Junos-FIPS 10.4 L2 OS Cryptographic Module

Security Policy

For the M Series, MX Series and T Series Routers

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1. Module Overview

The Junos-FIPS 10.4 L2 OS Cryptographic Module for M Series, MX Series, and T Series routers (hereafter referred to as Junos-FIPS 10.4) executes on a multiple-chip embedded routing engine with Juniper Networks M Series Multiservice Edge Routers, Juniper Networks MX Series 3D Universal Edge Routers, and Juniper Networks T Series Core Routers. The validated version of Junos-FIPS 10.4 is 10.4R5; the image is `junos-juniper-10.4R5.3-fips.tgz`. See Table 1 below for hardware platform specifics.

Junos-FIPS 10.4 is a release of the Junos operating system, the first routing operating system designed specifically for the Internet. Junos is currently deployed in the largest and fastest-growing networks worldwide. A full suite of industrial-strength routing protocols, a flexible policy language, and a leading MPLS implementation efficiently scale to large numbers of network interfaces and routes.

Junos-FIPS 10.4, the logical cryptographic boundary, meets the requirements of the FIPS Publication 140-2. Junos-FIPS 10.4 is a firmware-only module designed to operate on Routing Engine (RE) hardware, which is equivalent to PC hardware. The firmware is executed by the processor and by the memory devices that contain the executable code and data. The cryptographic module's operational environment is a limited operational environment.

The physical cryptographic boundary is formed by embedding a RE within a platform chassis, which is provided by the M Series, MX Series, and T Series chassis. The combinations of the configurations are shown in Table 1. Figure 1 below represents the module boundary. Additional boundary configuration requirements are specified in Appendix A.

Table 1. Junos-FIPS 10.4 Series/Platform/RE

Series	Platform	Routing Engine
M Series	M120	RE-A-2000-4096 - 2GHz processor with 4GB of memory
	M320	RE-A-2000-4096 - 2GHz processor with 4GB of memory
MX Series	MX240	RE-S-2000-4096 - 2GHz processor with 4GB of memory
	MX480	RE-S-2000-4096 - 2GHz processor with 4GB of memory
	MX960	RE-S-2000-4096 - 2GHz processor with 4GB of memory
T Series	T1600	RE-A-2000-4096 - 2GHz processor with 4GB of memory

