OmniAccess SafeGuard OS Administration Guide

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Preface

In this preface:

About This Guide

This guide provides concept and configuration instructions for the major features SafeGuard OS and its supported products.

Audience

This guide is intended for experienced network administrators who are responsible for managing SafeGuard OS.

Conventions Used in This Guide

Table 1 lists the text conventions used in this guide.

Table 1 Text Conventions

Convention	Description
`courier`	Command name or screen text.
`courier bold`	Command text to be entered by the user.
italic	Indicates a book title, menu item, or new term.

This guide uses the following formats to highlight special messages in the text:

NOTE: Highlights information that is important or that has special interest.

CAUTION: Highlights information to help prevent damage to equipment or loss of data.

WARNING: Highlights safety information that is related to electric shock or bodily injury.

Related Publications

For more information about configuring and managing a SafeGuard device, refer to the following guides:

- *OmniAccess SafeGuard Controller Installation Guide*

  Describes the OmniAccess SafeGuard Controller. The guide provides detailed installation instructions and technical specifications for the OmniAccess SafeGuard Controller.

- *OmniVista SafeGuard Manager Administration Guide*

  Describes how to manage the OmniAccess SafeGuard Controller using the OmniVista SafeGuard Manager software.

- *ICS Dissolvable Agent for SafeGuard Administration Guide*

  Describes how to configure the Integrity Clientless Security (ICS) module of the Alcatel-Lucent Network Admission Control (NAC).

Additional Resources

Alcatel-Lucent publishes documents for Alcatel-Lucent customers at:
www.Alcatel-Lucent.com

Guide Organization

Table 2 briefly describes each chapter in this guide.

Table 2 Guide Organization

Chapter or Appendix	Contents
Chapter 1, SafeGuard OS Overview	Provides an overview to the Alcatel-Lucent SafeGuard OS, the basic feature overview, and how it supports the Alcatel-Lucent SafeGuard product line. Also, describes typical deployment models for SafeGuard devices; they can be deployed in either a standard topology or in a High Availability (HA) topology.
Chapter 2, Accessing and Managing the System	Describes connecting display devices, such as a terminal, PC, or laptop computer, to the SafeGuard device and logging in to the system.
Chapter 3, Working with Configuration Files and Upgrading Images	Describes functions and commands related to configuration files and upgrade processes.

Table 2 Guide Organization *(continued)*

Chapter or Appendix	Contents
Chapter 4, Configuring SafeGuard Controllers	Describes features specific to SafeGuard Controllers.
Chapter 5, Setting Up SafeGuard Switches	Describes numerous configurations specific to SafeGuard switches, including: ■ setting up Virtual Local Area Networks (VLANs) ■ setting up IP unicast or multicast routing.
Chapter 6, Configuring Authentication and Role Derivation	This chapter describes the commands used for configuring authentication, including their names, descriptions, prototypes, arguments, and argument descriptions. SafeGuard OS supports two types of user authentication: active and passive. Describes the different types of user authentication available in SafeGuard OS as well as applicable CLI commands for implementing authentication. Describes how to configure special authentication lists used for circumventing the normal authentication processes, as needed. Explains the different types of user authentication available in SafeGuard OS. It also explains how to configure the SafeGuard device using the CLI to achieve the maximum benefit in a deployment. Describes how to configure IEEE 802.1x, port-based authentication, on the SafeGuard Switch.
Chapter 7, Establishing a Security Policy	Discusses the key concepts of policy, how to develop a Policy workflow, and procedures for coding Policy commands.
Chapter 8, Visualization	Describes the concepts and procedures for configuring the Visualization component.
Chapter 9, End Point Validation	Describes the concepts and procedures for configuring End Point Validation (EPV) commands.
Chapter 10, Detecting and Isolating Malware Security Threats	Provides an overview of the malware detection process and provides procedures for coding the commands used for detecting and remedying malware.
Chapter 11, Troubleshooting	Describes the commands used for configuring logging, including their names, descriptions, prototypes, arguments, and argument descriptions.

chapter

1 SafeGuard OS Overview

In this chapter:

Alcatel-Lucent enables enterprises to secure their LANs with purpose-built devices based on custom silicon. IT can control who is allowed onto the LAN, restrict what users can do on the LAN, and prevent threats from disrupting network services or compromising data.

Customers can embed security directly in their LAN infrastructure using Alcatel-Lucent's network device products: the SafeGuard Controller and SafeGuard Switch.

This chapter reviews Alcatel-Lucent's devices and products which make up the complete Alcatel-Lucent solution.

Alcatel-Lucent Solution and Product Overview

Alcatel-Lucent' solution and products are comprised of:

- *SafeGuard device(s)*

  A SafeGuard device, such as a *SafeGuard Controller* and/or *SafeGuard Switch*, is a network infrastructure device for inline policy enforcement. The hardware is designed with custom security silicon consisting of multi-core processors and custom traffic-processing programmable ASICs. The flexible architecture of these devices is the backbone for the SafeGuard operating system (OS).

  The SafeGuard Controller is available in two models:

  — The OmniAccess 1000 SafeGuard supports up to 800 authenticated users across four gigabit uplinks, with deep packet inspection at 4 Gbps, with appropriate licensing.

  — The OmniAccess 2400 SafeGuard supports up to 2000 authenticated users across ten 1-Gb uplinks, with 10 Gbps of deep packet inspection, with appropriate licensing.

  The OAG4048X Switch includes 10/100/1000 Mbps ports and 10 Gbps ports. A similar model, the OAG4048X-PoE, includes additional Power over Ethernet. As an enterprise-class switch, it has the performance, resiliency, and software features expected of a network switch connecting user machines into the core or distribution layer of the LAN. It has dual-homed uplinks, Rapid-Spanning Tree for fast failover, and hot-swappable power supplies and fans.

  While user and application-based controls are available for both the SafeGuard Controller and SafeGuard Switch devices, the SafeGuard Switch provides per-port control. The SafeGuard Controller provides per-uplink control.

- *SafeGuard OS*

  The operating system that runs on Alcatel-Lucent SafeGuard devices is the SafeGuard OS. The SafeGuard OS drives the device, providing traffic usage monitoring, access, and malware controls. The SafeGuard OS provides all of the

following capabilities in the same device, ensuring that there is no centralized point of failure:

- **Device Management** – Administrators can set up, manage, and diagnose problems for the device as a network device.
- **Authentication** – With Network Access Control (NAC) capabilities, authentication and posture check is provided to control who can enter the LAN. NAC leverages an organization's existing authentication servers and identity stores with flexibility to provide either passive or active authentication using Active Directory, RADIUS, or Captive Portal web logon.
- **End Point Validation (EPV)** – As an optional component of NAC to validate health or *posture* of end-user host machines, EPV policies use a temporary or *dissolvable* client to check for out-of-date OS, anti-virus software, etc. Hosts that are not in compliance with corporate security standards are redirected to an appropriate site to download patches and fixes before accessing the internet.
- **Security Policy** – Role-based provisioning learned from the authentication component, the defined policy component allows the administrator to assign ACLs (Access Control Lists) at Layer 4 and Layer 7 to individual users. This capability is especially useful in the post admission separation of users regardless of point of entry (for example, separation of employees, contractors and business partners). While initiating policy enforcement on TCP connections or groupings of UDP packets, a stateful deep packet inspection of all flows is allowed.
- **Threat Control** – An essential part of LAN control, Alcatel-Lucent threat control algorithms monitor application connection patters for signs of malicious behavior. Because these algorithms do not rely on signatures, they can detect zero-day malware. The threat detection algorithms are built with a goal of preventing network meltdown by detecting the malicious activity in the quickest amount of time with very low false-positive rates.
- **Visualization** – Collects information about users and applications and how those users and applications impact the network. Visualization serves as the conduit between other SafeGuard OS components and the Alcatel-Lucent OmniVista SafeGuard Manager Command Center.

■ *OmniVista SafeGuard Manager Command Center*

OmniVista SafeGuard Manager is a central command center that displays data flow information collected from the SafeGuard OS visualization component. The OmniVista SafeGuard Manager interface, a graphical user interface, provides at-a-glance views of network usage and security violations, which enables the IT administrator to properly define security policies—global access and malware policies—relevant to the unique characteristics, trends, and usage patterns and characteristics of users on the network.

OmniVista SafeGuard Manager compiles information based on user transactions, presenting all of the activities and access violations tied to usernames. It provides traffic views on a per-user and per-flow basis, allowing for detailed auditing, reporting, and forensics. For example, OmniVista SafeGuard Manager could display all users running Instant Messenger or detail every application, computer, and file a particular user has touched.

OmniVista SafeGuard Manager also supports role-based provisioning, allowing IT to define access controls for broad groups of users, such as employees, contractors, and guests, or for smaller groups, such as the finance department. OmniVista SafeGuard Manager gives IT flexible malware control, allowing traffic to be stopped on a per-user or per-application basis if malware is detected.

Using the Alcatel-Lucent OmniVista SafeGuard Manager command center, IT is provided with full LAN visibility, policy creation capabilities and distribution.

The SafeGuard product family provides the full set of capabilities needed to protect enterprise assets.

Deployment Models

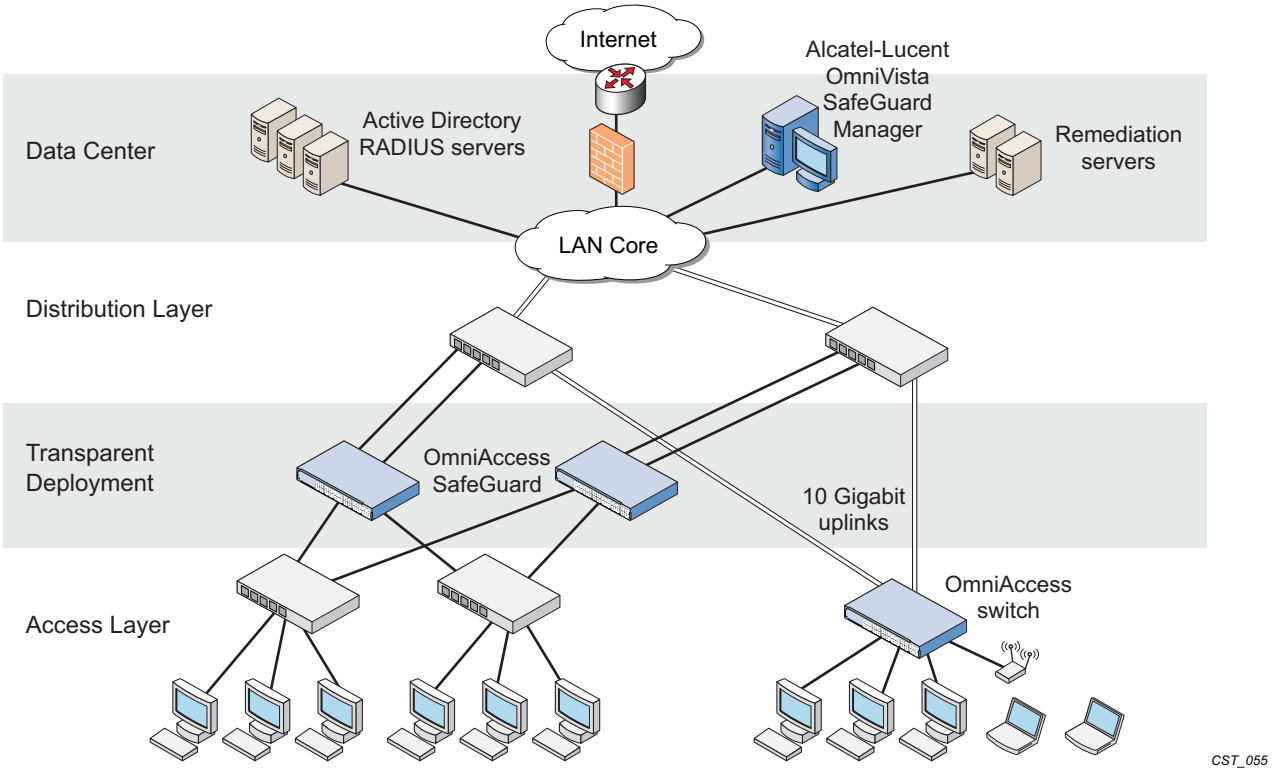
In terms of deployment, the SafeGuard Controller sits between access switches and the distribution or core layer, aggregating uplinks from the wiring closets and enforcing access policies on all traffic. As a transparent device, the Controller requires no changes to network design or user behavior, simplifying deployment and IT's cost of operations.

The Controller supports high availability and resiliency modes. Enterprises that have dual-homed wiring closet switches can deploy two SafeGuard Controllers as peers—the two platforms would share state and preserve user authentications in case of failover. The Controller runs in *fail pass-through mode* following a failure, where all LAN traffic will traverse the Controller untouched, or *protect mode*, where all traffic is stopped (based on security policy settings).

While the Controller sits behind existing switches, which suits environments not upgrading their switches, the SafeGuard Switch provides an integrated secure switch ideal for customers in the midst of a switch upgrade or building a new LAN for enterprises to secure the fabric of their LAN.

The integrated platform with both the SafeGuard Controller and SafeGuard Switch reduces the number of platforms customers need to buy and manage, lowering capital and operational costs. The SafeGuard Switch also provides per-port control, vs. the per-uplink control in the SafeGuard Controller. While user- and application-based controls are available in both SafeGuard platforms, the switch's per-port control means worms are contained to a single user rather than all users connected to one uplink port.

Figure 1 SafeGuard Controller and Switch in a Typical Deployment



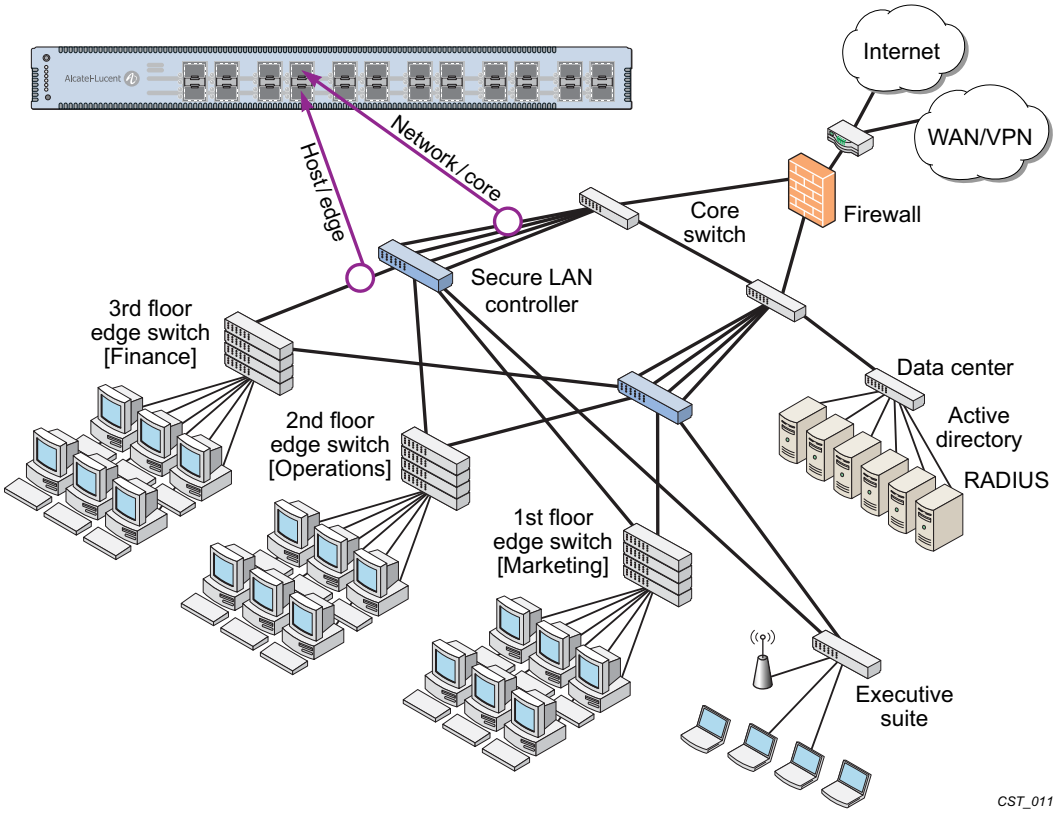
With the preferred standard and typical deployment model, the SafeGuard Controller device is a multi-port "bump-in-the-wire" device between the edge switch and the next layer switch, whether that be the distribution layer or the core switch. The uplinks can either be fiber or copper. A SafeGuard Switch is deployed like any other switch device, but it can link directly to the distribution layer.

When deploying SafeGuard devices using this model, all SafeGuard OS features are supported, including policy enforcement, captive portal, IP header validity, and malware enforcement. Further, devices can be deployed without disrupting existing wiring closet configurations. *Figure 1* shows SafeGuard devices in the typical deployment model.

System recovery and high availability (HA) can be configured when deploying SafeGuard Controllers. To, it requires an additional (redundant) SafeGuard Controller of the same model, running the same software release, and configured with the same port configuration.

In HA mode, the authentication state is propagated to the peer device before there is a failure so that users do not have to re-authenticate. For example, end users do not need to log in to the captive portal feature again if there is a system failure. *Figure 2* shows this type of deployment (for details on configuring high availability, see *Configuring High Availability Support on page 100*).

Figure 2 High Availability (Redundant) SafeGuard Controller Deployment



Understanding Protection Modes

Ingress and egress data traffic is managed by SafeGuard devices based on the level of protection mode set within the device. Based on the established protection mode—Pass-thru mode, Monitor mode, or Protect mode. For details on setting protection modes, see *Changing the Protection Mode of Ports on page 95*.

Table 3 Supported Protection Modes

Protection Mode	When Used	SafeGuard Controller	SafeGuard Switch
Pass-thru Mode	First time set up and cabling	Acts as a transparent bridge. All security functionality is bypassed.	Acts as a standard L2/ L3 switch. All security functionality is bypassed.
Monitor Mode	Testing and trials	Authentication, captive portal, visualization, malware detection and protection and user-based policy checking is applied to all data traffic, but enforcement is ignored.	

Table 3 Supported Protection Modes *(continued)*

Protection Mode	When Used	SafeGuard Controller	SafeGuard Switch
Protect Mode	Typical Deployment	Authentication, captive portal, visualization, malware detection and protection and user-based policy checking is applied to all data traffic, and actively enforced.	

SafeGuard OS Overall Feature Summary

The following table summarizes SafeGuard OS features supported by SafeGuard devices.

User/Machine Authentication

- Authentication via 802.1X or MAC address
- Passive Active Directory authentication snooping
- Passive RADIUS authentication snooping
- Captive portal authentication
- Trusted DHCP serve

Role Derivation

- RADIUS attributes
- Active Directory attributes
- Physical location
- Combination of above

Role-Based Policy (Access Control By)

- User group
- Application
- Select application attributes
- Destination port
- Resource (e.g. servers)

Host Posture Check

- Dissolvable agent
- Scan for known threats, anti-virus definition, service packs, and custom registry keys and files

Enforcement Actions

- Allow
- Deny
- TCP reset
- Mirroring, logging

Threat Detection/Mitigation

- Zero-hour threat detection
- No signature updates necessary
- Drops malformed packets
- Block by: physical port, SRC MAC, offending application

Visualization

- Ties usernames to applications and security violations
- Identifies applications and application content
- Reports application details to centralized policy center

Centralized Visualization

- Ties into Alcatel-Lucent OmniVista SafeGuard Manager Command Center
- User and application usage repository
- Real-time alert dashboard
- Fully drillable forensics capability
- Reporting and scheduler
- Full policy and role-derivation configuration GUI

Logging and Reporting

- Direct syslog reporting
- Detailed security log messages
- Formatted for SIEM integration
- Formatted syslog to multiple destinations

Management and Control

- Industry-standard Command Line Interface (CLI)
- Managed by Alcatel-Lucent OmniVista SafeGuard Manager Command Center
- SNMP v1/v2
- Telnet
- SSH
- TFTP
- Standard and privileged access modes

Administrator Authentication

- RADIUS authentication

Performance (Switch Only)

- Switching capacity: 101 million pps
- Secure Switching Rate: 10 Gbps

Protocols (Switch Only)

- 802.1D Bridging
- 802.1D Spanning Tree
- 802.1Q/p VLAN Tagging and Priority
- 802.1w Rapid Spanning Tree
- 802.1S MSTP
- 802.1X Port-based authentication
- 802.3 10Base-T
- 802.3u 100Base-T
- 802.3z 1000Base-SX/T
- 802.3ae 10 Gbps Ethernet
- 802.3af Power-over-Ethernet

Layer 2 Features (Switch Only)

- 4,096 VLANs
- 16,000 MAC Addresses
- Protocol VLAN (802.1v)
- Port Security (MAC address locking)
- Mirror/monitor ports
- IGMP v1/v2 snooping

Layer 3 Features (Switch Only)

- Static routing
- Additional L3 capabilities due in future software releases

chapter

2 Accessing and Managing the System

In this chapter:

This chapter describes the tasks associated with managing the SafeGuard Controller or the SafeGuard Switch as a device in the network.

Connecting to a SafeGuard Device Console

SafeGuard devices can be managed using a PC or laptop computer connected to the SafeGuard Controller or SafeGuard Switch.

To connect a SafeGuard device console:

1. Using a null cable, connect a PC or laptop computer to the DCE port on the back of the device.
2. Launch a terminal emulation program and configure the settings as shown in *Table 4*.
3. The login prompt is displayed.

Table 4 PC Terminal Emulator Settings

PC or Laptop	Setting
Emulation type	vt100
Bits per second	9600
Data bits	8
Parity bits	None
Stop bits	1
Flow control	None

See the following sections for details on accessing the SafeGuard device command line interface.

Accessing the SafeGuard Device Command Line Interface

The first time that you log into a SafeGuard device, use the default 'Admin' as a username (and no [null] password). Upon first logging into the command interface, you are in Non-Privileged mode. To perform management and configuration functions, you need to be in Privileged mode.

To access Privileged mode, use the **`enable`** command in Non-Privileged mode.

enable

This command has no parameters or variables.

For example:

```
(SafeGuardOS) #?
(SafeGuardOS) #enable
(SafeGuardOS) #
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #
```

See the following sections for more details on accessing SafeGuard devices:

- *Using Telnet*
- *Using Secure Shell (SSH)*
- *Customizing and Working with the Command Line Interface Default Settings*

Using Telnet

A SafeGuard device can be accessed via a Telnet session.

This section describes basic Telnet commands that may be useful when first accessing a SafeGuard device via a Telnet session. See the following sections for more details:

- *Enabling and Disabling Telnet*
- *Displaying the Current Telnet and Serial Port Connections*
- *Closing a Telnet or SSH Session*
- *Specifying the Maximum Number of Telnet Connections Allowed*
- *Setting the Telnet Connection Session Timeout*

Enabling and Disabling Telnet

Telnet access is enabled by default. If Telnet has been disabled, use the **ip telnet** command in Privileged Exec mode. To disable Telnet, use the **no** form of the command.

ip telnet

no ip telnet

The commands have no parameters or variables.

Displaying the Current Telnet and Serial Port Connections

To display the current Telnet and serial port connections, use the **show sessions** command in Privileged Exec mode.

show sessions

An example of this output and explanation of the fields is described in *Tracking an Authenticated User Session on page 219*.

Closing a Telnet or SSH Session

To close a Telnet or SSH session, use the **disconnect** command in Privileged Exec mode.

disconnect [*sessionID* | **all**]

Syntax Description	*sessionID*	Disconnects the session specified by the session identifier. Use the **show sessions** command to find the session ID.
	all	Disconnects all remote sessions.

The following example disconnects session ID 10:

```
(SafeGuardOS) # disconnect 10
(SafeGuardOS) #
```

Specifying the Maximum Number of Telnet Connections Allowed

To specify the maximum number of Telnet connection sessions that can be established, use the **ip telnet maxsessions** command in Global Configuration mode. Use the **no** version of the command to restore the default value.

ip telnet maxsessions *number*

no ip telnet maxsessions

Syntax Description	*number*	Sets the number of Telnet sessions. Valid range is from 1 to 5. The default value is 5.

The following example sets the number of Telnet sessions to 3:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # ip telnet maxsessions 3
(SafeGuardOS) (config) #
```

Setting the Telnet Connection Session Timeout

To set the Telnet connection session timeout value (in minutes), use the **ip telnet timeout** command in Global Configuration mode. Use the **no** version of the command to restore the default value.

ip telnet timeout *timeout*

no ip telnet timeout

Syntax Description	*timeout*	Sets the number of minutes that a session can be idle. Valid range is a decimal value from 0 to 160. A value of 0 indicates that the session remains active indefinitely. The default value is 5.

The following example sets the Telnet connection timer to never expire:

```
(SafeGuardOS)# configure terminal
(SafeGuardOS) (config) # ip telnet timeout 0
(SafeGuardOS) (config) #
```

Using Secure Shell (SSH)

Like Telnet, Secure Shell (SSH) is a protocol that allows the logging into of another computer over a network to execute commands in a remote machine, and to move files from one machine to another. Unlike Telnet that sends text in a clear text format, however, SSH encrypts the connection session.

SSH provides more security for remote connections than Telnet by providing strong encryption when a device is authenticated. The SafeGuard OS supports:

- SSH version 1 (SSHv1)
- SSH version 2 (SSHv2)
- Rivest, Shamir and Adleman (RSA) keys, versions 1 and 2
- Digital Signature Standard (DSA) keys
- A maximum of 5 SSH sessions

NOTE: SafeGuard OS does not support SSH passwords or *passkeys*.

This section describes basic SSH commands that may be useful when first accessing a SafeGuard device via a SSH session.

See the following sections:

- *Enabling an SSH Session*
- *Downloading SSH Key Files from TFTP Server*
- *Generating DSA, RSA, RSA Keys*
- *Deleting DSA, RSA, RSA Keys*

- *Changing SSH Protocols*
- *Limiting SSH Sessions*
- *Setting the SSH Timer*
- *Displaying SSH Configuration Information*

Enabling an SSH Session

To enable an SSH session on the device:

1. Enable SSH on the device by entering the **ip ssh** command in Global Configuration mode. The **no** version of the command disables SSH, which is the default state.

   ```
   ip ssh
   no ip ssh
   ```

   The commands have no parameters or variables. The first time that SSH is enabled on a device, SafeGuard OS detects that keys are not present and generates the keys automatically.

   ```
   (SafeGuardOS) #configure terminal
   (SafeGuardOS) (config) #ip ssh
   (SafeGuardOS) (config) #exit
   (SafeGuardOS) #
   ```

2. Verify the configuration using the **show ip ssh** command.

Downloading SSH Key Files from TFTP Server

To download private key files from a Trivial File Transfer Protocol (TFTP) server for SSH (that do not contain passkeys), use the Privileged Exec **copy** command to download a key file.

NOTE: If you want to TFTP your own keys instead of having them generated by the SafeGuard device, you must TFTP all three types of keys (DSA, RSA1, AND RSA). All three keys are required for proper SSH functionality.

copy tftp://ip/{*filepath*/}*file* **nvram:**[**sshkey-dsa** |**sshkey-rsa1** |**sshkey-rsa**]

Syntax Description	*ip*	IP address of the TFTP server
	filepath	(Optional) Directory path to the file.
	file	Filename of the key file.
	nvram:sshkey-dsa	Specifies to download a SSH DSA key file.

	nvram:sshkey-rsa1	Specifies to download a SSH RSA1 key file.
	nvram:sshkey-rsa	Specifies to download a SSH RSA2 key file.

The following example specifies how to download an SSH RSA1 key file from the TFTP server:

```
(SafeGuardOS) # copy tftp://180.29.52.20/keys nvram:sshkey-rsa1
(SafeGuardOS) #
```

Generating DSA, RSA, RSA Keys

The first time that SSH is enabled, the SafeGuard OS generates keys for DSA, RSA and RSA1 which are not installed. The key deciphers the SSH encryption. To generate new SSH keys, in Global Configuration mode use the **ip ssh key generate** command.

NOTE: In order to be in export compliance, the SafeGuard OS generates keys that are just 56-bits in length. If you need a key that is larger than this, create the key externally.

ip ssh key generate *key*

Syntax Description	*key*	Key to generate. Valid entries are: ■ **DSA** ■ **RSA** ■ **RSA1** ■ **all** Specifying **all** generates all SSH keys. If **key** is not specified, the command generates any keys not currently installed.

The following example generates all SSH keys:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #ip ssh key generate all
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Deleting DSA, RSA, RSA Keys

To delete all installed SSH keys, in Global Configuration mode enter the **ip ssh key delete** command. The command has no parameters or variables.

The following example deletes all installed keys:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #ip ssh key delete
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Changing SSH Protocols

By default, SafeGuard OS supports both SSH versions 1 and 2. The protocols can be deleted or added as necessary by explicitly defining one or both. Use the **ip ssh protocol** command in Global Configuration mode to change the protocol support.

ip ssh protocol *protocol_level* {*protocol_level*}

Syntax Description	*protocol_level*	Specifies one or both SSH protocols. Valid entries are: ■ **1** – SSH version 1 ■ **2** – SSH version 2 ■ **1 2** – for both

The following example limits the SSH protocol to SSH version 2:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #ip ssh protocol 2
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Limiting SSH Sessions

The default for SSH sessions is set to the maximum of 5 sessions. To reduce the number of sessions, in Global Configuration mode use the **ip ssh maxsessions** command.

ip ssh maxsessions *sessions*

Syntax Description	*sessions*	Specifies the maximum number of SSH sessions allowed. Valid entries are 1 to 5.

The following example limits the SSH sessions to 3:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #ip ssh maxsessions 3
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Setting the SSH Timer

SSH connections time out at 5 minutes, by default. To change the timeout timer from 1 to 160 minutes, in Global Configuration mode use the **ip ssh timeout** command.

NOTE: A session is active as long as the session is idle for the value set. Changing the timeout value for active sessions does not become effective until the session is re-accessed. Also, any keystroke activates the new timeout duration.

ip ssh timeout *minutes*

Syntax Description	*minutes*	Specifies the connection timer in minutes. Valid entries are 1 to 160.

The following example limits the idle time for SSH connections to 20 minutes:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #ip ssh timeout 20
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Displaying SSH Configuration Information

To display the current SSH configuration, use the **show ip ssh** command in Privileged Exec mode:

show ip ssh

The command has no parameters or variables.

The following example is representative of the command output:

```
(SafeGuardOS) #show ip ssh

SSH Configuration

Administrative Mode: ..... Enabled
Operational Mode: ..... Enabled
Protocol Levels: ..... Versions 1 and 2
SSH Sessions Currently Active: ..... 0
Max SSH Sessions Allowed: ..... 2
SSH Timeout: ..... 4
SSH Keys Installed: ..... RSA1 RSA DSA

(SafeGuardOS) #
```

The fields in the output represent:

Display	Description
Administrative Mode	Displays whether the administrative state of SSH has been enabled or disabled.
Operational Mode	Displays the operational status of SSH and indicates whether SSH is currently enabled or disabled.
Protocol Levels	Displays the protocol level. This field may have the values of version 1, version 2 or both versions 1 and version 2.
SSH Sessions Currently Active	Displays the number currently active SSH connections. This field can be from 0 to 5.
Max SSH Sessions Allowed	Displays the maximum number of SSH connections allowed. This field can be from 0 to 5. The default is 5.
SSH Timeout	Displays the idle timer for connection time. This field can be from 1 to 160 minutes.
SSH Keys Installed	Displays which keys are currently installed. Possible keys are: RSA1, RSA and DSA.

Customizing and Working with the Command Line Interface Default Settings

See the following sections for details on how to customize the command line interface default settings:

- *Changing the System Command Prompt*
- *Setting a Maximum Serial Console Connect Time*
- *Enabling and Disabling CLI Display Paging*
- *Uploading a New CLI Banner File*
- *Uploading the CLI Log File*
- *Copying the System Diagnostics File*
- *Copying the System Debug File*
- *Displaying the Current HTTP Information*

Changing the System Command Prompt

To change the command line interface prompt, use the **set prompt** command in enable mode. The length of the prompt can be up to 64 alphanumeric characters.

set prompt *string*

Syntax Description	*string*	Sets the command prompt to an alphanumeric string up to 64 characters and numbers. The prompt is case sensitive

The following example sets the command prompt to OmniAccess 2400 SafeGuard:

```
(SafeGuardOS) # set prompt OmniAccess 2400 SafeGuard
(OmniAccess 2400 SafeGuard) #
```

Setting a Maximum Serial Console Connect Time

To set a maximum connect time (in minutes) without console activity for the serial console, use the **serial timeout** command in Line Configuration submode. Line Configuration Mode is entered by using the **lineconfig** command in Global Configuration mode.

serial timeout *time*

Syntax Description	*time*	Sets the number of minutes that a serial console can be idle. Valid range is a decimal value from 0 to 160. A value of 0 indicates that the console remains active indefinitely. The default value is 5.

The following example sets the console timeout to 10 minutes:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # lineconfig
(SafeGuardOS) (line) # serial timeout 10
(SafeGuardOS) (line) #
```

Enabling and Disabling CLI Display Paging

To enable or disable CLI display paging, use the **paging** command in Privileged Exec mode.

paging [**enable** | **disable**]

Syntax Description	**enable**	Enable CLI display paging mode.
	disable	Disable CLI display paging mode.

The following example disables CLI display paging:

```
(SafeGuardOS)# paging disable
(SafeGuardOS)#
```

Uploading a New CLI Banner File

To upload the CLI banner file, use the **copy nvram:clibanner** command in Global Configuration mode.

copy nvram:clibanner tftp://*ip*/{*filepath*/}*filename*

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	filename	Specifies the filename of the file being saved.

Uploading the CLI Log File

To upload the log file, use the **copy nvram:log** command in Global Configuration mode.

copy nvram:log tftp://*ip*/{*filepath*/}*filename*

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	filename	Specifies the filename of the file being saved.

Copying the System Diagnostics File

To copy a system diagnostics file, use the **copy system:diag-info** command in Global Configuration mode.

copy system:diag-info tftp://*ip*/{*filepath*/}*filename*

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	filename	Specifies the filename of the file being saved.

Copying the System Debug File

To copy a system debug file, use the **copy system:dump** command in Global Configuration mode.

copy system:dump:*//ip/{filepath/}filename*

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	filename	Specifies the filename of the file being saved.

Displaying the Current HTTP Information

To display the current HTTP information, use the **show ip http** command in Privileged Exec mode.

```
show ip http
```

This command has no parameters or variables.

Exiting or Logging Out of a Command Line Session

To exit or log out of a command level session, use either the **exit** or **logout** command in any mode.

```
exit
logout
```

The command has no options or parameters. For example:

```
(SafeGuardOS) # logout
```

Configuring Management Users

The Admin user has full access to all CLI both from the front-panel ports and from the rear-panel management port.

- **Management Users** – A management user can be defined as having three levels of authority:
  - **Admin-user** has full access to all commands.
  - **Privilege-user** has permission to execute action, clear and configure commands, with the exception of the user management commands.
  - **Exec-user** has access to limited commands.

- **Network Users** – Network users are end-users defined in the SafeGuard local authentication database. Network users do not have authority to execute commands at the command line. For more information on managing network users, see *Maintaining Users on page 258*.

This section describes setting up administrator and network user access to SafeGuard devices. By default, an "Admin" user is configured with the initial configuration. See the following sections for more details:

- *Configuring Management Users*
- *Assigning a Login List to the Default Login User*
- *Configuring RADIUS Users for Management Users*
- *Clearing All Passwords*

For more information on managing *network* users, see *Maintaining Users on page 258*.

Configuring Management Users

This section describes adding and changing management accounts. See the following sections for more details:

- *Adding Management Users to the Database*
- *Displaying the Management Users*
- *Setting a Password for the Default Admin Account*
- *Configuring Local Authentication for Management Users*

Adding Management Users to the Database

Management users are the administrators who will be logging in from the service/front panel port and manage SafeGuard. To add a management user to the database, in the Global Configuration mode use the **aaa mgmt-user** command.

To remove a management user use the **no** form of the command.

aaa mgmt-user *username* **passwd** *password* **access-mode** *mode*

no aaa mgmt-user *username*

Syntax Description	*username*	The name of the user being added to the database. User names can be up to 31 characters long.
	password	The login password. Login passwords can be up to 31 characters long.

mode	The mode from highest to lowest privileges are: ■ **admin-user** – An admin user is allowed to access all commands. ■ **priv-user** – The privilege user is allowed to access only show and action commands. ■ **exec-user** – The exec user is allowed to access only show commands.

The following example adds a management user with username abcd, password abcd and access mode exec-user:

```
(SafeGuardOS) (config) #no aaa mgmt-user abcd passwd abcd access-mode exec-user
```

The following example deletes the management user with username abcd:

```
(SafeGuardOS) (config) #no aaa mgmt-user abcd
```

The following example changes the password of an administrator user (mgmtuser) to f00onU3.

```
(SafeGuardOS) (config) # aaa mgmt-user mgmtuser passwd f00onU3
```

When a password is changed, a prompt asks for the former password. If none exists, press the **Enter** key. The passwords are stored in encrypted format for protection.

The system contains a default "Admin" administrator user that cannot be deleted. The default administrative password (set to null by default), however, can be changed and encrypted.

Displaying the Management Users

To display the management users, in the Global Configuration mode use the **show aaa mgmt-users** command.

show aaa mgmt-users

The command has no parameters.

The following example shows sample output from the **show aaa mgmt-users** command:

```
(SafeGuardOS) #show aaa mgmt-users

                                SNMPv3          SNMPv3          SNMPv3
User Name   User Access Mode  Access Mode  Authentication  Encryption
----------  ----------------  -----------  --------------  ----------
admin       Admin             Read/Write   None            None
guest       Exec              Read Only    None            None
execuser    Exec              Read Only    None            None
admin1      Admin             Read Only    None            None
```

```
abcd        Exec              Read Only    None            None
priv-user   Exec              Read Only    None            None

(SafeGuardOS) #
```

NOTE: SafeGuard OS will support SNMPv3 will be supported in a future release.

The fields in the output represent:

Field	Description
User Name	Username as detected by its authentication.
User Access Mode	The user's access mode.
SNMPv3 Access Mode	The SNMPv3 access mode.
SNMPv3 Authentication	Whether the user has SNMPv3 authentication.
SNMPv3 Encryption	Whether the user has SNMPv3 Encryption.

Setting a Password for the Default Admin Account

To set the password for the default administrator (admin) account, use the **aaa mgmt-user passwd admin** command. If a user is authorized for authentication or encryption is enabled, the password must be at least eight alphanumeric characters in length.

The username and password are not case sensitive. When a password is changed, a prompt asks for the former password. If none exists, press the Enter key. Use the **no** version of the command to set the password to blank.

aaa mgmt-user passwd admin *passwd*
no aaa mgmt-user passwd admin *passwd*

Syntax Description	*passwd*	Specifies the new password.

The following example sets the default password to f00onU2:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa mgmt-user passwd admin f00onU2
Password Changed!
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Configuring Local Authentication for Management Users

Users are set up in the authentication database by assigning them to a set of roles usually defined by group and then by mapping a set of authentication protocol-specific attributes and their values to a role. The attributes are first obtained by user authentication against the local authentication database. If the user does not authenticate against the local database, you can configure the user to authenticate against a centralized RADIUS database as a backup.

Creating Authentication Lists

In most instances, users are assigned roles based on their group or job responsibilities. To identify those groups of users, you need to create a list for each distinct user group.

Use the **aaa mgmt-user authentication login** command in Global Configuration mode to create a user group or organizational list.

aaa mgmt-user authentication login *listname* {*methods*}

Syntax Description	*listname*	The name of the list being created. A list name can be up to 15 characters long.
	methods	One or more authentication methods used to authenticate this group of users. You may specify up to 3 non-repeating methods. If not specified, the system uses the default-list. If less than 3 methods are specified, the remaining methods are classified as undefined. Specify the method in the order of precedence you want to run. Valid values for methods are: ■ local – Use local authentication. ■ RADIUS – Use remote RADIUS authentication. ■ Reject – Deny the user.

The following example creates an authentication list for a group of sales people. The group uses local authentication as the only authentication method and users who are unable to authenticate using that method are denied access to the network:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa mgmt-user authentication login salesList local
reject
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Displaying the Authentication Login List

To verify the contents and methods being used for authentication, use the **show aaa mgmt-users authentication-list** command in Privileged Exec mode:

show aaa mgmt-users authentication list

This command has no options or parameters. The following is sample output from the command:

```
Authentication Login List  Method 1    Method 2    Method 3
-------------------------  --------    --------    --------
defaultList                local       undefined   undefined
list123                    reject      undefined   undefined
authLoginList              radius      local       reject
radius-list                radius      local       reject
salesList                  radius      local       reject
```

The fields of the output represent:

Field	Description
Authentication Login	The name of the authentication login list.
Method 1	The primary method of authentication.
Method 2	This method of authentication is used if the primary method is unavailable. If a secondary method is not used, this field is undefined.
Method 3	This method of authentication is used if the secondary method is unavailable. If a secondary method is not used, this field is undefined.

Assigning a Login List to the Default Login User

To ensure that any non-configured users who attempt to log into the management port are forced to authenticate against the RADIUS server, use the **aaa mgmt-user defaultlogin** command in the Global Configuration mode. To disable RADIUS authentication, use the **no** version of the command.

aaa mgmt-user defaultlogin *listname*

no aaa mgmt-user defaultlogin *listname*

Syntax Description	*listname*	Name of the authentication list or group name being authenticated.

The following example assigns salesList to the defaultLogin list:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa mgmt-user defaultlogin salesList
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

The following example shows the disabling RADIUS authentication of non-configured users:

```
(SafeGuardOS) (config) # no aaa mgmt-user defaultlogin salesList
(SafeGuardOS) (config) #
```

Configuring RADIUS Users for Management Users

In order to provide administrative privileges to remote RADIUS users, the `Service-Type` field in RADIUS must be configured to return the appropriate value. Configure the RADIUS server to return **Service-Type = 1** or **Login** for priv-user, **Service-Type = 7** or **NAS Prompt** for exec-user. For FreeRadius, **Service-Type = NAS-Prompt-User** and **Service-Type = Login-User**.

Different implementations of RADIUS might have slight variations on how to set this field. See *Table 5* for some examples of this field, and see your RADIUS product documentation for further help.

Table 5 RADIUS Service-Type Settings

Implementation	Service-Type
FreeRADIUS	6 or Administrative-User
Microsoft IAS	Administrative
SteelBelt RADIUS	Administrative

In the following example, MyCompany uses FreeRADIUS. Users Moe and Larry are setup for administrative privileges while user Curley logs in as priv-user has most of the privileges of the administrative user.

```
Moe     Auth-Type:=System
        Service-Type=6
        Login-Service=Telnet

Larry   Auth-Type:=System
        Service-Type=Administrative-User
        Login-Service=Telnet

Curley  Auth-Type:=System
        Service-Type=Login-User
        Login-Service=Telnet
        Alcatel-Lucent-Role="Curley-Alcatel-Lucent-
        VSA"
```

Clearing All Passwords

To clear all user passwords and reset them to the factory defaults (null) without powering off the device, use the **clear pass** command in Privileged Exec mode. When prompted to confirm that the password reset should proceed, enter **y** for Yes.

```
clear pass
```

The following example clears all user passwords and reinstates the system defaults:

```
(SafeGuardOS) #clear pass
Are you sure you want to reset all passwords? <n/y> y
Passwords reset
(SafeGuardOS) #
```

Managing Out-of-Band Management Port

This section describes the tasks and commands used for configuring and displaying information for the out-of-band management port on SafeGuard devices. The management port is also referred to as the *service port*.

See the following sections for more details:

- *Setting the IP Configuration Protocol*
- *Enabling or Disabling the Management Port*
- *Setting Speed and Duplex for the Management Port*
- *Displaying Configuration Information for the Management Port*

Setting the IP Configuration Protocol

To set the configuration protocol for the management port, use the **serviceport protocol** command in Global Configuration mode.

When using this command, it is suggested to run the command twice: once with the value **none**, and once with the value desired for the management port's protocol support (either **bootp** or **dhcp**). When modified, the change takes effect immediately.

For more details on bootstrap and DHCP protocols, see *Configuring Bootstrap or DHCP Relay on page 194*.

```
serviceport protocol [none | bootp | dhcp]
```

Syntax Description	**none**	Specifies no protocol.
	bootp	Specifies BOOTP as the protocol.

	dhcp	(Default) Specifies DHCP as the protocol.

The following command example changes the protocol to bootstrap:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # service protocol none
(SafeGuardOS) (config) # service protocol bootp
(SafeGuardOS) (config) #
```

Setting the IP Address, Netmask, and Gateway of the System

To set the IP address, netmask, and gateway of the management port, use the **serviceport ip** command in Global Configuration mode. Before running this command, however, the service port protocol must be set to **none** first (see *Setting the IP Configuration Protocol on page 46*).

serviceport ip *ipaddr netmask* [*gateway*]

Syntax Description	*ipaddr*	IP address for the service port.
	netmask	Network mask for the service port.
	gateway	Optional for Controller only. Gateway IP address. (To set the default gateway on the Switch, use ip route.)

The following example sets the service port configuration:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # serviceport protocol none
(SafeGuardOS) (config) # serviceport ip 172.68.15.1 255.255.0.0
(SafeGuardOS) (config) #
```

Enabling or Disabling the Management Port

The management port is enabled, by default, and so therefore is not explicitly displayed in the **show running-config** command output. The **serviceport enable** command enables the PHY and lights the management port link LED. The **no** version of the command disables the PHY and extinguishes the management port link LED. The Global Configuration commands use the following syntax:

serviceport enable

no serviceport enable

The commands have no parameters or variables.

Setting Speed and Duplex for the Management Port

The management port can operate at a variety of speeds and duplex settings. The default settings are to auto-negotiate with the link partner. For auto-negotiation to succeed, the management port and the link partner must both be set for auto-negotiating. Otherwise, the management port attempts to auto-negotiate but could fail if traffic does not match the auto-negotiated speed.

Use the **serviceport speed** command in Global Configuration mode to override the auto-negotiation and set the speed and duplex for the management port using the following syntax:

serviceport speed [**10** | **100**] [**full-duplex** | **half-duplex**]

Syntax Description	**10**	Specifies running the management port at 10 Mbps.
	100	Specifies running the management port at 100 Mbps.
	half-duplex	Specifies half duplex; transmitting and receiving data one direction at a time.
	full-duplex	Specifies full duplex; transmitting and receiving data at the same time.

The following example forces the management port to run at 100 Mbps half-duplex.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # serviceport speed 100 half-duplex
(SafeGuardOS) (config) # exit
```

Use the **show serviceport** command in Privileged Exec mode to verify the configuration. See *Displaying Configuration Information for the Management Port on page 48*.

Use the **serviceport auto-negotiate** command in Global Configuration mode to override the speed and duplex settings on the management port. The **no** version of the command disables auto-negotiation.

serviceport auto-negotiate

no serviceport auto-negotiate

Displaying Configuration Information for the Management Port

To display service port configuration information, use the **show serviceport** command in Privileged Exec mode. For example:

show serviceport

The command has no options or parameters.

The following output is representative of the **show serviceport** command on a SafeGuard Switch. This command's output on a SafeGuard Controller would be similar, but with the addition of "Gateway Address" following the "Subnet Mask" line:

```
(SafeGuardOS) #show serviceport
Current ServicePort IP configuration
IP Address..................................... 172.16.1.10
Subnet Mask.................................... 255.255.192.0
ServPort Configured Protocol Current........... None

Burned In MAC Address.......................... 00:12:36:FE:92:CE
ServicePort Link Status........................ Up
ServicePort Admin Status....................... Enabled
Configured ServicePort speed................... auto-negotiate
ServicePort Duplex Status...................... 100M FULL

ServicePort Statistics
Total Packets Received ........................       110
Total Packets Transmitted .....................        46
Total Bytes Received...........................      9784
Total Bytes Transmitted........................      4166
Total Bad Packets Received.....................         0
Total Packet Transmit Problems.................         0
No Receive Space in Buffers....................         0
No Transmit Space in Buffers...................         0
Multicast Packets Received  ...................         0
Total Collisions...............................         0

ServicePort Detailed Rx Statistics
Packet Length Errors...........................         0
Ring Buffer Overflow Errors....................         0
CRC Errors.....................................         0
Frame Alignment Errors.........................         0
Fifo Overrun Errors............................         0
Missed Errors..................................         0
ServicePort Detailed Tx Statistics
Aborted Errors.................................         0
Carrier Errors.................................         0
Fifo Overrun Errors............................         0
Heartbeat Errors...............................         0
Window Errors..................................         0
```

The fields in the output represent:

Field	Description
Current service Port IP configuration	
IP address	IP address of the interface.
Subnet Mask	IP subnet mask for this interface.

Field	Description
ServPort Configured Protocol Current	Network protocol that is currently being used, if any.
Service Port Statistics	
Total Packets Received	Total number of packets (including broadcast packets and multicast packets) that were received by the management port.
Total Packets Transmitted	Total number of packets that were transmitted from the management port.
Total Bytes Received	Total number of octets of data (including those in bad packets) received on the port.
Total Bytes Transmitted	Total number of octets of data (including those in bad packets) transmitted from the port.
Total Bad Packets Received	Total number of bad packets received on the port.
Total Packet Transmit Problems	Total number of bad packets transmitted from the port.
No Receive Space in Buffers	0
No Transmit Space in Buffers	0
Multicast Packets Received	0
Total Collisions	0
Service Port Detailed Rx Statistics	
Packet Length Errors	0
Ring Buffer Overflow Errors	0
CRC Errors	0
Frame Alignment Errors	0
Fifo Overrun Errors	0
Missed Errors	0
Service Port Detailed Tx Statistics	
Aborted Errors	0
Carrier Errors	0
Fifo Overrun Errors	0

Field	Description
Heartbeat Errors	0
Window Errors	0

Displaying Address Resolution Protocol Information

SafeGuard Controllers have a preset configuration for the address resolution protocol (ARP) table and the ARP cache. SafeGuard Switches allow modification of the ARP settings. For details on configuring ARP on the SafeGuard Switch, see *Configuring Address Resolution Protocol on page 184*. To display ARP information, see *Displaying ARP Information on page 189*

Setting Up the System Time and Date (SNTP)

If a Simple Network Time Protocol (SNTP) server is used to synchronize time settings in the network, it is not necessary to manually configure clock settings for the SafeGuard device(s). SNTP setup is discussed in *Configuring SNTP on page 54*.

See the following sections for more details:

- *Manually Setting the Time and Date*
- *Configuring SNTP*
- *Optional SNTP Client Configurations*

Manually Setting the Time and Date

SafeGuard devices have an on-board real-time clock. The following settings can be manually adjusted:

- Timezone setting. Setting the timezone is a recommended step during product installation.
- Automatic changeover for daylight savings settings
- Software system clock settings

NOTE: The order in which clock settings are configured can affect the accuracy of the time setting.

To manually configure the time and date on the device:

1 Set the timezone. Skip this step if the timezone was set up during installation.

To set the device to the correct timezone, use the **clock timezone** command in either Privileged Exec or Global Configuration modes.

clock timezone *zonename hours_offset* {*minutes_offset*}

Syntax Description	*zonename*	Specifies an arbitrary name of the timezone in a 3-letter abbreviation. For example, Eastern Standard Time is entered as EST.
	hours_offset	Specifies the number of hours difference from Universal Time (a.k.a. Greenwich Mean Time, GMT). Valid entries are -23 to 23.
	minutes_offset	(Optional) Specifies the number of minutes offset from Universal Time.

The following example sets the timezone to Pacific Standard Time (PST).

```
(SafeGuardOS) # clock timezone PST -8
(SafeGuardOS) #
```

2 Set the time and date.

If no other time sources are available to set the current time and date, use the **set clock** command in Privileged Exec mode. The time specified in this command is relative to Universal Time Clock (UTC) time zone. The system can then be synchronized to an external Network Time Protocol (NTP) clock source.

This command also updates the real time clock chip so it is preserved across reboots.

clock set *time month day year*

Syntax Description	*time*	Time using 24 hour format (military).
	month	Month abbreviated to 3 characters, for example, Jan for January or Jun for June.
	day	Date in the month, for example, 29 for October 29th.
	year	4-digit year, for example, 2006.

The following example sets the time to November 29, 2007 at 4:25:37 PM:

```
(SafeGuardOS) # clock set 16:25:37 NOV 29 2007
(SafeGuardOS) #
```

3 Set up Daylight Savings Time.

In many countries, clocks are set back an hour in the Summer when the days become longer. Often referred to as Daylight Savings Time, system clocks must be reset for this seasonal adjustment. Use the **clock summer-time** command in Global Configuration modes to adjust for this seasonal change.

clock summer-time *zonename* [**recurring** | *startweek startday startmonth starttime endweek endday endmonth endtime*]

Syntax Description	*zonename*	An arbitrary name of the timezone in a 3-letter abbreviation. For example, Eastern Standard Time is entered as EST.
	recurring	Indicates that the change happens every year. If this option is used, the system uses the United States Daylight Savings Time rules as enacted by the Uniform Time Act amended in 1986. In the European Union, Daylight Saving Time starts at slightly different times of the year and need to be manually entered.
	startweek	Week in the month to make the time change. Valid values are 1 to 5 or last.
	startday	Day of the week to make the time change. Valid values are Monday through Sunday.
	startmonth	Month to start the time change. Valid values are January though December.
	starttime	Hour to make the change. The format is hh:mm.
	endweek	Week in the month to change the time back. Valid values are 1 to 5 or last.
	endday	Day of the week to change the time back. Valid values are Monday through Sunday.
	endmonth	Month to change the time back. Valid values are January though December.

	endtime	Hour to change the time back. The format is hh:mm.

The following example, configures Summer hours as a recurring event.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # clock summertime recurring
(SafeGuardOS) (config) # exit
```

4 To display the system time, use the **show clock** command in Privileged Exec mode using the following syntax:

show clock

The command has no parameters or variables.

Configuring SNTP

Simple Network Time Protocol (SNTP) is an adaptation of the Network Time Protocol (NTP) used to synchronize computer clocks across the Internet. For a stand-alone system that sets and synchronizes the time for the network, configure SNTP on the SafeGuard device.

To configure SNTP:

1 Designate a SNTP server using the **sntp server** command in Global Configuration mode. Up to 3 SNTP servers can be configured.

sntp server *ipaddr* {*priority* {*version* {*portid*}}}

Syntax Description	*ipaddr*	Specifies the poll interval for SNTP unicast clients in seconds as a power of two. Valid values are 6 to 30 seconds.
	priority	(Optional) Ranks or prioritizes the server among other servers. Up to 3 SNTP servers may be specified. Valid values are 1 to 3.
	version	(Optional) Specifies the version of SNTP. Valid values are 1 to 4.
	portid	(Optional) Specifies the port identification number. Valid values are 1 to 65535.

The following example configures an SNTP server running SNTPv4 on port ID 25.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # sntp server 172.82.45.23
```

```
(SafeGuardOS) (config) # exit
(SafeGuardOS) #
```

To delete this server, use the **no** version of the command.

2 Validate the SNTP server setup using the **show sntp server** command in Privileged Exec mode.

`show sntp server`

This command has no options or parameters.

The following example is representative of the command output:

```
(SafeGuardOS) #show sntp server

Most recent SNTP response
-------------------------

Server IP Address:                172.16.3.100
Server Type:                      ipv4
Server Stratum:                   15
Server Reference Id:
Server Mode:                      Server
Server Maximum Entries:           3
Server Current Entries:           1

SNTP Servers
------------

IP Address: 172.16.3.100
Address Type: IPV4
Priority: 1
Version: 4
Port: 123
Last Update Time: Jul 28 00:01:46 2006 UTC
Last Attempt Time: Jul 28 00:01:46 2006 UTC
Last Update Status: Success
Total Unicast Requests: 5888
Failed Unicast Requests: 164

(SafeGuardOS) #
```

The fields in the **show sntp server** output represent:

Display	Description
Server IP Address	Displays the address of the configured SNTP server.
Server Type	Displays the address type of server.
Server Stratum	Displays the claimed stratum of the server for the last received valid packet.

Display	Description
Server Reference ID	Displays the reference clock identifier of the server for the last received valid packet.
Server Mode	Displays the SNTP server mode.
Server Maximum Entries	Displays the total number of SNTP servers allowed.
Server Current Entries	Displays the total number of SNTP servers configured.
IP Address	Displays the IP address of the SNTP server.
Address Type	Displays the address type of the configured server.
Priority	Displays the IP priority type of the configured server.
Version	Displays the SNTP version number of the server. The protocol version used to query the server in unicast mode.
Port	Displays the server port number.
Last Attempt Time	Displays the last server attempt time for the specified server.
Last Update Status	Displays the last server attempt for the server.
Total Unicast Requests	Displays the number of requests to the server.
Failed Unicast Requests	Displays the number of failed requests to the server.

3 Enable SafeGuard devices to operate as an SNTP client. Allow the client to either broadcast or unicast to synchronize clocks using the **sntp client mode** command. The Global Configuration command has the following syntax:

sntp client mode [**broadcast** | **unicast**]

broadcast	Specifies the SNTP client mode is broadcast.
unicast	Specifies the SNTP client mode is unicast.

The **no** version of the command disables SNTP client mode.

The following example enables SNTP client mode for unicast:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # sntp client mode unicast
(SafeGuardOS) (config) # exit
(SafeGuardOS) #
```

4 Validate the SNTP client settings and status using the **show sntp client** command in Privileged Exec mode.

show sntp client

This command has no options or parameters.

The following example is representative of the command output:

```
(SafeGuardOS) #show sntp client

Client Supported Modes:             unicast broadcast
SNTP Version:                       4
Port:                               123
Client Mode:                        disabled
```

The fields in the **show sntp client** output represent:

Display	Description
Client Supported Modes	Displays the supported SNTP Modes (Broadcast or Unicast).
SNTP Version	Displays the highest SNTP version the client supports.
Port	Displays the SNTP client port.
Client Mode	Displays the configured SNTP client mode.
Poll Interval	Displays the poll interval value for SNTP clients in seconds as a power of two.
Poll Timeout	Displays the poll timeout value in seconds for SNTP clients.
Poll Retry	Displays the poll retry value for SNTP clients.

To display SNTP information, use the **show sntp info** command in Privileged Exec mode.

show sntp info

The following example shows a sample output from the **show sntp info** command:

```
(SafeGuardOS) #show sntp info

Last Update Time:                   Never
Last Unicast Attempt Time:          Dec 16 11:35:10 2006 PST
Last Attempt Status:                Request Timed Out

Broadcast Count:                    0
```

Optional SNTP Client Configurations

SafeGuard OS also allows for optional SNTP configuration. The poll interval can be set for either broadcast or unicast clients. The poll retry and the poll timeout values can also be set for the clients.

See the following sections for more details:

- *Setting the Poll Interval*
- *Setting the Poll Retry and Poll-Timeout Timers for Unicast Clients*
- *Setting the Port ID for the Port Client*

Setting the Poll Interval

Set the poll interval for either broadcast or unicast clients using the following Global Configuration commands. The **no** version of the command resets the poll interval back to the default of 64 seconds.

`sntp broadcast client poll-interval` *`seconds`*

`no sntp broadcast client poll-interval`

`sntp unicast client poll-interval` *`seconds`*

`no sntp unicast client poll-interval`

seconds	Specifies the poll interval for SNTP clients in seconds as a power of two. Valid values for both broadcast and unicast clients are: ■ 6 = 64 seconds ■ 7 = 128 seconds ■ 8 = 256 seconds ■ 9 = 512 seconds ■ 10 = 1024 seconds ■ The default is 6, for both commands

The following example sets the poll-interval to 8 seconds for a broadcast client.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # sntp broadcast client poll-interval 8
(SafeGuardOS) (config) # exit
(SafeGuardOS) #
```

Setting the Poll Retry and Poll-Timeout Timers for Unicast Clients

Set the poll retry using the following Global Configuration command. The **no** version of the command resets the poll retry times for SNTP unicast clients to the default value of 1.

sntp unicast client poll-retry *retry*

no sntp unicast client poll-retry

retry	Specifies the number of retries for SNTP client polling. Valid values are 0 to 10. The default is 1.

The following example sets the SNTP retries to 2:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # sntp unicast client poll-retry 2
(SafeGuardOS) (config) # exit
(SafeGuardOS) #
```

To set the poll-timeout timers for unicast clients, use the **sntp unicast client poll-timeout** Global Configuration command. The **no** form of this command resets the poll time-out for SNTP unicast clients to its default value of 5 seconds.

sntp unicast client poll-timeout *seconds*

no sntp unicast client poll-timeout

seconds	Specifies the number of seconds for polling. Valid values are 1 to 30 seconds. The default is 5 seconds.

The following example sets the timer to 10 seconds.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # sntp unicast client poll-timeout 10
(SafeGuardOS) (config) # exit
(SafeGuardOS) #
```

Setting the Port ID for the Port Client

To set the port ID for the client port, use the **sntp client port** command in Global Configuration mode. The **no** version of the command resets the client port back to the default value of 123.

sntp client port *portid*

no sntp client port

portid	Specifies the SNTP client port ID. Valid values are 1 to 65535.

The following example configures SNTP clients to use port 1200.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # sntp client port 1000
(SafeGuardOS) (config) # exit
```

```
(SafeGuardOS) #
```

Managing Device Information

This section describes the commands used for managing the Alcatel-Lucent SafeGuard device, including their names, description, arguments, and argument descriptions.

See the following information for more details:

- *Clearing the Counters*
- *Checking for Another Computer on the Network*
- *Displaying Version Information*
- *Displaying Hardware Information*
- *Displaying the Serial Communication Settings for the Device*
- *Setting Up a Trace Route*

Clearing the Counters

To clear the statistics for a specified slot or port, all ports, or the entire device based on the argument, use the **clear** command in Privileged Exec mode.

clear counters [*slot/port* | **all**]

Syntax Description	*slot/port*	Clears the counters for the specified port.
	all	Clears the counters for all ports on the device.

The following example clears port 8 of the counters:

```
(SafeGuardOS) # clear counters 0/8
(SafeGuardOS) #
```

Checking for Another Computer on the Network

To check whether another node is alive on the network, use the **ping** command in Privileged Exec mode. To use this command, configure the device for network (in-band) connection. The source and target devices must have the ping utility enabled and be running on top of TCP/IP.

The SafeGuard device can be pinged from any IP workstation with which the device is connected through the default VLAN (VLAN 1), as long as a physical path exists between the device and workstation. The terminal interface sends three pings to the target device.

ping *ipaddr*

Syntax Description	*ipaddr*	Target IP address to ping.

The following example pings the device at IP address 10.1.1.0:

```
(SafeGuardOS) # ping 10.1.1.0
(SafeGuardOS) #
```

Displaying Version Information

To display the SafeGuard OS version information, use the **show version** command in Privileged Exec mode.

show version

The command has no options or parameters.

The following sample output is representative of the **show version** command:

```
(SafeGuardOS) #show version

Manufacturer..................................... Alcatel-Lucent Inc.
System Description............................... OmniAccess 2400 SafeGuard
Serial Number.................................... 0538FCS002
Burned In MAC Address............................ 00:12:36:FF:DA:FE
Software Version................................. SafeGuardOS-3.0.2.X-xp
Software Build Date.............................. Dec 19 22:33:40 PST 2006
Image Selected................................... Secondary
Image Booted..................................... Secondary
Primary Image.................................... SafeGuardOS-3.0.2.X-xp-release-
042512192006
Secondary Image.................................. SafeGuardOS-3.0.2.X-xp-release-
223312192006
Bootstrap Version................................ 1.0.0.3 (Boot Package: 1.0.0.10)
Active Bootrom Version........................... 2.0.0.26  (Boot Package:
1.0.0.10)
Bootrom Selected................................. Primary
Bootrom Booted................................... Primary
Primary Bootrom Version.......................... 2.0.0.26 (Boot Package:
1.0.0.10)
Secondary Bootrom Version........................ 2.0.0.26 (Boot Package:
1.0.0.10)
System Time...................................... Dec 20 14:09:40 PST 2006
CPU Utilization.................................. user: 0.98% system 27.45% idle:
71.57%
Free Memory...................................... 188 MB / Total 244 MB
Uptime........................................... 2 hours 54 minutes 46 seconds
(SafeGuardOS) #
```

The fields in the output represent:

Display	Description
Manufacturer	Identifies the device as manufactured by Alcatel-Lucent
System Description	Factory-assigned description of the system
Serial Number	Serial number of the device.
Burned In MAC Address	Burned-in MAC address. Used as the MAC address for the serviceport.
Software Version	Version of SafeGuard OS. The version is in the format of: version.release.maintence_level.build_number
Software Build Date	When the build was created
Image Selected	Primary or secondary image being run
Image Booted	Method used to boot the device. Valid entries are primary, secondary and TFTP
Primary Image	Release information of the primary image
Secondary Image	Release information of the secondary image
Bootstrap Version	Bootrom version number. The current release of SafeGuard OS supports a simple boot loader or a two-stage boot loader. If both boot loaders are on the system, the simple boot loader cannot read version information from the two-stage boot loader. In that case, the show version command does not display bootRom information.
Active Bootrom Version	The active bootrom version number.
Bootrom Selected	Which bootrom is selected, primary or secondary.
Bootrom Booted	Which bootrom was used to boot the device.
Primary Bootrom Version	Version of primary bootrom version.
Secondary Bootrom Version	Version of secondary bootrom version.
System Time	Date and time stamp.
CPU Utilization	Percentage being used by the user, system and the remaining percentage for idle.
Free Memory	Amount of free memory in megabytes; amount of total memory in megabytes.
Uptime	Elapsed time since the last reboot.

