FIPS 140-2 Non-Proprietary Security Policy

for Aruba AP-203R, AP-203RP, and AP-303H Wireless Access Points

Version 1.3

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aruba

a Hewlett Packard
Enterprise company

3333 Scott Blvd.
Santa Clara, CA 95054

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1 Introduction

This document constitutes the non-proprietary Cryptographic Module Security Policy for the Aruba AP-AP-203R, AP-203RP, and AP-303H Wireless Access Points with FIPS 140-2 Level 2 validation from Aruba Networks. This security policy describes how the AP meets the security requirements of FIPS 140-2 Level 2, and how to place and maintain the AP in a secure FIPS 140-2 mode. This policy was prepared as part of the FIPS 140-2 Level 2 validation of the product.

FIPS 140-2 (Federal Information Processing Standards Publication 140-2, *Security Requirements for Cryptographic Modules*) details the U.S. 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) Web-site at:

https://csrc.nist.gov/projects/cryptographic-module-validation-program

This document can be freely distributed. In addition, in this document, the Aruba AP-203R, AP-203RP, and AP-303H Wireless Access Points are referred to as the Access Point, the AP, the module, the cryptographic module, and Aruba Wireless AP.

- The exact firmware version:
  - ArubaOS 8.5.0.3-FIPS and ArubaOS 8.2.2.5-FIPS

Aruba's development processes are such that future releases under AOS 8.5 and 8.2 should be FIPS validate-able and meet the claims made in this document. Only the versions that explicitly appear on the certificate, however, are formally validated. The CMVP makes no claim as to the correct operation of the module or the security strengths of the generated keys when operating under a version that is not listed on the validation certificate.

1.1 Acronyms and Abbreviations

AES	Advanced Encryption Standard
AP	Access Point
CBC	Cipher Block Chaining
CLI	Command Line Interface
CO	Crypto Officer
CPSec	Control Plane Security protected
CSEC	Communications Security Establishment Canada
CSP	Critical Security Parameter
ECO	External Crypto Officer
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FE	Fast Ethernet
GE	Gigabit Ethernet
GHz	Gigahertz
HMAC	Hashed Message Authentication Code
Hz	Hertz
IKE	Internet Key Exchange
IPsec	Internet Protocol security
KAT	Known Answer Test
KEK	Key Encryption Key
L2TP	Layer-2 Tunneling Protocol
LAN	Local Area Network
LED	Light Emitting Diode
SHA	Secure Hash Algorithm
SNMP	Simple Network Management Protocol
SPOE	Serial & Power Over Ethernet
TEL	Tamper-Evident Label
TFTP	Trivial File Transfer Protocol
WLAN	Wireless Local Area Network

2 Product Overview

This section introduces the various Aruba Wireless Access Points, providing a brief overview and summary of the physical features of each model covered by this FIPS 140-2 security policy.

The tested version of the firmware is: **ArubaOS 8.5.0.3-FIPS and ArubaOS 8.2.2.5-FIPS**

Aruba's development processes are such that future releases under AOS 8.2 and 8.5 should be FIPS validate-able and meet the claims made in this document. Only the versions that explicitly appear on the certificate, however, are formally validated. The CMVP makes no claim as to the correct operation of the module or the security strengths of the generated keys when operating under a version that is not listed on the validation certificate.

2.1 AP-203R

This section introduces the various Aruba Wireless Access Points, providing a brief overview and summary of the physical features of each model covered by this FIPS 140-2 security policy.

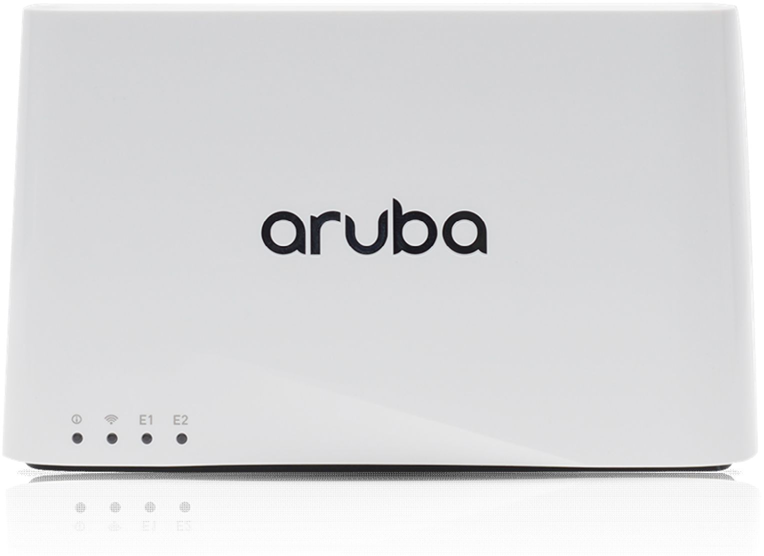


Figure 1 - Aruba AP-203R

This section introduces the Aruba AP-203R Wireless Access Point (AP) with FIPS 140-2 Level 2 validation. It describes the purpose of the AP, its physical attributes, and its interfaces.

Unique in the industry, the compact Aruba AP-203R remote AP is software configurable to operate in either 1x1 dual radio mode, or 2x2 single radio mode. It supports up to 867Mbps in the 5GHz band (with 2SS/VHT80 clients) or up to 400Mbps in the 2.4 GHz band (with 2SS/VHT40 clients) when operating in single radio 2x2 mode. In dual radio 1x1 mode, the maximum data rates for the 203R AP are 433Mbps in the 5GHz band and 200Mbps in the 2.4GHz band.

When managed by Aruba Mobility Controllers, AP-203R offers centralized configuration, data encryption, policy enforcement and network services, as well as distributed and centralized traffic forwarding.

2.1.1 Physical Description

The Aruba AP-203R Access Point is a multi-chip standalone cryptographic module consisting of hardware and software, all contained in a hard, opaque plastic case. The module contains 802.11 a/b/g/n/ac transceivers via internal antennas.

The case physically encloses the complete set of hardware and software components and represents the cryptographic boundary of the module.

The Access Point configuration validated during the cryptographic module testing included:

- HW: AP-203R-USF1 (HPE SKU JY715A)
- HW: AP-203R-RWF1 (HPE SKU JY713A)

2.1.1.1 Dimensions/Weight

The AP has the following physical dimensions:

- Dimensions/weight (unit, excluding mount accessories): - 155mm (W) x 50mm (D) x 95mm (H) - 320g
- Environmental: Operating: - Temperature: 0° C to +40° C (+32° F to +104° F) - Humidity: 5% to 93% non-condensing

Storage and transportation:

- Temperature: -40° C to +70° C (-40° F to +158° F)

2.1.1.2 Interfaces

The module provides the following network interfaces:

- 1 - (Uplink) 10/100/1000BASE-T Ethernet network interface (RJ-45)
- 2 – (Local) 10/100/1000BASE-T Ethernet (RJ-45)
- Serial Console port (proprietary; optional adapter cable available)
- USB 2.0 Host Interface

AC power interface

- 2 prong IEC 60320-1 C8 receptacle (back)

Bluetooth Low Energy (BLE) radio

- Up to 4dBm transmit power (class 2) and -94dBm receive sensitivity

Other Interfaces

- Visual indicators (tri-color LEDs): For system and radio status
- Reset button: Factory reset (during device power up), LED Toggle On/Off (during normal operation)

AP-203R LED Status Indicators

LED	Color/State	Meaning

System Status (Left-most)	Off	AP powered off
	Green/Amber Alternating	Device booting; not ready
	Green- Solid	Device ready
	Amber- Solid	Device ready; power-save mode (802.3af PoE): * Single radio * USB disabled
	Green or Amber Flashing	Restricted mode: * Uplink negotiated in sub optimal speed; or * Radio in non-high throughput (HT) mode
	Red	System error condition
Radio Status (Second)	Off	AP powered off, or both radios disabled
	Green- Solid	Both radios enabled in access mode
	Amber- Solid	Both radios enabled in monitor mode
	Green/Amber Alternating	One radio enabled in access mode, one enabled in monitor mode
Local Network Status (Third and Fourth)	Off	Link unavailable
	Amber – Solid	10/100 Mbps link negotiated
	Green – Solid	1000 Mbps link negotiated
	Flashing	Ethernet Link Activity

2.2 AP-203RP

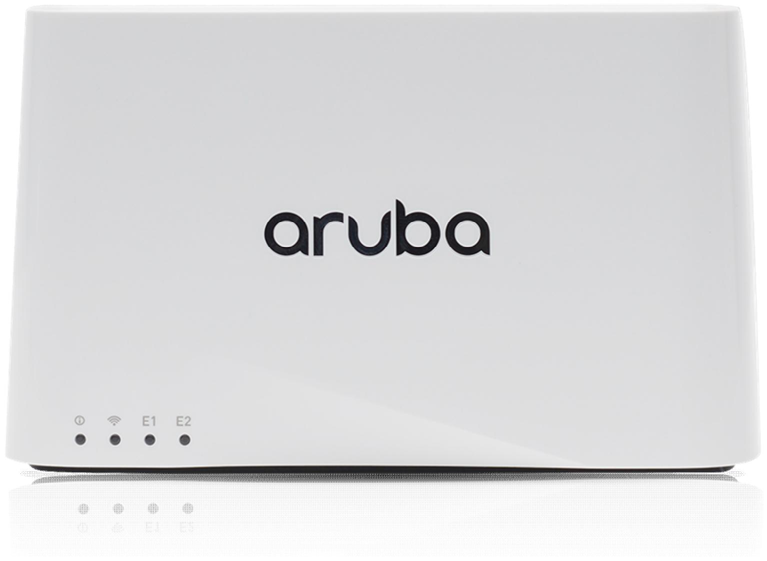


Figure 2 - Aruba AP-203RP

This section introduces the Aruba AP-203RP Wireless Access Point (AP) with FIPS 140-2 Level 2 validation. It describes the purpose of the AP, its physical attributes, and its interfaces.

