



# Hewlett Packard Enterprise

## HPE FlexNetwork 7500 and HPE FlexFabric 7900 and 12904 Switch Series

FIPS 140-2 Non-Proprietary Security Policy

Security Level 1 Validation

Version 1.00

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# Table of Contents

<b>1 Introduction</b>	<b>8</b>
<b>2 Overview</b>	<b>9</b>
2.1 Comware Switch Block Level Diagram	10
2.2 HPE FlexNetwork 7500 Switch Series	13
2.2.1 Product overview	13
2.2.2 Test Modules	13
2.3 HPE FlexFabric 7900 Switch Series	17
2.3.1 Product overview	17
2.3.2 Test Modules	17
2.4 HPE FlexFabric 12904E Switch	19
2.4.1 Product overview	19
2.4.2 Test Modules	19
<b>3 Security Appliance Validation Level</b>	<b>20</b>
<b>4 Physical Characteristics and Security Appliance Interfaces</b>	<b>21</b>
4.1 HPE FlexNetwork 7500 Switch Series	21
4.2 HPE FlexFabric 7900 Switch Series	22
4.3 HPE FlexFabric 12904E Switch	22
4.4 Physical Interfaces Mapping	23
<b>5 Roles, Services, and Authentication</b>	<b>24</b>
5.1 Roles	24
5.2 Authentication Mechanisms	25
<b>6 Services, Key / CSP and Algorithm Tables</b>	<b>27</b>
6.1 Services	28
6.1.2 Unauthenticated Services	41
6.1.3 Non-Approved Services	41
6.2 Critical Security Parameters	42
6.3 Approved Algorithms	55
6.4 Allowed Algorithms	64
6.5 Non-Approved Algorithms	65
<b>7 Self-Tests</b>	<b>67</b>
7.1 Power-On Self-Tests	67
7.2 Conditional Self-Tests	68
<b>8 Delivery and Operation</b>	<b>69</b>
8.1 Secure Delivery	69
8.2 Secure Operation	70
<b>9 Physical Security Mechanism</b>	<b>71</b>
<b>10 Mitigation of Other Attacks</b>	<b>72</b>
<b>11 Documentation References</b>	<b>73</b>
11.1 Obtaining documentation	73
11.2 Technical support	73

## TABLE OF TABLES

Table 1 Test configuration 1.....	16
Table 2 Test configuration 2.....	16
Table 3 Test configuration 3.....	16
Table 4 Test configuration 4.....	16
Table 5 Test configuration 5.....	16
Table 6 Test configuration 6.....	16
Table 7 Test configuration 7.....	16
Table 8 Test configuration 1.....	18
Table 9 Test configuration 2.....	18
Table 10 Test configuration 3.....	18
Table 11 Validation Level by Section .....	20
Table 12 Correspondence between Physical and Logical Interfaces .....	23
Table 13 Roles and Role description.....	24
Table 14 Crypto Officer Services .....	29
Table 15 User Services .....	37
Table 16 Critical Security Parameters .....	45
Table 17 Comware V7 Kernel – Approved Algorithms.....	57
Table 18 Comware V7 Firmware – Approved Algorithms.....	59
Table 19 Comware V7 Firmware - Allowed Algorithms.....	64
Table 20 Non-Approved Algorithms .....	65
Table 21 Power-On Self-Tests.....	67
Table 22 Conditional Self-Tests.....	68

## TABLE OF FIGURES

Figure 1 Security Architecture Block Diagram .....	10
Figure 2 HPE FlexNetwork 7502 Switch Chassis (JD242C) .....	14
Figure 3 HPE FlexNetwork 7503 Switch Chassis (JD240C) .....	14

Figure 4 HPE FlexNetwork 7506 Switch Chassis (JD239C) ..... 15  
Figure 5 HPE FlexNetwork 7510 Switch Chassis (JD238C) ..... 15  
Figure 6 HPE FlexFabric 7904 Switch Chassis (JG682A) ..... 17  
Figure 7 HPE FlexFabric 7910 Switch Chassis (JG841A) ..... 18  
Figure 8 HPE FlexFabric 12904E Switch AC Chassis (JH262A)..... 19

# FIPS 140-2 Non-Proprietary Security Policy for the HPE Networking Switches

Keywords: Security Policy, CSP, Roles, Service, Cryptographic Module

List of abbreviations:

Abbreviation	Full spelling
AAA	Authentication, Authorization, and Accounting
AES	Advanced Encryption Standard
CF	Compact Flash
CLI	Command Line Interface
CMVP	Cryptographic Module Validation Program
CSP	Critical Security Parameter
DES	Data Encryption Standard
DOA	Dead on arrival
FCoE	Fibre Channel over Ethernet
FIPS	Federal Information Processing Standard
HMAC	Hash-based Message Authentication Code
HTTP	Hyper Text Transfer Protocol
IRF	Intelligent Resilient Framework
KAT	Known Answer Test
LED	Light Emitting Diode
LPU	Line Processing Unit
MAC	Message Authentication Code
MAN	Metropolitan Area Network
MPU	Main Processing Unit
NIST	National Institute of Standards and Technology
OAA	Open Application Architecture
OAP	Open Application Platform
PSU	Power Supply Unit
RADIUS	Remote Authentication Dial In User Service
RAM	Random Access Memory
RSA	Rivest Shamir and Adleman method for asymmetric encryption
SFP	Small Form-Factor Pluggable

Abbreviation	Full spelling
SFP+	Enhanced Small Form-Factor Pluggable
SHA	Secure Hash Algorithm
SRPU	Switching and routing processor unit
SSL	Secure Sockets Layer
XFP	10 Gigabit Small Form-Factor Pluggable

# 1 Introduction

This document is a non-proprietary Cryptographic Module Security Policy for HPE FlexNetwork 7500 and HPE FlexFabric 7900 and 12904 Switch Series. The policy describes how the HPE FlexNetwork 7500 and HPE FlexFabric 7900 and 12904 Switch Series meet the requirements of FIPS 140-2. This document also describes how to configure the HPE FlexNetwork 7500 and HPE FlexFabric 7900 and 12904 Switch Series in FIPS 140-2 mode. This document was prepared as part of the FIPS 140-2 Security Level 1 validation.

FIPS 140-2 standard details the U.S. Government requirements for cryptographic security appliances. More information about the standard and validation program is available on the NIST website at [csrc.nist.gov/groups/STM/cmvp/](https://csrc.nist.gov/groups/STM/cmvp/).

This document includes the following sections:

- Overview
- Security Appliance Validation Level
- Physical Characteristics and Security Appliance Interfaces
- Roles, Services and Authentication
- Services, Key / CSP and Algorithm Tables
- Self-Tests
- Delivery and Operation
- Physical Security Mechanism
- Mitigation of Other Attacks
- Obtaining Documentation and Technical Assistance

NOTE: The following names are referencing the same thing: HPE FlexFabric, HPE Networking devices and HPE Networking Switches.

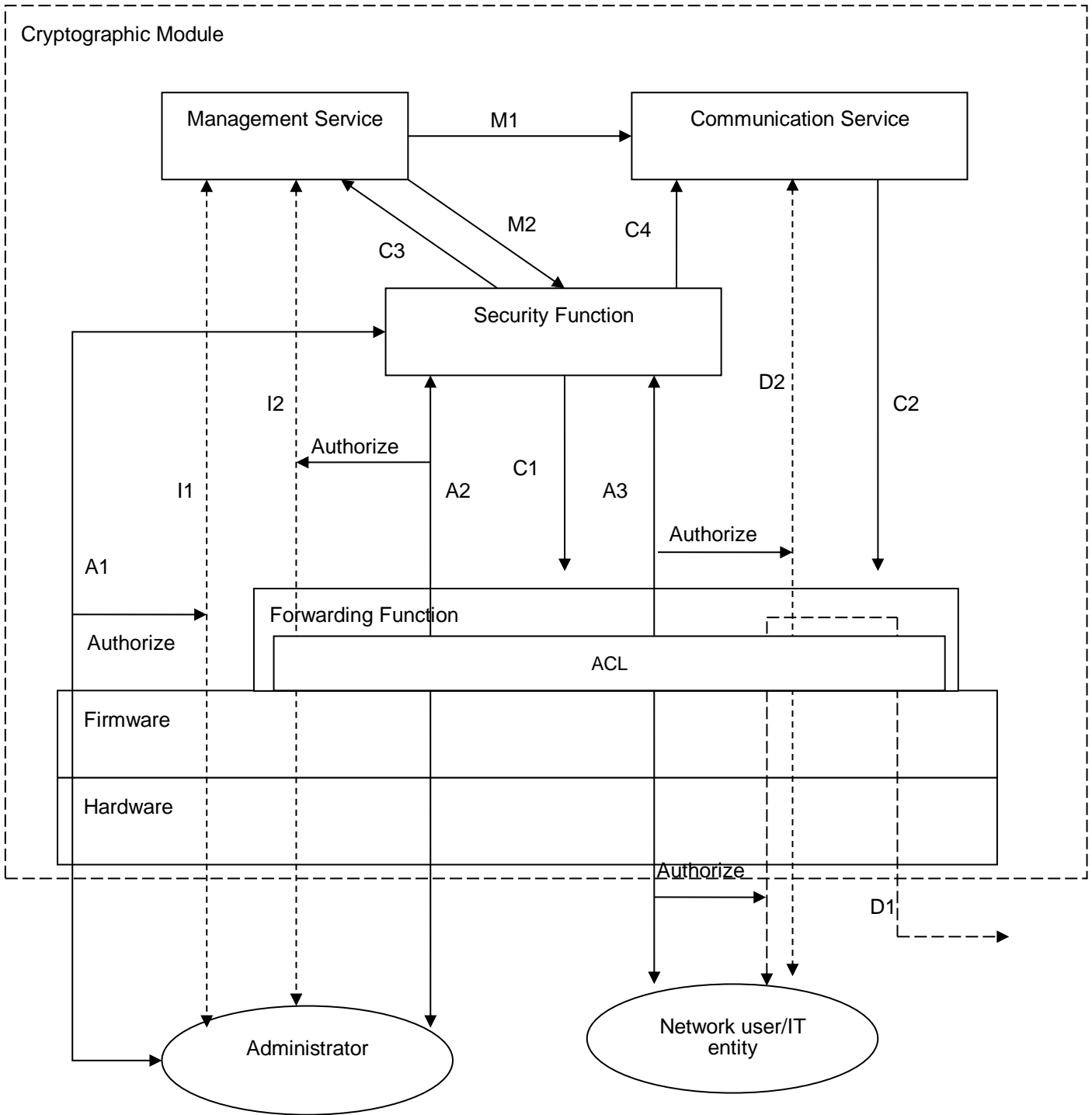


## 2 Overview

The HPE Networking devices are suitable for a range of uses: at the edge of a network, connecting server clusters in a data center, in an enterprise LAN core, and in large-scale industrial networks and campus networks. Each device is based on the HPE Comware Software, Version 7.1.045 platform.

The HPE FlexNetwork 7500 and HPE FlexFabric 7900 and 12904 Switch Series modules are being validated as a multi-chip standalone module at FIPS 140-2 Security Level 1.

## 2.1 Comware Switch Block Level Diagram



**Figure 1 Security Architecture Block Diagram**

The cryptographic module provides the following services externally:

1. Management: supports various login methods and configuration interfaces for managing the system.

2. Communication: supports interoperation between the communication protocols at different layers in the protocol stack, such as 802.3, PPP, and IP, and uses the forwarding function to receive/send packets for the local device and forward packets for other devices.

To ensure security, the security function provides appropriate access control for the cryptographic module to identify and authenticate the external entities attempting to access them, and authorize the external entities that pass the identification and authentication. The access control function also records the external entities' accesses to the services, such as the beginning time and end time of a visit. The figure above shows how administrators (crypto officer, user role) and network users access to a cryptographic module service.

M2: The administrator accesses the management service to configure the security function.

M1: The administrator accesses the management service to configure the communication service.

C1: The security function issues the forwarding control ACL or other control measures to the forwarding function for security processing like packet filtering.

D2: The communication service uses the forwarding function to receive and send packets for the local device.

C2: The communication service issues routing entries or MAC address entries to the forwarding function for forwarding packets for other devices.

A1: The administrator connects to a physical management interface (the console for example) of the cryptographic module to access the system management access control service of the security function. If the access succeeds, the I1 access to the management service is authorized. The security function uses the C3 authorization action to authorize the administrator administrative roles.

I1: The administrator accesses the management service through the physical management interface.

