



life.augmented

STM32Cube ecosystem overview

Making STM32 development easier



Inside the STM32Cube ecosystem

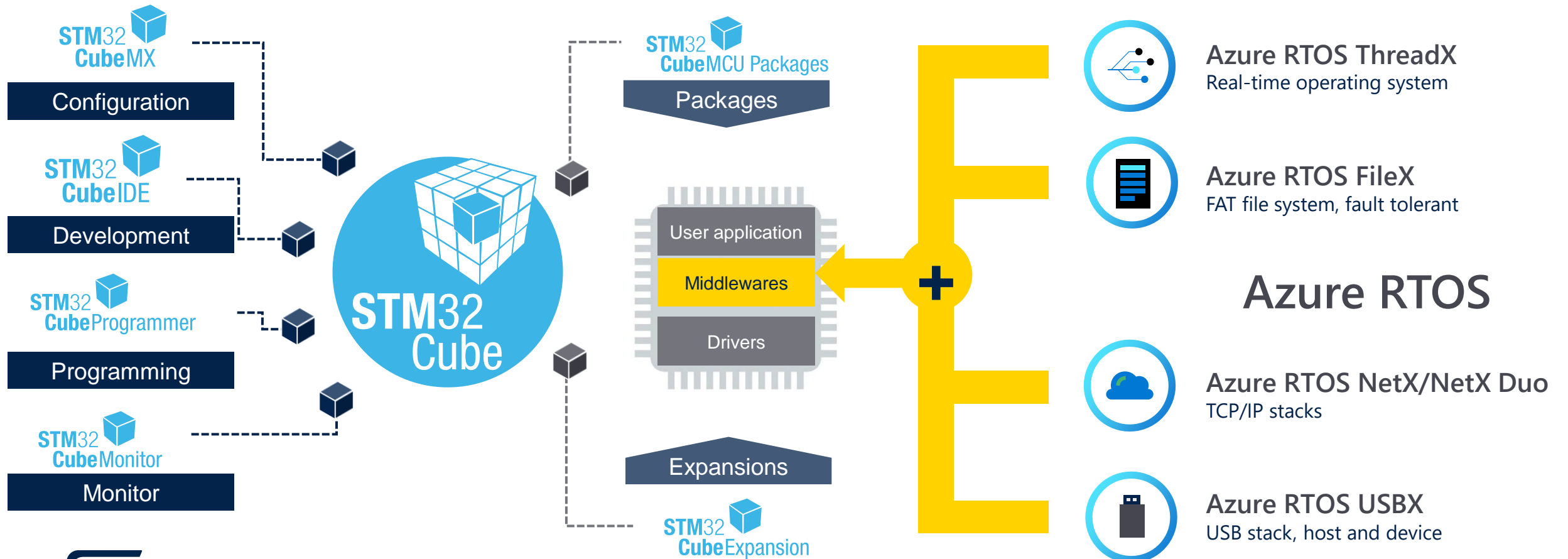
Software Tools



Embedded Software



Complemented with Microsoft Azure RTOS

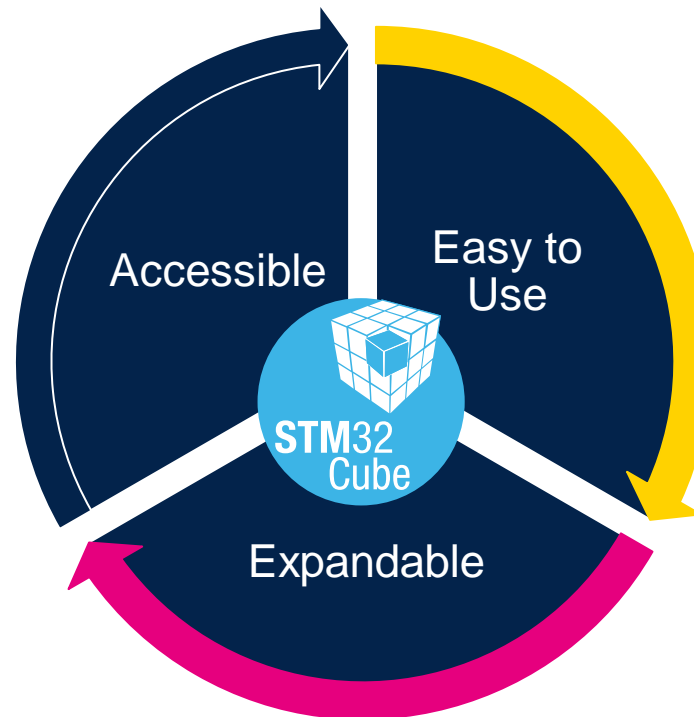


STM32Cube Ecosystem: User benefits

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

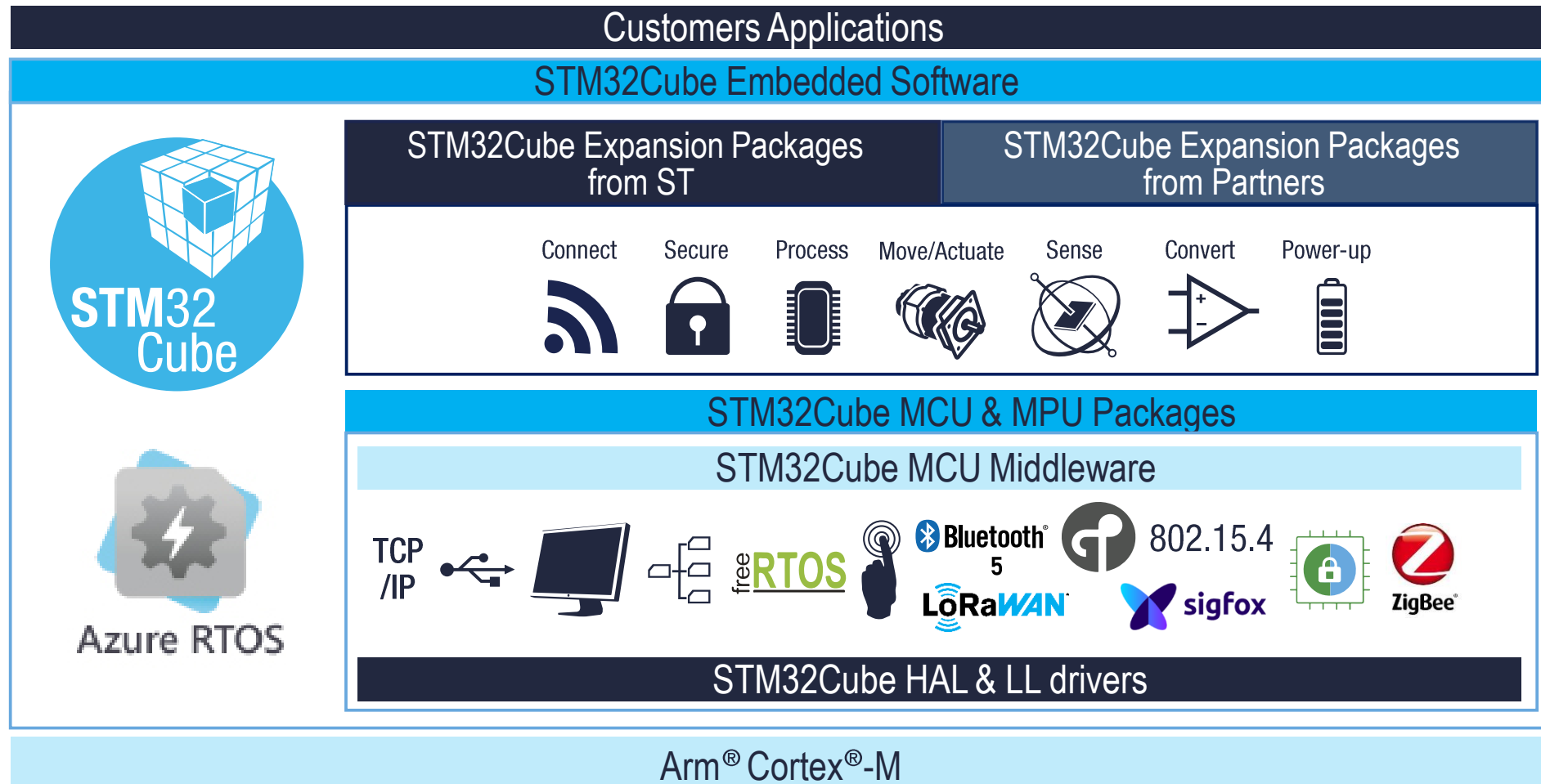
Fits many customer use cases

- 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

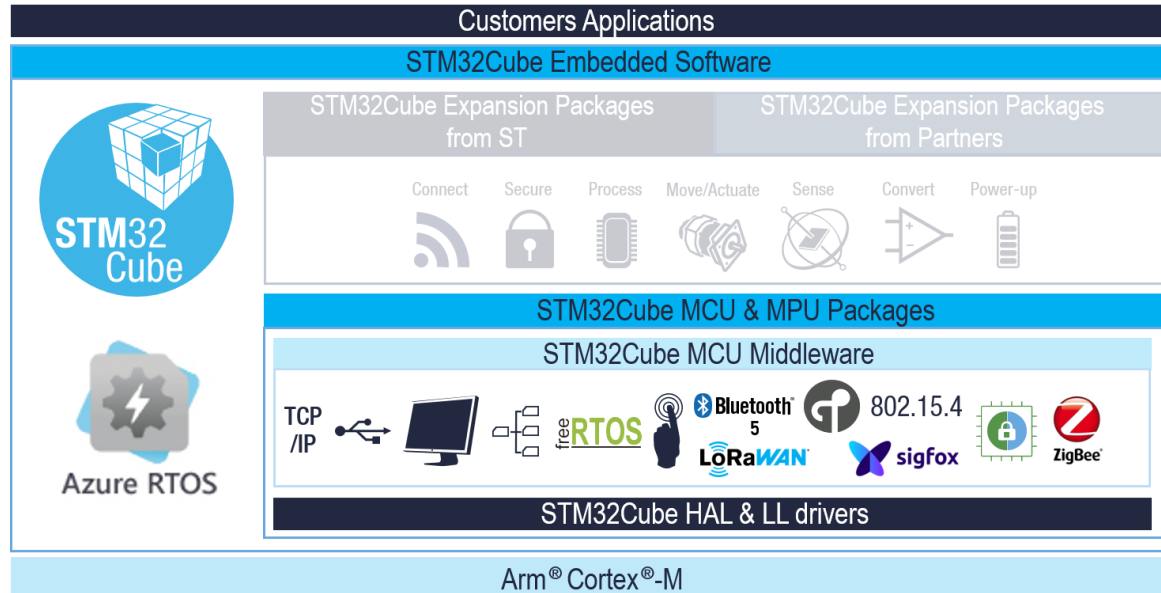
STM32
CubeL5

Wireless MCU

STM32
CubeWB

STM32
CubeWL

One-stop-shop SW packages



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

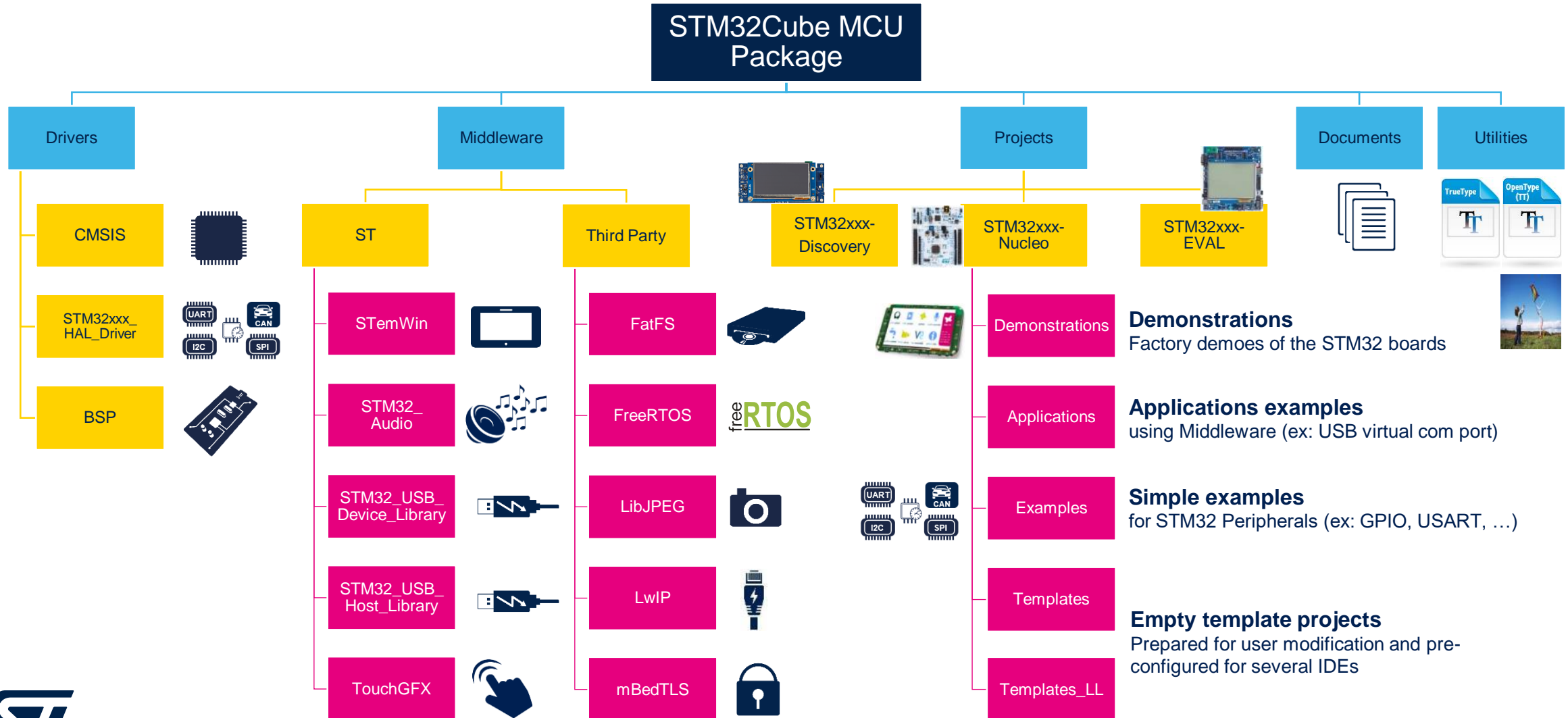
Generic MW

- 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



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
STM32CubeF0	✓	✓	✓	✓	✓		✓		✓								
STM32CubeF1	✓	✓	✓	✓	✓	✓	✓	✓									
STM32CubeF2	✓	✓	✓	✓	✓	✓	✓	✓									
STM32CubeF3	✓	✓	✓	✓	✓		✓		✓								
STM32CubeF4	✓	✓	✓	✓	✓	✓	✓	✓									
STM32CubeF7	✓	✓	✓	✓	✓	✓	✓	✓									
STM32CubeH7	✓	✓	✓	✓	✓	✓	✓	✓			✓						
STM32CubeG0	✓	✓	✓	✓						✓							
STM32CubeG4	✓	✓	✓	✓			✓			✓							
STM32CubeL0	✓	✓	✓	✓			✓		✓								
STM32CubeL1	✓	✓	✓	✓	✓	✓	✓		✓								
STM32CubeL4	✓	✓	✓	✓	✓	✓	✓		✓								
STM32CubeL5	✓	✓	✓	✓			✓		✓	✓							✓
STM32CubeWB	✓	✓	✓	✓			✓		✓			✓	✓	✓			
STM32CubeWL	✓	✓	✓	✓											✓	✓	
STM32CubeMP1	✓	✓	✓								✓						10