Unique in the industry, the compact Aruba AP-203RP remote AP is software configurable to operate in either 1x1 dual radio mode, or 2x2 single radio mode. It supports up to 867Mbps in the 5GHz band (with 2SS/VHT80 clients) or up to 400Mbps in the 2.4 GHz band (with 2SS/VHT40 clients) when operating in single radio 2x2 mode. In dual radio 1x1 mode, the maximum data rates for the 203R AP are 433Mbps in the 5GHz band and 200Mbps in the 2.4GHz band.

When managed by Aruba Mobility Controllers, AP-203RP offers centralized configuration, data encryption, policy enforcement and network services, as well as distributed and centralized traffic forwarding.

2.2.1 Physical Description

The Aruba AP-203RP Access Point is a multi-chip standalone cryptographic module consisting of hardware and software, all contained in a hard, opaque plastic case. The module contains 802.11 a/b/g/n/ac transceivers via internal antennas.

The case physically encloses the complete set of hardware and software components and represents the cryptographic boundary of the module.

The Access Point configuration validated during the cryptographic module testing included:

- HW: AP-203RP-USF1 (HPE SKU JY723A)
- HW: AP-203RP-RWF1 (HPE SKU JY721A)

2.2.1.1 Dimensions/Weight

The AP has the following physical dimensions:

- Dimensions/weight (unit, excluding mount accessories): - 155mm (W) x 50mm (D) x 95mm (H) - 340g
- Environmental: Operating: - Temperature: 0° C to +40° C (+32° F to +104° F) - Humidity: 5% to 93% non-condensing

Storage and transportation:

- Temperature: -40° C to +70° C (-40° F to +158° F)

2.2.1.2 Interfaces

The module provides the following network interfaces:

- 1 - (Uplink) 10/100/1000BASE-T Ethernet network interface (RJ-45)
    - PoE-PSE (output): 48 Vdc (nominal) 802.3af PoE
- 2 – (Local) 10/100/1000BASE-T Ethernet (RJ-45)
- Serial Console port (proprietary; optional adapter cable available)
- USB 2.0 Host Interface

AC power interface

- 2 prong IEC 60320-1 C8 receptacle (back)

Bluetooth Low Energy (BLE) radio

- Up to 4dBm transmit power (class 2) and -94dBm receive sensitivity

Other Interfaces

- Visual indicators (tri-color LEDs): For system and radio status
- Reset button: Factory reset (during device power up), LED Toggle On/Off (during normal operation)

AP-203RP LED Status Indicators

LED	Color/State	Meaning
System Status (Left-most)	Off	AP powered off
	Green/Amber Alternating	Device booting; not ready
	Green- Solid	Device ready
	Amber- Solid	Device ready; power-save mode (802.3af PoE): * Single radio * USB disabled
	Green or Amber Flashing	Restricted mode: * Uplink negotiated in sub optimal speed; or * Radio in non-high throughput (HT) mode

	Red	System error condition
Radio Status (Second)	Off	AP powered off, or both radios disabled
	Green- Solid	Both radios enabled in access mode
	Amber- Solid	Both radios enabled in monitor mode
	Green/Amber Alternating	One radio enabled in access mode, one enabled in monitor mode
Local Network Status (Third and Fourth)	Off	Link unavailable
	Amber – Solid	10/100 Mbps link negotiated
	Green – Solid	1000 Mbps link negotiated
	Flashing	Ethernet Link Activity

2.3 AP-303H

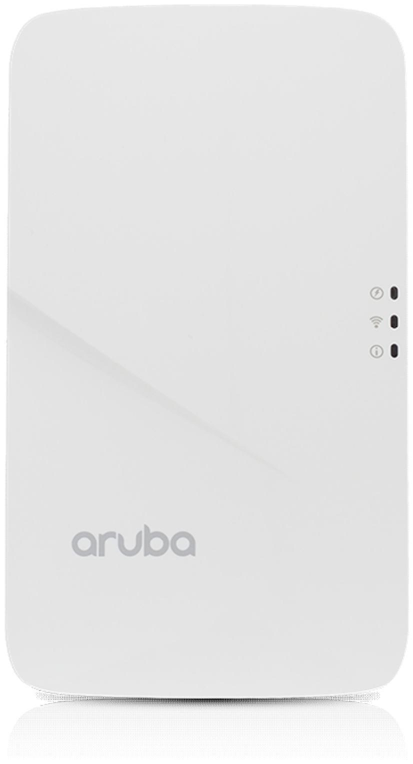


Figure 1 - Aruba AP-303H

This section introduces the Aruba AP-303H Wireless Access Point (AP) with FIPS 140-2 Level 2 validation. It describes the purpose of the AP, its physical attributes, and its interfaces.

With a maximum concurrent data rate of 867Mbps in the 5GHz band (with 2SS/VHT80 clients) and 300Mbps in the 2.4GHz band (with 2SS/HT40 clients), the 303H AP delivers high-performance Gigabit Wi-Fi for hospitality and branch environments at an attractive price point. It supports multi-user MIMO (MU-MIMO) and 2 spatial streams (2SS) to provide simultaneous data transmission for up to 2 devices, maximizing data throughput and improving network efficiency. The 802.11ac Wave 2 303H AP combines wireless and wired access in a single compact device. Three local Gigabit Ethernet ports are available to securely attach wired devices to your network. One of these ports is also capable of supplying PoE power to the attached device.

When managed by Aruba Mobility Controllers, AP-303H offers centralized configuration, data encryption, policy enforcement and network services, as well as distributed and centralized traffic forwarding.

2.3.1 Physical Description

The Aruba AP-303H Access Point is a multi-chip standalone cryptographic module consisting of hardware and software, all contained in a hard, opaque plastic case. The module contains 802.11 a/b/g/n/ac transceivers via two internal dual-band antennas.

The case physically encloses the complete set of hardware and software components and represents the cryptographic boundary of the module.

The Access Point configuration validated during the cryptographic module testing included:

- HW: AP-303H-USF1 (HPE SKU JY681A)
- HW: AP-303H-RWF1 (HPE SKU JY679A)

2.3.1.1 Dimensions/Weight

The AP has the following physical dimensions:

- Dimensions/weight: - 86mm (W) x 40mm (D) x 150mm (H) - 310g

Environmental

- Operating: - Temperature: 0° C to +40° C (+32° F to +104° F) - Humidity: 5% to 93% non-condensing

Storage and transportation:

- Temperature: -40° C to +70° C (-40° F to +158° F)

2.3.1.2 Interfaces

The module provides the following network interfaces:

- 1 – (Uplink) 10/100/1000BASE-T Ethernet network interfaces (RJ-45)
    - PoE-PD (input): 48 Vdc (nominal) 802.3af or 802.3at PoE
- 3 – (Local) 10/100/1000BASE-T Ethernet (RJ-45)
    - One port: PoE-PSE (output): 48 Vdc (nominal) 802.3af PoE
- 1 - USB 2.0 host interface (Type A connector)

DC power interface, accepts 1.35/3.5-mm center-positive

- 12V DC power interface circular plug with 9.5-mm length

Bluetooth Low Energy (BLE) radio

- Up to 4dBm transmit power (class 2) and -91dBm receive sensitivity

Other Interfaces

- Visual indicators (tri-color LEDs): For system and radio status
- Reset button: Factory reset (during device power up), LED Toggle On/Off (during normal operation)
- Serial console interface (proprietary; optional adapter cable available)

AP-303H LED Status Indicators

LED	Color/State	Meaning
System Status (Top)	Off	AP powered off
	Green/Amber Alternating	Device booting; not ready
	Green- Solid	Device ready
	Amber- Solid	Device ready; power-save mode (802.3af PoE): * Single radio * USB disabled
	Green or Amber Flashing	Restricted mode: * Uplink negotiated in sub optimal speed; or * Radio in non-high throughput (HT) mode
	Red	System error condition
Radio Status (Middle)	Off	AP powered off, or both radios disabled
	Green- Solid	Both radios enabled in access mode
	Amber- Solid	Both radios enabled in monitor mode
	Green/Amber Alternating	One radio enabled in access mode, one enabled in monitor mode
PoE-PSE Status (Bottom)	Off	AP Powered off, or PoE Capability Disabled
	Green – Solid	PoE Power Enabled
	Red	PoE Power Sourcing Error or Overload Condition
Local Network Status (Bottom of AP)	Off	Link unavailable
	Amber – Solid	10/100 Mbps link negotiated
	Green – Solid	1000 Mbps link negotiated
	Flashing	Ethernet Link Activity

3 Module Objectives

This section describes the assurance levels for each of the areas described in the FIPS 140-2 Standard. .

