UM2237
User manual

STM32CubeProgrammer software description

Introduction

STM32CubeProgrammer (STM32CubeProg) provides an all-in-one software tool to program STM32 devices in any environment: multi-OS, graphical user interface or command line interface, support for a large choice of connections (JTAG, SWD, USB, UART, SPI, CAN, I2C), with manual operation or automation through scripting.

This document details the hardware and software environment prerequisites, as well as the available STM32CubeProgrammer software features.

Contents

List of figures

1 Getting started

This section describes the requirements and procedures to install the STM32CubeProgrammer software tool.

STM32CubeProgrammer supports STM32 32-bit MCUs based on Arm®[a] Cortex®-M processors and STM32 32-bit MPUs based on Arm® Cortex®-A processors.

1.1 System requirements

Supported operating systems and architectures:

- Linux® 64-bit
- Windows® 7/8/10 32-bit and 64-bit
- macOS® (minimum version OS X® Yosemite)

There is no need to install any Java™ SE Run Time Environment since version 2.6.0. The STM32CubeProgrammer runs with a bundled JRE available inside the downloaded package and no longer with the one installed on your machine.

Note: The bundled JRE is Liberica 8.0.265.

For macOS software minimum requirements are

- Xcode® must be installed on macOS computers
- both Xcode® and Rosetta® must be installed on macOS computers embedding Apple® M1 processor

The minimal supported screen resolution is 1024x768.

1.2 Installing STM32CubeProgrammer

This section describes the requirements and the procedure for the use of the STM32CubeProgrammer software. The setup also offers optional installation of the "STM32 trusted package creator" tool, used to create secure firmware files for secure firmware install and update. For more information, check *STM32 Trusted Package Creator tool software description* (UM2238), available on www.st.com.

1.2.1 Linux install

If you are using a USB port to connect to the STM32 device, install the libusb1.0 package by typing the following command:

sudo apt-get install libusb-1.0.0-dev

To use ST-LINK probe or USB DFU to connect to a target, copy the rules files located under *Driver/rules* folder in */etc/udev/rules.d/* on Ubuntu (*"sudo cp *.* /etc/udev/rules.d"*).

Note: libusb1.0.12 version or higher is required to run STM32CubeProgrammer.

a. Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

To install the STM32CubeProgrammer tool, download and extract the zip package on your Linux machine from STM32CubeProg-Linux part number on the website and execute *SetupSTM32CubeProgrammer-vx.y.z.linux*, which guides you through the installation process. In Ubuntu 20 STM32CubeProgrammer icon is not enabled by default. To enable it right click on the icon and choose *"Allow launching".*

1.2.2 Windows install

To install the STM32CubeProgrammer tool, download and extract the zip package from STM32CubeProg-Win-32bits or STM32CubeProg-Win-64bits for, respectively, Windows 32 bits and Windows 64 bits, and execute *SetupSTM32CubeProgrammer-vx.y.z.exe*, which guides you through the installation process.

1.2.3 macOS install

To install the STM32CubeProgrammer tool, download and extract the zip package from STM32CubeProg-Mac part number on the website and execute *SetupSTM32CubeProgrammer-vx.y.z.app*, which guides you through the installation process.

Note: If the installation fails, launch it in CLI mode using the command ./SetupSTM32CubeProgrammer-x.y.z.app/Contents/MacOs/SetupSTM32CubeProgrammer-x_y_z_macos.

Make sure you have administrator rights, then double-click *SetupSTM32CubeProgrammer-macos* application file to launch the installation wizard.

In case of error, try one of the following fixes:

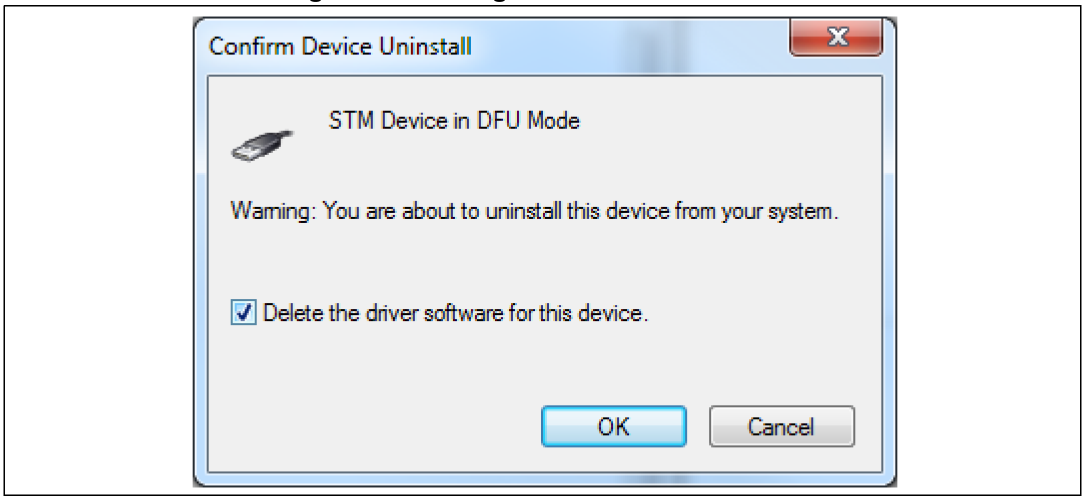
- *$sudo xattr -cr ~/SetupSTM32CubeProgrammer-macos.app*
- launch the .exe file with the command *sudo java -jar SetupSTM32CubeProgrammer-2.7.0.exe*.

1.2.4 DFU driver

If you are using the STM32 device in USB DFU mode, install the STM32CubeProgrammer's DFU driver by running the *"STM32 Bootloader.bat"* file. This driver is provided with the release package, it can be found in the DFU driver folder.

If you have the DFUSE driver installed on your machine, first uninstall it, then reboot the machine and run the previously mentioned ".bat" file. You must check the 'Delete the driver software for this device' option to avoid reinstalling the old driver when, later, a board is plugged in.

Figure 1. Deleting the old driver software

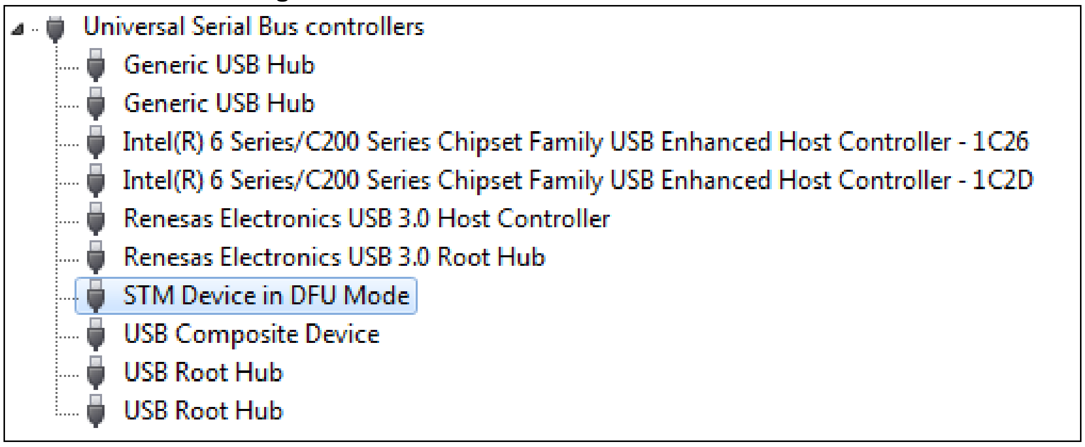


STM Device in DFU Mode

Warning: You are about to uninstall this device from your system.

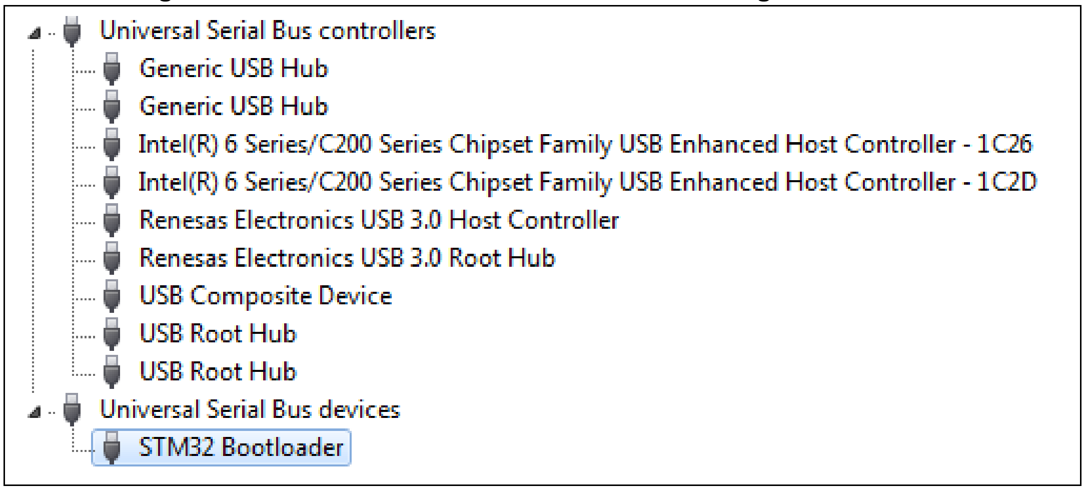
[✓] Delete the driver software for this device.

Figure 2. STM32 DFU device with DfuSe driver



- Universal Serial Bus controllers
  - Generic USB Hub
  - Generic USB Hub
  - Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C26
  - Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C2D
  - Renesas Electronics USB 3.0 Host Controller
  - Renesas Electronics USB 3.0 Root Hub
  - STM Device in DFU Mode
  - USB Composite Device
  - USB Root Hub
  - USB Root Hub

Figure 3. STM32 DFU device with STM32CubeProgrammer driver



- Universal Serial Bus controllers
  - Generic USB Hub
  - Generic USB Hub
  - Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C26
  - Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C2D
  - Renesas Electronics USB 3.0 Host Controller
  - Renesas Electronics USB 3.0 Root Hub
  - USB Composite Device
  - USB Root Hub
  - USB Root Hub
- Universal Serial Bus devices
  - STM32 Bootloader

Note: When using USB DFU interface or STLink interface on a Windows 7 PC, ensure that all USB 3.0 controller's drivers are up to date. Older versions of the drivers may have bugs that prevent access or cause connection problems with USB devices.

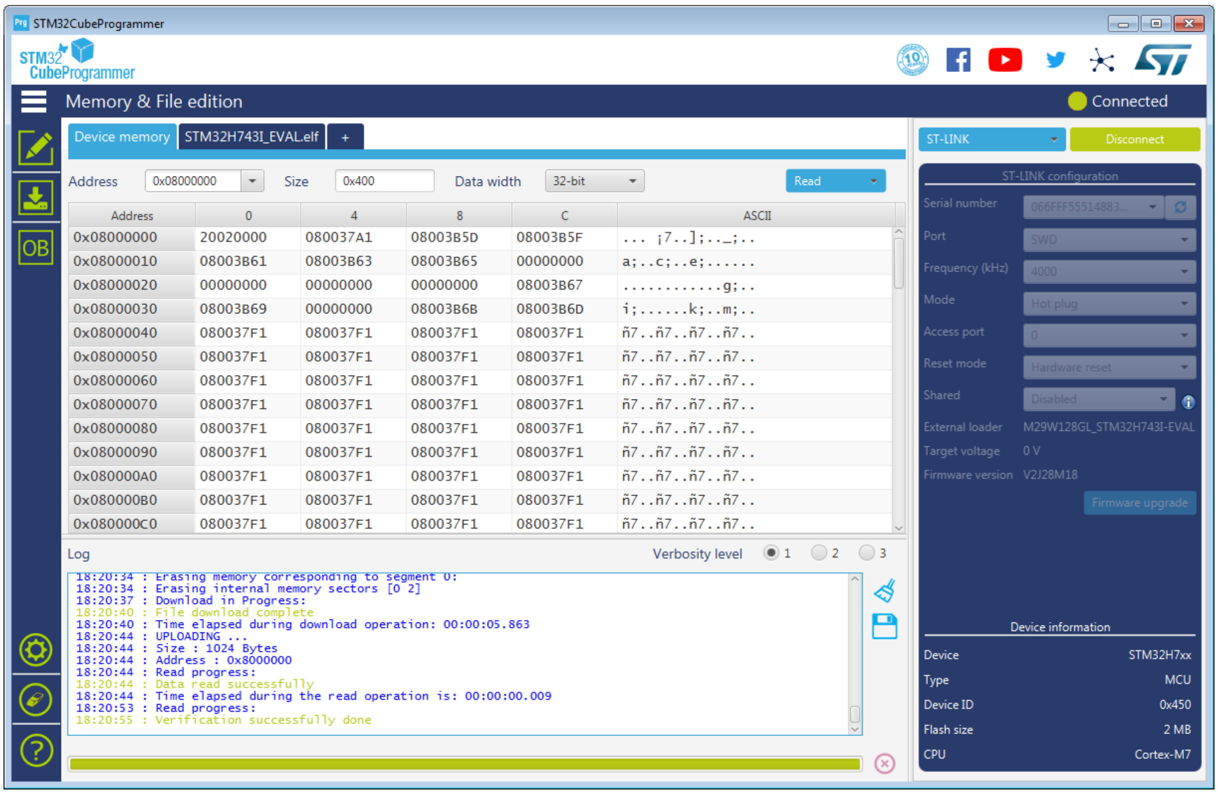
1.2.5 ST-LINK driver

To connect to an STM32 device through a debug interface using ST-LINK/V2, ST-LINKV2-1 or ST-LINK-V3, install the ST-LINK driver by running the *“stlink_winusb_install.bat”* file. This driver is provided with the release package, it can be found under the *“Driver/stsw-link009_v3”* folder.

2 STM32CubeProgrammer user interface for MCUs

2.1 Main window

Figure 4. STM32CubeProgrammer main window



Address 0x08000000 Size 0x400 Data width 32-bit

Address	0	4	8	C	ASCII
0x08000000	20020000	080037A1	08003B5D	08003B5F	... ¡7..];.._;..
0x08000010	08003B61	08003B63	08003B65	00000000	a;..c;..e;......
0x08000020	00000000	00000000	00000000	08003B67	............g;..
0x08000030	08003B69	00000000	08003B6B	08003B6D	i;......k;..m;..
0x08000040	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000050	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000060	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000070	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000080	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000090	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000A0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000B0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000C0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..

Log Verbosity level [✓ 1] 2 3

```
18:20:34 : Erasing memory corresponding to segment 0:
18:20:34 : Erasing internal memory sectors [0 2]
18:20:37 : Download in Progress:
18:20:40 : File download complete
18:20:40 : Time elapsed during download operation: 00:00:05.863
18:20:44 : UPLOADING ...
18:20:44 : Size : 1024 Bytes
18:20:44 : Address : 0x8000000
18:20:44 : Read progress:
18:20:44 : Data read successfully
18:20:44 : Time elapsed during the read operation is: 00:00:00.009
18:20:53 : Read progress:
18:20:55 : Verification successfully done
```

ST-LINK configuration

Serial number	066FFF55514883...
Port	SWD
Frequency (kHz)	4000
Mode	Hot plug
Access port	0
Reset mode	Hardware reset
Shared	Disabled
External loader	M29W128GL_STM32H743I-EVAL
Target voltage	0 V
Firmware version	V2J28M18

Device information

Device	STM32H7xx
Type	MCU
Device ID	0x450
Flash size	2 MB
CPU	Cortex-M7

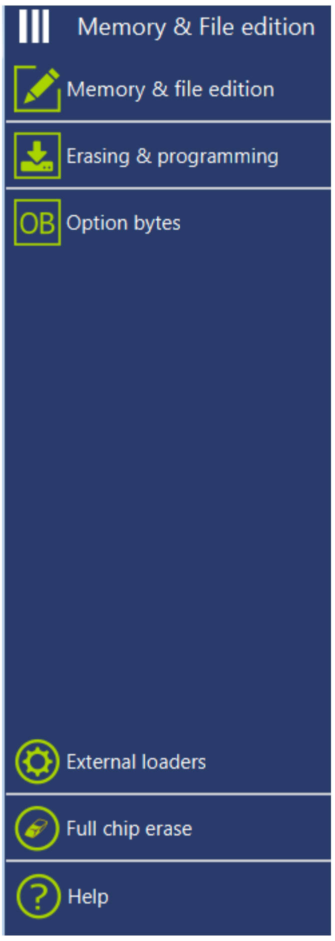
The main window is composed of the parts described in the following sections.

2.1.1 Main menu

The Main menu allows the user to switch between the three main panels of the Memory and file edition, Memory programming and erasing, and Option byes tools.

By clicking on the Hamburger menu (the three-line button) on the top left corner, the Main menu expands and displays the textual description shown in *Figure 5*.

Figure 5. Expanded main menu



2.1.2 Log panel

Displays errors, warnings, and informational events related to the operations executed by the tool. The verbosity of the displayed messages can be refined using the verbosity radio buttons above the log text zone. The minimum verbosity level is 1, and the maximum is 3, in which all transactions via the selected interface are logged. All displayed messages are time stamped with the format “hh:mm:ss:ms” where “hh” is for hours, “mm” for minutes, “ss” for seconds and “ms” for milliseconds (in three digits).

On the right of the log panel there are two buttons, the first to clean the log, and the second to save it to a log file.

2.1.3 Progress bar

The progress bar visualizes the progress of any operation or transaction done by the tool (e.g. Read, Write, Erase). You can abort any ongoing operation by clicking on the ‘Stop’ button in front of the progress bar.

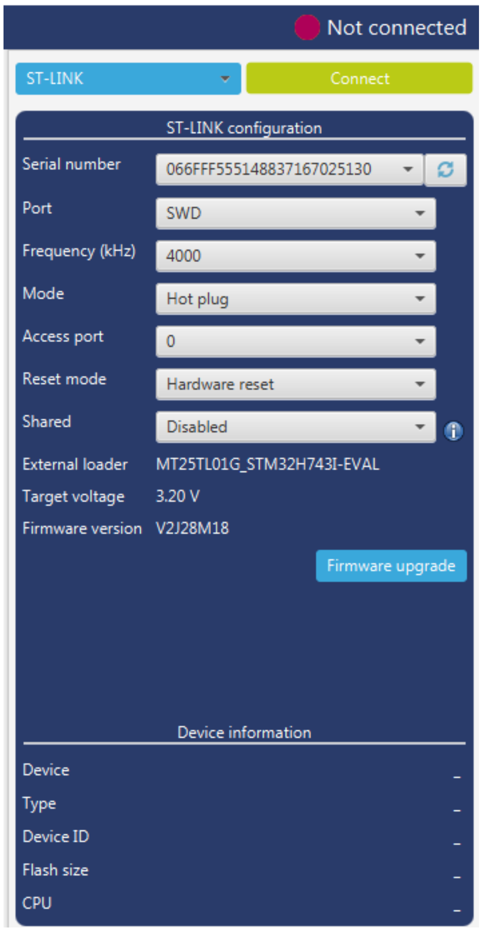
2.1.4 Target configuration panel

This is the first panel to look at before connecting to a target. It allows the user to select the target interface; either the debug interface using ST-LINK debug probe or the bootloader interface over UART, USB, SPI, CAN or I2C.

The refresh button allows you to check the available interfaces connected to the PC. When this button is pressed while the ST-LINK interface is selected, the tool checks the connected ST-LINK probes and lists them in the Serial numbers combo box. If the UART interface is selected, it checks the available com ports of the PC, and lists them in the Port combo box. If the USB interface is selected, it checks the USB devices in DFU mode connected to the PC and lists them also in the Port combo box. Each interface has its own settings, to be set before connection.

ST-LINK settings

Figure 6. ST-LINK configuration panel



Serial number 066FFF555148837167025130
Port SWD
Frequency (kHz) 4000
Mode Hot plug
Access port 0
Reset mode Hardware reset
Shared Disabled
External loader MT25TL01G_STM32H743I-EVAL
Target voltage 3.20 V
Firmware version V2J28M18

Device -
Type -
Device ID -
Flash size -
CPU -

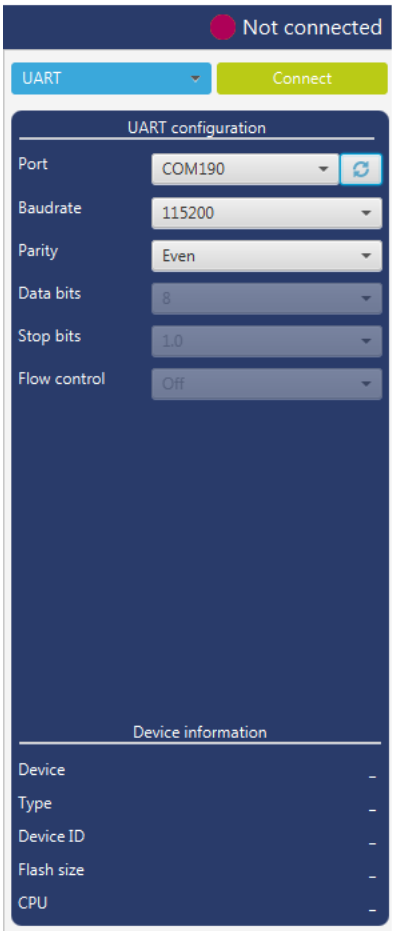
- **Serial number**: This field contains the serial numbers of all connected ST-LINK probes. The user can choose one of them, based on its serial number.
- **Port**: ST-LINK probe supports two debug protocols, JTAG and SWD.

Note: JTAG is not available on all embedded ST-LINK in the STM32 Nucleo or Discovery boards.

- **Frequency**: The JTAG or SWD clock frequency
- **Access port**: Selects the access port to connect to. Most of the STM32 devices have only one access port, which is Access port 0.
- **Mode**:
  - **Normal**: With ‘Normal’ connection mode, the target is reset then halted. The type of reset is selected using the ‘Reset Mode’ option.
  - **Connect Under Reset**: This mode enables connection to the target using a reset vector catch before executing any instructions. This is useful in many cases, for example when the target contains a code that disables the JTAG/SWD pins.
  - **Hot Plug**: Enables connection to the target without a halt or reset. This is useful for updating the RAM addresses or the IP registers while the application is running.
- **Reset mode:**
  - **Software system reset**: Resets all STM32 components except the Debug via the Cortex-M application interrupt and reset control register (AIRCR).
  - **Hardware reset**: Resets the STM32 device via the nRST pin. The RESET pin of the JTAG connector (pin 15) must be connected to the device reset pin.
  - **Core reset**: Resets only the core Cortex-M via the AIRCR.
- **Shared**: Enables shared mode allowing connection of two or more instances of STM32CubeProgrammer or other debugger to the same ST-LINK probe.
- **External loader**: Displays the name of the external memory loader selected in the “External loaders” panel accessible from the main menu (Hamburger menu).
- **Target voltage**: The target voltage is measured and displayed here.
- **Firmware version**: Displays the ST-LINK firmware version. The Firmware upgrade button allows you to upgrade the ST-LINK firmware.

UART settings

Figure 7. UART configuration panel



Port: COM190
Baudrate: 115200
Parity: Even
Data bits: 8
Stop bits: 1.0
Flow control: Off

Device: -
Type: -
Device ID: -
Flash size: -
CPU: -

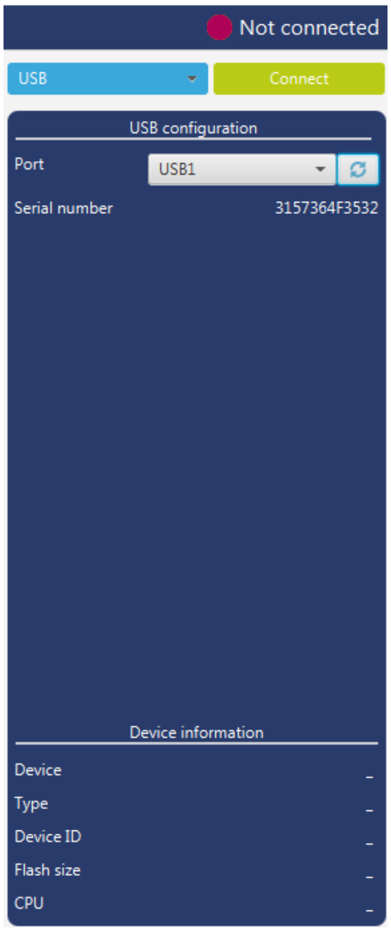
- **Port**: Selects the com port to which the target STM32 is connected. Use the refresh button to recheck the available com port on the PC.

Note: The STM32 must boot in bootloader mode using boot pins and/or the option bits. Check "STM32 microcontroller system memory boot mode" (AN2606), available on www.st.com, for more information on the STM32 bootloader.

- **Baudrate**: Selects the UART baud rate.
- **Parity**: Selects the parity (even, odd, none). Must be 'even' for all STM32 devices.
- **Data bits**: Must be always 8. Only 8-bit data is supported by the STM32.
- **Stop bits**: Must be always 1. Only 1-bit stop bit is supported by the STM32.
- **Flow control**: Must be always off.

USB settings

Figure 8. USB configuration panel



Port USB1

Serial number 3157364F3532

Device -

Type -

Device ID -

Flash size -

CPU -

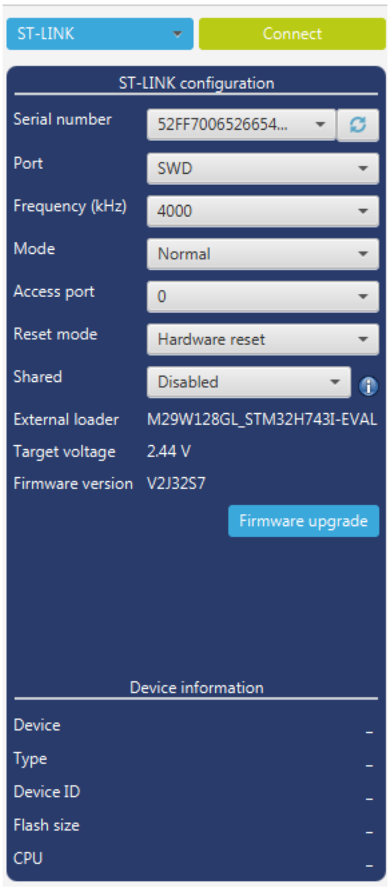
- **Port**: Selects the USB devices in DFU mode connected to the PC. You can use the refresh button to recheck the available devices.

Note: The STM32 must boot in bootloader mode using boot pins and/or the option bits. Check AN2606, available on www.st.com, for more information on the STM32 bootloader.

Once the correct interface settings are set, click on the ‘Connect’ button to connect to the target interface. If the connection succeeds, it is shown in the indicator above the button, which turns to green.

Once connected, the target information is displayed in the device information section below the settings section, which is then disabled as in *Figure 9*.

Figure 9. Target information panel

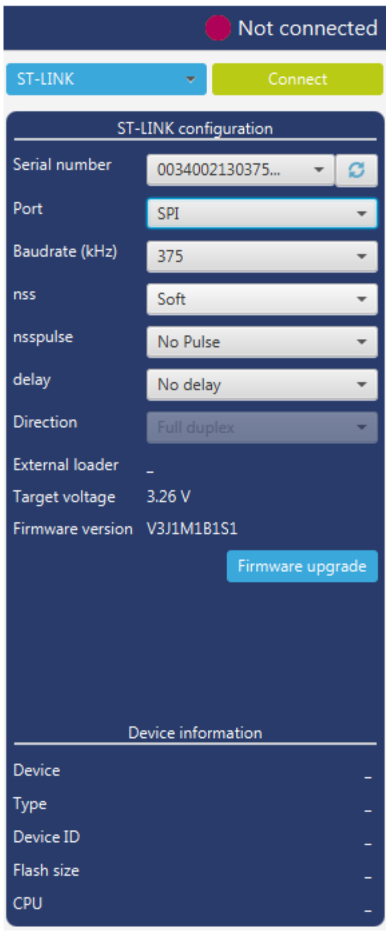


Serial number	52FF7006526654...
Port	SWD
Frequency (kHz)	4000
Mode	Normal
Access port	0
Reset mode	Hardware reset
Shared	Disabled
External loader	M29W128GL_STM32H743I-EVAL
Target voltage	2.44 V
Firmware version	V2J32S7

Device	-
Type	-
Device ID	-
Flash size	-
CPU	-

SPI settings

Figure 10. SPI configuration panel



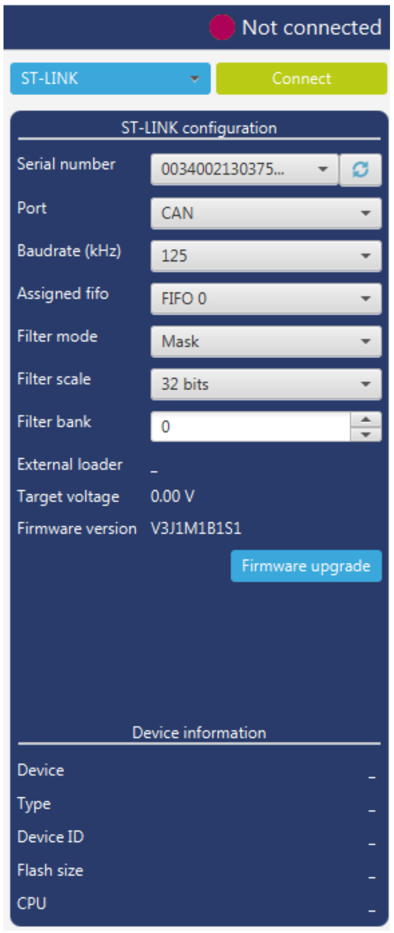
Serial number 0034002130375...
Port SPI
Baudrate (kHz) 375
nss Soft
nsspulse No Pulse
delay No delay
Direction Full duplex
External loader _
Target voltage 3.26 V
Firmware version V3J1M1B1S1

Device _
Type _
Device ID _
Flash size _
CPU _

- **Serial number**: This field contains the serial numbers of all connected ST-LINK-V3 probes in case of use of SPI bootloader.
- **Port**: Selects the SPI devices connected to the PC. You can use the refresh button to recheck the available devices.
- **Baudrate**: Selects the SPI baud rate.
- **nss**: Slave Select software or hardware.
- **nsspulse**: the Slave Selection signal can operate in a pulse mode where the master generates pulses on nss output signal between data frames for a duration of one SPI clock period when there is a continuous transfer period.
- **Delay**: used to insert a delay of several microseconds between data.
- **Direction**: Must be always Full-duplex, both data lines are used and synchronous data flows in both directions.

CAN settings

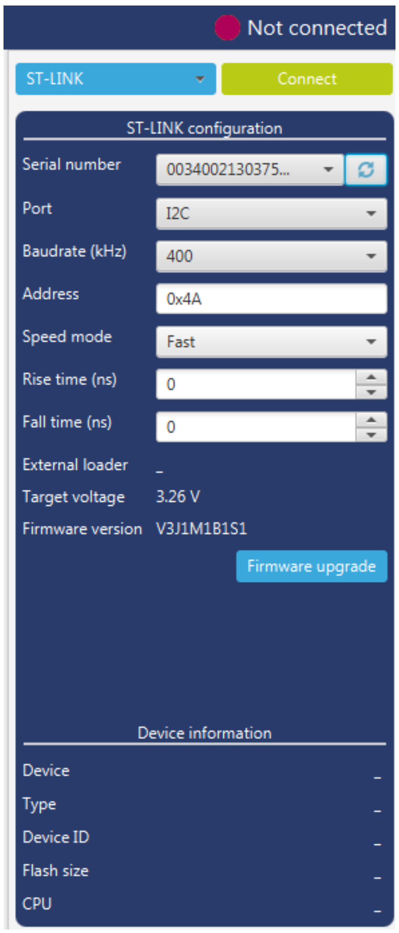
Figure 11. CAN configuration panel



Serial number	0034002130375...
Port	CAN
Baudrate (kHz)	125
Assigned fifo	FIFO 0
Filter mode	Mask
Filter scale	32 bits
Filter bank	0
External loader	_
Target voltage	0.00 V
Firmware version	V3J1M1B1S1
Device	_
Type	_
Device ID	_
Flash size	_
CPU	_

- **Serial number**: This field contains the serial numbers of all connected ST-LINK-V3 probes in case to use CAN bootloader.
- **Port**: Selects the CAN devices connected to the PC. You can use the refresh button to recheck the available devices.
- **Baudrate**: Selects the CAN baud rate.
- **Assigned FIFO**: Selects the receive FIFO memory to store incoming messages.
- **Filter mode**: Selects the type of the filter, MASK or LIST.
- **Filter scale**: Selects the width of the filter bank, 16 or 32 bits.
- **Filter bank**: Values between 0 and 13, to choose the filter bank number.

I2C settings


Not connected

ST-LINK | Connect

ST-LINK configuration

Serial number	0034002130375...
Port	I2C
Baudrate (kHz)	400
Address	0x4A
Speed mode	Fast
Rise time (ns)	0
Fall time (ns)	0
External loader	_
Target voltage	3.26 V
Firmware version	V3J1M1B1S1

Firmware upgrade

Device information

Device	_
Type	_
Device ID	_
Flash size	_
CPU	_

Figure 12. I2C configuration panel

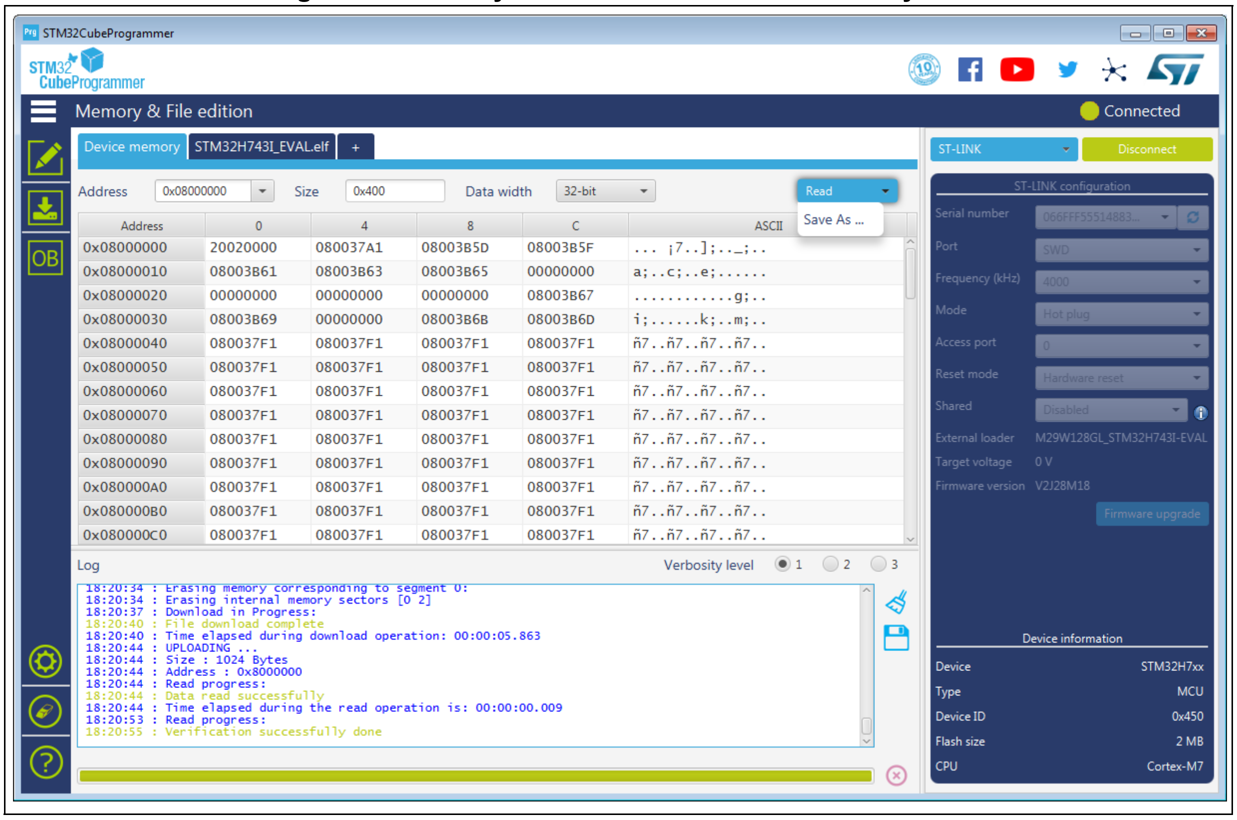
- **Serial number**: This field contains the serial numbers of all connected ST-LINK-V3 probes in case to use I2C bootloader.
- **Port**: Selects the I2C devices connected to the PC. You can use the refresh button to recheck the available devices.
- **Baudrate**: Selects the I2C baud rate.
- **Address**: Adds the address of the slave bootloader in hex format.
- **Speed mode**: Selects the speed mode of the transmission Standard or Fast.
- **Rise time**: Chooses values according to Speed mode, 0-1000 (STANDARD), 0-300 (FAST).
- **Fall time**: Chooses values according to Speed mode, 0-300 (STANDARD), 0-300 (FAST).

2.2 Memory and file edition

The Memory and file edition panel allows the user to read and display target memory and file contents.

2.2.1 Reading and displaying target memory

Figure 13. Memory and file edition: Device memory tab



Address 0x08000000 Size 0x400 Data width 32-bit

Address	0	4	8	C	ASCII
0x08000000	20020000	080037A1	08003B5D	08003B5F	... ¡7..];.._;..
0x08000010	08003B61	08003B63	08003B65	00000000	a;..c;..e;......
0x08000020	00000000	00000000	00000000	08003B67	............g;..
0x08000030	08003B69	00000000	08003B6B	08003B6D	i;......k;..m;..
0x08000040	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000050	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000060	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000070	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000080	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000090	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000A0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000B0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000C0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..

Log   Verbosity level [✓ 1] 2 3

```
18:20:34 : Erasing memory corresponding to segment 0:
18:20:34 : Erasing internal memory sectors [0 2]
18:20:37 : Download in Progress:
18:20:40 : File download complete
18:20:40 : Time elapsed during download operation: 00:00:05.863
18:20:44 : UPLOADING ...
18:20:44 : Size : 1024 Bytes
18:20:44 : Address : 0x8000000
18:20:44 : Read progress:
18:20:44 : Data read successfully
18:20:44 : Time elapsed during the read operation is: 00:00:00.009
18:20:53 : Read progress:
18:20:55 : Verification successfully done
```

ST-LINK configuration

Serial number	066FFF55514883...
Port	SWD
Frequency (kHz)	4000
Mode	Hot plug
Access port	0
Reset mode	Hardware reset
Shared	Disabled
External loader	M29W128GL_STM32H743I-EVAL
Target voltage	0 V
Firmware version	V2J28M18

Device information

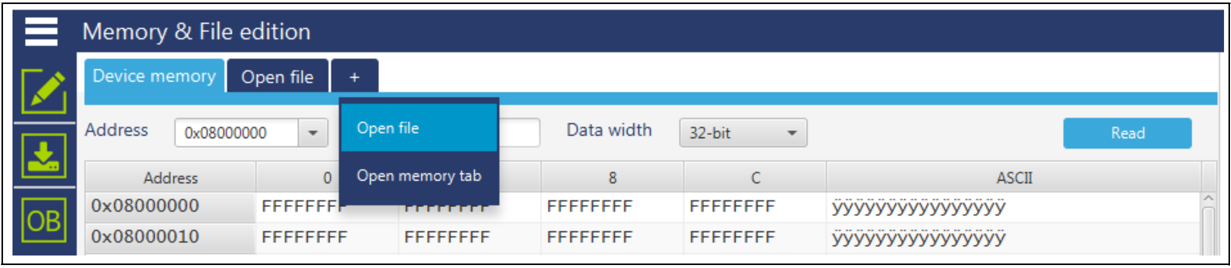
Device	STM32H7xx
Type	MCU
Device ID	0x450
Flash size	2 MB
CPU	Cortex-M7

After target connection, you can read the STM32 target memory using this panel. To do this, specify the address and the size of the data to be read, then click on the Read button in the top-left corner. Data can be displayed in different formats (8-, 16- and 32-bit) using the ‘Data width’ combo box.

You can also save the device memory content in .bin, .hex or .srec file using the “Save As...” menu from the tab contextual menu or the action button.