Figure 1. Diagram of the Cryptographic Module

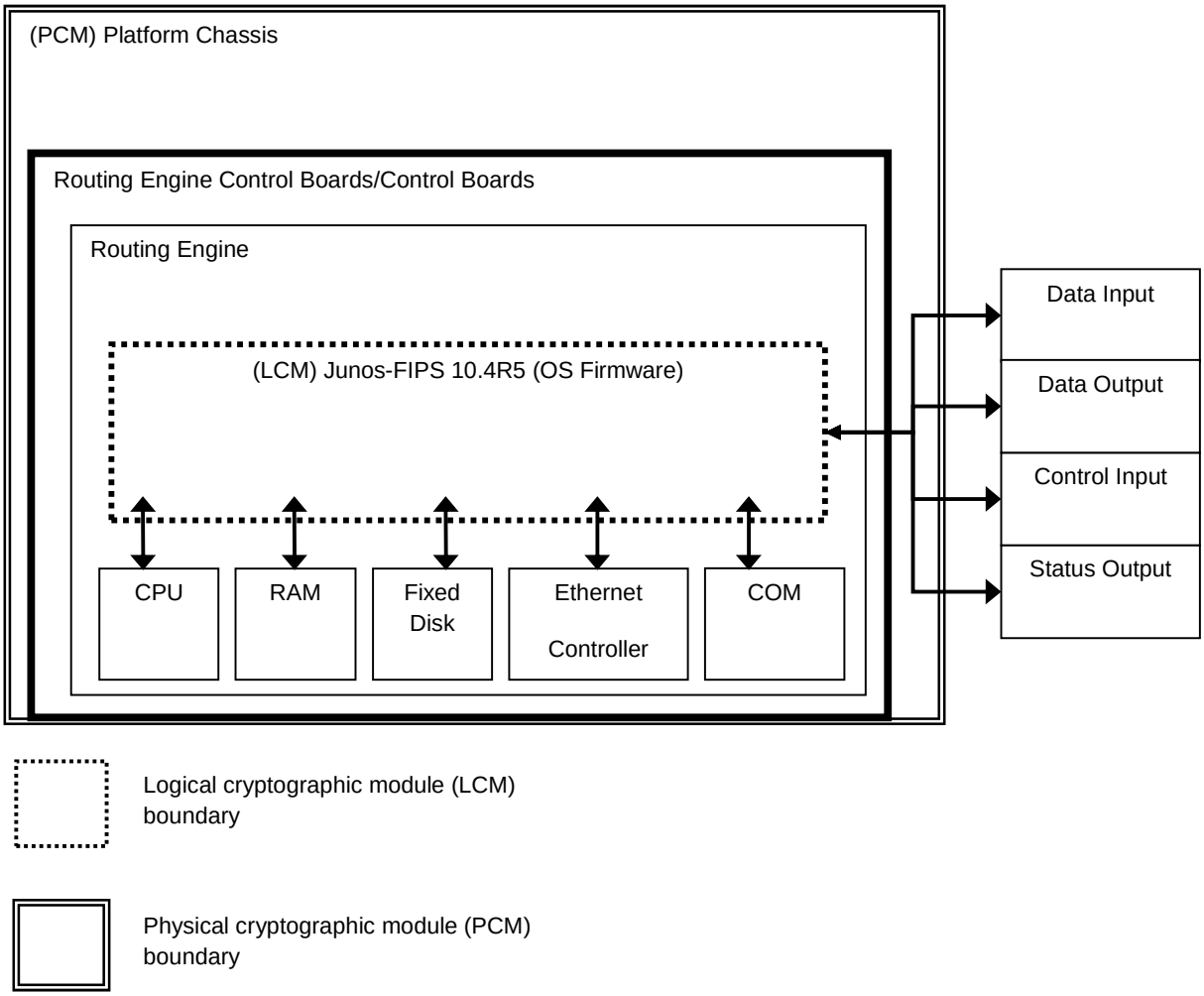


Figure 2. RE-A-2000

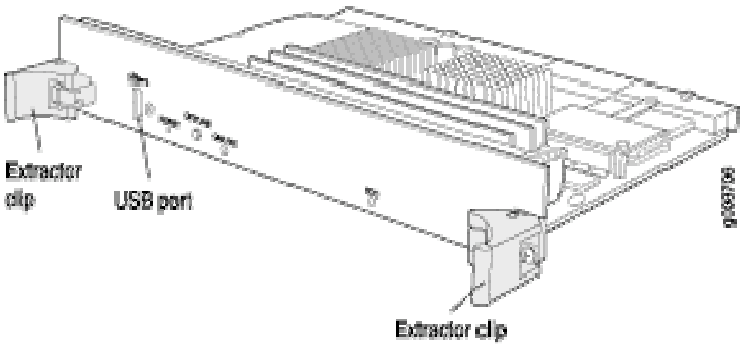


Figure 3. RE-S-2000

Figure 4. M120 with Routing Engine

Figure 4A. M120 FIPS Physical Boundary - M120 Chassis and Routing Engine RE-A-2000 is slots marked as RE0 and RE1

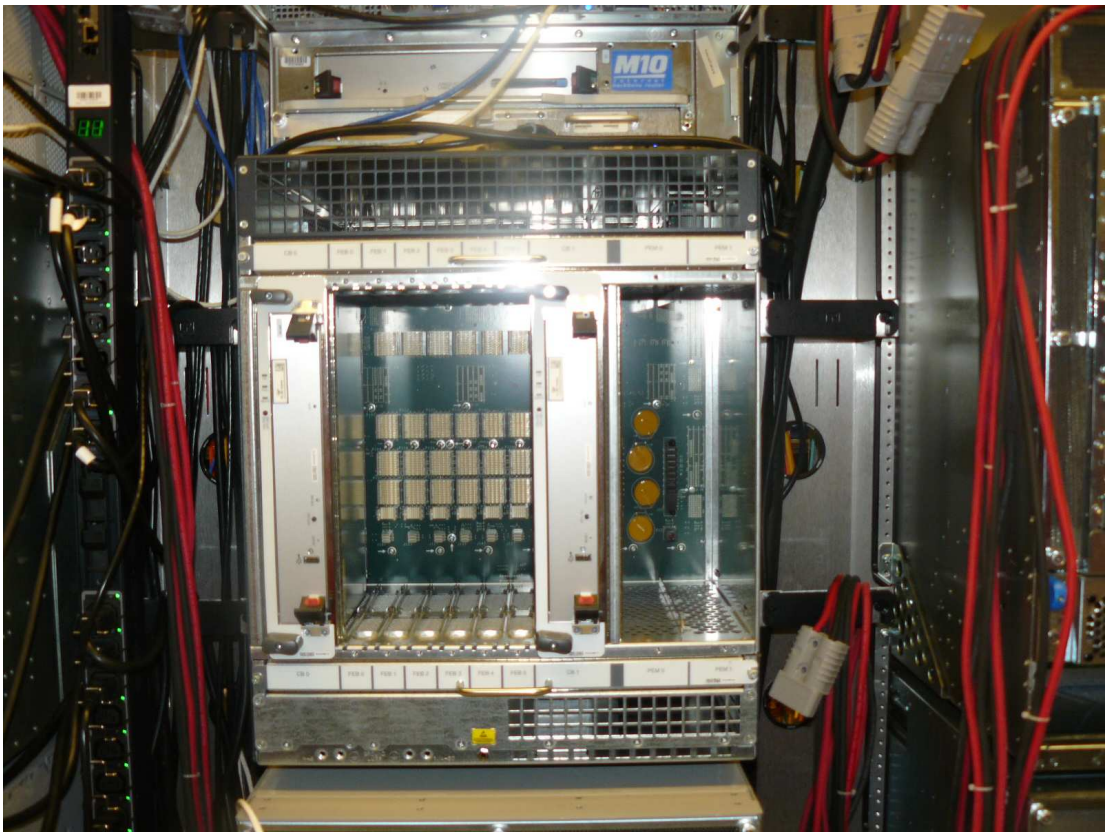


Figure 5. M320 with Routing Engine

Figure 5A. M320 FIPS Physical Boundary- M320 Chassis, Routing Engine RE-A-2000 in slots marked as RE0 and RE1 and Control Board in slot marked as CB0

