Cisco Catalyst C4500X-32SFP+ and Catalyst C4500X-F-32SFP+

FIPS 140-2 Level 2
Non-Proprietary Security Policy

Overall Level 2 (Sections 3 and 10 Level 3) Validation

Version 0.4
April 2013
Introduction
This is a non-proprietary Cryptographic Module Security Policy for the Cisco Catalyst C4500X-32SFP+ and Catalyst C4500X-F-32SFP+, referred to in this document as the modules or switches. This security policy describes how modules meet the security requirements of FIPS 140-2 and how to run the modules in a FIPS 140-2 mode of operation and may be freely distributed.

Versions:
- Catalyst C4500X-32SFP+
- Catalyst C4500X-F-32SFP+
- FIPS kit packaging (CVPN4500FIPS/KIT)
- IOS-XE version 3.3.1SG

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 Cisco Systems website (http://www.cisco.com) contains information on the full line of products from Cisco Systems.
- The NIST Cryptographic Module Validation Program website (http://csrc.nist.gov/groups/STM/cmvp/index.html) contains contact information for answers to technical or sales-related questions for the module.

FIPS 140-2 Submission Package
The security policy document is one document in a FIPS 140-2 Submission Package. In addition to this document, the submission package includes:

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

With the exception of this non-proprietary security policy, the FIPS 140-2 validation documentation is proprietary to Cisco Systems, Inc. and is releasable only under appropriate non-disclosure agreements. For access to these documents, please contact Cisco Systems, Inc. See “Obtaining Technical Assistance” section for more information.
Module Description

Branch office networking requirements are dramatically evolving, driven by web and e-commerce applications to enhance productivity and merging the voice and data infrastructure to reduce costs. The Catalyst 4500-X series switches with the VPN Services Port Adapter offer versatility, integration, and security to branch offices. With numerous network modules and service modules available, the modular architecture of the Cisco switches easily allows interfaces to be upgraded to accommodate network expansion. The Catalyst 4500-X series switches provide a scalable, secure, manageable remote access server that meets FIPS 140-2 Level 2 requirements, as a multi-chip standalone module.

The switches include cryptographic algorithms implemented in IOS-XE software and IOS-XE Image Signing software.

The switches support the following cryptographic protocols SSH, TLS, and IPsec to provide remote administrative access to the module and data plane security.

The following pictures are representative each of the switch modules:

![Figure 1: Catalyst 4500X-32SFP+/ 4500X-F-32SFP+](image1)

![Figure 2: Front to Back Airflow on the back of Catalyst 4500-32SFP+](image2)

![Figure 3: Back to Front Airflow on the back of Catalyst 4500-F-32SFP+](image3)

Module Validation Level

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

<table>
<thead>
<tr>
<th>No.</th>
<th>Area Title</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cryptographic Module Specification</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Cryptographic Module Ports and Interfaces</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Roles, Services, and Authentication</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Finite State Model</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Physical Security</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Operational Environment</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Cryptographic Boundary
The cryptographic boundary is defined as being the physical enclosure of the chassis.

All of the functionality described in this publication is provided by components within this cryptographic boundary. The module is a fixed configuration.

Cryptographic Module Ports and Interfaces
Each module provides a number of physical and logical interfaces to the device, and the physical interfaces provided by the module are mapped to four FIPS 140-2 defined logical interfaces: data input, data output, control input, and status output. The module also supports a power interface. The logical interfaces and their mapping are described in the following tables:

<table>
<thead>
<tr>
<th>Physical Interface</th>
<th>Logical Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Port</td>
<td>Data Input Interface</td>
</tr>
<tr>
<td>USB Ports</td>
<td></td>
</tr>
<tr>
<td>Secure Digital Slot</td>
<td></td>
</tr>
<tr>
<td>Console Port</td>
<td></td>
</tr>
<tr>
<td>10G SFP+ Port</td>
<td></td>
</tr>
<tr>
<td>Management Port</td>
<td>Data Output Interface</td>
</tr>
<tr>
<td>USB Ports</td>
<td></td>
</tr>
<tr>
<td>Secure Digital Slot</td>
<td></td>
</tr>
<tr>
<td>USB port</td>
<td></td>
</tr>
<tr>
<td>Console Port</td>
<td></td>
</tr>
<tr>
<td>10G SFP+ Port</td>
<td></td>
</tr>
<tr>
<td>Console Port</td>
<td>Control Input Interface</td>
</tr>
<tr>
<td>Management Port</td>
<td></td>
</tr>
<tr>
<td>Management Port</td>
<td>Status Output Interface</td>
</tr>
<tr>
<td>USB Ports</td>
<td></td>
</tr>
<tr>
<td>Secure Digital Slot</td>
<td></td>
</tr>
<tr>
<td>LEDs</td>
<td></td>
</tr>
<tr>
<td>Console Port</td>
<td></td>
</tr>
<tr>
<td>Power Plug</td>
<td>Power Interface</td>
</tr>
</tbody>
</table>

