



life.augmented

# STM32Cube ecosystem overview Making STM32 development easier



# Inside the STM32Cube ecosystem

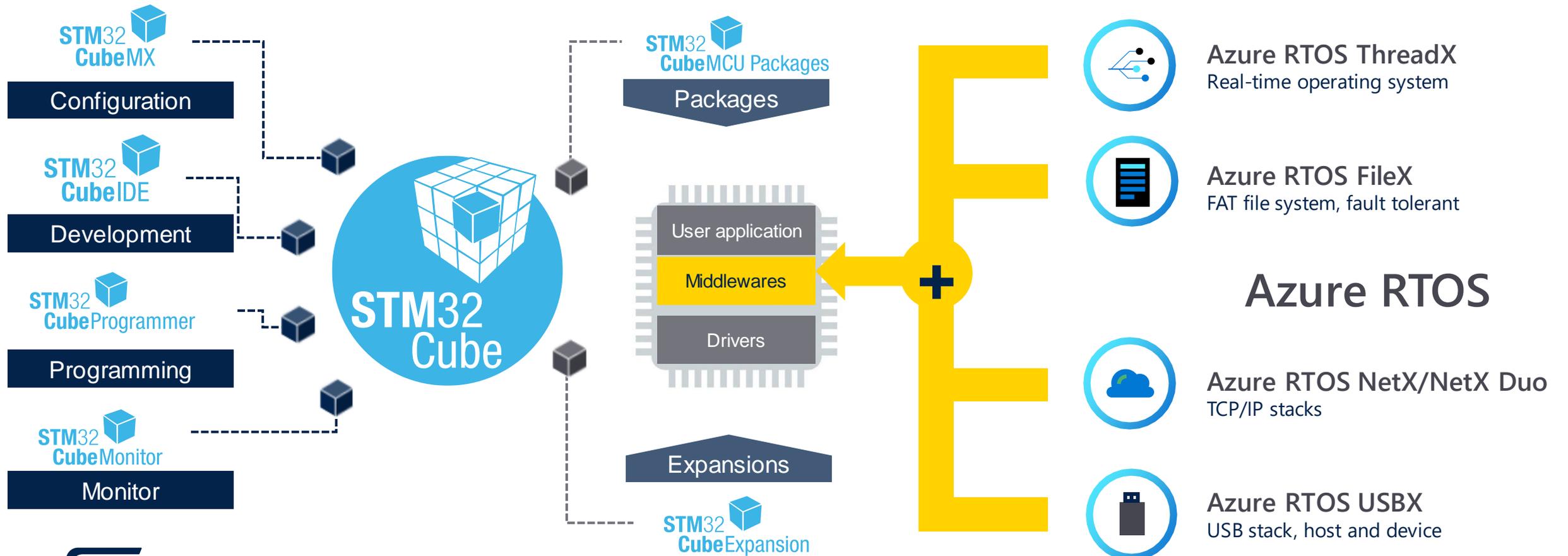
Software Tools



Embedded Software



Complemented with Microsoft Azure RTOS

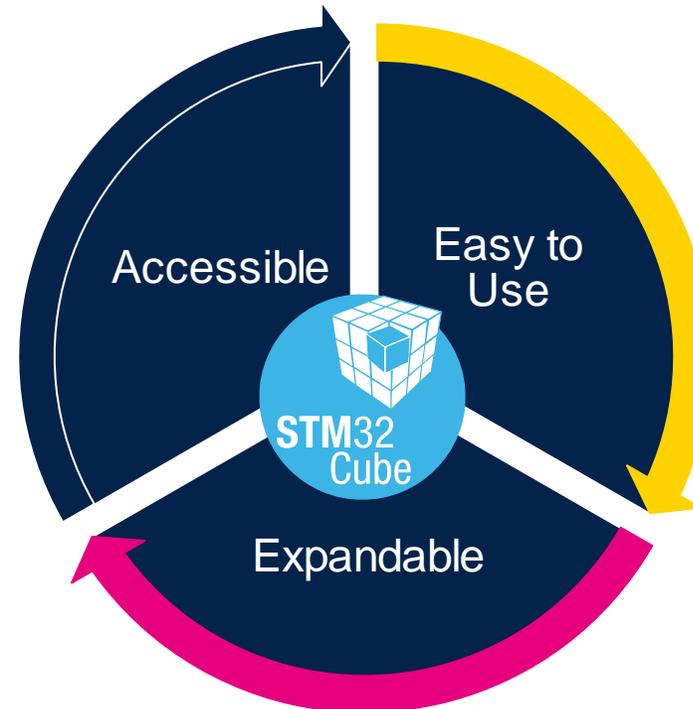


# STM32Cube Ecosystem: User benefits

**Easily getting the most out of STM32 MCUs for a drastically reduced customer development cycle and time-to-market**

**Fits many developer profiles from beginners to experts**

- Exhaustive software development framework
- Free ST IDE (GCC) and professional IDE partners
- Free of charge and business-friendly license terms



**Easy and fast learning curve for a competitive advantage**

- Reduced time-to-market
- Allows focusing on applicative differentiation

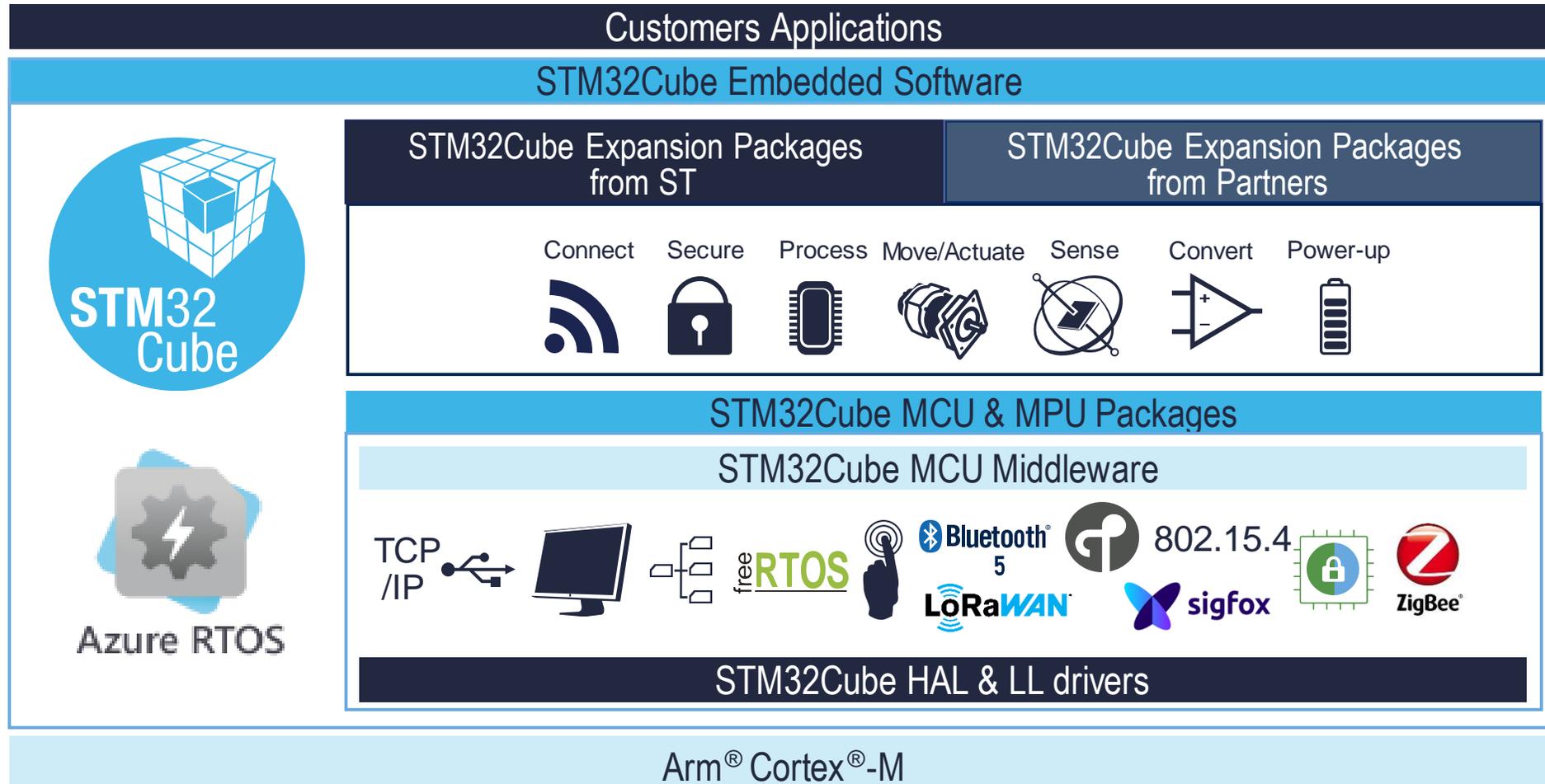
**Fits many customer use cases**

- Complemented by many solutions from official ST partners
- Production-ready

# STM32Cube embedded software



# A flexible, scalable and consistent MCU offer



# STM32Cube MCU packages

## STM32 CubeMCU Packages



# Dedicated to each STM32 Series

## Mainstream MCU

STM32   
CubeG4

STM32   
CubeF3

STM32   
CubeF1

STM32   
CubeG0

STM32   
CubeF0

## High Performance MCU

STM32   
CubeH7

STM32   
CubeF7

STM32   
CubeF4

STM32   
CubeF2

## MPU

STM32   
CubeMP1

## Ultra-Low Power MCU

STM32   
CubeL0

STM32   
CubeL1

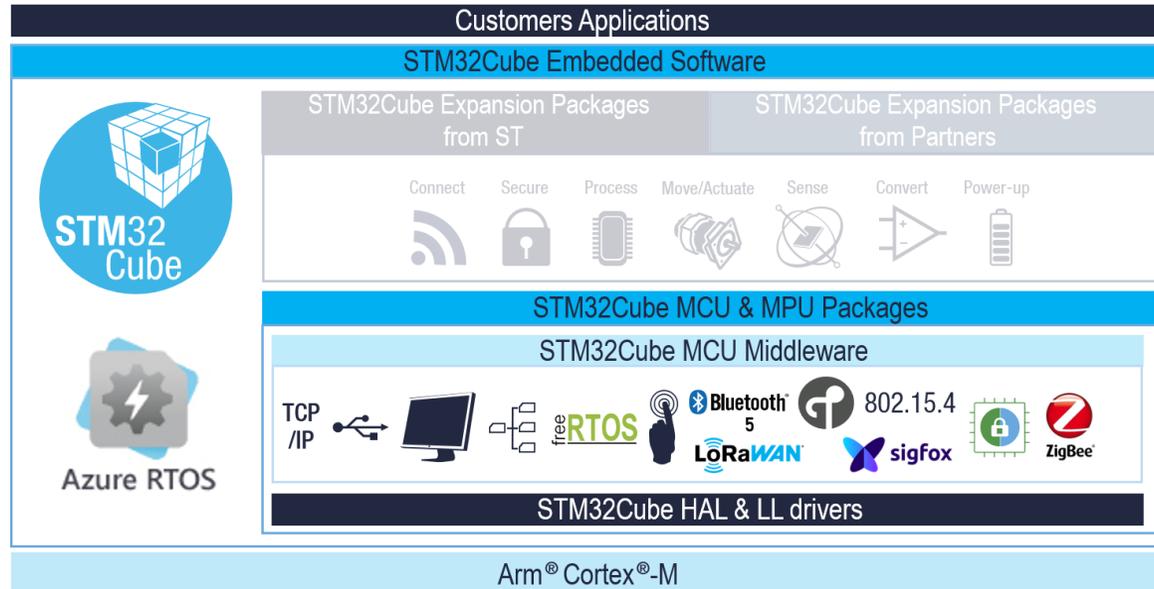
STM32   
CubeL4

STM32   
CubeL5

## Wireless MCU

STM32   
CubeWB

STM32   
CubeWL



## Peripheral drivers

### HAL API

Hardware Abstraction Layer, highly portable and easy to use

### LL APIs

Low-Layer APIs, light weight and highly optimized for runtime efficiency

## STM32Cube Middleware

### Generic MW

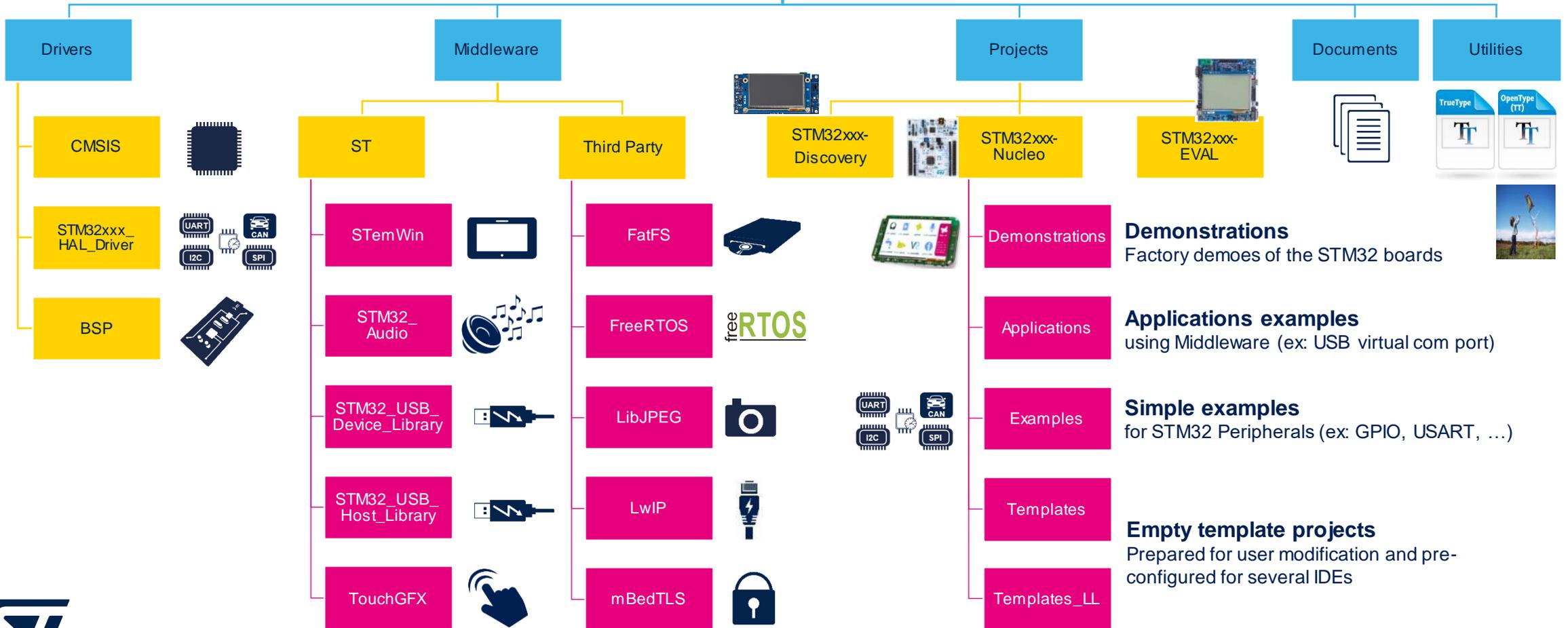
- FreeRTOS
- FatFS file system
- LwIP TCP/IP stack
- mbedTLS and mbedCrypto
- Open Bootloader

### Dedicated MW

- ST Bluetooth 5 stack
- OpenThread stack
- ST 802.15.4 MAC
- Zigbee 3 stack
- STM32 WPAN
- LoRaWAN stack
- Sigfox stack
- Sub-GHz phy
- ST Key Management Services (KMS)
- TF-M
- ST USB Host & Device stacks
- STM32 Touch Sensing library
- STemWin graphics stack

