Brocade Directors and Switches Security Target

Version Number	Publication Date
1.6	March 18, 2009

LIST OF TABLES

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 the Brocade Directors and Switches provided by Brocade Communications Systems, Inc. Brocade Directors and Switches are hardware appliances that implement what is called a "Storage Area Network" or "SAN". SANs provide physical connections between servers that are located in the environment and storage devices such as disk storage systems and tape libraries that are also located in the environment.

The Security Target contains the following additional sections:

- Section 2 – Target of Evaluation (TOE) Description
  This section gives an overview of the TOE, describes the TOE in terms of its physical and logical boundaries, and states the scope of the TOE.
- Section 3 – TOE Security Environment
  This section details the expectations of the environment, the threats that are countered by the TOE and the environment, and the organizational policy that the TOE must fulfill.
- Section 4 – TOE Security Objectives
  This section details the security objectives of the TOE and environment.
- Section 5 – IT Security Requirements
  The section presents the security functional requirements (SFR) for the TOE and environment that supports the TOE, and details the assurance requirements.
- Section 6 – TOE Summary Specification
  The section describes the security functions represented in the TOE that satisfy the security requirements.
- Section 7 – Protection Profile Claims
  This section presents any protection profile claims.
- Section 8 – Rationale
  This section closes the ST with the justifications of the security objectives, requirements and TOE summary specifications as to their consistency, completeness, and suitability.

1.1 Security Target, TOE and CC Identification

Security Target Title – Brocade Directors and Switches Security Target

Security Target Version – Version 1.6

Security Target Date – March 18, 2009

TOE Identification –

- Director Blade[1] Models: FC2-16, FC4-16, FC4-32, FC4-48, FC4-16, FC4-32, FC4-48, FR4-18i, FC8-16, FC8-32, FC8-48, CP4, CP8, CR8
- Director Models: 48000, DCX
- Switch Appliance Models: 200E, 300, 4100, 4900, 5000, 5100, 5300, 7500 and 7500E
- Embedded Blades[2]: 4012, 4016, 4018, 4020, and 4024
- All models running FabricOS version 6.1.1

TOE Guidance Documents –

- Brocade - FabricOS Administrator's Guide – Publication #531000598-04, 18-July-2008

[1] A blade refers to a purpose-built component that is installed in a Brocade director.
[2] An embedded blade is a Brocade switch in a blade form factor that may be installed in a blade server product.

- Brocade – FabricOS Command Reference – Publication #531000599-02, 18-July-2008
- Brocade – FabricOS Message Reference – Publication #531000600-03 Date 6-June-2008

TOE Developer – Brocade Communications Systems, Inc.

Evaluation Sponsor – Brocade Communications Systems, Inc.

CC Identification – Common Criteria for Information Technology Security Evaluation, Version 3.1, Revision 2, September 2007

1.2 Conformance Claims

This TOE is conformant to the following CC specifications:

- Common Criteria for Information Technology Security Evaluation Part 2: Security Functional Requirements, Version 3.1, Revision 2, September 2007.
  - Part 2 Conformant
- Common Criteria for Information Technology Security Evaluation Part 3: Security Assurance Components, Version 3.1, Revision 2, September 2007.
  - Part 3 Conformant
  - Assurance Level: EAL 3 augmented with ALC_FLR.2

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 letter placed at the end of the component. For example FDP_ACC.1a and FDP_ACC.1b indicate that the ST includes two iterations of the FDP_ACC.1 requirement, a and b.
  - 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 …").
- Other sections of the ST – Other sections of the ST use bolding to highlight text of special interest, such as captions.

2. TOE Description

The Target of Evaluation (TOE) is the Brocade Directors and Switches hardware appliances.

Brocade Directors and Switches are hardware appliances that implement what is called a "Storage Area Network" or "SAN". SANs provide physical connections between machines in the environment containing a type of network card called a Host Bus Adapter (HBA) that are located in the environment and storage devices such as disk storage systems and tape libraries that are also located in the environment. The network connection between the storage devices in the environment, the TOE, and HBAs in the environment use high-speed network hardware. SANs are optimized to transfer large blocks of data between HBAs and storage devices. SANs can be used to replace or supplement server-attached storage solutions, for example.

The basic concept of operations from a *user's* perspective is depicted below.

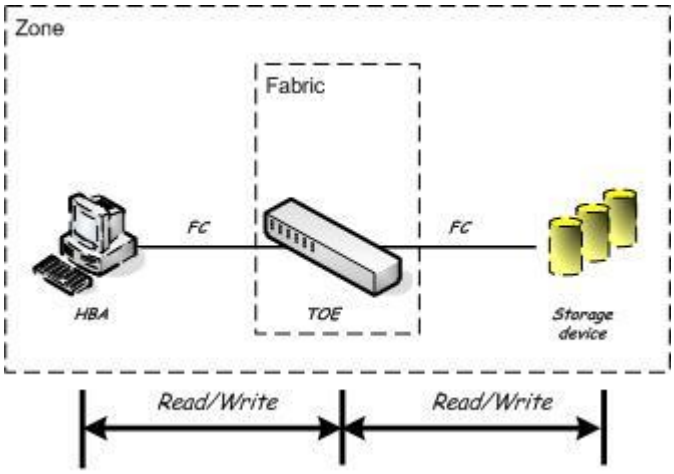


Figure 1: Host bus adapters can only access storage devices that are members of the same zone.

HBAs communicate with the TOE using Fibre Channel (FC) or FC over IP (FCIP) protocols. Storage devices in turn are physically connected to the TOE using FC/FCIP interfaces. When more than one instance of the TOE is interconnected (i.e. installed and configured to work together), they are referred to collectively as a "SAN fabric". A zone is a specified group of fabric-connected devices (called zone members) that have access to one another.

The remainder of this section summarizes the TOE architecture.

2.1 TOE Overview

The TOE provides the ability to centralize the location of storage devices in a network in the environment. Instead of attaching disks or tapes to individual hosts in the environment, or for example attaching a disk or tape directly to the network, storage devices can be physically attached to the TOE, which can then be physically attached to host bus adapters in the environment. Host bus adapters that are connected to the TOE can then read from and write to storage devices that are attached to the TOE according to TOE configuration. Storage devices in the environment appear to the operating system running on the machine that the host bus adapter is installed in as local (i.e. directly-attached) devices.

More than one host bus adapter can share one or more storage devices that are attached to the TOE according to TOE configuration. Scalability is achieved by interconnecting multiple instances of TOE directors and switches to form a fabric that supports different numbers of host bus adapters and storage devices.

Directors and switches both can be used by host bus adapters to access storage devices using the TOE. Switch appliances provide a fixed number of physical interfaces to hosts and storage devices in the environment. Directors provide a configurable number of physical interfaces using a chassis architecture that supports the use of blades that can be installed in and removed from the director chassis according to administrator configuration.

There are administrative interfaces to manage TOE services that can be accessed using an Ethernet network, as well as interfaces that can be accessed using a directly-attached console as follows:

- Ethernet network-based web-based administrator console interfaces –Provides web-based administrator console interfaces called the "Brocade Advanced Web Tools."
- Ethernet network-based command-line administrator console interfaces – Provides command-line administrator console interfaces called the "FabricOS Command Line Interface."
- Serial terminal-based command-line administrator console interfaces – Provides command-line administrator console interfaces called the "FabricOS Command Line Interface."

There also exists administrative Ethernet network-based programmatic API interfaces, however these interfaces are disabled during initial installation and configuration in the evaluated configuration. Similarly, there exists a modem hardware component that is optional to the product that can be used in a similar manner as a serial console port, but it is disabled by virtue of not being physically installed during initial installation and configuration in the evaluated configuration.

The basic concept of operations from an *administrator's* perspective is depicted below.

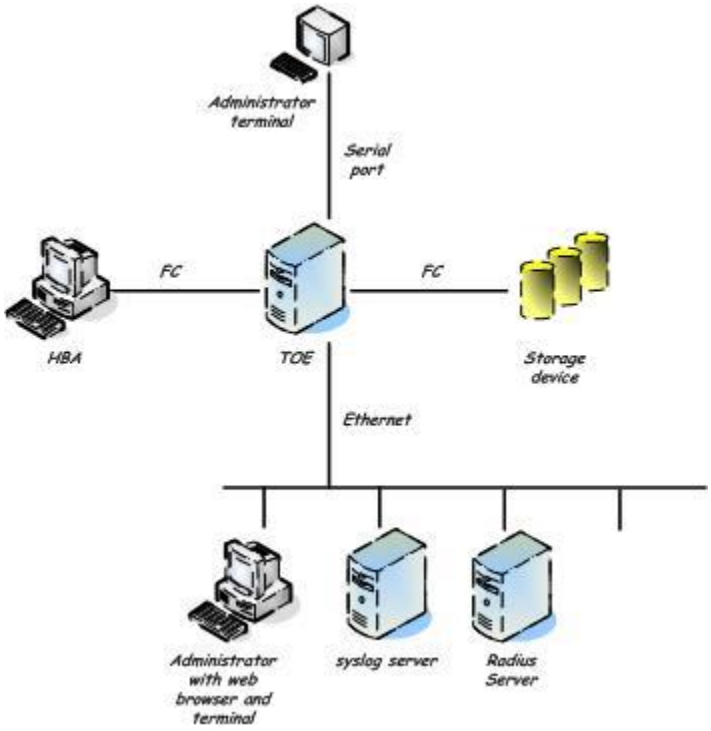


Figure 2: Administrators can access the TOE using a serial terminal or across a network. Audit records are sent to a syslog server.

