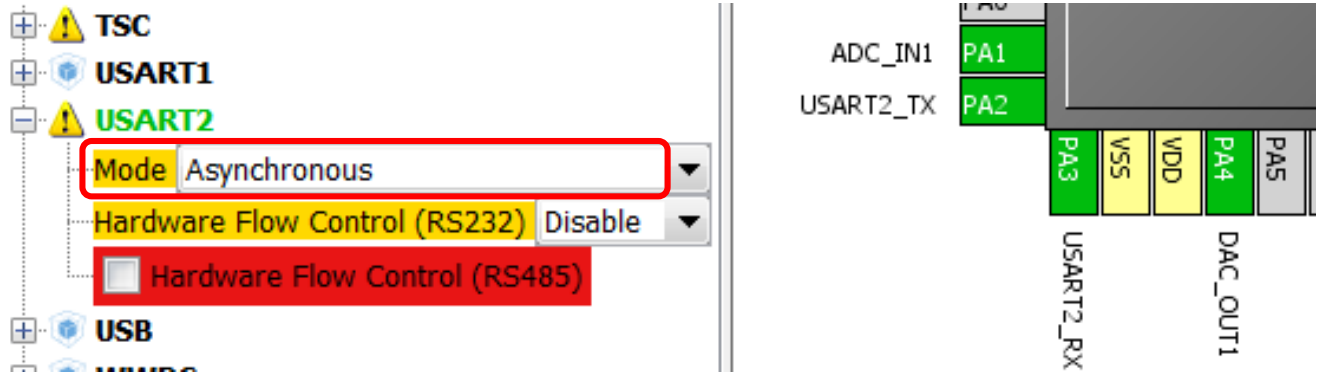
1. Open **L4_DAC_ADC.ioc** project in STM32CubeMX
   - *Menu File → Open Project*
2. In STM32CubeMX, pinout tab enable SWO pin
   - Select *SYS → Debug → Trace Asynchronous Sw*



3. Click left button on mouse over PC13 pin and select GPIO_EXTI13 mode



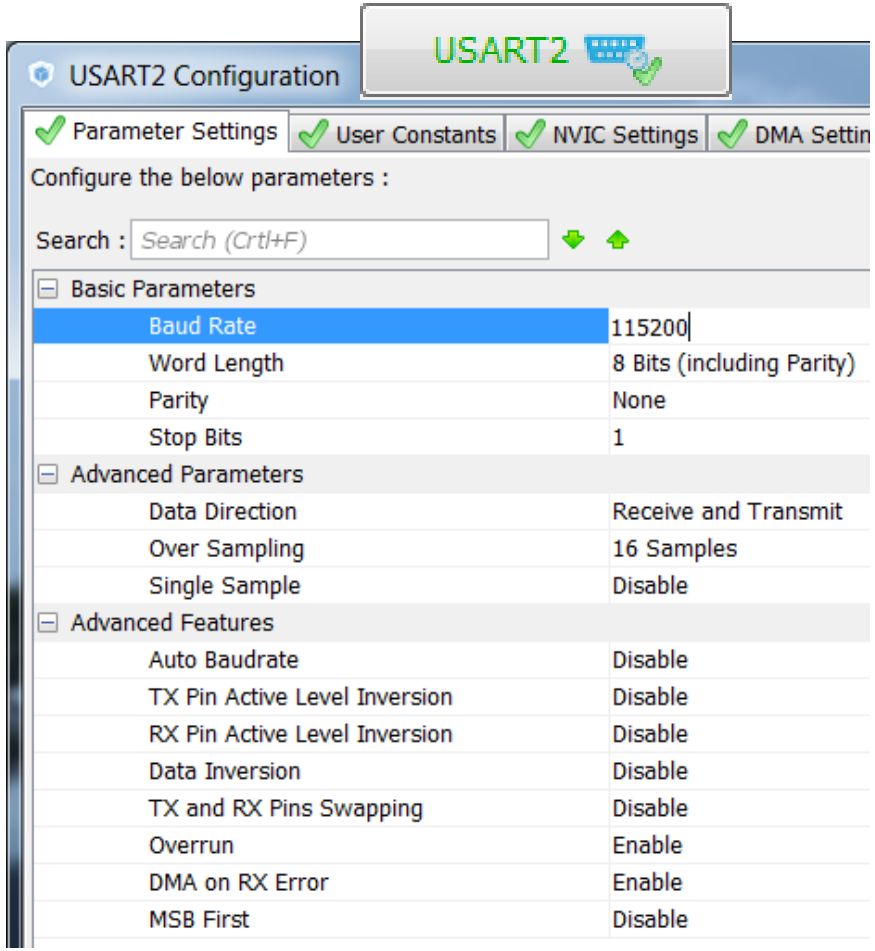
4. Select USART2 in asynchronous mode
   - Select USART2->Mode: Asynchronous



