STM32L4 technical training

Universal Serial Bus (USB)

Hands-on session





USB Lab 2

USB device in CDC class: MCU – PC communication using VCP (Virtual COM Port)



USB VCP communication

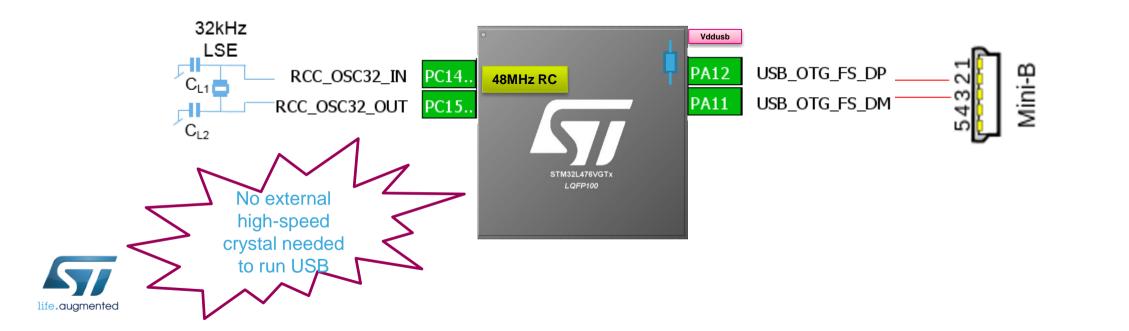
Objective

- Learn how to design USB hardware with STM32L4
- Learn how to configure USB device (USB clock and USB CDC class) in CubeMX
- Learn how to configure joystick (four input GPIOs) in CubeMX
- Learn how to generate code in CubeMX and use HAL functions
- Method
 - Create a bidirectional USB VCP communication between MCU and PC terminal



User USB hardware connection

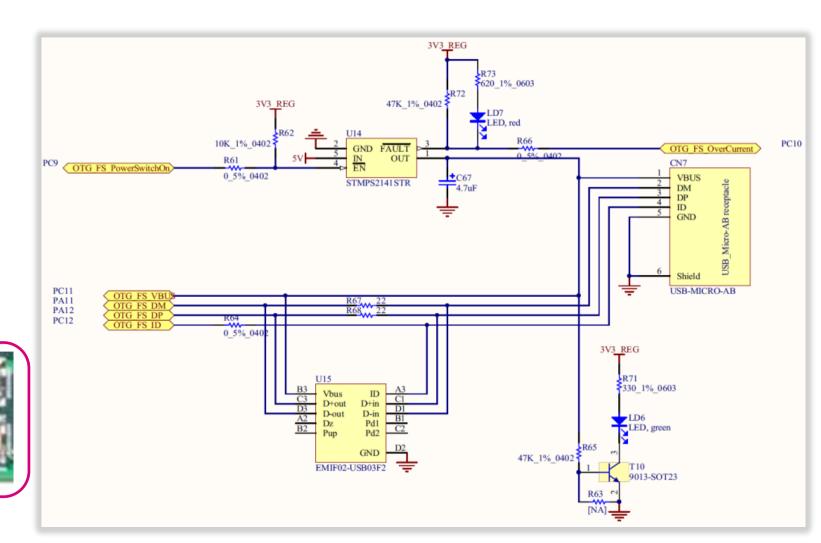
- STM32L4 is optimised in terms of BOM for USB connectivity
 - Pull-up resistor is embedded in USB PHY
 - Serial resistors are not needed
 - Internal RC 48MHz (MSI Multi Speed Internal), which can be used to run USB, after trimming by LSE (Low Speed External)



User USB connection STM32L476RG-Discovery

- STM32F476RG-Discovery is equipped User USB connector. Pins assignment:
 - PA11 (USB D-)
 - PA12 (USB D+)