Separate appliance ports are relied on to physically separate connected HBAs. The appliance's physical location between HBAs and storage devices is relied on to ensure TOE interfaces cannot be bypassed. The TOE encrypts commands sent from terminal applications by administrators using SSH for the command line interface and HTTPS for the Advanced Web Tools GUI interface. The TOE requires administrators to login after a SSH or HTTPS connection has been established.

2.2 TOE Architecture

The TOE can be described in terms of the following components:

- Brocade Switch and Director appliances – One or more of each type are supported in the evaluated configuration. The evaluated configuration also supports one or more blades per director, depending on the number supported by a given director model.
- Brocade FabricOS operating system – Linux-based operating system that runs on Brocade switches and directors. FabricOS is comprised of user-space programs, kernel daemons and kernel modules loaded as proprietary components into LINUX. The base features of LINUX, including the file system, memory management, processor and I/O support infrastructure for FOS user-space programs, daemons, and kernel modules. Interprocess communication is handled through commonly mapped memory or shared PCI memory and semaphores as well as IOCTL parameter passing. LINUX provides access to memory or to make a standard IOCTL call, and all the contents of the buffers and IOCTL message blocks or other message blocks are proprietary to the FOS user-space programs, kernel modules and daemons. The FabricOS operating system is considered to include the OpenSSL crypto engine as internal functionality supporting TOE operation.

The TOE in its intended environment of the TOE is depicted in the figure below.

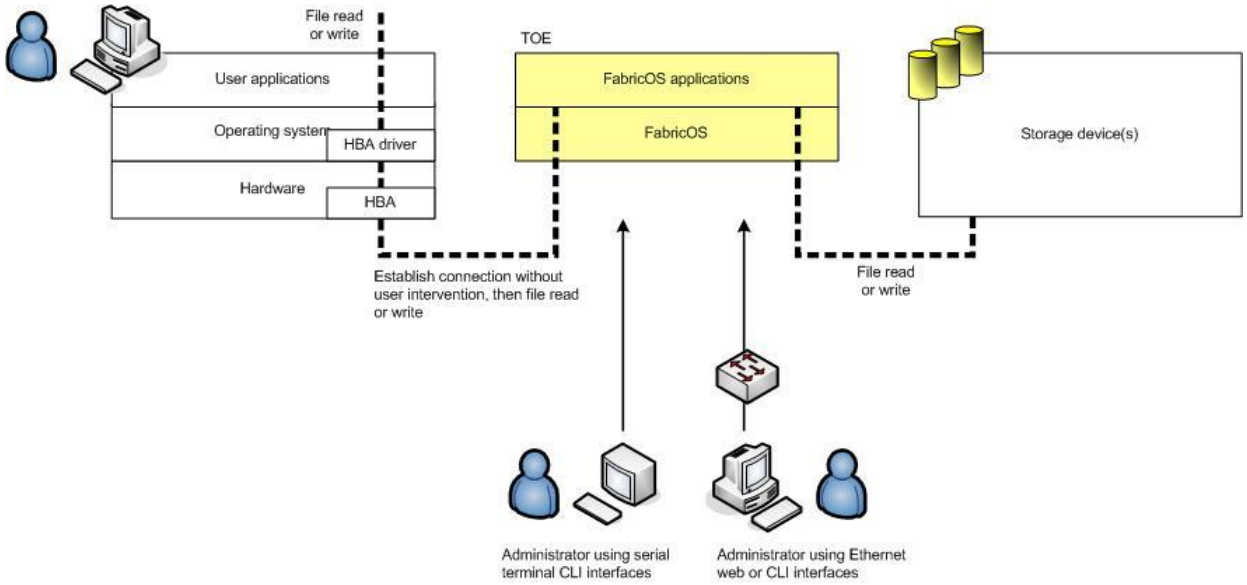


Figure 3: TOE and environment components.

The intended environment of the TOE can be described in terms of the following components:

- Host – A system in the environment that uses TOE SAN services.
- Host Bus Adapters (HBAs) – Provides physical network interfaces from host machines in the environment to the TOE. HBA drivers provide operating system interfaces on host machines in the environment to storage devices in the environment. Storage devices in the environment appear to the host operating system as local (i.e. directly-attached) devices.
- Storage device – A device used to store data (e.g. a disk or tape) that is connected to the TOE using a FC/FCIP connection and is accessed by a host using the TOE.
- Terminal application – Provides a runtime environment for console-based (i.e. SSH) client administrator console interfaces.
- Web browser – Provides a runtime environment for web-based (i.e. HTTPS) client administrator console interfaces.
- Syslog server – Provides logging to record auditable event information generated by the TOE. The syslog server is expected to protect audit information sent to it by the TOE and make that data available to administrators of the TOE.

- RADIUS/LDAP Server – An optional component that can perform authentication based on user credentials passed to it by the TOE. The TOE then enforces the authentication result returned by the RADIUS or LDAP Server.
- Certificate Authority (CA) – Provides digital certificates for SSH and HTTPS-based interfaces that are installed during initial TOE configuration. After installation, the CA no longer needs to be on the network for operation.

2.2.1 Physical Boundaries

The components that make up the TOE are identified in Section 1.1 above.

The TOE relies on a syslog server in the environment to store and protect audit records that are generated by the TOE. The TOE can be configured to use a RADIUS or LDAP Server for authentication. The TOE does not rely on any other components in the environment to provide security-related services. The TOE is interoperable with any adapter or device that is interoperable with one or more of the following standards:

- FC-AL-2 INCITS 332: 1999
- FC-GS-5 ANSI INCITS 427:2006 (includes the following.)
    - FC-GS-4 ANSI INCITS 387: 2004
- FC-IFR revision 1
- FC-SW-4 INCITS 418:2006 (includes the following)
    - FC-SW-3 INCITS 384: 2004
- FC-VI INCITS 357: 2002
- FC-TAPE INCITS TR-24: 1999
- FC-DA INCITS TR-36: 2004 (includes the following)
    - FC-FLA INCITS TR-20: 1998
    - FC-PLDA INCIT S TR-19: 1998
- FC-MI-2 ANSI/INCITS TR-39-2005
- FC-PI INCITS 352: 2002
- FC-PI-2 INCITS 404: 2005
- FC-FS-2 ANSI/INCITS 424:2006 (includes the following)
    - FC-FS INCITS 373: 2003
- FC-LS revision 1.51 (under development)
- FC-BB-3 INCITS 414: 2006 (includes the following)
    - FC-BB-2 INCITS 372: 2003
- FC-SB-3 INCITS 374: 2003 (replaces FC-SB ANSI X3.271: 1996; FC-SB-2 INCITS 374: 2001)
- RFC 2625 IP and ARP Over FC
- RFC 2837 Fabric Element MIB
- MIB-FA INCITS TR-32: 2003
- FCP-2 INCITS 350: 2003 (replaces FCP ANSI X3.269: 1996)
- SNIA Storage Management Initiative Specification (SMI-S) Version 1.2 (includes the following)
    - SNIA Storage Management Initiative Specification (SMI-S) Version 1.02 (ANSI INCITS 388: 2004)

- SNIA Storage Management Initiative Specification (SMI-S) Version 1.1.0

2.2.2 Logical Boundaries

This section summarizes the security functions provided by the TOE:

- Security audit
- User data protection
- Identification and authentication
- Security management
- Protection of the TSF
- Trusted path

There is no distinction between the product and the TOE.

2.2.2.1 Security audit

The TOE generates audit events for an unspecified level of audit. A syslog server in the environment is relied on to store audit records generated by the TOE. The TOE generates a complete audit record including the IP address of the TOE, the event details, and the time the event occurred. The time stamp is provided by the TOE appliance hardware. When the syslog server writes the audit record to the audit trail, it applies its own time stamp, placing the entire TOE-generated syslog protocol message MSG contents into an encapsulating syslog record.

2.2.2.2 User data protection

Host bus adapters can only access storage devices that are members of the same zone. The TOE enforces an access control policy called the SAN Fabric SFP to accomplish this. The SAN Fabric SFP is implemented using hardware-enforced zoning (also called "hard zoning" or simply "zoning") that prevents a host bus adapter from accessing a device the host bus adapter is not authorized to access. A zone is a region within the fabric[3] where a specified group of fabric-connected devices (called zone members) have access to one another. Zone members do not have access to any devices outside the zone and devices outside the zone do not have access to devices inside the zone.

2.2.2.3 Identification and authentication

The TOE authenticates administrative users. In order for an administrative user to access the TOE, a user account including a user name and password must be created for the user, and an administrative role must be assigned. Either the TOE performs the validation of the login credentials or the information is passed to a RADIUS or LDAP Server to perform the validation and the TOE enforces the decision.

