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# **Android Data Protection SDK (ASPP12/ASFEEP10) Security Target**

Version 1.0  
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*Prepared for:*

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The logo for Gossamer Laboratories, featuring a stylized red 'G' icon followed by the word 'Gossamer' in a bold, italicized red font, and 'Laboratories' in a smaller, italicized red font below it.

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## 1. Security Target Introduction

This section identifies the Security Target (ST) and Target of Evaluation (TOE) identification, ST conventions, ST conformance claims, and the ST organization. The TOE is Android Data Protection SDK provided by Trivalent. The TOE is being evaluated as a file encryption software application.

The Security Target contains the following additional sections:

- Conformance Claims (Section 2)
- Security Objectives (Section 3)
- Extended Components Definition (Section 4)
- Security Requirements (Section 5)
- TOE Summary Specification (Section 6)

### Conventions

The following conventions have been applied in this document:

- Security Functional Requirements – Part 2 of the CC defines the approved set of operations that may be applied to functional requirements: iteration, assignment, selection, and refinement.
  - Iteration: allows a component to be used more than once with varying operations. In the ST, iteration is indicated by a parenthetical number placed at the end of the component. For example FDP\_ACC.1(1) and FDP\_ACC.1(2) indicate that the ST includes two iterations of the FDP\_ACC.1 requirement.
  - Assignment: allows the specification of an identified parameter. Assignments are indicated using bold and are surrounded by brackets (e.g., [**assignment**]). Note that an assignment within a selection would be identified in italics and with embedded bold brackets (e.g., [*[**selected-assignment**]*]).
  - Selection: allows the specification of one or more elements from a list. Selections are indicated using bold italics and are surrounded by brackets (e.g., [***selection***]).
  - Refinement: allows the addition of details. Refinements are indicated using bold, for additions, and strike-through, for deletions (e.g., “... **all** objects ...” or “... ~~some~~ **big** things ...”).
- Other sections of the ST – Other sections of the ST use bolding to highlight text of special interest, such as captions.

### 1.1 Security Target Reference

**ST Title** – Android Data Protection SDK ASPP12/ASFEEP10) Security Target

**ST Version** – Version 1.0

**ST Date** – April 10, 2017

### 1.2 TOE Reference

**TOE Identification** – Trivalent Android Data Protection SDK

**TOE Developer** – Trivalent

**Evaluation Sponsor** – Trivalent

### 1.3 TOE Overview

The Target of Evaluation (TOE) is Trivalent’s Android Data Protection SDK Version 2.13 software application package residing on evaluated mobile devices running Android 5.1 and Android 6.0. The TOE is a software solution providing the capability to handle file encryption on mobile devices. Below are the current evaluated platforms:

- Samsung Galaxy S7 & S7 Edge
- Samsung Galaxy S6 & S6 Edge
- Galaxy Note 5

Device Name	Chipset/CPU	Architecture	Android Version
Samsung Galaxy S7 & S7 Edge	Exynos 8890	A64	6.0.1
Samsung Galaxy S7 & S7 Edge	Qualcomm MSM 8996	A64	6.0.1
Galaxy S6 & S6 Edge	Exynos 7420	A64	6.0.1
Galaxy Note 5	Exynos 7420	A64	5.1.1

Any of the above products utilize the Snapdragon 800 family processor and are appropriate for use with the TOE.

### 1.4 TOE Description

Trivalent’s Android Data Protection SDK provides file level encryption through an APK and a library implementation. The library contains both Java and native (c/c++) interfaces in order to support the majority of android application storage requirements. The same implementation and functionality for both java and c/c++ are provided by the TOE. The library offers two groups of API: one set to manipulate files and one set to manipulate SQLite databases. While the API groups provide different abstractions for the read and write operations, they both are ultimately simply reading and writing a single file. The library is providing file level encryption.

The Management Service Application is a straight Java Data Protection SDK APK, while the library is intended to be included into one’s mobile application (and then the mobile application can use the library’s APIs). The Management Service Application runs in the background and uses both Android and BouncyCastle keystores to provide the File Encryption Key Encryption Key (FEKEK) to each of the applications. The Data Protection SDK also uses the Android keystore to store an RSA key pair used by the Management Service, and a per application Android keystore to store each application’s RSA keypair to wrap the AES-wrapped FEKEK. The Management Service handles necessary authentication and key management. The file level encryption suite is an API designed to support the use of specialized file level encryption for Android applications. Encryption is provided by the SPX Core (Security First, Secure Parser Library).

#### 1.4.1 TOE Architecture

The TOE is software installed on an evaluated mobile device running Android 5.1 or Android 6.0. The TOE software is installed as a Management Service as well as a TSF interface library that is compiled into other applications. References to applications noted in this Security Target are regarded as applications that are compiled with the TSF interface API library. The Management Service is responsible for handling the File Encryption Key Encryption Keys (FEKEKs) necessary to unwrap the FEK. The Management Service obtains the Android Data Protection SDK password (hereafter referred to as the DaR password) from the user and double wraps the FEKEK by using RSA-2048 first and then wrapping it again using AES-256.

The TOE’s interface library is compiled into another application’s package. The library allows the other application to invoke the TOE’s services. This library allows the application to call the TOE’s file encryption services. The application must register itself with the Management Service. Applications registered to the TOE have a unique RSA public/private keypair, so applications pass their RSA public keys to the Management Service along with a

certificate fingerprint (which is what the application uses as the password to the application's BouncyCastle key store). Android's keystore protects keys by storing them in a container with limited access to the keys through Android's keystore API. The TOE allows only a single user at a time.

The TOE stores the double wrapped FEKEKs in the Management Service's BouncyCastle keystore and the single wrapped FEKEKs in the Application's specific BouncyCastle keystore. The keys are protected by requiring a password to load both the Management Service and Application's BouncyCastle keystore. In order for other applications to access its FEK, the application must use the TOE's interface library API in order to request the Management Service's functions. The Management Service uses the application's public key to wrap the FEKEK (via RSA-OAEP) so that it can be passed to the Application by placing the single wrapped FEKEK into the Application's BouncyCastle keystore. The wrapped FEKEKs in each application's BouncyCastle keystore are ephemeral. The Management Service has a configurable timer in which all BouncyCastle keystores will be wiped once the timer expires.

The TOE utilizes Security First's Secure Parser Library (SPX Core) for cryptographic services. The TOE uses the SPX Core for generating 256 bit AES keys.

During evaluation testing, Gossamer tested the Trivalent Android Data Protection SDK on the Samsung Galaxy S7 running Android 6.0.1 and the Galaxy Note 5 running Android 5.5.1.

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#### **1.4.1.1 Physical Boundaries**

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The physical boundary of the TOE is the physical perimeter of the evaluated device (Android 5.1 or Android 6.0) on which the TOE resides.

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#### **1.4.1.2 Logical Boundaries**

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This section summarizes the security functions provided by Data Protection SDK:

- Cryptographic support
- User data protection
- Identification and authentication
- Security management
- Privacy
- Protection of the TSF
- Trusted path/channels

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##### **1.4.1.2.1 Cryptographic support**

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The evaluated platform runs Android 5.1 or Android 6.0 operating system. Android's APIs allow generation of keys through KeyGenerator, and random numbers are generated using SecureRandom. Keys are used to protect data belonging to the applications that use the TOE.

The TOE uses Security First's SPX Core (Security First, Secure Parser Library) for cryptographic algorithms. The SPX Core supports encryption via AES and random number generation via an SP 800-90 AES-256 CTR DRBG. The TOE uses the platform's cryptographic API to perform AES key wrapping and keyed hashing via HMAC.

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##### **1.4.1.2.2 User data protection**

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The TOE protects user data by providing encryption services for applications to encrypt their data. The TOE allows encryption of data using AES-256 bit keys.

