
# Aruba 2930M, 3810M and 5400R zl2 Switch Series

## FIPS 140-2 Non-Proprietary Security Policy

## Security Level 1 Validation

Hardware: 2930M – Switches: JL319A, JL320A, JL321A, JL322A, JL323A, and JL324A; Expansion Cards: JL078A, JL081A, and JL083A

3810M – Switches: JL071A, JL072A, JL073A, JL074A, JL075A, and JL076A; Expansion Cards: JL078A, JL079A, JL081A, and JL083A

5400R zl2 – Switch Chassis: 5406R zl2 J9821A and 5412R zl2 J9822A; Management Card: J9827A; Interface Cards: J9986A, J9987A, J9988A, J9989A, J9990A, J9991A, J9992A, J9993A, J9995A, and J9996A

Firmware: 2930M – WC.16.11
3810M - KB.16.11
5400R zl2 - KB.16.11

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# TABLE OF TABLES and FIGURES

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

TABLE 1 - LIST OF ABBREVIATIONS

| Abbreviation | Full spelling |
|---|---|
| ACL | Access Control List |
| AES | Advanced Encryption Standard |
| CAVP | Cryptographic Algorithm Validation Program |
| CLI | Command Line Interface |
| CMVP | Cryptographic Module Validation Program |
| CSE | Communication Security Establishment |
| CSP | Critical Security Parameter |
| DES | Data Encryption Standard |
| DHCP | Dynamic Host Configuration Protocol |
| DOA | Dead on Arrival |
| FIPS | Federal Information Processing Standard |
| HMAC | Hash-based Message Authentication Code |
| HTTP | Hyper Text Transfer Protocol |
| IPQC | In Process Quality Control |
| IRF | Intelligent Resilient Framework |
| KAT | Known Answer Test |
| LED | Light Emitting Diode |
| MPU | Main Processing Unit |
| NIST | National Institute of Standards and Technology |
| PoE+ | Power over Ethernet |
| QoS | Quality of Service |
| QSFP+ | Quad Small Form-factor Pluggable (40G Ethernet port) |
| RADIUS | Remote Authentication Dial In User Service |
| RAM | Random Access Memory |
| RIP | Routing Information Protocol |
| RSA | Rivest Shamir and Adleman method for asymmetric encryption |
| SDN | Software Defined Networking |
| sFlow | Sampled Flow |
| SFP | Small Form-Factor Pluggable (1G Ethernet port) |
| SFP+ | Enhanced Small Form-Factor Pluggable (10G Ethernet port) |
| SHA | Secure Hash Algorithm |

| Abbreviation | Full spelling |
|---|---|
| SSL | Secure Sockets Layer |
| TFTP | Trivial File Transfer Protocol |

# 1 Introduction

## Purpose

This is a non-proprietary Cryptographic Module Security Policy for the Aruba 2930M, 3810M and 5400R zl2 Switch Series from Aruba, a Hewlett Packard Enterprise (HPE) Company. This Security Policy describes how the Aruba 2930M, 3810M and 5400R zl2 Switch Series meet the security requirements of Federal Information Processing Standards (FIPS) Publication 140-2, which details the U.S. and Canadian Government requirements for cryptographic modules. More information about the FIPS 140-2 standard and validation program is available on the National Institute of Standards and Technology (NIST) and the Communications Security Establishment (CSE) Cryptographic Module Validation Program (CMVP) websites at http://csrc.nist.gov/groups/STM/cmvp and https://www.cse-cst.gc.ca/en, respectively.

This document also describes how to run the module in a secure FIPS-Approved mode of operation. This policy was prepared as part of the Overall Level 1 FIPS 140-2 validation of the module. The Aruba 2930M, 3810M and 5400R zl2 Switch Series are referred to in this document as Aruba 2930M, 3810M and 5400R zl2 Switch Series, the switches, the cryptographic module, or the module.

## References

This document deals only with operations and capabilities of the module in the technical terms of a FIPS 140-2 cryptographic module security policy. More information is available on the module from the following sources:

- The HPE website (www.hpe.com) and Aruba website (www.arubanetworks.com) contain information on the full line of products for Aruba.
- The CMVP website (http://csrc.nist.gov/groups/STM/cmvp/documents/140-1/140val-all.htm) contains contact information for individuals to answer technical or sales-related questions for the module.

# 2 Overview

The Aruba 2930M Switch Series is designed for customers creating digital workplaces that are optimized for mobile users with an integrated wired and wireless approach. These Layer 3 access switches come with high performance modular stacking for up to 10 switches. The 2930M supports 10GbE and 40GbE uplinks, Dual Modular Power Supplies, up to 1440 Watts of PoE+, HPE Smart Rate, robust QoS, RIP, Access OSPF routing, Tunnel Node, PIM, VRRP and IPv6.

The Aruba 3810M Switch Series is an industry-leading mobile campus access solution for enterprises, SMBs, and branch office networks. This Aruba Layer 3 switch series comes with backplane stacking, low latency and resiliency and HPE Smart Rate for high-speed multi-gigabit capacity and PoE+ power, modular line rate 10GbE and 40GbE ports for wireless aggregation, full PoE+ on all ports for high-speed wireless APs.

The Aruba 5400R zl2 Switch Series is an industry-leading mobile campus access solution with HPE Smart Rate multi-gigabit ports for high-speed connectivity and bandwidth for next wave 802.11ac devices. Robust solutions, hitless failover, QoS, and security with full L3 features and flexible connectivity including 40 Gigabit Ethernet ports and full PoE+, the Aruba 5400R zl2 requires no add-on firmware licensing. The Aruba 5400R zl2 Switch Series is suitable for a range of uses. These switches can be deployed at enterprise edge and remote branch offices, and converged networks.

Each device is based on the Aruba OS Firmware platform:

- 2930M – Version WC.16.11
- 3810M – Version KB.16.11
- 5400R zl2 – Version KB.16.11

The modules are being validated as a multi-chip standalone network device at FIPS 140-2 Overall Security Level 1.

## Configuration:

The Switches included as part of the FIPS 140-2 validation may be configured as follows:

### 2930M Switch Series Configuration

TABLE 2 - 2930M SWITCH SERIES CONFIGURATION

| Chassis | Expansion Card |
|---|---|
| JL319A - 24G 1-slot Switch | One (1) of the following expansion cards in any configuration:<br>JL078A - 40GbE 1QSFP+ Card<br>JL081A - 4SR PoE+ Card<br>JL083A - 4SFP+ Card |
| JL320A - 24G PoE+ 1-slot Switch | |
| JL321A - 48G 1-slot Switch | |
| JL322A - 48G PoE+ 1-slot Switch | |
| JL323A - 40-port 1G+ 8 port SmartRate PoE+ Switch | |
| JL324A - 24-port SmartRate PoE+ Switch | |

## 3810M Switch Series Configuration

TABLE 3 - 3810M SWITCH SERIES CONFIGURATION

| Chassis | Expansion Card |
|---|---|
| JL071A – 24G 8 1-slot Switch | One (1) of the following expansion cards in any configuration:<br>JL078A - 40GbE 1QSFP+ Card<br>JL081A - 4SR PoE+ Card<br>JL083A - 4SFP+ Card |
| JL073A – 24G PoE+ 1-slot Switch | |
| JL072A – 48G 1-slot Switch | One (1) of the following expansion cards in any configuration:<br>JL078A - 40GbE 1QSFP+ Card<br>JL079A – 40Gbe 2QSFP+ Card<br>JL081A - 4SR PoE+ Card<br>JL083A - 4SFP+ Card |
| JL074A - 48G PoE+ 1-slot Switch | |
| JL076A - 40G 8 HPE Smart Rate PoE+ 1-slot Switch | |
| JL075A - 16SFP+ 2-slot Switch | Up to two (2) of the following expansion cards in the configuration:<br>JL078A - 40GbE 1QSFP+ Card<br>JL081A - 4SR PoE+ Card<br>JL083A - 4SFP+ Card |

## 5400R zl2 Switch Series Configuration

TABLE 4 - 5400R ZL2 SWITCH SERIES CONFIGURATION

| Chassis | Management Card | Interface Card |
|---|---|---|
| J9821A – 5406R zl2 Switch | Up to two (2) identical Management Cards in any configuration:<br>• J9827A – zl2 Management Card | Up to six (6) of the following interface cards in any configuration:<br>J9986A - 24-port 10/100/1000Base-T PoE+ MACsec v3 zl2 Card<br>J9987A - 24p 1000BASE-T v3 zl2 Card<br>J9988A - 24p SFP v3 zl2 Card<br>J9989A - 12p PoE+ / 12p 1GbE SFP v3 zl2 Card<br>J9990A - 20p PoE+ / 4p SFP+ v3 zl2 Card<br>J9991A - 20p PoE+ / 4p 1/25/5/XGT PoE+ v3 z12 Card<br>J9992A - 20p PoE+ / 1p 40GbE QSPF+ v3 zl2 Card<br>J9993A - 8p 1G/10GbE SFP+ v3 zl2 Card<br>J9995A - 8-port 1/2.5/5/10GBASE-T PoE+ MACsec v3 zl2 Card<br>J9996A - 2-port 40GbE QSFP+ v3 zl2 Card |
| J9822A – 5412R zl2 Switch | Up to two (2) identical Management Cards in any configuration:<br>• J9827A – zl2 Management Card | Up to twelve (12) of the following interface cards in any configuration:<br>J9986A - 24-port 10/100/1000Base-T PoE+ MACsec v3 zl2 Card<br>J9987A - 24p 1000BASE-T v3 zl2 Card<br>J9988A - 24p SFP v3 zl2 Card<br>J9989A - 12p PoE+ / 12p 1GbE SFP v3 zl2 Card<br>J9990A - 20p PoE+ / 4p SFP+ v3 zl2 Card<br>J9991A - 20p PoE+ / 4p 1/25/5/XGT PoE+ v3 z12 Card<br>J9992A - 20p PoE+ / 1p 40GbE QSPF+ v3 zl2 Card<br>J9993A - 8p 1G/10GbE SFP+ v3 zl2 Card<br>J9995A - 8-port 1/2.5/5/10GBASE-T PoE+ MACsec v3 zl2 Card<br>J9996A - 2-port 40GbE QSFP+ v3 zl2 Card |

## Security Validation Level

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

TABLE 5 - 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 |

# 3 Cryptographic Module Specifications

The module is a multi-chip standalone networking device, 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 module include firmware and hardware, which are placed in the three-dimensional space within the case.

