STM32 & SCILAB

Readme

Rev 1.1

Table of Contents

Must be read

Recommended reading

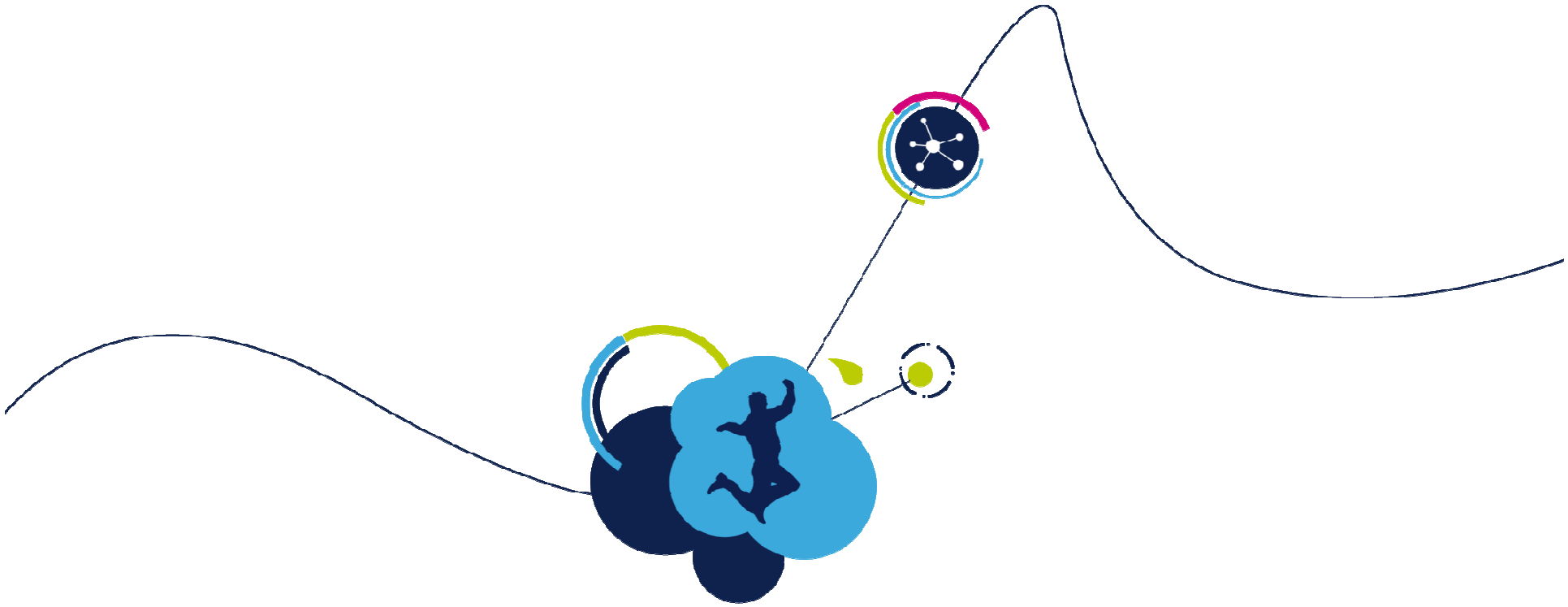
Detailed

Objectives

- Hands-on workshop to show you the steps needed to quickly develop STM32 graphical applications using SCILAB XCos environment.
- Know tools installations and settings to be able to start development.
- Know « C » Code Generation possibility
- Know how to develop application from scratch
- Know where to obtain additional technical support

Systems Check

- Mandatory Software
  - From SCILAB
    - SCILAB Xcos version 5.5.2
  - From STMicroelectronics
    - STM32CubeMX
  - One of following Toolchain
    - EWARM from IAR
    - MDK-ARM from Keil
    - TrueSTUDIO from Atollic
    - SW4STM32 from STMicroelectronics
  - STM32-SCILAB toolkit to develop STM32 applications
- Hardware
  - Any electronic application board with STM32 and SWD/JTAG connection.
  - STLink or 3rd parties dongle if not integrated to STM32 application board.



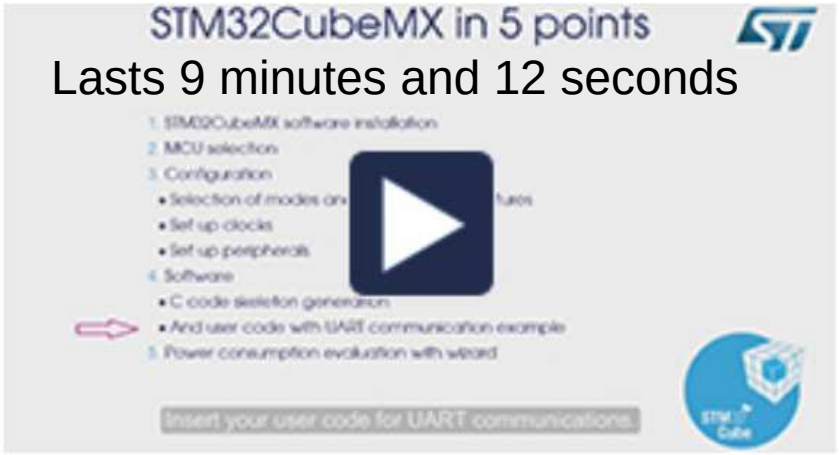
Pre-requisites

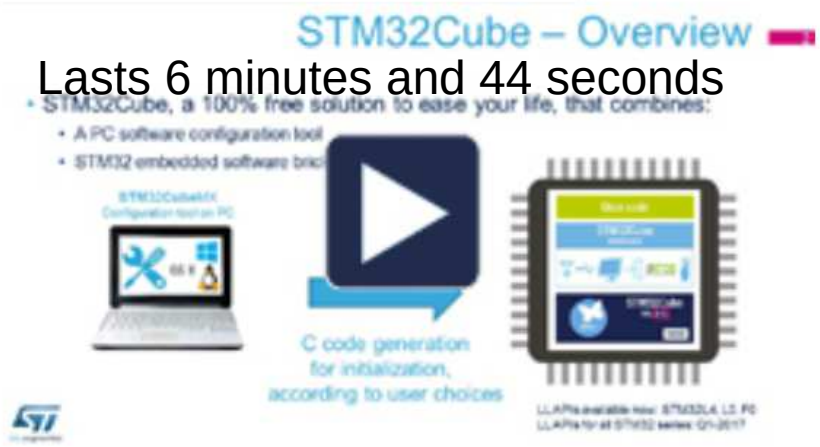
Pre-requisites

- STM32CubeMX
  - Have a look to STM32CubeMX videos to know how using this powerfull tool.

FEATURED VIDEOS

See All





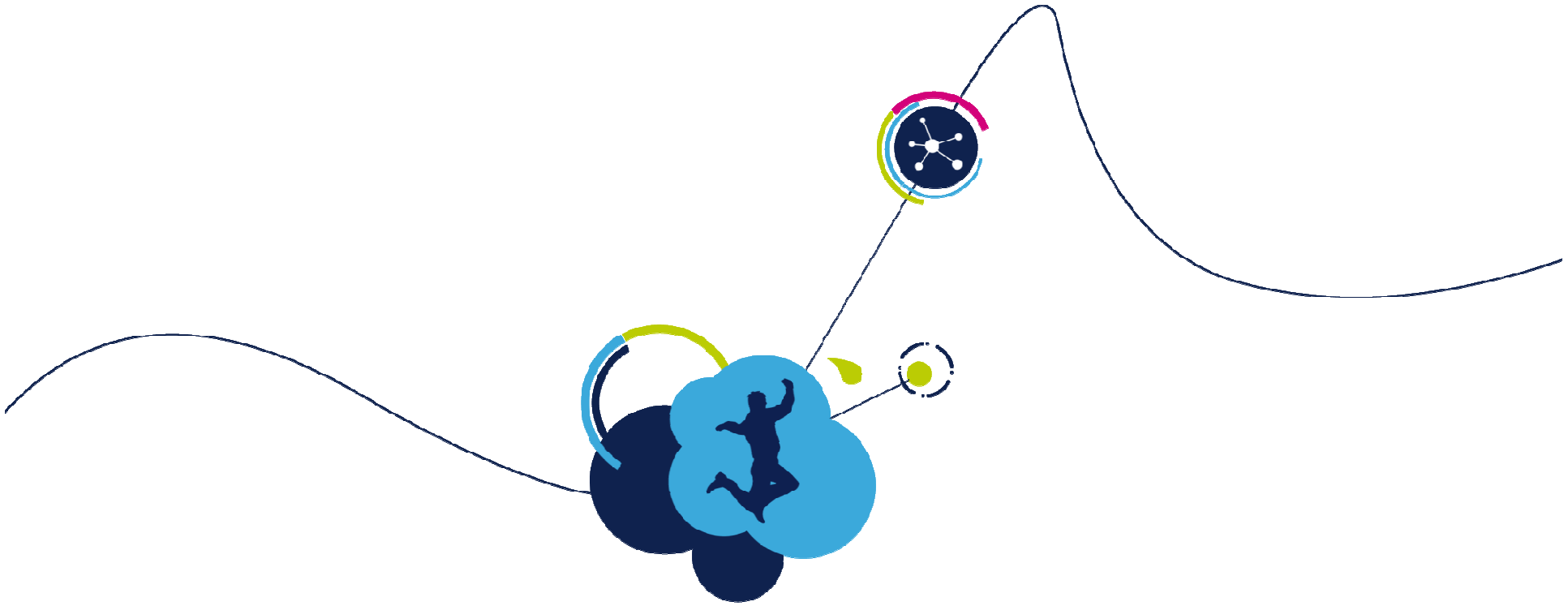
Pre-requisites

- Toolchain
  - You must be confortable with one of following toolchain.
  - Ewarm from IAR
    Embedded **W**orkbench for **Arm** (Ewarm)

  - µVision from Keil

  - TrueSTUDIO from Atollic

  - SW4STM32 from ST

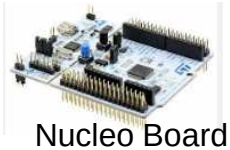


Hardware setup

Step #1 – Hardware selection

- Use one of STM32 boards including STLink
  - Nucleo, Discovery, EvaluationBoard etc…
  - STM32F3348-DISCO and STM32F429i-DISCO

  will be used during examples.


Nucleo Board


Discovery Board


Evaluation Board

- Or STM32 application board connected to SWD (Single Wire Debug)/JTAG dongle.
  - STLink, ULink2, JLink etc..


STLink

ULink2


JLink

Step #2 – Hardware connection

- Connect USB dongle port to PC USB port
  - And connect STM32 HE10 20 pins dongle connector to STM32 target board

Exemple: Connect STLink dongle USB to PC on one side.

Exemple:
Connect HE10 20 pins STLink dongle connector to HE10 20 pins connector of
STM32 Evaluation Board on the other side.

- Or connect PC USB port to embedded STLink

Exemple: Connect USB PC port to STLink USB port embedded in STM32 board.

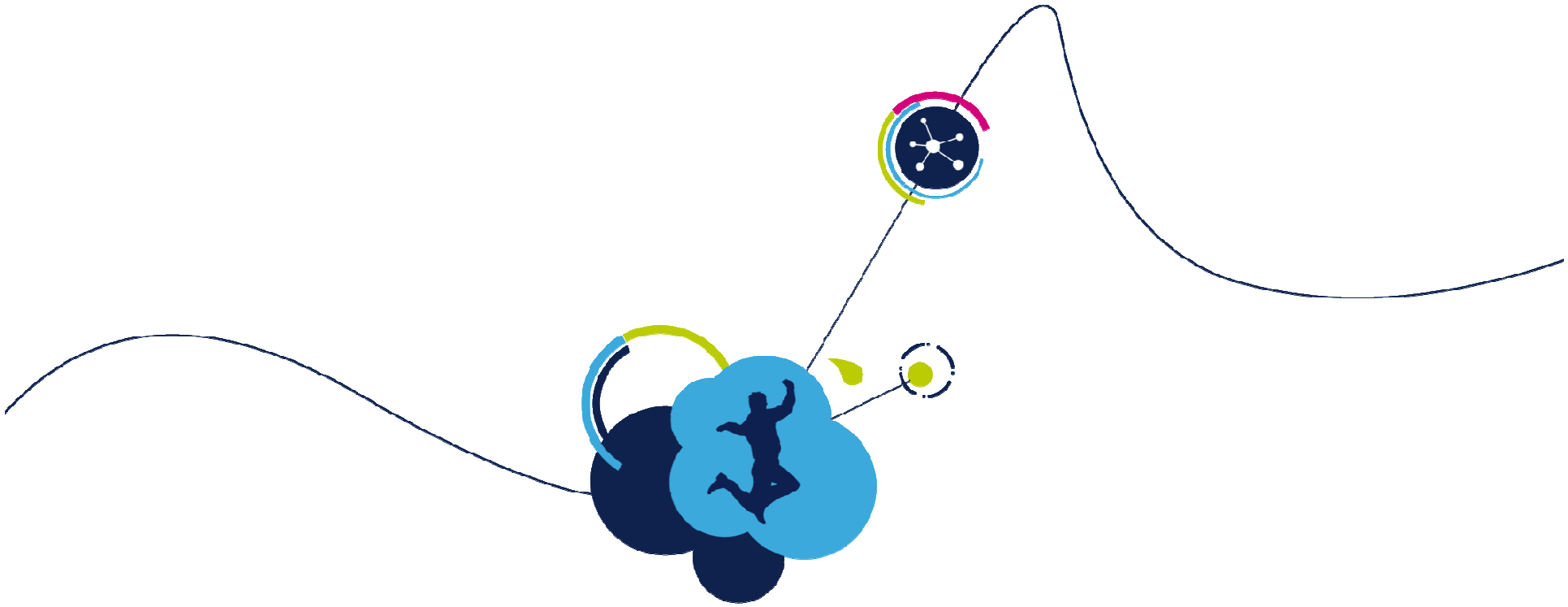
Usually, all ST recent boards embedd STLink tool.

Step #3 – Hardware connection

- As soon as you are using ST-LINK
  - look at http://www.st.com/web/catalog/tools/FM146/CL1984/SC720/SS1450/PF251168?s_searchtype=partnumber
  - « Related Tools and Software » section to check or update firmware

Related Tools and Software

Related Tools and Software	
Part Number	Description
STSW-LINK004	STM32 ST-LINK utility
STSW-LINK005	ST-LINK/V2 firmware upgrade
STSW-LINK009	ST-Link, ST-Link/V2, ST-Link/V2-1 USB driver signed for XP, Windows7, Windows8



Software setup

Quick description of tools

Toolchain

scilab enterprises

SCILAB — High level language for complex calculation

XCos — Graphical development environment for simulation

STM32Cube Embedded Software — Collection of embedded software components, highly portable from one STM32 to another

STM32CubeMX — Configuration software tool on the PC, able to generate initialization C code versus user choices

One toolchain from partners or ST is required to compile and link C code generated by SCILAB, STM32CubeMX and STM32Cube embedded software

IAR SYSTEMS

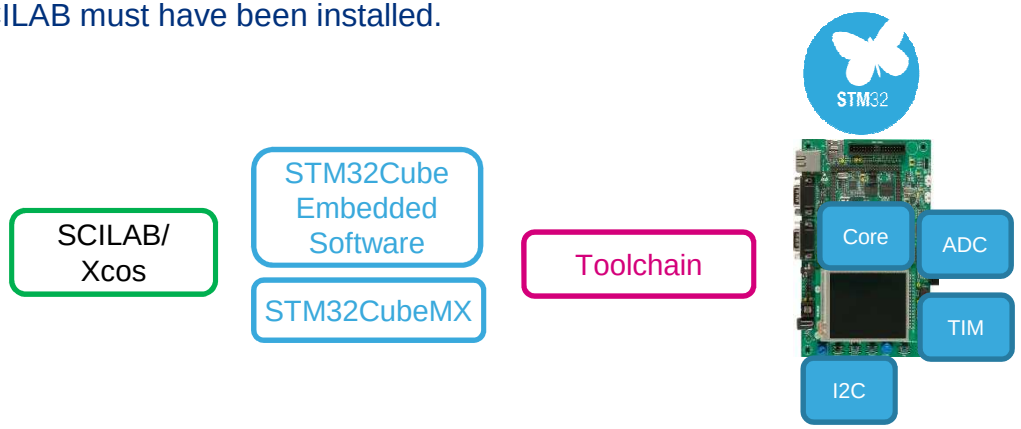
KEIL Tools by ARM

atollic

STM32

Tools usage

- Code Generation for STM32
  - Data (input or output) obtained within STM32 through its peripherals (ADC, Timers, …) and algorithm fully executed on STM32.
  - Code generated from Xcos diagram.
  - Needed tools: SCILAB/Xcos, STM32CubeMX, one of supported toolchains and STM32 toolbox for SCILAB must have been installed.