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#### **1.4.1.2.3 Identification and authentication**

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The TOE authenticates applications by requiring a PIN/passphrase to unlock the application's file encryption key. A wrong password results in the unsuccessful loading of the application's BouncyCastle keystore. Without the correct keystore, the application cannot load the keys necessary for file encryption/decryption.

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#### **1.4.1.2.4 Security management**

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The TOE's services/options are inaccessible until a configuration has been created. The TOE does not allow invocation of its services without configuration of the TOE's settings upon first start up. The TOE allows the changing of passwords for management purposes.

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#### **1.4.1.2.5 Privacy**

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The TOE does not transmit Personally Identifiable Information over any network interfaces.

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#### **1.4.1.2.6 Protection of the TSF**

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The TOE relies on the physical boundary of the evaluated platform as well as the Android operating system for the protection of the TOE's application components.

The TOE checks for updates by selecting the check current version option on its menu. If an update is needed, Trivalent shall deliver, via email or other agreed upon method, an updated application. The TOE's software is digitally signed by Trivalent. Each update is accompanied by documentation outlining changes to the overall service, as well as compatible versions of the Trivalent API.

The native Android cryptographic library, which provides the TOE's cryptographic services, have built-in self-tests that are run at power-up to ensure that the algorithms are correct. If any self-tests fail, the TOE will not be able to perform its cryptographic services.

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#### **1.4.1.2.7 Trusted path/channels**

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The TOE does not transmit any data between itself and another product. All of the data managed by the TOE resides on the evaluated platform (Android 5.1 or Android 6.0).

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### **1.4.2 TOE Documentation**

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Trivalent offers documents that describe the operation and maintenance for the TOE. The following list of documents was examined as part of the evaluation.

[AGD] Operations & Maintenance Manual, Trivalent Management Service, December 2016.

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## 2. Conformance Claims

This TOE is conformant to the following CC specifications:

- Common Criteria for Information Technology Security Evaluation Part 2: Security functional components, Version 3.1, Revision 4, September 2012.
  - Part 2 Extended
- Common Criteria for Information Technology Security Evaluation Part 3: Security assurance components, Version 3.1 Revision 4, September 2012.
  - Part 3 Conformant
- Package Claims:
  - Protection Profile for Application Software, Version 1.2, 22 April 2016 (ASPP12) and
  - Application Software Protection Profile (ASPP) Extended Package: File Encryption: Mitigating the Risk of Disclosure of Sensitive Data on a System, Version 1.0, 10 November 2014 (ASFEEP10)

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### 2.1 Conformance Rationale

The ST conforms to the ASPP12/ASFEEP10. As explained previously, the security problem definition, security objectives, and security requirements have been drawn from the PP.

### 3. Security Objectives

The Security Problem Definition may be found in the ASPP12/ASFEED10 and this section reproduces only the corresponding Security Objectives for operational environment for reader convenience. The ASPP12/ASFEED10 offers additional information about the identified security objectives, but that has not been reproduced here and the ASPP12/ASFEED10 should be consulted if there is interest in that material.

In general, the ASPP12/ASFEED10 has defined Security Objectives appropriate for file encryption software application and as such are applicable to the Android Data Protection SDK TOE.

#### 3.1 Security Objectives for the Operational Environment

**OE.AUTHORIZATION** The TOE must enforce the entry of authorization factor(s) by authorized users to be able to encrypt and decrypt user data.

**OE.AUTHORIZATION\_FACTOR\_STRENGTH** An authorized user will be responsible for ensuring that all externally derived authorization factors have sufficient strength and entropy to reflect the sensitivity of the data being protected. This can apply to password- or passphrase-based, ECC CDH, and RSA authorization factors.

**OE.PLATFORM** The TOE relies upon a trustworthy computing platform for its execution. This includes the underlying operating system and any discrete execution environment provided to the TOE.

**OE.POWER\_SAVE** The non-mobile operational environment must be configurable so that there exists at least one mechanism that will cause the system to power down after a period of time in the same fashion as the user electing to shutdown the system (A.SHUTDOWN). Any such mechanism (e.g., sleep, hibernate) that does not conform to this requirement must be capable of being disabled.

The mobile operational environment must be configurable such that there exists at least one mechanism that will cause the system to lock upon a period of time.

**OE.PROPER\_ADMIN** The administrator of the application software is not careless, willfully negligent or hostile, and administers the software within compliance of the applied enterprise security policy.

**OE.PROPER\_USER** The user of the application software is not willfully negligent or hostile, and uses the software within compliance of the applied enterprise security policy.

**OE.STRONG\_ENVIRONMENT\_CRYPTO** The Operating environment will provide a cryptographic function capability that is commensurate with the requirements and capabilities of the TOE.

**OE.TRAINED\_USERS** Authorized users of the host machine will be trained to follow all provided guidance.

## 4. Extended Components Definition

All of the extended requirements in this ST have been drawn from the ASPP12/ASFEED10. The ASPP12/ASFEED10 defines the following extended requirements and since they are not redefined in this ST the ASPP12/ASFEED10 should be consulted for more information in regard to those CC extensions.

### Extended SFRs:

- FCS\_CKM\_EXT.1: Key Encrypting Key (KEK) Support
- FCS\_CKM\_EXT.1(0): Extended: Cryptographic key generation (Password/Passphrase conditioning) (TD0067 applied)
- FCS\_CKM\_EXT.2: Cryptographic key generation (FEK)
- FCS\_CKM\_EXT.4: Extended: Cryptographic Key Destruction
- FCS\_IV\_EXT.1: Extended: Initialization Vector Generation
- FCS\_KYC\_EXT.1: Key Chaining and Key Storage
- FCS\_RBG\_EXT.1: Random Bit Generation Services
- FCS\_RBG\_EXT.2: Random Bit Generation from Application
- FCS\_STO\_EXT.1: Storage of Credentials
- FDP\_DAR\_EXT.1: Encryption Of Sensitive Application Data
- FDP\_DEC\_EXT.1: Access to Platform Resources
- FDP\_NET\_EXT.1: Network Communications
- FDP\_PRT\_EXT.1: Extended: Protection of Selected User Data
- FIA\_AUT\_EXT.1: User Authorization
- FIA\_FCT\_EXT.1(2): Extended: User Authorization with Password/Passphrase Authorization Factors
- FMT\_CFG\_EXT.1: Secure by Default Configuration
- FMT\_MEC\_EXT.1: Supported Configuration Mechanism
- FPR\_ANO\_EXT.1: User Consent for Transmission of Personally Identifiable
- FPT\_AEX\_EXT.1: Anti-Exploitation Capabilities
- FPT\_API\_EXT.1: Use of Supported Services and APIs
- FPT\_FEK\_EXT.1: File Encryption Key (FEK) Support
- FPT\_KYP\_EXT.1: Extended: Protection of Key and Key Material (FPT\_KYP\_EXT)
- FPT\_LIB\_EXT.1: Use of Third Party Libraries
- FPT\_TUD\_EXT.1: Integrity for Installation and Update
- FTP\_DIT\_EXT.1: Protection of Data in Transit

### Extended SARs:

- ALC\_TSU\_EXT.1: Timely Security Updates

## 5. Security Requirements

This section defines the Security Functional Requirements (SFRs) and Security Assurance Requirements (SARs) that serve to represent the security functional claims for the Target of Evaluation (TOE) and to scope the evaluation effort.

The SFRs have all been drawn from the ASPP12/ASFEED10. The refinements and operations already performed in the ASPP12/ASFEED10 are not identified (e.g., highlighted) here, rather the requirements have been copied from the ASPP12/ASFEED10 and any residual operations have been completed herein. Of particular note, the ASPP12/ASFEED10 made a number of refinements and completed some of the SFR operations defined in the Common Criteria (CC) and that PP should be consulted to identify those changes if necessary.