STM32CubeMX

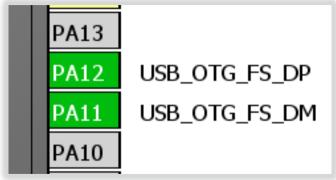
Selecting USB interface and USB class

- Create project in STM32CubeMX
 - Menu > File > New Project
 - Select STM32L4 -> STM32L4x6 -> LQFP100 package -> STM32L476VGTx
- Select USB:
 - Select "Device_Only" for Mode of USB_OTG_FS

🖨 💿 USB_	OTG_FS	
Mode	Device_Only	-
Activa	te_VBUS Disable	•

 Select "Communication Device Class (Virtual Port COM)" for Class For FS IP of USB_DEVICE







Selecting LSE clock and Joystick buttons

 $^{\Lambda}$

- Select LSE:
 - Select "Crystal/Ceramic Resonator" for Low Speed Clock (LSE) of RCC

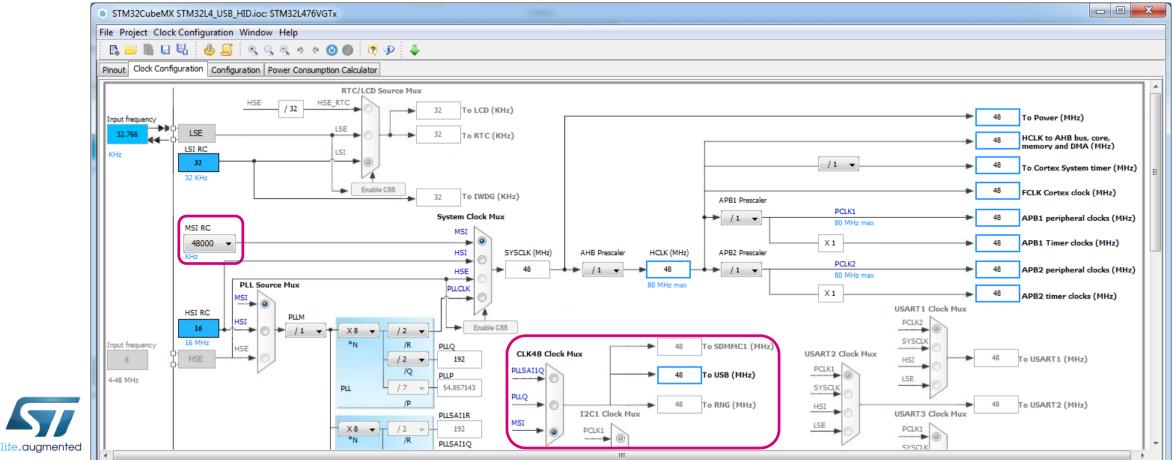
	PC1	13	
High Speed Clock (HSE) Disable	RCC_OSC32_IN PC1		LSE is needed to
Low Speed Clock (LSE) Crystal/Ceramic Resonator	RCC_OSC32_OUT PC1		trimm the MSI



STM32CubeMX

clock configuration

- Go to Clock Configuration tab and configure MCU clock system:
 - 1. Change MSI default value (4 MHz) to 48 MHz
 - 2. Select MSI as a clock source for USB



STM32CubeMX Configure USB

Go to Configuration tab and select USB peripheral

STM32CubeMX STM32L4_USB_HID.id	oc*: STM32L476VGTx	100	-		
File Project Window Help					
🖪 🗁 🖥 🖶 🔩 🍐 🚄 🕂	- 🛛 🕫 🦆				
Pinout Clock Configuration Configuration	Power Consumption Calculator				
Configuration					
Enabled			Middlewares		
Class For FS IP H					
Peripherals					
Activated	Multimedia	Connectivity	Analog	System	Control
Contraction of the second clock (LSE Contraction of the second clock		USB_FS			
□ • ● •					
Activated One Pulse Mode TIM7					

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STM32CubeMX configuration of USB VBUS

- Select Parameter Settings tab
 - Disable VBUS sensing
- Press **Ok** to confirm the configuration

