Aruba Virtual Intranet Access (VIA) Client Version 4.3 Security Target

Version 1.0

2022-08-23

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Table of Contents

List of Tables and Figures

1 Security Target Introduction

This section introduces the Target of Evaluation (TOE) and provides the Security Target (ST) and TOE identification, ST and TOE conformance claims, ST conventions, glossary and list of abbreviations.

The TOE is the Aruba Virtual Intranet Access (VIA) Client version 4.3. The TOE is a VPN client application that remote workers and mobile users can install on their computers or mobile devices to securely connect to their enterprise network from remote locations using IPsec.

The focus of this evaluation is on the TOE functionality supporting the claims in the Protection Profile for Application Software, version 1.3 ([PP_APP_v1.3]) and PP-Module for VPN Clients, version 2.3 ([MOD_VPNC_V2.3]). The security functionality specified in [PP_APP_v1.3] and [MOD_VPNC_V2.3] includes protection of communications between the TOE and external IT entities, ability to verify the source and integrity of updates to the TOE, and use of NIST-validated cryptographic mechanisms.

The Security Target (ST) includes the following additional sections:

- TOE Description (Section 2)—provides an overview of the TOE and describes the physical and logical boundaries of the TOE
- Security Problem Definition (Section 3)—describes the threats and assumptions that define the security problem to be addressed by the TOE and its environment
- Security Objectives (Section 4)—describes the security objectives for the TOE and its operational environment necessary to counter the threats and satisfy the assumptions that define the security problem
- IT Security Requirements (Section 5)—specifies the security functional requirements (SFRs) and security assurance requirements (SARs) to be met by the TOE
- TOE Summary Specification (Section 6)—describes the security functions of the TOE and how they satisfy the SFRs
- Protection Profile Claims (Section 7)—provides rationale supporting the claims for conformance of the ST and the TOE to [PP_APP_v1.3] and [MOD_VPNC_V2.3]
- TOE Summary Specification Rationale (Section 8)—provides mappings and rationale for the security problem definition, security objectives, security requirements, and security functions to justify their completeness, consistency, and suitability.

1.1 Security Target, Target of Evaluation, and Common Criteria Identification

ST Title: Aruba Virtual Intranet Access (VIA) Client Version 4.3 Security Target

ST Version: Version 1.0

ST Date: 2022-08-23

Target of Evaluation (TOE) Identification: Aruba Virtual Intranet Access (VIA) Client version 4.3.

TOE Versions: All of the following platforms will be supported by the application:

- Windows 10 (64-bit)
- Android 11
- Linux (Ubuntu 18.04)

TOE Developer: Aruba

Evaluation Sponsor: Aruba

CC Identification: Common Criteria for Information Technology Security Evaluation, Version 3.1, Revision 5, April 2017

1.2 Conformance Claims

This TOE claims exact conformance to the following CC specifications:

- *PP-Configuration for Application Software and Virtual Private Network (VPN) Clients*, Version 1.0, 2021-08-13, which includes the following:
    - *Protection Profile for Application Software,* version 1.3, 2019-03-01 [PP_APP_V1.3]
    - *PP-Module for Virtual Private Network (VPN) Clients,* version 2.3, 2021-08-10 [MOD_VPNC_V2.3].

This TOE and ST are conformant to Part 2 (extended) and Part 3 (extended) of Common Criteria Version 3.1, Revision 5, dated April 2017. The TOE does not claim conformance to any packages.

The following NIAP Technical Decisions for [PP_APP_v1.3] and [MOD_VPNC_V2.3] apply to the materials to which the TOE conforms, the TOE evidence, or how the TOE is evaluated:

- TD0622: VPNC MOD FTP_DIT_EXT.1 corrections
- TD0601: X.509 SFR Applicability in App PP
- TD0600: Conformance claim sections updated to allow for MOD_VPNC_V2.3
- TD0598: Expanded AES Modes in FCS_COP for App PP
- TD0582: PP-Configuration for Application Software and Virtual Private Network (VPN) Clients now allowed
- TD0561: Signature verification update
- TD0554: iOS/iPadOS/Android AppSW Virus Scan
- TD0548: Integrity for installation tests in AppSW PP 1.3
- TD0544: Alternative testing methods for FPT_AEX_EXT.1.1
- TD0543: FMT_MEC_EXT.1 evaluation activity update
- TD0519: Linux symbolic links and FMT_CFG_EXT.1

- TD0515: Use Android APK manifest in test
- TD0498: Application Software PP Security Objectives and Requirements Rationale
- TD0495: FIA_X509_EXT.1.2 Test Clarification
- TD0465: Configuration Storage for .NET Apps
- TD0445: User Modifiable File Definition
- TD0437: Supported Configuration Mechanism
- TD0435: Alternative to SELinux for FPT_AEX_EXT.1.3
- TD0434: Windows Desktop Applications Test
- TD0427: Reliable Time Source
- TD0416: Correction to FCS_RBG_EXT.1 Test Activity

Technical Decisions not applicable to the evaluation:

- TD0510: Obtaining random bytes for iOS/macOS
  - The TD is not applicable since iOS/macOS is not included in the evaluation.

1.3 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 either by adding a string starting with "/" (e.g. "FPT_TST_EXT.1/VPN") or by using a bracketed number (e.g. FCS_COP.1(1)).
  - 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 …"). Note that 'cases' that are not applicable in a given SFR have simply been removed without any explicit identification.
- Other sections of the ST – Other sections of the ST use bolding to highlight text of special interest, such as captions.

1.3.1 Acronyms

Table 1: Acronyms

Acronym	Definition
AES	Advanced Encryption Standard
API	Application Programming Interface
CBC	Cipher-Block Chaining
CA	Certificate Authority
CAVP	Cryptographic Algorithm Validation Program
CM	Configuration Management
CSP	Critical Security Parameter
DH	Diffie-Hellman
ECC	Elliptic-curve cryptography
FFC	Finite Field Cryptography
FIPS	Federal Information Processing Standard
HMAC	Hashed Message Authentication Code
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IPsec	Internet Protocol Security
NIST	National Institute of Standards and Technology
OCSP	Online Certificate Status Protocol
RSA	Rivest, Shamir and Adleman (algorithm for public-key cryptography)
SAR	Security Assurance Requirement
SFR	Security Functional Requirement
SHA	Secure Hash Algorithm
ST	Security Target
TLS	Transport Layer Security
TOE	Target of Evaluation
TSF	TOE Security Functions
VIA	Aruba Virtual Intranet Access

2 TOE Description

2.1 Product Overview

VIA is a part of the Aruba remote networks solution intended for teleworkers and mobile users. VIA detects the network environment (trusted and untrusted) of the user and connects the users to the enterprise network. A trusted network refers to a protected office network that allows users to access the corporate intranet directly. Untrusted networks are public Wi-Fi hotspots, such as airports, cafes, or home networks.

The VIA solution includes VIA Client and the Mobility Controller. The Mobility Controller running ArubaOS delivers network services that always on network with controller clustering, maximize Wi-Fi performance, ensure seamless roaming, and extends secure VPN access for Remote APs, Instant APs and VIA VPN clients. Note that the Mobility Controller is not part of the Common Criteria evaluation. The product relies on a platform-provided mechanism to establish HTTPS connectivity with the Mobility Controller to acquire VPN configuration settings. This is an environmental mechanism and is therefore not within the TOE boundary.

2.2 TOE Overview

The Target of Evaluation (TOE) is the Aruba Virtual Intranet Access (VIA) Client version 4.3. The TOE is a software application with IPsec VPN client capability.

With respect to the security functionality of the TOE, the TSF is limited to the relevant functionality that is defined in the claimed [PP_APP_v1.3] and [MOD_VPNC_V2.3]. The logical boundary of the TOE is summarized in section 2.3.2. However, the following general capabilities are considered to be within the scope of the TOE:

- **Cryptographic Support:** The TOE implements NIST CAVP approved cryptographic algorithms. The TOE protects communication between itself and an Aruba Mobility Controller over an unprotected network using IPsec and uses various mechanisms to protect credential data at rest.
- **User Data Protection**: The TOE informs a user of hardware and software resources the TOE accesses. The TOE leverages platform-provided functionality to encrypt sensitive data and allows network communications to be initiated by the user in order to connect to the VPN Gateway.
- **Identification and Authentication**: The TOE provides the ability to use, store, and protect X.509 certificates that are used for IPsec Virtual Private Network (VPN) connections. The TOE performs peer authentication using pre-shared keys or certificates.
- **Security Management:** The TOE and its IPsec VPN are fully configurable by a combination of functions provided directly by the TOE and those available to the associated VPN gateway.
- **Privacy:** The TOE does not transmit PII over a network.
- **Protection of the TSF:** The TOE performs self-tests that cover the TOE as well as the functions necessary to securely update the TOE. The TOE includes the use only documented platform APIs.
- **Trusted Path/Channel:** The TOE implements IPsec to establish a trusted channel to an external VPN gateway.

This ST focuses on the security functionality of application software and IPsec VPN capabilities of the TOE. The TOE provides secure remote network connectivity for Android, Linux, and Windows mobile devices and workstations. The TOE has two primary purposes:

- to provide secure corporate access to employee workstations and smartphones from anywhere
- to provide ease-of-use for the end users and network administrators

The IPsec VPN capabilities are the primary function of the TOE. IPsec is used by the TOE to protect communication between itself and an Aruba Mobility Controller over an unprotected network.

VIA can be downloaded directly from an Aruba Mobility Controller, pushed out using enterprise management tools, installed manually, or install the Android version from the Google Play Store. An Aruba Mobility Controller is required to terminate connections from a VIA client – VIA is not a general-purpose VPN client that works with third-party VPN gateways.

2.3 TOE Architecture

The TOE provides secure connectivity for users when accessing an enterprise or corporate resource (example: workstation, server) from an untrusted or trusted network connection. By default, the TOE automatically launches and establishes a remote connection when the user logs in to their system from an untrusted network.

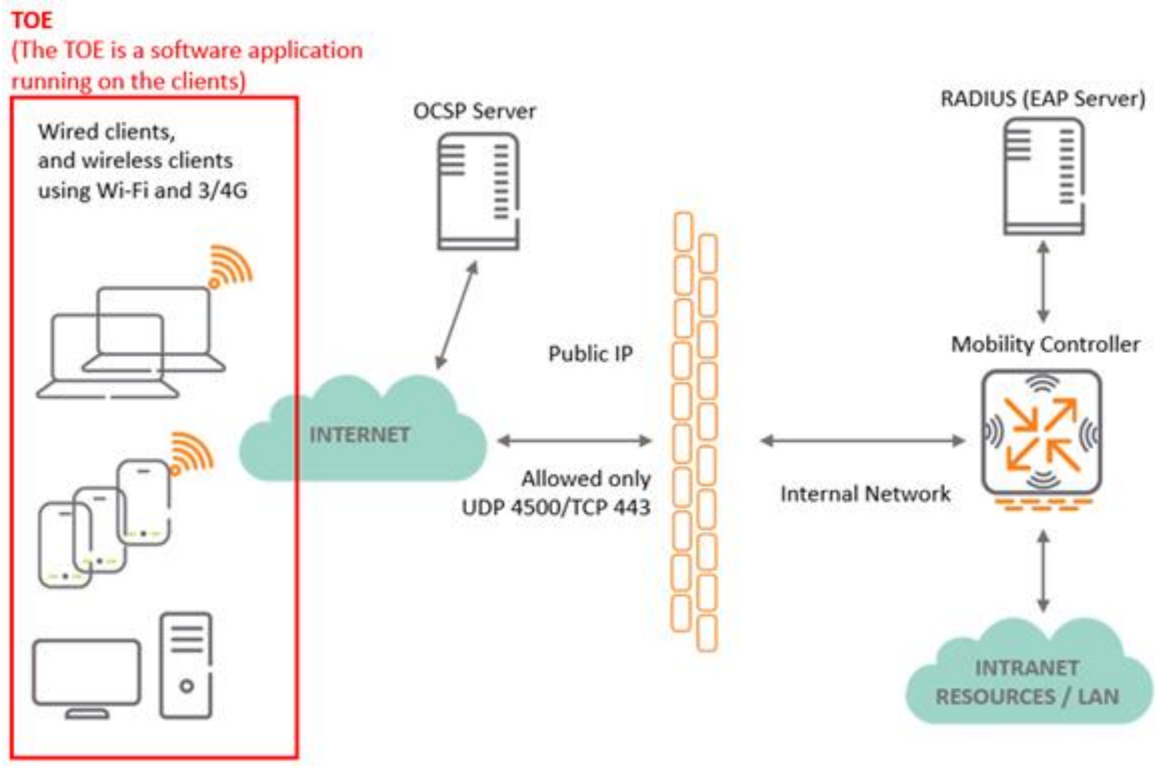
The TOE runs on an end-user device and communicates with a gateway located on a Mobility Controller. The server component is used to manage the client and ensure policies are enforced. The Mobility Controller maintains certain VIA configuration profiles, such as the VIA authentication profile, the VIA connection profile, and the VIA web authentication profile. Each profile plays an important role in authenticating the users and establishing a secure connection. When multiple authentication profiles are available, the VIA client prompts the user to select an authentication profile.

The first time a connection is established, a user opens the VIA client and enters the gateway name, username, and password. VIA then connects to the gateway over an HTTPS channel and attempts to authenticate using the user supplied credentials. The TSF relies on the underlying OS platform for establishment of the HTTPS channel; it is not part of the TOE itself. This connection is used to retrieve configuration settings for the IPsec connection and any site-specific branding (e.g. logo graphics).

If the VIA web authentication list has more than one VIA authentication profile, the user can choose a VIA authentication profile from the available ones. After successful authentication, the VIA client downloads the appropriate VIA connection profile and establishes the IPsec connection if the user is connected to an untrusted network.

At a protocol level, VIA operates over UDP port 4500, which is defined for IKE/IPsec traversal of NATs in RFC 3947. VIA uses HTTPS over TCP port 443 in order to contact the authentication server and download configuration profile updates before establishing each IKE/IPsec connection. The VIA topography is shown in the figure below.

Figure 1: VIA Topography


TOE
(The TOE is a software application running on the clients)
Wired clients, and wireless clients using Wi-Fi and 3/4G
OCSP Server
RADIUS (EAP Server)
Public IP
Mobility Controller
INTERNET
Allowed only UDP 4500/TCP 443
Internal Network
INTRANET RESOURCES / LAN

The OCSP server is required for the TOE to be able to perform certificate validation in accordance with the claim of FIA_X509_EXT.1 (see section 5.2.3.2). The Mobility Controller is required in the operational environment because the TOE uses it as its VPN gateway. The RADIUS (EAP Server) component is shown on the diagram because the Mobility Controller also functions as a wireless access system that uses EAP for client authentication. However, this functionality is separate from the VPN Client functionality and is outside the scope of the TOE and its operational environment; it is just included because a typical Mobility Controller deployment will have one present for its other functions.