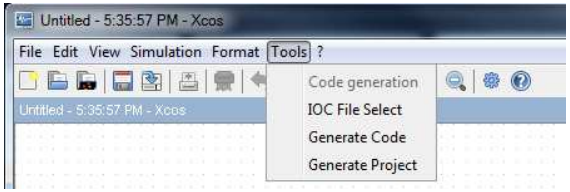


Step #1 – Software installation

- Install SCILAB 5.5.2 software
  - SCILAB/Xcos is mandatory
  - http://www.scilab.org
- Install STM32CubeMX
  - Download and documents available from : *www.st.com/microxplorer*
- Install toolchain (Cf Slide 4 : « Systems Check »)
  - Cf Slide 3 « Systems Check » to get link to supported 3rd parties download area.

Step #2 – Software installation

- Install STM32 for SCILAB
  - This toolkit is mandatory to be able to design Xcos graphical application for STM32.
  - Set ATOMS Config Proxy and Network parameters to download using atomsGui() command
    - atomsSetConfig('parameter','value') for parameters :
      - useProxy , proxyHost, proxyPort, proxyUser, proxyPassword and offline
  - Or download from https://atoms.scilab.org/ (Xcos or Real-Time) and enter the install command to install xcos_stm32_toolbox
  - STM32 is available from Xcos diagram
    - Functionalities have been added to the « Tools » menu :



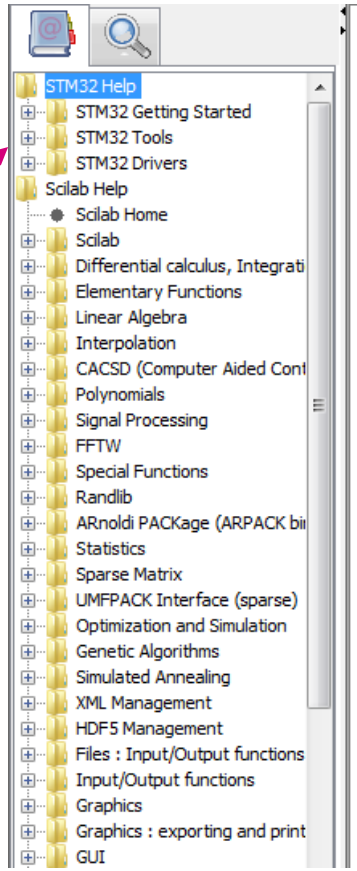
Step #4 – STM32 for SCILAB integration

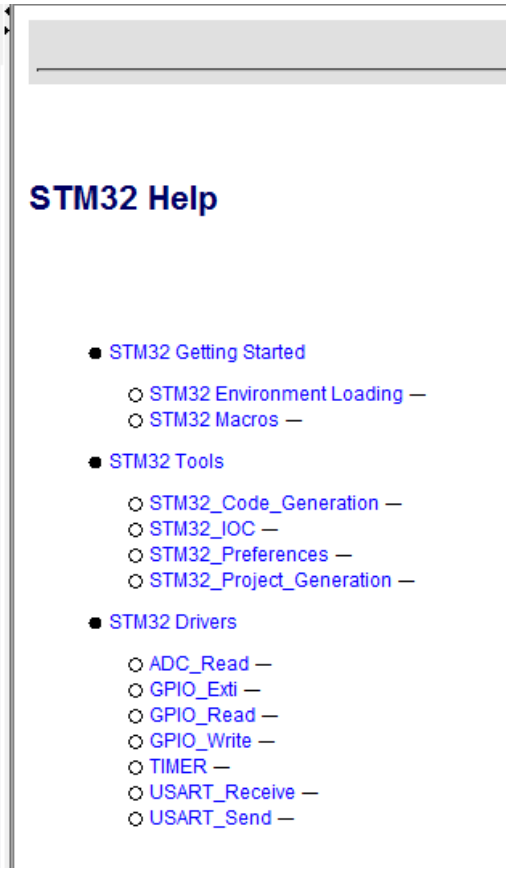
- STM32 Help document available for SCILAB
  1. Enter help from Scilab 5.5.2 Console

```
-->help
```

  2. Help Browser window opens
     1. STM32 dedicated Help is available

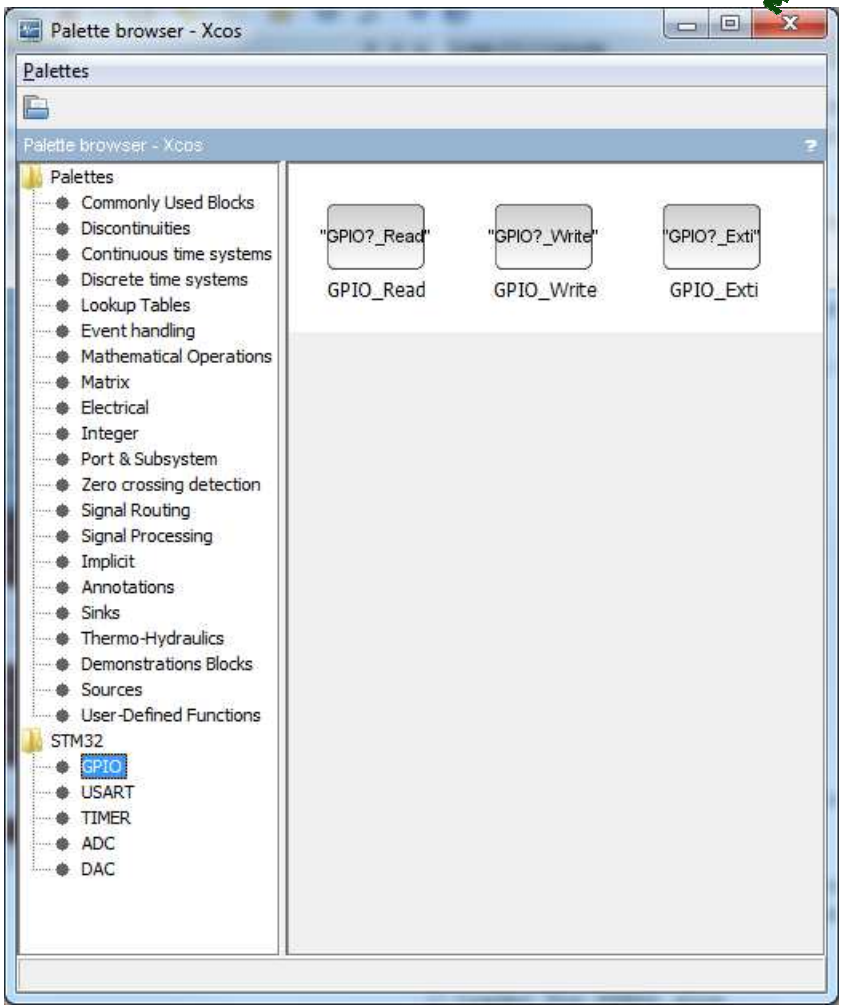
Help regarding STM32 functionalities



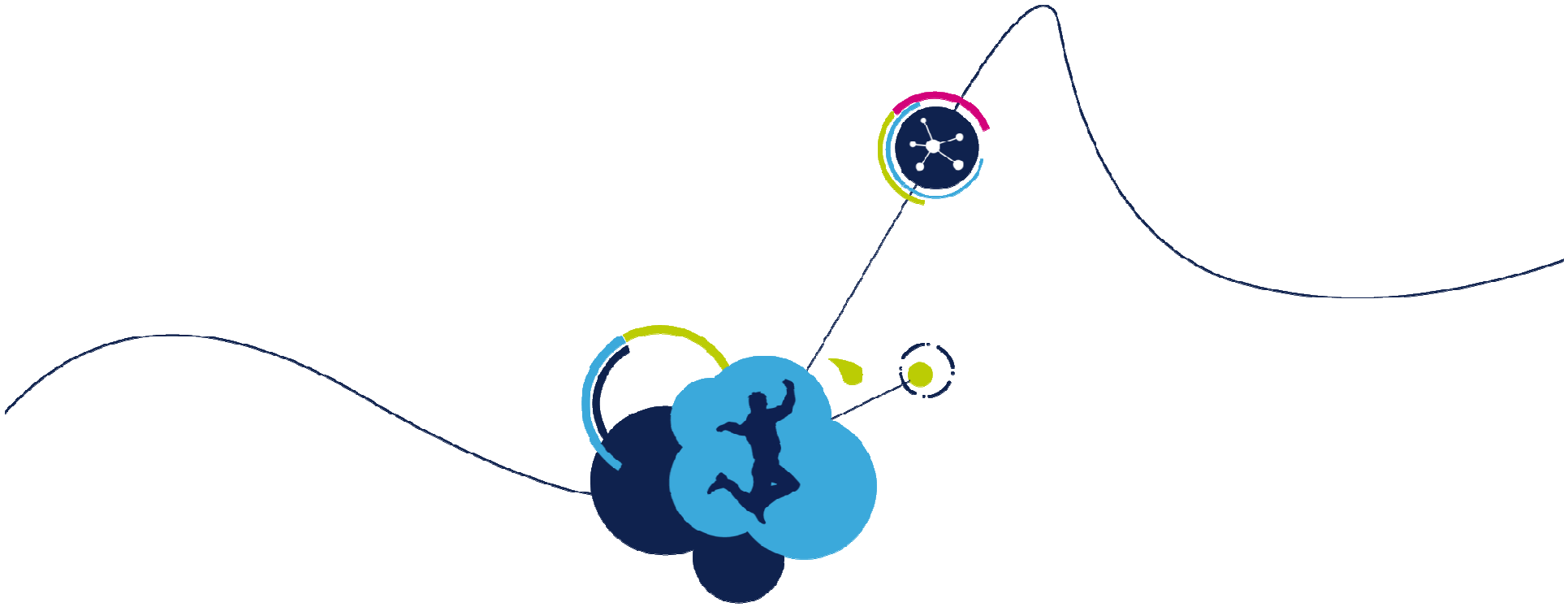


Step #4 – STM32 for SCILAB integration

- STM32 Palette for STM32 peripherals integrated to Palette browser
  1. Available drivers:
     - GPIO
       - Read, Write, External Interrupt
     - USART
       - Send, Receive
     - TIMER
       - Output PWM,
     - ADC
       - Read
     - DAC
       - Write



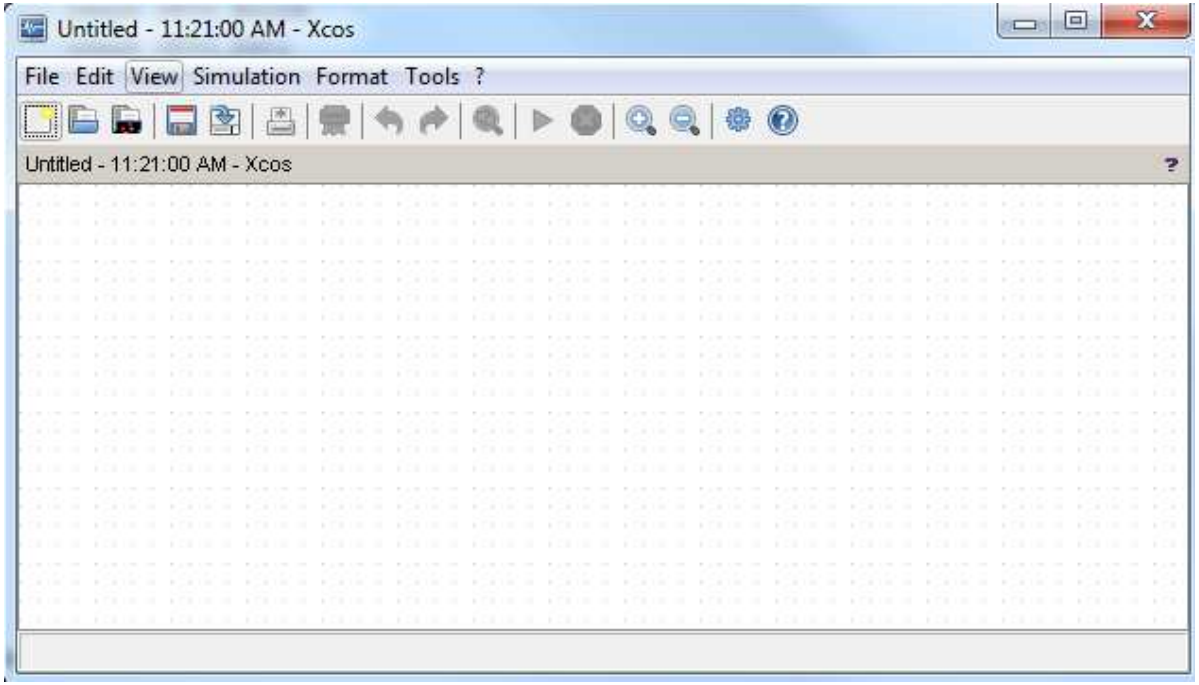
Look at release note for restrictions and not supported functionalities.



Xcos diagram setting

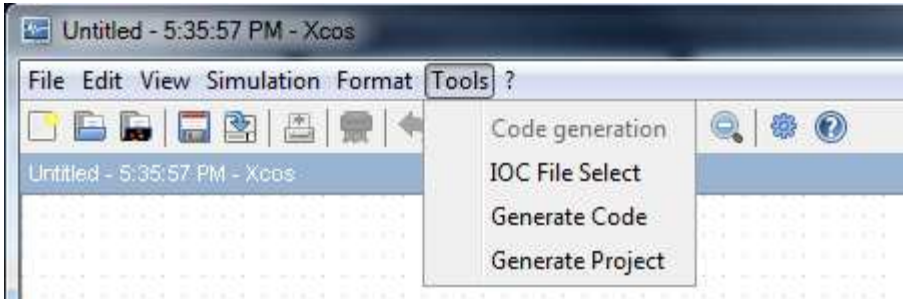
Xcos diagram Setting 1/5

- Enter xcos command from Scilab 5.5.2 Console `-->xcos` or click xcos icon .
- Then new xcos diagram is opened



Xcos diagram Setting 2/5

- Tools tab gives possibility to :



1. Select .ioc file.
   - Ioc file is STM32 configuration done using STM32CubeMX . (cf slide 6)
2. Generate C code for this diagram.
   - Based on STM32 HAL C code libraries
3. Generate project for this diagram.
   - STM32CubeMX generates project for the selected toolchain.

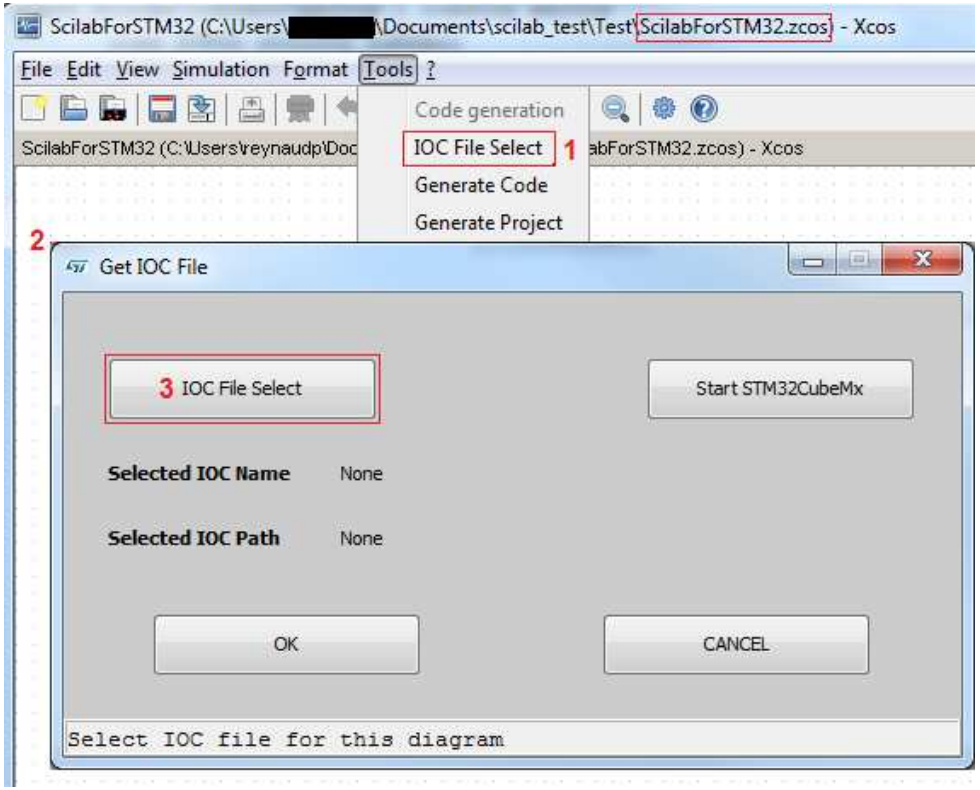
Toolchain is selected from STM32CubeMx Project settings (Alt+P).