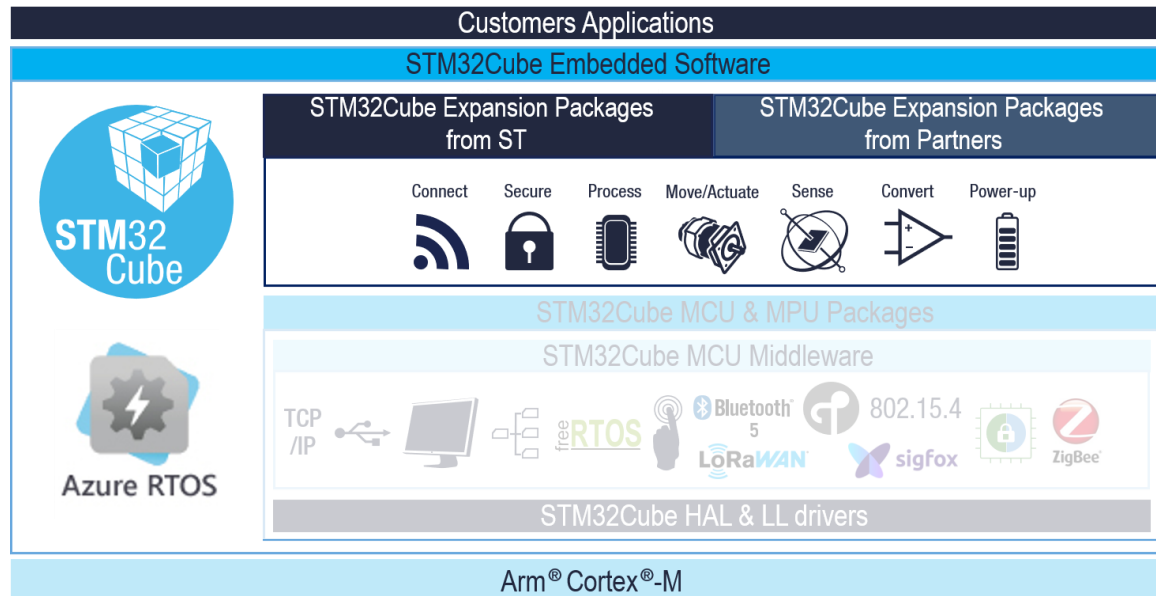
STM32Cube expansion packages



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 3rd 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

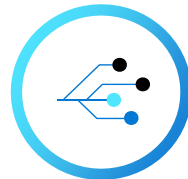


Azure RTOS

X-CUBE

X-CUBE-AZRTOS-H7

Enhanced for
STM32 Toolset



Azure RTOS ThreadX
Real-time operating system



Azure RTOS NetX/NetX Duo
TCP/IP stacks

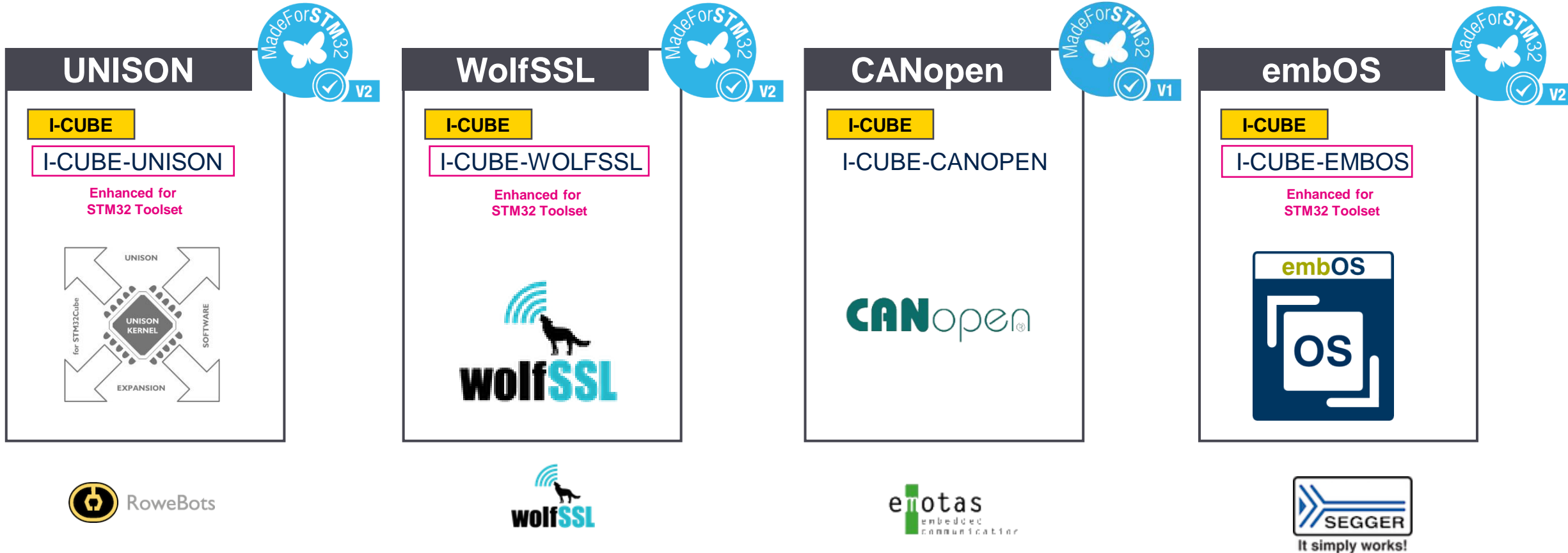


Azure RTOS FileX
FAT file system, fault tolerant




Azure RTOS USBX
USB stack, host and device

Expansions with middleware



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-STL¹

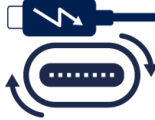
Crypto



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-NFC4² 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
X-CUBE-MEMS1-V4

Enhanced for
STM32 Toolset

FP

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

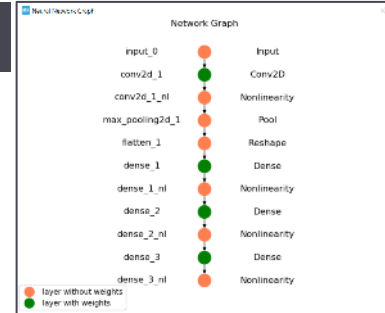
AI



X-CUBE

X-CUBE-AI

Enhanced for
STM32 toolset



FP

FP-AI-SENSING1
FP-AI-VISION1

Expansions for motor control

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



Enviren 83 000 résultats (0,38 secondes)

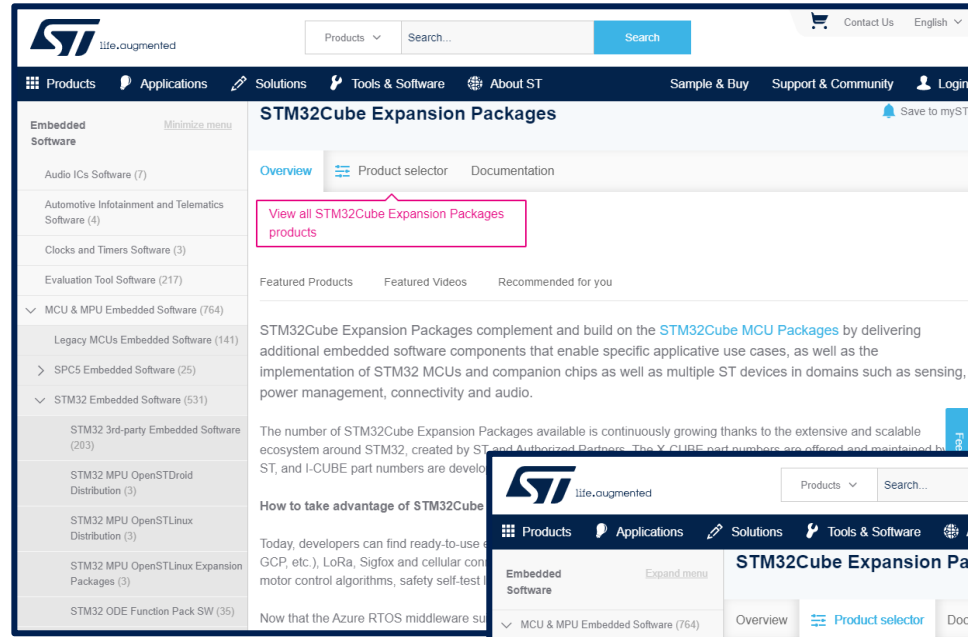
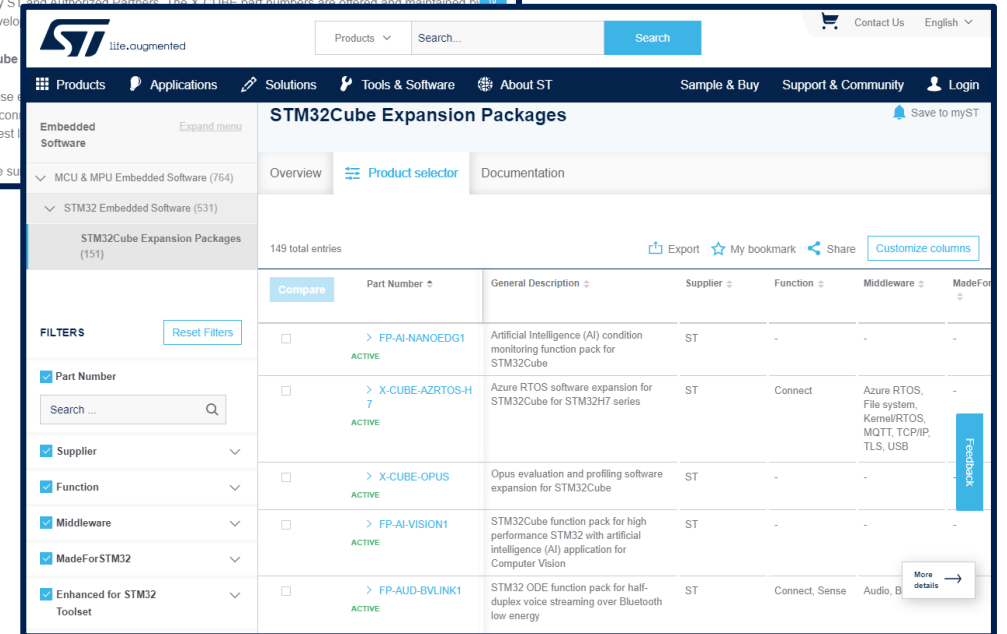
<https://www.st.com> > ... > STM32 Embedded Software
STM32Cube Expansion Packages - STMicroelectronics
 The **STM32Cube expansion** software contains embedded software components that enable the usage of a multitude of ST devices in domains such as of ...

<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.

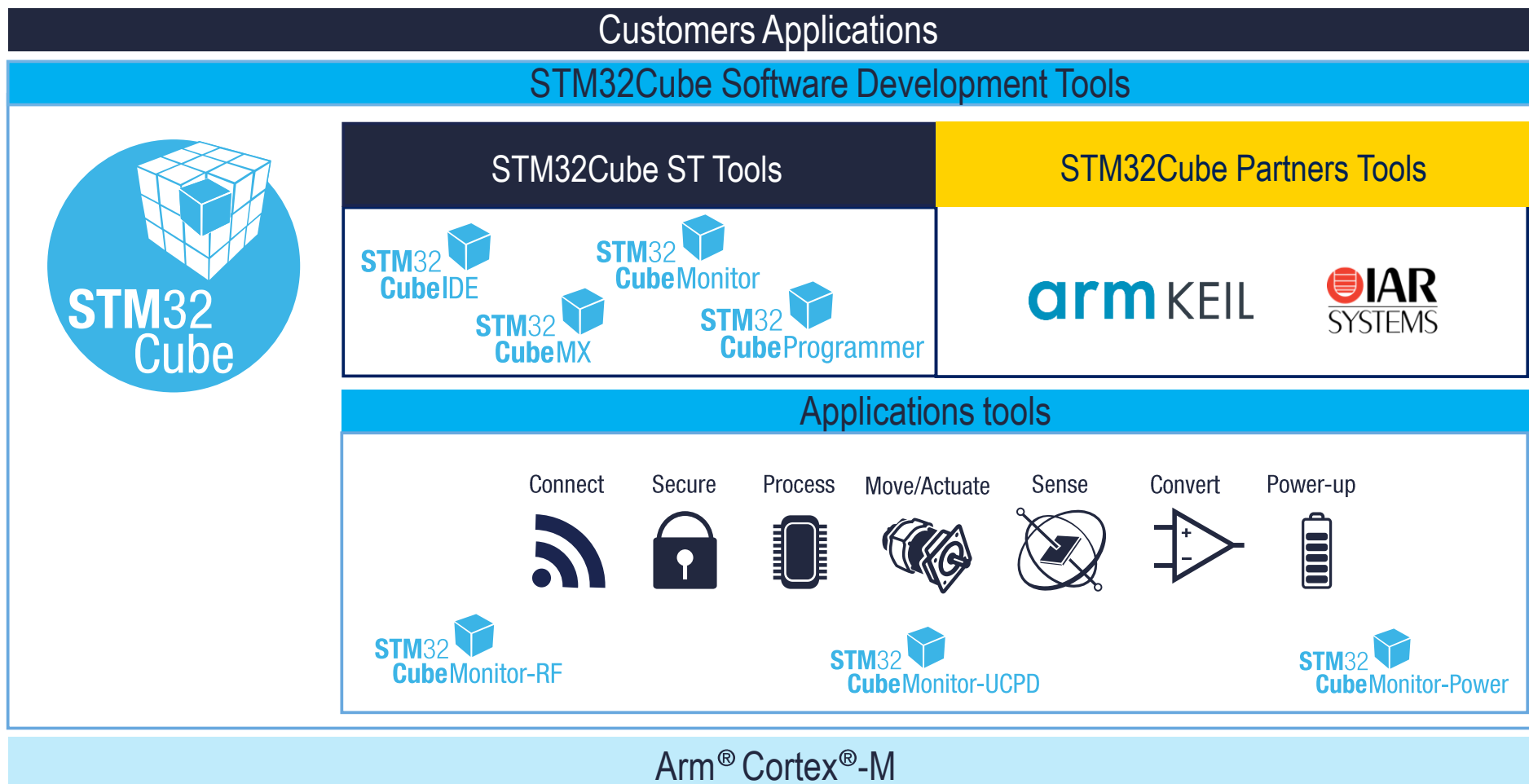



STM32Cube Expansion Packages							
149 total entries							
Part Number	General Description	Supplier	Function	Middleware	MadeFor	Compare	
> FP-AI-NANOEDG1 ACTIVE	Artificial Intelligence (AI) condition monitoring function pack for STM32Cube	ST	-	-	-	<input type="checkbox"/>	
> X-CUBE-AZRTOS-H7 ACTIVE	Azure RTOS software expansion for STM32Cube for STM32H7 series	ST	Connect	Azure RTOS, File system, Kernel/RTOS, MQTT, TCP/IP, TLS, USB	-	<input type="checkbox"/>	
> X-CUBE-OPUS ACTIVE	Opus evaluation and profiling software expansion for STM32Cube	ST	-	-	-	<input type="checkbox"/>	
> FP-AI-VISION1 ACTIVE	STM32Cube function pack for high performance STM32 with artificial intelligence (AI) application for Computer Vision	ST	-	-	-	<input type="checkbox"/>	
> FP-AIJD-BVLINK1 ACTIVE	STM32 ODE function pack for half-duplex voice streaming over Bluetooth low energy	ST	Connect, Sense	Audio, B	-	<input type="checkbox"/>	More details →

STM32Cube software Development tools



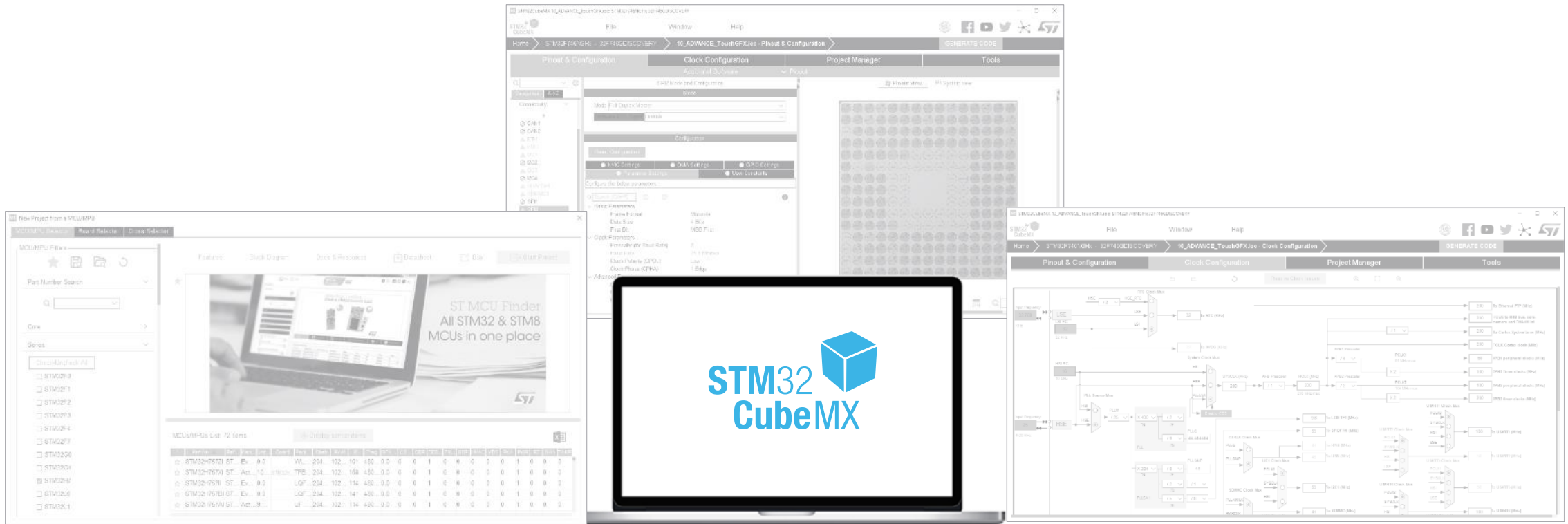
A complete Software Development Tools offer



STM32CubeMX



What's STM32CubeMX?

