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DRAFT Protection Profile for General-Purpose Computing Platforms DRAFT

Version: 2.0
2025-01-13
National Information Assurance Partnership

Revision History

Version	Date	Comment
0.1	2020-11-16	Started
1.0	2022-02-10	Initial publication.
1.1	2024-12-13	Updates for CC:2022
2.0	2025-01-13	Draft: Incorporate TRRTs

Contents

1 Introduction

1.1 Overview

The scope of this Protection Profile (PP) is to describe the security functionality of General-Purpose Computing Platforms in terms of the Common Criteria and to define functional and assurance requirements for such products.

A platform is a collection of hardware devices and firmware that provide the functional capabilities and services needed by tenant software. Such components typically include embedded controllers, trusted platform modules, management controllers, host processors, network interface controllers, graphics processing units, flash memory, storage controllers, storage devices, boot firmware, runtime firmware, human interface devices, and a power supply.

This Protection Profile for General-Purpose Computing Platforms derives requirements from the following documents:

- NIAP, *BIOS Update for PC Client Devices protection Profile*, Version 1.0, 12 Feb 2013
- NIST SP 800-147 *BIOS Protection Guidelines*, April 2011
- NIST SP 800-147B *BIOS Protection Guidelines for Servers*, August 2014
- NIST SP 800-193 *Platform Firmware Resiliency Guidelines*

Additionally, the following specifications and standards may be relevant to requirements in this PP:

- NIST SP 800-155 (Draft) *BIOS Integrity Measurement Guidelines (Draft)*, December 2011
- NIST SP 1800-34 (Draft) *Validating the Integrity of Computing Devices (Preliminary Draft)*, 2021
- Trusted Computing Group, *TCG PC Client Platform Firmware Integrity Measurement* Version 1.0 Revision Specification 43 Family 2.0, May 7, 2021
- IEEE Std 802.1AR-2018, *Secure Device Identity*

1.2 Terms

The following sections list Common Criteria and technology terms used in this document.

1.2.1 Common Criteria Terms

Assurance	Grounds for confidence that a TOE meets the SFRs [CC].
Base Protection Profile (Base-PP)	Protection Profile used as a basis to build a PP-Configuration.
Collaborative Protection Profile (cPP)	A Protection Profile developed by international technical communities and approved by multiple schemes.
Common Criteria (CC)	Common Criteria for Information Technology Security Evaluation (International Standard ISO/IEC 15408).
Common Criteria Testing Laboratory	Within the context of the Common Criteria Evaluation and Validation Scheme (CCEVS), an IT security evaluation facility accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and approved by the NIAP Validation Body to conduct Common Criteria-based evaluations.
Common Evaluation Methodology (CEM)	Common Evaluation Methodology for Information Technology Security Evaluation.
Extended Package (EP)	A deprecated document form for collecting SFRs that implement a particular protocol, technology, or functionality. See Functional Packages.
Functional Package (FP)	A document that collects SFRs for a particular protocol, technology, or functionality.
Operational Environment (OE)	Hardware and software that are outside the TOE boundary that support the TOE functionality and security policy.
Protection Profile (PP)	An implementation-independent set of security requirements for a category of products.
Protection Profile	A comprehensive set of security requirements for a product type that consists of at least one Base-PP and at least one PP-Module.

Configuration (PP-Configuration)	
Protection Profile Module (PP-Module)	An implementation-independent statement of security needs for a TOE type complementary to one or more Base-PPs.
Security Assurance Requirement (SAR)	A requirement to assure the security of the TOE.
Security Functional Requirement (SFR)	A requirement for security enforcement by the TOE.
Security Target (ST)	A set of implementation-dependent security requirements for a specific product.
Target of Evaluation (TOE)	The product under evaluation.
TOE Security Functionality (TSF)	The security functionality of the product under evaluation.
TOE Summary Specification (TSS)	A description of how a TOE satisfies the SFRs in an ST.

1.2.2 Technical Terms

Administrator	An Administrator is responsible for management activities, including setting policies that are applied by the enterprise on the platform. An Administrator can act remotely through a management server, from which the platform receives configuration policies and updates. An Administrator can enforce settings on the system that cannot be overridden by non-Administrator users.
American National Standards Institute (ANSI)	A private organization that oversees development of standards in the United States.
Application	Software that runs on a platform and performs tasks on behalf of the user or owner of the platform.
Application Programming Interface (API)	A specification of routines, data structures, object classes, and variables that allows an application to make use of services provided by another software component, such as a library. APIs are often provided for a set of libraries included with the platform.
Baseboard Management Controller (BMC)	Or Management Controller. A small computer generally found on Server motherboards that performs management tasks on behalf of an Administrator.
Cipher-based Message Authentication Code (CMAC)	A mode of AES that provides authentication, but not confidentiality.
Commercial Solutions for Classified (CSfC)	An US Department of Defense program for delivering cybersecurity solutions that leverage commercial technologies and products.
Credential	Data that establishes the identity of a user, e.g. a cryptographic key or password.
Critical Security Parameters (CSP)	Information that is either user or system defined and is used to operate a cryptographic module in processing encryption functions including cryptographic keys and authentication data, such as passwords, the disclosure or modification of which can compromise the security of a cryptographic module or the security of the information protected by the

	module.
Data-at-Rest (DAR) Protection	Countermeasures that prevent attackers, even those with physical access, from extracting data from non-volatile storage. Common techniques include data encryption and wiping.
Developer	An entity that manufactures platform hardware or writes platform software/firmware. For the purposes of this document, vendors and developers are the same.
Diffie-Hellman Key Exchange (DH)	A cryptographic key exchange protocol using public/private key pairs.
Distinguished Name (DN)	Information used in certificate-based operations to uniquely identify a person, organization, or business.
End-User Device (EUD)	A class of computing platform characterized by having a user interface for a single user. Often, EUDs are portable (e.g., laptop, tablet, mobile device), but this is not necessarily the case (e.g., desktop PC).
General Purpose Operating System	A class of OS designed to support a wide-variety of workloads consisting of many concurrent applications or services. Typical characteristics for OSes in this class include support for third-party applications, support for multiple users, and security separation between users and their respective resources.
General-Purpose Computing Platform (GPCP)	A physical computing platform designed to support general-purpose operating systems, virtualization systems, and applications.
Internet of Things (IoT)	Physical computing devices that are embedded with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over communications networks.
Joint Test Action Group (JTAG)	A standard for verifying and testing circuit boards after manufacture.
KECCAK Message Authentication Code (KMAC)	A variable-length keyed hash function described in NIST SP 800-185.
Management Controller (MC)	Or Baseboard Management Controller (BMC). A small computer generally found on server motherboards that performs management tasks on behalf of an Administrator.
Open Mobile Terminal Platform (OMTP)	A forum created by mobile network operators to discuss standards with manufacturers of mobile devices.
Operating System (OS)	Software that manages physical and logical resources and provides services for applications. Operating systems are the generally the primary tenant of a GPCP.
Physical Presence	A user or administrator having physical access to the TOE. An assertion of physical presence can take the form, for example, of requiring entry of a password at a boot screen, unlocking of a physical lock (e.g., a motherboard jumper), or inserting a USB cable before permitting platform firmware to be updated.
Root of Trust (RoT)	Roots of trust are highly reliable hardware, firmware, and software components that perform specific, critical security functions. Roots of trust are the foundation for integrity of computing devices.
Sensitive Data	Sensitive data may include all user or enterprise data or may be specific application data such as PII, emails, messaging, documents, calendar items, and contacts. Sensitive data must minimally include credentials and keys.
Subject Alternative Name (SAN)	An extended X.509 certificate field.
Tenant Software	Software that runs on and is supported by a platform. In the case of a GPCP, tenant software generally consists of an operating system, virtualization system, or "bare-metal" application.
Trusted	An isolated and secure area that ensures the confidentiality and integrity of code and data

Execution Environment (TEE)	loaded inside.
User	In the context of a GPCP, a User is a human who interacts with the platform through a user interface. Users do not need to be authenticated by the platform to use the platform, but generally authenticate to tenant software such as on Operating System.
Virtualization System (VS)	A software product that enables multiple independent computing systems to execute on the same physical hardware platform without interference from one other.

1.3 TOE Overview

This Protection Profile for General-Purpose Computing Platforms (GPCP) specifies security requirements for general-purpose computing platforms. A GPCP is is a hardware device that is capable of hosting one or more general-purpose operating systems as defined by the Protection Profile for General Purpose Operating Systems, one or more virtualization systems as defined by the Protection Profile for Virtualization, or more than one application. Typical platform implementations include servers, PC clients, laptops, and tablets.

Mobile Device platforms as defined in the Protection Profile for Mobile Device Fundamentals and Network Device platforms as defined in the collaborative Protection Profile for Network Devices are out of scope of this PP. Mobile Device and Network Device platforms must be evaluated against the more specific requirements in their respective specialized PPs.

The core security features of GPCPs include protected firmware and a boot integrity processes. Platform firmware must be protected such that it is not permitted to execute if it has been modified outside of authorized and authenticated update processes. Other use-case-specific features include audit capabilities, Administrator authentication, and protections against physical tampering.

1.3.1 TOE Boundary

The TOE comprises the hardware and firmware necessary for the hosting of tenant software. Generally, tenant software is an operating system or virtualization system, but may also be "bare-metal" applications. Tenant software is outside the TOE boundary.

For example, for a PC Client platform, the hardware and firmware responsible for booting the platform and operation of platform devices (such as BIOS, device controller firmware, and platform management firmware would all be included in the TOE. Operating systems and application software is outside the TOE.

For server-class hardware, any management controller responsible for updating platform firmware (such as a baseboard management controller) is expressly included within the TOE.

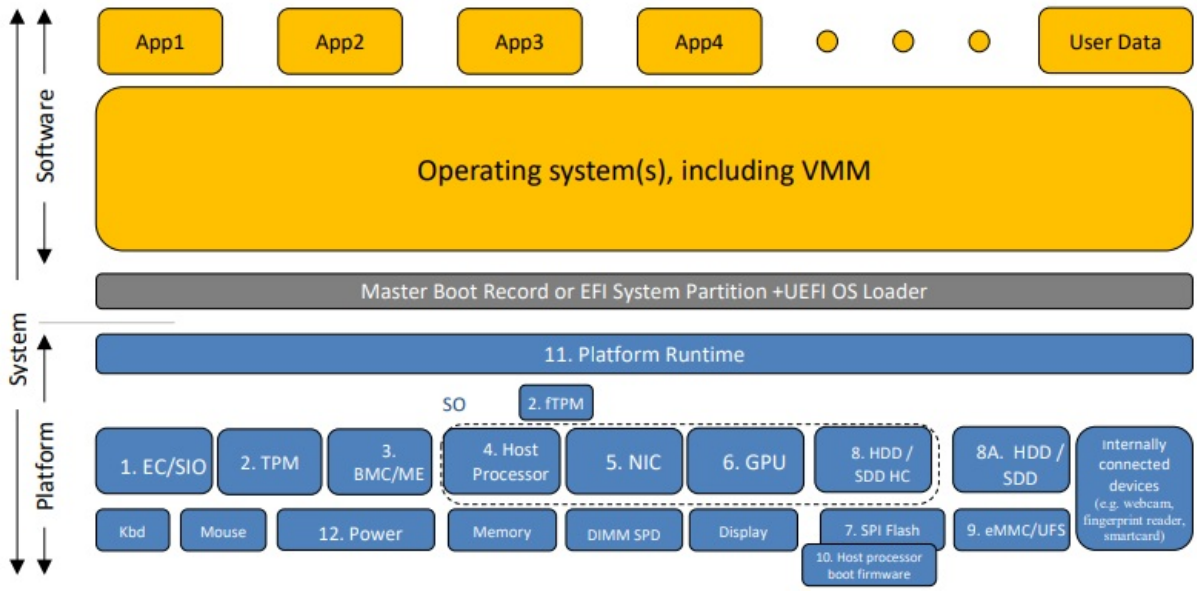

Figure 1: High-Level Architecture of a Generic Platform

Figure 1 (taken from NIST SP 800-193) shows a high-level system architecture for a typical generic computing platform. Tenant software (operating system/virtualization system and applications) is shown in orange. The tenant-specific software responsible for booting the tenant (Master Boot Record, etc.) is shown in grey. Platform components are in blue.

In general, the TOE consists of the platform components represented by the blue boxes, along with their associated firmware. Any particular platform may have additional hardware components, or fewer than those illustrated.

Addresses TRRT 1567 If the GPCP includes Full Drive Encryption (FDE), and the FDE component has been previously evaluated against the FDEcPPs, or will be evaluated against the FDEcPPs concurrently with the GPCP evaluation, then the FDE component may be excluded from the TOE for purposes of the GPCP

evaluation.

1.3.2 TOE Operational Environment

The TOE has no platform since it is itself a platform, but the TOE does have an operational environment. The OE consists of the physical environment in which the TOE operates (e.g., data center, enterprise office, vehicle, outdoors) and any networks to which the TOE may be connected. Different use cases may invoke different requirements depending on the operational environment.

1.4 Use Cases

This Protection Profile supports several use cases. The cases enumerated below add requirements to the baseline for GPCP due to additional threats or changes in assumptions about the operational environment. Use cases not listed below (e.g. consumer-grade desktop computers) need be evaluated only against the baseline requirements subject to the appropriate selections.

The requirements associated with some use case encompass those of other use cases. In these situations, a TOE that meets the larger set of requirements meets both use cases. Specifically

- a TOE that meets [USE CASE 2] Server-Class Platform, Enhanced also meets [USE CASE 1] Server-Class Platform, Basic
- a TOE that meets [USE CASE 5] CSfC EUD also meets [USE CASE 4] Portable Clients (laptops, tablets), Enhanced and [USE CASE 3] Portable Clients (laptops, tablets), Basic, and
- a TOE that meets [USE CASE 6] Tactical EUD also meets [USE CASE 4] Portable Clients (laptops, tablets), Enhanced and [USE CASE 3] Portable Clients (laptops, tablets), Basic.

[USE CASE 1] Server-Class Platform, Basic

This use case encompasses server-class hardware in a data center. There are no additional physical protections required because the platform is assumed to be protected by the operational environment as indicated by A.PHYSICAL_PROTECTION. The platform is administered through a management controller that accesses the MC through a console or remotely.

This use case adds audit requirements and Administrator authentication requirements to the base mandatory requirements.

For changes to included SFRs, selections, and assignments required for this use case, see F.1 Server-Class Platform, Basic.

[USE CASE 2] Server-Class Platform, Enhanced

This use case adds physical protections to the base requirements for server-class hardware. Additional physical protections are required because the platform us assumed to be minimally protected by the by the operational environment. This use case can also be invoked for servers in data centers where there are enhanced security requirements.

This use case adds requirements for audit, physical protections, and Administrator authentication to the base mandatory SFRs. It removes the assumption that the TOE is physically protected by the OE.

For changes to included SFRs, selections, and assignments required for this use case, see F.2 Server-Class Platform, Enhanced.

[USE CASE 3] Portable Clients (laptops, tablets), Basic

This use case defines the base requirements for portable clients.

This use case adds no requirements to the base mandatory SFRs.

[USE CASE 4] Portable Clients (laptops, tablets), Enhanced

This use case adds physical protections to the base requirements for portable clients or end-user devices. It is intended for devices that are used in high-assurance scenarios.

For changes to included SFRs, selections, and assignments required for this use case, see F.4 Portable Clients (laptops, tablets), Enhanced.

[USE CASE 5] CSfC EUD

Modified to address TRRT 1560 EUDs used in accordance with the CSfC Mobile Access Capability Package can include smart phones, tablets, and laptops. This use case covers the basic CSfC requirements for tablet and laptop EUDs (mobile devices are out of scope for this PP).

CSfC requires that users maintain physical control of EUDs at all times. This use case adds requirements for audit and for protection of debug ports .

For changes to included SFRs, selections, and assignments required for this use case, see F.5 CSfC EUD.

[USE CASE 6] Tactical EUD

This use case adds requirements for portable end user computing devices in a tactical environment.

For changes to included SFRs, selections, and assignments required for this use case, see F.6 Tactical EUD.

[USE CASE 7] Enterprise Desktop clients

This use case covers the requirements for non-portable desktop computing devices in a low-threat enterprise physical environment.

This use case adds only audit to the base mandatory SFRs.

For changes to included SFRs, selections, and assignments required for this use case, see F.7 Enterprise Desktop clients.

[USE CASE 8] IoT Devices

IoT devices are field-located devices without human interfaces when in normal operation. In order to qualify for evaluation under this PP, the device must meet the basic criteria for a general-purpose platform, and not meet the requirements for a mobile device or network device.

For changes to included SFRs, selections, and assignments required for this use case, see F.8 IoT Devices.

1.5 Roles

For purposes of these requirements there are two entities that interact with a general-purpose computing platform:

1. Users (unprivileged users)
2. Administrators (privileged users)

Users are humans who interact with the platform through user interfaces. They usually have to authenticate themselves to tenant software (e.g. an operating system), but generally not to the platform itself. Throughout this document the term "user" refers generally to a person interacting with the platform.

Administrators are users who manage the platform through a management interface. The interface may be local or remote to the platform.

Administrators manage the physical platform, not the OS (OS Administrators would be classified as platform Users). Administrators must be authenticated to the platform before the platform can allow them to perform administrative functions. For an EUD, this could be accomplished through an interface implemented in firmware. For server-class hardware, the management interface could be implemented in a management controller that is part of the platform. Administrators are assumed to be acting in the best interests of the platform owner.

Tenant Software generally consists of an operating system, virtualization system, or application that uses platform resources to run workloads on behalf of Users. Tenant software generally has the privilege of the User or Administrator in whose context it runs.

2 Conformance Claims

Conformance Statement

An ST must claim exact conformance to this PP.

The evaluation methods used for evaluating the TOE are a combination of the workunits defined in [CEM] as well as the Evaluation Activities for ensuring that individual SFRs and SARs have a sufficient level of supporting evidence in the Security Target and guidance documentation and have been sufficiently tested by the laboratory as part of completing ATE_IND.1. Any functional packages this PP claims similarly contain their own Evaluation Activities that are used in this same manner.

CC Conformance Claims

This PP is conformant to Part 2 (extended) and Part 3 (extended) of Common Criteria CC:2022, Revision 1 as corrected and interpreted in [ERR], Version 1.1.

PP Claim

This PP does not claim conformance to any Protection Profile.

There are no PPs or PP-Modules that are allowed in a PP-Configuration with this PP.

Package Claim

- This PP is Functional Package for Secure Shell (SSH) Version 2.0 conformant.
- This PP is Functional Package for Transport Layer Security Version 2.1 conformant.
- This PP is Functional Package for X.509 Version 1.0 conformant.
- This PP does not conform to any assurance packages.

The functional packages to which the PP conforms may include SFRs that are not mandatory to claim for the sake of conformance. An ST that claims one or more of these functional packages may include any non-mandatory SFRs that are appropriate to claim based on the capabilities of the TSF and on any triggers for their inclusion based inherently on the SFR selections made.

3 Security Problem Definition

The security problem is described in terms of the threats that the GPCP is expected to address, assumptions about the operational environment, and any organizational security policies that the GPCP is expected to enforce.

The platform has three major security responsibilities:

- ensuring the integrity of its own firmware and hardware
- ensuring that it is resilient
- providing security services to tenant workloads

These responsibilities manifest as protecting:

- Platform firmware and hardware
- Platform firmware updates
- Tenant initialization (boot)

3.1 Threats

T.PHYSICAL
An attacker with physical access might be able to compromise TOE integrity, subvert TOE protections, or access tenant data through hardware attacks such as probing, physical manipulation, fault-injection, side-channel analysis, environmental stress, or activating disabled features or pre-delivery services. This threat is mitigated by TOE functionality for the use cases listed below; for other use cases, the expectation is that the environmental security objectives are sufficient mitigation for this threat.

- Server-Class Platform, Enhanced
- Portable Clients (laptops, tablets), Enhanced
- CSfC EUD
- Tactical EUD
- IoT Devices

T.SIDE_CHANNEL_LEAKAGE
An attacker running in a tenant context might be able to leverage physical effects caused by the operation of the TOE to derive sensitive information about other tenants or the TOE.

T.PERSISTENCE
An attacker might be able to establish a permanent presence on the TOE in firmware. This could result in permanent compromise of tenant information, as well as TOE updates. This threat does not encompass attacker presence in tenant software, as tenant software is not part of the TOE.

T.UPDATE_COMPROMISE
An attacker may attempt to provide a compromised update of TOE firmware. Such updates can undermine the security functionality of the device if they are unauthorized, unauthenticated, or are improperly validated using non-secure or weak cryptography.

T.SECURITY_FUNCTIONALITY_FAILURE
An attacker could leverage failed or compromised security functionality to access, change, or modify tenant data, TOE data, or other security functionality of the device.

T.TENANT_BASED_ATTACK
An attacker running software as a tenant can attempt to access or modify TOE firmware or functionality. Note that direct tenant attacks against other tenants are not encompassed by this threat as they are out of scope.

T.NETWORK_BASED_ATTACK
An attacker from off the TOE can attempt to compromise the TOE through a network interface connected to an active TOE component, such as a management subsystem.

T.UNAUTHORIZED_RECONFIGURATION
An attacker might be able to modify the configuration of the TOE and alter its functionality. This might include, activating dormant subsystems, disabling hardware assists, or altering boot-time behaviors.

T.UNAUTHORIZED_PLATFORM_ADMINISTRATOR
An attacker might be able to attain platform administrator status by defeating or bypassing authentication measures.

3.2 Assumptions

A.PHYSICAL_PROTECTION
The TOE is assumed to be physically protected in its operational environment and thus is not subject to physical attacks that could compromise its security or its ability to support the security of tenant workloads. This assumption does not apply if the TOE implements any of the below, in which case physical protection from the Operational Environment is not assumed and the threat T.PHYSICAL and its associated TOE Objectives apply:

- Server-Class Platform, Enhanced

- Portable Clients (laptops, tablets), Enhanced
- CSfC EUD
- Tactical EUD
- IoT Devices

A.ROT_INTEGRITY
The TOE includes one or more Roots of Trust composed of TOE firmware, hardware, and pre-installed credentials. Roots of Trust are assumed to be free of malicious capabilities as their integrity cannot be verified.

A.TRUSTED_ADMIN
TOE Security Administrator are assumed to be trusted and to act in the best interest of security for the organization. The TOE is not expected to be capable of defending against a malicious Administrator that actively works to bypass or compromise the security of the platform.

A.MFR_ROT
The root signing credential of the manufacturer is assumed to be secure and has not been compromised.

A.TRUSTED_DEVELOPMENT_AND_BUILD_PROCESSES
The TOE cannot protect itself during its own development and build processes. Therefore it is assumed that the developers and participants in the build process are not hostile.

A.SUPPLY_CHAIN_SECURITY
The hardware components that comprise the TOE are assumed to be non-hostile and not compromised at the time of TOE construction. Likewise, the TOE is assumed to retain its integrity throughout transportation until delivery to its operational site.

A.CORRECT_INITIAL_CONFIGURATION
It is assumed that the initial setup and configuration of the TOE at its operational site is correct and in accordance with organizational security policy and operational use case.

A.TRUSTED_USERS
Physically present non-administrative users of the TOE are assumed to be trusted as far as they are assumed to not be actively trying to subvert the system. (Not for all use cases).

A.REGULAR_UPDATES
It is assumed that the manufacturer provides updates to TOE firmware in a timely manner in response to known vulnerabilities, and that Administrators apply these updates when they are received.

3.3 Organizational Security Policies

This document does not define any additional OSPs.

4 Security Objectives

4.1 Security Objectives for the Operational Environment

The following security objectives for the operational environment assist the GPCP in correctly providing its security functionality. These track with the assumptions about the environment.

OE.PHYSICAL_PROTECTION
Platforms that operate within data centers or in other access-controlled environments are expected to receive a considerable degree of protection from these environments. In addition to physical protection, these environments often provide malware-detection and behavior-monitoring services for networked computing assets.

OE.SUPPLY_CHAIN
The manufacturer is expected to implement processes to ensure that TOE hardware and firmware is not compromised between time of TOE manufacture and delivery to its operational site.

OE.TRUSTED_ADMIN
The administrator of the GPCP is not careless, willfully negligent or hostile, and administers the platform within compliance of enterprise security policy.

4.2 Security Objectives Rationale

This section describes how the assumptions and organizational security policies map to operational environment security objectives.

Table 1: Security Objectives Rationale

Assumption or OSP	Security Objectives	Rationale
A.PHYSICAL_PROTECTION	OE.PHYSICAL_PROTECTION	The operational environment objective OE.PHYSICAL_PROTECTION is realized through A.PHYSICAL_PROTECTION.
A.ROT_INTEGRITY	OE.SUPPLY_CHAIN	The operational environment objective OE.SUPPLY_CHAIN is realized through A.ROT_INTEGRITY.
A.TRUSTED_ADMIN	OE.TRUSTED_ADMIN	The operational environment objective OE.TRUSTED_ADMIN is realized through A.TRUSTED_ADMIN.
A.MFR_ROT	OE.TRUSTED_ADMIN	The operational environment objective OE.TRUSTED_ADMIN is realized through A.TRUSTED_ADMIN.
A.TRUSTED_DEVELOPMENT_AND_BUILD_PROCESSES	OE.TRUSTED_ADMIN	The operational environment objective OE.TRUSTED_ADMIN is realized through A.TRUSTED_ADMIN.
A.SUPPLY_CHAIN_SECURITY	OE.TRUSTED_ADMIN	The operational environment objective OE.TRUSTED_ADMIN is realized through A.TRUSTED_ADMIN.
A.CORRECT_INITIAL_CONFIGURATION	OE.TRUSTED_ADMIN	The operational environment objective OE.TRUSTED_ADMIN is realized through A.TRUSTED_ADMIN.
A.TRUSTED_USERS	OE.TRUSTED_ADMIN	The operational environment objective OE.TRUSTED_ADMIN is realized through A.TRUSTED_ADMIN.
A.REGULAR_UPDATES	OE.TRUSTED_ADMIN	The operational environment objective OE.TRUSTED_ADMIN is realized through A.TRUSTED_ADMIN.

5 Security Requirements

This chapter describes the security requirements which have to be fulfilled by the product under evaluation. Those requirements comprise functional components from Part 2 and assurance components from Part 3 of [CC]. The following conventions are used for the completion of operations:

- **Refinement** operation (denoted by **bold text** or ~~strikethrough text~~): Is used to add details to a requirement or to remove part of the requirement that is made irrelevant through the completion of another operation, and thus further restricts a requirement.
- **Selection** (denoted by *italicized text*): Is used to select one or more options provided by the [CC] in stating a requirement.
- **Assignment** operation (denoted by *italicized text*): Is used to assign a specific value to an unspecified parameter, such as the length of a password. Showing the value in square brackets indicates assignment.
- **Iteration** operation: Is indicated by appending the SFR name with a slash and unique identifier suggesting the purpose of the operation, e.g. "/EXAMPLE1."

5.1 Security Functional Requirements

5.1.1 Auditable Events for Mandatory SFRs

Table 2: Auditable Events for Mandatory Requirements

Requirement	Auditable Events	Additional Audit Record Contents
FCS_COP.1/KeyEncap	No events specified	N/A
FCS_COP.1/KeyWrap	No events specified	N/A
FCS_COP.1/XOF	No events specified	N/A
FCS_OTV_EXT.1	No events specified	N/A
FCS_RBG.6	No events specified	N/A
FMT_CFG_EXT.1	No events specified	N/A
FMT_MOF.1	No events specified	N/A
FMT_SMF.1	No events specified	N/A
FMT_SMR.1	No events specified	N/A
FPT_JTA_EXT.1	No events specified	N/A
FPT_PPF_EXT.1	No events specified	N/A
FPT_ROT_EXT.1	No events specified	N/A
FPT_ROT_EXT.2	**[selection:** *Failure of integrity verification, None***]**	None.
FPT_STM.1	No events specified	N/A
FPT_TUD_EXT.1	No events specified	N/A

5.1.2 Class: Security Audit (FAU)

FAU_GEN.1 Audit Data Generation

This is a selection-based component. Its inclusion depends upon selection from FPT_ROT_EXT.2.2, FPT_ROT_EXT.3.2, FPT_TUD_EXT.2.5, FPT_TUD_EXT.3.4.

FAU_GEN.1.1 The TSF shall be able to generate audit data of the following auditable events:

1. Start-up and shutdown of the audit functions
2. All administrative actions
3. Start-up, shutdown, and reboot of the platform
4. Specifically defined auditable events in Table 2
5. [**selection**:
    - *Specifically defined auditable event in Table t-audit-optional for*

Strictly Optional requirements
- *Specifically defined auditable event in Table t-audit-objective for Objective requirements*
- *Specifically defined auditable event in Table t-audit-sel-based for Selection-based requirements*
- *Additional information defined in the audit table for the Functional Package for Transport Layer Security (TLS), version 2.1*
- *Additional information defined in the audit table for the Functional Package for Secure Shell (SSH), version 2.0*
- *no additional auditable events*

].

FAU_GEN.1.2

The TSF shall record within the audit data at least the following information:

a. Date and time of the event
b. Type of event
c. Subject and object identity (if applicable)
d. The outcome (success or failure) of the event
e. [**Additional information defined in Table 2**]
f. **[selection:**
   - ***Additional information defined in Table t-audit-optional for Strictly Optional SFRs***
   - ***Additional information defined in Table t-audit-objective for Objective SFRs***
   - ***Additional information defined in Table t-audit-sel-based for Selection-Based SFRs***
   - ***Additional information defined in the audit table for the Functional Package for Transport Layer Security (TLS), version 2.1***
   - ***Additional information defined in the audit table for the Functional Package for Secure Shell (SSH), version 2.0***
   - ***no other information***

].

Application Note: The ST Author should include this SFR in the ST if the TOE generates audit events for integrity verification or boot failures as indicated by the appropriate selections in FPT_ROT_EXT.2, FPT_ROT_EXT.3, FPT_TUD_EXT.2, or FPT_TUD_EXT.3.4; or if the TOE supports the Server (basic or enhanced), CSfC EUD, or Enterprise Desktop use cases.

If this SFR is included in the ST, then all the other FAU SFRs must also be claimed.

Appropriate entries from Table t-audit-optional, Table t-audit-objective, and Table t-audit-sel-based should be included in the ST if the associated SFRs and selections are included.

Specific auditable events required for SFRs from the functional packages are defined in the respective packages.

Evaluation Activities

FAU_GEN.1
TSS
The evaluator shall check the TSS and ensure that it lists all of the auditable events and provides a format for audit records. Each audit record format type shall be covered, along with a brief description of each field.

Guidance
The evaluator shall also make a determination of the administrative actions that are relevant in the context of this PP. The evaluator shall examine the AGD and make a determination of which administrative commands, including subcommands, scripts, and configuration files, are related to the configuration (including enabling or disabling) of the mechanisms implemented in the TOE that are necessary to enforce the requirements claimed in the ST. The evaluator shall document the methodology or approach taken while determining which actions in the AGD are security-relevant with respect to this PP.

Tests
The evaluator shall test the TOE's ability to correctly generate audit records by having the TOE generate audit records for the events listed and administrative actions. For administrative

actions, the evaluator shall test that each action determined by the evaluator above to be security relevant in the context of this PP is auditable. When verifying the test results, the evaluator shall ensure the audit records generated during testing match the format specified in the administrative guide, and that the fields in each audit record have the proper entries.

Note that the testing here can be accomplished in conjunction with the testing of the security mechanisms directly.

FAU_SAR.1 Audit Review

This is a selection-based component. Its inclusion depends upon selection from .

FAU_SAR.1.1

The TSF shall provide **the Administrator** with the capability to read **all audited events and record contents** from the audit data.

FAU_SAR.1.2

The TSF shall provide the audit data in a manner suitable for the **Administrator** to interpret the information.

Application Note: This SFR must be included in the ST if FAU_GEN.1 is claimed.

Evaluation Activities

FAU_SAR.1
TSS
There are no additional TSS evaluation activities for this component.

Guidance
The evaluator shall review the AGD for the procedure on how to review the audit records.

Tests
The evaluator shall verify that the audit records provide all of the information specified in FAU_GEN.1 and that this information is suitable for human interpretation. The evaluation activity for this requirement is performed in conjunction with the evaluation activity for FAU_GEN.1.

FAU_STG.1 Audit Data Storage Location

This is a selection-based component. Its inclusion depends upon selection from .

FAU_STG.1.1

The TSF shall be able to transfer generated audit data on the [**selection**: *transmit the generated audit data to an external IT entity using a trusted channel according to FTP_ITC**_EXT.1**, [removable media]*]

Application Note: The ST Author must select "*trusted channel*" and include FTP_ITC_EXT.1 in the ST if the TOE offloads audit data to external IT entity over a network connection. Protocols used for implementing the trusted channel must be selected in FTP_ITC_EXT.1.

The ST Author must select "*removable media*" if the TOE supports offload of audit data using removable media such as thumb drives or disks.

Evaluation Activities

FAU_STG.1.1
TSS
The evaluator shall examine the TSS to ensure it describes the means by which the audit data are transferred to the external audit server.

Guidance
If "trusted channel" is selected above, the evaluator shall examine the AGD to ensure it describes how to establish the trusted channel to the audit server, as well as describe any requirements on the audit server (particular audit server protocol, version of the protocol required, etc.), as well as configuration of the TOE needed to communicate with the audit server.

Furthermore, it must describe whether the transfer mechanism is periodic or continuous, and what happens in the event of a loss of connectivity.

If "removable media" is selected, the evaluator shall ensure that the AGD describes the process for accessing audit data and copying it to media. The AGD must also include high-level guidance on how frequently this operation may need to be done to minimize risk of data loss.

Tests
If "trusted channel" is selected above, testing of the trusted channel mechanism itself is to be performed as specified in the evaluation activities for FTP_ITC_EXT.1. In addition, the evaluator must perform the following test:

The evaluator shall establish a session between the TOE and the audit server according to the configuration guidance provided. The evaluator shall then examine the traffic that passes between the audit server and the TOE during several activities of the evaluator's choice designed to generate audit data to be transferred to the audit server. The evaluator shall observe that these data are not able to be viewed in the clear during this transfer, and that they are successfully received by the audit server. The evaluator shall record the particular software (name, version) used on the audit server during testing.

If "removable media" is selected above, the evaluator must run the system for a time long enough to generate some audit data and then collect audit data onto removable media for transfer to another machine. On another machine, the evaluator shall examine the audit data to ensure that it appears to be complete and correct. This test may be performed in conjunction with any other requirement that generates audit events.

FAU_STG.2 Protected Audit Trail Storage

This is a selection-based component. Its inclusion depends upon selection from .

FAU_STG.2.1

The TSF shall protect the stored audit data in the audit trail from unauthorized deletion.

FAU_STG.2.2

The TSF shall be able to [*prevent*] unauthorized modifications to the stored audit data in the audit trail.

Application Note: This SFR must be included in the ST if FAU_GEN.1 is claimed.

Evaluation Activities

FAU_STG.2
TSS
The evaluator shall ensure that the TSS lists the locations of all logs and the access controls of those files such that unauthorized modification and deletion are prevented.

Guidance
The evaluator shall ensure that the AGD describes the steps necessary for an authorized administrator to delete audit records, if such a capability is implemented.

Tests
The evaluator shall perform the following tests:

- *Test FAU_STG.2:1: [conditional] If the TOE implements an audit record deletion capability, then the evaluator shall attempt to delete the audit trail in a manner that the access controls should prevent (as an unauthorized user) and shall verify that the attempt fails.*
- *Test FAU_STG.2:2: The evaluator shall attempt to modify the audit trail in a manner that the access controls should prevent (as an unauthorized application) and shall verify that the attempt fails.*

FAU_STG.5 Prevention of Audit Data Loss

This is a selection-based component. Its inclusion depends upon selection from .

FAU_STG.5.1

The TSF shall [*overwrite the oldest stored audit records*] if the audit data storage is full.

Application Note: This SFR must be included in the ST if FAU_GEN.1 is claimed.

Evaluation Activities

FAU_STG.5
TSS
The evaluator shall examine the TSS to ensure that it describes the size limits on the audit records, the detection of a full audit trail, and the action(s) taken by the TSF when the audit trail is full. The evaluator shall ensure that the action(s) results in the deletion or overwrite of the oldest stored record.

Guidance
The evaluator shall examine the AGD to ensure that it describes the means used by the TOE to indicate that the audit trail is full and overwrite is about to commence.

Tests
The evaluator shall cause audit records to be written until the size limits are met and exceeded. The evaluator shall verify that the overwrite function works as described in the TSS and that the indication of full audit trail is evident as described in the AGD.

5.1.3 Class: Cryptographic Support (FCS)

FCS_CKM.1/AKG Cryptographic Key Generation - Asymmetric Key

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.1.2.
This component may also be included in the ST as if optional.

FCS_CKM.1.1/AKG

The TSF shall generate **asymmetric** cryptographic keys in accordance with a specified cryptographic key generation algorithm [**selection**: *Cryptographic key generation algorithm*] and specified cryptographic **algorithm parameters** ~~key sizes~~ [**selection**: *Cryptographic algorithm parameters*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_CKM.1/AKG.

Table 3: Recommended choices for FCS_CKM.1/AKG

Identifier	Cryptographic key generation algorithm	Cryptographic algorithm parameters	List of standards
RSA	RSA	Modulus of size [**selection**: *2048, 3072, 4096*] bits	NIST FIPS PUB 186-5 (Section A.1.1)
ECC-ERB	ECC-ERB - Extra Random Bits	Elliptic Curve [**selection**: *P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1*]	FIPS PUB 186-5 (Section A.2.1) [**selection**: *NIST SP 800-186 (Section 3) [NIST Curves], RFC 5639 (Section 3) [Brainpool curves]*]
ECC-RS	ECC-RS - Rejection Sampling	Elliptic Curve [**selection**: *P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1*]	FIPS PUB 186-5 (Section A.2.2) [**selection**: *NIST SP 800-186 (Section 3) [NIST Curves], RFC 5639 (Section 3) [Brainpool curves]*]
FFC-ERB	FFC-ERB - Extra Random Bits	Static domain parameters approved for [**selection**:	NIST SP 800-56A Revision 3 (Section 5.6.1.1.3) [key pair

		• *IKE Groups [**selection**: MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192]* • *TLS Groups [**selection**: ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]*]	generation] [**selection**: *RFC 3526 [IKE groups], RFC 7919 [TLS groups]*]
FFC-RS	FFC-RS - Extra Random Bits	Static domain parameters approved for [**selection**: • *IKE Groups [**selection**: MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192]* • *TLS Groups [**selection**: ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]*]	NIST SP 800-56A Revision 3 (Section 5.6.1.1.3) [key pair generation] [**selection**: *RFC 3526 [IKE groups], RFC 7919 [TLS groups]*]
EdDSA	EdDSA	Domain parameters approved for elliptic curves [**selection**: *Edwards25519*, *Edwards448*]	NIST FIPS PUB 186-5 (Section 6.2.1) [key-pair generation] NIST SP 800-186 (Section 3.2.3) [Edwards Curves]
KCDSA	KCDSA	Domain parameters generation with (L, N) = [**selection**: *(2048, 224)*, *(2048, 256)*, *(3072, 256)*]bits	ISO/IEC 14888-3:2018 (Subclause 6.3) [KCDSA]
EC-KCDSA	EC-KCDSA	Elliptic Curves [**selection**: *P-224*, *B-233*, *K-233*, *P-256*, *B-283*, *K-283*]	ISO/IEC 14888-3:2018 (Subclause 6.7) [EC-KCDSA] NIST SP 800-186 (Section 3) [NIST Curves]
LMS	LMS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Winternitz parameter = [**selection**: *1*, *2*, *4*, *8*] Tree height = [**selection**: *5*, *10*, *15*, *20*, *25*]	RFC 8554 [LMS] NIST SP 800-208 [parameters]
HSS	HSS	Private key size =	RFC 8554 [HSS]

		[**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Winternitz parameter = [**selection**: *1*, *2*, *4*, *8*] Tree height = [**selection**: *5*, *10*, *15*, *20*, *25*] Number of levels = [**selection**: *1*, *2*, *3*, *4*, *5*, *6*, *7*, *8*]	NIST SP 800-208 [parameters]
XMSS	XMSS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Tree height = [**selection**: *10*, *16*, *20*]	RFC 8391 [XMSS] NIST SP 800-208 [parameters]
XMSS(MT)	XMSS(MT)	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] (Total Tree height, Number of Levels) = [**selection**: *(20, 2)*, *(20, 4)*, *(40, 2)*, *(40, 4)*, *(40, 8)*, *(60, 3)*, *(60, 6)*, *(60, 12)*]	RFC 8391 [XMSS(MT)] NIST SP 800-208 [parameters]

Application Note: This SFR must be included in the ST if asymmetric key generation is a service provided by the TOE to tenant software, or if it is used by the TOE itself to support or implement PP-specified security functionality.

Also, this SFR must be included in the ST if FCS_IPSEC_EXT.1 is claimed, or if "*causing the TOE to generate [asymmetric] keys/secrets*" is selected in FCS_STG_EXT.1.2.

If this SFR is included in the ST, then FCS_CKM.6 and FCS_RBG.1 must also be claimed.

From catalogFor RSA the choice of the modulus implies the resulting key sizes of the public and private keys generated using the specified standard methods.

For Finite Field Cryptography (FFC) DSA, ST authors should consult schemes for guidelines on use. FIPS PUB 186-5 does not approve DSA for digital signature generation but allows DSA for digital signature verification for legacy purposes. “FFC-ERB” or “FFC–RS” may be claimed only for generating private and public keys when “DH” is claimed in FCS_CKM_EXT.7.

When generating ECC keys pairs for key agreement and if “ECDH” or “ECDH-

Ed” is claimed in FCS_CKM_EXT.7, then “ECC–ERB” or “ECC–RS” must be claimed. The sizes of the private key, which is a scalar, and the public key, which is a point on the elliptic curve, are determined by the choice of the curve.

When generating ECC key pairs for digital signature generation and if “ECDSA” or “EC-KCDSA” are claimed in FCS_COP.1/SigGen, then “ECC–ERB” or “ECC–RS” must be claimed. The sizes of the private key, which is a scalar, and the public key, which is a point on the elliptic curve, are determined by the choice of the curve.

When generating EdDSA key pairs for digital signatures and if “EdDSA” is claimed in FCS_COP.1/SigGen, then “EdDSA” must be claimed here. The chosen domain parameters determine the size of the private keys and the public keys.

For LMS, HSS, XMSS, and XMSS^{MT}, the key sizes do not represent the expected security strength. All key sizes given here correspond to an expected security strength of 128 bits, per NIST SP 800-208.

For HSS and XMSS^{MT} the same hash or XOF function must be used at each level. Within each level, the same Winternitz parameter must be used but can be different for each level. For HSS, within each level, the same tree height must be used but can be different for each level.

Evaluation Activities

FCS_CKM.1/AKG
TSS
All below from CWG Draft 20250218 The evaluator shall examine the TSS to verify that it describes how the TOE obtains a key based on input from a random bit generator as specified in FCS_RBG.1. The evaluator shall review the TSS to verify that it describes how the functionality described by FCS_RBG.1 is invoked. The evaluator shall examine the TSS to verify that it identifies the usage for each row identifier (key name, key size, standards) selected in the ST.

The evaluator shall examine the TSS to verify that it identifies the key types (e.g., see NIST SP 800-57 Part 1 Release 5, Section 5), key usage, and key lifecycle for keys generated using each selected algorithm.

Guidance
The evaluator shall verify that the AGD instructs the administrator how to configure the TOE to generate keys for the selected key generation algorithms for all key types and uses identified in the TSS.

Tests
The following tests are conditional based upon the selections made in the SFR. The evaluator shall perform the following test or witness respective tests executed by the developer. The tests must be executed on a platform that is as close as practically possible to the operational platform (but which may be instrumented in terms of, for example, use of a debug mode). Where the test is not carried out on the TOE itself, the test platform shall be identified and the differences between test environment and TOE execution environment shall be described.

RSA Key Generation

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
RSA	*RSA*	*Modulus of size [**selection:** 2048, 3072, 4096] bits*	*NIST FIPS PUB 186-5 (Section A.1.1)*

FIPS PUB 186-5 Key Pair generation specifies five methods for generating the primes p and q.

These are:
- *Random Provable primes*
- *Random Probable primes*
- *Provable primes with conditions based on auxiliary provable primes*
- *Probable primes with conditions based on auxiliary provable primes*
- *Probable primes with conditions based on auxiliary probable primes*

In addition to the key generation method, the input parameters are:
- *Modulus [2048, 3072, 4096]*
- *Hash algorithm [SHA-1, SHA-224, SHA-256, SHA-384, SHA-512, SHA-512/224, SHA-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512] (methods 1, 3, 4 only)*
- *Rabin-Miller prime test [2^{100}, $2^{Security\ String}$] (methods 2, 4, 5 only)*
- *p mod 8 value [0,1,3,5,7]*

- *q mod 8 value [0,1,3,5,7]*
- *Private key format [standard, Chinese Remainder Theorem]*
- *Public exponent [fixed value, random]*

The evaluator shall verify the ability of the TSF to correctly produce values for the RSA key components, including the public verification exponent e, the private prime factors p and q, the public modulus n and the calculation of the private signature exponent d.

Testing for Random Provable Primes and Conditional Methods

To test the key generation method for the Random Provable primes method and for all the Primes with Conditions methods (methods 1, 3-5), the evaluator must seed the TSF key generation routine with sufficient data to deterministically generate the RSA key pair.

For each supported combination of the above input parameters, the evaluator shall have the TSF generate 25 key pairs. The evaluator shall verify the correctness of the TSF's implementation by comparing values generated by the TSF with those generated by a known good implementation using the same input parameters.

Testing for Random Probable Primes Method

If the TOE generates Random Probable Primes (method 2) then, if possible, the Random Probable primes method should also be verified against a known good implementation as described above. If verification against a known good implementation is not possible, the evaluator shall have the TSF generate 25 key pairs for each supported key length nlen and verify that all of the following are true:

- $n = p*q$
- *p and q are probably prime according to Miller-Rabin tests with error probability* $<2^{(-125)}$
- $2^{16} < e < 2^{256}$ *and e is an odd integer*
- $GCD(p-1,e) = 1$
- $GCD(q-1,e) = 1$
- $|p-q| > 2^{(nlen/2 - 100)}$
- $p \geq squareroot(2)*(2^{(nlen/2 -1)})$
- $q \geq squareroot(2)*(2^{(nlen/2 -1)})$
- $2^{(nlen/2)} < d < LCM(p-1,q-1)$
- $e*d = 1 \bmod LCM(p-1,q-1)$

Eliptic Curve Key Generation

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
ECC-ERB	*ECC - Extra Random Bits*	*Elliptic Curve [**selection:** P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1]*	*NIST FIPS PUB 186-5 (Section A.2.1)* *[**selection:** NIST SP 800-186 (Section 3) [NIST Curves], RFC 5639 (Section 3) [Brainpool curves]]*
ECC-RS	*ECC - Rejection Sampling*	*Elliptic Curve [**selection:** P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1]*	*NIST FIPS PUB 186-5 (Section A.2.2)* *[**selection:** NIST SP 800-186 (Section 3) [NIST Curves], RFC 5639 (Section 3) [Brainpool curves]]*

To test the TOE's ability to generate asymmetric cryptographic keys using elliptic curves, the evaluator shall perform the ECC Key Generation Test and the ECC Key Validation Test using the following input parameters:

- *Elliptic curve [P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1]*
- *Key pair generation method [extra random bits, rejection sampling]*

ECC Key Generation Test

For each supported combination of the above input parameters the evaluator shall require the implementation under test to generate 10 private/public key pairs (d, Q). The private key, d, shall be generated using a random bit generator as specified in FCS_RBG.1. The private key, d, is used to compute the public key, Q'. The evaluator shall confirm that 0<d<n (where n is the order of the group), and the computed value Q' is then compared to the generated public/private key pairs' public key, Q, to confirm that Q is equal to Q'.

ECC Key Validation Test
For each supported combination of the above parameters the evaluator shall generate 12 private/public key pairs using the key generation function of a known-good implementation. For each set of 12 public keys, the evaluator shall modify four public key values by shifting x or y out of range by adding the order of the field and modify four other public key values by shifting x or y so that they are still in bounds, but not on the curve. The remaining public key values are left unchanged (i.e., correct). To determine correctness, the evaluator shall submit the public keys to the public key validation (PKV) function of the TOE and shall confirm that the results correspond as expected for the modified and unmodified values.

Finite Field Cryptography Key Generation

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
FFC-ERB	*FFC – Extra Random Bits*	*Static domain parameters approved for [**selection:** IKE groups [**selection:** MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192], TLS groups [**selection:** ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]]]*	*NIST SP 800-56A Revision 3 (Section 5.6.1.1.3) [key pair generation]* *[**selection:** RFC 3526 [IKE groups], RFC 7919 [TLS groups]]*
FFC-RS	*FFC – Rejection Sampling*	*Static domain parameters approved for [**selection:** IKE groups [**selection:** MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192], TLS groups [**selection:** ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]]]*	*NIST SP 800-56A Revision 3 (Section 5.6.1.1.4) [key pair generation]* *[**selection:** RFC 3526 [IKE groups], RFC 7919 [TLS groups]]*

To test the TOE's ability to generate asymmetric cryptographic keys using finite fields, the evaluator shall perform the Safe Primes Generation Test and the Safe Primes Validation Test using the following input parameter:

- *Fields/Groups [MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192, ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]*

Safe Primes Generation Test
For each supported safe primes group, generate 10 key pairs. The evaluator shall verify the correctness of the TSF's implementation by comparing values generated by the TSF with those generated by a known good implementation using the same input parameters.

Safe Primes Verification Test
For each supported safe primes group, use a known good implementation to generate 10 key pairs. For each set of 10, the evaluator shall modify three such that they are incorrect. The remaining values are left unmodified (i.e. correct). To determine correctness, the evaluator shall submit the key pairs to the public key validation (PKV) function of the TOE and shall confirm that the results correspond as expected for the modified and unmodified values.

Edwards Elliptic Curve Key Generation

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
EdDSA	*EdDSA*	*Domain parameters approved for elliptic curves [**selection:***	*NIST FIPS PUB 186-5 (Section 6.2.1) [key-*

		Edwards25519, Edwards448]	*pair generation]* *NIST SP 800-186 (Section 3.2.3) [Edwards Curves]*

To test the TOE's ability to generate asymmetric cryptographic keys using Edwards key generation, the evaluator shall perform the EdDSA Key Generation Test and the EdDSA Key Validation Test using the following input parameter:

- *Elliptic curve [Edwards25519, Edwards448]*

EdDSA Key Generation Test
For each supported curve the evaluator shall require the implementation under test to generate 10 private/public key pairs (d, Q). The private key, d, shall be generated using a random bit generator as specified in FCS_RBG.1. The private key, d, is used to compute the public key, Q'. The evaluator shall confirm that 0<d<n (where n is the order of the group), and the computed value Q' is then compared to the generated public/private key pairs' public key, Q, to confirm that Q is equal to Q'.

EdDSA Key Validation Test
For each supported curve, the evaluator shall generate 10 private/public key pairs using the key generation function of a known good implementation, For each set of 10 public keys the evaluator shall modify five public key values by shifting x or y so that they are still in bounds, but not on the curve. The remaining values are left unmodified (i.e. correct). To determine correctness, the evaluator shall submit the public keys to the public key validation (PKV) function of the TOE and shall confirm that the results correspond as expected for the modified and unmodified values.

KCDSA Key Generation

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
KCDSA	*KCDSA*	*Domain parameters generation with (L, N) = [**selection:** (2048, 224), (2048, 256), (3072, 256)] bits*	*ISO/IEC 14888-3:2018 (Subclause 6.3) [KCDSA]*

To test the TOE's ability to generate asymmetric cryptographic keys using KCDSA, the evaluator shall perform the DSA Key Generation Test using the following input parameter:

- *Values of L and N: [(2048, 224), (2048, 256), (3072, 256)]*

KCDSA Key Generation Test
For each supported (L, N) the evaluator shall cause the TOE to generate 10 key pairs. The evaluator shall verify the correctness of the TSF's implementation by comparing values generated by the TSF with those generated by a known good implementation using the same input parameters.

