Cisco Aggregation Services Router (ASR) 1000 Series

Security Target

Version 0.4

May 5, 2015

Americas Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

Table of Contents

List of Tables

Acronyms

The following acronyms and abbreviations are common and may be used in this Security Target:

Table 1 Acronyms

Acronyms/Abbreviations	Definition
AAA	Administration, Authorization, and Accounting
AES	Advanced Encryption Standard
BRI	Basic Rate Interface
CC	Common Criteria for Information Technology Security Evaluation
CEM	Common Evaluation Methodology for Information Technology Security
CM	Configuration Management
CSU	Channel Service Unit
DHCP	Dynamic Host Configuration Protocol
DSU	Data Service Unit
EAL	Evaluation Assurance Level
EHWIC	Ethernet High-Speed WIC
ESP	Encapsulating Security Payload
ESPr	Embedded Services Processors
GE	Gigabit Ethernet port
HTTPS	Hyper-Text Transport Protocol Secure
ISDN	Integrated Services Digital Network
IT	Information Technology
NDPP	Network Device Protection Profile
OS	Operating System
PoE	Power over Ethernet
PP	Protection Profile
SA	Security Association
SFP	Small–form-factor pluggable port
SHS	Secure Hash Standard
ST	Security Target
TCP	Transport Control Protocol
TSC	TSF Scope of Control
TSF	TOE Security Function
TSP	TOE Security Policy
WAN	Wide Area Network
WIC	WAN Interface Card

Terminology

Table 2 Terminology

Term	Definition
Authorized Administrator	Any user which has been assigned to a privilege level that is permitted to perform all TSF-related functions.
Peer	Another router on the network that the TOE interfaces with.
Privilege level	Assigns a user specific management access to the TOE to run specific commands. The privilege levels are from 1-15 with 15 having full administrator access to the TOE similar to root access in UNIX or Administrator access on Windows. Privilege level 1 has the most limited access to the CLI. By default when a user logs in to the Cisco IOS, they will be in user EXEC mode (level 1). From this mode, the administrator has access to some information about the TOE, such as the status of interfaces, and the administrator can view routes in the routing table. However, the administrator can't make any changes or view the running configuration file. The privilege levels are customizable so that an Authorized Administrator can also assign certain commands to certain privilege levels.
Remote VPN Gateway/Peer	A remote VPN Gateway/Peer is another network device that the TOE sets up a VPN connection with. This could be a VPN client or another router.
Role	An assigned role gives a user varying access to the management of the TOE. For the purposes of this evaluation the privilege level of user is synonymous with the assigned privilege level.
Security Administrator	Synonymous with Authorized Administrator for the purposes of this evaluation.
User	Any entity (human user or external IT entity) outside the TOE that interacts with the TOE.
Vty	vty is a term used by Cisco to describe a single terminal (whereas Terminal is more of a verb or general action term). For configuration purposes vty defines the line for remote access policies to the router.

DOCUMENT INTRODUCTION

Prepared By:
Cisco Systems, Inc.
170 West Tasman Dr.
San Jose, CA 95134

This document provides the basis for an evaluation of a specific Target of Evaluation (TOE), the Aggregation Services Router (ASR) 1000 Series. This Security Target (ST) defines a set of assumptions about the aspects of the environment, a list of threats that the product intends to counter, a set of security objectives, a set of security requirements, and the IT security functions provided by the TOE which meet the set of requirements.

1 SECURITY TARGET INTRODUCTION

The Security Target contains the following sections:

- Security Target Introduction [Section 1]
- Conformance Claims [Section 2]
- Security Problem Definition [Section 3]
- Security Objectives [Section 4]
- IT Security Requirements [Section 5]
- TOE Summary Specification [Section 6]

The structure and content of this ST comply with the requirements specified in the Common Criteria (CC), Part 1, Annex A, and Part 3, Chapter 11.

1.1 ST and TOE Reference

This section provides information needed to identify and control this ST and its TOE.

Table 3 ST and TOE Identification

Name	Description
ST Title	Cisco Aggregation Services Router (ASR) 1000 Series Security Target
ST Version	0.4
Publication Date	May 5, 2015
Vendor and ST Author	Cisco Systems, Inc.
TOE Reference	Cisco Aggregation Services Router (ASR) 1000 Series
TOE Hardware Models	Chassis: ASR 1001X, ASR 1002X, ASR 1006, ASR 1013; Embedded Services Processors (ESPr): ESPr100, ESPr200; Route Processor (RP): RP2
TOE Software Version	IOS XE 3.13
Keywords	Router, Network Appliance, Data Protection, Authentication, Cryptography, Secure Administration, Network Device, Virtual Private Network(VPN), VPN Gateway

1.2 TOE Overview

The Cisco Aggregation Services Router (ASR) 1000 Series TOE is a purpose-built, routing platform. The TOE includes seven (7) chassis options, as defined in Table 3 in section 1.1.

1.2.1 TOE Product Type

The Cisco Aggregation Services Router (ASR) 1000 Series delivers embedded hardware acceleration for multiple Cisco IOS® XE Software services. In addition, the Cisco ASR 1000

Series Router features redundant Route and Embedded Services Processors, as well as software-based redundancy.

In support of the routing capabilities, the Cisco Aggregation Services Router (ASR) 1000 Series provides IPSec connection capabilities to facilitate secure communications with external entities, as required.

1.2.2 Supported non-TOE Hardware/ Software/ Firmware

The TOE supports (in some cases optionally) the following hardware, software, and firmware in its environment when the TOE is configured in its evaluated configuration:

Table 4 IT Environment Components

Component	Mandatory	Usage/Purpose Description for TOE performance
RADIUS AAA Server	No	This includes any IT environment RADIUS AAA server that provides single-use authentication mechanisms. This can be any RADIUS AAA server that provides single-use authentication. The TOE correctly leverages the services provided by this RADIUS AAA server to provide single-use authentication to administrators.
Management Workstation with SSH client	Yes	This includes any IT Environment Management workstation with a SSH client installed that is used by the TOE administrator to support TOE administration through SSH protected channels. Any SSH client that supports SSHv2 may be used.
Local Console	Yes	This includes any IT Environment Console that is directly connected to the TOE via the Serial Console Port and is used by the TOE administrator to support TOE administration.
Certification Authority (CA)	Yes	This includes any IT Environment Certification Authority on the TOE network. This can be used to provide the TOE with a valid certificate during certificate enrollment.
Remote VPN Gateway/Peer	Yes	This includes any VPN peer with which the TOE participates in VPN communications. Remote VPN Endpoints may be any device that supports IPsec VPN communications.
NTP Server	No	The TOE supports communications with an NTP server in order to synchronize the date and time on the TOE with the NTP server's date and time. A solution must be used that supports secure communications with up to a 32 character key.
Audit (syslog) Server	Yes	This includes any syslog server to which the TOE would transmit syslog messages.
Another instance of the TOE	No	Includes "another instance of the TOE" that would be installed in the evaluated configuration, and likely administered by the same personnel. Used as a VPN peer.

1.3 TOE DESCRIPTION

This section provides an overview of the Cisco Aggregation Services Router (ASR) 1000 Series Target of Evaluation (TOE). This section also defines the TOE components included in the evaluated configuration of the TOE. The TOE consists of a number of components including:

- Chassis: The TOE chassis includes 2-RU, 6-RU and 13-RU form factors. The chassis is the component of the TOE in which all other TOE components are housed.
- Embedded Services Processor (ESPr): The Cisco ASR 1000 Series ESPrs are responsible for the data-plane processing tasks, and all network traffic flows through them.
- Route Processor (RP): The Cisco ASR 1000 Series RPs provide the advanced routing capabilities of the TOE. They also monitor and manage the other components in the Cisco ASR 1000 Series Aggregation Services.
- Shared Port Adaptors (SPAs): Used for connecting to networks. These SPAs interface with the TOE to provide the network interfaces that will be used to communicate on the network.

Cisco IOS-XE is a Cisco-developed highly configurable proprietary operating system that provides for efficient and effective routing and switching. Although IOS performs many networking functions, this TOE only addresses the functions that provide for the security of the TOE itself as described in Section 1.6 Logical Scope of the TOE below.

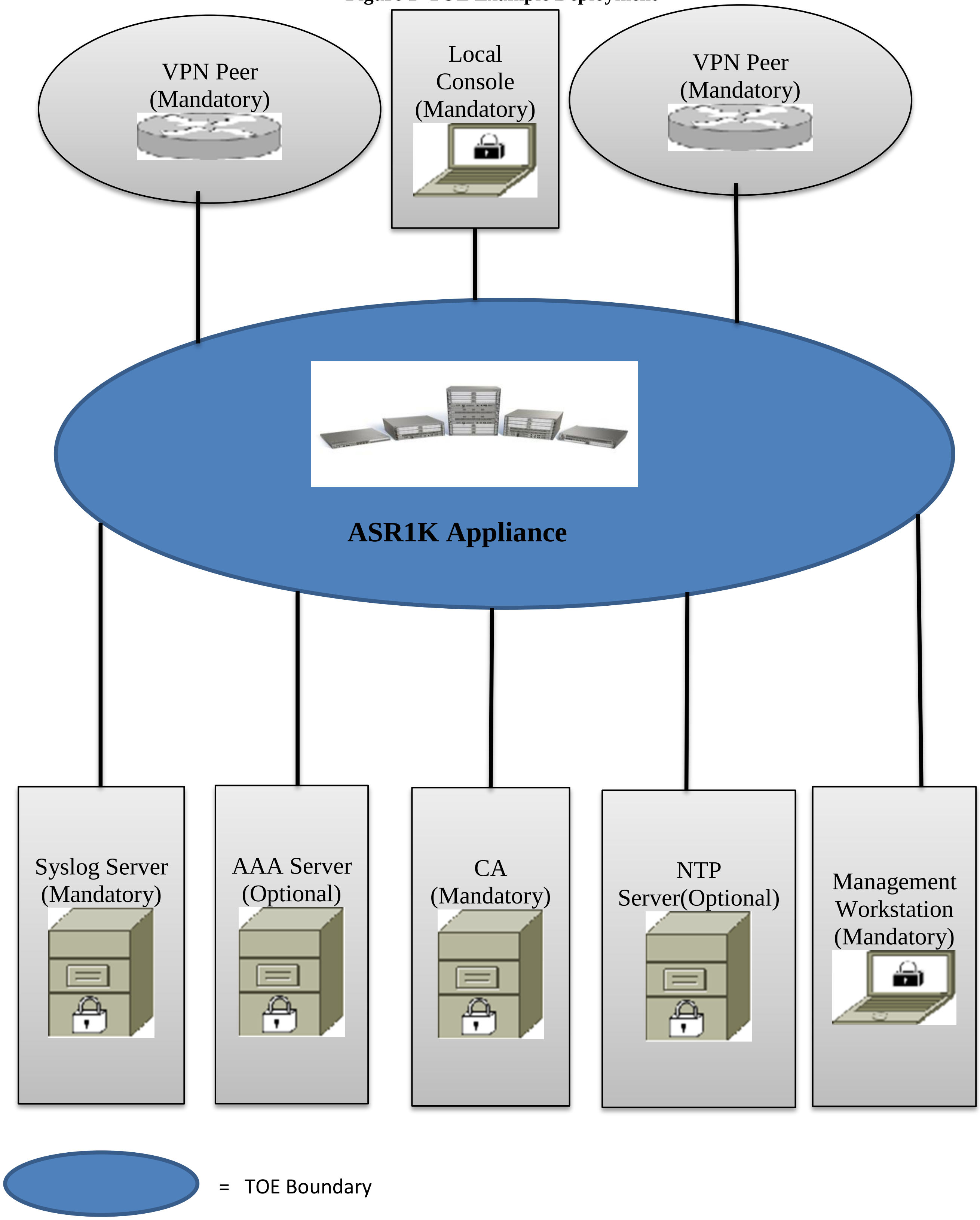
1.4 TOE Evaluated Configuration

The TOE consists of one or more physical devices as specified in section 1.5 below and includes the Cisco IOS-XE software. The TOE has two or more network interfaces and is connected to at least one internal and one external network. The Cisco IOS-XE configuration determines how packets are handled to and from the TOE's network interfaces. The router configuration will determine how traffic flows received on an interface will be handled. Typically, packet flows are passed through the internetworking device and forwarded to their configured destination.

The TOE can optionally connect to an NTP server for clock synchronization. A syslog server must be used to store audit records.

The following figure provides a visual depiction of an example TOE deployment.

Figure 1 TOE Example Deployment



The previous figure includes the following:

- Several examples of TOE Models

- The following are considered to be in the IT Environment:
    - (2) VPN Peers
    - Management Workstation
    - Authentication Server
    - NTP Server
    - Syslog Server
    - Local Console
    - CA

NOTE: While the previous figure includes several TOE devices and several non-TOE IT environment devices, the TOE is only the ASR 1000 device. Only one TOE device is required for deployment of the TOE in an evaluated configuration.