The SARs are also drawn from the ASPP12/ASFEED10 which includes all the SARs for EAL 1. However, the SARs are effectively refined since requirement-specific 'Assurance Activities' are defined in the ASPP12/ASFEED10 that serve to ensure corresponding evaluations will yield more practical and consistent assurance than the EAL 1 assurance requirements alone. The ASPP12/ASFEED10 should be consulted for the assurance activity definitions.

### 5.1 TOE Security Functional Requirements

The following table identifies the SFRs that are satisfied by Android Data Protection SDK TOE.

Requirement Class	Requirement Component
<b>FCS: Cryptographic support</b>	FCS_CKM.1(0): Cryptographic key generation (Password/Passphrase conditioning)
	FCS_CKM_EXT.1: Key Encrypting Key (KEK) Support
	FCS_CKM_EXT.1(0): Extended: Cryptographic key generation (Password/Passphrase conditioning) (TD0067 applied)
	FCS_CKM_EXT.2: Cryptographic key generation (FEK)
	FCS_CKM_EXT.4: Extended: Cryptographic Key Destruction
	FCS_COP.1(1): Cryptographic operation (Data Encryption)
	FCS_COP.1(4): Cryptographic Operation (Keyed-Hash Message Authentication)
	FCS_COP.1(5): Cryptographic operation (Key Wrapping)
	FCS_IV_EXT.1: Extended: Initialization Vector Generation
	FCS_KYC_EXT.1: Key Chaining and Key Storage
	FCS_RBG_EXT.1: Random Bit Generation Services
	FCS_RBG_EXT.2: Random Bit Generation from Application
	FCS_STO_EXT.1: Storage of Credentials
<b>FDP: User data protection</b>	FDP_DAR_EXT.1: Encryption Of Sensitive Application Data
	FDP_DEC_EXT.1: Access to Platform Resources
	FDP_NET_EXT.1: Network Communications
	FDP_PRT_EXT.1: Extended: Protection of Selected User Data
<b>FIA: Identification and authentication</b>	FIA_AUT_EXT.1: User Authorization
	FIA_FCT_EXT.1(2): Extended: User Authorization with Password/Passphrase Authorization Factors
<b>FMT: Security management</b>	FMT_CFG_EXT.1: Secure by Default Configuration
	FMT_MEC_EXT.1: Supported Configuration Mechanism
	FMT_SMF.1: Specification of Management Functions
<b>FPR: Privacy</b>	FPR_ANO_EXT.1: User Consent for Transmission of Personally Identifiable

<b>FPT: Protection of the TSF</b>	FPT_AEX_EXT.1: Anti-Exploitation Capabilities
	FPT_API_EXT.1: Use of Supported Services and APIs
	FPT_FEK_EXT.1: File Encryption Key (FEK) Support
	FPT_KYP_EXT.1: Extended: Protection of Key and Key Material (FPT_KYP_EXT)
	FPT_LIB_EXT.1: Use of Third Party Libraries
	FPT_TUD_EXT.1: Integrity for Installation and Update
<b>FTP: Trusted path/channels</b>	FTP_DIT_EXT.1: Protection of Data in Transit

Table 5-1 TOE Security Functional Components

## 5.1.1 Cryptographic support (FCS)

### 5.1.1.1 Cryptographic key generation (Password/Passphrase conditioning) (FCS\_CKM.1(0))

#### FCS\_CKM.1(0).1

Requirement renamed to FCS\_CKM\_EXT.1(0) per TD0067.

### 5.1.1.2 Key Encrypting Key (KEK) Support (FCS\_CKM\_EXT.1)

#### FCS\_CKM\_EXT.1.1

The TSF shall support KEK in the following manner based on the selection chosen in

FPT\_FEK\_EXT.1: [

- *derive a KEK using a password-based authorization factor conditioned as defined in FCS\_CKM.1(0) and in accordance with FIA\_FCT\_EXT.1(2),*
- *using a Random Bit Generator as specified in FCS\_RBG\_EXT.1 (from the AS PP) and with entropy corresponding to the security strength of AES key sizes of [256 bit]*

#### FCS\_CKM\_EXT.1.2

All KEKs shall be [256-bit] keys corresponding to at least the security strength of the keys encrypted by the KEK.

### 5.1.1.3 Extended: Cryptographic key generation (Password/Passphrase conditioning) (TD0067 applied) (FCS\_CKM\_EXT.1(0))

#### FCS\_CKM\_EXT.1(0).1

The TSF shall support a password/passphrase of up to [128] characters used to generate a password authorization factor.

#### FCS\_CKM\_EXT.1(0).2

The TSF shall allow passwords to be composed of any combination of upper case characters, lower case characters, numbers, and the following special characters: “!”, “@”, “#”, “\$”, “%”, “^”, “&”, “\*”, “(”, and “)”, and [no other characters].

#### FCS\_CKM\_EXT.1(0).3

The TSF shall perform Password-based Key Derivation Functions in accordance with a specified cryptographic algorithm HMAC-[SHA-512], with [4096] iterations, and output cryptographic key sizes[256] that meet the following: NIST SP 800-132.

#### FCS\_CKM\_EXT.1(0).4

The TSF shall not accept passwords less than [a value settable by the administrator] and greater than the maximum password length defined in FCS\_CKM\_EXT.1.1(0).

#### FCS\_CKM\_EXT.1(0).5

The TSF shall generate all salts using a RBG that meets FCS\_RBG\_EXT.1 (from the AS PP) and with entropy corresponding to the security strength selected for PBKDF in FCS\_CKM\_EXT.1.3(0). (Renumbered by TD0067)

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#### 5.1.1.4 Cryptographic key generation (FEK) (FCS\_CKM\_EXT.2)

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##### FCS\_CKM\_EXT.2.1

The TSF shall generate FEK cryptographic keys [*using a Random Bit Generator as specified in FCS\_RBG\_EXT.1 (from the AS PP) and with entropy corresponding to the security strength of AES key sizes of [256 bit]*]

##### FCS\_CKM\_EXT.2.2

The TSF shall create a unique FEK for each file (or set of files) using the mechanism on the client as specified in FCS\_CKM\_EXT.2.1.

##### FCS\_CKM\_EXT.2.3

The FEKs must be generated by the TOE.

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#### 5.1.1.5 Extended: Cryptographic Key Destruction (FCS\_CKM\_EXT.4)

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##### FCS\_CKM\_EXT.4.1

The TSF shall destroy cryptographic keys in accordance with a specified cryptographic key destruction method [*- For volatile memory, the destruction shall be executed by a [destruction of reference to the key directly followed by a request for garbage collection]*] that meets the following: No Standard. (per TD0175)

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#### 5.1.1.6 Cryptographic operation (Data Encryption) (FCS\_COP.1(1))

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##### FCS\_COP.1(1).1

Refinement: The application shall [*implement AES encryption*] shall perform data encryption and decryption in accordance with a specified cryptographic algorithm AES used in [*CBC (as defined in NIST SP 800-38A)*] mode and cryptographic key sizes [*256 bits*].

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#### 5.1.1.7 Cryptographic Operation (Keyed-Hash Message Authentication) (FCS\_COP.1(4))

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##### FCS\_COP.1(4).1

Refinement: The application shall [*invoke platform-provided functionality*] to perform keyed-hash message authentication in accordance with a specified cryptographic algorithm HMAC- [*SHA-384, SHA-512*], key size [*384, 512*], and message digest size of [*384, 512*] bits that meet the following: FIPS PUB 198-1, 'The Keyed-Hash Message Authentication Code', and FIPS PUB 180-4, 'Secure Hash Standard'.

