



Cisco Firepower 2100 Cryptographic Module

**FIPS 140-2 Non Proprietary Security Policy
Level 2 Validation**

Version 0.6

July 20, 2018

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1 Introduction

1.1 Purpose

This is the non-proprietary Security Policy for the Cisco Firepower 2100 Cryptographic Module running firmware 9.8. This security policy describes how this module containing two cryptographic libraries meets the security requirements of FIPS 140-2 Level 2 and how to run this module in a FIPS 140-2 mode of operation. This Security Policy may be freely distributed.

FIPS 140-2 (Federal Information Processing Standards Publication 140-2 — *Security Requirements for Cryptographic Modules*) details the U.S. Government requirements for cryptographic modules. More information about the FIPS 140-2 standard and validation program is available on the NIST website at <http://csrc.nist.gov/groups/STM/index.html>.

1.2 Module Validation Level

The following table lists the level of validation for each area in the FIPS PUB 140-2.

No.	Area Title	Level
1	Cryptographic Module Specification	2
2	Cryptographic Module Ports and Interfaces	2
3	Roles, Services, and Authentication	3
4	Finite State Model	2
5	Physical Security	2
6	Operational Environment	N/A
7	Cryptographic Key management	2
8	Electromagnetic Interface/Electromagnetic Compatibility	2
9	Self-Tests	2
10	Design Assurance	2
11	Mitigation of Other Attacks	N/A
	Overall module validation level	2

Table 1 Module Validation Level

1.3 References

This document deals with the specification of the security rules listed in Table 1 above, under which the Cisco Firepower 2100 Cryptographic Module will operate, including the rules derived from the requirements of FIPS 140-2, FIPS 140-2 IG and additional rules imposed by Cisco Systems, Inc. More information is available on the module from the following sources:

The Cisco Systems website contains information on the full line of Cisco Systems security. Please refer to the following website:

<http://www.cisco.com/c/en/us/products/index.html>

<https://www.cisco.com/c/en/us/support/security/firepower-2100-series/tsd-products-support-series-home.html>

For answers to technical or sales related questions please refer to the contacts listed on the Cisco Systems website at www.cisco.com.

The NIST Validated Modules website (<http://csrc.nist.gov/groups/STM/cmvp/validation.html>) contains contact information for answers to technical or sales-related questions for the module.

1.4 Terminology

In this document, the Cisco Firepower 2100 Cryptographic Module identified running two cryptographic libraries is referred to as Cisco Firepower 2100 Cryptographic Module, Cisco Firepower 2100 CM, FX-OS Crypto Library, ASA Crypto Library, CM, Module or the System.

1.5 Document Organization

The Security Policy document is part of the FIPS 140-2 Submission Package. In addition to this document, the Submission Package contains:

- Vendor Evidence document
- Finite State Machine
- Other supporting documentation as additional references

This document provides an overview of the Cisco Firepower 2100 Cryptographic Module identified above and explains the secure layout, configuration and operation of the module. This introduction section is followed by Section 2, which details the general features and functionality of the module. Section 3 specifically addresses the required configuration for the FIPS-mode of operation.

With the exception of this Non-Proprietary Security Policy, the FIPS 140-2 Validation Submission Documentation is Cisco-proprietary and is releasable only under appropriate non-disclosure agreements. For access to these documents, please contact Cisco Systems.

2 Cisco Firepower 2100 Series Overview

The Cisco Firepower 2100 Series NGFW appliances can be deployed either as a Next-Generation Firewall (NGFW) or as a Next-Generation IPS (NGIPS). They are perfect for the Internet edge and all the way in to the data center. There are four identical externally looking, new models: Firepower 2110 and 2120 models offer 1.9 and 3 Gbps of firewall throughput while Firepower 2130 and 2140 models provide 5 and 8.5 Gbps respectively of firewall throughput. When deployed as next-generation firewall (NGFW) appliances, it uses the Cisco Firepower 2100 Cryptographic Module

Cisco Firepower 2100 Series

- Firepower 2110
- Firepower 2120
- Firepower 2130
- Firepower 2140



Firepower 2100 Series

2.1 Cisco FX-OS with FX-OS Crypto Library

The Cisco Firepower eXtensible Operating System (FX-OS) running on the 2100 Series is a next-generation network and content security solutions which provides a web interface that makes it easy to configure platform settings and interfaces, provision devices, and monitor system status. The FX-OS is part of the Cisco Application Centric Infrastructure (ACI) Security Solution and provides an agile, open, built for scalability, consistent control, and simplified management. The FX-OS provides the following features:

- Modular chassis-based security system—provides high performance, flexible input/output configurations, and scalability.
- Firepower Chassis Manager—graphical user interface provides streamlined, visual representation of current chassis status and simplified configuration of chassis features.
- FX-OS CLI—provides command-based interface for configuring features, monitoring chassis status, and accessing advanced troubleshooting features.
- FX-OS REST API—allows users to programmatically configure and manage their chassis.

2.2 Cisco ASA with ASA Crypto Library

The Cisco ASA delivers enterprise-class firewall for businesses, improving security at the Internet edge, high performance and throughput for demanding enterprise data centers. It is available in a blade form factor that can be integrated into the Cisco Firepower 2100 Series.

The ASA solution offers a combination of the industry's most deployed stateful firewall along with a comprehensive range of next-generation network security services, intrusion prevention system (IPS), content security, secure unified communications, SSHv2, SNMPv3, HTTPS/TLSv1.2 and StrongSwan (IPSec/IKEv2).

2.3 Cryptographic Module Characteristics

The Cisco Firepower 2100 Cryptographic Module contains FX-OS Cryptographic Library running on the Intel 64-bit Xeon and the ASA Cryptographic Library executing on the Cavium Octeon processor, providing the cryptographic services required for their perspective hosts within the module.

2.4 Cryptographic Boundary

The module is a hardware, multi-chip standalone crypto module. The cryptographic boundary is defined as the 2100 series chassis unit encompassing the "top," "front," "left," "right," "rear" and "bottom" surfaces of the case representing the module's physical perimeter. Diagram 1 below is the block diagram showing two independent crypto libraries running on the same hardware platform (the rectangle area).