Table 2: Physical To Logical Interfaces

Note: USB ports and Secure Digital slot are disabled by TELs in FIPS mode.
Roles, Services, and Authentication

Authentication is identity-based. Each user is authenticated upon initial access to the module. There are two roles in the Switch that operators may assume: the Crypto Officer (CO) role and the User role. The administrator of the Switch assumes the CO role in order to configure and maintain the Switch using CO services, while the Users exercise security services over the network. The module supports RADIUS for authentication.

User Role

The role assumed by users obtaining general security services. From a logical view, user activity exists in the data-plane. Users access via network ports using the IPsec, SSH, or TLS protocols.

IPsec, SSH, and TLS can use password based credentials – in such a case the user credentials must be at least eight (8) characters long (max characters for the password is twenty-five (25)), including at least one letter and at least one number character, in length (enforced procedurally). If six (6) integers, one (1) special character and one (1) alphabet are used without repetition for an eight (8) digit PIN, the probability of randomly guessing the correct sequence is one (1) in 832,000,000. In order to successfully guess the sequence in one minute would require the ability to make over 13,000,000 guesses per second, which far exceeds the operational capability of the console port. Including the rest of the alphanumeric characters drastically decreases the odds of guessing the correct sequence.

IPsec, SSH, and TLS can also use certificate credentials using 1024 bit RSA keys and SHA-1 – in such a case the security strength is 80 bits, so an attacker would have a 1 in $2^{80}$ chance of a successful authentication 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 $1.8 \times 10^{21}$ attempts per minute, which vastly exceeds the operational capabilities of the module to support.

CO Role

The role assumed by an authorized CO connecting to the switch via CLI through the console port and performing management functions and module configuration. From a logical view, CO activity exists only in the control plane. IOS prompts the CO for their username and password, if the password is validated against the CO’s password in IOS memory, the user is allowed entry to the IOS executive program. A CO can assign permission to access the CO role to additional accounts, thereby creating additional COs.

CO passwords must be at least eight (8) characters long (max characters for the password is twenty-five (25)), including at least one letter and at least one number character, in length (enforced procedurally). If six (6) integers, one (1) special character and one (1) alphabet are used without repetition for an eight (8) digit PIN, the probability of randomly guessing the correct sequence is one (1) in 832,000,000. In order to successfully guess the sequence in one minute would require the ability to make over 13,000,000 guesses per second, which far exceeds the operational capability of the
console port. Including the rest of the alphanumeric characters drastically decreases the odds of guessing the correct sequence.

**Services**

<table>
<thead>
<tr>
<th>Role</th>
<th>Authentication Method</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>SSH, TLS, IPsec</td>
<td><strong>Status Functions</strong>: view state of interfaces, state of connections, version of IOS currently running.</td>
</tr>
<tr>
<td></td>
<td>Authentication</td>
<td><strong>Network Functions</strong>: connect to other network devices through outgoing telnet or PPP, and initiate diagnostic network services (for example, ping or mtrace).</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Terminal Functions</strong>: adjust the terminal session (that is, lock the terminal and adjust flow control).</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Directory Services</strong>: display directory of files kept in flash memory.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Perform Self Tests</strong>: occurs upon system startup</td>
</tr>
<tr>
<td>Cryptographic Officer</td>
<td>Console login</td>
<td><strong>Configure the switch</strong>: define network interfaces and settings, create command aliases, set the protocols the switch will support, enable interfaces and network services, set system date and time, and load authentication information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Define rules and filters</strong>: 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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Status functions</strong>: view the switch configuration, routing tables, and active sessions; view health, temperature, memory status, voltage, and packet statistics; review accounting logs, and view physical interface status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Manage the switch</strong>: log off users, shut down or reload the switch, manually back up switch configurations, view complete configurations, manager user rights, and restore switch configurations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Set Encryption/Bypass</strong>: Place module into Encryption or Bypass state.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Perform Self-Tests</strong>: Perform the FIPS 140 start-up tests on demand.</td>
</tr>
<tr>
<td>Unauthenticated</td>
<td>N/A</td>
<td><strong>Show status</strong> (viewing LEDs), passing traffic through the device and power-cycling the device.</td>
</tr>
</tbody>
</table>

