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Non-Proprietary Security Policy for the FIPS 140-2 Level 2 Validated AirFortress™ AF2100 Wireless Security Gateway Cryptographic Module

(Document Version 1.0, Rev.2)

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This security policy of Fortress Technologies, Inc., for the FIPS 140-2 validated AirFortress™ Wireless Security Gateway Cryptographic Module (AF2100), defines general rules, regulations, and practices under which the AF2100 was designed and developed and for its correct operation. These rules and regulations have been and must be followed in all phases of security projects, including the design, development, manufacture service, delivery and distribution, and operation of products.

Contents

Figures and Tables

1.0 Introduction

This security policy defines all security rules under which the AirFortress™ AF2100 Wireless Security |Gateway Cryptographic Module (AF2100) must operate and which it must enforce, including rules from relevant standards such as FIPS. The AF2100 complies with all FIPS 140-2 level 2 requirements.

1.1 Identification

Hardware Model Number: AF2100

Firmware Version: 2.5

The AF2100, also referred to as the AF2100 Wireless Cryptographic Module, is a *firmware-hardware cryptographic system, a multi-chip standalone electronic cryptographic encryption module*. The cryptographic boundary of the AF2100 is the self-contained compiled code that is installed at the point of manufacturing into production-quality compliant computer hardware. The physical boundary is the hardware platform, the AF-2100, on which the AF Gateway, the module firmware component is installed. This firmware and computer hardware system operates as an *electronic encryption device* designed to prevent unauthorized access to data transferred across a wireless network. The AF2100 is designed to prevent unauthorized access to data transferred across a wireless network. It provides strong encryption (TDES and AES) and advanced security protocols. DES (transitional phase only - valid until May 19, 2007) encryption is available for use with legacy systems.

Two major components of the AF2100 are depicted in Figure 1.

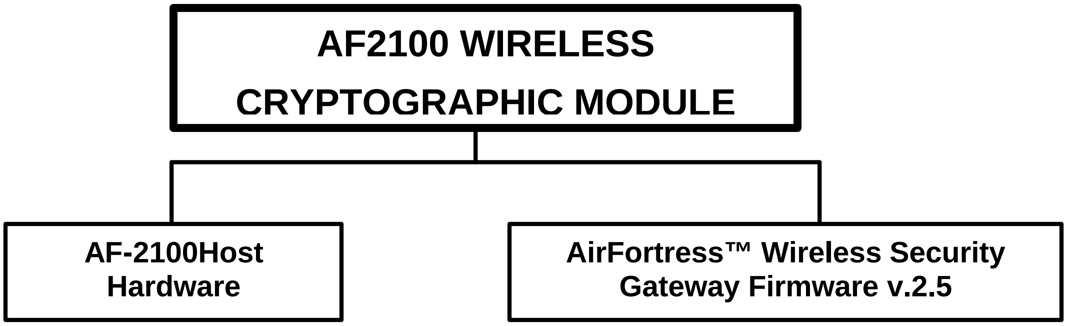


Figure 1: The AF2100 Cryptographic Module Top Level Configuration

The AF2100 encrypts and decrypts traffic transmitted on that network, protecting all clients “behind” it on a protected network. Only authorized personnel, the system administrator (cryptographic officer) and administrators, can log into the module.

The AF2100 operates at the datalink, (also known as MAC) layer of the OSI model as shown in Figure 2. Most of the security protocols are implemented without human intervention to prevent any chance of human error.

