McAfee, Inc.

McAfee Firewall Enterprise 4150F

Hardware Part Number: NSA-4150-FWEX-FRR; Firmware Version: 7.0.1.01.E12

FIPS 140-2 Non-Proprietary Security Policy

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1 Introduction

1.1 Purpose

This is a non-proprietary Cryptographic Module Security Policy for the McAfee Firewall Enterprise 4150F from McAfee, Inc. This Security Policy describes how the McAfee Firewall Enterprise 4150F meets the security requirements of Federal Information Processing Standards (FIPS) Publication 140-2, which details the U.S. and Canadian Government requirements for cryptographic modules. More information about the FIPS 140-2 standard and validation program is available on the National Institute of Standards and Technology (NIST) and the Communications Security Establishment Canada (CSEC) Cryptographic Module Validation Program (CMVP) website at http://csrc.nist.gov/groups/STM/cmvp.

This document also describes how to run the module in a secure FIPS-Approved mode of operation. This policy was prepared as part of the Level 2 FIPS 140-2 validation of the module. The McAfee Firewall Enterprise 4150F is referred to in this document as the 4150F, the crypto-module, or the module.

1.2 References

This document deals only with operations and capabilities of the module in the technical terms of a FIPS 140-2 cryptographic module security policy. More information is available on the module from the following sources:

- The McAfee corporate website (http://www.mcafee.com) contains information on the full line of products from McAfee.
- The CMVP website (http://csrc.nist.gov/groups/STM/cmvp/documents/140-1/140val-all.htm) contains contact information for individuals to answer technical or sales-related questions for the module.

1.3 Document Organization

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

- Vendor Evidence document
- Finite State Model document
- Validation Submission Summary Document
- Other supporting documentation as additional references

This Security Policy and the other validation submission documentation were produced by Corsec Security, Inc. under contract to McAfee. With the exception of this Non-Proprietary Security Policy, the FIPS 140-2 Submission Package is proprietary to McAfee and is releasable only under appropriate non-disclosure agreements. For access to these documents, please contact McAfee.

2 McAfee Firewall

2.1 Overview

McAfee, Inc. is a global leader in Enterprise Security solutions. The company's comprehensive portfolio of network security products and solutions provides unmatched protection for the enterprise in the most mission-critical and sensitive environments. The McAfee Firewall Enterprise 4150F appliances are created to meet the specific needs of organizations of all types and enable those organizations to reduce costs and mitigate the evolving risks that threaten today's networks and applications.

Consolidating all major perimeter security functions into one system, the McAfee Firewall Enterprise 4150F appliance is the strongest self-defending perimeter firewall in the world. Built with a comprehensive combination of high-speed application proxies, McAfee's TrustedSource™ reputation-based global intelligence, and signature-based security services, Firewall Enterprise defends networks and Internet-facing applications from all types of malicious threats, both known and unknown.

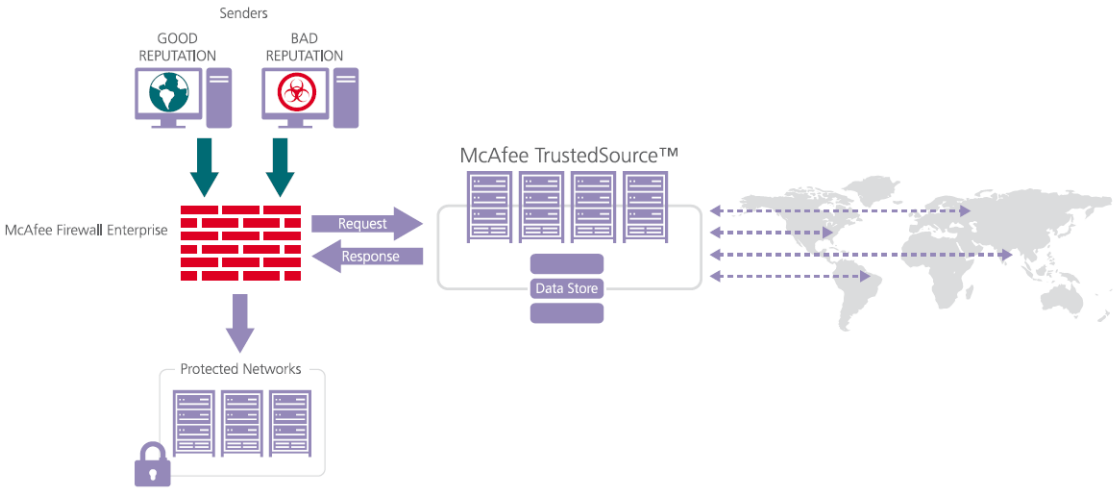


Figure 1 – Typical Deployment Scenario

Firewall Enterprise appliances are market-leading, next-generation firewalls that provide application visibility and control even beyond Unified Threat Management (UTM) for multi-layer security – and the highest network performance. Global visibility of dynamic threats is the centerpiece of Firewall Enterprise and one of the key reasons for its superior ability to detect unknown threats along with the known. Firewall Enterprise appliances deliver the best-of-breed in security systems to block attacks, including:

- Viruses
- Worms
- Trojans
- Intrusion attempts
- Spam and phishing tactics
- Cross-site scripting
- Structured Query Language (SQL) injections
- Denial of service (DoS)
- Attacks hiding in encrypted protocols

A Firewall Enterprise appliance is managed using a proprietary graphical user interface (GUI), referred as Admin Console, and a command line management interface. Hundreds of Firewall Enterprise appliances can be managed centrally using McAfee's CommandCenter tool. Firewall Enterprise security features include:

- Firewall feature for full application filtering, web application filtering, and Network Address Translation (NAT)
- Authentication using local database, Active Directory, LDAP[1], RADIUS[2], Windows Domain Authentication, and more
- High Availability (HA) for remote Internet Protocol (IP) monitoring
- Geo-location filtering
- Encrypted application filtering using TLS[3] and IPsec[4] protocols
- Intrusion Prevention System
- Networking and Routing
- Management via Simple Network Management Protocol (SNMP) version 3

Although SNMP v3 can support AES encryption, it does not utilize a FIPS-Approved key generation method; therefore, the module has been designed to block the ability to view or alter critical security parameters (CSPs) through this interface. Also note that the SNMP v3 interface is a management interface for the McAfee Firewall Enterprise 4150F and that no CSPs or user data are transmitted over this interface.

The McAfee Firewall Enterprise 4150F is an Enterprise 5U rack-mountable appliance appropriate for mid- to large-sized organizations. A front view of the cryptographic module is shown in Figure 2 below.

Figure 2 – McAfee Firewall Enterprise 4150F

The McAfee Firewall Enterprise 4150F is validated at the following FIPS 140-2 Section levels:

Table 1 – Security Level Per FIPS 140-2 Section

Section	Section Title	Level
1	Cryptographic Module Specification	2
2	Cryptographic Module Ports and	2

[1] LDAP – Lightweight Directory Access Protocol
[2] RADIUS – Remote Authentication Dial-In User Service
[3] TLS – Transport Layer Security
[4] IPSec – Internet Protocol Security

Section	Section Title	Level
	Interfaces	
3	Roles, Services, and Authentication	2
4	Finite State Model	2
5	Physical Security	2
6	Operational Environment	N/A
7	Cryptographic Key Management	2
8	EMI/EMC[5]	2
9	Self-tests	2
10	Design Assurance	2
11	Mitigation of Other Attacks	N/A

2.2 Module Specification

The McAfee Firewall Enterprise 4150F is a multi-chip standalone hardware module that meets overall Level 2 FIPS 140-2 requirements. The cryptographic boundary of the 4150F is defined by the hard metal chassis, which surrounds all the hardware and firmware components.