# Detailed content and organization

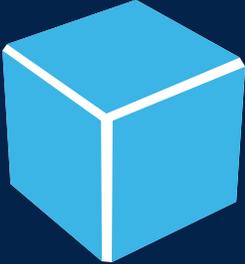
## STM32Cube MCU Package



# Middleware tailored for each series

Family	LL API	HAL API	FreeRTOS	FatFS	STemWin	USB Host	USB Device	LwIP mBedTLS	Touch Sense	USB PD	OpenAMP	BLE Stack	OpenThread Stack	Zigbee 3	LoRaWAN	Sigfox	TF-M
<a href="#">STM32CubeF0</a>	✓	✓	✓	✓	✓		✓		✓								
<a href="#">STM32CubeF1</a>	✓	✓	✓	✓	✓	✓	✓	✓									
<a href="#">STM32CubeF2</a>	✓	✓	✓	✓	✓	✓	✓	✓									
<a href="#">STM32CubeF3</a>	✓	✓	✓	✓	✓		✓		✓								
<a href="#">STM32CubeF4</a>	✓	✓	✓	✓	✓	✓	✓	✓									
<a href="#">STM32CubeF7</a>	✓	✓	✓	✓	✓	✓	✓	✓									
<a href="#">STM32CubeH7</a>	✓	✓	✓	✓	✓	✓	✓	✓			✓						
<a href="#">STM32CubeG0</a>	✓	✓	✓	✓						✓							
<a href="#">STM32CubeG4</a>	✓	✓	✓	✓			✓			✓							
<a href="#">STM32CubeL0</a>	✓	✓	✓	✓			✓		✓								
<a href="#">STM32CubeL1</a>	✓	✓	✓	✓	✓	✓	✓		✓								
<a href="#">STM32CubeL4</a>	✓	✓	✓	✓	✓	✓	✓		✓								
<a href="#">STM32CubeL5</a>	✓	✓	✓	✓			✓		✓	✓							✓
<a href="#">STM32CubeWB</a>	✓	✓	✓	✓			✓		✓			✓	✓	✓			
<a href="#">STM32CubeWL</a>	✓	✓	✓	✓											✓	✓	
<a href="#">STM32CubeMP1</a>	✓	✓	✓								✓						

# STM32Cube expansion packages

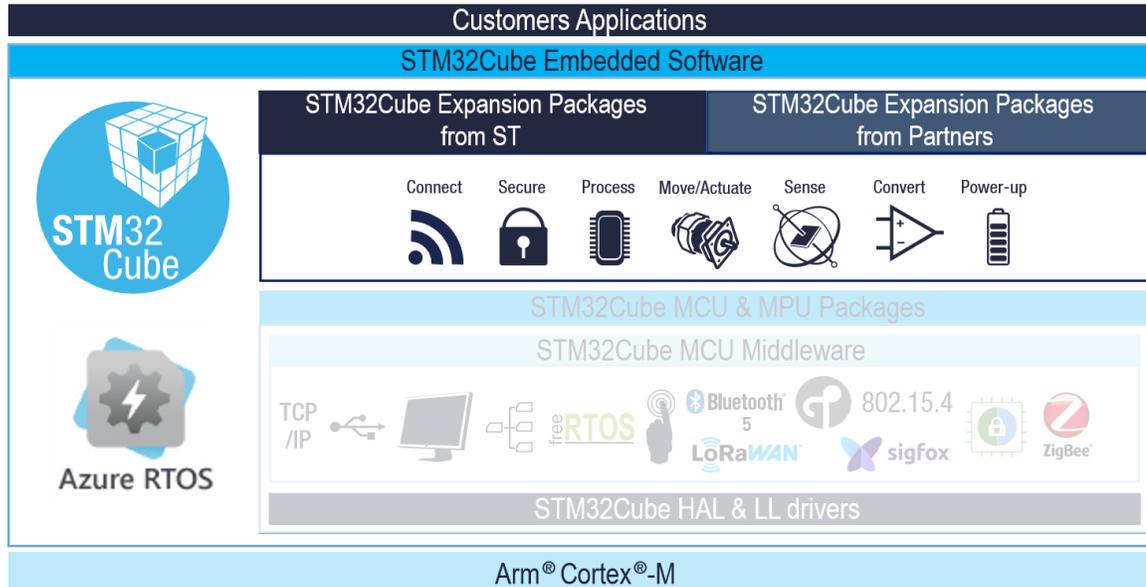
STM32   
CubeExpansion



# X-CUBE / I-CUBE / Function Pack (FP)

## Function Pack (FP)

Advanced applicative projects and libraries



## X-CUBE packages

### From ST

Ex: X-CUBE-AZRTOS-H7, X-CUBE-AI, X-CUBE-TOUCHGFX, X-CUBE-SBSFU, X-CUBE-CRYPTO, ...

## I-CUBE packages

### From 3<sup>rd</sup> parties

Ex: I-CUBE-EMBOS, I-CUBE-UNISON, I-CUBE-CANOPEN...

Complementing and expanding the STM32Cube MCU Packages with middleware alternatives or straightforward implementations of real applicative use cases

## Azure RTOS

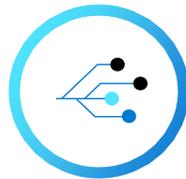
### X-CUBE

X-CUBE-AZRTOS-H7

Enhanced for  
STM32 Toolset



Azure RTOS



Azure RTOS ThreadX  
Real-time operating system



Azure RTOS NetX/NetX Duo  
TCP/IP stacks



Azure RTOS FileX  
FAT file system, fault tolerant



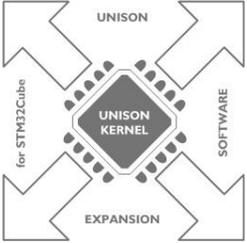
Azure RTOS USBX  
USB stack, host and device

# Expansions with middleware

**UNISON** 

**I-CUBE**  
**I-CUBE-UNISON**

Enhanced for  
STM32 Toolset




**WolfSSL** 

**I-CUBE**  
**I-CUBE-WOLFSSL**

Enhanced for  
STM32 Toolset




**CANopen** 

**I-CUBE**  
I-CUBE-CANOPEN




**embOS** 

**I-CUBE**  
**I-CUBE-EMBOS**

Enhanced for  
STM32 Toolset




# Expansions for various applications

## Audio



**X-CUBE**  
X-CUBE-AUDIO  
X-CUBE-VS4A  
X-CUBE-USB-AUDIO

## Bootloader/Secure Boot



**X-CUBE**  
X-CUBE-IAP-USART  
X-CUBE-IAP-SD  
X-CUBE-SBSFU

## Safety



**X-CUBE**  
X-CUBE-CLASSB  
X-CUBE-STL<sup>1</sup>

## Crypto



**X-CUBE**  
X-CUBE-CRYPTOLIB

## USB



**X-CUBE**  
X-CUBE-USB-PD

## SigFox



**X-CUBE**  
X-CUBE-SFOX

## LoRa



**I-CUBE**  
I-CUBE-LRWAN

## Sub-1G



**X-CUBE**  
X-CUBE-SUBG1

## BLE



**X-CUBE**  
X-CUBE-BLE1 Enhanced for STM32 Toolset  
X-CUBE-BLE2 Enhanced for STM32 Toolset

## NFC



**X-CUBE**  
X-CUBE-NFC4<sup>2</sup> Enhanced for STM32 Toolset

## GRAPHICS

**X-CUBE**  
X-CUBE-TOUCHGFX Enhanced for STM32 Toolset

# Expansions with Function Packs

**Cloud** 

**X-CUBE**

- X-CUBE-CLD-GEN1
- X-CUBE-AWS
- X-CUBE-AZURE
- X-CUBE-WATSON
- X-CUBE-GCP

**FP**

- FP-CLD-AWS1
- FP-CLD-AZURE1
- FP-CLD-WASTON1

**Motion** 

**X-CUBE**

- X-CUBE-6180XA1
- X-CUBE-IKA02A1
- X-CUBE-MEMS-XT1
- X-CUBE-MEMS1** *Enhanced for STM32 Toolset*
- X-CUBE-MEMS1-V4

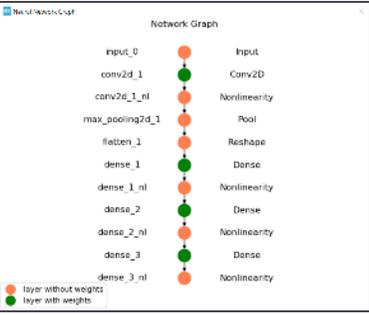
**FP**

- FP-SNS-6LPNODE1
- FP-SNS-ALLMEMS1
- FP-SNS-FLIGHT1
- FP-SNS-MOTENV1

**AI** 

**X-CUBE**

**X-CUBE-AI** *Enhanced for STM32 toolset*

**FP**

- FP-AI-SENSING1
- FP-AI-VISION1

## Motor - PMSM



### X-CUBE

#### X-CUBE-MCSDK

STM32 Motor Control SDK (MCSDK)

#### X-CUBE-MCSDK-FUL

STM32 Motor Control SDK (MCSDK) –  
FULL source code –  
Registration/approbation needed for  
download



#### X-CUBE-SPN7

Three-phase brushless DC motor driver

## Motor - Stepper



### X-CUBE

#### X-CUBE-SPN1

Stepper bipolar motor driver software expansion for STM32Cube

#### X-CUBE-SPN2

Two axes stepper motor driver software expansion for STM32Cube

#### X-CUBE-SPN3

High-power stepper motor driver software expansion for STM32Cube

#### X-CUBE-SPN4

Dual-brush DC motor driver software expansion for STM32Cube

#### X-CUBE-SPN5

Stepper bipolar motor driver software expansion for STM32Cube

# Expansions enhanced for STM32 Toolset

MX Embedded Software Packages Manager

STM32Cube MCU Packages and embedded software packs releases

Releases Information was last refreshed 11 days ago.

STM32Cube MCU Packages | STMicroelectronics | ARM | RoweBots | SEGGER | wolfSSL

Status	Description	Available Version
▶	X-CUBE-AI	
▶	X-CUBE-ALGOBUILD	
▼	X-CUBE-AZRTOS-H7	
■	Azure RTOS STM32Cube expansion package for STM32H7 series	1.0.0

Details

Release version : 1.0.0  
Release date : 2021-02-25

Release information :  
STM32CubeExpansion\_AZRTOS-H7 V1.0.0

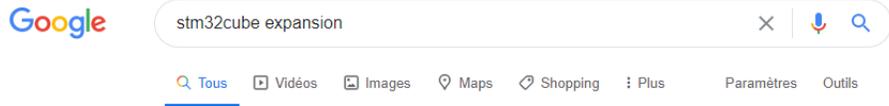
First official release of Azure RTOS STM32Cube expansion package for STM32H7 series

This version is compatible with STM32CubeMX 6.2.0 and STM32PackCreator 3.2.0

From Local ... From Url ... Refresh Install Now Remove Now Close

- I-CUBE-EMBOS
- I-CUBE-UNISON
- I-CUBE-WOLFSSL
- X-CUBE-AI
- X-CUBE-ALGOBUILD
- X-CUBE-BLE1
- X-CUBE-BLE2
- X-CUBE-EEPRMA1
- X-CUBE-GNSS1
- X-CUBE-MEMS1
- X-CUBE-NFC4
- X-CUBE-SUBG2
- X-CUBE-SFXS2LP1
- X-CUBE-TOUCHGFX

# STM32Cube expansions on ST website



Environ 83 000 résultats (0,38 secondes)

<https://www.st.com> > ... > STM32 Embedded Software

## STM32Cube Expansion Packages - STMicroelectronics

The **STM32Cube expansion** software contains embedded software components that enable the usage of a multitude of ST devices in domains such as of ...

<https://www.st.com> > ecosystems > stm32cube-expansion-...

## STM32Cube Expansion Software - STMicroelectronics

The **STM32Cube expansion** software contains embedded software components that complement the functionalities of the STM32Cube and/or enable the usage ...

<https://www.st.com> > resource > user\_manual > d... > PDF

## Development guidelines for STM32Cube Expansion Packages

1 sept. 2020 — STM32Cube low-layer APIs, a consistent set of middleware components, and all embedded software utilities. • **STM32Cube Expansion** ...

<https://www.st.com> > ... > STM32Cube Expansion Packages

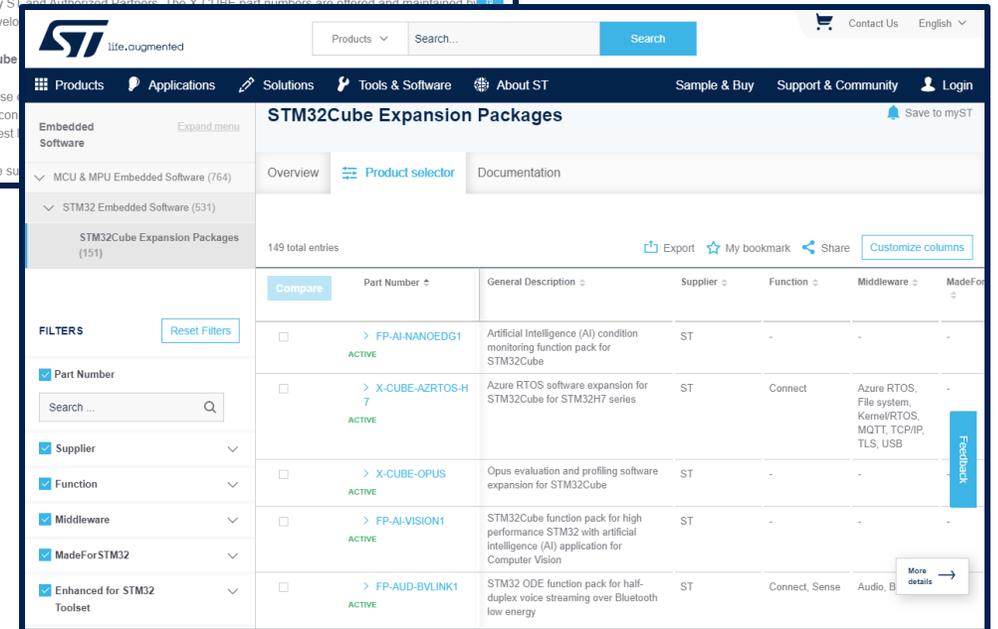
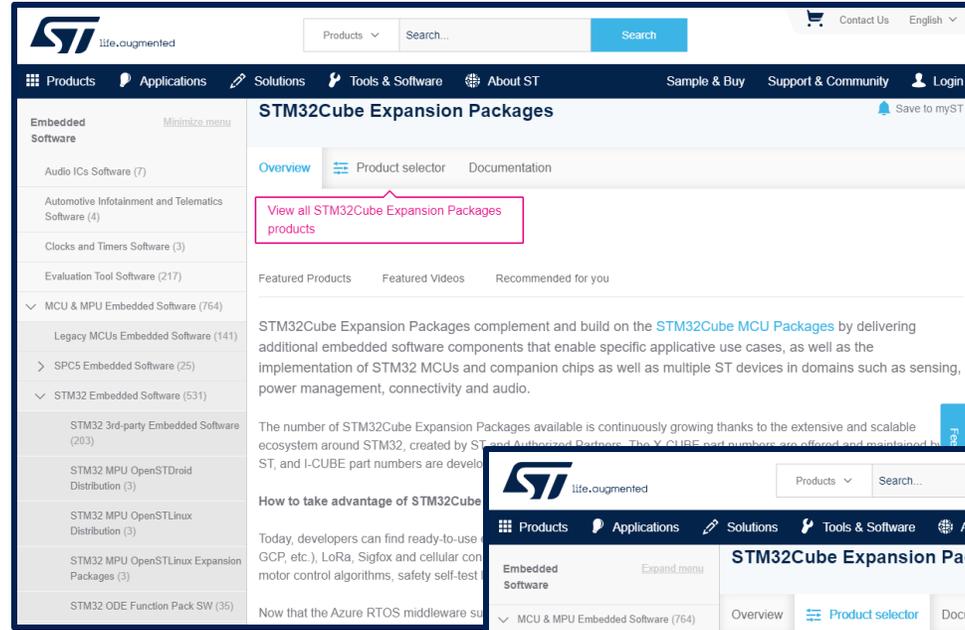
## X-CUBE-AI - AI expansion pack for STM32CubeMX ...

X-CUBE-AI is an **STM32Cube Expansion** Package part of the STM32Cube.AI ecosystem and extending STM32CubeMX capabilities with automatic conversion ...

