# SafeNet ProtectServer Network HSM and PCIe HSM

Migration Guide

gemalto
security to be free

## Document Information

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## Revision History

| Revision | Date | Reason |
|---|---|---|
| A | 14 March 2016 | 5.2 release |

## Trademarks



## Gemalto Rebranding

In early 2015, Gemalto NV completed its acquisition of SafeNet, Inc. As part of the process of rationalizing the product portfolios between the two organizations, the HSM product portfolio has been streamlined under the SafeNet brand. As a result, the ProtectServer/ProtectToolkit product line has been rebranded as follows:

| Old product name | New product name |
|---|---|
| Protect Server External 2 (PSE2) | SafeNet ProtectServer Network HSM |
| Protect Server Internal Express 2 (PSI-E2) | SafeNet ProtectServer PCIe HSM |
| ProtectToolkit | SafeNet ProtectToolkit |

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# Contents

# Preface

This document describes how to migrate from the legacy ProtectServer HSMs (PSI and PSI-E) to the SafeNet ProtectServer Network HSM or SafeNet ProtectServer PCIe HSM. It contains the following chapters:



## Customer Release Notes

The Customer Release Notes (CRN) document provides important information about this release that is not included in other customer documentation. It is strongly recommended that you read the CRN to fully understand the capabilities, limitations, and known issues for this release. You can view or download the latest version of the CRN for this release at the following location:

- http://www.securedbysafenet.com/releasenotes/ptk/crn_ptk_5-2.pdf

## Audience

This document is intended for personnel responsible for maintaining your organization's security infrastructure. This includes Luna HSM users and security officers, the key manager administrators, and network administrators. It is assumed that the users of this document are proficient with security concepts.

All products manufactured and distributed by Gemalto, Inc. are designed to be installed, operated, and maintained by personnel who have the knowledge, training, and qualifications required to safely perform the tasks assigned to them. The information, processes, and procedures contained in this document are intended for use by trained and qualified personnel only.

## Document Conventions

This section provides information on the conventions used in this template. The information presented is to instruct the writer on how to use the template and can be removed if you do not wish to include it in your customer-facing document. For example, you may wish to remove the “Hyperlinks” sections but keep the “Notifications” section.

### Notifications

This template uses notes, cautions, and warnings to alert you to important information that may help you to complete your task, or prevent personal injury, damage to the equipment, or data loss.

#### Notes

Notes are used to alert you to important or helpful information. These elements use the following format:

**Note:** Take note. Notes contain important or helpful information that you want to make stand out to the user.

### Cautions

Cautions are used to alert you to important information that may help prevent unexpected results or data loss. These elements use the following format:

**CAUTION:** Exercise caution. Caution alerts contain important information that may help prevent unexpected results or data loss.

### Warnings

Warnings are used to alert you to the potential for catastrophic data loss or personal injury. These elements use the following format:

**WARNING:** Be extremely careful and obey all safety and security measures. In this situation you might do something that could result in catastrophic data loss or personal injury.

## Command Syntax and Typeface Conventions

| Convention | Description |
|---|---|
| **bold** | The bold attribute is used to indicate the following:<br>• Command-line commands and options (Type **dir /p**.)<br>• Button names (Click **Save As**.)<br>• Check box and radio button names (Select the **Print Duplex** check box.)<br>• Window titles (On the **Protect Document** window, click **Yes**.)<br>• Field names (**User Name:** Enter the name of the user.)<br>• Menu names (On the **File** menu, click **Save**.) (Click **Menu** > **Go To** > **Folders**.)<br>• User input (In the **Date** box, type **April 1**.) |
| *italic* | The italic attribute is used for emphasis or to indicate a related document. (See the *Installation Guide* for more information.) |
| <variable> | In command descriptions, angle brackets represent variables. You must substitute a value for command line arguments that are enclosed in angle brackets. |
| [ optional ] | Square brackets enclose optional keywords or <variables> in a command line description. Optionally enter the keyword or <variable> that is enclosed in square |

| Convention | Description |
|---|---|
| [ <optional> ]<br><br>[ a \| b \| c ]<br>[<a> \| <b> \| <c>] | brackets, if it is necessary or desirable to complete the task.<br>Square brackets enclose optional alternate keywords or variables in a command line description. Choose one command line argument enclosed within the braces, if desired. Choices are separated by vertical (OR) bars. |
| { a \| b \| c }<br>{ <a> \| <b> \| <c> } | Braces enclose required alternate keywords or <variables> in a command line description. You must choose one command line argument enclosed within the braces. Choices are separated by vertical (OR) bars. |