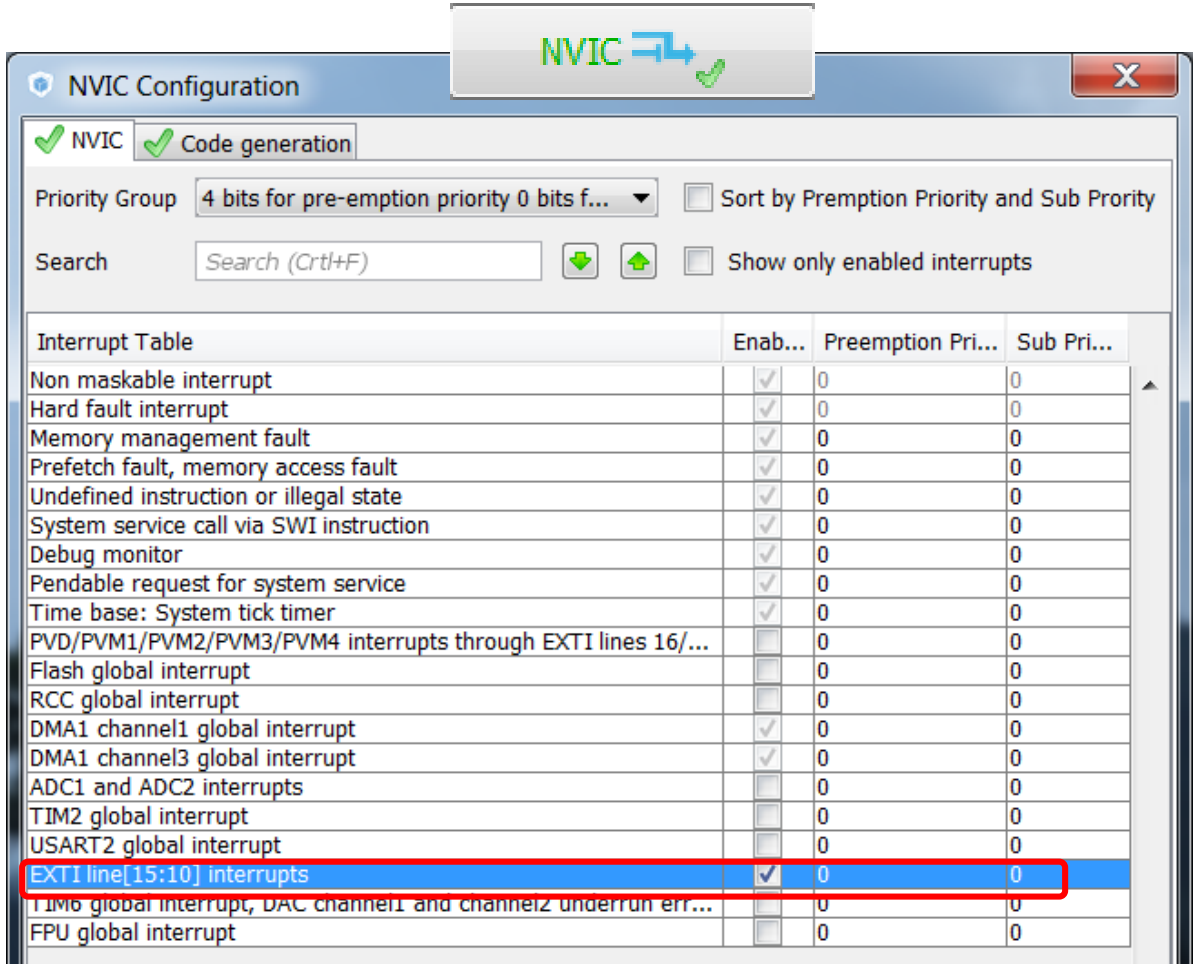
Configure USART2 and EXTI13

STM32CubeMX – Configuration tab

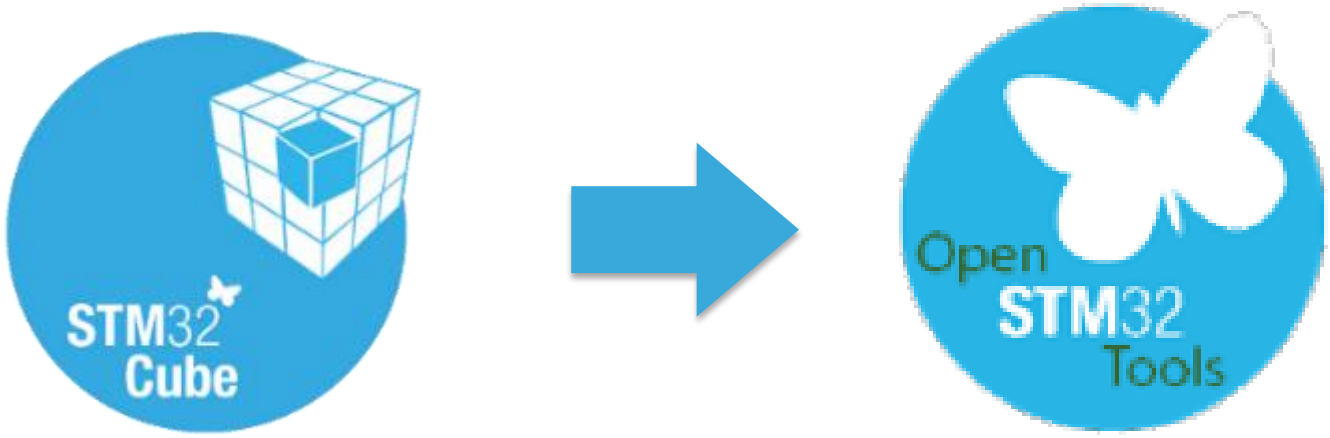
- Configure USART2 parameters:
  - 115200 bps / 8 bit data / 1 bit stop / no parity / no HW control



- Enable EXTI line[15:10] within NVIC configuration



- Generate the code with added new features
- Perform further processing in SW4STM32 (L4_DAC_ADC project)



Using SWO for printf in gcc

In **main.c** source file:

- include the **stdio.h** library to make printf working
- define **_write()** function used to send data over SWO using **ITM_SendChar()** function
- as ITM_SendChar() function is accepting single character, we should send data character by character in the loop.
- add some messages at the beginning of the application
- compile and run the code

```
/* USER CODE BEGIN Includes */
#include <stdio.h>
/* USER CODE END Includes */
```

```
/* USER CODE BEGIN 4 */

int _write(int file, char *ptr, int len)
{
 int DataIdx;

  for(DataIdx=0; DataIdx<len; DataIdx++)
  {
    ITM_SendChar(*ptr++);
  }
}

/* USER CODE END 4 */
```

```
printf("Application start.\n");
printf("Press User button to start new acquisition\n");

/* USER CODE END 2 */
```

Using USART2 for printf in gcc

In **main.c** source file:

- include the **stdio.h** library to make printf working