EC-KCDSA Key Generation

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
EC-KCDSA	*EC-KCDSA*	*Elliptic Curves [**selection:** P-224, B-233, K-233, P-256, B-283, K-283]*	*ISO/IEC 14888-3:2018 (Subclause 6.7) [EC-KCDSA]* *NIST SP 800-186 (Section 3) [NIST Curves]*

To test the TOE's ability to generate asymmetric cryptographic keys using KCDSA with elliptic curves, the evaluator shall perform the ECC Key Generation Test and the ECC Key Validation Test using the following input parameters:

- *Elliptic curve [P-224, B-233, K-233, P-256, B-283, K-283]*
- *Key pair generation method [extra random bits, rejection sampling]*

ECC Key Generation Test
For each supported combination of the above input parameters the evaluator shall require the implementation under test to generate 10 private/public key pairs (d, Q). The private key, d,

shall be generated using a random bit generator as specified in FCS_RBG.1. The private key, d, is used to compute the public key, Q'. The evaluator shall confirm that 0<d<n (where n is the order of the group), and the computed value Q' is then compared to the generated public/private key pairs' public key, Q, to confirm that Q is equal to Q'.

ECC Key Validation Test
For each supported combination of the above parameters the evaluator shall generate 12 private/public key pairs using the key generation function of a known-good implementation. For each set of 12 public keys, the evaluator shall modify four public key values by shifting x or y out of range by adding the order of the field and modify four other public key values by shifting x or y so that they are still in bounds, but not on the curve. The remaining public key values are left unchanged (i.e., correct). To determine correctness, the evaluator shall submit the public keys to the public key validation (PKV) function of the TOE and shall confirm that the results correspond as expected for the modified and unmodified values.

Key Generation using LMS and HSS

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
LMS	*LMS*	*Private key size = [**selection:** 192 bits with [**selection:** SHA-256/192, SHAKE256/192], 256 bits with [**selection:** SHA-256, SHAKE256]], Winternitz parameter = [**selection:** 1, 2, 4, 8], and tree height = [**selection:** 5, 10, 15, 20, 25]*	*RFC 8554 [LMS]* *NIST SP 800-208 [parameters]*
HSS	*HSS*	*Private key size = [**selection:** 192 bits with [**selection:** SHA-256/192, SHAKE256/192], 256 bits with [**selection:** SHA-256, SHAKE256]], Winternitz parameter = [**selection:** 1, 2, 4, 8], and tree height = [**selection:** 5, 10, 15, 20, 25],], and number of levels = [selection: 1, 2, 3, 4, 5, 6, 7, 8]*	*RFC 8554 [HSS]* *NIST SP 800-208 [parameters]*

To test the TOE's ability to generate asymmetric cryptographic keys using LMS or HSS, the evaluator shall perform the LMS Key Generation Test using the following input parameters:

- *Hash algorithm [SHA-256/192, SHAKE256/192, SHA-256, SHAKE256]*
- *Winternitz [1, 2, 4, 8]*
- *Tree height [5, 10, 15, 20, 25]*
- *Number of levels [1, 2, 3, 4, 5, 6, 7, 8] (HSS only)*

LMS Key Generation Test
For each supported combination of the hash algorithm, Winternitz parameter, and tree height the evaluator shall generate one public key for each of the test cases. The number of test cases depends on the tree height:

Table 4: Number of LMS Test Cases

Height	***Number of test cases***
5	*5*
10	*4*
15	*3*
20	*2*
25	*1*

The evaluator shall verify the correctness of the TSF's implementation by comparing the public key generated by the TSF with that generated by a known good implementation using the same input parameters.

HSS Key Generation Test
For each level and LMS parameter set, generate one public key for each test case, the number of which depends on the height of the underlying LMS parameter specified in Table 4.

The evaluator shall verify the correctness of the TSF's implementation by comparing the public key generated by the TSF with that generated by a known good implementation using the same

input parameters.

Note: The number of test cases is limited due to the extreme amount of time it can take to generate LMS and HSS trees.

XMSS Key Generation

Identifier	***Cryptographic Key Generation Algorithm***	***Cryptographic Algorithm Parameters***	***List of Standards***
XMSS	*XMSS*	*Private key size = [**selection:** 192 bits with [**selection:** SHA-256/192, SHAKE256/192], 256 bits with [**selection:** SHA-256, SHAKE256]], tree height = [**selection:** 10, 16, 20]*	*RFC 8391 [XMSS]* *NIST SP 800-208 [parameters]*
XMSS^{MT}	*XMSS^{MT}*	*Private key size = [**selection:** 192 bits with [**selection:** SHA-256/192, SHAKE256/192], 256 bits with [**selection:** SHA-256, SHAKE256]], (total tree height, number of levels) = [**selection:** (20, 2), (20, 4), (40, 2), (40, 4), (40, 8), (60, 3), (60, 6), (60, 12)]*	*RFC 8391 [XMSS^{MT}]* *NIST SP 800-208 [parameters]*

To test the TOE's ability to generate asymmetric cryptographic keys using XMSS or XMSS^{MT}, the evaluator shall perform the XMSS Key Generation Test using the following input parameters:

- *Hash algorithm [SHA-256/192, SHAKE256/192, SHA-256, SHAKE256]*
- *Tree height [10, 16, 20] (XMSS only)*
- *Tree height/levels [20/2, 20/4, 40/2, 40/4, 40/8, 60/3, 60/6, 60/12] (XMSS^{MT} only)*

Table 5: Number of Test Cases for XMSS and XMSS^{MT}

Height	***Number of test cases***
10	*5*
16	*4*
20	*3*
40	*2*
60	*1*

XMSS Key Generation Test
For each supported combination of hash algorithm and tree height, the evaluator shall generate one public key for each test case. The number of test cases depends on the tree height as specified in Table 5.

The evaluator shall verify the correctness of the TSF's implementation by comparing values generated by the TSF with those generated by a known good implementation using the same input parameters.

XMSS^{MT} Key Generation Test
For each supported combination of hash algorithm and tree height, the evaluator shall generate one public key for each test case. The number of test cases depends on the tree height as specified in Table 5.

The evaluator shall verify the correctness of the TSF's implementation by comparing values generated by the TSF with those generated by a known good implementation using the same input parameters.

Note: The number of test cases is limited due to the extreme amount of time it can take to generate XMSS trees.

FCS_CKM.1/SKG Cryptographic Key Generation - Symmetric Key

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.1.2.

This component may also be included in the ST as if optional.

FCS_CKM.1.1/SKG

The TSF shall generate **symmetric** cryptographic keys in accordance with a specified cryptographic key generation algorithm [**selection**: *Cryptographic Key Generation Algorithm*] and specified cryptographic key sizes [**selection**: *Cryptographic Key Sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_CKM.1/SKG.

Table 6: Recommended choices for FCS_CKM.1/SKG

Identifier	Cryptographic Key Generation Algorithm	Cryptographic Key Sizes	List of standards
RSK	Direct Generation from a Random Bit Generator as specified in FCS_RBG.1	[**selection**: *123*, *256*, *512*] bits	NIST SP 800-133 Revision 2 (Section 6.1)[Direct generation of symmetric keys]

Application Note: This SFR must be included in the ST if it is a service provided by the TOE to tenant software, or if it is used by the TOE itself to support or implement PP-specified security functionality.

This SFR must be included in the ST if "*causing the TOE to generate [symmetric] keys/secrets*" is selected in FCS_STG_EXT.1.2.

If this SFR is included in the ST, then FCS_CKM.6 and FCS_RBG.1 must also be claimed.

Evaluation Activities

FCS_CKM.1/SKG
TSS
The evaluator shall examine the TSS to verify that it describes how the TOE obtains an SK through direct generation as specified in FCS_RBG.1. The evaluator shall review the TSS to verify that it describes how the TSF invokes the functionality described by FCS_RBG.1.

The evaluator shall use the description of the RBG functionality in FCS_RBG.1 or documentation available for the operational environment to determine that the key size being requested is greater than or equal to the key size and mode to be used for the encryption/decryption of the data.

Guidance
The evaluator shall verify that the AGD guidance instructs the administrator how to configure the TOE to use the selected key types for all uses identified in the ST.

KMD
The evaluator shall confirm that the KMD describes the RBG interface and how the TOE uses it in symmetric key generation. If the TOE uses the generated key in a key chain/hierarchy, then the KMD shall describe how the ST uses the key as part of the key chain/hierarchy.

Tests
The following tests are conditional based upon the selections made in the SFR. The evaluator shall perform the following test or witness respective tests executed by the developer. The tests must be executed on a platform that is as close as practically possible to the operational platform (but which may be instrumented in terms of, for example, use of a debug mode). Where the test is not carried out on the TOE itself, the test platform shall be identified and the differences between test environment and TOE execution environment shall be described.

To test the TOE's ability to generate symmetric cryptographic keys using a random bit generator, the evaluator shall configure the asymmetric cryptographic key generation capability for each claimed key size. The evaluator shall use the description of the RBG interface to verify that the TOE requests and receives an amount of RBG output greater than or equal to the requested key size.

FCS_CKM.2 Cryptographic Key Distribution

This is a selection-based component. Its inclusion depends upon selection from

***FTP_ITE_EXT.1.1*.**
This component may also be included in the ST as if optional.

FCS_CKM.2.1

The TSF shall distribute cryptographic keys in accordance with a specified cryptographic key distribution method [**selection**: *key encapsulation*, *key wrapping*, *encrypted channels*] that meets the following: [none].

Application Note: If "key encapsulation" is selected, FCS_COP.1/KeyEncap must be claimed, which specifies the relevant list of standards.

If "key wrapping" is selected, FCS_COP.1/KeyWrap must be claimed, which specifies the relevant list of standards.

If "encrypted channels" is selected, FTP_PRO.1 must be claimed, which specifies the relevant list of standards.

Evaluation Activities

FCS_CKM.2
Tests are TBD

FCS_CKM_EXT.5 Cryptographic Key Derivation

This is an optional component. However, applied modules or packages might redefine it as mandatory.

FCS_CKM_EXT.5.1

The TSF shall derive cryptographic keys [**selection**: *Key type*] from [**selection**: *Input parameters*] in accordance with a specified key derivation algorithm [**selection**: *Key derivation algorithm*] and specified cryptographic key sizes [**selection**: *Key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_CKM.5.

Table 7: Recommended choices for FCS_CKM.5

Key type	Input parameters	Key derivation algorithm	Key sizes	List of standards
KDF-CTR	[**selection**: *Direct Generation from a Random Bit Generator as specified in FCS_RBG.1*, *Concatenated keys*]	KPF2 - KDF in Counter Mode using [**selection**: *AES-128-CMAC*, *AES-192-CMAC*, *AES-256-CMAC*, *Camillia-128-CMAC*, *Camillia-192-CMAC*, *Camillia-256-CMAC*, *CMAC-HIGHT-128*, *CMAC-LEA-128*, *CMAC-LEA-256*, *CMAC-SEED-128*, *HMAC-SHA-1*, *HMAC-SHA-256*, *HMAC-SHA-512*] as the PRF	[**selection**: *128*, *192*, *256*, *512*] bits	[**selection**: *ISO/IEC 11770-6:2016 (Subclause 7.3.2) [KPF2]*, *NIST SP 800-108 Revision 1 Update 1 (Section 4.1) [KDF in Counter Mode]*]
KDF-FB	[**selection**: *Direct Generation from a Random Bit Generator as specified in FCS_RBG.1*, *Concatenated keys*]	KPF3 - KDF in Feedback Mode using [**selection**: *AES-128-CMAC*, *AES-192-CMAC*, *AES-256-CMAC*, *Camillia-128-CMAC*, *Camillia-192-CMAC*, *Camillia-256-CMAC*, *CMAC-HIGHT-128*, *CMAC-LEA-128*, *CMAC-LEA-256*, *CMAC-SEED-128*, *HMAC-SHA-1*, *HMAC-SHA-256*, *HMAC-SHA-512*] as the PRF	[**selection**: *128*, *192*, *256*, *512*] bits	[**selection**: *ISO/IEC 11770-6:2016 (Subclause 7.3.3) [KPF3]*, *NIST SP 800-108 Revision 1 Update 1 (Section 4.2) [KDF*

				in Feedback Mode]]
KDF-DPI	[**selection**: *Direct Generation from a Random Bit Generator as specified in FCS_RBG.1, Concatenated keys*]	KDF in Double Pipeline Iteration Mode using [**selection**: *AES-128-CMAC, AES-192-CMAC, AES-256-CMAC, Camillia-128-CMAC, Camillia-192-CMAC, Camillia-256-CMAC, CMAC-HIGHT-128, CMAC-LEA-128, CMAC-LEA-256, CMAC-SEED-128, HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-512*] as the PRF	[**selection**: *128, 192, 256, 512*]bits	[**selection**: *ISO/IEC 11770-6:2016 (Subclause 7.3.4) [KPF4], NIST SP 800-108 Revision 1 Update 1 (Section 4.3) [KDF in Double-Pipeline Iteration Mode]*]
KDF-XOR	More than one intermediary key	exclusive OR (XOR)	[**selection**: *128, 192, 256, 512*] bits	N/A
KDF-ENC	Two keys	Encrypting using an algorithm specified in [**selection**: *FCS_COP.1/SKC, FCS_COP.1/AEAD*]	[**selection**: *128, 192, 256, 512*] bits	N/A
KDF-HASH	Shared secret	Hash function from FCS_COP.1/Hash	[**selection**: *128, 192, 256, 512*] bits	NIST SP 800-56C Revision 2 (Section 4.1, Option 1) [One-Step Key Derivation]
KDF-MAC-1S	Shared secret, salt, IV, output length, fixed information	Keyed hash from FCS_COP.1/KeyedHash	[**selection**: *128, 192, 256, 512*] bits	NIST SP 800-56C Revision 2 (Section 4.1, Options 2, 3) [One-Step Key Derivation]
KDF-MAC-2S	Shared secret, salt, IV, output length, fixed information	MAC Step [**selection**: *AES-128-CMAC, AES-192-CMAC, AES-256-CMAC, Camillia-128-CMAC, Camillia-192-CMAC, Camillia-256-CMAC, HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-512*] as randomness extraction and; KDF Step [**selection**: *KDF-CTR, KDF-FB, KDF-DPI*] using [**selection**: *AES-128-CMAC, AES-192-CMAC, AES-256-CMAC, Camillia-128-CMAC, Camillia-192-CMAC, Camillia-256-CMAC, HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-512*] as PRF.	[**selection**: *128, 192, 256, 512*] bits	NIST SP 800-56C Revision 2 (Section 5) [Two-Step Key Derivation]
KDF-KMAC	Key, context string, output length, label	[**selection**: *KMAC128, KMAC256*]	[**selection**: *128, 192, 256, 512*] bits	NIST SP 800-108 Revision 1 Update 1

(Section 4.4 “KDF Using KMAC”)

Application Note: The "key type" assignment should indicate the type type of key being derived, e.g. "*symmetric*," "*asymmetric*," or "*HMAC*."

This SFR must be included in the ST if key derivation is a service provided by the TOE to tenant software, or if it is used by the TOE itself to support or implement PP-specified security functionality.

If this SFR is included in the ST, then FCS_CKM.6 must also be claimed.

If "*KDF-XOR*" and at least one of the SHA hashes is selected, then FCS_COP.1/Hash must be claimed.

If "*KDF-HASH*" or "*KDF-MAC*" is selected, then FCS_COP.1/Hash must be claimed.

If "*KDF-MAC*" is selected, then FCS_COP.1/KeyedHash must be claimed.

If "*KDF-PBKDF*" is selected, then FCS_COP.1/KeyedHash must be claimed.

If "*KDF-CTR*," "*KDF-FB*," or "*KDF-DPI*" is selected, then FCS_RBG.1 must be claimed.

If "*KDF-CTR*," "*KDF-FB*," or "*KDF-DPI*" is selected, and HMAC is selected as part of the key derivation algorithm, then FCS_COP.1/KeyedHash must be claimed.

For Authorization Factor Submasks, the key size to be used in the HMAC falls into a range between L1 and L2 defined in ISO/IEC 10118 for the appropriate hash function (for example for SHA-256 L1 = 512, L2 = 256) where L2 <= k <= L1.

NIST SP 800-131A Rev 1 allows the use of SHA-1 in these use cases.

KDF-ENC and KDF-XOR create an “inverted key hierarchy” in which the TSF will combine two or more keys to create a third key. These same KDFs may also use a submask key as input, which could be an authorization factor or derived from a PBKDF. In these cases the ST Author must explicitly declare this option and should present a reasonable argument that the entropy of the inputs to the KDFs will result in full entropy of the expected output.

From catalogIn KDF-MAC-2S, if a CMAC is selected in the MAC step, then select AES-128-CMAC or Camellia-128-CMAC in the KDF step and select 128 as the output key size. If HMAC is selected in the MAC step, then select the same HMAC in the KDF.

The respective FCS_COP.1 component must be claimed for each primitive selected in key derivation algorithm.

Evaluation Activities

FCS_CKM_EXT.5
TSS
The evaluator shall check that the TSS includes a description of the key derivation functions and shall check that this uses a key derivation algorithm and key sizes according to the specification selected in Table 7. The evaluator shall confirm that the TSS supports the selected methods.

If key combination is used to form a KEK, the evaluator shall verify that the TSS describes the method of combination and that this method is either an XOR, a KDF, or encryption.

If a KDF is used to form a KEK, the evaluator shall ensure that the TSS includes a description of the key derivation function and shall verify the key derivation uses an approved derivation mode and key expansion algorithm according to SP 800-108.

If key concatenation is used to derive KEKs, the evaluator shall ensure the TSS includes a description of the randomness extraction step, including the following:

- *The description must include how an approved untruncated MAC function is being used for the randomness extraction step and the evaluator must verify the TSS describes that the output length (in bits) of the MAC function is at least as large as the targeted security strength (in bits) of the parameter set employed by the key establishment scheme (see Tables 1-3 of SP 800-56C).*

- *The description must include how the MAC function being used for the randomness extraction step is related to the PRF used in the key expansion and verify the TSS description includes the correct MAC function:*
  - *If an HMAC-hash is used in the randomness extraction step, then the same HMAC-hash (with the same hash function hash) is used as the PRF in the key expansion step.*
  - *If an AES-CMAC (with key length 128, 192, or 256 bits) is used in the randomness extraction step, then AES-CMAC with a 128-bit key is used as the PRF in the key expansion step.*
- *The description must include the lengths of the salt values being used in the randomness extraction step and the evaluator shall verify the TSS description includes correct salt lengths:*
  - *If an HMAC-hash is being used as the MAC, the salt length can be any value up to the maximum bit length permitted for input to the hash function hash.*
  - *If an AES-CMAC is being used as the MAC, the salt length shall be the same length as the AES key (i.e. 128, 192, or 256 bits).*

Guidance
The evaluator shall verify that the AGD instructs the administrator how to configure the TOE to use the selected key types for all uses identified in the ST.

KMD
The evaluator shall examine the KMD to ensure that:
- *The KMD describes the complete key derivation chain and the description must be consistent with the description in the TSS. For all key derivations the TOE must use a method as described in the PP table. There should be no uncertainty about how a key is derived from another in the chain.*
- *The length of the key derivation key is defined by the PRF. The evaluator should check whether the key derivation key length is consistent with the length provided by the selected PRF.*
- *If a key is used as an input to several KDFs, each invocation must use a distinct context string. If the output of a KDF execution is used for multiple cryptographic keys, those keys must be disjoint segments of the output.*
- *If keys are combined, the ST Author shall describe which method of combination is used in order to justify that the effective entropy of each factor is preserved.*

Tests
The evaluator shall perform the following test or witness respective tests executed by the developer. The tests must be executed on a platform that is as close as practically possible to the operational platform (but which may be instrumented in terms of, for example, use of a debug mode). Where the test is not carried out on the TOE itself, the test platform shall be identified and the differences between test environment and TOE execution environment shall be described.

The evaluator shall perform one or more of the following tests to verify the correctness of the key derivation function, depending on the specific functions that are supported:

Preconditions for testing:
- *Specification of input parameter to the key derivation function to be tested*
- *Specification of further required input parameters*
- *Access to derived keys*

The following table maps the data fields in the tests below to the notations used in SP 800-108 and SP 800-56C

Data Fields	***Notations***	
	SP 800-108	*SP 800-56C*
Pseudorandom function	*PRF*	*PRF*
Counter length	*r*	*r*
Length of output of PRF	*r*	*r*
Length of derived keying material	*L*	*L*
Length of input values	*I_length*	*I_length*
Pseudorandom input values I	*K1 (key derivation key)*	*Z (shared secret)*
Pseudorandom salt values		*S*
Randomness extraction MAC	*n/a*	*MAC*

KDF in Counter Mode

Key	***Input***	***Key Derivation Algorithm***	***Key Sizes***	***List of***

Type	Parameters			Standards
KDF-CTR	[**selection:** Direct Generation from a Random Bit Generator as specified in FCS_RBG.1, Concatenated keys]	KPF2 - KDF in Counter Mode using [**selection:** AES-128-CMAC; AES-192-CMAC; AES-256-CMAC; Camellia-128-CMAC; Camellia-192-CMAC; Camellia-256-CMAC; CMAC-HIGHT-128; CMAC-LEA-128; CMAC-LEA-256; CMAC-SEED-128; HMAC-SHA-1; HMAC-SHA-256; HMAC-SHA-512] as the PRF	[**selection:** 128, 192, 256, 512] bits	[**selection:** ISO/IEC 11770-6:2016 (Subclause 7.3.2) [KPF2], NIST SP 800-108 Revision 1 Update 1 (Section 4.1) [KDF in Counter Mode]]

To test the TOE's ability to derive cryptographic keys using KDF in Counter Mode/KDF2, the evaluator shall perform the Counter KDF Algorithm Functional Test using the following input parameters:

- *Pseudo Random Function (PRF) [AES-128-CMAC, AES-192-CMAC, AES-256-CMAC, Camellia-128-CMAC, Camellia-192-CMAC, Camellia-256-CMAC, CMAC-HIGHT-128, CMAC-LEA-128, CMAC-LEA-256, CMAC-SEED-128, HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-512]*
- *Derived key length [128, 192, 256, 512] bits*
- *Location of the counter [after fixed data, before fixed data, middle fixed data]*
- *Counter length [8, 16, 24, 32] bits*

Counter KDF Algorithm Functional Test
For each supported combination of the above input parameters the evaluator shall require the implementation under test to derive two keys using random data. The evaluator shall compare the resulting keys with keys generated using a known-good implementation using the same input parameters.

KDF in Feedback Mode

Key Type	Input Parameters	Key Derivation Algorithm	Key Sizes	List of Standards
KDF-FB	[**selection:** Direct Generation from a Random Bit Generator as specified in FCS_RBG.1, Concatenated keys]	KPF3 - KDF in Feedback Mode using [**selection:** AES-128-CMAC; AES-192-CMAC; AES-256-CMAC; Camellia-128-CMAC; Camellia-192-CMAC; Camellia-256-CMAC; CMAC-HIGHT-128; CMAC-LEA-128; CMAC-LEA-256; CMAC-SEED-128; HMAC-SHA-1; HMAC-SHA-256; HMAC-SHA-512] as the PRF	[**selection:** 128, 192, 256, 512] bits	[**selection:** ISO/IEC 11770-6:2016 (Subclause 7.3.3) [KPF3], NIST SP 800-108 Revision 1 Update 1 (Section 4.2) [KDF in Feedback Mode]]

To test the TOE's ability to derive cryptographic keys using KDF in Feedback Mode/KDF3, the evaluator shall perform the Feedback KDF Algorithm Functional Test using the following input parameters:

- *Pseudo Random Function (PRF) [AES-128-CMAC, AES-192-CMAC, AES-256-CMAC, Camellia-128-CMAC, Camellia-192-CMAC, Camellia-256-CMAC, CMAC-HIGHT-128, CMAC-LEA-128, CMAC-LEA-256, CMAC-SEED-128, HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-512]*
- *Derived key length [128, 192, 256, 512] bits*
- *Location of the counter [none, after fixed data, before fixed data, before iterator]*
- *Counter length [0, 8, 16, 24, 32] bits*

Feedback KDF Algorithm Functional Test
For each supported combination of the above input parameters the evaluator shall require the implementation under test to derive two keys using random data. The evaluator shall compare the resulting keys with keys generated using a known-good implementation using the same input

parameters.

KDF in Double-Pipeline Iteraton Mode

Key Type	Input Parameters	Key Derivation Algorithm	Key Sizes	List of Standards
KDF-DPI	*[**selection:** Direct Generation from a Random Bit Generator as specified in FCS_RBG.1, Concatenated keys]*	*KPF4 - KDF in Double-Pipeline Iteration Mode using [**selection:** AES-128-CMAC; AES-192-CMAC; AES-256-CMAC; Camellia-128-CMAC; Camellia-192-CMAC; Camellia-256-CMAC; CMAC-HIGHT-128; CMAC-LEA-128; CMAC-LEA-256; CMAC-SEED-128; HMAC-SHA-1; HMAC-SHA-256; HMAC-SHA-512] as the PRF*	*[**selection:** 128, 192, 256, 512] bits*	*[**selection:** ISO/IEC 11770-6:2016 (Subclause 7.3.4) [KPF4], NIST SP 800-108 Revision 1 Update 1 (Section 4.3) [KDF in Double-Pipeline Iteration Mode]]*

To test the TOE's ability to derive cryptographic keys using KDF in Double Pipeline Iteration Mode/KDF4, the evaluator shall perform the Double Pipeline Iteration KDF Algorithm Functional Test using the following input parameters:

- *Pseudo Random Function (PRF) [AES-128-CMAC, AES-192-CMAC, AES-256-CMAC, Camellia-128-CMAC, Camellia-192-CMAC, Camellia-256-CMAC, CMAC-HIGHT-128, CMAC-LEA-128, CMAC-LEA-256, CMAC-SEED-128, HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-512]*
- *Derived key length [128, 192, 256, 512] bits*
- *Location of the counter [none, after fixed data, before fixed data, before iterator]*
- *Counter length [0, 8, 16, 24, 32] bits*

Double Pipeline Iteration KDF Algorithm Functional Test
For each supported combination of the above input parameters the evaluator shall require the implementation under test to derive two keys using random data. The evaluator shall compare the resulting keys with keys generated using a known-good implementation using the same input parameters.

KDF XORing Keys

Key Type	Input Parameters	Key Derivation Algorithm	Key Sizes	List of Standards
KDF-XOR	*More than one intermediary keys*	*exclusive OR (XOR)*	*[**selection:** 128, 192, 256, 512] bits*	*N/A*

There are no tests for this key derivation method.

KDF by Encrypting Keys

Key Type	Input Parameters	Key Derivation Algorithm	Key Sizes	List of Standards
KDF-ENC	*Two keys*	*Encrypting using an algorithm specified in [**selection:** FCS_COP.1/SKC, FCS_COP.1/AEAD]*	*[**selection:** 128, 192, 256, 512] bits*	*N/A*

Specific testing for this key derivation method is covered by testing for the supported symmetric encryption algorithms in FCS_COP.1/SKC or FCS_COP.1/AEAD.

KDF by Hashing a Shared Secret

Key Type	Input Parameters	Key Derivation Algorithm	Key Sizes	List of Standards
KDF-	*Shared*	*Hash function*	*[**selection:**	*NIST SP 800-56C Revision 2*

HASH	*secret*	*from FCS_COP.1/Hash*	*128, 192, 256, 512] bits*	*(Section 4.1, Option 1) [One-Step Key Derivation]*

To test the TOE's ability to derive cryptographic keys by hashing a shared secret (a.k.a. One-Step HASH-based Key Derivation), the evaluator shall perform the Algorithm Functional Test and Validation Test using the following input parameters:

- *Auxiliary Function [SHA-1, SHA-224, SHA-256, SHA-384, SHA-512, SHA-512/224, SHA-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512]*
- *Derived key length [128, 192, 256, 512] bits*
- *Fixed information pattern*

Algorithm Functional Test

For each supported fixed information pattern and combination of the above input parameters the evaluator shall require the implementation under test to derive five keys using random data for a shared secret that is the same size as the derived key. The evaluator shall compare the resulting keys with keys derived using a known-good implementation using the same fixed information patterns and input parameters.

Validation Test

Catalog EA not finalizedFor each supported fixed information pattern and combination of the above input parameters the evaluator shall require the implementation under test to derive fifteen keys using random data for a shared secret that is the same size as the derived key. The evaluator will modify one of every five derived keys so that the derived key material is invalid. To determine correctness, the evaluator shall confirm that the results correspond as expected for the modified and unmodified values.

One-Step MAC-based KDF

Key Type	***Input Parameters***	***Key Derivation Algorithm***	***Key Sizes***	***List of Standards***
KDF-MAC-1S	*Shared secret, salt, output length, fixed information*	*Keyed Hash function from FCS_COP.1/KeyedHash*	*[**selection:** 128, 192, 256, 512] bits*	*NIST SP 800-56C Revision 2 (Section 4.1, Options 2, 3) [One-Step Key Derivation]*

Catalog EA not finalized To test the TOE's ability to derive cryptographic keys using One-Step MAC-based Key Derivation, the evaluator shall perform the Algorithm Functional Test and Validation Test using the following input parameters:

- *Auxiliary Function [HMAC-SHA-1, HMAC-SHA-224, HMAC-SHA-256, HMAC-SHA-384, HMAC-SHA-512, KMAC128, KMAC256, KMACXOF128, KMACXOF256]*
- *Salt [0s, random]*
- *Derived key length [128, 192, 256, 512] bits*
- *Fixed information pattern*

Algorithm Functional Test

For each supported fixed information pattern and combination of the above input parameters the evaluator shall require the implementation under test to derive five keys using random data for a shared secret. The evaluator shall compare the resulting keys with keys derived using a known-good implementation using the same fixed information patterns and input parameters.

Validation Test

Catalog EA not finalizedFor each supported fixed information pattern and combination of the above input parameters the evaluator shall require the implementation under test to derive five keys using random data for a shared secret. The evaluator will modify one of every five keys so that the derived key material is invalid [What specific ways is the key to be modified?]. To determine correctness, the evaluator shall submit the derived key material to the key validation function of the TOE and shall confirm that the results correspond as expected for the modified and unmodified values.

Two-Step MAC-based KDF

Key Type	***Input Parameters***	***Key Derivation Algorithm***	***Key Sizes***	***List of Standards***
KDF-MAC-2S	*Shared secret, salt, IV, output length, fixed information*	*MAC Step [**selection:** AES-128-CMAC; AES-192-CMAC; AES-256-CMAC; Camellia-128-CMAC; Camellia-192-CMAC; Camellia-256-CMAC; HMAC-SHA-1; HMAC-SHA-256; HMAC-SHA-512] as randomness extraction*	*[**selection:** 128, 192, 256, 512] bits*	*NIST SP 800-56C Revision 2 (Section 5) [Two-Step*

		*and; KDF Step [**selection:** KDF-CTR, KDF-FB, KDF-DPI] using [**selection:** AES-128-CMAC; AES-192-CMAC; AES-256-CMAC; Camellia-128-CMAC; Camellia-192-CMAC; Camellia-256-CMAC; HMAC-SHA-1; HMAC-SHA-256; HMAC-SHA-512] as PRF*		*Key Derivation]*

Catalog EA not finalized *To test the TOE's ability to derive cryptographic keys using Two-Step MAC-based Key Derivation, the evaluator shall perform the Algorithm Functional Test and Validation Test using the following input parameters:*

- *MAC mode [AES-128-CMAC; AES-192-CMAC; AES-256-CMAC; Camellia-128-CMAC; Camellia-192-CMAC; Camellia-256-CMAC; HMAC-SHA-1; HMAC-SHA-256; HMAC-SHA-512]*
- *KDF Mode [Counter, feedback, Double Pipeline iteration]*
- *Salt [0s, random]*
- *Length of shared secret [224-65535]*
- *Hybrid shared secret ???, aux Shared Secret length??*
- *Derived key length [128, 192, 256, 512] bits*
- *Fixed information pattern*
- *Counter location [none, before fixed data, after fixed data, before iterator]*
- *Counter length [0, 8, 16, 24, 32]*

Algorithm Functional Test
For each supported fixed information pattern and combination of the above input parameters the evaluator shall require the implementation under test to derive five keys using random data for a shared secret. The evaluator shall compare the resulting keys with keys derived using a known-good implementation using the same fixed information patterns and input parameters.

Validation Test
Catalog EA not finalized*For each supported fixed information pattern and combination of the above input parameters the evaluator shall require the implementation under test to derive five keys using random data for a shared secret. The evaluator will modify one of every five keys so that the derived key material is invalid [What specific ways is the key to be modified?]. To determine correctness, the evaluator shall submit the derived key material to the key validation function of the TOE and shall confirm that the results correspond as expected for the modified and unmodified values.*

KMAC KDF

Key Type	***Input Parameters***	***Key Derivation Algorithm***	***Key Sizes***	***List of Standards***
KDF-KMAC	*Key, context string, output length, label*	*[**selection:** KMAC128, KMAC256]*	*[**selection:** 128, 192, 256, 512] bits*	*NIST SP 800-108 Revision 1 Update 1 (Section 4.4 "KDF Using KMAC")*

To test the TOE's ability to derive cryptographic keys using KMAC Key Derivation, the evaluator shall perform the Algorithm Functional Test using the following input parameters:

- *MAC Function [KMAC128, KMAC256]*
- *Key Derivation Key Length [112-4096 by 8] bits*
- *Context length [8-4096 by 8] bits*
- *Label length [8-4096 by 8] bits*
- *Derived key length [128, 192, 256, 512] bits*

Algorithm Functional Test
For each supported MAC function [KMAC128, KMAC256], for each supported minimum and maximum key length:

Generate 50 test cases using random data for Key Derivation Key, Context, and Label. The length of each derived key shall be randomly selected from all supported values such that the minimum and maximum lengths are chosen once each. The evaluator shall compare the resulting derived keys with keys derived using a known-good implementation using the same input parameters.

FCS_CKM.6 Timing and Event of Cryptographic Key Destruction

This is a selection-based component. Its inclusion depends upon selection from .

FCS_CKM.6.1

The TSF shall destroy [**assignment**: *list of cryptographic keys (including keying material)*] when [**selection**: *no longer needed*, *[**assignment**: other circumstances for key or keying material destruction]*]

Application Note: From catalogThe TOE will have mechanisms to destroy keys, including intermediate keys and key material, by using an approved method as specified in FCS_CKM.6.2. Examples of keys include intermediate keys, leaf keys, encryption keys, and signing keys. Key material includes seeds, authentication secrets, passwords, PINs, and other secret values used to derive keys. The ST Author shall list all such keys and keying material that are subject to destruction in the first assignment.

This SFR does not apply to the public component of asymmetric key pairs or to keys that are permitted to remain stored, such as device identification keys.

FCS_CKM.6.2

The TSF shall destroy cryptographic keys and keying material specified by FCS_CKM.6.1 in accordance with a specified cryptographic key destruction method [

- *For volatile memory, the destruction shall be executed by a [**selection**:*
  - *single overwrite consisting of [**selection, choose one of**: a pseudo-random pattern using the TSF's RBG, zeroes, ones, a new value of a key, [**assignment**: some value that does not contain any CSP]]*
  - *removal of power to the memory*
  - *removal of all references to the key directly followed by a request for garbage collection*

  ]
- *For non-volatile memory [**selection**:*
  - *that employs a wear-leveling algorithm, the destruction shall be executed by a [**selection**:*
    - *single overwrite consisting of [**selection, choose one of**: zeroes, ones, pseudo-random pattern, a new value of a key of the same size, [**assignment**: some value that does not contain any CSP]]*
    - *block erase*

    ]
  - *that does not employ a wear-leveling algorithm, the destruction shall be executed by a [**selection**:*
    - *[**selection, choose one of**: single, [**assignment**: ST Author-defined multi-pass]] overwrite consisting of [**selection**: zeros, ones, pseudo-random pattern, a new value of a key of the same size, [**assignment**: some value that does not contain any CSP]] followed by a read-verify. If the read-verification of the overwritten data fails, the process shall be repeated again up to [**assignment**: number of times to attempt overwrite] times, whereupon an error is returned*
    - *block erase*

    ]

  ]

] that meets the following: [*no standard*].

Application Note: This SFR must be included in the ST if the TOE handles sensitive cryptographic keys or credentials. In particular, if the TOE creates or stores keys, it must be able to destroy them. Specifically, this SFR must be included in the ST if any of the following SFRs are claimed: FCS_CKM.1/AKG, FCS_CKM.1/SKG, FCS_CKM.2, FCS_CKM_EXT.5, FCS_COP.1/KAT, FCS_STG_EXT.1, or FIA_AFL_EXT.1

The term "cryptographic keys" in this SFR includes the authorization data that is the entry point to a key chain and all other cryptographic keys and keying material (whether in plaintext or encrypted form). Examples of keys and key material include intermediate keys, encryption keys, signing keys, verification keys, authentication tokens, and submasks. This SFR does not apply to the public component of asymmetric key pairs, or to keys that are permitted to remain stored such as device identification keys. The TOE will have mechanisms to destroy keys and key material when the keys and key material is no longer needed. Based on their implementations, vendors will explain when certain keys are no longer needed.

In the case of volatile memory, the selection "*removal of all references to the key directly followed by a request for garbage collection*" is used in a situation where

the TSF cannot address the specific physical memory locations holding the data to be erased and therefore relies on addressing logical addresses (which frees the relevant physical addresses holding the old data) and then requesting the platform to ensure that the data in the physical addresses is no longer available for reading (i.e. the “garbage collection” referred to in the SFR text).

The selection for destruction of data in non-volatile memory includes block erase as an option, and this option applies only to flash memory. A block erase does not require a read verify, since the mappings of logical addresses to the erased memory locations are erased as well as the data itself.

Some selections allow assignment of “some value that does not contain any CSP.” This means that the TOE uses some specified data not drawn from an RBG meeting FCS_RBG requirements, and not being any of the particular values listed as other selection options. The point of the phrase “does not contain any sensitive data” is to ensure that the overwritten data is carefully selected, and not taken from a general pool that might contain current or residual data that itself requires confidentiality protection.

From crypto catalogIn the case of volatile memory, the selection “removal of all references to the key directly followed by a request for garbage collection” is used in a situation where the TSF cannot address the specific physical memory locations holding the data to be erased and therefore relies on addressing logical addresses (which frees the relevant physical addresses holding the old data) and then requesting the platform to ensure that the data in the physical addresses is no longer available for reading (i.e. the “garbage collection” referred to in the SFR text).

The selection for destruction of data in non-volatile memory includes block erase as an option, and this option applies only to flash memory. A block erase does not require a read verify, since the mappings of logical addresses to the erased memory locations are erased, as well as the data itself.

Some selections allow the assignment of “some value that does not contain any CSP.” This means that the TOE uses some specified data not drawn from an RBG meeting FCS_RBG requirements, and not being any of the values listed as other selection options. The point of the phrase “does not contain any CSP” is to ensure that the overwritten data is carefully selected, and not taken from a general pool that might contain data that itself requires confidentiality protection.

Evaluation Activities

FCS_CKM.6
TSS
The evaluator shall examine the TSS to ensure it lists all relevant keys and keying material (describing the source of the data, all memory types in which the data is stored (covering storage both during and outside of a session, and both plaintext and non-plaintext forms of the data)), all relevant destruction situations (including the point in time at which the destruction occurs; e.g. factory reset or device wipe function, change of authorization data, change of DEK, completion of use of an intermediate key) and the destruction method used in each case. The evaluator shall confirm that the description of the data and storage locations is consistent with the functions carried out by the TOE (e.g. that all keys in the key chain are accounted for). (Where keys are stored encrypted or wrapped under another key then this may need to be explained in order to allow the evaluator to confirm the consistency of the description of keys with the TOE functions).

The evaluator shall check that the TSS identifies any configurations or circumstances that may not conform to the key destruction requirement (see further discussion in the AGD section below). Note that reference may be made to the AGD for description of the detail of such cases where destruction may be prevented or delayed.

Where the ST specifies the use of “a value that does not contain any sensitive data” to overwrite keys, the evaluator shall examine the TSS to ensure that it describes how that pattern is obtained and used, and that this justifies the claim that the pattern does not contain any sensitive data.

Guidance
A TOE may be subject to situations that could prevent or delay data destruction in some cases. The evaluator shall check that the AGD identifies configurations or circumstances that may not strictly conform to the key destruction requirement, and that this description is consistent with the relevant parts of the TSS (and KMD). The evaluator shall check that the AGD provides guidance on situations where key destruction may be delayed at the physical layer, identifying any additional mitigation actions for the user (e.g. there might be some operation the user can

invoke, or the user might be advised to retain control of the device for some particular time to maximize the probability that garbage collection has occurred).

For example, when the TOE does not have full access to the physical memory, it is possible that the storage may implement wear-leveling and garbage collection. This may result in additional copies of the data that are logically inaccessible but persist physically. Where available, the TOE might then describe use of the TRIM command and garbage collection to destroy these persistent copies upon their deletion (this would be explained in TSS and AGD).

Where TRIM is used then the TSS or AGD is also expected to describe how the keys are stored such that they are not inaccessible to TRIM, (e.g. they would need not to be contained in a file less than 982 bytes which would be completely contained in the master file table.

KMD
The evaluator shall examine the KMD to verify that it identifies and describes the interfaces that are used to service commands to read/write memory. The evaluator shall examine the interface description for each different media type to ensure that the interface supports the selections made by the ST Author.

The evaluator shall examine the KMD to ensure that all keys and keying material identified in the TSS and KMD have been accounted for.

Note that where selections include "destruction of reference to the key directly followed by a request for garbage collection" (for volatile memory) then the evaluator shall examine the KMD to ensure that it explains the nature of the destruction of the reference, the request for garbage collection, and of the garbage collection process itself.

Tests
The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are typically not found on factory products.

The evaluator shall perform the following tests:

- *Test FCS_CKM.6:1: Applied to each key or keying material held as plaintext in volatile memory and subject to destruction by overwrite by the TOE (whether or not the plaintext value is subsequently encrypted for storage in volatile or non-volatile memory).*

  The evaluator shall:
  1. *Record the value of the key or keying material.*
  2. *Cause the TOE to dump the SDO/SDE memory of the TOE into a binary file.*
  3. *Search the content of the binary file created in Step #2 to locate all instances of the known key value from Step #1.*

     Note that the primary purpose of Step #3 is to demonstrate that appropriate search commands are being used for Steps #8 and #9.
  4. *Cause the TOE to perform normal cryptographic processing with the key from Step #1.*
  5. *Cause the TOE to destroy the key.*
  6. *Cause the TOE to stop execution but not exit.*
  7. *Cause the TOE to dump the SDO/SDE memory of the TOE into a binary file.*
  8. *Search the content of the binary file created in Step #7 for instances of the known key value from Step #1.*
  9. *Break the key value from Step #1 into an evaluator-chosen set of fragments and perform a search using each fragment. (Note that the evaluator shall first confirm with the developer how the key is normally stored, in order to choose fragment sizes that are the same or smaller than any fragmentation of the data that may be implemented by the TOE. The endianness or byte-order should also be taken into account in the search.)*

  Steps #1-8 ensure that the complete key does not exist anywhere in volatile memory. If a copy is found, then the test fails.

  Step #9 ensures that partial key fragments do not remain in memory. If the evaluator finds a 32-or-greater-consecutive-bit fragment, then fail immediately. Otherwise, there is a chance that it is not within the context of a key (e.g., some random bits that happen to match). If this is the case the test should be repeated with a different key in Step #1. If a fragment is also found in this repeated run, then the test fails unless the developer provides a reasonable explanation for the collision, then the evaluator may give a pass on this test.

- *Test FCS_CKM.6:2: Applied to each key and keying material held in non-volatile memory and subject to destruction by overwrite by the TOE.*
  1. *Record the value of the key or keying material.*
  2. *Cause the TOE to perform normal cryptographic processing with the key from Step #1.*
  3. *Search the non-volatile memory the key was stored in for instances of the known key value from Step #1.*

     Note that the primary purpose of Step #3 is to demonstrate that appropriate search commands are being used for Steps #5 and #6.
  4. *Cause the TOE to clear the key.*
  5. *Search the non-volatile memory in which the key was stored for instances of the known*

key value from Step #1. If a copy is found, then the test fails.

6. *Break the key value from Step #1 into an evaluator-chosen set of fragments and perform a search using each fragment. (Note that the evaluator shall first confirm with the developer how the key is normally stored, in order to choose fragment sizes that are the same or smaller than any fragmentation of the data that may be implemented by the TOE. The endianness or byte-order should also be taken into account in the search).*

Step #6 ensures that partial key fragments do not remain in non-volatile memory. If the evaluator finds a 32-or-greater-consecutive-bit fragment, then fail immediately. Otherwise, there is a chance that it is not within the context of a key (e.g., some random bits that happen to match). If this is the case the test should be repeated with a different key in Step #1. If a fragment is also found in this repeated run, then the test fails unless the developer provides a reasonable explanation for the collision, then the evaluator may give a pass on this test.

- *Test FCS_CKM.6:3: Applied to each key and keying material held in non-volatile memory and subject to destruction by overwrite by the TOE.*
  1. *Record memory of the key or keying material.*
  2. *Cause the TOE to perform normal cryptographic processing with the key from Step #1.*
  3. *Cause the TOE to clear the key. Record the value to be used for the overwrite of the key.*
  4. *Examine the memory from Step #1 to ensure the appropriate pattern (recorded in Step #3) is used.*

  The test succeeds if correct pattern is found in the memory location. If the pattern is not found, then the test fails.

FCS_CKM_EXT.7 Cryptographic Key Agreement

This is a selection-based component. Its inclusion depends upon selection from .
This component may also be included in the ST as if optional.

FCS_CKM_EXT.7.1

The TSF shall derive shared cryptographic keys with input from multiple parties in accordance with specified cryptographic key agreement algorithms [**selection**: *Cryptographic algorithm*] and specified cryptographic parameters [**selection**: *Cryptographic parameters*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_CKM_EXT.7.

Table 8: Recommended choices for FCS_CKM_EXT.7

Identifier	Cryptographic algorithm	Cryptographic parameters	List of standards
KAS2	RSA	Modulus size [**selection**: *2048*, *3072*, *4096*, *6144*, *8192*] bits	NIST SP 800-56B Revision 2 (Section 8.3) [KAS2]
DH	Finite Field Cryptography Diffie-Hellman	Static domain parameters approved for [**selection**: • *IKE Groups [**selection**: MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192]* • *TLS Groups [**selection**: ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]*]	NIST SP 800-56A Revision 3 (Section 5.7.1.1) [DH] [**selection**: *RFC 3526 [IKE groups], RFC 7919 [TLS groups]*]
ECDH	Elliptic Curve	Elliptic Curve	NIST SP 800-56A

	Diffie-Hellman	[**selection**: *P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1*]	Revision 3 (Section 5.7.1.2) [ECDH] [**selection**: *: NIST SP 800-186 (Section 3.2.1) [NIST Curves], RFC 5639 (Section 3) [Brainpool curves]*]
ECDH-Ed	ECDH with Montgomery Curves	Domain parameters approved for elliptic curves [**selection**: *curve25519, curve448*]	RFC 7748 (Section 5) [ECDH-Ed] NIST SP 800-186 (Section 3.2.2) [Montgomery Curves]

Application Note: This SFR must be included in the ST if key agreement or transport is a service provided by the TOE to tenant software, or if they are used by the TOE itself to support or implement PP-specified security functionality.

Also, this SFR must be included in the TOE if FCS_CKM.2 is claimed and a key establishment scheme other than FFC is selected.

If "*ECIES*" is selected, then FCS_COP.1/KeyedHash and FCS_COP.1/SKC must be claimed.

If this SFR is included in the ST, then FCS_CKM.6 must also be claimed.

Evaluation Activities

FCS_CKM_EXT.7
TSS
The evaluator shall ensure that the selected RSA and ECDH key agreement/transport schemes correspond to the key generation schemes selected in FCS_CKM.1/AKG, and the key establishment schemes selected in FCS_CKM.2 If the ST selects DH, the TSS shall describe how the implementation meets the relevant sections of RFC 3526 (Section 3-7) and RFC 7919 (Appendices A.1-A.5). If the ST selects ECIES, the TSS shall describe the key sizes and algorithms (e.g. elliptic curve point multiplication, ECDH with either NIST or Brainpool curves, AES in a mode permitted by FCS_COP.1/SKC, a SHA-2 hash algorithm permitted by FCS_COP.1/Hash, and a MAC algorithm permitted by FCS_COP.1/KeyedHash) that are supported for the ECIES implementation.

The evaluator shall ensure that, for each key agreement/transport scheme, the size of the derived keying material is at least the same as the intended strength of the key agreement/transport scheme, and where feasible this should be twice the intended security strength of the key agreement/transport scheme.

Table 2 of NIST SP 800-57 identifies the key strengths for the different algorithms that can be used for the various key agreement/transport schemes.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
The following tests are conditional based upon the selections made in the SFR. The evaluator shall perform the following test or witness respective tests executed by the developer. The tests must be executed on a platform that is as close as practically possible to the operational platform (but which may be instrumented in terms of, for example, use of a debug mode). Where the test is not carried out on the TOE itself, the test platform shall be identified and the differences between test environment and TOE execution environment shall be described.

KAS2

Identifier	***Cryptographic Algorithm***	***Cryptographic Parameters***	***List of Standards***
KAS2	*RSA*	*Modulus Size [**selection:** 2048, 3072, 4096, 6144, 8192] bits*	*NIST SP 800-56B Revision 2 (Section 8.3) [KAS2]*

To test the TOE's implementation of the of the KAS2 RSA Key Agreement scheme, the evaluator shall perform the Algorithm Functional Test and Validation Test using the following input parameters:

- *RSA Private key format [Basic, Prime Factor, Chinese Remainder Theorem]*
- *Modulo value [2048, 3072, 4096, 6144, 8192]*

- *Role [initiator, responder]*

The evaluator shall generate a test group (i.e. set of tests) for each parameter value of the above parameter type with the largest number of supported values. For example, if the TOE supports all five Modulo values, then the evaluator shall generate five test groups. Each of the above supported parameter values must be included in at least one test group.

Regardless of how many parameter values are supported, there must be at least two test groups.

Half of the test groups are designated as Algorithm Functional Tests (AFT) and the remainder are designated as Validation Tests (VAT). If there is an odd number of groups, then the extra group is designated randomly as either AFT or VAT.

Algorithm Functional Test
For each test group designated as AFT, the evaluator shall generate 10 test cases using random data (except for a fixed public exponent, if supported). The resulting shared secrets shall be compared with those generated by a known-good implementation using the same inputs.

Validation Test
For each test group designated as VAT, the evaluator shall generate 25 test cases are using random data (except for a fixed public exponent, if supported). Of the 25 test cases:

- *Two test cases must have a shared secret with a leading nibble of 0s,*
- *Two test cases have modified derived key material,*
- *Two test cases have modified tags, if key conformation is supported,*
- *Two test cases have modified MACs, if key confirmation is used, and*
- *The remaining test cases are not modified.*

To determine correctness, the evaluator shall confirm that the resulting 25 shared secrets correspond as expected for both the modified and unmodified values.

FFC Diffie-Hellman Key Agreement

Identifier	***Cryptographic Algorithm***	***Cryptographic Parameters***	***List of Standards***
DH	*Finite Field Cryptography Diffie-Hellman*	*Static domain parameters approved for [**selection:** IKE groups [**selection:** MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192], TLS groups [**selection:** ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]]]*	*NIST SP 800-56A Revision 3 (Section 5.7.1.1) [DH]* *[**selection:** RFC 3526 [IKE Groups], RFC 7919 [TLS Groups]]*

To test the TOE's implementation of FFC Diffie-Hellman Key Agreement, the evaluator shall perform the Algorithm Functional Test and Validation Test using the following input parameters:

- *Domain Parameter Group [MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192, ffdhe2048, ffdhe3072, ffdhe4096, ffdhe6144, ffdhe8192]*

Algorithm Functional Test
For each supported domain parameter group, the evaluator shall generate 10 test cases by generating the initiator and responder secret keys using random data, calculating the responder public key, and creating the shared secret. The resulting shared secrets shall be compared with those generated by a known-good implementation using the same inputs.