## Support Contacts

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| Contact Method | Contact Information | |
|---|---|---|
| **Address** | Gemalto, Inc.<br>4690 Millennium Drive<br>Belcamp, Maryland 21017, USA | |
| **Phone** | US | 1-800-545-6608 |
| | International | 1-410-931-7520 |
| **Technical Support Customer Portal** | https://serviceportal.safenet-inc.com<br>Existing customers with a Technical Support Customer Portal account can log in to manage incidents, get the latest software upgrades, and access the Gemalto Knowledge Base. | |

# 1

# Introducing the SafeNet ProtectServer Network and PCIe HSMs

This chapter provides an introduction to the new SafeNet ProtectServer Network and PCIe HSMs. The information in this chapter provides a high-level overview of what is new or changed, and how these differences may impact you when you migrate from a legacy ProtectServer HSM to a new SafeNet ProtectServer HSM. It contains the following sections:



## Overview

The SafeNet ProtectServer Network and PCIe HSMs are direct replacements for the legacy PSE and PSI-E HSMs, which have been declared end of sale, and are no longer available for purchase.

Although the SafeNet ProtectServer Network and PCIe HSMs are functionally equivalent to their legacy counterparts, the underlying hardware is significantly different. The major hardware change is to the embedded cryptographic engine used on the HSMs. The legacy PSE/PSI-E HSMs incorporate the K5 cryptographic engine. The SafeNet ProtectServer Network and PCIe HSMs incorporate the more modern K6 cryptographic engine.

Although every effort has been made to mitigate the impact of these hardware changes, the introduction of a new cryptographic engine impacts the following:

- Functionality modules (FMs). The processor used on the SafeNet ProtectServer Network and PCIe HSMs is different from the processor used on the legacy ProtectServer HSMs. As a result, you must rebuild your FMs to run on the new hardware.
- Serial devices. The serial port on the ProtectServer HSMs has been replaced on the SafeNet ProtectServer Network and PCIe HSMs with a USB port and a USB-to-serial cable. Any serial devices that were previously attached to a ProtectServer HSM will continue to work on the SafeNet ProtectServer Network and PCIe HSMs.

In addition to these changes, the SafeNet ProtectToolkit also includes some software fixes/enhancements, as described in "Software Changes" on page 10.

# Functionality Modules

The K5 cryptographic engine is based on the ARM processor. The K6 cryptographic engine is based on the PowerPC processor. As a result, any FMs built for the PSE/PSI-E (K5) HSMs will not run on the SafeNet ProtectServer Network and PCIe HSMs. You must rebuild your existing FMs to run on the PowerPC (K6) platform. This requires a Linux workstation or VM and some changes to your source files, as described in “FM Migration” on page 12.

# Serial Devices

The SafeNet ProtectServer Network and PCIe HSMs do not include a serial port. The serial port on these HSMs has been replaced with a USB port that provides serial access to the HSMs via the included USB-to-serial cable.

# Software Changes

The software changes introduced in this release primarily affect the FM SDK, as detailed in “FM Migration” on page 13. Any additional changes are described in the following sections.

## FM SDK (formerly PPO) is now included with the PTK software

In previous releases, the FM SDK (PPO) was provided on a separate CD. The FM SDK software is now bundled with the PTK software on the software DVD. Documentation for all of the software is provided on the PTK documentation DVD.

## Installation Directories

The installation directories have been modified to conform to SafeNet standard conventions, as follows:

| | |
|---|---|
| **Linux** | /opt/safenet/protecttoolkit5<br>/opt/safenet/fm-toolchain |
| **Windows** | C:\Program Files\SafeNet\Protect Toolkit 5 |

## Environment Variables

Environment configuration for the PTK-C SDK and FM SDK has been simplified in this release as follows. Manual setting of environment variables is no longer required.

| | |
|---|---|
| **Linux** | A configuration script (setvars.sh) is now included with PTK-C to configure your development environment. You would typically run this script each time you open a new shell. See the installation documentation for more information. |
| **Windows** | The runtime environment is automatically configured as part of the installation process. The FM SDK installation directory includes a configuration batch (fmsdkvars.bat) file to configure your FM development environment. You would typically run this batch file each time you open a new shell. See the installation documentation for more information. |