Displaying Hardware Information

To display the device hardware information for either a SafeGuard Controller or a SafeGuard Switch, use the **show hardware** command in Privileged Exec mode.

`show hardware`

The command has no options or parameters. The following sample output is representative of the command on a controller:

```
(SafeGuardOS) #show hardware
Manufacturer..................................... Alcatel-Lucent Inc.
System Description............................... OmniAccess 2400 SafeGuard
Serial Number.................................... 123-45-6789
Part Number...................................... 9000004
Hardware revision................................ 2.1
System Memory.................................... 256 MB
Flash Memory..................................... 128 MB
CAM Size......................................... 256K Entries
Network Processing Device....................... SafeGuard Processor 1.1 128MMT
Network Processor Revision...................... 0x01
SafeGuard Accelerator Chip Id. ................. 0x44
SafeGuard Accelerator Revision Level........... 0x36
SafeGuard Visualizer Chip Id.................... 0x26
SafeGuard Visualizer Revision Level............ 0x17
Switching Chip Revision......................... A1
Internal Temperature............................ 46 Celsius
Fan 1 Speed...................................... 6435 RPM
Fan 2 Speed...................................... 6435 RPM
Fan 3 Speed...................................... 6435 RPM
Fan 4 Speed...................................... 6435 RPM
Fan 5 Speed...................................... 6435 RPM
Fan 6 Speed...................................... 6435 RPM
Power Supply 1 (AC).............................. PASS
Power Supply 2................................... NOT DETECTED

(SafeGuardOS) #
```

The following sample output is representative of the command on a switch:

```
(SafeGuardOS) #show hardware
Manufacturer..................................... Alcatel-Lucent Inc.
System Description............................... OAG4048X
Serial Number.................................... C06100003
Part Number...................................... 9000007
Hardware revision................................ A1
System Memory.................................... 512 MB
Flash Memory..................................... 256 MB
CAM Size......................................... 64K Entries
Network Processing Device....................... SafeGuard Processor 1.1 128MMT
Network Processor Revision...................... 0x01
SafeGuard Accelerator Chip Id. ................. 0x45
SafeGuard Accelerator Revision Level........... 0x35
SafeGuard Visualizer Chip Id.................... 0x27
SafeGuard Visualizer Revision Level............ 0x18
LSD Part Number.................................. 6000008
```

```
LSD Serial Number.............................. 0614FCB008
LSD Rev........................................ 11
Main Board CPLD Version........................ 08
Internal Temperature........................... 41 Celsius
Fan 1 Speed.................................... 5066 RPM
Fan 2 Speed.................................... 5066 RPM
Power Supply 1 (AC)............................ OFF
Power Supply 2 (AC)............................ PASS

(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
Manufacturer	Identifies the device as manufactured by Alcatel-Lucent
System Description	The factory-assigned description of the system
Serial Number	The factory-assigned serial number
Part Number	The Alcatel-Lucent part number for the device
Hardware Revision	Alcatel-Lucent internal revision code
System Memory	The total memory available for the system, fixed at 256 MB
Flash Memory	Internal Flash memory for system images; size in megabytes.
CAM Size	Table space available in Content Addressable Memory (CAM)
Network Processing Device	Alcatel-Lucent internal revision code
Network Processing Revision	Alcatel-Lucent internal revision code
SafeGuard Accelerator Chip ID	Alcatel-Lucent internal revision code
SafeGuard Accelerator Revision Level	Alcatel-Lucent internal revision code
SafeGuard Visualizer Chip ID	Alcatel-Lucent internal revision code
SafeGuard Visualizer Revision Level	Alcatel-Lucent internal revision code
Switching Chip Revision	Alcatel-Lucent internal revision code
Internal Temperature	The internal temperature of the device. Valid ranges are from 0 to 40º degrees Celsius. Typically, the internal temperature is 5-10 degrees warmer than ambient.
Fan Speed	Cooling fan speed. Valid range is from 2000 to 10000 RPM

Field	Description
Power Supply	SafeGuard Controllers have one power supply that cannot be hot swapped. The SafeGuard Switch has two power supplies that can be hot swapped. If the power supply is present and operating, it displays as PASS. If the power supply is absent or not operating, it displays as FAIL.

To display the device compact flash memory information for either a SafeGuard Controller or a SafeGuard Switch, use the **show hardware media** command in Privileged Exec mode.

show hardware media

The command has no options or parameters.

The following example is representative of the command output:

```
(SafeGuardOS) #show hardware media

Compact Flash.................................. 1024 MB (Free 978 MB)

(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
Compact Flash	The amount of compact flash memory (in megabytes). Free indicates the number of megabytes of available space.

Displaying the Serial Communication Settings for the Device

To display serial communication settings for the device, use the **show serial** command in Privileged Exec mode.

show serial

The command has no options or parameters. The following example is representative of the command output:

```
(SafeGuardOS) #show serial

Serial Port Login Timeout (minutes)............ 5
Baud Rate (bps)................................ 9600
Character Size (bits).......................... 8
Flow Control................................... Disable
Stop Bits...................................... 1
```

```
Parity..................................... none

(SafeGuardOS)#
```

The fields in the output represent:

Field	Description
Serial Port Login Timeout (minutes)	The time (in minutes) of inactivity on a serial port connection, after which the device closes the configured connection. Any numeric value between 0 and 160 is allowed. The factory default is 5. A value of 0 disables the timeout.
Baud Rate	The default baud rate at which the serial port tries to connect. The available bauds are 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200. The factory default is 9600 baud.
Character Size	The number of bits in a character. The number of bits is always 8.
Flow Control	Whether hardware flow control is enabled or disabled. Hardware flow control is always disabled.
Stop Bits	The number of stop bits for each character. The number of stop bits is always 1.
Parity Type	The parity method used on the serial port. The parity method is always none.

Setting Up a Trace Route

To set up a trace route, that is, to discover the routes that packets actually take when traveling to their destination through the network on a hop-by-hop basis, use the **traceroute** command. The Privileged Exec mode command has the following syntax:

traceroute *ipaddr port*

Syntax Description	*ipaddr*	IP address.
	port	Decimal integer in the range of 0(zero) to 65535. The default value is 33434. This argument is the UDP port used as the destination of packets sent as part of the traceroute. This port should be an unused port on the destination system.

The following example performs a trace route for port 8080 on IP address 10.10.10.2:

```
(SafeGuardOS) # traceroute 10.10.10.2 8080
(SafeGuardOS) #
```

The following example performs a trace route on IP address 172.16.1.22:

```
(SafeGuardOS) # traceroute 172.16.1.22

Tracing route over a maximum of 20 hops

1 172.16.1.22 1 ms 0 ms 0 ms

(SafeGuardOS) #
```

Managing Network Information

This section describes the commands used for configuring the network. See the following sections for more details:

- *Configuring the Network MAC Address*
- *Configuring the Network MAC Type*
- *Configuring the Network VLAN ID*
- *Configuring the Network Protocol*

Configuring the Network MAC Address

To configure the network MAC address, use the **network mac-address** command in Global Configuration mode.

network mac-address *mac-address*

Syntax Description	*mac-address*	The network MAC address.

The following example sets the network MAC address to `3f:78:45:a2:34 50:`

```
(SafeGuardOS) #terminal
(SafeGuardOS) (config) #network mac-address 3f:78:45:a2:34 50
(SafeGuardOS) (config) #
```

Configuring the Network MAC Type

To select the locally administered or burned in MAC address, use the **network mac-type** command in Global Configuration mode.

```
network mac-type {network | burnedin}
```

Syntax Description	**network**	Select the locally administered MAC address.
	burnedin	Select the burned in MAC address.

The following example selects the locally administered MAC address:

```
(SafeGuardOS) #terminal
(SafeGuardOS) (config) #network mac-type network
(SafeGuardOS) (config) #
```

Configuring the Network VLAN ID

To configure the management VLAN ID of the switch, use the **network mgmt_vlan** command in Global Configuration mode.

```
network mgmt_vlan vlan_id
```

Syntax Description	*vlan_id*	VLAN ID of the management VLAN. Range is 1 to 4094.

The following example sets the management VLAN ID to 3:

```
(SafeGuardOS) #terminal
(SafeGuardOS) (config) #network mgmt_vlan 3
(SafeGuardOS) (config) #
```

Configuring the Network Protocol

To specify the network port configuration protocol, use the **network protocol** command in Global Configuration mode.

```
network protocol
```

Configuring SNMP on the Device

This section describes the commands used for configuring SNMP. See the following sections for more details:

- *Setting the SNMP Name*
- *Setting the SNMP Physical Location*
- *Designating the SNMP Contact*

- *Configuring SNMP Communities*
- *Configuring a SNMP Target*
- *Enabling and Disabling SNMP Traps*
- *Displaying SNMP Community Information*
- *Displaying SNMP Target Information*
- *Displaying SNMP System Information*

Setting the SNMP Name

To set the SNMP name of the device, use the **snmp-server sysinfo name** command. The syntax for the Global Configuration command is:

snmp-server sysinfo name *name*

Syntax Description	*name*	Name of a device. It can be up to 31 alphanumeric characters.

The following example sets the SNMP name for a device to bridge OmniAccess 2400 SafeGuard:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # snmp-server sysinfo name bridgeOmniAccess 2400
SafeGuard
(SafeGuardOS) (config) #
```

Setting the SNMP Physical Location

To set the SNMP physical location of the device, use the **snmp-server sysinfo location** command. The syntax for the Global Configuration command is:

snmp-server sysinfo location *location*

Syntax Description	*location*	Text used to identify the location of the device. It can be up to 31 alphanumeric characters. The factory default is blank.

The following example indicates that the SNMP server is located in the central data center:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # snmp-server sysinfo location central_data_center
(SafeGuardOS) (config) #
```

Designating the SNMP Contact

To designate the person or the organization responsible for SNMP on the network, use the **snmp-server sysinfo contact** command. The syntax for the Global Configuration command is:

snmp-server sysinfo contact *contact*

Syntax Description	*contact*	Text used to identify a contact person or organization for the device. It can be up to 31 alphanumeric characters. The factory default is blank.

The following example indicates that the SNMP server maintained by Joe in the IT department:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # snmp-server sysinfo contact IT_joe
(SafeGuardOS) (config) #
```

Configuring SNMP Communities

Adding and Naming a New SNMP Community

To add and name a new SNMP community, use the **snmp-server community** command. A community name is a name associated with the device and a set of SNMP managers that manage it with a specified privileged level.

No default community strings exist; SNMP access is disabled by default on the device. On initial installation, the read-only and read-write community strings must be configured. Configure OmniVista SafeGuard Manager with the device names.

snmp-server community *name*

Syntax Description	*name*	Name for an SNMP server community. By default, this community string is read only. The name can be up to 16 case-sensitive characters.

The following example creates a community string with the name *public*.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # snmp-server community public
(SafeGuardOS) (config) #
```

Establishing Access for the SNMP Community

To change an existing community string to read-write access privileges, use the **snmp-service community rw** command.

snmp-server community [**rw** *name*| **ro** *name*]

Syntax Description	**ro**	(Default) Indicates that the specified name has read-only privileges.
	rw	Indicates that the specified name has read-write privileges.
	name	Name of an SNMP server community.

The following example shows how to configure the well-known standard community strings "public" and "private":

```
(SafeGuardOS) (config) #no snmp-server community public
(SafeGuardOS) (config) #no snmp-server community private
(SafeGuardOS) (config) #snmp-server community public
(SafeGuardOS) (config) #snmp-server community private
(SafeGuardOS) (config) #snmp-server community rw private
(SafeGuardOS) (config) #show snmpcommunity

SNMP Community Name Client IP Address  Client IP Mask   Access Mode  Status
------------------- ----------------- ----------------- ----------- --------
public              0.0.0.0           0.0.0.0           Read Only   Enable
private             0.0.0.0           0.0.0.0           Read/Write  Enable
```

Setting a Client IP Address for an SNMP Community

To set a client IP address for an SNMP community, use the **snmp-server community ipaddr** command. The address is the associated community SNMP packet-sending address and is used along with the client IP mask to denote a range of IP addresses from which SNMP clients may use that community to access the device. A value of 0.0.0.0 allows access from any IP address. Otherwise, this value is ANDed with the mask to determine the range of allowed client IP addresses. The name is the applicable community name.

snmp-server community ipaddr *addr name*

Syntax Description	*ip_addr*	IP address (or portion thereof) from which this device accepts SNMP packets with the associated community.
	name	SNMP community name.

Setting a Client Netmask SNMP Community

To set a client netmask for an SNMP community, use the **snmp-server community netmask** command.

snmp-server community netmask *mask name*

Syntax Description	*mask*	The netmask.
	name	SNMP community name.

Configuring a SNMP Target

The SafeGuard device allows authorized SNMP community trap receivers to be one or more network management stations on the network.

Creating the Trap Receiver

To create and enable a trap receiver use the **snmp-server target** command in Global Configuration mode.

snmp-server target *trapcomm ipaddr*

Syntax Description	*trapcomm*	The name for this SNMP community trap receiver.
	ipaddr	IP address of the trap receiver.

The following example assigns community "public" to the trap receiver 172,16.140.90:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # snmp-server target ipaddr public 172.16.140.90
(SafeGuardOS) (config) #
```

Changing the IP Address of a Trap Receiver

The IP address of the trap receiver can be changed by using the **snmp-server target ipaddr** command. This Global Configuration command acts as a toggle to switch between enabled and disabled mode.

snmp-server target ipaddr *trapcomm old-ipaddr new-ipaddr*

Syntax Description	*trapcomm*	The name for this SNMP community trap receiver.
	old-ipaddr	The existing IP address of the trap receiver.

	new-ipaddr	The new IP address of the trap receiver.

The following example changes the address of the trap receiver with the community "public" and the IP address of 172.16.140.90 to have an IP Address of 172.16.230.10:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # snmp-server target ipaddr public 172.16.140.90
172.16.230.10
(SafeGuardOS) (config) #
```

Changing the Trap Receiver Version

The trap receiver version may be changed using the **snmp-server target version** command.

snmp-server target version *trapcomm ipaddress version*

Syntax Description	*trapcomm*	The community name for the SNMP trap receiver.
	ipaddress	The IP address of the trap receiver.
	version	The version to set.

The following example sets the version of the trap receiver at 172.16.140.90 to v1:

```
(SafeGuardOS) (config) # snmp-server target version public 172.16.140.90 v1
(SafeGuardOS) (config) #
```

Enabling and Disabling SNMP Traps

To enable an SNMP trap, use the **snmp-server traps** command. To disable the trap, use the **no** form of the command.

snmp-server traps *trap*
no snmp-server traps *trap*

Syntax Description	*trap*	The trap to enable/disable.

The following example enables the authentication trap:

```
(SafeGuardOS) (config) # snmp-server traps authentication
(SafeGuardOS) (config) #
```

The following example disables the multiple users login trap:

```
(SafeGuardOS) (config) # no snmp-server traps multiusers
(SafeGuardOS) (config) #
```

Displaying SNMP Community Information

To display the SafeGuard device SNMP community information, use the **show snmp-server community** command.

Communities can be added, changed, or deleted. The device does not have to be reset for changes to take effect.

The SNMP agent of the device complies with SNMP Version 2 (for more information about the SNMP specification, refer to the SNMP RFCs). The SNMP agent sends traps through TCP/IP to an external SNMP manager based on the SNMP configuration.

show snmp-server community

The command has no options or parameters.

The following example is representative of the command output:

```
(SafeGuardOS) #show snmp-server community

SNMP Community Name Client IP Address  Client IP Mask   Access Mode  Status
------------------- ----------------- ----------------- ----------- --------
Alcatel-Lucent_ro        0.0.0.0           0.0.0.0          Read Only    Enable
Alcatel-Lucent_rw        0.0.0.0           0.0.0.0          Read/Write   Enable

(SafeGuardOS) #
```

Table 6 describes the output displayed with the **show snmp-server community** command.

Table 6 Parameters Displayed with the show snmp-server community Command

Option	Description
SNMP Community Name	Community string to which this entry grants access. A valid entry is a case-sensitive alphanumeric string of up to 16 characters. Each row of this table must contain a unique community name.
Client IP Address	IP address (or portion thereof) from which this device accepts SNMP packets with the associated community. The IP address of the requesting entity is ANDed with the subnet mask before being compared to the IP address. **Note:** that if the subnet mask is set to 0.0.0.0, an IP address of 0.0.0.0 matches all IP addresses. The default value is 0.0.0.0
Client IP Mask	Mask to be ANDed with the IP address of the requesting entity before comparison with the IP address. If the result matches the IP address, then the address is an authenticated IP address. For example, if the IP address is 9.47.128.0 and the corresponding subnet mask is 255.255.255.0 a range of incoming IP addresses would match, that is, the incoming IP address could be from 9.47.128.0 to 9.47.128.255. The default value is 0.0.0.0

Table 6 Parameters Displayed with the show snmp-server community Command

Option	Description
Access Mode	Access level for this community string, valid entries are read only and read/write.
Status	Status of this community access entry, either enabled or disabled.

Displaying SNMP Target Information

To display the SNMP target information, use the **show snmp-server target** command.

```
show snmp-server target
```

The following sample output is representative of the **show snmp-server target** command:

```
(SafeGuardOS) #show snmp-server target

Trap Community      IP Address        Version          Status
------------------- ----------------- -------------   --------
private             172.16.3.77       snmpv2         Enable
public              172.16.3.77       snmpv2         Enable
Alcatel-Lucent           172.16.3.77       snmpv2         Enable
Alcatel-Lucent           172.16.3.103      snmpv2         Enable
apple               172.16.3.115      snmpv2         Enable
orange              172.16.3.115      snmpv2         Enable
(SafeGuardOS) #
```

Table 7 describes the output displayed with the **show snmp-server target** command.

Table 7 Parameters Displayed with the show snmp-server target Command

Option	Description
SNMP Trap Community	Displays the name of an SNMP trap community.
IP Address	Displays the IP address assigned to a specified community name.
Status	One of two modes, either enabled or disabled.

Displaying SNMP System Information

To display the SNMP information, use the **show snmp-server sysinfo** command.

```
show snmp-server sysinfo
```

The following example is representative of the **show snmp-server sysinfo** command:

```
(SafeGuardOS) #show snmp-server sysinfo

System Description.............................. OAG4048x
System Name..................................... oag4048
System Location................................. ca95134
System Contact.................................. it2028
System Object ID................................ Alcatel-Lucent.2.1.3
System Up Time.................................. 2 days 22 hrs 39 mins 52 secs

MIBs Supported:

RFC 1907 - SNMPv2-MIB              The MIB module for SNMPv2 entities
Alcatel-Lucent-MIB                      Alcatel-Lucent MIB
SNMP-COMMUNITY-MIB                 This MIB module defines objects to help
                                   support coexistence between SNMPv1, SNMPv2,
                                   and SNMPv3.
SNMP-FRAMEWORK-MIB                 The SNMP Management Architecture MIB
SNMP-MPD-MIB                       The MIB for Message Processing and
                                   Dispatching
SNMP-NOTIFICATION-MIB              The Notification MIB Module
SNMP-TARGET-MIB                    The Target MIB Module
SNMP-USER-BASED-SM-MIB             The management information definitions for
                                   the SNMP User-based Security Model.
SNMP-VIEW-BASED-ACM-MIB            The management information definitions for
                                   the View-based Access Control Model for SNMP.
USM-TARGET-TAG-MIB                 SNMP Research, Inc.
RFC 1213 - RFC1213-MIB             Management Information Base for Network
                                   Management of TCP/IP-based internets: MIB-II
RFC 1493 - BRIDGE-MIB              Definitions of Managed Objects for Bridges
                                   (dot1d)
RFC 2674 - P-BRIDGE-MIB            The Bridge MIB Extension module for managing
                                   Priority and Multicast Filtering, defined by
                                   IEEE 802.1D-1998.
RFC 2674 - Q-BRIDGE-MIB            The VLAN Bridge MIB module for managing
                                   Virtual Bridged Local Area Networks
RFC 2863 - IF-MIB                  The Interfaces Group MIB using SMIv2
RFC 3635 - Etherlike-MIB           Definitions of Managed Objects for the
                                   Ethernet-like Interface Types
```

Table 7 describes the output displayed with the **show snmp-server sysinfo** command.

Table 8 Parameters Displayed with the show snmp-server sysinfo Command

Option	Description
System Description	Description of the system.
System Name	Name of the system.
System Location	Location of the system.
System Contact	Contact for the system.

Table 8 Parameters Displayed with the show snmp-server sysinfo Command

Option	Description
System Object ID	System Object ID.
System Up Time	The amount of time the system has been running.
MIBs Supported	A list of supported MIBs.

Configuring Domain Name Servers

To use some of the posture checking features, domain name servers (DNS) must be configured. In order to resolve a host name, the system uses the default DNS domain and the names of the servers in the DNS name server list. See the following sections for more details:

- *Specifying a Default Domain*
- *Creating a DNS Name Server List*
- *Displaying DNS Information*

Specifying a Default Domain

To create a default DNS domain, use the **ip domain** command in Privileged Exec mode. This results of this command stay in persistent memory.

ip domain [lookup] [name *name*] [retry *number*] [round-robin] [timeout *seconds*]

Syntax Description	**lookup**	Enable DNS lookups.
	name	Default domain name.
	number	Number of retries (1-100).
	round-robin	Load balance nameservers in round-robin order.
	seconds	Number of seconds to wait for a DNS response.

This example specifies Alcatel-Lucent.com as the default domain name.

```
(SafeGuardOS) # ip domain name Alcatel-Lucent.com
(SafeGuardOS) #
```

Creating a DNS Name Server List

A DNS name server list with up to three IP addresses in the list can be created. When more than one address is listed, the system uses the order specified to determine the order of priority for name resolution. To create a DNS name list, use the **ip nameserver** command in Privileged Exec mode.

To remove one or two of the name servers, re-enter the **ip nameserver** command without their IP addresses. Specifying the command replaces all the existing nameservers with the new IP addresses. To remove all of the nameservers, use the **no** version of the command:

ip nameserver *ipaddr* {*ipaddr2 ipaddr3*}

no ip nameserver

Syntax Description	*ipaddr*	Specifies the IP address of a name server.
	ipaddr2	(Optional) Specifies the IP address of the secondary name server.
	ipaddr3	(Optional) Specifies the IP address of the final name server.

For example,

```
(SafeGuardOS) # ip name-server 1.1.1.1
(SafeGuardOS) #
```

Displaying DNS Information

Use the **show dns** command in Privileged Exec mode to display the current DNS configuration:

show dns

For example,

```
(SafeGuardOS) #show dns
DNS configuration:
ip domain lookup
ip domain name Alcatel-Lucent.com
ip name-server 1.1.1.1
(SafeGuardOS)
```

Resetting the Device

To reset the SafeGuard device without powering it off, use the **reload** command in Privilege Exec mode. A reset means that all network connections are terminated and the boot code executes.

The device uses the stored configuration to initialize itself. When prompted to confirm that the reset should proceed, enter **y** for Yes. The LEDs on the device indicate a successful reset.

```
reload
```

Configuring Data Traffic Ports

This section describes the commands used for configuring the device port on the device. See the following sections for more details:

- *Entering Interface Configuration Mode*
- *Enabling and Disabling an Interface*
- *Displaying Interface Information*
- *Displaying Ethernet Interface Information*
- *Understanding Mirroring and Monitoring Ports*
- *Configuring Port-Based Mirroring*
- *Changing the Protection Mode of Ports*

Entering Interface Configuration Mode

To enter into interface configuration mode, use the **interface** command in Global Configuration mode using the following syntax:

interface [*slot/port* | **vlan id** *id* | **vlan name** *name*]

Syntax Description	*slot/port*	Slot/port format for interface.
	vlan id	Keyword for configuration of a VLAN interface by ID.
	vlan name	Keyword for configuration of a VLAN interface by name.
	id	ID of VLAN interface to configure.
	name	Name of VLAN interface to configure.

The following example enters interface configuration mode for slot 0 port 25:

```
(SafeGuardOS)#configure terminal
(SafeGuardOS) (config) #interface 0/25
(SafeGuardOS) (Interface 0/25)#
```

Enabling and Disabling an Interface

To disable an interface, use the **shutdown** command in interface configuration submode. This command disables all functions on the specified interface and marks it as unavailable.

shutdown

This command has no options or arguments.

The following command sequence brings down port 9:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # interface 0/9
(SafeGuardOS) (interface 0/9) # shutdown
(SafeGuardOS) (interface 0/9) #
```

By default, all interfaces are initially disabled. To start or restart a disabled interface, use the **no** form of this command. The command enables the specified interface. For example, to restore port 9:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # interface 0/9
(SafeGuardOS) (interface 0/9) # no shutdown
(SafeGuardOS) (interface 0/9) #
```

Using the **shutdown all** command in global configuration mode disables all ports in the system. The **no** form of the command enables all ports in the system. The following example enables all ports in the system:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # no shutdown all
```

Displaying Interface Information

To display the interface information for the device, use the **show interface** command.

This command displays a summary of statistics for a specific port or a count of all CPU traffic based on the argument.

show interface [*slot/port* | **switchport**]

Syntax Description

slot/port	Displays information for a specific interface.

switchport Displays statistics for the entire switch.

The following example shows the data available for port 20:

```
(SafeGuardOS) (config) #show interface 0/20

Packets Received.............................. 30495512
Packets Received With Error................... 0
Broadcast Packets Received.................... 0
Packets Transmitted........................... 0
Transmit Packet Errors........................ 0
Collision Frames.............................. 0
Time Since Counters Last Cleared.............. 0 day 3 hr 45 min 6 sec

(SafeGuard) (config) #
```

Options for the show interface command specifying an interface are listed in *Table 9*.

Table 9 Show interface Option Descriptions

Option	Description
Packets Received	The total number of packets (including broadcast packets and multicast packets) received by the processor.
Packets Received With Error	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
Broadcast Packets Received	The total number of packets received that were directed to the broadcast address. Note that this does not include multicast packets.
Packets Transmitted	The total number of packets transmitted out of the interface.
Transmit Packets Errors	The number of outbound packets that could not be transmitted because of errors.
Collisions Frames	The best estimate of the total number of collisions on this Ethernet segment. The display parameters, when the argument is 'switchport', is as follows: ■ Packets Received Without Error – The total number of packets (including broadcast packets and multicast packets) received by the processor. ■ Broadcast Packets Received – The total number of packets received that were directed to the broadcast address. Note that this does not include multicast packets. ■ Packets Received With Error – The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.

Table 9 Show interface Option Descriptions *(continued)*

Option	Description
Time Since Counters Last Cleared	The elapsed time, in days, hours, minutes, and seconds since the statistics for this port were last cleared.

Displaying Ethernet Interface Information

To display the Ethernet interface information for the device, use the **show interface ethernet** command. This command displays a summary of statistics for a specific port or a count of all CPU traffic based on the argument.

show interface ethernet [*slot/port* | **switchport**]

Syntax Description	*slot/port*	Displays information for a specific interface.
	switchport	Displays statistics for the entire switch.

The following example is representative of the **show interface ethernet** command:

```
(SafeGuardOS) #show interface ethernet 0/21

Total Bytes Received: 0
Packets Received > 1522 Octets: 0
Packets RX and TX 64 Octets: 0
Packets RX and TX 65-127 Octets: 0
Packets RX and TX 128-255 Octets: 0
Packets RX and TX 256-511 Octets: 0
Packets RX and TX 512-1023 Octets: 0
Packets RX and TX 1024-1518 Octets: 0
Packets Received: 0
Unicast Packets Received: 0
Multicast Packets Received: 0
Broadcast Packets Received: 0
Total Packets Received with MAC Errors: 0
Jabbers Received: 0
Fragments/Undersize Received: 0
FCS Errors: 0
Overruns: 0
Total Received Packets Not Forwarded: 0
Local Traffic Frames: 0
802.3x Pause Frames Received: 0
Unacceptable Frame Type: 0
VLAN Membership Mismatch: 0
VLAN Viable Discards: 0
Multicast Tree Viable Discards: 0
Reserved Address Discards: 0
Broadcast Storm Recovery: 0
CFI Discards: 0
Upstream Threshold: 0
```

```
Total Bytes Transmitted: 0
Max Frame Size: 1522
Total Packets Transmitted Successfully: 0
Unicast Packets Transmitted: 0
Multicast Packets Transmitted: 0
Broadcast Packets Transmitted: 0
Total Transmit Errors: 0
FCS Errors: 0
Tx Oversized: 0
Underrun Errors: 0
Total Transmit Packets Discarded: 0
Single Collision Frames: 0
Multiple Collision Frames: 0
Excessive Collision Frames: 0
Port Membership Discards: 0
VLAN Viable Discards: 0
802.3x Pause Frames Transmitted: 0
STP BPDUs Transmitted: 0
STP BPDUs Received: 0
RSTP BPDUs Transmitted: 0
RSTP BPDUs Received: 0
MSTP BPDUs Transmitted: 0
MSTP BPDUs Received: 0
EAPOL Frames Transmitted: 0
EAPOL Start Frames Received: 0
Time Since Counters Last Cleared: 3 day 6 hr 57 min

(SafeGuardOS) #
```

Table 10 shows Ethernet interface options and descriptions.

Table 10 Ethernet Interface Options

Option	Description
Packets Received Without Error	**Octets Received** – The total number of octets of data (including those in bad packets) received on the network (excluding framing bits but including Frame Check Sequence (FCS) octets). This object can be used as a reasonable estimate of Ethernet utilization. If greater precision is desired, the etherStatsPkts and etherStatsOctets objects should be sampled before and after a common interval. The result of this equation is the value Utilization which is the percent utilization of the ethernet segment on a scale of 0 to 100 percent. **Packets Received < 64 Octets** – The total number of packets (including bad packets) received that were < 64 octets in length (excluding framing bits but including FCS octets). **Packets Received 64 Octets** – The total number of packets (including bad packets) received that were 64 octets in length (excluding framing bits but including FCS octets). **Packets Received 65-127 Octets** – The total number of packets (including bad packets) received that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Received 128-255 Octets** – The total number of packets (including bad packets) received that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Received 256-511 Octets** – The total number of packets (including bad packets) received that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Received 512-1023 Octets** – The total number of packets (including bad packets) received that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Received 1024-1518 Octets** – The total number of packets (including bad packets) received that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Received 1519-1522 Octets** – The total number of packets (including bad packets) received that were between 1519 and 1522 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Received > 1522 Octets** – The total number of packets received that were longer than 1522 octets (excluding framing bits, but including FCS octets) and were otherwise well formed.

Table 10 Ethernet Interface Options *(continued)*

Option	Description
Packets Received Successfully	**Total** – The total number of packets received that were without errors. **Unicast Packets Received** – The number of subnetwork-unicast packets delivered to a higher-layer protocol. **Multicast Packets Received** – The total number of good packets received that were directed to a multicast address. Note that this number does not include packets directed to the broadcast address. **Broadcast Packets Received** – The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
Packets Received with MAC Errors	**Total** – The total number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol. **Jabbers Received** – The total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error). Note that this definition of jabber is different than the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition where any packet exceeds 20 ms. The allowed range to detect jabber is between 20 ms and 150 ms. **Fragments/Undersize Received** – The total number of packets received that were less than 64 octets in length (excluding framing bits but including FCS octets). **Alignment Errors** – The total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had a bad Frame Check Sequence (FCS) with a non-integral number of octets. **Rx FCS Errors** – The total number of packets received that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had a bad Frame Check Sequence (FCS) with an integral number of octets **Overruns** – The total number of frames discarded as this port was overloaded with incoming packets, and could not keep up with the inflow.

Table 10 Ethernet Interface Options *(continued)*

Option	Description
Received Packets not Forwarded	**Total** – A count of valid frames received which were discarded (i.e.,filtered) by the forwarding process. **Local Traffic Frames** – The total number of frames dropped in the forwarding process because the destination address was located off of this port. **802.3x Pause Frames Received** – A count of MAC Control frames received on this interface with an opcode indicating the PAUSE operation. This counter does not increment when the interface is operating in half-duplex mode. **Unacceptable Frame Type** – The number of frames discarded from this port due to being an unacceptable frame type. **VLAN Membership Mismatch** – The number of frames discarded on this port due to ingress filtering. **VLAN Viable Discards** – The number of frames discarded on this port when a lookup on a particular VLAN occurs while that entry in the VLAN table is being modified, or if the VLAN has not been configured. **Multicast Tree Viable Discards** – The number of frames discarded when a lookup in the multicast tree for a VLAN occurs while that tree is being modified. **Reserved Address Discards** – The number of frames discarded that are destined to an IEEE 802.1 reserved address and are not supported by the system. **Broadcast Storm Recovery** – The number of frames discarded that are destined for FF:FF:FF:FF:FF:FF when Broadcast Storm Recovery is enabled. **CFI Discards** – The number of frames discarded that have CFI bit set and the addresses in RIF are in non-canonical format. **Upstream Threshold** – The number of frames discarded due to lack of cell descriptors available for that packet's priority level.

Table 10 Ethernet Interface Options *(continued)*

Option	Description
Packets Transmitted Octets	**Total Bytes** – The total number of octets of data (including those in bad packets) received on the network (excluding framing bits but including FCS octets). This object can be used as a reasonable estimate of ethernet utilization. If greater precision is desired, the etherStatsPkts and etherStatsOctets objects should be sampled before and after a common interval. **Packets Transmitted 64 Octets** – The total number of packets (including bad packets) received that were 64 octets in length (excluding framing bits but including FCS octets). **Packets Transmitted 65-127 Octets** – The total number of packets (including bad packets) received that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Transmitted 128-255 Octets** – The total number of packets (including bad packets) received that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Transmitted 256-511 Octets** – The total number of packets (including bad packets) received that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Transmitted 512-1023 Octets** – The total number of packets (including bad packets) received that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Transmitted 1024-1518 Octets** – The total number of packets (including bad packets) received that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets). **Packets Transmitted 1519-1522 Octets** – The total number of packets (including bad packets) received that were between 1519 and 1522 octets in length inclusive (excluding framing bits but including FCS octets). **Max Info** – The maximum size of the Info (non-MAC) field that this port will receive or transmit.

Table 10 Ethernet Interface Options *(continued)*

Option	Description
Packets Transmitted Successfully	**Total** – The number of frames that have been transmitted by this port to its segment.
	Unicast Packets Transmitted – The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.
	Multicast Packets Transmitted – The total number of packets that higher-level protocols requested be transmitted to a Multicast address, including those that were discarded or not sent.
	Broadcast Packets Transmitted – The total number of packets that higher-level protocols requested be transmitted to the Broadcast address, including those that were discarded or not sent.
Transmit Errors	**Total Errors** – The sum of Single, Multiple, and Excessive Collisions.
	Tx FCS Errors – The total number of packets transmitted that had a length (excluding framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive, but had a bad Frame Check Sequence (FCS) with an integral number of octets
	Oversized – The total number of frames that exceeded the max permitted frame size. This counter has a max increment rate of 815 counts per sec. at 10 Mb/s.
	Underrun Errors – The total number of frames discarded because the transmit FIFO buffer became empty during frame transmission.
Transmit Discards	**Total Discards** – The sum of single collision frames discarded, multiple collision frames discarded, and excessive frames discarded.
	Single Collision Frames – A count of the number of successfully transmitted frames on a particular interface for which transmission is inhibited by exactly one collision.
	Multiple Collision Frames – A count of the number of successfully transmitted frames on a particular interface for which transmission is inhibited by more than one collision.
	Excessive Collisions – A count of frames for which transmission on a particular interface fails due to excessive collisions.
	Port Membership – The number of frames discarded on egress for this port due to egress filtering being enabled.
	VLAN Viable Discards – The number of frames discarded on this port when a lookup on a particular VLAN occurs while that entry in the VLAN table is being modified, or if the VLAN has not been configured.

Table 10 Ethernet Interface Options *(continued)*

Option	Description
Protocol Statistics	**BPDU received** – The count of BPDUs (Bridge Protocol Data Units) received in the spanning tree layer.
	BPDUs Transmitted – The count of BPDUs (Bridge Protocol Data Units) transmitted from the spanning tree layer.
	802.3x Pause Frames Received – A count of MAC Control frames received on this interface with an opcode indicating the PAUSE operation. This counter does not increment when the interface is operating in half-duplex mode.
	GARP layer.
	STP BPDUs Transmitted – Spanning Tree Protocol Bridge Protocol Data Units sent
	STP BPDUs Received – Spanning Tree Protocol Bridge Protocol Data Units received
	RST BPDUs Transmitted – Rapid Spanning Tree Protocol Bridge Protocol Data Units sent
	RSTP BPDUs Received – Rapid Spanning Tree Protocol Bridge Protocol Data Units received
	MSTP BPDUs Transmitted – Multiple Spanning Tree Protocol Bridge Protocol Data Units sent
	MSTP BPDUs Received – Multiple Spanning Tree Protocol Bridge Protocol Data Units received
Dot1x Statistics	**EAPOL Frames Received** – The number of valid EAPOL frames of any type that has been received by this authenticator.
	EAPOL Frames Transmitted – The number of EAPOL frames of any type that have been transmitted by this authenticator.
Time Since Counters Last Cleared	The elapsed time, in days, hours, minutes, and seconds since the statistics for this port were last cleared.

Switchport Statistics Display Information

```
(SafeGuardOS) #show interface ethernet switchport

Total Bytes Received..........................  0
Unicast Packets Received......................  0
Multicast Packets Received....................  0
Broadcast Packets Received....................  0
Receive Packets Discarded.....................  0

Octets Transmitted............................  0
Packets Transmitted...........................  0
Unicast Packets Transmitted...................  0
Multicast Packets Transmitted.................  0
Broadcast Packets Transmitted.................  0
Transmit Packets Discarded....................  0
```

```
Most Address Entries Ever Used..................... 2
Address Entries Currently in Use................... 1

Maximum VLAN Entries............................... 4094
Most VLAN Entries Ever Used........................ 4094
Static VLAN Entries................................ 4094
Dynamic VLAN Entries............................... 0
VLAN Deletes....................................... 0
Time Since Counters Last Cleared................... 3 day 6 hr 48 min 0 sec

(SafeGuardOS) #
```

Additional Statistics Display Information

Table 11 shows additional Ethernet options.

Table 11 Additional Ethernet Options

Option	Description
Total Packets Received Without Error	Total number of packets (including broadcast packets and multicast packets) that were received by the processor.
Broadcast Packets Received	Total number of packets that were received and directed to the broadcast address. Note that this number does not include multicast packets.
Packets Transmitted without Errors	Total number of packets that were transmitted from the interface.
Broadcast Packets Transmitted	Total number of packets that higher-level protocols requested to be transmitted to the broadcast address, including those that were discarded or not sent.
Address Entries in Use	Number of learned and static entries in the Forwarding Database Address Table for this device.
Static VLAN Entries	The number of static VLAN entries configured on the interface.
Dynamic VLAN Entries	The number of dynamic VLAN entries configured on the interface.
VLAN Deletes	The number of frames discarded on this port when a lookup on a particular VLAN occurs while that entry in the VLAN table is being modified, or if the VLAN has not been configured.
Time Since Counters Last Cleared	Elapsed time (in days, hours, minutes, and seconds) since statistics for this device were last cleared.

Understanding Mirroring and Monitoring Ports

The SafeGuard OS supports two types of mirroring:

- port-based mirroring – Monitors all of the traffic on a port and copies, or *mirrors*, the data to a destination port.
- policy-based mirroring – Allows mirroring at the rule-level of a policy. Policy-based mirroring is described in *Configuring Policy-Based Mirroring on page 323*.

Port-based mirroring is device dependant. The SafeGuard Switch supports multiple mirroring sessions and the forwarding of mirrored frames to a remote port. *Table 12* shows the differences between the devices.

Table 12 Port-Based Mirroring on SafeGuard Devices

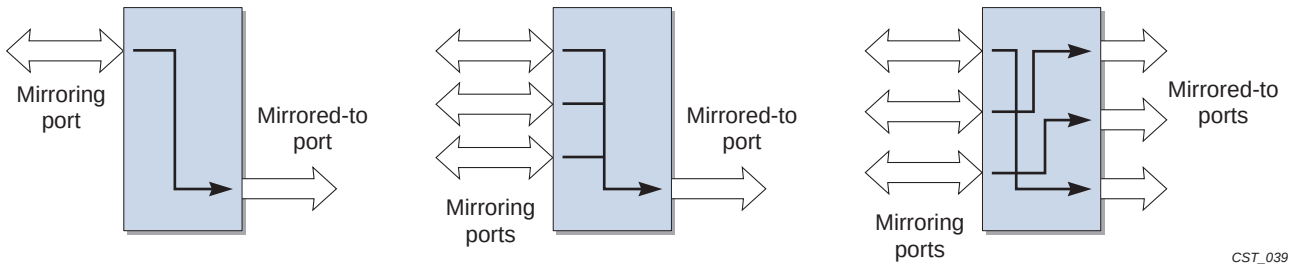
Device	Mirror Sessions	Remote Mirroring
SafeGuard Switch	1-4	Yes
SafeGuard Controller	1	No

As shown in *Figure 3*, the SafeGuard Switch supports:

- A single mirroring port to a single mirrored-to port.
- Multiple mirroring ports to a single mirrored-to port
- Multiple mirroring ports to multiple mirrored-to ports

However, note that a single mirroring port cannot be connected to multiple mirrored-to ports.

Figure 3 Example of Port-Based Mirroring Configuration for SafeGuard Switch



About Remote Span Support

The system can direct a mirrored frame to a specified remote monitoring device. This device may not be another Alcatel-Lucent Switch. Frames are identified during VLAN classification, tagged and directed to the RSPAN VLAN. The mirrored frames are

directed to the analyzer that is attached to the other switching device. *Table 13* shows the impact of frames traversing port ingress and egress with RSPAN enabled and disabled.

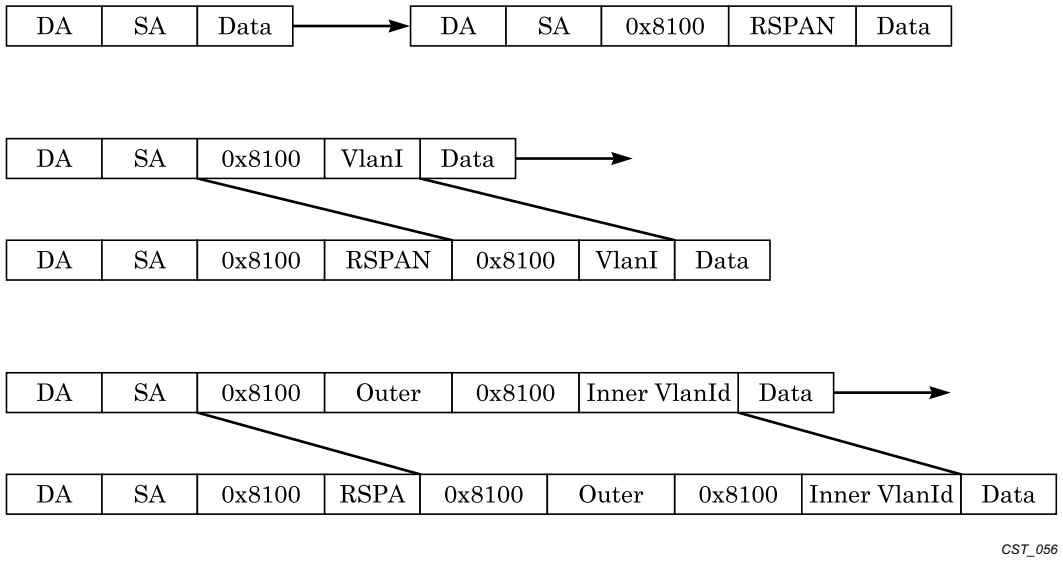
NOTE: If RSPAN is enabled, the receiver should be configured to support jumbo frames, since adding a VLAN tag to the ingress frame may result in a jumbo frame being sent on the mirror port.

Table 13 RSPAN Ingress and Egress Frame Tagging

RSPAN Disabled	
Ingress Frame	**Egress Frame**
Untagged	Untagged
802.1Q tagged	802.1Q tagged
Double Tagged (802.1Q in 802.1Q)	Double Tagged (802.1Q in 802.1Q)
RSPAN Enabled	
Ingress Frame	**Egress Frame**
Untagged	802.1Q tagged (RSPAN VLAN)
802.1Q tagged	802.1Q in 802.1Q tagged (Outer RSPAN VlanId, Inner original VlanId)
Double Tagged (802.1Q in 802.1Q)	3 tagged 802.1Q in 802.1Q tagged (Outer RSPAN VID, Inner original VID

Figure 4 illustrates the packet frame data translation from ingress to egress.

Figure 4 RSPAN Frame Translation



Configuring Port-Based Mirroring

Port mirroring, which is also known as port monitoring, selects network traffic that you can analyze with a network analyzer, such as a SwitchProbe device or other Remote Monitoring (RMON) probe.

For details on policy-based mirroring, see *Configuring Policy-Based Mirroring on page 323*.

Setting the Source or Destination Port

To configure a probe port or a monitored port for a monitor session, use the **monitor session** command in the Global configuration mode. Use the **no** version of the command without optional parameters to remove the monitor session designation from the source probe port, the destination monitored port and all VLANs.

Once the port is removed from the VLAN, you must manually add the port to any desired VLANs. In a session on the OAG4048 there can be up to eight source ports. On the OmniAccess 2400 SafeGuard/1000 there can be up to three source ports.

monitor session *sessionID* {**source interface** *slot/port* [**rx** | **tx**]} | **destination interface** *slot/port* | **mode**

no monitor session *sessionID* **destination interface**

Syntax Description		
	source interface *slot/port*	Specifies the interface to monitor. The **no** form of the command removes the specified interface from the port monitoring session.
	rx	(Optional, for Switch only) Monitor only ingress packets. If neither **rx** or **tx** is chosen, both ingress and egress packets will be monitored.
	tx	(Optional, for Switch only) Monitor only egress packets. If neither **rx** or **tx** is chosen, both ingress and egress packets will be monitored.
	destination interface *slot/port*	Interface to receive the monitored traffic. The **no** form of the command does not specify the slot/port; see syntax example.
	mode	Enable or disable (using the **no** form of the command) the administrative mode of the session. If enabled, the probe port monitors all the traffic received and transmitted on the monitored port.

Restoring the Default Mirror Session Mode

To restore the default mirror session mode value for all configured sessions and remove all source and destination ports, use the **no monitor** command in the Global configuration mode.

no monitor

This command has no parameters.

Showing the Monitor Session

To display port monitoring information for a particular mirroring session, use the **show monitor session** command in the Privileged Exec mode.

show monitor session *sessionID*

Syntax Description		
	sessionID	An integer value used to identify the session. Its value can be anything between 1 and the maximum number of mirroring sessions allowed on the platform.

Following is an example of the command output on a SafeGuard Controller:

```
(SafeGuardOS) #show monitor session 1

Session ID   Admin Mode   Probe Port   Mirrored Port
----------   ----------   ----------   -------------
1            Enable       0/21         0/20
```

Following is an example of the command output on a SafeGuard Switch:

```
(SafeGuardOS) #show monitor session 1

Session ID   Admin Mode   Probe Port   RSPAN VLAN    Mirrored Port   Type
----------   ----------   ----------   ------------  -------------   -----
1            Enable       0/9                        0/1             Rx,Tx
                                                     0/2             Rx,Tx

(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
Session ID	Id to identify the session.
Admin Mode	Indicates whether the Port Mirroring feature is enabled or disabled for the session. The possible values are Enabled and Disabled.
Probe Port	The Probe (destination) port for the session. If the probe port is not set the field is blank.
RSPAN VLAN	In Switch output only. The VLAN RSPAN.
Mirrored Port	The port configured as the mirrored (source) port for the session If no source port is configured for this session then this field is blank.
Type	Shown in Switch output only. Direction in which the source port is configured for port mirroring. Values are tx, for transmitted packets, or rx for received packets.

Changing the Protection Mode of Ports

The device has three protection modes which have an impact on IP forwarding:

- Pass-thru – No protection policies are employed. This mode is the default.
- Monitor – The system monitors for policy visualization based on user-defined policy controls, however no enforcement actions are taken.

- Protect – The system monitors and enforces policies on user-defined and malware policy controls.

Table 14 Supported Protection Modes

Protection Mode	When Used	SafeGuard Controller	SafeGuard Switch
Pass-thru Mode	First time set up and cabling	Acts as a transparent bridge. All security functionality is bypassed.	Acts as a standard L2/ L3 switch. All security functionality is bypassed.
Monitor Mode	Testing and trials	Authentication, captive portal, visualization, malware detection and protection and user-based policy checking is applied to all data traffic, but enforcement is ignored.	
Protect Mode	Typical Deployment	Authentication, captive portal, visualization, malware detection and protection and user-based policy checking is applied to all data traffic, and actively enforced.	

For the SafeGuard Controller

For the SafeGuard Controller, device protection mode is set per port-pair. The global form of the **protection-mode** command will set all ports to the specified configuration. Use the **protection-mode** command in Global or Interface Configuration submode.

`protection-mode` *`mode`* **`all`**

Syntax Description	*`mode`*	The protection mode of the port-pair. Valid values are: ■ pass-thru – (Default) No protection policies are employed. ■ monitor – The system monitors for policy visualization based on user-defined policy controls, however no enforcement actions are taken. ■ protect – The system monitors and enforces policies on user-defined and malware policy controls.
	`all`	Indicates that the mode parameter applies to all interfaces. The **all** keyword applies only in the Global Configuration mode. In Interface Configuration mode, it does not apply.

The following example sets ports 1 and 2 to protect mode, in Global Configuration mode:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/1
(SafeGuardOS) (interface 0/1) #protection-mode protect all
(SafeGuardOS) (interface 0/1) #exit
(SafeGuardOS) (config) #exit
```

The following example sets the protection-mode globally (on all ports).

```
(CS106) #configure terminal
(CS106) (config) #protection-mode protect all
Enabled: All SafeGuard security features
(CS106) (config) #
```

Another example showing protection mode settings follows:

```
(SafeGuardOS) #show protection-mode

Interface              Protection Mode      port type
---------              ---------------      ---------
0/1                    Protect              network
0/2                    Protect              host
0/3                    Protect              network
0/4                    Protect              host
0/5                    Protect              network
0/6                    Protect              host
0/7                    Protect              network
0/8                    Protect              host
0/9                    Protect              network
0/10                   Protect              host
0/11                   Protect              network
0/12                   Protect              host
0/13                   Protect              network
0/14                   Protect              host
0/15                   Protect              network
0/16                   Protect              host
0/17                   Protect              network
0/18                   Protect              host
0/19                   Protect              network
0/20                   Protect              host
0/21                   Pass-thru            network
0/22                   Pass-thru            host
0/23                   Pass-thru            network
0/24                   Pass-thru            host
(SafeGuardOS) #
```

For the SafeGuard Switch

For the SafeGuard Switch, device protection mode is set on a global basis. Individual interfaces cannot be configured with different protection modes. Use the **protection-mode** command in Global Configuration mode.

protection-mode *mode* **all**

Syntax Description	*mode*	The protection mode of the port-pair. Valid values are: ■ Pass-thru – (Default) No protection policies are employed. ■ Monitor – The system monitors for policy visualization based on user-defined policy controls, however no enforcement actions are taken. ■ Protect – The system monitors and enforces policies on user-defined and malware policy controls.

The following example sets the SafeGuard Switch to protect mode:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #protection-mode protect all
Enabled: All SafeGuard security features
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Displaying Protection Mode Information

Use the **show protection-mode** command to verify the protection mode setting. The following sample output is representative from a SafeGuard Controller:

```
(SafeGuardOS) #show protection-mode

Interface             Protection Mode      port type
---------             ---------------      ---------
0/1                   Protect              network
0/2                   Protect              host
0/3                   Protect              network
0/4                   Protect              host
0/5                   Protect              network
0/6                   Protect              host
0/7                   Protect              network
0/8                   Protect              host
0/9                   Protect              network
0/10                  Protect              host
0/11                  Protect              network
0/12                  Protect              host
0/13                  Protect              network
0/14                  Protect              host
0/15                  Protect              network
0/16                  Protect              host
0/17                  Protect              network
0/18                  Protect              host
0/19                  Protect              network
0/20                  Protect              host
```

```
0/21                  Pass-thru           network
0/22                  Pass-thru           host
0/23                  Pass-thru           network
0/24                  Pass-thru           host
(SafeGuardOS) #
```

The next example is representative output of the **show protection-mode** command on the SafeGuard Switch:

```
(SafeGuardOS) #show protection-mode

Interface   Protection Mode       Port Type
----        ---------------       ---------
0/1            Monitor              host
0/2            Monitor              host
0/3            Monitor              host
0/4            Monitor              host
0/5            Monitor              host
0/6            Monitor              host
0/7            Monitor              host
0/8            Monitor              host
0/9            Monitor              host
0/10           Monitor              host
0/11           Monitor              host
0/12           Monitor              host
0/13           Monitor              host
0/14           Monitor              host
0/15           Monitor              host
0/16           Monitor              host
0/17           Monitor              host
0/18           Monitor              host
0/19           Monitor              host
0/20           Monitor              host
0/21           Monitor              host
0/22           Monitor              host
0/23           Monitor              host
0/24           Monitor              host
0/25           Monitor              host
0/26           Monitor              host
0/27           Monitor              host
0/28           Monitor              host
0/29           Monitor              host
0/30           Monitor              host
0/31           Monitor              host
0/32           Monitor              host
0/33           Monitor              host
0/34           Monitor              host
0/35           Monitor              host
0/36           Monitor              host
0/37           Monitor              host
0/38           Monitor              host
0/39           Monitor              host
0/40           Monitor              host
0/41           Monitor              host
0/42           Monitor              host
0/43           Monitor              host
0/44           Monitor              host
```

```
0/45            Monitor             network
0/46            Monitor             network
0/47            Monitor             network
0/48            Monitor             network
0/49            Monitor             network
0/50            Monitor             network

(SafeGuardOS) #
```

The fields in the **show protection-mode** output represent:

Display	Description
Interface	Displays the interface number in slot/port format.
Protection Mode	Displays the protection mode of the interface. Entries can be pass-thru, monitor, or protect.
Port Type	Identifies whether the port is connected to the hosts or network.

Configuring High Availability Support

This section discusses the high availability options. It contains the following sections:

- *Configuring Fail-over Device Support*
- *Configuring System Recovery*
- *Configuring Exception Recovery*

Configuring Fail-over Device Support

For high-availability, the SafeGuard Controller device must be configured to populate the authentication state to a fail-over device.

To take configure the SafeGuard Controller device to accommodate high-availability:

1. Ensure that the devices in the topology have identical versions and identical configurations.
2. Ensure that cabling to the downstream and upstream devices are the same. For example, if an edge switch is connected to port 5 on the device, the same edge switch must also be connected to port 5 on the redundant device.
3. Ensure that the system is configured to reboot (default) should there be a critical error. If the devices are set in fail-passthru mode, the redundant system does not take over traffic when a crucial error occurs. The traffic continues to pass through

the failed system. Use the **show system recovery** command in Privileged Exec mode to check the setting for system recovery.

4 Configure each device to have a peer that synchronizes authentication state. To add the peer, use the Global Configuration command:

ha peer *ip_address*

The following example establishes two devices (172.15.4.2 and 172.10.10.1) as peers:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) #ha peer 172.15.4.2
(SafeGuardOS) (config) #ha peer 172.10.10.1
(SafeGuardOS) #
```

Use the `no` version of the command to remove a peer:

no ha peer *ip_address*

The following commands describe the show commands that can be used to show high availability configuration information.

- Use the following Global Configuration command to verify the recovery setting for a peer:

  show system recovery

  The system either displays that on a critical system error, the system will either reboot or it will go into pass-through mode.

- Use the following Global Configuration command to locate a peer device:

  show ha peer

  The following output is representative of the `show ha peer` command:

```
(SafeGuardOS) #show ha peers



HA Peer Table

-------------


Number of Rows:1


Peer ID                         IP                          Conns             MSG TX MSG RX        HB
TX           HB RX Connect time
```

```
-------                          --                          -----            ------       ------  --
---          ----- ------------

001236fffffecbc2                172.16.5.101 1                               4           0
661          661           22:26:44 UTC 13-Feb-2006
```

- Use the following Global Configuration command to display the current HA configuration:

  `show ha info`

  The following output is representative of the `show ha info` command:

  ```
  (SafeGuardOS) #show ha info
  ha heartbeat-loss-threshold = 10 seconds
  ha heartbeat-interval       = 1 seconds
  ```

- Use the following Global Configuration commands to display the authentication tables used in HA configurations:

  — The Interface Table contains an entry for each Layer 3 interface detected on the network. Use the following Global Configuration command to display the Interface Table:

  `show ha aaa interface-table`

  The output of the command has these fields:

Table 15 Field Descriptions of the Interface Table

Field	Description
IP	The IP address of a downstream device, which is used as the primary key to this table. Each L3 learning event for a unique source generates a new entry in the table.
MAC	The MAC address, which can be used as a secondary key to this table. The system can learn an L2 mapping based on an L3 learning event.
Hostname	The hostname displays when the information is available to the L3 mapping event.
Interface Spec	For an L3 learning event, the system records the port and VLAN information for the user.
Credential ID	This field binds an interface to a particular credential.
Role	This is a list of roles assigned to a user interface.

Table 15 Field Descriptions of the Interface Table *(continued)*

Field	Description
Source	The protocol from which the entry was learned. Possible values are: ■ DHCP – The entry was created by DHCP; There is a MAC value associated with this entry. ■ LSP – The entry was learned based on active network traffic noted by the SafeGuard Processor. ■ PROTO – The entry was learned from the protocol header from one of the authentication events.
State	Provides the age out time and backup for each entry in the system.
Attribute ID	The attribute ID for any interface with attributes associated with it.

Sample output from the **`show ha aaa interface-table`** follows:

```
(SafeGuardOS) #show ha aaa interface-table
HA Interface Table
------------------

Number of Rows:1
IP          Cred ID   Origin    Owner     Active    Flows     Aging
--          -------   ------    -----     ------    ------    -----
10.25.0.93  0         L0CAL     LOCAL     true      3600
```

Each interface is mapped to a single credential, representing the user information associated with that IP or MAC address. The entry in the credential table, mapped to each interface, is represented by the Credential ID field. To display the contents of the Credential Table, use the following Global Configuration command:

`show ha aaa credential-table`

The output of the command has these fields:

Table 16 Field Descriptions of the Credential Table

Field	Description
MAC	The primary index for L2 entries.
IP	The primary index for L3 entries.
Credential ID	The system-wide identifier used by the Interface Table to map to a credential. This field is shared by the two tables.
User Name	This field is the login name generated by the authentication event.

Table 16 Field Descriptions of the Credential Table *(continued)*

Field	Description
Source	The protocol that generated the entry. Possible values are: ■ white-list ■ captive portal ■ RADIUS ■ Kerberos
State	The authentication state. Possible values are: ■ authing ■ failed ■ success
State	Provides the age out time and backup for each entry in the system.
Attribute ID	When this is a non-zero field, it provides an index into the attribute table. Any attributes derived from the authentication protocol are stored in this entry.

Sample output from the `show ha aaa credential-table` follows:

```
(SafeGuardOS) #show ha aaa credential-table



HA Credential Table

-------------------


Number of Rows:1


ID      IP MAC User Origin Owner Ref Count

--      -- --- ---- ------ ----- ---------

2       10.25.0.9300:0f:1f:b8:44:68   jdoe  LOCAL LOCAL 1
```

Configuring System Recovery

Because there is only one SafeGuard device in the typical deployment model, the device must be configured for fail-passthru mode. When in fail-passthru mode, the device sets the protection mode to pass-thru if a critical error occurs.

When the protection mode is set to pass-thru mode, policy enforcement, visualization, and malware detection are not enabled in addition to any high availability features. *Table 17* depicts the protection modes in greater details for the SafeGuard Switch or Controller.

Table 17 Supported Protection Modes

Protection Mode	When Used	SafeGuard Controller	SafeGuard Switch
Pass-thru Mode	First time set up and cabling	Acts as a transparent bridge. All security functionality is bypassed.	Acts as a standard L2/ L3 switch. All security functionality is bypassed.
Monitor Mode	Testing and trials	Authentication, captive portal, visualization, malware detection and protection and user-based policy checking is applied to all data traffic, but enforcement is ignored.	
Protect Mode	Typical Deployment	Authentication, captive portal, visualization, malware detection and protection and user-based policy checking is applied to all data traffic, and actively enforced.	

To configure the system recovery mode, use the **`system recovery`** command in Global Configuration mode.

`system recovery` [**`reboot`** | **`fail-passthru`**]

Syntax Description	**`reboot`**	The switch will be rebooted on system fault. This is the default setting.
	`fail-passthru`	Sets the switch to fail-passthru mode. If a critical error occurs, the device will be set to pass-thru mode.

CAUTION: When the user logs into the system, a warning message is displayed if the system is in Fail-PassThru mode. When system is in Fail-PassThru mode, the user should not make any configuration changes because some components are not operational.

In this state, user can use show commands for debugging and use the copy command to transfer the core file and perform an upgrade. However, all other commands are not disabled. Use any commands with extra caution.

The following example shows how to verify system recovery settings:

```
(SafeGuardOS) #show system recovery
Recovery Mode.............................. Fail-Passthru
Recovery State............................. N/A
(SafeGuardOS) #
```

In the above example, the system has been configured for “system recovery fail-passthru”. N/A means there has not been a critical fault since the last reboot.

After a critical error has occurred, the output would look like this:

```
(SafeGuardOS) #show system recovery
Recovery Mode.............................. Fail-Passthru
Recovery State............................. Fail-Passthru on Dec 13 14:53:59
PST 2006
(SafeGuardOS) #
```

The Recovery State timestamps exactly when the system was put in fail-passthru mode.

Configuring Exception Recovery

Exception recovery is intended to allow the controller’s processor to survive certain kinds of errors and keep processing. The user may enable the recovery feature and set the limits before rebooting the unit as well as inspecting the state of recovery while viewing statistics about its operation since reboot.

See the following sections for more details:

- *Enabling and Disabling Exception Recovery*
- *Changing the Exception Recovery Parameters*
- *Viewing the Exception Recovery Status*

Enabling and Disabling Exception Recovery

To enable exception recovery, use the **lsp recovery-mode** command in Global Configuration mode. To disable exception recovery, use the **no** form of the command.

lsp recovery-mode

no lsp recovery-mode

This command has no options or parameters.

For example:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # lsp recovery-mode
(SafeGuardOS) (config) #
```

Changing the Exception Recovery Parameters

Recovery will "permit" a certain rate of exceptions per second, but will not tolerate a certain number of exceptions over time. This is done with a "leaky bucket" system using a sustain rate and threshold value. The sustain rate defines how many recoveries per second the system can sustain. Each second, the recovery quota is increased by the sustain value. The threshold is the recovery quota's maximum value. No matter what the sustain value is, the quota cannot exceed the threshold limit.

For example, to configure up to two recoveries per second to never crash the controller, but any period of ten seconds when the recoveries happen faster than that to force a reboot, the solution would look something like this:

- A threshold of twenty is defined, to indicate that ten seconds of more than two recoveries each second will reach the threshold between continued operation and a reboot.
- A sustain rate of two is defined, to indicate that every second the system can restore two recoveries to the recovery quota.

The recoveries are defined per group. Traffic passing through the LSP processor is divided into four groups for processing. These groups are related to the front-panel ports of the SafeGuard controller.

To change the exception recovery parameters, use the **lsp recovery** command in Global Configuration mode.

lsp recovery [**threshold** *threshold*] [**sustain** *sustain*]]

Syntax Description	*threshold*	The maximum value of the recovery quota.
	sustain	Exceptions credited per second that the system can sustain.

For example:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # lsp recovery threshold 20 sustain 2
```

```
(SafeGuardOS) (config) #
```

Enabling System Reboots on LSP Watchdog Events

To enable system reboots on LSP watchdog events, use the **lsp watchdog** command in Global Configuration mode. To disable system reboots on LSP watchdog events, use the **no** form of the command.

lsp watchdog

no lsp watchdog

This command has no options or parameters.