1.5 Physical Scope of the TOE

The TOE is a hardware and software solution that makes up the router models as follows: Chassis: ASR1001X, ASR 1002X, ASR 1006, ASR 1013; Embedded Services Processors (ESP): ESP100, ESP200; Route Processor (RP): RP2. The network, on which they reside, is considered part of the environment. The software is pre-installed and is comprised of the Cisco IOS-XE software image Release 3.13. In addition, the software image is also downloadable from the Cisco web site. A login id and password is required to download the software image. The TOE is comprised of the following physical specifications as described in Table 5 below:

Table 5 Hardware Models and Specifications

Hardware Model	ASR 1001-X	ASR 1002-X	ASR 1006	ASR 1013
Size	1-Rack Unit	2-Rack Units	6-Rack Units	13-Rack Units
Power	DC power: 500W AC Power: 471W	DC power: 590W AC Power: 560W	DC power: 1700W AC Power: 1600W	DC power: 4000W AC Power: 3760W
Supported ESPs	Integrated ESP	Integrated ESP	Dual ESP100	Dual ESP100 ESP200
Supported RPs	Integrated RP	Integrated RP	Dual RP2	Dual RP2
SPA Slots	1 SPA slot	1 SPA slot	12 SPA slots	24 SPA slots

Interfaces	Port Adapter Interface Console Port Auxiliary Port 10/100 BITS Ethernet Port 10/100 Management Ethernet Port USB Port GigE Ports (4)	Port Adapter Interface Console Port Auxiliary Port 10/100 BITS Ethernet Port 10/100 Management Ethernet Port USB Port GigE Ports (4)	Port Adapter Interface (12) Console Port Auxiliary Port (2) 10/100 BITS Ethernet Port (2) 10/100 Management Ethernet Port (2) USB Ports (4)	Port Adapter Interface (24) Console Port Auxiliary Port (2) 10/100 BITS Ethernet Port (4) 10/100 Management Ethernet Port (4) USB Ports (4)

1.6 Logical Scope of the TOE

The TOE is comprised of several security features. Each of the security features identified above consists of several security functionalities, as identified below.

1. Security Audit
2. Cryptographic Support
3. Full Residual Information Protection
4. Identification and Authentication
5. Security Management
6. Packet Filtering
7. Protection of the TSF
8. TOE Access
9. Trusted Path/Channels

These features are described in more detail in the subsections below. In addition, the TOE implements all RFCs of the NDPP v1.1 and VPNGWEP v1.1 as necessary to satisfy testing/assurance measures prescribed therein.

1.6.1 Security Audit

The Cisco Aggregation Services Router (ASR) 1000 Series provide extensive auditing capabilities. The TOE can audit events related to cryptographic functionality, identification and authentication, and administrative actions. The Cisco Aggregation Services Router (ASR) 1000 Series generates an audit record for each auditable event. Each security relevant audit event has the date, timestamp, event description, and subject identity. The administrator configures auditable events, performs back-up operations and manages audit data storage. The TOE provides the administrator with a circular audit trail or a configurable audit trail threshold to track the storage capacity of the audit trail. Audit logs are backed up over an encrypted channel to an external audit server.

1.6.2 Cryptographic Support

The TOE provides cryptography in support of other Cisco Aggregation Services Router (ASR) 1000 Series security functionality. This cryptography has been validated for conformance to the requirements of FIPS 140-2 Level 2 [Reference: CMVP Cert#2090] (see Table 6 for certificate references). The TOE utilizes the Intel Xeon hardware for this.

Table 6 FIPS References

Algorithm	Supported Mode	Cert. #
AES	CBC (128, 192, 256) ECB (128, 192, 256)	2817
SHS	Byte Oriented	2361, 2338
HMAC	Byte Oriented	1764
Triple-DES	KO 1, CBC	1670, 1671, 1688
DRBG	CTR (using AES-256)	481
RSA	PKCS#1 v.1.5, 1024-4096 bit key, FIPS 186-2 Key Gen	1471

The TOE provides cryptography in support of VPN connections and remote administrative management via SSHv2. The cryptographic services provided by the TOE are described in Table 7 below.

Table 7 TOE Provided Cryptography

Cryptographic Method	Use within the TOE
Internet Key Exchange	Used to establish initial IPsec session.
Secure Shell Establishment	Used to establish initial SSH session.
RSA/DSA Signature Services	Used in IPsec session establishment. Used in SSH session establishment. X.509 certificate signing
SP 800-90 RBG	Used in IPsec session establishment. Used in SSH session establishment.
SHS	Used to provide IPsec traffic integrity verification Used to provide SSH traffic integrity verification Used for keyed-hash message authentication

Cryptographic Method	Use within the TOE
AES	Used to encrypt IPsec session traffic. Used to encrypt SSH session traffic.
RSA	Used in IKE protocols peer authentication Used to provide cryptographic signature services
ECC	Used to provide cryptographic signature services
DH	Used as the Key exchange method for SSH

1.6.3 Full Residual Information Protection

The TOE ensures that all information flows from the TOE do not contain residual information from previous traffic. Packets are padded with zeroes. Residual data is never transmitted from the TOE.

1.6.4 Identification and Authentication

The TOE performs two types of authentication: device-level authentication of the remote device (VPN peers) and user authentication for the Authorized Administrator of the TOE. Device-level authentication allows the TOE to establish a secure channel with a trusted peer. The secure channel is established only after each device authenticates the other. Device-level authentication is performed via IKE/IPsec mutual authentication. The TOE supports use of IKEv1 (ISAKMP) and IKEv2 pre-shared keys for authentication of IPsec tunnels. The IKE phase authentication for the IPsec communication channel between the TOE and authentication server and between the TOE and syslog server is considered part of the Identification and Authentication security functionality of the TOE.

The TOE provides authentication services for administrative users to connect to the TOE's secure CLI administrator interface. The TOE requires Authorized Administrators to authenticate prior to being granted access to any of the management functionality. The TOE can be configured to require a minimum password length of 15 characters. The TOE provides administrator authentication against a local user database. Password-based authentication can be performed on the serial console or SSH interfaces. The SSHv2 interface also supports authentication using SSH keys. The TOE optionally supports use of a RADIUS AAA server (part of the IT Environment) for authentication of administrative users attempting to connect to the TOE's CLI.

The TOE provides an automatic lockout when a user attempts to authenticate and enters invalid information. After a defined number of authentication attempts fail exceeding the configured allowable attempts, the user is locked out until an authorized administrator can enable the user account.

The TOE uses X.509v3 certificates as defined by RFC 5280 to support authentication for IPsec, and SSH connections.

1.6.5 Security Management

The TOE provides secure administrative services for management of general TOE configuration and the security functionality provided by the TOE. All TOE administration occurs either through a secure SSHv2 session or via a local console connection. The TOE provides the ability to securely manage:

- Administration of the TOE locally and remotely;
- All TOE administrative users;
- All identification and authentication;
- All audit functionality of the TOE;
- All TOE cryptographic functionality;
- The timestamps maintained by the TOE;
- Update to the TOE and verification of the updates;
- Configuration of IPsec functionality;
- TOE configuration file storage and retrieval.

The TOE supports two separate administrator roles: non-privileged administrator and privileged administrator. Only the privileged administrator can perform the above security relevant management functions. Management of the TSF data is restricted to Security Administrators. The ability to enable, disable, determine and modify the behavior of all of the security functions of the TOE is restricted to authenticated administrators.

Administrators can create configurable login banners to be displayed at time of login, and can also define an inactivity timeout for each admin interface to terminate sessions after a set period of inactivity.

1.6.6 Packet Filtering

The TOE provides packet filtering and secure IPsec tunneling. The tunnels can be established between two trusted VPN peers as well as between remote VPN clients and the TOE. More accurately, these tunnels are sets of security associations (SAs). The SAs define the protocols and algorithms to be applied to sensitive packets and specify the keying material to be used. SAs are unidirectional and are established per the ESP security protocol. An authorized administrator can define the traffic that needs to be protected via IPsec by configuring access lists (permit, deny, log) and applying these access lists to interfaces using crypto map sets.

1.6.7 Protection of the TSF

The TOE protects against interference and tampering by untrusted subjects by implementing identification, authentication, and access controls to limit configuration to Authorized Administrators. The TOE prevents reading of cryptographic keys and passwords. Additionally Cisco IOS-XE is not a general-purpose operating system and access to Cisco IOS-XE memory space is restricted to only Cisco IOS-XE functions.

The TOE internally maintains the date and time. This date and time is used as the timestamp that is applied to audit records generated by the TOE. Administrators can update the TOE's clock manually, or can configure the TOE to use NTP to synchronize the TOE's clock with an external time source. Finally, the TOE performs testing to verify correct operation of the router itself and that of the cryptographic module.

The TOE is able to verify any software updates prior to the software updates being installed on the TOE to avoid the installation of unauthorized software.
Whenever a failure occurs within the TOE that results in the TOE ceasing operation, the TOE securely disables its interfaces to prevent the unintentional flow of any information to or from the TOE and reloads.

1.6.8 TOE Access

The TOE can terminate or lock inactive sessions after an Authorized Administrator configurable time-period. Once a session has been terminated the TOE requires the user to re-authenticate to establish a new session. Sessions can also be terminated if an Authorized Administrator enters the "exit" command.

The TOE can also display a Security Administrator specified banner on the CLI management interface prior to allowing any administrative access to the TOE.

1.6.9 Trusted Path/Channel

The TOE allows trusted paths to be established to itself from remote administrators over SSHv2, and initiates outbound IPsec tunnels to transmit audit messages to remote syslog servers. In addition, IPsec is used to secure the session between the TOE and the authentication servers. The TOE can also establish trusted paths of peer-to-peer IPsec sessions. The peer-to-peer IPsec sessions can be used for securing the communications between the TOE and authentication server/syslog server, as well as to protect communications with a CA or remote administrative console.

1.7 Excluded Functionality

The following functional is excluded from the evaluation.

Table 8 Excluded Functionality

Excluded Functionality	Exclusion Rationale
Non-FIPS 140-2 mode of operation	This mode of operation includes non-FIPS allowed operations.

These services will be disabled by configuration. The exclusion of this functionality does not affect compliance to the U.S. Government Protection Profile for Security Requirements for Network Devices Version 1.1 and Network Device Protection Profile Extended Package VPN Gateway 1.1.

2 CONFORMANCE CLAIMS

2.1 Common Criteria Conformance Claim

The TOE and ST are compliant with the Common Criteria (CC) Version 3.1, Revision 4, dated: September 2012. For a listing of Assurance Requirements claimed see section 5.5.

The TOE and ST are CC Part 2 extended and CC Part 3 conformant.

2.2 Protection Profile Conformance

This ST claims compliance to the following Common Criteria validated Protection Profiles:

Table 9 Protection Profiles

Protection Profile	Version	Date
U.S. Government Protection Profile for Security Requirements for Network Devices (NDPP)	1.1	June 8, 2012
Network Device Protection Profile Extended Package VPN Gateway (VPNGWEP)	1.1	April 12, 2013
Security Requirements for Network Devices – Errata # 2 (Errata 2)	n/a	January 13, 2013

2.3 Protection Profile Conformance Claim Rationale

2.3.1 TOE Appropriateness

The TOE provides all of the functionality at a level of security commensurate with that identified in the U.S. Government Protection Profile and extended package:

- U.S. Government Protection Profile for Security Requirements for Network Devices, Version 1.1
- Network Device Protection Profile Extended Package VPN Gateway, Version 1.1

2.3.2 TOE Security Problem Definition Consistency

The Assumptions, Threats, and Organizational Security Policies included in the Security Target represent the Assumptions, Threats, and Organizational Security Policies specified in the U.S. Government Protection Profile for Security Requirements for Network Devices Version 1.1 and Network Device Protection Profile Extended Package VPN Gateway Version 1.1 for which conformance is claimed verbatim. All concepts covered in the Protection Profile Security Problem Definition are included in the Security Target Statement of Security Objectives Consistency.

The Security Objectives included in the Security Target represent the Security Objectives specified in the NDPPv1.1, and VPNGWEPv1.1 for which conformance is claimed verbatim. All concepts covered in the Protection Profile's Statement of Security Objectives are included in the Security Target.

2.3.3 Statement of Security Requirements Consistency

The Security Functional Requirements included in the Security Target represent the Security Functional Requirements specified in the NDPPv1.1, and VPNGWEP v1.1 for which conformance is claimed verbatim. All concepts covered in the Protection Profile's Statement of Security Requirements are included in this Security Target. Additionally, the Security Assurance Requirements included in this Security Target are identical to the Security Assurance Requirements included in section 4.3 of the NDPPv1.1 as well as section 5.2 of the VPNGWEP v1.1.

3 SECURITY PROBLEM DEFINITION

This chapter identifies the following:

- Significant assumptions about the TOE's operational environment.
- IT related threats to the organization countered by the TOE.
- Environmental threats requiring controls to provide sufficient protection.
- Organizational security policies for the TOE as appropriate.

This document identifies assumptions as A.assumption with "assumption" specifying a unique name. Threats are identified as T.threat with "threat" specifying a unique name. Organizational Security Policies (OSPs) are identified as P.osp with "osp" specifying a unique name.

3.1 Assumptions

The specific conditions listed in the following subsections are assumed to exist in the TOE's environment. These assumptions include both practical realities in the development of the TOE security requirements and the essential environmental conditions on the use of the TOE.