3.1 Security Levels

Table 1 - Security Levels

Section	Section Title	Level
1	Cryptographic Module Specification	2
2	Cryptographic Module Ports and Interfaces	2
3	Roles, Services, and Authentication	2
4	Finite State Model	2
5	Physical Security	2
6	Operational Environment	N/A
7	Cryptographic Key Management	2
8	EMI/EMC	2
9	Self-tests	2
10	Design Assurance	2
11	Mitigation of Other Attacks	N/A
Overall	**Overall module validation level**	**2**

3.2 Physical Security

The Aruba Wireless AP is a scalable, multi-processor standalone network device and is enclosed in hard, opaque plastic case. The AP enclosure is resistant to probing (please note that this feature has not been validated as part of the FIPS 140-2 validation) and is opaque within the visible spectrum. The enclosure of the AP has been designed to satisfy FIPS 140-2 Level 2 physical security requirements.

3.2.1 Applying TELs

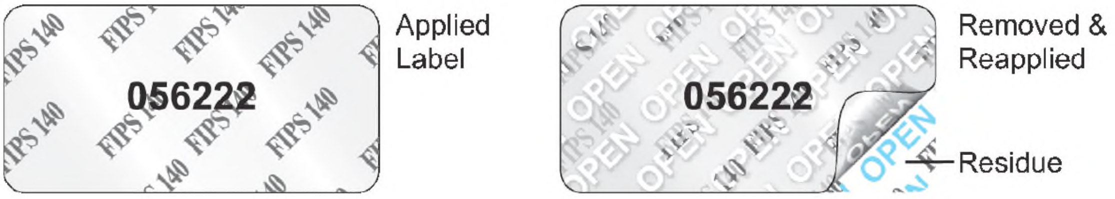
The Crypto Officer must apply Tamper-Evident Labels (TELs) to the AP to allow detection of the opening of the device, and to block the serial console port (on the bottom of the device). The TELs shall be installed for the module to operate in a FIPS Approved mode of operation. Vendor provides FIPS 140 designated TELs which have met the physical security testing requirements for tamper evident labels under the FIPS 140-2 Standard. TELs are not endorsed by the Cryptographic Module Validation Program (CMVP). Aruba provides double the required amount of TELs with shipping and additional replacement TELs can be obtained by calling customer support and requesting part number 4011570-01 (HPE SKU JY894A).

The Crypto Officer is responsible for securing and having control at all times of any unused tamper evident labels. If evidence of tampering is found with the TELs, the module must immediately be powered down and the administrator must be made aware of a physical security breach. The Crypto Officer should employ TELs as follows:

- Before applying a TEL, make sure to clean the target surfaces with alcohol and let dry.

- Do not cut, trim, punch, or otherwise alter the TEL.
- Apply the wholly intact TEL firmly and completely to the target surfaces.
- Ensure that TEL placement is not defeated by simultaneous removal of multiple modules.
- Allow 24 hours for the TEL adhesive seal to completely cure.
- Record the position and serial number of each applied TEL in a security log.
- To obtain additional or replacement TELS, please order Aruba Networks part number: 4011570—01 (HPE SKU JY894A).

Once applied, the TELs included with the AP cannot be surreptitiously broken, removed or reapplied without an obvious change in appearance:



Each TEL has a unique serial number to prevent replacement with similar label. To protect the device from tampering, TELs should be applied by the Crypto Officer as pictured below:

3.2.2 Inspection/Testing of Physical Security Mechanisms

Table 3.2 - Inspection/Testing of Physical Security Mechanisms

Physical Security Mechanism	Recommended Test Frequency	Guidance
Tamper-evident labels (TELs)	Once per month	Examine for any sign of removal, replacement, tearing, etc. See images above for locations of TELs. If any TELS are found to be missing or damaged, contact a system administrator immediately
Opaque module enclosure	Once per month	Examine module enclosure for any evidence of new openings or other access to the module internals. If any TELS are found to be missing or damaged, contact a system administrator immediately

3.2.3 TELs Placement

This section displays all the TELs locations on each of module.

3.2.3.1 TELs Placement on the AP-203R

The AP-203R requires 5 TELs. Two on the side edges so it cannot be pried apart (labels 1 and 2), 1 on the console port (label 3), and then 2 (labels 4 and 5) on the faceplate on the same side as the console port. See figures 6, 7, and 8 for placement.

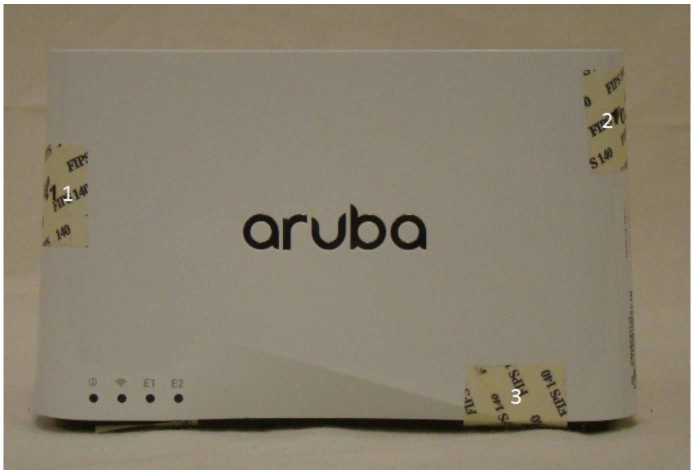


Figure 6 - Front View of AP-203R with TELs

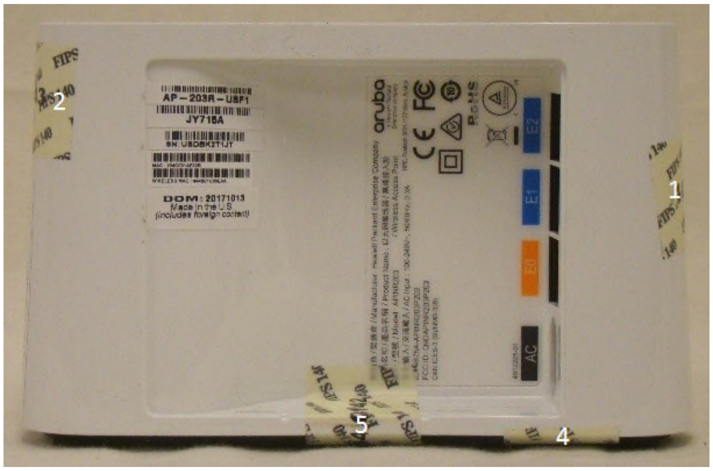


Figure 7 – Back View of AP-203R with TELs

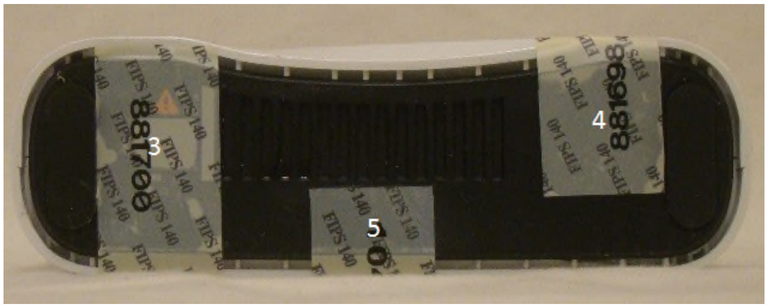


Figure 8 – Bottom View of AP-203R with TELs

3.2.3.2 TELs Placement on the AP-203RP

The AP-203RP require 5 TELS. Two on the side edges so it cannot be pried apart (labels 1 and 2), 1 on the console port (label 3), and then 2 (labels 4 and 5) on the faceplate on the same side as the console port. See figures 9, 10, and 11 for placement.