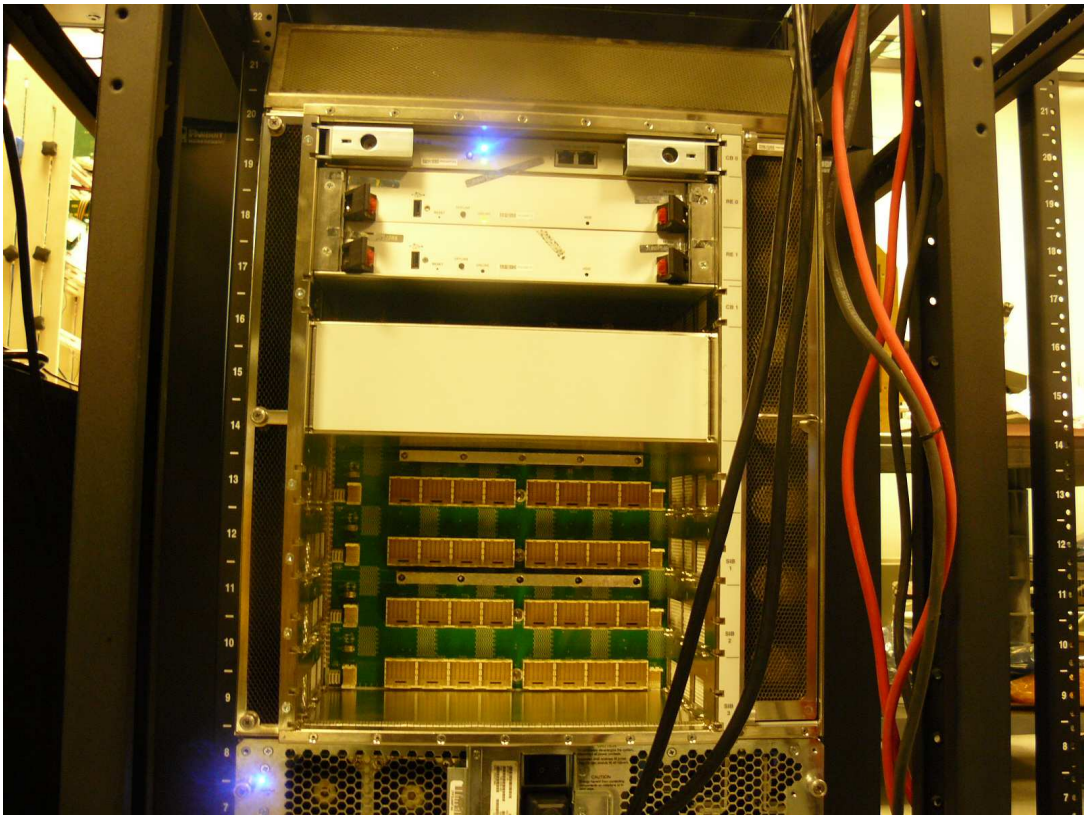


Figure 6. MX240 with Routing Engine

Figure 6A. MX240 FIPS Physical Boundary – MX240 Chassis, Routing Engine RE-S-2000 within RE housing in slots marked as RE0 and RE1

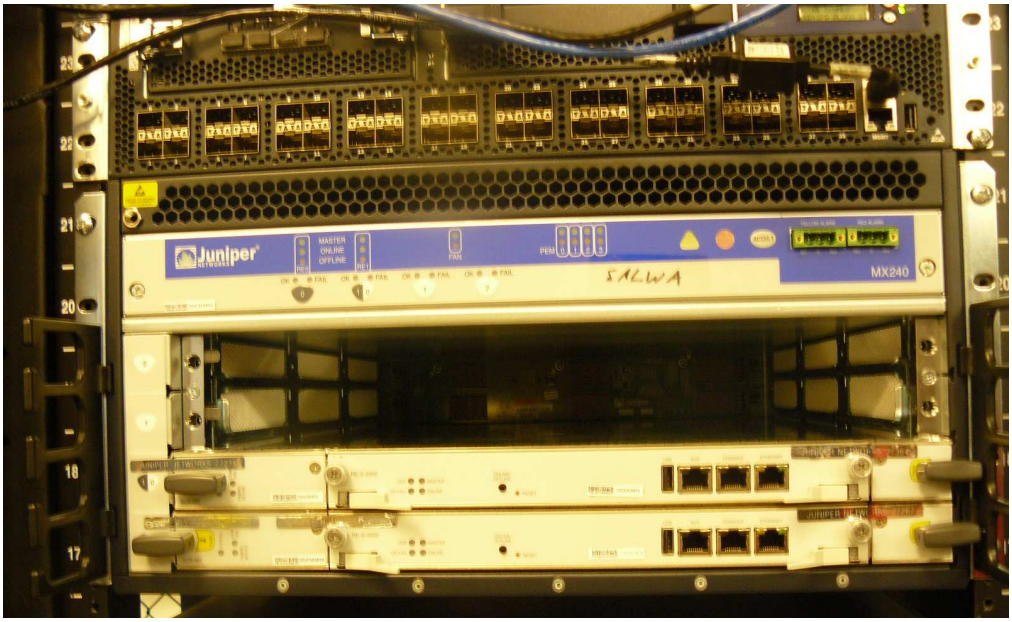


Figure 7. MX480 with Routing Engine

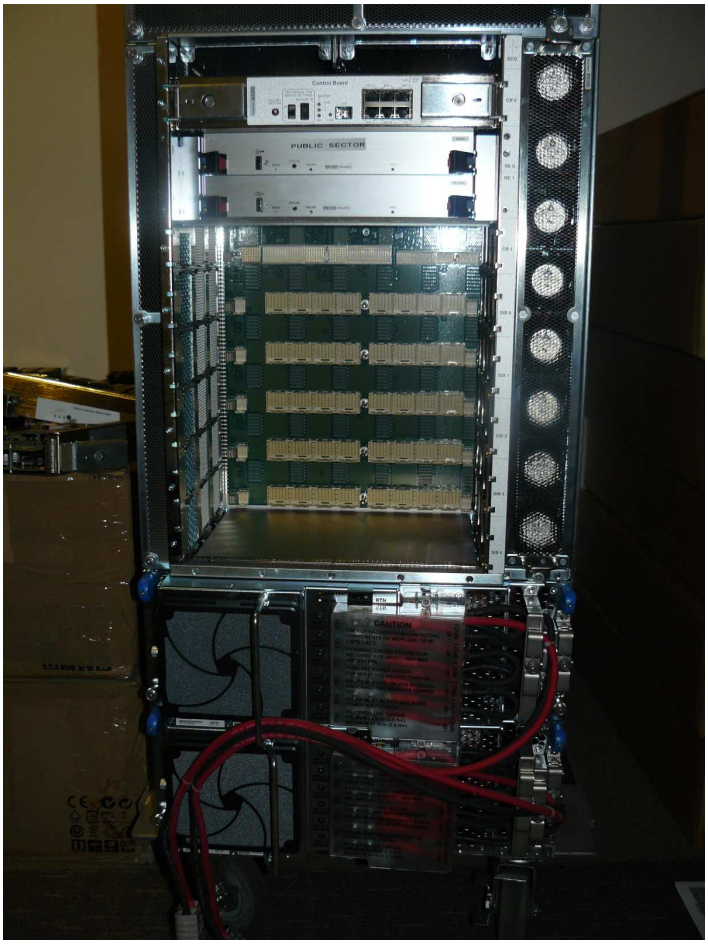
Figure7A. MX480 FIPS Physical Boundary - MX480 Chassis, Routing Engine RE-S-2000 within RE housing in slots marked as RE0 and RE1

Figure 8. MX960 with Routing Engine

Figure 8A. MX960 Physical Boundary- MX960 Chassis, RE-S-2000 in RE housing, in slots marked as 6 and 7, and a blanking plate in slot 8.