Table 10 TOE Assumptions

Assumption	Assumption Definition
Reproduced from the U.S. Government Protection Profile for Security Requirements for Network Devices	
A.NO_GENERAL_PURPOSE	It is assumed that there are no general-purpose computing capabilities (e.g., compilers or user applications) available on the TOE, other than those services necessary for the operation, administration and support of the TOE.
A.PHYSICAL	Physical security, commensurate with the value of the TOE and the data it contains, is assumed to be provided by the environment.
A.TRUSTED_ADMIN	TOE Administrators are trusted to follow and apply all administrator guidance in a trusted manner.
Reproduced from U.S. Government Approved Protection Profile - Network Device Protection Profile (NDPP) Extended Package VPN Gateway Version 1.1	
A.CONNECTIONS	It is assumed that the TOE is connected to distinct networks in a manner that ensures that the TOE security policies will be enforced on all applicable network traffic flowing among the attached networks.

3.2 Threats

The following table lists the threats addressed by the TOE and the IT Environment. The assumed level of expertise of the attacker for all the threats identified below is Enhanced-Basic.

Table 11 Threats

Threat	Threat Definition
Reproduced from the U.S. Government Protection Profile for Security Requirements for Network Devices	
T.ADMIN_ERROR	An administrator may unintentionally install or configure the TOE incorrectly, resulting in ineffective security mechanisms.
T.TSF_FAILURE	Security mechanisms of the TOE may fail, leading to a compromise of the TSF.
T.UNDETECTED_ACTIONS	Malicious remote users or external IT entities may take actions that adversely affect the security of the TOE. These actions may remain undetected and thus their effects cannot be effectively mitigated.
T.UNAUTHORIZED_ACCESS	A user may gain unauthorized access to the TOE data and TOE executable code. A malicious user, process, or external IT entity may masquerade as an authorized entity in order to gain unauthorized access to data or TOE resources. A malicious user, process, or external IT entity may misrepresent itself as the TOE to obtain identification and authentication data.
T.UNAUTHORIZED_UPDATE	A malicious party attempts to supply the end user with an update to the product that may compromise the security features of the TOE.
T.USER_DATA_REUSE	User data may be inadvertently sent to a destination not intended by the original sender.
Reproduced from the VPNGWEP	
T.NETWORK_DISCLOSURE	Sensitive information on a protected network might be disclosed resulting from ingress- or egress-based actions.
T. NETWORK_ACCESS	Unauthorized access may be achieved to services on a protected network from outside that network, or alternately services outside a protected network from inside the protected network.
T.NETWORK_MISUSE	Access to services made available by a protected network might be used counter to Operational Environment policies.
T.TSF_FAILURE	Security mechanisms of the TOE mail fail[1], leading to a compromise of the TSF.
T.REPLAY_ATTACK	If malicious or external IT entities are able to gain access to the network, they may have the ability to capture information traversing throughout the network and send them on to the intended receiver.
T.DATA_INTEGRITY	A malicious party attempts to change the data being sent – resulting in loss of integrity.

[1] Should read – “may fail” and not “mail fail”. Typo in the PP.

3.3 Organizational Security Policies

The following table lists the Organizational Security Policies imposed by an organization to address its security needs.

Table 12 Organizational Security Policies

Policy Name	**Policy Definition**
P.ACCESS_BANNER	The TOE shall display an initial banner describing restrictions of use, legal agreements, or any other appropriate information to which users consent by accessing the TOE.

4 SECURITY OBJECTIVES

This Chapter identifies the security objectives of the TOE and the IT Environment. The security objectives identify the responsibilities of the TOE and the TOE's IT environment in meeting the security needs.

- This document identifies objectives of the TOE as O.objective with objective specifying a unique name. Objectives that apply to the IT environment are designated as OE.objective with objective specifying a unique name.

4.1 Security Objectives for the TOE

The following table, Security Objectives for the TOE, identifies the security objectives of the TOE. These security objectives reflect the stated intent to counter identified threats and/or comply with any security policies identified. An explanation of the relationship between the objectives and the threats/policies is provided in the rationale section of this document.

Table 13 Security Objectives for the TOE

TOE Objective	TOE Security Objective Definition
Reproduced from the U.S. Government Protection Profile for Security Requirements for Network Devices	
O.PROTECTED_COMMUNICATIONS	The TOE will provide protected communication channels for administrators, other parts of a distributed TOE, and authorized IT entities.
O.VERIFIABLE_UPDATES	The TOE will provide the capability to help ensure that any updates to the TOE can be verified by the administrator to be unaltered and (optionally) from a trusted source.
O.SYSTEM_MONITORING	The TOE will provide the capability to generate audit data and send those data to an external IT entity.
O.DISPLAY_BANNER	The TOE will display an advisory warning regarding use of the TOE.
O.TOE_ADMINISTRATION	The TOE will provide mechanisms to ensure that only administrators are able to log in and configure the TOE, and provide protections for logged-in administrators.
O.RESIDUAL_INFORMATION_CLEARING	The TOE will ensure that any data contained in a protected resource is not available when the resource is reallocated.
O.SESSION_LOCK	The TOE shall provide mechanisms that mitigate the risk of unattended sessions being hijacked.
O.TSF_SELF_TEST	The TOE will provide the capability to test some subset of its security functionality to ensure it is operating properly.

TOE Objective	TOE Security Objective Definition
Reproduced from the VPNGWEP	
O.ADDRESS_FILTERING	The TOE will provide the means to filter and log network packets based on source and destination addresses.
O.AUTHENTICATION	The TOE will provide a means to authenticate the user to ensure they are communicating with an authorized external IT entity.
O.CRYPTOGRAPHIC_FUNCTIONS	The TOE will provide means to encrypt and decrypt data as a means to maintain confidentiality and allow for detection and modification of TSF data that is transmitted outside of the TOE
O.FAIL_SECURE	Upon a self-test failure, the TOE will shutdown to ensure data cannot be passed while not adhering to the security policies configured by the administrator.
O.PORT_FILTERING	The TOE will provide the means to filter and log network packets based on source and destination transport layer ports.

4.2 Security Objectives for the Environment

All of the assumptions stated in section 3.1 are considered to be security objectives for the environment. The following are the Protection Profile non-IT security objectives, which, in addition to those assumptions, are to be satisfied without imposing technical requirements on the TOE. That is, they will not require the implementation of functions in the TOE hardware and/or software. Thus, they will be satisfied largely through application of procedural or administrative measures.

Table 14 Security Objectives for the Environment

Environment Security Objective	IT Environment Security Objective Definition
Reproduced from the U.S. Government Protection Profile for Security Requirements for Network Devices	
OE.NO_GENERAL_PURPOSE	There are no general-purpose computing capabilities (e.g., compilers or user applications) available on the TOE, other than those services necessary for the operation, administration and support of the TOE.
OE.PHYSICAL	Physical security, commensurate with the value of the TOE and the data it contains, is provided by the environment.
OE.TRUSTED_ADMIN	TOE Administrators are trusted to follow and apply all administrator guidance in a trusted manner.
Reproduced from the VPNGWEP	
OE.CONNECTIONS	TOE administrators will ensure that the TOE is installed in a manner that will allow the TOE to effectively enforce its policies on network traffic flowing among attached networks.

5 SECURITY REQUIREMENTS

This section identifies the Security Functional Requirements for the TOE. The Security Functional Requirements included in this section are derived from Part 2 of the *Common Criteria for Information Technology Security Evaluation, Version 3.1, Revision 4, dated: September 2012* and all international interpretations.

5.1 Conventions

The CC defines operations on Security Functional Requirements: assignments, selections, assignments within selections and refinements. This document uses the following font conventions to identify the operations defined by the CC:

- Assignment: Indicated with *italicized* text;
- Refinement: Indicated with **bold** text;
- Selection: Indicated with <u>underlined</u> text;
- Iteration: Indicated by appending the iteration number in parenthesis, e.g., (1), (2), (3).
- Where operations were completed in the NDPP, NDPP Errata#2 and VPNGWEP itself, the formatting used in those documents has been retained.

Explicitly stated SFRs are identified by having a label 'EXT' after the requirement name for TOE SFRs. Formatting conventions outside of operations matches the formatting specified within the NDPP.

The following conventions were used to resolve conflicting SFRs between the NDPP, NDPP Errata#2 and VPNGWEP:

- All SFRs from VPNGWEP reproduced as-is
- SFRs that appear in both NDPP and VPNGWEP are modified based on instructions specified in VPNGWEP
- NDPP SFRs with Errata modifications are defined based on instructions specified in the Errata
- NDPP SFRs with no Errata modifications are defined based on instructions specified in the NDPP

5.2 TOE Security Functional Requirements

This section identifies the Security Functional Requirements for the TOE. The TOE Security Functional Requirements that appear in the following table are described in more detail in the following subsections.

Table 15 Security Functional Requirements

Class Name	Component Identification	Component Name
FAU: Security audit	FAU_GEN.1	Audit data generation

Class Name	Component Identification	Component Name
	FAU_GEN.2	User Identity Association
	FAU_STG_EXT.1	External Audit Trail Storage
FCS: Cryptographic support	FCS_CKM.1(1)	Cryptographic Key Generation (for asymmetric keys)
	FCS_CKM.1(2)	Cryptographic Key Generation (for asymmetric keys)
	FCS_CKM_EXT.4	Cryptographic Key Zeroization
	FCS_COP.1(1)	Cryptographic Operation (for data encryption/decryption)
	FCS_COP.1(2)	Cryptographic Operation (for cryptographic signature)
	FCS_COP.1(3)	Cryptographic Operation (for cryptographic hashing)
	FCS_COP.1(4)	Cryptographic Operation (for keyed-hash message authentication)
	FCS_IPSEC_EXT.1	Extended: Internet Protocol Security (IPsec) Communications
	FCS_RBG_EXT.1	Extended: Cryptographic Operation (Random Bit Generation)
	FCS_SSH_EXT.1	Explicit: SSH
FDP: User data protection	FDP_RIP.2	Full Residual Information Protection
FIA: Identification and authentication	FIA_AFL.1	Authentication Failure Handling
	FIA_PMG_EXT.1	Password Management
	FIA_PSK_EXT.1	Extended: Pre-Shared Key Composition
	FIA_UIA_EXT.1	User Identification and Authentication
	FIA_UAU_EXT.2	Extended: Password-based Authentication Mechanism
	FIA_UAU.7	Protected Authentication Feedback
	FIA_X509_EXT.1	Extended: X.509 Certificates
FMT: Security management	FMT_MOF.1	Management of Security Functions Behavior
	FMT_MTD.1	Management of TSF Data (for general TSF data)
	FMT_SMF.1	Specification of Management Functions
	FMT_SMR.2	Restrictions on Security Roles

Class Name	Component Identification	Component Name
FPF: Packet Filtering	FPF_RUL_EXT.1	Packet Filtering
FPT: Protection of the TSF	FPT_FLS.1	Fail Secure
	FPT_SKP_EXT.1	Extended: Protection of TSF Data (for reading of all symmetric keys)
	FPT_APW_EXT.1	Extended: Protection of Administrator Passwords
	FPT_STM.1	Reliable Time Stamps
	FPT_TST_EXT.1	Extended: TSF Testing
	FPT_TUD_EXT.1	Extended: Trusted Update
FTA: TOE Access	FTA_SSL_EXT.1	TSF-initiated Session Locking
	FTA_SSL.3	TSF-initiated Termination
	FTA_SSL.4	User-initiated Termination
	FTA_TAB.1	Default TOE Access Banners
FTP: Trusted Path/Channels	FTP_ITC.1	Inter-TSF trusted channel
	FTP_TRP.1	Trusted Path

5.3 SFRs from NDPP and VPN Gateway EP

5.3.1.1 FAU_GEN.1 Audit data generation

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

a) Start-up and shut-down of the audit functions;
b) All auditable events for the not specified level of audit; and
c) *All administrative actions*;
d) [*Specifically defined auditable events listed in Table 16*].

FAU_GEN.1.2 The TSF shall record within each audit record at least the following information:

a) Date and time of the event, type of event, subject identity, and the outcome (success or failure) of the event; and
b) For each audit event type, based on the auditable event definitions of the functional components included in the PP/ST, [*information specified in column three of* ***Table 16***].

Table 16 Auditable Events

SFR	Auditable Event	Additional Audit Record Contents
FAU_GEN.1	None.	None.
FAU_GEN.2	None.	None.
FAU_STG_EXT.1	None.	None.
FCS_CKM.1(1)	None.	None.
FCS_CKM.1(2)	None.	None.
FCS_CKM_EXT.4	None.	None.
FCS_COP.1(1)	None.	None.
FCS_COP.1(2)	None.	None.
FCS_COP.1(3)	None.	None.
FCS_COP.1(4)	None.	None.
FCS_IPSEC_EXT.1	Failure to establish an IPsec SA.	Reason for failure.
	Establishment/Termination of an IPsec SA.	Non-TOE endpoint of connection (IP address) for both successes and failures.
	Session Establishment with peer	Source and destination addresses Source and destination ports TOE Interface
FCS_RBG_EXT.1	None.	None.
FCS_SSH_EXT.1	Failure to establish an SSH session	Reason for failure.
	Establishment/Termination of an SSH session.	Non-TOE endpoint of connection (IP address) for both successes and failures.
FDP_RIP.2	None.	None.
FIA_PMG_EXT.1	None.	None.
FIA_UIA_EXT.1	All use of the identification and authentication mechanism.	Provided user identity, origin of the attempt (e.g., IP address).
FIA_UAU_EXT.2	All use of the authentication mechanism.	Origin of the attempt (e.g., IP address).