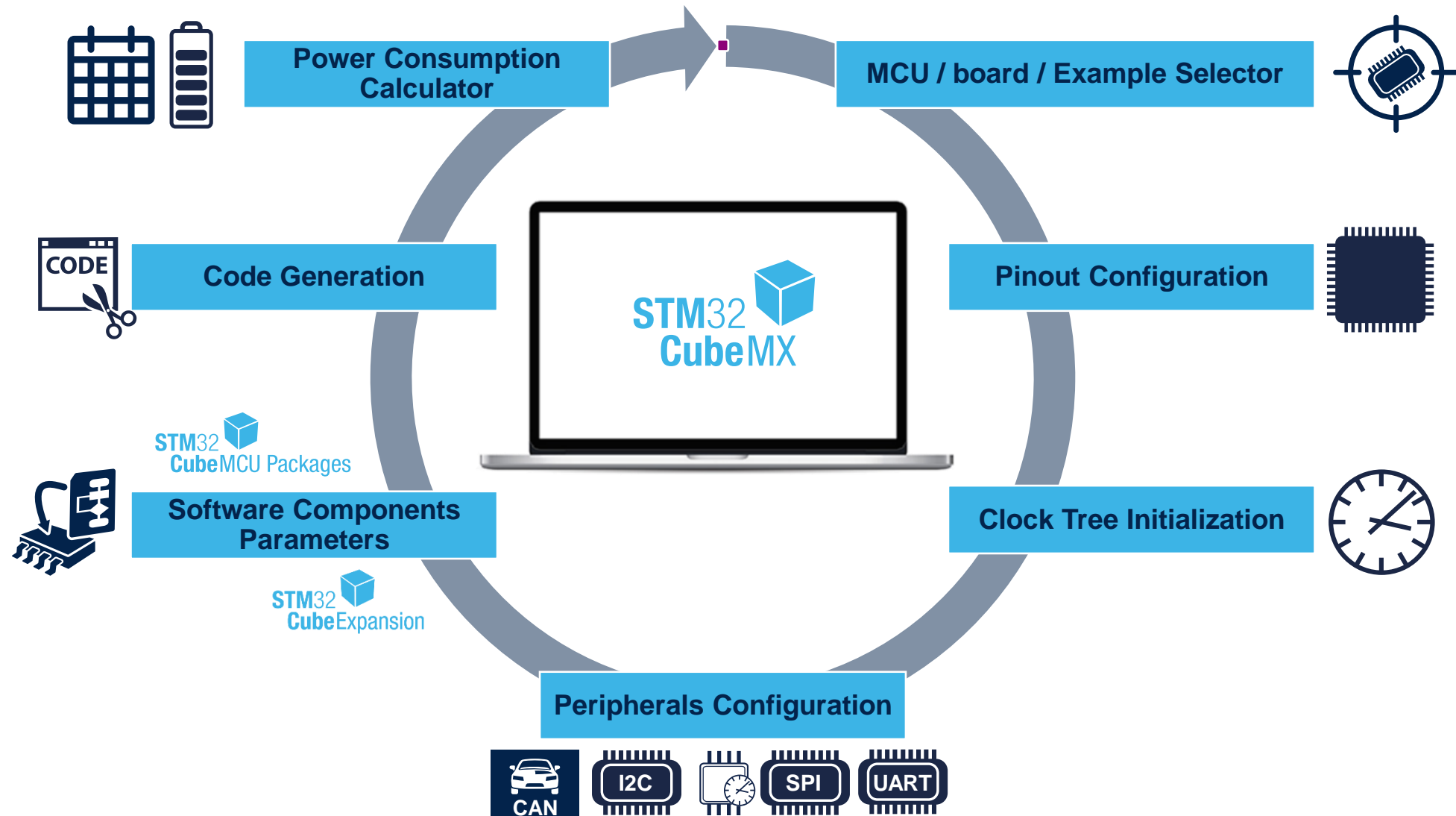


Graphical Configuration
(Pinout/Peripherals/Middleware/Clock-Tree)

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

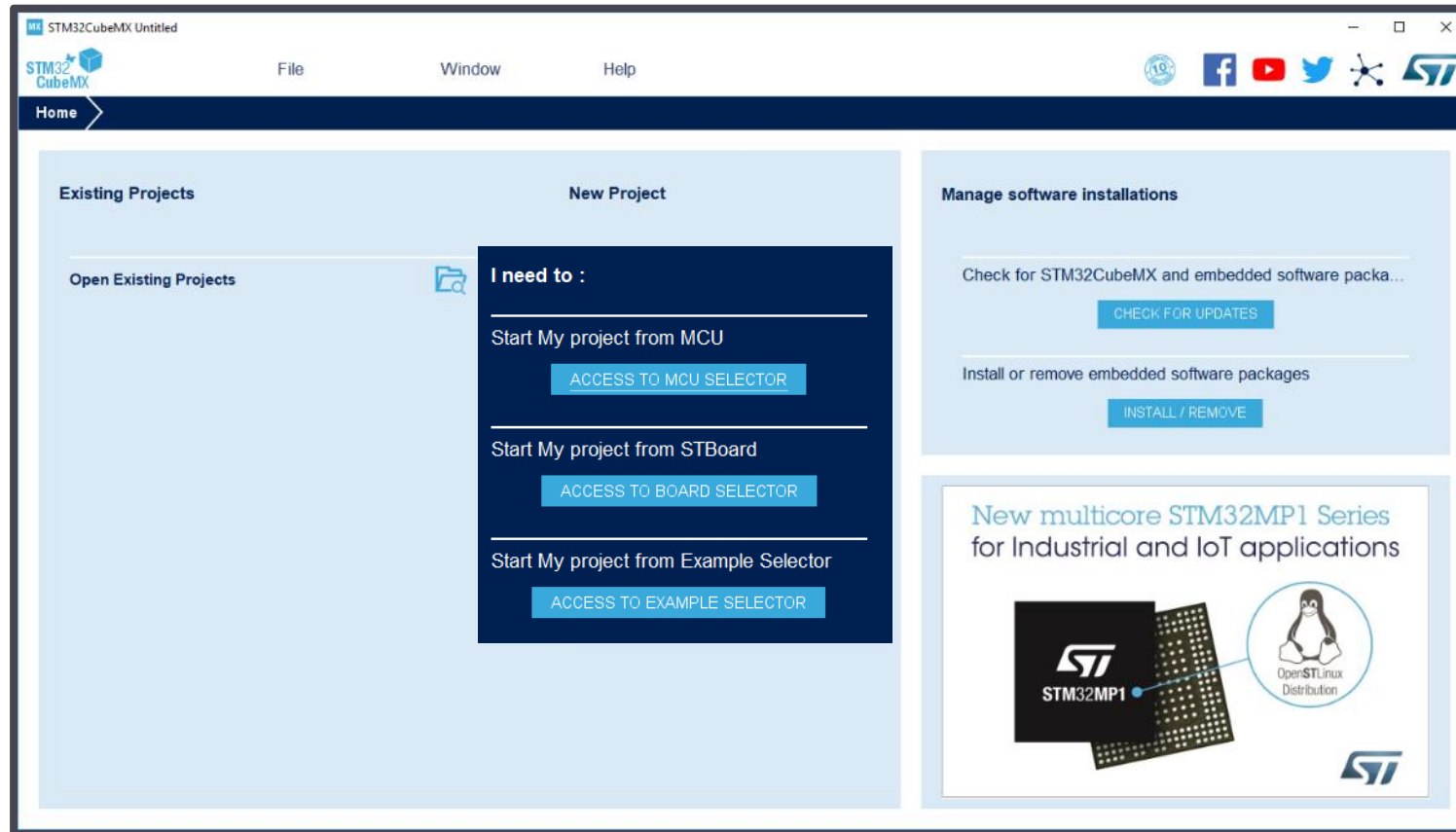
Multi-platform
(Windows, Linux, macOS)

STM32CubeMX key steps





MCU / MPU selection



MCU / MPU
SELECTOR

BOARD
SELECTOR

EXAMPLE
SELECTOR



MCU/MPU selector

MCU / MPU
SELECTOR

BOARD
SELECTOR

EXAMPLE
SELECTOR

DEDICATED
FILTERS

DESCRIPTION
&
INFORMATION

PRODUCT
LIST

New Project from Example

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

Example Filters

Name

Keyword Aa [ab]

Vendor

Board

Name

Type

[Check/Uncheck All](#)

☐ Discovery Kit

☐ Evaluation Board

☐ Nucleo-144

☐ Nucleo-32

☐ Nucleo-64

MCU / MPU

Name

Series

[Check/Uncheck All](#)

☐ STM32F4

☐ STM32F7

☒ STM32G0

☐ STM32G4

Features

[Start Project](#)

Projects/STM32G081B-EVAL/Examples/SPVSPullDuplex_ComDMA_Slave/

STM32G0

V1.4.0

Required Software Package
STM32Cube_FW_G0_V1.4.0
(size: 202.0 MB) [Download](#)

Vendor
STMicroelectronics

Board
[STM32G081B-EVAL](#)

Mounted device
[STM32G081RBTx](#)
LQFP64

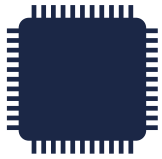
Supported Toolchain/IDE
EWARM, MDK-ARM, STM32CubeIDE

STM32CubeMX Minimum Compatible Version
6.0.0 [Check](#)

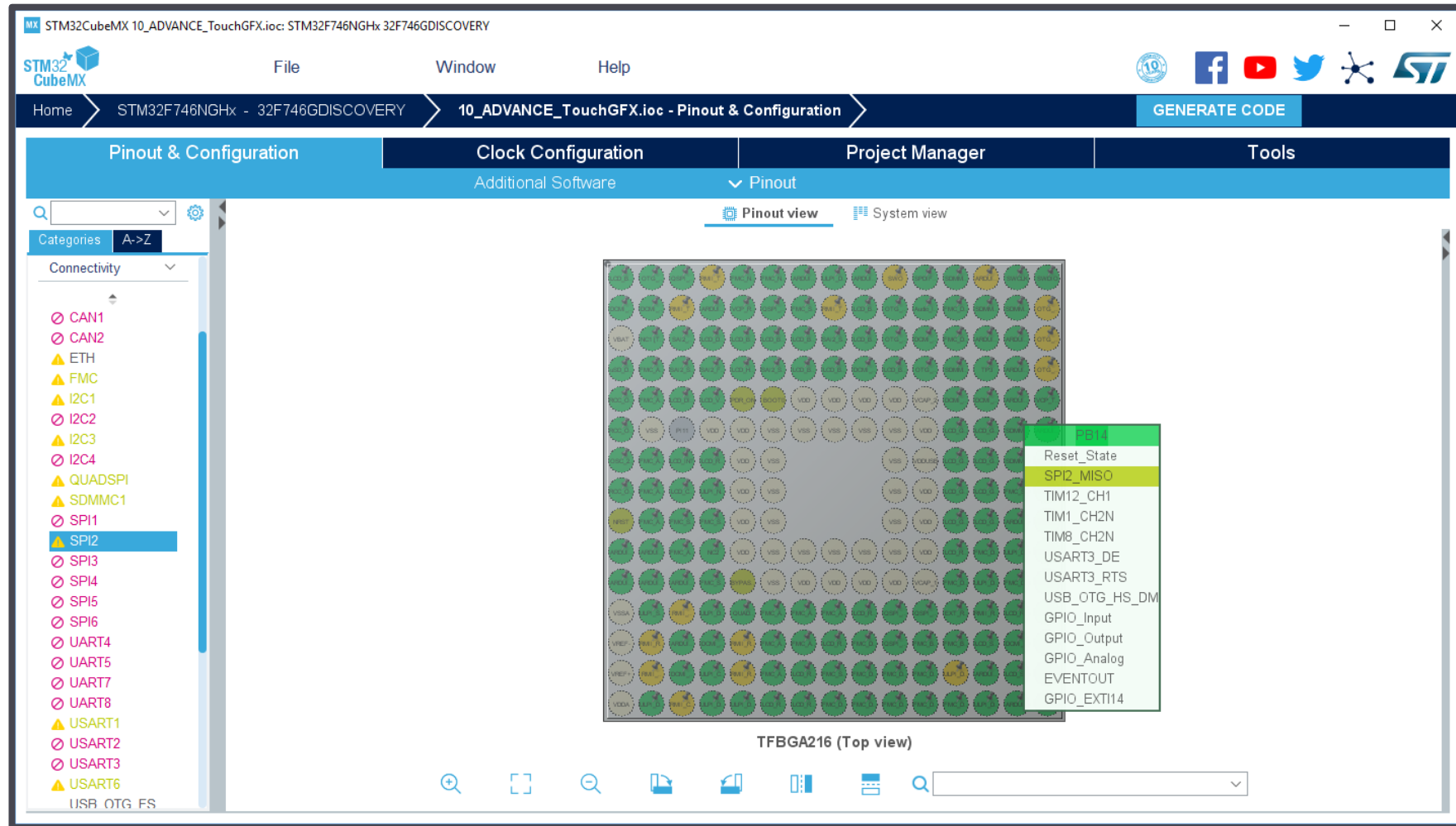
Keywords
[Connectivity](#), [DMA](#), [Full-duplex](#), [Interrupt](#), [MISO](#), [MOSI](#), [Master](#), [Reception](#), [SPI](#), [Slave](#), [Transmission](#)

Examples List: 632 items [Export](#)

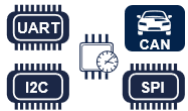
	Name	Board	Board Type	STM32CubeFW	Series	Project Type	Driver
☆	SPI_FullDuplex_ComDMA_Slave	STM32G081B-EVAL	Evaluation Board	✓	STM32G0	Example	HAL
☆	SPI_FullDuplex_ComDMA_Slave	NUCLEO-G031K8	Nucleo-32	✓	STM32G0	Example	HAL
☆	SPI_FullDuplex_ComIT_Master	NUCLEO-G070RB	Nucleo-64	✓	STM32G0	Example	HAL
☆	SPI_FullDuplex_ComIT_Master	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



Pinout configuration







Peripheral parameters

STM32CubeMX 10_ADVANCE_TouchGFX.ioc: STM32F746NGHx 32F746GDISCOVERY

File Window Help

Home > STM32F746NGHx - 32F746GDISCOVERY > 10_ADVANCE_TouchGFX.ioc - Pinout & Configuration > GENERATE CODE