A2: The administrator connects to a network interface (such as an Ethernet interface) of the cryptographic module to access the system management access control service of the security function. If the access succeeds, the I2 access to the management service is authorized.

I2: The administrator accesses the management service through the network interface.

A3: A network user connects to a network interface of the cryptographic module to access the communication access control service of the security function. If the access succeeds, D1/D2 are authorized. The security function uses the C4 authorization action to authorize the network user the communication service access privilege, namely, the network access privilege.

D1: Forwarding packets for the network user.

To facilitate cryptographic module management, the administrator is allowed to access the system management service by remote login through a network interface. To prevent the authentication data of the administrator (such as the username and password) from being intercepted and prevent the operation commands from being tampered, the cryptographic module provides the SSH2/HTTPS for secure remote management.

For the management service, the cryptographic module defines predefined roles and custom user roles, which service differs as result of different access permissions.

Each user can switch to a different user role without reconnecting to the device. To switch to a different user role, a user must provide the role switching authentication information. The authentication is identity-based. All users can be authenticated locally, and optionally supports authentication via a RADIUS and TACACS+ server.

If needed, IPSec can be configured to protect the network data.

No external programs can take control of the cryptographic module, because the cryptographic module does not provide the general-purpose computing service. This ensures the absolute control of the cryptographic module.

## 2.2 HPE FlexNetwork 7500 Switch Series

### 2.2.1 Product overview

The HPE FlexNetwork 7500 Switch Series comprises modular, multilayer chassis switches that meet the evolving needs of integrated services networks. The switches can be deployed in multiple network environments, including the enterprise LAN core, aggregation layer, and wiring closet edge. They offer 40GbE connectivity and cost-effective, wire-speed 10GbE ports to safeguard the throughput and bandwidth needed for your mission-critical data and high-speed communications.

A passive backplane, support for load sharing, and redundant management and fabrics help the switch series provide high availability. Moreover, these switches deliver wire-speed Layer 2 and Layer 3 routing services for the most demanding applications with hardware-based IPv4 and IPv6 support. A summary of the highlights of the HPE FlexNetwork7500 Switch Series:

- Versatile, high-performance modular switches
- Enterprise LAN core, aggregation, and edge
- Extensive switching and routing, IPv6, and multiprotocol label switching (MPLS)
- Advanced functionality with service modules
- Robust network and service virtualization

### 2.2.2 Test Modules

Testing included seven models in the HPE FlexNetwork 7500 series

- HPE FlexNetwork 7502 Switch Chassis (JD242C)
- HPE FlexNetwork 7503 Switch Chassis (JD240C)
- HPE FlexNetwork 7503 Switch with 2x2.4Tbps Fabric and Main Processing Unit Bundle (JH331A)
- HPE FlexNetwork 7506 Switch Chassis (JD239C)
- HPE FlexNetwork 7506 Switch with 2x2.4Tbps Fabric and Main Processing Unit Bundle (JH332A)
- HPE FlexNetwork 7510 Switch Chassis (JD238C)
- HPE FlexNetwork 7510 Switch with 2x2.4Tbps Fabric and Main Processing Unit Bundle (JH333A)



**Figure 2 HPE FlexNetwork 7502 Switch Chassis (JD242C)**



**Figure 3 HPE FlexNetwork 7503 Switch Chassis (JD240C)**



**Figure 4 HPE FlexNetwork 7506 Switch Chassis (JD239C)**



**Figure 5 HPE FlexNetwork 7510 Switch Chassis (JD238C)**

The Table 1 through Table 7 lists the test configurations for the HPE FlexFabric 7500 Switch Series switch series.

Chassis	Modules
HPE FlexNetwork 7502 Switch Chassis (JD242C)	HPE FlexNetwork 7502 Main Processing Unit (JH208A)

**Table 1 Test configuration 1**

Chassis	Modules
HPE FlexNetwork 7503 Switch Chassis (JD240C)	HPE FlexNetwork 7500 1.2Tbps Fabric with 2-port 40GbE QSFP+ for IRF-only Main Processing Unit (JH207A)

**Table 2 Test configuration 2**

Chassis	Modules
HPE FlexNetwork 7503 Switch with 2x2.4Tbps Fabric and Main Processing Unit Bundle (JH331A)	HPE FlexNetwork 7500 2.4Tbps Fabric with 8-port 1/10GbE SFP+ and 2-port 40GbE QSFP+ MPU (JH209A)

**Table 3 Test configuration 3**

Chassis	Modules
HPE FlexNetwork 7506 Switch Chassis (JD239C)	HPE FlexNetwork 7500 1.2Tbps Fabric with 2-port 40GbE QSFP+ for IRF-only Main Processing Unit (JH207A)

**Table 4 Test configuration 4**

Chassis	Modules
HPE FlexNetwork 7506 Switch with 2x2.4Tbps Fabric and Main Processing Unit Bundle (JH332A)	HPE FlexNetwork 7500 2.4Tbps Fabric with 8-port 1/10GbE SFP+ and 2-port 40GbE QSFP+ MPU (JH209A)

**Table 5 Test configuration 5**

Chassis	Modules
HPE FlexNetwork 7510 Switch Chassis (JD238C)	HPE FlexNetwork 7500 1.2Tbps Fabric with 2-port 40GbE QSFP+ for IRF-only Main Processing Unit (JH207A)

**Table 6 Test configuration 6**

Chassis	Modules
HPE FlexNetwork 7510 Switch with 2x2.4Tbps Fabric and Main Processing Unit Bundle (JH333A)	HPE FlexNetwork 7500 2.4Tbps Fabric with 8-port 1/10GbE SFP+ and 2-port 40GbE QSFP+ MPU (JH209A)

**Table 7 Test configuration 7**



## 2.3 HPE FlexFabric 7900 Switch Series

### 2.3.1 Product overview

The HPE FlexFabric 7900 Switch Series is the next generation compact modular data center core switch designed to support virtualized data centers and evolutionary needs of private and public clouds deployments.

The HPE FlexFabric 7900 delivers unprecedented levels of performance, buffering, scale, and availability with high-density 10GbE, 40GbE, and 100GbE interfaces using only a fraction of the footprint used by traditional chassis. The switch supports full Layer 2 and 3 features along with advanced data center features including TRILL, IRF, VXLAN, and open standards-based programmability with OpenFlow support. A summary of the highlights of the HPE FlexFabric 7900 Switch Series:

- Nonblocking and lossless Clos architecture
- Large Layer 2 scaling with TRILL and IRF
- VXLAN support for virtualized and cloud deployments
- SDN-enabled with OpenFlow 1.3 support
- High 10GbE, 40GbE, and 100GbE density across 9.6 Tbps switch fabric

### 2.3.2 Test Modules

Testing included two models in the HPE FlexFabric 7900 switch series

- HPE FlexFabric 7904 Switch Chassis (JG682A)
- HPE FlexFabric 7910 Switch Chassis (JG841A)



Figure 6 HPE FlexFabric 7904 Switch Chassis (JG682A)



**Figure 7 HPE FlexFabric 7910 Switch Chassis (JG841A)**

The Table 8 through Table 10 lists the test configurations for the HPE FlexFabric 7900 Switch Series switch series.

Chassis	Modules
HPE FlexFabric 7904 Switch Chassis (JG682A)	HPE FlexFabric 7900 12p 40GbE QSFP+ FX Mod (JG683B)

**Table 8 Test configuration 1**

Chassis	Modules
HPE FlexFabric 7910 Switch Chassis (JG841A)	HPE FlexFabric 7910 7.2Tbps Fabric / MPU (JG842A)
	HPE FlexFabric 7900 12p 40GbE QSFP+ FX Mod (JG683B)

**Table 9 Test configuration 2**

Chassis	Modules
HPE FlexFabric 7910 Switch Chassis (JG841A)	HPE FlexFabric 7910 2.4Tbps Fabric / MPU (JH001A)
	HPE FlexFabric 7900 12p 40GbE QSFP+ FX Mod (JG683B)

**Table 10 Test configuration 3**

## 2.4 HPE FlexFabric 12904E Switch

### 2.4.1 Product overview

The HPE FlexFabric 12904E Switch is a next-generation modular data center core switch designed to support virtualized data centers and the evolving needs of private and public cloud deployments.

The HPE FlexFabric 12904E Switch delivers unprecedented levels of performance, buffering, scale, and availability with high density 10GbE, 40GbE and 100GbE.

Ready for software-defined networking (SDN), the switch supports full Layer 2 and 3 features, including advanced features such as Transparent Interconnection of Lots of Links (TRILL) and Intelligent Resilient Framework (IRF), which provides the ability to build large, resilient switching fabrics. The HPE FlexFabric 12904E Switch also supports fully redundant and hot-swappable components to complement its other enterprise-class capabilities.

- Nonblocking, lossless Clos architecture
- Large Layer 2 scaling with TRILL and HPE IRF
- DCB and FCoE convergence
- Enhanced modularity with control and data plane separation
- High 10GbE, 40GbE and 100 GbE density across 36 Tb/s switch fabric

### 2.4.2 Test Modules

Testing included one model in the HPE FlexFabric 12904E switch:

- HPE FlexFabric 12904E Switch AC Chassis (JH262A)



**Figure 8 HPE FlexFabric 12904E Switch AC Chassis (JH262A)**

### 3 Security Appliance Validation Level

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

**Table 11 Validation Level by Section**

No.	Area	Level
1	Cryptographic Module Specification	1
2	Cryptographic Module Ports and Interfaces	1
3	Roles, Services, and Authentication	3
4	Finite State Model	1
5	Physical Security	1
6	Operational Environment	N/A
7	Cryptographic Key management	1
8	Electromagnetic Interface/Electromagnetic Compatibility	1
9	Self-Tests	1
10	Design Assurance	2
11	Mitigation of Other Attacks	N/A
12	Overall Level	1

# 4 Physical Characteristics and Security Appliance Interfaces

## 4.1 HPE FlexNetwork 7500 Switch Series

The HPE FlexNetwork 7500 switch series is a multi-chip standalone security appliance, and the cryptographic boundary is defined as encompassing the “top,” “front,” “rear,” “left,” “right,” and “bottom” surfaces of the case. The general components of the HPE FlexNetwork 7500 switch series include firmware and hardware, which are placed in the three-dimensional space within the case.

	Ethernet ports	Serial Ports	USB ports	Other Ports
HP 7500 1.2Tbps Fabric w/ 2-port 40GbE for IRF-Only Main Processing Unit (JH207A)	2 10/100/1000M	1 RJ45 RS232	1 Host 1 Console	2 40GE(QSFP+) for IRF-only
HP 7502 Main Processing Unit (JH208A)	1 10/100/1000M	1 RJ45 RS232	1 HOST	NA
HP 7500 2.4Tbps Fabric w/ 8-port GbE/10GbE and 2-port 40GbE User Ports Main Processing Unit (JH209A)	2 10/100/1000M 2 SFP GE	1 RJ45 RS232	1 HOST 1 Console	2 40GE(QSFP+) 8 10GE(SFP+)

The HPE FlexNetwork 7500 switch provides:

- Gigabit Ethernet ports, or
- autosensing 10/100/1000 ports, or
- 1/10GbE ports, or
- 10GbE ports, or
- or 40 40GbE ports, or
- a combination of the above.
- LEDs for system, power, and module status.
- Power switch
- Reset switch

The documents on HPE website (<https://www.hpe.com/us/en/product-catalog/networking/networking-switches/pip.4177519.html>) describe the ports in detail along with the interpretation of the LEDs.

## 4.2 HPE FlexFabric 7900 Switch Series

The HPE FlexFabric 7900 switch series is a multi-chip standalone security appliance, and the cryptographic boundary is defined as encompassing the “top,” “front,” “rear,” “left,” “right,” and “bottom” surfaces of the case. The general components of the HPE FlexFabric 7900 switch series include firmware and hardware, which are placed in the three-dimensional space within the case.

	Gigabit Ethernet ports	Serial Ports	USB ports	Other Ports
HP FlexFabric 7910 2.4Tbps Fabric / Main Processing Unit (JH001A)	1	1	1	NA
HP FlexFabric 7910 7.2Tbps Fabric / Main Processing Unit (JG842A)	1	1	1	NA

The HPE FlexFabric 7900 switch provides:

- 12-port 40GbE QSFP+ module
- 24-port 1/10GbE SFP+ module
- 2-port 100GbE CXP/6-port 40GbE QSFP+ module
- A serial console port
- A management Gigabit Ethernet port.
- LEDs for system, power, and module status.
- USB 2.0 port.
- Power switch
- Reset switch

The documents on HPE website (<https://www.hpe.com/us/en/product-catalog/networking/networking-switches/pip.7074890.html>) describe the ports in detail along with the interpretation of the LEDs.

