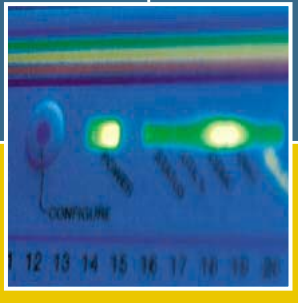
# AT-8800 SERIES SWITCH

## USER GUIDE



Allied Telesyn
Simply connecting the IP world

**Software Release 2.6.1**

AT-8800 Series Switch User Guide for Software Release 2.6.1
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# Contents

Chapter 1

# Introduction

## Introducing the AT-8800 Series Switch

Congratulations on purchasing an AT-8800 Series Intelligent Workgroup Switch. The AT-8800 Series Switch has been developed to meet the exceptionally high performance demands of low to mid-range applications and deliver low-latency high-bandwidth wirespeed Layer 2 and 3 switching.

This guide introduces the AT-8800 Series Switch and will guide you through the most common uses and applications of your new switch. Getting started will not take long—many applications are set up in just a few minutes. If you have any questions about the switch, contact your authorised distributor or reseller.

Your AT-8800 Series Switch is supplied with default settings which enable it to operate as a Layer 2 switch immediately, without any configuration. Even if this is all you want to do, you should still gain access to the switch configuration, if only to change the *manager* password to prevent unauthorised access.

To change the switching configuration, and to take advantage of the advanced routing features, you will need to enter detailed configuration. The switch has both a Command Line Interface (CLI) and a Graphical User Interface (GUI) for configuration and management. Before you can use the GUI, you will need to login to the switch and use its CLI to allocate an IP address to at least one interface.

## Why Read this User Guide?

Before you use your switch in a live network, please read this guide. The guide tells you how to access and use the Command Line Interface (CLI) and Graphical User Interface (GUI) to configure the switch software. It then introduces a number of common switch functions and how to configure them using the CLI. For more detailed descriptions of all commands, display outputs, and background information, see the *Software Reference*. For information on configuration using the GUI, see the context-sensitive online GUI help.

This user guide is organised into the following chapters:

- *Chapter 1, Introduction* gives an overview of the switch features and of the documentation supplied with your switch.
- *Chapter 2, Getting Started with the Command Line Interface (CLI)* describes how to gain access to the command lineinterface.
- *Chapter 3, Getting Started with the Graphical User Interface (GUI)* describes how to access and use the graphical user interface, including troubleshooting the GUI.
- *Chapter 4, Operating the switch* introduces general operation, management and support features, including loading and installing support files and new releases.
- *Chapter 5, Layer 2 Switching* describes how to configure Layer 2 switching features, including switch ports and VLANs.
- *Chapter 6, Layer 3* outlines some of the switch's Layer 3 features, including IP, IP multicasting, IPX and Appletalk.
- *Chapter 7, Maintenance and Troubleshooting* describes some of the commands you can use to monitor the switch and diagnose faults.

# Where To Find More Information

Before installing the switch and any expansion options, read the important safety information in the *AT-8800 Series Switch Safety and Statutory Information* booklet.

Follow the *Quick Install Guide's* step-by-step instructions for physically installing the switch.

The *AT-8800 Series Switch Hardware Reference* gives detailed information about the equipment hardware.

The context-sensitive online *GUI help* gives descriptions of each page and element of the GUI.

Once you are familiar with the basic operations of the switch, use the *AT-8800 Series Switch Software Reference* for full descriptions of routing features and command syntax.

## The AT-8800 Series Switch Documentation Set

The documentation set for the AT-8800 Series Switch includes:

- AT-8800 Series Switch Safety and Statutory Information
- AT-8800 Series Switch Quick Install Guide

- AT-8800 Series Switch Documentation and Tools CD-ROM

  The AT-8800 Series Switch Documentation Set in Adobe Acrobat PDF format is bundled with every switch—the complete reference to installing, configuring and managing the switch, including detailed descriptions of all commands.

  The CD-ROM includes the following PDF documents:

  - AT-8800 Series Switch Safety and Statutory Information
  - AT-8800 Series Switch Quick Install Guide
  - AT-8800 Series Switch Hardware Reference
  - AT-8800 Series Switch Software Reference

  The CD-ROM also includes:

  - AT-TFTP Server for Windows, for downloading software releases, scripts and other files to or from an AT8800 switch.
  - Adobe Acrobat Reader for Windows for viewing and printing the online documentation in PDF format. Get instant access to information with full-text searching of PDF documents by keyword or phrase.
  - Microsoft Internet Explorer.
  - A demonstration version of F-Secure's Secure Shell client for Windows.
  - Information about other Allied Telesyn routing and switching products.