Pinout & Configuration Clock Configuration Project Manager Tools

Additional Software Pinout

Categories A-Z

Connectivity

- CAN1
- CAN2
- ETH
- FMC
- I2C1
- I2C2
- I2C3
- I2C4
- QUADSPI
- SDMMC1
- SPI1
- SPI2**
- SPI3
- SPI4
- SPI5
- SPI6
- UART4
- UART5
- UART7
- UART8
- USART1
- USART2
- USART3
- USART6
- USB OTG FS

SPI2 Mode and Configuration

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 :

Search (Ctrl+F)

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

Pinout view System view

TFBGA216 (Top view)



Middleware and software components parameters

STM32CubeMX 10_ADVANCE_TouchGFX.ioc: STM32F746NGHx 32F746GDISCOVERY

File Window Help

Home STM32F746NGHx - 32F746GDISCOVERY 10_ADVANCE_TouchGFX.ioc - Pinout & Configuration GENERATE CODE

Pinout & Configuration Clock Configuration Project Manager Tools

Additional Software Pinout

Categories A-Z

- System Core
- Analog
- Timers
- Connectivity
- Multimedia
- Security
- Computing
- Middleware
 - FATFS
 - FREERTOS**
 - GRAPHICS**
 - LIBJPEG
 - LWIP
 - MBEDTLS
 - PDM2PCM
 - USB_DEVICE
 - USB_HOST

FREERTOS Mode and Configuration

Mode

Interface CMSIS_V1

Configuration

Reset Configuration

- ☒ Mutexes
- ☒ FreeRTOS Heap Usage
- ☒ Tasks and Queues
- ☒ Timers and Semaphores
- ☒ Config parameters
- ☒ Include parameters
- ☒ User Constants

Configure the following parameters:

Search (Ctrl+F)

Kernel settings

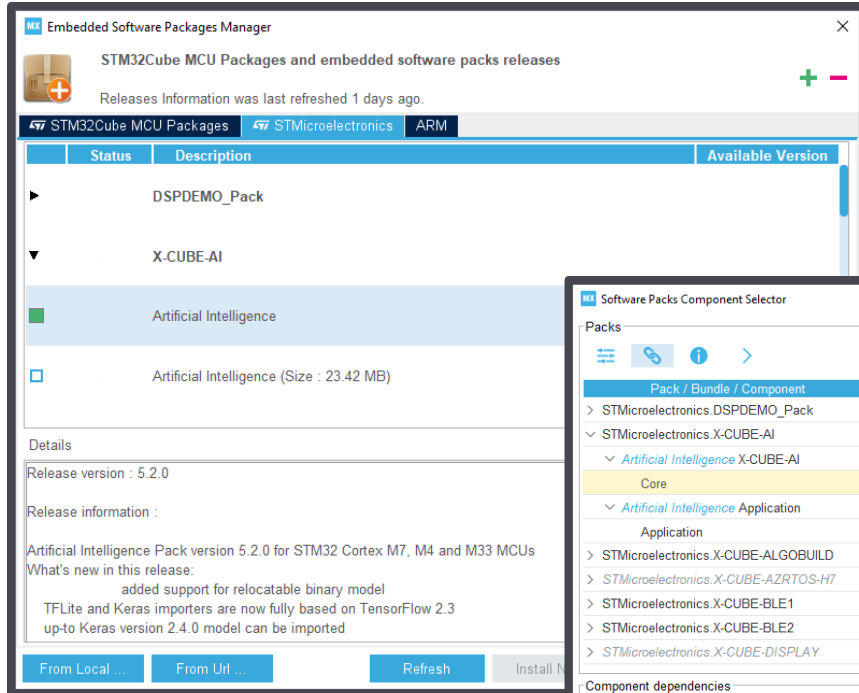
USE_PREEMPTION	Enabled
CPU_CLOCK_HZ	SystemCoreClock
TICK_RATE_HZ	1000
MAX_PRIORITIES	7
MINIMAL_STACK_SIZE	128 Words
MAX_TASK_NAME_LEN	16
USE_16_BIT_TICKS	Disabled
IDLE_SHOULD_YIELD	Enabled
USE_MUTEXES	Enabled
USE_RECURSIVE_MUTEXES	Enabled
USE_COUNTING_SEMAPHORS	Enabled
QUEUE_REGISTRY_SIZE	8
USE_APPLICATION_TASK_TAG	Enabled

Pinout view System view

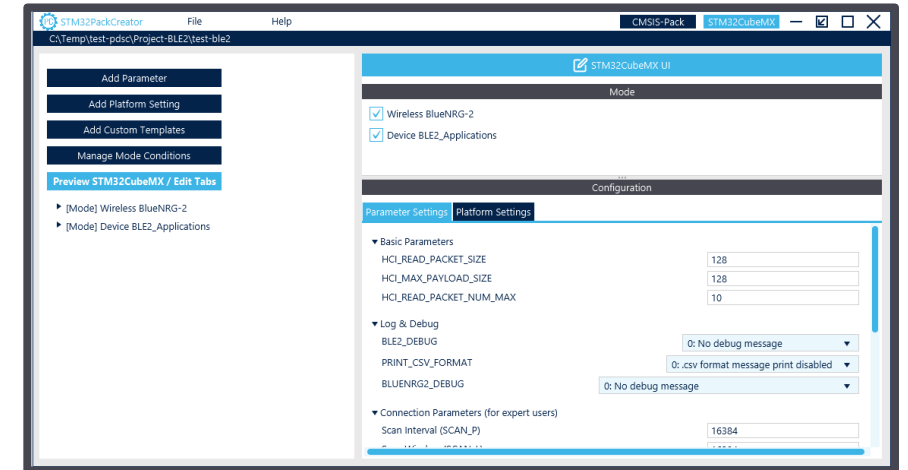
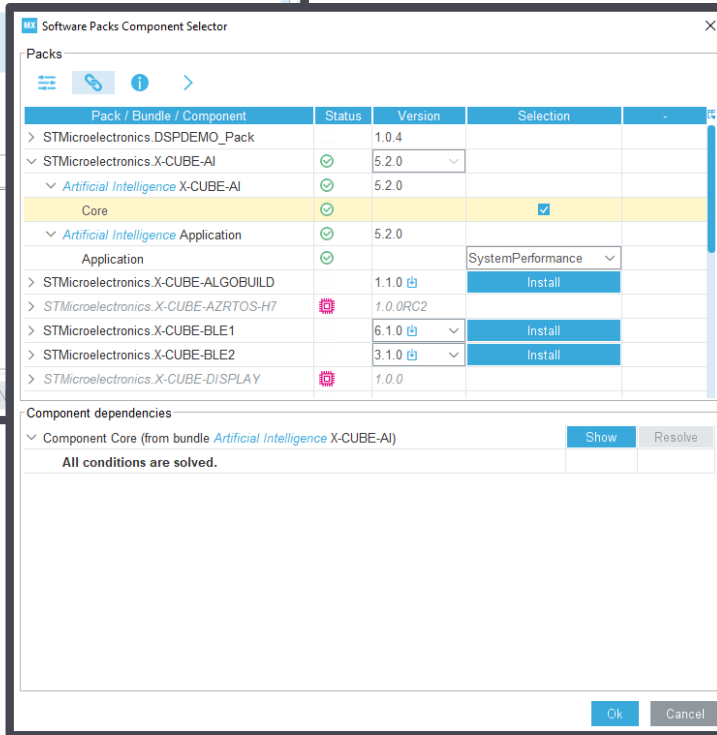
TFBGA216 (Top view)



Add Expansion Middleware and build your own



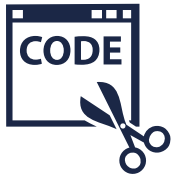
Download and install
existing Expansion Package...



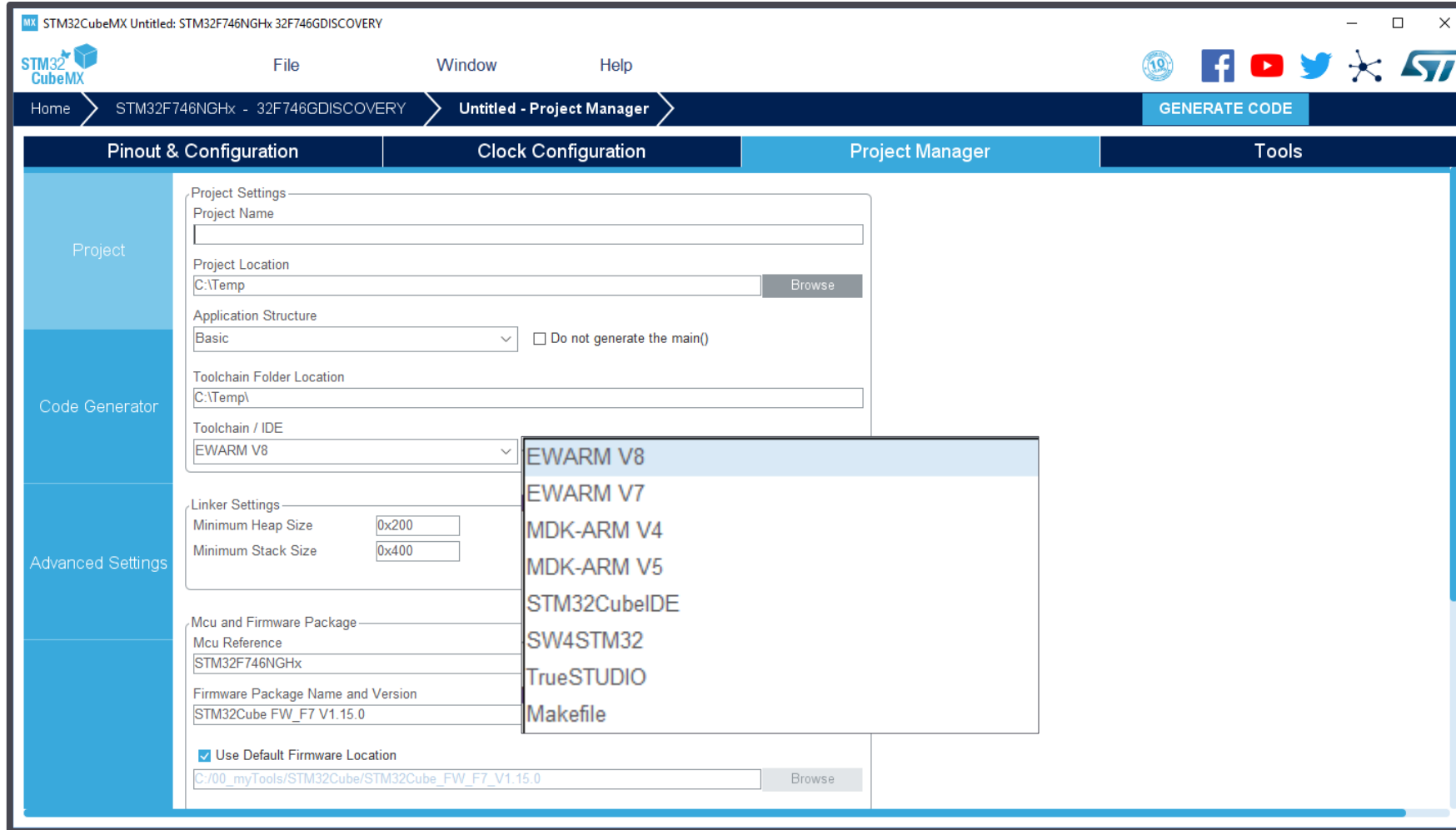
or

Build your own Expansion Package
with **STM32PackCreator**

...and select components to add to your project



Code generation



STM32
CubeIDE

IAR
SYSTEMS

arm KEIL



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_A 25°C / V_{DD} 3.3V

Alkaline(C LR14) (1x1)

Change Reset

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/FLASH-ART/1Cache/REGION

V_{DD}: 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, DAC, DMA2D, FMAC, GPIOA, GPIOB, GPIOC, GPIOD, GPIOE, GPIOF, GPIOG, GPIOH, GPIOI, GPIOJ, GPIOK, I2C1, I2C3, LTDC, QUADSPI, RTC, SAO, SEMI4, SPOFRX, SYS, TM1, TM2, TM5, TM6, TM12, USART1, USART2

Sequence

New Step

Sequence Table

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

Display Selection

Select your Preferred Display Plot: All Steps

Consumption Profile by Step

Consumption (mA)

Time (ms)

Legend: Add by Step (Pink line), Average Current (Blue line)

Sequence Time / Ta Max 2 ms / 89.35 °C

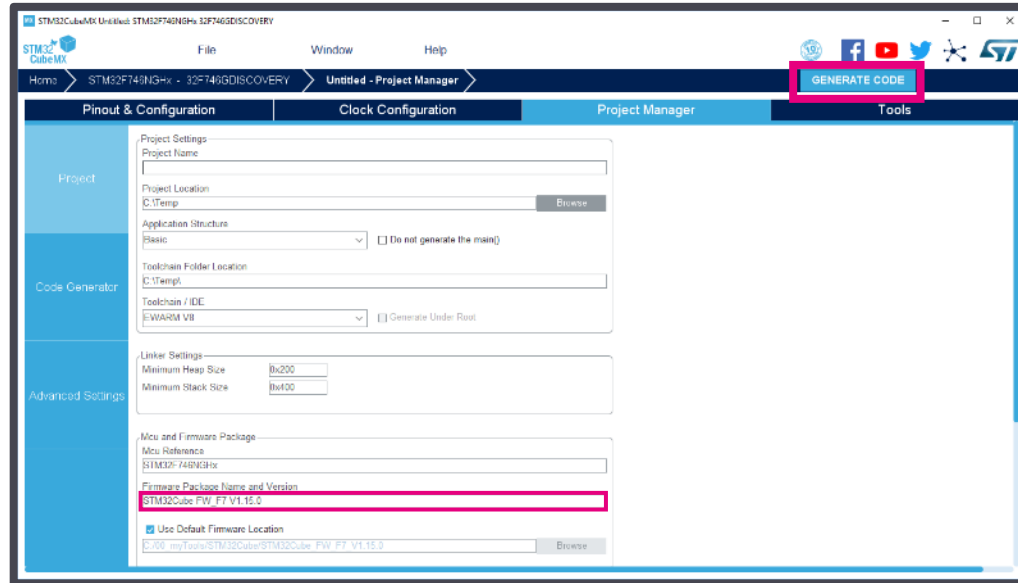
Battery Life Estimation 4 days, 5 hours

Average Consumption 81.89 mA

Average DMIPS 462.24 DMIPS



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

Embedded Software Packages Manager

STM32Cube MCU Packages and embedded software packs releases

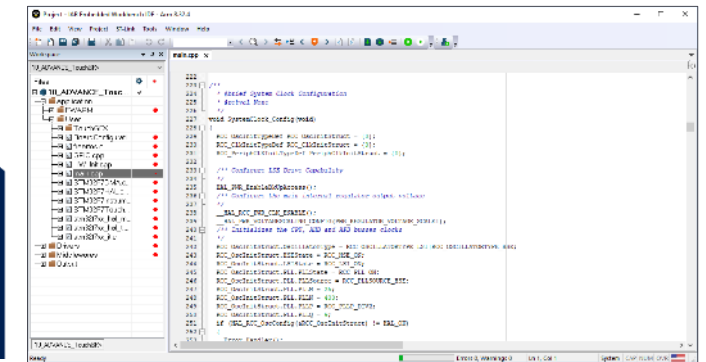
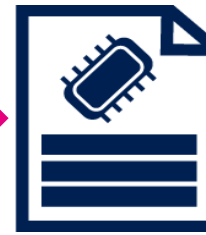
Releases Information was last refreshed less than one hour ago.