You can open multiple device memory tabs to display different locations of the target memory. To do this, just click on the “+” tab to display a contextual menu that allows you to add a new “Device memory” tab, or to open a file and display it in a “File” tab:

Figure 14. Memory and file edition: Contextual menu



Address 0x08000000 Data width 32-bit

Address	0	4	8	C	ASCII
0x08000000	FFFFFFFF	FFFFFFFF	FFFFFFFF	FFFFFFFF	ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
0x08000010	FFFFFFFF	FFFFFFFF	FFFFFFFF	FFFFFFFF	ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ

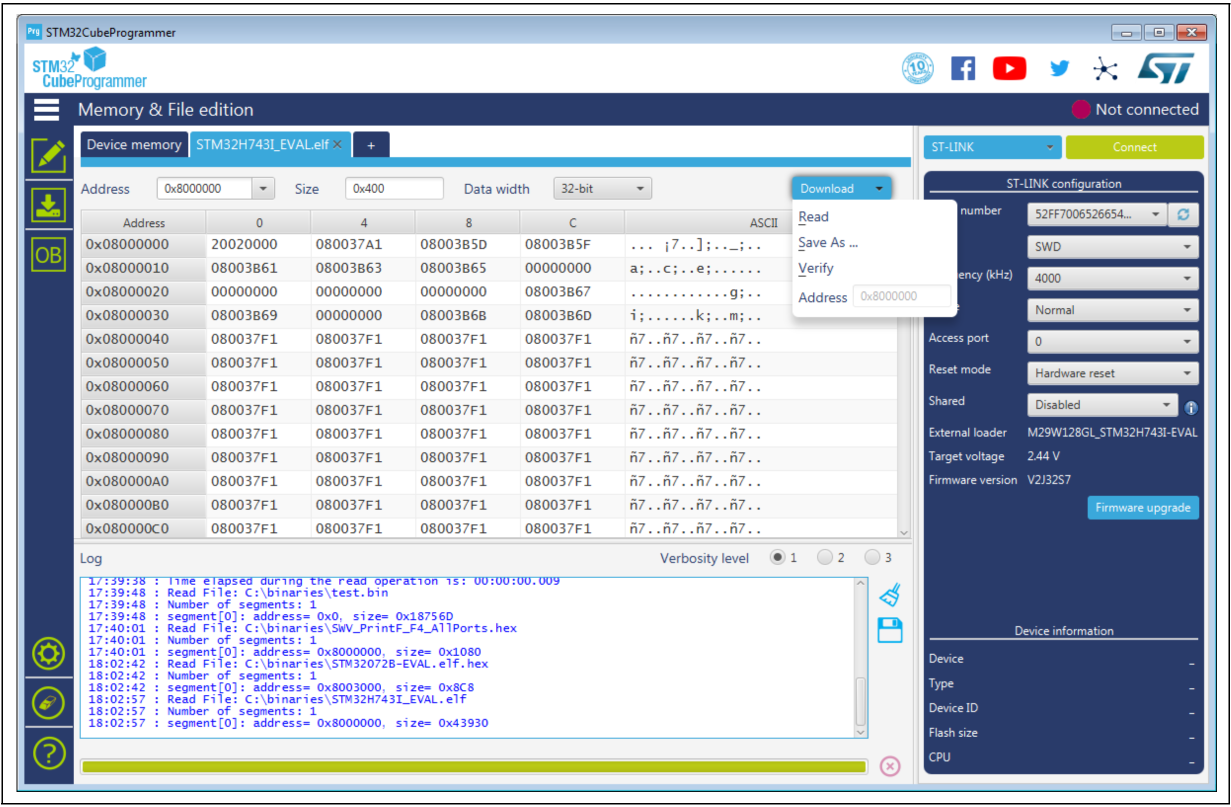
2.2.2 Reading and displaying a file

To open and display a file, just click on the “+” and select ‘Open File’ menu, as illustrated in *Figure 14*.

The file formats supported are binary files (.bin), ELF files (.elf, .axf, .out), Intel hex files (.hex) and Motorola S-record files (.Srec).

Once the file is opened and parsed, it is displayed in a dedicated tab with its name, as illustrated in *Figure 15*. The file size is displayed in the ‘Size’ field, and the start address of hex, srec or ELF files, is displayed in the ‘Address’ field, for a binary file it is 0.

Figure 15. Memory and file edition: File display



Address 0x8000000 Size 0x400 Data width 32-bit Address 0x8000000

Address	0	4	8	C	ASCII
0x08000000	20020000	080037A1	08003B5D	08003B5F	... ¡7..];.._;..
0x08000010	08003B61	08003B63	08003B65	00000000	a;..c;..e;......
0x08000020	00000000	00000000	00000000	08003B67	............g;..
0x08000030	08003B69	00000000	08003B6B	08003B6D	i;......k;..m;..
0x08000040	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000050	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000060	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000070	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000080	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x08000090	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000A0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000B0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..
0x080000C0	080037F1	080037F1	080037F1	080037F1	ñ7..ñ7..ñ7..ñ7..

Log Verbosity level [✓ 1] 2 3

```
17:39:38 : Time elapsed during the read operation is: 00:00:00.009
17:39:48 : Read File: C:\binaries\test.bin
17:39:48 : Number of segments: 1
17:39:48 : segment[0]: address= 0x0, size= 0x18756D
17:40:01 : Read File: C:\binaries\SWV_PrintF_F4_AllPorts.hex
17:40:01 : Number of segments: 1
17:40:01 : segment[0]: address= 0x8000000, size= 0x1080
18:02:42 : Read File: C:\binaries\STM32072B-EVAL.elf.hex
18:02:42 : Number of segments: 1
18:02:42 : segment[0]: address= 0x8003000, size= 0x8C8
18:02:57 : Read File: C:\binaries\STM32H743I_EVAL.elf
18:02:57 : Number of segments: 1
18:02:57 : segment[0]: address= 0x8000000, size= 0x43930
```

ST-LINK configuration

number	52FF7006526654...
	SWD
ency (kHz)	4000
	Normal
Access port	0
Reset mode	Hardware reset
Shared	Disabled
External loader	M29W128GL_STM32H743I-EVAL
Target voltage	2.44 V
Firmware version	V2J32S7

Device information

Device	_
Type	_
Device ID	_
Flash size	_
CPU	_

The address field can be modified to display the file content starting from an offset. Using the tab contextual menu or the action button, you can download the file using “Download” button/menu. For a binary file you need to specify the download address in the “Address” menu. You can verify if the file is already downloaded using the “Verify” menu, and also save it in another format (.bin, .hex or .srec).

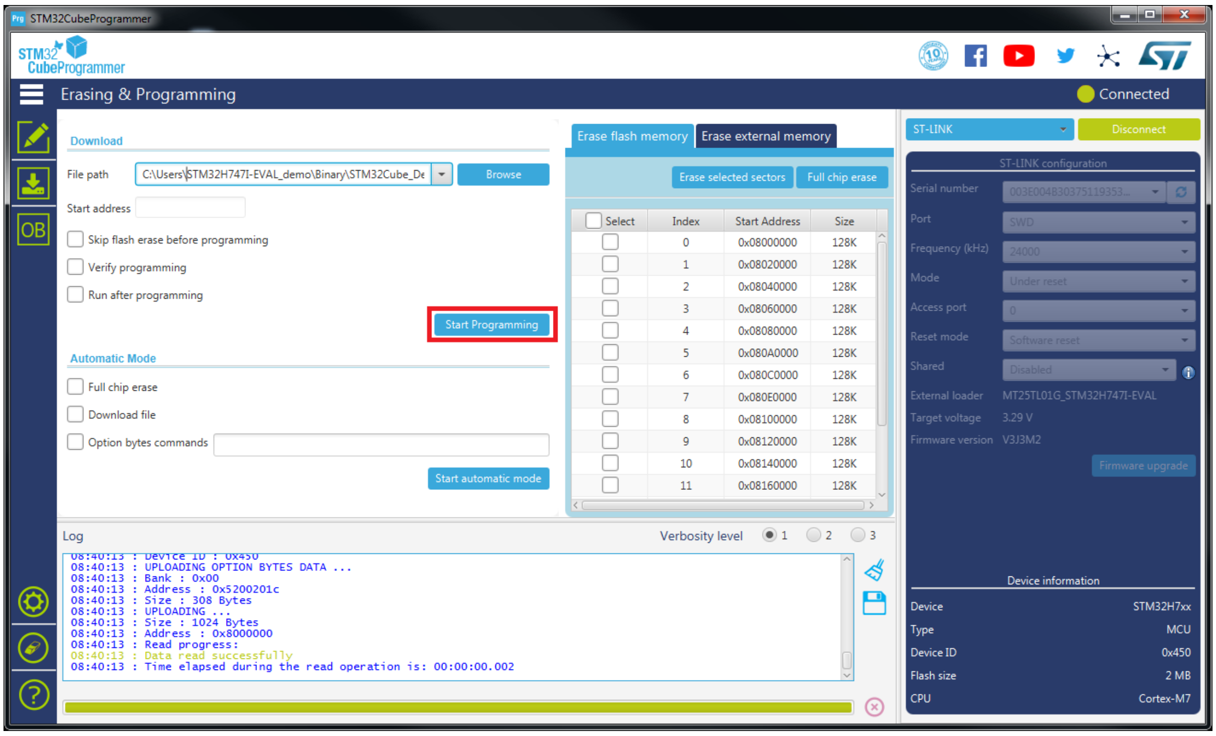
As for the ‘Device memory’ tab, you can display the file memory content in different formats (8-, 16- and 32-bit) using the ‘Data width’ combo box.

2.3 Memory programming and erasing

This panel is dedicated to Flash memory programming and erasing operations.

2.3.1 Internal Flash memory programming

Figure 16. Flash memory programming and erasing (internal memory)



File path: C:\Users\STM32H747I-EVAL_demo\Binary\STM32Cube_De

Start address:

- [ ] Skip flash erase before programming
- [ ] Verify programming
- [ ] Run after programming

Automatic Mode

- [ ] Full chip erase
- [ ] Download file
- [ ] Option bytes commands

Select	Index	Start Address	Size
☐	0	0x08000000	128K
☐	1	0x08020000	128K
☐	2	0x08040000	128K
☐	3	0x08060000	128K
☐	4	0x08080000	128K
☐	5	0x080A0000	128K
☐	6	0x080C0000	128K
☐	7	0x080E0000	128K
☐	8	0x08100000	128K
☐	9	0x08120000	128K
☐	10	0x08140000	128K
☐	11	0x08160000	128K

ST-LINK configuration	
Serial number	003E004B30375119353...
Port	SWD
Frequency (kHz)	24000
Mode	Under reset
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	MT25TL01G_STM32H747I-EVAL
Target voltage	3.29 V
Firmware version	V3J3M2

Device information	
Device	STM32H7xx
Type	MCU
Device ID	0x450
Flash size	2 MB
CPU	Cortex-M7

Verbosity level: [✓ 1] 2 3

```
08:40:13 : Device ID : 0x450
08:40:13 : UPLOADING OPTION BYTES DATA ...
08:40:13 : Bank : 0x00
08:40:13 : Address : 0x5200201c
08:40:13 : Size : 308 Bytes
08:40:13 : UPLOADING ...
08:40:13 : Size : 1024 Bytes
08:40:13 : Address : 0x8000000
08:40:13 : Read progress:
08:40:13 : Data read successfully
08:40:13 : Time elapsed during the read operation is: 00:00:00.002
```

Memory erasing

Once connected to a target, the memory sectors are displayed in the right-hand panel showing the start address and the size of each sector. To erase one or more sectors, select them in the first column and then click on the “Erase selected sectors” button.

The ‘Full chip erase’ button erases the whole Flash memory.

Memory programming

To program a memory execute the following steps:

1. Click on the browse button and select the file to be programmed. The file format supported are binary files (.bin), ELF files (.elf, .axf, .out), Intel hex files (.hex) and Motorola S-record files (.Srec).
2. In case of programming a binary file, the address must be set.
3. Select the programming options:
   – Verify after programming: Read back the programmed memory and compare it byte per byte with the file.
   – Skip Flash erase before programming: if checked, the memory is not erased before programming. This option must be checked only when you are sure that the target memory is already erased.
   – Run after programming: Start the application just after programming.
4. Click on the 'Start programming' button to start programming.

The progress bar on the bottom of the window shows the progress of the erase and programming operations.

2.3.2 External Flash memory programming

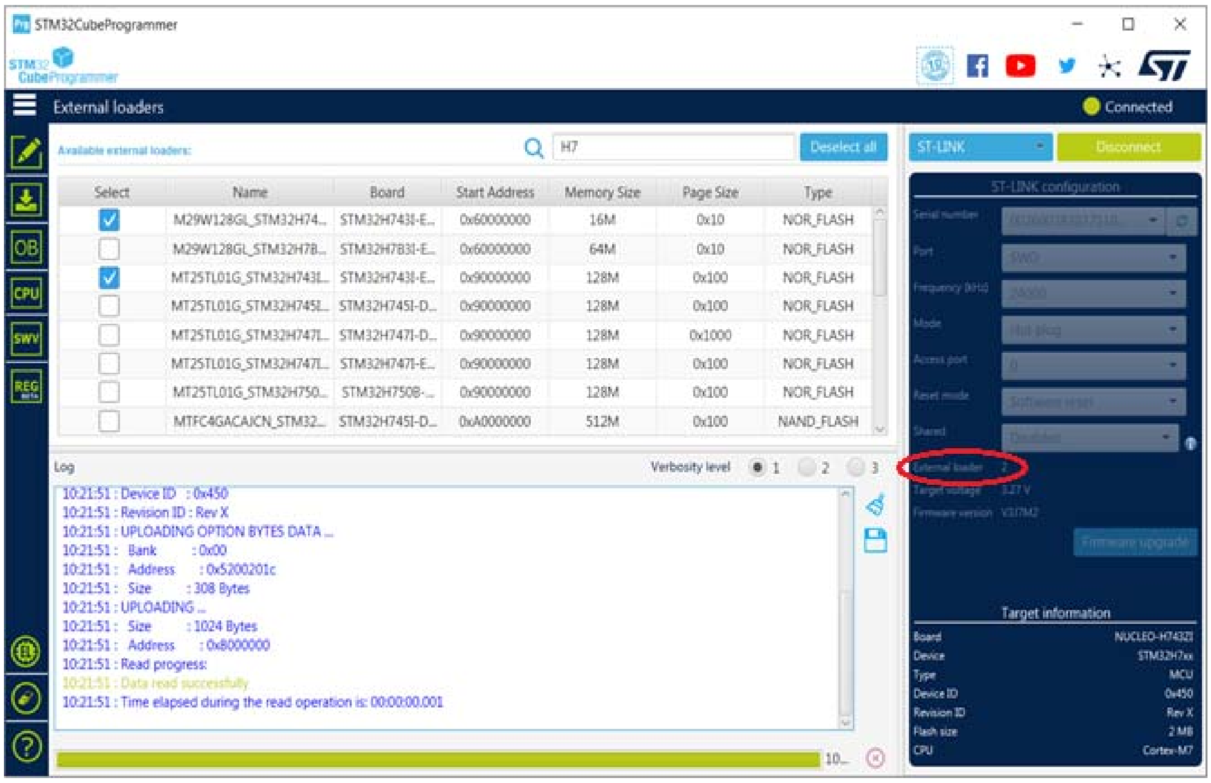
To program an external memory connected to the microcontroller via any of the available interfaces (e.g. SPI, FMC, FSMC, QSPI, OCTOSPI) you need an external loader.

STM32CubeProgrammer is delivered with external loaders for most available STM32 Evaluation and Discovery boards available under the "bin/ExternalLoader" directory. If you need to create a new external loader, see *Section 2.3.3* for more details.

To program an external memory, select one or more external loaders from the "ExternalLoader" panel to be used by the tool to read, program, or erase external memories as shown in *Figure 17*. Once selected, the external loader(s) is (are) used for any memory operation in its (their) memory range.

The "External flash erasing" tab on the right of the "Erasing and Programming" panel displays the memory sectors for each selected loader, and enables sector or full-chip erase, as shown in *Figure 18*.

Figure 17. Flash memory programming (external memory)



Select	Name	Board	Start Address	Memory Size	Page Size	Type
✓	M29W128GL_STM32H74...	STM32H743I-E...	0x60000000	16M	0x10	NOR_FLASH
	M29W128GL_STM32H7B...	STM32H7B3I-E...	0x60000000	64M	0x10	NOR_FLASH
✓	MT25TL01G_STM32H743I...	STM32H743I-E...	0x90000000	128M	0x100	NOR_FLASH
	MT25TL01G_STM32H745I...	STM32H745I-D...	0x90000000	128M	0x100	NOR_FLASH
	MT25TL01G_STM32H747I...	STM32H747I-D...	0x90000000	128M	0x1000	NOR_FLASH
	MT25TL01G_STM32H747I...	STM32H747I-E...	0x90000000	128M	0x100	NOR_FLASH
	MT25TL01G_STM32H750...	STM32H750B-...	0x90000000	128M	0x100	NOR_FLASH
	MTFC4GACAJCN_STM32...	STM32H745I-D...	0xA0000000	512M	0x100	NAND_FLASH

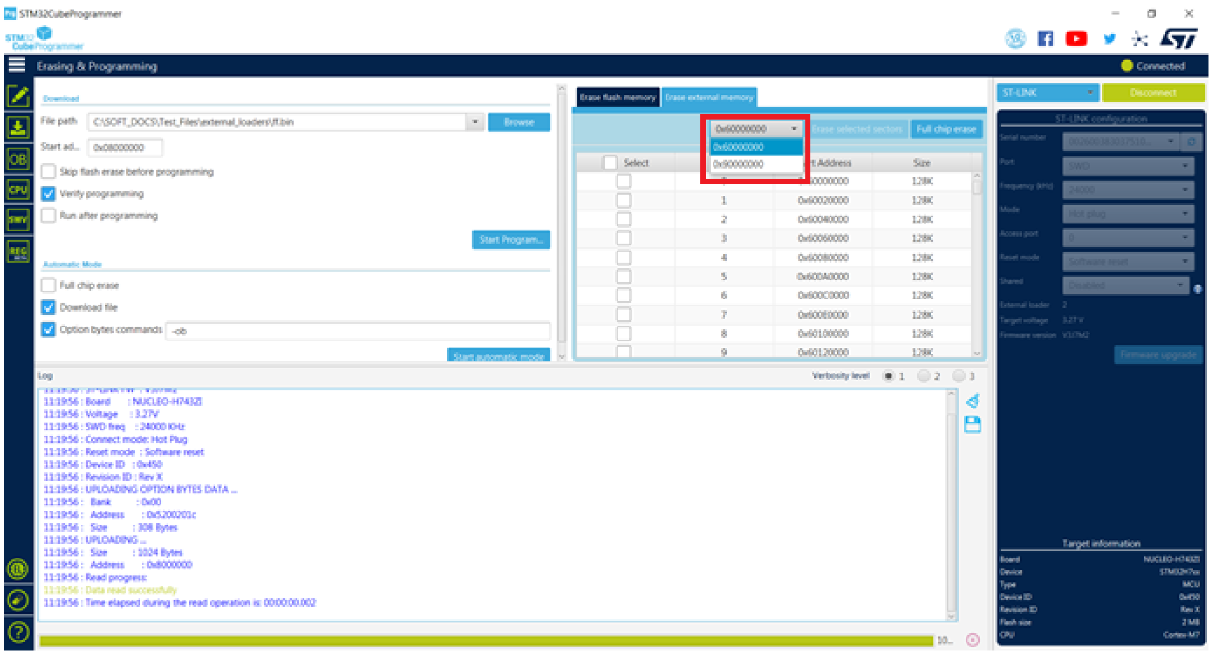
Log

```
10:21:51 : Device ID   : 0x450
10:21:51 : Revision ID : Rev X
10:21:51 : UPLOADING OPTION BYTES DATA ...
10:21:51 :   Bank          : 0x00
10:21:51 :   Address       : 0x5200201c
10:21:51 :   Size          : 308 Bytes
10:21:51 : UPLOADING ...
10:21:51 :   Size          : 1024 Bytes
10:21:51 :   Address       : 0x8000000
10:21:51 : Read progress:
10:21:51 : Data read successfully
10:21:51 : Time elapsed during the read operation is: 00:00:00.001
```

Serial number	0026003B3037511...
Port	SWD
Frequency (kHz)	24000
Mode	Hot plug
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	2
Target voltage	3.27 V
Firmware version	V3J7M2

Board	NUCLEO-H743ZI
Device	STM32H7xx
Type	MCU
Device ID	0x450
Revision ID	Rev X
Flash size	2 MB
CPU	Cortex-M7

Figure 18. Flash memory erasing (external memory)



File path: C:\SOFT_DOCS\Test_Files\external_loaders\ff.bin
Start ad...: 0x08000000
Skip flash erase before programming
[✓] Verify programming
Run after programming
Full chip erase
[✓] Download file
[✓] Option bytes commands: -ob

0x60000000
0x60000000
0x90000000

Select		t Address	Size
		0000000	128K
	1	0x60020000	128K
	2	0x60040000	128K
	3	0x60060000	128K
	4	0x60080000	128K
	5	0x600A0000	128K
	6	0x600C0000	128K
	7	0x600E0000	128K
	8	0x60100000	128K
	9	0x60120000	128K

Log

```
11:19:56 : Board        : NUCLEO-H743ZI
11:19:56 : Voltage      : 3.27V
11:19:56 : SWD freq     : 24000 KHz
11:19:56 : Connect mode: Hot Plug
11:19:56 : Reset mode   : Software reset
11:19:56 : Device ID    : 0x450
11:19:56 : Revision ID : Rev X
11:19:56 : UPLOADING OPTION BYTES DATA ...
11:19:56 :   Bank          : 0x00
11:19:56 :   Address       : 0x5200201c
11:19:56 :   Size          : 308 Bytes
11:19:56 : UPLOADING ...
11:19:56 :   Size          : 1024 Bytes
11:19:56 :   Address       : 0x8000000
11:19:56 : Read progress:
11:19:56 : Data read successfully
11:19:56 : Time elapsed during the read operation is: 00:00:00.002
```

Board	NUCLEO-H743ZI
Device	STM32H7xx
Type	MCU
Device ID	0x450
Revision ID	Rev X
Flash size	2 MB
CPU	Cortex-M7

2.3.3 Developing customized loaders for external memory

Based on the examples available under the *"bin/ExternalLoader"* directory, users can develop their custom loaders for a given external memory. These examples are available for three toolchains: MDK-ARM™, EWARM and TrueSTUDIO®. The development of custom loaders can be performed using one of these toolchains, keeping the same compiler/linker configurations, as in the examples.

The external Flash programming mechanism is the same used by the STM32 ST-LINK utility tool. Any Flash loader developed to be used with the ST-LINK utility is compatible with the STM32CubeProgrammer tool, and can be used without any modification.

To create a new external memory loader, follow the steps below:

1. Update the device information in *StorageInfo* structure in the *Dev_Inf.c* file with the correct information concerning the external memory.
2. Rewrite the corresponding functions code in the *Loader_Src.c* file.
3. Change the output file name.

Note: Some functions are mandatory and cannot be omitted (see the functions description in the Loader_Src.c file).

Linker or scatter files must not be modified.

After building the external loader project, an ELF file is generated. The extension of the ELF file depends upon the used toolchain (.axf for Keil, .out for EWARM and .elf for TrueSTUDIO or any gcc-based toolchain).

The extension of the ELF file must be changed to '.stldr' and the file must be copied under the "*bin/ExternalLoader*" directory.

Loader_Src.c file

Developing an external loader for a memory, based on a specific IP requires the following functions:

- **`Init`** function

  The **`Init`** function defines the used GPIO pins connecting the external memory to the device, and initializes the clock of the used IPs.

  Returns 1 if success, and 0 if failure.

  ```
  int Init (void)
  ```

- **`Write`** function

  The **`Write`** function programs a buffer defined by an address in the RAM range.

  Returns 1 if success, and 0 if failure.

  ```
  int Write (uint32_t Address, uint32_t Size, uint8_t* buffer)
  ```

- **`SectorErase`** function

The **`SectorErase`** function erases the memory specified sectors.

Returns 1 if success, and 0 if failure.

```
int SectorErase (uint32_t StartAddress, uint32_t EndAddress)
```

Where "**`StartAddress`**" equals the address of the first sector to be erased and "**`EndAddress`**" equals the address of the end sector to be erased.

Note: This function is not used in case of an external SRAM loader.

It is imperative to define the functions mentioned above in an external loader. They are used by the tool to erase and program the external memory. For instance, if the user clicks on the program button from the external loader menu, the tool performs the following actions:

- Automatically calls the **`Init`** function to initialize the interface (QSPI, FMC …) and the Flash memory
- Calls **`SectorErase()`** to erase the needed Flash memory sectors
- Calls the **`Write()`** function to program the memory

In addition to these functions, you can also define the functions below:

- **`Read`** function

  The **`Read`** function is used to read a specific range of memory, and returns the reading in a buffer in the RAM.

  Returns 1 if success, and 0 if failure.

  ```
  int Read (uint32_t Address, uint32_t Size, uint16_t* buffer)
  ```

  Where "**`Address`**" = start address of read operation, "**`Size`**" is the size of the read operation and "**`buffer`**" is the pointer to data read.

Note: For QSPI / OSPI (Quad-SPI / Octo-SPI) memories, the memory mapped mode can be defined in the Init function; in that case the Read function is useless since the data can be read directly from JTAG/SWD interface.

- **`Verify`** function

  The **`Verify`** function is called when selecting the "verify while programming" mode. This function checks if the programmed memory corresponds to the buffer defined in the RAM. It returns an uint64 defined as follows:

  ```
  Return value = ((checksum<<32) + AddressFirstError)
  ```

  where "**`AddressFirstError`**" is the address of the first mismatch, and "**`checksum`**" is the checksum value of the programmed buffer

  ```
  uint64_t Verify (uint32_t FlashAddr, uint32_t RAMBufferAddr,
  uint32_t Size)
  ```

- **`MassErase`** function

  The **`MassErase`** function erases the full memory.

  Returns 1 if success, and 0 if failure.

  ```
  int MassErase (void)
  ```

- A Checksum function

All the functions described return 1 in case of a successful operation, and 0 in case of a fail.

Dev_Inf.c file

The StorageInfo structure defined in this file provides information on the external memory. An example of the type of information that this structure defines is given below:

```
#if defined (__ICCARM__)
      __root struct StorageInfo const StorageInfo = {
#else
      struct StorageInfo const StorageInfo = {
#endif
      "External_Loader_Name", // Device Name + version number
      MCU_FLASH, // Device Type
      0x08000000, // Device Start Address
```

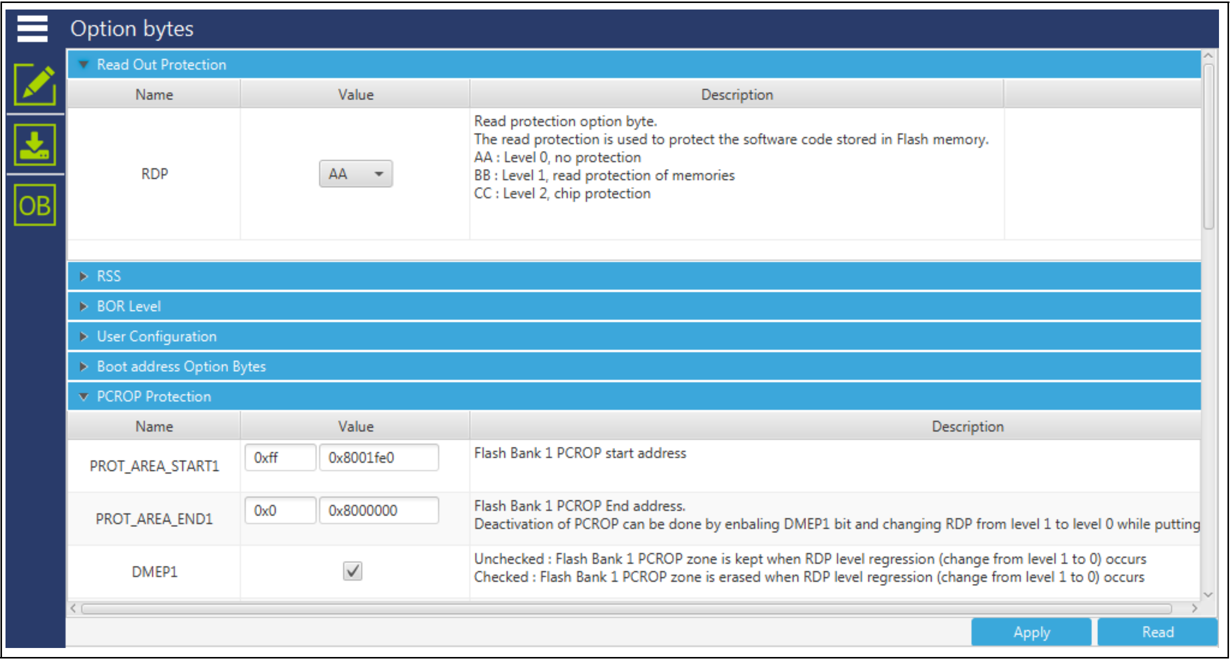
```
        0x00100000, // Device Size in Bytes (1MBytes/8Mbits)
        0x00004000, // Programming Page Size 16KBytes
        0xFF, // Initial Content of Erased Memory
// Specify Size and Address of Sectors (view example below)
        0x00000004, 0x00004000, // Sector Num : 4 ,Sector Size: 16KBytes
        0x00000001, 0x00010000, // Sector Num : 1 ,Sector Size: 64KBytes
        0x00000007, 0x00020000, // Sector Num : 7 ,Sector Size: 128KBytes
        0x00000000, 0x00000000,
};
```

2.4 Option bytes

The option bytes panel allows the user to read and display target option bytes grouped by categories. The option bits are displayed in tables with three columns containing the bit(s) name, value and a description of the impact on the device.

The user can modify the values of these option bytes by updating the value fields, then clicking on the apply button, which programs and then verifies that the modified option bytes are correctly programmed. The user can click at any time on the read button, to read and refresh the displayed option bytes.

Figure 19. Option bytes panel



Option bytes

Read Out Protection

Name	Value	Description
RDP	AA	Read protection option byte. The read protection is used to protect the software code stored in Flash memory. AA : Level 0, no protection BB : Level 1, read protection of memories CC : Level 2, chip protection

RSS

BOR Level

User Configuration

Boot address Option Bytes

PCROP Protection

Name	Value		Description
PROT_AREA_START1	0xff	0x8001fe0	Flash Bank 1 PCROP start address
PROT_AREA_END1	0x0	0x8000000	Flash Bank 1 PCROP End address. Deactivation of PCROP can be done by enbaling DMEP1 bit and changing RDP from level 1 to level 0 while putting
DMEP1	✓		Unchecked : Flash Bank 1 PCROP zone is kept when RDP level regression (change from level 1 to 0) occurs Checked : Flash Bank 1 PCROP zone is erased when RDP level regression (change from level 1 to 0) occurs

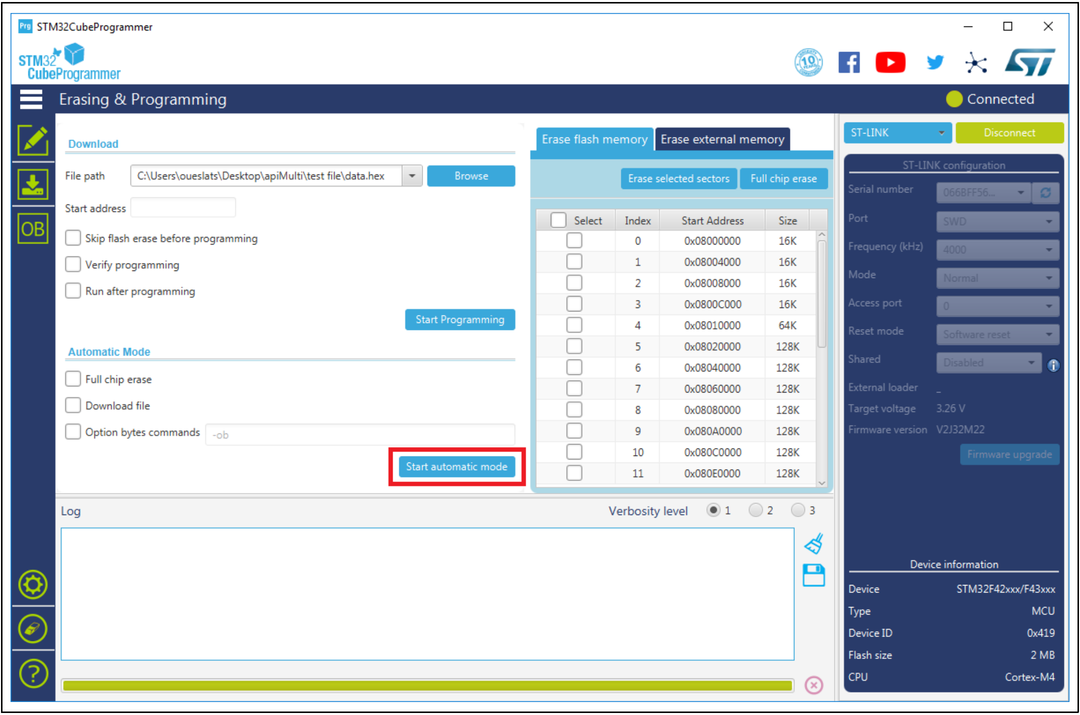
For more details refer to the option bytes section in the Flash memory programming manual and reference manual available from *www.st.com*.

2.5 Automatic mode

The Automatic mode feature shown in Erasing & Programming window (see *Figure 20*) allows the user to program and configure STM32 devices in loop. Allowed actions:

- Full chip erase: erase all the Flash memory
- Download file: activate and set programming options from Download section:
  – File path
  – Start address
  – Skip erase before programming
  – Verify programming
  – Run after programming
- Option bytes commands: configure the device by setting option bytes command line

Figure 20. Automatic mode in Erasing & Programming window



Download
File path: C:\Users\oueslats\Desktop\apiMulti\test file\data.hex
Start address
☐ Skip flash erase before programming
☐ Verify programming
☐ Run after programming

Automatic Mode
☐ Full chip erase
☐ Download file
☐ Option bytes commands -ob

Select	Index	Start Address	Size
☐	0	0x08000000	16K
☐	1	0x08004000	16K
☐	2	0x08008000	16K
☐	3	0x0800C000	16K
☐	4	0x08010000	64K
☐	5	0x08020000	128K
☐	6	0x08040000	128K
☐	7	0x08060000	128K
☐	8	0x08080000	128K
☐	9	0x080A0000	128K
☐	10	0x080C0000	128K
☐	11	0x080E0000	128K

Log
Verbosity level [✓ 1] 2 3

ST-LINK configuration

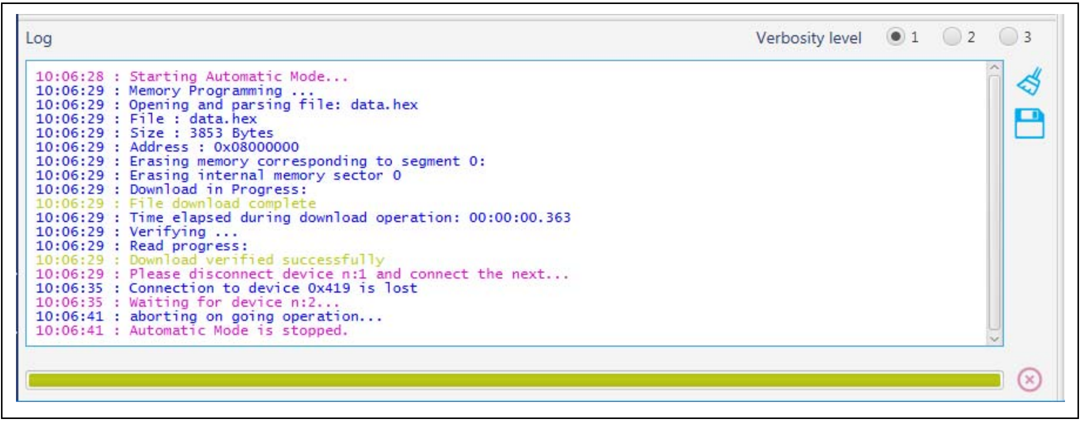
Serial number	066BFF56...
Port	SWD
Frequency (kHz)	4000
Mode	Normal
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	_
Target voltage	3.26 V
Firmware version	V2J32M22

Device information

Device	STM32F42xxx/F43xxx
Type	MCU
Device ID	0x419
Flash size	2 MB
CPU	Cortex-M4

All automatic mode traces are indicated in the Log panel (see *Figure 21*) to show the process evolution and user intervention messages.

Figure 21. Automatic mode Log traces



```
10:06:28 : Starting Automatic Mode...
10:06:29 : Memory Programming ...
10:06:29 : Opening and parsing file: data.hex
10:06:29 : File : data.hex
10:06:29 : Size : 3853 Bytes
10:06:29 : Address : 0x08000000
10:06:29 : Erasing memory corresponding to segment 0:
10:06:29 : Erasing internal memory sector 0
10:06:29 : Download in Progress:
10:06:29 : File download complete
10:06:29 : Time elapsed during download operation: 00:00:00.363
10:06:29 : Verifying ...
10:06:29 : Read progress:
10:06:29 : Download verified successfully
10:06:29 : Please disconnect device n:1 and connect the next...
10:06:35 : Connection to device 0x419 is lost
10:06:35 : Waiting for device n:2...
10:06:41 : aborting on going operation...
10:06:41 : Automatic Mode is stopped.
```

Graphical guide

- Connection to a first target must be established before performing automatic mode to collect connection parameters values associated to all next devices.
- If the Download file is checked, the system takes all Download file options in consideration, otherwise any Download option is performed.
- If the Option bytes commands is checked, the text field is activated, then the user can insert option bytes commands (like CLI commands), and make sure that there are no white spaces at the beginning:
  `-ob [OptionByte=value] [OptionByte=value] [OptionByte=value] …`
- Example of Option bytes command: "**`-ob BOR_LEV=0 nBOOT0=1`**"
- If the Start automatic mode button is pressed, the system enters in a loop, until a system stop is called.
- While the automatic mode is in execution state, all graphical objects are disabled.
- The user can stop the process at any preferred time by pressing cancel button or stop automatic mode button.

Log messages

- “Starting Automatic Mode...”

  Indicates that the system entered successfully in automatic process.
- “More than one ST-LINK probe detected! Keep only one ST-LINK probe! “

  The automatic mode cannot be used if more than one ST-LINK probe is connected to the computer when using JTAG/SWD interfaces. A message is displayed to prevent the user and ask him to keep only one ST-LINK probe connected to continue using this mode.
- “More than one ST-LINK Bridge detected! Keep only one ST-LINK Bridge!”

  The automatic mode cannot be used if more than one ST-LINK bridge is connected to the computer when using bootloader interface SPI/CAN/I^{2}C interfaces. A message is displayed to prevent the user and ask him to keep only one ST-LINK bridge connected to continue using this mode.
- “More than one ST-LINK USB DFU detected! Keep only one USB DFU!”

  The automatic mode cannot be used if more than one USB DFU is connected to the computer when using USB bootloader interface. A message is displayed to prevent the user and ask him to keep only one USB DFU connected to continue using this mode.
- “More UART ports detected than last connection!”