## 4.3 HPE FlexFabric 12904E Switch

The HPE FlexFabric 12904E Switch Series is a multi-chip standalone security appliances, and the cryptographic boundary is defined as encompassing the “top,” “front,” “rear,” “left,” “right,” and “bottom” surfaces of the case.

HPE FlexFabric 12904E Switch chassis accommodates four LPUs. LPUs provide Gigabit Ethernet, SFP Gigabit, SFP+ 10-Gigabit, XFP 10-Gigabit, QSFP+ 40-Gigabit and CFP 100-Gigabit ports in a range of numbers and combinations.

In addition, the HPE FlexFabric 12904E Switch requires a MPU. The chassis have two MPU slots. Each MPU provides a 100-Mbps Ethernet management port, a serial management port, an

auxiliary serial port, two USB ports (host and device), and a CF card slot. (The MPUs have reserved ports, which are not supported at present (a RS-232/485 port, standby main board coaxial clock interfaces, and MCC Gigabit Ethernet interfaces).) The MPUs have status LEDs for switching fabric modules, LPU, fan, power, MPU, and CF status reporting. Each MPU has a reset button.

	Gigabit Ethernet ports	Serial Ports	USB ports	Other Ports
HPE FlexFabric 12904E Main Processing Unit (JH263A)	4	1	1	NA

Chassis power is provided through AC power frames. Each AC power frame accommodates up to four hot-swappable 1U AC PSU. The frame has status LED and a power frame switch. A power entry module supplies power input to each PSU.

<https://www.hpe.com/us/en/product-catalog/networking/networking-switches/pip.5443167.html> describes MPU options, LPU options, and ports in detail along with the interpretation of the LEDs

## 4.4 Physical Interfaces Mapping

The physical interfaces provided by the HPE Networking products map to four FIPS 140-2 defined logical interface: data input, data output, control input and status output. Table 12 presents the mapping.

**Table 12 Correspondence between Physical and Logical Interfaces**

Physical Interface	FIPS 140-2 Logical Interface
Networking ports	Data Input Interface
Console port	
Management Ethernet port	
CF card slot	
USB ports	
Networking ports	Data Output Interface
Console port	
Management Ethernet port	
CF card slot	
USB ports	
Networking ports	Control Input Interface
Console port	
Management Ethernet port	
Power switches	
Reset Switch	
Port status LED mode switching button	Status Output Interface
Networking ports	
Console port	
Management Ethernet port	
LEDs	Power Interface
Power Slot	
Backplane	

# 5 Roles, Services, and Authentication

## 5.1 Roles

The HPE FlexNetwork 7500 and HPE FlexFabric 7900 and 12904 Switch Series provides 18 predefined roles and 64 custom user roles. There are 16 roles (0) in the device that operators may assume:

- network-admin, level-15, level-9 and security-audit which are the FIPS Crypto-Officer Role,
- network-operator, level 0 ~ level 8, level 10 ~ level 14 and 64 custom user roles which are defined as the FIPS User Role.

Table 13 presents the roles and roles description. The devices allow multiple management users to operate the appliance simultaneously.

The HPE Networking switches do not employ a maintenance interface and do not have a maintenance role.

**Table 13 Roles and Role description**

FIPS Role	Comware Role Name	Role Description
Crypto-Officer	network-admin	<ul style="list-style-type: none"> <li>• Accesses all features and resources in the system, except for the <b>display security-logfile summary</b>, <b>info-center security-logfile directory</b>, and <b>security-logfile save</b> commands.</li> </ul>
	level-15	Has the same rights as network-admin
	Level-9	Has access to all features and resources except those in the following list. <ul style="list-style-type: none"> <li>• RBAC non-debugging commands.</li> <li>• Local users.</li> <li>• File management.</li> <li>• Device management.</li> <li>• The <b>display history-command all</b> command.</li> </ul>
	security-audit	Security log manager. The user role has the following access to security log files: <ul style="list-style-type: none"> <li>• Access to the commands for displaying and maintaining security log files (for example, the <b>dir</b>, <b>display security-logfile summary</b>, and more commands).</li> <li>• Access to the commands for managing security log files and security log file system (for example, the <b>info-center security-logfile directory</b>, <b>mkdir</b>, and <b>security-logfile save</b> commands).</li> </ul> Only the security-audit user role has access to security log files.
User	network-operator	<ul style="list-style-type: none"> <li>• Accesses the display commands for all features and resources in the system, except for commands such as <b>display history-command all</b> and <b>display security-logfile summary</b>.</li> <li>• Enables local authentication login users to change their own password.</li> </ul>
	level-0	Has access to diagnostic commands, including ping, tracer, and ssh2.



	level-1	Has access to the display commands of all features and resources in the system except display history-command all. The level-1 user role also has all access rights of the user role level-0.
	custom user role; level-2 to level-8; level-10 to level-14	Have no access rights by default. Access rights are configurable.

## 5.2 Authentication Mechanisms

HPE networking devices support identity-based authentication, and role-based access control.

- Identity-based authentication

Each user is authenticated upon initial access to the device. The authentication is identity-based. All users can be authenticated locally, and optionally supports authentication via a RADIUS and TACACS+ server.

To logon to the appliances, an operator must connect to it through one of the management interfaces (console port, SSH) and provide a password.

A user must be authenticated using usernames and passwords. The minimum password length is 15 characters, and the maximum is 63. The passwords must contain at least one lower case letter (26), one upper case letter (26), one special character (32) and one numeric character (10). The remaining eleven characters can be a lower case letter (26), an upper case letter (26), a special character (32) and/or a numeric character (10) equaling 94 possibilities per character. Therefore, for a 15 characters password, the probability of randomly guessing the correct sequence is 1 in  $3.16228 \times 10^{29}$ <sup>1</sup> (this calculation is based on the use of the typical standard American QWERTY computer keyboard).

In order to guess the password in 1 minute with close to probability 1 requires  $3.16228 \times 10^{29}$  trials, which is stronger than the one in a million chance required by FIPS 140-2. By default, the maximum number of consecutive failed login attempts is three and a user failing to log in after the specified number of attempts must wait for one minute before trying again. Using Anderson's formula to calculate the probability of guessing a password in 1 minute:

- *P* probability of guessing a password in specified period of time
- *G* number of guesses tested in 1 time unit
- *T* number of time units

---

<sup>1</sup> Calculation is:  $94^{15}$  (total combinations of alpha, numeric, and special characters) -  $68^{15}$  (combinations with no uppercase letters) -  $68^{15}$  (combinations with no lowercase letters) -  $84^{15}$  (combinations with no numbers) -  $62^{15}$  (combinations with no special characters) +  $42^{15}$  (combinations with no uppercase letters and no lowercase letters) +  $60^{15}$  (combinations with no uppercase letters and no numbers) +  $36^{15}$  (combinations with no uppercase letters and no special characters) +  $60^{15}$  (combinations with no lowercase letters and no numbers) +  $36^{15}$  (combinations with no lowercase letters and no special characters) +  $52^{15}$  (combinations with no numbers and no special characters) -  $24^{15}$  (combinations with only uppercase letters) -  $24^{15}$  (combinations with only lowercase letters) -  $10^{15}$  (combinations with only numbers) -  $32^{15}$  (combinations with only special characters)  $\approx 3.16228 \times 10^{29}$

Calculation without text:  
 $94^{15} - 68^{15} - 68^{15} - 84^{15} - 62^{15} + 42^{15} + 60^{15} + 36^{15} + 60^{15} + 36^{15} + 52^{15} - 24^{15} - 24^{15} - 10^{15} - 32^{15} \approx 3.16228 \times 10^{29}$

- $N$  number of possible passwords

Then  $P \geq T \times G / N$  ( $9.48682E-30 = 1 \times 3 / 3.16228 \times E^{29}$ )

The probability of guessing a password in 1 minute is  $9.48682E-30$ .

To provide additional password security, Comware 7.1 provides additional limits to the number of consecutive failed login attempts. If an FTP or VTY user fails authentication, the system adds the user to a password control blacklist. If a user fails to provide the correct password after the specified number of consecutive attempts, the system can take one of the following actions, based on the administrator's choice:

Blocks the user's login attempts until the user is manually removed from the password control blacklist.

Blocks the user's login attempts within a configurable period of time, and allows the user to log in again after the period of time elapses or the user is removed from the password control blacklist.

HPE Networking devices can also use certificate credentials using 2048 bit RSA keys and SHA-256; in such a case the security strength is 112 bits, so an attacker would have a 1 in  $2^{112}$  chance of a successful authentication which is much stronger than the one in a million chance required by FIPS 140-2. Certificate credentials using ECDSA keys with curves (P224, P-256, P-384, or P-521) and SHA algorithms (SHA-224, SHA-256, SHA-384, or SHA-512) are also available and provide a minimum of 112 bits security.

The users who try to log in or switch to a different user privilege level can be authenticated by RADIUS and TACACS+ Server. The minimum password length is 15 characters, and the maximum is 63. Therefore, for a 15 characters password, the probability of randomly guessing the correct sequence is one in  $3.16228 \times E^{29}$ . The device (RADIUS client) and the RADIUS server use a shared key to authenticate RADIUS packets and encrypt user passwords exchanged between them. For more details, see RFC 2865: 3 Packet Format Authenticator field and 5.2 User-password.

- Role-based access control

In HPE Comware 7.1.045, the command and resource access permissions are assigned to roles.

Users are given permission to access a set of commands and resources based on the users' user roles. Each user can have one or more roles. The user may alternate between authorized roles after first authenticating to the module.

## 6 Services, Key / CSP and Algorithm Tables

### Assumptions, Assertions and Caveats

1. The preferred approach is to link Services to Keys/CSPs, Keys/CSPs to Algorithms and Algorithms to Services. When linkage is completed, there is a continuous loop among the three tables.
2. For linking the tables together, the goals are:
  - Confirm every Algorithm is listed at least once by a service.
  - Provide a direct mapping of the algorithm to each service that uses it.
  - Confirm every CSP is listed at least once by a service
  - Provide a direct mapping of the service to each CSP that it uses.
  - Provide a quick and easy way for the reviewer to navigate among the tables.

## 6.1 Services

### **Assumptions, Assertions and Caveats**

1. The services table is the main focus of the validation. Preferably, it should be listed before the CSP and Algorithm tables.
2. Each service should map to the Key(s) / CSP(s) used by the service. It is not required that each service map to a Key / CSP.
3. Each service should be uniquely identifiable so the entries in the Algorithm Table can easily map to a service.

### **Services Table Column Definitions**

#### 1. Description

Objective of this column is to provide a brief description of the service.

- This column shall include a description of the service.
- Where applicable the service description should describe the action being taken.

#### 2. Input

Objective of this column is to list the input to the service.

- List the type of input such as command, configuration data or output of another service.

#### 3. Output

Objective of this column is to list the output of the service.

- List the type of output generated by the service.

4. CSP Access

Objective of this column is to provide additional information about the CSP utilized by the service.

- Where applicable this column shall include the unique CSP identifier.
- The CSP identifier should contain a hyperlink to the entry in the CSP table.

5. Available to role

Objective of this column is to identify the role that can utilize the service.

- This column shall include the name of the role that can utilize the service.

