HP A-Series Routers with VPN Firewall Module

FIPS 140-2 Non-Proprietary Security Policy

Level 2 Validation

Version 1.01

March 2012

Table of Contents

FIPS 140-2 Non-Proprietary Security Policy for the HP A-Series Routers

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

List of abbreviations:

Abbreviation	Full spelling
AAA	Authentication, Authorization, and Accounting
AES	Advanced Encryption Standard
CE1	Channelized E1
CE3	Channelized E3
CF	Compact Flash
CLI	Command Line Interface
CMVP	Cryptographic Module Validation Program
CPOS	Channelized Packet Over SONET/SDH
CSP	Critical Security Parameter
CT1	Channelized T1
DES	Data Encryption Standard
DOA	Dead on arrival
FCoE	Fibre Channel over Ethernet
FE1	Fractional E1
FIP	Flexible Interface Platform
FIPS	Federal Information Processing Standard
FT1	Fractional T1
HIM	High-speed Interface Module
HMAC	Hash-based Message Authentication Code
HTTP	Hyper Text Transfer Protocol
IKE	Internet Key Exchange
IPsec	Internet Protocol Security
IRF	Intelligent Resilient Framework
KAT	Known Answer Test
LED	Light Emitting Diode
LPU	Line Processing Unit
MAC	Message Authentication Code

Abbreviation	Full spelling
MAN	Metropolitan Area Network
Mbps	Megabits per second
MIM	Multifunctional Interface Module
MPLS	Multiprotocol Label Switching
MPU	Main Processing Unit
NAT	Network Address Translation
NIST	National Institute of Standards and Technology
NP	Network Processor
OAA	Open Application Architecture
OAP	Open Application Platform
OC	Optical Carrier
OSPF	Open Shortest Path First
PSU	Power Supply Unit
QoS	Quality of Service
RADIUS	Remote Authentication Dial In User Service
RAM	Random Access Memory
RSA	Rivest Shamir and Adleman method for asymmetric encryption
SDH	Synchronous Digital Hierarchy
SFP	Small Form-Factor Pluggable
SFP+	Enhanced Small Form-Factor Pluggable
SHA	Secure Hash Algorithm
SMB	SubMinature version B
SONET	Synchronous Optical Networking
SRPU	Switching and routing processor unit
SSL	Secure Sockets Layer
STM	Synchronous Transport Module
TLS	Transport Layer Security
VPLS	Virtual Private LAN Service
XFP	10 Gigabit Small Form-Factor Pluggable

1 Introduction

This document is a non-proprietary Cryptographic Module Security Policy for HP A-series Routers with VPN Firewall Module (6600 and 8800 series). The policy describes how the HP A-series routers meet the requirements of FIPS 140-2. This document also describes how to configure HP A-series routers in FIPS 140-2 mode. This document was prepared as part of the Level 2 FIPS 140-2 validation.

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

This document includes the following sections:

- Overview
- Security Appliance Validation Level
- Physical Characteristics and Security Appliance Interfaces
- Roles, Services and Authentication
- FIPS Approved Algorithms
- Non-FIPS Approved Algorithms
- Cryptographic Key Management
- Self-Tests
- Delivery and Operation
- Physical Security Mechanism
- Mitigation of Other Attacks
- Obtaining Documentation and Technical Assistance

2 Overview

The HP A-series provides devices are suitable for a range of uses: in IP backbone networks, IP metropolitan area networks (MANs), or the core or convergence layers of large IP networks. The A-series routers provide a flexible, modular form factor.

2.1 HP 6600 Router Series

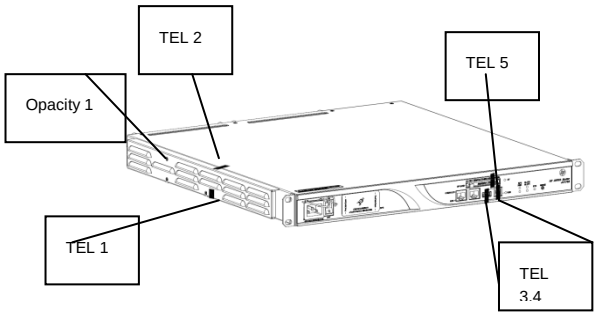
As the first service convergence routers based on a multi-core processor, the HP 6600 router series dramatically enhance service processing capacity. Distributed processing architecture, isolated routing, and service engines, as well as isolated control and service panels, provide higher reliability and continual services. Different software service engines can handle different services such as network address translation (NAT), quality of service (QoS), IPsec, and NetStream, with no further cost from additional hardware service modules. 6600 routers feature a modular design and an embedded hardware encryption capacity, as well as flexible deployment configurations, including High-speed Interface Modules (HIMs), Multi-function Interface Modules (MIMs), and Open Application Architecture (OAA)-enabled modules that

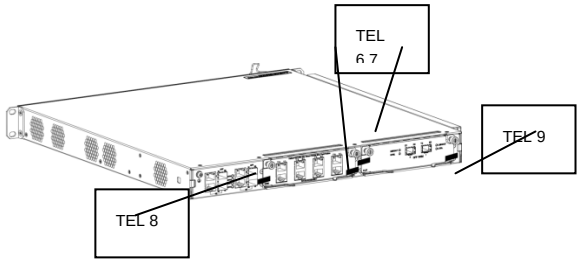
provide network customization and investment protection. These routers provide carrier-class reliability from network, device, link, and service layers.