Figure 9. T1600 with Routing Engine

Figure 9A. T1600 FIPS Physical Boundary- T1600 Chassis RE-A-2000 in slots marked as RE1 and RE0, and Control Board in slot marked as CB0



2. Security Level

The cryptographic module, which is a multiple-chip embedded embodiment, meets the overall requirements applicable to Level 2 security of FIPS 140-2.

Table 2. Security Level

Security Requirements Section	Level
Cryptographic Module Specification	2
Module Ports and Interfaces	2
Roles, Services and Authentication	2
Finite State Model	2
Physical Security	2
Operational Environment	N/A
Cryptographic Key Management	2
EMI/EMC	2
Self-Tests	2
Design Assurance	3
Mitigation of Other Attacks	N/A

3. Modes of Operation

Approved Mode of Operation

The cryptographic module supports FIPS-Approved algorithms (see Appendix B — Cryptographic Algorithm Validation (CAVS) Certificates) as follows:

- AES 128, 192, 256 for encryption/decryption
- ECDSA with Curve P-192 for digital signature generation and verification
- DSA with 1024-bit keys for digital signature generation and verification
- RSA with 1024 or 2048-bit keys for digital signature generation and verification
- Triple-DES (three key) for encryption/decryption
- SHA-1 for hashing
- SHA-2 for hashing (SHA-224, SHA-256, SHA-384, SHA-512)
- HMAC-SHA-1
- HMAC-SHA-256
- AES-128-CMAC
- FIPS 186-2 RNG (with Change Notice)

The cryptographic module also supports the following non-Approved algorithms:

- RSA with 1024-bit keys (key wrapping; key establishment methodology provides 80 bits of encryption strength)
- MD5 for message digests (used during authentication, for the purposes of protocol interoperability – see Protocol Peer entries in Tables 3, 4, 5 and 6)
- Diffie-Hellman with 1024-bit keys (key agreement; key establishment methodology provides 80 bits of encryption strength)
- Non-Approved RNG (used to seed Approved FIPS 186-2 RNG)

The cryptographic module supports the commercially available TLS, IKEv1, and SSH-2 protocols for key establishment in accordance with FIPS 140-2 Annex D.

The cryptographic module relies on the implemented deterministic random number generator (RNG) that is compliant with FIPS 186-2 for generation of all cryptographic keys in accordance with FIPS 140-2 Annex C.

Non-FIPS Mode of Operation

The cryptographic module does not provide a non-Approved mode of operation.

4. Ports and Interfaces

The cryptographic module supports the following physical ports and corresponding logical interfaces:

- **Ethernet:** Data Input, Data Output, Control Input, Status Outputs
- **Serial:** Data Input, Data Output, Control Input, Status Outputs
- **Backplane:** Data Input, Data Output, Control Input, Status Outputs
- **Power interface:** Power Input
- **LEDs:** Status Output

The flow of input and output of data, control, and status is managed by the cryptographic module's defined service interfaces. These physical interfaces are mapped to the logical interfaces, which include SSH-2, TLS (Ethernet) and Console (Serial).

5. Identification and Authentication Policy

Assumption of Roles

The cryptographic module supports six distinct operator roles as follows:

- User
- Cryptographic Officer (CO)
- AS2-FIPS PIC
- RE-to-RE
- IKE Peer
- Protocol Peer

The cryptographic module shall enforce the separation of roles using either identity-based or role-based operator authentication; the cryptographic module meets Level 2 requirements because identity-based authentication is not enforced for all authorized services.

Table 3. Roles and Required Identification and Authentication

Role	Type of Authentication	Authentication Data
User	Identity-based operator authentication	• Via Console: Username and password • Via TLS: Username and password • Via SSH-2: Password or RSA signature verification or DSA signature verification
	Role-based authentication	• Via RADIUS or TACACS+: pre-shared secret, minimum 10 characters
Cryptographic Officer	Identity-based operator authentication	• Via Console: Username and password • Via TLS: Username and password • Via SSH-2: Password or RSA signature verification or DSA signature verification
	Role-based authentication	• Via RADIUS or TACACS+: pre-shared secret, minimum 10 characters
AS2-FIPS PIC	Identity-based operator authentication	Serial Number (6 bytes) and password (32 bytes)
RE-to-RE	Identity-based operator authentication	Pre-shared keys The RE role will use pre-shared keys for secure communication.

Role	Type of Authentication	Authentication Data
IKE Peer	Identity-based operator authentication	IKE pre-shared keys Uses IKE to establish keys to be used by the PIC for IPsec communication with IPsec clients.
Protocol Peer	Role-based authentication	Will use pre-shared keys to send encrypted traffic. Uses TCP/UDP MD5 MAC only to authenticate operator. Alternatively, a manually configured IPsec SA can be used for authentication.