Table 3: Module Roles/Service
Cryptographic Key/CSP Management

The module securely administers both cryptographic keys and other critical security parameters such as passwords. The tamper evidence seals provide physical protection for all keys. All keys are also protected by the password-protection on the CO role login, and can be zeroized by the CO. All zeroization consists of overwriting the memory that stored the key. Keys are exchanged and entered electronically. Persistent keys are entered by the CO via the console port CLI, transient keys are generated or established and stored in DRAM.

The module supports the following critical security parameters (CSPs):

<table>
<thead>
<tr>
<th>ID</th>
<th>Algorithm/Size/Mode</th>
<th>Size</th>
<th>Description</th>
<th>Origin</th>
<th>Storage</th>
<th>Zeroization Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNG Seed</td>
<td>ANSI X9.31 Appendix A.2.4 Using the 2-Key Triple-DES Algorithm</td>
<td>64-bits</td>
<td>This is the seed for X9.31 RNG.</td>
<td>Generated by the module</td>
<td>DRAM (plaintext)</td>
<td>Power cycle the device</td>
</tr>
<tr>
<td>RNG Seed Key</td>
<td>ANSI X9.31 Appendix A.2.4 Using the 2-Key Triple-DES Algorithm</td>
<td>128-bits</td>
<td>This is the seed key for X9.31 RNG.</td>
<td>Generated by the module</td>
<td>DRAM (plaintext)</td>
<td>power cycle the device</td>
</tr>
<tr>
<td>DRBG V</td>
<td>SP 800-90 CTR_DRBG</td>
<td>128-bits</td>
<td>Internal V value used as part of SP 800-90 CTR_DRBG</td>
<td>Generated by entropy source via the CTR_DRBG derivation function.</td>
<td>DRAM (plaintext)</td>
<td>power cycle the device</td>
</tr>
<tr>
<td>DRBG Key</td>
<td>SP 800-90 CTR_DRBG</td>
<td>256-bits</td>
<td>Internal Key value used as part of SP 800-90 CTR_DRBG</td>
<td>Generated from entropy source via CTR_DRBG derivation function</td>
<td>DRAM (plaintext)</td>
<td>power cycle the device</td>
</tr>
<tr>
<td>Diffie-Hellman</td>
<td>Diffie-Hellman 256 bits</td>
<td>Shared secret generated by the Diffie-Hellman Key exchange</td>
<td>Shared secret derived by the Diffie-Hellman Key exchange</td>
<td>DRAM (plaintext)</td>
<td>Automatically when session expires</td>
<td></td>
</tr>
<tr>
<td>Skeyid</td>
<td>HMAC-SHA-1 160-bits</td>
<td>Used to derive skey_d.</td>
<td>Value derived from the shared secret within IKE exchange. Zeroized when IKE session is terminated.</td>
<td>DRAM (plaintext)</td>
<td>Automatically after IKE session terminated.</td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>Algorithm/Size/Mode</td>
<td>Size</td>
<td>Description</td>
<td>Origin</td>
<td>Storage</td>
<td>Zeroization Method</td>
</tr>
<tr>
<td>--------------</td>
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<td>--------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>skeyid_d</td>
<td>HMAC-SHA-1</td>
<td>160-bits</td>
<td>Derived as part of the IKE process.</td>
<td>The IKE key derivation key for non ISAKMP security associations.</td>
<td>DRAM (plaintext)</td>
<td>Automatically after IKE session terminated.</td>
</tr>
<tr>
<td>IKE session encryption key</td>
<td>Triple-DES/AES</td>
<td>Triple-DES (168-bits)/AES (128/192/256-bits)</td>
<td>The IKE session encrypt key.</td>
<td>Value derived from the shared secret within IKE exchange</td>
<td>DRAM (plaintext)</td>
<td>Automatically after IKE session terminated.</td>
</tr>
<tr>
<td>IKE session authentication key</td>
<td>HMAC-SHA-1</td>
<td>160-bits</td>
<td>The IKE session authentication key.</td>
<td>Value derived from the shared secret within IKE exchange</td>
<td>DRAM (plaintext)</td>
<td>Automatically after IKE session terminated.</td>
</tr>
<tr>
<td>ISAKMP preshared</td>
<td>Shared Secret</td>
<td>At least eight characters</td>
<td>The key used to generate IKE skeyid during preshared-key authentication. This key can have two forms based on whether the key is related to the hostname or the IP address.</td>