Xcos diagram Setting 3/5

- Save diagram :
  - C:\Users\xx\AppData\Roaming\Scilab\scilab-5.5.2\ « diagramName.conf » contains informations about STM32 used and ioc file (path and name) attached to the diagram.
  - This file is created when you attach an ioc file to diagram from « Tools > IOC File Select »
  - It is better to save the file before selecting the ioc.

  - Example:

1. Save diagram as ScilabForSTM32.zcos
2. Select « IOC File Select »
3. Get Ioc File window opens
4. Push IOC File Select button.
5. Browser opens
6. Select an ioc file
7. Push OK button



- ioc file is generated from STM32CubeMx tool.
- It contains STM32 configuration (hardware and peripherals settings) used for the diagram.
- See following Xcos application example for details.

Xcos diagram Setting 4/5

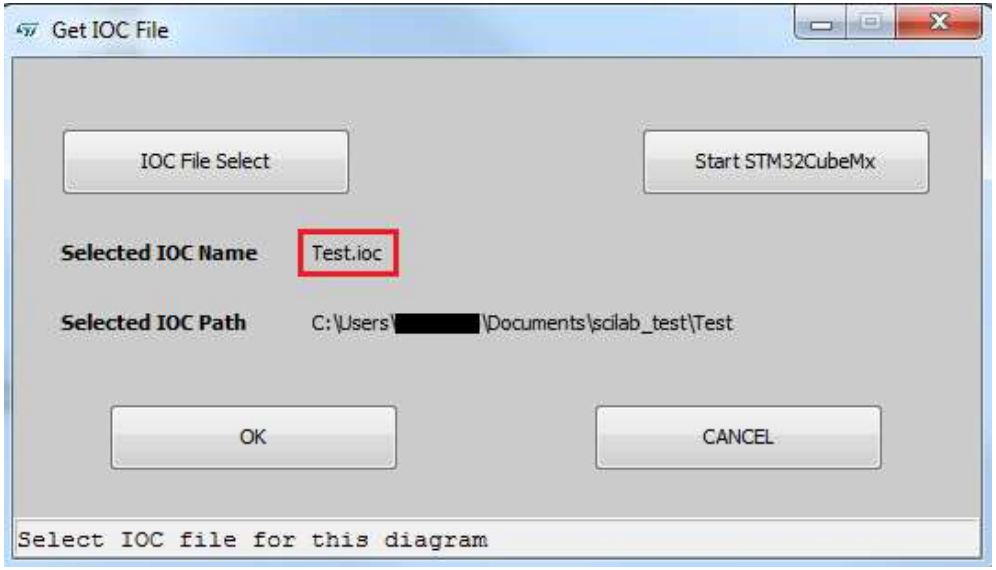
- IOC file MUST be selected every time diagram is opened
  - Selected IOC Name and Selected IOC Path are automatically updated with parameters saved in C:\Users\xx\AppData\Roaming\Scilab\scilab-5.5.2\« DiagramName.conf »

  - Example:

1. Diagram saved as ScilabForSTM32.zcos
2. Select « IOC File Select »
3. Selected IOC Name and Selected IOC Path

Are updated with parameters from:

AppData\Roaming\Scilab\scilab-5.5.2\ScilabForSTM32.conf



ScilabForSTM32.conf file contents:

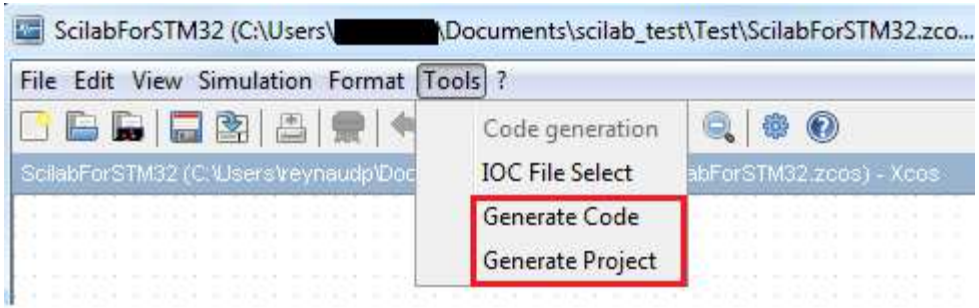
```
Test.ioc
C:\Users\[redacted]\Documents\scilab_test\Test
STM32F4
```

1. Ioc file name
2. Ioc file path
3. STM32 family

- Convention : Same name for ioc file and its repository.

Xcos diagram Setting 5/5

- Generate Code and Generate Project

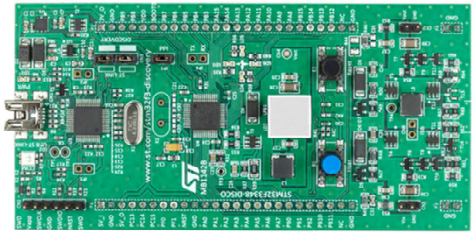


Cf slides:

code generation
and
project generation

Xcos application example

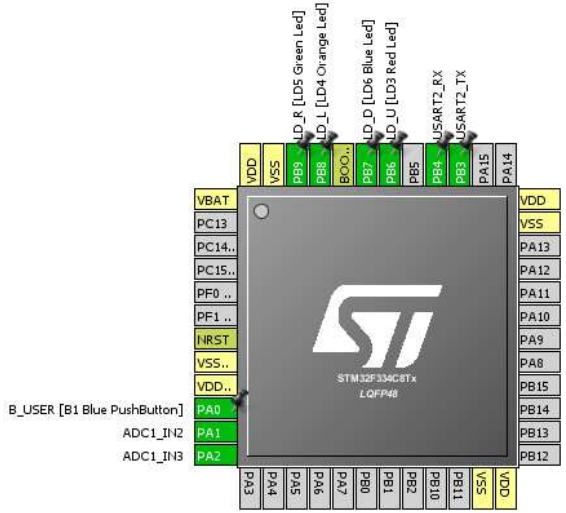
- Hardware :
  - Example based on STM32F3348-DISCO
  - Configuration :
    - Leds (LED3/4/5/6)
    - Push Button (User blue button)
    - USART2 Virtual Com Port (SB14&SB16 soldered)
    - ADC1
    - TIM1 & TIM6



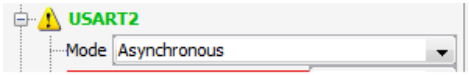
- Software application :
  - Use TIM1 to blink LED3 at 1Hz
  - Use TIM6 to blink LED4 at 2Hz
  - Use TIM6 to trig ADC1 channels 2&3 conversion
  - Blink Led6 when user push button is pressed
  - Send ADC1 channel 3 values on USART2 when user push button is pressed

STM32CubeMX STM32F3348 Pinout

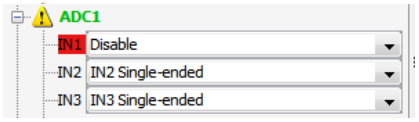
- Hardware pinout configuration
  - PA0 : GPIO_EXTI0
  - PA1 : ADC1_IN1
  - PA2 : ADC1_IN2
  - PB3 : Usart2_Tx
  - PB4 : Usart2_Rx
  - PB6 to PB9 : GPIO_Output



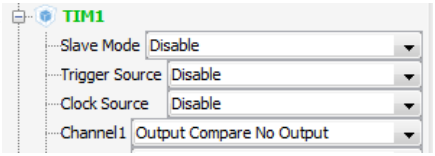
- Hardware setting
  - USART2 is Asynchronous



  - ADC1 IN2 & IN3 Single-ended



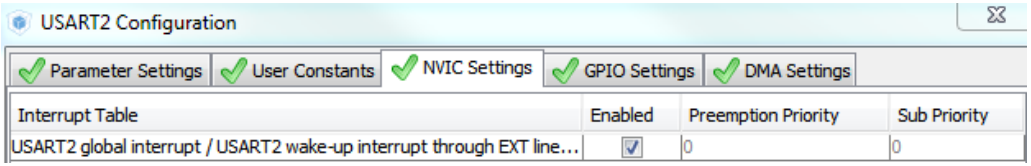
  - TIM1 Channel1 as Ouput Compare No output

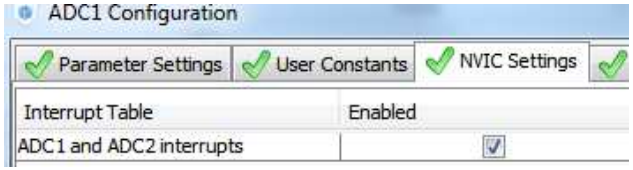


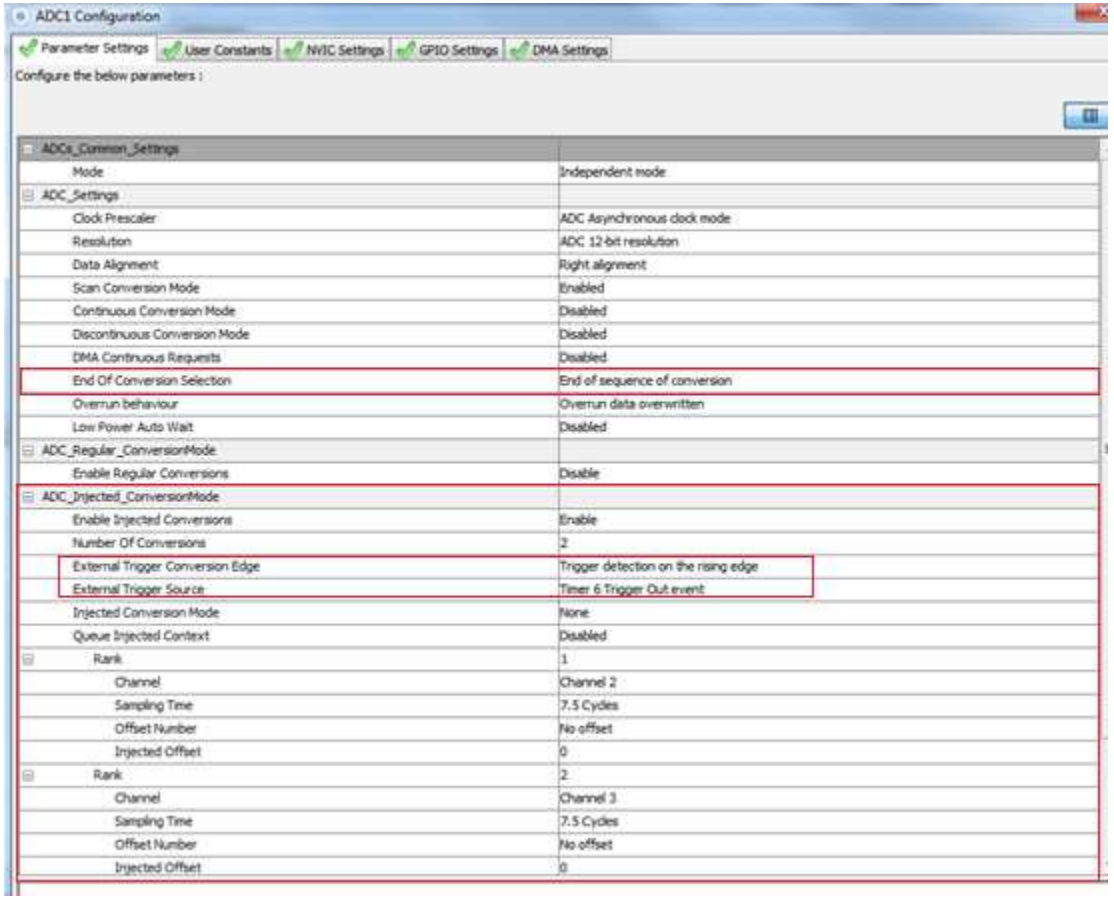
  - TIM6 Activated (No Output)

STM32CubeMX Peripheral settings 1/2

- Peripheral configuration :
  - USART2
    - Baud Rate : 115200
    - Word Length: 8 Bits
    - Parity: None
    - Stop Bits: 1
    - Enable global interrupt
  - ADC1
    - Injected Channels 2&3
    - Interrupt at end of sequence of conversion
    - Conversion triggered from Timer6
    - Interrupt Enabled

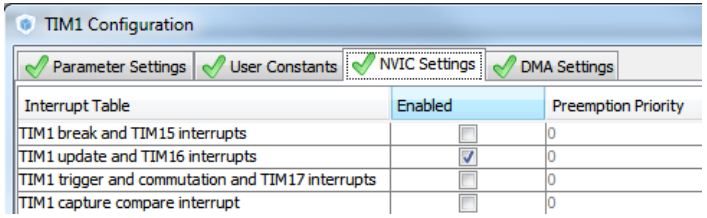




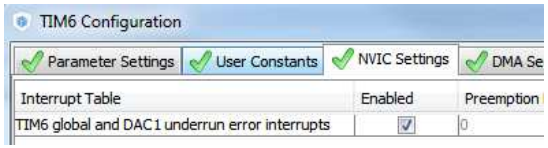


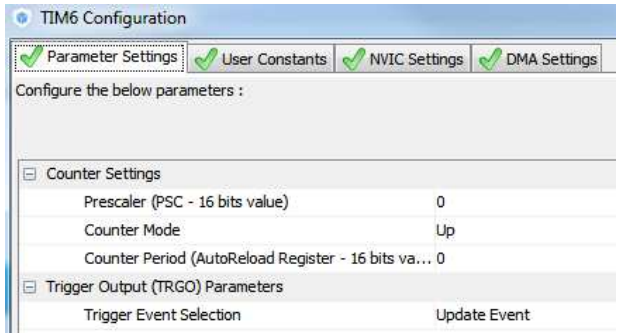
STM32CubeMX Peripheral settings 2/2

- Peripheral configuration :
  - TIM1
    - Default configuration
    - TIM1 Update interrupt enabled

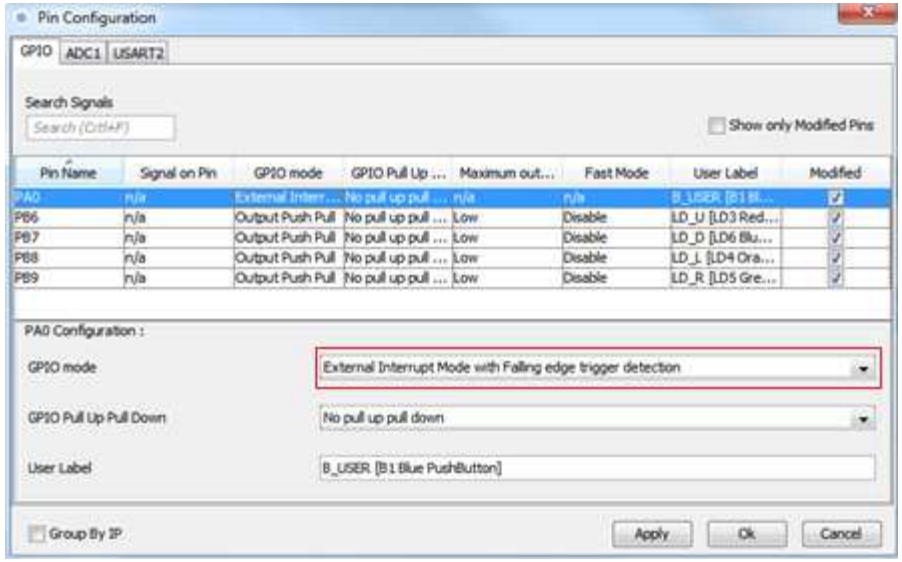


  - TIM6
    - Trigger event :Update Event
    - TIM6 global interrupt enabled



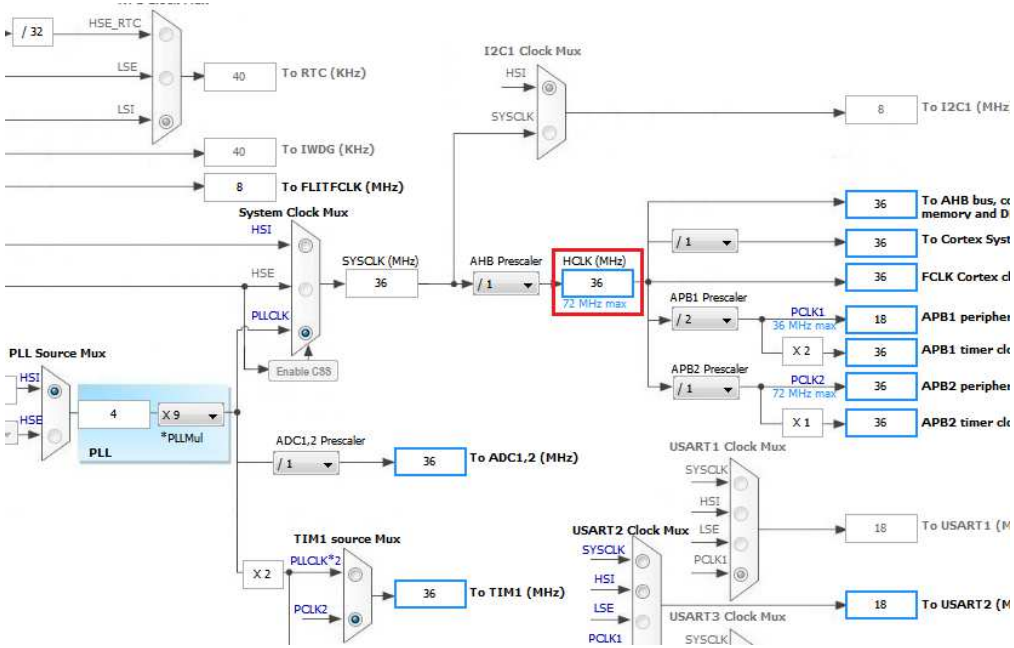


  - GPIO External interrupt
    - External Interrupt Mode with Falling edge trigger detection