2.3 Module Interfaces

Interfaces on the McAfee Firewall Enterprise 4150F can be categorized as the following FIPS 140-2 logical interfaces:

- Data Input Interface
- Data Output Interface
- Control Input interface
- Status Output Interface
- Power Interface

The physical ports and interfaces for the model 4150F are depicted in Figure 3, Figure 4, and Figure 5. Note the following acronyms used in the figures below:

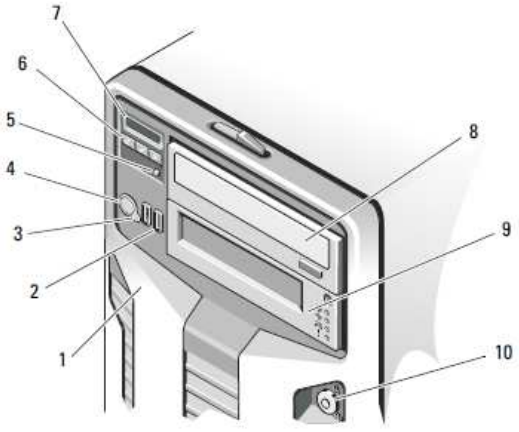
- NMI – Nonmaskable Interrupt
- USB – Universal Serial Bus
- LCD – Liquid Crystal Display
- PCIe – Peripheral Component Interconnect Express
- iDRAC6 – Integrated Dell™ Remote Access Controller 6

Table 2 - McAfee Firewall Enterprise 4150F Ports

Model	Physical Ports
McAfee Firewall	• Power button

[5] EMI/EMC – Electromagnetic Interference / Electromagnetic Compatibility

Model	Physical Ports
Enterprise 4150F (Front)	• Power LED • NMI button • Two (2) Universal Serial Bus (USB) ports • Two (2) LCD menu buttons • One (1) System identification button • Four (4) Drive-activity LED • Four (4) Drive-status LED
McAfee Firewall Enterprise 4150F (Back)	• One (1) serial connector • One (1) VGA port • Six (6) USB ports • Two (2) 10/100/1000 Ethernet RJ-45 ports • One (1) system identification button • Two (2) power connectors

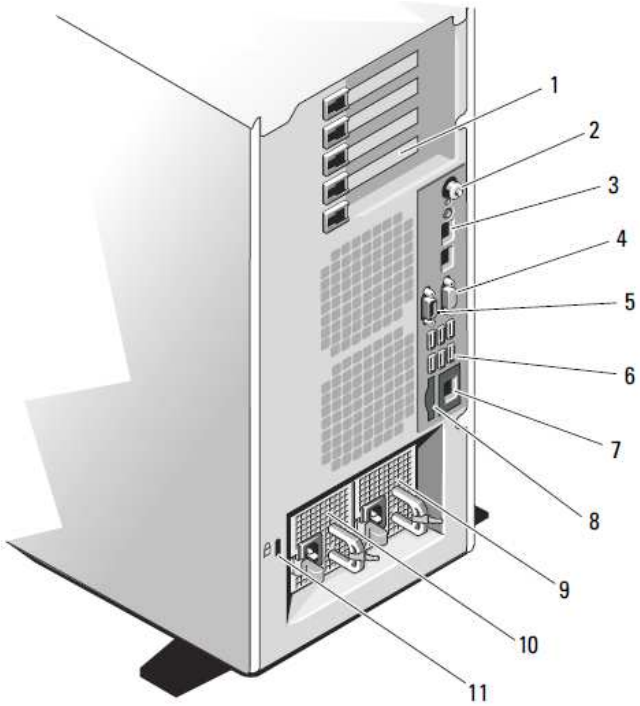


1. Front bezel
2. USB connectors (2)
3. NMI button
4. Power-on indicator, power button
5. System identification button
6. LCD menu buttons
7. LCD panel
8. Optical drive (optional)
9. Tape drive (optional)
10. Front bezel lock

Figure 3 – 4150F Front Panel Features and Indicators

1. Drive-activity indicator (green)
2. Drive-status indicator (green/amber)

Figure 4 – 4150F Hard Drive Indicators



1. PCIe expansion card slots (5)
2. System identification button
3. Ethernet connectors (2)
4. Video connector
5. Serial connector.
6. USB connectors (6)
7. iDRAC6 Enterprise port (optional)
8. iDRAC6 VFlash media slot (optional)
9. Power supply 1
10. Power supply 2
11. Security cable slot

Figure 5 – 4150F Back Panel Features and Indicators

All of these physical interfaces are separated into logical interfaces defined by FIPS 140-2, as described in Table 3.

Table 3 – FIPS 140-2 Logical Interface Mappings

FIPS 140-2 Interface	McAfee Firewall Enterprise 4150F Physical Port

FIPS 140-2 Interface	McAfee Firewall Enterprise 4150F Physical Port
Data Input	Connectors (Ethernet)
Data Output	Connectors (Ethernet)
Control Input	Buttons (NMI, power, LCD menu, system identification), Connectors (Ethernet, USB, serial)
Status Output	Connectors (video, Ethernet, serial), LED indicators (power-on), LCD panel
Power	Connectors (power)

2.4 Roles and Services

The module supports role-based authentication. There are three authorized roles in the module that an operator may assume: a Crypto-Officer (CO) role, a User role, and a Network User role.

Please note that the keys and Critical Security Parameters (CSPs) listed in the table indicate the type of access required using the following notation:

- Read: The CSP is read
- Write: The CSP is established, generated, modified, or zeroized
- Execute: The CSP is used within an Approved or Allowed security function or authentication mechanism

2.4.1 Crypto-Officer Role

The Crypto-Officer role performs administrative services on the module, such as initialization, configuration, and monitoring of the module. Before accessing the module for any administrative service, the operator must authenticate to the module. The module offers management interfaces in three ways:

- Administration Console
- Command Line Interface (CLI)
- SNMP v3

The Administration Console (or Admin Console) is the graphical software that runs on a Windows computer within the protected network. Admin Console is McAfee's proprietary GUI management software tool that needs to be installed on a Windows based workstation. This is the primary management tool. All Admin Console sessions to the module are protected over secure TLS channel. Authentication of the administrator is through a username/password prompt checked against a local password database.

CLI sessions are offered by the module for troubleshooting. The CLI is accessed locally over the serial port, while remote access is via Secure Shell (SSH) session. The CO authenticates to the module using a username and password.

The crypto-module uses the SNMP v3 protocol for remote management, and to provide information about the state and statistics as part of a Network Management System (NMS).

Services available to the Crypto-Officer are provided in Table 4 below.

Table 4 – Crypto-Officer Services

Service	Description	Input	Output	CSP and Type of Access
Authenticate to the Admin Console	Used when administrators login to the appliance using the Firewall Enterprise Admin Console	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write); Administrative Password (Read)
Authenticate to the Admin Console using Common Access Card (CAC)	Used when administrators login to the appliance with CAC authentication to access the Firewall Enterprise Admin Console	Command	Status Output	Common Access Card Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write); Common Access Card One-Time Password (Read)
Authenticate to the Admin CLI	Used when administrators login to the appliance using the Firewall Enterprise Admin CLI	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); SSH Session Authentication Key (Read/Write); SSH Session Key (Read/Write); Administrative Password (Read)

Service	Description	Input	Output	CSP and Type of Access
Authenticate to the Admin CLI using Common Access Card (CAC)	Used when administrators login to the appliance with CAC authentication to access the Firewall Enterprise Admin CLI	Command	Status Output	Common Access Card Authentication Keys (Read); Key Agreement Key (Read); SSH Session Authentication Key (Read/Write); SSH Session Key (Read/Write); Common Access Card One-Time Password (Read)
Change password	Allows external users to use a browser to change their Firewall Enterprise, SafeWord PremierAccess, or LDAP login password	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write); Administrative Password (Read, Write)
Configure cluster communication	Services required to communicate with each other in Firewall Enterprise multi-appliance configurations	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write)

