ORACLE
Communications

FIPS 140-3 Non-Proprietary Security Policy

Oracle Communications

Acme Packet 1100, Acme Packet 3900, Acme Packet 3950 and Acme Packet 4900

Prepared by:

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Hardware and Software, Engineered to Work Together

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1 General

1.1 Overview

This document is the FIPS 140-3 Non-Proprietary Security Policy for the Acme Packet 1100, Acme Packet 3900, Acme Packet 3950 and Acme Packet 4900 appliances (running firmware version: S-Cz9.3) manufactured by Oracle Communications, hereafter referred to as "the module" or "module". This Security Policy specifies the security rules under which the module shall operate to meet the requirements of FIPS 140-3 Overall Security Level 1. It also describes how the Acme Packet 1100, Acme Packet 3900, Acme Packet 3950 and Acme Packet 4900 appliances function to meet the FIPS requirements, and the actions that operators must take to maintain the security of the modules.

This Security Policy describes the features and design of the Acme Packet 1100, Acme Packet 3900, Acme Packet 3950 and Acme Packet 4900 modules using the terminology contained in the FIPS 140-3 specification. FIPS 140-3, Security Requirements for Cryptographic Modules specifies the security requirements that will be satisfied by a cryptographic module utilized within a security system protecting sensitive but unclassified information. The NIST/CCCS Cryptographic Module Validation Program (CMVP) validates cryptographic modules to FIPS 140-3. Validated products are accepted by the Federal agencies of both the USA and Canada for the protection of sensitive or designated information.

1.2 Security Levels

Section	Title	Security Level
1	General	1
2	Cryptographic module specification	1
3	Cryptographic module interfaces	1
4	Roles, services, and authentication	2
5	Software/Firmware security	1
6	Operational environment	1
7	Physical security	1
8	Non-invasive security	N/A
9	Sensitive security parameter management	1
10	Self-tests	1
11	Life-cycle assurance	1
12	Mitigation of other attacks	N/A
	Overall Level	1

Table 1: Security Levels

1.3 Additional Information

Except for this Non-Proprietary Security Policy, the FIPS 140-3 Validation Documentation is proprietary to Oracle and is releasable only under appropriate non-disclosure agreements. For access to these documents, please contact Oracle.

2 Cryptographic Module Specification

2.1 Description

Purpose and Use:

The Acme Packet 1100, Acme Packet 3900, Acme Packet 3950 and Acme Packet 4900 are Enterprise Session Border Controllers. The Acme Packet 4900 can also be configured as a Session Router. The module is designed to securely manage, control, and protect real-time IP-based communications such as voice, video, and unified communications across trusted and untrusted network boundaries. The module is intended for use in government, enterprise, and carrier-grade environments.

Module Type: Hardware

Module Embodiment: Multi-Chip Standalone

Cryptographic Boundary:

The cryptographic boundary for the Acme Packet 1100, Acme Packet 3900, Acme Packet 3950 and Acme Packet 4900 is defined as the module case and all components within the case.

A representation of the cryptographic boundary is shown in the Figures below:

Figure 1: Acme Packet 1100

Figure 2: Acme Packet 3900

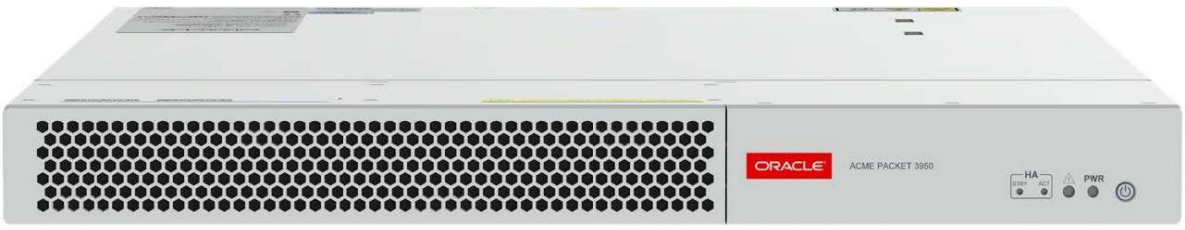

Figure 3: Acme Packet 3950

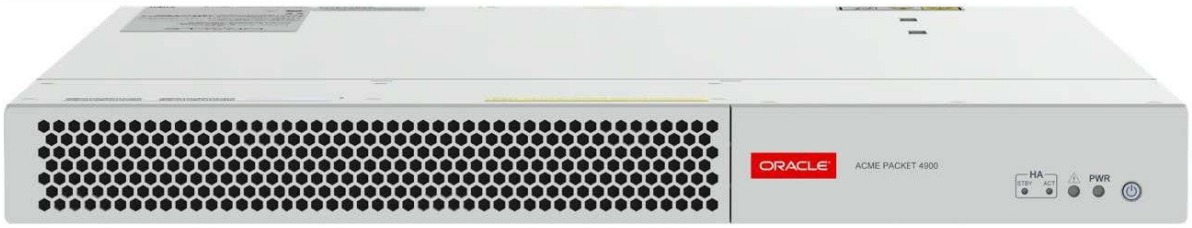

Figure 4: Acme Packet 4900

2.2 Tested and Vendor Affirmed Module Version and Identification

Tested Module Identification – Hardware:

Model and/or Part Number	Hardware Version	Firmware Version	Processors	Features
Acme Packet 1100	1100	S-Cz9.3	Intel Atom C2358	
Acme Packet 3900	3900	S-Cz9.3	Intel Xeon D-1548	
Acme Packet 3950	3950	S-Cz9.3	Intel Xeon D-2166NT	
Acme Packet 4900	4900	S-Cz9.3	Intel Xeon D-2166NT	

Table 2: Tested Module Identification – Hardware

2.3 Excluded Components

There are no components within the cryptographic boundary that are excluded from the FIPS 140-3 security requirements.

2.4 Modes of Operation

Modes List and Description:

Mode Name	Description	Type	Status Indicator
Approved Mode	When installed, initialized and configured as specified in Section 11 of the Security Policy, the module only runs in the approved mode of operation.	Approved	Global

Table 3: Modes List and Description

2.5 Algorithms

Approved Algorithms:

Oracle Acme Packet Mocana Cryptographic Library

Algorithm	CAVP Cert	Properties	Reference
AES-CBC	A6580	Direction - Decrypt, Encrypt Key Length - 128, 192, 256	SP 800-38A
AES-CTR	A6580	Direction - Decrypt, Encrypt Key Length - 128, 192, 256	SP 800-38A
HMAC-SHA2-256	A6580	Key Length - Key Length: 112-524288 Increment 8	FIPS 198-1
HMAC-SHA2-384	A6580	Key Length - Key Length: 112-524288 Increment 8	FIPS 198-1
HMAC-SHA2-512	A6580	Key Length - Key Length: 112-524288 Increment 8	FIPS 198-1
KAS-FFC-SSC Sp800-56Ar3	A6580	Domain Parameter Generation Methods - MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192 Scheme - dhEphem - KAS Role - initiator, responder	SP 800-56A Rev. 3
KDF IKEv2 (CVL)	A6580	Diffie-Hellman Shared Secret Length - Diffie-Hellman Shared Secret Length: 2048	SP 800-135 Rev. 1

Algorithm	CAVP Cert	Properties	Reference
		Derived Keying Material Length - Derived Keying Material Length: 1024-2048 Increment 8 Hash Algorithm - SHA2-256, SHA2-384, SHA2-512	
RSA SigGen (FIPS186-4)	A6580	Signature Type - PKCS 1.5 Modulo - 2048, 4096	FIPS 186-4
RSA SigVer (FIPS186-4)	A6580	Signature Type - PKCS 1.5 Modulo - 2048, 4096	FIPS 186-4
Safe Primes Key Generation	A6580	Safe Prime Groups - MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192	SP 800-56A Rev. 3
Safe Primes Key Verification	A6580	Safe Prime Groups - MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192	SP 800-56A Rev. 3
SHA-1	A6580	Message Length - Message Length: 8-51200 Increment 8	FIPS 180-4
SHA2-256	A6580	Message Length - Message Length: 8-51200 Increment 8	FIPS 180-4
SHA2-384	A6580	Message Length - Message Length: 8-51200 Increment 8	FIPS 180-4
SHA2-512	A6580	Message Length - Message Length: 8-65536 Increment 8	FIPS 180-4

