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# **Hewlett Packard Enterprise 7900 Series, 7500 Series, 5700 Series, 5130 EI Series, 5130 HI Series and 5510 HI Series Switches Security Target**

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**Prepared for:**  
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## 1. Security Target Introduction

This section identifies the Security Target (ST) and Target of Evaluation (TOE) identification, ST conventions, ST conformance claims, and the ST organization. The TOE is Hewlett Packard Enterprise 7900, 7500, 5700, 5130 EI, 5130 HI and 5510 HI Series Switches provided by Hewlett Packard Enterprise. Each device in the TOE is a stand-alone gigabit Ethernet switch that implements network layers 2 and 3 switching, service and routing operations.

The focus of the evaluation is on the TOE functionality supporting the claims in the Protection Profile for Network Devices (NDPP). The only capabilities covered by the evaluation are those specified in the aforementioned Protection Profile, all other capabilities are not covered in the evaluation. The security functionality specified in NDPP, includes protection of communications with remote administrators and trusted IT entities, identification and authentication of administrators, auditing of security-relevant events, ability to verify the source and integrity of updates to the TOE, and specifies NIST-validated cryptographic mechanisms.

The Security Target contains the following additional sections:

- TOE Description (Section 2)
- Security Problem Definition (Section 3)
- Security Objectives (Section 4)
- IT Security Requirements (Section 5)
- TOE Summary Specification (Section 6)
- Protection Profile Claims (Section 7)
- Rationale (Section 8).

### 1.1 Security Target, TOE and CC Identification

**ST Title** – Hewlett Packard Enterprise 7900 Series, 7500 Series, 5700 Series, 5130 EI Series, 5130 HI Series and 5510 HI Series Switches Security Target.

**ST Version** – Version 1.0

**ST Date** February 16, 2016

**TOE Identification** – Hewlett Packard Enterprise 7900 Series running Comware V7.1.045 Release 2138P02, 7500 Series running Comware V7.1.045 Release 7170, 5700 Series Switches running Comware v7.1.045 Release 2423, 5130 EI Switch Series running Comware 7.1.045 Release 3109P16, 5130 HI Series Switches running Comware V7.1.045 Release 1116, and 5510 HI Series running Comware 7.1.045 Release 1118.

On November 1, 2015, Hewlett-Packard became two separate companies: Hewlett Packard Enterprise and HP Inc. The network products are part of the new Hewlett Packard Enterprise. The former HP network switches and routers are undergoing product rebranding. The rebranding is not complete in the documentation and on the websites. The TOE maybe referred to with the suffix “HP”, “HP FlexFabric”, “HPE” or “HPE FlexFabric”. For the purpose of this evaluation, these name variations are used interchangeably and refer to the same product.

Product Series	Specific Devices
HP 7900	HP FlexFabric 7904 Switch Chassis (JG682A) HP FlexFabric 7910 Switch Chassis (JG841A) with one or both of the following modules: <ul style="list-style-type: none"> <li>• HP FlexFabric 7910 – 7.2Tbps Fabric / Main Processing Unit (JG842A)</li> <li>• HP FlexFabric 7910 -- 2.4Tbps Fabric / Main Processing Unit (JH001A)</li> </ul>
HP 7500	HP 7502 Switch Chassis (JD242C) with Main Processing Unit (JH208A) HP 7503 Switch Chassis (JD240C) with Main Processing Unit (JH207A or JH209A) HP 7506 Switch Chassis (JD239C) with Main Processing Unit (JH207A or JH209A)

Product Series	Specific Devices
	HP 7510 Switch Chassis (JD238C) with Main Processing Unit (JH207A or JH209A)
HP 5700	HP FlexFabric 5700-40XG-2QSFP+Switch (JG896A) HP FlexFabric 5700-48G-4XG-2QSFP+Switch (JG894A) HP FlexFabric 5700-32XGT-8XG-2QSFP+ Switch (JG898A) HP FlexFabric 5700-40XG-2QSFP+TAA-Compliant Switch (JG697A) HP FlexFabric 5700-48G-4XG-2QSFP+TAA-Compliant Switch (JG895A) HP FlexFabric 5700-32XGT-8XG-2QSFP+TAA-Compliant Switch (JG899A)
HP 5130 EI	HP 5130-24G-4SFP+ EI Switch (JG932A) HP 5130-24G-SFP-4SFP+ EI Switch (JG933A) HP 5130-48G-4SFP+ EI Switch (JG934A) HP 5130-24G-PoE+-4SFP+ (370W) EI Switch (JG936A) HP 5130-48G-PoE+-4SFP+ (370W) EI Switch (JG937A) HP 5130-24G-4SFP+ EI TAA-compliant Switch ( JG942A) HP 5130-24G-SFP-4SFP+ EI TAA-compliant Switch (JG943A) HP 5130-48G-4SFP+ EI TAA-compliant Switch (JG944A) HP 5130-24G-PoE+-4SFP+ (370W) EI TAA-compliant Switch (JG946A) HP 5130-48G-PoE+-4SFP+ (370W) EI TAA-compliant Switch (JG947A)
HP 5130 HI	HP 5130-24G-4SFP+ HI Switch with 1 Slot (JH323A) HP 5130-48G-4SFP+ HI Switch with 1 Slot (JH324A) HP 5130-24G-PoE+-4SFP+ HI Switch with 1 Slot (JH325A) HP 5130-48G-PoE+-4SFP+ HI Switch with 1 Slot (JH326A)
HPE 5510 HI	HPE 5510 24G 4SFP+ HI 1-slot Switch (JH145A) HPE 5510 24G PoE+ 4SFP+ HI 1-slot Switch (JH147A) HPE 5510 24G SFP 4SFP+ HI 1-slot Switch (JH149A) HPE 5510 48G 4SFP+ HI 1-slot Switch (JH146A) HPE 5510 48G PoE+ 4SFP+ HI 1-slot Switch (JH148A)

**Table 1 TOE Series and Devices**

**TOE Developer** – Hewlett Packard Enterprise

**Evaluation Sponsor** – Hewlett Packard Enterprise

**CC Identification** – *Common Criteria for Information Technology Security Evaluation*, Version 3.1, Revision 3, July 2009

## 1.2 Conformance Claims

This TOE is conformant to the following CC specifications:

- This ST is conformant to the *Protection Profile for Network Devices*, Version 1.1, 8 June 2012, as amended by Errata #3 dated 3 November 2014, and including the following optional SFRs: FCS\_IPSEC\_EXT.1; FCS\_SSH\_EXT.1; and FIA\_PSK\_EXT.1. The following NIAP Technical Decisions apply to this PP and have been accounted for in the ST development and the conduct of the evaluation:
  - TD0004: FCS\_TLS\_EXT Man-in-the-Middle Test - This Technical Decision removes the FCS\_TLS\_EXT man-in-the-middle tests for the NDPP (FCS\_TLS\_EXT.1.1, Test 2),

pending development of new TLS requirements and assurance activities and identification of suitable test tools.

- TD0005: FPT\_ITT Test 3 Resolution - This Technical Decision removes the need to perform Test 3 associated with FPT\_ITT.1 in NDPP, consistent with the test requirements for FTP\_ITC.1 and FTP\_TRP.1.
  - TD0011: FCS\_SSH\_EXT.1.4 Clarification - The SFR requires that the SSH transport implementation use specific encryption algorithms. The TD clarifies that the restrictions must be implemented by the TOE and cannot be reliant upon configuration of the SSH client.
  - TD0012: FCS\_SSH\_EXT.1.4 - Algorithms not identified in FCS\_SSH\_EXT.1.4 must not be allowed; other cipher suites (such as 3DES-CBC) must be disabled in evaluated configurations. The Assurance Activities associated with this requirement must verify that connection attempts with algorithms not listed in FCS\_SSH\_EXT.1.4 are denied. The NDPP was updated via errata to reflect this decision.
  - TD0017: NDPP Audit Shutdown - This Technical Decision allows for the use of a startup audit record to indicate audit shutdown in the event of an uncontrolled shutdown.
  - TD0026: FPT\_TUD\_EXT.1 - This Technical Decision allows for the administrator following TOE guidance to reject an illegitimate update detected by the TOE, in addition to the TOE rejecting the update automatically (during testing).
  - TD0032: FCS\_SSH\_EXT.1.2 – The SFR was rewritten to conditionally require password-based authentication.
- Common Criteria for Information Technology Security Evaluation Part 2: Security functional components, Version 3.1, Revision 3, July 2009.
    - Part 2 Extended
  - Common Criteria for Information Technology Security Evaluation Part 3: Security assurance components, Version 3.1 Revision 3, July 2009.
    - Part 3 Conformant

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## 1.3 Conventions

The following conventions have been applied in this document:

- Security Functional Requirements – Part 2 of the CC defines the approved set of operations that may be applied to functional requirements: iteration, assignment, selection, and refinement.
  - Iteration: allows a component to be used more than once with varying operations. In the ST, iteration is indicated by a number in parentheses placed at the end of the component. For example FDP\_ACC.1(1) and FDP\_ACC.1(2) indicate that the ST includes two iterations of the FDP\_ACC.1 requirement, (1) and (2).
  - Assignment: allows the specification of an identified parameter. Assignments are indicated using bold and are surrounded by brackets (e.g., [**assignment**]). Note that an assignment within a selection would be identified in italics and with embedded bold brackets (e.g., [*[**selected-assignment**]*]).
  - Selection: allows the specification of one or more elements from a list. Selections are indicated using bold italics and are surrounded by brackets (e.g., [***selection***]).
  - Refinement: allows the addition of details. Refinements are indicated using bold, for additions, and strike-through, for deletions (e.g., “... **all** objects ...” or “... ~~some~~ **big** things ...”). Note that ‘cases’ that are not applicable in a given SFR have simply been removed without any explicit identification.

- The NDPP uses an additional convention – the ‘case’ – which defines parts of an SFR that apply only when corresponding selections are made or some other identified conditions exist. Only the applicable cases are identified in this ST and they are identified using **bold** text.
- Other sections of the ST – Other sections of the ST use bolding to highlight text of special interest, such as captions.

### 1.3.1 Abbreviations and Acronyms

AAA	Authentication, Authorization and Accounting
ACL	Access Control List
AES	Advanced Encryption Standard
Bpps	Billion packets per second
CBC	Cipher-Block Chaining
CC	Common Criteria for Information Technology Security Evaluation
CM	Configuration Management
CLI	Command Line Interface
DH	Diffie-Hellman
FIPS	Federal Information Processing Standard
GbE	Gigabit Ethernet
Gbps	Gigabit per second
HMAC	Hashed Message Authentication Code
IP	Internet Protocol
IPsec	Internet Protocol Security
IRF	Intelligent Resilient Framework
ISSU	In Service Software Upgrades
IT	Information Technology
LACP	Link Aggregation Control Protocol
MDC	Multitenant device context
MPLS	Multiprotocol Label Switching
Mpps	Million packets per second
NDPP	Protection Profile for Network Devices
OAA	Open Application Architecture
OSPF	Open Shortest Path First
PP	Protection Profile
QoS	Quality of Service
RADIUS	Remote Authentication Dial In User Service
RIP	Routing Information Protocol
RSA	Rivest, Shamir and Adleman (algorithm for public-key cryptography)
RTC	Real-Time Clock
SA	Security Association
SAR	Security Assurance Requirement
SFP	Small Form-factor Pluggable
SFR	Security Functional Requirement
SHA	Secure Hash Algorithm
SSH	Secure Shell
ST	Security Target
TAA	Trade Agreements Act (19 U.S.C. & 2501-2581)
Tbps	Terabits per second
TACACS+	Terminal Access Controller Access Control System Plus
TOE	Target of Evaluation
ToR	Top-of-Rack
TRILL	Transparent Interconnection of Lots of Links
TSF	TOE Security Functions
VLAN	Virtual Local Area Network
VxLAN	Virtual Extensible LAN





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## 2. TOE Description

The Target of Evaluation (TOE) is the Hewlett Packard Enterprise 7900 Series, 7500 Series, 5700 Series, 5130 EI, and 5130 HI Series Switches.

The 7900 Series devices in the evaluated configuration are as follows:

- HP FlexFabric 7904 Switch Chassis (JG682A)
- HP FlexFabric 7910 Switch Chassis (JG841A)
  - HP FlexFabric 7910 -- 7.2Tbps Fabric / Main Processing Unit (JG842A) and/or
  - HP FlexFabric 7910 -- 2.4Tbps Fabric / Main Processing Unit (JH001A)

The 7500 Series devices in the evaluated configuration are as follows:

- HP 7502 Switch Chassis (JD242C) with Main Processing Unit (JH208A)
- HP 7503 Switch Chassis (JD240C) with Main Processing Unit (JH207A or JH209A)
- HP 7506 Switch Chassis (JD239C) with Main Processing Unit (JH207A or JH209A)
- HP 7510 Switch Chassis (JD238C) with Main Processing Unit (JH207A or JH209A)

The 5700 Series devices in the evaluated configuration are as follows:

- HP FlexFabric 5700-40XG-2QSFP+Switch (JG896A)
- HP FlexFabric 5700-48G-4XG-2QSFP+Switch (JG894A)
- HP FlexFabric 5700-32XGT-8XG-2QSFP+ Switch (JG898A)
- HP FlexFabric 5700-40XG-2QSFP+TAA-Compliant Switch (JG697A)
- HP FlexFabric 5700-48G-4XG-2QSFP+TAA-Compliant Switch (JG895A)
- HP FlexFabric 5700-32XGT-8XG-2QSFP+TAA-Compliant Switch (JG899A)

The 5130 EI Series devices in the evaluated configuration are as follows:

- HP 5130-24G-4SFP+ EI Switch (JG932A)
- HP 5130-24G-SFP-4SFP+ EI Switch (JG933A)
- HP 5130-48G-4SFP+ EI Switch (JG934A)
- HP 5130-24G-PoE+-4SFP+ (370W) EI Switch (JG936A)
- HP 5130-48G-PoE+-4SFP+ (370W) EI Switch (JG937A)
- HP 5130-24G-4SFP+ EI TAA-compliant Switch (JG942A)
- HP 5130-24G-SFP-4SFP+ EI TAA-compliant Switch (JG943A)
- HP 5130-48G-4SFP+ EI TAA-compliant Switch (JG944A)
- HP 5130-24G-PoE+-4SFP+ (370W) EI TAA-compliant Switch (JG946A)
- HP 5130-48G-PoE+-4SFP+ (370W) EI TAA-compliant Switch (JG947A)

The 5130 HI Series devices in the evaluated configuration are as follows:

- HP 5130-24G-4SFP+ HI Switch with 1 Slot (JH323A)
- HP 5130-48G-4SFP+ HI Switch with 1 Slot (JH324A)
- HP 5130-24G-PoE+-4SFP+ HI Switch with 1 Slot (JH325A)

- HP 5130-48G-PoE+-4SFP+ HI Switch with 1 Slot (JH326A)

The 5150 HI Series devices in the evaluated configuration are as follows:

- HPE 5510 24G 4SFP+ HI 1-slot Switch (JH145A)
- HPE 5510 24G PoE+ 4SFP+ HI 1-slot Switch (JH147A)
- HPE 5510 24G SFP 4SFP+ HI 1-slot Switch (JH149A)
- HPE 5510 48G 4SFP+ HI 1-slot Switch (JH146A)
- HPE 5510 48G PoE+ 4SFP+ HI 1-slot Switch (JH148A)

Each series of switches included in the TOE comprises a set of distinct devices (as identified in Section 1.1), which vary primarily according to power delivery, performance, and port density.

The HP 7500 Switch Series comprises modular, multilayer chassis switches that can be deployed in multiple network environments, including the enterprise LAN core, aggregation layer, and wiring closet edge. They offer 40GbE connectivity wire-speed 10GbE ports and can be deployed as a single device or alternately up to four switches performing as a single L2 switch and L3 router using the IRF technology to effectively form a logical switch device.