2.2.2.4 Security management

The TOE provides both serial terminal- and Ethernet network-based management interfaces. Each of the three types of interfaces provides equivalent management functionality. The TOE provides administrative interfaces to configure hard zoning, as well as to set and reset administrator passwords. By default, host bus adapters do not have access to storage devices.

2.2.2.5 Protection of the TSF

Protection of the TSF is provided primarily by virtue of the fact that the TOE is a hardware appliance that is physically protected in the environment. The TOE does not encrypt data written to or read from storage devices by host bus adapters. The TOE relies instead on the environment to physically protect the network between the HBA

[3] When more than one instance of the TOE is interconnected (i.e. installed and configured to work together), they are referred to collectively as a "SAN fabric" or simply a "fabric."

and the TOE, and between the TOE and the storage device. Separate appliance ports are relied on to physically separate connected HBAs. The appliance's physical location between HBAs and storage devices is relied on to ensure TOE interfaces cannot be bypassed. The TOE encrypts commands sent from terminal applications by administrators using SSH or HTTPS. Further, TOE requires administrators to login after a SSH or HTTPS connection has been established. The TOE provides a reliable time stamp for audit records.

2.2.2.6 Trusted Path

The TOE enforces a trusted path between the TOE administrators and the TOE using SSH and HTTPS connections for Ethernet connections from the Administrator terminal to the TOE. The TOE encrypts commands sent from terminal applications by administrators using SSH for the command line interface and HTTPS for the Advanced Web Tools GUI interface.

2.3 TOE Documentation

Brocade offers a series of documents that describe the installation process for the TOE as well as guidance for subsequent use and administration of the applicable security features. See section 1.1 for the applicable guidance documentation included in the TOE.

3. Security Environment

This section summarizes the threats addressed by the TOE and assumptions about the intended environment of the TOE. Note that while the identified threats are mitigated by the security functions implemented in the TOE, the overall assurance level (EAL 3) also serves as an indicator of whether the TOE would be suitable for a given environment.

3.1 Threats

T.ACCOUNTABILITY:	A user may not be held accountable for their actions.
T.ADMIN_ERROR:	An authorized administrator may incorrectly install or configure the TOE resulting in ineffective security mechanisms.
T.MASQUERADE:	An unauthorized user, process, or external IT entity may masquerade as an authorized entity to gain access to data or TOE resources.
T.TSF_COMPROMISE:	A malicious user may cause configuration data to be inappropriately accessed (viewed, modified or deleted).
T.UNAUTH_ACCESS:	A user may gain unauthorized access (view, modify, delete) to a storage device.

3.2 Assumptions

A.LOCATE	The TOE will be located within controlled access facilities, which will prevent unauthorized physical access.
A.NETWORK	The environment will protect network communication to and from the TOE from unauthorized disclosure or modification.
A.NO_EVIL	The TOE will be installed, configured, managed and maintained in accordance with its guidance documentation.

4. Security Objectives

This section summarizes the security objectives for the TOE and its environment.

4.1 Security Objectives for the TOE

O.ACCESS	The TOE will ensure that users gain only authorized access to the TOE and to the resources that the TOE controls.
O.ADMIN_ROLE	The TOE will provide authorized administrator roles to isolate administrative actions thus limiting the scope of errors that an administrator may cause.
O.AUDIT_GENERATION	The TOE will provide the capability to create records of security relevant events associated with users.
O.MANAGE	The TOE will allow administrators to effectively manage the TOE and its security functions, must ensure that only authorized administrators are able to access such functionality, and that communication between the TOE and the administrator is protected.
O.TOE_PROTECTION	The TOE will protect the TOE and its assets from external interference or tampering.
O.USER_AUTHENTICATION	The TOE will verify the claimed identity of users.
O.USER_IDENTIFICATION	The TOE will uniquely identify users.

4.2 Security Objectives for the Environment

OE.NETWORK	The Environment will protect network communication to and from the TOE from unauthorized disclosure or modification.
OE.CONFIG	The TOE will be installed, configured, managed and maintained in accordance with its guidance documentation.
OE.PHYCAL	The TOE will be located within controlled access facilities, which will prevent unauthorized physical access.

5. IT Security Requirements

5.1 TOE Security Functional Requirements

Requirement Class	Requirement Component
FAU: Security audit	FAU_GEN.1: Audit data generation
FDP: User data protection	FDP_ACC.1: Subset access control
	FDP_ACF.1: Security attribute based access control
FIA: Identification and authentication	FIA_ATD.1: User attribute definition
	FIA_UAU.1: Timing of authentication
	FIA_UID.2: User identification before any action
FMT: Security management	FMT_MSA.1: Management of security attributes
	FMT_MSA.3: Static attribute initialization
	FMT_MTD.1a: Management of TSF data
	FMT_MTD.1b: Management of TSF data
	FMT_SMF.1: Specification of Management Functions
	FMT_SMR.1: Security roles
FPT: Protection of the TSF	FPT_ITT.1: Basic internal TSF data transfer protection
	FPT_STM.1: Reliable time stamps

Table 1 TOE Security Functional Components

5.1.1 Security audit (FAU)

5.1.1.1 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: a) Start-up and shutdown of the audit functions; b) All auditable events for the [***not specified***] level of audit; and c) [**the events listed in the table below**].

FAU_GEN.1.2 The TSF shall record within each audit record at least the following information: a) Date and time of the event, type of event, subject identity (if applicable), and the outcome (success or failure) of the event; and b) For each audit event type, based on the auditable event definitions of the functional components included in the PP/ST, [**no additional details**].

Requirement Component	Auditable event
FAU_GEN.1	start-up and shutdown of the audit functions (specifically, of the TOE)
FDP_ACF.1	unsuccessful requests to perform an operation on an object covered by the SFP.
FIA_UAU.1	unsuccessful use of the authentication mechanism
FIA_UID.2	unsuccessful use of the user identification mechanism, including the user identity provided
FMT_SMF.1	use of the management functions (specifically, zone configuration and setting user attributes)
FMT_SMR.1	modifications to the group of users that are part of a role

5.1.2 User data protection (FDP)

5.1.2.1 Subset access control (FDP_ACC.1)

FDP_ACC.1.1 The TSF shall enforce the [**SAN Fabric SFP**] on [

a.) **subjects: host bus adapters**

b.) **objects: storage devices**

c.) **operations: block-read and block-write**

].

5.1.2.2 Security attribute based access control (FDP_ACF.1)

FDP_ACF.1.1 The TSF shall enforce the [**SAN Fabric SFP**] to objects based on the following: [

a.) **subject security attributes:**

- **port number;**
- **zone membership**

b.) **storage device security attributes:**

- **storage device address;**
- **zone membership**

].

FDP_ACF.1.2 The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed: [**for any zone, if the subject port is a member of that zone and the device address is a member of that zone, then the operation is allowed**].

FDP_ACF.1.3 The TSF shall explicitly authorize access of subjects to objects based on the following additional rules: [**no additional rules**].

FDP_ACF.1.4 The TSF shall explicitly deny access of subjects to objects based on the [**no additional rules**].

5.1.3 Identification and authentication (FIA)

5.1.3.1 User attribute definition (FIA_ATD.1)

FIA_ATD.1.1 The TSF shall maintain the following list of security attributes belonging to individual users:[

a.) **the security attributes of users possessing administrative roles:**

- **user identity**
- **password**
- **role**

].

5.1.3.2 Timing of authentication (FIA_UAU.1)

FIA_UAU.1.1 The TSF shall allow [**authentication by a third-party RADIUS or LDAP Server**] on behalf of the user to be performed before the user is authenticated.

FIA_UAU.1.2 The TSF shall require each user to be successfully authenticated before allowing any other TSF-mediated actions on behalf of that user.

5.1.3.3 User identification before any action (FIA_UID.2)

FIA_UID.2.1 The TSF shall require each user to identify itself before allowing any other TSF-mediated actions on behalf of that user.

5.1.4 Security management (FMT)

5.1.4.1 Management of security attributes (FMT_MSA.1)

FMT_MSA.1.1 The TSF shall enforce the [**SAN Fabric SFP**] to restrict the ability to [***[add or remove members of a zone***]] the security attributes [**zone membership of a host bus adapter and zone**

membership of a storage device] to [**users possessing one of the following administrative roles: admin, zoneAdmin, fabricAdmin, root, factory**].

Application note: Host bus adapters and storage devices are referred to as members of a zone when they are added to a zone.

5.1.4.2 Static attribute initialization (FMT_MSA.3)

FMT_MSA.3.1 The TSF shall enforce the [**SAN Fabric SFP**] to provide [***restrictive***] default values for security attributes that are used to enforce the SFP.

FMT_MSA.3.2 The TSF shall allow the [**no user**] to specify alternative initial values to override the default values when an object or information is created.

5.1.4.3 Management of TSF data (FMT_MTD.1a)

FMT_MTD.1a.1 The TSF shall restrict the ability to [***query, modify, delete, [and assign]***] the [**user identity and role**] to [**users possessing one of the following administrative roles: admin, SecurityAdmin, root, factory**].