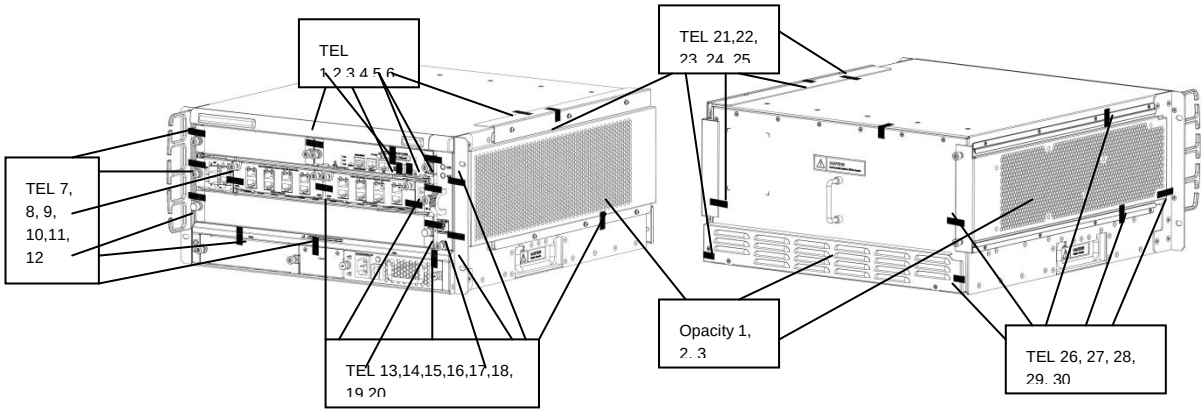
Testing included three models in the 6600 series:

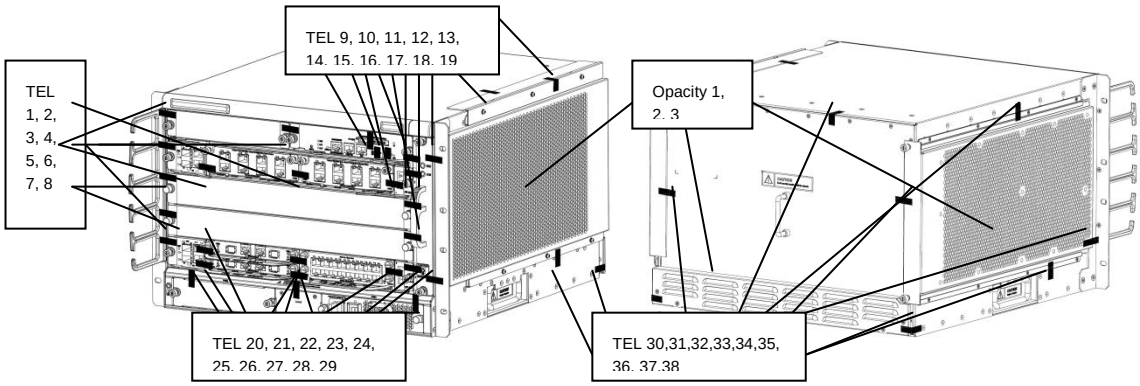
- HP 6604 Router Chassis
- HP 6608 Router Chassis
- HP 6616 Router Chassis

Figure 1 shows representatives of the series. This series requires 9 Tamper-evident labels and 1 opacity shield, 38 tamper-evident labels and 3 opacity shields, and 38 tamper-evident labels and 2 opacity shields as configured and shown in Figure 1.