<td>Configured by CO</td>
<td>NVRAM (plaintext )</td>
<td>“# no crypto isakmp key”</td>
</tr>
<tr>
<td>IKE RSA Authentication private Key</td>
<td>RSA</td>
<td>1024 - 2048 bits</td>
<td>RSA private key for IKE authentication.</td>
<td>Generated by using FIPS approved DRBG</td>
<td>NVRAM (plaintext)</td>
<td>“# crypto key zeroize rsa”</td>
</tr>
<tr>
<td>IPSec encryption key</td>
<td>Triple-DES/AES</td>
<td>Triple-DES (168-bits)/AES (128/192/256 bits AES keys)</td>
<td>The IPSec encryption key. Zerized when IPSec session is terminated.</td>
<td>Derived using the IKE key derivation function</td>
<td>DRAM (plaintext)</td>
<td>Automatically when IPSec session terminated.</td>
</tr>
<tr>
<td>IPSec authentication key</td>
<td>HMAC-SHA-1</td>
<td>160-bits</td>
<td>The IPSec authentication key.</td>
<td>Derived using the IKE key derivation function</td>
<td>DRAM (plaintext)</td>
<td>Automatically when IPSec session terminated.</td>
</tr>
<tr>
<td>RSA private key (SSH)</td>
<td>RSA</td>
<td>1024 - 2048 bits</td>
<td>Private key used in SSH protocol</td>
<td>Generated by using FIPS approved DRBG</td>
<td>NVRAM (plaintext)</td>
<td>“#crypto key zeroize rsa”</td>
</tr>
<tr>
<td>SSH session key</td>
<td>TDES / AES</td>
<td>128, 256 bits (AES) 168 bits (TDES)</td>
<td>This is the SSH session key. It is used to encrypt all SSH data traffics traversing between the SSH client and SSH server.</td>
<td>Derived as part of SSH session set-up</td>
<td>DRAM (plaintext)</td>
<td>Zerized when SSH session is terminated</td>
</tr>
<tr>
<td>SSH session authentication key</td>
<td>HMAC-SHA-1</td>
<td>160-bits</td>
<td>This key is used to perform the authentication between the SSH</td>
<td>Derived as part of SSH session set-up</td>
<td>DRAM (plaintext)</td>
<td>Zerized when SSH session is terminated</td>
</tr>
<tr>
<td>ID</td>
<td>Algorithm/Size/Mode</td>
<td>Size</td>
<td>Description</td>
<td>Origin</td>
<td>Storage</td>
<td>Zeroization Method</td>
</tr>
<tr>
<td>----</td>
<td>-------------------</td>
<td>------</td>
<td>-------------</td>
<td>--------</td>
<td>---------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td>RSA private key (TLS)</td>
<td>RSA 1024 - 2048 bits</td>
<td>Identity certificates for module itself and also used in TLS negotiations. This CSP is used for both SSL VPN and SIP Gateway Signaling Over TLS Transport.</td>
<td>Generated by using FIPS approved DRBG</td>
<td>NVRAM (plaintext)</td>
<td>“#crypto key zeroize rsa”</td>
</tr>
<tr>
<td></td>
<td>TLS pre-master secret</td>
<td>Shared Secret 384-bits</td>
<td>Shared secret created using asymmetric cryptography from which new HTTPS session keys can be created.</td>
<td>Created as part of TLS session establishment</td>
<td>DRAM (plaintext)</td>
<td>Zeroized when TLS session is terminated</td>
</tr>
<tr>
<td></td>
<td>TLS Session Key</td>
<td>Triple-DES/AES 168-256-bits</td>
<td>Derived using the TLS protocol.</td>
<td>Derived as part of TLS session establishment</td>
<td>DRAM (plaintext)</td>
<td>Zeroized when TLS session is terminated</td>
</tr>
<tr>
<td></td>
<td>TLS Session Authentication Key</td>
<td>HMAC-SHA-1 160-bits</td>
<td>Derived using the TLS protocol.</td>
<td>Derived as part of TLS session establishment</td>
<td>DRAM (plaintext)</td>
<td>Zeroized when TLS session is terminated</td>
</tr>
<tr>
<td></td>
<td>User password</td>
<td>Shared Secret 8-25 characters long, including at least one letter and at least one number character</td>
<td>Password of the user role</td>
<td>CO configured</td>
<td>NVRAM (plaintext)</td>
<td>Set new password</td>
</tr>
<tr>
<td></td>
<td>Enable password</td>
<td>Shared Secret 8-25 characters long, including at least one letter and at least one number character</td>
<td>CO password</td>
<td>CO configured</td>
<td>NVRAM (plaintext)</td>
<td>Set new password</td>
</tr>
</tbody>
</table>
### Table 4: CSP Table