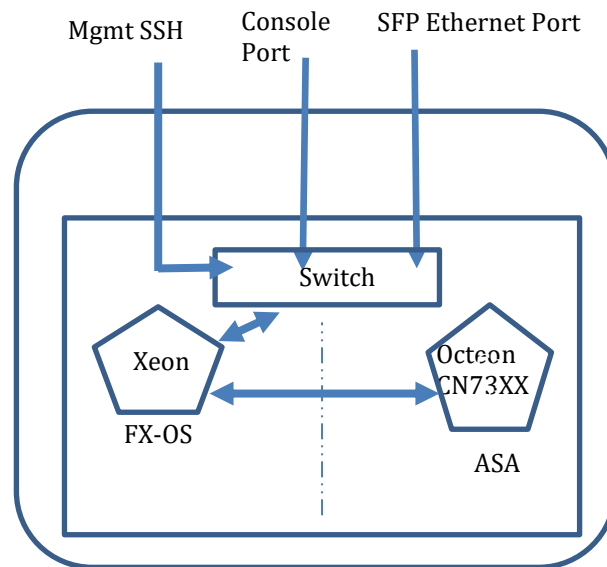


Diagram 1 Block Diagram

2.5 Module Interfaces

The module provides a number of physical and logical interfaces to the device, and the physical interfaces provided by the module are mapped to the following FIPS 140-2 defined logical interfaces: data input, data output, control input, status output, and power. The module provided

no power to external devices and takes in its power through normal power input/cord. The logical interfaces and their mapping are described in the following table:

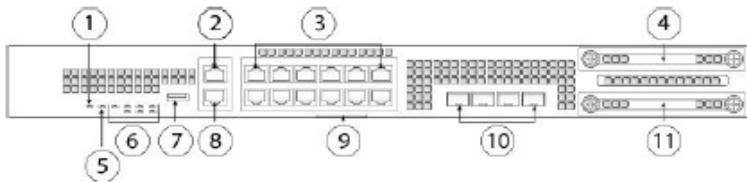
FIPS 140-2 Logical Interface	2100 Physical Interfaces
Data Input	MGMT Port Console port SFP/SFP+ Ethernet and/or RJ-45 Gigabit Ethernet Ports
Data Output	MGMT Port Console port SFP/SFP+ Ethernet and/or RJ-45 Gigabit Ethernet Ports
Control Input	MGMT Port Console port SFP/SFP+ Ethernet and/or RJ-45 Gigabit Ethernet Ports
Status Output	MGMT Port Console port SFP/SFP+ Ethernet and/or RJ-45 Gigabit Ethernet Ports LEDs

Table 2 Hardware/Physical Boundary Interfaces

Note: Each module has a Type A USB 2.0 port, but it is considered to be disabled once the Crypto-Officer has applied the Opacity Shield.

2.6 Front and Rear Panels

2110 and 2120 Front



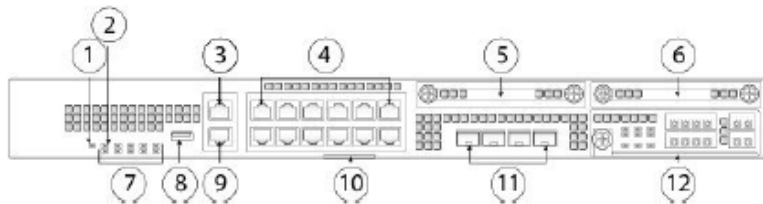
1	Power LED	2	One Gigabit Ethernet management port
3	12 RJ-45 1G/100M/10M auto duplex/auto MDI-X Base-T ports Ethernet 1 through 12 labeled top to bottom, left to right	4	SSD 1
5	Locator beacon	6	System LEDs
7	Type A USB 2.0 port	8	RJ-45 console port
9	Pull-out label card	10	Four fixed SFP (1G) ports (2110 and 2120) Fiber ports 13 through 16 labeled left to right
11	SSD 2		

2110 and 2120 Rear



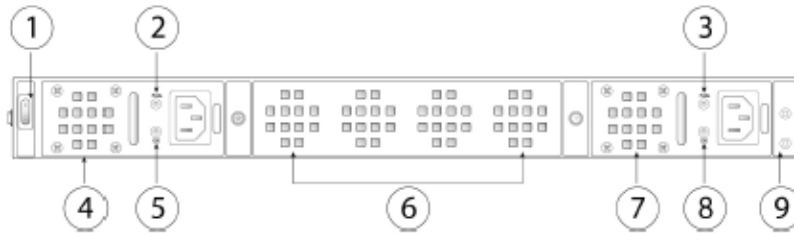
1	Power on/off switch	2	Fixed power supply module
3	Fixed fan tray	4	Location of the two-post grounding lug Note The two-post grounding lug is included in the accessory kit.

2130 and 2140 Front



1	Power LED	2	Locator LED
3	One Gigabit Ethernet management port	4	12 RJ-45 1G/100M/10M auto duplex/auto MDI-X Base-T ports Ethernet 1 through 12 labeled top to bottom, left to right
5	SSD 1	6	SSD 2
7	System LEDs	8	Type A USB 2.0 port
9	RJ-45 console port	10	Pull-out label card
11	Four fixed SFP+ (1G/10G) ports (2130 and 2140) Fiber ports 13 through 16 labeled left to right	12	Network Module (network module slot 1)

2130 and 2140 Rear



1	Power on/off switch	2	Power supply module 1 FAIL LED
3	Power supply module 2 FAIL LED	4	Power supply module 1
5	Power supply module 1 OK LED	6	Fan tray
7	Power supply module 2	8	Power supply module 2 OK LED
9	Location of the two-post grounding lug Note The two-post grounding lug is included in the accessory kit.		

2.7 Roles and Services

The module can be accessed in one of the following ways:

- SSHv2
- HTTPS/TLSv1.2
- IPSec/IKEv2
- SNMPv3

Authentication is identity-based. As required by FIPS 140-2, there are two roles that operators may assume: a Crypto Officer role and User role. The module also supports RADIUS and TACACS+ as another means of authentication, allowing the storage of usernames and passwords on an external server as opposed to using the module's internal database for storage. If not using TACACS+, then the module automatically assigns the authenticated identity to the user role (and the operator can escalate their privileges by issuing the "enable" command and providing the enable password). When using the TACACS+, the CO can configure the module to behave in the same way as when using a local user database, or the CO can configure the TACACS+ server to respond with the identity's privilege level (in addition to whether or not they should be granted access) and the module will automatically place the operator into the highest role supported by their privilege level.

The User and Crypto Officer passwords (used for console, SSH, HTTPS/TLS and SNMP) and all shared secrets must each be at a minimum eight (8) characters long. There must be at least one special character and at least one number character (enforced procedurally) along with six additional characters taken from the 26 upper case, 26 lower case, 10 numbers and 32 special characters. See the Secure Operation section for more information. If six (6) special/alpha/number characters, one (1) special character and one (1) number are used without repetition for an eight (8) digit value, the probability of randomly guessing the correct sequence is one (1) in 187,595,543,116,800. This is calculated by performing $94 \times 93 \times 92 \times 91 \times 90 \times 89$

x 32 x 10. In order to successfully guess the sequence in one minute would require the ability to make over 3,126,592,385,280 guesses per second, which far exceeds the operational capabilities of the module.