2.3.1 Physical Boundary

The TOE is a software application running on a general-purpose or mobile device operating system. These platforms and their corresponding CC certificates are as follows:

- **Windows:**
  - Microsoft Windows 10 and Server version 1903 (May 2019 Update) (https://www.niap-ccevs.org/Product/CompliantCC.cfm?CCID=2019.1244)
  - Windows 10 and Windows Server 2019 version 1809 (https://www.niap-ccevs.org/Product/CompliantCC.cfm?CCID=2019.1204)
  - Windows 10 and Windows Server (April 2018 Update) (https://www.niap-ccevs.org/Product/CompliantCC.cfm?CCID=2019.1018)
- **Android:**

    - Samsung Galaxy Devices on Android 11 – Fall (CCEVS-VR-VID11211-2021)
- **Linux:**
    - Ubuntu 18.04 – (https://www.commoncriteriaportal.org/files/epfiles/ST%20-%20Canonical%20Ubuntu%20Server%2018.04%20LTS.pdf)

Different platform versions of the TOE rely on their underlying OS platforms to varying extents. For cases where these differ within an individual SFR, the SFRs themselves are iterated to show which claims apply to which platform versions. In all cases, the TSF will rely on the OS platform to establish HTTPS connectivity to the VPN gateway for acquisition of IPsec configuration settings; this is outside the TOE boundary so no SFRs apply to this.

2.3.1.1 Software Requirements

Windows

- Microsoft Windows 10

  Windows clients running VIA on a Windows Enterprise platform using Secure Boot require the Long-Term Servicing Channel (LTSC) version of Windows 10.

Android

- Device is running Android 11.

Linux

- Device is running Ubuntu 18.04.

2.3.1.2 Hardware Requirements

The TOE is the Aruba Virtual Intranet Access (VIA) client version 4.3 running on general-purpose personal computing and mobile device hardware. The tested configuration included the following hardware devices:

- Windows – Windows 10 64-bit on HP Elitebook x360 830 G5 with the Intel Core i5-11400H processor.
- Android – Android 11 on Samsung Galaxy S20 FE 5G with the Snapdragon 865 processor.
- Linux – Ubuntu 18.04.1 on HPE EliteBook 840 G3 with the Intel Core i7-6600U processor.

2.3.2 Logical Boundary

This section summarizes the security functions provided by Aruba Virtual Intranet Access (VIA) client:

- Cryptographic support
- User data protection
- Identification and authentication

- Security management
- Privacy
- Protection of the TSF
- Trusted path/channel

2.3.2.1 Cryptographic Support

The TOE implements NIST CAVP approved cryptographic algorithms.

The TOE does not store keys unencrypted in persistent storage. While the TOE manipulates keys, on all platforms, the TOE platform's key storage is used. The TOE also uses various mechanisms to protect credential data at rest.

The IPsec implementation is the primary function of the TOE. IPsec is used by the TOE to protect communication between itself and an Aruba Mobility Controller over an unprotected network.

The TOE implements IKEv1 in tunnel mode only and main mode as defined in RFCs 2407, 2408, 2409, RFC 4109. Aggressive mode is not supported for IKEv1 Phase 1 exchanges. The TSF supports hash functions defined in RFC 4868 and supports XAUTH. Extended sequence numbers are not supported. The TOE performs peer authentication using certificates or pre-shared keys.

The TOE implements IKEv2 as defined in RFCs 7296 (with mandatory support for NAT traversal as specified in section 2.23), RFC 8784, RFC 8247 in tunnel mode only. The TOE does not offer transport mode as a configuration option. The TOE implements peer authentication using RSA certificates or ECDSA certificates that conform to RFC 4945 and pre-shared keys. If certificates are used, the TOE ensures that the distinguished name (DN) contained in a certificate matches the expected DN for the entity attempting to establish a connection and ensures that the certificate has not been revoked (using the Online Certificate Status Protocol [OCSP] in accordance with RFC 6960).

The TOE implements the IPsec protocol as specified in RFC 4301; however the TOE relies upon the VPN Gateway to ensure that the cryptographic algorithms and key sizes negotiated during the IKEv1 and IKEv2 negotiation ensure that the security strength of the IKE_SA is greater than or equal to that of the CHILD_SA

The IKEv1 and IKEv2 SA lifetimes are configured by the VPN Gateway based upon the length of time. Length of time includes 24 hours or less for Phase 1 and 8 hours or less for Phase 2.

2.3.2.2 User Data Protection

The TOE informs a user of hardware and software resources the TOE accesses. It uses the platform's permission mechanism to get a user's approval for access as part of the installation process. The TOE leverages platform-provided functionality to encrypt sensitive data and allows network communications to be initiated by the user in order to connect to the VPN Gateway. The TOE can also provide always-on functionality for application-initiated network communication.

The TOE ensures that residual information is protected from potential reuse in accessible objects such as network packets.

2.3.2.3 Identification and Authentication

The TOE provides the ability to use, store, and protect X.509 certificates that are used for IPsec Virtual Private Network (VPN) connections. The TOE performs peer authentication using pre-shared keys or certificates.

Pre-shared keys apply to IKEv1 only. Character limits and character set are not enforced programmatically; therefore, the administrative guidance includes instructions on setting strong pre-shared keys.

2.3.2.4 Security Management

The TOE and its IPsec VPN are fully configurable by a combination of functions provided directly by the TOE and those available to the associated VPN gateway. The TOE is not provided with any default credentials or pre-shared keys. All external configuration comes from the Mobility Controller. The configuration options for the TOE consists of the URL of the gateway and the credentials used for the connection. The configuration options are stored and set using the mechanisms supported by the platform.

2.3.2.5 Privacy

The TOE does not transmit PII over a network.

2.3.2.6 Protection of the TSF

The TOE performs self-tests that cover the TOE as well as the functions necessary to securely update the TOE.

The TOE includes the use only documented platform APIs.

For each platform, the application does not allocate any memory region with both write and execute permissions nor does the TOE request to map memory to an explicit address. The TOE does not write user-modifiable files to directories that contain executable files. The application is built with stack-based buffer overflow protection enabled.

Aruba provides a version control system for its software components. The TOE has a unique software versioning that identifies major versions and their subsequent maintenance releases.

The `About` tab on the TOE displays the current system image version number for the TOE. The TOE platforms support loading updates by the administrator. For Windows and Linux platforms, the administrator obtains the update in the form of an installer through the Aruba Mobility Controller or the Aruba Support Portal. The update is verified using a RSA 2048 with SHA-1 digital signature. For Android versions, the application and signature are provided to and verified by the Google Play Store.

The TOE does not download, modify, replace or update its own binary code. The application is packaged such that its removal results in the deletion of all traces of the application, with the exception of configuration settings and output files.

2.3.2.7 Trusted Path/Channel

TOE connects to the server over an HTTPS connection and attempts to authenticate using the user supplied credentials. The cryptography for the initial HTTPS connection is provided by the platform and is therefore outside the scope of the TOE. The IKE/IPsec transversal is secured using the TOE cryptography.

The TOE acts as a VPN client using IPsec to established secure channels to corresponding VPN gateways.

2.4 TOE Documentation

The administrative guides are identified as online documents:

- https://www.arubanetworks.com/techdocs/VIA/4x/Content/home.htm
- Aruba, a Hewlett Packard Enterprise Company Virtual Intranet Access (VIA) 4.x Client Common Criteria Guidance, Version 1.2, March 2022

3 Security Problem Definition

This security target includes by reference the Security Problem Definition from the [PP_APP_v1.3] and [MOD_VPNC_V2.3]. The Security Problem Definition consists of threats that a conformant TOE is expected to address and assumptions about the operational environment of the TOE.

In general, the [PP_APP_v1.3] and [MOD_VPNC_V2.3] have presented a Security Problem Definition appropriate for application software that provides a Virtual Private Network used to establish a secure IPsec connection between a host platform and a remote system. As such, the [PP_APP_v1.3] and [MOD_VPNC_V2.3] Security Problem Definition applies to the TOE.

4 Security Objectives

This ST is conformant to the Protection Profile for Application Software, Version 1.3, 2019-03-01 [PP_APP_v1.3] and PP-Module for Virtual Private Network (VPN) Clients, Version 2.3, 2021-08-10 [MOD_VPNC_V2.3].

This section reproduces only the corresponding Security Objectives for the TOE and the Security Objectives of the Operational Environment for reader convenience. The [PP_APP_v1.3] and [MOD_VPNC_V2.3] offer additional information about the identified security objectives but have not been reproduced here and the [PP_APP_v1.3] and [MOD_VPNC_V2.3] should be consulted if there is interest in that material.

In general, the [PP_APP_v1.3] and [MOD_VPNC_V2.3] have defined Security Objectives appropriate for a software application and IPsec VPN client and as such are applicable to the Aruba Virtual Intranet Access (VIA) Client TOE.

4.1 Security Objectives for the TOE

Table 2 Security Objectives for the TOE

Objective	Description
[PP_APP_v1.3]	
O.INTEGRITY	Conformant TOEs ensure the integrity of their installation and update packages, and also leverage execution environment-based mitigations. Software is seldom, if ever, shipped without errors. The ability to deploy patches and updates to fielded software with integrity is critical to enterprise network security. Processor manufacturers, compiler developers, execution environment vendors, and operating system vendors have developed execution environment-based mitigations that increase the cost to attackers by adding complexity to the task of compromising systems. Application software can often take advantage of these mechanisms by using APIs provided by the runtime environment or by enabling the mechanism through compiler or linker options.
O.QUALITY	To ensure quality of implementation, conformant TOEs leverage services and APIs provided by the runtime environment rather than implementing their own versions of these services and APIs. This is especially important for cryptographic services and other complex operations such as file and media parsing. Leveraging this platform behavior relies upon using only documented and supported APIs.
O.MANAGEMENT	To facilitate management by users and the enterprise, conformant TOEs provide consistent and supported interfaces for their security-relevant configuration and maintenance. This includes the deployment of applications and application updates through the use of platform-supported deployment mechanisms and formats, as well as providing mechanisms for configuration. This also includes providing control to the user regarding disclosure of any PII.

O.PROTECTED_STORAGE	To address the issue of loss of confidentiality of user data in the event of loss of physical control of the storage medium, conformant TOEs will use data-at-rest protection. This involves encrypting data and keys stored by the TOE in order to prevent unauthorized access to this data. This also includes unnecessary network communications whose consequence may be the loss of data.
O.PROTECTED_COMMS	To address both passive (eavesdropping) and active (packet modification) network attack threats, conformant TOEs will use a trusted channel for sensitive data. Sensitive data includes cryptographic keys, passwords, and any other data specific to the application that should not be exposed outside of the application.
[MOD_VPNC_V2.3]	
O.AUTHENTICATION	To address the issues associated with unauthorized disclosure of information in transit, a compliant TOE's authentication ability (IPsec) will allow the TSF to establish VPN connectivity with a remote VPN gateway or peer and ensure that any such connection attempt is both authenticated and authorized.
O.CRYPTOGRAPHIC_FUNCTIONS	To address the issues associated with unauthorized disclosure of information in transit, a compliant TOE will implement cryptographic capabilities. These capabilities are intended to maintain confidentiality and allow for detection and modification of data that is transmitted outside of the TOE.
O.KNOWN_STATE	The TOE will provide sufficient measures to ensure it is operating in a known state. At minimum this includes management functionality to allow the security functionality to be configured and self-test functionality that allows it to assert its own integrity. It may also include auditing functionality that can be used to determine the operational behavior of the TOE.
O.NONDISCLOSURE	To address the issues associated with unauthorized disclosure of information at rest, a compliant TOE will ensure that non-persistent data is purged when no longer needed. The TSF may also implement measures to protect against the disclosure of stored cryptographic keys and data through implementation of protected storage and secure erasure methods. The TOE may optionally also enforce split-tunneling prevention to ensure that data in transit cannot be disclosed inadvertently outside of the IPsec tunnel.

4.2 Security Objectives for the Operational Environment

Table 3: Security Objectives for the Operational Environment

Objective	Description
[PP_APP_v1.3]	

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.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.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.
[MOD_VPNC_V2.3]	
OE.NO_TOE_BYPASS	Information cannot flow onto the network to which the VPN client's host is connected without passing through the TOE.
OE.PHYSICAL	Physical security, commensurate with the value of the TOE and the data it contains, is assumed to be provided by the environment.
OE.TRUSTED_CONFIG	Personnel configuring the TOE and its operational environment will follow the applicable security configuration guidance.

5 IT 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 TOE and to scope the evaluation effort.

The SFRs have all been drawn from the [PP_APP_v1.3] and the [MOD_VPNC_V2.3].

As a result, any selection, assignment, or refinement operations already performed by that Protection Profile (PP) on the claimed SFRs are not identified here (i.e., they are not formatted in accordance with the conventions specified in section 1.3 of this ST). Formatting conventions are only applied on SFR text that was chosen at the ST author's discretion.

The TOE and ST claim the following additional requirements beyond the minimum that is required by the claimed PP-Configuration. Note per the claim of Exact Conformance that these additional requirements are drawn exclusively from those specified in the PP and PP-Module from the PP-Configuration as optional and selection-based requirements:

- From [PP_APP_V1.3]: FCS_CKM.1(1), FCS_CKM.1(2), FCS_CKM.2, FCS_COP.1(1), FCS_COP.1(2), FCS_COP.1(3), FCS_COP.1(4), FCS_RBG_EXT.2, FIA_X509_EXT.1, FIA_X509_EXT.2, and FPT_TUD_EXT.2.
- From [MOD_VPNC_V2.3]: FIA_PSK_EXT.1

5.1 Extended Requirements

All of the extended requirements in this ST have been drawn from the [PP_APP_v1.3] and the [MOD_VPNC_V2.3]. This ST references the following extended SFRs and SARs.