Service	Description	Input	Output	CSP and Type of Access
Configure and monitor Virtual Private Network (VPN) accounts	Used to generate and exchange keys for VPN sessions and configure the user accounts	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write); IKE Preshared key (Write); IPsec Session Key (Write); IPsec Authentication Key (Write)
Create and configure bypass mode	Create and monitor IPsec policy table that governs alternating bypass mode	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write)
Manage mail services	Used when running 'sendmail' service on a Firewall Enterprise appliance	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write)

Service	Description	Input	Output	CSP and Type of Access
Manage web filter	Manages configuration with the SmartFilter	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write)
Manage CommandCenter communication	Verifies registration and oversees communication among the CommandCenter and managed Firewall Enterprise appliances	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write)
Monitor status on SNMP	Monitors non security relevant status of the module via SNMPv3	Command	Status Output	SNMP v3 Session Key (Read)
Perform self-tests	Run self-tests on demand	Command	Status Output	None
Enable FIPS mode	Configures the module in FIPS mode	Command	Status Output	Firewall Authentication Keys (Read); Key Agreement Key (Read); TLS Session Authentication Key (Read/Write); TLS Session Key (Read/Write)
Show status	Allows Crypto-Officer to check whether FIPS mode is enabled	Command	Status Output	None

Service	Description	Input	Output	CSP and Type of Access
Zeroize	Zeroizes the module to the factory default state	Command	Status Output	Firewall Authentication public/private keys (Read/Write); Local CA public/private keys (Read/Write); IKE Preshared Key (Read/Write); IPsec Session Authentication Key (Read/Write); Administrator Passwords (Read/Write)

2.4.2 User Role

The User role has the ability to utilize the module's data transmitting functionalities via Ethernet port. Descriptions of the services available to the Users are provided in the table below.

Table 5 – User Services

Service	Description	Input	Output	CSP and Type of Access
Encrypt/decrypt	Allow secure VPN into corporate network over IPsec tunnel	Command	Secure tunnel established	Firewall Authentication Keys (Read); Key Agreement Key (Read); IKE Session Authentication Key (Write); IKE Session Key (Write); IKE Preshared Key (Read); IPsec Session Key (Read); IPsec Authentication Key (Read)

Service	Description	Input	Output	CSP and Type of Access
Bypass	Access bypass capabilities of the module	Command	Traffic in plaintext	None

2.4.3 Network User Role

The Network User role is defined as users within the secured network who have been given access to the device by a security policy rule granted by the Crypto-Officer. The CO defines security policy rules as to how a Network User is to communicate with other devices or computers. Table 6 lists all the services that are available to the Network User role.

Table 6 – Network User Services

Service	Description	Input	Output	CSP and Type of Access
Communicate within the network	Communicate with other devices or computers within the network	Command	Traffic in plaintext	None

2.4.4 Authentication Mechanism

The module employs the following authentication methods to authenticate Crypto-Officer, Users, and Network Users.

Table 7 – Authentication Mechanisms Employed by the Module

Role	Type of Authentication	Authentication Strength

Role	Type of Authentication	Authentication Strength
Crypto-Officer	Password	Passwords are required to be at least 8 characters long. The password requirement is enforced by the Security Policy. The maximum password length is 64 characters. Case-sensitive alphanumeric characters and special characters can be used with repetition, which gives a total of 94 characters to choose from. The chance of a random attempt falsely succeeding is $1:94^8$, or 1: 6,095,689,385,410,816. This would require about 60,956,893,854 attempts in one minute to raise the random attempt success rate to more than 1:100,000. The fastest connection supported by the module is 1 Gbps. Hence, at most 60,000,000,000 bits of data ($1000 \times 10^6 \times 60$ seconds, or 6×10^{10}) can be transmitted in one minute. At that rate and assuming no overhead, a maximum of 812,759 attempts can be transmitted over the connection in one minute. The maximum number of attempts that this connection can support is less than the amount required per minute to achieve a 1:100,000 chance of a random attempt falsely succeeding.
	Common Access Card	One-time passwords are required to be at least 8 characters long. The password requirement is enforced by the Security Policy. The maximum password length is 128 characters. The password is generated by a base64 encoding of a random number, which gives a total of 64 characters to choose from. The chance of a random attempt falsely succeeding is $1:64^8$, or 1:281,474,976,710,656. This would require about 2,814,749,767 attempts in one minute to raise the random attempt success rate to more than 1:100,000. The fastest connection supported by the module is 1 Gbps. Hence, at most 60,000,000,000 bits of data ($1000 \times 10^6 \times 60$ seconds, or 6×10^{10}) can be transmitted in one minute. At that rate and assuming no overhead, a maximum of 812,759 attempts can be transmitted over the connection in one minute. The maximum number of attempts that this connection can support is less than the amount required per minute to achieve a 1:100,000 chance of a random attempt falsely succeeding.

Role	Type of Authentication	Authentication Strength
User	Password	Passwords are required to be at least 8 characters long. The password requirement is enforced by the Security Policy. The maximum password length is 64 characters. Case-sensitive alphanumeric characters and special characters can be used with repetition, which gives a total of 94 characters to choose from. The chance of a random attempt falsely succeeding is $1:94^8$, or 1: 6,095,689,385,410,816. This would require about 60,956,893,854 attempts in one minute to raise the random attempt success rate to more than 1:100,000. The fastest connection supported by the module is 1 Gbps. Hence, at most 60,000,000,000 bits of data ($1000 \times 10^6 \times 60$ seconds, or 6×10^{10}) can be transmitted in one minute. At that rate and assuming no overhead, a maximum of 812,759 attempts can be transmitted over the connection in one minute. The maximum number of attempts that this connection can support is less than the amount required per minute to achieve a 1:100,000 chance of a random attempt falsely succeeding.

Role	Type of Authentication	Authentication Strength
Network User	Password, Certificate, or IP Address	Passwords are required to be at least 8 characters long. The password requirement is enforced by the Security Policy. The maximum password length is 64 characters. Case-sensitive alphanumeric characters and special characters can be used with repetition, which gives a total of 94 characters to choose from. The chance of a random attempt falsely succeeding is $1:94^8$, or 1: 6,095,689,385,410,816. This would require about 60,956,893,854 attempts in one minute to raise the random attempt success rate to more than 1:100,000. The fastest connection supported by the module is 1 Gbps. Hence, at most 60,000,000,000 bits of data ($1000 \times 10^6 \times 60$ seconds, or 6×10^{10}) can be transmitted in one minute. At that rate and assuming no overhead, a maximum of 812,759 attempts can be transmitted over the connection in one minute. The maximum number of attempts that this connection can support is less than the amount required per minute to achieve a 1:100,000 chance of a random attempt falsely succeeding. Certificates used as part of TLS, SSH, and IKE[6]/IPsec are at a minimum 1024 bits. The chance of a random attempt falsely succeeding is $1:2^{80}$, or $1:1.20893 \times 10^{24}$. The module also authenticates network users by IP address via firewall rules. The fastest network connection supported by the module is 1000 Mbps. Hence, at most 60,000,000,000 bits of data ($1000 \times 10^6 \times 60$ seconds, or 6×10^{10}) can be transmitted in one minute. The passwords are sent to the module via security protocols such as IPsec, TLS, and SSH. These protocols provide strong encryption (AES 128-key at minimum, providing 128 bit of security) and require large computational and transmission capability. The probability that a random attempt will succeed or a false acceptance will occur is less than one in $2^{128} \times 84^4$.

[6] IKE – Internet Key Exchange

2.5 Physical Security

The McAfee Firewall Enterprise 4150F is a multi-chip standalone cryptographic module. The module is contained in a hard metal chassis which is defined as the cryptographic boundary of the module. The module's chassis is opaque within the visible spectrum. The enclosure of the module has been designed to satisfy Level 2 physical security requirements. There are a limited set of ventilation holes provided in the case that, when coupled with the installation of opacity baffles, obscure the internal components of the module. Tamper-evident seals are applied to the case to provide physical evidence of attempts to remove the chassis cover or front bezel. Additionally, the tamper-evident seals must be inspected periodically for tamper evidence. The placement of the opacity baffles and tamper-evident seals can be found in Secure Operation section of this document.