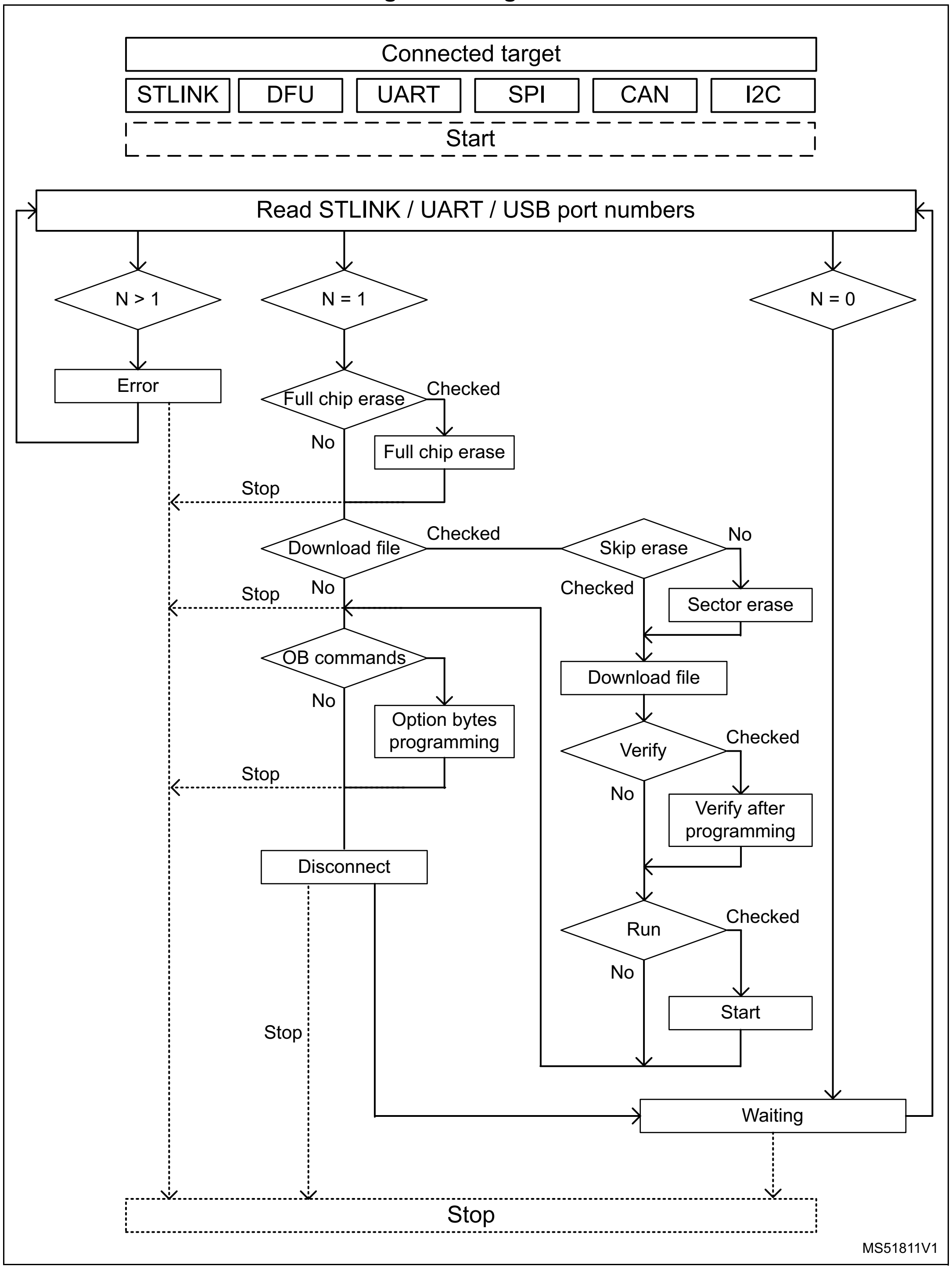
  In the first connection time the automatic mode calculates the number of the available Serial ports and put it as a reference to detect correctly that we use only one port UART for STM32 device.
- “Please disconnect device and connect the next...”

  If the system finishes the first process, and whatever the result, disconnect the current device to prepare the second device connection.
- “Waiting for device...”

  Once the connection to the previous device is correctly lost, the system keeps searching for a new device.
- “Automatic Mode is stopped.”

  Indicates that there is a required cancel and the system stops the process.

Figure 22. Algorithm



2.6 STM32WB OTA programming

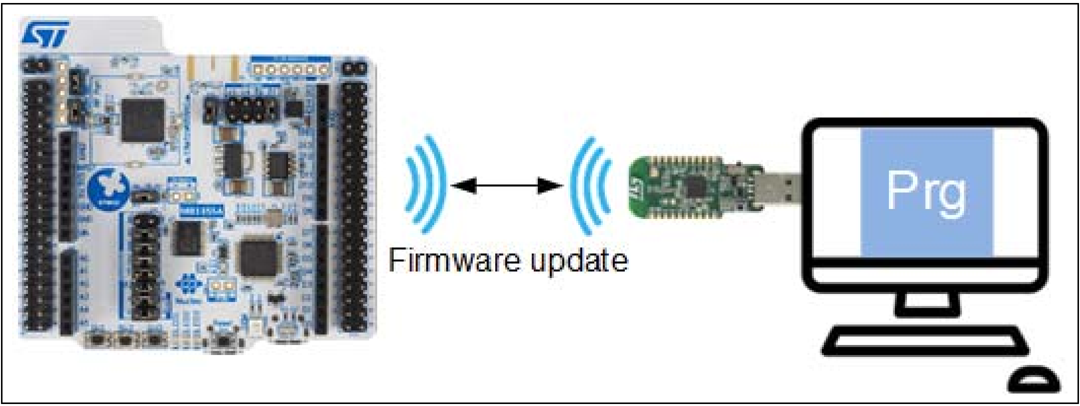
Over-the-air (OTA) programming mode in STM32CubeProgrammer tool allows the user to transfer data from a device to a remote device through a Bluetooth® Low Energy (BLE) connection.

The STM32CubeProgrammer tool is communicating with a BLE using an STM32WB dongle or a Nucleo board configured in HCI transparent mode as shown in *Figure 23*.

The implementation example does not include security in the transfer process. It is expected that users change their loader, or the application to perform the security verification based on the customer requirements.

It is not possible to load the BLE stack.

Figure 23. OTA update of STM32WB firmware through BLE connection



The target board to be programmed must be running the OTA loader. When the user application is running in normal mode, the OTA loader is not active, and the OTA service is not available. To perform OTA transfer the application needs to reboot the device in OTA mode.

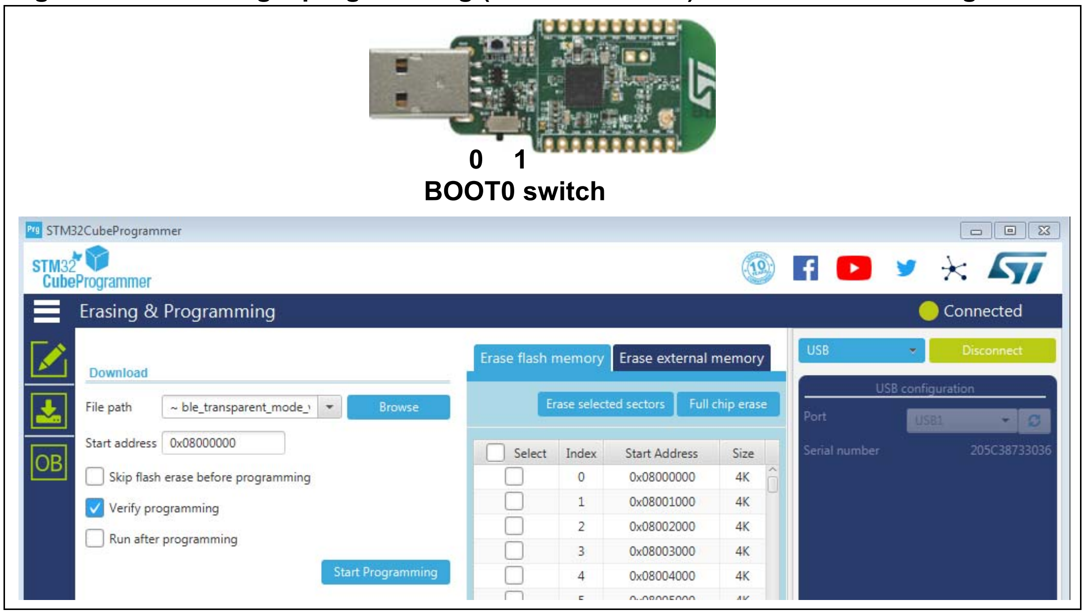
2.6.1 USB dongle configuration

The USB dongle provided with the Nucleo STM32WB package is configured in “transparent mode” for this purpose. Open and compile, within STM32Cube_FW_WB package available on *www.st.com*, the project ~\Projects\NUCLEO-WB55.USBDongle\Applications\BLE\ble_transparent_mode_vcp.

The USB dongle can be easily programmed in USB-DFU mode with STM32CubeProgrammer (version 2.0 and above) tool using USB DFU mode.

To access DFU mode, move the BOOT0 switch to 1 (to the right in *Figure 24*). Once programmed, move back the BOOT0 switch to 0 (to the left in *Figure 24*).

Figure 24. USB dongle programming (USB DFU mode) with STM32CubeProgrammer



File path: ~ ble_transparent_mode_

Start address: 0x08000000

- [ ] Skip flash erase before programming
- [✓] Verify programming
- [ ] Run after programming

Select	Index	Start Address	Size
☐	0	0x08000000	4K
☐	1	0x08001000	4K
☐	2	0x08002000	4K
☐	3	0x08003000	4K
☐	4	0x08004000	4K

Port: USB1

Serial number: 205C38733036

For more information on how to configure the source board in HCI transparent mode and the target board in OTA loader mode, check AN5247, available on *www.st.com*.

2.6.2 OTA update procedure

The OTA function is available in the target interface combo box in the configuration panel. Select the OTA interface and click the connect button.

If the connected STM32WB board is configured in HCI transparent mode, the OTA updater window is displayed.

Figure 25. OTA updater window

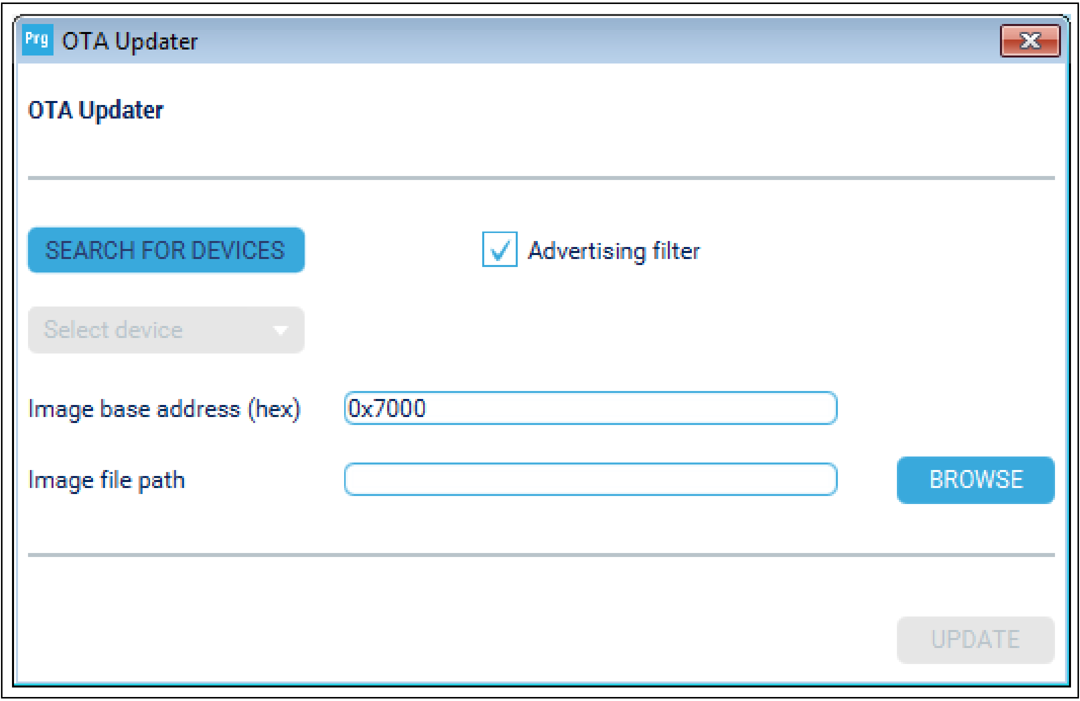
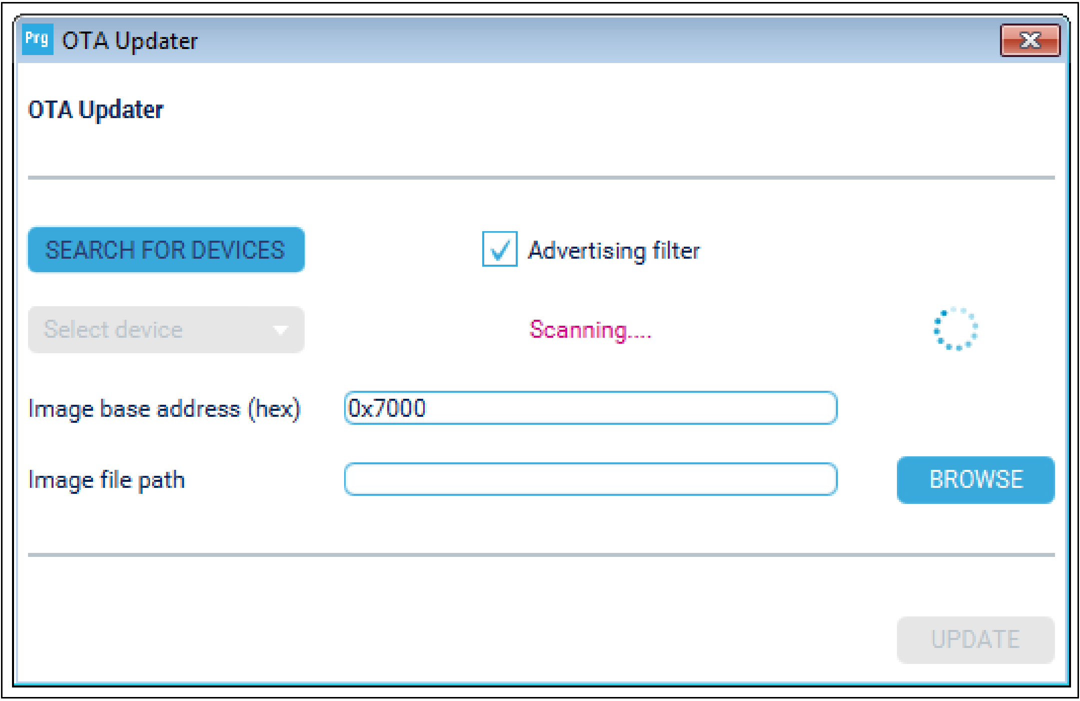


Image base address (hex) 0x7000

Image file path

The first operation is to find the target device. The tool needs to perform a scan of BLE devices and list all those with OTA capabilities.

Figure 26. Searching BLE devices



Scanning....

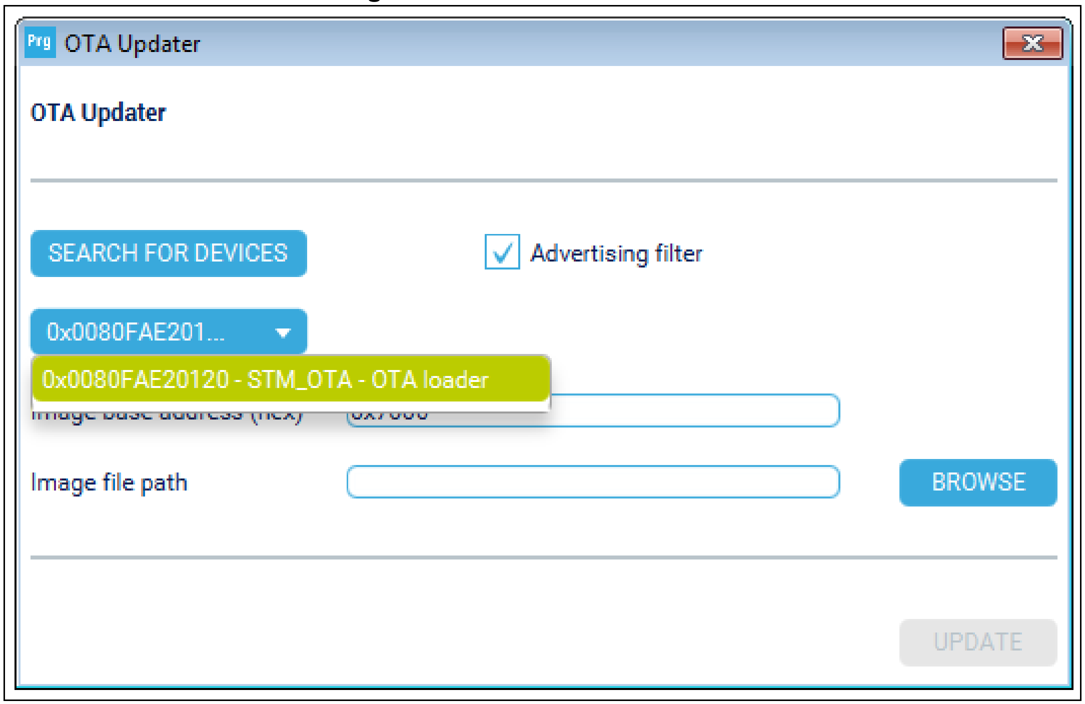
Image base address (hex) 0x7000

Image file path

The tool provides an advertising filter to refine the search procedure with advertising message.

To start search, click on the ‘SEARCH FOR DEVICES’ button. If Advertising filter is not checked, all BLE devices are listed, even if not compatible for OTA. It is recommended to check the Advertising filter option to list only devices with ST OTA information.

Figure 27. OTA device selection



OTA Updater

OTA Updater

SEARCH FOR DEVICES

[✓] Advertising filter

0x0080FAE201...

0x0080FAE20120 - STM_OTA - OTA loader

Image base address (hex) 0x7000

Image file path

BROWSE

UPDATE

The picklist displays the list of detected boards:

- for devices with BLE characteristic: BLE address - Device name - OTA enabled
- for devices already in OTA mode: BLE address - Device name - OTA loader

The image base address is the place where the binary file must be stored on the target device. It is an hexadecimal value, and must be a multiple of 0x1000 to match with Flash memory sector.

After selecting a device, click on “BROWSE” to select the binary file you want to program. Once selected the right path to the binary file click on “UPDATE”.

Figure 28. Image file selection

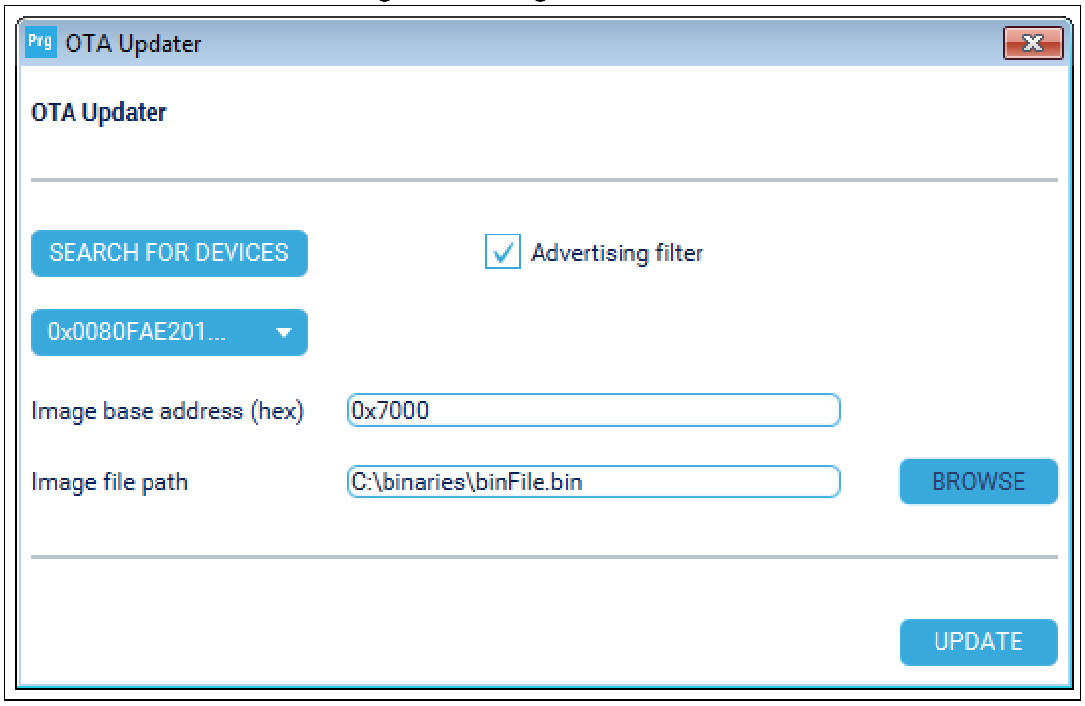


Image base address (hex): 0x7000

Image file path: C:\binaries\binFile.bin

The progress of Flash memory programming (flashing) is indicated by a bar.

Figure 29. OTA flashing

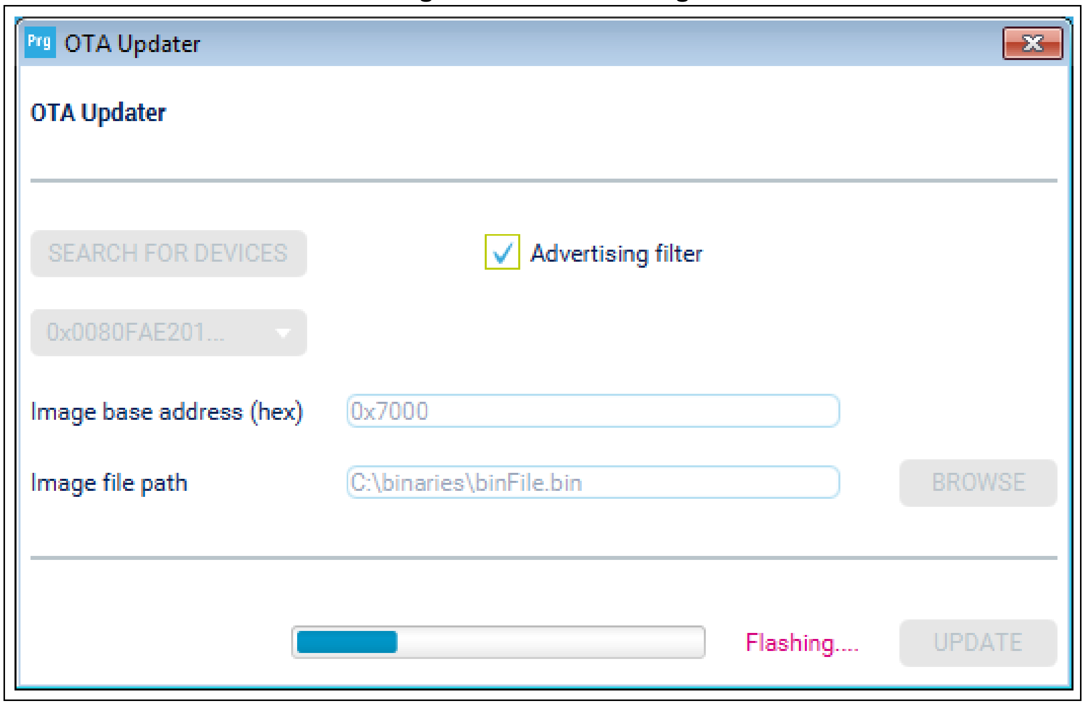
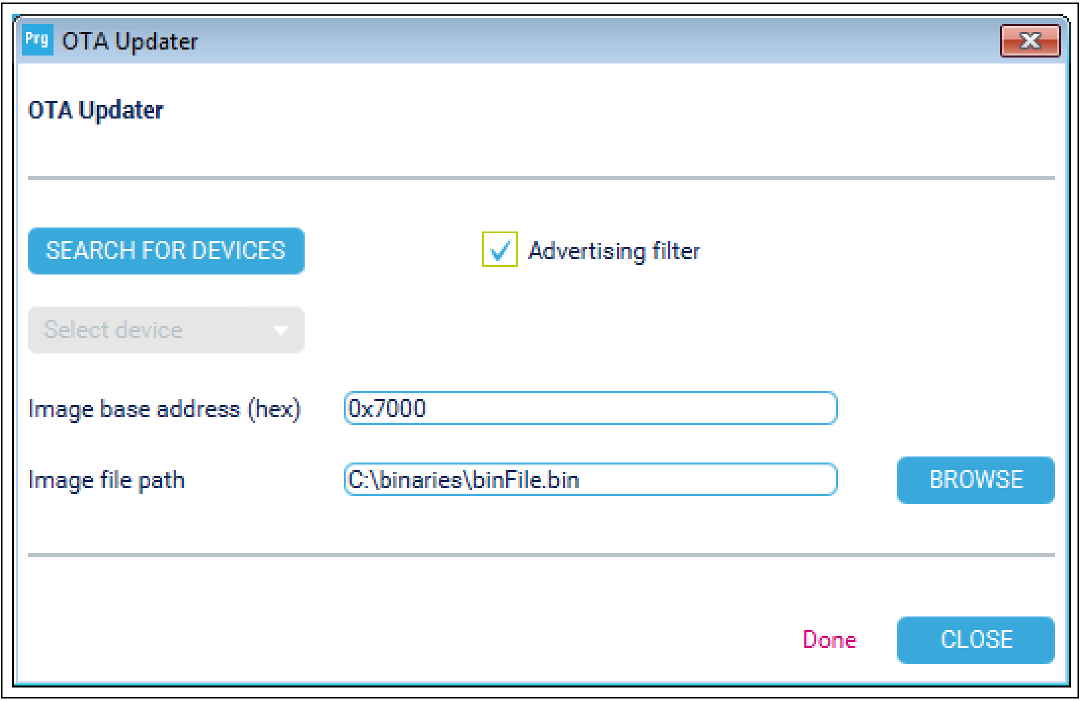


Image base address (hex): 0x7000

Image file path: C:\binaries\binFile.bin

Once the flashing is done, the target device reboots and starts the loaded application.

Figure 30. OTA flashing completed



✓ Advertising filter

Image base address (hex): 0x7000

Image file path: C:\binaries\binFile.bin

Done

For this feature STM32CubeMon-RF tool is called by STM32CubeProgrammer to perform OTA.

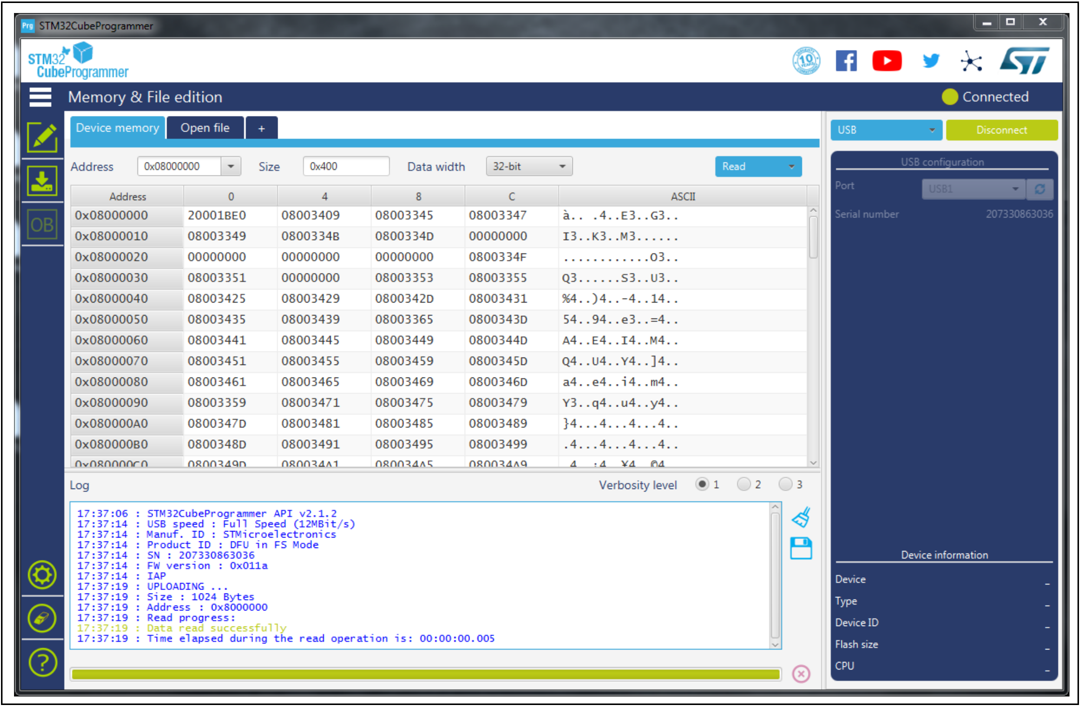
2.7 In application programming (IAP)

STM32CubeProgrammer supports IAP only with USB DFU connection mode. When USB connection is chosen and the boot is from Flash memory, STM32CubeProgrammer detects the IAP like DFU bootloader and after connection an IAP message appears in the log panel.

Note: Option byte and sector erase are not available with IAP.

Sample IAPs are available in CubeFW on *www.st.com*.

Figure 31. STM32Cube Programmer in IAP mode



Address	0	4	8	C	ASCII
0x08000000	20001BE0	08003409	08003345	08003347	à.. .4..E3..G3..
0x08000010	08003349	0800334B	0800334D	00000000	I3..K3..M3......
0x08000020	00000000	00000000	00000000	0800334F	............O3..
0x08000030	08003351	00000000	08003353	08003355	Q3......S3..U3..
0x08000040	08003425	08003429	0800342D	08003431	%4..)4..-4..14..
0x08000050	08003435	08003439	08003365	0800343D	54..94..e3..=4..
0x08000060	08003441	08003445	08003449	0800344D	A4..E4..I4..M4..
0x08000070	08003451	08003455	08003459	0800345D	Q4..U4..Y4..]4..
0x08000080	08003461	08003465	08003469	0800346D	a4..e4..i4..m4..
0x08000090	08003359	08003471	08003475	08003479	Y3..q4..u4..y4..
0x080000A0	0800347D	08003481	08003485	08003489	}4...4...4...4..
0x080000B0	0800348D	08003491	08003495	08003499	.4...4...4...4..
0x080000C0	0800349D	080034A1	080034A5	080034A9	.4..¡4..¥4..©4

Verbosity level [✓ 1] 2 3

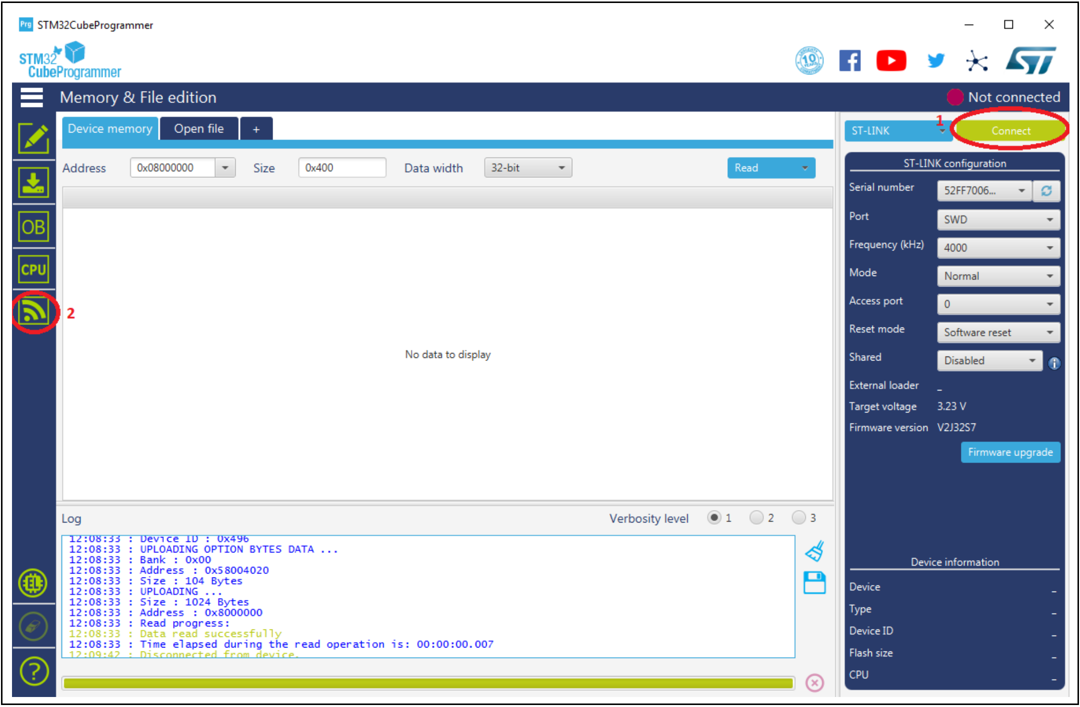
```
17:37:06 : STM32CubeProgrammer API v2.1.2
17:37:14 : USB speed : Full Speed (12MBit/s)
17:37:14 : Manuf. ID : STMicroelectronics
17:37:14 : Product ID : DFU in FS Mode
17:37:14 : SN : 207330863036
17:37:14 : FW version : 0x011a
17:37:14 : IAP
17:37:19 : UPLOADING ...
17:37:19 : Size : 1024 Bytes
17:37:19 : Address : 0x8000000
17:37:19 : Read progress:
17:37:19 : Data read successfully
17:37:19 : Time elapsed during the read operation is: 00:00:00.005
```

2.8 Flash the co-processor binary using graphical interface

2.8.1 Using JTAG

1. Use STM32CubeProgrammer (version 2.4 or higher), see *Figure 32*
2. Access the SWD interface, see *Figure 33*
3. Delete the current wireless stack, see *Figure 34*
4. Upgrade the FUS version the same way you would download the stack when there is not an updated FUS version
5. Download the new FUS
6. Download the new wireless stack (pop-up must appear to ensure successful upgrade), see *Figure 35*

Figure 32. STM32CubeProgrammer API SWD connection



Address 0x08000000 Size 0x400 Data width 32-bit

ST-LINK configuration

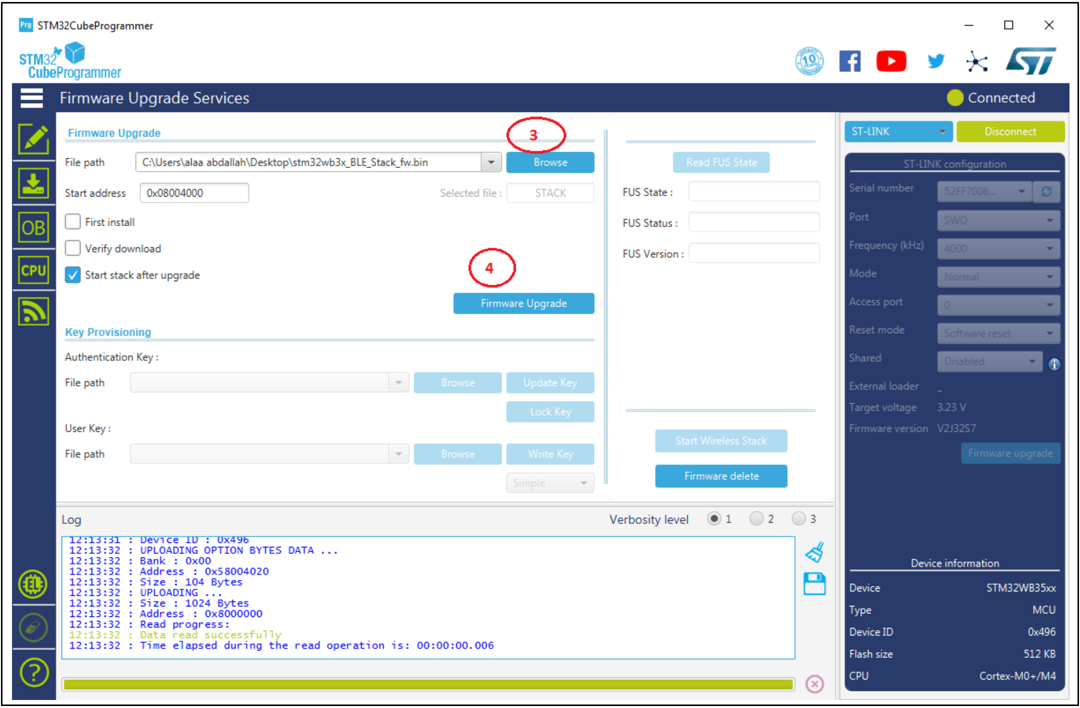
Serial number	52FF7006...
Port	SWD
Frequency (kHz)	4000
Mode	Normal
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	_
Target voltage	3.23 V
Firmware version	V2J32S7

Device information

Device	_
Type	_
Device ID	_
Flash size	_
CPU	_

```
12:08:33 : Device ID : 0x496
12:08:33 : UPLOADING OPTION BYTES DATA ...
12:08:33 : Bank : 0x00
12:08:33 : Address : 0x58004020
12:08:33 : Size : 104 Bytes
12:08:33 : UPLOADING ...
12:08:33 : Size : 1024 Bytes
12:08:33 : Address : 0x8000000
12:08:33 : Read progress:
12:08:33 : Data read successfully
12:08:33 : Time elapsed during the read operation is: 00:00:00.007
12:09:42 : Disconnected from device.
```

Figure 33. Steps for firmware upgrade



File path C:\Users\alaa abdallah\Desktop\stm32wb3x_BLE_Stack_fw.bin

Start address 0x08004000 Selected file : STACK

First install ☐

Verify download ☐

Start stack after upgrade ✓

Authentication Key :

File path

User Key :

File path

FUS State :

FUS Status :

FUS Version :

ST-LINK configuration

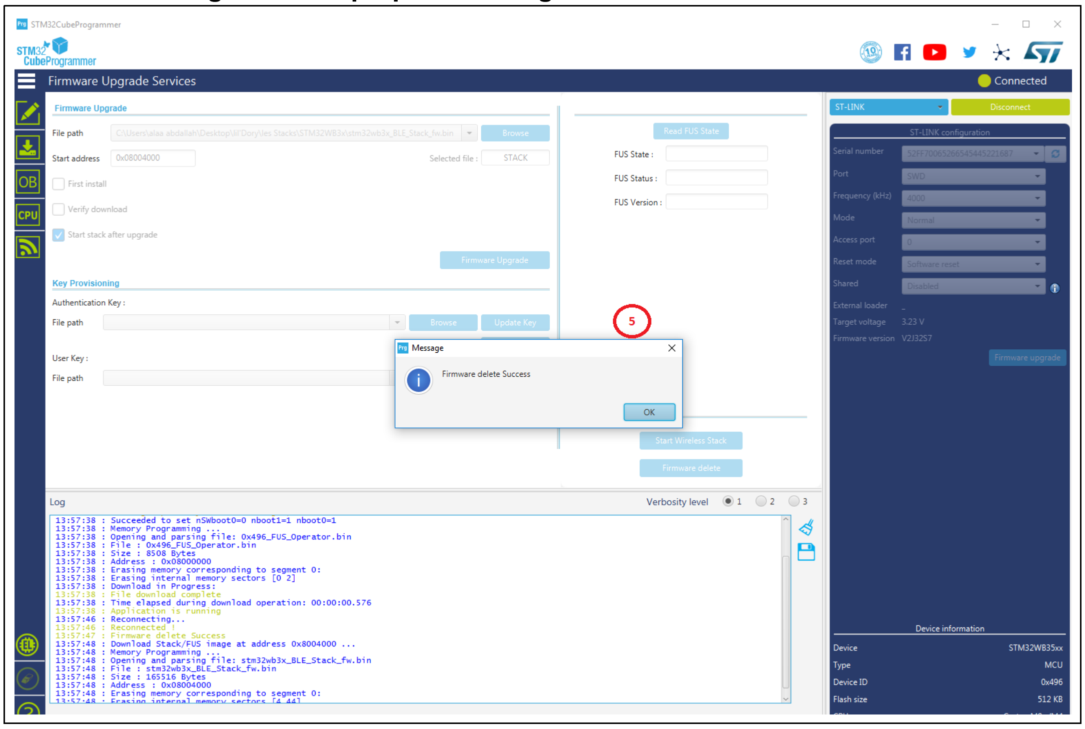
Serial number	52FF7006...
Port	SWD
Frequency (kHz)	4000
Mode	Normal
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	_
Target voltage	3.23 V
Firmware version	V2J32S7