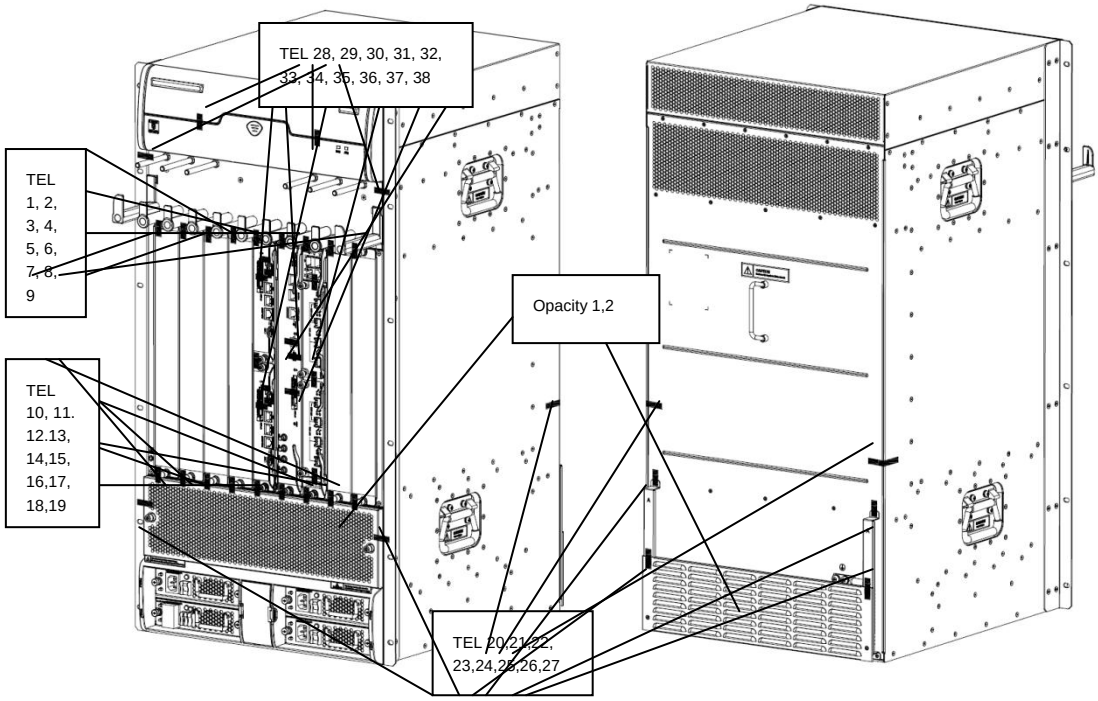


Figure 1 HP 6600 Router Series Representative View

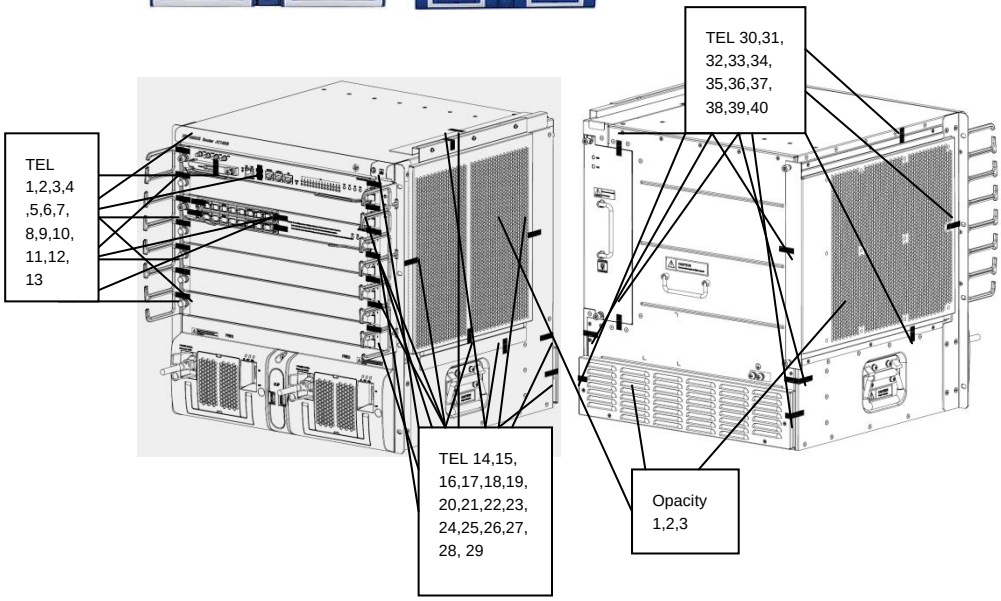
2.2 **HP 8800 Router Series**

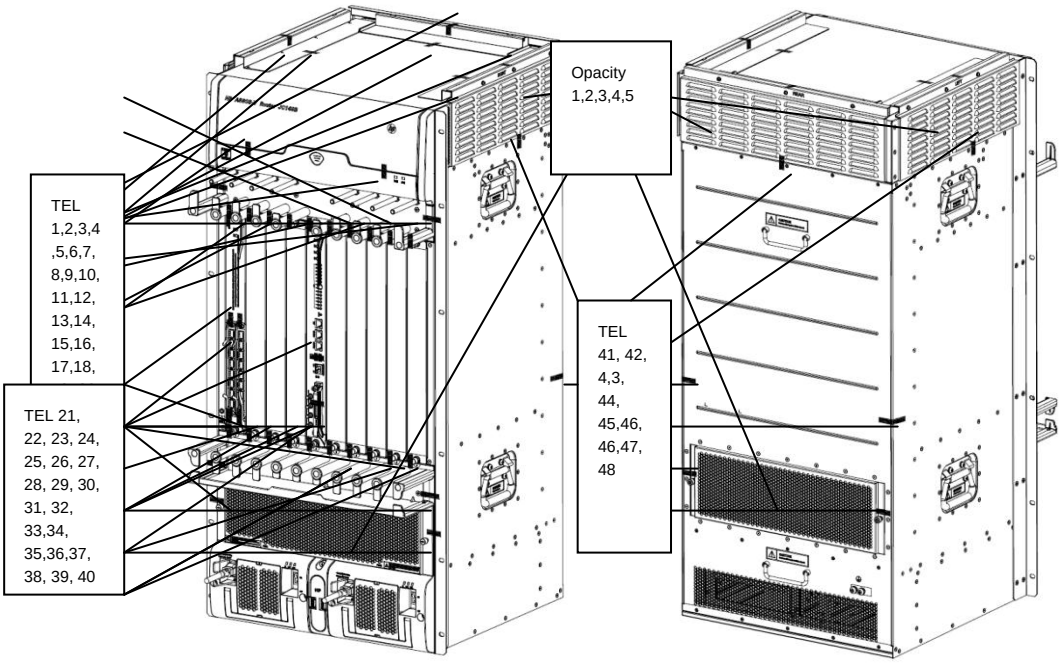
The HP 8800 router series feature a distributed high-performance network processor (NP) as well as high-capacity crossbar non-blocking switching technology that delivers robust network processing performance and flexibility. A distributed QoS control unit provides end-to-end service, as well as core services at a fine granularity. Furthermore, the routers' distributed operation, administration, and maintenance detection engines implement fault detection within 30 ms to provide uninterrupted core services. These innovative technologies, paired with the QoS control mechanism, provide smooth operation of multiple users and multiple services. The 8800 routers are commonly deployed in IP backbone networks, IP MANs, or the core or convergence layers of large IP networks. Offering high forwarding performance and abundant services, 8800 series routers can capably fulfill user needs in a range of networking scenarios.

Testing included three models in the HP 8800 series:

- HP 8805 Router Chassis
- HP 8808 Router Chassis
- HP 8812 Router Chassis

Figure 2 shows representatives of the series. This series requires 40 Tamper-evident labels and 3 opacity shields, 48 tamper-evident labels and 5 opacity shields, and 52 tamper-evident labels and 3 opacity shields as configured and shown in Figure 2