**Table 14 Crypto Officer Services**

Description	Input	Output	CSP Access	Available to Role
<b>View Device Status</b>				
1. View currently running image version	Commands	Status of devices	None	Network-admin, level-15, level-9
2. View installed hardware components status and version	Commands	Status of devices	None	Network-admin, level-15, level-9
<b>View Running Status</b>				
3. View memory status, packet statistics, interface status, current running image version, current configuration, routing table, active sessions, temperature and SNMP MIB statistics.	Commands	Status of device functions	None	Network-admin, level-15, level-9

Perform Network Functions				
4. Network diagnostic service such as "ping"	Commands	Status of commands	None	Network-admin, level-15, level-9
5. Network connection service such as "SSHv2" client	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP1-1 RSA Public key (read)</a> <a href="#">CSP1-2 DSA Public key (read)</a> <a href="#">CSP1-3 ECDSA Public key (read)</a> <a href="#">CSP2-1 IPsec authentication keys (read/write/delete)</a> <a href="#">CSP2-2 IPsec encryption keys (read/write/delete)</a> <a href="#">CSP2-3 IPsec authentication keys (read)</a> <a href="#">CSP2-4 IPsec encryption keys (read)</a> <a href="#">CSP3-1 IKE pre-shared keys (read)</a> <a href="#">CSP3-2 IKE RSA Authentication private Key (read)</a> <a href="#">CSP3-3 IKE DSA Authentication private Key (read)</a> <a href="#">CSP3-4 IKE Authentication key (read/write/delete)</a> <a href="#">CSP3-5 IKE Encryption Key (read/write/delete)</a> <a href="#">CSP3-6 IKE Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP3-7 IKE Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP4-1 IKEv2 pre-shared keys (read)</a> <a href="#">CSP4-2 IKEv2 RSA Authentication private Key (read)</a> <a href="#">CSP4-3 IKEv2 DSA Authentication private Key (read)</a> <a href="#">CSP4-4 IKEv2 ECDSA Authentication private Key (read)</a> <a href="#">CSP4-5 IKEv2 Authentication key (read/write/delete)</a> <a href="#">CSP4-6 IKEv2 Encryption Key (read/write/delete)</a> <a href="#">CSP4-7 IKEv2 Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP4-8 IKEv2 Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP4-9 IKEv2 ECDH Public Key (read/write/delete)</a>	Network-admin, level-15, level-9

			<a href="#">CSP4-10 IKEv2 ECDH Private Key (read/write/delete)</a> <a href="#">CSP5-1 SSH RSA Private key (read)</a> <a href="#">CSP5-2 SSH ECDSA Private key (read)</a> <a href="#">CSP5-3 SSH Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP5-4 SSH Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP5-5 SSH ECDH Public Key (read/write/delete)</a> <a href="#">CSP5-6 SSH ECDH Private Key (read/write/delete)</a> <a href="#">CSP5-7 SSH Session encryption Key (read/write/delete)</a> <a href="#">CSP5-8 SSH Session authentication Key (read/write/delete)</a> <a href="#">CSP9-1 SNMPv3 Authentication Key (read)</a> <a href="#">CSP9-2 SNMPv3 Encryption Key (read)</a> <a href="#">CSP7-1 DRBG entropy input (read/write/delete)</a> <a href="#">CSP8-1 DRBG seed (read/write/delete)</a> <a href="#">CSP8-2 DRBG V (read/write/delete)</a> <a href="#">CSP8-3 DRBG Key (read/write/delete)</a>	
6. Provide SSHv2 service.	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP1-1 RSA Public key (read)</a> <a href="#">CSP1-3 ECDSA Public key (read)</a> <a href="#">CSP5-1 SSH RSA Private key (read)</a> <a href="#">CSP5-2 SSH ECDSA Private key (read)</a> <a href="#">CSP5-3 SSH Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP5-4 SSH Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP5-5 SSH ECDH Public Key (read/write/delete)</a> <a href="#">CSP5-6 SSH ECDH Private Key (read/write/delete)</a> <a href="#">CSP5-7 SSH Session encryption Key (read/write/delete)</a> <a href="#">CSP5-8 SSH Session authentication Key (read/write/delete)</a> <a href="#">CSP6-1 User Passwords (read/write/delete)</a> <a href="#">CSP6-3 RADIUS shared secret keys (read)</a> <a href="#">CSP6-4 TACACS+ shared secret keys (read)</a>	Network-admin, level-15, level-9

			<a href="#">CSP7-1 DRBG entropy input (read/write/delete)</a> <a href="#">CSP8-1 DRBG seed (read/write/delete)</a> <a href="#">CSP8-2 DRBG V (read/write/delete)</a> <a href="#">CSP8-3 DRBG Key (read/write/delete)</a>	
7. Provide IKEv1/IKEv2/IPsec service to protect the session between the router and external server(e.g. Radius Server/Log Server)	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP1-1 RSA Public key (read)</a> <a href="#">CSP1-2 DSA Public key (read)</a> <a href="#">CSP1-3 ECDSA Public key (read)</a> <a href="#">CSP2-1 IPsec authentication keys (read/write/delete)</a> <a href="#">CSP2-2 IPsec encryption keys (read/write/delete)</a> <a href="#">CSP2-3 IPsec authentication keys (read)</a> <a href="#">CSP2-4 IPsec encryption keys (read)</a> <a href="#">CSP3-1 IKE pre-shared keys (read)</a> <a href="#">CSP3-2 IKE RSA Authentication private Key (read)</a> <a href="#">CSP3-3 IKE DSA Authentication private Key (read)</a> <a href="#">CSP3-4 IKE Authentication key (read/write/delete)</a> <a href="#">CSP3-5 IKE Encryption Key (read/write/delete)</a> <a href="#">CSP3-6 IKE Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP3-7 IKE Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP4-1 IKEv2 pre-shared keys (read)</a> <a href="#">CSP4-2 IKEv2 RSA Authentication private Key (read)</a> <a href="#">CSP4-3 IKEv2 DSA Authentication private Key (read)</a> <a href="#">CSP4-4 IKEv2 ECDSA Authentication private Key (read)</a> <a href="#">CSP4-5 IKEv2 Authentication key (read/write/delete)</a> <a href="#">CSP4-6 IKEv2 Encryption Key (read/write/delete)</a> <a href="#">CSP4-7 IKEv2 Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP4-8 IKEv2 Diffie-Hellman Private Key (read/write/delete)</a>	Network-admin, level-15, level-9



			<a href="#">CSP4-9 IKEv2 ECDH Public Key (read/write/delete)</a> <a href="#">CSP4-10 IKEv2 ECDH Private Key (read/write/delete)</a> <a href="#">CSP7-1 DRBG entropy input (read/write/delete)</a> <a href="#">CSP8-1 DRBG seed (read/write/delete)</a> <a href="#">CSP8-2 DRBG V (read/write/delete)</a> <a href="#">CSP8-3 DRBG Key (read/write/delete)</a>	
8. Provide SNMPv3 service.	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP9-1 SNMPv3 Authentication Key (read)</a> <a href="#">CSP9-2 SNMPv3 Encryption Key (read)</a> <a href="#">CSP7-1 DRBG entropy input (delete)</a> <a href="#">CSP8-1 DRBG seed (delete)</a> <a href="#">CSP8-2 DRBG V (delete)</a> <a href="#">CSP8-3 DRBG Key (delete)</a>	Network-admin, level-15, level-9
9. Initial Configuration setup (IP, hostname, DNS server)	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
10. Change the role	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP6-1 User Passwords (read)</a> <a href="#">CSP6-2 Super password (read)</a> <a href="#">CSP6-3 RADIUS shared secret keys (read)</a> <a href="#">CSP6-4 TACACS+ shared secret keys (read)</a>	Network-admin, level-15, level-9
11. Reset and change the password of same/lower privilege user	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP6-1 User Passwords (write/delete)</a>	Network-admin, level-15, level-9
12. Maintenance of the super password	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP6-2 Super password (write/delete)</a>	Network-admin, level-15, level-9
13. Maintenance (create, destroy, import, export) of public key/private key/shared key	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP1-1 RSA Public key (read/write/delete)</a> <a href="#">CSP1-2 DSA Public key (read/write/delete)</a> <a href="#">CSP1-3 ECDSA Public key (read/write/delete)</a> <a href="#">CSP2-3 IPsec authentication keys (read/write/delete)</a> <a href="#">CSP2-4 IPsec encryption keys (read/write/delete)</a> <a href="#">CSP3-1 IKE pre-shared keys (read/write/delete)</a>	Network-admin, level-15, level-9

			<a href="#">CSP3-2 IKE RSA Authentication private Key (read/write/delete)</a> <a href="#">CSP3-3 IKE DSA Authentication private Key (read/write/delete)</a> <a href="#">CSP4-1 IKEv2 pre-shared keys (read/write/delete)</a> <a href="#">CSP4-2 IKEv2 RSA Authentication private Key (read/write/delete)</a> <a href="#">CSP4-3 IKEv2 DSA Authentication private Key (read/write/delete)</a> <a href="#">CSP4-4 IKEv2 ECDSA Authentication private Key (read/write/delete)</a> <a href="#">CSP5-1 SSH RSA Private key (read/write/delete)</a> <a href="#">CSP5-2 SSH ECDSA Private key (read/write/delete)</a> <a href="#">CSP9-1 SNMPv3 Authentication Key (read/write/delete)</a> <a href="#">CSP9-2 SNMPv3 Encryption Key (read/write/delete)</a> <a href="#">CSP7-1 DRBG entropy input (read/write/delete)</a> <a href="#">CSP8-1 DRBG seed (read/write/delete)</a> <a href="#">CSP8-2 DRBG V (read/write/delete)</a> <a href="#">CSP8-3 DRBG Key (read/write/delete)</a>	
14. Management (create, delete, modify) of the user roles	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
15. Management of the access control rules for each role	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
16. Management (create, delete, modify) of the user account	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP6-1 User Passwords (read/write/delete)</a>	Network-admin, level-15, level-9
17. Management of the time	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
18. Maintenance (delete, modify) system start-up parameters	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
19. File operation (e.g. dir, copy, del)	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP11-1 Firmware Signature (write/delete)</a>	Network-admin, level-15, level-9

<p>20. Shut down or Reboot the security appliance</p>	<p>Commands and configuration data</p>	<p>Status of commands and configuration data</p>	<p><a href="#">CSP2-1 IPsec authentication keys (delete)</a>  <a href="#">CSP2-2 IPsec encryption keys (delete)</a>  <a href="#">CSP3-4 IKE Authentication key (delete)</a>  <a href="#">CSP3-5 IKE Encryption Key (delete)</a>  <a href="#">CSP4-5 IKEv2 Authentication key (delete)</a>  <a href="#">CSP4-6 IKEv2 Encryption Key (delete)</a>  <a href="#">CSP4-7 IKEv2 Diffie-Hellman Public Key (delete)</a>  <a href="#">CSP4-8 IKEv2 Diffie-Hellman Private Key (delete)</a>  <a href="#">CSP4-9 IKEv2 ECDH Public Key (delete)</a>  <a href="#">CSP4-10 IKEv2 ECDH Private Key (delete)</a>  <a href="#">CSP5-3 SSH Diffie-Hellman Public Key (delete)</a>  <a href="#">CSP5-4 SSH Diffie-Hellman Private Key (delete)</a>  <a href="#">CSP5-5 SSH ECDH Public Key (delete)</a>  <a href="#">CSP5-6 SSH ECDH Private Key (delete)</a>  <a href="#">CSP5-7 SSH Session encryption Key (delete)</a>  <a href="#">CSP5-8 SSH Session authentication Key (delete)</a>  <a href="#">CSP7-1 DRBG entropy input (delete)</a>  <a href="#">CSP8-1 DRBG seed (delete)</a>  <a href="#">CSP8-2 DRBG V (delete)</a>  <a href="#">CSP8-3 DRBG Key (delete)</a>  <a href="#">CSP11-1 Firmware Signature (read)</a></p>	<p>Network-admin, level-15, level-9</p>
<p>21. Maintenance of IKEv1/IKEv2/IPsec.</p>	<p>Commands and configuration data</p>	<p>Status of commands and configuration data</p>	<p><a href="#">CSP1-1 RSA Public key (read/write/delete)</a>  <a href="#">CSP1-2 DSA Public key (read/write/delete)</a>  <a href="#">CSP1-3 ECDSA Public key (read/write/delete)</a>  <a href="#">CSP2-3 IPsec authentication keys (read/write/delete)</a>  <a href="#">CSP2-4 IPsec encryption keys (read/write/delete)</a>  <a href="#">CSP3-1 IKE pre-shared keys (read/write/delete)</a>  <a href="#">CSP3-2 IKE RSA Authentication private Key (read/write/delete)</a>  <a href="#">CSP3-3 IKE DSA Authentication private Key (read/write/delete)</a>  <a href="#">CSP4-1 IKEv2 pre-shared keys (read/write/delete)</a>  <a href="#">CSP4-2 IKEv2 RSA Authentication private Key (read/write/delete)</a></p>	<p>Network-admin, level-15, level-9</p>

			<a href="#">CSP4-3 IKEv2 DSA Authentication private Key (read/write/delete)</a> <a href="#">CSP4-4 IKEv2 ECDSA Authentication private Key (read/write/delete)</a>	
22. Maintenance of SNMPv3	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP9-1 SNMPv3 Authentication Key (read/write/delete)</a> <a href="#">CSP9-2 SNMPv3 Encryption Key (read/write/delete)</a>	Network-admin, level-15, level-9
23. Maintenance of SSHv2	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP1-1 RSA Public key (read/write/delete)</a> <a href="#">CSP1-3 ECDSA Public key (read/write/delete)</a> <a href="#">CSP5-1 SSH RSA Private key (read/write/delete)</a> <a href="#">CSP5-2 SSH ECDSA Private key (read/write/delete)</a> <a href="#">CSP5-7 SSH Session encryption Key (read/write/delete)</a> <a href="#">CSP5-8 SSH Session authentication Key (read/write/delete)</a>	Network-admin, level-15, level-9
24. Perform self-test	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
25. Displaying and maintaining security log files	Commands and configuration data	Status of commands and configuration data	None	security-audit
<b>Perform Configuration Functions</b>				
26. Save configuration	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
27. Management of information center	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
28. Define network interfaces and settings	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
29. Set the protocols the routers will support(e.g. SFTP server, SSHv2 server)	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9

30. Enable interfaces and network services	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
31. Management of access control scheme	Commands and configuration data	Status of commands and configuration data	None	Network-admin, level-15, level-9
32. Config managing security log files and security log file system	Commands and configuration data	Status of commands and configuration data	None	security-audit
33. Enable/Disable FIPS mode of operation	Commands and configuration data	Status of commands and configuration data	All private and session keys are zeroized when switching between FIPS and non-FIPS modes	Network-admin, level-15
34. Load firmware <sup>2</sup>	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP11-1 Firmware Signature (read)</a>	Network-admin, level-15

**Table 15 User Services**

Description	Input	Output	CSP Access	Available to Role
<b>View Device Status</b>				
1. View currently running image version; 2. View installed hardware components status and version	Commands	Status of devices	None	network-operator level-1
<b>View Running Status</b>				
3. View memory status, packet statistics, interface status, current running image version, current configuration, routing table, active sessions, temperature and SNMP MIB statistics.	Commands	Status of device functions	None	network-operator level-1
<b>Perform Network Functions</b>				

<sup>2</sup> New firmware versions within the scope of this validation must be validated through the FIPS 140-2 CMVP. Any other firmware loaded into this module is out of the scope of this validation and requires a separate FIPS 140-2 validation.