Table 4. Strengths of Authentication Mechanisms

Authentication Mechanism	Strength of Mechanism
Username and password	The module enforces 10-character passwords (at minimum) chosen from the 96+ human readable ASCII characters. The module enforces a timed access mechanism as follows: For the first two failed attempts (assuming 0 time to process), no timed access is enforced. Upon the third attempt, the module enforces a 5-second delay. Each failed attempt thereafter results in an additional 5-second delay above the previous (e.g. 4^{th} failed attempt = 10-second delay, 5^{th} failed attempt = 15-second delay, 6^{th} failed attempt = 20-second delay, 7^{th} failed attempt = 25-second delay). This leads to a maximum of 7 possible attempts in a one-minute period for each getty. The best approach for the attacker would be to disconnect after 4 failed attempts, and wait for a new getty to be spawned. This would allow the attacker to perform roughly 9.6 attempts per minute (576 attempts per hour/60 mins); this would be rounded down to 9 per minute, because there is no such thing as 0.6 attempts. Thus the probability of a successful random attempt is $1/96^{10}$, which is less than 1/1 million. The probability of a success with multiple consecutive attempts in a one-minute period is $9/(96^{10})$, which is less than 1/100,000.
RSA signature	The module supports RSA (1024 or 2048-bit), which has a minimum equivalent computational resistance to attack of either 2^{80} or 2^{112} depending on the modulus size. Thus the probability of a successful random attempt is $1/(2^{80})$ or $1/(2^{112})$, which are both less than 1/1,000,000. The probability of a success with multiple consecutive attempts in a one-minute period is $5.6e7/(2^{80})$ or $5.6e7/(2^{112})$, which are both less than 1/100,000.
DSA signature	The module supports DSA (1024-bit only) which has an equivalent computational resistance to attack of 2^{80}. Thus the probability of a successful random attempt is $1/2^{80}$, which is less than 1/1,000,000. The probability of a success with multiple consecutive attempts in a one-minute period is $5.6e7/(2^{80})$, which is less than 1/100,000.
AS2-FIPS PIC password	The module supports 32 byte passwords to authenticate the PIC. Thus the probability of a successful random attempt is $1/(256^{32})$, which is less than 1/1,000,000. The probability of a success with multiple consecutive attempts in a one minute period is $5,084,005/(256^{32})$, which is less than 1/100,000.

RE-to-RE pre-shared keys	The module uses 160-bit HMAC keys for RE-to-RE authentication. Thus the probability of a successful random attempt is $1/(2^{160})$, which is less than 1/1,000,000. The probability of a success with multiple consecutive attempts in a one-minute period is $54,347,880/(2^{160})$, which is less than 1/100,000.
IKE pre-shared keys	The module uses 160-bit HMAC keys for the PIC to use for IPsec communication with IPsec clients. Thus the probability of a successful random attempt is $1/(2^{160})$, which is less than 1/1 million. The probability of a success with multiple consecutive attempts in a one minute period is $54,347,880/(2^{160})$, which is less than 1/100,000.
Protocol peer pre-shared keys	The module supports TCP-MD5 with a 128-bit pre-shared key. Thus the probability of a successful random attempt is $1/ (2^{128})$, which is less than 1/1,000,000. The probability of a success with multiple consecutive attempts in a one minute period is $54,347,880/(2^{128})$, which is less than 1/100,000.

6. Access Control Policy

Roles and Services

Table 5. Services Authorized for Roles

Role	Authorized Services
User: Configures and monitors the router via the console, SSH-2, or TLS.	• Configuration Management: Allows the user to configure the router. • Router Control: Allows the user to modify the state of the router. (Example: shutdown, reboot) • Status Checks: Allows the user to get the current status of the router • SSH-2: Provides encrypted login via the SSH-2 protocol. • TLS: Provides encrypted login via the TLS protocol. • Console Access: Provides direct login access via the console.
Cryptographic Officer: Configures and monitors the RE via the console, SSH-2, or TLS. Also has permissions to view and edit secrets within the RE.	• Configuration Management: Allows the CO to configure the router. • Router Control: Allows the user to modify the state of the router. (Example: shutdown, reboot) • Status Checks: Allows the user to get the current status of the router. • Zeroize: Allows the user to zeroize the configuration (all CSPs) within the module. • Load New Software: Allows the verification and loading of new software into the router. Note: Loading of software invalidates the module's FIPS 140-2 validation. • SSH-2: Provides encrypted login via the SSH-2 protocol. • TLS: Provides encrypted login via the TLS protocol. • Console Access: Provides direct login access via the console.

AS2-FIPS PIC	• Receives SAs: Allows the PIC to receive the SAs associated with a particular IPsec tunnel. • Secure IPC Tunnel: Allows the PIC to communicate with the RE using a secure tunnel.
RE-to-RE The RE role is able to communicate with other REs to enable failover capabilities.	• Configuration Management: Allows propagation of configuration database to the backup RE. • Router Control: Allows the master RE to control the state of the backup RE. • Status Checks: This service will allow the user to get the current status of the router (ports, number of packets, uptime, and so forth) • Secure Transport: Allows the master RE to communicate with the backup RE using a secure IPsec connection. • Secure IPC Tunnel: Allows the PIC to communicate with the RE using a secure tunnel.
IKE Peer This role performs IKE negotiation with the RE. The IKE peer will create SAs for the AS2-FIPS PIC to use when using IPsec with a VPN client in cyberspace.	• Key Agreement: Allows the negotiation of keys for use with an IPsec tunnel.
Protocol Peer This role allows remote router to communicate with the RE via standard networking protocols. The supported routing protocols (BGP, ISIS, LDP, MSDP, OSPF, RIP2, RSVP, VRRP, and NTP) authenticate peers to each other for purpose of updating routing tables.	• Mutual Authentication: Allows validating a known protocol peer. • Protocol Exchange: Allows the peers to communicate using an agreed-upon protocol. • Secure Protocol Transport: Allows IPsec connection between protocol peer and router.