The HP FlexFabric 5700 Switch Series enables scaling of the server edge with 1GbE and 10GbE Top-of-Rack (ToR) deployments with high-density 32- and 48-port solutions delivered in a 1RU form factor with capacity for local switching and L2/L3 support. The FlexFabric 5700 switches can be setup as standalone layer 2 and lite layer 3 switches. The HP 5700 Switch Series offer 1/10GbE ports supporting SFP and BASE-T with 10/40GbE; a maximum throughput of 714.2 Mpps; and a routing/switching capacity of 960 Gbps. HP Intelligent Resilient Fabric (IRF) technology simplifies the architecture of server access networks; up to nine HP 5700 switches can be combined to deliver unmatched scalability of virtualized access layer switches and flatter two-tier networks using IRF, which reduces cost and complexity.

The HP 5130 EI Switch Series Gigabit Ethernet switches that support static and RIP Layer 3 routing, diversified services, and IPv6 forwarding, as well as provides four 10-Gigabit Ethernet (10GbE) extended interfaces. The switches can be used at the edge of a network or to connect server clusters in data centers. The Hewlett Packard Enterprise IRF can be used to create one virtual switch configuration consisting of two to nine switches managed by using a single IP address.

The 5130 HI Ethernet Switch Series Gigabit Ethernet switches deliver scalability and resiliency at the access layer of medium and large enterprise campus networks. This FlexNetwork switch supports enterprise class QoS and security, HPE Intelligent Resilient Framework (IRF) stacking, static Layer 3 routing and RIP, dual redundant power supplies, 4 fixed and modular 10GbE uplinks ports, PoE+, ACLs, IPv6 and support for 10GBASE-T. The Hewlett Packard Enterprise IRF can be used to create one virtual switch configuration consisting of two to nine switches managed by using a single IP address.

The HPE 5510 HI FlexNet Series Layer 3 Switches deliver resiliency, security, and multiservice support for medium and large enterprise networks. The switches include enterprise-class QoS; dual, redundant power supplies with support for PoE+; 10GbE and 40GbE uplinks; 9 chassis IRF stacking; Static & RIP Routing, MACsec, OSPF, IPv6 and Energy Efficient Ethernet. The HPE 5510 HI has a non-blocking architecture that provides up to 336 Gb/s of wire-speed switching with a non-blocking switching fabric and up to 250 million pps throughput. The HPE Intelligent Resilient Framework (IRF) virtualizes up to nine physical switches into one logical device for simpler, flatter, more agile networks.

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## 2.1 TOE Overview

The various switches comprising the TOE are all gigabit Ethernet switch appliances that consist of hardware and software components. While the physical form factor of each distinct series is substantially different, the underlying hardware shares a similar architecture. The software shares a common code base of a modular nature, with only the modules applicable for the specific hardware installed.

### 2.1.1 HP 7900 Series Switches

HP FlexFabric 7900 Switch Series is the next generation compact modular data center core switch designed to support virtualized data centers and evolution needs of private and public cloud deployments. The 7900 provides buffering, scalability, and availability with up to 10 interface module slots to scale up to 120 40GbE ports. The 7900 can deliver up to 9.6 Tbps switching capacity and 5.94 Bpps throughput with non-blocking wire-speed performance. The HP 7904 Switch Chassis provides four I/O module slots that can support a maximum of 48 40 GbE ports. The HP 7910 Switch chassis provides ten I/O slots that can support a maximum of 120 40 GbE ports.

The 7900 series supports the following optional module, which extend the physically available ports and do not otherwise affect any of the claimed security functions:

- Modules HP FlexFabric 7900 12-port 40GbE QSFP+ SA Module (JG683B)
- HPE FlexFabric 7900 24-port 1/10GbE SFP+ FX Module (JG845A)
- HPE FlexFabric 7900 2-port 100GbE CXP/6-port 40GbE QSFP+/4-port 10GbE SFP+ FX Module (JH002A)

### 2.1.2 HP 7500 Series Switches

The HP 7500 Series Switch provides a choice of eight chassis ranging from a 10-slot to a 2-slot chassis. The 10 interface module slots can support up to 40 40GbE ports, 84 10GbE ports, 480 Fiber Gigabit ports, or 480 PoE-enabled ports per HP 7500 Switch Series system. The switches deliver wire-speed L2 and L3 routing services for the most demanding applications with hardware-based IPv4 and IPv6 support.

Each Switch in the 7500 Series requires a Main Processing Unit. The 7502 Switch requires Main Processing Unit with part number JH208A. The 7503, 7506, and 7510 Switches require one of the following Main Processing Units:

- HP 1.2T Fabric IRF-only MPU (JH207A) or
- HP 2.4T 8p G/10G and 2p 40G MPU (JH209A)

The 7500 series supports the following optional modules, which extend the physically available ports and do not otherwise affect any of the claimed security functions:

- HP 7500 12-port GbE SFP Module (JD207A)
- HP 7500 24-port GbE SFP Module (JD203B)
- HP 7500 24-port GbE SFP Enhanced Module (JD231A)
- HP 7500 24-port GbE SFP Extended Module (JD234A)
- HP 7500 24-port GbE SFP / 2-port 10GbE XFP Module (JD205A)
- HP 7500 24-port GbE SFP / 2-port 10GbE XFP Extended Module (JD230A)
- HP 7500 48-port GbE SFP Module (JD211B)
- HP 7500 48-port GbE SFP Enhanced Module (JD221A)
- HP 7500 48-port GbE SFP Extended Module (JD237A)
- HP 7500 20-port Gig-T / 4-port GbE Combo PoE-upgradable SC Module (JC669A)
- HP 7500 24-port Gig-T Module (JD204B)
- HP 7500 24-port Gig-T / 2-port 10GbE XFP Module (JD206A)
- HP 7500 40-port Gig-T / 8-port SFP PoE-ready Module (JD228B)
- HP 7500 48-port Gig-T Module (JD210A)
- HP 7500 48-port Gig-T PoE+ Extended Module (JD229B)
- HP 7500 48-port 1000BASE-T PoE+ SC Module (JG663A)
- HP 7500 2-port 10GbE XFP Module (JD201A)
- HP 7500 2-port 10GbE XFP Enhanced Module (JD233A)
- HP 7500 2-port 10GbE XFP Extended Module (JD236A)
- HP 7500 4-port 10GbE XFP Enhanced Module (JD232A)
- HP 7500 4-port 10GbE XFP Extended Module (JD235A)
- HP 7500 8-port 10GbE XFP Extended Module (JD191A)
- HP 7500 8-port 10G SFP+ Module (JF290A)
- HP 7500 4-port 40GbE QSFP+ SC Module (JC792A)

- HP 7500 4-port 40GbE CFP SC Module (JG373A)
- HPE 7500 44-port SFP/4-port SFP+ SE Module (JH210A)
- HPE 7500 24-port SFP/4-port SFP+ SE Module (JH211A)
- HPE 7500 48-port 1000BASE-T SE Module (JH212A)
- HPE 7500 48-port 1000BASE-T with PoE+ SE Module (JH213A)
- HPE 7500 16-port 1/10GbE SFP+ SF Module (JH214A)
- HPE 7500 12-port 1/10GbE SFP+ EC Module (JH309A)
- HPE 7500 48-port 100BASE-FX Module (JD197B)
- HPE 7500 48-port 10/100BASE-T Module (JD198B)

### 2.1.3 HP 5700 Series Switches

The HP FlexFabric 5700 Switch Series enables scaling of the server edge with 1GbE and 10GbE Top-of-Rack (ToR) deployments with high-density 32- and 48-port solutions delivered in a 1RU form factor. The FlexFabric 5700 switches can be setup as standalone layer 2 and lite layer 3 switches. The HP 5700 Switch Series can have up to a maximum throughput of 714.2 Mpps and a routing/switching capacity of 960 Gbps. The 5700 series supports the following optional modules, which extend the physically available ports and do not otherwise affect any of the claimed security functions:

- HP X120 1G SFP LC LH40 1550nm Transceiver (JD062A)
- HP X120 1G SFP LC BX 10-U Transceiver (JD098B)
- HP X120 1G SFP LC BX 10-D Transceiver (JD099B)
- HP X120 1G SFP LC LX Transceiver (JD119B)
- HP X120 1G SFP RJ45 T Transceiver (JD089B)
- HP X120 1G SFP LC SX Transceiver (JD118B)
- HP X125 1G SFP LC LH40 1310nm Transceiver (JD061A)
- HP X125 1G SFP LC LH70 Transceiver (JD063B)
- HP X130 10G SFP+ LC SR Transceiver (JD092B)
- HP X130 10G SFP+ LC LRM Transceiver (JD093B)
- HP X130 10G SFP+ LC LR Transceiver (JD094B)
- HP X130 10G SFP+ LC ER 40km Transceiver (JG234A)
- HP X140 40G QSFP+ MPO SR4 Transceiver (JG325A)
- HP X240 10G SFP+ to SFP+ 0.65m Direct Attach Copper Cable (JD095C)
- HP X240 10G SFP+ to SFP+ 1.2m Direct Attach Copper Cable (JD096C)
- HP X240 10G SFP+ to SFP+ 3m Direct Attach Copper Cable (JD097C)
- HP X240 10G SFP+ to SFP+ 5m Direct Attach Copper Cable (JG081C)
- HP X240 40G QSFP+ to QSFP+ 1m Direct Attach Copper Cable (JG326A)
- HP X240 40G QSFP+ to QSFP+ 3m Direct Attach Copper Cable (JG327A)
- HP X240 40G QSFP+ to QSFP+ 5m Direct Attach Copper Cable (JG328A)
- HP X240 40G QSFP+ to 4x10G SFP+ 1m Direct Attach Copper Splitter Cable (JG329A)
- HP X240 40G QSFP+ to 4x10G SFP+ 3m Direct Attach Copper Splitter Cable (JG330A)
- HP X240 40G QSFP+ to 4x10G SFP+ 5m Direct Attach Copper Splitter Cable (JG331A)
- HP X240 10G SFP+ SFP+ 7m Direct Attach Copper Cable (JC784C)
- HP X140 40G QSFP+ LC LR4 SM 10km 1310nm Transceiver (JG661A)
- HP X140 40G QSFP+ MPO SR4 Transceiver (JG325B)
- HP X140 40G QSFP+ MPO MM 850nm CSR4 300m Transceiver (JG709A)

### 2.1.4 HP 5130 EI Series Switches

The HP 5130 EI Series Switches provide up to 48 fixed 10/100/1000BASE-T ports in a Layer 2/Layer 3 switch. The switch allows grouping of ports to increase overall data throughput to a remote device for 10GbE port aggregation. The HP 5130 EI has a non-blocking architecture that provides up to 130.9 Mpps throughput. The 5130 EI series supports the following optional modules, which extend the physically available ports and do not otherwise affect any of the claimed security functions:

- HP X125 1G SFP LC LH40 1310nm Transceiver (JD061A)

- HP X120 1G SFP LC LH40 1550nm Transceiver (JD062A)
- HP X125 1G SFP LC LH70 Transceiver (JD063B)
- HP X120 1G SFP LC LH100 Transceiver (JD103A)
- HP X120 1G SFP LC SX Transceiver (JD118B)
- HP X120 1G SFP LC LX Transceiver (JD119B)
- HP X120 1G SFP LC BX 10-U Transceiver (JD098B)
- HP X120 1G SFP LC BX 10-D Transceiver (JD099B)
- HP X120 1G SFP RJ-45 T Transceiver (JD089B)
- HP X130 10G SFP+ LC SR Transceiver (JD092B)
- HP X130 10G SFP+ LC LRM Transceiver JD093B
- HP X130 10G SFP+ LC LR Transceiver (JD094B)
- HP X240 10G SFP+ to SFP+ 0.65m Direct Attach Copper Cable (JD095C)
- HP X240 10G SFP+ to SFP+ 1.2m Direct Attach Copper Cable (JD096C)
- HP X240 10G SFP+ to SFP+ 3m Direct Attach Copper Cable (JD097C)
- HP X240 10G SFP+ to SFP+ 5m Direct Attach Copper Cable (JG081C)
- HP X130 10G SFP+ LC ER 40km Transceiver (JG234A)
- HP X130 10G SFP+ LC LH 80km Transceiver (JG915A)

### 2.1.5 HP 5130 HI Series Switches

The HP 5130 HI Series Switches provide up to 48 fixed 10/100/1000BASE-T ports in a Layer 3 switch. The switch allows grouping of ports to increase overall data throughput to a remote device for 10GbE port aggregation. The HP 5130 HI has a non-blocking architecture that provides up to 190.5 Mpps throughput. The 5130 HI series supports the following optional modules/transceivers, which extend the physically available ports and do not otherwise affect any of the claimed security functions:

- HP 5130/5510 10GBASE-T 2-port Module (JH156A)
- HP 5130/5510 10GbE SFP+ 2-port Module (JH157A)
- HP X110 100M SFP LC LH40 Transceiver (JD090A)
- HP X110 100M SFP LC LH80 Transceiver (JD091A)
- HP X110 100M SFP LC FX Transceiver (JD102B)
- HP X110 100M SFP LC LX Transceiver (JD120B)
- HP X115 100M SFP LC BX 10-U Transceiver (JD100A)
- HP X115 100M SFP LC BX 10-D Transceiver (JD101A)
- HP X125 1G SFP LC LH40 1310nm Transceiver (JD061A)
- HP X120 1G SFP LC LH40 1550nm Transceiver (JD062A)
- HP X125 1G SFP LC LH70 Transceiver (JD063B)
- HP X120 1G SFP LC LH100 Transceiver (JD103A)
- HP X120 1G SFP LC SX Transceiver (JD118B)
- HP X120 1G SFP LC LX Transceiver (JD119B)
- HP X120 1G SFP LC BX 10-U Transceiver (JD098B)
- HP X120 1G SFP LC BX 10-D Transceiver (JD099B)
- HP X120 1G SFP RJ-45 T Transceiver (JD089B)
- HP X130 10G SFP+ LC SR Transceiver (JD092B)
- HP X130 10G SFP+ LC LR Transceiver (JD094B)
- HP X240 10G SFP+ to SFP+ 0.65m Direct Attach Copper Cable (JD095C)
- HP X240 10G SFP+ to SFP+ 1.2m Direct Attach Copper Cable (JD096C)
- HP X240 10G SFP+ to SFP+ 3m Direct Attach Copper Cable (JD097C)
- HP X240 10G SFP+ to SFP+ 5m Direct Attach Copper Cable (JG081C)

### 2.1.6 HPE 5510 HI Series Switches

The HPE 5510 HI Series Switches provide up to 48 fixed 10/100/1000BASE-T and up to 4 SFP ports in a Layer 3 switch; or (24) SFP and (4) 10/100/1000 ports, (2) SFP+ 10GbE ports. The switch allows grouping of ports to increase overall data throughput to a remote device for 10GbE port aggregation. The HPE 5510 HI has a non-

blocking architecture that provides up to 336 Gb/s of wire-speed switching with a non-blocking switching fabric and up to 250 million pps throughput. The HPE Intelligent Resilient Framework (IRF) virtualizes up to nine physical switches into one logical device for simpler, flatter, more agile networks. The 5510 HI series supports the following optional modules/transceivers, which extend the physically available ports and do not otherwise affect any of the claimed security functions:

- HPE 5510 QSFP+ 2-port Module (JH155A)
- HPE 5130/5510 10GBASE-T 2-port Module (JH156A)
- HPE 5130/5510 10GbE SFP+ 2-port Module (JH157A)
- HP X110 100M SFP LC LH40 Transceiver (JD090A)
- HP X110 100M SFP LC LH80 Transceiver (JD091A)
- HP X110 100M SFP LC FX Transceiver (JD102B)
- HP X110 100M SFP LC LX Transceiver (JD120B)
- HP X115 100M SFP LC BX 10-U Transceiver (JD100A)
- HP X115 100M SFP LC BX 10-D Transceiver (JD101A)
- HP X125 1G SFP LC LH40 1310nm Transceiver (JD061A)
- HP X120 1G SFP LC LH40 1550nm Transceiver (JD062A)
- HP X125 1G SFP LC LH70 Transceiver (JD063B)
- HP X120 1G SFP LC LH100 Transceiver (JD103A)
- HP X120 1G SFP LC SX Transceiver (JD118B)
- HP X120 1G SFP LC LX Transceiver (JD119B)
- HP X120 1G SFP LC BX 10-U Transceiver (JD098B)
- HP X120 1G SFP LC BX 10-D Transceiver (JD099B)
- HP X120 1G SFP RJ-45 T Transceiver (JD089B)
- HP X130 10G SFP+ LC SR Transceiver (JD092B)
- HP X130 10G SFP+ LC LR Transceiver (JD094B)
- HP X240 10G SFP+ to SFP+ 0.65m Direct Attach Copper Cable (JD095C)
- HP X240 10G SFP+ to SFP+ 1.2m Direct Attach Copper Cable (JD096C)
- HP X240 10G SFP+ to SFP+ 3m Direct Attach Copper Cable (JD097C)
- HP X240 10G SFP+ to SFP+ 5m Direct Attach Copper Cable (JG081C)
- HP X130 10G SFP+ LC ER 40km Transceiver (JG234A)
- HP X130 10G SFP+ LC LH 80km Transceiver (JG915A)
- HP X130 10G SFP+ LC LRM Transceiver (JD093B)
- HP X140 40G QSFP+ MPO SR4 Transceiver (JG325B)
- HP X240 40G QSFP+ to QSFP+ 1m Direct Attach Copper Cable (JG326A)
- HP X240 40G QSFP+ to QSFP+ 3m Direct Attach Copper Cable (JG327A)
- HP X240 40G QSFP+ to QSFP+ 5m Direct Attach Copper Cable (JG328A)
- HP X240 40G QSFP+ to 4x10G SFP+ 1m Direct Attach Copper Splitter Cable (JG329A)
- HP X240 40G QSFP+ to 4x10G SFP+ 3m Direct Attach Copper Splitter Cable (JG330A)
- HP X240 40G QSFP+ to 4x10G SFP+ 5m Direct Attach Copper Splitter Cable (JG331A)
- HP X140 40G QSFP+ LC LR4 SM 10km 1310nm Transceiver (JG661A)
- HP X140 40G QSFP+ MPO MM 850nm CSR4 300m Transceiver (JG709A)

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## 2.2 TOE Architecture

The various switches comprising the TOE share a common software code base, called Comware. Comware is special purpose appliance system software that implements various networking technologies, including: IPv4/IPv6 dual-stacks; a data link layer; layer 2 and 3 routing; Ethernet switching; VLANs; IRF routing; and Quality of Service (QoS). The evaluated version of Comware is V7.1. It should be noted that although Comware can run on a variety of underlying architectures, including VxWorks, Linux, pSOS and Windows, the only underlying architecture found in the evaluated configuration is Linux. The TOE supports both IPv4 and IPv6 networks; however, IPv6 was not tested as part of this evaluation.

Comware V7.1 implements full modularization and multi-process applications, and provides the following benefits:

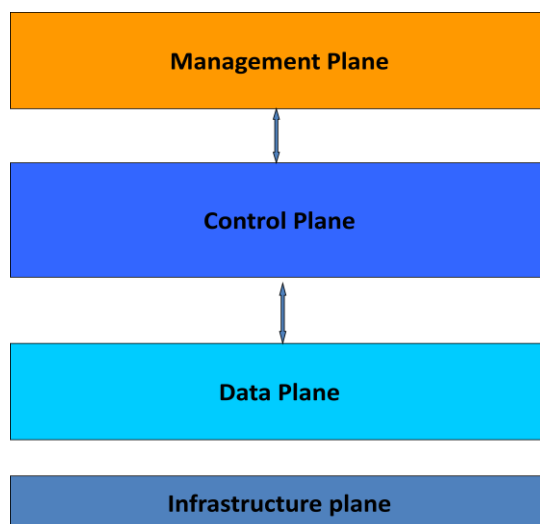
- Full modularization—Brings improvements in system availability, virtualization, multi-core multi-CPU applications, distributed computing, and dynamic loading and upgrading.
- Openness—Comware V7.1 is a generic, open system based on Linux.
- Improved operations—Comware V7.1 improves some detailed operations. For example, it uses preemptive scheduling to improve real-time performance.

Comware V7.1 optimizes the following functions:

- Virtualization—Supports N:1 virtualization.
- In Service Support Updates (ISSU)—Supports ISSU for line cards.
- Auxiliary CPU and OAA—Improves scalability for devices.

In addition, Comware V7.1 supports IETF industry standard TRILL (Transparent Interconnection of Lots of Links). TRILL provides support for VLANs and is a link state routing protocol running over layer 2 that enables loop free large Layer 2 networks with multi-path support. TRILL and the optimization functions are not security relevant and not covered by the evaluation but can be included in the evaluated configuration as they do not affect any of the claimed security functions.

Comware V7.1 comprises four planes: management; control; data; and infrastructure.



**Figure 1: Comware V7.1 Architecture**

- **Infrastructure**—the infrastructure plane provides basic Linux services and Comware support functions. Basic Linux services comprise basic Linux functions, C language library functions, data structure operations, and standard algorithms. Comware support functions provide software and service infrastructure for Comware processes, including all basic functions.
- **Data**—the data plane provides data forwarding for local packets and received IPv4 and IPv6 packets at different layers.
- **Control**—the control plane comprises all routing, signaling, and control protocols, such as MPLS, OSPF, and security control protocols. It generates forwarding tables for the data plane.
- **Management**—the management plane provides a management interface for operators to configure, monitor, and manage Comware V7.1. The management interface comprises a Command Line Interface (CLI) accessed using SSH.

The Comware V7.1 software is further decomposed into subsystems designed to implement applicable functions. For example, there are subsystems dedicated to the security management interface. There are also subsystems

dedicated to the IPv4 and IPv6 network stacks as well as the applicable network protocols and forwarding, routing, etc.

From a security perspective, the TOE implements NIST-validated cryptographic algorithms that support the IPsec and SSH protocols as well as digital signature services that support the secure update capabilities of the TOE. Otherwise, the TOE implements various network switching protocols and functions.

The various TOE devices include the same security functions. The salient differences between the devices are the available ports and port adapters, primarily representing differences in numbers, types, and speeds of available network connections.

## 2.2.1 Modular Design

Comware V7.1 implements full modularization based on Linux. All software features run independent processes in different spaces. A failed process does not affect other processes. Preemptive scheduling used by Linux threads enables Comware V7.1 to provide high-speed services. In addition, Linux supports multi-core, multi-CPU, and Symmetrical Multi-Processing (SMP) technologies, which can maximize multi-CPU performance.

The modular design makes Comware V7.1 totally different from earlier versions.

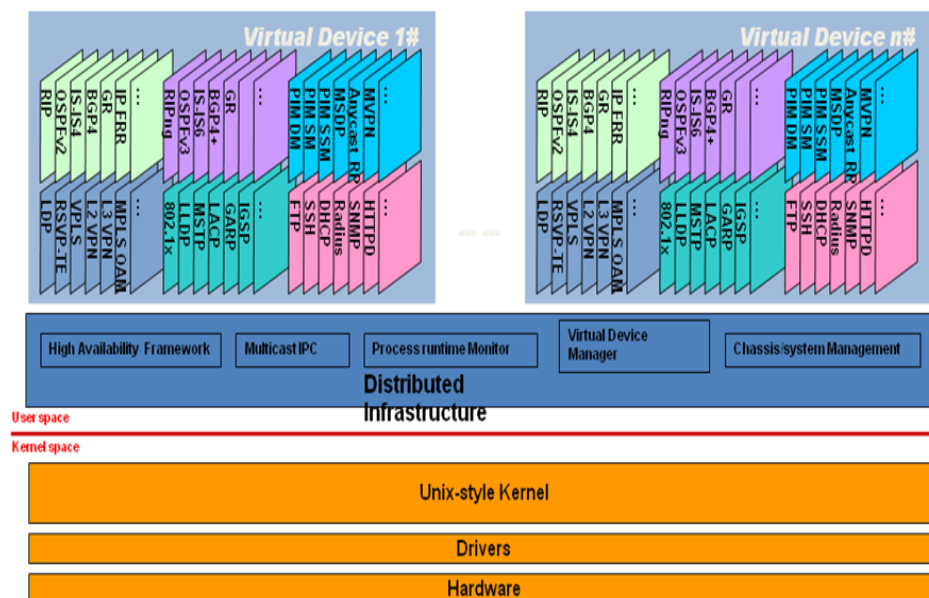


Figure 2: Comware V7.1 Module Design

- **Process isolation**—the modular design isolates processes to improve system availability. Each process can be managed separately. This refined management method enhances system stability and performance.
- **Multi-core support**—Comware V7.1 supports multi-core CPU and SMP technologies besides multi-core support at the data plane. The modular design enables concurrent running of threads through direct Linux scheduling, which can maximize multi-CPU performance. More CPUs improve performance for the whole system to implement faster route convergence and less recovery time.

Comware V7.1 allows a group of processes to run on a dedicated CPU set to ensure enough resources for key services. The thread preemptive scheduling and priority marking mechanisms enable real-time services to fast respond to requests even when the CPU system is busy.

The multi-core CPU replaces auxiliary CPUs to complete related tasks, simplifying software operations.

- **On-demand operation**—the modular design enables a process to load only needed functions to complete a task. Unused functions do not occupy any system resources and thus will not be attacked. This mechanism improves both system performance and security.



- **Modular upgrading**—the modular design allows upgrades to a single feature or additions of new features without affecting other services.
- **Simplified software tailoring**—Comware V7.1 software processes are independent of one another. This makes software tailoring much easier, without the need of re-compiling.
- **Open interfaces**—Comware V7.1 provides APIs through dynamic Link Library for users to develop their own applications. This method is more flexible than OAA.

## 2.2.2 Intelligent Resilient Framework

As indicated above, multiple devices can be deployed as an IRF group. Each device in the IRF group is directly connected to the other IRF group members using an IRF stack utilizing dedicated network connections. One device in the group is designated as master and should that device fail a voting procedure ensues to elect a new master among the remaining IRF group members.

All devices in the group share the same configuration, which is shared across the IRF connections when the group is formed and later when configuration changes occur. Management of the IRF group can occur via any of the IRF group members by an authorized administrator.

Once configured, the IRF group acts as a single, logical switch with a common configuration and will act to receive and forward network traffic in accordance with that common configuration. When necessary, network traffic is forwarded through the IRF connection in order to get the network traffic to and from the applicable physical network connections used to attach other network peers or clients.

Note that the IRF connections are not secured (e.g., using encryption) by the TOE, so the IRF group members must be collocated and the IRF connections need to be as protected as the IRF group devices themselves. The IRF is excluded from the evaluation.

## 2.2.3 Multitenant Device Context

Multitenant device context (MDC) is a 1:N virtualization technology. It virtualizes the data plane, control plane, and management plane of a physical device to create multiple logical devices called MDCs. MDCs use the same kernel, but their data is separated. Each MDC has its own interfaces and CPU resources. Rebooting an MDC does not affect the configuration or service of any other MDC.

The modular design of Comware V7.1 enables each MDC to run its own control protocol processes on a separate control plane. A process failure of an MDC does not affect other MDCs.

Note that since this technology is not covered in the NDPP, MDC was not subject to evaluation.

## 2.2.4 Physical Boundaries

A TOE device in the 7900 series is a physical network rack-mountable appliance that supports 4 or 10 12-port 40GbE QSFP+ SA modules which provide a switching capacity up to 9.6 Tbps.

A TOE device in the 7500 series is a physical network rack-mountable appliance that supports modules that provide a range of 52-84 10GbE ports or 288-480 autosensing 10/100/1000 ports or 288-480 SFP ports, or 24-40 40GbE ports or combination of each.

A TOE FlexFabric 5700-40XG-2QSFP+series switch is a physical network rack-mountable appliance that supports 40 fixed 1000/10000 SFP+ ports. The FlexFabric 5700-48G-4XG-2QSFP+ switch supports 48 RJ-45 autosensing 10/100/1000 ports and 4 fixed 1000/10000 SFP+ ports. The HP FlexFabric 5700-32XGT-8XG-2QSFP+ Switch supports 32 RJ-45 1/10GBASE-T ports and 8 fixed 1000/10000 SFP+ ports. All of the TOE 5700 Series Switches support 2 QSFP+ transceivers

A TOE HP 5130-24G-4SFP+ EI Switch is a physical network rack-mountable appliance that supports 24 RJ-45 autosensing 10/100/1000 ports and 4 SFP+ fixed 1000/10000 SFP+ ports. The HP 5130-24G-SFP-4SFP+ EI Switch supports 16 SFP 100/1000 Mbps ports, 8 SFP dual-personality ports and 4 SFP+ fixed 1000/10000 SFP+ ports. The HP 5130-48G-4SFP+ EI Switch supports 48 RJ-45 autosensing 10/100/1000 ports and 4 SFP+ fixed 1000/10000 SFP+ ports.

A TOE HP 5130-24G-4SFP+ HI Switch with 1 Slot is a physical network rack-mountable appliance that supports 24 RJ-45 autosensing 10/100/1000 ports and 4 SFP+ fixed Gigabit Ethernet SFP+ ports. The HP 5130-48G-4SFP+ HI Switch with 1 Slot supports 48 RJ-45 autosensing 10/100/1000 ports and 4 fixed Gigabit Ethernet SFP+ ports. The HP 5130-24G-PoE+-4SFP+ HI Switch with 1 Slot supports 24 RJ-45 autosensing 10/100/1000 PoE+ ports and 4 fixed Gigabit Ethernet SFP+ ports. The HP 5130-48G-PoE+-4SFP+ HI Switch with 1 Slot supports 48 RJ-45 autosensing 10/100/1000 PoE+ ports and 4 fixed Gigabit Ethernet SFP+ ports.

A TOE HPE 5510 24G 4SFP+ HI Switch is a physical network rack-mountable appliance that supports 24 RJ-45 autosensing 10/100/1000 ports and 4 fixed Gigabit Ethernet SFP+ ports. The HPE 5510 48G 4SFP+ HI Switch supports 48 RJ-45 autosensing 10/100/1000 ports and 4 fixed Gigabit Ethernet SFP+ ports. The HPE 5510 24G PoE+ 4SFP+ HI Switch supports 24 RJ-45 autosensing 10/100/1000 PoE+ ports and 4 fixed Gigabit Ethernet SFP+ ports. The HPE 5510 48G PoE+ 4SFP+ HI Switch supports 48 RJ-45 autosensing 10/100/1000 PoE+ ports and 4 fixed Gigabit Ethernet SFP+ ports. The HPE 5510 24G SFP 4SFP+ HI Switch supports 16 SFP fixed Gigabit Ethernet SFP ports (min=0 \ max=16 SFP Transceivers); 8 RJ-45/ SFP fixed combo ports (min=0 \ max=8 SFP Transceivers); and 4 fixed SFP+ ports (min=0 \ max=4 SFP+ Transceivers).

A Table of applicable series, devices, and CPU's is provided below and the applicable modules for each series are identified in Section 2.1.