For example:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # lsp watchdog
(SafeGuardOS) (config) #
```

Viewing the Exception Recovery Status

To view the exception recovery status, use the **show lsp recovery-mode** command in Privileged Mode.

show lsp recovery-mode

This command has no options or parameters.

For example:

```
(SafeGuardOS) #show lsp recovery-mode
(SafeGuardOS) #
LSP group 0: threshold 20, sustain  2, remaining 20, recoveries 1
LSP group 1: threshold 20, sustain  2, remaining 20, recoveries 4
LSP group 2: threshold 20, sustain  2, remaining 20, recoveries 1
LSP group 3: threshold 20, sustain  2, remaining 20, recoveries 0
(SafeGuardOS) #
```

chapter

3 Working with Configuration Files and Upgrading Images

In this chapter:

This chapter describes the tasks associated with the configuration files and how to upgrade system software.

Understanding Configuration Files

The SafeGuard OS maintains two basic configuration files that manage the device: the startup configuration and the running configuration.

- The *startup configuration* is used when the device is started or rebooted.
- The *running configuration* is the current operating configuration.

While the two configurations can be the same, the running configuration and the startup configuration can also be different. A third kind of configuration file, a *backup* configuration, can also be created. This file may be a backup of an existing running configuration, or a starting configuration.

See the following sections for more details:

- *Saving Changes to the Running Configuration*
- *Saving Changes to the Startup Configuration*
- *Moving Backup Files to External Storage*
- *Restoring Configuration Files*
- *Erasing the Startup Configuration*
- *Displaying Configuration Information*

Saving Changes to the Running Configuration

After making changes to the running configuration, save the changes to the startup configuration to make sure that the changes persist across system reloads. In addition to saving the running configuration as the startup file, it is recommended to store the file to external storage (for example, Compact Flash (CF) or to a Trivial File Transfer Protocol (TFTP) server).

From Running to the Startup

If the startup file is overwritten with the running configuration, the system uses the updated file on the next reboot.

There are two separate Privileged Exec commands that can be used to save the running configuration as the startup configuration: **write memory** or **copy system:running-config**.

- **write memory** has no parameters or variables.

- **copy system:running-config** has the following syntax:

  copy system:running-config [**nvram:startup-config** | **nvram:backup-config**]

Syntax Description	**startup-config**	Saves the running configuration to the start up configuration in flash.
	backup-config	Saves the running configuration to the backup configuration on flash.

From Running to External Storage

A copy of the running configuration can be stored directly onto external storage, such as CF or to a TFTP server, using the following **copy system:running-config** command in Privileged Exec mode:

copy system:running-config [[**tftp:**//ip/{filepath/}*filename*] | [**cf:**//{*filepath/}filename*]]

Syntax Description	**tftp | cf**	Specifies whether to save the configuration onto a TFTP server or CF. The **cf** parameter is a controller only feature.
	ip	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	filename	Specifies the filename of the file being saved.

Saving Changes to the Startup Configuration

Startup configurations can be saved as follows:

- As the backup file in flash memory.
- To external storage; either CF or to a Trivial File Transfer Protocol (TFTP) server

From Startup to Backup

To save the startup configuration in flash memory as a backup configuration file, use the **copy nvram:startup-config** command in Privileged Exec mode.

copy nvram:startup-config nvram:backup-config

Syntax Description	**backup-config**	Saves the starting configuration in flash memory as a backup configuration.

From Startup to External Storage

To save the startup configuration to either a Trivial File Transfer Protocol (TFTP) server or to CF use the **copy nvram:startup-config** command in Privileged Exec mode.

copy system:startup-config [[**tftp:**//*ip*/{*filepath*/}*filename*] | [**cf:**//{*filepath*/}*filename*]]

Syntax Description	**tftp** | **cf**	Specifies whether to save the configuration onto a TFTP server or CF.
	ip	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	filename	Specifies the filename of the file being saved.

Moving Backup Files to External Storage

Use this command to copy a backup file in flash memory to a TFTP server or to CF.

copy nvram:backup-config [[**tftp:**//*ip*/{*filepath*/}*filename*] | [**cf:**//*filename*]

Syntax Description	**tftp** | **cf**	Specifies whether to save the configuration onto a TFTP server or CF.
	ip	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	filename	Specifies the filename of the file being saved.

The following example copies the backed-up startup configuration file to CF.

```
(SafeGuardOS) #
(SafeGuardOS) # copy nvram:backup-config cf://start091207
(SafeGuardOS) #
```

Restoring Configuration Files

Either as part of a back up and recovery system or as a method of propagating files to multiple machines, backup configuration files can be restored to flash memory.

From Flash Memory to Flash Memory

If the startup configuration has been saved to flash memory as a backup file, this file can be used again using the **copy nvram:backup-config** command to write over the startup

configuration. The change takes effect after a system reboot. The syntax of the Privileged Exec command is:

copy nvram:backup-config nvram:startup-config

There are no parameters or variables.

From TFTP to Flash Memory

Either a startup configuration or a running configuration can be downloaded from a TFTP server location using the **copy tftp:startup** command and the **copy tftp:backup** command in Privileged Exec mode to perform the download.

copy tftp://ip/{*filepath*/}*file* [**nvram:backup-config** | **nvram:startup-config**]

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	file	Specifies the filename of the startup or running configuration being downloaded.
	nvram:backup-config	Specifies to download a backup configuration file.
	nvram:startup-config	Specifies to download a startup configuration file.

The following example downloads a startup configuration file from a TFTP server:

```
(SafeGuardOS) #
(SafeGuardOS) # copy tftp://175.39.34.30/start45 nvram:startup-config
(SafeGuardOS) #
```

From Compact Flash to Flash Memory

To copy a startup or backup configuration file from Compact Flash (CF) to non-volatile memory, use the **copy cf:nvram** command. The syntax of the Privileged Exec command is:

copy cf://{filepath/}*filename* [**nvram:startup-config** | **nvram:backup-config**]

Syntax Description	*filepath*	(Optional) Specifies the directory path to the file.

	filename	Specifies the filename of the startup or running configuration being downloaded.
	nvram:startup-config	Specifies to copy a start up configuration file to flash memory.
	nvram:backup-config	Specifies to copy a back up configuration file to flash memory.

The following example copies a back up file to flash memory:

```
(SafeGuardOS) #
(SafeGuardOS) # copy cf://start45 nvram:backup-config
(SafeGuardOS) #
```

Erasing the Startup Configuration

To erase the startup configuration and reset it to the factory defaults without powering off the device, use the **write erase** command in Privileged Exec mode. After a **write erase**, a **reload** is required.

`write erase`

The following example erases and reloads the startup configuration:

```
(SafeGuardOS) # write erase
(SafeGuardOS) # Are you sure that you would like to erase the running
configuration? <y/n>
(SafeGuardOS) # y
(SafeGuardOS) #
(SafeGuardOS) #reload
(SafeGuardOS) #
```

Displaying Configuration Information

To display configuration information, use one of the commands in the following sections:

- *Running Config*
- *Startup Config*

Running Config

There are two Privileged Exec commands that display the contents of the running configuration to the terminal, **show running-config** and **write terminal**:

- The **show running-config** command has no parameters or variables.

  `show running-config`

- The **write termina**l command also has no parameters or variables.

```
write terminal
```

The output is displayed in the script format, which can be used to configure another device with the same configuration. The output from the **show running-config** command is shown in *Appendix A, Sample Output*.

Startup Config

To display the contents of the startup configuration to the terminal, use the **show startup-config** command in Privileged Exec mode.

```
show startup-config
```

The command has no parameters or variables.

The output from the show startup-config command is shown in *Appendix A, Sample Output*.

Upgrading System Images

This section describes the overall tasks associated with upgrading system software on the Alcatel-Lucent SafeGuard devices. Be sure to check the *Alcatel-Lucent Release Notes* for the specifics of upgrading an image.

The system image file contains executable code that brings up the system. An initial copy is pre-installed on the device at the factory. Periodically, the software should be upgraded to take advantage of new features and software updates.

To upgrade SafeGuard OS software:

1. Download the new image from Alcatel-Lucent to an external TFTP server.
2. Copy the image file to either the primary or secondary image location.
3. Specify whether to boot using the primary or secondary image.

NOTE: A new boot loader became available with SafeGuard OS Release 3.0.2. If both 2.x and 3.0 releases are installed concurrently and 2.x is the running image, the 2.x image cannot indicate that the 3.0 image is installed. For more details on the boot loader, see *Upgrading the Boot Image on page 117*.

The following sections describe additional commands useful in version control and software management tasks:

- *Copying Images*

Copying Images

To copy the image file to either the primary or secondary image location, use the **copy tftp** command in the Privileged Exec mode.

copy tftp://*ip*/{*filepath*/}*file* [**image-primary** | **image-secondary**]

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the file.
	file	Specifies the filename of the file being downloaded.
	image-primary	Copies an image file to the primary image area.
	image-secondary	Copies an image file to the secondary image area.

The following example loads an EPV image into the primary image area:

```
(SafeGuardOS) #
(SafeGuardOS) # copy tftp://192.158.25.25/SafeGuardOS-3.0.2.x-cp.img image-
primary
(SafeGuardOS) #
```

Specifying the System Image

The device boots with the primary system image. To specify whether the system loads the primary or secondary image, use the **use image** command in Privileged Exec mode. With the next boot, the system loads the selected image.

use image [**primary** | **secondary**]

Syntax Description	**primary**	Specifies to load the primary image on the next boot.
	secondary	Specifies to load the secondary image on the next boot.

The following example loads the secondary image on the next bootup.

```
(SafeGuardOS) # use image secondary
(SafeGuardOS) #
```

Upgrading the Boot Image

SafeGuard devices use a boot sequence to bring up the device and load application software, such as SafeGuard OS into memory. There are two methods of performing this boot sequence:

- Simple – A single piece of code that performs both the bootstrap and boot loader function.

  This type of boot loader was introduced in SafeGuard OS release 1.0 and continues to be supported. The simple boot loader provides backward compatibility to early releases and allow SafeGuard OS users to use Release 3.0 without upgrading the boot loader. The simple boot loader stores the image into a raw image partition.

- Dual-stage – Two distinct pieces of code that separate the bootstrap and boot loader functions.

  This type of boot loader was introduced in SafeGuard OS release 3.0 and provides improved reliability over the simple boot loader. The dual-stage boot loader stores the image into a set of components that are industry-standard.

  For information on migrating a simple boot loader system to a dual-stage boot loader, see *Migrating a Simple Boot Loader to a Dual-Stage Boot Loader on page 119*.

To update the Boot Loader:

1. Download the new boot loader from Alcatel-Lucent to an external TFTP server.
2. Copy the boot loader to either the primary or secondary flash location.
3. Specify whether to boot using the primary or secondary boot loader.
4. Validate the configuration using the **show version** command.

See the following sections for more details:

- *Dual-Stage Boot Loader Upgrades*
- *Simple Boot Loader Upgrades*

Dual-Stage Boot Loader Upgrades

The dual-stage boot loader is comprised of two components: the bootstrap and a primary and secondary boot loader. The bootstrap runs when the system is reset and is responsible for locating, selecting, validating and running the boot loader. The boot loader is responsible for loading and running application software, such as SafeGuard OS.

The bootstrap component may only be upgraded at the factory, as opposed to the boot loader, which can be upgraded with a software update.

Copying a Boot Loader from a TFTP Server

Use the **copy bootrom** Privileged Exec command to install a single boot loader into the either the primary or secondary image area of flash.

copy tftp://*ip*/{*filepath*/}*bootfile* [**bootrom-package** | **bootrom-primary** | **bootrom-secondary**]

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the boot loader.
	bootfile	Specifies the name of the boot loader being downloaded.
	bootrom-package	This is the recommended option since it updates both the primary and secondary image areas in a single command.
	bootrom-primary	Copies the boot loader to the primary image area.
	bootrom-secondary	Copies the boot loader to the secondary image area.

The following example loads a dual-stage boot loader into both the primary and secondary image areas:

```
(SafeGuardOS) #
(SafeGuardOS) # copy tftp://192.158.25.25/oagbootpackage-1.0.0.0.img bootrom-
package
(SafeGuardOS) #
```

Specifying the Boot Loader

To specify whether the bootstrap should use the primary or secondary boot loader on a dual-stage boot loader system, specify the **use bootrom** command in Privileged Exec mode.

use bootrom [**primary** | **secondary**]

Syntax Description	**primary**	Specifies to load the primary boot loader.
	secondary	Specifies to load the secondary boot loader.

The following example specifies using the primary boot loader.

```
(SafeGuardOS) # use bootrom primary
(SafeGuardOS) #
```

Simple Boot Loader Upgrades

With a simple boot loader system, see the following sections for either of the following upgrade procedures, as desired. Only one of these procedures need to be performed for an upgrade:

- *Updating the Simple Boot Loader*
- *Migrating a Simple Boot Loader to a Dual-Stage Boot Loader*

Updating the Simple Boot Loader

To update boot code on a simple boot loader system or to downgrade from a dual-stage boot loader system, use the **copy tftp image-bootrom** command. The Privileged Exec command has the following syntax:

copy tftp://*ip*/{*filepath*/}*bootcode-filename* **image-bootrom**

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the simple boot loader.
	bootcode-filename	Specifies the name of the boot loader being downloaded.

After the image is downloaded and installed, the CLI prompt is released.

Migrating a Simple Boot Loader to a Dual-Stage Boot Loader

The dual-stage boot loader can be loaded along with the simple boot loader. When both types of boot loaders are found on the system, the switch installs the dual-stage boot loader and converts the raw image to an industry standard format. The installation process is:

1. Install the dual-stage boot loader system using the **copy bootrom-package** command. The Privileged Exec command has the following syntax:

   copy tftp://*ip/filepath/bootpkg-filename* **bootrom-package**

Syntax Description	*ip*	Specifies the IP address of the TFTP server.
	filepath	(Optional) Specifies the directory path to the dual-stage boot loader package.

bootpkg-filename	Specifies the name of the boot loader package being downloaded.

2 Specify using the 3.0 image in either the primary or secondary image location as described in *Specifying the Boot Loader on page 118*. If not specified, the boot loader uses the primary image.

3 Reboot the system.

When the system comes back up, SafeGuard OS detects the dual-stage boot loader and that it was booted from a raw image partition. SafeGuard OS installs the dual-stage boot loader and converts the raw image partition to the new format.

4 Reboot the system again.

The dual-stage boot loader boots the SafeGuard OS from the new format.

Displaying Image and Boot Loader Information

The **show version** command displays both image and boot loader information. The following example is representative of the output of the command for an EPV image with a simple boot loader.

```
(SafeGuardOS) #show version

Manufacturer..................................... Alcatel-Lucent Inc.
System Description............................... OmniAccess 2400 SafeGuard
Serial Number.................................... 0538FCS002
Burned In MAC Address............................ 00:12:36:FF:DA:FE
Software Version................................. SafeGuardOS-3.0.2.X-xp
Software Build Date.............................. Dec 19 22:33:40 PST 2006
Image Selected................................... Secondary
Image Booted..................................... Secondary
Primary Image.................................... SafeGuardOS-3.0.2.X-xp-release-
042512192006
Secondary Image.................................. SafeGuardOS-3.0.2.X-xp-release-
223312192006
Bootstrap Version................................ 1.0.0.3 (Boot Package: 1.0.0.10)
Active Bootrom Version........................... 2.0.0.26  (Boot Package:
1.0.0.10)
Bootrom Selected................................. Primary
Bootrom Booted................................... Primary
Primary Bootrom Version.......................... 2.0.0.26 (Boot Package:
1.0.0.10)
Secondary Bootrom Version........................ 2.0.0.26 (Boot Package:
1.0.0.10)
System Time...................................... Dec 20 14:09:40 PST 2006
CPU Utilization.................................. user: 0.98% system 27.45% idle:
71.57%
Free Memory...................................... 188 MB / Total 244 MB
Uptime........................................... 2 hours 54 minutes 46 seconds
```

```
(SafeGuardOS) #
```

The fields of the output represent:

Field	Description
Manufacturer	Indicates the device is manufactured by Alcatel-Lucent
System Description	The model number of the device
Base Mgmt Port MAC Address	The MAC address of the management port
Software Version	The software version; an extension of Captive Portal indicates an EPV version.
Software Build Date	The time and date that the build was created.
Image Selected	Indicates whether the primary or secondary image was selected to boot.
Image Booted	Indicates whether the primary or secondary image was actually booted.
Primary Image	The image name in the primary image area of flash memory.
Secondary Image	The image name in the secondary image area of flash memory.
Bootrom Version	Displays the boot loader version for simple boot loader systems.
System Time	The creation date and time for the system.
CPU Utilization	Current CPU utilization, both of the user and the system.
Free Memory	The amount of free memory and total memory.
Uptime	The amount of time since the last reload.
Protection Mode	The protection mode configured for the system. Possible values are pass-thru, monitor, and protect.

Following is an example of the show version output when using the dual-stage bootloader.

```
(SafeGuardOS) #show version

Manufacturer..................................... Alcatel-Lucent Inc.
System Description............................... OmniAccess 2400 SafeGuard
Base mgmt port MAC Address....................... 00:12:36:FF:F9:E0
Software Version................................. SafeGuardOS-3.0.2.x-cp
Software Build Date.............................. Jul 30 10:45:49 PDT 2006
Image Selected................................... Secondary
Image Booted..................................... Secondary
```

```
Primary Image.............................. SafeGuardOS-3.0.2.x-cp-exxxxx-
104507302006
Secondary Image............................ SafeGuardOS-3.0.2.x-cp-exxxxx-
104507302006
Bootstrap Version.......................... 1.0.0.0
Bootrom Selected........................... Secondary
Bootrom Booted............................. Primary
Primary Bootrom Version.................... 2.0.0.16
Secondary Bootrom Version.................. 2.0.0.16
System Time................................ Jan 1 00:01:07 2006
Cpu Utilization............................ user: 0.98% system 9.80% idle:
89.22%
Free Memory................................ 153 MB / Total 244 MB
Uptime..................................... 1 minutes 13 seconds
Protection Mode............................ protect
```

The fields of the output represent:

Field	Description
Manufacturer	Indicates the device is manufactured by Alcatel-Lucent
System Description	The model number of the device
Base Mgmt Port MAC Address	The MAC address of the management port
Software Version	The software version; an extension of Captive Portal indicates an EPV version.
Software Build Date	The time and date that the build was created.
Image Selected	Indicates whether the primary or secondary image was selected to boot.
Image Booted	Indicates whether the primary or secondary image was actually booted.
Primary Image	The image name in the primary image area of flash memory.
Secondary Image	The image name in the secondary image area of flash memory.
Bootstrap Version	Displays the bootstrap version for dual-stage boot loader systems.
Bootrom Selected	Indicates whether the primary or secondary boot loader was selected on dual-stage boot loader systems.
Bootrom Booted	Indicates the actual boot loader running on a dual-stage boot loader system.
Primary Bootrom Version	Indicates the version number of the boot loader in the primary image area.
Secondary Bootrom Version	Indicates the version number of the boot loader in the secondary image area.

Field	Description
System Time	The creation date and time for the system.
CPU Utilization	Current CPU utilization, both of the user and the system.
Free Memory	The amount of free memory and total memory.
Uptime	The amount of time since the last reload.
Protection Mode	The protection mode configured for the system. Possible values are pass-thru, monitor, and protect.

Removing All Data from Memory

Government installations or companies that require mil-spec compliance might need to completely remove all data from memory before the device can leave the site.

Use the following procedure to perform a military scrub of the NAND and NOR Flash memory:

1. Connect a serial cable to the management port on the rear panel of the SafeGuard device.
2. Attach the other end of the serial cable to a properly configured terminal or terminal emulator.
3. Power cycle the SafeGuard device.
4. When prompted, press any key to display the boot loader prompt.
5. Enter the **formatF nand** command to completely remove all data from NAND flash. For example:

```
Alcatel-Lucent> formatF nand
offset=5000000, size=3000000
Start: 5000000, Num Blocks: 3072
Erasing flash region:
.............................................................
.............................................................
.............................................................
Alcatel-Lucent>
```

6. Enter the **formatVars** command to completely remove all data from NOR flash. For example:

```
Alcatel-Lucent> formatVars
Erasing flash env variables sector.....
>>>     Done
..
Done.
```

chapter

4 Configuring SafeGuard Controllers

In this chapter:

Configuring VLANs on the SafeGuard Controller

A VLAN is a logical grouping of endpoint devices on different physical LAN segments that communicate as if they are on the same physical LAN segment. These endpoint devices are referred to as *members* of the VLAN. Unlike a LAN connected using hardware, a VLAN is configured using the SafeGuard OS CLI, making it a virtual connection.

VLANs are part of the IEEE 802.1Q standard, which is designed to address how to break large networks into smaller parts so broadcast and multicast traffic would not grab more bandwidth than necessary. The standard also helps provide a higher level of security between segments of internal networks.

On SafeGuard Controllers, VLANs do not need to be created; they are pre-configured already. However, some of the VLAN settings are adjustable. Controllers classify all untagged traffic upon ingress into the Controller and into the reserved VLAN. The reserved VLAN is always enabled. The reserved VLAN is set to a VLAN ID of 1 by default.

To set the VLAN ID for the reserved VLAN, use the reserved vlan command in Global Configuration mode.

`reserved vlan` *`vlanid`*

Syntax Description	*`vlanid`*	Specifies a VLAN ID number. Valid entries are 1 to 4094.

The following example assigns a VLAN ID of 50 to a Controller;

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #reserved vlan 50
(SafeGuardOS) (config) #
```

To validate the assignment of the VLAN ID, use the **show reserved vlan** or the **show running-config** commands. An example of the **show running-config** is shown in *Sample Output on page 395*. The syntax of the show reserved vlan command is:

`show reserved vlan`

The Privileged Exec command has no options or parameters. The following example is representative of the output from the command.

```
(SafeGuardOS) #show reserved vlan
The untagged Vlan id = 50
(SafeGuardOS) #
```

For more details on SafeGuard Controllers and their features, see *Alcatel-Lucent Solution and Product Overview on page 20*.

Link Pair Synchronization

The SafeGuard Controller sits between the user and the network. It is important that if a link between a user and the controller goes down, the link between the controller and the network is also brought down. In addition, if the link between the controller and the network goes down, the link between the user and the controller must be brought down. This is required so that protocols can converge in the event of link failures. By default, link pair synchronization is enabled on controllers.

Link pair synchronization is a feature available only on the SafeGuard Controller to constantly monitor the link on both the user and network side. If either side of the link fails or is brought down administratively, link pair synchronization will bring the other side of the link down. Link pair synchronization will mark the link that it brought down as SUSPENDED. If the failed link comes back up then link pair synchronization will restore the link it brought down to UP state.

A link pair is a combination of neighbor ports, such as {P1,P2}, {P3, P4}, and so on. A link pair cannot be formed with arbitrary port sets such as {P1, P5}. A link pair combination consists of the user connected on one side of the pair and the network connected to the other side of the pair.

The network administrator can monitor changes in link states using the **`show port all`** command.

For example:

```
(SafeGuard) #show port all

               Admin   Physical   Physical   Link   LACP
 Intf   Type    Mode    Mode       Status   Status  Mode
------ ------ ------- ---------- ---------- ------ -------
0/1           Enable  Auto                Down       Disable short
0/2           Enable  Auto                Suspended  Disable short
```

In the example above port 0/1 is down, so Link pari synchronization will suspend port 0/2 to allow for protocols such as STP, RSTP, EAP, etc to converge.

The current Link pair synchronization settings can be seen by executing the following command from Privileged Exec mode:

```
(SafeGuard) #show linkpair-sync
Link pair synchronization is enabled.
(SafeGuard) #
```

To enable Link pair synchronization (enabled by default):

```
(SafeGuard) #config terminal
(SafeGuard) (config) #linkpair-sync enable
(SafeGuard) (config) #
```

To disable Link pair synchronization:

```
(SafeGuard) #config terminal
(SafeGuard) (config) #linkpair-sync disable
(SafeGuard) (config) #
```

chapter

5 Setting Up SafeGuard Switches

In this chapter:

Overview of VLANs

This chapter describes setting up Virtual Local Area Networks (VLANs) on SafeGuard devices. The SafeGuard Switch and the Controller both support VLANs but use different techniques and commands.

A VLAN is a logical grouping of endpoint devices on different physical LAN segments that communicate as if they are on the same physical LAN segment. These endpoint devices are referred to as *members* of the VLAN. Unlike a LAN connected using hardware, a VLAN is configured using the SafeGuard OS CLI, making it a virtual connection.

VLANs are part of the IEEE 802.1Q standard, which is designed to address how to break large networks into smaller parts so broadcast and multicast traffic would not grab more bandwidth than necessary. The standard also helps provide a higher level of security between segments of internal networks.

See the following sections for more details:

- *Tagged and Untagged Frames*
- *Ingress VLAN Classification and Egress Forwarding for the SafeGuard Switch*
- *Why Use VLANs?*
- *Configuring VLANs on the SafeGuard Switch*

For more details on SafeGuard Switches and their features, see *Alcatel-Lucent Solution and Product Overview on page 20*.

Tagged and Untagged Frames

The IEEE 802.1Q specification establishes a standard method for tagging Ethernet frames with VLAN membership information. To tag a VLAN, insert an identification number (*VLAN ID*) into a predefined field through configuration.

Tagged VLANs provide switch-to-switch connectivity over a single physical connection called a *trunk*. Tagged VLANs over trunk lines allow multiple VLANs to span from switch to switch.

An untagged frame received at a port will be classified into an appropriate VLAN based on one of the criteria specified in the following section.

Ingress VLAN Classification and Egress Forwarding for the SafeGuard Switch

The switch uses a set of rules to determine VLAN membership when a frame enters a port (*ingress*). After the frame is examined and the VLAN membership is determined, the packet is assigned to the VLAN and transmitted out of the ports (*egress*) associated with the VLAN.

Ingress VLAN Classification

A frame can be tagged, untagged or priority-tagged. When a switch receives a frame, it will first classify the incoming frame to assign the VLAN ID, as described in the following points:

- If the frame is 802.1Q tagged, the switch uses the VID in the frame to assign the VLAN ID.
- If the frame is untagged or priority-tagged, the switch uses one of four *classifications* methods to assign the VLAN ID. Internally, each packet is evaluated in the following precedence order. The switch uses whichever method matches first.
  - **MAC-based VLAN** assigns the VLAN ID based on the source MAC address in the frame using a global MAC-based VLAN association table. The MAC address is the hardwired address built into the NIC (network interface card) of the endpoint device. These VLANs offer the capability of defining a VLAN composed of specific hosts.

    The MAC-based VLAN association table is configured globally. Each entry in the table defines mapping between a MAC-address and an associated VLAN ID. Any incoming frame with the matching source MAC address is assigned the associated VLAN ID. The MAC-based association table is built using CLI commands.
  - **IP subnet-based classification** assigns the VLAN ID based on the source IP address in the packet using an IP subnet-based VLAN association table. The IP subnet-based VLAN association table is defined globally. Each entry in the table defines mapping between the IP subnet address (address/mask) and associated VLAN ID. Any incoming IP packet with the matching IP source address is assigned the associated VLAN ID. This type of VLAN permits multiple subnets on a single interface. IP subnet-based VLANs are typically used when all of the hosts can belong to the same VLAN.
  - **Protocol-based classification** assigns the VLAN ID based on the type field of the Ethernet header in the packet. Protocol-based VLANs are configured on a per-interface basis and use the VID that is mapped from the link-layer protocol carried in the frame.
  - **Port-based classification** assigns the VLAN ID based on the Port VID (PVID) configured on the ingress port.LAN membership on assignment to a port or to a group of ports. If no other classification matches, SafeGuard OS uses port-based classification as the default classification method.

NOTE: By default, the PVID of a port is set to 1. The user needs to set the proper PVID on every port.

All frames assigned a VLAN ID for a VLAN that does not exist will be discarded.

Ingress Filtering

If ingress filtering is enabled, incoming frames for VLANs which do not include this ingress port in their member set will be discarded at the ingress port; otherwise, the incoming frames are admitted and forwarded to the ports that are member of that VLAN.

By default, ingress filtering is enabled per port, and can be disabled.

Ingress filtering does not affect VLAN independent BPDU frames, such as STP. However, it does affect VLAN dependent BPDU frames, such as GMRP.

For example, VLAN2 is dedicated to hosts running the IPX protocol on ports 6-10. A host connected to port 5 is also running IPX, but port 5 is not in the VLAN configuration for the VLAN2. When the frame goes through the ingress rules the system classifies the frame as protocol-based. The system assigns the frame to VLAN 2 even though the port is not configured in the VLAN. To have the system drop the frame rather than forward to VLAN 2, it needs to filter on the ingress. For more information on ingress filtering, see *Enabling Ingress Filtering on page 138*.

Assigning Ports to VLANs

Before a VLAN becomes active, you need to assign one or more ports to the VLAN in which it participates. By default, all ports are assigned to default VLAN 1 as untagged ports. A port can be member of multiple VLANs as either tagged or untagged.

Add a port as a tagged port if this port carries traffic for one or more VLANs, and intermediate network devices or the host at the other end of connection supports VLANs.

Tagging mode of a member port decides whether switch should transmit a frame out of this port as tagged or untagged frame.

Forwarding Tagged and Untagged Frames

After the Ingress classification determines the VLAN ID for the received frame, the switch decides to which member ports of the VLAN switch the frame should be forwarded.

Tagged and untagged frames are treated as follows:

- Tagged frames – If an egress port is a tagged member, the frame will be transmitted as a tagged frame. Otherwise, the switch will first strip off the VLAN tag before forwarding the frame as an untagged frame.
- Untagged frames – If an egress port is a tagged member, A VLAN tag will be inserted into the frame before forwarding. Otherwise, the switch will forward the frame as untagged.

Why Use VLANs?

VLANs provide several advantages:

- *Location independent* – When an endpoint device is moved to another location, it can remain on the same VLAN without needing to reconfigure any hardware.
- *Increased network efficiency* – The network is more efficient by allowing a VLAN to control and screen broadcast traffic.
- *Increased security* – By confining broadcast traffic to users in a workgroup, there is increased security because sensitive data is confined to only that group.

Configuring VLANs on the SafeGuard Switch

The SafeGuard Switch comes with a single pre-configured VLAN or *default* VLAN. The default VLAN is assigned the ID of 1 (VID 1) and is reserved, which means it cannot be deleted.

See the following sections for more details on configuring VLANs:

- *Configuring Port-Based VLANs*
- *Configuring Protocol-Based VLANs*
- *Configuring MAC-Based VLANs*
- *Configuring IP Subnet-Based VLANs*
- *Deleting a VLAN*
- *Verifying the VLAN Configuration*

Configuring Port-Based VLANs

To create a port-based VLAN on the SafeGuard Switch, follow these steps, described in more detail in the following sections:

1. *Creating the VLAN and Assigning a VLAN ID on page 134*
2. *Assigning a Name to the VLAN on page 135*
3. *Assigning the Ports and Egress Tagging on page 136*
4. *Assigning a Port VLAN ID on page 137*
5. *Assigning an IP Address to the VLAN on page 137*
6. *Setting Frame Acceptance on page 138*
7. *Enabling Ingress Filtering on page 138*
8. *Verifying the Configurations on page 139*

Creating the VLAN and Assigning a VLAN ID

Create VLANs in the VLAN database mode, which is a submode of Global Configuration. To enter the mode, use the **vlan database** command:

`vlan database`

The command has no parameters or variables. For example:

```
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan)#
```

To assign an ID and an optional name to the VLAN, use the **`vlan`** command in VLAN database mode. Eligible ID numbers are from 2 to 4094. Each VLAN is assigned a default system-generated name in the format "VLANxxxx", where xxx is the ID of the VLAN. The VLAN can be renamed to any name meaningful to its network configuration, such as "finance_dept". However, the following restrictions apply:

- The new name can not be a system reserved name, such as: "default", "MgmgVlan", "ServicePort", or "VLANxxxx".
- Each VLAN name must be unique within the system.

`vlan` *`id`* {**`name`** *`name`*}

Syntax Description	*`id`*	Assigns a VLAN having this identification number. Valid assignment numbers are from 2 to 4094. ID 1 is reserved for the default VLAN.
	`name`	A user defined name for the VLAN.

The following example assigns a VLAN with the ID of 85:

```
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan)#vlan 85
(SafeGuardOS) (Vlan)#exit
```

To validate the creation of the VLAN, use the **show vlan brief** command in Privileged Exec mode.

```
(SafeGuardOS) #show vlan brief

VLAN ID Name            Type    IP Addr/MaskLen    Ports(active/total)
------- --------------- ------- ------------------ ------------------
1       Default         Default                    0/50
85      VLAN0085        Static                     0/0
```

Note that the system assigned an internal name to the VLAN when the VLAN was created. The internal name is comprised of the word VLAN concatenated to the ID number in a four digit format.

For further discussion of the **show vlan brief** command and a description of the output fields, see *Showing a VLAN Brief on page 146*.

Assigning a Name to the VLAN

This step is optional, however, most organizations prefer to identify their VLANs by an organizational name rather than by a number. Use the **vlan name** command in VLAN database submode of Privileged Exec.

vlan name *vlanid name*

Syntax Description	*vlanid*	Specifies an existing VLAN ID number. Valid entries are 1 to 4094.
	name	Assigns a name to the VLAN by the ID. VLAN names can be up to 32 characters in length. The following restrictions apply: ■ The new name can not be a system reserved name, such as: “default”, “MgmgVlan”, “ServicePort”, or “VLANxxxx”. ■ Each VLAN name must be unique within the system.

In the following example, VLAN 85 is assigned the name of sales.

```
(SafeGuardOS) (Vlan)#vlan name 85 sales
(SafeGuardOS) (Vlan)#exit
```

The **show vlan brief** command no longer displays the system-generated name of VLAN0085 for VLAN 85, but instead displays *sales*.

```
(SafeGuardOS) #show vlan brief

VLAN ID Name            Type    IP Addr/MaskLen    Ports(active/total)
------- --------------- ------- ------------------ ------------------
1       Default         Default                    0/50
85      sales           Static                     0/0
```

For further discussion of the **show vlan brief** command and a description of the output fields, see *Showing a VLAN Brief on page 146*.

Restoring the System Generated VLAN Name

To change the name of a VLAN back to the system generated name, use the **no vlan name** command in VLAN database mode.

no vlan name *vlanid*

Syntax Description	*vlanid*	ID of the VLAN.

Assigning the Ports and Egress Tagging

Although packets are inspected at port ingress, the system acts on the frame when it exits the port (on egress). At the assignment time, the ports can also be designated as tagged or untagged, as desired. Tagging is optional.

For port-based VLANs, port membership and tagging are assigned on a per interface basis. At the assignment time, the ports can also be designated as tagged or untagged.

To configure a VLAN by individual interface basis, use the **vlan participation command** in Interface mode.

vlan participation [**auto** | **include** | **exclude**] *vlanid* {**tagged**}

Syntax Description	**auto**	Specifies that the interface is automatically registered in the VLAN after a join request is received on the interface. This option is equivalent to registration normal.
	include	Specifies that the interface is always a member of the VLAN. This option is equivalent to registration fixed.
	exclude	Specifies that the interface is never a member of the VLAN. This is equivalent to registration forbidden.
	vlanid	Specifies the VLAN ID of the VLAN being individually tagged.
	tagged	Specified that the VLAN is tagged.

The following command sets the participation to **auto** for interface 0/13:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/13
(SafeGuardOS) (interface 0/13) #vlan participation auto name sales
(SafeGuardOS) (interface 0/13) #exit
(SafeGuardOS) (config) #exit
```

To display the configuration, use the **show vlan brief** command. This command is discussed in *Showing a VLAN Brief on page 146*.

Assigning a Port VLAN ID

To specify that the VLAN is classified as port-based, use the **vlan pvid** command in Interface Configuration submode of Global Configuration.

vlan pvid *vid*

Syntax Description	*vid*	Specifies the VLAN ID being associated with the port.

The following example specifies VLAN 85 using a port VLAN ID on port 18:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/18
(SafeGuardOS) (interface 0/18) #vlan pvid 85
(SafeGuardOS) (interface 0/18) #exit
(SafeGuardOS) (config) #
```

Verify the configuration using the **show vlan association** command. This command is discussed in *Showing a VLAN Association on page 145*.

Assigning an IP Address to the VLAN

This optional step assigns an IP address to the VLAN. The IP address should be assigned if the VLAN will be a Layer 3 VLAN providing logical routing interfaces to VLANs on Layer 2 switches. Use the **no** version of the command to delete the IP address. To assign the IP address, use the **ip address** command in Interface configuration submode of Global Configuration.

ip address *ipaddr subnet-mask* {**secondary**}

no ip address *ipaddr subnet-mask* {**secondary**}

Syntax Description	*ipaddr*	Specifies the IP address of the routing interface in 32-bit dotted quad format.
	subnet-mask	Specifies a 4-digit dotted-decimal number that represents the subnet mask of the interface. The subnet mask must be contiguous and be no longer than 30 bits, for example 255.255.255.0.
	secondary	(Optional) Species that the IP address is a secondary address.

The following example adds an IP address and mask to the sales VLAN (85):

```
(SafeGuardOS) (config) #interface vlan name sales
(SafeGuardOS) (interface vlan sales) #ip address 172.68.24.1 255.255.255.0
(SafeGuardOS) (interface vlan sales) #exit
(SafeGuardOS) (config) #exit
```

Setting Frame Acceptance

To select the types of frames that can be received on a port, use the **vlan acceptframe** command. Untagged or priority tagged frames are either discarded or accepted and assigned the value of the VLAN ID for the interface.

With either option, VLAN tagged frames are forwarded in accordance with the IEEE 802.1Q VLAN specification. Use the **no** version of the command to set the frame acceptance mode for all interfaces to accept or admit all. To select whether to accept or reject the frame type, use the following syntax in Interface configuration mode:

`vlan acceptframe` [**`all`** | **`vlanonly`**]

`no vlan acceptframe`

Syntax Description	**`all`**	Specifies that untagged frames or priority frames received on this interface are accepted and assigned the value of the interface VLAN ID for this port.
	`vlanonly`	Specifies that untagged frames or priority frames received on this interface are discarded.

In the following example, all priority frames are accepted on interface 0/18:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/18
(SafeGuardOS) (interface 0/18) #vlan acceptframe all
(SafeGuardOS) (interface 0/18) #exit
(SafeGuardOS) (config) #exit
```

Use the **show vlan name** command as described in *Showing a VLAN Name on page 149* or the show vlan port command as described on *Showing a VLAN Port on page 151* to verify the configuration.

Enabling Ingress Filtering

When ingress filtering is disabled, frames received with VLAN IDs that do not match the VLAN membership of the receiving interface are admitted and forwarded to ports that are members of that VLAN.

By default, ingress filtering is enabled per port in SafeGuardOS.

Global Filtering

To enable ingress filtering for all interfaces, use the **vlan port ingressfilter all command** in Global Configuration mode. The **no** version of the command disables ingress filtering for all interfaces.

`vlan port ingressfilter all`

```
no vlan port ingressfilter all
```

The commands have no parameters or variables.

In the following example, ingress filtering is enabled:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan port ingressfilter all
(SafeGuardOS) (config) #exit
```

Per-Interface Filtering

To enable ingress filtering for a specific interface, use the **vlan port ingressfilter** command in Interface Configuration mode. The **no** version of the command disables ingress filtering for the interface.

```
vlan ingressfilter
```

```
no vlan ingressfilter
```

These commands have no parameters or variables.

In the following example, ingress filtering is enabled on port 0/12:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/12
(SafeGuardOS) (interface 0/12) #vlan ingressfilter
(SafeGuardOS) (interface 0/12) #exit
(SafeGuardOS) (config) #exit
```

Verifying the Configurations

Verify the configuration using either of the following commands:

- **show vlan port** command as described in *Showing a VLAN Port on page 151*
- **show vlan name** command as described in *Showing a VLAN Name on page 149*

Configuring Protocol-Based VLANs

A protocol VLAN filters protocol traffic from being forwarded out of the switch. Use a protocol VLAN when only one of the supported protocols—ARP, IP or IPX—should run on the VLAN. Protocol VLANs are configured in a similar manner as port-based VLANs.

To create a Protocol-Based VLAN:

1. Assign the VLAN ID. See *Creating the VLAN and Assigning a VLAN ID on page 134* for more details.
2. (Optional) Assign a name to the VLAN. See *Assigning a Name to the VLAN on page 135* for more details.
3. Assign ports to the VLAN and (optionally) set egress tagging

4 Create a protocol group name.

5 Assign a protocol to that group name.

6 Assign the VLAN to the group name.

7 Associate the VLAN ID to a protocol group.

8 (Optional) Assign an IP address. See *Assigning an IP Address to the VLAN on page 137* for more details.

9 (Optional) Enable ingress filtering. See *Enabling Ingress Filtering on page 138* for more details.

10 Verify the configuration using the **show vlan brief** or **show running-config** commands. See *Verifying the VLAN Configuration on page 145* for more details.

Assigning the Egress Port Membership and Optional Tagging for All Ports

To configure the VLAN for all ports on the Switch, use the Global Configuration **vlan participation all** command.

`vlan participation all` [**`auto`**|**`include`**|**`exclude`**] *`vlanid`* {*`tagged`*}

Syntax Description	**`auto`**	(Default) Specifies that the interface is automatically registered in the VLAN after a join request is received on the interface. This option is equivalent to registration normal.
	`include`	Specifies that the interface is always a member of the VLAN. This option is equivalent to registration fixed.
	`exclude`	Specifies that the interface is never a member of the VLAN. This is equivalent to registration forbidden.
	`vlanid`	Specifies the VLAN ID of the VLAN being globally tagged
	`tagged`	(Optional) Specified that the VLAN is tagged.

For example, the following command sets all ports to be members of the VLAN:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan participation all include id 50
(SafeGuardOS) (config) #exit
```

To display the configuration, use the **show vlan brief** command. This command is discussed in *Showing a VLAN Brief on page 146*.

Creating a Protocol Group

A protocol group is associated with a specific protocol identified by a group name. Use the **vlan protocol group** command to create a group name for a protocol group. Use the **no** version of the command to remove the group.

vlan protocol group *groupname*

no vlan protocol group *groupname*

Syntax Description	*groupname*	Specifies to associate the VLAN with this VLAN ID to the group name. Valid entries are from 1 to 128 characters.

The following example creates a group called ipgroup.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan protocol group ipgroup
(SafeGuardOS) (config) #
```

Assigning a Protocol to the Group Name

Use the **vlan protocol group add protocol** command in Global Configuration mode to add a protocol to the protocol-based VLAN group. Use the **no** version of the command to remove the protocol from the VLAN group.

vlan protocol group add protocol *groupname* [**ip** | **arp** | **ipx**]

no vlan protocol group add protocol

Syntax Description	*groupname*	Specifies the group name for the protocol VLAN.
	ip	Specifies to use the Internet Protocol (IP).
	arp	Specifies to use the Address Resolution Protocol (ARP).
	ipx	Specifies to use the Internetwork Packet Exchange (IPX).

The following example adds the IP protocol to the IPgroup.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan protocol group add protocol ipgroup ip
(SafeGuardOS) (config) #
```

Assigning the VLAN to the Group Name

To add a single physical interface to the protocol-based VLAN, or add all physical interfaces to the protocol-based VLAN, use the **protocol vlan group** command in Global Configuration mode using the following syntax:

protocol vlan group {**all**} *groupname*

Syntax Description	**all**	Specifies to all physical interfaces to the protocol VLAN.
	groupname	Specifies to associate the VLAN with this VLAN ID to the group name. Valid entries are from 1 to 128 characters.

The following example adds all physical interfaces to the protocol VLAN.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #protocol vlan group all ipgroup
(SafeGuardOS) (config) #exit
```

Configuring MAC-Based VLANs

A MAC-based VLAN is a VLAN of specific end point devices. These VLANs are useful for workstations that move frequently because they are not tied to a port. MAC-based VLANs are defined globally; all traffic from the device with the matching MAC address is funneled into the VLAN.

To create a MAC-based VLAN, follow these steps described in the following sections:

1. *Creating the VLAN and Assigning a VLAN ID on page 134*.
2. *Assigning a Name to the VLAN on page 135*.
3. *Assigning the Egress Port Membership and Optional Tagging for All Ports on page 140*.
4. *Associating the VLAN to a MAC address on page 142*
5. *Assigning an IP Address to the VLAN on page 137*
6. *Setting Frame Acceptance on page 138*
7. *Enabling Ingress Filtering on page 138*
8. Verify the configuration using the **show vlan brief** or **show running-config** commands. This step is described in *Verifying the VLAN Configuration on page 145*.

Associating the VLAN to a MAC address

To associate the VLAN to a MAC address, use the **vlan association** command in VLAN database submode of Global Configuration. The **no** version of the command removes the association.

vlan association [**mac** *macaddr*] *vlanid*

no vlan association [**mac** *macaddr*]

Syntax Description	*macaddr*	Species the MAC address being associated to the VLAN. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	vlanid	Specifies the VLAN ID being associated.

The following command associates a MAC address to a VLAN with the VLAN ID of 50.

```
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan) #vlan association mac 3f:78:45:a2:34 50
(SafeGuardOS) (Vlan) #exit
```

Verify the configuration using the **show vlan association** command. This command is described further in *Showing a VLAN Association on page 145*.

Configuring IP Subnet-Based VLANs

IP subnet-based VLANs filter Layer 3 information to build VLANs based on a source IP address, network mask, and the VLAN ID. This type of VLAN permits multiple subnets on a single interface. IP subnet-based VLANs are typically used when all of the end points can belong to the same VLAN. These VLANs are defined globally; all traffic from matching devices are included in the VLAN.

To create an IP Subnet-based VLAN:

1. *Creating the VLAN and Assigning a VLAN ID on page 134*.
2. *Assigning a Name to the VLAN on page 135*.
3. *Assigning the Egress Port Membership and Optional Tagging for All Ports on page 140*.
4. *Associate the VLAN to an IP Subnet Address on page 144*
5. *Assigning an IP Address to the VLAN on page 137*.
6. *Setting Frame Acceptance on page 138*.
7. *Enabling Ingress Filtering on page 138*.
8. Verify the configuration using the **show vlan brief** or **show running-config** commands. This step is described in *Verifying the VLAN Configuration on page 145*.

Associate the VLAN to an IP Subnet Address

To associate the VLAN to an IP subnet address, use the **vlan association** command in VLAN database mode. The **no** version of the command removes the association.

vlan association [**subnet** *ipaddr netmask*] *vlanid*

no vlan association [**subnet** *ipaddr netmask*]

Syntax Description	*ipaddr*	Specifies the IP address being associated to the VLAN.
	netmask	Specifies a 4-digit dotted-decimal number that represents the subnet mask. The subnet mask must be contiguous and be no longer than 30 bits, for example 255.255.255.0.
	vlanid	Specifies the VLAN ID being associated.

The following command associates an IP subnet to a VLAN with the ID of 50.

```
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan) #vlan association subnet 10.201.4.99 255.255.255.0 50
(SafeGuardOS) (Vlan) #exit
```

Verify the configuration using the **show vlan association** command. This command is described further in *Showing a VLAN Association on page 145*.

Deleting a VLAN

With the exception of a reserved VLAN, to delete a VLAN, use the **no vlan** command in **vlan database** mode.

no vlan [*vlanid* |*name*]

Syntax Description	*vlanid*	Specifies to delete the VLAN based on its ID.
	name	Specifies to delete the VLAN based on its name.

The following example deletes the sales VLAN with the ID of 85.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan) #no vlan 85
(SafeGuardOS) (Vlan) #exit
```

Verifying the VLAN Configuration

There are Privileged Exec **show** commands to display VLAN and VLAN-related configurations:

Command	Use
show running-configuration	Displays the running configuration for the Switch, which includes VLAN configuration. An example of the **show running-config** is shown in *Appendix A, Sample Output*.
show vlan association	Displays the VLAN associated with a specific configured IP address or netmask.
show vlan brief	Displays a summary of all configured VLANs.
show vlan ID	Displays VLAN information about tagging, link state and the Include Mode by VLAN ID.
show vlan name	Displays VLAN summary or detailed information by VLAN name.
show vlan port	Displays information about an interface, all interfaces, or a port-channel.

Showing a VLAN Association

The **show vlan association** command displays the VLAN associated with a specific IP address or netmask.

show vlan association [**mac** *macaddr* | **subnet** *mask*]

Syntax Description	*macaddr*	Specifies to display the VLAN information associated with this MAC address.
	mask	Specifies to display the VLAN information associated with this subnet mask.

The following sample output is representative of the **show vlan association** command:

```
(SafeGuardOS) #show vlan association subnet

IP Address      IP Mask           VLAN ID

10.201.4.99     255.255.255.0     50
77.77.77.10     255.255.255.0     50
```

The fields in the **show vlan association** output represent:

Display	Description
IP Address	Displays the IP address associated with the VLAN.
IP Mask	Displays the subnet mask associated with the VLAN.
VLAN ID	Displays the ID for the associated VLAN.

Showing a VLAN Brief

The **show vlan brief** command displays summary information about all configured VLANs.

```
show vlan brief
```

This command has no options or parameters.

The following sample output is representative of the **show vlan brief** command:

```
(SafeGuardOS) #show vlan brief

VLAN ID Name            Type    IP Addr/MaskLen    Ports(active/total)
------- --------------- ------- ------------------ ------------------
1       Default         Default                    0/50
85      sales           Static   172.68.24.1   /24 0/0
```

The fields in the **show vlan brief** output represent:

Display	Description
VLAN ID	Displays the VLAN identification number.
Name	Displays the name assigned to the VLAN.
Type	Displays the type of VLAN. Valid types are default, port, static or protocol.
IP Addr/MaskLen	Displays the IP address and mask associated with the VLAN.
Ports (active/total)	Displays the active and total port count.

Showing VLAN ID

The **show vlan ID** command displays either a summary or detailed information about a VLAN by the VLAN ID.

show vlan id [**id** *vlanid* | **name** *vlan_name*]{*detailed*}

Syntax Description	*vlanid*	Specifies to display information about the VLAN identified by this VLAN ID.
	detailed	(Optional) Displays Include mode information about the specified VLAN.

The following example displays summary information for the default VLAN:

```
(SafeGuardOS) #show vlan id 1

VLAN ID          : 1
VLAN Name        : Default
VLAN Type        : Default
Ports            : 50  (Number of active ports =  2)
IP Address       :

Interface       Tagging   Link State
--------------- -------   ----------
0/1             Untagged  Disable
0/2             Untagged  Down
0/3             Untagged  Disable
0/4             Untagged  Down
0/5             Untagged  Disable
0/6             Untagged  Disable
0/7             Untagged  Up
0/8             Untagged  Up
0/9             Untagged  Disable
0/10            Untagged  Disable
0/11            Untagged  Disable
0/12            Untagged  Disable
0/13            Untagged  Disable
0/14            Untagged  Disable
0/15            Untagged  Disable
0/16            Untagged  Disable
0/17            Untagged  Disable
0/18            Untagged  Disable
```

The next example includes additional fields when the `detailed` parameter is specified.

```
(SafeGuardOS) #show vlan id 1 detailed

VLAN ID          : 1
VLAN Name        : Default
VLAN Type        : Default
Ports            : 50  (Number of active ports =  2)
IP Address       :
```

```
Interface       Current   Configured   Tagging   Link State
--------------- -------   ----------   -------   ----------
0/1             Include   Include      Untagged  Disable
0/2             Include   Include      Untagged  Down
0/3             Include   Include      Untagged  Disable
0/4             Include   Include      Untagged  Down
0/5             Include   Include      Untagged  Disable
0/6             Include   Include      Untagged  Disable
0/7             Include   Include      Untagged  Up
0/8             Include   Include      Untagged  Up
0/9             Include   Include      Untagged  Disable
0/10            Include   Include      Untagged  Disable
0/11            Include   Include      Untagged  Disable
0/12            Include   Include      Untagged  Disable
0/13            Include   Include      Untagged  Disable
0/14            Include   Include      Untagged  Disable
0/15            Include   Include      Untagged  Disable
0/16            Include   Include      Untagged  Disable
0/17            Include   Include      Untagged  Disable
0/18            Include   Include      Untagged  Disable
```

The fields in the **show vlan id** output represent:

Display	Description
VLAN ID	Displays the VLAN identification number.
VLAN Name	Displays the name assigned to the VLAN.
VLAN Type	Displays the type of VLAN. Valid types are default, port or protocol.
Ports	Displays the total port count and the number of active ports.
IP Address	Displays the following information for the IP address: ■ Interface number in slot/port format ■ (detailed only) Displays the current VLAN participation. Valid values are include, exclude, or auto. ■ (detailed only) Displays the configuration of the VLAN participation. Valid values are include, exclude, or auto. ■ Displays whether the VLAN is tagged or untagged. ■ Displays the link state: disabled, up or down.
Interface	Displays the interface number in slot/port format.
Current	Displays whether this VLAN is included in the current configuration.
Configured	Displays whether this VLAN is configured in the startup configuration.

Display	Description
Tagging	Displays whether this interface is configured for tagging.
Link State	Displays the link state: disabled, down (enabled), or up.

Showing a VLAN Name

Use this command to display either a summary or detailed information about a VLAN by name.

show vlan name *vlan_name* {*detailed*}

Syntax Description	*vlan_name*	Specifies to display information about the VLAN identified by the VLAN name.
	detailed	(Optional) Displays Include mode information about the specified VLAN.

The following example displays summary information for the default VLAN:

```
(SafeGuardOS) #show vlan name default

VLAN ID          : 1
VLAN Name        : Default
VLAN Type        : Default
Ports            : 50  (Number of active ports =  2)
IP Address       :

Interface       Tagging   Link State
--------------- -------   ----------
0/1             Untagged  Disable
0/2             Untagged  Down
0/3             Untagged  Disable
0/4             Untagged  Down
0/5             Untagged  Disable
0/6             Untagged  Disable
0/7             Untagged  Up
0/8             Untagged  Up
0/9             Untagged  Disable
0/10            Untagged  Disable
0/11            Untagged  Disable
0/12            Untagged  Disable
0/13            Untagged  Disable
0/14            Untagged  Disable
0/15            Untagged  Disable
0/16            Untagged  Disable
0/17            Untagged  Disable
0/18            Untagged  Disable
```

The next example includes additional fields when the `detailed` parameter is specified.

```
(SafeGuardOS) #show vlan name default detailed
```

```
VLAN ID          : 1
VLAN Name        : Default
VLAN Type        : Default
Ports            : 50  (Number of active ports =  2)
IP Address       :

Interface       Current   Configured   Tagging   Link State
--------------- -------   ----------   -------   ----------
0/1             Include   Include      Untagged  Disable
0/2             Include   Include      Untagged  Down
0/3             Include   Include      Untagged  Disable
0/4             Include   Include      Untagged  Down
0/5             Include   Include      Untagged  Disable
0/6             Include   Include      Untagged  Disable
0/7             Include   Include      Untagged  Up
0/8             Include   Include      Untagged  Up
0/9             Include   Include      Untagged  Disable
0/10            Include   Include      Untagged  Disable
0/11            Include   Include      Untagged  Disable
0/12            Include   Include      Untagged  Disable
0/13            Include   Include      Untagged  Disable
0/14            Include   Include      Untagged  Disable
0/15            Include   Include      Untagged  Disable
0/16            Include   Include      Untagged  Disable
0/17            Include   Include      Untagged  Disable
0/18            Include   Include      Untagged  Disable
```

The fields in the **show vlan name** output represent:

Display	Description
VLAN ID	Displays the VLAN identification number.
VLAN Name	Displays the name assigned to the VLAN.
VLAN Type	Displays the type of VLAN. Valid types are default, port or protocol.
Ports	Displays the total port count and the number of active ports.
IP Address	Displays the following information for the IP address: ■ Interface number in slot/port format ■ (detailed only) Displays the current VLAN participation. Valid values are include, exclude, or auto. ■ (detailed only) Displays the configuration of the VLAN participation. Valid values are include, exclude, or auto. ■ Displays whether the VLAN is tagged or untagged. ■ Displays the link state.

Showing a VLAN Port

Use this command to display information about an interface, all interfaces or a port-channel.

show vlan port [*slot/port* | **all** | **port-channel** *port-channel-name*

slot/port	Specifies to display information about the interface that is shown in slot/port format.
all	Specifies to display information about all of the interfaces.
port-channel-name	Specifies to display information about the named port-channel.

The following example is representative of the output of the **show vlan port** command:

```
(SafeGuardOS) #show vlan port 0/22

          Port    Acceptable   Ingress             Default
Interface VLAN ID Frame Types  Filtering    GVRP   Priority
--------- ------- ------------ ----------- ------- --------
0/22      1       Admit All    Enable      Disable     0
```

The fields in the **show vlan name** output represent:

Display	Description
Interface	Displays a valid slot and port number separated by forward slashes.
Port ID or VLAN ID	Displays the port-channel name or VLAN identification number that this port uses to assign untagged frames or priority tagged frames.
Acceptable Frame Types	Displays the types of frames that may be received on this port. The options are 'VLAN only' and 'Admit All'. ■ When set to 'VLAN only', untagged frames or priority tagged frames received on this port are discarded. ■ When set to 'Admit All', untagged frames or priority tagged frames received on this port are accepted and assigned the value of the Port VLAN ID for this port. With either option, VLAN tagged frames are forwarded in accordance to the 802.1Q VLAN specification.

Display	Description
Ingress Filtering	Displays whether filtering is enabled or disabled. When enabled, the frame is discarded if this port is not a member of the VLAN with which this frame is associated. In a tagged frame, the VLAN is identified by the VLAN ID in the tag. In an untagged frame, the VLAN is the Port VLAN ID specified for the port that received this frame. When disabled, all frames are forwarded in accordance with the 802.1Q VLAN bridge specification. The factory default is disabled.
GVRP	Displays whether GVRP may be enabled or disabled.
Default Priority	Displays the 802.1p priority assigned to tagged packets arriving on the port.

Displaying Forwarding Database Entries Information

To display the forwarding database entries, use the **show mac fdb-table** command in Privileged Exec mode. This command applies to the switch only. It is not available on the controller.

If the command is entered with no argument, the entire table is displayed. Or, the administrator can enter a MAC address to display the table entry for the requested MAC address and all entries following the requested MAC address.

show mac fdb-table [*macaddr* | **all**]

Syntax Description	*macaddr*	Displays the table entry for the specified MAC address. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	all	Displays all forwarding database entries.

Following is example output of the **show mac fdb-table** command:

```
(SafeGuardOS) # show mac fdb-table all

 VlanID     Mac Address      Interface  IfIndex     Status
--------  -----------------  ---------  -------  ------------
 0001     00:01:09:00:01:00   0/20       20       Learned
 1005     00:12:36:FF:DC:F2   0/1        1        Management
```

The fields in the output represent:

Field	Description
VLAN ID	Identifier for the VLAN.
MAC Address	A unicast MAC address for which the device has forwarding and or filtering information. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
Interface	Slot and port which this address was learned.
If Index	IfIndex of the interface table entry associated with this port.
Status	Status of this entry, which can be: ■ Learned – Value of the corresponding instance was learned by observing the source MAC addresses of incoming traffic and is currently in use. ■ Management – Value of the corresponding instance (system MAC address) is also the value of an existing instance of dot1dStaticAddress. It is identified with interface 0/1 and is currently used when enabling VLANs for routing.

Configuring Spanning Trees

The SafeGuard Switch supports the Spanning-Tree Protocol (STP) on all Ethernet, Fast Ethernet, Gigabit Ethernet, and port-based VLANs. STP eliminates undesirable Layer 2 loops in networks, by selectively blocking some ports and allowing other ports to forward traffic, based on configurable bridge and port parameters.

STP ensures that the most efficient path is taken when multiple paths exist between ports or VLANs. If the selected path fails, STP searches for and then establishes an alternate path to prevent or limit retransmission of data. STP is transparent to end stations, which cannot detect whether they are connected to a single LAN segment or a switched LAN of multiple segments.

By default, a single instance of STP runs on each configured VLAN (assuming that STP is not disabled). STP can be enabled on a global basis. STP is disabled by default. When STP is enabled on a switch, STP is still disabled on each port.

The following sections describe commands to support STP:

Enabling or Disabling STP Globally

STP is disabled by default. The only required configuration step is to enable the feature. To enable STP globally on the SafeGuard Switch, use the **spanning-tree** command in Global Configuration mode.

Use the **no** version of the command to disable STP.

`spanning-tree`

`no spanning-tree`

The commands have no parameters or variables.

The following example enables STP on the SafeGuard Switch:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree
(SafeGuardOS) (config) #exit
```

Forcing Transmission of Rapid Spanning Tree

To force a transmission of rapid spanning tree (RSTP) BPDUs, use the **spanning-tree bdpumigrationcheck** command in Global Configuration mode. Use the *`slot/port`* parameter to transmit a BPDU from a specified interface, or use the *`all`* keyword to transmit BPDUs from all interfaces.

This command forces the BPDU transmission, so the command does not change the system configuration or have a "no" version.

spanning-tree bdpumigrationcheck [*slot/port* | **all**]

Syntax Description	*slot/port*	Specifies to transmit a BDPU from the interface that is shown in slot/port format.
	all	Transmits BDPUs from all interfaces.

The following example forces a transmission of RSTP and MSTP BPDUs on all ports of the SafeGuard switch:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree bdpumigrationcheck all
(SafeGuardOS) (config) #exit
```

Setting the Configuration Identifier Name

To set the Configuration Identifier Name for identifying the configuration that a switch is currently using, use the **spanning-tree configuration name** command in Global Configuration mode. The default value is the base MAC address in hexadecimal notation.

spanning-tree configuration name *name*

Syntax Description	*name*	The configuration identifier name. It is string of up to 32 characters.

The following example sets "00-12-36-FE-76-FF" as the configuration identifier name that the switch is using:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree configuration name "00-12-36-FE-76-FF"
(SafeGuardOS) (config) #exit
```

Setting the Configuration Identifier Revision Level

To set the Configuration Identifier Revision Level for use in identifying the configuration that a switch is currently using, use the **spanning-tree configuration revision** command in Global Configuration mode. The default level is 0.

To set the Configuration Identifier Revision Level to the default, use the **no** version of the command.

spanning-tree configuration revision *revision-level*

no spanning-tree configuration revision

Syntax Description	*revision-level*	The configuration revision level. It is number in the range of 0 to 65535. The default value is 0.

The following example sets "32768" as the configuration revision for the SafeGuard switch:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree configuration revision 32768
(SafeGuardOS) (config) #exit
```

Specifying an Edge Port

To specify that a port is an *edge port* within the common and internal spanning tree, use the **spanning-tree edgeport** command in Interface Configuration mode. This allows the port to transition to *forwarding state* without delay.

To specify that a port is not an edge port within the common and internal spanning tree, use the **no** version of the command.

spanning-tree edgeport

no spanning-tree edgeport

The commands have no parameters or variables.

The following example specifies 0/25 as an edge port within the common and internal spanning tree:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/25
(SafeGuardOS) (interface 0/25) #spanning-tree edgeport
(SafeGuardOS) (interface 0/25) #exit
```

Setting the Force Protocol Version Parameter

To set the Force Protocol Version parameter to a new value, use the **spanning-tree forceversion** command in Global Configuration mode. The default version is 802.1w.

To set the Force Protocol Version parameter to the default value, use the **no** version of the command.

spanning-tree forceversion [802.1d | 802.1w]

no spanning-tree forceversion

Syntax Description	**802.1d**	Specifies that the switch transmits ST BPDUs rather than MST BPDUs (IEEE 802.1d functionality supported).
	802.1w	Specifies that the switch transmits RST BPDUs rather than MST BPDUs (IEEE 802.1w functionality supported).

The following example sets the force protocol version parameter to 802.1d:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree forceversion 802.1d
(SafeGuardOS) (config) #exit
```

Setting the Bridge Forward Delay Parameter

To set the Bridge Forward Delay parameter to a new value for the common and internal spanning tree, use the **spanning-tree forward-time** command in Global Configuration mode. The default value is 15.

To set the Bridge Forward Delay parameter to the default value, use the **no** version of the command.

spanning-tree forward-time *time*

no spanning-tree forward-time

Syntax Description	*time*	Time in seconds within a range of 4 to 30. The value must be greater than or equal to (Bridge Max Age / 2) + 1.

The following example sets the Bridge Forward Delay parameter to 10:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree forward-time 10
(SafeGuardOS) (config) #exit
```

Setting the Bridge Max Age Parameter

To set the Bridge Max Age parameter to a new value for the common and internal spanning tree, use the **spanning-tree forward-time** command in Global Configuration mode. The default value is 20.

To set the Bridge Max Age parameter to the default value, use the **no** version of the command.

spanning-tree max-age *time*

no spanning-tree max-age

Syntax Description	*time*	Time in seconds within a range of 6 to 40. The value must be less than or equal to - 1 (2 x Bridge Forward Delay).

The following example sets the Bridge Max Age parameter to 20:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree max-age 20
(SafeGuardOS) (config) #exit
```

Setting the Path Cost or Port Priority

To set the Path Cost or Port Priority for a port, use the **spanning-tree port** command in Interface Configuration mode.

To set the Path Cost or Port Priority for a port in the common and internal spanning tree to the respective default values, use the **no** version of the command.

spanning-tree port [**cost** [*1-200000000* | **auto**] | **priority** *0-240*]

no spanning-tree port [**cost** | **priority**]

Syntax Description	*port*	Spanning tree settings for a port.
	cost *1-200000000*	The path cost. Must be a number in the range of 1 to 200000000.
	auto	Selecting **auto** causes the path cost value to be based on link speed.
	priority *0-240*	The priority for this port. The priority value is a number in the range of 0 to 240 in increments of 16.