- FCS_RBG_EXT.1: Random Bit Generation Services
- FCS_RBG_EXT.2: Random Bit Generation from Application
- FCS_CKM_EXT.1: Cryptographic Key Generation Services
- FCS_CKM_EXT.2: Cryptographic Key Storage
- FCS_CKM_EXT.4: Cryptographic Key Destruction
- FCS_STO_EXT.1: Storage of Credentials
- FCS_IPSEC_EXT.1: IPsec
- FDP_DEC_EXT.1: Access to Platform Resources
- FDP_NET_EXT.1 Network Communications
- FDP_DAR_EXT.1: Encryption Of Sensitive Application Data
- FIA_PSK_EXT.1: Pre-Shared Key Composition
- FIA_X509_EXT.1 X.509: Certificate Validation

- FIA_X509_EXT.2: X.509 Certificate Authentication
- 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 Information
- FPT_AEX_EXT.1: Anti-Exploitation Capabilities
- FPT_API_EXT.1: Use of Supported Services and APIs
- FPT_IDV_EXT.1: Software Identification and Versions
- FPT_LIB_EXT.1: Use of Third Party Libraries
- FPT_TUD_EXT.1: Trusted Update[1]
- FPT_TUD_EXT.2: Integrity for Installation and Update
- FPT_TST_EXT.1: TSF Self-Test (VPN Client)[2]
- FTP_DIT_EXT.1: Protection of Data in Transit
- ALC_TSU_EXT.1 Timely Security Updates

5.2 TOE Security Functional Requirements

Table 4 identifies the SFRs satisfied by the TOE.

Table 4: TOE Security Functional Components

Requirement Class	Requirement Component
FCS: Cryptographic Support	FCS_CKM.1(1): Cryptographic Asymmetric Key Generation
	FCS_CKM.1(2): Cryptographic Symmetric Key Generation
	FCS_CKM.1/VPN: Cryptographic Key Generation (IKE)
	FCS_CKM_EXT.1: Cryptographic Key Generation Services
	FCS_CKM.2: Cryptographic Key Establishment
	FCS_CKM_EXT.2: Cryptographic Key Storage
	FCS_CKM_EXT.4: Cryptographic Key Destruction

[1] The ST identifies multiple iterations of this SFR.

[2] The ST iterates this SFR per its definition in [MOD_VPNC_V2.3].

Requirement Class	Requirement Component
	FCS_COP.1(1): Cryptographic Operation – Encryption/Decryption
	FCS_COP.1(2): Cryptographic Operation - Hashing
	FCS_COP.1(3): Cryptographic Operation - Signing
	FCS_COP.1(4): Cryptographic Operation - Keyed-Hash Message Authentication
	FCS_IPSEC_EXT.1: IPsec
	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: User Data Protection	FDP_DAR_EXT.1: Encryption Of Sensitive Application Data
	FDP_DEC_EXT.1: Access to Platform Resources
	FDP_NET_EXT.1: Network Communications
	FDP_RIP.2: Full Residual Information Protection
FIA: Identification and Authentication	FIA_PSK_EXT.1: Pre-Shared Key Composition
	FIA_X509_EXT.1 X.509: Certificate Validation
	FIA_X509_EXT.2: X.509 Certificate Authentication
FMT: Security Management	FMT_CFG_EXT.1: Secure by Default Configuration
	FMT_MEC_EXT.1: Supported Configuration Mechanism
	FMT_SMF.1: Specification of Management Functions
	FMT_SMF.1/VPN: Specification of Management Functions (VPN)
FPR: Privacy	FPR_ANO_EXT.1: User Consent for Transmission of Personally Identifiable Information
FPT: Protection of the TSF	FPT_AEX_EXT.1: Anti-Exploitation Capabilities
	FPT_API_EXT.1: Use of Supported Services and APIs
	FPT_IDV_EXT.1: Software Identification and Versions
	FPT_LIB_EXT.1: Use of Third Party Libraries
	FPT_TST_EXT.1/VPN(1): TSF Self-Test (VPN Client) (Windows and Linux)
	FPT_TST_EXT.1/VPN(2): TSF Self-Test (VPN Client) (Android)

Requirement Class	Requirement Component
	FPT_TUD_EXT.1(1): Trusted Update (Android)
	FPT_TUD_EXT.1(2): Trusted Update (Windows and Linux)
	FPT_TUD_EXT.2: Integrity for Installation and Update
FTP: Trusted Path/Channels	FTP_DIT_EXT.1: Protection of Data in Transit

5.2.1 Cryptographic Support (FCS)

5.2.1.1 FCS_CKM.1(1) Cryptographic Asymmetric Key Generation

FCS_CKM.1.1(1) The application shall [***implement functionality***] to generate asymmetric cryptographic keys in accordance with a specified cryptographic key generation algorithm

- [ECC schemes] using [“NIST curves” P-256, P-384 and [***no other curves***]] that meet the following: [FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Appendix B.4]; and,

[

- ***[FFC schemes] using Diffie-Hellman group 14 that meet the following: [RFC 3526, Section 3]***]

].

5.2.1.2 FCS_CKM.1(2) Cryptographic Symmetric Key Generation

FCS_CKM.1.1(2) The application shall generate symmetric cryptographic keys using a Random Bit Generator as specified in FCS_RBG_EXT.1 and specified cryptographic key sizes

- ***128 bit,***
- ***256 bit***

].

5.2.1.3 FCS_CKM.1/VPN Cryptographic Key Generation (IKE)

FCS_CKM.1.1/VPN The TSF shall **[*implement functionality*]** to generate asymmetric cryptographic keys used for IKE peer authentication in accordance with: **[**

- ***FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Appendix B.3 for RSA schemes;***
- ***FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Appendix B.4 for ECDSA schemes and implementing “NIST curves”, P-256, P-384 and [no other curves]***]

and specified cryptographic key sizes [*equivalent to, or greater than, a symmetric key strength of 112 bits*].

5.2.1.4 FCS_CKM_EXT.1 Cryptographic Key Generation Services

FCS_CKM_EXT.1.1 The application shall [***implement asymmetric key generation***

].

5.2.1.5 FCS_CKM.2 Cryptographic Key Establishment

FCS_CKM.2.1 The application shall [***implement functionality***] to perform cryptographic key establishment in accordance with a specified cryptographic key establishment method:

- [Elliptic curve-based key establishment schemes] that meets the following: [NIST Special Publication 800-56A, "Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography"]; and

[

- ***Key establishment scheme using Diffie-Hellman group 14 that meets the following: RFC 3526, Section 3***].

5.2.1.6 FCS_CKM_EXT.2 Cryptographic Key Storage

FCS_CKM_EXT.2.1 The [***TOE***] shall store persistent secrets and private keys when not in use in platform-provided key storage.

5.2.1.7 FCS_CKM_EXT.4 Cryptographic Key Destruction

FCS_CKM_EXT.4.1 The [***TOE, TOE platform***] shall zeroize all plaintext secret and private cryptographic keys and CSPs when no longer required.

5.2.1.8 FCS_COP.1(1) Cryptographic Operation – Encryption/Decryption

FCS_COP.1.1(1) The application shall perform encryption/decryption in accordance with a specified cryptographic algorithm

- AES-CBC (as defined in NIST SP 800-38A) mode
- AES-GCM (as defined in NIST SP 800-38D) mode

[

- ***No other AES modes***

] and cryptographic key sizes [***128-bit, 256-bit***].

5.2.1.9 FCS_COP.1(2) Cryptographic Operation - Hashing

FCS_COP.1.1(2) The application shall perform cryptographic hashing services in accordance with a specified cryptographic algorithm [

- ***SHA-1,***
- ***SHA-256,***
- ***SHA-384***]

and message digest sizes [

- ***160,***
- ***256,***
- ***384***

] bits that meet the following: FIPS Pub 180-4.

5.2.1.10 FCS_COP.1(3) Cryptographic Operation - Signing

FCS_COP.1.1(3) The application shall perform cryptographic signature services (generation and verification) in accordance with a specified cryptographic algorithm [

- ***RSA schemes using cryptographic key sizes of 2048-bit or greater that meet the following: FIPS PUB 186-4, "Digital Signature Standard (DSS)", Section 4,***
- ***ECDSA schemes using "NIST curves" P-256, P-384 and [no other curves] that meet the following: FIPS PUB 186-4, "Digital Signature Standard (DSS)", Section 5***

].

5.2.1.11 FCS_COP.1(4) Cryptographic Operation - Keyed-Hash Message Authentication

FCS_COP.1.1(4) The application shall perform keyed-hash message authentication in accordance with a specified cryptographic algorithm

- HMAC-SHA-256

and [

- ***SHA-1***
- ***SHA-384***

] with key sizes [**160, 256, 384 bits**] and message digest sizes 256 and [***160, 384***] bits that meet the following: FIPS Pub 198-1 The Keyed-Hash Message Authentication Code and FIPS Pub 180-4 Secure Hash Standard.

5.2.1.12 FCS_IPSEC_EXT.1 IPsec

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 [***tunnel 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,* ***[AES-CBC-128, AES-CBC-256 (both specified by RFC 3602) together with a Secure Hash Algorithm (SHA)-based HMAC]***].
FCS_IPSEC_EXT.1.5	The TSF shall implement the protocol: [• ***IKEv1, using Main Mode for Phase I exchanges, as defined in RFCs 2407, 2408, 2409, RFC 4109, [no other RFCs for extended sequence numbers], [RFC 4868 for hash functions], and [support for XAUTH]***; • ***IKEv2 as defined in RFCs 7296 (with mandatory support for NAT traversal as specified in section 2.23), RFC 8784, RFC 8247, and [no other RFCs for hash functions]***].
FCS_IPSEC_EXT.1.6	The TSF shall ensure the encrypted payload in the [***IKEv1, IKEv2***] protocol uses the cryptographic algorithms [*AES-CBC-128, AES-CBC-256 as specified in RFC 6379 and* ***[no other algorithm]***].
FCS_IPSEC_EXT.1.7	The TSF shall ensure that [***IKEv2 SA lifetimes can be configured by [VPN Gateway] based on [length of time], IKEv1 SA lifetimes can be configured by [VPN Gateway] based on [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.
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 ***[14 (2048-bit MODP)]***].
FCS_IPSEC_EXT.1.9	The TSF shall generate the secret value x used in the IKE Diffie-Hellman key exchange ("x" in g^x mod p) using the random bit generator specified in FCS_RBG_EXT.1, and having a length of at least [**224, 256, 384**] 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^[**112, 128, 192**].
Application Note:	*The probability that a specific nonce value will be repeated during the life of a specific IPsec SA is less than 1 in 2^112 for DH Group 14, 2^128 for DH Group 19, or 2^192 for DH Group 20.*

FCS_IPSEC_EXT.1.11 The TSF shall ensure that all IKE protocols perform peer authentication using a [***RSA, ECDSA***] that use X.509v3 certificates that conform to RFC 4945 and [***Pre-shared Keys***].

FCS_IPSEC_EXT.1.12 The TSF shall not establish an SA if the [***[Distinguished Name (DN)] and [no other 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 [***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 [***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 [***IKEv1 Phase 2, IKEv2 CHILD_SA***] connection.

5.2.1.13 FCS_RBG_EXT.1 Random Bit Generation Services

FCS_RBG_EXT.1.1 The application shall [

- ***implement DRBG functionality***

] for its cryptographic operations.

5.2.1.14 FCS_RBG_EXT.2 Random Bit Generation from Application

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.

5.2.1.15 FCS_STO_EXT.1 Storage of Credentials

FCS_STO_EXT.1.1 The application shall [

- ***invoke the functionality provided by the platform to securely store [RSA/ECDSA Certificates (IKEv1 and IKEv2)],***
- ***implement functionality to securely store [Pre-shared keys (IKEv1)] according to [FCS_COP.1(1)]***

] to non-volatile memory.

5.2.2 User Data Protection (FDP)

5.2.2.1 FDP_DAR_EXT.1 Encryption of Sensitive Application Data

FDP_DAR_EXT.1.1[3] The application shall [

- ***protect sensitive data in accordance with FCS_STO_EXT.1***

] in non-volatile memory.

5.2.2.2 FDP_DEC_EXT.1 Access to Platform Resources

FDP_DEC_EXT.1.1 The application shall restrict its access to [

network connectivity

].

FDP_DEC_EXT.1.2 The application shall restrict its access to [

- ***no sensitive information repositories***

].

5.2.2.3 FDP_NET_EXT.1 Network Communications

FDP_NET_EXT.1.1 The application shall restrict network communication to [

- **user-initiated communication for** [***connection to the VPN Gateway***],
- ***[always on functionality for application-initiated network communication,***

].

5.2.2.4 FDP_RIP.2 Full Residual Information Protection

FDP_RIP.2.1 The [***TOE***] shall enforce that any previous information content of a resource is made unavailable upon the [***allocation of the resource to***] all objects.

5.2.3 Identification and Authentication (FIA)

5.2.3.1 FIA_PSK_EXT.1 Pre-Shared Key Composition

FIA_PSK_EXT.1.1 The TSF shall be able to use pre-shared keys for IPsec.

FIA_PSK_EXT.1.2 The TSF shall be able to accept text-based pre-shared keys that:

[3] Modified per TD0582

- are 22 characters and [***[from 6 to 160 characters]***];
- composed of any combination of [*upper and lower case letters, numbers, and special characters (that include: "!", "@", "#", "$", "%", "^", "&", "*", "(", ")", and* ***[no other special characters]****)*].

FIA_PSK_EXT.1.3 The TSF shall condition the text-based pre-shared keys by using [***[conversion of ASCII to binary]***], [***and be able to [accept] bit-based pre-shared keys***].

5.2.3.2 FIA_X509_EXT.1 X.509 Certificate Validation

FIA_X509_EXT.1.1[4] The application shall [***implement functionality***] to validate certificates in accordance with the following rules:

- RFC 5280 certificate validation and certificate path validation.
- The certificate path must terminate with a trusted CA certificate.
- The application shall validate a certificate path by ensuring the presence of the basicConstraints extension, that the CA flag is set to TRUE for all CA certificates, and that any path constraints are met.
- The application shall validate that any CA certificate includes caSigning purpose in the key usage field
- The application shall validate the revocation status of the certificate using [***OCSP as specified in RFC 6960***]
- The application shall validate the extendedKeyUsage (EKU) field according to the following rules:
    - Certificates used for trusted updates and executable code integrity verification shall have the Code Signing Purpose (id-kp 3 with OID 1.3.6.1.5.5.7.3.3) in the extendedKeyUsage field.
    - Server certificates presented for TLS shall have the Server Authentication purpose (id-kp 1 with OID 1.3.6.1.5.5.7.3.1) in the EKU field.
    - Client certificates presented for TLS shall have the Client Authentication purpose (id-kp 2 with OID 1.3.6.1.5.5.7.3.2) in the EKU field.
    - S/MIME certificates presented for email encryption and signature shall have the Email Protection purpose (id-kp 4 with OID 1.3.6.1.5.5.7.3.4) in the EKU field.
    - OCSP certificates presented for OCSP responses shall have the OCSP Signing purpose (id-kp 9 with OID 1.3.6.1.5.5.7.3.9) in the EKU field.

[4] Modified per TD0601

- Server certificates presented for EST shall have the CMC Registration Authority (RA) purpose (id-kp-cmcRA with OID 1.3.6.1.5.5.7.3.28) in the EKU field.

FIA_X509_EXT.1.2 The application shall treat a certificate as a CA certificate only if the basicConstraints extension is present and the CA flag is set to TRUE.