- define **_write()** function used to send data over USART2
- add some messages at the beginning of the application

```
/* USER CODE BEGIN Includes */
#include <stdio.h>
/* USER CODE END Includes */
```

```
/* USER CODE BEGIN 4 */

int _write(int file, char *ptr, int len)
{
 HAL_UART_Transmit(&huart2,ptr,len,10);
 return len;
}

/* USER CODE END 4 */
```

```
printf("Application start.\n");
printf("Press User button to start new acquisition\n");

/* USER CODE END 2 */
```

Sending ADC results over printf


```
volatile uint8_t flag=1;
/* USER CODE END PV */
```

```
/* USER CODE BEGIN 4 */
void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
  if(GPIO_PIN_13==GPIO_Pin)
   {
    if(0==flag)
     {
      HAL_TIM_OC_Stop(&htim2,TIM_CHANNEL_2);
      printf("Acquisition stopped\n");
      printf("Press button to START a new one\n");
      flag=1;
     }
    else
     {
      printf("Acquisition started\n");
      printf("Press button to STOP it\n");
      flag=0;
      HAL_TIM_OC_Start(&htim2,TIM_CHANNEL_2);
     }
   }
}
```

- In **main.c** source file (inside USER CODE section) implement own EXTI13 and ADC conversion complete callbacks:
  - First one to control start/stop acquisition
  - Second one for sending **adcbuf[]** using printf() once acquisition is stopped

