



life.augmented

Rich easy-to-use Embedded development tools

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STMicroelectronics India

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Agenda

Introduction

Hands-on demo

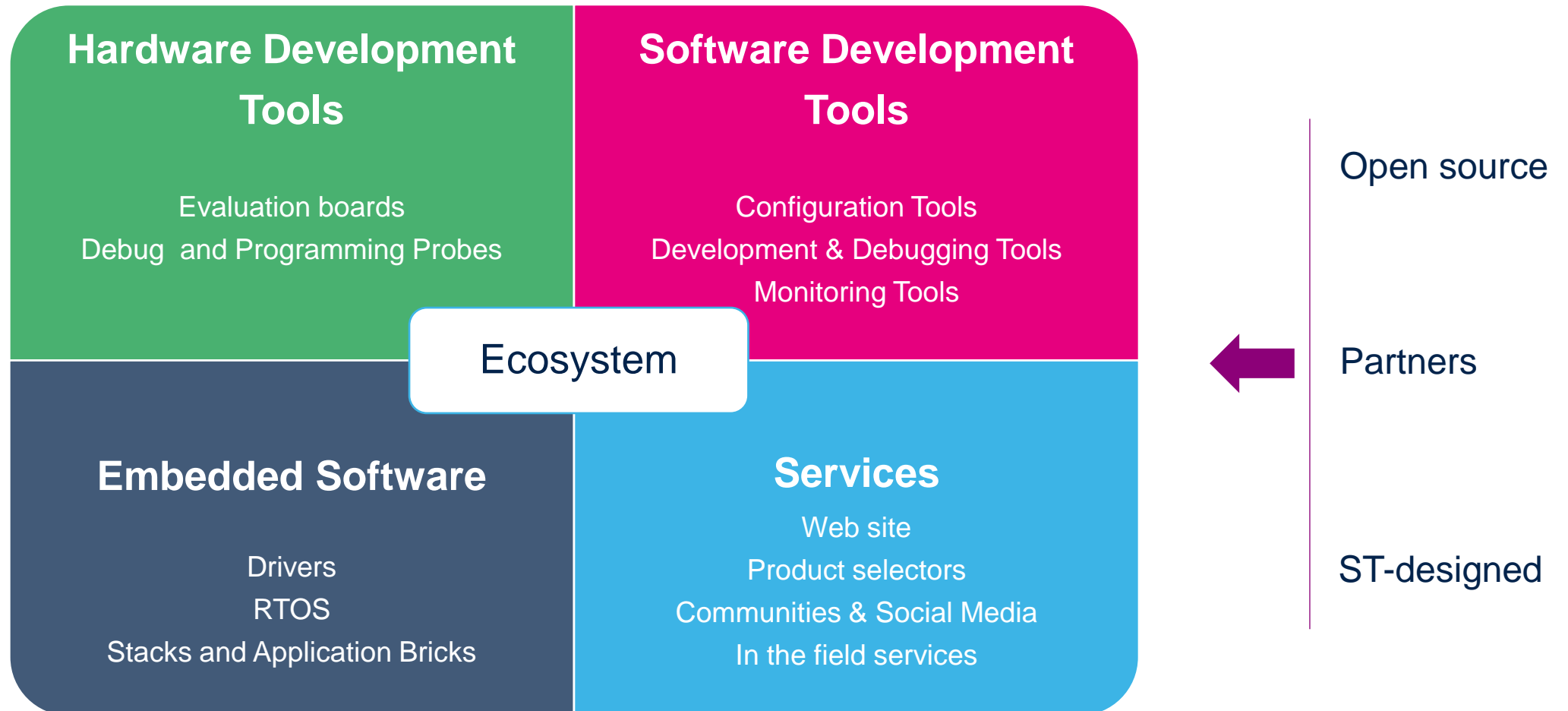
Hardware development tools

Embedded software

Software development Tools

What is a generic ecosystem?

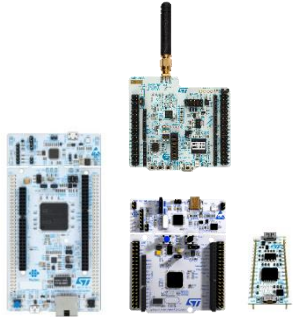
All collaterals required to develop with an MCU



Hardware development tools



HW development tools overview



STM32 Nucleo

Flexible
prototyping

www.st.com/stm32nucleo



Discovery kits

Key feature
prototyping

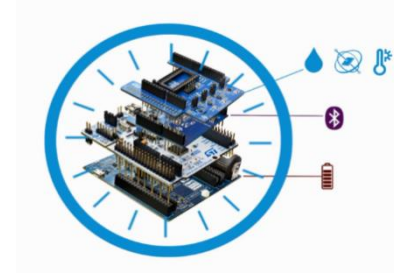
www.st.com/stm32discovery



Evaluation
boards

Full feature
evaluation

www.st.com/stm32evaltools



STM32 Nucleo
expansion

Functionality
add-on

www.st.com/x-nucleo



Third-party
boards

From full
evaluation to
open hardware



Move Actuate



Connect



Power Drive



Sense



Translate



STM32 Nucleo form choices

Ethernet

USB

ST Zio
(Uno extended)

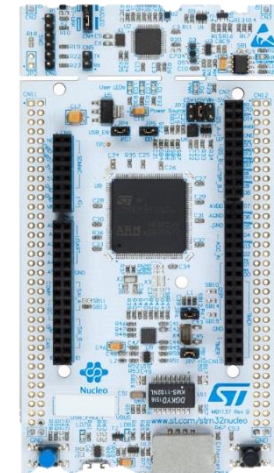
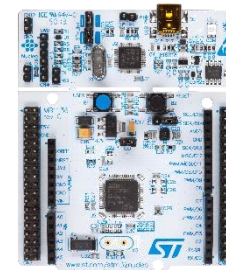
Arduino Uno
ST morpho

**

**

Arduino Nano

*



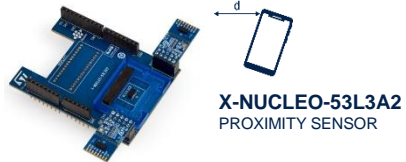
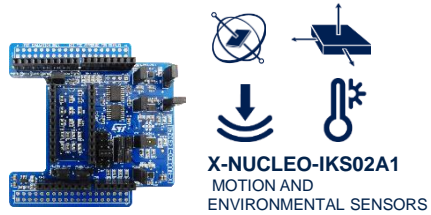
Nucleo-32
32-pin MCU

Nucleo-64
64-pin MCU

Nucleo-144
144-pin MCU

Nucleo expansion boards from ST

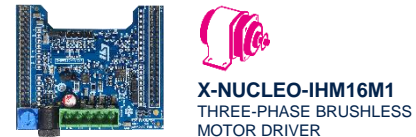
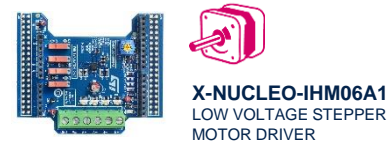
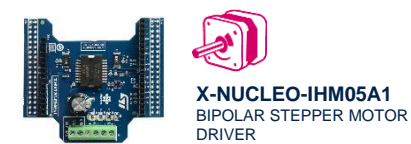
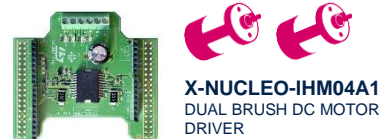
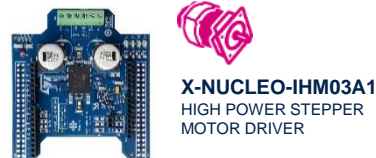
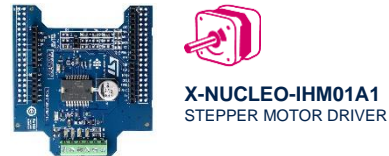
Sensors and analog



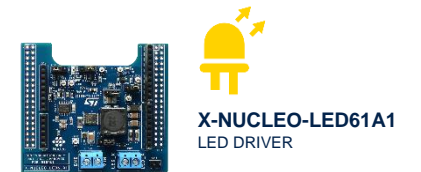
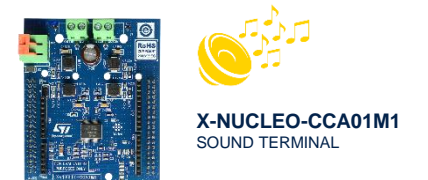
Communication



Motor drive



Translate





Fast and affordable development & prototyping

Developer community and support
Compatibility with free and commercial Development Environments

Mobile app prototyping & cloud prototyping

Function packs
Set of function examples for some of the most common application use cases