<https://www.st.com> > ... > STM32Cube Expansion Packages

## I-CUBE-LRWAN - LoRaWAN software expansion for ...

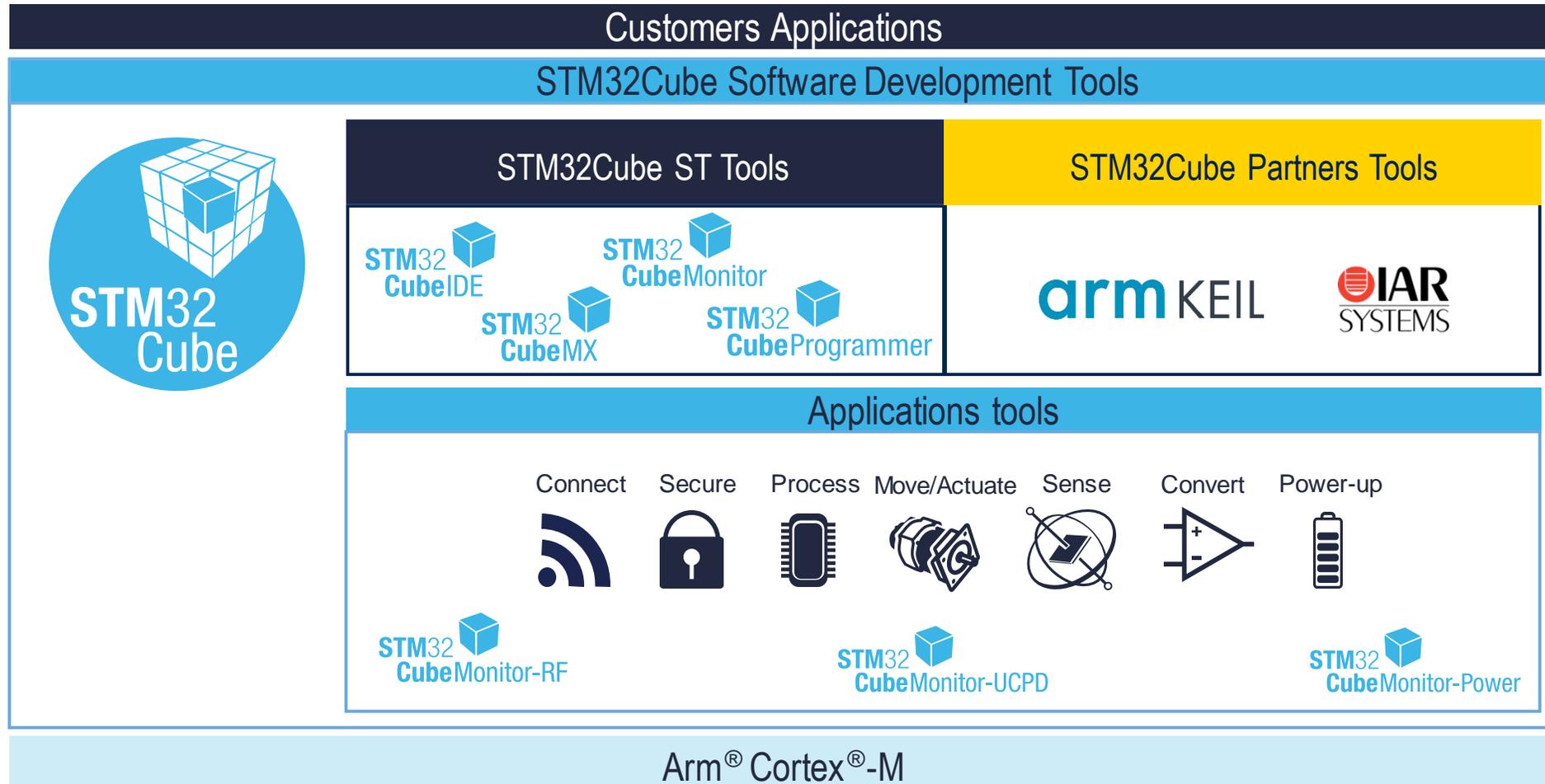
**STM32CubeMX** is part of the **STM32cube** initiative designed to simplify and accelerate the development of applications for STM32 microcontrollers.



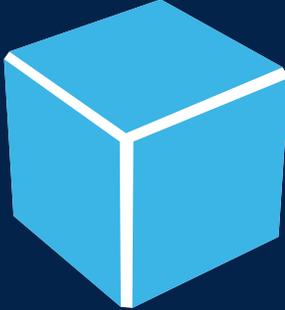
# STM32Cube software Development tools



# A complete Software Development Tools offer



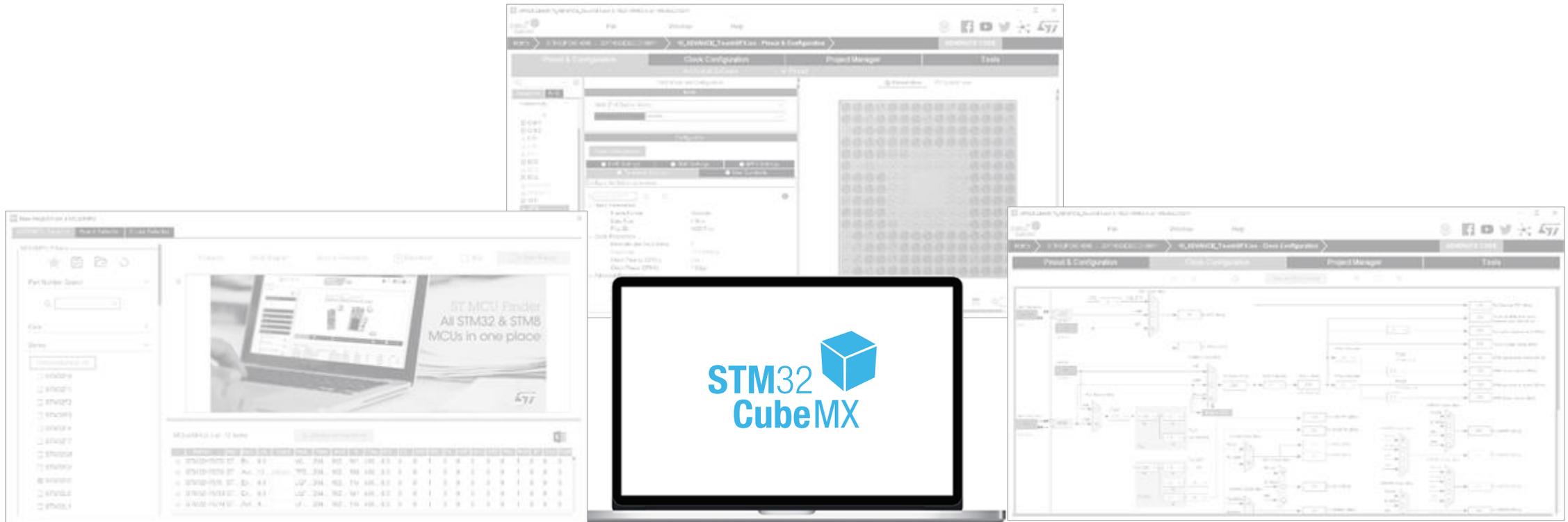
**STM32CubeMX**

**STM32**   
**CubeMX**



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# What's STM32CubeMX?

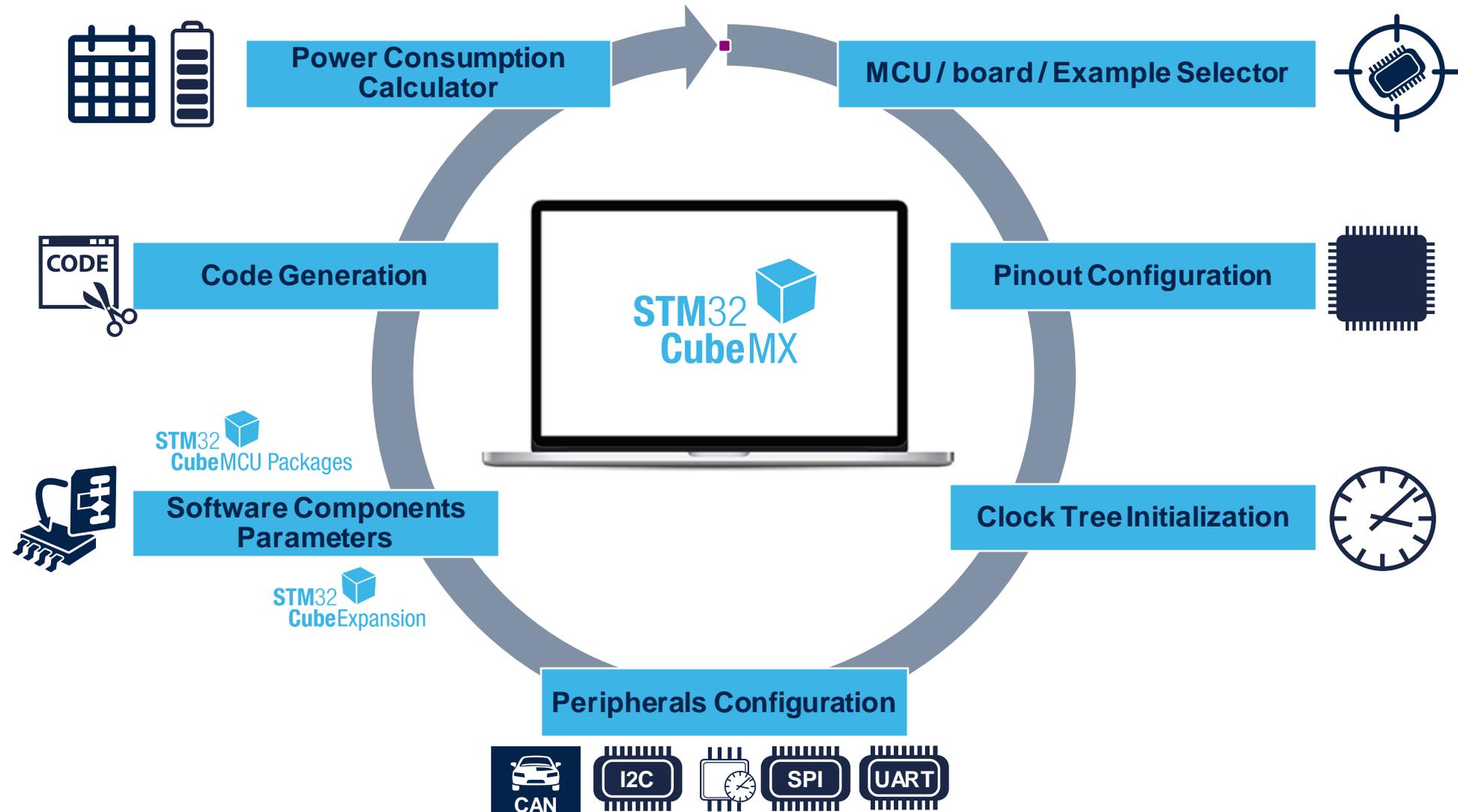


**Graphical Configuration**  
(Pinout/Peripherals/Middleware/Clock-Tree)

**IDE Project Generation**  
(IAR™, Keil™ and GCC compilers)

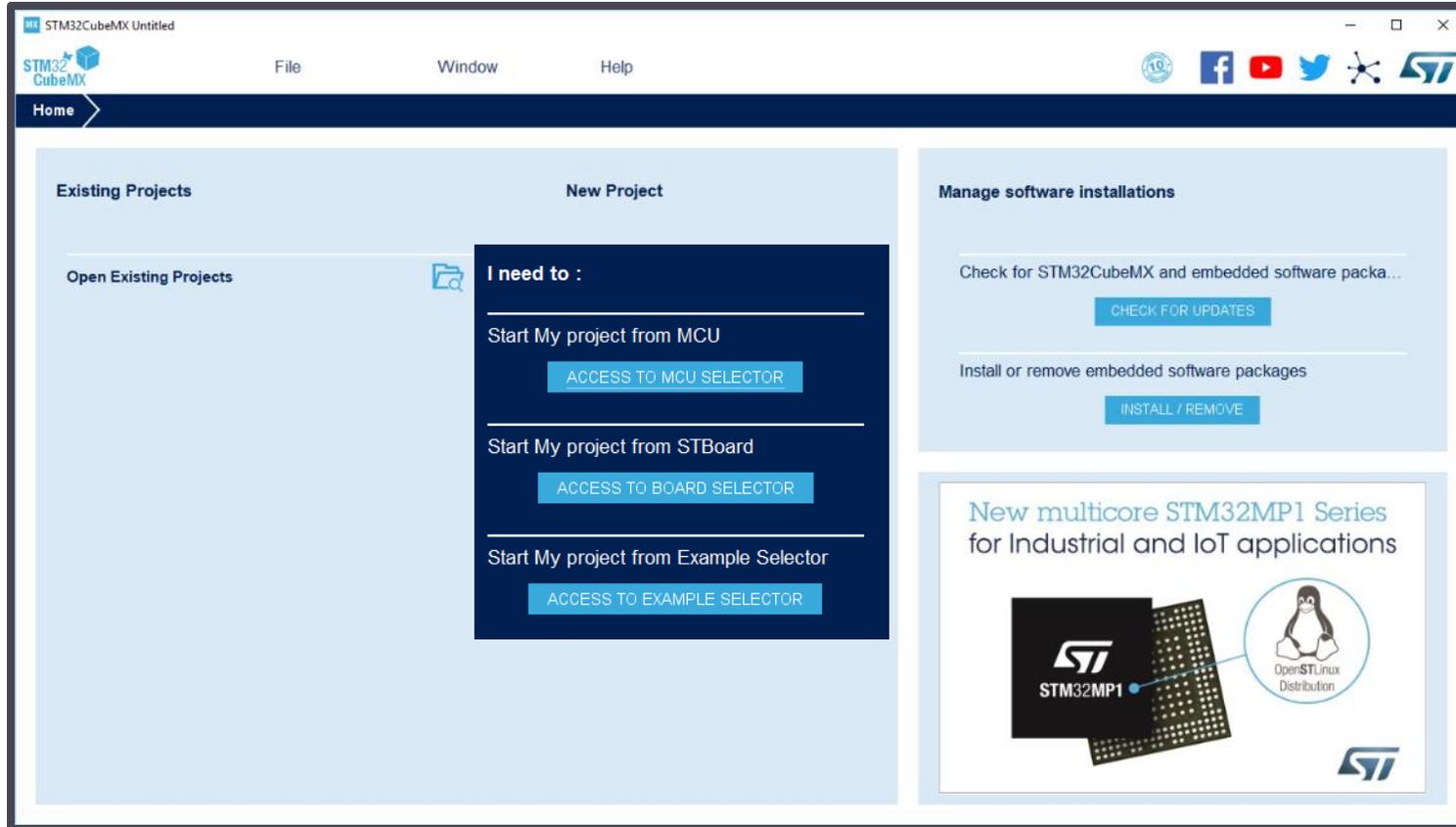
**Multi-platform**  
(Windows, Linux, macOS)

# STM32CubeMX key steps





# MCU / MPU selection



MCU / MPU  
SELECTOR

BOARD  
SELECTOR

EXAMPLE  
SELECTOR



# MCU/MPU selector

MCU / MPU  
SELECTOR

BOARD  
SELECTOR

EXAMPLE  
SELECTOR

New Project from Example

MCU/MPU Selector | Board Selector | **Example Selector** | Cross Selector

Example Filters

Name:

Keyword:  Aa [ab]

Vendor:

Board:

Name:

Type:

Discovery Kit

Evaluation Board

Nucleo-144

Nucleo-32

Nucleo-64

MCU / MPU

Name:

Series:

STM32F4

STM32F7

STM32G0

STM32G4

Features

Projects/STM32G081B-EVAL/Examples/SPVSPIDuplex\_ComDMA\_Slave/

**STM32G0** **SPI\_FullDuplex\_ComDMA\_Slave** V1.4.0

Required Software Package: STM32Cube\_FW\_G0\_V1.4.0 (size: 202.0 MB)

Vendor: STMicroelectronics

Board: STM32G081B-EVAL

Mounted device: STM32G081RBTx LQFP64

Supported Toolchain/IDE: EWARM, MDK-ARM, STM32CubeIDE

STM32CubeMX Minimum Compatible Version: 6.0.0

Keywords: Connectivity, DMA, Full-duplex, Interrupt, MISO, MOSI, Master, Reception, SPI, Slave, Transmission

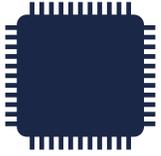
Examples List: 632 items

Name	Board	Board Type	STM32Cub...	Series	Project Type	Driver
SPI_FullDuplex_ComDMA_Slave	STM32G081B-EVAL	Evaluation Board	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComDMA_Slave	NUCLEO-G031K8	Nucleo-32	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Master	NUCLEO-G070RB	Nucleo-64	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Master	NUCLEO-G071RB	Nucleo-64	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Master	STM32G081B-EVAL	Evaluation Board	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Master	NUCLEO-G031K8	Nucleo-32	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Slave	NUCLEO-G070RB	Nucleo-64	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Slave	NUCLEO-G071RB	Nucleo-64	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Slave	STM32G081B-EVAL	Evaluation Board	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComIT_Slave	NUCLEO-G031K8	Nucleo-32	✓	STM32G0	Example	HAL
SPI_FullDuplex_ComPolling_Master	NUCLEO-G081RE	Nucleo-64	✓	STM32G0	Example	MIX
SPI_FullDuplex_ComPolling_Master	STM32G0C1E-EV	Evaluation Board	✓	STM32G0	Example	HAL