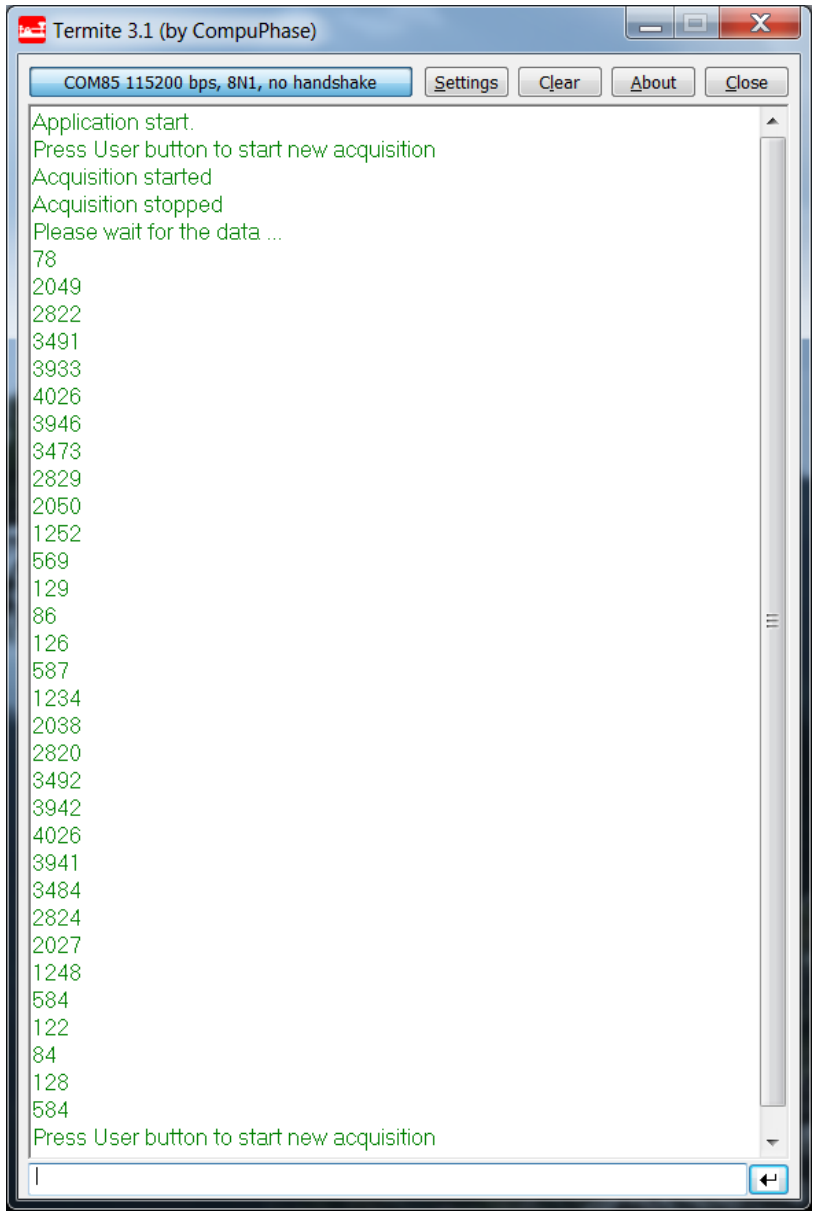
```
void HAL_ADC_ConvCpltCallback(ADC_HandleTypeDef* hadc)
{
  printf("%d\n",adcbuf[0]);
}
/* USER CODE END 4 */
```

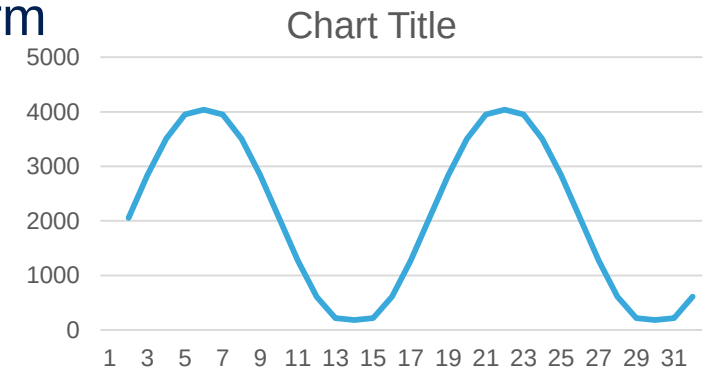
Additionally we should not start Timer2 at the beginning (USER CODE 2 section, before while(1) loop)