## Online Technical Support

For online support for your AT-8800 Series Switch, see our online support page at http://www.alliedtelesyn.co.nz/support/ar8800/

This page also contains the latest switch software releases, patches and GUI resource files. Use the LOAD command to download software upgrades directly from the Allied Telesyn web site to the router's FLASH memory. Use the SET INSTALL command to enable the new software (see "*Upgrading Switch Software*" on page 56 for detailed instructions).

If you require further assistance, contact your authorised distributor or reseller.

# Features of the AT-8800 Series Switch

There are two models in the AT-8800 Series, which provide either 48 or 24 10/100 TX Fast Ethernet ports. Both models also feature:

- 2 GBIC uplink ports
- Single PSU and redundant PSU (RPS)
- PAC interface connection

The software support provides wirespeed Layer 2 switching, including support for Virtual LANs, and wirespeed Layer 3 switching of IP and IP multicasting packets. In addition, the switch provides a wide array of multiprotocol routing, security and network management features.

## Management Features

The following features enhance management of the switch:

- A sophisticated and configurable event logging facility for monitoring and alarm notification to single or multiple management centres.
- Triggers for automatic and timed execution of commands in response to events.
- Scripting for automated configuration and centralised management of configurations.
- Dynamic Host Configuration Protocol (DHCP) for IP and IPv6. DHCP lets you automatically assign IP addresses and other configuration information to PCs and other hosts on TCP/IP networks.
- Support for the Simple Network Management Protocol (SNMP), standard MIBs and the Allied Telesyn Enterprise MIB, enabling the switch to be managed by a separate SNMP management station.
- Telnet client and server.
- Secure Shell remote management.
- An HTTP client that allows the direct download of files from a web server to the router's FLASH memory.

For complete descriptions of these software features, see the *AT-8800 Series Switch Software Reference*.

## Software Features

AT-8800 Series Intelligent Workgroup Switches provide efficient and cost-effective multiprotocol routing, terminal serving and integrated network management over wide area networks and LANs. All models can run the same software suite and can provide all of the following functions simultaneously (depending on the hardware configuration):

- Wide area networking via Point-to-Point Protocol.
- TCP/IP routing.
- Novell® IPX routing.
- AppleTalk routing.
- Generic Routing Encapsulation (GRE) protocols.
- IP multicast routing support, including Internet Group Management Protocol (IGMP), Distance Vector Multicast Routing Protocol (DVMRP) and Protocol Independent Multicast (PIM) Sparse and Dense Modes.
- Ping Polling for determining device reachability and responding when a device or link goes up or down.
- IPv6 routing support, including stateless address autoconfiguration, RIPv6 and ICMPv6.
- IPv6 multicast routing support, including Multicast Listener Discovery (MLDv2) and Protocol Independent Multicast (PIM) Sparse and Dense Modes.
- OSPF, RIP (IP and Novell®), SAP (Novell®), EGP and BGP routing protocols.
- ARP, Proxy ARP and Inverse ARP address resolution protocols.

- Sophisticated packet filtering.
- Bridging.
- Van Jacobson's header compression, STAC LZS and Predictor compression, and DES encryption.
- Terminal serving using Telnet, with local host nicknames.
- Access to network printers via LPD or TCP streams.
- Resource Reservation Protocol (RSVP) for delivering quality of service to application data streams.
- A fully featured, stateful inspection firewall.
- IPsec-compliant IP security services.
- Integration with a Public Key Infrastructure (PKI).
- Virtual Router Redundancy Protocol (VRRP).
- Border Gateway Protocol version 4 (BGP-4).
- Load Balancing for distributing traffic among multiple resources.
- Software Secure Sockets Layer (SSL).
- 802.1x port authentication.