The Aruba 2930M and 3810M Switch Series are multiport switches that can be used to build high-performance switched networks. These switches are store-and-forward devices offering low latency for high-speed networking. The Aruba 2930M and 3810M switches also support a field-replaceable Redundant Power Supply and fan tray, Power over Ethernet (PoE+) technologies, full network management capabilities and a flexible uplink port slot (refer to Tables 2 and 3 for interface cards for each module).

The Aruba 5400R zl2 Switch offers power and management redundancy in a modular 6-slot or 12-slot chassis supporting interface cards providing 1GbE, 10GbE and 40GbE ports, multi-gigabit HPE Smart Rate ports, and full PoE+ (refer to Table 4 for list of interface cards).

## Aruba 2930M Switch Series

There are 6 models in the 2930M Switch Series. The expansion cards (listed in Table 2) can be inserted in the expansion slot in the back panel of the switch (refer to Figure 6 and Table 9).

FIGURE 1 - 2930M SWITCH SERIES

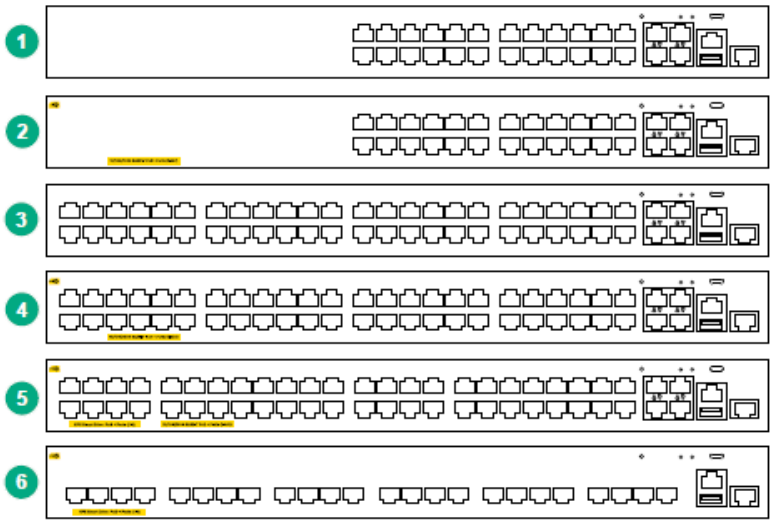



TABLE 6 - 2930M SWITCH SERIES

| Label | Description |
|---|---|
| 1 | Aruba 2930M 24G 1-slot Switch (JL319A) |
| 2 | Aruba 2930M 24G PoE+ 1-slot Switch (JL320A) |
| 3 | Aruba 2930M 48G 1-slot Switch (JL321A) |
| 4 | Aruba 2930M 48G PoE+ 1-slot Switch (JL322A) |
| 5 | Aruba 2930M 40G 8SR PoE+ 1-slot Switch (JL323A) |
| 6 | Aruba 2930M 24SR PoE+ 1-slot Switch (JL324A) |

## Aruba 3810M Switch Series

There are 6 models in the 3810M Switch Series. The expansion cards (listed in Table 3) can be inserted in the expansion slot located at the bottom right corner in the front panel of the switch (refer to Figure 7 and Table 10).

FIGURE 2- 3810M SWITCH SERIES

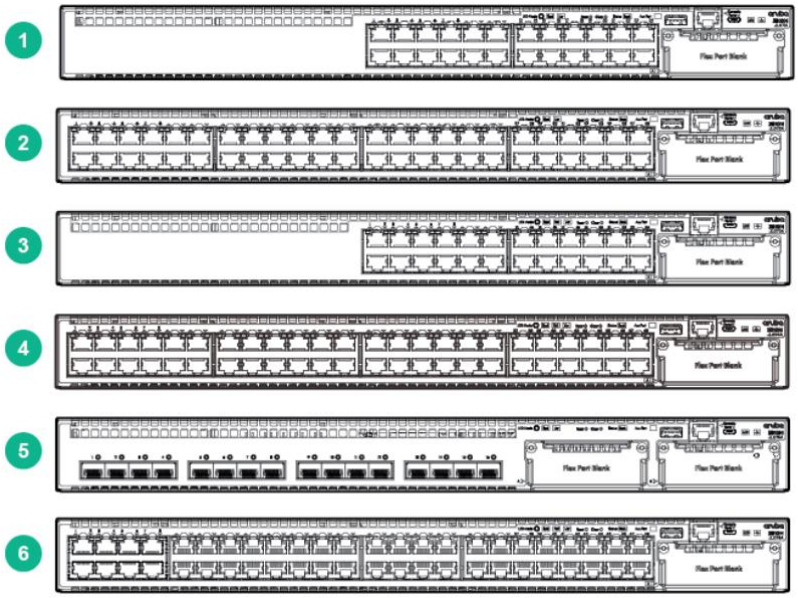


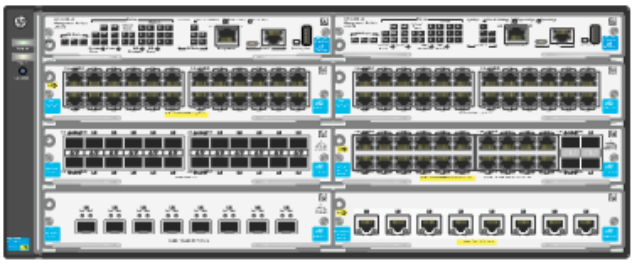

TABLE 7 - 3810M SWITCH SERIES

| Label | Description |
|---|---|
| 1 | Aruba 3810M 24G 1-slot Switch (JL071A) |
| 2 | Aruba 3810M 48G 1-slot Switch (JL072A) |
| 3 | Aruba 3810M 24G PoE+ 1-slot Switch (JL073A) |
| 4 | Aruba 3810M 48G PoE+ 1-slot Switch (JL074A) |
| 5 | Aruba 3810M 16SFP+ 2-slot Switch (JL075A) |
| 6 | Aruba 3810M 40G 8 HPE Smart Rate PoE+ 1-slot Switch (JL076A) |

## Aruba 5400R zl2 Switch Series

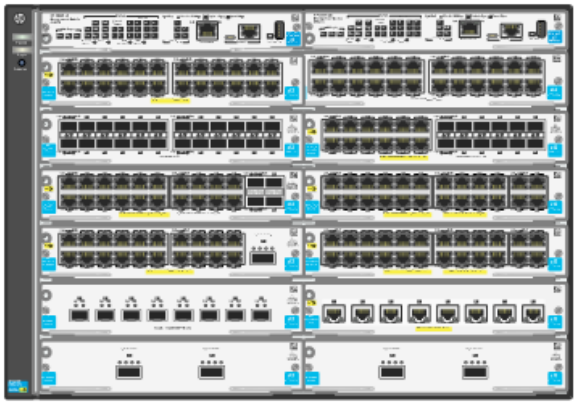
The following illustration is the Aruba 5406R zl2 with one additional Management Card and fully loaded with 6 interfaces cards.

FIGURE 3 - 5406R ZL2 SWITCH SERIES



The following illustration is the Aruba 54126R zl2 with one additional Management Card and fully loaded with 12 interfaces cards.

FIGURE 4 - 5412R ZL2 SWITCH SERIES



# 4 Cryptographic Module Port and Interfaces

The cryptographic module's physical ports can be categorized into the following logical interfaces defined by FIPS 140-2:

- Data Input Interface
- Data Output Interface
- Control Input Interface
- Status Output Interface
- Power Interface

## Aruba 2930M Switch Series Ports

### Aruba 2390M Switch Series – Front Panel

The module data and management ports are located on the switch front panel.