5.1.4.4 Management of TSF data (FMT_MTD.1b)

FMT_MTD.1b.1 The TSF shall restrict the ability to [***set***] the [**passwords**] to [**the administrative user associated with the password, and users possessing one of the following administrative roles: admin, SecurityAdmin, root, factory**].

5.1.4.5 Specification of Management Functions (FMT_SMF.1)

FMT_SMF.1.1 The TSF shall be capable of performing the following security management functions:[

- **add or remove members of a zone;**
- **query, modify, delete, and assign the user identity and role; and**
- **set and reset passwords of users possessing administrative roles.**

].

5.1.4.6 Security roles (FMT_SMR.1)

FMT_SMR.1.1 The TSF shall maintain the roles [**the following administrative roles:**

- **user**
- **admin**
- **switchAdmin**
- **operator**
- **zoneAdmin**
- **fabricAdmin**
- **SecurityAdmin**
- **basicSwitchAdmin**
- **root**
- **factory**

].

FMT_SMR.1.2 The TSF shall be able to associate users with roles.

Application note: Other than being able to log into TOE management interfaces and change their own passwords, users possessing the user administrative role can only access interfaces that provide the ability to monitor TOE performance.

5.1.5 Protection of the TSF (FPT)

5.1.5.1 Reliable time stamps (FPT_STM.1)

FPT_STM.1.1 The TSF shall be able to provide reliable time stamps for its own use.

5.1.6 Trusted Path (FTP)

5.1.6.1 Trusted path (FTP_TRP.1)

FTP_TRP.1.1 The TSF shall provide a communication path between itself and [***remote***] users that is logically distinct from other communication paths and provides assured identification of its end points and protection of the communicated data from [***disclosure, modification***].

FTP_TRP.1.2 The TSF shall permit [***remote users***] to initiate communication via the trusted path.

FTP_TRP.1.3 The TSF shall require the use of the trusted path for [***[administrator access of the TOE via Ethernet]***].

5.2 TOE Security Assurance Requirements

The security assurance requirements for the TOE are the EAL 3 components and ALC_FLR.2, as specified in Part 3 of the Common Criteria. No operations are applied to the assurance components.

EAL3 augmented was selected as the assurance level because the TOE is a commercial product whose users require a moderate to high level of independently assured security. ALC_FLR.2 was selected to exceed EAL3 assurance objectives in order to ensure that identified flaws are addressed The TOE is targeted at a relatively benign environment with good physical access security and competent administrators. Within such environments it is assumed that attackers will have little attack potential. As such, EAL3 is appropriate to provide the assurance necessary to counter the limited potential for attack.

Requirement Class	Requirement Component
ADV: Development	ADV_ARC.1: Security architecture description
	ADV_FSP.3: Functional specification with complete summary
	ADV_TDS.2: Architectural design
AGD: Guidance documents	AGD_OPE.1: Operational user guidance
	AGD_PRE.1: Preparative procedures
ALC: Life-cycle support	ALC_CMC.3: Authorization controls
	ALC_CMS.3: Implementation representation CM coverage
	ALC_DEL.1: Delivery procedures
	ALC_DVS.1: Identification of security measures
	ALC_FLR.2: Flaw reporting procedures
	ALC_LCD.1: Developer defined life-cycle model
ATE: Tests	ATE_COV.2: Analysis of coverage
	ATE_DPT.1: Testing: basic design
	ATE_FUN.1: Functional testing
	ATE_IND.2: Independent testing - sample
AVA: Vulnerability assessment	AVA_VAN.2: Vulnerability analysis
ASE: Security Target evaluation[4]	ASE_CCL.1 Conformance claims
	ASE_ECD.1 Extended components definition
	ASE_INT.1 ST introduction
	ASE_OBJ.2 Security objectives
	ASE_REQ.2 Derived security requirements
	ASE_SPD.1 Security problem definition
	ASE_TSS.1 TOE summary specification

Table 3 EAL 3 Assurance Components

[4] The ASE requirements are not copied into this document as they are intended to define the requirements upon which this document is evaluated. Assurance requirements in this document are those used to evaluate the product.

5.2.1 Development (ADV)

5.2.1.1 Security architecture description (ADV_ARC.1)

ADV_ARC.1.1d The developer shall design and implement the TOE so that the security features of the TSF cannot be bypassed.
ADV_ARC.1.2d The developer shall design and implement the TSF so that it is able to protect itself from tampering by untrusted active entities.
ADV_ARC.1.3d The developer shall provide a security architecture description of the TSF.
ADV_ARC.1.1c The security architecture description shall be at a level of detail commensurate with the description of the SFR-enforcing abstractions described in the TOE design document.
ADV_ARC.1.2c The security architecture description shall describe the security domains maintained by the TSF consistently with the SFRs.
ADV_ARC.1.3c The security architecture description shall describe how the TSF initialization process is secure.
ADV_ARC.1.4c The security architecture description shall demonstrate that the TSF protects itself from tampering.
ADV_ARC.1.5c The security architecture description shall demonstrate that the TSF prevents bypass of the SFR-enforcing functionality.
ADV_ARC.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.1.2 Functional specification with complete summary (ADV_FSP.3)

ADV_FSP.3.1d The developer shall provide a functional specification.
ADV_FSP.3.2d The developer shall provide a tracing from the functional specification to the SFRs.
ADV_FSP.3.1c The functional specification shall completely represent the TSF.
ADV_FSP.3.2c The functional specification shall describe the purpose and method of use for all TSFI.
ADV_FSP.3.3c The functional specification shall identify and describe all parameters associated with each TSFI.
ADV_FSP.3.4c For each SFR-enforcing TSFI, the functional specification shall describe the SFR-enforcing actions associated with the TSFI.
ADV_FSP.3.5c For each SFR-enforcing TSFI, the functional specification shall describe direct error messages resulting from security enforcing effects and exceptions associated with invocation of the TSFI.
ADV_FSP.3.6c The functional specification shall summarize the SFR-supporting and SFR-non-interfering actions associated with each TSFI.
ADV_FSP.3.7c The tracing shall demonstrate that the SFRs trace to TSFIs in the functional specification.
ADV_FSP.3.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.
ADV_FSP.3.2e The evaluator shall determine that the functional specification is an accurate and complete instantiation of the SFRs.

5.2.1.3 Architectural design (ADV_TDS.2)

ADV_TDS.2.1d The developer shall provide the design of the TOE.
ADV_TDS.2.2d The developer shall provide a mapping from the TSFI of the functional specification to the lowest level of decomposition available in the TOE design.
ADV_TDS.2.1c The design shall describe the structure of the TOE in terms of subsystems.
ADV_TDS.2.2c The design shall identify all subsystems of the TSF.
ADV_TDS.2.3c The design shall describe the behavior of each SFR non-interfering subsystem of the TSF in detail sufficient to determine that it is SFR non-interfering.
ADV_TDS.2.4c The design shall describe the SFR-enforcing behavior of the SFR-enforcing subsystems.
ADV_TDS.2.5c The design shall summarize the SFR-supporting and SFR-non-interfering behavior of the SFR-enforcing subsystems.
ADV_TDS.2.6c The design shall summarize the behavior of the SFR-supporting subsystems.
ADV_TDS.2.7c The design shall provide a description of the interactions among all subsystems of the TSF.
ADV_TDS.2.8c The mapping shall demonstrate that all behavior described in the TOE design is mapped to the TSFIs that invoke it.
ADV_TDS.2.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ADV_TDS.2.2e The evaluator shall determine that the design is an accurate and complete instantiation of all security functional requirements.

5.2.2 Guidance documents (AGD)

5.2.2.1 Operational user guidance (AGD_OPE.1)

AGD_OPE.1.1d The developer shall provide operational user guidance.
AGD_OPE.1.1c The operational user guidance shall describe, for each user role, the user-accessible functions and privileges that should be controlled in a secure processing environment, including appropriate warnings.
AGD_OPE.1.2c The operational user guidance shall describe, for each user role, how to use the available interfaces provided by the TOE in a secure manner.
AGD_OPE.1.3c The operational user guidance shall describe, for each user role, the available functions and interfaces, in particular all security parameters under the control of the user, indicating secure values as appropriate.
AGD_OPE.1.4c The operational user guidance shall, for each user role, clearly present each type of security-relevant event relative to the user-accessible functions that need to be performed, including changing the security characteristics of entities under the control of the TSF.
AGD_OPE.1.5c The operational user guidance shall identify all possible modes of operation of the TOE (including operation following failure or operational error), their consequences and implications for maintaining secure operation.
AGD_OPE.1.6c The operational user guidance shall, for each user role, describe the security measures to be followed in order to fulfill the security objectives for the operational environment as described in the ST.
AGD_OPE.1.7c The operational user guidance shall be clear and reasonable.
AGD_OPE.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.2.2 Preparative procedures (AGD_PRE.1)

AGD_PRE.1.1d The developer shall provide the TOE including its preparative procedures.
AGD_PRE.1.1c The preparative procedures shall describe all the steps necessary for secure acceptance of the delivered TOE in accordance with the developer's delivery procedures.
AGD_PRE.1.2c The preparative procedures shall describe all the steps necessary for secure installation of the TOE and for the secure preparation of the operational environment in accordance with the security objectives for the operational environment as described in the ST.
AGD_PRE.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.
AGD_PRE.1.2e The evaluator shall apply the preparative procedures to confirm that the TOE can be prepared securely for operation.