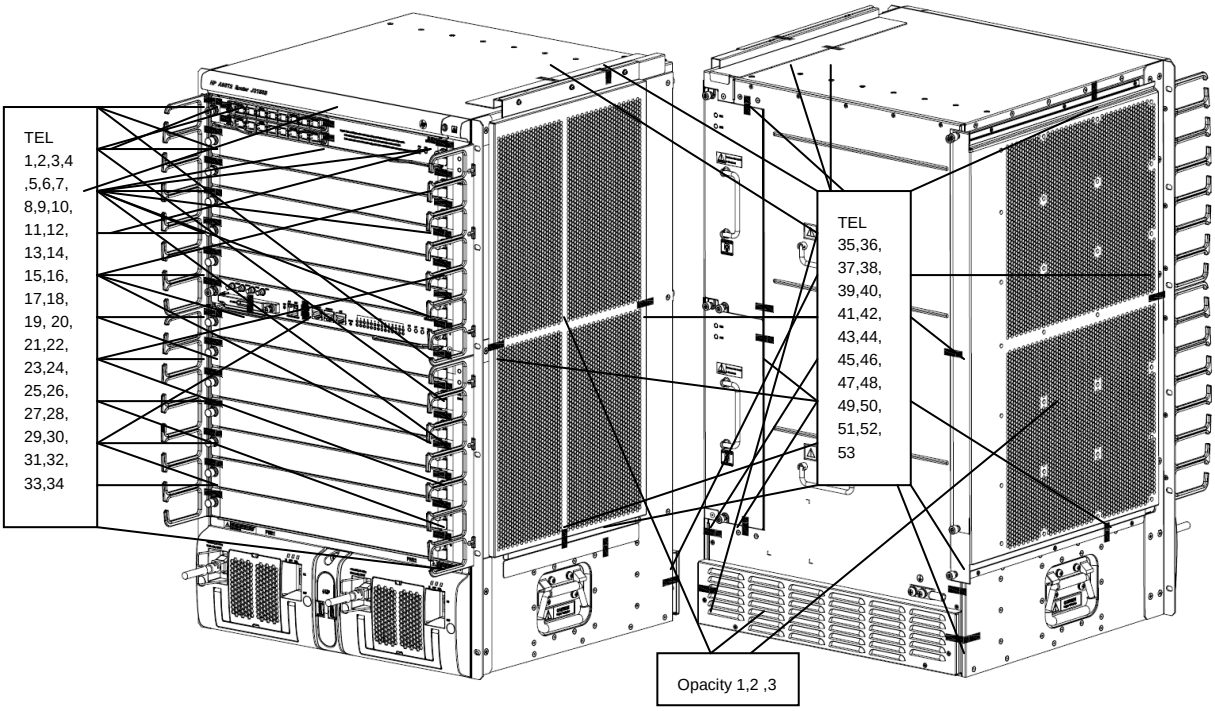


Figure 2 HP 8800 Router Series Representative View

3 Security Appliance Validation Level

Table 1 lists the level of validation for each area in the FIPS PUB 140-2.

Table 1 Validation Level by Section

No.	Area	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	Electromagnetic Interface/Electromagnetic Compatibility	2
9	Self-Tests	2

10	Design Assurance	2
11	Mitigation of Other Attacks	N/A

4 Physical Characteristics and Security Appliance Interfaces

Each HP A-series router is a multi-chip standalone security appliance. The cryptographic boundary is defined as encompassing the “top,” “front,” “left,” “right,” “rear” and “bottom” surfaces of the integrated chassis. The general components of each router include firmware and hardware which are placed in the three-dimensional space within the chassis.

The HP A-series routers use a distributed architecture, which comprises the chassis, power module, fan, backplane, main processing units (MPUs), and line processing units (LPUs). An MPU calculates routes, manages the forwarding information base, supervises and controls the system, and provides precise system clock and real-time clock function. LPU either provide network interfaces directly or host interface modules that provide network interfaces.

4.1 HP 6600 Router Series Interfaces

HP 6600 routers support two types of interface modules: HIMs and MIMs. A HIM provide high speed service processing while a MIM provides high-density narrowband aggregation. HP offers HIMs providing a variety of ports:

- 10/100 Mpbs Ethernet (8 ports),
- Gigabit Ethernet (4 and 8 ports),
- SFP Gigabit (4 and 8 ports),
- XFP 10-Gigabit (1 port),
- OC-3/STM-1 CPOS E1/T1 (1 and 2 ports),
- OC-3/STM-1 CPOS E3/T3 (1 and 2 ports),
- OC-3/STM-1 and OC-12/STM-4 POS (2 and 4 ports),
- OC-48/STM-16 CPOS or POS (1 port),
- OC-3/STM-1 ATM (1 and 2 ports),
- CO-48/STM-16 RPR (2 RPR interfaces with 2 Mate interfaces)

MIMs provide:

- POS (1 port)
- Gigabit Ethernet (1 ports)
- E1/CE1/FE1 (8 ports (DB-68 connector with BNC splitter cable))
- CT1/FT1 (8 ports (DB-68 connector with RJ-45 splitter cable))
- E3/CE3 (1 port (2 SMB interfaces for Tx/Rx))
- T3/CT3 (1 port (2 SMB interfaces for Tx/Rx))
- OC-3/STM-1 ATM (1 port)
- Serial (2, 4, and 8 ports (DB-28 interfaces supporting V.24, V.35, RS-449, X.21, and RS-

530)

Each HIM and each MIM has LEDs for port status.

The HP 6604, 6608, and 6616 have a distributed architecture. HIMs and MIMs are mounted in flexible interface platform (FIP) modules, which are in turn mounted in a router to support different network services. The routers support FIP-110 and FIP-210 modules. A FIP-110 has four slots for MIMs. A FIP-210 has two slots for either HIMs or MIMs. Each FIP also has two combination ports (Gigabit Ethernet / SPF Gigabit) with status LEDs. The 6604, 6608, and 6616 routers have, respectively, two, four, and eight service module slots that can each accommodate a FIP module. One service module slot may be used for an MPU in place of a FIP module.

The HP 6600 routers support service aggregation platform (SAP) modules. A SAP module provides network ports for receiving packets from the network and sending packets to the network. HP 6600 routers support two types of SAP modules, one type with 48 Gigabit Ethernet ports and the other type with 24 SFP Gigabit port. Both models can be routed or switched. Each SAP module has status LEDs for each port as well as for the SAP module itself. An HP 6600 Router service module slot can accommodate a SAP module.

The HP 6600 routers with distributed architecture each require at least one MPU. There are two types of MPU: RPE-X1 and RSE-X1. The MPUs have similar interfaces: reset button, Gigabit Ethernet management port, serial console port, auxiliary serial port, two USB ports (type A and B), and a CF card slot with CF card button. They have LEDs for run, system alarm, active/standby, management port, USB, and CF card status. RSE-X1 has an additional power status LED. The MPU differ in form factor. RPE-X1 is a half-slot wide while RSE-X1 is a full slot wide. Each model supports up to two MPU. Each router has a slot dedicated for an MPU, which can accommodate two RPE-X1 MPU. One service slot may be used for an MPU to accommodate two RSE-X1 MPUs.

