STM32 AZURE RTOS workshop

STM32Cube and Azure RTOS

Agenda

STM32Cube software suite offer until now

Software Tools

Embedded Software

STM32 CubeMX
Configuration

STM32 CubeIDE
Development

STM32 CubeProgrammer
Programming

STM32 CubeMonitor
Monitor

STM32Cube

STM32 CubeMCU Packages
Packages

User application

Middleware

STM32Cube HAL/LL

Expansions

STM32 CubeExpansion
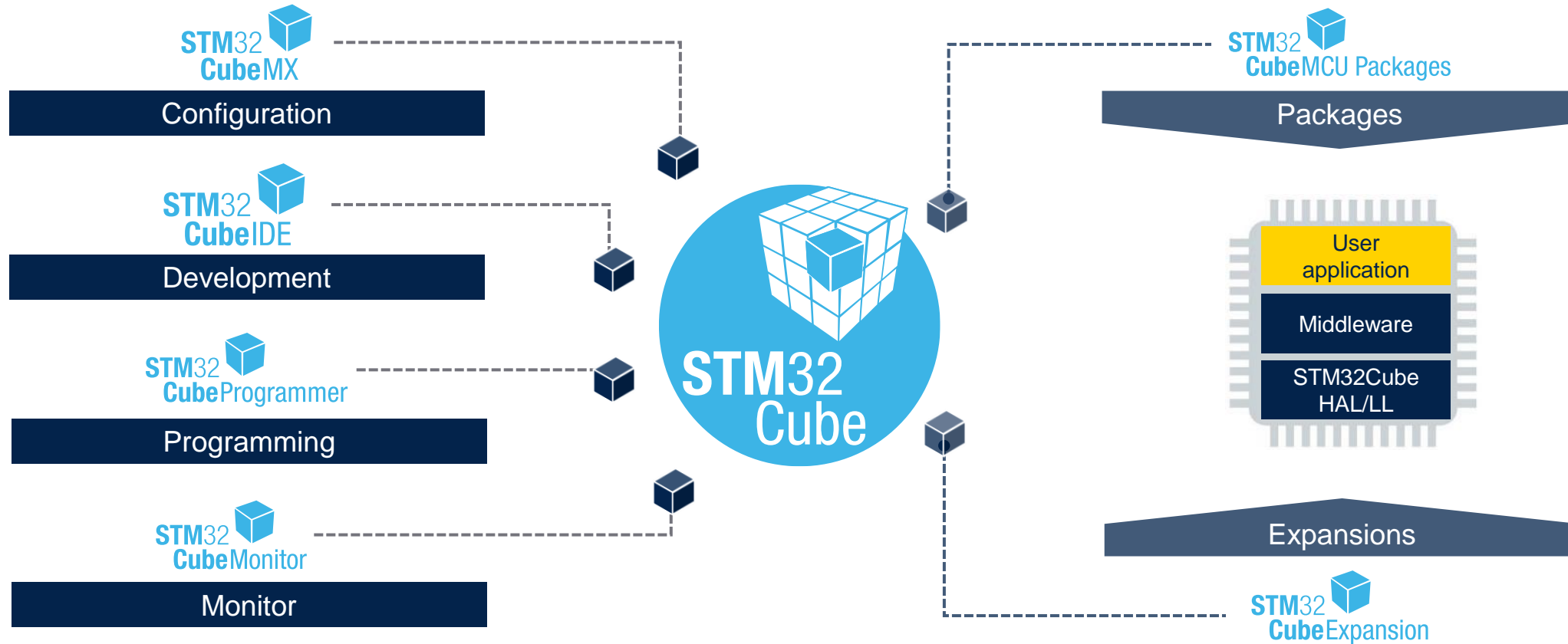
ℹ STM32Cube is available since 2014, for more than 7 billion STM32 units worldwide

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STM32Cube software suite
Middleware offer