The services accessing the CSPs, the type of access and which role accesses the CSPs are listed below.

<table>
<thead>
<tr>
<th>Role</th>
<th>Service</th>
<th>Critical Security Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Role</td>
<td>Network Functions</td>
<td>RNG Seed, RNG Seed, RNG Seed Key, Diffie-Hellman private exponent, Diffie-Hellman shared secret, Skeyid, skeyid_d, IKE session encrypt key, IKE session authentication key, ISAKMP preshared, IKE RSA Authentication private Key, IPSec encryption key, IPSec authentication key (R) and User password (W)</td>
</tr>
<tr>
<td>Crypto-Officer Role</td>
<td>Configure the Switch</td>
<td>Enable Password, Skeyid, skeyid_d, IKE session encrypt key, IKE session authentication key, ISAKMP preshared, IKE RSA Authentication private Key, IPSec encryption key, IPSec authentication key (R/W/D)</td>
</tr>
</tbody>
</table>

Table 5: Role CSP Access
Cryptographic Algorithms

Approved Cryptographic Algorithms

The Cisco Switches support many different cryptographic algorithms. However, only FIPS approved algorithms may be used while in the FIPS mode of operation. The following table identifies the approved algorithms included in the Switches for use in the FIPS mode of operation.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Implementation</th>
<th>CAVP Certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES</td>
<td>IOS-XE Cryptographic Implementation</td>
<td>#1977</td>
</tr>
<tr>
<td>Triple-DES</td>
<td>IOS-XE Cryptographic Implementation</td>
<td>#1282</td>
</tr>
<tr>
<td>SHS</td>
<td>IOS-XE Cryptographic Implementation</td>
<td>#1730</td>
</tr>
<tr>
<td></td>
<td>IOS-XE Image Signing Implementations</td>
<td>#1731</td>
</tr>
<tr>
<td>HMAC</td>
<td>IOS-XE Cryptographic Implementation</td>
<td>#1190</td>
</tr>
<tr>
<td>RSA</td>
<td>IOS-XE Cryptographic Implementation</td>
<td>#1023</td>
</tr>
<tr>
<td></td>
<td>IOS-XE Image Signing Implementations</td>
<td>#1024</td>
</tr>
<tr>
<td>ANSI X9.31 RNG</td>
<td>IOS-XE Cryptographic Implementation</td>
<td>#1072</td>
</tr>
<tr>
<td>SP 800-90A CTR DRBG</td>
<td>IOS-XE Cryptographic Implementation</td>
<td>#179</td>
</tr>
</tbody>
</table>

Table 6: FIPS-Approved Algorithms for use in FIPS Mode

Non-FIPS Approved Algorithms Allowed in FIPS Mode

- Diffie-Hellman (key establishment methodology provides between 80 and 112 bits of encryption strength)
- RSA key transport (key establishment methodology provides between 80 and 112 bits of encryption strength)

Non-Approved Algorithms

The cryptographic module implements the following non-approved algorithms that are not permitted for use in FIPS 140-2 mode of operations:

- MD4
- MD5

Self-Tests

The modules include an array of self-tests that are run during startup and periodically during operations to prevent any secure data from being released and to ensure all components are functioning correctly. The modules implement the following power-on self-tests:

- IOS-XE Firmware Implementation Known Answer Tests:
  - Firmware Integrity Test
  - AES KAT (encryption/decryption)
- AES-CMAC KAT
- CTR_DRBG KAT
- HMAC SHA-1 KAT
- X9.31 RNG KAT
- FIPS 186-2 RSA KAT
- SHA-1 KAT
- SHA-512 KAT
- Triple-DES KAT (encryption/decryption)

- IOS-XE Image Signing Implementation Known Answer Tests:
  - FIPS 186-3 RSA KAT
  - SHA-512 KAT

The modules perform all power-on self-tests automatically at boot. All power-on self-tests must be passed before any operator can perform cryptographic services. The power-on self-tests are performed after the cryptographic systems are initialized but prior any other operations; this prevents the module from passing any data during a power-on self-test failure.

In addition, the modules also provide the following conditional self-tests:

- IOS-XE Firmware Implementation Conditional Self-Tests
  - Continuous Random Number Generator test for ANSI X9.31 RNG
  - Continuous Random Number Generator test for SP800-90A CTR_DRBG
  - Continuous Random Number Generator test for the non-approved RNGs
  - Bypass Test
  - FIPS 186-2 RSA Pairwise Consistency Test
  - Firmware Load Test

- IOS-XE Image Signing Implementation Conditional Self-Tests
  - FIPS 186-3 RSA Pairwise Consistency Test
Physical Security

This module is a multi-chip standalone cryptographic module.

The FIPS 140-2 level 2 physical security requirements for the modules are met by the use of tamper evident seals to provide the required tamper evidence. The FIPS 140-2 level 2 opacity requirements are natively by the device.

The following section illustrates the physical security provided by the module.

Tamper Evidence

The module is validated when tamper evident labels and security devices are installed on the initially built configuration as indicated. Any changes, modifications or repairs performed after the initially built configuration that requires the removal of any TEL will invalidate the module. TELs are found in the FIPS kit packaging (CVPN4500FIPS/KIT). Each kit includes sixty (60) FIPS tamper evidence labels.

The total number of tamper evident labels required for the configuration is 10.

Once the module has been configured to meet overall FIPS 140-2 Level 2 requirements, the module cannot be accessed without signs of tampering. The CO shall inspect for signs of tampering periodically. Any extra TELs must remain in the CO control and must be securely stored in a monitored location.

If the CO must remove or change 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.

To seal the system, CO should apply TELs as depicted in the figures below.
Secure Operation

The Switches meet all the overall Level 2 requirements for FIPS 140-2. Follow the setup instructions provided below to place the module in FIPS-approved mode. Operating this Switch without maintaining the following settings will remove the module from the FIPS approved mode of operation.

Initial Setup

1. The CO must apply tamper evidence labels as described above.

System Initialization and Configuration

1. The CO must create the “enable” password for the CO role. Procedurally, the password must be at least 8 characters, including at least one letter and at least one number, and is entered when the CO first engages the “enable” command. The CO enters the following syntax at the “#” prompt:

   ```
   enable secret [PASSWORD]
   ```

2. The CO must always assign passwords (of 8-25 characters, including at least one letter and at least one number) to users. Identification and authentication on the console/auxiliary port is required for Users. From the “configure terminal” command line, the CO enters the following syntax:

   ```
   line con 0
   password [PASSWORD]
   login local
   ```

3. The CO enables FIPS mode using the following command:

   ```
   Switch(config)# fips
   ```
4. The CO may configure the module to use RADIUS or TACACS+ for authentication. If the module is configured to use RADIUS, the Crypto-Officer must define RADIUS or shared secret keys that are at least 8 characters long, including at least one letter and at least one number.

5. The CO shall only assign users to a privilege level 1 (the default).

6. The CO shall not assign a command to any privilege level other than its default.

**Remote Access**

1. SSH access to the module is allowed in FIPS approved mode of operation, using SSH v2 and a FIPS approved algorithm.

2. HTTPS/TLS access to the module is allowed in FIPS approved mode of operation, using SSLv3.1/TLSv1.0 and the associated FIPS approved algorithms.