FIGURE 5 - EXAMPLE OF FRONT OF THE 2930M SWITCH

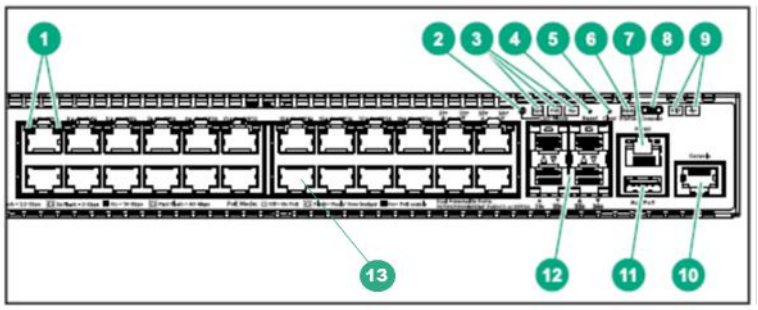


TABLE 8 – FRONT OF THE 2930M SWITCH LABELS AND DESCRIPTIONS

| Label | Description |
|---|---|
| 1 | Switch Port LEDs |
| 2 | LED Mode button |
| 3 | Speed, PoE+, Usr LEDs |
| 4,5 | Reset, Clear Buttons |
| 6 | Back Module status LED |
| 7 | OOBM port (RJ-45 Gig-T) |
| 8 | Console port (Micro USB) |
| 9 | Unit Identification, Global Status LEDs |
| 10 | Console port (RJ-45) |
| 11 | USB port |
| 12 | SFP+ ports |
| 13 | RJ-45 Gigabit Ethernet ports |
| * PoE Mode LED is present only on switch models that support PoE. | |

Note: USB port will be disabled in FIPS mode. Please refer to page 39 of this document for the details.

## Aruba 2930M Switch Series - Back Panel

FIGURE 6 - BACK OF THE 2930M SWITCHES

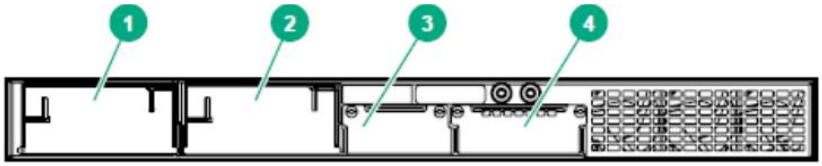



TABLE 9 - BACK OF THE 2930M SWITCH LABELS AND DESCRIPTIONS

| Label | Description |
|---|---|
| 1 | AC power connector / power supply slot 1 |
| 2 | AC power connector / power supply slot 2 |
| 3 | Stacking module slot |
| 4 | Expansion card slot |

# Aruba 3810M Switch Series Ports

## Aruba 3810M Switch Series – Front Panel

The module data and management ports are located on the switch front panel.

FIGURE 7 -FRONT PANEL OF 3810M SWITCH SERIES

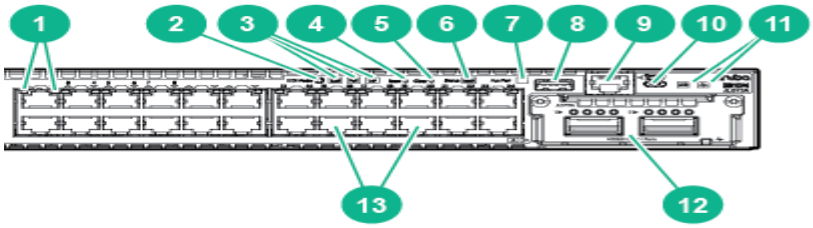



TABLE 10 - FRONT OF THE 3810M SWITCH LABELS AND DESCRIPTIONS

| Label | Description |
|---|---|
| 1 | Switch Port LEDs |
| 2 | LED Mode button |
| 3 | Speed, PoE*, Usr LEDs |
| 4, 5 | Reset, Clear buttons |
| 6 | Back Module Status LED |
| 7 | Aux port status LED |
| 8 | USB Port |
| 9 | Console Port (RJ-45) |
| 10 | Console Port (Micro USB) |
| 11 | Global Status, Unit Identification LEDs |
| 12 | Expansion card slot |
| 13 | RJ-45 Gigabit Ethernet Ports |
| * PoE Mode LED is present only on switch models that support PoE. | |

Note: USB port will be disabled in FIPS mode. Please refer to page 39 of this document for the details.

## Aruba 3810M Switch Series - Back Panel

FIGURE 8 - BACK OF THE 3810M SWITCH SERIES

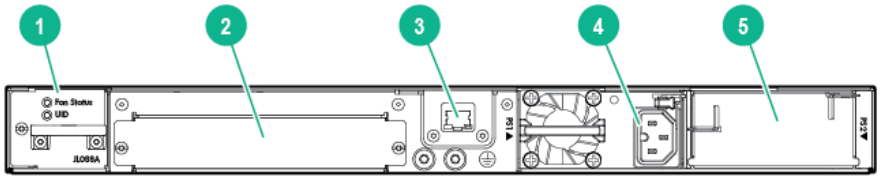


TABLE 11 - BACK OF THE 3810M SWITCH LABELS AND DESCRIPTION

| Label | Description |
|---|---|
| 1 | Fan Status LED |
| 2 | Stacking Module Slot |
| 3 | OOBM port (RJ-45 Gig-T) |
| 4 | AC Power connector/Power Supply slot 1 |
| 5 | Redundant Power Supply slot 2 |

## Aruba 2930M and 3810M Switch Series – Expansion Cards

FIGURE 9 - FRONT OF 2930M/3810M EXPANSION CARDS

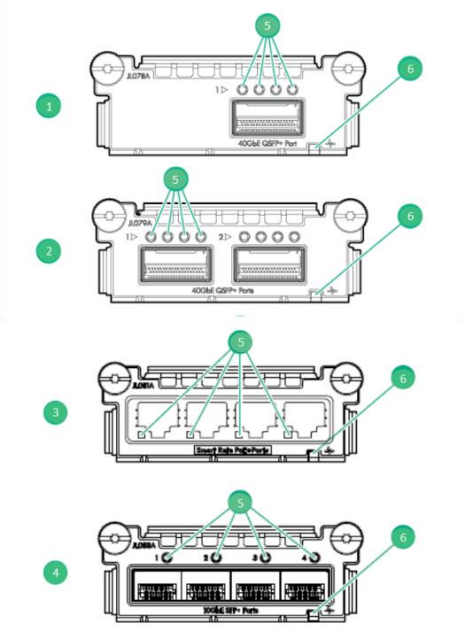


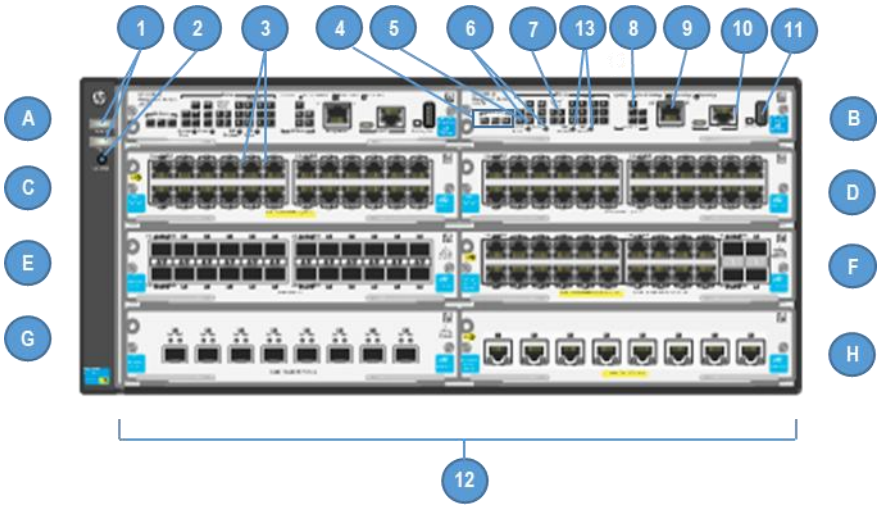
TABLE 12- 2930M/3810M EXPANSION CARD LABEL AND DESCRIPTION

| Label | Description | Port Type |
|---|---|---|
| 1 | Aruba 2930M/3810M 1QSFP+ 40GbE Card (JL078A) | QSFP+ |
| 2 | Aruba 3810M 2QSFP+ 40GbE Card (JL079A) | QSFP+ |
| 3 | Aruba 2930M/3810M 4 Smart Rate PoE+ Card (JL081A) | RJ-45 Gigabit Ethernet ports |
| 4 | Aruba 2930M/3810M 4SFP+ Card (JL083A) | SFP+ |
| 5 | Port LEDs | |
| 6 | Status LEDs | |

# Aruba 5400R zl2 Switch Series Ports

## Aruba 5400R zl2 Switch Series – Front Panel

FIGURE 10 - FRONT OF 5400R ZL2 SWITCH SERIES




This illustration shows the 5406R zl2 Switch. The labeling and descriptions apply also to the Aruba 5412R zl2 switches.