4.2 **HP 8800 Router Series Interfaces**

HP 8805, 8808, and 8812 have slots for five, eight, and 12 LPUs, respectively. HP 8800 routers support two types of LPUs. One type has a fixed set of ports and the other type hosts interface daughter cards. Fixed-port LPUs provide:

- Gigabit Ethernet (48 ports),
- SFP Gigabit (48 ports),
- XFP 10-Gigabit (2 and 4 ports),
- Gigabit Ethernet and SPF Gigabit (24 ports (16 Gigabit Ethernet ports and 8 combination))

HP offers four LPU that support interface daughter cards. SPE-1010-II and SPE-1010-E-II each support one interface daughter card. SPE-1020-II and SPE-1020-E-II each support two interface daughter cards. Interface daughter cards provide:

- Gigabit Ethernet (20 ports),
- SFP Gigabit (10 and 20 ports),
- XFP 10-Gigabit (1 port),
- OC-48c/STM-16c RPR SFP (2 ports),
- OC-192c/STM-64c RPR XFP (1 port),
- OC-3c/OC-12c POS SFP (8 ports),

- OC-48c/STM-16c POS SFP (4 ports),
- OC-192c/STM-64c POS XFP (1 port),
- OC-3c ATM SFP (4 ports),
- OC-12c ATM SFP (1 port),
- OC-3c/STM-1c POS SFP (2 ports) and SFP Gigabit (6 ports),
- OC-12c/STM-4c POS SFP (2 ports) and SFP Gigabit (6 ports),
- OC-48c/STM-16c POS SFP (2 ports) and SFP Gigabit (4 ports),
- OC-3/STM-1 CPOS E1/T1 SFP (1 and 2 ports) and SFP Gigabit (8 ports),
- CE1/CT1 (8 ports) and SFP Gigabit (8 ports),
- OC-3 E3/T3 (4 ports) and SFP Gigabit (4 ports),
- OC-12 E3/T3 (1 port) and SFP Gigabit (4 ports),
- CE1/TE1 (32 ports (2 DB-28 connectors) and SFP Gigabit (2 ports),

HP 8805, 8808, and 8812 each have two slots for MPUs. The routers support SR02SRP1F3 and SR02SRP2F3 MPU. The MPUs present the same interfaces: SMB coaxial clock interfaces, reset button, USB (type A and B), console serial port, auxiliary serial port, RS-232/485[1], Gigabit Ethernet management port, and CF card slot. They have LEDs for LPU, MPU, USB, and CF card status.

Each HP 8800 router can accommodate two power supply units. HP has power supply units for both AC and DC power. Each power supply unit has a power switch and status LEDs.

4.3 **Physical Interfaces Mapping**

The physical interfaces provided by the HP A-series routers map to four FIPS 140-2 defined logical interface: data input, data output, control input and status output. Table 1 presents the mapping.

Table 1 Correspondence between Physical and Logical Interfaces

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

[1] The RS-232/485 interfaces is reserved and not supported at present.

Physical Interface	FIPS 140-2 Logical Interface
AUX port	
SMB coaxial clock interfaces	
RS-232/485 interfaces	

5 Roles, Services, and Authentication

5.1 Roles

The HP A-series routers provide management and VPN roles. There are four management roles: Visit, Monitor, Config, and Manage. Roles Visit, Monitor, and Config correspond to the FIPS 140-2 User Role. The Manage role corresponds to the FIPS 140-2 Crypto Officer role. The devices allow multiple management users to operate the appliance simultaneously.

The HP A-series routers do not employ a maintenance interface and do not have a maintenance role.

5.2 Services

The HP A-series routers provide Internet Protocol Security (IPsec) service with Internet Key Exchange (IKE). An HP A-series router can apply the IPsec service to protect network data and to protect communication between itself and Authentication, Authorization, and Accounting (AAA) servers. The service is applied at the protocol level, and consequently, IPsec is not associated with a role. IPsec with IKE supports:

- Multiprotocol Label Switching (MPLS) Layer 3 VPN,
- MPLS Layer 2 VPN,
- Virtual Private LAN Service (VPLS),
- Multicast Domain multicast VPN,
- Open Shortest Path First (OSPF) Multi-VPN Instance Customer Edge,
- Dynamic Virtual Private Network, and
- Embedded VPN firewall.

The IPsec service is limited to the following protocol / algorithm combinations in FIPS mode of operation:

- ah
- esp

HP A-series routers provide six classes of management services:

- View device status,
- Network functions,
- Security management,
- Review the audit trail,
- View running status, and
- Configure the security appliance.

You can access these management services by using any of the following methods:

- Console Port
- SSH
- Web user interface via HTTPS

The console port and SSH present a command line interface while the web user interface is a graphical user interface. The following table lists services available to each role within each class of service. The role in the brackets is the corresponding role specified in FIPS 140-2. HP A-series routers do not support bypass (that is, services provided without cryptographic processing).

Table 2 Services by Role

Role	Privilege level	Services
Visit [User role]	0	1) View device status: Currently running image version; Installed hardware components status and version. 2) Network functions: Network diagnostic service such as “ping”; Network connection service such as “SSH” client. 3) Security management: Change the privilege level.
Monitor [User role]	1	1) View device status: Currently running image version; Installed hardware components status and version 2) Network functions: Network diagnostic service such as “ping”; Network connection service such as “SSH” client. 3) Security management: Change the privilege level. 4) Review the audit trail;
Config [User role]	2	1) View device status: Currently running image version; Installed hardware components status and version 2) Network functions: Network diagnostic service such as “ping”; Network connection service such as “SSH” client. 3) Security management: Change the privilege level; Reset and change the password of same/lower privilege user; Maintenance of the super password; Maintenance (create, destroy, import, export) of

Role	Privilege level	Services
		public key/private key/shared key. 4) Review the audit trail 5) View running status: Memory status, Packet statistics, Interface status, Current running Image version, Current configuration, Routing table, Active sessions, Temperature, SNMP MIB statistics. 6) Configure the security appliance: Save configuration; Management of information center (start-up and shut down audit functions; setting logbuffer, setting logfile; setting log output destination); Managing (create, modify, delete apply) the filtering rules; Management of firewall; Define network interfaces and settings; Set the protocols the security appliance will support; enable interfaces and network services.
Manage [Crypto Officer role]	3	1) View device status: Currently running image version; Installed hardware components status and version 2) Network functions: Network diagnostic service such as “ping”; Network connection service such as “SSH” client. 3) Security management: Change the privilege level; Reset and change the password of same/lower privilege user; Maintenance of the super password; Maintenance (create, destroy, import, export) of public key/private key/shared key; Shut down or Reboot the security appliance;