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#### 5.1.1.8 Cryptographic operation (Key Wrapping) (FCS\_COP.1(5))

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##### FCS\_COP.1(5).1

Refinement: The application shall [*use platform-provided functionality to perform Key Wrapping, implement functionality to perform Key Wrapping*] in accordance with a specified cryptographic algorithm [*AES Key Wrap, RSA using the KTS-OAEP-basic scheme*] and the cryptographic key size [*256 bits (AES), 2048 (RSA)*] that meet the following: [*NIST SP 800-38F' for Key Wrap (section 6.2) and Key Wrap with Padding (section 6.3), NIST SP 800-56B' for RSA using the KTS-OAEP-basic (section 9.2.3) and KTS-OAEP-receiver-confirmation (section 9.2.4) scheme*].

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#### 5.1.1.9 Extended: Initialization Vector Generation (FCS\_IV\_EXT.1)

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##### FCS\_IV\_EXT.1.1

The application shall [*generate IVs*] in accordance with Appendix H: Initialization Vector Requirements for NIST-Approved Cipher Modes.

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#### 5.1.1.10 Key Chaining and Key Storage (FCS\_KYC\_EXT.1)

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##### FCS\_KYC\_EXT.1.1

The TSF shall maintain a primary key chain of [

- **KEKs originating from one or more authorization factor(s) to the FEK(s) using the following method(s):** [
  - **utilization of the platform key storage,**
  - **implement key wrapping as specified in FCS\_COP.1(5) ,**while maintaining an overall effective strength of [
  - **[256 bits] for symmetric keys,**
  - **[112 bits] for asymmetric keys]**commensurate with the strength of the FEK] and [No supplemental key chains]. (TD0076 applied)

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#### 5.1.1.11 Random Bit Generation Services (FCS\_RBG\_EXT.1)

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##### FCS\_RBG\_EXT.1.1

The application shall [**invoke platform-provided DRBG functionality, implement DRBG functionality**] for its cryptographic operations.

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#### 5.1.1.12 Random Bit Generation from Application (FCS\_RBG\_EXT.2)

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##### FCS\_RBG\_EXT.2.1

The application shall perform all deterministic random bit generation (DRBG) services in accordance with NIST Special Publication 800-90A using [**CTR\_DRBG (AES)**].

##### FCS\_RBG\_EXT.2.2

The deterministic RBG shall be seeded by an entropy source that accumulates entropy from a platform-based DRBG and [**a software-based noise source**] with a minimum of [**256 bits**] of entropy at least equal to the greatest security strength (according to NIST SP 800-57) of the keys and hashes that it will generate.

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#### 5.1.1.13 Storage of Credentials (FCS\_STO\_EXT.1)

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##### FCS\_STO\_EXT.1.1

The application shall [**invoke the functionality provided by the platform to securely store [keys]**] to non-volatile memory.

---

### 5.1.2 User data protection (FDP)

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#### 5.1.2.1 Encryption Of Sensitive Application Data (FDP\_DAR\_EXT.1)

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##### FDP\_DAR\_EXT.1.1

The application shall [**implement functionality to encrypt sensitive data**] in non-volatile memory.

---

#### 5.1.2.2 Access to Platform Resources (FDP\_DEC\_EXT.1)

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##### FDP\_DEC\_EXT.1.1

The application shall restrict its access to [**network connectivity, [SD card]**].

##### FDP\_DEC\_EXT.1.2

The application shall restrict its access to [**no sensitive information repositories**].

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#### 5.1.2.3 Network Communications (FDP\_NET\_EXT.1)

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##### FDP\_NET\_EXT.1.1

The application shall restrict network communication to [**application checking for updates**].

---

#### 5.1.2.4 Extended: Protection of Selected User Data (FDP\_PRT\_EXT.1)

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##### FDP\_PRT\_EXT.1.1

The TSF shall perform encryption and decryption of the user-selected file (or set of files) in accordance with FCS\_COP.1(1).

##### FDP\_PRT\_EXT.1.2

The application shall [*implement functionality*] to ensure that all sensitive data created by the TOE when decrypting/encrypting the user-selected file (or set of files) are destroyed in volatile and non-volatile memory when the data is no longer needed. (TD0065 applied)

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#### 5.1.3 Identification and authentication (FIA)

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##### 5.1.3.1 User Authorization (FIA\_AUT\_EXT.1)

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##### FIA\_AUT\_EXT.1.1

The application shall [*provide user authorization*] based on [*password/passphrase authorization factors*].

---

##### 5.1.3.2 Extended: User Authorization with Password/Passphrase Authorization Factors (FIA\_FCT\_EXT.1(2))

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##### FIA\_FCT\_EXT.1(2).1

The TSF shall provide a mechanism as defined in FCS\_CKM\_EXT.1 and FCS\_COP.1(4) to perform user authorization.

##### FIA\_FCT\_EXT.1(2).2

The TSF shall perform user authorization using the mechanism provided in FIA\_FCT\_EXT.1.1(2) before allowing decryption of user data.

##### FIA\_FCT\_EXT.1(2).3

The TSF shall support the use of multiple instances of authorization factors that result in unique encryption keys.

##### FIA\_FCT\_EXT.1(2).4

The TSF shall verify that the user-entered authorization factors are valid before decrypting the user's encrypted files.

##### FIA\_FCT\_EXT.1(2).5

The TSF shall ensure that the method of validation for each authorization factor does not expose or reduce the effective strength of the KEK, FEK, or CSPs used to derive the KEK or FEK.

##### FIA\_FCT\_EXT.1(2).6

The TSF shall perform user authorization using the mechanism provided in FIA\_FCT\_EXT.1.1(2) before allowing the user to change the passphrase-based authorization factor as specified in FMT\_SMF.1(c).

---

#### 5.1.4 Security management (FMT)

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##### 5.1.4.1 Secure by Default Configuration (FMT\_CFG\_EXT.1)

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##### FMT\_CFG\_EXT.1.1

The application shall provide only enough functionality to set new credentials when configured with default credentials or no credentials.

##### FMT\_CFG\_EXT.1.2

The application shall be configured by default with file permissions which protect it and its data from unauthorized access.

---

#### 5.1.4.2 Supported Configuration Mechanism (FMT\_MEC\_EXT.1)

---

##### FMT\_MEC\_EXT.1.1

The TSF shall [*invoke the mechanisms recommended by the platform vendor for storing and setting configuration options*]. (TD0121 applied)

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#### 5.1.4.3 Specification of Management Functions (FMT\_SMF.1)

---

##### FMT\_SMF.1.1

The TSF shall be capable of performing the following management functions: [  
a) *configure password/passphrase complexity setting,*  
b) *change password/passphrase authentication credential*]. (TD0122 applied)

---

#### 5.1.5 Privacy (FPR)

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##### 5.1.5.1 User Consent for Transmission of Personally Identifiable (FPR\_ANO\_EXT.1)

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##### FPR\_ANO\_EXT.1.1

The application shall [*not transmit PII over a network*].

---

#### 5.1.6 Protection of the TSF (FPT)

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##### 5.1.6.1 Anti-Exploitation Capabilities (FPT\_AEX\_EXT.1)

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##### FPT\_AEX\_EXT.1.1

The application shall not request to map memory at an explicit address except for [*none*].

##### FPT\_AEX\_EXT.1.2

The application shall [*not allocate any memory region with both write and execute permissions*].

##### FPT\_AEX\_EXT.1.3

The application shall be compatible with security features provided by the platform vendor.

##### FPT\_AEX\_EXT.1.4

The application shall not write user-modifiable files to directories that contain executable files unless explicitly directed by the user to do so.

##### FPT\_AEX\_EXT.1.5

The application shall be compiled with stack-based buffer overflow protection enabled.

---

##### 5.1.6.2 Use of Supported Services and APIs (FPT\_API\_EXT.1)

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##### FPT\_API\_EXT.1.1

The application shall use only documented platform APIs.

---

##### 5.1.6.3 File Encryption Key (FEK) Support (FPT\_FEK\_EXT.1)

---

##### FPT\_FEK\_EXT.1.1

The TSF shall [*- Store a FEK in Non-Volatile memory conformant with FPT\_KYP\_EXT.1*].