Product Series	Specific Devices	CPU
HP 7900	HP FlexFabric 7904 Switch Chassis (JG682A) HP FlexFabric 7910 Switch Chassis (JG841A) with one or both of the following modules: <ul style="list-style-type: none"> <li>HP FlexFabric 7910 – 7.2Tbps Fabric / Main Processing Unit (JG842A)</li> <li>HP FlexFabric 7910 -- 2.4Tbps Fabric / Main Processing Unit (JH001A)</li> </ul>	Broadcom XLP108, 1.0GHz, MIPS
HP 7500	HP 7502 Switch Chassis (JD242C) with Main Processing Unit (JH208A)	Broadcom XLP108AQ
	HP 7503 Switch Chassis (JD240C) with Main Processing Unit (JH207A or JH209A)	Broadcom XLP208
	HP 7506 Switch Chassis (JD239C) with Main Processing Unit (JH207A or JH209A)	
	HP 7510 Switch Chassis (JD238C) with Main Processing Unit (JH207A or JH209A)	
HP 5700	HP FlexFabric 5700-40XG-2QSFP+Switch (JG896A) HP FlexFabric 5700-48G-4XG-2QSFP+Switch (JG894A) HP FlexFabric 5700-32XGT-8XG-2QSFP+ Switch (JG898A) HP FlexFabric 5700-40XG-2QSFP+TAA-Compliant Switch (JG697A) HP FlexFabric 5700-48G-4XG-2QSFP+TAA-Compliant Switch (JG895A) HP FlexFabric 5700-32XGT-8XG-2QSFP+TAA-Compliant Switch (JG899A)	Broadcom XLS408, 1.2GHz, MIPS
HP 5130 EI	HP 5130-24G-4SFP+ EI Switch (JG932A) HP 5130-24G-SFP-4SFP+ EI Switch (JG933A) HP 5130-48G-4SFP+ EI Switch (JG934A) HP 5130-24G-PoE+-4SFP+ (370W) EI Switch	ARM Cortex-A9 1GHz

Product Series	Specific Devices	CPU
	(JG936A) HP 5130-48G-PoE+-4SFP+ (370W) EI Switch (JG937A) HP 5130-24G-4SFP+ EI TAA-compliant Switch (JG942A) HP 5130-24G-SFP-4SFP+ EI TAA-compliant Switch (JG943A) HP 5130-48G-4SFP+ EI TAA-compliant Switch (JG944A) HP 5130-24G-PoE+-4SFP+ (370W) EI TAA-compliant Switch (JG946A) HP 5130-48G-PoE+-4SFP+ (370W) EI TAA-compliant Switch (JG947A)	
HP 5130 HI	HP 5130-24G-4SFP+ HI Switch with 1 Slot (JH323A) HP 5130-48G-4SFP+ HI Switch with 1 Slot (JH324A) HP 5130-24G-PoE+-4SFP+ HI Switch with 1 Slot (JH325A) HP 5130-48G-PoE+-4SFP+ HI Switch with 1 Slot (JH326A)	ARM Cortex-A9 1GHz * 2
HPE 5510 HI	HPE 5510 24G 4SFP+ HI 1-slot Switch (JH145A) HPE 5510 24G PoE+ 4SFP+ HI 1-slot Switch (JH147A) HPE 5510 24G SFP 4SFP+ HI 1-slot Switch (JH149A) HPE 5510 48G 4SFP+ HI 1-slot Switch (JH146A) HPE 5510 48G PoE+ 4SFP+ HI 1-slot Switch (JH148A)	ARM Cortex-A9 1GHz * 2

**Table 2 TOE Series, Devices, and CPUs**

The TOE can be configured to use the following components in its operational environment:

- Syslog server—to receive audit records when the TOE is configured to deliver them to an external log server.
- RADIUS and TACACS servers—the TOE can be configured to use external authentication servers.
- Management Workstation—the TOE supports remote access to the CLI over SSHv2. As such, an administrator requires an SSHv2 client to access the CLI remotely.

### 2.2.5 Logical Boundaries

This section summarizes the security functions provided by the TOE:

- Security audit
- Cryptographic support
- User data protection
- Identification and authentication
- Security management
- Protection of the TSF
- TOE access
- Trusted path/channels.

### **2.2.5.1 Security Audit**

The TOE is able to generate audit records of security relevant events. The TOE can be configured to store the audit records locally so they can be accessed by an administrator or alternately to send the audit records to a designated log server.

### **2.2.5.2 Cryptographic Support**

The TOE includes NIST-validated cryptographic mechanisms that provide key management, random bit generation, encryption/decryption, digital signature and secure hashing and key-hashing features in support of higher level cryptographic protocols, including IPsec and SSHv2. Note that to be in the evaluated configuration, the TOE must be configured in FIPS mode, which ensures the TOE uses only FIPS-approved and NIST-recommended cryptographic algorithms..

### **2.2.5.3 User Data Protection**

The TOE performs network switching and routing functions, passing network traffic among its various physical and logical network connections. While implementing applicable network protocols associated with network traffic forwarding, the TOE employs mechanisms to ensure that it does not inadvertently reuse data found in network traffic.

### **2.2.5.4 Identification and Authentication**

The TOE requires administrators to be successfully identified and authenticated before they can access any security management functions available in the TOE. The TOE offers both a locally connected console and a network accessible interface (SSHv2) for interactive administrator sessions.

The TOE supports on device definition of administrators with usernames and passwords. Additionally, the TOE can be configured to use the services of trusted RADIUS and TACACS servers in the operational environment to support, for example, centralized user administration. The TOE supports the use of text-based pre-shared keys for IKE peer authentication.

### **2.2.5.5 Security Management**

The TOE provides a CLI to access its security management functions. Security management commands are limited to administrators and are available only after they have provided acceptable user identification and authentication data to the TOE.

### **2.2.5.6 Protection of the TSF**

The TOE implements a number of features to protect itself to ensure the reliability and integrity of its security features.

It protects data such as stored passwords and cryptographic keys so that they are not accessible even by an administrator. It also provides its own timing mechanism to ensure that reliable time information is available (e.g., for log accountability).

The TOE uses cryptographic means to protect communication with remote administrators. When the TOE is configured to use the services of a Syslog server or authentication servers in the operational environment, the communication between the TOE and the operational environment component is protected using encryption.

The TOE includes functions to perform self-tests so that it might detect when it is failing. It also includes mechanisms to ensure updates to the TOE will not introduce malicious or other unexpected changes in the TOE.

### **2.2.5.7 TOE Access**

The TOE can be configured to display an informative banner that will appear prior to authentication when accessing the TOE via the console or SSH interfaces. The TOE can be configured to enforce an administrator-defined inactivity timeout value which, when exceeded, will terminate the inactive session.

### 2.2.5.8 Trusted path/channels

The TOE protects interactive communication with administrators using SSHv2 for CLI access. Using SSHv2, both integrity and disclosure protection is ensured.

The TOE protects communication with external IT entities, including audit and authentication servers, using IPsec connections, which prevent unintended disclosure or modification of data.

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## 2.3 TOE Documentation

There are numerous documents that provide information and guidance for the deployment of the TOE. In particular, there are four Common Criteria specific guides that reference the security-related guidance material for all products evaluated:

- *Preparative Procedures for CC NDPP Evaluated HPE 7900 Series, 7500 Series, 5700 Series, 5510 Series, 5130HI and 5130EI Series Switch Modules based on Comware V7.1*, Revision 1.01, dated 2/16/2016
- *Command Reference for CC Supplement*, Revision 1.05, dated 1/22/2016
- *Configuration Guide for CC Supplement*, Revision 1.6, dated 1/22/2016
- *Comware V7.1 Platform System Log Messages*, Revision 1.00, dated 4/21/2014.

The links in Appendix A for each series can be used to find the full set of documentation for each of the evaluated switch series. Note that only the documents listed above were examined during the course of the evaluation, and are the approved documents for configuring and using the TOE in its evaluated configuration.

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### **3. Security Problem Definition**

This security target includes by reference the Security Problem Definition (composed of organizational policies, threat statements, and assumption) from the NDPP.

In general, the NDPP has presented a Security Problem Definition appropriate for network infrastructure devices, such as switches, and as such is applicable to the Hewlett Packard Enterprise TOE.

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## 4. Security Objectives

Like the Security Problem Definition, this security target includes by reference the Security Objectives from the NDPP. The NDPP security objectives for the operational environment are reproduced below, since these objectives characterize technical and procedural measures each consumer must implement in their operational environment.

In general, the NDPP has presented a Security Objectives appropriate for network infrastructure devices, such as switches, and as such are applicable to the Hewlett Packard Enterprise TOE.

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### 4.1 Security Objectives for the Environment

OE.NO\_GENERAL\_PURPOSE

There are no general-purpose computing capabilities (e.g., compilers or user applications) available on the TOE, other than those services necessary for the operation, administration and support of the TOE.

OE.PHYSICAL

Physical security, commensurate with the value of the TOE and the data it contains, is provided by the environment.

OE.TRUSTED\_ADMIN

TOE Administrators are trusted to follow and apply all administrator guidance in a trusted manner.

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## 5. IT Security Requirements

This section defines the Security Functional Requirements (SFRs) and Security Assurance Requirements (SARs) that serve to represent the security functional claims for the Target of Evaluation (TOE) and to scope the evaluation effort.

The SFRs have all been drawn from the Protection Profile (PP): *Protection Profile for Network Devices, Version 1.1, 8 June 2012* (NDPP), as amended by Errata #3. As a result, refinements and operations already performed in that PP are not identified (e.g., highlighted) here, rather the requirements have been copied from that PP and any residual operations have been completed herein. Of particular note, the NDPP made a number of refinements and completed some of the SFR operations defined in the CC and that PP should be consulted to identify those changes if necessary.

The SARs are the set of SARs specified in NDPP.

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### 5.1 Extended Requirements

All of the extended requirements in this ST have been drawn from the NDPP. The NDPP defines the following extended SFRs and since they are not redefined in this ST, the NDPP should be consulted for more information in regard to those CC extensions.

- FAU\_STG\_EXT.1: External Audit Trail Storage
- FCS\_CKM\_EXT.4: Cryptographic Key Zeroization
- FCS\_IPSEC\_EXT.1: Explicit: IPSEC
- FCS\_RBG\_EXT.1: Extended: Cryptographic Operation (Random Bit Generation)
- FCS\_SSH\_EXT.1: Explicit: SSH
- FIA\_PMG\_EXT.1: Password Management
- FIA\_PSK\_EXT.1: Extended: Pre-Shared Key Composition
- FIA\_UAU\_EXT.2: Extended: Password-based Authentication Mechanism
- FIA\_UIA\_EXT.1: User Identification and Authentication
- FPT\_APW\_EXT.1: Extended: Protection of Administrator Passwords
- FPT\_SKP\_EXT.1: Extended: Protection of TSF Data (for reading of all symmetric keys)
- FPT\_TST\_EXT.1: TSF Testing
- FPT\_TUD\_EXT.1: Extended: Trusted Update
- FTA\_SSL\_EXT.1: TSF-initiated Session Locking.



## 5.2 TOE Security Functional Requirements

The following table identifies the SFRs that are satisfied by the HP Switches.

Requirement Class	Requirement Component
<b>FAU: Security audit</b>	FAU_GEN.1: Audit Data Generation
	FAU_GEN.2: User identity association
	FAU_STG_EXT.1: External Audit Trail Storage
<b>FCS: Cryptographic support</b>	FCS_CKM.1: Cryptographic Key Generation (for asymmetric keys)
	FCS_CKM_EXT.4: Cryptographic Key Zeroization
	FCS_COP.1(1): Cryptographic Operation (for data encryption/decryption)
	FCS_COP.1(2): Cryptographic Operation (for cryptographic signature)
	FCS_COP.1(3): Cryptographic Operation (for cryptographic hashing)
	FCS_COP.1(4): Cryptographic Operation (for keyed-hash message authentication)
	FCS_IPSEC_EXT.1: Explicit: IPSEC
	FCS_RBG_EXT.1: Extended: Cryptographic Operation (Random Bit Generation)
	FCS_SSH_EXT.1: Explicit: SSH
<b>FDP: User data protection</b>	FDP_RIP.2: Full Residual Information Protection
<b>FIA: Identification and authentication</b>	FIA_PMG_EXT.1: Password Management
	FIA_PSK_EXT.1: Extended: Pre-Shared Key Composition
	FIA_UAU.7: Protected Authentication Feedback
	FIA_UAU_EXT.2: Extended: Password-based Authentication Mechanism
	FIA_UIA_EXT.1: User Identification and Authentication
<b>FMT: Security management</b>	FMT_MTD.1: Management of TSF Data (for general TSF data)
	FMT_SMF.1: Specification of Management Functions
	FMT_SMR.2: Restrictions on Security Roles
<b>FPT: Protection of the TSF</b>	FPT_APW_EXT.1: Extended: Protection of Administrator Passwords
	FPT_SKP_EXT.1: Extended: Protection of TSF Data (for reading of all symmetric keys)
	FPT_STM.1: Reliable Time Stamps
	FPT_TST_EXT.1: TSF Testing
	FPT_TUD_EXT.1: Extended: Trusted Update
<b>FTA: TOE access</b>	FTA_SSL.3: TSF-initiated Termination
	FTA_SSL.4: User-initiated Termination
	FTA_SSL_EXT.1: TSF-initiated Session Locking
	FTA_TAB.1: Default TOE Access Banners
<b>FTP: Trusted path/channels</b>	FTP_ITC.1: Trusted Channel
	FTP_TRP.1: Trusted Path

**Table 3: TOE Security Functional Components**

## 5.2.1 Security Audit (FAU)

### 5.2.1.1 Audit Data Generation (FAU\_GEN.1)

**FAU\_GEN.1.1** The TSF shall be able to generate an audit record of the following auditable events:

- Start-up and shutdown of the audit functions;
- All auditable events for the not specified level of audit; and
- All administrative actions;
- Specifically defined auditable events listed in **Table 4**.

**FAU\_GEN.1.2** The TSF shall record within each audit record at least the following information:

- Date and time of the event, type of event, subject identity, and the outcome (success or failure) of the event; and
- For each audit event type, based on the auditable event definitions of the functional components included in the PP/ST, information specified in column three of **Table 4**.

Requirement	Auditable Events	Additional Audit Record Contents
FAU_GEN.1	None.	
FAU_GEN.2	None.	
FAU_STG_EXT.1	None.	
FCS_CKM.1	None.	
FCS_CKM_EXT.4	None.	
FCS_COP.1(1)	None.	
FCS_COP.1(2)	None.	
FCS_COP.1(3)	None.	
FCS_COP.1(4)	None.	
FCS_IPSEC_EXT.1	Failure to establish an IPsec SA. Establishment/Termination of an IPsec SA.	Reason for failure. Non-TOE endpoint of connection (IP address) for both successes and failures.
FCS_RBG_EXT.1	None.	
FCS_SSH_EXT.1	Failure to establish an SSH session. Establishment/Termination of an SSH session.	Reason for failure Non-TOE endpoint of connection (IP address) for both successes and failures.
FDP_RIP.2	None.	
FIA_PMG_EXT.1	None.	
FIA_UAU_EXT.2	All use of the authentication mechanism.	Origin of the attempt (e.g., IP address).
FIA_UIA_EXT.1	All use of the authentication and authentication mechanism.	Provided user identity, origin of the attempt (e.g., IP address).
FIA_UAU.7	None.	
FMT_MTD.1	None.	
FMT_SMF.1	None.	
FMT_SMR.2	None.	
FPT_APW_EXT.1	None.	
FPT_SKP_EXT.1	None.	

Requirement	Auditable Events	Additional Audit Record Contents
FPT_STM.1	Changes to the time.	The old and new values for the time. Origin of the attempt (e.g., IP address).
FPT_TUD_EXT.1	Initiation of update.	No additional information.
FPT_TST_EXT.1	None.	
FTA_SSL_EXT.1	Any attempts at unlocking of an interactive session.	No additional information.
FTA_SSL.3	The termination of a remote session by the session locking mechanism.	No additional information.
FTA_SSL.4	The termination of an interactive session.	No additional information.
FTA_TAB.1	None.	
FTP_ITC.1	Initiation of the trusted channel. Termination of the trusted channel. Failure of the trusted channel functions.	Identification of the initiator and target of failed trusted channels establishment attempt.
FTP_TRP.1	Initiation of the trusted channel. Termination of the trusted channel. Failures of the trusted path functions.	Identification of the claimed user identity.

Table 4: Auditable Events

#### 5.2.1.2 User Identity Association (FAU\_GEN.2)

**FAU\_GEN.2.1** For audit events resulting from actions of identified users, the TSF shall be able to associate each auditable event with the identity of the user that caused the event.

#### 5.2.1.3 External Audit Trail Storage (FAU\_STG\_EXT.1)

**FAU\_STG\_EXT.1.1** The TSF shall be able to [*transmit the generated audit data to an external IT entity*] using a trusted channel implementing the [*IPsec*] protocol.