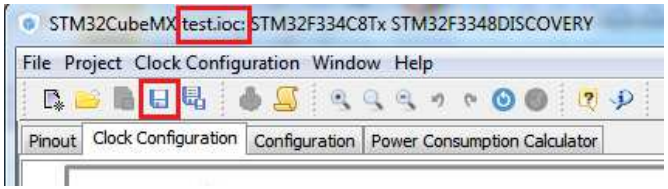
STM32CubeMX Clock Configuration

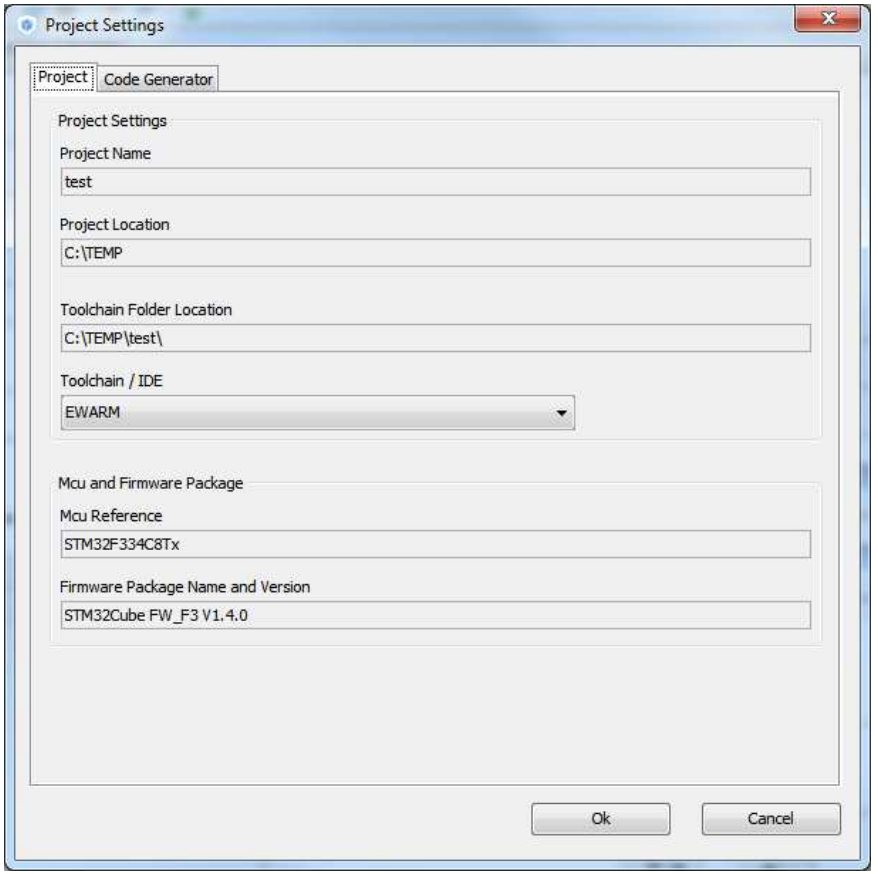
- Clock Default Configuration:
  - 16 MHz
- Modification not mandatory
  - Can be 36 MHz for example



STM32CubeMX project Settings

- Project Name:
  - «test» for this example
- Project Location :
  - C:\TEMP for this example
- Save the current project
  - test.ioc file is available from c:\TEMP\test repository

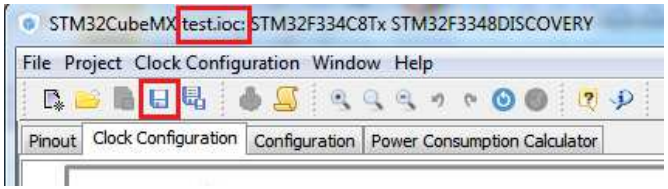


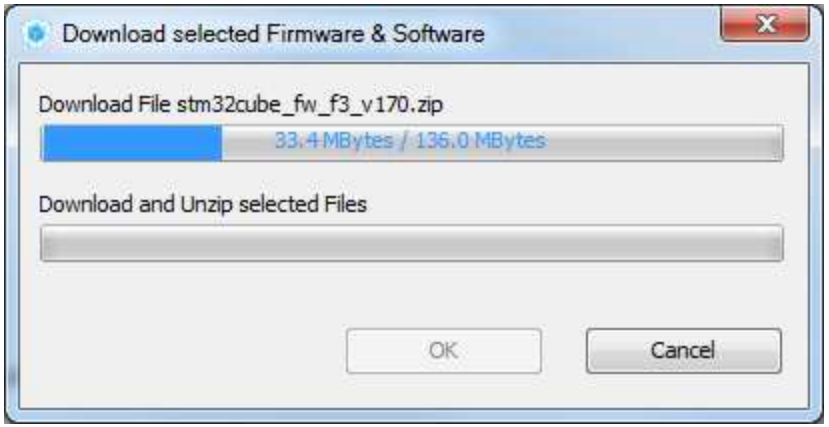


- You can save ioc file anywhere but
- It is preferable to save ioc file in same repository as diagram that will use it. Repository and ioc file must have same name.

STM32CubeMX project Settings

- Project Name:
  - «test» for this example
- Project Location :
  - C:\TEMP for this example
- Save the current project
  - test.ioc file is available from c:\TEMP\test repository



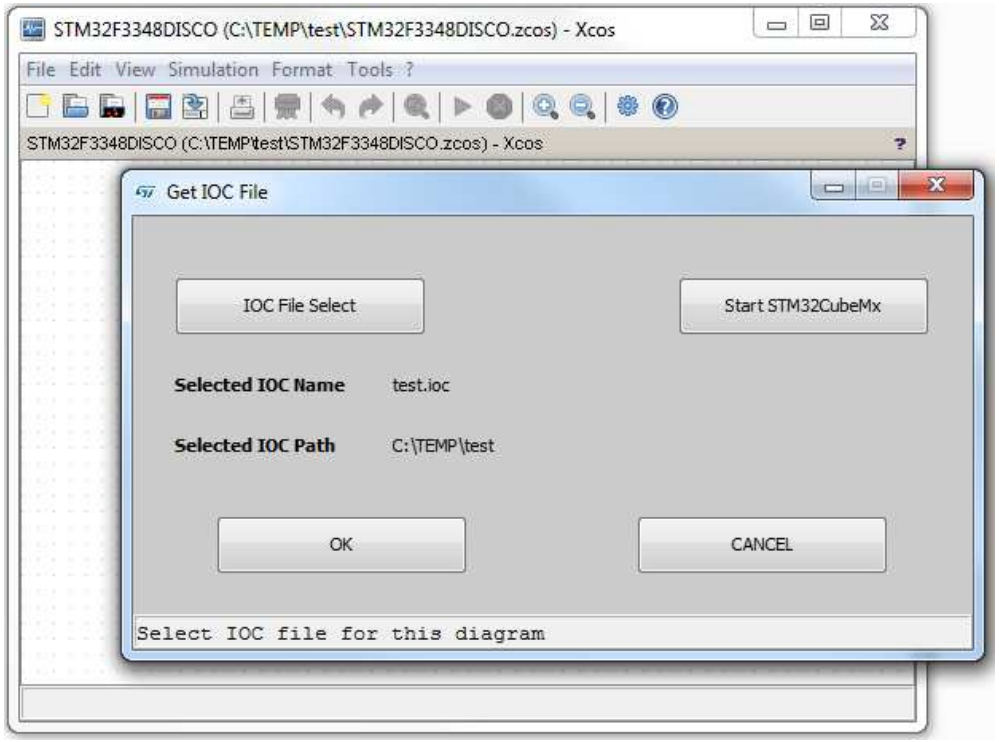


- Generated code is based on STM32 HAL C librairies.
- It is automatically downloaded/updated if it is necessary.

Xcos diagram creation

- Open new xcos diagram from Scilab 5.5.2.
- Save xcos diagram as C:\Temp\test\STM32F3348DISCO.zcos
- Link diagram to previously saved C:\Temp\test\test.ioc file

Tools > IOC File Select

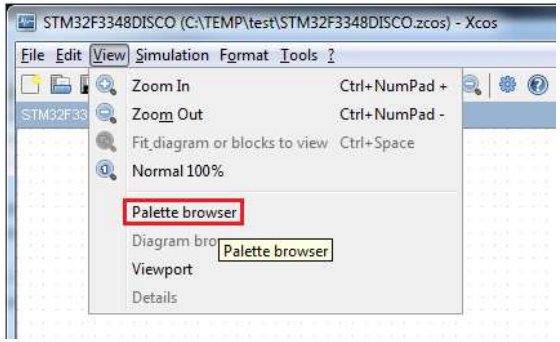


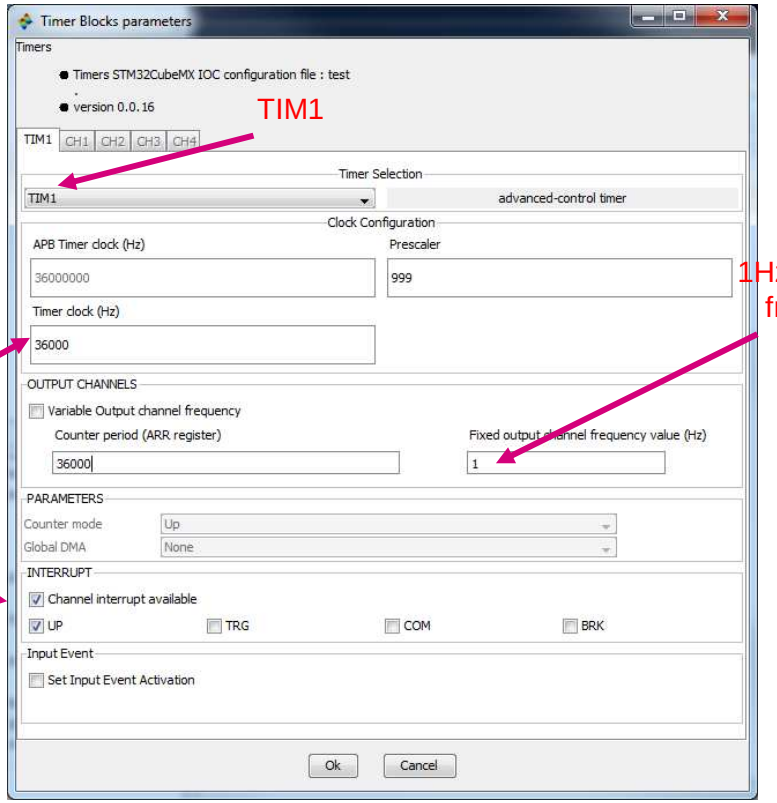
USE TIM1 to Blink LED3 at 1Hz

- Software application example:
  - **Use TIM1 to blink LED3 at 1Hz**
  - Use TIM6 to blink LED4 at 2Hz
  - Use TIM6 to trig ADC1 channels 2&3 conversion
  - Blink Led6 when user push button is pressed
  - Send ADC1 channel 3 values on USART2 when user push button is pressed

TIM1 Selection & Configuration

- Palette browser
  - Select View>Palette browser if it is not visible
- TIM1 Selection
  - Drag&Drop TIMER block from Palette browser
- TIM1 Configuration
  - Open (double click) TIMER block parameters window
  - Select TIM1 and set parameters.





- Prescaler must be set with constraint that ARR max value is 65535 regarding needed output channel frequency.

TIM1

Prescaler or Timer Clock

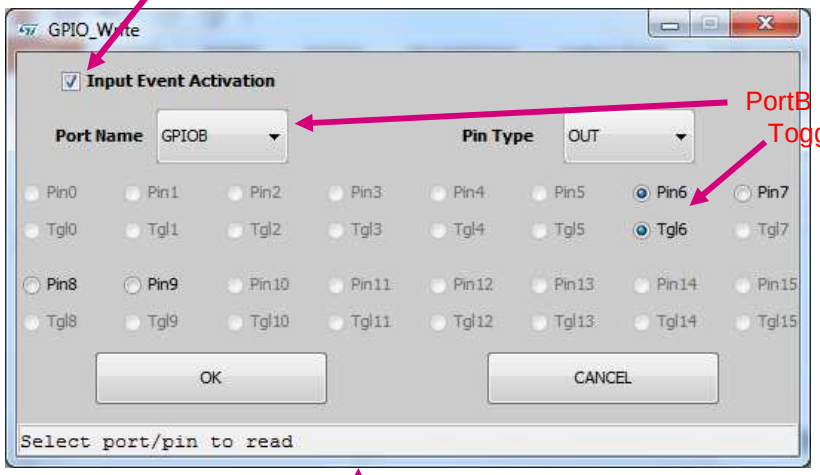
1Hz for output frequency

Validate Update interrupt

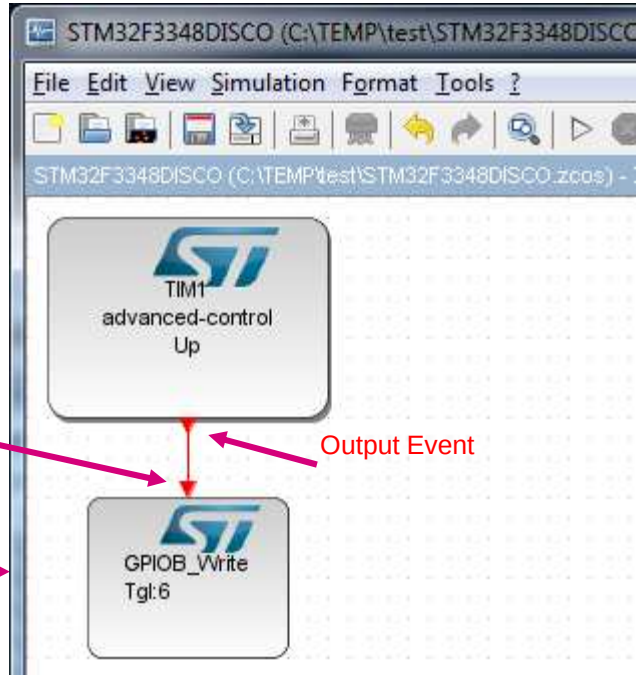
TIM1 Application

- TIM1 toggle LED3 at 1Hz
  - Drag&Drop GPIO_Write block to diagram and open (double click) GPIO_Write block parameters.