Device information

Device	STM32WB35xx
Type	MCU
Device ID	0x496
Flash size	512 KB
CPU	Cortex-M0+/M4

```
12:13:31 : Device ID : 0x496
12:13:32 : UPLOADING OPTION BYTES DATA ...
12:13:32 : Bank : 0x00
12:13:32 : Address : 0x58004020
12:13:32 : Size : 104 Bytes
12:13:32 : UPLOADING ...
12:13:32 : Size : 1024 Bytes
12:13:32 : Address : 0x8000000
12:13:32 : Read progress:
12:13:32 : Data read successfully
12:13:32 : Time elapsed during the read operation is: 00:00:00.006
```

Figure 34. Pop-up confirming successful firmware delete



File path: C:\Users\alaa abdallah\Desktop\lil'Dory\les Stacks\STM32WB3x\stm32wb3x_BLE_Stack_fw.bin
Start address: 0x08004000
Selected file : STACK
First install
Verify download
[✓] Start stack after upgrade

FUS State :
FUS Status :
FUS Version :

Firmware delete Success

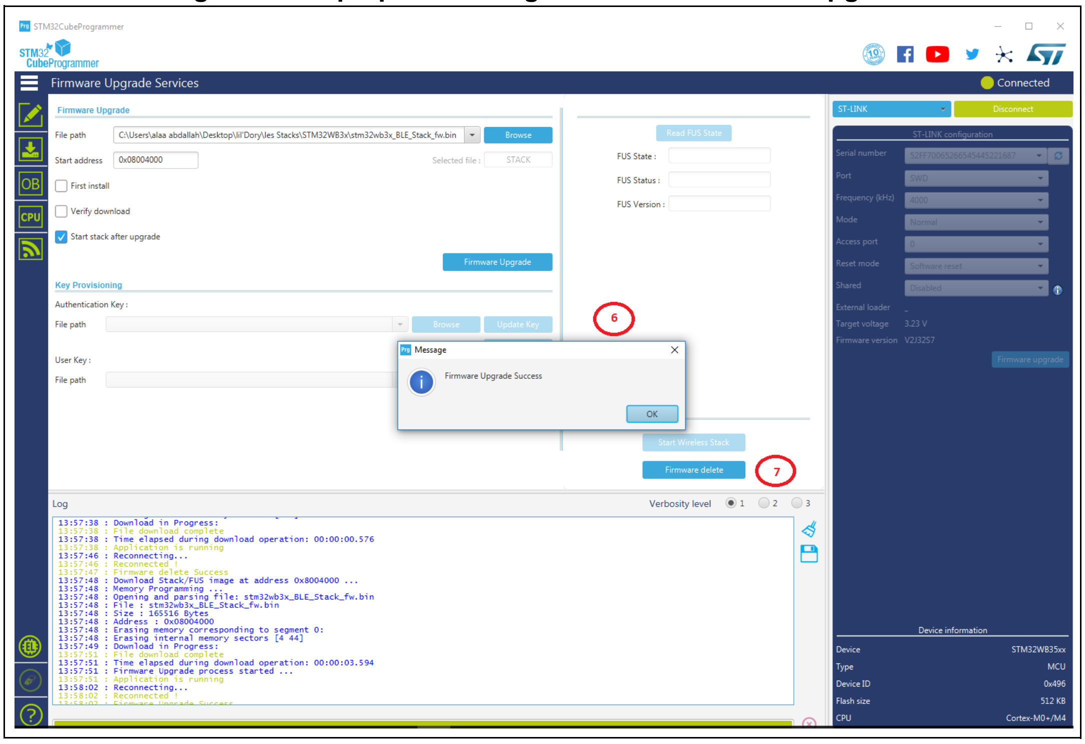
Verbosity level: [✓ 1] 2 3

```
13:57:38 : Succeeded to set nSWboot0=0 nboot1=1 nboot0=1
13:57:38 : Memory Programming ...
13:57:38 : Opening and parsing file: 0x496_FUS_Operator.bin
13:57:38 : File : 0x496_FUS_Operator.bin
13:57:38 : Size : 8508 Bytes
13:57:38 : Address : 0x08000000
13:57:38 : Erasing memory corresponding to segment 0:
13:57:38 : Erasing internal memory sectors [0 2]
13:57:38 : Download in Progress:
13:57:38 : File download complete
13:57:38 : Time elapsed during download operation: 00:00:00.576
13:57:38 : Application is running
13:57:46 : Reconnecting...
13:57:46 : Reconnected !
13:57:47 : Firmware delete Success
13:57:48 : Download Stack/FUS image at address 0x8004000 ...
13:57:48 : Memory Programming ...
13:57:48 : Opening and parsing file: stm32wb3x_BLE_Stack_fw.bin
13:57:48 : File : stm32wb3x_BLE_Stack_fw.bin
13:57:48 : Size : 165516 Bytes
13:57:48 : Address : 0x08004000
13:57:48 : Erasing memory corresponding to segment 0:
13:57:48 : Erasing internal memory sectors [4 44]
```

Serial number	52FF70065266545445221687
Port	SWD
Frequency (kHz)	4000
Mode	Normal
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	_
Target voltage	3.23 V
Firmware version	V2J32S7

Device	STM32WB35xx
Type	MCU
Device ID	0x496
Flash size	512 KB

Figure 35. Pop-up confirming successful firmware upgrade



File path: C:\Users\alaa abdallah\Desktop\lil'Dory\les Stacks\STM32WB3x\stm32wb3x_BLE_Stack_fw.bin
Start address: 0x08004000
Selected file : STACK
First install
Verify download
[✓] Start stack after upgrade

FUS State :
FUS Status :
FUS Version :

Firmware Upgrade Success

Verbosity level: [✓ 1] 2 3

```
13:57:38 : Download in Progress:
13:57:38 : File download complete
13:57:38 : Time elapsed during download operation: 00:00:00.576
13:57:38 : Application is running
13:57:46 : Reconnecting...
13:57:46 : Reconnected !
13:57:47 : Firmware delete Success
13:57:48 : Download Stack/FUS image at address 0x8004000 ...
13:57:48 : Memory Programming ...
13:57:48 : Opening and parsing file: stm32wb3x_BLE_Stack_fw.bin
13:57:48 : File : stm32wb3x_BLE_Stack_fw.bin
13:57:48 : Size : 165516 Bytes
13:57:48 : Address : 0x08004000
13:57:48 : Erasing memory corresponding to segment 0:
13:57:48 : Erasing internal memory sectors [4 44]
13:57:49 : Download in Progress:
13:57:51 : File download complete
13:57:51 : Time elapsed during download operation: 00:00:03.594
13:57:51 : Firmware Upgrade process started ...
13:57:51 : Application is running
13:58:02 : Reconnecting...
13:58:02 : Reconnected !
13:58:02 : Firmware Upgrade Success
```

Serial number	52FF70065266545445221687
Port	SWD
Frequency (kHz)	4000
Mode	Normal
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	_
Target voltage	3.23 V
Firmware version	V2J32S7

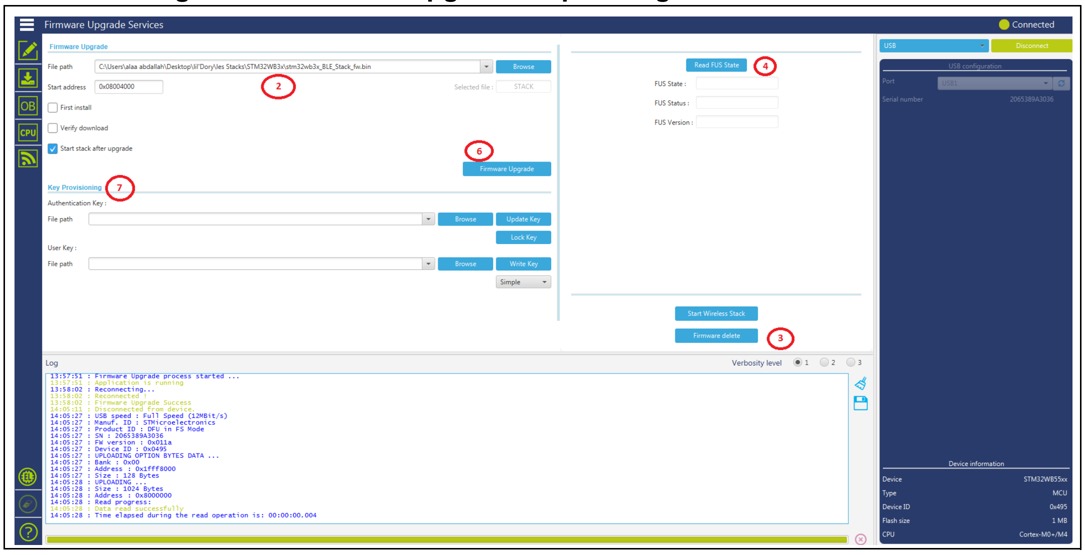
Device	STM32WB35xx
Type	MCU
Device ID	0x496
Flash size	512 KB
CPU	Cortex-M0+/M4

2.8.2 Using bootloader

1. Use STM32 CubeProgrammer (version 2.4.0 or higher)
2. Access the bootloader USB interface (system Flash memory)
3. Delete the current wireless stack
4. Read and upgrade the FUS version
5. Download the new FUS the same way you would download the stack when there is not an updated FUS version
6. Download the new wireless stack

Note: Provisioning section is only for users who already have a key to be implemented.

Figure 36. Firmware upgrade steps using bootloader interface



File path: C:\Users\alaa abdallah\Desktop\lil'Dory\les Stacks\STM32WB3x\stm32wb3x_BLE_Stack_fw.bin

Start address: 0x08004000

First install [ ]

Verify download [ ]

Start stack after upgrade [✓]

Verbosity level: [✓ 1] 2 3

Port: USB1

Serial number: 2065389A3036

Device	STM32WB55xx
Type	MCU
Device ID	0x495
Flash size	1 MB
CPU	Cortex-M0+/M4

```
13:57:51 : Firmware Upgrade process started ...
13:57:51 : Application is running
13:58:02 : Reconnecting...
13:58:02 : Reconnected !
13:58:02 : Firmware Upgrade Success
14:05:11 : Disconnected from device.
14:05:27 : USB speed : Full Speed (12MBit/s)
14:05:27 : Manuf. ID : STMicroelectronics
14:05:27 : Product ID : DFU in FS Mode
14:05:27 : SN : 2065389A3036
14:05:27 : FW version : 0x011a
14:05:27 : Device ID : 0x0495
14:05:27 : UPLOADING OPTION BYTES DATA ...
14:05:27 : Bank : 0x00
14:05:27 : Address : 0x1fff8000
14:05:27 : Size : 128 Bytes
14:05:28 : UPLOADING ...
14:05:28 : Size : 1024 Bytes
14:05:28 : Address : 0x8000000
14:05:28 : Read progress:
14:05:28 : Data read successfully
14:05:28 : Time elapsed during the read operation is: 00:00:00.004
```

For complete documentation on STM32WBxx products visit the dedicated pages on *www.st.com*.

2.9 Serial wire viewer (SWV)

The serial wire viewer window (see *Figure 37*) displays the printf data sent from the target through SWO. It displays useful information on the running firmware.

Note: The serial wire viewer is only available through SWD interface.

Before starting to receive SWO data, the user has to specify the exact target System clock frequency (in MHz) to allow the tool to correctly configure the ST-LINK and the target for the correct SWO frequency. The “Stimulus port” combo box allows the user to choose either a given ITM Stimulus port (from port 0 to 31) or receive data simultaneously from all ITM Stimulus ports.

The user can optionally specify a “.log” file to save the SWV trace log by using the “Browse” button, the default is “$USER_HOME/STMicroelectronics/STM32CubeProgrammer/SWV_Log/swv.log”.

The user can optionally check the “Activate colors” checkbox to enable colored traces output. This feature requires the original traces to contain the color codes listed below:

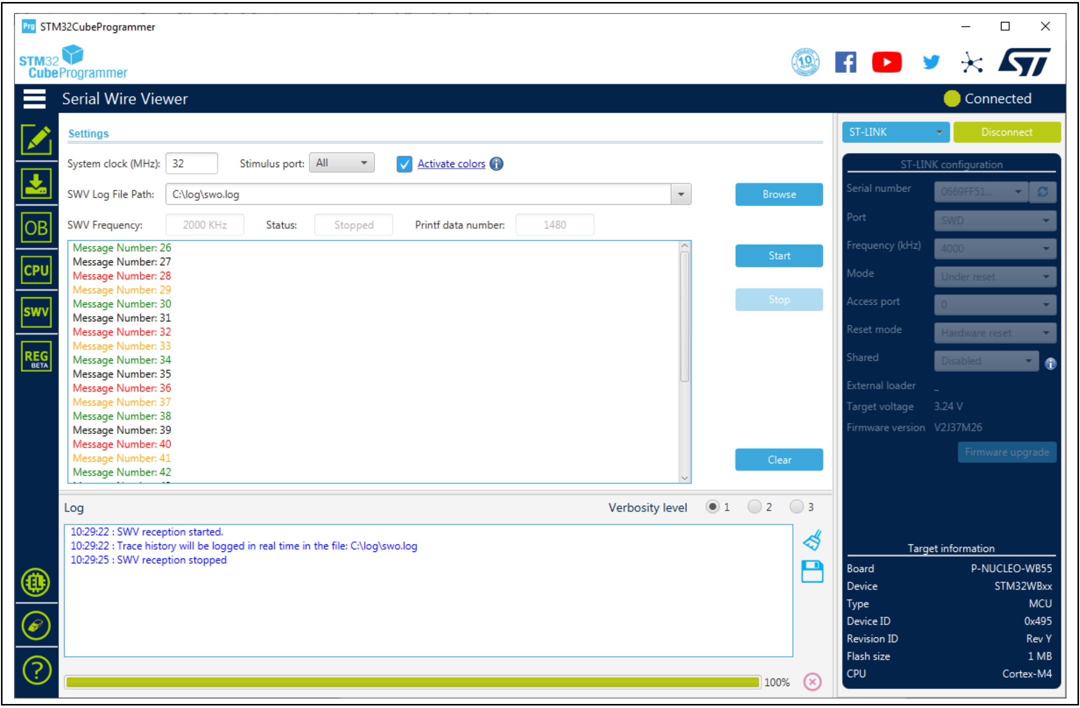
- #GRN# for green color
- #RED# for red color
- #ORG# for orange color

Example:

`printf("#GRN#This outputs a green message!");`

A help window that demonstrates the feature and shows how to use it can be accessed by clicking on the “Info icon” button next to the “Activate colors” checkbox.

Figure 37. SWV window



Settings

System clock (MHz): 32 Stimulus port: All ✓ Activate colors

SWV Log File Path: C:\log\swo.log

SWV Frequency: 2000 KHz Status: Stopped Printf data number: 1480

```
Message Number: 26
Message Number: 27
Message Number: 28
Message Number: 29
Message Number: 30
Message Number: 31
Message Number: 32
Message Number: 33
Message Number: 34
Message Number: 35
Message Number: 36
Message Number: 37
Message Number: 38
Message Number: 39
Message Number: 40
Message Number: 41
Message Number: 42
```

Log Verbosity level [✓ 1] 2 3

```
10:29:22 : SWV reception started.
10:29:22 : Trace history will be logged in real time in the file: C:\log\swo.log
10:29:25 : SWV reception stopped
```

100%

ST-LINK configuration

Serial number	0669FF51...
Port	SWD
Frequency (kHz)	4000
Mode	Under reset
Access port	0
Reset mode	Hardware reset
Shared	Disabled
External loader	_
Target voltage	3.24 V
Firmware version	V2J37M26

Target information

Board	P-NUCLEO-WB55
Device	STM32WBxx
Type	MCU
Device ID	0x495
Revision ID	Rev Y
Flash size	1 MB
CPU	Cortex-M4

After specifying the SWV configuration, SWV reception can be started or stopped using the “Start” and “Stop” buttons. The SWO data is displayed in the dedicated area, which can be cleared by using the “Clear” button.

The SWV information bar displays useful information on the current SWV transfer, such as the SWO frequency (deduced from the system clock frequency), and the received printf data number (expressed in bytes).

Note: Some SWV bytes can be lost during transfer due to ST-LINK hardware buffer size limitation.

2.10 DFU IAP with custom PID and VID

STM32CubeProgrammer DFU IAP supports not only ST product IDs while connecting via DFU IAP.

Before starting the DFU connection using a new product ID, sign your USB driver (for more info visit http://woshub.com).

When USB connection with a new product ID is chosen and the boot is from Flash memory, STM32CubeProgrammer detects the IAP like DFU bootloader and after connection an IAP message appears in the log panel.

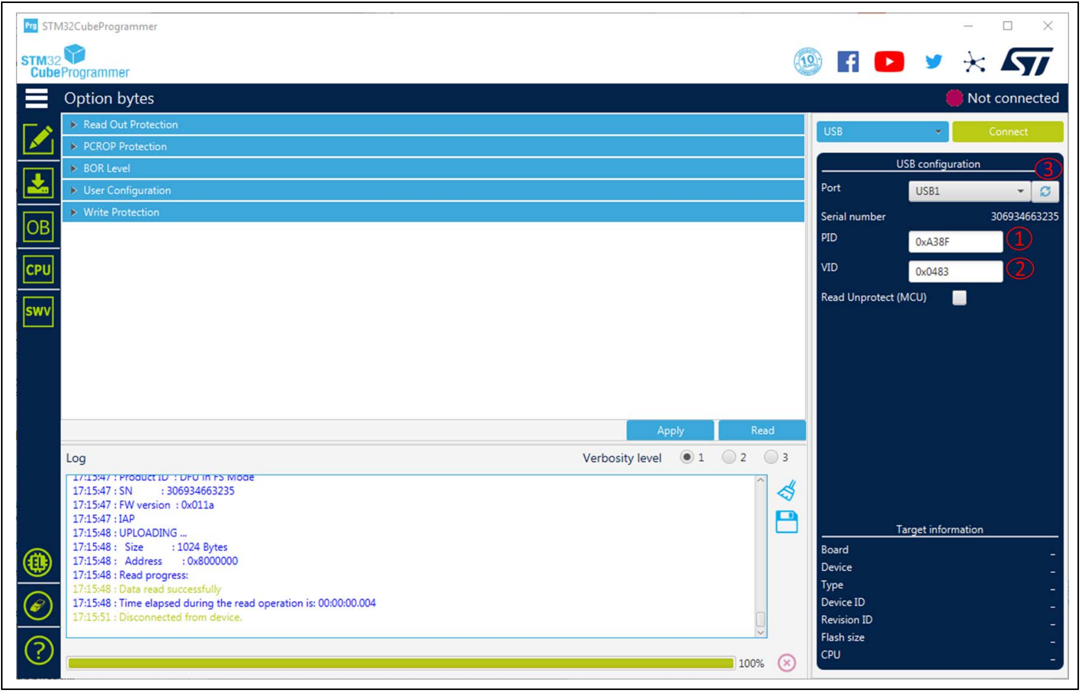
To connect via the new USB DFU follow this sequence:

1. modify the default product ID
2. modify the default vendor ID
3. click on refresh button then on the connect button

Note: If user does not enter a PID or VID value STM32CubeProgrammer takes the default PID and VID of ST products (PID=0XDF11, VID=0X0483).

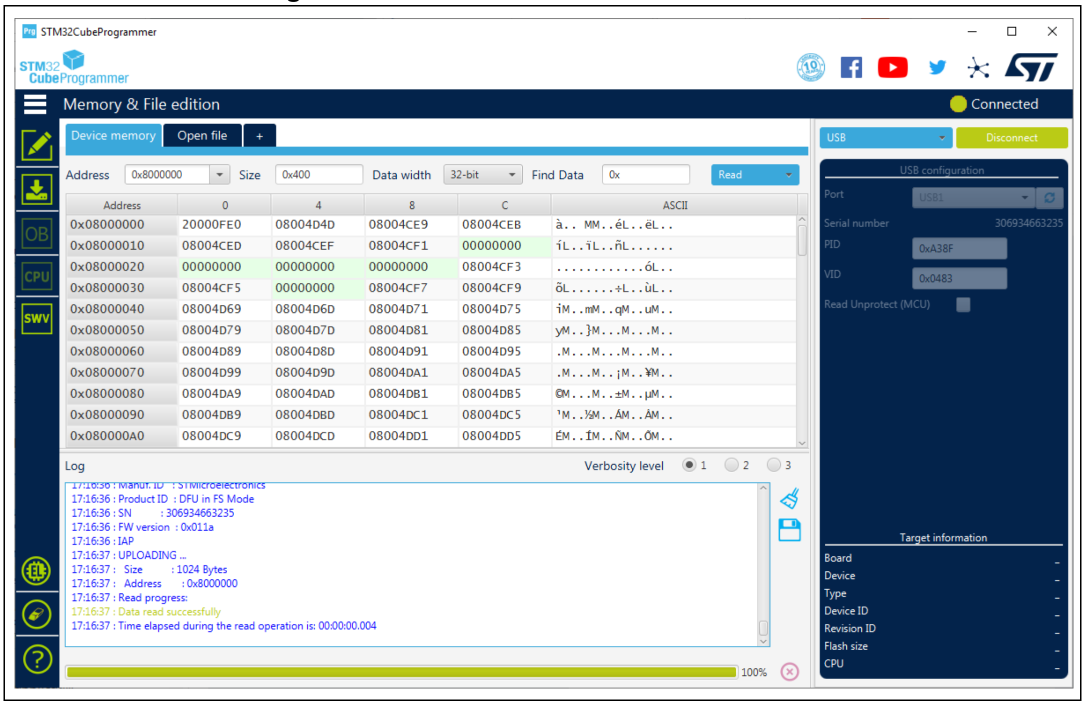
Figure 38 shows the steps to connect via the new USB DFU panel, and *Figure 39* the main window of STM32CubeProgrammer after connection.

Figure 38. Connect via USB DFU panel



```
17:15:47 : Product ID  : DFU in FS Mode
17:15:47 : SN          : 306934663235
17:15:47 : FW version  : 0x011a
17:15:47 : IAP
17:15:48 : UPLOADING ...
17:15:48 :   Size        : 1024 Bytes
17:15:48 :   Address     : 0x8000000
17:15:48 : Read progress:
17:15:48 : Data read successfully
17:15:48 : Time elapsed during the read operation is: 00:00:00.004
17:15:51 : Disconnected from device.
```

Figure 39. Main window after the connection



Address 0x8000000 Size 0x400 Data width 32-bit Find Data 0x

Address	0	4	8	C	ASCII
0x08000000	20000FE0	08004D4D	08004CE9	08004CEB	à.. MM..éL..ëL..
0x08000010	08004CED	08004CEF	08004CF1	00000000	íL..ïL..ñL......
0x08000020	00000000	00000000	00000000	08004CF3	............óL..
0x08000030	08004CF5	00000000	08004CF7	08004CF9	õL......÷L..ùL..
0x08000040	08004D69	08004D6D	08004D71	08004D75	iM..mM..qM..uM..
0x08000050	08004D79	08004D7D	08004D81	08004D85	yM..}M...M...M..
0x08000060	08004D89	08004D8D	08004D91	08004D95	.M...M...M...M..
0x08000070	08004D99	08004D9D	08004DA1	08004DA5	.M...M..¡M..¥M..
0x08000080	08004DA9	08004DAD	08004DB1	08004DB5	©M...M..±M..µM..
0x08000090	08004DB9	08004DBD	08004DC1	08004DC5	¹M..½M..ÁM..ÅM..
0x080000A0	08004DC9	08004DCD	08004DD1	08004DD5	ÉM..ÍM..ÑM..ÕM..

Log Verbosity level (● 1) 2 3

```
17:16:36 : Manuf. ID   : STMicroelectronics
17:16:36 : Product ID  : DFU in FS Mode
17:16:36 : SN          : 306934663235
17:16:36 : FW version  : 0x011a
17:16:36 : IAP
17:16:37 : UPLOADING ...
17:16:37 :   Size        : 1024 Bytes
17:16:37 :   Address     : 0x8000000
17:16:37 : Read progress:
17:16:37 : Data read successfully
17:16:37 : Time elapsed during the read operation is: 00:00:00.004
```

100%

USB configuration

Port	USB1
Serial number	306934663235
PID	0xA38F
VID	0x0483
Read Unprotect (MCU)	☐

Target information

Board	_
Device	_
Type	_
Device ID	_
Revision ID	_
Flash size	_
CPU	_

Note: For CLI mode check the Section 3.2.1: Connect command.

2.11 SigFox™ credentials

As soon as an STM32WL device is connected, the window shown in *Figure 40* is displayed.

This window displays the chip certificate having the size of 136 bytes. The user can save it in binary file and copy the data to the clipboard.

After extracting the chip certificate, a back-end web-service verifies the data and returns two SigFox credentials: binary and header files.

Case 1: Binary-Raw

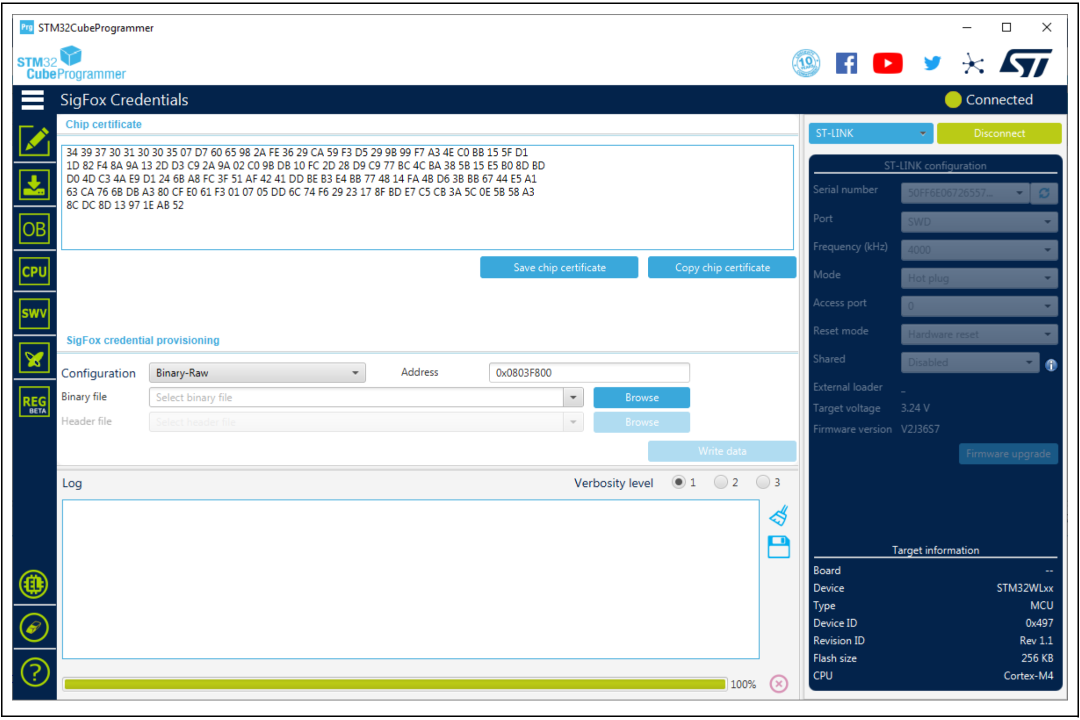
Use the binary file returned by the back-end web-service. The size of this file must be equal to 48 bytes, it is written at the default address 0x0803E500.

Case 2: Binary KMS

Use the header file returned by the back-end web-service. It is written at the default address 0x0803E500.

Note: To access ST SigFox server using STM32CubeProgrammer, user must click on “Open Sigfox page”. A web page opens, the user must manually copy the certificate and then generate the SigFox credentials (binary and header files).

Figure 40. SigFox credentials



SigFox Credentials — Connected

Chip certificate

```
34 39 37 30 31 30 30 35 07 D7 60 65 98 2A FE 36 29 CA 59 F3 D5 29 9B 99 F7 A3 4E C0 BB 15 5F D1
1D 82 F4 8A 9A 13 2D D3 C9 2A 9A 02 C0 9B DB 10 FC 2D 28 D9 C9 77 BC 4C BA 38 5B 15 E5 B0 8D BD
D0 4D C3 4A E9 D1 24 6B A8 FC 3F 51 AF 42 41 DD BE B3 E4 BB 77 48 14 FA 4B D6 3B BB 67 44 E5 A1
63 CA 76 6B DB A3 80 CF E0 61 F3 01 07 05 DD 6C 74 F6 29 23 17 8F BD E7 C5 CB 3A 5C 0E 5B 58 A3
8C DC 8D 13 97 1E AB 52
```

SigFox credential provisioning

Configuration	Binary-Raw
Address	0x0803F800
Binary file	Select binary file
Header file	Select header file

Verbosity level: (●) 1 ( ) 2 ( ) 3 — 100%

ST-LINK configuration

Serial number	50FF6E06726557...
Port	SWD
Frequency (kHz)	4000
Mode	Hot plug
Access port	0
Reset mode	Hardware reset
Shared	Disabled
External loader	-
Target voltage	3.24 V
Firmware version	V2J36S7

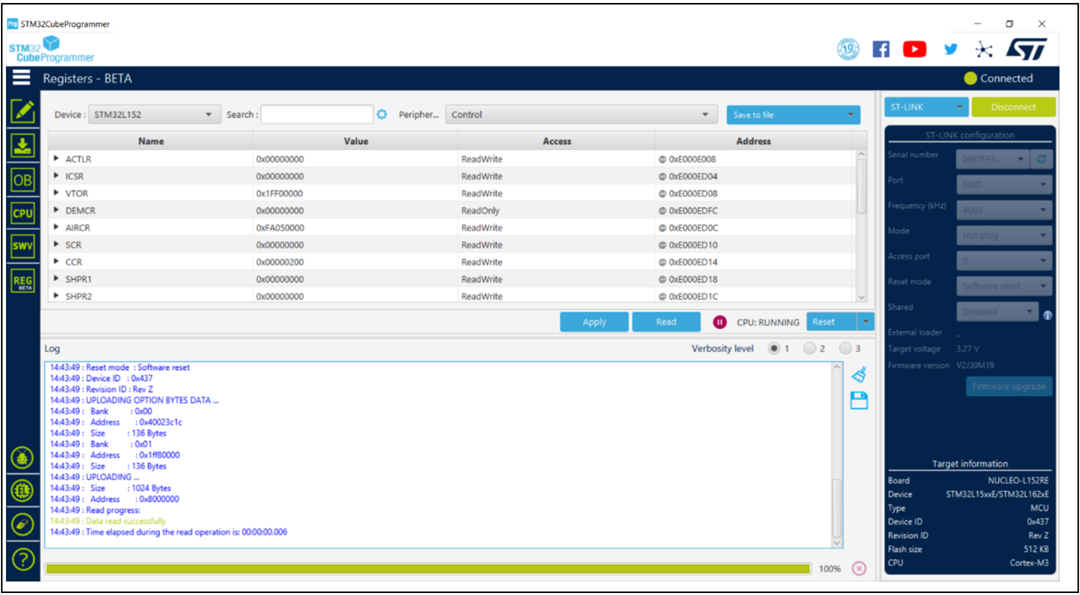
Target information

Board	--
Device	STM32WLxx
Type	MCU
Device ID	0x497
Revision ID	Rev 1.1
Flash size	256 KB
CPU	Cortex-M4

2.12 Register Viewer

STM32CubeProgrammer supports the Register Viewer feature (see *Figure 41*), allowing the user to visualize all the MCU and core registers in real time while running the application. It also allows the modification of MCU registers values or saving them into a log file.

Figure 41. Register Viewer window



Registers - BETA — Connected

Device : STM32L152 — Search : — Peripher... Control

Name	Value	Access	Address
ACTLR	0x00000000	ReadWrite	@ 0xE000E008
ICSR	0x00000000	ReadWrite	@ 0xE000ED04
VTOR	0x1FF00000	ReadWrite	@ 0xE000ED08
DEMCR	0x00000000	ReadOnly	@ 0xE000EDFC
AIRCR	0xFA050000	ReadWrite	@ 0xE000ED0C
SCR	0x00000000	ReadWrite	@ 0xE000ED10
CCR	0x00000200	ReadWrite	@ 0xE000ED14
SHPR1	0x00000000	ReadWrite	@ 0xE000ED18
SHPR2	0x00000000	ReadWrite	@ 0xE000ED1C

CPU: RUNNING

Verbosity level: (●) 1 ( ) 2 ( ) 3

```
14:43:49 : Reset mode  : Software reset
14:43:49 : Device ID   : 0x437
14:43:49 : Revision ID : Rev Z
14:43:49 : UPLOADING OPTION BYTES DATA ...
14:43:49 :   Bank          : 0x00
14:43:49 :   Address       : 0x40023c1c
14:43:49 :   Size          : 136 Bytes
14:43:49 :   Bank          : 0x01
14:43:49 :   Address       : 0x1ff80000
14:43:49 :   Size          : 136 Bytes
14:43:49 : UPLOADING ...
14:43:49 :   Size          : 1024 Bytes
14:43:49 :   Address       : 0x8000000
14:43:49 : Read progress:
14:43:49 : Data read successfully
14:43:49 : Time elapsed during the read operation is: 00:00:00.006
```

100%

ST-LINK configuration

Serial number	0667FF3...
Port	SWD
Frequency (kHz)	4000
Mode	Hot plug
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	-
Target voltage	3.27 V
Firmware version	V2J30M19

Target information

Board	NUCLEO-L152RE
Device	STM32L15xxE/STM32L162xE
Type	MCU
Device ID	0x437
Revision ID	Rev Z
Flash size	512 KB
CPU	Cortex-M3

Note: The register viewer is only available through SWD/JTAG interfaces.

Register Viewer has as input a list of files containing the data describing the mapping of the core and STM32 registers ("svd" files).

2.13 Hard fault analyzer

2.13.1 Description

The STM32CubeProgrammer Fault Analyzer feature interprets information extracted from the Cortex-M based device to identify the reasons that caused a fault.

This information is visualized in the Fault Analyzer window in GUI mode or in CLI mode. It helps to identify system faults occurring when the CPU is driven into a fault condition by the application software.

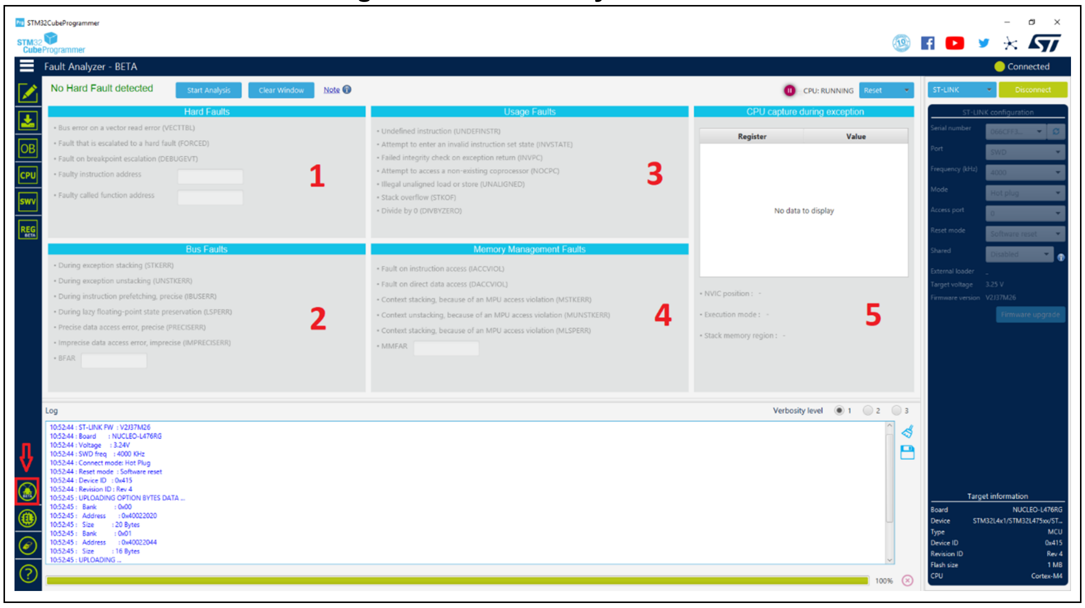
Possible detected fault exceptions:

- Hard Fault: default exception, can be triggered by an error during exception processing by Bus Fault, Memory Management Fault, or Usage Fault if their handler cannot be executed.
- Memory Management Fault: detects memory access violations to regions defined in the memory management unit (MPU), such as code execution from a memory region with read/write access only.
- Bus Fault: detects memory access errors on instruction fetch, data read/write, interrupt vector fetch, and register stacking (save/restore) on interrupt (entry/exit).
- Usage Fault: detects execution of undefined instructions, unaligned memory access for load/store multiple. When enabled, divide-by-zero and other unaligned memory accesses are detected.
- Secure Fault: provides information about security related faults for Cortex-M33 based devices.

Note: Fault Analyzer is available only for ST-LINK interfaces.

As shown in *Figure 42* the Fault Analyzer Window has five main sections.

Figure 42. Fault Analyzer window


STM32CubeProgrammer
Fault Analyzer - BETA
Connected
No Hard Fault detected
Start Analysis
Clear Window
Note
CPU: RUNNING
Reset
ST-LINK
Disconnect
Hard Faults
• Bus error on a vector read error (VECTTBL)
• Fault that is escalated to a hard fault (FORCED)
• Fault on breakpoint escalation (DEBUGEVT)
• Faulty instruction address
• Faulty called function address
1
Usage Faults
• Undefined instruction (UNDEFINSTR)
• Attempt to enter an invalid instruction set state (INVSTATE)
• Failed integrity check on exception return (INVPC)
• Attempt to access a non-existing coprocessor (NOCPC)
• Illegal unaligned load or store (UNALIGNED)
• Stack overflow (STKOF)
• Divide by 0 (DIVBYZERO)
3
CPU capture during exception
Register
Value
No data to display
Bus Faults
• During exception stacking (STKERR)
• During exception unstacking (UNSTKERR)
• During instruction prefetching, precise (IBUSERR)
• During lazy floating-point state preservation (LSPERR)
• Precise data access error, precise (PRECISERR)
• Imprecise data access error, imprecise (IMPRECISERR)
• BFAR
2
Memory Management Faults
• Fault on instruction access (IACCVIOL)
• Fault on direct data access (DACCVIOL)
• Context stacking, because of an MPU access violation (MSTKERR)
• Context unstacking, because of an MPU access violation (MUNSTKERR)
• Context stacking, because of an MPU access violation (MLSPERR)
• MMFAR
4
• NVIC position : -
• Execution mode : -
• Stack memory region : -
5
ST-LINK configuration
Serial number
Port
Frequency (kHz)
Mode
Access port
Reset mode
Shared
External loader
Target voltage 3.25 V
Firmware version V2J37M26
Firmware upgrade
Log
Verbosity level 1 2 3
100%
Target information
Board NUCLEO-L476RG
Device STM32L4x1/STM32L475xx/ST...
Type MCU
Device ID 0x415
Revision ID Rev 4
Flash size 1 MB
CPU Cortex-M4

```
10:52:44 : ST-LINK FW  : V2J37M26
10:52:44 : Board       : NUCLEO-L476RG
10:52:44 : Voltage     : 3.24V
10:52:44 : SWD freq    : 4000 KHz
10:52:44 : Connect mode: Hot Plug
10:52:44 : Reset mode  : Software reset
10:52:44 : Device ID   : 0x415
10:52:44 : Revision ID : Rev 4
10:52:45 : UPLOADING OPTION BYTES DATA ...
10:52:45 :   Bank         : 0x00
10:52:45 :   Address      : 0x40022020
10:52:45 :   Size         : 20 Bytes
10:52:45 :   Bank         : 0x01
10:52:45 :   Address      : 0x40022044
10:52:45 :   Size         : 16 Bytes
10:52:45 : UPLOADING ...
```

1. Hard Faults details: indicates the type of occurred fault, locates the instruction and the called function addresses.
2. Bus Faults details: shows the status of bus errors resulting from instruction fetches and data accesses and indicates memory access faults detected during a bus operation. An address should be displayed on the BFAR text field.
3. Usage Faults details: contains the status for some instruction execution faults, and for data access.
4. Memory Management Faults details: indicates a memory access violation detected by the MPU. If this fault was triggered by a faulty address, access is displayed on the MMFAR text field.
5. CPU capture during exception: shows the CPU state when an exception was generated to have an overview for CPU registers and some helpful information.
   a) NVIC position: indicates the number of the interrupt imposing the error, if it is “-“ the interrupt/exception vector has no specific position.
   b) Execution mode: indicates the operation mode Handler/Thread.
   c) Stack memory region: indicates the used stack memory during the fault, Main or Process stack.