The 4150F system has been tested and found conformant to the Electromagnetic Interference/Electromagnetic Compatibility (EMI/EMC) requirements specified by 47 Code of Federal Regulations, Part 15, Subpart B, Unintentional Radiators, Digital Devices, Class A (i.e., for business use).

2.6 Operational Environment

The operational environment requirements do not apply to the McAfee Firewall Enterprise 4150F, because the module does not provide a general-purpose operating system (OS) to the user. The OS has limited operational environment and only the module's custom written image can be run on the system. The module provides a method to update the firmware in the module with a new version. This method involves downloading a digitally signed firmware update to the module.

2.7 Cryptographic Key Management

The module implements three firmware cryptographic libraries to offer secure networking protocols and cryptographic functionalities. The firmware libraries are the Cryptographic Library for SecureOS® (CLSOS) Version 7.0.1 for 32 and 64-bit systems and the Kernel Cryptographic Library for SecureOS® (KCLSOS) Version 7.0.1. Security functions offered by the libraries in FIPS mode of operation (and their associated algorithm implementation certificate numbers) are listed in Table 8.

Table 8 – Approved Security Functions

Security Function	64-bit Cryptographic Library for SecureOS®	32-bit Cryptographic Library for SecureOS®	Kernel Cryptographic Library for SecureOS®
Symmetric Key Algorithm			
AES[7] 128-, 192-, 256-bit in CBC[8], OFB[9], and ECB[10] modes	972	973	N/A
AES 128-, 192-, 256-bit in CBC and ECB modes	N/A	N/A	974
Triple-DES[11] – 112- and 192-bit in CBC, ECB, OFB, and CFB64 modes	765	766	N/A

[7] AES - Advanced Encryption Standard
[8] CBC – Cipher-Block Chaining
[9] OFB – Output Feedback
[10] ECB – Electronic Codebook

Security Function	64-bit Cryptographic Library for SecureOS®	32-bit Cryptographic Library for SecureOS®	Kernel Cryptographic Library for SecureOS®
Triple-DES – 112- and 192-bit in CBC mode	N/A	N/A	767
Secure Hash Standard (SHS)			
SHA[12]-1, SHA-256, SHA-384, and SHA-512	941	942	943
Message Authentication Code (MAC) Function			
HMAC[13] using SHA-1, SHA-256, SHA-384, and SHA-512	544	545	546
Pseudo Random Number Generator (PRNG)			
ANSI[14] X9.31 Appendix A.2.4 PRNG with 256-bit AES	549	550	551
Asymmetric Key Algorithm			
RSA[15] PKCS[16] #1 sign/verify: 1024-, 2048-, 4096-bit	469	470	Not implemented
RSA ANSI X9.31 key generation: 1024-, 2048-, 4096-bit	469	470	Not implemented
Digital Signature Algorithm (DSA) verify: 1024-bit	338	339	Not implemented

Non-FIPS-Approved security functions offered by the libraries in FIPS mode of operation are listed in Table 9.

Table 9 – Non-Approved Security Functions Used in FIPS Mode

Security Function	64-bit Cryptographic Library for SecureOS®	32-bit Cryptographic Library for SecureOS®	Kernel Cryptographic Library for SecureOS®
AES 128-, 192-, 256-bit in CFB[17]128 mode (FIPS non-compliant)	N/A	N/A	N/A
Diffie-Hellman (DH): 1024 and 2048 bits[18]	Implemented	Implemented	Not

[11] DES – Data Encryption Standard
[12] SHA – Secure Hashing Algorithm
[13] HMAC – (Keyed-) Hash Message Authentication Code
[14] ANSI – American National Standards Institute
[15] RSA – Rivest, Shamir, and Adleman
[16] PKCS – Public Key Cryptography Standard
[17] CFB – Cipher Feedback Block

Security Function	64-bit Cryptographic Library for SecureOS®	32-bit Cryptographic Library for SecureOS®	Kernel Cryptographic Library for SecureOS®
(key agreement)			implemented
RSA encrypt/decrypt: 1024-, 2048-, 4096-bit[19] (key transport)	Implemented	Implemented	Not implemented

Additional information concerning 112-bit (2 key) TDES, 1024-bit RSA, 1024-bit DSA, ANSI X9.31 PRNG, SHA-1, and Diffie-Hellman and specific guidance on transitions to the use of stronger cryptographic keys and more robust algorithms is contained in NIST Special Publication 800-131A.

The module also implements the following non-Approved algorithms to be used in non-FIPS mode of operation.

Table 10 – Non-Approved Security Functions Used in Non-FIPS Mode

Security Function	64-bit Cryptographic Library for SecureOS®	32-bit Cryptographic Library for SecureOS®	Kernel Cryptographic Library for SecureOS®
Blowfish	Implemented	Implemented	Not implemented
Rivest Cipher (RC) 4	Implemented	Implemented	Not implemented
RC2	Implemented	Implemented	Not implemented
Message Digest (MD) 5	Implemented	Implemented	Not implemented
DES	Implemented	Implemented	Not implemented

[18] Caveat: Diffie-Hellman (key agreement; key establishment methodology provides 80 or 112 bits of encryption strength)
[19] Caveat: RSA (key wrapping; key establishment methodology provides between 80 and 150 bits of encryption strength)

The module supports the CSPs listed below in Table 11.

Table 11 – List of Cryptographic Keys, Cryptographic Key Components, and CSPs

Key/CSP	Key/CSP Type	Generation / Input	Output	Storage	Zeroization	Use
SNMPv3 Session Key		Internally generated but not FIPS Compliant	Never exits the module	Resides in volatile memory in plaintext	Power cycle or session termination	Used with non-Approved AES implementation
Common Access Card Authentication keys	RSA 1024-, 2048-bit keys or DSA 1024-, 2048-bit keys	Imported electronically in plaintext	Never exits the module	Resides in plaintext on volatile memory	Power cycle or session termination	Common Access Card Authentication for generation of one-time password
Firewall Authentication public/private keys	RSA 1024-, 2048-, 4096-bit keys or DSA 1024-bit key	Internally generated or imported electronically in plaintext via local management port	Encrypted form over Network port or local management port in plaintext	Stored in plaintext on the hard disk	By command	- Peer Authentication of TLS, IKE, and SSH sessions - Audit log signing
Peer public keys	RSA 1024-, 2048-, 4096-bit keys, DSA 1024-bit keys	Imported electronically in plaintext during handshake protocol	Never exit the module	Resides in plaintext on volatile memory	Power cycle or session termination	Peer Authentication for SSH and IKE sessions

Key/CSP	Key/CSP Type	Generation / Input	Output	Storage	Zeroization	Use
Local CA[20] public/private keys	RSA 1024,2048,4096-bit keys, DSA 1024-bit keys	Internally generated	Public key certificate exported electronically in plaintext via local management port	Stored in plaintext on the hard disk	By command	Local signing of firewall certificates and establish trusted point in peer entity
Key Establishment keys	Diffie-Hellman 1024,2048-bit keys, RSA 1024,2048,4096-bit keys	Internally generated	Public exponent electronically in plaintext, private component not exported	Resides in volatile memory in plaintext	Power cycle or session termination	Key exchange/agreement for TLS, IKE/IPsec and SSH sessions
TLS Session Authentication Key	HMAC SHA-1 key	Internally generated	Never exits the module	Resides in volatile memory in plaintext	Power cycle or session termination	Data authentication for TLS sessions
TLS Session Key	Triple-DES, AES-128, AES-256	Internally generated	Never exits the module	Resides in volatile memory in plaintext	Power cycle or session termination	Data encryption/decryption for TLS sessions
IKE Session Authentication Key	HMAC SHA-1 key	Internally generated	Never exists the module	Resides in volatile memory in plaintext	Power cycle or session termination	Data authentication for IKE sessions