5.2.3 Life-cycle support (ALC)

5.2.3.1 Authorization controls (ALC_CMC.3)

ALC_CMC.3.1d The developer shall provide the TOE and a reference for the TOE.
ALC_CMC.3.2d The developer shall provide the CM documentation.
ALC_CMC.3.1c The TOE shall be labeled with its unique reference.
ALC_CMC.3.2c The CM documentation shall describe the method used to uniquely identify the configuration items.
ALC_CMC.3.3c The CM system shall uniquely identify all configuration items.
ALC_CMC.3.4c The CM system shall provide measures such that only authorized changes are made to the configuration items.
ALC_CMC.3.5c The CM documentation shall include a CM plan.
ALC_CMC.3.6c The CM plan shall describe how the CM system is used for the development of the TOE.
ALC_CMC.3.7c The evidence shall demonstrate that all configuration items are being maintained under the CM system.

ALC_CMC.3.8c The evidence shall demonstrate that the CM system is being operated in accordance with the CM plan.

ALC_CMC.3.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.3.2 Implementation representation CM coverage (ALC_CMS.3)

ALC_CMS.3.1d The developer shall provide a configuration list for the TOE.

ALC_CMS.3.1c The configuration list shall include the following: the TOE itself; the evaluation evidence required by the SARs; the parts that comprise the TOE; and the implementation representation.

ALC_CMS.3.2c The configuration list shall uniquely identify the configuration items.

ALC_CMS.3.3c For each TSF relevant configuration item, the configuration list shall indicate the developer of the item.

ALC_CMS.3.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.3.3 Delivery procedures (ALC_DEL.1)

ALC_DEL.1.1d The developer shall document procedures for delivery of the TOE or parts of it to the consumer.

ALC_DEL.1.2d The developer shall use the delivery procedures.

ALC_DEL.1.1c The delivery documentation shall describe all procedures that are necessary to maintain security when distributing versions of the TOE to the consumer.

ALC_DEL.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.3.4 Identification of security measures (ALC_DVS.1)

ALC_DVS.1.1d The developer shall produce development security documentation.

ALC_DVS.1.1c The development security documentation shall describe all the physical, procedural, personnel, and other security measures that are necessary to protect the confidentiality and integrity of the TOE design and implementation in its development environment.

ALC_DVS.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ALC_DVS.1.2e The evaluator shall confirm that the security measures are being applied.

5.2.3.5 Flaw reporting procedures (ALC_FLR.2)

ALC_FLR.2.1d The developer shall provide flaw remediation procedures addressed to TOE developers.

ALC_FLR.2.2d The developer shall establish a procedure for accepting and acting upon all reports of security flaws and requests for corrections to those flaws.

ALC_FLR.2.3d The developer shall provide flaw remediation guidance addressed to TOE users.

ALC_FLR.2.1c The flaw remediation procedures documentation shall describe the procedures used to track all reported security flaws in each release of the TOE.

ALC_FLR.2.2c The flaw remediation procedures shall require that a description of the nature and effect of each security flaw be provided, as well as the status of finding a correction to that flaw.

ALC_FLR.2.3c The flaw remediation procedures shall require that corrective actions be identified for each of the security flaws.

ALC_FLR.2.4c The flaw remediation procedures documentation shall describe the methods used to provide flaw information, corrections and guidance on corrective actions to TOE users.

ALC_FLR.2.5c The flaw remediation procedures documentation shall describe a means by which the developer receives from TOE users reports and enquiries of suspected security flaws in the TOE.

ALC_FLR.2.6c The procedures for processing reported security flaws shall ensure that any reported flaws are corrected and the correction issued to TOE users.

ALC_FLR.2.7c The procedures for processing reported security flaws shall provide safeguards that any corrections to these security flaws do not introduce any new flaws.

ALC_FLR.2.8c The flaw remediation guidance shall describe a means by which TOE users report to the developer any suspected security flaws in the TOE.

ALC_FLR.2.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.3.6 Developer defined life-cycle model (ALC_LCD.1)

ALC_LCD.1.1d The developer shall establish a life-cycle model to be used in the development and maintenance of the TOE.
ALC_LCD.1.2d The developer shall provide life-cycle definition documentation.
ALC_LCD.1.1c The life-cycle definition documentation shall describe the model used to develop and maintain the TOE.
ALC_LCD.1.2c The life-cycle model shall provide for the necessary control over the development and maintenance of the TOE.
ALC_LCD.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.4 Tests (ATE)

5.2.4.1 Analysis of coverage (ATE_COV.2)

ATE_COV.2.1d The developer shall provide an analysis of the test coverage.
ATE_COV.2.1c The analysis of the test coverage shall demonstrate the correspondence between the tests in the test documentation and the TSFIs in the functional specification.
ATE_COV.2.2c The analysis of the test coverage shall demonstrate that all TSFIs in the functional specification have been tested.
ATE_COV.2.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.4.2 Testing: basic design (ATE_DPT.1)

ATE_DPT.1.1d The developer shall provide the analysis of the depth of testing.
ATE_DPT.1.1c The analysis of the depth of testing shall demonstrate the correspondence between the tests in the test documentation and the TSF subsystems in the TOE design.
ATE_DPT.1.2c The analysis of the depth of testing shall demonstrate that all TSF subsystems in the TOE design have been tested.
ATE_DPT.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.4.3 Functional testing (ATE_FUN.1)

ATE_FUN.1.1d The developer shall test the TSF and document the results.
ATE_FUN.1.2d The developer shall provide test documentation.
ATE_FUN.1.1c The test documentation shall consist of test plans, expected test results and actual test results.
ATE_FUN.1.2c The test plans shall identify the tests to be performed and describe the scenarios for performing each test.
ATE_FUN.1.3c The expected test results shall show the anticipated outputs from a successful execution of the tests.
ATE_FUN.1.4c The actual test results shall be consistent with the expected test results.
ATE_FUN.1.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.4.4 Independent testing - sample (ATE_IND.2)

ATE_IND.2.1d The developer shall provide the TOE for testing.
ATE_IND.2.1c The TOE shall be suitable for testing.
ATE_IND.2.2c The developer shall provide an equivalent set of resources to those that were used in the developer's functional testing of the TSF.
ATE_IND.2.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.
ATE_IND.2.2e The evaluator shall execute a sample of tests in the test documentation to verify the developer test results.
ATE_IND.2.3e The evaluator shall test a subset of the TSF to confirm that the TSF operates as specified.

5.2.5 Vulnerability assessment (AVA)

5.2.5.1 Vulnerability analysis (AVA_VAN.2)

AVA_VAN.2.1d The developer shall provide the TOE for testing.

AVA_VAN.2.1c The TOE shall be suitable for testing.

AVA_VAN.2.1e The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

AVA_VAN.2.2e The evaluator shall perform a search of public domain sources to identify potential vulnerabilities in the TOE.

AVA_VAN.2.3e The evaluator shall perform an independent vulnerability analysis of the TOE using the guidance documentation, functional specification, TOE design and security architecture description to identify potential vulnerabilities in the TOE.

AVA_VAN.2.4e The evaluator shall conduct penetration testing, based on the identified potential vulnerabilities, to determine that the TOE is resistant to attacks performed by an attacker possessing Basic attack potential.

6. TOE Summary Specification

This chapter describes the security functions and associated assurance measures.

6.1 TOE Security Functions

6.1.1 Audit

The TOE generates audit records for start-up and shutdown of the TOE, and for an unspecified level of audit. Audit records include date and time of the event, type of event, user identity that caused the event to be generated, and the outcome of the event. The TOE sends audit records to a syslog server in the environment. The environment is relied on to provide interfaces to read from the audit trail. The auditable events include:

Requirement Component	Auditable event
FAU_GEN.1	start-up and shutdown of the audit functions (specifically, of the TOE)
FDP_ACF.1	unsuccessful requests to perform an operation on an object covered by the SFP
FIA_UAU.1	unsuccessful use of the authentication mechanism
FIA_UID.2	unsuccessful use of the user identification mechanism, including the user identity provided
FMT_SMF.1	use of the management functions (specifically, zone configuration and setting user attributes)
FMT_SMR.1	modifications to the group of users that are part of a role

Syslog protocol messages containing audit records have three parts. The first part is called the PRI, the second part is the HEADER, and the third part is the MSG. The TOE generates syslog audit records as follows:

- The TOE generates a complete audit record including the IP address of the TOE, the event details, and the time the event occurred. The time stamp is provided by the underlying TOE appliance hardware.

  Each audit record contains the following fields:

  > *AUDIT, <Timestamp generated by TOE>, <Event Identifier>, <Severity>, <Event Class>, <Username>/<Role>/<IP address>/<Interface>/<Application name>, <Admin Domain>/<Switch name>, <Reserved field for future expansion>, <Message>*

  For example:

  > *AUDIT, 2006/12/10-09:54:03 (GMT), [SEC-1000], WARNING, SECURITY, JohnSmith/root/192.168.132.10/Telnet/CLI, Domain A/JohnsSwitch, , Incorrect password during login attempt*

- The audit record is packaged into a syslog protocol message. The complete audit record is packaged into the syslog MSG part. The PRI and HEADER are then added.
- A network connection is established with the syslog server in the environment and the audit record is sent.