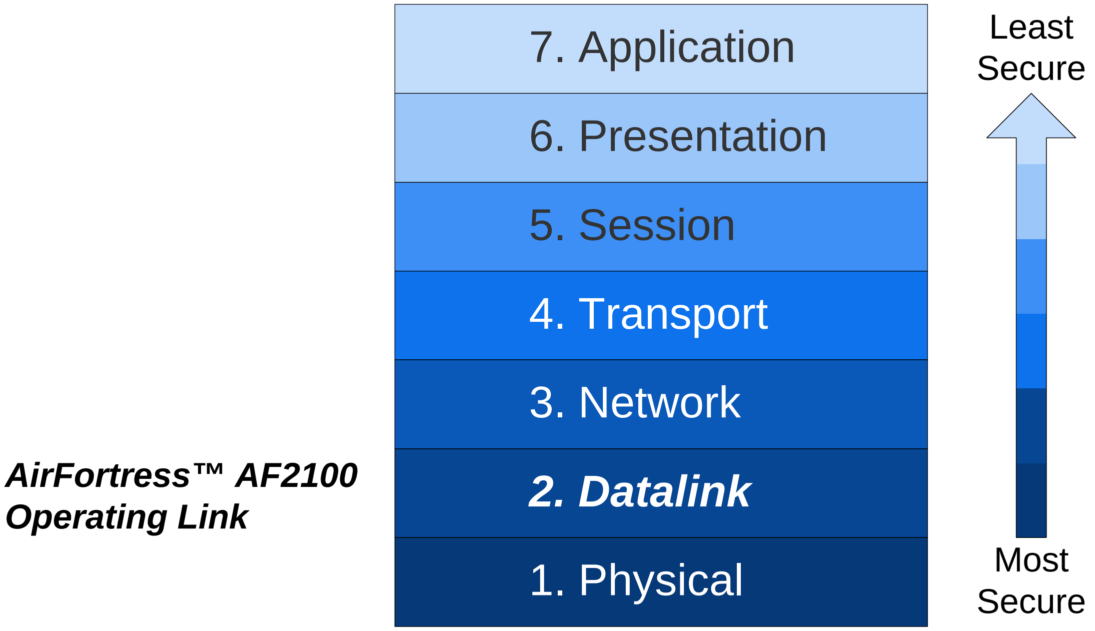


Figure 2. The Seven Layers of the OSI Reference Module

The AF2100 requires no special configuration for different network applications. Its security protocols are implemented without human intervention to prevent any chance of human error; therefore, the products operate with minimal intervention from the user. It secures communication within LANs, WANs, and WLANs.

The AF2100 offers point-to-point-encrypted communication for the computer and Local Area Network (LAN) or Wireless LAN (WLAN) it protects. The products encrypt outgoing data from a client device and decrypts incoming data from networked computers located at different sites. Two or more AF2100s can also communicate with each other directly. A typical application of the AF2100 is shown in Figure 3.

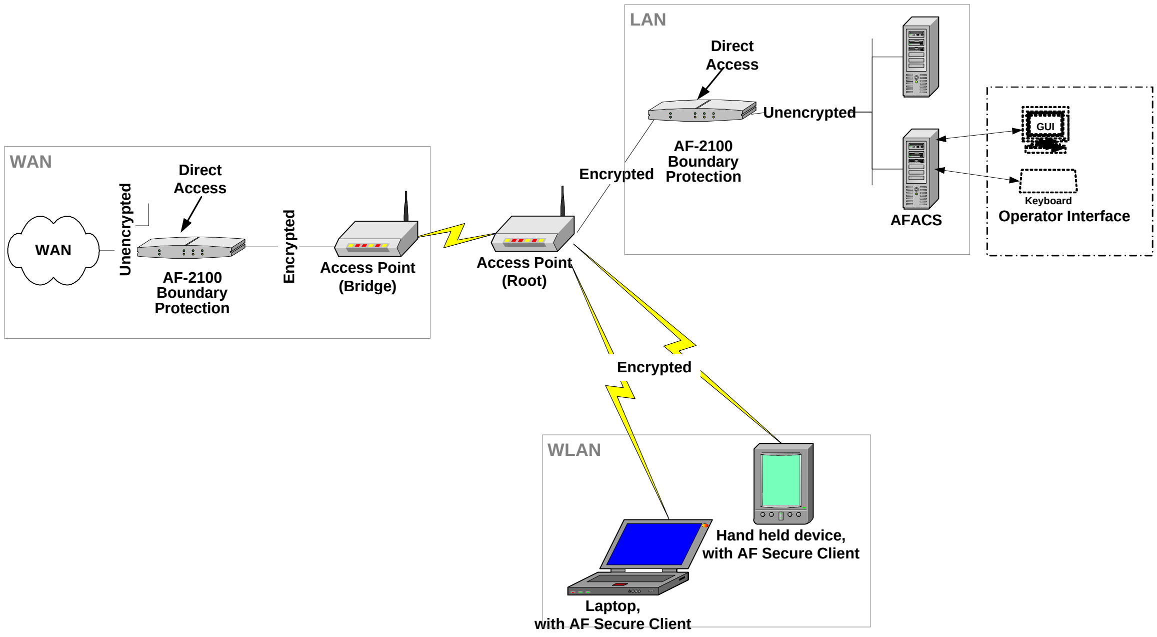


Figure 3: Example Configuration of AirFortress™ AF2100 Wireless Modules in a WAN

2.0 AF2100 Security Features

The AF2100 provides true datalink layer (Layer 2 in Figure) security. To accomplish this, it was designed with the security features described in the following sections.