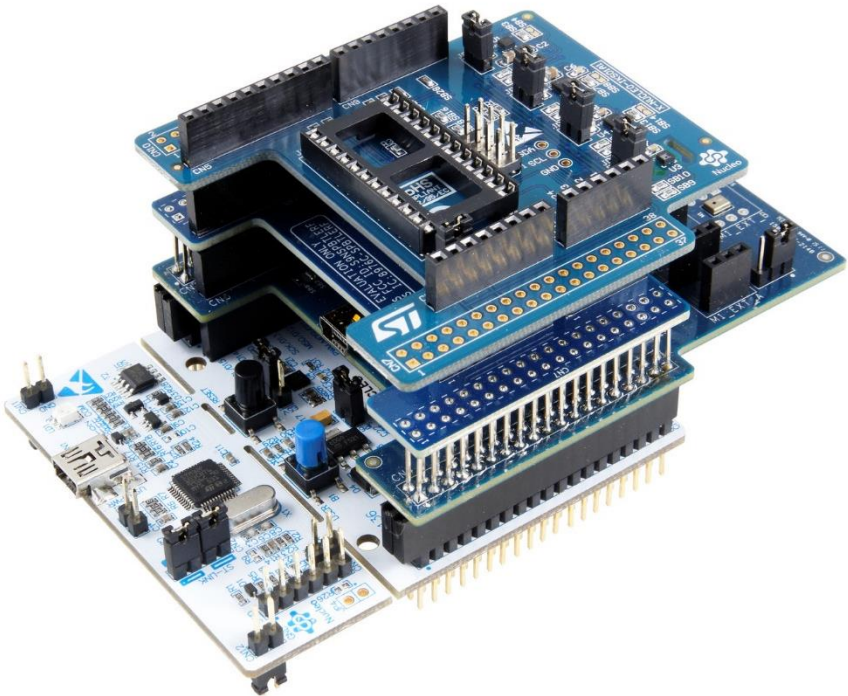
STM32Cube
development software

STM32Cube
expansion software



STM32 Nucleo
development boards

STM32 Nucleo
expansion boards



Latest discovery kits



STM32WB5MM-DK



B-U585I-IOT02A



B-L462E-CELL1



B-L072Z-LRWAN1



STM32G0316-DISCO



B-G474E-DPOW1



STM32H735G-DK



STM32MP157F-DK2

STM32Cube

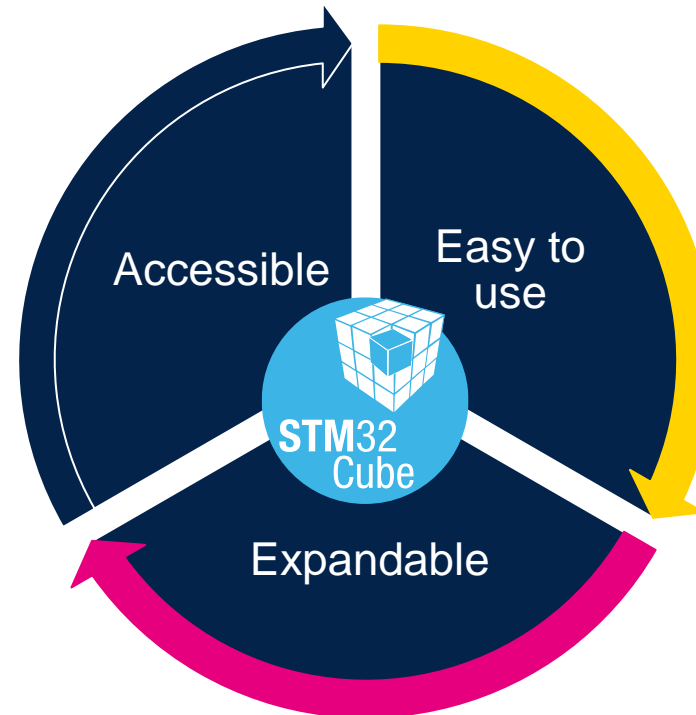


STM32Cube ecosystem: user benefits

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

Inside the STM32Cube ecosystem

Software Tools



Embedded Software



STM32
CubeMX

Configuration

STM32
CubeIDE

Development

STM32
CubeProgrammer

Programming

STM32
CubeMonitor

Monitor

STM32
Cube

STM32
CubeMCU Packages

Packages

User application

Middlewares

Drivers

Expansions

STM32
CubeExpansion

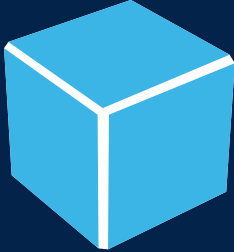
Save time

Save cost

Go beyond
existing solutions

Easily monitor &
debug applications

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

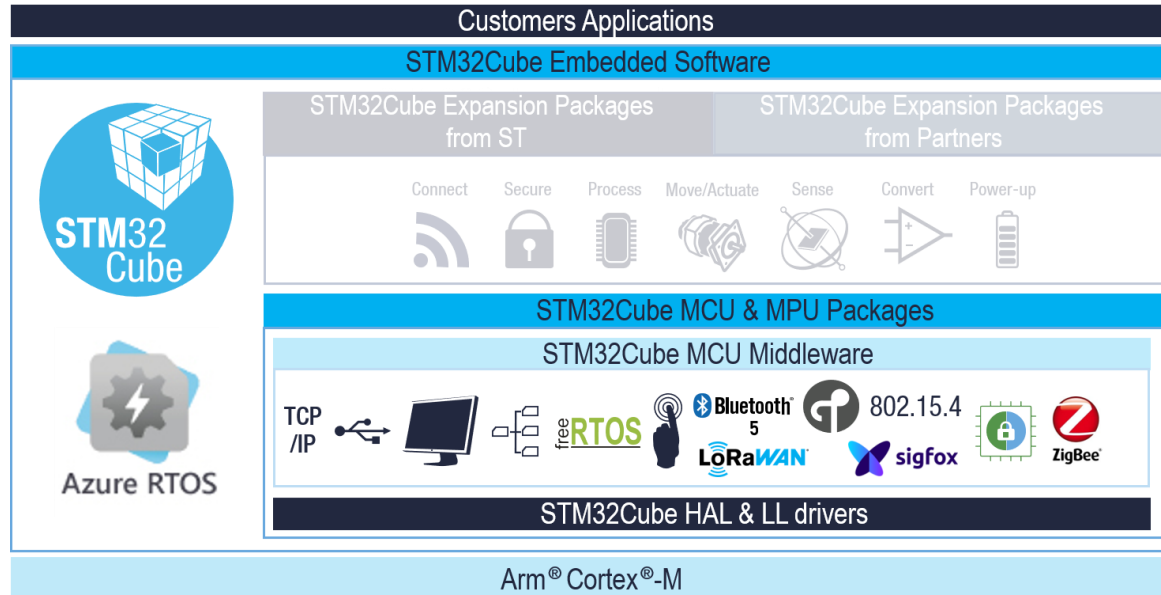
STM32
CubeL5

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

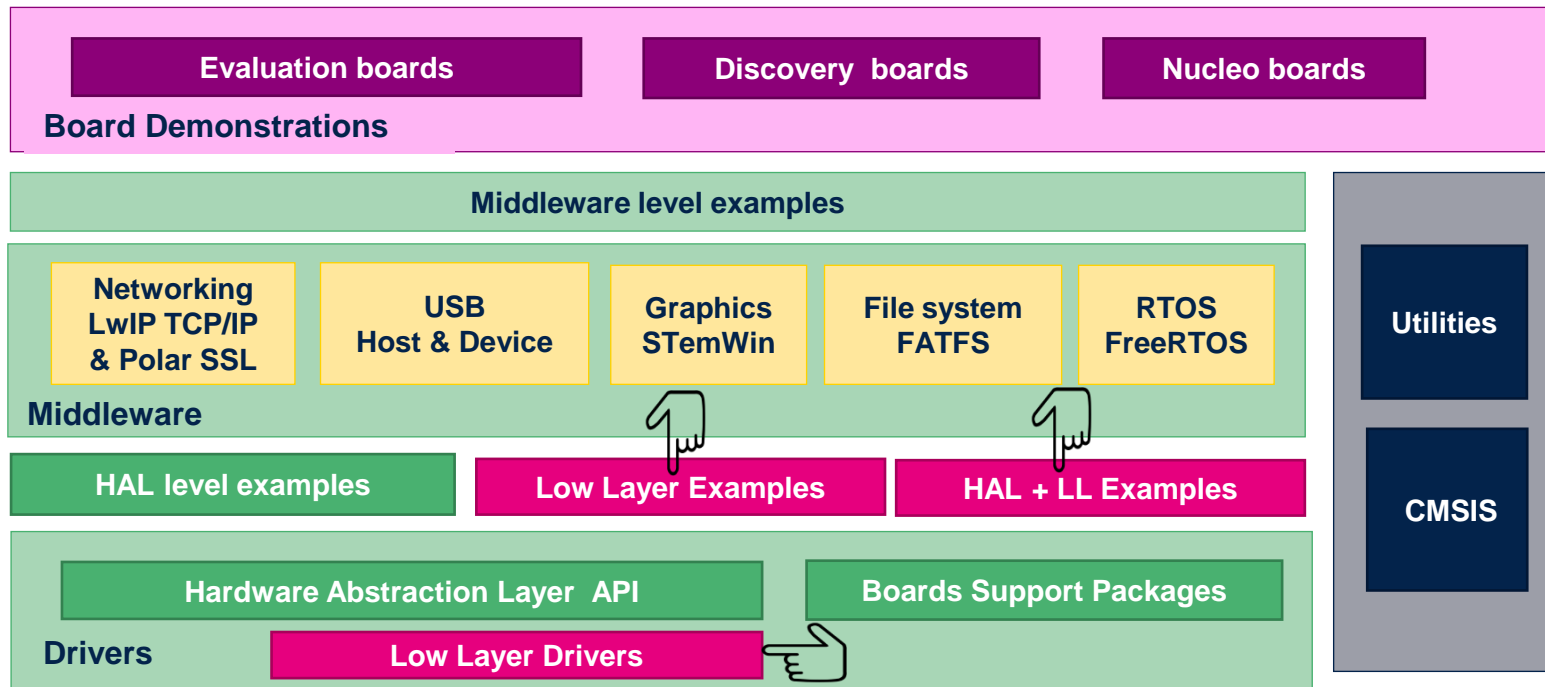
Generic MW

- 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

STM32Cube package overview

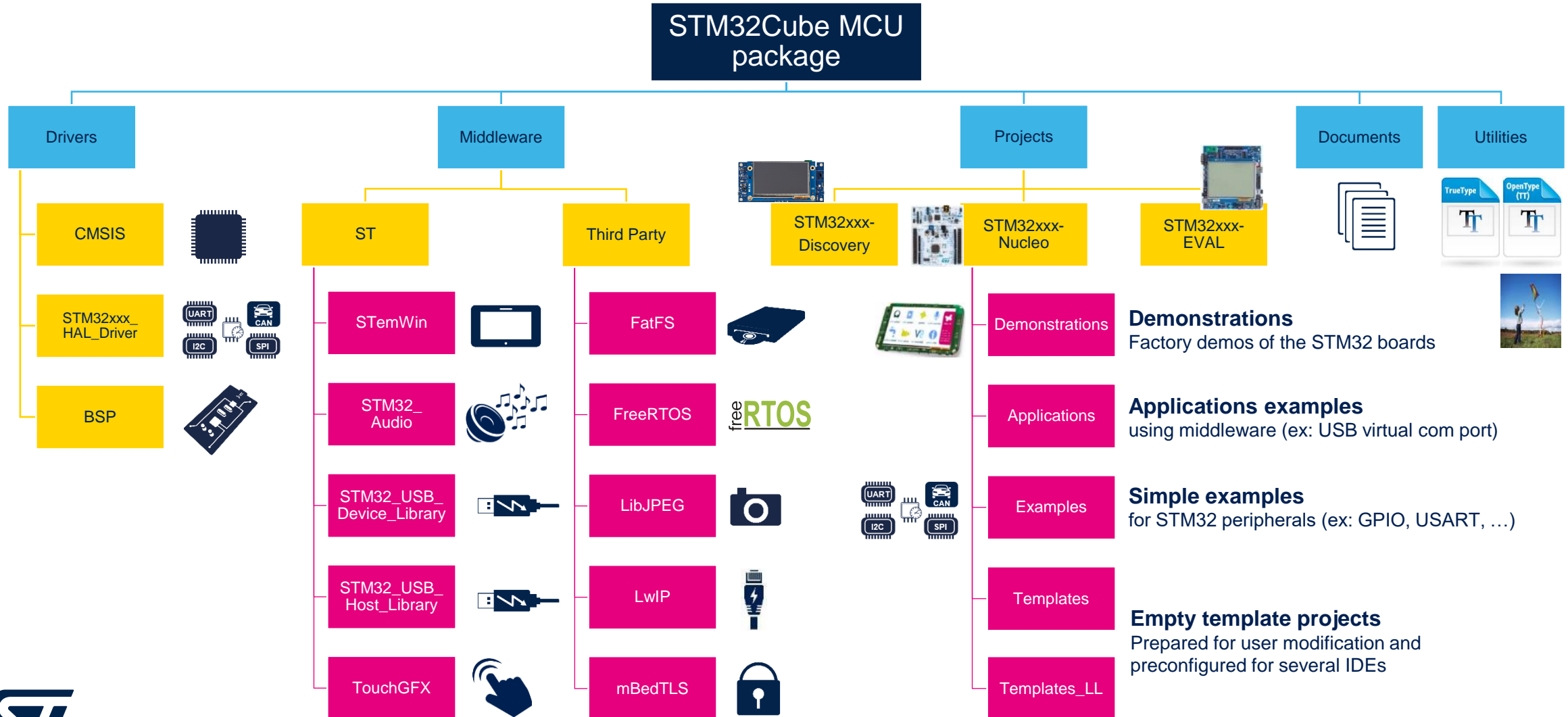


Application benefits

- Single package
- Compatible with all STM32 series
- Source code with open-source BSD license



