UM2238
User manual

STM32 Trusted Package Creator tool software description

Introduction

STM32 Trusted Package Creator is part of the STM32CubeProgrammer tool set (STM32CubeProg), and allows the generation of secure firmware and modules to be used for STM32 secure programming solutions which are:

- Secure firmware install (SFI): SFI is a secure mechanism that allows secure installation of OEM firmware in untrusted production environments by having the whole firmware encrypted with an AES-GCM key.
- Secure module install (SMI): SMI is intended to protect a part of the firmware (a section of an ELF file) by also encrypting this section using an AES-GCM key.

  A combined SFI-SMI image is an SFI image that contains one or more module areas.
- Secure firmware upgrade (SFU): SFU is a solution to allow the upgrade of the STM32 microcontroller built-in program in a secure way. For more information about SFU, please refer to the X-CUBE-SBSFU package on http://www.st.com for further information.

This user manual details the software environment prerequisites, as well as the available features of the STM32 Trusted Package Creator tool software.

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1 System requirements

Supported operating systems and architectures:

- Linux® 64-bit
- Windows® 7/8/10 32-bit and 64-bit
- macOS® (minimum version OS X® Yosemite)

STM32CubeProgrammer and STM32 Trusted Package Creator support STM32 32-bit devices based on Arm®(a) Cortex®-M processors.

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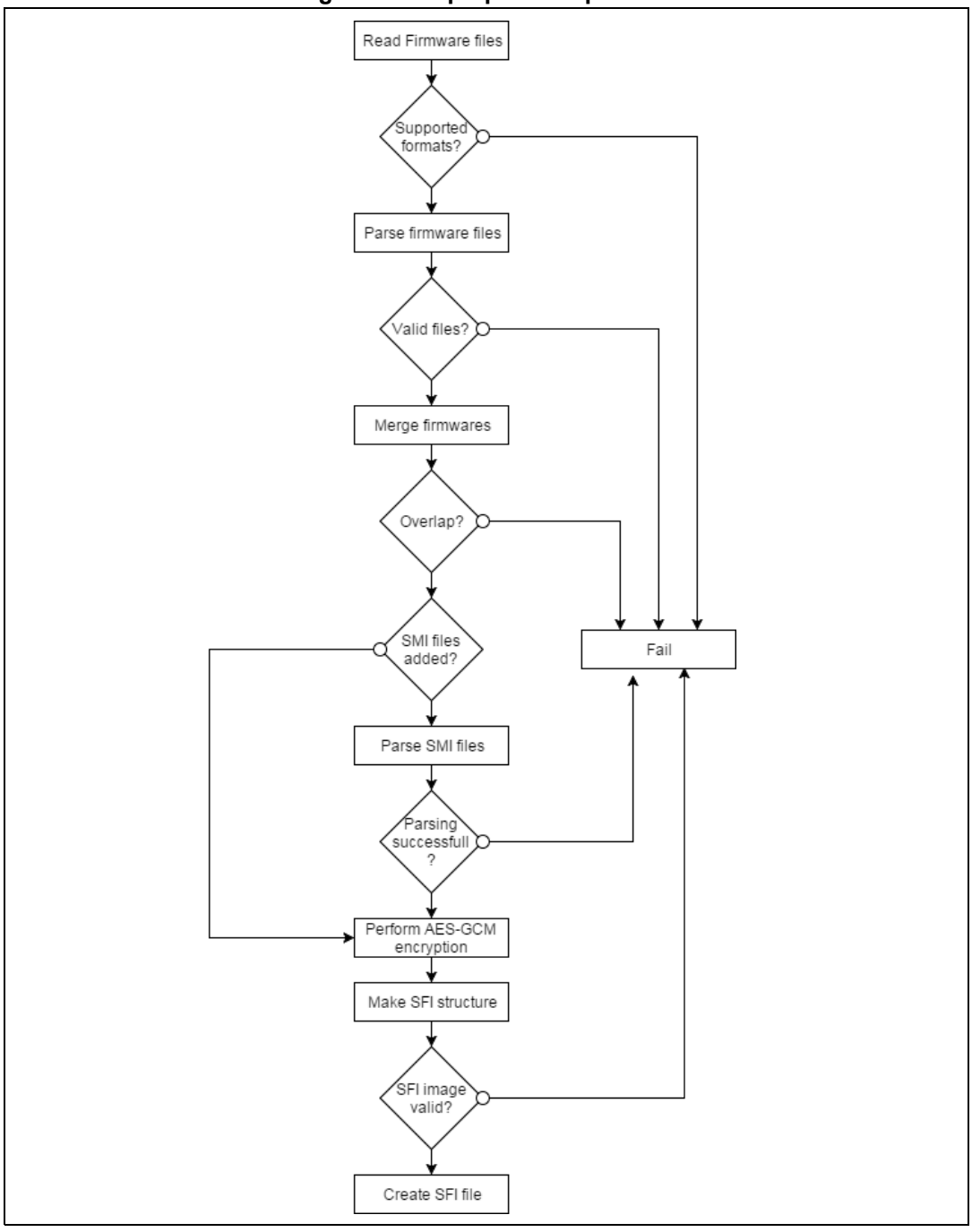
2 Preparation processes