[20] CA – Certificate Authority

Key/CSP	Key/CSP Type	Generation / Input	Output	Storage	Zeroization	Use
IKE Session Key	Triple-DES, AES-128, AES-256	Internally generated	Never exits the module	Resides in volatile memory in plaintext	Power cycle or session termination	Data encryption/decryption for IKE sessions
IKE Preshared Key	Triple-DES, AES-128, AES-256	- Imported in encrypted form over network port or local management port in plaintext - Manually entered	Never exits the module	Stored in plaintext on the hard disk	By command	Data encryption/decryption for IKE sessions
IPsec Session Authentication Key	HMAC SHA-1 key	- Imported in encrypted form over network port or local management port in plaintext - Internally generated - Manually entered	Never exits the module	- Stored in plaintext on the hard disk - Resides in volatile memory	By command or power cycle	Data authentication for IPsec sessions
IPsec Session Key	Triple-DES, AES-128, AES-256	Internally generated	Never exits the module	Resides in volatile memory in plaintext	Power cycle	Data encryption/decryption for IPsec sessions

Key/CSP	Key/CSP Type	Generation / Input	Output	Storage	Zeroization	Use
IPsec Preshared Session Key	Triple-DES, AES-128, AES-256	- Imported in encrypted form over network port or local management port in plaintext - Manually entered	Exported electronically in plaintext	Stored in plaintext on the hard disk	Power cycle	Data encryption/decryption for IPsec sessions
SSH Session Authentication Key	HMAC-SHA1 key	Internally generated	Never exists the module	Resides in volatile memory in plaintext	Power cycle or session termination	Data authentication for SSH sessions
SSH Session Key	Triple-DES, AES-128, AES-256	Internally generated	Never exists the module	Resides in volatile memory in plaintext	Power cycle or session termination	Data encryption/decryption for SSH sessions
Package Distribution Public Key	DSA 1024-bit public key	Externally generated and hard coded in the image	Never exits the module	Hard coded in plaintext	Erasing the system image	Verifies the signature associated with a firewall update package
License Management Public Key	DSA 1024-bit public key	Externally generated and hard coded in the image	Never exits the module	Hard coded in plaintext	Erasing the system image	Verifies the signature associated with a firewall license

Key/CSP	Key/CSP Type	Generation / Input	Output	Storage	Zeroization	Use
Administrator Passwords	PIN	Manually or electronically imported	Never exits the module	Stored on the hard disk through one-way hash obscurement	By command	Standard Unix authentication for administrator login
Common Access Card one-time password	8 character ASCII string	Internally generated; Manually or electronically imported	Exported electronically in encrypted form over TLS	Resides in volatile memory inside the CAC Warder process	Password Expiration, Session Termination, or Power cycle	Common Access Card authentication for administrator login
SecureOS® ANSI X9.31 PRNG seed	16 bytes of seed value	Generated internally by the Kernel Cryptographic Library for SecureOS® PRNG	Never exits the module	Resides in volatile memory in plaintext	Power cycle	Generates FIPS approved random number
CLSOS ANSI X9.31 PRNG seed	16 bytes of seed value	Generated internally by the Kernel Cryptographic Library for SecureOS® PRNG	Never exits the module	Resides in volatile memory in plaintext	Power cycle	Generates FIPS approved random number

Key/CSP	Key/CSP Type	Generation / Input	Output	Storage	Zeroization	Use
SecureOS® kernel ANSI X9.31 PRNG seed	16 bytes of seed value	Generated internally by entropy gathering	Never exits the module	Resides in volatile memory in plaintext	Power cycle	Generates FIPS approved random number
SecureOS® ANSI X9.31 PRNG key	AES-128	Generated internally by the Kernel Cryptographic Library for SecureOS® PRNG	Never exits the module	Resides in volatile memory in plaintext	Power cycle	Generates FIPS approved random number
CLSOS ANSI X9.31 PRNG key	AES-128	Generated internally by the Kernel Cryptographic Library for SecureOS® PRNG	Never exits the module	Resides in volatile memory in plaintext	Power cycle	Generates FIPS approved random number
SecureOS® kernel ANSI X9.31 PRNG key	AES-128	Generated internally by entropy gathering	Never exits the module	Resides in volatile memory in plaintext	Power cycle	Generates FIPS approved random number

2.8 Self-Tests

2.8.1 Power-Up Self-Tests

The 4150F performs the following self-tests at power-up:

- Firmware integrity check using SHA-1 Error Detection Code (EDC)
- Approved algorithm tests
  - AES Known Answer Test (KAT)
  - Triple-DES KAT
  - SHA-1 KAT, SHA-256 KAT, SHA-384 KAT, and SHA-512 KAT
  - HMAC KAT with SHA-1, SHA-256, SHA-384, and SHA-512
  - RSA KAT for sign/verify and encrypt/decrypt
  - DSA pairwise consistency check
  - ANSI X9.31 Appendix A.2.4 PRNG KAT for all implementations

If any of the tests listed above fails to perform successfully, the module enters into a critical error state where all cryptographic operations and output of any data is prohibited. An error message is logged for the CO to review and requires action on the Crypto-Officer's part to clear the error state.

2.8.2 Conditional Self-Tests

The McAfee Firewall Enterprise 4150F performs the following conditional self-tests:

- Continuous PRNG Test (CRNGT) all implementations of FIPS-Approved random number generator
- RSA pairwise consistency test upon generation of an RSA keypair
- DSA pairwise consistency test upon generation of an DSA keypair
- Manual key entry test
- Bypass test using SHA-1
- Firmware Load Test using DSA signature verification

Failure in any of the tests listed above leads the module to a soft error state and logs an error message.

2.9 Mitigation of Other Attacks

This section is not applicable. The module does not claim to mitigate any attacks beyond the FIPS 140-2 Level 2 requirements for this validation.

3 Secure Operation

The McAfee Firewall Enterprise 4150F meets Level 2 requirements for FIPS 140-2. The sections below describe how to place and keep the module in FIPS-Approved mode of operation.

3.1 Crypto-Officer Guidance

The Crypto-Officer is responsible for initialization and security-relevant configuration and management of the module. Please see McAfee's Administration Guide for more information on configuring and maintaining the module. The Crypto-Officer receives the module from the vendor via trusted delivery services (UPS, FedEx, etc.). The shipment should contain the following:

- McAfee Firewall Enterprise 4150F appliance
- Media and Documents
- Activation Certificate
- Setup Guide
- Port Identification Guide
- Management Tools CD[21]
- Secure Firewall Installation Media USB drive (for appliances without a CD-ROM[22] drive)
- Power cord
- Rack mount kit

The Crypto-Officer is responsible for the proper initial setup of the Admin Console Management Tool software and the 4150F. Setup of the Admin Console software is done by installing the software on an appropriate Windows® workstation. The Crypto-Officer receives the FIPS Kit (Part #: SAC-4150F-FIPS-KT) separately, also via trusted delivery service. The FIPS Kit includes the FIPS Kit instructions, Velcro strips, opacity baffles, a new warranty seal, and tamper-evident seals.

When you install the Management Tool, a link to the documents page is added to the "Start" menu of the computer. To view the Secure Firewall documents on the McAfee web site, select

Start > Programs > McAfee > Firewall Enterprise > Online Manuals

Table 12 provides a list of available Firewall Enterprise documents.

Table 12 – Summary of Firewall Enterprise Documentation

Document	Description
Secure Firewall Setup Guide	Leads through the initial firewall configuration.
Secure Firewall Administration Guide	Complete administration information on all firewall functions and features.
Secure Firewall CommandCenter Setup Guide	Leads through the initial CommandCenter configuration.
Secure Firewall CommandCenter Administration Guide	Complete administration information on all CommandCenter functions and features. This guide is supplemented by the Secure Firewall Administration Guide.
Common Access Card	Describes how to configure Department of Defense Common

[21] CD – Compact Disc
[22] CD-ROM – Compact Disc – Read-Only Memory

Document	Description
Configuration Guide	Access Card authentication for Admin Console, Telnet, and SSH on McAfee® Firewall Enterprise. It also describes login procedures.
Online help	Online help is built into Secure Firewall Management Tools programs. The Quick Start Wizard provides help for each configuration window. The Admin Console program provides help for each window, as well as comprehensive topic-based help. Note: A browser with a pop-up blocker turned on, must allow blocked content to view the Secure Firewall help.