The following example sets the path cost and port priority:

```
(SafeGuardOS)#configure terminal
(SafeGuardOS) (config) #interface 0/25
(SafeGuardOS) (interface 0/25)#spanning-tree port cost 32768
(SafeGuardOS) (interface 0/25)#spanning-tree port priority 128
(SafeGuardOS) (interface 0/25)#exit
(SafeGuardOS) (config) #exit
```

Setting the Bridge Priority

To set the bridge priority, use the **spanning-tree priority** command in Global Configuration mode. The default priority is 32768.

To set the bridge priority, use the **no** version of the command.

spanning-tree priority *priority*

no spanning-tree priority

Syntax Description	*priority*	The priority. A number within a range of 0 to 61440 in increments of 4096. The twelve least significant bits are masked according to the 802.1s specification. This causes the priority to be rounded down to the next lower valid priority.

The following example sets the bridge priority to 0:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #spanning-tree priority 0
(SafeGuardOS) (config) #exit
```

Setting the Administrative Switch Port State for a Port

To set the Administrative Switch Port State for a port to be enabled, use the **spanning-tree port mode** command in Interface Configuration mode By default the port is disabled.

To set the Administrative Switch Port State for a port to be disabled, use the **no** version of the command.

spanning-tree port mode

no spanning-tree port mode

The commands have no parameters or variables.

The following example sets the Administrative Switch Port State for a port to be enabled:

```
(SafeGuardOS)#configure terminal
(SafeGuardOS) (config) #interface 0/25
(SafeGuardOS) (interface 0/25)#spanning-tree port mode
(SafeGuardOS) (interface 0/25)#exit
(SafeGuardOS) (config) #exit
```

Setting the Administrative Switch Port State for all Ports

To set the Administrative Switch Port State for all ports to be enabled, use the **spanning-tree port mode all** command in Global Configuration mode By default the ports are disabled. To set the Administrative Switch Port State for all ports to be disabled, use the **no** version of the command.

spanning-tree port mode all

no spanning-tree port mode all

The commands have no parameters or variables.

```
(SafeGuardOS)#configure terminal
(SafeGuardOS) (config) #spanning-tree port mode all
(SafeGuardOS) (config) #exit
```

Displaying STP Information

The following commands allow the display of STP information.

Displaying Spanning Tree Settings for the Bridge

To display STP information for the bridge, use the **show spanning-tree** command in the Privileged Exec or User Exec modes.

show spanning-tree

The command has no parameters or variables.

The following example displays spanning tree settings for the bridge:

```
(SafeGuardOS) #show spanning-tree
(SafeGuardOS) #

Spanning Tree.............................. Enabled
Spanning Tree Version...................... IEEE 802.1d

Bridge Info:
      Priority............................. 32768
      Identifier........................... 80:00:00:12:36:FE:76:69
      Max Age.............................. 20
      Hello Time........................... 2
      Forward Delay........................ 15
      Hold Time............................ 3
Root Bridge:
      Identifier........................... 80:00:00:12:36:FE:76:69
      Path Cost............................ 0
      Port Identifier...................... 00:00
      Max Age.............................. 20
      Forward Delay........................ 15
      Hello Time........................... 2
Time Since Topology Change................. 0 day 0 hr 0 min 3 sec
```

```
Topology Change Count..................... 1
Topology Change in progress.................. TRUE

Interface   STP Mode      STP State          Port Role    Cost
---------   --------   ----------------     ---------    ------
0/1         Enabled    Forwarding           Designated   20000
0/43        Enabled    Forwarding           Designated   20000
0/44        Enabled    Discarding           Backup       20000
```

The fields in the output represent:

Field	Description
Bridge Priority	Configured value.
Bridge Identifier	The bridge identifier for the selected MST instance. It is made up using the bridge priority and the base MAC address of the bridge.
Bridge Max Age	Configured value.
Bridge Hold Time	Minimum time between transmission of Configuration Bridge Protocol Data Units (BPDUs).
Bridge Forward Delay	Configured value.
Bridge Hello Time	Configured value.
Bridge Max Hops	Bridge max-hops count for the device.
Root Path Cost	Value of the Root Path Cost parameter for the common and internal spanning tree.
Root Port Identifier	Identifier of the port to access the Designated Root for the CST.
Time Since Topology Change	Time in seconds.
Topology Change Count	Number of times changed.
Topology Change In Progress	Boolean value of the Topology Change parameter for the switch indicating if a topology change is in progress on any port assigned to the common and internal spanning tree.
STP Mode	The STP Mode.
STP State	The STP State.
Port Role	The role of the port.
Cost	The port cost.

Displaying Settings for a Port

To display settings and parameters for a specific switch port, use the **show spanning-tree port** command in the Privileged Exec or User Exec mode.

show spanning-tree port [*slot/port* **detailed** | [*slot/port* | **all**] **summary** | *slot/port* **statistics**]

Syntax Description	*slot/port*	The desired switch port.
	detailed	Show detailed settings.
	all	Show settings for all *slot/port*s.
	summary	Show a summary of the settings.
	statistics	Show statistics.

The following example displays STP information:

```
(SafeGuardOS) #show spanning-tree port 0/1 summary
(SafeGuardOS) #

MST Instance ID.............................. CST

            STP                  STP            Port
Interface   Mode   Type         State          Role
--------- -------- ------- ---------------- ----------
0/1       Enabled          Forwarding        Designated

(SafeGuardOS) #show spanning-tree port 0/1 statistics

Hello Time................................... Not Configured
Port Mode.................................... Enabled
Port Up Time Since Counters Last Cleared..... 0 day 0 hr 7 min 9 sec
STP BPDUs Transmitted........................ 217
STP BPDUs Received........................... 0
RSTP BPDUs Transmitted....................... 0
RSTP BPDUs Received.......................... 0
```

The fields in the output represent:

Field	Description
Hello Time	Admin hello time for this port.
Port mode	Enabled or disabled.
Port Up Time Since Counters Last Cleared	Time since port was reset, displayed in days, hours, minutes, and seconds.
STP BPDUs Transmitted	Spanning Tree Protocol Bridge Protocol Data Units sent.

Field	Description
STP BPDUs Received	Spanning Tree Protocol Bridge Protocol Data Units received.
RST BPDUs Transmitted	Rapid Spanning Tree Protocol Bridge Protocol Data Units sent.
RST BPDUs Received	Rapid Spanning Tree Protocol Bridge Protocol Data Units received.

Displaying Spanning Tree Settings and Parameters for a Switch

To display STP settings and parameters for a switch, use the **show spanning-tree summary** command in the Privileged Exec or User Exec mode.

`show spanning-tree summary`

The command has no parameters or variables.

The following example displays STP settings and parameters for a switch:

```
(SafeGuardOS) #show spanning-tree summary
(SafeGuardOS) #

Spanning Tree..................... Enabled
Spanning Tree Version............. IEEE 802.1d
Configuration Name................ 00-12-36-FE-76-FF
Configuration Revision Level...... 2222
Configuration Digest Key.......... 0xac36177f50283cd4b83821d8ab26de62
Configuration Format Selector..... 0
```

The fields in the output represent:

Field	Description
Spanning Tree Adminmode	Enabled or disabled.
Spanning Tree Version	Spanning tree version of 802.1 currently supported (IEEE 802.1w, or 802.1d) based on the Force Protocol.
Configuration Name	Identifier used to identify the configuration currently being used.
Configuration Revision Level	Identifier used to identify the configuration currently being used.
Configuration Digest Key	Identifier used to identify the configuration currently being used.

Configuring IGMP Snooping

Internet Group Management Protocol (IGMP) is a multicast group membership discovery protocol. In subnets where IGMP is configured, a host that wants to be a multicast data receiver joins the group by sending a message to a multicast router on a local interface. There are three versions of IGMP: IGMPv1, IGMPv2, and IGMPv3. All three versions are supported by SafeGuard OS.

Even though multicast routing is more efficient than unicast routing, if the data receivers are sparsely distributed, it can still be a waste of network resources. A more intelligent method of forwarding multicast packets in a broadcast domain is called *IGMP Snooping.* IGMP Snooping is a multicast traffic pruning technique on a LAN or VLAN.

The IGMP Snooping configuration tells the SafeGuard Switch which switch ports are members of IGMP groups. By snooping IGMP registers information as it passes through the switch, SafeGuard can determine which hosts are to receive packets with a specific multicast address.

The following sections describe commands to configure IGMP Snooping:

- *Configuring Global IGMP Snooping*
- *Configuring IGMP Snooping on a VLAN*
- *Optional IGMP Snooping Configuration*
- *Displaying IGMP Snooping Information*

Configuring Global IGMP Snooping

IGMP Snooping is disabled by default. The only required configuration step is to enable the feature. All other global IGMP Snooping configuration is optional. To enable IGMP Snooping globally on the SafeGuard Switch, use the **Igmpsnooping** command in Global Configuration mode. Use the **no** version of the command to disable IGMP Snooping.

```
Igmpsnooping
```

```
no Igmpsnooping
```

The commands have no parameters or variables.

The following example enables IPMP Snooping on the SafeGuard Switch:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #Igmpsnooping
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Configuring IGMP Snooping on a VLAN

IGMP Snooping is disabled by default. The only required configuration step is to enable the feature on the VLAN. All other VLAN for l IGMP Snooping configuration is optional.

To enable IGMP Snooping on a VLAN, use the **igmpsnooping** command in VLAN Database mode. Use the **no** version of the command to disable IGMP snooping.

igmpsnooping vlan *vlanid*

no igmpsnooping vlan *vlanid*

Syntax Description	*vlanid*	Enables IGMP Snooping on a VLAN having this identification number. Valid assignment numbers are from 1 to 4094.

The following example enables IGMP Snooping on the VLAN with the ID of 2.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan) #igmpsnooping vlan 2
(SafeGuardOS) (Vlan) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Optional IGMP Snooping Configuration

For global IGMP Snooping configurations, the following configuration settings can be changed:

- *Setting the Group Membership Interval Time on page 166*
- *Setting the Maximum Response Time on page 167*
- *Setting the Multicast Router Expiration Time on page 168*
- *Clearing IGMP Snooping Entries Globally on page 171*

For VLAN IGMP Snooping configurations, the following configuration settings can be changed:

- *Setting the Group Membership Interval Time on page 166*
- *Setting the Maximum Response Time on page 167*
- *Setting the Multicast Router Expiration Time on page 168*
- *Enabling Fast-Leave Mode on page 170*

- *Creating a Static Connection to a Multicast Router on page 171*
- *Clearing IGMP Snooping Entries Globally on page 171*

Setting the Group Membership Interval Time

This optional configuration step is only valid for IGMPv3 environments and is available both globally and for VLANs. The group membership interval time is the amount of time in seconds that the switch waits for a report from a particular group on an interface before deleting the interface from the entry. The valid range is between 2 to 3600 seconds. The default setting is 260 seconds.

Global

To globally set the group membership interval time, in Global Configuration mode use the **igmpsnooping vlan group-membership-interval** command.

Use the **no** version of the command to return the setting to the default value.

igmpsnooping group-membership-interval *seconds*
no igmpsnooping group-membership-interval

Syntax Description	*seconds*	Sets the group membership interval time in seconds in IGMPv3 environments. Valid ranges are from 2 to 3600 seconds. The default is 260 seconds.

The following example sets all interfaces to have a group membership interval time of 360 seconds:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #igmpsnooping group-membership-interval 360
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Per VLAN

To set the group membership interval time by VLAN, in VLAN database mode use the **igmpsnooping groupmembership-interval** command. Use the **no** version of the command to return the setting to the default value.

igmpsnooping vlan *vlanid* **group-membership-interval** *seconds*

no igmpsnooping vlan *vlanid* **group-membership-interval**

Syntax Description	*vlanid*	Sets the group membership interval on a VLAN having this identification number in IGMPv3 environments. Valid assignment numbers are from 1 to 4094.
	seconds	Sets the group membership interval time in seconds. Valid ranges are from 2 to 3600 seconds. The default is 260 seconds.

The following example sets interfaces on VLAN 2 to have a group membership interval time of 360 seconds:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan) #igmpsnooping vlan 2 group-membership-interval 360
(SafeGuardOS) (Vlan) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Setting the Maximum Response Time

This optional configuration step is available both globally and for VLANs. The maximum response time is the amount of time in seconds that the switch waits after sending a query on an interface when it does not receive a report for a particular group in that interface. The valid range is between 1 to 3599 seconds and must be less than the IGMP query interval time value (which is equal to group membership-interval). The default setting is 10 seconds.

Global

To globally set the maximum response time, in Global Configuration mode use the **igmpsnooping maximum-response-time** command. Use the **no** version of the command to return the setting to the default value.

igmpsnooping maximum-response-time *seconds*
no igmpsnooping maximum-response-time

Syntax Description	*seconds*	Sets the maximum response time in seconds for queries sent after not receiving a report. Valid ranges are from 1 to 3599 seconds and must be less than the IGMP query interval time value. The default is 10 seconds.

The following example sets the maximum response time to 15 seconds:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #igmpsnooping maximum-response-time 15
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Per VLAN

To set the maximum response time by VLAN, in VLAN database mode use the **igmpsnooping vlan maximum-response-time** command. Use the **no** version of the command to return the setting to the default value.

igmpsnooping vlan *vlanid* **maximum-response-time** *seconds*
no igmpsnooping vlan *vlanid* **maximum-response-time**

Syntax Description	*vlanid*	Sets the maximum response time on a VLAN having this identification number. Valid assignment numbers are from 1 to 4094.
	seconds	Sets the maximum response time in seconds on a VLAN for queries sent after not receiving a report. Valid ranges are from 1 to 3599 seconds and must be less than the IGMP query interval time value. The default is 10 seconds.

The following example sets interfaces on VLAN 2 to have a maximum response time of 15 seconds:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan) #igmpsnooping vlan 2 maximum-response-time 15
(SafeGuardOS) (Vlan) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Setting the Multicast Router Expiration Time

This optional configuration step is available both globally and for VLANs. The multicast router expiration time is the amount of time in seconds that the switch waits for a query to be received on an interface before the interface is removed from the list of interfaces with multicast routers attached. The valid range is between 0 to 3600 seconds. A value of 0 indicates that the timer never expires, which is the default.

Global

To globally set the multicast router expiration time, use the **igmpsnooping mrouter-expire-time** command in Global Configuration mode. Use the **no** version of the command to return the setting to the default value.

igmpsnooping mrouter-expire-time *seconds*
no igmpsnooping mrouter-expire-time

Syntax Description	*seconds*	Sets the multicast router expiration time in seconds for queries for a query to be received on an interface before the interface is removed from the list of interfaces with multicast routers attached. Valid ranges are from 0 to 3600 seconds. The default is 0 seconds, which is an infinite timeout.

```
The following example sets the multicast router time to 2400 seconds:
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #igmpsnooping mrouter-expire-time 2400
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Per VLAN

To set the multicast router expiration time by VLAN, in VLAN database mode use the **igmpsnooping vlan mrouter-expire-time** command. Use the **no** version of the command to return the setting to the default value.

igmpsnooping vlan *vlanid* **mrouter-expire-time** *vlanid seconds*
no igmpsnooping vlan *vlanid* **mrouter-expire-time**

Syntax Description	*vlanid*	Sets the multicast router expiration time on a VLAN having this identification number. Valid assignment numbers are from 1 to 4094.
	seconds	Sets the multicast router expiration time in seconds for queries for a query to be received on an interface before the interface is removed from the list of interfaces with multicast routers attached. Valid ranges are from 0 to 3600 seconds. The default is 0 seconds, which is an infinite timeout.

The following example sets the multicast router time on VLAN 2 to 2400 seconds:

```
(SafeGuardOS) #configure terminal
```

```
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (Vlan) #igmpsnooping vlan 2 mrouter-expire-time 2400
(SafeGuardOS) (Vlan) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Enabling Fast-Leave Mode

Fast-leave is an optional feature of IGMP Snooping for VLANs and is only supported on IGMPv2 hosts. Use fast-leave processing only on VLANs where only one host is connected to each interface. Fast-leave mode is disabled by default. If fast-leave is enabled on VLANs where more than one host is connected to an interface, some hosts can be dropped when connected to the same Layer 2 port receiving multicast traffic directed to the group.

This feature allows the switch to remove the Layer 2 LAN interface from the forwarding-table entry without first sending out MAC-based queries to the interface. To enable fast-leave mode, use the **igmpsnooping vlan fast-leave** command in Vlan Configuration mode. Use the **no** version of the command to disable the feature.

`igmpsnooping vlan` *`vlanid`* **`fast-leave`**
`no igmpsnooping vlan` *`vlanid`* **`fast-leave`**

Syntax Description	*`vlanid`*	Enables fast-leave mode on a VLAN having this identification number. Valid assignment numbers are from 1 to 4094.

The following example enables fast-leave mode on the VLAN:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (interface interface 0/3) #igmpsnooping vlan 2 fast-leave
(SafeGuardOS) (interface interface 0/3) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping** command. This command is described further in *Showing the IGMP Snooping Configuration on page 172*.

Enabling Fast-Leave Mode On An Interface

to enable fast-leave mode on an interface, use the **`igmpsnooping fast-leave`** command in Interface Configuration mode. To disable fast-leave mode on an interface, use the **no** form of the command.

```
igmpsnooping fast-leave
no igmpsnooping fast-leave
```

The following example enables fast-leave mode on an interface:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #vlan database
(SafeGuardOS) (interface interface 0/3) #igmpsnooping fast-leave
(SafeGuardOS) (interface interface 0/3) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Creating a Static Connection to a Multicast Router

To enable a static connection to a multicast router, use the **igmpsnooping mrouter** command in Interface Configuration mode. Use the **no** version of the command to disable the interface.

```
igmpsnooping mrouter vlan vlanid
no igmpsnooping mrouter vlan vlanid
```

Syntax Description	*vlanid*	Enables a static connection to a multicast router on a VLAN having this identification number. Valid assignment numbers are from 2 to 3965. ID 1 is reserved for the default VLAN.

The following example enables static connection to a multicast router on the VLAN running over interface 0/5, which has a VLAN ID of 85:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/5
(SafeGuardOS) (interface interface 0/5) #igmpsnooping mrouter vlan 85
(SafeGuardOS) (interface interface 0/5) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, use the Privileged Exec **show igmpsnooping mrouter** command. This command is described further in *Displaying Static Configurations to a Multicast Router on page 174*.

Clearing IGMP Snooping Entries Globally

To clear the MAC multicast tables managed by IGMP Snooping and to delete these entries from the multicast Forwarding Database, use the **clear igmpsnooping** command in Privileged Exec mode. The command has no parameters or variables.

The following example clears IGMP Snooping entries globally:

```
(SafeGuardOS) #clear igmpsnooping
(SafeGuardOS) #
```

To verify that the tables have been cleared, use the Privileged Exec **show mac multicast-table igmpsnooping** command. This command is described further in *Showing IGMP Snooping Entries on page 175*.

Displaying IGMP Snooping Information

There are Privileged Exec **show** commands to display IGMP Snooping configurations and related table information

Command	Use
show igmpsnooping	Displays the IGMP Snooping configuration.
show igmpsnooping mrouter	Displays information about the statically configured multicast router interface.
show mac multicast-table igmpsnooping	Displays the MAC multicast tables managed by IGMP Snooping.

Showing the IGMP Snooping Configuration

To display or verify the IGMP Snooping configuration, use the **show igmpsnooping** command in Privileged Exec mode. The command has the following syntax

show igmpsnooping vlan [*vlanid*]

Syntax Description	*vlanid*	(Optional) Displays the IGMP Snooping information on the VLAN having this identification number. Valid numbers are from 1 to 4094.

The following sample output is representative of the command without specifying a VLAN ID.

```
(SafeGuardOS) #show igmpsnooping

Global IGMP Snooping Admin Mode.............. Enabled
Multicast Control Frame Count................ 0
Group Membership Interval.................... 360
Maximum Response Time........................ 15
Multicast Router Expiry Time................. 2400

(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
Global IGMP Snooping Admin Mode	Displays whether IGMP Snooping is globally enabled on the switch.
Multicast Control Frame Count	Displays the number of multicast control frames that are processed by the CPU.
Group Membership Interval	Displays the amount of time in seconds that a switch waits for a report from a particular group on a specific interface that is participating in a VLAN before deleting the interface from the entry. This value must be greater than the IGMP V3 Maximum Response Time value. The range is 2 to 3600 seconds.
Maximum Response Time	Displays the amount of time in seconds the switch waits after it sends a query on an interface, participating in the VLAN, because it did not receive a report for a particular group on that interface. This value must be less than the IGMP Query Interval time value. The range is 1 to 3599 seconds.
Multicast Router Expiry Time	Displays the amount of time in seconds that a switch waits for a query to be received on an interface before the interface is removed from the interfaces with multicast routers attached. the range is 0 to 3600 seconds. A value of '0' indicates an infinite time- out, meaning no expiration.

The following is sample output is representative of the command when specifying a VLAN id.

```
(SafeGuardOS) #show igmpsnooping vlan 1

Vlan ID..................................... 1
IGMP Snooping Admin Mode.................... Disabled
Fast Leave Mode............................. Disabled
Group Membership Interval................... 260
Maximum Response Time....................... 10
Multicast Router Expiry Time................ 0

(SafeGuardOS) #
```

The fields in the output for the VLAN represent:

Field	Description
VLAN ID	Displays the number of the VLAN having this identification number.

Field	Description
IGMP Snooping Admin Mode	Displays whether IGMP Snooping is active on the VLAN.
Fast Leave Mode	Displays whether fast leave mode is enabled or disabled on the VLAN.
Group Membership Interval	Displays the amount of time in seconds that a switch waits for a report from a particular group on a specific interface that is participating in a VLAN before deleting the interface from the entry. This value must be greater than the IGMP V3 Maximum Response time value. The range is 2 to 3600 seconds.
Maximum Response Time	Displays the amount of time the switch waits after it sends a query on an interface, participating in the VLAN, because it did not receive a report for a particular group on that interface. This value must be less than the IGMP Query Interval time value. the range is 1 to 3599 seconds.
Multicast Router Expiry Time	Displays the amount of time in seconds that a switch waits for a query to be received on an interface before the interface is removed from the interfaces with multicast routers attached. The range is 0 to 3600 seconds. A value of '0' indicates an infinite time-out, meaning no expiration.

Displaying Static Configurations to a Multicast Router

To display information about statically configured multicast routers, use the **show igmpsnooping mrouter** command.

show igmpsnooping mrouter [**vlan** *vlanid*]

The following sample output is representative of the command without specifying a VLAN ID.

```
(SafeGuardOS) #show igmpsnooping mrouter

VlanID     Interface
--------   ---------------
2          0/1,0/2
1111       0/1
```

The next sample is representative of the command when specifying a VLAN ID.

```
(SafeGuardOS) #show igmpsnooping mrouter vlan 2
VlanID     Interface
--------   ---------------
2          0/1,0/2
```

The fields in the output represent:

Field	Description
VLAN ID	Displays the number of the VLAN having this identification number.
Interface	Displays the interface number running the static connection.

Showing IGMP Snooping Entries

To display information about the IGMP Snooping entries in the multicasting Forwarding Database, use the **show mac multicast-table igmpsnooping** command.

```
show mac multicast-table igmpsnooping
```

The command has no parameters or variables.

The following example is representative of the command output:

```
MAC AddressTypeDescriptionInterfaces
-------------------------------------------------------
00:14:01:00:5E:01:02:02DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:03DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:04DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:05DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:06DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:07DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:08DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:09DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:0ADynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:0BDynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:0CDynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:0DDynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:0EDynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:0FDynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:10DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:11DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:12DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:13DynamicNetwork AssistFwd: 0/23,0/25
00:14:01:00:5E:01:02:14DynamicNetwork AssistFwd: 0/23,0/25
```

The fields in the output represent:

Field	Description
MAC Address	Physical address of the multicast devices.
Type	Indicates whether dynamic (learned through IGMP protocol) or static (administratively configured).

Field	Description
Description	Possible values are: “Mgmt Config” (management configured entries) and “Network Assist” (network assisted entries).
Interfaces	Interfaces on which this multicast address was learned or the mrouter ports for this particular VLAN.

Configuring Port Security

This section describes the commands used to configure port security on the switch. Port security, which is also known as port MAC locking, allows the network to be secured by locking certain MAC addresses on a given port. Packets with a matching source MAC address are forwarded normally, and all other packets are discarded. Port security also limits the number of MAC addresses that can be learned on a port. Once the maximum number has been reached, new MAC addresses will not be learned and packets with new MAC addresses will be discarded. The Port security feature must be enabled both globally and at the interface level.

See the following sections for more details:

- *Enabling Port Locking*
- *Setting the Maximum Number of Dynamically Locked MAC Addresses*
- *Setting the Maximum Number of Statically Locked MAC Addresses*
- *Adding a MAC Address to the Statically Locked List*
- *Converting Dynamically Locked Address To Statically Locked Addresses*
- *Displaying the Port Security Settings*
- *Displaying the Dynamically Locked MAC Addresses for a Port*
- *Displaying the Statically Locked MAC Addresses for a Port*

Enabling Port Locking

To enable port locking, use the **port-security** command. The command may be used in the Global Configuration mode for system level port locking and in the Interface Configuration mode for port level locking (for enabling on a specific interface/port). Use the **no** version of the command to disable port locking in the appropriate configuration mode.

```
port-security

no port-security
```

The commands have no parameters or variables.

The following example enables port security at the system level on the SafeGuard Switch:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #port-security
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

NOTE: The global configuration setting overrides all interface configuration, thus to enable port-security functionality, the global configuration port-security must be enabled. By default, port-security is disabled

Setting the Maximum Number of Dynamically Locked MAC Addresses

To set the maximum number of dynamically locked MAC addresses allowed on a specific port, use the **port-security max-dynamic** command in Interface Configuration mode. To reset the maximum number of dynamically locked MAC addresses allowed on a specific port to its default value, use the **no** version of the command.

port-security max-dynamic *maxvalue*

no port-security max-dynamic

Syntax Description	*maxvalue*	The maximum number of dynamically locked MAC addresses allowed on a specific port. The default value is 600.

The following example sets the maximum number of dynamically locked addresses to 20:

```
SafeGuardOS) (Interface 0/1)#show port-security 0/1

         Admin    Dynamic     Static    Violation
 Intf    Mode      Limit      Limit     Trap Mode
------  -------  ----------  ---------  ----------
0/1     Disabled 600         20         Disabled

(SafeGuardOS) (interface 0/1)#
(SafeGuardOS) (interface 0/1)#port-security max-dynamic 20
(SafeGuardOS) #show port-security 0/1

         Admin    Dynamic     Static    Violation
 Intf    Mode      Limit      Limit     Trap Mode
------  -------  ----------  ---------  ----------
0/1     Disabled 20          20         Disabled
```

The following example restores the maximum number of dynamically locked MAC addresses to the default (600):

```
(SafeGuardOS) (interface 0/1)#no port-security max-dynamic
(SafeGuardOS) (interface 0/1)#show port-security 0/1

         Admin    Dynamic     Static    Violation
 Intf    Mode      Limit      Limit     Trap Mode
------  -------  ----------  ---------  ----------
0/1     Disabled 600         20         Disabled

(SafeGuardOS) (interface 0/1)#
```

Setting the Maximum Number of Statically Locked MAC Addresses

To set the maximum number of statically locked MAC addresses allowed on a specific port, use the **port-security max-static** command in Interface Configuration mode. To reset the maximum number of statically locked MAC addresses allowed on a specific port to its default value, use the **no** version of the command.

port-security max-static *maxvalue*

no port-security max-static

Syntax Description	*maxvalue*	The maximum number of statically locked MAC addresses allowed on a specific port. The default value is 20.

The following example sets the maximum number of statically locked addresses to 10:

```
(SafeGuardOS) #show port-security 0/1

         Admin    Dynamic     Static    Violation
 Intf    Mode      Limit      Limit     Trap Mode
------  -------  ----------  ---------  ----------
0/1     Disabled 600         20         Disabled

(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/1
(SafeGuardOS) (interface 0/1)#
(SafeGuardOS) (interface 0/1)#port-security max-static 10
(SafeGuardOS) (interface 0/1)#show port-security 0/1

         Admin    Dynamic     Static    Violation
 Intf    Mode      Limit      Limit     Trap Mode
------  -------  ----------  ---------  ----------
0/1     Disabled 600         10         Disabled
```

The following example restores the maximum number of statically locked MAC addresses to the default (20):

```
(SafeGuardOS) (interface 0/1)#no port-security max-static
(SafeGuardOS) (interface 0/1)#show port-security 0/1

         Admin    Dynamic     Static    Violation
 Intf    Mode      Limit      Limit     Trap Mode
------  -------  ----------  ---------  ----------
0/1     Disabled 600         20         Disabled

(SafeGuardOS) (interface 0/1)#
```

Adding a MAC Address to the Statically Locked List

To add a MAC address to the list of statically locked MAC address, use the **port-security mac-address** command in Interface Configuration mode. To remove a MAC address from the list, use the **no** version of the command.

port-security mac-address *mac-address vid*

no port-security mac-address *mac-address vid*

Syntax Description	*mac-address*	The address to add or remove.
	vid	The VLAN ID.

The following example adds MAC address 01:02:03:04:05:06 to the list with the VLAN ID of 1:

```
(SafeGuardOS) #show port-security static 0/1

There are no dynamically learned MAC addresses.

(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/1
(SafeGuardOS) (interface 0/1)#port-security mac-address 01:02:03:04:05:06 1
(SafeGuardOS) (interface 0/1)#exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #show port-security static 0/1

 Number of static MAC addresses configured: 1

 Statically configured MAC Address              VLAN ID
 ---------------------------------              -------
 01:02:03:04:05:06                                    1

(SafeGuardOS) #
```

Converting Dynamically Locked Address To Statically Locked Addresses

To convert dynamically locked MAC addresses to statically locked addresses, use the **port-security mac-address move** command in Interface Configuration mode.

port-security mac-address move

This command has no parameters.

The following examples shows this command:

```
(SafeGuardOS) (interface 0/4)#show port-security static 0/4

There are no dynamically learned MAC addresses.

(SafeGuardOS) (interface 0/4)#port-security mac-address move

(SafeGuardOS) (interface 0/4)#show port-security static 0/4

 Number of static MAC addresses configured: 1

 Statically configured MAC Address              VLAN ID
 ---------------------------------              -------
 00:00:00:22:22:22                                    1
```

Displaying the Port Security Settings

To display the port security settings, use the **show port-security** command in Privileged Exec mode.

show port-security [*slot/port* | **all**]

Syntax Description	*slot/port*	Slot and port number to display.
	all	Display the settings on all interfaces

The fields in the output represent:

Field	Description
Admin Mode	Port Locking mode for the entire system. This field displays if you do not supply any parameters.
Admin Mode	Port Locking mode for the Interface.
Dynamic Limit	Maximum dynamically allocated MAC Addresses.
Static Limit	Maximum statically allocated MAC Addresses.

Field	Description
Violation Trap Mode	Whether violation traps are enabled.

The following example shows the **show port-security** command using the **all** keyword:

```
(SafeGuardOS) (interface 0/8)#show port-security all

         Admin    Dynamic    Static      Violation
 Intf    Mode     Limit      Limit       Trap Mode
------  -------  ---------- ---------   ----------
0/1     Enabled   124         10         Disabled
0/2     Disabled  600         20         Disabled
0/3     Disabled  600         20         Disabled
0/4     Enabled   600         20         Disabled
0/5     Disabled  600         20         Disabled
0/6     Disabled  600         20         Disabled
0/7     Disabled  600         20         Disabled
0/8     Enabled   600         20         Disabled
0/9     Disabled  600         20         Disabled
0/10    Disabled  600         20         Disabled
0/11    Disabled  600         20         Disabled
0/12    Disabled  600         20         Disabled
0/13    Disabled  600         20         Disabled
0/14    Disabled  600         20         Disabled
0/15    Disabled  600         20         Disabled
0/16    Disabled  600         20         Disabled
0/17    Disabled  600         20         Disabled
0/18    Disabled  600         20         Disabled
0/19    Disabled  600         20         Disabled
--More-- or (q)uit


0/20    Disabled  600         20         Disabled
0/21    Disabled  600         20         Disabled
0/22    Disabled  600         20         Disabled
0/23    Disabled  600         20         Disabled
0/24    Disabled  600         20         Disabled
0/25    Disabled  600         20         Disabled
0/26    Disabled  600         20         Disabled
0/27    Disabled  600         20         Disabled
0/28    Disabled  600         20         Disabled
0/29    Disabled  600         20         Disabled
0/30    Disabled  600         20         Disabled
0/31    Disabled  600         20         Disabled
0/32    Disabled  600         20         Disabled
0/33    Disabled  600         20         Disabled
0/34    Disabled  600         20         Disabled
0/35    Disabled  600         20         Disabled
0/36    Disabled  600         20         Disabled
0/37    Disabled  600         20         Disabled
0/38    Disabled  600         20         Disabled
--More-- or (q)uit
```

```
0/39    Disabled  600         20         Disabled
0/40    Disabled  600         20         Disabled
0/41    Disabled  600         20         Disabled
0/42    Disabled  600         20         Disabled
0/43    Disabled  600         20         Disabled
0/44    Disabled  600         20         Disabled
0/45    Disabled  600         20         Disabled
0/46    Disabled  600         20         Disabled
0/47    Disabled  600         20         Disabled
0/48    Disabled  600         20         Disabled
0/49    Disabled  600         20         Disabled
0/50    Disabled  600         20         Disabled

(SafeGuardOS) (interface 0/8)#
```

Displaying the Dynamically Locked MAC Addresses for a Port

To display the dynamically locked MAC addresses for a port, use the **show port-security dynamic** command in Privileged Exec mode.

show port-security dynamic *slot/port*

Syntax Description	*slot/port*	Slot and port number.

The fields in the output represent:

Field	Description
MAC Address	Dynamically locked MAC address.

The following example shows the output of the **show port-security dynamic** command:

```
(SafeGuardOS))#show port-security dynamic 0/8
 00:0B:0C:0D:0E:0F                                1

(SafeGuardOS)#
```

Displaying the Statically Locked MAC Addresses for a Port

To display the statically locked MAC addresses for a port, use the **show port-security static** command in Privileged Exec mode.

show port-security static *slot/port*

Syntax Description	*slot/port*	Slot and port number.

The fields in the output represent:

Field	Description
MAC Address	Statically locked MAC addresses.

The following example shows the output of the **show port-security static** command:

```
(SafeGuardOS) (interface 0/4)#show port-security static 0/4

 Number of static MAC addresses configured: 1

 Statically configured MAC Address         VLAN ID
 ---------------------------------         -------
 00:00:00:22:22:22                            1
```

Displaying the Source MAC Address of the Last Packet Discarded on a Locked Port

To display the source MAC address of the last packet discarded on a locked port, use the **show port-security violation** command in Privileged Exec mode.

show port-security violation *slot/port*

Syntax Description	*slot/port*	Slot and port number.

The fields in the output represent:

Field	Description
MAC Address	MAC address of the last discarded packet on a locked port.

The following example shows the output of the **show port-security violation** command:

```
(SafeGuardOS) (interface 0/4)#show port-security violation 0/4


 Last Violation MAC Address      VLAN ID
 --------------------------      -------
 00:00:00:22:22:28                     1
```

Configuring Routing

SafeGuard OS supports both IP unicast and IP multicast routing on the SafeGuard Switch. In IP unicast routing, data packets are sent from a single source device to a single recipient. In IP multicast routing, a single copy of data is sent to a group of recipients using a single address for the group.

Networks that employ IP unicast communication send datagrams from a source device to a single destination device. SafeGuard Switches use Address Resolution Protocol (ARP) to resolve the link layer address.

Multicasting allows a device on a LAN or VLAN to send packets, not to just one recipient, but to a group or collection of other devices. Multicasting is considered a more efficient method of routing because it conserves bandwidth and reduces traffic by being able to deliver simultaneously a single stream of information to multiple devices.

In a multicast environment, instead of using an individual IP address, the source device uses an address that identifies the members of the group. When the source device sends the group IP address, routers on the LAN or VLAN forward the packets to all the members of the multicast group. If necessary, the routers forward duplicate data packets wherever the path to recipients diverge.

See the following sections for more details:

- *Configuring IP Unicast Routing*
- *Configuring Static Routing*
- *Displaying Routing Information*
- *Configuring Bootstrap or DHCP Relay*
- *IP Multicast Routing*

Configuring IP Unicast Routing

This section describes how to configure IP unicast routing. See the following sections for more details:

- *Configuring Address Resolution Protocol*
- *Displaying ARP Information*
- *Optional Routing Configurations*
- *Setting an Administrative Distance or Preference*

Configuring Address Resolution Protocol

A network device uses Address Resolution Protocol (ARP) to locate other devices by associating MAC addresses with IP Addresses. ARP is a very simple protocol that

broadcasts IP addresses and gets the MAC address as a response from the device owning that IP.

Layer 3 devices can respond to an ARP request for the host for which it has a route. This type of ARP response is called *Proxy ARP*. Even though a host is on another LAN segment or network, the hosts behaves as if all other hosts are actually on the network. If a host does not know the default gateway, proxy ARP can learn the first hop.

The SafeGuard Switch has an ARP cache to store IP addresses and MAC addresses so that it does not need to broadcast to locate local devices. ARP entries are created either statically or dynamically and stored in the cache. Static entries are added manually to the cache table for a device and kept in the cache permanently. Dynamic entries are added to the cache by the system as the result of previous ARP requests being successfully completed. Dynamic entries are aged-out periodically to limit the size of the cache.

ARP and proxy ARP are enabled by default. The following sections describe the configuration options for ARP:

- *Creating a Static ARP entry*
- *Setting the ARP Cache Size*
- *Enabling or Disabling Proxy ARP*
- *Controlling ARP Renewals*
- *Setting the ARP Response Time*
- *Setting the Retry Limit*
- *Changing the ARP Timer*
- *Clearing the ARP Cache*

Creating a Static ARP entry

To create a static ARP entry, use the **arp** command in Global Configuration mode. Use the **no** version of the command to discard the entry.

arp *ipaddr macaddr*

no arp *ipaddr macaddr*

Syntax Description	*ipaddr*	Specifies the IP address of a device on a subnet attached to an existing routing interface.

	macaddr	Specifies a unicast MAC address for that device. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff

The following example creates an entry with an IP address of 10.12.14.1 and a MAC address of 34:78:A8:23:56:9B:

```
(SafeGuardOS) #configure terminal
Enter configuration commands, one per line. End with CNTL/Z
(SafeGuardOS) (config) #arp 10.12.14.1 34:78:a8:23:56:9b
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Setting the ARP Cache Size

The **arp cachesize** command configures the ARP cache size. The default cache size is 3968, the maximum cache size.

This Global Configuration command has the following syntax:

arp cachesize *size*

Syntax Description	*size*	Specifies the ARP cache size number of entries. Valid entries are 384 to 3968.

The following example sets the size of the cache to 500 entries:

```
(SafeGuardOS) #configure terminal
Enter configuration commands, one per line. End with CNTL/Z
(SafeGuardOS) (config) #arp cachesize 500
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Enabling or Disabling Proxy ARP

Proxy ARP is enabled by default on a router interface. To disable Proxy ARP use the **no** version of the **ip proxy-arp** command. Without proxy ARP, a device only responds to an ARP request if the target IP address is an address configured on the interface where the ARP request arrived.

With proxy ARP, the device may also respond if the target IP address is reachable. The device only responds if all next hops in its route to the destination are through interfaces other than the interface that received the ARP request. The syntax of the Interface Configuration mode commands are:

ip proxy-arp

no ip proxy-arp

The commands have no parameters or variables.

This example enables Proxy ARP on interface 0/48, which is an uplink to a router:

```
(SafeGuardOS) #configure terminal
Enter configuration commands, one per line. End with CNTL/Z
(SafeGuardOS) (config) #interface 0/48
(SafeGuardOS) (interface 0/48) #ip proxy-arp
(SafeGuardOS) (interface 0/48) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Controlling ARP Renewals

To choose whether ARP automatically renews entries when they time out or not (by default, entries are renewed dynamically), use the **arp dynamicrenew** command in Privileged Exec mode to renew entries. Use the **no** version of the command to allow the entry to age out.

arp dynamicrenew

no dynamicrenew

These commands have no parameters or variables.

The following example forces ARP entries to age out of the table:

```
(SafeGuardOS) #no dynamicrenew
(SafeGuardOS) #
```

Setting the ARP Response Time

To set the ARP request response time out, use the **arp resptime** command in Global Configuration mode. Use the **no** version of the command to reset the response time to the default value of 1 second.

arp resptime *seconds*

no arp resptime

Syntax Description	*seconds*	Specifies the amount of time in seconds. Valid entries are from 1 to 10 seconds. The default is 1 second.

Setting the Retry Limit

By default, the system retries an ARP request up to 4 times. Use the **arp retries** command to change the maximum retry limit. Use the **no** version of the command to reinstate the default retry limit to 4 tries. The syntax of the Global Configuration commands are:

arp retries *attempts*

no arp retries

Syntax Description	*attempts*	Specifies the maximum number of request for retries. Valid values are 0 to 10 retries.

The following example sets the retry limit to 8 retries.

```
(SafeGuardOS) #configure terminal
Enter configuration commands, one per line. End with CNTL/Z
(SafeGuardOS) (config) #arp retries 8
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Changing the ARP Timer

An ARP entry ages out of the ARP cache after 20 minutes. To change the ARP entry age timeout, use the **arp timeou**t Global Configuration command. Use the **no** version of the command to reinstate the default value of 1200 seconds.

arp timeout *seconds*

no arp timeout

Syntax Description	*seconds*	Specifies the amount of time in seconds before an ARP entry ages out. Valid entries are 15 to 21600 seconds. The default value is 1200 seconds.

The following example sets the age out time to 5 minutes.

```
(SafeGuardOS) #configure terminal
Enter configuration commands, one per line. End with CNTL/Z
(SafeGuardOS) (config) #arp timeout 60
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Clearing the ARP Cache

To clear the ARP cache of dynamic (and gateway) entries, use the **clear arp-cache** command in Privileged Exec mode. If the gateway parameter is specified, dynamic entries of type gateway are also removed. This command does not clear static entries.

clear arp-cache {**gateway**}

Syntax Description	**gateway**	(Optional) Clears all dynamic entries, including gateway entries from the ARP cache. A gateway ARP entry is the ARP entry ARPed by the switch for the IP address that is used as nexthop in static and dynamic routes.

Displaying ARP Information

There are two Privileged Exec **show** commands to display the ARP cache and ARP table configurations:

Command	Use
show arp	Displays the ARP cache. The displayed results are not the total ARP entries.
show arp switch	Displays the contents of the ARP table for the service port (management port).

To display all ARP entries, enter both the **show arp** and the **show arp switch** commands.

Showing the ARP Cache

To display the contents of the ARP cache, in Privileged Exec mode use the **show arp** command. To only see the ARP configuration, use the optional parameter **brief**.

show arp {**brief**}

Syntax Description	**brief**	(Optional) Clears all dynamic entries, including gateway entries from the ARP cache.

The following example is representative of the command output:

```
(SafeGuardOS) #show arp

Age Time (seconds)............................ 1200
Response Time (seconds)....................... 1
Retries....................................... 4
Cache Size.................................... 3968
Dynamic Renew Mode ........................... Enable
Total Entry Count Current / Peak ............. 6 / 6
Static Entry Count Configured / Active / Max .. 0 / 0 / 128

  IP Address        MAC Address      Interface        Type        Age
---------------  -----------------  -------------  --------  -----------
10.10.1.1        00:12:36:FE:76:06  vlan700        Local         n/a
10.10.1.10       00:15:C5:5F:FA:95  vlan700        Dynamic    0h  2m 49s
```

```
10.10.2.1        00:12:36:FE:76:06  vlan701         Local          n/a
10.10.2.200      00:16:76:4B:65:BB  vlan701         Dynamic    0h  2m 52s
10.20.3.1        00:12:36:FE:76:06  vlan702         Local          n/a
66.66.66.1       00:12:36:FE:76:06  vlan300         Local          n/a
```

The fields in the output represent:

Field	Description
Age Time (seconds)	Displays the time it takes for an ARP entry to age out. This value was configured into the unit. Age time is measured in seconds.
Response Time (seconds)	Displays the time it takes for an ARP request to timeout. Response time is measured in seconds.
Retries	Displays the maximum number of times an ARP request is retried.
Cache Size	Displays the maximum number of entries in the ARP table.
Dynamic Renew Mode	Displays whether the ARP component automatically attempts to renew dynamic ARP entries when they age out.
Total Entry Count Current / Peak	Displays the total number of entries in the ARP table and the peak entry count in the ARP table.
Static Entry Count Current / Max	Displays the static entry count in the ARP table and maximum static entry count in the ARP table.
When the brief keyword is not used, the following fields are displayed for each ARP entry:	
IP Address	Displays the IP address of a device on a subnet attached to an existing routing interface.
MAC Address	Displays the hardware MAC address of that device.
Interface	Displays the routing slot/port associated with the device ARP entry.
Type	Displays the type that was configured into the unit. The possible values are Local, Gateway, Dynamic and Static.
Age	Displays the current age of the ARP entry since last refresh (in hh:mm:ss format).

Showing the ARP Table

To display the contents of the ARP table for the service port (management port), use the **show arp switch** command.

```
show arp switch
```

The command has no parameters or variables.

The following example is representative of the command output:

```
(SafeGuardOS) #show arp switch

    MAC Address        IP Address     Interface
------------------- --------------- ------------
00:15:C5:03:63:36   172.16.3.35      Management
00:0D:56:38:BB:63   172.16.3.134     Management
```

The fields in the output represent:

Field	Description
MAC Address	Displays the hardware MAC address of the device.
IP Address	Displays the IP address of a device on a subnet attached to the switch.
Interface	Displays the routing slot/port associated with the device's ARP entry.

Configuring Static Routing

SafeGuard OS supports simple, static routing. A static route entry consists of the destination IP network address and the IP address of the next hop router.

1. Verify that routing is enabled on the VLANs using the interface. Use the **show vlan id** command to display the link state of the interface. If the VLAN is enabled, it shows as being in either the up or down link state. See *Showing VLAN ID on page 147*. An ip address must be configured on the VLANs

2. Enable routing on the switch using the **ip routing** command in Global Configuration mode. Use the **no** version of the command to disable routing (default).

   ```
   ip routing
   no ip routing
   ```

   The commands have no parameters or variables. The following example enables routing on the switch:

   ```
   (SafeGuardOS) #configure terminal
   (SafeGuardOS) (config) #ip routing
   (SafeGuardOS) (config) #
   ```

3. Create the static route to the destination router using the **ip route** command in Global Configuration mode. Use the **no** version of the command to delete the next hop to the destination router.

```
ip route net_addr netmask next_hop {distance}
no ip route net_addr netmask {next_hop}
```

Syntax Description	*net_addr*	A valid IP address entered in dotted quad format. For example 172.23.45.1.
	netmask	A subnet mask entered in dotted quad format. For example: 255.255.255.0.
	next_hop	Specifies the IP address of the next hop router. If *next_hop* is specified in the **no** form, the route with that next hop will be deleted. If *next_hop* is not specified, all the static routes to the specific network address are deleted.
	distance	Specifies the administrative distance of this individual static route. Among routes to the same destination, the route with the lowest metric value is the route entered into the forwarding database. A route with a metric of 255 cannot be used to forward traffic. The default is 1.

Optional Routing Configurations

See the following sections for additional optional routing configurations:

- *Setting an Administrative Distance or Preference*
- *Creating a Default Route*

Setting an Administrative Distance or Preference

A default administrative distance, or metric, for all new routes can be defined. When determining the best route, use a lower value for distance. The **ip route** and **ip route default** commands allows the distance (metric) of an individual static route to be set.

The default distance is used when no distance is specified in these commands. Changing the default distance does not update the distance of existing static routes, even if they were assigned the original default distance. The default distance is only applied to static routes created after invoking the **ip route distance** command.

Use the **ip route distance** command in Global Configuration mode to use the same distance or hop value for all new routes. Use the **no** version of the command to return the administrative distance to the default value of 1.

```
ip route distance distance
```

no ip route distance

Syntax Description	*distance*	Specifies the administrative distance of all new static routes. Among routes to the same destination, the route with the lowest metric value is the route entered into the forwarding database. A route with a metric of 255 cannot be used to forward traffic. The default is 1.

This example sets the administrative distance to 2 hops for all static routes.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #ip route distance 2
(SafeGuardOS) (config) #
```

Creating a Default Route

The switch uses a default route when a more specific route is unavailable. To create a default route, use the **ip route default** command in Global Configuration mode. Use the **no** version of the command to delete the default route.

ip route default *next_hop* {*distance*}
no ip route default *{next_hop}*

Syntax Description	*next_hop*	Specifies the IP address of the next hop router. If *next_hop* is specified in the **no** form, the default route with that next hop will be deleted. If *next_hop* is not specified, all the static default routes are deleted
	distance	Specifies the administrative distance of this individual static route. Among routes to the same destination, the route with the lowest metric value is the route entered into the forwarding database. A route with a metric of 255 cannot be used to forward traffic. The default is 1. For more details, see *Setting an Administrative Distance or Preference on page 192*.

For example:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #ip route default 192.38.28.5 1
(SafeGuardOS) (config) #
```

Displaying Routing Information

To display or verify the routing configuration, use the **show ip route** command in Privileged Exec mode.

The syntax for this command is:

show ip route

The following example is representative of the command output:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #show ip route

Route Codes: C - Connected, S - Static

S 0.0.0.0/0     [1/0] via 172.16.0.254,   ServicePort
C 2.2.2.0/24    [0/1] directly connected, Default
S 3.3.3.0/24    [1/0] via 2.2.2.20,       Default
S 4.3.3.0/24    [1/0] via 2.2.2.20,       Default
S 5.3.3.0/24    [1/0] via 2.2.2.20,       Default
S 88.8.8.0/24   [1/0] via 2.2.2.20,       Default
C 172.16.0.0/18 [0/1] directly connected, ServicePort

(SafeGuardOS) (config) #
```

The fields in the output represent:

Column	Description
Route Code	Displays either a C for connected or an S for static.
IP Address and mask	Displays the IP address of the destination network corresponding to this route.
Interface	Displays the routing slot/port associated with the device's ARP entry.
Directly Connected or via IP address	Shows whether directly connected or IP route.
VLAN	The name of the VLAN.

Configuring Bootstrap or DHCP Relay

The Bootstrap Protocol (BOOTP) is a relatively simple UDP network protocol that automatically assigns an IP address to a network host during the bootstrap process. The protocol was originally defined in RFC 951. The Dynamic Host Configuration Protocol (DHCP) is the more recent and robust follow-on to BOOTP.

When the BOOTP and DHCP relay feature is configured in SafeGuard OS, the Alcatel-Lucent Switch forwards the protocol requests coming from connected hosts to the

BOOP/DHCP servers on different subnets. BOOTP and DHCP relay are disabled by default.

Enabling BOOTP or DHCP Relay

To enable BOOTP or DHCP relay:

1. Configure VLANs and IP unicast routing before enabling BOOTP and DHCP relay. VLANs are discussed at length in *Chapter 5, Setting Up SafeGuard Switches*. Steps for configuring unicast routing are found in *Configuring Static Routing on page 191*.

2. Enable the DHCP and BOOTP relay function, using the **bootpdhcprelay enable** command. The **no** version of the command disables the forwarding of relay requests. These Global Configuration commands have the following syntax:

   ```
   bootpdhcprelay enable
   no bootpdhcprelay enable
   ```

   The commands have no parameters or variables.

3. Specify the server address for DHCP or BOOTP relay requests, using the **bootpdhcprelay serverip** Global Configuration command. The **no** version of the command reinstates the default server IP address (0.0.0.0).

   ```
   bootpdhcprelay serverip ipaddr
   no bootpdhcprelay serverip
   ```

Syntax Description	*ipaddr*	Specifies the IP address of the BOOTP or DHCP server. The default IP is 0.0.0.0, meaning not yet configured.

Optional BOOTP or DHCP Relay Configuration

Optional BOOTP or DHCP relay feature options and configurations are described in the following sections:

- *Enabling the Circuit ID Option Mode*
- *Setting the Maximum Hop Count*
- *Establishing a BOOTP or DHCP Relay Minimum Wait Time*
- *Displaying BOOTP or DHCP Relay Information*

Enabling the Circuit ID Option Mode

This DHCP feature allows information to be inserted into the request packet by the relay agent when forwarding host-originated DHCP packets to a DHCP server. This feature

inserts a piece of information, called the *relay agent informat*ion option (option 82), into any DHCP request packet that is being relayed by the switch. The relay agent information option is organized as a single DHCP option that contains one or more sub-options. One of these sub-options is for the incoming circuit in a public circuit access unit. Examples of a public circuit access unit include RAS's, cable modem termination systems, and ADSL access units.

The relay agent automatically adds the circuit identifier to the relay agent information option and forwards it to the DHCP server. When a DHCP reply contains a valid relay agent option, the option is stripped from the packet before it is relayed to the host.

This sub-option MAY be added by DHCP relay agents which terminate switched or permanent circuits. It encodes an agent-local identifier of the circuit from which a DHCP client-to-server packet was received. It is intended for use by agents in relaying DHCP responses back to the proper circuit. Possible uses of this field include:

- Router interface number
- Switching Hub port number
- Remote Access Server port number

To enable the circuit ID option, use the **bootpdhcprelay cidoptmode** command in Global Configuration mode. Use the **no** version of the command to disable the circuit ID option mode.

```
bootpdhcprelay cidoptmode
no bootpdhcprelay cidoptmode
```

The commands have no parameters or variables.

The following example, enables port information to be inserted into the DHCP request packet:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #bootpdhcprelay cidoptmode
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Setting the Maximum Hop Count

By default, a relay agent can hop 4 times. To change the maximum number of hop counts for a relay agent, use the **bootpdhcprelay maxhopcount** command. Use the **no** version of the command to reinstate the default maximum allowable relay agent hops. These Global Configuration commands have the following syntax:

```
bootpdhcprelay maxhopcount hops
no bootpdhcprelay maxhopcount
```

Syntax Description	*hops*	Specifies the maximum number of permitted hops for a relay request. Valid values are 1 to 16. The default is 4 hops

The following example, extends the BOOTP or DHCP relay hop count to 8:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #bootpdhcprelay maxhopcount 8
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Establishing a BOOTP or DHCP Relay Minimum Wait Time

When the BOOTP or DHCP relay agent receives a BOOTREQUEST message the request is immediately relayed. To configure a minimum delay or wait time of up to 100 seconds using the seconds-since-client-began-booting field for BOOTP or DHCP relay requests, use the **bootphcprelay minwaittime** command in Global Configuration mode.

bootpdhcprelay minwaittime *seconds*

Syntax Description	*seconds*	Minimum amount of time in seconds before a BOOTP or DHCP relay request is relayed. Valid values are 0 to 100. The default value is 0.

The following example sets the relay minimum wait time to 4 seconds:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #bootpdhcprelay minwaittime 4
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Displaying BOOTP or DHCP Relay Information

To display BOOTP or DHCP relay information, use the **show bootpdhcprelay** command in Privileged Exec mode.

show bootpdhcprelay

The command has no parameters or variables.

The following example is representative of the command output:

```
(SafeGuardOS) #show bootpdhcprelay

Maximum Hop Count.............................. 8
Minimum Wait Time(Seconds)..................... 3
Admin Mode..................................... Enable
Server IP Address.............................. 172.56.20.1
Circuit Id Option Mode......................... Enable
Requests Received.............................. 40
Requests Relayed............................... 40
Packets Discarded.............................. 0

(SafeGuardOS) #
```

The fields in the **show bootpdhcprelay** output represent:

Display	Description
Maximum Hop Count	Maximum allowable relay agent hops.
Minimum Wait Time (Seconds)	Minimum wait time.
Admin Mode	Indicates whether the relaying of requests is enabled or disabled.
Server IP Address	IP address of either the BOOTP or DHCP relay server.
Circuit Id Option Mode	Indicates if the DHCP circuit ID option is enabled or disabled.
Requests Received	Number of requests received.
Requests Relayed	Number of requests relayed.
Packets Discarded	Number of packets discarded.

Clearing BOOTP or DHCP Relay Information

To clear BOOTP or DHCP relay information, use the **clear bootpdhcprelay statistics** command in Privileged Exec mode.

clear bootpdhcprelay statistics

The command has no parameters or variables.

The following example is representative of the command output:

```
(SafeGuardOS) #show bootpdhcprelay

Maximum Hop Count.............................. 8
Minimum Wait Time(Seconds)..................... 3
Admin Mode..................................... Enable
Server IP Address.............................. 172.56.20.1
Circuit Id Option Mode......................... Enable
Requests Received.............................. 40
Requests Relayed............................... 40
Packets Discarded.............................. 0

(SafeGuardOS) #clear bootpdhcprelay statistics

(SafeGuardOS) #show bootpdhcprelay

Maximum Hop Count.............................. 8
Minimum Wait Time(Seconds)..................... 3
Admin Mode..................................... Enable
Server IP Address.............................. 172.56.20.1
Circuit Id Option Mode......................... Enable
Requests Received.............................. 0
```

```
Requests Relayed.............................. 0
Packets Discarded............................. 0
```

IP Multicast Routing

IP multicasting allows a device on a LAN or VLAN to send packets, not to just one recipient, but to a group or collection of other devices. Multicasting is considered a more efficient method of routing because it conserves bandwidth and reduces traffic by being able to deliver simultaneously a single stream of information to multiple devices.

In a multicast environment, instead of using an individual IP address, the source device uses an address that identifies the members of the group. When the source device sends the group IP address, routers on the LAN or VLAN forward the packets to all the members of the multicast group. If necessary, the routers forward duplicate data packets wherever the path to recipients diverge.

Internet Group Management Protocol (IGMP) is a multicast group membership discovery protocol. In subnets where IGMP is configured, a host that wants to be a data receiver joins the group by sending a message to a multicast router on a local interface. There are three versions of IGMP: IGMPv1, IGMPv2, and IGMPv3. All three versions are supported by SafeGuard OS. For more details, see *Configuring IGMP Snooping on page 164*.

chapter

6 Configuring Authentication and Role Derivation

In this chapter:

Configuring User Authentication

This section explains the different types of user authentication available in SafeGuard OS. It also explains how to configure the SafeGuard device using the CLI to achieve the maximum benefit in your deployment. It contains the following sections:

- *Authentication Concepts*
- *Limiting Access with Trusted Servers*
- *Maintaining the Host Mapping Table*
- *Working with Protocol Data Unit Parsers*
- *Configuring Captive Portal*
- *Configuring MAC-Based RADIUS*

Authentication Concepts

An integral part of any security solution is access control, which is the way you control user access into the network and what services users are allowed to use after they have access.

Authentication, Authorization, and Accounting (AAA) is an industry accepted framework that implements access control. This chapter focuses on the authentication component and how SafeGuard OS offers a wide variety of implementation features that can be tailored to various types of network configurations.

Users in the network belong to one of two groups: authenticated users, and unauthenticated users. Unauthenticated users are users that have not authenticated, or have tried to authenticate and failed. These users are placed in the unauthenticated user role (for more information on roles, see *Role Derivation on page 276*). Authenticated users are users that have authenticated through either an active mechanism (Captive Portal, 802.1x), or a passive mechanism (snooped kerberos or RADIUS). When a user is authenticated, they are granted additional network access, as defined by their user specific role.

Authentication is defined as the process by which we map or associate a user's identity with a set of user hosts. SafeGuard OS supports two forms of authentication: active and passive.

During active authentication, the SafeGuard OS interacts directly with the end-user's host machine to obtain the authentication status of a client. Examples of active authentication are:

- HTTP-based Captive Portal
- MAC-based RADIUS
- IEEE 802.1x with either local or RADIUS backend (SafeGuard Switch only)

When providing active authentication, the system disables network access for client stations until an authentication exchange takes place. When access is disabled, it prevents users from accessing the network without the proper credentials.

During passive authentication, the SafeGuard OS sniffs the results of external authentication devices and servers to obtain a user name that can then be used in traffic visualization. Examples of passive authentication are:

- Windows Active Directory (AD) login
- RADIUS

Users in the LANSheild OS are kept in the user table. This table keeps information on each user in the network including the user name, interfaces, and assigned roles. Entries, including the credentials, are aged from the user table based on inactivity of the end hosts. In addition, per-protocol timers can be configured to forcibly age out users after some time.

NOTE: No user configuration is required to passively authenticate a user on a new SafeGuard device. By default, when the device is in monitor or protection mode, passive authentication will work without any user configuration required.

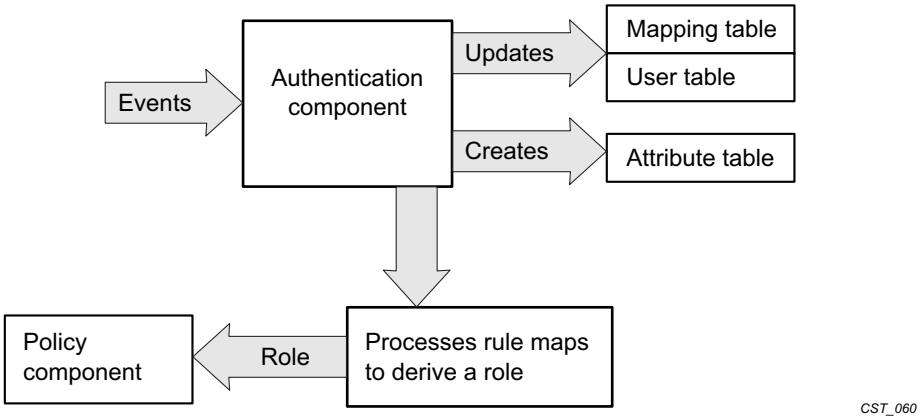
Authentication Component Process

The authentication component begins by receiving login events using either the active or passive authentication methods, and then updates the user tables with information contained in the login event. After the tables are updated, the authentication component assigns a role to the new user.

The information in the event can be matched against other sets of criteria or *rules*. The rules can be matched against an AD store, RADIUS protocol, or known system information. If the information in the event matches the rules, then a role can be assigned based on the match. The matching of event information to rules is called *role derivation*. The rules that we use to perform the match are called *rule maps*. Role derivation and rule maps are described, in length in *Role Derivation on page 276*.

After the role is derived, it is sent to the policy component for group-specific access control and policy enforcement. The flow through the authentication component to the policy component is shown in *Figure 5*.

Figure 5 Authentication Component Process



Planning for Your Authentication and Policy Deployment

Authentication and policy are tightly interwoven. When planning to implement a new security system, it is important to understand how policy is dependent on authentication. Role definition and policy definition are part of the policy component, but role derivation is part of the authentication component.

Before defining rule maps for deriving a role, outline the following aspects required for authentication and policy deployment:

1. Configure backend servers. See *Configuring RADIUS Servers on page 252* and *Configuring Active Directory Servers on page 255*.

2. Logically define users by role definitions. See *User Policies on page 305* for more details on roles and role hierarchy.

   It is not necessary to configure the roles before configuring rule maps, but they must be complete before attempting to bring up a full system.

3. Determine the policies that apply to each role. See *Defining and Applying User Policies on page 314*.

4. Determine the resources available for each role. Access control not only means access to the network, it is also access to the resources on a network.

   SafeGuard OS supports policy enforcement at the Application Layer, which allows you to set resources by role. For more information about controlling resources through policies, see *Layer 7 Policies on page 307*.

5. Determine how users will be distinguished based upon attributes.

   This step is important for specifying rule maps. As mentioned in *Authentication Concepts on page 202*, there is information in the authentication event that can be unique to a user. Often these protocol and system elements are sufficient enough to categorize the user to a role. Some of the attributes supported are:

— System attributes: source IP, source MAC, port number, VLAN ID, authentication type, mapping type, user name, role name, domain name, and time of day

— DHCP attributes: requested IP address, subnet mask.

— Active Directory attributes: member of, title, department, host operating system, and version

— RADIUS attributes: calling station, called station, network access server (NAS) IP and Vendor Specific Attributes (VSAs)

For more details, see *Configuring the Rule Map Attributes on page 281*.

Limiting Access with Trusted Servers

SafeGuard OS provides two methods of filtering authentication events:

- trusted servers
- grey lists

To create a trusted server, the SafeGuard device can be configured to respond only to authentication events from specific servers, such as Kerberos or RADIUS. When so configured, the system applies a default action to leases from all unrecognized servers.

To configure access to services, use the **aaa session-tracking trusted-server** Global Configuration command.

aaa session-tracking trusted-server [**default-action** *protocol* | **ip-address** *ipaddr*] **action** [**deny**|**permit**]

Syntax Description	*protocol*	The protocol to permit or deny by default. Valid values are: ■ all ■ dhcp ■ kerberos ■ lsp (only for default action) ■ radius
	ipaddr	IP address of the server. This address is obtained from the SERVER_ID field of the packet.
	deny	The mapping table does not accept new mappings.
	permit	The mapping table is updated to reflect the new mapping. Permit is the default action.