**Identifying Switch Operation in an Approved Mode**

The following activities are required to verify that the module is operating in an Approved mode of operation.

1. Verify that the tamper evidence labels have been properly placed on the module based on the instructions specified in the “Physical Security” and “Secure Operation” sections of this document.

2. Verify that the length of User and Crypto Officer passwords and all shared secrets are at least eight (8) characters long, include at least one letter, and include at least one number character, as specified in the “Secure Operation” section of this document.

3. Verified that the output of "The FIPS mode is on" was shown on the Command Line Interface after login Crypto Officer role.
Related Documentation
This document deals only with operations and capabilities of the security appliances in the technical terms of a FIPS 140-2 cryptographic device security policy. More information is available on the security appliances from the sources listed in this section and from the following source:

- The NIST Cryptographic Module Validation Program website (http://csrc.nist.gov/groups/STM/cmvp/index.html) contains contact information for answers to technical or sales-related questions for the security appliances.

Obtaining Documentation
Cisco documentation and additional literature are available on Cisco.com. Cisco also provides several ways to obtain technical assistance and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com
You can access the most current Cisco documentation at this URL:

http://www.cisco.com/techsupport

You can access the Cisco website at this URL:

http://www.cisco.com

You can access international Cisco websites at this URL:


Product Documentation DVD
Cisco documentation and additional literature are available in the Product Documentation DVD package, which may have shipped with your product. The Product Documentation DVD is updated regularly and may be more current than printed documentation.

The Product Documentation DVD is a comprehensive library of technical product documentation on portable media. The DVD enables you to access multiple versions of hardware and software installation, configuration, and command guides for Cisco products and to view technical documentation in HTML. With the DVD, you have access to the same documentation that is found on the Cisco website without being connected to the Internet. Certain products also have .pdf versions of the documentation available.

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http://www.cisco.com/go/marketplace/
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http://www.cisco.com/go/marketplace/

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San Jose, CA 95134-9883

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Cisco Product Security Overview

Cisco provides a free online Security Vulnerability Policy portal at this URL:


From this site, you can perform these tasks:
- Report security vulnerabilities in Cisco products.
- Obtain assistance with security incidents that involve Cisco products.
- Register to receive security information from Cisco.

A current list of security advisories and notices for Cisco products is available at this URL:

http://www.cisco.com/go/psirt

If you prefer to see advisories and notices as they are updated in real time, you can access a Product Security Incident Response Team Really Simple Syndication (PSIRT RSS) feed from this URL:

**Reporting Security Problems in Cisco Products**

Cisco is committed to delivering secure products. We test our products internally before we release them, and we strive to correct all vulnerabilities quickly. If you think that you might have identified a vulnerability in a Cisco product, contact PSIRT:

- **Emergencies** — security-alert@cisco.com

An emergency is either a condition in which a system is under active attack or a condition for which a severe and urgent security vulnerability should be reported. All other conditions are considered nonemergencies.

- **Nonemergencies** — psirt@cisco.com

In an emergency, you can also reach PSIRT by telephone:

- 1 877 228-7302
- 1 408 525-6532

**Tip**

We encourage you to use Pretty Good Privacy (PGP) or a compatible product to encrypt any sensitive information that you send to Cisco. PSIRT can work from encrypted information that is compatible with PGP versions 2.x through 8.x. Never use a revoked or an expired encryption key. The correct public key to use in your correspondence with PSIRT is the one linked in the Contact Summary section of the Security Vulnerability Policy page at this URL:


The link on this page has the current PGP key ID in use.

**Obtaining Technical Assistance**

Cisco Technical Support provides 24-hour-a-day award-winning technical assistance. The Cisco Technical Support & Documentation website on Cisco.com features extensive online support resources. In addition, if you have a valid Cisco service contract, Cisco Technical Assistance Center (TAC) engineers provide telephone support. If you do not have a valid Cisco service contract, contact your reseller.