---

##### 5.1.6.4 Extended: Protection of Key and Key Material (FPT\_KYP\_EXT) (FPT\_KYP\_EXT.1)

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##### FPT\_KYP\_EXT.1.1

The TSF shall [*only store keys in non-volatile memory when*  
- *The plaintext key is used to wrap a key as specified in FCS\_COP.1(5) that is already wrapped as specified in FCS\_COP.1(5)* (TD0123 applied) ].

### 5.1.6.5 Use of Third Party Libraries (FPT\_LIB\_EXT.1)

#### FPT\_LIB\_EXT.1.1

The application shall be packaged with only [*libparser4.so, libparser4jni.so, and libstlport\_shared.so*].

### 5.1.6.6 Integrity for Installation and Update (FPT\_TUD\_EXT.1)

#### FPT\_TUD\_EXT.1.1

The application shall [*leverage the platform*] to check for updates and patches to the application software.

#### FPT\_TUD\_EXT.1.2

The application shall be distributed using the format of the platform-supported package manager.

#### FPT\_TUD\_EXT.1.3

The application shall be packaged such that its removal results in the deletion of all traces of the application, with the exception of configuration settings, output files, and audit/log events.

#### FPT\_TUD\_EXT.1.4

The application shall not download, modify, replace or update its own binary code.

#### FPT\_TUD\_EXT.1.5

The application shall [*provide the ability*] to query the current version of the application software.

#### FPT\_TUD\_EXT.1.6

The application installation package and its updates shall be digitally signed such that its platform can cryptographically verify them prior to installation.

### 5.1.7 Trusted path/channels (FTP)

#### 5.1.7.1 Protection of Data in Transit (FTP\_DIT\_EXT.1)

##### FTP\_DIT\_EXT.1.1

The application shall [*not transmit any sensitive data*] between itself and another trusted IT product.

## 5.2 TOE Security Assurance Requirements

The SARs for the TOE are the components as specified in Part 3 of the Common Criteria. Note that the SARs have effectively been refined with the assurance activities explicitly defined in association with both the SFRs and SARs.

Requirement Class	Requirement Component
<b>ADV: Development</b>	ADV_FSP.1: Basic functional specification
<b>AGD: Guidance documents</b>	AGD_OPE.1: Operational user guidance
	AGD_PRE.1: Preparative procedures
<b>ALC: Life-cycle support</b>	ALC_CMC.1: Labelling of the TOE
	ALC_CMS.1: TOE CM coverage
	ALC_TSU_EXT.1: Timely Security Updates
<b>ATE: Tests</b>	ATE_IND.1: Independent testing - conformance
<b>AVA: Vulnerability assessment</b>	AVA_VAN.1: Vulnerability survey

Table 5-2 Assurance Components

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## 5.2.1 Development (ADV)

### 5.2.1.1 Basic functional specification (ADV\_FSP.1)

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- ADV\_FSP.1.1d** The developer shall provide a functional specification.
- ADV\_FSP.1.2d** The developer shall provide a tracing from the functional specification to the SFRs.
- ADV\_FSP.1.1c** The functional specification shall describe the purpose and method of use for each SFR-enforcing and SFR-supporting TSFI.
- ADV\_FSP.1.2c** The functional specification shall identify all parameters associated with each SFR-enforcing and SFR-supporting TSFI.
- ADV\_FSP.1.3c** The functional specification shall provide rationale for the implicit categorisation of interfaces as SFR-non-interfering.
- ADV\_FSP.1.4c** The tracing shall demonstrate that the SFRs trace to TSFIs in the functional specification.
- 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.

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## 5.2.2 Guidance documents (AGD)

### 5.2.2.1 Operational user guidance (AGD\_OPE.1)

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- AGD\_OPE.1.1d** The developer shall provide operational user guidance.
- 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.
- 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.
- 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 fulfil 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.

**AGD\_OPE.1.1e**

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

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**5.2.2.2 Preparative procedures (AGD\_PRE.1)**

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**AGD\_PRE.1.1d**

The developer shall provide the TOE including its preparative procedures.

**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.

**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.

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**5.2.3 Life-cycle support (ALC)**

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**5.2.3.1 Labelling of the TOE (ALC\_CMC.1)**

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**ALC\_CMC.1.1d**

The developer shall provide the TOE and a reference for the TOE.

**ALC\_CMC.1.1c**

The TOE shall be labelled with its unique reference.

**ALC\_CMC.1.1e**

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

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**5.2.3.2 TOE CM coverage (ALC\_CMS.1)**

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**ALC\_CMS.1.1d**

The developer shall provide a configuration list for the TOE.

**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.

**ALC\_CMS.1.1e**

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

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**5.2.3.3 Timely Security Updates (ALC\_TSU\_EXT.1)**

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**ALC\_TSU\_EXT.1.1d**

The developer shall provide a description in the TSS of how timely security updates are made to

the TOE. Application developers must support updates to their products for purposes of fixing security vulnerabilities.

**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.

**ALC\_TSU\_EXT.1.1c**

The description shall include the process for creating and deploying security updates for the TOE software.

**ALC\_TSU\_EXT.1.2c**

The description shall express the time window as the length of time, in days, between public disclosure of a vulnerability and the public availability of security updates to the TOE.

**ALC\_TSU\_EXT.1.3c**

The description shall include the mechanisms publicly available for reporting security issues pertaining to the TOE. 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).

**ALC\_TSU\_EXT.1.1e**

The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

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## 5.2.4 Tests (ATE)

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### 5.2.4.1 Independent testing - conformance (ATE\_IND.1)

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**ATE\_IND.1.1d**

The developer shall provide the TOE for testing.

**ATE\_IND.1.1c**

The TOE shall be suitable for testing.

**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.

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## 5.2.5 Vulnerability assessment (AVA)

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### 5.2.5.1 Vulnerability survey (AVA\_VAN.1)

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**AVA\_VAN.1.1d**

The developer shall provide the TOE for testing.

**AVA\_VAN.1.1c**

The TOE shall be suitable for testing.

**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.

**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.

## 6. TOE Summary Specification

This section describes the security functions:

- Cryptographic support
- User data protection
- Identification and authentication
- Security management
- Privacy
- Protection of the TSF
- Trusted path/channels

### 6.1 Cryptographic support

The TOE operates on an evaluated Android 5.1 or Android 6.0 device, and uses the Security First’s Secure Parser Library version 4.7.1.0 for encryption services and random number generation. The TOE utilizes cryptographic functions provided by the TOE platform. Cryptographic functions offered by the TOE platform are described in the following Security Targets.

- Samsung Electronics Co., Ltd. Samsung Galaxy S7 on Android 6 (MDFPP20) Security Target, Version 0.6, 2016/05/10 (VID-10739)
- Samsung Electronics Co., Ltd. Samsung Galaxy Devices on Android 6 (MDFPP20) Security Target, Version 0.6, 2016/05/10 (VID-10726)
- Samsung Electronics Co., Ltd. Samsung Galaxy Note 5 & Galaxy Tab S2 (MDFPP20) Security Target, Version 0.4, 2015/10/08 (VID-10683)

The following table denotes the CAVP certificates applicable to the TOE. These CAVP certificates explicitly identify their environment to include the Qualcomm MSM 8996 processor and the Exynos 7420 processor. The Exynos 8890 processor is in the same processor family as the 7420 and offers the same 64-bit ARMv8 architecture.