## Special Feature Licences

You need a special feature licence and password to activate some special features over and above the standard software release. Typically, these special features are covered by government security regulations. Special feature licences and passwords are quite separate and distinct from the standard software release licences and passwords. Some of the software features that require a special feature licence are:

- Triple DES S/W
- Firewall SW
- Firewall SMTP Application Gateway
- Firewall HTTP Application Gateway
- DES encryption
- IPv6
- IP Multicast routing: DVMRP and PIM-Sparse Mode
- IPX routing
- IPX/SPX Spoofing
- IPX Filtering (not between switch ports)
- AppleTalk
- BGP-4
- Load balancer

Most software features that require a special feature licence are bundled into one of the following special feature licence packs:

- Full Layer 3 Feature Licence
- Advanced Layer 3 Feature Licence
- Security Pack Feature Licence

For more information about purchasing special feature licences, contact your Allied Telesyn authorised distributor or reseller. For information on how to enable special feature licences using the CLI, see "*Enabling Special Feature Licences*" on page 20.

# Warning about FLASH memory

Before you start to configure your switch, note that it is possible to enter commands that can impact severely on your router's performance.

***DO NOT clear the FLASH memory completely. The software release files are stored in FLASH, and clearing FLASH memory would leave no software to run the switch.***

***While FLASH is compacting, do not restart the switch or use any commands that affect the FLASH file subsystem. Do not restart the switch, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files. Damaged files are likely to prevent the switch from operating correctly.***

For more information, see "*How to Avoid Problems*" on page 109 and "*What to Do if You Clear FLASH Memory Completely*" on page 111.

Chapter 2

# Getting Started with the Command Line Interface (CLI)

## This Chapter

This chapter describes how to access the switch's CLI, and provides basic information about configuring the switch, including how to:

- Physically connect a terminal or PC to the switch (see "*Connecting a Terminal or PC*" on page 14 and the *Quick Install Guide).*
- Set the Terminal Communication parameters to match the router's settings (see "*Terminal Communication Parameters*" on page 14).
- Log in to the switch as a manager (see "*Logging In*" on page 15).
- Configure IP addresses on the switch interfaces over which you will manage the switch. This is necessary if you will access the switch using the GUI or Telnet (see "*Assigning an IP Address*" on page 15).
- Set routes (see "*Setting Routes*" on page 16)
- Change the management password to limit unauthorised access to the switch configuration (see "*Changing a Password*" on page 17).
- Use the command line interface to control the switch software, including creating aliases for often used character sequences (see "*Using the Commands*" on page 18).
- Set the online help file to gain access to command syntax help (see "*Getting Command Line Help*" on page 19).
- Enable any special feature licences (see "*Enabling Special Feature Licences*" on page 20).
- Set the name, location and contact details for the switch (see "*Setting System Parameters*" on page 20).

# Connecting a Terminal or PC

The first thing to do after physically installing the switch is to start a terminal or terminal emulation session to access the switch. Then you can use the command line interface (CLI) to configure the switch. If you wish to configure the switch using the Graphical User Interface, you must first access the CLI and assign an IP address to at least one interface.

You can use a PC running terminal emulation software as the manager console instead of a terminal. Many terminal emulation applications are available for the PC, but the most readily available is the HyperTerminal application included in Microsoft® Windows™ 95, Windows™ 98, and Windows™ 2000. In a normal Windows™ installation HyperTerminal is located in the Accessories group. In Windows™ 2000, HyperTerminal is located in the **Start** > **Programs** > **Accessories** > **Communications** menu.

The key to successfully using terminal emulation software with the switch is to configure the communications parameters in the terminal emulation software to match the default settings of the console port on the switch. For instructions on how to configure HyperTerminal, see the *AT-8800 Series Switch Hardware Reference*.

To start a terminal session, connect to the switch in one of the following ways:

- Connect a VT100-compatible terminal to the RS-232 Terminal Port (asyn0), set the communications parameters on the terminal (Table 1 on page 14), and press [Enter] a few times until the router's login prompt appears

  *OR*

- Connect the COM port of a PC running terminal emulation software such as Windows Terminal or HyperTerminal to the RS-232 Terminal Port (asyn0), set the communications parameters on the terminal emulation software (Table 1 on page 14), and press [Enter] a few times until the router's login prompt appears.

# Terminal Communication Parameters

Check that the terminal or modem's communication settings match the settings of the asynchronous port. By default, the asynchronous port (also known as the Console, RS-232, or Config port) on the switch is set to the parameters shown in Table 1 on page 14:

**Table 1: Parameters for terminal communication**

| Parameter | Value |
|---|---|
| Baud rate | 9600 |
| Data bits | 8 |
| Parity | None |
| Stop bits | 1 |
| Flow control | Hardware |

Refer to the user manual supplied with the terminal or modem for details of how to change the communications settings for the terminal or modem.