2.13.2 Example

Develop a simple application that generates a Usage fault, set an instruction making a divide by zero (a non-permitted operation) in the main program function.

int a = 4, b = 0, c = 0;

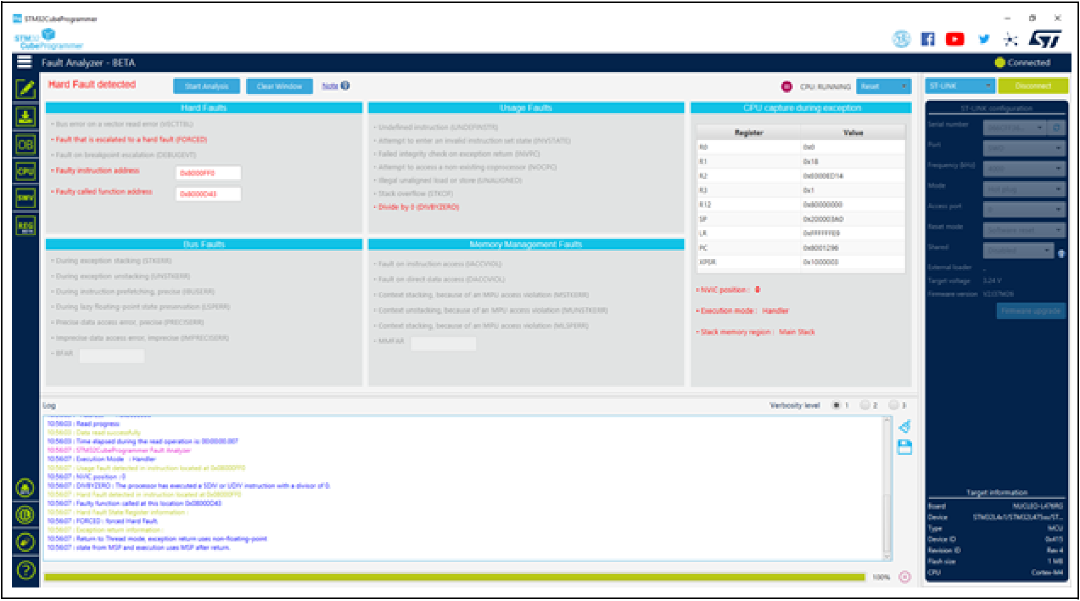
c = a / b ;

Open the Fault Analyzer window, press the “Start Analysis” button to start the fault detection algorithm, the reason of the error is displayed.

In this example, it displays “Hard Fault Detected”, and the label “divide by zero (DIVBYZERO)” is highlighted with additional informations:

- Faulty instruction address: 0x8000FF0
- Faulty called function address: 0x8000D40, indicates the address calling the faulty instruction.
- NVIC position: 0, window watchdog interrupt
- Execution mode: Handler
- Stack memory region: main stack

Figure 43. Fault analyzer GUI view when Hard Fault detected



Hard Fault detected

Hard Faults
- Bus error on a vector read error (VECTTBL)
- Fault that is escalated to a hard fault (FORCED)
- Fault on breakpoint escalation (DEBUGEVT)
- Faulty instruction address: 0x8000FF0
- Faulty called function address: 0x8000D43

Usage Faults
- Undefined instruction (UNDEFINSTR)
- Attempt to enter an invalid instruction set state (INVSTATE)
- Failed integrity check on exception return (INVPC)
- Attempt to access a non-existing coprocessor (NOCP)
- Illegal unaligned load or store (UNALIGNED)
- Stack overflow (STKOF)
- Divide by 0 (DIVBYZERO)

Bus Faults
- During exception stacking (STKERR)
- During exception unstacking (UNSTKERR)
- During instruction prefetching, precise (IBUSERR)
- During lazy floating-point state preservation (LSPERR)
- Precise data access error, precise (PRECISERR)
- Imprecise data access error, imprecise (IMPRECISERR)
- BFAR

Memory Management Faults
- Fault on instruction access (IACCVIOL)
- Fault on direct data access (DACCVIOL)
- Context stacking, because of an MPU access violation (MSTKERR)
- Context unstacking, because of an MPU access violation (MUNSTKERR)
- Context stacking, because of an MPU access violation (MLSPERR)
- MMFAR

CPU capture during exception

Register	Value
R0	0x0
R1	0x18
R2	0x80000ED14
R3	0x1
R12	0x80000000
SP	0x200003A0
LR	0xFFFFFFE9
PC	0x8001298
XPSR	0x1000000

- NVIC position : 0
- Execution mode : Handler
- Stack memory region : Main Stack

ST-LINK configuration

Serial number	[illegible]
Port	SWD
Frequency (kHz)	4000
Mode	Hot plug
Access port	0
Reset mode	Software reset
Shared	Disabled
External loader	-
Target voltage	3.24 V
Firmware version	V2J37M26

Log   Verbosity level [✓ 1] 2 3

```
10:56:03 : Read progress:
10:56:03 : Data read successfully
10:56:03 : Time elapsed during the read operation is: 00:00:00.007
10:56:07 : STM32CubeProgrammer Fault Analyzer
10:56:07 : Execution Mode   : Handler
10:56:07 : Usage Fault detected in instruction located at 0x08000FF0
10:56:07 : NVIC position : 0
10:56:07 : DIVBYZERO : The processor has executed a SDIV or UDIV instruction with a divisor of 0.
10:56:07 : Hard Fault detected in instruction located at 0x08000FF0
10:56:07 : Faulty function called at this location 0x08000D43
10:56:07 : Hard Fault State Register information :
10:56:07 : FORCED : forced Hard Fault.
10:56:07 : Exception return information :
10:56:07 : Return to Thread mode, exception return uses non-floating-point
10:56:07 : state from MSP and execution uses MSP after return.
```

100%

Target information

Board	NUCLEO-L476RG
Device	STM32L4x1/STM32L475xx/ST...
Type	MCU
Device ID	0x415
Revision ID	Rev 4
Flash size	1 MB
CPU	Cortex-M4

2.13.3 Fault Analyzer Note

Fault Analyzer may be unable to detect untracked faults since they were not enabled by software.

The configuration and control register (CCR) controls the behavior of the Usage Fault for divide by-zero and unaligned memory accesses and it is used mainly to control customizable fault exceptions.

The following bits of the CCR control the behavior of the Usage Fault:

Figure 44. CCR bits

31 ... 10	9	8	7	6	5	4	3	2	1	0
Reserved	STKALIGN	BFHFNMIGN		Reserved		DIV_0_TRP	UNALIGN_TRP	Reserved	USERSETMPEND	NONBASETHRDENA

- DIV_0_TRP: Enable Usage Fault when the processor executes an SDIV or UDIV instruction with a 0 divider.
  - 0 = do not trap divide by 0; a divide by 0 returns a quotient of 0.
  - 1 = trap divide by 0.
- UNALIGN_TRP: enable usage fault when a memory access to unaligned addresses is performed.
  - 0 = do not trap unaligned half-word and word accesses
  - 1 = trap unaligned half-word and word accesses; an unaligned access generates a usage fault.

Note that unaligned accesses with LDM, STM, LDRD, and STRD instructions always generate a usage fault, even when UNALIGN_TRP is set to 0.

STM32CubeProgrammer enables the required bits at the analysis startup, if no fault detected an informative popup is displayed to indicate that you must reproduce the scenario and restart the fault Analysis.

2.13.4 Secure Fault Analyzer for Cortex-M33

STM32CubeProgrammer provides information about security related faults for Cortex-M33 based devices for both CLI and GUI interfaces.

A new field named “Secure Faults” is added to Fault Analyzer window when you connect a device based on Cortex-M33 (such as MCUs of the STM32L5 Series).

The result analysis is based on Secure Fault Status Register (SFSR) settings and a fault is triggered if an error occurs:

- INVEP: this bit is set if a function call from the Non-secure state or exception targets a non-SG instruction in the Secure state. This bit is also set if the target address is a SG instruction, but there is no matching SAU/IDAU region with the NSC flag set.
- INVIS: this bit is set if the integrity signature in an exception stack frame is found to be invalid during the unstacking operation.
- INVER: set to 1 when returning from an exception in the Non-secure state.
- AUVIOL: attempt was made to access parts of the address space that are marked as Secure with NS-Req for the transaction set to Non-secure. This bit is not set if the violation occurred during lazy state preservation.
- INVTRAN: indicates that an exception was raised due to a branch not flagged as being domain crossing causing a transition from Secure to Non-secure memory.

- LSPERR: Indicates that an SAU or IDAU violation occurred during the lazy preservation of floating-point state.
- SFARVALID: this bit is set when the SFAR register contains a valid value.
- LSERR: indicates that an error occurred during lazy state activation or deactivation.
- SFAR: indicates the address value when a secure fault is raised.

3 STM32CubeProgrammer command line interface (CLI) for MCUs

3.1 Command line usage

The following sections describe how to use the STM32CubeProgrammer from the command line. Available commands are shown in *Figure 45*.

Note: To launch command line interface on macOS, you need to call STM32CubeProgrammer.app/Contents/MacOs/bin/STM32_Programmer_CLI.

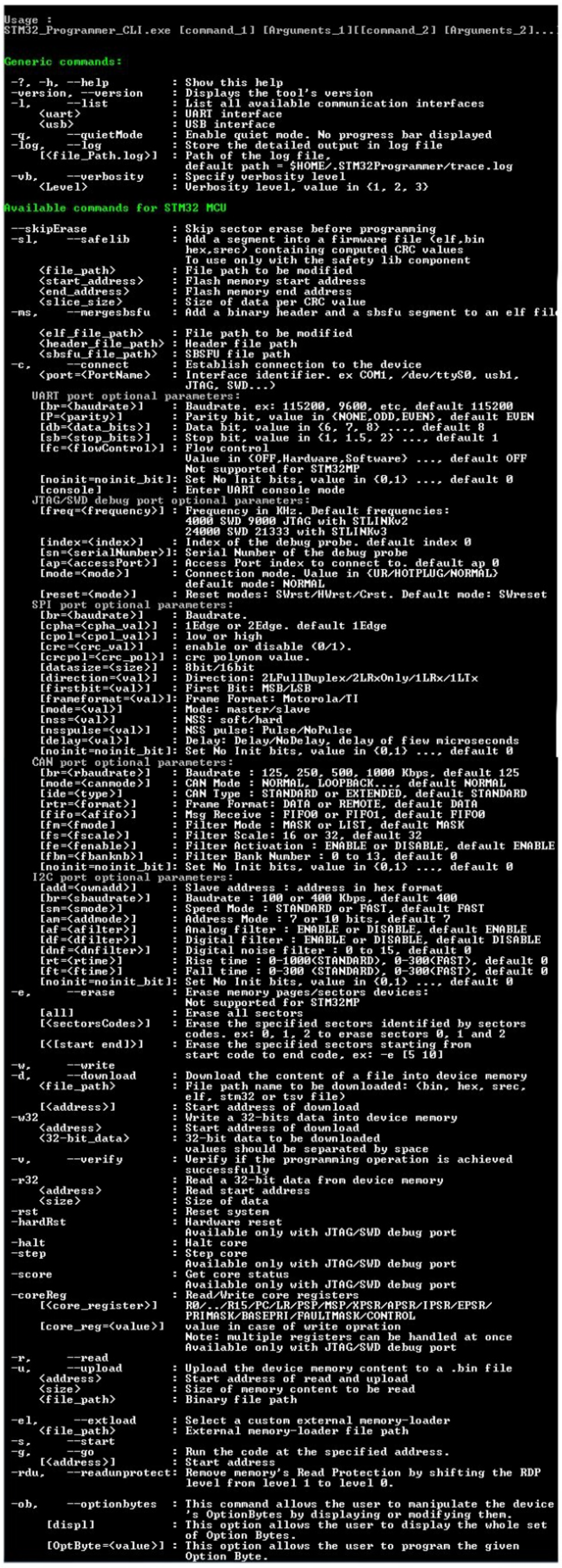


Figure 45. STM32CubeProgrammer: available commands

```
Usage :
STM32_Programmer_CLI.exe [command_1] [Arguments_1][[command_2] [Arguments_2]...

Generic commands:

 -?, -h, --help          : Show this help
 -version, --version     : Displays the tool's version
 -l,     --list          : List all available communication interfaces
     <uart>              : UART interface
     <usb>               : USB interface
 -q,     --quietMode     : Enable quiet mode. No progress bar displayed
 -log,   --log           : Store the detailed output in log file
     [<file_Path.log>]   : Path of the log file,
                           default path = $HOME/.STM32Programmer/trace.log
 -vb,    --verbosity     : Specify verbosity level
     <Level>             : Verbosity level, value in {1, 2, 3}

Available commands for STM32 MCU

 --skipErase             : Skip sector erase before programming
 -sl,    --safelib       : Add a segment into a firmware file (elf,bin
                           hex,srec) containing computed CRC values
                           To use only with the safety lib component
     <file_path>         : File path to be modified
     <start_address>     : Flash memory start address
     <end_address>       : Flash memory end address
     <slice_size>        : Size of data per CRC value
 -ms,    --mergesbsfu    : Add a binary header and a sbsfu segment to an elf fil

     <elf_file_path>     : File path to be modified
     <header_file_path>  : Header file path
     <sbsfu_file_path>   : SBSFU file path
 -c,     --connect       : Establish connection to the device
     <port=<PortName>    : Interface identifier. ex COM1, /dev/ttyS0, usb1,
                           JTAG, SWD...)
    UART port optional parameters:
     [br=<baudrate>]     : Baudrate. ex: 115200, 9600, etc, default 115200
     [P=<parity>]        : Parity bit, value in {NONE,ODD,EVEN}, default EVEN
     [db=<data_bits>]    : Data bit, value in {6, 7, 8} ..., default 8
     [sb=<stop_bits>]    : Stop bit, value in {1, 1.5, 2} ..., default 1
     [fc=<flowControl>]  : Flow control
                           Value in {OFF,Hardware,Software} ..., default OFF
                           Not supported for STM32MP
     [noinit=noinit_bit]: Set No Init bits, value in {0,1} ..., default 0
     [console]           : Enter UART console mode
    JTAG/SWD debug port optional parameters:
     [freq=<frequency>]  : Frequency in KHz. Default frequencies:
                           4000 SWD 9000 JTAG with STLINKv2
                           24000 SWD 21333 with STLINKv3
     [index=<index>]     : Index of the debug probe. default index 0
     [sn=<serialNumber>]: Serial Number of the debug probe
     [ap=<accessPort>]   : Access Port index to connect to. default ap 0
     [mode=<mode>]       : Connection mode. Value in {UR/HOTPLUG/NORMAL}
                           default mode: NORMAL
     [reset=<mode>]      : Reset modes: SWrst/HWrst/Crst. Default mode: SWreset
    SPI port optional parameters:
     [br=<baudrate>]     : Baudrate.
     [cpha=<cpha_val>]   : 1Edge or 2Edge. default 1Edge
     [cpol=<cpol_val>]   : low or high
     [crc=<crc_val>]     : enable or disable (0/1).
     [crcpol=<crc_pol>]  : crc polynom value.
     [datasize=<size>]   : 8bit/16bit
     [direction=<val>]   : Direction: 2LFullDuplex/2LRxOnly/1LRx/1LTx
     [firstbit=<val>]    : First Bit: MSB/LSB
     [frameformat=<val>]: Frame Format: Motorola/TI
     [mode=<val>]        : Mode: master/slave
     [nss=<val>]         : NSS: soft/hard
     [nsspulse=<val>]    : NSS pulse: Pulse/NoPulse
     [delay=<val>]       : Delay: Delay/NoDelay, delay of fiew microseconds
     [noinit=noinit_bit]: Set No Init bits, value in {0,1} ..., default 0
    CAN port optional parameters:
     [br=<rbaudrate>]    : Baudrate : 125, 250, 500, 1000 Kbps, default 125
     [mode=<canmode>]    : CAN Mode : NORMAL, LOOPBACK..., default NORMAL
     [ide=<type>]        : CAN Type : STANDARD or EXTENDED, default STANDARD
     [rtr=<format>]      : Frame Format: DATA or REMOTE, default DATA
     [fifo=<afifo>]      : Msg Receive : FIFO0 or FIFO1, default FIFO0
     [fm=<fmode]         : Filter Mode : MASK or LIST, default MASK
     [fs=<fscale>]       : Filter Scale: 16 or 32, default 32
     [fe=<fenable>]      : Filter Activation : ENABLE or DISABLE, default ENABLE
     [fbn=<fbanknb>]     : Filter Bank Number : 0 to 13, default 0
     [noinit=noinit_bit]: Set No Init bits, value in {0,1} ..., default 0
    I2C port optional parameters:
     [add=<ownadd>]      : Slave address : address in hex format
     [br=<sbaudrate>]    : Baudrate : 100 or 400 Kbps, default 400
     [sm=<smode>]        : Speed Mode : STANDARD or FAST, default FAST
     [am=<addmode>]      : Address Mode : 7 or 10 bits, default 7
     [af=<afilter>]      : Analog filter : ENABLE or DISABLE, default ENABLE
     [df=<dfilter>]      : Digital filter : ENABLE or DISABLE, default DISABLE
     [dnf=<dnfilter>]    : Digital noise filter : 0 to 15, default 0
     [rt=<rtime>]        : Rise time : 0-1000(STANDARD), 0-300(FAST), default 0
     [ft=<ftime>]        : Fall time : 0-300 (STANDARD), 0-300(FAST), default 0
     [noinit=noinit_bit]: Set No Init bits, value in {0,1} ..., default 0
 -e,     --erase         : Erase memory pages/sectors devices:
                           Not supported for STM32MP
     [all]               : Erase all sectors
     [<sectorsCodes>]    : Erase the specified sectors identified by sectors
                           codes. ex: 0, 1, 2 to erase sectors 0, 1 and 2
     [<[start end]>]     : Erase the specified sectors starting from
                           start code to end code, ex: -e [5 10]
 -w,     --write
 -d,     --download      : Download the content of a file into device memory
     <file_path>         : File path name to be downloaded: (bin, hex, srec,
                           elf, stm32 or tsv file)
     [<address>]         : Start address of download
 -w32                    : Write a 32-bits data into device memory
     <address>           : Start address of download
     <32-bit_data>       : 32-bit data to be downloaded
                           values should be separated by space
 -v,     --verify        : Verify if the programming operation is achieved
                           successfully
 -r32                    : Read a 32-bit data from device memory
     <address>           : Read start address
     <size>              : Size of data
 -rst                    : Reset system
 -hardRst                : Hardware reset
                           Available only with JTAG/SWD debug port
 -halt                   : Halt core
 -step                   : Step core
                           Available only with JTAG/SWD debug port
 -score                  : Get core status
                           Available only with JTAG/SWD debug port
 -coreReg                : Read/Write core registers
     [<core_register>]     R0/../R15/PC/LR/PSP/MSP/XPSR/APSR/IPSR/EPSR/
                           PRIMASK/BASEPRI/FAULTMASK/CONTROL
     [core_reg=<value>]    value in case of write opration
                           Note: multiple registers can be handled at once
                           Available only with JTAG/SWD debug port
 -r,     --read
 -u,     --upload        : Upload the device memory content to a .bin file
     <address>           : Start address of read and upload
     <size>              : Size of memory content to be read
     <file_path>         : Binary file path

 -el,     --extload      : Select a custom external memory-loader
     <file_path>         : External memory-loader file path
 -s,     --start
 -g,     --go            : Run the code at the specified address.
     [<address>]         : Start address
 -rdu,   --readunprotect: Remove memory's Read Protection by shifting the RDP
                           level from level 1 to level 0.

 -ob,    --optionbytes   : This command allows the user to manipulate the device
                           's OptionBytes by displaying or modifying them.
      [displ]            : This option allows the user to display the whole set
                           of Option Bytes.
      [OptByte=<value>] : This option allows the user to program the given
                           Option Byte.
```

3.2 Generic commands

This section presents the set of commands supported by all STM32 MCUs.

3.2.1 Connect command

-c, --connect

Description: Establishes the connection to the device. This command allows the host to open the chosen device port (UART/USB/JTAG/SWD/SPI/CAN/I2C).

Syntax: `-c port=<Portname> [noinit=<noinit_bit>] [options]`

`port=<Portname`	Interface identifier, ex COMx (for Windows), /dev/ttySx for Linux), usbx for USB interface, SPI, I2C and CAN for, respectively, SPI, I2C and CAN interfaces.
`[noinit=<noinit_bit>]`	Set No Init bits, value in {0, 1} ..., default 0. Noinit = 1 can be used if a previous connection is usually active.

- ST-LINK options

`[freq=<frequency>]`	Frequency in kHz used in connection. Default value is 4000 kHz for SWD port, and 9000 kHz for JTAG port

Note: The entered frequency values are rounded to correspond to those supported by ST-LINK probe.

`[index=<index>]`	Index of the debug probe. Default index value is 0.
`[sn=<serialNumber>]`	Serial number of the debug probe. Use this option if you need to connect to a specific ST-LINK probe of which you know the serial number. Do not use this option with Index option in the same connect command.
`[mode=<mode>]`	Connection mode. Value in {NORMAL/UR/HOTPLUG}. Default value is NORMAL.
`Normal`	With ‘Normal’ connection mode, the target is reset then halted. The type of reset is selected using the ‘Reset Mode’ option.
`UR`	The ‘Connect Under Reset’ mode enables connection to the target using a reset vector catch before executing any instructions. This is useful in many cases, for example when the target contains a code that disables the JTAG/SWD pins.
`HOTPLUG`	The ‘Hot Plug’ mode enables connection to the target without a halt or reset. This is useful for updating the RAM addresses or the IP registers while the application is running.
`[ap=<accessPort>]`	Access port index. Default access port value is 0.

`[shared]`	Enables shared mode allowing connection of two or more instances of STM32CubeProgrammer or other debugger to the same ST-LINK probe.
`[tcpport=<Port>]`	Selects the TCP Port to connect to an ST-Link Server. Shared option must be selected. Default value is 7184.

Note: Shared mode is supported only on Windows.

- USB options

The connection under the DFU interface supports two options, namely product and vendor ID (default values PID=0xDF11, VID=0x0483).

- SPI options

`[br=<baudrate>]`	Baudrate (e.g. 187, 375, 750), default 375

Note: To use SPI on high speed, an infrastructure hardware must be respected to ensure the proper connection on the bus.

`[cpha=<cpha_val>]`	1Edge or 2Edge, default 1Edge
`[cpol=<cpol_val>]`	Low or high, default low
`[crc=<crc_val>]`	Enable or disable (0/1), default 0
`[crcpol=<crc_pol>]`	CRC polynomial value
`[datasize=<size>]`	8- or 16-bit, default 8-bit
`[direction=<val>]`	2LFullDuplex/2LRxOnly/1LRx/1LTx
`[firstbit=<val>]`	MSB/LSB, default MSB
`[frameformat=<val>]`	Motorola/TI, default Motorola
`[mode=<val>]`	Master/slave, default master
`[nss=<val>]`	Soft/hard, default hard
`[nsspulse=<val>]`	Pulse/NoPulse, default Pulse
`[delay=<val>]`	Delay/NoDelay, default Delay

- I2C options

`[add=<ownadd>]`	Slave address: address in hex format

Note: I2C address option must be always inserted, otherwise the connection is not established.

`[br=<sbaudrate>]`	Baudrate: 100 or 400 Kbps, default 400.
`[sm=<smode>]`	Speed Mode, STANDARD or FAST, default FAST.
`[am=<addmode>]`	Address Mode: 7 or 10 bits, default 7.
`[af=<afilter>]`	Analog filter: ENABLE or DISABLE, default ENABLE.
`[df=<dfilter>]`	Digital filter: ENABLE or DISABLE, default DISABLE.
`[dnf=<dnfilter>]`	Digital noise filter: 0 to 15, default 0.

`[rt=<rtime>]`	Rise time: 0-1000 (STANDARD), 0-300 (FAST), default 0.
`[ft=<ftime>]`	Fall time: 0-300 (STANDARD), 0-300 (FAST), default 0.

- CAN options

`[br=<rbaudrate>]`	Baudrate: 125, 250..., default 125.
`[mode=<canmode>]`	Mode: NORMAL, LOOPBACK..., default NORMAL.

Note: The software must request the hardware to enter Normal mode to synchronize on the CAN bus and start reception and transmission between the Host and the CAN device. Normal mode is recommended.

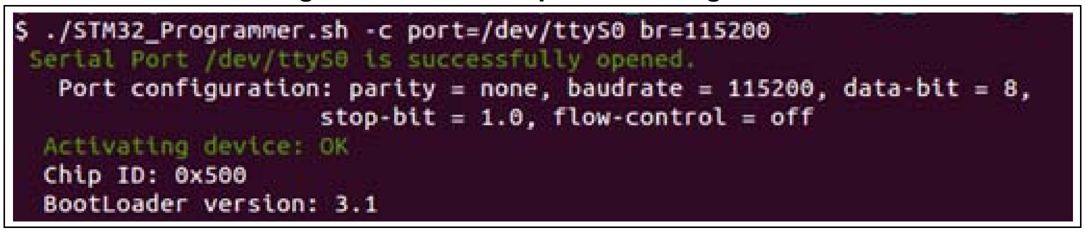
`[ide=<type>]`	Type: STANDARD or EXTENDED, default STANDARD
`[rtr=<format>]`	Frame format: DATA or REMOTE, default DATA
`[fifo=<afifo>]`	Assigned FIFO: FIFO0 or FIFO1, default FIFO0
`[fm=<fmode]`	Filter mode: MASK or LIST, default MASK
`[fs=<fscale>]`	Filter scale: 16 or 32, default 32
`[fe=<fenable>]`	Activation: ENABLE or DISABLE, default ENABLE
`[fbn=<fbanknb>]`	Filter bank number: 0 to 13, default 0

- Using UART

./STM32_Programmer.sh -c port=/dev/ttyS0 br=115200

The result of this example is shown in *Figure 46*.

Figure 46. Connect operation using RS232



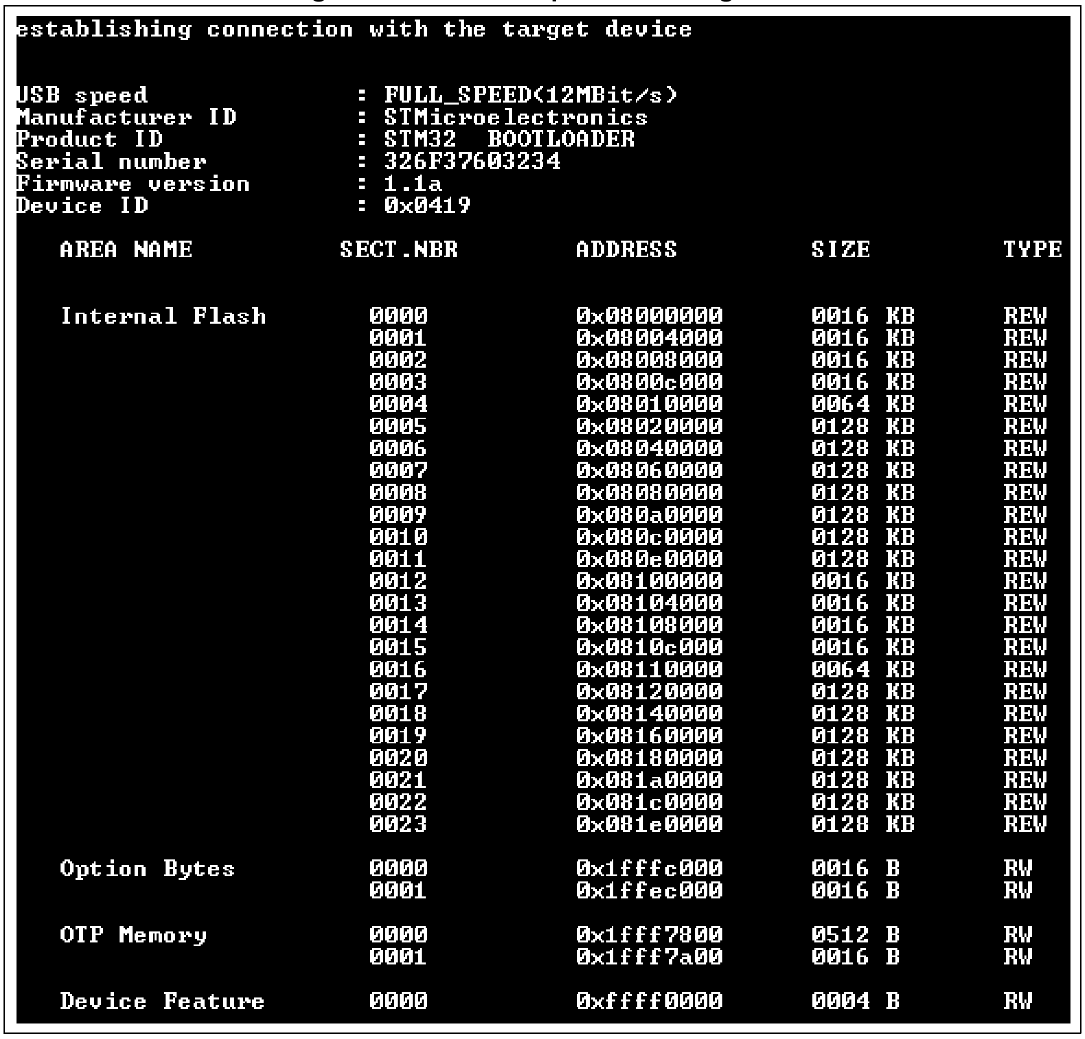
```
$ ./STM32_Programmer.sh -c port=/dev/ttyS0 br=115200
 Serial Port /dev/ttyS0 is successfully opened.
   Port configuration: parity = none, baudrate = 115200, data-bit = 8,
                     stop-bit = 1.0, flow-control = off
  Activating device: OK
  Chip ID: 0x500
  BootLoader version: 3.1
```

Example using USB

./STM32_Programmer.sh -c port=usb1

The result of this example is shown in *Figure 47*.

Figure 47. Connect operation using USB



```
establishing connection with the target device


USB speed              : FULL_SPEED(12MBit/s)
Manufacturer ID        : STMicroelectronics
Product ID             : STM32  BOOTLOADER
Serial number          : 326F37603234
Firmware version       : 1.1a
Device ID              : 0x0419
   AREA NAME          SECT.NBR        ADDRESS         SIZE         TYPE


   Internal Flash       0000          0x08000000      0016 KB      REW
                        0001          0x08004000      0016 KB      REW
                        0002          0x08008000      0016 KB      REW
                        0003          0x0800c000      0016 KB      REW
                        0004          0x08010000      0064 KB      REW
                        0005          0x08020000      0128 KB      REW
                        0006          0x08040000      0128 KB      REW
                        0007          0x08060000      0128 KB      REW
                        0008          0x08080000      0128 KB      REW
                        0009          0x080a0000      0128 KB      REW
                        0010          0x080c0000      0128 KB      REW
                        0011          0x080e0000      0128 KB      REW
                        0012          0x08100000      0016 KB      REW
                        0013          0x08104000      0016 KB      REW
                        0014          0x08108000      0016 KB      REW
                        0015          0x0810c000      0016 KB      REW
                        0016          0x08110000      0064 KB      REW
                        0017          0x08120000      0128 KB      REW
                        0018          0x08140000      0128 KB      REW
                        0019          0x08160000      0128 KB      REW
                        0020          0x08180000      0128 KB      REW
                        0021          0x081a0000      0128 KB      REW
                        0022          0x081c0000      0128 KB      REW
                        0023          0x081e0000      0128 KB      REW

   Option Bytes         0000          0x1fffc000      0016 B       RW
                        0001          0x1ffec000      0016 B       RW

   OTP Memory           0000          0x1fff7800      0512 B       RW
                        0001          0x1fff7a00      0016 B       RW

   Device Feature       0000          0xffff0000      0004 B       RW
```

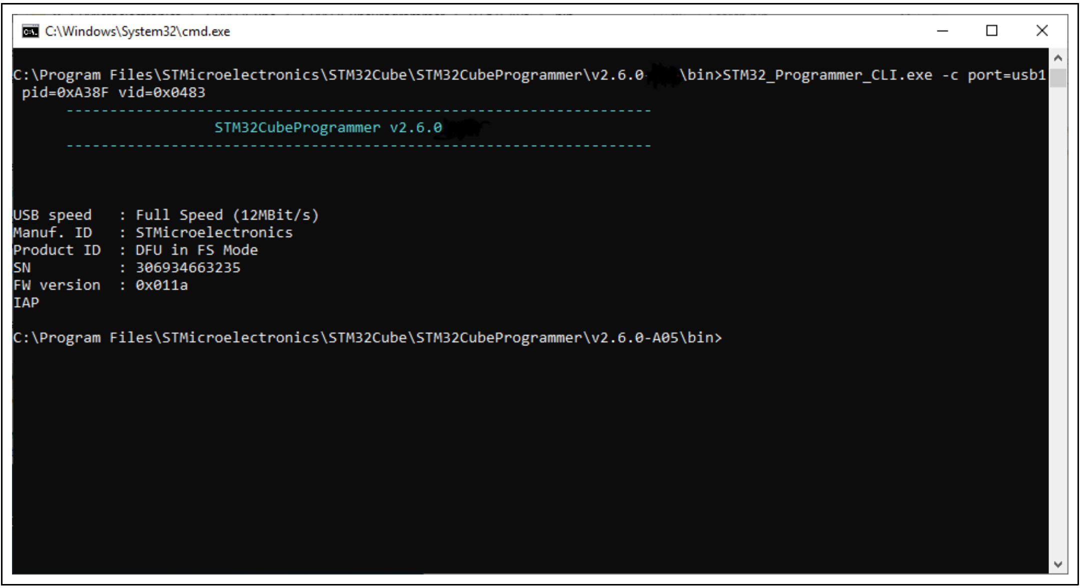
Note: *When using a USB interface, all the configuration parameters (e.g. baud rate, parity, data-bits, frequency, index) are ignored. To connect using a UART interface the port configuration (baudrate, parity, data-bits, stopbits and flow-control) must have a valid combination, depending on the used device.*

Example using DFU IAP options

/STM32_Programmer.sh -c port=usb1 pid=0xA38F vid=0x0438

The result of this example is shown in *Figure 48*.

Figure 48. Connect operation using USB DFU options



C:\Windows\System32\cmd.exe

```
C:\Program Files\STMicroelectronics\STM32Cube\STM32CubeProgrammer\v2.6.0-[redacted]\bin>STM32_Programmer_CLI.exe -c port=usb1
 pid=0xA38F vid=0x0483
      -------------------------------------------------------------------
                       STM32CubeProgrammer v2.6.0[redacted]
      -------------------------------------------------------------------



USB speed     : Full Speed (12MBit/s)
Manuf. ID     : STMicroelectronics
Product ID    : DFU in FS Mode
SN            : 306934663235
FW version    : 0x011a
IAP

C:\Program Files\STMicroelectronics\STM32Cube\STM32CubeProgrammer\v2.6.0-A05\bin>
```

Note: *The default value of product ID and vendor ID are ST products values (PID=0xDF11, VID=0x0483).*

Example using JTAG/SWD debug port

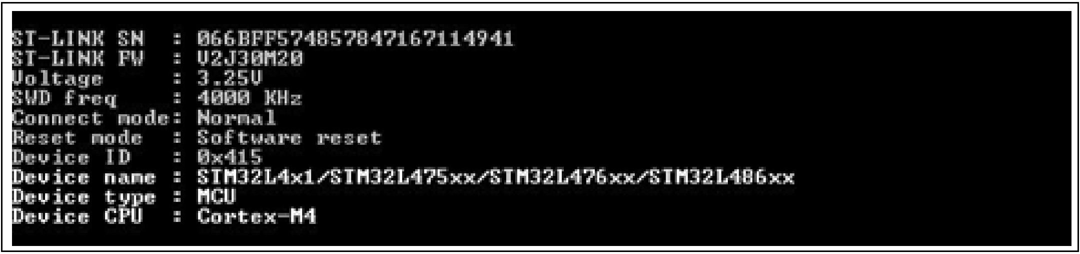
To connect using port connection mode with ST-LINK probe it is necessary to mention the port name with the connect command at least (for example: `-c port=JTAG`).

Note: *Make sure that the device being used contains a JTAG debug port when trying to connect through the JTAG.*

There are other parameters used in connection with JTAG/SWD debug ports that have default values (see the Help menu of the tool for more information about default values).

The example below shows a connection example with an STM32 with device ID 0x415.

Figure 49. Connect operation using SWD debug port



```
ST-LINK SN   : 066BFF574857847167114941
ST-LINK FW   : V2J30M20
Voltage      : 3.25V
SWD freq     : 4000 KHz
Connect mode: Normal
Reset mode   : Software reset
Device ID    : 0x415
Device name  : STM32L4x1/STM32L475xx/STM32L476xx/STM32L486xx
Device type  : MCU
Device CPU   : Cortex-M4
```

The corresponding command line for this example is `-c port=SWD freq=3900 ap=0`

In the connect command `(-c port=SWD freq=3900 ap=0)`

- The <port> parameter is mandatory.
- The index is not mentioned in the command line. The Index parameter takes the default value 0.
- The frequency entered is 3900 kHz, however the connection is established with 4000 kHz. This is due to the fact that ST-LINK probe has fixed values with SWD and JTAG debug ports.
- ST-LINK v2/v2.1
  - SWD (4000, 1800, 950, 480, 240, 125, 100, 50, 25, 15, 5) kHz
  - JTAG (9000, 4500, 2250, 1125, 562, 281, 140) kHz
- ST-LINK v3
  - SWD (24000, 8000, 3300, 1000, 200, 50, 5)
  - JTAG (21333, 16000, 12000, 8000, 1777, 750)

If the value entered does not correspond to any of these values, the next highest one is considered. Default frequency values are:

- SWD: STLinkV2: 4000 kHz, STLinkV3: 24000 kHz
- JTAG: STLinkV2: 9000 kHz, STLinkV3: 21333 kHz

Note: JTAG frequency selection is only supported with ST-LINK firmware versions from V2J23 onward.

To connect to access port 0 the ap parameter is used in this example, so any command used after the connect command is established through the selected access port.

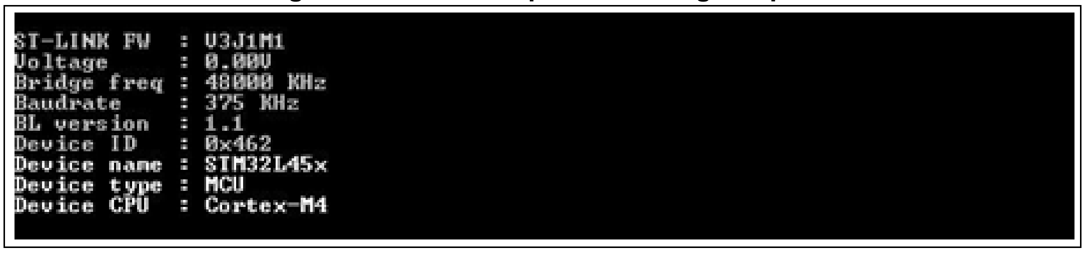
Note: The ST-LINK probe firmware version is shown when connecting to the device. Make sure that you have the latest version of ST-LINK firmware V2J28M17 (STSW-LINK007), available on www.st.com.

Example using SPI

`STM32_Programmer_CLI -c port=SPI br=375 cpha=1edge cpol=low`

The result of this example is shown in *Figure 50*.