Analize the data from ADC

data sent over USART2

- **Open serial terminal** selecting COM port assigned to Virtual COMP Port (VCP) implemented in STLink, using the configuration:
  - **115200pbs / 8 data bits / 1 STOP bit / NO parity / NO HW flow control**
- Reset the board, now you should see “Application start” message in terminal window
- Follow the instructions in the terminal window (User button is the blue one on Nucleo board)
- Using copy&paste mechanism copy data to clipboard and then paste them into the spread sheet application (i.e. Excel)
- Display the waveform





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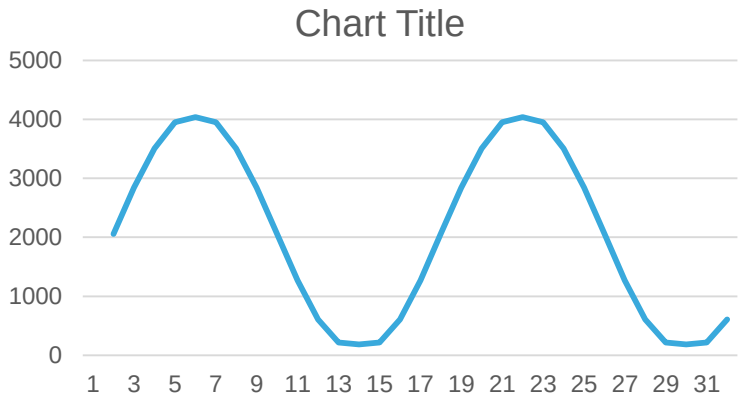
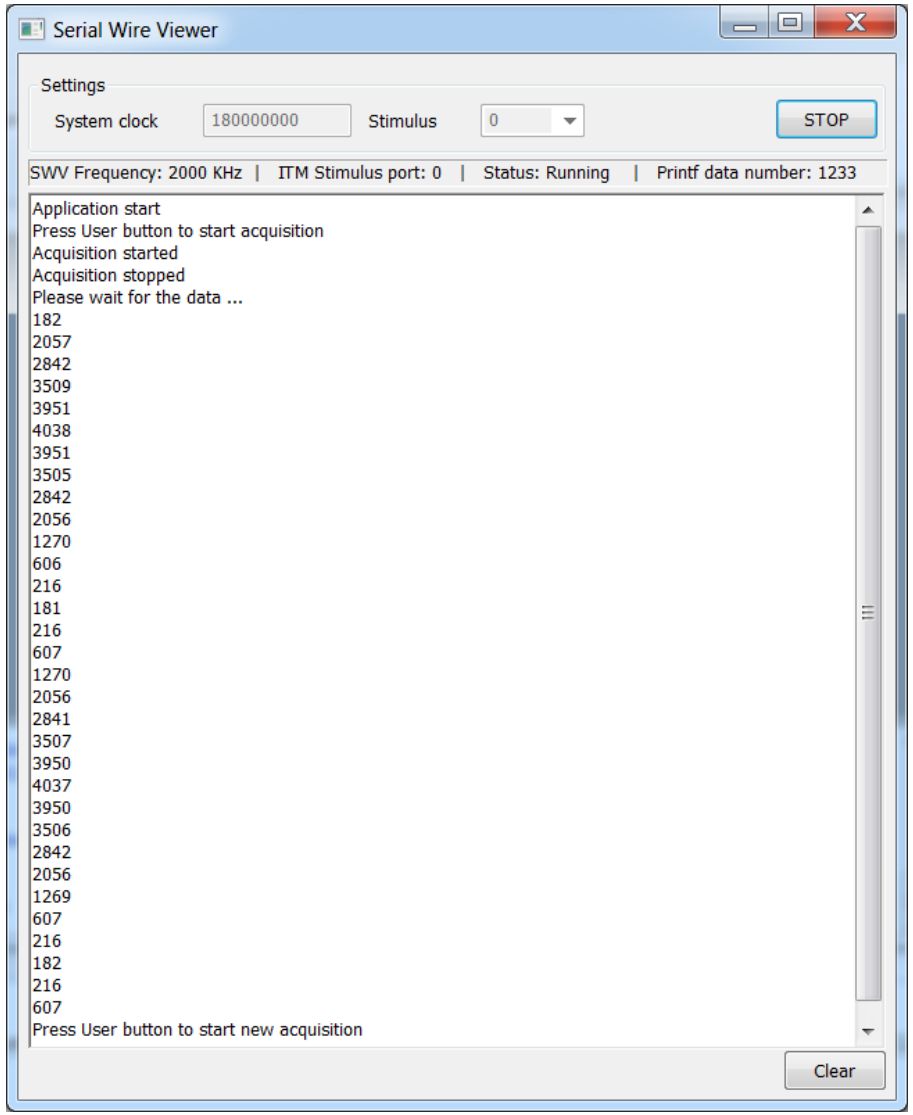
Analize the data from ADC