DESCRIPTION  
&  
INFORMATION

DEDICATED  
FILTERS

PRODUCT  
LIST

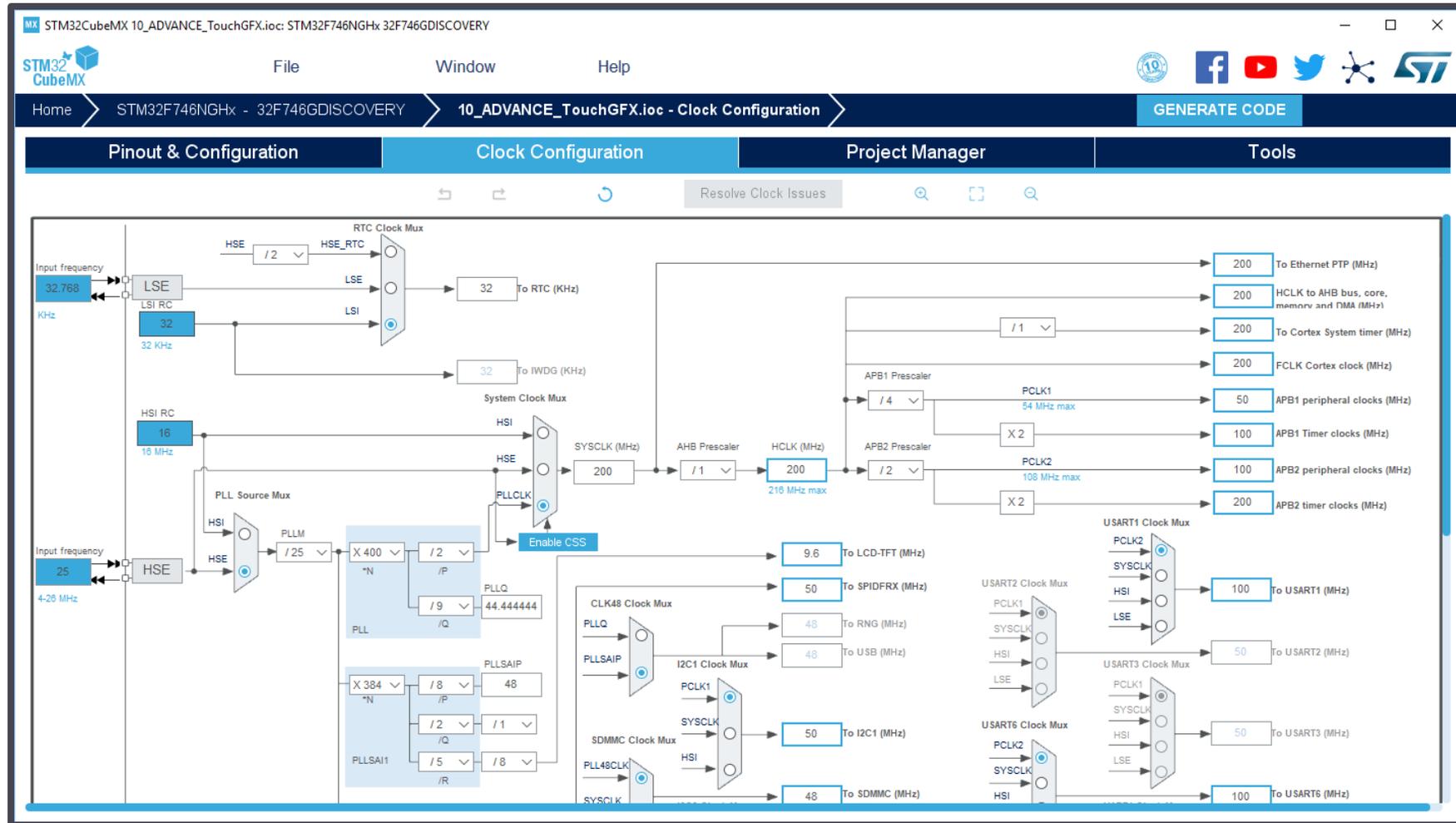


# Pinout configuration

The screenshot displays the STM32CubeMX Pinout Configuration tool. The main window shows the pinout configuration for the STM32F746NGHx microcontroller. The interface includes a menu bar (File, Window, Help), a breadcrumb trail (Home > STM32F746NGHx - 32F746GDISCOVERY > 10\_ADVANCE\_TouchGFX.ioc - Pinout & Configuration), and a toolbar with a 'GENERATE CODE' button. The main area is divided into four tabs: Pinout & Configuration, Clock Configuration, Project Manager, and Tools. The 'Pinout & Configuration' tab is active, showing a 'Pinout view' of the TFBGA216 package. A context menu is open over pin FB14, listing the following options: Reset\_State, SPI2\_MISO, TIM12\_CH1, TIM1\_CH2N, TIM8\_CH2N, USART3\_DE, USART3\_RTS, USB\_OTG\_HS\_DM, GPIO\_Input, GPIO\_Output, GPIO\_Analog, EVENTOUT, and GPIO\_EXTI14. On the left, a 'Connectivity' list shows various peripheral options, with SPI2 selected. The bottom of the interface features a search bar and navigation icons.



# Clock-tree configuration





# Peripheral parameters

The screenshot displays the STM32CubeMX software interface for configuring the SPI2 peripheral. The main window is titled "STM32CubeMX 10\_ADVANCE\_TouchGFX.ioc: STM32F746NGHx 32F746GDISCOVERY". The interface includes a menu bar (File, Window, Help), a toolbar with social media icons and the ST logo, and a navigation pane on the left showing various peripheral categories. The "Pinout & Configuration" tab is active, and the "SPI2 Mode and Configuration" settings are displayed in the main area.

**Mode:**

- Mode: Full-Duplex Master
- Hardware NSS Signal: Disable

**Configuration:**

- Reset Configuration
- NVIC Settings
- DMA Settings
- GPIO Settings
- Parameter Settings
- User Constants

**Configure the below parameters:**

Category	Parameter	Value
Basic Parameters	Frame Format	Motorola
	Data Size	4 Bits
	First Bit	MSB First
Clock Parameters	Prescaler (for Baud Rate)	2
	Baud Rate	25.0 MBits/s
	Clock Polarity (CPOL)	Low
	Clock Phase (CPHA)	1 Edge
Advanced Parameters	CRC Calculation	Disabled
	NSSP Mode	Enabled
	NSS Signal Type	Software

The right side of the interface shows a "Pinout view" of the TFBGA216 package (Top view), displaying a grid of pins with their respective configurations.



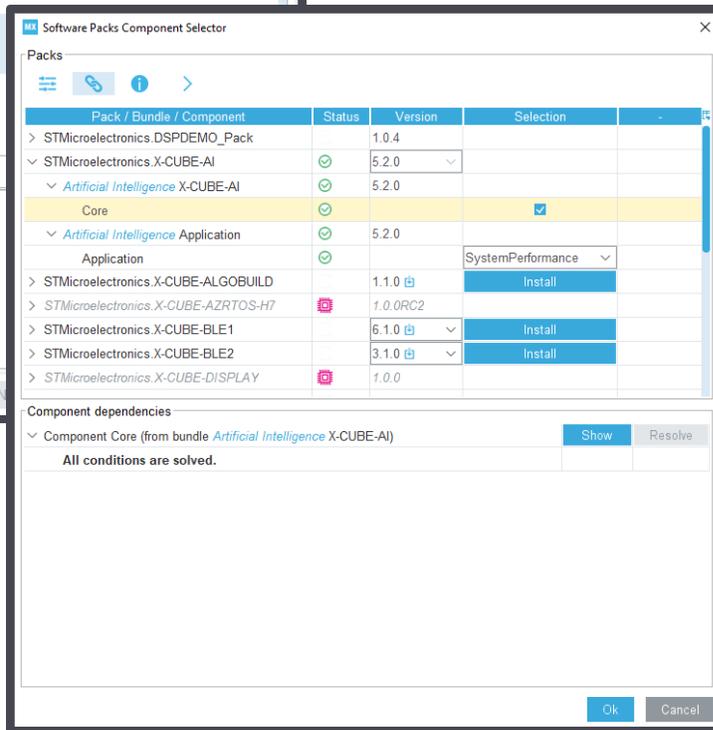
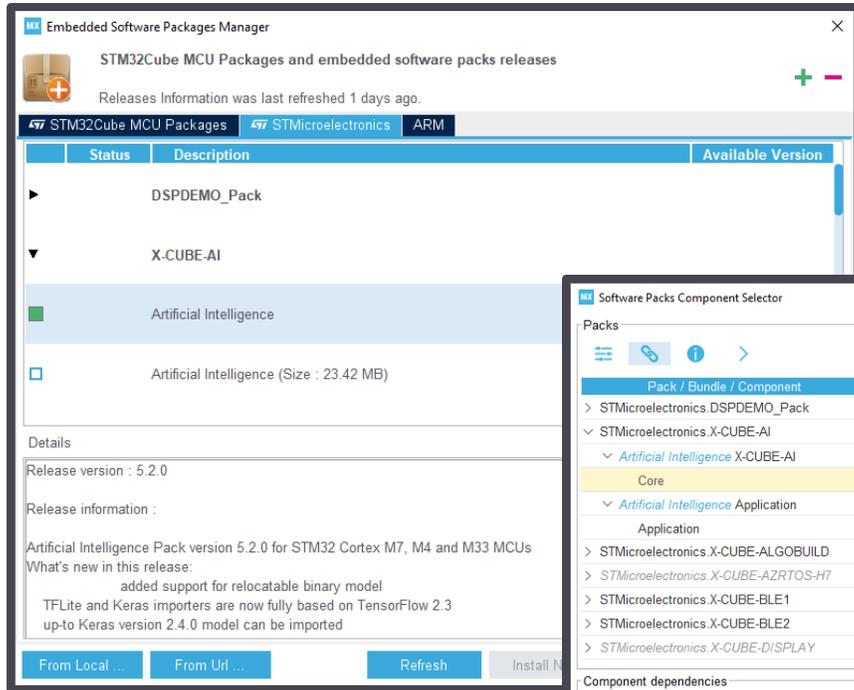
# Middleware and software components parameters

The screenshot displays the STM32CubeMX software interface for configuring a project. The main window is titled "STM32CubeMX 10\_ADVANCE\_TouchGFX.ioc: STM32F746NGHx 32F746GDISCOVERY". The interface is divided into several sections:

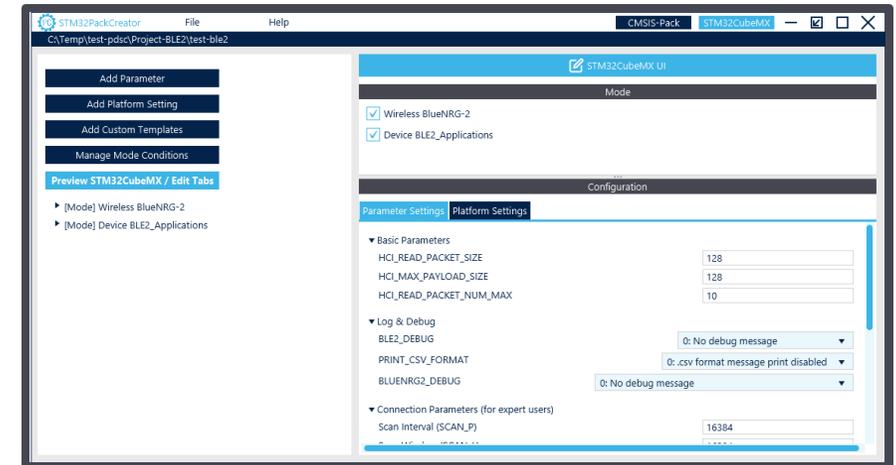
- Top Bar:** Includes the STM32CubeMX logo, menu options (File, Window, Help), and social media icons (Facebook, YouTube, Twitter, GitHub, ST).
- Navigation Bar:** Shows the current project path: "Home > STM32F746NGHx - 32F746GDISCOVERY > 10\_ADVANCE\_TouchGFX.ioc - Pinout & Configuration". A "GENERATE CODE" button is visible on the right.
- Configuration Tabs:** "Pinout & Configuration" is selected, with other tabs for "Clock Configuration", "Project Manager", and "Tools".
- Left Panel (Categories):** Lists various hardware and software categories: System Core, Analog, Timers, Connectivity, Multimedia, Security, Computing, and Middleware. Under "Middleware", "FREERTOS" and "GRAPHICS" are checked.
- Main Configuration Area:**
  - Mode:** Interface is set to "CMSIS\_V1".
  - Configuration:** Includes a "Reset Configuration" button and several checked options: "Mutexes", "FreeRTOS Heap Usage", "Tasks and Queues", "Timers and Semaphores", "Config parameters", "Include parameters", and "User Constants".
  - Kernel settings:** A table of parameters to be configured:
- Right Panel (Pinout view):** Shows a top view of the "TFBGA216" package with a grid of pins. The pins are color-coded (green and yellow) to indicate their configuration status.



# Add Expansion Middleware and build your own



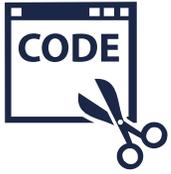
Download and install existing Expansion Package...



or

Build your own Expansion Package with **STM32PackCreator**

...and select components to add to your project



# Code generation

The screenshot shows the STM32CubeMX Project Manager interface. The 'Project Manager' tab is active, displaying various configuration options. A dropdown menu is open for the 'Toolchain / IDE' field, listing several options:

- EWARM V8
- EWARM V7
- MDK-ARM V4
- MDK-ARM V5
- STM32CubeIDE
- SW4STM32
- TrueSTUDIO
- Makefile

Other visible settings include:

- Project Name: [Empty field]
- Project Location: C:\Temp [Browse]
- Application Structure: Basic [Do not generate the main() checkbox]
- Toolchain Folder Location: C:\Temp
- Linker Settings: Minimum Heap Size (0x200), Minimum Stack Size (0x400)
- Mcu Reference: STM32F746NGHx
- Firmware Package Name and Version: STM32Cube FW\_F7 V1.15.0
- Use Default Firmware Location: [Checked]
- Firmware Location: C:/00\_myTools/STM32Cube/STM32Cube\_FW\_F7\_V1.15.0 [Browse]





# Power consumption calculator

STM32CubeMX 10\_ADVANCE\_TouchGFX.ioc\*: STM32F746NGHx 32F746GDISCOVERY

File Window Help

Home > STM32F746NGHx - 32F746GDISCOVERY > 10\_ADVANCE\_TouchGFX.ioc - Tools > GENERATE CODE

Pinout & Configuration Clock Configuration Project Manager Tools

Power

STM32F746NGHx >

T<sub>A</sub> 25°C / V<sub>DD</sub> 3.3V >

Alkaline(C LR14) (1x1) v

PCC Change Reset

Step Sequence

New Step

Step	Mode	Vdd	Range/Scale	Memory	CPU/Bus Freq	Clock Config	Peripherals	Step Current	Duration
1	RUN	3.3	Scale1-High	SRAM/FLAS...	216 MHz	HSE PLL	ADC3 CRC D...	163.5 mA	1 ms
2	STOP_NM (N...	3.3	No Scale	n/a	0 Hz	Regulator_LP ...	IWDG	270.25 µA	1 ms

Sequence Table

Display Selection

Select your Preferred Display Plot: All Steps

Consumption Profile by Step

Consumption (mA)

Time (ms)

Legend: Idd by Step (pink line), Average Current (blue line)

Sequence Time / Ta Max 2 ms / 89.35 °C

Battery Life Estimation 4 days, 5 hours

Average Consumption 81.89 mA

Average DMIPS 462.24 DMIPS

Edit Step

Reset Step Settings Enable All IPs Disable All IPs Enable IPs from Pinout

Power/Memory

Power Mode: RUN

Power Scale: Scale1-High

Memory Fetch Type: SRAM/LASH-ARTIL1Cache/REGON

V<sub>DD</sub>: 3.3

Voltage Source: Battery

Clocks

CPU Frequency: 216 MHz

Interpolation Ranges: [ ]

User Choice (Hz): [ ]

Clock Configuration: HSE PLL

Clock Source Frequency: 4 MHz

Optional Settings

Step Duration: 1 ms

Additional Consumption: 0 mA

Results

Step Consumption: 163.5 mA

Without Peripherals: 108 mA

Peripherals Part: 55.5 mA (A: 1.75 mA - D: 53.77 mA)

Ta Max (°C): 89.35

Warnings

Peripherals Selection

Enabled Peripherals

- ADC1
- ADC2
- ADC3
- BKPSRAM
- BusMatrix
- CAN1
- CAN2
- CEC
- CRC
- Cryp
- DAC
- OUT1
- OUT1+OUT2
- OUT2
- DCMI
- DMA1
- 1\_Stream
- 2\_Streams
- 3\_Streams
- 4\_Streams
- 6\_Streams
- 7\_Streams
- 8\_Streams
- DMA2
- 1\_Stream
- 2\_Streams