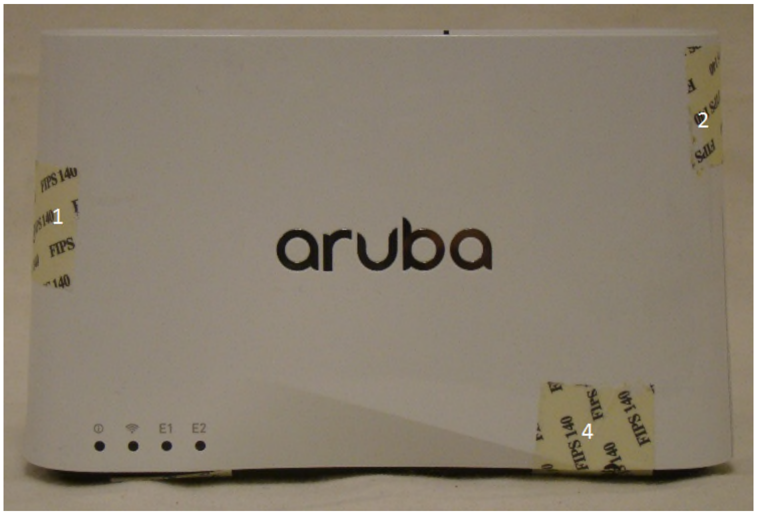


Figure 9 – Front View of AP-203RP with TELs

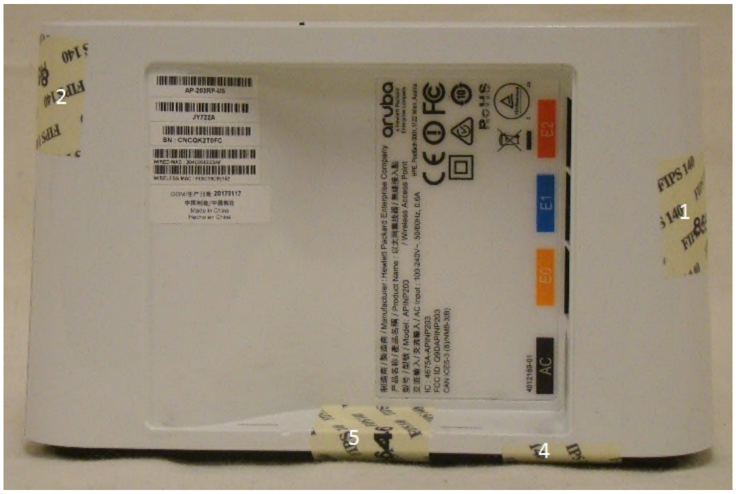


Figure 10 – Back View of AP-203RP with TELs

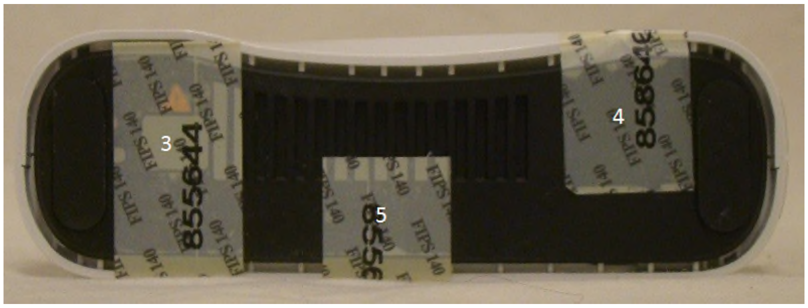


Figure 11 – Bottom View of AP-203RP with TELs

3.2.3.3 TELs Placement on the AP-303H

The AP-303H requires three TELs. One on each edge (labels 1 and 2) and one covering the console port (label 3). See figures 12, 13, and 14 for placement.

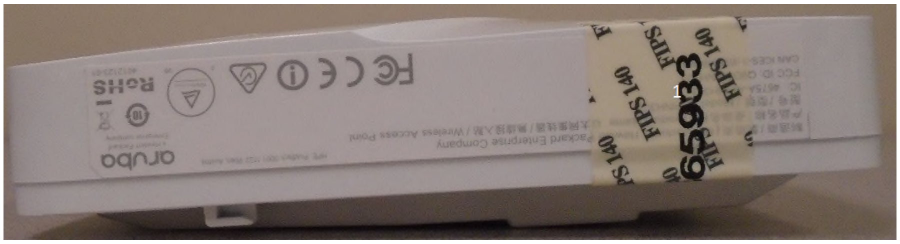


Figure 12 - Right View of AP-303H with TELs

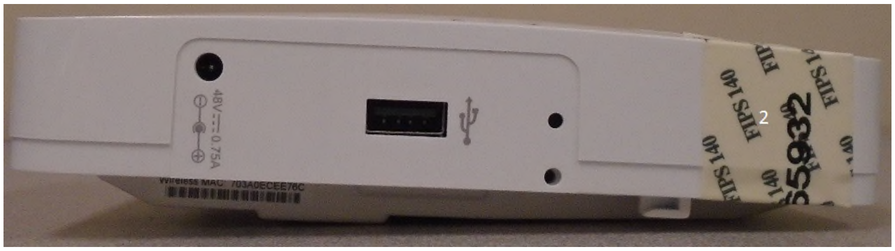


Figure 13 – Left View of AP-303H with TELs

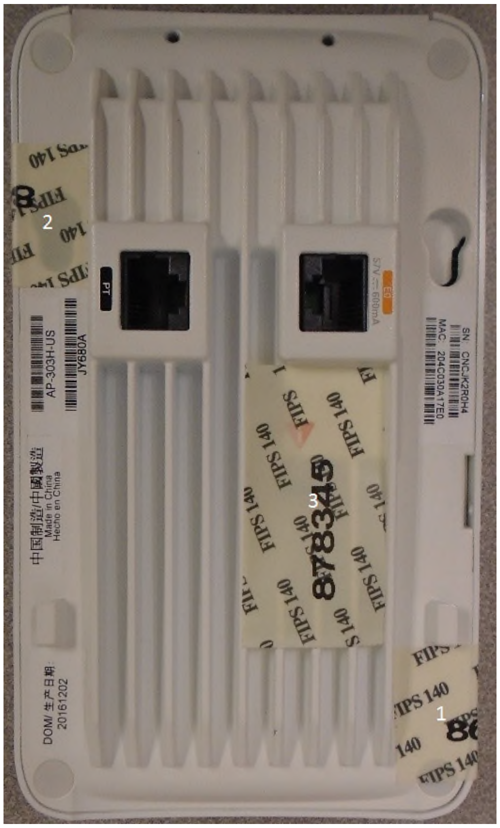


Figure 14 – Bottom View of AP-303H with TELs

3.3 Operational Environment

The FIPS 140-2 Operational Environment requirements are not applicable because the module is designated as a non-modifiable operational environment. The module only allows the loading of trusted and verified firmware that is signed by Aruba.

3.4 Logical Interfaces

The physical interfaces are divided into logical interfaces defined by FIPS 140-2 as described in the following table.

Table 3 - Logical Interfaces

FIPS 140-2 Logical Interface	Module Physical Interface
Data Input Interface	• 10/100/1000 Ethernet Ports • 802.11a/b/g/n/ac Antenna Interfaces
Data Output Interface	• 10/100/1000 Ethernet Ports • 802.11a/b/g/n/ac Antenna Interfaces
Control Input Interface	• 10/100/1000 Ethernet Ports • 802.11a/b/g/n/ac Antenna Interfaces • Reset button
Status Output Interface	• 10/100/1000 Ethernet Ports • 802.11a/b/g/n/ac Antenna Interfaces • LEDs on case
Power Interface	• Power Input • Power-over-Ethernet (POE) – AP-303H only

Data input and output, control input, status output, and power interfaces are defined as follows:

- Data input and output are the packets that use the networking functionality of the module.
- Control input consists of manual control inputs for power and reset through the power interfaces (power supply or POE). It also consists of all of the data that is entered into the access point while using the management interfaces. A reset button is present which is used to reset the AP to factory default settings.
- Status output consists of the status indicators displayed through the LEDs, the status data that is output from the module while using the management interfaces, and the log file.
  - LEDs indicate the physical state of the module, such as power-up (or rebooting), utilization level, and activation state. The log file records the results of self-tests, configuration errors, and monitoring data.
- The module may be powered by an external power supply. Operating power may also be provided via Power Over Ethernet (POE) device, when connected, the power is provided through the connected Ethernet cable. The POE is available only on the AP-303H.
- Console port is disabled when operating in FIPS mode by TEL.

The module distinguishes between different forms of data, control, and status traffic over the network ports by analyzing the packet headers and contents.

4 Roles, Authentication and Services

4.1 Roles

The module supports the role-based authentication of Crypto Officer, User, and Wireless Client; no additional roles (e.g., Maintenance) are supported. Administrative operations carried out by the Aruba Mobility Controller or Aruba Mobility Master map to the Crypto Officer role. The Crypto Officer has the ability to configure, manage, and monitor the module, including the configuration, loading, and zeroization of CSPs. Configuration can be performed through a standalone Mobility Controller or by a Mobility Master if deployed in the environment. The Mobility master also acts as a CO for the APs.

Defining characteristics of the roles depend on whether the module is configured as in either Remote AP FIPS mode, Control Plane Security (CPSec) Protected AP FIPS mode or Mesh AP FIPS Mode. There are four FIPS approved modes of operations, which are Remote AP FIPS mode, Control Plane Security (CPSec) Protected AP FIPS mode and the two Mesh Modes, Mesh Portal FIPS Mode and Mesh Point FIPS Mode. Please refer to section 8 in this documentation for more information.

- **Remote AP FIPS mode**:
  - Crypto Officer role: the Crypto Officer is the Aruba Mobility Controller or Mobility Master that has the ability to configure, manage, and monitor the module, including the configuration, loading, and zeroization of CSPs.
  - User role: in the configuration, the User operator shares the same services and authentication techniques as the Mobility Controller in the Crypto Officer role.
  - Wireless Client role: in Remote AP FIPS mode configuration, a wireless client can create a connection to the module using 802.11i and access wireless network access/bridging services. When Remote AP cannot communicate with the controller, the wireless client role authenticates to the module via 802.11i Pre-shared secret only.