Role	Privilege level	Services
		Management (create, delete, modify) of the user group; Management (create, delete, modify) of the user account; Management of the time; Maintenance (delete, modify) system start-up parameters; File operation (e.g. dir, copy, del); Management of the command privilege; Install or remove HP A-series Security Appliance. 4) Review the audit trail; 5) View running status: Memory status, Packet statistics, Interface status, Current running image version, Current configuration, Routing table, Active sessions, Temperature, SNMP MIB statistics. 6) Configure the security appliance: Save configuration; Management of information center (start-up and shut down audit functions; setting logbuffer, setting logfile; setting log output destination delete of the audit trail.); Managing (create, modify, delete apply) the filtering rules; Management of firewall; Define network interfaces and settings; Set the protocols the security appliance will support (e.g. SFTP server, SSH server); enable interfaces and network services; Management of access control scheme (e.g. domain and RADIUS scheme).

The “Fundamentals Configuration Guide” chapter of each product’s configuration document provides details of the commands that provide the services listed in Table 2. The “Fundamentals Configuration Guide” presents the corresponding web user interface.

5.3 **Authentication Mechanisms**

HP A-Series Routers support both role-based and identity-based authentication.

- Identity-based authentication

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

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

- Role-based authentication

  Each User can switch to a different user privilege level without logging out and terminating the current connection. To switch to a different privilege level, a user must provide the privilege level switching authentication information. The authentication is role-based. All users can be authenticated locally, and optionally supports authentication via a RADIUS and TACACS+ server.

  After the privilege level switching, users can continue to manage the device without relogging in, but the commands they can execute have changed. For example, with the user privilege level 3, a user can configure system parameters as crypto officer role. After switching to user privilege level 0, the user can execute only basic commands like ping and tracert and use a few display commands as user role.

  Operators must be authenticated using user names and passwords. The passwords must:

1) Be a minimum of six characters long, and the maximum password size is 63.
2) Be a combination of alphabetic and numeric characters.
3) Contain punctuation characters.
4) Contain lower and upper case characters.

   The probability of a false positive for a random password guess is less than 1 in 1,000,000. This is also valid for RADIUS or TACACS+ shared secret keys

   The users who try to log in or switch to a different user privilege level can be authenticated by RADIUS and TACACS+ Server. The device (RADIUS client) and the RADIUS server use a shared key to authenticate RADIUS packets and encrypt user

passwords exchanged between them. For more details, see RFC 2865: 3 Packet Format Authenticator field and 5.2 User-password

6 Approved Cryptographic Algorithms

Table 3 lists the FIPS-Approved algorithms HP A-series routers provide.

Table 3 FIPS-Approved Cryptography Algorithms

Algorithm	Application	Certificate
AES	Encryption/decryption	1927
Triple-DES	Encryption/decryption	1254
SHA	SHA hashing	1692
HMAC SHA	HMAC SHA for hashed message authentication	1161
RSA	Signing and verifying	993
DSA	Signing and verifying	611
X9.31 for RNG	Random number generation	1014

7 Non-approved Cryptographic Algorithms

HP A-series routers provide additional cryptographic algorithms that are not FIPS Approved:

- DES
- RC4
- MD5
- MD5 HMAC
- RSA (key wrapping; key establishment methodology provides 80 or 112 bits of encryption strength)
- Diffie-Hellman (key agreement; key establishment methodology provides 80 or 112 bits of encryption strength)

8 Cryptographic Key Management

The security appliances use a variety of Critical Security Parameters (CSP) during operation. Table 4 lists the CSP including cryptographic keys used by the HP A-series security routers. It summarizes generation, storage, and zeroization methods for the CSP.

Table 4 Cryptographic Security Parameters

#	Key/ CSP Name	Generation/ Algorithm	Description	Storage	Zeroization
CSP1	RSA public/private keys	ANSI X9.31/RSA	Identity certificates for the security appliance itself and also used in IPSec, TLS, and SSH negotiations. The security appliance supports 1024 ~ 2048 bit key sizes.	Private Key-FLASH (cipher text/Triple-DES) and RAM (plain text) Public Key-FLASH(cipher text/Triple-DES)and RAM (plain text)	Private Key-Using CLI command to zeroize, then reboot. Public Key - Using CLI command to zeroize, then reboot.
CSP2	DSA public/private keys	ANSI X9.31/DSA	Identity certificates for the security appliance itself and also used in SSH negotiations.	Private Key-FLASH (cipher text/ Triple-DES) and RAM (plain text) Public Key-FLASH(cipher text/ Triple-DES and RAM (plain text)	Private Key-Using CLI command to zeroize, then reboot. Public Key - Using CLI command to zeroize, then reboot.
CSP3	Diffie-Hellman Key Pairs	ANSI X9.31 / DH	Key agreement for IKE, TLS, and SSH sessions.	RAM (plain text)	Resetting or rebooting the security appliance.
CSP4	Public keys	DSA / RSA	Public keys of peers	FLASH(plain text)/RAM (plain text)	Delete public keys of peers from configuration, write to startup config, then reboot
CSP5	TLS Traffic Keys	Generated using the TLS protocol (X9.31PRNG + HMAC-SHA1 + either DH or RSA) Algorithm: Also Triple-DES & AES	Used in HTTPS connections	RAM (plain text)	Resetting or rebooting the security appliance.
CSP6	SSH Session Keys	ANSI X9.31 / Triple-DES-AES	SSH keys	RAM (plain text)	Resetting or rebooting the security appliance