Validation Test
For each supported combination of the above parameters the evaluator shall generate 15 Diffie Hellman initiator/responder key pairs using the key generation function of a known-good implementation. For each set of key pairs, the evaluator shall modify five initiator private key values. The remaining key values are left unchanged (i.e., correct). To determine correctness, the evaluator shall confirm that the 15 shared secrets correspond as expected for both the modified and unmodified inputs.

Elliptic Curve Diffie-Hellman Key Agreement

Identifier	***Cryptographic***	***Cryptographic Parameters***	***List of Standards***

	Algorithm		
ECDH	*Elliptic Curve Diffie-Hellman*	*Elliptic Curve [**selection:** P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1]*	*NIST SP 800-56A Revision 3 (Section 5.7.1.2) [ECDH]* *[**selection:** NIST SP 800-186 (Section 3.2.1) [NIST Curves], RFC 5639 (Section 3) [Brainpool Curves]]*

To test the TOE's implementation of Elliptic Curve Diffie-Hellman Key Agreement, the evaluator shall perform the Algorithm Functional Test and Validation Test using the following input parameters:

- *Elliptic Curve [P-256, brainpoolP256r1, P-384, brainpoolP384r1, P-521, brainpoolP512r1]*

Algorithm Functional Test
For each supported Elliptic Curve the evaluator shall generate 10 test cases by generating the initiator and responder secret keys using random data, calculating the responder public key, and creating the shared secret. The resulting shared secrets shall be compared with those generated by a known-good implementation using the same inputs.

Validation Test
For each supported Elliptic Curve the evaluator shall generate 15 Diffie Hellman initiator/responder key pairs using the key generation function of a known-good implementation. For each set of key pairs, the evaluator shall modify five initiator private key values. The remaining key values are left unchanged (i.e., correct). To determine correctness, the evaluator shall confirm that the 15 shared secrets correspond as expected for the modified and unmodified values.

Elliptic Curve Diffie-Hellman Key Agreement with Montgomery Curves

Identifier	***Cryptographic Algorithm***	***Cryptographic Parameters***	***List of Standards***
ECDH-Ed	*ECDH with Montgomery Curves*	*Domain parameters approved for elliptic curves [**selection:** curve25519, curve448]*	*RFC 7748 (Section 5) [ECDH-Ed]* *NIST SP 800-186 (Section 3.2.2) [Montgomery Curves]*

To test the TOE's implementation of Elliptic Curve Diffie-Hellman Key Agreement with Montgomery Curves, the evaluator shall perform the Algorithm Functional Test and Validation Test using the following input parameters:

- *- Domain Parameters for elliptic curves [curve25519, curve448]*

Algorithm Functional Test
For each supported set of domain parameters, the evaluator shall generate 10 test cases by generating the initiator and responder secret keys using random data, calculating the responder public key, and creating the shared secret. The resulting shared secrets shall be compared with those generated by a known-good implementation using the same inputs

Validation Test
For each supported combination of the above parameters the evaluator shall generate 15 Diffie Hellman initiator/responder key pairs using the key generation function of a known-good implementation. For each set of key pairs, modify five initiator private keys values. The remaining key values are left unchanged (i.e., correct). To determine correctness, the evaluator shall confirm that the 15 shared secrets correspond as expected for the modified and unmodified values.

FCS_CKM_EXT.8 Password-Based Key Derivation

This is an optional component. However, applied modules or packages might redefine it as mandatory.

FCS_CKM_EXT.8.1

The TSF shall perform password-based key derivation functions in accordance with a specified cryptographic algorithm [HMAC-[**selection**: *SHA-256*, *SHA-384*,

SHA-512, *SHA3-256*, *SHA3-384*, *SHA3-512*], with iteration count of [**assignment**: *number of iterations*] using a randomly generated salt of length [**assignment**: *equal to or greater than 128*] and output cryptographic key sizes [**selection**: *128*, *192*, *256*, *512*] bits that meet the following standard: [NIST SP 800-132 (Section 5.3) [PBKDF2]].

Application Note: NIST recommends a minimum “number of iterations” of 1000 but prefers the largest number feasible given performance constraints.

NIST recommends that the randomly generated portion of the salt have length of at least 128 bits and must be derived from a Random Bit Generation. Therefore FCS_OTV_EXT.1 must be claimed.

Evaluation Activities

FCS_CKM_EXT.8
TBD

FCS_COP.1/AEAD Cryptographic Operation – Authenticated Encryption with Associated Data

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.3.1, FDP_ITC_EXT.1.2.
This component may also be included in the ST as if optional.

FCS_COP.1.1/AEAD

The TSF shall perform [authenticated encryption with associated data] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/AEAD.

Table 9: Recommended choices for FCS_COP.1/AEAD

Identifier	Cryptographic algorithm	Cryptographic key sizes	List of standards
AES-CCM	AES in CCM mode with unpredictable, non-repeating nonce, minimum size of 64 bits	[**selection**: *128 bits*, *192 bits*, *256 bits*]	[**selection**: *ISO/IEC 18033-3:2010 (Subclause 5.2)*, *FIPS PUB 197*] [AES] [**selection**: *ISO/IEC 19772:2020 (Clause 7)*, *NIST SP 800-38C*] [CCM]
AES-GCM	AES in GCM mode with non-repeating IVs using [**selection**: *deterministic*, *RBG-based*], IV construction; the tag must be of length [**selection**: *96*, *104*, *112*, *120*, *128*] bits.	[**selection**: *128 bits*, *192 bits*, *256 bits*]	[**selection**: *ISO/IEC 18033-3:2010 (Subclause 5.2)*, *FIPS PUB 197*] [AES] [**selection**: *ISO/IEC 19772:2020 (Clause 10)*, *NIST SP 800-38D*] [GCM]

CAM-CCM	Camellia in CCM mode with non-repeating nonce, minimum size of 64 bits	[**selection**: *128 bits*, *192 bits*, *256 bits*]	ISO/IEC 18033-3:2010 (Subclause 5.3) [Camellia] [**selection**: *ISO/IEC 19772:2020 (Clause 7)*, *NIST SP 800-38C*] [CCM]
CAM-GCM	Camillia in GCM mode with non-repeating IVs using [**selection**: *deterministic*, *RBG-based*], IV construction; the tag must be of length [**selection**: *96*, *104*, *112*, *120*, *128*] bits.	[**selection**: *128 bits*, *192 bits*, *256 bits*]	ISO/IEC 18033-3:2010 (Subclause 5.3) [Camellia] [**selection**: *ISO/IEC 19772:2020 (Clause 10)*, *NIST SP 800-38D*] [GCM]
SEED-CCM	SEED in CCM mode with non-repeating nonce, minimum size of 64 bits	128 bits	ISO/IEC 18033-3:2010 (Subclause 5.4) [SEED] [**selection**: *ISO/IEC 19772:2020 (Clause 7)*, *NIST SP 800-38C*] [CCM]
SEED-GCM	SEED in GCM mode with non-repeating IVs using [**selection**: *deterministic*, *RBG-based*], IV construction; the tag must be of length [**selection**: *96*, *104*, *112*, *120*, *128*] bits.	128 bits	ISO/IEC 18033-3:2010 (Subclause 5.4) [SEED] [**selection**: *ISO/IEC 19772:2020 (Clause 10)*, *NIST SP 800-38D*] [GCM]
LEA-CCM	LEA in CCM mode with non-repeating nonce, minimum size of 64 bits	[**selection**: *128 bits*, *192 bits*, *256 bits*]	ISO/IEC 29192-2:2019 (Subclause 6.3 [LEA] [**selection**: *ISO/IEC 19772:2020 (Clause 7)*, *NIST SP 800-38C*] [CCM]
LEA-GCM	LEA in GCM mode with non-repeating IVs using [**selection**: *deterministic*, *RBG-based*], IV	[**selection**: *128 bits*, *192 bits*, *256 bits*]	ISO/IEC 29192-2:2019

	construction; the tag must be of length [**selection**: *96*, *104*, *112*, *120*, *128*] bits.	(Subclause 6.3 [LEA] [**selection**: *ISO/IEC 19772:2020 (Clause 10), NIST SP 800-38D*] [GCM]

Application Note: This SFR must be included in the ST if symmetric-key cryptography is a service provided by the TOE to tenant software, or if the TOE itself uses SKC to support or implement PP-specified security functionality.

Specifically, this SFR must be included if the ST includes FCS_IPSEC_EXT.1 or FCS_STG_EXT.2, or includes any of the following selections:

- "*CTR_DRBG (AES)*" in FCS_RBG.1
- "*ECIES*" in FCS_COP.1/KAT
- "*AES-**" in FCS_STG_EXT.3

From catalogIf the selected cryptographic algorithm requires an IV or nonce, then FCS_OTV_EXT.1 must be claimed.

Evaluation Activities

FCS_COP.1/AEAD

TSS

The evaluator shall check that the TSS includes a description of encryption functions used for symmetric key encryption. The evaluator should check that this description of the selected encryption function includes the key sizes and modes of operations as specified in Table 16.

The evaluator shall check that the TSS describes the means by which the TOE satisfies constraints on algorithm parameters included in the selections made for "cryptographic algorithm" and "list of standards."

Guidance

If the product supports multiple modes, the evaluator shall examine the AGD to determine that the method of choosing a specific mode/key size is described.

KMD

The evaluator shall examine the KMD to ensure that the points at which symmetric key encryption and decryption occurs are described, and that the complete data path for symmetric key encryption is described. The evaluator checks that this description is consistent with the relevant parts of the TSS.

Assessment of the complete data path for symmetric key encryption includes confirming that the KMD describes the data flow from the device's host interface to the device's non-volatile memory storing the data, and gives information enabling the user data path to be distinguished from those situations in which data bypasses the data encryption engine (e.g. read-write operations to an unencrypted Master Boot Record area). The evaluator shall ensure that the documentation of the data path is detailed enough that it thoroughly describes the parts of the TOE that the data passes through (e.g. different memory types, processors and co-processors), its encryption state (i.e. encrypted or unencrypted) in each part, and any places where the data is stored. For example, any caching or buffering of the data should be identified and distinguished from the final destination in non-volatile memory (the latter represents the location from which the host will expect to retrieve the data in future).

If support for AES-CTR is claimed and the counter value source is internal to the TOE, the evaluator shall verify that the KMD describes the internal counter mechanism used to ensure that it provides unique counter block values.

Tests

The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are typically not found on factory products.

The following tests are conditional based upon the selections made in the SFR. The evaluator shall perform the following test or witness respective tests executed by the developer. The tests must be executed on a platform that is as close as practically possible to the operational platform (but which may be instrumented in terms of, for example, use of a debug mode). Where the test is not carried out on the TOE itself, the test platform shall be identified and the differences between test environment and TOE execution environment shall be described.

Preconditions for testing:

- *Specification of keys as input parameter to the function to be tested*

- *specification of required input parameters such as modes*
- *Specification of user data (plaintext)*
- *Tapping of encrypted user data (ciphertext) directly in the non-volatile memory*

AES-CBC:
For the AES-CBC tests described below, the plaintext, ciphertext, and IV values shall consist of 128-bit blocks. To determine correctness, the evaluator shall compare the resulting values to those obtained by submitting the same inputs to a known-good implementation.

These tests are intended to be equivalent to those described in NIST's AES Algorithm Validation Suite (AESAVS) (http://csrc.nist.gov/groups/STM/cavp/documents/aes/AESAVS.pdf). It is not recommended that the evaluator use values obtained from static sources such as the example NIST's AES Known Answer Test Values from the AESAVS document, or use values not generated expressly to exercise the AES-CBC implementation.

AES-CBC Known Answer Tests

KAT-1 (GFSBox): To test the encrypt functionality of AES-CBC, the evaluator shall supply a set of five different plaintext values for each selected key size and obtain the ciphertext value that results from AES-CBC encryption of the given plaintext using a key value of all zeros and an IV of all zeros.

To test the decrypt functionality of AES-CBC, the evaluator shall supply a set of five different ciphertext values for each selected key size and obtain the plaintext value that results from AES-CBC decryption of the given ciphertext using a key value of all zeros and an IV of all zeros.

KAT-2 (KeySBox): To test the encrypt functionality of AES-CBC, the evaluator shall supply a set of five different key values for each selected key size and obtain the ciphertext value that results from AES-CBC encryption of an all-zeros plaintext using the given key value and an IV of all zeros.

To test the decrypt functionality of AES-CBC, the evaluator shall supply a set of five different key values for each selected key size and obtain the plaintext that results from AES-CBC decryption of an all-zeros ciphertext using the given key and an IV of all zeros.

KAT-3 (Variable Key): To test the encrypt functionality of AES-CBC, the evaluator shall supply a set of keys for each selected key size (as described below) and obtain the ciphertext value that results from AES encryption of an all-zeros plaintext using each key and an IV of all zeros.

Key i in each set shall have the leftmost i bits set to ones and the remaining bits to zeros, for values of i from 1 to the key size. The keys and corresponding ciphertext are listed in AESAVS, Appendix E.

To test the decrypt functionality of AES-CBC, the evaluator shall use the same keys as above to decrypt the ciphertext results from above. Each decryption should result in an all-zeros plaintext.

KAT-4 (Variable Text): To test the encrypt functionality of AES-CBC, for each selected key size, the evaluator shall supply a set of 128-bit plaintext values (as described below) and obtain the ciphertext values that result from AES-CBC encryption of each plaintext value using a key of each size and IV consisting of all zeros.

Plaintext value i shall have the leftmost i bits set to ones and the remaining bits set to zeros, for values of i from 1 to 128. The plaintext values are listed in AESAVS, Appendix D.

To test the decrypt functionality of AES-CBC, for each selected key size, use the plaintext values from above as ciphertext input, and AES-CBC decrypt each ciphertext value using key of each size consisting of all zeros and an IV of all zeros.

AES-CBC Multi-Block Message Test

The evaluator shall test the encrypt functionality by encrypting nine i-block messages for each selected key size, for $2 \leq i \leq 10$. For each test, the evaluator shall supply a key, an IV, and a plaintext message of length i blocks, and encrypt the message using AES-CBC. The resulting ciphertext values shall be compared to the results of encrypting the plaintext messages using a known good implementation.

The evaluator shall test the decrypt functionality by decrypting nine i-block messages for each selected key size, for $2 \leq i \leq 10$. For each test, the evaluator shall supply a key, an IV, and a ciphertext message of length i blocks, and decrypt the message using AES-CBC. The resulting plaintext values shall be compared to the results of decrypting the ciphertext messages using a known good implementation.

AES-CBC Monte Carlo Tests

The evaluator shall test the encrypt functionality for each selected key size using 100 3-tuples of pseudo-random values for plaintext, IVs, and keys.

The evaluator shall supply a single 3-tuple of pseudo-random values for each selected key size. This 3-tuple of plaintext, IV, and key is provided as input to the below algorithm to generate the remaining 99 3-tuples, and to run each 3-tuple through 1000 iterations of AES-CBC encryption.

```
# Input: PT, IV, Key
Key[0] = Key
IV[0] = IV
```

```
PT[0] = PT
for i = 0 to 99 {
        Output Key[i], IV[i], PT[0]
        for j = 0 to 999 {
                if (j == 0) {
                        CT[j] = AES-CBC-Encrypt(Key[i], IV[i], PT[j])
                        PT[j+1] = IV[i]
                } else {
                        CT[j] = AES-CBC-Encrypt(Key[i], PT[j])
                        PT[j+1] = CT[j-1]
                }
        }
        Output CT[j]
        If (KeySize == 128) Key[i+1] = Key[i] xor CT[j]
        If (KeySize == 192) Key[i+1] = Key[i] xor (last 64 bits of CT[j-1] || CT[j])
        If (KeySize == 256) Key[i+1] = Key[i] xor ((CT[j-1] | CT[j])
        IV[i+1] = CT[j]
        PT[0] = CT[j-1]
}
```

The ciphertext computed in the 1000th iteration (CT[999]) is the result for each of the 100 3-tuples for each selected key size. This result shall be compared to the result of running 1000 iterations with the same values using a known good implementation.

The evaluator shall test the decrypt functionality using the same test as above, exchanging CT and PT, and replacing AES-CBC-Encrypt with AES-CBC-Decrypt.

AES-CCM:

These tests are intended to be equivalent to those described in the NIST document, "The CCM Validation System (CCMVS)," updated 9 Jan 2012, found at http://csrc.nist.gov/groups/STM/cavp/documents/mac/CCMVS.pdf.

It is not recommended that the evaluator use values obtained from static sources such as http://csrc.nist.gov/groups/STM/cavp/documents/mac/ccmtestvectors.zip or use values not generated expressly to exercise the AES-CCM implementation.

The evaluator shall test the generation-encryption and decryption-verification functionality of AES-CCM for the following input parameter and tag lengths:

- ***Keys:** All supported and selected key sizes (e.g., 128, 192, or 256 bits).*
- ***Associated Data:** Two or three values for associated data length: The minimum (≥ 0 bytes) and maximum (≤ 32 bytes) supported associated data lengths, and 2^16 (65536) bytes, if supported.*
- ***Payload:** Two values for payload length: The minimum (≥ 0 bytes) and maximum (≤ 32 bytes) supported payload lengths.*
- ***Nonces:** All supported nonce lengths (e.g., 8, 9, 10, 11, 12, 13) in bytes.*
- ***Tag:** All supported tag lengths (e.g., 4, 6, 8, 10, 12, 14, 16) in bytes.*

The testing for CCM consists of five tests. To determine correctness in each of the below tests, the evaluator shall compare the ciphertext with the result of encryption of the same inputs with a known good implementation.

Variable Associated Data Test: For each supported key size and associated data length, and any supported payload length, nonce length, and tag length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting ciphertext.

Variable Payload Text: For each supported key size and payload length, and any supported associated data length, nonce length, and tag length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting ciphertext.

Variable Nonce Test: For each supported key size and nonce length, and any supported associated data length, payload length, and tag length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting ciphertext.

Variable Tag Test: For each supported key size and tag length, and any supported associated data length, payload length, and nonce length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting ciphertext.

Decryption-Verification Process Test: To test the decryption-verification functionality of AES-CCM, for each combination of supported associated data length, payload length, nonce length, and tag length, the evaluator shall supply a key value and 15 sets of input plus ciphertext, and obtain the decrypted payload. Ten of the 15 input sets supplied should fail verification and five should pass.

***AES-GCM:** These tests are intended to be equivalent to those described in the NIST document, "The Galois/Counter Mode (GCM) and GMAC Validation System (GCMVS) with the Addition of XPN Validation Testing," rev. 15 Jun 2016, section 6.2, found at http://csrc.nist.gov/groups/STM/cavp/documents/mac/gcmvs.pdf.*

It is not recommended that the evaluator use values obtained from static sources such as

http://csrc.nist.gov/groups/STM/cavp/documents/mac/gcmtestvectors.zip, or use values not generated expressly to exercise the AES-GCM implementation.

The evaluator shall test the authenticated encryption functionality of AES-GCM by supplying 15 sets of Key, Plaintext, AAD, IV, and Tag data for every combination of the following parameters as selected in the ST and supported by the implementation under test:

- ***Key size in bits:** Each selected and supported key size (e.g., 128, 192, or 256 bits).*
- ***Plaintext length in bits:** Up to four values for plaintext length: Two values that are non-zero integer multiples of 128, if supported. And two values that are non-multiples of 128, if supported.*
- ***AAD length in bits:** Up to five values for AAD length: Zero-length, if supported. Two values that are non-zero integer multiples of 128, if supported. And two values that are integer non-multiples of 128, if supported.*
- ***IV length in bits:** Up to three values for IV length: 96 bits. Minimum and maximum supported lengths, if different.*
- ***MAC length in bits:** Each supported length (e.g., 128, 120, 112, 104, 96).*

To determine correctness, the evaluator shall compare the resulting values to those obtained by submitting the same inputs to a known-good implementation.

The evaluator shall test the authenticated decrypt functionality of AES-GCM by supplying 15 Ciphertext-Tag pairs for every combination of the above parameters, replacing Plaintext length with Ciphertext length. For each parameter combination the evaluator shall introduce an error into either the Ciphertext or the Tag such that approximately half of the cases are correct and half the cases contain errors. To determine correctness, the evaluator shall compare the resulting pass/fail status and Plaintext values to the results obtained by submitting the same inputs to a known-good implementation.

AES-CTR:

For the AES-CTR tests described below, the plaintext and ciphertext values shall consist of 128-bit blocks. To determine correctness, the evaluator shall compare the resulting values to those obtained by submitting the same inputs to a known-good implementation.

These tests are intended to be equivalent to those described in NIST's AES Algorithm Validation Suite (AESAVS) (http://csrc.nist.gov/groups/STM/cavp/documents/aes/AESAVS.pdf). It is not recommended that the evaluator use values obtained from static sources such as the example NIST's AES Known Answer Test Values from the AESAVS document, or use values not generated expressly to exercise the AES-CTR implementation.

AES-CTR Known Answer Tests

KAT-1 (GFSBox): To test the encrypt functionality of AES-CTR, the evaluator shall supply a set of five different plaintext values for each selected key size and obtain the ciphertext value that results from AES-CTR encryption of the given plaintext using a key value of all zeros.

To test the decrypt functionality of AES-CTR, the evaluator shall supply a set of five different ciphertext values for each selected key size and obtain the plaintext value that results from AES-CTR decryption of the given ciphertext using a key value of all zeros.

KAT-2 (KeySBox): To test the encrypt functionality of AES-CTR, the evaluator shall supply a set of five different key values for each selected key size and obtain the ciphertext value that results from AES-CTR encryption of an all-zeros plaintext using the given key value.

To test the decrypt functionality of AES-CTR, the evaluator shall supply a set of five different key values for each selected key size and obtain the plaintext that results from AES-CTR decryption of an all-zeros ciphertext using the given key.

KAT-3 (Variable Key): To test the encrypt functionality of AES-CTR, the evaluator shall supply a set of keys for each selected key size (as described below) and obtain the ciphertext value that results from AES encryption of an all-zeros plaintext using each key.

Key i in each set shall have the leftmost i bits set to ones and the remaining bits to zeros, for values of i from 1 to the key size. The keys and corresponding ciphertext are listed in AESAVS, Appendix E.

To test the decrypt functionality of AES-CTR, the evaluator shall use the same keys as above to decrypt the ciphertext results from above. Each decryption should result in an all-zeros plaintext.

KAT-4 (Variable Text): To test the encrypt functionality of AES-CTR, for each selected key size, the evaluator shall supply a set of 128-bit plaintext values (as described below) and obtain the ciphertext values that result from AES-CTR encryption of each plaintext value using a key of each size.

Plaintext value i shall have the leftmost i bits set to ones and the remaining bits set to zeros, for values of i from 1 to 128. The plaintext values are listed in AESAVS, Appendix D.

To test the decrypt functionality of AES-CTR, for each selected key size, use the plaintext values from above as ciphertext input, and AES-CTR decrypt each ciphertext value using key of each size consisting of all zeros.

AES-CTR Multi-Block Message Test

The evaluator shall test the encrypt functionality by encrypting nine i-block messages for each selected key size, for 2 ≤ i ≤ 10. For each test, the evaluator shall supply a key and a plaintext message of length i blocks, and encrypt the message using AES-CTR. The resulting ciphertext values shall be compared to the results of encrypting the plaintext messages using a known good implementation.

The evaluator shall test the decrypt functionality by decrypting nine i-block messages for each selected key size, for 2 ≤ i ≤ 10. For each test, the evaluator shall supply a key and a ciphertext message of length i blocks, and decrypt the message using AES-CTR. The resulting plaintext values shall be compared to the results of decrypting the ciphertext messages using a known good implementation.

AES-CTR Monte Carlo Tests

The evaluator shall test the encrypt functionality for each selected key size using 100 2-tuples of pseudo-random values for plaintext and keys.

The evaluator shall supply a single 2-tuple of pseudo-random values for each selected key size. This 2-tuple of plaintext and key is provided as input to the below algorithm to generate the remaining 99 2-tuples, and to run each 2-tuple through 1000 iterations of AES-CTR encryption.

```
# Input: PT, Key
Key[0] = Key
PT[0] = PT
for i = 0 to 99 {
        Output Key[i], PT[0]
        for j = 0 to 999 {
                CT[j] = AES-CTR-Encrypt(Key[i], PT[j])
                PT[j+1] = CT[j]
        }
        Output CT[j]
        If (KeySize == 128) Key[i+1] = Key[i] xor CT[j]
        If (KeySize == 192) Key[i+1] = Key[i] xor (last 64 bits of CT[j-1] || CT[j])
        If (KeySize == 256) Key[i+1] = Key[i] xor ((CT[j-1] | CT[j])
        PT[0] = CT[j]
}
```

The ciphertext computed in the 1000th iteration (CT[999]) is the result for each of the 100 2-tuples for each selected key size. This result shall be compared to the result of running 1000 iterations with the same values using a known good implementation.

The evaluator shall test the decrypt functionality using the same test as above, exchanging CT and PT, and replacing AES-CTR-Encrypt with AES-CTR-Decrypt. 198 Note additional design considerations for this mode are addressed in the KMD requirements.

***XTS-AES:** These tests are intended to be equivalent to those described in the NIST document, "The XTS-AES Validation System (XTSVS)," updated 5 Sept 2013, found at http://csrc.nist.gov/groups/STM/cavp/documents/aes/XTSVS.pdf*

It is not recommended that the evaluator use values obtained from static sources such as the XTS-AES test vectors at http://csrc.nist.gov/groups/STM/cavp/documents/aes/XTSTestVectors.zip or use values not generated expressly to exercise the XTS-AES implementation.

The evaluator shall generate test values as follows:

For each supported key size (256 bit (for AES-128) and 512 bit (for AES-256) keys), the evaluator shall provide up to five data lengths:

- *Two data lengths divisible by the 128-bit block size, If data unit lengths of complete block sizes are supported.*
- *Two data lengths not divisible by the 128-bit block size, if data unit lengths of partial block sizes are supported.*
- *The largest data length supported by the implementation, or 2^16 (65536), whichever is larger.*

The evaluator shall specify whether the implementation supports tweak values of 128-bit hexadecimal strings or a data unit sequence numbers, or both.

For each combination of key size and data length, the evaluator shall provide 100 sets of input data and obtain the ciphertext that results from XTS-AES encryption. If both kinds of tweak values are supported, then each type of tweak value shall be used in half of every 100 sets of input data, for all combinations of key size and data length. The evaluator shall verify that the resulting ciphertext matches the results from submitting the same inputs to a known-good implementation of XTS-AES.

The evaluator shall test the decrypt functionality of XTS-AES using the same test as for encrypt, replacing plaintext values with ciphertext values and XTS-AES encrypt with XTS- AES decrypt.

The evaluator shall check that the full length keys are created by methods that ensure that the two halves are different and independent.

AES-KWP:

The tests below are derived from "The Key Wrap Validation System (KWVS), Updated: June 20, 2014" from the National Institute of Standards and Technology.

The evaluator shall test the authenticated-encryption functionality of AES-KWP (KWP-AE) using the same test as for AES-KW authenticated-encryption with the following change in the five plaintext lengths:

- *Four lengths that are multiples of 8 bits*
- *The largest supported length less than or equal to 4096 bits.*

The evaluator shall test the authenticated-decryption (KWP-AD) functionality of AES-KWP using the same test as for AES-KWP authenticated-encryption, replacing plaintext values with ciphertext values and AES-KWP authenticated encryption with AES-KWP authenticated-decryption. For the Authenticated Decryption test, 20 out of the 100 trials per plaintext length have ciphertext values that fail authentication.

Additionally, the evaluator shall perform the following negative tests:

***Test 1: (invalid plaintext length):** Determine the valid plaintext lengths of the implementation from the TOE specification. Verify that the implementation of KWP-AE in the TOE rejects plaintext of invalid length by testing plaintext of the following lengths: 1) plaintext with length greater than 64 semi-blocks, 2) plaintext with bit-length not divisible by 8, and 3) plaintext with length 0.*

***Test 2: (invalid ciphertext length):** Determine the valid ciphertext lengths of the implementation from the TOE specification. Verify that the implementation of KWP-AD in the TOE rejects ciphertext of invalid length by testing ciphertext of the following lengths: 1) ciphertext with length greater than 65 semi-blocks, 2) ciphertext with bit-length not divisible by 64, 3) ciphertext with length 0, and 4) ciphertext with length of one semi-block.*

***Test 3: (invalid ICV2):** Test that the implementation detects invalid ICV2 values by encrypting any plaintext value four times using a different value for ICV2 each time as follows: Start with a base ICV2 of 0xA65959A6. For each of the four tests change a different byte of ICV2 to a different value, so that each of the four bytes is changed once. Verify that the implementation of KWP-AD in the TOE outputs FAIL for each test.*

***Test 4: (invalid padding length):** Generate one ciphertext using algorithm KWP-AE with substring [len(P)/8]32 of S replaced by each of the following 32-bit values, where len(P) is the length of P in bits and [ ]32 denotes the representation of an integer in 32 bits:*

- *[0]32*
- *[len(P)/8-8]32*
- *[len(P)/8+8]32*
- *[513]32.*

Verify that the implementation of KWP-AD in the TOE outputs FAIL on those inputs.

***Test 5: (invalid padding bits):** If the implementation supports plaintext of length not a multiple of 64-bits, then*

```
for each PAD length [1..7]
        for each byte in PAD set a zero PAD value;
                replace current byte by a non-zero value and use the resulting plaintext as
                        input to algorithm KWP-AE to generate ciphertext;
                verify that the implementation of KWP-AD in the TOE outputs FAIL on
                        this input.
```

AES-KW:

The tests below are derived from "The Key Wrap Validation System (KWVS), Updated: June 20, 2014" from the National Institute of Standards and Technology.

The evaluator shall test the authenticated-encryption functionality of AES-KW for each combination of the following input parameters:

- *Supported key lengths selected in the ST (e.g. 128 bits, 256 bits)*
- *Five plaintext lengths:*
  - *Two lengths that are non-zero multiples of 128 bits (two semi-block lengths)*
  - *Two lengths that are odd multiples of the semi-block length (64 bits)*
  - *The largest supported plaintext length less than or equal to 4096 bits.*

For each set of the above parameters the evaluator shall generate a set of 100 key and plaintext pairs and obtain the ciphertext that results from AES-KW authenticated encryption. To determine correctness, the evaluator shall compare the results with those obtained from the AES-KW authenticated-encryption function of a known good implementation.

The evaluator shall test the authenticated-decryption functionality of AES-KW using the same test as for authenticated-encryption, replacing plaintext values with ciphertext values and AES-KW authenticated-encryption (KW-AE) with AES-KW authenticated-decryption (KW-AD). For the authenticated-decryption test, 20 out of the 100 trials per plaintext length must have ciphertext values that are not authentic; that is, they fail authentication.

Additionally, the evaluator shall perform the following negative tests:

***Test 1 (invalid plaintext length):** Determine the valid plaintext lengths of the implementation from the TOE specification. Verify that the implementation of KW-AES in the TOE rejects plaintext of invalid length by testing plaintext of the following lengths: 1) plaintext length greater than 64 semi-blocks, 2) plaintext bit-length not divisible by 64, 3) plaintext with length 0,*

and 4) plaintext with one semi-block.

Test 2 (invalid ciphertext length): *Determine the valid ciphertext lengths of the implementation from the TOE specification. Verify that the implementation of KW-AD in the TOE rejects ciphertext of invalid length by testing ciphertext of the following lengths: 1) ciphertext with length greater than 65 semi-blocks, 2) ciphertext with bit-length not divisible by 64, 3) ciphertext with length 0, 4) ciphertext with length of one semiblock, and 5) ciphertext with length of two semi-blocks.*

Test 3 (invalid ICV1): *Test that the implementation detects invalid ICV1 values by encrypting any plaintext value eight times using a different value for ICV1 each time as follows: Start with a base ICV1 of 0xA6A6A6A6A6A6A6A6. For each of the eight tests change a different byte to a different value, so that each of the eight bytes is changed once. Verify that the implementation of KW-AD in the TOE outputs FAIL for each test.*

FCS_COP.1/CMAC Cryptographic Operation - CMAC

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.3.1.
This component may also be included in the ST as if optional.

FCS_COP.1.1/CMAC

The TSF shall perform [CMAC] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/CMAC.

Table 10: Recommended choices for FCS_COP.1/CMAC

Identifier	Cryptographic algorithm	Cryptographic key sizes	List of standards
AEC-CMAC	AES using CMAC mode	[**selection**: *128 bits, 192 bits, 256 bits*]	[**selection**: *ISO/IEC 18033-3:2010 (Subclause 5.2), FIPS PUB 197*] [AES] [**selection**: *: ISO/IEC 9797-1:2011 Subclause 7.6, NIST SP 800-38B*] [CMAC]
CAM-CMAC	Camillia using CMAC mode	[**selection**: *128 bits, 192 bits, 256 bits*]	ISO/IEC 18033-3:2010 Subclause 5.3 [Camellia] [**selection**: *: ISO/IEC 9797-1:2011 Subclause 7.6, NIST SP 800-38B*] [CMAC]

Evaluation Activities

FCS_COP.1/CMAC
TBD

FCS_COP.1/Hash Cryptographic Operation - Hashing)

This is a selection-based component. Its inclusion depends upon selection from FCS_CKM_EXT.5.1, FDP_ITC_EXT.1.2, FPT_ROT_EXT.2.1, FPT_TUD_EXT.2.1.
This component may also be included in the ST as if optional.

FCS_COP.1.1/Hash

The TSF shall perform [*cryptographic hashing*] in accordance with a specified cryptographic algorithm [**selection**: *SHA-1, SHA-224, SHA-256, SHA-384, SHA-512, SHA-512/224, SHA-512/256, SHA-3-224, SHA-3-256, SHA-3-384, SHA-3-512*] that meet the following: [**selection**: *ISO/IEC 10118-3:2018 [SHA, SHA3], FIPS PUB 180-4 [SHA], FIPS PUB 202 [SHA3]*].

Application Note: This SFR must be included in the ST if it is a service provided by the TOE to tenant software, or if it is used by the TOE itself to support or implement PP-specified security functionality.

Also, this SFR must be included in the ST if FCS_COP.1/KeyedHash, FCS_COP.1/SigGen, or FCS_COP.1/SigVer are claimed.

It must be included in the ST if "*hash value of the public key*" is selected in FPT_TUD_EXT.2.1.

It must be included in the ST if "*KDF-HASH*" or "*KDF-MAC*" or one of the SHA hashes is selected within "*KDF-XOR*" in FCS_CKM_EXT.5.1.

It must be included in the ST if "*Hash_DRBG (any)*" or "*HMAC_DRBG (any)*" is selected in FCS_RBG.1.1.

It must be included in the ST if "*cryptographic hash as specified in FCS_COP.1/Hash*" is selected in FDP_ITC_EXT.1.2.

It must be included in the ST if "*computation and verification of a hash by trusted code/data*" is selected in FPT_ROT_EXT.2.1.

The hash selection should be consistent with the overall strength of the algorithm used for signature generation. For example, the ST Author should choose SHA-256 for 2048-bit RSA or ECC with P-256, SHA-384 for 3072-bit RSA, 4096-bit RSA, or ECC with P-384, and SHA-512 for ECC with P-521. The ST Author selects the standard based on the algorithms selected.

SHA-1 may be used for the following applications: generating and verifying hash-based message authentication codes (HMACs), key derivation functions (KDFs), and random bit/number generation. In certain cases, SHA-1 may also be used for verifying old digital signatures and time stamps, provided that this is explicitly allowed by the application domain.

From catalogThe hash selection should be consistent with the overall strength of the algorithm used for signature generation. For example, the TOE should choose SHA-256 for 2048-bit RSA or ECC with P-256; SHA-384 for 3072-bit RSA, 4096-bit RSA, or ECC with P-384; and SHA-512 for ECC with P-521. The ST author selects the standard based on the algorithms selected.

SHA-1 may be used as a general hash function and for the following applications: generating and verifying hash-based message authentication codes (HMACs), key derivation functions (KDFs), and random bit/number generation. SHA-1 may also be used for verifying old digital signatures and time stamps, if this is explicitly allowed by the application domain. SHA-1 should not be used in applications in which collision resistance is needed.

Evaluation Activities

FCS_COP.1/Hash
TSS
The evaluator shall check that the association of the hash function with other TSF cryptographic functions (e.g., the digital signature verification function) is documented in the TSS.

Guidance
The evaluator checks the AGD to determine that any configuration that is required to be done to configure the functionality for the required hash sizes is present.

Tests
SHA-1 and SHA-2 Tests
The TSF hashing functions can be implemented in one of two modes. The first mode is the byte-oriented mode. In this mode the TSF only hashes messages that are an integral number of bytes in length; i.e., the length (in bits) of the message to be hashed is divisible by 8. The second mode is the bit-oriented mode. In this mode the TSF hashes messages of arbitrary length. As there are different tests for each mode, an indication is given in the following sections for the bit-oriented vs. the byte-oriented test macs.

The evaluator shall perform all of the following tests for each hash algorithm implemented by the TSF and used to satisfy the requirements of this PP.

Assurance Activity Note:
The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are typically not found on factory products.

Short Messages Test Bit-oriented Mode
The evaluator devises an input set consisting of m+1 messages, where m is the block length of the hash algorithm. The length of the messages range sequentially from 0 to m bits. The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are

provided to the TSF.

Short Messages Test Byte-oriented Mode
The evaluator devises an input set consisting of m/8+1 messages, where m is the block length of the hash algorithm. The length of the messages range sequentially from 0 to m/8 bytes, with each message being an integral number of bytes. The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are provided to the TSF.

Selected Long Messages Test Bit-oriented Mode
*The evaluator devises an input set consisting of m messages, where m is the block length of the hash algorithm. The length of the ith message is 512 + 99*i, where 1 <= i <= m. The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are provided to the TSF.*

Selected Long Messages Test Byte-oriented Mode
*The evaluator devises an input set consisting of m/8 messages, where m is the block length of the hash algorithm. The length of the ith message is 512 + 8*99*i, where 1 <= i <= m/8. The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are provided to the TSF.*

Pseudo-randomly Generated Messages Test
This test is for byte-oriented implementations only. The evaluator randomly generates a seed that is n bits long, where n is the length of the message digest produced by the hash function to be tested. The evaluator then formulates a set of 100 messages and associated digests by following the algorithm provided in Figure 1 of [SHAVS]. The evaluator then ensures that the correct result is produced when the messages are provided to the TSF.

SHA-3 Tests
The tests below are derived from the The Secure Hash Algorithm-3 Validation System (SHA3VS), Updated: April 7, 2016, from the National Institute of Standards and Technology.

For each SHA-3-XXX implementation, XXX represents d, the digest length in bits. The capacity, c, is equal to 2d bits. The rate is equal to 1600-c bits.

The TSF hashing functions can be implemented with one of two orientations. The first is a bit-oriented mode that hashes messages of arbitrary length. The second is a byte-oriented mode that hashes messages that are an integral number of bytes in length (i.e., the length (in bits) of the message to be hashed is divisible by 8). Separate tests for each orientation are given below.

The evaluator shall perform all of the following tests for each hash algorithm and orientation implemented by the TSF and used to satisfy the requirements of this PP. The evaluator shall compare digest values produced by a known-good SHA-3 implementation against those generated by running the same values through the TSF.

Short Messages Test, Bit-oriented Mode
The evaluator devises an input set consisting of rate+1 short messages. The length of the messages ranges sequentially from 0 to rate bits. The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are provided to the TSF. The message of length 0 is omitted if the TOE does not support zero-length messages.

Short Messages Test, Byte-oriented Mode
The evaluator devises an input set consisting of rate/8+1 short messages. The length of the messages ranges sequentially from 0 to rate/8 bytes, with each message being an integral number of bytes. The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are provided to the TSF. The message of length 0 is omitted if the TOE does not support zero-length messages.

Selected Long Messages Test, Bit-oriented Mode
The evaluator devises an input set consisting of 100 long messages ranging in size from rate+(rate+1) to rate+(100(rate+1)), incrementing by rate+1. (For example, SHA-3-256 has a rate of 1088 bits. Therefore, 100 messages will be generated with lengths 2177, 3266, …, 109988 bits.) The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are provided to the TSF.*

Selected Long Messages Test, Byte-oriented Mode
The evaluator devises an input set consisting of 100 messages ranging in size from (rate+(rate+8)) to (rate+100(rate+8)), incrementing by rate+8. (For example, SHA-3-256 has a rate of 1088 bits. Therefore 100 messages will be generated of lengths 2184, 3280, 4376, …, 110688 bits.) The message text shall be pseudo-randomly generated. The evaluator computes the message digest for each of the messages and ensure that the correct result is produced when the messages are provided to the TSF.*

Pseudo-randomly Generated Messages Monte Carlo) Test, Byte-oriented Mode

The evaluator supplies a seed of d bits (where d is the length of the message digest produced by

the hash function to be tested. This seed is used by a pseudorandom function to generate 100,000 message digests. One hundred of the digests (every 1000th digest) are recorded as checkpoints. The TOE then uses the same procedure to generate the same 100,000 message digests and 100 checkpoint values. The evaluator then compares the results generated ensure that the correct result is produced when the messages are generated by the TSF.

FCS_COP.1/KeyedHash Cryptographic Operation - Keyed Hash

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.3.1, FDP_ITC_EXT.1.2.
This component may also be included in the ST as if optional.

FCS_COP.1.1/KeyedHash

The TSF shall perform [keyed hash message authentication] in accordance with a specified cryptographic algorithm [**selection**: *Keyed Hash Algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/KeyedHash.

Table 11: Recommended choices for FCS_COP.1/KeyedHash

Keyed Hash Algorithm	Cryptographic key sizes	List of standards
HMAC-SHA-1	[**selection**: *(ISO, FIPS) 160, (FIPS) 128*] bits	[**selection**: *ISO/IEC 9797-2:2021 (Section 7 “MAC Algorithm 2”), FIPS PUB 198-1*]
HMAC-SHA-224	[**selection**: *224 (ISO, FIPS), 192 (FIPS), 128 (FIPS)*] bits	[**selection**: *ISO/IEC 9797-2:2021 (Section 7 “MAC Algorithm 2”), FIPS PUB 198-1*]
HMAC-SHA-256	[**selection**: *256 (ISO, FIPS), 192 (FIPS), 128 (FIPS)*] bits	[**selection**: *ISO/IEC 9797-2:2021 (Section 7 “MAC Algorithm 2”), FIPS PUB 198-1*]
HMAC-SHA-384	[**selection**: *384 (ISO, FIPS), 256 (FIPS), 192 (FIPS), 128 (FIPS)*] bits	[**selection**: *ISO/IEC 9797-2:2021 (Section 7 “MAC Algorithm 2”), FIPS PUB 198-1*]
HMAC-SHA-512	[**selection**: *512 (ISO, FIPS), 384 (FIPS), 256 (FIPS), 192 (FIPS), 128 (FIPS)*] bits	[**selection**: *ISO/IEC 9797-2:2021 (Section 7 “MAC Algorithm 2”), FIPS PUB 198-1*]
KMAC128	128 bits	[**selection**: *ISO/IEC 9797-2:2021 (Section 9 “MAC Algorithm 4”), NIST SP 800-185 (Section 4 “KMAC”)*]
KMAC256	256 bits	[**selection**: *ISO/IEC 9797-2:2021 (Section 9 “MAC Algorithm 4”), NIST SP 800-185 (Section 4 “KMAC”)*]
KMACXOF128	[**assignment**: *integer 256 le Lk lt 2^2040*]	[**selection**: *ISO/IEC 9797-2:2021 (Section 9 “MAC Algorithm 4”), NIST SP 800-185 (Section 4 “KMAC”)*]
KMACXOF256	[**assignment**: *integer 256 le Lk lt 2^2040*]	[**selection**: *ISO/IEC 9797-2:2021 (Section 9 “MAC Algorithm 4”), NIST SP 800-185 (Section 4 “KMAC”)*]

Application Note: This SFR must be included in the ST if it is a service provided by the TOE to tenant software, or if it is used by the TOE itself to support or implement PP-specified security functionality.

This SFR must be included in the ST if FCS_IPSEC_EXT.1 is claimed.

Also, this SFR must be claimed under the following conditions:

- If "*KDF-MAC*" or "*KDF-PBKDF*" is selected in FCS_CKM_EXT.5
- If "*KDF-CTR,*" "*KDF-FB,*" ""KDF-DPI is selected in FCS_CKM_EXT.5 and HMAC is selected for use by the key derivation algorithm.
- If "*A keyed hash of the stored key in accordance with FCS_COP.1/KeyedHash*" is selected in FCS_STG_EXT.3.1
- If "*ECIES*" is selected in FCS_COP.1/KAT
- If "*HMAC_DRBG (any)*" is selected in FCS_RBG.1.1
- If "*keyed hash as specified in FCS_COP.1/KeyedHash*" is selected in FDP_ITC_EXT.1.2

If this SFR is included in the ST, then FCS_COP.1/Hash must also be claimed.

The HMAC key size falls into a range between L1 and L2 defined in ISO/IEC 10118 for the appropriate hash function (e.g., for SHA-256 L1 = 512, L2 = 256) where L2 ≤ k ≤ L1.

From catalog The HMAC minimum key sizes in the table are specified in ISO/IEC 9797-2:2021, which requires that the minimum key size be equal to the digest size. The FIPS standard specifies no minimum or maximum key sizes, so if FIPS PUB 198-1 is selected, larger or smaller key sizes may be used. This is indicated by the parenthesized annotations in the Cryptographic Key Sizes column.

If “KMACXOF128” or “KMACXOF256” is selected as Keyed Hash Algorithm, then FCS_COP.1/XOF must be claimed.

Evaluation Activities

FCS_COP.1/KeyedHash
TSS
The evaluator shall examine the TSS to ensure that it specifies the following values used by the HMAC and KMAC functions: output MAC length used.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
The following test requires the developer to provide access to a test platform that provides the evaluator with tools that are typically not found on factory products.

This test is derived from The Keyed-Hash Message Authentication Code Validation System (HMACVS), updated 6 May 2016.

The evaluator shall provide 15 sets of messages and keys for each selected hash algorithm and hash length/key size/MAC size combination. The evaluator shall have the TSF generate HMAC or KMAC tags for these sets of test data. The evaluator shall verify that the resulting HMAC or KMAC tags match the results from submitting the same inputs to a known-good implementation of the HMAC or KMAC function, having the same characteristics.

FCS_COP.1/KeyEncap Cryptographic Operation - Key Encapsulation

FCS_COP.1.1/KeyEncap

The TSF shall perform [key encapsulation] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/KeyEncap.

Table 12: Recommended choices for FCS_COP.1/KeyEncap

Identifier	Cryptographic algorithm	Cryptographic key sizes	List of standards
KAS1	KAS1 [RSA-single party]	[**selection**: *2048 bit, 3072 bit, 4096 bit, 8192 bit*]	NIST SP 800-56B Revision 2 (Sections 6.3 and 8.2)
KTS-OAEP	KTS-OAEP [RSA-OAEP]	[**selection**: *2048 bit, 3072 bit, 4096 bit, 8192 bit*]	NIST SP 800-56B Revision 2 (Sections 6.3 and 9)

Application Note: NIST SP 800-57 Part 1 Revision 5 Section 5.6.2 specifies that the size of key used to protect the key being transported should be at least the security strength of the key it is protecting.

Evaluation Activities

FCS_COP.1/KeyEncap
TBD

FCS_COP.1/SigGen Cryptographic Operation - Signature Generation

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.3.1.
This component may also be included in the ST as if optional.

FCS_COP.1.1/SigGen

The TSF shall perform [digital signature generation] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/SigGen.

Table 13: Recommended choices for FCS_COP.1/SigGen

Identifier	Cryptographic algorithm	Cryptographic key sizes	List of standards
RSA-PKCS	RSASSA-PKCS1-v1_5	Modulus of size [**selection**: *2048*, *3072*, *4096*] bits, hash or XOF [**selection**: *SHA-256*, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*]	RFC 8017 (Section 8.2) [PKCS #1 v2.2] FIPS PUB 186-5 (Section 5.4) [RSASSA-PKCS1-v1_5]
RSA-PSS	RSASSA-PSS	Modulus of size [**selection**: *2048*, *3072*, *4096*] bits, hash or XOF [**selection**: *SHA-256*, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*, *SHAKE128*, *SHAKE256*]	RFC 8017 (Section 8.1) [PKCS#1 v2.2] FIPS PUB 186-5 (Section 5.4) [RSASSA-PSS]
ECDSA	ECDSA	Elliptic Curve [**selection**: *NIST P-256*, *brainpoolP256r1*, *NIST P-384*, *brainpoolP384r1*, *NIST P-521*, *brainpoolP512r1*], per-message secret number generation [**selection**: *extra random bits*, *rejection sampling*, *deterministic*] and hash or XOF function using[**selection**: *SHA-256*, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*, *SHAKE128*, *SHAKE256*]	[**selection**: *ISO/IEC 14888-3:2018 (Subclause 6.6)*, *FIPS PUB 186-5 (Sections 6.3.1, 6.4.1]*] [ECDSA] [**selection**: *RFC 5639 (Section 3) [Brainpool Curves]*, *NIST SP-800 186 (Section 4) [NIST Curves]]*]

KCDSA	KCDSA	hash function using[**selection**: *SHA-224*, *SHA-256*, *SHA-384*, *SHA-512*]	ISO/IEC 14888-3:2018 (Subclause 6.3) [KCDSA]
EC-KCDSA	EC-KCDSA	Elliptic Curve [**selection**: *P-224*, *P-256*, *B-233*, *B-283*, *K-233*, *K-283*] using hash [**selection**: *SHA-224*, *SHA-256*, *SHA-384*, *SHA-512*]	ISO/IEC 14888-3:2018 (Subclause 6.7) [EC-KCDSA] NIST SP 800-186 (Section 3) [NIST Curves]
EdDSA	Edwards-Curve Digital Signature Algorithm	Domain parameters approved for elliptic curves [**selection**: *Edwards25519*, *Edwards448*]	NIST FIPS PUB 186-5 (Section 7.6) [EdDSA] RFC 8032 [Edwards Curves]
LMS	LMS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Winternitz parameter = [**selection**: *1*, *2*, *4*, *8*] Tree height = [**selection**: *5*, *10*, *15*, *20*, *25*]	RFC 8554 [LMS] NIST SP 800-208 [parameters]
HSS	Multitree version of LMS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Winternitz parameter = [**selection**: *1*, *2*, *4*, *8*] Tree height = [**selection**: *5*, *10*, *15*, *20*, *25*] Number of levels = [**selection**: *1*, *2*, *3*, *4*, *5*, *6*, *7*, *8*]	RFC 8554 [HSS] NIST SP 800-208 [parameters]
XMSS	XMSS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Tree height = [**selection**: *10*, *16*, *20*]	RFC 8391 [XMSS] NIST SP 800-208 [parameters]
XMSS(MT)	Multitree version of XMSS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**:*	RFC 8391 [XMSS(MT)] NIST SP 800-208 [parameters]

SHA-256, SHAKE256]

]

(Total Tree height, Number of Levels) = [**selection**: *(20, 2), (20, 4), (40, 2), (40, 4), (40, 8), (60, 3), (60, 6), (60, 12)*]

Application Note: This SFR must be included in the ST if digital signature generation is a service provided by the TOE to tenant software, or if digital signature generation is used by the TOE itself to support or implement PP-specified security functionality.

Specifically, this SFR must be included if "*A digital signature of the stored key in accordance with FCS_COP.1/SigGen using an asymmetric key that is protected in accordance with FCS_STG_EXT.2*" is selected in FCS_STG_EXT.3.

If this SFR is included in the ST, then FCS_COP.1/Hash and FCS_RBG.1 must also be claimed.

From catalogThe dependency on FCS_OTV_EXT.1 is needed only for signature schemes that require random bits, such as ECDSA.

Evaluation Activities

FCS_COP.1/SigGen
TSS
The evaluator shall examine the TSS to ensure that all signature generation functions use the approved algorithms and key sizes.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are typically not found on factory products.

Each section below contains tests the evaluator must perform for each selected digital signature scheme. Based on the assignments and selections in the requirement, the evaluator chooses the specific activities that correspond to those selections.