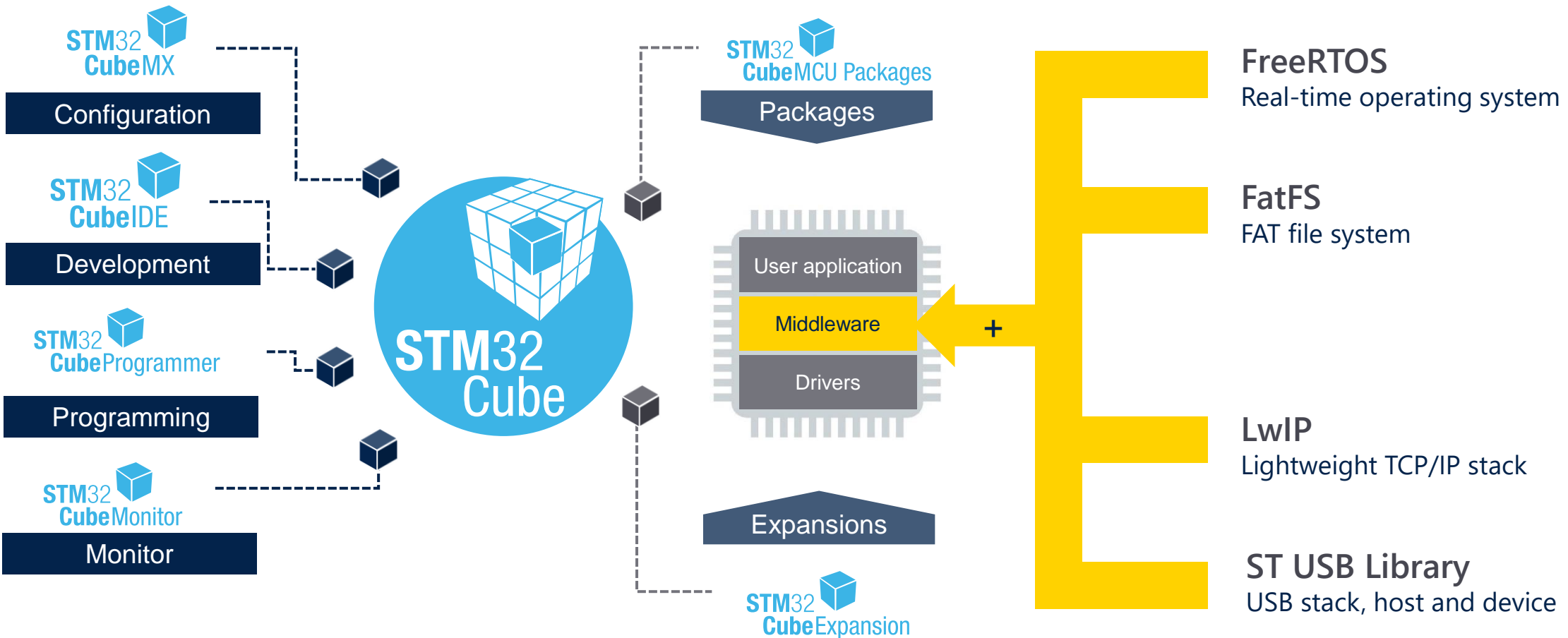| Software Tools	Embedded Software	**Existing middleware offer until 2021**

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User application

Middleware

Drivers

+

STM32 CubeExpansion
Expansions

FreeRTOS
Real-time operating system

FatFS
FAT file system

LwIP
Lightweight TCP/IP stack

ST USB Library
USB stack, host and device

STM32Cube software suite now enriched with Microsoft® Azure RTOS

Software Tools	Embedded Software	**Complemented by Microsoft Azure RTOS (2021)**

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+

Azure RTOS ThreadX
Real-time operating system

Azure RTOS FileX
FAT file system, fault tolerant

Azure RTOS

Azure RTOS NetX/NetX Duo
TCP/IP stacks

Azure RTOS USBX
USB stack, host and device

5

Production License for any STM32

STM32Cube software suite

Microsoft Azure RTOS brings additional key benefits to STM32Cube software suite, from 2021