**Cisco Technical Support & Documentation Website**

The Cisco Technical Support & Documentation website provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The website is available 24 hours a day, at this URL:

[http://www.cisco.com/techsupport](http://www.cisco.com/techsupport)

Access to all tools on the Cisco Technical Support & Documentation website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register at this URL:


**Note**
Use the Cisco Product Identification (CPI) tool to locate your product serial number before submitting a web or phone request for service. You can access the CPI tool from the Cisco Technical Support & Documentation website by clicking the Tools & Resources link under Documentation & Tools. Choose Cisco Product Identification Tool from the Alphabetical Index drop-down list, or click the Cisco Product Identification Tool link under Alerts & RMAs. The CPI tool offers three search options: by product ID or model name; by tree view; or for certain products, by copying and pasting show command output. Search results show an illustration of your product with the serial number label location highlighted. Locate the serial number label on your product and record the information before placing a service call.

**Submitting a Service Request**

Using the online TAC Service Request Tool is the fastest way to open S3 and S4 service requests. (S3 and S4 service requests are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Service Request Tool provides recommended solutions. If your issue is not resolved using the recommended resources, your service request is assigned to a Cisco engineer. The TAC Service Request Tool is located at this URL:

http://www.cisco.com/techsupport/servicerequest

For S1 or S2 service requests or if you do not have Internet access, contact the Cisco TAC by telephone. (S1 or S2 service requests are those in which your production network is down or severely degraded.) Cisco engineers are assigned immediately to S1 and S2 service requests to help keep your business operations running smoothly.

To open a service request by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)EMEA: +32 2 704 55 55USA: 1 800 553-2447

For a complete list of Cisco TAC contacts, go to this URL:

http://www.cisco.com/techsupport/contacts

**Definitions of Service Request Severity**

To ensure that all service requests are reported in a standard format, Cisco has established severity definitions.

Severity 1 (S1) – Your network is “down,” or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Severity 2 (S2) – Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Severity 3 (S3) – Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.
Severity 4 (S4) – You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- Cisco Marketplace provides a variety of Cisco books, reference guides, documentation, and logo merchandise. Visit Cisco Marketplace, the company store, at this URL:
  http://www.cisco.com/go/marketplace/

- *Cisco Press* publishes a wide range of general networking, training and certification titles. Both new and experienced users will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press at this URL:
  http://www.ciscopress.com

- *Packet* magazine is the Cisco Systems technical user magazine for maximizing Internet and networking investments. Each quarter, Packet delivers coverage of the latest industry trends, technology breakthroughs, and Cisco products and solutions, as well as network deployment and troubleshooting tips, configuration examples, customer case studies, certification and training information, and links to scores of in-depth online resources. You can access Packet magazine at this URL:
  http://www.cisco.com/packet

- *iQ Magazine* is the quarterly publication from Cisco Systems designed to help growing companies learn how they can use technology to increase revenue, streamline their business, and expand services. The publication identifies the challenges facing these companies and the technologies to help solve them, using real-world case studies and business strategies to help readers make sound technology investment decisions. You can access iQ Magazine at this URL:
  http://www.cisco.com/go/iqmagazine
  or view the digital edition at this URL:
  http://ciscoiq.texterity.com/ciscoiq/sample/

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:
  http://www.cisco.com/ipj

- Networking products offered by Cisco Systems, as well as customer support services, can be obtained at this URL:
• Networking Professionals Connection is an interactive website for networking professionals to share questions, suggestions, and information about networking products and technologies with Cisco experts and other networking professionals. Join a discussion at this URL:

http://www.cisco.com/discuss/networking

• World-class networking training is available from Cisco. You can view current offerings at this URL:


**Definition List**

AES – Advanced Encryption Standard  
CMVP – Cryptographic Module Validation Program  
CSEC – Communications Security Establishment Canada  
CSP – Critical Security Parameter  
CSFP – Compact Small Form-Factor Pluggable Transceiver  
FIPS – Federal Information Processing Standard  
HMAC – Hash Message Authentication Code  
HTTP – Hyper Text Transfer Protocol  
KAT – Known Answer Test  
LED – Light Emitting Diode  
MAC – Message Authentication Code  
NIST – National Institute of Standards and Technology  
NVRAM – Non-Volatile Random Access Memory  
RAM – Random Access Memory  
RNG – Random Number Generator  
SHA – Secure Hash Algorithm  
SFP - Small form-factor pluggable transceiver  
SFP+ - Enhanced Small Form-Factor Pluggable  
Triple-DES – Triple Data Encryption Standard