2.1 SFI preparation process

An SFI (Secure firmware install) image is a format created by STMicroelectronics that contains an encrypted and authenticated piece of firmware using an AES-GCM algorithm. The SFI preparation process is described in *Figure 1*.

Figure 1. SFI preparation process



Before performing AES-GCM to encrypt an area, the tool calculates the Initialization Vector (IV) as:

IV = nonce + Area Index

Where nonce is a number used only once as a start of an iterated process in the AES-GCM algorithm to give different cipher texts to same blocks of data.

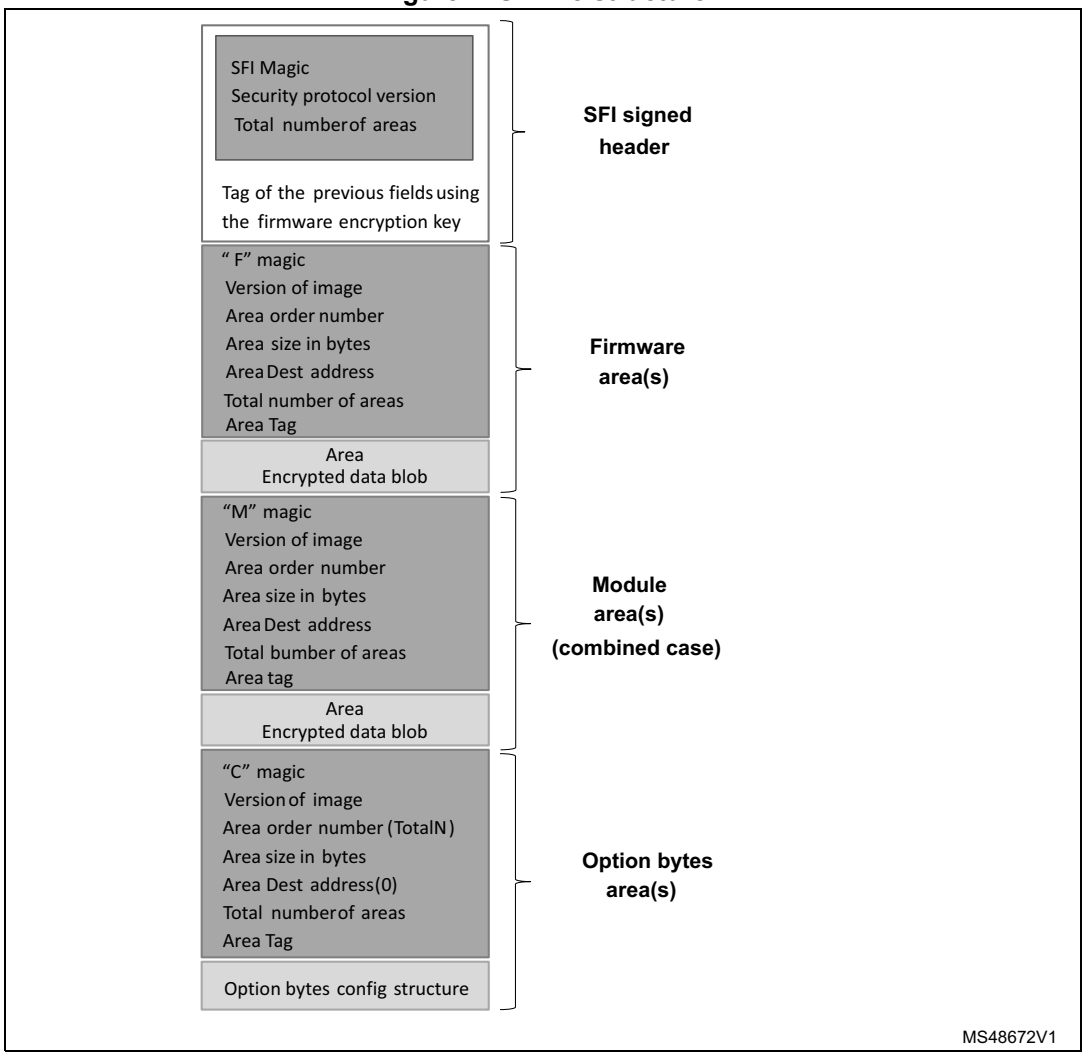
It then, it passes the area descriptor (starting from the magic to the total number of areas) as additional authenticated data (AAD).