5.2.3.3 FIA_X509_EXT.2 X.509 Certificate Authentication

FIA_X509_EXT.2.1[5] The application shall use X.509v3 certificates as defined by RFC 5280 to support authentication for [***IPsec***].

FIA_X509_EXT.2.2 When the application cannot establish a connection to determine the validity of a certificate, the application shall [***not accept the certificate***].

5.2.4 Security Management (FMT)

5.2.4.1 FMT_CFG_EXT.1 Secure by Default Configuration

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 the application binaries and data files from modification by normal unprivileged users.

5.2.4.2 FMT_MEC_EXT.1 Supported Configuration Mechanism

FMT_MEC_EXT.1.1[6] The application shall [

- ***invoke the mechanisms recommended by the platform vendor for storing and setting configuration options***].

5.2.4.3 FMT_SMF.1 Specification of Management Functions

FMT_SMF.1.1 The TSF shall be capable of performing the following management functions [

- ***[management functions defined in FMT_SMF.1/VPN]***].

5.2.4.4 FMT_SMF.1/VPN Specification of Management Functions (VPN)

FMT_SMF.1.1/VPN The TSF shall be capable of performing the following management functions:

[

- ***Specify VPN gateways to use for connections,***

[5] Modified per TD0601

[6] Modified per TD0437

- ***Specify client credentials to be used for connections***

].

5.2.5 Privacy (FPR)

5.2.5.1 FPR_ANO_EXT.1 User Consent for Transmission of Personally Identifiable Information

FPR_ANO_EXT.1.1 The application shall [

- ***not transmit PII over a network***

].

5.2.6 Protection of the TSF (FPT)

5.2.6.1 FPT_AEX_EXT.1 Anti-Exploitation Capabilities

FPT_AEX_EXT.1.1 The application shall not request to map memory at an explicit address except for [**no exceptions**].

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 built with stack-based buffer overflow protection enabled.

5.2.6.2 FPT_API_EXT.1 Use of Supported Services and APIs

FPT_API_EXT.1.1 The application shall use only documented platform APIs.

5.2.6.3 FPT_IDV_EXT.1 Software Identification and Versions

FPT_IDV_EXT.1.1 The application shall be versioned with [***[Aruba internal versioning scheme]***].

5.2.6.4 FPT_LIB_EXT.1 Use of Third Party Libraries

FPT_LIB_EXT.1.1 The application shall be packaged with only [

- **Windows: openssl**
- **Android: openssl**

- **Linux: openssl, curl**

].

5.2.6.5 FPT_TST_EXT.1/VPN(1) TSF Self-Test (VPN Client) (Windows and Linux)

FPT_TST_EXT.1.1/VPN(1) The [***TOE***] shall run a suite of self-tests during initial start-up (on power on) to demonstrate the correct operation of the TSF.

FPT_TST_EXT.1.2/VPN(1) The [***TOE***] shall provide the capability to verify the integrity of stored TSF executable code when it is loaded for execution through the use of the [**TOE cryptographic known-answer tests**].

5.2.6.6 FPT_TST_EXT.1/VPN(2) TSF Self-Test (VPN Client) (Android)

FPT_TST_EXT.1.1/VPN(2) The [***TOE***] shall run a suite of self-tests during initial start-up (on power on) to demonstrate the correct operation of the TSF.

FPT_TST_EXT.1.2/VPN(2) The [***TOE platform***] shall provide the capability to verify the integrity of stored TSF executable code when it is loaded for execution through the use of the [**TOE cryptographic known-answer tests**].

5.2.6.7 FPT_TUD_EXT.1(1) Trusted Update (Android)

FPT_TUD_EXT.1.1(1) The application shall [***leverage the platform***] to check for updates and patches to the application software.

FPT_TUD_EXT.1.2(1) The application shall [***provide the ability***] to query the current version of the application software.

FPT_TUD_EXT.1.3(1) The application shall not download, modify, replace or update its own binary code.

FPT_TUD_EXT.1.4(1)[7] Application updates shall be digitally signed such that the application platform can cryptographically verify them prior to installation.

FPT_TUD_EXT.1.5(1) The application is distributed [***as an additional software package to the platform OS***].

5.2.6.8 FPT_TUD_EXT.1(2) Trusted Update (Windows and Linux)

FPT_TUD_EXT.1.1(2) The application shall [***provide the ability***] to check for updates and patches to the application software.

FPT_TUD_EXT.1.2(2) The application shall [***provide the ability***] to query the current version of the application software.

[7] Modified per TD0561

FPT_TUD_EXT.1.3(2) The application shall not download, modify, replace or update its own binary code.

FPT_TUD_EXT.1.4(2)[8] Application updates shall be digitally signed such that the application platform can cryptographically verify them prior to installation.

FPT_TUD_EXT.1.5(2) The application is distributed [***as an additional software package to the platform OS***].

5.2.6.9 FPT_TUD_EXT.2 Integrity for Installation and Update

FPT_TUD_EXT.2.1 The application shall be distributed using the format of the platform-supported package manager.

FPT_TUD_EXT.2.2 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.2.3[9] The application installation package shall be digitally signed such that its platform can cryptographically verify them prior to installation.

5.2.7 Trusted Path/Channels (FTP)

5.2.7.1 FTP_DIT_EXT.1 Protection of Data in Transit

FTP_DIT_EXT.1.1[10] The application shall encrypt all transmitted [sensitive data] with IPsec and [***no other protocols***] between itself and another trusted IT product.

5.3 TOE Security Assurance Requirements

The security assurance requirements for the TOE are included by reference according to TD0600: Conformance claim sections updated to allow for MOD_VPNC_V2.3. These SARs are consistent with those specified in PP-Configuration for Application Software and Virtual Private Network (VPN) Clients, Version 1.0, 2021-08-13.

Table 5: Assurance Components

Requirement Class	Requirement Component
ADV: Development	ADV_FSP.1 Basic functional specification
AGD: Guidance documents	AGD_OPE.1: Operational user guidance
	AGD_PRE.1: Preparative procedures

[8] Modified per TD0561

[9] Modified per TD0561

[10] Modified per TD0601, TD0622

ALC: Life-cycle support	ALC_CMC.1 Labelling of the TOE
	ALC_CMS.1 TOE CM coverage
	ALC_TSU_EXT.1 Timely Security Updates
ATE: Tests	ATE_IND.1 Independent testing - conformance
AVA: Vulnerability assessment	AVA_VAN.1 Vulnerability survey

These assurance requirements imply the following requirements from CC class ASE: Security Target Evaluation.

- ASE_CCL.1 Conformance claims
- ASE_ECD.1 Extended components definition
- ASE_INT.1 ST introduction
- ASE_OBJ.2 Security objectives
- ASE_REQ.2 Derived security requirements
- ASE_TSS.1 TOE summary specification

Consequently, the evaluation activities specified in PP-Configuration for Application Software and Virtual Private Network (VPN) Clients, Version 1.0, 2021-08-13 apply to the TOE evaluation.

6 TOE Summary Specification

This chapter describes the following security functions:

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

6.1 Cryptographic Support

The list below identifies the operating systems that have successfully completed Common Criteria evaluations. The TSF relies on the OS platforms listed below for AES encryption of credential data as well as full-stack implementation of HTTPS for initial connectivity to the VPN gateway to acquire configuration settings for IPsec.

- **Windows:**
  - Microsoft Windows 10 and Server version 1903 (May 2019 Update) (https://www.niap-ccevs.org/Product/CompliantCC.cfm?CCID=2019.1244)
  - Windows 10 and Windows Server 2019 version 1809 (https://www.niap-ccevs.org/Product/CompliantCC.cfm?CCID=2019.1204)
  - Windows 10 and Windows Server (April 2018 Update) (https://www.niap-ccevs.org/Product/CompliantCC.cfm?CCID=2019.1018)
- **Android:**
  - Samsung Galaxy Devices on Android 11 – Fall (CCEVS-VR-VID11211-2021)
- **Linux:**
  - Ubuntu 18.04 – (https://www.commoncriteriaportal.org/files/epfiles/ST%20-%20Canonical%20Ubuntu%20Server%2018.04%20LTS.pdf)

Table 6: Cryptographic Functions

Requirements	Functions	Certificate		
		Windows	Android	Linux
Cryptographic Asymmetric Key Generation				
FCS_CKM.1(1)	ECC schemes using “NIST curves” P-256, P-384 that meet the following: FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Appendix B.4	A2147	A2147	A2147
	FFC schemes] using Diffie-Hellman group 14 that meet the following: RFC 3526, Section 3	A2147	A2147	A2147
Cryptographic Key Generation (IKE)				
FCS_CKM.1.1/VPN	FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Appendix B.3 for RSA schemes;	A2147	A2147	A2147
	FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Appendix B.4 for ECDSA schemes and implementing “NIST curves”, P-256 and P-384	A2147	A2147	A2147
Cryptographic Key Establishment				
FCS_CKM.2.1	Elliptic curve-based key establishment schemes] that meets the following: NIST Special Publication 800-56A, “Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography”	A2147	A2147	A2147
	Key establishment scheme using Diffie-Hellman group 14 that meets the following: RFC 3526, Section 3	A2147	A2147	A2147
Cryptographic Operation – Encryption/Decryption				
FCS_COP.1.1(1)	AES-CBC (128-bit, 256-bit) as defined in NIST SP 800-38A AES-GCM (128-bit, 256-bit) as defined in NIST SP 800-38D	A2147	A2147	A2147
Cryptographic Operation - Hashing				
FCS_COP.1.1(2)	SHA-1, SHA-256, and SHA-384 as FIPS Pub 180-4	A2147	A2147	A2147
Cryptographic Operation - Signing				
FCS_COP.1.1(3)	RSA schemes using cryptographic key sizes of 2048-bit or greater that meet the following: FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Section 4	A2147	A2147	A2147

Requirements	Functions	Certificate		
		Windows	Android	Linux
	ECDSA schemes using "NIST curves" P-256, P-384 that meet FIPS PUB 186-4, "Digital Signature Standard (DSS)", Section 5	A2147	A2147	A2147
Cryptographic Operation - Keyed-Hash Message Authentication				
FCS_COP.1.1(4)	HMAC-SHA-1 HMAC-SHA-256 HMAC-SHA-384 That meets the following: FIPS Pub 198-1 and FIPS Pub 180-4	A2147	A2147	A2147
Random Bit Generation Services Random Bit Generation from Application				
FCS_RBG_EXT.1 FCS_RBG_EXT.2	256-bits NIST Special Publication 800-90A using CTR_DRBG (AES)	A2147	A2147	A2147

6.1.1 FCS_CKM.1(1): Cryptographic Asymmetric Key Generation

The TOE generates asymmetric keys using the following key generation algorithms:

- Elliptic-curve cryptography (ECC) using NIST curves P-256 (256-bits) and P-384 (384-bits) key pairs for key establishment that meet FIPS PUB 186-4, "Digital Signature Standard (DSS)", Appendix B.4 for IPsec (DH groups 19 and 20, respectively).
- Finite Field Cryptography (FFC) using Diffie-Hellman group 14 (2048-bits) that meets RFC 3526, Section 3 for IPsec.

The TOE invokes cryptographic key generation using the Aruba Common Cryptographic Module (ACCM).

6.1.2 FCS_CKM.1(2): Cryptographic Symmetric Key Generation

The TOE generates symmetric cryptographic keys using a Random Bit Generator as specified in FCS_RBG_EXT.1 with 128 bit and 256 bit cryptographic key sizes.

The TOE includes an AES-256 CTR_DRBG (irrespective of the underlying Platform) that seeds itself with 384-bits of entropy (composed of a 256-bit entropy input and a 128-bit nonce) drawn from a Platform function intended to provide cryptographically secure randomness (and conditioned using SHA-1). The following list describes the mechanism by which VIA obtains its seeding.

- Android- /dev/random
- Windows - BCryptGenRandom()

- Linux - getrandom() and that it uses a flag of GRND_RANDOM and behaves exactly as /dev/random.

Based on NIAP's "Clarification to the Entropy Documentation and Assessment Annex", Aruba assumes a minimum entropy of 0.67 bits of entropy per bit of data from platform provided sources. This minimum-entropy estimate along with knowledge that the seed is 384-bits means that the TOE seeds itself with at least 256-bits of entropy.

6.1.3 FCS_CKM.1/VPN: Cryptographic Key Generation (IKE)

The TOE supports RSA (2048 bits) and ECDSA (for curves P-256 and P-384) key pairs for use with IKE peer authentication.

The TOE fulfills all of the FIPS PUB 186-4 requirements for cryptographic key generation without extensions. The TOE conforms to all shall, shall-not, should and should-not statements. For RSA key establishment, the TOE implements section B.3.6 in Appendix B.3 of FIPS PUB 186-4. For ECDSA, the TOE implements section B.4.2 in Appendix B of FIPS PUB 186-4.

6.1.4 FCS_CKM.2: Cryptographic Key Establishment

The TOE implements the following key establishment schemes for IPsec:

- Elliptic curve-based key establishment schemes that meets NIST Special Publication 800-56A, "Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography" for Diffie-Hellman groups 19 and 20.

- Key establishment scheme using Diffie-Hellman group 14 that meets RFC 3526, Section 3.

6.1.5 FCS_CKM_EXT.1: Cryptographic Key Generation Services

The TOE implements asymmetric key generation. The cryptographic functions (including key generation) are implemented by the Aruba Common Cryptographic Module. Table 7 Key Purpose/Key Storage/Key Destruction describes the keys and secrets used by the TOE.

6.1.6 FCS_CKM_EXT.2: Cryptographic Key Storage

Table 7 identifies the purpose of each key used by the TOE, the key storage location, and the key destruction method when the key is no longer required.