### 5.2.2 Cryptographic Support (FCS)

#### 5.2.2.1 Cryptographic Key Generation (for asymmetric keys) (FCS\_CKM.1)

**FCS\_CKM.1.1** Refinement: The TSF shall generate asymmetric cryptographic keys used for key establishment in accordance with [

- *NIST Special Publication 800-56A, "Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography" for elliptic curve-based key establishment schemes and implementing "NIST curves" P-256, P-384 and [P-521] (as defined in FIPS PUB 186-3, "Digital Signature Standard")*
- *NIST Special Publication 800-56B, 'Recommendation for Pair-Wise Key Establishment Schemes Using Integer Factorization Cryptography' for RSA-based key establishment schemes]*

and specified cryptographic key sizes equivalent to, or greater than, a symmetric key strength of 112 bits.

#### 5.2.2.2 Cryptographic Key Zeroization (FCS\_CKM\_EXT.4)

**FCS\_CKM\_EXT.4.1** The TSF shall zeroize all plaintext secret and private cryptographic keys and CSPs when no longer required.

### 5.2.2.3 Cryptographic Operation (for data encryption/decryption) (FCS\_COP.1(1))

- FCS\_COP.1(1).1** Refinement: The TSF shall perform [encryption and decryption] in accordance with a specified cryptographic algorithm [AES operating in [*CBC*, *GCM*, *CTR*]] and cryptographic key sizes 128-bits and 256-bits that meets the following:
- FIPS PUB 197, 'Advanced Encryption Standard (AES)'
  - [*NIST SP 800-38A*, *NIST SP 800-38D*].

### 5.2.2.4 Cryptographic Operation (for cryptographic signature) (FCS\_COP.1(2))

- FCS\_COP.1(2).1** Refinement: The TSF shall perform cryptographic signature services in accordance with a [
- (1) *RSA Digital Signature Algorithm (rDSA) with a key size (modulus) of 2048 bits or greater or*
  - (2) *Elliptic Curve Digital Signature Algorithm (ECDSA) with a key size of 256 bits or greater*

that meets the following:

[*Case: RSA Digital Signature Algorithm*

- *FIPS PUB 186-2 or FIPS PUB 186-3, 'Digital Signature Standard'.*

*Case: Elliptic Curve Digital Signature Algorithm*

- *FIPS PUB 186-3, 'Digital Signature Standard'.*
- *The TSF shall implement "NIST curves" P-256, P-384 and [P-521] (as defined in FIPS PUB 186-3, "Digital Signature Standard").*

### 5.2.2.5 Cryptographic Operation (for cryptographic hashing) (FCS\_COP.1(3))

- FCS\_COP.1(3).1** Refinement: The TSF shall perform cryptographic hashing services in accordance with a specified cryptographic algorithm [*SHA-1*, *SHA-256*, *SHA-384*, *SHA-512*] and message digest sizes [*160*, *256*, *384*, *512*] bits that meet the following: FIPS Pub 180-3, 'Secure Hash Standard.'

### 5.2.2.6 Cryptographic Operation (for keyed-hash message authentication) (FCS\_COP.1(4))

- FCS\_COP.1(4).1** Refinement: The TSF shall perform keyed-hash message authentication in accordance with a specified cryptographic algorithm HMAC-[*SHA-1*, *SHA-256*, *SHA-384*, *SHA-512*], key size [*160*, *256*, *384*, *512 bits*], and message digest sizes [*160*, *256*, *384*, *512*] bits that meet the following: FIPS Pub 198-1, 'The Keyed-Hash Message Authentication Code', and FIPS Pub 180-3, 'Secure Hash Standard.'

### 5.2.2.7 Explicit: IPSEC (FCS\_IPSEC\_EXT.1)

- FCS\_IPSEC\_EXT.1.1** The TSF shall implement the IPsec architecture as specified in RFC 4301.
- FCS\_IPSEC\_EXT.1.2** The TSF shall implement [*tunnel mode*, *transport mode*].
- FCS\_IPSEC\_EXT.1.3** The TSF shall have a nominal, final entry in the SPD that matches anything that is otherwise unmatched, and discards it.
- FCS\_IPSEC\_EXT.1.4** The TSF shall implement the IPsec protocol ESP as defined by RFC 4303 using [*the cryptographic algorithms*
- *AES-CBC-128 (as specified by RFC 3602) together with a Secure Hash Algorithm (SHA)-based HMAC,*
  - *AES-CBC-256 (as specified by RFC 3602) together with a Secure Hash Algorithm (SHA)-based HMAC,*
  - *AES-GCM-128 as specified in RFC 4106,*
  - *AES-GCM-256 as specified in RFC 4106,*

].

- FCS\_IPSEC\_EXT.1.5** The TSF shall implement the protocol: [*IKEv1 as defined in RFCs 2407, 2408, 2409, RFC 4109, [no other RFCs for extended sequence numbers], and [RFC 4868 for hash functions]*]; *IKEv2 as defined in RFCs 5996 (with mandatory support for NAT traversal as specified in section 2.23), 4307, and [RFC 4868 for hash functions]*].
- FCS\_IPSEC\_EXT.1.6** The TSF shall ensure the encrypted payload in the [*IKEv1, IKEv2*] protocol uses the cryptographic algorithms AES-CBC-128, AES-CBC-256 as specified in RFC 6379 and [*no other algorithm*].
- FCS\_IPSEC\_EXT.1.7** The TSF shall ensure that IKEv1 Phase 1 exchanges use only main mode.
- FCS\_IPSEC\_EXT.1.8** The TSF shall ensure that [*IKEv2 SA lifetimes can be established based on [number of packets/number of bytes; length of time, where the time values can be limited to: 24 hours for Phase 1 SAs and 8 hours for Phase 2 SAs]; IKEv1 SA lifetimes can be established based on [number of packets/number of bytes; length of time, where the time values can be limited to: 24 hours for Phase 1 SAs and 8 hours for Phase 2 SAs]*].
- FCS\_IPSEC\_EXT.1.9** The TSF shall ensure that all IKE protocols implement DH Groups 14 (2048-bit MODP), and [*24 (2048-bit MODP with 256-bit POS), 19 (256-bit Random ECP) (IKEv2 only), and 20 (384-bit Random ECP) (IKEv2 only)*].
- FCS\_IPSEC\_EXT.1.10** The TSF shall ensure that all IKE protocols perform Peer Authentication using the [*RSA, ECDSA (IKEv2 only)*] algorithm and Pre-shared Keys.

#### 5.2.2.8 Extended: Cryptographic Operation (Random Bit Generation) (FCS\_RBG\_EXT.1)

- FCS\_RBG\_EXT.1.1** The TSF shall perform all random bit generation (RBG) services in accordance with [*NIST Special Publication 800-90 using [CTR\_DRBG (AES)]*] seeded by an entropy source that accumulated entropy from [*a software-based noise source*].
- FCS\_RBG\_EXT.1.2** The deterministic RBG shall be seeded with a minimum of [*256 bits*] of entropy at least equal to the greatest security strength of the keys and hashes that it will generate.

#### 5.2.2.9 Explicit: SSH (FCS\_SSH\_EXT.1)

- FCS\_SSH\_EXT.1.1** The TSF shall implement the SSH protocol that complies with RFCs 4251, 4252, 4253, 4254, and [*5656*].
- FCS\_SSH\_EXT.1.2** The TSF shall ensure that the SSH protocol implementation supports the following authentication methods as described in RFC 4252: public key-based, [*password-based*]<sup>1</sup>.
- FCS\_SSH\_EXT.1.3** The TSF shall ensure that, as described in RFC 4253, packets greater than [*256K*] bytes in an SSH transport connection are dropped.
- FCS\_SSH\_EXT.1.4** The TSF shall ensure that the SSH transport implementation uses the following encryption algorithms: AES-CBC-128, AES-CBC-256, [*AEAD\_AES\_128\_GCM, AEAD\_AES\_256\_GCM*].
- FCS\_SSH\_EXT.1.5** The TSF shall ensure that the SSH transport implementation uses [*SSH\_RSA, ecdsa-sha2-nistp256*] and [*ecdsa-sha2-nistp384*] as its public key algorithm(s).
- FCS\_SSH\_EXT.1.6** The TSF shall ensure that data integrity algorithms used in SSH transport connection is [*hmac-sha1, hmac-sha1-96, hmac-sha2-256, hmac-sha2-512*].
- FCS\_SSH\_EXT.1.7** The TSF shall ensure that diffie-hellman-group14-sha1 and [*ecdh-sha2-nistp256, ecdh-sha2-nistp384*] are the only allowed key exchange methods used for the SSH protocol.

### 5.2.3 User Data Protection (FDP)

#### 5.2.3.1 Full Residual Information Protection (FDP\_RIP.2)

- FDP\_RIP.2.1** The TSF shall ensure that any previous information content of a resource is made unavailable upon the [*allocation of the resource to*] all objects.

<sup>1</sup> Marked as a selection per NIAP Technical Decision TD0032 ([https://www.niap-ccevs.org/Documents\\_and\\_Guidance/view\\_td.cfm?td\\_id=34](https://www.niap-ccevs.org/Documents_and_Guidance/view_td.cfm?td_id=34))

## 5.2.4 Identification and Authentication (FIA)

### 5.2.4.1 Extended: Pre-Shared Key Composition (FIA\_PSK\_EXT.1)

- FIA\_PSK\_EXT.1.1** The TSF shall be able to use pre-shared keys for IPsec.
- FIA\_PSK\_EXT.1.2** The TSF shall be able to accept text-based pre-shared keys that:
- are 22 characters and *[[lengths from 15 to 128 characters]]*;
  - composed of any combination of upper and lower case letters, numbers, and special characters (that include: “!”, “@”, “#”, “\$”, “%”, “^”, “&”, “\*”, “(”, and “)”).
- FIA\_PSK\_EXT.1.3** The TSF shall condition the text-based pre-shared keys by using *[[the bit representation of the ASCII coding of the entered characters as the key]]* and be able to *[use no other pre-shared key]*.

### 5.2.4.2 Password Management (FIA\_PMG\_EXT.1)

- FIA\_PMG\_EXT.1.1** The TSF shall provide the following password management capabilities for administrative passwords:
1. Passwords shall be able to be composed of any combination of upper and lower case letters, numbers, and the following special characters: *[[“!”, “@”, “#”, “\$”, “%”, “^”, “&”, “\*”, “(”, “)”, [“”, “+”, “,”, “-”, “.”, “/”, “:”, “;”, “<”, “=”, “>”, “[”, “\”, “]”, “\_”, “~”, “{”, “}”, and “~”]]*;
  2. Minimum password length shall be settable by the Security Administrator, and support passwords of 15 characters or greater;

### 5.2.4.3 Protected Authentication Feedback (FIA\_UAU.7)

- FIA\_UAU.7.1** The TSF shall provide only obscured feedback to the administrative user while the authentication is in progress at the local console.

### 5.2.4.4 Extended: Password-based Authentication Mechanism (FIA\_UAU\_EXT.2)

- FIA\_UAU\_EXT.2.1** The TSF shall provide a local password-based authentication mechanism, *[[and access to external RADIUS and TACACS]]* to perform administrative user authentication.

### 5.2.4.5 User Identification and Authentication (FIA\_UIA\_EXT.1)

- FIA\_UIA\_EXT.1.1** The TSF shall allow the following actions prior to requiring the non-TOE entity to initiate the identification and authentication process:
- Display the warning banner in accordance with FTA\_TAB.1;
- FIA\_UIA\_EXT.1.2** The TSF shall require each administrative user to be successfully identified and authenticated before allowing any other TSF-mediated actions on behalf of that administrative user.

## 5.2.5 Security Management (FMT)

### 5.2.5.1 Management of TSF Data (for general TSF data) (FMT\_MTD.1)

- FMT\_MTD.1.1** The TSF shall restrict the ability to manage the TSF data to the Security Administrators.

### 5.2.5.2 Specification of Management Functions (FMT\_SMF.1)

- FMT\_SMF.1.1** The TSF shall be capable of performing the following management functions:
- Ability to administer the TOE locally and remotely;
  - Ability to update the TOE, and to verify the updates using the *[digital signature]* capability prior to installing those updates; [
  - *Ability to configure the cryptographic functionality]*.

### 5.2.5.3 Restrictions on Security Roles (FMT\_SMR.2)

- FMT\_SMR.2.1** The TSF shall maintain the roles:
- Authorized Administrator.
- FMT\_SMR.2.2** The TSF shall be able to associate users with roles.
- FMT\_SMR.2.3** The TSF shall ensure that the conditions
- Authorized Administrator role shall be able to administer the TOE locally;
  - Authorized Administrator role shall be able to administer the TOE remotely;
- are satisfied.

## 5.2.6 Protection of the TSF (FPT)

### 5.2.6.1 Extended: Protection of Administrator Passwords (FPT\_APW\_EXT.1)

- FPT\_APW\_EXT.1.1** The TSF shall store passwords in non-plaintext form.
- FPT\_APW\_EXT.1.2** The TSF shall prevent the reading of plaintext passwords.

### 5.2.6.2 Extended: Protection of TSF Data (for reading of all symmetric keys) (FPT\_SKP\_EXT.1)

- FPT\_SKP\_EXT.1.1** The TSF shall prevent reading of all pre-shared keys, symmetric key, and private keys.

### 5.2.6.3 Reliable Time Stamps (FPT\_STM.1)

- FPT\_STM.1.1** The TSF shall be able to provide reliable time stamps for its own use.

### 5.2.6.4 TSF Testing (FPT\_TST\_EXT.1)

- FPT\_TST\_EXT.1.1** The TSF shall run a suite of self tests during initial start-up (on power on) to demonstrate the correct operation of the TSF.

### 5.2.6.5 Extended: Trusted Update (FPT\_TUD\_EXT.1)

- FPT\_TUD\_EXT.1.1** The TSF shall provide security administrators the ability to query the current version of the TOE firmware/software.
- FPT\_TUD\_EXT.1.2** The TSF shall provide security administrators the ability to initiate updates to TOE firmware/software.
- FPT\_TUD\_EXT.1.3** The TSF shall provide a means to verify firmware/software updates to the TOE using a [*digital signature mechanism*] prior to installing those updates.

## 5.2.7 TOE Access (FTA)

### 5.2.7.1 TSF-initiated Termination (FTA\_SSL.3)

- FTA\_SSL.3.1** Refinement: The TSF shall terminate a remote interactive session after a Security Administrator-configurable time interval of session inactivity.

### 5.2.7.2 User-initiated Termination (FTA\_SSL.4)

- FTA\_SSL.4.1** The TSF shall allow Administrator-initiated termination of the Administrator's own interactive session.

### 5.2.7.3 TSF-initiated Session Locking (FTA\_SSL\_EXT.1)

- FTA\_SSL\_EXT.1.1** The TSF shall, for local interactive sessions, [*terminate the session*] after a Security Administrator-specified time period of inactivity.

#### 5.2.7.4 Default TOE Access Banners (FTA\_TAB.1)

**FTA\_TAB.1.1** Refinement: Before establishing an administrative user session the TSF shall display a Security Administrator-specified advisory notice and consent warning message regarding use of the TOE.

### 5.2.8 Trusted path/channels (FTP)

#### 5.2.8.1 Trusted Channel (FTP\_ITC.1)

**FTP\_ITC.1.1** Refinement: The TSF shall use [*IPsec*] to provide a trusted communication channel between itself and authorized IT entities supporting the following capabilities: audit server, [*authentication server*] that is logically distinct from other communication channels and provides assured identification of its end points and protection of the channel data from disclosure and detection of modification of the channel data.

**FTP\_ITC.1.2** The TSF shall permit the TSF, or the authorized IT entities to initiate communication via the trusted channel.

**FTP\_ITC.1.3** The TSF shall initiate communication via the trusted channel for [**transmitting audit records to an audit server, and external authentication functions**].

#### 5.2.8.2 Trusted Path (FTP\_TRP.1)

**FTP\_TRP.1.1** Refinement: The TSF shall use [*SSH*] to provide a trusted communication path between itself and remote administrators that is logically distinct from other communication paths and provides assured identification of its end points and protection of the communicated data from disclosure and detection of modification of the communicated data.