- **CPSec Protected AP FIPS mode**:
  - Crypto Officer role: the Crypto Officer is the Aruba Mobility Controller or Mobility Master that has the ability to configure, manage, and monitor the module, including the configuration, loading, and zeroization of CSPs.
  - User role: in the configuration, the User operator shares the same services and authentication techniques as the Mobility Controller in the Crypto Officer
  - Wireless Client role: in CPSec Protected AP FIPS mode configuration, a wireless client can create a connection to the module using 802.11i Pre-shared secret and access wireless network access services.
- **Mesh Portal FIPS mode:**
  - Crypto Officer role: the Crypto Officer is the Aruba Mobility Controller or Mobility Master that has the ability to configure, manage, and monitor the module, including the configuration, loading, and zeroization of CSPs.
  - User role: the adjacent Mesh Point APs in a given mesh cluster. Please notice that Mesh Portal AP must be physically wired to Mobility Controller.
  - Wireless Client role: in Mesh Portal FIPS AP configuration, a wireless client can create a connection to the module using WPA2 and access wireless network access services.
- **Mesh Point FIPS mode:**

- Crypto Officer role: the Crypto Officer role is the Aruba Mobility Controller or Mobility Master that has the ability to configure, manage, and monitor the module, including the configuration, loading, and zeroization of CSPs. The first mesh AP configured is the only AP with the direct wired connection.
- User role: the adjacent Mesh APs in a given mesh cluster. Please notice that User role can be a Mesh Point AP or a Mesh Portal AP in the given mesh network.
- Wireless Client role: in Mesh Mesh Point FIPS AP configuration, a wireless client can create a connection to the module using WPA2 and access wireless network access services.

4.1.1 Crypto Officer Authentication

In each of FIPS approved modes, the Aruba Mobility Controller or Mobility Master implements the Crypto Officer role. Connections between the module and the mobility controller are protected using IPSec. Crypto Officer's authentication is accomplished via either Pre-shared secret (IKEv1), RSA digital certificate (IKEv1/IKEv2) or ECDSA digital certificate (IKEv2). The Mobility Master interacts with the APs through the Mobility Controller through provisioning of configurations.

4.1.2 User Authentication

Authentication for the User role depends on the module configuration. When the module is configured in Mesh Portal FIPS mode or Mesh Point FIPS mode, the User role is authenticated via the WPA2 pre-shared key or EAP. When the module is configured as a Remote AP FIPS mode and CPSec protected AP FIPS mode, the User role is authenticated via the same IKEv1/IKEv2 pre-shared key or RSA/ECDSA certificate that is used by the Crypto Officer

4.1.3 Wireless Client Authentication

The wireless client role defined in each of FIPS approved modes authenticates to the module via 802.11i. Please notice that WEP and TKIP configurations are not permitted in FIPS mode. When Remote AP cannot communicate with the controller, the wireless client role authenticates to the module via 802.11i Pre-shared secret only.

4.1.4 Strength of Authentication Mechanisms

The following table describes the relative strength of each supported authentication mechanism.

Table 4 - Strength of Authentication Mechanisms

Authentication Mechanism	Mechanism Strength

Authentication Mechanism	**Mechanism Strength**
IKEv1 Pre-shared secret based authentication (CO/User role)	Passwords are required to be a minimum of eight ASCII characters and a maximum of 64 with a minimum of one letter and one number, or 64 HEX characters. Assuming the weakest option of 8 ASCII characters with the listed restrictions, the probability of randomly guessing the correct sequence is one (1) in 3,608,347,333,959,680 (this calculation is based on the assumption that the typical standard American QWERTY computer keyboard has 10 Integer digits, 52 alphabetic characters, and 32 special characters providing 94 characters to choose from in total. The calculation should be 94^8 (Total number of 8-digit passwords) – 84^8 (Total number of 8-digit passwords without numbers) – 42^8 (Total number of 8-digit passwords without letters) + 32^8 (Total number of 8-digit passwords without letters or numbers, added since it's double-counted in the previous two subtractions) = 3,608,347,333,959,680). At optimal network conditions (assuming 1ms round-trip latency), an attacker would only get 60,000 guesses per minute. Therefore the associated probability of a successful random attempt during a one-minute period is 60,000/3,608,347,333,959,680, which is less than 1 in 100,000 required by FIPS 140-2.
802.11i Pre-shared secret based authentication (Wireless Client and Mesh AP user roles)	Passwords are required to be a minimum of eight ASCII characters and a maximum of 63 with a minimum of one letter and one number, or the password must be exactly 64 HEX characters. Assuming the weakest option of 8 ASCII characters with the listed restrictions, the probability of randomly guessing the correct sequence is one (1) in 3,608,347,333,959,680 (this calculation is based on the assumption that the typical standard American QWERTY computer keyboard has 10 Integer digits, 52 alphabetic characters, and 32 special characters providing 94 characters to choose from in total. The calculation should be 94^8 (Total number of 8-digit passwords) – 84^8 (Total number of 8-digit passwords without numbers) – 42^8 (Total number of 8-digit passwords without letters) + 32^8 (Total number of 8-digit passwords without letters or numbers, added since it's double-counted in the previous two subtractions) = 3,608,347,333,959,680). At optimal network conditions (assuming 1ms round-trip latency), an attacker would only get 60,000 guesses per minute. Therefore the associated probability of a successful random attempt during a one-minute period is 60,000/3,608,347,333,959,680, which is less than 1 in 100,000 required by FIPS 140-2.
RSA Certificate based authentication (CO/User role)	The module supports 2048-bit RSA key authentication during IKEv1 and IKEv2. RSA 2048 bit keys correspond to 112 bits of security. Assuming the low end of that range, the associated probability of a successful random attempt is 1 in 2^112, which is less than 1 in 1,000,000 required by FIPS 140-2. At optimal network conditions (assuming 1ms round-trip latency), an attacker would only get 60,000 guesses per minute. Therefore the associated probability of a successful random attempt during a one-minute period is 60,000/2^112, which is less than 1 in 100,000 required by FIPS 140-2.
ECDSA Certificate based authentication (CO/User role)	ECDSA signing and verification is used to authenticate to the module during IKEv1/IKEv2. Both P-256 and P-384 curves are supported. ECDSA P-256 provides 128 bits of equivalent security, and P-384 provides 192 bits of equivalent security. Assuming the low end of that range, the associated probability of a successful random attempt during a one-minute period is 1 in 2^128, which is less than 1 in 1,000,000 required by FIPS 140-2. At optimal network conditions (assuming 1ms round-trip latency), an attacker would only get 60,000 guesses per minute. Therefore the associated probability of a successful random attempt during a one-minute period is 60,000/2^128, which is less than 1 in 100,000 required by FIPS 140-2.

4.2 Services

The module provides various services depending on role. These are described below.

4.2.1 Crypto Officer Services

The CO role in each of FIPS modes defined in section 4.1 has the same services.

Table 5 - Crypto Officer Services

Services	**Description**	**CSPs Accessed** (see section 6 below for a complete description to each CSP and the associated cryptographic algorithms)
FIPS mode enable/disable	The CO enables FIPS mode by following the procedures under Section 8 to ensure the AP is configured for Secure Operations. The CO can disable FIPS mode by reverting these changes.	None.
Key Management	The CO can configure/modify the IKEv1/IKEv2 shared secret (The RSA private key is protected by non-volatile memory and cannot be modified), IKEv1/IKEv2 certifications, and the 802.11i Pre-shared secret (used in advanced Remote AP configuration). Also, the CO/User implicitly uses the KEK to read/write configuration to non-volatile memory.	1 (read) 13 and 25(write) 21, 22, 23, 24 (read, write)
Remotely reboot module	The CO can remotely trigger a reboot	None
Self-test triggered by CO/User reboot	The CO can trigger a programmatic reset leading to self-test and initialization	None.
Update module firmware[1]	The CO can trigger a module firmware update	1, 12 (read)
Configure non-security related module parameters	CO can configure various operational parameters that do not relate to security	None.

[1] Any firmware loaded into this module that is not shown on the module certificate is out of the scope of this validation and requires a separate FIPS 140-2 validation.

Services	**Description**	**CSPs Accessed** (see section 6 below for a complete description to each CSP and the associated cryptographic algorithms)
Creation/use of secure management session between module and CO[2]	The module supports use of IPSec for securing the management channel.	2, 3, 4, 5. 6, 7, .8, 9, 10, 11 (read, write) 13 (read) 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24 (read, write)
System Status	CO may view system status information through the secured management channel	See creation/use of secure management session above.
Creation/use of secure mesh channel[3]	The module requires secure connections between mesh points using 802.11i	1, 25 (read) 26, 27, 28, 29, 30 (read/write)
Zeroization	The cryptographic keys stored in SDRAM memory can be zeroized by rebooting the module. The cryptographic keys (IKEv1 Pre-shared key and 802.11i Pre-Shared Key) stored in the flash can be zeroized by using command 'ap wipe out flash' or by overwriting with a new secret. The 'no' command in the CLI can be used to zeroize IKE, Ipsec CSPs. Please See CLI guide for details. The other keys/CSPs (RSA/ECDSA public key/private key and certificate) stored in Flash memory can be zeroized by using command 'ap wipeout flash'.	All CSPs (not including the Factory CA Public Key) will be destroyed.
Openflow Agent	Agent run on device for use with Mobility Master SDN. Leveraged by the SDN for discovering of hosts and networks, configuration of networks, and collection of statistics.	None

4.2.2 User Services

The User role for Remote AP FIPS mode and Control Plane Security (CPSec) Protected AP FIPS mode supports the same services listed in the Section 4.2.1 Crypto Officer Services.

The User role for Mesh Portal FIPS mode and Mesh Point FIPS mode supports the services listed in Section 4.2.3 Wireless Client Role.