Additional product manuals, configuration-specific application notes, and the KnowledgeBase are available at http://mysupport.mcafee.com.

3.1.1 Initialization

The Crypto-Officer is responsible for initialization and security-relevant configuration and management activities for the module through the management interfaces. Installation and configuration instructions for the module can also be found in the Secure Firewall Setup Guide, Secure Firewall Administration Guide, and this FIPS 140-2 Security Policy. The initial Administration account, including username and password for login authentication to the module, is created during the startup configuration using the Quick Start Wizard.

The Crypto-Officer must perform five activities to ensure that the module is running in an approved FIPS mode of operation:

- Install opacity baffles
- Apply tamper-evident seals
- Modify the BIOS[23]
- Set FIPS environment
- Set FIPS mode enforcement

3.1.1.1 Install Opacity Baffles

It is important that the CO install the opacity baffles over the ventilation holes as described in the instructions provided below. Access to inside of the module is necessary to install the opacity baffles; therefore this step must be completed before applying the tamper-evident seals.

Before beginning to install the opacity baffles, it is important to protect against electrostatic discharge (ESD). Because of the need to access the inside of the module, the CO must prevent electrostatic damage to inner components as well as personal injury. Follow these precautionary procedures to prevent against ESD:

- Do not remove components from their antistatic packing material until you are ready to install them in the appliance. Just before unwrapping the antistatic package, discharge static electricity from your body by touching the power supply or any unpainted metal surface on the appliance chassis
- Handle all electrostatic sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads

[23] BIOS – Basic Input/Output System

- Discharge static electricity from your body before you touch any electronic components

Follow these instructions to securely install the opacity baffles:

1. Turn off the appliance and disconnect all cords and cables
    a. Use the Admin Console to "Halt System" and turn off the appliance
    b. Disconnect the appliance and all attached devices from their electrical outlets
    c. Press the power button to ground the system
    d. Unplug all network cables from the appliance
2. Remove the front bezel (if applicable) and top cover of the appliance. **Note:** this will break the McAfee warranty seal. This seal will be replaced after installing the opacity baffles.
    a. Rotate the latch release lock counter clockwise to unlock the top cover
    b. Pull the cover release latch, and rotate the latch end of the cover away from the system
    c. Grasp the cover on both sides and lift away from the system
3. Install opacity baffling to the rear of the appliance
    a. Apply the adhesive Velcro strips to the inside of the rear of the chassis as highlighted in red in Figure 6
    b. Apply the opacity baffling to the Velcro strips

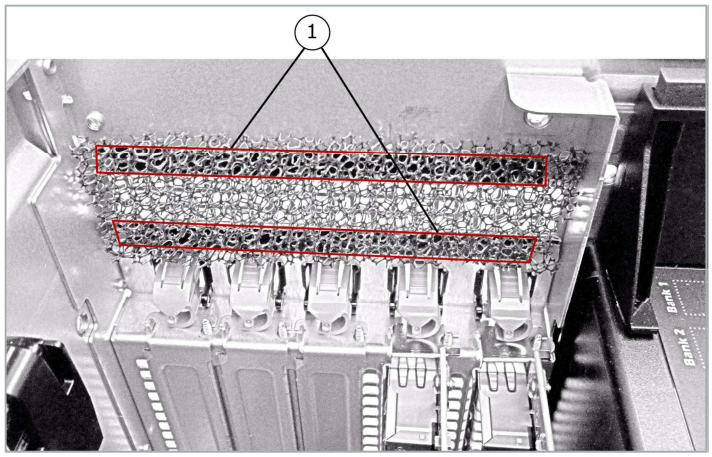


Figure 6 – Velcro Strip Placement in Rear of Chassis

4. Finish installation of opacity baffles
    a. Re-attach the appliance cover
    b. Apply the replacement McAfee warranty seal over the previously broken seal
    c. Connect all cords and cables
    d. Turn on the appliance
    e. Attach the front bezel to the appliance and lock it (turning the release clock clockwise)

3.1.1.2 Applying Tamper-Evident Seals

The CO must place tamper-evident seals on the module as described in the information provided below. Prior to affixing the seals, the front bezel must be attached. It is up to the CO to ensure proper placement of the tamper-evidence labels using the following steps:

- The surface must be dry and free of dirt, oil, and grease, including finger oils. Alcohol pads can be used.
- Slowly peel backing material from label, taking care not to touch the adhesive. Do not use fingers to directly peel label.

- Place the label and apply very firm pressure over the entire label surface to ensure complete adhesion.
- Allow 72 hours for adhesive to cure. Tamper evidence may not be apparent before this time.

The module has the following removable components:

- a front bezel, which covers the removable hard drives
- a top panel, which can expose internal components when removed
- dual power supplies on the rear panel

The seals must be placed on the appliance as shown in the figures below. Three tamper-evident seals are required to secure the entire module. Instructions to place the seals to secure the bezel and top panel as follows:

1. To secure the front bezel, place a tamper-evident seal on the front bezel such that the seal overlaps the front bezel and metal cover at the top of the chassis (see Figure 7).
2. To secure the power supplies, place tamper-evident seals on the power supplies such that the seals are affixed to where the power supplies and the chassis meet (see Figure 8).

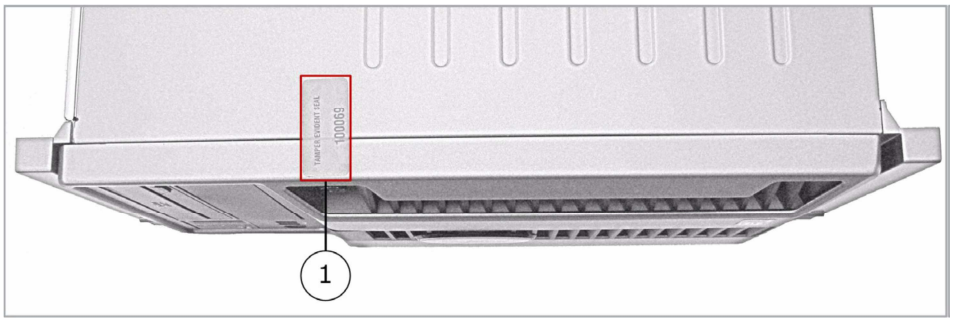


Figure 7 – Tamper-Evident Seal Application Position (Front Bezel)

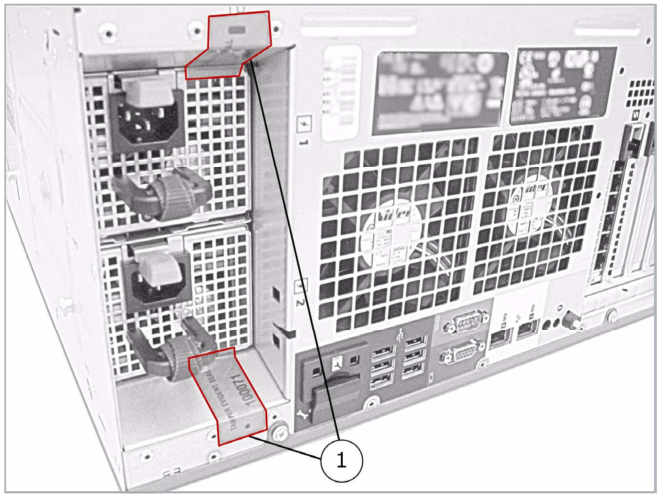


Figure 8 – Tamper-Evident Seal Application Positions (Power Supplies)

After the seals are placed as instructed above, the module can be powered up and the Crypto-Officer may proceed with initial configuration.