Additionally, when using RSA based authentication, the RSA key pair used for authentication must have a modulus size of 2048 bits, thus providing 112 bits of strength. Thus an attacker would have a 1 in 2^{112} chance of randomly obtaining the key, which is much stronger than the one in a million chance required by FIPS 140-2. To exceed a one in 100,000 probability of a successful random key guess in one minute, an attacker would have to be capable of approximately 8.65×10^{31} attempts per second, which far exceeds the operational capabilities of the module to support.

2.8 User Services

A User accesses the system through a console port, SSHv2, SNMPv3 or HTTPS/TLSv1.2 to one of the data input interfaces listed in Table 2. The module prompts the User for username and password. If the password is correct, the User is allowed entry to the module management functionality. The other means of accessing the console is via telnet tunneled within an IPSec session. This session is authenticated either using a shared secret or an RSA digital signature authentication mechanism. The services available to the User role accessing the CSPs, the type of access – read (r), write (w) and zeroized/delete (d) – and which role accesses the CSPs are listed below:

Services	Description	Keys and CSPs Access
Status Functions	View the module configuration, routing tables, active sessions health, and view physical interface status.	Operator password (r, w, d)
Terminal Functions	Adjust the terminal session (e.g., lock the terminal, adjust flow control).	Operator password (r, w, d)
Directory Services	Display directory of files kept in flash memory.	Operator password (r, w, d)
Self-Tests	Execute the FIPS 140 start-up tests on demand.	N/A
IPSec VPN	Negotiation and encrypted data transport via IPSec VPN.	Operator password, skeyid, skeyid_d, SKEYSEED, IKE session encrypt key, IKE session authentication key, ISAKMP preshared, IKE authentication private Key, IKE authentication public key, ECDSA private key, ECDSA public key, IPSec encryption key, IPSec authentication key, DRBG entropy input, DRBG seed, DRBG V and DRBG key (r, w, d)
SSHv2 Functions	Negotiation and encrypted data transport via SSHv2.	Operator password, SSHv2 RSA private key, SSHv2 RSA public key and SSHv2 session key, DRBG entropy input, DRBG seed, DRBG V and DRBG key (r, w, d)
HTTPS Functions (TLSv1.2)	Negotiation and encrypted data transport via HTTPS/TLSv1.2.	Operator password, DRBG entropy input, DRBG Seed, DRBG V, DRBG Key, ECDSA private key, ECDSA public key, TLS RSA private key, TLS RSA public key, TLS pre-master secret, TLS master secret, TLS encryption keys and TLS integrity key (r, w, d)

Table 3 User Services

2.9 Crypto Officer Services

A Crypto Officer enters the system by accessing the console port with a terminal program or SSHv2, SNMPv3 or HTTPS/TLSv1.2 session to one of the data input interfaces listed in Table 2. The Crypto Officer authenticates in the same manner as a User. A Crypto Officer may assign

permission to access the Crypto Officer role to additional accounts, thereby creating additional Crypto Officers.

The Crypto Officer role is responsible for the configuration of the module. The services available to the Crypto Officer role accessing the CSPs, the type of access – read (r), write (w) and zeroized/delete (d) – and which role accesses the CSPs are listed below:

Services	Description	Keys and CSPs Access
Configure the Security	Define network interfaces and settings, create command aliases, set the protocols the appliance will support, enable interfaces and network services, set system date and time, and load authentication information.	ISAKMP preshared, Operator password, Enable password, Enable secret, IKE session encrypt key, IKE session authentication key, IKE authentication private Key, IKE authentication public key, IPsec encryption key, IPsec authentication key (r, w, d)
Firmware Installation	Install the firmware during the System Initialization.	Integrity test key
Configure External Authentication Server	Configure Client/Server authentication.	RADIUS secret, TACACS+ secret
Define Rules and Filters	Create packet Filters that are applied to User data streams on each interface. Each Filter consists of a set of Rules, which define a set of packets to permit or deny based on characteristics such as protocol ID, addresses, ports, TCP connection establishment, or packet direction.	Operator password, Enable password (r, w, d)
View Status Functions	View the appliance configuration, routing tables, active sessions health, temperature, memory status, voltage, packet statistics, review accounting logs, and view physical interface status.	Operator password, Enable password (r, w, d)
HTTPS/TLS (TLSv1.2)	Configure HTTPS/TLS parameters, provide entry and output of CSPs.	DRBG entropy input, DRBG Seed, DRBG V, DRBG Key, ECDSA private key, ECDSA public key, TLS RSA private key, TLS RSA public key, TLS pre-master secret, TLS master secret, TLS encryption keys and TLS integrity key (r, w, d)
IPSec VPN Functions	Configure IPSec VPN parameters, provide entry and output of CSPs.	ISAKMP preshared, skeyid, skeyid_d, SKEYSEED, IKE session encrypt key, IKE session authentication key, IKE authentication private Key, IKE authentication public key, ECDSA private key, ECDSA public key, DRBG entropy input, DRBG Seed, DRBG V, DRBG Key, IPsec encryption key, IPsec authentication key (r, w, d)
SSHv2 Functions	Configure SSH v2 parameter, provide entry and output of CSPs.	Diffie-Hellman private key, Diffie-Hellman public key, Diffie-Hellman Shared Secret, EC Diffie-Hellman private key, EC Diffie-Hellman public key, EC Diffie-Hellman Shared Secret, SSHv2 Private Key, SSHv2 Public Key and SSHv2 session key, DRBG entropy input, DRBG seed, DRBG V and DRBG key (r, w, d)
Self-Tests	Execute the FIPS 140 start-up tests on demand.	N/A
User services	The Crypto Officer has access to all User services.	Operator password (r, w, d)
SNMPv3	Configure SNMPv3 MIB and monitor status.	SNMPv3 Password, SNMPv3 session key (r, w, d)
Zeroization	Zeroize cryptographic keys/CSPs by running the zeroization methods classified in table 6, Zeroization column.	All CSPs (d)

Table 4 Crypto Officer Services

2.10 Non-FIPS mode Services

The cryptographic module in addition to the above listed FIPS mode of operation can operate in a non-FIPS mode of operation. This is not a recommended operational mode but because the associated RFC's for the following protocols allow for non-approved algorithms and non-approved key sizes, a non-approved mode of operation exist. So those services listed above with their FIPS approved algorithms in addition to the following services with their non-approved algorithms and non-approved keys sizes are available to the User and the Crypto Officer. Prior

to using any of the Non-Approved services in Section 2.10, the Crypto Officer must zeroize all CSPs which places the module into the non-FIPS mode of operation.