TABLE 13 - FRONT OF 5400R ZL2 SWITCH SERIES

| Label | Description |
|---|---|
| 1 | Power and Fault LEDs |
| 2 | Locator LED |
| 3 | Module Link and Mode LEDs |
| 4 | Management Module Status LEDs |
| 5 | Status LEDs |
| 6 | System Reset and Clear buttons |
| 7 | Status LEDs for the Fans, Power Supplies, and Switch Modules |
| 8 | LED Mode Select button and indicator LEDs |
| 9 | OOBM Port (RJ-45 Gig-T) |
| 10 | Console Port (RJ-45) |
| 11 | USB/ Port |
| 12 | Management card and Interface card slots<br>Slots A-B: Management Module<br>Slots C-H: Interface Cards |
| 13 | MM Shutdown and MM Reset buttons |

## Aruba 5400R zl2 Switch Series – Back Panel

FIGURE 11 - BACK OF 5406R ZL2 SWITCH SERIES WITH ONE POWER SUPPLY

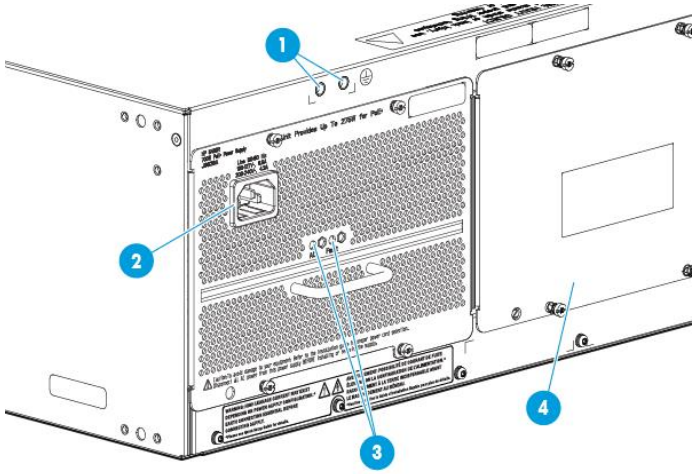



FIGURE 12 - BACK OF 5412R ZL2 SWITCH SERIES WITH TWO POWER SUPPLY

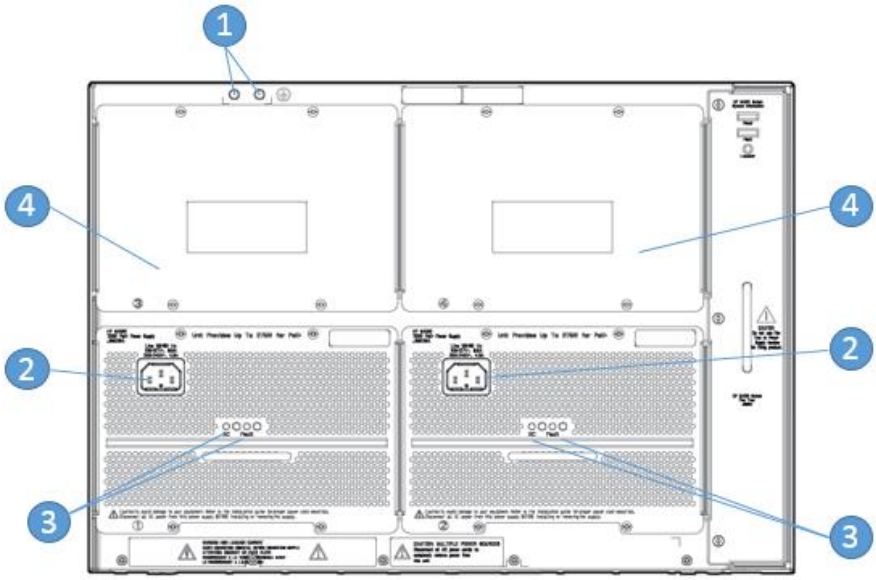
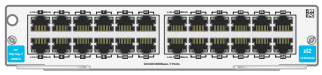



TABLE 14 – BACK PANEL OF 5400R ZL2 SWITCH SERIES

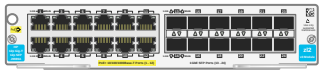
| Label | Description |
|---|---|
| 1 | Ground lug mounting holes |
| 2 | AC power connector |
| 3 | Power and Fault LEDs |
| 4 | Slot for installing optional redundant power supply |

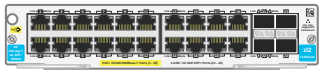
FIGURE 13 - 5400R ZL2 INTERFACE CARDS

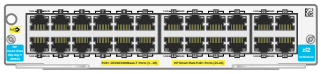
J9986A 

J9987A 

J9988A 

J9989A 

J9990A 

J9991A 

J9992A 

J9993A 

J9995A 

J9996A 

TABLE 15- 5400R ZL2 INTERFACE CARDS

| Interface Card | Description | Port Type |
|---|---|---|
| J9986A | 24-port Gig-T PoE+ MACsec v3 zl2 Card | RJ-45 Gigabit Ethernet ports |
| J9987A | 24p Gig-T v3 zl2 Card | RJ-45 Gigabit Ethernet ports |
| J9988A | 24p SFP v3 zl2 Card | SFP |
| J9989A | 12p PoE+ / 12p 1GbE SFP v3 zl2 Card | SFP |
| J9990A | 20p PoE+ / 4p SFP+ v3 zl2 Card | SFP+ |
| J9991A | 20p PoE+ / 4p 1/2.5/5/XGT PoE+ v3 z12 Card | RJ-45 Gigabit Ethernet ports |
| J9992A | 20p PoE+ / 1p 40GbE QSPF+ v3 zl2 Card | QSFP+ |
| J9993A | 8p 1G/10GbE SFP+ v3 zl2 Card | SFP+ |
| J9995A | 8-port 1/2.5/5/10GBASE-T PoE+ MACsec v3 zl2 Card | RJ-45 Gigabit Ethernet ports |
| J9996A | 2-port 40GbE QSFP+ v3 zl2 Card | QSFP+ |

# Aruba 2930M, 3810M and 5400R zl2 Switch Series Ports and Interfaces

The mapping of logical and physical interfaces to the FIPS validated configuration of the modules are detailed in the following table.

TABLE 16 - LOGICAL AND PHYSICAL INTERFACES

| Logical Interface | Module Physical Interface |
|---|---|
| Data Input | RJ-45 Gigabit Ethernet ports |
| | SFP/SFP+/QSFP+ ports |
| | Console port (RJ-45 or Micro USB) |
| | OOBM port (RJ-45 Gig-T) |
| Data Output | RJ-45 Gigabit Ethernet ports |
| | SFP/SFP+/QSFP+ ports |
| | Console port (RJ-45 or Micro USB) |
| | OOBM port (RJ-45 Gig-T) |
| Control Input | RJ-45 Gigabit Ethernet ports |
| | SFP/SFP+/QSFP+ ports |
| | Console port (RJ-45 or Micro USB) |
| | OOBM port (RJ-45 Gig-T) |
| | Reset Push Button |
| | Clear Push Button |
| | LED Mode Push Button |
| | Management Card Shutdown Push Button (5400R only) |
| | Management Card Reset Push Button (5400R only) |
| Status Output | RJ-45 Gigabit Ethernet ports |
| | SFP/SFP+/QSFP+ ports |
| | Console port (RJ-45 or Micro USB) |
| | OOBM port (RJ-45 Gig-T) |
| | LEDs |
| Power Interface | Power Supply |

## Console Port

There are two serial console port options on the switch, an RJ-45 or Micro USB. These ports are used to connect a console to the switch either by using the RJ-45 serial cable supplied with the switch, or a standard Micro USB cable (not supplied). The Micro USB connector has precedence for input. If both cables are plugged in, the console output is echoed to both the RJ-45 and the Micro-USB ports, but the input is only accepted from the Micro USB port. For more information about the console connection, see “Connect a management console” in Chapter 2 of “Installing the Switch”.

## Out-of-Band Management (OOBM) Port

This RJ-45 port is used to connect a dedicated management network to the switch. To use this port, the switch must have an IP address. IP settings can be configured through a Console port connection or automatically from a DHCP/Bootp server. A networked out-of-band connection through the Management port allows management of data network switches from a physically and logically separate management network.

To use: connect an RJ-45 network cable to the Management port to manage the module through SSH from a remote PC or a UNIX workstation.

For more information, see the "Network Out-of-Band Management (OOBM)" appendix in the Management and Configuration Guide at: www.hpe.com/us/en/networking/switches.html.

# 5 Roles, Services, and Authentication

## Roles

Each cryptographic module supports three roles that an operator can assume: a Crypto Officer (Manager) role, a User (Operator) role, and a Security Officer role. Each role is accessed through proper identity-based authentication to the switch. Services associated with each role are listed in the following sections.

The Crypto Officer is responsible for the set up and initialization of the module as documented in Section 10 (Delivery and Operation) of this document. The Crypto Officer has complete control of the module and is in charge of configuring all of the settings for each switch. The Crypto Officer can create RSA key pairs for SSHv2 and TLS. The Crypto Officer is also in charge of maintaining access control and checking error and intrusion logs.

The User role can show the current secure-mode of the module.

The Security Officer role is to view and delete security logs. This role can also copy security logs from the switch but does not have permission to execute any other commands. The security logs cannot be viewed or deleted by other roles on the switch.

The devices allow multiple management users to operate the networking device simultaneously. The module does not employ a maintenance interface and does not have a maintenance role.