Table 7 Key Purpose/Key Storage/Key Destruction

Key Name:	Origin/Purpose:	Storage Location:	Key Destruction:
DH Private Components	Used to derive the secret session key during DH key agreement protocol Group 14 (384 bits)	Temporarily in volatile RAM	An application program which uses the API may destroy the key. The TOE zeroizes (zero overwrite) this CSP.
DRNG Seed Key	DRBGs for key generation	Temporarily in volatile RAM	An application program which uses the API may destroy the key. The

Key Name:	Origin/Purpose:	Storage Location:	Key Destruction:
	DRBG Seed: SP800-90a DRBG (384 bits) DRBG Key: SP800-90a (256 bits)		TOE zeroizes (zero overwrite) this CSP.
RSA Private Key	Used to create RSA digital signatures key size: 2048 bits	Temporarily in volatile RAM (while in use), persistently in platform key storage (while not in use)	An application program which uses the API may destroy the key. The TOE zeroizes (zero overwrite) this CSP when residing in memory; when persistently stored in platform key storage, it is destroyed by the platform. The TOE has no mechanism to initiate the destruction of persistently stored certificates.
ECDSA Private Key	Used to create DSA digital signatures NIST curves: P-256, P-384	Temporarily in volatile RAM (while in use), persistently in platform key storage (while not in use)	An application program which uses the API may destroy the key. The TOE zeroizes (zero overwrite) this CSP when residing in memory; when persistently stored in platform key storage, it is destroyed by the platform. The TOE has no mechanism to initiate the destruction of persistently stored certificates.
AES Keys	Used during AES encryption, decryption, and CMAC operations Key sizes: 128 bits, 192 bits, 256 bits	Temporarily in volatile RAM	An application program which uses the API may destroy the key. The TOE zeroizes (zero overwrite) this CSP.
HMAC Keys	Used during HMAC-SHA- 1, HMAC-SHA-256, HMAC-384 operations Key sizes: 160 bits, 256 bits, 384 bits	Temporarily in volatile RAM	An application program which uses the API may destroy the key. The TOE zeroizes (zero overwrite) this CSP.

Key Name:	Origin/Purpose:	Storage Location:	Key Destruction:
DH Public Component	Used to derive the secret session key during DH key agreement protocol DH Groups: Group 14 (2048 bits)	Temporarily in volatile RAM	No longer needed by trusted channel
ECDH Public Component	Used to derive the secret session key during ECDH key agreement protocol Group 19 (P-256), Group 20 (P-384)	Temporarily in volatile RAM	N/A
RSA Public Keys	Used to verify RSA Signatures key size: 2048 bits	Temporarily in volatile RAM	N/A
ECDSA Public Keys	Used to verify ECDSA Signatures NIST Curves: P-256, P-384	Temporarily in volatile RAM	N/A
Pre-shared Key	Used for IKEv1 phase 1 authentication Text Based 1 - 256 characters	Stored encrypted per FCS_STO_EXT.1 and stored using platform functionality (registry, keystore, app preference data)	After use, decrypted buffer is zeroed with platform mechanism SecureZeroMemory() (Windows) or memset with values of 0x00 (Linux, Android)

Table 7 lists all the keys manipulated by the TOE. The TOE does not store these keys unencrypted into persistent storage. While the TOE manipulates keys, on all platforms, the TOE platform's key storage is used. The key storage repositories for each platform are as follows:

- Android: Android Keystore
- Windows: Windows Certificate Store
- Linux: Linux keyrings

6.1.7 FCS_CKM_EXT.4: Cryptographic Key Destruction

The TOE and its platform collectively zeroize all plaintext secret and private cryptographic keys and CSPs when no longer required. The cryptographic keys are destroyed when they are no longer in use by the system. Table 7 above details how each key is destroyed. The details apply to all platforms.

6.1.8 FCS_COP.1(1): Cryptographic Operation – Encryption/Decryption

The TOE stores pre-shared keys using 128-bit AES-CBC according to FCS_COP.1 on all of the platforms.

The TOE implements the IPsec protocol ESP as defined by RFC 4303 using the cryptographic algorithms AES-GCM-128, AES-GCM-256 as specified in RFC 4106, and AES-CBC-128, AES-CBC-256 both specified by RFC 3602.

6.1.9 FCS_COP.1(2): Cryptographic Operation - Hashing

The TOE uses the hash function with other application cryptographic functions. Specifically, SHA-1 is used as the hash algorithm for the HMAC-SHA-1 message authentication function for ESP. Similarly, each of SHA-1, SHA-256, and SHA-384 are used as hash algorithms for the corresponding HMAC algorithms used as message authentication for IKE.

Additionally, TOE software updates are verified using a 2048-bit RSA digital signature with SHA-1.

6.1.10 FCS_COP.1(3): Cryptographic Operation - Signing

The TOE performs cryptographic signature services (generation and verification) in accordance with the following cryptographic algorithms:

- RSA schemes using cryptographic key sizes of 2048-bits that meets FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Section 4 is used for IPsec authentication and TOE update verification.
- ECDSA schemes using “NIST curves” P-256 and P-384 that meet FIPS PUB 186-4, “Digital Signature Standard (DSS)”, Section 5 is used for IPsec authentication.

6.1.11 FCS_COP.1(4): Cryptographic Operation - Keyed-Hash Message Authentication

The TOE provides the HMAC-SHA-1, HMAC-SHA-256 and HMAC-SHA-384 algorithms. Refer to Table 6: Cryptographic Functions for the corresponding CAVP certificate demonstrating compliance with these algorithms. These keyed-hash functions can be defined for use in an IPsec connection. The HMAC-SHA-1, HMAC-SHA-256 and HMAC-SHA-384 algorithms are used with key sizes and block sizes of 160, 256 and 384-bits respectively, producing output MAC lengths equal to the block size.

HMAC-SHA-1 is used as authentication for ESP. HMAC-SHA-1, HMAC-SHA-256, and HMAC-SHA-384 are used as authentication for IKE.

6.1.12 FCS_IPSEC_EXT.1: IPsec

The TOE implements its own cryptography via the Aruba Common Crypto Module (ACCM). The cryptographic functionality is implemented by the application itself as a separate executable that is bundled with the platform. The TOE interacts with the network stack of the platforms using sockets through the respective platform APIs.

The TOE implements the IPsec protocol as specified in RFC 4301; however, the TOE relies upon the VPN Gateway to ensure that the cryptographic algorithms and key sizes negotiated during the IKEv1 and IKEv2 negotiation ensure that the security strength of the IKE_SA is greater than or equal to that of the CHILD_SA[11].

The IKEv1 and IKEv2 SA lifetimes are configured by the VPN Gateway based upon the length of time. Length of time includes 24 hours or less for Phase 1 and 8 hours or less for Phase 2.

The TOE implements IKEv1, in tunnel mode only and main mode as defined in RFCs 2407, 2408, 2409, RFC 4109. Aggressive mode is not supported for IKEv1 Phase 1 exchanges. The IKEv1 supports hash functions defined in RFC 4868 and supports XAUTH. Extended sequence numbers is not supported. The TOE performs peer authentication using pre-shared keys or certificates.

Pre-shared keys for the TOE are configured on the Aruba Mobility Controller. The TOE supports the use of pre-shared keys (the TOE allows 1 to 256 character PSKs) for IPsec VPNs. The specific length of 22 characters required by the [MOD_VPNC_V2.3] is supported by the TOE. Pre-shared keys can include any letter from a-z, A-Z, the numbers 0 – 9, and the special characters "!", "@", "#", "$", "%", "^", "&", "*", "(", and ")".

The TOE conditions the text-based pre-shared keys by converting the ASCII to binary. The TOE is able to accept bit-based pre-shared keys. The pre-shared key shall be loaded onto the VIA Client via the connection profile.

Pre-shared keys apply to IKEv1 only. Character limits and character set are not enforced programmatically; therefore, the administrative guidance includes instructions on setting strong pre-shared keys.

The TOE implements IKEv2, in tunnel mode only. The TOE does not offer transport mode as a configuration option. IKEv2 is implemented as defined in RFCs 7296 (with mandatory support for NAT traversal as specified in section 2.23), RFC 8784, RFC 8247.

The TOE implements peer authentication using RSA certificates or ECDSA certificates that conform to RFC 4945. If certificates are used, the TOE ensures that the distinguished name (DN) contained in a certificate matches the expected DN for the entity attempting to establish a connection and ensures that the certificate has not been revoked (using the Online Certificate Status Protocol [OCSP] in accordance with RFC 6960).

During the Peer Authentication stage of IPsec, the TOE will verify the authenticity of the VPN gateway's X.509v3 certificate by validating the certificate, the certificate path, the certificates revocation status using OCSP, the certificate path terminates in a trusted CA certificate, and that the CA certificate has the basicConstraints extension present and the CA flag set to true.

The SHA hash algorithm (all claimed key sizes) is used as part of HMAC, but is also used independently as part of digital signature creation and verification. The TOE generates RSA and ECDSA signatures during IKEv2 peer authentication. The TOE verifies RSA & ECDSA signatures during IKEv2 peer authentication and trusted updates.

[11] Note that the algorithm negotiated will be AES because that is the only available algorithm, so strength is based solely upon key size where more bits are stronger.

The TOE implements various HMAC algorithms to be used for authentication with ESP. The specific algorithms used depend upon the ciphersuite being used. The TOE implements AES-GCM-128, AES-GCM-256, AES-CBC-128, and AES-CBC-256 as ESP encryption algorithms and implements HMAC-SHA1 as the authentication algorithm. The TOE implements AES-CBC-128 and AES-CBC-256 as encryption algorithms and implements HMAC-SHA1, HMAC-SHA-256 and HMAC-SHA-384 as the authentication algorithm.

As configured on the VPN Gateway, the TOE supports the following Diffie-Hellman (DH) groups for use in SA negotiation:

- 14 (2048-bit MODP),
- 19 (256-bit Random ECP), and
- 20 (384-bit Random ECP).

Only one DH group can be configured for a specific policy so there is no negotiation. Different policies can have different groups. Implementation is the same for both versions of IKE.

The TOE generates the secret value x used in the Diffie-Hellman key exchange ('x' in g^x mod p) using the CAVP tested RBG specified in FCS_RBG_EXT.1 and having possible lengths of 224 for group 14, 256 for group 19, or 384 bits for group 20. When a random number is needed for a nonce, the probability that a specific nonce value will be repeated during the life of a specific IPsec SA is less than 1 in 2^{112}, 2^{128}, or 2^{192}.

The TOE implements minimal SPD rules that are defined implicitly through the configuration and connection of a VPN session. The TOE does not support direct editing of SPD rules. As part of initial configuration the administrator must manually configure the SPD such that if no "rules" are found to match, a final rule exists that causes the network packet to be discarded. The PROTECT and BYPASS rules are implicit and are implemented by configuring a split tunnel. The administrator may configure PROTECT and BYPASS rules by enabling or disabling split-tunnel mode in the VIA connection profile on the VPN Gateway.

All traffic originating from the client operating system is passed through the tunnel established by the VIA client to the VPN Gateway. When split-tunneling is enabled, the VPN Gateway pushes routes configured with the tunnel address command in the VIA connection profile on the VPN Gateway to the VIA client. Traffic matching the routes is forwarded through the IPsec tunnel. The DISCARD rule is not supported by the TOE and must be provided by firewall rules configured on the VPN Gateway and the Platform.

6.1.13 FCS_RBG_EXT.1: Random Bit Generation, FCS_RBG_EXT.2: Random Bit Generation from Application

The application implements the DRBG functionality. Therefore FCS_RBG_EXT.2 is included in the security target. The TOE implements SP 800-90A using CTR_DRBG (AES) for all deterministic random bit generation services.

The TOE includes an AES-256 CTR_DRBG (irrespective of the underlying Platform) that seeds itself with 384 bits of entropy (composed of a 256 bit entropy input and a 128 bit nonce) drawn from a platform function intended to provide cryptographically secure randomness (and conditioned using SHA-1). The following list describes the mechanism by which VIA obtains its seeding.

- Android - /dev/random
- Windows - BCryptGenRandom()
- Linux - getrandom() and that it uses a flag of GRND_RANDOM and behaves exactly as /dev/random.

Based on NIAP's "Clarification to the Entropy Documentation and Assessment Annex", Aruba assumes a minimum entropy of 0.67 bits of entropy per bit of data from platform provided sources. This minimum-entropy estimate along with knowledge that the seed is 384 bits means that the TOE seeds itself with at least 256 bits of entropy.

6.1.14 FCS_STO_EXT.1 Storage of Credentials

The TOE maintains two types of credentials: certificates and pre-shared keys (used for IKEv1). All platform versions of the TOE protect pre-shared keys using AES. For certificates, platform storage mechanisms are used. Specifically, the Windows version of the TOE uses the Windows Certificate Store while the Linux version of the TOE uses the Linux keyring and the Android version of the TOE uses the Android keystore.

6.2 User Data Protection (FDP)

6.2.1 FDP_DAR_EXT.1: Encryption of Sensitive Application Data

The TOE does not store any sensitive data in non-volatile memory other than the credential data that is protected by FCS_STO_EXT.1.

6.2.2 FDP_DEC_EXT.1: Access to Platform Resources

Sensitive information repositories are defined as those collections of sensitive data that could be expected to be shared among some applications, users, or user roles, but to which not all of these would ordinarily require access.

The TOE restricts its access to using network connectivity when it is needed to communicate to the VPN Gateway.

6.2.3 FDP_NET_EXT.1: Network Communications

The TOE allows network communications to be initiated by the user in order to connect to the VPN Gateway. The TOE can also provide always-on functionality for application-initiated network communication. The Windows and Linux TOE platforms provide always-on functionality for application-initiated network communication. However, this functionality must be enabled by an administrator. The Android TOE platform provides always-on functionality available by default.

6.2.4 FDP_RIP.2; Full Residual Information Protection

The TOE ensures that no residual information exists in network packets. When the TOE allocates a new buffer for either an incoming or outgoing a network packet, the new packet data will be used to overwrite any previous data in the buffer. If an allocated buffer exceeds the size of the packet, additional space will be overwritten (padded) with zeros before the packet is forwarded (to the external network or delivered to the appropriate, internal application).

The clearing of residual information is processed the same on the Android, Windows, and Linux platforms.

6.3 Identification and Authentication

6.3.1 FIA_PSK_EXT.1: Pre-Shared Key Composition

The TOE supports the use of pre-shared keys (the TOE allows 6 to 160 character PSKs) for IPsec VPNs. The specific length of 22 characters required by the [MOD_VPNC_V2.3] is supported by the TOE. Pre-shared keys can include any letter from a-z, A-Z, the numbers 0 – 9, and the special characters "!", "@", "#", "$", "%", "^", "&", "*", "(", and ")".

The TOE conditions the text-based pre-shared keys by converting the ASCII to binary. The TOE is able to accept bit-based pre-shared keys.

6.3.2 FIA_X509_EXT.1: X.509 Certificate Validation

The TOE can use X.509 certificates for authentication. The TOE uses a user specified certificate when attempting to establish the VPN connection. The Android, Linux, and Windows versions of the TOE validate authentication certificates (including the full path) and checks their revocation status using OCSP.

The TOE processes a VPN connection to a server by first comparing the Identification (ID) Payload received from the server against the certificate sent by the server, and if the DN of the certificate does not match the ID, then the TOE does not establish the connection. Assuming the server's certificate matches the ID, the TOE then validates that it can construct a certificate path from the server's certificate through any intermediary CAs to the CA certificate specified by the user in the VPN configuration. If the TOE can successfully build the certificate path, then the TOE will next check the validity of the certificates (e.g., checking its validity dates and that the CA flag is present in the basic constraints section for all CA certs). Assuming the certificates are valid, the TOE finally checks the revocation status of all certificates (starting with the server's certificate and working up the chain). Configuration settings applied by the Aruba Mobility Controller will determine if a certificate is accepted or rejected if the connection to the OCSP server cannot be established; in the evaluated configuration, a configuration will be applied to the TOE that rejects the certificate in these cases.