## DVD Directory Structure

```
├──<part_number>_sw_license_agreement.pdf
├──<part_number>_sw_license_agreement.txt
├──autorun.inf
│
├──firmware
│   └──<firmware_upgrade_files>
│
└──SDKs
    ├── safeNet-install.sh
    │
    ├── Linux
    │   ├── fm_sdk
    │   │   └── PTKfmsdk-<version>.i386.rpm
    │   ├── fm_toolchain
    │   │   └── fm-toolchain-ppc440e-<version>.i686.rpm
    │   ├── hsm_net_server
    │   │   └── PTKnetsrv-<version>.i386.rpm
    │   ├── network_hsm_access_provider
    │   │   └── PTKnethsm-<version>.i386.rpm
    │   ├── pci_hsm_access_provider
    │   │   └── PTKpcihsm2-<version>.i386.rpm
    │   ├── ptkc_runtime
    │   │   └── PTKcprt-<version>.i386.rpm
    │   ├── ptkc_sdk
    │   │   └── PTKcpsdk-<version>.i386.rpm
    │   ├── ptkj_runtime
    │   │   └── PTKjprov-<version>.i386.rpm
    │   └── ptkj_sdk
    │       └── PTKjpsdk-<version>.i386.rpm
    │
    ├── Linux64
    │   ├── fm_sdk
    │   │   └── PTKfmsdk-<version>.x86_64.rpm
    │   ├── fm_toolchain
    │   │   └── fm-toolchain-ppc440e-<version>.i686.rpm
    │   ├── hsm_net_server
    │   │   └── PTKnetsrv-<version>.x86_64.rpm
    │   ├── network_hsm_access_provider
    │   │   └── PTKnethsm-<version>.x86_64.rpm
    │   ├── pci_hsm_access_provider
    │   │   └── PTKpcihsm2-<version>.x86_64.rpm
    │   ├── ptkc_runtime
    │   │   └── PTKcprt-<version>.x86_64.rpm
    │   ├── ptkc_sdk
    │   │   └── PTKcpsdk-<version>.x86_64.rpm
    │   ├── ptkj_runtime
    │   │   └── PTKjprov-<version>.x86_64.rpm
    │   └── ptkj_sdk
    │       └── PTKjpsdk-<version>.x86_64.rpm
```

```
│
├──Win32
│   ├──fm_sdk
│   │   └── PTKfmsdk.msi
│   ├──hsm_net_server
│   │   └── PTKnethsm.msi
│   ├──network_hsm_access_provider
│   │   └── PTKnethsm.msi
│   ├──pci_hsm_access_provider
│   │   └── PTKpcihsm2.msi
│   ├──ptkc_runtime
│   │   └── PTKcprt.msi
│   ├──ptkc_sdk
│   │   └── PTKcpsdk.msi
│   ├──PTKJ_Runtime
│   │   └──PTKjprt.msi
│   ├──PTKJ_SDK
│   │   └── PTKjpsdk.msi
│   └──Ptk-M
│       └── SafenetKSP32.msi
│
└──Win64
    ├──fm_sdk
    │   └── PTKfmsdk.msi
    ├──hsm_net_server
    │   └── PTKnethsm.msi
    ├──network_hsm_access_provider
    │   └── PTKnethsm.msi
    ├──pci_hsm_access_provider
    │   └── PTKpcihsm2.msi
    ├──ptkc_runtime
    │   └── PTKcprt.msi
    ├──ptkc_sdk
    │   └── PTKcpsdk.msi
    ├──PTKJ_Runtime
    │   └──PTKjprt.msi
    ├──PTKJ_SDK
    │   └── PTKjpsdk.msi
    └──Ptk-M
        ├── PTKmprt64.msi
        └── SafenetKSP64.msi
```

# 2
# FM Migration

This chapter describes the changes and enhancements to the FM development process for the SafeNet ProtectServer Network and PCIe HSMs. It provides guidance and recommends best practices for developing new FMs or migrating your existing FMs to work on the SafeNet ProtectServer Network and PCIe HSMs. This chapter contains the following sections:



## Supported Hardware and Software

FM, HOST or Cryptoki applications built or recompiled using the Release 5 (or higher) FM SDK are supported on the SafeNet ProtectServer Network and PCIe HSMs.

Recompiling your existing FM, HOST, and Cryptoki application source code should require makefile modifications only. FMs must be compiled on Linux instead of Windows.

Platform support is as follows:

| | |
|---|---|
| **Embedded FM development** | Linux only |
| **FM HOST applications** | Windows and Linux |

The minimum required installation for building FM HOST applications with PTK 5 on Windows is Microsoft Visual C++ (the 2005, 2008, and 2010 runtime redistributables must all be installed), PTKcpsdk, and PTKfmsdk. Compilers other than Microsoft Visual C++ may work, but our examples and configuration makefile (<FMDIR>**cfgbuild.mak**) are built for Microsoft Visual C++.

