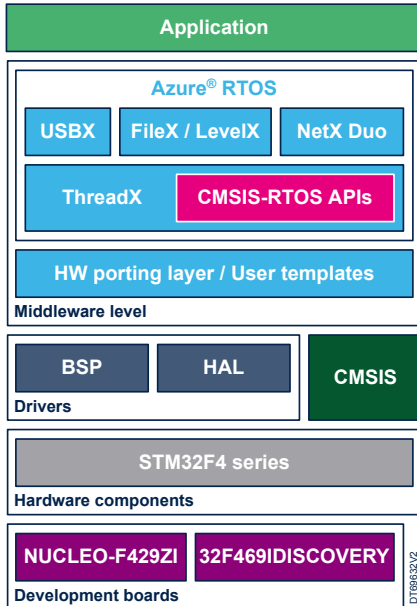


## STM32F4 series Azure<sup>®</sup> RTOS software expansion for STM32Cube



### Features

- Based on Azure<sup>®</sup> RTOS release 6.1.10
- Integrated and full-featured operating system: Azure<sup>®</sup> RTOS ThreadX
  - FreeRTOS<sup>™</sup> adaptation layer for ThreadX
  - CMSIS RTOS V2 adaptation layer for ThreadX
- Industrial grade networking stack optimized for performance coming with many IoT protocols: Azure<sup>®</sup> RTOS NetX Duo
- Advanced Flash file system (FS) / Flash translation layer (FTL), fully featured to support NOR and NAND flash memories: Azure<sup>®</sup> RTOS FileX and Azure<sup>®</sup> RTOS LevelX
- USB Host and Device stacks coming with multiple classes: Azure<sup>®</sup> RTOS USBX
  - The following USB Device classes are provided with examples: HID, CDC ACM, MSC, DFU, CDC ECM, composite HID/CDC ACM
  - The following USB Host classes are provided with examples: HID, MSC, CDC ACM, Dual Class, composite HID/CDC ACM
- Azure<sup>®</sup> RTOS FileX, Azure<sup>®</sup> RTOS LevelX, and Azure<sup>®</sup> RTOS USBX running with Azure<sup>®</sup> RTOS ThreadX or in bare-metal mode
- Safety documentation packages (available from Microsoft) enabling the use in applications targeting IEC 61508, IEC 62304, and ISO 26262
- High security assurance from hardware to software, including middleware such as TLS/DTLS and cryptography
- Many applicative examples available for STMicroelectronics NUCLEO-F429ZI and 32F469IDISCOVERY boards
- Free user-friendly license terms
- Enhanced for STMicroelectronics toolset: graphical configuration of Azure<sup>®</sup> RTOS middleware and initialization code generation with STM32CubeMX and STM32CubeIDE
- Update mechanism, which the user can enable to be notified of new releases

**Product status link**  
X-CUBE-AZRTOS-F4



## Description

X-CUBE-AZRTOS-F4 (Azure® RTOS STM32Cube Expansion Package) provides a full integration of Microsoft® Azure® RTOS in the STM32Cube environment for the STM32F4 series of microcontrollers. Ready-to-run applicative examples provided for the NUCLEO-F429ZI and 32F469IDISCOVERY Evaluation boards, along with a full compatibility with STM32CubeMX and STM32CubeIDE, ensure that X-CUBE-AZRTOS-F4 drastically reduces the learning curve and provides a smooth application development experience with Azure® RTOS and STM32F4 series microcontrollers.

The scope of this Expansion Package covers the following Azure® RTOS middleware: RTOS (ThreadX), USB Host and Device (USBX), file system including the support for NOR and NAND flash memories (FileX and LevelX), and networking including Ethernet and Wi-Fi® media (NetX Duo).

Azure® RTOS FileX, Azure® RTOS LevelX, and Azure® RTOS USBX are also available to run in bare-metal mode without the Azure® RTOS ThreadX kernel.

FreeRTOS™ and CMSIS RTOS V2 adaptation layers are included and demonstrated, making it easy and quick to migrate from FreeRTOS™ or another RTOS to Azure® RTOS ThreadX for STM32F4 users.

X-CUBE-AZRTOS-F4 is only an STM32Cube integration of middleware stacks from Microsoft® Azure® RTOS. Neither the “Azure SDK for Embedded C” nor the “Azure IoT Middleware for Azure RTOS”, available from [www.github.com/azure](http://www.github.com/azure), are part of the X-CUBE-AZRTOS-F4 Expansion Package, which therefore does not support native connectivity to the Azure® IoT Hub.

## 1 General information

The X-CUBE-AZRTOS-F4 STM32Cube Expansion Package runs on the STM32F4 microcontrollers based on the Arm® Cortex® processor.