When the syslog server writes the audit record to the audit trail, it applies its own time stamp, placing the entire TOE-generated syslog protocol message MSG contents into an encapsulating syslog record, as depicted below.

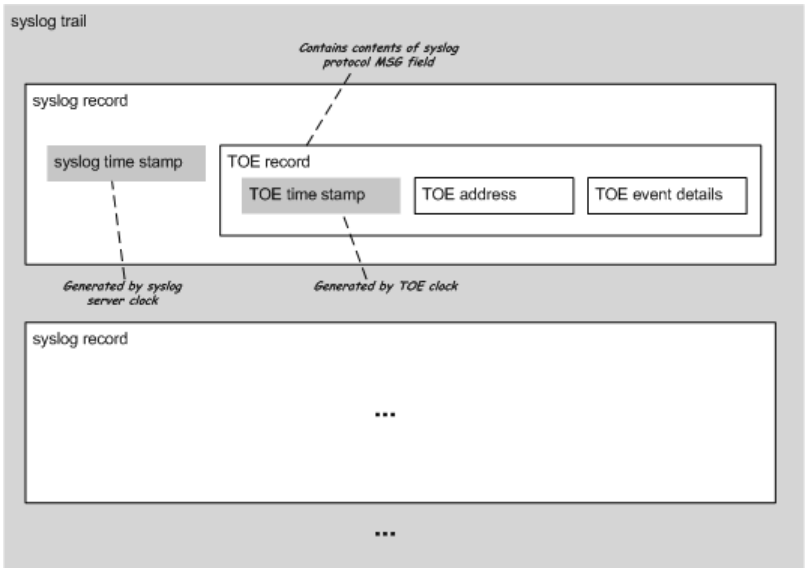


Figure 4: TOE and environment audit record components.

Since the time stamp applied by the TOE was included as part of the event details, the time stamp in the event details can be used to determine the order in which events occurred on the TOE. Similarly, the instance of the TOE that generated the record can be determined by examining the field containing the IP address of the TOE.

For example:

> *Jun 20 11:07:11 [10.33.8.20.2.2] raslogd: AUDIT, 2006/12/10-09:54:03 (GMT), [SEC-1000], WARNING, SECURITY, JohnSmith/root/192.168.132.10/Telnet/CLI, Domain A/JohnsSwitch, , Incorrect password during login attempt.*

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

- FAU_GEN.1: The TOE generates audit events for the not specified level of audit. A syslog server in the environment is relied on to store audit records generated by the TOE.

6.1.2 User data protection

The evaluated configuration supports only interconnected TOE instances operated in a fabric switch mode.

The TOE defines host bus adapters in terms of port number and zone membership. The first thing a host bus adapter must do is establish connectivity with at least one storage device located in the fabric. In order for a host bus adapter to access a storage device using the TOE, a port must be configured by an administrator to be a member of a zone of which a target storage device is already a member. After establishing a physical connection with the TOE, the HBA acquires what is called a SAN fabric address from the TOE, which is a 24-bit address format. Upon receiving an address, the HBA next registers itself with the TOE. The HBA then initiates FC/FCIP-protocol commands to establish connectivity with one or more targets located within the fabric. The TOE then determines whether or not to allow access to the storage device by comparing zone memberships.

The TOE implements the SAN Fabric SFP to restrict block-read and block-write operations to an HBA that is a member of the same zone as the object storage device. Host bus adapters can only access storage devices that are members of the same zone. Hardware-enforced zoning (also called “hard zoning” or simply “zoning”) prevents a host bus adapter from accessing a device the host bus adapter is not authorized to access. The product also includes what is called soft zoning. Soft zoning does not restrict access to connected storage devices. If a host bus adapter has knowledge of the network address of a target device, the host bus adapter can read and write to it. That is why soft zoning is not supported in the evaluated configuration. Administrative guidance is relied on to warn against the use of soft zoning and it is not otherwise enabled by default in the evaluated configuration. A host bus adapter must be a member of a zone under hard zoning, configured by an administrator, before a host bus adapter can access a storage device.

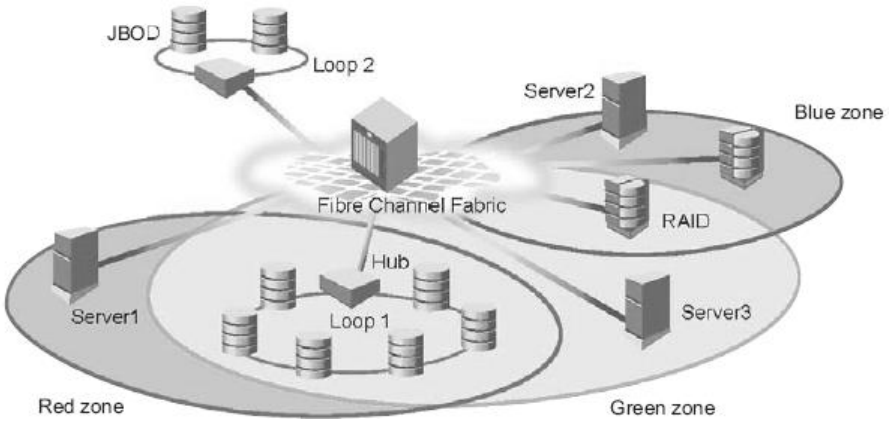
Zoning works by checking each frame before it is delivered to a zone member and discarding it if there is a zone mismatch. The TOE monitors HBA communications and blocks any frames that do not comply with the zone configuration. Zoning prevents users from even discovering the existence of unauthorized target devices.

A zone is a region within the fabric where a specified group of fabric-connected devices (called zone members) have access to one another. Storage devices not explicitly defined in a zone are isolated, and host bus adapters in the zoned fabric do not have access to them.

- A group of one or more zones is called a *zone configuration*.
- The complete set of all zone members defined in a fabric is called the *defined zone configuration*.
- Zoning configuration procedures change zone objects in the defined configuration. When a configuration is enabled by an administrator, it becomes the *effective zone configuration*. The effective zone configuration is restored after a TOE reboot. This is also known as the *active zone configuration*.
- A copy of the defined zone configuration (plus the name of the effective zone configuration) can be saved by an administrator. The resulting *saved zone configuration* is restored after a switch reboot. If an administrator makes changes to the defined zone configuration but does not save them, there will be differences between the defined zone configuration and the saved zone configuration.
- A *default zone* is a zone that contains all ports that are not members of any zone in the active zone set.

Any zone object connected to the fabric can be included in one or more zones. Zone objects can communicate only with other objects in the same zone. For example, consider the figure below, which shows:

- Three zones are configured, named Red, Green, and Blue.
- Server 1 can communicate only with the Loop 1 devices.
- Server 2 can communicate only with the RAID and Blue zone devices.
- Server 3 can communicate with the RAID device and the Loop1 device.
- The Loop 2 JBODs are not assigned to a zone; no other zoned fabric device can access them.



The TOE determines whether or not to allow an HBA access to a storage device by comparing zone memberships. If access is permitted, the HBA is subsequently permitted to issue FC/FCIP-protocol commands that correspond to disk read and write operations. If access is not permitted, a rejection command is returned to the HBA and any subsequent read or write operations from that HBA are discarded by the TOE.

When a host bus adapter performs a read or a write after the HBA has established a connection with a storage device using the TOE according to the SAN Fabric SFP, the HBA either breaks data blocks up into multiple data frames (in the case of a block-write operation) before sending the information to the TOE, or reassembles data frames into blocks (in the case of a block-read operation). When a write operation is performed, the storage device after the operation has completed transmits a single frame back through the TOE to the HBA to acknowledge that all data was received and written to the storage device.

When a host bus adapter performs a read to a target device for which it has established a connection, the HBA first issues the appropriate FC/FCIP protocol command to the target at its defined 24-bit address. Next, the TOE inspects the user's HBA's Host address and target address within the frame to verify that connectivity is allowed via the current zoning configuration.

- If connectivity is allowed, then no further action is taken by the TOE besides ensuring that all of the frames are properly routed to their assigned destination based on their 24-bit destination address.
- If connectivity is not allowed, then the TOE sends a rejection command to the HBA and any subsequent read operations are rejected by the TOE.

Finally, the HBA collects all data frames and combines the data into the requested block for the host.

When a host bus adapter performs a write to a target device for which it has established a connection, the HBA first issues the appropriate FC/FCIP protocol command to the target at its defined 24-bit address. Next, the TOE inspects the user's HBA's Host address and target address within the frame to verify that connectivity is allowed via the current zoning configuration.

- If connectivity is allowed, then no further action is taken by the TOE besides ensuring that all of the frames are properly routed to their assigned destination based on their 24-bit destination address.
- If connectivity is not allowed, then the TOE sends a rejection command to the HBA and any subsequent write operations are rejected by the TOE..