SFR	Auditable Event	Additional Audit Record Contents
FIA_UAU.7	None.	None.
FIA_X509_EXT.1	Establishing session with CA	Source and destination addresses Source and destination ports TOE Interface
FMT_MOF.1	None.	None.
FMT_MTD.1	None.	None.
FMT_SMF.1	None.	None.
FMT_SMR.2	None.	None.
FPF_RUL_EXT.1	Application of rules configured with the ‘log’ operation	Source and destination addresses Source and destination ports Transport Layer Protocol TOE Interface
	Indication of packets dropped due to too much network traffic	TOE interface that is unable to process packets
FPT_FLS.1	None.	None.
FPT_SKP_EXT.1	None.	None.
FPT_APW_EXT.1	None.	None.
FPT_STM.1	Changes to the time.	The old and new values for the time. Origin of the attempt (e.g., IP address).
FPT_TUD_EXT.1	Initiation of update.	No additional information.
FPT_TST_EXT.1	Indication that TSF self-test was completed.	Any additional information generated by the tests beyond “success” or “failure”.
FTA_SSL_EXT.1	Any attempts at unlocking of an interactive session.	No additional information.
FTA_SSL.3	The termination of a remote session by the session locking mechanism.	No additional information.
FTA_SSL.4	The termination of an interactive session.	No additional information.
FTA_TAB.1	None.	None.

SFR	Auditable Event	Additional Audit Record Contents
FTP_ITC.1	Initiation of the trusted channel.	Identification of the initiator and target of failed trusted channels establishment attempt
	Termination of the trusted channel.	
	Failure of the trusted channel functions.	
FTP_TRP.1	Initiation of the trusted channel.	Identification of the claimed user identity.
	Termination of the trusted channel.	
	Failures of the trusted path functions	

5.3.1.2 FAU_GEN.2 User Identity Association

FAU_GEN.2.1 For audit events resulting from actions of identified users, the TSF shall be able to associate each auditable event with the identity of the user that caused the event.

5.3.1.3 FAU_STG_EXT.1 External Audit Trail Storage

FAU_STG_EXT.1.1 The TSF shall be able to [transmit the generated audit data to an external IT entity] using a trusted channel implementing the [IPsec] protocol.

5.3.2 Cryptographic Support (FCS)

5.3.2.1 FCS_CKM.1 Cryptographic Key Generation (for asymmetric keys)

FCS_CKM.1.1(1) Refinement: The TSF shall generate **asymmetric** cryptographic keys **used for key establishment** in accordance with [

- *NIST Special Publication 800-56A, "Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography" for elliptic curve-based key establishment schemes and implementing "NIST curves" P-256, P-384 and [no other curves] (as defined in FIPS PUB 186-3, "Digital Signature Standard")*
- *NIST Special Publication 800-56B, "Recommendation for Pair-Wise Key Establishment Schemes Using Integer Factorization Cryptography" for RSA-based key establishment schemes*]

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

5.3.2.1 FCS_CKM.1(2) Cryptographic Key Generation (for asymmetric keys)

FCS_CKM.1.2 Refinement: The TSF shall generate **asymmetric** cryptographic keys **used for**

IKE peer authentication in accordance with a:

[

- FIPS PUB 186-3, “Digital Signature Standard (DSS)”, Appendix B.3 for RSA schemes;
- FIPS PUB 186-3, “Digital Signature Standard (DSS)”, Appendix B.4 for ECDSA schemes and implementing “NIST curves” P-256, P-384 and [P-521];
- ANSI X9.31-1998, Appendix A.2.4 Using AES for RSA schemes]

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

5.3.2.2 FCS_CKM_EXT.4 Cryptographic Key Zeroization

FCS_CKM_EXT.4.1 The TSF shall zeroize all plaintext secret and private cryptographic keys and CSPs when no longer required.

5.3.2.3 FCS_COP.1(1) Cryptographic Operation (for data encryption/decryption)

FCS_COP.1.1(1) Refinement: The TSF shall perform [*encryption and decryption*] in accordance with a specified cryptographic algorithm *AES operating in* **GCM, CBC,** [*no other modes*] and cryptographic key sizes 128-bits, 256-bits, and [192 bits] that meets the following:

- **FIPS PUB 197, “Advanced Encryption Standard (AES)”**
- **NIST SP 800-38D, NIST SP 800-38A [no other standards]**

5.3.2.4 FCS_COP.1(2) Cryptographic Operation (for cryptographic signature)

FCS_COP.1.1(2) Refinement: The TSF shall perform **cryptographic signature services** in accordance with a :

- [**RSA Digital Signature Algorithm (RSA) with a key size (modulus) of 2048 bits or greater that meets FIPS PUB 186-2 or FIPS PUB 186-3, “Digital Signature Standard”,**
- ***Elliptic Curve Digital Signature Algorithm (ECDSA) with a key size of 256 bits or greater*** **that meets FIPS PUB 186-3, “Digital Signature Standard” with “NIST curves” P-256, P-384 and [P-521] (as defined in FIPS PUB 186-3, “Digital Signature Standard”)].**

5.3.2.5 FCS_COP.1(3) Cryptographic Operation (for cryptographic hashing)

FCS_COP.1.1(3) Refinement: The TSF shall perform [*cryptographic hashing services*] in accordance with a specified cryptographic algorithm [SHA-1, SHA-256, SHA-512**] and message digest sizes [**160, 256, 512**] bits** that meet the following: *FIPS Pub 180-3, "Secure Hash Standard."*

5.3.2.6 FCS_COP.1(4) Cryptographic Operation (for keyed-hash message authentication)

FCS_COP.1.1(4) Refinement: The TSF shall perform [*keyed-hash message authentication*] in accordance with a specified cryptographic algorithm HMAC-**[**SHA-1**], key size [***160*], **and message digest sizes [**160**] bits** that meet the following: *FIPS Pub 198-1, "The Keyed-Hash Message Authentication Code, and FIPS Pub 180-3, "Secure Hash Standard."*

5.3.2.7 FCS_IPSEC_EXT.1 Explicit: IPSEC

FCS_IPSEC_EXT.1.1 The TSF shall implement the IPsec architecture as defined by RFC 4301.

FCS_IPSEC_EXT.1.2 The TSF shall implement [tunnel mode, transport mode].

FCS_IPSEC_EXT.1.3 The TSF shall have a nominal, final entry in the SPD that matches anything that is otherwise unmatched, and discards it.

FCS_IPSEC_EXT.1.4 The TSF shall implement the IPsec protocol ESP as defined by RFC 4303 using the cryptographic algorithms AES-GCM-128, AES-GCM-256 as specified in RFC 4106, [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 as defined in RFCs 2407, 2408, 2409, RFC 4109, [no other RFCs for extended sequence numbers] and [no other RFCs for hash functions]; IKEv2 as defined in RFCs 5996 (with mandatory support for NAT traversal as specified in section 2.23) 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 [AES-GCM-128, AES-GCM-256 as specified in RFC 5282].

FCS_IPSEC_EXT.1.7 The TSF shall ensure that IKEv1 Phase 1 exchanges use only main mode.

FCS_IPSEC_EXT.1.8 The TSF shall ensure that [IKEv2 SA lifetimes can be configured by an Administrator based on number of packets or length of time, where the time values can be limited to: 24 hours for Phase 1 SAs and 8 hours for Phase 2 SAs, IKEv1 SA lifetimes can be configured by an Administrator based on number of packets or length of time, where the time values can be limited to: 24 hours for Phase 1 SAs and 8 hours for Phase 2 SAs].

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 [*320 (for DH Group 14), 256 (for DH Group 19), 256 (for DH Group 24), 384 (for DH Group 20), 424 (for DH Group 15), and 480 (bits for DH Group 16)*] 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^[*128*].

FCS_IPSEC_EXT.1.11 The TSF shall ensure that all IKE protocols implement DH Groups 14 (2048-bit MODP), 19 (256-bit Random ECP), and [24 (2048-bit MODP with 256-bit POS), 20 (384-bit Random ECP), *15 (3072 bit MODP), and 16 (4096-bit MODP)*].

FCS_IPSEC_EXT.1.12 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.1.13 The TSF 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.

5.3.2.8 FCS_RBG_EXT.1 Extended: Cryptographic Operation (Random Bit Generation)

FCS_RBG_EXT.1.1 The TSF shall perform all random bit generation (RBG) services in accordance with [NIST Special Publication 800-90 using CTR_DRBG (AES)] seeded by an entropy source that accumulated entropy from a TSF-hardware based noise source, and [no other noise source].

FCS_RBG_EXT.1.2 The deterministic RBG shall be seeded with a minimum of [256 bits] of entropy at least equal to the greatest security strength of the keys and hashes that it will generate.

5.3.2.9 FCS_SSH_EXT.1 Explicit: SSH

FCS_SSH_EXT.1.1 The TSF shall implement the SSH protocol that complies with RFCs 4251, 4252, 4253, 4254, and [no other RFCs].

FCS_SSH_EXT.1.2 The TSF shall ensure that the SSH protocol implementation supports the following authentication methods as described in RFC 4252: public key-based, password-based.

FCS_SSH_EXT.1.3 The TSF shall ensure that, as described in RFC 4253, packets greater than [*35,000*] bytes in an SSH transport connection are dropped.

FCS_SSH_EXT.1.4 The TSF shall ensure that the SSH transport implementation uses the following encryption algorithms: AES-CBC-128, AES-CBC-256, [no other algorithms].

FCS_SSH_EXT.1.5 The TSF shall ensure that the SSH transport implementation uses [SSH_RSA] and [*no other public key algorithms*] as its public key algorithm(s).

FCS_SSH_EXT.1.6 The TSF shall ensure that data integrity algorithms used in SSH transport connection is [*hmac-sha1, hmac-sha1-96*].

FCS_SSH_EXT.1.7 The TSF shall ensure that diffie-hellman-group14-sha1 and [no other methods] are the only allowed key exchange method used for the SSH protocol.

5.3.3 User data protection (FDP)

5.3.3.1 FDP_RIP.2 Full Residual Information Protection

FDP_RIP.2.1 The TSF shall ensure that any previous information content of a resource is made unavailable upon the [*allocation of the resource to, deallocation of the resource from*] all objects.

5.3.4 Identification and authentication (FIA)

5.3.4.1 FIA_AFL.1 Authentication Failure Handling

FIA_AFL.1.1 Refinement: The TSF shall detect when **an Administrator configurable positive integer of successive** unsuccessful authentication attempts occur related to **administrators attempting to authenticate remotely**.

FIA_AFL.1.2 When the defined number of unsuccessful authentication attempts has been **met**, the TSF shall [prevent the offending remote administrator from successfully authenticating until [*an authorized administrator unlocks the locked user account*] is taken by a local Administrator].

5.3.4.2 FIA_PMG_EXT.1 Password Management

FIA_PMG_EXT.1.1 The TSF shall provide the following password management capabilities for administrative passwords:

1. Passwords shall be able to be composed of any combination of upper and lower case letters, numbers, and the following special characters:[“!”, “@”, “#”, “$”, “%”, “^”, “&”, “*”, “(“, “)”];
2. Minimum password length shall settable by the Security Administrator, and support passwords of 15 characters or greater;

5.3.4.3 FIA_PSK_EXT.1 Extended: Pre-Shared Key Composition

FIA_PSK_EXT.1.1 The TSF shall be able to use pre-shared keys for IPsec and [no other protocols].

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

- are 22 characters and [*any combination of alphanumeric or special characters up to 128 bytes*];
- composed of any combination of upper and lower case letters, numbers, and special characters (that include: “!”, “@”, “#”, “$”, “%”, “^”, “&”, “*”, “(“, and “)”).

FIA_PSK_EXT.1.3 The TSF shall condition the text-based pre-shared keys by using [SHA-1, *AES in CBC mode*].

FIA_PSK_EXT.1.4 The TSF shall be able to [accept] bit-based pre-shared keys.

5.3.4.4 FIA_UIA_EXT.1 User Identification and Authentication

FIA_UIA_EXT.1.1 The TSF shall allow the following actions prior to requiring the non-TOE entity to initiate the identification and authentication process:

- Display the warning banner in accordance with FTA_TAB.1;
- [no other actions]

FIA_UIA_EXT.1.2 The TSF shall require each administrative user to be successfully identified and authenticated before allowing any other TSF-mediated action on behalf of that administrative user.

5.3.4.5 FIA_UAU_EXT.2 Extended: Password-based Authentication Mechanism

FIA_UAU_EXT.2.1 The TSF shall provide a local password-based authentication mechanism, [*remote password-based authentication via RADIUS, public-key based authentication for SSH connections*] to perform administrative user authentication.

5.3.4.6 FIA_UAU.7 Protected Authentication Feedback

FIA_UAU.7.1 The TSF shall provide only *obscured feedback* to the administrative user while the authentication is in progress at the local console.