- Each segment in the input firmwares constitutes a firmware (F) area in the SFI file.
- Each SMI file (combined case) constitutes a module (M) area.
- The option bytes configuration constitute the configuration (C) area.

To generate a header tag, the tool performs an authenticated only AES-GCM encryption (without a plain text nor a cipher text) using the SFI header as an AAD and the nonce as the IV.

The structure of an SFI file is shown in *Figure 2*.

Figure 2. SFI file structure



To prepare an SFI image from multiple firmware files you have to make sure that there is no overlap between their segments, otherwise you will get the error message: *"Overlap between segments, unable to merge firmware files"*.

Furthermore, in the case of a combined SFI-SMI image, there is also an overlap check between the areas (in case there is an overlap between firmware and module areas). If the check fails, an error message is shown: *"Overlap between SFI areas"*.

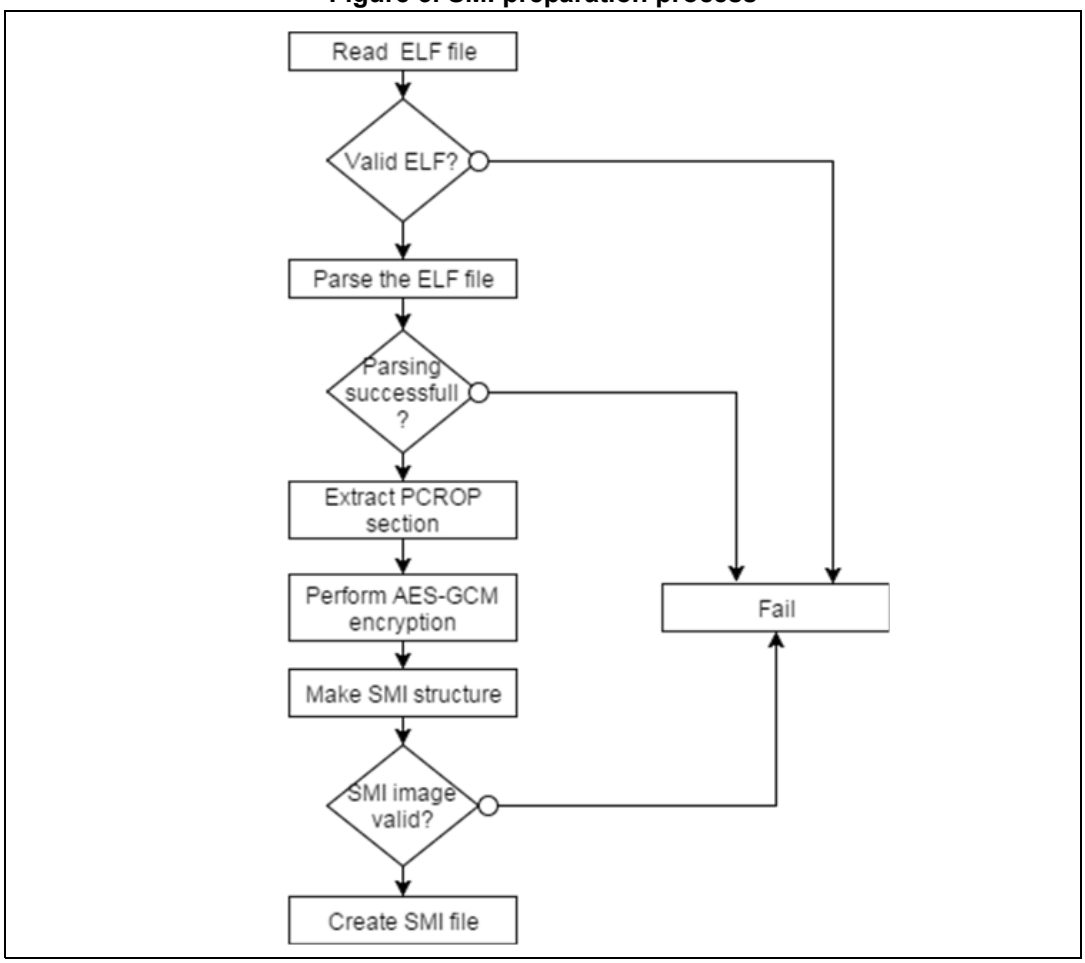
Also, all SFI areas must be located in Flash memory, otherwise the generation fails gving the error message: *"One or more SFI areas are not located in Flash memory"*.