2.1 The AF Gateway Cryptographic Firmware

The following security design concepts were applied to the AF Gateway:

1. Use strong, proven encryption solutions, such as Triple DES (TDES) and AES.
2. Minimize the human intervention to the module operation with a high degree of automation to prevent human error and to ease the use and management of a security solution.
3. Secure all points where a LAN, WLAN, or WAN can be accessed by using a unique access ID, defined by the customer, to identify authorized devices and authenticate them when also using an AirFortress™ Access Control Server.
4. The AF Gateway can be installed only in production grade, AF-2100, FCC-compliant computer hardware at the customer's site or at Fortress Technologies' production facilities. This hardware platform meets all FIPS 140-2, L2 requirements.

The underlying Wireless Link Layer Security™ (wLLS) technology ensures that cryptographic processing is secure on a wireless network, automating most of the security operations to prevent any chance of human error. wLLS builds upon the proven security architecture of Fortress Technologies Secure Packet Shield™ protocol, with several enhancements to support wireless security needs. Because wLLS operates at the datalink layer, header information is less likely to be intercepted. In addition to applying standard strong encryption algorithms, wLLS also compresses data; disguising the length of the data to prevent analytical attacks and yielding a significant performance gain on network throughput.

The AF2100 requires no special configuration for different network applications, although customers are encouraged to change certain security settings, such as the system administrator password and the access ID for the device, to ensure that each customer has unique parameters that must be met for access. The AF2100 allows role-based access to user interfaces that access the appropriate set of management and status monitoring tools. Direct console access supports the majority of system administrator (cryptographic officer) tasks and a browser-based interface supports administrator access.

2.2 Module Interfaces

The AF2100 includes two logical interfaces for information flow, Network (eth1) for encrypted data across a LAN or WLAN and Client (eth0) for data sent as plaintext to clients on the protected wired network that the AF2100 is deployed on. These logical interfaces correspond with two separate network interface cards (NICs) provided by the hardware platform. The Network interface connects the module to an access point to an unprotected LAN or WLAN; the Client interface connects the module to a protected node for a network. Data sent and received through the Network interface to a connected access point are always encrypted; the AF2100 does not allow plaintext transmission of data, cryptographic keys, or critical security parameters across a LAN or WLAN. Figure 4 shows this information flow in the AF-2100, the hardware platform on which the AF Gateway is installed.

The AF2100 includes a console interface for use by the Crypto-officer in setting FIPS mode and the entering other control data.

A 5VDC power interface is provided.

A status output interface is provided using front panel LEDs.