Table 4: Approved Algorithms - Oracle Acme Packet Mocana Cryptographic Library

Oracle Acme Packet Cryptographic Library

Algorithm	CAVP Cert	Properties	Reference
AES-CBC	A6582	Direction - Decrypt, Encrypt Key Length - 128, 192, 256	SP 800-38A
AES-CCM	A6582	Key Length - 128	SP 800-38C
AES-CFB128	A6582	Direction - Decrypt, Encrypt Key Length - 128	SP 800-38A
AES-CTR	A6582	Direction - Decrypt, Encrypt Key Length - 128, 192, 256	SP 800-38A
AES-ECB	A6582	Direction - Decrypt, Encrypt Key Length - 128, 256	SP 800-38A
AES-GCM	A6582	Direction - Decrypt, Encrypt IV Generation - Internal IV Generation Mode - 8.2.1 Key Length - 128, 256	SP 800-38D
Counter DRBG	A6582	Prediction Resistance - No Mode - AES-256 Derivation Function Enabled - Yes	SP 800-90A Rev. 1
ECDSA KeyGen (FIPS186-5)	A6582	Curve - P-256, P-384 Secret Generation Mode - testing candidates	FIPS 186-5
ECDSA SigGen (FIPS186-5)	A6582	Curve - P-256, P-384 Hash Algorithm - SHA2-256, SHA2-384	FIPS 186-5
ECDSA SigVer (FIPS186-5)	A6582	Curve - P-256, P-384 Hash Algorithm - SHA2-256, SHA2-384	FIPS 186-5
Hash DRBG	A6582	Prediction Resistance - No Mode - SHA-1	SP 800-90A Rev. 1
HMAC-SHA-1	A6582	Key Length - Key Length: 112-524288 Increment 8	FIPS 198-1
HMAC-SHA2-256	A6582	Key Length - Key Length: 112-524288 Increment 8	FIPS 198-1
HMAC-SHA2-384	A6582	Key Length - Key Length: 112-524288 Increment 8	FIPS 198-1
HMAC-SHA2-512	A6582	Key Length - Key Length: 112-524288 Increment 8	FIPS 198-1
KAS-ECC-SSC Sp800-56Ar3	A6582	Domain Parameter Generation Methods - P-256, P-384 Scheme - ephemeralUnified - KAS Role - initiator, responder	SP 800-56A Rev. 3
KAS-FFC-SSC Sp800-56Ar3	A6582	Domain Parameter Generation Methods - ffdhe2048, MODP-2048, MODP-4096, MODP-8192 Scheme - dhEphem - KAS Role - initiator, responder	SP 800-56A Rev. 3

Algorithm	CAVP Cert	Properties	Reference
KDF SNMP (CVL)	A6582	Password Length - Password Length: 64-128 Increment 8	SP 800-135 Rev. 1
KDF SRTP (CVL)	A6582	AES Key Length - 128, 256	SP 800-135 Rev. 1
KDF SSH (CVL)	A6582	Cipher - AES-128, AES-192, AES-256 Hash Algorithm - SHA-1, SHA2-256	SP 800-135 Rev. 1
RSA KeyGen (FIPS186-5)	A6582	Key Generation Mode - probable Modulo - 2048, 3072, 4096 Primality Tests - 2pow100 Private Key Format - standard	FIPS 186-5
RSA SigGen (FIPS186-5)	A6582	Modulo - 2048, 3072, 4096 Signature Type - pkcs1v1.5, pss	FIPS 186-5
RSA SigVer (FIPS186-5)	A6582	Modulo - 2048, 3072, 4096 Signature Type - pkcs1v1.5, pss	FIPS 186-5
Safe Primes Key Generation	A6582	Safe Prime Groups - ffdhe2048, MODP-2048, MODP-4096, MODP-8192	SP 800-56A Rev. 3
Safe Primes Key Verification	A6582	Safe Prime Groups - ffdhe2048, MODP-2048, MODP-4096, MODP-8192	SP 800-56A Rev. 3
SHA-1	A6582	Message Length - Message Length: 8-51200 Increment 8	FIPS 180-4
SHA2-256	A6582	Message Length - Message Length: 8-51200 Increment 8	FIPS 180-4
SHA2-384	A6582	Message Length - Message Length: 8-65536 Increment 8	FIPS 180-4
SHA2-512	A6582	Message Length - Message Length: 8-65536 Increment 8	FIPS 180-4
TLS v1.2 KDF RFC7627 (CVL)	A6582	Hash Algorithm - SHA2-256, SHA2-384	SP 800-135 Rev. 1
TLS v1.3 KDF (CVL)	A6582	HMAC Algorithm - SHA2-256, SHA2-384 KDF Running Modes - DHE	SP 800-135 Rev. 1

Table 5: Approved Algorithms - Oracle Acme Packet Cryptographic Library

Vendor-Affirmed Algorithms:

Name	Properties	Implementation	Reference
CKG	Key Type:Symmetric and Asymmetric	N/A	SP800-133rev2: Section 4, example 1

Table 6: Vendor-Affirmed Algorithms

Non-Approved, Allowed Algorithms:

N/A for this module.

Non-Approved, Allowed Algorithms with No Security Claimed:

N/A for this module.

Non-Approved, Not Allowed Algorithms:

N/A for this module.

2.6 Security Function Implementations

Name	Type	Description	Properties	Algorithms
IKE Encrypt/Decrypt	BC-UnAuth			AES-CBC: (A6580) AES-CTR: (A6580)
IKE Message Authentication	MAC			HMAC-SHA2-256: (A6580) HMAC-SHA2-384: (A6580) HMAC-SHA2-512:

Name	Type	Description	Properties	Algorithms
				(A6580) SHA2-256: (A6580) SHA2-384: (A6580) SHA2-512: (A6580)
IPSec Encrypt/Decrypt	BC-UnAuth			AES-CBC: (A6582) AES-CTR: (A6582)
IPSec Message Authentication	MAC			HMAC-SHA2-256: (A6582) HMAC-SHA2-384: (A6582) HMAC-SHA2-512: (A6582) SHA2-256: (A6582) SHA2-384: (A6582) SHA2-512: (A6582)
IKE/IPSec KAS	KAS-Full		IG D.F:Scenario 2 Path 2 / Bit Strength: Provides between 112 and 200 bits of encryption strength	KAS-FFC-SSC Sp800-56Ar3: (A6580) KDF IKEv2: (A6580)
IKE KDF	KAS-135KDF			KDF IKEv2: (A6580)
IKE Digital Signature Verification	DigSig-SigVer			RSA SigVer (FIPS186-4): (A6580) SHA-1: (A6580) SHA2-256: (A6580) SHA2-384: (A6580)
IKE Digital Signature Generation	DigSig-SigGen			RSA SigGen (FIPS186-4): (A6580) SHA2-256: (A6580) SHA2-384: (A6580)
IKE Key Pair Generation	AsymKeyPair-KeyGen			RSA KeyGen (FIPS186-5): (A6582) Modulo: 2048, 4096
KAS SafePrimes KeyGen 1	AsymKeyPair-KeyGen			Safe Primes Key Generation: (A6580) Safe Primes Key Verification: (A6580)
SNMP Encrypt/Decrypt	BC-UnAuth			AES-CFB128: (A6582)
SNMP Message Authentication	MAC			HMAC-SHA2-256: (A6582) HMAC-SHA2-512: (A6582) SHA2-256: (A6582) SHA2-512: (A6582)
TLS Encrypt/Decrypt	BC-Auth			AES-CCM: (A6582) AES-GCM: (A6582)
TLS Message Authentication	MAC			HMAC-SHA2-256: (A6582) HMAC-SHA2-384: (A6582) SHA2-256: (A6582) SHA2-384: (A6582)
SRTP Encrypt/Decrypt	BC-Auth BC-UnAuth			AES-CTR: (A6582) Key Length: 128, 256 AES-GCM: (A6582) Key Length: 256

Name	Type	Description	Properties	Algorithms
SRTP Message Authentication	MAC			HMAC-SHA-1: (A6582) MAC: 80 SHA-1: (A6582)
SSH Encrypt/Decrypt	BC-Auth BC-UnAuth			AES-CTR: (A6582) AES-GCM: (A6582)
SSH Message Authentication	MAC			HMAC-SHA-1: (A6582) MAC: 96, 160 HMAC-SHA2-256: (A6582) SHA-1: (A6582) SHA2-256: (A6582)
SSH Key Transport 1	KTS-Wrap		IG D.G:Approved Bullet 2 / Bit Strength: Provides 128 or 256 bits of encryption strength	AES-GCM: (A6582)
SSH Key Transport 2	KTS-Wrap		IG D.G:Approved Bullet 2 / Bit Strength: Provides between 128 and 256 bits of encryption strength	AES-CTR: (A6582) HMAC-SHA-1: (A6582) HMAC-SHA2-256: (A6582)
TLS Key Transport	KTS-Wrap		IG D.G:Approved Bullet 2 / Bit Strength: Provides 128 or 256 bits of encryption strength	AES-GCM: (A6582)
DRBG 1	DRBG			Counter DRBG: (A6582) AES-ECB: (A6582)
DRBG 2	DRBG			Hash DRBG: (A6582) SHA-1: (A6582)
TLS Key Pair Generation	AsymKeyPair-KeyGen			ECDSA KeyGen (FIPS186-5): (A6582) RSA KeyGen (FIPS186-5): (A6582) Modulo: 2048, 4096
TLS Digital Signature Generation	DigSig-SigGen			ECDSA SigGen (FIPS186-5): (A6582) RSA SigGen (FIPS186-5): (A6582) Modulo: 2048, 4096
TLS Digital Signature Verification	DigSig-SigVer			ECDSA SigVer (FIPS186-5): (A6582) RSA SigVer (FIPS186-5): (A6582) Modulo: 2048, 4096
Bypass Integrity Check	MAC			HMAC-SHA2-256: (A6582) SHA2-256: (A6582)
TLS KAS 1	KAS-Full		IG D.F:Scenario 2 Path 2 / Bit Strength: Provides 128 or 192 bits of encryption strength	KAS-ECC-SSC Sp800-56Ar3: (A6582) TLS v1.2 KDF RFC7627: (A6582) TLS v1.3 KDF: (A6582)
TLS KAS 2	KAS-Full		IG D.F:Scenario 2 Path 2 / Bit Strength:	KAS-FFC-SSC Sp800-56Ar3: (A6582) Domain Parameter