Displaying Trusted Server Information

To review the current trusted server configuration, use the **show aaa trusted-server** command in Privileged Exec mode:

```
show aaa session-tracking trusted-server
```

This command has no options or parameters. Output of the command is similar to this example:

```
(SafeGuardOS) #show aaa session-tracking trusted-server


Trusted Servers
---------------

Number of Rows:1

Server              Allowed Protocols          Denied Protocols
------              -----------------          ----------------
1.2.3.4             DHCP,LSP                   KRB,RADIUS

(SafeGuardOS) #
```

Field	Description
Server	Indicates the server name or the default server.
Allowed Protocols	Indicates all protocols that are configured as permitted.
Denied Protocols	Indicates all protocols that are configured as denied.

Maintaining the Host Mapping Table

SafeGuard OS creates a set of mappings between MAC and IP addresses on the network. All traffic with the same MAC address is assumed to have originated from the same host. To build up these mappings, the system processes the following events:

- DHCP traffic – The system can detect the DHCP traffic and determine which IP address has been assigned to a client.
- Static IP traffic – This is the traffic seen in the data path by the SafeGuard Processor (LSP).

Entries are aged from the mapping table after an idle period (default 30 minutes after the last detected flow). After idle period, connectivity will timeout.

To display the contents of the mapping table, see *Displaying the Current Contents of the Mapping Table on page 208*.

Configuring Layer 3 Devices for Mapping

Because SafeGuard OS assumes that all traffic with the same MAC address has originated from the same host, it implies that a change in authentication status for one IP on a MAC changes the authentication status for all IPs on that MAC address. When a Layer 3 device (such as a router) is placed downstream of the SafeGuard device, all Layer 3 traffic is incorrectly mapped to a single user device.

To ensure correct mapping for Layer 3 devices, use the Global Configuration **aaa session-tracking l3device** command. This command instructs SafeGuard OS to use IP addresses to map to hosts rather than the default process of mapping MAC addresses to hosts in session tracking mode.

To specify up to 32 MAC addresses as Layer 3 addresses, use the **aaa session-tracking l3device description** command. Traffic from these MAC addresses is not assumed to be from the same host and authentication is processed by IP address only.

aaa session-tracking l3device *mac* **description** {*description*}

Syntax Description	*mac*	MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	description	(Optional) A string description for the MAC address. The length of the string can be up to 30 characters. Specify descriptions in double quotation marks.

The following example identifies a Cisco Systems router to the mapping table:

```
(SafeGuardOS) # aaa session-tracking l3device 00:11:11:ea:8b:7d description
“Cisco 811”
(SafeGuardOS) #
```

To remove a Layer 3 device from the mapping table, use the **no** version of the command:

no aaa session-tracking l3device *mac*

Syntax Description	*mac*	MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff

Use the **show aaa session-tracking l3device** command to display the list of currently configured Layer 3 devices. This command is described in *Displaying the Current Contents of the Mapping Table on page 208*.

Displaying the Current Contents of the Mapping Table

To display the current contents of the mapping table, use the **show host l3 interfaces** Privileged Exec command. To see all of the entries in the table, enter the command without any options.

show host l3 interfaces {[**ip-address** *ipaddr*] | [**mac-address** *macaddr*] | [**port-number** *slot/port*] | [**vlan** *vlanid*] | [**hostname** *host*]}

Syntax Description	*ipaddr*	IP address of the mapping.
	macaddr	MAC address of the mapping. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	slot/port	Physical port where the mapping was detected.
	vlanid	VLAN that the mapping was detected on. VLAN 1 is the default VLAN.
	host	String name of the host that the IP is assigned to.

Based on the options selected, this command displays in tabular or single-user form the following information.

Field	Description
Port	The physical port where the mapping was detected. The interface is shown in slot/port notation.
VLAN	The VLAN the mapping was detected on. VLAN 1 is the default VLAN.
MAC	The MAC address of the mapping. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
IP	The IP address of the mapping.
Source	The source of the mapping. Possible options are: ■ dhcp – The mapping was learned via DHCP ■ lsp – The mapping was learned from LSP
Role Name	A string role name that has been assigned to this IP. Unauthenticated indicates that this user failed authentication. No role will be assigned if authentication failed. Authenticated indicates the default system role has been assigned.
Learned	The time at which the L3 entry was learned.
HA	Indicates whether a local or remote high availability server. Possible values are: ■ LOCAL – Indicates that traffic for this L3 interface has been seen on this peer. ■ REMOTE – Indicates that this L3 interface was learned from the other HA peer.

Ed. Note:

In the detail mode the following additional information is shown:

Field	Description
MAP Source	LSP for mappings learned based on traffic, DHCP for mappings learned based on DHCP.
	Ed. Note:
Configured Role	This is the role derived from role derivation. It is also displayed in the brief output.
Effective Role	This is the role that policy has used for enforcement. It may be different than the configured role based on misconfiguration.
HA State	ADDED indicates the interface has been seen and processed, REMOVED indicates the interface has been removed by this peer, and is waiting for an acknowledgement from the other peer. PENDING TRAFFIC indicates that this interface was learned from a peer which subsequently failed, and this device is waiting for traffic from the interface before marking it active.
EPV Posture	Either "healthy" or "unknown" based on the results of the EPV scan.
EPV State	"discovered" indicates that this host has started the scan process, "postured" indicates the host has finished being scanned, "unknown" indicates that the host has not engaged with the EPV feature.
EPV Scan Started/Refresh	Time when the EPV scan was started (host first was redirected to scan page) and the last refresh was processed.

To see the l2-interface information, use the **show host l2 interfaces** Privileged Exec command. To see all of the entries in the table, enter the command without any options.

show host l2 interfaces {[**ip-address** *ipaddr*] | [**mac-address** *macaddr*] | [**port-number** *slot/port*] | [**vlan** *vlanid*] | [**hostname** *host*]}

Syntax Description	*ipaddr*	IP address of the mapping.

	macaddr	MAC address of the mapping. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	slot/port	Physical port where the mapping was detected.
	vlanid	VLAN that the mapping was detected on. VLAN 1 is the default VLAN.
	host	String name of the host that the IP is assigned to.

Based on the options selected, this command displays in tabular or single-user form the following information.

Field	Description
Port	Physical interface this L2 interface was seen on.
VLAN	VLAN traffic was seen on.
MAC	MAC address of this L2 interface.
Type	HOST/RTR indicates if this is an L2/L3 interface.
Learned	Time when this interface was first seen.
Idle	Indicates if traffic has been seen from this interface, or it was just learned from HA.

In the detail mode the following additional information is shown:

Field	Description
HA Owner	Local/Remote indicates who "owns" the interface from the timer perspective.
HA State	ADDED/REMOVED/PENDING TRAFFIC the state field indicates the interface was just ADDED, is being REMOVED pending HA notification, or was learned from an HA peer that has failed but has not sent traffic yet.

When the host database sees a DHCP exchange for an interface it makes an entry in the DHCP cache. When traffic is observed from that host, the cache entry is removed from the cache and the information contained in it is applied to the host table.

To see the contents of the DHCP cache, use the **show host dhcp-cache** command.

show host dhcp-cache

The following table describes the output of the command:

Field	Description
VLAN	VLAN that traffic was seen on.
MAC	Client MAC address (this is the hwaddr field in the bootp packets).
IP Addr	IP address assigned by the DHCP server.
SRC	Mapping source (DHCP).
Learned	Time when the DHCP cache entry was made.
HA - Remote/Local	Indicates which system originally saw the DHCP exchange.

The host database maintains counters for each event that it processes. These events are viewable with the command **show host counters**. These events include:

- L2 Events – The number of times L2 interfaces have been added, deleted, or moved from one port to another.
- L3 Events – The number of times L3 interfaces have been added, deleted or filtered (L3 events from network side ports are filtered).
- DHCP Events – The number of entries that have been added to/deleted from the DHCP table.

For example:

```
SafeGuardOS) #show host counters
L2 Add Events.............................. 2
L2 Del Events.............................. 1
L2 Move Events............................. 0
L2 Errors.................................. 0
L2 Filter.................................. 4
L3 Add Events.............................. 4
L3 Del Events.............................. 2
L3 Errors.................................. 0
L3 Filter.................................. 9
DHCP Del................................... 0
DHCP Add................................... 2
DB Errors.................................. 0
HA Errors.................................. 0
```

```
SOAP Reqs..................................... 1
SOAP Errors................................... 0
AES Errors.................................... 0
Ticks......................................... 117
DHCP Age Out.................................. 1
```

These counters can be cleared with the command **`clear host counters`**.

Displaying Layer 3 Devices

Up to 32 MAC address can be configured as Layer 3 devices. To display information about these addresses, use the **show aaa session-tracking l3device** command.

`show aaa session-tracking l3device`

This command has no options or parameters. The following is sample output from the command:

```
(SafeGuardOS) #show aaa session-tracking l3device
Layer 3 Devices

Total Count : 4

MAC Address             Description
----------------        --------------------------------
00:c0:a8:01:14:00       test14
00:c0:a8:01:21:00       test21
00:c0:a8:01:26:00       test26
00:c0:a8:01:04:00       test4
```

The fields of the output represent:

Field	Description
Total Count	Total number of MAC addresses configured. The system limit is 32.
MAC address	MAC address for the L3 device. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
Description	Description for the entry, if provided.

Displaying Authenticated Users

To display authenticated users, use the **show aaa users** command. If you specify the command without options, all authenticated users are displayed.

```
show aaa users {[user-name Name] | [ip-address Ipaddr] | [mac-address Mac]
| [port-number slot/port| [role-name rolename] | [vlan vlanid]}
```

Syntax Description	*Name*	(Optional) Filter the user table and show entries corresponding to the given user name. User name here is case-sensitive. A single user can be authenticated on multiple hosts and multiple interfaces.
	Ipaddr	(Optional) Filter the user table and only show the entry which corresponds to the argument IP address.
	Mac	(Optional) Filter the user table and only show entries corresponding to the given MAC address. For a single MAC address there may be more than one entry, if that MAC has more than one IP address mapped to it. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	slot/port	(Optional) Filter the user table by the interface. The interface is entered in slot/port notation.
	rolename	(Optional) Filter the user table by the given role name. The role name is case-sensitive.
	vlan_id	(Optional) Filter the user table by the VLAN ID.

Show AAA Users Command on page 396 shows the output format from the **show aaa users** command.

Based on the options, this command displays in tabular or single-user form the following information.

Field	Description
Port	Physical port on which the user was detected.
IP Address	IP address for the interface of the user.
User Name	Username as detected by its authentication.
Role	Role derived for this user-based on the authentication protocol, server, and username.

Field	Description
SATE	Coded string that indicates the following information using the following syntax: SATE ■ **S** – current state of the user, based on the state of the users authentication. Possible values are: **f** (failed) or **s** (success). ■ **A** – authentication type. Possible values are: **k** (Kerberos), **c** (captive-portal), **m** (mac-radius), **r** (radius), **x** (802.1x), **w** (white-list) ■ **T** – Interface type. Possible values are: **h** (normal host) or **r** (L3 interface) ■ **E** – EPV state. Possible values are: **u** (unknown) or **h** (healthy).
Login Time	The login time of the user.

In addition to the tabular format, the **show aaa users** command provides a detail version as well. If this option is specified, the following information is printed for each user.

Field	Description
Port	Physical port on which the user was detected.
User Name	Username of the user.
Domain Name	Domain name for the user.
IP Address	IP address for the interface of the user.
Auth Source	The protocol that authenticated the user (such as Kerberos, Captive-Portal or RADIUS).
Auth Server	IP address of the server that authenticated the user. In the case of Kerberos, this is the ticket-granting server. In the case of RADIUS, the RADIUS server. If Captive-Portal, it gives the IP of the backend server that authenticated the user.
Login Time	Time that the user was last seen logging in.
Last Refresh	System up time as of the last authentication attempt by the user.
Force logout	If a protocol specific logout time is configured, this will be show here.
White List	Name or ID of the white-list entry, if any, that authenticated the user.
Role Name	Role name that the role derivation component has assigned to the user.

Field	Description
Effective Role	Role name that the policy component has enforced for the user.
Rule Map Name	Name of the rule map that assigned the role for the user.
MAC	MAC address associated with the L3 interface for this user.
VLAN	VLAN ID associated with this interface.
Port	Physical port the user is connected on.
Type	Type of the L2 interface the user is connected on, Router or Host.
EPV Posture	Posture state of the user. Possible values are: ■ unknown – EPV scan has not been run for this user ■ healthy – EPV scan has determined this user's PC conforms to the IT policies.
EPV State	State of the user machine in the EPV component: ■ **unknown** – Host has not been seen by EPV yet. ■ **postured** – Host has been processed by the EPV component, and the posture is good. ■ **discovered** – Host has been hijacked by EPV, but has not started a scan yet. ■ **timedout** – Host has been aged out of the EPV tables. ■ **force** – Host has been cleared by a management user from the EPV tables.
EPV Scan Started	Time when the user was hijacked by the EPV feature.
EPV Scan Refresh	Last time when the user refreshed their scan results.

Working with Protocol Data Unit Parsers

It is sometimes helpful to look at the protocol data unit (PDU) parser information. SafeGuard OS provides two toggles that allow you to control the handling of PDUs.

Port Checking

As described in *Traffic Flow on page 299*, the device is configured so that requests from the user arrive on the user ports and network responses arrive on the network side of the

device. When traffic arrives in other directions, it is not examined. To enable port checking, use the following Global Configuration command:

```
aaa session-tracking do-port-check
```

Verify the setting of the port check using the **show aaa debug** command in Global Configuration mode.

SECURITY: Disabling of port checking is not recommended. When disabled, users can replay previously successful login attempts and appear as authenticated on the device.

To disable the checking of ingress interface, use the **no** version of the command:

```
no aaa session-tracking do-port-check
```

This command has no options or parameters.

Enabling Safe Mode

Under some circumstances, such as an SMB mount, the protocol traffic is identical to a login. To avoid these false login failures, run in safe mode. When safe mode is enabled, failed logins are ignored. Safe mode is also useful when users enter incorrect passwords to unlock their stations and there are processes running that require network connectivity. If safe mode is disabled, the user becomes unauthenticated on the device with the first login failure.

Safe mode is enabled by default. If disabled, use the **aaa session-tracking safe-mode** command to enable it in Global Configuration mode.

```
aaa session-tracking safe-mode
```

This command has no options or parameters. Verify the setting of safe mode using the **show aaa debug** command in Global Configuration mode.

Disabling Safe Mode

To reset safe mode to the default setting, use the **no** version of the command:

```
no aaa session-tracking safe-mode
```

This command has no options or parameters.

Displaying PDU Counters

To see various PDU counters for passive authentication, use the **aaa debug command** in Global Configuration mode.

```
show aaa debug
```

This command has no options or parameters. The output of the command is similar to this example:

```
(SafeGuardOS) #show aaa debug
CACHE AGE..................................... 0
L2 AUTH ADDED................................. 0
L2 AUTH REMOVED............................... 0
L2 AUTH REFRESH............................... 0
L2 AUTH IGNORE................................ 0
L2 AUTH ERROR................................. 0
L3 AUTH ADDED................................. 0
L3 AUTH REMOVED............................... 0
L3 AUTH REFRESH............................... 0
L3 AUTH IGNORE................................ 0
L3 AUTH ERROR................................. 0
L3 MAP ADDED.................................. 0
L3 MAP REMOVED................................ 0
L3 MAP UPDATE................................. 0
L3 MAP ERROR.................................. 0
L3 ACTIVE..................................... 0
AES ERROR..................................... 0

Current State................................. enabled
FDB events.................................... disabled
Safe Mode..................................... enabled
Port Check.................................... enabled
Total Intercepts.............................. 3389
Total PDU Msgs................................ 2942
Total PDUs OK................................. 2629
Total PDU Errors.............................. 313
FDB Events.................................... 0
Total Ticks................................... 157927
Max Protocols................................. 4

Name               Status   OK     ERROR  CUR    MAX    HIGH   TOUT
----------------   -------- ------ ------ ------ ------ ------ ------
DHCP             : enabled  2591 295 0      256    238
RADIUS           : enabled  18     7  0      128    20
KRB.UDP          : enabled  20     11 0      128    00
KRB.TCP          : enabled  0 0    0      0      00

(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
Name	PDU type.
Status	State of the protocol, either enabled or disabled.
OK	Number of PDUs that are alright. This sum of this column should match the total PDUs OK field.

Field	Description
ERROR	Number of PDU errors. The sum of this column should match the total PDU Errors field.
CUR	Current number of events in the queue.
MAX	Maximum queue limit.
HIGH	High water mark.
TOUT	Number of times a user's request was aged out.

Tracking an Authenticated User Session

The authentication component records the time at which a user logs in. By default, the system will keep the user session until the IP in question has been idle for a certain period of time.

It may be desirable to force users to log in over a certain time period, for example a work day. To do this, the administrator can configure a force-timeout. When a force timeout has been configured for a protocol, users logging in using that protocol will be logged out after the indicated time, regardless of subsequent activity. This is done using the **`aaa timer-config [protocol] force timeout`** routine.

NOTE: A white-list can have a specific force-timeout applied to it. In this case, the specific time out "wins" in priority over the less-specific protocol-based white-list timeout.

To configure the per-protocol timer, use the **aaa session-tracking protocol-config timeout** Global Configuration command.

`aaa timer-config` *`protocol`* **`force-timeout`**

Syntax Description	*`protocol`*	Protocol being configured. The argument can be any one of the following: ■ Captive-portal ■ Kerberos ■ MAC-based RADIUS ■ 802.1x ■ RADIUS

To display the age-out timer settings by protocol, use the **`show aaa timer-config`** Privileged Exec command.

`show aaa timer-config`

This command has no options or parameters. The output of the command is similar to this example:

```
(SafeGuardOS) #show aaa timer-config

Protocol Configuration
----------------------

Number of Rows:6

Protocol           Force Ageout (Secs 0 - never)
--------           ---------------
mac-radius         600
radius             600
kerberos           600
captive-portal     3600

(SafeGuardOS) #
```

Field	Description
Protocol	Configured protocols.
Force Ageout	Timeout (in seconds) for a user authenticating with this protocol. Valid range is between 1to 5184000 seconds.

Configuring Captive Portal

This section describes the commands used for configuring, enabling, and customizing Captive Portal.

Captive Portal provides active, HTTP-based authentication for users. When a user first attempts to open a web browser, the initial connection is hijacked. The user is redirected to a switch-local web page that prompts him or her for a user name and password. This login page also allows the user to select from one or more domains using a pull-down menu. By default, the redirected location is cp.Alcatel-Lucent.com. This name is available through DNS to any host connected to the Internet. If DNS is not available, or the client is on a private network, this name can either be added to private DNS or the redirected location can be reconfigured.

The local user name and password are found in the local authentication database, if not found, the RADIUS server is presented with the credentials. If the user is authenticated, a welcome screen popup is displayed and the original URL is opened in the browser.

The device opens a final window, called the heartbeat window. This window periodically re-contacts the device to let it know that the user is still logged in. The refresh interval on this window is configurable. If the user fails authentication, a failure message is displayed and user traffic continues to be blocked. SafeGuard devices support both SSL and clear-text versions of this setup. If the device is configured to do SSL, the redirected URL reflects this configuration with an **https** prefix.

Captive Portal can be turned on or off for each port. By default, Captive Portal is disabled on all ports. If Captive Portal is enabled on a port and a user uses a different authentication mechanism (for example, Kerberos), the user is not presented with the Captive Portal screens.

NOTE: Captive Portal can be enabled only on downstream interfaces. The Captive Portal command has no effect on upstream interfaces or on SPAN interfaces.

Planning for Captive Portal

The basic configuration checklist for Captive Portal follows:

1. Configure backend authentication, which means configuring:
   - One or more RADIUS servers for backend authentication. See *Configuring RADIUS Servers on page 252*.
   - The local user database. See *Configuring Rule Maps on page 279*.
2. Configure the SafeGuard device to operate in monitor or protect mode (Captive Portal does not operate in pass-through mode).
3. *Configuring the Hijack Port*
4. *Configuring the Redirect Port*
5. *Configuring the Redirect Location*
6. *Setting the Refresh Interval Timer*
7. *Enabling and Disabling Captive Portal*
8. *Optional Captive Portal Configuration*
9. *Downloading New Certificates*

Other tasks that are useful when working with Captive Portal CLI include:

- *Enabling and Disabling HTTPS*
- *Specifying a Proxy Server*
- *Restoring Certificates*
- *Customizing Captive Portal and EPV Pages*
- *Clearing the Login Page*
- *Displaying the Current Configuration*
- *Displaying Captive Portal Statistics*

Configuring the Hijack Port

See the following sections for details on hijack port configurations options:

- *Adding or Changing the Hijack Port*
- *Removing the Hijack Port*

Adding or Changing the Hijack Port

By default, the SafeGuard OS hijacks port 80. To change or to add additional hijack ports, use the **aaa captive-portal hijack-port** Global Configuration command.

aaa captive-portal hijack-port *port number [use-ssl]*

Syntax Description	*port_number*	TCP port that is captured. Valid port range is from 1 to 65535.
	use-ssl	If this option is used, traffic on this port will be treated as SSL and decrypted.

For example, to add port 800 to the list containing port 80, use the following commands:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #aaa captive-portal hijack-port 800
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

Removing the Hijack Port

Ports can be removed from the Captive Portal hijack list with the **no** form of the command.

no aaa captive-portal hijack-port *port number*

Syntax Description	*port_number*	TCP port that is reinstated. Valid port range is from 1 to 65535.

For example, to remove port 800 as a Captive Portal hijack port:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #no aaa captive-portal hijack-port 800
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

Configuring the Redirect Port

By default, SafeGuard OS uses 16978 and 16979 as the redirect port. To change the port to which the user is redirected, use the **aaa captive-portal redirect-port** Global

Configuration command. The system uses both the specified port (for cleartext traffic) and next port number (for SSL traffic).

aaa captive-portal redirect-port *port number*

Syntax Description	*port_number*	TCP port for redirected traffic. Valid port range is from 1 to 65535

For example, to change the redirect port from port 16978 to port 128:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #aaa captive-portal redirect-port 128
(SafeGuardOS)(config) #exit
(SafeGuardOS #
```

Configuring the Redirect Location

The location of the redirect is the server name to which the client is being redirected. By default, the system redirects users to cp.Alcatel-Lucent.com. Because the traffic is intercepted by the system, the actual value is irrelevant. It simply must resolve to an IP address that the client tries to reach.

However when an address in the same broadcast domain is used, then the address must actually exist, or must have a proxy-arp setup. To change the redirect location, use the **aaa captive-portal redirect-location** Global Configuration command:

aaa captive-portal redirect-location *dns-name*

Syntax Description	*dns-name*	Host name to which clients are redirected during capture. The default location is cp.Alcatel-Lucent.com.

The system automatically supplies http://.

For example, this command resolves the redirection-location to the home page for myCompany.com:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #aaa captive-portal redirect-location mycompany.com/home
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

Setting the Refresh Interval Timer

Captive Portal contains a timer called the refresh interval. The refresh interval controls how long (in minutes) before the client browser refreshes the connection with the system through the heartbeat page. When the timer expires, the user is marked as idle. If the idle

timer also expires, the user loses connection with Captive Portal and needs to re-authenticate again.

Use the **aaa captive-portal refresh-interval** Global Configuration command to set the timer limits.

aaa captive-portal refresh-interval *minutes*

Syntax Description	*minutes*	Interval (in minutes) between refresh reloads. The interval can range from 0 to 720 minutes. The default is 15 minutes. 0 infers no refresh.

This example sets the refresh-interval to the maximum limit:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #aaa captive-portal refresh-interval 720
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

Enabling and Disabling Captive Portal

See the following sections for details on enabling and disabling Captive Portal configuration options:

- *Enabling a Captive Portal Port*
- *Disabling a Captive Portal Port*

Enabling a Captive Portal Port

By default, Captive Portal is disabled on all ports. By enabling Captive Portal on a port, you indicate that all web traffic from unauthenticated users is directed to the redirect port. Use the **aaa captive-portal** interface submode command to enable Captive Portal.

aaa captive-portal

The command has no options or parameters. The following example enables Captive Portal on port 2:

```
(SafeGuard OS) (config) #interface 0/2
(SafeGuard OS) (interface) #aaa captive-portal
(SafeGuard OS) (interface) #
```

Disabling a Captive Portal Port

To disable Captive Portal on a port, use the **no** form of this command.

```
no aaa captive-portalv
```

NOTE: Captive Portal is supported only on ports that face towards hosts. Entering the command for a network-facing port has no effect.

For example, to return port 1 to the default setting, enter the following commands:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/2
(SafeGuardOS) (interface 0/2) #no aaa captive-portal
(SafeGuardOS) (interface 0/2) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Optional Captive Portal Configuration

See the following sections for details on additional yet optional Captive Portal configuration options:

- *Enabling and Disabling HTTPS*
- *Specifying a Proxy Server*
- *Restoring Certificates*
- *Customizing Captive Portal and EPV Pages*
- *Clearing the Login Page*
- *Displaying the Current Configuration*
- *Displaying Captive Portal Statistics*

Enabling and Disabling HTTPS

Captive Portal supports Secure Socket Layer (SSL) for client credential protection. By default, the SafeGuard OS ships with a server certificate for cp.Alcatel-Lucent.com. This certificate is issued by the Alcatel-Lucent Captive Portal Root Certification Authority (CA).

To configure HTTPS for most user configurations, use the **aaa captive-portal https-login** Global Configuration command:

```
aaa captive-portal https-login
```

This command has no options or parameters. For example:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #aaa captive-portal https-login
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

This command forces the user to use SSL when submitting their username and password. It has no effect on ports added with the **use-ssl** keyword.

To disable HTTPS, use the **no** form of the command:

```
no aaa captive-portal https-login
```

This command has no options or parameters. For example:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #no aaa captive-portal https-login
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

Captive Portal now runs under HTTP.

Specifying a Proxy Server

If you use an automatic proxy, the SafeGuard device does not display the login splash page for Captive Portal. In order to display the login splash screen correctly, the IP address of the proxy must be specified.

In the following example, we are resolving the Alcatel-Lucent Captive Portal splash screen (cp.Alcatel-Lucent.com IP: 63.233.160.203).

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa captive-portal redirect-location cp.Alcatel-
Lucent.com
Captive-portal redirect url updated
(SafeGuardOS) (config) #aaa captive-portal redirect-port 16978
HTTP Redirect port now 16978
(SafeGuardOS) (config) #aaa captive-portal hijack-port 8088
HTTP hijack port 8088 added
(SafeGuardOS) (config) #aaa captive-portal use-popup
Popup enabled
(SafeGuardOS) (config) #aaa captive-portal proxy-ip 172.58.28.18
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

NOTE: Hijack port settings only take effect after resetting the interface using the **aaa captive portal** (Captive Portal enable) command.

Microsoft Windows proxy server settings are found under the Internet Connections, Advanced Proxy Server Settings. Ensure that the DNS and IP address are in the exceptions list.

Downloading New Certificates

SafeGuard devices ship with default certificates. To download new certificates and new Diffie-Helmann (DH) key material, use the following Global Configuration commands:

```
copy tftp://ip/file nvram:sslpem-root
copy tftp://ip/file nvram:sslpem-server
```

Syntax Description	*ip*	IP address of the TFTP server.
	file	Filename of the certificate.

The **nvram:sslpem-root** keywords download the root certificate, and **nvram:sslpem-server** keywords download the server certificate. Both files must be downloaded for SSL to operate and both files should be in PEM format.

NOTE: When using **copy tftp://*ip/file* nvram:sslpem-server**, the file to be downloaded must contain both the certificate and the matching private key. The certificate and key can be concatenated together, as:

-----BEGIN CERTIFICATE-----
<encoded certificate>
-----END CERTIFICATE-----
-----BEGIN RSA PRIVATE KEY-----
<encoded private key>
-----END RSA PRIVATE KEY-----

For example:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #copy tftp://172.58.17.19/cert1 nvram:sslpem-root
(SafeGuardOS)(config) #copy tftp://172.58.17.19/cert1 nvram:sslpem-server
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

The system uses DH key exchange during the SSL process and supports the downloading of DH key parameters using the following commands:

```
copy tftp://ip/file nvram:sslpem-dhweak
copy tftp://ip/file nvram:sslpem-dhstrong
```

These are the 512- and 1024-bit DH parameters, respectively. These files are also in PEM format.

For example, the following commands support 1024-bit DH parameters:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #copy tftp://172.58.17.19/cert1 nvram:sslpem-root
(SafeGuardOS)(config) #copy tftp://172.58.17.19/cert1 nvram:sslpem-server
(SafeGuardOS)(config) #copy tftp://172.58.17.19/cert1 nvram:sslpem-dhstrong
```

```
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

Restoring Certificates

If you have changed the certificates and want to restore the them to the system defaults, use the **clear aaa captive-portal cert-store** Global Configuration command:

```
clear aaa captive-portal cert-store
```

This command has no options or parameters. For example, the following command reinstates the default certificates:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #clear aaa captive-portal cert-store
(SafeGuardOS)(config) #exit
(SafeGuardOS) #
```

NOTE: After entering this command, you must reboot the SafeGuard device for the changes to take effect.

There is an interaction between the redirect location and the subject name, as given in a certificate. Most Web browsers check that the DNS name of the server matches the subject name of the certificate that is presented by that server.

If a new certificate is downloaded, the redirect URL and any corresponding DNS might need to be updated. For more information on configuring the DNS, see *Configuring the Redirect Location on page 223*.

Customizing Captive Portal and EPV Pages

Customers often wish to modify the Login Web page and subsequently displayed pages with custom details, layout, and images. After customizing Web pages, they are deployed to a SafeGuard device using OmniVista SafeGuard Manager or a TFTP command. Both Captive Portal and End Point Validation (EPV) use the same customized Web pages.

The following Web pages can be customized:

Page Name	Description	HTML Page
Login page	On a Login page, Captive Portal and EPV require the user to enter their username and password credentials in order to be authenticated by the device for network access. In addition, this page can be customized with additional information, pointers (URLs), terms & conditions, disclaimers, and so on.	Login.html (Loginform.html) [a]

Page Name	Description	HTML Page
Authorization page	The Authorization page is displayed by the SafeGuard device while processing an authentication request.	Authing.html
Refresh or Reload page	After authentication is successful, the SafeGuard device displays the Refresh or Reload pop-up page that continues to refresh a user's session at periodic intervals. **Note:** This page displays only if enabled on the device and allowed by the user's browser.	Reload.html
Failed page	If authentication is unsuccessful, a Failed page is displayed for a brief moment before the user is redirected back to the Login page.	Failed.html

Notes . . .

a **Loginform.html** does not get customized (like the others), but it is critically important and required to be included with the rest of the Web pages. Login.html refers to it and requires it. A stylesheet called style.css is referred to by the above pages.

To customize the SafeGuard device Web pages:

1. At the command line, issue the following command, which clears existing Web pages and restores a default set of Captive Portal Web pages. Even with a new device, this command should be issued:

   ```
   clear aaa captive-portal customization
   ```

2. Upload the Captive Portal set of pages to your local disk by issuing the following command:

   ```
   copy nvram:captive-portal tftp://ip/cpfiles.tar
   ```

3. Locally, edit the Web pages with customizations, as appropriate. Swap in a new logo.gif file, if desired. Be careful to not break the existing HTML flow and syntax of the pages; if you did need to start over and get the defaults HTML files again, repeat step 2.

NOTE: When editing the login.html page, do not omit the reference to the loginform.html. If this is omitted, users will not see the login input form.

4. Review the edited Web pages in a Web browser to make sure they lay out and display as desired.

5. When done, "tar" up all six edited HTML files in a flat directory tarball. The six required files are:

   - **Login.html**

- **Authing.html**
- **Reload.html**
- **Failed.html**
- **logo.gif**
- **style.css**

6 Download the HTML files to the SafeGuard Switch or Controller using the following command:

```
copy tftp://ip/cpfiles.tar nvram:captive-portal
```

Clearing the Login Page

If you have customized the splash screen and wish to reinstate the default setup, use the Privileged Exec **clear aaa captive-portal customization** command. This command has no parameters or variables.

Displaying the Current Configuration

To display the current configuration of captive portal, use the **show aaa captive-portal configuration** Privileged Exec command:

```
show aaa captive-portal configuration
```

This command has no options or parameters. Output of the command is similar to this example:

```
(SafeGuardOS) #show aaa captive-portal configuration

HTTPS Login Enabled.......................... TRUE
Popup Enabled................................ FALSE
Refresh Interval(min)........................ 20
Redirect Port................................ 16978
Redirect Location............................ cp.Alcatel-Lucent.com
Proxy Server Configuration................... NONE
Hijack non-SSL Ports......................... 80,3128
Hijack SSL Ports............................. NONE
Interfaces................................... 0/8,0/44
(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
HTTPS Login Enabled	■ If HTTPS is enabled for login, this field is true ■ If HTTP is enabled for login, this field is false
Popup Enabled	■ If pop-ups are allowed, this field is true ■ If pop-ups are denied, this field is false

Field	Description
Refresh Interval	Interval (in minutes) between refresh reloads. The interval can range from 1 to 720 minutes.
Redirect Port	TCP port for redirected traffic. Valid port range is from 1 to 65535. Port 16978 is the default.
Redirect Location	The location of the redirect is the server name to which the client is being redirected. The default location is cp.Alcatel-Lucent.com
Proxy Server Configuration	If a proxy server is configured, displays configuration information.
Hijack non-SSL Ports	One or more clear-text ports that Captive Portal uses to hijack users. The default port is 80.
Hijack SSL ports	One or more SSL-based ports that Captive Portal uses to hijack users. The default is 443.
Interfaces	Interfaces that have Captive Portal enabled.

Displaying Captive Portal Statistics

To display the statistics, use the **show aaa captive-portal statistics** command in Privileged Exec mode:

```
show aaa captive-portal statistics
```

The command has no options or parameters. The output of the command is similar to this example:

```
(SafeGuardOS) #show aaa captive-portal statistics


RX     TX     DROP   HDR    FRAG   CHKSUM PROTO
------ ------ ------ ------ ------ ------ ------
241    266    0      0      0      0      0


RX     TX     DROP   CHKSUM ACKERR RST    RXMIT  SYNRST SYNDRP
------ ------ ------ ------ ------ ------ ------ ------ ------
241    266    0      0      0      2      43     0      0

(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
RX	Requests received
TX	Responses sent

Field	Description
DROP	Requests dropped
HDR	Invalid TCP header
FRAG	IP fragment
CHKSUM	Invalid checksum
ACKERR	Number of segments with a bad acknowledgement
RST	TCP resets
RXMIT	Retransmits
SYNRST	TCP SYNs for closed ports
SYNDRP	TCP SYNs for dropped connections

Configuring MAC-Based RADIUS

SafeGuard OS supports MAC-based RADIUS as an active authentication method. MAC-based authentication is a Layer 2 interface-based authentication method that uses the MAC address of the client for authentication.

SECURITY: Because MAC addresses can be spoofed on a network, use this authentication method only for IP devices that cannot function as 802.1x supplicants, such as printers or IP phones.

MAC-based RADIUS authentication begins when the system sees IP traffic from a new host interface. The MAC address is sent internally in ASCII format without colons for both a user name and user password to the local database. If the user does not exist in the local database, the system generates a RADIUS PAP request to the RADIUS server for authentication.

To configure the local database for MAC-based RADIUS supplicants, follow the procedure in *Adding or Deleting a User from the Local Authentication Database on page 258*. Be sure to use the MAC address in ASCII format without colons for both the user name and user password.

MAC-based RADIUS is enabled on individual interfaces. Use the **aaa mac-radius** command in Interface Configuration mode to enable an interface. Use the **no** version of the command to disable an interface.

```
aaa mac-radius
```

```
no aaa mac-radius
```

These commands have no parameters or variables. The following example enables MAC-based RADIUS on interface 0/8:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/8
(SafeGuardOS) (interface 0/8) #aaa mac-radius
(SafeGuardOS) (interface 0/8) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Use the **show mac-radius configuration** command in Privileged Exec Mode to verify the configuration. For example, the previous configuration of interface 0/8 displays as follows:

```
(SafeGuardOS) #show aaa mac-radius configuration
Interfaces..................................... 0/8
(SafeGuardOS) #
```

Configuring Device Authentication Lists

Sometimes the normal authentication process needs to be circumvented for a user or a process. SafeGuard OS allows for the creation of special lists—authentication lists—to handle these situations. This chapter explains how to configure those authentication lists.

The authentication manager allows you to use these special purpose lists:

- White list – Allows you to authenticate a user manually. The white list is a mechanism to pre-provision a users' authentication status. When traffic is seen from a new host, the authentication system consults the white-lists for an entry that matched based on some criteria. If a match is found, the system simulates a user authentication event, which results in the host being automatically authenticated.

  There are two types of white list:

  — Simple – Identifies the user being placed on the white list by IP address, subnet mask, MAC address, or MAC mask.

  — Extended – Identifies the user by using an extensive set of attributes gathered from mapping and authentication events.

- Grey list – Allows you to run scripts on a user's machine without logging the credentials of the administrator.

See the following sections for more details:

- *Configuring Simple White Lists*
- *Configuring Extended White Lists*
- *Configuring Grey Lists*

Configuring Simple White Lists

This section describes how to create, remove, and display a simple white list. See the following sections for more details.

- *Creating a Simple White List*
- *Removing a Simple White List Entry*
- *Displaying a Simple White List*

Creating a Simple White List

Use the simple form of white list when the IP or MAC address information is readily available, or when backwards compatibility to older releases is desired.

To create a white list, use the **aaa session-tracking white-list id** command in Global Configuration mode.

aaa session-tracking white-list id *int* **user** *name*
[[**mac-address** *macaddr* **mac-mask** *macmask*]|
[**ip-address** *ipaddr* **net-mask** *netmask*]] [**host** *hostname*]
[**comment** *text*] [**role** *rolename*] [**force-timeout** *sec*]

Syntax Description	*int*	An unique integer for this white-list entry.
	name	A string identifying the user.
	macaddr	The MAC address for this user session. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	macmask	Specifies the MAC mask in dotted-quad notation. To specify a wildcard match, use zeros in the lower portion of the mask, i.e. ff:ff:ff:00:00:00
	ipaddr	IP address of the user.
	netmask	Specifies the IP mask. To specify a wildcard match, use zeros in the lower portion of the address, i.e. 255.255.255.0
	hostname	Hostname of the client machine.
	text	Description or comment as to why this entry is being made. Enter comments within double quotation marks.
	rolename	Role being assigned to this user. Once assigned, the user no longer runs role derivation; the system uses this assignment.
	sec	Specifies the timeout in seconds. Valid range is 0 to 518400 seconds. Default is 0 seconds. Specifying 0 seconds indicates no timeout for the session being placed on the white list. Note that a white-list force-timeout value will take precedence over a protocol-based timeout.

In the following example, user cisco_1_&2_users is added to the white list and is authenticated with the role of engineer:

```
(SafeGuardOS) #configure terminal
```

```
(SafeGuardOS) (config) #aaa session-tracking white-list id 1
user cisco_1_&_2_users ip-address 170.25.68.10 net-mask 255.255.255.0
host stonehenge comment “engineering requirements” role engineer
force-timeout 20
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Removing a Simple White List Entry

Removing a white list entry reinstates the user to the normal authentication process. To remove a user from the white-list, use the **no** form of this command:

no aaa session-tracking white-list id *id*

Syntax Description	*id*	A unique ID to identify the client being deleted from the list.

Displaying a Simple White List

To see white list entries, use the **show aaa session-tracking white-list** command in Global Configuration mode.

show aaa session-tracking white-list

There are no options or parameters for this command.

The following example is representative of the command output:

```
(SafeGuard OS) (config) #show aaa session-tracking white-list

Number of Entries : 2

Id ..................................... 1
User ................................... cisco_1_&_2_users
Mac Address ............................ 00:00:00:00:00:00
Mac mask ............................... 00:00:00:00:00:00
Ip Address ............................. 170.25.68.0
Net mask ...............................255.255.255.0
Host name .............................. Stonehenge
Role name .............................. Engineer
Auth state ............................. ok
Timeout ................................ 0
Comment ................................ Engineering requirements

Id ..................................... 3
User ................................... printer
Mac Address ............................ 12:3c:3f:5d:00:00
Mac mask ............................... ff:ff:ff:ff:ff:00
Ip Address ............................. 0.0.0.0
Net mask ...............................0.0.0.0
Host name .............................. Piccadilly
Role name ..............................
Auth state ............................. ok
```

```
Timeout ..................................... 0
Comment ..................................... unauthenticated printers
(SafeGuard OS) (config) #
```

Field	Description
ID	A unique system-wide ID.
User Name	The userid of the client being added to the list.
MAC Address	MAC address for the interface of the user. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
MAC Mask	The mask for the MAC address.
IP Address	The IP address of the user.
Netmask	The mask for the IP address.
Host Name	The hostname of the client machine.
Role Name	The role assigned to this user.
Auth State	Indicates whether the user was able to successfully authenticate.
Timeout	Indicates the force-timeout setting.
Comment	A description or comment as to why this entry is being made.

Configuring Extended White Lists

Like the simple white list, the extended white list manually sets the authentication state for a host. In addition to the simple criteria such as subnet and MAC address, the extended white lists provide the ability to recognize trusted systems based on a range of criteria such as the source port or VLAN, or the time of day. Extended white lists also provide the ability to combine these attribute requirements into arbitrarily complex statements.

To create an extended white list:

1 (Optional) Create one or more attribute rule sets. An attribute rule set is a collection of match statements. While it is possible to create an extended white list without using attribute rule sets, an attribute rule set allows many white list

entries to call on the same set of match conditions. An attribute rule set is comprised of:

— The name of the rule

— (Optional) A description

— (Optional) An operation

— A set of match statements

2 Create the extended white list entry. The white list entry is comprised of:

— The name of the white list entry

— (Optional) A description

— (Optional) An operation

— One or more match statements

— A set command that reflects how to set user name and role values

3 Apply the white list and assign a precedence number

Create an Attribute Rule Set

Choose to place your match statements in an attribute ruleset, place them inline within the extended white list entry, or a mixture of the two.

1 Create the attribute rule set by assigning a name to the rule.

If you choose to create an attribute rule set, start by naming the attribute rule set. The name is a text string to identify the rule; the name has no bearing on the matches it performs. It must be unique within the system.

To assign a name to an attribute rule set, enter rule map submode by using the **aaa attribute-rule** command in Global Configuration mode:

aaa attribute-rule *rule_name*

Syntax Description	*rule_name*	The name of the attribute rule being created.

The following example creates an attribute rule set called “briefingCtr”:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa attribute-rule briefingctr
(SafeGuardOS) (attr-rule)#
```

To remove an attribute rule set, use the **no** version of this command.

2 (Optional) Add a description of the attribute rule set.

This step allows you to define a string that describes the entry. Specify the description in double quotation marks. In Attribute Rule submode, use the **description** statement using the following syntax:

description *string*

Syntax Description	*string*	The description of the attribute rule being created. Enter the string in double quotation marks.

The following example creates a description statement for the customer briefing center attribute rule set:

```
(SafeGuardOS) (config) #aaa attribute-rule briefingctr
(SafeGuardOS) (attr-rule) #description “Customer Briefing Center rules”
(SafeGuardOS) (attr-rule) #
```

To delete a description statement, use the **no** version of the command.

3 (Optional) Specify logical operators.

Attribute rule sets support the boolean AND and OR logical operators when performing the attribute match. When the AND operator is specified, all match statements within an attribute rule set must evaluate to true for the attribute rule set to be true. When the OR operator is specified, the attribute rule set is true if any of the match statements are true. The expression is short-circuit evaluated for increased system performance. Use the following syntax for the **operation** statement in Attribute Rule submode:

operator [AND | OR]

Syntax Description	**AND**	Specifies that all of the conditions in the following match statements must be true for the attribute rule to be true.
	OR	(Default) Specifies that only one of the match statements must be true for the attribute rule to be true.

The following example explicitly sets the criteria for a customer briefing center. The `match` statement requirements are described in the next step.

```
(SafeGuardOS) (config) #aaa attribute-rule briefingctr
(SafeGuardOS) (attr-rule) #description “Customer Briefing Center rules”
(SafeGuardOS) (attr-rule) #operation and
(SafeGuardOS) (attr-rule) #match system.srcIP contained-by 172.58.0.0/24
(SafeGuardOS) (attr-rule) #match system.timeOfDay contained-by 8:00 /
   17:00
(SafeGuardOS) (attr-rule) #exit
(SafeGuardOS) (config) #
```

4 Define the match conditions.

The match statement describes what constitutes a match against the attribute rule. All match attributes are string values that are identified in the system by an attribute class and an attribute name. The notation for attributes is: *class.name.*

NOTE: Match statements are not case sensitive.

Attribute rule sets support two types of attribute data:

— System Attributes

These attributes are common system attributes that are available for every mapping event.

— DHCP Attributes

These attributes can be found if the mapping is DHCP-based.

5 Specify the match statements.

To match attribute values, use the **match** command in Attribute Rule mode:

match *class.name rule-op value*

Syntax Description	*class.name*	Name of the attribute based on the authentication type. See the following list of attributes by class: ■ System attribute are shown in *System Attributes for Attribute Rules on page 241*. ■ DHCP attributes are shown in *DHCP Attributes for Attribute Rules on page 243*.
	rule-op	Each attribute type can support one or more rule comparator operations depending the *class.name*. The comparator operators are defined as: ■ exists – The attribute exists in the authentication event ■ equals – The attribute value matches the user-supplied rule value ■ contains – The attribute value contains the user-supplied rule value ■ contained-by – The attribute is completely contained by the rule value ■ less-than – The numeric value is converted and compared to see if it is less than the value in the mapping table ■ greater-than – The numeric value is converted and compared to see if it is more than the value in the mapping table ■ not – Inverts the match criteria
	value	Value can have one or more items listed as entries. Multiple entries are listed and separated by commas. String values are not case sensitive.

Table 18 System Attributes for Attribute Rules

Attribute	Description
system.domainName	Match rule based on value of domain name. Supported operations for this attribute are: ■ contains ■ equals ■ not
system.mapType	Match rule based on mapping type used. Supported operations for this attribute are: ■ equals ■ not

Table 18 System Attributes for Attribute Rules *(continued)*

Attribute	Description
system.portNum	Match rule based on user slot/port. Supported operations for this attribute are: ■ equals ■ greater-than ■ less-than ■ not
system.srcIP	Match rule based on source IP. Supported operations for this attribute are: ■ contains ■ equals ■ not
system.srcMAC	Match rule based on source MAC. Supported operations for this attribute are: ■ contains ■ equals ■ not
system.timeOfDay	Match rule based on current system time. Supported operations for this attribute are: ■ contained-by ■ equals ■ greater-than ■ less-than ■ not
system.vlanID	Match rule based on the value of the user VLAN ID. Supported operations for this attribute are: ■ equals ■ greater-than ■ less-than ■ not

Table 19 DHCP Attributes for Attribute Rules

dhcp.netmask (1)	Match rule based on value of dhcp.netmask. Supported operations are: ■ equals ■ exists ■ not
dhcp.timeOffset (2)	Match rule based on the value of dhcp.timeOffset. Supported operations are: ■ equals ■ exists ■ greater than ■ less than ■ not
dhcp.router (3)	Match rule based on value of dhcp.router. Supported operations are: ■ contained by ■ equals ■ exists ■ not
dhcp.hostName (4)	Match rule based on value of dhcp.hostName. Supported operations are: ■ contains ■ equals ■ exists ■ not
dhcp.domainName (15)	Match rule based on value of dhcp.domainName. Supported operations are: ■ contains ■ equals ■ exists ■ not
dhcp.serverIP (54)	Match rule based on value of dhcp.serverIP. Supported operations are: ■ contained by ■ equals ■ exists ■ not

Table 19 DHCP Attributes for Attribute Rules *(continued)*

dhcp.vendorClass (60)	Match rule based on value of dhcp.vendorClass. Must be ASCII text string in order to be processed (if not, any rule matches against them will fail). Supported operations are: ■ contains ■ equals ■ exists ■ not
dhcp.userClass (77)	Match rule based on value of dhcp.userClass. Must be ASCII text string in order to be processed (if not, any rule matches against them will fail). Supported operations are: ■ contains ■ equals ■ exists ■ not
dhcp.leaseTime (51)	Match rule based on the value of the lease time option. Supported operations are: ■ equals ■ exists ■ greater than ■ less than ■ not

After specifying the match conditions, verify the attribute rule configuration using the **show aaa attribute-rules** command in Privileged Exec mode. For details of this command, see *Showing Attribute Rules Information on page 249*.

Create an Extended White List Entry

The extended white list allow you to specify a set of attributes for a host or a group of hosts.

As mentioned earlier, place match statements in an attribute rule and then reference that rule in the extended white list entry, or place them inline within the extended white list entry, or a mixture of the two.

1 Create the extended white list by assigning a name to the entry.

The name of an extended white list is a text string to identify the entry; the name has no bearing on the matches it performs. It must be unique within the white list.

To assign a name to an extended white list, enter White-list submode by using the **aaa extended white-list** command in Global Configuration mode:

aaa extended white-list *entry_name*

Syntax Description	*entry_name*	The name of the white list entry being created.

Suppose your IT department has a lab or office where they perform installations. The devices boot with a special DCHP class ID, which is changed during the installation. The following example creates an extended white list entry called "WHinstall" for those device installations.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa extended white-list WHinstall
(SafeGuardOS) (white-list)#
```

To remove a white-list entry, use the **no** version of the command after removing the apply. For details see *Removing an Extended White List Entry on page 248*.

2 (Optional) Add a description of the extended white-list entry.

This step allows you to define a string that describes the entry. Specify the description in double quotation marks. In White-list submode, use the **description** statement using the following syntax:

description *string*

Syntax Description	*string*	The description of the white list being created. Enter the string in double quotation marks.

The following example creates a description statement for DHCP installations:

```
(SafeGuardOS) (config) #aaa extended white-list WHinstall
(SafeGuardOS) (white-list)#description "DHCP installs white list"
(SafeGuardOS) (white-list)#
```

To delete a description statement, use the **no** version of the command.

3 (Optional) Specify logical operators

Extended white-list entries support the boolean AND and OR logical operators when performing the attribute match. When the AND operation is specified the set statements are only evaluated if all the match statements are true. If the OR operation is specified, the set statements are evaluated if any of the match statements are true. The expression is short-circuit evaluated for increased system performance. Use the following syntax for the **operation** statement in White-list submode:

operation [AND | OR]

Syntax Description		
	AND	Specifies that all of the conditions in the following match statements must be true for the attribute rule to be true.
	OR	(Default) Specifies that only one of the match statements must be true for the attribute rule to be true.

The AND logical operator specifies that all conditions must be said to match.

```
(SafeGuardOS) (config) #aaa extended white-list WHinstall
(SafeGuardOS) (white-list)#description “DHCP installs white list”
(SafeGuardOS) (white-list)#operation and
```

4 Specify the match statements.

Match statements can be included directly in the body of an extended white list, or indirectly using an attribute rule. For more information on match statements see *Specify the match statements. on page 240*.

To build on our existing example:

```
(SafeGuardOS) (config) #aaa extended white-list WHinstall
(SafeGuardOS) (white-list)#description “DHCP installs white list”
(SafeGuardOS) (white-list)#operation and
(SafeGuardOS) (white-list)#match system.srcIP contained-by 192.168.0.0 /
   24
(SafeGuardOS) (white-list)#match dhcp.classID equals “DLSINSTL”
```

5 Set the values in the attribute map.

Values in the attribute map can be set two ways:

— They can be set the current value of an attribute in the map.

— They can be set explicitly using the command line. Use the **set** statement in White-list submode using this syntax:

set *system.attr* [*value* | **value-of** *class.attr*]

Syntax Description		
	system.attr	The name of a system attribute. Possible values are: ■ system.roleName ■ system.forceAgeOut ■ system.userName
	value	The value of the attribute in the attribute map, such as the value of dhcp.classID.

	class.attr	The name of a system or DHCP attribute. These attributes are listed in *Table 18 on page 241* and *Table 19 on page 243*.

When both match conditions are satisfied, the set command assigns the user name and role for the host.

```
(SafeGuardOS) (config) #aaa extended white-list WHinstall
(SafeGuardOS) (white-list)#description “DHCP installs white list”
(SafeGuardOS) (white-list)#operation and
(SafeGuardOS) (white-list)#match system.srcIP contained-by 192.168.0.0 /
   24
(SafeGuardOS) (white-list)#match dhcp.classID equals “DLSINSTL”
(SafeGuardOS) (white-list)#set system.username “INSTALL”
(SafeGuardOS) (white-list)#set system.roleName “ONLYIT”
(SafeGuardOS) (white-list)#
```

The same result could be accomplished using an attribute rule that could be referenced by multiple extended white list entries:

```
(SafeGuardOS) (config) #aaa attribute-rule installMachine
(SafeGuardOS) (attr-rule)#description “DHCP match conditions”
(SafeGuardOS) (attr-rule)#operation and
(SafeGuardOS) (attr-rule)#match system.srcIP contained-by 192.168.0.0 / 24
(SafeGuardOS) (attr-rule)#match dhcp.classID equals “DLSINSTL”
(SafeGuardOS) (attr-rule)#exit
(SafeGuardOS) (config) #
(SafeGuardOS) (config) #aaa extended white-list WHinstall
(SafeGuardOS) (white-list)#description “DHCP installs white list”
(SafeGuardOS) (white-list)#match attribute-rule installMachine
(SafeGuardOS) (white-list)#set system.username “INSTALL”
(SafeGuardOS) (white-list)#set system.roleName “ONLYIT”
(SafeGuardOS) (white-list)#exit
(SafeGuardOS) (config) #
```

Apply the White List and Assign a Precedence

The final step is to apply the white list. White lists are evaluated in precedence order from lowest number (1) to highest number (65535). Do not assign the same precedence number to multiple white lists.

Use the **aaa extended white-list apply** command in Global Configuration mode using the following syntax:

aaa extended white-list apply *list_name* (**precedence** *number*)

Syntax Description	*list_name*	Name of the white list that is being bound.
	number	Specifies the precedence order for the white list. Valid values are 1 through 65535, with 1 being the highest precedence value.

The apply command for the DHCP install scenario is:

```
(SafeGuardOS) (config) # aaa extended white-list apply WHinstall precedence 100
(SafeGuardOS) (config) #
```

Removing an Extended White List Entry

Before removing the extended white list entry, remove the apply for the white-list using the following command in Global Configuration mode:

no aaa extended white-list apply *whitelist_name*

Syntax Description	*whitelist_name*	White list name in character string format.

The command has no options or parameters.

Next, remove the configured extended white list using the **no** version of the **aaa extended white-list** command.

no aaa extended white-list *whitelist_name*

Syntax Description	*whitelist-name*	White list name in character string format.

In this example, we are removing the extended white-list called "WHinstall".

```
(SafeGuardOS) (config) # no aaa extended white-list apply WHinstall
(SafeGuardOS) (config) # no aaa extended white-list specialUsers
(SafeGuardOS) (config) #
```

Displaying Extended White List Information

There are Privileged Exec **show** commands to display attribute rules and extended white list configurations:

Command	Use
show aaa attribute-rules	Displays configuration information for an attribute rule or for all attribute rules.
show aaa extended white-list application	Displays statistics and precedence information for one of more of the white lists.
show aaa extended white-list configuration	Displays the current configuration of one or more extended white lists.

Showing Attribute Rules Information

To display information about a single attribute rule or all attribute rules, use the **show aaa attribute-rules configuration** command using the following syntax:

show aaa attribute-rules configuration {*rule_name*}

Syntax Description	*rule-name*	Displays the description of the attribute rule. If you do not specify an attribute rule name, all configured attribute rules are displayed.

Specifying the command without a attribute rule name displays all the configured attribute rules.

The following example is representative of the command output:

```
(SafeGuardOS) #show aaa attribute-rules configuration installMachine
aaa attribute-rule installMachine
        description "DHCP match conditions"
        operation and
        match system.srcIP contained-by "192.168.0.0 / 24"
        match dhcp.classID equals "dlsinstl"
(SafeGuardOS) #
```

Showing Extended White List Usage

To display the activity level of one or more extended white list entries, use the **show aaa extended white-list application** command in Privileged Exec mode:

show aaa extended white-list application {*whitelist_name*}

Syntax Description	*whitelist_name*	(Optional) Displays the usage for the specified white list. If you do not specify a white list name, all configured white list entries are displayed.

The following example is representative of the command output:

```
(SafeGuardOS) #show aaa extended white-list application whinstall
Precedence  White-List Name                Hit Count       Hit Failure
-------------------------------------------------------------------------
100         WHinstall                      3            0

(SafeGuardOS) #
```

The fields in the output represent:

Field	Description
Precedence	The precedence order for the white list. Valid values are 1 through 65535, with 1 being the highest precedence value.
White List Name	The name of the white list entry.
Hit Count	The number of times a white list's condition has matched causing the variables to be set.
Hit Failures	The number of times a match was made, but the variable could not be assigned.

Showing an Extended White List Configuration

To display the configuration of one or more white list entries, use the **show aaa extended white-list configuration** command in Privileged Exec mode:

show aaa extended white-list configuration {*whitelist_name*}

Syntax Description	*whitelist_name*	(Optional) Displays the configuration for the specified white list entry. If you do not specify a white list name, all configured white list entries are displayed.

The following example is representative of the command output:

```
(SafeGuardOS) #show aaa extended white-list configuration whinstall
aaa extended white-list WHinstall
        description "DHCP installs white list"
        operation and
        match attribute-rule installMachine
        set system.userName "INSTALL"
        set system.roleName "ONLYIT"
(SafeGuardOS) #
```

Configuring Grey Lists

A user on a grey list is ignored during authentication.For environments where scripts are pushed-down from the system to users on a regular basis, you can filter PDU events by creating a grey list for the administrator. Entries that are on a grey list are not logged by the system.

Creating a Grey List Entry

To create a grey list entry, use the **aaa session-tracking grey-list id** command in Global Configuration mode:

aaa session-tracking grey-list id *entryid* **user** *name* {**is-partial**}

Syntax Description	*entryid*	A unique numerical ID.
	name	The userid being dropped from logging.
	is-partial	(Optional) Use to match part of a string.

In the following example, user admin is added to the grey list.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa session-tracking grey-list id 1 user admin
is-partial
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Removing a Grey List Entry

Removing a grey list entry causes the system to log the update to the credential. To remove a user from the grey-list, use the **no** form of this command:

no aaa session-tracking grey-list id *entryid*

Syntax Description	*entryid*	The system-generated number for this entry.

Displaying a Grey List

To see grey list entries, use the **show aaa session-tracking grey-list** command in Global Configuration mode.

show aaa session-tracking grey-list

There are no options or parameters for this command.

The following example is representative of the command output:

```
(SafeGuardOS) (config) #show aaa session-tracking grey-list


Grey List Table
---------------

Number of Rows:1

ID    User                                Is Partial
--    ----                                ----------
```

```
1     admin                              yes

(SafeGuardOS) (config) #
```

Field	Description
ID	A system-generated indicator.
User	The userid of the user not being logged.
Is Partial	A partial string identifier used when you want to match part of a string

Setting Up Authentication Servers

This chapter explains the different types of user authentication available in SafeGuard OS. It also explains how to configure the SafeGuard device using the CLI to achieve the maximum benefit in your deployment. It contains the following sections:

- *Configuring RADIUS Servers*
- *Maintaining Users*
- *Displaying User Sessions*
- *Configuring Remote Authentication*

Configuring RADIUS Servers

RADIUS servers are identified to SafeGuard OS by unique integers. To configure a RADIUS server, use the following command in Global Configuration mode:

aaa radius-server Global Configuration command.

aaa radius-server *id* [**ip-address** *ipaddr*] [**key** *secret*][**port** *authport*] [**retransmit** *retries*] [**timeout** *seconds*]

Syntax Description	*id*	Unique numeric identifier for the RADIUS server. Valid range is 0 (primary) and 1 (secondary).
	ipaddr	The IP address of the RADIUS server.
	secret	Shared secret as configured on the RADIUS server for this client.
	authport	The authentication port.
	retries	Number of times to retry a request to the backend server. The default is 3.

	seconds	Number of seconds between retries to the backend server. The default is 3.

The following example configures the a RADIUS server:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa radius-server 1 ip-address 192.200.187.101 key
r0kar0unddaCl0ck port 4078 retransmit timeout 4
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To remove a RADIUS server, use the **no** version of the command. For example:

```
(SafeGuardOS) (config) #no aaa radius-server 1
```

Displaying RADIUS Configurations

There are Privileged Exec **show** commands to display RADIUS configurations:

Command	Use
show aaa radius server configuration	Displays either a specific RADIUS server configuration or all RADIUS configurations.
show aaa radius server statistics	Displays the statistics.

Show AAA RADIUS Server Configuration

The **show aaa radius-server configuration** command displays information about RADIUS configurations. The Privileged Exec command has the following syntax:

show aaa radius-server configuration {**id** [**0**|**1**]}

Syntax Description	**id**	(Optional) Unique numeric identifier for the RADIUS server. Valid range is 0 and 1.

In this example we are requesting the configuration information of RADIUS server 0:

```
(SafeGuardOS) # show aaa radius-server configuration id 0
(SafeGuardOS) #
```

The following output is representative of the command:

```
(SafeGuardOS) # show aaa radius-server configuration id 0

                                        Secret      Message
Current   IP Address     Port   Type    Configured Authenticator
------- --------------- ---- --------- ---------- -------------
   *      172.16.0.20   1812 Primary   Yes        Enable

(SafeGuardOS) #
```

Show AAA RADIUS Server Statistics

The **show aaa radius-server statistics** command provides information about the transmissions to and from the server. The Privileged Exec command has the following syntax:

```
show aaa radius-server statistics
```

The command has no options or keywords. The following example and sample output are representative of the command:

```
(SafeGuardOS) #show aaa radius-server statistics

Server..................................... 172.16.0.20
Total Request.............................. 0
Total Pending.............................. 0
Total Retransmit........................... 0
Total OK................................... 0
Total Failed............................... 0
RTT........................................ 0
Total Challenged........................... 0
Total Timeout.............................. 0
Total Bad Authenticator.................... 0
Total Other................................ 0
(SafeGuardOS) #
```

The output of the command has these fields:

Field	Description
Server	The IP address of the RADIUS server.
Total Requests	The total number of RADIUS queries sent to this server.
Total Pending	The total number of queries pending for this server.
Total Retransmit	The total number of requests that were transmitted again.
Total OK	The total number of successful requests to the RADIUS server.
Total Failed	The total number of all failures on the RADIUS server.
RTT	The round-trip time for the request.
Total Challenged	The number of requests that were challenged.
Total Timeout	The number of times a query request timed-out for the RADIUS server.
Total Bad Authenticator	The number of requests with a bad authenticator field.
Total Other	The total number of other types of failures.

Configuring Active Directory Servers

For networks using Active Directory (AD) for authentication, SafeGuard OS can query the backend AD servers for user attributes. SafeGuard OS maintains a list of the AD servers and retrieves the information from AD by domain name and by server IP address. You can have multiple servers per domain. SafeGuard OS first searches AD by domain, then by IP address.

To add an AD server to the system's list, use the **aaa ldap-server** command in Global Configuration mode:

```
aaa ldap-server domain ip [bind-dn dn]
[password pwd | password-encrypted pwd]
   [base-dn base]{timeout secs} {port num} {no-ssl}
```

Syntax Description	*domain*	Specifies the domain for the LDAP server. You can have multiple servers per domain.
	ip	The IP address of the domain server.
	dn	The Distinguished Name used in the LDAP bind.
	pwd	The login password used for the LDAP bind.
	base	Specifies the Distinguished Name used as a root of all LDAP searches.
	secs	(Optional) Number of seconds to the backend server. The valid range is 1 to 60 seconds. The default is 1 second.
	num	(Optional) The TCP port number.
	no-ssl	(Optional) Turns off secure socket layer. No information is encrypted.

The following example configures a server:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa ldap-server authdomain 172.58.36.17 bind-dn
cn=Administrator,c=Users,dc=Alcatel-Lucent,dc=com password m00nllght base-dn
dc=Alcatel-Lucent,dc=com
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To remove an AD server, use the **no** version of the command. For example:

```
(SafeGuardOS) (config) #no aaa ldap-server authdomain 172.58.36.17
```

Displaying Active Directory Configurations

There are Privileged Exec **show** commands to display AD and LDAP configurations. See the following sections:

- *Showing AAA LDAP Servers Configuration*
- *Showing AAA LDAP Servers Status*

Showing AAA LDAP Servers Configuration

To display information about AD and LDAP configurations, use the **show aaa ldap-servers configuration** command. The Privileged Exec command has the following syntax:

```
show aaa ldap-servers configuration
```

The command has no options or parameters. In the following example is representative of the output.

```
(SafeGuardOS) # show aaa ldap-servers configuration

Server Domain..................................... authdomain

Server IP......................................... 172.58.36.17

Bind DN........................................... cn=Administrator,c=Users,dc=auth,dc=com

Base DN........................................... dc=Alcatel-Lucent,dc=com

Timeout........................................... 1

Port Number....................................... 636

SSL............................................... Enabled

(SafeGuardOS) #
```

The output of the command has these fields:

Field	Description
Server Domain	The domain name of the LDAP server.
Server IP	The IP address the server. This address must be unique across the device.
Bind DN	The Distinguished Name for the bind request.
Base DN	The Distinguished Name used as a root of all LDAP searches
Timeout	The currently configured time out.
Port Number	The port for contacting the LDAP server.