USB_OTG_FS Configuration		X
Parameter Settings √ User Constants	🖋 NVIC Settings 🖋 GPIO Settings	
Configure the below parameters :		
	• •	
Speed	Full Speed 12MBit/s	
Endpoint 0 Max Packet size	64 Bytes	
Enable internal IP DMA	Disabled	
Low power	Disabled	
Link Power Management	Disabled	
VBUS sensing	Disabled	
Signal start of frame	Disabled	
Restore Default	Apply Ok Ca	ancel



STM32CubeMX Configure clock

Go to Configuration tab and select RCC peripheral

STM32CubeMX STM32L4_USB_HID.ic	oc*: STM32L476VGTx	100	-		
File Project Window Help					
🖪 🕒 🖥 🖶 🔩 🔸	• 🗕 🝳 🧈 🦆				
Pinout Clock Configuration Configuration	Power Consumption Calculator				
Configuration					
Enabled			Middlewares		
OUSB_DEVICE Class For FS IP H					
Peripherals					
Activated	Multimedia	Connectivity	Analog	System	Control
🖶 💿 IWDG					
Activated		USB_FS			
RNG Activated SYS					
Timebase Source:Sys1				RCC 🔧 🧹	
Cone Pulse Mode TIM7					

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STM32CubeMX

configuration of the MSI calibration with LSE

- Select Parameter Settings tab
 - Enable MSI Auto Calibration
- Press **Ok** to confirm the configuration

-	e the below parameters :		
Search :	Search (Crtl+F)	k 🛧	
Syst	em Parameters		•
	VDD voltage (V)	3.3 V	
	Instruction Cache	Enabled	
	Prefetch Buffer	Disabled	
	Data Cache	Enabled	
	Flash Latency(WS)	2 WS (3 CPU cycle)	=
RCC	Parameters		
	HSI Calibration Value	16	
_	MSI Calibration Value	0	
	MSI Auto Calibration	Enabled	
	HSE Startup Timout Value (ms)	100	
	LSE Startup Timout Value (ms)	5000	
	LCE Drive Carachility	CC	



STM32CubeMX Project generation

- 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			
oject Code Generator Adva	ced Settings		
	-		
Project Settings			
Project Name STM32L4_USB_VCP			
Project Location			
C:\Users\szymon panecki\De	.top\		Browse
Toolchain Folder Location			
C: \Users\szymon panecki\De	top\STM32L4_USB_VCP\		
Teel-heie (IDE			
Toolchain / IDE			
SW4STM32	▼ Generate Under	r Root	
Minimum Stack Size Mcu and Firmware Package	0x400		
Mcu Reference			
STM32L476VGTx			
Firmware Package Name and	ersion		
STM32Cube FW_L4 V1.6.0			
Use Default Firmware Loc	tion		
C:/Program Files/STMicroelec	onics/STM32Cube4.12/Libraries/STM32Cube_FW_L4	4_V1.6.0	Browse
		Ok	Cancel

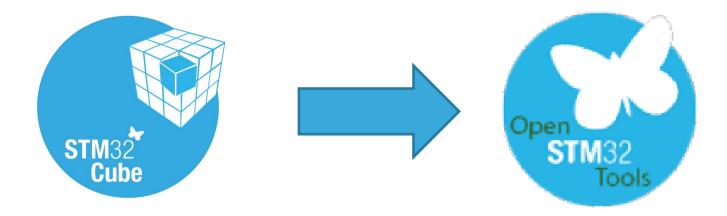


STM32 VCP driver

- In order to communicate between STM32 and PC terminal via VCP install driver
 - In <u>www.st.com</u> find **STSW-STM32102**
 - Click on Get Software button
 - Install downloaded driver on PC

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Home > Development Tools > 3	Software Development Tools > ST	M32 Software Development Tools > S	TM32 Utilities > ST SV	V-STM32102	
STSW-STM32102	ACTIVE				
STM32 Virtual COM Po	rt Driver				
DESIGN		GET S	OFTWARE		
DESIGN					
Legal					
License Agreement					
Description				Version	Size
SLA0048: Mix Libert	y + OSS + 3rd- party V1 - SOF	TWARE LICENSE AGREEMENT		2.18	112 KB
GET SOFTWARE					
Part Number	Software Version	Marketing Status	Supplier 🔶	Order from S	T 🔶
STSW-STM32102	1.4.0	Active	ST	Get Sof	tware