Name	Type	Description	Properties	Algorithms
			Provides 112 bits of encryption strength	Generation Method: ffdhe2048 TLS v1.2 KDF RFC7627: (A6582) TLS v1.3 KDF: (A6582)
SSH KAS	KAS-Full		IG D.F:Scenario 2 Path 2 / Bit Strength: Provides between 112 and 200 bits of encryption strength	KAS-FFC-SSC Sp800-56Ar3: (A6582) Domain Parameter Generation Methods: MODP-2048, MODP-4096, MODP-8192 KDF SSH: (A6582)
SNMP KDF	KAS-135KDF			KDF SNMP: (A6582)
SRTP KDF	KAS-135KDF			KDF SRTP: (A6582)
SSH KDF	KAS-135KDF			KDF SSH: (A6582)
SSH Key Pair Generation	AsymKeyPair-KeyGen			RSA KeyGen (FIPS186-5): (A6582)
SSH Signature Generation	DigSig-SigGen			RSA SigGen (FIPS186-5): (A6582) Signature type: pkcs1v1.5
SSH Signature Verification	DigSig-SigVer			RSA SigVer (FIPS186-5): (A6582) Signature type: pkcs1v1.5
TLS KDF	KAS-135KDF			TLS v1.2 KDF RFC7627: (A6582) TLS v1.3 KDF: (A6582)
Verify Firmware Integrity	DigSig-SigVer			RSA SigVer (FIPS186-5): (A6582) Signature Type: pss Modulus: 2048 Hash: SHA2-256
Entropy Source	ENT-ESV			
KAS ECDSA KeyGen	AsymKeyPair-KeyGen			ECDSA KeyGen (FIPS186-5): (A6582)
KAS SafePrimes KeyGen 2	AsymKeyPair-KeyGen			Safe Primes Key Generation: (A6582) Safe Primes Key Verification: (A6582)
Generate Symmetric Key	CKG			CKG: ()
Password Hash/Verify	SHA			SHA2-512: (A6582)

Table 7: Security Function Implementations

2.7 Algorithm Specific Information

The module's TLS v1.2 firmware AES-GCM implementation conforms to FIPS 140-3 IG C.H Scenario #1. The module is compatible with TLS v1.2 and provides support for acceptable GCM ciphersuites from SP 800-52 Rev2, Section 3.3.1. The counter portion of the IV is set by the module within its cryptographic boundary. The nonce_explicit management logic inside the module ensures that when the nonce_explicit part of the IV exhausts the maximum number of possible values for a given session key, the first party, client or server, to encounter this condition will trigger a handshake to establish a new encryption key (in accordance with 7.4.1.1 and 7.4.1.2 RFC 5246). In case the module's power is lost and then restored, a new key for use with the AES GCM encryption/decryption shall be established.

The module's TLS v1.3 firmware AES-GCM implementation conforms to FIPS 140-3 IG C.H Scenario #1. The module is compatible with TLS v1.3 and provides support for acceptable GCM ciphersuites from SP 800-52 Rev2, Section 3.3.1. The counter portion of the IV is set by the module within its cryptographic boundary. The sequence number, and the client_write_iv or server_write_iv value (depending on role) are used to construct the per-record nonce, following the procedure in Section 5.3 of RFC 8446. Furthermore, as required by Section 5.3 of RFC 8446, the module ensures that when the sequence number would wrap, the first party, client or server, to encounter this condition rekeys (in accordance with Section 4.6.3 in RFC 8446) or terminates the connection. In case the module's power is lost and then restored, a new key for use with the AES GCM encryption/decryption shall be established.

The module's SSHv2 firmware AES-GCM implementation conforms to FIPS 140-3 IG C.H Scenario #1. The IV generation is in compliance with the SSHv2 specification and only for use within the SSHv2 protocol, following the specifications defined in RFCs 4252, 4253 and 5647. In case the module's power is lost and then restored, a new key for use with the AES GCM encryption/decryption shall be established.

The module's SRTP firmware AES-GCM implementation conforms to FIPS 140-3 IG C.H Scenario #5. The IV is generated and used within this SRTP protocol's implementation. The SRTP protocol and, specifically, the use of the AES-GCM encryption within the protocol are defined in RFC 7714.

2.8 RBG and Entropy

Cert Number	Vendor Name
E235	Oracle Corporation

Table 8: Entropy Certificates

Name	Type	Operational Environment	Sample Size	Entropy per Sample	Conditioning Component
Kernel CPU Time Jitter RNG Entropy Source	Non-Physical	Intel Atom C2358, Intel Xeon D-1548, Intel Xeon D-2166NT	64 bits	59.119	

Table 9: Entropy Sources

The module employs a Deterministic Random Bit Generator (DRBG) based on [SP800-90Arev1] for random number generation. The DRBGs used for the module are CTR_DRBG and Hash_DRBG. The module performs the DRBG health tests as defined in Section 11.3 of [SP800-90Arev1]. The module uses an [SP 800-90B] compliant entropy source for seeding the DRBG.

2.9 Key Generation

Please see SFI Table entries for the following: IKE KDF, IKE Key Pair Generation, KAS SafePrimes KeyGen 1, TLS Key Pair Generation, SNMP KDF, SRTP KDF, SSH KDF, SSH Key Pair Generation, TLS KDF, KAS ECDSA KeyGen, KAS SafePrimes KeyGen 2, Generate Symmetric Key.

When the module generates symmetric keys or seeds used for generating asymmetric keys, unmodified DRBG output is used as the symmetric key or as the seed for generating the asymmetric keys.

2.10 Key Establishment

Key Agreement:

Please see SFI Table entries for the following: IKE/IPSec KAS, TLS KAS 1, TLS KAS 2, SSH KAS.

Key Transport:

Please see SFI Table entries for the following: SSH Key Transport 1, SSH Key Transport 2, TLS Key Transport.

2.11 Industry Protocols

No parts of the SSH, TLS, IKE, SNMP or SRTP protocols, other than the approved cryptographic algorithms and the KDFs, have been tested by the CAVP and CMVP.

3 Cryptographic Module Interfaces

3.1 Ports and Interfaces

Physical Port	Logical Interface(s)	Data That Passes
Acme Packet 1100 USB Ports	Control Input	The USB port is reserved for recovery only by Oracle, for a non-bootable system.
Acme Packet 1100 SER MGT (Console) Port	Data Input Control Input Status Output	The SER MGT port provides system console access to the Acme Packet 1100 via a console over an RS-232C serial connection.
Acme Packet 1100 NET MGT Port	Data Input Data Output Control Input Status Output	The NET MGT 10/100 Mbps Ethernet port allows for configuring the Acme Packet 1100 and for providing high availability (HA) for the chassis.
Acme Packet 1100 Signaling and Media (INT) Port	Data Input Data Output	The INT 10/100 Mbps Ethernet port allows for connection to an internal network (e.g., IPBX). The INT Ethernet port is a media port.
Acme Packet 1100 Signaling and Media (EXT) Port	Data Input Data Output	The EXT 10/100 Mbps Ethernet port allows for connection to a SIP trunk from a service provider. The EXT Ethernet port is a media port.
Acme Packet 1100 T1/E1 TDM Ports	Data Input Data Output	T1/E1 ports allow for connection to TDM connections.
Acme Packet 1100 LEDs	Status Output	Status information output from the module.
Acme Packet 1100 Reset Pinhole	Control Input	Provides reset functionality.
Acme Packet 1100 Power Port	Power	Provides the power supply to the module.
Acme Packet 3900 USB Ports	Control Input	The USB port is reserved for recovery only by Oracle, for a non-bootable system.
Acme Packet 3900 SER MGT (Console) Port	Data Input Control Input Status Output	The serial management port on the Acme Packet 3900 rear panel provides console access to the unit over an RS-232C serial connection.
Acme Packet 3900 MGT (MGMT0, MGMT1*, MGMT2*) Ports	Data Input Data Output Control Input Status Output	Used for EMS control, CDR accounting, CLI management, and other management functions. High Availability (HA), use ports 1 and 2.
Acme Packet 3900 Signaling and Media (P0, P1, P2, P3) Ports	Data Input Data Output	Provide network connectivity for signaling and media traffic. These ports are also used for incoming and outgoing data (voice) connections.
Acme Packet 3900 T1/E1 TDM Ports	Data Input Data Output	T1/E1 ports allow for connection to TDM connections.
Acme Packet 3900 LEDs	Status Output	Status information output from the module.
Acme Packet 3900 Reset Button	Control Input	Provides reset functionality.
Acme Packet 3900 Power Ports	Power	Provides the power supply to the module.
Acme Packet 3950 USB Ports	Control Input	The USB port is reserved for recovery only by Oracle, for a non-bootable system.
Acme Packet 3950 SER MGT (Console) Port	Data Input Control Input Status Output	The serial management port on the Acme Packet 3950 rear panel provides console access to the unit over an RS-232C serial connection.
Acme Packet 3950 MGT (MGMT0, MGMT1*, MGMT2*) Ports	Data Input Data Output Control Input Status Output	Used for EMS control, CDR accounting, CLI management, and other management functions. High Availability (HA), use ports 1 and 2.

Physical Port	Logical Interface(s)	Data That Passes
Acme Packet 3950 Signaling and Media (P0, P1, P2, P3, P4, P5) Ports	Data Input Data Output	Provide network connectivity for signaling and media traffic. These ports are also used for incoming and outgoing data (voice) connections.
Acme Packet 3950 T1/E1 TDM Ports	Data Input Data Output	T1/E1 ports allow for connection to TDM connections.
Acme Packet 3950 LEDs	Status Output	Status information output from the module.
Acme Packet 3950 Reset Button	Control Input	Provides reset functionality.
Acme Packet 3950 Power Ports	Power	Provides the power supply to the module.
Acme Packet 4900 USB Ports	Control Input	The USB port is reserved for recovery only by Oracle, for a non-bootable system.
Acme Packet 4900 SER MGT (Console) Port	Data Input Control Input Status Output	The serial management port on the Acme Packet 4900 rear panel provides console access to the unit over an RS-232C serial connection.
Acme Packet 4900 MGT (MGMT0, MGMT1*, MGMT2*) Ports	Data Input Data Output Control Input Status Output	Used for EMS control, CDR accounting, CLI management, and other management functions. High Availability (HA), use ports 1 and 2.
Acme Packet 4900 Signaling and Media (P0, P1, P2, P3, P4, P5) Ports	Data Input Data Output	Provide network connectivity for signaling and media traffic. These ports are also used for incoming and outgoing data (voice) connections.
Acme Packet 4900 LEDs	Status Output	Status information output from the module.
Acme Packet 4900 Reset Button	Control Input	Provides reset functionality.
Acme Packet 4900 Power Ports	Power	Provides the power supply to the module.