Description	Input	Output	CSP Access	Available to Role
4. Network diagnostic service such as “ping”;	Commands and configuration data	Status of commands and configuration data	None	Level-0, Level-1
5. Network connection service such as “SSHv2” client.	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP1-1 RSA Public key (read)</a> <a href="#">CSP1-2 DSA Public key (read)</a> <a href="#">CSP1-3 ECDSA Public key (read)</a> <a href="#">CSP2-1 IPsec authentication keys (read/write/delete)</a> <a href="#">CSP2-2 IPsec encryption keys (read/write/delete)</a> <a href="#">CSP2-3 IPsec authentication keys (read)</a> <a href="#">CSP2-4 IPsec encryption keys (read)</a> <a href="#">CSP3-1 IKE pre-shared keys (read)</a> <a href="#">CSP3-2 IKE RSA Authentication private Key (read)</a> <a href="#">CSP3-3 IKE DSA Authentication private Key (read)</a> <a href="#">CSP3-4 IKE Authentication key (read/write/delete)</a> <a href="#">CSP3-5 IKE Encryption Key (read/write/delete)</a> <a href="#">CSP3-6 IKE Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP3-7 IKE Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP4-1 IKEv2 pre-shared keys (read)</a> <a href="#">CSP4-2 IKEv2 RSA Authentication private Key (read)</a> <a href="#">CSP4-3 IKEv2 DSA Authentication private Key (read)</a> <a href="#">CSP4-4 IKEv2 ECDSA Authentication private Key (read)</a> <a href="#">CSP4-5 IKEv2 Authentication key (read/write/delete)</a> <a href="#">CSP4-6 IKEv2 Encryption Key (read/write/delete)</a> <a href="#">CSP4-7 IKEv2 Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP4-8 IKEv2 Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP4-9 IKEv2 ECDH Public Key (read/write/delete)</a>	Level-0, Level-1

Description	Input	Output	CSP Access	Available to Role
			<a href="#">CSP4-10 IKEv2 ECDH Private Key (read/write/delete)</a> <a href="#">CSP5-1 SSH RSA Private key (read)</a> <a href="#">CSP5-2 SSH ECDSA Private key (read)</a> <a href="#">CSP5-3 SSH Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP5-4 SSH Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP5-5 SSH ECDH Public Key (read/write/delete)</a> <a href="#">CSP5-6 SSH ECDH Private Key (read/write/delete)</a> <a href="#">CSP5-7 SSH Session encryption Key (read/write/delete)</a> <a href="#">CSP5-8 SSH Session authentication Key (read/write/delete)</a> <a href="#">CSP9-1 SNMPv3 Authentication Key (read)</a> <a href="#">CSP9-2 SNMPv3 Encryption Key (read)</a> <a href="#">CSP7-1 DRBG entropy input (delete)</a> <a href="#">CSP8-1 DRBG seed (delete)</a> <a href="#">CSP8-2 DRBG V (delete)</a> <a href="#">CSP8-3 DRBG Key (delete)</a>	
6. Provide SSHv2 service.	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP1-1 RSA Public key (read)</a> <a href="#">CSP1-3 ECDSA Public key (read)</a> <a href="#">CSP5-1 SSH RSA Private key (read)</a> <a href="#">CSP5-2 SSH ECDSA Private key (read)</a> <a href="#">CSP5-3 SSH Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP5-4 SSH Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP5-5 SSH ECDH Public Key (read/write/delete)</a> <a href="#">CSP5-6 SSH ECDH Private Key (read/write/delete)</a> <a href="#">CSP5-7 SSH Session encryption Key (read/write/delete)</a> <a href="#">CSP5-8 SSH Session authentication Key (read/write/delete)</a> <a href="#">CSP6-1 User Passwords (read/write/delete)</a> <a href="#">CSP6-3 RADIUS shared secret keys (read)</a>	Level-0, Level-1

Description	Input	Output	CSP Access	Available to Role
			<a href="#">CSP6-4 TACACS+ shared secret keys (read)</a> <a href="#">CSP7-1 DRBG entropy input (delete)</a> <a href="#">CSP8-1 DRBG seed (delete)</a> <a href="#">CSP8-2 DRBG V (delete)</a> <a href="#">CSP8-3 DRBG Key (delete)</a>	
<p>7. Provide IKEv1/IKEv2/IPsec service to protect the session between the router and external server(e.g. Radius Server/Log Server)</p>	<p>Commands and configuration data</p>	<p>Status of commands and configuration data</p>	<a href="#">CSP1-1 RSA Public key (read)</a> <a href="#">CSP1-2 DSA Public key (read)</a> <a href="#">CSP1-3 ECDSA Public key (read)</a> <a href="#">CSP2-1 IPsec authentication keys (read/write/delete)</a> <a href="#">CSP2-2 IPsec encryption keys (read/write/delete)</a> <a href="#">CSP2-3 IPsec authentication keys (read)</a> <a href="#">CSP2-4 IPsec encryption keys (read)</a> <a href="#">CSP3-1 IKE pre-shared keys (read)</a> <a href="#">CSP3-2 IKE RSA Authentication private Key (read)</a> <a href="#">CSP3-3 IKE DSA Authentication private Key (read)</a> <a href="#">CSP3-4 IKE Authentication key (read/write/delete)</a> <a href="#">CSP3-5 IKE Encryption Key (read/write/delete)</a> <a href="#">CSP3-6 IKE Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP3-7 IKE Diffie-Hellman Private Key (read/write/delete)</a> <a href="#">CSP4-1 IKEv2 pre-shared keys (read)</a> <a href="#">CSP4-2 IKEv2 RSA Authentication private Key (read)</a> <a href="#">CSP4-3 IKEv2 DSA Authentication private Key (read)</a> <a href="#">CSP4-4 IKEv2 ECDSA Authentication private Key (read)</a> <a href="#">CSP4-5 IKEv2 Authentication key (read/write/delete)</a> <a href="#">CSP4-6 IKEv2 Encryption Key (read/write/delete)</a> <a href="#">CSP4-7 IKEv2 Diffie-Hellman Public Key (read/write/delete)</a> <a href="#">CSP4-8 IKEv2 Diffie-Hellman Private Key (read/write/delete)</a>	<p>Level-0, Level-1</p>



Description	Input	Output	CSP Access	Available to Role
			<a href="#">CSP4-9 IKEv2 ECDH Public Key (read/write/delete)</a> <a href="#">CSP4-10 IKEv2 ECDH Private Key (read/write/delete)</a> <a href="#">CSP7-1 DRBG entropy input (read/write/delete)</a> <a href="#">CSP8-1 DRBG seed (read/write/delete)</a> <a href="#">CSP8-2 DRBG V (read/write/delete)</a> <a href="#">CSP8-3 DRBG Key (read/write/delete)</a>	
8. Provide SNMPv3 service.	Commands and configuration data	Status of commands and configuration data	<a href="#">CSP9-1 SNMPv3 Authentication Key (read)</a> <a href="#">CSP9-2 SNMPv3 Encryption Key (read)</a> <a href="#">CSP7-1 DRBG entropy input (read/write/delete)</a> <a href="#">CSP8-1 DRBG seed (read/write/delete)</a> <a href="#">CSP8-2 DRBG V (read/write/delete)</a> <a href="#">CSP8-3 DRBG Key (read/write/delete)</a>	Level-0, Level-1

### 6.1.1 Unauthenticated Services

- Cycle the power on the switch
- View currently running image version;
- View installed hardware components status and version
- View memory status, packet statistics, interface status, current running image version, current configuration, routing table, active sessions, temperature and SNMP MIB statistics

### 6.1.2 Non-Approved Services

The HPE network routers support the following non-approved services:

- Internet Key Exchange (IKE) or Internet Protocol Security (IPsec) with AES-XCBC-MAC, Camellia, DES, Triple-DES, MD5, HMAC-MD5, Diffie-Hellman (<2048-bits), RSA (< 2048-bits), DSA (< 2048-bits), ECDSA (<224-bits).
- Perform Network Time Protocol (NTP) service.
- Perform Secure Socket Layer (SSL) 3.0 or Transport Layer Security (TLS) 1.0, 1.1, 1.2.

- Perform Secure Shell version 1.x.
- Perform Secure Shell version 2.0 with DES, Triple-DES, MD5, HMAC-MD5, Diffie-Hellman (<2048-bits), RSA (< 2048-bits), DSA (<2048-bits), ECDSA (<224-bits)
- Perform Telnet

## 6.2 Critical Security Parameters

<sup>3</sup>**Critical security parameter (CSP):** security-related information (e.g., secret and private cryptographic keys, and authentication data such as passwords and PINs) whose disclosure or modification can compromise the security of a cryptographic module.<sup>4</sup>

### Assumptions, Assertions and Caveats

1. Preferably, the Key / CSP Table should be listed after the Services Table.
2. Each Key(s) / CSP(s) must be mapped to by a service. A Key / CSP cannot exist unless associated with a service.
3. Each Key / CSP should be uniquely identifiable so the entries in the Services Table can easily map to a Key / CSP.
4. The DH key pairs should be 2 entries in the table. One for the public key and one for the private key – since the key lengths are different

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<sup>3</sup> FIPS Pub 140-2

<sup>4</sup> In Comware, CSPs generated in FIPS mode cannot be used in non-FIPS mode, and vice versa.

- Each public key should be in its own row.
  - Each private key should be in its own row.
5. For all RSA keys, state whether it is used for key transport or signature generation/verification.
    - Key transport should be in its own row.
    - Signature generation/verification should be in its own row.
  6. Where possible, group Key / CSP together e.g. Keys associated with a protocol should be grouped together.

### **KEY / CSP Table Column Definitions**

1. Key / CSP #

Unique identifier of CSP

2. Key or CSP Name

Objective of this column is to list the type of key or CSP used by the cryptographic module.

- To avoid confusion wherever possible it is recommended that the name of the key/CSP be consistent with a recognized industry standard such as ISO, IETF or NIST Special Publication.

3. Key/CSP Type & Algorithm Link

Objective of this column is to provide additional information about the CSP.

- Where applicable this column shall include the type of key/CSP, algorithm(s) (including reference to FIPS or NIST SP).
- The Algorithm link points to the Algorithm in the Algorithm table the Key/CSP uses.

4. Key size

Size of the key used by the CSP.

5. Use

The objective of this column is to provide information on how the key is used during cryptographic module operation.

- This column should contain a short description of the Key/CSP.

- It is important that each CSP is mapped directly **from** an Approved service that the cryptographic module performs.
- For all RSA keys, this column shall specify whether it is used for key transport or signature generation/verification

#### 6. Generation/Input

The objective of this column is to specify how and when the CSP is generated, derived or enters the module.