Check Input Event Activation.
GPIO_Write block will be activated by the connected event



PortB Pin6 Toggle



Input Event

Output Event

Connect TIM1 Up output event to GPIO_Write input event to blink LED3 when TIM1 update interrupt occurs. Every second at 1Hz

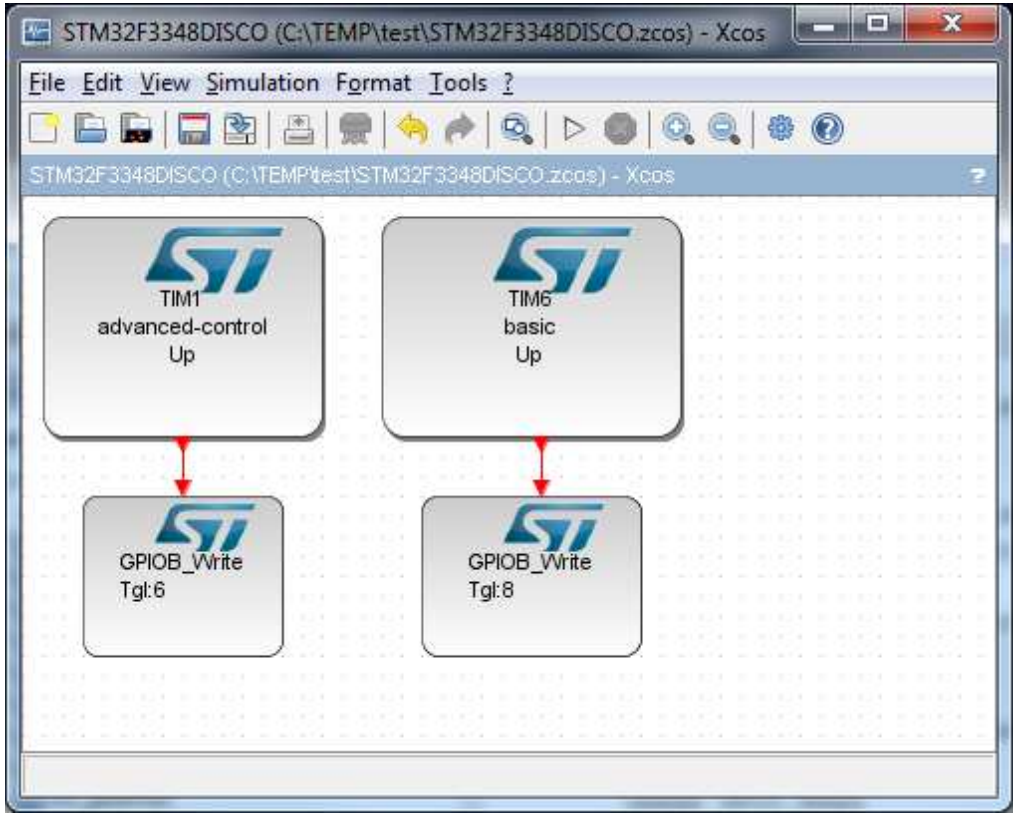
USE TIM6 to Blink LED4 at 2Hz

- Software application example:
  - Use TIM1 to blink LED3 at 1Hz
  - **Use TIM6 to blink LED4 at 2Hz**
  - Use TIM6 to trig ADC1 channels 2&3 conversion
  - Blink Led6 when user push button is pressed
  - Send ADC1 channel 3 values on USART2 when user push button is pressed

TIM6 Application

- TIM6 toggle LED4 at 2Hz
  - Make the same thing as for TIM1 but frequency is 2Hz and PortB Pin8 toggle as it is connected to Led4

Connect TIM6 Up output event to GPIO_Write input event to blink LED4 when TIM6 update interrupt occurs. Every 0.5 second at 2Hz

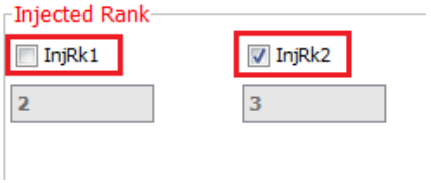


USE TIM6 to trig ADC1 channels 2&3

- Software application example:
  - Use TIM1 to blink LED3 at 1Hz
  - Use TIM6 to blink LED4 at 2Hz
  - **Use TIM6 to trig ADC1 channels 2&3 conversion**
  - Blink Led6 when user push button is pressed
  - Send ADC1 channel 3 values on USART2 when user push button is pressed

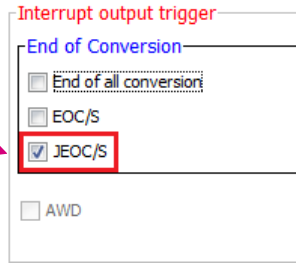
ADC1 Selection & Configuration

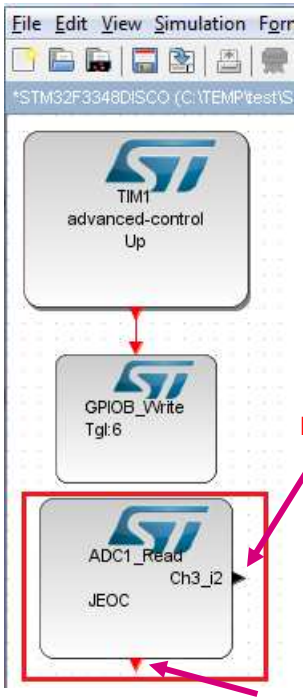
- TIM6 is configured to trig ADC1 from STM32CubeMx
- ADC1 Selection
  - Drag&Drop ADC block from Palette Browser and open ADC block parameters
- ADC1 Configuration
  - We will need ADC Ch3 value, uncheck Injected Rank1 for not needed Ch2



  - Select JEOC/S as interrupt output trigger

Injected end of conversion trigger





ADC1_Read End of Injected Convertion (JEOC) event is available to trig process

Ch3 value is available as output

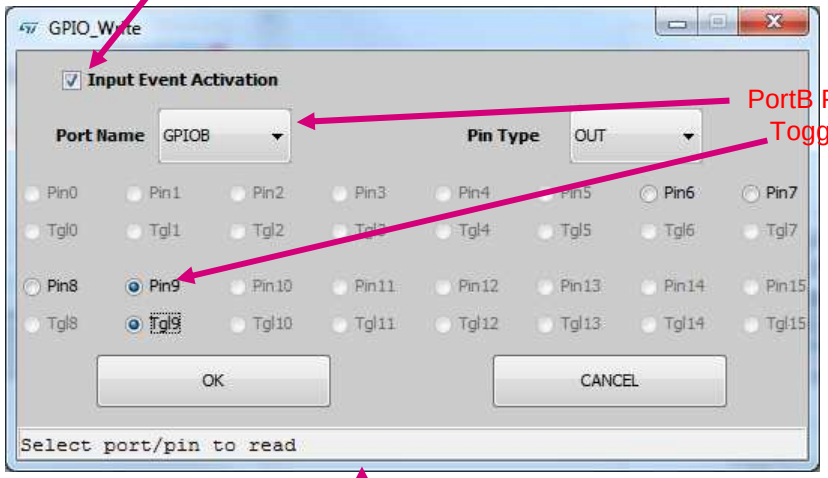
Data output

Output Event

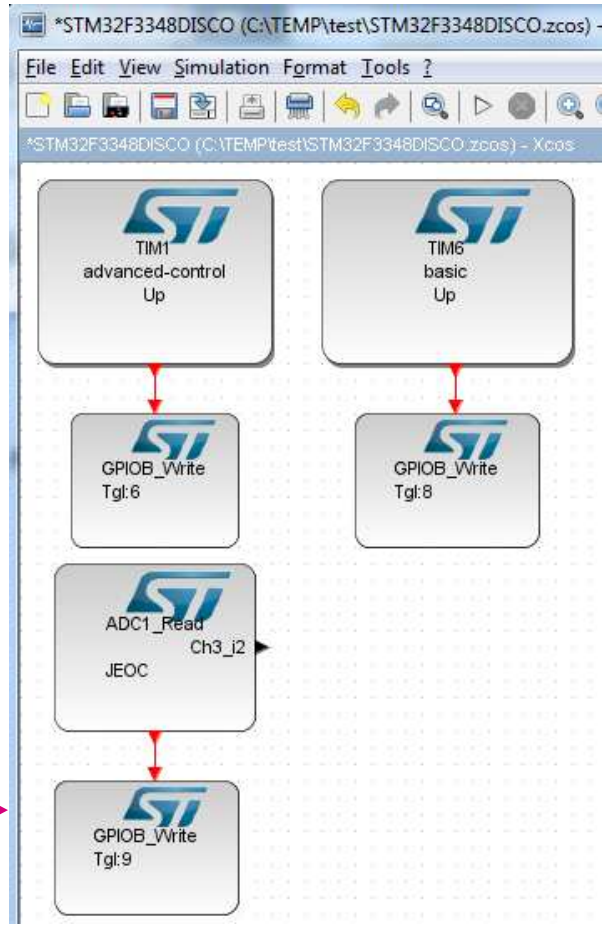
ADC1 Application

- TIM6 trig ADC1 channels conversion
  - Blink LED5 at end of ADC1 conversion to verify that TIM6 has triggerer it.
  - Drag&Drop GPIO_Write block.
  - Set GPIO_Write block parameters window to toggle Pin9 (LED5 is connected to Pin9)

Check Input Event Activation.
GPIO_Write block will be activated by the connected event



PortB Pin9 Toggle



LED5 will blink when ADC1 injected channels 2&3 has been converted.

Sart of Conversion is triggered from TIM6

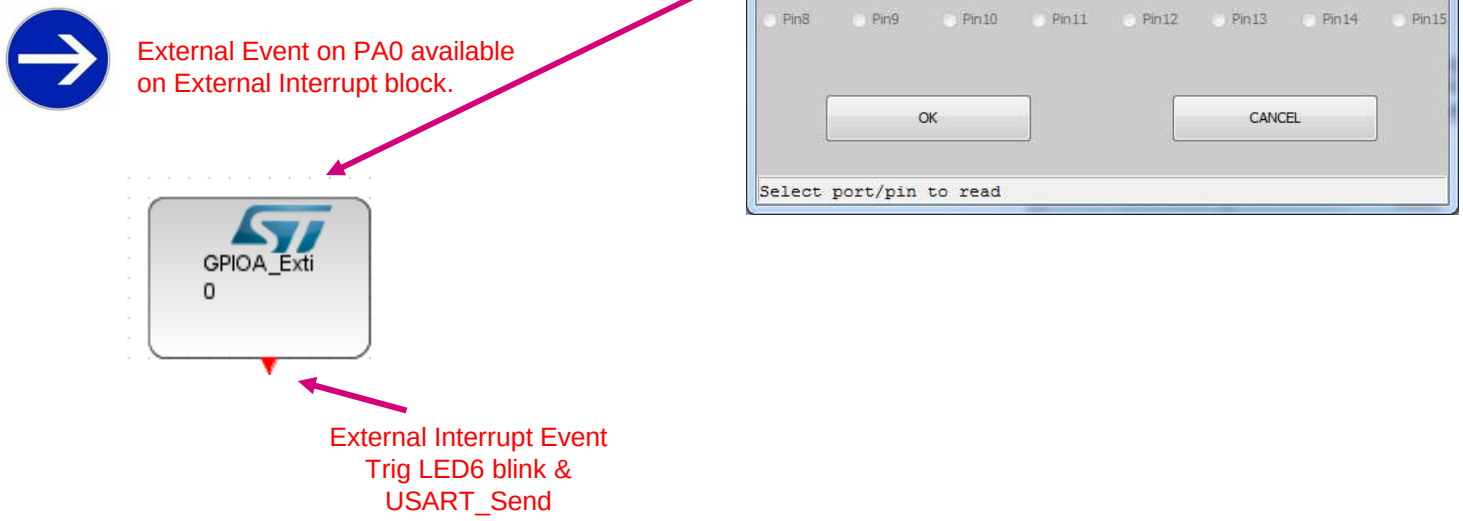
Channels 2&3 values are available at the end of conversion

Push Button functions

- Software application example:
  - Use TIM1 to blink LED3 at 1Hz
  - Use TIM6 to blink LED4 at 2Hz
  - Use TIM6 to trig ADC1 channels 2&3 conversion
  - **Blink Led6 when user push button is pressed**
  - **Send ADC1 channel 3 values on USART2 when user push button is pressed**

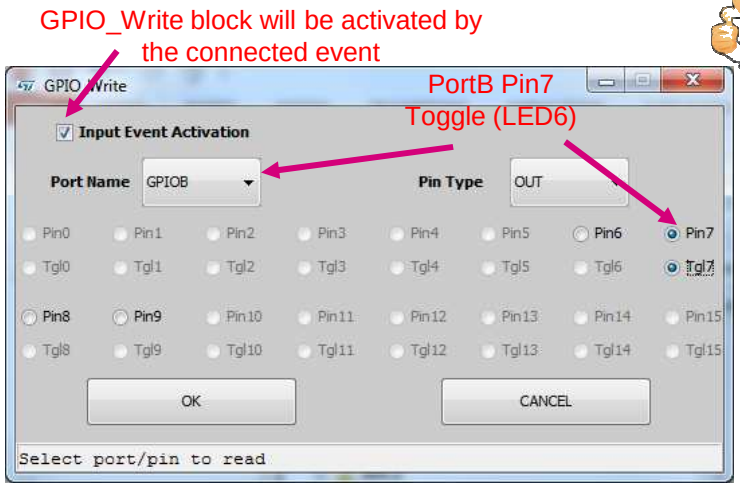
EXTI Selection & Configuration

- EXTI0 Selection
  - Push Button is connected to External Interrupt 0 on PA0
  - External interrupt Event will be generated for action on Push Button.
  - Drag&Drop GPIO_Exti block from palette Browser
  - Open (double click) GPIO_Exti block parameters window and select GPIOA pin0

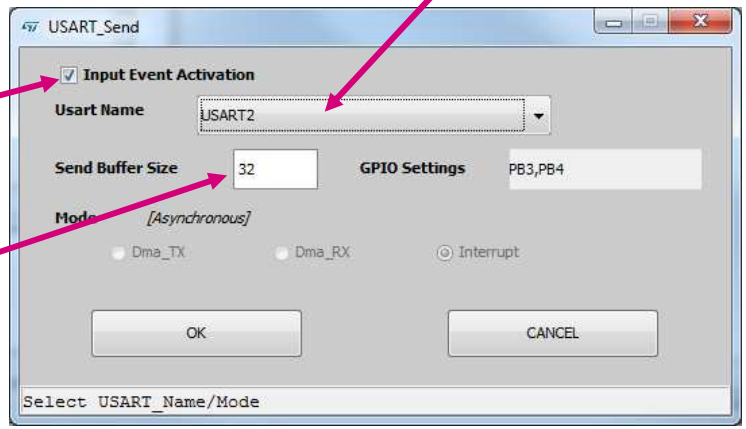


Push Button Action 1/2

- Blink LED6
  - Drag&Drop GPIO_Write block from palette browser to diagram.
  - Open (double click) GPIO_Write block parameters window and select Pin7 (LED6 is connected to Pin7)
  - Connect GPIOA_Exti0 output event to GPIOB_Write Tgl:7 input event. PB7 will blink every button pushed.



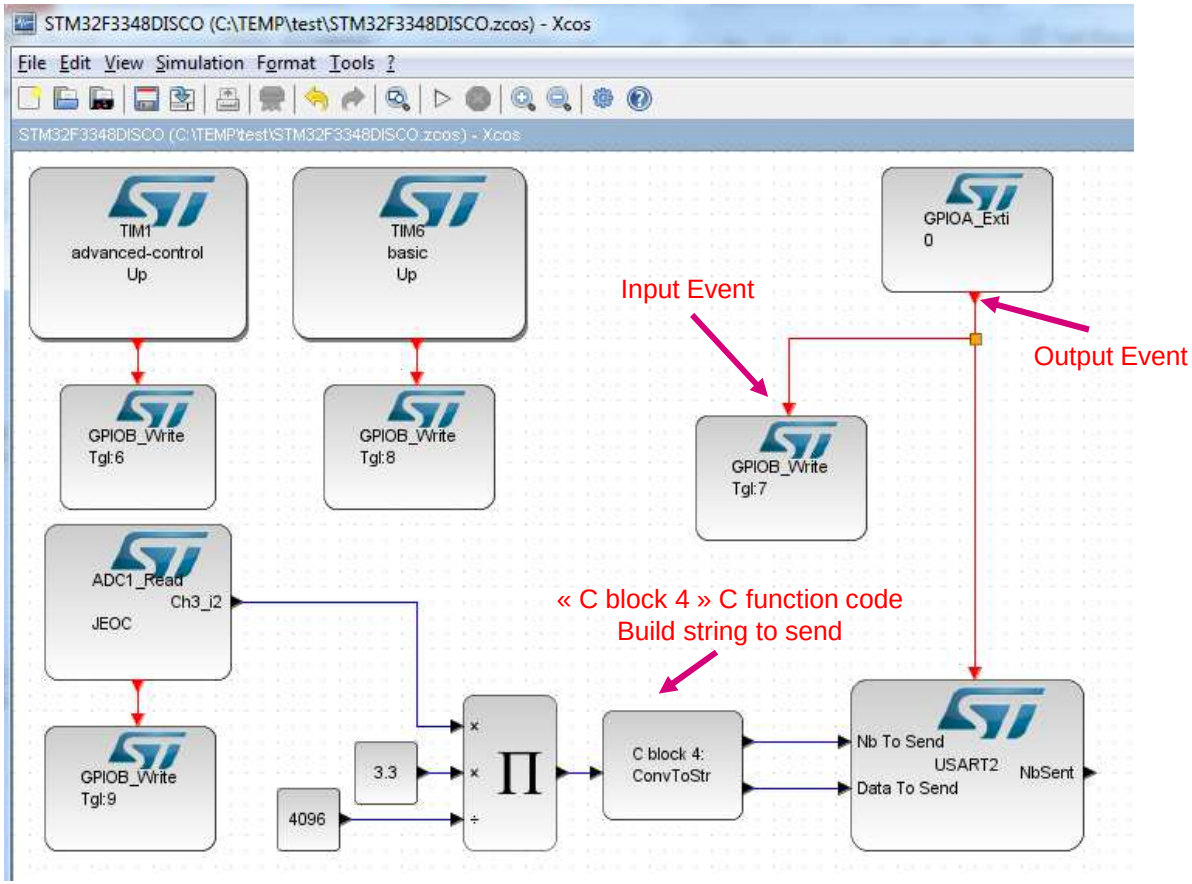
- USART2 Settings
  - Drag&Drop USART_Send block from Palette Browser and open parameters window. Connect GPIOA_Exti0 output event to USART2 input event.