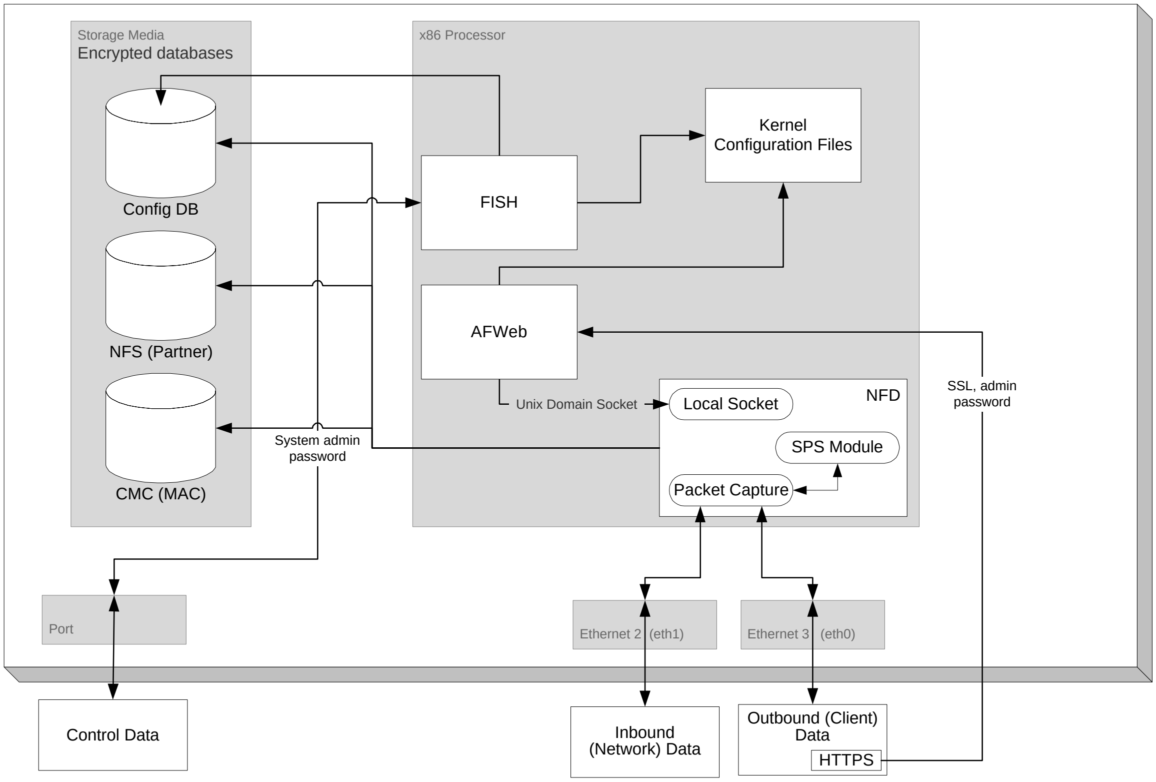


Figure 4. Information Flow Through the AF2100

3.0 Identification and Authentication Policy

3.1 Roles

The AF2100 employs role-based authentication.

The AF2100 supports the following operator roles: System Administrator (cryptographic officer) and User. End users benefit from the AF2100 cryptographic processing without manual intervention, thus eliminating any direct interaction with the module; the AF2100 secures data transparently to users.

The system administrator role is the module's cryptographic officer. The system administrator performs the following tasks in particular:

- Set the operational mode (FIPS or non-FIPS) of the AF2100
- Configure the unique access ID
- Zeroize all cryptographic keys as needed
- Configure security settings
- Define use and configuration of an authentication server
- Deletes client database (NF.cmc) as needed
- Deletes partner database (nfdsdb.nfs) as needed
- Resets configuration database
- Resets the AF2100 to factory default settings, which zeroizes current cryptographic keys and requires creation of a new session key for further communication
- Enter the system date and time
- Enter the device serial number
- Ping a device on the unencrypted network (devices on the encrypted network are tracked directly)
- Trace a packet
- Change the system passwords
- Upgrade the AF2100 firmware with Fortress-validated firmware upgrades
- Reboot the AF2100

The administrator cannot change any critical system or cryptographic settings and accesses the system only through the browser-based interface.

3.1.1 Authentication

User authentication is by a 16 hexadecimal digit Access ID (64-bit). Crypto-Officer authentication is by 8-character password (72^8).

3.2 Services

The following services are provided in the module:

Crypto-Officer

- Configuration as described above
- Creating and maintaining tables (crypto-officer can manually clear tables)
- Generating the module's keys
- Reinitiating key exchange at user-specified intervals

- Zeroizing keys if power to the module is turned off
- Performing self-tests automatically at every power-on and/or by the cryptographic officer's demand.
- Display status
- Upgrade the entire module's firmware

User

- Generating cryptographic keys using encrypted Diffe-Hellman exchanges to prevent man-in-the-middle attacks
- Authenticating devices attempting to communicate with the AF2100
- Filtering packets to prevent any unencrypted (and, therefore, unauthorized) packets from entering the network
- Encrypting and decrypting packets at the datalink layer (OSI level 2)
- Authenticating the origin of packets
- Testing packet integrity using a HMAC-SHA-1 hash

3.3 Self-Tests

The AF2100 conducts the following self-tests at power-up and conditionally as needed, when a module performs a particular function or operation:

A. *Power-Up Tests*
   - Cryptographic Algorithm Test: AES KAT, TDES KAT, DES KAT, HMAC-SHA-1 KAT, SHA-1 KAT, and RNG KAT
   - Software/Firmware Integrity Test: HMAC-SHA-1
   - Critical Functions Test: None

B. *Conditional Test*
   - Continuous Random Number Generator test

Failure of any self-test listed above puts the module in its error state.

