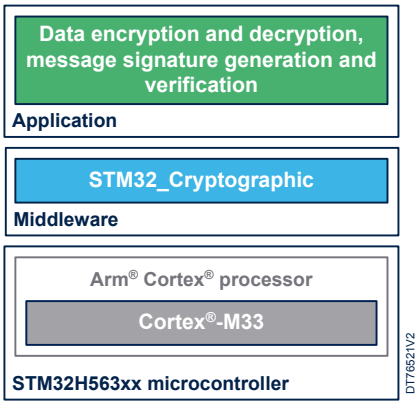
X-CUBE-PQC

Data brief

STM32 post-quantum cryptographic library software expansion for STM32Cube



Product status
X-CUBE-PQC

Features

X-CUBE-CRYPTOLIB security algorithms

- Cipher encryption and decryption
- Digest generation
- Message authentication code (MAC) generation
- Elliptic curves key generation, signature, and verification
- Elliptic curves Diffie-Hellman key exchange
- RSA signature, verification, encryption, and decryption
- Deterministic random bit generator (DRBG)

PQC public key cryptography

- Stateful hash-based signatures (HBS):
  - LMS digital signature verification
  - XMSS digital signature verification
- Lattice-based algorithm (ML):
  - ML-DSA digital signature verification and generation, key generation
  - ML-KEM key encapsulation and decapsulation, key generation

Description

With the advent of quantum computers, traditional asymmetric cryptographic algorithms such as RSA, ECC, DH, ECDH, and ECDHE become vulnerable. In response, NIST has selected a new set of algorithms designed to be resistant to quantum computing attacks.

The STM32 post-quantum cryptographic library package (X-CUBE-PQC) includes all the major security algorithms for encryption, hashing, message authentication, and digital signing. This enables developers to satisfy application requirements for any combination of data integrity, confidentiality, identification/authentication, and nonrepudiation. It includes both the PQC Leighton-Micali signature (LMS) and the extented Merkle signature scheme (XMSS) verification methods, which are used mainly for secure boot code authentication. It also includes the ML-KEM lattice-based algorithm, which can replace the current use of key exchange mechanisms to establish a secret key between two parties. ML-DSA is included for digital signatures. ML-DSA can replace ECDSA, EdDSA, and RSA-PSS in protocols, for instance in high-level applications as a method of authentication, of attestation, or both.

The library includes firmware functions for the STM32H563xx microcontrollers, based on the Arm® Cortex®-M33 processor, and all cryptographic functions of STMicroelectronics X-CUBE-CRYPTOLIB. For more details on PQC, refer to the *STM32 introduction to PQC* dedicated pages of the STM32 MCU wiki at wiki.st.com/stm32mcu.

The ML-DSA and ML-KEM algorithms are certified according to the NIST cryptographic algorithm validation program (CAVP), helping customers to prove quickly and cost-effectively the security of their new products.

Full details are available online at the NIST CSRC algorithm validation lists website, selecting the CAVP web page.

This package contains examples of LMS and XMSS signature verification using the STM32 cryptographic accelerator, ML-KEM functions (key generation, key encapsulation, key decapsulation), and ML-DSA functions (key generation, signature generation, signature verification). To benefit from all other cryptographic examples, refer to the X-CUBE-CRYPTOLIB Expansion Package.

1 General information

The X-CUBE-PQC Expansion Package runs on the STM32H563xx microcontrollers, based on the Arm® Cortex®-M33 processor with Arm® TrustZone®.

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

arm

1.1 Ordering information

X-CUBE-PQC is available for free download from the *www.st.com* website.

1.2 NIST algorithm validation lists

Refer to Table 1 for access to the certification listing on the National Institute of Standards and Technology (NIST) portal.

Table 1. NIST CSRC algorithm validation lists

Cortex® architecture	Optimization type	CAVP link
Cortex®-M33	Size	csrc.nist.gov/projects/cryptographic-algorithm-validation-program/details?product=19884

1.3 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 STM32CubeH5 for the STM32H5 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 ThreadX, FileX, LevelX, NetX Duo, USBX, USB PD, mbed-crypto, MCUboot, and OpenBL
  - 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

2 License

X-CUBE-PQC is delivered under the SLA0048 software license agreement and its Additional License Terms.

Revision history

Table 2. **Document revision history**

Date	Revision	Changes
05-Mar-2025	1	Initial release.
27-Jun-2025	2	Added the XMSS, ML-DSA, and ML-KEM post-quantum cryptographic algorithms: • Updated the cover image • Updated *Features* and *Description* Extended the document scope to all STM32H563xx microcontrollers. Updated the references to the NIST cryptographic algorithm validation program (CAVP) and STM32 MCU wiki in *Description*.
29-Aug-2025	3	Added the certification of the ML-DSA and ML-KEM algorithms according to the NIST cryptographic algorithm validation program (CAVP) in Description. Updated NIST CSRC algorithm validation lists.

IMPORTANT NOTICE – READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice.

In the event of any conflict between the provisions of this document and the provisions of any contractual arrangement in force between the purchasers and ST, the provisions of such contractual arrangement shall prevail.

The purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgment.

The purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of the purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

If the purchasers identify an ST product that meets their functional and performance requirements but that is not designated for the purchasers' market segment, the purchasers shall contact ST for more information.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.