It is mandatory to set Buffer Size as close as messages sent in order to avoid memory waste.

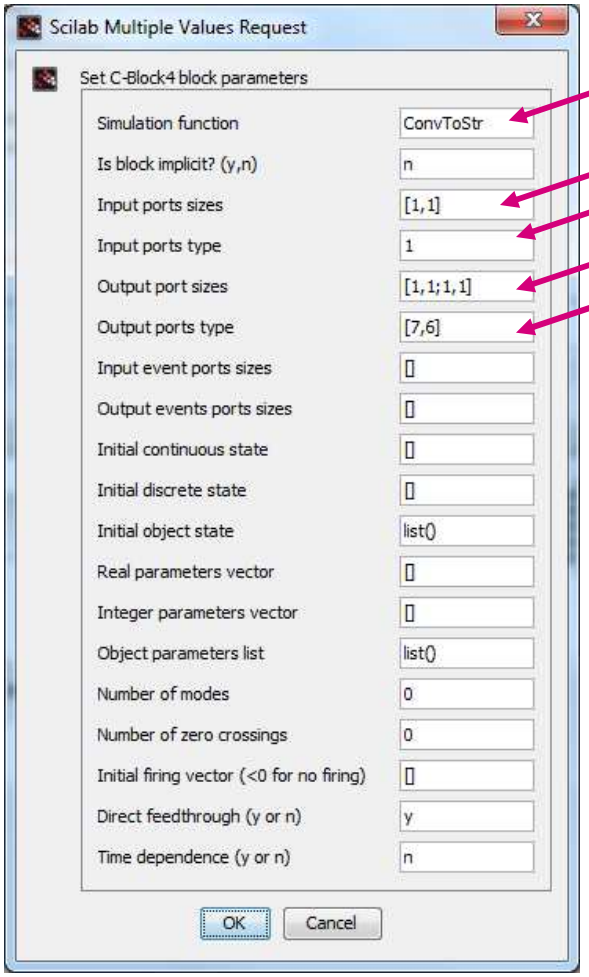
Push Button Action 2/2

- String to send on USART2
  - Build string with ADC1 Ch3 value
  - ADC1 Ch3 output is 12bits value. It should be converted to 0-3.3V value. Connect converted value to « C block 4 » to build string to send.
  - Connect ConvToStr block outputs to USART2 Send block.



« C block 4 » configuration 1/2

- C function parameter description
  - Drag&Drop « C block 4 ».
  - It is used to include C code to SCILAB.
  - Set « C block 4 » parameters.
  - Click OK



Function name

Input = 1 data value

Input type = real (double)

output = 2 data values

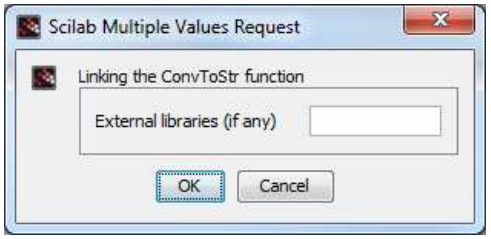
output type = uint16 and uint32

Data types:

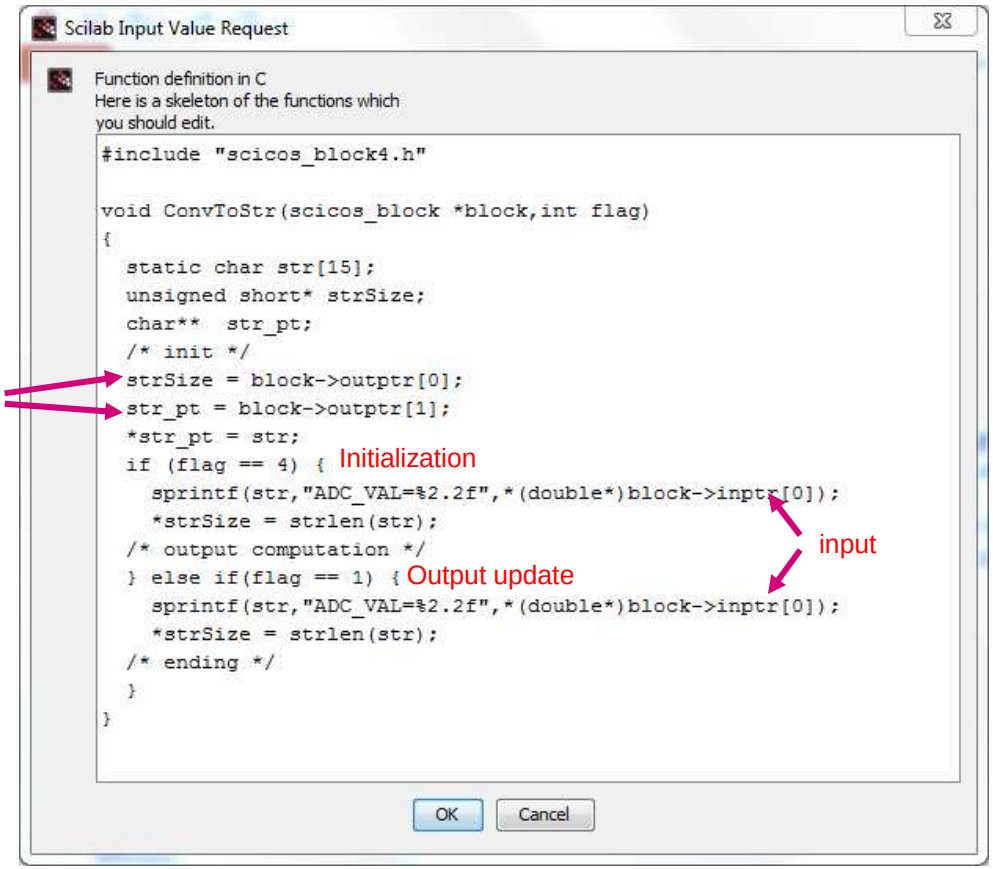
- 1 real
- 2 complex
- 3 int32
- 4 int16
- 5 int8
- 6 uint32
- 7 uint16
- 8 uint8

« C block 4 » configuration 2/2

- C function write
  - Write C code application processing input(s) to generate output(s)
  - Click OK.
  - « External librairies » not processed for the moment.



Flag input value:
- -5 Error
- 0 Derivative state
- 1 Output state
- 2 State update
- 3 Output Event Timing
- 4 initialization
- 5 Ending
- 6 Reinitialization
- 7 Continuous property Update
- 9 Zero Crossing
- 10 Jacobian



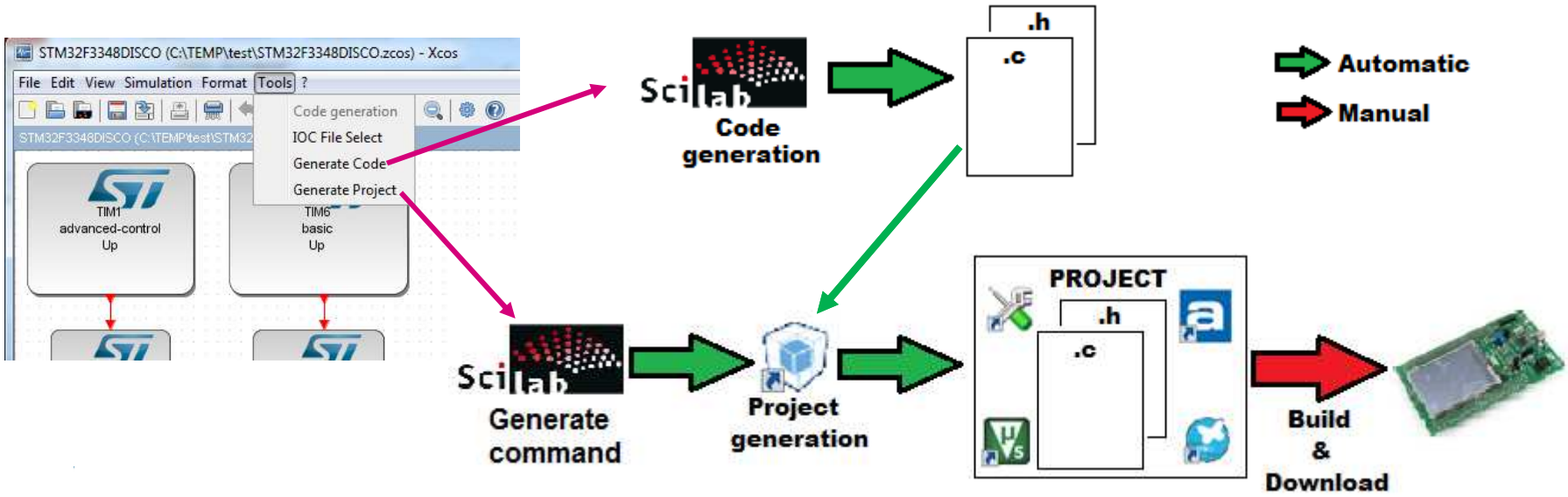
Build Application flow

- Build Xcos Application Process
  - Build application has been divided in 2 steps:
    - Generate Code
    - Generate Project

IOC File Selection is mandatory.
IOC file must have been selected before generating code / generating project

- Generate Code
  - Press « Generate Code » to automatically call stm32BuildProject function that will generate C code for the diagram.

- Generate Project
  - Press « Generate Project » to automatically call stm32GenerateProject function.
  - It is used to retrieve all C generated files and generate STM32CubeMx command.
  - Project is generated from STM32CubeMx depending on project settings parameters.



Generate Code

- Code generation flow
  - Entry point: stm32BuildProject function.
  - The process gives a « flat image » of the diagram, which is a data base of all blocks connections, inputs, outputs, events etc…
  - Then, generated code is Synchronous or Asynchronous.
  - Asynchronous code manages interrupts where Synchronous code is called every regular steps.
  - Generated code depends on block input event connection.
    1. When block input event is connected to an STM32 output event. Generated code is asynchronous (interrupts)
    2. When block input event is connected to a Palettes>Event handling block. Generated code is synchronous.
    3. When block do not have input event:
       - If data flow (input/output connection) including block is connected to a block with input event, cf 1 or 2.
       - If data flow do not include any block with input event, Generated code is synchronous. Minus synchonous step time used or default Tick Handler value. (cf help STM32_Preferences)

- Synchronous code
  - The process gets all activation clocks and computes STM32 systick value (PGCD or default Tick Handler when diagram do not have any clock event)
  - A stepi (i= 1…n) function is generated for every activation clock.

- Asynchronous code
  - Only STM32 block generates asynchronous code. Code of blocks connected to an STM32 output event is generated in STM32 peripheral HAL interrupt Callback function.
  - Then, code will be called every time STM32 peripheral event occurs.

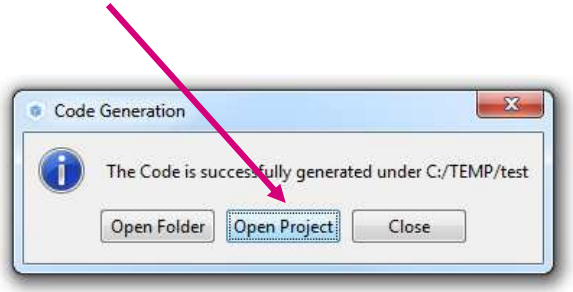
Generate Project

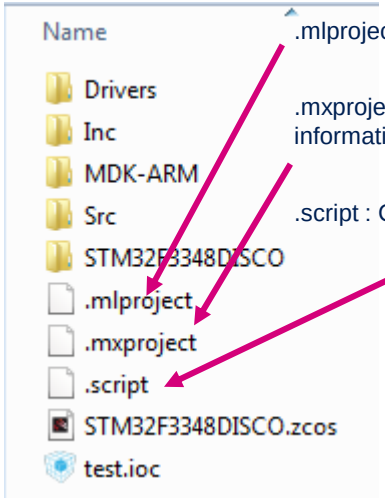
- Project generation flow
  - When « Generate Code » is called, .c/.h files are created as well as main.c.
  - Then, STM32CubeMX is called to integrate peripherals initialization to main.c and to generate project including all .c/.h files.
  - Interface files with STM32CubeMX are .mlproject and .script files.

« Generate Project » is mandatory every time « Generate Code » has been called.

- Generate Project
  - Press « Generate Project » to automatically call STM32CubeMx.
  - Press « Open Project » to start toolchain.
  - Project can be built, downloaded into STM32 target and run or debug.

Click « Open Project » to automatically open project using selected toolchain.





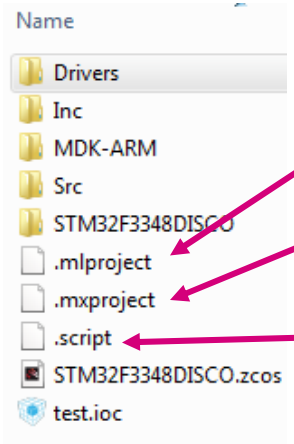
.mlproject : Contains information about .c/.h files to add to project.

.mxproject : Generated from STM32CubeMX. Contains information about .c/.h files generated from STM32CubeMX

.script : Contains STM32CubeMX command to generate project.

STM32CubeMX Code Generation

- STM32CubeMX project generation
  - Project is generated in same repository as ioc file. (cf « test » project example)



.mlproject : Contains information about .c/.h files to add to project.

.mxproject : Generated from STM32CubeMX. Contains information about .c/.h files generated from STM32CubeMX

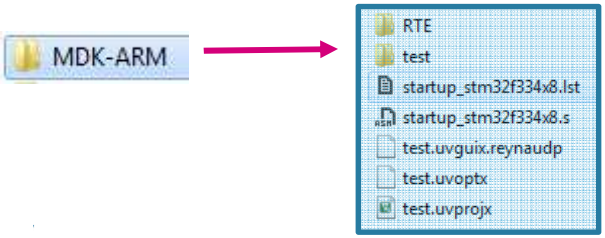
.script : Contains STM32CubeMX command to generate project.

- STM32CubeMX project contains
  - Drivers : Contains STM32 selected library and CMSIS files

  - EWARM/MDK-ARM: Contains toolchain project files (For example)

(IAR)

(KEIL)



- Inc & Src: Contains STM32CubeMX generated or modified files.