The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are not found on the TOE in its evaluated configuration.

If RSASSA-PKCS1-v1_5 or RSASSA-PSS is claimed:

The below test is derived from The 186-4 RSA Validation System (RSA2VS). Updated 8 July 2014, Section 6.3, from the National Institute of Standards and Technology.

To test the implementation of RSA signature generation the evaluator uses the system under test to generate signatures for 10 messages for each combination of modulus size and SHA algorithm. The evaluator then uses a known-good implementation and the associated public keys to verify the signatures.

If Digital Signature Scheme 2 (DSS2) or Digital Signature Scheme 3 (DSS3) is claimed:

To test the implementation of DSS2/3 signature generation the evaluator uses the system under test to generate signatures for 10 messages for each combination of SHA algorithm, hash size and key size. The evaluator them uses a known-good implementation and the associated public keys to verify the signatures.

If ECDSA is claimed:

The below test is derived from The FIPS 186-5 Elliptic Curve Digital Signature Algorithm Validation System (ECDSA2VS). Updated 18 March 2014, Section 6.4, from the National Institute of Standards and Technology.

To test the implementation of ECDSA signature generation the evaluator uses the system under test to generate signatures for 10 messages for each combination of curve, SHA algorithm, hash size, and key size. The evaluator then uses a known-good implementation and the associated public keys to verify the signatures.

FCS_COP.1/SigVer Cryptographic Operation - Signature Verification

This is a selection-based component. Its inclusion depends upon selection from

***FDP_ITC_EXT.1.2*, *FPT_ROT_EXT.2.1*, *FPT_TUD_EXT.1.1*.**
This component may also be included in the ST as if optional.

FCS_COP.1.1/SigVer

The TSF shall perform [digital signature verification] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/SigVer.

Table 14: Recommended choices for FCS_COP.1/SigVer

Identifier	Cryptographic algorithm	Cryptographic key sizes	List of standards
RSA-PKCS	RSASSA-PKCS1-v1_5	Modulus of size [**selection**: *2048*, *3072*, *4096*] bits, hash or XOF [**selection**: *SHA-256*, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*]	RFC 8017 (Section 8.2) [PKCS #1 v2.2] FIPS PUB 186-5 (Section 5.4) [RSASSA-PKCS1-v1_5]
RSA-PSS	RSASSA-PSS	Modulus of size [**selection**: *2048*, *3072*, *4096*] bits, hash or XOF [**selection**: *SHA-256*, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*, *SHAKE128*, *SHAKE256*]	RFC 8017 (Section 8.1) [PKCS#1 v2.2] FIPS PUB 186-5 (Section 5.4) [RSASSA-PSS]
DSA	DSA	Domain parameters for (L, N) = [**selection**: *(2048, 224), (2048, 256), (3072, 256)*] bits	FIPS PUB 186-4 (Section 4.7) [DSA Signature Verification]
ECDSA	ECDSA	Elliptic Curve [**selection**: *NIST P-256*, *brainpoolP256r1*, *NIST P-384*, *brainpoolP384r1*, *NIST P-521*, *brainpoolP512r1*] using hash or XOF [**selection**: *SHA-256*, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*, *SHAKE128*, *SHAKE256*]	[**selection**: *ISO/IEC 14888-3:2018 (Subclause 6.6)*, *FIPS PUB 186-5 (Section 6.4.2)*] [ECDSA] [**selection**: *RFC 5639 (Section 3) [Brainpool Curves]*, *NIST SP-800 186 (Section 4) [NIST Curves]*]
KCDSA	KCDSA	hash function using[**selection**: *SHA-224*, *SHA-256*, *SHA-384*, *SHA-512*]	ISO/IEC 14888-3:2018 (Subclause 6.3) [KCDSA]
EC-KCDSA	EC-KCDSA	Elliptic Curve [**selection**: *P-224*, *P-256*, *B-233*, *B-283*, *K-233*, *K-283*] using hash [**selection**: *SHA-*	ISO/IEC 14888-3:2018

		224, *SHA-256*, *SHA-384*, *SHA-512*]	(Subclause 6.7) [EC-KCDSA] NIST SP 800-186 (Section 3) [NIST Curves]
EdDSA	Edwards-Curve Digital Signature Algorithm	Domain parameters approved for elliptic curves [**selection**: *Edwards25519*, *Edwards448*]	NIST FIPS PUB 186-5 (Section 7.6) [EdDSA] RFC 8032 [Edwards Curves]
LMS	LMS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Winternitz parameter = [**selection**: *1*, *2*, *4*, *8*] Tree height = [**selection**: *5*, *10*, *15*, *20*, *25*]	RFC 8554 [LMS] NIST SP 800-208 [parameters]
HSS	Multitree version of LMS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Winternitz parameter = [**selection**: *1*, *2*, *4*, *8*] Tree height = [**selection**: *5*, *10*, *15*, *20*, *25*] Number of levels = [**selection**: *1*, *2*, *3*, *4*, *5*, *6*, *7*, *8*]	RFC 8554 [HSS] NIST SP 800-208 [parameters]
XMSS	XMSS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] Tree height = [**selection**: *10*, *16*, *20*]	RFC 8391 [XMSS] NIST SP 800-208 [parameters]
XMSS(MT)	Multitree version of XMSS	Private key size = [**selection**: • *192 bits with [**selection**: SHA-256/192, SHAKE256/192]* • *256 bits with [**selection**: SHA-256, SHAKE256]*] (Total Tree height, Number of Levels) = [**selection**: *(20, 2)*, *(20, 4)*, *(40, 2)*, *(40, 4)*, *(40, 8)*, *(60, 3)*, *(60, 6)*, *(60, 12)*]	RFC 8391 [XMSS(MT)] NIST SP 800-208 [parameters]

Application Note: This SFR must be included in the ST if digital signature verification is a service provided by the TOE to tenant software, or if digital

signature verification is used by the TOE itself to support or implement PP-specified security functionality.

Specifically, this SFR must be included if the ST Author chooses "*implement an authenticated platform firmware update mechanism as described in FPT_TUD_EXT.2*" or "*implement a delayed-authentication platform firmware update mechanism as described in FPT_TUD_EXT.3*" in FPT_TUD_EXT.1; or if the ST Author selects "*verification of a digital signature by trusted code/data*" in FPT_ROT_EXT.2.

If this SFR is included in the ST, then FCS_COP.1/Hash must also be claimed.

The ST Author should choose the algorithm implemented to perform verification of digital signatures. For the algorithm chosen, the ST Author should make the appropriate assignments/selections to specify the parameters that are implemented for that algorithm. In particular, if ECDSA is selected as one of the signature algorithms, the key size specified must match the selection for the curve used in the algorithm.

For elliptic curve-based schemes, the key size refers to the binary logarithm (log2) of the order of the base point. As the preferred approach for digital signatures, elliptic curves will be required after all the necessary standards and other supporting information are fully established.

From catalog The TOE may contain a public key which is integrity protected (e.g., in hardware), in which case the FDP_ITC.1 and FDP_ITC.2 dependencies do not apply. In this case, no dependencies may be chosen. For signature verifications, private keys are not necessary, so there are no dependencies required for generating or destroying cryptographic keys.

Evaluation Activities

FCS_COP.1/SigVer

TSS

The evaluator shall check the TSS to ensure that it describes the overall flow of the signature verification. This should at least include identification of the format and general location (e.g., "firmware on the hard drive device" rather than "memory location 0x00007A4B") of the data to be used in verifying the digital signature; how the data received from the operational environment are brought onto the device; and any processing that is performed that is not part of the digital signature algorithm (for instance, checking of certificate revocation lists).

Guidance

There are no additional Guidance evaluation activities for this component.

Tests

The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are typically not found on factory products.

Each section below contains tests the evaluator must perform for each selected digital signature scheme. Based on the assignments and selections in the requirement, the evaluator chooses the specific activities that correspond to those selections.

The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are not found on the TOE in its evaluated configuration.

RSASSA-PKCS1-v1_5 and RSASSA-PSS

These tests are derived from The 186-4 RSA Validation System (RSA2VS), updated 8 Jul 2014, Section 6.4.

The FIPS 186-4 RSA Signature Verification Test tests the ability of the TSF to recognize valid and invalid signatures. The evaluator shall provide a modulus and three associated key pairs (d, e) for each combination of selected SHA algorithm, modulus size and hash size. Each private key d is used to sign six pseudorandom messages each of 1024 bits. For five of the six messages, the public key (e), message, IR format, padding, or signature is altered so that signature verification should fail. The test passes only if all the signatures made using unaltered parameters result in successful signature verification, and all the signatures made using altered parameters result in unsuccessful signature verification.

ECDSA on NIST and Brainpool Curves

These tests are derived from The FIPS 186-4 Elliptic Curve Digital Signature Algorithm Validation System (ECDSA2VS), updated 18 Mar 2014, Section 6.5.

The FIPS 186-5 ECC Signature Verification Test tests the ability of the TSF to recognize valid and invalid signatures. The evaluator shall provide a modulus and associated key pair (x, y) for each combination of selected curve, SHA algorithm, modulus size, and hash size. Each private

key (x) is used to sign 15 pseudorandom messages of 1024 bits. For eight of the fifteen messages, the message, IR format, padding, or signature is altered so that signature verification should fail. The test passes only if all the signatures made using unaltered parameters result in successful signature verification, and all the signatures made using altered parameters result in unsuccessful signature verification.

Digital Signature Scheme 2

The following or equivalent steps shall be taken to test the TSF.

For each supported modulus size, underlying hash algorithm, and length of the trailer field (1- or 2-byte), the evaluator shall generate NT sets of recoverable message (M1), non-recoverable message (M2), salt, public key and signature (Σ).

1. *N_T shall be greater than or equal to 20.*
2. *The length of salts shall be selected from its supported length range of salt. The typical length of salt is equal to the output block length of underlying hash algorithm (see 9.2.2 of ISO/IEC 9796-2:2010).*
3. *The length of recoverable messages should be selected by considering modulus size, output block length of underlying hash algorithm, and length of salt (L_S). As described in Annex D of ISO/IEC 9796-2:2010, it is desirable to maximize the length of recoverable message. The following table shows the maximum bit-length of recoverable message that is divisible by 512, for some combinations of modulus size, underlying hash algorithm, and length of salt. None that 2-byte trailer field is assumed in calculating the maximum length of recoverable message*

Maximum length of recoverable message divisible by 512 (bits)	***Modulus size (bits)***	***Underlying hash algorithm (bits)***	***Length of salt L_S (bits)***
1536	*2048*	*SHA-256*	*128*
1024			*256*
1024		*SHA-512*	*128*
1024			*256*
512			*512*
2560	*3072*	*SHA-256*	*128*
2048			*256*
2048		*SHA-512*	*128*
2048			*256*
1536			*512*

4. *The length of non-recoverable messages should be selected by considering the underlying hash algorithm and usages. If the TSF is used for verifying the authenticity of software/firmware updates, the length of non-recoverable messages should be selected greater than or equal to 2048-bit. With this length range, it means that the underlying hash algorithm is also tested for two or more input blocks.*
5. *The evaluator shall select approximately one half of N_T sets and shall alter one of the values (non-recoverable message, public key exponent or signature) in the sets. In altering public key exponent, the evaluator shall alter the public key exponent while keeping the exponent odd. In altering signatures, the following ways should be considered:*
   a. *Altering a signature just by replacing a bit in the bit-string representation of the signature*
   b. *Altering a signature so that the trailer in the message representative cannot be interpreted. This can be achieved by following ways:*
      - *Setting the rightmost four bits of the message representative to the values other than '1100'.*
      - *In the case when 1-byte trailer is used, setting the rightmost byte of the message representative to the values other than '0xbc', while keeping the rightmost four bits to '1100'.*
      - *In the case when 2-byte trailer is used, setting the rightmost byte of the message representative to the values other than '0xcc', while keeping the rightmost four bits to '1100'.*
   c. *In the case when 2-byte trailer is used, altering a signature so that the hash algorithm identifier in the trailer (i.e. the left most byte of the trailer) does not correspond to hash algorithms identified in the SFR. The hash algorithm identifiers are 0x34 for SHA-256 (see Clause 10 of ISO/IEC 10118-3:2018), and 0x35 for SHA-512 (see Clause 11 of ISO/IEC 10118-3:2018).*
   d. *Let L_S be the length of salt, altering a signature so that the intermediate bit string D in the message representative is set to all zeroes except for the rightmost L_S bits of D.*
   e. *(non-conformant signature length) Altering a signature so that the length of signature*

Σ is changed to modulus size and the most significant bit of signature Σ is set equal to '1'.

f. *(non-conformant signature) Altering a signature so that the integer converted from signature Σ is greater than modulus n.*

The evaluator shall supply the NT sets to the TSF and obtain in response a set of NT Verification-Success or Verification-Fail values. When the Verification-Success is obtained, the evaluator shall also obtain recovered message (M 1).*

The evaluator shall verify that Verification-Success results correspond to the unaltered sets and Verification-Fail results correspond to the altered sets.

For each recovered message, the evaluator shall compare the recovered message (M1) with the corresponding recoverable message (M 1) in the unaltered sets.*

The test passes only if all the signatures made using unaltered sets result in Verification-Success, each recovered message (M 1) is equal to corresponding M 1 in the unaltered sets, and all the signatures made using altered sets result in Verification-Fail.*

Digital Signature Scheme 3

The evaluator shall perform the test described for Digital Signature Scheme 2 while using a fixed salt for NT sets.

FCS_COP.1/KeyWrap Cryptographic Operation - Key Wrapping

FCS_COP.1.1/KeyWrap

The TSF shall perform [key wrapping] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/KeyWrap.

Table 15: Recommended choices for FCS_COP.1/KeyWrap

Identifier	Cryptographic algorithm	Cryptographic key sizes	List of standards
KW	[**selection**: *AES*, *CAM*, *SEED*, *LEA*] in KW mode	[**selection**: *128 (AES, CAM, SEED, LEA), 192 (AES, CAM, LEA), 256 (AES, CAM, LEA)*] bits	[**selection**: *ISO/IEC 19772:2020 (clause 6), NIST SP 800-38F (Section 6.2)*] [KW mode]
KWP	[**selection**: *AES*, *CAM*, *SEED*, *LEA*] in KWP mode	[**selection**: *128 (AES, CAM, SEED, LEA), 192 (AES, CAM, LEA), 256 (AES, CAM, LEA)*] bits	NIST SP 800-38F (Section 6.3) [KWP mode]
CCM	[**selection**: *AES*, *CAM*, *SEED*, *LEA*] in CCM mode with non-repeating nonce, minimum size of 64 bits	[**selection**: *128 (AES, CAM, SEED, LEA), 192 (AES, CAM, LEA), 256 (AES, CAM, LEA)*] bits	[**selection**: *ISO/IEC 19772:2020 (Clause 7), NIST SP 800-38C*] [CCM mode]
GCM	[**selection**: *AES*, *CAM*, *SEED*, *LEA*] in GCM mode with non-repeating IVs IV length must be equal to 96 bits; the deterministic IV construction method [SP800-38D, Section 8.2.1] must be used; the MAC length t must be one of the values 96, 104, 112, 120, and 128 bits.	[**selection**: *128 (AES, CAM, SEED, LEA), 192 (AES, CAM, LEA), 256 (AES, CAM, LEA)*] bits	[**selection**: *ISO/IEC 19772:2020 (Clause 10), NIST SP 800-38D*] [GCM mode]

Application Note: NIST 800-57p1rev5 sec. 5.6.2 specifies that the size of key used to protect the key being transported should be at least the security strength of the key it is protecting.

The SEED algorithm supports keys of size 128 bits only.

Evaluation Activities

FCS_COP.1/KeyWrap
TBD

FCS_COP.1/SKC Cryptographic Operation - Symmetric Key Cryptography

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.3.1, FDP_ITC_EXT.1.2.
This component may also be included in the ST as if optional.

FCS_COP.1.1/SKC

The TSF shall perform [symmetric-key encryption/decryption] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and cryptographic key sizes [**selection**: *Cryptographic key sizes*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/SKC.

Table 16: Recommended choices for FCS_COP.1/SKC

Identifier	Cryptographic algorithm	Cryptographic key sizes	List of standards
AES-CBC	AES in CBC mode with non-repeating and unpredictable IVs	[**selection**: *128*, *192*, *256*] bits	[**selection**: *ISO/IEC 18033-3:2010 (Subclause 5.2), FIPS PUB 197*] [AES] [**selection**: *ISO/IEC 10116:2017 (Clause 7), NIST SP 800-38A*] [CBC]
XTS-AES	AES in XTS mode with unique tweak values that are consecutive non-negative integers starting at an arbitrary non-negative integer	[**selection**: *256*, *512*] bits	[**selection**: *ISO/IEC 18033-3:2010 (Subclause 5.2), FIPS PUB 197*] [AES] [**selection**: *IEEE Std. 1619-2018, NIST SP 800-38E*] [XTS]
AES-CTR	AES in Counter Mode with a non-repeating initial counter and with no repeated use of counter values across multiple messages with the same secret key	[**selection**: *128*, *192*, *256*] bits	[**selection**: *ISO/IEC 18033-3:2010 (Subclause 5.2), FIPS*

			PUB 197] [AES] [**selection**: *: ISO/IEC 10116:2017 (Clause 10), NIST SP 800-38A*] [CBC]
CAM-CBC	Camellia in CBC mode with non-repeating and unpredictable IVs	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 18033-3:2010 (Subclause 5.3) [Camellia] [**selection**: *ISO/IEC 10116:2017 (Clause 7), NIST SP 800-38A*] [CBC]
CAM-CFB	Camellia in CFB mode with non-repeating and unpredictable IVs	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 18033-3:2010 (Subclause 5.3) [Camellia] [**selection**: *ISO/IEC 10116:2017 (Clause 8), NIST SP 800-38A*] [CFB]
CAM-OFB	Camellia in OFB mode with unique IVs	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 18033-3:2010 (Subclause 5.3) [Camellia] [**selection**: *ISO/IEC 10116:2017 (Clause 9), NIST SP 800-38A*] [OFB]
XTS-CAM	Camellia in XTS mode with unique tweak values that are consecutive non-negative integers starting at an arbitrary non-negative integer	[**selection**: *256*, *512*] bits	ISO/IEC 18033-3:2010 (Subclause 5.3) [Camellia] [**selection**: *IEEE Std. 1619-2018, NIST SP 800-38E*] [XTS]
CAM-CTR	Camellia in CTR mode with a non-repeating initial counter and with no repeated use of counter values across multiple messages with the same secret key.	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 18033-3:2010 (Subclause 5.3) [Camellia] [**selection**:

			ISO/IEC 10116:2017 (Clause 10), NIST SP 800-38A] [CTR]
SEED-CBC	SEED in CBC mode with non-repeating and unpredictable IVs	128 bits	ISO/IEC 18033-3:2010 (Subclause 5.4) [SEED] [**selection**: *ISO/IEC 10116:2017 (Clause 7), NIST SP 800-38A*] [CBC]
SEED-CFB	SEED in CFB mode with non-repeating and unpredictable IVs	128 bits	ISO/IEC 18033-3:2010 (Subclause 5.4) [SEED] [**selection**: *ISO/IEC 10116:2017 (Clause 8), NIST SP 800-38A*] [CFB]
SEED-OFB	SEED in OFB mode with unique IVs	128 bits	ISO/IEC 18033-3:2010 (Subclause 5.4) [SEED] [**selection**: *ISO/IEC 10116:2017 (Clause 9), NIST SP 800-38A*] [OFB]
SEED-CTR	SEED in CTR mode with unique, incremental counter	128 bits	ISO/IEC 18033-3:2010 (Subclause 5.4) [SEED] [**selection**: *ISO/IEC 10116:2017 (Clause 10), NIST SP 800-38A*] [CTR]
HIGHT-CBC	HIGHT in CBC mode with non-repeating and unpredictable IVs	128 bits	ISO/IEC 18033-3:2010 (Subclause 4.5) [HIGHT] [**selection**: *ISO/IEC 10116:2017 (Clause 7), NIST SP 800-38A*] [CBC]

HIGHT-CFB	HIGHT in CFB mode with non-repeating and unpredictable IVs	128 bits	ISO/IEC 18033-3:2010 (Subclause 4.5) [HIGHT] [**selection**: *ISO/IEC 10116:2017 (Clause 8), NIST SP 800-38A*] [CFB]
HIGHT-OFB	HIGHT in OFB mode with unique IVs	128 bits	ISO/IEC 18033-3:2010 (Subclause 4.5) [HIGHT] [**selection**: *ISO/IEC 10116:2017 (Clause 9), NIST SP 800-38A*] [OFB]
HIGHT-CTR	HIGHT in CTR mode with unique, incremental counter	128 bits	ISO/IEC 18033-3:2010 (Subclause 4.5) [HIGHT] [**selection**: *ISO/IEC 10116:2017 (Clause 10), NIST SP 800-38A*] [CTR]
LEA-CBC	LEA in CBC mode with non-repeating and unpredictable IVs	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 29192-2:2019 (Subclause 6.3) [LEA] [**selection**: *ISO/IEC 10116:2017 (Clause 7), NIST SP 800-38A*] [CBC]
LEA-CFB	LEA in CFB mode with non-repeating and unpredictable IVs	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 29192-2:2019 (Subclause 6.3) [LEA] [**selection**: *ISO/IEC 10116:2017 (Clause 8), NIST SP 800-38A*] [CFB]
LEA-OFB	LEA in OFB mode with unique IVs	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 29192-2:2019 (Subclause

			6.3) [LEA] [**selection**: *ISO/IEC 10116:2017 (Clause 9), NIST SP 800-38A*] [OFB]
LEA-CTR	LEA in CTR mode with a non-repeating initial counter and with no repeated use of counter values across multiple messages with the same secret key.	[**selection**: *128*, *192*, *256*] bits	ISO/IEC 29192-2:2019 (Subclause 6.3) [LEA] [**selection**: *ISO/IEC 10116:2017 (Clause 10), NIST SP 800-38A*] [CTR]

Application Note: This SFR must be included in the ST if symmetric-key cryptography is a service provided by the TOE to tenant software, or if the TOE itself uses SKC to support or implement PP-specified security functionality.

Specifically, this SFR must be included if the ST includes FCS_IPSEC_EXT.1 or FCS_STG_EXT.2, or includes any of the following selections:

- "*CTR_DRBG (AES)*" in FCS_RBG.1
- "*ECIES*" in FCS_COP.1/KAT
- "*AES-**" in FCS_STG_EXT.3

From catalog If the selected “cryptographic algorithm" requires an IV, counter, or tweak value, then FCS_OTV_EXT.1 must be claimed.

Evaluation Activities

FCS_COP.1/SKC

TSS

The evaluator shall check that the TSS includes a description of encryption functions used for symmetric key encryption. The evaluator should check that this description of the selected encryption function includes the key sizes and modes of operations as specified in Table 16.

The evaluator shall check that the TSS describes the means by which the TOE satisfies constraints on algorithm parameters included in the selections made for "cryptographic algorithm" and "list of standards."

Guidance

If the product supports multiple modes, the evaluator shall examine the AGD to determine that the method of choosing a specific mode/key size is described.

KMD

The evaluator shall examine the KMD to ensure that the points at which symmetric key encryption and decryption occurs are described, and that the complete data path for symmetric key encryption is described. The evaluator checks that this description is consistent with the relevant parts of the TSS.

Assessment of the complete data path for symmetric key encryption includes confirming that the KMD describes the data flow from the device’s host interface to the device’s non-volatile memory storing the data, and gives information enabling the user data path to be distinguished from those situations in which data bypasses the data encryption engine (e.g. read-write operations to an unencrypted Master Boot Record area). The evaluator shall ensure that the documentation of the data path is detailed enough that it thoroughly describes the parts of the TOE that the data passes through (e.g. different memory types, processors and co-processors), its encryption state (i.e. encrypted or unencrypted) in each part, and any places where the data is stored. For example, any caching or buffering of the data should be identified and distinguished from the final destination in non-volatile memory (the latter represents the location from which the host will expect to retrieve the data in future).

If support for AES-CTR is claimed and the counter value source is internal to the TOE, the evaluator shall verify that the KMD describes the internal counter mechanism used to ensure that it provides unique counter block values.

Tests
The following tests require the developer to provide access to a test platform that provides the evaluator with tools that are typically not found on factory products.

The following tests are conditional based upon the selections made in the SFR. The evaluator shall perform the following test or witness respective tests executed by the developer. The tests must be executed on a platform that is as close as practically possible to the operational platform (but which may be instrumented in terms of, for example, use of a debug mode). Where the test is not carried out on the TOE itself, the test platform shall be identified and the differences between test environment and TOE execution environment shall be described.

Preconditions for testing:

- *Specification of keys as input parameter to the function to be tested*
- *specification of required input parameters such as modes*
- *Specification of user data (plaintext)*
- *Tapping of encrypted user data (ciphertext) directly in the non-volatile memory*

AES-CBC:
For the AES-CBC tests described below, the plaintext, ciphertext, and IV values shall consist of 128-bit blocks. To determine correctness, the evaluator shall compare the resulting values to those obtained by submitting the same inputs to a known-good implementation.

These tests are intended to be equivalent to those described in NIST's AES Algorithm Validation Suite (AESAVS) (http://csrc.nist.gov/groups/STM/cavp/documents/aes/AESAVS.pdf). It is not recommended that the evaluator use values obtained from static sources such as the example NIST's AES Known Answer Test Values from the AESAVS document, or use values not generated expressly to exercise the AES-CBC implementation.

AES-CBC Known Answer Tests

KAT-1 (GFSBox): To test the encrypt functionality of AES-CBC, the evaluator shall supply a set of five different plaintext values for each selected key size and obtain the ciphertext value that results from AES-CBC encryption of the given plaintext using a key value of all zeros and an IV of all zeros.

To test the decrypt functionality of AES-CBC, the evaluator shall supply a set of five different ciphertext values for each selected key size and obtain the plaintext value that results from AES-CBC decryption of the given ciphertext using a key value of all zeros and an IV of all zeros.

KAT-2 (KeySBox): To test the encrypt functionality of AES-CBC, the evaluator shall supply a set of five different key values for each selected key size and obtain the ciphertext value that results from AES-CBC encryption of an all-zeros plaintext using the given key value and an IV of all zeros.

To test the decrypt functionality of AES-CBC, the evaluator shall supply a set of five different key values for each selected key size and obtain the plaintext that results from AES-CBC decryption of an all-zeros ciphertext using the given key and an IV of all zeros.

KAT-3 (Variable Key): To test the encrypt functionality of AES-CBC, the evaluator shall supply a set of keys for each selected key size (as described below) and obtain the ciphertext value that results from AES encryption of an all-zeros plaintext using each key and an IV of all zeros.

Key i in each set shall have the leftmost i bits set to ones and the remaining bits to zeros, for values of i from 1 to the key size. The keys and corresponding ciphertext are listed in AESAVS, Appendix E.

To test the decrypt functionality of AES-CBC, the evaluator shall use the same keys as above to decrypt the ciphertext results from above. Each decryption should result in an all-zeros plaintext.

KAT-4 (Variable Text): To test the encrypt functionality of AES-CBC, for each selected key size, the evaluator shall supply a set of 128-bit plaintext values (as described below) and obtain the ciphertext values that result from AES-CBC encryption of each plaintext value using a key of each size and IV consisting of all zeros.

Plaintext value i shall have the leftmost i bits set to ones and the remaining bits set to zeros, for values of i from 1 to 128. The plaintext values are listed in AESAVS, Appendix D.

To test the decrypt functionality of AES-CBC, for each selected key size, use the plaintext values from above as ciphertext input, and AES-CBC decrypt each ciphertext value using key of each size consisting of all zeros and an IV of all zeros.

AES-CBC Multi-Block Message Test

The evaluator shall test the encrypt functionality by encrypting nine i-block messages for each selected key size, for $2 \leq i \leq 10$. For each test, the evaluator shall supply a key, an IV, and a plaintext message of length i blocks, and encrypt the message using AES-CBC. The resulting ciphertext values shall be compared to the results of encrypting the plaintext messages using a known good implementation.

The evaluator shall test the decrypt functionality by decrypting nine i-block messages for each selected key size, for $2 \leq i \leq 10$. For each test, the evaluator shall supply a key, an IV, and a ciphertext message of length i blocks, and decrypt the message using AES-CBC. The resulting

plaintext values shall be compared to the results of decrypting the ciphertext messages using a known good implementation.

AES-CBC Monte Carlo Tests

The evaluator shall test the encrypt functionality for each selected key size using 100 3-tuples of pseudo-random values for plaintext, IVs, and keys.

The evaluator shall supply a single 3-tuple of pseudo-random values for each selected key size. This 3-tuple of plaintext, IV, and key is provided as input to the below algorithm to generate the remaining 99 3-tuples, and to run each 3-tuple through 1000 iterations of AES-CBC encryption.

```
# Input: PT, IV, Key
Key[0] = Key
IV[0] = IV
PT[0] = PT
for i = 0 to 99 {
        Output Key[i], IV[i], PT[0]
        for j = 0 to 999 {
                if (j == 0) {
                        CT[j] = AES-CBC-Encrypt(Key[i], IV[i], PT[j])
                        PT[j+1] = IV[i]
                } else {
                        CT[j] = AES-CBC-Encrypt(Key[i], PT[j])
                        PT[j+1] = CT[j-1]
                }
        }
        Output CT[j]
        If (KeySize == 128) Key[i+1] = Key[i] xor CT[j]
        If (KeySize == 192) Key[i+1] = Key[i] xor (last 64 bits of CT[j-1] || CT[j])
        If (KeySize == 256) Key[i+1] = Key[i] xor ((CT[j-1] | CT[j])
        IV[i+1] = CT[j]
        PT[0] = CT[j-1]
}
```

The ciphertext computed in the 1000th iteration (CT[999]) is the result for each of the 100 3-tuples for each selected key size. This result shall be compared to the result of running 1000 iterations with the same values using a known good implementation.

The evaluator shall test the decrypt functionality using the same test as above, exchanging CT and PT, and replacing AES-CBC-Encrypt with AES-CBC-Decrypt.

AES-CCM:

These tests are intended to be equivalent to those described in the NIST document, "The CCM Validation System (CCMVS)," updated 9 Jan 2012, found at http://csrc.nist.gov/groups/STM/cavp/documents/mac/CCMVS.pdf.

It is not recommended that the evaluator use values obtained from static sources such as http://csrc.nist.gov/groups/STM/cavp/documents/mac/ccmtestvectors.zip or use values not generated expressly to exercise the AES-CCM implementation.

The evaluator shall test the generation-encryption and decryption-verification functionality of AES-CCM for the following input parameter and tag lengths:

- ***Keys:*** *All supported and selected key sizes (e.g., 128, 192, or 256 bits).*
- ***Associated Data:*** *Two or three values for associated data length: The minimum (≥ 0 bytes) and maximum (≤ 32 bytes) supported associated data lengths, and 2^16 (65536) bytes, if supported.*
- ***Payload:*** *Two values for payload length: The minimum (≥ 0 bytes) and maximum (≤ 32 bytes) supported payload lengths.*
- ***Nonces:*** *All supported nonce lengths (e.g., 8, 9, 10, 11, 12, 13) in bytes.*
- ***Tag:*** *All supported tag lengths (e.g., 4, 6, 8, 10, 12, 14, 16) in bytes.*

The testing for CCM consists of five tests. To determine correctness in each of the below tests, the evaluator shall compare the ciphertext with the result of encryption of the same inputs with a known good implementation.

Variable Associated Data Test: For each supported key size and associated data length, and any supported payload length, nonce length, and tag length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting ciphertext.

Variable Payload Text: For each supported key size and payload length, and any supported associated data length, nonce length, and tag length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting ciphertext.

Variable Nonce Test: For each supported key size and nonce length, and any supported associated data length, payload length, and tag length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting ciphertext.

Variable Tag Test: For each supported key size and tag length, and any supported associated data length, payload length, and nonce length, the evaluator shall supply one key value, one nonce value, and 10 pairs of associated data and payload values, and obtain the resulting

ciphertext.

Decryption-Verification Process Test: To test the decryption-verification functionality of AES-CCM, for each combination of supported associated data length, payload length, nonce length, and tag length, the evaluator shall supply a key value and 15 sets of input plus ciphertext, and obtain the decrypted payload. Ten of the 15 input sets supplied should fail verification and five should pass.

***AES-GCM:** These tests are intended to be equivalent to those described in the NIST document, "The Galois/Counter Mode (GCM) and GMAC Validation System (GCMVS) with the Addition of XPN Validation Testing," rev. 15 Jun 2016, section 6.2, found at http://csrc.nist.gov/groups/STM/cavp/documents/mac/gcmvs.pdf.*

It is not recommended that the evaluator use values obtained from static sources such as http://csrc.nist.gov/groups/STM/cavp/documents/mac/gcmtestvectors.zip, or use values not generated expressly to exercise the AES-GCM implementation.

The evaluator shall test the authenticated encryption functionality of AES-GCM by supplying 15 sets of Key, Plaintext, AAD, IV, and Tag data for every combination of the following parameters as selected in the ST and supported by the implementation under test:

- ***Key size in bits:** Each selected and supported key size (e.g., 128, 192, or 256 bits).*
- ***Plaintext length in bits:** Up to four values for plaintext length: Two values that are non-zero integer multiples of 128, if supported. And two values that are non-multiples of 128, if supported.*
- ***AAD length in bits:** Up to five values for AAD length: Zero-length, if supported. Two values that are non-zero integer multiples of 128, if supported. And two values that are integer non-multiples of 128, if supported.*
- ***IV length in bits:** Up to three values for IV length: 96 bits. Minimum and maximum supported lengths, if different.*
- ***MAC length in bits:** Each supported length (e.g., 128, 120, 112, 104, 96).*

To determine correctness, the evaluator shall compare the resulting values to those obtained by submitting the same inputs to a known-good implementation.

The evaluator shall test the authenticated decrypt functionality of AES-GCM by supplying 15 Ciphertext-Tag pairs for every combination of the above parameters, replacing Plaintext length with Ciphertext length. For each parameter combination the evaluator shall introduce an error into either the Ciphertext or the Tag such that approximately half of the cases are correct and half the cases contain errors. To determine correctness, the evaluator shall compare the resulting pass/fail status and Plaintext values to the results obtained by submitting the same inputs to a known-good implementation.

AES-CTR:

For the AES-CTR tests described below, the plaintext and ciphertext values shall consist of 128-bit blocks. To determine correctness, the evaluator shall compare the resulting values to those obtained by submitting the same inputs to a known-good implementation.

These tests are intended to be equivalent to those described in NIST's AES Algorithm Validation Suite (AESAVS) (http://csrc.nist.gov/groups/STM/cavp/documents/aes/AESAVS.pdf). It is not recommended that the evaluator use values obtained from static sources such as the example NIST's AES Known Answer Test Values from the AESAVS document, or use values not generated expressly to exercise the AES-CTR implementation.

AES-CTR Known Answer Tests

KAT-1 (GFSBox): To test the encrypt functionality of AES-CTR, the evaluator shall supply a set of five different plaintext values for each selected key size and obtain the ciphertext value that results from AES-CTR encryption of the given plaintext using a key value of all zeros.

To test the decrypt functionality of AES-CTR, the evaluator shall supply a set of five different ciphertext values for each selected key size and obtain the plaintext value that results from AES-CTR decryption of the given ciphertext using a key value of all zeros.

KAT-2 (KeySBox): To test the encrypt functionality of AES-CTR, the evaluator shall supply a set of five different key values for each selected key size and obtain the ciphertext value that results from AES-CTR encryption of an all-zeros plaintext using the given key value.

To test the decrypt functionality of AES-CTR, the evaluator shall supply a set of five different key values for each selected key size and obtain the plaintext that results from AES-CTR decryption of an all-zeros ciphertext using the given key.

KAT-3 (Variable Key): To test the encrypt functionality of AES-CTR, the evaluator shall supply a set of keys for each selected key size (as described below) and obtain the ciphertext value that results from AES encryption of an all-zeros plaintext using each key.

Key i in each set shall have the leftmost i bits set to ones and the remaining bits to zeros, for values of i from 1 to the key size. The keys and corresponding ciphertext are listed in AESAVS, Appendix E.

To test the decrypt functionality of AES-CTR, the evaluator shall use the same keys as above to decrypt the ciphertext results from above. Each decryption should result in an all-zeros

plaintext.

KAT-4 (Variable Text): To test the encrypt functionality of AES-CTR, for each selected key size, the evaluator shall supply a set of 128-bit plaintext values (as described below) and obtain the ciphertext values that result from AES-CTR encryption of each plaintext value using a key of each size.

Plaintext value i shall have the leftmost i bits set to ones and the remaining bits set to zeros, for values of i from 1 to 128. The plaintext values are listed in AESAVS, Appendix D.

To test the decrypt functionality of AES-CTR, for each selected key size, use the plaintext values from above as ciphertext input, and AES-CTR decrypt each ciphertext value using key of each size consisting of all zeros.

AES-CTR Multi-Block Message Test

The evaluator shall test the encrypt functionality by encrypting nine i-block messages for each selected key size, for 2 ≤ i ≤ 10. For each test, the evaluator shall supply a key and a plaintext message of length i blocks, and encrypt the message using AES-CTR. The resulting ciphertext values shall be compared to the results of encrypting the plaintext messages using a known good implementation.

The evaluator shall test the decrypt functionality by decrypting nine i-block messages for each selected key size, for 2 ≤ i ≤ 10. For each test, the evaluator shall supply a key and a ciphertext message of length i blocks, and decrypt the message using AES-CTR. The resulting plaintext values shall be compared to the results of decrypting the ciphertext messages using a known good implementation.

AES-CTR Monte Carlo Tests

The evaluator shall test the encrypt functionality for each selected key size using 100 2-tuples of pseudo-random values for plaintext and keys.

The evaluator shall supply a single 2-tuple of pseudo-random values for each selected key size. This 2-tuple of plaintext and key is provided as input to the below algorithm to generate the remaining 99 2-tuples, and to run each 2-tuple through 1000 iterations of AES-CTR encryption.

```
# Input: PT, Key
Key[0] = Key
PT[0] = PT
for i = 0 to 99 {
        Output Key[i], PT[0]
        for j = 0 to 999 {
                CT[j] = AES-CTR-Encrypt(Key[i], PT[j])
                PT[j+1] = CT[j]
        }
        Output CT[j]
        If (KeySize == 128) Key[i+1] = Key[i] xor CT[j]
        If (KeySize == 192) Key[i+1] = Key[i] xor (last 64 bits of CT[j-1] || CT[j])
        If (KeySize == 256) Key[i+1] = Key[i] xor ((CT[j-1] | CT[j])
        PT[0] = CT[j]
}
```

The ciphertext computed in the 1000th iteration (CT[999]) is the result for each of the 100 2-tuples for each selected key size. This result shall be compared to the result of running 1000 iterations with the same values using a known good implementation.

The evaluator shall test the decrypt functionality using the same test as above, exchanging CT and PT, and replacing AES-CTR-Encrypt with AES-CTR-Decrypt. 198 Note additional design considerations for this mode are addressed in the KMD requirements.

***XTS-AES:** These tests are intended to be equivalent to those described in the NIST document, "The XTS-AES Validation System (XTSVS)," updated 5 Sept 2013, found at http://csrc.nist.gov/groups/STM/cavp/documents/aes/XTSVS.pdf*

It is not recommended that the evaluator use values obtained from static sources such as the XTS-AES test vectors at http://csrc.nist.gov/groups/STM/cavp/documents/aes/XTSTestVectors.zip or use values not generated expressly to exercise the XTS-AES implementation.

The evaluator shall generate test values as follows:

For each supported key size (256 bit (for AES-128) and 512 bit (for AES-256) keys), the evaluator shall provide up to five data lengths:

- *Two data lengths divisible by the 128-bit block size, If data unit lengths of complete block sizes are supported.*
- *Two data lengths not divisible by the 128-bit block size, if data unit lengths of partial block sizes are supported.*
- *The largest data length supported by the implementation, or 2^16 (65536), whichever is larger.*

The evaluator shall specify whether the implementation supports tweak values of 128-bit hexadecimal strings or a data unit sequence numbers, or both.

For each combination of key size and data length, the evaluator shall provide 100 sets of input data and obtain the ciphertext that results from XTS-AES encryption. If both kinds of tweak

values are supported, then each type of tweak value shall be used in half of every 100 sets of input data, for all combinations of key size and data length. The evaluator shall verify that the resulting ciphertext matches the results from submitting the same inputs to a known-good implementation of XTS-AES.

The evaluator shall test the decrypt functionality of XTS-AES using the same test as for encrypt, replacing plaintext values with ciphertext values and XTS-AES encrypt with XTS- AES decrypt.

The evaluator shall check that the full length keys are created by methods that ensure that the two halves are different and independent.

AES-KWP:

The tests below are derived from "The Key Wrap Validation System (KWVS), Updated: June 20, 2014" from the National Institute of Standards and Technology.

The evaluator shall test the authenticated-encryption functionality of AES-KWP (KWP-AE) using the same test as for AES-KW authenticated-encryption with the following change in the five plaintext lengths:

- *Four lengths that are multiples of 8 bits*
- *The largest supported length less than or equal to 4096 bits.*

The evaluator shall test the authenticated-decryption (KWP-AD) functionality of AES-KWP using the same test as for AES-KWP authenticated-encryption, replacing plaintext values with ciphertext values and AES-KWP authenticated encryption with AES-KWP authenticated-decryption. For the Authenticated Decryption test, 20 out of the 100 trials per plaintext length have ciphertext values that fail authentication.

Additionally, the evaluator shall perform the following negative tests:

***Test 1: (invalid plaintext length):** Determine the valid plaintext lengths of the implementation from the TOE specification. Verify that the implementation of KWP-AE in the TOE rejects plaintext of invalid length by testing plaintext of the following lengths: 1) plaintext with length greater than 64 semi-blocks, 2) plaintext with bit-length not divisible by 8, and 3) plaintext with length 0.*

***Test 2: (invalid ciphertext length):** Determine the valid ciphertext lengths of the implementation from the TOE specification. Verify that the implementation of KWP-AD in the TOE rejects ciphertext of invalid length by testing ciphertext of the following lengths: 1) ciphertext with length greater than 65 semi-blocks, 2) ciphertext with bit-length not divisible by 64, 3) ciphertext with length 0, and 4) ciphertext with length of one semi-block.*

***Test 3: (invalid ICV2):** Test that the implementation detects invalid ICV2 values by encrypting any plaintext value four times using a different value for ICV2 each time as follows: Start with a base ICV2 of 0xA65959A6. For each of the four tests change a different byte of ICV2 to a different value, so that each of the four bytes is changed once. Verify that the implementation of KWP-AD in the TOE outputs FAIL for each test.*

***Test 4: (invalid padding length):** Generate one ciphertext using algorithm KWP-AE with substring [len(P)/8]32 of S replaced by each of the following 32-bit values, where len(P) is the length of P in bits and [ ]32 denotes the representation of an integer in 32 bits:*

- *[0]32*
- *[len(P)/8-8]32*
- *[len(P)/8+8]32*
- *[513]32.*

Verify that the implementation of KWP-AD in the TOE outputs FAIL on those inputs.

***Test 5: (invalid padding bits):** If the implementation supports plaintext of length not a multiple of 64-bits, then*

```
for each PAD length [1..7]
        for each byte in PAD set a zero PAD value;
                replace current byte by a non-zero value and use the resulting plaintext as
                        input to algorithm KWP-AE to generate ciphertext;
                verify that the implementation of KWP-AD in the TOE outputs FAIL on
                        this input.
```

AES-KW:

The tests below are derived from "The Key Wrap Validation System (KWVS), Updated: June 20, 2014" from the National Institute of Standards and Technology.

The evaluator shall test the authenticated-encryption functionality of AES-KW for each combination of the following input parameters:

- *Supported key lengths selected in the ST (e.g. 128 bits, 256 bits)*
- *Five plaintext lengths:*
  - *Two lengths that are non-zero multiples of 128 bits (two semi-block lengths)*
  - *Two lengths that are odd multiples of the semi-block length (64 bits)*
  - *The largest supported plaintext length less than or equal to 4096 bits.*

For each set of the above parameters the evaluator shall generate a set of 100 key and plaintext pairs and obtain the ciphertext that results from AES-KW authenticated encryption. To

determine correctness, the evaluator shall compare the results with those obtained from the AES-KW authenticated-encryption function of a known good implementation.

The evaluator shall test the authenticated-decryption functionality of AES-KW using the same test as for authenticated-encryption, replacing plaintext values with ciphertext values and AES-KW authenticated-encryption (KW-AE) with AES-KW authenticated-decryption (KW-AD). For the authenticated-decryption test, 20 out of the 100 trials per plaintext length must have ciphertext values that are not authentic; that is, they fail authentication.

Additionally, the evaluator shall perform the following negative tests:

***Test 1 (invalid plaintext length):** Determine the valid plaintext lengths of the implementation from the TOE specification. Verify that the implementation of KW-AES in the TOE rejects plaintext of invalid length by testing plaintext of the following lengths: 1) plaintext length greater than 64 semi-blocks, 2) plaintext bit-length not divisible by 64, 3) plaintext with length 0, and 4) plaintext with one semi-block.*

***Test 2 (invalid ciphertext length):** Determine the valid ciphertext lengths of the implementation from the TOE specification. Verify that the implementation of KW-AD in the TOE rejects ciphertext of invalid length by testing ciphertext of the following lengths: 1) ciphertext with length greater than 65 semi-blocks, 2) ciphertext with bit-length not divisible by 64, 3) ciphertext with length 0, 4) ciphertext with length of one semiblock, and 5) ciphertext with length of two semi-blocks.*

***Test 3 (invalid ICV1):** Test that the implementation detects invalid ICV1 values by encrypting any plaintext value eight times using a different value for ICV1 each time as follows: Start with a base ICV1 of 0xA6A6A6A6A6A6A6A6. For each of the eight tests change a different byte to a different value, so that each of the eight bytes is changed once. Verify that the implementation of KW-AD in the TOE outputs FAIL for each test.*

FCS_COP.1/XOF Cryptographic Operation - Extendable-Output Function

FCS_COP.1.1/XOF

The TSF shall perform [extendable-output function] in accordance with a specified cryptographic algorithm [**selection**: *Cryptographic algorithm*] and and parameters [**selection**: *Parameters*] that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/XOF.

Table 17: Recommended choices for FCS_COP.1/XOF

Cryptographic algorithm	Parameters	List of standards
cSHAKE	Output length d = [**selection**: *128*, *256*] bits and function [**selection**: *SHAKEd*, *KECCAK[2d]*]	NIST SP 800-185 Section 3 [cSHAKE], Section 6.2 [SHAKE] NIST FIPS PUB 202 Section 5 [KECCAK]
KMACXOF	Output length d = [**selection**: *128*, *256*] bits	NIST SP 800-185 Section 4.3.1 [KMACXOF]
SHAKE	Output length d = [**selection**: *128*, *256*] bits	NIST FIPS PUB 202 Section 6.2 [SHAKE]

Application Note: The functions in cSHAKE depend on the output length d. i.e. SHAKEd is either SHAKE128 for d = 128 or SHAKE256 for d = 256. Similarly, KECCAK[2d] is either KECCAK[256] for d = 128 or KECCAK[512] for d = 256. Note that KECCAK is a cryptographic primitive which should have no direct interface exposed to the user of the TOE.

Evaluation Activities

FCS_COP.1/XOF
TBD

FCS_HTTPS_EXT.1 HTTPS Protocol

This is a selection-based component. Its inclusion depends upon selection from FTP_ITC_EXT.1.1.

FCS_HTTPS_EXT.1.1

The TSF shall implement the HTTPS protocol that complies with RFC 2818.

Application Note: This SFR is included in the ST if the ST Author selects "*TLS/HTTPS*" in FTP_ITC_EXT.1.1.

If this SFR is included in the ST, then the Functional Package for Transport Layer Security (TLS), version 2.1 must also be claimed.

FCS_HTTPS_EXT.1.2

The TSF shall implement HTTPS using TLS.

Evaluation Activities

FCS_HTTPS_EXT.1
TSS
The evaluator shall check the TSS to ensure that it is clear on how HTTPS uses TLS to establish an administrative session, focusing on any client authentication required by the TLS protocol vs. security administrator authentication which may be done at a different level of the processing stack.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
Testing for this activity is done as part of the TLS testing; this may result in additional testing if the TLS tests are done at the TLS protocol level.

FCS_IPSEC_EXT.1 IPsec Protocol

This is a selection-based component. Its inclusion depends upon selection from FTP_ITC_EXT.1.1.

FCS_IPSEC_EXT.1.1

The TSF shall implement the IPsec architecture as specified in RFC 4301.

Application Note: This SFR must be included in the ST if the ST Author selects "*IPsec*" in FTP_ITC_EXT.1.1.

If this SFR is claimed, then FCS_COP.1/KeyedHash and FCS_RBG.1 must also be claimed.

RFC 4301 calls for an IPsec implementation to protect IP traffic through the use of a Security Policy Database (SPD). The SPD is used to define how IP packets are to be handled: PROTECT the packet (e.g., encrypt the packet), BYPASS the IPsec services (e.g., no encryption), or DISCARD the packet (e.g., drop the packet). The SPD can be implemented in various ways, including router access control lists, firewall rule-sets, a "traditional" SPD, etc. Regardless of the implementation details, there is a notion of a "rule" that a packet is "matched" against and a resulting action that takes place.

While there must be a means to order the rules, a general approach to ordering is not mandated, as long as the TOE can distinguish the IP packets and apply the rules accordingly. There may be multiple SPDs (one for each network interface), but this is not required.

FCS_IPSEC_EXT.1.2

The TSF shall implement [**selection**: *transport mode*, *tunnel mode*].

Application Note: If the TOE is used to connect to a VPN gateway for the purposes of establishing a secure connection to a private network, the ST Author should select tunnel mode. If the TOE uses IPsec to establish an end-to-end connection to another IPsec VPN Client, the ST Author should select transport mode. If the TOE uses IPsec to establish a connection to a specific endpoint device for the purpose of secure remote administration, the ST Author should select transport mode.

FCS_IPSEC_EXT.1.3

The TSF shall have a nominal, final entry in the SPD that matches anything that is otherwise unmatched, and discards it.

FCS_IPSEC_EXT.1.4

The TSF shall implement the IPsec protocol ESP as defined by RFC 4303 using the cryptographic algorithms [AES-GCM-128, AES-GCM-256 (as specified in RFC 4106), [**selection**: *AES-CBC-128 (specified in RFC 3602)*, *AES-CBC-256 (specified in RFC 3602)*, *no other algorithms*]] together with a Secure Hash Algorithm (SHA)-based HMAC.

FCS_IPSEC_EXT.1.5

The TSF shall implement the protocol:

[**selection**:

- *IKEv1, using Main Mode for Phase 1 exchanges, as defined in RFC 2407, RFC 2408, RFC 2409, RFC 4109, [**selection, choose one of**: no other RFCs for extended sequence numbers, RFC 4304 for extended sequence numbers], [**selection, choose one of**: no other RFCs for hash functions, RFC 4868 for hash functions], and [**selection, choose one of**: support for XAUTH, no support for XAUTH]*
- *IKEv2 as defined in RFC 7296 (with mandatory support for NAT traversal as specified in section 2.23), RFC 8784, RFC 8247, and [**selection, choose one of**: no other RFCs for hash functions, RFC 4868 for hash functions]*

].

Application Note: If the TOE implements SHA-2 hash algorithms for IKEv1 or IKEv2, the ST Author should select RFC 4868.

FCS_IPSEC_EXT.1.6

The TSF shall ensure the encrypted payload in the [**selection**: *IKEv1*, *IKEv2*] protocol uses the cryptographic algorithms AES-CBC-128, AES-CBC-256 as specified in RFC 6379 and [**selection**: *AES-GCM-128 as specified in RFC 5282*, *AES-GCM-256 as specified in RFC 5282*, *no other algorithm*].