5.3.4.7 FIA_X509_EXT.1 Extended: X.509 Certificates

FIA_X509_EXT.1.1 The TSF shall use X.509v3 certificates as defined by RFC 5280 to support authentication for IPsec and [SSH] connections.

FIA_X509_EXT.1.2 The TSF shall store and protect certificate(s) from unauthorized deletion and modification.

FIA_X509_EXT.1.3 The TSF shall provide the capability for authenticated Administrators to load X.509v3 certificates into the TOE for use by the security functions specified in this PP.

FIA_X509_EXT.1.4 The TSF shall generate a Certificate Request Message as specified in RFC 2986 and be able to provide the following information in the request: public key, Common Name, Organization, Organizational Unit, and Country.

FIA_X509_EXT.1.5 The TSF shall validate the certificate using [Online Certificate Status Protocol (OCSP) as specified in RFC 2560, a Certificate Revocation List (CRL) as specified in RFC 5759].

FIA_X509_EXT.1.6 The TSF shall validate a certificate path by ensuring the presence of the basicConstraints extension is present and the cA flag is set to TRUE for all CA certificates.

FIA_X509_EXT.1.7 The TSF shall not treat a certificate as a CA certificate if the basicConstraints extension is not present or the cA flag is not set to TRUE.

FIA_X509_EXT.1.8 The TSF shall not establish an SA if a certificate is deemed invalid.

FIA_X509_EXT.1.9 The TSF shall not establish an SA if the distinguished name (DN) contained in a certificate does not match the expected DN for the entity attempting to establish a connection.

FIA_X509_EXT.1.10 When the TSF cannot establish a connection to determine the validity of a certificate, the TSF shall, at the option of the administrator, establish an SA or disallow the establishment of an SA.

5.3.5 Security management (FMT)

5.3.5.1 FMT_MOF.1 Management of Security Functions Behavior

FMT_MOF.1.1 Refinement: The TSF shall restrict the ability to enable, disable, determine and modify the behavior of all of the security functions of the TOE identified in this **ST** to an authenticated Administrator.

5.3.5.2 FMT_MTD.1 Management of TSF Data (for general TSF data)

FMT_MTD.1.1 The TSF shall restrict the ability to *manage* the *TSF data* to the *Security Administrators*.

5.3.5.3 FMT_SMF.1 Specification of Management Functions

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

- *Ability to administer the TOE locally and remotely;*
- *Ability to update the TOE, and to verify the updates using [digital signature, published hash] capability prior to installing those updates;*
- *Ability to configure the cryptographic functionality;*
- *Ability to configure the IPsec functionality,*
- *Ability to enable, disable, determine and modify the behavior of all the security functions of the TOE identified in this **ST** to the Administrator,*
- *Ability to configure all security management functions identified in other sections of this **ST**.*

5.3.5.4 FMT_SMR.2 Restrictions on Security Roles

FMT_SMR.2.1 The TSF shall maintain the roles:

- **Authorized Administrator.**

FMT_SMR.2.2 The TSF shall be able to associate users with roles.

FMT_SMR.2.3 The TSF shall ensure that the conditions

- **Authorized Administrator role shall be able to administer the TOE locally;**
- **Authorized Administrator role shall be able to administer the TOE remotely;**

are satisfied.

5.3.6 Packet Filtering (FPF)

5.3.6.1 FPF_RUL_EXT.1 Packet Filtering

FPF_RUL_EXT.1.1 The TSF shall perform Packet Filtering on network packets processed by the TOE.

FPF_RUL_EXT.1.2 The TSF shall process the following network traffic protocols:

- Internet Protocol (IPv4)
- Internet Protocol version 6 (IPv6)

- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)

and be capable of inspecting network packet header fields defined by the following RFCs to the extent mandated in the other elements of this SFR

- RFC 791 (IPv4)
- RFC 2460 (IPv6)
- RFC 793 (TCP)
- RFC 768 (UDP).

FPF_RUL_EXT.1.3 The TSF shall allow the definition of Packet Filtering rules using the following network protocol fields:

- IPv4
  - Source address
  - Destination Address
  - Protocol
- IPv6
  - Source address
  - Destination Address
  - Next Header (Protocol)
- TCP
  - Source Port
  - Destination Port
- UDP
  - Source Port
  - Destination Port

and distinct interface.

FPF_RUL_EXT.1.4 The TSF shall allow the following operations to be associated with Packet Filtering rules: permit, deny, and log.

FPF_RUL_EXT.1.5 The TSF shall allow the Packet Filtering rules to be assigned to each distinct network interface.

FPF_RUL_EXT.1.6 The TSF shall process the applicable Packet Filtering rules (as determined in accordance with FPF_RUL_EXT.1.5) in the following order: Administrator-defined.

FPF_RUL_EXT.1.7 The TSF shall deny packet flow if a matching rule is not identified.

5.3.7 Protection of the TSF (FPT)

5.3.7.1 FPT_FLS.1 Fail Secure

FPT_FLS.1.1 Refinement: The TSF shall **shutdown** when the following types of failures occur: failure of the power-on self-tests, failure of integrity check of the TSF executable image, failure of noise source health tests.

5.3.7.2 FPT_SKP_EXT.1 Extended: Protection of TSF Data (for reading of all symmetric keys)

FPT_SKP_EXT.1.1 The TSF shall prevent reading of all pre-shared keys, symmetric keys, and private keys.

5.3.7.3 FPT_APW_EXT.1 Extended: Protection of Administrator Passwords

FPT_APW_EXT.1.1 The TSF shall store passwords in non-plaintext form.

FPT_APW_EXT.1.2 The TSF shall prevent the reading of plaintext passwords.

5.3.7.4 FPT_STM.1 Reliable time stamps

FPT_STM.1.1 The TSF shall be able to provide reliable time stamps for its own use.

5.3.7.5 FPT_TST_EXT.1: Extended: TSF Testing

FPT_TST_EXT.1.1 The TSF 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 The TSF shall provide the capability to verify the integrity of stored TSF executable code when it is loaded for execution through the use of the TSF-provided cryptographic service specified in FCS_COP.1(2).

5.3.7.6 FPT_TUD_EXT.1 Extended: Trusted Update

FPT_TUD_EXT.1.1 The TSF shall provide security administrators the ability to query the current version of the TOE firmware/software.

FPT_TUD_EXT.1.2 The TSF shall provide security administrators the ability to initiate updates to TOE firmware/software.

FPT_TUD_EXT.1.3 The TSF shall provide a means to verify firmware/software updates to the TOE using a digital signature mechanism and [published hash] prior to installing those updates.

5.3.8 TOE Access (FTA)

5.3.8.1 FTA_SSL_EXT.1 TSF-initiated Session Locking

FTA_SSL_EXT.1.1 The TSF shall, for local interactive sessions, [

- lock the session - disable any activity of the user's data access/display devices other than unlocking the session, and requiring that the administrator re-authenticate to the TSF prior to unlocking the session]

after a Security Administrator-specified time period of inactivity.

5.3.8.2 FTA_SSL.3 TSF-initiated Termination

FTA_SSL.3.1 Refinement: The TSF shall terminate **a remote** interactive session after a [*Security Administrator-configurable time interval of session inactivity*].

5.3.8.3 FTA_SSL.4 User-initiated Termination

FTA_SSL.4.1 The TSF shall allow Administrator-initiated termination of the Administrator's own interactive session.

5.3.8.4 FTA_TAB.1 Default TOE Access Banners

FTA_TAB.1.1 Refinement: Before establishing **an administrative user** session the TSF shall display **a Security Administrator-specified** advisory **notice and consent** warning message regarding use of the TOE.

5.3.9 Trusted Path/Channels (FTP)

5.3.9.1 FTP_ITC.1 Inter-TSF trusted channel

FTP_ITC.1.1 Refinement: The TSF shall use IPsec, and [no other protocols] to provide a trusted communication channel between itself and all authorized IT entities that is logically distinct from other communication channels and provides assured identification of its end points and protection of the channel data from disclosure and detection of modification of the channel data.

FTP_ITC.1.2 The TSF shall permit *the TSF, or the **authorized IT entities*** to initiate communication via the trusted channel.

FTP_ ITC.1.3 The TSF shall initiate communication via the trusted channel for [*communications with the following:*

- *external audit servers using IPsec,*
- *remote AAA servers using IPsec,*
- *remote VPN gateways/peers using IPsec,*
- *another instance of the TOE using IPsec*
- *a CA server using IPsec*].

5.3.9.2 FTP_TRP.1 Trusted Path

FTP_TRP.1.1 Refinement: The TSF shall **use** [**IPsec, SSH**] provide a **trusted** communication path between itself and **remote administrators** that is logically distinct from other communication paths and provides assured identification of its end points and protection of the communicated data from *disclosure and detection of modification of the communicated data*.

FTP_TRP.1.2 Refinement: The TSF shall permit **remote administrators** to initiate communication via the trusted path.

FTP_TRP.1.3 The TSF shall require the use of the trusted path for *initial administrator authentication and all remote administration actions.*

5.4 TOE SFR Dependencies Rationale for SFRs Found in PP

The NDPPv1.1, NDPP Errata#2 and VPNGWEP v1.1 contain all the requirements claimed in this Security Target. The order of precedence followed in case of duplicate requirements is as follows - VPNGWEP v1.1 > NDPP Errata#2 > NDPPv1.1. As such the dependencies are not applicable since the PP and EP have been approved.

5.5 Security Assurance Requirements

5.5.1 SAR Requirements

The TOE assurance requirements for this ST are taken directly from the NDPP which are derived from Common Criteria Version 3.1, Revision 4. The assurance requirements are summarized in the table below.

Table 17 Assurance Measures

Assurance Class	Components	Components Description
DEVELOPMENT	ADV_FSP.1	Basic Functional Specification
GUIDANCE DOCUMENTS	AGD_OPE.1	Operational user guidance
	AGD_PRE.1	Preparative User guidance
TESTS	ATE_IND.1	Independent testing – conformance

Assurance Class	Components	Components Description
VULNERABILITY ASSESSMENT	AVA_VAN.1	Vulnerability analysis
LIFE CYCLE SUPPORT	ALC_CMC.1	Labeling of the TOE
	ALC_CMS.1	TOE CM coverage

5.5.2 Security Assurance Requirements Rationale

The Security Assurance Requirements (SARs) in this Security Target represent the SARs identified in the NDPPv1.1 and the VPNGWv1.1. As such, the NDPP SAR rationale is deemed acceptable since the PPs have been validated.

5.6 Assurance Measures

The TOE satisfies the identified assurance requirements. This section identifies the Assurance Measures applied by Cisco to satisfy the assurance requirements. The table below lists the details.

Table 18 Assurance Measures

Component	How requirement will be met
ADV_FSP.1	The functional specification describes the external interfaces of the TOE; such as the means for a user to invoke a service and the corresponding response of those services. The description includes the interface(s) that enforces a security functional requirement, the interface(s) that supports the enforcement of a security functional requirement, and the interface(s) that does not enforce any security functional requirements. The interfaces are described in terms of their purpose (general goal of the interface), method of use (how the interface is to be used), parameters (explicit inputs to and outputs from an interface that control the behavior of that interface), parameter descriptions (tells what the parameter is in some meaningful way), and error messages (identifies the condition that generated it, what the message is, and the meaning of any error codes). The development evidence also contains a tracing of the interfaces to the SFRs described in this ST.
AGD_OPE.1	The Administrative Guide provides the descriptions of the processes and procedures of how the administrative users of the TOE can securely administer the TOE using the interfaces that provide the features and functions detailed in the guidance.
AGD_PRE.1	The Installation Guide describes the installation, generation, and startup procedures so that the users of the TOE can put the components of the TOE in the evaluated configuration.
ALC_CMC.1	The Configuration Management (CM) document(s) describes how the consumer (end-user) of the TOE can identify the evaluated TOE (Target of Evaluation). The CM document(s), identifies the configuration items, how those configuration items are uniquely identified, and the adequacy of the procedures that are used to control and track changes that are made to the TOE. This includes details on what changes are tracked, how potential changes are incorporated, and the degree to which automation is used to reduce the scope for error.
ALC_CMS.1	
ATE_IND.1	Cisco will provide the TOE for testing.
AVA_VAN.1	Cisco will provide the TOE for testing.

6 TOE SUMMARY SPECIFICATION

6.1 TOE Security Functional Requirement Measures

This chapter identifies and describes how the Security Functional Requirements identified above are met by the TOE.