Services ¹	Non-Approved Algorithms
SSH	Hashing: MD5 MACing: HMAC MD5 Symmetric: DES Asymmetric: 768-bit/1024-bit RSA (key transport), 1024-bit Diffie-Hellman
IPSec	Hashing: MD5 MACing: MD5 Symmetric: DES, RC4 Asymmetric: RSA (key transport), Diffie-Hellman
TLS	Symmetric: DES, RC4 Asymmetric: 768-bit/1024-bit RSA (key transport), 1024-bit Diffie-Hellman

Table 5 Non-approved algorithms in the Non-FIPS mode services

Neither the User nor the Crypto Officer are allowed to operate any of these services while in FIPS mode of operation.

All services available can be found at <http://www.cisco.com/c/en/us/td/docs/security/firepower/60/configuration/guide/fpmc-config-guide-v60.pdf>. This site lists all configuration guides.

2.11 Unauthenticated Services

The services for someone without an authorized role are to view the status output from the module's LED pins and to cycle power.

2.12 Cryptographic Key/CSP Management

The module administers both cryptographic keys and other critical security parameters such as passwords. All keys and CSPs are protected by the password-protection of the Crypto Officer role login, and can be zeroized by the Crypto Officer. Zeroization consists of overwriting the memory that stored the key or refreshing the volatile memory. Keys are both manually and electronically distributed but entered electronically. Persistent keys with manual distribution are used for pre-shared secret whereas protocols such as IKE, TLS and SSH are used for electronic distribution.

All pre-shared keys are associated with the CO role that created the keys, and the CO role is protected by a password. Therefore, the CO password is associated with all the pre-shared keys. The Crypto Officer needs to be authenticated to store keys. Only an authenticated Crypto Officer can view the keys. All Diffie-Hellman (DH)/ECDH keys agreed upon for individual tunnels are directly associated with that specific tunnel only via the IKE protocol. RSA Public keys are entered into the module using digital certificates which contain relevant data such as the name of the public key's owner, which associates the key with the correct entity. All other keys are associated with the user/role that entered them.

¹ These approved services become non-approved when using any non-approved algorithms or non-approved key or curve sizes. When using approved algorithms and key sizes these services are approved.

The entropy comes from a process of extracting bits from dev/urandom and is fed into the DRBG. The module provides approximately 274 bits entropy to instantiate the DRBG.

Name	CSP Type	Size	Description/Generation	Storage	Zeroization
DRBG entropy input	SP800-90A CTR_DRBG	384-bits	This is the entropy for SP 800-90A CTR_DRBG. It is used to construct the DRBG seed.	DRAM (plaintext)	Power cycle the device
DRBG Seed	SP800-90A CTR_DRBG	384-bits	Input to the DRBG that determines the internal state of the DRBG. Generated using DRBG derivation function that includes the entropy input.	DRAM (plaintext)	Power cycle the device
DRBG V	SP800-90A CTR_DRBG	128-bits	The DRBG V is one of the critical values of the internal state upon which the security of this DRBG mechanism depends. Generated first during DRBG instantiation and then subsequently updated using the DRBG update function.	DRAM (plaintext)	Power cycle the device
DRBG Key	SP800-90A CTR_DRBG	256-bits	Internal critical value used as part of SP 800-90A CTR_DRBG. Established per SP 800-90A CTR_DRBG.	DRAM (plaintext)	Power cycle the device
Diffie-Hellman Shared Secret	DH	2048–4096 bits	The shared secret used in Elliptic Curve Diffie-Hellman (ECDH) exchange. Established per the Elliptic Curve Diffie-Hellman (ECDH) protocol.	DRAM (plaintext)	Power cycle the device
Diffie Hellman private key	DH	224–384 bits	The private key used in Diffie-Hellman (DH) exchange. This key is generated by calling SP800-90A DRBG.	DRAM (plaintext)	Power cycle the device
Diffie Hellman public key	DH	2048-4096 bits	The public key used in Diffie-Hellman (DH) exchange. This key is derived per the Diffie-Hellman key agreement.	DRAM (plaintext)	Power cycle the device
EC Diffie-Hellman Shared Secret	ECDH	P-256, P-384, P-521 Curves	The shared secret used in Elliptic Curve Diffie-Hellman (ECDH) exchange. Established per the Elliptic Curve Diffie-Hellman (ECDH) protocol.	DRAM (plaintext)	Power cycle the device

Name	CSP Type	Size	Description/Generation	Storage	Zeroization
EC Diffie Hellman private key	ECDH	P-256, P-384, P-521 Curves	Used in establishing the session key for an IPSec session. The private key used in Elliptic Curve Diffie-Hellman (ECDH) exchange. This key is generated by calling SP800-90A DRBG.	DRAM (plaintext)	Power cycle the device
EC Diffie Hellman public key	ECDH	P-256, P-384, P-521 Curves	Used in establishing the session key for an IPSec session. The public key used in Elliptic Curve Diffie-Hellman (ECDH) exchange. This key is established per the EC Diffie-Hellman key agreement.	DRAM (plaintext)	Power cycle the device
skeyid	Keying material	160 bits	A shared secret known only to IKE peers. It was established via key derivation function defined in SP800-135 KDF and it will be used for deriving other keys in IKE protocol implementation.	DRAM (plaintext)	Power cycle the device
skeyid_d	Keying material	160 bits	A shared secret known only to IKE peers. It was derived via key derivation function defined in SP800-135 KDF (IKEv2) and it will be used for deriving IKE session authentication key.	DRAM (plaintext)	Power cycle the device
SKEYSEED	Keying material	160 bits	A shared secret known only to IKE peers. It was derived via key derivation function defined in SP800-135 KDF (IKEv2) and it will be used for deriving IKE session authentication key.	DRAM (plaintext)	Power cycle the device
IKE session encrypt key	Triple-DES/AES	Triple-DES 192 bits or AES 128/192/256 bits	The IKE session (IKE Phase I) encrypt key. This key is derived via key derivation function defined in SP800-135 KDF (IKEv2).	DRAM (plaintext)	Automatically when IPSec session is terminated
IKE session authentication key	HMAC-SHA-1/256/384/512	160-512 bits	The IKE session (IKE Phase I) authentication key. This key is derived via key derivation function defined in SP800-135 KDF (IKEv2).	DRAM (plaintext)	Automatically when IPSec session is terminated
ISAKMP preshared	Pre-shared secret	Variable 8 plus characters	The secret used to derive IKE skeyid when using preshared secret authentication. This CSP is entered by the Crypto Officer.	NVRAM (plaintext)	Overwrite with new secret