FCS_IPSEC_EXT.1.7

The TSF shall ensure that [**selection**:

- *IKEv2 SA lifetimes can be configured by [**selection**: an Administrator, a VPN Gateway] based on [**selection**: number of packets/number of bytes, length of time]*
- *IKEv1 SA lifetimes can be configured by [**selection**: an Administrator, a VPN Gateway] based on [**selection**: number of packets/number of bytes, length of time]*
- *IKEv1 SA lifetimes are fixed based on [**selection**: number of packets/number of bytes, length of time]. If length of time is used, it must include at least one option that is 24 hours or less for Phase 1 SAs and 8 hours or less for Phase 2 SAs.*

].

Application Note: The ST Author is afforded a selection based on the version of IKE in their implementation. There is a further selection within this selection that allows the ST Author to specify which entity is responsible for “configuring” the life of the SA. An implementation that allows an administrator to configure the client or a VPN gateway that pushes the SA lifetime down to the client are both acceptable.

As far as SA lifetimes are concerned, the TOE can limit the lifetime based on the number of bytes transmitted, or the number of packets transmitted. Either packet-based or volume-based SA lifetimes are acceptable; the ST Author makes the appropriate selection to indicate which type of lifetime limits are supported.

The ST Author chooses either the IKEv1 requirements or IKEv2 requirements (or both, depending on the selection in FCS_IPSEC_EXT.1.5. The IKEv1 requirement can be accomplished either by providing Authorized Administrator-configurable lifetimes (with appropriate instructions in documents mandated by AGD_OPE), or by “hard coding” the limits in the implementation. For IKEv2, there are no hard-coded limits, but in this case it is required that an administrator be able to configure the values. In general, instructions for setting the parameters of the implementation, including lifetime of the SAs, should be included in the operational guidance generated for AGD_OPE. It is appropriate to refine the requirement in terms of number of MB/KB instead of number of packets, as long as the TOE is capable of setting a limit on the amount of traffic that is protected by the same key (the total volume of all IPsec traffic protected by that key).

FCS_IPSEC_EXT.1.8

The TSF shall ensure that all IKE protocols implement DH groups [*19 (256-bit Random ECP), 20 (384-bit Random ECP), and* [**selection**: *24 (2048-bit MODP with 256-bit POS), 15 (3072-bit MODP), 14 (2048-bit MODP), no other DH groups*]].

Application Note: The selection is used to specify additional DH groups supported. This applies to IKEv1 and IKEv2 exchanges. It should be noted that if any additional DH groups are specified, they must comply with the requirements (in terms of the ephemeral keys that are established) listed in FCS_CKM.1.

Since the implementation may allow different Diffie-Hellman groups to be negotiated for use in forming the SAs, the assignments in FCS_IPSEC_EXT.1.9 and FCS_IPSEC_EXT.1.10 may contain multiple values. For each DH group supported, the ST Author consults Table 2 in 800-57 to determine the “bits of security” associated with the DH group. Each unique value is then used to fill in the assignment (for 1.9 they are doubled; for 1.10 they are inserted directly into the assignment). For example, suppose the implementation supports DH group 14 (2048-bit MODP) and group 20 (ECDH using NIST curve P-384). From Table 2, the bits of security value for group 14 is 112, and for group 20 it is 192. For FCS_IPSEC_EXT.1.9, then, the assignment would read “[224, 384]” and for FCS_IPSEC_EXT.1.10 it would read “[112, 192]” (although in this case the requirement should probably be refined so that it makes sense mathematically).

FCS_IPSEC_EXT.1.9

The TSF shall generate the secret value x used in the IKE Diffie-Hellman key exchange (“x” in gx mod p) using the random bit generator specified in FCS_RBG.1, and having a length of at least [**assignment**: *(one or more) number(s) of bits that is at least twice the “bits of security” value associated with the negotiated Diffie-Hellman group as listed in Table 2 of NIST SP 800-57, Recommendation for Key Management – Part 1: General*] bits.

FCS_IPSEC_EXT.1.10

The TSF shall generate nonces used in IKE exchanges in a manner such that the probability that a specific nonce value will be repeated during the life a specific IPsec SA is less than 1 in 2^[**assignment**: *(one or more) “bits of security” value(s) associated with the negotiated Diffie-Hellman group as listed in Table 2 of NIST SP 800-57, Recommendation for Key Management – Part 1: General*].

FCS_IPSEC_EXT.1.11

The TSF shall ensure that all IKE protocols perform peer authentication using a [**selection**: *RSA*, *ECDSA*] that use X.509v3 certificates that conform to RFC 4945 and [**selection, choose one of**: *Pre-shared Keys*, *no other method*].

Application Note: At least one public-key-based Peer Authentication method is required in order to conform to this PP. One or more of the public key schemes is chosen by the ST Author to reflect what is implemented. The ST Author also ensures that appropriate FCS requirements reflecting the algorithms used (and key generation capabilities, if provided) are listed to support those methods. Applicable claims from the , version are made to support X.509 validation functionality, most notably FIA_XCU_EXT.1 (mandatory requirement defining the TOE's use of certificates), FIA_X509_EXT.1 (X.509 certificate validation) and FIA_X509_EXT.2 (X.509 certificate authentication).

FCS_IPSEC_EXT.1.12

The TSF shall not establish an SA if the [**selection**: *IP address*, *Fully Qualified Domain Name (FQDN)*, *user FQDN*, *Distinguished Name (DN)*] and [**selection, choose one of**: *no other reference identifier type*, [***assignment****: other supported reference identifier types*]] contained in a certificate does not match the expected value(s) for the entity attempting to establish a connection.

Application Note: The TOE must support at least one of the following identifier types: IP address, Fully Qualified Domain Name (FQDN), user FQDN, or Distinguished Name (DN). In the future, the TOE will be required to support all of these identifier types. The TOE is expected to support as many IP address formats (IPv4 and IPv6) as IP versions supported by the TOE in general. The ST Author may assign additional supported identifier types in the second selection.

FCS_IPSEC_EXT.1.13

The TSF shall not establish an SA if the presented identifier does not match the configured reference identifier of the peer.

Application Note: At this time, only the comparison between the presented identifier in the peer’s certificate and the peer’s reference identifier is mandated by the testing below. However, in the future, this requirement will address two aspects of the peer certificate validation: 1) comparison of the peer’s ID payload to the peer’s certificate which are both presented identifiers, as required by RFC

4945 and 2) verification that the peer identified by the ID payload and the certificate is the peer expected by the TOE (per the reference identifier). At that time, the TOE will be required to demonstrate both aspects (i.e. that the TOE enforces that the peer's ID payload matches the peer's certificate which both match configured peer reference identifiers).

Excluding the DN identifier type (which is necessarily the Subject DN in the peer certificate), the TOE may support the identifier in either the Common Name or Subject Alternative Name (SAN) or both. If both are supported, the preferred logic is to compare the reference identifier to a presented SAN, and only if the peer's certificate does not contain a SAN, to fall back to a comparison against the Common Name. In the future, the TOE will be required to compare the reference identifier to the presented identifier in the SAN only, ignoring the Common Name.

FCS_IPSEC_EXT.1.14

The [**selection**: *TSF*, *VPN Gateway*] shall be able to ensure by default that the strength of the symmetric algorithm (in terms of the number of bits in the key) negotiated to protect the [**selection**: *IKEv1 Phase 1*, *IKEv2 IKE_SA*] connection is greater than or equal to the strength of the symmetric algorithm (in terms of the number of bits in the key) negotiated to protect the [**selection**: *IKEv1 Phase 2*, *IKEv2 CHILD_SA*] connection.

Application Note: If this functionality is configurable, the TSF may be configured by a VPN Gateway or by an Administrator of the TOE itself.

The ST Author chooses either or both of the IKE selections based on what is implemented by the TOE. Obviously, the IKE version(s) chosen should be consistent not only in this element, but with other choices for other elements in this component. While it is acceptable for this capability to be configurable, the default configuration in the evaluated configuration (either "out of the box" or by configuration guidance in the AGD documentation) must enable this functionality.

Evaluation Activities

FCS_IPSEC_EXT.1
TSS
In addition to the TSS EAs for the individual FCS_IPSEC_EXT.1 elements below, the evaluator shall perform the following:

If the TOE boundary includes a general-purpose operating system or mobile device, the evaluator shall examine the TSS to ensure that it describes whether the VPN client capability is architecturally integrated with the platform itself or whether it is a separate executable that is bundled with the platform.

Guidance
In addition to the AGD EAs for the individual FCS_IPSEC_EXT.1 elements below, the evaluator shall perform the following:

If the configuration of the IPsec behavior is from an environmental source, most notably a VPN gateway (e.g through receipt of required connection parameters from a VPN gateway), the evaluator shall ensure that the AGD contains any appropriate information for ensuring that this configuration can be properly applied.

Note in this case that the implementation of the IPsec protocol must be enforced entirely within the TOE boundary; i.e. it is not permissible for a software application TOE to be a graphical front-end for IPsec functionality implemented totally or in part by the underlying OS platform. The behavior referenced here is for the possibility that the configuration of the IPsec connection is initiated from outside the TOE, which is permissible so long as the TSF is solely responsible for enforcing the configured behavior. However, it is allowable for the TSF to rely on low-level platform-provided networking functions to implement the SPD from the client (e.g., enforcement of packet routing decisions).

Tests
As a prerequisite for performing the Test EAs for the individual FCS_IPSEC_EXT.1 elements below, the evaluator shall do the following:

The evaluator shall minimally create a test environment equivalent to the test environment illustrated below. The traffic generator used to construct network packets should provide the evaluator with the ability manipulate fields in the ICMP, IPv4, IPv6, UDP, and TCP packet headers. The evaluator shall provide justification for any differences in the test environment.

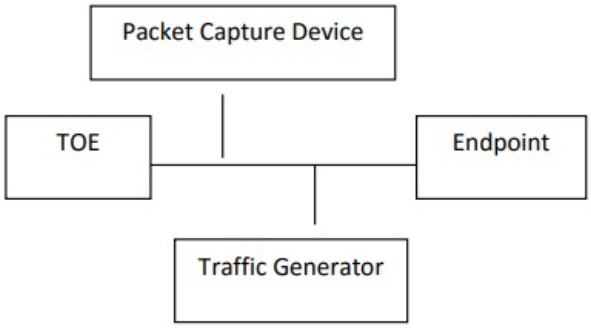

Figure 2: IPsec Test Environment

FCS_IPSEC_EXT.1.1
TSS
The evaluator shall examine the TSS and determine that it describes how the IPsec capabilities are implemented.

The evaluator shall ensure that the TSS describes at a high level the architectural relationship between the IPsec implementation and the rest of the TOE.

The evaluator shall ensure that the TSS describes how the SPD is implemented and the rules for processing both inbound and outbound packets in terms of the IPsec policy. The TSS describes the rules that are available and the resulting actions available after matching a rule. The TSS describes how the available rules and actions form the SPD using terms defined in RFC 4301 such as BYPASS (e.g., no encryption), DISCARD (e.g., drop the packet), and PROTECT (e.g., encrypt the packet) actions defined in RFC 4301.

As noted in section 4.4.1 of RFC 4301, the processing of entries in the SPD is non-trivial and the evaluator shall determine that the description in the TSS is sufficient to determine which rules will be applied given the rule structure implemented by the TOE. For example, if the TOE allows specification of ranges, conditional rules, etc., the evaluator shall determine that the description of rule processing (for both inbound and outbound packets) is sufficient to determine the action that will be applied, especially in the case where two different rules may apply. This description shall cover both the initial packets (that is, no SA is established on the interface or for that particular packet) as well as packets that are part of an established SA.

Guidance
The evaluator shall examine the AGD to verify it instructs the Administrator how to construct entries into the SPD that specify a rule for processing a packet. The description includes all three cases – a rule that ensures packets are encrypted/decrypted, dropped, and flow through the TOE without being encrypted. The evaluator shall determine that the description in the AGD is consistent with the description in the TSS, and that the level of detail in the AGD is sufficient to allow the administrator to set up the SPD in an unambiguous fashion. This includes a discussion of how ordering of rules impacts the processing of an IP packet.

Tests
The evaluator uses the operational guidance to configure the TOE to carry out the following tests:

- *Test FCS_IPSEC_EXT.1.1:1: The evaluator shall configure the SPD such that there is a rule for dropping a packet, encrypting a packet, and allowing a packet to flow in plaintext. The selectors used in the construction of the rule shall be different such that the evaluator can generate a packet and send packets to the gateway with the appropriate fields (fields that are used by the rule - e.g., the IP addresses, TCP/UDP ports) in the packet header. The evaluator performs both positive and negative test cases for each type of rule (e.g., a packet that matches the rule and another that does not match the rule). The evaluator observes via the audit trail, and packet captures that the TOE exhibited the expected behavior: appropriate packets were dropped, allowed to flow without modification, encrypted by the IPsec implementation.*
- *Test FCS_IPSEC_EXT.1.1:2: The evaluator shall devise several tests that cover a variety of scenarios for packet processing. As with Test 1, the evaluator ensures both positive and negative test cases are constructed. These scenarios shall exercise the range of possibilities for SPD entries and processing modes as outlined in the TSS and operational guidance. Potential areas to cover include rules with overlapping ranges and conflicting entries, inbound and outbound packets, and packets that establish SAs as well as packets that belong to established SAs. The evaluator shall verify, via the audit trail and packet captures, for each scenario that the expected behavior is exhibited, and is consistent with both the TSS and the operational guidance.*

FCS_IPSEC_EXT.1.2
TSS
The evaluator checks the TSS to ensure it states that an IPsec VPN can be established to operate in tunnel mode or transport mode (as selected).

Guidance
The evaluator shall confirm that the AGD contains instructions on how to configure the

connection in each mode selected.

If both transport mode and tunnel mode are implemented, the evaluator shall review the AGD to determine how the use of a given mode is specified.

Tests
The evaluator shall perform the following test(s) based on the selections chosen:

- *Test FCS_IPSEC_EXT.1.2:1: [conditional] If tunnel mode is selected, the evaluator uses the operational guidance to configure the TOE/platform to operate in tunnel mode and also configures a VPN peer to operate in tunnel mode. The evaluator configures the TOE/platform and the VPN peer to use any of the allowable cryptographic algorithms, authentication methods, etc. to ensure an allowable SA can be negotiated. The evaluator shall then initiate a connection from the TOE/Platform to the VPN peer. The evaluator observes (for example, in the audit trail and the captured packets) that a successful connection was established using the tunnel mode.*
- *Test FCS_IPSEC_EXT.1.2:2: [conditional] If transport mode is selected, the evaluator uses the operational guidance to configure the TOE/platform to operate in transport mode and also configures a VPN peer to operate in transport mode. The evaluator configures the TOE/platform and the VPN peer to use any of the allowed cryptographic algorithms, authentication methods, etc. to ensure an allowable SA can be negotiated. The evaluator then initiates a connection from the TOE/platform to connect to the VPN peer. The evaluator observes (for example, in the audit trail and the captured packets) that a successful connection was established using the transport mode.*

FCS_IPSEC_EXT.1.3
TSS
There are no additional TSS evaluation activities for this element.

Guidance
The evaluator shall check that the AGD provides instructions on how to construct or acquire the SPD and uses the AGD to configure the TOE for the following test.
If both transport mode and tunnel mode are implemented, the evaluator shall review the AGD to determine how the use of a given mode is specified.

Tests
The evaluator shall perform the following test:

The evaluator shall configure the SPD such that it has entries that contain operations that DISCARD, PROTECT, and (if applicable) BYPASS network packets. The evaluator may use the SPD that was created for verification of FCS_IPSEC_EXT.1.1. The evaluator shall construct a network packet that matches a BYPASS entry and send that packet. The evaluator should observe that the network packet is passed to the proper destination interface with no modification. The evaluator shall then modify a field in the packet header; such that it no longer matches the evaluator-created entries (there may be a "TOE-created" final entry that discards packets that do not match any previous entries). The evaluator sends the packet, and observes that the packet was not permitted to flow to any of the TOE's interfaces.

FCS_IPSEC_EXT.1.4
TSS
The evaluator shall examine the TSS to verify that the algorithms AES-GCM-128 and AES-GCM-256 are implemented. If the ST Author has selected either AES-CBC-128 or AES-CBC-256 in the requirement, then the evaluator verifies the TSS describes these as well. In addition, the evaluator ensures that the SHA-based HMAC algorithm conforms to the algorithms specified in FCS_COP.1/KeyedHash Cryptographic Operations (Keyed Hash Algorithms).

Guidance
The evaluator checks the AGD to ensure it provides instructions on how the TOE is configured to use the algorithms selected in this component and whether this is performed through direct configuration, defined during initial installation, or defined by acquiring configuration settings from an environmental component.

Tests
The evaluator shall perform the following test:

The evaluator shall configure the TOE/platform as indicated in the operational guidance configuring the TOE/platform to use each of the supported algorithms, attempt to establish a connection using ESP, and verify that the attempt succeeds.

FCS_IPSEC_EXT.1.5
TSS
The evaluator shall examine the TSS to verify that IKEv1 and/or IKEv2 are implemented. If IKEv1 is implemented, the evaluator shall verify that the TSS indicates whether or not XAUTH is supported, and that aggressive mode is not used for IKEv1 Phase 1 exchanges (i.e. only main mode is used). It may be that these are configurable options.

Guidance
The evaluator shall check the AGD to ensure it instructs the administrator how to configure the TOE to use IKEv1 and/or IKEv2 (as selected), and uses the guidance to configure the TOE to perform NAT traversal for the test below. If XAUTH is implemented, the evaluator shall verify

that the AGD provides instructions on how it is enabled or disabled.
If the TOE supports IKEv1, the evaluator shall verify that the AGD either asserts that only main mode is used for Phase 1 exchanges, or provides instructions for disabling aggressive mode.

Tests
Tests are performed in conjunction with the other IPsec evaluation activities with the exception of the activities below:

- *Test FCS_IPSEC_EXT.1.5:1: The evaluator shall configure the TOE so that it will perform NAT traversal processing as described in the TSS and RFC 7296, section 2.23. The evaluator shall initiate an IPsec connection and determine that the NAT is successfully traversed. If the TOE supports IKEv1 with or without XAUTH, the evaluator shall verify that this test can be successfully repeated with XAUTH enabled and disabled in the manner specified by the operational guidance. If the TOE only supports IKEv1 with XAUTH, the evaluator shall verify that connections not using XAUTH are unsuccessful. If the TOE only supports IKEv1 without XAUTH, the evaluator shall verify that connections using XAUTH are unsuccessful.*
- *Test FCS_IPSEC_EXT.1.5:2: [conditional] If the TOE supports IKEv1, the evaluator shall perform any applicable operational guidance steps to disable the use of aggressive mode and then attempt to establish a connection using an IKEv1 Phase 1 connection in aggressive mode. This attempt should fail. The evaluator shall show that the TOE will reject a VPN gateway from initiating an IKEv1 Phase 1 connection in aggressive mode. The evaluator should then show that main mode exchanges are supported.*

FCS_IPSEC_EXT.1.6
TSS
The evaluator shall ensure the TSS identifies the algorithms used for encrypting the IKEv1 and/or IKEv2 payload, and that the algorithms AES-CBC-128, AES-CBC-256 are specified, and if others are chosen in the selection of the requirement, those are included in the TSS discussion.

Guidance
The evaluator checks the AGD to ensure it provides instructions on how the TOE is configured to use the algorithms selected in this component and whether this is performed through direct configuration, defined during initial installation, or defined by acquiring configuration settings from an environmental component.

Tests
The evaluator shall use the operational guidance to configure the TOE (or to configure the Operational Environment to have the TOE receive configuration) to perform the following test for each ciphersuite selected:

The evaluator shall configure the TOE to use the ciphersuite under test to encrypt the IKEv1 and/or IKEv2 payload and establish a connection with a peer device, which is configured to only accept the payload encrypted using the indicated ciphersuite. The evaluator will confirm the algorithm was that used in the negotiation. The evaluator will confirm that the connection is successful by confirming that data can be passed through the connection once it is established. For example, the evaluator may connect to a webpage on the remote network and verify that it can be reached.

FCS_IPSEC_EXT.1.7
TSS
There are no additional TSS evaluation activities for this element.

Guidance
The evaluator shall check the AGD to ensure it provides instructions on how the TOE configures the values for SA lifetimes. In addition, the evaluator shall check that the AGD has the option for either the Administrator or VPN Gateway to configure Phase 1 SAs if time-based limits are supported. Currently there are no values mandated for the number of packets or number of bytes, the evaluator shall simply check the AGD to ensure that this can be configured if selected in the requirement.

Tests
When testing this functionality, the evaluator needs to ensure that both sides are configured appropriately. From the RFC "A difference between IKEv1 and IKEv2 is that in IKEv1 SA lifetimes were negotiated. In IKEv2, each end of the SA is responsible for enforcing its own lifetime policy on the SA and rekeying the SA when necessary. If the two ends have different lifetime policies, the end with the shorter lifetime will end up always being the one to request the rekeying. If the two ends have the same lifetime policies, it is possible that both will initiate a rekeying at the same time (which will result in redundant SAs). To reduce the probability of this happening, the timing of rekeying requests SHOULD be jittered."

Each of the following tests shall be performed for each version of IKE selected in the FCS_IPSEC_EXT.1.5 protocol selection:

- *Test FCS_IPSEC_EXT.1.7:1: [conditional] The evaluator shall configure a maximum lifetime in terms of the # of packets (or bytes) allowed following the operational guidance. The evaluator shall establish an SA and determine that once the allowed # of packets (or bytes) through this SA is exceeded, the connection is closed.*
- *Test FCS_IPSEC_EXT.1.7:2: [conditional] The evaluator shall construct a test where a Phase*

1 SA is established and attempted to be maintained for more than 24 hours before it is renegotiated. The evaluator shall observe that this SA is closed or renegotiated in 24 hours or less. If such an action requires that the TOE be configured in a specific way, the evaluator shall implement tests demonstrating that the configuration capability of the TOE works as documented in the operational guidance.

- *Test FCS_IPSEC_EXT.1.7:3: [conditional] The evaluator shall perform a test similar to Test 2 for Phase 2 SAs, except that the lifetime will be 8 hours or less instead of 24 hours or less.*
- *Test FCS_IPSEC_EXT.1.7:4: [conditional] If a fixed limit for IKEv1 SAs is supported, the evaluator shall establish an SA and observe that the connection is closed after the fixed traffic and/or time value is reached.*

FCS_IPSEC_EXT.1.8
TSS
The evaluator shall check to ensure that the DH groups specified in the requirement are listed as being supported in the TSS. If there is more than one DH group supported, the evaluator checks to ensure the TSS describes how a particular DH group is specified/negotiated with a peer.

Guidance
There are no additional Guidance evaluation activities for this element.

Tests
The evaluator shall perform the following test:

For each supported DH group, the evaluator shall test to ensure that all supported IKE protocols can be successfully completed using that particular DH group.

FCS_IPSEC_EXT.1.9
TSS
The evaluator shall check to ensure that, for each DH group supported, the TSS describes the process for generating "x" (as defined in FCS_IPSEC_EXT.1.9) and each nonce. The evaluator shall verify that the TSS indicates that the random number generated that meets the requirements in this EP is used, and that the length of "x" and the nonces meet the stipulations in the requirement.

Guidance
There are no additional Guidance evaluation activities for this element.

Tests
There are no test activities for this element.

FCS_IPSEC_EXT.1.10
EAs for this element are tested through EAs for FCS_IPSEC_EXT.1.9.

FCS_IPSEC_EXT.1.11
TSS
The evaluator ensures that the TSS identifies RSA and/or ECDSA as being used to perform peer authentication.

If pre-shared keys are chosen in the selection, the evaluator shall check to ensure that the TSS describes how pre-shared keys are established and used in authentication of IPsec connections. The description in the TSS shall also indicate how pre-shared key establishment is accomplished depending on whether the TSF can generate a pre-shared key, accept a pre-shared key, or both.

The evaluator shall ensure that the TSS describes how the TOE compares the peer's presented identifier to the reference identifier. This description shall include whether the certificate presented identifier is compared to the ID payload presented identifier, which field(s) of the certificate are used as the presented identifier (DN, Common Name, or SAN) and, if multiple fields are supported, the logical order comparison. If the ST Author assigned an additional identifier type, the TSS description shall also include a description of that type and the method by which that type is compared to the peer's presented certificate.

Guidance
The evaluator shall check that the AGD describes how pre-shared keys are to be generated and established.

The evaluator ensures the AGD describes how to set up the TOE to use the cryptographic algorithms RSA and/or ECDSA.

In order to construct the environment and configure the TOE for the following tests, the evaluator will ensure that the AGD also describes how to configure the TOE to connect to a trusted CA, and ensure a valid certificate for that CA is loaded into the TOE as a trusted CA.

The evaluator shall also ensure that the AGD includes the configuration of the reference identifier(s) for the peer.

Tests
For efficiency's sake, the testing that is performed here has been combined with the testing for X.509 certificate validation defined by , version , FCS_IPSEC_EXT.1.12, and

FCS_IPSEC_EXT.1.13. The following tests shall be repeated for each peer authentication protocol selected in the FCS_IPSEC_EXT.1.11 selection above:

- *Test FCS_IPSEC_EXT.1.11:1: The evaluator shall have the TOE generate a public-private key pair, and submit a CSR (Certificate Signing Request) to a CA (trusted by both the TOE and the peer VPN used to establish a connection) for its signature. The values for the DN (Common Name, Organization, Organizational Unit, and Country) will also be passed in the request. Alternatively, the evaluator may import to the TOE a previously generated private key and corresponding certificate.*
- *Test FCS_IPSEC_EXT.1.11:2: The evaluator shall configure the TOE to use a private key and associated certificate signed by a trusted CA and shall establish an IPsec connection with the peer.*
- *Test FCS_IPSEC_EXT.1.11:3: The evaluator shall test that the TOE can properly handle revoked certificates – conditional on whether CRL or OCSP is selected; if both are selected, then a test is performed for each method. For this current version of the PP-Module, the evaluator has to only test one up in the trust chain (future drafts may require to ensure the validation is done up the entire chain). The evaluator shall ensure that a valid certificate is used, and that the SA is established. The evaluator then attempts the test with a certificate that will be revoked (for each method chosen in the selection) to ensure when the certificate is no longer valid that the TOE will not establish an SA.*
- *Test FCS_IPSEC_EXT.1.11:4: [conditional] The evaluator shall generate a pre-shared key and use it, as indicated in the operational guidance, to establish an IPsec connection with the VPN GW peer. If the generation of the pre-shared key is supported, the evaluator shall ensure that establishment of the key is carried out for an instance of the TOE generating the key as well as an instance of the TOE merely taking in and using the key.*

  For each supported identifier type (excluding DNs), the evaluator shall repeat the following tests:

- *Test FCS_IPSEC_EXT.1.11:5: For each field of the certificate supported for comparison, the evaluator shall configure the peer's reference identifier on the TOE (per the administrative guidance) to match the field in the peer's presented certificate and shall verify that the IKE authentication succeeds.*
- *Test FCS_IPSEC_EXT.1.11:6: For each field of the certificate support for comparison, the evaluator shall configure the peer's reference identifier on the TOE (per the administrative guidance) to not match the field in the peer's presented certificate and shall verify that the IKE authentication fails.*

  The following tests are conditional:
- *Test FCS_IPSEC_EXT.1.11:7: [conditional] If, according to the TSS, the TOE supports both Common Name and SAN certificate fields and uses the preferred logic outlined in the Application Note, the tests above with the Common Name field shall be performed using peer certificates with no SAN extension. Additionally, the evaluator shall configure the peer's reference identifier on the TOE to not match the SAN in the peer's presented certificate but to match the Common Name in the peer's presented certificate, and verify that the IKE authentication fails.*
- *Test FCS_IPSEC_EXT.1.11:8: [conditional] If the TOE supports DN identifier types, the evaluator shall configure the peer's reference identifier on the TOE (per the administrative guidance) to match the subject DN in the peer's presented certificate and shall verify that the IKE authentication succeeds. To demonstrate a bit-wise comparison of the DN, the evaluator shall change a single bit in the DN (preferably, in an Object Identifier (OID) in the DN) and verify that the IKE authentication fails. To demonstrate a comparison of DN values, the evaluator shall change any one of the four DN values and verify that the IKE authentication fails.*
- *Test FCS_IPSEC_EXT.1.11:9: [conditional] If the TOE supports both IPv4 and IPv6 and supports IP address identifier types, the evaluator must repeat test 1 and 2 with both IPv4 address identifiers and IPv6 identifiers. Additionally, the evaluator shall verify that the TOE verifies that the IP header matches the identifiers by setting the presented identifiers and the reference identifier with the same IP address that differs from the actual IP address of the peer in the IP headers and verifying that the IKE authentication fails.*
- *Test FCS_IPSEC_EXT.1.11:10: [conditional] If, according to the TSS, the TOE performs comparisons between the peer's ID payload and the peer's certificate, the evaluator shall repeat the following test for each combination of supported identifier types and supported certificate fields (as above). The evaluator shall configure the peer to present a different ID payload than the field in the peer's presented certificate and verify that the TOE fails to authenticate the IKE peer.*

FCS_IPSEC_EXT.1.12
EAs for this element are tested through EAs for FCS_IPSEC_EXT.1.11.

FCS_IPSEC_EXT.1.13
EAs for this element are tested through EAs for FCS_IPSEC_EXT.1.11.

FCS_IPSEC_EXT.1.14
TSS

The evaluator shall check that the TSS describes the potential strengths (in terms of the number of bits in the symmetric key) of the algorithms that are allowed for the IKE and ESP exchanges. The TSS shall also describe the checks that are done when negotiating IKEv1 Phase 2 and/or IKEv2 CHILD_SA suites to ensure that the strength (in terms of the number of bits of key in the symmetric algorithm) of the negotiated algorithm is less than or equal to that of the IKE SA this is protecting the negotiation.

Guidance
There are no additional Guidance evaluation activities for this element.

Tests
The evaluator follows the guidance to configure the TOE to perform the following tests for each version of IKE supported:

- *Test FCS_IPSEC_EXT.1.14:1: The evaluator shall successfully negotiate an IPsec connection using each of the supported algorithms and hash functions identified in the requirements.*
- *Test FCS_IPSEC_EXT.1.14:2: [conditional]The evaluator shall attempt to establish an SA for ESP that selects an encryption algorithm with more strength than that being used for the IKE SA (i.e., symmetric algorithm with a key size larger than that being used for the IKE SA). Such attempts should fail.*
- *Test FCS_IPSEC_EXT.1.14:3: The evaluator shall attempt to establish an IKE SA using an algorithm that is not one of the supported algorithms and hash functions identified in the requirements. Such an attempt should fail.*
- *Test FCS_IPSEC_EXT.1.14:4: The evaluator shall attempt to establish an SA for ESP (assumes the proper parameters where used to establish the IKE SA) that selects an encryption algorithm that is not identified in FCS_IPSEC_EXT.1.4. Such an attempt should fail.*

FCS_OTV_EXT.1 One-Time Value

FCS_OTV_EXT.1.1

The TSF shall perform cryptographic one-time value generation for [**selection**: *Algorithm or mode*] using the output of a [**selection**: *random bit generator as defined in FCS_RBG.1*, *deterministic OTV construction*, *[**assignment**: OTV construction method]*] and sizes of length that meet the following: [**selection**: *List of standards*]

The following table provides the recommended choices for completion of the selection operations of FCS_COP.1/XOF.

Table 18: Recommended choices and guidance for FCS_OTV_EXT.1

Algorithm or mode	List of standards	Notes
HMAC	FIPS PUB 198-1, NIST SP 800-56C Revision 2	Depending on the use case, salts can be secret or known, randomly generated or all zero. Secret IVs may be required, e.g., for key derivation. Refer to the relevant standards for your use case.
KMAC	NIST SP 800-185 NIST SP 800-56C Revision 2	Depending on the use case, salts can be secret or known, randomly generated or all zero. Secret IVs may be required, e.g., for key derivation. Refer to the relevant standards for your use case.
KDF	NIST SP 800-108 Revision 1 NIST SP 800-135 Revision 1 ISO/IEC 11770-6:2016 (Subclause 7.3.2)	Salts and IVs are generated as directed for HMAC, AES, and CAM cryptographic algorithms. Refer to the relevant standards.
PBKDF	NIST SP 800-132	Salts are generated and used as directed in PBKDFs.
CTR	NIST SP 800-38A	"Initial Counter" (nonce) shall be non-repeating. No counter value shall be repeated across multiple messages with the same secret key.

CBC	NIST SP 800-38A Appendix C	Depending on the use case, IVs shall be unpredictable. Repeating IVs leak information about whether the first one or more blocks are shared between two messages, so IVs should be non-repeating in such situations. Refer to the relevant standards for your use case.
OFB	NIST SP 800-38A	IVs shall be non-repeating and shall not be generated by invoking the cipher on another IV. OFB may require the IV to be a nonce.
CFB	NIST SP 800-38A	IVs should be non-repeating as repeating IVs leak information about the first plaintext block and about common shared prefixes in messages
XTS	NIST SP 800-38E IEEE Std 1619-2018	Tweak values shall be non-negative integers, assigned consecutively, and starting at an arbitrary non-negative integer (i.e., sequential nonces).
CMAC	NIST SP 800-38B	IV is all zeroes
KW, KWP	NIST SP 800-38F	Depending on the use case, nonces may be required. Please reference the relevant standards for your use case.
CCM	NIST SP 800-38C	Nonces shall be non-repeating.
GCM	NIST SP 800-38D	For RBG-based IV construction (section 8.2.2) the number of invocations of GCM shall not exceed 2^32 for a given secret key.
RSA-OAEP	NIST SP 800-56B Revision 2	Mask for padding shall be randomly generated

Application Note: See the algorithm- or mode-specific Notes above for guidance on completing the second selection.

Evaluation Activities

FCS_OTV_EXT.1
TBD

FCS_RBG.1 Random Bit Generation (RBG)

This is a selection-based component. Its inclusion depends upon selection from FCS_CKM_EXT.5.1.
This component may also be included in the ST as if optional.

FCS_RBG.1.1

TSF shall perform deterministic random bit generation services using [**selection**: *DRBG Algorithm*] in accordance with [**selection**: *List of standards*] after initialization.

The following table provides the recommended choices for completion of the selection operations of FCS_RBG.1.

Table 19: Recommended choices for FCS_RBG.1.1

Identifier	DRBG Algorithm	List of standards
HASH_DRBG	Hash_DRBG with [**selection**: *SHA-256*, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*]	[**selection**: *ISO/IEC 18031: 2011 (Section C.2.2)*, *NIST SP 800-90A Revision 1 Section 10.1.1*]
HMAC_DRBG	HMAC_DRBG with [**selection**: *SHA-*	[**selection**: *ISO/IEC*

	256, *SHA-384*, *SHA-512*, *SHA3-256*, *SHA3-384*, *SHA3-512*]	*18031: 2011 (Section C.2.3)*, *NIST SP 800-90A Revision 1 Section 10.1.2*]
CTR_DRBG	CTR_DRBG with [**selection**: *AES-128*, *AES-192*, *AES-256*, *CAM-128*, *CAM-192*, *CAM-256*, *SEED-128*, *HIGHT-128*, *LEA-128*, *LEA-192*, *LEA-256*]	[**selection**: *ISO/IEC 18031: 2011 (Section C.3.2)*, *NIST SP800-90A Revision 1 Section 10.2.1*]

Application Note: NIST SP 800-90A contains three different methods of generating random numbers; each of these, in turn, depends on underlying cryptographic primitives (hash functions/ciphers). The ST author will select the function used and include the specific underlying cryptographic primitives used in the requirement or in the TSS. While any of the identified hash functions (SHA-224, SHA-256, SHA-384, SHA-512) are allowed for Hash_DRBG or HMAC_DRBG, only AES-based implementations for CTR_DRBG are allowed.
This SFR must be included in the ST if random bits are provided by the TOE to tenant software, or if it is used by the TOE itself to support or implement PP-specified security functionality.

This SFR is also needed if the following SFRs are included in the ST: FCS_IPSEC_EXT.1, FCS_SLT_EXT.1, FCS_CKM.1/AKG, FCS_CKM.1/SKG, and FCS_COP.1/SigGen.

Also, this SFR must be claimed if "*KDF-CTR*," "*KDF-FB*," or "*KDF-DPI*" is selected in FCS_CKM_EXT.5.

If "*HMAC_DRBG (any)*" is selected, then FCS_COP.1/KeyedHash must be claimed.

If "*Hash_DRBG (any)*" is selected, then FCS_COP.1/Hash must be claimed. If "*CTR_DRBG (any)*" is selected, then FCS_COP.1/SKC must be claimed.

FCS_RBG.1.2

The TSF shall use a [**selection**: *TSF noise source [**assignment**: name of noise source], TSF interface for seeding*] for initialization and reseeding.

Application Note: For the selection in this requirement, the ST author selects "TSF noise source" if a single noise source is used as input to the DRBG. The ST author selects "multiple TSF noise sources" if a seed is formed from a combination of two or more noise sources within the TOE boundary. If the TSF implements two or more separate DRBGs that are seeded in separate manners, this SFR should be iterated for each DRBG. It multiple distinct noise sources exist such that each DRBG only uses one of them, then each iteration would select "TSF noise source"; "multiple TSF noise sources" is only selected if a single DRBG uses multiple noise sources for its seed. The ST author selects "TSF interface for seeding" if noise source data is generated outside the TOE boundary.
If "TSF noise source" is selected, FCS_RBG.3 must be claimed.

If "multiple TSF noise sources" is selected, FCS_RBG.4 and FCS_RBG.5 must be claimed.

If "TSF interface for seeding" is selected, FCS_RBG.2 must be claimed.

The security strength of the entropy used for seeding depends on the functions for which the TSF uses entropy. The security strength for the various functions is defined in Tables 2 and 3 of NIST SP 800-57A.

FCS_RBG.1.3

The TSF shall update the DRBG state by [**selection**: *reseeding*, *uninstantiating and re-instantiating*] using a [**selection**: *TSF entropy source [**assignment**: name of entropy source], TSF interface for obtaining entropy [**assignment**: name of the interface]*] in the following situations: [**selection**:

- *never*
- *on demand*
- *on the condition: [**assignment**: condition]*
- *after [**assignment**: time]*

] in accordance with [**assignment**: *list of standards*].

Application Note: From catalog No rationale is acceptable for not satisfying one of these dependencies.

If a reseeding is selected in the first selection and something other than “never” is selected in the third selection of FCS_RBG.1.3, but reseeding is not feasible, the TSF will uninstantiate RBGs, rather than produce output that is of insufficient quality. The listed standards should specify the reseed interval and procedure for uninstantiating and reseeding. The remaining selection allows the PP Author to require application-specific conditions for reseeding.

"Uninstantiate” means that the internal state of the DRBG is no longer available for use. In the second selection of FCS_RBG.1.3, “on demand” means that a TOE presents an interface to reseed as a TSFI (e.g., an API call). The interface causes the DRBG to reseed at the request of an authorized user, either with an internal source, an external source, or from input provided through the TSFI (e.g., the API call).

Evaluation Activities

FCS_RBG.1.1
TSS
The evaluator shall verify that the TSS identifies the DRBGs used by the TOE.

Guidance
If the DRBG functionality is configurable, the evaluator shall verify that the operational guidance includes instructions on how to configure this behavior.

Tests
The evaluator shall perform the following tests:

The evaluator shall perform 15 trials for the RNG implementation. If the RNG is configurable, the evaluator shall perform 15 trials for each configuration. The evaluator shall also confirm that the operational guidance contains appropriate instructions for configuring the RNG functionality.

If the RNG has prediction resistance enabled, each trial consists of (1) instantiate DRBG, (2) generate the first block of random bits (3) generate a second block of random bits (4) uninstantiate. The evaluator verifies that the second block of random bits is the expected value. The evaluator shall generate eight input values for each trial. The first is a count (0 – 14). The next three are entropy input, nonce, and personalization string for the instantiate operation. The next two are additional input and entropy input for the first call to generate. The final two are additional input and entropy input for the second call to generate. These values are randomly generated. "generate one block of random bits" means to generate random bits with number of returned bits equal to the Output Block Length (as defined in NIST SP 800-90A).

If the RNG does not have prediction resistance, each trial consists of (1) instantiate DRBG, (2) generate the first block of random bits (3) reseed, (4) generate a second block of random bits (5) uninstantiate. The evaluator verifies that the second block of random bits is the expected value. The evaluator shall generate eight input values for each trial. The first is a count (0 – 14). The next three are entropy input, nonce, and personalization string for the instantiate operation. The fifth value is additional input to the first call to generate. The sixth and seventh are additional input and entropy input to the call to reseed. The final value is additional input to the second generate call.

The following list contains more information on some of the input values to be generated/selected by the evaluator.

- ***Entropy input:*** *The length of the entropy input value must equal the seed length.*
- ***Nonce:*** *If a nonce is supported (CTR_DRBG with no Derivation Function does not use a nonce), the nonce bit length is one-half the seed length.*
- ***Personalization string:*** *The length of the personalization string must be less than or equal to seed length. If the implementation only supports one personalization string length, then the same length can be used for both values. If more than one string length is support, the evaluator shall use personalization strings of two different lengths. If the implementation does not use a personalization string, no value needs to be supplied.*
- ***Additional input:*** *The additional input bit lengths have the same defaults and restrictions as the personalization string lengths.*

FCS_RBG.1.2
Documentation will be produced - and the evaluator shall perform the activities - in accordance with and the Clarification to the Entropy Documentation and Assessment Annex.

FCS_RBG.1.3
TSS
The evaluator shall verify that the TSS identifies how the DRBG state is updated, and the situations under which this may occur.

Guidance
If the ST claims that the DRBG state can be updated on demand, the evaluator shall verify that the operational guidance has instructions for how to perform this operation.

Tests
There are no test activities for this element.

FCS_RBG.2 Random Bit Generation (External Seeding)

This is a selection-based component. Its inclusion depends upon selection from FCS_RBG.1.2.

FCS_RBG.2.1

The TSF shall be able to accept a minimum input of [**assignment**: *minimum input length greater than zero*] from a TSF interface for the purpose of obtaining entropy.

Application Note: This requirement is claimed when a DRBG is seeded with entropy from one or more noise source that is outside the TOE boundary. In the case of a general purpose computing platform this would likely only occur when the entropy source is a Dedicated Security Component that is integrated with the TOE. Typically the entropy produced by an environmental noise source is conditioned such that the input length has full entropy and is therefore usable as the seed. However, if this is not the case, it should be noted what the minimum entropy rate of the noise source is so that the TSF can collect a sufficiently large sample of noise data to be conditioned into a seed value. From catalog In order to maintain compliance with NIST SP 800-90A Revision 1, the TSF accepts enough bits of input from an external noise source to satisfy the entropy requirements of the DRBG. The TSF should also protect the integrity and confidentiality of the entropy it receives from the external noise source.

The TSF interface for the purpose of seeding here is the interface used to gather entropy for initializing the seed.

Evaluation Activities

FCS_RBG.2
The evaluator shall examine the entropy documentation required by FCS_RBG.1.2 to verify that it identifies, for each DRBG function implemented by the TOE, the TSF external interface used to seed the TOE's DRBG. The evaluator shall verify that this includes the amount of sampled data and the min-entropy rate of the sampled data such that it can be determined that sufficient entropy can be made available for the highest strength keys that the TSF can generate (e.g., 256 bits). If the seed data cannot be assumed to have full entropy (e.g., the min-entropy of the sampled bits is less than 1), the evaluator shall ensure that the entropy documentation describes the method by which the TOE estimates the amount of entropy that has been accumulated to ensure that sufficient data is collected and any conditioning that the TSF applies to the output data to create a seed of sufficient size with full entropy.

FCS_RBG.3 Random Bit Generation (Internal Seeding - Single Source)

This is a selection-based component. Its inclusion depends upon selection from FCS_RBG.1.2.

FCS_RBG.3.1

The TSF shall be able to seed the DRBG using a [**selection, choose one of**: *TSF software-based entropy source, TSF hardware-based entropy source [**assignment**: name of entropy source]*] with [**assignment**: *number of bits*] bits of min-entropy.

Application Note: This requirement is claimed when a DRBG is seeded with entropy from a single noise source that is within the TOE boundary. Min-entropy should be expressed as a ratio of entropy bits to sampled bits so that the total amount of data needed to ensure full entropy is known, as well as the conditioning function by which that data is reduced in size to the seed. From catalog If an ST Author wishes to use multiple internal noise sources, they iterate this requirement for each noise source used by the TSF.

Hardware-based noise sources are entropy sources whose primary function is noise generation, such as ring oscillators, diodes, and thermal noise. While a TOE may use software to collect the noise from these hardware sources, these are not software-based. Software-based noise sources are those sources that

have some other primary function, and the noise is a byproduct of their normal operation. Examples of software-based noise sources are user or system-based events, reading the least significant bits from an event timer, etc.

Hardware-based noise sources may be stochastically modelled, in which case the amount of entropy is well understood. Software-based noise sources are usually less well understood and therefore will typically take a more conservative approach, gathering larger numbers of bits than required, then performing a compression function to derive the final output. Software-based noise sources often rely on an entropy estimator.

Evaluation Activities

FCS_RBG.3
The evaluator shall examine the entropy documentation required by FCS_RBG.1.2 to verify that it identifies, for each DRBG function implemented by the TOE, the TSF noise source used to seed the TOE's DRBG. The evaluator shall verify that this includes the amount of sampled data and the min-entropy rate of the sampled data such that it can be determined that sufficient entropy can be made available for the highest strength keys that the TSF can generate (e.g., 256 bits). If the seed data cannot be assumed to have full entropy (e.g., the min-entropy of the sampled bits is less than 1), the evaluator shall ensure that the entropy documentation describes the method by which the TOE estimates the amount of entropy that has been accumulated to ensure that sufficient data is collected and any conditioning that the TSF applies to the output data to create a seed of sufficient size with full entropy.

FCS_RBG.4 Random Bit Generation (Internal Seeding - Multiple Sources)

This is a selection-based component. Its inclusion depends upon selection from .

FCS_RBG.4.1

The TSF shall be able to seed the DRBG using [**selection**: *[**assignment**: number] TSF software-based entropy source(s), [**assignment**: number] TSF hardware-based entropy source(s)*].

Application Note: This requirement is claimed when a DRBG is seeded with entropy from multiple noise sources that are within the TOE boundary. FCS_RBG.5 defines the mechanism by which these sources are combined to ensure sufficient minimum entropy.

Evaluation Activities

FCS_RBG.4
The evaluator shall examine the entropy documentation required by FCS_RBG.1.2 to verify that it identifies, for each DRBG function implemented by the TOE, each TSF noise source used to seed the TOE's DRBG. The evaluator shall verify that this includes the amount of sampled data and the min-entropy rate of the sampled data from each data source.

FCS_RBG.5 Random Bit Generation (Combining Entropy Sources)

This is a selection-based component. Its inclusion depends upon selection from .

FCS_RBG.5.1

The TSF shall [**selection**: *hash*, *concatenate and hash*, *XOR*, *input into a linear feedback shift register*, *[**assignment**: combining operation]*] [**selection**: *output from TSF entropy source(s)*, *input from TSF interface(s) for obtaining entropy*] resulting in a minimum of [**assignment**: *number of bits*] bits of min-entropy to create the entropy input into the derivation function as defined in [**selection**: *ISO/IEC 18031:2011*, *NIST SP 800-90A Revision 1*]

Application Note: From catalog One can apply NIST SP 800-90B (or AIS-31) statistical tests against internal noise sources (a.k.a. raw entropy) to confirm the min-entropy of the noise sources either in aggregate or individually. One should not apply NIST SP 800-90B (or AIS-31) statistical tests against external noise sources since the TOE is unable to enforce entropy requirements or conditioning requirements against external sources of entropy. However, the TSS may include estimates for min-entropy from external sources that contribute to the overall

entropy requirements for either the DRBG or for FCS_OTV_EXT.1.

FCS_RBG.5 specifies the combining operation such that the combined min-entropy of all the internal sources and the estimated entropy of the external sources is greater than or equal to the desired entropy of the output of the combining operation. The output could be used as a nonce or a seed for a DRBG. The combining operation should avoid crushing the entropy of the sources such that the desired entropy of the output cannot be met.

The TSF interface(s) for seeding here is the interface used to gather entropy for initializing the seed.

Evaluation Activities

FCS_RBG.5
Using the entropy sources specified in FCS_RBG.4, the evaluator shall examine the entropy documentation required by FCS_RBG.1.2 to verify that it describes the method by which the various entropy sources are combined into a single seed. This should include an estimation of the rate at which each noise source outputs data and whether this is dependent on any system-specific factors so that each source's relative contribution to the overall entropy is understood. The evaluator shall verify that the resulting combination of sampled data and the min-entropy rate of the sampled data is described in sufficient detail to determine that sufficient entropy can be made available for the highest strength keys that the TSF can generate (e.g., 256 bits). If the seed data cannot be assumed to have full entropy (e.g., the min-entropy of the sampled bits is less than 1), the evaluator shall ensure that the entropy documentation describes the method by which the TOE estimates the amount of entropy that has been accumulated to ensure that sufficient data is collected and any conditioning that the TSF applies to the output data to create a seed of sufficient size with full entropy.

FCS_RBG.6 Random Bit Generation (Combining Entropy Sources)

FCS_RBG.6.1

The TSF shall provide a [**selection**: *hardware*, *software*, *[**assignment**: other interface type]*] interface to make the DRBG output, as specified in FCS_RBG.1 Random Bit Generation (RBG), available as a service to entities outside of the TOE.

Evaluation Activities

FCS_RBG.6
TBD

FCS_SLT_EXT.1 Cryptographic Salt Generation

This is an optional component. However, applied modules or packages might redefine it as mandatory.

FCS_SLT_EXT.1.1

The TSF shall use salts and nonces generated by an RBG as specified in FCS_RBG.1.

Application Note: This SFR must be included in the ST if it is a service provided by the TOE to tenant software, or if it is used by the TOE itself to support or implement PP-specified security functionality.

Evaluation Activities

FCS_SLT_EXT.1
TSS
The evaluator shall ensure the TSS describes how salts are generated using the RBG.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
The evaluator shall confirm by testing that the salts obtained in the cryptographic operations

that use the salts are of the length specified in FCS_SLT_EXT.1, are obtained from the RBG, and are fresh on each invocation.

This testing may be carried out as part of the testing for the relevant cryptographic operations.

FCS_STG_EXT.1 Protected Storage

This is an optional component. However, applied modules or packages might redefine it as mandatory.

FCS_STG_EXT.1.1

The TSF shall provide [**selection**: *mutable hardware-based*, *immutable hardware-based*, *software-based*] protected storage for asymmetric private keys and [**selection**: *symmetric keys*, *persistent secrets*, *no other keys*].

Application Note: This SFR should be included in the ST if the TOE provides protected storage as a service for tenant software, or if it stores keys or other persistent secrets for its own use.

This SFR must be claimed if the TOE includes a Dedicated Security Component that provides storage services, such as a TPM.

If the protected storage is implemented in software that is protected as required by FCS_STG_EXT.2, the ST Author is expected to select "*software-based*." If "*software-based*" is selected, the ST Author is expected to select "*software-based key storage*" in FCS_STG_EXT.2 and also claim FCS_STG_EXT.3.

If this SFR is included in the ST, then FCS_CKM.6 must also be claimed.

FCS_STG_EXT.1.2

The TSF shall support the capability of [**selection**:

- *importing keys/secrets into the TOE*
- *causing the TOE to generate [**selection**: asymmetric, symmetric]keys/secrets*

] upon request of [**selection**: *a client application*, *an administrator*].

Application Note: If "causing the TOE to generate keys/secrets" is selected in FCS_STG_EXT.1.2, then the ST must include at least one of FCS_CKM.1/AKG or FCS_CKM.1/SKG depending on the value of the internal selection.

FCS_STG_EXT.1.3

The TSF shall be capable of destroying keys/secrets in the protected storage upon request of [**selection**: *a client application*, *an administrator*].

Evaluation Activities

FCS_STG_EXT.1
TSS
The evaluator shall review the TSS to determine that the TOE implements the required protected storage. The evaluator shall ensure that the TSS contains a description of the protected storage mechanism that justifies the selection of mutable hardware-based or software-based.

Guidance
The evaluator shall examine the AGD to ensure that it describes the process for generating keys, importing keys, or both, based on what is claimed by the ST. The evaluator shall also examine the AGD to ensure that it describes the process for destroying keys that have been imported or generated.