3.4 Cryptographic Key Management

The AF2100 itself automatically performs all cryptographic processing and key management functions.

3.4.1 Key Generation

The AF2100 uses seven cryptographic keys, generated by FIPS-approved processes:

- Module's Secret Key (Symmetric, TDES, and AES)
- Static Private Key
- Static Public Key
- Static Secret Encryption Key (Symmetric, TDES, and AES)
- Dynamic Private Key
- Dynamic Public Key
- Dynamic Session Key (Symmetric, TDES, and AES)

Notes:

- Symmetric DES keys are used for backward compatibility with legacy units.
- The public and private keys above refer to those used in the Diffie-Hellman key agreement protocol.

A non-Approved ANSI X9.31 A.2.4 pseudo-random number generator creates numbers used in the key agreement algorithm.

3.4.2 Key Storage

No encryption keys are stored permanently in the module's hardware. Public, private and session keys are stored in RAM. The Access ID and Device ID are stored encrypted.

3.4.3 Zeroization of Keys

The session keys, which are encrypted, of the AF2100 are automatically zeroized when the system is turned off and regenerated at every boot-up of the host hardware. All session keys can be zeroized manually as needed.

3.4.4 Protocol Support

The AF2100 supports the Diffie-Hellman, SHA-1, and automatic key re-generation methods.

3.4.5 Cryptographic Algorithms

The AF Gateway applies the following cryptographic algorithms:

FIPS Algorithms	**NIST-FIPS Certificate number**
AES (ECB, CBC, encrypt/decrypt; 128, 192, 256)	14
TDES (CBC, encrypt/decrypt)	19
DES (ECB, CBC, encrypt/decrypt)	23
SHS	316
HMAC-SHA-1	62

Non-FIPS Algorithms
Diffie-Hellman (Key Agreement), MD5, RSA`

4.0 Access Control Policy

The AF2100 allows role-based access to user interfaces that access to the appropriate set of management and status monitoring tools. Direct console access supports the majority of system administrator (cryptographic officer) tasks, and a browser-based interface supports administrator access.

The system administrator (cryptographic officer role) manages the cryptographic configuration of the AF2100. Administrators can review module status and manage system settings where appropriate but not cryptographic settings when the modules are operating in FIPS mode. Because of the AF2100 automates cryptographic processing, end users do not have to actively initiate cryptographic processing; the AF2100 encrypts and decrypts data sent or received by users operating authenticated devices connected to the AF2100

The following tables, defined by Fortress Technologies' Access Control Policy, show the authorized access and services supported and allowed to each role within each product.

Table 1. AF2100 System Administrator (Cryptographic Officer)

Function/Service	Show	Set	Enable	Disable	Add	Delete	Reboot	Password	Zeroize	Reset	Default Reset
Access Control Server	X	X	X	X						X	X
Access ID		X							X	X	X
Access point	X				X	X				X	X
afweb			X	X						X	X
ARP	X										
Client DB (NF.cmc)						X			X	X	X
Config database										X[1]	X
Crypto keys									X[2]	X	X
Cryptography algorithm	X	X									
Device ID	X										
Device MAC	X										
FIPS mode			X	X						X	X
Hostname	X	X								X	X
Interface	X										
IP Address	X	X								X	X
Memory	X										
Netmask	X	X								X	X

Function/Service	Show	Set	Enable	Disable	Add	Delete	Reboot	Password	Zeroize	Reset	Default Reset
Network gateway	X	X								X	X
Partner DB (nfdsdb.nfs)						X			X	X	X
Rekey interval	X	X								X	X
Role passwords								X			X
Self Tests							X				
Serial number	X	X									
SNMP (non-FIPS only)			X	X							X

[1] The `reset` command resets the configuration database except for the serial number, device ID, MAC address, cryptographic algorithm selected, and user passwords. The `default reset` command resets everything except for the serial number. All cryptographic keys are automatically regenerated at the system reboot, and reset except the Module's Secret Key.

[2] When the system administrator logs in, cryptographic processing halts, which effectively zeroizes the keys.