Field	Description
SSL	The secure socket layer. Valid values are: enabled or disabled. Enabled, is the default, and encrypts the connection Disabled indicates that passwords are in clear text.

Showing AAA LDAP Servers Status

The **show aaa ldap-servers status** command provides information about the transmissions to and from the server. The Privileged Exec command has the following syntax:

```
show aaa ldap-server status
```

The command has no options or keywords. The following example and sample output are representative of the command:

```
(SafeGuardOS) # show aaa ldap-servers status
Server Domain.............................. AUTH.DEV
Server IP.................................. 172.16.3.108
Server State............................... idle
Total Requests............................. 0
Total Responses............................ 0
Total Timeouts............................. 0
Bind Failures.............................. 0
Other Errors............................... 0
(SafeGuardOS) #
```

The output of the command has these fields:

Field	Description
Server Domain	The domain name of the LDAP server.
Server IP	The IP address the server. This address must be unique across the device.
Server State	The state of the server. Valid values are: ■ idle – The server is bound but is inactive ■ binding – The system is trying to bind to the server ■ pending – A request has been sent to this server and the system is waiting for a response
Total Requests	The total number of LDAP queries that have been sent to server.
Total Responses	The total number of complete responses received from this server.
Total Timeouts	The number of times a bind or query request has timed out from this server.

Field	Description
Bind Failures	The number of times the system has failed to find to this server.
Other Errors	The total number of failures, other than bind and timeouts, that have occurred on this server.

Maintaining Users

SafeGuard OS has a local authentication mechanism built-in to the authentication manager. You can use SafeGuard OS' authentication in stand-alone mode or use it with external authentication servers such as RADIUS. The local system also serves as a local mechanism to derive the role for a given user.

The database contains an entry for each user, which includes the user name, password, and the role being assigned to the user.

Adding or Deleting a User from the Local Authentication Database

The following sections describe adding and deleting users from the local authentication database.

- *Adding Users to the Database*
- *Deleting a User from the Database*
- *Continuing or Stopping Assigning Roles*

Adding Users to the Database

Enter the **aaa user** command in Global Configuration mode.

aaa user *username* **passwd** *password* {**role** *role*}

Syntax Description	*username*	The name of the user being added to the database. User names can be up to 31 characters long. **Note:** If you are adding a MAC RADIUS user, use the MAC address without colons as the uname and pwd.
	password	The login password. Login passwords can be up to 31 characters long.
	role	Once assigned, the user no longer runs role derivation; the system uses this assignment. This is an optional parameter.

The following example adds a user with and without a role:

```
(SafeGuardOS) (config) #aaa user test passwd test role engineer
(SafeGuardOS) (config) #aaa user test1 passwd test1
(SafeGuardOS) (config) #
```

Deleting a User from the Database

To remove a user from the database, use the **no** version of the **aaa** command in Global Configuration Mode.

no aa user *username*

For example:

```
(SafeGuardOS) (config) #no aaa user test1
(SafeGuardOS) (config) #
```

Displaying the Local Authentication Database

To display the contents of the user authentication database, use the **show aaa users database** Privileged Exec command:

show aaa users database

There are no parameters or options for this command.

The following example shows sample output from the **show aaa users database** command:

```
(SafeGuardOS) #show aaa users database

Contents of User authentication database
----------------------------------------
Number of Rows:206
User name    Encrypted Password   Role name
---------    ------------------   ---------
eap10        8D0R0K035[           Local 802.1x User
test         8=8D0U8=             engineer
user1        8E0U8D0M03
user10       8E0U8D0M035[
user100      8E0U8D0M035[5[
user101      8E0U8D0M035[03       Role-101
```

The fields in the output represent:

Field	Description
User Name	The username.
Encrypted Password	The user's encrypted password
Role Name	Role that will be assigned to this user when they log in.

Clearing an Authenticated User

Entries are aged from the user table at configurable intervals. You can also clear them by using the CLI. To clear authenticated users, use the **clear aaa user** Privileged Exec command.

clear aaa user [all | [ip-address *ipaddr*]]

Syntax Description	**all**	All user sessions are removed from the user table.
	ipaddr	The user session matching this IP address will be removed from the user table.

Displaying User Sessions

To display the status of a user session, use the **show sessions** Privileged Exec command:

show sessions

This command does not have any options or parameters. The following output is representative of the **show sessions** command:

```
(SafeGuardOS) #show sessions

ID    User Name     Connection From   Idle Time    Session Time  Session Type
-- --------------  --------------  -----------  -----------  ------------
00 admin            EIA-232          01:55:40      90:29:43      Serial Port

01 admin            172.16.3.102     00:00:00      00:00:58      Telnet

(SafeGuardOS) #
```

Field	Description
ID	Unique session ID.
User Name	Username as detected by its authentication.
Connection From	The IP address or connection type. Valid connection types are: ■ EIA-232 ■ IP address of the remote telnet client
Idle Time	The amount of time the user in this session has been idle. The time is displayed in hour:minute:second format.
Session Time	The amount of time the user has been in this session. The time is displayed in hour:minute:second format.

Field	Description
Session Type	The type of connection the user is using. The session type can either be telnet or serial.

Configuring Remote Authentication

In addition to local authentication, SafeGuard OS also supports authentication by RADIUS servers.

To configure a RADIUS server, use the following checklist:

1. Configure the RADIUS servers on the SafeGuard device by using the **aaa radius-server** command described in *Configuring RADIUS Servers on page 252*.
2. Create an authentication login list that uses RADIUS as the authentication method. The commands for creating and displaying the configuration are described in *Adding or Deleting a User from the Local Authentication Database on page 258* and *Displaying the Local Authentication Database on page 259*.
3. Assign the list to the **`defaultLogin`** user to ensure that any non-configured users who attempt to login to the management port are authenticated against the RADIUS server. See *Assigning a Login List to the Default Login User on page 44* for further details.
4. Verify that your RADIUS list is assigned to the **`defaultLogin`** list using the **show running-config** command. This command is described in *Displaying Configuration Information on page 114*.
5. Configure users on the RADIUS server to have administrative access.

IEEE 802.1x Authentication

NOTE: IEEE 802.1x authentication applies to SafeGuard Switches, and does not apply to SafeGuard Controllers.

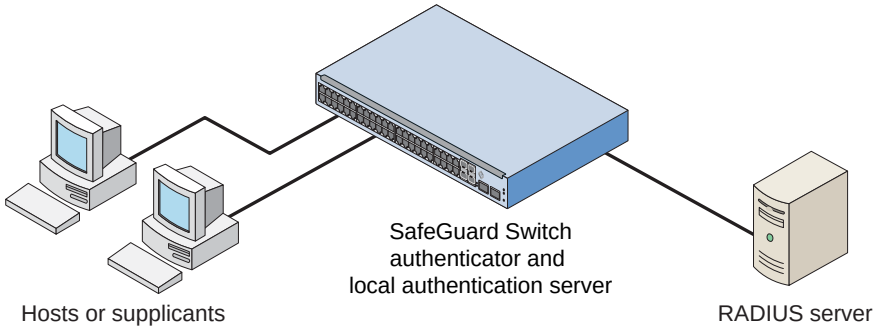
This section describes how to configure IEEE 802.1x, port-based authentication, on the SafeGuard Switch. The IEEE 802.1x is a standard for network access control that covers both wired and wireless network authentication for hosts or *supplicants.* Under 802.1x, the network port remains disconnected until the host completes authentication.

There are three components to an 802.1x implementation:

- Host – This component has many names, it is also referred to as the supplicant, the client, or the workstation. It is the device that is making the request to the LAN for switch services.
- Switch – This component is the SafeGuard Switch. The switch controls the physical access to the network using the authentication status of the host.
- RADIUS server – This component is the remote authentication server.

Figure 6 shows the relationship of these components.

Figure 6 802.1x Components



Communication between components is conducted using extensible authentication protocol (EAP). EAP messages are encapsulated in another protocol called EAP over LAN (EAPOL). 802.1X uses EAPOL to start and end the authentication session and pass EAP messages between the host and switch and from the host to the authentication server. EAP messages from the switch to an external authentication server use the RADIUS protocol.

See the following sections for more details:

- *Component Requirements*
- *Impact of Protection Modes on 802.1x*
- *Configuring IEEE 802.1x Authentication*
- *Displaying 802.1x Configuration Information*

Component Requirements

SafeGuard OS supports the following configurations:

- 802.1x supplicants running
  - Microsoft Windows XP
  - Microsoft Windows CE with Odyssey Software

- Open1x X supplicant for Linux systems

- RADIUS servers
  - OpenSource FreeRADIUS
  - Juniper Networks Steel-Belted Radius
  - Microsoft Internet Authentication Server (IAS) for Windows 2000
  - Microsoft IAS for Windows 2003
  - Open Systems Consultants Radiator

The SafeGuard Switch supports the following EAP authentication types or *methods* on hosts.

Table 20 Supported EAP Methods

Host Authentication Method	Operating Environment	Local Authentication	RADIUS Authentication
EAP-MD5 – Message Digest 5	Windows and Linux	Yes	Yes
EAP-TLS – Transport Layer Security	Windows and Linux	No	Yes
EAP-TTLS – Tunneled TLS	Linux only	No	Yes
PEAP – Protected EAP	Windows and Linux	No	Yes

Impact of Protection Modes on 802.1x

The SafeGuard Switch can be set for different security levels called *protection modes*. The protection level can influence how 802.1x behaves because it can change the forwarding mode.

- Pass-thru – This mode is the default for the switch. In this mode, the switch implements 802.1x in accordance to the standard but cannot take advantage of any of the SafeGuard features, such as security policies or role derivation.
- Monitor – The system monitors for policy visualization based on user-defined policy controls, however no enforcement actions are taken. In this mode, the switch uses the Authentication Manager to provide SafeGuard features, such as session tracking and role derivation for 802.1x authenticated hosts.
- Protect – The system monitors and enforces policies on user-defined and malware policy controls. In this mode, the switch is able to provide the same services as in monitor mode for 802.1x authenticated hosts in addition to enforcing policies.

For information on the protection-mode command and on changing the protection mode, see *Changing the Protection Mode of Ports on page 95*.

If you plan to take advantage of the SafeGuard features, in addition to setting the protection mode you need to control the port authorization state. You set the port's authorization state using the **aaa dot1x port-control** command, which works in either Global Configuration mode or in Interface Configuration mode. The commands use the following keywords:

Force Authorized

The port acts as if 802.1x is disabled. Any authorized host connected to the port does not need to support 802.1x. The Authentication Manager does not receive the credentials for the host but does receive the port's traffic because the unauthenticated policy is still applied.

Instead, the Authentication Manager derives the credentials using passive authentication (Kerberos, RADIUS), active authentication (Captive Portal, MAC RADIUS, or a white list), or from mapping information (DHCP, the SafeGuard processor.) When the user authenticates and a policy and role are applied, the port remains in the authenticated state even after the user clears the credentials.

Force Unauthorized

The port is blocked and is administratively unauthorized. Traffic is prohibited in all directions for all clients.

Auto

The port enforced 802.1x authentication for 802.1x clients and grants controlled access to an authenticated 802.1x client. 802.1x communicates status changes of clients with the Authentication Manager. The Authentication Manager removes the unauthenticated policy for 802.1x clients and applies the authentication policy and role after role derivation.

If the SafeGuard Switch is set in protect or monitor mode, you must also set the 802.1x port control mode to auto to take advantage of the SafeGuard features and 8021.x port access control.

NOTE: One 802.1x client (supplicant) is supported on a physical port. Clients/hosts attempting to access the port are permitted while the port is authenticated for one 802.1x client. In protect and monitor mode the additional hosts/clients can be authenticated with SafeGuard authentication features. The number of hosts permitted on a port can be controlled using port (MAC) security. Reference to chapter 5, page 156.

Configuring IEEE 802.1x Authentication

The primary process of configuring 802.1x authentication involves preparing for authentication, enabling 802.1x globally on the switch, specifying the port to use, and specifying the port control.

To configure 802.1x authentication:

NOTE: If you plan to connect the host to a VLAN, complete the VLAN configuration before setting up 802.1x authentication.

1 Prepare for authentication by configuring the following:

— One or more RADIUS servers for backend authentication. See *Configuring RADIUS Servers on page 252*.

— The local user database. See *Configuring Rule Maps on page 279*.

2 Enable 802.1x authentication globally for the switch, as follows:

By default, 802.1x is disabled. When disabled, the 802.1x configuration is retained and can be changed, but is not activated.

Use the **aaa dot1x system-auth-control** command in Global Configuration mode to enable 802.1x. Use the **no** version of the command to disable the dot1x authentication support.

```
aaa dot1x system-auth-control
```

```
no aaa dot1x system-auth-control
```

These commands have no options or parameters.

The following example enables 802.1x globally:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #aaa dot1x system-auth-control
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

3 Set the port authorization state either globally or at an interface level.

NOTE: This command has a substantial impact on the protection mode of the switch, see *Impact of Protection Modes on 802.1x on page 263* before configuring these commands.

To Set Globally:

To set the port authorization for the entire switch, use the **aaa dot1x port-control all** in Global Configuration mode. Use the **no** version of the command to reinstate the switch to the default value.

```
aaa dot1x port-control all [auto | force-authorized | force-
unauthorized]
```

no aaa dot1x port-control all

Syntax Description	**auto**	(Default) Specifies that all ports enforce 802.1x authentication for 802.1x clients and grants controlled access to an authenticated 802.1x client. 802.1x communicates status changes of clients with the Authentication Manager.
	force-unauthorized	Specifies that all ports are blocked and are administratively unauthorized. Traffic is prohibited in all directions for all clients.
	force-authorized	Specifies that the ports act as if 802.1x is disabled. Any authorized host connected to the port does not need to support 802.1x. The Authentication Manager does not receive the credentials for the host but does receive the port's traffic because the unauthenticated policy is still applied. Instead, the Authentication Manager derives the credentials using passive or active authentication.

The following example sets the authentication mode to force-unauthorized:

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) # aaa dot1x port-control all force-unauthorized
(SafeGuardOS) (config) # exit
```

To Set for an Interface:

Use the **aaa dot1x port-control** command in Interface Configuration mode to set the authentication mode for a specific port. Use the **no** version of the command to return to the default value of auto.

aaa dot1x port-control [**auto** | **force-authorized** | **force-unauthorized**]

```
no aaa dot1x port-control
```

Syntax Description	**auto**	(Default) Specifies that all ports enforce 802.1x authentication for 802.1x clients and grants controlled access to an authenticated 802.1x client. 802.1x communicates status changes of clients with the Authentication Manager.
	force-unauthorized	Specifies that all ports are blocked and are administratively unauthorized. Traffic is prohibited in all directions for all clients.
	force-authorized	Specifies that the ports act as if 802.1x is disabled. Any authorized host connected to the port does not need to support 802.1x. The Authentication Manager does not receive the credentials for the host but does receive the port's traffic because the unauthenticated policy is still applied. Instead, the Authentication Manager derives the credentials using passive or active authentication.

The following example sets the authentication mode to force-authorized on interface 0/12:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/12
(SafeGuardOS) (interface 0/12) #aaa dot1x port-control force-authorized
(SafeGuardOS) (interface 0/12) #
```

4 Initialize the port for auto (dot1x initialize).

5 Verify your configuration with the **show aaa dot1x** command.

Displaying 802.1x Configuration Information

There are Privileged Exec **show** commands to display 802.1x configuration and 802.1x-related information. See the following sections:

- *Showing a Detailed Configuration*
- *Showing 802.1x Statistics*

Showing a Detailed Configuration

Use the **show aaa dot1x detail** command to display the all of the 802.1x configuration information for a specified interface. The comm and has the following syntax:

show aaa dot1x detail *slot/port*

Syntax Description	*slot/port*	Displays the 802.1x configuration for this interface. The slot number is 0.

The following sample output is representative of the output:

```
(SafeGuardOS) #show aaa dot1x detail 0/22

Port..................................... 0/22
Protocol Version......................... 1
PAE Capabilities......................... Authenticator
Authenticator PAE State.................. Initialize
Backend Authentication State............. Initialize
Quiet Period............................. 60
Transmit Period.......................... 30
Supplicant Timeout....................... 30
Server Timeout (secs).................... 30
Maximum Requests......................... 2
Reauthentication Period.................. 3600
Reauthentication Enabled................. FALSE
Key Transmission Enabled................. FALSE
Control Direction........................ both

(SafeGuardOS) #
```

The fields in the output represent:

Display	Description
Port	Displays the interface number.
Protocol Version	Displays the protocol version associated with this port. The only possible value is 1, which corresponds to the first version of the 802.1x specification.
PAE Capabilities	Displays the port access entity (PAE) functions of this port. Possible values are Authenticator or Supplicant.

Display	Description
Authenticator PAE State	Displays the current state of the authenticator PAE state machine. Possible values are: ■ Initialize ■ Disconnected ■ Connecting ■ Authenticating ■ Authenticated ■ Aborting ■ Held ■ ForceAuthorized ■ ForceUnauthorized
Quiet Period	Displays the timer used by the authenticator state machine on this port to define periods of time in which it does not attempt to acquire a supplicant. The quiet period range is from 0 to 65535 seconds.
Transmit Period	Displays the timer value used by the authenticator state machine on the specified port to determine when to send an EAPOL EAP Request/Identity frame to the supplicant. The timer range is from 1 to 65535 seconds.
Supplicant Timeout	Displays the timer value used by the authenticator state machine on this port to timeout the supplicant. The timer range is from 1 to 65535 seconds.
Server Timeout (secs)	Displays the timer value used by the authenticator on this port to timeout the authentication server. The timer range is from 1 to 65535 seconds.
Maximum Requests	Displays the maximum number of times the authenticator state machine on this port retransmits an EAPOL EAP Request/Identity before timing out the supplicant. The request maximum has the range from 1 to 10.
Reauthentication Period	Displays the timer used by the authenticator state machine on this port to determine when reauthentication of the supplicant takes place. The period has the range of 1 to 65535 seconds.
Reauthentication Enabled	Displays whether reauthentication is enabled on this port. Possible values are true or false.
Key Transmission Enabled	Displays whether the key is transmitted to the supplicant for the specified port. Possible values are true or false.

Display	Description
Control Direction	Displays the control direction for the specified port. The control direction is always both directions.

Showing 802.1x Statistics

Use the **show aaa 802.1x statistics** command to display the statistics for a specified interface.

show aaa dot1x statistics *slot/port*

Syntax Description	*slot/port*	Displays the 802.1x statistics for this interface. The slot number is 0.

The following example is representative of the command output:

```
(SafeGuardOS) #show aaa dot1x statistics 0/22

Port..................................... 0/22
EAPOL Frames Received.................... 0
EAPOL Frames Transmitted................. 1
EAPOL Start Frames Received.............. 0
EAPOL Logoff Frames Received............. 0
Last EAPOL Frame Version................. 0
Last EAPOL Frame Source.................. 00:00:00:00:00:00
EAP Response/Id Frames Received.......... 0
EAP Response Frames Received............. 0
EAP Request/Id Frames Transmitted........ 0
EAP Request Frames Transmitted........... 0
Invalid EAPOL Frames Received............ 0
EAPOL Length Error Frames Received....... 0

(SafeGuardOS) #
```

The fields in the output represent:

Display	Description
Port	Displays the interface number.
EAPOL Frames Received	Displays the number of valid EAPOL frames of any type that are received by this authenticator.
EAPOL Frames Transmitted	Displays the number of EAPOL frames of any type that are transmitted by this authenticator.
EAPOL Start Frames Received	Displays the number of EAPOL start frames of any type that are received by this authenticator.

Display	Description
EAPOL Logoff Frames Received	Displays the number of EAPOL logoff frames of any type that are received by this authenticator.
Last EAPOL Frame Version	Displays the protocol version number carried in the most recently received EAPOL frame.
Last EAPOL Frame Source	Displays the source MAC address carried in the most recently received EAPOL frame.
EAP Response/ID Frames Transmitted	Displays the number of EAP response/identity frames transmitted by this authenticator.
EAP Response Frames Transmitted	Displays the number of valid EAP response frames (other than resp/id frames) received by this authenticator.
Invalid EAPOL Frames Received	Displays the number of EAPOL frames received by this authenticator in which the frame type is not recognized.
EAPOL Length Error Frames Received	Displays the number of EAPOL frames received by this authenticator that had a length error.

Showing Summary Information for 802.1x

Use the **show aaa dot1x summary** command to display a summary of the global 802.1x configuration for a specific interface or for all switch interfaces.

show aaa dot1x summary [*slot/port* | **all**

slot/port	Displays a summary of the 802.1x configuration for this interface. The slot number is 0.
all	Displays a summary of the 802.1x configuration for all interfaces.

This sample output represents output for a single port:

```
(SafeGuardOS) #show aaa dot1x summary 0/22

                                Operating      Reauthentication
Interface   Control Mode      Control Mode        Enabled        Port Status
--------- ----------------- ----------------- --------------- -------------
0/22      auto              auto              FALSE           Authorized
```

In this example, the output represents output for all ports.

```
(SafeGuardOS) #show aaa dot1x summary all

                           Operating          Reauthentication
Interface Control Mode     Control Mode       Enabled          Port Status
--------- ----------------- ----------------- --------------- -------------
0/1       auto              auto              FALSE           Unauthorized
```

```
0/2       auto               auto               FALSE          Unauthorized
0/3       auto               auto               FALSE          Unauthorized
0/4       auto               auto               FALSE          Unauthorized
0/5       auto               auto               FALSE          Unauthorized
0/6       auto               auto               FALSE          Unauthorized
0/7       force-authorized   force-authorized   FALSE          Authorized
0/8       force-authorized   force-authorized   TRUE           Authorized
0/9       auto               auto               FALSE          Unauthorized
0/10      auto               auto               FALSE          Unauthorized
0/11      auto               auto               FALSE          Unauthorized
0/12      auto               auto               FALSE          Unauthorized
0/13      auto               auto               FALSE          Unauthorized
0/14      auto               auto               FALSE          Unauthorized
0/15      auto               auto               FALSE          Unauthorized
0/16      auto               auto               FALSE          Unauthorized
0/17      auto               auto               FALSE          Unauthorized
0/18      auto               auto               FALSE          Unauthorized
0/19      auto               auto               FALSE          Unauthorized
0/20      auto               auto               FALSE          Unauthorized
0/21      auto               auto               FALSE          Unauthorized
0/22      auto               auto               FALSE          Unauthorized
0/23      auto               auto               FALSE          Unauthorized
0/24      auto               auto               FALSE          Unauthorized
0/25      auto               auto               FALSE          Unauthorized
0/26      auto               auto               FALSE          Unauthorized
0/27      auto               auto               FALSE          Unauthorized
0/28      auto               auto               FALSE          Unauthorized
0/29      auto               auto               FALSE          Unauthorized
0/30      auto               auto               FALSE          Unauthorized
0/31      auto               auto               FALSE          Unauthorized
0/32      auto               auto               FALSE          Unauthorized
0/33      auto               auto               FALSE          Unauthorized
0/34      auto               auto               FALSE          Unauthorized
0/35      auto               auto               FALSE          Unauthorized
0/36      auto               auto               FALSE          Unauthorized
0/37      auto               auto               FALSE          Unauthorized
0/38      auto               auto               FALSE          Unauthorized
0/39      auto               auto               FALSE          Unauthorized
0/40      auto               auto               FALSE          Unauthorized
 (SafeGuardOS) #
```

The fields in the output represent:

Display	Description
Interface	Displays the interface number.
Control Mode	Displays the configured control mode for this port. Possible values are: ■ force-unauthorized ■ force-authorized ■ auto

Display	Description
Operating Control Mode	Displays the control mode under which this port is operating. Possible values are: ■ authorized ■ unauthorized
Reauthentication Enabled	Displays whether re-authentication is enabled on this port. Values are either true or false.
Port Status	Displays the authorization of the port. Values are either authorized or unauthorized.

Optional 802.1x Configuration Commands

Optional 802.1x configuration commands are described in the following sections:

- *Clearing 802.1x Statistics*
- *Initializing the 802.1x Port*
- *Reauthenticating the 802.1x Port*
- *Configuring the Maximum Authentications for the 802.1x Port*
- *Re-authenticating the Supplicant for the 802.1x Port*
- *Configuring the 802.1x Port Timeout*

Clearing 802.1x Statistics

Use the **clear aaa dot1x statistics** command in Privileged Exec mode to reset the 802.1x statistics for a specified port or for all ports.

clear aaa dot1x statistics {*slot/port* | **all**}

slot/port	Port for which to reset statistics. The slot number is 0.
all	Clear statistics for all ports.

The following example is representative of the command:

```
(SafeGuardOS) #clear aaa dot1x statistics all

Are you sure you want to clear dot1x stats? (y/n)y

(SafeGuardOS) #
```

Initializing the 802.1x Port

Use the **aaa dot1x initialize** command in Privileged Exec mode to begin the initialization sequence on the specified port. This command is only valid if the control mode for the specified port is 'auto'. If the control mode is not 'auto' an error will be returned.

aaa dot1x initialize *slot/port*

slot/port	Port on which to begin initialization sequence. The slot number is 0.

The following example is representative of the command:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/5
(SafeGuardOS) (interface 0/5) #aaa dot1x initialize 0/5
(SafeGuardOS) (interface 0/5) #
```

Reauthenticating the 802.1x Port

User the **aaa dot1x re-authenticate** command in Privileged Exec mode to begin the re-authentication sequence on the specified port. This command is only valid if the control mode for the specified port is 'auto'. If the control mode is not 'auto' an error will be returned.

aaa dot1x re-authenticate *slot/port*

slot/port	Port on which to begin re-authentication sequence. The slot number is 0.

The following example is representative of the command:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/5
(SafeGuardOS) (interface 0/5) #aaa dot1x re-authenticate 0/5
(SafeGuardOS) (interface 0/5) #
```

Configuring the Maximum Authentications for the 802.1x Port

Use the **aaa dot1x max-req** command in interface configuration mode to set the maximum number of times the authenticator state machine on a port will transmit an EAPOL EAP Request/Identity frame before timing out the supplicant. Use the **no** form of the command to set the maximum number to the default.

aaa dot1x max-req *count*

no aaa dot1x max-req

count	Maximum number of transmissions. The range is 1 to 10. The default value is 2.

The following example is representative of the command:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/5
(SafeGuardOS) (interface 0/5) #aaa dot1x max-req 5
(SafeGuardOS) (interface 0/5) #
```

Re-authenticating the Supplicant for the 802.1x Port

Use the **aaa dot1x re-authentication** command in interface configuration mode to enable re-authentication of the supplicant for the specified port. Use the **no** form of the command to disable re-authentication. By default re-authentication is disabled.

aaa dot1x re-authentication

no aaa dot1x re-authentication

The following example is representative of the command:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/5
(SafeGuardOS) (interface 0/5) #aaa dot1x re-authentication
(SafeGuardOS) (interface 0/5) #
```

Configuring the 802.1x Port Timeout

Use the **aaa dot1x timeout** command in interface configuration mode to set the value, in seconds, of the timer used by the authenticator state machine on a port. Depending on the token used and the value (in seconds) passed, various timeout configurable parameters are set. Use the **no** form of the command to set the value to its default.

aaa dot1x timeout [**reauth-period** *seconds* | **quiet-period** *seconds* | **tx-period** *seconds* | **supp-timeout** *seconds* | **server-timeout** *seconds*]

no aaa dot1x timeout [**reauth-period** | **quiet-period** | **tx-period** | **supp-timeout** | **server-timeout**]

re-auth period seconds	Sets the value, in seconds, of the timer used by the authenticator state machine on this port to determine when re-authentication of the supplicant takes place. The reauthperiod must be a value in the range 1 - 65535. The default value is 3600.

quiet-period seconds	Sets the value, in seconds, of the timer used by the authenticator state machine on this port to define periods of time in which it will not attempt to acquire a supplicant. The quiet-period must be a value in the range 0 - 65535. The default value is 60.
tx-period seconds	Sets the value, in seconds, of the timer used by the authenticator state machine on this port to determine when to send an EAPOL EAP Request/Identity frame to the supplicant. The tx-period must be a value in the range 1 - 65535. The default value is 30.
supp-timeout seconds	Sets the value, in seconds, of the timer used by the authenticator state machine on this port to timeout the supplicant. The supp-timeout must be a value in the range 1 - 65535. The default value is 30.
server-timeout seconds	Sets the value, in seconds, of the timer used by the authenticator state machine on this port to timeout the authentication server. The supp-timeout must be a value in the range 1 - 65535. The default value is 30.

The following example is representative of the command:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #interface 0/5
(SafeGuardOS) (interface 0/5) #aaa dot1x timeout reauth-period 3000
(SafeGuardOS) (interface 0/5) #
```

Role Derivation

As discussed in *Authentication Component Process on page 203*, after a user authenticates, he or she is assigned to a user role. There are multiple methods for assigning a role to a user. One assignment method is to explicitly configure the role using the white list. Another method is to apply rule maps to groups of users.

Using this method, a role can be defined based on a set of rules called r*ule maps*. A rule map is a conditional set of statements that we process in a linear order to match the user attributes. Each rule map contains:

- A precedence value (which is the order that we apply the rule)
- A series of rules
- A name
- A description
- A value to set
- A logical AND or OR operation

Each rule in the rule map is evaluated, in order, against information in the user authentication event. If the rule map's conditions are met, the rule map is said to *match*. When a rule map matches, a role value can be assigned to the user.

The role value can be explicitly specified, or it can be derived based on the value of some information in the authentication event. For example, an explicitly specified role value would be where you place a user in group “systems”. The derived method would be to indicate that the user's role should be equal to the value of the authentication attribute, if one exists.

Rule maps are applied in order, based on their precedence. A rule map with a lower precedence is evaluated before a rule map with a higher precedence. After a rule map matches, the system can either stop evaluating rule maps or continue processing. The decision to stop or continue processing rule maps is user configurable.

Within a rule map, each individual rule is evaluated in the order it was configured. When the system determines that the current rule map matches, or cannot match, it stops processing rules in the current rule map and either assigns the role value (in the case of a match) or continues processing (in the case of a match failure). Some performance gains can be obtained with careful ordering of rules and rule maps.

If a rule map specifies the role value as an attribute using the value-of syntax, an error can occur if the specified attribute does not exist in the authentication attributes. For example, if the role value was configured to be based on the value of radius.filterId and the user did not use the RADIUS protocol, an error would occur. In this case, the system acts as if the rule map failed to match; the system continues to process and evaluates the next rule map. In addition, the system increments the “Hit Failure” counter to indicate a role-assignment failure.

The derived role information is passed to the policy component to bind the role to the network resource permissions. The importance of roles is further discussed in *Role Hierarchy on page 306*.

Match conditions are evaluated against information in the login event. This information is stored in attributes. All attributes are string values that are identified in the system by an attribute class and an attribute name. The notation for attributes is: *`class.name.`* The attribute class identifies the source of the attribute, such as DHCP, RADIUS, or AD. The attribute name is the protocol element that is unique to the authentication event.

System attributes are automatically created for each login event based on system parameters. These parameters are common to all authentication types and protocols. For example:

Attribute	Description
`system.userName`	The name of the user
`system.srcIP`	IP of the user interface
`system.authType`	Protocol used to authenticate

Attribute	Description
system.timeOfDay	Time of day when the user authenticated
system.roleName	A special attribute, used to assign a role to the user based on a rule-map match

AD and RADIUS also have attributes that can be used for deriving a role. AD attributes are queried using LDAP when a user authenticates. For each domain, the SafeGuard device has one or more domain controllers that it can query. RADIUS attributes are collected from the sniffed conversation between a NAS and a server. RADIUS attributes can also be collected from a Captive Portal login when it is implemented in the network. The system supports both standard RADIUS attributes and Vendor Supported Attributes (VSAs). In addition, DHCP options obtained when the client machined received it's IP address can also be used.

The following are examples of DHCP, AD, and RADIUS attributes:

Attribute	Description
ad.department	User department. Be sure that the department attribute on the AD Organization tab matches the department name you are entering into the Alcatel-Lucent database.
ad.distinguishedName	User's distinguished name, such as Alcatel-Lucent.com/Users/Bill Smith
ad.company	Employer, such as Alcatel-Lucent
ad.memberOf	List of AD groups to which the user belongs
ad.hostOperatingSystem	Host operating system where the user is logged in
radius.nasIP	IP address of the NAS
radius.calledStation	String indicating the network service accessed by the user
radius.Alcatel-Lucent.roleName	Vendor-specific attribute indicating the user role-name

See the following sections for more details:

- *Configuring Rule Maps*
- *Removing the Rule Map*
- *Displaying Rule Map Information*

Configuring Rule Maps

To creating a rule map, follow the steps described in the following sections:

1. *Assigning a Name*
2. *Adding a Description*
3. *Specifying Logical Operators (Optional)*
4. *Configuring the Rule Map Attributes*
5. *Setting the Role*
6. *Continuing or Stopping Assigning Roles*
7. *Applying the Rule Map and Assign a Precedence*

NOTE: The syntax for creating a rule map is lengthy. Use the syntax described in this section to define each user, or use the question mark (?) prompt and allow the CLI to guide the process. By using the prompted method, only the keyword choices that are applicable at that point in the process are shown. For ease, the prompted method of entry is recommended.

Assigning a Name

The name of a rule map is a text string to identify the rule map; the name has no bearing on the role being assigned. It must be unique within the system. To assign a name to a rule map, enter rule map submode by using the **aaa rule-map** command in Global Configuration mode:

aaa rule-map *rulemap_name*

Syntax Description	*rulemap_name*	The name of the rule map being created.

The following example creates a rule map called “sales”:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) # aaa rule-map sales
(SafeGuardOS) (rulemap) #
```

To remove a rule map, use the **no** version of this command.

Adding a Description

This optional step allows you to define a string that describes the entry. Specify the description in double quotation marks. In rule map submode, use the **description** statement using the following syntax:

description *string*

Syntax Description	*string*	Description of the rulemap being created. Enter the string in double quotation marks.

The following example creates a rule map for the sales department and adds a description string to it:

```
(SafeGuardOS) (config) # aaa rule-map sales
(SafeGuardOS) (rulemap) # description “rule map for the sales force”
(SafeGuardOS) (rulemap) #
```

Specifying Logical Operators (Optional)

Rule maps support the boolean AND and OR logical operators when performing the role match.

- When the AND operator is specified, a rule map is only evaluated when all of the conditions are met.
- When the OR operator is specified, a rule map is evaluated when any of the conditions are met.

The expression is short-circuit evaluated for increased system performance. Use the following syntax for the **operation** statement in rule map submode:

operation [AND | OR]

Syntax Description	**AND**	Specifies that all of the conditions in the following match statements must be said to match to set the role.
	OR	(Default) Specifies that only one of the conditions in the following match statements must be said to match to set the role.

The following example explicitly sets any user from hardware engineering, software engineering, or quality assurance to the role of “Engineering”. The match statement requirements are described in *Configuring the Rule Map Attributes*.

```
(SafeGuardOS) (config) # aaa rule-map engr
(SafeGuardOS) (rulemap) # description “HW, SW and QA are engineering”
(SafeGuardOS) (rulemap) # operation or
(SafeGuardOS) (rulemap) # match ad.department equals HARDWARE
(SafeGuardOS) (rulemap) # match ad.department equals SOFTWARE
(SafeGuardOS) (rulemap) # match ad.department equals QA
(SafeGuardOS) (rulemap) # set system.roleName “ENGINEERING”
(SafeGuardOS) (rulemap) # end
```

```
(SafeGuardOS) (config) #
```

In this example, the role name is picked up and assigned from the value on the Active Directory `department` attribute if the entry is listed on the AD server and the domain name has "corp" within the name.

```
(SafeGuardOS) (config) # aaa rule-map others
(SafeGuardOS) (rulemap) # description "the remainder of the company"
(SafeGuardOS) (rulemap) # operation and
(SafeGuardOS) (rulemap) # match ad.department exists
(SafeGuardOS) (rulemap) # match ad.domainName contains corp
(SafeGuardOS) (rulemap) # set system.roleName value-of ad.department
(SafeGuardOS) (rulemap) # end
(SafeGuardOS) (config) #
```

Configuring the Rule Map Attributes

The match statement describes what constitutes a match against the rule map. All match attributes are string values that are identified in the system by an attribute class and an attribute name. The notation for attributes is: *`class.name.`*

NOTE: Match statements are not case sensitive.

Table 21 Match Attributes When Creating a Rule

Attribute Area	Description
System Attributes	System attributes are common system attributes that are available for every authentication event.
DHCP Attributes	DHCP attributes are learned from DHCP protocol exchange.
AD Attributes	AD attributes are derived from an external LDAP server. Some attributes contain multiple values, such as ad.memberOf. Attributes with multiple values are separated by commas. For more details, see *Configuring Active Directory Servers on page 255*.  **Note:** The Distinguished Name (DN) is presented in AD canonical format. For example: "cn=John Smith,cn=Users,dc=Auth,dc=dev" would be translated to "auth.dev/Users/John Smith".

Table 21 Match Attributes When Creating a Rule *(continued)*

Attribute Area	Description
RADIUS Attributes	RADIUS attributes are learned from RADIUS protocol exchanges. The *class.name* notation in the **match** statement for standard RADIUS attributes would translate to: **radius.***attrName* For RADIUS vendor-specific extensions (VSAs), this would be **radius.***vendor.attrName*. For example, NAS-IP would be given as **radius.nasIP**, whereas 3 Com Corporation's User Access Level attribute would be given as **radius.3com.3Com-User-Access-Level**. Alcatel-Lucent Network's VSA is **radius.Alcatel-Lucent.roleName**. For more details, see *Adding VSAs to the Dictionary File on page 294*.

To match attribute values, use the **match** command in rulemap mode:

match *class.name rule-op value*

Syntax Description	*class.name*	Attribute name based on the authentication type. For detailed lists of attributes by class, see the following references: ■ AD attributes; see *Table 22 on page 283* ■ RADIUS attributes; see *Table 23 on page 286* ■ System attributes; see *Table 24 on page 288* ■ DHCP attributes; see *Table 25 on page 288* ■ Text string formats; see *Table 26 on page 289*
	rule-op	Each attribute type can support one or more rule comparator operations depending the *class.name*. See the corresponding description of the attribute to see the supported rule operations. The comparator operators are defined as: ■ exists – The attribute exists in the authentication event ■ equals – The attribute value matches the user-supplied rule value ■ contains – The attribute value contains the user-supplied rule value ■ contained-by – The attribute is completely contained by the rule value ■ less-than – The numeric value is converted and compared to see if it is less than the value in the mapping table ■ greater-than – The numeric value is converted and compared to see if it is more than the value in the mapping table ■ not – Inverts the match criteria
	value	Value can have one or more items listed as entries. Multiple entries are listed and separated by commas. String values are not case sensitive.

Table 22 AD Attributes

Attribute	Description
ad.city	Match rule baed on value of ad.city. Supported operations for this attribute are: contains, equals, exists, not.

Table 22 AD Attributes *(continued)*

Attribute	Description
ad.comment	Match rule based on value of ad.comment. Supported operations for this attribute are: contains, equals, exists, not.
ad.commonName	Match rule based on value of ad.commonName. Supported operations for this attribute are: contains, equals, exists, not.
ad.company	Match rule based on value of ad.company. Supported operations for this attribute are: contains, equals, exists, not.
ad.country	Match rule based on value of ad.country. Supported operations for this attribute are: contains, equals, exists, not.
ad.department	Match rule based on value of ad.department. Supported operations for this attribute are: contains, equals, exists, not.
ad.description	Match rule based on value of ad.description. Supported operations for this attribute are: contains, equals, exists, not.
ad.distinguishedName	Match rule based on value of ad.distinguishedName. Supported operations for this attribute are: contains, equals, exists, not.
ad.emailAddresses	Match rule based on value of ad.emailAddresses. Supported operations for this attribute are: contains, equals, exists, not.
ad.employeeID	Match rule based on value of ad.employeeID. Supported operations for this attribute are: contains, equals, exists, not.
ad.hostCommonName	Match rule based on value of ad.hostCommonName. Supported operations for this attribute are: contains, equals, exists, not.
ad.hostCanonicalName	Match rule based on value of ad.hostCanonicalName. Supported operations for this attribute are: contains, equals, exists, not.
ad.hostDescription	Match rule based on value of ad.hostDescription. Supported operations for this attribute are: contains, equals, exists, not.
ad.hostDistinguishedName	Match rule based on value of ad.hostDistinguishedName. Supported operations for this attribute are: contains, equals, exists, not.
ad.hostDNSHostName	Match rule based on value of ad.hostDNSHostName. Supported operations for this attribute are: contains, equals, exists, not.

Table 22 AD Attributes *(continued)*

Attribute	Description
ad.hostMemberOf	Match rule based on value of ad.hostMemberOf. Supported operations for this attribute are: contains, exists, not.
ad.hostOperatingSystem	Match rule based on value of ad.hostOperatingSystem. Supported operations for this attribute are: contains, equals, exists, not.
ad.hostOperatingSystemServicePack	Match rule based on value of ad.hostOperatingSystemServicePack. Supported operations for this attribute are: contains, equals, exists, not.
ad.hostOperatingSystemVersion	Match rule based on value of ad.hostOperatingSystemVersion. Supported operations for this attribute are: contains, equals, exists, not.
ad.manager	Match rule based on value of ad.manager. Supported operations for this attribute are: contains, equals, exists, not.
ad.memberOf	Match rule based on value of ad.memberOf. Supported operations for this attribute are: contains, exists, not.
ad.phoneHome	Match rule based on value of ad.phoneHome. Supported operations for this attribute are: contains, equals, exists, not.
ad.phoneHomeOther	Match rule based on value of ad.phoneHomeOther. Supported operations for this attribute are: contains, equals, exists, not.
ad.postalCode	Match rule based on value of ad.postalCode. Supported operations for this attribute are: contains, equals, exists, not.
ad.state	Match rule based on value of ad.state. Supported operations for this attribute are: contains, equals, exists, not.
ad.streetAddress	Match rule based on value of ad.streetAddress. Supported operations for this attribute are: contains, equals, exists, not.
ad.telephoneNumber	Match rule based on value of ad.telephoneNumber. Supported operations for this attribute are: contains, equals, exists, not.
ad.title	Match rule based on value of ad.title. Supported operations for this attribute are: contains, equals, exists, not.
ad.userPrincipleName	Match rule based on value of ad.userPrincipleName. Supported operations for this attribute are: contains, equals, exists, not.

Table 23 RADIUS Attributes

Attribute	Description
radius.calledStation	Match rule based on the RADIUS Called Station attribute. Supported operations for this attribute are: contains, equals, not.
radius.callingStation	Match rule based on the RADIUS Calling Station attribute. Supported operations for this attribute are: contains, equals, not.
radius.Alcatel-Lucent.roleName	Match rule based on the RADIUS Alcatel-Lucent attribute. Supported operations for this attribute are: equals, exists, greater-than, less-than, not.
radius.filterId	Match rule based on the RADIUS Filter Id attribute. Supported operations for this attribute are: contains, equals, not.
radius.loginIP	Match rule based on the RADIUS NAS login IP attribute. Supported operations for this attribute are: contains, equals, not.
radius.loginService	Match rule based on the RADIUS login service attribute. Supported operations for this attribute are: equals, exists, greater-than, less-than, not.
radius.loginTCPPort	Match rule based on the RADIUS login TCP port attribute. Supported operations for this attribute are: equals, exists, greater-than, less-than, not.
radius.nasFramedIP	Match rule based on RADIUS NAS Framed IP attribute. Supported operations for this attribute are: contained-by, contains, equals, not.
radius.nasFramedNetmask	Match rule based on RADIUS NAS Framed Netmask attribute. Supported operations for this attribute are: contained-by, contains, equals, not.
radius.nasID	Match rule based on RADIUS NAS ID attribute. Supported operations for this attribute are: contained-by, equals, exists, not.
radius.nasIP	Match rule based on RADIUS NAS IP attribute. Supported operations for this attribute are: contains, equals, not.
radius.nasPort	Match rule based on the RADIUS NAS port attribute. Supported operations for this attribute are: equals, exists, greater-than, less-than, not.
radius.nasPortType	Match rule based on the RADIUS NAS port type attribute. Supported operations for this attribute are: equals, exists, not.

Table 23 RADIUS Attributes *(continued)*

Attribute	Description
radius.nasServiceType	Match rule based on the RADIUS NAS service type attribute. Supported operations for this attribute are: equals, exists, not.
radius.reply	Match rule based on RADIUS Reply attribute. Supported operations for this attribute are: contains, equals, not.
radius.userName	Match rule based on RADIUS User Name attribute. Supported operations for this attribute are: contains, equals, not.

Table 24 System Attributes

Attribute	Description
system.authType	Match rule based on authentication type used. Supported operations for this attribute are: equals, not.
system.domainName	Match rule based on value of domain name. Supported operations for this attribute are: contains, equals, not.
system.mapType	Match rule based on mapping type used. Supported operations for this attribute are: equals, not.
system.portNum	Match rule based on user slot/port. Supported operations for this attribute are: equals, greater-than, less-than, not.
system.roleName	The value of the role name, if it is already assigned. This attribute allows you to chain rule maps together. Supported operations for this attribute are: contains, exists, equals, not.
system.srcIP	Match rule based on source IP. Supported operations for this attribute are: contains, equals, not.
system.srcMAC	Match rule based on source MAC. Supported operations for this attribute are: contains, equals, not.
system.timeOfDay	Match rule based on current system time. Supported operations for this attribute are: between, equals, greater-than, less-than, not.
system.userName	Match rule based on the value of the user name. Supported operations for this attribute are: equals, not.
system.vlanID	Match rule based on the value of the user VLAN ID. Supported operations for this attribute are: equals, greater-than, less-than, not.
system.matchValue	This is a special attribute, available only when assigning a role value. It it equal to the string form of the last matched value. By using this attribute in the set statement, you can assign multiple roles at one time. For an example of this attribute, see *Examples on page 290*.

Table 25 DHCP Attributes

Attribute	Description
dhcp.netmask	Netmask option (1) as returned by the DHCP server.
dhcp.timeOffset	Time offset option (2), which is the number of seconds offset from GMT time in the given location.

Table 25 DHCP Attributes *(continued)*

Attribute	Description
dhcp.hostName	Host name option (12), as supplied by the DHCP client.
dhcp.domainName	Domain name option (15) as supplied by the DHCP server.
dhcp.leaseTime	Lease time option (51), which is the number of seconds the IP address lease is good for.
dhcp.serverIP	IP address of the granting server, option (54)
dhcp.vendorClass	Vendor class option (60), which is a free form text string.
dhcp.userClass	User class option (77), which is a free form text string.

Table 26 Text String Formats

Type	Format	Description
IP address	100.100.100.100	IP addresses are expressed in dotted decimal notation.
MAC address	FF:FF:FF:FF:FF:FF	MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
Date	Universal Time Coordinated (UTC)	Dates are expressed in UTC format. For example: Wed Apr 5 19:33:01 PST 2006.
Time	HH:MM:SS	Timestamp without the date is expressed in hours, minutes and seconds using a 24 hour clock. The decimal numbers are separated by colons, for example: 18:36:45.
List of *x*	*x*1,*x*2,*x*3	A list is expressed as items separated by commas.
Subnet	IP address/24	Subnets are expressed in the number of maskbits in the subnet mask.
MAC Mask	MAC address/24	Subnets are expressed in the number of maskbits in the MAC mask.

The following example, defines a rule-map called execStaff and creates two match statements for that rule-map.

```
(SafeGuardOS) (config) # aaa rule-map execStaff
(SafeGuardOS) (rulemap) # description “The top brass of the company”
(SafeGuardOS) (rulemap) # match ad.distinguishedName contains “Finance”
(SafeGuardOS) (rulemap) # match ad.distinguishedName contains “Exec”
(SafeGuardOS) (rulemap) # set system.roleName “HIGHPOWER”
(SafeGuardOS) (rulemap) # end
(SafeGuardOS) (config) #
```

The **no** form of the statement removes the match statement from the rule map. If you wanted to remove the only match statement for Finance in the last example, change it as follows:

```
(SafeGuardOS) (config) # aaa rule-map execStaff
(SafeGuardOS) (rulemap) # no match ad.distinguishedName contains “Finance”
(SafeGuardOS) (rulemap) # end
(SafeGuardOS) (config) #
```

After specifying the **no** statement, it is equivalent to:

```
(SafeGuardOS) (config) # aaa rule-map execStaff
(SafeGuardOS) (rulemap) # description “The top brass of the company”
(SafeGuardOS) (rulemap) # match ad.distinguishedName contains “Exec”
(SafeGuardOS) (rulemap) # set system.roleName “HIGHPOWER”
(SafeGuardOS) (rulemap) # end
(SafeGuardOS) (config) #
```

Setting the Role

After defining the matching criteria, you set the role. The role information is sent to the policy component for enforcement. Use the **set system.roleName** statement in rule map submode using this syntax:

set system.roleName (*value* | **value of** *attribute_name*)

Syntax Description	*value*	A string literal such as “Marketing”.
	attribute_name	The value of another attribute in the attribute map, such as the value of ad.department.

Examples

In the following example, we select a role based on membership in a particular group. Because the value is in a list, we use the contains operation to see if a user is a member of a particular group before assigning a role.

```
(SafeGuardOS) (config) # aaa rule-map specialGroups
(SafeGuardOS) (rulemap) # operation or
(SafeGuardOS) (rulemap) # match ad.memberOf contains “specialGroup1”
(SafeGuardOS) (rulemap) # match ad.memberOf contains “specialGroup2”
```

```
(SafeGuardOS) (rulemap) # set system.roleName “specialPerson”
(SafeGuardOS) (rulemap) # end
(SafeGuardOS) (config) #
```

In this next example, the role name is set to any match in the list. Therefore, matches for Sales are set to sales and matches for Engineering are set to engineering.

```
(SafeGuardOS) (config) # aaa rule-map alphaGroup
(SafeGuardOS) (rulemap) # operation or
(SafeGuardOS) (rulemap) # match ad.memberOf contains “Engineering”
(SafeGuardOS) (rulemap) # match ad.memberOf contains “Sales”
(SafeGuardOS) (rulemap) # match ad.memberOf contains “Exec”
(SafeGuardOS) (rulemap) # match ad.memberOf contains “FrontOffice”
(SafeGuardOS) (rulemap) # set system.roleName value-of system.matchedValue
(SafeGuardOS) (rulemap) # end
(SafeGuardOS) (config) #
```

Continuing or Stopping Assigning Roles

Depending on how the rule maps have been structured, either stop assigning roles after the first successful match or continue to evaluate further. The default action is to stop evaluating rule maps after the first role assignment. Use the action statement in rule map submode using this syntax:

action [**continue** | **stop**]

Syntax Description	**continue**	Specifies to continue processing rule maps to find more role matches.
	stop	Specifies to stop processing rule maps.

Applying the Rule Map and Assign a Precedence

The final step is to apply the rule map. Rule maps are evaluated in precedence order from lowest number (1) to highest number (65535). It is possible to assign to rule maps to the same precedence level. In this case, the evaluation order of the rule maps is not predetermined. Assigning the same precedence level should only be done when the two rule maps apply to completely distinct groups of people.

Use the **aaa rule-map apply** command in Global Configuration mode using the following syntax:

aaa rule-map apply *rule_name* (**precedence** *number*)

Syntax Description	*rule_name*	Name of the rule map that is being bound.
	number	Specifies the precedence order for the rule map. Valid values are 1 through 65535, with 1 being the highest precedence value.

Building off of the previous example of the two types of user groups, we would want to assign a higher precedence value to the "highPower" user group over the normal "user" group.

```
(SafeGuardOS) (config) # aaa rule-map apply allUsers precedence 2000
(SafeGuardOS) (config) # aaa rule-map apply specialUser precedence 10
(SafeGuardOS) (config) #
```

Removing the Rule Map

Before removing the rule map, remove the apply for the rule map using the following command in Global Configuration mode:

no aaa rule-map apply [*rulemap_name* | *all*]

Syntax Description	*rulemap_name*	Rule map name in character string
	all	This will unapply all the currently applied rule maps.

The command has no options or parameters.

Next, remove the configured rule map using the **no** version of the **aaa rule-map** command.

no aaa rule-map [*rulemap_name* | *all*]

Syntax Description	*rulemap_name*	Rule map name in character string
	all	This will unapply all the currently applied rule maps.

In this example, we are removing the rule map called "specialUsers".

```
(SafeGuardOS) (config) # no aaa rule-map apply specialUsers
(SafeGuardOS) (config) # no aaa rule-map specialUsers
(SafeGuardOS) (config) #
```

Displaying Rule Map Information

There are Privileged Exec **show** commands to display rule map and rule-related configurations. See the following sections:

- *Showing Rule Map Usage*
- *Showing a Rule Map Configuration*
- *Adding VSAs to the Dictionary File*

Showing Rule Map Usage

To display the activity level of one or more rule maps, use the **show aaa rule-maps application** command in Privileged Exec mode:

show aaa rule-maps application {*mapname*}

Syntax Description	*mapname*	(Optional) Displays the usage for the specified rule-map. If you do not specify a rule map name, all configured rule maps are displayed.

The following example is representative of the command output:

```
(SafeGuardOS) # show aaa rule-maps application

Precedence       Rule Map Name       Hit Count    Hit Failures
----------       -------------       ---------    ------------
9                greyListExample     109          0
12               whiteListExample    112          0
```

The fields in the output represent:

Field	Description
Precedence	The precedence order for the rule map. Valid values are 1 through 65535, with 1 being the highest precedence value.
Rule Map Name	The name of the rule map.
Hit Count	The number of times a rule-map's condition have matched causing the role to be assigned.
Hit Failures	The number of times a match was made, but the role couldn't be assigned.

Showing a Rule Map Configuration

To display the configuration of one or more rule maps, use the **show aaa rule-maps configuration** command in Privileged Exec mode:

show aaa rule-maps configuration {*mapname*}

Syntax Description	*mapname*	(Optional) Displays the configuration for the specified rule-map. If you do not specify a rule map name, all configured rule maps are displayed.

The following example is representative of the command output:

```
(SafeGuardOS) # show aaa rule-maps configuration j9

aaa rule-map j9
   operation or
   action stop
   match system.userName equals “jjones”
   set system.roleName “writer”

(SafeGuardOS) #
```

Adding VSAs to the Dictionary File

To add the VSA to the VSA dictionary file, use the following syntax:

vendorName vendor-ID stringName VSA-ID type

Syntax Description	*vendorName*	RADIUS vendor name.
	vendor-ID	A unique ID number for each RADIUS vendor.
	stringName	A description of the vendor in string format.
	VSA-ID	A unique ID number for each RADIUS dictionary entry.

	type	Each vendor has a unique 3-byte OUI which is appended to a one-byte tag to provide a VSA value. These are conforming attributes. Each conforming attribute in the system can be of the following types: ■ int – The protocol unit being specified is converted into a standard 32-bit signed integer. If fewer than 4 bytes are found in the PDU the resulting value is sign extended. If more than 4 bytes are found, the value is truncated. ■ uint – The protocol unit being specified. It is converted into a standard 32-bit unsigned integer. The rules are the same as for signed integers. ■ MAC – 6 byte MAC address. MAC addresses may be specified in any of the following formats: aa:bb:cc:dd:ee:ff aabb:ccdd:eeff aa-bb-cc-dd-ee-ff aabb.ccdd.eeff aabbccddeeff ■ IP – 4 byte IP address. ■ string – The printable characters in the protocol unit are copied into a NULL-terminated character string. The value will be truncated at the first non-printable character.

For example, the following shows the specification of the 3Com Corporations's User Access Level attribute:

```
3com 43 3Com-User-Access-Level 1 integer
```

The user downloads a VSA file by using the following **copy** command:

copy tftp:/*ip*/*filename* **radius-dictionary**

Syntax Description	*ip*	The IP address.
	filename	The filename of the VSA file.

After the file completes downloading, the syntax is checked. If there are errors they are printed to the console and no update action is taken. When the file has successfully parsed, the file is copied to permanent storage and the box must be rebooted using the **reload** command. When the box reboots, the VSAs are added to the CLI and to the parsing engine.

To remove already configured VSAs, us either **write erase** or **clear aaa radius-dictionary** commands.

chapter

7 Establishing a Security Policy

In this chapter:

Policy Concepts

Policy is an important aspect of the SafeGuard OS solution. This chapter discusses the key concepts of policy, how to develop a policy workflow, and procedures for coding policy commands.

Policies are the rules that govern access for users and resources. We use policies to establish the boundaries and enforce a security philosophy for these users and resources. Policies can be divided into the following categories:

- *System white-black list* – Is a list of MAC addresses, IP addresses, or VLAN IDs that are either permitted or denied traffic into the network. Use the system white-black list to override policy enforcement, visualization, and malware detection. To configure a system white-black list, see *System White-Black List on page 302*.
- *Malware policies* – When SafeGuard OS detects malware on the system, malware policies specify how the infection is handled. These policies allow you to set how little or how much access a user or application can have on the network when it is suspected of being infected.

  Malware policies can be set up to block an infected user or application, or allow the end device to communicate to an IT server or Internet website for automatic upload of the most recent anti-virus software or operating system patch. When the attack is specific to a particular application, malware policies allow traffic from other applications to continue unimpeded. Malware polices are described further in *Detecting and Isolating Malware Security Threats on page 361*
- *Override policies* – Allows you to override a system policy with this special user policy. Override policies are discussed in *Overriding System Policies with a User Policy on page 323*.
- *System policies* – SafeGuard OS has a set of default policies and roles that are primarily used by internal routines. These policies are normally not configured by users. For more information about these policies, see *System Generated Policies and Roles on page 325*
- *EPV policies* – EPV helps ensure that a user's system and virus software are kept up-to-date. End point Posture Verification (EPV) is a component of SafeGuard OS that validates software compliance. EPV policies are the mechanisms that control whether a user's machine is scanned (checked) or whether the user is allowed to bypass the check. EPV policies are discussed in *EPV System Policies on page 326*.
- *User policies* – Allow user access to network resources and applications based on the authentication state of the user. These are policies configured by the user/administrator to control the network access to his network.

  Unlike competitive products that look at the destination L4 port to determine the application, SafeGuard OS performs *deep packet inspection*. After performing deep packet inspection, the SafeGuard OS not only knows the application but knows what the user is trying to accomplish with the application. With this information

the system can enforce access control based on the what the user is doing with the application and extend enforcement from Layer 3 through Layer 7. User policies are discussed in *User Policies on page 305*.

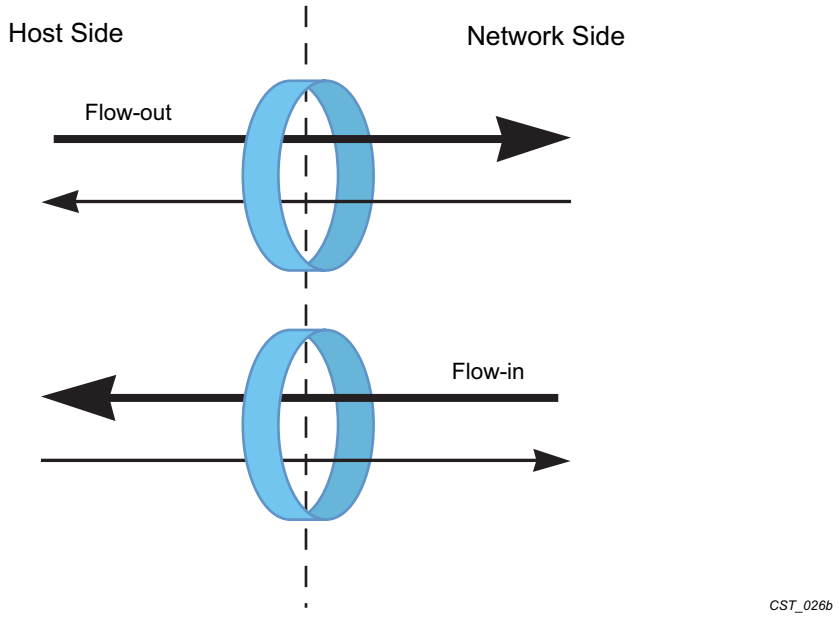
Traffic Flow

Unlike competitive products, SafeGuard devices are not packet-based nor do they use packet-based control mechanisms. Instead, the system initiates policy enforcement on TCP connections or groupings of UDP packets. These connections are called *flows.*

The upper physical ports of the SafeGuard devices are called the *network side* of the device and the lower physical ports the *host side*. In the default policy configuration, we express a policy from the host side perspective but it is applied to traffic in both directions. This bidirectional behavior is unlike traditional Access Control Lists (ACLs), which require explicit command level configuration for each direction. This physical distribution for user and network ports is only for controllers. In a switch/user network it is just a logical concept and its use is more as originator and destination.

However, there might be an occasion when you want to control a flow from the network side of the device. This change of direction can be configured using the **flow-in** and **flow-out** keywords on the policy filter. These keywords are described in *Configuring the Rules on page 316*.

Figure 7 Flow Direction



Policy Enforcement

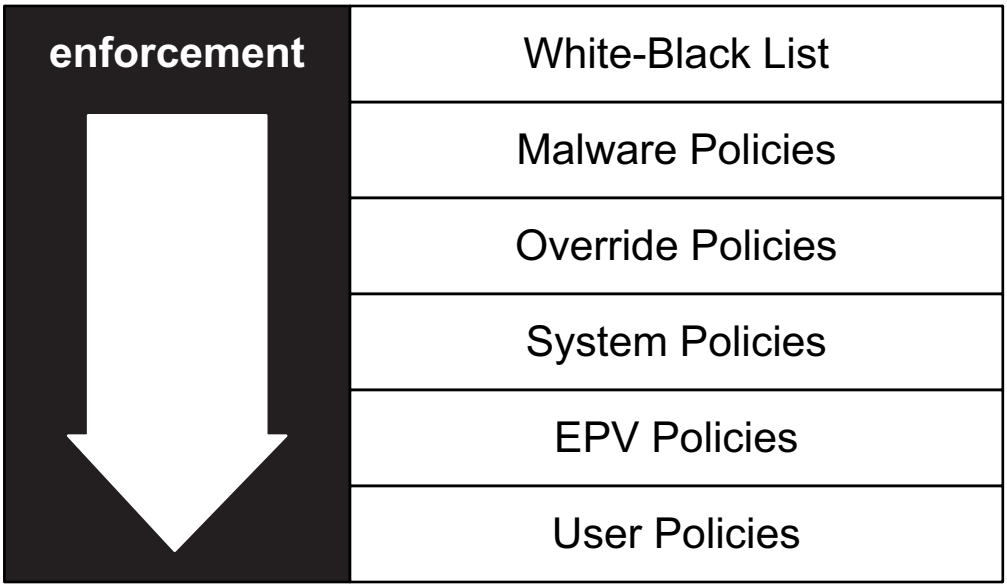
The order in which a policy is enforced depends on two factors:

1 The ranking of the type of policy

2 The precedence of the policy within a policy type

Policies have an internal ranking system that stacks the policies in the order shown in *Figure 8*. This ranking is done by SafeGuard OS and cannot be overridden by users.

Figure 8 Order of Policy Enforcement



Precedence

Malware and user policies allow you to assign a precedence number to rules and policies. These precedence numbers for policies are secondary to the overall ranking of the policies; the precedence numbers for rules are tertiary (nested within a policy).

Filter Precedence

Because a policy can have many rules, a precedence number can be assigned to the filter statements of a rule. The precedence of a filter will determine the order in which the rule is applied for a specific user. Precedence numbers can be in the range of 1 to 65535, where 1 has the highest precedence and 65535 the lowest.

If you do not specify a precedence number on a filter, SafeGuard OS assigns a precedence number for you (*auto-precedence*). The system assigns the precedence in the sequential order the filters are configured. If you already have precedence numbers assigned on other filter statements in the policy, SafeGuard OS adds 10 to the highest number and assigns it to the rule. If you do not have any precedence numbers on the rules within a policy, SafeGuard OS begins assigning precedence numbers beginning with 10 and adding in increments of 10.

Policy Precedence

Multiple user policies can be assigned to a role. When a user policy is applied to a role, it too can have a precedence. Precedence numbers can be in the range of 1 to 65535, where 1 has the highest precedence and 65535 the lowest. Policy precedence comes before rule precedence. *Figure 9* shows an example of policy precedence.

Figure 9 Policy and Filter Precedence

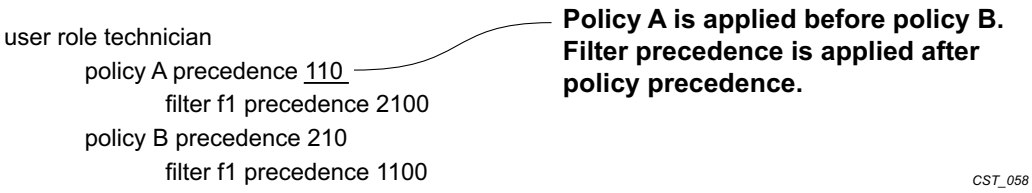


Table 27 Policy Precedence Ranges within a Role

Policy Type	Precedence range
Malware policies	0
Override user policies	1–9
System policies	Starts with 10 and increments by 10
EPV-System policies	Not Applicable
User policies	User Defined

Designing a Policy Workflow

A policy workflow is simply an approach to planning, organizing, and implementing a policy management strategy. Before configuring your rules, roles and policies, it is helpful to do some ground work.