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	✓	✓	✓								✓						

Adding Azure RTOS in the STM32Cube ecosystem

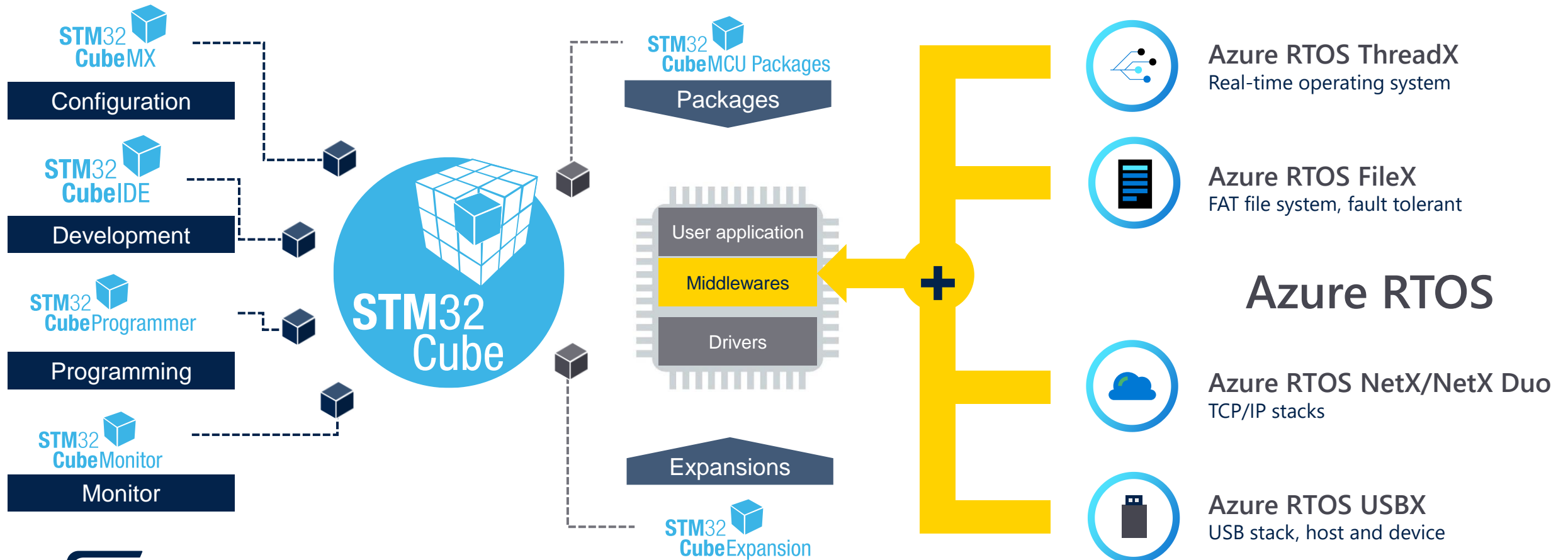
Software Tools



Embedded Software



Complemented with Microsoft Azure RTOS



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

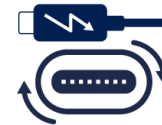
Crypto



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-NFC1

X-CUBE-NFC2

X-CUBE-NFC3

X-CUBE-NFC4

Enhanced for
STM32 Toolset

X-CUBE-NFC5

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

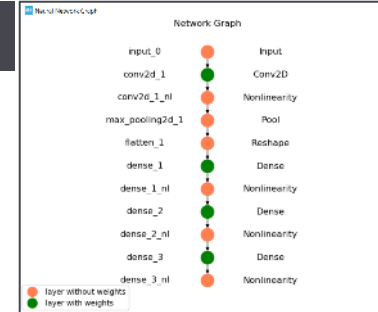
AI



X-CUBE

X-CUBE-AI

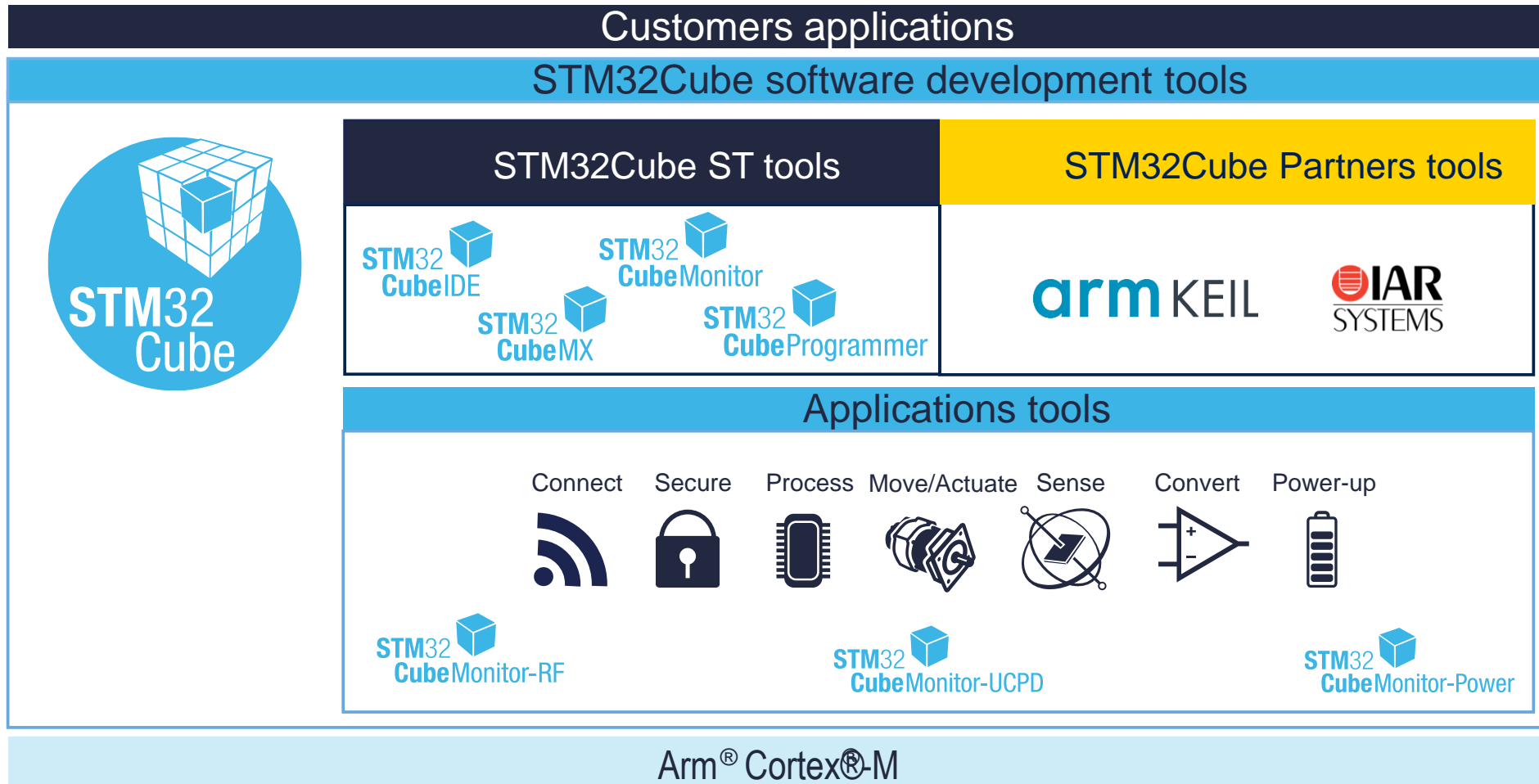
Enhanced for
ST Toolset



FP

FP-AI-SENSING1
FP-AI-VISION1

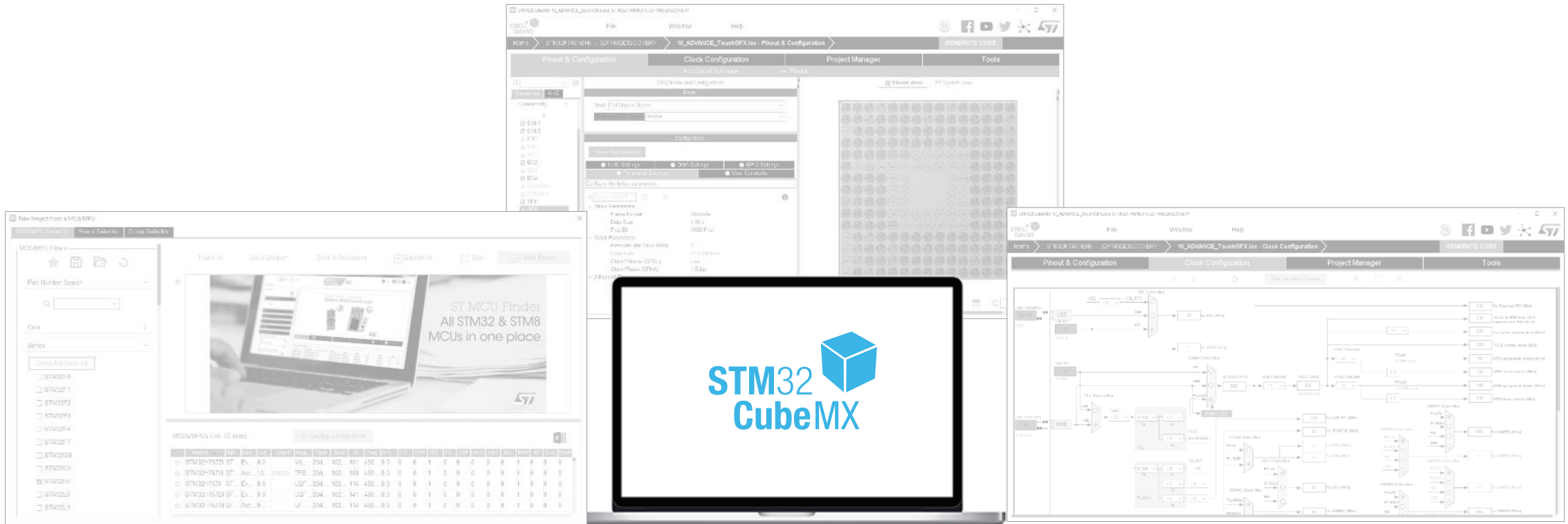
A complete software development tools offer



STM32CubeMX



What's STM32CubeMX?

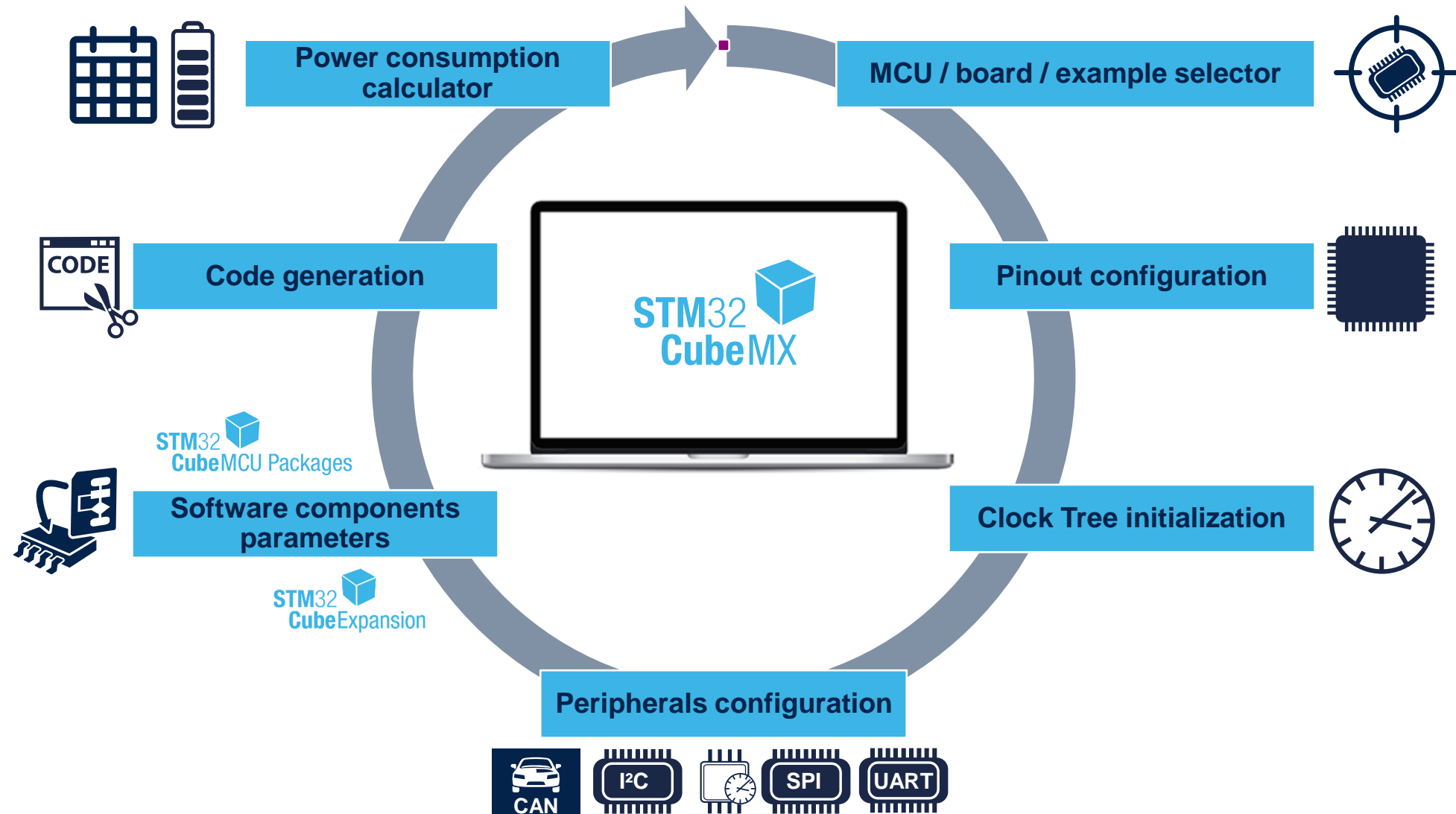


Graphical configuration
(Pinout/Peripherals/Middleware/Clock-Tree)

IDE project generation
(IAR™, Keil™ and GCC compilers)

Multiplatform
(Windows, Linux, macOS)

STM32CubeMX key steps



STM32CubeMX CAD resources



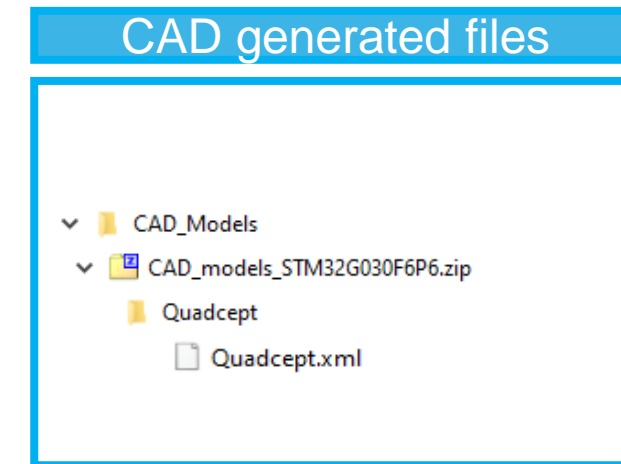
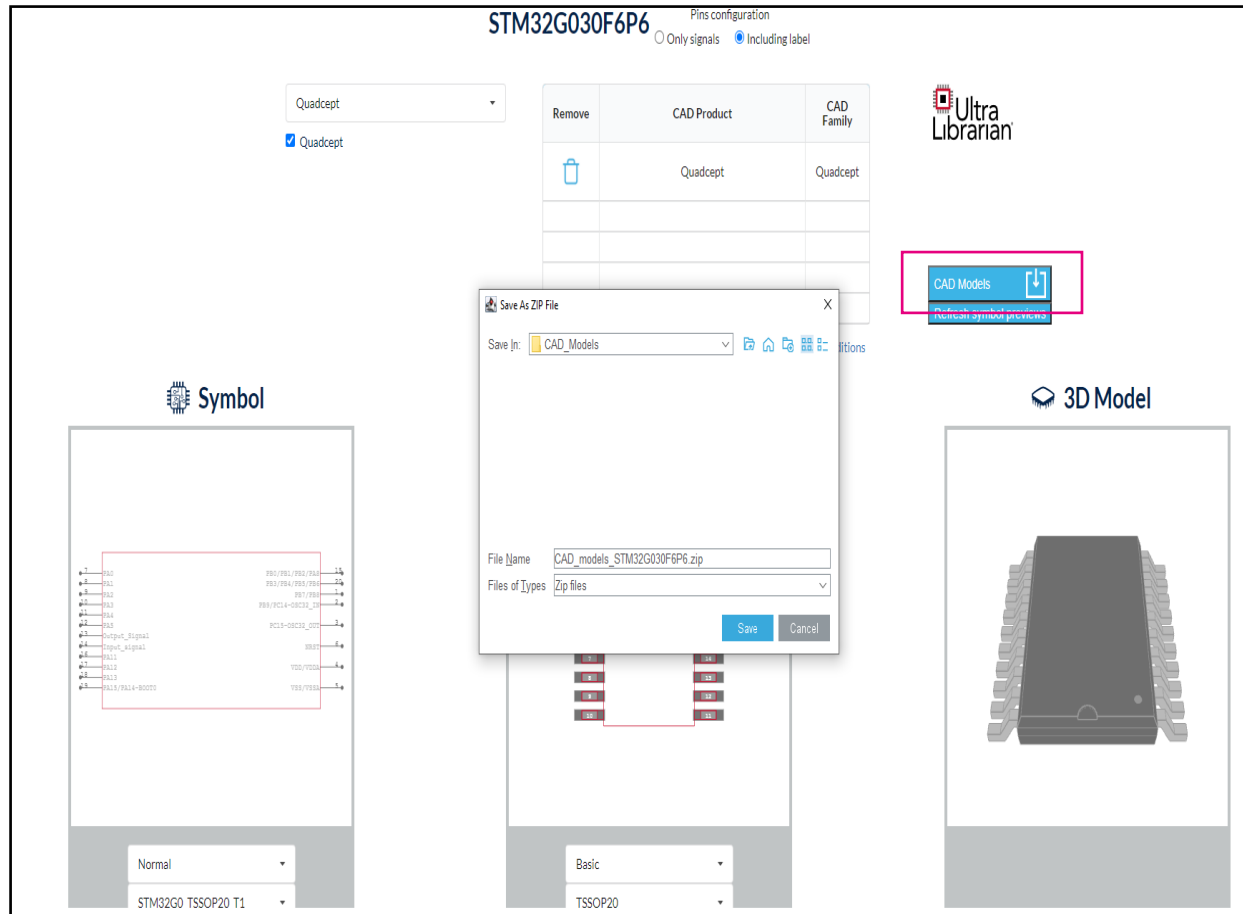
Design toolchain