[2] This service is *not* available in Mesh Point FIPS mode. In Mesh Point mode, the IPSec tunnel will be between the Mesh Portal and the controller, not the Mesh Point and the controller.

[3] This service is only applicable in the Mesh Portal FIPS mode and Mesh Point FIPS mode. It is not applicable in Control Plane Security (CPSec) Protected AP FIPS mode and Remote AP FIPS mode.

4.2.3 Wireless Client Services

The following services are provided for the Wireless Client role in Remote AP FIPS mode, CPSec protected AP FIPS mode, Mesh Portal FIPS mode and Mesh Point FIPS mode.

Table 6- User Services (Wireless Client Services)

Service	**Description**	**CSPs Accessed** (see section 6 below for a complete description to each CSP and the associated cryptographic algorithms)
Generation and use of 802.11i cryptographic keys	In all modes, the links between the module and wireless client are secured with 802.11i.	1, 25 (read) 26,27,28,29,30 (read/write)
Use of 802.11i Pre-shared secret for establishment of IEEE 802.11i keys	When the module is in advanced Remote AP configuration, the links between the module and the wireless client are secured with 802.11i. This is authenticated with a shared secret only.	1, 25 (read)
Wireless bridging services	The module bridges traffic between the wireless client and the wired network.	None

4.2.4 Unauthenticated Services

The module provides the following unauthenticated services, which are available regardless of role.

- System status – module LEDs
- Reboot module by removing/replacing power
- Self-test and initialization at power-on.

4.2.5 Services Available in Non-FIPS Mode

• All of the services that are available in FIPS mode are also available in non-FIPS mode.

• If not operating in the Approved mode as per the procedures in section 8, then non-Approved algorithms and/or sizes are available.

• Upgrading the firmware via the console port.

• Debugging via the console port.

4.2.6 Non-Approved Services Disallowed in FIPS Mode

- The Suite-B (bSec) protocol is a pre-standard protocol that has been proposed to the IEEE 802.11 committee as an alternative to 802.11i.
- WPA3
- WPA-2 Multiple Pre-Shared Key (MPSK), where every client connected to the WLAN SSID may have its own unique PSK.
- IPSec/IKE using Triple-DES

5 Cryptographic Algorithms

The firmware in each module contains the following cryptographic algorithm implementations/crypto libraries to implement the different FIPS approved cryptographic algorithms that will be used for the corresponding security services supported by the module in FIPS mode: NOTE: The modes listed for each algorithm are only those actually used by the module (additional modes may have been tested during CAVS testing and not currently used).

- ArubaOS OpenSSL Module algorithm implementation
- ArubaOS Crypto Module algorithm implementation
- ArubaOS UBOOT Bootloader algorithm implementation
- Aruba AP HW Algorithm Implementation

Below are the detailed lists for the FIPS approved algorithms and the associated certificate implemented by each crypto library

ArubaOS OpenSSL					
CAVP Certificate #	Algorithm	Standard	Mode/Method	Key Lengths, Curves, Moduli	Use
5266 & 5928	AES	FIPS 197, SP 800-38A	ECB, CBC, CFB (128only), CTR (192, 256, ext only)	128, 192, 256	Data Encryption/Decryption
2150 & 2151	CVL RSASP1 PKCS 1.5	FIPS 186-4		MOD 2048	RSA
1738 & 2149	CVL IKEv1	SP 800-135 Rev1	IKEv1(DSA, PSK 2048, SHA-256, 384),	MOD 2048	Key Derivation
2017 & 2481	DRBG	SP 800-90A	AES CTR	256	Deterministic Random Number Generation
1375 & 1579	ECDSA	186-4	PKG, PKV, SigGen, SigVer	P256, P384	Digital Key Generation and Verification, Signature Generation and Verification
3485 & 3906	HMAC	FIPS 198-1	HMAC-SHA1, HMAC-SHA-256, HMAC-SHA-384, HMAC-SHA-512	112, 126, 160, 256	Message Authentication
181 & 246	KBKDF	SP 800-108	CTR	HMAC-SHA1,HMAC-SHA256, HMAC-SHA384	Deriving Keys

2816 & 3107	RSA	FIPS 186-2	SHA-1, SHA-256, SHA-384, SHA-512 PKCS1 v1.5	1024 (legacy SigVer only), 2048	Digital Signature Verification
2816 & 3107	RSA	FIPS 186-4	SHA-1, SHA-256, SHA-384, SHA-512 PKCS1 v1.5	2048	Key Gen, Digital Signature Generation and Verification
1366 & 1501	DSA	FIPS 186-4		2048	Key Generation, PQG Generation
4236 & 4682	SHS	FIPS 180-4	SHA-1, SHA-256, SHA-384, SHA-512 Byte Only		Message Digest
2664 & 2885	Triple-DES	SP 800-67 Rev2	TECB, TCBC	192	Data Encryption/Decryption
AES 5266 HMAC 3485	KTS	SP 800-38F	AES-CBC[4]	128, 192, 256	Key Wrapping/Key Transport via IKE/IPSec
AES 5928 HMAC 3906	KTS	SP 800-38F	AES-CBC[5]	128, 192, 256	Key Wrapping/Key Transport via IKE/IPSec

Note:

- In FIPS Mode, Triple-DES is only used in the Self-Tests and with the KEK.

ArubaOS Crypto Module					
CAVP Certificate #	Algorithm	Standard	Mode/Method	Key Lengths, Curves, Moduli	Use
5265 & 5945	AES	FIPS 197, SP 800-38A SP 800-38D	CBC, GCM	128, 192, 256	Data Encryption/Decryption
1736 & 2174	CVL IKEv2	SP800-135 Rev1	IKEv2(2048 SHA-256 384)		Key Derivation
2155 & 2175	RSASP1	FIPS 186-4	2048 PKCS #1.5		Key Gen, SigVer, SigGen
1374 & 1591	ECDSA	FIPS 186-4	PKG, PKV, SigGen,	P256, P384	Digital Key Generation and Verification, Signature Generation

[4] key establishment methodology provides between 128 and 256 bits of encryption strength

[5] key establishment methodology provides between 128 and 256 bits of encryption strength

			SigVer		and Verification
1365 & 1507	DSA	FIPS 186-4	PQG, KeyGen	2048	Digital Signature Generation, Digital Key Generation
3484 & 3918	HMAC	FIPS 198-1	HMAC-SHA1, HMAC-SHA-256, HMAC-SHA-384, HMAC-SHA-512	112, 126, 160, 256	Message Authentication
2815 & 3121	RSA	FIPS 186-2	SHA-1, SHA-256, SHA-384, SHA-512 PKCS1 v1.5	1024 (legacy SigVer only), 2048	Digital Signature Verification
2815 & 3121	RSA	FIPS 186-4	SHA-1, SHA-256, SHA-384, SHA-512 PKCS1 v1.5	2048, 1024 (legacy SigVer only)	Key Generation, Digital Signature Generation and Verification
4235 & 4697	SHS	FIPS 180-4	SHA-1, SHA-256, SHA-384, SHA-512 Byte Only		Message Digest
2663 & 2896	Triple-DES	SP 800-67 Rev2	TCBC	192	Data Encryption/Decryption
AES Cert #5265	KTS	SP 800-38F	AES-GCM[6]	128, 192, 256	Key Wrapping/Key Transport via IKE/IPSec
AES Cert #5265 and HMAC Cert #3484	KTS	SP 800-38F	AES-CBC[7]	128, 192, 256	Key Wrapping/Key Transport via IKE/IPSec
AES Cert #5945	KTS	SP 800-38F	AES-GCM[8]	128, 192, 256	Key Wrapping/Key Transport via IKE/IPSec
AES Cert #5945 and HMAC Cert #3918	KTS	SP 800-38F	AES-CBC[9]	128, 192, 256	Key Wrapping/Key Transport via IKE/IPSec

[6] key establishment methodology provides between 128 and 256 bits of encryption strength

[7] key establishment methodology provides between 128 and 256 bits of encryption strength

[8] key establishment methodology provides between 128 and 256 bits of encryption strength

[9] key establishment methodology provides between 128 and 256 bits of encryption strength

Note:

- In FIPS Mode, Triple-DES is only used in the Self-Tests.
- The algorithms in the table are not used when the module is configured into the Mesh Point FIPS mode.

ArubaOS UBOOT Bootloader					
CAVP Certificate #	Algorithm	Standard	Mode/Method	Key Lengths, Curves, Moduli	Use
2395 & 3111	RSA	FIPS 186-4	SHA-1, SHA256	2048	Digital Signature Verification
3633 & 4685	SHS	FIPS 180-4	SHA-1, SHA-256 Byte Only		Message Digest

NOTE: Only Firmware signed with SHA-256 is permitted in the Approved mode. Digital signature verification with SHA-1, while available within the module, shall only be used while in the non-Approved mode.

Aruba AP Hardware					
CAVP Certificate #	Algorithm	Standard	Mode/Method	Key Lengths, Curves, Moduli	Use
5412	AES	FIPS 197, SP 800-38A SP800-38C	ECB, CCM, GCM(used for self-test only)	128, 256	Data Encryption/Decryption

Non-FIPS Approved Algorithms Allowed in FIPS Mode

- NDRNG (used solely to seed the Approved DRBG)
- Diffie-Hellman (key agreement; key establishment methodology provides 112 bits of encryption strength)
- EC Diffie-Hellman (key agreement; key establishment methodology provides 128 or 192 bits of encryption strength)

NOTE: IKEv1 and IKEv2 protocols have not been reviewed or tested by the CAVP and CMVP.