Tests
The evaluator shall test the functionality of each security function as described below. If the TOE supports both import and generation of keys, the evaluator shall repeat the testing as needed to demonstrate that the keys resulting from both operations are treated in the same manner. The devices used with the tooling may need to be non-production devices in order to enable the execution of testing and gathering of evidence.

- *Test FCS_STG_EXT.1:1: The evaluator shall import or generate keys/secrets of each supported type according to the operational guidance. The evaluator shall write, or the developer shall provide access to, an application that generates a key/secret of each supported type and calls the import functions. The evaluator shall verify that no errors occur during import.*

- *Test FCS_STG_EXT.1:2: The evaluator shall write, or the developer shall provide access to, tenant software that uses a generated or imported key/secret:*
  - *For RSA, the secret shall be used to sign data.*
  - *For ECDSA, the secret shall be used to sign data.*

  The evaluator shall verify that the tenant software is able to access and use the key/secret as described.
- *Test FCS_STG_EXT.1:3: The evaluator shall destroy keys/secrets of each supported type according to the operational guidance. The evaluator shall write, or the developer shall provide access to, tenant software that destroys an imported or generated key/secret. The evaluator shall verify that the tenant software is able to cause the deletion of only keys that were created or imported on its behalf.*

FCS_STG_EXT.2 Key Storage Encryption

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.1.1.

FCS_STG_EXT.2.1

The TSF shall encrypt [*AKs, SKs, KEKs, and [**selection**: long-term trusted channel key material, all software-based key storage, no other keys]*] using [**selection**: *AES-CCM*, *AES-GCM*, *AES-KW*, *AES-KWP*].

Application Note: This SFR is included in the ST if "software-based" is selected in FCS_STG_EXT.1.

Evaluation Activities

FCS_STG_EXT.2
TSS
The evaluator shall review the TSS to determine that the TSS describes the protection of symmetric keys, KEKs, long-term trusted channel key material, and software-based key storage as claimed in FCS_STG_EXT.2.1.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
There are no test activities for this component.

FCS_STG_EXT.3 Key Integrity Protection

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.1.1.

FCS_STG_EXT.3.1

The TSF shall protect the integrity of any encrypted [*AKs, SKs, KEKs, and [**selection**: long-term trusted channel key material, all software-based key storage, no other keys]*] by using [**selection**:

- *Symmetric encryption in [**selection**: AES_CCM, AES_GCM, AES_KW, AES_KWP] mode in accordance with FCS_COP.1/SKC*
- *A keyed hash of the stored key in accordance with FCS_COP.1/KeyedHash*
- *A digital signature of the stored key in accordance with FCS_COP.1/SigGen using an asymmetric key that is protected in accordance with FCS_STG_EXT.2*
- *An immediate application of the key for decrypting the protected data followed by a successful verification of the decrypted data with previously known information*

].

Application Note: This SFR is included in the ST if "software-based" is selected in FCS_STG_EXT.1.

FCS_STG_EXT.3.2

The TSF shall verify the integrity of the [**selection**: *digital signature*, *MAC*] of the stored key prior to use of the key.

Application Note: This requirement is not applicable to derived keys that are

not stored. It is not expected that a single key will be protected from corruption by multiple of these methods; however, a product may use one integrity-protection method for one type of key and a different method for other types of keys.

Evaluation Activities

FCS_STG_EXT.3
TSS
The evaluator shall examine the TSS and ensure that it contains a description of how the TOE protects the integrity of its keys.

Guidance
There are no additional Guidance evaluation activities for this component.

KMD
The documentation of the product's encryption key management should be detailed enough that, after reading, the evaluator will thoroughly understand the product's key management and how it meets the requirements to ensure the keys are adequately protected. This documentation should include an essay and diagrams. This documentation may be marked as developer proprietary.

Tests
There are no test activities for this component.

5.1.4 Class: User Data Protection (FDP)

FDP_ITC_EXT.1 Key/Credential Import

This is a selection-based component. Its inclusion depends upon selection from FCS_STG_EXT.1.2.

FDP_ITC_EXT.1.1

The TSF shall support importing keys/key material using [**selection**: *physically protected channels as specified in FTP_ITP_EXT.1, encrypted data buffers as specified in FTP_ITE_EXT.1, cryptographically protected data channels as specified in FTP_ITC_EXT.1*].

FDP_ITC_EXT.1.2

The TSF shall verify the integrity of imported keys/key material using [**selection**:

- *cryptographic hash as specified in FCS_COP.1/Hash*
- *keyed hash as specified in FCS_COP.1/KeyedHash*
- *integrity-providing encryption algorithm as specified in FCS_COP.1/SKC [**selection**: AES-CCM, AES-GCM, AES-KW, AES-KWP]*
- *digital signature as specified in FCS_COP.1/SigVer*
- *integrity verification supported by FTP_ITC_EXT.1*

].

Application Note: This SFR is included in the ST when "*importing keys/secrets into the TOE*" is selected in FCS_STG_EXT.1.

The way the TSF checks the integrity of the keys depends on the method of importation. For example, the encrypted data channel may provide data integrity as part of its service.

Evaluation Activities

FDP_ITC_EXT.1
TSS
The evaluator shall confirm the TSS contains descriptions of the supported methods the TSF uses to import keys and key material into the TOE. For each import method selected, the TSS shall describe integrity verification schemes employed.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
For each supported import method selected in FDP_ITC_EXT.1.1 and for each supported

integrity verification method selected in FDP_ITC_EXT.1.2. used by the selected import method, provide one key/credential with valid integrity credentials, one with invalid integrity credentials (e.g. hash). The operations with invalid integrity credentials must result in error. The operations with valid integrity credentials must accept the keys/credentials.

FDP_TEE_EXT.1 Trusted Execution Environment for Tenant Software

This is an optional component. However, applied modules or packages might redefine it as mandatory.

FDP_TEE_EXT.1.1

The TSF shall implement a trusted execution environment that conforms to the following standard: [*Advanced Trusted Environment: OMTP TR1 v1.1*] and make this TEE available to tenant software.

Application Note: This SFR should be claimed in the ST if the TOE includes a trusted execution environment for the use of tenant software.

Evaluation Activities

FDP_TEE_EXT.1
TSS
The evaluator shall examine the TSS to ensure that it describes the protections provided by the TOE's TEE implementation.

Guidance
The evaluator shall examine the AGD to ensure that it describes the steps required for tenant software to invoke the TEE.

Tests
There are no test activities for this component.

5.1.5 Class: Identification and Authentication (FIA)

FIA_AFL_EXT.1 Authentication Failure Handling

This is a selection-based component. Its inclusion depends upon selection from FMT_SMR.1.1.

FIA_AFL_EXT.1.1

The TSF shall consider password and [*no other*] as critical authentication mechanisms.

Application Note: This SFR is included in the ST if the "*Administrator*" role is selected in FMT_SMR.1, or if the "*Server-Class Platform, Basic*" or "*Server-Class Platform, Enhanced*" use cases are selected.

If this SFR is included in the ST, then FCS_CKM.6 must also be claimed.

This SFR specifies the actions to be taken in the event of multiple authentication failures.

This requirement applies to both critical and non-critical authentication mechanisms. The difference between the two is that excessive authentication failures of critical authentication mechanisms result in the wiping of all protected data (see FIA_AFL_EXT.1.5.). If the TOE implements multiple Authentication Factor interfaces (for example, a DAR decryption interface, a lockscreen interface, an auxiliary boot mode interface), this element applies to all available interfaces. For example, a password is a critical authentication mechanism regardless of if it is being entered at the DAR decryption interface or at a lockscreen interface.

FIA_AFL_EXT.1.2

The TSF shall detect when a configurable positive integer within [**assignment**: *range of acceptable values for each authentication mechanism*] of [**selection, choose one of**: *unique, non-unique*] unsuccessful authentication attempts occur related to last successful authentication for each authentication mechanism.

Application Note: The positive integer is configured according to Table 20 in FMT_SMF.1.1.

An unique authentication attempt is defined as any attempt to verify an authentication attempt in which the input is different from a previous attempt. "Unique" must be selected if the authentication system increments the counter only for unique unsuccessful authentication attempts. For example, if the same incorrect password is attempted twice the authentication system increments the counter once. "Non-unique" must be selected if the authentication system increments the counter for each unsuccessful authentication attempt, regardless of whether the input is unique. For example, if the same incorrect password is attempted twice the authentication system increments the counter twice.

If the TOE supports multiple authentication mechanisms per FIA_UAU.5.1, this element applies to all authentication mechanisms. It is acceptable for each authentication mechanism to utilize an independent counter or for multiple authentication mechanisms to utilize a shared counter. The interaction between the authentication factors with regard to the authentication counter must be in accordance with FIA_UAU.5.2.

If the TOE implements multiple Authentication Factor interfaces (for example, a DAR decryption interface, a lockscreen interface, an auxiliary boot mode interface), this element applies to all available interfaces. However, it is acceptable for each Authentication Factor interface to be configurable with a different number of unsuccessful authentication attempts.

FIA_AFL_EXT.1.3

The TSF shall maintain the number of unsuccessful authentication attempts that have occurred upon power off.

Application Note: The TOE may implement an Authentication Factor interface that precedes another Authentication Factor interface in the boot sequence (for example, a volume DAR decryption interface which precedes the lockscreen interface) before the user can access the GPCP. In this situation, because the user must successfully authenticate to the first interface to access the second, the number of unsuccessful authentication attempts need not be maintained for the second interface.

FIA_AFL_EXT.1.4

When the defined number of unsuccessful authentication attempts has exceeded the maximum allowed for a given authentication mechanism, all future authentication attempts shall be limited to other available authentication mechanisms, unless the given mechanism is designated as a critical authentication mechanism.

Application Note: See FIA_AFL_EXT.1.5 for exceeding the maximum failure threshold for critical authentication mechanisms.

In accordance with FIA_AFL_EXT.1.3, this requirement also applies after the TOE is powered off and powered back on.

FIA_AFL_EXT.1.5

When the defined number of unsuccessful authentication attempts for the last available authentication mechanism or a critical authentication mechanism has been surpassed, the TSF shall [**selection**:

- *perform a wipe of all protected data*
- *exclude the current User/Administrator from further authentication attempts*
- *exclude the current User/Administrator from further authentication attempts for a period of [**assignment**: greater than zero seconds] time*

].

Application Note: Wipe is performed in accordance with FCS_CKM.6. Protected data is all non-TSF data, including all user or enterprise data. Some or all of this data may be considered sensitive data as well.

If the TOE implements multiple Authentication Factor interfaces (for example, a DAR decryption interface, a lockscreen interface, an auxiliary boot mode interface), this element applies to all available interfaces.

FIA_AFL_EXT.1.6

The TSF shall increment the number of unsuccessful authentication attempts prior to notifying the user that the authentication was unsuccessful.

Application Note: This requirement is to ensure that if power is cut to the device directly after an authentication attempt, the counter will be incremented to reflect that attempt.

Evaluation Activities

FIA_AFL_EXT.1

TSS

The evaluator shall ensure that the TSS describes that a value corresponding to the number of unsuccessful authentication attempts since the last successful authentication is kept for each Authentication Factor interface. The evaluator shall ensure that this description also includes if and how this value is maintained when the TOE loses power, either through a graceful powered off or an ungraceful loss of power. The evaluator shall ensure that if the value is not maintained, the interface is after another interface in the boot sequence for which the value is maintained.

If the TOE supports multiple authentication mechanisms, the evaluator shall ensure that this description also includes how the unsuccessful authentication attempts for each mechanism selected in FIA_UAU.5.1 is handled. The evaluator shall verify that the TSS describes if each authentication mechanism utilizes its own counter or if multiple authentication mechanisms utilize a shared counter. If multiple authentication mechanisms utilize a shared counter, the evaluator shall verify that the TSS describes this interaction.

The evaluator shall confirm that the TSS describes how the process used to determine if the authentication attempt was successful. The evaluator shall ensure that the counter would be updated even if power to the device is cut immediately following notifying the TOE user if the authentication attempt was successful or not.

Guidance

The evaluator shall verify that the AGD describes how the Administrator configures the maximum number of unique unsuccessful authentication attempts, and the lockout time period, if applicable.

The evaluator shall verify that the AGD describes how an Administrator may recover from authentication failure when another Administrator is locked out.

Tests

The evaluator shall configure the device with all authentication mechanisms selected in FIA_UAU.5.1, and configure a maximum number of unsuccessful authentication attempts for each mechanism.

- *Test FIA_AFL_EXT.1:1: The evaluator shall for each authentication mechanism make unsuccessful authentication attempts until the maximum is exceeded and verify that the number of failures corresponds to the configured maximum and that no further authentication attempts can be made using that mechanism.*
- *Test FIA_AFL_EXT.1:2: [conditional] If the mechanism is critical or if all authentication mechanisms are exhausted, then if "perform a wipe of all protected data" is selected in FIA_AFL_EXT.1.5 the evaluator shall verify that the wipe is implemented.*
- *Test FIA_AFL_EXT.1:3: [conditional] If the mechanism is critical or if all authentication mechanisms are exhausted, then if "exclude the current User/Administrator from further authentication attempts" is selected in FIA_AFL_EXT.1.5 the evaluator shall verify that the User/Administrator can make no further authentication attempts.*
- *Test FIA_AFL_EXT.1:4: [conditional] If the mechanism is critical or if all authentication mechanisms are exhausted, then if "exclude the current User/Administrator from further authentication attempts for a period of [assignment: greater than zero seconds] time" is selected in FIA_AFL_EXT.1.5 the evaluator shall verify that the User/Administrator can make no further authentication attempts until the specified time period has expired.*

FIA_PMG_EXT.1 Password Management

This is a selection-based component. Its inclusion depends upon selection from FMT_SMR.1.1.

FIA_PMG_EXT.1.1

The TSF shall support the following for the Password Authentication Factor:

1. Passwords shall be able to be composed of any combination of [**selection**: *upper and lower case letters, [**assignment**: a character set of at least 52 characters]*], numbers, and special characters: [**selection**: "*!*", "@", "#", "*$*", "*%*", "^", "&", "*", "*(*", "*)*", [***assignment**: other characters]*]
2. Password length up to [**assignment**: *an integer greater than or equal to 14*] characters shall be supported.

Application Note: This SFR is included in the ST if the "*Administrator*" role is selected in FMT_SMR.1, or if the "*Server-Class Platform, Basic*" or "*Server-Class Platform, Enhanced*" use cases are selected.

While some corporate policies require passwords of 14 characters or better, the use of a Root Encryption Key for DAR protection and key storage protection and the anti-hammer requirement (FIA_TRT_EXT.1) addresses the threat of attackers with physical access using much smaller and less complex passwords.

The ST Author selects the character set: either the upper and lower case Basic Latin letters or another assigned character set containing at least 52 characters. The assigned character set must be well defined: either according to an international encoding standard (such as Unicode) or defined in the assignment by the ST Author. The ST Author also selects the special characters that are supported by TOE; they may optionally list additional special characters supported using the assignment.

Evaluation Activities

FIA_PMG_EXT.1
TSS
There are no additional TSS evaluation activities for this component.

Guidance
The evaluator shall examine the AGD to determine that it provides guidance to security administrators on the composition of strong passwords, and that it provides instructions on setting the minimum password length. The evaluator shall also perform the following tests. Note that one or more of these tests can be performed with a single test case.

Tests
The evaluator shall perform the following test:

The evaluator shall compose passwords that either meet the requirements, or fail to meet the requirements, in some way. For each password, the evaluator shall verify that the TOE supports the password. While the evaluator is not required (nor is it feasible) to test all possible compositions of passwords, the evaluator shall ensure that all characters, rule characteristics, and a minimum length listed in the requirement are supported, and justify the subset of those characters chosen for testing.

FIA_TRT_EXT.1 Authentication Throttling

This is an optional component. However, applied modules or packages might redefine it as mandatory.

FIA_TRT_EXT.1.1

The TSF shall limit user authentication attempts by [**selection**: *preventing authentication via an external port, enforcing a delay between incorrect authentication attempts*] for all authentication mechanisms selected in FIA_UAU.5.1.

FIA_TRT_EXT.1.2

The minimum delay between incorrect authentication attempts shall be such that no more than 10 attempts can be attempted per 500 milliseconds.

Application Note: This SFR should be included in the ST if the TOE implements a mechanism for limiting the number or frequency of Administrator authentication attempts.

The authentication throttling applies to all authentication mechanisms selected in FIA_UAU.5.1. The user authentication attempts in this requirement are attempts to guess the Authentication Factor. The developer can implement the timing of the delays in the requirements using unequal or equal timing of delays. The minimum delay specified in this requirement provides defense against brute forcing.

Evaluation Activities

FIA_TRT_EXT.1
TSS
The evaluator shall verify that the TSS describes the method by which authentication attempts are not able to be automated. The evaluator shall ensure that the TSS describes either how the TSF disables authentication via external interfaces (other than the ordinary user interface) or how authentication attempts are delayed in order to slow automated entry and shall ensure that no more than 10 attempts can be attempted per 500 milliseconds for all authentication

mechanisms selected in FIA_UAU.5.1.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
There are no test activities for this component.

FIA_UAU.5 Multiple Authentication Mechanisms

This is a selection-based component. Its inclusion depends upon selection from FMT_SMR.1.1.

FIA_UAU.5.1

The TSF shall provide [*password and [**selection**: X.509 certificate-based authentication, SSH-based authentication, biometric authentication, hybrid authentication, no other authentication mechanism]*] to support user authentication.

Application Note: This SFR is included in the ST if the "*Administrator*" role is selected in FMT_SMR.1, or if the "*Server-Class Platform, Basic*" or "*Server-Class Platform, Enhanced*" use cases are selected.

A "user" in the context of this SFR is an Administrator.

The TSF must support a Password Authentication Factor and may optionally implement a biometric authentication factor. A hybrid authentication factor is where a user has to submit a combination of PIN/password and biometric sample where both have to pass and if either fails the user is not made aware of which factor failed.

The Password Authentication Factor is configured according to FIA_PMG_EXT.1. If "hybrid" is selected, a biometric modality does not need to be selected, but should be selected if the biometric authentication can be used independent of the hybrid authentication, i.e. without having to enter a PIN/password.

If "*X.509 certificate-based authentication*" is selected, then the ST must include FIA_X509_EXT.1 and FIA_X509_EXT.2 from , version .

The ST Author should select "*SSH-based authentication*" if the TOE supports SSH-based authentication, whether public key-, password-, or certificate-based. In this case, the ST claims the Functional Package for Secure Shell (SSH), version 2.0.

FIA_UAU.5.2

The TSF shall authenticate any user's claimed identity according to the [**assignment**: *rules describing how the multiple authentication mechanisms provide authentication*].

Application Note: Rules regarding how the authentication factors interact in terms of unsuccessful authentication are covered in FIA_AFL_EXT.1.

Evaluation Activities

FIA_UAU.5
TSS
The evaluator shall ensure that the TSS describes each mechanism provided to support user authentication and the rules describing how the authentication mechanism(s) provide authentication.

Specifically, for all authentication mechanisms specified in FIA_UAU.5.1, the evaluator shall ensure that the TSS describes the rules as to how each authentication mechanism is used. Example rules are how the authentication mechanism authenticates the user (i.e. how does the TSF verify that the correct password or biometric sample was entered), the result of a successful authentication (i.e. is the user input used to derive or unlock a key) and which authentication mechanism can be used at which authentication factor interfaces (i.e. if there are times, for example, after a reboot, that only specific authentication mechanisms can be used). If multiple Biometric Authentication Factors (BAF) are supported per FIA_UAU.5.1, the interaction between the BAFs must be described. For example, whether the multiple BAFs can be enabled at the same time.

Guidance

The evaluator shall verify that configuration information for each authentication mechanism is addressed in the AGD guidance.

Tests
The evaluator shall perform the following tests:

- *Test FIA_UAU.5:1: For each authentication mechanism selected in FIA_UAU.5.1, the evaluator shall enable that mechanism and verify that it can be used to authenticate the user at the specified authentication factor interfaces.*
- *Test FIA_UAU.5:2: For each authentication mechanism rule, the evaluator shall ensure that the authentication mechanism behaves accordingly.*

FIA_UAU.7 Protected Authentication Feedback

This is a selection-based component. Its inclusion depends upon selection from FMT_SMR.1.1.

FIA_UAU.7.1

The TSF shall provide only [*obscured feedback*] to the user while the authentication is in progress.

Application Note: This SFR is included in the ST if the "*Administrator*" role is selected in FMT_SMR.1, or if the "*Server-Class Platform, Basic*" or "*Server-Class Platform, Enhanced*" use cases are selected.

This requirement applies to all authentication mechanisms specified in FIA_UAU.5.1 that provide feedback to a user or Administrator during authentication.

For authentication mechanisms that require the user or Administrator to enter a password or PIN, the TSF may briefly (1 second or less) display each character or provide an option to allow the user to unmask the user input; however, the user input must be obscured by default.

If a BAF is selected in FIA_UAU.5.1, the TSF must not display sensitive information regarding the biometric that could aid an adversary in identifying or spoofing the respective biometric characteristics of a given human user. While it is true that biometric samples, by themselves, are not secret, the analysis performed by the respective biometric algorithms, as well as output data from these biometric algorithms, is considered sensitive and must be kept secret. Where applicable, the TSF must not reveal or make public the reasons for authentication failure.

In the cases of SSH- or X.509-based authentication, the TSF must likewise not not display sensitive information regarding the authentication factors that could aid an adversary in spoofing or circumventing the authentication protocols.

Evaluation Activities

FIA_UAU.7
TSS
The evaluator shall ensure that the TSS describes the means of obscuring the authentication information for all authentication methods specified in FIA_UAU.5.1.

Guidance
The evaluator shall verify that any configuration of this requirement is addressed in the AGD guidance and that user authentication input is obscured by default.

Tests
The evaluator shall perform the following tests:

- *Test FIA_UAU.7:1: The evaluator shall enter passwords on the device, including at least the Password Authentication Factor at lockscreen, and verify that the password is not displayed on the device.*
- *Test FIA_UAU.7:2: [conditional] For each Biometric Authentication Factor (BAF) selected in FIA_UAU.5.1, the evaluator shall authenticate by producing a biometric sample at lockscreen. As the biometric algorithms are performed, the evaluator shall verify that sensitive images, audio, or other information identifying the user are kept secret and are not revealed to the user. Additionally, the evaluator shall produce a biometric sample that fails to authenticate and verify that the reason(s) for authentication failure (user mismatch, low sample quality, etc.) are not revealed to the user. It is acceptable for the BAF to state*

that it was unable to physically read the biometric sample, for example, if the sensor is unclean or the biometric sample was removed too quickly. However, specifics regarding why the presented biometric sample failed authentication shall not be revealed to the user. [conditional] For each SSH- or X.509-based authentication mechanism, the evaluator shall examine whether the TSF displays sensitive information during the authentication process for both successful and failed authentication attempts.

FIA_UIA_EXT.1 Administrator Identification and Authentication

This is a selection-based component. Its inclusion depends upon selection from FMT_SMR.1.1.

FIA_UIA_EXT.1.1

The TSF shall require Administrators to be successfully identified and authenticated using one of the methods in FIA_UAU.5 before allowing any TSF-mediated management function to be performed by that Administrator.

Application Note: This SFR is included in the ST if the "*Administrator*" role is selected in FMT_SMR.1, or if the "*Server-Class Platform, Basic*" or "*Server-Class Platform, Enhanced*" use cases are selected.

Ordinary unprivileged users of the platform need not authenticate to the platform, though they may well have to authenticate themselves to tenant software such as an Operating System.

The TSF-mediated management functions are listed in the management functions table (Table 20) in FMT_SMF.1.

Evaluation Activities

FIA_UIA_EXT.1
TSS
The evaluator shall examine the TSS to determine that it describes the logon process for each logon method (local, remote (HTTPS, SSH, etc.)) supported for the platform. This description shall contain information pertaining to the credentials allowed/used, any protocol transactions that take place, and what constitutes a "successful logon."

Guidance
The evaluator shall examine the AGD to determine that any necessary preparatory steps (e.g., establishing credential material such as pre-shared keys, tunnels, certificates) to logging in are described. For each supported login method, the evaluator shall ensure the AGD provides clear instructions for successfully logging on. If configuration is necessary to ensure the services provided before login are limited, the evaluator shall determine that the AGD provides sufficient instruction on limiting the allowed services.

Tests
There are no test activities for this component.

5.1.6 Class: Security Management (FMT)

FMT_CFG_EXT.1 Secure by Default Configuration

FMT_CFG_EXT.1.1

The TSF shall enforce that Administrator credentials be changed immediately after first use when configured with default Administrator credentials or with no Administrator credentials.

Application Note: Default credentials are credentials (e.g., passwords, keys) that are pre-installed (without user interaction) onto the platform, generally by the manufacturer, whether they are default values or randomly generated. This requirement applies only to credentials used by an Administrator for logging in to the TOE, and not to other platform credentials that might come pre-installed.

Evaluation Activities

FMT_CFG_EXT.1
TSS

The evaluator shall check the TSS to determine whether the platform comes pre-installed with default Administrator credentials, or does not require credentials for initial Administrator access.

Guidance
The evaluator shall examine the AGD to ensure that it describes the process for replacing or specifying Administrator credentials on first use.

Tests
If the platform uses default Administrator credentials or no Administrator credentials on first use the evaluator shall run the following tests:

- *Test FMT_CFG_EXT.1:1: The evaluator shall reset the platform to factory state and restart the platform to verify that only the functionality required to set new Administrator credentials is available immediately after Administrator login.*
- *Test FMT_CFG_EXT.1:2: The evaluator shall log in to the platform as Administrator using the default credentials, establish new credentials, and verify that the original default credentials no longer provide Administrative access to the platform.*

FMT_MOF.1 Management of Security Functions Behavior

FMT_MOF.1.1

The TSF shall restrict the ability to [*determine the behaviour of*] the functions [*listed in Table 20*] to [*the roles indicated in Table 20*].

Application Note: There are two roles defined in this PP: Administrator and User (see FIA_SMR.1). Administrators can perform most management functions on the platform, and only Administrators are required to authenticate themselves to the platform.

Users have a limited ability to select responses to certain events as specified in the Management Functions table in FMT_SMF.1.

Evaluation Activities

FMT_MOF.1
TSS
The evaluator shall verify that the TSS describes those management functions that may be performed by the Administrator, and those that can be performed by ordinary users. The TSS also describes any functionality that is affected by administrator-configured policy and how. This activity will be performed in conjunction with FMT_SMF.1.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
Testing of this SFR is covered in the tests for FMT_SMF.1.

FMT_SMF.1 Specification of Management Functions

FMT_SMF.1.1

The TSF shall be capable of performing the following management functions: [

Table 20: Management Functions

Status Markers:
M - Mandatory
O - Optional/Selectable/Conditional
X - Not permitted

#	Management Function	Admin	User	Application Notes
1	Ability to administer the platform [**selection**: *locally, remotely, not at all*]	M	X	Administration is considered “local” if the Administrator is physically present at the GPCP. Administration is considered “remote” if communications between the Administrator and GPCP is over a network.

				"*Not at all*" is the proper selection for Function 1 only in the case where the GPCP is incapable of being Administered at all. If "*remotely*" is selected, then FTP_TRP.1 must be claimed in the ST and Function 5 must be selected.
2	Ability to configure and manage the audit functionality and audit data.	O	X	This Function must be claimed if FAU_GEN.1 is claimed in the ST.
3	Ability to configure name/address of audit/logging server to which to send audit/logging records.	O	X	This function must be claimed if FAU_STG.1 is claimed in the ST.
4	Ability to review audit records.	O	X	This Function must be claimed if FAU_SAR.1 is claimed in the ST.
5	Ability to initiate a trusted channel for remote administration.	O	X	This Function must be claimed if FTP_TRP.1 is claimed in the ST.
6	Ability to set parameters for allowable number of authentication failures.	O	X	This Function must be claimed if FIA_AFL_EXT.1 is claimed in the ST.
7	Ability to configure password length and complexity.	O	X	This Function must be claimed if FIA_PMG_EXT.1 is claimed in the ST. If password length and complexity are not configurable, then the Administrator Option should be denied.
8	Ability to configure authentication throttling policy.	O	X	This Function must be claimed if FIA_TRT_EXT.1 is claimed in the ST. If authentication throttling policy is not configurable, then the Administrator Option should be denied.
9	Ability to manage authentication methods and change default authorization factors.	O	X	This Function must be claimed if FIA_UAU.5 is claimed in the ST. If authentication methods are not configurable, then the Administrator Option should be denied.
10	Ability to configure of certificate revocation checking methods.	O	X	This function must be claimed if FIA_X509_EXT.1 is claimed in the ST (i.e., the TOE claims conformance to , version . If TOE does not support configuration of certificate revocation checking methods, then the Administrator option should be denied.

11	Ability to configure TSF behavior when certificate revocation status cannot be determined.	O	X	This function must be claimed if FIA_X509_EXT.2 is claimed in the ST (i.e., the TOE claims conformance to , version . and the claims made in the SFR indicate that the administrator is allowed to configure how the TSF treats a certificate with undetermined revocation status.
12	Ability to configure default action to take on integrity failure.	O	X	This Function must be claimed if FPT_ROT_EXT.2 or FPT_ROT_EXT.3 are claimed in the ST and "*in accordance with Administrator-configurable policy*" is selected in FPT_ROT_EXT.2.2 or FPT_ROT_EXT.3.2.
13	Ability to configure default action to take on update failure.	O	X	This Function must be claimed if FPT_TUD_EXT.2 or FPT_TUD_EXT.3 is claimed in the ST and "*in accordance with Administrator-configurable policy*" is selected in FPT_TUD_EXT.2.5 or FPT_TUD_EXT.3.4.
14	Ability to initiate the update process.	O	X	This Function must be claimed if something other than "*no mechanism for platform firmware update*" is selected in FPT_TUD_EXT.1.1.
15	Ability to determine the action to take on update failure.	O	O	This Function must be claimed if FPT_TUD_EXT.2 or FPT_TUD_EXT.3 are claimed in the ST. The Administrator Option must be selected if "*by express determination of an [Administrator]*" is selected in FPT_TUD_EXT.2.5 or FPT_TUD_EXT.3.4. The User Option must be selected if "*by express determination of an [User]*" is selected in FPT_TUD_EXT.2.5 or FPT_TUD_EXT.3.4.
16	Ability to determine the action to take on integrity check failure.	O	O	This Function must be claimed if FPT_ROT_EXT.2 or FPT_ROT_EXT.3 is claimed in the ST. The Administrator Option must be selected if "*by express determination of an [Administrator]*" is selected in FPT_ROT_EXT.2.2 or FPT_ROT_EXT.3.2. The User Option must be selected if "*by express determination of an [User]*" is selected in FPT_ROT_EXT.2.2 or FPT_ROT_EXT.3.2.
17	Ability to manage import and export of keys/secrets to and from protected storage.	O	X	This Function must be claimed if FCS_STG_EXT.1 is claimed in the ST.

Application Note: These functions become Mandatory or Selectable as indicated in the Notes. If "*not at all*" is selected in Function 1, then no other management Management Functions may be selected.

Evaluation Activities

FMT_SMF.1
TSS
The evaluator shall examine the TSS to ensure that it describes each management function and its associated actions.

Guidance
The evaluator shall examine the AGD to ensure that it describes how the Administrator performs each management function that the ST claims the TOE supports.

The evaluator shall verify for each claimed management function that the guidance is sufficiently detailed to allow the function to be performed.

Tests
The evaluator shall test each management function included in the ST to demonstrate that the function can be performed only by the roles indicated in Table 20 and the result of the function is demonstrated.

FMT_SMR.1 Security Roles

FMT_SMR.1.1

The TSF shall maintain the roles [*User* and [**selection**: *Administrator, no other roles*]].

FMT_SMR.1.2

The TSF shall be able to associate users with roles.

Application Note: If "*Administrator*" is selected, then the user authentication SFRs in FIA must be claimed.

A User is a human who interacts with the GPCP through a user interface. Users do not authenticate themselves to the GPCP, though they may be authenticated by tenant software. The User role is considered to exist even if no humans normally interact with a GPCP.

An Administrator is a privileged user that must be authenticated by the GPCP in order to administer the GPCP. This role is distinct from OS or VS administrators, who are may are authenticated to tenant software and are considered to be Users in the context of the GPCP.

Evaluation Activities

FMT_SMR.1
Documentation and testing for roles is covered in the Evaluation Activities for FMT_SMF.1

5.1.7 Class: Protection of the TSF (FPT)

FPT_FLS.1 Failure with Preservation of Secure State

This is a selection-based component. Its inclusion depends upon selection from FCS_CKM_EXT.5.1.
This component may also be included in the ST as if optional.

FPT_FLS.1.1

The TSF shall preserve a secure state when the following types of failures occur: [*DRBG self-test failure*].

Application Note: The intent of this requirement is to ensure that cryptographic services requiring random bit generation cannot be performed if a failure of a self-test defined in FPT_TST.1 occurs.

Evaluation Activities

FPT_FLS.1
TSS

The evaluator shall verify that the TSF describes how the TOE enters an error state in the event of a DRBG self-test failure.

Guidance
The evaluator shall verify that the guidance documentation describes the error state that results from a DRBG self-test failure and the actions that a user or administrator should take in response to attempt to resolve the error state.

Tests
There are no test activities for this component.

FPT_JTA_EXT.1 JTAG/Debug Port Access

FPT_JTA_EXT.1.1

The TSF shall allow access to JTAG or other debug ports only to an authorized Administrator through platform firmware or through assertion of physical presence.

Application Note: This requirement means that JTAG ports may not be accessible to tenant software.

For use cases that include the threat T.PHYSICAL, FPT_JTA_EXT.2 should also be included in the ST.

Evaluation Activities

FPT_JTA_EXT.1
TSS
The evaluator shall examine the TSS to determine how access to the JTAG or debug ports is denied to tenant software.

Guidance
The evaluator shall examine the AGD to ensure that it describes how Administrators assert physical presence to the TSF.

Tests
The evaluator shall perform the following tests:

- *Test FPT_JTA_EXT.1:1: The evaluator shall attempt to access the debug port without authenticating as an Administrator. The attempt should fail.*
- *Test FPT_JTA_EXT.1:2: The evaluator shall authenticate as an Administrator and then attempt to access the debug port. The attempt should succeed.*

FPT_JTA_EXT.2 JTAG/Debug Port Disablement

This is a selection-based component. Its inclusion depends upon selection from .

FPT_JTA_EXT.2.1

The TSF shall [**selection, choose one of**: *disable access through hardware*, *control access by a signing key*] to JTAG or other debug interfaces.

Application Note: This requirement should be included in the ST for use cases that include the threat T.PHYSICAL.

Evaluation Activities

FPT_JTA_EXT.2
TSS
If "disable access through hardware" is selected:
The evaluator shall examine the TSS to determine the location of the JTAG ports on the TSF, to include the order of the ports (i.e. Data In, Data Out, Clock, etc.).

If "control access by a signing key" is selected:
The evaluator shall examine the TSS to determine how access to the JTAG is controlled by a signing key. The evaluator shall examine the TSS to determine when the JTAG can be accessed, i.e. what has the access to the signing key.

Guidance

There are no additional Guidance evaluation activities for this component.

Tests
The following test requires the developer to provide access to a test platform that provides the evaluator with chip level access.

[conditional] If "disable access through hardware" is selected:
The evaluator shall connect a packet analyzer to the JTAG ports. The evaluator shall query the JTAG port for its device ID and confirm that the device ID cannot be retrieved.

FPT_PHP.1 Passive detection of physical attack

This is a selection-based component. Its inclusion depends upon selection from .
This component may also be included in the ST as if optional, but may be mandatory in the future.

FPT_PHP.1.1

The TSF shall provide unambiguous detection of physical tampering that can compromise the TSF.

FPT_PHP.1.2

The TSF shall provide the capability to determine whether physical tampering with the TSF's devices or TSF's elements has occurred.

Application Note: This SFR should be included in the ST if the TOE implements the following use cases:

1. Portable Clients (laptops, tablets), Enhanced
2. IoT Devices

CSfC EUDs also require detection of physical attack, but in this case FPT_PHP.2 is required instead.

Evaluation Activities

FPT_PHP.1
TSS
The evaluator shall examine the TSS to ensure it describes the methods used by the TOE to detect physical tampering and how tampering is indicated when detected.

Guidance
The evaluator shall ensure that the AGD describes how the TOE indicates to users and Administrators that it has detected tampering.

Tests
The evaluator shall verify that attempts to open the TOE enclosure result in indications consistent with the operational guidance. Such indications could include damaged tamper seals, logged events, or other physical or electronic manifestations.

FPT_PHP.2 Notification of Physical Attack

This is a selection-based component. Its inclusion depends upon selection from .
This component may also be included in the ST as if optional, but may be mandatory in the future.

FPT_PHP.2.1

The TSF shall provide unambiguous detection of physical tampering that can compromise the TSF.

FPT_PHP.2.2

The TSF shall provide the capability to determine whether physical tampering with the TSF's devices or TSF's elements has occurred.

FPT_PHP.2.3

For [**assignment**: *list of TSF devices/elements for which active detection is required*], the TSF shall monitor the devices and elements and notify [**assignment**: *a designated user or role*] when physical tampering with the TSF's devices or TSF's elements has occurred.

Application Note: This SFR should be included in the ST if the TOE implements the following use cases:

1. Server-Class Platform, Enhanced
2. CSfC EUD

FPT_PHP.2 is hierarchical to FPT_PHP.1 which means that all requirements of FPT_PHP.1 are also included as part of FPT_PHP.2. A TOE that conforms to FPT_PHP.2 therefore does not claim FPT_PHP.1.

Evaluation Activities

FPT_PHP.2
TSS
The evaluator shall examine the TSS to ensure it describes the methods used by the TOE to detect physical tampering and how the TOE will respond when physical tampering has been detected for each device/element specified in FPT_PHP.2.3.

Guidance
The evaluator shall ensure that the AGD describes how the TOE notifies users or Administrators that it has detected tampering.

Tests
The evaluator shall perform the following tests:

- *Test FPT_PHP.2:1: The evaluator shall verify that attempts to open the TOE enclosure result in indications consistent with the operational guidance. Such indications could include damaged tamper seals, logged events, or other physical or electronic manifestations.*
- *Test FPT_PHP.2:2: For each device/element listed in FPT_PHP.2.3, the evaluator shall verify that attempts to physically tamper with the device/element results in notification to the designated users or roles consistent with the operational guidance.*

FPT_PHP.3 Resistance to Physical Attack

This is a selection-based component. Its inclusion depends upon selection from .

FPT_PHP.3.1

The TSF shall resist [**assignment**: *physical tampering scenarios*] to the [**assignment**: *list of TSF devices/elements*] by responding automatically such that the SFRs are always enforced.

Application Note: This SFR should be included in the ST if the TOE implements the following use cases:

1. Server-Class Platform, Enhanced
2. Tactical EUD

Evaluation Activities

FPT_PHP.3
TSS
The evaluator shall examine the TSS to ensure it describes the methods used by the TOE to detect physical tampering and how the TOE will respond when physical tampering has been detected such that SFRs are always enforced.

Guidance
The evaluator shall examine the AGD to ensure that it describes the expected response of the TOE when physical tampering is detected.

Tests
The evaluator shall perform the following test:

For each physical tampering scenario and device/element listed in FPT_PHP.3.1, the evaluator shall verify that tampering attempts result in a response from the TSF consistent with the operational guidance.

FPT_PPF_EXT.1 Protection of Platform Firmware and Critical Data

FPT_PPF_EXT.1.1

The TSF shall allow modification of platform firmware only through the update mechanisms described in FPT_TUD_EXT.1.

Application Note: Platform firmware must be modifiable only through one of the secure update mechanisms specified in FPT_TUD_EXT.1. If the update mechanism itself is implemented in platform firmware, then naturally, it must itself also be modifiable only through the secure update mechanism. Configuration data used by platform firmware that is stored in nonvolatile memory is not included in these protections. Executable portions of the TSF and data critical for ensuring the integrity of the TSF are included in these protections. Specifically, this includes the key store and the signature verification algorithm used by the update mechanisms.

Evaluation Activities

FPT_PPF_EXT.1
TSS
The evaluator shall examine the TSS to ensure that it explains how the various areas of platform firmware and critical data are protected from modification outside of the platform firmware update mechanism described in FPT_TUD_EXT.1. If the TOE implements an authenticated update mechanism as specified in FPT_TUD_EXT.2, then the evaluator shall ensure that the TSS describes specifically how the signature verification code and key store is protected from update outside of the secure platform firmware update mechanism.

Guidance
The evaluator shall check the AGD to ensure that there are instructions for how to securely modify the platform firmware and critical data using a mechanism specified in FPT_TUD_EXT.1.

Tests
The evaluator shall perform the following test:

The evaluator shall attempt to overwrite or modify the platform firmware without invoking one of the update mechanisms specified in FPT_TUD_EXT.1 (e.g., using a modified Linux boot loader such as GRUB that attempts to write to the memory where platform firmware is stored). The test succeeds if the attempts to overwrite platform firmware fail. The evaluator shall attempt at least three such tests--one that attempts to overwrite the first platform firmware that executes after boot, one that targets the secure update mechanism (if implemented), and one that targets firmware that has been integrity-checked since the last boot.

FPT_ROT_EXT.1 Platform Integrity Root

FPT_ROT_EXT.1.1

The integrity of platform firmware shall be rooted in [**selection**:

- *code or data written to immutable memory or storage*
- *credentials held in immutable storage on-platform or protected storage off-platform*
- *a separate management controller that is itself rooted in a mechanism that meets this requirement*
- *integrity measurements held securely in an on-platform dedicated security component*
- *integrity measurements held securely by an off-platform entity*

].

Application Note: Roots of Trust are components that constitute a set of unconditionally trusted functions. The above are acceptable roots of trust for platform firmware integrity. The ST Author must select the root of trust used to ensure the integrity of the first platform firmware that executes. The integrity of subsequently executed platform firmware must be traceable back to this root or to some other root as specified in FPT_ROT_EXT.2. This SFR should be iterated for additional TOE roots (for example, a management controller or firmware executed from an add-in card).

Selection of "*a separate management controller...*" implies the existence of an Administrator role.

Evaluation Activities

FPT_ROT_EXT.1
TSS

The evaluator shall verify that the TSS describes the Root of Trust on which initial integrity of platform firmware is anchored, consistent with the selection above. The description shall include means by which the Root of Trust is protected from modification.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
There are no test activities for this component.

FPT_ROT_EXT.2 Platform Integrity Extension

FPT_ROT_EXT.2.1

The integrity of all mutable platform firmware outside of the platform integrity root specified in FPT_ROT_EXT.1 shall be verified prior to execution or use through: [**selection**:

- *computation and verification of a hash by trusted code/data*
- *verification of a digital signature by trusted code/data*
- *measurement and verification by trusted code/data*
- *measurement and verification by an on-platform dedicated security component*
- *measurement and verification by an off-platform entity*

].

Application Note: This requirement specifies the means for extending the initial integrity of platform firmware established by FPT_ROT_EXT.1.1 to subsequently executed platform firmware and data that is located in mutable storage. (Integrity of code and data written to immutable storage is assured).

Otherwise, integrity must be extended through cryptographic means: either through hashes or digital signatures computed and verified by firmware that is trusted because it has previously had its integrity verified or is itself a Root of Trust. Verification can be performed by TOE components such as management controllers or non-TOE trusted entities.

If "*computation and verification of a hash by trusted code/data*" is selected, then FCS_COP.1/Hash must be claimed.

If "*verification of a digital signature by trusted code/data*" is selected, then FCS_COP.1/SigVer must be claimed.

FPT_ROT_EXT.2.2

The TOE shall take the following actions if an integrity check specified in FPT_ROT_EXT.2.1 fails:

1. Halt,
2. Notify an [**selection**: *Administrator*, *User*] by [**selection**: *generating an audit event*, *[**assignment**: other notification method(s)]*], and
3. [**selection, choose one of**:
   - *Stop all execution and shut down*
   - *Initiate a recovery process as specified in FPT_RVR_EXT.1*

   ]

[**selection, choose one of**:

- *automatically*
- *in accordance with Administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

].

Application Note: Notification of an administrator can take many forms. For server-class platforms, such notification could take the form of administrator alerts or audit events. For platforms without management controllers, notification could be achieved, for example, by blinking lights, beep codes, screen indications, or local logging. If "Administrator" is selected anywhere in FPT_ROT_EXT.2.2, or if "in accordance with Administrator-configurable policy" is selected, then all Administrator authentication requirements must be included in the ST (FIA_UIA_EXT.1, FIA_UAU.5, FIA_PMG_EXT.1, FIA_AFL_EXT.1, FIA_UAU.7). If "*generating an audit event*" is selected, then FAU_GEN.1, FAU_SAR.1, FAU_STG.1, FAU_STG.2, and FAU_STG.5 must be included in the ST.

If "*computation and verification of a hash by trusted code/data*" is selected, then

FCS_COP.1/Hash must be included in the ST.

If "*verification of a digital signature by trusted code/data*" is selected, then FCS_COP.1/SigVer must be included in the ST.

If "*Initiate a recovery process as specified in FPT_RVR_EXT.1*" is selected, then FPT_RVR_EXT.1 must be included in the ST.

If "*in accordance with administrator-configurable policy*" is selected, then FMT_MOF.1 and FMT_SMF.1 must be included in the ST.

Evaluation Activities

FPT_ROT_EXT.2
TSS
The evaluator shall verify that the TSS describes the means by which initial integrity of platform firmware is extended to other platform components, and that the means are consistent with the selection(s) made in FPT_ROT_EXT.2. The TSS shall also describe how the TOE responds to failure of verification consistent with the selections in FPT_ROT_EXT.2.2.

Guidance
The evaluator shall examine the AGD to ensure that it describes the actions taken and notification methods used in case of failure to establish the integrity of the platform firmware root. If the actions are configurable, the AGD shall explain how they are configured.

Tests
The evaluator shall modify the platform firmware in a way that should cause a failure of the integrity check. The test passes if the mechanism specified in FPT_ROT_EXT.2.2 is triggered on the first subsequent boot of the platform.

Depending on the protections implemented, the evaluator may need a specially crafted update module from the vendor to perform this test. But note that this is not necessarily the same as a test of the update mechanism. The update mechanism can be tested either at boot time or at the time of the update. This verification check must be done during boot.

If modification of platform firmware in situ or using the update mechanism is deemed to be not feasible within the time and cost constraints of the evaluation, then the evaluator shall make such an argument in the AAR, and with concurrence of the CC scheme, this test can be replaced by evidence of vendor testing.

FPT_ROT_EXT.3 Hardware component integrity

This is an objective component.

FPT_ROT_EXT.3.1

Outside of the integrity root specified in FPT_ROT_EXT.1, the integrity of [**assignment**: *critical platform hardware components*] shall be verified prior to execution or use through: [**assignment**: *method for ensuring integrity of platform hardware components*].

Application Note: The purpose of this objective requirement is to encourage platform and component vendors to adopt mechanisms similar to those defined in upcoming NIST SP 1800-34 for ensuring the integrity of the hardware supply chain. The scope of SP 1800-34 is to cover "manufacturing and OEM processes that protect against counterfeits, tampering, and insertion of unexpected software and hardware, and the corresponding customer processes that verify that client and server computing devices and components have not been tampered with or otherwise modified. Manufacturing processes that cannot be verified by the customer are explicitly out of scope."

As a basic step, SP 1800-34 specifies that critical platform components should include immutable hardware IDs that can be listed in a hardware component manifest that is provided to the purchaser and signed by the manufacturer. It should then be possible for the TOE to verify the signature on the manifest and check that each hardware ID in the manifest matches the IDs in the actual hardware. The component manifest and hardware IDs provide proof of provenance for the TOE and its hardware components.

For purposes of this requirement, hardware identities can be verified once on first boot, on every boot, when new hardware is detected, or during normal

operation of the platform - as long as the hardware integrity is verified before the component or device is used.

The ST Author lists the hardware components for which the integrity is checked, and the methods used for conducting the checks. "Critical components" generally would include chassis, motherboards, CPUs, network cards, memory chips, hard drives, controllers, graphics processors, and service controllers.

FPT_ROT_EXT.3.2

The TOE shall take the following actions if an integrity check specified in FPT_ROT_EXT.3.1 fails:

1. Halt,
2. Notify an [**selection**: *Administrator*, *User*] by [**selection**: *generating an audit event*, *[**assignment**: other notification method(s)]*], and
3. [**selection, choose one of**:
   - *Stop all execution and shut down*
   - *Continue execution without the integrity-compromised component*
   - *Continue execution*

   ]

[**selection, choose one of**:

- *in accordance with administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

].

Application Note: Notification of an administrator can take many forms. For server-class platforms, such notification could take the form of administrator alerts or audit events. For platforms without management controllers, notification could be achieved, for example, by blinking lights, beep codes, screen indications, or local logging. If "*administrator*" is selected anywhere in FPT_ROT_EXT.3.2, or if "*in accordance with administrator-configurable policy*" is selected, then all administrator authentication requirements must be included in the ST (FIA_UIA_EXT.1, FIA_UAU.5, FIA_PMG_EXT.1, FIA_AFL_EXT.1, FIA_UAU.7).

If "*generating an audit event*" is selected, then FAU_GEN.1, FAU_SAR.1, FAU_STG.1, FAU_STG.2, and FAU_STG.5, must be included in the ST.

If "*in accordance with administrator-configurable policy*" is selected, then FMT_MOF.1 and FMT_SMF.1 must be claimed in the ST.

Evaluation Activities

FPT_ROT_EXT.3
TSS
The evaluator shall verify that the TSS describes the means by which integrity of platform hardware and firmware is maintained from TOE manufacture to delivery of the TOE to its operational site. The TSS shall also describe how the TOE responds to failure of an integrity check consistent with the selections in FPT_ROT_EXT.3.2.

Guidance
The evaluator shall examine the AGD to ensure that it describes the actions taken and notification methods used in case of detection of a platform integrity violation. If the actions are configurable, the AGD shall explain how they are configured.

Tests
There are no test activities for this component.

FPT_RVR_EXT.1 Platform Firmware Recovery

This is a selection-based component. Its inclusion depends upon selection from FPT_ROT_EXT.2.2, FPT_TUD_EXT.2.5, FPT_TUD_EXT.3.4.

FPT_RVR_EXT.1.1

The TSF shall implement a mechanism for recovering from boot firmware failure consisting of [**selection**:

- *the secure local update mechanism described in FPT_TUD_EXT.4*
- *installation of a known-good or recovery firmware image*

- *reversion to the prior firmware image*
- *installation of a recovery image that puts the TOE into a maintenance mode*

].

Application Note: This SFR must be included in the ST if:

- "*Initiate a recovery process as specified in FPT_RVR_EXT.1*" is selected in FPT_ROT_EXT.2.2,
- "*Initiate a recovery process as specified in FPT_RVR_EXT.1*" is selected in FPT_TUD_EXT.2.5,
- "*Initiate a recovery process as specified in FPT_RVR_EXT.1*" is selected in FPT_TUD_EXT.3.4,
- The TOE implements a recovery mechanism for firmware corruption not necessarily related to integrity or update failure.

If the ST Author selects "*the secure local update mechanism described in FPT_TUD_EXT.4*," then FPT_TUD_EXT.4 must be claimed in the ST.

As indicated above, in addition to integrity or update failure, the TOE may use a recovery mechanism to deal with non-security-related failures, such as a power outage during update or a power surge during normal operation.

The recovery process may be initiated automatically on failure, as the result of physically present user action, or as the result of pre-configured policy. The action taken may depend on the nature of the failure as specified in FPT_ROT_EXT.2.2 and FPT_TUD_EXT.2.5.

Evaluation Activities

FPT_RVR_EXT.1
TSS
The evaluator shall examine the TSS section to confirm that it describes how the platform firmware recovery mechanism works and the conditions under which it is invoked.

Guidance
The evaluator shall examine the AGD to ensure that is describes how to configure the conditions under which the recovery mechanism is initiated (if configurable).