Table 2. AF2100 Administrator

Function/Service	Show	Set	Delete	Reboot	Password
Access Control Server	X				
Access ID					
Access point	X				
afweb					
ARP					
Client DB (NF.cmc)			X		
Config database					
Crypto keys					
Cryptography algorithm	X				
Device ID	X				
Device MAC	X				
FIPS mode	X				
Hostname	X				

Function/Service	Show	Set	Delete	Reboot	Password
Interface	X				
IP Address	X				
Memory					
Netmask	X				
Network gateway	X				
Partner DB (nfdsdb.nfs)					
Rekey interval	X				
Role passwords					X[1]
Self Tests				X	
Serial number	X	X			
SNMP (non-FIPS only)	X				

[1] The administrator can only change the administrator password and not the system administrator password.

Table 3. AF2100 User

Service	Execute	Read
Encryption	X	
Decryption	X	
Module Authentication	X	
Key Generation	X	
Tables		X
Packet Filter	X	
Packet Authentication	X	
Packet Integrity	X	

5.0 Physical Security Policy

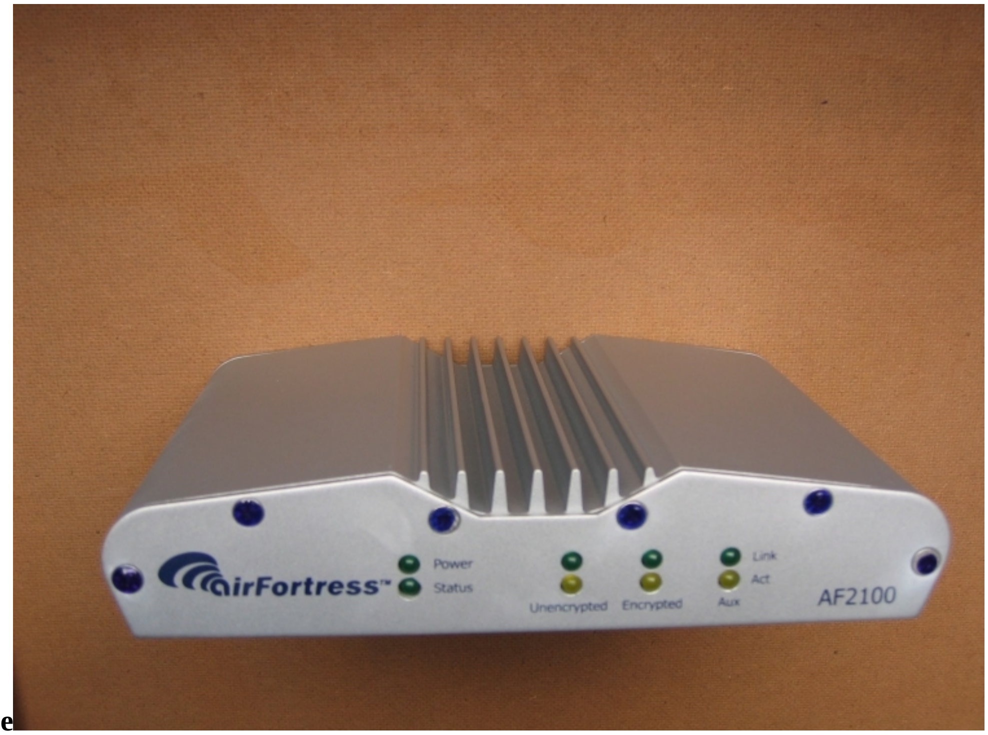
The AF Gateway firmware is installed by Fortress Technologies on a production-quality, FCC-certified hardware device, the AF-2100, which also defines the module's physical boundary. The AF-2100 is manufactured to meet FIPS 140-2, L2 requirements.

The host hardware platform server must be located in a controlled access area. Tamper evidence is provided by the use of an epoxy potting material covering the chassis access screws. All screws on the front and back panel are covered with the material as shown in Figures 5 and 6 and Table 4 lists recommended physical security related activities at the user's site.

Table 4. Recommended Physical Security Activities.