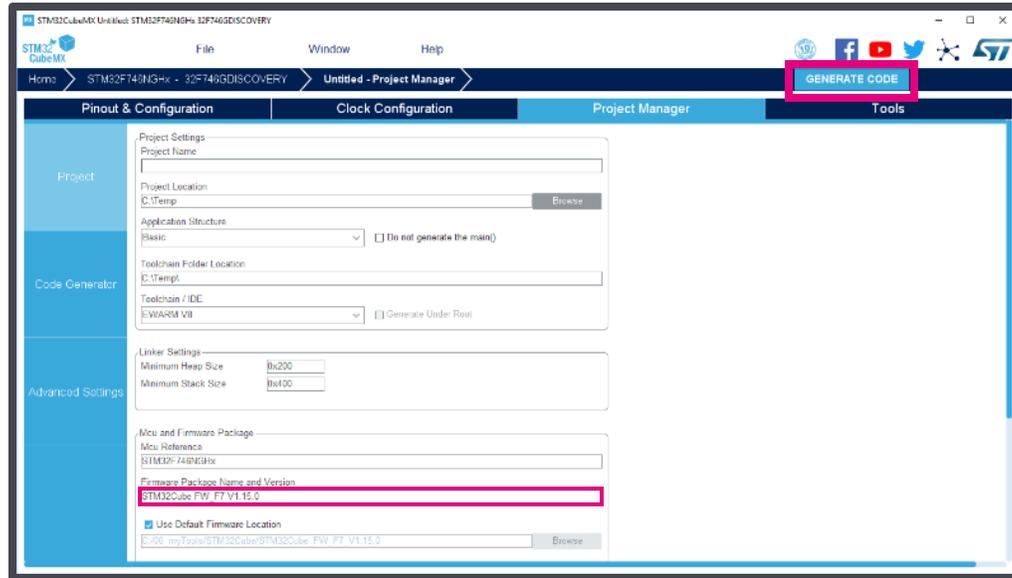
Enabled Peripherals

- ADC3
- CRC
- DCMI
- DMA2D
- FMIC
- GPIOA
- GPIOB
- GPIOC
- GPIOC
- GPIOE
- GPIOF
- GPIOG
- GPIOH
- GPIOI
- GPIOJ
- GPIOK
- LC1
- LC3
- LTDC
- QUADSPI
- RTC
- SAD
- SDMMC1
- SPI/FSMC
- SYSC
- TM1
- TM2
- TMS
- TIM2
- USART1
- USART6

OK Cancel



# STM32CubeMX repository



After pressing “GENERATE CODE”:

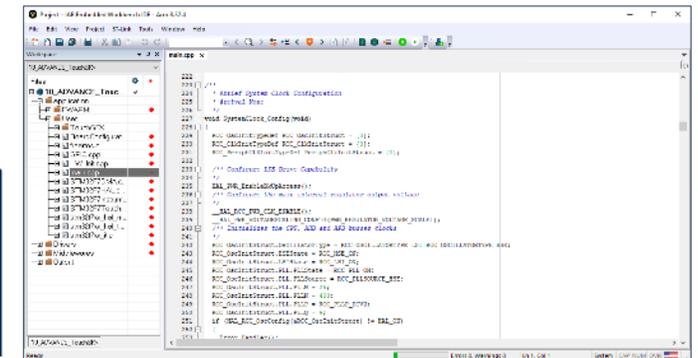
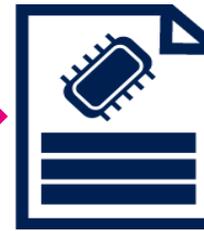
1. STM32CubeMX grabs necessary peripheral drivers based on your pinout/peripheral configuration from STM32Cube MCU Package in STM32CubeMX Repository
2. STM32CubeMX grabs necessary middleware based on your middleware configuration from STM32Cube MCU Package in STM32CubeMX repository
3. Generate IDE project

	Description	Installed Version	Available Version
▼	STM32F7		
■	STM32Cube MCU Package for STM32F7 Series	1.15.0	1.15.0
■	STM32Cube MCU Package for STM32F7 Series	1.14.0	1.14.0
□	STM32Cube MCU Package for STM32F7 Series (Size : 584 MB)		1.12.0
□	STM32Cube MCU Package for STM32F7 Series (Size : 569 MB)		1.11.0

STM32CubeMX  
Repository



IDE  
Project





# MCU/MPU selection for AI application

MX New Project from a MCU/MPU

MCU/MPU Selector Board Selector Cross Selector

Core >  
Series >  
Line >  
Package >  
Other >  
Advanced Graphic >  
Artificial Intelligence >

Enable

Model: Keras  
Type: Saved model  
Model: HAR-CNN-Kera...h5  
Browse  
Compression: 4  
Analyze

Peripheral >

Features Block Diagram Docs & Resources Datasheet Buy Start Project

New multicore STM32MP1 Series for Industrial and IoT applications

Graphic Summary AI Summary

**K Keras** Minimum Ram: 44.50 KBytes Minimum Flash: 775.52 KBytes C:\100\_myProjects\AI\_ML\_DL\Trials\HAR-CNN-Keras\_model.h5

List: 338 items + Display similar items

	Ref...	Mark...	Unit...	Board	Pack...	Flash	RAM	IO	Freq	GFX	CO...	DDR	DEB...	FM...	HDP	HMAC	MD5	PKA	PWR	RF	SHA	TAMP
☆	STM32F405...	ST...	Act...4...		WL...	102...	192...	72	168...	0.0	0	0	0	0	0	0	0	0	0	0	0	0
☆	STM32F405...	ST...	Act...4...		LQF...	102...	192...	51	168...	0.0	0	0	0	0	0	0	0	0	0	0	0	0
☆	STM32F405...	ST...	Act...5...		LQF...	102...	192...	82	168...	0.0	0	0	0	0	0	0	0	0	0	0	0	0
☆	STM32F405...	ST...	Act...5...		LQF...	102...	192...	114	168...	0.0	0	0	0	0	0	0	0	0	0	0	0	0
☆	STM32F407IG	ST...	Act...6...	STM324...	UF...	102...	192...	140	168...	0.0	0	0	0	0	0	0	0	0	0	0	0	0

# STM32CubeIDE

STM32   
CubeIDE

# Background of STM32CubeIDE

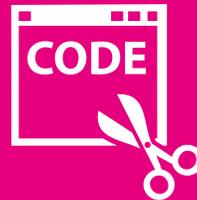


# One tool for all your STM32 development

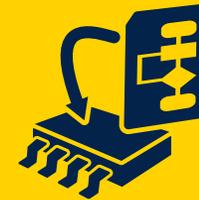
Chipset / Board  
Configuration



Code  
Development

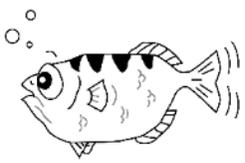
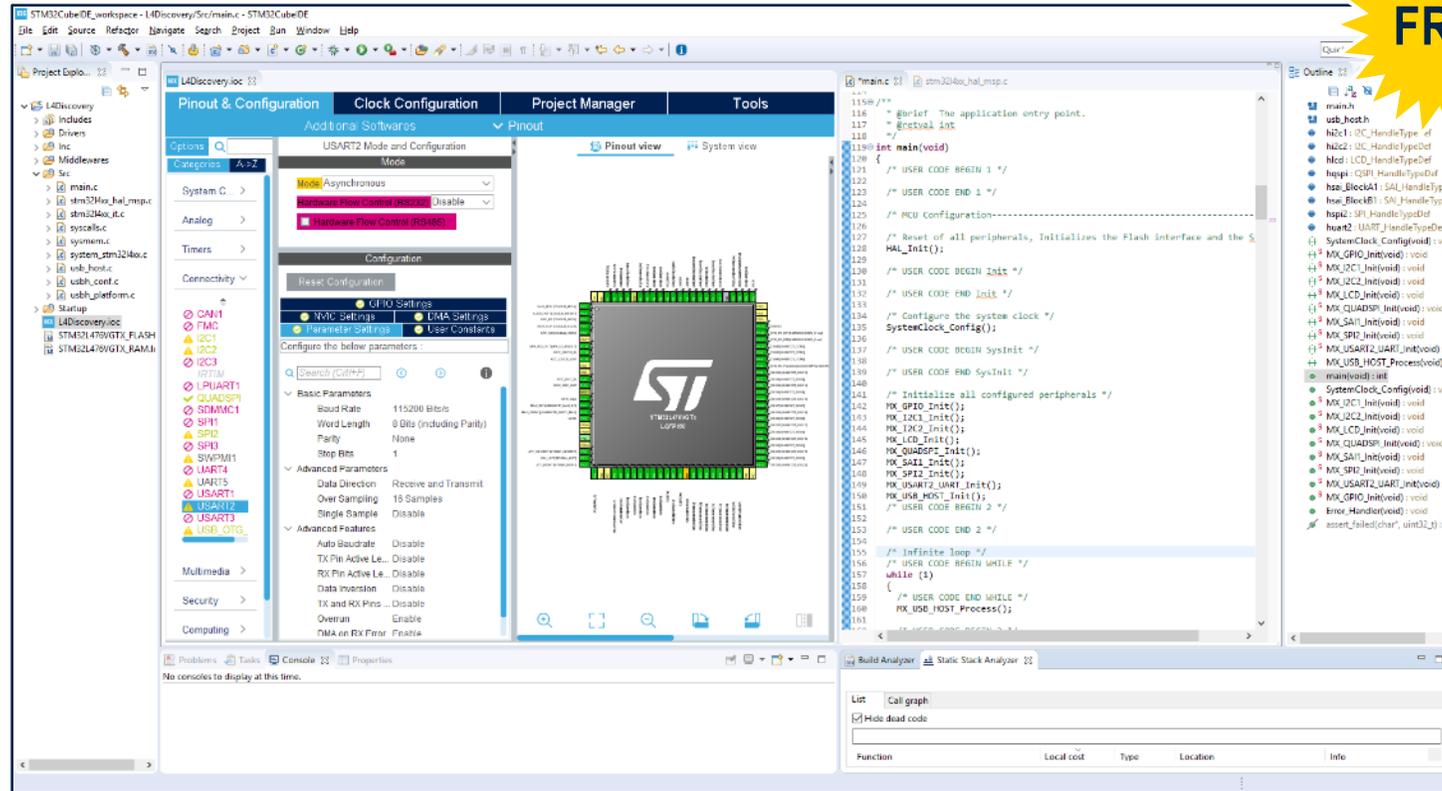


Validation  
Debug



# Free multi-platform development tool

FREE



macOS

Eclipse/GCC Based

Free for Commercial Development

Multi-OS Support



# Project management

## Importer

STM32CubeIDE Home

Welcome to STM32CubeIDE

Start a project

Start new STM32 project

Import SW / TS project

TrueSTUDIO Project

SW4STM32 Project

## IOC Editor

```
usb_host.c
76 if (USBH_Init(&UsbHostHS, USBH_UserProcess, HOST_HS) != USBH_OK)
77 {
78     Error_Handler();
79 }
80 if (USBH_RegisterClass(&UsbHostHS, USBH_CDC_CLASS) != USBH_OK)
81 {
82     Error_Handler();
83 }
```



# Code editor – navigation

## Symbol Hyperlink

```
BSP_LED_Init(LED1);  
BSP_LED_Init(LED2);  
BSP_LED_Init(LED3);  
BSP_LED_In  
  
void BSP_LED_Init(Led_TypeDef Led)  
{  
    GPIO_InitTypeDef gpio_init_structure;  
  
    if (Led <= LED4)  
    {  
        /* Configure the GPIO_LED pin */  
        gpio_init_structure.Pin = GPIO_PIN[Led];  
        gpio_init_structure.Mode = GPIO_MODE_OUTPUT_PP;  
        gpio_init_structure.Pull = GPIO_PULLUP;  
        gpio_init_structure.Speed = GPIO_SPEED_HIGH;  
    }  
}
```

## Include Browser

```
Include Browser  
Files included by 'main.c(/F746-DISCO-HID/Src)' - in workspace  
main.c  
main.h  
stm32f7xx_hal.h  
stm32f7xx_hal_conf.h  
stm32f7xx_hal_rcc.h  
stm32f7xx_hal_exti.h  
stm32f7xx_hal_gpio.h  
stm32f7xx_hal_dma.h  
stm32f7xx_hal_cortex.h
```

## Call Hierarchy

```
HAL_StatusTypeDef USB_WritePacket(USB_OTG_GlobalTypeDef *USBx, uint8_t *src, uint8_t  
{  
    uint32_t USB_BASE = (uint32_t)USBx;  
    uint32_t *pSrc = (uint32_t *)src;  
    uint32_t count32b, i;  
  
    Call Hierarchy  
Callers of USB_WritePacket(USB_OTG_GlobalTypeDef *USBx, uint8_t *src, uint8_t):  
- USB_WritePacket(USB_OTG_GlobalTypeDef *USBx, uint8_t *src, uint8_t): HAL_StatusTypeDef  
- PCD_WriteEmptyTxFifo(PCD_HandleTypeDef *hpcd, uint32_t): HAL_StatusTypeDef  
- HAL_PCD_IRQHandler(PCD_HandleTypeDef *hpcd): void  
- OTG_FS_IRQHandler(): void  
- USB_EPStartXfer(USB_OTG_GlobalTypeDef *USBx, USB_OTG_EPTypeDef *ep, uint8_t): HAL_StatusTypeDef  
- HAL_PCD_EP_Receive(PCD_HandleTypeDef *hpcd, uint8_t *buf, uint32_t): HAL_StatusTypeDef  
- USB_LL_PrepareReceive(USB_HandleTypeDef *hdev, uint8_t *buf, uint32_t): USB_StatusTypeDef  
- HAL_PCD_EP_Transmit(PCD_HandleTypeDef *hpcd, uint8_t *buf, uint32_t): HAL_StatusTypeDef  
- USB_LL_Transmit(USB_HandleTypeDef *hdev, uint8_t *buf, uint16_t): USB_StatusTypeDef  
- USB_HC_StartXfer(USB_OTG_GlobalTypeDef *USBx, USB_OTG_HCTypeDef *hcb, uint8_t): HAL_StatusTypeDef
```

## Brace Navigation

```
294 /* Check the parameters */  
295 assert_param(IS_OPTIONBYTE(poBInit->OptionType));  
296  
297 /* Write protection configuration */  
298 if((poBInit->OptionType & OPTIONBYTE_WRP) == OPTIONBYTE_WRP)  
000 {  
001     assert_param(IS_WRPSTATE(poBInit->WRPState));  
002     if(poBInit->WRPState == OB_WRPSTATE_ENABLE)  
003     {  
004         /*Enable of Write protection on the selected Sector*/  
005         status = FLASH_OB_EnableWRP(poBInit->WRPSector);  
006     }  
007     else  
008     {  
009         /*Disable of Write protection on the selected Sector*/  
010         status = FLASH_OB_DisableWRP(poBInit->WRPSector);  
011     }  
312 }
```

## Macro Expansion Browser

```
Explore Macro Expansion - 2 step(s)  
#define USB_OTG_FS ((USB_OTG_GlobalTypeDef *) USB_OTG_FS_PERIPH_BASE)  
Original Fully Expanded  
1 USB_OTG_FS 1 ((USB_OTG_GlobalTypeDef *) 0x50000000UL)  
  
Explore Macro Expansion - 2 step(s)  
#define USB_OTG_FS ((USB_OTG_GlobalTypeDef *) USB_OTG_FS_PERIPH_BASE)  
Original Expansion #1 of 2  
1 USB_OTG_FS 1 ((USB_OTG_GlobalTypeDef *) USB_OTG_FS_PERIPH_BASE)  
  
Explore Macro Expansion - 2 step(s)  
#define USB_OTG_FS_PERIPH_BASE 0x50000000UL  
Expansion #1 of 2 Fully Expanded  
1 USB_OTG_FS 1 ((USB_OTG_GlobalTypeDef *) 0x50000000UL)
```

## Type Hierarchy

```
46 UART_HandleTypeDef huart2;  
47  
48 /* USER CODE BEGIN PV */  
49  
50  
51  
52  
Type Hierarchy  
UART_HandleTypeDef  
- UART_HandleTypeDef  
- AdvancedInit: UART_AdvFeatureInitTypeDef - __UART_HandleTypeDef  
- ErrorCode: volatile uint32_t - __UART_HandleTypeDef  
- gState: volatile HAL_UART_StateTypeDef - __UART_HandleTypeDef  
- hdmarx: DMA_HandleTypeDef * - __UART_HandleTypeDef  
- hdmatx: DMA_HandleTypeDef * - __UART_HandleTypeDef  
- Init: UART_InitTypeDef - __UART_HandleTypeDef  
- Instance: USART_TypeDef * - __UART_HandleTypeDef  
- Lock: HAL_LockTypeDef - __UART_HandleTypeDef  
- Mask: uint16_t - __UART_HandleTypeDef  
- pRxBuffPtr: uint8_t * - __UART_HandleTypeDef  
- pTxBuffPtr: uint8_t * - __UART_HandleTypeDef
```