	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

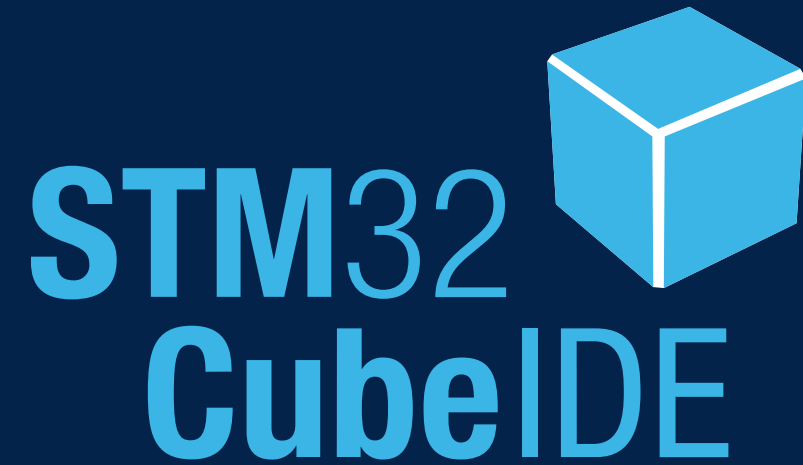
Graphic Summary AI Summary

Keras Minimum Ram: 44.50 KBytes Minimum Flash: 775.52 KBytes C:\00_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



Background of STM32CubeIDE

History

 atollic
TrueSTUDIO®

 |  atollic
TrueSTUDIO® for STM32

STM32 
CubeMX

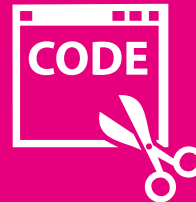


One tool for all your STM32 development

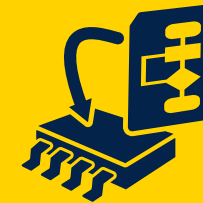
Chipset / Board
Configuration



Code
Development

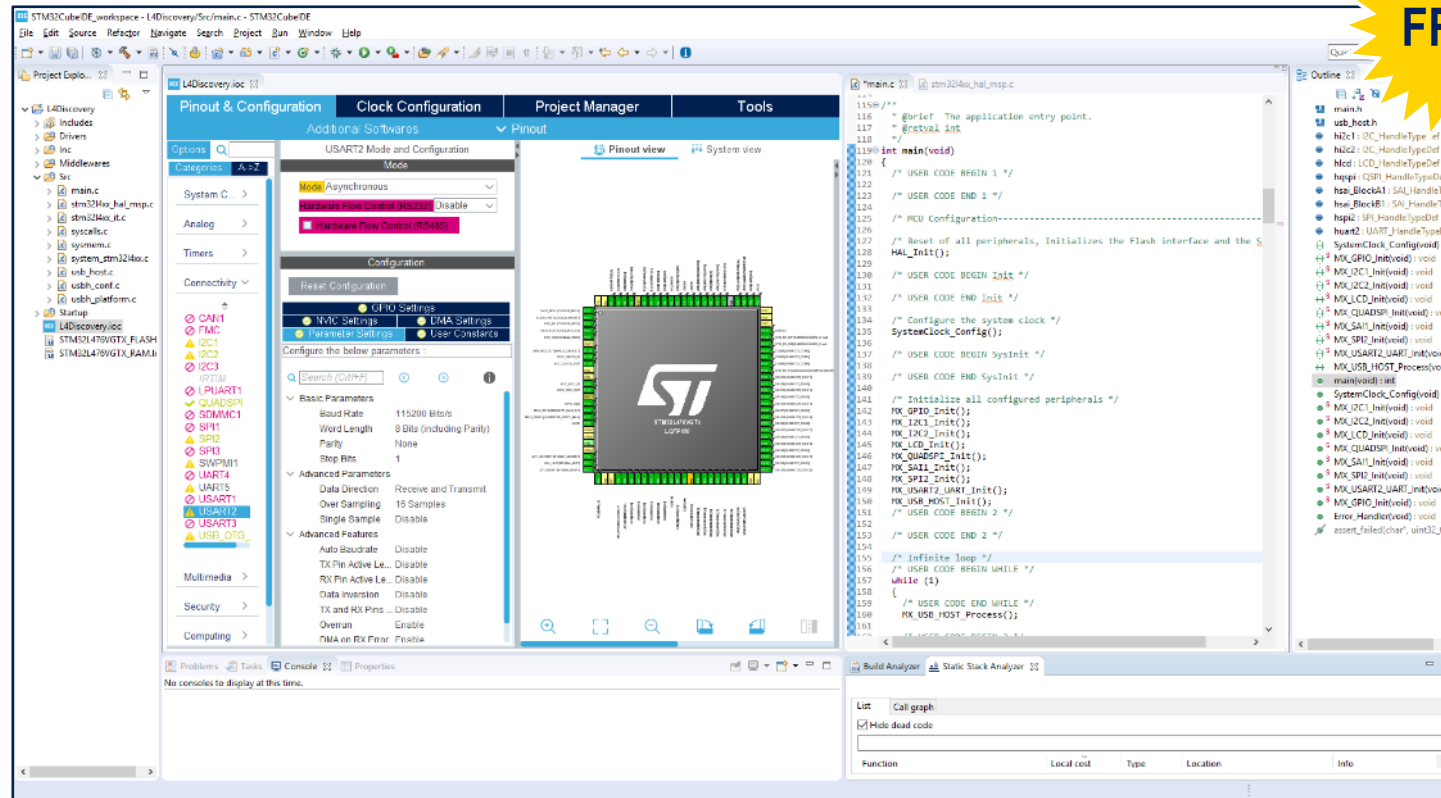
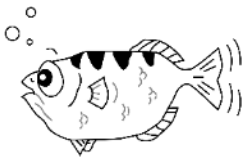


Validation
Debug



Free multi-platform development tool

FREE



macOS

Eclipse/GCC Based

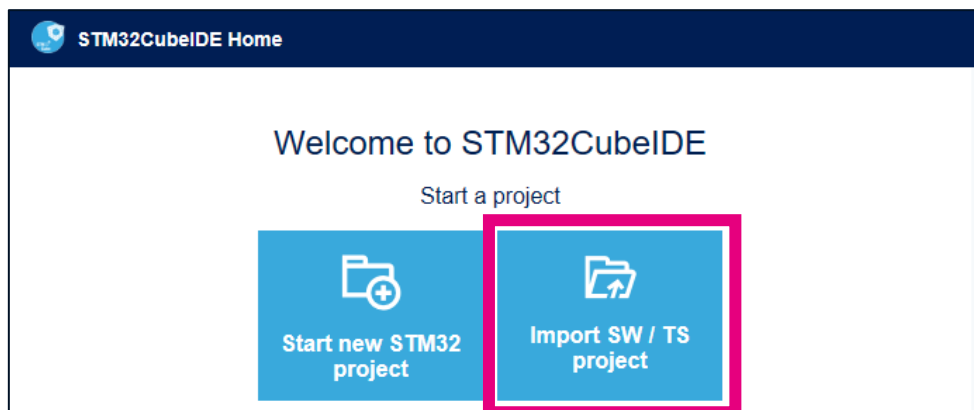
Free for Commercial Development

Multi-OS Support



Project management

Importer

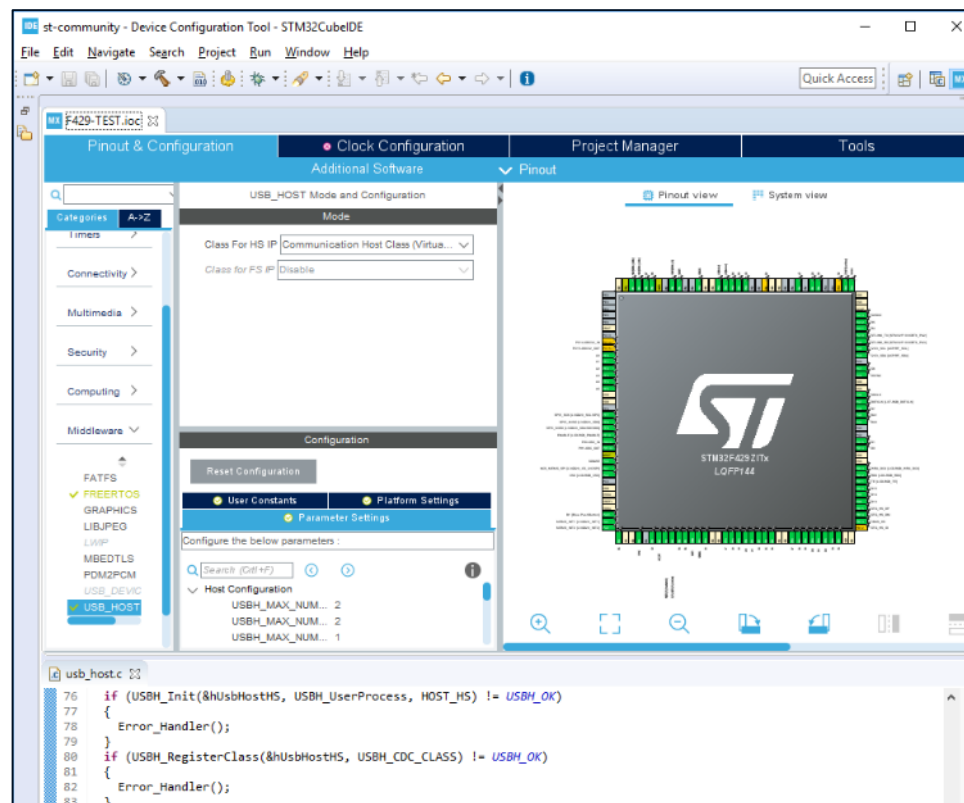


TrueSTUDIO
Project



SW4STM32
Project

IOC Editor





Code editor – navigation

Symbol Hyperlink

```
BSP_LED_Init(LED1);
BSP_LED_Init(LED2);
BSP_LED_Init(LED3);
BSP_LED_Init(LED4);

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 t)
{
    uint32_t USBx_BASE = (uint32_t)USBx;
    uint32_t *pSrc = (uint32_t *)src;
    uint32_t count32b, i;

    /* ... */
}

Call Hierarchy
Calls of USB_WritePacket(USB_OTG_GlobalTypeDef *USBx, uint8_t *src, uint8_t t) - /F746-DISCO-TEST/Drivers/S


- USB_WritePacket(USB_OTG_GlobalTypeDef *USBx, uint8_t *src, uint8_t 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_RxReceive(PCD_HandleTypeDef *hpcd, uint8_t *pbuf, uint32_t) : HAL_StatusTypeDef
- USB_LL_PrepareReceive(USB_LL_HandleTypeDef *hll, uint8_t *pbuf, uint32_t) : HAL_StatusTypeDef
- HAL_PCD_EP_Transmit(PCD_HandleTypeDef *hpcd, uint8_t *pbuf, uint32_t) : HAL_StatusTypeDef
- USB_LL_Transmit(USB_LL_HandleTypeDef *hll, uint8_t *pbuf, uint32_t) : HAL_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)
299 {
300     assert_param(IS_WRPSTATE(pOBInit->WRPState));
301     if(pOBInit->WRPState == OB_WRPSTATE_ENABLE)
302     {
303         /*Enable of Write protection on the selected Sector*/
304         status = FLASH_OB_EnableWRP(pOBInit->WRPSector);
305     }
306     else
307     {
308         /*Disable of Write protection on the selected Sector*/
309         status = FLASH_OB_DisableWRP(pOBInit->WRPSector);
310     }
311 }
```

Macro Expansion Browser

Explore Macro Expansion - 2 step(s)

#define USB_OTG_FS ((USB_OTG_GlobalTypeDef *) USB_OTG_FS_PERIPH_BASE)

Original	Fully Expanded
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
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
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

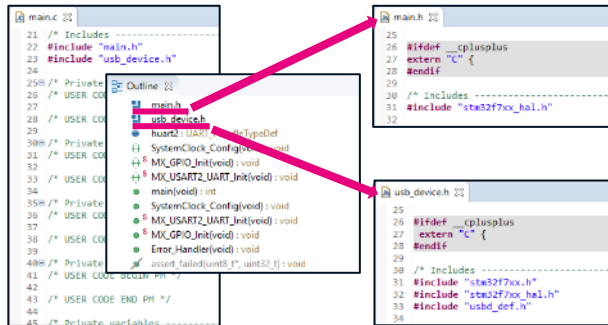

- UART_HandleTypeDef
  - AdvancedInit : UART_AdvFeatureInitTypeDef - __UART_HandleTypeDef
  - ErrorCode : volatile uint32_t - __UART_HandleTypeDef
  - gState : volatile HAL_UART_StateTypeDef - __UART_HandleTypeDef
  - hdmax : DMA_HandleTypeDef * - __UART_HandleTypeDef
  - hdmatx : DMA_HandleTypeDef * - __UART_HandleTypeDef
  - Init : UART_InitTypeDef - __UART_HandleTypeDef
  - Instance : USART_TypeDef * - __UART_HandleTypeDef
  - Lock : HAL_LockTypeDef - __UART_HandleTypeDef
  - Mask : uint16_t - __UART_HandleTypeDef
  - pRxBuffer : uint8_t * - __UART_HandleTypeDef
  - pTxBuffer : uint8_t * - __UART_HandleTypeDef

```

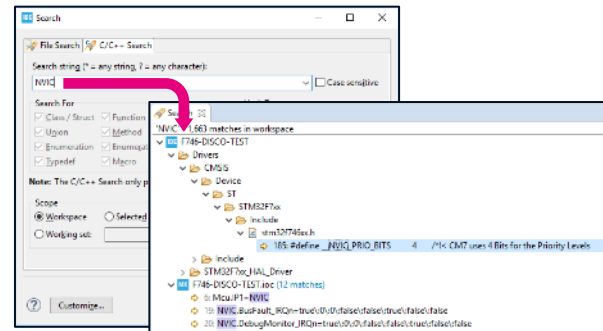



Code editor – navigation (2/2)

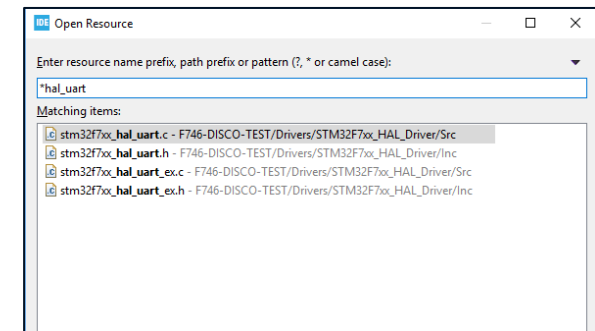
Outline View



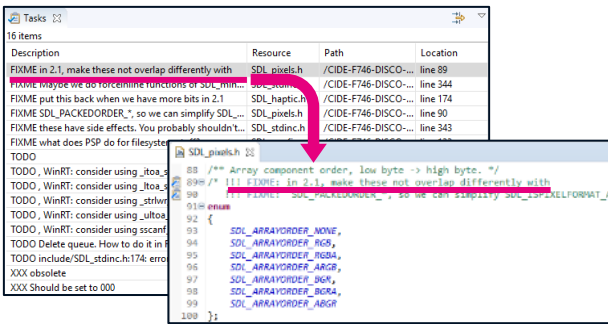
Powerful Search



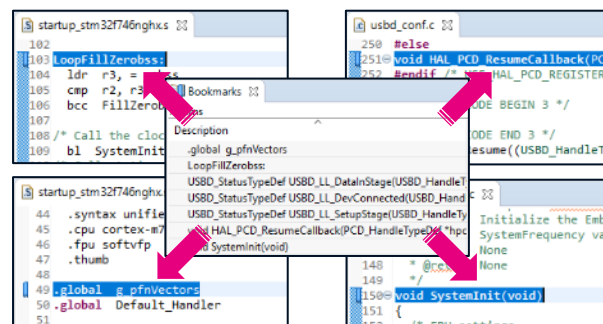
Open Resource



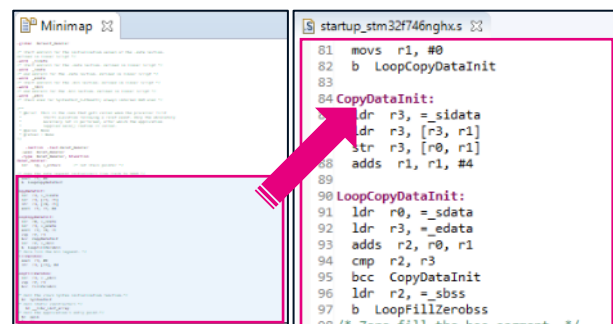
Task Tags



Bookmark



Minimap