## Summary of Changes and Enhancements

This section provides a summary of the changes and enhancements made to the FM SDK and toolchain. In most cases, your existing FMs should continue to work after recompiling on the new platform.

The most significant change to the FM development process in Release 5 (or higher) is that FMs must now be compiled on Linux instead of Windows. This will require moving your source to a Linux workstation or VM. Recompiling in the new environment should not require any source changes.

If your existing FMs use the makefile syntax used in the samples provided in previous ProtectServer releases, you must update your makefiles to use the syntax defined in the samples provided with the Release 5 (or higher) ProtectToolkit.

Some of the APIs used in previous ProtectServer releases have been changed or deprecated, however the header files provided with Release 5 (or higher) ProtectToolkit include backwards compatibility for the old APIs. Warnings for the deprecated APIs will be displayed at compile time.

## FM SDK Toolkit

The FM SDK cross-compiler is now Linux-only.

There are no longer separate FM and HOST toolkits. All FM-SDK toolkits are the same, except that the cross compiler and embedded libraries will only be available on Linux hosts, and are no longer supported on Windows XP.

## Toolchain

The major changes to the toolchain are as follows:

- GCCFMDIR is no longer required
- gnumake is now make, and you can now use the native system make
- C99 support
- additional function support
- the tool naming convention has changed
- some of the tools in the toolchain use newer versions

### $GCCFMDIR No Longer Required

$GCCFMDIR is not required for building FMs on the SafeNet ProtectServer PCIe HSM since the toolchain is non-relocatable.

**Best practice:** Ensure that $GCCFMDIR is not defined.

### Builds Use make Instead of gnumake

In Release 5 (or higher), **gnumake** becomes simply **make**, and the host's native make can be used. If the host's native **make** is older than 3.82, **make** can also be used from the fm-toolchain from the following location:

/opt/safenet/fm-toolchain/fmsdk-ppc440e-1.0/sysroots/i686-fmsdk-linux/usr/bin/make

In previous releases, we provided GNU make (renamed to **gnumake**). The **gnumake** command was used to build FMs. This has changed as follows:

| | |
|---|---|
| **Linux** | The **gnumake** command is no longer available. If you use an automated build that calls **gnumake** you must update your build scripts to call **make** instead of **gnumake**. |
| **Windows** | The **gnumake** command is provided in <fm_install_dir>/**bin**. It is simply a renamed version of the **make** command. |

## C99 Support

The FM SDK supports a subset of the ISO C 99 standard library as defined by ISO/IEC 9899:1999. In general, floating point math, multibyte characters, localization, and I/O APIs are not supported. **printf** and **vprintf** are exceptions, and are redirected to the logging channel.

In addition to the standard library, you can also use C99 language features not present in ANSI C (C89/90). C99 **stdint.h** types are now supported by the FM SDK toolchain, however sized types from the proprietary **Integers.h** remain used for FM SDK published APIs to maintain continuity and compatibly with pre-C99 versions.

Due to the change to C99, and the default C99 locale, the **strftime %x** result is a different format than in PPO3. It is now **mm/dd/yy** instead of **Ddd Mmm dd yyy**.

See the *FM SDK Programming Guide* for more information.

**Best practice:** Update your code to take advantage of the features offered by C99.

## Functions added to the FM SDK in ProtectServer 2

The following functions have been added:

**ctype.c:**

isblank

**stdio.h**

printf, vprintf, vsscanf

snprintf (moves from non-standard to C99 variant).

**stdlib.h**

atoll, llabs, lldiv, strtoll, strtoull

## Updated Tool Versions

| Tool | PPO 3.0 version | FM SDK 5.0 version |
|---|---|---|
| gcc | 2.95.3 | 4.6.1 |
| gnu make | 3.78.1 | 3.82 |
| binutils | 2.11.2 | 2.21.1 |
| C standard | C89 | C99 |

## New Tool Naming Convention

The tool naming convention changes from <toolname>**-fm** to <arch>**-fm-**<toolname>. For example **gcc-fm** becomes **powerpc-fm-linux-gcc**.

## Makefiles

The emulation mode makefile syntax used in Release 5 (or higher) is different than in previous releases. See the makefiles in the **samples** directory for the new syntax. You must change your existing makefiles to conform to the new syntax.