Table 10: Ports and Interfaces

The module does not support a Control Output interface. All data output via the data output interface is inhibited whenever the cryptographic module is performing pre-operational self-tests, zeroization, and when the module is in an error state.

Figure 5: Acme Packet 1110 Front View

Figure 6: Acme Packet 1100 Rear View

Figure 7: Acme Packet 3900 Front View

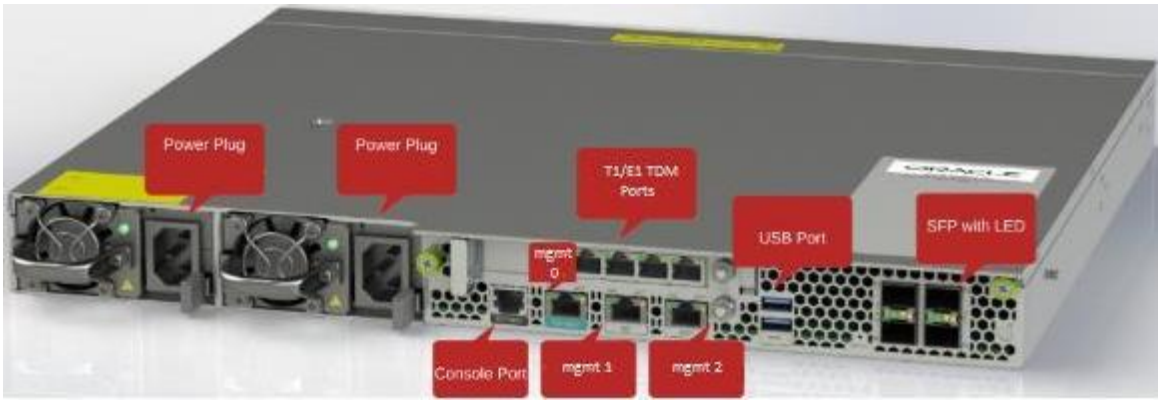

Figure 8: Acme Packet 3900 Rear View

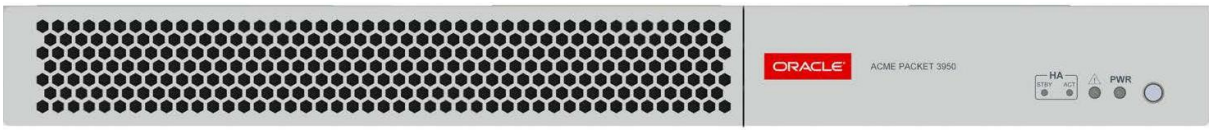

Figure 9: Acme Packet 3950 Front View

Figure 10: Acme Packet 3950 Rear View

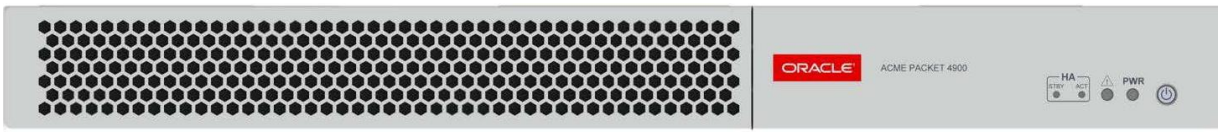

Figure 11: Acme Packet 4900 Front View

Figure 12: Acme Packet 4900 Rear View

4 Roles, Services, and Authentication

4.1 Authentication Methods

Method Name	Description	Security Mechanism	Strength Each Attempt	Strength per Minute
Console Auth		Username and Password	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. The probability of a successful random attempt is 1/94^8, which is less than 1/1,000,000.	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. Assuming 10 attempts per second via a scripted or automatic attack, the probability of a success with multiple attempts in a one-minute period is 600/94^8, which is less than 1/100,000.
SSH Auth 1		Username and Password	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. The probability of a successful random attempt is 1/94^8, which is less than 1/1,000,000.	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. Assuming 10 attempts per second via a scripted or automatic attack, the probability of a success with multiple attempts in a one-minute period is 600/94^8, which is less than 1/100,000.
SSH Auth 2		RSA SigVer (FIPS186-5) (A6582)	A 2048-bit RSA has at least 112-bits of equivalent strength. The probability of a successful random attempt is 1 /2^112, which is less than 1/1,000,000.	Assuming the module can support 60 authentication attempts in one minute, the probability of a success with multiple consecutive attempts in a one-minute period is 60/2^112, which is less than 1/100,000.
WebGUI Auth		Username and Password	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. The probability of a successful random attempt is 1/94^8, which is less than 1/1,000,000.	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. Assuming 10 attempts per second via a scripted or automatic attack, the probability of a success with multiple attempts in a one-minute period is 600/94^8, which is less than 1/100,000.
SNMP Auth		Username and Password	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. The probability of a successful random attempt is 1/94^8, which is less than 1/1,000,000.	Passwords must be a minimum of 8 characters. The password can consist of alphanumeric values, [a-z, A-Z, 0-9, and special characters], yielding 94 choices per character. Assuming 10 attempts per second via a scripted or automatic attack, the probability of a success with multiple attempts in a one-minute period is 600/94^8, which is less than 1/100,000.

Table 11: Authentication Methods

4.2 Roles

Name	Type	Operator Type	Authentication Methods
Crypto-Officer	Role	CO	Console Auth SSH Auth 1 SSH Auth 2 WebGUI Auth SNMP Auth

Name	Type	Operator Type	Authentication Methods
User	Role	User	Console Auth SSH Auth 1 SSH Auth 2 WebGUI Auth SNMP Auth

Table 12: Roles

4.3 Approved Services

The abbreviations of the access rights to SSPs have the following interpretation:

G = Generate: The module generates or derives the SSP.

R = Read: The SSP is read from the module (e.g., the SSP is output).

W = Write: The SSP is updated, imported, or written to the module.

E = Execute: The module uses the SSP in performing a cryptographic operation.

Z = Zeroise: The module zeroises the SSP.

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
Initialization	Initializes the module for Approved Mode of Operation	N/A	Command and parameters	Command response/ Status output		Crypto-Officer
Configure System Settings	Configure approved system parameters and operational settings	N/A	Command and parameters	Command response/Status output		Crypto-Officer
Show Module's Versioning Information	Outputs the module name/identifier and the versioning information that can be correlated with the validation record	N/A	Command	Module Versioning information		Crypto-Officer User
View Alarms	View system alarms	N/A	Command	Alarm information		Crypto-Officer User
View Performance	View system performance metrics	N/A	Command	Performance information		Crypto-Officer User
Manage Users	Create, edit, or delete user accounts	N/A	Command and parameters	Command response/Status output		Crypto-Officer
Change Password	Change authentication credentials	Global and successful completion of service	Command and parameters	Command response/Status output	Password Hash/Verify	Crypto-Officer - Operator Passwords: W - Operator RSA public key: W
Authenticate	Authenticates users	Global and successful completion of service	Authentication data	Status output	Password Hash/Verify	Crypto-Officer - Operator Passwords: W - Operator RSA public key: W User - Operator Passwords: W

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						- Operator RSA public key: W
Show Status	Outputs current status of the module	N/A	Command	Command response/Status output		Crypto-Officer User
Certificates	Management and viewing of X.509 certificates	Global and successful completion of service	Command and parameters	Command response/Status output		Crypto-Officer - Web UI Certificate: R User - Web UI Certificate: R
Bypass	Configure bypass using TCP or UDP and viewing bypass service status	Global and successful completion of service	Command and parameters	Command response/Status output	Bypass Integrity Check	Crypto-Officer - Bypass Key: G,E
SSH	Establish secure session	Global and successful completion of service	Command	Session establishment	SSH Encrypt/Decrypt SSH Message Authentication SSH Key Transport 1 SSH Key Transport 2 SSH KAS SSH KDF SSH Key Pair Generation SSH Signature Generation SSH Signature Verification KAS SafePrimes KeyGen 2	Crypto-Officer - Diffie-Hellman Public Key: G,R,W,E - Diffie-Hellman Private Key: G,E - Diffie-Hellman Shared Secret: G,E - SSH Authentication Public Key: G,R,E - SSH Authentication Private Key: G,E - SSH Session Keys: G,E - SSH Integrity Keys: G,E User - Diffie-Hellman Public Key: G,R,W,E - Diffie-Hellman Private Key: G,E - Diffie-Hellman Shared Secret: G,E - SSH Authentication Public Key: G,R,E - SSH Authentication Private Key: G,E - SSH Session Keys: G,E - SSH Integrity Keys: G,E