```
usb_desc.c 23
157
158 #if defined ( __ICARM__ ) /* IAR Compiler */
159 #pragma data_alignment=4
160 #endif /* defined ( __ICARM__ ) */
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_LPM_ENABLED == 1)
167     0x01, /* bcdUSB */ /* changed to USB version 2.01
168                                     in order to support LPM L1 suspend
169                                     resume test of USBV2.0*/
170 #else
171     0x00, /* bcdUSB */
172 #endif /* (USB_LPM_ENABLED == 1) */
173     0x02, /* bDeviceClass */
174     0x00, /* bDeviceSubClass */
175     0x00, /* bDeviceProtocol */
176     0x00, /* bMaxPacketSize */
177     USB_MAX_EP_SIZE, /* bMaxPacketSize */
178     LOWBYTE(USB0_VID), /* bVendor */
179     HIGHBYTE(USB0_VID), /* bVendor */
180 }
```

```

97  /* USER CODE BEGIN 2 */
98  HAL_GPIO_
99  /* USER CODE END 2 */
100
101  /* Infinite loop */
102  /* USER CODE BEGIN WHILE */
103  while (1)
104  {
105      /* USER CODE BEGIN WHILE */
106
107      /* USER CODE END WHILE */
108  }
109  /* USER CODE BEGIN WHILE */
110  }
111
112  /**
113   * @brief
114   * @retval

```

```

116 void SystemClock_Config(void)
117 {
118     RCC_OscInitTypeDef RCC_OscInitStruct = {0};
119     RCC_ClkInitTypeDef RCC_ClkInitStruct = {0};
120     RCC_PeriphCLKInitTypeDef PeriphClkInitStruct = {0};
121
122     /** Configure the main internal regulator output voltage
123     */
124     __HAL_RCC_PWR_CLK_ENABLE();
125     __HAL_PWR_VOLTAGESCALING_CONFIG(PWR_REGULATOR_VOLTAGE_SCALE3);
126     /** Initializes the CPU, AHB and APB busses clocks
127     */
128     RCC_OscInitStruct.OscillatorType = RCC_OSCILLATORTYPE_HSI;
129     RCC_OscInitStruct.HSEState = RCC_HSE_ON;
130     RCC_OscInitStruct.HSIState = RCC_HSI_ON;
131     RCC_OscInitStruct.HSICalibrationValue = RCC_HSICALIBRATION_DEFAULT;
132     RCC_OscInitStruct.PLL.PLLState = RCC_PLL_ON;
133     RCC_OscInitStruct.PLL.PLLSource = RCC_PLLSOURCE_HSE;
134     RCC_OscInitStruct.PLL.PLLM = 15;
135     RCC_OscInitStruct.PLL.PLLN = 144;

```

File: Compare ("F746-DISCO-TEST/Src/main.c" - "F746-DISCO-TEST-2/Src/main.c")

C Compare

- StartDefaultTask
- SystemClock_Config
- cmsis_os.h
- fatfs.h
- usb_device.h

C Compare (Cannot Compare Structures)

C Compare Viewer

F746-DISCO-TEST/Src/main.c

```

20
21 /* Includes
22 #include "main.h"
23 #include "usb_device.h"
24
25 /* Private includes
26 /* USER CODE BEGIN Includes */
27
28 /* USER CODE END Includes */
29

```

F746-DISCO-TEST-2/Src/main.c

```

20
21 /* Includes
22 #include "main.h"
23 #include "cmsis_os.h"
24 #include "fatfs.h"
25 #include "usb_host.h"
26
27 /* Private includes
28 /* USER CODE BEGIN Includes */
29

```

The diagram illustrates the flow of code execution. It consists of two code blocks. The top block contains a while loop that calls a function named `HAL_GPIO_Toggle` three times with arguments `GPIOA`, `GPIO_PIN1`, `GPIOA`, `GPIO_PIN2`, and `GPIOA`, `GPIO_PIN3`. A red arrow points from the first call to `HAL_GPIO_Toggle` in the while loop to the start of a second code block. This second block contains the implementation of the `HAL_GPIO_Toggle` function, which also calls `HAL_GPIO_Toggle` three times with the same arguments. The red arrow indicates that the code inside the function is executed when the function is called within the while loop.

```
/* USER CODE BEGIN 2 */
HAL_GPIO_Toggle(GPIOA, GPIO_PIN1);
HAL_GPIO_Toggle(GPIOA, GPIO_PIN2);
HAL_GPIO_Toggle(GPIOA, GPIO_PIN3);
/* USER CODE END 2 */

/* Infinite loop */
/* USER CODE BEGIN WHILE */
while (1)
{
    /* USER CODE BEGIN 2 */
    HAL_GPIO_Toggle(GPIOA, GPIO_PIN1);
    HAL_GPIO_Toggle(GPIOA, GPIO_PIN2);
    HAL_GPIO_Toggle(GPIOA, GPIO_PIN3);
    /* USER CODE END 2 */

    /* Infinite loop */
    /* USER CODE BEGIN WHILE */
    while (1)
    {
```

Visual Studio Preferences dialog, Code Style > Formatter section.

Active profile:

- K&R [built-in]
- C++ [built-in]**
- BSD/Allman [built-in]
- GNU [built-in]
- Whitesmiths [built-in]

Code:

```

/* A sample source file for the code formatter preview
*/
#include <math.h>

class Point {
public:
    Point(double x, double y) :
        x(x), y(y) {

```




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	...	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	

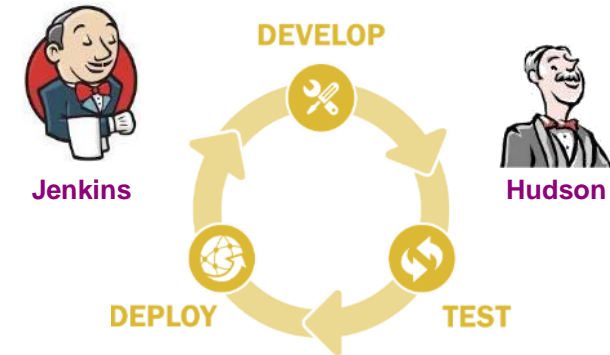
Build Analyzer Static Stack Analyzer Search

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		
init	0	0	0		

Headless Build



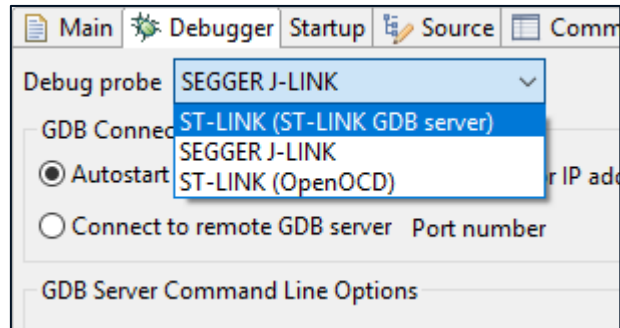
Continuous Integration

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



Debug

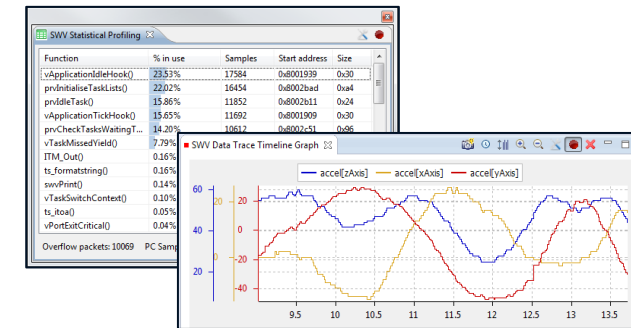
Debugger



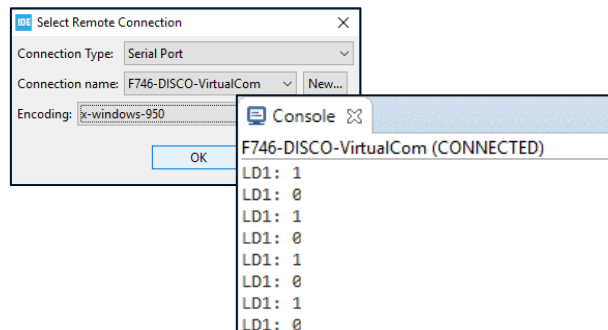
Live expressions

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

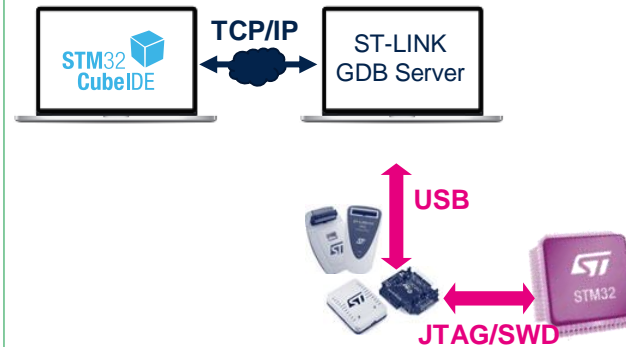
SWV



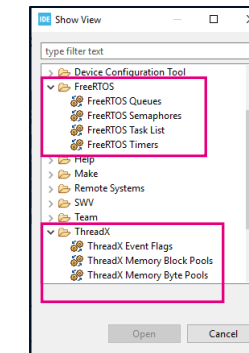
Integrated UART Terminal



Remote Debug



RTOS aware Debug



FreeRTOS

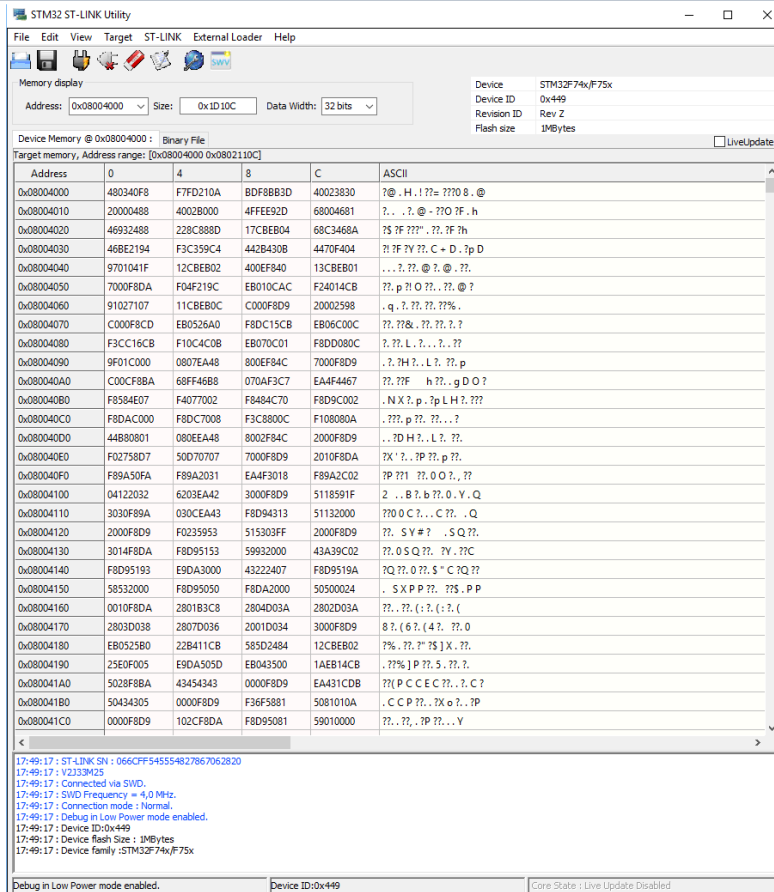
ThreadX Microsoft Azure

STM32CubeProgrammer

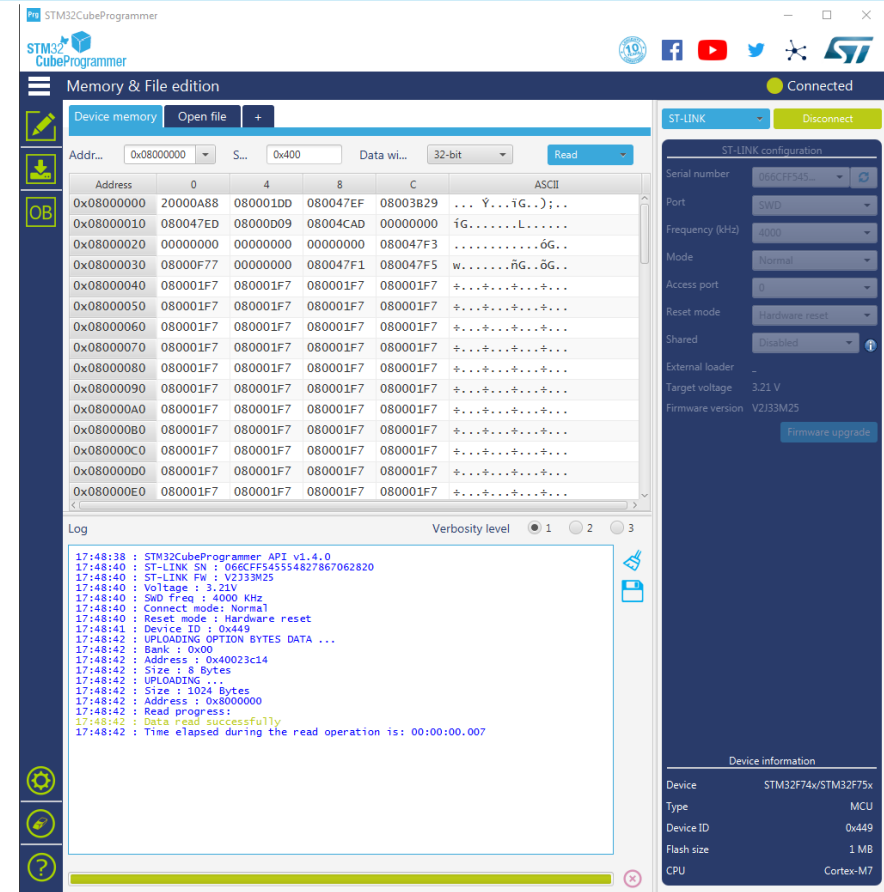
STM32 
CubeProgrammer

From ST-LINK Utility to STM32CubeProgrammer

ST-Link Utility



STM32CubeProgrammer



All-in-one programming software tool



Intuitive GUI

Multi-platform
(Windows, Linux, macOS)

STLink Direct Support
(JTAG, SWD)

Automatic Mode

Option Bytes
Program & Upload

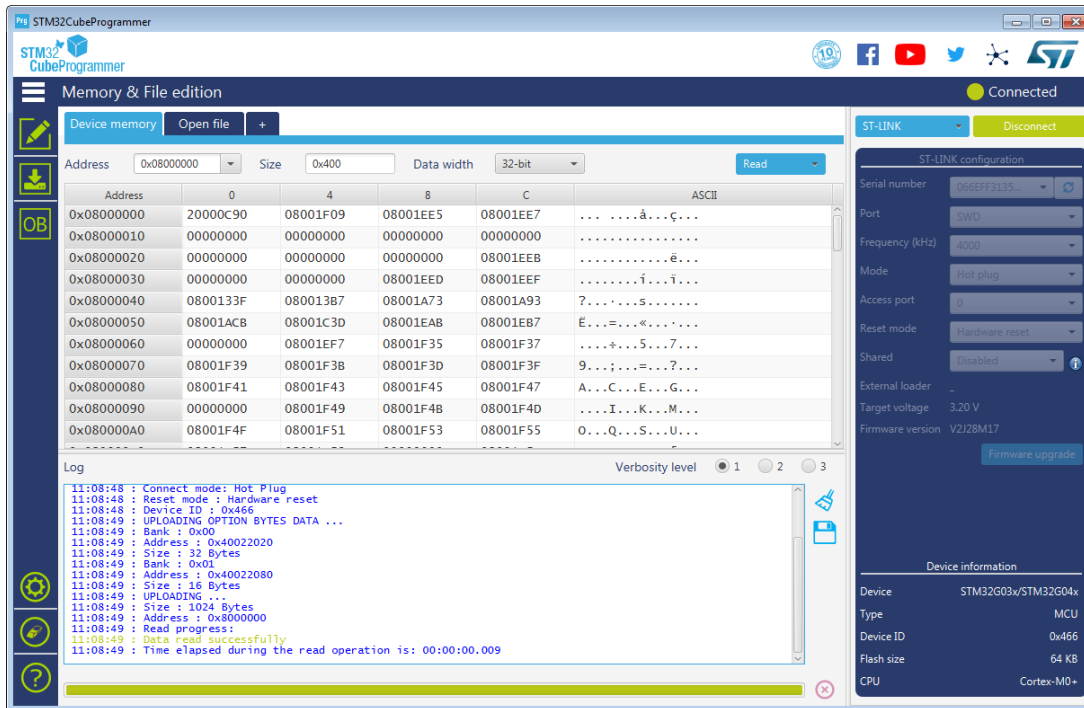
Bootloader Interface Support
(USB, UART, SPI, I2C, CAN)

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

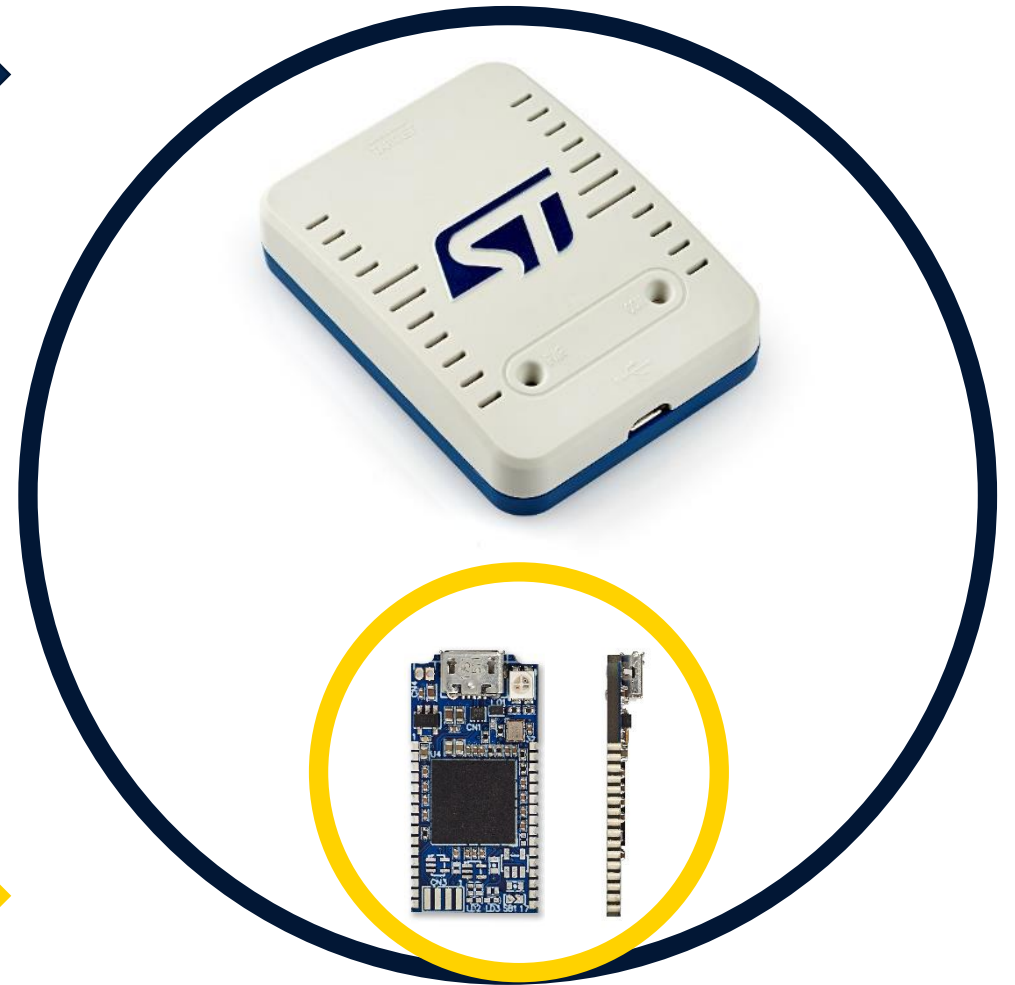
Easier/Faster/Affordable

Stand-alone and scalable (V3SET)

Multi-path Bridge (I²C/SPI/CAN/UART/USB)

Drag&Drop Flash Programming

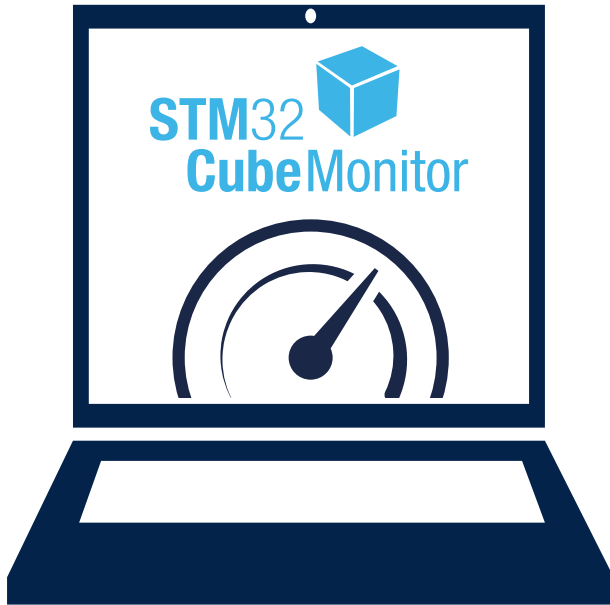
Compact (V3MINI) or On-board (V3MODS)



STM32CubeMonitor

STM32 