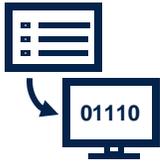
# Code editor – writing

## Highlight Inactive Code

```
usb_desc.c 23
157
158 #if defined ( __ICCARM__ ) /* IAR Compiler */
159 #pragma data_alignment=4
160 #endif /* defined ( __ICCARM__ ) */
161 /** USB standard device descriptor. */
162 _ALIGN_BEGIN uint8_t USB_DFS_DeviceDesc[USB_LEN_DEV_DESC] _ALIGN_END =
163 {
164     0x12,          /*bLength*/
165     USB_DESC_TYPE_DEVICE, /*bDescriptorType*/
166     #if (USB_DFS_LPM_ENABLED == 1)
167     0x01,          /*bcdUSB*/ /* changed to USB version 2.01
168                                     In order to support LPM L1 suspend
169                                     resume test of USBCV3.0*/
170 #else
171     0x00,          /*bcdUSB*/
172 #endif /* (USB_DFS_LPM_ENABLED == 1) */
173     0x00,          /*bDeviceClass*/
174     0x00,          /*bDeviceSubClass*/
175     0x00,          /*bDeviceProtocol*/
176     USB_MAX_EP0_SIZE, /*bMaxPacketSize*/
177     LOBYTE(USB_DFS_VID), /*idVendor*/
178     HIBYTE(USB_DFS_VID), /*idVendor*/
179 }
```