Software Tools

STM32 Cube Embedded Software

+ Azure RTOS

Microsoft Azure

Faster & Easier Development	Fast performance
Business-friendly terms	Complete consistent solution
Better Quality	Industry certifications

+

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Professional grade, highly reliable and market proven MW suite

- **Industrial grade** networking stack: optimized for performance coming with **many IoT protocols**
- Advanced FS/FTL: **fully featured** to support **NAND/NOR Flash** memories
- USB **Host** and **Device** stacks coming with **many classes, including composite**
- **Safety pre-certifications (from MSFT)***: IEC 61508 SIL4, IEC 62304 Class C and ISO 26262 ASIL D
- **Security pre-certifications (from MSFT)**: EAL4+ for TLS/DTLS, FIPS 140-2 for SW crypto lib
- **Tracing** and debugging capability
- STM32 **granted production license of all Azure RTOS components:** https://github.com/azure-rtos/threadx/blob/master/LICENSED-HARDWARE.txt

* Contact your ST representative for detailed information

Azure RTOS ThreadX Real-Time Operating System

Azure RTOS ThreadX — Real-time operating system

- **Small**: 2 Kbytes Minimal Footprint
- **Fast**: Sub microsecond context switch
- **Safe**: SIL 4, ASIL D, Medical Class C
- **Security**: Extensive Pen Testing, Part of EAL 4+, FIPS 140-2
- **Advanced**: Preemption-threshold, Event Chaining, Auto Scaling
- **Easy**: Consistent API, Extensive out-of-box examples, FreeRTOS middleware layer

ThreadX	
Azure RTOS ThreadX API	
Thread Services	Messaging Queues
Counting Semaphores	Mutexes
Event Flags	Block Memory Pools
Byte Memory Pools	Application Timers
Azure RTOS ThreadX Core Scheduler	

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Azure RTOS USBX
USB Host and Device stack
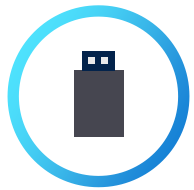
- **Small**: ~8.5 Kbytes Device, ~12Kbytes Host

- **Fast**: Leverages DMA, Minimal Function Call Layering

- **Safe**: SIL 4, ASIL D, Medical Class C

- **Advanced**: Comprehensive class support

- **Easy**: Consistent API, Extensive out-of-box examples and device/host controller integration

USBX		
USB X Host API		USB Device API
ASIX	HUB	CDC/ACM
AUDIO	PIMA	CDC/ECM
CDC/ACM	PRINTER	DFU
GSER	PROFILIC	HID
HID	STORAGE	PIMA
CDC/ECM		STORAGE
		RNDIS
USBX Host Stack		USBX Device Stack

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Azure RTOS NetX Duo TCP/IP stack

Azure RTOS NetX/NetX Duo
TCP/IP stacks

- **Small**: 50 Kbytes Device-to-Cloud
- **Fast**: Near Wire Speed, Minimal CPU usage
- **Safe**: SIL 4, ASIL D, Medical Class C
- **Security**: Extensive Pen Testing, EAL4+, FIPS 140-2
- **Advanced**: Extensive Components, Zero Copy, Auto Scaling
- **Easy**: Consistent API

NetX duo		
Azure RTOS NetX Duo application		
MQTT	CoAP	LwM2M
Auto IP	HTTP/HTTPS	SMTP
DHCP	NAT	SNMP
DNS, mDNS, DNS-SD	POP3	Telnet
FTP, TFTP	PPP, PPPoE	PTP, SNTP
Azure RTOS NetX Duo API		
IGMP	NetX Secure TLS	NetX Secure DTLS
ICMP	IPV4 & IPV6	Azure RTOS NetX Secure Ipsec
ARP/RARP	UDP	
	6LowPAN	TCP
Ethernet, Wi-Fi, Bluetooth LE, 15.4, custom		