Non-FIPS Approved Cryptographic Algorithms used only in Non-FIPS 140 Mode

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

- DES
- HMAC-MD5
- MD5
- RC4

- RSA (non-compliant less than 112 bits of encryption strength)
- Null Encryption (Disallowed by Policy)
- Triple-DES as used in IKE/IPSec (Disallowed by Policy)

Note: These algorithms are used for older version of WEP in non-FIPS mode.

6 Critical Security Parameters

The following Critical Security Parameters (CSPs) are used by the module (unless explicitly specified, a CSP is applicable to all approved modes of operation):

Table 7 - Critical Security Parameters

#	Name	Algorithm/Key Size	Generation/Use	Storage	Zeroization
General Keys/CSPs					
1	Key Encryption Key (KEK) – Not considered a CSP	Triple-DES (192 bits)	Hardcoded during manufacturing. Used only to obfuscate keys stored in the flash, not for key transport. (3 Key, CBC)	Stored in Flash memory (plaintext)	The zeroization requirements do not apply to this key as it is not considered a CSP.
2	DRBG entropy input	SP 800-90a CTR_DRBG (512 bits)	Entropy inputs to DRBG function used to construct the DRBG seed. 64 bytes are gotten from the entropy source on each call by any service that requires a random number.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
3	DRBG seed	SP 800-90a CTR_DRBG (384-bits)	Input to the DRBG that determines the internal state of the DRBG. Generated using DRBG derivation function that includes the entropy input from the entropy source.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
4	DRBG Key	SP 800-90a CTR_DRBG (256 bits)	This is the DRBG key used for SP 800-90a CTR_DRBG.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
5	DRBG V	SP 800-90a CTR_DRBG V (128 bits)	Internal V value used as part of SP 800-90a CTR_DRBG.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module

#	Name	Algorithm/Key Size	Generation/Use	Storage	Zeroization
6	Diffie-Hellman private key	Diffie-Hellman Group 14 (224 bits)	Generated internally by calling FIPS approved DRBG (Certs. #2017 and #2481) to derive Diffie-Hellman shared secret used in both IKEv1 and IKEv2.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
7	Diffie-Hellman public key	Diffie-Hellman Group 14 (2048 bits)	Derived internally in compliance with Diffie-Hellman key agreement scheme. Used for establishing DH shared secret.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
8	Diffie-Hellman shared secret	Diffie-Hellman Group 14 (2048 bits)	Established during Diffie-Hellman Exchange. Used for deriving IPSec/IKE cryptographic keys.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
9	EC Diffie-Hellman private key	EC Diffie-Hellman (Curves: P-256 or P-384).	Generated internally by calling FIPS approved DRBG (Certs. #2017 and #2481) during EC Diffie-Hellman Exchange. Used for establishing ECDH shared secret.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
10	EC Diffie-Hellman public key	EC Diffie-Hellman (Curves: P-256 or P-384).	Derived internally in compliance with EC Diffie-Hellman key agreement scheme. Used for establishing ECDH shared secret.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
11	EC Diffie-Hellman shared secret	EC Diffie-Hellman (Curves: P-256 or P-384)	Established during EC Diffie-Hellman Exchange. Used for deriving IPSec/IKE cryptographic keys.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
12	Factory CA Public Key	RSA (2048 bits)	This is RSA public key. Loaded into the module during manufacturing. Used for Firmware verification.	Stored in TPM.	As this is a public key, the zeroization requirements do not apply

#	Name	Algorithm/Key Size	Generation/Use	Storage	Zeroization
IPSec/IKE[10]					
13	IKEv1 Pre-shared secret[11]	Shared secret (8 - 64 ASCII or 64 HEX characters)	Entered by CO role. Used for IKEv1 peers authentication.	Stored in Flash memory obfuscated with KEK	Zeroized by using command 'ap wipe out flash' or by overwriting with a new secret
14	skeyid	Shared Secret (160/256/384 bits)	A shared secret known only to IKEv1 peers. It was established via key derivation function defined in SP800-135 KDF (IKEv1). Used for deriving other keys in IKEv1 protocol implementation.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module.
15	skeyid_d	Shared Secret (160/256/384 bits)	A shared secret known only to IKEv1 peers. It was derived via key derivation function defined in SP800-135 KDF (IKEv1). Used for deriving IKEv1 session authentication key.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
16	SKEYSEED	Shared Secret (160/256/384 bits)	A shared secret known only to IKEv2 peers. It was derived via key derivation function defined in SP800-135 KDF (IKEv2) and it will be used for deriving other keys in IKEv2 protocol.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
17	IKE session authentication key	HMAC-SHA-1/256/384 (160/256/384 bits)	The IKE session (IKE Phase I) authentication key. This key is derived via key derivation function defined in SP800-135 KDF	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module

[10] Not used in Mesh Point modes of operation

[11] Applicable only to Remote AP and Mesh Portal modes

#	Name	Algorithm/Key Size	Generation/Use	Storage	Zeroization
			(IKEv1/IKEv2). Used for IKEv1/IKEv2 payload integrity verification.		
18	IKE session encryption key	AES (128/192/256 bits, CBC)	The IKE session (IKE Phase I) encrypt key. This key is derived via key derivation function defined in SP800-135 KDF (IKEv1/IKEv2). Used for IKE payload protection. The IPsec session encryption keys can also be used for the Double Encrypt feature.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
19	IPSec session encryption keys	AES (CBC) and AES-GCM (128/192/256 bits)	The IPsec (IKE phase II) encryption key. This key is derived via a key derivation function defined in SP800-135 KDF (IKEv1/IKEv2). Used for IPSec traffics protection. These keys can also be used for the Double Encrypt feature.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
20	IPSec session authentication keys	HMAC-SHA-1 (160 bits)	The IPsec (IKE Phase II) authentication key. This key is derived via using the KDF defined in SP800-135 KDF (IKEv1/IKEv2). Used for IPSec traffics integrity verification.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
21	IKE RSA Private Key	RSA private key (2048 bits)	This is the RSA private key. This key is generated by the module in compliance with FIPS 186-4 RSA key pair generation method. In both IKEv1 and IKEv2, DRBG (Certs. #2017 and #2481) is called for key generation. It is used for	Stored in Flash memory obfuscated with KEK	Zeroized by using command ‘ap wipe out flash’

#	Name	Algorithm/Key Size	Generation/Use	Storage	Zeroization
			RSA signature signing in either IKEv1 or IKEv2. This key can also be entered by the CO.		
22	IKE RSA public key	RSA public key (2048 bits)	This is the RSA public key. This key is derived in compliance with FIPS 186-4 RSA key pair generation method in the module. It is used for RSA signature verification in either IKEv1 or IKEv2. This key can also be entered by the CO.	Stored in Flash memory (plaintext)	Zeroized by using command 'ap wipe out flash'
23	IKE ECDSA Private Key	ECDSA suite B (Curves: P-256 or P-384)	This is the ECDSA private key. This key is generated by the module in compliance with FIPS 186-4 ECDSA key pair generation method. In IKEv2, DRBG (Certs. #2017 and #2481) is called for key generation. It is used for ECDSA signature signing in IKEv2. This key can also be entered by the CO.	Stored in Flash memory obfuscated with KEK	Zeroized by using command 'ap wipe out flash'.
24	IKE ECDSA Public Key	ECDSA suite B (Curves: P-256 or P-384)	This is the ECDSA public key. This key is derived in compliance with FIPS 186-4 ECDSA key pair generation method in the module. It is used for ECDSA signature verification in IKEv2. This key can also be entered by the CO.	Stored in Flash memory obfuscated with KEK	Zeroized by using command 'ap wipe out flash'

#	Name	Algorithm/Key Size	Generation/Use	Storage	Zeroization
802.11i[12]					
25	802.11i Pre-shared secret	Shared secret (8-63 ASCII characters, or 64 HEX characters)	Entered by CO role. Used for 802.11i client/server authentication.	Stored in Flash memory obfuscated with KEK	Zeroized by using command 'ap wipe out flash' or by overwriting with a new secret.
26	802.11i Pair-Wise Master key (PMK)	Shared secret (256 bits)	The PMK is transported to the module, protected by IPSec secure tunnel. Used to derive the Pairwise Transient Key (PTK) for 802.11i communications.	Stored in SDRAM (plaintext)	Zeroized by rebooting the module
27	802.11i Pairwise Transient Key (PTK)	HMAC (384 bits)	This key is used to derive 802.11i session key by using the KDF defined in SP800-108.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
28	802.11i session key	AES-CCM (128 bits)	Derived during 802.11i 4-way handshake by using the KDF defined in SP800-108 then used as the session key.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
29	802.11i Group Master Key (GMK)	Shared secret (256 bits)	Generated by calling DRBG (Certs. #2017 and #2481). Used to derive 802.11i Group Transient Key GTK.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module
30	802.11i Group Transient Key (GTK)	AES-CCM (256 bits)	Derived from 802.11 GMK by using the KDF defined in SP800-108. The GTK is the 802.11i session key used for broadcast communications protection.	Stored in SDRAM memory (plaintext)	Zeroized by rebooting the module

[12] While operating in Mesh Point or Mesh Portal mode, the AP will only use PSK for 802.11. RAP and CPsec modes use both Certificate-based and PSK-based 802.11

Please note that:

- AES GCM IV generation is performed in compliance with the Implementation Guidance A.5 scenario 1. FIPS approved DRBG (Certs. #2017 and #2481) is used for IV generation and 96 bits of IV is supported).
- For keys identified as being "Generated internally by calling FIPS approved DRBG", the generated seed used in the asymmetric key generation is an unmodified output from the DRBG.
- The module generates a minimum of 256 bits of entropy for use in key generation.
- CSPs labeled as “Entered by CO” are transferred into the module from the Mobility Controller via IPSec.
- In Remote AP FIPS mode, all CSPs are applicable.
- In CPSec Protected AP FIPS mode, the IKEv1 PSK CSPs are not applicable.
- In Mesh Point FIPS modes, all IPSec/IKE CSPs are not applicable.