The screenshot displays the STMicroelectronics design toolchain interface for the STM32G030C6T6. The interface is divided into several sections:

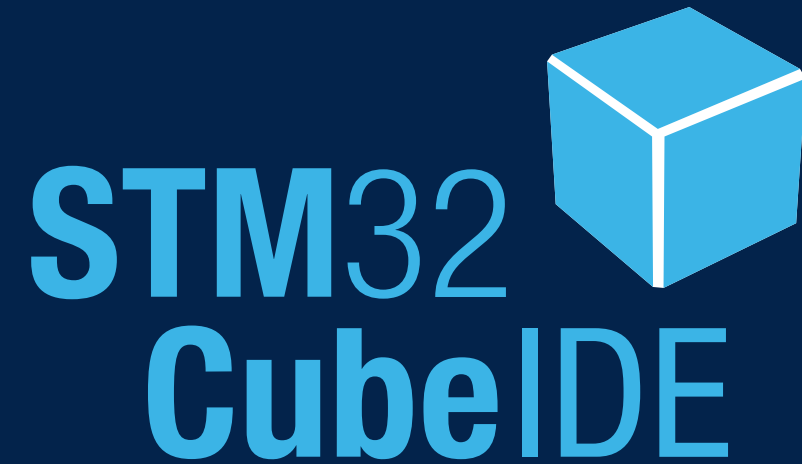
- Top Navigation:** Includes tabs for MCU/MPU Selector, Board Selector, Example Selector, and Cross Selector. A green box highlights the **CAD Resources** tab.
- Left Sidebar:** Contains filters and product information.
 - MCU/MPU Filters:** Includes a star icon, a folder icon, a refresh icon, and a search bar.
 - PRODUCT INFO:** Lists Segment, Series, Line, Marketing Status, Price, Package, Core, and Coprocessor.
 - MEMORY:** Includes sliders for Flash (16 to 512 kBytes), EEPROM (0 Bytes), RAM Total (8 to 144 kBytes), RAM (8 to 144 kBytes), CCM RAM (0 kBytes), and On-chip SRAM (0 kBytes).
- Main Content Area:** Displays the **STM32G030C6T6** product details.
 - CAD Resources:** A table with columns for Remove, CAD Product, and CAD Family. A dropdown menu shows options: Altium, 3D, Altium, Autodesk, Cadence, RS Components, and KICAD. A checkbox indicates agreement to the Ultra Librarian Terms and Conditions.
 - Ultra Librarian:** A logo and a button for CAD Models.
 - Symbol:** A diagram showing the pinout of the STM32G030C6T6 package.
- Bottom Section:** A table listing similar MCUs/MPUs with columns for Commercial Part No, Part No, Reference, Marketing Status, Unit Price for 10kU (US\$), Board, Package, Flash, and RAM.



CAD tool within STM32CubeMX project (2/2)



STM32CubeIDE



Background of STM32CubeIDE

History

 atollic
TrueSTUDIO®

 |  atollic
TrueSTUDIO® for STM32

STM32 
CubeMX

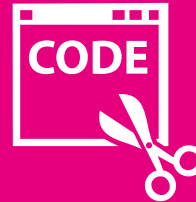


One tool for all your STM32 development

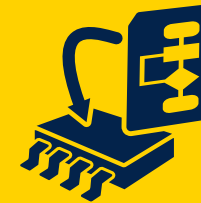
Chipset / Board
configuration



Code
development

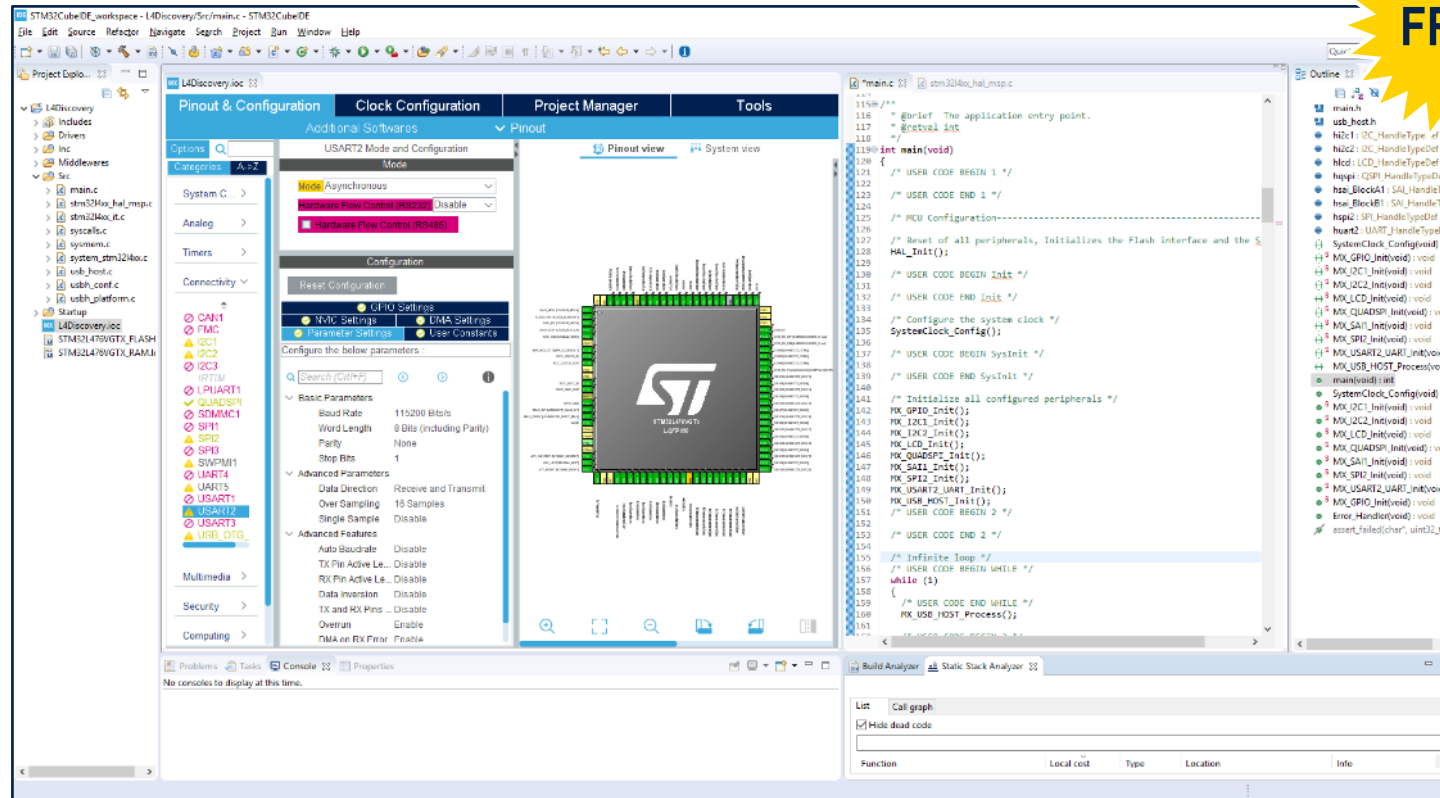


Validation
debug



Free multiplatform development tool

FREE



macOS

Eclipse/GCC based

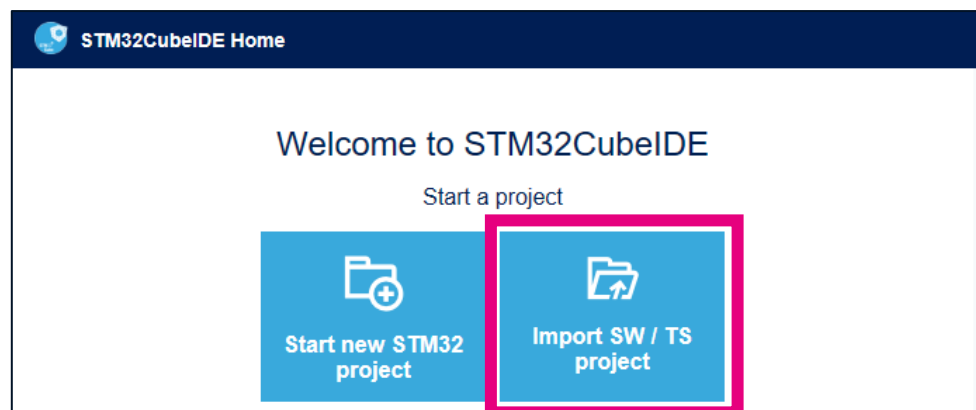
Free for commercial development

Multi-OS support



Project management

Importer

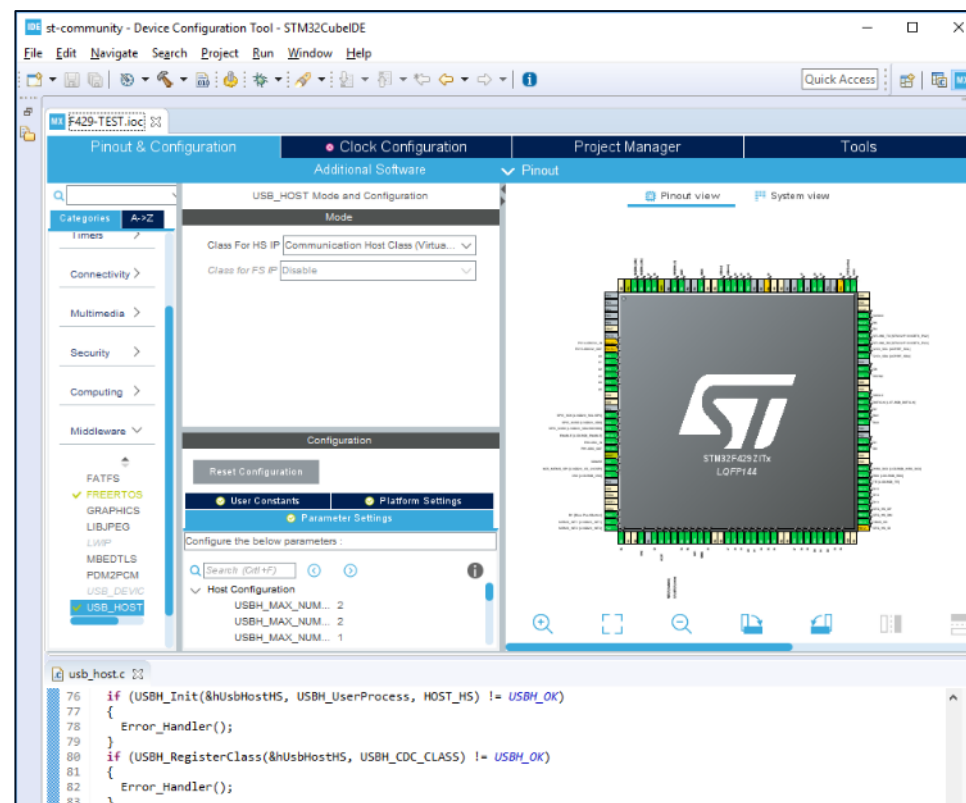


**TrueSTUDIO
Project**



**SW4STM32
Project**

IOC editor





Code editor–navigation (1/2)