Next the HBA breaks up the data block to be written into multiple data frames, and transmits each one to the target. The TOE inspects the 24-bit address of each data frame, either allowing it to route properly, or rejecting it depending on the current zoning configuration.

Finally, the storage device transmits back a single frame acknowledging that all data was received and written to the storage media.

The User data protection function is designed to satisfy the following security functional requirements:

- FDP_ACC.1, FDP_ACF.1: The TOE provides the ability to restrict block-read and block-write operations to connected storage devices that are initiated by host bus adapters. Host bus adapter can only access storage devices that are members of the same zone.

6.1.3 Identification and authentication

The TOE defines administrative users in terms of:

- user identity; and
- password; and
- role.

Role permissions determine the functions that administrators may perform. Nine roles, each with a fixed set of permissions, are supported: Root, Factory, Admin, FabricAdmin, SecurityAdmin, SwitchAdmin, BasicSwitchAdmin, ZoneAdmin, Operator and User. There are four pre-defined administrator accounts called "root", "factory", "admin" and "user", each of which is assigned the respective role of the same name, e.g. the "admin" account is assigned the Admin role. Note that neither the account called "user" nor any account that is assigned the User role, corresponds to a host bus adapter that is attempting to access a storage device, rather a User-role account corresponds to an administrative user that can view but not change configuration settings. The root account is disabled during TOE configuration, since it allows access to the operating system.

The TOE authenticates administrative users using either its own authentication mechanism or a RADIUS or LDAP Server. The TOE provides its own password authentication mechanism to authenticate administrative users. In order for an administrative user to access the TOE, a user account including a user name and password must be created for the user, and an administrative role must be assigned. The TOE password authentication mechanism enforces password composition rules. Passwords must be between 8 and 40 characters; they must begin with an alphabetical character; they can include numeric characters, the dot (.), and the underscore (_); they are case-sensitive. In the case of RADIUS or LDAP Server authentication, the TOE passes the login credentials supplied to the RADIUS or

LDAP Server for validation. If the RADIUS or LDAP Server returns a success value, the TOE matches the user name to a user name stored internally.

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

- FIA_ATD.1: The TOE maintains security attributes for administrative users.
- FIA_UAU.1: The TOE provides a password-based authentication mechanism but does permit authentication to occur using a third-party RADIUS or LDAP Server.
- FIA_UID.2: The TOE offers no TSF-mediated functions until the user is identified. Administrative users are identified using user identifiers.

6.1.4 Security management

The TOE defines the following administrative roles:

- user – can be used to monitor system activity
- admin – can perform all administrative commands
- switchAdmin – can perform administrative commands except for those related to user management and zoning configuration commands
- operator – can perform administrative commands that do not affect security settings
- zoneAdmin – can perform administrative commands that only affect zoning configuration
- fabricAdmin – can perform administrative commands except for those related to user management
- basicSwitchAdmin – can be used to monitor system activity
- SecurityAdmin – can perform security-related configuration including user management and security policy configuration
- root – can perform all administrative commands and access the OS; this user account is disabled during TOE configuration
- factory – can perform all administrative commands

The TOE administrative interfaces consist of an Ethernet network-based interface and a serial terminal-based interface. Ethernet interfaces use a command-line interface called the "FabricOS Command Line Interface". Each of the two types of interfaces provides equivalent management functionality. The Ethernet and serial terminal interfaces support the same command-line interface commands after a session has been established.

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

- FMT_MSA.1: The ability to modify host bus adapters and storage devices zone membership is limited to users possessing the admin, zoneAdmin, fabricAdmin, root, or factory role; the root role (account) is disabled during TOE configuration.
- FMT_MSA.3: By default, host bus adapters do not have access to storage devices.
- FMT_MTD.1a: The ability to query, modify, delete, and assign administrative user security attributes is limited to users possessing one of the following administrative roles: admin, SecurityAdmin, root, factory; the root role (account) is disabled during TOE configuration..
- FMT_MTD.1b: Administrators can set their own passwords. The administrative roles admin, and Security Admin, root, and factory may set any account's password; the root role (account) is disabled during TOE configuration..
- FMT_SMF.1: The TOE provides administrative interfaces to modify host bus adapters and storage device zone membership, as well as to set and reset administrator passwords.
- FMT_SMR.1: The TOE maintains administrative user roles.

6.1.5 Protection of the TSF

The TOE maintains a security domain using appliance hardware. The use of a hardware appliance protects the TOE from external physical interference or tampering, including providing separate physical interfaces to separate hosts and storage devices.

The TOE does not encrypt data written to or read from storage devices by host bus adapters. The TOE relies instead on the environment to physically protect the network between the HBA and the TOE, and between the TOE and the storage device. Separate appliance ports are relied on to physically separate connected HBAs. The appliance's physical location between HBAs and storage devices is relied on to ensure TOE interfaces cannot be bypassed. The TOE does encrypt commands sent from terminal applications by administrators using SSH and HTTPS. Further, TOE requires administrators to login after a SSH or HTTPS connection has been established.

Administrators cannot bypass TOE functions because they are required to log in before the requested operation is allowed. When an administrator attempts to login using SSH, the SSL switch certificate is the one that is presented to the calling application in the environment. The SSL cipher list is configured as follows:

- ALL – all ciphers suites except the eNULL ciphers which must be explicitly enabled
- ADH – anonymous DH cipher suites.
- EXPORT56 – 56 bit export encryption algorithms. In OpenSSL 0.9.8d and later the set of 56 bit export ciphers is empty unless OpenSSL has been explicitly configured with support for experimental ciphers.
- RC4 – cipher suites using RC4.
- RSA cipher suites using RSA key exchange.
- HIGH – ``high'' encryption cipher suites. This currently means those with key lengths larger than 128 bits, and some cipher suites with 128-bit keys.
- MEDIUM – ``medium'' encryption cipher suites, currently some of those using 128 bit encryption.
- LOW – ``low'' encryption cipher suites, currently those using 64 or 56 bit encryption algorithms but excluding export cipher suites.
- ssl2 – only include SSL v2 ciphers.

The application must be configured with the same issuing CA certificate in order to build a path and to verify the switch certificate's signature to establish the secure connection.

The TOE generates time stamps to support the auditing function.

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

- FPT_STM.1: The TOE generates time stamps for use in audit records.

6.1.6 Trusted Path

The TOE provides a trusted path for its remote administrative users accessing the TOE via the Ethernet ports provided on the TOE using either the command line interface using SSH or Advanced Web Tools using HTTPS. Note that local administrator access via the serial port is also allowed for command line access, however this access is protected by physical protection of the serial interface along with the TOE itself.

During TOE installation, a 1024-bit RSA key pair and then a corresponding PKCS#10 certificate request is generated. The TOE provides command-line interfaces to generate new keys and certificate requests. The private key is stored in persistent memory in the clear (the TOE will be located within controlled access facilities, which will prevent unauthorized physical access). The TOE uses the OpenSSL crypto engine to perform all cryptographic operations. After a key pair is generated, after a certificate request is generated using the new keys, the certificate request is sent to a CA in the environment. After the CA creates the certificate, the certificate is imported into the TOE using additional command-line interfaces. This certificate is called the "SSL switch certificate". There are also interfaces to import the issuing CA's certificate.

The application must be configured with the same issuing CA certificate in order to build a path and to verify the switch certificate's signature to establish the secure connection.

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

- FTP_TRP.1: The TOE uses SSH and HTTPS to provide a trusted path to its terminal-based management interfaces to protect the communication from disclosure and modification.

7. Protection Profile Claims

There is no Protection Profile claim.

8. Rationale

This section provides the rationale for completeness and consistency of the Security Target. The rationale addresses the following areas:

- Security Objectives;
- Security Functional Requirements;
- Security Assurance Requirements;
- Requirement Dependencies;
- TOE Summary Specification; and,
- PP Claims.

8.1 Security Objectives Rationale

This section shows that all secure usage assumptions, organizational security policies, and threats are completely covered by security objectives. In addition, each objective counters or addresses at least one assumption, organizational security policy, or threat.

8.1.1 Security Objectives Rationale for the TOE and Environment

This section provides evidence demonstrating the coverage of organizational policies and usage assumptions by the security objectives.

	O.ACCESS	O.ADMIN_ROLE	O.AUDIT_GNEERATION	O.MANAGE	O.TOE_PROTECTION	O.USER_AUTHENTICATION	O.USER_IDENTIFICATION	OE.CONFIG	OE.NETWORK	OE.PHYCAL
T.ACCOUNTABILITY			x							
T.ADMIN_ERROR		x		x						
T.MASQERADE						x	x			
T.TSF_COMPROMISE					x					
T.UNAUTH_ACCESS	x									
A.LOCATE										x
A.NETWORK									x	
A.NO_EVIL								x		

Table 2 Environment to Objective Correspondence

8.1.1.1 T.ACCOUNTABILITY

A user may not be held accountable for their actions.

This Threat is countered by ensuring that:

- O.AUDIT_GENERATION: The TOE will provide the capability to create records of security relevant events associated with users.

8.1.1.2 T.ADMIN_ERROR

An authorized administrator may incorrectly install or configure the TOE resulting in ineffective security mechanisms.