3.1.1.3 Modifying the BIOS

Enter the module's System Setup program to enforce the following module usage policies:

- Booting the module from any device other than the FIPS-enabled hard drive is prohibited.
- Only authenticated users are allowed to enter the System Setup program.

Additionally, since the module's power button is not accessible, the AC Power Recovery setting must be modified. Follow the instructions below to update the BIOS settings (requires the connection of a monitor and keyboard):

1. From the command line, restart the firewall.
2. When the *F2 = Setup* menu line appears in the upper right corner of the screen, press the F2 key. The BIOS window appears.
3. To disable other bootable devices:
   a. Select **Boot Sequence** and then press Enter.
   b. Verify that the hard drive is enabled. If necessary, use the space bar to enable the hard drive.
   c. Select all other devices and use the space bar to disable them.
   d. Press Esc to return to the main BIOS menu. Note: PXE[24] booting on Ethernet devices is not allowed. If PXE booting is enabled on an onboard NIC[25], select **Integrated Devices**, select the appropriate NIC, and use the right arrow to select **Enabled** (do not select **Enabled with PXE**).
4. To create a password for accessing the System Setup program and set the power recovery option:
   a. Select **System Security** and then press Enter.
   b. Select **Setup Password** and then press Enter.
   c. Enter a password and a confirmation and then press Enter.
   d. Select **AC Power Recovery** and then press Enter.
   e. Use the space bar to set AC Power Recovery to "On".
   f. Press Esc to return to the main BIOS menu.
5. Press Esc, select **Save Changes and Exit**, and then press Enter. The firewall will then complete its startup process.

3.1.1.4 Setting FIPS Environment

The cryptographic module requires that firmware version 7.0.1.01 be upgraded with patch E12. While some models may have the patch version pre-installed, others may require upgrading. To check if the module is currently running version **7.0.1.01.E12**, the Crypto-Officer must open the GUI-based administrative console provided with the module. Under the software management and manage packages table, the Crypto-Officer can see which firmware upgrade has been installed along with their versions.

To perform the upgrade, the Crypto-Officer must first check the firmware to ensure they are running version **7.0.1.01**. If this version is not running, the Crypto-Officer must take measures to upgrade the module to **7.0.1.01**. If required, this upgrade can be performed through the GUI-based administrative console. If the module is being newly-built from the onboard virtual disk, then the Crypto-Officer will first need to set up the network configuration and enable the admin account with a new password.

To update the module to **7.0.1.01.E12**, the Crypto-Officer must:

1. Under "**Software Management / Manage Packages**" table, select "70101.E12";
2. Select download;
3. Select install;
4. Verify that the "**Manage Packages**" tab states that "70101.E12" is installed.

[24] PXE – Preboot Execution Environment
[25] NIC – Network Interface Card

3.1.1.5 Setting FIPS Mode Enforcement

Before enforcing FIPS on the module, the Admin Console CO must check that no non-FIPS-Approved services are running on the module. To view the services that are currently used in enabled rules, select "**Monitor / Service Status**". The Service Status window appears as shown in Figure 9 below. If the window lists any non-FIPS-Approved protocols (such as telnet as shown below), then those protocols must be disabled before the module is considered to be in an approved FIPS mode of operation.

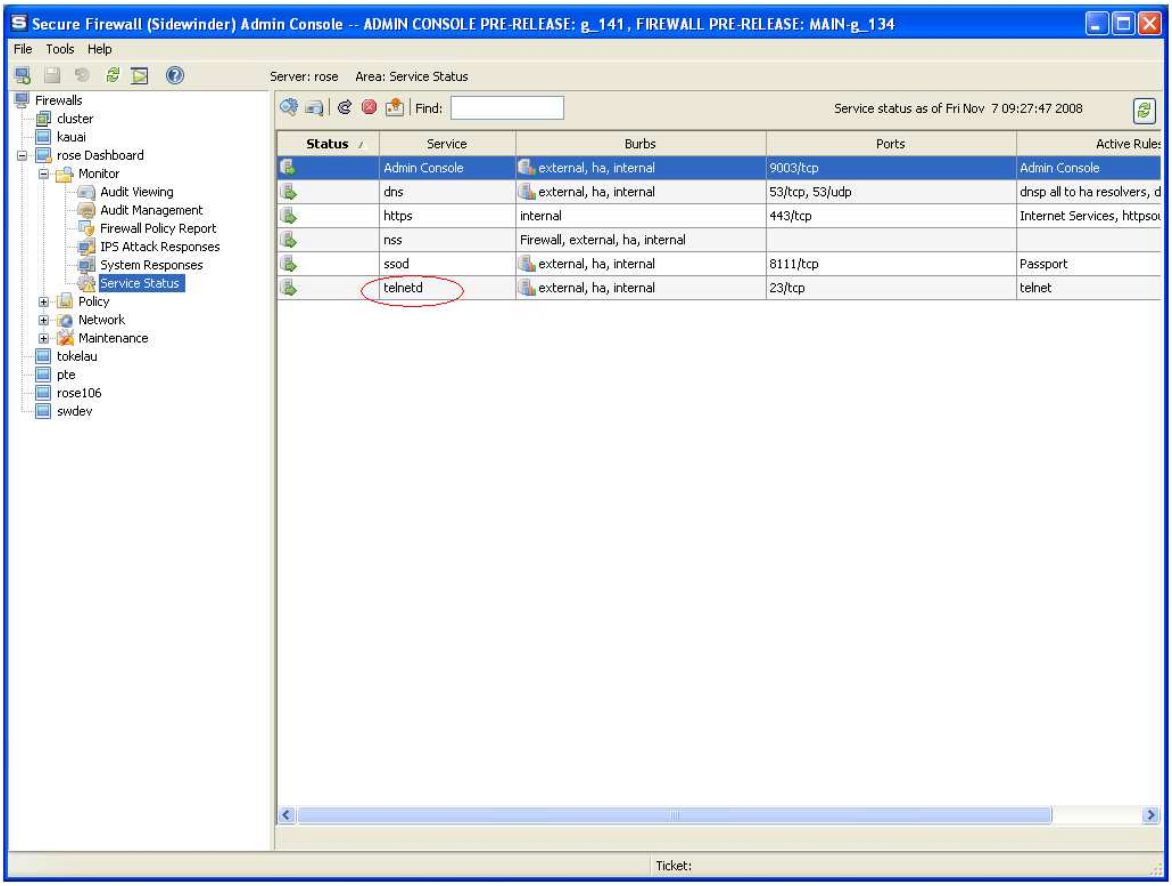


Figure 9 – Service Status

The process to enable and enforce FIPS mode is provided below:

1. Under **"Policy/Application Defences/ Defenses/HTTPS"**, disable all non-Approved versions of SSL, leaving only TLS 1.0 operational.
2. Under **"Maintenance / Certificate Management"**, ensure that the certificates only use FIPS approved cryptographic algorithms.
3. Select "**Maintenance / FIPS**". The FIPS check box appears in the right pane (shown in Figure 10).
4. Select Enforce US Federal Information Processing Standard.
5. Save the configuration change.
6. Select "**Maintenance / System Shutdown**" to reboot the firewall to the Operational kernel to activate the change.