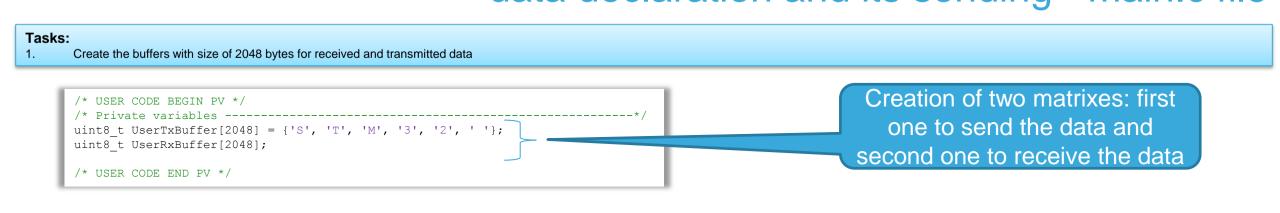




• After successful code generation by STM32CubeMX this is the right time to import it into SW4STM32 toolchain for further processing

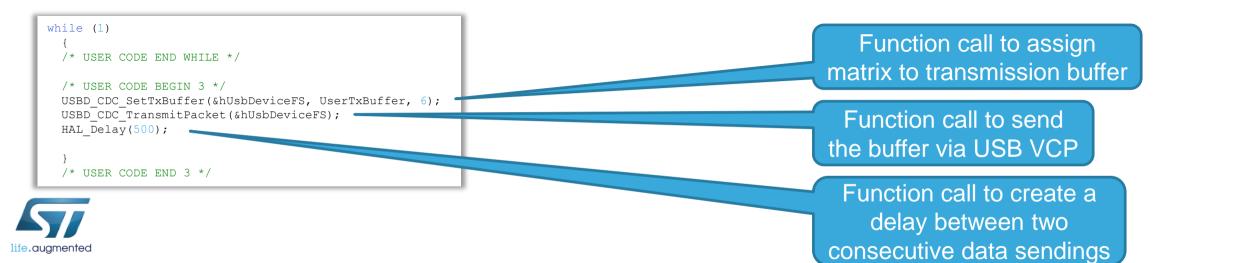


Modifying the code data declaration and its sending - main.c file

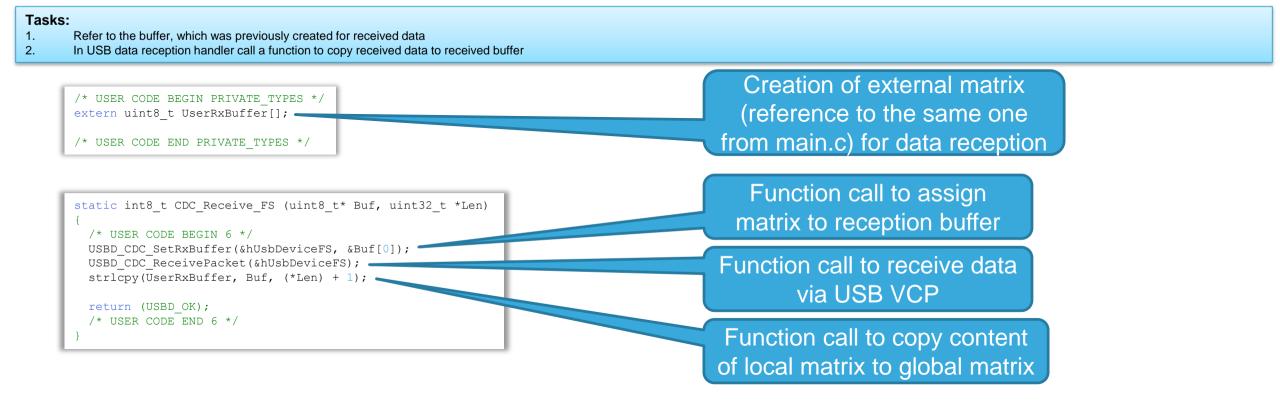


Tasks:

- 1. Call a function to associate previosulty created matrix with transmission buffer
- 2. Call a function to transmit packet with content from transmission buffer
- 3. Call a delay function to create a delay between sending of data in the loop



Modifying the code receiving of VCP data - usbd_cdc_if.c file

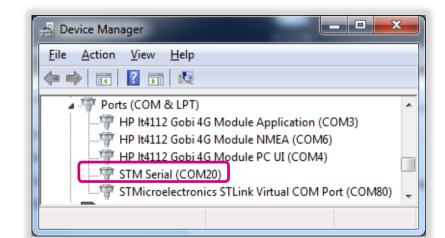




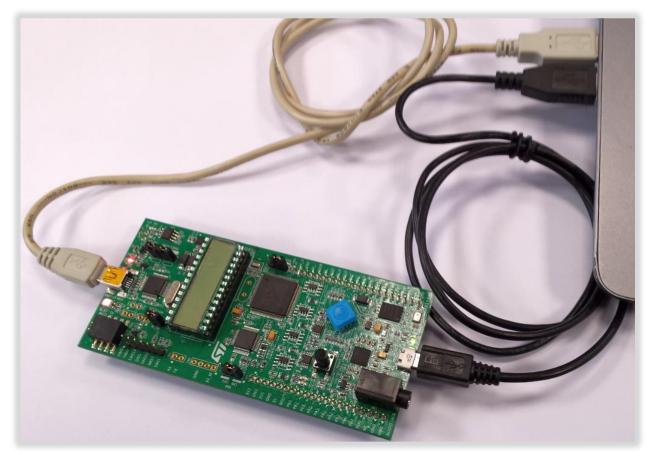
Running the application

 Connect STM32L476RG-Discovery with PC using micro USB cable

 Identify number of COM Port, which was assigned by PC's operating system to STM32L476RG-Discovery



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Running the application

MCU -> PC communication

• Open PC terminal (for example RealTerm), connect to identified COM Port and observe the traffic



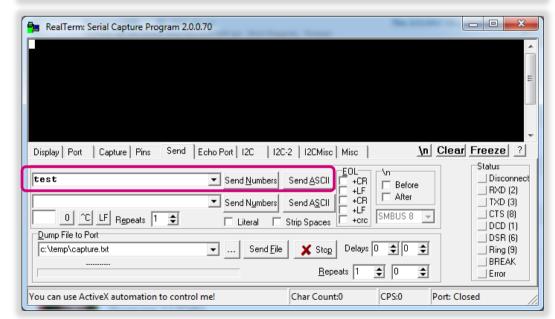
- PC -> MCU communication
 - Open PC terminal (for example RealTerm), connect to identified COM and send some data
 - In debug session observe content of the reception

buffer

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Name	Value	Туре	
🖃 🍄 UserRxBuffer	0x2000118C	. unsigned ch	
 (0) 	0x74 't'	unsigned ch	
🔷 [1]	0x65 'e'	unsigned ch	
🔷 💜 [2]	0x73 's'	unsigned ch	
. 🔷 [3]	0x74 't'	unsigned ch	
🧭 [4]	0x00	unsigned ch	

RealTerm: Serial Capture Program 2.0.0.70	
M32 STM32 ST	STM32 STM32 STM32 STM32 STM32 IM32 STM32 STM32 STM32 STM32 ST
Baud 57600 Port 20 Image: Constraint of the state of the	Char: 17 TXD (3) TXD (3) CTS (8)
Char Co	ount:828 CPS:0 Port: 20 57600 8N1 Non 👻



Further reading

- UM1734 STM32Cube USB device library user manual
- STSW-STM32102 STM32 VCP driver









www.st.com/mcu