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Azure RTOS FileX
Fault tolerant FAT file system

- **Small**: 9 Kbytes Minimal Footprint

- **Fast**: Direct Data Write, Cache optimized for speed

- **Safe**: SIL 4, ASIL D, Medical Class C

- **Advanced**: Fault tolerant, FAT 12/16/32/exFAT, Extensive Cache Support, NAND/NOR Wear Leveling, Auto Scaling, Free of charge exFAT license for STM32

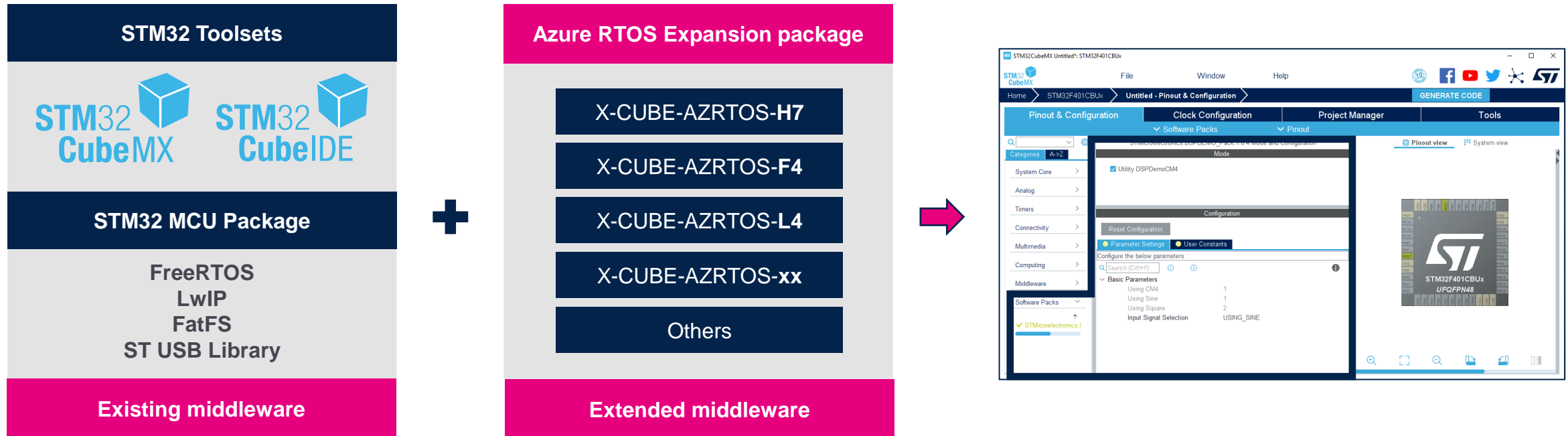- **Easy**: Consistent API, Extensive out-of-box examples, standalone-available

FileX		
Azure RTOS FileX API		
Media services	Directory Services	File Services
LevelX (NOR/NAND), RAM Disk, USB X, SD CARD, Custom		

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Azure RTOS delivery model

Azure RTOS deployment within STM32 and STM32Cube portfolio

STM32Cube Expansions for existing STM32 series, enhanced for STM32 Toolset (STM32CubeMX and STM32CubeIDE)