The TOE implements X.509 certificate validation functionality for the following:

- IPsec – Windows, Android, Linux.

6.3.3 FIA_X509_EXT.2: X.509 Certificate Authentication

A certificate is assigned to each VPN profile by an administrator. The VPN profile is downloaded from the server to the client. The VPN Profile tab displays the following information about each downloaded VPN profile:

- Profile: Name of the VPN profile, and the date and time that the profile was added.
- Authentication: IKE protocol version and authentication type.
- Server: IP address of the VPN server.
- Auth Profile: Web authentication profile.

- Certificate: VPN connection certificate (only for certificate-based authentication).

The TOE uses X.509v3 certificates for authentication as defined in RFC 5280 in IPsec exchanges and rejects any certificates that cannot be validated as described above. The certificate will not be accepted when the connection to OCSP server cannot be reached.

6.4 Security Management

6.4.1 FMT_CFG_EXT.1: Secure by Default Configuration

The TOE is not provided with any default credentials or pre-shared keys. All external configuration comes from the Mobility Controller. The configuration options for the TOE consists of the URL of the gateway, entering credentials, pre-shared key (if used) and the profile prior to establishing a connection.

The TOE requires the following permissions:

- Windows: no end user modification is permitted,
- Linux and Android: all require root permission.

6.4.2 FMT_MEC_EXT.1: Supported Configuration Mechanism[12]

The TOE configuration options come from Aruba Mobility Controller and deploy platform-specific options. The configuration options are stored and set using the mechanisms supported by the following platforms.

- Windows: Registry (HKCU\SOFTWARE\ARUBANETWORKS), C:\ProgramData, and an XML file in %USERPROFILE%.
- Android: /data/data/com.aruba.via/files/ - controller IP address and credential information is stored using SharedPreferences.
- Linux: XML file on disk in user profile.

The configuration options for the TOE consists of entering the URL of the gateway, entering credentials, pre-shared key (if used), and downloading profile prior to establishing a connection.

6.4.3 FMT_SMF.1: Specification of Management Functions

The TOE does not support any management functionality as described in the [PP_APP_v1.3]. The TOE supports the management functionality as defined in [MOD_VPNC_V2.3].

6.4.4 FMT_SMF.1/VPN: Specification of Management Functions (VPN)

The following security management functions are provided by the TOE:

- Specify VPN gateways to use for connections,
- Specify client credentials to be used for connections,

[12] Modified per TD0543 (Windows 10)

The first time a connection is established, a user opens the VIA client and enters the server name, username, and password. If the VIA web authentication list has more than one VIA authentication profile, the user can choose a VIA authentication profile from the available ones. After successful authentication, the VIA client downloads the appropriate VIA connection profile and establishes the IPsec connection if the user is connected to an untrusted network.

6.5 Privacy

6.5.1 FPR_ANO_EXT.1: User Consent for Transmission of Personally Identifiable Information

The TOE does not transmit personally identifiable information over a network.

6.6 Protection of the TSF

6.6.1 FPT_AEX_EXT.1: Anti-Exploitation Capabilities

For each platform, the application does not allocate any memory region with both write and execute permissions nor does the TOE request to map memory to an explicit address. The TOE does not write user-modifiable files to directories that contain executable files. The application is built with stack-based buffer overflow protection enabled. The details of each specific platform is identified below.

- The Windows VPN client application does not allocate any memory region with both write and execute permissions nor does the TOE request to map memory to an explicit address. By default, /DYNAMICBASE is enabled to support ASLR. The TOE does not write user-modifiable files to directories that contain executable files. No files are downloaded to Program Files. The application is built with stack-based buffer overflow protection enabled using the */GS* flag for Windows. The Windows VPN client application is compatible with security features provided by the platform vendor.

- The Android VPN Client application does not allocate any memory region with both write and execute permissions nor does the TOE request to map memory to an explicit address. The `–fpic` flag is set to support ASLR. The TOE does not write user-modifiable files to directories that contain executable files. No files are downloaded to `/data/data/package`. The application is built with stack-based buffer overflow protection enabled using `–fstack-protector-strong`. The Android VPN client application is compatible with security features provided by the platform vendor.

- The Linux VPN Client application does not allocate any memory region with both write and execute permissions nor does the TOE request to map memory to an explicit address. ASLR is supported by default. By default, the TOE does not write user-modifiable files to directories that contain executable files. The application is built with stack-based buffer overflow protection enabled using `–fpic`. The Linux VPN client application is compatible with security features with SELinux.

6.6.2 FPT_API_EXT.1: Use of Supported Services and APIs

The TOE includes the use only documented platform APIs. The Platform APIs are documented below.

- **Windows:** See Appendix A.
- **Android:** See Appendix B.
- **Linux:** See Appendix C.

6.6.3 FPT_IDV_EXT.1: Software Identification and Versions

Aruba provides a version control system for its software components. The TOE has a unique software versioning that identifies major versions and their subsequent maintenance releases in the following form: <major>.<minor>.<patch>.<build>. Major and minor releases introduce new major and minor features for the product, and patch and build releases identify bug and security patches and the build number.

6.6.4 FPT_LIB_EXT.1: Use of Third Party Libraries

The TOE is packaged with the following third party libraries.

- Windows: openssl
- Android: openssl
- Linux: openssl, curl

6.6.5 FPT_TST_EXT.1/VPN(1): TSF Self-Test (VPN Client) (Windows and Linux) and FPT_TST_EXT.1/VPN(2): TSF Self-Test (VPN Client) (Android)

The TOE performs known answer power on self-tests (POST) on its cryptographic algorithms to ensure that they are functioning correctly. The TOE utilizes the Aruba Common Cryptographic Module (ACCM) library which implements known answer tests on its cryptographic algorithms to ensure they are working correctly. These known answer tests involve using the ACCM library functions to encrypt blocks of data and comparing the resulting encrypted block of data to a block that is known to be correct. The result of encrypting a block of data is the same every time if the encryption library operates properly. These tests cover the following algorithms, known answer tests, and pairwise consistency tests:

- AES-GCM – 128 bits, 256 bits,
- AES-CBC – 128 bits, 256 bits,
- SHA 1, SHA 256, SHA 384,
- HMAC-SHA1, HMAC-SHA-256, HMAC-SHA-384,
- RSA Pairwise Consistency Test,
- RSA Encrypt/Decrypt Known Answer Test,
- DSA Pairwise Consistency Test,
- ECDSA Pairwise Consistency Test,
- ECDH Pairwise Consistency Test,

- DH Pairwise Consistency Test, and
- FIPS 186-4 RNG Known Answer Test.

The TOE invokes these self-tests of the ACCM library at start to ensure that those cryptographic algorithms are working correctly.

A self-test is additionally performed on the cryptographic executable code. For Windows and Linux platforms, the cryptographic module is signed by Aruba using 2048-bit RSA. For Android, the entire application is signed by Google as part of its distribution on the Google Play store. This signature uses 4096-bit RSA.

If any self-test fails, the TOE will not start. Successful execution of self-testing is implicit through the application starting without error. For troubleshooting purposes, a debug log can be enabled that writes the outcome of the self-test to a local file that shows the results of the self-test. Since the success or failure of the self-test is implicit in whether or not the application starts successfully, the debug log is only used to confirm the reason behind any anomalous behavior for reporting to Aruba Support.

- Windows:
  - Success: “FIPS Powerup Self Finished Successfully”
  - Failure: “FIPS_powerupSelfTest() failed error <code>”
- Android:
  - Success: “Finished Mocana initialization...”
  - failure: “Mocana initialization error <code>”
- Linux:
  - Success: “Power up self test passed...”
  - Failure: “!!ERROR!! :Power up self test failed: <error code>”

The entire purpose of the TSF is to establish IPsec connectivity. Any tampering of the IPsec functionality, either as a whole or through corruption of individual cryptographic algorithms, would be detected through a failure of the software integrity test or of the individual cryptographic known-answer/pairwise consistency tests. Therefore, the testing provided by the TOE (and its underlying platform in the case of Android) is sufficient to ensure that the application cannot be modified without detection in a way that would compromise the behavior of the TSF.

6.6.6 FPT_TUD_EXT.1(1) (Android): Trusted Update, FPT_TUD_EXT.1(2) (Windows and Linux): Trusted Update FPT_TUD_EXT.2: Integrity for Installation and Update

The `About` tab on the TOE shows the current system image version number.

The TOE platforms support loading updates by the administrator. For Android version, the application and signature are provided and verified by the Google Play Store. The Android version is signed through the app store using RSA 2048 bit with SHA-1 digital signature. The TOE platform checks the signature against the downloaded application when the update is obtained by the TOE platform.

For Windows and Linux platforms, the administrator obtains the update in the form of an installer through the Aruba Mobility Controller or the Aruba Support Portal. Regardless of its origin, the update is verified using an RSA 2048 digital signature with SHA-1, signed by Aruba. The installer automatically verifies the digital signature on the update during the installation. An unverified update cannot be installed.

The authorized source for the Windows and Linux updates is via Aruba. The Google Play Store is the authorized source for the Android update.

The TOE application package is delivered in the following platform-supported formats:

- Windows: .msi
- Android: .apk, playstore
- Linux: .deb, .rpm

The TOE does not download, modify, replace or update its own binary code. The application is packaged such that its removal results in the deletion of all traces of the application, with the exception of configuration settings and output files.

6.7 Trusted Path/Channels

6.7.1 FTP_DIT_EXT.1: Protection of Data in Transit

The application encrypts all transmitted sensitive data with IPsec between itself and another trusted IT product. The purpose of the application is to enable a secure IPsec connection between its underlying host OS platform and a remote system that is protected by a VPN gateway. Therefore, any data that traverses the IPsec tunnel is network traffic generated by the underlying OS platform or other applications running on it.

6.8 ALC_TSU_EXT.1: Timely Security Updates

Aruba has a Security Incident Response Team (SIRT) that security information can be provided to at https://www.arubanetworks.com/support-services/sirt/. Findings can be submitted over email using a PGP key or by opening a ticket on support site (HTTPS). Aruba does not disclose any identified vulnerability until a patch is available. If vulnerability is disclosed on a side channel (e.g. a published CVE), high or critical findings are addressed as a priority. High vulnerabilities are addressed within 30 days, moderate vulnerabilities within 90 days, and low vulnerabilities within 180 days. Historically, all findings have been addressed within 30 days regardless of severity.

7 Protection Profile Claims

This TOE is conformant to the following CC specifications:

- *Protection Profile for Application Software, Version 1.3, 2019-03-01* [PP_APP_v1.3] with the optional requirements: FCS_CKM.1(2), and the selection-based requirements: FCS_CKM.1(1), FCS_CKM.2, FCS_COP.1(1), FCS_COP.1(2), FCS_COP.1(3), FCS_COP.1(4), FCS_RBG_EXT.2, FIA_X509_EXT.1, FIA_X509_EXT.2, and FPT_TUD_EXT.2.
- *PP-Module for Virtual Private Network (VPN) Clients*, Version 2.3, 2021-08-10 [MOD_VPNC_V2.3] with the selection-based requirement FIA_PSK_EXT.1.
- *PP-Configuration for Application Software and Virtual Private Network (VPN) Clients*, Version 1.0, 2021-08-13 as per TD0600.

As explained in Section 3, Security Problem Definition, the Security Problem Definition of the [PP_APP_v1.3] and [MOD_VPNC_V2.3] have been copied verbatim into this ST.

As explained in Section 4, Security Objectives, the Security Objectives of this ST is conformant to [PP_APP_v1.3] and [MOD_VPNC_V2.3] have been copied verbatim into this ST.

The following table identifies all the Security Functional Requirements (SFRs) in this ST. Each SFR is drawn from the [PP_APP_v1.3] and the [MOD_VPNC_V2.3].

Table 8: SFR Protection Profile Sources

Requirement Class	Requirement Component	Source
FCS: Cryptographic Support	FCS_CKM.1(1): Cryptographic Asymmetric Key Generation	PP_APP_v1.3
	FCS_CKM.1(2): Cryptographic Symmetric Key Generation	PP_APP_v1.3
	FCS_CKM.1/VPN: Cryptographic Key Generation (IKE)	MOD_VPNC_V2.3
	FCS_CKM_EXT.1: Cryptographic Key Generation Services	PP_APP_v1.3
	FCS_CKM.2: Cryptographic Key Establishment	PP_APP_v1.3
	FCS_CKM_EXT.2: Cryptographic Key Storage	MOD_VPNC_V2.3
	FCS_CKM_EXT.4: Cryptographic Key Destruction	MOD_VPNC_V2.3
	FCS_COP.1(1): Cryptographic Operation – Encryption/Decryption	PP_APP_v1.3
	FCS_COP.1(2): Cryptographic Operation - Hashing	PP_APP_v1.3
	FCS_COP.1(3): Cryptographic Operation - Signing	PP_APP_v1.3
	FCS_COP.1(4): Cryptographic Operation - Keyed-Hash Message Authentication	PP_APP_v1.3
	FCS_IPSEC_EXT.1: IPsec	MOD_VPNC_V2.3

Requirement Class	Requirement Component	Source
	FCS_RBG_EXT.1: Random Bit Generation Services	PP_APP_v1.3
	FCS_RBG_EXT.2: Random Bit Generation from Application	PP_APP_v1.3
	FCS_STO_EXT.1: Storage of Credentials	PP_APP_v1.3
FDP: User Data Protection	FDP_DAR_EXT.1: Encryption Of Sensitive Application Data	PP_APP_v1.3
	FDP_DEC_EXT.1: Access to Platform Resources	PP_APP_v1.3
	FDP_NET_EXT.1: Network Communications	PP_APP_v1.3
	FDP_RIP.2: Full Residual Information Protection	MOD_VPNC_V2.3
FIA: Identification and Authentication	FIA_PSK_EXT.1: Pre-Shared Key Composition	MOD_VPNC_V2.3
	FIA_X509_EXT.1: X.509 Certificate Validation	PP_APP_v1.3
	FIA_X509_EXT.2: X.509 Certificate Authentication	PP_APP_v1.3
FMT: Security Management	FMT_CFG_EXT.1: Secure by Default Configuration	PP_APP_v1.3
	FMT_MEC_EXT.1: Supported Configuration Mechanism	PP_APP_v1.3
	FMT_SMF.1: Specification of Management Functions	PP_APP_v1.3
	FMT_SMF.1/VPN: Specification of Management Functions (VPN)	MOD_VPNC_V2.3
FPR: Privacy	FPR_ANO_EXT.1: User Consent for Transmission of Personally Identifiable Information	PP_APP_v1.3
FPT: Protection of the TSF	FPT_AEX_EXT.1: Anti-Exploitation Capabilities	PP_APP_v1.3
	FPT_API_EXT.1: Use of Supported Services and APIs	PP_APP_v1.3
	FPT_IDV_EXT.1: Software Identification and Versions	PP_APP_v1.3
	FPT_LIB_EXT.1: Use of Third Party Libraries	PP_APP_v1.3
	FPT_TUD_EXT.1: Trusted Update (iterated by ST author)	PP_APP_v1.3
	FPT_TUD_EXT.2: Integrity for Installation and Update	PP_APP_v1.3
	FPT_TST_EXT.1/VPN: TSF Self-Test (VPN Client) (iterated by ST author)	MOD_VPNC_V2.3
FTP: Trusted Path/Channels	FTP_DIT_EXT.1: Protection of Data in Transit	PP_APP_v1.3

8 TOE Summary Specification Rationale

Each subsection in Section 6, the TOE Summary Specification, describes a security function of the TOE. Each description is followed with rationale that indicates which requirements are satisfied by aspects of the corresponding security function. The set of security functions work together to satisfy all of the security functions and assurance requirements. Furthermore, all of the security functions are necessary in order for the TSF to provide the required security functionality.