**FTP\_TRP.1.2** Refinement: The TSF shall permit remote administrators to initiate communication via the trusted path.

**FTP\_TRP.1.3** The TSF shall require the use of the trusted path for initial administrator authentication and all remote administrative actions.



## 5.3 TOE Security Assurance Requirements

The security assurance requirements for the TOE are included by reference from the NDPP.

Requirement Class	Requirement Component
<b>ADV: Development</b>	ADV_FSP.1 Basic functional specification
<b>AGD: Guidance documents</b>	AGD_OPE.1: Operational user guidance
	AGD_PRE.1: Preparative procedures
<b>ALC: Life-cycle support</b>	ALC_CMC.1 Labelling of the TOE
	ALC_CMS.1 TOE CM coverage
<b>ATE: Tests</b>	ATE_IND.1 Independent testing - conformance
<b>AVA: Vulnerability assessment</b>	AVA_VAN.1 Vulnerability survey

**Table 5: Assurance Components**

Consequently, the assurance activities specified in NDPP apply to the TOE evaluation.

## 6. TOE Summary Specification

This chapter describes the security functions:

- Security audit
- Cryptographic support
- User data protection
- Identification and authentication
- Security management
- Protection of the TSF
- TOE access
- Trusted path/channels.

### 6.1 Security Audit

The TOE is to generate log records of security relevant and other events as they occur. The events that can cause an audit record to be logged include starting and stopping the audit function, any use of an administrator command via the CLI interface, as well as all of the events identified in **Table 4** (which corresponds to the audit events specified in NDPP). Note that the only protocol (i.e., IPsec, SSH) failures auditable by the TOE are authentication failures for user-level connections.

The generated audit records identify the date and time, the nature or type of the triggering event, an indication of whether the event succeeded, failed or had some other outcome, and the identity of the agent (e.g. user) responsible for the event (e.g., user or network host). The logged audit records also include event-specific content that includes at least all of the content required in **Table 4**.

The TOE includes an internal log implementation that can be used to store and review audit records locally. The maximum storage space reserved for the local log file can be configured to a range between 1 and 10MB. When the local log storage is full, the TOE will overwrite the oldest records with new records. Only users with the role network-admin, network-operator, or level-15 can access the local audit trail. Alternately, the TOE can be configured to send generated audit records to an external Syslog server using IPsec.

Note that audit records are not buffered for transmission to the syslog server. If the connection to the syslog server goes down, generated audit records are not queued and will not be transmitted to the syslog server when the connection is re-established. However, audit records will still be delivered to any other configured audit destinations, such as the log buffer and local log file. Therefore, the administrator is advised to ensure additional

audit destinations are configured so that generated audit records will still be available for review in the event of loss of connectivity to the syslog server. In addition, multiple log servers can be configured to provide redundancy.

The Security Audit function is designed to satisfy the following security functional requirements:

- FAU\_GEN.1: The TOE can generate audit records for events including starting and stopping the audit function, administrator commands, and all other events identified in **Table 4**. Furthermore, each audit record identifies the date/time, event type, outcome of the event, responsible subject/user, as well as the additional event-specific content indicated in **Table 4**.
- FAU\_GEN.2: The TOE identifies the responsible user for each event based on the specific administrator or network entity (identified by IP address) that caused the event.
- FAU\_STG\_EXT.1: The TOE can be configured to export audit records to an external Syslog server and can be configured to use IPsec for communication with the Syslog server.

## 6.2 Cryptographic Support

The TOE includes NIST-validated cryptographic algorithms providing supporting cryptographic functions. The following functions have been certified in accordance with the identified standards.

Functions	Standards	Certificates
Asymmetric key generation		
ECC key pair generation(NIST curves P-256, P-384 and P-521)	NIST Special Publication 800-56A	#834
RSA key generation (key size 2048 bits)	NIST Special Publication 800-56B	#1969
Encryption/Decryption		
AES CBC, CTR and GCM (128 and 256 bit key lengths)	FIPS PUB 197 NIST SP 800-38A NIST SP 800-38D	Firmware: #3855 Kernel: #3854
Cryptographic signature services		
RSA Digital Signature Algorithm (rDSA) (modulus 2048 bits) ECDSA (NIST curves P-256, P-384 and P-521)	FIPS PUB 186-2 FIPS PUB 186-3	Firmware: #1969 (RSA), #834(ECDSA)
Cryptographic hashing		
SHA-1, SHA-256, SHA-384 and SHA-512 (digest sizes 160 , 256, 384 and 512 bits)	FIPS Pub 180-3	Firmware: #3177 Kernel: #3176
Keyed-hash message authentication The certificates for HMAC-SHA-1 should be Firmware: #2503 & Kernel: 2502		
HMAC-SHA-1 (block size 512 bits, key size 160 bits, and digest size 160 bits) HMAC-SHA-256 (key size 256 bits and digest size 256 bits ) HMAC-SHA-384 (block size 1024 bits, key Size 384 bits and digest size 384 bits) HMAC-SHA-512 (block size 1024 bits, key Size 512 bits and digest size 512 bits)	FIPS Pub 198-1 FIPS Pub 180-3	Firmware: #2503 Kernel: #2502
Random bit generation		

Functions	Standards	Certificates
CTR_DRBG (AES) with one independent software-based noise source of 256 bits of non-determinism	NIST Special Publication 800-90	Firmware: #1094

**Table 6: Cryptographic Functions**

The following table demonstrates that the TSF complies with 800-56B. The table identifies the sections in 800-56B that are implemented by the TSF; and the “should”, “should not”, and “shall not” conditions from the publication along with an indication of whether the TOE conforms to those conditions with deviations rationalized. Key establishment is among the identified sections.

NIST SP800-56B Section Reference	“should”, “should not”, or “shall not”	Implemented accordingly?	Rationale for deviation
5.6	should	yes	
5.8	shall not	no	RSA-OAEP is not supported. The device supports RSA-PKCS1 Padding
5.9	shall not (first occurrence)	yes	
5.9	shall not (second occurrence)	yes	
6.1	should not	yes	
6.1	should (first occurrence)	yes	
6.1	should (second occurrence)	yes	
6.1	should (third occurrence)	yes	
6.1	should (fourth occurrence)	yes	
6.1	shall not (first occurrence)	yes	
6.1	shall not (second occurrence)	yes	
6.2.3	should	yes	
6.5.1	should	yes	
6.5.2	should	yes	
6.5.2.1	should	yes	
6.6	shall not	yes	
7.1.2	should	yes	
7.2.1.3	should	yes	
7.2.1.3	should not	yes	
7.2.2.3	should (first occurrence)	no	RSA-OAEP is not supported. The device supports RSA-PKCS1 Padding
7.2.2.3	should (second occurrence)	no	RSA-OAEP is not supported. The device supports RSA-PKCS1 Padding
7.2.2.3	should (third occurrence)	no	RSA-OAEP is not supported. The device supports RSA-PKCS1 Padding
7.2.2.3	should (fourth occurrence)	no	RSA-OAEP is not supported. The device supports RSA-PKCS1 Padding
7.2.2.3	should not	no	RSA-OAEP is not supported. The device supports RSA-PKCS1

NIST SP800-56B Section Reference	“should”, “should not”, or “shall not”	Implemented accordingly?	Rationale for deviation
			Padding
7.2.2.3	shall not	no	RSA-OAEP is not supported. The device supports RSA-PKCS1 Padding
7.2.3.3	should (first occurrence)	no	RSA-KEM-KWS is not supported
7.2.3.3	should (second occurrence)	no	RSA-KEM-KWS is not supported
7.2.3.3	should (third occurrence)	no	RSA-KEM-KWS is not supported
7.2.3.3	should (fourth occurrence)	no	RSA-KEM-KWS is not supported
7.2.3.3	should (fifth occurrence)	no	RSA-KEM-KWS is not supported
7.2.3.3	should not	no	RSA-KEM-KWS is not supported
8	should	yes	
8.3.2	should not	yes	

**Table 7: NIST SP800-56B Conformance**

The TOE uses a software-based deterministic random bit generator (DRBG) that complies with NIST SP 800-90, using CTR\_DRBG (AES). The entropy used to seed the DRBG is a 256-bit value obtained from the Comware entropy source. The design architecture of the Comware entropy source is the same as the architecture of the Linux kernel entropy pool. The noise sources for the Comware entropy pool include interrupt, process scheduling and memory allocation.

The TOE is designed to zeroize secret and private cryptographic keys and critical security parameters (CSPs) when they are no longer required by the TOE. The following table identifies the applicable secret and private cryptographic keys and CSPs, and summarizes how and when they are deleted. Note that where identified zeroization occurs as follows: 1) when deleted from FLASH, the previous value is overwritten once with zeroes; 2) when added or changed in FLASH, any old value is overwritten completely with the new value; and, 3) the zeroization of values in RAM is achieved by overwriting once with zeroes. Note that only some of the keys and CSPs are applicable to the evaluation.

#	Key/ CSP Name	Generation/ Algorithm	Key Size	Description	Storage	Zeroization
<b>Public key management</b>						
CSP1-1	RSA private key	CTR_DRBG (AES)/RSA	2048 bits	Identity certificates for the security appliance itself and also used in IPsec and SSH negotiations.	FLASH (cipher text / AES-CTR 256)	Using CLI command <b>“public-key local destroy rsa ...”</b> to zeroize.
CSP1-2	ECDSA private key	CTR_DRBG(AE S)/ECDSA	NIST P256, P384, P521	Identity certificates for the security appliance itself and also used in IPsec, SSH and SSL.	FLASH (cipher text /AES-CTR 256)	Using CLI command <b>“public-key local destroy ecdsa ...”</b> to zeroize.
CSP1-3	RSA Public keys	RSA	RSA:1024 ~ 2048 bits  Note: 192 – bit keys are not used in the evaluated configuration	Public keys of peers to validate the digital signature	FLASH(plain text)	Peer public keys exist in a FLASH start-up configuration file.  Using CLI commands <b>“undo public-key peer”</b> and <b>“save”</b> to zeroize the public keys.
CSP1-4	ECDSA Public keys	ECDSA	NIST P256, P384, P521	Public keys of peers to validate the digital signature	FLASH (plain text)	Peer public keys exist in a FLASH start-up configuration file.

#	Key/ CSP Name	Generation/ Algorithm	Key Size	Description	Storage	Zeroization
						Using CLI commands " <b>undo public-key peer</b> " and " <b>save</b> " to zeroize the public keys.
<b>IPsec</b>						
CSP2-1	IPsec authentication keys	Generated using IKE protocol (CTR_DRBG (AES)+HMAC-SHA1/HMAC-SHA256/SHA384/SHA512+DH).  Algorithms: HMAC-SHA1-96 HMAC-SHA-256-128 HMAC-SHA-384-192 HMAC-SHA-512-256 AES-GMAC	160 bits 256 bits 384 bits 512 bits  AES-GMAC: 128, 256 bits  Note: GMAC is not used in any of the evaluated mechanisms	Used for authenticating the IPsec traffic	RAM (plain text)	Zeroized upon deleting the IPsec session.
CSP2-2	IPsec encryption keys	Generated using IKE protocol (CTR_DRBG (AES)+HMAC-SHA1/HMAC-SHA256/SHA384/SHA512+DH).  Algorithms: AES-CBC, AES-GCM	128 bits 192 bits 256 bits  Note: 192 – bit keys are not used in the evaluated configuration	Used for encrypting the IPsec traffic	RAM (plain text)	Zeroized upon deleting the IPsec session.
CSP2-3	IPsec authentication keys	HMAC-SHA1-96 HMAC-SHA-256-128 HMAC-SHA-384-192 HMAC-SHA-512-256	160 bits 256 bits 384 bits 512 bits	Manually configured key used for authenticating the IPsec traffic.	FLASH (cipher text / AES-CTR 256) and RAM (plain text)	Keys will be zeroized using CLI commands " <b>undo sa hex-key authentication ...</b> " and " <b>save</b> ",
CSP2-4	IPsec encryption keys	AES	128 bits 192 bits 256 bits  Note: 192 – bit keys are not used in the evaluated configuration	Manually configured key used for encrypting the IPsec traffic.	FLASH (cipher text / AES-CTR 256) and RAM (plain text)	Keys will be zeroized using CLI commands " <b>undo sa hex-key encryption ...</b> " and " <b>save</b> ",
<b>IKEv1</b>						
CSP3-1	IKE pre-shared keys	Shared Secret	15 ~ 128 bytes	Entered by the Crypto-Officer in plain text form and used for authentication during IKE	FLASH (cipher text/ AES-CTR 256) and RAM (plain)	Keys will be zeroized using CLI commands " <b>undo pre-shared-key ...</b> " and " <b>save</b> ",

#	Key/ CSP Name	Generation/ Algorithm	Key Size	Description	Storage	Zeroization
CSP3-2	IKE RSA Authentication private Key	RSA	RSA: 2048 bits	private key used for IKE protocol during the handshake	RAM(plain text)	Automatically zeroized upon handshake finishing
CSP3-3	IKE Diffie-Hellman Key Pairs	CTR_DRBG (AES) / DH	2048 bits	Key agreement for IKE	RAM (plain text)	Automatically zeroized upon handshake finishing
CSP3-4	IKE Integrity key	Generated using IKE (CTR_DRBG (AES)+HMAC-SHA1/HMAC-SHA256/SHA384/SHA512+DH).  Algorithms: HMAC-SHA1, HMAC-SHA256, HMAC-SHA384, HMAC-SHA512	160 bits 256 bits	Used for integrity test of IKE negotiations	RAM (plain text)	Zeroized upon deleting the IKE session.
CSP3-5	IKE Encryption Key	Generated using IKE (CTR_DRBG (AES)+HMAC-SHA1/HMAC-SHA256/SHA384/SHA512+DH).  Algorithms: AES	128 bits, 192 bits, 256 bits  Note: 192 – bit keys are not used in the evaluated configuration	Used for encrypting IKE negotiations	RAM (plain text)	Zeroized upon deleting the IKE session.
<b>IKEv2</b>						
CSP4-1	IKE pre-shared keys	Shared Secret	15 ~ 128 bytes	Entered by the Crypto-Officer in plain text form and used for authentication during IKE	FLASH(ciphertext/ AES-CTR 256) and RAM (plain)	Keys will be zeroized using CLI commands " <b>undo pre-shared-key ...</b> " and " <b>save</b> ",
CSP4-2	IKE RSA Authentication private Key	RSA ECDSA	RSA:2048 bits ECDSA:P-256, P-384, P-521	private key used for IKE protocol during the handshake	RAM(plain text)	Automatically zeroized upon handshake finishing
CSP4-3	IKE Diffie-Hellman Key Pairs	CTR_DRBG (AES) / DH,ECDH	DH:2048 bits ECDH:P-256, P-384	Key agreement for IKE	RAM (plain text)	Automatically zeroized upon handshake finishing
CSP4-4	IKE Integrity key	Generated using IKE (CTR_DRBG (AES)+DH/ECDH + HMAC-SHA1/HMAC-SHA256/HMAC-SHA384).  Algorithms:	160 bits 256 bits 384 bits	Used for integrity test of IKE negotiations	RAM (plain text)	Zeroized upon deleting the IKE session.