CubeMonitor

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.

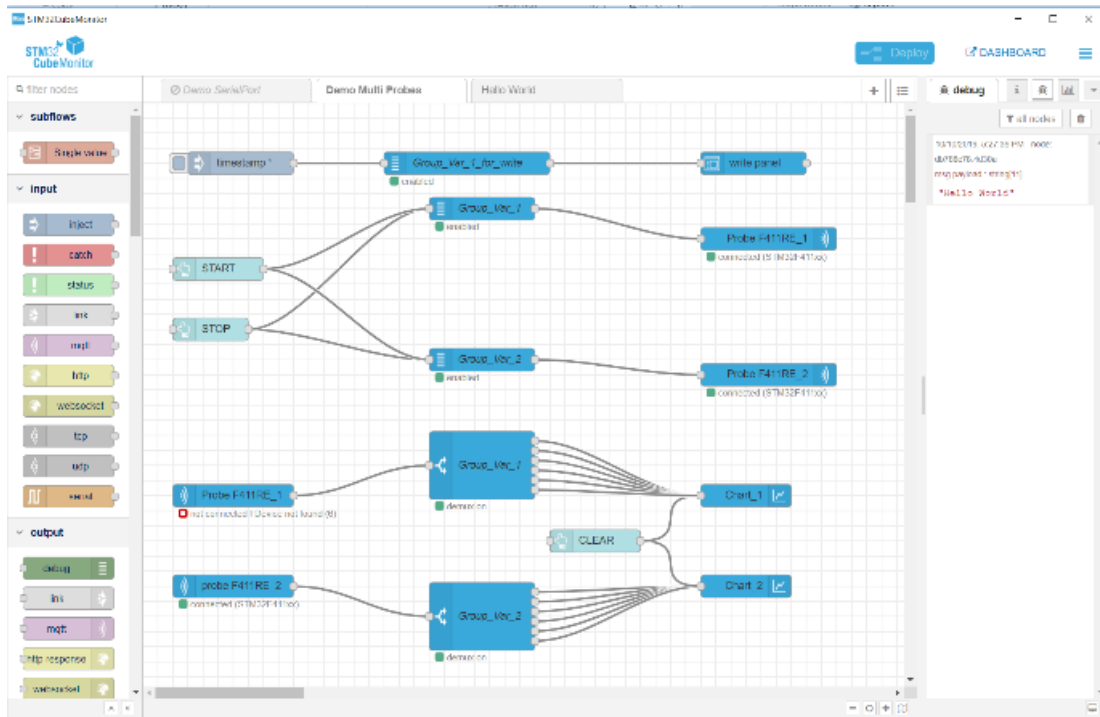
Graphical visualization on any display

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

Graphical custom data visualization

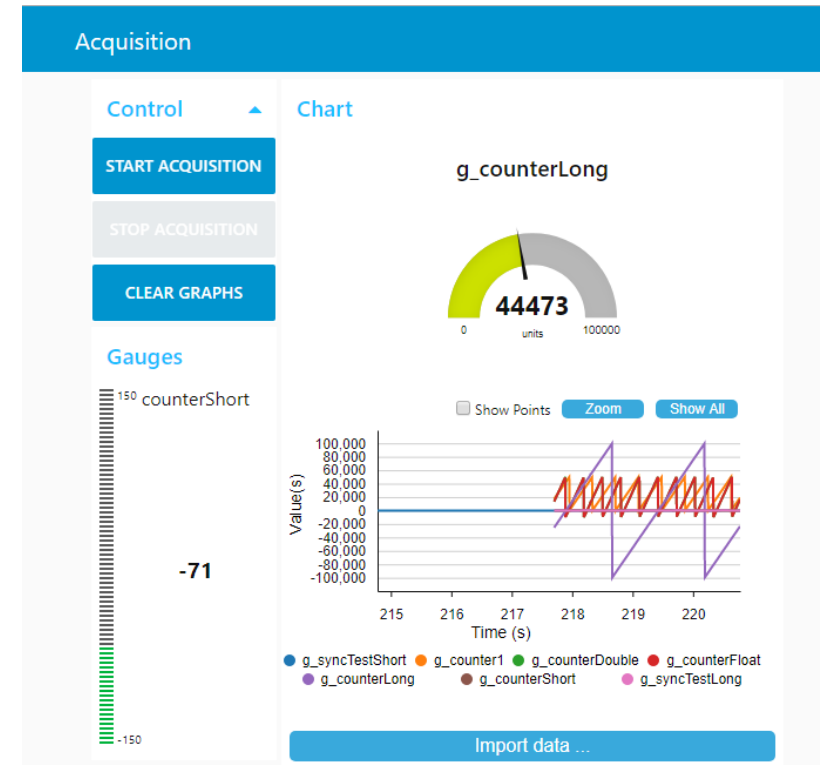
Design mode to create

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.

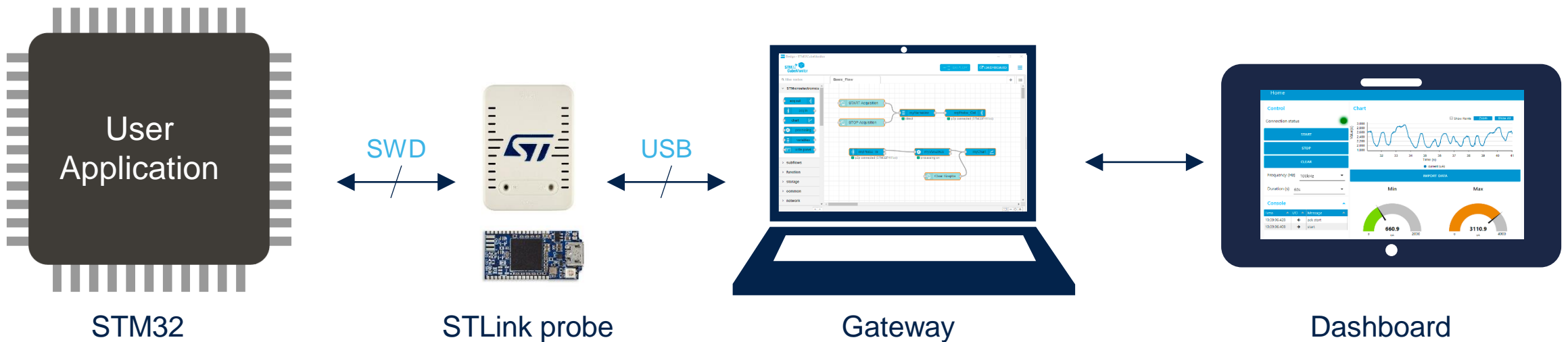


Native support of multi-format displays

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

Remote data acquisition with web server technology

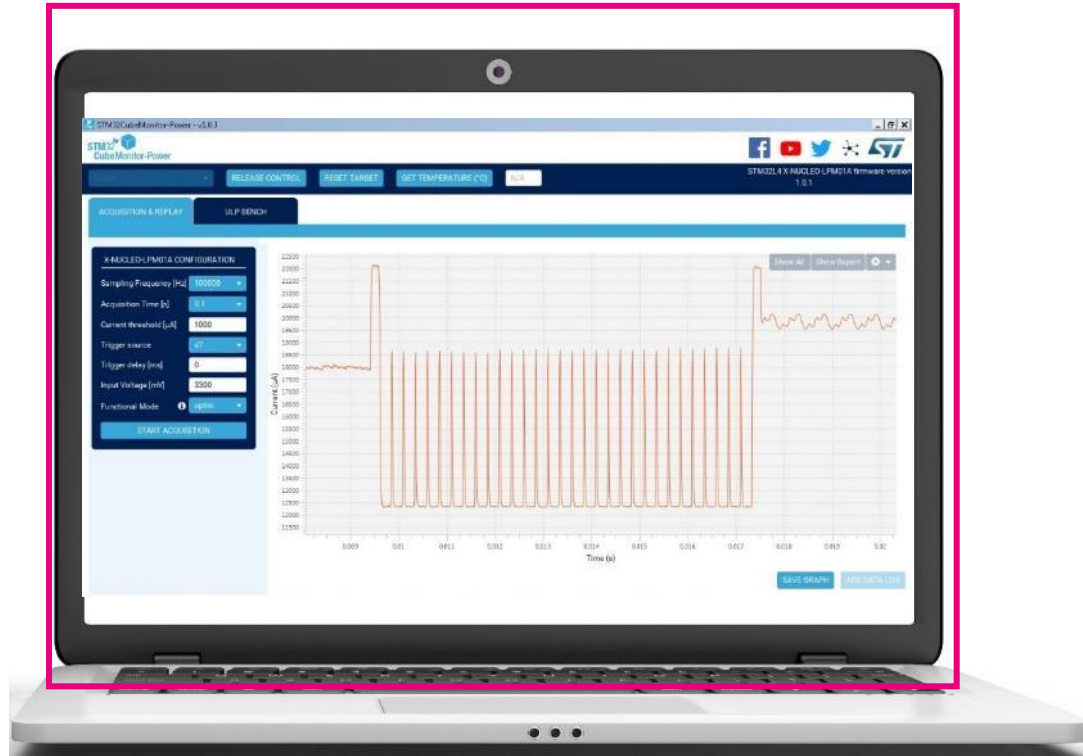
Monitor across a network with a web browser



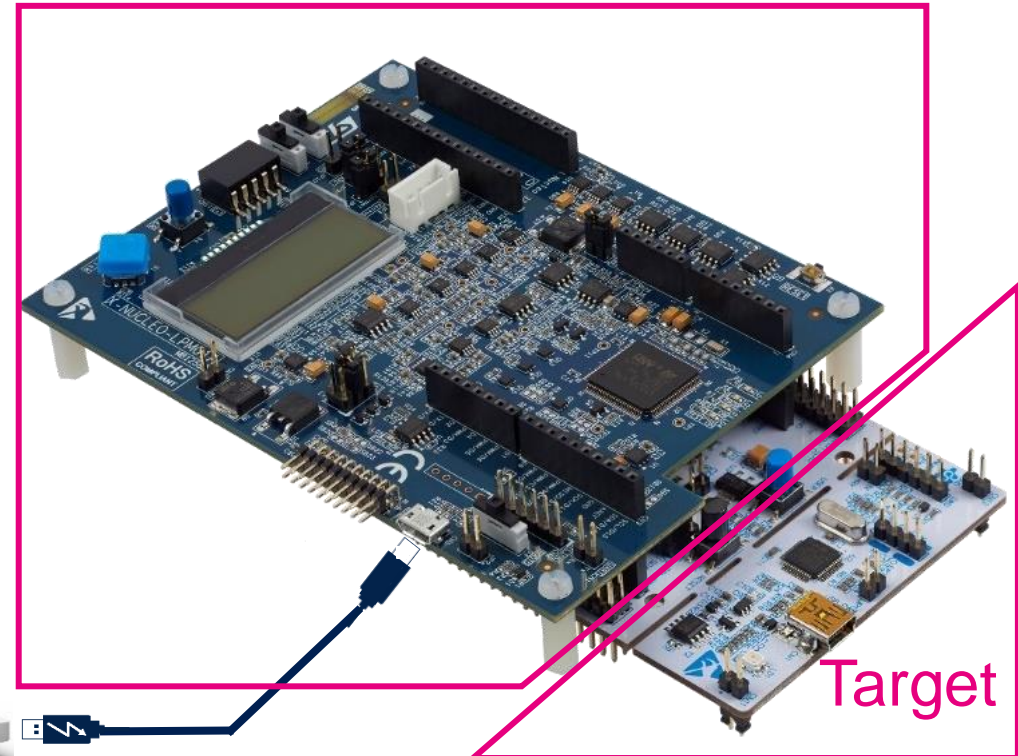
STM32CubeMonitor-Power

STM32 
CubeMonitor-Power

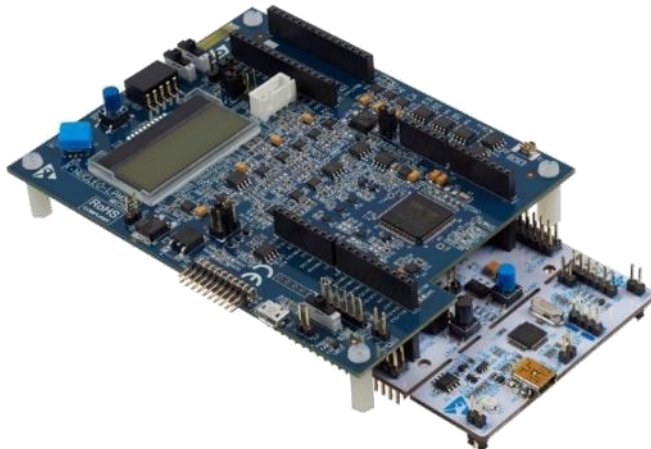
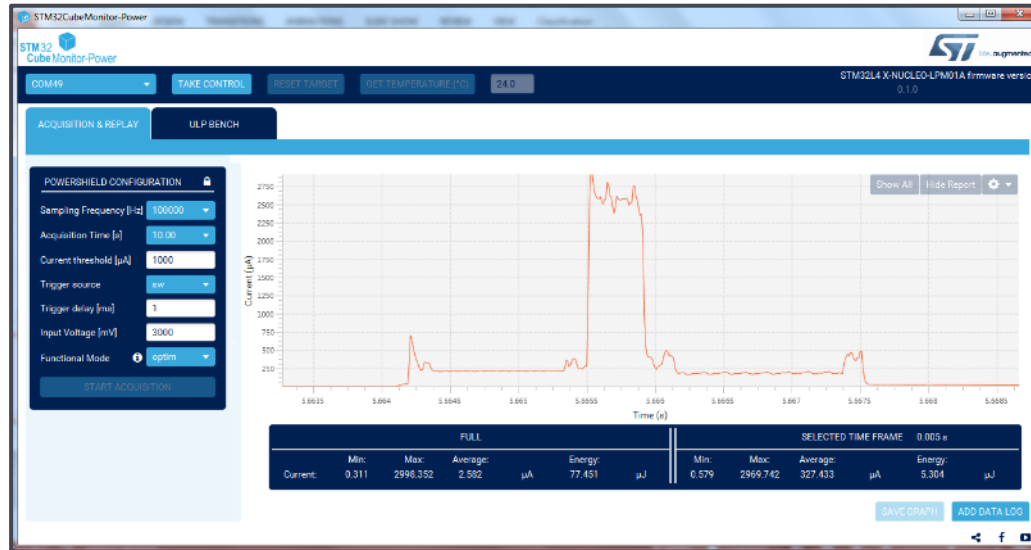
STM32CubeMonPwr



X-NUCLEO-LPM01A



STM32 power profiling



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

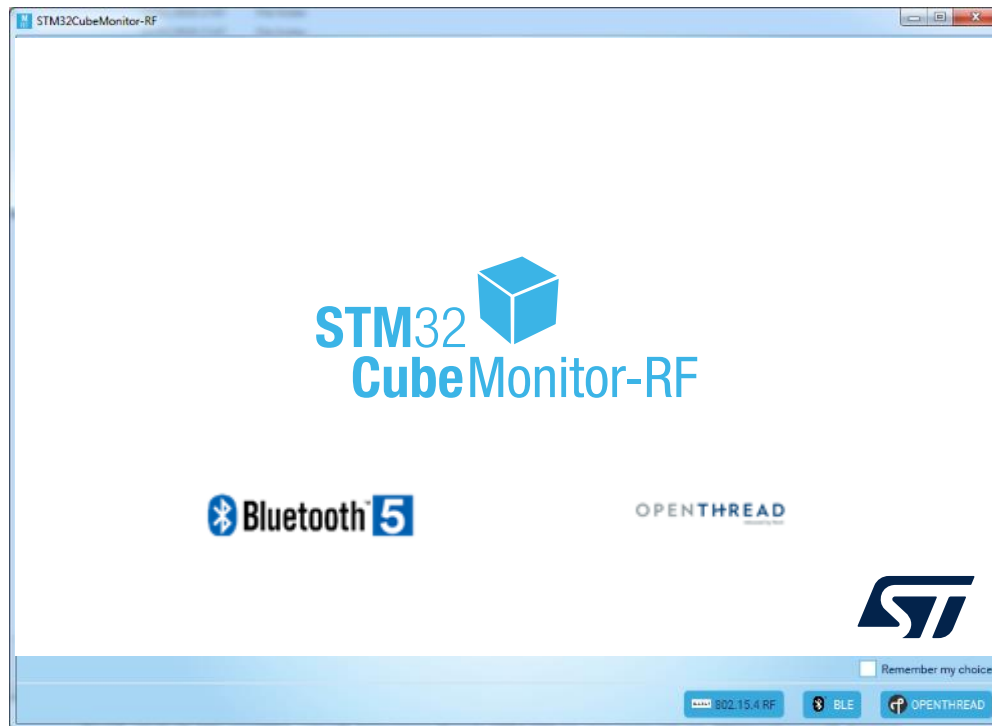
Direct computation of ULPMark scores



STM32CubeMonitor-RF

STM32 
CubeMonitor-RF

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



Test protocol sequences

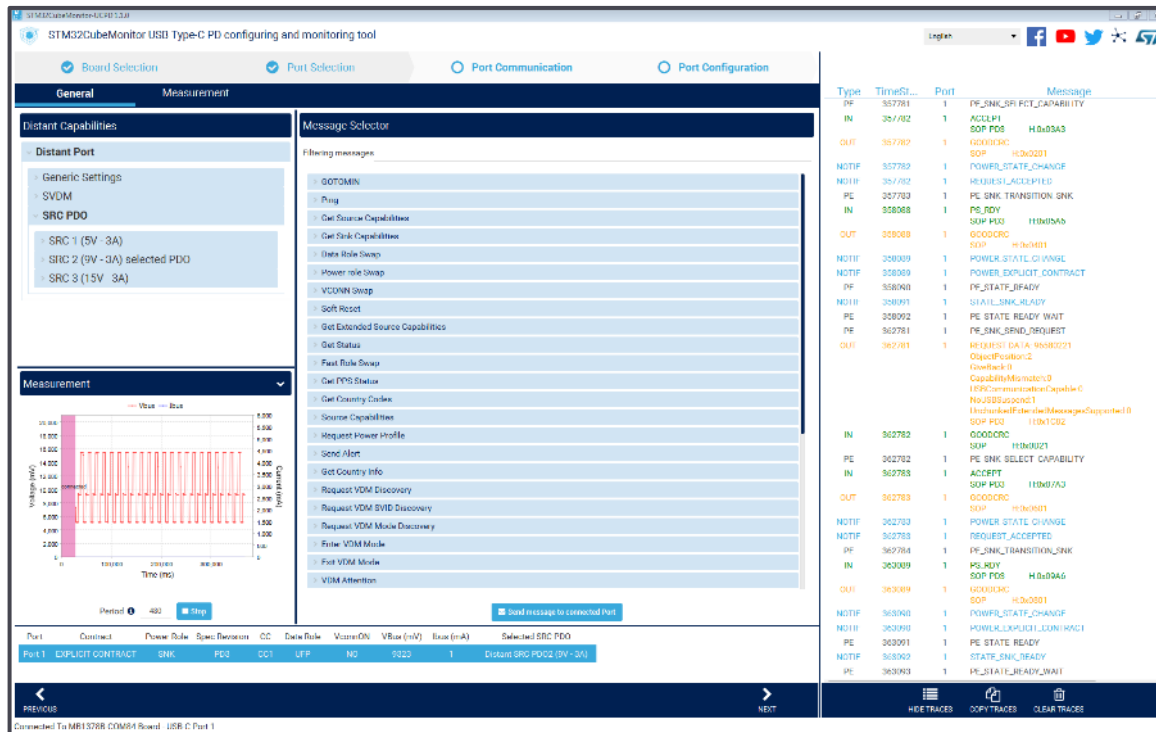
Configure static / dynamic beacons

Manage Over the Air (OTA) file transfer

STM32CubeMonitor-UCPD

STM32 
CubeMonitor-UCPD

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**

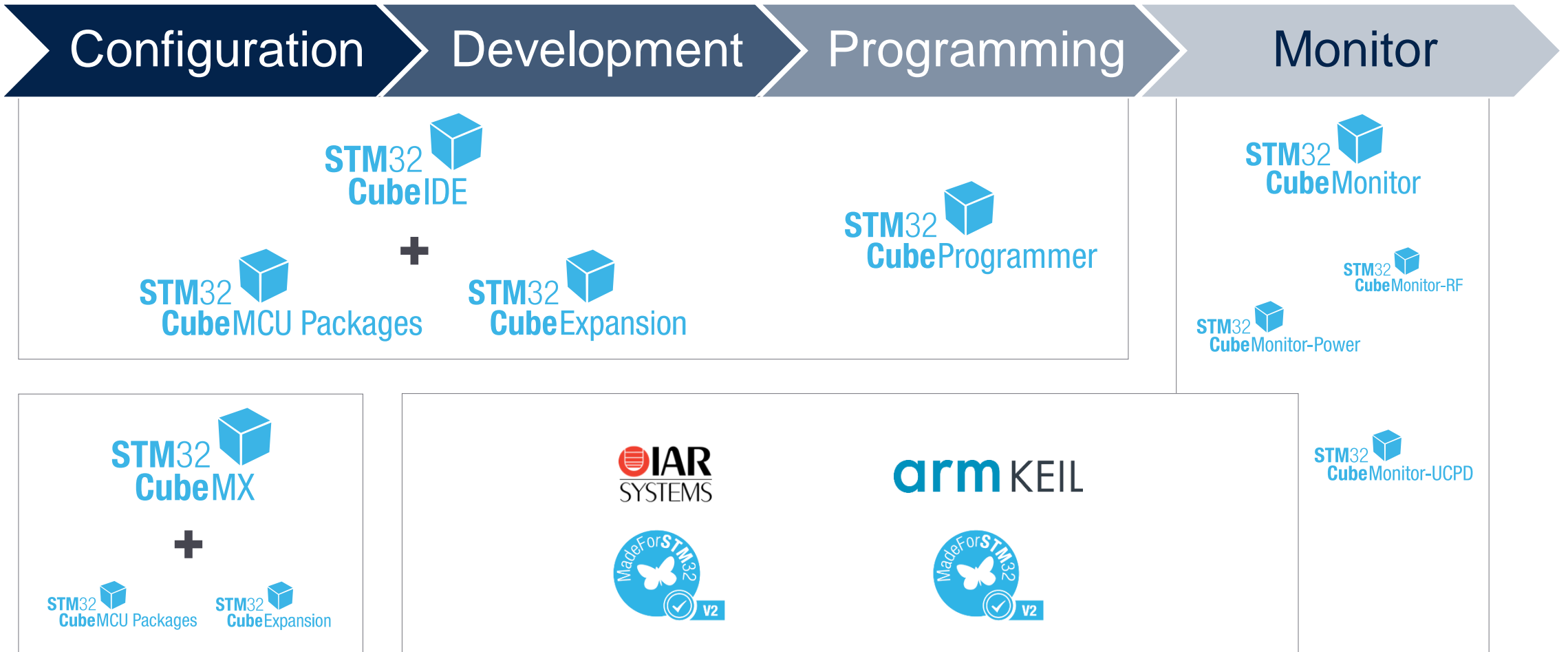
Port configuration pane for **PD setting, VDM, SOP, Source and Sink Capabilities**

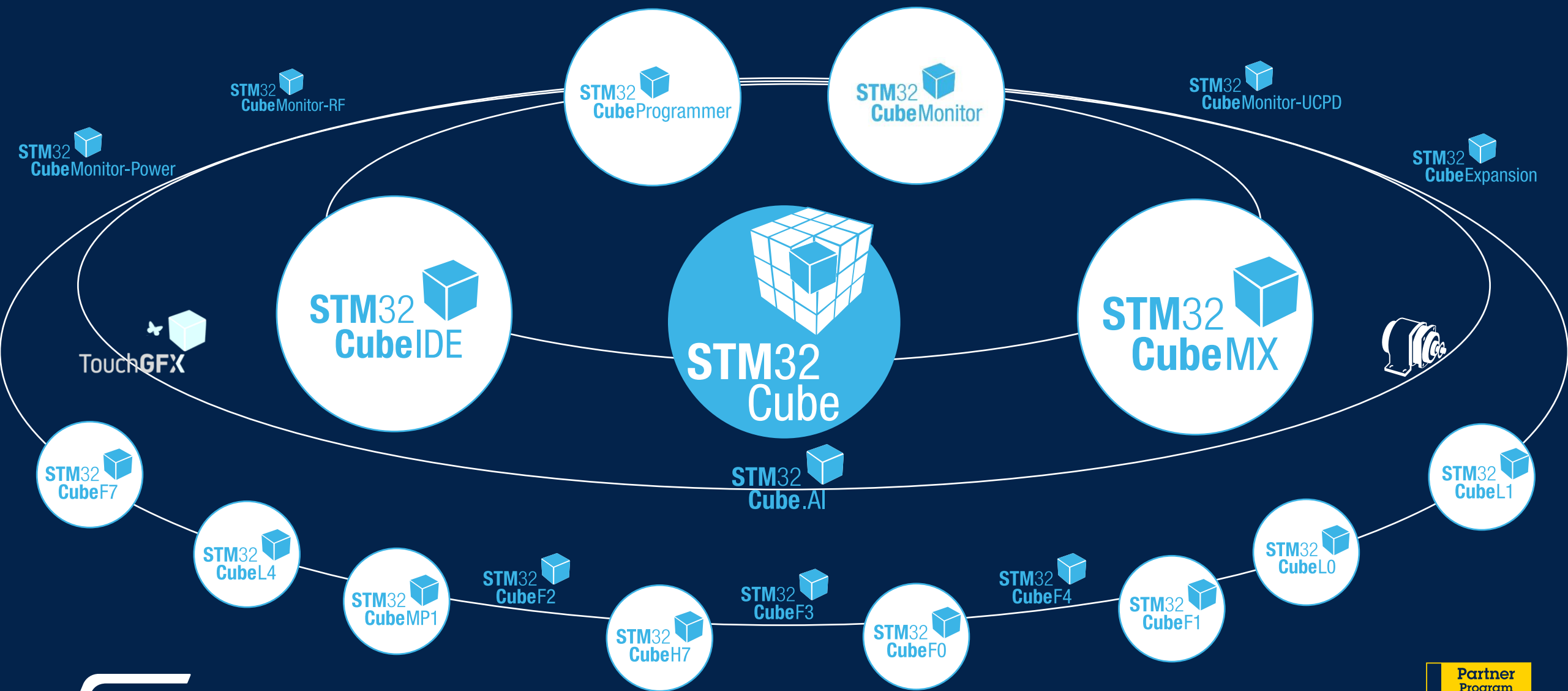
Port communication pane for **VBUS and IBUS monitoring, distant port capabilities, message selector, and real-time traces**

Key takeaways



Iterative development process





Thank you

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