Name	CSP Type	Size	Description/Generation	Storage	Zeroization
IKE authentication private Key	RSA/ECDSA	RSA (2048 bits) or ECDSA (Curves: P-256, P-384, P-521)	RSA/ECDSA private key used in IKE authentication. This key is generated by calling SP800-90A DRBG.	NVRAM (plaintext)	Zeroized by RSA/ECDSA keypair deletion command
IKE authentication public key	RSA/ECDSA	RSA (2048 bits) or ECDSA (Curves: P-256, P-384, P-521)	RSA/ECDSA public key used in IKE authentication. The key is derived in compliance with FIPS 186-4 RSA/ECDSA key pair generation method in the module.	NVRAM (plaintext)	Zeroized by RSA/ECDSA keypair deletion command
IPSec encryption key	Triple-DES/AES/AES-GCM	192 bits Triple-DES or 128/192/256 bits AES	The IPSec (IKE phase II) encryption key. This key is derived via a key derivation function defined in SP800-135 KDF (IKEv2). IPSec	DRAM (plaintext)	Automatically when IPSec session is terminated
IPSec authentication key	HMAC-SHA-1/256/384/512	160-512 bits	The IPSec (IKE Phase II) authentication key. This key is derived via a key derivation function defined in SP800-135 KDF (IKEv2). IPSec	DRAM (plaintext)	Automatically when IPSec session is terminated
Operator password	Password	8 plus characters	The password of the User role. This CSP is entered by the User.	NVRAM (plaintext)	Overwrite with new password
Enable password	Password	8 plus characters	The password of the CO role. This CSP is entered by the Crypto Officer.	NVRAM (plaintext)	Overwrite with new password
RADIUS secret	Shared Secret	16 characters	The RADIUS shared secret. Used for RADIUS Client/Server authentication. This CSP is entered by the Crypto Officer.	NVRAM (plaintext)	Overwrite with new secret
TACACS+ secret	Shared Secret	16 characters	The TACACS+ shared secret. Used for TACACS+ Client/Server authentication. This CSP is entered by the Crypto Officer.	NVRAM (plaintext)	Overwrite with new secret
SSHv2 Private Key	RSA	2048 bits modulus	The RSA private key used in SSHv2 connection. This key is generated by calling SP 800-90A DRBG.	NVRAM (plaintext)	Zeroized by RSA keypair deletion command
SSHv2 Public Key	RSA	2048 bits modulus	The RSA public key used in SSHv2 connection. The key is derived in compliance with FIPS 186-4 RSA key pair generation method in the module.	NVRAM (plaintext)	Zeroized by RSA keypair deletion command

Name	CSP Type	Size	Description/Generation	Storage	Zeroization
SSHv2 Session Key	Triple-DES/AES	Triple-DES 192 bits or AES 128/192/256 bits	This is the SSHv2 session key. It is used to encrypt all SSHv2 data traffics traversing between the SSHv2 Client and SSHv2 Server. This key is derived via key derivation function defined in SP800-135 KDF (SSH).	DRAM (plaintext)	Automatically when SSH session is terminated
ECDSA private key	ECDSA	Curves: P-256, 384, 521	Signature generation used in IPSec/IKE and TLS. This key is generated by calling SP 800-90A DRBG.	NVRAM (plaintext)	Zeroized by ECDSA keypair deletion command
ECDSA public key	ECDSA	Curves: P-256, 384, 521	Signature verification used in IPSec/IKE and TLS. This key is derived in compliance with FIPS 186-4 ECDSA key pair generation method in the module.	NVRAM (plaintext)	Zeroized by ECDSA keypair deletion command
Enable secret	Shared Secret	At least eight characters	The obfuscated password of the CO role. However, the algorithm used to obfuscate this password is not FIPS approved. Therefore, this password is considered plaintext for FIPS purposes. This password is zeroized by overwriting it with a new password. The Crypto Officer configures the module to obfuscate the Enable password. This CSP is entered by the Crypto Officer.	NVRAM (plaintext)	Overwrite with new password
TLS RSA private key	RSA	2048 bits	Identity certificates for the security appliance itself and also used in TLS session negotiations. This key is generated by calling SP 800-90A DRBG.	NVRAM (plaintext)	Zeroized by RSA keypair deletion command
TLS RSA public key	RSA	2048 bits	Identity certificates for the security appliance itself and also used in TLS session negotiations. This key is derived in compliance with FIPS 186-4 RSA key pair generation method in the module.	NVRAM (plaintext)	Zeroized by RSA keypair deletion command
TLS pre-master secret	Shared Secret	At least eight characters	Shared secret created/derived using asymmetric cryptography from which new HTTPS/TLS session keys can be created. This key entered into the module in cipher text form, encrypted by RSA public key.	DRAM (plaintext)	Automatically when TLS session is terminated

Name	CSP Type	Size	Description/Generation	Storage	Zeroization
TLS master secret	keying material	48 Bytes	Keying material used to derive other HTTPS/TLS keys. This key was derived from TLS pre-master secret during the TLS session establishment	DRAM (plaintext)	Automatically when TLS session is terminated
TLS encryption keys	Triple-DES/AES/AES-GCM	Triple-DES 192 bits or AES 128/192/256 bits	Used in HTTPS/TLS connections to protect the session traffic. This key was derived in the module.	DRAM (plaintext)	Automatically when TLS session is terminated
TLS integrity key	HMAC-SHA-256/384	256-384 bits	Used for TLS integrity to assure the traffic integrity. This key was derived in the module.	DRAM	Automatically when TLS session is terminated
SNMPv3 password	Shared Secret	256 bits	The password is used to setup SNMPv3 connection. This key is entered by Crypto Officer.	NVRAM (plaintext)	Overwrite with new password
SNMPv3 session key	AES	128 bits	Encryption key used to protect SNMP traffic. This key is derived via key derivation function defined in SP800-135 KDF (SNMPv3).	DRAM (plaintext)	Power cycle the device
Integrity test key	RSA-2048 Public key	2048 bits	A hard coded key used for firmware power-up integrity verification.	Hard coded for firmware integrity testing	Zeroized by commands 'install platform platform-vers' and 'scope auto-install'

Table 6 Cryptographic Keys and CSPs

2.13 Cryptographic Algorithms

The module implements a variety of approved and non-approved algorithms.