- test (name: Contains all .c/h files generated from MATLAB®

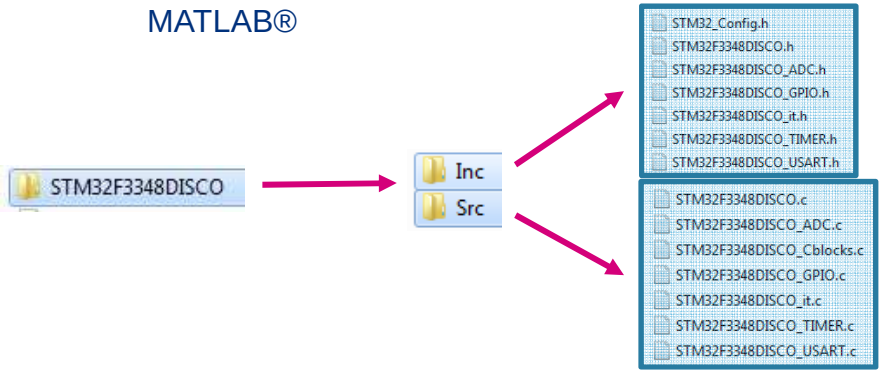
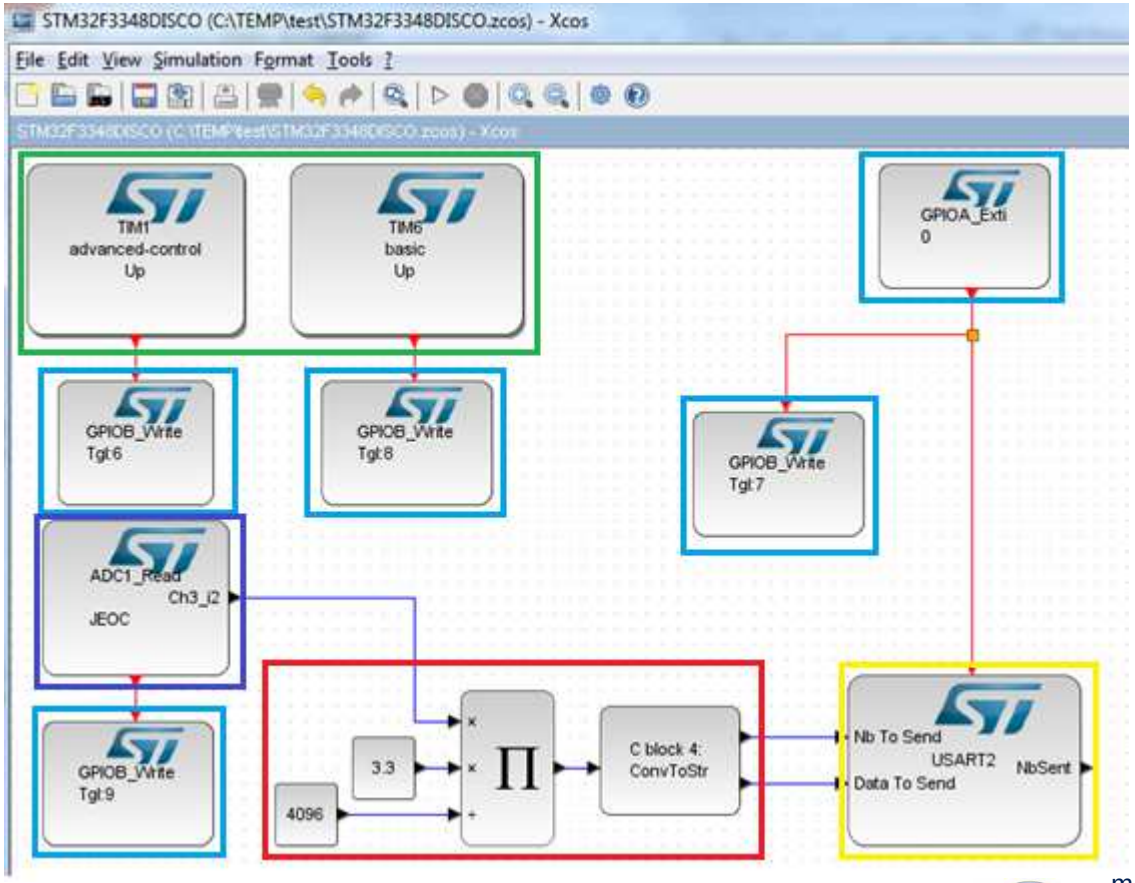
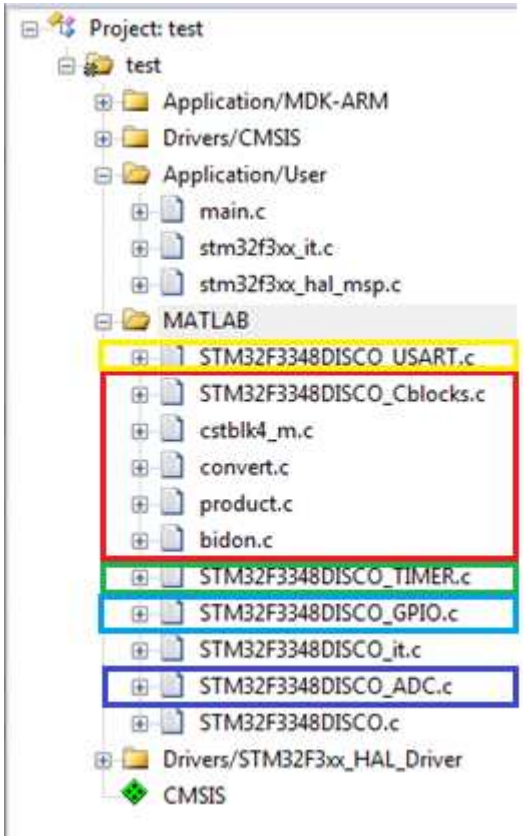


Diagram vs Generated Code

- Every STM32 peripherals generate initialization code in .c/.h files which name is created using name of the diagram and peripheral name. Asynchronous code (interrupts) is generated in "DiagramName"_it.c file and Synchronous code is generated in "DiagramName".c file.

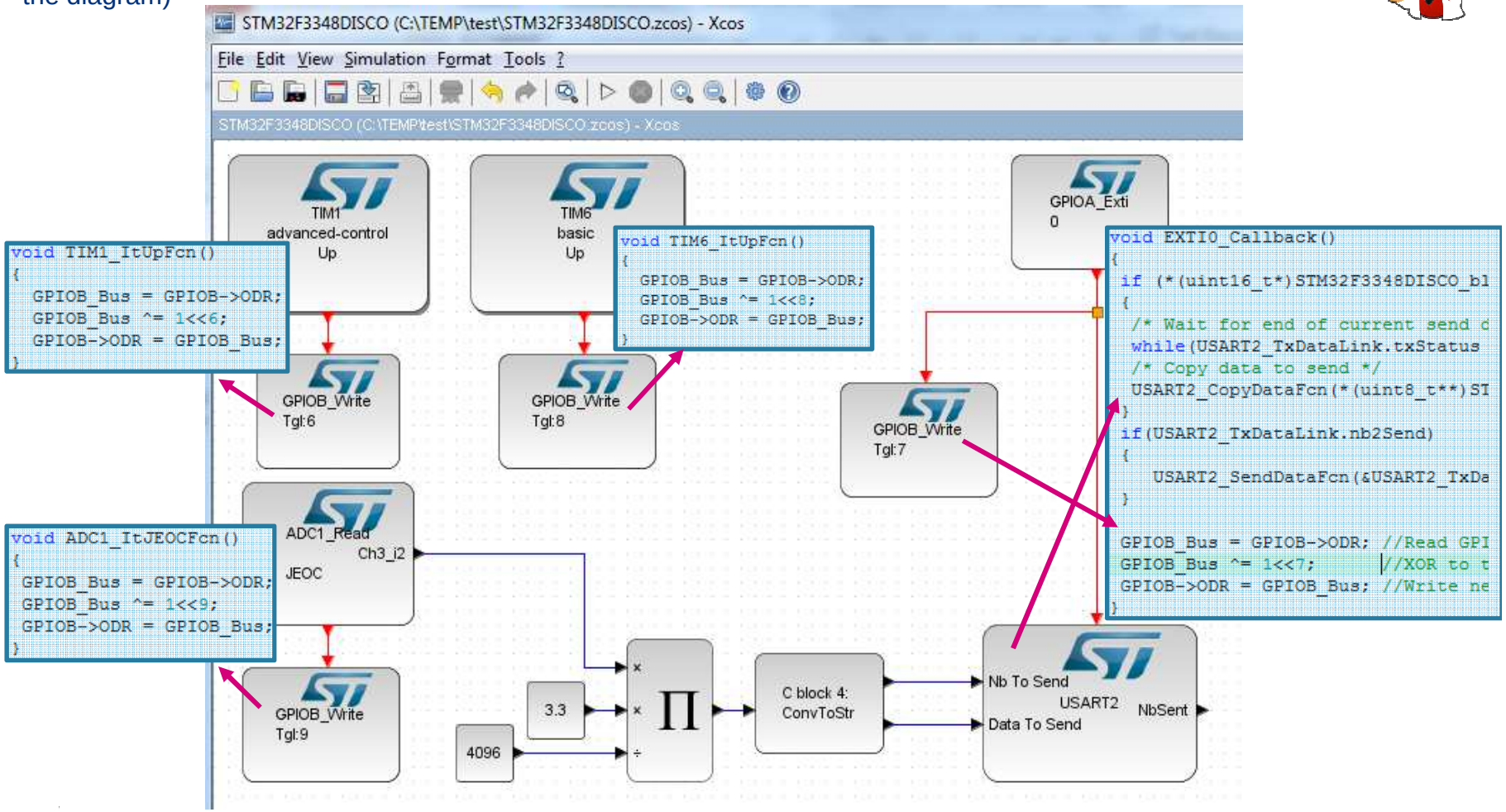




main.c : Generated from SCILAB. It has been modified by STM32CubeMX to add project configuration.
_hal_msp.c: Peripherals configuration
_it.c : Interrupt handlers for configured interrupt only.

Asynchronous Generated Code

- Asynchronous code is generated in xx_it.c file from blocks connected to STM32 event. (XX is name of the diagram)



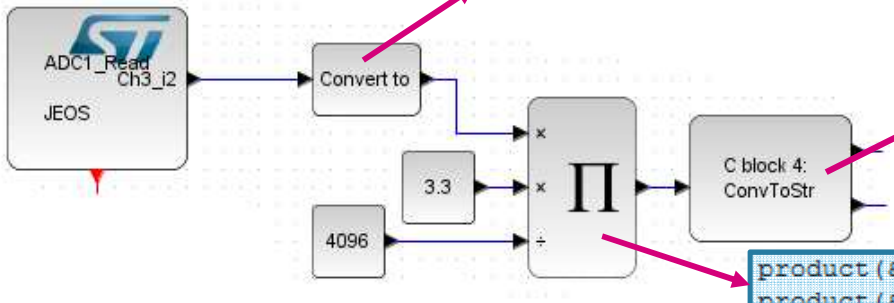
Synchronous Generated Code

- Synchronous code is generated in "DiagramName".c file from blocks connected to « Event Handling » blocks. Each Event is associated to a Step function including all code it manages.

```
/* Re-Start interrupt conversion for ADC1 injected channel */
HAL_ADCEx_InjectedStart_IT(&hadc1);
```

```
void STM32F3348DISCO_Step()
{
```

```
convert(&block_STM32F3348DISCO,1);
convert(&block_STM32F3348DISCO,2);
```




```
ConvToStr(&block_STM32F3348DISCO,1);
ConvToStr(&block_STM32F3348DISCO,2);
```

```
product(&block_STM32F3348DISCO,1);
product(&block_STM32F3348DISCO,2);
```

Functions are called twice.

1. Output State (parameter 1)
2. State Update (parameter 2)

- Step functions are scheduled from main depending on « Event Handling » step parameter time or default tick handler step when there is no « Event Handling » in the diagram.

```
/* Systick configuration and enable SysTickHandler interrupt */
if (SysTick_Config((uint32_t)(SystemCoreClock * 0.001)))
```

Step function is scheduled at default 1ms tick handler value. (cf preferences)

```
/* Infinite loop */
/* Real time from systickHandler */
while(1) {
   /*Process tasks every solver time*/
   if(remainAutoReloadTimerLoopVal_S == 0) {
      remainAutoReloadTimerLoopVal_S = autoReloadTimerLoopVal_S;
      /* Step the model for base rate */
      STM32F3348DISCO_Step();
   } //End if
} //End while
```

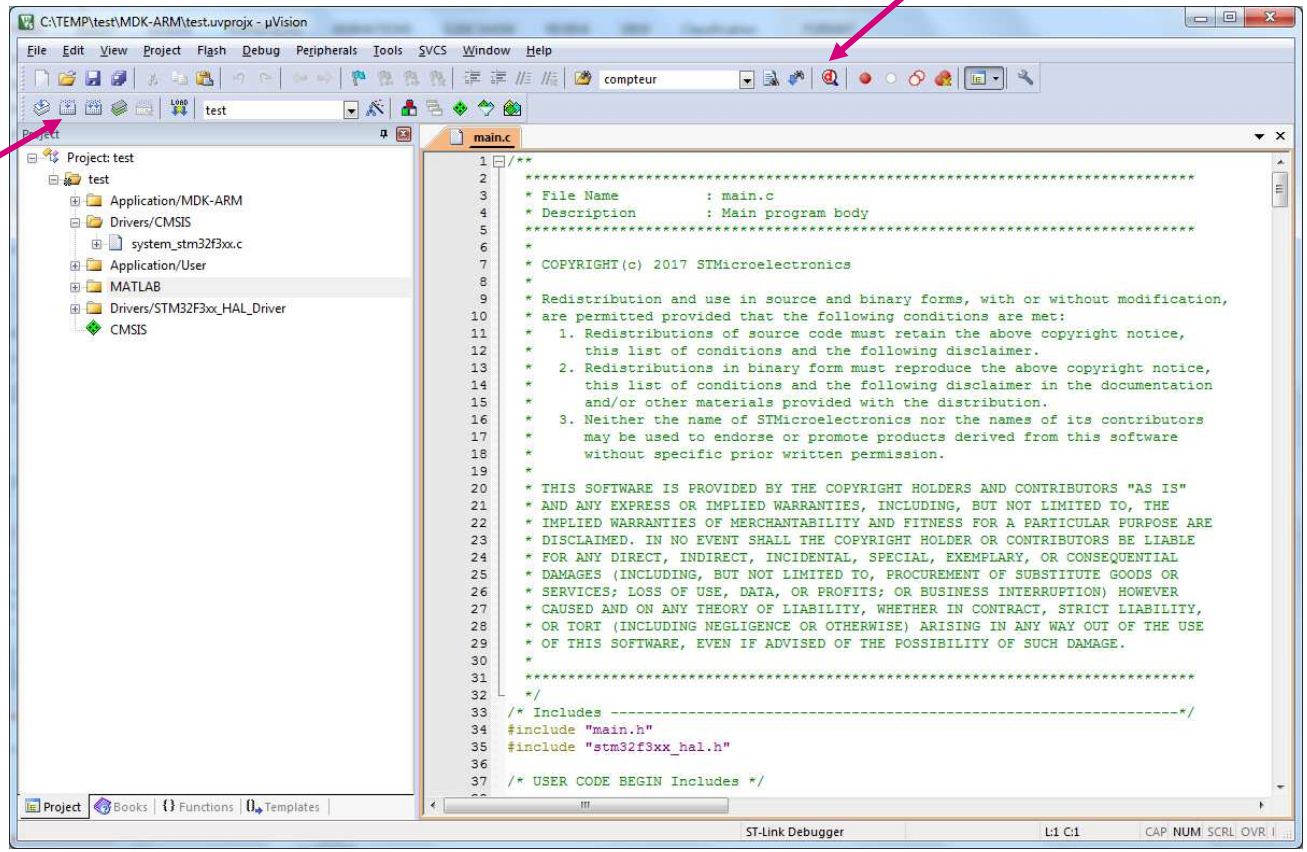
Toolchain Project

It is required to know toolchain functionalities.
Keil µVision used here as example

- Toolchain settings
  - STM32CubeMX has automatically generated project including mandatory settings. It is exactly same project at it should be generated « by hand ». Possibility to tune all settings.
- Toolchain Actions
  - Build project
  - Start Debug Session (Ctrl+F5)

Start Debug

BUILD project



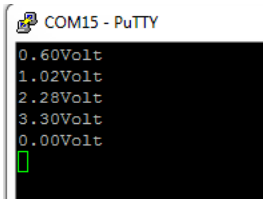
STM32 board must be connected to PC when you click « Start Debug Session »

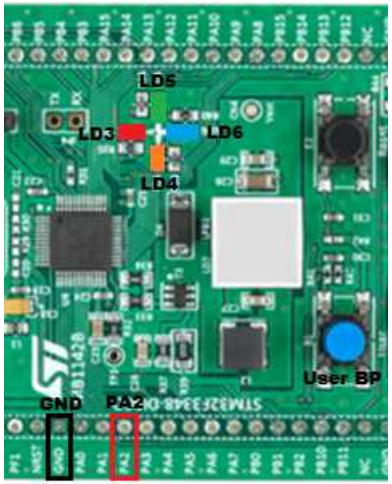
It is required to know toolchain functionalities.

Run Project

Example using µVision (KEIL) toolchain

- STM32F3348DISCO example results
  - Project is started and waits at 1st main instruction.
  - Click «Go»
  - LD3/LD4/LD5 are blinking
  - LD6 is alternatively ON and OFF when you press User button. ADC value set on PA2 (ADC1 Ch3) is sent to PC through USART.
    You can see ADC value on PC using PuTTY for example.