Figure 50. Connect operation using SPI port



```
ST-LINK FW   : V3J1M1
Voltage      : 0.00V
Bridge freq  : 48000 KHz
Baudrate     : 375 KHz
BL version   : 1.1
Device ID    : 0x462
Device name  : STM32L45x
Device type  : MCU
Device CPU   : Cortex-M4
```

Note: *Make sure that the device being used supports a SPI bootloader when trying to connect through the SPI.*

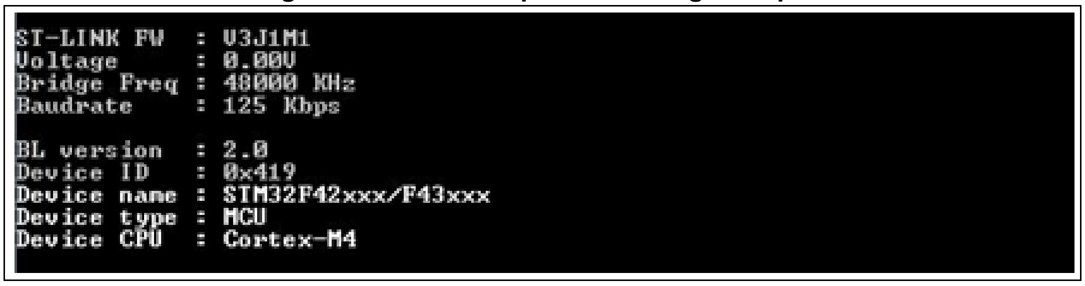
There are other parameters used in connection with SPI port that have default values, and some others must have specific values (see the help menu of the tool for more information).

Example using CAN

`STM32_Programmer_CLI -c port=CAN br=125 fifo=fifo0 fm=mask fs=32 fe=enable fbn=2`

The result of this example is shown in *Figure 51*.

Figure 51. Connect operation using CAN port



```
ST-LINK FW   : V3J1M1
Voltage      : 0.00V
Bridge Freq  : 48000 KHz
Baudrate     : 125 Kbps

BL version   : 2.0
Device ID    : 0x419
Device name  : STM32F42xxx/F43xxx
Device type  : MCU
Device CPU   : Cortex-M4
```

Note: *Not all devices implement this feature, make sure the one you are using supports a CAN bootloader.*

There are other parameters used in connection with CAN port that have default values and some others must have specific values (see the help menu of the tool for more information).

Example using I2C

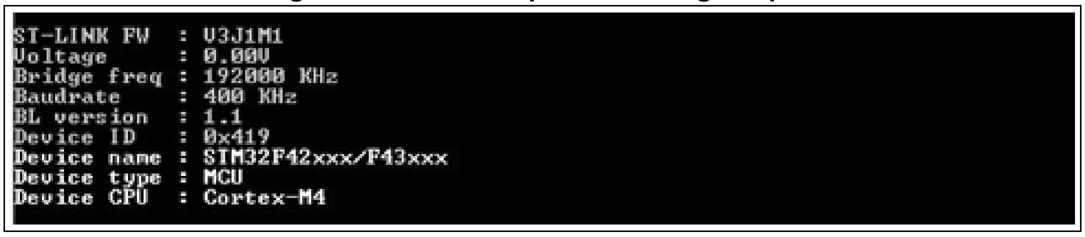
`STM32_Programmer_CLI -c port=I2C add=0x38 br=400 sm=fast`

In the connect command:

- The parameter <add> changes from a device to another, refer to AN2606 to extract the correct one. In this case, the STM32F42xxx has a bootloader address equal to 0x38.
- The baudrate parameter <br> depends directly on the speed mode parameter <sm>, for example, if sm=standard then the baudrate does not support the value 400.

The result of this example is shown in *Figure 52*.

Figure 52. Connect operation using I2C port



```
ST-LINK FW   : V3J1M1
Voltage      : 0.00V
Bridge freq  : 192000 KHz
Baudrate     : 400 KHz
BL version   : 1.1
Device ID    : 0x419
Device name  : STM32F42xxx/F43xxx
Device type  : MCU
Device CPU   : Cortex-M4
```

Note: For each I2C connection operation the address parameter is mandatory.

Note: Not all devices implement this feature, make sure that the device supports an I2C bootloader.

There are other parameters used in connection with I2C port that have default values and some others must have specific values (see the help menu of the tool for more information).

Note: For the parallel programming of more than one STM32 device using multiple instances of STM32CubeProgrammer, it is mandatory to add the serial number of each device in the suitable instance, as shown in the following example:

- *"–c port=swd/usb sn=SN1" (instance 1 of STM32CubeProgrammer)*
- *"–c port=swd/usb sn=SN2" (instance 2 of STM32CubeProgrammer)*
- *"–c port=swd/usb sn=SN3" (instance 3 of STM32CubeProgrammer)*

3.2.2 Erase command

-e, --erase

Description: According to the given arguments, this command can be used to erase specific sectors or the entire Flash memory. This operation can take a second or more to complete, depending on the involved size.

Syntax:

`[all]`	Erase all sectors.
`[<sectorsCodes>]`	Erase the sectors identified by codes (e.g. `0,1,2` to erase sectors 0, 1 and 2). For EEPROM: `ed1 & ed2`.
`[<[start end]>]`	Erase the specified sectors starting from start code to end code, e.g. `-e [5 10]`.

Example

```
./STM32_Programmer.sh --connect port=/dev/ttyS0 -e 2 4
```

This command erases only sectors 2 and 4.

Note: *In the case of a multiplicity of external loaders, the first selected is the one that will be taken into account during erasing of the external memory.*

3.2.3 Download command

-w, --write, -d, --download

Description: Downloads the content of the specified binary file into device memory. The download operation is preceded by the erase operation before the Flash memory is downloaded. A write address is only needed to download binary files.

Syntax: `-w <file_path> [start_address]`

`[file_path]`	Path of the file to be downloaded
`[start_address]`	Start address of download

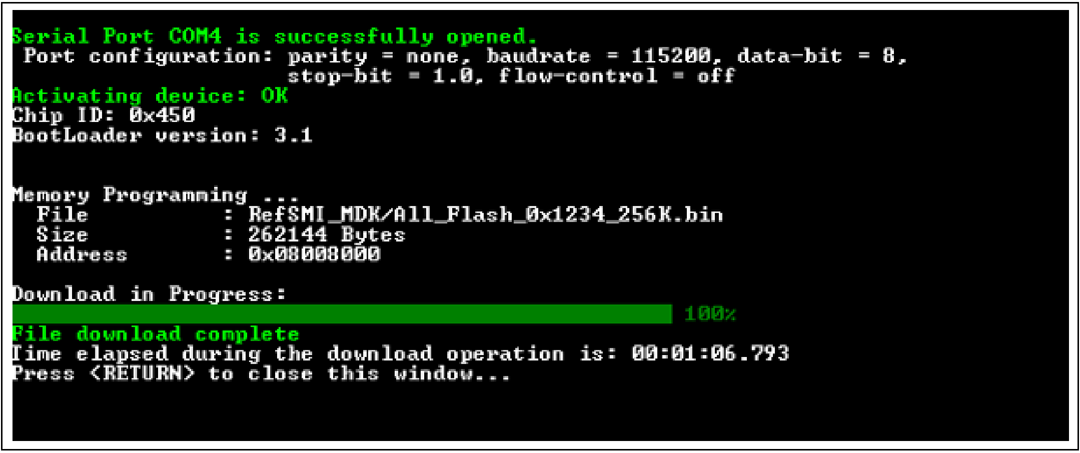
Example

```
-c port=COM4 -w RefSMI_MDK/All_Flash_0x1234_256K.bin 0x08008000
```

This command programs the binary file “All_Flash_0x1234_256K.bin” at address 0x08008000.

The result of this example is shown in *Figure 53*.

Figure 53. Download operation



```
Serial Port COM4 is successfully opened.
 Port configuration: parity = none, baudrate = 115200, data-bit = 8,
                     stop-bit = 1.0, flow-control = off
Activating device: OK
Chip ID: 0x450
BootLoader version: 3.1


Memory Programming ...
  File          : RefSMI_MDK/All_Flash_0x1234_256K.bin
  Size          : 262144 Bytes
  Address       : 0x08008000

Download in Progress:
                                                   100%
File download complete
Time elapsed during the download operation is: 00:01:06.793
Press <RETURN> to close this window...
```

Note: *To verify that the download was successful, call the verify option (-v or –verify) just after the write command, otherwise the verify option is ignored.*

3.2.4 Download 32-bit data command

-w32

Description: Downloads the specified 32-bit data into Flash memory starting from a specified address.

Syntax: `-w32 <start_address> <32_data_bits>`

`<start_address>`	Start address of download.
`<32_data_Bits>`	32 data bits to be downloaded. Data must be separated by escape.

Example

```
./STM32_Programmer.sh -c port=/dev/ttyS0 br=9600 -w32 0x08000000
0x12345678 0xAABBCCFF 0x12AB34CD -verify
```

Note: This command makes it possible the 32 data bits (0x12345678, 0xAABBCCFF, 0x12AB34CD) to be written into the Flash memory starting from address 0x08000000.

3.2.5 Download 64-bit data command

-w64

Description: Downloads the specified 64-bit data into a destination address.

Syntax: `-w64 <start_address> <64-bit_data>`

`<start_address>`	Start address of download.
`<64_data_Bits>`	64-bit data to be downloaded. Data must be separated by escape.

Example:

```
/STM32_Programmer_CLI.exe -c port=swd -w64 0x08000000 0x12345678AABBCCFF
```

3.2.6 Read command

-r, --read, -u, --upload

Description: Reads and uploads the device memory content into a specified binary file starting from a specified address.

Syntax: `--upload <start_address> <size> <file_path>`

`<start_address>`	Start address of read.
`<size>`	Size of memory content to be read.
`<file_path>`	Binary file path to upload the memory content.

Example

```
./STM32_Programmer.sh -c port=/dev/ttyS0 br=9600 --upload
0x20007000 2000 "/local/ benayedh/Binaries/read2000.bin"
```

This command makes it possible to read 2000 bytes, starting from address 0x20007000, and uploads the content to a binary file *"/local/benayedh/Binaries/read2000.bin"*

-r32

Description: Read 32-bit data memory.

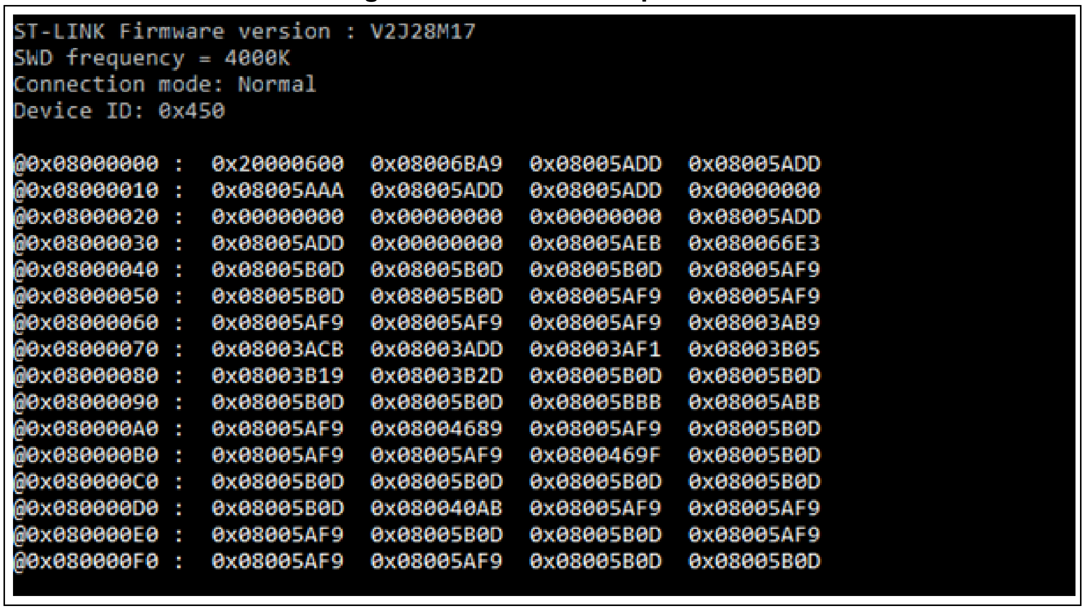
Syntax: `-r32 <start_address> <size>`

`<start_address>`	Start address of read.
`<size>`	Size of memory content to be read.

Example

```
./STM32_Programmer.sh -c port=SWD -r32 0x08000000 0x100
```

Figure 54. Read 32-bit operation



```
ST-LINK Firmware version : V2J28M17
SWD frequency = 4000K
Connection mode: Normal
Device ID: 0x450

@0x08000000 :  0x20000600  0x08006BA9  0x08005ADD  0x08005ADD
@0x08000010 :  0x08005AAA  0x08005ADD  0x08005ADD  0x00000000
@0x08000020 :  0x00000000  0x00000000  0x00000000  0x08005ADD
@0x08000030 :  0x08005ADD  0x00000000  0x08005AEB  0x080066E3
@0x08000040 :  0x08005B0D  0x08005B0D  0x08005B0D  0x08005AF9
@0x08000050 :  0x08005B0D  0x08005B0D  0x08005AF9  0x08005AF9
@0x08000060 :  0x08005AF9  0x08005AF9  0x08005AF9  0x08003AB9
@0x08000070 :  0x08003ACB  0x08003ADD  0x08003AF1  0x08003B05
@0x08000080 :  0x08003B19  0x08003B2D  0x08005B0D  0x08005B0D
@0x08000090 :  0x08005B0D  0x08005B0D  0x08005BBB  0x08005ABB
@0x080000A0 :  0x08005AF9  0x08004689  0x08005AF9  0x08005B0D
@0x080000B0 :  0x08005AF9  0x08005AF9  0x0800469F  0x08005B0D
@0x080000C0 :  0x08005B0D  0x08005B0D  0x08005B0D  0x08005B0D
@0x080000D0 :  0x08005B0D  0x080040AB  0x08005AF9  0x08005AF9
@0x080000E0 :  0x08005AF9  0x08005B0D  0x08005B0D  0x08005AF9
@0x080000F0 :  0x08005AF9  0x08005AF9  0x08005B0D  0x08005B0D
```

Note: The maximum size allowed with the –r32 command is 32 Kbytes.

3.2.7 Start command

-g, --go, -s, --start

Description: This command enables execution of the device memory starting from the specified address.

Syntax: `--start [start_address]`

`[start_address]` Start address of application to be executed.

Example

```
./STM32_Programmer.sh --connect port=/dev/ttyS0 br=9600 --start
0x08000000
```

This command runs the code specified at 0x08000000.

3.2.8 Debug commands

The following commands are available only with the JTAG/SWD debug port.

-rst

Description: Executes a software system reset;

Syntax: `-rst`

-hardRst

Description: Generates a hardware reset through the RESET pin in the debug connector.

The RESET pin of the JTAG connector (pin 15) must be connected to the device reset pin.

Syntax: `-hardRst`

-halt

Description: Halts the core.

Syntax: `-halt`

-step

Description: Executes one instruction.

Syntax: `-step`

-score

Description: Displays the Cortex-M core status.

The core status can be one of the following: ‘Running’, ‘Halted’, ‘Locked up’, ‘Reset’, ‘Locked up or Kept under reset’

Syntax: `-score`

-coreReg

Description: Read/write Cortex-M core registers. The core is halted before a read/write operation.

Syntax: `-coreReg [<core_register>]`
`R0/../R15/PC/LR/PSP/MSP/XPSR/APSR/IPSR/EPSR/PRIMASK/BASEPRI/FAULTMASK/CONTROL`

`[core_reg=<value>]`: The value to write in the core register for a write operation. Multiple registers can be handled at once.

Example

`-coreReg`	This command displays the current values of the core registers.
`-coreReg R0 R8`	This command displays the current values of R0 and R8.
`-coreReg R0=5 R8=10`	This command modifies the values of R0 and R8.

3.2.9 List command

-l, -list

Description: This command lists all available RS232 serial ports.

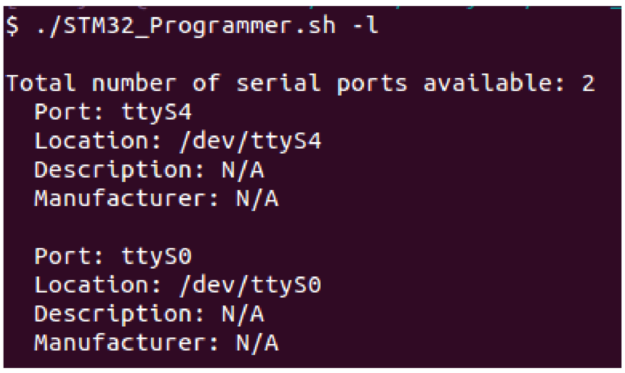
Syntax: `-l, --list`

Example

```
./STM32_Programmer.sh --list
```

The result of this example is shown in *Figure 55*.

Figure 55. The available serial ports list



```
$ ./STM32_Programmer.sh -l

Total number of serial ports available: 2
  Port: ttyS4
  Location: /dev/ttyS4
  Description: N/A
  Manufacturer: N/A

  Port: ttyS0
  Location: /dev/ttyS0
  Description: N/A
  Manufacturer: N/A
```

Note: This command is not supported with JTAG/SWD debug port.

3.2.10 QuietMode command

-q, --quietMode

Description: This command disables the progress bar display during download and read commands.

Syntax: `-q, --quietMode`

Example

```
./STM32_Programmer.sh -c port=/dev/ttyS0 br=115200 -quietMode -w
binaryPath.bin 0x08000000
```

3.2.11 Verbosity command

-vb, --verbosity

Description: This command makes it possible to display more messages, to be more verbose.

Syntax: `-vb <level>`

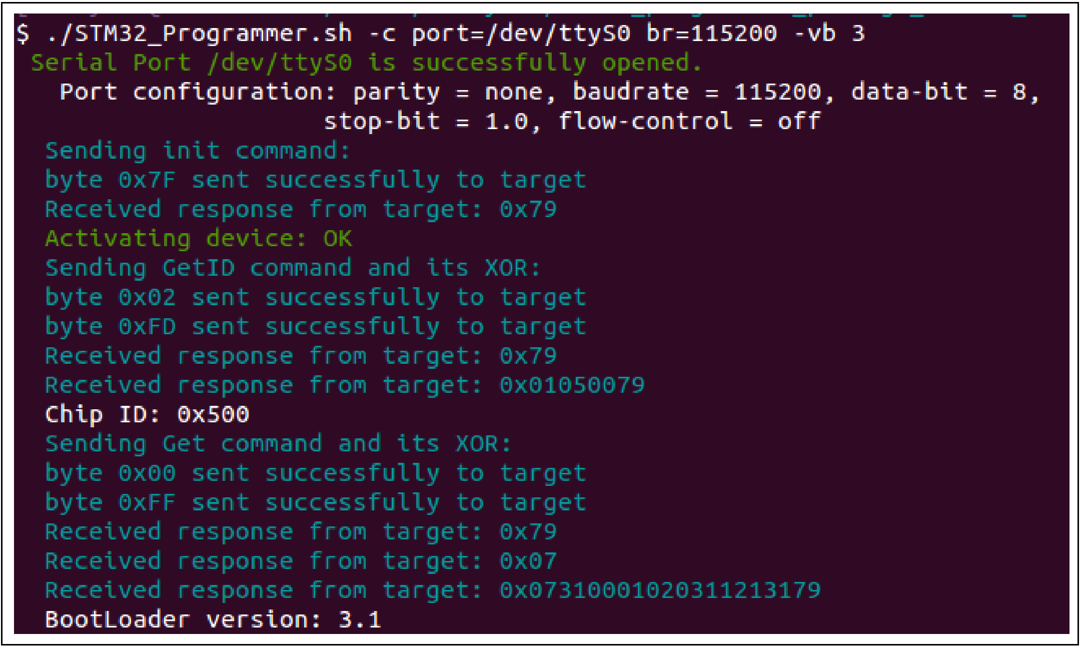
`<level>` : Verbosity level, value in {1, 2, 3} default value vb=1

Example

```
./STM32_Programmer.sh -c port=/dev/ttyS0 br=115200 -vb 3
```

The result of this example is shown in *Figure 56*.

Figure 56. Verbosity command



```
$ ./STM32_Programmer.sh -c port=/dev/ttyS0 br=115200 -vb 3
 Serial Port /dev/ttyS0 is successfully opened.
   Port configuration: parity = none, baudrate = 115200, data-bit = 8,
                     stop-bit = 1.0, flow-control = off
  Sending init command:
  byte 0x7F sent successfully to target
  Received response from target: 0x79
  Activating device: OK
  Sending GetID command and its XOR:
  byte 0x02 sent successfully to target
  byte 0xFD sent successfully to target
  Received response from target: 0x79
  Received response from target: 0x01050079
  Chip ID: 0x500
  Sending Get command and its XOR:
  byte 0x00 sent successfully to target
  byte 0xFF sent successfully to target
  Received response from target: 0x79
  Received response from target: 0x07
  Received response from target: 0x07310001020311213179
  BootLoader version: 3.1
```

3.2.12 Log command

-log, --log

Description: This traceability command makes it possible to store the whole traffic (with maximum verbosity level) into a log file.

Syntax: `-log [filePath.log]`

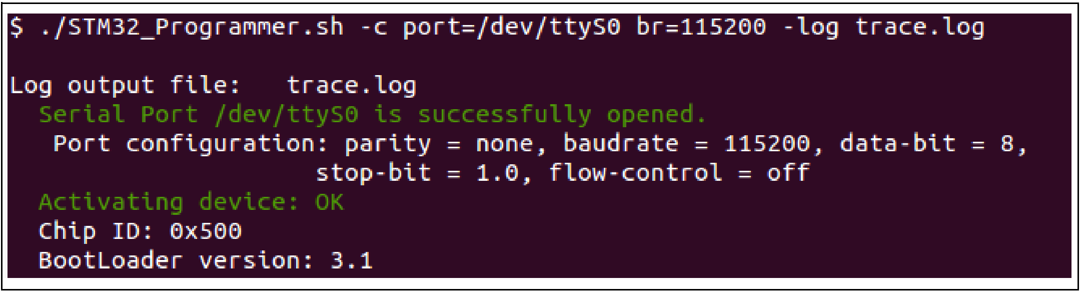
`[filePath.log]`	Path of log file, default is $HOME/.STM32CubeProgrammer/trace.log.

Example

`./STM32_Programmer.sh -c port=/dev/ttyS0 br=115200 -log trace.log`

The result of this example is shown in *Figure 57*.

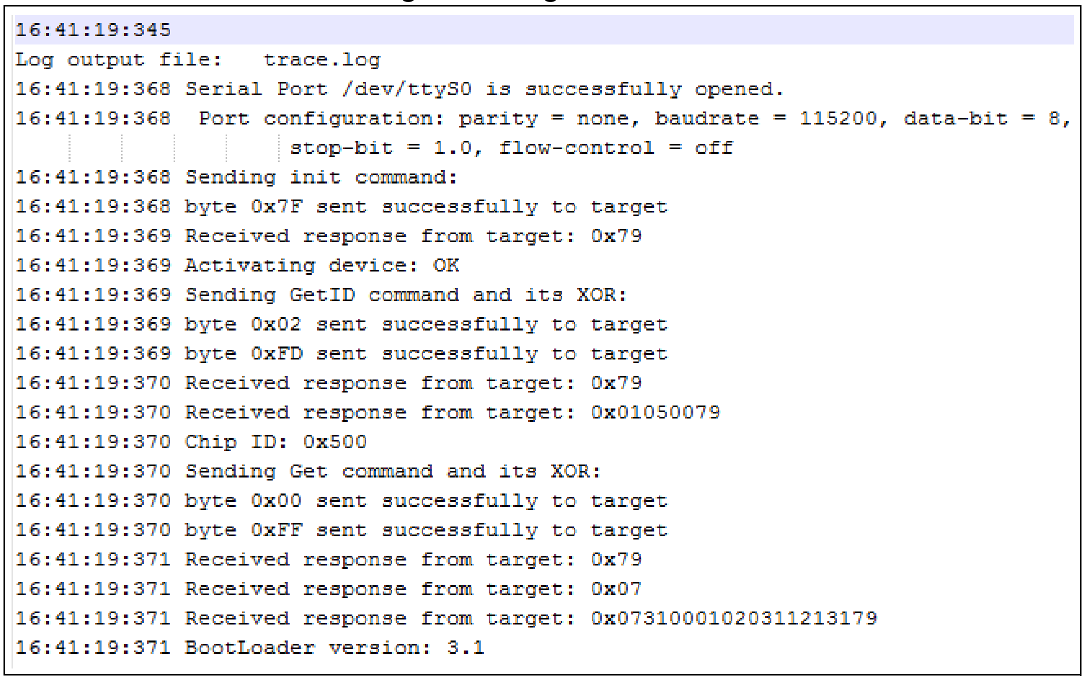
Figure 57. Log command



```
$ ./STM32_Programmer.sh -c port=/dev/ttyS0 br=115200 -log trace.log

Log output file:   trace.log
  Serial Port /dev/ttyS0 is successfully opened.
   Port configuration: parity = none, baudrate = 115200, data-bit = 8,
                     stop-bit = 1.0, flow-control = off
  Activating device: OK
  Chip ID: 0x500
  BootLoader version: 3.1
```

The log file trace.log contains verbose messages, as shown in *Figure 58*.

Figure 58. Log file content



```
16:41:19:345
Log output file:   trace.log
16:41:19:368 Serial Port /dev/ttyS0 is successfully opened.
16:41:19:368  Port configuration: parity = none, baudrate = 115200, data-bit = 8,
                    stop-bit = 1.0, flow-control = off
16:41:19:368 Sending init command:
16:41:19:368 byte 0x7F sent successfully to target
16:41:19:369 Received response from target: 0x79
16:41:19:369 Activating device: OK
16:41:19:369 Sending GetID command and its XOR:
16:41:19:369 byte 0x02 sent successfully to target
16:41:19:369 byte 0xFD sent successfully to target
16:41:19:370 Received response from target: 0x79
16:41:19:370 Received response from target: 0x01050079
16:41:19:370 Chip ID: 0x500
16:41:19:370 Sending Get command and its XOR:
16:41:19:370 byte 0x00 sent successfully to target
16:41:19:370 byte 0xFF sent successfully to target
16:41:19:371 Received response from target: 0x79
16:41:19:371 Received response from target: 0x07
16:41:19:371 Received response from target: 0x07310001020311213179
16:41:19:371 BootLoader version: 3.1
```

3.2.13 External loader command

-el

Description: This command allows the path of one or more external memory loaders to be entered, to perform programming, write erase and read operations with an external memory.

Syntax: **`-el [externalLoaderFilePath1.stldr]`** Absolute path of external loader file.

`-el [externalLoaderFilePath1.stldr]... -el [externalLoaderFilePath10.stldr]` Absolute path of external loader files.

Example 1:

```
./STM32_Programmer.sh -c port=swd -w "file.bin" 0x90000000 -v -el
"/local/user/externalLoaderPath.stldr"
```

Example 2:

```
./STM32_Programmer.sh -c port=swd -e all -el
"/local/user/externalLoaderPath.stldr"
```

Example 3:

```
./STM32_Programmer.sh -c port=swd -w "file.bin" 0x90000000 -v -el
"/local/user/externalLoaderPath1.stldr"
"/local/user/externalLoaderPath2.stldr"
```

Note: This command is only supported with SWD/JTAG ports.

Note: A maximum of ten external loaders can be used.

3.2.14 External loader command with bootloader interface

-elbl

Description: This command allows to provide the path of an external memory loader used to perform programming, write, erase and read operations with an external memory using Bootloader interface (only in RSS/RSSe context). This command is used only when performing SFIx process.

Syntax: **`-elbl [externalLoaderFilePath.stldr]`** Absolute path of external loader file.

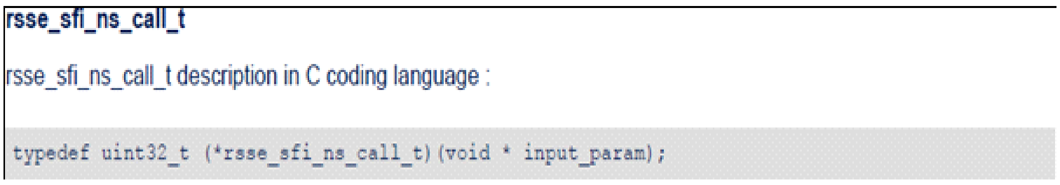
Example 1:

```
>STM32_Programmer_CLI.exe -c port=usb1 -elbl MX25LM51245G_STM32L552E-EVAL-
SFIX-BL.stldr -sfi out.sfix hsm=0 license.bin -rsse
RSSe\L5\enc_signed_RSSe_sfi_jtag.bin
```

Note: This command is only supported with Bootloader interface (UART/I2C/SPI/USB).

External loader for SFIx:

The external loader for SFIx operation is aligned with the RSSe_SFI_CallNsFunction, as a result, all the functions used inside the external loader must have the same signature as this function.

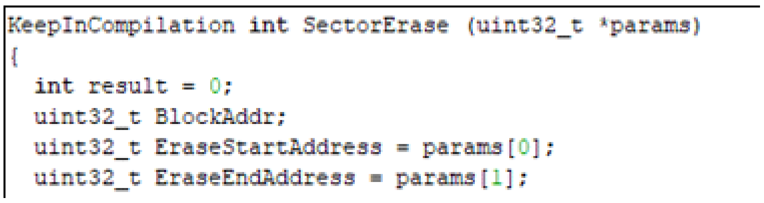

rsse_sfi_ns_call_t

rsse_sfi_ns_call_t description in C coding language :

```
typedef uint32_t (*rsse_sfi_ns_call_t)(void * input_param);
```

As a consequence the implementation of these function inside the external loader must be slightly modified to be synchronized with input parameters.

Example of Sector erase function after modification:


```
KeepInCompilation int SectorErase (uint32_t *params)
{
  int result = 0;
  uint32_t BlockAddr;
  uint32_t EraseStartAddress = params[0];
  uint32_t EraseEndAddress = params[1];
```

3.2.15 Read unprotect command

-rdu, --readunprotect

Description: This command removes the memory read protection by changing the RDP level from level 1 to level 0.

Syntax: `--readunprotect`

Example

```
./STM32_Programmer.sh -c port=swd -rdu
```

3.2.16 TZ regression command

-tzenreg, --tzenregression

Description: This command removes TrustZone protection by disabling TZEN from 1 to 0.

Syntax: `--tzenregression`

Example

```
./STM32_Programmer.sh -c port=usb1 -tzenreg
```

Note: This command is only supported for bootloader interface and MCUs with trusted zone.

3.2.17 Option bytes command

-ob, --optionbytes

Description: This command allows the user to manipulate the device option bytes by displaying or modifying them.

Syntax: `-ob [displ] / -ob [OptByte=<value>]`

`[displ]`:	Allows the user to display the whole set of option bytes.
`[OptByte=<value>]`:	Allows the user to program the given option byte.

Example

```
./STM32_Programmer.sh -c port=swd -ob rdp=0x0 -ob displ
```

Note: For more information about the device option bytes, refer to the dedicated section in the programming manual and reference manual, both available on www.st.com.

3.2.18 Safety lib command

-sl, --safelib

Description: This command allows a firmware file to be modified by adding a load area (segment) containing the computed CRC values of the user program.

Supported formats are: bin, elf, hex and Srec.

Syntax: `-sl <file_path> <start_address> <end_address> <slice_size>`

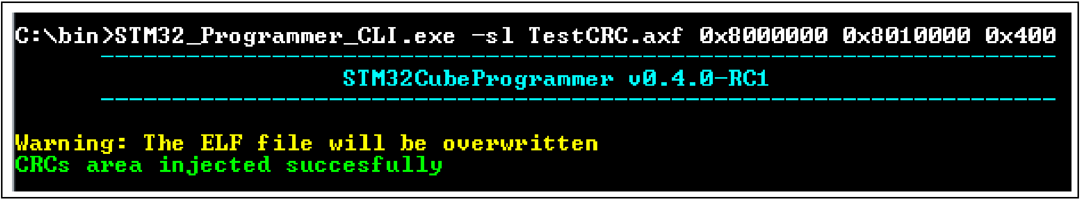
`<file_path>`	The file path (bin, elf, hex or Srec)
`<start_address>`	Flash memory start address
`<end_address>`	Flash memory end address
`<slice_size>`	Size of data per CRC value

Example

```
STM32_Programmer_CLI.exe -sl TestCRC.axf 0x8000000 0x8010000 0x400
```

The result is shown in *Figure 59*.

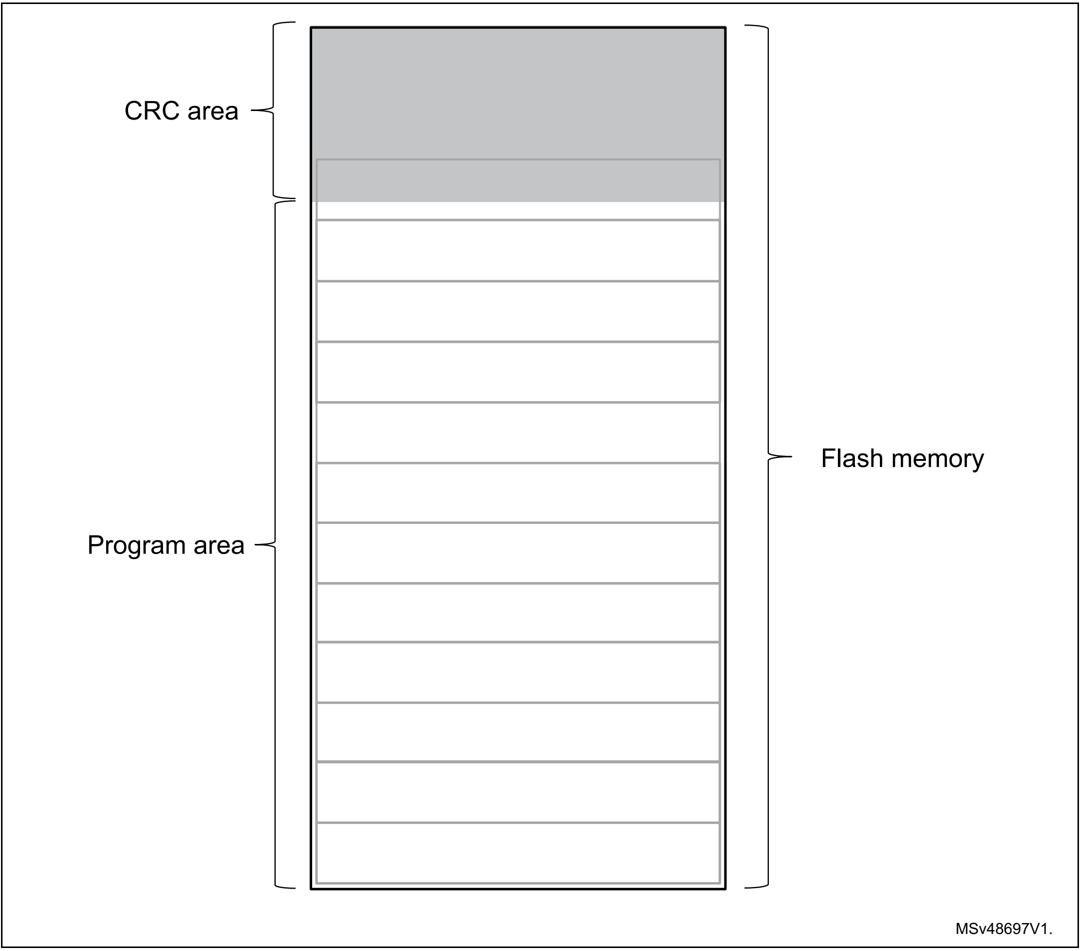
Figure 59. Safety lib command



```
C:\bin>STM32_Programmer_CLI.exe -sl TestCRC.axf 0x8000000 0x8010000 0x400
      -------------------------------------------------------------------
                        STM32CubeProgrammer v0.4.0-RC1
      -------------------------------------------------------------------

Warning: The ELF file will be overwritten
CRCs area injected succesfully
```

The Flash program memory is divided into slices, whose size is given as a parameter to the safety lib command as shown in the example above. For each slice a CRC value is computed and placed in the CRC area. The CRC area is placed at the end of the memory, as shown in *Figure 60*.

Figure 60. Flash memory mapping



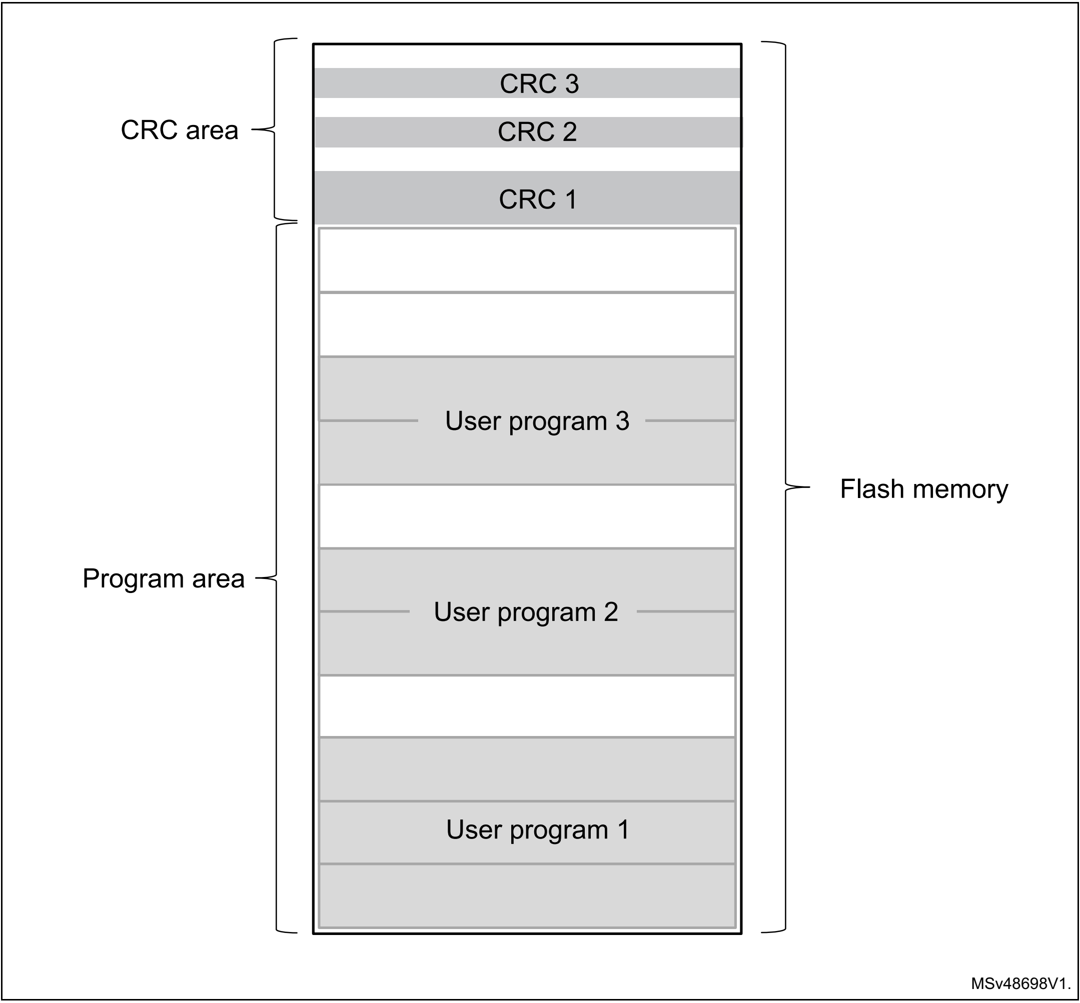
The address and size of the CRCs area are determined as follows:

CRCs_Area_Size = Flash_Size / Slice_Size * 4 bytes

CRCs_Start_Address = Flash_End_Address - CRCs_Area_Size

The CRC values in the CRC area are placed according to the position(s) of the user program in the Flash memory, see *Figure 61*.

Figure 61. Flash memory mapping example



The address of a CRCs region inside the CRCs area is calculated as:

$$@ = \text{CRCs\_Start\_Address} + \left(\frac{\text{UserProg\_Start\_Address} - \text{Flash\_Start\_Address}}{\text{Slice\_Size}} \cdot 4\ \text{bytes}\right)$$

3.2.19 Secure programming SFI specific commands

Secure firmware install (SFI) is a feature supporting secure firmware flashing, available on some STM32 devices. The firmware provider has the possibility to protect its internal firmware against any illegal access, and to control the number of devices that can be programmed.

The protected firmware installation can be performed using different communication channels, such as JTAG/SWD or bootloader interfaces (UART, SPI and USB).