Approved Cryptographic Algorithms

The module supports the following FIPS 140-2 approved algorithm implementations:

Algorithm	FX-OS Crypto Library	ASA Crypto Library
AES (128/192/256 CBC, GCM)	4905	4234
Triple-DES (CBC, 3-key)	2559	2293
SHS (SHA-1/256/384/512)	4012	3471
HMAC (SHA-1/256/384)	3272	2772
ECDSA (KeyGen, SigGen, SigVer; P-256, P-384, P-521)	N/A	1254
RSA (PKCS1_V1_5; KeyGen, SigGen, SigVer; 2048 bits)	2678	2286
CTR_DRBG (AES-256)	1735	1317
CVL Component (IKEv2, TLSv1.2, SSHv2, SNMPv3)	1521	983
CKG (vendor affirmed)	N/A	N/A

Table 7 Approved Cryptographic Algorithms and Associated Certificate Number

Notes:

- There are some algorithm modes that were tested but not used by the module. Only the algorithms, modes, and key sizes that are implemented by the module are shown in this table.
- The module's AES-GCM implementation conforms to IG A.5 scenario #1 following RFC 5288 for TLS and RFC 7296 for IPSec/IKEv2. The module is compatible with TLSv1.2 and provides support for the acceptable GCM cipher suites from SP 800-52 Rev1, Section 3.3.1. The counter portion of the IV is set by the module within its cryptographic boundary. When the IV exhausts the maximum number of possible values for a given session key, the first party, client or server, to encounter this condition will trigger a handshake to establish a new encryption key. In case the module's power is lost and then restored, a new key for use with the AES GCM encryption/decryption shall be established. The module uses RFC 7296 compliant IKEv2 to establish the shared secret SKEYSEED from which the AES GCM encryption keys are derived. When the IV exhausts the maximum number of possible values for a given session key, the first party, client or server, to encounter this condition will trigger a handshake to establish a new encryption key. In case the module's power is lost and then restored, a new key for use with the AES GCM encryption/decryption shall be established.
- Each of TLS, SSH and IPSec protocols governs the generation of the respective Triple-DES keys. Refer to RFC 5246 (TLS), RFC 4253 (SSH) and RFC 6071 (IPSec) for details relevant to the generation of the individual Triple-DES encryption keys. The user is responsible for ensuring the module limits the number of encryptions with the same key to 2^{20} .
- No parts of the SSH, TLS, SNMP and IPSec protocols, other than the KDF, have been tested by the CAVP and CMVP.
- In accordance with FIPS 140-2 IG D.12, the cryptographic module performs Cryptographic Key Generation as per scenario 1 of section 5 in SP800-133. The resulting generated symmetric key and the seed used in the asymmetric key generation are the unmodified output from SP800-90A DRBG.

Non-FIPS Approved Algorithms Allowed in FIPS Mode

The module supports the following non-FIPS approved algorithms which are permitted for use in the FIPS approved mode:

- Diffie-Hellman (CVL Certs. #983 and #1521, key agreement; key establishment methodology provides between 112 and 150 bits of encryption strength)
- EC Diffie-Hellman (CVL Certs. #983 and #1521, key agreement; key establishment methodology provides between 128 and 256 bits of encryption strength)
- NDRNG (entropy source)
- RSA (key wrapping; key establishment methodology provides 112 bits of encryption strength)

Non-Approved Cryptographic Algorithms

The module supports the following non-approved cryptographic algorithms that shall not be used in FIPS mode of operation:

- DES
- Diffie-Hellman (key agreement; key establishment methodology less than 112 bits of encryption strength; non-compliant)

- HMAC MD5
- HMAC-SHA1 is not allowed with key size under 112-bits
- MD5
- RC4
- RSA (key wrapping; key establishment methodology less than 112 bits of encryption strength; non-compliant)

Self-tests performed

- FX-OS Crypto Library POSTs
 - AES Encrypt/Decrypt KATs
 - AES-GCM KAT
 - DRBG KAT (Note: DRBG Health Tests as specified in SP800-90A Section 11.3 are performed)
 - Firmware Integrity Test (using RSA 2048 with SHA-512)
 - HMAC-SHA-1 KAT
 - HMAC-SHA-256 KAT
 - HMAC-SHA-384 KAT
 - HMAC-SHA-512 KAT
 - RSA KATs (separate KAT for signing; separate KAT for verification)
 - SHA-1 KAT
 - Triple-DES Encrypt/Decrypt KATs
- FX-OS Crypto Library Conditional tests
 - RSA pairwise consistency test
 - Continuous Random Number Generator test for SP800-90A DRBG
 - Continuous Random Number Generator test for NDRNG
- ASA Crypto Library POSTs
 - AES Encrypt/Decrypt KATs
 - AES-GCM KAT
 - DRBG KAT (Note: DRBG Health Tests as specified in SP800-90A Section 11.3 are performed)
 - ECDSA (Sign and Verify) Power on Self-Test
 - HMAC-SHA-1 KAT
 - HMAC-SHA-256 KAT
 - HMAC-SHA-384 KAT
 - HMAC-SHA-512 KAT
 - RSA KATs (separate KAT for signing; separate KAT for verification)
 - SHA-1 KAT
 - SHA-256 KAT
 - SHA-384 KAT
 - SHA-512 KAT
 - Triple-DES Encrypt/Decrypt KATs
- ASA Crypto Library Conditional tests
 - RSA pairwise consistency test
 - ECDSA pairwise consistency test
 - Conditional IPsec Bypass test

- Continuous Random Number Generator test for SP800-90A DRBG
- Continuous Random Number Generator test for NDRNG

The security module performs all power-on self-tests automatically when the power is applied. All power-on self-tests must be passed before a User/Crypto Officer can perform services. The power-on self-tests are performed after the cryptographic systems are initialized but prior to the initialization of the LAN's interfaces; this prevents the security module from passing any data during a power-on self-test failure. In the unlikely event that a power-on self-test fails, an error message is displayed on the console followed by a security appliance reboot.

2.14 Physical Security

The FIPS 140-2 level 2 physical security requirements for the modules are met by the use of opacity shields covering the front panels of modules to provide the required opacity and tamper evident seals to provide the required tamper evidence.

Opacity Shield Security

The following table shows the tamper labels and opacity shields that shall be installed on the modules to operate in a FIPS approved mode of operation. The CO is responsible for using, securing and having control at all times of any unused tamper evident labels. Actions to be taken when any evidence of tampering should be addressed within site security program.

Models	Number Tamper labels	Tamper Evident Labels	Number Opacity Shields	Opacity Shields
FP 2110, 2120, 2130, 2140	7	AIR-AP-FIPSKIT=	1	69-100250-01

Opacity Shield installation

2100 Series

Inspection of the opacity shields should be incorporated into facility security procedures to include how often to inspect and any recording of the inspection. It is recommended inspection occur at least every 30 days but this is the facilities Security Manager decision.