#	Key/ CSP Name	Generation/ Algorithm	Key Size	Description	Storage	Zeroization
		HMAC-SHA1, HMAC-SHA256- 128 HMAC-SHA384- 192				
CSP4-5	IKE Encryption Key	Generated using IKE (CTR_DRBG (AES)+DH/ECD H + HMAC- SHA1/HMAC- SHA256/HMAC- SHA384).  Algorithms: AES	128 bits, 192 bits, 256 bits  Note: 192 – bit keys are not used in the evaluated configuration	Used for encrypting IKE negotiations	RAM (plain text)	Zeroized upon deleting the IKE session.
<b>SSH</b>						
CSP5-1	SSH Private key	RSA ECDSA	RSA:2048 bits ECDSA: P- 256, P-384	private key used for SSH protocol during handshake	RAM(plain text)	Automatically zeroized upon finishing handshake.
CSP5-2	SSH Diffie- Hellman Key Pairs	CTR_DRBG (AES) / DH/ECDH	DH: 2048 bits ECDH: P- 256, P-384	Key agreement for SSH sessions.	RAM (plain text)	Automatically zeroized upon finishing handshake.
CSP5-3	SSH Session encryption key	Generated using the SSH protocol(CTR_D RBG(AES)+SHA 1+DH)  Algorithms: AES-CBC, AES- GCM	128 bits, 256 bits	Key used for encrypting SSH session.	RAM (plain text)	Automatically zeroized when SSH session terminated.
CSP5-4	SSH Session authentication key	Generated using the SSH protocol(CTR_D RBG(AES)+SHA 1+DH)  Algorithms: HMAC-SHA1, HMAC-SHA1- 96, hmac- sha256, hmac- sha512  AES-GCM	SHA1: 160 bits  AES-GCM: 128 bits, 256 bits	Key used for authenticating SSH session.	RAM (plain text)	Automatically zeroized when SSH session terminated.
<b>AAA</b>						
CSP6-1	User Passwords	Secret	15 ~ 63 bytes	Critical security parameters used to authenticate the administrator login.	FLASH (hashed text/SHA- 512) and RAM (plain)	Use CLI command "password" to set new password, or use CLI command "undo local- user ..." to zeroize the password and delete user account.

#	Key/ CSP Name	Generation/ Algorithm	Key Size	Description	Storage	Zeroization
CSP6-2	Super password	Secret	15 ~ 63 bytes	Critical security parameters used to authenticate privilege promoting.	FLASH (hashed text/SHA-512) and RAM (plain)	Use CLI command <b>"undo super password"</b> to zeroize the super password.
CSP6-3	RADIUS shared secret keys	Shared Secret	15 ~ 64 bytes	Used for authenticating the RADIUS server to the security appliance and vice versa. Entered by the Security administrator in plain text form and stored in cipher text form.	FLASH (cipher text/AES-CTR 256) and RAM (plain)	Keys will be zeroized using following commands:  <b>"undo primary authentication"</b> , <b>"undo primary accounting"</b> ,  <b>"undo secondary authentication"</b> , <b>"undo secondary accounting"</b> .
CSP6-4	TACACS+ shared secret keys	Shared Secret	15~255 bytes	Used for authenticating the TACACS+ server to the security appliance and vice versa. Entered by the Security administrator in plain text form and stored in cipher text form.	FLASH (cipher text/AES-CTR 256) and RAM (plain)	Keys will be zeroized using following commands:  <b>"undo primary authentication"</b> , <b>"undo primary accounting"</b> , <b>"undo primary authorization"</b> ,  <b>"undo secondary authentication"</b> , <b>"undo secondary accounting"</b> , <b>"undo secondary authorization"</b> .
<b>Random Bits Generation</b>						
CSP7-1	DRBG seed	Entropy / SP 800 - 90 CTR_DRBG	256 bits	Input to the DRBG that determines the internal state of the DRBG	RAM (plaintext)	Automatically zeroized when DRBG initialized
CSP7-2	DRBG V	SP 800 - 90 CTR_DRBG	128 bits	Generated by entropy source via the CTR_DRBG derivation function	RAM (plaintext)	Resetting or rebooting the security appliance
CSP7-3	DRBG Key	SP 800 - 90 CTR_DRBG	256 bits	Generated by entropy source via the CTR_DRBG derivation function	RAM (plaintext)	Resetting or rebooting the security appliance

Table 8: Key/CSP Zeroization Summary



These supporting cryptographic functions are included to support the IPsec, IKE, and SSHv2 (RFCs 4251, 4252, 4253, 4254, and 5656) secure communication protocols. The TOE implements SHA-1, SHA-256, SHA-384 and SHA-512 (digest sizes 160, 256, 384 and 512 bits) in accordance with FIPS Pub 180-3 for cryptographic hashing.

The TOE supports SSHv2 with AES (CBC, GCM) 128 or 256 bit ciphers, in conjunction with HMAC-SHA-1 or HMAC-SHA-1-96, hmac-sha2-256, or hmac-sha2-512. The TOE supports public key algorithms RSA, ecdsa-sha2-nistp256, and ecdsa-sha2-nistp384. It supports diffie-hellman-group14-sha1, ecdh-sha2-nistp256 and with ecdh-sha2-nistp384 key exchange methods. While DES and 3DES (CBC), HMAC-MD5 and HMAC-MD5-96, as well as diffie-hellman-group-1 and diffie-hellman-exchange are all implemented, they are disabled while the TOE is operating in CC/FIPS mode.

SSHv2 connections are rekeyed prior to reaching  $2^{28}$  packets; the default authentication timeout period is 60 seconds allowing clients to retry only 3 times; both public-key and password based authentication can be configured; and packets are limited to 256K bytes. Note that the TOE manages a packet counter for each SSH session so that it can initiate a new key exchange when the  $2^{28}$  packet limit is reached. Whenever the timeout period or authentication retry limit is reached, the TOE closes the applicable TCP connection and releases the SSH session resources. As SSH packets are being received, the TOE uses a buffer to build all packet information. Once complete, the packet is checked to ensure it can be appropriately decrypted. However, if it is not complete when the buffer becomes full (256K bytes) the packet will be dropped.

The TOE includes an implementation of IPsec in accordance with RFC 4301. The TOE's implementation of IPsec supports both tunnel mode and transport mode. Furthermore, ESP mode "confidentiality only" is disabled by default. The TOE implements the Encapsulating Security Payload (ESP) IPsec protocol, as defined by RFC 4303, supporting AES-CBC-128 and AES-CBC-256 (both specified by RFC 3602) with HMAC-SHA1 and HMAC-SHA-256; and AES-GCM-128, and AES-GCM-256 (both specified by 4106). The TOE implements both versions 1 and 2 of Internet Key Exchange (IKEv1, IKEv2).

IKEv1 is implemented as defined in RFCs 2407, 2408, 2409, 4109, and 4868 and supports use of AES-CBC-128 and AES-CBC-256 to encrypt IKEv1 payloads. Note that the TOE supports both main and aggressive modes, though aggressive mode is disabled in CC/FIPS mode. HMAC SHA-1 (key size 160 bits), HMAC SHA-256 (key size 256), HMAC SHA-384 (key size 384 bits) and HMAC-512 (key size 512 bits) are used in support of the IPsec protocol ESP (FCS\_IPSEC\_EXT.1.4). IKE authentication keys are generated using the HMAC algorithms. The keys are used for authenticating IKE negotiations and IPsec traffic authentications and subsequent traffic encryption. HMAC SHA for IPsec key authentication and encryption can be generated by using IKE commands.

The TOE's implementation of IKEv2 conforms with RFCs 5996 (with mandatory support for NAT traversal as specified in section 2.23), 4307, and 4868 for hash functions. IKEv2 supports the same algorithms as for IKEv1 described above. Table 7 sections IPsec and IKEv2 identify HMAC support for key generation, authentication, and integrity. The TOE supports the 128-bit and 256-bit AES for both IKE\_SA and CHILD\_SAs.

The TOE provides mechanisms to implement an IPsec Security Policy Database (SPD) and to process packets to satisfy the behavior of DISCARD, BYPASS and PROTECT packet processing as described in RFC 4301. This is achieved through the administrator configuring appropriately specified access control lists (ACLs). The administrator first establishes an IPsec Policy containing a Security ACL to match traffic to be encrypted (PROTECTED) and applies it to the outbound interface. The Security ACL contains one or more rules, which are ordered based on a numeric index from lowest to highest. The TOE compares packets in turn against each rule in the Security ACL to determine if the packet matches the rule. Packets can be matched based on protocol (e.g., TCP, UDP), source IP address and destination IP address. As soon as a match is found, the packet is handled based on the action specified in the rule—either **permit**, which equates to PROTECT, or **deny**, which equates to BYPASS. Traffic matching a **deny** rule or not matching any rule in the Security ACL is passed on to the next stage of processing. Note that multiple IPsec Policies can be assigned to an interface as a policy group. In this case, each policy in the group has its own priority number that is unique within the policy group. Each policy is considered in turn, starting at the lowest number policy (which has highest priority) and proceeding in turn with increasing policy numbers until a match is found or until all policies have been examined. To cater for packets that match a **deny** rule or do not match any of the IPsec Policies, the administrator needs to configure further ACLs and bind them to the outbound interface using the `packet-filter` command. These ACLs specify permit/deny rules to implement BYPASS/DISCARD behavior. As with the Security ACL, the TOE compares packets against rules in the Firewall ACL based on protocol, source IP address and destination IP address. The rules in the Firewall ACL can be ordered in the same fashion as in a Security ACL. In the Firewall ACL, a **permit** rule equates to BYPASS, and a **deny** rule

equates to DISCARD. By default, the packet filter permits packets that do not match any ACL rule to pass through the TOE. In the evaluated configuration, an administrator changes this action to deny.

IKEv1 and IKEv2 SA lifetime and volume limits can be configured by an authorized administrator. IKEv1 SA lifetimes can be limited to 24 hours (any value between 60 and 604,800 seconds) for phase 1 and 8 hours any value from 180 to 604,800 seconds) for phase 2 and also to as little as 2.5 MB (any value between 2,560 and 4,294,967,295 KB) of traffic for phase 2. IKEv2\_SA lifetime can be limited to 24 hours (actually any value between 120 and 86,400 seconds). CHILD\_SA lifetimes can be limited to 8 hours (actually any value from 180 to 604,800 seconds). Volume can be limited to as little as 2.5 MB (actually any value between 2,560 and 4,294,967,295 KB).

The IKEv1 protocols implemented by the TOE include DH Groups 2 (1024-bit MODP), 5 (1536-bit MODP), 14 (2048-bit MODP) and 24 (2048-bit MODP with 256-bit POS) and use RSA (aka rDSA) peer authentication. However, when the TOE is operating in FIPS mode, only DH Groups 14 and 24 are supported. In the IKEv1 phase 1 and phase 2 exchanges, the TOE and peer will agree on the best DH group both can support. When the TOE initiates IKE negotiation, the DH group is sent in order according to the peer's configuration. When the TOE receives an IKE proposal, it will select the first match and the negotiation will fail if there is no match. During IKEv1 phase 1 authentication is based on a verifiable signature as described in RFC2409. The IKEv2 protocol implemented by the TOE includes DH 14 (2048-bit MODP), 24 (2048-bit MODP with 256-bit POS), 19 (256-bit Random ECP), and 20 (384-bit Random ECP) using RSA and ECDSA peer authentication. In the IKE\_SA\_INIT and CREATE\_CHILD\_SA exchanges, the TOE and peer will agree on the best DH group both can support. When the TOE initiates IKE negotiation, the DH group is sent in order according to the peer's configuration. When the TOE receives an IKE proposal, it will select the first match and the negotiation will fail if there is no match.

The TOE can be configured to use pre-shared keys with a given peer. When a pre-shared key is configured, IKE peer authentication will be performed using the configured pre-shared key, provided that the peer also has the pre-shared key. Text-based pre-shared keys used for IKE can be constructed of essentially any alphabetic character (upper and lower case), numerals, and special characters (e.g., “!”, “@”, “#”, “\$”, “%”, “^”, “&”, “\*”, “(”, and “)”) and can be anywhere from 15 to 128 characters in length (e.g., 22 characters). In this case, the TOE uses the bit representation of the underlying ASCII characters of the text-based pre-shared key as the key for IKE peer authentication. The TOE requires suitable keys to be entered by an authorized administrator.

The Cryptographic Support function is designed to satisfy the following security functional requirements:

- FCS\_CKM.1: See **Table 7** above.
- FCS\_CKM\_EXT.4: See **Table 8** above.
- FCS\_COP.1(1): See **Table 6** above.
- FCS\_COP.1(2): See **Table 6** above.
- FCS\_COP.1(3): See **Table 6** above.
- FCS\_COP.1(4): See **Table 6** above.
- FCS\_IPSEC\_EXT.1: The TOE supports IPsec cryptographic network communication protection.
- FCS\_RBG\_EXT.1: See **Table 6** above.
- FCS\_SSH\_EXT.1: The TOE supports SSHv2 interactive command-line secure administrator sessions as indicated above.
- FIA\_PSK\_EXT.1: The TOE supports pre-shared keys for IPsec peer authentication.

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## 6.3 User Data Protection

The TOE is designed to ensure its own internal integrity as well as to protect user data from potential, unintended reuse by clearing resources (e.g., memory) as they are allocated to create objects used in the implementation of the TOE operations. Note that volatile memory is the primary resource involved in normal TOE execution while its persistent storage is based on non-volatile flash memory.

When a network packet is sent, the buffer used by the packet is recalled and managed by the buffer pool. After that, if a new packet acquires a buffer from the buffer pool, the new packet data will be used to overwrite any previous data in the buffer. If an allocated buffer exceeds the size of the packet, the additional space will be overwritten (padded) with zeroes.

The User Data Protection function is designed to satisfy the following security functional requirements:

- FDP\_RIP.2: The TOE always overwrites resources when allocated for use in objects.

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## 6.4 Identification and Authentication

The TOE is designed to require users to be identified and authenticated before they can access any of the TOE functions. Note that the normal switching of network traffic is not considered accessing TOE functions in this regard.

In the evaluated configuration, users can connect to the TOE CLI via a local console or remotely using SSHv2. For each session, the user is required to log in prior to successfully establishing a session through which TOE functions can be exercised. Note that the only capabilities allowed prior to users authenticating are the display of the warning banner before authentication..

In order to log in, the user must provide an identity and also authentication data (e.g., password or RSA public key used in conjunction with an SSH session) that matches the provided identity. Users can be defined locally within the TOE with a user identity, password or public key authentication data, and user role. Alternatively, users can be defined within an external RADIUS or TACACS server configured to be used by the TOE, each of which also define the user's role in the TOE. Note that only password-based authentication is supported for users defined in an external authentication server. Locally defined users are authenticated directly by the TOE, while remotely defined users are authenticated by the external server and the result is enforced by the TOE. In either case, any resulting session is dependent upon successful authentication and established sessions are associated with the privilege level/role (see Section 6.5) assigned to the user.

When logging in the TOE will not echo passwords so that passwords are not inadvertently displayed to the user and any other users that might be able to view the login display.

Note also that should a console user have their session terminated (e.g., due to inactivity), they are required to successfully authenticate, by reentering their identity and authentication data, in order to establish a new session.

Passwords can be composed of upper and lower case letters, numbers and special characters, including blank space and ~!@#%&\*( )\_+={ }|[]:;,'<>,. Also, new passwords have to satisfy a configurable minimum password length. The administrator can specify a minimum password length of 15 to 32 characters.

The Identification and Authentication function is designed to satisfy the following security functional requirements:

- FIA\_PMG\_EXT.1: The TOE implements a set of password composition constraints as described above.
- FIA\_UAU.7: The TOE does not echo passwords as they are entered.
- FIA\_UAU\_EXT.2: The TOE can be configured to use external RADIUS and TACACS authentication servers.
- FIA\_UIA\_EXT.1: The TOE only displays the warning banner prior to a user being identified and authenticated.

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## 6.5 Security Management

The TOE controls user access to commands and resources based on user role. Users are given permission to access a set of commands and resources based on their user role. The TOE includes pre-defined user roles, of which only the user roles: network-admin and level-15, are considered instances of the 'Security Administrator' as defined in the NDPP. These Security Administrator roles are capable of managing the security functions of the TOE since they allow for security relevant configuration. These capabilities include changing the user permission settings including user-role, authentication-mode, protocol, and setting the authentication password in user interface view.

The other roles represent logical subsets of those security management roles, but do not offer any security relevant configuration management capabilities. The other roles are limited to the ability to change a user's own password, non-security relevant functions and review of information. For example, the roles: network-operator, level-1 and level-9 can display the configuration and status of the TOE. The local audit log can only be accessed by those with the network-admin, network-operator, or level-15 role.

The TOE offers a CLI providing a range of security management functions for use by an authorized administrator. Among these functions are those necessary to manage all aspects of the cryptographic functions of the TOE and the functions necessary to review the TOE versions, update the TOE components, and also to verify the validity of those updates.