If your existing makefiles include **cfgbuild.mak**, you should be able to recompile existing non-emulation code without making any changes, other than changing the path separators, as described below. If you only used **cfgbuild.mak** as an example, changes will be required in your makefiles for the new toolchain. See the makefiles in the **samples** directory, and the **cfgbuild.mak** file.

### Path Separators

When building for SafeNet ProtectServer PCIe HSM on Linux hosts, all path separators in your makefiles must use forward slashes ( / ). Windows-style backslashes ( \ ) will not work.

> **Best practice:** Change all backslashes ( \ ) to forward slashes ( / ) in your makefiles.

### The cfgbuild.mak File

For both FMs and HOST applications, **cfgbuild.mak** is now a supported file and not a simply an example. The **cfgbuild.mak** file has been moved to $(FMDIR)/ from $(FMDIR)/**samples**. A wrapper is provided in $(FMDIR)/**samples** for compatibility.

The default libraries provided by the FM SDK are now automatically included by **cfgbuild.mak** and should not be specified within the FM's makefile directly.

> **Best practice**: Include **cfgbuild.mak** in all of your makefiles to set up the compiler, link flags, and link the FM toolchain.

## Memory Endian Issues

The processors on the SafeNet ProtectServer Network and PCIe HSMs are big endian, whereas the PSI-E and PSG processors are little endian. In Release 5 (or higher) all methods of endian byte order manipulation are consolidated into the **endyn.h** header file.

> **Best practice:** Use the endian macros provided in the PTK-C header file **endyn.h** to encode all messages in network byte order. By using the endian macros on both host and FM, endian differences between host and HSM are not an issue.

### FM_MAKE_VERSION Macro

The samples included in previous ProtectServer releases did not use the FM_MAKE_VERSION(major,minor) macro. The samples in Release 5 (or higher) use this macro. Not using the macro may result in FM version numbers being displayed reversed in **ctconf** and **ctfm**.

> **Best practice:** Use the FM_MAKE_VERSION(major,minor) macro to define the version number passed to DEFINE_FM_HEADER().

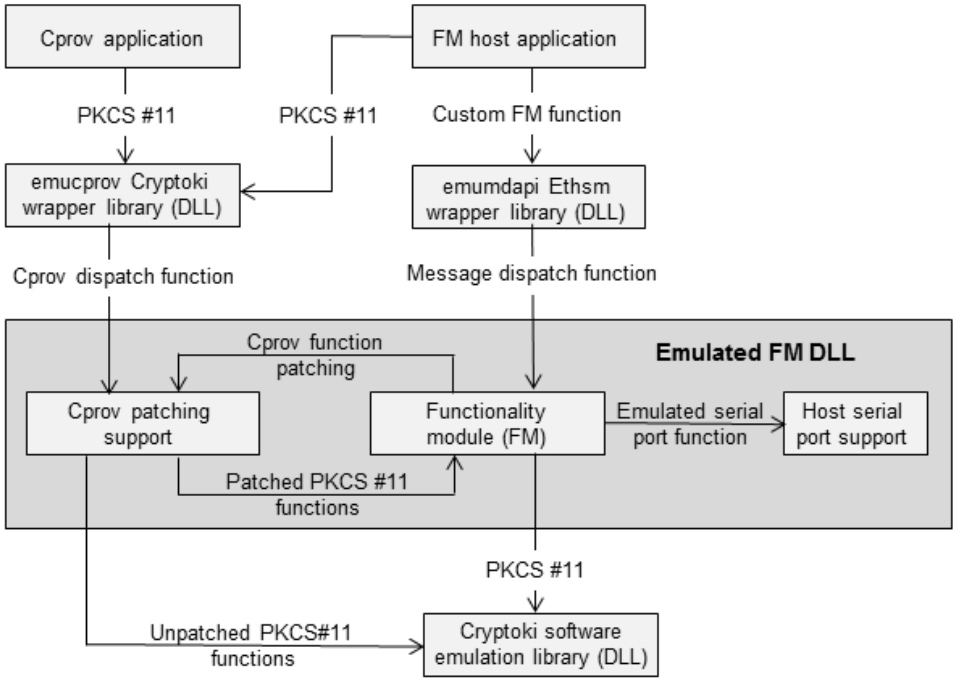
## Emulation Mode Enhancements

Emulation mode has been enhanced to support C99 and Cryptoki (Cprov) function patching of any application that is run against the emulated **cryptoki** wrapper built with the emulated FM.