- If the CSP is generated or derived, this column shall specify the function or technique responsible.
- If the CSP is entered, the column shall specify if the CSP is entered electronically or manually.
- The column shall specify if it is stored encrypted or in plaintext form.
- If the CSP is ephemeral this column shall specify conditions upon which it is generated (A cryptographic key is called ephemeral if it is generated for each execution of a key establishment process.).

#### 7. Storage

The objective of this column is to specify where the CSP is stored during cryptographic module operation.

- The column shall also state the location and type of storage.
- The column shall state if the CSP is persistent, ephemeral or hardcoded.
- The column shall specify if it is stored encrypted or in plaintext form.
- The column shall specify if only a pointer or reference to the CSP is stored or the actual CSP.

#### 8. Output

The objective of this column is to specify if the CSP can be output from the cryptographic module.

- If the CSP can be output, the column shall specify how it can be output.
- If the CSP can be output, the column shall specify if it is encrypted or plaintext form.

#### 9. Zeroization

The objective of this column is to provide details on how the CSP shall be zeroized.

- All possible zeroization techniques for the CSP shall be listed.

**Table 16 Critical Security Parameters**

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
<b>Public key management</b>								
CSP1-1	RSA public key	RSA <a href="#">RSA-1</a> <a href="#">RSA-2</a> <a href="#">RSA-3</a> <a href="#">RSA-4</a>	2048 bits	Identity certificates for the security appliance itself and also used in IPsec and SSH.	Electronically generated OR Externally generated; input in ciphertext	FLASH (cipher text / AES256)	Plaintext	Using CLI command to zeroize.
CSP1-2	DSA public key	DSA <a href="#">DSA-1</a> <a href="#">DSA-2</a> <a href="#">DSA-3</a> <a href="#">DSA-4</a>	2048 bits	Identity certificates for the security appliance itself and also used in IPsec and SSH.	Electronically generated OR Externally generated; input in ciphertext	FLASH (cipher text / AES256)	Plaintext	Using CLI command to zeroize
CSP1-3	ECDSA public key	ECDSA	NIST P256, P384, P521	Identity certificates for the security appliance	Electronically generated	FLASH (cipher text / AES256)	Plaintext	Using CLI command to zeroize

<sup>5</sup> For all keys marked as "Electronically generated", the resulting symmetric key or the generated seed to be used in the asymmetric key generation is an unmodified output from the DRBG.

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
		<a href="#">ECDSA-1</a> <a href="#">ECDSA-2</a> <a href="#">ECDSA-3</a>		itself and also used in IPsec and SSH.	OR Externally generated; input in ciphertext			
<b>IPsec</b>								
CSP2-1	IPsec authentication keys	HMAC-SHA1-96 HMAC-SHA-256-128 HMAC-SHA-384-192 HMAC-SHA-512-256 GMAC-128 GMAC-192 GMAC-256 <a href="#">HMAC-1</a> <a href="#">HMAC-3</a> <a href="#">AES-1</a> <a href="#">AES-2</a>	HMAC: 160 bits 256 bits 384 bits 512 bits AES GMAC: 128 bits 192 bits 256 bits	Used to authenticate the IPsec traffic	Electronically generated	RAM (plain text)	No	Automatically when session expires.
CSP2-2	IPsec encryption keys	AES <a href="#">AES-1</a> <a href="#">AES-2</a>	128 bits, 192 bits, 256 bits	Used to encrypt the IPsec traffic	Electronically generated as part of SP800-135 KDF	RAM (plain text)	No	Automatically when session expires.
CSP2-3	IPsec	HMAC-SHA1-96	HMAC:	Used to authenticate the	Manually entered	FLASH (cipher	Encrypted	Keys will be zeroized

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
	authentication keys	HMAC-SHA-256-128 HMAC-SHA-384-192 HMAC-SHA-512-256 GMAC-128 GMAC-192 GMAC-256  <a href="#">HMAC-1</a> <a href="#">HMAC-3</a> <a href="#">AES-1</a> <a href="#">AES-2</a>	160 bits 256 bits 384 bits 512 bits AES GMAC: 128 bits 192 bits 256 bits	IPsec traffic	by the Crypto-Officer	text / AES-CTR 256) and RAM (plain text)		using CLI commands “ <b>undo sa hex-key authentication ...</b> ” and “ <b>save</b> ”,
CSP2-4	IPsec encryption keys	AES  <a href="#">AES-1</a> <a href="#">AES-2</a>	128 bits, 192 bits, 256 bits	Used to encrypt the IPsec traffic	Manually entered by the Crypto-Officer	FLASH (cipher text / AES-CTR 256) and RAM (plain text)	Encrypted	Keys will be zeroized using CLI commands “ <b>undo sa hex-key encryption ...</b> ” and “ <b>save</b> ”,
<b>IKEv1</b>								
CSP3-1	IKE pre-shared keys	Shared Secret  None	15 ~ 128 bytes	Used for authentication during IKE	Manually entered by the Crypto-Officer	FLASH(cipher text/ AES-CTR-256) and RAM (cipher text/ AES-CTR-256)	Encrypted	Using CLI command to zeroize
CSP3-2	IKE RSA Authentication	RSA	2048 bits	private key used for IKE protocol during the	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
	private Key	<a href="#">RSA-1</a> <a href="#">RSA-3</a> <a href="#">RSA-4</a>		handshake	OR Externally generated; input in ciphertext			
CSP3-3	IKE DSA Authentication private Key	DSA <a href="#">DSA-3</a> <a href="#">DSA-4</a>	256 bits	private key used for IKE protocol during the handshake	Electronically generated OR Externally generated; input in ciphertext	RAM (plain text)	No	Automatically when handshake finishing
CSP3-4	IKE Authentication key	HMAC-SHA1, HMAC-SHA256 HMAC-HA384, HMAC-SHA512 <a href="#">HMAC-3</a>	160 bits 256 bits 384 bits, 512 bits	Used to authenticate IKE negotiations	Electronically generated	RAM (plain text)	No	Automatically when session expires.
CSP3-5	IKE Encryption Key	AES <a href="#">AES-2</a>	128 bits, 192 bits, 256 bits	Used to encrypt IKE negotiations	Electronically generated as part of SP800-135 KDF	RAM (plain text)	No	Automatically when session expires.
CSP3-6	IKE Diffie-Hellman Public Key	DH <a href="#">CVL-1</a>	2048 bits	Key agreement for IKE	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
CSP3-7	IKE Diffie-Hellman Private Key	DH <a href="#">CVL-1</a>	DH Group 14: 2048 bits DH Group 24: 256 bits	Key agreement for IKE	Electronically generated as part of SP800-135 KDF	RAM (plain text)	No	Automatically when handshake finishing



#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
<b>IKEv2</b>								
CSP4-1	IKEv2 pre-shared keys	Shared Secret <a href="#">AES-2</a>	15 ~ 128 bytes	Used for authentication during IKEv2	Manually entered by the Crypto-Officer	FLASH(cipher text/ AES-CTR-256) and RAM (cipher text/ AES-CTR-256)	Encrypted	Using CLI command to zeroize
CSP4-2	IKEv2 RSA Authentication private Key	RSA <a href="#">RSA-1</a> <a href="#">RSA-3</a> <a href="#">RSA-4</a>	2048 bits	private key used for IKEv2 protocol during the handshake	Electronically generated OR Externally generated; input in ciphertext	RAM (plain text)	No	Automatically when handshake finishing
CSP4-3	IKEv2 DSA Authentication private Key	DSA <a href="#">DSA-3</a> <a href="#">DSA-4</a>	256 bits	private key used for IKEv2 protocol during the handshake	Electronically generated OR Externally generated; input in ciphertext	RAM (plain text)	No	Automatically when handshake finishing
CSP4-4	IKEv2 ECDSA Authentication private Key	ECDSA <a href="#">ECDSA-2</a> <a href="#">ECDSA-3</a>	ECDSA:P-256, P-384, P-521	private key used for IKEv2 protocol during the handshake	Electronically generated OR Externally generated; input in ciphertext	RAM (plain text)	No	Automatically when handshake finishing
CSP4-5	IKEv2 Authentication key	HMAC-SHA1, HMAC-SHA256 HMAC-HA384,	160 bits 256 bits 384 bits,	Used to authenticate IKEv2 negotiations	Electronically generated	RAM (plain text)	No	Automatically when session expires.

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
		HMAC-SHA512	512 bits					
		<a href="#">HMAC-3</a>						
CSP4-6	IKEv2 Encryption Key	AES	128 bits, 192 bits, 256 bits	Used to encrypt IKEv2 negotiations	Electronically generated as part of SP800-135 KDF	RAM (plain text)	No	Automatically when session expires.
		<a href="#">AES-2</a>						
CSP4-7	IKEv2 Diffie-Hellman Public Key	DH	2048 bits	Key agreement for IKEv2	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-1</a>						
CSP4-8	IKEv2 Diffie-Hellman Private Key	DH	DH Group 14: 2048 bits DH Group 24: 256 bits	Key agreement for IKEv2	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-1</a>						
CSP4-9	IKEv2 ECDH Public Key	ECDH	P-256, P-384	Key agreement for IKEv2	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-2</a>						
CSP4-10	IKEv2 ECDH Private Key	ECDH	P-256: 256 bits P-384: 384 bits	Key agreement for IKEv2	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-2</a>						
<b>SSH</b>								

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
CSP5-1	SSH RSA Private key	RSA	2048 bits	private key used for SSH protocol	Electronically generated OR Externally generated; input in ciphertext	RAM(plain text)	No	Automatically when handshake finishing
		<a href="#">RSA-1</a> <a href="#">RSA-3</a> <a href="#">RSA-4</a>						
CSP5-2	SSH ECDSA Private key	ECDSA	P-256, P-384	private key used for SSH protocol	Electronically generated OR Externally generated; input in ciphertext	RAM(plain text)	No	Automatically when handshake finishing
		<a href="#">ECDSA-2</a> <a href="#">ECDSA-3</a>						
CSP5-3	SSH Diffie-Hellman Public Key	DH	2048 bits	Public key agreement for SSH sessions.	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-1</a>						
CSP5-4	SSH Diffie-Hellman Private Key	DH	2048 bits	Private key agreement for SSH sessions.	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-1</a>						
CSP5-5	SSH ECDH Public Key	ECDH	P-256, P-384	Public key agreement for SSH sessions.	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-2</a>						
CSP5-6	SSH ECDH Private Key	ECDH	P-256, P-384	Private key agreement for SSH sessions.	Electronically generated	RAM (plain text)	No	Automatically when handshake finishing
		<a href="#">CVL-2</a>						
CSP5-7	SSH Session	AES	128 bits	SSH session symmetric	Electronically	RAM (plain text)	No	Automatically when

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
	encryption Key	<a href="#">AES-2</a>	192 bits 256 bits	key	generated as part of SP800-135 KDF			SSH session terminated
CSP5-8	SSH Session authentication Key	HMAC	160 bits	SSH session authentication key	Electronically generated	RAM (plain text)	No	Automatically when SSH session terminated
		<a href="#">HMAC-3</a>	256 bits 512 bits					
<b>Authentication</b>								
CSP6-1	User Passwords	Secret	15 ~ 63 bytes	Used to authenticate the administrator login.	Manually entered by the Crypto-Officer	FLASH (cipher text / AES256)	Encrypted	Using CLI command to zeroize
		<a href="#">AES-2</a>						
CSP6-2	Super password	Secret	15 ~ 63 bytes	Used to authenticate the user role.	Manually entered by the Crypto-Officer	FLASH (cipher text / AES256)	Encrypted	Using CLI command to zeroize
		<a href="#">AES-2</a>						
CSP6-3	RADIUS shared secret keys	Shared Secret	15 ~ 64 bytes	Used for authenticating the RADIUS server to the security appliance and vice versa.	Manually entered by the Crypto-Officer	FLASH (cipher text / AES256)	Encrypted	Using CLI command to zeroize
		<a href="#">AES-2</a>						
CSP6-4	TACACS+ shared secret keys	Shared Secret	15~255 bytes	Used for authenticating the TACACS+ server to the security appliance and vice versa.	Manually entered by the Crypto-Officer	FLASH (cipher text / AES256)	Encrypted	Using CLI command to zeroize
		<a href="#">AES-2</a>						
<b>Entropy</b>								