Table 19 How TOE SFRs Measures

TOE SFRs	How the SFR is Met
FAU_GEN.1	The TOE generates an audit record whenever an audited event occurs. The types of events that cause audit records to be generated include: startup and shutdown of the audit mechanism cryptography related events, identification and authentication related events, and administrative events (the specific events and the contents of each audit record are listed in the table within the FAU_GEN.1 SFR, "Auditable Events Table"). Each of the events is specified in syslog records in enough detail to identify the user for which the event is associated, when the event occurred, where the event occurred, the outcome of the event, and the type of event that occurred. Additionally, the startup and shutdown of the audit functionality is audited. The audit trail consists of the individual audit records; one audit record for each event that occurred. The audit record can contain up to 80 characters and a percent sign (%), which follows the time-stamp information. As noted above, the information includes at least all of the required information. Example audit events are included below: Nov 19 13:55:59: %CRYPTO-6-SELF_TEST_RESULT: Self test info: (Self test activated by user: lab) Nov 19 13:55:59: %CRYPTO-6-SELF_TEST_RESULT: Self test info: (Software checksum ... passed) Nov 19 13:55:59: %CRYPTO-6-SELF_TEST_RESULT: Self test info: (DES encryption/decryption ... passed) Nov 19 13:55:59: %CRYPTO-6-SELF_TEST_RESULT: Self test info: (3DES encryption/decryption ... passed) Nov 19 13:55:59: %CRYPTO-6-SELF_TEST_RESULT: Self test info: (SHA hashing ... passed) Nov 19 13:55:59: %CRYPTO-6-SELF_TEST_RESULT: Self test info: (AES encryption/decryption ... passed) In the above log events a date and timestamp is displayed as well as an event description "CRYPTO-6-SELF_TEST_RESULT: Self test info: (Self test)". The subject identity where a command is directly run by a user is displayed "user: lab." The outcome of the command is displayed: "passed" The logging buffer size can be configured from a range of 4096 (default) to 4,294,967,295 bytes. It is noted to not make the buffer size too large because the TOE could run out of memory for other tasks. Use the show memory privileged EXEC command to view the free processor memory on the TOE. However, this value is the maximum available, and the buffer size should not be set to this amount. The administrator can also configure a 'configuration logger' to keep track of

<table>
<tr><th>TOE SFRs</th><th>How the SFR is Met</th></tr>
<tr><td></td><td>
<p>configuration changes made with the command-line interface (CLI). The administrator can configure the size of the configuration log from 1 to 1000 entries (the default is 100).</p>
<p>The log buffer is circular, so newer messages overwrite older messages after the buffer is full. Administrators are instructed to monitor the log buffer using the show logging privileged EXEC command to view the audit records. The first message displayed is the oldest message in the buffer. There are other associated commands to clear the buffer, to set the logging level, etc.</p>
<p>The administrator can set the level of the audit records to be displayed on the console or sent to the syslog server. For instance all emergency, alerts, critical, errors, and warning messages can be sent to the console alerting the administrator that some action needs to be taken as these types of messages mean that the functionality of the TOE is affected. All notifications and information type message can be sent to the syslog server. The audit records are transmitted using IPSec tunnel to the syslog server. If the communications to the syslog server is lost, the TOE generates an audit record and all permit traffic is denied until the communications is re-established.</p>
<p>Once the box is up and operational and the crypto self test command is entered, then the result messages would be displayed on the console and will also be logged. If the TOE encounters a failure to invoke any one of the cryptographic functions, a log record is generated.</p>
<p>When the incoming traffic to the TOE exceeds what the interface can handle, the packets are dropped at the input queue itself and there are no error messages generated.</p>
<table>
<tr><th>Auditable Event</th><th>Rationale</th></tr>
<tr><td>All use of the user identification mechanism.</td><td>Events will be generated for attempted identification/ authentication, and the username attempting to authenticate and source address or interface will be included in the log record.</td></tr>
<tr><td>Any use of the authentication mechanism.</td><td>Events will be generated for attempted identification/ authentication, and the username attempting to authenticate will be included in the log record, along with the origin or source of the attempt.</td></tr>
<tr><td>Management functions</td><td>The use of the security management functions is logged; modifications of the behavior of the functions in the TSF and modifications of default settings.</td></tr>
<tr><td>Changes to the time.</td><td>Changes to the time are logged.</td></tr>
</table>
</td></tr>
</table>

TOE SFRs	How the SFR is Met	
	Failure to establish an IPsec SA. Establishment/Termination of an IPsec SA. Session Establishment with peer.	Reason for failure. Non-TOE endpoint of connection (IP address) for both successes and failures Source and destination addresses Source and destination ports TOE Interface
	Establishing session with CA	The connection to CA's for the purpose of certificate verification is logged.
	Failure to establish and/or establishment/termination of an SSH session	Attempts to establish a SSH session or the failure of an established SSH session is logged as well as successfully established and terminated sessions.
	Application of rules configured with the 'log' operation	Logs are generated when traffic matches acls that are configured with the log operation.
	Indication that TSF self-test was completed.	During bootup, if the self-test fails, the failure is logged.
	Initiation of update	Audit event is generated for the initiation of a software update.
	Any attempts at unlocking of an interactive session.	Audit event is generated after a user's session is locked and the admin user is required to re-authenticate.
	Once a remote interactive session is terminated after a Security Administrator-configurable time interval of session inactivity.	An audit event is generated by when sessions are terminated after exceeding the inactivity settings.
	The termination of an	An audit event is generated by an

<table>
<tr><th>TOE SFRs</th><th>How the SFR is Met</th></tr>
<tr><td></td><td><table>
<tr><td>interactive session.</td><td>authorized administrator when the exit command is used.</td></tr>
<tr><td>Initiation of the trusted channel/ path.
Termination of the trusted channel/ path.
Failure of the trusted channel/ path functions.</td><td>See the rows for IPsec and SSH above.</td></tr>
</table></td></tr>
<tr><td>FAU_GEN.2</td><td>The TOE shall ensure that each auditable event is associated with the user that triggered the event and as a result, they are traceable to a specific user. For example, a human user, user identity or related session ID would be included in the audit record. For an IT entity or device, the IP address, MAC address, host name, or other configured identification is presented. A sample audit record is below:

Jun 18 11:17:20.769: AAA/BIND(0000004B): Bind i/f
Jun 18 11:17:20.769: AAA/AUTHEN/LOGIN (0000004B): Pick method list 'default'
Jun 18 2012 11:17:26 UTC: %SEC_LOGIN-5-LOGIN_SUCCESS: Login Success [user: admin] [Source: 100.1.1.5] [localport: 22] at 11:17:26 UTC Mon Jun 18 2012</td></tr>
<tr><td>FAU_STG_EXT.1</td><td>The TOE is configured to export syslog records to a specified, external syslog server. The TOE protects communications with an external syslog server via IPSec. The TOE transmits its audit events to all configured syslog servers at the same time logs are written to the local log buffer and to the console. The TOE is capable of detecting when the IPSec connection fails. The TOE also stores a limited set of audit records locally on the TOE, and continues to do so if the communication with the syslog server goes down. If the IPSec connection fails, the TOE will buffer between 4096-bytes and 4,294,967,295 bytes of audit records on the TOE when it discovers it can no longer communicate with its configured syslog server, and will transmit the buffer contents when connectivity to the syslog server is restored. The exact size of the audit storage is configured using the “logging buffered” command.

Only Authorized Administrators are able to clear the local logs, and local audit records are stored in a directory that does not allow administrators to modify the contents.

For audit records stored internally to the TOE, the Authorized Administrator has the ability to configure the TOE to stop all auditable events when an audit storage threshold is met (lossless auditing) or configure the TOE to overwrite the oldest audit records when the audit trail becomes full.</td></tr>
</table>

TOE SFRs	How the SFR is Met
FCS_CKM.1(1)	The TOE implements a random number generator for Diffie-Hellman and Elliptic curve key establishment (conformant to NIST SP 800-56A), and for RSA key establishment schemes (conformant to NIST SP 800-56B). The TOE complies with section 5.6 and all subsections regarding asymmetric key pair generation and key establishment in the NIST SP 800-56A. The TOE complies with section 6 and all subsections regarding RSA key pair generation and key establishment in the NIST SP 800-56B. The TOE can create a RSA public-private key pair that can be used to generate a Certificate Signing Request (CSR). Through use of Simple Certificate Enrollment Protocol (SCEP), the TOE can: send the CSR to a Certificate Authority (CA) for the CA to generate a certificate; and receive its X.509v3 certificate from the CA. Integrity of the CSR and certificate during transit are assured through use of digitally signatures (encrypting the hash of the TOE's public key contained in the CSR and certificate). The TOE can store and distribute the certificate to external entities including Registration Authorities (RA). The IOS Software supports embedded PKI client functions that provide secure mechanisms for distributing, managing, and revoking certificates. In addition, the IOS Software includes an embedded certificate server, allowing the router to act as a certification authority on the network. The TOE can act as a certification authority thus digitally signing and issuing certificates to both the TOE and external entities. The TOE can also use the X.509v3 certificate for securing IPsec and SSH sessions. The TOE provides cryptographic signature services using ECDSA that meets FIPS 186-3, "Digital Signature Standard" with NIST curves P-256 and P-384 and RSA that meets FIPS PUB 186-2 or FIPS 186-3, "Digital Signature Standard"
FCS_CKM.1(2)	
FCS_CKM_EXT.4	The TOE meets all requirements specified in FIPS 140-2 for destruction of keys and Critical Security Parameters (CSPs) in that none of the symmetric keys, pre-shared keys, or private keys are stored in plaintext form. See refer to Table 20 for more information on the key zeroization.
FCS_COP.1 (1)	The TOE provides symmetric encryption and decryption capabilities using AES in ECB and CBC mode (128, 192, 256 bits) as described in NIST SP 800-38A. Please see CAVP certificate in Table 6 for validation details. AES is implemented in the following protocols: IPsec and SSH.
FCS_COP.1(2)	The TOE provides cryptographic signature services using RSA Digital Signature Algorithm with key size of 2048 and greater as specified in FIPS PUB 186-3, "Digital Signature Standard" and FIPS PUB 186-2, "Digital Signature Standard". Please see CAVP certificate in Table 6 for validation details.
FCS_COP.1(3)	The TOE provides cryptographic hashing services using SHA-1, SHA-256, and SHA-512 as specified in FIPS Pub 180-3 "Secure Hash Standard." Please see CAVP certificate in Table 6 for validation details.
FCS_COP.1(4)	The TOE provides keyed-hashing message authentication services using HMAC-SHA-1 as specified in FIPS Pub 198-1,"The Keyed-Hash Message Authentication Code," and FIPS 180-3, "Secure Hash Standard." Please see CAVP certificate in Table 6 for validation details.
FCS_RBG_EXT.1	The TOE implements a NIST-approved AES-CTR Deterministic Random Bit Generator (DRBG), as specified in SP 800-90. The DRBG is supplied with entropy from jitter from the internal OCTEON processor which produces a minimum of 256 bits of entropy.

TOE SFRs	How the SFR is Met
FCS_IPSEC_EXT.1	The TOE implements IPsec to provide authentication and encryption services to prevent unauthorized viewing or modification of data as it travels over the external network. The IPsec implementation provides both VPN peer-to-peer and VPN client to TOE capabilities. The VPN peer-to-peer tunnel allows for example the TOE and another router to establish an IPsec tunnel to secure the passing of route tables (user data). Another configuration in the peer-to-peer configuration is to have the TOE be set up with an IPsec tunnel with a VPN peer to secure the session between the TOE and syslog server. The VPN client to TOE configuration would be where a remote VPN client connects into the TOE in order to gain access to an authorized private network. Authenticating with the TOE would give the VPN client a secure IPsec tunnel to connect over the internet into their private network. In addition to tunnel mode, which is the default IPsec mode, the TOE also supports transport mode, allowing for only the payload of the packet to be encrypted. If tunnel mode is explicitly specified, the router will request tunnel mode and will accept only tunnel mode. The TOE implements IPsec to provide both certificates and pre-shared key-based authentication and encryption services to prevent unauthorized viewing or modification of data as it travels over the external network. The TOE implementation of the IPsec standard (in accordance with the RFCs noted in the SFR) uses the Encapsulating Security Payload (ESP) protocol to provide authentication, encryption and anti-replay services. The IPsec protocol ESP is implemented using the cryptographic algorithms AES-GCM-128, AES-GCM-256, AES-CBC-128 and AES-CBC-256 together with HMAC-SHA-1. Preshared keys can be configured using the 'crypto isakmp key' key command and may be proposed by each of the peers negotiating the IKE establishment. IPsec Internet Key Exchange, also called ISAKMP, is the negotiation protocol that lets two peers agree on how to build an IPsec Security Association (SA). The strength of the symmetric algorithm negotiated to protect the IKEv1 Phase 1 and IKEv2 IKE_SA connection is greater than or equal to the strength of the symmetric algorithm negotiated to protect the IKEv1 Phase 2 or IKEv2 CHILD_SA connection. The IKE protocols implement Peer Authentication using RSA and ECDSA along with X.509v3 certificates, or pre-shared keys. IKE separates negotiation into two phases: phase 1 and phase 2. Phase 1 creates the first tunnel, which protects later ISAKMP negotiation messages. The key negotiated in phase 1 enables IKE peers to communicate securely in phase 2. During Phase 2 IKE establishes the IPsec SA. IKE maintains a trusted channel, referred to as a Security Association (SA), between IPsec peers that is also used to manage IPsec connections, including: • The negotiation of mutually acceptable IPsec options between peers (including peer authentication parameters, either signature based or pre-shared key based), • The establishment of additional Security Associations to protect packets flows using Encapsulating Security Payload (ESP), and • The agreement of secure bulk data encryption AES keys for use with ESP. After the two peers agree upon a policy, the security parameters of the policy are identified by an SA established at each peer, and these IKE SAs apply to all