Unlike Protect Processing 3.0 and earlier releases, applications do not have to be recompiled with the emulated libraries, they simply have to have the **emucprov** and **emumdapi** wrapper libraries (with standard **cryptoki.so** and **ethsm.so** naming) in the library search path ahead of the real **cryptoki** library.

> **Best practice:** Ensure that the **emucprov** and **emumdapi** wrapper libraries appear before the **cryptoki** library in your library search path.

The following diagram illustrates the functionality provided by the FM SDK in emulation mode. See the *FM SDK Programming Guide* for more information.




## FM Certificates

By default, MKFM will not sign with a 512-bit certificate. It is recommended that you create your FM certificates using RSA 2048 instead of RSA512. For example:

| | |
|---|---|
| **ProtectServer** | ctcert c -s0 -k -trsa -z512 -lfm |
| **ProtectServer 2** | ctcert c -s0 -k -trsa -z2048 -lfm |

MKFM now uses SHA-512 instead of SHA-1. To continue using a legacy 512-bit certificate for signing with a SHA-1 hash, you can use the -3 option of the MKFM command, although this is not recommended.

> **Best practice:** Create your FM certificates using RSA 2048.

## FM Debug Logging Using printf

Historically, debug logging has been via a simulated serial port 0 and the **dbgprint** routines. These methods are maintained for backwards compatibility.

As a simpler alternative to these methods, ProtectServer 2 adds support for standard C **printf** to write debug messages to the **hsmtrace** log.

> **Best practice:** Update your code to use **printf** instead of serial port 0 and the **dbgprint** routines.

## Compile-Time Checking

The _SFNT_FM_ compiler define has been added to enable a compile time check for an FM build.

_SFNT_FM_ is also set for emulation builds, which also have FM_EMU and EMUL set.

## The clock() Function Uses the ANSI/ISO Standard for Returning CPU Time

The clock() function now follows the ANSI/ISO standard of returning CPU time. This differs from Microsoft Windows clock() which returns wall time. Elapsed time checks should now use the more accurate THR_BeginTiming and THR_UpdateTiming APIs. Although these APIs existed in PPO, clock() on the PSG and K5 behaved like Windows, returning wall time instead of CPU time.

> **Best practice:** Use the **THR_BeginTiming** and **THR_UpdateTiming** APIs to perform elapsed time checks.

## The integers.h Header File Removed From $(FMSDK)/include

The **integers.h** header file is no longer included in both **$(FMSDK)/include** and **$(CPROVDIR)/include**. It is now only included in **$(CPROVDIR/include** since PTK-C is required in order to use the FM SDK.

## MKFM and CTFM Disable (d) Flag is Now Delete

The tools used to load and manage your FMs, such as MKFM and CTFM are the same as in previous releases with the exception of the "Disable" (d) flag. In previous releases, this flag disabled, but did not remove the FM. In this release, this flag will fully remove an FM rather than simply disabling it.

## Obsolete FM SDK Copy Function Removed

The **Copy** function, which is obsolete and previously deprecated, has been removed from both the **Cipher** object and the **Hash** object.

> **Best practice:** Remove all instances of the **CipherObj copy** and **HashObj copy** functions from your code.

## Support Removed for libfmhost

The **libfmhost** library is no longer supported for HOST applications. The **fmdisp.h** header remains and has wrappers around the supported MD APIs for migration purposes. If your application uses these legacy APIs, your compile output will include deprecated warnings.

## Failed FMs

Failed FMs are now deleted instead of being disabled.

# Migrating Your FMs

Migrating your existing FMs should require only makefile changes and recompilation. It is recommended that you take advantage of the enhancements to the FM SDK introduced in Release 5 (or higher) when migrating your source.

**To migrate an FM**

1. Install the PTK-C SDK and FM SDK on a workstation or VM running a supported Linux OS.

   > **Note:** By default, the FM SDK is set to operate in emulation mode. You cannot install FMs while in emulation mode. To install an FM you must change the operating mode to hardware mode  The operating mode is specified when you run the installation script, and can be changed by re-running the script.

2. Update your makefiles, as outlined in “Makefiles” on page 16.
3. Review the list of changes and enhancements introduced in the Release 5 (or higher) FM SDK, as detailed in “Summary of Changes and Enhancements on page 12, to determine whether any additional changes are required. You may also want to update your code at this time to implement some of the enhancements.
4. Build your source.
5. If necessary, fix any compile errors. See “Summary of Changes and Enhancements” on page 13 for a list of the changes introduced in Release 5 (or higher) that may be the source of the errors.