**Table 6-1 Secure Parser Library CAVP Algorithms**

Functions	Standards	Certificates
<b>Encryption/Decryption (Performed by Secure Parser Library)</b>		
SPX Core: AES CBC (256) and Key Wrapping (256 bits)	FIPS PUB 197 NIST SP 800-38A NIST SP 800-38F	AES Cert # 4071
<b>Random bit generation (Performed by Secure Parser Library)</b>		
SPX Core AES-256 CTR_DRBG with software based noise sources with a minimum of 256 bits of non-determinism	NIST SP 800-90	DRBG Cert # 1220

The following table identifies the cryptographic algorithms provided by the TOE Platform which the TOE uses.

**Table 6-2 TOE Platform Cryptographic Algorithms**

Functions	Standards	Certificates
<b>Encryption/Decryption (TOE Invokes Platform)</b>		
TOE Platform: AES CBC (256) and Key Wrapping (256 bits)	FIPS PUB 197 NIST SP 800-38A NIST SP 800-38F	See Security Targets referenced above.
<b>Keyed-hash message authentication (TOE Invokes Platform)</b>		
TOE Platform: HMAC-SHA-384 HMAC-SHA-512	FIPS Pub 198-1 FIPS Pub 180-3	See Security Targets referenced above.
<b>Random bit generation (TOE Invokes Platform)</b>		
TOE Platform: AES-256 CTR_DRBG	NIST SP 800-90	See Security Targets referenced above.

The Cryptographic support function is designed to satisfy the following security functional requirements:

- FCS\_CKM.1(0): See FCS\_CKM\_EXT.1(0).
- FCS\_CKM\_EXT.1: The TOE generates keys using both the Security First’s Secure Parser (SPX Core) cryptographic module) and the platform’s API (KeyGenerator) as described here. The SPX Core API uses an SP 800-90A AES-256 CTR DRBG and the platform uses an SP 800-90A AES-256 CTR DRBG. Both DRBGs are seeded with sufficient entropy from the platform itself.

The platform DRBG is used to generate 256-bit AES FEKEKs. The file encryption key encryption key (FEKEK) is generated using the KeyGenerator API. The FEKEK is stored in the Management Service’s BouncyCastle keystore. The FEKEK is wrapped twice, once using RSA and one more time using AES. The AES key used to wrap the FEKEK is derived from the Android Data Protection SDK password (hereafter referred to as the DaR password) using PBKDF2. Both the Management Service and Application’s RSA keys used to wrap the FEKEK are generated using the KeyGenerator API. If the DaR password provided by the user is not correct, then the Management Service’s BouncyCastle keystore will not properly load, preventing the Management Service from accessing its keystore. Furthermore, an incorrect DaR password results in the incorrect derivation of the PBKDF2 derived AES key, therefore the FEKEK will not be unwrapped properly. The SPX Core DRBG is used to generate the FEKs. The FEK is wrapped by the FEKEK before being stored.

- FCS\_CKM\_EXT.2: The TOE generates file encryption keys using the Security First’s Secure Parser cryptographic module, which implements an SP 800-90A AES-256 CTR DRBG. The DRBG is seeded with sufficient entropy to generate keys with 256 bits of security strength by using seeding material collected by the evaluated platform. The FEKs are generated every time a new file is going to be encrypted. The TOE associates a FEK with an individual file that is being encrypted by storing the wrapped FEK in the same hidden directory as the encrypted file. The TOE automatically generates a FEK (without user action) whenever the application attempts to encrypt a new file.
- FCS\_CKM\_EXT.1(0): The TOE allows the use of DaR passwords that support all special characters mentioned in FCS\_CKM\_EXT.1(0). The TOE encodes the DaR password using UTF-8 before the DaR password is passed into the evaluated Android platform’s cryptographic APIs to perform Password-Based key derivation (SP 800-132 PBKDF2) using HMAC-SHA-512 pseudo-random function. Note that this DaR password does not derive the FEK. The password input into the PBKDF2 function derives a key that serves as a secondary AES wrap on the FEFEK in conjunction with an asymmetric key wrap using RSA key pair stored in the Android keystore. The TOE enforces a minimum password length of 6 characters, and can

support a maximum password of 128 characters. The minimum password length can be changed by an administrator to be any value between 6 and 128 characters.

The TOE performs 4096 iterations of the key derivation function in PBKDF2 to increase the computation needed to derive a key from the DaR password. With a thousand iterations on the evaluated platform, the average derivation time is 249.035 milliseconds.

The salt used in the PBKDF2 operations is generated by the platform's java.security.SecureRandom cryptographic API. First, a byte array is declared. The byte arrays are then filled with a random value from the platform's nextBytes method from SecureRandom. SecureRandom uses /dev/random. The salts are saved in /data/data, which is Android's protected directory. The salt lengths are 64 bytes.

- **FCS\_CKM\_EXT.2:** The TOE generates file encryption keys using the Security First's Secure Parser cryptographic module, which implements an SP 800-90A AES-256 CTR DRBG. The DRBG is seeded with sufficient entropy to generate keys with 256 bits of security strength by using seeding material collected by the evaluated platform. The FEKs are generated every time a new file is going to be encrypted. The TOE associates a FEK with an individual file that is being encrypted by storing the wrapped FEK in the same hidden directory as the encrypted file. The TOE automatically generates a FEK (without user action) whenever the application attempts to encrypt a new file.
- **FCS\_CKM\_EXT.4:** The TOE relies on the platform and SPX Core for destroying keys. The platform utilizes Java Garbage Collection in order to clear memory. The TOE releases all references to objects (e.g. keys) when they are no longer needed, and the Java Garbage Collection clears out the memory that is no longer in use. The SPX Core also utilizes platform functions to destroy FEKs. The SPX Core module\_destroy API overwrites the reference to the key directly and initiates a request for garbage collection for the destruction of non-persistent CSPs from volatile memory.

**Table 6-3 Key Destruction**

Key Name	Cleartext Storage Location	Destruction	Entity responsible for Destruction	When it is destroyed
FEK	RAM	Native memory destruction	SPX Core	After file encryption/decryption
Management Service unwrapped FEKEK	RAM	Java Garbage Collection	Platform key destruction API	After storing FEKEK to Application's BouncyCastle keystore
Application unwrapped FEKEK	RAM	Java Garbage Collection	SPX Core	After wrapping/unwrapping the FEK
PBKDF2 derived key	RAM	Java Garbage Collection	Platform key destruction API	After AES unwrapping double wrapped FEKEK
Management Service's private RSA key	TrustZone	TrustZone	TrustZone	After RSA unwrapping of double-wrapped FEKEK
Application's private RSA key	TrustZone	TrustZone	TrustZone	After RSA unwrapping of single-wrapped FEKEK

- **FCS\_COP.1(1):** The TOE invokes the Security First's Secure Parser cryptographic module to perform AES-256-CBC encryption. The TOE invokes the SPX Core's AES implementation to perform AES 256-CBC encryption when encrypting files using the 256-bit FEK.
- **FCS\_COP.1(4):** The TOE uses the platform's HMAC-SHA-384 to hash<sup>1</sup> the DaR password with a salt generated by the platform's DRBG. The hash value is used as an authentication factor to load the Management Service's BouncyCastle keystore, which houses an RSA wrapped file encryption key

<sup>1</sup> Using the platform API javax.crypto.Mac.init(Key).

encryption key (FEKEK). If the DaR password is incorrect, the keystore will not load, and the calling application does not gain access to the key used to decrypt its files. The TOE uses the platform's HMAC-SHA-512 to hash a PBKDF2 derived key with a second salt to produce a key used to further unwrap the FEKEK using AES key wrap, after the FEKEK has been unwrapped using RSA-OAEP.