TOE SFRs	How the SFR is Met
	subsequent IKE traffic during the negotiation. The TOE supports both IKEv1 and IKEv2 session establishment. As part of this support, the TOE can be configured to not support aggressive mode for IKEv1 exchanges and to only use main mode using the ‘crypto ISAKMP aggressive-mode disable’ command. The TOE supports configuration lifetimes of both Phase 1 SAs and Phase 2 SAs using the following command, lifetime. The time values for Phase 1 SAs can be limited up to 24 hours and for Phase 2 SAs up to 8 hours, but it is configurable to 8 hours. The Phase 2 SA lifetimes can also be configured by an Administrator based on number of packets. The TOE supports Diffie-Hellman Group 14, 19, 24, 20, 15 and 16. Group 14 (2048-bit keys) can be set by using the “group 14” command in the config mode. The nonces used in IKE exchanges are generated 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^[128]. The secret value ‘x’ used in the IKE Diffie-Hellman key exchange (“x” in g^x mod p) is generated using a NIST-approved AES-CTR Deterministic Random Bit Generator (DRBG). Preshared keys can be configured using the ‘crypto isakmp key’ key command and may be proposed by each of the peers negotiating the IKE establishment. The TOE supports configuring the maximum amount of traffic that is allowed to flow for a given IPsec SA using the following command, ‘crypto ipsec security-association lifetime’. The default amount is 2560KB, which is the minimum configurable value. The maximum configurable value is 4GB. The TOE provides AES-CBC-128 and AES-CBC-256 for encrypting the IKEv1 Phase 1, and AES-CBC-128, AES-CBC-256, AES-GCM-128 and AES-GCM-256 for IKEv1 Phase 2 and IKEv2 payloads. The administrator is instructed in the AGD to ensure that the size of key used for ESP must be greater than or equal to the key size used to protect the IKE payload. The TOE supports Diffie-Hellman Group 14 (2048-bit keys), 19 (256-bit Random ECP), 24 (2048-bit MODP with 256-bit POS), 20 (384-bit Random ECP), 15 (3072 bit MODP), and 16 (4096-bit MODP) in support of IKE Key Establishment. These keys are generated using the AES-CTR Deterministic Random Bit Generator (DRBG), as specified in SP 800-90, and the following corresponding key sizes (in bits) are used: 320 (for DH Group 14), 256 (for DH Group 19), 256 (for DH Group 24), 384 (for DH Group 20), 424 (for DH Group 15), and 480 (bits for DH Group 16)] bits. IPsec provides secure tunnels between two peers, such as two routers and remote VPN clients. An authorized administrator defines which packets are considered sensitive and should be sent through these secure tunnels. When the IPsec peer recognizes a sensitive packet, the peer sets up the appropriate secure tunnel and sends the packet through the tunnel to the remote peer. More accurately, these tunnels are sets of security associations (SAs) that are established between two IPsec peers or between the TOE and remote VPN client. The SAs define the protocols and algorithms to be applied to sensitive packets and specify the keying material to be used. SAs are unidirectional and are established per security protocol (AH or ESP). In the evaluated configuration only ESP will be configured for use. A crypto map (the Security Policy Definition) set can contain multiple entries, each with a different access list. The crypto map entries are searched in a

TOE SFRs	How the SFR is Met
	sequence - the router attempts to match the packet to the access list (acl) specified in that entry. When a packet matches a permit entry in a particular access list, the method of security in the corresponding crypto map is applied. If the crypto map entry is tagged as ipsecisakmp, IPsec is triggered. The traffic matching the permit acls would then flow through the IPSec tunnel and be classified as "PROTECTED". Traffic that does not match a permit acl in the crypto map, but that is not disallowed by other acls on the interface is allowed to BYPASS the tunnel. Traffic that does not match a permit acl and is also blocked by other non-crypto acls on the interface would be DISCARDED. If there is no SA that the IPsec can use to protect this traffic to the peer, IPsec uses IKE to negotiate with the remote peer to set up the necessary IPsec SAs on behalf of the data flow. The negotiation uses information specified in the crypto map entry as well as the data flow information from the specific access list entry.
FCS_SSH_EXT.1	The TOE implementation of SSHv2 supports the following: • Public key algorithms for authentication: RSA Signature Verification. • Local password-based authentication for administrative users accessing the TOE through SSHv2, and optionally supports deferring authentication to a remote AAA server. • Encryption algorithms, AES-CBC-128, AES-CBC-256 to ensure confidentiality of the session. • The TOE's implementation of SSHv2 supports hashing algorithms hmac-sha1 and hmac-sha1-96 to ensure the integrity of the session. • The TOE's implementation of SSHv2 can be configured to only allow Diffie-Hellman Group 14 (2048-bit keys) Key Establishment, as required by the PP. • Packets greater than 35,000 bytes in an SSH transport connection are dropped. Large packets are detected by the SSH implementation, and dropped internal to the SSH process
FDP_RIP.2	The TOE ensures that packets transmitted from the TOE do not contain residual information from data allocated to or deallocated from previous packets. Packets that are not the required length use a four-byte repeating pattern for padding. Residual data is never transmitted from the TOE. Once packet handling is completed the contents of the memory buffer that previously contained the packet is zeroized (overwritten with 0x00) before being reused. This applies to both data plane traffic and administrative session traffic.
FIA_AFL.1	The TOE provides the privileged administrator the ability to specify the maximum number of unsuccessful authentication attempts (between 1 and 25) before privileged administrator or non-privileged administrator is locked out through the administrative CLI using a privileged CLI command. When a privileged administrator or non-privileged administrator attempting to log into the administrative CLI reaches the administratively set maximum number of failed authentication attempts, the user will not be granted access to the administrative functionality of the TOE until a privileged administrator resets the user's number of failed login attempts through the administrative CLI.
FIA_PMG_EXT.1	The TOE supports the local definition of users with corresponding passwords.

TOE SFRs	How the SFR is Met
	The passwords can be composed of any combination of upper and lower case letters, numbers, and special characters (that include: “!”, “@”, “#”, “$”, “%”, “^”, “&”, “*”, “(“, and “)”. Minimum password length is settable by the Authorized Administrator, and can be configured for minimum password lengths of up 15 characters.
FIA_PSK_EXT.1	The TOE supports use of IKEv1 (ISAKMP) and IKEv2 pre-shared keys for authentication of IPsec tunnels. Preshared keys can be entered as ASCII characters (from 22 and up to 128 characters long) using the “crypto isakmp key” command and are conditioned by the TOE (using AES in CBC mode or SHA-1) to a bit-based string used by IKE. The AES key wrap implementation in the TOE has been FIPS 140-2 validated to be compliant with the NIST SP 800-38F. HEX keys generated off system can be input for IKEv2 using the following: ‘**pre-shared-key hex [hex key]**’. *For example:* **pre-shared-key hex 0x6A6B6C**. To set the key for a tunnel, use the following command after configuring that tunnel to authenticate using a pre-shared key instead of RSA: *crypto isakmp key <enc-type-digit> <keystring>* To enter the keystring in encrypted form (AES encrypted), specify 6 as the enc-type-digit.
FIA_UIA_EXT.1	The TOE displays an administratively configured warning banner prior to administrative identification and authentication and provides no access to the administrative capabilities of the TOE prior to the administrative user presenting the authentication credentials.
FIA_UAU_EXT.2	The TOE can be configured to require local authentication and/or remote authentication via a RADIUS server as defined in the authentication policy for interactive (human) users. The administrator authentication policies include, authenticated to the local user database, or have redirection to a remote authentication server. Interfaces can be configured to try one or more remote authentication servers, and then fail back to the local user database if the remote authentication servers are inaccessible. The process for password-based authentication is the same for administrative access whether administration is occurring via a directly connected console cable or remotely via SSH or IPsec over SSH. At initial login in the administrative user is prompted to provide a username. After the user provides the username, the user is prompted to provide the administrative password associated with the user account. The TOE then either grants administrative access or indicates that the login was unsuccessful. The SSH interface also supports authentication using SSH keys which are provided during the SSH connection request.
FIA_UAU.7	When a user enters their password at the local console, the TOE displays only

TOE SFRs	How the SFR is Met
	'*' characters so that the user password is obscured. For remote session authentication, the TOE does not echo any characters as they are entered. The TOE does not provide a reason for failure in the cases of a login failure.
FIA_X509_EXT.1	The TOE uses X.509v3 certificates as defined by RFC 5280 to support authentication for IPsec and SSH connections. Public key infrastructure (PKI) credentials, such as Rivest, Shamir, and Adelman (RSA) keys and certificates can be stored in a specific location on the router, such as NVRAM and flash memory or on a USB eToken 64 KB smart card. The certificates themselves provide protection in that they are digitally signed. If a certificate is modified in any way, it would be invalidated. Only authorized administrators with the necessary privilege level can access the certificate storage and add/delete them. The digital signature verifications process would show that the certificate had been tampered with when the hash value would be invalid. The physical security of the router (A.Physical) protects the router and the certificates from being tampered with or deleted. In addition, the TOE identification and authentication security functions protect an unauthorized user from gaining access to the TOE. USB tokens provide for secure configuration distribution of the digital certificates and private keys. RSA operations such as on-token key generation, signing, and authentication, and the storage of Virtual Private Network (VPN) credentials for deployment can be implemented using the USB tokens. Both OCSP and CRL are configurable and may be used for certificate revocation (the TOE supports use of OCSP only when using RSA certs and not when using ECDSA certs). Checking is also done for the basicConstraints extension and the cA flag to determine whether they are present and set to TRUE. If they are not, the certificate is not accepted. The certificate chain path validation is configured on the TOE by first setting crypto pki trustpoint name and then configuring the level to which a certificate chain is processed on all certificates including subordinate CA certificates using the *chain-validation* command**.**
FMT_MOF.1	The TOE provides the ability for Authorized Administrators to access TOE data, such as audit data, configuration data, security attributes, routing tables, and session thresholds. Each of the predefined and administratively configured roles has create (set), query, modify, or delete access to the TOE data. The TOE performs role-based authorization, using TOE platform authorization mechanisms, to grant access to the semi-privileged and privileged roles. For the purposes of this evaluation, the privileged role is equivalent to full administrative access to the CLI, which is the default access for IOS privilege level 15; and the semi-privileged role equates to any privilege level that has a subset of the privileges assigned to level 15. Privilege levels 0 and 1 are defined by default and are customizable, while levels 2-14 are undefined by default and are also customizable. The term "Authorized Administrator" is used in this ST to refer to any user which has been assigned to a privilege level that is permitted to perform the relevant action; therefore has the appropriate privileges to perform the requested functions. Therefore, semi-privileged administrators with only a subset of privileges can also modify TOE data based on if granted the privilege.
FMT_MTD.1	
FMT_SMF.1	The TOE provides all the capabilities necessary to securely manage the TOE and the services provided by the TOE. The management functionality of the TOE is provided through the TOE CLI. The specific management capabilities

TOE SFRs	How the SFR is Met
	available from the TOE include, - Local and remote administration of the TOE and the services provided by the TOE via the TOE CLI. - The ability to update the IOS-XE software (image integrity verification is provided using SHA-256) - Ability to configure the cryptographic functions including IPsec functionality.
FMT_SMR.2	The TOE platform maintains privileged and semi-privileged administrator roles. The TOE performs role-based authorization, using TOE platform authorization mechanisms, to grant access to the semi-privileged and privileged roles. For the purposes of this evaluation, the privileged role is equivalent to full administrative access to the CLI, which is the default access for IOS privilege level 15; and the semi-privileged role equates to any privilege level that has a subset of the privileges assigned to level 15. Privilege levels 0 and 1 are defined by default and are customizable, while levels 2-14 are undefined by default and are also customizable. Note: the levels are not hierarchical. The term “Authorized Administrator” is used in this ST to refer to any user which has been assigned to a privilege level that is permitted to perform the relevant action; therefore has the appropriate privileges to perform the requested functions. The privilege level determines the functions the user can perform; hence the Authorized Administrator with the appropriate privileges. Refer to the Guidance documentation and IOS Command Reference Guide for available commands and associated roles and privilege levels. The TOE can and shall be configured to authenticate all access to the command line interface using a username and password. The TOE supports both local administration via a directly connected console cable and remote administration via SSH or IPSec over SSH.
FPF_RUL_EXT.1	An authorized administrator can define the traffic that needs to be protected by configuring access lists (permit, deny, log) and applying these access lists to interfaces using access and crypto map sets. Therefore, traffic may be selected on the basis of the source and destination address, and optionally the Layer 4 protocol and port. The TOE enforces information flow policies on network packets that are received by TOE interfaces and leave the TOE through other TOE interfaces. When network packets are received on a TOE interface, the TOE verifies whether the network traffic is allowed or not and performs one of the following actions, pass/not pass information, as well as optional logging. By implementing rules that defines the permitted flow of traffic between interfaces of the ASR for unauthenticated traffic. These rules control whether a packet is transferred from one interface to another based on: 1. presumed address of source 2. presumed address of destination 3. transport layer protocol (or next header in IPv6) 4. Service used (UDP or TCP ports, both source and destination)