#	Key/ CSP Name	Generation/ Algorithm	Description	Storage	Zeroization
CSP7	IPSec authentication keys	ANSI X9.31 / Triple-DES-AES / DH	Exchanged using the IKE protocol and the public/ private key pairs. These are Triple-DES or AES keys.	RAM (plain text)	Resetting or rebooting the se curity appliance
CSP8	IPSec traffic keys	ANSI X9.31 / Triple-DES-AES / DH	Exchanged using the IKE protocol and the public/ private key pairs. These are Triple-DES or AES keys.	RAM (plain text)	Resetting or rebooting the security appliance
CSP9	IPSec authentication keys	Triple-DES-AES	Triple-DES or AES Keys are manually configured for IPv6 routing protocol such as OSPFv3, RIPng, IPv6 BGP.	FLASH(plain text)/RAM (plain text)	Delete IPsec keys from configuration, write to startup config, then reboot
CSP10	IPSec traffic keys	Triple-DES-AES	Triple-DES or AES Keys are manually configured for IPv6 routing protocol such as OSPFv3, RIPng, IPv6 BGP.	FLASH(plain text)/RAM (plain text)	Delete IPsec keys from configuration, write to startup config, then reboot
CSP11	IKE pre-shared keys	Shared Secret	Entered by the Crypto-Officer in plain text form and used for authentication during IKE	FLASH(plain text) and RAM (plain text)	Deleting keys from the configuration via erase flash: command (or replacing), write to startup config, then reboot.
CSP12	IKE Authentication key	Generated using IKE (X9.31+HMAC-SHA1+DH). Algorithms: Triple-DES, AES, SHA-1	Used to encrypt and authenticate IKE negotiations	RAM (plain text)	Resetting or rebooting the security appliance
CSP13	IKE Encryption Key	Generated using IKE (X9.31+HMAC-SHA1+DH). Algorithms: Triple-DES, AES, SHA-1	Used to encrypt IKE negotiations	RAM (plain text)	Resetting or rebooting the security appliance
CSP14	RADIUS shared secret keys	Shared Secret	Used for authenticating the RADIUS server to the security appliance and vice versa. Entered by the Crypto-Officer in plain text form and stored in plain text form.	FLASH (plain text) and RAM (plain text)	Deleting keys from the configuration via erase flash: command (or replacing), write to startup config, then reboot.

#	Key/ CSP Name	Generation/ Algorithm	Description	Storage	Zeroization
CSP15	Usernames/ Passwords/ super password	Secret	Critical security parameters used to authenticate the administrator login or privilege promoting.	FLASH (plain text) and RAM (plain text)	Overwriting the passwords with new ones, write to startup config, then reboot.
CSP16	Certificates of Certificate Authorities (CAs)	ANSI X9.31	Necessary to verify certificates issued by the CA. Install the CA's certificate prior to installing subordinate certificates.	FLASH (plain text) and RAM (plain text)	1. Delete PKI domain from configuration via erase flash: command, write to startup config, then reboot. 2. Use “pki delete-certificate”CLI command to delete certificates, then reboot
CSP17	PRNG Seed Key	Entropy	Seed key for X9.31 PRNG	RAM (plain text)	Zeroized with generation of new seed

8.1 **Access Control Policy**

Table 5, Table 6, and Table 7 list by role services accessing CSPs. Each table identifies the services that access each CSP along with the type of access allowed for the role(s). The types of access are: read (r), write (w), and delete (d).

Table 5 CSP Access by Service for Visit and Monitor Roles

Service Access /CSP	View device status	Network functions	Security management
CSP1	r	r	r
CSP2	r	r	r
CSP3	r	r	r
CSP4	r	r	r
CSP5	r	r	r
CSP6	r	r	r
CSP7	r	r	r
CSP8	r	r	r
CSP9	r	r	r
CSP10	r	r	r
CSP11	r	r	r
CSP12	r	r	r

Service Access /CSP	View device status	Network functions	Security management
CSP13	r	r	r
CSP14	r	r	r
CSP14	r	r	r
CSP16	r	r	r
CSP17	r	r	r

r = read, w = write, d = delete

Table 6 Access by Service for Config Role

Service Access /CSP	View device status	Network functions	Security management	Review the audit trail	View running status	Configure the security appliance
CSP1	r	r	rwd	r	r	r
CSP2	r	r	rwd	r	r	r
CSP3	r	r	rwd	r	r	r
CSP4	r	r	rwd	r	r	r
CSP5	r	r	rwd	r	r	r
CSP6	r	r	rwd	r	r	r
CSP7	r	r	rwd	r	r	r
CSP8	r	r	rwd	r	r	r
CSP9	r	r	rwd	r	r	r
CSP10	r	r	rwd	r	r	r
CSP11	r	r	rwd	r	r	r
CSP12	r	r	rwd	r	r	r
CSP13	r	r	rwd	r	r	r
CSP14	r	r	r	r	r	r
CSP15	r	r	rwd	r	r	r
CSP16	r	r	rwd	r	r	r
CSP17	r	r	rwd	r	r	r

Table 7 Access by Service for Manage Role

Service Access /CSP	View device status	Network functions	Security management	Review the audit trail	View running status	Configure the security appliance
CSP1	r	r	rwd	r	r	r
CSP2	r	r	rwd	r	r	r
CSP3	r	r	rwd	r	r	r
CSP4	r	r	rwd	r	r	r
CSP5	r	r	rwd	r	r	r
CSP6	r	r	rwd	r	r	r
CSP7	r	r	rwd	r	r	r
CSP8	r	r	rwd	r	r	r
CSP9	r	r	rwd	r	r	r
CSP10	r	r	rwd	r	r	r
CSP11	r	r	rwd	r	r	r
CSP12	r	r	rwd	r	r	r
CSP13	r	r	rwd	r	r	r
CSP14	r	r	rwd	r	r	r
CSP15	r	r	rwd	r	r	r
CSP16	r	r	rwd	r	r	r
CSP17	r	r	rwd	r	r	r

9 Self-Tests

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

9.1 Power-On Self-Tests

The routers perform all power-on self-tests automatically at boot when FIPS mode is enabled. All power-on self-tests must be passed before any role can perform services. The power-on

self-tests are performed prior to the initialization of the forwarding function, which prevents the security appliance from passing any data during a power-on self-test failure.