- FCS\_COP.1(5): The TOE uses the SPX Core 256 bit AES key wrapping to wrap the FEK with the FEKEK. The TOE uses the evaluated platform's approved cryptographic API (e.g. `cipher.init(Cipher.WRAP_MODE, aesWrappingKey)`, `cipher.init(Cipher.UNWRAP_MODE, aesWrappingKey)`, `OAEPencoding(rsa, digest, null)`, `cipher.wrap` and `cipher.unwrap`) to perform key wrapping functions. The evaluated platform's API performs AES key wrapping in accordance with SP 800-38F and RSA key wrapping in accordance with SP 800-56B. The TOE's [AGD] contains the full list of APIs used by the TOE.
- FCS\_IV\_EXT.1: The TOE uses the SPX Core approved cryptographic API to perform Initialization vector generation using the SPX Core AES-256 CTR DRBG. The TOE's [AGD] contains the full list of APIs used by the TOE. The TOE only uses initialization vectors when performing AES-256 encryption/decryption of user data using the FEK. IVs are not used as part of any key wrap/unwrap process.
- FCS\_KYC\_EXT.1: The DaR password is used in two places. First, it is hashed using SHA-384 with a salt (generated using the platform's DRBG) and used to load the Management Service's BouncyCastle keystore. The DaR password is then used as input to PBKDF2 with 4096 iterations and HMAC-SHA-512 PRF along with a second salt value (also generated using the platform's DRBG).

The platform retrieves the double-wrapped FEKEK from the Management Service's BouncyCastle keystore. The double wrapped FEKEK is AES unwrapped using the 256-bit PBKDF2 derived key, resulting in an RSA wrapped FEKEK.

The RSA wrapped FEKEK is unwrapped using the Management Service's RSA keypair, resulting in a cleartext FEKEK that is re-encrypted using the Application's RSA public key. The Management Service passes this single wrapped FEKEK to the application by temporarily<sup>2</sup> placing it in the Application's BouncyCastle keystore. The Management Service obtains the Application's RSA public key as well as the Application's certificate fingerprint when the Application registers itself to the Management Service (performed once). The Application's RSA public key is kept within Android's SharedPreferences under `MODE_PRIVATE`.

The Management Service uses the Application's certificate fingerprint to read/write to the Application's BouncyCastle keystore.

When the Application needs to access the FEKEK, it obtains its RSA keypair from its own Android keystore and the single wrapped FEKEK from its own BouncyCastle keystore. The Application performs RSA-2048 unwrapping on the single wrapped FEKEK to obtain a cleartext FEKEK. The FEKEK is used as a 256-bit AES key to unwrap the FEK. The FEK is a 256-bit AES key used to decrypt user data.

- FCS\_RBG\_EXT.1: TOE uses the Security First's Secure Parser cryptographic module for random number generation, which utilizes an SP 800-90A AES-256 CTR DRBG. This DRBG is used to generate the File Encryption keys (FEKs). The TOE generates the FEKEK using the platform's AES-256 AES CTR DRBG.
- FCS\_RBG\_EXT.2: The TOE uses the Security First's Secure Parser cryptographic module to generate random data. This Module always creates a global AES-256 CTR\_DRBG upon load, seeds the global DRBG with 384-bits taken from `/dev/urandom`, uses that global DRBG elsewhere within the module when it requires random data, and reseeds the global DRBG (again drawing from `/dev/urandom`) after generating 1,000 blocks of random output.

When the TOE must generate an AES-256 bit FEK, the Security First's Secure Parser cryptographic module creates a separate AES-256 CTR\_DRBG context that it uses solely for generation of keys. The module will seed this AES-256 DRBG context using 384-bits of data drawn from the global DRBG.

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<sup>2</sup> The Management Service erases the single wrapped FEKEK from the application's keystore when the password timer expires.

- FCS\_STO\_EXT.1: All keystores live in Android's protected directory /data/misc/keystore, which is also on the platform's flash storage.
  - The TOE uses the evaluated Android platform's Android keystore to store all RSA keypairs.
  - Upon registration, each Application passes its public key to the Management Service, which is stored in Android's SharedPreferences under MODE\_PRIVATE.
  - The TOE uses the Management Service's BouncyCastle keystore to store the double wrapped FEKEK.
  - The TOE uses the Application's BouncyCastle keystore to store the single wrapped FEKEK.
  - The wrapped FEK and IV are stored in the same hidden directory as the encrypted file, which is all stored on flash.

## 6.2 User data protection

The TOE protects user data by providing encryption of user selected data. The TOE uses 256-bit AES keys to encrypt the files stored to flash. These keys are derived from DaR passwords through a key derivation and key wrapping process. If an application does not enter the right DaR password, the file encryption key will never be derived correctly, thus preventing the application from decrypting its files. The AES keys used as a File Encryption Key (FEK) are generated using the Security First's Secure Parser cryptographic module. The random data collected to seed the SPX Core DRBG comes from the evaluated device's /dev/urandom.

The User data protection function is designed to satisfy the following security functional requirements:

- FDP\_DAR\_EXT.1: The TOE offers two groups of API: one set to manipulate files and one set to manipulate SQLite databases. While the API groups provide different abstractions for the read and write operations, they both are ultimately simply reading and writing a single file. The TOE implements functionality to encrypt data and store it securely on the evaluated platform. The TOE uses the Security First's Secure Parser cryptographic module to generate AES-256 bit keys for file encryption (a.k.a., FEK).
- FDP\_DEC\_EXT.1: The TOE only uses the READ\_EXTERNAL\_STORAGE to write to an external SD Card. The TOE does not access any of the listed sensitive information repositories. The TOE communicates over networks only for the purpose of checking for TOE updates and does not transmit PII data over a network. According to the TOE's [AGD], the Android Data Protection SDK can read/write data to any directory based on the permissions of the integrated application. These directories can reside either in the internal Android SD Card or in expandable memory.

The TOE requires permissions in order to perform the following:

- Modify or delete the contents of USB storage
  - Read the contents of USB storage
  - Use Accounts on the device
  - Full network access in order to check for product updates
  - Reorder running apps
  - Retrieve running apps
  - Run at startup
  - Prevent Phone from Sleeping
- FDP\_NET\_EXT.1: The TOE communicates over networks only for the purpose of checking for TOE updates and does not transmit PII data over a network.
  - FDP\_PRT\_EXT.1: The TOE encrypts each individual file separately. The encrypted files are stored in a hidden directory at the same directory level as the original files. Before encryption, the TOE splits a file

into chunks so that access to specific parts within an encrypted file is easier. Using the SPX Core's API, each chunk is then encrypted separately. The original file is replaced with a directory structure of different files after chunking and encryption. The directory structure of the encrypted file includes a metadata file that describes the chunking structure, a hidden folder for every chunk that includes a header file, and the encrypted file chunks split into encrypted pieces. The TOE implements functionality to ensure that sensitive data is destroyed in volatile and non-volatile memory upon completion of either a decrypt or encrypt operation of the sensitive files. The Android Data Protection SDK returns the plaintext data returned by the API to the application for processing. The Android Data Protection SDK clears all internal buffers of the data. The SPX Core also has routines to destroy keys stored inside the SPX Core. The TOE does not create any temporary resources.

Each chunk is decrypted separately (using the SPX Core's decryption API). This allows much faster access to read/write encrypted data to the encrypted file (e.g. random access files). For example, if data is added to the middle of an encrypted file that has not been chunked, the entire file needs to be decrypted, and the data needs to be inserted before the file is re-encrypted. In the same scenario, if the encrypted file was chunked, then the first half of the chunks can be skipped before reaching the point at which the data needs to be encrypted and inserted. The Android Data Protection SDK chunks the data set on 10MB boundaries, so if only a subset of the data is needed, the system will only encrypt the 10MB chunk that contains the desired data set. If the data in the file wishes to be changed, then the whole file must be re-encrypted. Decrypted pieces are retained for caching purposes for up to 30 seconds, before they are purged and the memory is wiped. Each file has a unique FEK and IV, which is used to encrypt/decrypt each chunk. The wrapped FEK and IV are stored in a hidden directory that resides in the same directory as the encrypted file.