TOE SFRs	How the SFR is Met
	5. Network interface on which the connection request occurs These rules are supported for the following protocols: RFC 791(IPv4); RFC 2460 (IPv6); RFC 793 (TCP); RFC 768 (UDP). TOE compliance with these protocols is verified via regular quality assurance, regression, and interoperability testing. Packets will be dropped unless a specific rule has been set up to allow the packet to pass (where the attributes of the packet match the attributes in the rule and the action associated with the rule is to pass traffic). Rules are enforced on a first match basis from the top down. As soon as a match is found the action associated with the rule is applied. These rules are entered in the form of access lists at the CLI (via 'access list' and 'access group' commands). These interfaces reject traffic when the traffic arrives on an external TOE interface, and the source address is an external IT entity on an internal network; These interfaces reject traffic when the traffic arrives on an internal TOE interface, and the source address is an external IT entity on the external network; These interfaces reject traffic when the traffic arrives on either an internal or external TOE interface, and the source address is an external IT entity on a broadcast network; These interfaces reject traffic when the traffic arrives on either an internal or external TOE interface, and the source address is an external IT entity on the loopback network; These interfaces reject requests in which the subject specifies the route for information to flow when it is in route to its destination; and For application protocols supported by the TOE (e.g., DNS, HTTP, SMTP, and POP3), these interfaces deny any access or service requests that do not conform to its associated published protocol specification (e.g., RFC). This is accomplished through protocol filtering proxies that are designed for that purpose. Otherwise, these interfaces pass traffic only when its source address matches the network interface originating the traffic through another network interface corresponding to the traffic's destination address. These rules are operational as soon as interfaces are operational following startup of the TOE. There is no state during initialization/ startup that the access lists are not enforced on an interface.
FPT_FLS.1	Whenever a failure occurs within the TOE that results in the TOE ceasing operation, the TOE securely disables its interfaces to prevent the unintentional flow of any information to or from the TOE and reloads. So long as the failures persist, the TOE will continue to reload. This functionally prevents any failure from causing an unauthorized information flow. There are no failures that circumvent this protection.
FPT_SKP_EXT.1	The TOE stores all private keys in a secure directory that is not readily accessible to administrators. All pre-shared and symmetric keys are stored in encrypted form using AES encryption to additionally obscure access. This functionality is configured on the TOE using the 'password encryption aes' command.

TOE SFRs	How the SFR is Met
	The TOE is configured to not display configured keys as part of configuration files using the 'hidekeys' command.
FPT_APW_EXT.1	The TOE includes a Master Passphrase feature that can be used to configure the TOE to encrypt all locally defined user passwords using AES. In this manner, the TOE ensures that plaintext user passwords will not be disclosed even to administrators. Password encryption is configured using the 'service password-encryption' command.
FPT_STM.1	The TOE provides a source of date and time information used in audit event timestamps. The clock function is reliant on the system clock provided by the underlying hardware. The TOE can optionally be set to receive clock updates from an NTP server. This date and time is used as the time stamp that is applied to TOE generated audit records and used to track inactivity of administrative sessions. The time information is also used in various routing protocols such as, OSPF, BGP, and ERF; Set system time, Calculate IKE stats (including limiting SAs based on times); determining AAA timeout, and administrative session timeout.
FPT_TUD_EXT.1	The TOE has specific versions that can be queried by an administrator. When updates are made available by Cisco, an administrator can obtain and install those updates. The updates can be downloaded from the Cisco.com web site. Authorized Administrators can download the approved image file from Cisco.com onto a trusted computer system for usage in the trusted update functionality. Software images are available from Cisco.com at the following: http://www.cisco.com/cisco/software/navigator.html. Digital signatures and published hash mechanisms are used to verify software/firmware update files (to ensure they have not been modified from the originals distributed by Cisco) before they are used to actually update the applicable TOE components. The digital certificates used by the update verification mechanism are contained on the TOE. Instructions for how to do this verification are provided in the administrator guidance for this evaluation.
FPT_TST_EXT.1	As a FIPS 140-2 validated product, the TOE runs a suite of self-tests during initial start-up to verify its correct operation. Refer to the FIPS Security Policy for available options and management of the cryptographic self-test. For testing of the TSF, the TOE automatically runs checks and tests at startup and during resets to ensure the TOE is operating correctly, including checks of image integrity and all cryptographic functionality. During the system bootup process (power on or reboot), all the Power on Startup Test (POST) components for all the cryptographic modules perform the POST for the corresponding component (hardware or software). These tests include: • AES Known Answer Test • RSA Signature Known Answer Test (both signature/verification) • Power up bypass test • RNG Known Answer Test • Diffie Hellman test • HMAC Known Answer Test • SHA-1/256/512 Known Answer Test • Triple-DES Known Answer Test

TOE SFRs	How the SFR is Met
	• Software Integrity Test If any component reports failure for the POST, the system crashes and appropriate information is displayed on the screen, and saved in the crashinfo file. All ports are blocked from moving to forwarding state during the POST. If all components of all modules pass the POST, the system is placed in FIPS PASS state and ports are allowed to forward data traffic. These tests are sufficient to verify that the correct version of the TOE software is running as well as that the cryptographic operations are all performing as expected because any deviation in the TSF behavior will be identified by the failure of a self-test. The integrity of stored TSF executable code when it is loaded for execution can be verified through the use of RSA and Elliptic Curve Digital Signature algorithms.
FTA_SSL_EXT.1	An administrator can configure maximum inactivity times individually for both local and remote administrative sessions through the use of the "session-timeout" setting applied to the console. When a session is inactive (i.e., no session input from the administrator) for the configured period of time the TOE will terminate the session, and no further activity is allowed requiring the administrator to log in (be successfully identified and authenticated) again to establish a new session. If a remote user session is inactive for a configured period of time, the session will be locked and will require authentication to establish a new session. The allowable inactivity timeout range is from 1 to 65535 seconds. Administratively configurable timeouts are also available for the EXEC level access (access above level 1) through use of the "exec-timeout" setting.
FTA_SSL.3	
FTA_SSL.4	An administrator is able to exit out of both local and remote administrative sessions. Each administrator logged onto the TOE can manually terminate their session using the "exit" command.
FTA_TAB.1	The TOE displays a privileged Administrator specified banner on the CLI management interface prior to allowing any administrative access to the TOE. This is applicable for both local and remote TOE administration.
FTP_ITC.1	The TOE protects communications with peer or neighbor routers using keyed hash as defined in FCS_COP.1.1(4) and cryptographic hashing functions FCS_COP.1.1(3). This protects the data from modification of data by hashing that verify that data has not been modified in transit. In addition, encryption of the data as defined in FCS_COP.1.1(1) is provided to ensure the data is not disclosed in transit. The TSF allows the TSF, or the authorized IT entities to initiate communication via the trusted channel. The TOE also requires that peers and other TOE instances establish an IKE/IPSec connection in order to forward routing tables used by the TOE. In addition the TOE can establish secure VPN tunnels with IPSec VPN clients. The TOE also requires that peers establish an IKE/IPsec connection to a CA

TOE SFRs	How the SFR is Met
	server for sending certificate signing requests. The TOE protects communications between the TOE and the remote audit server using IPsec. This provides a secure channel to transmit the log events. Likewise communications between the TOE and AAA servers are secured using IPsec. The distinction between “remote VPN gateway/peer” and “another instance of the TOE” is that “another instance of the TOE” would be installed in the evaluated configuration, and likely administered by the same personnel, whereas a “remote VPN gateway/peer” could be any interoperable IPsec gateway/peer that is expected to be administered by personnel who are not administrators of the TOE, and who share necessary IPsec tunnel configuration and authentication credentials with the TOE administrators. For example, the exchange of X.509 certificates for certificate based authentication.
FTP_TRP.1	All remote administrative communications take place over a secure encrypted SSHv2 session which has the ability to be encrypted further using IPsec. The SSHv2 session is encrypted using AES encryption. The remote users are able to initiate SSHv2 communications with the TOE.

7 ANNEX A: KEY ZEROIZATION

7.1 Key Zeroization

The following table describes the key zeroization referenced by FCS_CKM_EXT.4 provided by the TOE.

Table 20 TOE Key Zeroization

Name	Description of Key	Storage	Zeroization
Diffie-Hellman Shared Secret	This is the shared secret used as part of the Diffie-Hellman key exchange.	SDRAM (plaintext)	Automatically after completion of DH exchange. Overwritten with: 0x00
Diffie Hellman private exponent	This is the private exponent used as part of the Diffie-Hellman key exchange.	SDRAM (plaintext)	Zeroized upon completion of DH exchange. Overwritten with: 0x00
Skeyid	This is an IKE intermittent value used to create skeyid_d.	SDRAM (plaintext)	Automatically after IKE session terminated. Overwritten with: 0x00
skeyid_d	This is an IKE intermittent value used to derive keying data for IPsec.	SDRAM (plaintext)	Automatically after IKE session terminated. Overwritten with: 0x00
IKE session encrypt key	This the key IPsec key used for encrypting the traffic in an IPsec connection.	SDRAM (plaintext)	Automatically after IKE session terminated. Overwritten with: 0x00
IKE session authentication key	This the key IPsec key used for authenticating the traffic in an IPsec connection.	SDRAM (plaintext)	Automatically after IKE session terminated. Overwritten with: 0x00
ISAKMP preshared	This is the configured pre-shared key for ISAKMP negotiation.	NVRAM (plaintext)	Zeroized using the following command: **# no crypto isakmp key** Overwritten with: 0x0d
IKE RSA Private Key	The RSA private-public key pair is created by the device itself using the key generation CLI described below. Afterwards, the device's public key must be put into the device certificate. The device's certificate is created by creating a trustpoint on the device. This trustpoint authenticates with the CA server to get the CA certificate and	NVRAM (plaintext)	Zeroized using the following command: **# crypto key zeroize rsa** Overwritten with: 0x0d

Name	Description of Key	Storage	Zeroization
	also enrolls with the CA server to generate the device certificate. In the IKE authentication step, the device's certificate is firstly sent to other device to be authenticated. The other device verifies that the certificate is signed by CA's signing key, then sents back a random secret encrypted by the device's public key in the valid device certificate. . Only the device with the matching device private key can decrypt the message and obtain the random secret.		
IPSec encryption key	This is the key used to encrypt IPsec sessions.	SDRAM (plaintext)	Automatically when IPSec session terminated. Overwritten with: 0x00
IPSec authentication key	This is the key used to authenticate IPsec sessions.	SDRAM (plaintext)	Automatically when IPSec session terminated. Overwritten with: 0x00
RADIUS secret	Shared secret used as part of the Radius authentication method.	NVRAM (plaintext)	Zeroized using the following command: **# no radius-server key** Overwritten with: 0x0d
SSH Private Key	Once the function has completed the operations requiring the RSA key object, the module over writes the entire object (no matter its contents) using memset. This overwrites the key with all 0's.	SDRAM (plaintext)	Zeroized using the following command: # crypto key zeroize rsa Overwritten with: 0x00
SSH Session Key	The results zeroized using the poisioning in free to overwrite the values with 0x00. This is called by the ssh_close function when a session is ended.	SDRAM (plaintext)	Automatically when the SSH session is terminated. Overwritten with: 0x00

8 ANNEX B: REFERENCES

The following documentation was used to prepare this ST:

Table 21 Documentation References

Identifier	Description
[CC_PART1]	Common Criteria for Information Technology Security Evaluation – Part 1: Introduction and general model, dated September 2012, version 3.1, Revision 4, CCMB-2012-009-001
[CC_PART2]	Common Criteria for Information Technology Security Evaluation – Part 2: Security functional components, dated September 2012, version 3.1, Revision 4, CCMB-2012-009-002
[CC_PART3]	Common Criteria for Information Technology Security Evaluation – Part 3: Security assurance components, dated September 2012, version 3.1, Revision 4, CCMB-2012-009-003
[CEM]	Common Methodology for Information Technology Security Evaluation – Evaluation Methodology, dated September 2012, version 3.1, Revision 4, CCMB-2012-009-004
[NDPP]	Protection Profile for Network Devices, version 1.1, June 8, 2012
[Errata 2]	Security Requirements for Network Devices, Errata#2, April 12, 2013
[VPNGWEP]	Network Device Protection Profile Extended Package VPN Gateway (VPNGWEP)
[800-38A]	NIST Special Publication 800-38A Recommendation for Block 2001 Edition Recommendation for Block Cipher Modes of Operation Methods and Techniques December 2001
[800-56A]	NIST Special Publication 800-56A, March, 2007 Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography (Revised)
[800-56B]	NIST Special Publication 800-56B Recommendation for Pair-Wise, August 2009 Key Establishment Schemes Using Integer Factorization Cryptography
[FIPS 140-2]	FIPS PUB 140-2 Federal Information Processing Standards Publication Security Requirements for Cryptographic Modules May 25, 2001
[FIPS PUB 186-2]	FIPS PUB 186-2 Federal Information Processing Standards Publication 2000 January 27
[FIPS PUB 186-3]	FIPS PUB 186-3 Federal Information Processing Standards Publication Digital Signature Standard (DSS) June, 2009
[FIPS PUB 198-1]	Federal Information Processing Standards Publication The Keyed-Hash Message Authentication Code (HMAC) July 2008
[800-90]	NIST Special Publication 800-90A Recommendation for Random Number Generation Using Deterministic Random Bit Generators January 2012
[FIPS PUB 180-3]	FIPS PUB 180-3 Federal Information Processing Standards Publication Secure Hash Standard (SHS) October 2008