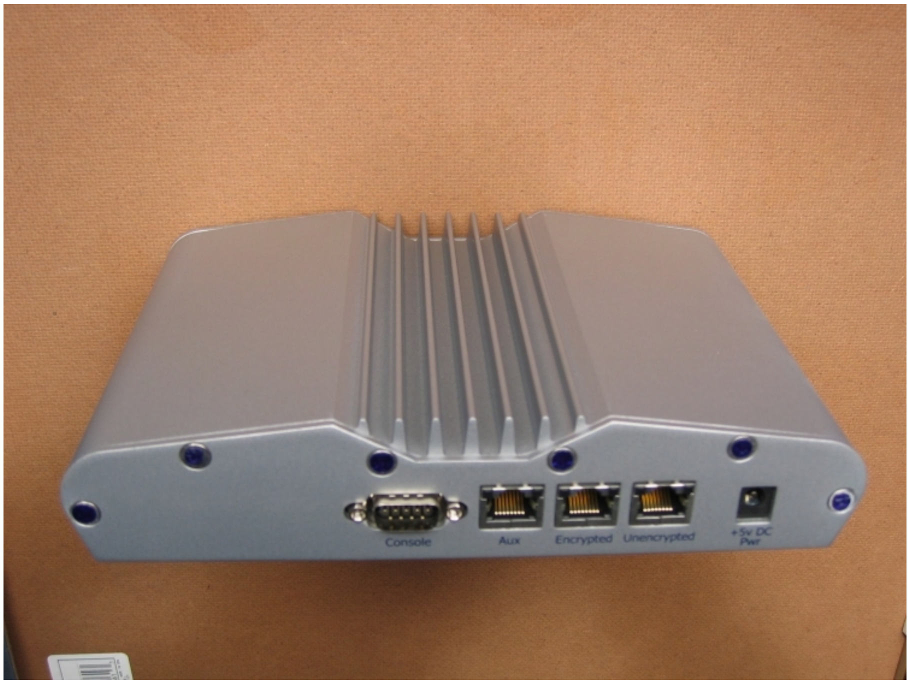
Physical Security Mechanism	Recommended Frequency of Inspection	Inspection Guidance
Chassis screws covered with epoxy coating	Daily	Inspect screw heads for chipped epoxy material. If found, remove module from service.

Figure 5: Front View of the AF-2100



Hardware

Figure 6: Back View of the AF-2100 Hardware



6.0 Software Security

Firmware components are not available to either the Crypto-officer or User. The operator has only limited access to module via the AFWEB or AFFISH tools. Firmware cannot be changed, nor can the firmware be partially upgraded. Self-tests validate the operational status of each product, including critical functions and files. If the firmware is compromised, the module enters an error state in which no cryptographic processing occurs, preventing a security breach through a malfunctioning device.

7.0 Operating System Security

The AF2100 operates automatically after power-up. The AF2100 operates on limited non-modifiable version of Linux 2.4.16 that is installed along with the module's firmware, with user access to standard OS functions eliminated. The module provides no means whereby an operator could load and execute software or firmware that was not included as part of the module's validation. Updates to the firmware are supported, but can only be made using the vendor provided and authenticated services.

8.0 Mitigation of Other Attacks Policy

No special mechanisms are built in the AF2100 module; however, the cryptographic module is designed to mitigate several specific attacks above the FIPS defined functions. Additional features that mitigate attacks are listed here:

1. The dynamic session key is changed at least once every 24 hours, with 4 hours being the factory default duration: *Mitigates key discovery*.
2. A second Diffie-Hellman key exchange produces a dynamic common secret key in each of the modules by combining the other module's dynamic public key with the module's own dynamic private key: *Mitigates "man-in-the-middle" attacks*.
3. All key exchanges are encrypted: *Mitigates encryption key sniffing by hackers.*
4. Compression and encryption of header information inside of the frame, making it impossible to guess. Use of strong encryption further protects the information. Any bit flipping would be useless in this frame to try to change the IP address of the frame: *Mitigates active attacks from both ends*.
5. Encryption happens at the datalink layer so that all network layer information is hidden: *Mitigates hacker's access to the communication.*

9.0 EMI/EMC

The AF2100 is an FCC compliant and certified (Part 15, Subpart J, Class B) device.

10.0 Customer Security Policy Issues

Fortress Technologies, Inc. expects that after the module's installation, any potential *customer* (government organization or commercial entity or division) *employs its own internal security policy* covering all the rules under which the module(s) and the customer's network(s) must operate. In addition, the customer systems are expected to be upgraded as needed to contain appropriate security tools to enforce the internal security policy.

10.1 FIPS Mode

The Crypto-Officer must select FIPS mode during module initialization. Set FIPS by using AF FISH to access the console port and then selecting FIPS enable. Once FIPS is enabled the prompt changes to "<FIPS>" and the AF Web Interface reports "FIPS MODE ENABLED" as indicators.

11.0 Maintenance Issues

The AF2100 has no operator maintainable components. Unserviceable modules must be returned to the factory for repair.