The TOE programmatically destroys keys in volatile memory per Table 5 Key Destruction (such as keys stored in RAM and used by the TOE) by calling Android's Arrays.fill method in order to zero out the key array.

The SPX Core also has its own zeroization. The module\_destroy API zeroes the FEK and FEKEK from volatile memory per Table 5 Key Destruction.

### 6.3 Identification and authentication

The TOE maintains identification and authentication by using DaR passwords. In order for an application to unlock its files, the application must provide the correct DaR password. The DaR password is used to derive the necessary keys in order to obtain the file encryption key, which is used to decrypt the files.

The Identification and authentication function is designed to satisfy the following security functional requirements:

- FIA\_AUT\_EXT.1: The TOE provides a DaR password based authorization factor in order to authenticate to the Android Data Protection SDK service.
- FIA\_FCT\_EXT.1(2): The TOE allows a single user to login to the TOE with their own DaR password (a.k.a., authorization factor). The TOE prompts for a DaR password when the Android Data Protection SDK service starts. The TOE provides user authorization by requiring a user to provide a DaR password to gain access to the Android Data Protection SDK service as well as the user's associated keys for the specific application. Encrypt and Decrypt operations are explicitly requested using the TOE library. The DaR password is used to obtain two unique keys used to recover the file encryption key encryption key (FEKEK). The DaR password is first hashed using HMAC-SHA384. The resulting hash is used as a DaR password to load the Management Service's BouncyCastle keystore. If the DaR password is incorrect, the keystore will not load, and the wrapped FEKEK cannot be loaded. The DaR password previously provided is then used to derive a key using PBKDF2 with HMAC-SHA-512 as the pseudo-random function. This key is used to further unwrap the FEKEK. If the DaR password is incorrect, the key derived using PBKDF2 will not be able to successfully unwrap the FEKEK retrieved from the Management Service's BouncyCastle keystore. The FEKEK is ultimately used to decrypt the actual file encryption key used to encrypt/decrypt files. In order to change a DaR password, the user must provide the previous DaR

password to retrieve the FEKEK. If authentication is successful, the FEKEK is loaded, and the TOE will then use the new DaR password to derive keys to rewrap the FEKEK.

## 6.4 Security management

The TOE does not allow invocation of its services until a configuration file has been created. The configuration options are stored in the evaluated Android 5.1 or Android 6.0 OS's defined private area on flash memory. The TOE allows users to change DaR passwords as part of its security management.

The Security management function is designed to satisfy the following security functional requirements:

- **FMT\_CFG\_EXT.1:** The TOE restricts access to its services upon first use. The services are grayed out until a configuration file is created. This allows the TOE to force the user to configure the TOE before accessing the TOE's services. There are no default credentials within the TOE.
- **FMT\_MEC\_EXT.1:** The TOE's evaluated Android platform automatically uses `/data/data/package/shared_prefs/` to store configuration options and settings. The Time-outs, Lock-outs, and SALTs for PBKDFv2 are stored in private files in the file directory.
- **FMT\_SMF.1:** The TOE provides the ability to change DaR passwords/passphrases and configure the DaR password/passphrase complexity setting.

## 6.5 Privacy

The Privacy function is designed to satisfy the following security functional requirements:

- **FPR\_ANO\_EXT.1:** The TOE does not transmit any PII over a network. The only use of a network is to determine the currently available product version for the purpose of detecting available updates.

## 6.6 Protection of the TSF

The TOE is physically protected by the boundary of the evaluated device. The TOE is executed on an evaluated Android 5.1 or Android 6.0 OS. The TOE utilizes the evaluated platform's APIs only. Android's application management requires application updates to be signed with an Android key, thus allowing the secure updates of its applications. The Android OS Linux kernel is capable of ASLR (address space layout randomization), ensuring that no application uses the same address layout on two different devices. Keys are also stored in memory, which can be wiped by rebooting the device.

The Protection of the TSF function is designed to satisfy the following security functional requirements:

- **FPT\_AEX\_EXT.1:** The application is compiled with `"-v -DBUILD_JNI -DANDROID -DCyber -O2 -fstack-protector-all -fexceptions"` in order to enable ASLR and stack-based buffer overflow protection. The Linux kernel of the TOE's Android OS also provides address space layout randomization utilizing the `get_random_int(void)` kernel random function to provide eight unpredictable bits to the base address of any user-space memory mapping. The random function, though not cryptographic, ensures that one cannot predict the value of the bits.
- **FPT\_API\_EXT.1:** The TOE uses only platform provided APIs and does not import any third party APIs. The TOE's [AGD] contains the full list of APIs used by the TOE.
- **FPT\_FEK\_EXT.1:** The TOE stores keys in non-volatile memory in conformance with **FPT\_KYP\_EXT.1**. When keys are no longer needed, they are destroyed by the platform's mechanism. The TOE destroys keys in volatile memory (such as keys stored in RAM and used by the TOE) by calling Android's `Arrays.fill` method in order to zero out the key array. The TOE programmatically destroys these keys in memory after they are no longer needed by the TOE (i.e. after encryption/decryption). The TOE relies on Android's platform application protections to prevent disclosure of application memory, which can lead to recovery of keys. The TOE also stores FEKs on flash storage. The SPX Core has routines to destroy keys and secrets

that are stored within the SPX Core. The TOE calls the SPX Core's module\_destroy function to destroy FEKs.

- **FPT\_KYP\_EXT.1:** The TOE stores keys in non-volatile memory by relying on the Android and BouncyCastle keystores. The TOE uses the Management Service's BouncyCastle keystore to store the double wrapped FEKEK. The TOE uses the Android keystore to store all RSA public/private keys, which are used to unwrap the double wrapped FEKEKS. The unwrapped FEKEKS are further unwrapped using AES key wrap. The TOE wraps the file encryption keys (FEK, used for encrypting files) with another AES key, and then stores the wrapped FEK on the evaluated device's flash memory. The TOE utilizes the evaluated Android platform's AES key wrap and RSA OAEP key wrap functions to protect keys. The keys are stored in non-volatile memory using Android's keystore API.
- **FPT\_LIB\_EXT.1:** The TOE only uses the third party library libparser4.so, libparser4jni.so, and libstlport\_shared.so.
  - libparser4.so – main SPX Core crypto library;
  - libparser4jni.so – utilities used by libparser4.so; and
  - libstlport\_shared.so – library of standard C++ headers (replaces libstdc++.so)
- **FPT\_TUD\_EXT.1:** If a security vulnerability was found by a user, then the user must report it to Trivalent's email at support@trivalent.co. In the case that the vulnerability impacts the Trivalent Android Data Protection SDK: Trivalent will deliver updated API Code, as well as additional developer's documentation outlining any potential changes in the implementation. In order to deliver the final resolution to the end-user, the partner developer or customer will need to implement the updated code into their target applications. The time for final delivery will be dependent on their ability to update the end-user application, and to distribute to users via Mobile Device Management Service, application store, or other delivery mechanism.

In the case the vulnerability directly relates to the Trivalent Management Service APK: Trivalent shall deliver, via email or other agreed upon method, an updated application with security vulnerabilities addressed. The delivered software shall be accompanied by documentation outlining changes to the overall service, as well as compatible versions of the Trivalent API. Once delivered to the customer or partner, the application can be delivered to end-users via Internal MDM instances, Internal 'App Stores' or other agreed upon methodologies.

The TOE's software is digitally signed by Trivalent. Each update is accompanied by documentation outlining changes to the overall service, as well as compatible versions of the Trivalent API.

Checking for updates can be done in the app by selecting the following:



A popup will appear indicating whether an update is necessary and instructions on how to retrieve it.

## 6.7 Trusted path/channels

The TOE does not transmit data to any other products.

The Trusted path/channels function is designed to satisfy the following security functional requirements:

- **FTP\_DIT\_EXT.1:** The TOE does not transmit any data between itself and other products.