*Note:* Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere. All other trademarks are the property of their respective owners.



### 1.1 Ordering information

X-CUBE-AZRTOS-F4 is available for free download from the [www.st.com](http://www.st.com) website and through the STM32CubeMX and STM32CubeIDE software tools.

### 1.2 What is STM32Cube?

STM32Cube is an STMicroelectronics original initiative to improve designer productivity significantly by reducing development effort, time, and cost. STM32Cube covers the whole STM32 portfolio.

STM32Cube includes:

- A set of user-friendly software development tools to cover project development from conception to realization, among which are:
  - STM32CubeMX, a graphical software configuration tool that allows the automatic generation of C initialization code using graphical wizards
  - STM32CubeIDE, an all-in-one development tool with peripheral configuration, code generation, code compilation, and debug features
  - STM32CubeCLT, an all-in-one command-line development toolset with code compilation, board programming, and debug features
  - STM32CubeProgrammer (STM32CubeProg), a programming tool available in graphical and command-line versions
  - STM32CubeMonitor (STM32CubeMonitor, STM32CubeMonPwr, STM32CubeMonRF, STM32CubeMonUCPD), powerful monitoring tools to fine-tune the behavior and performance of STM32 applications in real time
- STM32Cube MCU and MPU Packages, comprehensive embedded-software platforms specific to each microcontroller and microprocessor series (such as STM32CubeF4 for the STM32F4 series), which include:
  - STM32Cube hardware abstraction layer (HAL), ensuring maximized portability across the STM32 portfolio
  - STM32Cube low-layer APIs, ensuring the best performance and footprints with a high degree of user control over hardware
  - A consistent set of middleware components such as RTOS, USB, TCP/IP, graphics, and FAT file system
  - All embedded software utilities with full sets of peripheral and applicative examples
- STM32Cube Expansion Packages, which contain embedded software components that complement the functionalities of the STM32Cube MCU and MPU Packages with:
  - Middleware extensions and applicative layers
  - Examples running on some specific STMicroelectronics development boards

## 1.3 How does X-CUBE-AZRTOS-F4 complement STM32Cube?

### 1.3.1 Complementing STM32Cube

X-CUBE-AZRTOS-F4 extends STM32Cube by providing a full porting of Azure<sup>®</sup> RTOS middleware stacks, based on the STM32Cube HAL hardware abstraction layer for the STM32 microcontroller for maximized consistency and level of integration.

Azure<sup>®</sup> RTOS is a professional-grade, highly reliable and market-proven middleware suite ideally complementing the extensive STM32Cube ecosystem providing free development tools, software bricks and Expansion Packages. STM32 users can now also leverage the rich services of Azure<sup>®</sup> RTOS, which meet the needs of tiny, smart, connected devices, while still enjoying all the user-friendly features and terms they have always known with STM32Cube.

### 1.3.2 Enhanced for the STMicroelectronics toolset

The X-CUBE-AZRTOS-F4 STM32Cube Expansion Package includes different applicative examples and is compatible with [STM32CubeMX](#) (enhanced for the STMicroelectronics toolset). It can be downloaded from and installed directly into STM32CubeMX, as detailed in the user manual [UM1718](#) (freely available on [www.st.com](http://www.st.com)), or from the product page on STMicroelectronics website.



## 2 License

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X-CUBE-AZRTOS-F4 is delivered under the [SLA0048](#) software license agreement and its Additional License Terms.

## Revision history

**Table 1. Document revision history**

Date	Revision	Changes
6-Sep-2021	1	Initial release.
19-Nov-2021	2	Added the Azure® RTOS base release in <i>Features</i> . Updated <i>Features</i> and <i>Description</i> : <ul style="list-style-type: none"> <li>• FreeRTOS™ adaptation layer for ThreadX</li> <li>• USB Host and Device classes for USBX</li> <li>• No native connectivity to Azure® IoT</li> </ul>
26-Sep-2023	3	Updated the Azure® RTOS base release to 6.1.10 in <i>Features</i> . Added the possibility to run Azure® RTOS FileX, Azure® RTOS LevelX, and Azure® RTOS USBX in bare-metal mode in <i>Features</i> and <i>Description</i> . Added the CMSIS RTOS V2 adaptation layer for Azure® RTOS ThreadX in <i>Features</i> and <i>Description</i> . Updated <i>Features</i> : <ul style="list-style-type: none"> <li>• Updated the safety documentation and security assurance</li> <li>• Updated the enhancement for STMicroelectronics toolset</li> </ul> Updated <i>What is STM32Cube?</i>

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