1 Determine your corporate philosophy to security.

There are two schools of thought on how to execute a policy system. One method creates a wall where all users are initially denied access. You then punch holes, or exceptions into the wall. The other method is to allow everything through and then to block specific network resources and applications.

SafeGuard OS is best suited for the later approach, as it optimizes the number of rules required to enforce a specific access policy. The default condition for SafeGuard OS is to assume that everyone and everything can go through.

2 Using your existing corporate security plan and documents for organizing your role hierarchy, organize your users, servers, and other resources into logical groups.

   As mentioned before, users are organized by role. Resources can also be organized into *network zones*, which are collections of nodes and network segments.

   A network zone is an easy way to take all of the resources for a group and naming that entity. For example, define a network zone for the servers for the Finance organization or for the resources that will be unauthenticated users.

3 Determine what applications and what files you want to monitor or block.

4 Define the list of permissions (rules) based on the access criteria.

5 Order the filters within each role by precedence.

System White-Black List

SafeGuard OS allows designating specific MAC address, VLAN, or IP address (TCP, UDP, or ICMP) as white/black listed addresses.

In addition to permitting or denying access to the network, a system white-black list disables the following features for specified entries:

- Malware detection
- Policy
- Visualization

Adding a System White-Black List Entry

To configure a system white-black list:

1 Use the Global Configuration command, **system white-black list**, to enter the whiteblack-list submode. This command does not have any options or parameters.

2 Specify one or more MAC addresses, VLAN, or IP addresses (TCP, UDP, or ICMP) to add using the command:

system white-black list [**mac** *mac_addr mask* | **vlan** *vlan* | **IP** *address*] [**deny**|**permit**] {**description** *string*}

Syntax Description		
	mac_addr	MAC address that overrides policy. The MAC address can either be the source or destination address; it is independent of direction. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	mask	Specifies a MAC mask in dotted-quad notation. For example, ff:ff:ff:ff:ff:ff
	deny	Denies access to the MAC address.
	permit	Permits access to the MAC address.
	string	(Optional) A string that describes the entry. Specify strings in double quotation marks.

The following example adds MAC address 11:22:33:44:55:66 to the white list, or those addresses permitted into the network.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #system white-black list
(SafeGuardOS) (whiteblack-list) #mac 11:22:33:44:55:66 ff:ff:ff:ff:ff:ff
   permit description “printer”
(SafeGuardOS) (whiteblack-list) #
```

To put the MAC address on the black list, specify the **deny** option:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #system white-black list
(SafeGuardOS) (whiteblack-list) #mac 11:22:33:44:55:66 ff:ff:ff:ff:ff:ff
   deny description “printer”
(SafeGuardOS) (whiteblack-list) #
```

Prioritizing List Entries

System white-black list entries are processed from the top to the bottom of the list. Items found first in the list have priority over items lower on the list.

For example, take the following scenario. An administrator has 100 IP phones and want to create a single system MAC entry with a MAC mask to deny access for all of the

phones. However, she wants an exception for one IP phone to be permitted. The order of the entries becomes important.

Example 1, (incorrect):

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #system white-black list
(SafeGuardOS) (whiteblack-list) #mac 1a:2b:3c:00:00:00 ff:ff:ff:00:00:00 deny
description “IP phones”
(SafeGuardOS) (whiteblack-list) #mac 1a:2b:3c:aa:bb:cc ff:ff:ff:ff:ff:ff permit
description “My IP phone”
```

Example 2, (correct):

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #system white-black list
(SafeGuardOS) (whiteblack-list) #mac 1a:2b:3c:aa:bb:cc ff:ff:ff:ff:ff:ff permit
description “My IP phone”
(SafeGuardOS) (whiteblack-list) #mac 1a:2b:3c:00:00:00 ff:ff:ff:00:00:00 deny
description “IP phones”
(SafeGuardOS) (whiteblack-list) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Example 2 has the correct configuration because the more specific MAC address/mask overrides the following deny statement. In example 1 is incorrect because even though the second statement is more specific, the deny statement has already set all phones to deny.

Removing an Entry

To remove an entry from the system white-black list, use the **no** version of the command:

no mac *mac_addr mask*

Syntax Description	*mask*	Specifies a subnet mask in dotted-quad notation. For example, ff:ff:ff:ff:ff:ff.

The **no** version of the command removes the MAC address from the system white-black list. This example removes a printer from the system white-black list:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #system white-black list
(SafeGuardOS) (whiteblack-list) #no mac 11:22:33:44:55:66 ff:ff:ff:ff:ff:ff
(SafeGuardOS) (whiteblack-list) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Use the **show system white-black list** command to see the contents of the list. This command is further discussed in *Showing System White-Black List on page 333*.

User Policies

User policies allow the control of user access to network resources. When a user logs on to the network, the host starts authentication. It provides the user name and password information to the authentication server, such as Microsoft AD or Kerberos.

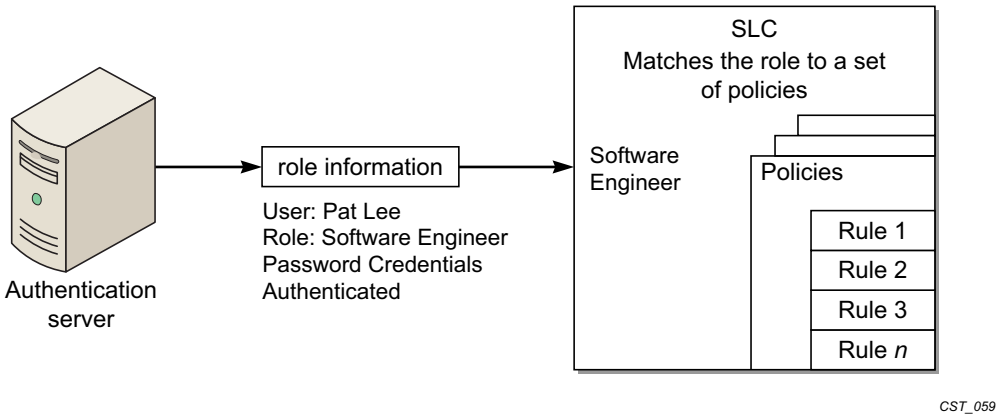
The SafeGuard device notes the machine's IP address, the user name and that it is in the process of authenticating. When the authentication server sends back the response, SafeGuard OS intercepts that information, which includes:

- User name
- Password credentials
- IP address
- MAC address
- Authentication state
- User role

The system matches the IP address and notes whether the user is authenticated or unauthenticated. Using a set of configured role mapping rules and information intercepted from the authentication server, a user role is derived for the user. The system uses the role and the configured role mapping rules. Using a role hierarchical system, it applies all of the policies or rules for that particular user based on the user *role*. A user role is a designation for the user, for example, a job classification such as a software engineer. If the role derived by applying the rule map is not configured in the system, The user assumes the default 'authenticated' role.

Each policy is comprised of multiple *rules*, which is the how we match the traffic. A rule has two parts: a filter and an action. When a filter condition is true, its action might be to allow access or deny access to a resource. For example, all software engineers might be allowed to use instant messaging (IM) but are not allowed to access any of the Human Resources or Finance servers. *Figure 10*, shows the relationship between policies, roles, and rules.

Figure 10 Policies, Rules, and Roles



Therefore, when you enforce a policy you are applying a set of rules against a user role.

Role Hierarchy

Each role has a different set of privileges. Any user-defined role, by default, has the authenticated role as the parent. A role can be designated as a child of other roles, except for the authenticated and unauthenticated roles. If a role hierarchy is not established, then duplicate policies would need to be duplicated throughout each role. A child role can only have one parent role.

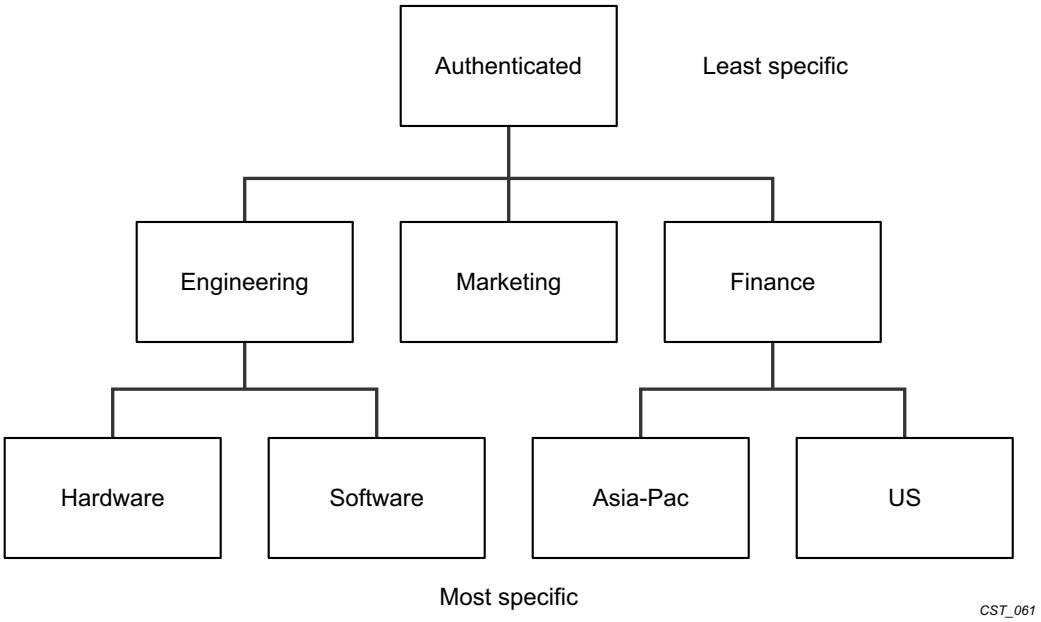
SafeGuard OS provides two default system roles:

- authenticated
- unauthenticated.

Any user who is unauthenticated is assigned the unauthenticated role. Any policies defined for that role are assigned to all users having that role.

Policies are applied from the bottom of the hierarchy to the top of the hierarchy. In other words, applied from the most specific to the least specific role. *Figure 11* shows a simple role hierarchy.

Figure 11 Role Hierarchy



Layer 7 Policies

A unique feature of SafeGuard OS is the ability to enforce policies at the Application Layer. A Layer 7 policy is a type of user policy. By defining an application group, you could restrict a vendor or contractor from using an application such as FTP. Application traffic can be refined in the policy to permit or deny a certain filetypes.

An application filter is even further refinement of an application group. It blocks the application based upon some action that the user performs. For example, suppose that a vendor is allowed to use FTP, unless they attempt to upload any document that has the string 'payroll' in the filename.

Visualization

The internal analysis of what the user is doing with an application is called *Visualization*. Without Visualization, administrators cannot tell what users are doing in the network. To control what is sent to OmniVista SafeGuard Manager when there is a policy violation or to monitor statistics by indicating the **log** option in the filter action, deep packet inspection and Visualization are integral to performing Layer 7 policies.

Configuring User Policies

Policy offers an enormous variety of configuration possibilities. This section describes the coding and syntax for the basic policy commands and gives you guidance on the many options available.

Policy Made Simple

For those who are new to configuring policies, start with some simple, yet powerful policy statements. For example:

- *Network Zone* – Is a collection of nodes and network segments?
- *Application Group* – Is a method of permitting or denying a group of applications?
- *Application Filters* – Is a further refinement of application group?

Network Zone

An easy way to define a collection of nodes or network segments is to create a network zone. The order of the entries is not significant. By defining the network into zones, uses can later be filtered based upon their zone. A zone is a useful way to designate a physical topology or a building configuration.

1 Name the zone using the **network-zone** Global Configuration command. To remove a zone, use the **no** form of the command. The syntax of the commands is:

network-zone *zone_name*
no network-zone *zone_name*

Syntax Description	*zone_name*	Name of the zone

The following example defines a network zone for all the servers in a topology.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #network-zone finance_servers
(SafeGuardOS) (network_zone) #
```

The network-zone command places you in network_zone mode.

2 Define the zone by host, IP address, or a range of IP addresses.

— *Host* – By IP or MAC address

host [**ip-address** *addr* | **mac-address** *addr*]

Syntax Description	*addr*	IP or MAC address of the host

The following example specifies the finance_servers zone as host address 192.168.0.2:

```
(SafeGuardOS) (config) # network-zone finance_servers
(SafeGuardOS) (network_zone) # host ip-address 192.168.0.2
(SafeGuardOS) (network_zone) #
```

— *Network* – By a subnet

network *ipaddr mask*

Syntax Description	*ipaddr*	An IP address.
	mask	A subnet mask in dotted-quad notation. For example, 255.255.255.255.

This example specifies the finance_servers zone by subnet:

```
(SafeGuardOS) (config) # network-zone finance_servers
(SafeGuardOS) (network_zone) # network 192.168.0.0 255.255.252.0
(SafeGuardOS) (network_zone)#
```

— *Range* – By IP range

range *starting_addr ending_address*

Syntax Description	*starting_addr*	Start the range at this IP address
	ending_address	End the range at this IP address

This example specifies the finance_servers zone by an IP range:

```
(SafeGuardOS) (config) # network-zone finance_servers
(SafeGuardOS) (network_zone) # network 192.168.0.2 192.168.0.56
(SafeGuardOS) (network_zone) #
```

For additional examples of network zones, see *Network Zones Example on page 321*.

3 To remove an existing configuration use the **no** version of the command.

no host [**ip-address** *addr*|**mac-address** *addr*]| **network** [*ipaddr*|*mask*] | **range** *starting_addr ending_address*

This example removes the previously configured subnet configuration:

```
(SafeGuardOS) (config) # network-zone billing
(SafeGuardOS) (network_zone) # no network 192.168.0.0 255.255.252.0
(SafeGuardOS) (network_zone) #
```

The following example defines a network zone for telnet called `netzoneTelnet`, that contains four IP addresses:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) # network-zone netzoneTelnet
(SafeGuardOS) (network-zone) # host ip-address 192.168.4.7
(SafeGuardOS) (network-zone) # host ip-address 192.168.4.24
(SafeGuardOS) (network-zone) # host ip-address 192.168.5.10
(SafeGuardOS) (network-zone) # host ip-address 192.168.5.26
(SafeGuardOS) (network-zone) # end
(SafeGuardOS) #
```

For an additional example of network zones, see *Network Zones Example on page 321*.

Application Group

Application groups are collections of application protocols used to filter Layer 7 applications in rules. Either define custom application groups or use one of the predefined supplied groups:

- application-group IM
  - application AOLIM
  - application MSNIM
  - application YAHOOIM
- application-group NetworkConnectivity
  - application CIFS
  - application FTP
  - application SSH
  - application TELNET
- application-group P2P
  - application WINNY
- application-group Web
  - application ALT-HTTP
  - application HTTP

To create or delete a custom application group, use the **`application-group`** Global Configuration command:

`application-group` *`group_name`*

This example create a custom IM group called verbotenIM:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #application-group verbotenIM
(SafeGuardOS) (app-group) #
```

The application-group command places you in app-group mode. In this mode, define the custom group using any combination of application protocol found in the default groups.

`application` *`application_name`*

This example adds three application protocols to verbotenIM:

```
(SafeGuardOS) (config) # application-group verbotenIM
(SafeGuardOS) (app-group) # application AOLIM
```

```
(SafeGuardOS) (app-group) # application MSMIM
(SafeGuardOS) (app-group) # application YAHOOIM
(SafeGuardOS) (app-group) #
```

The **no** version of the command removes an application from an existing group. For example, this statement removes AOLIM from verbotemIM:

```
(SafeGuardOS) (app-group) # no application AOLIM
(SafeGuardOS) (app-group) #
```

For an additional example of application groups, see *Application Groups Example on page 322*.

Application Filters

Application filters are a special type of user policies that allow you to filter Layer 7 applications against a user. To be able to filter by user and application, you must first define the user policy. For example, the file name in an FTP transfer can be matched against in a policy. The supported applications are FTP, HTTP and CIFS.

See the following sections for more details:

- *Creating FTP Application Filters*
- *Creating HTTP Application Filters*
- *Creating CIFS Application Filters*

Creating FTP Application Filters

To create an application filter for an FTP application:

1. Enter app-filter submode by using the **application-filter** command in Global Configuration mode:

   application-filter *filter_name*

Syntax Description	*filter_name*	The name of the application filter being created. **Note:** Filter names are case sensitive.

2. (Optional) Specify a boolean logical operator that the filter is to use:

   {**operation** [**OR**]}

Syntax Description	**OR**	Logical OR operator.

3 Specify the filter conditions:

```
FTP [FileName|UserName]
[{contains string}|{does-not-contain string}|
{does-not-end-with string}|
{does-not-match string}|
{does-not-start-with string}|
{ends-with string}|
{matches string}|
{starts-with string}]
```

Syntax Description	*string*	A value to be matched against.

Creating HTTP Application Filters

Ed. Note:

The syntax for an application filter for an HTTP application is slightly different than the an application filter for FTP.

To create an application filter for an HTTP application:

1 Enter app-filter submode by using the **application-filter** command in Global Configuration mode:

```
application-filter filter_name
```

Syntax Description	*filter_name*	The name of the application filter being created.

2 (Optional) Specify a boolean logical operator that the filter is to use:

```
{operation [OR]}
```

Syntax Description	**OR**	Logical OR operator.

3 Specify the filter conditions:

```
HTTP [Host
[{contains string}|{does-not-contain string}|
{does-not-end-with string}|
{does-not-match string}|
{does-not-start-with string}|
{ends-with string}|
{matches string}|
{starts-with string}]|
UserAgent [contains string | does-not-contain string]|
ContentType [contains string]]
```

Syntax Description	*string*	A value to be matched against.

Following is an example of an HTTP application filter user policy using a logical OR operation:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy application-filter "afAppleMarketing"
(SafeGuardOS) (app-filter) #operation OR
(SafeGuardOS) (app-filter) #HTTP ContentType contains "application/x-javascript"
(SafeGuardOS) (app-filter) #HTTP Host contains "www.google.com"
(SafeGuardOS) (app-filter) #HTTP Host does-not-contain "www.google.com"
(SafeGuardOS) (app-filter) #HTTP Host does-not-end-with ".google.com"
(SafeGuardOS) (app-filter) #HTTP Host does-not-match "www.google.com"
(SafeGuardOS) (app-filter) #HTTP Host does-not-start-with "www.google."
(SafeGuardOS) (app-filter) #HTTP Host ends-with ".google.com"
(SafeGuardOS) (app-filter) #HTTP UserAgent contains "Mozilla/5.0"
(SafeGuardOS) (app-filter) #HTTP UserAgent does-not-contain "/5.0"
(SafeGuardOS) (app-filter) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To display application filters, use the **show policy application-filter** command, as discussed in *Showing Application Filters on page 327*.

Creating CIFS Application Filters

To create an application filter for a CIFS application:

1 Enter app-filter submode by using the **application-filter** command in Global Configuration mode:

```
application-filter filter_name
```

Syntax Description	*filter_name*	The name of the application filter being created.

2 (Optional) Specify a boolean logical operator that the filter is to use:

```
{operation [OR]}
```

Syntax Description		
	OR	Logical OR operator.

```
CIFS [UserName
[{contains string}|{does-not-contain string}|
{does-not-end-with string}|
{does-not-match string}|
{does-not-start-with string}|
{ends-with string}|
{matches string}|
{starts-with string}]|
FileName contains string]
```

Syntax Description		
	string	A value to be matched against.

For example,

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #application-filter "test1"
(SafeGuardOS) (config) #CIFS FileName contains "test.exe"
(SafeGuardOS) (config) #application-filter "test2"
(SafeGuardOS) (config) #CIFS UserName contains "marisa"
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Defining and Applying User Policies

A policy is a set of rules that define a set of permissions for the user. For each policy you create:

1. *Assigning the Policy a Name on page 315*
2. *Adding a Description on page 315*
3. *Adding a Severity on page 315*
4. *Adding a Category on page 316*
5. *Configuring the Rules on page 316*
6. *Configuring the Roles on page 319*

Assigning the Policy a Name

To define a user policy, begin by assigning a name to a policy using the Global Configuration command:

policy user *name*

Syntax Description	*name*	A name that identifies the policy.

For example, the following statement defines a policy for the Finance group called finance_policy.

```
(SafeGuardOS) (config) # policy user finance_policy
(SafeGuardOS) (policy-user) #
```

After defining the policy name, the system goes into user policy mode.

To display the contents of a user policy, use the **show policy user** command. This command is discussed further in *Showing Policy User on page 332*.

Adding a Description

An optional description of the user policy can be added in double quotation marks with the following command:

description *string*

Syntax Description	*string*	A description of the policy. Place the string within double quotation marks.

Building on our previous example, a description might be:

```
(SafeGuardOS) (config) # policy user finance_policy
(SafeGuardOS) (policy-user) # description “Policy for finance users and
resources”
(SafeGuardOS) (policy-user) #
```

Adding a Severity

If you specify a severity, it dictates the color that the message displays in OmniVista SafeGuard Manager. Add an optional severity of the user policy with the **severity** command:

severity [**critical** | **info** | **major** | **minor**]

Syntax Description	**critical**	Indicates a critical severity and the message displays in red.

info	Indicates an informational severity and the message displays in white.
major	Indicates a major severity and the message displays in orange.
minor	Indicates a minor severity and the message displays in yellow.

The following example assigns the policy, sw_engineering_policy, as a major severity:

```
(SafeGuardOS) (config) # policy user sw_engineering_policy
(SafeGuardOS) (policy-user) # severity major
(SafeGuardOS) (policy-user) #
```

The severity of the policy does not influence the order in which policy is assigned. The order is specified by precedence number.

Adding a Category

A policy can be optionally designated in a certain category as a method of controlling applications or of controlling resources. If the **log** option is specified in rules, this information displays in OmniVista SafeGuard Manager. Add this optional parameter using the following command:

category [**ApplicationControl** | **ResourceAccess** | **string**]

Syntax Description		
	ApplicationControl	Indicates that the policy is being used to control applications.
	ResourceAccess	Indicates that the policy is being used to control resources.
	string	Indicates a custom use of the policy.

The following example assigns the policy, testbed_policy, as being under resource control:

```
(SafeGuardOS) (config) # policy user testbed_policy
(SafeGuardOS) (policy-user) # category ResourceAccess
(SafeGuardOS) (policy-user) #
```

Configuring the Rules

For each rule we need to define a filter and an action to execute. The overall syntax of a policy filter is:

```
filter name {direction} from source to destination protocol action
   {[mirror] [log] [precedence number]}
```

Syntax Description

name — Name of the user filter.

direction — Specifies the direction that a flow is initiated. Direction can be any of the following:

- `flow-in` – apply to flows initiated from the host-side of the SafeGuard device
- `flow-out` – apply to flows initiated from the network-side of the device
- (Default) blank, which applies to flows in either direction

source — Specifies the source endpoint of the traffic. It can be any of the following:

- any – Wildcard, which matches all source
- host – L3 IP address of the host
- macmask – L2 MAC mask of the host
- network – L3 IP address of the subnet
- network-zone – L3 address (MAC address, IP address, network address, or address range)
- port – L1 physical source port
- range – L3 IP address range
- role – User role
- username – User name
- NOT – Negates the from criteria, except for 'any'

Note: Filters using role or username are not supported for unauthenticated user role. Also these filters do not take effect if the policy applied to a role of a user does not match.

destination — Specifies the destination endpoint of the traffic. It can be any of the following:

- any – Wildcard, which matches all destination.
- host – L3 IP address of the host
- network – L3 IP address of the subnet
- network-zone – L3 address (MAC address, IP address, network address, or address range)
- range – L3 IP address range
- NOT – Negates the from criteria, except for 'any'

protocol

Matches the IP protocol of the traffic. It can be any of the following:

- any – Wildcard, which matches TCP or UDP protocols and application
- application-filter – L7+ rule

  Configuring application filters is discussed separately. For more details, see *Application Filters on page 311*.
- application-group – L7 application

  Configuring application groups is discussed separately. For more details, see *Application Group on page 310*.
- tcp – TCP; specify protocol port number and the port operation:

  1 to 65535 – End port or the start of the end port

  GE – Greater than or equal to

  NE – Not equal to

  LE – Less than or equal to

  range – Destination TCP port range

  out-of-range – Out of the destination TCP port range
- udp – UDP; specify protocol port number and the port operation:

  1 to 65535 – End port or the start of the end port

  GE – Greater than or equal to

  NE – Not equal to

  LE – Less than or equal to

  range – Destination UDP port range

  out-of-range – Out of the destination UDP port range
- AND logical operator. Make a UDP or TCP protocol condition more specific by using the AND logical operator with an L7 application filter to application group. For example, specify ‘tcp 80 AND application-group web’ to define that the traffic is web and that it only runs on TCP port 80.

action	Specifies the action to be taken if the traffic matches the preceding patterns. When log is specified, it is sent to OmniVista SafeGuard Manager as part of Visualization. Action can be any of the following: ■ action deny – drop the packet ■ action deny RESET – drop the packet and reset the denied TCP connection (L7 only) ■ action permit – permit the packet
mirror	Mirror the flow. For more details, see *Configuring Policy-Based Mirroring on page 323*.
log	Log the event to OmniVista SafeGuard Manager.
precedence number	Each policy filter has an associated precedence, which sorts the filters with in the policy. The precedences have a valid range of 1(highest) to 65535 (lowest). If a precedence number is not supplied, the system assigns a precedence. For more details, see *Displaying Policy Configurations on page 327*.

Configuring the Roles

Two system roles, authenticated and unauthenticated, are created by default for you. All user-defined roles are assumed to be children of the authenticated role, unless the new role is designated to be a child of another role.

Although configure roles can be configured in any order, it is usually easiest to configure roles from the least specific to the most specific. For example, *Figure 11 on page 307*, shows a simple role hierarchy. In this example, perhaps you would start configuring a role for the Engineering role, and continue down the tree towards Hardware Engineer and Software Engineer roles.

After binding all the required user policies to the role, issue a “refresh policy role blah” command to refresh the policies applied to the role blah. Likewise, unbinding the policy from a user role will also be effective only after refresh is done.

Some rules for configuring roles are:

- Each user role can have up to eight policies bound to it.
- The chain within a role hierarchy cannot be cyclical.
- The default role of unauthenticated cannot be a parent of other user configured roles.
- Default roles cannot be deleted.

For more details on system roles, see *System Generated Policies and Roles on page 325*.

The procedure for creating a role is:

1. *Assigning the Role a Name on page 320*
2. *Defining the Parent Role on page 320*
3. *Configuring the Role for User or Malware Policies on page 320*

Assigning the Role a Name

Assign the role a name using the Global Configuration command:

user-role *name*

Syntax Description	*name*	A name that identifies the role.

This statement creates a user role called finance. The policies defined in our earlier example of `finance_policy` are applied to this new role when a user is authenticated.

```
(SafeGuardOS) (config) # user-role finance
(SafeGuardOS) (user-role) #
```

Entering a role name places you in user-role mode.

Defining the Parent Role

By default, the authenticated role is the parent role. To change to a new parent, designate the parent using the following command:

parent *role_name*

Syntax Description	*role_name*	A name that identifies the role.

In this example, we are assigning the finance role as a child of the default authenticated role.

```
(SafeGuardOS) (config) #user-role finance
(SafeGuardOS) (user-role) #parent authenticated
(SafeGuardOS) (user-role) #
```

Configuring the Role for User or Malware Policies

Multiple user policies and malware remediation policies can be configured for a role. You would configure the **user-policy** keyword to bind policies to roles. A `malware-policy` keyword binds malware remediation policies to the role. Malware remediation policies are further discussed in *Configuring a Malware Remediation Policy on page 364*. For either designation, you must specify a precedence number. Precedence numbers are discussed in *Displaying Policy Configurations on page 327*.

In this example, we are binding both a malware policy and a user policy to the Finance role. We are also assigning a precedence number to the user policy but we are allowing the system to assign an auto-precedence number to blaster-policy.

```
(SafeGuardOS) (config) #user-role finance
(SafeGuardOS) (user-role) #malware-policy blaster-policy
(SafeGuardOS) (user-role) #user-policy finance-policy precedence 101
(SafeGuardOS) (user-role) #
```

Removing a Role

A role can be deleted using the **no** version of the command:

no user-role *role_name*

Syntax Description	*role_name*	A name that identifies the role.

In this example, we are removing the user role for Finance.

```
(SafeGuardOS) (config) # user-role finance
(SafeGuardOS) (user-role) # no user-role finance
(SafeGuardOS) (user-role) #
```

Refreshing Policies and Roles

When you map to a role, or if you remove a role, an update is automatically triggered by the software. However, if you modify a policy that has already been mapped or if you change a role definition, you must refresh the policy or role. You must perform a refresh even if the policy configuration occurred while in pass-thru mode.

To individually refresh a policy or role, use the **refresh** command. All policies and roles can be refreshed at the same time.

To allow the system to download the changed policy and roles for the affected users, use the following **refresh** Privileged Exec command:

refresh policy [**all** | **policy** *name* | **role** *name*]

Syntax Description	**all**	Refreshes all policies and roles.
	name	Refreshes an individual policy or role.

Network Zones Example

The following is an example of a user policy with a network zone. In the first portion of the example we define the network zone; in the second portion, we bind the zone to a user policy.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #network-zone nzSample1
(SafeGuardOS) (network-zone) #host ip-address 192.168.4.7
(SafeGuardOS) (network-zone) #host mac-address 00:ab:cd:11:22:33
(SafeGuardOS) (network-zone) #network 192.168.200.0 255.255.255.0
(SafeGuardOS) (network-zone) #range 192.168.5.1 192.168.5.50
(SafeGuardOS) (network-zone) #exit
(SafeGuardOS) (config) #

(SafeGuardOS) (config) #policy user policyTelnet
(SafeGuardOS) (policy-user) #filter f1 from any to network-zone nzSample1 tcp 23
permit precedence 10
(SafeGuardOS) (policy-user) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

In the next example of network zones, two zones are created: one for internal servers and another zone for external servers.

```
# Network-zone Our Company internal networks.

(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #network-zone nzInternal
(SafeGuardOS) (network-zone) #network 172.16.192.0 255.255.255.0
(SafeGuardOS) (network-zone) #network 172.16.193.0 255.255.255.0
(SafeGuardOS) (network-zone) #network 172.16.195.0 255.255.255.0
(SafeGuardOS) (network-zone) #network 172.16.196.0 255.255.255.0
(SafeGuardOS) (network-zone) #network 172.16.197.0 255.255.255.0
(SafeGuardOS) (network-zone) #network 172.16.198.0 255.255.255.0
(SafeGuardOS) (network-zone) #network 172.16.199.0 255.255.255.0
(SafeGuardOS) (network-zone) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #

# Network-zone for Active Directory servers.
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #network-zone nzAdServers
(SafeGuardOS) (network-zone) #host ip-address 172.16.194.30
(SafeGuardOS) (network-zone) #host ip-address 172.16.194.31
(SafeGuardOS) (network-zone) #host ip-address 172.16.194.32
(SafeGuardOS) (network-zone) #host ip-address 172.16.0.20
(SafeGuardOS) (network-zone) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Application Groups Example

The following example defines an application group with three applications and then binds the group to a user policy:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #application-group agSshTelnetWinNY
(SafeGuardOS) (app-group) #application SSH
(SafeGuardOS) (app-group) #application TELNET
(SafeGuardOS) (app-group) #application WINNY
(SafeGuardOS) (app-group) #exit
```

```
(SafeGuardOS) (config) #policy user policySshTelnetWinNY
(SafeGuardOS) (policy-user) #filter f1 from any to any application-group
agSshTelnetWinNY deny log precedence 20
(SafeGuardOS) (policy-user) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Overriding System Policies with a User Policy

In the rare case where it is necessary to temporarily override a system policy, create an override policy. These policies have a higher ranking than system policies and are executed after malware policies. For more information on the ranking of policies, see *Policy Enforcement on page 299*.

The **policy override** command follows all of the syntax of the **policy user** command, see *Defining and Applying User Policies on page 314* for further details.

EPV Policies

End point Posture Validation (EPV) is a component of SafeGuard OS that verifies that an end user's system and virus software is current. EPV uses policies as the enforcement agent to determine whether the user needs to have their machine scanned for current software levels or whether the user can bypass examination. There are two required EPV policies: trigger and bypass.

- The trigger policy determines which packets need checking and what to do with those packets until EPV is complete.
- The bypass policy defines users and resources that do not require checking. For example, you might want to put an IP-enabled printer in the bypass policy.

For a full discussion of EPV and how to configure the EPV policies, see *End Point Validation on page 341*.

Configuring Policy-Based Mirroring

SafeGuard OS supports both port-based mirroring and policy-based mirroring. Port-based mirroring copies all traffic from a port onto a destination port. Port-based mirroring is further discussed in *Understanding Mirroring and Monitoring Ports on page 91*. Policy-based mirroring is a refinement on port-based mirroring. Policy-based mirroring allows you to specify mirroring at the rule-level of a policy. When you specify the keyword `mirror` on the filter statement of a user or malware policy, only the traffic matching that user or malware policy is mirrored to the destination port. See also, *Configuring the Rules on page 316*.

Policy-based mirroring is used in user and malware policies to mirror specific host activities. Port 21 on the OmniAccess 2400 SafeGuard and port 9 on the OmniAccess 1000 SafeGuard may be configured as the destination port for mirroring. To configure policy-based mirroring use the **monitor policy-based destination m1** command in Global Configuration mode.

monitor policy-based destination m1 [*slot/port*]

Syntax Description	*slot/port*	The port assigned as the mirror destination port. The port is designated in slot/port notation. Valid entries are 0/21 for the OmniAccess 2400 SafeGuard and 0/9 on the OmniAccess 1000 SafeGuard. On the OAG4048, any port can be designated as the destination port.

This command is used in conjunction with the policy filter which controls the specific traffic to mirror.

For example, the following command assigns port 9 on a OmniAccess 1000 SafeGuard to receive the mirrored data:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #monitor policy-based destination m1 0/9
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Use the **no** version of the **monitor policy-based destination m1** command to clear the mirroring port configuration. The syntax of the Global Configuration command is:

no monitor policy-based destination m1

The following example clears port 21 on a OmniAccess 2400 SafeGuard as the destination port for mirroring:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #no monitor policy-based destination m1
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Policy Debug

To enable the capture of debug information for policy, use the **policy debug** command in Privileged Exec mode. When policy debug is enabled, the policy hit events are logged on the host side and some additional statistics is maintained to help system debugging.

policy debug [**enable** | **disable**]

Syntax Description	**enable**	Enables the capture of debug information.
	disable	Disables the capture of debug information.

To verify the settings of policy debug, use the **show policy debug** command as discussed in *Showing Policy Debug on page 330*.

System Generated Policies and Roles

SafeGuard OS creates policies and roles for internal use. These policies and roles are not available for external configuration, but have key significance when understanding policy. Configure whether this information should be hidden or displayed in related **show** command output. To enable viewing of system policy information, use the following Global Configuration command:

policy system-display

The command has no options or parameters. The command is enabled by default. To prevent system policy information from displaying in show command output, use the no version of the command:

no policy system-display

Default System Policies

The SafeGuard OS creates default policies to facilitate the authentication process.

The System_CPAuthRedir helps to redirect Captive Portal traffic to the CPU.

```
policy user System_CPAuthRedir
  filter System_CPAuthRedir-1 from any to any tcp 16978 redirect-cpu precedence 1
  filter System_CPAuthRedir-2 from any to any tcp 16979 redirect-cpu precedence 2
```

The System_Redirect helps to send the supported authentication packets to the CPU to facilitate the initial authentication and reauthentication process.

```
system-policy System_Redirect
  filter System_Redirect-radius from any to any udp 1812 copy-cpu precedence 1
  filter System_Redirect-dhcp-1 from any to any udp 67 copy-cpu precedence 2
  filter System_Redirect-dhcp-2 from any to any udp 68 copy-cpu precedence 3
  filter System_Redirect-krb from any to any udp 88 copy-cpu precedence 4
  filter System_Redirect-krb-tcp from any to any tcp 88 copy-cpu precedence 5
```

EPV System Policies

EPV also maintains a system-level policy to permit EPV processing for certain types of packets.

```
Filter System_Redirect-epvhttp-tcp from any to host 69.233.160.203 tcp 31862
redirect-cpu precedence 7
```

EPV also has system-level bypass policies to bypass certain types of packets:

```
(SW108) #show policy epv system
policy epv "System-epv"
filter "bypass1" from host 255.255.255.255 to any any bypass precedence 1
filter "bypass2" from network 0.0.0.0 255.255.255.255 to any any bypass
precedence 2
filter "bypass3" from network 224.0.0.0 240.0.0.0 to any any bypass precedence 3
filter "bypass4" from network 127.0.0.0 255.0.0.0 to any any bypass precedence 4
filter "bypass-dhcp1" from any to any udp 67 bypass precedence 5
filter "bypass-dhcp2" from any to any udp 68 bypass precedence 6
filter "bypass-dns-udp" from any to any udp 53 bypass precedence 7
```

Default System Roles

SafeGuard OS creates two system roles, with all other user roles are based off of, authenticated and unauthenticated. These default roles are automatically applied to the default system and EPV system policies. All customer-defined roles are assumed to be children of the authenticated role, unless the new role is designated to be a child of another role.

Dynamic System Policies

Dynamic system policies only apply to the unauthenticated role.

After Captive Portal is enabled using the **aaa captive portal** command, the system automatically creates a policy to redirect web portal traffic. An example for port 6 follows:

```
system-policy System_6
  filter System_6-1 from port 6 to any tcp 3128 redirect-cpu
  filter System_6-2 from port 6 to any tcp 443 redirect-cpu
  filter System_6-3 from port 6 to any tcp 80 redirect-cpu
```

Likewise, if you configure EPV bypass and trigger policies, the system automatically creates system policies.

Displaying Policy Configurations

Following are Privileged Exec **show** commands to display policy and policy-related configurations:

Command	Use
show application-filters	Displays the filters for all policy application rules.
show application-group	Displays either a specific application-group configuration or all application groups.
show monitor policy-based	Displays the mirror configuration.
show network-zone	Displays a network zone configuration or all network zone configurations.
show policy debug	Displays whether policy debug is enabled or disabled.
show policy enforcement-priority	Displays the order of enforcement among the different policy types.
show policy epv	A series of commands that display information about EPV policies.
show policy malware	Displays either the named malware policy or all malware policies. This command is described in *Displaying a Malware Policy Configuration on page 371*.
show policy override	Displays details of override policies.
show policy user	Displays all user or system policies.
show system white-black list	Displays the contents of the system white-black list.
show user-role	Displays a single user-role or all user-roles on the SafeGuard device.

Related show commands are discussed in:

- *Displaying Malware Configurations on page 370*.
- *Displaying and Clearing the EPV Posture State on page 357*.

Showing Application Filters

The **show application-filter** Privileged Exec command displays all configured application filters.

show application-filter [*filter_name* | **all**]

Syntax Description	*filter_name*	Displays the named application filter.
	all	Displays all configured application filters.

The following sample output is representative of the **show policy application-filter** command:

```
SafeGuardOS) #show application-filter all

policy application-filter "af0001"
   operation OR
   CIFS FileName contains "bogus"
   CIFS UserName contains "bozo"
!
policy application-filter "af0002"
   operation OR
   FTP FileName contains "abcxyz"
   FTP UserName contains "bozo"
!
policy application-filter "af0003"
   operation OR
   HTTP ContentType contains "bogus"
   HTTP Host ends-with ".abcxyz.com"
   HTTP UserAgent contains "Mozilla/5.0"
!
```

Showing Application-Group

The Privileged Exec **show application-group** command either displays the configuration of a named application group or the configuration of all application-groups on the SafeGuard device.

show application-group [*app_group_name* |**all**]

Syntax Description	*app_group_name*	Displays the named application group.
	all	Displays all configured application groups.

The following sample output is representative of the **show application-group** command:

```
(SafeGuardOS) #show application-group all

application-group IM
        application AOLIM
        application MSNIM
        application YAHOOIM
!
application-group NetworkConnectivity
        application CIFS
```

```
        application FTP
        application SSH
        application TELNET
!
application-group Web
        application ALT-HTTP
        application HTTP

!
```

Showing Policy-Based Mirroring

The Privileged Exec **show monitor policy-based** command displays the assignment for the mirroring ports. The destination port for a OmniAccess 2400 SafeGuard is 0/21 and for a OmniAccess 1000 SafeGuard it is 0/9.

show monitor policy-based

The command has no options or parameters.

The following sample output shows the format of the **show monitor policy-based** command for a OmniAccess 2400 SafeGuard:

```
(SafeGuard OS) #show monitor policy-based

mirror port m1: 0/21
```

Showing Network Zones

The Privileged Exec **show network-zone** command either displays the configuration of a named network zone or the configuration of all network zones on the SafeGuard device.

show network-zone [*zone_name* |**all**]]

Syntax Description	*zone_name*	Displays the named network zone.
	all	Displays all configured network zones.

The following sample output shows the format from the **show network-zone** command for a zone called print_pool:

```
(SafeGuard OS) #show network-zone print_pool


network-zone print_pool
        host ip-address 192.168.4.7
        range 192.168.5.1 192.168.5.50
        network 192.168.200.0 255.255.255.0
!
(SafeGuard OS) #
```

Showing Policy Debug

The **show policy debug** command indicates whether policy debug is enabled or disabled.

```
show policy debug
```

The command has no options or parameters. The following sample output is representative of the **show policy debug** command:

```
(SafeGuardOS) # show policy debug
Policy Debug is Enabled
(SafeGuardOS) #
```

Showing Policy Enforcement-Priority

The **show policy enforcement-priority** command is an easy way to display the ranking of policies for a user.

```
show policy enforcement-priority
```

The command has no options or parameters. The following sample output is representative of the **show policy enforcement-priority** command:

```
(SafeGuardOS) #show policy enforcement-priority
Policy enforcement priority in descending order:

    Malware policy
    Override policy
    EPV-system policy
    EPV policy
    System policy
    User policy

(SafeGuardOS) #
```

Showing Policy EPV

The following commands display information about EPV policies:

- *Showing Policy EPV Host-Table*
- *Showing Policy EPV All*
- *Showing Policy EPV System*

Showing Policy EPV Host-Table

This command displays the mapping between hosts in the EPV table and the dynamic policies they inherit.

```
show policy epv host-table
```

The command has no options or parameters. The following sample output is representative of the **show policy epv host-table** command:

```
(SafeGuardOS) #show policy epv host-table

Global EPV status: enabled
IP              MAC                 Policy
-----------------------------------------------
172.16.145.17   00:0c:29:93:c4:51   dynamic_e
172.16.145.2    00:11:11:79:c4:de   dynamic_a
```

The fields in the output represent:

Field	Description
Global EPV status	Indicates whether EPV is enabled or disabled.
IP	The IP address of the EPV host.
MAC	The MAC address of the host.
Policy	The policy that this host inherits.

Showing Policy EPV All

This command displays all configured bypass and trigger policies.

show policy epv all

The command has no options or parameters. The following sample output is representative of the **show policy epv all** command:

```
(SafeGuardOS) #show policy epv all
policy epv "bypass"
filter "f1" from any to any tcp 53 bypass precedence 10
filter "f2" from any to any udp 53 bypass precedence 20
filter "f3" from any to any tcp 88 bypass precedence 30
filter "f4" from any to any udp 88 bypass precedence 40
filter "f5" from any to any tcp 389 bypass precedence 50
filter "f6" from any to any udp 389 bypass precedence 60
filter "f7" from network-zone "EPV Bypass Hosts" to any any bypass precedence 70
filter "f8" from any to network-zone "EPV Remediation" any bypass precedence 80
!
policy epv "trigger"
filter "f1" flow-out from any to any tcp 80 redirect-cpu precedence 10
filter "f2" flow-out from any to any any deny precedence 20
!
(SafeGuardOS) #
```

Showing Policy EPV System

This command displays the pre-configured EPV system policies.

The command has no options or parameters. The following sample output is representative of the **show policy epv system** command:

```
(SW108) #show policy epv system
policy epv "System-epv"
filter "bypass1" from host 255.255.255.255 to any any bypass precedence 1
filter "bypass2" from network 0.0.0.0 255.255.255.255 to any any bypass
precedence 2
filter "bypass3" from network 224.0.0.0 240.0.0.0 to any any bypass precedence 3
filter "bypass4" from network 127.0.0.0 255.0.0.0 to any any bypass precedence 4
filter "bypass-dhcp1" from any to any udp 67 bypass precedence 5
filter "bypass-dhcp2" from any to any udp 68 bypass precedence 6
filter "bypass-dns-udp" from any to any udp 53 bypass precedence 7
filter "bypass-dns-tcp" from any to any tcp 53 bypass precedence 8
```

Showing Policy Override

The **show policy override** command displays any configured override policies. The command has no options or parameters. The following sample output is representative of the **show policy override** command:

```
(SafeGuardOS) (policy-override )# show policy override all


policy override "RIDEover"
        filter "bypass1" from  host 172.15.28.1 to any  any deny precedence 1
!

(SafeGuardOS) (policy-override)#
```

Showing Policy User

The **show policy user** command can display user or system policies.

show policy user [*policy_name*|**all**|**system**]

Syntax Description	*policy_name*	Displays the named user policy.
	all	Displays all configured user policies.
	system	Displays the internal system policies.

The following sample output shows the default system policies:

```
(SafeGuardOS) #show policy user system

policy user System_CPAuthRedir
   severity MAJOR
   filter System_CPAuthRedir-1 from any to any tcp 16978 redirect-cpu precedence
1
```

```
   filter System_CPAuthRedir-2 from any to any tcp 16979 redirect-cpu precedence
2
!
policy user System_Redirect
   severity MAJOR
   filter System_Redirect-radius from any to any udp 1812 copy-cpu precedence 1
   filter System_Redirect-dhcp-1 from any to any udp 67 copy-cpu precedence 2
   filter System_Redirect-dhcp-2 from any to any udp 68 copy-cpu precedence 3
   filter System_Redirect-krb from any to any udp 88 copy-cpu precedence 4
   filter System_Redirect-krb-tcp from any to any tcp 88 copy-cpu precedence 5
```

The following sample shows the output of user policies:

```
(OmniAccess 2400 SafeGuard) #show policy user all
policy user global_policy
        filter global1 from any to any application-group outsideFTP deny log
precedence 10
!
policy user j9
       description “Tech Pubs”
       filter pubs from any to any any permit
!
policy user port_restrict_policy
        description "Restrict Eng from server 172.80.10.4"
        filter hrFilter from any to host 172.80.10.4 any deny log
!
```

Showing System White-Black List

The **show system white-black list** command displays all of the nodes that are in the list.

`show system white-black list`

The command does not have any options or parameters.

The output of the command displays the number of items in the list. It also provides the source MAC address, action, and a description (if configured) for each list item in tabular format.

For example,

```
(SafeGuardOS) #show system white-black list

Contents of system white and black list
---------------------------------------

Number of Rows:2

MAC Addr            MAC Mask            Action      Description
--------            --------            ------      -----------
00:11:22:33:44:55   ff:ff:ff:ff:ff:ff   permit      you rock girl
11:22:33:44:55:66   ff:ff:ff:ff:ff:ff   deny        no way Jose
(SafeGuardOS) #
```

Showing User-Role

To displays a single user-role name or all user-role names on the device, use the **show user-role** command.

show user-role [*user_role_name* | **all**]

Syntax Description	*user_role_name*	Displays a specific user role.
	all	Displays all configured user roles.

The following example is representative output from the **show user-role** command:

```
(SafeGuardOS) #show user-role all

user-role “authenticated”
   user-policy “POLICY4U” precedence 10
!
user-role “hw_engr”
!
user-role “sw_engr”
!
user-role “unauthenticated”
   malware-policy “a4” precedence 10
   override-policy “testrun” precedence 10
   user-policy “a1” precedence 10
   user-policy “a3” precedence 20
!
(SafeGuardOS) #
```

chapter

8 Visualization

In this chapter:

About Visualization

The visualization component of SafeGuard OS allows you to collect information about users, applications and how those users and applications impact on your network. This component serves as the conduit between the other SafeGuard OS components and the Alcatel-Lucent OmniVista SafeGuard Manager Command Center. OmniVista SafeGuard Manager is a central management system that displays this information through a GUI.

Network visualization can derive detailed information about what users are doing with an application by collecting network events and aggregating those events on a user and application basis.

These events are passed to OmniVista SafeGuard Manager where they are presented in a visual and easy-to-understand format. Having network visualization allows you to take remediation steps faster and have a better understanding when problems occur.

Say for example, you have a vendor working on site on a regular basis. You might want to give this vendor more privileges than a visitor, but might also want to restrict their use to certain applications or to certain file types. Network visualization allows you to apply policies that can block access and can log information about that access to OmniVista SafeGuard Manager.

Total User Awareness

Network visualization provides all the user, application, and performance information you need to have visibility into the network usage. This usage is constant and covers all points in the network.

Network visualization provides granular controls, including:

- Providing active and inactive user data
- Identifying who is using the network
- Identifying applications and resources as they interact with each other
- Identifying traffic patterns that represent normal and legitimate use of the network
- Identifying which traffic patterns represent abnormal (and possibly abusive) behavior
- Identifying the response times or throughputs that users are seeing
- Identifying when important events occur
- Identifying classified documents that passed over the network

Application Control

To help solve application problems, network visualization evaluates communication flows and packets in depth to pinpoint the application being used. Network visualization automatically discovers and records the user and application identities in real time without changing how users interact with systems and applications. It reports this information to OmniVista SafeGuard Manager, which offers a simple and accurate method of audit and control.

OmniVista SafeGuard Manager Table Support

SafeGuard OS maintains a set of tables for OmniVista SafeGuard Manager and for the CLI. The information in the tables are periodically pushed to OmniVista SafeGuard Manager at regular intervals. The tables and the fields that make them unique are:

- User Table
  - User name
  - IP address
  - MAC address
- Application Table
  - Application name
  - Application ID
- Application Instance Table
  - Destination IP address
  - Destination port
  - Application ID
- User Application Instance Table
  - Application ID
  - User ID
- Flow Table
  - User ID
  - Application ID
  - Source port
- Policy Table
- Malware Table

- Layer 7 Event Table

Configuring Visualization

For the most part, you do not need to explicitly configure visualization in order to see data in OmniVista SafeGuard Manager. SafeGuard OS does however, provide some options for how you push information to OmniVista SafeGuard Manager. To keep changes to the configuration after a reboot, save the running configuration to the startup configuration using the **write memory** command.

Setting Up the Controller or Switch for OmniVista SafeGuard Manager

The OmniVista SafeGuard Manager server establishes and maintains the connection with the SafeGuard device. A SafeGuard device allows up to four OmniVista SafeGuard Manager servers to be simultaneously connected, which is the default. The **mgmt-server max-servers** command allows you to specify the number of OmniVista SafeGuard Manager servers connected to the SafeGuard device. To change the number of management servers, use this command in Global Configuration mode:

`mgmt-server max-servers` *`number`*

Syntax Description	*number*	The number of OmniVista SafeGuard Manager servers connected to the SafeGuard device. Valid entries are from 1 to 4. The default is 4.

In the following example, we limit the number of connections to 3 OmniVista SafeGuard Manager servers:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #mgmt-server max-servers 3
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

You can verify the number of servers configured using the **show mgmt-server max-server** command. For more information, see *Showing Server Connections on page 339*.

Setting the Update Interval for OmniVista SafeGuard Manager

You can change the update interval for the SafeGuard device to send refreshed information to OmniVista SafeGuard Manager. The default time is 30 seconds, but valid range are from 15 to 120 seconds. Setting the interval to a shorter time interval causes more frequent updates and more overhead on OmniVista SafeGuard Manager; longer intervals use more memory on the device process.

The first time you change the interval setting, the interval update is longer because the timer completes the existing interval before starting the new interval timer. To change the update interval, use the **mgmt-server update-interval** command in Global Configuration mode.

mgmt-server update-interval *seconds*

Syntax Description	*seconds*	The time (in seconds) between updates to OmniVista SafeGuard Manager. Valid entries are from 15 to 120 seconds. The default is 30 seconds.

In the following example, we set the update interval to 1 minute:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #mgmt-server update-interval 60
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

You can verify the update interval configured using the **show mgmt-server update-interval** command. For more details, see *Showing the Update Interval on page 340*.

Displaying Visualization Information

There are Privileged Exec **show** commands to display visualization and OmniVista SafeGuard Manager-related configurations:

Command	Use
show mgmt-server max-server	Displays the number of OmniVista SafeGuard Manager management servers that can be connected to the SafeGuard device.
show mgmt-server update interval	Displays the time (in seconds) between updates to OmniVista SafeGuard Manager. Valid entries are from 15 to 120 seconds. The default is 30 seconds.
show mgmt-server connection info	Displays current OmniVista SafeGuard Manager connection information

Showing Server Connections

Use the **show mgmt-server max-server** command to display the number of OmniVista SafeGuard Manager management servers that are configured to communicate with the SafeGuard device. The connections exceeding the configured maximum are denied.

show mgmt-server max-server

The command does not have any options or parameters. For example:

```
(SafeGuardOS) # show mgmt-server max-server
Maximum 3 simultaneous management servers are supported.
(SafeGuardOS) #
```

Showing the Update Interval

Use the **show mgmt-server update-interval** command to display the update interval that the SafeGuard device sends refreshed information to OmniVista SafeGuard Manager.

`show mgmt-server update-interval`

The command does not have any options or parameters. For example:

```
(SafeGuardOS) # show mgmt-server update-interval
Mgmt-server update interval is 60 seconds.
(SafeGuardOS) #
```

Showing Connection Information

Use the **show mgmt-server connection-info** command to display all the OmniVista SafeGuard Manager management servers currently connected to the SafeGuard device with their connection information.

`show mgmt-server connection-info`

The command does not have any options or parameters. For example:

```
(SafeGuardOS) # show mgmt-server connection-info

OmniVista SafeGuard Manager connection info

------------------------


Number of Rows:1


Id    OmniVista SafeGuard Manager IP                Connect TimeLast update Time Updates Messages
Sent                  Bytes Sent

--    ----------                                  ---------------------------- ------- ------------ -
---------

2     172.16.3.187                                                                    Fri Mar  3
21:29:21 2006                                                                         Fri Mar  3
21:32:42 2006         9                                                               2 60808

(SafeGuardOS) #
```

chapter

9 End Point Validation

In this chapter:

Determining the Posture of a Host

This chapter describes the concepts and procedures for configuring End Point Validation (EPV).

The EPV component enforces a corporation's or entity's end point security compliance rules. When a user's system is current and in compliance with your corporate or enterprise security philosophy, it is said to be in good *posture*. EPV checks the versions and operational status of *end point*'s (any IP enabled device) security software to ensure that the software is up-to-date. Some checks that EPV performs are:

- Out-of-date virus definition files
- Out-of-date operating system (Service packs and hot fixes)
- Disabled or missing antivirus software
- Disabled or missing firewall
- Malicious key loggers
- Out-of-date antivirus scan engines
- Windows registry key values

The EPV component is disabled by default. To take advantage of EPV, you must configure its features. EPV is initiated when a user opens a browser for the first time in a session. If both EPV and Captive Portal are configured, the end point hosts are logged in to Captive Portal before being checked by EPV for software compliance. For more information about Captive Portal and its configuration, see *Configuring Captive Portal on page 220*.

SECURITY: EPV and malware policies have a higher ranking and priority than user policies. Although a user has authenticated to the system, been assigned a role, and have one or more user policies assigned, those user policies could be overruled by a policy having a higher ranking. Policy ranking is discussed in detail in *Precedence on page 300*.

The system flow of EPV is:

1. A user on an end point host, such as a desktop system, starts the machine and logs into the network.
2. Either the user authenticates (passive authentication) directly to the network, or the user opens a Web browser, which attempts to access the Internet and the user authenticates (active authentication) using Captive Portal. In either case, a role is assigned to the user and the system applies the policies that are pertinent to that role.

3 Once a user has authenticated on a host, the EPV sequence can either be triggered, or be bypassed, depending on the policies that apply to the IP interfaces on that host.

The bypass policy defines the IP-enabled devices that are known by IP address, IP mask, MAC address, or MAC mask and do not require EPV scanning. Examples of items that might not require scanning and could be put on the bypass policy are:

— A specific role, such as a guest role.

— An IP-enabled printer, IP phone, or downstream server

— The address of the remediation server, so that infected users or users with out-of-date software can access the servers to update and correct their machines

— DNS traffic

— Kerberos, LDAP, and RADIUS for passive authentication

For more information on bypass policies, see *Creating Global Bypass Policies on page 346*.

The trigger policy determines which packets need EPV and what to do with those packets until EPV is complete. The trigger policy is configured to either permit the packet without further evaluation or to deny all packets and redirect the request to the CPU.

When configuring a trigger policy, ensure the following:

— All possible TCP ports that are being listened to for traffic by HTTP servers are included in the trigger policy.

— Also, ensure that these ports are included in the Captive Portal hijack list (even if you are not using Captive Portal features). Configuration of the Captive Portal hijack ports is discussed in *Adding or Changing the Hijack Port on page 222*.

Configuration for a trigger policy is described further in *Configuring a Trigger Policy on page 348*.

When the trigger policy redirects to the CPU:

A The SafeGuard device hijacks the HTTP request and the user is redirected to a switch-local web page.

B The redirection causes the browser to download the Integrity™ Clientless Security (ICS) module from Check Point® Technologies Software Ltd. This scan agent determines whether the end point conforms to the configured end point policy.

C If the scan agent determines that the end point is in compliance with the corporate security policy, as defined on the ICS administration page, the end point is declared to be in good posture.

It also, optionally, can present a web page to the user saying they have passed posture validation. If the user is not in compliance, they are presented with a results page that tells what rules failed, how to remediate, and gives them the option to rescan.

NOTE: When the remediating action is a URL hyperlink to download a file or a patch, the EPV bypass policy must be configured not to trigger EPV for HTTP packets going to the remediation web server or network.

The EPV feature provides web based configuration of conformance policy. This is available by accessing the ICS configuration and reporting tools by following this link, where *`serviceport IP`* is the IP address assigned to the management port. This IP address can be obtained using the **`show serviceport`** command. See *Displaying Configuration Information for the Management Port on page 48*:

`http://serviceport IP:31862/ics/bin/ctool.cgi`

Use the ICS graphical user interface (GUI) to configure these ICS features:

- ICS rules.
- ICS policies. When there are multiple policies, determine which policies are applied.
- The rescan interval.
- Whether a user has access to non-standard operating systems.

Before accessing the ICS tools, you must log in. The default login process is described in the *Integrity Clientless Security Administration Guide*. To add additional users and passwords to the Alcatel-Lucent system, use the optional EPV configurations described in *Adding or Deleting Additional ICS Administrators on page 352*.

When configuring ICS, Alcatel-Lucent recommends that the following boxes have check marks on ICS gateway page:

- Require Integrity Security Scanner
- Allow access to endpoints running a non-supported OS
- Enforce Interval Scan

Set a scan interval that is 15 minutes or longer and ensure that a corporate security compliance policy is selected from the drop down list. Do not check

the last two boxes (Require Integrity Secure Workspace and Require Advanced Anti-keylogger) because Alcatel-Lucent does not support these features. After being set in ICS, you should keep these settings in an optional backup file in NVRAM or on a TFTP server. This procedure is described in *Backing Up and Restoring the ICS Gateway Configuration on page 355*.

4 After the user receives notification of a healthy posture, they must keep the browser window open. This is a CLI configurable option. The ICS agent that was downloaded will perform a periodic rescan of the host.

Configuring EPV

Configuration for EPV involves configuring SafeGuard OS components and components from Check Point Software Technologies Ltd. Details for configuring the ICS module of Check Point Software are not described in this guide.

To configure ICS posture validation rules and the scan interval, see *Chapter 4: Administering Security Scanner Policies* in the *Integrity Clientless Security Administration Guide*.

To configure a SafeGuard device for EPV:

1 Configure policies for bypass and trigger. These policies are described in *Configuring EPV Policies on page 345*.

2 Enable EPV. This step is described in *Enabling EPV on page 351*.

3 Configure DNS to ensure that ICS can perform client-side updates. These commands are discussed in *Configuring Domain Name Servers on page 77*.

EPV has the flexibility to also allow:

- *Adding or Deleting Additional ICS Administrators*
- *Backing Up and Restoring ICS Policies and Rules*
- *Backing Up and Restoring the ICS Gateway Configuration*
- *Tailoring Contact Information*

These optional configuration steps are discussed in *Optional EPV Configuration on page 352*.

Configuring EPV Policies

In an EPV policy, a set of rules are established that define the bypass conditions or trigger events for the user. For both types of policies, filter statements are used to create the rules.

See the following sections for more details:

Creating Global Bypass Policies

Use a global bypass policy to define users that are not required to have their virus and system software checked on a regular basis. Global bypass policies are useful for filtering users with specific roles that do not require posture checking. Also use the global bypass policy to allow LDAP access for passive authentication. For example, you might have an employee using their personal machine temporarily for a project. In this case you would want to allow the employee to authenticate and go through role assignment with user policies but would not want to check software levels. If users want to do role-based EPV then that is configured by using bypass policies.

To create a bypass policy:

1. Use the Global Configuration command, **`policy epv bypass`**, to enter the policy-epv submode. This command does not have any options or parameters. For example,

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy epv bypass
(SafeGuardOS) (policy-epv) #
```

2. Add a description of the policy, using the **`description`** keyword. This step is optional, but is recommended. Strings are entered in double quotation marks. For example:

```
(SafeGuardOS) (config) #policy epv bypass
(SafeGuardOS) (policy-epv) #description “This is our standard bypass
   policy.”
(SafeGuardOS) (policy-epv) #
```

3. Define a filter for each rule and an action to execute. The syntax of an EPV bypass filter is:

`filter` *`name`* {*`direction`*} **`from`** *`source`* **`to`** *`destination protocol`* **`bypass`**

Syntax Description	*`name`*	Name of the user filter.
	`direction`	Specifies the direction that a flow is initiated. Direction can be any of the following: ■ `flow-in` – apply to flows initiated from the user-side of the SafeGuard device ■ `flow-out` – apply to flows initiated from the network-side of the device ■ (Default) blank, which applies to flows in either direction

source — Specifies the source endpoint of the traffic. It can be any of the following:

- any – Wildcard, which matches all source
- host – IP address or MAC address of the host
- macmask – MAC mask of the host
- network – IP address of the subnet
- network-zone – MAC address, IP address, network address, or address range
- range – IP address range
- role – a user role
- NOT – Negates the from criteria, except for 'any'

destination — Specifies the destination endpoint of the traffic. It can be any of the following:

- any – Wildcard, which matches all destination.
- host – IP address of the host
- network – IP address of the subnet
- network-zone – IP address, network address, or address range
- range – IP address range
- NOT – Negates the from criteria, except for 'any'

protocol — Matches the IP protocol of the traffic. It can be any of the following:

- any – Wildcard, which matches TCP or UDP protocols and application
- tcp – TCP
- udp – UDP; specify protocol port number and the port operation:

  1 to 65535 – End port or the start of the end port

  GE – Greater than or equal to

  NE – Not equal to

  LE – Less than or equal to

  range – Destination TCP port range

  out-of-range – Out of the destination TCP port range

bypass — The only valid action is bypass, which bypasses EPV policy.

In addition to the standard L2-L4 policy rules, EPV bypass filters can be configured based on the assigned user role. This may be useful, for example, if a group of guest users authenticate via captive-portal, but should not be scanned. If these guest users are placed in a role called GUEST_ROLE, the following bypass filter can be used to keep these users from being subjected to EPV bypass:

filter *noGuestCheck* **from** *role GUEST_ROLE* **to** *any* **bypass**

This type of role-based filter can also be used to keep unauthenticated users from being scanned by EPV. This may be desirable in an environment where the unauthenticated role is being used to provide some minimal guest access. In this case, the following filter can be used:

filter *noUnauthCheck* **from** *role unauthenticated* **to** *any* **bypass**

Bypass Examples

In the following example, the UDP traffic coming from the conference center (conf_ctr) going to any destination is bypassed from posture checking:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy epv bypass
(SafeGuardOS) (policy-epv) #description “This is our standard bypass policy.”
(SafeGuardOS) (policy-epv) #filter stdBypass from network-zone conf_ctr to any
UDP range 60000 65535 bypass
(SafeGuardOS) (policy-epv) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

In the next example, users with the role of “guest” are bypassed from posture checking:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy epv bypass
(SafeGuardOS) (policy-epv) #description “Bypass policy for guests.”
(SafeGuardOS) (policy-epv) #filter guestPolicy from role guest to any any bypass
(SafeGuardOS) (policy-epv) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Configuring a Trigger Policy

Trigger policies control which conversations the EPV feature will hijack.