Tests
The evaluator shall perform the following tests:

- *Test FPT_RVR_EXT.1:1: To test this requirement, the evaluator shall trigger the recovery process either by forcing an update error or a boot integrity failure and observing that the recovery process has been initiated.*
- *Test FPT_RVR_EXT.1:2: The evaluator will engage with the recovery process as necessary, and after recovery will determine the version of the current firmware image. The test is passed if the resultant image is as expected in accordance with policy and the selections in FPT_RVR_EXT.1.1. If the recovery process uses the secure local update process as specified in FPT_TUD_EXT.4, then this test is satisfied by testing of that requirement.*

FPT_STM.1 Reliable Time Stamps

FPT_STM.1.1

The TSF shall be able to provide reliable time stamps.

Application Note: It is acceptable for the TSF to provide timestamp data either through an internal clock or a counter. It is also permissible for the TSF to obtain time data from a clock contained within the same physical enclosure as the TOE.

Evaluation Activities

FPT_STM.1
TSS
The evaluator shall examine the TSS to ensure that it lists each security function that makes use of time. The TSS provides a description of how the time is maintained and considered reliable in the context of each of the time related functions.

Guidance
The evaluator shall examine the AGD to ensure it instructs the Administrator on any mechanisms

for configuring the time source.

Tests
The evaluator shall perform the following tests:

[conditional] If the TSF provides a mechanism to manually set the time, the evaluator shall use the guidance documentation to set the time. The evaluator shall then use an available interface to observe that the time is reported correctly.

FPT_TST.1 TSF Self-Testing

This is a selection-based component. Its inclusion depends upon selection from FCS_CKM_EXT.5.1.
This component may also be included in the ST as if optional.

FPT_TST.1.1

The TSF shall run a suite of the following self-tests [**selection**: *during initial start-up, periodically during normal operation, at the request of the authorized user, at the conditions [**assignment**: conditions under which self-test should occur]*] to demonstrate the correct operation of [*TSF DRBG specified in FCS_RBG.1*].

FPT_TST.1.2

The TSF shall provide authorized users with the capability to verify the integrity of [*[DRBG seed/output data]*].

FPT_TST.1.3

The TSF shall provide authorized users with the capability to verify the integrity of [*[TSF DRBG specified in FCS_RBG.1]*].

Application Note: This SFR is a required dependency of FCS_RBG.1. It is intended to require that any DRBG implemented by the TOE undergo health testing to ensure that the random bit generation functionality has not been degraded. If the TSF supports multiple DRBGs, this SFR should be iterated to describe the self-test behavior for each.

Evaluation Activities

FPT_TST.1
TSS
The evaluator shall examine the TSS to ensure that it details the self-tests that are run by the TSF along with how they are run. This description should include an outline of what the tests are actually doing. The evaluator shall ensure that the TSS makes an argument that the tests are sufficient to demonstrate that the DRBG is operating correctly.

Note that this information may also be placed in the entropy documentation specified by .

Guidance
If a self-test can be executed at the request of an authorized user, the evaluator shall verify that the operational guidance provides instructions on how to execute that self-test.

Tests
For each self-test, the evaluator shall verify that evidence is produced that the self-test is executed when specified by FPT_TST.1.1.

If a self-test can be executed at the request of an authorized user, the evaluator shall verify that following the steps documented in the operational guidance to perform the self-test will result in execution of the self-test.

FPT_TUD_EXT.1 TOE Firmware Update

FPT_TUD_EXT.1.1

The TSF shall implement [**selection**:

- *no mechanism for platform firmware update*
- *an authenticated platform firmware update mechanism as described in FPT_TUD_EXT.2*
- *a delayed-authentication platform firmware update mechanism as described in FPT_TUD_EXT.3*
- *a secure local platform firmware update mechanism described in*

FPT_TUD_EXT.4

].

Application Note: The purpose of the platform firmware update mechanism is to ensure the authenticity and integrity of platform firmware updates. If platform firmware is immutable (not updateable by any non-destructive means), then the ST Author selects "*no mechanism for platform firmware update*."

If the platform implements an update mechanism that does not require physical presence at the platform, and that authenticates firmware updates prior to installing them, then the ST Author selects "*an authenticated platform firmware update mechanism...*" and includes FPT_TUD_EXT.2 and FCS_COP.1/SigVer in the ST.

If the platform implements an update mechanism that does not require physical presence at the platform, and that does not authenticate firmware updates prior to installing them, then the ST Author selects "*a delayed-authentication platform firmware update mechanism...*" and includes FPT_TUD_EXT.3 and FCS_COP.1/SigVer in the ST.

If platform firmware is modifiable only through a local update requiring physical presence at the platform, then the ST Author must select "*a secure local platform firmware update mechanism...*" and include FPT_TUD_EXT.4 in the ST.

Evaluation Activities

FPT_TUD_EXT.1
TSS
If the ST Author selects "no provision for platform firmware update," then the evaluator shall examine the TSS to ensure that it explains all ways of modifying platform firmware in the absence of any provided mechanism. For example, breaking open the case and prying a chip off the motherboard and then reprogramming the chip. The purpose of this activity is to ensure that the TOE does not implement a local update mechanism that does not meet the requirements of FPT_TUD_EXT.4.

This requirement is met if the platform implements no means for updating platform firmware and the TSS describes a method for updating or replacing platform firmware that involves potentially destroying or damaging the TOE or some of its components.

If the ST Author selects "an authenticated platform firmware update mechanism...," then this requirement is satisfied if FPT_TUD_EXT.2 is satisfied.

If the ST Author selects "a delayed-authentication platform firmware update mechanism...," then this requirement is satisfied if FPT_TUD_EXT.3 is satisfied.

If the ST Author selects "a secure local platform firmware update mechanism...," then this requirement is satisfied if FPT_TUD_EXT.4 is satisfied.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
There are no test activities for this component.

FPT_TUD_EXT.2 Platform Firmware Authenticated Update Mechanism

This is a selection-based component. Its inclusion depends upon selection from FPT_TUD_EXT.1.1.

FPT_TUD_EXT.2.1

The TSF shall authenticate the source of all platform firmware updates using a digital signature algorithm specified in FCS_COP.1/SigVer and using a key store that contains [**selection**: *the public key, hash value of the public key*].

Application Note: This SFR must be included in the ST if "*an authenticated platform firmware update mechanism as described in FPT_TUD_EXT.2*" is selected in FPT_TUD_EXT.1.1.

The ST must include FCS_COP.1/Hash if "*hash value of the public key*" is selected.

FPT_TUD_EXT.2.2

The TSF shall allow installation of updates only if the digital signature has been

successfully verified as specified in FCS_COP.1/SigVer and [**selection**: *the version number of the platform firmware update is more recent than the version number of the current installed platform firmware, no other conditions*].

Application Note: The ST Author should select "*the version number...*" if the TSF supports rollback prevention. That is, the TSF does not allow "update" to an older version of the platform firmware. In general, rollback should be permitted only through a secure local update mechanism at the express direction of an physically present Administrator or User.

FPT_TUD_EXT.2.3

The TSF shall include a platform firmware version identifier that is accessible by the update mechanism and includes information that enables the update mechanism to determine the relative order of updates.

FPT_TUD_EXT.2.4

The TSF shall provide an observable indication of the success or failure of the update operation.

Application Note: For success, this indication should include the version number of the newly installed firmware. Notification of failure could include generation of an audit event by a management subsystem, a beep code, an updated version number on a splash screen, or simple failure to continue functioning.

FPT_TUD_EXT.2.5

The TOE shall take the following actions if a platform firmware integrity, authenticity, or rollback-prevention check fails, or a platform firmware update fails for any other reason:

- Do not install the update,
- Notify an [**selection**: *Administrator*, *User*] by [**selection**: *generating an audit event*, ***[assignment**: notification method]*],

and [**selection, choose one of**:

- *Continue execution*
- *Halt*
- *Stop all execution and shut down*
- *Initiate recovery as specified in FPT_RVR_EXT.1*

] [**selection, choose one of**:

- *automatically*
- *in accordance with administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

].

Application Note: If "*generating an audit event*" is selected, then FAU_GEN.1 and the other audit requirements must be claimed.

If "*Initiate recovery as specified in FPT_RVR_EXT.1*" is selected, then FPT_RVR_EXT.1 must be included in the ST.

The platform firmware authenticated update mechanism employs digital signatures to ensure the authenticity of the firmware update image. The TSF includes a signature verification algorithm and a key store containing the public key needed to verify the signature on the firmware update image.

A hash of the public key may be stored if a copy of the public key is provided with firmware update images. In this case, the update mechanism hashes the public key provided with the update image, and ensure that it matches a hash which appears in the key store before using the provided public key to verify the signature of the update image. If the hash of the public key is selected, the ST Author may iterate the FCS_COP.1/Hash requirement to specify the hashing functions used.

An indication of success or failure can be generation of an audit event by a management subsystem, a beep code, an updated version number on a splash screen, or simple failure to continue functioning.

If the update mechanism generates audit events, the ST Author must make the appropriate selections from the audit events table (Table t-audit-sel-based).

Evaluation Activities

FPT_TUD_EXT.2

TSS
The evaluator shall ensure that the TSS includes a comprehensive description of how the authentication of platform firmware updates is implemented by the TSF. The TSS should cover the initialization process and the activities that are performed to ensure that the digital signature of the update image is verified before modification of the firmware.

The evaluator shall examine the TSF to ensure that it describes the platform firmware version identifier and explains its meaning and encoding.

The evaluator shall also ensure that the TSS describes the actions taken by the TSF is an update image fails authentication.

Guidance
The evaluator shall examine the AGD to ensure that it describes the process for updating the platform firmware.

The evaluator shall examine the AGD to ensure that it documents the observable indications of update success or failure, and that it describes how to access the platform firmware version indicators.

Tests
The evaluator shall perform the following tests:

- *Test FPT_TUD_EXT.2:1: The evaluator determines the current version of the platform firmware, and obtains or produces a valid, authentic, and permissible update image of platform firmware. The evaluator initiates an update using this image through the process described in the operational guidance. After the process is complete, the evaluator checks the current firmware version to ensure that the new firmware version matches that of the update.*
- *Test FPT_TUD_EXT.2:2: The evaluator performs the same test, this time using a valid update image that is signed with an incorrect key. The update must fail.*
- *Test FPT_TUD_EXT.2:3: The evaluator performs the same test, this time using an update image that is corrupted but is signed with the correct key. The update must fail.*
- *Test FPT_TUD_EXT.2:4: The evaluator performs the same test, this time using a valid update image that is not signed. The update must fail.*
- *Test FPT_TUD_EXT.2:5: [conditional] If the TSF implements rollback protections, the evaluator performs the same test, this time using a valid, signed update image that has an earlier version number than the currently installed firmware. The update must fail.*

FPT_TUD_EXT.3 Platform Firmware Delayed-Authentication Update Mechanism

This is a selection-based component. Its inclusion depends upon selection from FPT_TUD_EXT.1.1.

FPT_TUD_EXT.3.1

The TSF shall allow execution or use of platform firmware updates only if new platform firmware is integrity- and authenticity-checked using the mechanism described in FPT_ROT_EXT.2 prior to its execution or use, and [**selection**: *the version number of the platform firmware update is more recent than the version number of the previously installed platform firmware, no other conditions*].

Application Note: This requirement must be included in the ST if "*implement a delayed-authentication platform firmware update mechanism as described in FPT_TUD_EXT.3*" is selected in FPT_TUD_EXT.1.1.

This update mechanism does not require an integrity or authenticity check prior to installation, but the newly installed platform firmware must have its integrity and authenticity verified prior to being executed or used. This update mechanism takes advantage of the existing FPT_ROT_EXT.2 requirement to avoid having to verify the integrity and authenticity of an update package at install time.

The ST Author should select "*the version number of the platform firmware update is more recent than the version number of the previously installed platform firmware*" if the TSF supports rollback prevention.

FPT_TUD_EXT.3.2

The TSF shall include an observable platform firmware version identifier that is accessible by the update mechanism and includes information that enables the update mechanism to determine the relative order of updates.

FPT_TUD_EXT.3.3

The TSF shall provide an observable indication of the success or failure of the update operation.

Application Note: For success, this should at least include an indication of the version number of the newly installed firmware. Notification of failure could include generation of an audit event by a management subsystem, a beep code, an updated version number on a splash screen, or simple failure to continue functioning.

FPT_TUD_EXT.3.4

The TOE shall take the following actions if a platform firmware update integrity, authentication, or rollback-prevention check fails, or a platform firmware update fails for any other reason:

- Notify an [**selection**: *Administrator*, *User*] by [**selection**: *generating an audit event*, *[**assignment**: notification method]*]

and [**selection, choose one of**:

- *Halt*
- *Stop all execution and shut down*
- *Initiate a recovery process as specified in FPT_RVR_EXT.1*

] [**selection, choose one of**:

- *automatically*
- *in accordance with administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

].

Application Note: If "*generating an audit event*" is selected, then FAU_GEN.1 and the other audit SFRs must be claimed.

If "*Initiate recovery as specified in FPT_RVR_EXT.1*" is selected, then FPT_RVR_EXT.1 must be included in the ST.

The platform firmware unauthenticated update mechanism installs platform firmware updates without first checking their integrity or authenticity. Instead, this mechanism either invokes a special authentication/integrity check on the firmware *in situ* after install or relies on the firmware checks required by FPT_ROT_EXT.2 to ensure the integrity and authenticity of the update image. In either case, the integrity and authenticity of the update must be verified before the updated firmware is executed or used.

Likewise, if the TSF implements rollback prevention, this check must be made before the newly installed firmware is executed.

Evaluation Activities

FPT_TUD_EXT.3

TSS
The evaluator shall ensure that the TSS includes a comprehensive description of how the authentication of platform firmware updates is implemented by the TSF. The TSS should cover the initialization process and the activities that are performed to ensure that the digital signature of the update image is verified before it is executed or used.

The evaluator shall examine the TSF to ensure that it describes the platform firmware version identifier and explains its meaning and encoding.

The evaluator shall also ensure that the TSS describes the actions taken by the TSF if an update image fails authentication, integrity, or rollback-prevention checks.

Guidance
The evaluator shall examine the AGD to ensure that it describes the process for updating the platform firmware.

The evaluator shall examine the AGD to ensure that it documents the observable indications of update success or failure, and that it describes how to access the platform firmware version indicators.

Tests
The evaluator shall perform the following tests:

- *Test FPT_TUD_EXT.3:1: The evaluator determines the current version of the platform firmware, and obtains or produces a valid, authentic, and permissible update image of platform firmware. The evaluator initiates an update using this image through the process described in the operational guidance. After the process is complete, the evaluator checks the current firmware version to ensure that the new firmware version matches that of the update.*
- *Test FPT_TUD_EXT.3:2: The evaluator performs the same test, this time using a inauthentic update image. The update code must fail to execute.*

- *Test FPT_TUD_EXT.3:3: The evaluator performs the same test, this time using an update image that is corrupted but is otherwise authentic. The update code must fail to execute.*
- *Test FPT_TUD_EXT.3:4: [conditional] If the TSF implements rollback protections, the evaluator performs the same test, this time using a valid, signed update image that is has an earlier version number than the currently installed firmware. The update code must fail to execute.*

FPT_TUD_EXT.4 Secure Local Platform Firmware Update Mechanism

This is a selection-based component. Its inclusion depends upon selection from FPT_RVR_EXT.1.1, FPT_TUD_EXT.1.1.

FPT_TUD_EXT.4.1

The TSF shall provide a secure local update mechanism that requires an assertion of physical access to the TOE before installation of an update.

FPT_TUD_EXT.4.2

A user shall assert physical presence to the TSF through: [**selection**:

- *login to the TOE from a physically connected console or terminal*
- *physical connection of a jumper or cable*
- *connection to a debug port*
- *[**assignment**: description of other mechanism for asserting physical presence]*

].

Application Note: The requirement included in the ST if "*the secure local update mechanism described in FPT_TUD_EXT.4*" is selected in FPT_RVR_EXT.1.1 or "*implement a secure local platform firmware update mechanism described in FPT_TUD_EXT.4*" is selected in FPT_TUD_EXT.1.1.

This requirement pertains to platform firmware update mechanisms that do not use the authentication-based update mechanism described in FPT_TUD_EXT.2 or the delayed-authentication described in FPT_TUD_EXT.3. The secure local update mechanism ensures the authenticity and integrity of the firmware update image by requiring a user to be physically present at the TOE. An assertion of physical presence can take the form, for example, of requiring entry of a password at a boot screen, unlocking of a physical lock (e.g., a motherboard jumper), or inserting a USB cable before permitting platform firmware to be updated.

There is no requirement that the local update mechanism support rollback prevention.

The local update mechanism must be a designed mechanism. If update can be accomplished only through the physical removal and replacement of a part, then that is not a secure local update mechanism, and "make no provision for platform firmware update" should be selected in FPT_TUD_EXT.1.1.

FPT_TUD_EXT.4.3

The TSF shall include a platform firmware version identifier that is accessible by the update mechanism or to the user who asserts physical presence.

FPT_TUD_EXT.4.4

The TSF shall provide an observable indication of the success or failure of the update operation.

Application Note: For success, this indication should include the version number of the newly installed firmware. Notification of failure could be through a beep code, an indication on a splash screen, or simple failure to continue functioning.

Evaluation Activities

FPT_TUD_EXT.4
TSS
The evaluator shall check the TSS section to confirm that it clearly and thoroughly describes how the secure local update functionality is implemented.

Guidance

The evaluator shall examine the AGD to ensure that it describes instructions for using the local update mechanism, and how to validate that the update was successful.

Tests
The evaluator shall perform the following tests:

- *Test FPT_TUD_EXT.4:1: The evaluator tests the secure local update by following the instructions provided in the operational guidance to update the platform firmware image. The update must succeed.*
- *Test FPT_TUD_EXT.4:2: The evaluator next tries to update the platform firmware image without first asserting physical presence. The update must fail or be not possible.*

5.1.8 Class: Trusted Path/Channels (FTP)

FTP_ITC_EXT.1 Trusted Channel Communication

This is a selection-based component. Its inclusion depends upon selection from FDP_ITC_EXT.1.1, FMT_SMF.1.1.

FTP_ITC_EXT.1.1

The TSF shall use [**selection**:

- *TLS as conforming to the Functional Package for Transport Layer Security (TLS), version 2.1*
- *TLS/HTTPS as conforming to FCS_HTTPS_EXT.1*
- *IPsec as conforming to FCS_IPSEC_EXT.1*
- *SSH as conforming to the Functional Package for Secure Shell (SSH), version 2.0*

] protocols with [**selection, choose one of**:

- *X.509 certificate-based authentication of the remote peer*
- *non-certificate-based authentication of the remote peer*
- *no authentication of the remote peer*

] to provide a communication channel between itself and [**selection**:

- *audit servers (as required by FAU_STG.1.1 if selected)*
- *remote administrators (as required by FTP_TRP.1.1 if selected in FMT_MOF.1)*
- *[**assignment**: other capabilities]*
- *no other capabilities*

] that is logically distinct from other communication channels, provides assured identification of its end points, protects channel data from disclosure, and detects modification of the channel data.

Application Note: This SFR is included in the ST if a trusted channel is used to offload audit data or if the platform is administered remotely. That is, if "*a trusted channel as specified in FTP_ITC_EXT.1*" is selected in FAU_STG.1.1, if "*physically protected channels as specified in FTP_ITP_EXT.1*" is selected in FDP_ITC_EXT.1.1, or if "*remotely*" is selected in Management Function 1 in FMT_SMF.1.1.

If the ST Author selects either "*TLS*" or "*HTTPS*," the TOE must be validated against the Functional Package for TLS. This PP does not mandate that a product implement TLS with mutual authentication, but if the product includes the capability to perform TLS with mutual authentication, then mutual authentication must be included within the TOE boundary.

If the ST Author selects "*SSH*," the TOE must conform to Functional Package for Secure Shell (SSH), version 2.0.

If the ST Author selects "*certificate-based authentication of the remote peer*," then the TOE must conform to , version .

Claims from this package are only required to the extent that they are needed to support the functionality required by the trusted protocols that are claimed.

If the TSF implements a protocol that requires the validation of a certificate presented by an external entity, FIA_X509_EXT.1 and FIA_X509_EXT.2 will be claimed. FIA_TSM_EXT.1 may also be claimed if the TSF implements its own trust store. If the TSF implements a protocol that requires the presentation of any certificates to an external entity, FIA_XCU_EXT.2 will be claimed. FIA_X509_EXT.3 will also be claimed, along with any applicable dependencies,

depending on how the certificates presented by the TOE are obtained.

"*No authentication of the remote peer*" should be selected only if the TOE is acting as a server in a non-mutual authentication configuration.

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Evaluation Activities

FTP_ITC_EXT.1
TSS
The evaluator will review the TSS to determine that it lists all trusted channels the TOE uses for remote communications, including both the external IT entities and remote users that use the channel as well as the protocol that is used for each.

Guidance
The evaluator shall confirm that the AGD contains instructions for establishing connections to external IT entities and remote users.

Tests
The evaluator will configure the TOE to communicate with each external IT entity and type of remote user identified in the TSS. The evaluator will monitor network traffic while the VS performs communication with each of these destinations. The evaluator will ensure that for each session a trusted channel was established in conformance with the protocols identified in the selection.

FTP_ITE_EXT.1 Encrypted Data Communications

This is a selection-based component. Its inclusion depends upon selection from FDP_ITC_EXT.1.1.

FTP_ITE_EXT.1.1

The TSF shall encrypt data for transfer between the TOE and [**assignment**: *list of entities external to the TOE*] using a cryptographic algorithm and key size as specified in FCS_COP.1/SKC, and using [**selection**:

- *Pre-shared keys*
- *Keys established according to FCS_CKM.2*
- *Keys exchanged using a physically protected communication mechanism conformant with FTP_ITP_EXT.1*

].

Application Note: This SFR must be claimed if "*encrypted data buffers as specified in FTP_ITE_EXT.1*" is selected in FDP_ITC_EXT.1.

This requirement applies to encrypted data communications between the TOE and external entities that do not use a physically protected mechanism conforming to FTP_ITP_EXT.1, or a cryptographically protected data channel as conforming to FTP_ITC_EXT.1. For example, if data is transferred through encrypted buffers (or blobs), then this requirement applies. This requirement would apply, for example, for communications implemented through a shared data buffer.

Evaluation Activities

FTP_ITE_EXT.1
TSS
The evaluator shall review the TSS to determine that it lists all encryption mechanisms the TOE uses for protected external communications, along with the types of communications protected using each mechanism.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
The evaluator shall configure the TOE to communicate with each external entity identified in the TSS. The evaluator shall initiate a transaction that will result in data being transferred to the TOE through the mechanism and other data returned to the initiating entity through the mechanism. The evaluator must verify that the data returned to the entity was encrypted using

the documented mechanism when received.

FTP_ITP_EXT.1 Physically Protected Channel

This is a selection-based component. Its inclusion depends upon selection from FDP_ITC_EXT.1.1, FTP_ITE_EXT.1.1.

FTP_ITP_EXT.1.1

The TSF shall provide a physically protected communication channel between itself and [**assignment**: *list of other IT entities within the same platform*].

Application Note: This SFR must be claimed if "*physically protected channels as specified in FTP_ITP_EXT.1*" is selected in either FDP_ITC_EXT.1, or if "*Keys exchanged using a physically protected communication mechanism conformant with FTP_ITP_EXT.1*" is selected in FTP_ITE_EXT.1.1.

Evaluation Activities

FTP_ITP_EXT.1
TSS
The evaluator shall review the TSS to determine that it lists all mechanisms the TOE uses for physically protected external communications, along with the types of communications protected using each mechanism.

Guidance
There are no additional Guidance evaluation activities for this component.

Tests
There are no test activities for this component.

FTP_TRP.1 Trusted Path

This is a selection-based component. Its inclusion depends upon selection from FMT_SMF.1.1.

FTP_TRP.1.1

The TSF shall **use a trusted channel as specified in FTP_ITC_EXT.1 to** provide a **trusted** communication path between itself and [*remote*] **Administrators** that is logically distinct from other communication paths and provides assured identification of its end points and protection of the communicated data from [*modification, disclosure*].

FTP_TRP.1.2

The TSF shall permit [*remote **Administrators***] to initiate communication via the trusted path.

FTP_TRP.1.3

The TSF shall require the use of the trusted path for [*[all remote administration actions]*].

Application Note: This SFR is included in the ST if "*remotely*" is selected in Management Function 1 of FMT_SMF.1.1.

Protocols used to implement the remote administration trusted channel must be selected in FTP_ITC_EXT.1.

This requirement ensures that authorized remote Administrators initiate all communication with the TOE via a trusted path, and that all communications with the TOE by remote Administrators is performed over this path. The data passed in this trusted communication channel are encrypted as defined the protocol chosen in the first selection in FTP_ITC_EXT.1.

Evaluation Activities

FTP_TRP.1
TSS
The evaluator shall examine the TSS to determine that the methods of remote TOE

administration are indicated, along with how those communications are protected. The evaluator shall also confirm that all protocols listed in the TSS in support of TOE administration are consistent with those specified in the requirement, and are included in the requirements in the ST.

Guidance
The evaluator shall confirm that the AGD contains instructions for establishing the remote administrative sessions for each supported method.

Tests
The evaluator shall also perform the following tests:

- *Test FTP_TRP.1:1: The evaluator shall ensure that communications using each specified (in the AGD) remote administration method is tested during the course of the evaluation, setting up the connections as described in the AGD and ensuring that communication is successful.*
- *Test FTP_TRP.1:2: For each method of remote administration supported, the evaluator shall follow the AGD to ensure that there is no available interface that can be used by a remote user to establish remote administrative sessions without invoking the trusted path.*
- *Test FTP_TRP.1:3: The evaluator shall ensure, for each method of remote administration, the channel data is not sent in plaintext.*
- *Test FTP_TRP.1:4: The evaluator shall ensure, for each method of remote administration, modification of the channel data is detected by the TOE.*

Additional evaluation activities are associated with the specific protocols.

5.1.9 TOE Security Functional Requirements Rationale

The following rationale provides justification for each SFR for the TOE, showing that the SFRs are suitable to address the specified threats:

Table 21: SFR Rationale

Threat	Addressed by	Rationale
T.PHYSICAL	FPT_JTA_EXT.1	Mitigates threat by restricting access to debug ports to authorized Administrators or physical presence.
	FPT_ROT_EXT.3 (objective)	Mitigates threat by ensuring integrity of physical components and responding to integrity failures.
	FPT_JTA_EXT.2 (sel-based)	Mitigates threat by enforcing access control to debug ports.
	FPT_PHP.1 (sel-based/objective)	Mitigates threat by passively detecting physical tampering.
	FPT_PHP.2 (sel-based/objective)	Mitigates threat by providing methods to detect and report physical tampering.
	FPT_PHP.3 (sel-based)	Mitigates threat by resisting physical tampering.
T.SIDE_CHANNEL_LEAKAGE	FPT_TUD_EXT.1	Mitigates threat by providing a means to eliminate side-channel flaws through updates.
T.PERSISTENCE	FPT_ROT_EXT.1	Mitigates threat by providing platform integrity to prevent intrusion of a persistent presence on the platform.
	FPT_RVR_EXT.1 (sel-based)	Mitigates threat with firmware recovery mechanism in case of failure.
	FCS_STG_EXT.2 (sel-based)	Mitigates threat by enforcing access control on key data to prevent its unauthorized disclosure.
T.UPDATE_COMPROMISE	FPT_PPF_EXT.1	Mitigates threat by using the official update process to be the only method to modify platform firmware.
	FPT_ROT_EXT.2	Mitigates threat by providing a means to attest the validity of updates.
	FCS_COP.1/Hash (sel-based)	Mitigates threat by providing a means to validate the integrity of an update using a hash.
	FCS_COP.1/SigVer (sel-based)	Mitigates threat by providing a means to validate the integrity of an update using a hash.

	FPT_TUD_EXT.2 (sel-based)	Mitigates threat by using a digital signature mechanism to verify the integrity of updates and a rollback protection mechanism to prevent application of an unauthorized update.
	FPT_TUD_EXT.3 (sel-based)	Mitigates threat by using the TOE's root of trust to validate the authenticity and integrity of an update when it is applied.
	FPT_TUD_EXT.4 (sel-based)	Mitigates threat through an update mechanism that requires physical access to the TOE to use.
T.SECURITY_FUNCTIONALITY_FAILURE	FCS_STG_EXT.1 (optional)	Mitigates threat by generating keys/secrets and storing them in a secure manner, as well as destroying them on request.
	FCS_CKM.6 (sel-based)	Mitigates threat by using appropriate key destruction methods to protect the confidentiality of credential data.
	FCS_COP.1/SigGen (sel-based)	Mitigates threat by generating digital signatures with strong encryption.
	FCS_COP.1/SKC (sel-based)	Mitigates threat by establishing strong symmetric-key cryptography.
	FPT_FLS.1 (sel-based)	Mitigates threat by ensuring a DRBG self-test failure causes the TOE to enter an error state where it cannot perform secure functions using that DRBG.
	FDP_ITC_EXT.1 (sel-based)	Mitigates threat by importing keys and credentials in a secure fashion.
	FCS_RBG.1 (sel-based)	Mitigates threat by performing random-bit generation with sufficient complexity.
	FCS_RBG.2 (sel-based)	Mitigates threat by using an external seed source to ensure sufficiently strong random-bit generation.
	FCS_RBG.3 (sel-based)	Mitigates threat by using an internal seed source to ensure sufficiently strong random-bit generation.
	FCS_RBG.4 (sel-based)	Mitigates threat by using multiple internal seed sources to ensure sufficiently strong random-bit generation.
	FCS_RBG.5 (sel-based)	Mitigates threat by ensuring that each noise source's random data is combined to ensure strong entropy when multiple sources are used.
	FPT_TST.1 (sel-based)	Mitigates threat by using self-tests to ensure correct operation of the DRBG.
T.TENANT_BASED_ATTACK	FPT_STM.1	Mitigates threat by ensuring that audit data indicating a potential attack is accurately timestamped.
	FCS_RBG.6 (optional)	Mitigates threat by providing a well-defined interface by which tenant software can access the TSF to obtain random data.
	FCS_SLT_EXT.1 (optional)	Mitigates threat by using salts to increase the effectiveness of cryptographic functions used to protect against attack.
	FDP_TEE_EXT.1 (optional)	Mitigates threat by establishing a trusted execution environment for tenant software to use.
	FCS_CKM.1/AKG (sel-based)	Mitigates threat by generating strong cryptographic asymmetric keys to protect stored data.
	FCS_CKM.1/SKG (sel-based)	Mitigates threat by generating strong cryptographic symmetric keys to protect stored data.
	FCS_CKM.6 (sel-based)	Mitigates threat by implementing key destruction to prevent the disclosure of keys used to protect stored data.
	FCS_CKM_EXT.5 (sel-based)	Mitigates threat by utilizing strong algorithms to derive keys that protect stored data.

	FCS_COP.1/Hash (sel-based)	Mitigates threat by implementing hash functions used for trusted communications.
	FCS_COP.1/KeyedHash (sel-based)	Mitigates threat by implementing MAC functions used for trusted communications.
	FCS_COP.1/SigGen (sel-based)	Mitigates threat by implementing signature generation functions used for protected storage.
	FCS_COP.1/SigVer (sel-based)	Mitigates threat by implementing signature verification functions used for protected storage.
	FCS_COP.1/SKC (sel-based)	Mitigates threat by implementing symmetric encryption functions used for protected storage.
	FAU_GEN.1 (sel-based)	Mitigates threat by generating audit records that could provide evidence of attack or misuse.
	FAU_SAR.1 (sel-based)	Mitigates threat by recording audit data in a manner that could be interpreted to discover evidence of attack.
	FAU_STG.1 (sel-based)	Mitigates threat by using an external server to preserve audit data that may provide evidence of an attack.
	FAU_STG.2 (sel-based)	Mitigates threat by preventing audit records indicating a potential attack from being destroyed.
	FAU_STG.5 (sel-based)	Mitigates threat by ensuring that exhaustion of audit storage does not prevent audit data indicating a potential attack from being generated.
	FCS_STG_EXT.2 (sel-based)	Mitigates threat by using cryptography to protect the confidentiality of key data from outside access.
	FCS_STG_EXT.3 (sel-based)	Mitigates threat by using cryptography to protect the integrity of key data from outside modification.
T.NETWORK_ BASED_ATTACK	FPT_STM.1	Mitigates threat by ensuring that audit data indicating a potential attack is accurately timestamped.
	FCS_SLT_EXT.1 (optional)	Mitigates threat by using salts to increase the effectiveness of cryptographic functions used to protect against attack.
	FCS_CKM.1/AKG (sel-based)	Mitigates threat by generating strong cryptographic asymmetric keys to protect data in transit.
	FCS_CKM.1/SKG (sel-based)	Mitigates threat by generating strong cryptographic symmetric keys to protect data in transit.
	FCS_CKM.2 (sel-based)	Mitigates threat by implementing key establishment to negotiate trusted channels to protect data in transit.
	FCS_CKM.6 (sel-based)	Mitigates threat by implementing key destruction to prevent the compromise of trusted channels.
	FCS_COP.1/Hash (sel-based)	Mitigates threat by implementing hash functions used for trusted communications.
	FCS_COP.1/KAT (sel-based)	Mitigates threat by implementing key agreement and transport functions used for trusted communications.
	FCS_COP.1/KeyedHash (sel-based)	Mitigates threat by implementing MAC functions used for trusted communications.
	FCS_COP.1/SigGen (sel-based)	Mitigates threat by implementing signature generation functions used for trusted communications.
	FCS_COP.1/SigVer (sel-based)	Mitigates threat by implementing signature verification functions used for trusted communications.
	FCS_COP.1/SKC (sel-based)	Mitigates threat by implementing symmetric encryption functions used for trusted communications.
	FAU_GEN.1 (sel-based)	Mitigates threat by generating audit records that could provide evidence of attack or misuse.

	FCS_HTTPS_EXT.1 (sel-based)	Mitigates threat by implementing HTTPS as a means to protect data in transit.
	FCS_IPSEC_EXT.1 (sel-based)	Mitigates threat by implementing IPsec as a means to protect data in transit.
	FTP_ITC_EXT.1 (sel-based)	Mitigates threat by ensuring that sensitive data in transit uses trusted protocols.
	FTP_ITE_EXT.1 (sel-based)	Mitigates threat by ensuring that sensitive data transmitted over untrusted channels is encrypted prior to transit.
	FTP_ITP_EXT.1 (sel-based)	Mitigates threat by using a physically protected channel to protect data in transit.
	FAU_SAR.1 (sel-based)	Mitigates threat by recording audit data in a manner that could be interpreted to discover evidence of attack.
	FAU_STG.1 (sel-based)	Mitigates threat by using an external server to preserve audit data that may provide evidence of an attack.
	FAU_STG.2 (sel-based)	Mitigates threat by preventing audit records indicating a potential attack from being destroyed.
	FAU_STG.5 (sel-based)	Mitigates threat by ensuring that exhaustion of audit storage does not prevent audit data indicating a potential attack from being generated.
	FTP_TRP.1 (sel-based)	Mitigates threat by ensuring that remote administration only uses trusted channels.
T.UNAUTHORIZED_RECONFIGURATION	FMT_CFG_EXT.1	Mitigates threat by preventing knowledge of a default credential from being used to access the TSF without authorization.
	FMT_MOF.1	Mitigates threat by permitting management functions to be used only by authorized users.
	FMT_SMF.1	Mitigates threat by specifying the management functions implemented by the TSF.
	FMT_SMR.1	Mitigates threat by defining the management roles which can be used to grant access to management functions.
	FIA_UIA_EXT.1 (sel-based)	Mitigates threat by preventing the TSF from being modified by an unauthenticated subject.
T.UNAUTHORIZED_PLATFORM_ADMINISTRATOR	FPT_STM.1	Mitigates threat by ensuring that time-based authentication throttling or lockout is accurately enforced.
	FIA_TRT_EXT.1 (optional)	Mitigates threat by throttling authentication to prevent access via brute force.
	FIA_AFL_EXT.1 (sel-based)	Mitigates threat by limiting further authentication attempts once a failure threshold of a critical authentication mechanism has been reached.
	FIA_PMG_EXT.1 (sel-based)	Mitigates threat by enforcing password complexity requirements to prevent credentials from being easily guessed.
	FIA_UAU.5 (sel-based)	Mitigates threat by implementing multiple authentication mechanisms for accessing the TSF.
	FIA_UAU.7 (sel-based)	Mitigates threat by preventing disclosure of authentication data during authentication attempts.

5.2 Security Assurance Requirements

The Security Objectives in were constructed to address threats identified in Section 3.1 Threats. The Security Functional Requirements (SFRs) in Section 5.1 Security Functional Requirements are a formal instantiation of the Security Objectives. The PP identifies the Security Assurance Requirements (SARs) to frame the extent to which the evaluator assesses the documentation applicable for the evaluation and performs independent testing.

This section lists the set of SARs from CC part 3 that are required in evaluations against this PP. Individual Evaluation Activities to be performed are specified both in Section 5.1 Security Functional Requirements as well as in this section.

The general model for evaluation of GPCPs against STs written to conform to this PP is as follows:

After the ST has been approved for evaluation, the ITSEF will obtain the TOE, supporting environmental IT, and the administrative/user guides for the TOE. The ITSEF is expected to perform actions mandated by the Common Evaluation Methodology (CEM) for the ASE and ALC SARs. The ITSEF also performs the Evaluation Activities contained within Section 5.1 Security Functional Requirements, which are intended to be an interpretation of the other CEM assurance requirements as they apply to the specific technology instantiated in the TOE. The Evaluation Activities that are captured in Section 5.1 Security Functional Requirements also provide clarification as to what the developer needs to provide to demonstrate the TOE is compliant with the PP.

5.2.1 Class ASE: Security Target

As per ASE activities defined in [CEM].

5.2.2 Class ADV: Development

The information about the TOE is contained in the guidance documentation available to the end user as well as the TSS portion of the ST. The TOE developer must concur with the description of the product that is contained in the TSS as it relates to the functional requirements. The Evaluation Activities contained in Section 5.1 Security Functional Requirements should provide the ST Authors with sufficient information to determine the appropriate content for the TSS section.

ADV_FSP.1 Basic Functional Specification (ADV_FSP.1)

The functional specification describes the TSFIs. It is not necessary to have a formal or complete specification of these interfaces. Additionally, because TOEs conforming to this PP will necessarily have interfaces to the Operational Environment that are not directly invokable by TOE users, there is little point specifying that such interfaces be described in and of themselves since only indirect testing of such interfaces may be possible. For this PP, the activities for this family should focus on understanding the interfaces presented in the TSS, KMD, and any other supplemental evidence that may be required to satisfy the TSS Evaluation Activities, such as a non-public interface specification, in response to the functional requirements and the interfaces presented in the AGD documentation. No additional "functional specification" documentation is necessary to satisfy the Evaluation Activities specified. The interfaces that need to be evaluated are characterized through the information needed to perform the Evaluation Activities listed, rather than as an independent, abstract list.

Developer action elements:

ADV_FSP.1.1D

The developer shall provide a functional specification.

Content and presentation elements:

ADV_FSP.1.1C

The developer shall provide a tracing from the functional specification to the SFRs.

Application Note: As indicated in the introduction to this section, the functional specification comprises the information contained in the TSS, KMD, and any additional supplemental documentation. The developer may reference a website accessible to application developers and the evaluator. The Evaluation Activities in the functional requirements point to evidence that should exist in the documentation and TSS section; since these are directly associated with the SFRs, the tracing in element ADV_FSP.1.2D is implicitly already done and no additional documentation is necessary.

ADV_FSP.1.2C

The functional specification shall describe the purpose and method of use for each SFR-enforcing and SFR-supporting TSFI.

ADV_FSP.1.3C

The functional specification shall identify all parameters associated with each SFR-enforcing and SFR-supporting TSFI.

ADV_FSP.1.4C

The functional specification shall provide rationale for the implicit categorization of interfaces as SFR-non-interfering.

ADV_FSP.1.5C

The tracing shall demonstrate that the SFRs trace to TSFIs in the functional specification.

Evaluator action elements:

ADV_FSP.1.1E

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ADV_FSP.1.2E

The evaluator shall determine that the functional specification is an accurate and complete instantiation of the SFRs.

Evaluation Activities

ADV_FSP.1
There are no specific Evaluation Activities associated with these SARs, except ensuring the information is provided. The functional specification documentation is provided to support the evaluation activities described in Section 5.1 Security Functional Requirements, and other activities described for AGD, ATE, and AVA SARs. The requirements on the content of the functional specification information is implicitly assessed by virtue of the other Evaluation Activities being performed; if the evaluator is unable to perform an activity because there is insufficient interface information, then an adequate functional specification has not been provided.

5.2.3 Class AGD: Guidance Documentation

The guidance documents will be provided with the ST. Guidance must include a description of how the IT personnel verifies that the Operational Environment can fulfill its role for the security functionality. The documentation should be in an informal style and readable by the IT personnel. Guidance must be provided for every operational environment that the product supports as claimed in the ST. This guidance includes instructions to successfully install the TSF in that environment; and Instructions to manage the security of the TSF as a product and as a component of the larger operational environment. Guidance pertaining to particular security functionality is also provided; requirements on such guidance are contained in the Evaluation Activities specified with each requirement.

AGD_OPE.1 Operational User Guidance (AGD_OPE.1)

Developer action elements:

AGD_OPE.1.1D

The developer shall provide operational user guidance.

Application Note: The operational user guidance does not have to be contained in a single document. Guidance to users, administrators and application developers can be spread among documents or web pages. Rather than repeat information here, the developer should review the Evaluation Activities for this component to ascertain the specifics of the guidance that the evaluator will be checking for. This will provide the necessary information for the preparation of acceptable guidance.

Content and presentation elements:

AGD_OPE.1.1C

The operational user guidance shall describe, for each user role, the user-accessible functions and privileges that should be controlled in a secure processing environment, including appropriate warnings.

Application Note: User and administrator are to be considered in the definition of user role.

AGD_OPE.1.2C

The operational user guidance shall describe, for each user role, how to use the available interfaces provided by the TOE in a secure manner.

AGD_OPE.1.3C

The operational user guidance shall describe, for each user role, the available functions and interfaces, in particular all security parameters under the control of the user, indicating secure values as appropriate.

Application Note: This portion of the operational user guidance should be presented in the form of a checklist that can be quickly executed by IT personnel (or end-users, when necessary) and suitable for use in compliance activities. When possible, this guidance is to be expressed in the eXtensible Configuration Checklist Description Format (XCCDF) to support security automation. Minimally, it should be presented in a structured format which includes a title for each configuration item, instructions for achieving the secure configuration, and any relevant rationale.

AGD_OPE.1.4C

The operational user guidance shall, for each user role, clearly present each type of security-relevant event relative to the user-accessible functions that need to be performed, including changing the security characteristics of entities under the control of the TSF.

AGD_OPE.1.5C

The operational user guidance shall identify all possible modes of operation of the TOE (including operation following failure or operational error), their consequences, and implications for maintaining secure operation.

AGD_OPE.1.6C

The operational user guidance shall, for each user role, describe the security measures to be followed in order to fulfill the security objectives for the operational environment as described in the ST.

AGD_OPE.1.7C

The operational user guidance shall be clear and reasonable.

Evaluator action elements:

AGD_OPE.1.1E

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

Evaluation Activities

AGD_OPE.1
Some of the contents of the operational guidance are verified by the Evaluation Activities in Section 5.1 Security Functional Requirements and evaluation of the TOE according to the [CEM]. The following additional information is also required:

- *If cryptographic functions are provided by the TOE, the operational guidance shall contain instructions for configuring the cryptographic engine associated with the evaluated configuration of the TOE. It shall provide a warning to the administrator that use of other cryptographic engines was not evaluated nor tested during the CC evaluation of the TOE.*
- *If the TOE supports firmware updates, the documentation must describe the process for verifying updates to the TOE by verifying a digital signature – this may be done by the TOE or the underlying platform. The evaluator will verify that this process includes the following steps: Instructions for obtaining the update itself. This should include instructions for making the update accessible to the TOE (e.g., placement in a specific directory). Instructions for initiating the update process, as well as discerning whether the process was successful or unsuccessful. This includes generation of the hash/digital signature.*

The TOE will likely contain security functionality that does not fall in the scope of evaluation under this PP. The operational guidance shall make it clear to an administrator which security functionality is covered by the evaluation activities.

AGD_PRE.1 Preparative Procedures (AGD_PRE.1)

Developer action elements:

AGD_PRE.1.1D

The developer shall provide the TOE, including its preparative procedures.

Application Note: As with the operational guidance, the developer should look to the Evaluation Activities to determine the required content with respect to preparative procedures.

Content and presentation elements:

AGD_PRE.1.1C

The preparative procedures shall describe all the steps necessary for secure acceptance of the delivered TOE in accordance with the developer's delivery procedures.

AGD_PRE.1.2C

The preparative procedures shall describe all the steps necessary for secure installation of the TOE and for the secure preparation of the operational environment in accordance with the security objectives for the operational environment as described in the ST.

Evaluator action elements:

AGD_PRE.1.1E

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

AGD_PRE.1.2E

The evaluator shall apply the preparative procedures to confirm that the TOE can be prepared securely for operation.

Evaluation Activities

AGD_PRE.1
As indicated in the introduction above, there are significant expectations with respect to the documentation—especially when configuring the operational environment to support TOE functional requirements.

5.2.4 Class ALC: Life-cycle Support

At the assurance level provided for TOEs conformant to this PP, life-cycle support is limited to end-user-visible aspects of the life-cycle, rather than an examination of the TOE vendor's development and configuration management process. This is not meant to diminish the critical role that a developer's practices play in contributing to the overall trustworthiness of a product; rather, it is a reflection on the information to be made available for evaluation at this assurance level.

ALC_CMC.1 Labeling of the TOE (ALC_CMC.1)

This component is targeted at identifying the TOE such that it can be distinguished from other products or versions from the same vendor and can be easily specified when being procured by an end user.

Developer action elements:

ALC_CMC.1.1D

The developer shall provide the TOE and a reference for the TOE.

Content and presentation elements:

ALC_CMC.1.1C

The TOE shall be labeled with a unique reference.

Application Note: Unique reference information includes:

- TOE Model Name
- TOE Version
- TOE Description
- Software Identification (SWID) tags, if available

Evaluator action elements:

ALC_CMC.1.1E

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

Evaluation Activities

ALC_CMC.1
The evaluator will check the ST to ensure that it contains sufficient information to specifically identify the the TOE and the version that meets the requirements of the ST. Further, the evaluator will check the AGD guidance and TOE samples received for testing to ensure that the version number is consistent with that in the ST. If the vendor maintains a web site advertising the TOE, the evaluator will examine the information on the web site to ensure that the information in the ST is sufficient to distinguish the product.

ALC_CMS.1 TOE CM Coverage (ALC_CMS.1)

Given the scope of the TOE and its associated evaluation evidence requirements, this component's Evaluation Activities are covered by the Evaluation Activities listed for ALC_CMC.1.

Developer action elements:

ALC_CMS.1.1D

The developer shall provide a configuration list for the TOE.

Content and presentation elements:

ALC_CMS.1.1C

The configuration list shall include the following: the TOE itself; and the evaluation evidence required by the SARs.

ALC_CMS.1.2C

The configuration list shall uniquely identify the configuration items.

Evaluator action elements:

ALC_CMS.1.1E

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

Evaluation Activities

ALC_CMS.1
The "evaluation evidence required by the SARs" in this PP is limited to the information in the ST coupled with the guidance provided to administrators and users under the AGD requirements. By ensuring that the OS is specifically identified and that this identification is consistent in the ST and in the AGD guidance (as done in the Evaluation Activity for ALC_CMC.1), the evaluator implicitly confirms the information required by this component. Life-cycle support is targeted aspects of the developer's life-cycle and instructions to providers of applications for the developer's devices, rather than an in-depth examination of the TSF manufacturer's development and configuration management process. This is not meant to diminish the critical role that a developer's practices play in contributing to the overall trustworthiness of a product; rather, it's a reflection on the information to be made available for evaluation.

The evaluator will ensure that the developer has identified (in guidance documentation for application developers concerning the targeted platform) one or more development environments appropriate for use in developing applications for the developer's platform. For each of these development environments, the developer shall provide information on how to configure the environment to ensure that buffer overflow protection mechanisms in the environment(s) are invoked (e.g., compiler and linker flags). The evaluator will ensure that this documentation also includes an indication of whether such protections are on by default, or have to be specifically enabled. The evaluator will ensure that the TSF is uniquely identified (with respect to other products from the TSF vendor), and that documentation provided by the developer in association with the requirements in the ST is associated with the TSF using this unique identification.

ALC_TSU_EXT.1 Timely Security Updates

This component requires the TOE developer, in conjunction with any other necessary parties, to provide information as to how the TOE is updated to address security issues in a timely manner. The documentation describes the process of providing updates to the public from the time a security flaw is reported/discovered, to the time an update is released. This description includes the parties involved (e.g., developer/OEM, component manufacturers) and the steps that are performed (e.g., developer testing), including worst case time periods, before an update is made available to the public.

For TOE implementations with immutable firmware, update might not be possible other than through replacement of the entire device. In this case, delivery of a new device with the necessary security fixes would constitute deployment of the security update.

Developer action elements:

ALC_TSU_EXT.1.1D

The developer shall provide a description in the TSS of how timely security updates are made to the TOE.

ALC_TSU_EXT.1.2D

The developer shall provide a description in the TSS of how users are notified when updates change security properties or the configuration of the product.

Content and presentation elements:

ALC_TSU_EXT.1.1C

The description shall include the process for creating and deploying security updates for TOE firmware.

ALC_TSU_EXT.1.2C

The description shall include the mechanisms publicly available for reporting security issues pertaining to the TOE.

Note: The reporting mechanism could include web sites, email addresses, as well as a means to protect the sensitive nature of the report (e.g., public keys that could be used to encrypt the details of a proof-of-concept exploit).

Evaluator action elements:

ALC_TSU_EXT.1.1E

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

Evaluation Activities

ALC_TSU_EXT.1
The evaluator will verify that the TSS contains a description of the timely security update process used by the developer to create and deploy security updates for TOE firmware. The evaluator will also verify that, in addition to the TOE developer's process, any third-party processes are also addressed in the description. The evaluator will also verify that each mechanism for deployment of security updates is described.

The evaluator will verify that, for each deployment mechanism described for the update process, the TSS lists a time between public disclosure of a vulnerability and public availability of the security update to the TOE patching this vulnerability. The evaluator will verify that this time is expressed in a number or range of days.

The evaluator will verify that this description includes the publicly available mechanisms (including either an email address or website) for reporting security issues related to the TOE. The evaluator shall verify that the description of this mechanism includes a method for protecting the report either using a public key for encrypting email or a trusted channel for a website.

5.2.5 Class ATE: Tests

Testing is specified for functional aspects of the system as well as aspects that take advantage of design or implementation weaknesses. The former is done through the ATE_IND family, while the latter is through the AVA_VAN family. At the assurance level specified in this PP, testing is based on advertised functionality and interfaces with dependency on the availability of design information. One of the primary outputs of the evaluation process is the test report as specified in the following requirements.

ATE_IND.1 Independent Testing – Conformance (ATE_IND.1)

Testing is performed to confirm the functionality described in the TSS as well as the administrative (including configuration and operational) documentation provided. The focus of the testing is to confirm that the requirements specified in Section 5.1 Security Functional Requirements being met, although some additional testing is specified for SARs in Section 5.2 Security Assurance Requirements. The Evaluation Activities identify the additional testing activities associated with these components. The evaluator produces a test report documenting the plan for and results of testing, as well as coverage arguments focused on the hardware configurations that are claiming conformance to this PP. Given the scope of the TOE and its associated evaluation evidence requirements, this component's Evaluation Activities are covered by the Evaluation Activities listed for ALC_CMC.1.

Developer action elements:

ATE_IND.1.1D
The developer shall provide the TOE for testing.

Content and presentation elements:

ATE_IND.1.1C
The TOE shall be suitable for testing.

Evaluator action elements:

ATE_IND.1.1E
The evaluator *shall confirm* that the information provided meets all requirements for content and presentation of evidence.

ATE_IND.1.2E
The evaluator shall test a subset of the TSF to confirm that the TSF operates as specified.