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
CSP7-1	DRBG entropy input	SP 800-90A CTR_DRBG  <a href="#">DRBG-1</a>	256 bits	Entropy source used to construct seed	Electronically generated	RAM (plaintext)	No	Resetting or rebooting the security appliance
<b>Random Bits Generation</b>								
CSP8-1	DRBG seed	SP 800-90A CTR_DRBG  <a href="#">DRBG-1</a>	384 bits	Input to the DRBG that determines the internal state of the DRBG	Electronically generated	RAM (plaintext)	Never exits the module	Resetting or rebooting the security appliance
CSP8-2	DRBG V	SP 800-90A CTR_DRBG  <a href="#">DRBG-1</a>	128 bits	Generated by entropy source via the CTR_DRBG derivation function. It is stored in DRAM with plaintext form	Electronically generated	RAM (plaintext)	Never exits the module	Resetting or rebooting the security appliance
CSP8-3	DRBG Key	SP 800-90A CTR_DRBG  <a href="#">DRBG-1</a>	256 bits	AES key used for SP 800-90A CTR_DRBG	Electronically generated	RAM (plaintext)	Never exits the module	Resetting or rebooting the security appliance
<b>SNMPv3</b>								
CSP9-1	SNMPv3 Authentication Key	HMAC-SHA1  <a href="#">HMAC-3</a>	160 bits	Used to verify SNMPv3 packet.	Manually entered by the Crypto-Officer OR Electronically derived from	FLASH (cipher text / AES256)  RAM (plain text)	Encrypted	Using CLI command to zeroize

#	Key / CSP Name	Key / CSP Type	Key Size	Use	Generation <sup>5</sup> / Input	Storage	Output	Zeroization
		Algorithm Link						
					SP800-135 KDF			
CSP9-2	SNMPv3 Encryption Key	AES <a href="#">AES-2</a>	128 bits	Used to encrypt SNMPv3 packet.	Manually entered by the Crypto-Officer	FLASH (cipher text / AES256) RAM (plain text)	Encrypted	Using CLI command to zeroize
<b>System KEK</b>								
CSP10-1	Key encrypting key	AES <a href="#">AES-1</a> <a href="#">AES-2</a>	256 bits	Used to encrypt all private key, user password, and pre-shared key stored on internal storage. The KEK is generated using random bytes	Electronically generated	RAM (plain text)	No	Zeroized when Resetting or rebooting the security appliance
<b>System Firmware</b>								
CSP11-1	Firmware Signature	RSA	2048 bits	Factory signature used to verify Comware 7 firmware.	Generated by HPE Comware 7 Build Team	FLASH (binary images)	Binary image	Upon deletion of binary image.

## 6.3 Approved Algorithms

### **Assumptions, Assertions and Caveats**

1. Each instantiation of the algorithm should be in a separate table
  - e.g. kernel, firmware, accelerators
  - e.g. chassis / controller
2. Each instantiation of the algorithm should be uniquely identifiable so the Key / CSP can easily map to an algorithm.
3. Include a reference to the FIPS 140-2 approved standard for each algorithm. One example is to use a footnote.
4. The ECB mode is required for all other AES modes. The ECB mode should be listed as not used by the module if ECB is only used to support the other modes. If the ECB mode is used by one or more services, it should be listed as available. Although ECB is the basis for all other AES modes, it is latent functionality if there is no service that uses it.
5. Each instantiation of the algorithm must map to the service that uses it.
6. To expedite the review process, each instantiation of the algorithm should have a hyperlink to the CAVP page that contains the certification listing.
7. It is important to identify which algorithms are used by the module and which are not. All functionality listed on the CAVP certificate should be detailed somewhere in the tables, footnotes, or text of the Security Policy. If all of the functionality is used by the module, then all algorithm functionality belongs in the tables. If some functionality is not used by the module, then the author should determine the best to convey that to the reader. (The Tables use footnotes. But there are other ways to convey this information.)

### **Algorithm Table Column Definitions**

1. Algorithm #  
Unique identifier of the algorithm. Each instantiation should be uniquely identified.
2. CAVP Certificate  
Objective of this column is identify the CAVP certificate.
  - The certificate number should be listed.
  - A hyperlink should be create to the CAVP website to the certificate number.
3. Algorithm  
Objective of this column is identify the Algorithm in use.
  - The algorithm name should be consistent with the names list on the Cryptographic Algorithm Validation Program (CAVP) website.

- The acronym may be used instead of the full name.
- Include a reference to the FIPS 140-2 approved standard for each algorithm.

4. Mode / Method

Objective of this column is identify the Mode / Method used by the algorithm.

5. Key Lengths, Curves or Moduli

Objective of this column is identify the Key Lengths, Curves or Moduli used by the algorithm.

6. Use

Objective of this column is identify the use of the algorithm.

7. Service that uses Algorithm

Objective of this column is identify the services that use the algorithm.

- A cross reference should be made to the unique identifier in a services table
- The cross reference should contain a hyperlink to the entry in a services table.
- The relationship of algorithm to service maybe one-to-one, one-to-many, or many-to-many.



**Table 17 Comware V7 Kernel – Approved Algorithms**

#	CAVP Certificate	Algorithm	Mode/ Method	Key Lengths, Curves or Moduli	Use	Service that uses Algorithm
AES-1	<a href="#">4095</a> <a href="#">4097</a>	AES <sup>6</sup>	ECB <sup>7</sup> , CBC <sup>8</sup> , CTR, GCM <sup>9</sup> , GMAC	128, 192, 256	Kernel – Data Encryption/ Decryption	<b>Crypto Officer Services</b>  ( <a href="#">7</a> , <a href="#">21</a> , <a href="#">24</a> ) <b>User Services</b>  ( <a href="#">7</a> )
HMAC-1	<a href="#">2675</a> <a href="#">2677</a>	HMAC <sup>10</sup>	HMAC SHA-1 <sup>11</sup> , HMAC-SHA-1-96	160	Kernel - Message Authentication	<b>Crypto Officer Services</b>  ( <a href="#">7</a> , <a href="#">21</a> , <a href="#">24</a> ) <b>User Services</b>  ( <a href="#">7</a> )
SHS-1	<a href="#">3371</a> <a href="#">3373</a>	SHS <sup>12</sup>	SHA-1 <sup>13</sup>		Kernel – Message Digest	<b>Crypto Officer Services</b>  ( <a href="#">7</a> , <a href="#">21</a> , <a href="#">24</a> ) <b>User Services</b>  ( <a href="#">7</a> )

<sup>6</sup> FIPS 197

<sup>7</sup> Not used by the module

<sup>8</sup> SP 800-38A

<sup>9</sup> The module's AES-GCM implementation conforms to IG A.5 scenario #1 following RFC 6071 for IPsec and RFC 5288 for TLS. The module uses a 96-bit IV, which is comprised of a 4 byte salt unique to the crypto session and 8 byte monotonically increasing counter. The module generates new AES-GCM keys if the module loses power.

<sup>10</sup> FIPS 198-1

<sup>11</sup> Comware Kernel supports various options for HMAC, however, only those listed in the table are utilized.

<sup>12</sup> FIPS 180-4

<sup>13</sup> Comware Kernel supports various options for SHA, however, only those listed in the table are utilized.

#	CAVP Certificate	Algorithm	Mode/ Method	Key Lengths, Curves or Moduli	Use	Service that uses Algorithm
TDES-1 <sup>14</sup>	<a href="#">2238</a> <a href="#">2240</a>	Triple-DES <sup>15</sup>	TECB <sup>16</sup> , TCBC	192	Self-Tests	<u>Crypto Officer Services</u>  (24) <u>User Services</u>  None

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<sup>14</sup> Although the certification contains Triple-DES, Triple-DES is used only for self-tests in the approved mode.

<sup>15</sup> SP 800-67rev1

<sup>16</sup> Not used by the module

**Table 18 Comware V7 Firmware – Approved Algorithms**

#	CAVP Certificate	Algorithm	Mode/ Method	Key Lengths or Curves	Use	Service that uses Algorithm
AES-2	<a href="#">4090</a> <a href="#">4092</a>	AES <sup>17</sup>	ECB <sup>18</sup> , CBC, CTR, GCM <sup>19</sup> , GMAC, KW <sup>20</sup>	128, 192, 256	Data Encryption/ Decryption	<b><u>Crypto Officer Services</u></b> ( <a href="#">5</a> , <a href="#">6</a> , <a href="#">7</a> , <a href="#">8</a> , <a href="#">11</a> , <a href="#">12</a> , <a href="#">13</a> , <a href="#">21</a> , <a href="#">22</a> , <a href="#">23</a> , <a href="#">24</a> ) <b><u>User Services</u></b> ( <a href="#">5</a> , <a href="#">6</a> , <a href="#">7</a> , <a href="#">8</a> )
CVL-1 <sup>21</sup>	<a href="#">906</a> <a href="#">910</a>	CVL <sup>22</sup> IKEv1, IKEv2 TLS 1.0/1.1 <sup>23</sup> SSH, SNMPv3 KDFs			Key Derivation	<b><u>Crypto Officer Services</u></b> ( <a href="#">5</a> , <a href="#">6</a> , <a href="#">7</a> , <a href="#">8</a> , <a href="#">24</a> ) <b><u>User Services</u></b> ( <a href="#">5</a> , <a href="#">6</a> , <a href="#">7</a> , <a href="#">8</a> )
DRBG-1	<a href="#">1228</a> <a href="#">1230</a>	DRBG <sup>24</sup>	CTR (AES-256)		Deterministic Random Bit Generation	<b><u>Crypto Officer Services</u></b> ( <a href="#">5</a> , <a href="#">6</a> , <a href="#">7</a> , <a href="#">13</a> , <a href="#">24</a> ) <b><u>User Services</u></b>

<sup>17</sup> FIPS 197, SP 800-38A, SP 800-38D

<sup>18</sup> Not used by the module

<sup>19</sup> The module's AES-GCM implementation conforms to IG A.5 scenario #1 following RFC 6071 for IPsec and RFC 5288 for TLS. The module uses a 96-bit IV, which is comprised of a 4 byte salt unique to the crypto session and 8 byte monotonically increasing counter. The module generates new AES-GCM keys if the module loses power.

<sup>20</sup> Not used by the module

<sup>21</sup> Component Validation: the protocols covered under this certificate have not been reviewed or tested by the CAVP or CMVP

<sup>22</sup> SP 800-135rev1

<sup>23</sup> Although the certification contains TLS, it is not used in this version of Comware.

<sup>24</sup> SP 800-90A

#	CAVP Certificate	Algorithm	Mode/ Method	Key Lengths or Curves	Use	Service that uses Algorithm
						<a href="#">(5, 6, 7)</a>
DSA-1	<a href="#">1111</a> <a href="#">1113</a>	DSA <sup>25</sup>	SHA-256, SHA-384, SHA-512	(2048,256)	Domain Parameter Generation	<b>Crypto Officer Services</b> <a href="#">(13, 24)</a> <b>User Services</b> <a href="#">(none)</a>
DSA-2				(2048,256)	Key Pair Generation	<b>Crypto Officer Services</b> <a href="#">(13, 24)</a> <b>User Services</b> <a href="#">(none)</a>
DSA-3			SHA-224, SHA-256 SHA-384, SHA-512	(2048,256)	Digital Signature Generation	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7, 24)</a> <b>User Services</b> <a href="#">(5, 6, 7)</a>
DSA-4			SHA-1, SHA-224, SHA-256 SHA-384, SHA-512	(1024,160) (2048,256)	Digital Signature Verification	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7, 24)</a> <b>User Services</b> <a href="#">(5, 6, 7)</a>
CVL-2	<a href="#">905</a> <a href="#">909</a>	CVL – EC Diffie-Hellman Primitive <sup>26</sup>		P-224 <sup>27</sup> , P-256, P-384, P521 <sup>27</sup>	Shared Secret for Key Agreement Scheme	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7)</a> <b>User Services</b>

<sup>25</sup> FIPS 186-4

<sup>26</sup> SP 800-56A, Section 5.7.1.2: ECC CDH Primitive

<sup>27</sup> Not utilized by module.