## Services

The switches can be accessed through:

- Console Port
- SSH
- HTTPS/TLS WebUI
- SNMPv3

### Crypto Officer Services

The Crypto Officer role is responsible for the configuration and maintenance of the switches. The services available to the Crypto Officer role accessing the CSPs, the type of access – read (r), write (w) and zeroized/delete (d) – and which role accesses the CSPs are listed below:

TABLE 17 - CRYPTO OFFICER SERVICES

| Services | Description | Keys and CSPs Access |
|---|---|---|
| View Device Status | View status of devices and functions, version of currently running OS | Crypto Officer Password (R) |
| View Running Status | View memory status, packet statistics, interface status, current configuration, routing table, active sessions, temperature and SNMP MIB statistics | Crypto Officer Password (R) |

| | | |
|---|---|---|
| Perform Network Functions | Network diagnostic service such as “ping” and network configuration service such as “SSHv2” client, TLS service to protect the session between the switch and external server (e.g. Log Server), Initial Configuration setup (IP, hostname, DNS server), SNMPv3 password configuration | SSH private key, SSH Diffie-Hellman Private Key, SSH Diffie-Hellman Public Key, SSH Session Key, SSH Session authentication Key, SSH Public key, DRBG seed, DRBG V, DRBG Key, DRBG Entropy Input, TLS Master secret, TLS Traffic encryption key, TLS traffic authentication, TLS Server public key, TLS Elliptic Curve Diffie-Hellman Private Key, TLS Elliptic Curve Diffie-Hellman Public Key, RSA private key, RSA public key, RADIUS shared secret key, TACACS+ shared secret key, SNMPv3 Password, SNMPv3 Engine ID, SNMPv3 key and Crypto Officer Password (R,W, D) |
| Perform Security Management | Management (create, delete, modify) of the access control rules, user accounts, roles, and passwords for each role, maintenance of the bootware password, time management, system start-up parameters, file operation (e.g. dir, copy, del), perform self-tests, and shut down or reboot the networking device | Crypto Officer password, Operator Password, Security Officer Password, Encrypting Key, BootROM Password (R, W, D) |
| Perform Configuration Functions | Save configuration, management of information center, define network interfaces and settings, set the protocols the switches will support (e.g. SFTP server, SSHv2 server), enable interfaces and network services, management of access control scheme, configure the module to run in a FIPS Approved mode, reset of the CSPs | Crypto Officer Password, Operator Password, Security Officer Password (R, W, D) |
| Zeroization | CSP zeroization | All CSPs |

## User Services

The following table describes the services available to user service. The services available to the User role accessing the CSPs, the type of access – read (r), write (w) and zeroized/delete (d) – and which role accesses the CSPs are listed below:

TABLE 18 - USER SERVICES

| Services | Description | Keys and CSPs Access |
|---|---|---|
| View Device Status | View status of devices and functions, version of currently running OS | Operator Password (R) |
| View Running Status | View memory status, packet statistics, interface status, current configuration, routing table, active sessions, temperature and SNMP MIB statistics | Operator Password (R) |
| Perform Network Functions | Network diagnostic service such as “ping” | Operator Password (R) |

### Security Officer Services

The Security Officer can only view or clear the security logs and does not have permission to execute any other commands on the switch. The following table describes the services available to security officer. The services available to the Security Officer role accessing the CSPs, the type of access – read (r), write (w) and zeroized/delete (d) – and which role accesses the CSPs are listed below:

TABLE 19 - SECURITY OFFICER SERVICES

| Services | Description | Keys and CSPs Access |
|---|---|---|
| Perform Security Log Commands | View, Clear, and Copy security logs | Security Officer Password (R, D) |

### Unauthenticated Services

- Cycle the power on the switch
- Perform self-tests at power on
- Observe status LED

### Non-Approved Services

Please refer to Table 22 below in this document for the detailed non-approved algorithms and the associated services.

## Authentication Mechanisms

The module supports Identity-based authentication to control access to all services provided by the switches. The username and password will be configured by the Crypto Officer and the operator (User or Security Officer) will be able to login using these credentials. Once the authentication is completed, the operator will assume the respective role to carry out the available services as listed in Table 17, Table 18, and Table 19.

### Authentication Data Protection

The module does not allow the disclosure, modification, or substitution of authentication data to unauthorized operators. Authentication data can only be modified by the operator who has assumed the Crypto Officer role.

### Identity-based Authentication

Each operator (Crypto Officer, User, or Security Officer) is authenticated upon initial access to the device. The authentication of the operator is Identity-based. All Switch users can be either authenticated locally or authenticated via an external RADIUS or TACACS+ server. The authentication method is Username and Password.

To logon to the networking devices, an operator must connect to it through one of the management interfaces (Console port, SSH) and provide the Username and Password.

Each user must be authenticated using username and password. The minimum password length is 8 characters, and the maximum is 64. The passwords can contain the following, equaling 94 possibilities per character:

lower case letters (26),
upper case letters (26),
special characters (32) and

numeric characters (10)

Therefore, for an 8-character password, the probability of randomly guessing the correct sequence is 1 in $94^8$ (this calculation is based on the use of the typical standard American QWERTY computer keyboard).

Since the module requires an 8 characters password with 94 possible characters per password character, the probability of randomly guessing the correct sequence is one (1) in $94^8 = 6.096 \times 10^{15}$, which is less than one in 1,000,000. In addition, in order to successfully guess the sequence in one minute would require the ability to make over $94^8/60 = 1.016 \times 10^{14}$ guesses per second, which far exceeds the operational capabilities of the module. Therefore, the password strengths meet FIPS 140-2 requirements.

Additionally, each operator (Crypto Officer, User, or Security Officer) can also be authenticated via the RSA based authentication method. When using this authentication method, as RSA key pair has modulus size of 2048 bits, it provides 112 bits of authentication strength. In such a case, an attacker would have a 1 in $2^{112}$ chance of randomly obtaining the key, which is much stronger than the one in a million chance required by FIPS 140-2. To exceed a one in 100,000 probability of a successful random key guess in one minute, an attacker would have to be capable of approximately $8.6 \times 10^{31}$ ($5.2 \times 10^{33} /60 = 8.6 \times 10^{31}$) attempts per second, which far exceeds the operational capabilities of the module to support.

# 6 Physical Security Mechanism

The module meets the FIPS 140-2 Level 1 security requirements as production grade equipment.

# 7 Cryptographic Algorithms

## FIPS Approved Cryptographic Algorithms

The following table lists the FIPS-Approved algorithms that the module provides.

TABLE 20 - FIPS-APPROVED CRYPTOGRAPHY ALGORITHMS

| CAVP Certificate | Algorithm | Standard | Mode/ Method | Key Lengths, Curves or Moduli | Use |
|---|---|---|---|---|---|
| AES #A2638 | AES | FIPS 197,<br>SP 800-38A,<br>SP 800-38D | CBC and GCM | 128, 192, 256 | Data Encryption/ Decryption |
| CVL #A2638 | TLS v1.0/1.1/1.2,<br>SSHv2, SNMPv3<br>KDFs | SP 800-135rev1 | N/A | N/A | Key Derivation |
| DRBG #A2638 | DRBG | SP 800-90Arev1 | CTR (AES-256) | N/A | Deterministic Random Bit Generation |
| ECDSA #A2638 | ECDSA | FIPS 186-4 | KeyGen/KerVer | P-256, P-384 | KAS-ECC-SSC Domain Parameters Generation |
| HMAC #A2638 | HMAC | FIPS 198-1 | HMAC-SHA1 | 160 | Message Authentication |
| KAS-SSC #A2638 | KAS-ECC-SSC<br><br>KAS-FFC-SSC | SP 800-56Arev3 | KAS-ECC-SSC:<br>ephemeralUnified:<br>KAS Role: initiator, responder<br><br>KAS-FFC-SSC:<br>dhEphem:<br>KAS Role: initiator, responder: | KAS-ECC-SSC:<br>P-256, P-384<br><br>KAS-FFC-SSC:<br>MODP-2048 | KAS-ECC-SSC: Key establishment methodology provides 112 or 192 bits of encryption strength<br><br>KAS-FFC-SSC: Key establishment methodology provides 112 bits of encryption strength |

| CAVP Certificate | Algorithm | Standard | Mode/ Method | Key Lengths, Curves or Moduli | Use |
|---|---|---|---|---|---|
| KAS (KAS-SSC Cert. #A2638, CVL Cert. #A2638 | KAS (ECC)<br><br>KAS (FFC) | SP 800-56Arev3;<br><br>SP 800-135rev1 | KAS (ECC): ephemeralUnified: KAS Role: initiator, responder<br><br>KAS (FFC): dhEphem: KAS Role: initiator, responder | KAS (ECC): P-256 and P-384 with SSH and TLS KDF (SP800-135rev1)<br>KAS (FFC): MODP-2048 with SSH and TLS KDF (SP800-135rev1) | Key Agreement Scheme per SP800-56Arev3 with key derivation function (SP800-135rev1)<br>Note: The module's KAS (ECC/FFC) implementation is FIPS140-2 IG D.8 Scenario X1 (path 2) compliant |
| RSA #A2638 | RSA | FIPS 186-4 | Fixed Public Exponent e 10001 | 2048, 3072 | Key Pair Generation |
| | | | SHA-256, PKCS1 v.1.5 | 2048 | Digital Signature Generation |
| | | | SHA-1, SHA-256, SHA-384, SHA-512, PKCS1 v1.5 | 2048 | Digital Signature Verification |
| SHS #A2638 | SHS | FIPS 180-4 | SHA-1, SHA-224, SHA-256, SHA-384, SHA-512 | | Message Digest |
| Triple-DES #A2638 | Triple-DES | SP 800-67 | Triple-DES - CBC | 192 | Data Encryption/ Decryption |
| CKG (vendor affirmed) | Cryptographic Key Generation | SP 800-133rev2 | N/A | N/A | Key Generation |

Notes:

- There are algorithms, modes, and keys that have been CAVs tested but are not implemented or used by any service of the module. Only the algorithms, modes/methods, and key lengths/curves/moduli shown in this table are implemented by the module.
- The AES-GCM IV generation method from each of AES #A2638 is in compliance with IG A.5, scenario #2. The DRBG Cert. #A2638 is called to generate the IV inside the module and the IV length is 96 bits. The module generates new AES-GCM keys if the module loses power.
- Per SP 800-67 rev1, the user is responsible for ensuring the module's limit to $2^{32}$ encryptions with the same Triple-DES key while being used in TLS protocol.
- No parts of the protocol (SSH, TLS or SNMPv3), other than the KDF, have been tested by the CAVP and CMVP.
- In accordance with FIPS 140-2 IG D.12, the cryptographic module performs Cryptographic Key Generation as per section 6 in SP 800-133rev2. The resulting generated seed used in the asymmetric key generation are the unmodified output from SP 800-90Arev1 DRBG.