STM32 Toolsets

STM32 CubeMX   STM32 CubeIDE

STM32 MCU Package

FreeRTOS
LwIP
FatFS
ST USB Library

Existing middleware

+

Azure RTOS Expansion package

X-CUBE-AZRTOS-**H7**

X-CUBE-AZRTOS-**F4**

X-CUBE-AZRTOS-**L4**

X-CUBE-AZRTOS-**xx**

Others

Extended middleware

www.st.com/x-cube

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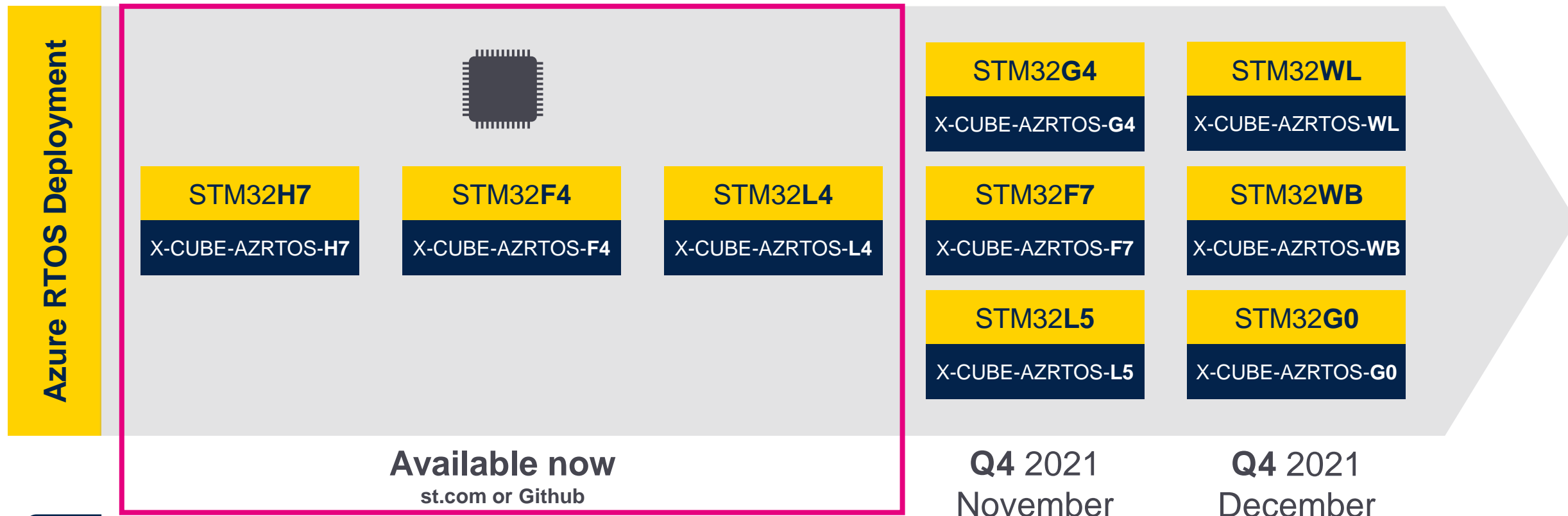
Azure RTOS deployment within STM32 and STM32Cube portfolio

STM32Cube native support for new STM32 series from 2021 onward
No legacy middleware support through STM32 Toolsets

STM32Cube MCU package

User application

Middleware *
Azure RTOS

Examples & Applications
STM32Cube HAL/LL, BSP
CMSIS
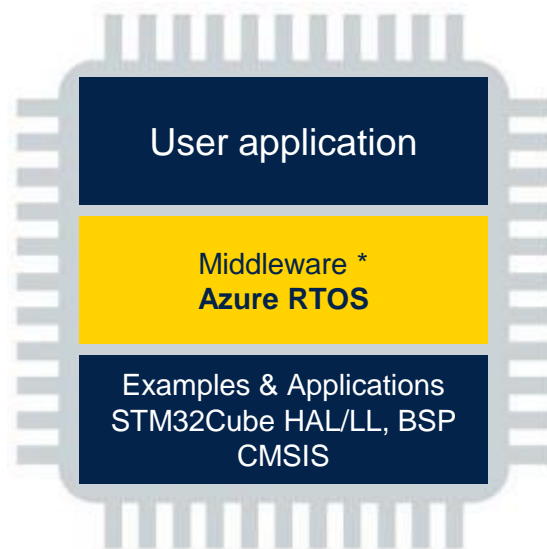
Legacy middleware replaced with Azure RTOS