## Auto-Complete

```
*main.c 23
97 /* USER CODE BEGIN 2 */
98 HAL_GPIO_
99
100
101 /* Infinite
102 /* USER CO
103 while (1)
104 {
105 /* USER
106
107 /* USER
108 }
109 /* USER CO
110 }
111
112 /**
113 * @brief S
114 * @retval
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# Build tools

## Build Analyzer

Build Analyzer Static Stack Analyzer Search

F769-DISCO-ITCM.elf - /F769-DISCO-ITCM/Debug - May 10, 2019 3:28:29 PM

Memory Regions Memory Details

Region	Start address	End address	Size	Free	Used	Usage (%)
FLASH	0x08000000	0x08200000	2048 KB	2043.22 KB	4.78 KB	0.23%
RAM	0x20000000	0x20080000	512 KB	510.45 KB	1.55 KB	0.30%
ITCMRAM	0x00000000	0x00004000	16 KB	15.48 KB	528 B	3.22%

Build Analyzer Static Stack Analyzer Search

F769-DISCO-ITCM.elf - /F769-DISCO-ITCM/Debug - May 10, 2019 3:28:29 PM

Memory Regions Memory Details

Search

Name	Run address (VMA)	Load address (LMA)	Size
ITCMRAM	0x00000000		16 KB
> .itcmram	0x00000000	0x0800110c	528 B
FLASH	0x08000000		2048 KB
> .itcmram	0x00000000	0x0800110c	528 B
> .isr_vector	0x08000000	0x08000000	60 B
> .text	0x0800003c	0x0800003c	4.16 KB
> .rodata	0x080010e0	0x080010e0	16 B
> .ARM	0x080010f0	0x080010f0	8 B
> .preinit_array	0x080010f8	0x080010f8	0 B
> .init_array	0x080010f8	0x080010f8	4 B
> .fini_array	0x080010fc	0x080010fc	4 B
> .data	0x20000000	0x08001100	12 B
RAM	0x20000000		512 KB
> .data	0x20000000	0x08001100	12 B
> .bss	0x2000000c		32 B
> .user_heap_stack	0x2000002c		1.5 KB

## Static Stack Analyzer

Build Analyzer Static Stack Analyzer Search

F769-DISCO-ITCM.elf - /F769-DISCO-ITCM/Debug - May 10, 2019 3:28:29 PM

List Call graph

Hide dead code

Function	L...	Type	Location	Info
SystemClock_Config	88	STATIC	main.c:108	
NVIC_EncodePriority	40	STATIC	core_cm7.h:2071	
HAL_RCC_GetSysClockFreq	40	STATIC	stm32f7xx_hal_rcc.c:982	
HAL_NVIC_SetPriority	32	STATIC	stm32f7xx_hal_cortex.c:165	
HAL_RCC_OscConfig	32	STATIC	stm32f7xx_hal_rcc.c:344	
__NVIC_SetPriorityGrouping	24	STATIC	core_cm7.h:1865	
HAL_RCC_ClockConfig	24	STATIC	stm32f7xx_hal_rcc.c:703	
HAL_InitTick	16	STATIC	stm32f7xx_hal.c:231	

Build Analyzer Static Stack Analyzer Search

F769-DISCO-ITCM.elf - /F769-DISCO-ITCM/Debug - May 10, 2019 3:28:29 PM

List Call graph

Function	Depth	Max cost	Local cost	Type	Location
LoopFillZerobss	7	208	0		
SysTick_Handler	0	8	8	STATIC	stm32f7xx_it.c:182
NMI_Handler	0	4	4	STATIC	stm32f7xx_it.c:70
UsageFault_Handler	0	4	4	STATIC	stm32f7xx_it.c:128
PendSV_Handler	0	4	4	STATIC	stm32f7xx_it.c:169
HardFault_Handler	0	4	4	STATIC	stm32f7xx_it.c:83
HAL_IncTick	0	4	4	STATIC	stm32f7xx_hal.c:290
SVC_Handler	0	4	4	STATIC	stm32f7xx_it.c:143
DebugMon_Handler	0	4	4	STATIC	stm32f7xx_it.c:156
MemManage_Handler	0	4	4	STATIC	stm32f7xx_it.c:98
BusFault_Handler	0	4	4	STATIC	stm32f7xx_it.c:113
Reset_Handler	0	0	0		

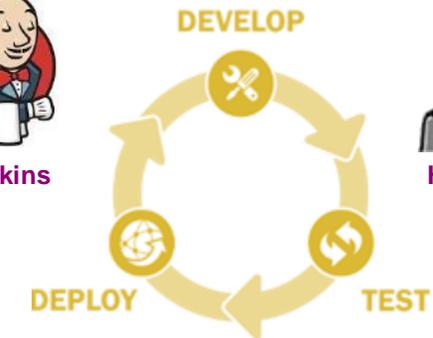
## Headless Build



Jenkins



Hudson

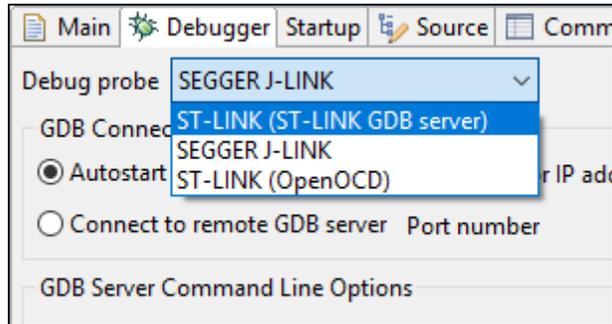


## Continuous Integration

- Build project without opening IDE
- No GUI shown but build system becomes active
- Supported for makefile and managed projects



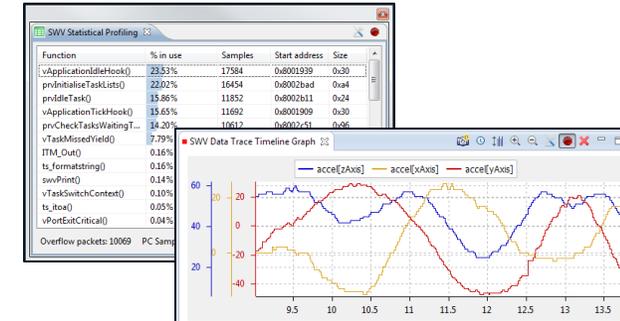
## Debugger



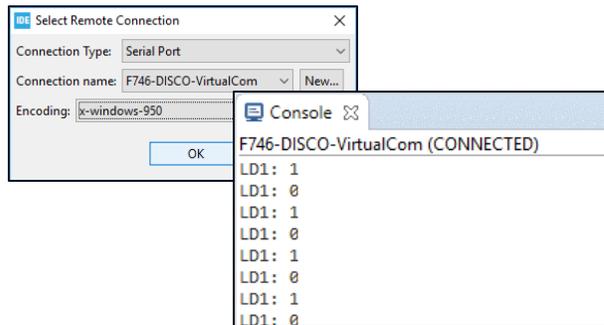
## Live expressions

Expression	Type	Value
(x)= uwTick	volatile uint32_t	1603
+ Add new expression		

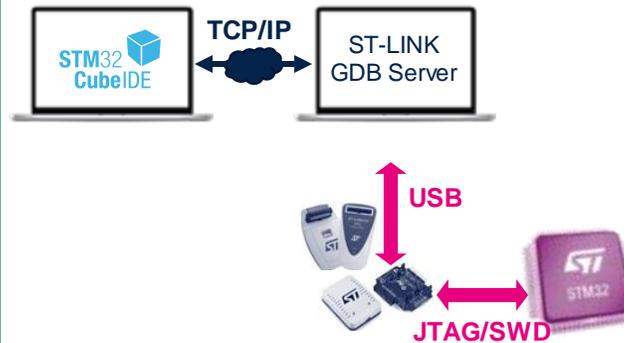
## SWV



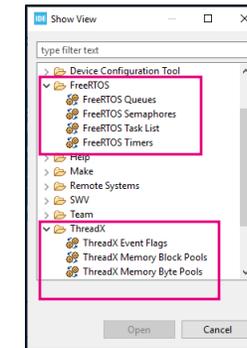
## Integrated UART Terminal



## Remote Debug



## RTOS aware Debug



FreeRTOS

ThreadX Microsoft Azure

# STM32CubeProgrammer

# STM32 CubeProgrammer



# From ST-LINK Utility to STM32CubeProgrammer

## ST-Link Utility

## STM32CubeProgrammer

The screenshot shows the STM32 ST-LINK Utility interface. The top menu includes File, Edit, View, Target, ST-LINK, External Loader, and Help. The main window is divided into several sections:

- Memory display:** Shows the current address (0x08004000), size (0x1D10C), and data width (32 bits).
- Device information:** Lists the device as STM32F74x/F75x, with Device ID 0x449, Revision ID Rev Z, and a 1MByte flash size.
- Target memory:** Displays a table of memory addresses and their corresponding data in binary, hexadecimal, and ASCII formats.
- Log:** Shows a list of system messages, including connection status and device identification.

Address	0	4	8	C	ASCII
0x08004000	480340F8	F7FD210A	BDF8BB3D	40023830	?@.H.!??=?008.@
0x08004010	20000488	4002B000	4FFEE92D	69004681	?..?.@-?0??.h
0x08004020	46932488	228C888D	17CBE804	68C3468A	?9?F???.???.F?h
0x08004030	468E2194	F3C359C4	442B4308	4470F404	??.F?Y??.C+D..?pD
0x08004040	9701041F	12CBE802	400EF840	13CBEB01	...?.??.@??.??.
0x08004050	7000F8DA	F04F219C	EB010CAC	F24014CB	??.p?!0??.??.@?
0x08004060	91027107	11CBE80C	C000F8D9	20002598	..q.?.??.??.???
0x08004070	C000F8CD	EB0526A0	F8D115CB	EB06C00C	??.??.??.??.??.?
0x08004080	F3C161CB	F10C4C0B	EB070C01	F8D0808C	??.?.L?.??.??.?
0x08004090	9F01C000	0807EA48	800EF84C	7000F8D9	..?.?H??.L??.??.?
0x080040A0	C00CF8BA	68F4688	070AF3C7	EA4F4467	??.??.??.h??.?gD0?
0x080040B0	F8584E07	F4077002	F8494C70	F8D9C002	..NX??.p..?pLH??.???
0x080040C0	F8DAC000	F8DC7008	F3C8800C	F108080A	..???.p??.??.??.?
0x080040D0	44880801	080EEA48	8002F84C	2000F8D9	...?DH??.L??.??.?
0x080040E0	F02758D7	50D70707	7000F8D9	2010F8DA	?X'?.?.??.??.p??.?
0x080040F0	F89A50FA	F89A2031	EA4F3018	F89A2C02	?P??.??.??.??.??.?
0x08004100	04122032	6203EA42	3000F8D9	5118591F	2..B??.b??.O..Y..Q
0x08004110	3030F89A	030CEA43	F8D94313	51132000	??.O??.??.??.??.??.?
0x08004120	2000F8D9	F0235953	515303FF	2000F8D9	??.SY#?.??.SQ??.
0x08004130	3014F8DA	F8D95153	59932000	43A39C02	??.O5Q??.??.??.??.?
0x08004140	F8D95193	E9DA3000	43222407	F8D9519A	?Q??.O???.S'C?Q??.?
0x08004150	58532000	F8D95050	F8DA2000	50500024	..SXP??.??.??.P.P
0x08004160	0010F8DA	2801B3C8	2804D03A	2802D03A	??.??.??.??.??.??.?
0x08004170	2803D038	2807D036	2001D034	3000F8D9	8??.(6??.[4??.??.?