Table 8 HP A-series Switch Power-On Self-Tests

Implementation	Tests Performed
Security Appliance Software	Software/firmware Test
	DSA KAT (signature/verification)
	RSA KAT (signature/verification)
	RSA KAT (encrypt/decrypt)
	AES KAT
	Triple-DES KAT
	SHA-1 KAT
	HMAC SHA-1 KAT
	PRNG KAT
Security Appliance crypto engine	DSA KAT (signature/verification)
	RSA KAT (signature/verification)
	RSA KAT (encrypt/decrypt)
	AES KAT
	Triple-DES KAT
	SHA-1 KAT
	HMAC SHA-1 KAT
	PRNG KAT

9.2 **Conditional Self-Tests**

Table 9 lists the conditional self-tests implemented by the routers. Conditional self tests run when a router generates a DSA or RSA key pair and when it generates a random number.

Table 9 HP A-series Switch Conditional Self-Tests

Implementation	Tests Performed
Security Appliance Software	Pairwise consistency test for RSA
	Pairwise consistency test for DSA
	Continuous Random Number Generator Test for the FIPS-approved RNG (X9.31)

10 Delivery and Operation

10.1 **Secure Delivery**

To ensure no one has tampered with the goods during delivery, inspect the A-series router physical package and check as follows:

- Outer Package Inspection

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

- Packing List Verification

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

- External Visual Inspection

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

- Confirm Software/firmware

1) Version verification

   To verify the software version, start the appliance, view the self test result during startup, and use the display version command to check that the software version is Comware software, Version 5.2, Release 1002(CC). 'FIPS1402&CC' indicate it is a FIPS 140-2 and CC certification version. If software loading failed or the version information is incorrect, please contact HP for support.

2) SHA-256 verification

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

- DOA (Dead on Arrival)

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

10.2 **Secure Operation**

The rules for securely operating an HP A-series router in FIPS mode are:

1) Install and connect the device according to the installation and configuration guides.
2) Start the device, and enter the configuration interface.
3) Check and configure the clock.
4) By default, the device does not run in FIPS mode. Enable the device to work in FIPS mode using the **fips mode enable** command in system view. This will allow the router to internally enforce FIPS-compliance behavior, such as run power-up self-test and conditional self-test.
5) Delete all MD5-based digital certificates.
6) Delete the DSA key pairs that have a modulus length of less than 1024 bits and all RSA key pairs.
7) Set up username/password for crypto officer role and user role. Each password must comprise no less than 6 characters and must contain uppercase and lowercase letters, digits, and special characters.
8) Save the configurations and re-start the device.
   The device works in FIPS mode after restarting:
9) Configure the security appliance to use SSHv2.
10) Configure the security appliance to use HTTPS for performing system management.

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

- The FTP/TFTP server is disabled.
- The Telnet server is disabled.
- The HTTP server is disabled.
- SNMP v1 and SNMP v2c are disabled. Only SNMP v3 is available.
- The SSL server only supports TLS1.0.
- The SSH server does not support SSHv1 clients
- Generated RSA/DSA key pairs have a modulus length from 1024 to 2048 bits.
- SSH, SNMPv3, IPsec and SSL do not support DES, RC4, or MD5.

11 Physical Security Mechanism

FIPS 140-2 Security Level 2 Physical Security requirements mandate that a cryptographic module have an opaque enclosure with tamper-evident seals for doors or removable covers. All A-series routers need both opacity shields and tamper-evident seals to meet the Physical Security requirements.

The security labels recommended for FIPS 140-2 compliance are provided in the FIPS Kits:

All units use the same label kits.

Label Kit – Description	**Label Kit - Part Number**
HP 12mm x 60mm Tamper-Evidence (30) Labels	JG585A
HP 12mm x 60mm Tamper-Evidence (100) Labels	JG586A

The opacity kit for each product model is below:

HP 6600 series

Unit	**Opacity Kit – Description**	**Opacity kit – Part Number**
HP 6602 Router Chassis	HP 6602 Router Opacity Shield Kit	JG575A
HP 6604 Router Chassis	HP 6604 Router Opacity Shield Kit	JG578A
HP 6608 Router Chassis	HP 6608 Router Opacity Shield Kit	JG577A
HP 6616 Router Chassis	HP 6616 Router Opacity Shield Kit	JG576A

HP 8800 series:

Unit	**Opacity Kit – Description**	**Opacity kit – Part Number**
HP 8805 Router Chassis	HP 8805 Opacity Shield Kit	JG570A
HP 8808 Router Chassis	HP 8808 Opacity Shield Kit	JG571A
HP 8812 Router Chassis	HP 8812 Opacity Shield Kit	JG572A

These security labels are very fragile and cannot be removed without clear signs of damage to the labels.

The tamper-evident seals and opacity shields shall be installed for the module to operate in a FIPS Approved mode of operation.

The Crypto Officer is responsible for properly placing all tamper evident labels on a router and is responsible for the securing and control of any unused seals and opacity shields. The Crypto Officer shall clean the module of any grease, dirt, or oil before applying the tamper-evident labels or opacity shields. The Crypto Officer is also responsible for the direct control and observation of any changes to the modules such as reconfigurations where the tamper-evident labels or opacity shields are removed or installed to ensure the security of the module is maintained during such changes and the module is returned to a FIPS approved state.

Each modular router is entirely encased by a thick steel chassis. Modular routers have MPU slots, LPU slots, fan trays, power supplies, and covers. Use the procedure described in the install guide to apply tamper evident labels and opacity shields to the router.

Any chassis slot that is not populated with a module must have a slot cover installed in order to operate in a FIPS compliant mode. The slot covers are included with each chassis, and additional slot covers may be ordered from HP.

The Crypto Officer should inspect the tamper evident labels periodically to verify they are intact and the serial numbers on the applied tamper evident labels match the records in the security log.

12 Mitigation of Other Attacks

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

13 Documentation References

13.1 Obtaining documentation

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

13.2 Technical support

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

The actual support website is:

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