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 *dest,
uint32_t *pSrc, uint32_t *pDest, uint32_t *pCount, uint32_t *pCount2b, 1);

void USB_WritePacket(USB_OTG_GlobalTypeDef *USBx, uint8_t *src, uint8_t *dest,
uint32_t *pSrc, uint32_t *pDest, uint32_t *pCount, uint32_t *pCount2b, 1);
```

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
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)
```

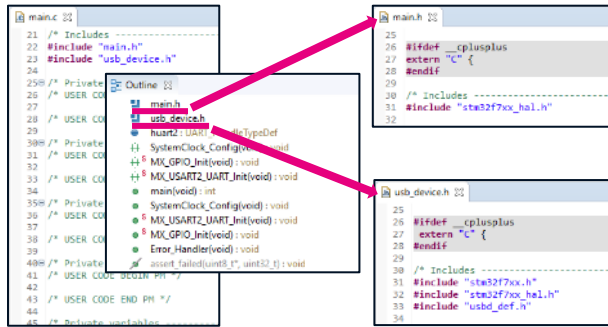
Type hierarchy

```
46 UART_HandleTypeDef huart2;
47
48 /* USER CODE BEGIN PV */
49
50
51
52
Type Hierarchy
UART_HandleTypeDef
├── AdvancedInit: UART_AdvFeatureInitTypeDef - __UART_HandleTypeDef
├── ErrorCode: volatile uint32_t - __UART_HandleTypeDef
├── gState: volatile HAL_UART_StateTypeDef - __UART_HandleTypeDef
├── hdmax: DMA_HandleTypeDef - __UART_HandleTypeDef
├── hdmamx: DMA_HandleTypeDef - __UART_HandleTypeDef
├── Init: UART_InitTypeDef - __UART_HandleTypeDef
├── Instance: UART_TypeDef - __UART_HandleTypeDef
├── Lock: HAL_LockTypeDef - __UART_HandleTypeDef
├── Mask: uint16_t - __UART_HandleTypeDef
├── pRxBuffer: uint8_t* - __UART_HandleTypeDef
├── pTxBuffer: uint8_t* - __UART_HandleTypeDef
```

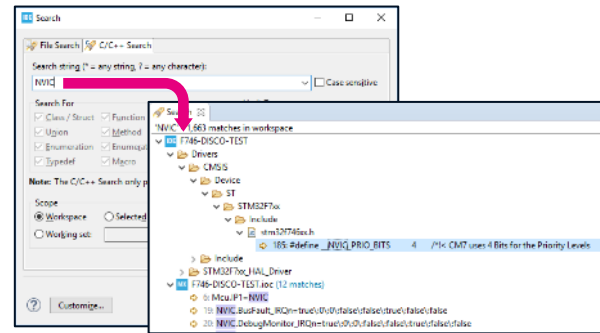



Code editor–navigation (2/2)

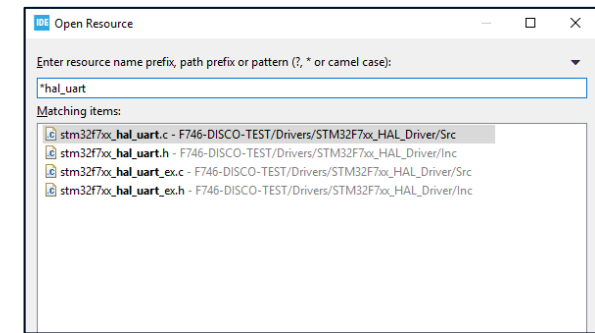
Outline view



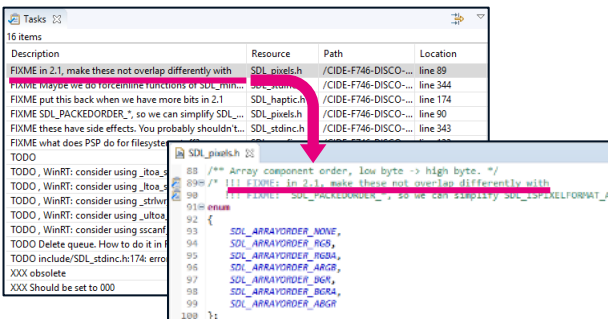
Powerful search



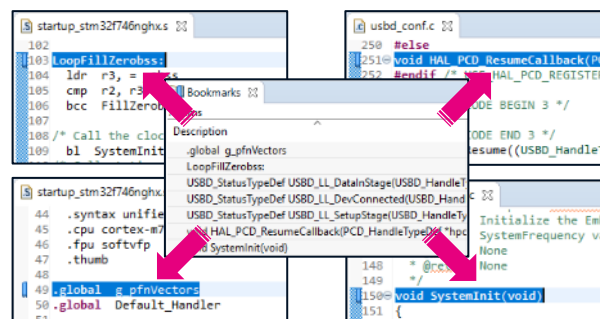
Open resource



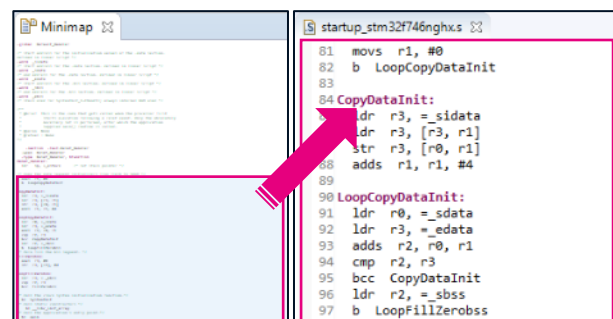
Task tags



Bookmark



Minimap





Code editor—writing

Highlight inactive code

```
152 void usb_desc_c {}
153
154 #if defined ( __ICCARM__ ) /* IAR Compiler */
155 #pragma data_alignment=4
156 #endif /* defined ( __ICCARM__ ) */
157 /** USB standard device descriptor. */
158 __ALIGN_BEGIN uint8_t USB_DFS_DeviceDesc[USB_LEN_DEV_DESC] __ALIGN_END =
159 {
160     0x12,          /* bLength */
161     USB_DESC_TYPE_DEVICE, /* bDescriptorType */
162     0x01,          /* bcdUSB */ /* changed to USB version 2.01
163                        In order to support LPM I1 suspend
164                        resume test of USBCV3.0 */
165     0x00,          /* bDeviceClass */
166     0x00,          /* bDeviceSubClass */
167     0x00,          /* bDeviceProtocol */
168     USB_MAX_EP0_SIZE, /* bMaxPacketSize */
169     LOBYTE(USB_D_VID), /* idVendor */
170     HIBYTE(USB_D_VID), /* idVendor */
171     0x00,          /* bcdUSB */
172     0x00,          /* bDeviceClass */
173     0x00,          /* bDeviceSubClass */
174     0x00,          /* bDeviceProtocol */
175     USB_MAX_EP0_SIZE, /* bMaxPacketSize */
176     LOBYTE(USB_D_VID), /* idVendor */
177     HIBYTE(USB_D_VID), /* idVendor */
178 }
```

Auto-complete

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

Syntax highlight

```
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 buses clocks
127     */
128     RCC_OscInitStruct.OscillatorType = RCC_OSCILLATORTYPE_HSI;
129     RCC_OscInitStruct.HSEState = RCC_HSE_ON;
130     RCC_OscInitStruct.HSICalibrationValue = RCC_HSICALIBRATION_DEFAULT;
131     RCC_OscInitStruct.PLL.PLLState = RCC_PLL_ON;
132     RCC_OscInitStruct.PLL.PLLSource = RCC_PLLSOURCE_HSE;
133     RCC_OscInitStruct.PLL.PLLM = 15;
134     RCC_OscInitStruct.PLL.PLLN = 144;
135 }
```

File diff/compare

```
Compare (F746-DISCO-TEST-2/Src/main.c - F746-DISCO-TEST-2/Src/main.c)
C Compare (Cannot Compare Structures)
StartDefaultTask
SystemClock_Config
cmsis_os.h
fatfs.h
usb_device.h
C Compare Viewer
F746-DISCO-TEST-2/Src/main.c
20 /* Includes
21 #include "main.h"
22 #include "cmsis_os.h"
23 #include "fatfs.h"
24 #include "usb_device.h"
25 /* Private includes
26 /* USER CODE BEGIN Includes */
27 /* USER CODE END Includes */
28
29 F746-DISCO-TEST-2/Src/main.c
20 /* Includes
21 #include "main.h"
22 #include "cmsis_os.h"
23 #include "fatfs.h"
24 #include "usb_device.h"
25 /* Private includes
26 /* USER CODE BEGIN Includes */
27 /* USER CODE END Includes */
28
29
```

Block select

```
/* 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 WHILE */
    /* USER CODE END WHILE */
}
```