7 Self Tests

The module performs Power On Self-Tests regardless the modes (non-FIPS mode, Remote AP FIPS mode, Control Plane Security (CPSec) Protected AP FIPS mode, Mesh Portal FIPS mode or Mesh Point FIPS mode). In addition, the module also performs Conditional tests after being configured into either Remote AP FIPS mode, Control Plane Security (CPSec) Protected AP FIPS mode Mesh Portal FIPS mode or Mesh Point FIPS mode. In the event any self-test fails, the module enters an error state, logs the error, and reboots automatically.

The module performs the following power on self-tests:

ArubaOS OpenSSL Module:

- SHA (SHA-1, SHA-256, SHA-384, SHA-512) KATs
- HMAC (HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-384, HMAC-SHA-512) KATs
- Triple-DES (encrypt/decrypt) KATs
- AES (Encrypt/Decrypt) KATs
- ECDSA (Sign/Verify) KATs
- RSA (Sign/Verify) KATs
- DSA (Sign/Verify) KATs
- DRBG KATs
- ECDH (P-256) KAT
- DH (2048) KAT
- KDF108 KAT

ArubaOS Crypto Module

- SHA (SHA-1, SHA-256, SHA-384, SHA-512) KATs
- HMAC (HMAC-SHA-1, HMAC-SHA-256, HMAC-SHA-384, HMAC-SHA-512) KATs
- AES (Encrypt/Decrypt) KATs
- AES-GCM (Encrypt/Decrypt) KATs
- Triple-DES (Encrypt/Decrypt KATs)
- ECDSA (Sign/Verify) KATs
- RSA (Sign/Verify) KATs
- DSA (Sign/Verify) KATs
- ECDH (P-256, P-384) Pairwise Consistency Tests
- DH (2048) Pairwise Consistency Tests

Aruba AP Hardware algorithm implementation power on self-tests:

- AES-CCM (encrypt/decrypt) KATs
- AES-GCM (encrypt/decrypt) KATs
- AES-ECB (encrypt/decrypt) KATs

ArubaOS UBOOT Bootloader Module

- Firmware Integrity Test: RSA PKCS#1 v1.5 (2048 bits) signature verification with SHA-256 (the integrity test is the KAT)

The following Conditional Tests are performed in the module:

ArubaOS OpenSSL Module algorithm implementation

- CRNG Test to Approved RNG (DRBG)

- SP800-90A Section 11.3 Health Tests for CTR_DRBG (Instantiate, Generate and Reseed).
- ECDSA Pairwise Consistency Test
- RSA Pairwise Consistency Test
- CRNG test to NDRNG

ArubaOS Crypto Module algorithm implementation

- RSA Pairwise Consistency Test
- ECDSA Pairwise Consistency Test

ArubaOS UBOOT Bootloader Module algorithm implementation

  - Firmware Load Test - RSA PKCS#1 v1.5 (2048 bits) signature verification with SHA-256

Self-test results are written to the serial console.

In the event of a KATs failure, the AP logs different messages, depending on the error.

For an ArubaOS OpenSSL AP module and ArubaOS cryptographic module KAT failure:

```
AP rebooted [DATE][TIME] : Restarting System, SW FIPS KAT failed
```

For an AES Atheros hardware POST failure:

```
Starting HW SHA1 KAT ...Completed HW SHA1 AT
Starting HW HMAC-SHA1 KAT ...Completed HW HMAC-SHA1 KAT
Starting HW AES KAT ...Restarting system.
```

8 Secure Operation

The module can be configured to be in the following FIPS approved modes of operations via corresponding Aruba Mobility Controllers that have been certified to FIPS level 2:

- Remote AP FIPS mode – When the module is configured as a Remote AP, it is intended to be deployed in a remote location (relative to the Mobility Controller). The module provides cryptographic processing in the form of IPSec for all traffic to and from the Mobility Controller.
- Control Plane Security (CPSec) Protected AP FIPS mode – When the module is configured as a Control Plane Security protected AP it is intended to be deployed in a local/private location (LAN, WAN, MPLS) relative to the Mobility Controller. The module provides cryptographic processing in the form of IPSec for all Control traffic to and from the Mobility Controller.
- Mesh Portal FIPS mode – When the module is configured in Mesh Portal mode, it is intended to be connected over a physical wire to the mobility controller. These modules serve as the connection point between the Mesh Point and the Mobility Controller. Mesh Portals communicate with the Mobility Controller through IPSec and with Mesh Points via 802.11i session. The Crypto Officer role is the Mobility Controller that authenticates via IKEv1/IKEv2 pre-shared key or RSA/ECDSA certificate authentication method, and Users are the "n" Mesh Points that authenticate via 802.11i preshared key.
- Mesh Point FIPS mode – an AP that establishes all wireless path to the Mesh portal in FIPS mode over 802.11 and an IPSec tunnel via the Mesh Portal to the controller.

In addition, the module also supports a non-FIPS mode – an un-provisioned AP, which by default does not serve any wireless clients. The Crypto Officer must first enable and then provision the AP into a FIPS AP mode of operation. Only firmware updates signed with SHA-256/RSA 2048 are permitted. The user is responsible for zeroizing all CSPs when switching modes.

The instructions for provisioning the APs are in the User Guide which is provided in Section 8.2 below. An important point in the Aruba APs is that to change configurations from any one mode to any other mode requires the module to be re-provisioned and rebooted before any new configured mode can be enabled.

The access point is managed by an Aruba Mobility Controller in FIPS mode, and access to the Mobility Controller's administrative interface via a non-networked general purpose computer is required to assist in placing the module in FIPS mode. The controller used to provision the AP is referred to as the "staging controller". The staging controller must be provisioned with the appropriate firmware image for the module, which has been validated to FIPS 140-2, prior to initiating AP provisioning. Additionally, if a Mobility Master Appliance is deployed in the environment, provisioning of the APs can be performed by passing policies down from the Mobility Master to the Mobility Controller which then provisions the AP. The Crypto Officer shall perform the following steps to ensure the APs are placed in the secure operational state:

1. Apply TELs according to the directions in section 3.2.
2. Enable FIPS mode on the staging controller: Log into the staging controller via SSH and enter the following commands: "configure terminal", "fips enable", "write memory", "reload" "y".
3. Connect the module via an Ethernet cable to the staging controller; note that this should be a direct connection, with no intervening network or devices; if PoE is being supplied by an injector, this represents the only exception. That is, nothing other than a PoE injector should be present between the module and the staging controller.
4. Provision the AP into one of the 4 modes listed above, as indicated in the ArubaOS User Guide (see section 8.2 for link).
5. Via the logging facility of the staging controller, ensure that the module (the AP) is successfully provisioned with firmware and configuration.

6. Terminate the administrative session.
7. Disconnect the module from the staging controller, and install it on the deployment network; when power is applied, the module will attempt to discover and connect to an Aruba Mobility Controller on the network

Once the AP has been provisioned, it is considered to be in FIPS mode provided that the guidelines on services, algorithms, physical security and key management found in this Security Policy are followed.

8.1 Verify that the module is in FIPS mode

When connecting the AP to the controller for initial configuration, the Mobility Controller will provide the AP with a FIPS firmware image for use. While running this image, the AP will be compliant with FIPS requirements. To verify that the image is being run, the CO can enter 'show ap image' on the controller to verify the correct image is present on the device. Additionally, the CO can enter 'fips enable' if connecting to a non-FIPS enabled Controller to ensure the Access Point only accepts FIPS approved cryptography.

8.2 Full Documentation

Full documentation can be found at the link provided below.

https://support.arubanetworks.com/Documentation/tabid/77/DMXModule/512/Default.aspx?EntryId=34189

8.3 Disallowed FIPS Mode Configurations

When you enable FIPS mode, the following configuration options are forcibly disallowed:

- All WEP features
- WPA
- TKIP mixed mode
- Any combination of DES, MD5, and PPTP

When you enable FIPS mode, the following configuration options are disallowed by policy:

- USB CSR-Key Storage
- Telnet
- Firmware images signed with SHA- 1
- Enhanced PAPI Security
- Null Encryption
- EAP-TLS Termination
- IPSec/IKE using Triple-DES