#	CAVP Certificate	Algorithm	Mode/ Method	Key Lengths or Curves	Use	Service that uses Algorithm
						<a href="#">(5, 6, 7)</a>
ECDSA-1	<a href="#">924</a> <a href="#">926</a>	ECDSA <sup>28</sup>		P-224, P-256, P-384, P-521	Key Pair Generation	<b>Crypto Officer Services</b> <a href="#">(13, 24)</a> <b>User Services</b> (none)
ECDSA-2			SHA-224, SHA-256, SHA-384, SHA-512	P-224, P-256, P-384, P-521	Digital Signature Generation	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7, 24)</a> <b>User Services</b> <a href="#">5, 6, 7</a>
ECDSA-3			SHA-1, SHA-224, SHA-256, SHA-384, SHA-512	P-192 <sup>29</sup> , P-224, P-256, P-384, P-521	Digital Signature Verification	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7, 24)</a> <b>User Services</b> <a href="#">5, 6, 7</a>
HMAC-3	<a href="#">2670</a> <a href="#">2672</a>	HMAC <sup>30</sup>	HMAC SHA-1, HMAC-SHA-1-96, HMAC SHA-224 <sup>31</sup> , HMAC SHA-256, HMAC SHA-384, HMAC SHA-512	160, 256, 384, 512	Message Authentication	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7, 8, 24)</a> <b>User Services</b> <a href="#">(5, 6, 7, 8)</a>

<sup>28</sup> FIPS 198-1

<sup>29</sup> Not used in the approved mode.

<sup>30</sup> FIPS 198-1

<sup>31</sup> Not used by module

#	CAVP Certificate	Algorithm	Mode/ Method	Key Lengths or Curves	Use	Service that uses Algorithm
RSA-1	<a href="#">2214</a> <a href="#">2216</a>	RSA <sup>32</sup>	SHA-1 PKCS1 v.1.5	2048	Digital Signature Verification	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7)</a> <b>User Services</b> <a href="#">5, 6, 7</a>
RSA-2		RSA <sup>33</sup>	Random Public Exponent e	2048	Key Pair Generation	<b>Crypto Officer Services</b> <a href="#">(13, 24)</a> <b>User Services</b> <a href="#">(none)</a>
RSA-3			SHA-224, SHA-256, SHA-384, SHA-512 PKCS1 v.1.5	2048	Digital Signature Generation	<b>Crypto Officer Services</b> <a href="#">(7, 24)</a> <b>User Services</b> <a href="#">(7)</a>
RSA-4			SHA-1, SHA-224, SHA-256, SHA-384, SHA-512 PKCS1 v1.5	2048	Digital Signature Verification	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7, 24, 34)</a> <b>User Services</b> <a href="#">(5, 6, 7)</a>
SHS-3	<a href="#">3366</a> <a href="#">3368</a>	SHS <sup>34</sup>	SHA-1, SHA-224, SHA-256, SHA-384, SHA-512		Message Digest	<b>Crypto Officer Services</b> <a href="#">(5, 6, 7, 8, 11, 12, 21, 22, 24)</a> <b>User Services</b>

<sup>32</sup> FIPS 186-2

<sup>33</sup> FIPS 186-4

<sup>34</sup> FIPS 180-4

#	CAVP Certificate	Algorithm	Mode/ Method	Key Lengths or Curves	Use	Service that uses Algorithm
						<a href="#">(5, 6, 7, 8)</a>
TDES-3 <sup>35</sup>	<a href="#">2233</a> <a href="#">2235</a>	Triple-DES <sup>36</sup>	TECB, TCBC	192	Self-Tests	<b><u>Crypto Officer Services</u></b> <b><u>(24)User Services</u></b> none

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<sup>35</sup> Although the certification contains Triple-DES, Triple-DES is used only for self-tests in the approved mode.

<sup>36</sup> SP 800-67rev1

## 6.4 Allowed Algorithms

**Table 19 Comware V7 Firmware - Allowed Algorithms**

Algorithm	Caveat	Use	Service that uses Algorithm
Diffie-Hellman	Provides 112 bits of encryption strength.	Key establishment	<u>Crypto Officer Services</u> <a href="#">(5, 6, 7)</a> <u>User Services</u> <a href="#">(5, 6, 7)</a>
Elliptic Curve Diffie-Hellman Supported curves: P-256 and P-384	Provides 128 or 192-bits of encryption strength.	Key establishment	<u>Crypto Officer Services</u> <a href="#">(5, 6, 7)</a> <u>User Services</u> <a href="#">(5, 6, 7)</a>
NDRNG <sup>37</sup>	A minimum of 256-bits of entropy is obtained before generating keys.	Seeding for the DRBG	<u>Crypto Officer Services</u> (none) <u>User Services</u> (none)

<sup>37</sup> This implementation satisfies Scenario 1(a) of IG 7.13



## 6.5 Non-Approved Algorithms

**Table 20 Non-Approved Algorithms<sup>38</sup>**

Algorithm	Use	Service that uses Algorithm
AES (non-compliant)	Encryption / Decryption	IKEv2, IPSEC
Camellia	Encryption / Decryption	IKEv2, IPSEC, SSHv2
DES	Encryption / Decryption	IKEv1/v2, IPSEC, SSHv1/v2, SSL
Diffie-Hellman	Key Establishment - Non-compliant less than 112 bits of encryption strength	IKEv1/v2, IPSEC, SSHv2, SSL, TLS
DSA (FIPS 186-2)	Digital Signature Generation	IKEv1/v2, IPSEC, SSHv2
DSA (FIPS 186-4)	Digital Signature Generation	IKEv1/v2, IPSEC, SSHv2
ECDSA (FIPS 186-2)	Digital Signature Generation	IKEv1/v2, IPSEC, SSHv2, SSL, TLS
ECDSA (FIPS 186-4; non-compliant)	Digital Signature	IKEv1/v2, IPSEC, SSHv2, SSL, TLS
HMAC-MD5	Keyed Hash	IKEv1/v2, IPSEC, SSHv2, SSL, TLS

<sup>38</sup> Please see NIST document SP800-131A for guidance regarding the use of non FIPS-approved algorithms

MD5	Hashing	IKEv1/v2, IPSEC, SSHv2, SSL, TLS
RC2	Encryption / Decryption	SSL
RC4	Encryption / Decryption	SSL
RNG (ANSI x9.31)	Random Number Generation	Self-test
RSA (FIPS 186-2)	Asymmetric Key Generation	IKEv1/v2, IPSEC, SSHv1/v2, SSL, TLS
RSA	Key Wrapping – non-compliant less than 112 bits of encryption strength	SSHv1, SSL, TLS

# 7 Self-Tests

HPE Networking devices include an array of self-tests that are run during startup and during operations to prevent any secure data from being released and to insure all components are functioning correctly.

## 7.1 Power-On Self-Tests

The following table lists the power-on self-tests implemented by the switches. The switches perform all power-on self-tests automatically at boot. All power-on self-tests must be passed before any role can perform services. The power-on self-tests are performed prior to the initialization of the forwarding function, which prevents the security appliance from passing any data during a power-on self-test failure.

**Table 21 Power-On Self-Tests**

Implementation	Tests Performed
Security Appliance Software	Software/firmware Test (non-Approved RSA 2048 with SHA-256 which acts as a 256 bit EDC)
	DSA signature and verification PWCT
	ECDSA signature and verification PWCT
	ECDH KAT
	Kernel Triple-DES encryption and Triple-DES decryption KAT
	Triple-DES encryption and Triple-DES decryption KAT
	RSA signature KAT and verification KAT
	RSA signature and verification PWCT
	RSA encryption and decryption PWCT
	Kernel AES encrypt KAT and AES decrypt KAT
	AES encrypt KAT and AES decrypt KAT
	Kernel AES-GCM encrypt KAT and AES-GCM decrypt KAT
	AES-GCM encrypt KAT and AES-GCM decrypt KAT
	Kernel GMAC KAT
	Kernel SHA KATs (SHA-1, SHA-256, SHA-384, and SHA-512)
	SHA KATs (SHA-1, SHA-224, SHA-256, SHA-384, and SHA-512)
	Kernel HMAC KATs (SHA-1, SHA-256, SHA-384, and SHA-512)
HMAC KATs (SHA-1, SHA-224, SHA-256, SHA-384, and SHA-512)	
SP800-90a CTR_DRBG KATs (Instantiate KAT, Generate KAT and Reseed KAT)	

## 7.2 Conditional Self-Tests

The following table lists the conditional self-tests implemented by the switches. Conditional self-tests run when a switch generates an ECDSA or RSA key pair and when it generates a random number.

**Table 22 Conditional Self-Tests**

Implementation	Tests Performed
Security Appliance Software	Pairwise consistency test for RSA
	Pairwise consistency test for DSA
	Pairwise consistency test for ECDSA
	Continuous Random Number Generator Test for the FIPS-approved SP800-90a CTR_DRBG
	SP800-90A Section 11.3 Health Tests for CTR_DRBG (Instantiate, Generate and Reseed)
	Continuous Random Number Generator Test for entropy source (NDRNG)
	Firmware Load Test (RSA PKCS#1 v1.5 2048 bits with SHA-256)

# 8 Delivery and Operation

## 8.1 Secure Delivery

To ensure no one has tampered with the goods during delivery, inspect the Networking switch physical package and check as follows:

1. Outer Package Inspection
  - 1) Check that the outer carton is in good condition.
  - 2) Check the package for a HPE Quality Seal or IPQC Seal, and ensure that it is intact.
  - 3) Check that the IPQC seal on the plastic bag inside the carton is intact.
  - 4) If any check failed, the goods shall be treated as dead-on-arrival (DOA) goods.

2. Packing List Verification

Check against the packing list for discrepancy in material type and quantity. If any discrepancy found, the goods shall be treated as DOA goods.

3. External Visual Inspection

Inspect the cabinet or chassis for any defects, loose connections, damages, and illegible marks. If any surface defect or material shortage found, the goods shall be treated as DOA goods.

4. Confirm Software/firmware

- 1) Version verification

To verify the software version, start the appliance, view the self-test result during startup, and use the display version command to check that the software version.

- For the 75xx, "HPE Comware Software, Version 7.1.045, Release R7179" indicates it is a FIPS 140-2 and CC certification version.
- For the 79xx, "HPE Comware Software, Version 7.1.045, Release R2150" indicates it is a FIPS 140-2 and CC certification version.
- For the 12904, "HPE Comware Software, Version 7.1.045, Release R1150" indicates it is a FIPS 140-2 and CC certification version.

If software loading failed or the version information is incorrect, please contact HPE for support.

- 2) RSA with SHA-256 verification

To verify that software/firmware has not been tampered, run SHA Hash command on the appliance. If the hash value is different from release notes of this software, contact HPE for support. To get release notes, please access HPE website.

5. DOA (Dead on Arrival)

If the package is damaged, any label/seal is incorrect or tampered, stop unpacking the goods, retain the package, and report to HPE for further investigation. The damaged goods will be replaced if necessary.

## 8.2 Secure Operation

The rules for securely operating an HPE Networking switch in FIPS mode are:

1. Install and connect the device according to the installation and configuration guides.
2. Start the device, and enter the configuration interface.
3. Check and configure the clock.
4. By default, the device does not run in FIPS mode. Enable the device to work in FIPS mode using the **fips mode enable** command in system view. This will allow the switch to internally enforce FIPS-compliance behavior, such as run power-up self-test and conditional self-test.
5. Set up username/password for crypto officer role. The password must comprise no less than 15 characters and must contain uppercase and lowercase letters, digits, and special characters.
6. Save the configurations and re-start the device.

The device works in FIPS mode after restarting:

1. Configure the security appliance to use SSHv2.

An operator can determine whether a switch is in FIPS mode with the command **display fips status**. When in FIPS mode:

1. The FTP/TFTP server is disabled.
2. The Telnet server is disabled.
3. The HTTP/S server is disabled.
4. SNMP v1 and SNMP v2c are disabled. Only SNMP v3 is available.
5. The SSH server does not support SSHv1 clients
6. Generated RSA key pairs have a modulus length 2048 bits.
7. Generated ECDSA key pairs with curves P-256, P-384 and P-521.
8. SSHv2, SNMPv3 and IPsec do not support Non-FIPS approved cryptographic algorithms.

## 9 Physical Security Mechanism

The HPE FlexNetwork 7500 and HPE FlexFabric 7900 and 12904 Switch Series conforms to the Security Level 1 requirements for physical security. The hardware portion of the cryptographic module is a production grade component. All internal hardware, firmware, and cryptographic data are protected by the enclosure of the module, which makes up its physical cryptographic boundary. The cryptographic module must be used in a production grade enclosure.

## 10 Mitigation of Other Attacks

The Security appliances do not claim to mitigate any attacks in a FIPS approved mode of operation.



# 11 Documentation References

## 11.1 Obtaining documentation

You can access the HPE Networking products page: <http://h17007.www1.hp.com/us/en/> , where you can obtain the up-to-date documents of HPE Routers and Switches, such as datasheet, installation manual, configuration guide, command reference, and so on.

## 11.2 Technical support

For technical or sales related question please refer to the contacts list on the HPE website: <http://www.HP.com>.

The actual support website is:

<http://www8.hp.com/us/en/support-drivers.html>