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
TLS	Establish secure session	Global and successful completion of service	Command	Session establishment	TLS Encrypt/Decrypt TLS Message Authentication TLS Key Transport TLS Key Pair Generation TLS Digital Signature Generation TLS Digital Signature Verification TLS KAS 1 TLS KAS 2 TLS KDF KAS ECDSA KeyGen KAS SafePrimes KeyGen 2	Crypto-Officer - Diffie-Hellman Public Key: G,R,W,E - Diffie-Hellman Private Key: G,E - Diffie-Hellman Shared Secret: G,E - ECDH Public Key: G,R,W,E - ECDH Private Key: G,E - ECDH Shared Secret: G,E - TLS Authentication Public Key: G,R,E - TLS Authentication Private Key: G,E - TLS Premaster Secret: G,E - TLS Master Secret: G,E - TLS Session Keys: G,E - TLS Integrity Keys: G,E User - Diffie-Hellman Public Key: G,R,W,E - Diffie-Hellman Private Key: G,E - Diffie-Hellman Shared Secret: G,E - ECDH Public Key: G,R,W,E - ECDH Private Key: G,E - ECDH Shared Secret: G,E - TLS Authentication Public Key: G,R,E - TLS Authentication Private Key: G,E - TLS Premaster Secret: G,E - TLS Master Secret: G,E

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						- TLS Session Keys: G,E - TLS Integrity Keys: G,E
IKE/IPsec (4900 Only)	Establish secure session	Global and successful completion of service	Command and parameters	Session establishment	IKE Encrypt/Decrypt IKE Message Authentication IPSec Encrypt/Decrypt IPSec Message Authentication IKE/IPSec KAS IKE KDF IKE Digital Signature Verification IKE Digital Signature Generation IKE Key Pair Generation KAS SafePrimes KeyGen 1	Crypto-Officer - Diffie-Hellman Public Key: G,R,W,E - Diffie-Hellman Private Key: G,E - Diffie-Hellman Shared Secret: G,E - SKEYSEED: G,E - SK_d: G,E - IKE Pre-Shared Key: W - IKE Session Encryption Key: G,E - IKE Session Authentication Key: G,E - IKE Public Key: G,E - IKE Private Key: G,E - IPsec Session Encryption Key: G,E - IPsec Session Authentication Key: G,E User - Diffie-Hellman Public Key: G,R,W,E - Diffie-Hellman Private Key: G,E - Diffie-Hellman Shared Secret: G,E - SKEYSEED: G,E - SK_d: G,E - IKE Pre-Shared Key: W - IKE Session Encryption Key: G,E - IKE Session Authentication Key: G,E - IKE Public Key: G,E - IKE Private Key: G,E

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						- IPsec Session Encryption Key: G,E - IPsec Session Authentication Key: G,E
SRTP	Establish secure session	Global and successful completion of service	Command and parameters	Session establishment	SRTP Encrypt/Decrypt SRTP Message Authentication SRTP KDF Generate Symmetric Key	Crypto-Officer - SRTP Master Key: G,W,E - SRTP Session Key: G,E - SRTP Authentication Key: G,E User - SRTP Master Key: G,W,E - SRTP Session Key: G,E - SRTP Authentication Key: G,E
SNMP	Secure network management	Global and successful completion of service	Command and parameters	Session establishment	SNMP Encrypt/Decrypt SNMP Message Authentication SNMP KDF	Crypto-Officer - SNMPv3 Passwords (Privacy and Auth): W,E - SNMP Privacy Key: G,E - SNMP Authentication Key: G,E User - SNMPv3 Passwords (Privacy and Auth): W,E - SNMP Privacy Key: G,E - SNMP Authentication Key: G,E
On-Demand Self-tests	Initiates and runs the pre-operational self-tests.	N/A	Command	Command response/ Status output	Verify Firmware Integrity	Crypto-Officer - Firmware Integrity Key: E
Zeroisation	Zeroises unprotected SSPs and key components.	Status	Command	Command response/ Status output		Crypto-Officer - Operator Passwords: Z - Operator RSA public key: Z - Firmware Integrity Key: Z - DRBG Entropy Input String and Nonce: Z - DRBG Seed: Z

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						- DRBG Internal State (V, Key): Z - DRBG Internal State (V, C): Z - Diffie-Hellman Public Key: Z - Diffie-Hellman Private Key: Z - Diffie-Hellman Shared Secret: Z - ECDH Public Key: Z - ECDH Private Key: Z - ECDH Shared Secret: Z - SNMPv3 Passwords (Privacy and Auth): Z - SNMP Privacy Key: Z - SNMP Authentication Key: Z - SRTP Master Key: Z - SRTP Session Key: Z - SRTP Authentication Key: Z - SSH Authentication Public Key: Z - SSH Authentication Private Key: Z - SSH Session Keys: Z - SSH Integrity Keys: Z - TLS Authentication Public Key: Z - TLS Authentication Private Key: Z - TLS Premaster Secret: Z - TLS Master Secret: Z - TLS Session Keys: Z - TLS Integrity Keys: Z

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						- SKEYSEED: Z - SK_d: Z - IKE Pre-Shared Key: Z - IKE Session Encryption Key: Z - IKE Session Authentication Key: Z - IKE Public Key: Z - IKE Private Key: Z - IPsec Session Encryption Key: Z - IPsec Session Authentication Key: Z - Web UI Certificate: Z - Bypass Key: Z
Random Number Generation	Random Number Generation	Global and successful completion of service	Command	Command response/ Status output	DRBG 1 DRBG 2 Entropy Source	Crypto-Officer - DRBG Entropy Input String and Nonce: G,E - DRBG Seed: G,E - DRBG Internal State (V, Key): G,E - DRBG Internal State (V, C): G,E User - DRBG Entropy Input String and Nonce: G,E - DRBG Seed: G,E - DRBG Internal State (V, Key): G,E - DRBG Internal State (V, C): G,E

Table 13: Approved Services

4.4 Non-Approved Services

N/A for this module.

4.5 External Software/Firmware Loaded

Not Applicable. The module does not support the capability of loading software of firmware from an external source.

4.6 Bypass Actions and Status

First, the Crypto-Officer must modify the SRTP configuration in order to enable the bypass capability for a specific SRTP profile. Then after the bypass settings for each SRTP profile have been set, the configuration must be saved. The module will prompt the operator to confirm the changes before committing them to the configuration. Status can be checked through configuration (show running-config media-sec-policy).

5 Software/Firmware Security

5.1 Integrity Techniques

The module performs a firmware integrity test over the entire firmware image using RSA 2048/SHA 256 signature verification.

5.2 Initiate on Demand

The integrity test can be invoked on demand by power cycling the module.

5.3 Additional Information

The temporary values generated during the module's integrity test are zeroised upon completion of the integrity test.

6 Operational Environment

6.1 Operational Environment Type and Requirements

Type of Operational Environment: Non-Modifiable

How Requirements are Satisfied:

The non-modifiable operational environment of the module prevents users from accessing SSPs which they are not authorized to access. There is no logical or physical access to the SSPs. The operating system provides process isolation and memory protection mechanisms that ensure appropriate separation for memory access among the processes on the system. Each process has control over its own data and uncontrolled access to the data of other processes is prevented.

As per ISO/IEC 19790:2012 7.6.3:

• The cryptographic module has control over its own SSPs.

• The operational environment provides the capability to separate individual application processes from each other to prevent uncontrolled access to CSPs and uncontrolled modifications of SSPs, regardless if this data is in the process memory or stored on persistent storage within the operational environment. This ensures that direct access to SSPs is restricted to the cryptographic module and the trusted parts of the operational environment.

• Processes that are spawned by the cryptographic module are owned by the module and are not owned by external processes/operators.

7 Physical Security

The module has a multi-chip standalone embodiment and is made of commercially available, production grade components meeting commercial specifications for power, temperature, reliability, shock and vibration. All production-grade components include standard passivation techniques, in the form of a coating applied over the module's circuitry to protect against environmental and other physical damage. The module is entirely contained within a production grade metal enclosure.

8 Non-Invasive Security

Currently, the ISO/IEC 19790:2012 non-invasive security area is not required by FIPS 140-3 (see NIST SP 800-140F). The requirements of this area are not applicable to the module.

9 Sensitive Security Parameters Management

9.1 Storage Areas

Storage Area Name	Description	Persistence Type
Flash	Non-volatile memory	Static
VRAM	Volatile memory	Dynamic

Table 14: Storage Areas

9.2 SSP Input-Output Methods

Name	From	To	Format Type	Distribution Type	Entry Type	SFI or Algorithm
SSP Input 1	External via SSH or TLS management session	Flash	Encrypted	Automated	Electronic	
SSP Input 2	External via console	Flash	Plaintext	Manual	Electronic	
SSP Input 3 (Peer)	External	VRAM	Plaintext	Automated	Electronic	
SSP Output 1	Flash	External via HA	Plaintext	Manual	Electronic	
SSP Output 2	VRAM	External	Plaintext	Automated	Electronic	
SSP Output 3	Flash	External	Plaintext	Automated	Electronic	

Table 15: SSP Input-Output Methods

9.3 SSP Zeroization Methods

Zeroization Method	Description	Rationale	Operator Initiation
Session Termination	Automatic zeroization upon session termination	Upon session termination, all respective SSPs stored in volatile memory are actively zeroized.	Operator closes protocol session
Power Cycle	Automatic zeroization upon power cycle	Upon power cycle, all SSPs stored in volatile memory are actively zeroized.	Operator power cycles the module
After Use	Automatic zeroization upon use	Upon crypto operation, all respective SSPs stored in volatile memory are actively zeroized.	
Factory Reset	Restores the module to factory defaults	Upon factory reset command, all SSPs stored in memory are actively zeroised by overwriting the memory locations with zeros.	Operator enters Factory Reset command