Code style

```
Preferences
format
C/C++
Code Style
Formatter
Editor
Active profile:
K&R [built-in]
K&R [built-in]
BSD/Allman [built-in]
GNU [built-in]
Whitesmiths [built-in]
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	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	

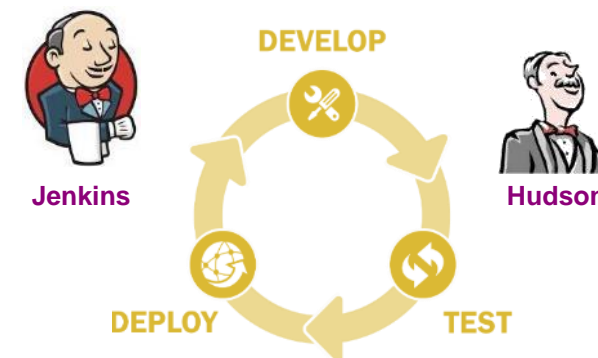
Build Analyzer Static Stack Analyzer Search

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		
init	0	0	0		

Headless build



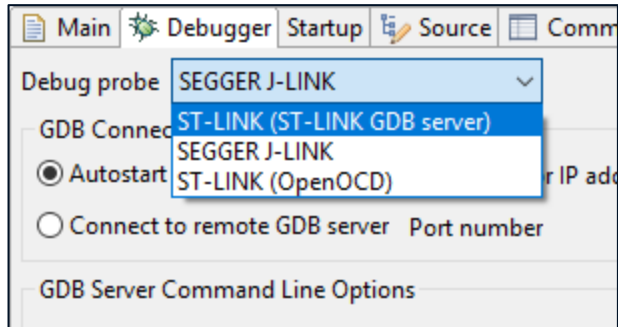
Continuous Integration

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



Debug

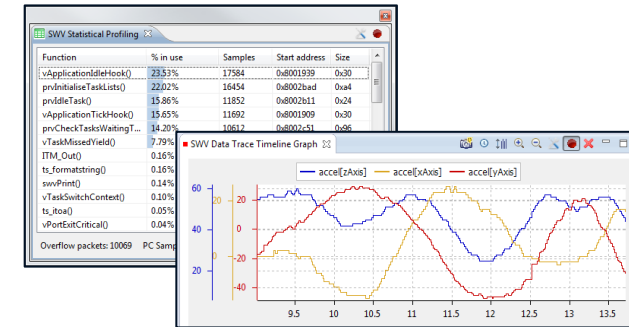
Debugger



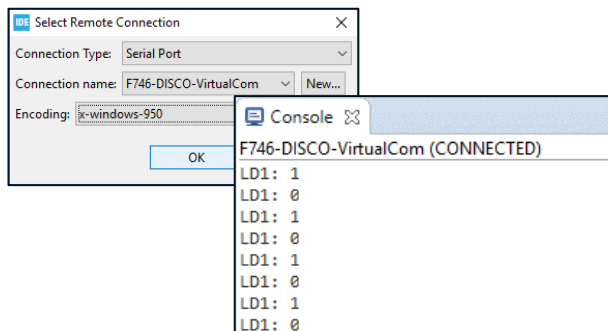
Live expressions

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

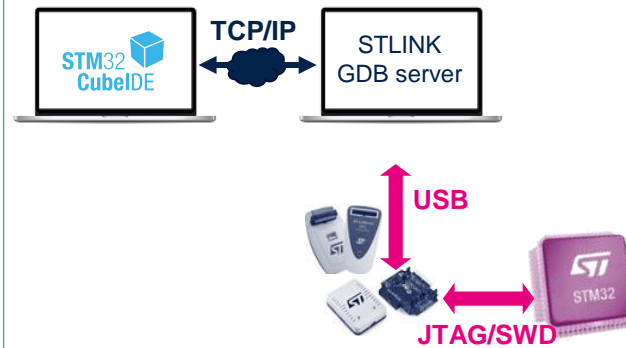
SW



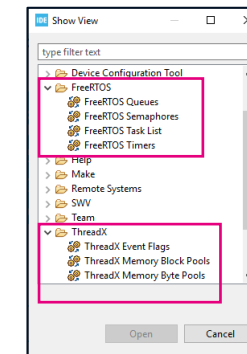
Integrated UART Terminal



Remote debug



RTOS aware debug



FreeRTOS™

ThreadX Microsoft Azure

STM32CubeProgrammer

STM32 
CubeProgrammer

All-in-one programming software tool



Intuitive GUI

Multiplatform
(Windows, Linux, macOS)

STLINK direct support
(JTAG, SWD)

Automatic mode

Option Bytes
Program & Upload

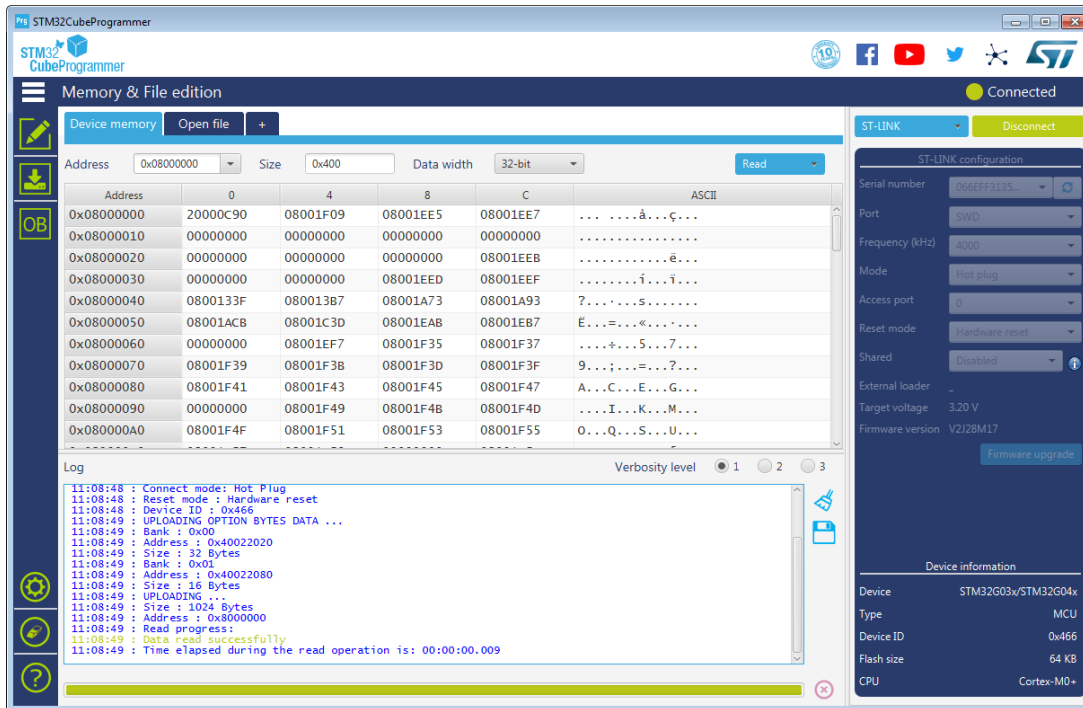
Bootloader interface support
(USB, UART, SPI, I²C, CAN)

Internal/External
Flash services


API DLL
for custom integration

Command Line Interface
for Scripting

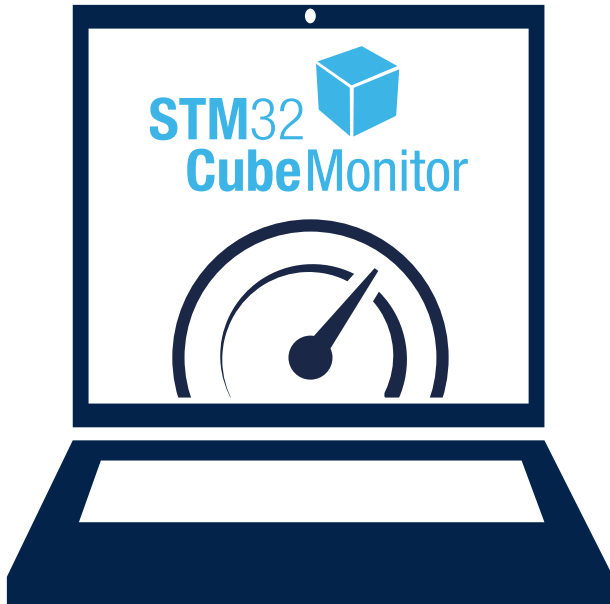
Trusted package creator
(secure programming)



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.

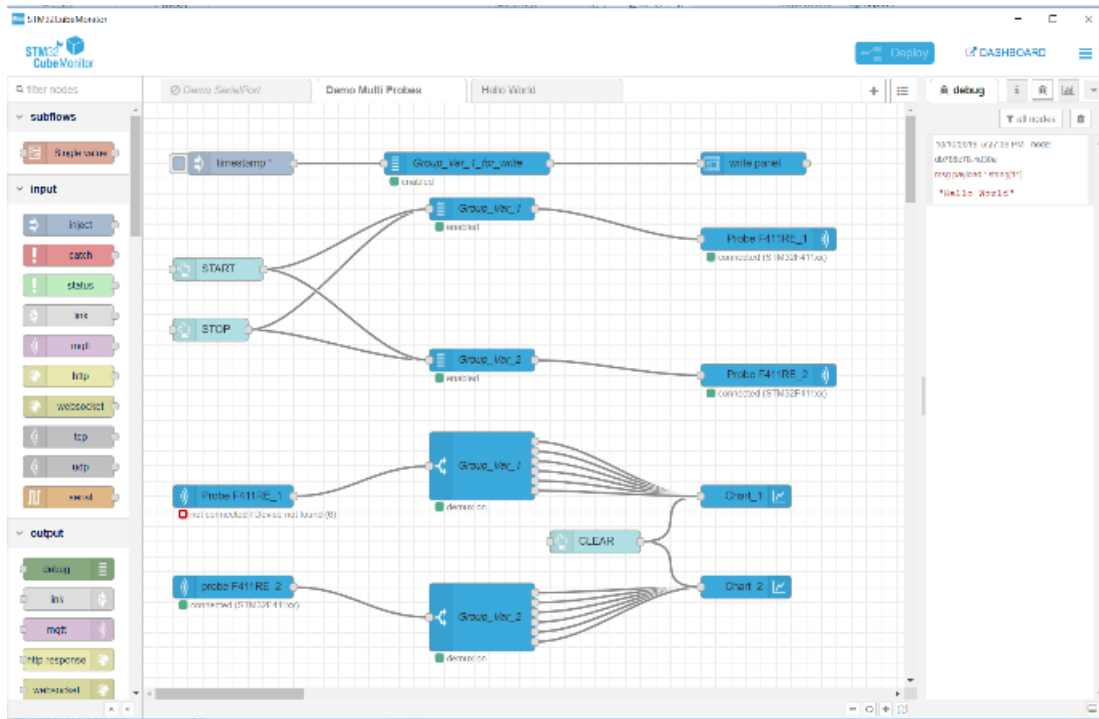
Graphical visualization on any display

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

Graphical custom data visualization

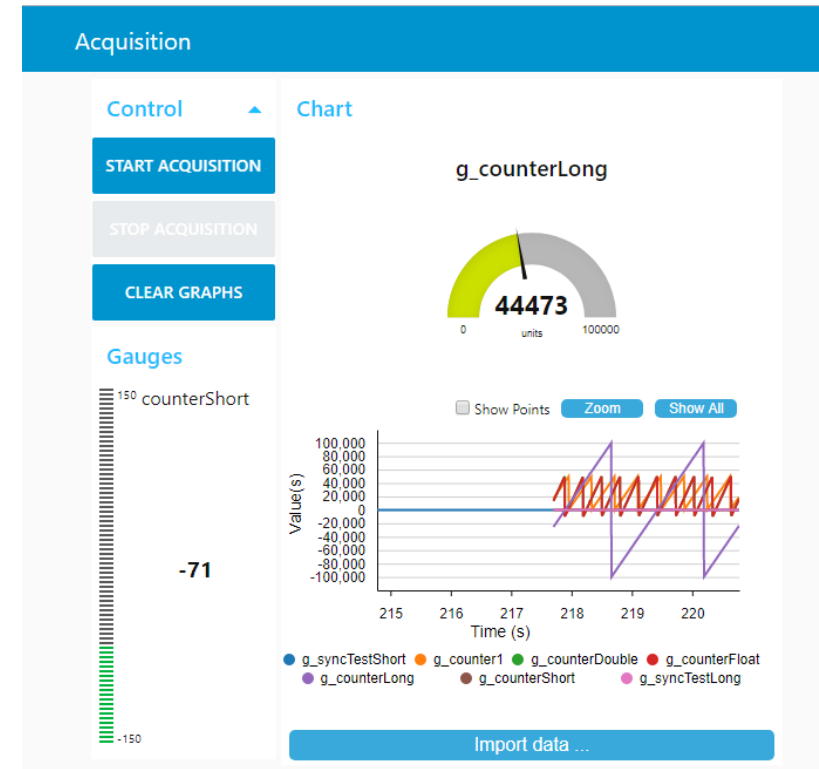
Design mode to create

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.

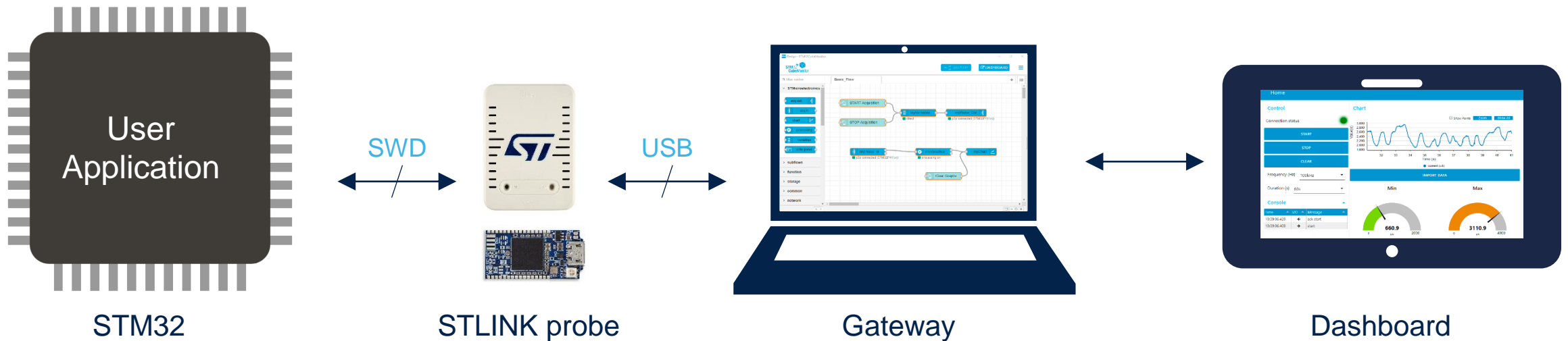


Native support of multiformat displays

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

Remote data acquisition with web server technology

Monitor across a network with a web browser

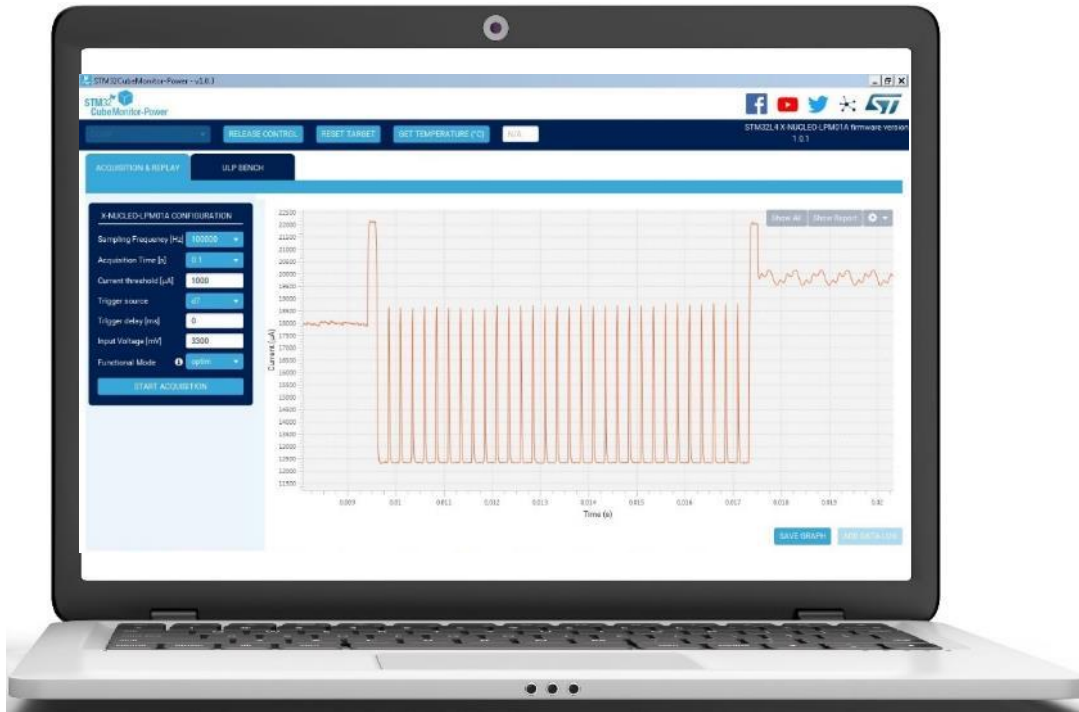


STM32CubeMonitor-Power

STM32 
CubeMonitor-Power

Visualize power data with STM32CubeMonitor-Power tool

STM32CubeMonPwr



Display

- Graphical rendering in real-time (up to 100 kSPS)
- Acquisition log over large period of time


Analyze

- Intuitive zoom and navigation into energy consumption data

Benchmark

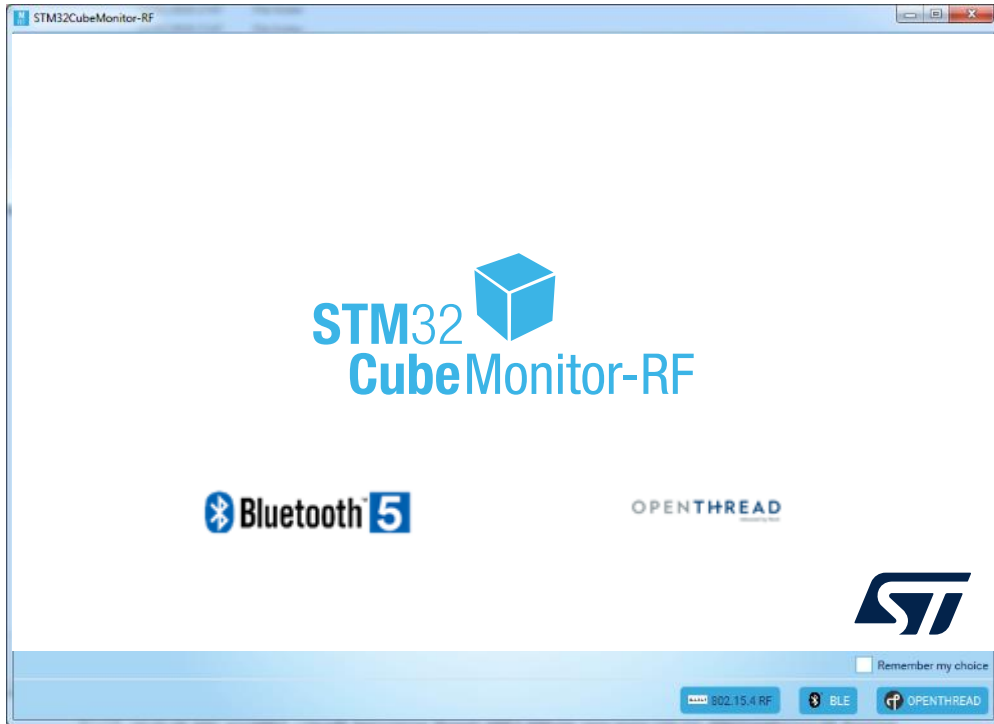
- Fast computation of EEMBC ULPMark-CP scores

STM32CubeMonitor-RF

STM32 
CubeMonitor-RF

STM32CubeMonitor-RF

A software tool allowing to test the radio performance of STM32WB MCUs for Bluetooth® Low Energy and 802.15.4 technologies