If a modem is connected, configure the switch to make and/or accept calls via the modem. To set the CDCONTROL parameter to "CONNECT" and the FLOW parameter to "HARDWARE", enter the command:

```
SET ASYN CDCONTROL=CONNECT FLOW=HARDWARE
```

If the terminal or modem is used with communications settings other than the default settings, then configure the asynchronous port to match the terminal or modem settings using the SET ASYN command.

See the router's online help or the *Interfaces* chapter in the *AT-8800 Series Switch Software Reference* for more information on how to configure the asynchronous port.

# Logging In

When you access the switch from a terminal or PC connected to the RS-232 terminal port (asyn0), or via a Telnet or HTTP connection, you must enter a login name and password to gain access to the command prompt. When the switch is supplied, it has a *manager* account with an initial password *friend*.

Enter your login name at the login prompt:

```
login: manager
```

Enter the password at the password prompt:

```
password: friend
```

After you log into the manager account you can enter commands from this document and from the *AT-8800 Series Switch Software Reference*.

# Assigning an IP Address

To configure the switch to perform IP routing (for example, to access the Internet) you need to configure IP. You also need to configure IP if you want to manage the switch from a Telnet session or with the GUI. For detailed instructions on accessing the switch with the GUI, see "Establishing a Connection to the Switch" on page 24.

First enable IP, using the command:

```
ENABLE IP
```

Then, add an IP address to each of the switch interfaces that you want to process IP traffic (for example, the default VLAN (vlan1)).

For the default VLAN, use the command:

```
ADD IP INTERFACE=vlan1 IPADDRESS=ipadd MASK=mask
```

where:

- *ipadd* is an unused IP address on your LAN.
- *mask* is the subnet mask (for example 255.255.255.0)

If IP addresses on your LAN are assigned dynamically by DHCP, you can set the switch to request an IP address from the DHCP server, using the commands:

```
ADD IP INTERFACE=vlan1 IPADDRESS=DHCP

ENABLE IP REMOTEASSIGN
```

You do not need to set the MASK parameter because the subnet mask received from the DHCP server is used.

*If you use DHCP to assign IP addresses to devices on your LAN, and you want to manage the switch within this DHCP regime, it is recommended that you set your DHCP server to always assign the same IP address to the switch. This will enable you to access the GUI by browsing to that IP address, and will also let you use the switch as a gateway device for your LAN. If you need the switch's MAC address for this, it can be displayed using the command SHOW SWITCH.*

To change the IP address for an interface, enter the command:

```
SET IP INTERFACE=interface IPADDRESS=ipadd MASK=ipadd
```

*When you are configuring the switch remotely, if you change the configuration (for example, the VLAN membership) of the port over which you are configuring, the switch is likely to break the connection.*

For more information about switch ports and Virtual LANs (VLANs), see *Chapter 5, Layer 2 Switching* in this document, and the *Switching* chapter in the *AT-8800 Series Switch Software Reference.* For more information about IP addressing and routing, see *Chapter 6, Layer 3* in this document, and the *Internet Protocol (IP)* chapter in the *AT-8800 Series Switch Software Reference.*

# Setting Routes

The process of routing packets consists of selectively forwarding data packets from one network to another. Your switch makes a decision to send a packet to a particular network on information it learns dynamically from listening to the selected route protocol and on the static information entered as part of the configuration process. In addition, you can configure user-defined filters to restrict the way packets are sent.

Your switch maintains a table of routes which holds information about routes to destinations. The route table tells the switch how to find a remote network or host. A route is uniquely identified by IP address, network mask, next hop, ifIndex, protocol and policy. A list of routes comprises all the different routes to a destination. The routes may have different metrics, next hops, policy or protocol. A list of routes is uniquely identified by its IP address and net mask.

The routing table is maintained dynamically by using one or more routing protocols such as RIP, EGP and OSPF. These act to exchange routing information with other switches or hosts.

You can also add static routes to the route table to define default routes to external switches or networks and to define subnets.

To add a static route, enter the command:

```
ADD IP ROUTE=ipadd INTERFACE=interface NEXTHOP=ipadd
    [CIRCUIT=miox-circuit] [DLCI=dlci]
    [MASK=ipadd][METRIC=1..16] [METRIC1=1..16]
    [METRIC2=1..65535][POLICY=0..7] [PREFERENCE=0..65535]
```

To displays the entire routing table, including both static and dynamic routes, enter the command:

```
SHOW IP ROUTE
```

For more information about setting IP routes, see the *Internet Protocol (IP)* chapter in the *AT-8800 Series Switch Software Reference.*

# Changing a Password

You should change this password to prevent unauthorised access to the switch. Enter the command:

```
SET PASSWORD
```

The switch prompts you for the current password, for the new password, and for confirmation of the new password. The password can contain any printable characters, and must be at least a minimum length, by default six characters. (To change the default minimum length, see the SET USER command in the *Operations* chapter, *AT-8800 Series Switch Software Reference*.)