Table 16: SSP Zeroization Methods

9.4 SSPs

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
Operator Passwords	Used for authentication of the crypto officer and user	8-64 characters - Please see Authentication Methods table for details.	Authentication - CSP			
Operator RSA public key	Used for public key authentication of the crypto officer and user via SSH management session.	2048 bits, 4096 bits - 112 bits, 152 bits	Authentication - CSP			

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
Firmware Integrity Key	Public key used to verify the integrity of firmware.	2048 bits - 112 bits	Public Key - Neither	Factory Installed		Verify Firmware Integrity
DRBG Entropy Input String and Nonce	Used in the random bit generation process	384 bits, 440-bits -	Entropy - CSP	Entropy Source		DRBG 1 DRBG 2
DRBG Seed	Used in the random bit generation process	CTR: 384 bits / Hash: 440 bits -	Seed - CSP	DRBG 1 DRBG 2		
DRBG Internal State (V, Key)	Used in the random bit generation process (CTR DRBG)	V:128 bits Key: 256 bits -	Internal State - CSP	DRBG 1		DRBG 1
DRBG Internal State (V, C)	Used in the random bit generation process (Hash-DRBG)	112 bits -	Internal State - CSP	DRBG 2		DRBG 2
Diffie-Hellman Public Key	Used as part of DH key agreement protocol	SSH: 2048 bits, 4096 bits, 8192 bits. / TLS1.2&3: 2048 bits. / IKE&IPsec: 2048 bits, 3072 bits, 4096 bits, 6144 bits, 8192 bits. - SSH: 112 bits, 152 bits, 200 bits. / TLS1.2&3: 112 bits. / IKE&IPsec: 112 bits, 128 bits, 152 bits, 176 bits, 200 bits.	Public - PSP	KAS SafePrimes KeyGen 1 KAS SafePrimes KeyGen 2		IKE/IPSec KAS TLS KAS 2 SSH KAS
Diffie-Hellman Private Key	Used as part of DH key agreement protocol	SSH: 2048 bits, 4096 bits, 8192 bits. / TLS1.2&3: 2048 bits. / IKE&IPsec: 2048 bits, 3072 bits, 4096 bits, 6144 bits, 8192 bits. - SSH: 112 bits, 152 bits, 200 bits. / TLS1.2&3: 112 bits. / IKE&IPsec: 112 bits, 128 bits, 152 bits, 176 bits, 200 bits.	Private - CSP	KAS SafePrimes KeyGen 1 KAS SafePrimes KeyGen 2		IKE/IPSec KAS TLS KAS 2 SSH KAS
Diffie-Hellman Shared Secret	Used as part of DH key agreement protocol	SSH: 2048 bits, 4096 bits, 8192 bits. / TLS1.2&3: 2048 bits. / IKE&IPsec: 2048 bits, 3072 bits, 4096 bits, 6144 bits, 8192 bits. - SSH: 112 bits, 152 bits, 200 bits. / TLS1.2&3: 112	Shared Secret - CSP		IKE/IPSec KAS TLS KAS 2 SSH KAS	IKE/IPSec KAS TLS KAS 2 SSH KAS

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
		bits. / IKE&IPsec: 112 bits, 128 bits, 152 bits, 176 bits, 200 bits.				
ECDH Public Key	Used as part of ECDH key agreement protocol	TLS1.2&3: P-256, P-384 - TLS1.2&3: 128 bits, 192 bits	Public - PSP	KAS ECDSA KeyGen		TLS KAS 1
ECDH Private Key	Used as part of ECDH key agreement protocol	TLS1.2&3: P-256, P-384 - TLS1.2&3: 128 bits, 192 bits	Private - CSP	KAS ECDSA KeyGen		TLS KAS 1
ECDH Shared Secret	Used as part of ECDH key agreement protocol	TLS1.2&3: P-256, P-384 - TLS1.2&3: 128 bits, 192 bits	Shared Secret - CSP		TLS KAS 1	TLS KAS 1
SNMPv3 Passwords (Privacy and Auth)	Used in the derivation of SNMP keys	8-64 characters - Please see Authentication Methods table for details.	Authentication String - CSP			SNMP KDF
SNMP Privacy Key	Used for encryption / decryption of SNMP session traffic	128 bits - 128 bits	Symmetric - CSP	SNMP KDF		SNMP Encrypt/Decrypt
SNMP Authentication Key	Used for message authentication and verification in SNMP	256 bits, 512 bits - 256 bits, 512 bits	Symmetric - CSP	SNMP KDF		SNMP Message Authentication
SRTP Master Key	Used in the derivation of SRTP session keys	128 bits, 256 bits - 128 bits, 256 bits	Symmetric - CSP	Generate Symmetric Key		SRTP KDF
SRTP Session Key	Used for encryption / decryption of SRTP session traffic	128 bits, 256 bits - 128 bits, 256 bits	Symmetric - CSP	SRTP KDF		SRTP Encrypt/Decrypt
SRTP Authentication Key	Used for message authentication and verification in SRTP	160 bits - 160 bits	Symmetric - CSP	SRTP KDF		SRTP Message Authentication
SSH Authentication Public Key	Used for SSH host/server authentication	2048 bits, 3072 bits, 4096 bits - 112 bits, 128 bits, 152 bits	Public - PSP	SSH Key Pair Generation		SSH Signature Verification
SSH Authentication Private Key	Used for SSH host/server authentication	2048 bits, 3072 bits, 4096 bits - 112 bits, 128 bits, 152 bits	Private - CSP	SSH Key Pair Generation		SSH Signature Generation
SSH Session Keys	Used for encryption/decryption of SSH session traffic	128 bits, 192 bits, 256 bits - 128 bits, 192 bits, 256 bits	Symmetric - CSP	SSH KDF		SSH Encrypt/Decrypt
SSH Integrity Keys	Used for message authentication and verification in SSH	160 bits, 256 bits - 160 bits, 256 bits	Symmetric - CSP	SSH KDF		SSH Message Authentication
TLS Authentication Public Key	Used for TLS host/server authentication	P-256, P-384, 2048 bits, 4096 bits - 128 bits, 192 bits, 112 bits, 152 bits	Public - PSP	TLS Key Pair Generation		TLS Digital Signature Verification

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
TLS Authentication Private Key	Used for TLS host/server authentication	P-256, P-384, 2048 bits, 4096 bits - 128 bits, 192 bits, 112 bits, 152 bits	Private - CSP	TLS Key Pair Generation		TLS Digital Signature Generation
TLS Premaster Secret	Used during the TLS handshake	384 bits -	Secret - CSP		TLS KAS 1 TLS KAS 2	TLS KDF
TLS Master Secret	Used for computing the TLS keys	384 bits -	Secret - CSP	TLS KDF		TLS KDF
TLS Session Keys	Used for encryption/decryption of TLS session traffic	128 bits, 256 bits - 128 bits, 256 bits	Symmetric - CSP	TLS KDF		TLS Encrypt/Decrypt
TLS Integrity Keys	Used for message authentication and verification in TLS	256 bits, 384 bits - 256 bits, 384 bits	Symmetric - CSP	TLS KDF		TLS Message Authentication
SKEYSEED	Used to derive IKE session keys	256 bits, 384 bits, 512 bits -	Shared Secret - CSP		IKE/IPSec KAS	IKE KDF
SK_d	Used to derive IPsec session keys	256 bits, 384 bits, 512 bits -	Shared Secret - CSP	IKE KDF		IKE KDF
IKE Pre-Shared Key	Secret used when using pre-shared secret authentication	-	Shared Secret - CSP			
IKE Session Encryption Key	Used for encryption/decryption of IKE session traffic	128 bits, 192 bits, 256 bits - 128 bits, 192 bits, 256 bits	Symmetric - CSP	IKE KDF		IKE Encrypt/Decrypt
IKE Session Authentication Key	Used for message authentication and verification in IKE	256 bits, 384 bits, 512 bits - 256 bits, 384 bits, 512 bits	Symmetric - CSP	IKE KDF		IKE Message Authentication
IKE Public Key	Used for IKE host/server authentication	2048 bits, 4096 bits - 112 bits, 152 bits	Public - CSP	IKE Key Pair Generation		IKE Digital Signature Verification
IKE Private Key	Used for IKE host/server authentication	2048 bits, 4096 bits - 112 bits, 152 bits	Private - CSP	IKE Key Pair Generation		IKE Digital Signature Generation
IPsec Session Encryption Key	Used for encryption/decryption of IPsec session traffic	128 bits, 192 bits, 256 bits - 128 bits, 192 bits, 256 bits	Symmetric - CSP	IKE KDF		IPSec Encrypt/Decrypt
IPsec Session Authentication Key	Used for message authentication and verification in IPsec	256 bits, 384 bits, 512 bits - 256 bits, 384 bits, 512 bits	Symmetric - CSP	IKE KDF		IPSec Message Authentication
Web UI Certificate	Used for secure, authenticated management connections	2048 bits, 4096 bits - 112 bits, 152 bits	Certificate - CSP			
Bypass Key	Used to protect bypass table	256 bits - 256 bits	Symmetric - CSP	Generate Symmetric Key		Bypass Integrity Check