## FIPS Allowed Cryptographic Algorithms

The following table contains the set of FIPS Allowed cryptographic algorithms that can also be used in FIPS-mode.

TABLE 21 - FIPS-ALLOWED CRYPTOGRAPHY ALGORITHMS

| Algorithm | Application |
|---|---|
| HMAC-MD5 | Only allowed with KDF in TLS 1.0/1.1<br>Note: other cryptographic uses of HMAC-MD5 are not allowed in FIPS mode. |
| MD5 | Only allowed with KDF in TLS 1.0/1.1<br>Note: other cryptographic uses of MD5 are not allowed in FIPS mode. |
| NDRNG | Seeding for the Approved DRBG<br>(contain no less than 256 bits of entropy) |
| RSA | Key wrapping; Key establishment<br>(provides 112 or 128 bits of encryption strength) |

## Non-FIPS Approved / Allowed Cryptographic Algorithms

The following table contains the set of non-FIPS Approved/Allowed cryptographic algorithms that are implemented but shall not be used when operating in FIPS-mode. These algorithms are used in non-FIPS-mode. Using the algorithms with the associated services listed in Table 20 will put the module in the Non-FIPS mode of operation.

TABLE 22 - NON-FIPS APPROVED CRYPTOGRAPHY ALGORITHMS

| Algorithm | Application | Services |
|---|---|---|
| DES | Encryption/Decryption | SSH and TLS |
| Diffie-Hellman (< 2048-bits) | Key Agreement | SSH |
| MD5 | Hashing | SNMP |
| HMAC-MD5 | Message Authentication | SSH |
| RSA (<2048-bits) | Key Pair Generation<br>Digital Signature Generation<br>Key Agreement<br>Key Wrapping | SSH and TLS |

| Algorithm | Application | Services |
|---|---|---|
| ECDSA SigGen/SigVer (non-compliant) | Digital Signature Generation<br>Digital Signature Verification | TLS |
| DSA SigGen/SigVer (non-compliant) | Digital Signature Generation<br>Digital Signature Verification | SSH |

# 8 Cryptographic Key Management

## Cryptographic Security Parameters

The networking devices use a variety of Critical Security Parameters (CSPs) during operation. The following table lists the CSPs including cryptographic keys used by the module. It summarizes generation, storage, and zeroization methods for the CSP.

TABLE 23 - CRYPTOGRAPHIC SECURITY PARAMETERS

| Name | CSP Type | Size | Description | Storage | Zeroization |
|---|---|---|---|---|---|
| RSA private key | RSA | 2048 bits | Identity certificates for the networking device itself. Generated within the module by calling SP 800-90Arev1 CTR_DRBG. | FLASH (plain text) | Using CLI command to zeroize |
| RSA Public key | RSA | 2048 bits | Public keys used to validate the firmware image. Generated within the module along with RSA private key generation. | FLASH (plain text) | This is part of the firmware code and will get deleted when the image is deleted |
| SSH Private key | RSA | 2048 bits, 3072 bits | Private key used for SSH protocol. Generated within the module by calling SP 800-90Arev1 CTR_DRBG. | FLASH (plain text) | Using CLI command to zeroize |
| SSH Public key | RSA | 2048 bits, 3072 bits | Public key used for SSH protocol. Generated within the module along with SSH private key generation. | Flash (plain text) | Using CLI command to zeroize |
| SSH Diffie-Hellman private Key | KAS-FFC-SSC SP 800-56Arev3 (Diffie-Hellman) | 224 bits | Private Key for Diffie-Hellman key agreement in SSH protocol implementation. Generated within the module by calling SP 800-90Arev1 CTR_DRBG. | RAM (plain text) | Automatically when handshake finishing |
| SSH Diffie-Hellman public key | KAS-FFC-SSC SP 800-56Arev3 (Diffie-Hellman) | MODP-2048 | Public Key for Diffie-Hellman key agreement in SSH protocol implementation. Generated within the module along with SSH Diffie-Hellman Private Key. | RAM (plain text) | Automatically when handshake finishing |
| SSH Session Key | AES-CBC | 128 bits, 256 bits | SSH session symmetric key. Derived within the module during the SSH protocol implementation. | RAM (plain text) | Automatically when SSH session terminated |
| SSH Session authentication Key | HMAC-SHA1 | 160 bits | SSH session authentication key. Derived within the module during the SSH protocol implementation. | RAM (plain text) | Automatically when SSH session terminated |
| Crypto-Officer Password | Password | 8 ~ 64 characters | Critical security parameters used to authenticate the CO role login. Entered by the Crypto Officer, encrypted by Encrypting Key stored in module's Flash memory. | FLASH (cipher text) | Using CLI command to zeroize |
| Operator Password | Password | 8 ~ 64 characters | Critical security parameters used to authenticate the Operator (User role). Entered by the Crypto Officer, encrypted by Encrypting Key stored in module's Flash memory. | FLASH (cipher text) | Using CLI command to zeroize |

| Name | CSP Type | Size | Description | Storage | Zeroization |
|---|---|---|---|---|---|
| RADIUS shared secret | Shared Secret | 8 ~ 32 characters | Used for authenticating the RADIUS server to the networking device and vice versa. Entered by the Crypto Officer, encrypted by Encrypting Key stored in module's Flash memory. | FLASH (cipher text) | Using CLI command to zeroize |
| TACACS+ shared secret | Shared Secret | 8 ~ 100 characters | Used for authenticating the TACACS+ server to the networking device and vice versa. Entered by the Crypto Officer, encrypted by Encrypting Key stored in module's Flash memory. | FLASH (cipher text) | Using CLI command to zeroize |
| Security-Officer Password | Password | 8 ~ 64 characters | Critical security parameters used to authenticate the security officer. Entered by the Crypto Officer, encrypted by Encrypting Key stored in module's Flash memory. | FLASH (cipher text) | Using CLI command to zeroize |
| DRBG seed | SP 800-90A CTR_DRBG | 384 bits | Input to the DRBG that determines the internal state of the DRBG. Derived by using DRBG derivation function that includes the entropy input. | RAM (plaintext) | Resetting or rebooting the networking device |
| DRBG V | SP 800-90A CTR_DRBG | 128 bits | Generated by entropy source via the CTR_DRBG derivation function. | RAM (plaintext) | Resetting or rebooting the networking device |
| DRBG Key | SP 800-90A CTR_DRBG | 256 bits | DRBG key used for SP 800-90Arev1 CTR_DRBG. Established per SP 800-90Arev1 CTR_DRBG. | RAM (plaintext) | Resetting or rebooting the networking device |
| DRBG Entropy input | SP 800-90A CTR_DRBG | 384 bits | DRBG input used for SP 800-90Arev1 CTR_DRBG. This is the entropy for SP 800-90Arev1 CTR_DRBG, used to construct the DRBG seed. | RAM (plaintext) | Resetting or rebooting the networking device |
| TLS Server private key | RSA | 2048 bits | Private key used for TLS negotiations. Generated within the module by calling approved SP 800-90Arev1 CTR_DRBG. | FLASH (plain text) | Using CLI command to zeroize |
| TLS Server public key | RSA | 2048 bits | Key agreement for HTTPS/TLS sessions. Generated within the module along with TLS Server private key. | RAM (plain text) | Using CLI command to zeroize |
| TLS Master secret | Shared key | 384 bits | Shared secret used for creating TLS traffic keys. Derived within the module during the TLS protocol implementation. | RAM (plain text) | Automatically zeroize when session terminated |
| TLS Traffic encryption key | AES-CBC/GCM Triple-DES | 128 / 256 bits or 192 bits | Used for encrypting HTTPS/TLS data. Derived within the module during the TLS protocol implementation. | RAM (plain text) | Automatically zeroize when session terminated |
| TLS traffic authentication key | HMAC-SHA1/HMAC-MD5 | 160 bits/128 bits | Used for authenticating HTTPS/TLS data. Derived within the module during the TLS protocol implementation. | RAM (plain text) | Automatically zeroize when session terminated |
| TLS Elliptic Curve Diffie-Hellman Private Key | KAS-ECC-SSC SP 800-56Arev3 (EC Diffie- | Curves P-256 and P-384 | Private Key for HTTPS/TLS sessions. Generated within the module by calling approved SP 800-90Arev1 CTR_DRBG. | RAM (plain text) | Automatically when handshake finishing |

| Name | CSP Type | Size | Description | Storage | Zeroization |
|---|---|---|---|---|---|
| | Hellman) | | | | |
| TLS Elliptic Curve Diffie-Hellman public Key | KAS-ECC-SSC SP 800-56Arev3 (EC Diffie-Hellman) | Curves P-256 and P-384 | Public Key for HTTPS/TLS sessions. Generated within the module along with EC Diffie-Hellman private key. | RAM (plain text) | Automatically when handshake finishing |
| Encrypting key | AES | 256 bits | A key embedded in the firmware, used to protect CSPs stored in the 'config' file. | FLASH (plain text) | This is part of the firmware code and will get deleted when the image is deleted |
| BOOTROM Password | Password | 8 ~ 64 characters | Password used to access the switch in BootROM mode. Entered by the Crypto Officer, encrypted by Encrypting Key stored in module's Flash memory. | FLASH (cipher text) | Using CLI command to zeroize |
| SNMP v3 Password | Password | 8 ~ 32 characters | Password used during SNMPv3 authentication. Entered by the Crypto Officer, encrypted by Encrypting Key stored in module's Flash memory. | FLASH (cipher text) | Using CLI command to zeroize |
| SNMPv3 engineID | Shared Secret | 96 bits | This is the SNMP engine ID. Entered by the Crypto Officer, a unique string used to identify the SNMP engine. | FLASH (plain text) | Using CLI command to zeroize |
| SNMP v3 key | AES | 128 bits | Key used to protect the SNMP traffic. Derived within the module during the SNMP v3 protocol implementation. | RAM (plain text) | Using CLI command to zeroize |