Azure RTOS Deployment

STM32**U5** **
STM32CubeU5 Azure RTOS
Q3 2021

STM32**xx**
STM32CubeXX Azure RTOS
Qx 202x

Azure RTOS released together with mass-market announcement of new product

* Legacy MW available through Github with examples
** Available online on st.com, Github or through CubeMX/IDE

Getting started with Azure RTOS

Start with STM32CubeMX, STM32CubeIDE, or with default examples

Azure RTOS ThreadX
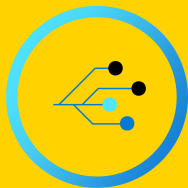
Thread
Creation, Synchronization, message queue
Low-power

OS wrappers
FreeRTOS
CMSIS OS

Azure RTOS USBX
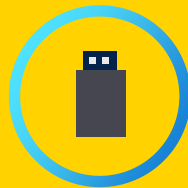
Host
MSC, HID, CDC ACM
Dual class

Device
MSC, CDC ACM,
HID, CDC ECM,
HID CDC ACM (dual-class)

Azure RTOS NetX Duo

TCP
Server, Client

UDP
Server, Client

Application
Web server, MQTT client, SNTP client

Azure RTOS FileX

Micro SD File edit
Multi-thread access
NOR memory File RW
NAND memory File RW
Multi-instance
In-Application-Programming

Get software on Github   Azure RTOS wiki

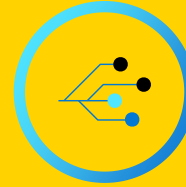Examples list is not exhaustive

Keep application layer, integrate industry leading operating system

FreeRTOS
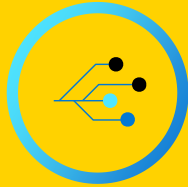
FreeRTOS compatibility layer for ThreadX

CMSIS OS

CMSIS OS compatibility Layer for ThreadX *

* Available only for STM32, developed by ST

Azure RTOS components importer and code generator

Expansion package importer

Graphical user configuration

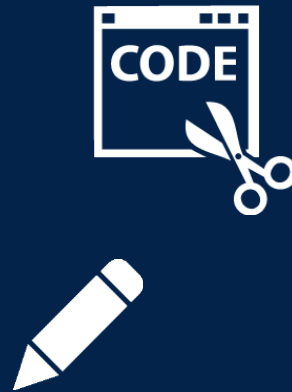**Code generation for any toolchain**

www.st.com/stm32cubemx

STM32CubeIDE

Azure RTOS ThreadX aware debugging

Project configuration with STM32CubeMX

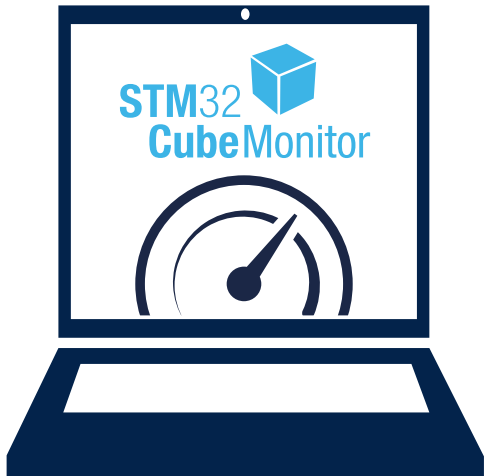**Code development Advanced IDE**

Debugging and programming

Azure RTOS OS awareness with threads call stack

www.st.com/stm32cubeide

STM32CubeMonitor

Non-intrusive runtime application monitoring

Non-intrusive tool to follow application behavior without interruption	**Drag & Drop creation of dashboard UI**
Large choice of graphical components, no programming	**Multi-OS tool, support of PC, tablets or smart phones**
Real-time analysis to finetune application configuration	**Driven by Node-RED engine**
Graphical visualization on any display	**Remote monitoring from any location**

www.st.com/stm32cubemonitor

Thank you

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