Table 17: SSP Table 1

Name	Input - Output	Storage	Storage Duration	Zeroization	Related SSPs
Operator Passwords	SSP Input 1 SSP Input 2 SSP Output 1	Flash:Obfuscated		Factory Reset	
Operator RSA public key	SSP Input 1	Flash:Plaintext		Factory Reset	
Firmware Integrity Key		Flash:Plaintext		Factory Reset	
DRBG Entropy Input String and Nonce		VRAM:Plaintext		Power Cycle	
DRBG Seed		VRAM:Plaintext		Power Cycle	DRBG Entropy Input String and Nonce:Derived From
DRBG Internal State (V, Key)		VRAM:Plaintext		Power Cycle	DRBG Seed:Derived From
DRBG Internal State (V, C)		VRAM:Plaintext		Power Cycle	DRBG Seed:Derived From
Diffie-Hellman Public Key	SSP Input 3 (Peer) SSP Output 2	VRAM:Plaintext		After Use	Diffie-Hellman Private Key:Paired With
Diffie-Hellman Private Key		VRAM:Plaintext		After Use	Diffie-Hellman Public Key:Paired With
Diffie-Hellman Shared Secret		VRAM:Plaintext		After Use	Diffie-Hellman Public Key:Computed Using Diffie-Hellman Private Key:Computed Using
ECDH Public Key	SSP Input 3 (Peer) SSP Output 2	VRAM:Plaintext		After Use	ECDH Private Key:Paired With
ECDH Private Key		VRAM:Plaintext		After Use	ECDH Public Key:Paired With
ECDH Shared Secret		VRAM:Plaintext		After Use	ECDH Public Key:Computed Using ECDH Private Key:Computed Using
SNMPv3 Passwords (Privacy and Auth)	SSP Input 1 SSP Input 2 SSP Output 1	Flash:Plaintext		Factory Reset	
SNMP Privacy Key		VRAM:Plaintext		Session Termination	SNMPv3 Passwords (Privacy and Auth):Derived From
SNMP Authentication Key		VRAM:Plaintext		Session Termination	SNMPv3 Passwords (Privacy and Auth):Derived From
SRTP Master Key	SSP Input 1	VRAM:Plaintext		Session Termination	
SRTP Session Key		VRAM:Plaintext		Session Termination	SRTP Master Key:Derived From
SRTP Authentication Key		VRAM:Plaintext		Session Termination	SRTP Master Key:Derived From
SSH Authentication Public Key	SSP Output 1 SSP Output 3	Flash:Plaintext		Factory Reset	SSH Authentication Private Key:Paired With
SSH Authentication Private Key		Flash:Plaintext		Factory Reset	SSH Authentication Public Key:Paired With
SSH Session Keys		VRAM:Plaintext		Session Termination	Diffie-Hellman Shared Secret:Derived From

Name	Input - Output	Storage	Storage Duration	Zeroization	Related SSPs
SSH Integrity Keys		VRAM:Plaintext		Session Termination	Diffie-Hellman Shared Secret:Derived From
TLS Authentication Public Key	SSP Output 1 SSP Output 3	Flash:Plaintext		Factory Reset	TLS Authentication Private Key:Paired With
TLS Authentication Private Key		Flash:Plaintext		Factory Reset	TLS Authentication Public Key:Paired With
TLS Premaster Secret		VRAM:Plaintext		After Use	
TLS Master Secret		VRAM:Plaintext		Session Termination	TLS Premaster Secret:Derived From
TLS Session Keys		VRAM:Plaintext		Session Termination	TLS Master Secret:Derived From
TLS Integrity Keys		VRAM:Plaintext		Session Termination	TLS Master Secret:Derived From
SKEYSEED		VRAM:Plaintext		After Use	Diffie-Hellman Shared Secret:Derived From
SK_d		VRAM:Plaintext		After Use	SKEYSEED:Derived From
IKE Pre-Shared Key	SSP Input 1 SSP Input 2 SSP Output 1	Flash:Plaintext		Factory Reset	
IKE Session Encryption Key		VRAM:Plaintext		Session Termination	SKEYSEED:Derived From
IKE Session Authentication Key		VRAM:Plaintext		Session Termination	SKEYSEED:Derived From
IKE Public Key	SSP Output 1	Flash:Plaintext		Factory Reset	IKE Private Key:Paired With
IKE Private Key		Flash:Plaintext		Factory Reset	IKE Public Key:Paired With
IPsec Session Encryption Key		VRAM:Plaintext		Session Termination	SK_d:Derived From
IPsec Session Authentication Key		VRAM:Plaintext		Session Termination	SK_d:Derived From
Web UI Certificate	SSP Output 3	Flash:Plaintext		Factory Reset	
Bypass Key		Flash:Plaintext		Factory Reset	

Table 18: SSP Table 2

9.5 Transitions

Please see the latest revision of SP 800-131A and CMVP Programmatic Transitions page for transitions that may affect this module.

10 Self-Tests

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

10.1 Pre-Operational Self-Tests

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details
RSA SigVer (FIPS186-5) (A6582)	pss Modulus: 2048 Hash: SHA2-256	Approved Integrity Technique	SW/FW Integrity	Status	Applied to all firmware components
Bypass Test	-	-	Bypass	Status	Ensures the correct operation of the logic governing activation of the bypass capability.

Table 19: Pre-Operational Self-Tests

Pre-Operational Self-Tests are run upon the power up/initialization of the module. The module transitions to the operational state only after the pre-operational self-tests (and the cryptographic algorithm self-tests (CASTs)) are passed successfully. The design of the modules ensures that all data output, via the data output interface, is inhibited whenever the module is in a pre-operational self-test condition.

10.2 Conditional Self-Tests

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details	Conditions
AES-CBC (A6580)	256-bit	KAT	CAST	Status	Separate Encrypt and Decrypt	Power Up
AES-CTR (A6580)	256-bit	KAT	CAST	Status	Separate Encrypt and Decrypt	Power Up
HMAC-SHA2-256 (A6580)	HMAC-SHA2-256	KAT	CAST	Status	MAC	Power Up
KAS-FFC-SSC Sp800-56Ar3 (A6580)	MODP-2048, MODP-3072	KAT	CAST	Status	dhEphem Shared Secret (Z) Computation	Power Up
KDF IKEv2 (A6580)	SHA2-512	KAT	CAST	Status	SP 800-135 Key Derivation	Power Up
RSA SigGen (FIPS186-4) (A6580)	pkcs Modulus: 2048 Hash: SHA2-256	KAT	CAST	Status	Sign	Power Up
RSA SigVer (FIPS186-4) (A6580)	pkcs Modulus: 2048 Hash: SHA2-256	KAT	CAST	Status	Verify	Power Up
Safe Primes Key Generation (A6580)	MODP-2048, MODP-3072, MODP-4096, MODP-6144, MODP-8192	PCT	PCT	Status	SP 800-56A Rev3 Section 5.6.2.1.4	Key Pair Generation
SHA-1 (A6580)	SHA-1	KAT	CAST	Status	Message Digest	Power Up
SHA2-256 (A6580)	SHA2-256 (A6580)	KAT	CAST	Status	Message Digest	Power Up
SHA2-512 (A6580)	SHA2-512	KAT	CAST	Status	Message Digest	Power Up
AES-CBC (A6582)	128-bit	KAT	CAST	Status	Separate Encrypt and Decrypt	Power Up
AES-CCM (A6582)	128-bit	KAT	CAST	Status	Separate Encrypt and Decrypt	Power Up

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details	Conditions
AES-GCM (A6582)	128-bit	KAT	CAST	Status	Separate Encrypt and Decrypt	Power Up
Counter DRBG (A6582)	AES-256	KAT	CAST	Status	SP 800-90Arev1 Section 11.3	Power Up
ECDSA KeyGen (FIPS186-5) (A6582)	P-256, P-384 SHA2-256	PCT	PCT	Status	Sign, Verify	Key Pair Generation
ECDSA SigGen (FIPS186-5) (A6582)	P-256 SHA2-256	KAT	CAST	Status	Sign	Power Up
ECDSA SigVer (FIPS186-5) (A6582)	P-256 SHA2-256	KAT	CAST	Status	Verify	Power Up
Hash DRBG (A6582)	SHA-1	KAT	CAST	Status	SP 800-90Arev1 Section 11.3	Power Up
HMAC-SHA-1 (A6582)	HMAC-SHA-1	KAT	CAST	Status	MAC	Power Up
HMAC-SHA2-256 (A6582)	HMAC-SHA2-256	KAT	CAST	Status	MAC	Power Up
HMAC-SHA2-512 (A6582)	HMAC-SHA2-512	KAT	CAST	Status	MAC	Power Up
KAS-ECC-SSC Sp800-56Ar3 (A6582)	P-256	KAT	CAST	Status	Ephemeral Unified Shared Secret (Z) Computation	Power Up
KAS-FFC-SSC Sp800-56Ar3 (A6582)	FFDHE2048	KAT	CAST	Status	dhEphem Shared Secret (Z) Computation	Power Up
KDF SNMP (A6582)	SHA-1	KAT	CAST	Status	SP 800-135 Key Derivation	Power Up
KDF SRTP (A6582)	-	KAT	CAST	Status	SP 800-135 Key Derivation	Power Up
KDF SSH (A6582)	Key Length: 256-bit, Hash: SHA2-256	KAT	CAST	Status	SP 800-135 Key Derivation	Power Up
RSA KeyGen (FIPS186-5) (A6582)	Modulus: 2048, 3072, 4096 Hash: SHA2-256	PCT	PCT	Status	Sign, Verify	Key Pair Generation
RSA SigGen (FIPS186-5) (A6582)	pkcs Modulus: 2048 Hash: SHA2-256	KAT	CAST	Status	Sign	Power Up
RSA SigVer (FIPS186-5) (A6582)	pkcs Modulus: 2048 Hash: SHA2-256	KAT	CAST	Status	Verify	Power Up
Safe Primes Key Generation (A6582)	FFDHE2048, MODP-2048, MODP-4096, MODP8192	PCT	PCT	Status	SP 800-56A Rev3 Section 5.6.2.1.4	Key Pair Generation
SHA-1 (A6582)	SHA-1	KAT	CAST	Status	Message Digest	Power Up
SHA2-256 (A6582)	SHA2-256	KAT	CAST	Status	Message Digest	Power Up
SHA2-512 (A6582)	SHA2-512	KAT	CAST	Status	Message Digest	Power Up
TLS v1.2 KDF RFC7627 (A6582)	SHA2-256	KAT	CAST	Status	SP 800-135 Key Derivation	Power Up