The Security Management function is designed to satisfy the following security functional requirements:

- FMT\_MTD.1: The TOE restricts the access to manage TSF data that can affect the security functions of the TOE to Security Administrators.
- FMT\_SMF.1: The TOE includes the functions necessary to manage the cryptomodule and associated functions, and to manage and verify updates of the TOE software and firmware.
- FMT\_SMR.2: The TOE includes 19 predefined roles. As described above only the network-admin, and level-15 roles, that have been configured to access all security management functions of the TOE correspond to the required 'Security Administrator'.

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## 6.6 Protection of the TSF

The TOE is an appliance and as such is designed to work independent of other components to a large extent. Secure communication with third-party peers is addressed in section 6.8.

While the administrative interface is function rich, the TOE is designed specifically to prevent access to locally-stored cryptographically protected passwords and also, while cryptographic keys can be entered, the TOE does not disclose any keys stored in the TOE. In the evaluated configuration (i.e., with FIPS mode enabled), the TOE protects user passwords either by saving a SHA-512 hash of the password (for user accounts that existed before FIPS mode was enabled) or by encrypting the password using AES in CTR mode (for user accounts created after FIPS mode was enabled). See Table 8: Key/CSP Zeroization Summary for more information about stored keys and passwords; note that while some keys and passwords occur in plain text in RAM, that is only while they are in use and are not accessible by any user from RAM.

The TOE is a hardware appliance where all of the switch models (except 5130EI, 5130HI, 5510HI and 5700) include a hardware-based real-time clock (RTC). A RTC is a battery-powered clock that is included in a microchip in a computer motherboard. When the switch starts up, the device gets the time from the hardware RTC and synchronizes it to the CPU. When the device is powered off, the RTC still keeps track of the current time. Since the 5130EI, 5130HI, 5510HI and 5700 Series Switches do not have a real-time clock, the TOE maintains time by adding CPU ticks to the default time of the system. The TOE's embedded OS manages the time/clock and exposes administrator clock-related functions. The time/clock is used for audit record time stamps, measuring session activity for termination, and for cryptographic operations based on time/date.

The TOE includes a number of built-in diagnostic tests that are run during start-up to determine whether the TOE is operating properly. An administrator can configure the TOE to reboot or to stop, with errors displayed, when an error is encountered. The built-in self-tests include basic read-write memory (i.e., each memory location is written with a non-zero value and read to ensure it is stored as expected), flash read, software checksum tests, and device detection tests. The TOE is designed to support upgrades to the boot ROM program and system boot file as well as to support software hotfixes. The TOE provides interfaces so that an administrator can query the current boot ROM program or system boot file versions as well as to identify any installed patches. The Basic BootROM and extended BootROM menus provide access to the BootROM program. Basic BootROM can be accessed by pressing CTRL+D while the device is booting. Note that this can only be performed while accessing the network device through the Serial Console. Extended BootROM menu can be accessed by pressing CTRL+B while the device is booting. Both the boot ROM program and system boot file can be upgraded via the Boot ROM menu or the command line interface, but a reboot is required in each case. Hotfixes, which can affect only the system boot file, can be installed via the command line interface and do not require a reboot to become effective.

The TOE includes a validity checking function that can be enabled when upgrading the boot ROM program, while system boot files and software patches are always validated prior to installation. In each case, the upgrade version will be checked to ensure it is appropriate and the upgrade file will be verified using an embedded (Hewlett Packard Enterprise authorized) digital signature verified against a configured pair of hard-coded keys embedded in the TOE. If the version is incorrect or the signature cannot be verified, the upgrade will not proceed in order to protect the integrity of the TOE. More specifically, each update includes a header and data. The header includes a SHA-256 secure hash of the data that is signed (using rDSA/RSA 2048) by Hewlett Packard Enterprise. In order to verify the data, the TOE generates its own SHA-256 secure hash of the update data, compares it with the signed hash in the update header to ensure they match, and verifies the hash signature using its configured public key.

The Protection of the TSF function is designed to satisfy the following security functional requirements:

- **FPT\_APW\_EXT.1:** The TOE does not offer any functions that will disclose to any user a plain text password. Note that passwords are stored in cryptographically protected form within the TOE FLASH.
- **FPT\_SKP\_EXT.1:** The TOE does not offer any functions that will disclose to any users a stored cryptographic key.
- **FPT\_STM.1:** The 7900 and 7500 switches each have their own hardware RTC. The 5130EI, 5130 HI, 5510 HI, 5700 switches do not have their own RTC.
- **FPT\_TST\_EXT.1:** The TOE includes a number of power-on diagnostics that will serve to ensure the TOE is functioning properly. The tests include insuring memory and flash can be accessed as expected, insuring that software checksums are correct, and also to test the presence and function of plugged devices.
- **FPT\_TUD\_EXT.1:** The TOE provides functions to query and upgrade the versions of the boot ROM program and system boot file (including installing hotfixes). Digital signatures are used to ensure the integrity of each upgrade prior to performing the upgrade; this checking is optional for the boot ROM program since special circumstances might require those checks to be disabled.

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## 6.7 TOE Access

The TOE can be configured to display administrator-configured advisory banners. A login banner can be configured to display warning information along with login prompts. The banner will be displayed when accessing the TOE via the console or SSH interfaces.

The TOE can be configured by an administrator to set an interactive session timeout value (any integer value in minutes and also optionally in seconds, with 0 disabling the timeout) – the default timeout is 10 minutes. A remote session that is inactive (i.e., no commands issuing from the remote client) for the defined timeout value will be terminated. A local session that is similarly inactive for the defined timeout period will be terminated. The user will be required to re-enter their user id and their password so they can establish a new session once a session is terminated. If the user id and password match those of the user that was locked, the session is reconnected with the console and normal input/output can again occur for that user.

An authorized administrator can set an inactivity time limit for IPsec SA. Time limits can be set globally or per IPsec policy (ipsec sa idle-time and sa idle-time, respectively).

The TOE Access function is designed to satisfy the following security functional requirements:

- **FTA\_SSL.3:** The TOE terminates remote sessions that have been inactive for an administrator-configured period of time.
- **FTA\_SSL.4:** The TOE provides the function to logout (or terminate) both local and remote user sessions as directed by the user.
- **FTA\_SSL\_EXT.1:** The TOE terminates local sessions that have been inactive for an administrator-configured period of time.
- **FTA\_TAB.1:** The TOE can be configured to display administrator-defined advisory banners before establishing an administrative user session.

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## 6.8 Trusted Path/Channels

The TOE can be configured to export audit records to an external Syslog server. The TOE uses IPsec to protect communications between itself and components in the operational environment including Syslog and authentication servers (RADIUS and TACACS).

To support secure remote administration, the TOE includes an implementation of SSHv2. An administrator with an appropriate SSHv2-capable client can establish secure remote connections with the TOE. The TOE supports both public key-based and password-based client authentication for the SSH trusted path. To successfully establish an interactive administrative session, the administrator must be able to provide acceptable user credentials (e.g., user id and password), after which they will be able to issue commands within their assigned authorizations.

All of the secure protocols are supported by NIST-validated cryptographic mechanisms included in the TOE implementation.

The Trusted Path/Channels function is designed to satisfy the following security functional requirements:

- FTP\_ITC.1: The TOE can be configured to use IPsec to protect authentication operations, exported audit records, and time information transmitted between the TOE and external servers from inappropriate disclosure or modification.
- FTP\_TRP.1: The TOE provides SSH to support secure remote administration. Administrators can initiate a remote session that is secured from disclosure and modification using NIST-validated cryptographic operations, and all remote security management functions require the use of this secure channel.

## 7. Protection Profile Claims

This ST is conformant to the *Protection Profile for Network Devices, Version 1.1, 8 June 2012* (NDPP), as amended by Errata #3 – with the optional SSH, IPsec and pre-shared key requirements.

The TOE includes Ethernet switch devices. As such, the TOE is a network device making the NDPP claim valid and applicable.

As explained in section 3, Security Problem Definition, the Security Problem Definition of the NDPP has been included by reference into this ST.

As explained in section 4, Security Objectives, the Security Objectives of the NDPP have been included by reference into this ST.

The following table identifies all the Security Functional Requirements (SFRs) in this ST. Each SFR is reproduced from the NDPP and operations completed as appropriate.

Requirement Class	Requirement Component	Source
<b>FAU: Security audit</b>	FAU_GEN.1: Audit Data Generation	NDPP
	FAU_GEN.2: User identity association	NDPP
	FAU_STG_EXT.1: External Audit Trail Storage	NDPP
<b>FCS: Cryptographic support</b>	FCS_CKM.1: Cryptographic Key Generation (for asymmetric keys)	NDPP
	FCS_CKM_EXT.4: Cryptographic Key Zeroization	NDPP
	FCS_COP.1(1): Cryptographic Operation (for data encryption/decryption)	NDPP
	FCS_COP.1(2): Cryptographic Operation (for cryptographic signature)	NDPP
	FCS_COP.1(3): Cryptographic Operation (for cryptographic hashing)	NDPP
	FCS_COP.1(4): Cryptographic Operation (for keyed-hash message authentication)	NDPP
	FCS_IPSEC_EXT.1: Explicit: IPSEC	NDPP
	FCS_RBG_EXT.1: Extended: Cryptographic Operation (Random Bit Generation)	NDPP
	FCS_SSH_EXT.1: Explicit: SSH	NDPP
<b>FDP: User data protection</b>	FDP_RIP.2: Full Residual Information Protection	NDPP
<b>FIA: Identification and authentication</b>	FIA_PMG_EXT.1: Password Management	NDPP
	FIA_PSK_EXT.1: Extended: Pre-Shared Key Composition	NDPP
	FIA_UAU.7: Protected Authentication Feedback	NDPP
	FIA_UAU_EXT.2: Extended: Password-based Authentication Mechanism	NDPP
	FIA_UIA_EXT.1: User Identification and Authentication	NDPP
<b>FMT: Security management</b>	FMT_MTD.1: Management of TSF Data (for general TSF data)	NDPP
	FMT_SMF.1: Specification of Management Functions	NDPP
	FMT_SMR.2: Restrictions on Security Roles	NDPP
<b>FPT: Protection of the TSF</b>	FPT_SKP_EXT.1: Extended: Protection of TSF Data (for reading of all symmetric keys)	NDPP
	FPT_APW_EXT.1: Extended: Protection of Administrator Passwords	NDPP
	FPT_STM.1: Reliable Time Stamps	NDPP
	FPT_TST_EXT.1: TSF Testing	NDPP
	FPT_TUD_EXT.1: Extended: Trusted Update	NDPP
<b>FTA: TOE access</b>	FTA_SSL.3: TSF-initiated Termination	NDPP
	FTA_SSL.4: User-initiated Termination	NDPP
	FTA_SSL_EXT.1: TSF-initiated Session Locking	NDPP
	FTA_TAB.1: Default TOE Access Banners	NDPP
<b>FTP: Trusted path/channels</b>	FTP_ITC.1: Trusted Channel	NDPP
	FTP_TRP.1: Trusted Path	NDPP

**Table 9 SFR Protection Profile Sources**

## 8. Rationale

This security target includes by reference the NDPP Security Problem Definition, Security Objectives, and Security Assurance Requirements. The security target makes no additions to the NDPP assumptions. NDPP security functional requirements have been reproduced with the protection profile operations completed. Operations on the security requirements follow NDPP application notes and assurance activities. Consequently, NDPP rationale applies but is incomplete. The TOE Summary Specification rationale below serves to complete the rationale required for the security target.

### 8.1 TOE Summary Specification Rationale

Each subsection in Section 6, the TOE Summary Specification, describes a security function of the TOE. Each description is followed with rationale that indicates which requirements are satisfied by aspects of the corresponding security function. The set of security functions work together to satisfy all of the security functions and assurance requirements. Furthermore, all of the security functions are necessary in order for the TSF to provide the required security functionality.

This Section in conjunction with Section 6, the TOE Summary Specification, provides evidence that the security functions are suitable to meet the TOE security requirements. The collection of security functions work together to provide all of the security requirements. The security functions described in the TOE summary specification are all necessary for the required security functionality in the TSF. **Table 10 Security Functions vs. Requirements Mapping** demonstrates the relationship between security requirements and security functions.

	Security audit	Cryptographic support	User data protection	Identification and authentication	Security management	Protection of the TSF	TOE access	Trusted path/channels
FAU_GEN.1	X							
FAU_GEN.2	X							
FAU_STG_EXT.1	X							
FCS_CKM.1		X						
FCS_CKM_EXT.4		X						
FCS_COP.1(1)		X						
FCS_COP.1(2)		X						
FCS_COP.1(3)		X						
FCS_COP.1(4)		X						
FCS_IPSEC_EXT.1		X						
FCS_RBG_EXT.1		X						
FCS_SSH_EXT.1		X						
FDP_RIP.2			X					
FIA_PMG_EXT.1				X				
FIA_UAU.7				X				
FIA_UAU_EXT.2				X				
FIA_UIA_EXT.1				X				
FMT_MTD.1					X			
FMT_SMF.1					X			
FMT_SMR.2					X			
FPT_APW_EXT.1						X		



	Security audit	Cryptographic support	User data protection	Identification and authentication	Security management	Protection of the TSF	TOE access	Trusted path/channels
FPT_SKP_EXT.1						X		
FPT_STM.1						X		
FPT_TST_EXT.1						X		
FPT_TUD_EXT.1						X		
FTA_SSL.3							X	
FTA_SSL.4							X	
FTA_SSL_EXT.1							X	
FTA_TAB.1							X	
FTP_ITC.1								X
FTP_TRP.1								X

**Table 10 Security Functions vs. Requirements Mapping**

## Appendix A: Documentation for Hewlett Packard Enterprise 7900 Series, 7500 Series, 5700 Series, 5130 EI Series, and 5510 HI Switches

This Appendix provides a list of the product documentation used during the evaluation of each HP 7900/7500/5700/5130EI/5510HI Series switch product family.

The following documents for the **HPE 7900 Series, 7500 Series, 5700 Series, 5510 HI Series, 5130HI and 5130EI Series Switch Modules** can be found under the *General Reference* and *Setup and Install* sections of the **HPE 7900 Series, 7500 Series, 5700 Series, 5510 HI Series, 5130HI and 5130EI Series Switch** documentation page on the HPE Web site. The links are provided below.

- HPE Switch Series ACL and QoS Command Reference
- HPE Switch Series Layer 3 - IP Services Command Reference
- HPE Switch Series Fundamentals Command Reference
- HPE Switch Series Security Command Reference
- HPE Switch Series Network Management and Monitoring Command Reference

The following documents for the **HPE 7900 Series, 7500 Series, 5700 Series, 5510 Series, 5130HI and 5130EI Series Switch Modules** can be found under the *Setup and Install* section of the **HPE 7900 Series, 7500 Series, 5700 Series, 5510 HI Series, 5130HI and 5130EI Series Switch Modules** documentation page on the HPE Web site. The link is provided below.

- HPE FlexNetwork MSR Router Series ACL and QoS Configuration Guide
- HPE FlexNetwork MSR Router Series Layer 3 - IP Services Configuration Guide
- HPE FlexNetwork MSR Router Series Fundamentals Configuration Guide
- HPE FlexNetwork MSR Router Series Security Configuration Guide
- HPE FlexNetwork MSR Router Series Network Management and Monitoring Configuration Guide

Product Family	HPE Website Link to Module Information
HPE 5130EI series	<a href="http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=7399420#manuals">http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=7399420#manuals</a>
HPE 5130HI series	<a href="http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=1008605458#manuals">http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=1008605458#manuals</a>
HPE 5510 HI series	<a href="http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=1008652960&amp;ac.admitted=1454097809230.125225703.1938120508#manuals">http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=1008652960&amp;ac.admitted=1454097809230.125225703.1938120508#manuals</a>
HPE 5700 series	<a href="http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=7268889#manuals">http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=7268889#manuals</a>
HPE 7500 series	<a href="http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=4177519#manuals">http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=4177519#manuals</a>
HPE 7900 series	<a href="http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=7074890#manuals">http://h20566.www2.hp.com/portal/site/hpsc/public/psi/home/?sp4ts.oid=7074890#manuals</a>