0x08004180	EB0525B0	22B411CB	585D2484	12CBE802	??.??.??.??.??.??.?
0x08004190	25E0F005	E9DA5050	EB043500	1AE814CB	..??.??.??.??.??.??.?
0x080041A0	5028F8BA	43454343	0000F8D9	EA431CDB	??.??.P??.C??.??.??.??.?
0x080041B0	50434305	0000F8D9	F36F5881	5081010A	..C??.??.??.??.??.??.?
0x080041C0	0000F8D9	102CF8DA	F8D95081	59010000	??.??.??.??.??.??.??.?

The screenshot shows the STM32CubeProgrammer interface. The top menu includes Memory & File edition, Open file, and a plus sign. The main window is divided into several sections:

- Device memory:** Shows a table of memory addresses and their corresponding data in binary, hexadecimal, and ASCII formats.
- ST-LINK configuration:** Lists various settings such as Serial number, Port (SWD), Frequency (4000 kHz), Mode (Normal), Access port, Reset mode (Hardware reset), Shared, External loader, Target voltage (3.21 V), and Firmware version (V2J3M25).
- Log:** Shows a list of system messages, including connection status and device identification.

Address	0	4	8	C	ASCII
0x08000000	20000A88	080001DD	080047EF	08003B29	...Y...tG...):...
0x08000010	080047ED	08000D09	08004CAD	00000000	iG.....L.....
0x08000020	00000000	00000000	00000000	080047F3	.....0G..
0x08000030	08000F77	00000000	080047F1	080047F5	w.....fG...0G..
0x08000040	080001F7	080001F7	080001F7	080001F7	+++++
0x08000050	080001F7	080001F7	080001F7	080001F7	+++++
0x08000060	080001F7	080001F7	080001F7	080001F7	+++++
0x08000070	080001F7	080001F7	080001F7	080001F7	+++++
0x08000080	080001F7	080001F7	080001F7	080001F7	+++++
0x08000090	080001F7	080001F7	080001F7	080001F7	+++++
0x080000A0	080001F7	080001F7	080001F7	080001F7	+++++
0x080000B0	080001F7	080001F7	080001F7	080001F7	+++++
0x080000C0	080001F7	080001F7	080001F7	080001F7	+++++
0x080000D0	080001F7	080001F7	080001F7	080001F7	+++++
0x080000E0	080001F7	080001F7	080001F7	080001F7	+++++

# All-in-one programming software tool



Intuitive GUI

Multi-platform  
(Windows, Linux, macOS)

STLink Direct Support  
(JTAG, SWD)

Automatic Mode

Option Bytes  
Program & Upload

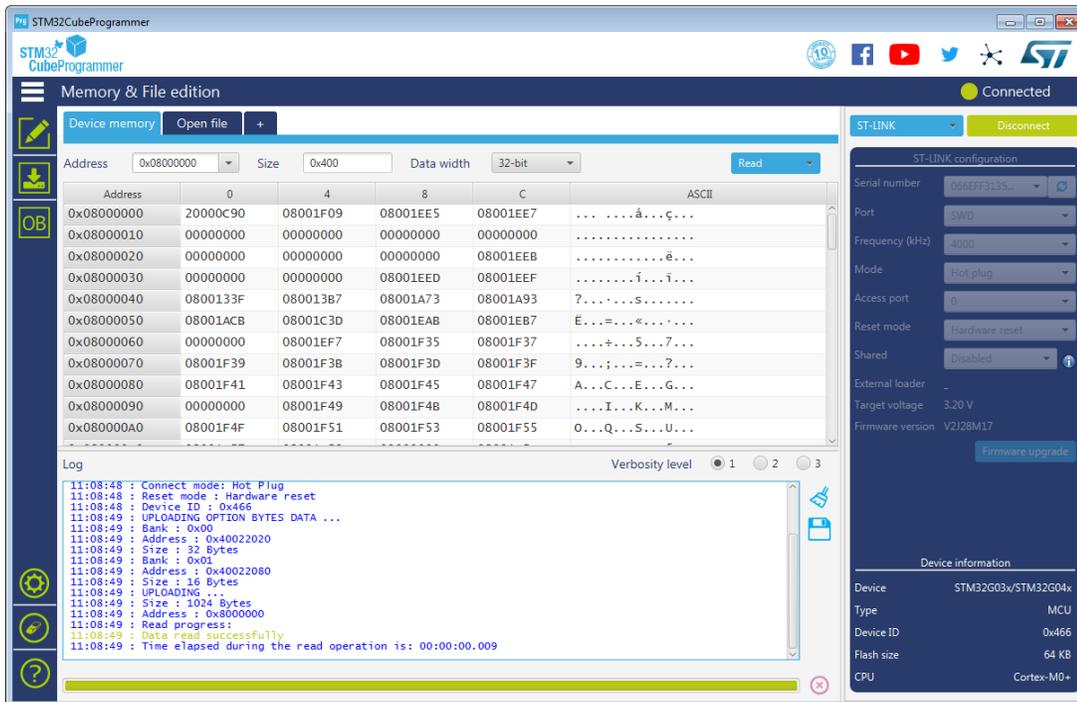
Bootloader Interface Support  
(USB, UART, SPI, I2C, CAN)

Internal/External  
Flash Services

API DLL  
for Custom Integration

Command Line Interface  
for Scripting

Trusted Package Creator  
(secure programming)



# From ST-Link V2 to STLink-V3

ST-Link V2

STLink-V3



# STLink-V3 debugger / programmer

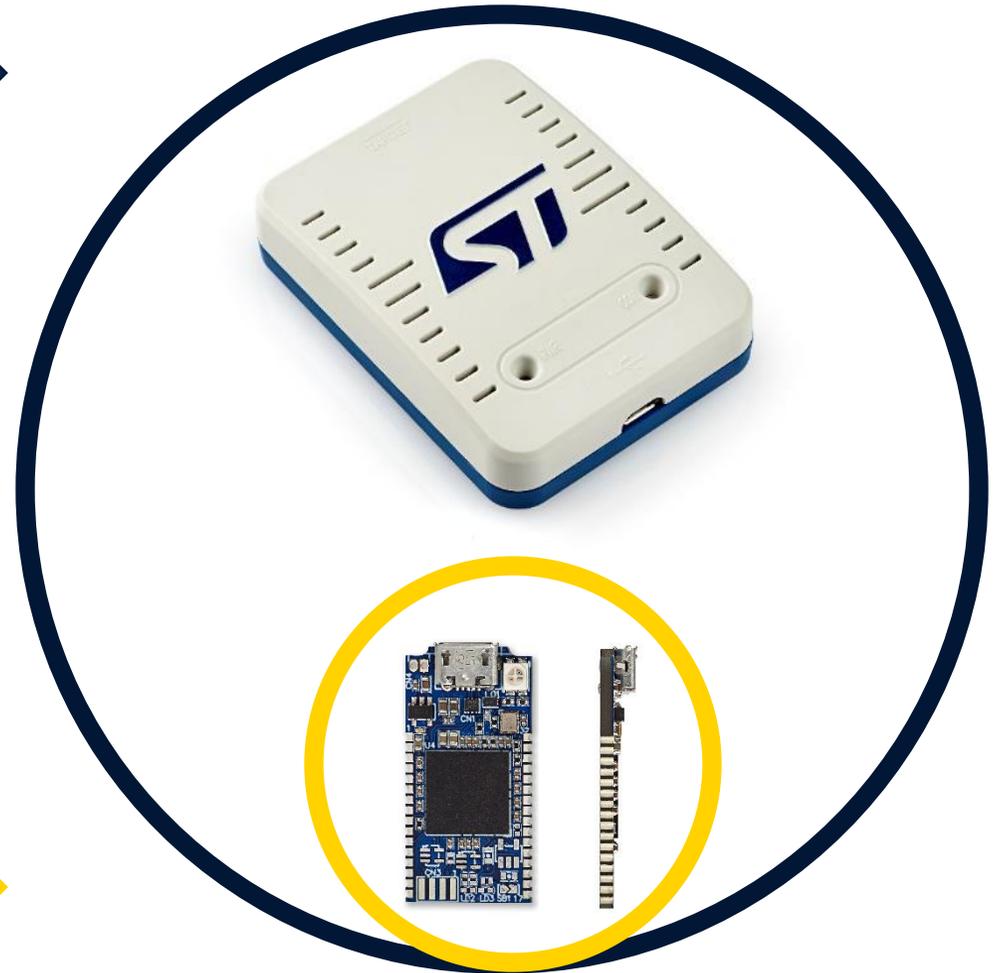
Easier/Faster/Affordable

Stand-alone and scalable (V3SET)

Multi-path Bridge (I<sup>2</sup>C/SPI/CAN/UART/USB)

Drag&Drop Flash Programming

Compact (V3MINI) or On-board (V3MODS)



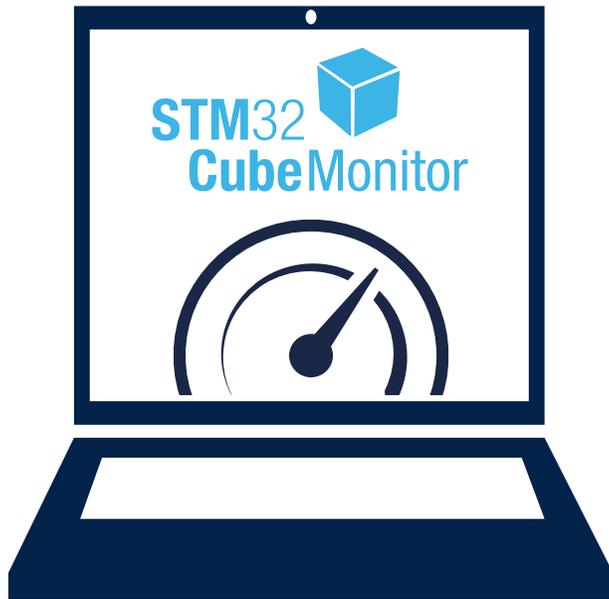
**STM32CubeMonitor**

**STM32**   
**CubeMonitor**



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# STM32CubeMonitor overview



## Monitoring application variables during runtime

- Non-intrusive tool to follow application behavior without interruption.
- Real-time analysis to finetune application configuration.

## Drag & drop creation of dashboard UI

- Large choice of graphical components (gauges, bar graphs, plots...)
- Customize settings. No need for programming.
- Direct support of the Node-RED® open community.

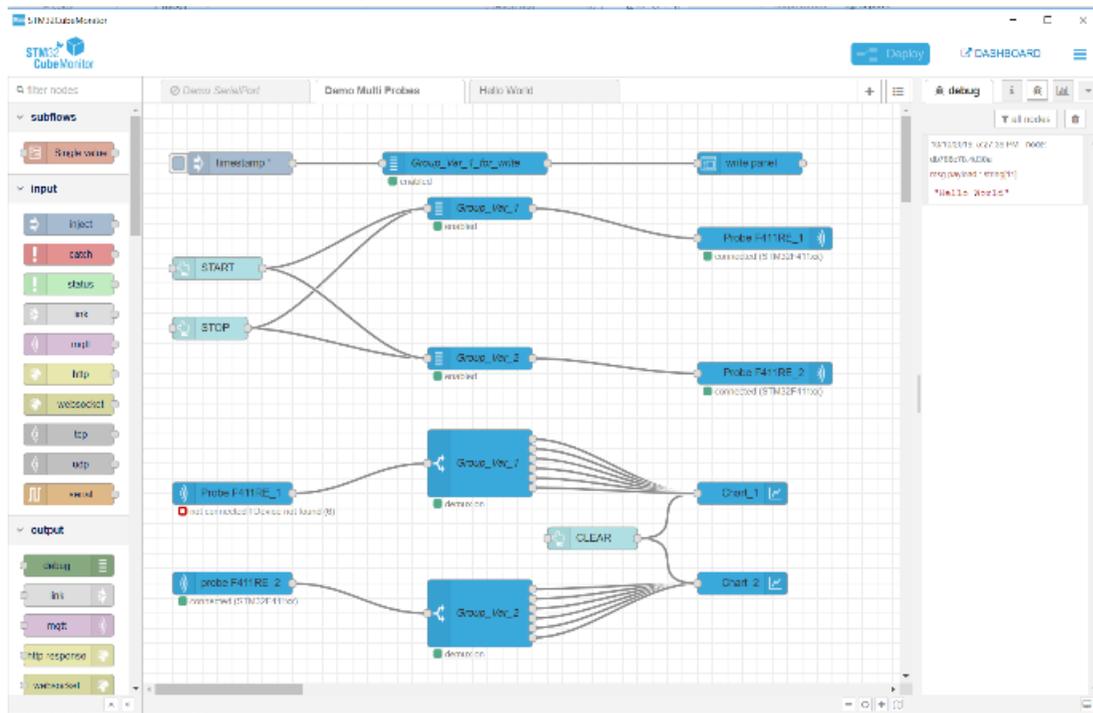
## Graphical visualization on any display

- Multi-OS tool: direct support of PC, tablets and smartphones.
- Remote monitoring.

# Graphical custom data visualization

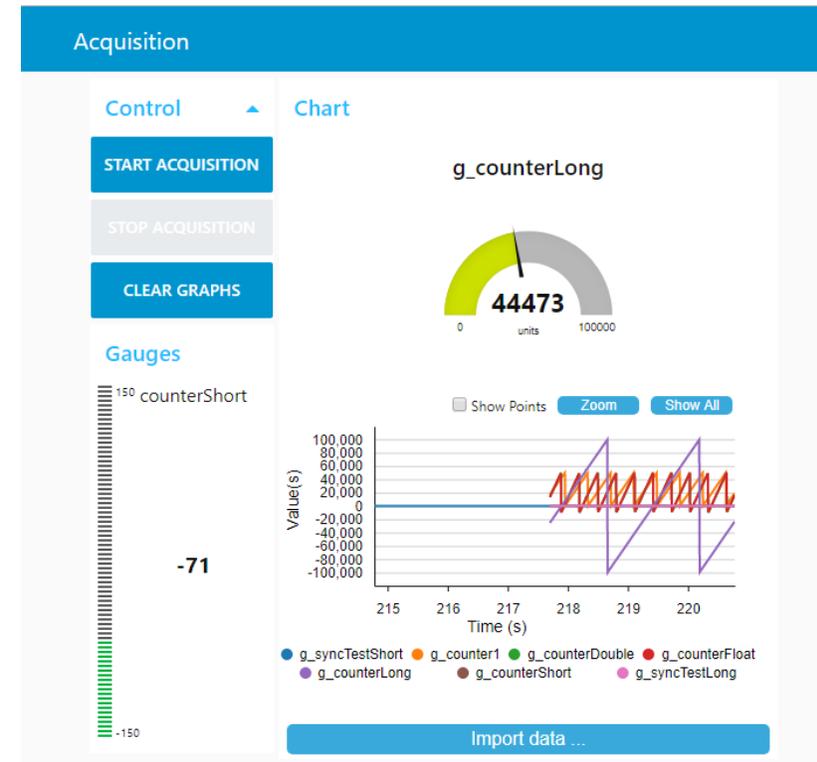
## Design mode to create

Build and edit the logical data flow and graphical rendering of the custom monitoring UI.



## Dashboard mode to visualize

Use the monitoring UI built previously and visualize locally or remotely.

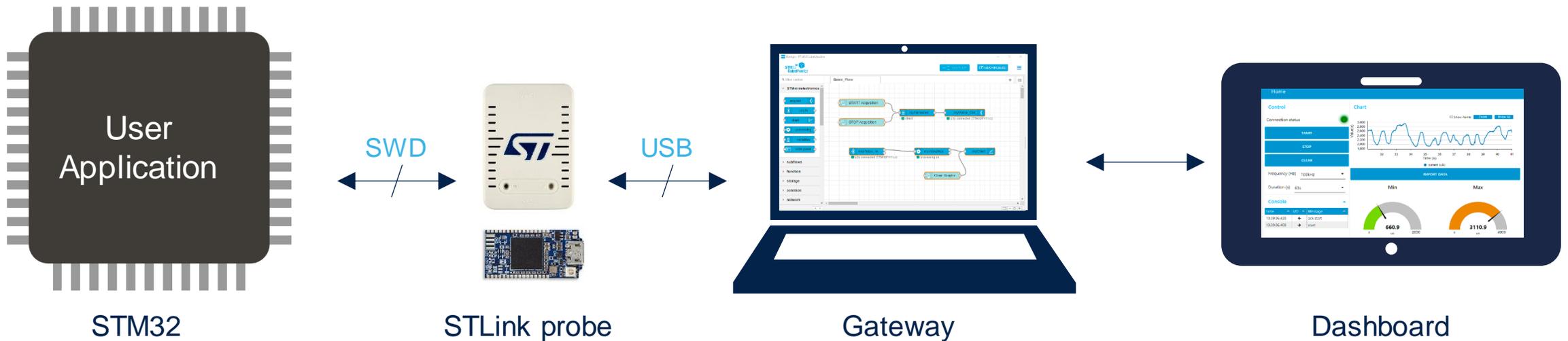


Native support of multi-format displays

Dynamic layout of dashboard UI on PCs, tablets, smartphones.

Remote data acquisition with web server technology

Monitor across a network with a web browser

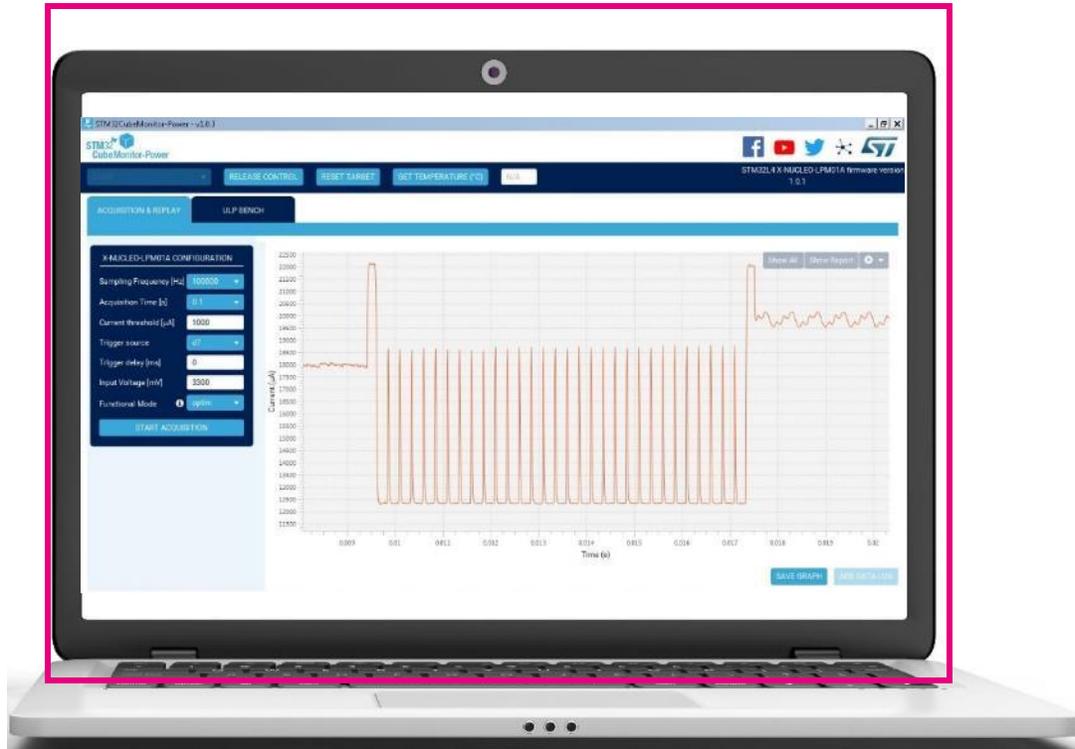


# STM32CubeMonitor-Power

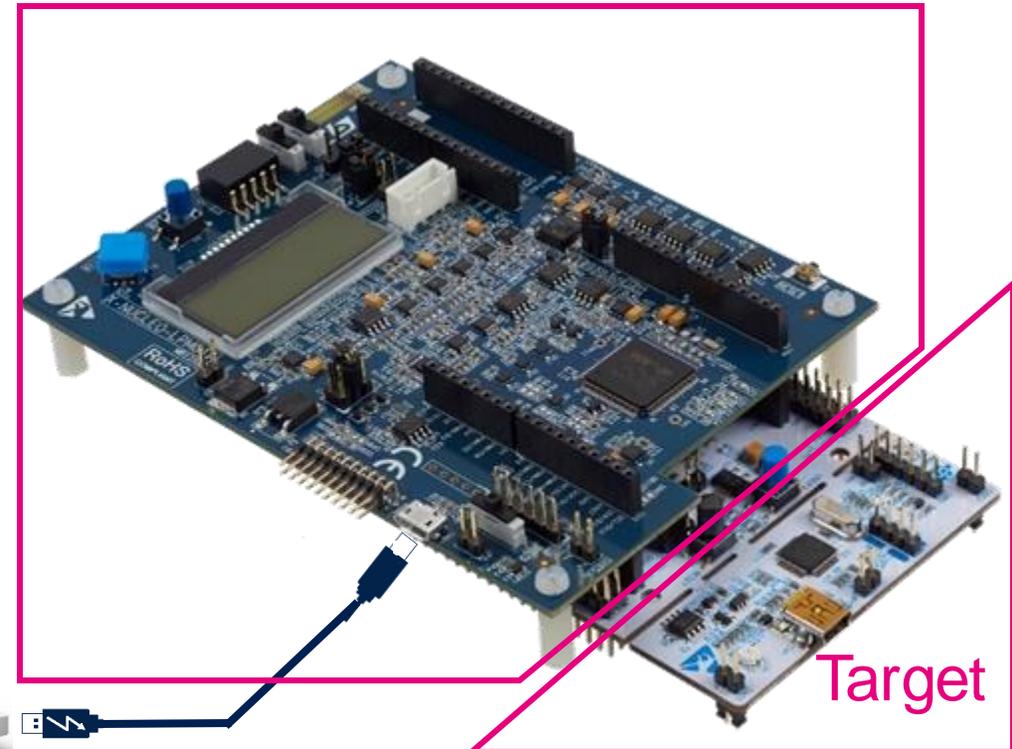
# STM32 CubeMonitor-Power



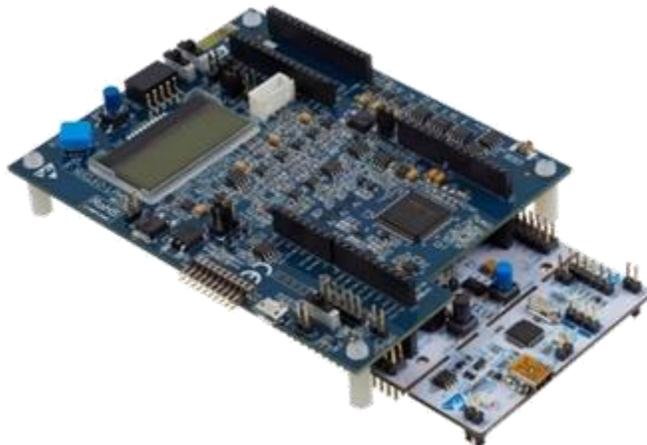
## STM32CubeMonPwr



## X-NUCLEO-LPM01A



Target



## Ultra-Low-Power Consumption Measurements

- Supply target board from **1.8V to 3.3V**
- Dynamic current from **100 nA to 50 mA (100 dB)**
- Static current from **1 nA to 200 mA**
- Accuracy approximately **2%**

## Intuitive User Experience

- Two operating modes (**stand-alone** or **PC-controlled**)
- Graphical PC application (reference: **STM32CubeMonPwr**)

## Official EEMBC Energy Monitor v2.0

Direct computation of ULPMark scores



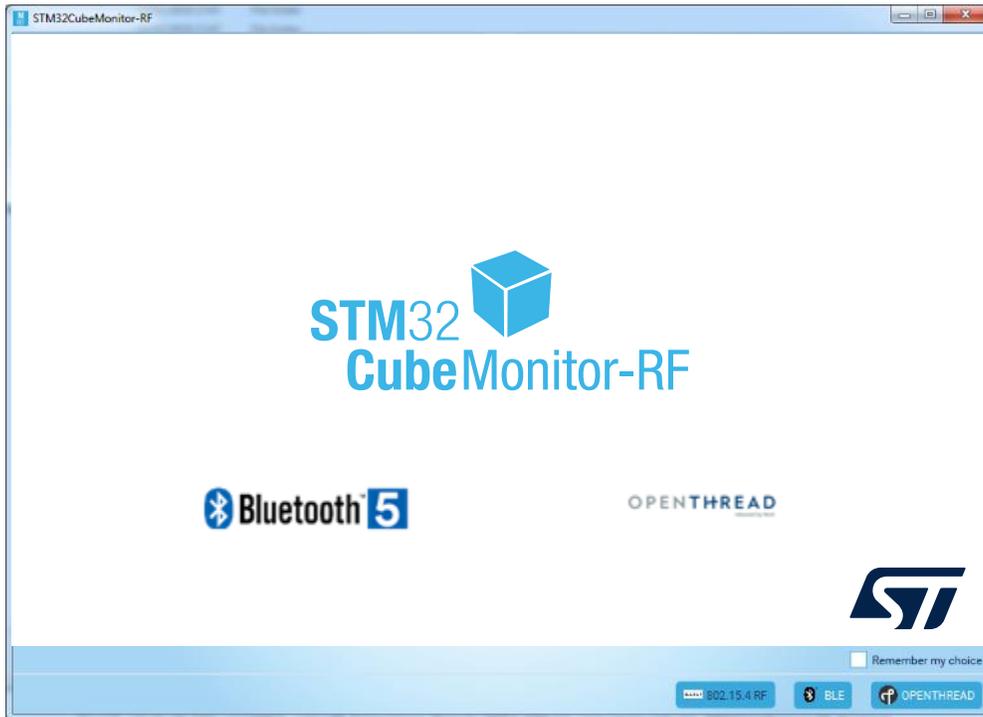
**STM32CubeMonitor-RF**

**STM32**   
**CubeMonitor-RF**



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A software tool allowing to test the radio performances of STM32WB MCUs for BLE and 802.15.4 technologies

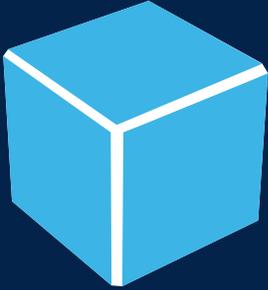


Test protocol sequences

Configure static / dynamic beacons

Manage Over the Air (OTA) file transfer

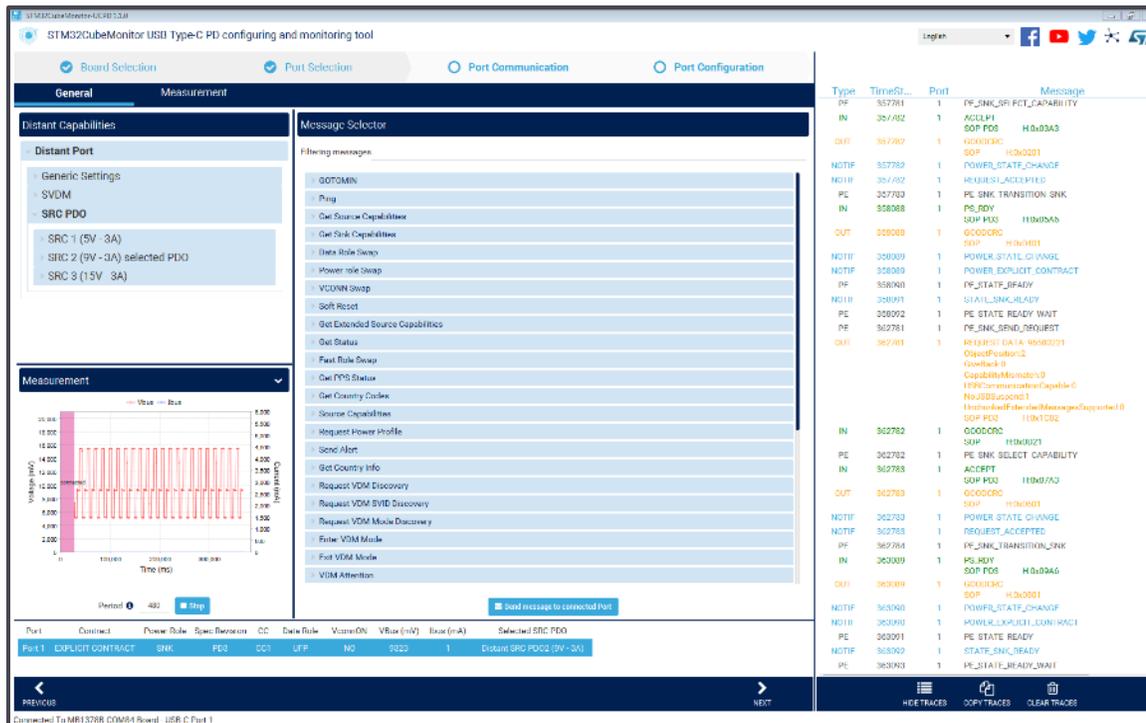
**STM32CubeMonitor-UCPD**

**STM32**   
**CubeMonitor-UCPD**



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## Monitoring and configuring tool for **USB Type-C™** and **USB Power Delivery** applications using STM32 microcontroller



Support of **USB Type-C™ 1.2** and **USB PD 2.0/3.0**

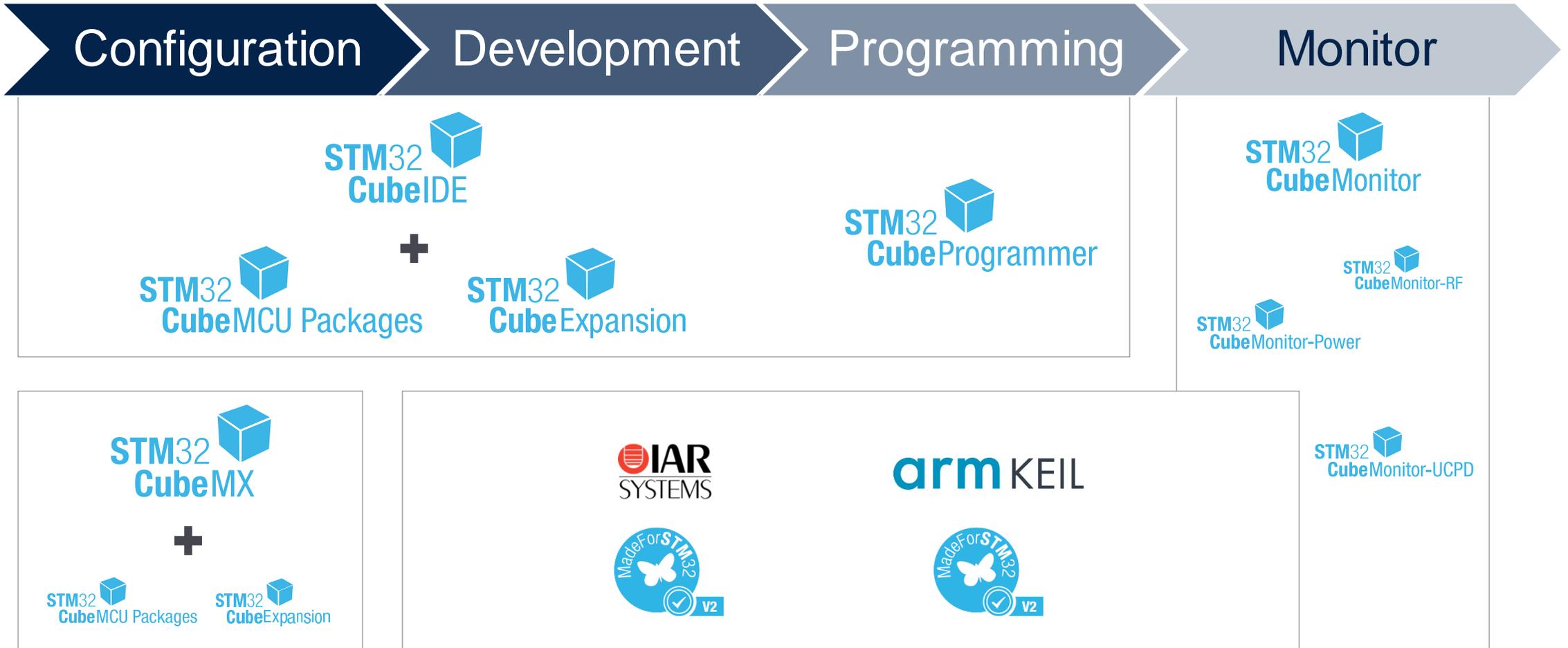
Port configuration pane for **PD setting, VDM, SOP, Source and Sink Capabilities**

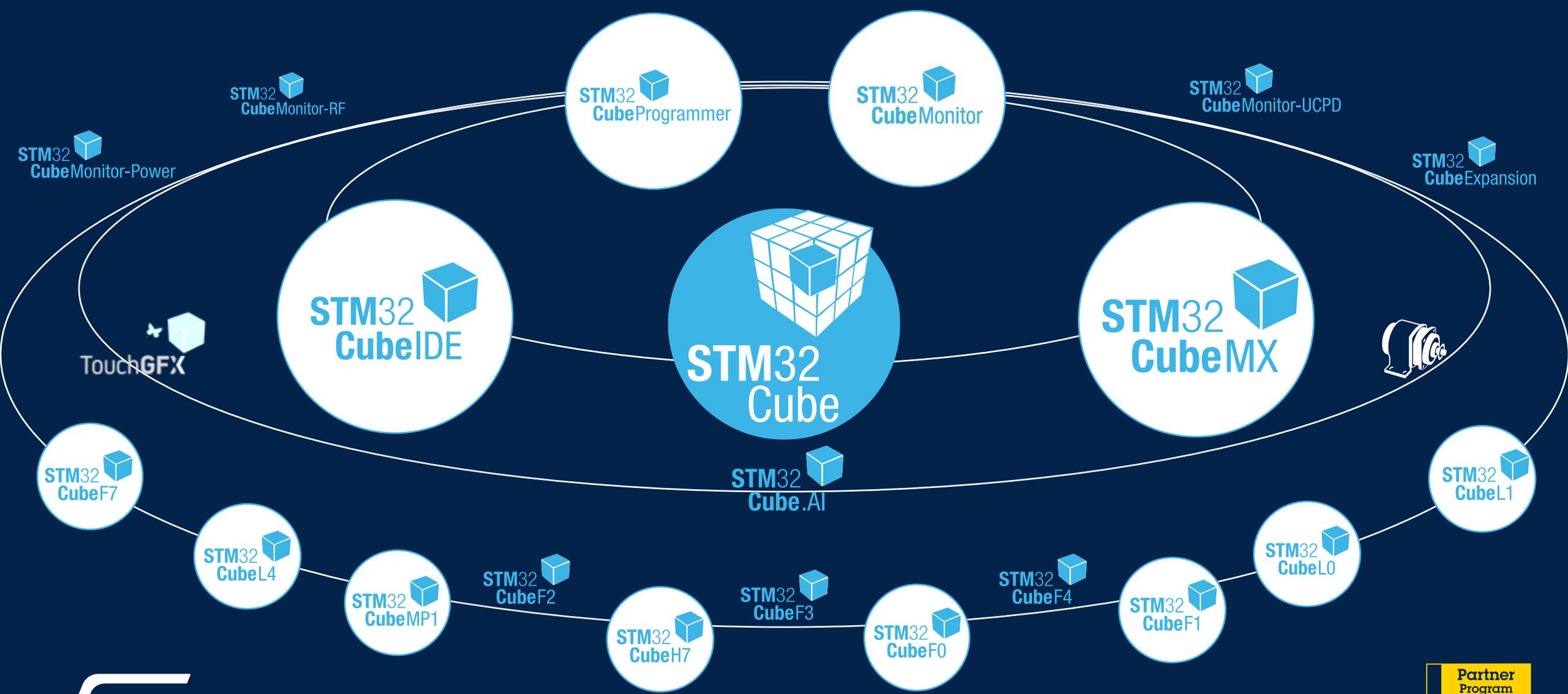
Port communication pane for **VBUS and IBUS monitoring, distant port capabilities, message selector, and real-time traces**

# Key takeaways



# Iterative development process





# Our technology starts with You



Find out more at [www.st.com/STM32Cube](http://www.st.com/STM32Cube)

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