# 9 Self-Tests

When the power is applied, the module will perform the Power-Up Self-Tests regardless of the mode (FIPS and non-FIPS mode). In addition, the module also performs Conditional tests after being configured into the FIPS mode. The purpose of these self-tests is to verify functionality and correctness of the cryptographic algorithms listed in Section 7 above. Should any of the power-up self-tests or conditional self-tests fail, the module will cease operation, inhibiting all data output from the module. The module will automatically reboot and perform power-up self-tests. Successful completion of the power-up self-tests will return the module to normal operation.

## Power-Up Self-Tests

Power-up self-tests are performed when the module first powers up.

There are two stages of power-up self-tests that are performed:

- BootROM self-tests
- Firmware self-tests

### BootROM Power-Up Self-Tests

The first instance is performed by the BootROM image. The BootROM, used for the selection of a cryptographic firmware image, performs the following self-tests:

- Known Answer Tests (KATs)
  - SHA-1 KAT
  - SHA-256 KAT
  - SHA-512 KAT
  - RSA Sign and Verify KATs (Separate KAT for signing; Separate KAT for verification)
- BootROM integrity check
- Firmware integrity check

The BootROM performs the integrity check on itself to ensure that its image is valid. To perform an integrity check on itself, as well as on images that can be downloaded within, the BootROM performs an RSA signature verification (RSA 2048 with SHA-256). If the BootROM integrity check fails, the switch will continuously reboot and thus must be returned to HPE. If the Firmware integrity check (RSA 2048 with SHA-256) fails, the switch will transition to the BootROM console where a new image with a valid signature can be downloaded.

### Firmware Power-Up Self-Tests

The power-up self-tests are performed on the module either when a FIPS Approved image has been loaded by the BootROM or when there is a ROM upgrade. These are performed by the corresponding image. The following power up self-tests are performed:

- AES Encrypt and Decrypt KATs
- CTR DRBG KATs (DRBG Health Tests as specified in SP 800-90Arev1 Section 11.3 are performed)
- HMAC-SHA1 KAT
- KAS-FFC-SSC Primitive “Z” computation KAT
- KAS-ECC-SSC Primitive “Z” computation KAT
- RSA Known Answer Tests (Separate KAT for signing; Separate KAT for verification)
- SHA1/256/512 KATs
- Triple-DES Encrypt and Decrypt KATs
- SP800-135rev1 SSHv2 KDF KAT
- SP800-135rev1 TLS v1.0/1.1/1.2 KDF KAT
- SP800-135rev1 SNMPv3 KDF KAT

When there is power up self-test failure, the error message indicating which crypto algorithm failed in self-test will be displayed and the switch will reboot.
An example error message with SHA1 power up self-test failure is:

“Crypto powerup self-tests for SHA1_KAT failed.”

## Conditional Self-Tests

Conditional self-tests implemented by the switches:

- CRNGT to DRBG
- CRNGT to NDRNG
- RSA PWCT
- Firmware Load Test

# 10 Delivery and Operation

## 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
    a) Check that the outer carton is in good condition.
    b) Check the package for an HPE Quality Seal or IPQC Seal, and ensure that it is intact.
    c) Check that the IPQC seal on the plastic bag inside the carton is intact.
    d) 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 any possible discrepancy in material type and quantity. If any discrepancy is 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/or illegible marks. If any surface defect or material shortage is found, the goods shall be treated as DOA goods.

4. Confirm Firmware
    a) Version verification

        To verify the firmware version, start the networking device, view the self-test result during startup, and use the **show version** command to check the firmware version. If firmware loading failed or the version information is incorrect, please contact HPE for support.

    b) RSA with SHA-256 verification

        To verify that firmware has not been tampered with, run **verify signature flash <primary/secondary>** on the networking device. The command will return a pass or fail message.

5. DOA (Dead on Arrival)

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

## Secure Operation

The module is capable of two different modes of operation:

- Standard Secure-Mode - Non-FIPS Approved mode of operation for the switches
- Enhanced Secure-Mode - FIPS-Approved mode of operation for the switches

In Enhanced Secure-Mode (FIPS-Approved Mode), services such as Telnet, TFTP, HTTP, and SNMPv2 will be disabled and other services such as SSHv2, SFTP and SNMPv3 will be enabled.
Auxiliary ports and buttons capable of manual reset and password clearing need to be disabled on the front panel of the module. Beginning at Pre-Initialization, the initialization steps identified below in this security

policy must be followed to ensure that the module is running in a FIPS-Approved mode of operation. The Crypto Officer shall strictly follow the setting instructions provided below to place the module in FIPS-approved mode. Operating the module without maintaining the following settings will remove the module from the FIPS approved mode of operation.

For more information on switch firmware commands related to Secure Mode, see the HPE ArubaOS-Switch Access Security Guide for WC.16.11 for the specific switch model number.

**Note**: The FIPS set-up instructions here-in are to be executed from the local serial port of the switch.

**Note**: The examples show an "`Aruba-Switch`" prompt. Prompts will differ based on the specific switch model number.

## Pre-Initialization

Prior to enabling the switch for a FIPS-Approved mode of operation, the Crypto Officer must download the latest FIPS-Approved firmware image from HPE and load it onto the switch. In the following example, the FIPS firmware image is downloaded as the primary flash image using this command structure: `Copy tftp flash <tftp server> <FIPS image>`

```
Aruba-Switch# copy tftp flash 192.168.1.1 WC_16_11_0005.swi
```

Once the image has been downloaded, the Crypto Officer must reboot the switch (still in Standard Secure-Mode) with the newly loaded FIPS-Approved firmware image.

```
Aruba-Switch# boot system flash primary
```

The switch will reboot to the primary flash image. Once presented with the CLI, the Crypto Officer must download the FIPS-Approved image a second time. This is a mandatory measure to ensure that a switch will not "downgrade" to a non FIPS-Approved image in the event that its primary image becomes corrupt. Again, the FIPS firmware image will be downloaded as the primary flash image:

```
ARUBA-SWITCH# copy tftp flash 192.168.1.1 WC_16_11_0005.swi
```

After completing the download, the Crypto Officer will set the configuration file of the switch to its default settings. This will erase custom keys and other custom configuration settings.

```
ARUBA-SWITCH# erase startup-config
```

After the startup configuration file has been set to its default settings, the Crypto Officer will enter the 'configuration' context and reboot the switch into a FIPS-ready mode of operation. This means that only FIPS-Approved algorithms and operations are used. Authentication, CSPs, and other services still need to be set up to bring the switch to a FIPS-Approved mode of operation.

```
ARUBA-SWITCH# configure

ARUBA-SWITCH(config)# secure-mode enhanced
```

Before transitioning to FIPS-mode, the Crypto Officer will be asked to confirm whether or not they would like to zeroize the switch, erasing all files except for the firmware image. Zeroization is required when bringing the switch out of or into a FIPS-Approved mode of operation. This is required so that private keys and CSPs

established in one mode of operation cannot be used in another. Zeroization can take up to an hour to complete.

```
The system will be rebooted and all files except firmware images will
be erased and zeroized.  This will take up to 60 minutes and the switch
will not be usable during that time.  Continue (y/n)?
```

After the Crypto Officer confirms the above message, the switch will reboot directly into the last loaded firmware image (the FIPS firmware image), run cryptographic self-tests, and do a complete zeroization of the switch. Once completed, the switch is ready to be configured to run in a FIPS-Approved mode of operation.

```
ATTENTION: Zeroization has started and will take up to 60 minutes.
           Interrupting this process may cause the switch
           to become unstable.


Backing up firmware images and other system files...
Zeroizing the file system...  100%
Verifying cleanness of the file system...  100%
Restoring firmware images and other system files...
Zeroization of the file system completed.
Continue initializing...initialization done.
```

## Initialization and Configuration

The steps outlined in this section will require the Crypto Officer to enter the 'configuration' context in order to execute the commands necessary for initializing the module.

```
ARUBA-SWITCH# configure
```