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details	Conditions
TLS v1.3 KDF (A6582)	SHA2-256	KAT	CAST	Status	SP 800-135 Key Derivation	Power Up
RCT	-	FD	CAST	Status	SP 800-90B Section 4	Power Up, On Demand and Continuously
APT	-	FD	CAST	Status	SP 800-90B Section 4	Power Up, On Demand and Continuously
Bypass Test	HMAC-SHA2-256	-	Bypass	Status	Ensures the correct operation of the services providing cryptographic processing when the mechanism governing the switching procedure is modified.	Bypass modification

Table 20: Conditional Self-Tests

10.3 Periodic Self-Test Information

Algorithm or Test	Test Method	Test Type	Period	Periodic Method
RSA SigVer (FIPS186-5) (A6582)	Approved Integrity Technique	SW/FW Integrity	On Demand	Power Cycle
Bypass Test	-	Bypass	On Demand	Power Cycle

Table 21: Pre-Operational Periodic Information

Algorithm or Test	Test Method	Test Type	Period	Periodic Method
AES-CBC (A6580)	KAT	CAST	On Demand	Power Cycle
AES-CTR (A6580)	KAT	CAST	On Demand	Power Cycle
HMAC-SHA2-256 (A6580)	KAT	CAST	On Demand	Power Cycle
KAS-FFC-SSC Sp800-56Ar3 (A6580)	KAT	CAST	On Demand	Power Cycle
KDF IKEv2 (A6580)	KAT	CAST	On Demand	Power Cycle
RSA SigGen (FIPS186-4) (A6580)	KAT	CAST	On Demand	Power Cycle
RSA SigVer (FIPS186-4) (A6580)	KAT	CAST	On Demand	Power Cycle
Safe Primes Key Generation (A6580)	PCT	PCT	N/A	N/A
SHA-1 (A6580)	KAT	CAST	On Demand	Power Cycle
SHA2-256 (A6580)	KAT	CAST	On Demand	Power Cycle
SHA2-512 (A6580)	KAT	CAST	On Demand	Power Cycle
AES-CBC (A6582)	KAT	CAST	On Demand	Power Cycle
AES-CCM (A6582)	KAT	CAST	On Demand	Power Cycle
AES-GCM (A6582)	KAT	CAST	On Demand	Power Cycle
Counter DRBG (A6582)	KAT	CAST	On Demand	Power Cycle
ECDSA KeyGen (FIPS186-5) (A6582)	PCT	PCT	N/A	NA
ECDSA SigGen (FIPS186-5) (A6582)	KAT	CAST	On Demand	Power Cycle
ECDSA SigVer (FIPS186-5) (A6582)	KAT	CAST	On Demand	Power Cycle
Hash DRBG (A6582)	KAT	CAST	On Demand	Power Cycle
HMAC-SHA-1 (A6582)	KAT	CAST	On Demand	Power Cycle

Algorithm or Test	Test Method	Test Type	Period	Periodic Method
HMAC-SHA2-256 (A6582)	KAT	CAST	On Demand	Power Cycle
HMAC-SHA2-512 (A6582)	KAT	CAST	On Demand	Power Cycle
KAS-ECC-SSC Sp800-56Ar3 (A6582)	KAT	CAST	On Demand	Power Cycle
KAS-FFC-SSC Sp800-56Ar3 (A6582)	KAT	CAST	On Demand	Power Cycle
KDF SNMP (A6582)	KAT	CAST	On Demand	Power Cycle
KDF SRTP (A6582)	KAT	CAST	On Demand	Power Cycle
KDF SSH (A6582)	KAT	CAST	On Demand	Power Cycle
RSA KeyGen (FIPS186-5) (A6582)	PCT	PCT	N/A	N/A
RSA SigGen (FIPS186-5) (A6582)	KAT	CAST	On Demand	Power Cycle
RSA SigVer (FIPS186-5) (A6582)	KAT	CAST	On Demand	Power Cycle
Safe Primes Key Generation (A6582)	PCT	PCT	N/A	N/A
SHA-1 (A6582)	KAT	CAST	On Demand	Power Cycle
SHA2-256 (A6582)	KAT	CAST	On Demand	Power Cycle
SHA2-512 (A6582)	KAT	CAST	On Demand	Power Cycle
TLS v1.2 KDF RFC7627 (A6582)	KAT	CAST	On Demand	Power Cycle
TLS v1.3 KDF (A6582)	KAT	CAST	On Demand	Power Cycle
RCT	FD	CAST	On Demand	Power Cycle
APT	FD	CAST	On Demand	Power Cycle
Bypass Test	-	Bypass	N/A	N/A

Table 22: Conditional Periodic Information

10.4 Error States

Name	Description	Conditions	Recovery Method	Indicator
Hard Error	The module halts operation, where all data output is inhibited.	Failed pre-operational self-test or CAST.	Attempt reboot, if reboot does not clear error, return to manufacturer.	Error Status and module halts operation
Soft Error	The module continues operation and repeats test.	Failed PCT	Module returns to operational state once error is logged.	Error Status returned

Table 23: Error States

11 Life-Cycle Assurance

This section describes the configuration, maintenance, and administration of the cryptographic module. If the steps outlined in Section 11.1 below are not followed, the module will be operating in a non-compliant state that is out of scope of the validation.

11.1 Installation, Initialization, and Startup Procedures

Approved Mode is enabled by implementing the following steps:

1. Open CLI: type “setup entitlements”
2. Select “5 Data Integrity (FIPS 140-3)” option and type “enabled”
3. Type “s” to save the above modified entitlements.
4. Then reboot the module for Approved Mode to take effect.

Once the secure setup and the secure initialization and configuration is complete, the module is in Approved Mode. The steps outlined in Section 11.2 can be performed to ensure that the Approved Mode was correctly configured.

11.2 Administrator Guidance

The crypto-officer can verify FIPS settings by following these steps:

- Verify that the firmware version of the module is S-Cz9.3 (“show version” section in Session Border Controller ACLI Configuration Guide)
- A new account for the Crypto-Officer and User shall be created as part of Setup and Initialization process. Upon creation of the new CO and User accounts the “default” accounts shipped with the module shall be disabled (“local-accounts” section in SBC Guide).
- Ensure all management traffic is encapsulated within a trusted session by encapsulating in a TLS, SSH, or SRTP tunnel as appropriate (“TLS-profile”, “SSH-config” and “Sdes-profile” sections in SBC Guide).
- HTTPS shall be enabled and configure the web server certificate prior to connecting to the WebUI over TLS (“http-config” section in SBC Guide).
- Ensure that SNMP V3 is configured with AES-128/HMAC only (“SNMP-Group-Entry” section in SBC Guide).
- Ensure IKEv2 is using AES CBC or CTR mode for encryption and HMAC-SHA-512 for authentication (“IKE-sainfo” section in SBC Guide).
- Ensure SSH is configured to use AES CTR/GCM mode for encryption (“Configure SSH Ciphers” section in SBC Guide).
- Ensure SSH and IKEv2 use at least Diffie-Hellman group 14 in Approved mode (“IKE-config” & “SSH-config” section in SBC Guide).
- Ensure RSA keys are at least 2048-bit keys for TLS, IKEv2. No 512-bit or 1024-bit keys can be used in Approved mode of operation (“Certificate-record” section in SBC Guide - 2048 is the default RSA modulus).
- All operator passwords must be a minimum of 8 characters in length (“password-policy” section in SBC Guide).
- Ensure use of FIPS-approved algorithms for TLS (“TLS-profile” in SBC Guide):
  - TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
  - TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
  - TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
  - TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
  - TLS_DHE_RSA_WITH_AES_256_GCM_SHA384
  - TLS_DHE_RSA_WITH_AES_128_GCM_SHA256
  - TLS_AES_128_CCM_SHA256
  - TLS_AES_128_GCM_SHA256
  - TLS_AES_256_GCM_SHA384
- Be aware that when configuring High Availability (HA), only a local HA configuration to a directly connected box via a physical cable over the management port is allowed in Approved Mode. Remote HA is not allowed in Approved mode.
- Be aware that HA configuration data that contains SSPs must never be transported over an untrusted network. Ensure that the HA ports used for the transport of HA data (including SSPs) are bound to a private IP address range during setup.
- Be aware that only the HA state transactions between the two devices over the direct physical connection are permitted over those dedicated ports.
- RADIUS and TACACS+ shall not be used in Approved Mode.

For more details, please refer to the Session Border Controller ACLI Configuration Guide (SBC Guide).

11.3 Non-Administrator Guidance

The User does not have the ability to configure sensitive information on the module, with the exception of their password. The module enforces a strong password, and the user must not reveal their password to anyone. Additionally, the User should be careful to protect any secret or private keys in their possession.

Additional non-administrator guidance is available in the FIPS Compliance Guide.

11.4 End of Life

The procedure for secure sanitization of the module at the end of life is to factory reset the platform, which performs the zeroization of the SSPs. This should be performed so that the module can be disposed or shipped back to Oracle.

12 Mitigation of Other Attacks

The module does not offer mitigation of other attacks and therefore this section is not applicable.