To create a trigger policy:

1. Use the Global Configuration command, **policy epv trigger**, to enter the Policy-epv submode. This command does not have any options or parameters.

   For example,

   ```
   (SafeGuardOS) #configure terminal
   (SafeGuardOS) (config) #policy epv trigger
   (SafeGuardOS) (policy-epv) #
   ```

2 Add a description of the policy, using the **`description`** keyword. This step is optional, but is recommended. Strings are entered in double quotation marks. For example:

```
(SafeGuardOS) (config) #policy epv trigger
(SafeGuardOS) (policy-epv) #description “This is our standard trigger
   policy for EPV.”
(SafeGuardOS) (policy-epv) #
```

3 Define a filter for each rule and an action to execute. The syntax of a trigger policy filter is:

`filter` *`name`* {*`direction`*} **`from`** *`source`* **`to`** *`destination protocol action`*

Syntax Description	*`name`*	Name of the user filter.
	`direction`	(Optional) Specifies the direction that a flow is initiated. Direction can be any of the following: ■ `flow-in` – apply to flows initiated from the user-side of the SafeGuard device ■ `flow-out` – apply to flows initiated from the network-side of the device ■ (Default) blank, which applies to flows in either direction
	`source`	Specifies the source endpoint of the traffic. It can be any of the following: ■ any – Wildcard, which matches all source ■ host – IP address or MAC address of the host ■ macmask – MAC mask of the host ■ network – IP address of the subnet ■ network-zone – MAC address, IP address, network address, or address range ■ range – IP address range ■ NOT – Negates the from criteria, except for ‘any’

destination Specifies the destination endpoint of the traffic. It can be any of the following:

- any – Wildcard, which matches all destination.
- host – IP address of the host
- network – IP address of the subnet
- network-zone – IP address, network address, or address range
- range – IP address range
- NOT – Negates the from criteria, except for 'any'

protocol Matches the IP protocol of the traffic. It can be any of the following:

- any – Wildcard, which matches TCP or UDP protocols and application
- tcp – TCP; specify protocol port number and the port operation:

  1 to 65535 – End port or the start of the end port

  GE – Greater than or equal to

  NE – Not equal to

  LE – Less than or equal to

  range – Destination TCP port range

  out-of-range – Out of the destination TCP port range
- udp – UDP; specify protocol port number and the port operation:

  1 to 65535 – End port or the start of the end port

  GE – Greater than or equal to

  NE – Not equal to

  LE – Less than or equal to

  range – Destination UDP port range

  out-of-range – Out of the destination UDP port range

action	Specifies the action to be taken if the traffic matches the preceding patterns. The preferred options are to redirect to the CPU or to permit the packet. Action can be any of the following: ■ deny – drop the packet ■ permit – allows the packet without further evaluation ■ redirect-CPU – redirect the packet to the CPU

Note: The deny action can cause heavy network traffic, so use with caution.

Trigger Examples

In the following example, all Web traffic is redirected to the CPU.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy epv trigger
(SafeGuardOS) (policy-epv) #description “This is our standard trigger policy for
EPV.”
(SafeGuardOS) (policy-epv) #filter stdTrigger flow-out from any to any tcp 80
redirect-CPU
(SafeGuardOS) (policy-epv) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

In the next example, TCP traffic coming from devices in a specific network range are permitted without redirection.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy epv trigger
(SafeGuardOS) (policy-epv) #description “Trigger policy for CEO office, which is
exempt.”
(SafeGuardOS) (policy-epv) #filter CEOTrigger range 172.28.15.6 172.28.15 42 any
any permit
(SafeGuardOS) (policy-epv) #exit
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Enabling EPV

The EPV feature can be globally enabled or disabled on the SafeGuard device. EPV is disabled by default. When enabled, EPV uses the configured trigger and bypass policies for all authenticated and unauthenticated hosts. Posture policies are applied based on the outcome of the validations.

To set EPV to the enabled state, use the following command:

epv enable

EPV trigger and bypass policies do not take effect when EPV is disabled.

Use the **no** version of the Global Configuration command to disable EPV.

no epv enable

Optional EPV Configuration

Additional configuration options for EPV are described in the following sections:

- *Adding or Deleting Additional ICS Administrators*
- *Backing Up and Restoring ICS Policies and Rules*
- *Backing Up and Restoring the ICS Gateway Configuration*
- *Tailoring Contact Information*

Adding or Deleting Additional ICS Administrators

The default administrator user name and password are both set to `icsadm`. You can create additional users or delete the default user and password. This information is stored in persistent memory.

See the following sections for more details:

- *Adding ICS Administrators*
- *Modifying ICS Administrator Passwords*
- *Deleting ICS Administrators*

Adding ICS Administrators

To create a new ICS admin user, use the following command in Global Configuration mode:

epv admin add user *uname* **password** *pwd*

Syntax Description	*uname*	Specifies name of the new ICS administrator.
	pwd	Specifies the password.

In the following example, a new administrator called “icsadmin2” is created with the password of “Alcatel-Lucent”.

```
(SafeGuardOS) # configure terminal
(SafeGuardOS) (config) #epv admin add user icsadmin2 password Alcatel-Lucent
(SafeGuardOS) (config) #
```

Modifying ICS Administrator Passwords

To modify the password of an existing ICS admin user, use the following command in Global Configuration mode:

epv admin modify user *uname* **password** *pwd*

Syntax Description	*uname*	Specifies name of the ICS administrator to modify.
	pwd	Specifies the new password.

In the following example, we are changing the password of the default ICS administrative user:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #epv admin modify user icsadm password newpassword
(SafeGuardOS) (config) #
```

Deleting ICS Administrators

To delete an existing ICS admin user, use the following command in Global Configuration mode:

epv admin delete user *uname*

Syntax Description	*uname*	Specifies name of the ICS administrator being deleted.

In the following example, we are deleting the default ICS administrative user:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #epv admin delete user icsadm password icsadm
(SafeGuardOS) (config) #
```

Backing Up and Restoring ICS Policies and Rules

After setting the ICS Policies and ICS Rules, you should backup the configuration to non-volatile memory (NVRAM) or to the root directory of a TFTP server. If you intend to keep multiple copies of the file, save the file to a different filename on the TFTP server each time.

See the following sections for more details:

- *Saving (Copying) ICS Policy and Rules Settings*

Saving (Copying) ICS Policy and Rules Settings

To save the policy and rules settings in an optional backup file, use the following Privileged Exec command:

copy nvram:ics-policy [[**tftp://***ipaddr* **/** *filename*] | [**nvram:ics-policy-backup**]]

Syntax Description	*ipaddr*	Specifies that the configuration is saved to the root directory of an TFTP server at this IP address.
	filename	Specifies the EPV policy configuration saved on the TFTP server.
	ics-policy-backup	Specifies that the configuration is saved in non-volatile memory, NVRAM.

The following example saves the new policy configuration to a TFTP server at IP address 192.208.58.1:

```
(SafeGuardOS) # copy nvram:ics-policy tftp://192.208.58.1/epv-policy1
(SafeGuardOS) #
```

Restoring the Policy Backup File

If you created a backup policy file, you can restore the configuration using the policy.xml as the restore file. To restore the policy backup file, use the following command in Privileged Exec mode:

copy [[**tftp://***ipaddr/ filename*] | [**nvram:ics-policy-backup**]] **nvram:ics-policy**

Syntax Description	*ipaddr*	Specifies to use the configuration saved in the root directory of an TFTP server at this IP address.
	filename	Specifies to use the ICS policy configuration saved on the TFTP server.
	ics-policy-backup	Specifies to use the configuration saved in non-volatile memory, NVRAM.

Restoring the Policy Default Configuration File

To restore the policy file to the factory default settings, use the following command in Privileged Exec mode:

copy nvram:ics-policy-default nvram:ics-policy

This command has no options or parameters.

Backing Up and Restoring the ICS Gateway Configuration

Alcatel-Lucent recommends backing up the ICS gateway configuration, also called the portal configuration. This configuration is made on the ICS Gateway Page and should be changed as follows:

- Require integrity security scanner
- Allow access to endpoints running a non-supported OS
- Enforce interval scan

Set a scan interval that is 15 minutes or longer and ensure that a corporate security compliance policy is selected from the drop down list. Do not check the last two boxes (Require Integrity Secure Workspace and Require Advanced Anti-keylogger). After being set in ICS, you can save these settings in an optional backup file (portal.xml) in NVRAM or on a TFTP server.

See the following sections for more details:

- *Copying and Saving Portal Settings*
- *Restoring the Portal Backup File*
- *Restoring the Portal Default Configuration File*

Copying and Saving Portal Settings

To copy and save the portal settings, use the following command:

copy nvram:ics-portal [[**tftp://***ipaddr/ filename*] | [**nvram:ics-portal-backup**]]

Syntax Description	*ipaddr*	Specifies that the ICS gateway configuration is saved to the root directory of an TFTP server at this IP address.
	filename	Specifies the ICS gateway configuration saved on the TFTP server.
	ics-portal-backup	Specifies that the ICS gateway configuration is saved in non-volatile memory, NVRAM.

The following example saves the new portal configuration to NVRAM:

```
(SafeGuardOS) # copy nvram:ics-portal nvram:ics-portal-backup
(SafeGuardOS) #
```

Restoring the Portal Backup File

If you created a backup portal file, you can restore the configuration using the portal.xml as the restore file. To restore the portal backup file, use the following command in Privileged Exec mode:

copy [[**tftp://***ipaddr/ filename*]| [**nvram:ics-portal-backup**]] **nvram:ics-portal**

Syntax Description	*ipaddr*	Specifies to use the configuration saved in the root directory of an TFTP server at this IP address.
	filename	Specifies to use this ICS gateway configuration file saved on the TFTP server.
	ics-portal-backup	Specifies to use the configuration saved in non-volatile memory, NVRAM.

Restoring the Portal Default Configuration File

To restore the portal file to the factory default settings, use the following command in Privileged Exec mode:

copy nvram:ics-portal-default nvram:ics-portal

After returning to the factory defaults, you need to configure the ICS Gateway again as described above.

Tailoring Contact Information

The default remediation message for users who are not in compliance is "Please contact your administrator". This text is in HTML format and can be modified using standard HTML tags. You can change the default message to a custom remediation message by using the **epv ics-config admin-info** command in Global Configuration mode for end users if they fail a scan.

epv ics-config admin-info *string*

Syntax Description	*string*	The contact information displayed when a user fails a scan. The text for the string must be in double quotation marks.

For example:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS)(config) #epv ics-config admin-info “For assistance with your
software problem, contact the help desk at 4-HELP (4-4357).”
(SafeGuardOS)(config) #
```

Displaying and Clearing the EPV Posture State

There are Privileged Exec **Show** commands to display EPV and EPV-policy related configurations:

Command	Use
show epv	Displays the EPV configuration of a host.
show policy epv	Displays the EPV configuration of a host.

See the following sections for more details:

- *Showing EPV Host Status*
- *Showing EPV User Status*
- *Configuring EPV Rescan Timers*
- *Configuring Refresh Window*
- *Showing the EPV Configuration*

Showing EPV Host Status

The Privileged Exec **show epv** command displays the EPV status of a host by IP address, MAC address, its posture, or by all hosts.

show epv [**ip** *ip_addr* | **mac** *mac_addr* | **posture** [**healthy** | **unknown**] **all**]

Syntax Description	*ip_addr*	Displays the host with this IP address.
	mac_addr	Displays the host with this MAC address.
	healthy	Displays hosts with healthy posture.
	unknown	Displays hosts that are in the process of having their posture checked and those that have failed the posture check.
	all	Displays the posture of all known hosts.

The following sample output is representative of the **show epv** command:

This example shows all of the hosts in the posture database:

```
(SafeGuardOS) #show epv all

Contents of Host posture database
---------------------------------
Number of Rows:3
Host IPHost MACHost PostureLast Scan StartedLast Scan Finished
---------------------------------------------------------------
10.25.0.300:0e:0c:80:1a:dcunknownNEVERNEVER
192.168.0.10200:11:43:4e:78:07unknownNEVERNEVER
192.168.0.10900:11:43:4e:78:48healthyOct 26 2006 11:51:50Oct 26 200611:52:00
```

This example shows the status of all known hosts with unknown posture:

```
(SafeGuardOS) #show epv posture unknown

Contents of Host posture database
---------------------------------
Number of Rows:2
Host IPHost MACHost PostureLast Scan StartedLast Scan Finished
---------------------------------------------------------------
10.25.0.300:0e:0c:80:1a:dcunknownNEVERNEVER
192.168.0.10200:11:43:4e:78:07unknownNEVERNEVER
```

This example shows the EPV posture of the end point with IP address 10.25.0.3:

```
(SafeGuardOS) #show epv ip 10.25.0.3

Contents of Host posture database
---------------------------------
Number of Rows:1
Host IPHost MACHost PostureLast Scan StartedLast Scan Finished
---------------------------------------------------------------
10.25.0.300:0e:0c:80:1a:dcunknownNEVERNEVER
```

This example shows the EPV posture of the end point with MAC address 00:0e:0c:80:1a:dc:

```
(SafeGuardOS) #show epv mac 00:0e:0c:80:1a:dc

Contents of Host posture database
---------------------------------
Number of Rows:1
Host IPHost MACHost PostureLast Scan StartedLast Scan Finished
---------------------------------------------------------------
10.25.0.300:0e:0c:80:1a:dcunknownNEVERNEVER
```

Showing EPV User Status

In addition to displaying EPV status based on host IP, the EPV state information has been integrated with the output of the **show aaa users** command.

This command has the following syntax:

show aaa users [*options*]

Example 1: The example below shows the summary view of the user table. In the state column (header SATE) the E field indicates the current EPV state. Note that IP 172.16.145.2 (user echua) is healthy, IP 172.16.145.5 (user alice) has not even attempted an EPV scan and IP 172.16.145.126 (user bob) is unknown:

```
(CS107) #show aaa users
Port IP              User             Role             SATE Login Time
---- --------------- ---------------- ---------------- ---- -----------------
0/20 172.16.145.2    echua            kerberos-users   skHh Nov 28 2006 18:26:53
0/20 172.16.145.5    alice            radius-users     srH- Nov 28 2006 20:06:38
0/20 172.16.145.126  bob              cp-users         scHu Nov 28 2006 20:07:18

Code:
    (S)tate: "f"=failed, "s"=success
    (A)uthType: "k"=kerberos, "c"=captive-portal, "m"=mac-radius, "r"=radius
                "x"=802.1x, "w"=white-list
    (T)ype: "H"=host, "R"=router
    (E)PV State: "-"=not scanned "u"=unknown "h"=healthy
```

Configuring EPV Rescan Timers

The number of minutes between ICS rescans of a host is configurable via both the CTOOL web interface, as well as through the device **epv rescan-interval** command.

This command has the following syntax:

epv rescan-interval [*minutes*]

Syntax Description	*minutes*	This is the number of minutes between rescans. The default value is 15 minutes. The minimum value is 1 minute, the maximum value is 9999 minutes.

Configuring Refresh Window

In the default configuration, once the user has been successfully scanned they are presented with a popup window that stays open for the remainder of their session. This window periodically reloads, causing the ICS component to rescan the host. This command has the following syntax:

epv refresh-window

The window can also be disabled by using the **no** form of the command. In this case, the rescan will not happen in the background. If the user is found to be unhealthy they will be re-hijacked by the device. The syntax of the **no** form of the command is:

no epv refresh-window

Following is an example of this command:

```
(SafeGuardOS) #configure terminal
```

```
(SafeGuardOS) (config) #no epv refresh-window
```

Showing the EPV Configuration

The current configuration of the EPV feature can be displayed by using the **show epv configuration** command.

This command has the following syntax:

show epv configuration

Following is an example of this command:

```
(BOX101) #show epv configuration
Enabled..................................... FALSE
Use Refresh Window.......................... TRUE
Rescan Interval............................. 15
```

Clearing EPV Status

Use the **clear epv** command in Privileged Exec mode to clear the EPV status by IP address, MAC address, posture, or all hosts configured for EPV.

clear epv [**ip** *ip_addr* | **mac** *mac_addr* | **posture** [**healthy** || **unknown**] **all**]

Syntax Description	*ip_addr*	Clears the host with this IP address.
	mac_addr	Clears the host with this MAC address.
	healthy	Clears hosts with healthy posture.
	unknown	Clears hosts that are either unknown or that are in remediation.
	all	Clears all configured EPV hosts.

For example, the following command clears all EPV hosts that have an unknown state or are in remediation:

```
(SafeGuardOS) #clear epv posture unknown
```

chapter

10 Detecting and Isolating Malware Security Threats

In this chapter:

Detecting and Quarantining Malware

The term *malware* is derived from *malicious software*, which is any program or file that is harmful to a computer system. Common types of malware include computer viruses, worms, Trojan horses and spyware.

SafeGuard OS stops malware from propagating past the edge switch. Not only can the system detect malware, but it can stop an attack before network resources are impacted.

The system can create a "soft quarantine" for the infected device. This soft quarantine achieves two goals. First, it blocks only the infected traffic but allows the end device to communicate a carefully monitored connection to an IT server or Internet website for automatic upload of the most recent anti-virus software or OS patch. Second, if the attack is specific to a particular application, the SafeGuard device allows traffic from other applications to continue unimpeded.

The SafeGuard Controller examines all traffic, identifying traffic anomalies and malware infections. The device stops the attacks before they get to the core switch and shuts down the application traffic without shutting down all the traffic from that device using multiple detection mechanisms, such as:

- Detecting deviations of usage behavior on a per-application basis
- Detecting deviations of network access patterns for each host without the need of daily signature updates
- Detecting devices trying to reach computers that do not exist
- Detecting devices trying to access services that are not available
- Detecting IP scanning, port scanning and other reconnaissance activity by infected devices
- Monitoring the rate at which a particular application from a user is interacting with the network
- Detecting sudden and large changes in user usage of the network
- Detecting zero-day attacks
- Detecting Denial of Service (DoS) including SYN flood attacks, and ICMP flood attacks.
- Detecting IP source address spoofing

The system does detection and monitoring by analyzing the host and user behavior using event-driven algorithms. Malware detection works by analyzing the rates of these various events and by maintaining the state for each event on a per host or per user basis. At each event, the state is verified against the profile and anomalies are reported to OmniVista SafeGuard Manager.

The system uses the following malware algorithms:

- High Connection Attempts Rate (HCAR) to detect fast worms
- High Connection Attempts Failures (HCAF) to detect blind worms
- HCARHCAF combination to detect fast and blind worms

After malware is detected on the host or host application, the system reports the event to the policy component for enforcement action. Depending on how the malware policy is constructed, the system enforces whether the user or application is permitted or blocked.

This chapter provides an overview of the malware detection process and provides procedures for coding the commands used for detecting and remedying malware.

Configuring Malware Detection

Basic configuration of the malware detection feature on the SafeGuard device requires:

1 *Enabling and Disabling Global Malware Detection*

2 *Configuring Malware Controls*

3 *Configuring a Malware Remediation Policy*

Enabling and Disabling Global Malware Detection

Malware is disabled by default. To enable the malware detection feature, use the Global Configuration **malware detection** command:

malware detection [**enable** | **disable**]

Syntax Description	**enable**	Enables malware detection in the SafeGuard device. Detection includes malware reporting, logging, and visualization.
	disable	(Default) Disables malware detection in the SafeGuard device. Malware processing is bypassed.

For example, the following command enables malware detection:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #malware detection enable
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To validate the setting, see *Displaying the Malware Detection State on page 373*.

Configuring Malware Controls

The enforcement the system makes when malware is detected on a host or host application is controlled by the **malware action** command. Use the Global Configuration command to block or unblock traffic.

`malware action` [**`none`**] [**`block`** [**`host`** | **`hostapp`**]]

Syntax Description	**host**	Blocks the host traffic by IP address.
	hostapp	Attempts to block the host application based on the type of service observed on the host. If the type of malware is DoS, port scanning, or if the anomaly detected on the host, the system blocks the entire host. The action taken is displayed in the **show malware status** command. When three or more application-related events are reported, the entire host is blocked.
	none	(Default) Does not block traffic and takes no enforcement action. Even when malware is detected on a host, the traffic from the host is not dropped or denied access.

The malware action can be changed at run time and the changes take effect immediately. However, if the action is set to **none**, the malware becomes unblocked but is not cleared. To clear the malware, use the **clear malware** command, as described in *Clearing Malware Configurations on page 380*.

The following example blocks malware at the application level:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #malware action block hostapp
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

See the following sections to verify the configuration.

- *Displaying Configuration Information on page 114*.
- *Displaying Malware Actions on page 373*
- *Displaying the Contents of the Malware White-List on page 379*

Configuring a Malware Remediation Policy

When SafeGuard OS detects that the traffic is classified as malware, the global malware controls determine whether the traffic is permitted or denied to a host or to the application. If traffic is permitted, malware remediation policies are not used. If traffic is

denied, the traffic is quarantined and malware remediation policies are used to determine where the user is sent to resolve the problem.

When traffic is denied, the malware configuration determines that either the application or the host is to be blocked. If a malware mediation policy is configured it is applied to punch a hole into the firewall for the specified traffic. The most common use for this type of policy is to allow end users access to the remediation server to download software patches for the infection.

Configuring Malware Policies

To create malware policies, follow the steps in the following sections:

1. *Assigning the Policy a Name*
2. *Adding a Description*
3. *Configuring the Rules*
4. *Attaching the Policy to the User Roles*

Assigning the Policy a Name

To define a malware policy, begin by assigning a name to a policy using the Global Configuration command:

policy malware *name*

Syntax Description	*name*	A name that identifies the policy.

For example, the following statement defines a malware policy called blaster_policy.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy malware blaster_policy
(SafeGuardOS) (policy-malware) #
```

After defining the policy name, the system enters the policy-malware submode.

Adding a Description

Add an optional description of the malware policy with the following command:

description *string*

Syntax Description	*string*	A description of the policy. Place the string within double quotation marks.

Building off of our previous example, a description might be:

```
(SafeGuardOS) (config) #policy malware blaster_policy
(SafeGuardOS) (policy-malware) #description Blaster worm policy
(SafeGuardOS) (policy-malware) #
```

Configuring the Rules

For each rule, define a filter, an action to execute, and the precedence. The overall syntax of a policy filter is:

`filter` *`name`* **`from`** *`source`* **`to`** *`destination protocol action`* **`precedence`** *`number`*

Syntax Description	*`name`*	Name of the malware filter.
	`source`	Specifies the source endpoint of the traffic. It can be any of the following: ■ any – Wildcard, which matches all source ■ host – IP address of the host ■ network – IP address of the subnet
	`destination`	Specifies the destination endpoint of the traffic. It can be any of the following: ■ any – Wildcard, which matches all destination ■ domain – Domain name. Up to 3 servers with 10 domain names may be specified before the list is overridden with new entries. See also *Configuring for Domain Name Service (DNS) Server Support (optional) on page 367*. ■ host – IP address of the host ■ network – IP address of the subnet
	`protocol`	Matches the IP protocol of the traffic. It can be any of the following: ■ any – Wildcard, apply to all traffic ■ tcp – TCP; specify a protocol port number and the port operation: 1 to 65535 – End port or the start of the end port ■ udp – UDP; specify a protocol port number and the port operation: 1 to 65535 – End port or the start of the end port
	`action`	Specifies the action to be taken if the traffic matches the preceding patterns. Action can be any of the following: ■ action deny – drops the packet ■ action permit – allows the packet

precedence number	Each policy filter has an associated precedence which sorts the filters with in the policy. The precedences have a valid range of 1(highest) to 65535 (lowest). If a precedence number is not supplied, the system assigns a precedence. For an overview to precedence numbers and auto-precedence, see *Displaying Policy Configurations on page 327*.

In the following example, a rule or filter called "worm1" is created. The source endpoint for worm1 is IP address 192.168.0.2 with any destination over TCP port 1275. When a match is found, the rule drops the packet. The filter has a precedence of 500.

```
(SafeGuardOS) (policy-malware) #filter worm1 from host 192.168.0.2 to any TCP
1275 action deny 500
(SafeGuardOS) (policy-malware) #
```

In the next example, filterfix1 allows any endpoint to access Microsoft's update page:

```
(SafeGuardOS) (policy-malware) #filter filterfix1 from any to domain
windowsupdate.microsoft.com TCP 1275 permit
(SafeGuardOS) (policy-malware) #
```

Attaching the Policy to the User Roles

Attach the malware remediation policy to the various user roles that are defined in the system. Use the **malware-policy** command in user-role submode, with the following syntax:

malware-policy *name*

Syntax Description	*name*	A name that identifies the policy.

In following example, we attach the malware policy to the two default roles "unauthenticated" and "authenticated".

```
(SafeGuardOS) (config) # user-role unauthenticated
(SafeGuardOS) (user-role) # malware-policy Allow-to-Remediation-Server
(SafeGuardOS) (user-role) # exit
(SafeGuardOS) (config) # user-role authenticated
(SafeGuardOS) (user-role) # malware-policy Allow-to-Remediation-Server
(SafeGuardOS) (user-role) #
```

Configuring for Domain Name Service (DNS) Server Support (optional)

If specifying a domain name as the destination on a filter, SafeGuard OS offers some additional customization to support DNS, as follows:

- *Configuring DNS Server IP Addresses*
- *Configuring a Refresh Rate*

Configuring DNS Server IP Addresses

Up to 3 DNS server IP addresses can be specified using the Privileged Exec command:

dns nameserver *ipaddr1 ipaddr2 ipadd3*

Syntax Description	*ipaddr*	Specifies the IP address of a DNS server.

For example,

```
(SafeGuardOS) #dns nameserver 10.0.0.1 10.0.0.2 10.0.0.3
```

Also see *Displaying DNS Information on page 371*.

Configuring a Refresh Rate

To configure the domain name refresh interval, use the **policy name-resolution interval** command in Global Configuration mode:

policy name-resolution interval *minutes*

Syntax Description	*minutes*	Specifies the number of minutes until a refresh occurs. Valid entries are 1 to 65535 minutes. The default is 60 minutes.

In this example, the domain name refresh interval is set to 5 minutes:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #policy name-resolution interval 5
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, see *Displaying DNS Server Names and Refresh Rates on page 372*.

Configuring a Malware White-list

If a host exhibits behavior that triggers a malware event, but is proven to be clean, the host can be configured to bypass evaluation for malware. Likewise in the event of a Denial of Service (DoS) attack, certain destinations might erroneously appear.

If needed, a list of IP addresses can be specified that bypass malware detection or DoS attack destination known as the malware white-list. These IP addresses can be configured using the Global Configuration **malware white-list** command:

malware white-list [**host** *ip_address* | **dos-destination** *ip_address*]

Syntax Description	*ip_address*	IP address that overrides policy.

For example, the following command makes the user-host machine 10.0.10.7 exempt from malware detection.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #malware white-list host 10.0.10.7
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the configuration, see *Displaying the Contents of the Malware White-List on page 379*.

Clearing the Malware White-List

When a host IP-address is placed in the white-list, the system also clears all outstanding malware events for the host. However, events cannot be cleared for a DoS destination.

Removing IP Addresses from the White-List

To remove an IP address from the malware white-list and restore malware checking on a device, use the **no** version of the **malware white-list** command.

The Global Configuration command has the following syntax:

no malware white-list [**host** *ip_address* | **destination** *ip-address*]

Syntax Description	*ip_address*	Clears the white-list entry for this IP address.

For example, the following command removes the user-host machine 10.0.10.7 from the white-list. This IP address now is subject to malware detection.

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #no malware white-list host 10.0.10.7
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Configuring Mirroring

All traffic can be mirrored from a host to a mirroring port when a malware event is detected by the system. Malware mirroring uses the setup and configuration of policy-based mirroring for implementation.

Before configuring malware mirroring, configure policy-based mirroring as described in *Configuring Policy-Based Mirroring on page 323*. To enable malware mirroring, use the **malware action mirror** command in Global Configuration mode:

malware action mirror [**disable** | **enable** *seconds*]

Syntax Description		
	disable	Malware traffic is not mirrored.
	enable	Malware traffic is mirrored for all ports for future events.
	seconds	The amount of time that traffic is mirrored. Valid values are from 15 to 180 seconds. The default is 60 seconds.

If a second malware event occurs while the system is mirroring an existing event, the mirroring timer restarts for the host. Mirroring can be enabled or disabled at run time; disabling stops all outstanding mirroring, enabling only affects future malware events.

The following example enables mirroring on port 9 of a OmniAccess 1000 SafeGuard. Each event will be mirrored for 90 seconds:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #monitor policy-based destination m1 0/9
(SafeGuardOS) (config) #malware action mirror enable 90
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

To verify the setting for mirroring, see *Displaying Malware Actions on page 373*.

Displaying Malware Configurations

Following are Privileged Exec **Show** commands to display malware and malware-policy related configurations:

Command	Use
show dns file	Displays DNS server IP addresses.
show policy malware	Displays either the named malware policy or all malware policies.
show policy name-resolution	Displays either the DNS names or the refresh interval.
show user-role	Displays either a single user-role or all user-roles.
show malware action	Displays the system action for malware detection.

Command	Use
show malware detection	Displays whether malware detection is enabled or disabled.
show malware algorithm-info	Displays algorithm-related information for each malware event.
show malware event-info	Displays connection event-related information about each malware event.
show malware status	Displays the malware status of the host by IP address.
show malware trace	Displays the last eight sights visited before the malware event triggered.
show malware white-list	Displays the contents of the malware white-list.

Displaying DNS Information

To display the configured IP addresses used during malware remediation, use the **show dns file** command.

show dns file

The command has no options or parameters. The following sample output is representative of the show dns file command:

```
(SafeGuardOS) #show dns file

nameserver 10.0.0.1
nameserver 10.0.0.2
nameserver 10.0.0.3
```

Also see *Displaying DNS Server Names and Refresh Rates on page 372*.

Displaying a Malware Policy Configuration

To display the results of a malware configuration, use the **show policy malware** command.

show policy malware [*policy_name* |**all**]

Syntax Description	*policy_name*	Displays the configuration for the named malware policy.
	all	Displays all configured malware policies.

The following sample output is representative of the **show policy malware** command:

```
(SafeGuardOS) #show policy malware all
policy malware Allow-to-Remediation-Server
filter Allow-to-McAfee-Srv from any to host 172.16.0.55 any permit precedence 10
!
```

Displaying DNS Server Names and Refresh Rates

To display either the domain names being resolved during malware remediation or the refresh interval for the name resolution, use the **show policy name-resolution** command.

show policy name-resolution [**entries** | **interval**]

Syntax Description	**entries**	Displays the domain names configured as destinations in the malware remediation policy.
	interval	Displays the refresh intervals for domain name resolution.

The following sample output is representative of the **show policy name-resolution entries** command:

```
(SafeGuardOS) # show policy name-resolution entries
windowsupdate.microsoft.com

(SafeGuardOS) #
```

The following sample output is representative of the **show policy name-resolution interval** command:

```
(SafeGuardOS) # show policy name-resolution interval
policy name-resolution interval 60

(SafeGuardOS)#
```

Displaying User-roles

To display a single user-role name or all user-role names on the SafeGuard device, use the **show user-role** command.

show user-role [*user_role_name* | **all**]

Syntax Description	*user_role_name*	Displays a specific user role.
	all	Displays all configured user roles.

The following example is representative output from the **show user-role** command:

```
(SafeGuardOS) #show user-role unauthenticated
user-role unauthenticated
malware-policy Allow-to-Remediation-Server precedence 10
!
(SafeGuardOS) #show user-role authenticated
user-role authenticated
malware-policy Allow-to-Remediation-Server precedence 10
!
```

Displaying Malware Actions

To display the action the system takes for malware and the mirroring settings, use the **show malware action** command.

`show malware action`

The command has no options or parameters.

The following example is representative of sample output from the command:

```
(SafeGuardOS) #show malware action
Malware action is currently set to block HOST
Malware mirroring is enabled for 65 seconds
```

Displaying the Malware Detection State

To display the malware state, use the **show malware detection** command.

`show malware detection`

The command has no options or parameters.

The following example is representative of sample output from the command:

```
(SafeGuardOS) #show malware detection

Malware is enabled
```

Displaying Malware Status

To display the current malware state for a host or for all hosts, use the **show malware status** command.

`show malware status` {*`ipaddress`*}

Syntax Description	*`ipaddress`*	(Optional) Displays the status of the host at this IP address.

The following example is representative of sample output from the command; it shows the malware status of any hosts having a malware event:

```
(SafeGuardOS) # show malware status



Current Malware Status

----------------------


Number of Rows:2


Host IP           Host MAC           User ID      Last Event Time               Action    Event Count

-------           --------           -------      ---------------               ------    -----------

192.168.101.1      00:0c:29:d0:e8:49   2            Fri Mar 17 13:02:51.002 2006   HOSTAPP   2

66.166.203.235     00:0c:29:d0:e8:49   1            Fri Mar 17 13:02:31.171 2006   HOSTAPP   2
```

Table 28 explains the output fields of the **show malware status** command.

Table 28 Show Malware Status Output Fields

Field	Description
Host IP	The host at this address is generating the event.
Host MAC	The MAC address for the host generating the event.
User ID	A system-generated identifier for the event.
Last Event Time	The date and timestamp for the last occurrence that this host was hit.
Action	The blocking action. The blocking action is either host or hostapp. Host blocks the traffic by IP address; hostapp blocks the host application by destination port. See *Configuring Malware Controls on page 364*.
Event Count	The number of events for this host.

Displaying which Algorithm Detected the Malware

To display the algorithms associated with a malware event, use the **show malware algorithm-info** command. The Privileged Exec command has the following syntax:

show malware algorithm-info {*ipaddress*}

Syntax Description	*ipaddress*	(Optional) Displays additional malware and algorithm information for this specific IP address.

The following example is representative of sample output from the command:

```
(SafeGuardOS) # show malware algorithm-info



Additional Malware Information

------------------------------


Number of Rows:4


Event Id Host IP          Category                Algorithm   App Group    Time(msec) Attempts    Success
-------- -------          --------                ---------   ---------    ---------- --------    -------
1        66.166.203.235   Outbout TCP/UDP IP Scan HCARHCAF    Microsoft    173                23   0
2        66.166.203.235   Outbout TCP/UDP IP Scan None        Microsoft    N/A        N/A         N/A
3        192.168.101.1    Outbout TCP/UDP IP Scan HCARHCAF    Microsoft    170        23          0
4        192.168.101.1    Outbout TCP/UDP IP Scan None        Microsoft    N/A        N/A         N/A
```

Table 29 explains the output fields of the **show malware algorithm-info** command.

Table 29 Show Malware Algorithm-Info Output Fields

Field	Description
Event ID	A system-generated identifier for the event.
Host IP	The host at this address is generating the event.
Category	The type of scan or attack: Valid categories are: ■ Outbound TCP/UDP IP scan ■ Outbound TCP/UDP port scan ■ Outbound ICMP IP scan ■ Outbound TCPSYN Denial of Service (DoS) attack ■ Outbound ICMP DoS attack

Table 29 Show Malware Algorithm-Info Output Fields *(continued)*

Field	Description
Algorithm	The algorithm detecting the event. Algorithm types are: ■ HCAR ■ HCAF ■ HCARHCAF
App Group	The type of application generating the event.
Time(msec)	The duration of the event in milliseconds.
Attempts	The number of times the malware attempted to contact a host during the event.
Success	The number of times the malware was able to connect successfully.

Displaying Malware for an IP Address

To display the malware configuration for an infected host by IP address, use the **show malware event-info** command in Privileged Exec mode.

show malware event-info {*ipaddress*}

Syntax Description	*ipaddress*	(Optional) Displays the IP address of the infected host.

The following example is representative of sample output from the command:

```
(SafeGuardOS) # show malware event-info



Additional Malware Information

------------------------------


Number of Rows:4


Event Id Host IP        Protocol  Src Port  Dst Port  Dst IP          Mirror Interval(seconds)/Start Time

-------- -------        --------  --------  --------  ------          -----------------------------------

1        66.166.203.235 TCP       4765      135       66.137.210.181  65/Fri Mar 17 13:02:30.801 2006
```

```
2        66.166.203.235 TCP       4322      445       66.166.141.177  65/Fri Mar 17 13:02:31.171 2006

3        192.168.101.1  TCP       4765      135       66.137.210.181  65/Fri Mar 17 13:02:50.622 2006

4        192.168.101.1  TCP       4322      445       66.166.141.177  65/Fri Mar 17 13:02:51.002 2006
```

Table 30 explains the output fields of the **show malware event-info** command.

Table 30 Show Malware Event-Info Output Fields

Field	Description
Event ID	A system-generated identifier for the event.
Host IP	The host at this address is generating the event.
Protocol	The protocol being used when the event was triggered. Valid protocols are TCP, UDP or ICMP.
Src Port	The source port number generating the request. This field shows as N/A for ICMP.
Dst Port	The destination port number. This field shows as N/A for ICMP.
Dst IP	The destination IP address.
Mirror Interval (Seconds)	The amount of time that traffic is mirrored. Valid values are from 15 to 180 seconds. The default is 60 seconds.
Start Time	The date an timestamp for when the malware event began.

Displaying Malware Trace Information

Trace information is available for certain types of new worms. When trace is specified, the history of the last eight unique sites the infected host visited are displayed. Repeated events are not shown. Depending upon the type of event trace information is available in IP trace and port trace formats. Malware categories that do *not* carry trace information are:

- Outbound TCPSYN DoS attacks
- Outbound ICMP DoS attacks
- Outbound ICMP IP scans

To display the contents of the last eight sites visited before the malware event triggered for a given host, use the **show malware trace** command. The Privileged Exec command has the following syntax:

show malware trace *ipaddress*

Syntax Description	*ipaddress*	Displays last eight destination IP and destination ports for this infected IP address.

The following example is representative of sample output from the command for an IP scan event:

```
(SafeGuardOS) # show malware trace 66.166.203.235



Trace Information

-----------------


Number of Rows:8


Event Id  DstIP            Protocol   DstPort   SrcPort  Visits  Last Visited Time

--------  -----            --------   -------   -------  ------  -----------------

1         66.137.210.181   TCP        135       4765     1       Fri Mar 17 13:02:30.801 2006

1         66.211.161.30    TCP        135       4764     1       Fri Mar 17 13:02:30.732 2006

1         66.238.4.54      TCP        135       4762     1       Fri Mar 17 13:02:30.732 2006

1         66.166.142.180   TCP        445       4260     1       Fri Mar 17 13:02:30.732 2006

1         66.166.142.190   TCP        445       4282     1       Fri Mar 17 13:02:30.732 2006

1         66.166.142.185   TCP        445       4270     1       Fri Mar 17 13:02:30.732 2006

1         66.166.142.182   TCP        445       4264     1       Fri Mar 17 13:02:30.732 2006

1         66.166.142.177   TCP        445       4251     1       Fri Mar 17 13:02:30.732 2006
```

Table 31 explains the output fields of the **show malware trace** command

Table 31 Show Malware Trace Output Fields

Field	Description
Event ID	A system-generated identifier for the event.
Dst IP	The destination IP address.
Protocol	The protocol being used when the event was triggered. Valid protocols are TCP, UDP or ICMP.
DstPort	The destination port number. This field shows as N/A for ICMP.
SrcPort	The source port number generating the request. This field shows as N/A for ICMP.

Table 31 Show Malware Trace Output Fields *(continued)*

Field	Description
Visits	The number of hits to this address.
Last Visited Time	The date an timestamp for the last visit.

SECURITY: To see the full extent of the event, use Alcatel-Lucent OmniVista SafeGuard Manager.

Displaying the Contents of the Malware White-List

To display the contents of the malware white-list, use the **show malware white-list** command.

show malware white-list [**host** |**dos-destination**]

Syntax Description	**host**	Displays host IP addresses.
	dos-destination	Displays IP addresses of DoS attack destinations.

The command has no options or parameters.

The following example is representative of sample output from the command:

```
(SafeGuardOS) #show malware white-list host

Number of white-list Entries:3
10.0.10.7
10.0.10.6
10.0.10.5
```

Downloading Malware Definition Files

To download the malware app categorization definition file or the malware profile definition file, use the Privileged Exec **copy** command.

copy tftp://ip/{*filepath*/}*file* [**malware-app-categories** | **malware-profile**]

Syntax Description	*ip*	Specifies the IP address of the TFTP server
	filepath	(Optional) Specifies the directory path to the file.
	file	Specifies the filename of the key file.
	malware-app-categories	Copies the app categorization definition file.
	malware-profile	Copies the malware profile definition file.

The following example copies a malware-app-categorization file from the TFTP server:

```
(SafeGuardOS) #
(SafeGuardOS) # copy tftp://180.29.52.20/mwareapp malware-app-categories
(SafeGuardOS) #
```

Clearing Malware Configurations

SafeGuard OS provides clear commands to change the malware state or to remove an IP address from the white-list.

To clear the malware state of both host or host application infections use the **clear malware** command. This Privileged Exec command clears the state of the specified host (IP or MAC) and restores network access, as determined by the policy for the host.

clear malware [[**ip-address** *ip*]| [**mac** *mac-address*]| **all**]

Syntax Description	*ip*	Clears the state for the infected host or host application at this IP address.
	mac-address	Clears the state for the infected host or host application at this MAC address. MAC addresses may be specified in any of the following formats: ■ aa:bb:cc:dd:ee:ff ■ aabb:ccdd:eeff ■ aa-bb-cc-dd-ee-ff ■ aabb.ccdd.eeff ■ aabbccddeeff
	all	Clears all malware states.

For example, the following command clears the malware state for IP address 10.0.10.2.

```
(SafeGuardOS) #clear malware ip-address 10.0.10.2
```

NOTE: After clearing a host, it might takes a few seconds before the **show** commands reflect the change in state.

chapter

11 Troubleshooting

In this chapter:

This chapter describes the commands used for configuring logging.

Logging Overview

Two types of log messages exist in the SafeGuard device: *trace* messages and *syslog* messages.

- Trace messages provide developers with debugging information for the product in the field. This information is primarily used by the system engineers and TAC to diagnose problems.
- Syslog messages inform the user of normal operational events.

Each message in the system has a type, severity level, and source component. The severity levels are shown in the table that follows:

Table 32 describes security levels and their severity.

Table 32 Security Levels and Their Security

Severity Level	Description
Emergency	These messages are always logged.
Alert	Action must be taken immediately to avoid system failure.
Critical	Recoverable failure of a component that may lead to system failure if not addressed
Error	Recoverable failure of a component
Warning	Minor failure, misconfiguration, etc.
Notice	Normal but significant conditions
Informational	Normal condition may be of interest to the operator.
Debug	Debug level messages, normally disabled unless operator is debugging

Each component in the system is identified by a string name. Each component can have independent threshold levels for both trace and syslog messages.

Currently supported components are shown in the table that follows:

Table 33 System Components and Descriptions

Component	Description
AUTH	Covers events generated by network login/logout, passive authentication, etc.
ALL	All components.
AUTH	Passive/active authentication.
CFGM	Device configuration processing including cross-process configuration.
CLI	CLI processing including configuration files, user actions, etc.
EPV	End Point Validation operations.
HIGHAVAIL	Events related to High Availability features.
HOST	Host L2/L3 mapping tables.
HWMON	Monitoring hardware events.
ICC	Communications with OmniVista SafeGuard Manager.
IPC	Communication between subsystems on the device.
LSP	SafeGuard Processor events.
LSPD	LSPD process debugging.
MALWARE	Malware component including detection, configuration, etc.
PLATFORM	Platform related issues including L2 configuration, link status, boot messages, etc.
POLICY	Policy operations.
PORTMON	Device port management.
PROMAN	Device process management.
TRAPMGR	Trap manager event supporting.
USERMGR	Role derivation and local user authentication.
VIZ	Visualization component. Includes flow updates, etc.

The SafeGuard device can send log messages to three different locations: a local file (buffered logging), currently active system console, or remote syslog server. Levels can be configured for each destination and component for both trace and syslog logging.

Setting Logging Levels

To configure trace and syslog levels for every component by each log destination, use the **logging** command. Note the presence of a special component **all**. If **all** is specified, then all components are configured.

By default, each component is configured so that syslog messages of INFO or greater are sent to the local system buffer. The Global Configuration command has the following syntax:

logging [**buffered** | **console** | **syslog**] **component** *name* **log-level** *level* **trace-level** *level*

Syntax Description	**buffered**	Log destination is internal buffer.
	console	Log destination is console.
	syslog	Log destination is syslog.
	name	Component name as listed in the Component Table.
	level	Severity level as defined in the Severity Level Table.

For example, to send syslog messages at information level and higher and all debug trace messages from the AUTH component to the syslog destination, enter the following command:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #logging syslog component AUTH log-level INFO trace-level
DEBUG
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Setting Logging Hosts

To configure a component to send syslog messages to a remote server, perform these steps:

1. Configure the component to send the messages to syslog as the destination.
2. Configure a remote host/port.

The first step is like configuring any other logging destination (that is, buffered logging). The second step uses the following Global Configuration **logging host** command:

logging host *ip port*

Syntax Description	*ip*	IP address of the host.
	port	UDP port number of the syslog daemon on receiver host. Must be between 1 and 65535.

For example, to configure all components to log syslog messages at INFO and higher to the server 1.2.3.4, use the following commands:

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #logging host 1.2.3.4
(SafeGuardOS) (config) #logging syslog component ALL log-level INFO trace-level
EMERGENCY
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

The SafeGuard device supports up to four syslog servers.

To send syslog messages to a remote syslog server using the Global Configuration **logging remote-facility** command:

logging remote-facility local[0-7]

Syntax Description	**local[0-7]**	Specifies to log messages to a remote host using this remote facility.

For example,

```
(SafeGuardOS) #configure terminal
(SafeGuardOS) (config) #logging remote-facility local6
(SafeGuardOS) (config) #exit
(SafeGuardOS) #
```

Terminal Monitor

To enable logging to a particular user session the console target should be specified. In addition the particular session must be configured to display log messages using the **terminal monitor** command. The Global Configuration command has the following syntax:

terminal monitor

The command has no options or parameters. To disable the display of log messages on a particular login session, use the **no** form of this command.

Enabling and Disabling the Logging of Commands

To enable the logging of commands, use the **logging commands log-level** command. The SafeGuard device can log all commands typed at the CLI by any user. These commands are logged at a user-specified syslog level. Use the following syntax for the **logging commands log-level** Global Configuration command:

logging commands log-level *level*

Syntax Description	*level*	Severity level as defined in the table of severity levels.

To disable the logging of commands, use the **no** form of the command.

Clearing the Logs

To clear the contents of the log (buffered logging), use the **clear logging** command in Global Configuration mode.

clear logging {**logfile** | **tracefile** | **all**}

Syntax Description	**logfile**	Clear contents of the local syslog buffer.
	tracefile	Clear contents of the local debug buffer.
	all	Clear contents of all local buffers. This is the default operation if no parameters are specified.

Clearing the Alarm LED

When Emergency, Alert, or Critical errors are logged, the alarm LED is lit on the front panel of the device. To extinguish the LED, use the **clear alarm-led** command in Privileged Exec mode.

clear alarm-led

The command has no parameters or variables.

Displaying the Logging Level

To display the currently configured trace and syslog levels, use the **show logging configuration** command in Privileged Exec mode.

`show logging configuration`

The command has no parameters or variables.

The following example is representative of the command output:

```
(SafeGuardOS) #show logging configuration
Command Logging Level
-------------- ----------
ENABLED        INFO

Remote Facility
---------------
local0

Module       SYSLOG              CONSOLE              BUFFER
             LOG       TRACE     LOG       TRACE      LOG       TRACE
------------ ------------------  -------------------  ------------------
AUTH         DEBUG     DEBUG     INFO                 DEBUG     DEBUG
CFGM         INFO      CRITICAL  INFO                 INFO      CRITICAL
CLI          INFO      CRITICAL  INFO                 INFO      CRITICAL
EPV          INFO                INFO                 INFO
HIGHAVAIL    INFO      CRITICAL  INFO                 INFO      CRITICAL
HOST         INFO                INFO                 INFO
HWMON        INFO      CRITICAL  INFO                 INFO      CRITICAL
ICC          INFO      CRITICAL  INFO                 INFO      CRITICAL
IPC          INFO      CRITICAL  INFO                 INFO      CRITICAL
LSP          INFO      CRITICAL  INFO                 INFO      CRITICAL
LSPD         INFO      CRITICAL  INFO                 INFO      CRITICAL
MALWARE      INFO      CRITICAL  INFO                 INFO      CRITICAL
PLATFORM     INFO      CRITICAL  INFO                 INFO      CRITICAL
POLICY       INFO      INFO      INFO                 INFO      CRITICAL
PORTMON      INFO      CRITICAL  INFO                 INFO      CRITICAL
PROMAN       INFO      CRITICAL  INFO                 INFO      CRITICAL
TRAPMGR      INFO      CRITICAL  INFO                 INFO      CRITICAL
USERMGR      INFO      CRITICAL  INFO                 DEBUG     DEBUG
VIZ          INFO      CRITICAL  INFO                 INFO      CRITICAL

ADDRESS           PORT
----------------- ----
172.16.137.21     514
172.16.197.10     514

Terminal Monitor State
----------------------

(SafeGuardOS) #
```

Displaying Log Information

Trace and syslog messages are buffered in two separate files: syslog messages are contained in the logfile and trace messages are contained in the trace file. To display the contents of either file, use the **show logging** command in Privileged Exec mode.

show logging [**logfile** | **tracefile** | **all**] [[-]***#lines*** | **match** | **reverse**]

Syntax Description	**logfile**	Displays the log file for syslog information.
	tracefile	Displays the trace file for trace information.
	all	Displays all log information.
	#lines	Displays specified first or last (-) number of lines.
	match	Display lines containing match pattern.
	reverse	Process the command in reverse chronological order (last message first).

Note that each command is logged with the following format:

```
<DATE> task: %%<component>-<level>: src=(host ip address) suser=(source
username)(connected session identifier) CMD: "command text"
```

The following sample output is representative of the **show logging tracefile** command:

```
(SafeGuardOS) # show logging tracefile


Total number of lines: 3283


May 12 2006 16:32:50 TRACE [369] %%TAUTH-DEBU auth client - map event 20:1 00:11

:11:79:c4:ec-172.16.3.110 (mapped)

May 12 2006 16:32:50 TRACE [286] %%TAUTH-INFO auth event - map (1210850) 20:1 00

:11:11:79:c4:ec-172.16.3.110 (mapped) filtered

May 12 2006 16:32:53 TRACE [369] %%TAUTH-DEBU auth client - map event 18:1 00:11

:11:79:be:ca-172.16.3.75 (mapped)

May 12 2006 16:32:53 TRACE [286] %%TAUTH-INFO auth event - map (1210851) 18:1 00

:11:11:79:be:ca-172.16.3.75 (mapped) filtered

May 12 2006 16:32:53 TRACE [369] %%TAUTH-DEBU auth client - map event 20:1 00:11

:11:79:be:ca-172.16.3.75 (mapped)
```

```
May 12 2006 16:32:53 TRACE [286] %%TAUTH-INFO auth event - map (1210852) 20:1 00
:11:11:79:be:ca-172.16.3.75 (mapped) filtered
May 12 2006 16:33:01 TRACE [369] %%TAUTH-DEBU auth client - map event 18:1 00:13
:20:04:07:b0-172.16.3.169 (mapped)
May 12 2006 16:33:01 TRACE [286] %%TAUTH-INFO auth event - map (1210853) 18:1 00
:13:20:04:07:b0-172.16.3.169 (mapped) filtered
May 12 2006 16:33:01 TRACE [369] %%TAUTH-DEBU auth client - map event 20:1 00:13
:20:04:07:b0-172.16.3.169 (mapped)
May 12 2006 16:33:01 TRACE [286] %%TAUTH-INFO auth event - map (1210854) 20:1 00
:13:20:04:07:b0-172.16.3.169 (mapped) filtered
May 12 2006 16:33:05 TRACE [369] %%TAUTH-DEBU auth client - map event 18:1 00:12
:3f:23:e7:df-172.16.3.98 (mapped)
May 12 2006 16:33:05 TRACE [286] %%TAUTH-INFO auth event - map (1210855) 18:1 00
:12:3f:23:e7:df-172.16.3.98 (mapped) filtered
May 12 2006 16:33:05 TRACE [369] %%TAUTH-DEBU auth client - map event 20:1 00:12
:3f:23:e7:df-172.16.3.98 (mapped)
May 12 2006 16:33:05 TRACE [286] %%TAUTH-INFO auth event - map (1210856) 20:1 00
:12:3f:23:e7:df-172.16.3.98 (mapped) filtered
May 12 2006 16:33:15 TRACE [369] %%TAUTH-DEBU auth client - map event 18:1 00:13
:72:08:5e:16-172.16.1.45 (mapped)
May 12 2006 16:33:15 TRACE [286] %%TAUTH-INFO auth event - map (1210857) 18:1 00
:13:72:08:5e:16-172.16.1.45 (mapped) filtered
```

Logging Display Options

The **show logging** command includes optional parameters for output display. These paramters can be specified at any point in the command line.

show logging [[-]*#lines*] [**reverse**] [**match**]]

Syntax Description	***#lines***	Displays specified first or last (-) number of lines.
	match	Display lines containing match pattern.

reverse	Process the command in reverse chronological order (last message first).

The following sample output displays the last five lines of the system log:

```
SafeGuardOS) #show logging logfile -5

Total number of lines: 55

Nov 10 17:15:33 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0)
act=cmd: enable

Nov 10 17:15:37 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0)
act=cmd: show logging all

Nov 10 17:16:38 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0)
act=cmd: show logging all reverse

Nov 10 17:16:49 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0)
act=cmd: show logging all -5

Nov 10 17:17:09 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0)
act=cmd: show logging all match policy -5
```

To show a file in reverse time order:

```
(SafeGuardOS) #show logging logfile reverse

Total number of lines: 61

Nov 10 17:29:21 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: enable

Nov 10 17:29:19 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: enbale

Nov 10 17:29:18 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: admin

Nov 10 17:29:01 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: enable

Nov 10 17:29:00 2006 switchdrvr: %%USRMGR-INFO src=127.0.0.1 suser=admin (0) Login attempt
act=succeeded msg=console session

Nov 10 17:22:26 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: show
logging logfile -5

Nov 10 17:17:09 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: show
logging all match policy -5

Nov 10 17:16:49 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: show
logging all -5

Nov 10 17:16:38 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: show
logging all reverse
```

```
Nov 10 17:15:37 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: show
logging all

Nov 10 17:15:33 2006 switchdrvr: %%USRMGR-INFO src=127.0.0.1 suser=admin (0) Login attempt
act=succeeded msg=console session

Nov 10 17:15:33 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: enable

Nov 10 17:15:31 2006 switchdrvr: %%USRMGR-INFO src=127.0.0.1 suser=admni (-1) Login attempt
act=failed (incorrect password) msg=console session
```

To show the most recent 5 lines in a file in reverse time order:

```
(SafeGuardOS) #show logging logfile reverse 5

Total number of lines: 62

Nov 10 17:29:27 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: show
logging logfile reverse

Nov 10 17:29:21 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: enable

Nov 10 17:29:19 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: enbale

Nov 10 17:29:18 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: admin

Nov 10 17:29:01 2006 switchdrvr: %%PFRM-EMER src=127.0.0.1 suser=admin (0) act=cmd: enable
```

appendix

A Sample Output

In this appendix:

Show AAA Users Command

```
(SafeGuardOS) #show aaa users


User Table

----------


Number of Rows:7

Port   VLAN   MAC                IP Address         User Name        Role Type                State Last Update

----   ----   ---                ----------         ---------        ---- ----                -----      ---------
----------

0/20   0      00:12:f0:17:3b:0a  169.254.89.195     jlew             employees radius          success    Wed Mar
1 18:05:53 2006

0/20   0      00:0a:95:a4:eb:c8  169.254.194.253    rcabaler         employees captive-portal  success    Wed Mar
1 17:21:52 2006

0/18   0      00:11:43:1e:77:8d  172.16.1.37        lwollric         employees kerberos        success    Wed Mar
1 17:05:45 2006

0/18   0      00:11:11:ea:8b:7d  172.16.1.124       sandee           authenticated white-list  success    Wed
Mar  1 17:25:20 2006

0/20   0      00:14:22:4f:dd:e5  172.16.1.139       guest            guest captive-portal      success    Wed Mar  1
17:58:24 2006

0/20   0      00:13:ce:1a:53:5b  172.16.3.11        msmith                                     authenticated radius success
Mon Feb 27 17:40:21 2006

0/20   0      00:13:ce:25:f8:2d  172.16.3.13        jchin            unauthenticated           radius failed     Wed Mar  1
17:55:23 2006


(SafeGuardOS) #
```

Show AAA Session-Tracking Mapping-Table Command

```
(SafeGuardOS) #show aaa session-tracking mapping-table


Current IP/MAC Mappings

------------------------


Number of Rows:17


Port   VLAN   MAC                IP                  Source   Authed   Idle Server      Lease TimeL3

----   ----   ---                --                  ------   ------   ---- ------      ------------

0/20   0      00:0a:95:a4:eb:c8   169.254.42.0        lsp      true     true 0.0.0.0     Mon May  1 09:14:50 2006false


0/18   0      00:0d:56:38:bb:63   169.254.113.156     lsp      true     true0.0.0.0     Mon May  1 13:39:59 2006
false

0/20   0      00:0b:85:33:10:20   172.16.0.16         lsp      false    false   0.0.0.0     Mon May  1 12:14:14 2006
false

0/20   0      00:0b:85:33:10:20   172.16.0.222        lsp      false    true    0.0.0.0     Mon May  1 13:34:33 2006
false

0/20   0      02:00:07:e3:34:7b   172.16.1.22         lsp      false    false   0.0.0.0     Mon May  1 13:03:30 2006
false
```

```
0/18    0       00:11:43:1e:77:8d   172.16.1.37         2       true     false   0.0.0.0     Mon May  1 13:05:25 2006
false

0/20    0       00:0f:1f:76:34:d1   172.16.1.98         2       true     false   0.0.0.0     Mon May  1 12:05:25 2006
false

0/20    0       00:08:02:42:65:e3   172.16.1.103        lsp     false    false   0.0.0.0     Mon May  1 13:03:30 2006
false

0/18    0       00:0d:61:5f:55:17   172.16.1.115        2       true     false   0.0.0.0     Mon May  1 13:05:25 2006
false

0/20    0       00:11:11:ea:90:06   172.16.1.122        2       false    false   0.0.0.0     Mon May  1 13:03:30 2006
false

0/20    0       00:11:11:79:be:99   172.16.1.125        lsp     false    false   0.0.0.0     Mon May  1 13:03:30 2006
false

0/20    0       00:13:20:04:07:2a   172.16.1.127        lsp     false    false   0.0.0.0     Mon May  1 13:03:30 2006
false

0/18    0       00:11:43:1e:76:e8   172.16.1.130        2       true     false   0.0.0.0     Mon May  1 13:05:25 2006
false

0/20    0       00:12:3f:75:a4:3a   172.16.1.136        2       true     true    0.0.0.0     Mon May  1 12:50:41 2006
false
```

```
0/20    0       00:14:22:4f:dd:e5   172.16.1.139        2        false    false   0.0.0.0     Mon May  1 13:03:30 2006
false

0/18    0       00:11:11:ea:8f:ae   172.16.1.141        lsp      false    false   0.0.0.0     Mon May  1 13:05:25 2006
false

0/18    0       00:14:22:4f:63:d9   172.16.1.148        2        true     false   0.0.0.0     Mon May  1 12:35:43 2006
false


(SafeGuardOS) #
```

Show Running-Config Command

```
(SafeGuardOS) #show running-config

set prompt "OmniAccess 2400 SafeGuard"

!Current Configuration:

!

serviceport protocol none

serviceport ip 172.16.5.22 255.255.192.0 0.0.0.0


!System Description "OmniAccess 2400 SafeGuard"

!System Description SafeGuardOS-2.1.0.13


snmp-server sysname "CS102"

snmp-server location "1690 McCandless Drive, Milpitas"

snmp-server sysinfo contact “Ivan Chroyla"

!

ip telnet timeout 30

forwarding-mode bridge

reserved vlan 1

sntp client mode unicast

!

sntp server status is active

sntp server 172.16.145.3
```

```
snmptrap public 172.16.145.3


lineconfig
serial timeout 1
exit
snmp-server community public
snmp-server community ipaddr 172.16.3.185 public
snmp-server community ipmask 255.255.192.0 public
snmp-server community private
snmp-server community ipaddr 172.16.145.3 private
snmp-server community ipmask 255.255.255.0 private
snmp-server community rw private


logging commands log-level INFO
logging host 172.16.145.3
logging buffered component AUTH log-level INFO
logging buffered component CLI log-level INFO
logging buffered component CFGM log-level INFO
logging buffered component EPV log-level INFO
logging buffered component HWMON log-level INFO
logging buffered component HIGHAVAIL log-level INFO
logging buffered component ICC log-level INFO
logging buffered component IPC log-level INFO
```

```
logging buffered component LSP log-level INFO
logging buffered component PLATFORM log-level INFO
logging buffered component POLICY log-level INFO
logging buffered component PORTMON log-level INFO
logging buffered component PROMAN log-level INFO
logging buffered component USERMGR log-level INFO
logging buffered component VIZ log-level INFO
logging syslog component AUTH log-level INFO
logging syslog component CLI log-level INFO
logging syslog component CFGM log-level INFO
logging syslog component EPV log-level INFO
logging syslog component HWMON log-level INFO
logging syslog component HIGHAVAIL log-level INFO
logging syslog component ICC log-level INFO
logging syslog component IPC log-level INFO
logging syslog component LSP log-level INFO
logging syslog component MALWARE log-level INFO
logging syslog component PLATFORM log-level INFO
logging syslog component POLICY log-level INFO
logging syslog component PORTMON log-level INFO
logging syslog component PROMAN log-level INFO
logging syslog component USERMGR log-level INFO
logging syslog component VIZ log-level INFO
```

```
logging console component AUTH log-level INFO
logging console component CLI log-level INFO
logging console component CFGM log-level INFO
logging console component EPV log-level INFO
logging console component HWMON log-level INFO
logging console component HIGHAVAIL log-level INFO
logging console component ICC log-level INFO
logging console component IPC log-level INFO
logging console component LSP log-level INFO
logging console component MALWARE log-level INFO
logging console component PLATFORM log-level INFO
logging console component POLICY log-level INFO
logging console component PORTMON log-level INFO
logging console component PROMAN log-level INFO
logging console component USERMGR log-level INFO
logging console component VIZ log-level INFO

lsp watchdog reboot

linkpair-sync enable

aaa session-tracking safe-mode
aaa session-tracking do-port-check
```

```
aaa captive-portal redirect-location cp.Alcatel-Lucent.com
aaa captive-portal redirect-port 16978
aaa captive-portal hijack-port 80
aaa captive-portal use-popup

clock timezone PST -8
clock summer-time PDT recurring

interface  0/1
no shutdown
protection-mode monitor
exit

interface  0/2
no shutdown
protection-mode monitor
exit

interface  0/3
shutdown
protection-mode monitor
exit
```

```
interface  0/4
shutdown
protection-mode monitor
exit

interface  0/5
shutdown
protection-mode monitor
exit

interface  0/6
shutdown
protection-mode monitor
exit

interface  0/7
shutdown
protection-mode monitor
exit

interface  0/8
shutdown
protection-mode monitor
```

```
exit

interface  0/9
shutdown
protection-mode monitor
exit

interface  0/10
shutdown
protection-mode monitor
exit

interface  0/11
shutdown
protection-mode monitor
exit

interface  0/12
shutdown
protection-mode monitor
exit
```

```
interface  0/13
shutdown
protection-mode monitor
exit

interface  0/14
shutdown
protection-mode monitor
exit

interface  0/15
shutdown
protection-mode monitor
exit

interface  0/16
shutdown
protection-mode monitor
exit

interface  0/17
shutdown
protection-mode monitor
```

```
exit

interface  0/18
shutdown
protection-mode monitor
exit

interface  0/19
shutdown
protection-mode monitor
exit

interface  0/20
shutdown
protection-mode monitor
exit

interface  0/21
shutdown
protection-mode pass-thru
exit

interface  0/22
```

```
shutdown
protection-mode pass-thru
exit

interface  0/23
shutdown
protection-mode pass-thru
exit

interface  0/24
shutdown
protection-mode pass-thru
exit

application-group  IM
        application AOLIM
        application ICHAT
        application IRC
        application IRCS
        application IRCU
        application MSNIM
        application NET2PHONE
        application YAHOOIM
```

```
!
application-group  NetworkConnectivity
        application CIFS
        application FTP
        application NFS
        application SSH
        application TELNET
!
application-group  Web
        application ALT-HTTP
        application HTTP
        application HTTPS
!
user-role "authenticated"
!
user-role "unauthenticated"
!
aaa session-tracking trusted-server default-action protocol dhcp action permit
aaa session-tracking trusted-server default-action protocol proto action permit
aaa session-tracking trusted-server default-action protocol lsp action permit
aaa session-tracking trusted-server default-action protocol kerberos action perm
it
aaa session-tracking trusted-server default-action protocol radius action permit
```

```
!

ha heartbeat-loss-threshold 10

ha heartbeat-interval 1


(SafeGuardOS) #
```

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