The Crypto Officer must create passwords for himself or herself, the User/Operator, and for the BootROM console in order to meet the security requirements laid out by FIPS PUB 140-2. All other commands for password management not used in this document are prohibited in the FIPS-Approved mode of operation. A password for the BootROM console is necessary to ensure that only an authorized operator is able to access the BootROM console services. The Crypto Officer shall be the only one with knowledge of the BootROM password. Substitute the "*" with a secure password.

```
ARUBA-SWITCH(config)# password operator
New password for operator: **********
      Please retype new password for operator: **********

ARUBA-SWITCH(config)# password manager
New password for manager: **********
Please retype new password for manager: **********


ARUBA-SWITCH(config)# password rom-console
Enter password:  **********
Re-enter password:  **********
```

```
ARUBA-SWITCH(config)# aaa authentication local-user secuser group
 default-security-group password plaintext
New password for secuser: *********
Please retype new password for secuser: *********
```

Following password initialization, the Crypto Officer will disable Telnet services.

```
ARUBA-SWITCH(config)# no telnet-server
```

SSHv2 services will be turned on to allow the User/Operator and Crypto Officer to access the switch's CLI services remotely. To do this, the Crypto Officer must first generate a new RSA key pair (2048 or 3072 bits) to be used for secure key and message transportation though the SSHv2 connection.

```
ARUBA-SWITCH(config)# crypto key generate ssh rsa bits 3072
Installing new key pair.  If the key/entropy cache is
depleted, this could take up to a minute.
```

The following command enables the SSHv2 server:

```
ARUBA-SWITCH(config)# ip ssh
```

SFTP/SCP services must be enabled in order to download new firmware images and security updates from HPE Networking. It may also be necessary to access an SFTP server to securely save a copy of the configuration file or device log to an external storage device. Enabling SFTP will disable the TFTP service.

```
ARUBA-SWITCH(config)# ip ssh filetransfer
Tftp and auto-tftp have been disabled.
```

As an added security measure, the Crypto Officer will type the following commands to ensure the switch does not have access to the TFTP client and server services:

```
ARUBA-SWITCH(config)# no tftp client
ARUBA-SWITCH(config)# no tftp server
```

In order to disable SNMPv1 and SNMPv2, the Crypto Officer must first initialize SNMPv3. Set-up of SNMPv3 requires that an 'initial' user be created with an associated MD5 authentication hash. After creating the 'initial' user, the Crypto Officer will type in an authentication password and associated privacy password for the 'initial' user:

```
ARUBA-SWITCH(config)# snmpv3 enable
SNMPv3 Initialization process.
Creating user 'initial'
Authentication Protocol: MD5
Enter authentication password: ********
Privacy protocol is DES
Enter privacy password: ********
```

Following the creation of the 'initial' user, the Crypto Officer will be asked if they would like to create a second user that uses SHA-1 for authentication. The Crypto Officer will type 'y' then press the "Enter" or "Return" key in order to create the second user.

```
User 'initial' has been created
Would you like to create a user that uses SHA? [y/n] y
Enter user name: crypto_officer
Authentication Protocol: SHA
Enter authentication password: **************
Privacy protocol is DES
Enter privacy password: **************
```

Once the FIPS-Approved user has been created with their associated authentication and privacy passwords, the Crypto Officer will limit access to SNMPv1 and SNMPv2c messages to 'read only'. This does not disable SNMPv1 and SNMPv2.

```
User creation is done.  SNMPv3 is now functional.

Would you like to restrict SNMPv1 and SNMPv2c messages to have read only
access (you can set this later by the command 'snmp restrict-access')?
[y/n] y
```

The privacy protocol for the SNMPv3 "crypto officer" user must be changed from DES to AES-128. Use the following command to manually change the privacy protocol for the "crypto officer" user.

```
ARUBA-SWITCH(config)# snmpv3 user crypto_officer auth sha ******** priv
aes ********
```

The following commands will be typed by the Crypto Officer in order to delete the unapproved SNMPv3 'initial' user and to disable use of SNMPv1 and SNMPv2.

```
ARUBA-SWITCH(config)# no snmpv3 user initial
ARUBA-SWITCH(config)# no snmp-server enable
ARUBA-SWITCH(config)# snmpv3 only
```

Plaintext connections to the switch are not allowed in a FIPS-Approved mode of operation and must be disabled with the following command:

```
ARUBA-SWITCH(config)# no web-management plaintext
```

HTTPS access to the module must be enabled. The Crypto Officer can use the following command to enable web management services.

```
ARUBA-SWITCH(config)# web-management ssl
```

To prevent unintentional factory reset of the switch, the "Reset" button located on the module (or the Management Card in the case of the 5400R) must be disabled. The Crypto Officer must confirm the prompt with a 'y' to complete the command.

```
ARUBA-SWITCH(config)# no front-panel-security factory-reset
```

```
                    **** CAUTION ****

          Disabling the factory reset option prevents switch configuration
          and passwords from being easily reset or recovered.  Ensure that
          you are familiar with the front panel security options before
          proceeding.


  Continue with disabling the factory reset option[y/n]? y
```

To prevent unintentional password reset of the switch, the "Clear" button located on the module (or the Management Card in the case of the 5400R) must be disabled. The Crypto Officer must confirm the prompt with a 'y' to complete the command.

```
ARUBA-SWITCH(config)# no front-panel-security password-clear

                          **** CAUTION ****

          Disabling the clear button prevents switch passwords from being
          easily reset or recovered.  Ensure that you are familiar with
          the front panel security options before proceeding.

  Continue with disabling the clear button [y/n]? y
```

Please disable the USB port using the following command.

```
ARUBA-SWITCH(config)# no usb-port
```

The start-up configuration file needs to be written with the new settings that have been applied in this section. The following command will write the new start-up configuration file:

```
ARUBA-SWITCH(config)# write memory
```

The last steps to ensure that the switch is running in a FIPS-Approved mode of operation are to set the default boot image to the primary image and then reboot the switch into the newly configured FIPS-Approved firmware image.

```
ARUBA-SWITCH(config)# boot set default primary
ARUBA-SWITCH(config)# boot system flash primary
```

Use the following command to confirm the switch is running in a FIPS-Approved mode of operation:

```
ARUBA-SWITCH(config)# show secure-mode
Secure-mode     : Enabled
```

## Zeroization

Zeroization is required when bringing the switch out of or into a FIPS-Approved mode of operation. This is required so that private keys and CSPs established in one mode of operation cannot be used in another. The module will execute full system zeroization when the switch is changing secure-mode states. For example, this can be done by calling `secure-mode enhanced` while the switch is in a "secure-mode standard" state. The

module will not execute zeroization if calling `secure-mode enhanced` while the switch is currently in the "secure-mode enhanced" state.

Zeroization can also be done by executing the `erase all zeroize` command. This command has the same effect as the above command; however the switch will not transition to the opposite mode from which the command was called in. The `secure-mode` commands shall only be called when accessing the switch directly through a serial connection. Otherwise status information about the zeroization process will not be displayed nor will the operator be able to access the module remotely until remote access has been set up. The only things that will remain on the switch after zeroization has completed are the BootROM image and the firmware images.

## Secure Management

Once the module has been configured for a FIPS-Approved mode of operation, the Crypto Officer will be responsible for keeping track of and regenerating RSA key pairs for SSHv2 authentication to the switches. Remote management is available via SSHv2. The Crypto Officer is the only operator that can change configuration settings of the switch, which includes access control, password management, and port security. Physical access to and local control of the module shall be limited to the Crypto Officer.

## User Management Access Guidance

The User will be able to access the module remotely via the access methods mentioned in Section 5, Services. When accessing the switches remotely, the User will be presented with the same CLI interface as if connected locally. In a remote session, the User is able to see most of the health information and configuration settings of the switches, but is unable to change them.

## BootROM Guidance

The primary purpose of the BootROM console is to download a new firmware image should there be a problem booting the current FIPS-Approved image. The BootROM may be accessed when rebooting the module locally through the serial port. When entering into the BootROM, the BootROM selection menu will present the Crypto Officer with three options. Option *0* allows the Crypto Officer to access BootROM console services. Option *1* and Option *2* allow the Crypto Officer to boot the system into either the primary or secondary firmware image, respectively. Only a FIPS approved firmware image may be selected from the menu. If nothing is pressed within 3 seconds of being presented with the selection menu, the switch will boot into the last booted image.

When accessing the BootROM console from the BootROM selection menu, the Crypto Officer will be prompted for the BootROM password which was previously configured by the Crypto Officer during switch initialization. This password shall be different than the Crypto Officer password. A limited set of commands is available to the Crypto Officer within the BootROM console that allows the Crypto Officer to download a new image, reboot the switch, zeroize the switch, or display BootROM image versioning information. The BootROM console may be exited at any time, to access the image selection menu, via the `quit` command.

# 11 Mitigation of Other Attacks

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

# 12 Documentation References

## Aruba Switch Series Documentation References

Access the HPE Networking products page to obtain the up-to-date documents of Aruba-Switches:

http://h17007.www1.hpe.com/us/en/networking/library/#.WqnKvTaWzSd

Search on the products and select from the models listed. Links will be provided with information about the product, such as datasheet, installation manual, configuration guide, command reference, and other reference documents.

More information is available on the full line of products for Aruba from the following sources:

- HPE website (www.hpe.com)
- Aruba website (www.arubanetworks.com)

## Technical support

For technical or sales related questions please refer to the contacts list on the HPE website:

http://www.hpe.com