Unauthenticated Services

The cryptographic module supports the following unauthenticated services:

- PIC Software Image Load: Downloads PIC software image to PIC.
- Receive Service Set Configuration: Allows the PIC to receive service set configuration database.
- Show Status: Provides the current status of the cryptographic module.
- Self-tests: Executes the suite of self-tests required by FIPS 140-2.
- Routing Protocols: Unauthenticated routing protocols (e.g., TCP, UDP)
- SNMP Traps (Status)

Definition of Critical Security Parameters (CSPs)

Table 6. Table of CSPs

CSP	Description
SSH-2 Private Host Key	The first time SSH-2 is configured, the key is generated. DSA. Used to identify the host.
SSH-2 Session Key	Session keys used with SSH-2, TDES (3 key), AES 128, 192, 256, HMAC-SHA-1 key (160), DH Private Key 1024
TLS Host Certificate, Private Portion	X.509 certificates for TLS for authentication. RSA or DSA
TLS Session Parameters	Session keys used with TLS, TDES (2 or 3 key), AES 128, 192, 256, HMAC-SHA-1; Pre-master Secret
User Authentication Key	HMAC-SHA-1 Key Used to authenticate users to the module.
CO Authentication Key	HMAC-SHA-1 Key Used to authenticate COs to the module.
IPsec SAs	Session keys used within IPsec. TDES (3 key), HMAC-SHA-1
IKE Session Parameters	Nonces, DH Private Key 1024-bit keys, TDES, HMAC-SHA-1, used within IKE
Secure IPC (Internal) Session Key	TDES (3 Key) Used to communicate securely between the RE and the PIC
RE-to-RE Authentication Key	HMAC Key (Manual IPsec SA) 160 bit key with 96 bit truncated MAC.
RE-to-RE Encryption Key	TDES key (Manual IPsec SA)
Protocol Peer Authentication Keys	TCP-MD5 key to authenticate the routing peer role for the following protocols: BGP, ISIS, LDP, MSDP, OSPF, RIP2, RSVP, VRRP, NTP, APSCP
ASPIC password	32 byte password
RADIUS shared secret	Used to authenticate COs and Users (10 chars minimum) This includes the Authentication Data Block
TACACS+ shared secret	Used to authenticate COs and Users (10 chars minimum) This includes the Authentication Data Block

CSP	Description
Manual SA for PIC	Entered into the RE, which is then passed over to the PIC for use by PIC with IPSEC
RNG Seed	Optional user input (XSEED)
RNG Seed-Key	Seed-key for RNG (XKEY)

Definition of Public Keys

Table 7. Table of Public Keys

Key	Description/Usage
SSH-2 Public Host Key	First time SSH-2 is configured, the key is generated. DSA. Identifies the host.
TLS Host Certificate, Public Portion	X.509 certificates for TLS for authentication. RSA (1024 or 2048-bit) or DSA
User Authentication Public Keys	Used to authenticate users to the module. RSA (1024 or 2048-bit) or DSA
CO Authentication Public Keys	Used to authenticate CO to the module. RSA (1024 or 2048-bit) or DSA
JuniperRootCA	RSA 2048-bit X.509 certificate Used to verify the validity of the Juniper image at software load and also at runtime for integrity.
EngineeringCA	RSA 2048-bit X.509 certificate Used to verify the validity of the Juniper image at software load and also at runtime for integrity.
PackageCA	RSA 2048-bit X.509 certificate Used to verify the validity of the Juniper image at software load and also at runtime for integrity.
PackageProduction	RSA 2048-bit X.509 certificate Certificate that holds the public key of the signing key that was used to generate all the signatures used on the packages and signature lists.
RE RSA Verify Key (Public Authentication key)	RSA 1024-bit key sent to the PIC to sign data to allow the PIC to authenticate to the RE by having the PIC sign data that is verified by the RE.
PIC RSA Verify (Public Authentication) Key	RSA 1024-bit key to allow the RE to authenticate to the PIC by signing data and having the PIC verify the signature.

PIC RSA Encrypt Key	RSA 1024-bit key used to encrypt the TDES session key.
RE RSA Encrypt Key	RSA 1024-bit key sent to the PIC; note that the PIC never uses this key.
DH Public Keys	Used within IKE and SSH-2 for key establishment.

Definition of CSP Modes of Access

Table 8 defines the relationship between access to CSPs and the different module services. The modes of access shown in the table are defined as follows:

Table 8. CSP Access Rights within Roles & Services

Role						Service	Cryptographic Keys and CSP Access Operation R=Read, W=Write, D=Delete
CO	User	RE-to-RE	AS2-FIPS PIC	IKE Peer	Prot. Peer		
X						Configuration Management	All CSPs (**R, W, D**)
	X					Configuration Management	No access to CSPs
		X				Configuration Management	All CSPs (**R, W**)
X	X	X				Router Control	No access to CSPs
X	X	X				Status Checks	No access to CSPs
X						Zeroize	All CSPs (**D**)
			X			Receives SAs	Relevant IPsec SAs (**R**)
				X		Key Agreement	IPsec SAs (**R**)
					X	Mutual Authentication	Relevant Authentication data: (**R**)
					X	Protocol Exchange (OSPF, VRRP, etc)	No access to CSPs
X						Load New Software	No access to CSPs
X	X					SSH-2	SSH-2 session key (**R**)
X	X					TLS	TLS session parameters (**R**)
X	X					Console Access	CO Authentication Key, User Authentication Key (**R**)

		X	X			Secure IPC Tunnel	Secure IPC (Internal) Session Key (**R**)
		X				Secure transport	RE-to-RE Encryption Key, RE-to-RE Authentication Key (**R**)
					X	Secure Protocol transport	Protocol Peer Authentication Keys **(R)**

7. Operational Environment

The FIPS 140-2 Area 6 Operational Environment requirements are not applicable because the cryptographic module is a limited operational environment.

8. Security Rules

The cryptographic module's design corresponds to the cryptographic module's security rules. This section documents the security rules enforced by the cryptographic module to implement the security requirements of this FIPS 140-2 Level 2 module.