2.2 SMI preparation process

An SMI image (Secure Module Install) protects only a module of the firmware.

The SMI preparation process is shown in *Figure 3*.

Figure 3. SMI preparation process



The AES-GCM encryption is performed using the following inputs:

- Nonce as the initialization vector (IV)
- The security version as additional authenticated Data (AAD)

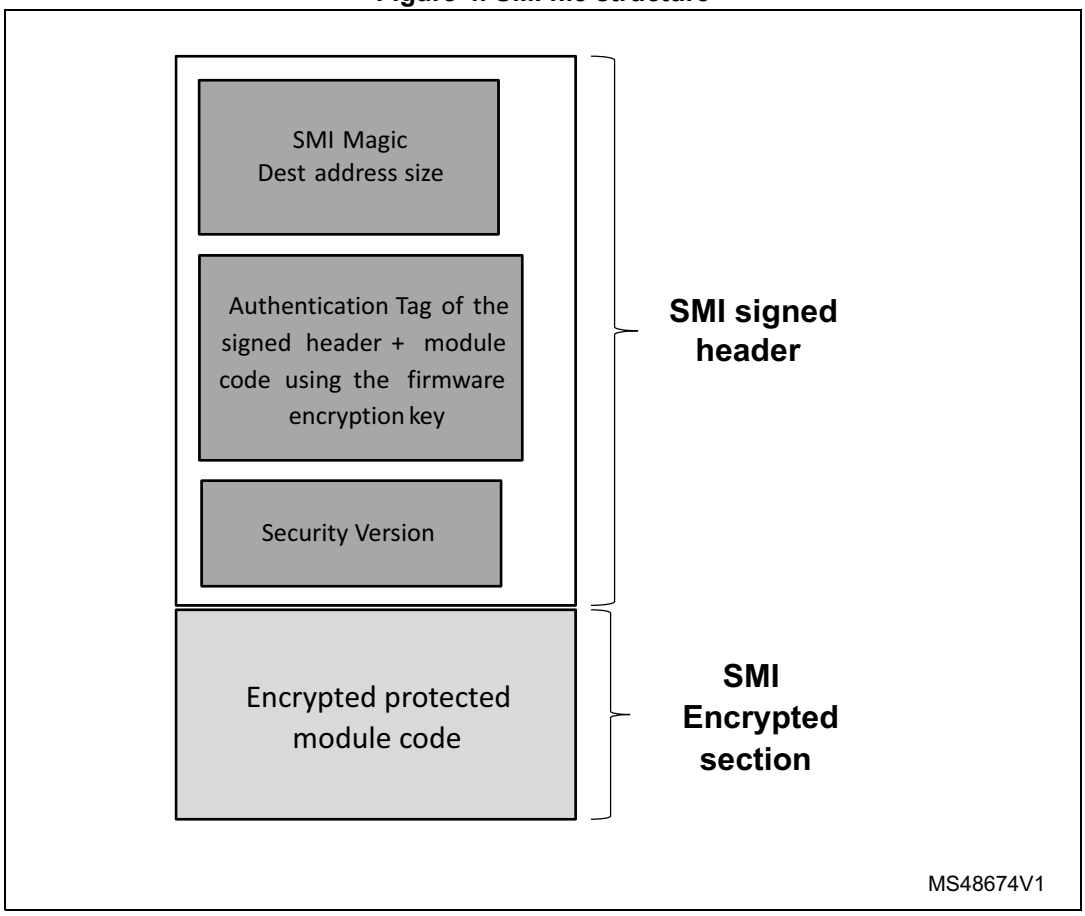
Before SMI preparation, the following checks are performed:

- A proprietary code read out protection (PCROP) section must be aligned on a Flash word (256 bits) otherwise a warning is shown
- The section's size must be at least 2 Flash words (512 bits) otherwise a warning is shown
- The section must end on a Flash word boundary (a 256 bit word) or a warning is shown
- If the section immediately following the PCROP area starts in the last Flash word of the PCROP section, the generation fails and an error message is shown.

After the SMI preparation, a clear (that is, not encrypted) ELF file is also generated containing program data and only clear sections of the code.

The structure of an SMI file is shown in *Figure 4*.

Figure 4. SMI file structure



2.3 SFU preparation process

An SFU image (Secure Firmware Upgrade) allows the upgrade of the STM32 microcontroller built-in program in a secure way to prevent unauthorized updates.

The SFU preparation process is shown in *Figure 5*.

Figure 5. SFU preparation process