Test protocol sequences

Configure static / dynamic beacons

Manage Over the Air (OTA) file transfer

STM32CubeMonitor-UCPD

STM32 
CubeMonitor-UCPD

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



life.augmented



STM32WB – Application processor for connectivity

Dual core architecture



Arm® Cortex® M4
Arm® Cortex® M0+

Up to
1MB flash / 256KB RAM



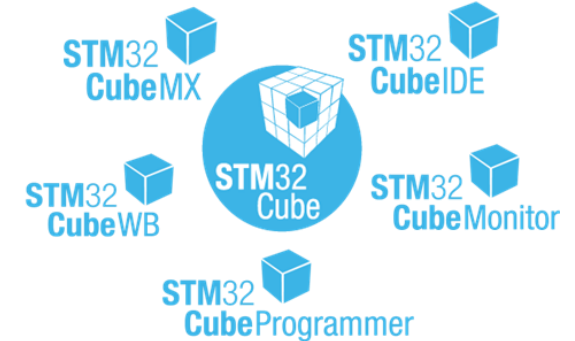
Multi-protocols



<https://wiki.st.com/stm32mcu/wiki/Category:Connectivity>



One-stop shop



Whatever the end device



STM32WL Reference designs

Best performance for your country regulation

Security services
Radio Stacks
RTOS



SOFTWARE

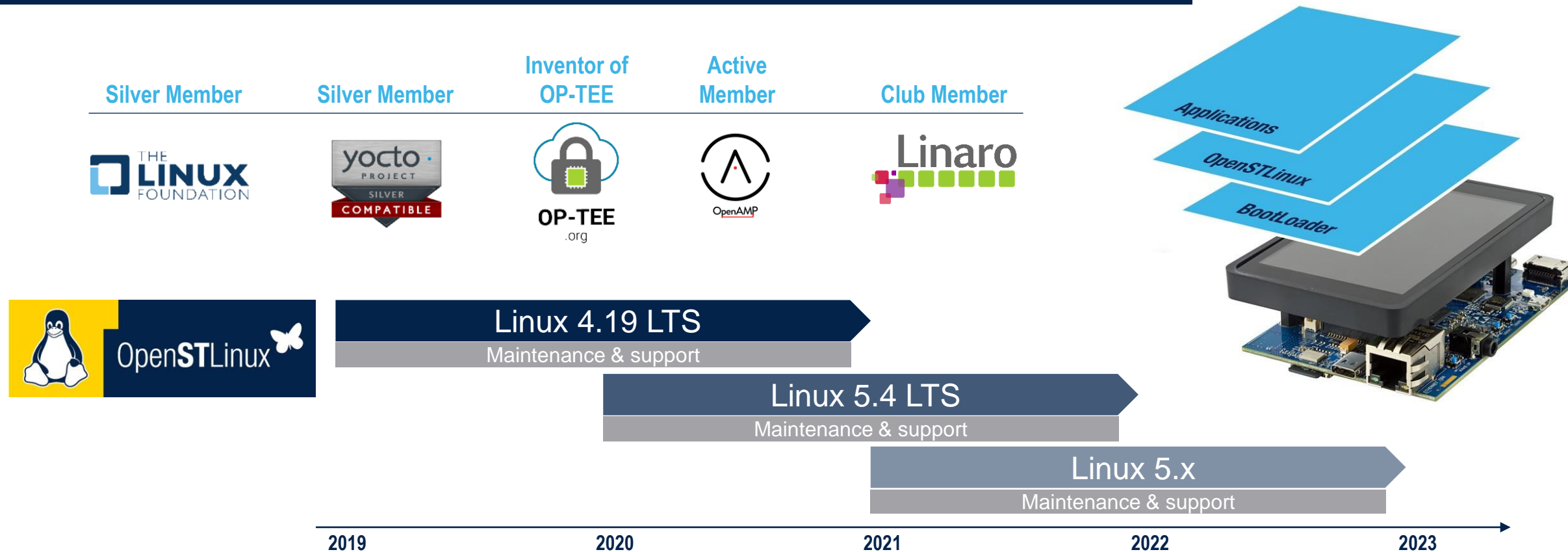
HARDWARE



Demo board
Nucleo boards
Reference designs

Continuous investment in Linux to make customers' design simpler and more efficient

ST is continuously upstreaming Linux drivers to the Linux community



A growing base of partners addressing customers' challenges

Embedded Software



GUI Solutions by TARA Systems











Software Development Tools










Training













Components and Modules












Engineering Services


















The 12 security functions

- STM32Trust brings **12 Security Functions** to align with customer use cases and security assurance
- STM32Trust brings material (documentation, software, tools...) to cover those 12 security functions
- Security functions to embed support of companion STSAFE secure elements



The 12 security functions definitions

1- Secure Boot

Ability to ensure the authenticity and integrity of an embedded application

2- Secure Install / Update

Installation or update of firmware with initial integrity and authenticity checks before programming and execution

3- Secure Storage

Ability to securely store secrets like data or keys

4- Isolation

Isolation between trusted and non-trusted parts of an application

5- Abnormal Situation Handling

Ability to detect and react to abnormal hardware and software situations

6- Crypto engine

Ability to process cryptographic algorithms, as recommended by security assurance schemes

7- Audit / Log

Keep trace of security events in an unchangeable way

8- Identification / Authentication / Attestation

Unique identification of a device and/or software, and ability to detect its authenticity

9- Silicon Device Life Cycle

Control states to securely protect silicon device assets through its lifetime

10- Software IP Protection

Ability to protect a section or the whole software package against external or internal reading. Can be multi-tenant