For more details refer to *Secure programming using STM32CubeProgrammer* (AN5054), available on *www.st.com.*

-sfi, --sfi

Description: Programs an sfi file

Syntax: `-sfi [<protocol=Ptype>] <.sfi file_path> [hsm=0|1] <lic_path|slot=slotID> [<licMod_path>|slot=slotID]`

`[<protocol=Ptype>]`	Protocol type to be used: static/live (only static protocol is supported so far), default: static.
`<file_path>`	Path of sfi file to be programmed.
`[hsm=0|1]`	Sets user option for HSM use value {0 (do not use HSM), 1 (use HSM)}, default: hsm=0.
`<lic_path|slot=slotID>`	Path to the SFI license file (if hsm=0) or reader slot ID if HSM is used (hsm=1).
`[<licMod_path>|slot=slotID]`	List of the integrated SMI license files paths if HSM is not used (hsm=0) or readers slot IDs list if HSM is used (hsm=1). Used only in combined case, the list order must correspond to modules integration order within the SFI file.

-rsse, --rsse

Description: This command allows the user to select the root secure services extension library (RSSe). Mandatory for devices using RSSe to make secure firmware install (SFI). The RSSe binary file can be found in STM32CubeProgrammer bin/RSSe folder.

Syntax: `-rsse <file_path>`

`<file_path>`	Path of RSSe file

-a, --abort

Description: This command allows the user to clean a not properly finished process. The currently ongoing operation stops and the system returns to idle state.

Syntax: `-a`

3.2.20 Secure programming SFIx specific commands

Secure firmware install (SFIx) is a feature supporting secure external firmware flashing, available on some STM32 devices with OTFDEC capability. The firmware provider has the possibility to protect its external firmware/data against any illegal access, and to control the number of devices that can be programmed.

The SFIx secure programming can be carried out only with JTAG/SWD interface.

For more details refer to AN5054 *Secure programming using STM32CubeProgrammer*.

-sfi, --sfi

Description: Programs an sfix file

Syntax: `-sfi [<protocol=Ptype>] <.sfix file_path> [hsm=0|1] <lic_path|slot=slotID> [<licMod_path>|slot=slotID]`

`[<protocol=Ptype>]`	Protocol type to be used: static/live (only static protocol is supported so far), default: static.
`<file_path>`	Path of sfi file to be programmed.
`[hsm=0|1]`	Sets user option for HSM use value {0 (do not use HSM), 1 (use HSM)}, default: hsm=0.
`<lic_path|slot=slotID>`	Path to the SFI license file (if hsm=0) or reader slot ID if HSM is used (hsm=1).
`[<licMod_path>|slot=slotID]`	List of the integrated SMI license file paths if HSM is not used (hsm=0) or readers slot IDs list if HSM is used (hsm=1). Used only in combined case, the list order must correspond to modules integration order within the SFI file.

-elbl --extload	Selects a custom external memory-loader, only for the JTAG/SWD interfaces
`<file_path>`	External memory-loader file path

-elbl --extloadbl	Selects a custom external memory-loader for the bootloader interface
`<file_path>`	External memory-loader file path

-rsse, --rsse

Description: This command allows the user to select the root secure services extension library (RSSe). Mandatory for devices using RSSe to make secure firmware install (SFI). The RSSe binary file can be found in STM32CubeProgrammer bin/RSSe folder.

Syntax: `-rsse <file_path>`

`<file_path>`	Path of RSSe file

-a, --abort

Description: This command allows the user to clean a not properly finished process. The ongoing operation stops and the system returns to idle state.

Syntax: `-a`

Note: The ExternalLoader is different for SFIx use case since some initializations are already done by RSS, and it is marked with –SFIX at the end of the External FlashLoader name.

3.2.21 HSM related commands

To control the number of devices that can be programmed ST offers a secure firmware flashing service based on HSM (hardware secure module) as a license generation tool to be deployed in the programming house.

Two HSM versions are available:

- HSMv1: static HSM, it allows the user to generate firmware licenses for STM32 secure programming of devices selected in advance.
- HSMv2: dynamic HSM, it is an updated version of the previous one, allows the generation of firmware licenses targeting STM32 secure programming of devices chosen via personalization data at the OEM site.

Before using the HSM, it must be programmed using Trusted Package Creator, this tool can program both versions with some specific input configurations, as detailed in UM2238.

For more details refer to AN5054 *Secure programming using STM32CubeProgrammer*.

-hsmgetinfo

Description: Reads the HSM available information

Syntax: `-hsmgetinfo [slot=<SlotID>]`

`[slot=<SlotID>]`	Slot ID of the smart card reader Default value: slot=1 (the PC integrated SC reader)

-hsmgetcounter

Description: Reads the current value of the license counter

Syntax: `-hsmgetcounter [slot=<SlotID>]`

`[slot=<SlotID>]`	Slot ID of the smart card reader Default value: slot=1 (the PC integrated SC reader)

-hsmgetfwid

Description: Reads the Firmware/Module identifier

Syntax: `-hsmgetfwid [slot=<SlotID>]`

`[slot=<SlotID>]`	Slot ID of the smart card reader Default value: slot=1 (the PC integrated SC reader)

-hsmgetstatus

Description: Reads the current card life-cycle state

Syntax: `-hsmgetstatus  [slot=<SlotID>]`

`[slot=<SlotID>]`	Slot ID of the smart card reader Default value: slot=1 (the PC integrated SC reader)

-hsmgetlicense

Description: Gets a license for the current chip if counter is not null

Syntax: `-hsmgetlicense <file_path> [slot=<SlotID>] [protocol=<Ptype>]`

`<file_path>`	File path into where the received license is stored
`[slot=<SlotID>]`	Slot ID of the smart card reader Default value: slot=1 (the PC integrated SC reader)
`[<protocol=Ptype>]`	Protocol type to be used: static/live Only static protocol is supported so far Default value: static

-hsmgetlicensefromcertifbin, -hsmglfcb

Description: Gets a license for the current certificate binary file if counter is not null.

Syntax: `-hsmglfcb <certif_file_path.bin> <license_file_path.bin> [slot=<SlotID>] [protocol=<Ptype>]`

`<certif_file_path.bin>`	File path from which the input certificate is read.
`<license_file_path.bin>`	File path where the received license is stored
`[slot=<SlotID>]`	Slot ID of the smart card reader. Default value: slot=1 (the PC integrated SC reader)

3.2.22 STM32WB specific commands

-antirollback

Description: Perform the antirollback operation

Syntax: `-antirollback`

-startfus

Description: Start the FUS

Syntax: `-startfus`

-getuid64

Description: Read the device unique identifier (UID)

Syntax: `-getuid64`

-fusgetstate

Description: Read the FUS state

Syntax: `-fusgetstate`

-fwdelete

Description: Delete the BLE stack firmware

Syntax: `-fwdelete`

-fwupgrade

Description: Upgrade of BLE stack firmware or FUS firmware.

Syntax: `-fwupgrade <file_path> <address> [firstinstall=0|1] [startstack=0|1] [-v]`

`<file_path>`	New firmware image file path
`<address>`	Start address of download
`[firstinstall=0|1]`	1 if it is the first installation, otherwise 0 Optional, default value `firstinstall=0`
`[-v]`	Verify if the download operation is achieved successfully before starting the upgrade

-startwirelessstack

Description: Start the wireless stack

Syntax: `-startwirelessstack`

-authkeyupdate

Description: Authentication key update

Syntax: `-authkeyupdate <file_path>`

`<file_path>`	Authentication key file path. This is the public key generated by STM32TrustedPackageCreator when signing the firmware using `-sign` command.

-authkeylock

Description: Authentication key lock

Once locked, it is no longer possible to change it using `-authkeyupdate` command

Syntax: `-authkeylock`

-wusrkey

Description: Customer key storage

Syntax: `-wusrkey <file_path> <keytype=1|2|3>`

`<file.path>`: customer key in binary format

`<keytype=1|2|3>`: User key type values: 1 (simple), 2 (master) or 3 (encrypted)

Note: These commands are available only through USB DFU and UART bootloader interfaces, except for the "-fwdelete" and the "-fwupgrade" commands, available through USB DFU, UART and SWD interfaces.

Note: Under Reset mode is mandatory.

Usage example for SWD interface

- FUS upgrade:
  STM32_Programmer_CLI.exe -c port=swd mode=UR -ob nSWboot0=0 nboot1=1 nboot0=1 -fwupgrade stm32wb5x_FUS_fw.bin 0x080EC000 firstinstall=1
- Stack install:
  STM32_Programmer_CLI.exe -c port=swd mode=UR -ob nSWboot0=0 nboot1=1 nboot0=1 -fwupgrade stm32wb5x_BLE_Stack_fw.bin 0x080EC000
- User application install:
  STM32_Programmer_CLI.exe -c port=swd mode=UR -d UserApplication.bin 0x08000000 -v

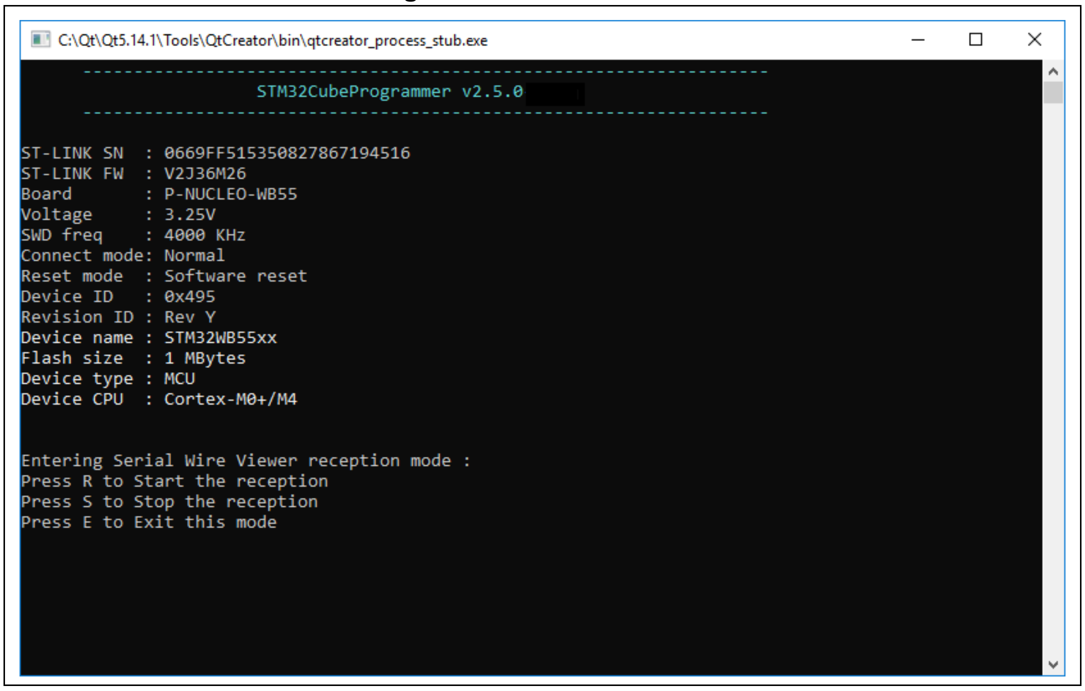
3.2.23 Serial wire viewer (SWV) command

-SWV

Description: This command allows the user to access the serial wire viewer console mode, which displays the printf data sent from the target through SWO.

In this mode (see *Figure 62*) the user can start and stop the reception of the SWO data by pressing, respectively, the "R" and "S" buttons on the keyboard. The received SWO data are displayed in the console. Pressing the "E" button allows the user to exit the serial wire viewer console mode and terminate the reception session.

Figure 62. SWV command



C:\Qt\Qt5.14.1\Tools\QtCreator\bin\qtcreator_process_stub.exe

```
      -------------------------------------------------------------------
                        STM32CubeProgrammer v2.5.0 [redacted]
      -------------------------------------------------------------------

ST-LINK SN  : 0669FF515350827867194516
ST-LINK FW  : V2J36M26
Board       : P-NUCLEO-WB55
Voltage     : 3.25V
SWD freq    : 4000 KHz
Connect mode: Normal
Reset mode  : Software reset
Device ID   : 0x495
Revision ID : Rev Y
Device name : STM32WB55xx
Flash size  : 1 MBytes
Device type : MCU
Device CPU  : Cortex-M0+/M4


Entering Serial Wire Viewer reception mode :
Press R to Start the reception
Press S to Stop the reception
Press E to Exit this mode
```

Syntax: `swv <freq=<frequency>> <portnumber=0-32> [<file_Path.log>]`

`<freq=<frequency>>`	System clock frequency in MHz.
`<portnumber=0-31|all>`	ITM port number, values: 0-31, or "all" for all ports.
`[<file_Path.log>]`	Path of the SWV log file (optional). If not specified default is: "$USER_HOME/STMicroelectronics/STM32Programmer /SWV_Log/swv.log"

Example:

```
STM32_Programmer_CLI.exe -c port=swd -swv freq=32 portnumber=0
C:\Users\ST\swvLog\example.log
```

Note: The serial wire viewer is only available through SWD interface.

Note: Some SWV bytes can be lost during transfer due to ST-LINK hardware buffer size limitation.

3.2.24 Specific commands for STM32WL

Before performing the encrypted firmware installation, set the device in its default status, i.e. with security disabled (ESE = 0x0) and all the option bytes at their default values.

For this purpose STM32CubeProgrammer allows users to perform these steps using two command lines:

1. **`desurity`**: allows the user to disable security.

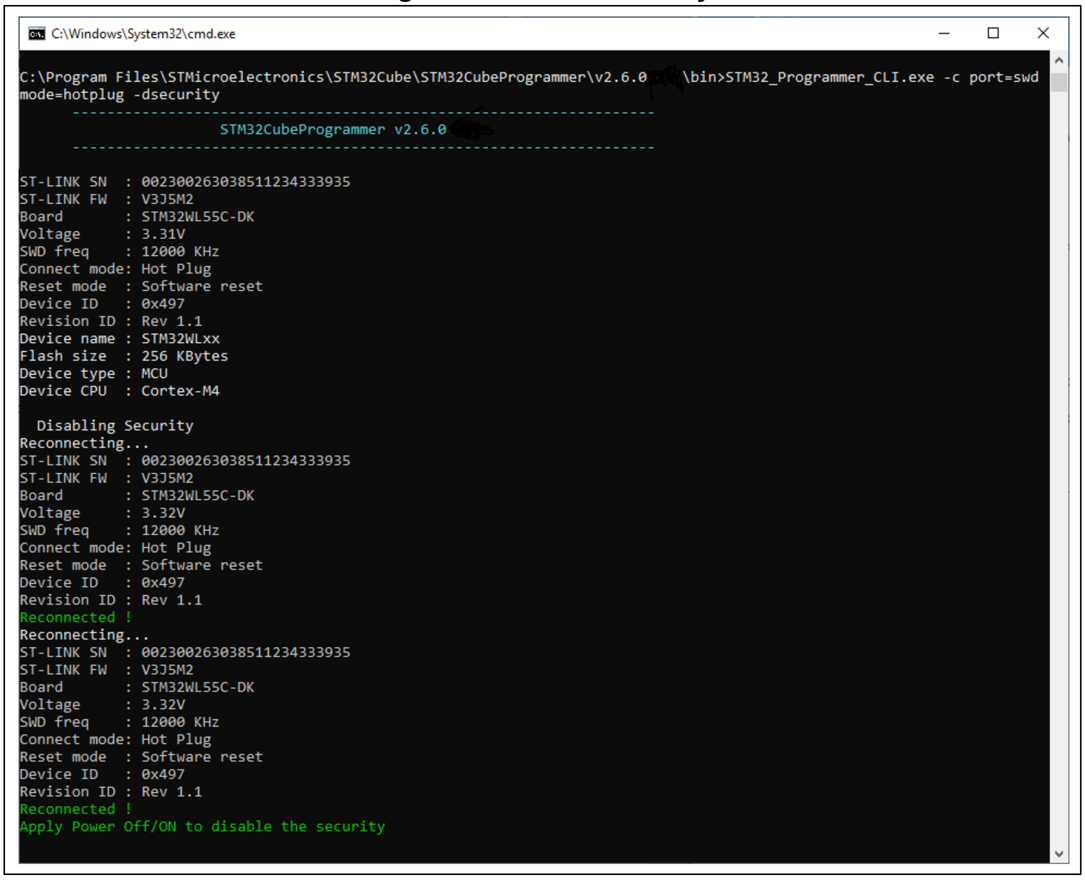
   Example: STM32_Programmer_CLI.exe -c port=swd mode=hotplug -dsecurity
2. **`setdefaultob`**: this command allows user to configure option bytes to their default values.

   Example: STM32_Programmer_CLI.exe -c port=swd mode=hotplug -setdefaultob

After the execution of these commands go through a power OFF / power ON sequence. These two commands allow the user to unlock the board in case of inability to change option bytes using the usual method.

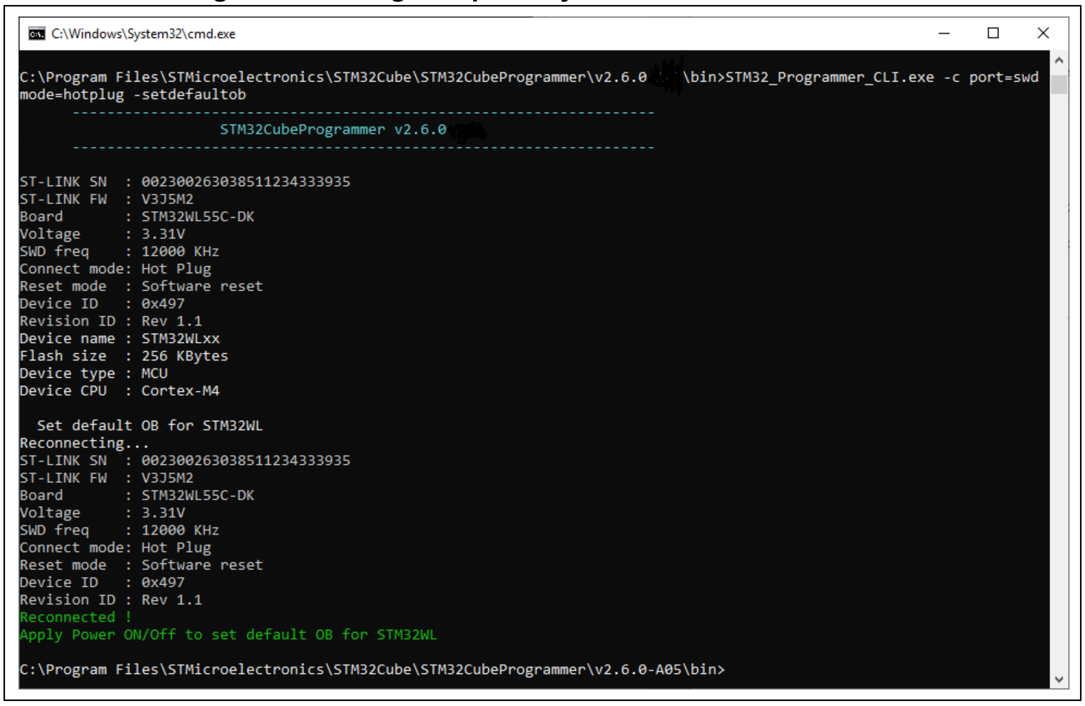
Figure 63 and *Figure 64* show the results of these command lines.

Figure 63. Disable security



```
C:\Program Files\STMicroelectronics\STM32Cube\STM32CubeProgrammer\v2.6.0[redacted]\bin>STM32_Programmer_CLI.exe -c port=swd
mode=hotplug -dsecurity
      -------------------------------------------------------------------
                        STM32CubeProgrammer v2.6.0[redacted]
      -------------------------------------------------------------------

ST-LINK SN   : 002300263038511234333935
ST-LINK FW   : V3J5M2
Board        : STM32WL55C-DK
Voltage      : 3.31V
SWD freq     : 12000 KHz
Connect mode: Hot Plug
Reset mode   : Software reset
Device ID    : 0x497
Revision ID : Rev 1.1
Device name : STM32WLxx
Flash size   : 256 KBytes
Device type : MCU
Device CPU   : Cortex-M4

  Disabling Security
Reconnecting...
ST-LINK SN   : 002300263038511234333935
ST-LINK FW   : V3J5M2
Board        : STM32WL55C-DK
Voltage      : 3.32V
SWD freq     : 12000 KHz
Connect mode: Hot Plug
Reset mode   : Software reset
Device ID    : 0x497
Revision ID : Rev 1.1
Reconnected !
Reconnecting...
ST-LINK SN   : 002300263038511234333935
ST-LINK FW   : V3J5M2
Board        : STM32WL55C-DK
Voltage      : 3.32V
SWD freq     : 12000 KHz
Connect mode: Hot Plug
Reset mode   : Software reset
Device ID    : 0x497
Revision ID : Rev 1.1
Reconnected !
Apply Power Off/ON to disable the security
```

Figure 64. Configure option bytes to their default values



```
C:\Program Files\STMicroelectronics\STM32Cube\STM32CubeProgrammer\v2.6.0[redacted]\bin>STM32_Programmer_CLI.exe -c port=swd
mode=hotplug -setdefaultob
      -------------------------------------------------------------------
                        STM32CubeProgrammer v2.6.0[redacted]
      -------------------------------------------------------------------

ST-LINK SN   : 002300263038511234333935
ST-LINK FW   : V3J5M2
Board        : STM32WL55C-DK
Voltage      : 3.31V
SWD freq     : 12000 KHz
Connect mode: Hot Plug
Reset mode   : Software reset
Device ID    : 0x497
Revision ID : Rev 1.1
Device name : STM32WLxx
Flash size   : 256 KBytes
Device type : MCU
Device CPU   : Cortex-M4

  Set default OB for STM32WL
Reconnecting...
ST-LINK SN   : 002300263038511234333935
ST-LINK FW   : V3J5M2
Board        : STM32WL55C-DK
Voltage      : 3.31V
SWD freq     : 12000 KHz
Connect mode: Hot Plug
Reset mode   : Software reset
Device ID    : 0x497
Revision ID : Rev 1.1
Reconnected !
Apply Power ON/Off to set default OB for STM32WL

C:\Program Files\STMicroelectronics\STM32Cube\STM32CubeProgrammer\v2.6.0-A05\bin>
```

If the user locks the board and is unable to unlock it with these two commands, there are specific scripts to unlock it. These scripts are under "../bin/STM32WLScripts", they contain a command line using –wdbg option to write directly scripts in the OPTR register.

The folder STM32Scripts contains two files and the Readme.txt:

1. "SetRDPLevelCM0.bat" to unlock the board via Cortex M0+
2. "SetRDPLevelCM4.bat" to unlock the board via Cortex M4

Note: In case of SFI command finished with a fail, the STM32WL chip must be set in its default status using the disable security command line (-dsecurity), then the set default option byte command line (-setdefaultob).

3.2.25 SigFox credential commands

These commands are supported only for STM32WL devices.

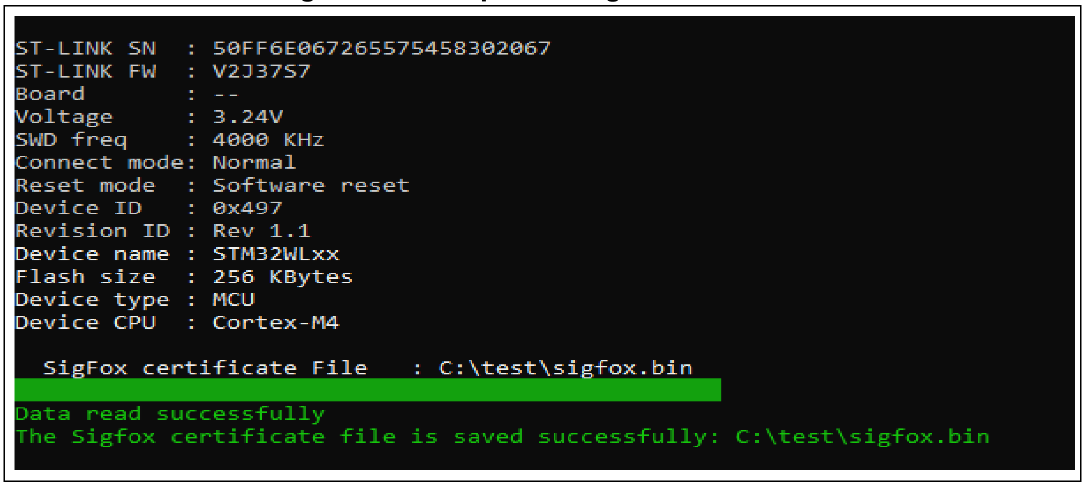
`-ssigfoxc`

Description: This command allows to user to save the chip certificate to a binary file.

Syntax: `-ssigfoxc <binary_file_path>`

Example: STM32_Programmer_CLI.exe -c port=swd -ssigfoxc "/local/user/chip_certif.bin"

Figure 65. Example of -ssigfoxc command



```
ST-LINK SN   : 50FF6E067265575458302067
ST-LINK FW   : V2J37S7
Board        : --
Voltage      : 3.24V
SWD freq     : 4000 KHz
Connect mode: Normal
Reset mode   : Software reset
Device ID    : 0x497
Revision ID : Rev 1.1
Device name : STM32WLxx
Flash size   : 256 KBytes
Device type : MCU
Device CPU   : Cortex-M4

  SigFox certificate File    : C:\test\sigfox.bin

Data read successfully
The Sigfox certificate file is saved successfully: C:\test\sigfox.bin
```

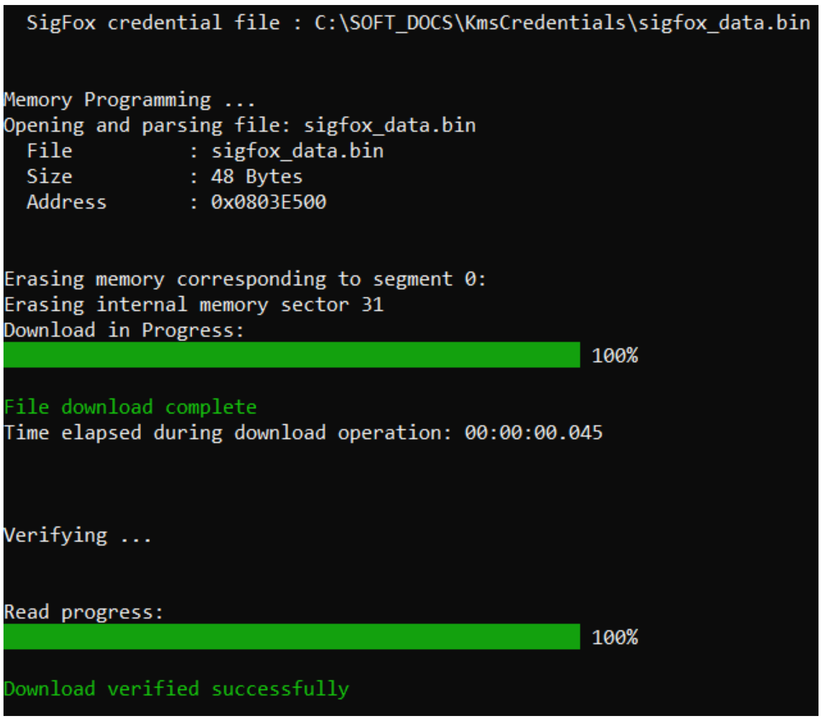
`-wsigfoxc`

Description: This command allows to user to write the chip certificate at address 0x0803E500

Syntax: `-wsigfoxc <binary_file_path> <address>` [The address is optional, by default is 0x0803E500]

Example 1: STM32_Programmer_CLI.exe -c port=swd -wsigfoxc "/local/user/sigfox_data.bin"0x0803E500

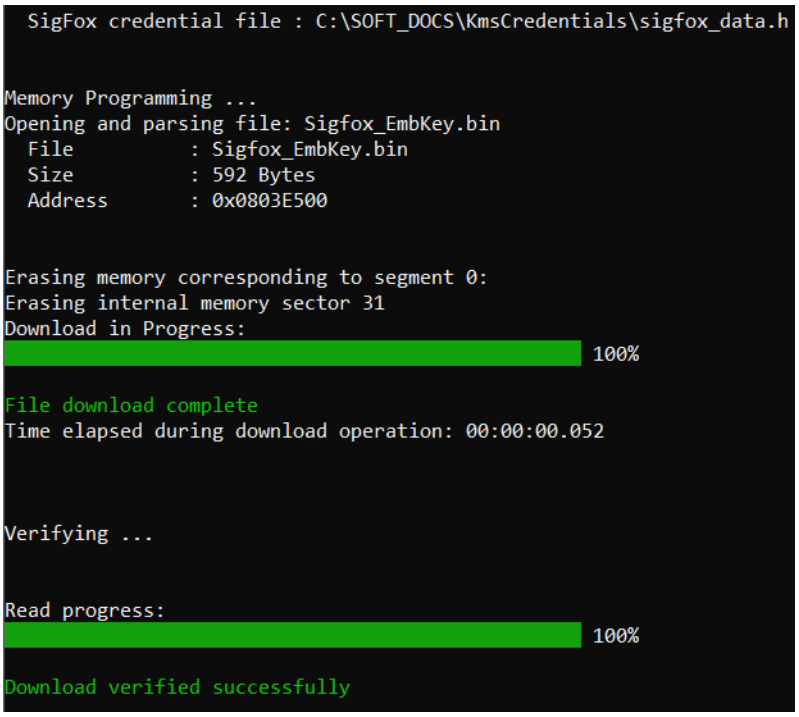
Figure 66. Example (1) of -wsigfoxc command



```
  SigFox credential file : C:\SOFT_DOCS\KmsCredentials\sigfox_data.bin


Memory Programming ...
Opening and parsing file: sigfox_data.bin
  File          : sigfox_data.bin
  Size          : 48 Bytes
  Address       : 0x0803E500


Erasing memory corresponding to segment 0:
Erasing internal memory sector 31
Download in Progress:
                                                  100%

File download complete
Time elapsed during download operation: 00:00:00.045



Verifying ...


Read progress:
                                                  100%

Download verified successfully
```

Example 2: STM32_Programmer_CLI.exe -c port=swd -wsigfoxc "/local/user/sigfox_data.h"

Figure 67. Example (2) of -wsigfoxc command



```
  SigFox credential file : C:\SOFT_DOCS\KmsCredentials\sigfox_data.h


Memory Programming ...
Opening and parsing file: Sigfox_EmbKey.bin
  File          : Sigfox_EmbKey.bin
  Size          : 592 Bytes
  Address       : 0x0803E500


Erasing memory corresponding to segment 0:
Erasing internal memory sector 31
Download in Progress:
                                                  100%

File download complete
Time elapsed during download operation: 00:00:00.052



Verifying ...


Read progress:
                                                  100%

Download verified successfully
```

3.2.26 Register Viewer

`-regdump`

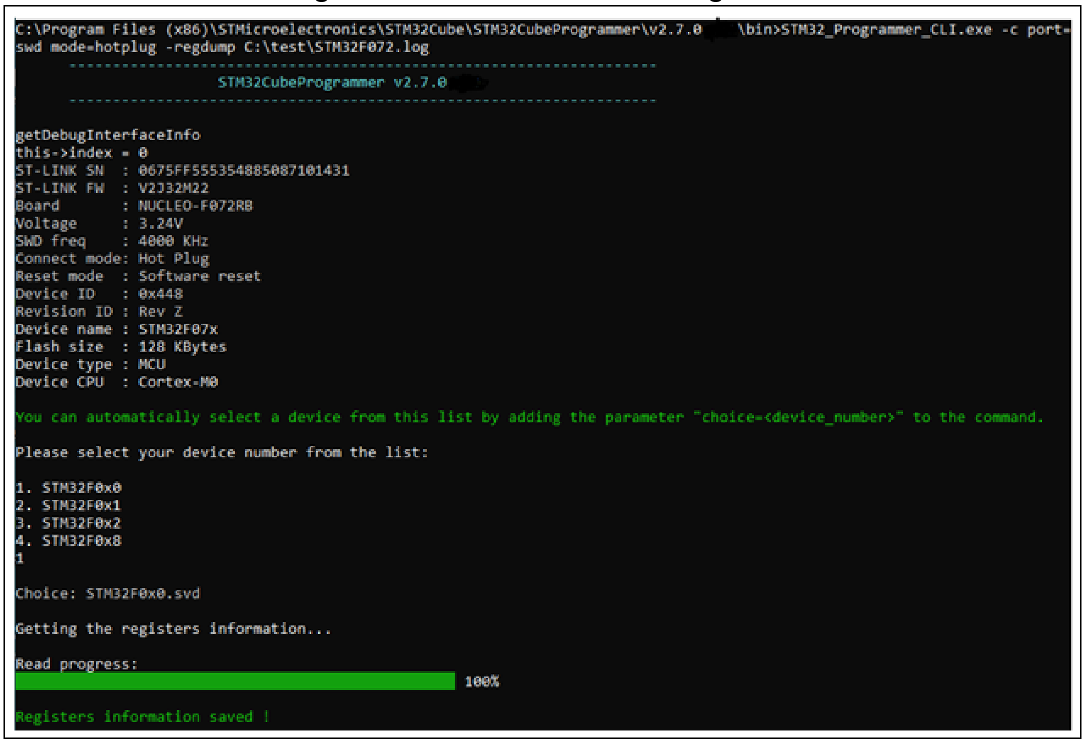
Description: Reads and dumps core and MCU registers

Syntax: `-regdump <file_path.log> [choice=<number>]`

<file_path.log>	Log file path
[choice=<number>]	Device number from the list of compatible devices (optional). This list is displayed if the command is performed without this optional argument.

Example: STM32_Programmer_CLI.exe -regdump C:\test\STM32F072.log

Figure 68. Read core and MCU registers



```
C:\Program Files (x86)\STMicroelectronics\STM32Cube\STM32CubeProgrammer\v2.7.0[redacted]\bin>STM32_Programmer_CLI.exe -c port=
swd mode=hotplug -regdump C:\test\STM32F072.log
      -------------------------------------------------------------------
                        STM32CubeProgrammer v2.7.0[redacted]
      -------------------------------------------------------------------

getDebugInterfaceInfo
this->index = 0
ST-LINK SN  : 0675FF555354885087101431
ST-LINK FW  : V2J32M22
Board       : NUCLEO-F072RB
Voltage     : 3.24V
SWD freq    : 4000 KHz
Connect mode: Hot Plug
Reset mode  : Software reset
Device ID   : 0x448
Revision ID : Rev Z
Device name : STM32F07x
Flash size  : 128 KBytes
Device type : MCU
Device CPU  : Cortex-M0

You can automatically select a device from this list by adding the parameter "choice=<device_number>" to the command.

Please select your device number from the list:

1. STM32F0x0
2. STM32F0x1
3. STM32F0x2
4. STM32F0x8
1

Choice: STM32F0x0.svd

Getting the registers information...

Read progress:
                                                  100%

Registers information saved !
```

3.2.27 Hard fault analyzer

To start the analysis (see *Section 2.13*), use a specific command line.

Syntax: **`-hf`**

The output trace contains different kinds of essential information for better understanding the reason that caused a particular fault.

An informative message "STM32CubeProgrammer Fault Analyzer" is displayed to indicate that the detection flow started.

Note: Connection to target must be established before performing Fault Analyzer command.

Example

Using the same example as GUI mode (division by 0).

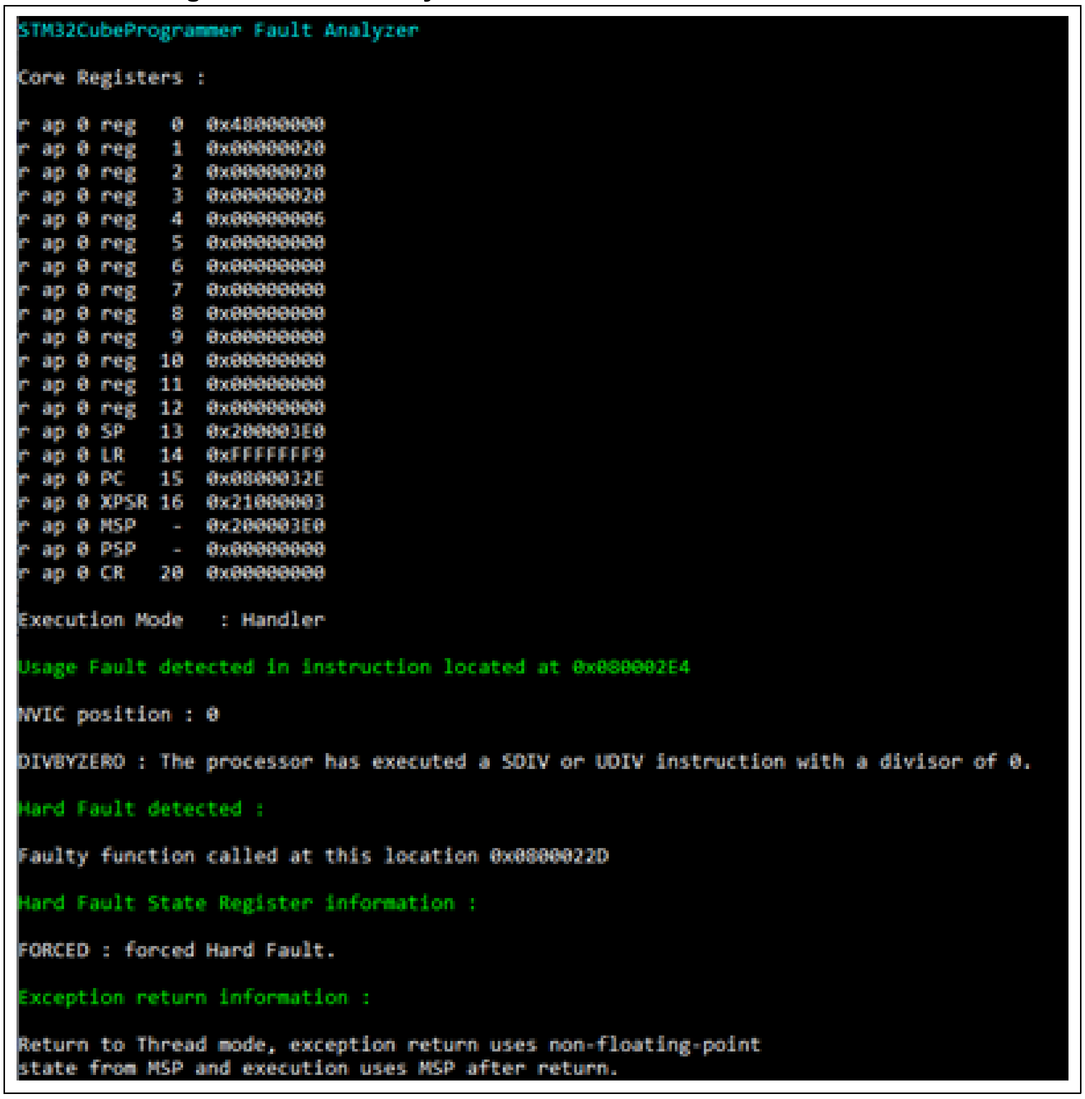
Command: **`-c port=swd mode=hotplug -hf`**

From the command line output, a Green message indicates a “Hard Fault Detected” and “The processor has executed a SDIV or UDIV instruction with a divisor of 0”.

Useful informations can be extracted:

- Faulty instruction address: 0x80002E4
- Faulty instruction called by a function located at this address: 0x800022D
- NVIC position: 0, Window Watchdog interrupt
- Execution mode: Handler
- Core registers capture.

