UM1718
User manual

STM32CubeMX for STM32 configuration and initialization C code generation

Introduction

STM32CubeMX is a graphical tool for 32-bit ARM® Cortex® STM32 microcontrollers. It is part of STMCube™ initiative (see *Section 1*) and is available either as a standalone application or as an Eclipse plug-in for integration in Integrated Development Environments (IDEs).

STM32CubeMX has the following key features:

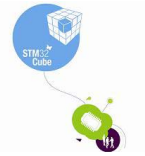
- **Easy microcontroller selection covering whole STM32 portfolio.**
- **Board selection from a list of STMicroelectronics boards.**
- **Easy microcontroller configuration** (pins, clock tree, peripherals, middleware) and generation of the corresponding initialization C code.
- **Easy switching to another microcontroller belonging to the same series** by importing a previously-saved configuration to a new MCU project.
- **Generation of configuration reports**.
- **Generation of IDE ready projects** for a selection of integrated development environment tool chains. STM32CubeMX projects include the generated initialization C code, STM32 HAL drivers, the middleware stacks required for the user configuration, and all the relevant files needed to open and build the project in the selected IDE.
- **Power consumption calculation** for a user-defined application sequence**.**
- **Self-updates** allowing the user to keep the STM32CubeMX up-to-date.
- Download and update of STM32Cube™ embedded software required for user application development (see *Appendix E: STM32Cube embedded software packages* for details on STM32Cube embedded software offer).

Although STM32CubeMX offers a user interface and generates a C code compliant with STM32 MCU design and firmware solutions, it is recommended to refer to the product technical documentation for details on actual implementation of microcontroller peripherals and firmware.

Reference documents

The following documents are available from *http://www.st.com*:

- STM32 microcontroller reference manuals
- STM32 microcontroller datasheets
- *STM32Cube HAL driver user manuals for STM32F0 (UM1785), STM32F1 (UM1850), STM32F2 (UM1940), STM32F3 (UM1786), STM32F4 (UM1725), STM32F7 (UM1905), STM32L0 (UM1749), STM32L1 (UM1816) and STM32L4 (UM1884).*



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1 STM32Cube overview

STMCube™ is an STMicroelectronics original initiative to ease developers life by reducing development efforts, time and cost. STM32Cube covers STM32 portfolio.

STM32Cube includes:

- The STM32CubeMX, a graphical software configuration tool that allows to generate C initialization C code using graphical wizards.
- A comprehensive embedded software platform, delivered per series (such as STM32CubeF2 for STM32F2 series and STM32CubeF4 for STM32F4 series)
  - The STM32Cube HAL, an STM32 abstraction layer embedded software, ensuring maximized portability across STM32 portfolio
  - A consistent set of middleware components such as RTOS, USB, TCP/IP, Graphics
  - All embedded software utilities coming with a full set of examples.

2 Getting started with STM32CubeMX

2.1 Principles

Customers need to quickly identify the MCU that best meets their requirements (core architecture, features, memory size, performance…). While board designers main concerns are to optimize the microcontroller pin configuration for their board layout and to fulfill the application requirements (choice of peripherals operating modes), embedded system developers are more interested in developing new applications for a specific target device, and migrating existing designs to different microcontrollers.

The time taken to migrate to new platforms and update the C code to new firmware drivers adds unnecessary delays to the project. STM32CubeMX was developed within STM32Cube initiative which purpose is to meet customer key requirements to maximize software reuse and minimize the time to create the target system:

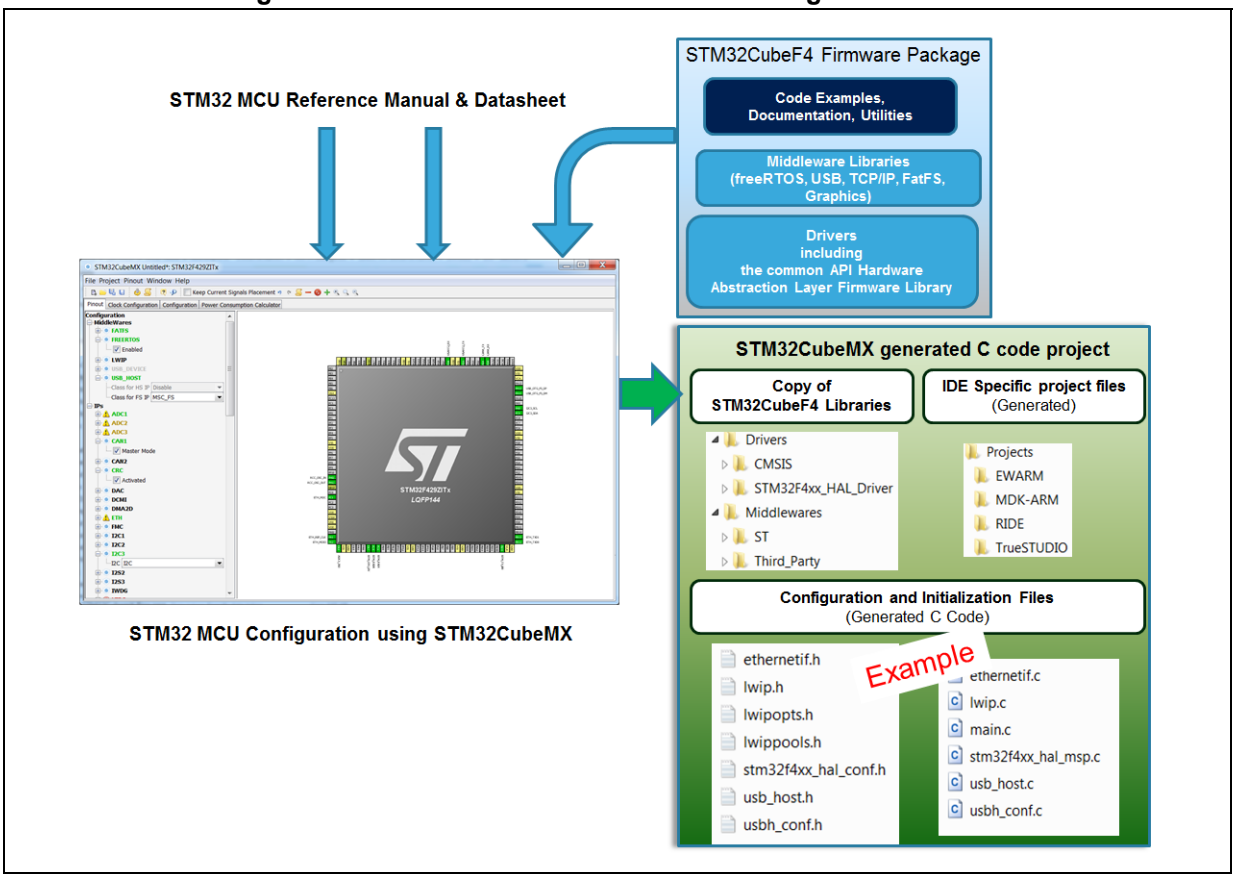
- Software reuse and application design portability are achieved through STM32Cube firmware solution proposing a common Hardware Abstraction Layer API across STM32 portfolio.
- Optimized migration time is achieved thanks to STM32CubeMX built-in knowledge of STM32 microcontrollers, peripherals and middleware (LwIP and USB communication protocol stacks, FatFs file system for small embedded systems, FreeRTOS).

STM32CubeMX graphical interface performs the following functions:

- Fast and easy configuration of the MCU pins, clock tree and operating modes for the selected peripherals and middleware
- Generation of pin configuration report for board designers
- Generation of a complete project with all the necessary libraries and initialization C code to set up the device in the user defined operating mode. The project can be directly open in the selected application development environment (for a selection of supported IDEs) to proceed with application development (see *Figure 1*).

During the configuration process, STM32CubeMX detects conflicts and invalid settings and highlights them through meaningful icons and useful tool tips.

Figure 1. Overview of STM32CubeMX C code generation flow



2.2 Key features

STM32CubeMX comes with the following features:

- **Project management**

  STM32CubeMX allows creating, saving and loading previously saved projects:

  – When STM32CubeMX is launched, the user can choose to create a new project or to load a previously saved project.

  – Saving the project saves user settings and configuration performed within the project in an .ioc file that will be used the next time the project will be loaded in STM32CubeMX.

  STM32CubeMX also allows importing previously saved projects in new projects.

  STM32CubeMX projects come in two flavors:

  – MCU configuration only: .ioc file are saved anywhere, next to other .ioc files.

  – MCU configuration with C code generation: in this case .ioc files are saved in a dedicated project folder along with the generated source C code. There can be only one .ioc file per project.

- **Easy MCU and STMicroelectronics board selection**

  When starting a new project, a dedicated window opens to select either a microcontroller or an STMicroelectronics board from STM32 portfolio. Different filtering options are available to ease the MCU and board selection.

- **Easy pinout configuration**

  – From the **Pinout** view, the user can select the peripherals from a list and configure the peripheral modes required for the application. STM32CubeMX assigns and configures the pins accordingly.

  – For more advanced users, it is also possible to directly map a peripheral function to a physical pin using the **Chip** view. The signals can be locked on pins to prevent STM32CubeMX conflict solver from moving the signal to another pin.

  – Pinout configuration can be exported as a .csv file.

- **Complete project generation**

  The project generation includes pinout, firmware and middleware initialization C code for a set of IDEs. It is based on STM32Cube embedded software libraries. The following actions can be performed:

  – Starting from the previously defined pinout, the user can proceed with the configuration of middleware, clock tree, services (RNG, CRC, etc...) and IP peripheral parameters. STM32CubeMX generates the corresponding initialization C code. The result is a project directory including generated main.c file and C header files for configuration and initialization, plus a copy of the necessary HAL and middleware libraries as well as specific files for the selected IDE.

  – The user can modify the generated source files by adding user-defined C code in user dedicated sections. STM32CubeMX ensures that the user C code is preserved upon next C code generation (the user C code is commented if it is no longer relevant for the current configuration).