Tamper Evidence Label (TEL) placement

The tamper evident seals (hereinafter referred to as tamper evident labels (TEL)) shall be installed on the security devices containing the module prior to operating in FIPS mode. TELs shall be applied as depicted in the figures below. Any unused TELs must be securely stored, accounted for, and maintained by the CO in a protected location.

Should the CO have to remove, change or replace TELs (tamper-evidence labels) for any reason, the CO must examine the location from which the TEL was removed and ensure that no residual debris is still remaining on the chassis or card. If residual debris remains, the CO must remove the debris using a damp cloth.

Any deviation of the TELs placement by unauthorized operators such as tearing, misconfiguration, removal, change, replacement or any other change in the TELs from its original configuration as depicted below shall mean the module is no longer in FIPS mode of operation. Returning the system back to FIPS mode of operation requires the replacement of the

TELS as depicted below and any additional requirement per the site security policy which are out of scope of this Security Policy.

To seal the system, apply tamper-evidence labels as depicted in the figures below.



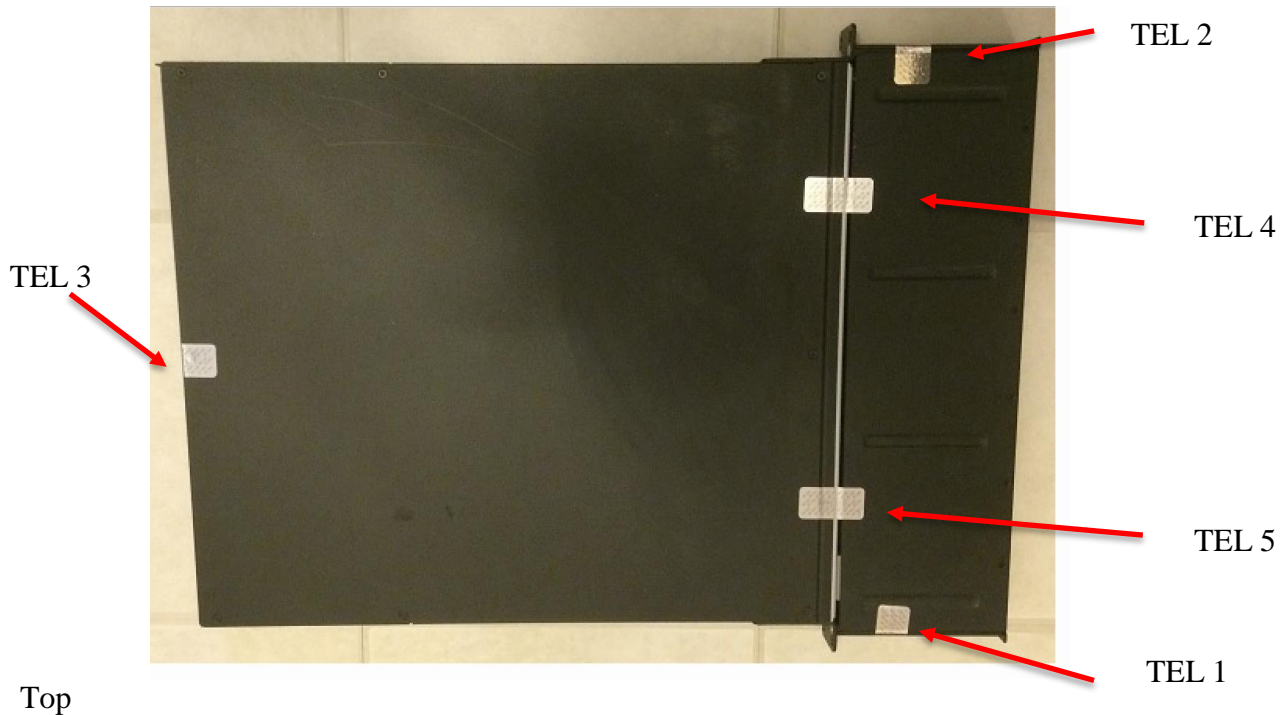
Front



Left side



Right side



Top



Bottom



Rear

TEL 3

Applying Tamper Evidence Labels

Step 1: Turn off and unplug the system before cleaning the chassis and applying labels.

Step 2: Clean the chassis of any grease, dirt, or oil before applying the tamper evident labels. Alcohol-based cleaning pads are recommended for this purpose.

Step 3: Apply a label to cover the security appliance as shown in figures above and allow the label to cure for a minimum of 12 hours.

The tamper evident labels are produced from a special thin gauge vinyl with self-adhesive backing. Any attempt to open the device will damage the tamper evident seals or the material of the security appliance cover. Because the tamper evident labels have non-repeated serial numbers, they may be inspected for damage and compared against the applied serial numbers to verify that the security appliance has not been tampered with. Tamper evident labels can also be inspected for signs of tampering, which include the following: curled corners, rips, and slices. The word “FIPS” or “OPEN” may appear if the label was peeled back.

Inspection of the tamper seals should be incorporated into facility security to include how often to inspect and any recording of the inspection. It is recommended 30 days but this is the facilities Security Manager decision.

3 Secure Operation

The module meets all the Level 2 requirements for FIPS 140-2. The module is shipped only to authorized operators by the vendor, and the modules are shipped in Cisco boxes with Cisco adhesive, so if tampered with the recipient will notice. Follow the setting instructions provided below to place the module in FIPS-approved mode. Operating this module without maintaining the following settings will remove the module from the FIPS approved mode of operation.

3.1 Crypto Officer Guidance - System Initialization

The single firmware image (File name: cisco-asa-fp2k.9.8.2.28.SPA; firmware version: 9.8) running in Cisco Firepower 2100 Cryptographic Module contains both FX-OS and ASA crypto libraries. This is the only allowable image for this current FIPS-approved mode of operation.

The Crypto Officer must configure and enforce the following security steps for Tamper labels and opacity shield:

Step 1: The Crypto Officer must install opacity shields as described in Section 2.14 of this document.

Step 2: The Crypto Officer must apply tamper evidence labels as described in Section 2.14 of this document.

Now the Crypto Officer must install and configure the FX-OS and ASA as below.

Step 1: firepower login:

At this prompt type username and press enter.
Then password

Step 2: remove your configuration and erase your application image). All configuration and bootable images will be lost

```
firepower # connect local  
firepower(local-mgmt)#  
firepower(local-mgmt)# format everything
```

```
Do you still want to format? (yes/no):yes  
100+0 records in ...
```

A BOOT STATUS MESSAGES WILL BE DISPLAYED
A 10 second countdown timer will start. Press the esc before it gets to 0

Use BREAK or ESC to interrupt boot. (PRESS THE ESC KEY TO GET TO ROMMON)

Use SPACE to begin boot immediately.