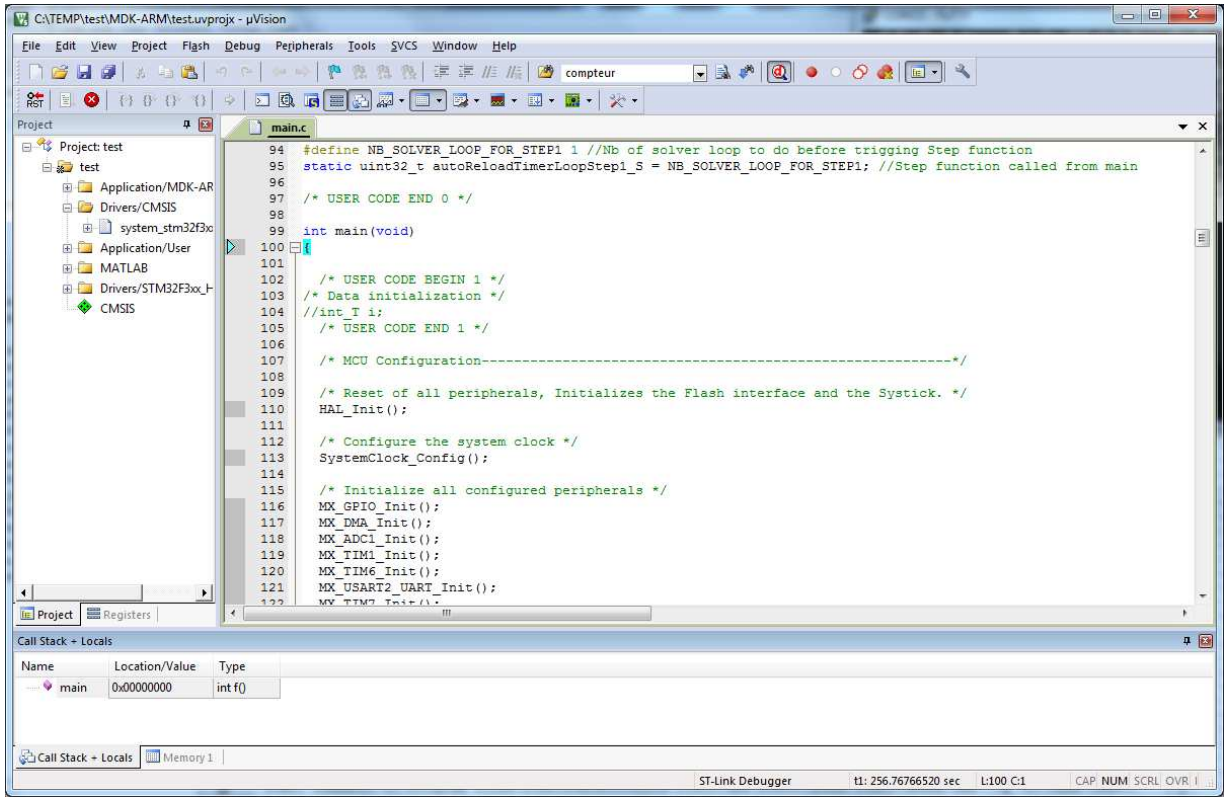
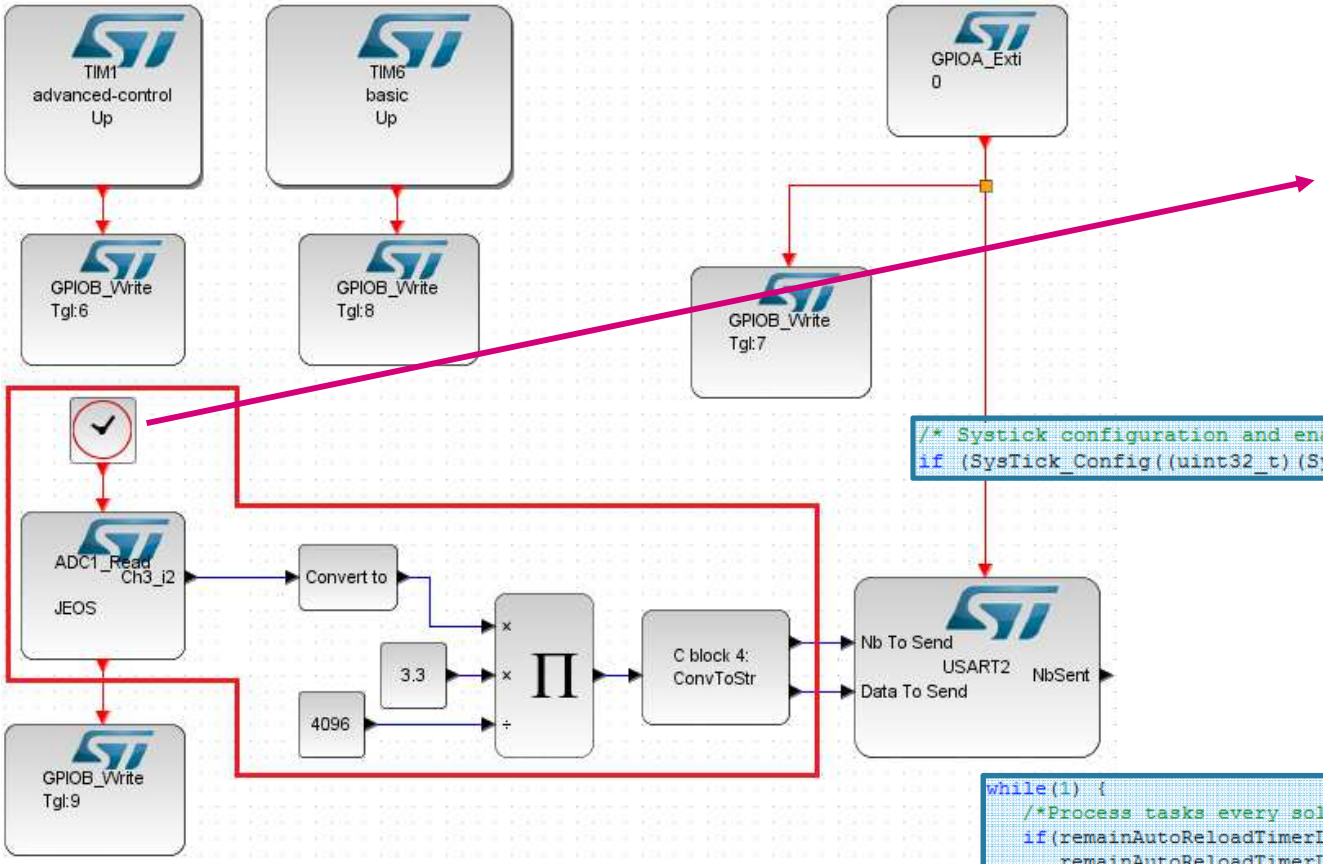
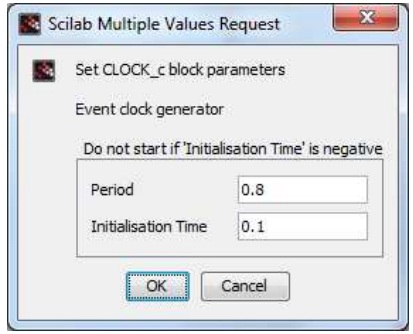


Diagram and Code variation 1/3

- One step function scheduled from « Event Handling »





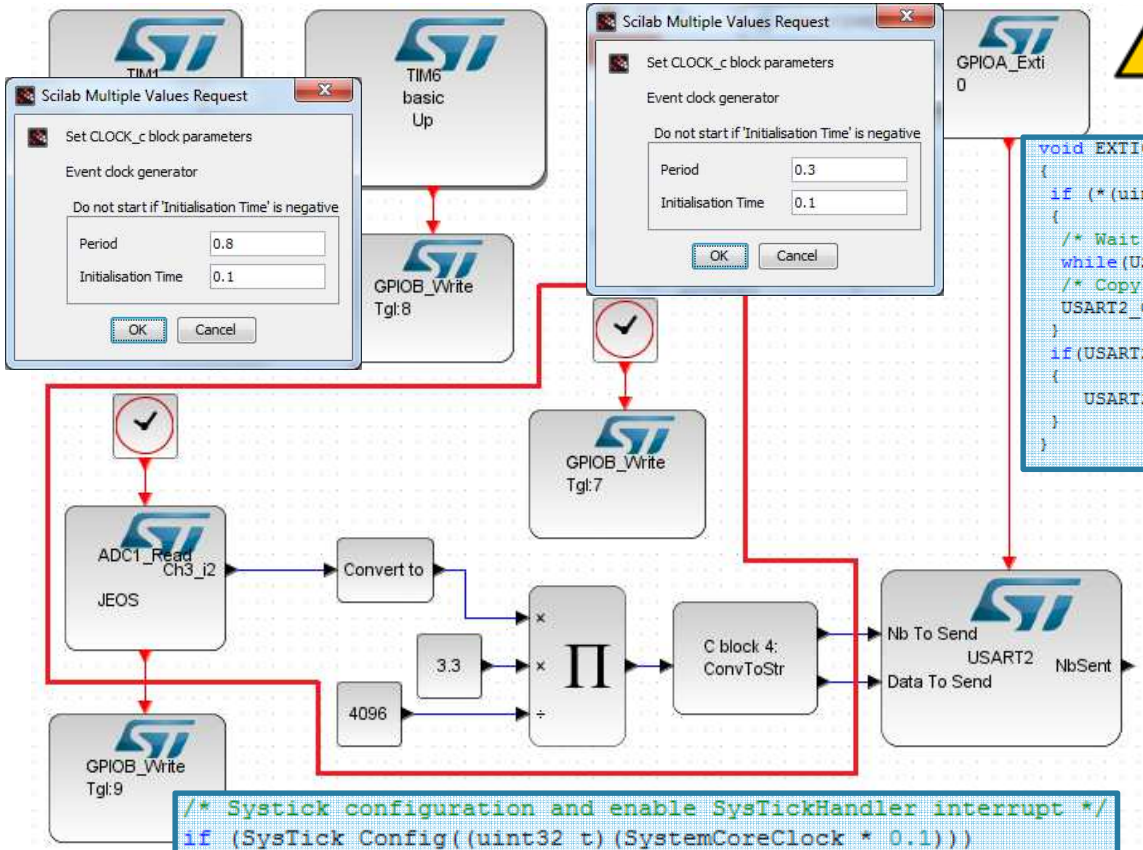

```
/* Systick configuration and enable SysTickHandler interrupt */
if (SysTick_Config((uint32_t)(SystemCoreClock * 0.8)))
```

```
while(1) {
   /*Process tasks every solver time*/
   if(remainAutoReloadTimerLoopVal_S == 0) {
      remainAutoReloadTimerLoopVal_S = autoReloadTimerLoopVal_S;
      autoReloadTimerLoopStep1_S--;
      if (autoReloadTimerLoopStep1_S == 0) {
         autoReloadTimerLoopStep1_S = NB_SOLVER_LOOP_FOR_STEP1;
         STM32F3348DISCO_Step1();
      }//End if
   } //End if
} //End while
```

Step1 function is scheduled at 0.8s

Diagram and Code variation 2/3

- Two steps functions scheduled from « Event Handling »



GPIO Toggle is no more in the Asynchronous external interrupt function.

```
void EXTI0_Callback()
{
 if (*(uint16_t*)STM32F3348DISCO_block_outtbptr[4] != 0)
 {
  /* Wait for end of current send data*/
  while(USART2_TxDataLink.txStatus == USART_TX_ON);
  /* Copy data to send */
  USART2_CopyDataFcn(*(uint8_t**)STM32F3348DISCO_block_outtbptr[3]
 }
 if(USART2_TxDataLink.nb2Send)
 {
    USART2_SendDataFcn(&USART2_TxDataLink);
 }
}
```

```
/* Systick configuration and enable SysTickHandler interrupt */
if (SysTick_Config((uint32_t)(SystemCoreClock * 0.1)))
```

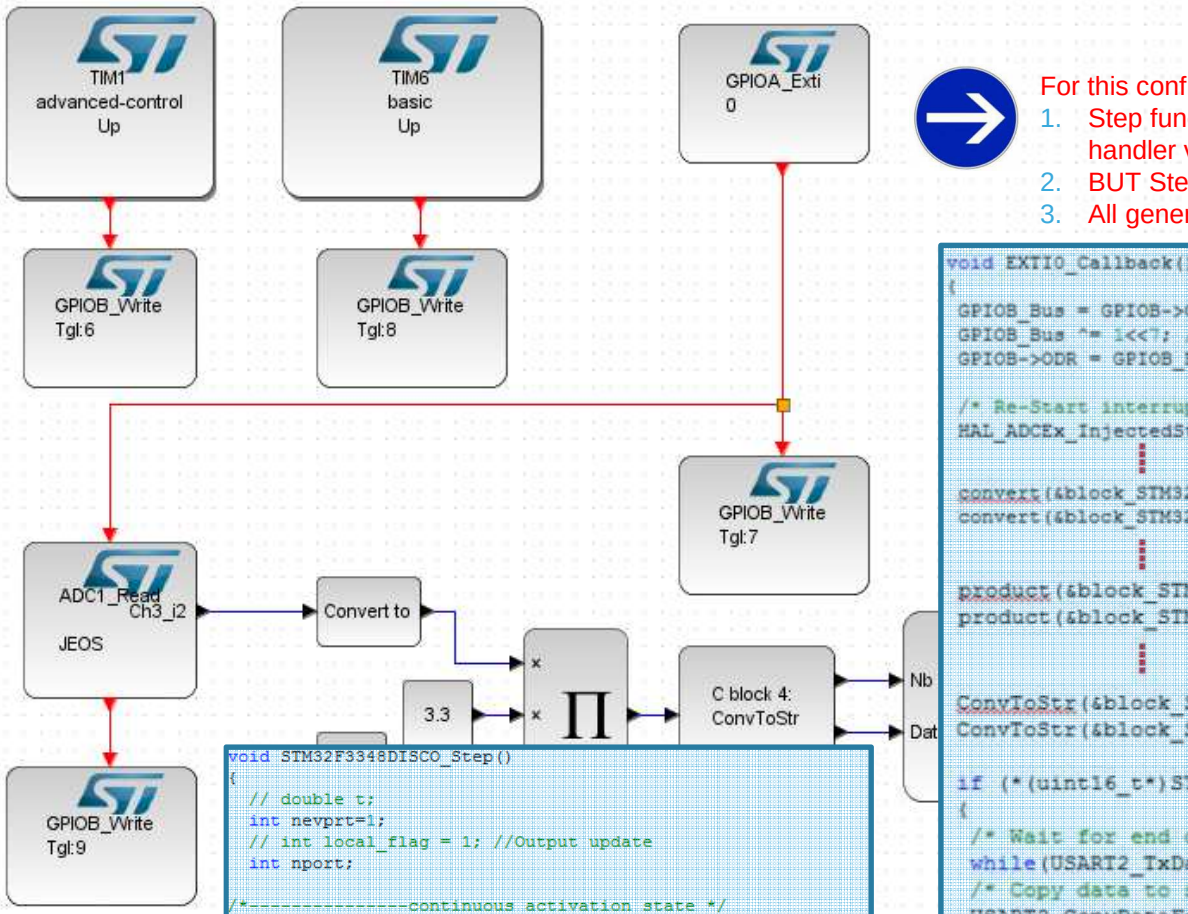
Systick is 0.1s, computed as PGCD of Event Handling periods.
Step1 function is scheduled at 0.8s
Step2 function is scheduled at 0.3s

```
#define NB_SOLVER_LOOP_FOR_STEP1 8 //Nb of solver loop to do before tr
static uint32_t autoReloadTimerLoopStep1_S = NB_SOLVER_LOOP_FOR_STEP1;
#define NB_SOLVER_LOOP_FOR_STEP2 3 //Nb of solver loop to do before tr
static uint32_t autoReloadTimerLoopStep2_S = NB_SOLVER_LOOP_FOR_STEP2;
```

```
while(1) {
    /*Process tasks every solver time*/
    if(remainAutoReloadTimerLoopVal_S == 0) {
       remainAutoReloadTimerLoopVal_S = autoReloadTimerLoopVal_S;
       autoReloadTimerLoopStep1_S--;
       if (autoReloadTimerLoopStep1_S == 0) {
          autoReloadTimerLoopStep1_S = NB_SOLVER_LOOP_FOR_STEP1;
          STM32F3348DISCO_Step1();
       }//End if
       autoReloadTimerLoopStep2_S--;
       if (autoReloadTimerLoopStep2_S == 0) {
          autoReloadTimerLoopStep2_S = NB_SOLVER_LOOP_FOR_STEP2;
          STM32F3348DISCO_Step2();
       }//End if
    } //End if
} //End while
```

Diagram and Code variation 3/3

- No Synchronous function



For this configuration:

1. Step function is scheduled at default 1ms tick handler value. (cf preferences)
2. BUT Step function is empty!
3. All generated code is Asynchrone

```
void STM32F3348DISCO_Step()
{
  // double t;
  int nevprt=1;
  // int local_flag = 1; //Output update
  int nport;

/*---------------continuous activation state */
/*---------------STM32 block(s) without activation state  */
/*---------------STM32 solver step: NoEvt NoIn NoOut*/
/*---------------STM32 solver step: NoEvt NoIn Out*/
/*---------------STM32 solver step: NoEvt In Out*/
/*---------------STM32 solver step: NoEvt In NoOut*/
/*---------------FLAG: 1  */

 } //End of STM32F3348DISCO_Step1 function
```

```
void EXTI0_Callback()
{
 GPIOB_Bus = GPIOB->ODR; //Read GPIO
 GPIOB_Bus ^= 1<<7; //XOR to toggle
 GPIOB->ODR = GPIOB_Bus; //Write new

 /* Re-Start interrupt conversion fo
 HAL_ADCEx_InjectedStart_IT(&hadc1);
                ⋮
 convert(&block_STM32F3348DISCO,1);
 convert(&block_STM32F3348DISCO,2);
                ⋮
 product(&block_STM32F3348DISCO,1);
 product(&block_STM32F3348DISCO,2);
                ⋮
 ConvToStr(&block_STM32F3348DISCO,1);
 ConvToStr(&block_STM32F3348DISCO,2);

 if (*(uint16_t*)STM32F3348DISCO_block_outtbptr[4] != 0)
 {
  /* Wait for end of current send data*/
  while(USART2_TxDataLink.txStatus == USART_TX_ON);
  /* Copy data to send */
  USART2_CopyDataFcn(*(uint8_t**)STM32F3348DISCO_block_outtbpt
 }
 if(USART2_TxDataLink.nb2Send)
 {
    USART2_SendDataFcn(&USART2_TxDataLink);
 }
}
```

* *

*