  – STM32CubeMX can generate user files by using user-defined freemarker .ftl template files.

  – From the Project settings menu, the user can select the development tool chain (IDE) for which the C code has to be generated. STM32CubeMX ensures that the IDE relevant project files are added to the project folder so that the project can be

directly imported as a new project within third party IDE (IAR™ EWARM, Keil™ MDK-ARM, Atollic® TrueSTUDIO and AC6 System Workbench for STM32).

- **Power consumption calculation**

  Starting with the selection of a microcontroller part number and a battery type, the user can define a sequence of steps representing the application life cycle and parameters (choice of frequencies, enabled peripherals, step duration). STM32CubeMX Power Consumption Calculator returns the corresponding power consumption and battery life estimates.

- **Clock tree configuration**

  STM32CubeMX offers a graphical representation of the clock tree as it can be found in the device reference manual. The user can change the default settings (clock sources, prescaler and frequency values). The clock tree is then updated accordingly. Invalid settings and limitations are highlighted and documented with tool tips. Clock tree configuration conflicts can be solved by using the solver feature. When no exact match is found for a given user configuration, STM32CubeMX proposes the closest solution.

- **Automatic updates of STM32CubeMX and STM32Cube firmware packages**

  STM32CubeMX comes with an updater mechanism that can be configured for automatic or on-demand check for updates. It supports STM32CubeMX self-updates as well as STM32Cube firmware library package updates. The updater mechanism also allows deleting previously installed packages.

- **Report generation**

  .pdf and .csv reports can be generated to document user configuration work.

2.3 Rules and limitations

- C code generation covers only peripheral and middleware initialization. It is based on STM32Cube HAL firmware libraries.
- STM32CubeMX C code generation covers only initialization code for peripherals and middlewares that use the drivers included in STM32Cube embedded software packages. The code generation of some peripherals and middlewares, such as cryptographic IPs and StemWin graphic library, is not yet supported.
- Refer to *Appendix A* for a description of pin assignment rules.
- Refer to *Appendix B* for a description of STM32CubeMX C code generation design choices and limitations.

3 Installing and running STM32CubeMX

3.1 System requirements

3.1.1 Supported operating systems and architectures

- Windows® XP: 32-bit (x86)
- Windows® 7: 32-bit (x86), 64-bit (x64)
- Windows® 8: 32-bit (x86), 64-bit (x64)
- Linux®: 32-bit (x86) and 64-bit (x64) (tested on RedHat, Ubuntu and Fedora)
- MacOS: 64-bit (x64) (tested on OS X Yosemite)

3.1.2 Memory prerequisites

- Recommended minimum RAM: 2 Gbytes.

3.1.3 Software requirements

The following software must be installed:

- Java Run Time Environment for 1.7.0_45

  If Java is not installed on your computer or if you have an old version, STM32CubeMX installer will open the Java download web page and stop.
- For Eclipse plug-in installation only, install one of the following IDE:
  - Eclipse IDE Juno (4.2)
  - Eclipse Luna (4.4)
  - Eclipse Kepler (4.3)
  - Eclipse Mars (4.5)

3.2 Installing/uninstalling STM32CubeMX standalone version

3.2.1 Installing STM32CubeMX standalone version

To install STM32CubeMX, follow the steps below:

1. Download STM32CubeMX installation package from www.st.com/stm32cubemx.
2. Extract (unzip) stm32cubemx.zip whole package into the same directory.
3. Check your access rights and launch the installation wizard:

   On windows:

   a) Make sure you have administrators rights.

   b) Double click the SetupSTM32CubeMX-VERSION.exe file to launch the installation wizard.

   On Linux:

   a) Make sure you have access rights to the target installation director. You can run the installation as root (or sudo) to install STM32CubeMX in shared directories.

b) Double click (or launch from the console window) on the SetupSTM32CubeMX-VERSION.linux file.

On MacOS:

a) Make sure you have administrators rights.

b) Double click SetupSTM32CubeMX application file to launch the installation wizard.

4. Upon successful installation of STM32CubeMX on Windows, STM32CubeMX icon is displayed on your desktop and STM32CubeMX application is available from the Program menu. STM32CubeMX .ioc files are displayed with a cube icon. Double-click them to open up them using STM32CubeMX.
5. Delete the content of the zip from your disk.

Note: If the proper version of the Java Runtime Environment (version 1.7_45 or newer) is not installed, the wizard will propose to download it and stop. Restart STM32CubeMX installation once Java installation is complete. Refer to Section 9: FAQ for issues when installing the JRE.

When working on Windows, only the latest installation of STM32CubeMX will be enabled in the program menu. Previous versions can be kept on your PC (not recommended) when different installation folders have been specified. Otherwise, the new installation overwrites the previous ones.

3.2.2 Installing STM32CubeMX from command line

There are 2 ways to launch an installation from a console window: either in console interactive mode or via a script.

Interactive mode

To perform interactive installation, type the following command:

```
java -jar SetupSTM32CubeMX-4.14.0.exe -console
```

At each installation step, an answer is requested (see *Figure 2* below).

Figure 2. Example of STM32CubeMX installation in interactive mode