Step 3: Boot interrupted. Type set, enter in appropriate information

```
rommon 1 > set
ADDRESS=1.1.1.1 <—mgmt port ip address
NETMASK=255.255.255.0
GATEWAY=1.1.1.2
SERVER=2.1.1.1
IMAGE=pathtoimage/cisco-asa-fp2k.9.8.2.28.SPA (image path)
CONFIG=
PS1="rommon! > "
```

Step 4: TYPE tftp -b to boot the FX-OS operating system

```
rommon 2 > tftp -b (THIS ONLY LOADS FXOS)
Enable boot bundle: tftp_reqsize = 268435456
```

```
ADDRESS: 1.1.1.1
NETMASK: 255.255.255.0
GATEWAY: 1.1.1.2
SERVER: 2.1.1.1
IMAGE: pathtoimage/cisco-asa-fp2k.9.8.2.28.SPA
MACADDR: 0c:75:bd:08:c9:80
VERBOSITY: Progress
RETRY: 40
PKTTIMEOUT: 7200
BLKSIZE: 1460
CHECKSUM: Yes
PORT: GbE/1
PHYMODE: Auto Detect
```

```
link up
Receiving pathtoimage/cisco-asa-fp2k.9.8.2.28.SPA from 1.1.1.1
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

File reception completed.

BOOT UP STATUS INFORMATION

Step 5: Login in when prompted.

```
firepower login:
Password:
Successful login attempts for user 'admin': 1
Cisco Firepower Extensible Operating System (FX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2009-2015, Cisco Systems, Inc. All rights reserved.
```


Configure network information for the physical management port. Type the commands below at the firepower prompt.

```
firepower #scope system
```

```
firepower/system # scope services
```

```
firepower/system/services# create ip-block 0.0.0.0 0 ssh
```

```
firepower/system/services/ip-block # exit
```

```
firepower/system/services# create ip-block 0.0.0.0 0 snmp
```

```
firepower/system/services/ip-block # exit
```

```
firepower/system/services# create ip-block 0.0.0.0 0 https
```

```
firepower/system/services/ip-block # exit
```

```
firepower/system/services# create ipv6-block :: 0 ssh
```

```
firepower/system/services/ip-block # exit
```

```
firepower/system/services# create ipv6-block :: 0 snmp
```

```
firepower/system/services/ip-block # exit
```

```
firepower/system/services# create ipv6-block :: 0 https
```

```
firepower/system/services/ip-block # exit
```

```
firepower/system/services # commit-buffer
```

```
firepower/system/services # top
```

```
firepower # scope fabric a
```

```
firepower /fabric-interconnect # set out-of-band static ip 1.1.1.1 netmask 255.255.255.0 gw 1.1.1.2 (substitute your ip info. This will set your physical mgmt. port information)
```

Warning: When committed, this change may disconnect the current CLI session.

Use commit-buffer command to commit the changes.

```
firepower /fabric-interconnect* # commit
```

```
firepower /fabric-interconnect # top
```

```
firepower # scope firmware
```

```
firepower /firmware # download image scp://username@1.1.1.1/tftp/cisco-asa-fp2k.9.8.2.28.SPA (insert your server ip address and file path)
```

```
Password:yourpassword here for the scp server
```

Please use the command 'show download-task' or 'show download-task detail' to check download progress.

```
firepower /firmware # show down cisco-asa-fp2k.9.8.2.28.SPA
```

```
firepower /firmware # show package
```

Name	Package-Vers
-----	-----
cisco-asa-fp2k.9.8.2.28.SPA	9.8.2.28

```
firepower /firmware # scope auto  
firepower /firmware/auto-install # install security-pack version 9.8.2.28
```

During the upgrade, the system will be reboot

Do you want to proceed? (yes/no): **yes**

This operation upgrades firmware and software on Security Platform Components
Here is the checklist of things that are recommended before starting Auto-Install

(1) Review current critical/major faults

(2) Initiate a configuration backup

Do you want to proceed? (yes/no): **yes**

Install started. This will take several minutes.

BOOT STATUS MESSAGES THIS MESSAGE WILL BE DISPLAYED

Cisco ASA starting ...

Registering to process manager ...

Cisco ASA started successfully.

WAIT ABOUT 5 MINUTES AFTER THIS MESSAGE AND YOU SHOULD SEE
DISPLAYED THE ASA PROMPT

```
ciscoasa>
```

Step 6: WHEN YOU HIT ENTER YOU WILL RETURN TO THE FXOS PROMPT.

Login to FXOS

At the FXOS prompt type connect asa to get to the ASA prompt.

```
ciscoasa> press enter  
firepower /ssa # connect asa
```

```
ciscoasa> en
```

Password:

```
ciscoasa# configure terminal
```

Enter in configure information for ASA. Once completed ping cisco.com If you can not ping out then you have not set the ASA up completely. Once you are able to ping then setup the ASA license.

```
ciscoasa# license smart register idtoken [enter in token]
```

```
ciscoasa# configure terminal
```

```
ciscoasa(conf)#sho configure
```

- read over the setting in the ASA configure. Make additions and/or deletions to the configure file.
- run ping tests both internal and external (cisco.com).

```
ciscoasa(config)#license smart
```

```
ciscoasa(config)# sh lic all
```

```
Smart Licensing Status
```

```
=====
```

```
Smart Licensing is ENABLED
```

```
License Usage
```

```
ciscoasa(config)#fips enable
```

3.2 Crypto Officer Guidance - System Configuration

To operate in FIPS mode, the Crypto Officer must perform the following steps:

Step 1: Assign users a Privilege Level of 1.

Step 2: Define RADIUS and TACACS+ shared secret keys that are at least 8 characters long and secure traffic between the security module and the RADIUS/TACACS+ server via IPsec tunnel.

Note: Perform this step only if RADIUS/TACAS+ is configured, otherwise proceed.

Step 3: Configure the security module such that any remote connections via Telnet are secured through IPsec.

Step 4: Configure the security module such that only FIPS-approved algorithms are used for IPsec tunnels.

Step 5: Configure the security module such that error messages can only be viewed by Crypto Officer.

Step 6: Disable the TFTP server.

Step 7: Disable HTTP for performing system management in FIPS mode of operation. HTTPS with TLS should always be used for Web-based management.

Step 8: Ensure that installed digital certificates are signed using FIPS approved algorithms.