This Section in conjunction with Section 6, the TOE Summary Specification, provides evidence that the security functions are suitable to meet the TOE security requirements. The collection of security functions work together to provide all of the security requirements. The security functions described in the TOE summary specification are all necessary for the required security functionality in the TSF. Table 10: Security Functions vs. Requirements Mapping demonstrates the relationship between security requirements and security functions.

Table 9: Security Functions vs. Requirements Mapping

	Cryptographic support	User Data Protection	Identification and authentication	Security management	Privacy	Protection of the TSF	Trusted path/channels
FCS_CKM_EXT.1	X						
FCS_CKM_EXT.2	X						
FCS_CKM.1(1)	X						
FCS_CKM.1(2)	X						
FCS_CKM.1/VPN	X						
FCS_CKM.2	X						
FCS_CKM_EXT.4	X						
FCS_COP.1(1)	X						
FCS_COP.1(2)	X						
FCS_COP.1(3)	X						
FCS_COP.1(4)	X						
FCS_IPSEC_EXT.1	X						
FCS_STO_EXT.1	X						
FCS_RBG_EXT.1	X						
FCS_RBG_EXT.2	X						
FDP_DEC_EXT.1		X					
FDP_DAR_EXT.1		X					
FDP_RIP.2		X					

	Cryptographic support	User Data Protection	Identification and authentication	Security management	Privacy	Protection of the TSF	Trusted path/channels
FIA_PSK_EXT.1			X				
FIA_X509_EXT.1			X				
FIA_X509_EXT.2			X				
FMT_CFG_EXT.1				X			
FMT_MEC_EXT.1				X			
FMT_SMF.1				X			
FMT_SMF.1/VPN				X			
FPR_ANO_EXT.1					X		
FPT_API_EXT.1						X	
FPT_AEX_EXT.1						X	
FPT_IDV_EXT.1						X	
FPT_LIB_EXT.1						X	
FPT_TUD_EXT.1(1)						X	
FPT_TUD_EXT.1(2)						X	
FPT_TUD_EXT.2						X	
FPT_TST_EXT.1/VPN						X	
FTP_DIT_EXT.1							X

Appendix A: Windows Platform APIs

WS2_32.dll

WTSAPI32.dll

MSVCP100.dll

SHLWAPI.dll

CRYPT32.dll

ncrypt.dll

SHELL32.dll

VERSION.dll

WINMM.dll

ole32.dll

bcrypt.dll

dbghelp.dll

WININET.dll

RPCRT4.dll

CRYPTUI.dll

WINHTTP.dll

credui.dll

GDI32.dll

COMCTL32.dll

MSIMG32.dll

WINSPOOL.DRV

COMDLG32.dll

gdiplus.dll

oledlg.dll

OLEACC.dll

mscoree.dll

IMM32.dll

USER32.dll

MSVCR100.dll

ADVAPI32.dll

KERNEL32.dll

Appendix B: Android Platform APIs

android.animation.Animator;

android.annotation.SuppressLint;

android.annotation.SuppressLint;

android.annotation.TargetApi;

android.app.Activity;

android.app.Activity;

android.app.AlertDialog;

android.app.Application;

android.app.Application;

android.app.Dialog;

android.app.KeyguardManager;

android.app.KeyguardManager;

android.app.ListActivity;

android.app.ListActivity;

android.app.PendingIntent;

android.app.PendingIntent;

android.app.ProgressDialog;

android.app.Service;

android.app.Service;

android.content.ActivityNotFoundException;

android.content.BroadcastReceiver;

android.content.ComponentName;

android.content.ComponentName;

android.content.ContentResolver;

android.content.Context;

android.content.Context;

android.content.DialogInterface.OnCancelListener;

android.content.DialogInterface.OnClickListener;

android.content.DialogInterface;

android.content.DialogInterface;

android.content.Intent;

android.content.Intent;

android.content.IntentFilter;

android.content.IntentFilter;

android.content.pm.PackageInfo;

android.content.pm.PackageInfo;

android.content.pm.PackageManager.NameNotFoundException;

android.content.pm.PackageManager.NameNotFoundException;

android.content.pm.PackageManager;

android.content.pm.PackageManager;

android.content.res.Configuration;

android.content.res.Resources;

android.content.RestrictionsManager;

android.content.ServiceConnection;

android.content.ServiceConnection;

android.content.SharedPreferences.Editor;

android.content.SharedPreferences;

android.database.Cursor;

android.graphics.Bitmap;

android.graphics.Bitmap;

android.graphics.BitmapFactory;

android.graphics.BitmapFactory;

android.graphics.Canvas;

android.graphics.Color;

android.graphics.ColorFilter;

android.graphics.drawable.Drawable;

android.graphics.drawable.LayerDrawable;

android.graphics.Paint;

android.graphics.Path;

android.graphics.PixelFormat;

android.graphics.Rect;

android.graphics.RectF;

android.graphics.Typeface;

android.net.ConnectivityManager;

android.net.ConnectivityManager;

android.net.http.SslError;

android.net.NetworkInfo;

android.net.NetworkInfo;

android.net.Uri;

android.net.VpnService;

android.net.VpnService;

android.net.wifi.ScanResult;

android.net.wifi.SupplicantState;

android.net.wifi.WifiConfiguration.KeyMgmt;

android.net.wifi.WifiConfiguration;

android.net.wifi.WifiInfo;

android.net.wifi.WifiManager;

android.net.wifi.WifiManager;

android.os.AsyncTask;

android.os.AsyncTask;

android.os.Binder;

android.os.Binder;

android.os.Build;

android.os.Build;

android.os.Bundle;

android.os.Bundle;

android.os.Environment;

android.os.Environment;

android.os.Handler;

android.os.Handler;

android.os.IBinder;

android.os.IBinder;

android.os.Looper;

android.os.Looper;

android.os.Message;

android.os.Message;

android.os.Messenger;

android.os.Messenger;

android.os.ParcelFileDescriptor;

android.os.ParcelFileDescriptor;

android.os.PersistableBundle;

android.os.RemoteException;

android.os.RemoteException;

android.os.SystemClock;

android.os.SystemClock;

android.provider.MediaStore;

android.provider.Settings.Secure;

android.security.KeyChain;

android.security.KeyChain;

android.security.KeyChainAliasCallback;

android.security.KeyChainAliasCallback;

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android.security.KeyChainException;
android.security.KeyChainException;
android.security.keystore.KeyInfo;
android.support.annotation.AnimRes;
android.support.annotation.AnimRes;
android.support.annotation.LayoutRes;
android.support.annotation.Nullable;
android.support.annotation.RequiresApi;
android.support.annotation.RequiresApi;
android.support.annotation.StringRes;
android.support.annotation.StringRes;
android.support.design.widget.TabLayout;
android.support.v4.app.ActivityCompat;
android.support.v4.app.Fragment;
android.support.v4.app.FragmentManager;
android.support.v4.app.FragmentPagerAdapter;
android.support.v4.app.FragmentTransaction;
android.support.v4.content.ContextCompat;
android.support.v4.content.FileProvider;
android.support.v4.view.ViewPager;
android.support.v7.app.AppCompatActivity;
android.support.v7.widget.Toolbar;
android.system.ErrnoException;
android.system.Os;
android.text.Editable;
android.text.format.Formatter;
android.text.format.Formatter;
android.text.InputType;
android.text.method.LinkMovementMethod;
android.text.TextUtils;
android.text.TextUtils;
android.text.TextWatcher;
android.util.AttributeSet;
android.util.DisplayMetrics;
android.util.Log;
android.util.Log;
android.view.animation.Animation;
android.view.animation.Animation;
android.view.animation.AnimationUtils;
android.view.animation.AnimationUtils;
android.view.animation.RotateAnimation;
android.view.inputmethod.InputMethodManager;
android.view.inputmethod.InputMethodManager;
android.view.KeyEvent;
android.view.LayoutInflater;
android.view.Menu;
android.view.MotionEvent;
android.view.View.OnClickListener;
android.view.View.OnClickListener;
android.view.View;
android.view.View;
android.view.ViewGroup;
android.view.ViewGroup;
android.webkit.CookieManager;
android.webkit.SslErrorHandler;
android.webkit.WebResourceError;
```

android.webkit.WebResourceRequest;

android.webkit.WebResourceResponse;

android.webkit.WebView;

android.webkit.WebViewClient;

android.widget.AdapterView.OnItemClickListener;

android.widget.AdapterView;

android.widget.ArrayAdapter;

android.widget.BaseAdapter;

android.widget.Button;

android.widget.Button;

android.widget.CheckBox;

android.widget.CheckBox;

android.widget.CheckedTextView;

android.widget.CompoundButton.OnCheckedChangeListener;

android.widget.CompoundButton.OnCheckedChangeListener;

android.widget.CompoundButton;

android.widget.CompoundButton;

android.widget.EditText;

android.widget.EditText;

android.widget.FrameLayout;

android.widget.ImageView;

android.widget.LinearLayout;

android.widget.ListView;

android.widget.ListView;

android.widget.RadioButton;

android.widget.RadioGroup;

android.widget.RelativeLayout;

android.widget.ScrollView;

android.widget.ScrollView;

android.widget.Switch;

android.widget.Switch;

android.widget.TextView;

android.widget.TextView;

android.widget.Toast;

android.widget.Toast;

android.widget.ViewSwitcher;

com.sec.enterprise.mdm.services.vpn.knoxvpn.IKnoxVpnService;

com.sec.vpn.knox.GenericVpnContext;

com.sec.vpn.knox.GenericVpnContext;

java.awt.datatransfer.DataFlavor;

java.io.*;

java.io.BufferedInputStream;

java.io.BufferedInputStream;

java.io.BufferedOutputStream;

java.io.BufferedOutputStream;

java.io.BufferedReader;

java.io.BufferedWriter;

java.io.ByteArrayInputStream;

java.io.ByteArrayInputStream;

java.io.ByteArrayOutputStream;

java.io.ByteArrayOutputStream;

java.io.DataInputStream;

java.io.DataOutputStream;

java.io.DataOutputStream;

java.io.EOFException;

java.io.File;

java.io.File;

java.io.FileFilter;

java.io.FileInputStream;

java.io.FileInputStream;

java.io.FileNotFoundException;

java.io.FileNotFoundException;

java.io.FileOutputStream;

java.io.FileOutputStream;

java.io.FilterInputStream;

java.io.FilterOutputStream;

java.io.InputStream;

java.io.InputStream;

java.io.InputStreamReader;

java.io.InputStreamReader;

java.io.IOException;

java.io.IOException;

java.io.LineNumberReader;

java.io.ObjectInputStream;

java.io.ObjectInputStream;

java.io.ObjectOutput;

java.io.ObjectOutputStream;

java.io.ObjectOutputStream;

java.io.OutputStream;

java.io.OutputStream;

java.io.OutputStreamWriter;

java.io.PipedInputStream;

java.io.PipedOutputStream;

java.io.PrintStream;

java.io.PushbackInputStream;

java.io.Reader;

java.io.Serializable;

java.io.StreamCorruptedException;

java.io.UnsupportedEncodingException;

java.io.Writer;

java.lang.reflect.Constructor;

java.math.*;

java.math.BigInteger;

java.math.BigInteger;

java.net.ConnectException;

java.net.CookieStore;

java.net.CookieStore;

java.net.HttpCookie;

java.net.HttpCookie;

java.net.HttpURLConnection;

java.net.Inet4Address;

java.net.InetAddress;

java.net.InetAddress;

java.net.InetSocketAddress;

java.net.InetSocketAddress;

java.net.NetworkInterface;

java.net.NetworkInterface;

java.net.ServerSocket;

java.net.Socket;

java.net.Socket;

java.net.SocketAddress;

java.net.SocketAddress;

java.net.SocketException;

java.net.SocketException;

java.net.UnknownHostException;

java.net.UnknownHostException;

java.net.URI;

java.net.URISyntaxException;

java.net.URL;

java.net.URL;

java.net.URLClassLoader;

java.nio.BufferUnderflowException;

java.nio.ByteBuffer;

java.nio.ByteOrder;

java.nio.charset.Charset;

java.nio.file.FileAlreadyExistsException;

java.nio.file.Files;

java.nio.file.Paths;

java.security.*;

java.security.AccessController;

java.security.AlgorithmParameterGenerator;

java.security.AlgorithmParameterGeneratorSpi;

java.security.AlgorithmParameters;

java.security.AlgorithmParametersSpi;

java.security.BasicPermission;

java.security.cert.*;

java.security.cert.Certificate;

java.security.cert.Certificate;

java.security.cert.CertificateEncodingException;

java.security.cert.CertificateEncodingException;

java.security.cert.CertificateException;

java.security.cert.CertificateException;

java.security.cert.CertificateExpiredException;

java.security.cert.CertificateExpiredException;

java.security.cert.CertificateFactory;

java.security.cert.CertificateFactory;

java.security.cert.CertificateFactorySpi;

java.security.cert.CertificateNotYetValidException;

java.security.cert.CertificateNotYetValidException;

java.security.cert.CertificateParsingException;

java.security.cert.CertPath;

java.security.cert.CertPathBuilder;

java.security.cert.CertPathBuilderException;

java.security.cert.CertPathBuilderResult;

java.security.cert.CertPathBuilderSpi;

java.security.cert.CertPathParameters;

java.security.cert.CertPathValidator;

java.security.cert.CertPathValidatorException;

java.security.cert.CertPathValidatorResult;

java.security.cert.CertPathValidatorSpi;

java.security.cert.CertSelector;

java.security.cert.CertStore;

java.security.cert.CertStoreException;

java.security.cert.CertStoreParameters;

java.security.cert.CertStoreSpi;

java.security.cert.CollectionCertStoreParameters;

java.security.cert.CRL;

java.security.cert.CRLException;

java.security.cert.CRLSelector;

java.security.cert.LDAPCertStoreParameters;

java.security.cert.PKIXBuilderParameters;

java.security.cert.PKIXCertPathBuilderResult;

java.security.cert.PKIXCertPathChecker;

java.security.cert.PKIXCertPathValidatorResult;

java.security.cert.PKIXParameters;

java.security.cert.PolicyNode;

java.security.cert.PolicyQualifierInfo;

java.security.cert.TrustAnchor;

java.security.cert.X509Certificate;

java.security.cert.X509Certificate;

java.security.cert.X509CertSelector;

java.security.cert.X509CRL;

java.security.cert.X509CRLEntry;

java.security.cert.X509CRLSelector;

java.security.cert.X509Extension;

java.security.DigestInputStream;

java.security.DigestOutputStream;

java.security.GeneralSecurityException;

java.security.GeneralSecurityException;

java.security.interfaces.DSAKey;

java.security.interfaces.DSAParams;

java.security.interfaces.DSAPrivateKey;

java.security.interfaces.DSAPublicKey;

java.security.interfaces.ECKey;

java.security.interfaces.ECPrivateKey;

java.security.interfaces.ECPublicKey;

java.security.interfaces.ECPublicKey;

java.security.interfaces.RSAPrivateCrtKey;

java.security.interfaces.RSAPrivateKey;

java.security.interfaces.RSAPublicKey;

java.security.interfaces.RSAPublicKey;

java.security.InvalidAlgorithmParameterException;

java.security.InvalidKeyException;

java.security.InvalidKeyException;

java.security.InvalidParameterException;

java.security.InvalidParameterException;

java.security.Key;

java.security.Key;

java.security.KeyFactory;

java.security.KeyFactory;

java.security.KeyFactorySpi;

java.security.KeyManagementException;

java.security.KeyManagementException;

java.security.KeyPair;

java.security.KeyPairGenerator;

java.security.KeyStore.LoadStoreParameter;

java.security.KeyStore.ProtectionParameter;

java.security.KeyStore;

java.security.KeyStore;

java.security.KeyStoreException;

java.security.KeyStoreException;

java.security.KeyStoreSpi;

java.security.MessageDigest;

java.security.NoSuchAlgorithmException;

java.security.NoSuchAlgorithmException;

java.security.NoSuchProviderException;

java.security.NoSuchProviderException;

java.security.Permission;

java.security.Principal;

java.security.Principal;

java.security.PrivateKey;

java.security.PrivateKey;

java.security.PrivilegedAction;

java.security.Provider;

java.security.ProviderException;

java.security.PublicKey;

java.security.PublicKey;

java.security.SecureRandom;

java.security.SecureRandom;

java.security.Security;

java.security.Security;

java.security.Signature;

java.security.Signature;

java.security.SignatureException;

java.security.SignatureException;

java.security.SignatureSpi;

java.security.spec.AlgorithmParameterSpec;

java.security.spec.DSAParameterSpec;

java.security.spec.DSAPrivateKeySpec;

java.security.spec.DSAPublicKeySpec;

java.security.spec.ECField;

java.security.spec.ECFieldF2m;

java.security.spec.ECFieldFp;

java.security.spec.ECGenParameterSpec;

java.security.spec.ECParameterSpec;

java.security.spec.ECPoint;

java.security.spec.ECPrivateKeySpec;

java.security.spec.ECPublicKeySpec;

java.security.spec.EllipticCurve;

java.security.spec.EllipticCurve;

java.security.spec.InvalidKeySpecException;

java.security.spec.InvalidKeySpecException;

java.security.spec.InvalidParameterSpecException;

java.security.spec.KeySpec;

java.security.spec.MGF1ParameterSpec;

java.security.spec.PKCS8EncodedKeySpec;

java.security.spec.PSSParameterSpec;

java.security.spec.RSAKeyGenParameterSpec;

java.security.spec.RSAPrivateCrtKeySpec;

java.security.spec.RSAPrivateKeySpec;

java.security.spec.RSAPublicKeySpec;

java.security.spec.X509EncodedKeySpec;

java.security.UnrecoverableKeyException;

java.security.UnrecoverableKeyException;

java.sql.Date;

java.text.DateFormat;

java.text.DateFormat;

java.text.DecimalFormat;

java.text.Format;

java.text.MessageFormat;