Figure 69. Fault Analyzer CLI view when Hard Fault detected

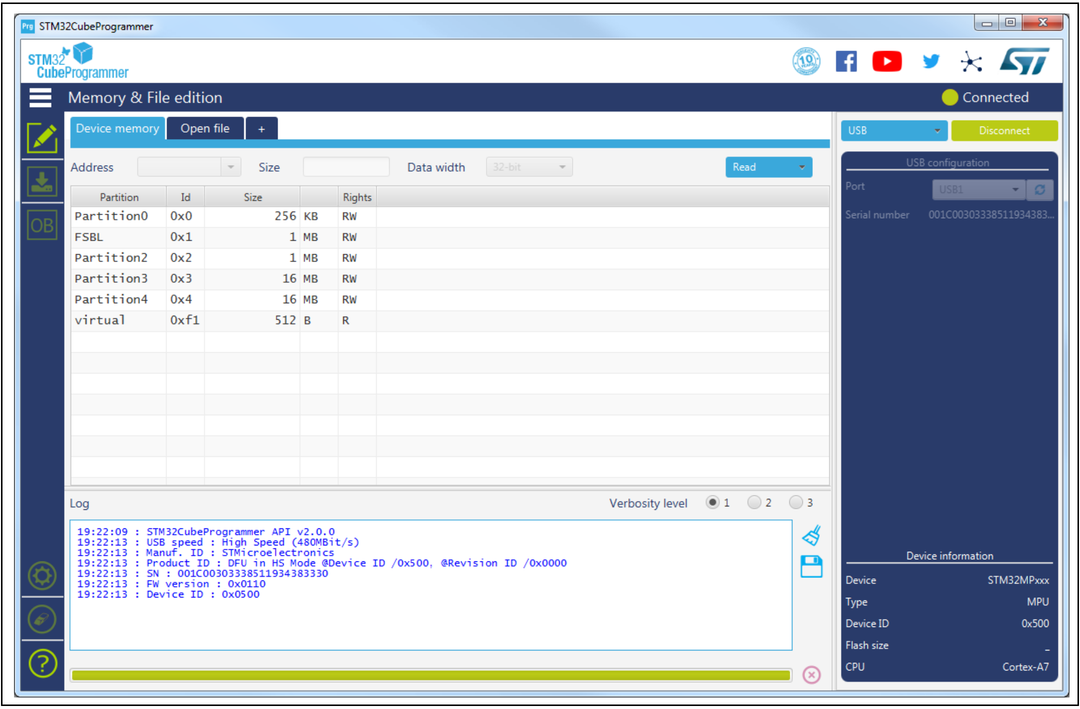


```
STM32CubeProgrammer Fault Analyzer

Core Registers :

r ap 0 reg    0  0x48000000
r ap 0 reg    1  0x00000020
r ap 0 reg    2  0x00000020
r ap 0 reg    3  0x00000020
r ap 0 reg    4  0x00000006
r ap 0 reg    5  0x00000000
r ap 0 reg    6  0x00000000
r ap 0 reg    7  0x00000000
r ap 0 reg    8  0x00000000
r ap 0 reg    9  0x00000000
r ap 0 reg   10  0x00000000
r ap 0 reg   11  0x00000000
r ap 0 reg   12  0x00000000
r ap 0 SP    13  0x200003E0
r ap 0 LR    14  0xFFFFFFF9
r ap 0 PC    15  0x0800032E
r ap 0 XPSR  16  0x21000003
r ap 0 MSP    -  0x200003E0
r ap 0 PSP    -  0x00000000
r ap 0 CR    20  0x00000000

Execution Mode    : Handler

Usage Fault detected in instruction located at 0x080002E4

NVIC position : 0

DIVBYZERO : The processor has executed a SDIV or UDIV instruction with a divisor of 0.

Hard Fault detected :

Faulty function called at this location 0x0800022D

Hard Fault State Register information :

FORCED : forced Hard Fault.

Exception return information :

Return to Thread mode, exception return uses non-floating-point
state from MSP and execution uses MSP after return.
```

4 STM32CubeProgrammer user interface for MPUs

4.1 Main window

Figure 70. STM32CubeProgrammer main window



Partition	Id	Size		Rights
Partition0	0x0	256	KB	RW
FSBL	0x1	1	MB	RW
Partition2	0x2	1	MB	RW
Partition3	0x3	16	MB	RW
Partition4	0x4	16	MB	RW
virtual	0xf1	512	B	R

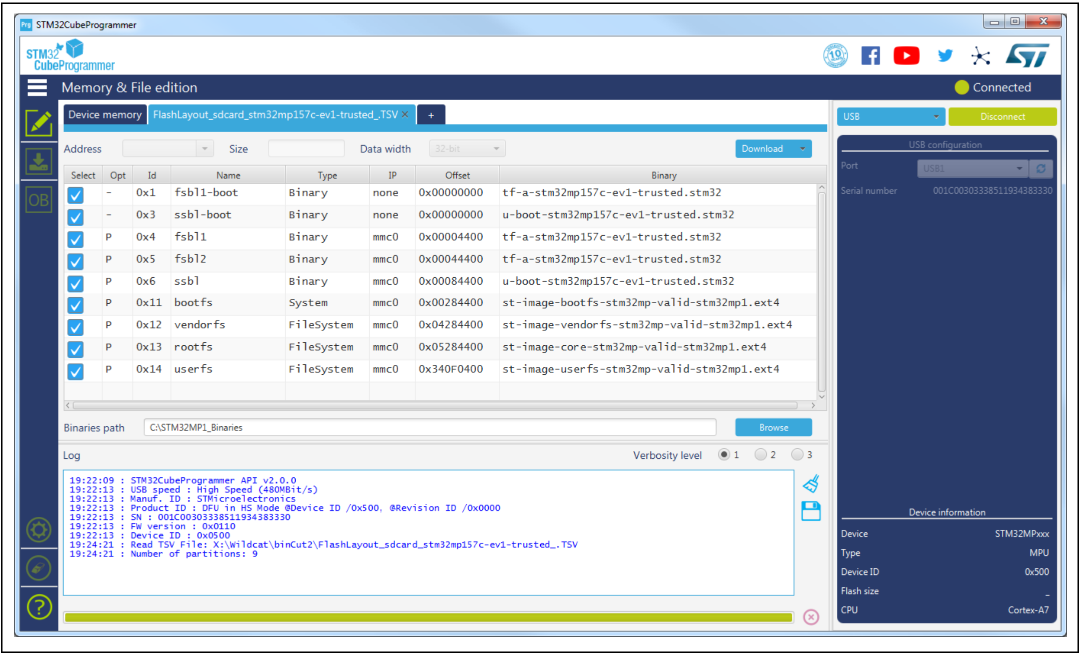
```
19:22:09 : STM32CubeProgrammer API v2.0.0
19:22:13 : USB speed : High Speed (480MBit/s)
19:22:13 : Manuf. ID : STMicroelectronics
19:22:13 : Product ID : DFU in HS Mode @Device ID /0x500, @Revision ID /0x0000
19:22:13 : SN : 001C00303338511934383330
19:22:13 : FW version : 0x0110
19:22:13 : Device ID : 0x0500
```

Serial number 001C003033385119343 83...

Device	STM32MPxxx
Type	MPU
Device ID	0x500
Flash size	_
CPU	Cortex-A7

The main window allows the user to select the interface used to connect to STM32MP1 BootROM, possible interfaces are USB-DFU and UART (programming throw stlink interface is not possible with STM32MP1 series). Once connected (using connect button) available partitions are displayed, now user is able to open a TSV file for programming.

4.2 Programming windows



Select	Opt	Id	Name	Type	IP	Offset	Binary
✓	-	0x1	fsbl1-boot	Binary	none	0x00000000	tf-a-stm32mp157c-ev1-trusted.stm32
✓	-	0x3	ssbl-boot	Binary	none	0x00000000	u-boot-stm32mp157c-ev1-trusted.stm32
✓	P	0x4	fsbl1	Binary	mmc0	0x00004400	tf-a-stm32mp157c-ev1-trusted.stm32
✓	P	0x5	fsbl2	Binary	mmc0	0x00044400	tf-a-stm32mp157c-ev1-trusted.stm32
✓	P	0x6	ssbl	Binary	mmc0	0x00084400	u-boot-stm32mp157c-ev1-trusted.stm32
✓	P	0x11	bootfs	System	mmc0	0x00284400	st-image-bootfs-stm32mp-valid-stm32mp1.ext4
✓	P	0x12	vendorfs	FileSystem	mmc0	0x04284400	st-image-vendorfs-stm32mp-valid-stm32mp1.ext4
✓	P	0x13	rootfs	FileSystem	mmc0	0x05284400	st-image-core-stm32mp-valid-stm32mp1.ext4
✓	P	0x14	userfs	FileSystem	mmc0	0x340F0400	st-image-userfs-stm32mp-valid-stm32mp1.ext4

Binaries path: C:\STM32MP1_Binaries

Log

```
19:22:09 : STM32CubeProgrammer API v2.0.0
19:22:13 : USB speed : High Speed (480MBit/s)
19:22:13 : Manuf. ID : STMicroelectronics
19:22:13 : Product ID : DFU in HS Mode @Device ID /0x500, @Revision ID /0x0000
19:22:13 : SN : 001C00303338511934383330
19:22:13 : FW version : 0x0110
19:22:13 : Device ID : 0x0500
19:24:21 : Read TSV File: X:\Wildcat\binCut2\FlashLayout_sdcard_stm32mp157c-ev1-trusted_.TSV
19:24:21 : Number of partitions: 9
```

Serial number: 001C00303338511934383330

Device information

Device	STM32MPxxx
Type	MPU
Device ID	0x500
Flash size	-
CPU	Cortex-A7

Figure 71. TSV programming window

To perform TSV files programming the user must perform the following operations:

- Open a TSV file by using “Open file” tab, if TSV file format is correct then TSV content is displayed in the main window. TSV Files are available in STM32MP1 Linux distributions, refer to STM32MP1 wiki for more details.
- Specify binaries path in “Binaries path” text box.
- Select the list of partitions to be programmed in “select” column, by default all partitions are selected.
- Launch download using “Download” button.

For more details concerning flashing operations refer to AN5275, available on *www.st.com*.

5 STM32CubeProgrammer CLI for MPUs

5.1 Available commands for STM32MP1

This section details the commands supported on STM32MP1 devices.

5.1.1 Connect command

-c, --connect

Description: Establishes the connection to the device. This command allows the host to open the chosen device port (UART/USB)

Syntax: `-c port=<Portname> [noinit=<noinit_bit>] [br=<baudrate>] [P=<Parity>] [db=<data_bits>] [sb=<stop_bits>] [fc=<flowControl>]`

`port=<Portname>`	Interface identifier: – ex COMx (for Windows) – /dev/ttySx (for Linux) – usbx for USB interface
`[noinit=<noinit_bit>]`	Sets No Init bits, value in {0,1}, default 0. Noinit=1 can be used if a previous connection is active (no need to send 0X7F).
`[br=<baudrate>]`	Baudrate, (e.g. 9600, 115200), default 115200.
`[P=<Parity>]`	Parity bit, value in (EVEN, NONE, ODD), default EVEN.
`[db=<data_bits>]`	Data bit, value in (6, 7, 8), default 8.
`[sb=<stop_bits>]`	Stop bit, value in (1, 1.5, 2), default 1.
`[fc=<flowControl>]`	Flow control, value in (OFF, Software, Hardware). Software and Hardware flow controls are not yet supported for STM32MP1 Series, default OFF.

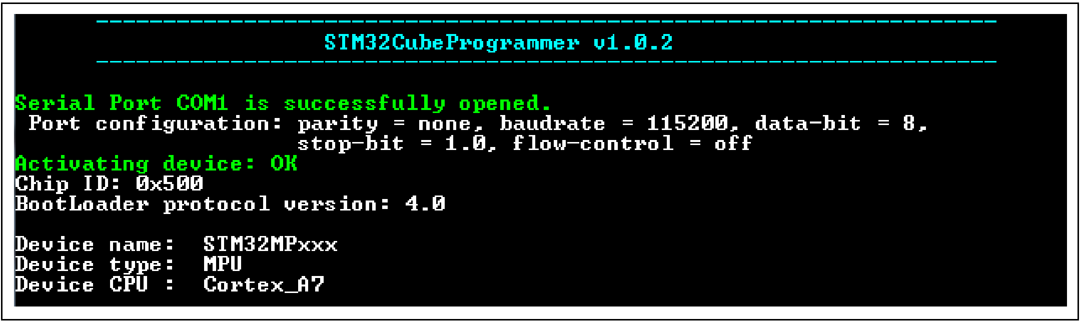
Example

Using UART:

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none
```

The result of this example is shown *Figure 72*.

Figure 72. Connect operation using RS232



```
            -------------------------------------------------------------------
                              STM32CubeProgrammer v1.0.2
            -------------------------------------------------------------------

Serial Port COM1 is successfully opened.
 Port configuration: parity = none, baudrate = 115200, data-bit = 8,
                     stop-bit = 1.0, flow-control = off
Activating device: OK
Chip ID: 0x500
BootLoader protocol version: 4.0

Device name:  STM32MPxxx
Device type:  MPU
Device CPU :  Cortex_A7
```

Note: When using the USB interface, all the configuration parameters (such as baudrate, parity, data-bits, frequency, index) are ignored.

Note: To connect using UART interface, the port configuration (baudrate, parity, data-bits, stop-bits and flow-control) must have a valid combination.

5.1.2 GetPhase command

-p, --phaseID

Description: This command allows knowing the next partition ID to be executed.

Syntax: `--phaseID`

Example

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none br=115200 --phaseID
```

5.1.3 Download command

-w, --write, -d, --download

Description: Downloads the content of the specified binary file into a specific partition in the Flash or SYSRAM memories.

Syntax: `-w <file_path> [partitionID]`

`[file_path]`	File path to be downloaded (bin, stm32, vfat, jffs2, ubi, ext2/3/4 and img file extensions).
`[partition_ID]`	Partition ID to be downloaded.

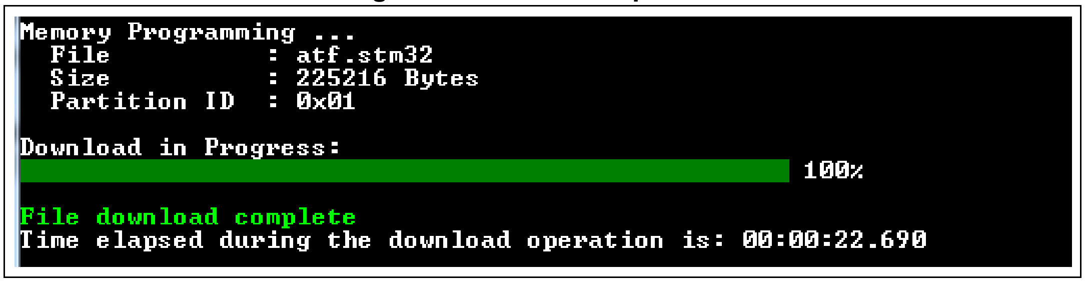
Example

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none -d atf.stm32 0x01
```

This command allows the user to download the atf binary file at Atf partition (partition ID: 0x01).

The result of this example is shown in *Figure 73*.

Figure 73. Download operation



```
Memory Programming ...
  File            : atf.stm32
  Size            : 225216 Bytes
  Partition ID    : 0x01

Download in Progress:
                                                    100%

File download complete
Time elapsed during the download operation is: 00:00:22.690
```

Note: For U-boot with USB interface, to program the non volatile memory (NVM) with the loaded partition using download command, user must execute a start command with the partition ID. Besides, to execute an application loaded in the NVM, it is needed to specify the start address.

Example: Download and manifestation on alternate 0x1

```
./STM32_Programmer.sh -c port=usb0 -w atf.stm32 0x1 -s 0x01
```

5.1.4 Flashing service

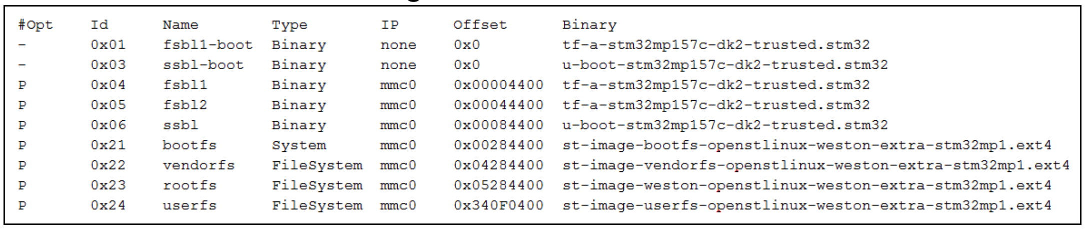
Description: The embedded flashing service aims to load sequentially the partitions requested by the bootloader. To do this STM32CubeProgrammer needs the TSV file, which contains information about the requested partitions to be loaded.

STM32CubeProgrammer downloads and starts the requested partition ID until the end of operation (phaseID = 0xFE).

Syntax: `-w < tsv file_path >`

`<tsv file_path>`	Path of the tsv file to be downloaded.

Figure 74. TSV file format



```
#Opt    Id      Name        Type        IP      Offset      Binary
-       0x01    fsbl1-boot  Binary      none    0x0         tf-a-stm32mp157c-dk2-trusted.stm32
-       0x03    ssbl-boot   Binary      none    0x0         u-boot-stm32mp157c-dk2-trusted.stm32
P       0x04    fsbl1       Binary      mmc0    0x00004400  tf-a-stm32mp157c-dk2-trusted.stm32
P       0x05    fsbl2       Binary      mmc0    0x00044400  tf-a-stm32mp157c-dk2-trusted.stm32
P       0x06    ssbl        Binary      mmc0    0x00084400  u-boot-stm32mp157c-dk2-trusted.stm32
P       0x21    bootfs      System      mmc0    0x00284400  st-image-bootfs-openstlinux-weston-extra-stm32mp1.ext4
P       0x22    vendorfs    FileSystem  mmc0    0x04284400  st-image-vendorfs-openstlinux-weston-extra-stm32mp1.ext4
P       0x23    rootfs      FileSystem  mmc0    0x05284400  st-image-weston-openstlinux-weston-extra-stm32mp1.ext4
P       0x24    userfs      FileSystem  mmc0    0x340F0400  st-image-userfs-openstlinux-weston-extra-stm32mp1.ext4
```

Example

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none br=115200 -d
Flashlayout.tsv
```

Note: While programming the Flashlayout.tsv file, U-boot can spend a long time to start correctly, for this reason configure the timeout value by using the timeout command (-tm <timeout>).

5.1.5 Start command

-g, --go, -s, --start

Description: This command allows executing the device memory starting from the specified address.

Syntax: `--start [start_address/Partition_ID]`

`[start_address]`	Start address of application to be executed. If not specified with STM32MP and UART interface, last loaded partition is started.
`[Partition_ID]`	This parameter is needed only with STM32MP devices. It specifies the partition ID to be started.

Example

```
./STM32_Programmer.sh --connect port=/dev/ttyS0 p=none br=115200 --start
0x03
```

This command allows the user to run the code specified at partition 0x03.

Note: For U-boot with USB interface, to program the NVM with the loaded partition using download command, you need to execute a start command with the partition ID. To execute an application loaded in the NVM, you need to specify the start address.

Example 1: Download and manifestation on alternate 0x1

```
./STM32_Programmer.sh -c port=usb0 -w atf.stm32 0x01 -s 0x01
```

Example 2: Execute code at a specific address

```
./STM32_Programmer.sh -c port=usb0 -s 0xC0000000
```

5.1.6 Read partition command

-rp, --readPart

Description: Reads and uploads the specified partition content into a specified binary file starting from an offset address. This command is supported only by U-boot.

Syntax: `--readPart <partition_ID> [offset_address] <size> <file_path>`

`<partition_ID>`	Partition ID
`[offset_address]`	Offset address of read
`<size>`	Size of memory content to be read
`<file_path>`	Binary file path to upload the memory content

Example:

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none br=115200 -rp 0x01 0x200
0x1000 readPart1.bin
```

This command allows the user to read 0x1000 bytes from the sebl1 partition at offset address 0x200 and to upload its content to a binary file “readPart1.bin”

5.1.7 List command

-l, -list

Description: This command lists all available communication interfaces UART and USB.

Syntax: `-l, --list <interface_name>`

`<uart/usb>`: UART or USB interface

Example:

```
./STM32_Programmer.sh -list uart
```

5.1.8 QuietMode command

-q, --quietMode

Description: This command disables the progress bar display during Download and Read partition commands.

Syntax: `-q, --quietMode`

Example:

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none br=115200 --quietMode -w
binaryPath.bin 0x01
```

5.1.9 Verbosity command

-vb, --verbosity

Description: This command allows the user to display more messages, to be more verbose.

Syntax: `-vb <level>`

`<level>` : Verbosity level, value in {1, 2, 3} default value vb=1

Example:

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none br=115200 -vb 3
```

5.1.10 Log command

-log, --log

Description: This traceability command allows the user to store the whole traffic (with maximum verbosity level) into log file.

Syntax: `-log [filePath.log]`

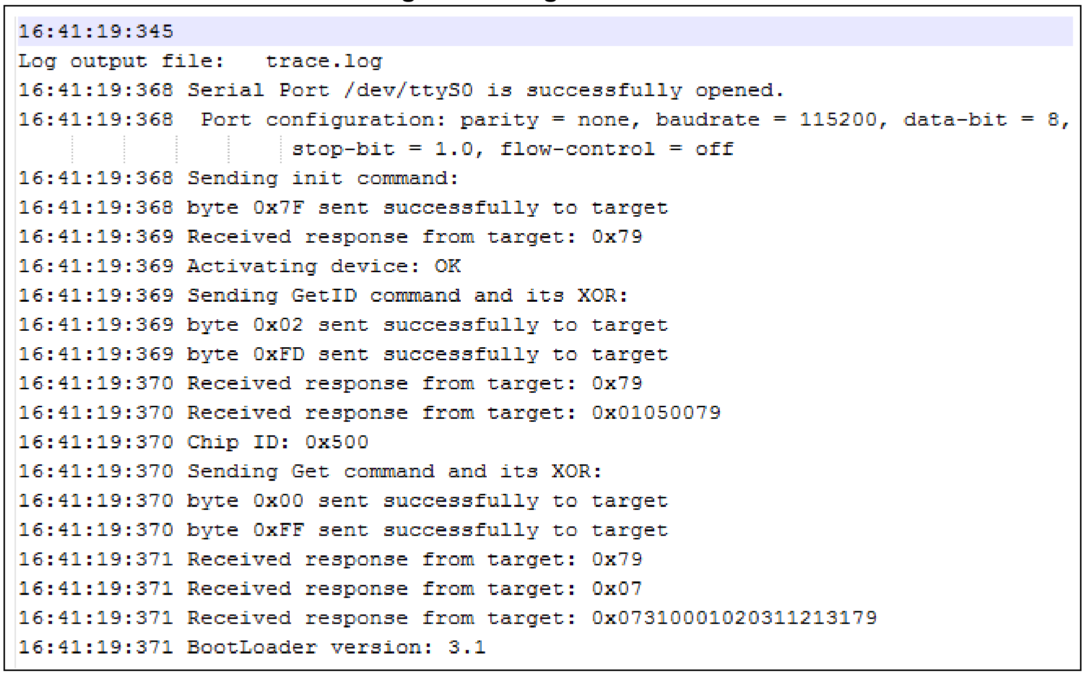
`[filePath.log]` : path of log file (default is $HOME/.STM32CubeProgrammer/trace.log)

Example:

```
./STM32_Programmer.sh -c port=/dev/ttyS0 p=none br=115200 -log trace.log
```

This command generates a log file “trace.log” containing verbose messages (see an example in *Figure 75*).

Figure 75. Log file content



```
16:41:19:345
Log output file:   trace.log
16:41:19:368 Serial Port /dev/ttyS0 is successfully opened.
16:41:19:368  Port configuration: parity = none, baudrate = 115200, data-bit = 8,
                      stop-bit = 1.0, flow-control = off
16:41:19:368 Sending init command:
16:41:19:368 byte 0x7F sent successfully to target
16:41:19:369 Received response from target: 0x79
16:41:19:369 Activating device: OK
16:41:19:369 Sending GetID command and its XOR:
16:41:19:369 byte 0x02 sent successfully to target
16:41:19:369 byte 0xFD sent successfully to target
16:41:19:370 Received response from target: 0x79
16:41:19:370 Received response from target: 0x01050079
16:41:19:370 Chip ID: 0x500
16:41:19:370 Sending Get command and its XOR:
16:41:19:370 byte 0x00 sent successfully to target
16:41:19:370 byte 0xFF sent successfully to target
16:41:19:371 Received response from target: 0x79
16:41:19:371 Received response from target: 0x07
16:41:19:371 Received response from target: 0x07310001020311213179
16:41:19:371 BootLoader version: 3.1
```

5.1.11 OTP programming

Description: These commands allow the user to program the OTP from a host computer. The OTP Programming commands functionalities, such as downloading or uploading a full OTP image and modifying an OTP value or proprieties, are explained below.

Note: The following commands are not supported in JTAG/SWD debug port connection mode.

- Loading shadow registers values to the tool:

  For load operation, the host requests the OTP partition data and the platform replies with the structure described on https://wiki.st.com/stm32mpu/index.php/STM32CubeProgrammer_OTP_management.
- Writing the modified shadow registers to the target:

  This operation is executed by performing the following sequence:

  a) The user types in the value and the status of each chosen OTP shadow register.

  b) The tool updates the OTP structure with the newly given OTP shadow registers values and status.

  c) The tool proceeds with sending the updated structure, with bit0 in the “Write/read conf” field set to 0 (“Write/read conf” is word number 7 in the OTP structure).

  d) Once the structure is sent, the shadow register values are reloaded to update the OTP structure in the tool.
- Programming the OTP with the modified shadow registers values:
  once the user updates the OTP values and the OTP structure is refreshed, the host sends the OTP structure with bit0 in the “Write/read conf” field (word number 7 in the OTP structure) set to 1.
- Reloading the OTP value to the shadow registers:
  once the OTP words are successfully programmed, the host uploads the OTP structure in order to update the OTP shadow registers. This operation allows the host to verify the status of the last SAFMEM programming via bit4 in the “Status” field.
- BSEC control register programming:
  once the user updates the values of the given BSEC control register (Configuration, Debug configuration, Feature configuration and General lock configuration) the host updates the OTP structure and sends it to the device with bit0 in the “Write/read conf” field set to 0.
- OTP programming CLI:
  the user is given a set of commands to perform a chosen sequence of operations on the OTP partition. Each one of these commands is described below.

5.1.12 Programming SAFMEM command

Description: This command allows the user to program SAFMEM memory by modifying the OTP words.

Syntax: `-otp program [wordID=(value)] [value=(value)] [sha_rsl=(value)] [sha_wsl=(value)] [sl=(value)] [pl=(value)]`

`[wordID=(value)]`	This field contains the shadow register number (between 0 and 95). Value must be written in hexadecimal form.
`[value=(value)]`	Loads value into the chosen OTP shadow register. Value must be written in hexadecimal form.

`[sha_rsl=(value)]`	Loads value into the corresponding shadow read sticky lock bit. Value can be either 0 or 1.
`[sha_wsl=(value)]`	Loads value into the corresponding shadow write sticky lock bit. Value can be either 0 or 1.
`[sl=(value)]`	Loads value into the corresponding programming sticky lock bit. Value can be either 0 or 1.
`[pl=(value)]`	Loads value into the corresponding programming permanent lock bit. Value can be either 0 or 1.

Example

```
./STM32_Programmer.sh --connect port=usb1 -otp program wordID=0x00
value=0x3f sl=1 wordID=0x08 value=0x18
```

5.1.13 Detach command

Description: This command allows the user to send detach command to USB DFU.

Syntax: -detach

5.1.14 GetCertif command

Description: This command allows user to read the chip certificate.

Syntax: `-gc certification.bin`

5.1.15 Write blob command

Description: This command allows user to send the blob (secrets and license).

Syntax: `-wb blob.bin`

5.1.16 Display command

Description: This command allows the user to display all or parts of the OTP structure.

Syntax: `-otp displ [upper] [lower] [ctrl]`

`[upper]`	Option to display the loaded upper OTP shadow registers values and status.
`[lower]`	Option to display the loaded lower OTP shadow registers values and status.
`[ctrl]`	Option to display the loaded BSEC control registers.

Example

```
./STM32_Programmer.sh --connect port=usb1 -otp displ
```

5.2 Secure programming SSP specific commands

Secure secret provisioning (SSP) is a feature supporting secure secret flashing procedure, available on STM32 MPU devices. STM32MP1 Series supports protection mechanisms allowing the user to protect critical operations (such as cryptography algorithms) and critical data (such as secret keys) against unexpected accesses.

This section gives an overview of the STM32 SSP command with its associated tools ecosystem and explains how to use it to protect OEM secrets during the CM product manufacturing stage.

For more details refer to AN5054 *Secure programming using STM32CubeProgrammer*.

STM32CubeProgrammer exports a simple SSP command with some options to perform the SSP programming flow.

-ssp, --ssp

Description: Program an SSP file

Syntax: `-ssp <ssp_file_path> <ssp-fw-path> <hsm=0|1> <license_path|slot=slotID>`

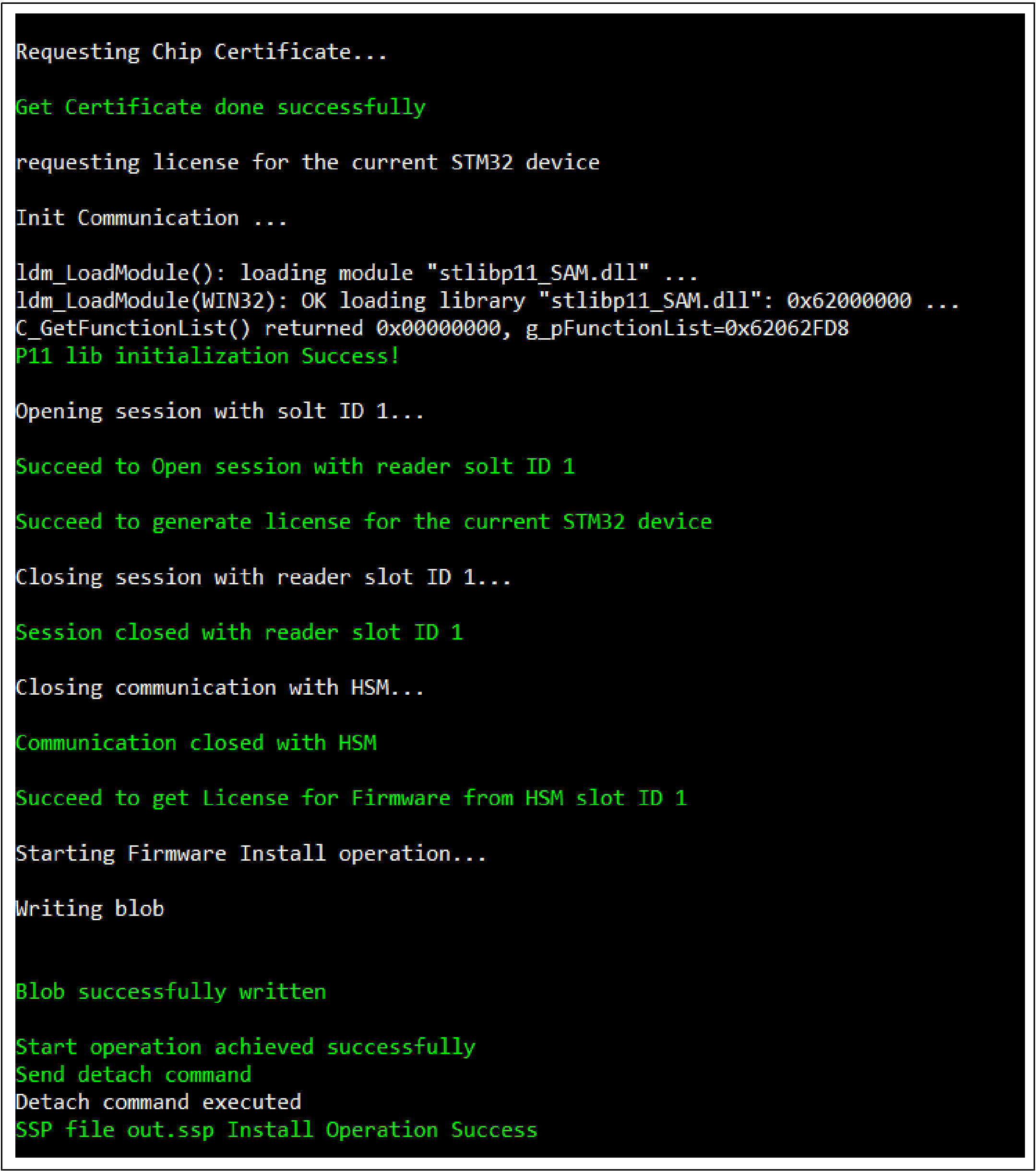
`<ssp_file_path>`	SSP file path to be programmed, bin or ssp extensions.
`<ssp-fw-path>`	SSP signed firmware path.
`<hsm=0|1>`	Set user option for HSM use (do not use / use HSM). Default value: hsm=0.
`<license_path|slot=slotID>`	• Path to the license file (if hsm=0) • Reader slot ID if HSM is used (if hsm=1)

Example using USB DFU bootloader interface:

```
STM32_Programmer_CLI.exe -c port=usb1 -ssp “out.ssp” “tf-a-ssp-
stm32mp157f-dk2-trusted.stm32” hsm=1 slot=1
```

Note: All SSP traces are shown on the output console.

Figure 76. SSP successfully installed



```
Requesting Chip Certificate...

Get Certificate done successfully

requesting license for the current STM32 device

Init Communication ...

ldm_LoadModule(): loading module "stlibp11_SAM.dll" ...
ldm_LoadModule(WIN32): OK loading library "stlibp11_SAM.dll": 0x62000000 ...
C_GetFunctionList() returned 0x00000000, g_pFunctionList=0x62062FD8
P11 lib initialization Success!

Opening session with solt ID 1...

Succeed to Open session with reader solt ID 1

Succeed to generate license for the current STM32 device

Closing session with reader slot ID 1...

Session closed with reader slot ID 1

Closing communication with HSM...

Communication closed with HSM

Succeed to get License for Firmware from HSM slot ID 1

Starting Firmware Install operation...

Writing blob


Blob successfully written

Start operation achieved successfully
Send detach command
Detach command executed
SSP file out.ssp Install Operation Success
```

If there is any faulty input the SSP process is aborted, and an error message is displayed to indicate the root cause of the issue.

6 STM32CubeProgrammer C++ API

In addition to the graphical user interface and to the command line interface STM32CubeProgrammer offers a C++ API that can be used to develop your application and benefit of the wide range of features to program the memories embedded in STM32 microcontrollers, either over the debug interface or the bootloader interface (USB DFU, UART, I^2C, SPI and CAN).

For more information about the C++ API, read the help file provided within the STM32CubeProgrammer package under API\doc folder.

7 Revision history

Table 1. Document revision history

Date	Revision	Changes
15-Dec-2017	1	Initial release.
02-Aug-2018	2	Updated: – *Section 1.1: System requirements* – *Section 1.2.3: macOS install* – *Section 1.2.4: DFU driver* Added: – *Section 3.2.8: Debug commands* – *Figure 1: macOS “Allow applications downloaded from:” tab* – *Figure 2: Deleting the old driver software*
12-Sep-2018	3	Added SPI, CAN and I2C settings on cover page and in *Section 2.1.4: Target configuration panel*. Updated: – *Figure 6: ST-LINK configuration panel* – *Figure 45: STM32CubeProgrammer: available commands*. – *Figure 49: Connect operation using SWD debug port* Replaced *Section 3.2.1: Connect command*.
16-Nov-2018	4	Updated *Section 2.1.4: Target configuration panel*, *Section 2.2.1: Reading and displaying target memory*, *Section 2.2.2: Reading and displaying a file* and *Section 2.3.2: External Flash memory programming*. Updated *Figure 4: STM32CubeProgrammer main window*, *Figure 5: Expanded main menu*, *Figure 6: ST-LINK configuration panel*, *Figure 7: UART configuration panel*, *Figure 8: USB configuration panel*, *Figure 9: Target information panel*, *Figure 10: SPI configuration panel*, *Figure 11: CAN configuration panel*, *Figure 12: I2C configuration panel*, *Figure 13: Memory and file edition: Device memory tab*, *Figure 15: Memory and file edition: File display*, *Figure 16: Flash memory programming and erasing (internal memory)* and *Figure 17: Flash memory programming (external memory)*. Minor text edits across the whole document.
03-Jan-2019	5	Updated *Section 1.2.4: DFU driver*. Added *Section 3.2.19: Secure programming SFI specific commands*, *Section 3.2.21: HSM related commands* and *Section 6: STM32CubeProgrammer C++ API*. Minor text edits across the whole document.
04-Mar-2019	6	Updated *Introduction* and *Section 1: Getting started*. Updated title of *Section 2: STM32CubeProgrammer user interface for MCUs* and of *Section 3: STM32CubeProgrammer command line interface (CLI) for MCUs*. Added *Section 2.5: Automatic mode*, *Section 2.6: STM32WB OTA programming*, *Section 4: STM32CubeProgrammer user interface for MPUs*, *Section 5: STM32CubeProgrammer CLI for MPUs* and their subsections.

Table 1. Document revision history (continued)

Date	Revision	Changes
19-Apr-2019	7	Updated *Section 1.1: System requirements*, *Section 2.2.2: Reading and displaying a file*, *Section 2.6.2: OTA update procedure*, *Section 3.2.19: Secure programming SFI specific commands*, *Section 3.2.21: HSM related commands* and *Section 3.2.22: STM32WB specific commands*. Updated *Figure 16: Flash memory programming and erasing (internal memory)*.
11-Oct-2019	8	Updated *Graphical guide*, *Section 3.2.19: Secure programming SFI specific commands*, *Section 3.2.21: HSM related commands* and *Section 3.2.22: STM32WB specific commands*. Added *Section 2.7: In application programming (IAP)*. Minor text edits across the whole document.
08-Nov-2019	9	Updated *Section 1.2.1: Linux install*, *Section 3.2.22: STM32WB specific commands* and *Section 5.1.6: Read partition command*. Minor text edits across the whole document.
07-Jan-2020	10	Updated *Section 1.1: System requirements*, *Section 1.2.3: macOS install* and *Section 3.2.19: Secure programming SFI specific commands*. Added *Section 3.2.16: TZ regression command* and *Section 3.2.20: Secure programming SFIx specific commands*. Removed former *Section 5.2.12: Writing to BSEC command*. Minor text edits across the whole document.
24-Feb-2020	11	Added *Section 2.8: Flash the co-processor binary using graphical interface* and its subsections.
23-Jul-2020	12	Added *Section 2.9: Serial wire viewer (SWV)*, *Section 3.2.23: Serial wire viewer (SWV) command* and *Section 5.2: Secure programming SSP specific commands*. Updated *Section 3.2.1: Connect command* and *Section 3.2.2: Erase command*. Minor text edits across the whole document.
17-Nov-2020	13	Updated *Section 1.1: System requirements*, *Section 1.2.1: Linux install*, *Section 1.2.2: Windows install*, *Section 1.2.3: macOS install*, *Section 2.3.2: External Flash memory programming*, *Section 2.9: Serial wire viewer (SWV)*, *Section 3.2.1: Connect command*, *Section 3.2.2: Erase command*, *Section 3.2.13: External loader command*, *Section 3.2.21: HSM related commands*, *Section 3.2.20: Secure programming SFIx specific commands*, *Section 3.2.22: STM32WB specific commands* and *Section 5.1.1: Connect command*. Added *Section 2.10: DFU IAP with custom PID and VID*, *Section 2.11: SigFox™ credentials*, *Example using DFU IAP options*, *Section 3.2.5: Download 64-bit data command*, *Section 3.2.14: External loader command with bootloader interface*, *Section 3.2.24: Specific commands for STM32WL* and *Section 5.2.5: Flashing service via USB serial gadget*. Updated *Figure 17: Flash memory programming (external memory)*, *Figure 37: SWV window* and *Figure 66: Available commands for MPUs*.
19-Nov-2020	14	Updated *Section 5.1.1: Connect command*. Removed former *Section 5.1: Command line usage* and *Section 5.2.5: Flashing service via USB serial gadget*.

Table 1. Document revision history (continued)

Date	Revision	Changes
11-Mar-2021	15	Updated *Section 1.1: System requirements*, *Section 1.2.1: Linux install*, *Section 1.2.3: macOS install*, *Section 2.11: SigFox™ credentials* and *Section 3.2.22: STM32WB specific commands*. Added *Section 2.12: Register Viewer*, *Section 2.13: Hard fault analyzer* with its subsections, *Section 3.2.26: Register Viewer* and *Section 3.2.27: Hard fault analyzer*. Minor text edits across the whole document.