data sent over SWO

- Open **STLink Utility**
- Connect to the board (*Target → Connect*)
- Open SWO viewer window (*ST-LINK → Printf via SWO viewer*)
- Update System clock to 80 000 000 and Stimulus to 0 (toolchain settings)
- Start data catching → **Start** button
- Grab the ADC data
- Using copy&paste mechanism copy data to clipboard and then paste them into the spread sheet application (i.e. Excel)
- Display the waveform





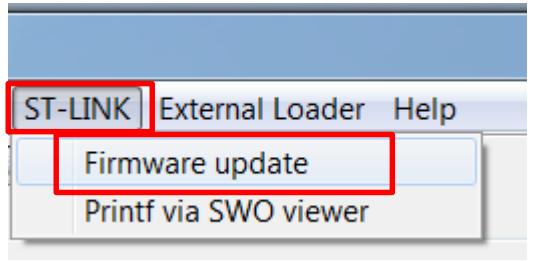
Hint: in case there is nothing in trace window, please check the version of STLink firmware -> see the next slide

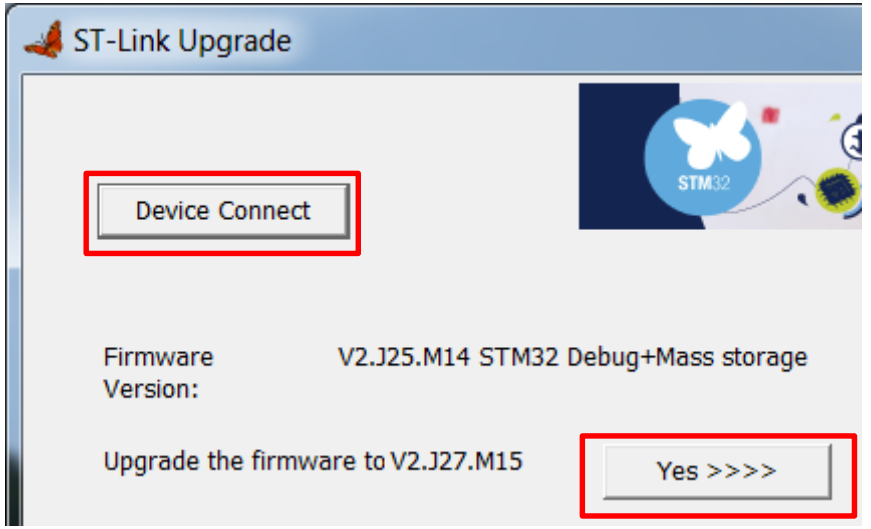
SWO viewer in STLink Utility

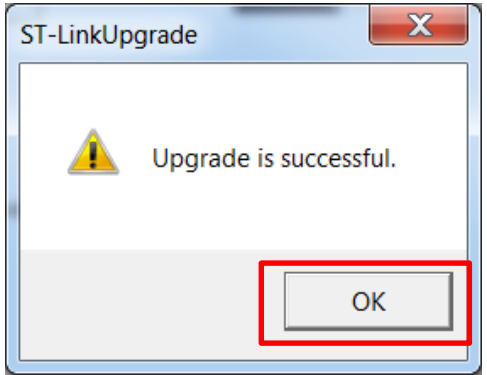
No data in trace window – upgrade of the driver

In case there is no data in trace window, it is highly probable that the STLink software on Nucleo board is not up-to-date

- To update this software, please follow the below procedure:
  - Select ST-LINK->Firmware update
  - Press Device Connect button on “ST-Link Upgrade” window
  - After a while there will be information about firmware version on STLink and the current one
  - In case the current one has higher number, please upgrade STLink by pressing **Yes >>>>** button
  - After completion of the operation message window will appear
  - We can close “ST-Link Upgrade” window and continue operations on upgraded board.







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What have we learnt

- ✓Practice a bit with STMStudio – monitoring variables and creating expressions
- ✓Practice a bit with printf implementation using SWO channel and STLink Utility application
- ✓Practice a bit with printf implementation using USART and any terminal application

Enjoy!

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