This Threat is countered by ensuring that:

- O.ADMIN_ROLE: The TOE will provide authorized administrator roles to isolate administrative actions thus limiting the scope of errors that an administrator may cause.
- O.MANAGE: The TOE will allow administrators to effectively manage the TOE and its security functions, must ensure that only authorized administrators are able to access such functionality, and that communication between the TOE and the administrator is protected.

8.1.1.3 T.MASQUERADE

An unauthorized user, process, or external IT entity may masquerade as an authorized entity to gain access to data or TOE resources.

This Threat is countered by ensuring that:

- O.USER_AUTHENTICATION: The TOE will verify the claimed identity of users.
- O.USER_IDENTIFICATION: The TOE will uniquely identify users.

8.1.1.4 T.TSF_COMPROMISE

A malicious user may cause configuration data to be inappropriately accessed (viewed, modified or deleted).

This Threat is countered by ensuring that:

- O.TOE_PROTECTION: The TOE will protect the TOE and its assets from external interference or tampering.

8.1.1.5 T.UNAUTH_ACCESS

A user may gain unauthorized access (view, modify, delete) to a storage device.

This Threat is countered by ensuring that:

- O.ACCESS: The TOE will ensure that users gain only authorized access to the TOE and to the resources that the TOE controls.

8.1.1.6 A.LOCATE

The TOE will be located within controlled access facilities, which will prevent unauthorized physical access.

This Assumption is satisfied by ensuring that:

- OE.PHYCAL: The TOE will be located within controlled access facilities, which will prevent unauthorized physical access.

8.1.1.7 A.NETWORK

The Environment will protect network communication to and from the TOE from unauthorized disclosure or modification.

This Assumption is satisfied by ensuring that:

- OE.NETWORK: The Environment will protect network communication to and from the TOE from unauthorized disclosure or modification.

8.1.1.8 A. NO_EVIL

The TOE will be installed, configured, managed and maintained in accordance with its guidance documentation.

This Assumption is satisfied by ensuring that:

- OE.CONFIG: The TOE will be installed, configured, managed and maintained in accordance with its guidance documentation

8.2 Security Requirements Rationale

This section provides evidence supporting the internal consistency and completeness of the components (requirements) in the Security Target. Note that **Table 3** indicates the requirements that effectively satisfy the individual objectives.

8.2.1 Security Functional Requirements Rationale

All Security Functional Requirements (SFR) identified in this Security Target are fully addressed in this section and each SFR is mapped to the objective for which it is intended to satisfy.

	O.ACCESS	O.ADMIN_ROLE	O.AUDIT_GNEERATION	O.MANAGE	O.TOE_PROTECTION	O.USER_AUTHENTICATION	O.USER_IDENTIFICATION
FAU_GEN.1			x				
FDP_ACC.1	x						
FDP_ACF.1	x						
FIA_ATD.1						x	x
FIA_UAU.1						x	
FIA_UID.2							x
FMT_MSA.1				x			
FMT_MSA.3				x			
FMT_MTD.1a				x			

FMT_MTD.1b				x			
FMT_SMF.1				x			
FMT_SMR.1		x		x			
FPT_STM.1			x				
FTP_TRP.1				x			
ADV_ARC.1					x		

Table 3 Objective to Requirement Correspondence

8.2.1.1 O.ACCESS

The TOE will ensure that users gain only authorized access to the TOE and to the resources that the TOE controls.

This TOE Security Objective is satisfied by ensuring that:

- FDP_ACC.1, FDP_ACF.1: The TOE provides the ability to restrict block-read and block-write operations to connected storage devices that are initiated by host bus adapters. Host bus adapter can only access storage devices that are members of the same zone.

8.2.1.2 O.ADMIN_ROLE

The TOE will provide authorized administrator roles to isolate administrative actions thus limiting the scope of errors that an administrator may cause.

This TOE Security Objective is satisfied by ensuring that:

- FMT_SMR.1: The TOE maintains only administrative roles.

8.2.1.3 O.AUDIT_GENERATION

The TOE will provide the capability create records of security relevant events associated with users.

This TOE Security Objective is satisfied by ensuring that:

- FAU_GEN.1: The TOE generates audit events for the not specified level of audit.
- FPT_STM.1: The TOE provides time stamps for its own use.

8.2.1.4 O.MANAGE

The TOE will allow administrators to effectively manage the TOE and its security functions, must ensure that only authorized administrators are able to access such functionality, and that communication between the TOE and the administrator is protected.

This TOE Security Objective is satisfied by ensuring that:

- FMT_MSA.1: The ability to modify host bus adapters and storage devices zone membership is limited to users possessing the admin, zoneAdmin, fabricAdmin, root, or factory role.
- FMT_MSA.3: By default, host bus adapters do not have access to storage devices.
- FMT_MTD.1a: The ability to query, modify, delete, and assign administrative user security attributes is limited to users possessing one of the following administrative roles: admin, Security Admin, root, factory.
- FMT_MTD.1b: Administrators can set their own passwords. The administrative roles admin, Security Admin, root and factory may set any account's password.
- FMT_SMF.1: The TOE provides administrative interfaces to modify and query host bus adapters and storage device zone membership, as well as to set and reset administrator passwords.

- FMT_SMR.1: The TOE maintains administrative user roles.
- FTP_TRP.1: The TOE provides a trusted path between itself and remote administrative users.

8.2.1.5 O.TOE_PROTECTION

The TOE will protect the TOE and its assets from external interference or tampering.

This TOE Security Objective is satisfied by ensuring that:

- ADV_ARC.1 requires that the TSF be able to protect itself from tampering and that the security mechanisms in the TSF cannot be bypassed. Without this objective, there could be no assurance that users could not view or modify TSF executables, TSF data or TSF-protected data.

8.2.1.6 O.USER_AUTHENTICATION

The TOE will verify the claimed identity of users.

This TOE Security Objective is satisfied by ensuring that:

- FIA_ATD.1: The TOE maintains security attributes for administrative users.
- FIA_UAU.1: The TOE performs user authentication before allowing any other actions. The TOE also supports the authentication of users via third-party RADIUS or LDAP servers.

8.2.1.7 O.USER_IDENTIFICATION

The TOE will uniquely identify users.

This TOE Security Objective is satisfied by ensuring that:

- FIA_ATD.1: The TOE maintains security attributes for administrative users.
- FIA_UID.2: The TOE offers no TSF-mediated functions until the user is identified. Administrative users are identified using user identifiers.

8.3 Security Assurance Requirements Rationale

EAL3 augmented was selected as the assurance level because the TOE is a commercial product whose users require a moderate to high level of independently assured security. ALC_FLR.2 was selected to exceed EAL3 assurance objectives in order to ensure that identified flaws are addressed The TOE is targeted at a relatively benign environment with good physical access security and competent administrators. Within such environments it is assumed that attackers will have little attack potential. As such, EAL3 is appropriate to provide the assurance necessary to counter the basic potential for attack.

8.4 Requirement Dependency Rationale

The following table demonstrates that all dependencies among the claimed security requirements are satisfied and therefore the requirements work together to accomplish the overall objectives defined for the TOE. The one additional assurance requirement beyond EAL3 (i.e., ALC_FLR.2) that has been added for this product has been included in this analysis.

ST Requirement	CC Dependencies	ST Dependencies
FAU_GEN.1	FPT_STM.1	FPT_STM.1
FDP_ACC.1	FDP_ACF.1	FDP_ACF.1
FDP_ACF.1	FDP_ACC.1 and FMT_MSA.3	FDP_ACC.1 and FMT_MSA.3
FIA_ATD.1	none	none
FIA_UAU.1	FIA_UID.1	FIA_UID.2

FIA_UID.2	none	none
FMT_MSA.1	FMT_SMR.1 and FMT_SMF.1 and (FDP_ACC.1 or FDP_IFC.1)	FMT_SMR.1 and FMT_SMF.1 and FDP_ACC.2
FMT_MSA.3	FMT_MSA.1 and FMT_SMR.1	FMT_MSA.1 and FMT_SMR.1
FMT_MTD.1	FMT_SMR.1 and FMT_SMF.1	FMT_SMR.1 FMT_SMF.1
FMT_SMF.1	none	none
FMT_SMR.1	FIA_UID.1	FIA_UID.2
FPT_STM.1	none	none
FTP_TRP.1	none	none
ALC_FLR.2	none	none

8.5 Extended Requirements Rationale

There are no extended requirements.

8.6 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 4 Security Functions vs. Requirements Mapping** demonstrates the relationship between security requirements and security functions.

	Security audit	**User data protection**	**Identification and authentication**	**Security management**	**Protection of the TSF**	**Trusted path**
FAU_GEN.1	x					
FDP_ACC.1		x				
FDP_ACF.1		x				
FIA_ATD.1			x			
FIA_UAU.1			x			
FIA_UID.2			x			
FMT_MSA.1				x		
FMT_MSA.3				x		
FMT_MTD.1				x		

FMT_SMF.1				x		
FMT_SMR.1				x		
FPT_STM.1					x	
FTP_TRP.1						x

Table 4 Security Functions vs. Requirements Mapping

8.7 PP Claims Rationale

See Section 7, Protection Profile Claims.