Evaluation Activities

ATE_IND.1
The evaluator will prepare a test plan and report documenting the testing aspects of the system, including any application crashes during testing. The evaluator shall determine the root cause of any application crashes and include that information in the report. The test plan covers all of the testing actions contained in the [CEM] and the body of this PP's Assurance Activities.

While it is not necessary to have one test case per test listed in an Assurance Activity, the evaluator must document in the test plan that each applicable testing requirement in the ST is covered. The test plan identifies the platforms to be tested, and for those platforms not included

in the test plan but included in the ST, the test plan provides a justification for not testing the platforms. This justification must address the differences between the tested platforms and the untested platforms, and make an argument that the differences do not affect the testing to be performed. It is not sufficient to merely assert that the differences have no affect; rationale must be provided. If all platforms claimed in the ST are tested, then no rationale is necessary. The test plan describes the composition of each platform to be tested, and any setup that is necessary beyond what is contained in the AGD documentation. It should be noted that the evaluator is expected to follow the AGD documentation for installation and setup of each platform either as part of a test or as a standard pre-test condition. This may include special test drivers or tools. For each driver or tool, an argument (not just an assertion) should be provided that the driver or tool will not adversely affect the performance of the functionality by the OS and its platform.

This also includes the configuration of the cryptographic engine to be used. The cryptographic algorithms implemented by this engine are those specified by this PP and used by the cryptographic protocols being evaluated (IPsec, TLS). The test plan identifies high-level test objectives as well as the test procedures to be followed to achieve those objectives. These procedures include expected results.

The test report (which could just be an annotated version of the test plan) details the activities that took place when the test procedures were executed, and includes the actual results of the tests. This shall be a cumulative account, so if there was a test run that resulted in a failure; a fix installed; and then a successful re-run of the test, the report would show a "fail" and "pass" result (and the supporting details), and not just the "pass" result.

5.2.6 Class AVA: Vulnerability Assessment

For the first generation of this protection profile, the evaluation lab is expected to survey open sources to discover what vulnerabilities have been discovered in these types of products. In most cases, these vulnerabilities will require sophistication beyond that of a basic attacker. Until penetration tools are created and uniformly distributed to the evaluation labs, the evaluator will not be expected to test for these vulnerabilities in the TOE. The labs will be expected to comment on the likelihood of these vulnerabilities given the documentation provided by the vendor. This information will be used in the development of penetration testing tools and for the development of future protection profiles.

AVA_VAN.1 Vulnerability Survey (AVA_VAN.1)

Developer action elements:

AVA_VAN.1.1D
The developer shall provide the TOE for testing.

Content and presentation elements:

AVA_VAN.1.1C
The TOE shall be suitable for testing.

Evaluator action elements:

AVA_VAN.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

AVA_VAN.1.2E
The evaluator shall perform a search of public domain sources to identify potential vulnerabilities in the TOE.

Application Note: Public domain sources include the Common Vulnerabilities and Exposures (CVE) dictionary for publicly known vulnerabilities.

AVA_VAN.1.3E
The evaluator shall conduct penetration testing, based on the identified potential vulnerabilities, to determine that the TOE is resistant to attacks performed by an attacker possessing Basic attack potential.

Evaluation Activities

AVA_VAN.1
The evaluator will generate a report to document their findings with respect to this requirement. This report could physically be part of the overall test report mentioned in ATE_IND, or a separate document. The evaluator performs a search of public information to find vulnerabilities that have been found in similar applications with a particular focus on network protocols the application uses and document formats it parses. The evaluator documents the sources consulted and the vulnerabilities found in the report.

For each vulnerability found, the evaluator either provides a rationale with respect to its non-applicability, or the evaluator formulates a test (using the guidelines provided in ATE_IND) to

confirm the vulnerability, if suitable. Suitability is determined by assessing the attack vector needed to take advantage of the vulnerability. If exploiting the vulnerability requires expert skills and an electron microscope, for instance, then a test would not be suitable and an appropriate justification would be formulated.

Appendix A - Implementation-dependent Requirements

Implementation-dependent Requirements Appendix defines requirements that must be claimed in the ST if the TOE implements particular product features. For this technology type, the following product features require the claiming of additional SFRs:

Appendix B - Extended Component Definitions

This appendix contains the definitions for all extended requirements specified in the PP.

B.1 Extended Components Table

All extended components specified in the PP are listed in this table:

Table 22: Extended Component Definitions

Functional Class	Functional Components
Class: Cryptographic Support (FCS)	FCS_CKM_EXT Cryptographic Key Management FCS_HTTPS_EXT HTTPS Protocol FCS_IPSEC_EXT IPsec Protocol FCS_SLT_EXT Cryptographic Salt Generation FCS_STG_EXT Cryptographic Key Storage
Class: Identification and Authentication (FIA)	FIA_AFL_EXT Authentication Failure Handling FIA_PMG_EXT Password Management FIA_TRT_EXT Authentication Throttling FIA_UIA_EXT Administrator Identification and Authentication
Class: Protection of the TSF (FPT)	FPT_JTA_EXT Debug Port Access FPT_PPF_EXT Protection of Platform Firmware FPT_ROT_EXT Platform Integrity FPT_RVR_EXT Platform Firmware Recovery FPT_TUD_EXT Platform Firmware Update
Class: Security Management (FMT)	FMT_CFG_EXT Secure by Default
Class: Trusted Path/Channels (FTP)	FTP_ITC_EXT Trusted Channel Communications FTP_ITE_EXT Encrypted Data Communications FTP_ITP_EXT Physically Protected Channel
Class: User Data Protection (FDP)	FDP_ITC_EXT Key Import FDP_TEE_EXT Trusted Execution Environment

B.2 Extended Component Definitions

B.2.1 Class: Cryptographic Support (FCS)

This PP defines the following extended components as part of the FCS class originally defined by CC Part 2:

B.2.1.1 FCS_CKM_EXT Cryptographic Key Management

Family Behavior

This family defines requirements for management of cryptographic keys. FCS_CKM_EXT.5 is necessary to express requirements for key derivation, which are missing from Part 2.

Component Leveling

B.2.1.2 FCS_HTTPS_EXT HTTPS Protocol

Family Behavior

This family defines requirements for protecting HTTP communications between the TOE and an external IT entity.

Component Leveling

FCS_HTTPS_EXT.1, HTTPS Protocol, defines requirements for the implementation of the HTTPS protocol.

Management: FCS_HTTPS_EXT.1

There are no management functions foreseen.

Audit: FCS_HTTPS_EXT.1

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

a. Failure to establish an HTTPS session.
b. Establishment/termination of an HTTPS session.

FCS_HTTPS_EXT.1 HTTPS Protocol

Hierarchical to: No other components.

Dependencies to:
[FCS_TLSC_EXT.1 TLS Client Protocol, or
FCS_TLSC_EXT.2 TLS Client Protocol with Mutual Authentication, or
FCS_TLSS_EXT.1 TLS Server Protocol, or
FCS_TLSS_EXT.2 TLS Server Protocol with Mutual Authentication]

FCS_HTTPS_EXT.1.1

The TSF shall implement the HTTPS protocol that complies with RFC 2818.

FCS_HTTPS_EXT.1.2

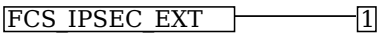
The TSF shall implement HTTPS using TLS.

B.2.1.3 FCS_IPSEC_EXT IPsec Protocol

Family Behavior

This family defines requirements for protecting communications using IPsec.

Component Leveling



FCS_IPSEC_EXT.1, IPsec Protocol, requires that IPsec be implemented as specified manner.

Management: FCS_IPSEC_EXT.1

The following actions could be considered for the management functions in FMT:

a. Managing the cryptographic functionality.

Audit: FCS_IPSEC_EXT.1

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

a. Failure to establish an IPsec SA.
b. Establishment/Termination of an IPsec SA.

FCS_IPSEC_EXT.1 IPsec Protocol

Hierarchical to: No other components.

Dependencies to:
FCS_CKM.1 Cryptographic Key Generation
FCS_CKM.2 Cryptographic Key Establishment
FCS_COP.1 Cryptographic Operation
FCS_RBG.1 Random Bit Generation
FIA_X509_EXT.1 X.509 Certificate Validation

FCS_IPSEC_EXT.1.1

The TSF shall implement the IPsec architecture as specified in RFC 4301.

FCS_IPSEC_EXT.1.2

The TSF shall implement [**assignment**: *IPsec modes*].

FCS_IPSEC_EXT.1.3

The TSF shall have a nominal, final entry in the SPD that matches anything that is otherwise unmatched, and discards it.

FCS_IPSEC_EXT.1.4

The TSF shall implement the IPsec protocol ESP as defined by RFC 4303 using the cryptographic algorithms [**assignment**: *cryptographic algorithms*] together with a Secure Hash Algorithm (SHA)-based HMAC.

FCS_IPSEC_EXT.1.5

The TSF shall implement the protocol: [**assignment**: *key exchange protocol*].

FCS_IPSEC_EXT.1.6

The TSF shall ensure the encrypted payload in the [**assignment**: *key exchange protocol*] protocol uses the cryptographic algorithms [**assignment**: *cryptographic algorithms*].

FCS_IPSEC_EXT.1.7

The TSF shall ensure that [**assignment**: *key exchange protocol lifetime configuration rules*].

FCS_IPSEC_EXT.1.8

The TSF shall ensure that all IKE protocols implement DH groups [**assignment**: *DH Groups*].

FCS_IPSEC_EXT.1.9

The TSF shall generate the secret value x used in the IKE Diffie-Hellman key exchange ("x" in gx mod p) using the random bit generator specified in FCS_RBG.1, and having a length of at least [**assignment**: *(one or more) number(s) of bits that is at least twice the "bits of security" value associated with the negotiated Diffie-Hellman group as listed in Table 2 of NIST SP 800-57, Recommendation for Key Management – Part 1: General*] bits.

FCS_IPSEC_EXT.1.10

The TSF shall generate nonces used in IKE exchanges in a manner such that the probability that a specific nonce value will be repeated during the life a specific IPsec SA is less than 1 in 2^[**assignment**: *(one or more) "bits of security" value(s) associated with the negotiated Diffie-Hellman group as listed in Table 2 of NIST SP 800-57, Recommendation for Key Management – Part 1: General*].

FCS_IPSEC_EXT.1.11

The TSF shall ensure that all IKE protocols perform peer authentication using a [**assignment**: *IKE peer authentication algorithm*] that use X.509v3 certificates that conform to RFC 4945 and [**assignment**: *other IKE peer authentication mechanism*].

FCS_IPSEC_EXT.1.12

The TSF shall not establish an SA if the [**assignment**: *specific certificate reference identifier*] and [**assignment**: *other certificate reference identifier type*] contained in a certificate does not match the expected value(s) for the entity attempting to establish a connection.

FCS_IPSEC_EXT.1.13

The TSF shall not establish an SA if the presented identifier does not match the configured reference identifier of the peer.

FCS_IPSEC_EXT.1.14

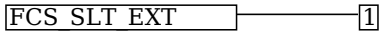
The [**assignment**: *configuring entity*] shall be able to ensure by default that the strength of the symmetric algorithm (in terms of the number of bits in the key) negotiated to protect the [**assignment**: *connection type*] connection is greater than or equal to the strength of the symmetric algorithm (in terms of the number of bits in the key) negotiated to protect the [**assignment**: *connection type*]connection.

B.2.1.4 FCS_SLT_EXT Cryptographic Salt Generation

Family Behavior

This family defines requirements for cryptographic salt generation.

Component Leveling



FCS_SLT_EXT.1, Cryptographic Salt Generation, requires the TSF to generate salt values in a specified manner.

Management: FCS_SLT_EXT.1

There are no management functions foreseen.

Audit: FCS_SLT_EXT.1

There are no audit events foreseen.

FCS_SLT_EXT.1 Cryptographic Salt Generation

Hierarchical to: No other components.

Dependencies to: FCS_RBG.1 Random Bit Generation

FCS_SLT_EXT.1.1

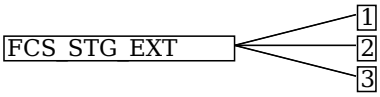
The TSF shall use salts and nonces generated by an RBG as specified in FCS_RBG.1.

B.2.1.5 FCS_STG_EXT Cryptographic Key Storage

Family Behavior

This family defines requirements for ensuring the protection of keys and secrets.

Component Leveling



FCS_STG_EXT.1, Protected Storage, requires the TSF to enforce protected storage for keys and secrets so that they cannot be accessed or destroyed without authorization.

FCS_STG_EXT.2, Key Storage Encryption, requires the TSF to ensure the confidentiality of stored data using a specified method.

FCS_STG_EXT.3, Key Integrity Protection, requires the TSF to ensure the integrity of stored data using a specified method.

Management: FCS_STG_EXT.1

The following actions could be considered for the management functions in FMT:

- Ability to manage import and export keys/secrets to and from protected storage.

Audit: FCS_STG_EXT.1

There are no audit events foreseen.

FCS_STG_EXT.1 Protected Storage

Hierarchical to: No other components.

Dependencies to: FCS_CKM.6 Timing and Event of Cryptographic Key Destruction

FCS_STG_EXT.1.1

The TSF shall provide [**assignment**: *protected storage type*] protected storage for asymmetric private keys and [**assignment**: *secrets to be stored*].

FCS_STG_EXT.1.2

The TSF shall support the capability of [**assignment**: *capability for acquiring keys*] upon request of [**assignment**: *entity requesting storage*].

FCS_STG_EXT.1.3

The TSF shall be capable of destroying keys/secrets in the protected storage upon request of [**assignment**: *authorized subject*].

Management: FCS_STG_EXT.2

There are no management functions foreseen.

Audit: FCS_STG_EXT.2

There are no audit events foreseen.

FCS_STG_EXT.2 Key Storage Encryption

Hierarchical to: No other components.

Dependencies to:
FCS_COP.1 Cryptographic Operation
FCS_STG_EXT.1 Protected Storage

FCS_STG_EXT.2.1

The TSF shall encrypt [**assignment**: *types of key material*] using [**assignment**: *cryptographic algorithm*].

Management: FCS_STG_EXT.3

There are no management functions foreseen.

Audit: FCS_STG_EXT.3

There are no audit events foreseen.

FCS_STG_EXT.3 Key Integrity Protection

Hierarchical to: No other components.

Dependencies to:
FCS_COP.1 Cryptographic Operation

FCS_STG_EXT.3.1

The TSF shall protect the integrity of any encrypted [**assignment**: *types of key material*] by using [**assignment**: *integrity protection mechanism*].

FCS_STG_EXT.3.2

The TSF shall verify the integrity of the [**selection**: *digital signature, MAC*] of the stored key prior to use of the key.

B.2.2 Class: Identification and Authentication (FIA)

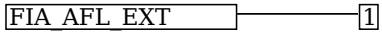
This PP defines the following extended components as part of the FIA class originally defined by CC Part 2:

B.2.2.1 FIA_AFL_EXT Authentication Failure Handling

Family Behavior

This family defines requirements for the TOE's behavior when repeated failed attempts to gain authorization to access TSF data occur.

Component Leveling



FIA_AFL_EXT.1, Authentication Failure Handling, requires the TSF to monitor authorization attempts, including counting and limiting the number of attempts at failed or passed authorizations. This extended component permits considerably more flexibility for dealing with multiple authentication mechanisms than FIA_AFL.

Management: FIA_AFL_EXT.1

The following actions could be considered for the management functions in FMT:

- Set authorization failure parameters

Audit: FIA_AFL_EXT.1

If FAU_GEN.1 is included in the ST, then the following audit events should be considered:

- Administrator authentication failures.

FIA_AFL_EXT.1 Authentication Failure Handling

Hierarchical to: No other components.

Dependencies to:
FCS_CKM.6 Timing and Event of Cryptographic Key Destruction
FIA_SMF.1 Specification of Management Functions

FIA_AFL_EXT.1.1

The TSF shall consider password and [**assignment**: *other authentication mechanisms*] as critical authentication mechanisms.\\

FIA_AFL_EXT.1.2

The TSF shall detect when a configurable positive integer within [**assignment**: *range of acceptable values for each authentication mechanism*] of [**selection, choose one of**: *unique*, *non-unique*] unsuccessful authentication attempts occur related to last successful authentication for each authentication mechanism.

FIA_AFL_EXT.1.3

The TSF shall maintain the number of unsuccessful authentication attempts that have occurred upon power off.

FIA_AFL_EXT.1.4

When the defined number of unsuccessful authentication attempts has exceeded the maximum allowed for a given authentication mechanism, all future authentication attempts shall be limited to other available authentication mechanisms, unless the given mechanism is designated as a critical authentication mechanism.

FIA_AFL_EXT.1.5

When the defined number of unsuccessful authentication attempts for the last available authentication mechanism or a critical authentication mechanism has been surpassed, the TSF shall [**selection**:

- *perform a wipe of all protected data*
- *exclude the current User/Administrator from further authentication attempts*
- *exclude the current User/Administrator from further authentication attempts for a period of [**assignment**: greater than zero seconds] time*

].

FIA_AFL_EXT.1.6

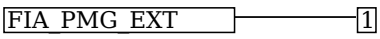
The TSF shall increment the number of unsuccessful authentication attempts prior to notifying the user that the authentication was unsuccessful.

B.2.2.2 FIA_PMG_EXT Password Management

Family Behavior

This family defines requirements for the composition of administrator passwords.

Component Leveling



FIA_PMG_EXT.1, Password Management, requires the TSF to support passwords with varying composition and length requirements.

Management: FIA_PMG_EXT.1

The following actions could be considered for the management functions in FMT:

- Ability to configure password composition and length requirements for authorization of Administrators.
- Ability to manage authentication methods and change default authorization factors

Audit: FIA_PMG_EXT.1

There are no audit events foreseen.

FIA_PMG_EXT.1 Password Management

Hierarchical to: No other components.

Dependencies to: No other components.

FIA_PMG_EXT.1.1

The TSF shall support the following for the Password Authentication Factor:

1. Passwords shall be able to be composed of any combination of [**assignment**: *characters sets*], numbers, and special characters: [**assignment**: *special characters*].
2. Password length up to [**assignment**: *an integer greater than or equal to 14*] characters shall be

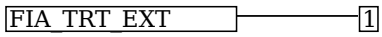
supported.

B.2.2.3 FIA_TRT_EXT Authentication Throttling

Family Behavior

This family defines requirements for the limiting administrator authentication attempts.

Component Leveling



FIA_TRT_EXT.1, Authentication Throttling, requires that the TSF enforce a limit on authentication attempts.

Management: FIA_TRT_EXT.1

The following actions could be considered for the management functions in FMT:

- Ability to configure an authentication throttling policy for the TOE.

Audit: FIA_TRT_EXT.1

The following should be considered for auditable events if FAU_GEN.1 is included in the ST:

- Authentication throttling is triggered.

FIA_TRT_EXT.1 Authentication Throttling

Hierarchical to: No other components.

Dependencies to: FIA_UAU.5 Multiple Authentication Mechanisms

FIA_TRT_EXT.1.1

The TSF shall limit user authentication attempts by [**selection**: *preventing authentication via an external port, enforcing a delay between incorrect authentication attempts*] for all authentication mechanisms selected in FIA_UAU.5.1.

FIA_TRT_EXT.1.2

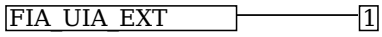
The minimum delay between incorrect authentication attempts shall be such that no more than 10 attempts can be attempted per 500 milliseconds.

B.2.2.4 FIA_UIA_EXT Administrator Identification and Authentication

Family Behavior

This family defines requirements for ensuring that access to the TSF is not granted to unauthenticated subjects.

Component Leveling



FIA_UIA_EXT.1, Administrator Identification and Authentication, requires the TSF to ensure that all subjects attempting to perform TSF-mediated actions are identified and authenticated prior to authorizing these actions to be performed.

Management: FIA_UIA_EXT.1

There are no management functions foreseen.

Audit: FIA_UIA_EXT.1

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

a. All use of the identification and authentication mechanism.

FIA_UIA_EXT.1 Administrator Identification and Authentication

Hierarchical to: No other components.

Dependencies to: FIA_UAU.5 Multiple Authentication Mechanisms

FIA_UIA_EXT.1.1

The TSF shall require Administrators to be successfully identified and authenticated using one of the methods in FIA_UAU.5 before allowing any TSF-mediated management function to be performed by that Administrator.

B.2.3 Class: Protection of the TSF (FPT)

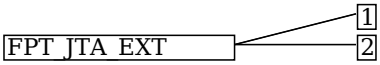
This PP defines the following extended components as part of the FPT class originally defined by CC Part 2:

B.2.3.1 FPT_JTA_EXT Debug Port Access

Family Behavior

This family defines requirements for access to debug ports during normal operation.

Component Leveling



FPT_JTA_EXT.1, JTAG/Debug Port Access, requires that debug ports be accessible only to authorized Administrators.

FPT_JTA_EXT.2, JTAG/Debug Port Disablement, requires that debug ports be disabled.

Management: FPT_JTA_EXT.1

There are no management functions foreseen.

Audit: FPT_JTA_EXT.1

There are no audit events foreseen.

FPT_JTA_EXT.1 JTAG/Debug Port Access

Hierarchical to: No other components.

Dependencies to: No dependencies.

FPT_JTA_EXT.1.1

The TSF shall allow access to JTAG or other debug ports only to an authorized Administrator through platform firmware or through assertion of physical presence.

Management: FPT_JTA_EXT.2

There are no management functions foreseen.

Audit: FPT_JTA_EXT.2

There are no audit events foreseen.

FPT_JTA_EXT.2 JTAG/Debug Port Disablement

Hierarchical to: No other components.

Dependencies to: No dependencies.

FPT_JTA_EXT.2.1

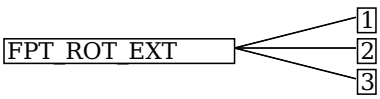
The TSF shall [**selection, choose one of**: *disable access through hardware*, *control access by a signing key*] to JTAG or other debug interfaces.

B.2.3.2 FPT_ROT_EXT Platform Integrity

Family Behavior

This family defines requirements for platform firmware and hardware integrity.

Component Leveling



FPT_ROT_EXT.1, Platform Integrity Root, requires that the platform integrity be anchored in a root of trust.

FPT_ROT_EXT.2, Platform Integrity Extension, specifies how platform integrity is extended from the integrity root to other platform firmware.

FPT_ROT_EXT.3, Hardware component integrity, requires that the TOE support hardware supply chain integrity.

Management: FPT_ROT_EXT.1

There are no management functions foreseen.

Audit: FPT_ROT_EXT.1

There are no audit events foreseen.

FPT_ROT_EXT.1 Platform Integrity Root

Hierarchical to: No other components.

Dependencies to: No dependencies.

FPT_ROT_EXT.1.1

The integrity of platform firmware shall be rooted in [**assignment**: *platform firmware root of trust*].

Management: FPT_ROT_EXT.2

The following actions could be considered for the management functions in FMT:

- Configuration of action to take on integrity failure.

Audit: FPT_ROT_EXT.2

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

- Failure of integrity verification.

FPT_ROT_EXT.2 Platform Integrity Extension

Hierarchical to: No other components.

Dependencies to:
FPT_ROT_EXT.1 Platform Integrity Root

FPT_ROT_EXT.2.1

The integrity of all mutable platform firmware outside of the platform integrity root specified in FPT_ROT_EXT.1 shall be verified prior to execution or use through: [**assignment**: *method for extending the platform integrity root*].

FPT_ROT_EXT.2.2

The TOE shall take the following actions if an integrity check specified in FPT_ROT_EXT.2.1 fails:

1. Halt,
2. Notify an [**selection**: *Administrator*, *User*] by [**assignment**: *notification method*], and
3. [**selection, choose one of**:
   - *Stop all execution and shut down*
   - *Initiate a recovery process*

   ]

[**selection, choose one of**:
- *automatically*
- *in accordance with Administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

].

Management: FPT_ROT_EXT.3

The following actions could be considered for the management functions in FMT:

- Configuration of action to take on integrity failure.

Audit: FPT_ROT_EXT.3

The following actions should be auditable if FAU_GEN Security audit data generation is included in the

PP/ST:

- Detection of attempted intrusion.

FPT_ROT_EXT.3 Hardware component integrity

Hierarchical to: No other components.

Dependencies to: FPT_ROT_EXT.1 Platform Integrity Root

FPT_ROT_EXT.3.1

Outside of the integrity root specified in FPT_ROT_EXT.1, the integrity of [**assignment**: *critical platform hardware components*] shall be verified prior to execution or use through: [**assignment**: *method for ensuring integrity of platform hardware components*].

FPT_ROT_EXT.3.2

The TOE shall take the following actions if an integrity check specified in FPT_ROT_EXT.3.1 fails:

1. Halt,
2. Notify an [**selection**: *Administrator, User*] by [**assignment**: *notification method*], and
3. [**selection, choose one of**:
   - *Stop all execution and shut down*
   - *Continue execution without the integrity-compromised component*
   - *Continue execution*

   ]

[**selection, choose one of**:

- *in accordance with administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

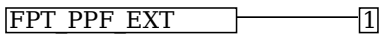
].

B.2.3.3 FPT_PPF_EXT Protection of Platform Firmware

Family Behavior

This family defines requirements for protecting platform firmware from unauthorized update.

Component Leveling



FPT_PPF_EXT.1, Protection of Platform Firmware and Critical Data, requires that the TSF prevent platform firmware from being modified outside of the update mechanisms defined in FPT_TUD_EXT.

Management: FPT_PPF_EXT.1

There are no management functions foreseen.

Audit: FPT_PPF_EXT.1

There are no audit events foreseen.

FPT_PPF_EXT.1 Protection of Platform Firmware and Critical Data

Hierarchical to: No other components.

Dependencies to: No dependencies.

FPT_PPF_EXT.1.1

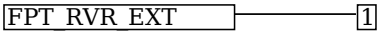
The TSF shall allow modification of platform firmware only through the update mechanisms described in FPT_TUD_EXT.1.

B.2.3.4 FPT_RVR_EXT Platform Firmware Recovery

Family Behavior

This family defines requirements for recovering from a firmware integrity failure.

Component Leveling



FPT_RVR_EXT.1, Platform Firmware Recovery, defines mechanisms for recovering from a platform firmware integrity failure.

Management: FPT_RVR_EXT.1

The following actions could be considered for the management functions in FMT:

- Configuration of action to take on integrity failure.

Audit: FPT_RVR_EXT.1

There are no audit events foreseen.

FPT_RVR_EXT.1 Platform Firmware Recovery

Hierarchical to: No other components.

Dependencies to:
FPT_TUD_EXT.4 Secure Local Update Mechanism

FPT_RVR_EXT.1.1

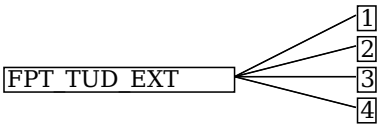
The TSF shall implement a mechanism for recovering from boot firmware failure consisting of [**assignment**: *recovery mechanism*].

B.2.3.5 FPT_TUD_EXT Platform Firmware Update

Family Behavior

This family defines requirements for updating platform firmware.

Component Leveling



FPT_TUD_EXT.1, TOE Firmware Update, requires that the TSF support update of platform firmware.

FPT_TUD_EXT.2, Platform Firmware Authenticated Update Mechanism, specifies the requirements for authenticated update of platform firmware.

FPT_TUD_EXT.3, Platform Firmware Delayed-Authentication Update Mechanism, specifies the requirements for delayed-authentication update of platform firmware.

FPT_TUD_EXT.4, Secure Local Platform Firmware Update Mechanism, specifies the requirements for secure local update of platform firmware.

Management: FPT_TUD_EXT.1

The following actions could be considered for the management functions in FMT:

- Initiation of the update process.

Audit: FPT_TUD_EXT.1

There are no audit events foreseen.

FPT_TUD_EXT.1 TOE Firmware Update

Hierarchical to: No other components.

Dependencies to:
FPT_TUD_EXT.2 Platform Firmware Authenticated Update Mechanism
FPT_TUD_EXT.3 Platform Firmware Delayed-Authentication Update Mechanism
FPT_TUD_EXT.4 Secure Local Platform Firmware Update Mechanism

FPT_TUD_EXT.1.1

The TSF shall implement [**assignment**: *update mechanism*].

Management: FPT_TUD_EXT.2

The following actions could be considered for the management functions in FMT:

- Configuration of action to take on an update failure.

Audit: FPT_TUD_EXT.2

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

- Failure of update authentication/integrity check/rollback
- Failure of update operation
- Success of update operation

FPT_TUD_EXT.2 Platform Firmware Authenticated Update Mechanism

Hierarchical to: No other components.

Dependencies to: FCS_COP.1 Cryptographic Operations

FPT_TUD_EXT.2.1

The TSF shall authenticate the source of all platform firmware updates using a digital signature algorithm specified in FCS_COP.1 and using a key store that contains [**selection**: *the public key, hash value of the public key*].

FPT_TUD_EXT.2.2

The TSF shall allow installation of updates only if the digital signature has been successfully verified as specified in FCS_COP.1 and [**assignment**: *additional constraints on updates*].

FPT_TUD_EXT.2.3

The TSF shall include a platform firmware version identifier that is accessible by the update mechanism and includes information that enables the update mechanism to determine the relative order of updates.

FPT_TUD_EXT.2.4

The TSF shall provide an observable indication of the success or failure of the update operation.

FPT_TUD_EXT.2.5

The TOE shall take the following actions if a platform firmware integrity, authenticity, or rollback-prevention check fails, or a platform firmware update fails for any other reason:

- Do not install the update,
- Notify an [**selection**: *Administrator*, *User*] by [**assignment**: *notification method*],

and [**selection, choose one of**:

- *Continue execution*
- *Halt*
- *Stop all execution and shut down*
- *Initiate recovery as specified in FPT_RVR_EXT.1*

] [**selection, choose one of**:

- *automatically*
- *in accordance with Administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

].

Management: FPT_TUD_EXT.3

The following actions could be considered for the management functions in FMT:

- Configuration of action to take on an update failure.

Audit: FPT_TUD_EXT.3

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

- Failure of update authentication/integrity check/rollback
- Failure of update operation
- Success of update operation

FPT_TUD_EXT.3 Platform Firmware Delayed-Authentication Update Mechanism

Hierarchical to: No other components.

Dependencies to: FPT_ROT_EXT.2 Platform Integrity Extension

FPT_TUD_EXT.3.1

The TSF shall allow execution or use of platform firmware updates only if new platform firmware is integrity- and authenticity-checked using the mechanism described in FPT_ROT_EXT.2 prior to its execution or use, and [**assignment**: *additional constraints on update*].

FPT_TUD_EXT.3.2

The TSF shall include an observable platform firmware version identifier that is accessible by the update mechanism and includes information that enables the update mechanism to determine the relative order of updates.

FPT_TUD_EXT.3.3

The TSF shall provide an observable indication of the success or failure of the update operation.

FPT_TUD_EXT.3.4

The TOE shall take the following actions if a platform firmware update integrity, authentication, or rollback-prevention check fails, or a platform firmware update fails for any other reason:

- Notify an [**selection**: *Administrator*, *User*] by [**assignment**: *notification method*]

and [**selection, choose one of**:

- *Halt*
- *Stop all execution and shut down*
- *Initiate a recovery process as specified in FPT_RVR_EXT.1*

] [**selection, choose one of**:

- *automatically*
- *in accordance with administrator-configurable policy*
- *by express determination of an [**selection**: Administrator, User]*

].

Management: FPT_TUD_EXT.4

There are no management functions foreseen.

Audit: FPT_TUD_EXT.4

There are no audit events foreseen.

FPT_TUD_EXT.4 Secure Local Platform Firmware Update Mechanism

Hierarchical to: No other components.

Dependencies to: No dependencies.

FPT_TUD_EXT.4.1

The TSF shall provide a secure local update mechanism that requires an assertion of physical access to the TOE before installation of an update.

FPT_TUD_EXT.4.2

A user shall assert physical presence to the TSF through: [**assignment**: *method for asserting physical presence*].

FPT_TUD_EXT.4.3

The TSF shall include a platform firmware version identifier that is accessible by the update mechanism or to the user who asserts physical presence.

FPT_TUD_EXT.4.4

The TSF shall provide an observable indication of the success or failure of the update operation.

B.2.4 Class: Security Management (FMT)

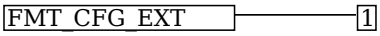
This PP defines the following extended components as part of the FMT class originally defined by CC Part 2:

B.2.4.1 FMT_CFG_EXT Secure by Default

Family Behavior

This family defines requirements for secure by default configuration of the TOE.

Component Leveling



FMT_CFG_EXT.1, Secure by Default Configuration, requires that default Administrator credentials be changed immediately after first use.

Management: FMT_CFG_EXT.1

There are no management functions foreseen.

Audit: FMT_CFG_EXT.1

There are no audit events foreseen.

FMT_CFG_EXT.1 Secure by Default Configuration

Hierarchical to: No other components.

Dependencies to:
FIA_UAU.1 Timing of Authentication
FMT_SMR.1 Security Roles

FMT_CFG_EXT.1.1

The TSF shall enforce that Administrator credentials be changed immediately after first use when configured with default Administrator credentials or with no Administrator credentials.

B.2.5 Class: Trusted Path/Channels (FTP)

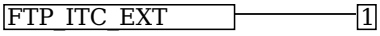
This PP defines the following extended components as part of the FTP class originally defined by CC Part 2:

B.2.5.1 FTP_ITC_EXT Trusted Channel Communications

Family Behavior

This family defines requirements for protection of data in transit between the TOE and its operational environment.

Component Leveling



FTP_ITC_EXT.1, Trusted Channel Communication, requires the TSF to implement one or more cryptographic protocols to secure connectivity between the TSF and various external entities.

Management: FTP_ITC_EXT.1

The following actions could be considered for the management functions in FMT:

a. Ability to configure the cryptographic functionality.

Audit: FTP_ITC_EXT.1

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

a. Initiation of the trusted channel.
b. Termination of the trusted channel.
c. Failures of the trusted path functions.

FTP_ITC_EXT.1 Trusted Channel Communication

Hierarchical to: No other components.

Dependencies to: No dependencies.

FTP_ITC_EXT.1.1

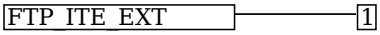
The TSF shall use [**assignment**: *trusted channel protocols*] protocols with [**assignment**: *authentication mechanism*] to provide a communication channel between itself and [**assignment**: *external IT entities*] that is logically distinct from other communication channels, provides assured identification of its end points, protects channel data from disclosure, and detects modification of the channel data.

B.2.5.2 FTP_ITE_EXT Encrypted Data Communications

Family Behavior

This family defines requirements for encryption of TSF data that is transmitted to an external entity over an insecure channel.

Component Leveling



FTP_ITE_EXT.1, Encrypted Data Communications, requires the TSF to encrypt data in the specified manner using key data that is provided to an external entity in the specified manner.

Management: FTP_ITE_EXT.1

There are no management functions foreseen.

Audit: FTP_ITE_EXT.1

There are no audit events foreseen.

FTP_ITE_EXT.1 Encrypted Data Communications

Hierarchical to: No other components.

Dependencies to: FCS_COP.1 Cryptographic Operation

FTP_ITE_EXT.1.1

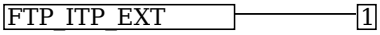
The TSF shall encrypt data for transfer between the TOE and [**assignment**: *list of entities external to the TOE*] using a cryptographic algorithm and key size as specified in FCS_COP.1, and using [**assignment**: *key establishment mechanism*].

B.2.5.3 FTP_ITP_EXT Physically Protected Channel

Family Behavior

This family defines requirements for use of physically protected communications mechanisms.

Component Leveling



FTP_ITP_EXT.1, Physically Protected Channel, requires the TSF to use a physically protected channel for transmission of data to an external entity.

Management: FTP_ITP_EXT.1

There are no management functions foreseen.

Audit: FTP_ITP_EXT.1

There are no audit events foreseen.

FTP_ITP_EXT.1 Physically Protected Channel

Hierarchical to: No other components.

Dependencies to: No dependencies.

FTP_ITP_EXT.1.1

The TSF shall provide a physically protected communication channel between itself and [**assignment**: *list of other IT entities within the same platform*].

B.2.6 Class: User Data Protection (FDP)

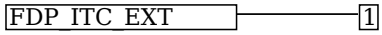
This PP defines the following extended components as part of the FDP class originally defined by CC Part 2:

B.2.6.1 FDP_ITC_EXT Key Import

Family Behavior

This family defines requirements for importing cryptographic keys and credentials into the TOE.

Component Leveling



FDP_ITC_EXT.1, Key/Credential Import, requires the TSF to implement one or more means for importing keys and credentials into the TOE, which are not addressed by the FDP_ITC component.

Management: FDP_ITC_EXT.1

There are no management functions foreseen.

Audit: FDP_ITC_EXT.1

There are no audit events foreseen.

FDP_ITC_EXT.1 Key/Credential Import

Hierarchical to: No other components.

Dependencies to:
FCS_COP.1 Cryptographic Operation
FCS_STG_EXT.1 Key Storage Encryption
FTP_ITC_EXT.1 Trusted Channel Communications
FTP_ITE_EXT.1 Encrypted Data Communications
FTP_ITP_EXT.1 Physically Protected Channel

FDP_ITC_EXT.1.1

The TSF shall support importing keys/key material using [**assignment**: *import mechanism*].

FDP_ITC_EXT.1.2

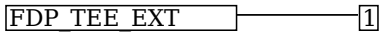
The TSF shall verify the integrity of imported keys/key material using [**assignment**: *integrity verification method*].

B.2.6.2 FDP_TEE_EXT Trusted Execution Environment

Family Behavior

This family defines requirements for Trusted Execution Environments implemented by the TOE for the use of tenant software.

Component Leveling



FDP_TEE_EXT.1, Trusted Execution Environment for Tenant Software, requires the TSF to implement a trusted execution environment for the use of tenant software.

Management: FDP_TEE_EXT.1

There are no management functions foreseen.

Audit: FDP_TEE_EXT.1

There are no audit events foreseen.

FDP_TEE_EXT.1 Trusted Execution Environment for Tenant Software

Hierarchical to: No other components.

Dependencies to: No dependencies.

FDP_TEE_EXT.1.1

The TSF shall implement a trusted execution environment that conforms to the following standard: [**assignment**: *Trusted Execution Environment standard*] and make this TEE available to tenant software.

Appendix C - Implicitly Satisfied Requirements

This appendix lists requirements that should be considered satisfied by products successfully evaluated against this PP. These requirements are not featured explicitly as SFRs and should not be included in the ST. They are not included as standalone SFRs because it would increase the time, cost, and complexity of evaluation. This approach is permitted by [CC] Part 1, 8.3 Dependencies between components.

This information benefits systems engineering activities which call for inclusion of particular security controls. Evaluation against the PP provides evidence that these controls are present and have been evaluated.

Table 23: Implicitly Satisfied Requirements

Requirement	Rationale for Satisfaction
FIA_UAU.1 – Timing of Authentication	FMT_CFG_EXT.1 has a dependency on FIA_UAU.1 because it cannot exist unless the TOE supports an authentication mechanism.

Appendix D - Entropy Documentation and Assessment

D.1 Design Description

Documentation shall include the design of the entropy source as a whole, including the interaction of all entropy source components. It will describe the operation of the entropy source to include how it works, how entropy is produced, and how unprocessed (raw) data can be obtained from within the entropy source for testing purposes. The documentation should walk through the entropy source design indicating where the random comes from, where it is passed next, any post-processing of the raw outputs (hash, XOR, etc.), if/where it is stored, and finally, how it is output from the entropy source. Any conditions placed on the process (e.g., blocking) should also be described in the entropy source design. Diagrams and examples are encouraged.

This design must also include a description of the content of the security boundary of the entropy source and a description of how the security boundary ensures that an adversary outside the boundary cannot affect the entropy rate.

D.2 Entropy Justification

There should be a technical argument for where the unpredictability in the source comes from and why there is confidence in the entropy source exhibiting probabilistic behavior (an explanation of the probability distribution and justification for that distribution given the particular source is one way to describe this). This argument will include a description of the expected entropy rate and explain how to ensure that sufficient entropy is going into the TOE randomizer seeding process. This discussion will be part of a justification for why the entropy source can be relied upon to produce bits with entropy.

D.3 Operating Conditions

Documentation will also include the range of operating conditions under which the entropy source is expected to generate random data. It will clearly describe the measures that have been taken in the system design to ensure the entropy source continues to operate under those conditions. Similarly, documentation shall describe the conditions under which the entropy source is known to malfunction or become inconsistent. Methods used to detect failure or degradation of the source shall be included.

D.4 Health Testing

More specifically, all entropy source health tests and their rationale will be documented. This will include a description of the health tests, the rate and conditions under which each health test is performed (e.g., at startup, continuously, or on-demand), the expected results for each health test, and rationale indicating why each test is believed to be appropriate for detecting one or more failures in the entropy source.

Appendix E - Equivalency Guidelines

E.1 Introduction

The purpose of equivalence in PP-based evaluations is to find a balance between evaluation rigor and commercial practicability--to ensure that evaluations meet customer expectations while recognizing that there is little to be gained from requiring that every variation in a product or platform be fully tested. Generally, if a product is found to be compliant with a PP on a particular platform, then all equivalent products on equivalent platforms are also considered to be compliant with the PP. In this case, since the GPCP is itself a platform, only equivalent GPCP products are considered in the analysis.

A vendor can make a claim of equivalence if the vendor believes that a particular instance of their product implements PP-specified security functionality in a way equivalent to the implementation of the same functionality on another instance of their product on which the functionality was tested. The product instances can differ in version number or feature level (model). Equivalence can be used to reduce the testing required across claimed evaluated configurations. It can also be used during Assurance Maintenance to reduce testing needed to add more evaluated configurations to a certification.

These equivalency guidelines do not replace Assurance Maintenance requirements or NIAP Policy #5 requirements for CAVP certificates. Nor may equivalence be used to leverage evaluations with expired certifications.

This appendix provides guidance for determining whether products are equivalent for purposes of evaluation against the GPCPPP. This guidance differs from that provided in other PPs in that a GPCP is itself a platform, and thus the distinction between product and platform is somewhat blurred. This equivalency analysis is adjusted to reflect this.

For a GPCP, equivalence has two aspects:

1. ***Product Equivalence:*** To be considered equivalent, GPCPs must be produced by the same vendor and support the same tenant software.
2. ***Technical Equivalence:*** GPCPs may be considered equivalent if there are no differences between them with respect to their implementations of PP-specified security functionality.

The equivalency determination is made in accordance with these guidelines by the validator and scheme using information provided by the evaluator/vendor.

E.2 Approach to Equivalency Analysis

There are two scenarios for performing equivalency analysis. One is when a product has been certified and the vendor wants to show that a later product should be considered certified due to equivalence with the earlier product. The other is when multiple product variants are going though evaluation together and the vendor would like to reduce the amount of testing that must be done. The basic rules for determining equivalence are the same in both cases. But there is one additional consideration that applies to equivalence with previously certified products. That is, the product with which equivalence is being claimed must have a valid certification in accordance with scheme rules and the Assurance Maintenance process must be followed. If a product’s certification has expired, then equivalence cannot be claimed with that product.

When performing equivalency analysis for a GPCP, the evaluator/vendor should first use the factors and guidelines for Product Equivalence to determine the set of products to be further considered.

Each non-equivalent product for which compliance is claimed must be fully tested.

“Differences in PP-Specified Security Functionality” Defined
PP-specified security functionality implemented by the TOE that differs in actual implementation between versions or product models break equivalence for that functionality. Likewise, the TOE invokes PP-specified security functionality differently in different versions or models of the TOE, then equivalence is broken for that functionality.

E.3 Specific Guidance for Determining Product Equivalence

Product Equivalence attempts to determine whether different feature levels or versions of the same product are equivalent for purposes of PP testing. For example, if a product has a “basic” edition and an “enterprise” edition, is it necessary to test both models? Or does testing one model provide sufficient confidence that both models are compliant?

Table 24: Factors for Determining Product Equivalence

Factor	Same/Different	Guidance
Product Type	Different	Products in different product classes are not equivalent. Servers, EUDs, and IoT devices are not equivalent.
Product	Different	Products manufactured by different vendors are not equivalent.

Vendors		
PP-Specified Functionality	Same	If differences between products affect only non-PP-specified functionality, then the models are equivalent.
	Different	If PP-specified security functionality is affected by the differences between products, then the products are not equivalent and must be tested separately. It is necessary to test only the functionality affected by the differences. If only differences are tested, then the differences must be enumerated, and for each difference the Vendor must provide an explanation of why each difference does or does not affect PP-specified functionality. If the products are fully tested separately, then there is no need to document the differences.

E.4 Technical Equivalence

Platform equivalence is based primarily on processor architecture and instruction sets.

Technical equivalence is based primarily on processor architecture, instruction sets, and firmware versions. It is determined on a per-SFR basis.

Platforms with different processor architectures and instruction sets are not equivalent. Processors with the same architecture that have instruction sets that are subsets or supersets of each other are not disqualified from being equivalent. If PP-specified security functionality takes the same code paths when executing on different processors of the same family, then the processors can be considered equivalent with respect to that functionality.

For example, if for some PP-specified security functionality, one code path is followed on platforms that support the AES-NI instruction and another on platforms that do not, then those two platforms are not equivalent with respect to that functionality. But if the same path is followed whether or not the platform supports AES-NI, then the platforms are equivalent with respect to that functionality.

Platforms that run the same versions of the same firmware are considered equivalent with respect to any PP-specified security functionality implemented by that firmware. If firmware versions are different, then more in-depth analysis is required to determine whether the security functionality is implemented equivalently.

The platforms are equivalent if they are equivalent with respect to all PP-specified security functionality.

Table 25: Factors for Determining Technical Equivalence

Factor	Same/Different/None	Guidance
Processor Vendors	Different	Functionality implemented through processors manufactured by different vendors is not equivalent.
Processor/Chipset Architecture	Different	Functionality implemented through processors with different processor and chipset architectures are not equivalent.
Firmware Versions	Same	Functionality implemented through equivalent processors by the same version of firmware is considered equivalent.
PP-Specified Functionality	Same	For PP-specified security functionality implemented through equivalent processors and different firmware versions, the platforms are equivalent with respect to the functionality if execution of the functionality follows the same code paths on both platforms.
PP-Specified Functionality	Different	For PP-specified security functionality implemented through equivalent processors and different firmware versions, the platforms are not equivalent with respect to the functionality if execution of the functionality follows different code paths on both platforms.

E.5 Level of Specificity for Tested and Claimed Equivalent Configurations

In order to make equivalency determinations, the vendor and evaluator must agree on the equivalency claims. They must then provide the scheme with sufficient information about the TOE instances and platforms that were evaluated, and the TOE instances and platforms that are claimed to be equivalent.

The ST must describe all configurations evaluated down to processor manufacturer, model number, and microarchitecture version.

Appendix F - Use Case Templates

F.1 Server-Class Platform, Basic

The configuration for *[USE CASE 1] Server-Class Platform, Basic* modifies the base requirements as follows:
- Include FAU_GEN.1 in the ST
- Include FAU_SAR.1 in the ST
- Include FAU_STG.1 in the ST
- Include FAU_STG.2 in the ST
- Include FAU_STG.5 in the ST

F.2 Server-Class Platform, Enhanced

The configuration for *[USE CASE 2] Server-Class Platform, Enhanced* modifies the base requirements as follows:
- Include FAU_GEN.1 in the ST
- Include FAU_SAR.1 in the ST
- Include FAU_STG.1 in the ST
- Include FAU_STG.2 in the ST
- Include FAU_STG.5 in the ST
- Include FPT_PHP.2 in the ST
- Include FPT_PHP.3 in the ST
- Include FPT_JTA_EXT.2 in the ST

F.3 Portable Clients (laptops, tablets), Basic

The use case *[USE CASE 3] Portable Clients (laptops, tablets), Basic* makes no changes to the base requirements.

F.4 Portable Clients (laptops, tablets), Enhanced

The configuration for *[USE CASE 4] Portable Clients (laptops, tablets), Enhanced* modifies the base requirements as follows:
- Include FPT_PHP.1 in the ST
- Include FPT_JTA_EXT.2 in the ST

F.5 CSfC EUD

The configuration for *[USE CASE 5] CSfC EUD* modifies the base requirements as follows:
- Include FPT_JTA_EXT.2 in the ST
- Include FAU_GEN.1 in the ST
- Include FAU_SAR.1 in the ST
- Include FAU_STG.1 in the ST
- Include FAU_STG.2 in the ST
- Include FAU_STG.5 in the ST

F.6 Tactical EUD

The configuration for *[USE CASE 6] Tactical EUD* modifies the base requirements as follows:
- Include FPT_PHP.3 in the ST
- Include FPT_JTA_EXT.2 in the ST
- Include FIA_AFL_EXT.1 in the ST

F.7 Enterprise Desktop clients

The configuration for *[USE CASE 7] Enterprise Desktop clients* modifies the base requirements as follows:
- Include FAU_GEN.1 in the ST
- Include FAU_SAR.1 in the ST
- Include FAU_STG.1 in the ST
- Include FAU_STG.2 in the ST
- Include FAU_STG.5 in the ST

F.8 IoT Devices

The configuration for *[USE CASE 8] IoT Devices* modifies the base requirements as follows:

- Include FPT_PHP.1 in the ST
- Include FPT_JTA_EXT.2 in the ST

Appendix G - Acronyms

Table 26: Acronyms

Acronym	Meaning
AES	Advanced Encryption Standard
AK	Asymmetric Key
ANSI	American National Standards Institute
API	Application Programming Interface
BAF	Biometric Authentication Factor
Base-PP	Base Protection Profile
BMC	Baseboard Management Controller
CC	Common Criteria
CEM	Common Evaluation Methodology
CMAC	Cipher-based Message Authentication Code
CN	Common Names
cPP	Collaborative Protection Profile
CRL	Certificate Revocation List
CSfC	Commercial Solutions for Classified
CSP	Critical Security Parameters
DAR	Data-at-Rest
DH	Diffie-Hellman Key Exchange
DN	Distinguished Name
DRBG	Deterministic Random Bit Generator
DSS	Digital Signature Standard
DTLS	Datagram Transport Layer Security
ECDHE	Elliptic Curve Diffie-Hellman Ephemeral
ECDSA	Elliptic Curve Digital Signature Algorithm
ECIES	Elliptic Curve Integrated Encryption Scheme
EP	Extended Package
EUD	End-User Device
FIPS	Federal Information Processing Standards
FP	Functional Package
FQDN	Fully Qualified Domain Name
GPCP	General-Purpose Computing Platform
HMAC	Hash-based Message Authentication Code
HTTPS	Hypertext Transfer Protocol Secure
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
IP	Internet Protocol
ISO	International Organization for Standardization

IT	Information Technology
ITSEF	Information Technology Security Evaluation Facility
JTAG	Joint Test Action Group
KDF	Key-Derivation Function
KMAC	KECCAK Message Authentication Code
MAC	Message Authentication Code
MC	Management Controller
NIST	National Institute of Standards and Technology
OCSP	Online Certificate Status Protocol
OE	Operational Environment
OEM	Original Equipment Manufacturer
OID	Object Identifier
OMTP	Open Mobile Terminal Platform
OS	Operating System
PBKDF	Password-based Key-Derivation Function
PKCS	Public Key Cryptography Standards
PP	Protection Profile
PP-Configuration	Protection Profile Configuration
PP-Module	Protection Profile Module
RBG	Random Bit Generator
RFC	Request for Comment
RNG	Random Number Generator
RoT	Root of Trust
SA	Security Association
SAN	Subject Alternative Name
SAR	Security Assurance Requirement
SFR	Security Functional Requirement
SHA	Secure Hash Algorithm
SK	Symmetric Key
SPD	Security Policy Database
SSH	Secure Shell
ST	Security Target
SWID	Software Identification
TEE	Trusted Execution Environment
TLS	Transport Layer Security
TOE	Target of Evaluation
TSF	TOE Security Functionality
TSFI	TSF Interface
TSS	TOE Summary Specification
USB	Universal Serial Bus

VPN	Virtual Private Network
VS	Virtualization System
XCCDF	eXtensible Configuration Checklist Description Format
XOR	Exclusive Or

Appendix H - Bibliography

Table 27: Bibliography

Identifier	Title
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