11- Secure Manufacturing

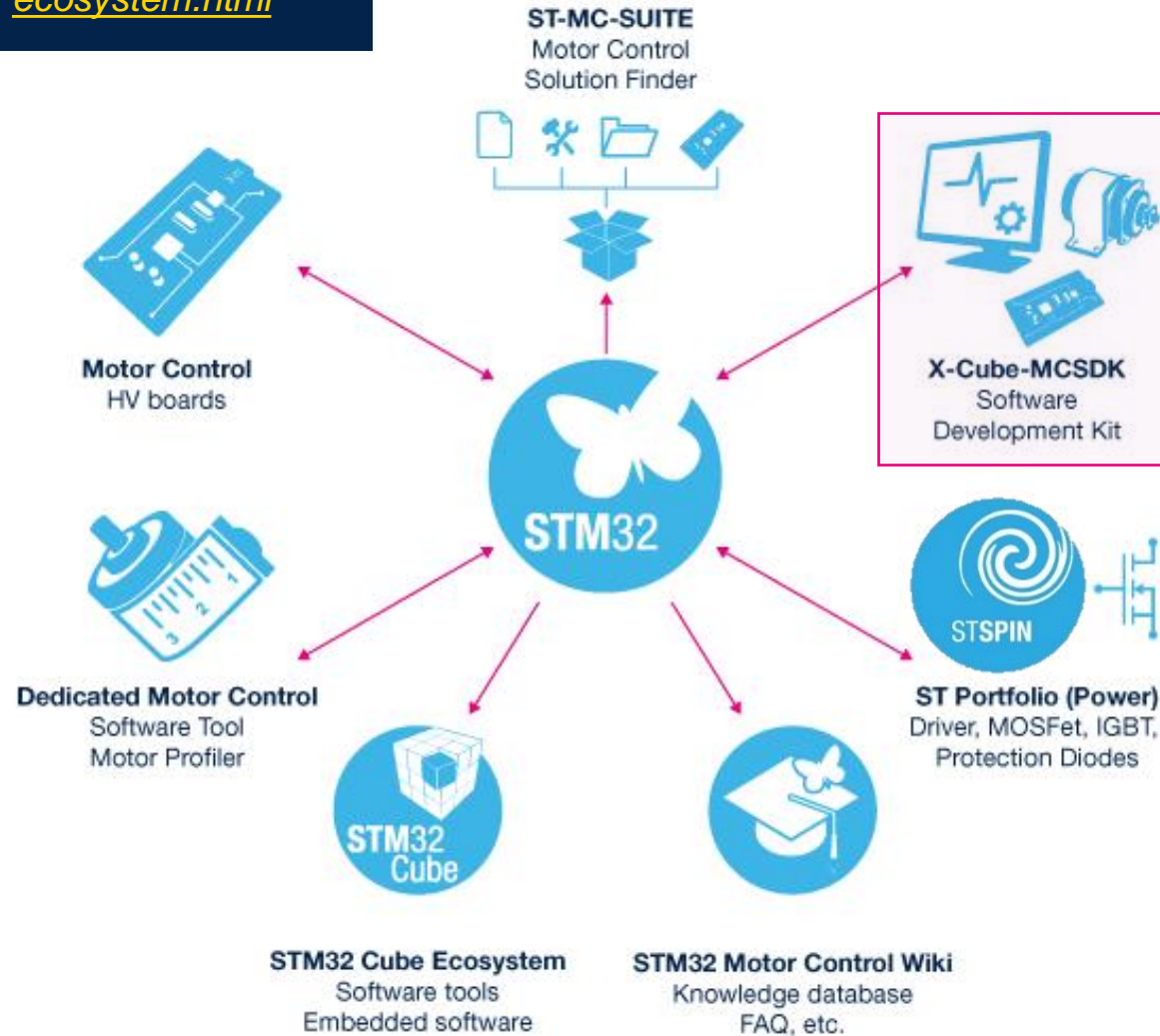
Device provisioning or personalization in untrusted environment with overproduction control

12- Application Life Cycle

Define unchangeable incremental states to securely protect application states and assets

Visit the STM32 Motor control web page:
stm32-motor-control-ecosystem.html

STM32 motor control ecosystem



Motor Control Suite (ST-MC-SUITE)

- Online tool that provides easy access to motor-control resources in our MCU ecosystem - for STM32, STSPIN32, and STM8 MCUs.

Motor control SW development kit (X-CUBE-MCSDK)

- Motor Control firmware lib: full feature library
- Motor Control Workbench: Graphical (GUI) configurator/monitor
- For STM32, STSPIN32 MCUs.

STM32Cubexx

- Embedded software bricks
- Most of STM32 series supported (STM32G4 = Motor Ctrl flagship)

Motor Control Profiler

- Automatic detection of key parameters (R_s , L_s , K_e)
- Zero equipment required
- For STM32 MCUs.



STM32 graphics examples of achievable UI performance

STM32G07x

+ TouchGFX

Display resolution up to 480x272



STM32H725

+ TouchGFX

Display resolution up to 1024x768



STM32L4+/U5

+ TouchGFX

Display resolution up to 640x480



STM32MP1

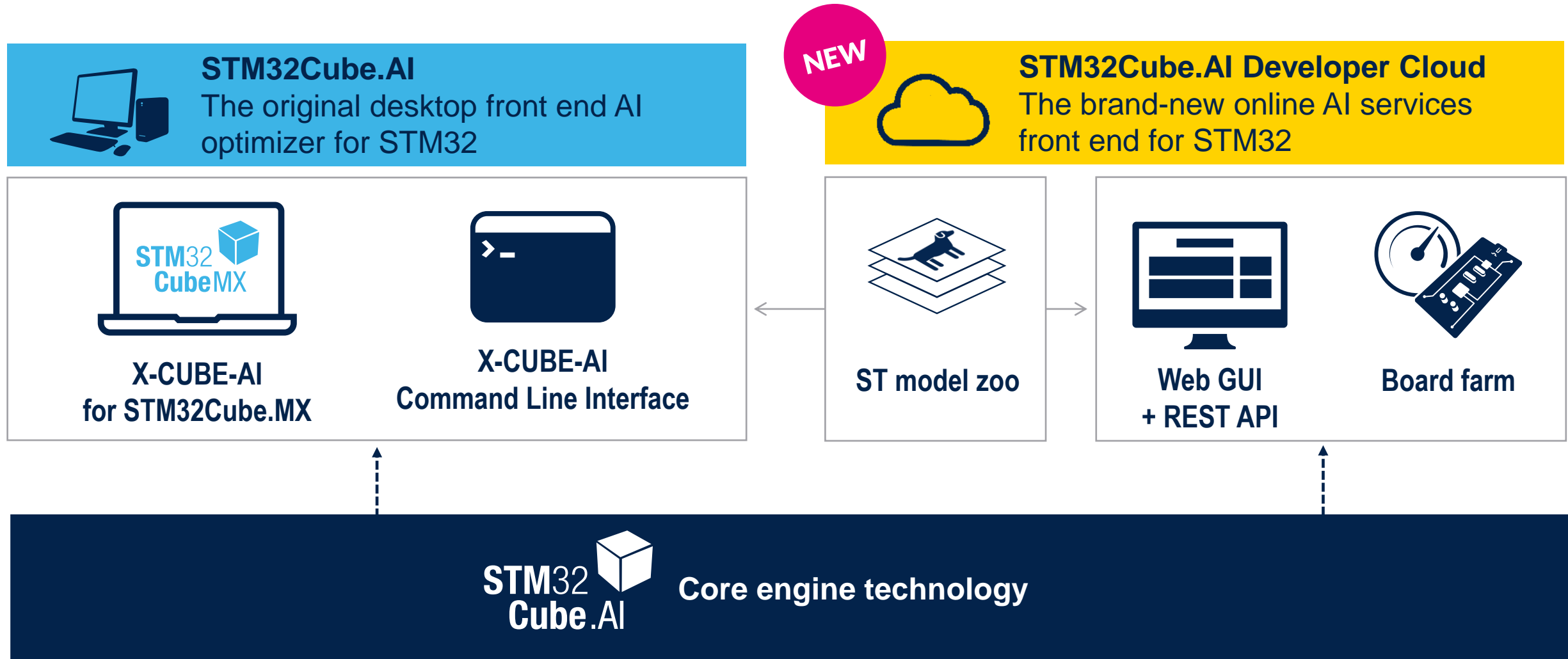
Embedded Wizard

CRANK SOFTWARE Qt

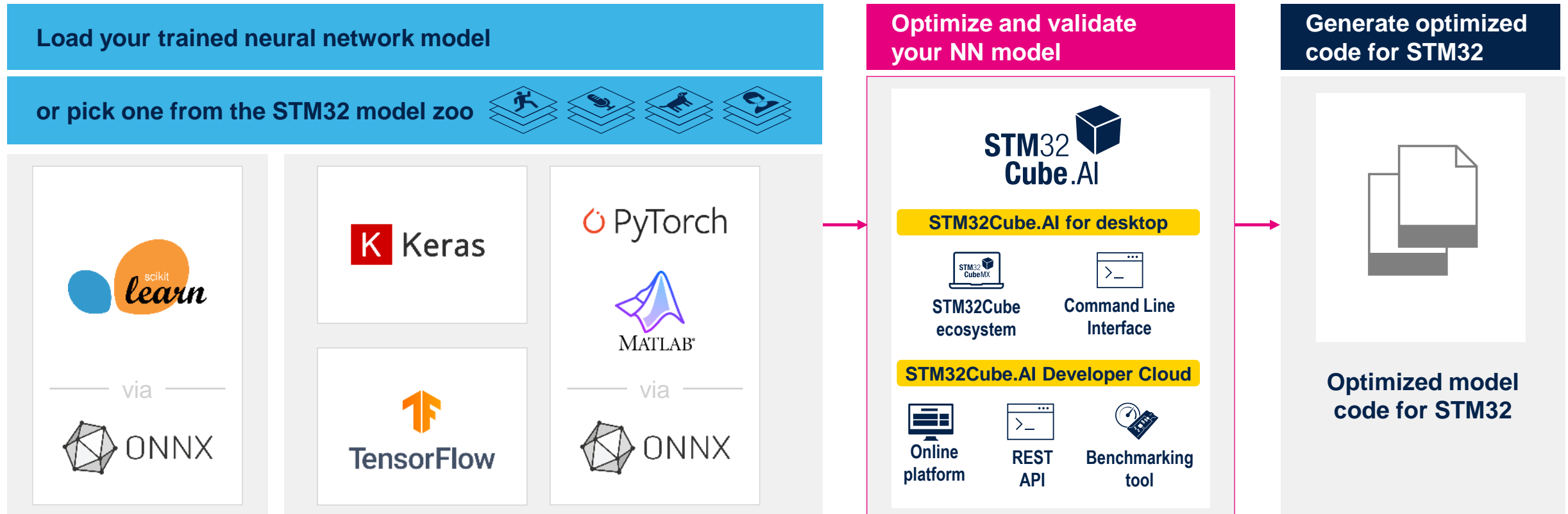
Display resolution up to 1280x800



STM32Cube.AI overview



One tool – two versions to deploy AI on STM32



STM32 MCU Developer Zone

Everything for STM32 developers, in one place



MCU portfolio and
selection



Hardware
evaluation and
development tools



Software
development kit



Artificial
Intelligence for
STM32



Wireless
Connectivity



STM32Trust
security framework



Solutions



Developer
resources



Community &
support





STM32 education and support

Wide support for developer communities



**FAE - Worldwide
Customer Support**



STM32 Online Training



community.st.com



**Massive Open Online
Courses**



**Wiki.st.com/stm32mpu
wiki.st.com/stm32mcu**



Textbooks



Partner training courses



github.com/STMicroelectronics



life.augmented

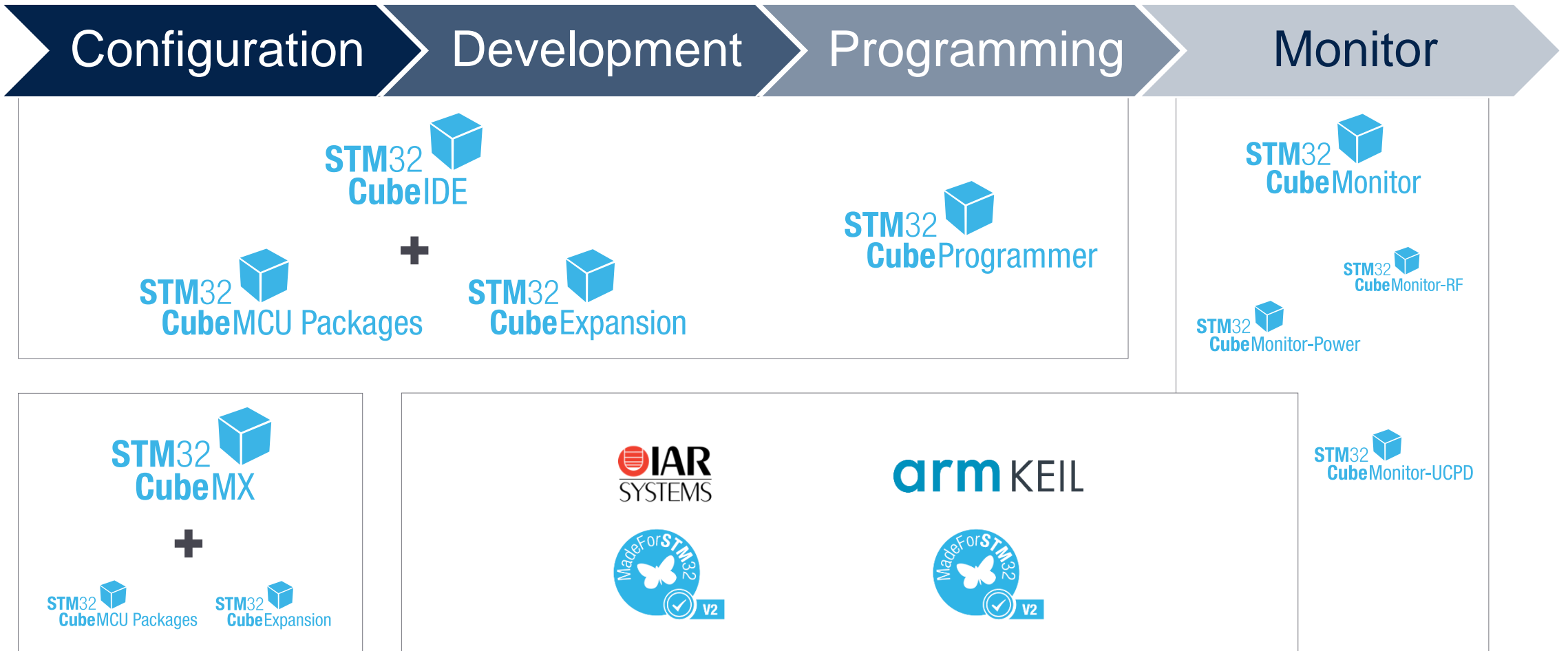


www.st.com/content/st_com/en/support/learning/stm32-education.html

Key takeaways



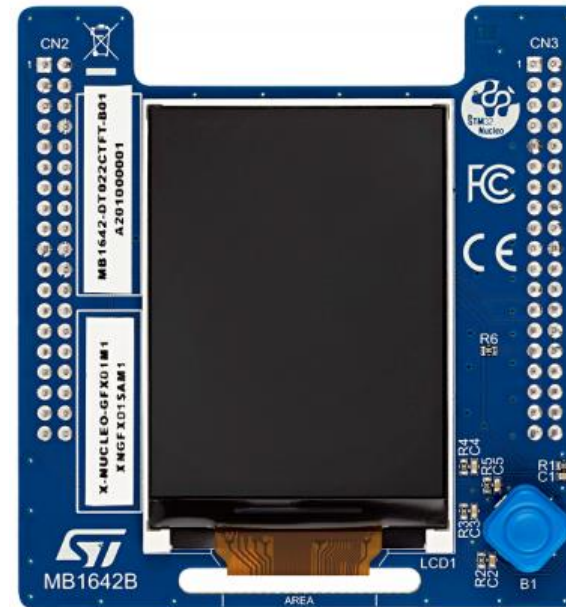
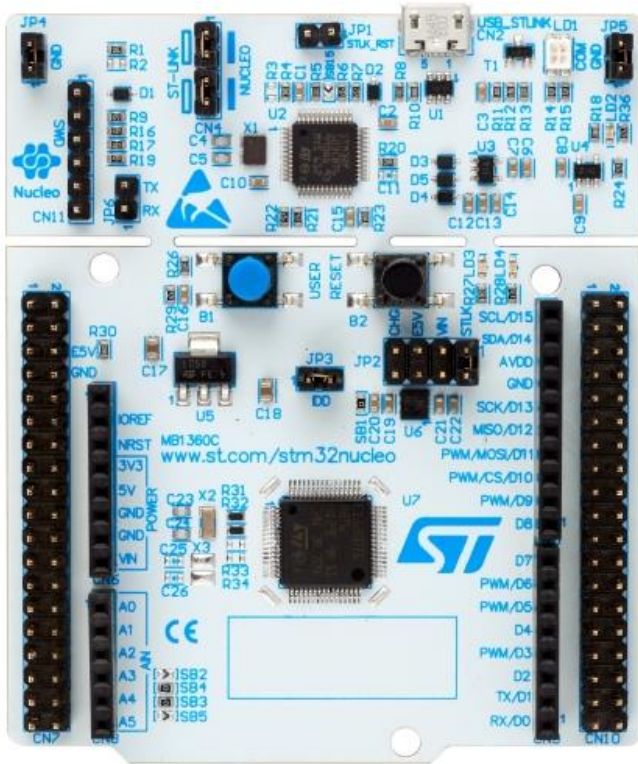
Iterative development process



Live hands-on demo

Demo using X-CUBE-DISPLAY expansion package on
NUCLEO-G071RB + X-NUCLEO-GFX01M2 Hardware

STM32
CubeExpansion



Our technology starts with You



Find out more at www.st.com

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