1. The cryptographic module shall provide six distinct operator roles. These are the User role, the Cryptographic Officer role, RE-to-RE role, AS2-FIPS PIC role, IKE Peer role, and Protocol Peer role.
2. The cryptographic module shall support both role-based and identity-based authentication mechanisms.
3. Authentication of identity to an authorized role is required for all services that modify, disclose, or substitute CSPs, use Approved security functions, or otherwise affect the security of the cryptographic module.
4. The cryptographic module shall perform the following tests:
    - Power up tests
        A. Cryptographic algorithm tests
            i. DES - KAT[1]
            ii. TDES - KAT
            iii. AES - KAT
            iv. AES - CMAC KAT
            v. SHA-1 KAT
            vi. SHA-224, 256, 384, 512 KAT
            vii. HMAC-SHA-1 KAT
            viii. HMAC-SHA-256 KAT
            ix. ECDH KAT
            x. ECDSA pairwise consistency test (sign/verify) and KAT
            xi. RSA pairwise consistency test (sign/verify and encrypt/decrypt) and KAT
            xii. DSA pairwise consistency test (sign/verify) and KAT
            xiii. FIPS 186-2 RNG KAT
            xiv. KDF-IKEv1 KAT

        B. Firmware integrity test:
            i. RSA digital signature verification (PKCS1.5, 2048-bit key, SHA-1) and SHA-1 hash verification

        C. Critical functions tests
            i. Verification of Limited Environment
            ii. Verification of Integrity of Optional Packages

[1] The DES function is used to implement TDES and is not otherwise available for use in the cryptomodule.

- Conditional tests
    A. Pairwise consistency tests
        i. ECDSA Pairwise Consistency test
        ii. RSA pairwise consistency test (sign/verify and encrypt/decrypt)
        iii. DSA pairwise consistency test (sign/verify)
    B. Firmware load test: RSA digital signature verification (2048-bit key)
    C. Manual key entry test: duplicate key entries test
    D. Continuous random number generator test: performed on the Approved FIPS 186-2, Appendix 3.1 RNG, and on a non-Approved RNG that is used to seed the Approved RNG.
    E. Bypass test is not applicable.

5. Any time the cryptographic module is in an idle state, the operator shall be capable of commanding the module to perform the power-up self-test by power-cycling the module.
6. Prior to each use, the internal RNG shall be tested using the continuous random number generation conditional test.
7. Data output shall be inhibited during self-tests and error states.
8. Key generation, manual key entry and zeroization processes shall be logically isolated from data output.
9. Status information shall not contain CSPs or sensitive data that if misused could lead to a compromise of the module.
10. The module shall support concurrent operators.
11. The FIPS module is a combination of Routing Engine and Juniper router platform chassis in which the RE is installed. The Routing Engine must be installed in one of the approved platforms as listed in Table 1, per Juniper installation guidance. The installation shall include the placement of tamper labels installed in specific locations on the module. To operate in the FIPS Approved mode of operation, the module must be installed and tamper labels applied to the routing engine hardware as specified in Appendix A for the tamper label locations.
12. The Crypto Officer is responsible for properly controlling and installing tamper evident labels. Additionally, the Crypto Officer is responsible for the direct control and observation of any changes to the module such as reconfigurations where the tamper evident seals or security appliances are removed or installed to ensure the security of the module is maintained during such changes and that the module is returned to a FIPS Approved state.
13. The validation of the firmware is invalid upon porting of the firmware module to systems not defined in this security policy.

9. Physical Security Policy

Physical Security Mechanisms

The Junos-FIPS 10.4 firmware module's physical embodiment, as represented by the tested platform, is a multi-chip embedded routing engine that meets Level 2 physical security requirements.

Table 9. Inspection/Testing of Physical Security Mechanisms

Physical Security Mechanisms	Recommended Frequency of Inspection/Test	Inspection/Test Guidance Details
Tamper labels, opaque metal enclosure. To operate in the FIPS Approved mode of operation, the module Routing Engine must be installed within a specified chassis with tamper labels applied to the hardware as specified in Appendix A for the tamper label locations.	Upon receipt of the module and per security policy of end user. The Crypto-Officer must inspect all tamper label locations and embedded chassis components for proper configuration. The Routing Engine slot and tamper labels must be examined every time hardware configuration changes affect adjacent slots or the module routing engine. The Crypto-Officer shall ensure tampering of the module through the chassis openings has not occurred.	Labels should be free of any tamper evidence.

Tamper Label Evidence

Figure 10. Tampered Label

10. Mitigation of Other Attacks Policy

The module has not been designed to mitigate attacks that are outside the scope of FIPS 140-2.

Table 10. Mitigation of Other Attacks

Other Attacks	Mitigation Mechanism	Specific Limitations
N/A	N/A	N/A

11. Acronyms

ACRONYM	DESCRIPTION
AES	Advanced Encryption Standard
CB	Control Board
DES	Data Encryption Standard
DSA	Digital Signature Algorithm
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FIPS	Federal Information Processing Standard
GMPLS	General Multiprotocol Label Switching
HMAC-SHA-1	Keyed-Hash Message Authentication Code
IKE	Internet Key Exchange Protocol
IPsec	Internet Protocol Security
MD5	Message Digest 5
MPLS	Multiprotocol Label Switching
PCG	Packet Forwarding Engine (PFE) Clock Generator (PCG)
PIC	Physical Interface Card
RADIUS	Remote Authentication Dial-In User Service
RE	Routing Engine
RNG	Random Number Generator (aka. Pseudo Random Number Generator)
RSA	Public-key encryption technology developed by RSA Data Security, Inc. The acronym stands for Rivest, Shamir, and Adelman.
SA	Security Association
SHA-1	Secure Hash Algorithms
SSH-2	Secure Shell
SSL	Secure Sockets Layer

TACACS	Terminal Access Controller Access Control System
TCP	Transmission Control Protocol
TDES	Triple - Data Encryption Standard
TLS	Transport Layer Security
UDP	User Datagram Protocol

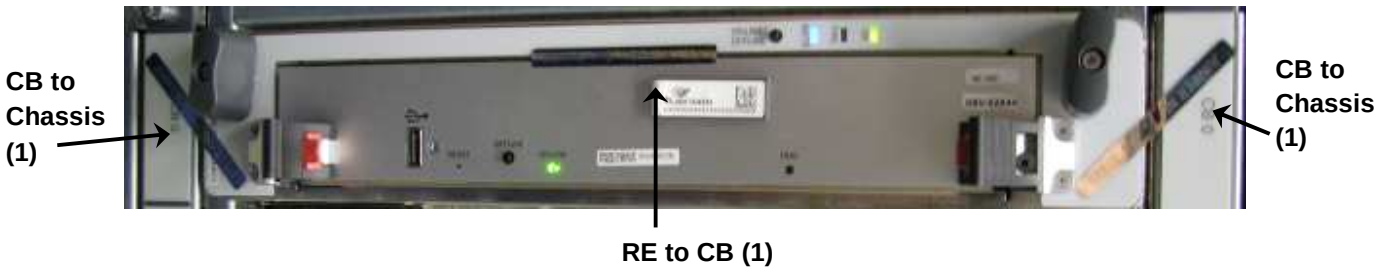
Appendix A, Tamper Label Placements

Tamper Label Placement
Label Application Instructions

For all label applications, observe the following instructions:

- Handle the labels with care. Do not touch the adhesive side.
- All surfaces to which the labels will be applied must be clean and dry. Ensure all surfaces are clean and clear of any residue.
- Apply with firm pressure across the label to ensure adhesion. Allow at least 1 hour for the adhesive to cure.

Figure 11. M120 with Two Routing Engines Tamper Label Placement (6 Tamper Labels)



The M120 houses the two RE-A-2000-4096. The physical boundary is the M120 chassis containing two routing engine units each mounted in an M120 control board tray and sealed in place with three (3) tamper evident labels. The label placement for the physical boundary is identified in the figure above. Note that the additional slots of the M120 chassis are not part of the physical boundary, and the boundary traces the routing engine unit mounted in an M120 control board tray and the inside of the M120 chassis.

Figure 12. M320 with Routing Engine Tamper Label Placement (5 Tamper Labels)

The M320 houses the RE-A-2000-4096. The physical boundary is the M320 chassis containing two routing engine units mounted next to a control board and sealed in place with five (5) tamper evident labels. The label placement for the physical boundary is identified in the figure above. Note that the additional slots of the M320 chassis are not part of the physical boundary, and the boundary traces the two routing engine units mounted next to a control board and the inside of the M320 chassis.

Figure 13. MX240, MX480, and MX960 with Routing Engine Tamper Label Placement (6 Tamper Labels)

The MX240, MX480 and MX960 house the RE-S-2000-4096. The physical boundary is the MX240, MX480 and MX960 chassis, two routing engine units are mounted within the control board trays with the bottom tray protected by the chassis and sealed in place with six (6) tamper evident labels. Note that the additional slots of the MX240, MX480 and MX960 chassis are not part of the physical boundary, and the boundary traces the two routing engine units are mounted within the control board trays and the inside of the MX240, MX480 and MX960 chassis.

Figure 14. T1600 with Routing Engine Tamper Label Placement (6 Tamper Labels)

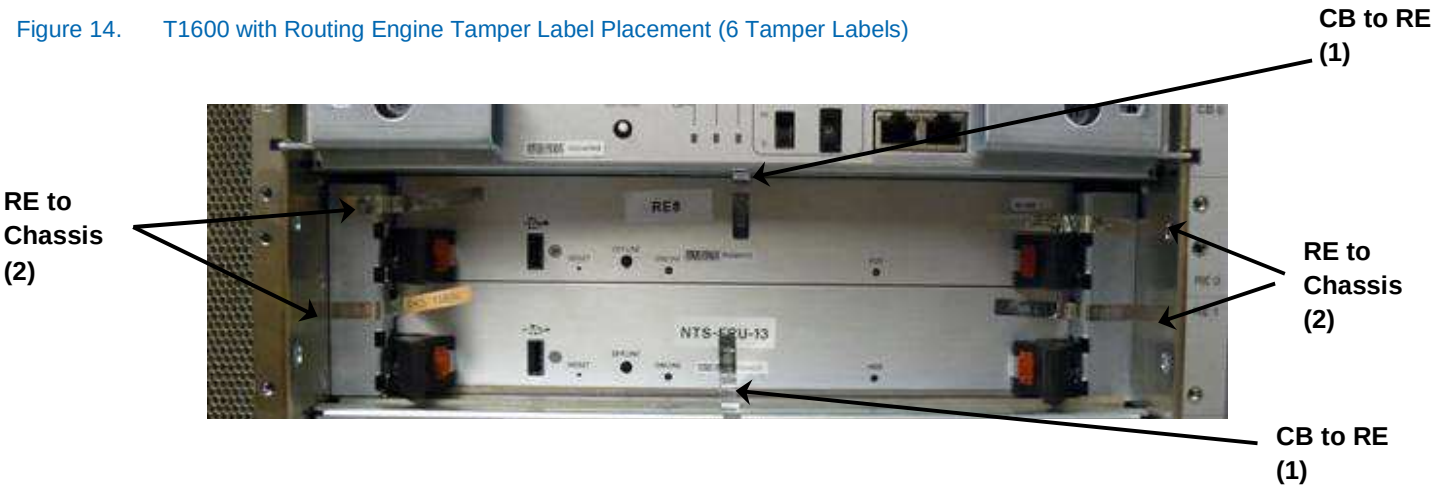


Figure 15. Alternate View - T1600 with Routing Engine Tamper Label Corner Placement for CB to RE

The T1600 houses the RE-A-2000-4096. The physical boundary is the T1600 chassis, two routing engines and control board units are mounted and sealed in place with six (6) tamper evident labels. The label placement for the physical boundary is identified in Figure 14 by the red highlights. Figure 15 shows the topography and proper corner placement between the control boards and routing engines. Note that the additional slots of the T1600 chassis are not part of the physical boundary, and the boundary traces the two routing engines, two control board units, and the inside of the T1600 chassis.

Appendix B — Cryptographic Algorithm Validation (CAVS) Certificates

	ALGORITHM	CAVS VALIDATION #
RNG	RNG	909
SSH-IPSEC	AES	1727
	TDES	1113
	SHA	1510
	HMAC	1002
Kernel	AES	1726
	TDES	1112
	SHA	1509
	HMAC	1001
MD	SHA	1508
	HMAC	1000
OpenSSL	AES	1719
	TDES	1106
	DSA	531
	SHA	1502
	RSA	847
	HMAC	994
	ECDSA	225

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