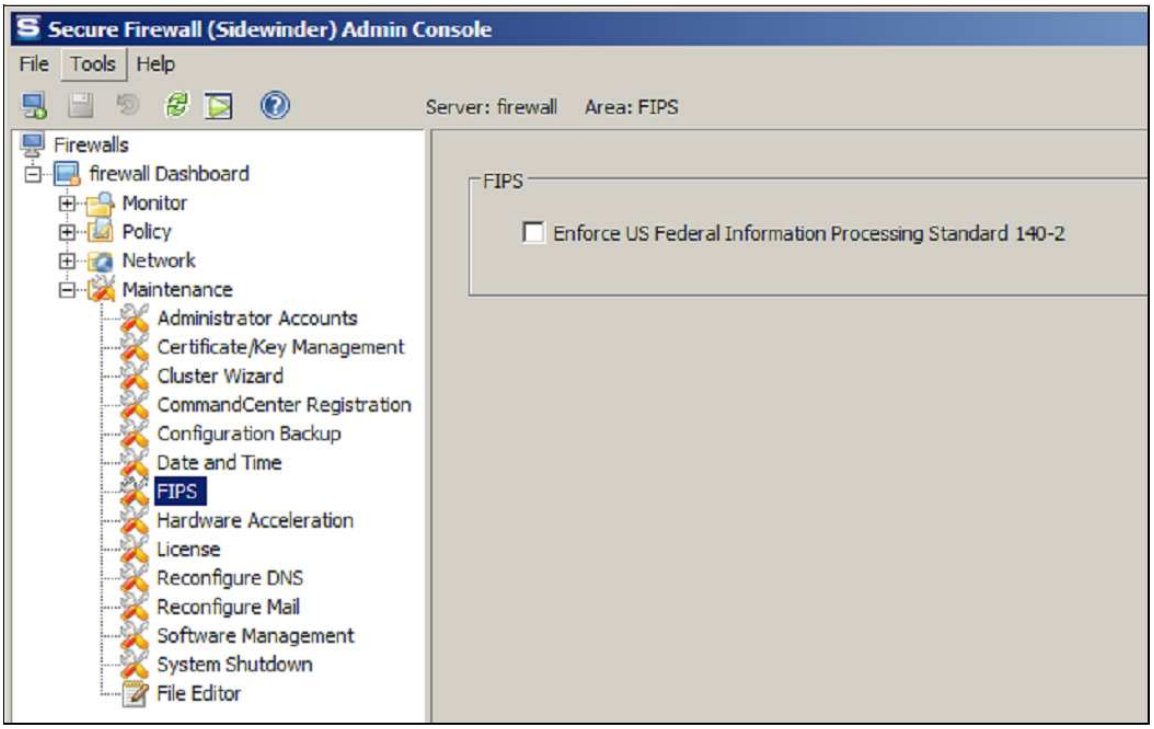


Figure 10 – Configuring For FIPS

Whether the module has been upgraded to **7.0.1.01** from an earlier firmware, or shipped with **7.0.1.01** already present, it is required to delete and recreate all required cryptographic keys and CSPs necessary for the module's secure operation. The keys and CSPs existing on the module were generated outside of FIPS mode of operation, and they must now be re-created for use in FIPS mode. The CO must replace the keys and CSPs listed in Table 13.

Table 13 – Required Keys and CSPs for Secure Operation

Services	Cryptographic Keys/CSPs
Admin Console (TLS)	Firewall Certificate/private key
Command Center (TLS)	Firewall Certificate/private key
HTTPS[26] Decryption (TLS)	Firewall Certificate/private key
TrustedSource (TLS)	Firewall Certificate/private key
Firewall Cluster Management (TLS)	Firewall Certificate/private key Local CA/private key
Passport Authentication (TLS)	Firewall Certificate/private key
IPsec/IKE certificate authentication	Firewall Certificate/private key
Audit log signing	Firewall Certificate/private key
SSH server	Firewall Certificate/private key

[26] HTTPS – Hypertext Transfer Protocol Secure

Administrator Passwords	Firewall Certificate/private key

The module is now operating in the FIPS-Approved mode of operation.

3.1.2 Management

The module can run in two different modes: FIPS-Approved and non-FIPS-Approved. While in a FIPS-Approved mode, only FIPS-Approved and Allowed algorithms may be used. Non-FIPS-Approved services are disabled in FIPS mode of operation. The Crypto-Officer is able to monitor and configure the module via the web interface (GUI over TLS), SSH, serial port, or VGA port. Detailed instructions to monitor and troubleshoot the systems are provided in the Secure Firewall Administration Guide. The Crypto-Officer should monitor the module's status regularly for FIPS mode of operation and active bypass mode. The CO also monitor that only FIPS approved algorithms as listed in Table 8 are being used for TLS and SSH sessions.

The "show status" service for FIPS mode of operation can be invoked by checking if the checkbox, shown in Figure 10, is checked. The "show status" service as it pertains to bypass is shown in the GUI under **VPN Definitions** and the module column. For the CLI, the Crypto-Officer may enter **"cf ipsec q type=bypass"** to get a listing of the existing bypass rules.

If any irregular activity is noticed or the module is consistently reporting errors, then McAfee customer support should be contacted.

3.1.3 Zeroization

In order to zeroize the module of all keys and CSPs, it is necessary to first rebuild the module's image, essentially wiping out all data from the module. Once a factory reset has been performed, default keys and CSPs will be set up as part of the renewal process. These keys must be recreated as per the instructions found in Table 13. Failure to recreate these keys will result in a non-compliant module.

For more information about resetting the module to a factory default, please consult the documentation that shipped with the module.

3.1.4 Disabling FIPS Mode of Operation

To take the module out of FIPS mode of operation, the Crypto-Officer must zeroize the CSPs as described in section 3.1.3 of this document. FIPS mode can be disabled from Admin Console window:

1. Select "**Maintenance / FIPS**". The FIPS check box appears in the right pane.
2. Unselect Enforce US Federal Information Processing Standard (shown in Figure 10).
3. Save the configuration change.
4. Select "**Maintenance / System Shutdown**" and reboot the firewall to the Operational kernel to activate the change.

3.2 User Guidance

When using key establishment protocols (RSA and DH) in the FIPS-Approved mode, the User is responsible for selecting a key size that provides the appropriate level of key strength for the key being transported.

4 Acronyms

This section describes the acronyms used throughout this document.

Table 14 – Acronyms

Acronym	Definition
AES	Advanced Encryption Standard
ANSI	American National Standards Institute
BIOS	Basic Input/Output System
CBC	Cipher-Block Chaining
CD	Compact Disc
CD-ROM	Compact Disc – Read-Only Memory
CFB	Cipher Feedback
CLI	Command Line Interface
CLSOS	Cryptographic Library for SecureOS®
CMVP	Cryptographic Module Validation Program
CO	Crypto-Officer
CRNGT	Continuous Random Number Generator Test
CSP	Critical Security Parameter
DES	Digital Encryption Standard
DH	Diffie-Hellman
DoS	Denial of Service
DSA	Digital Signature Algorithm
ECB	Electronic Codebook
EDC	Error Detection Code
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
FIPS	Federal Information Processing Standard
GUI	Graphical User Interface
HA	High Availability
HMAC	(Keyed-) Hash Message Authentication Code

Acronym	Definition
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
iDRAC6	Integrated Dell™ Remote Access Controller 6
IKE	Internet Key Exchange
IP	Internet Protocol
IPsec	Internet Protocol Security
KAT	Known Answer Test
KCLSOS	Kernel Cryptographic Library for SecureOS®
LCD	Liquid Crystal Display
LDAP	Lightweight Directory Access Protocol
LED	Light Emitting Diode
MAC	Message Authentication Code
MD	Message Digest
NAT	Network Address Translation
NIC	Network Interface Card
NIST	National Institute of Standards and Technology
NMI	Nonmaskable Interrupt
NMS	Network Management System
OS	Operating System
PCIe	Peripheral Component Interconnect Express
PKCS	Public Key Cryptography Standard
PRNG	Pseudo Random Number Generator
PXE	Preboot Execution Environment
RADIUS	Remote Authentication Dial-In User Service
RC	Rivest Cipher
RSA	Rivest Shamir and Adleman
SHA	Secure Hashing Algorithm
SHS	Secure Hash Standard
SNMP	Simple Network Management Protocol
SQL	Structured Query Language
SSH	Secure Shell

Acronym	Definition
TLS	Transport Layer Security
USB	Universal Serial Bus
UTM	Unified Threat Management
VGA	Video Graphics Array
VPN	Virtual Private Network

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