```
java.text.ParseException;
java.text.ParseException;
java.text.SimpleDateFormat;
java.text.SimpleDateFormat;
java.util.*;
java.util.ArrayList;
java.util.ArrayList;
java.util.Arrays;
java.util.Arrays;
java.util.Calendar;
java.util.Calendar;
java.util.Collection;
java.util.Collections;
java.util.Collections;
java.util.concurrent.atomic.AtomicBoolean;
java.util.concurrent.ConcurrentHashMap;
java.util.concurrent.Executors;
java.util.concurrent.Executors;
java.util.concurrent.ScheduledExecutorService;
java.util.concurrent.ScheduledExecutorService;
java.util.concurrent.TimeUnit;
java.util.concurrent.TimeUnit;
java.util.Date;
java.util.Date;
java.util.Enumeration;
java.util.Enumeration;
java.util.HashMap;
java.util.HashMap;
```

java.util.HashSet;

java.util.HashSet;

java.util.Hashtable;

java.util.Iterator;

java.util.Iterator;

java.util.LinkedHashSet;

java.util.LinkedList;

java.util.List;

java.util.List;

java.util.ListIterator;

java.util.ListIterator;

java.util.Locale;

java.util.Map;

java.util.Map;

java.util.MissingResourceException;

java.util.Properties;

java.util.Random;

java.util.regex.Matcher;

java.util.regex.Matcher;

java.util.regex.Pattern;

java.util.regex.Pattern;

java.util.ResourceBundle;

java.util.Scanner;

java.util.Scanner;

java.util.Set;

java.util.Set;

java.util.SimpleTimeZone;

java.util.StringTokenizer;

java.util.StringTokenizer;

java.util.Timer;

java.util.Timer;

java.util.TimerTask;

java.util.TimerTask;

java.util.TimeZone;

java.util.TimeZone;

java.util.Vector;

java.util.Vector;

java.util.zip.Deflater;

java.util.zip.DeflaterOutputStream;

java.util.zip.Inflater;

java.util.zip.InflaterInputStream;

java.util.zip.ZipEntry;

java.util.zip.ZipOutputStream;

javax.activation.ActivationDataFlavor;

javax.activation.CommandMap;

javax.activation.DataContentHandler;

javax.activation.DataHandler;

javax.activation.DataSource;

javax.activation.FileDataSource;

javax.activation.MailcapCommandMap;

javax.crypto.BadPaddingException;

javax.crypto.Cipher;

javax.crypto.Cipher;

javax.crypto.CipherInputStream;

javax.crypto.CipherOutputStream;

javax.crypto.CipherSpi;

javax.crypto.IllegalBlockSizeException;

javax.crypto.interfaces.DHKey;

javax.crypto.interfaces.DHPrivateKey;

javax.crypto.interfaces.DHPublicKey;

javax.crypto.interfaces.PBEKey;

javax.crypto.KeyAgreement;

javax.crypto.KeyAgreementSpi;

javax.crypto.KeyGenerator;

javax.crypto.KeyGenerator;

javax.crypto.KeyGeneratorSpi;

javax.crypto.Mac;

javax.crypto.MacSpi;

javax.crypto.NoSuchPaddingException;

javax.crypto.SecretKey;

javax.crypto.SecretKeyFactory;

javax.crypto.SecretKeyFactory;

javax.crypto.SecretKeyFactorySpi;

javax.crypto.ShortBufferException;

javax.crypto.spec.DESedeKeySpec;

javax.crypto.spec.DESedeKeySpec;

javax.crypto.spec.DESKeySpec;

javax.crypto.spec.DHGenParameterSpec;

javax.crypto.spec.DHParameterSpec;

javax.crypto.spec.DHPrivateKeySpec;

javax.crypto.spec.DHPublicKeySpec;

javax.crypto.spec.IvParameterSpec;

javax.crypto.spec.IvParameterSpec;

javax.crypto.spec.OAEPParameterSpec;

javax.crypto.spec.PBEKeySpec;

javax.crypto.spec.PBEParameterSpec;

javax.crypto.spec.PSource;

javax.crypto.spec.RC2ParameterSpec;

javax.crypto.spec.RC5ParameterSpec;

javax.crypto.spec.SecretKeySpec;

javax.crypto.spec.SecretKeySpec;

javax.mail.Address;

javax.mail.BodyPart;

javax.mail.Header;

javax.mail.internet.ContentType;

javax.mail.internet.InternetAddress;

javax.mail.internet.InternetHeaders;

javax.mail.internet.MimeBodyPart;

javax.mail.internet.MimeMessage;

javax.mail.internet.MimeMultipart;

javax.mail.internet.MimePart;

javax.mail.internet.SharedInputStream;

javax.mail.Message;

javax.mail.MessagingException;

javax.mail.Multipart;

javax.mail.Part;

javax.mail.Session;

javax.mail.Transport;

javax.naming.Context;

javax.naming.directory.Attribute;

javax.naming.directory.DirContext;

javax.naming.directory.InitialDirContext;

javax.naming.directory.SearchControls;

javax.naming.directory.SearchResult;

javax.naming.NamingEnumeration;

javax.naming.NamingException;

javax.net.ssl.HostnameVerifier;

javax.net.ssl.HostnameVerifier;

javax.net.ssl.HttpsURLConnection;

javax.net.ssl.HttpsURLConnection;

javax.net.ssl.KeyManager;

javax.net.ssl.KeyManager;

javax.net.ssl.SSLContext;

javax.net.ssl.SSLContext;

javax.net.ssl.SSLException;

javax.net.ssl.SSLException;

javax.net.ssl.SSLSession;

javax.net.ssl.SSLSession;

javax.net.ssl.SSLSocket;

javax.net.ssl.TrustManager;

javax.net.ssl.TrustManager;

javax.net.ssl.TrustManagerFactory;

javax.net.ssl.TrustManagerFactory;

javax.net.ssl.X509ExtendedKeyManager;

javax.net.ssl.X509ExtendedKeyManager;

javax.net.ssl.X509TrustManager;

javax.net.ssl.X509TrustManager;

javax.security.auth.x500.X500Principal;

javax.security.auth.x500.X500Principal;

javax.xml.parsers.DocumentBuilder;

javax.xml.parsers.DocumentBuilder;

javax.xml.parsers.DocumentBuilderFactory;

javax.xml.parsers.DocumentBuilderFactory;

org.apache.commons.io.IOUtils;

org.apache.http.client.CookieStore;

org.apache.http.client.entity.UrlEncodedFormEntity;

org.apache.http.client.entity.UrlEncodedFormEntity;

org.apache.http.client.HttpClient;

org.apache.http.client.HttpClient;

org.apache.http.client.methods.HttpGet;

org.apache.http.client.methods.HttpGet;

org.apache.http.client.methods.HttpPost;

org.apache.http.client.methods.HttpPost;

org.apache.http.client.protocol.ClientContext;

org.apache.http.client.protocol.ClientContext;

org.apache.http.client.utils.URIUtils;

org.apache.http.client.utils.URIUtils;

org.apache.http.conn.scheme.PlainSocketFactory;

org.apache.http.conn.scheme.PlainSocketFactory;

org.apache.http.conn.scheme.Scheme;

org.apache.http.conn.scheme.Scheme;

org.apache.http.conn.scheme.SchemeRegistry;

org.apache.http.conn.scheme.SchemeRegistry;

org.apache.http.conn.ssl.SSLSocketFactory;

org.apache.http.conn.ssl.SSLSocketFactory;

org.apache.http.cookie.Cookie;

org.apache.http.cookie.Cookie;

org.apache.http.Header;

org.apache.http.HttpEntity;

org.apache.http.HttpEntity;

org.apache.http.HttpResponse;

org.apache.http.HttpResponse;

org.apache.http.HttpStatus;

org.apache.http.HttpStatus;

org.apache.http.impl.client.DefaultHttpClient;

org.apache.http.impl.client.DefaultHttpClient;

org.apache.http.impl.conn.tsccm.ThreadSafeClientConnManager;

org.apache.http.impl.conn.tsccm.ThreadSafeClientConnManager;

org.apache.http.impl.cookie.BasicClientCookie;

org.apache.http.message.BasicNameValuePair;

org.apache.http.message.BasicNameValuePair;

org.apache.http.NameValuePair;

org.apache.http.NameValuePair;

org.apache.http.params.BasicHttpParams;

org.apache.http.params.BasicHttpParams;

org.apache.http.params.HttpConnectionParams;

org.apache.http.params.HttpConnectionParams;

org.apache.http.params.HttpParams;

org.apache.http.params.HttpParams;

org.apache.http.protocol.BasicHttpContext;

org.apache.http.protocol.BasicHttpContext;

org.apache.http.protocol.HttpContext;

org.apache.http.protocol.HttpContext;

org.json.JSONException;

org.json.JSONException;

org.json.JSONObject;

org.json.JSONObject;

org.w3c.dom.Document;

org.w3c.dom.Document;

org.w3c.dom.Element;

org.w3c.dom.Element;

org.w3c.dom.Node;

org.w3c.dom.Node;

org.w3c.dom.NodeList;

org.w3c.dom.NodeList

Appendix C: Linux Platform APIs

libdl.so

libxml2.so

libproxy.so

libdbus-1.so

libQt5Widgets.so

libQt5Gui.so

libQt5Network.so

libQt5Core.so

libpthread.so

libstdc++.so

libgcc_s.so

libc.so

ld-linux-x86-64.so

librt.so

libz.so

libicuuc.so

liblzma.so

libm.so

libsystemd.so

libgobject-2.0.so

libglib-2.0.so

libX11.so

libpng12.so

libharfbuzz.so

libGL.so

libicui18n.so

libpcre16.so

libicudata.so

libselinux.so

libgcrypt.so

libffi.so

libpcre.so

libxcb.so

libfreetype.so

libgraphite2.so

libexpat.so

libxcb-dri3.so

libxcb-present.so

libxcb-sync.so

libxshmfence.so

libglapi.so

libXext.so

libXdamage.so

libXfixes.so

libX11-xcb.so

libxcb-glx.so

libxcb-dri2.so

libXxf86vm.so

libdrm.so

libgpg-error.so

libXau.so

libXdmcp.so