# Choosing a Password

All users, including managers, should take care in selecting passwords. Tools exist that enable hackers to guess or test many combinations of login names and passwords easily. The User Authentication Facility (UAF) provides some protection against such attacks by allowing the manager to set the number of consecutive login failures allowed and a lockout period when the limit is exceeded.

However, the best protection against password discovery is to select a good password and keep it secret. When choosing a password:

- Do make it six or more characters in length. The UAF enforces a minimum password length, which the manager can change. The default is six characters.
- Do include both alphabetic (a–z) and numeric (0–9) characters.
- Do include both uppercase and lowercase characters. The passwords stored by the switch are case-sensitive, so “bgz4kal” and “Bgz4Kal” are different.
- Do avoid words found in a dictionary, unless combined with other random alphabetic and numeric characters.
- **Do not** use the login name, or the word “password” as the password.
- **Do not** use your name, your mother’s name, your spouse’s name, your pet’s name, or the name of your favourite cologne, actor, food or song.

- **Do not** use your birth date, street number or telephone number.
- **Do not** write down your password anywhere.

***Make sure you remember the new password created as you cannot retrieve a lost password. Recovery of access to the switch is complex.***

Once you have logged into the *manager* account you are able to enter commands from this guide and from the *AT-8800 Series Switch Software Reference*.

# Using the Commands

You control the switch with commands described in this document and in the *AT-8800 Series Switch Software Reference*. While the keywords in commands are not case sensitive, the values entered for some parameters are (especially passwords). The switch supports command line editing and recall. Command line editing functions and keystrokes are shown in Table 2 on page 18.

**Table 2: Command line editing functions and keystrokes .**

| Function | VT100 Terminal | Dumb terminal |
|---|---|---|
| Move cursor within command line | ←, → | *Not available* |
| Delete character to left of cursor | [Delete] or [Backspace] | [Delete] or [Backspace] |
| Toggle between insert/overstrike | [Ctrl/O] | *Not available* |
| Clear command line | [Ctrl/U] | [Ctrl/U] |
| Recall previous command | ↑ or [Ctrl/B] | [Ctrl/B] |
| Recall next command | ↓ or [Ctrl/F] | [Ctrl/F] |
| Display command history | [Ctrl/C] or SHOW PORT HISTORY | [Ctrl/C] or SHOW PORT HISTORY |
| Clear command history | RESET PORT HISTORY | RESET PORT HISTORY |
| Recall matching command | [Tab] or [Ctrl/I] | [Tab] or [Ctrl/I] |

The switch assumes that the width of the terminal screen is 80 characters, and performs command line wrapping at the 80th column regardless of the setting of the terminal. To execute a command the cursor does not need to be at the end of the line. The default editing mode is insert mode. Characters are inserted at the cursor position and any characters to the right of the cursor are pushed to the right to make room. In overstrike mode, characters are inserted at the cursor position and replace any existing characters.

Commands are limited to 1000 characters, excluding the prompt. Pathnames of up to 256 characters, including file names, and file names up to 16 characters long, with extensions of 3 characters, are supported.

## Aliases

The command line interface supports aliases. An alias is a short name for an often-used longer character sequence. When the user presses [Enter] to execute the command line, the command processor first checks the command line for aliases and substitutes the replacement text. The command line is then parsed and processed normally. Alias substitution is not recursive—the command line is scanned only once for aliases.

Aliases are created and destroyed using the commands:

```
ADD ALIAS=name STRING=substitution

DELETE ALIAS=name
```

# Getting Command Line Help

Online help is available for all switch commands. A multilingual, language-independent online help facility provides help information via the command:

```
HELP [topic]
```

If a topic is not specified, a list of available topics is displayed. The HELP command displays information from the system help file stored in FLASH memory. The help file uses a simple mark-up language to identify topics, access level (USER or MANAGER) and help text. Both standard ASCII and Unicode character encodings are supported. Alternate help files can be uploaded and stored in FLASH, then activated using the command:

```
SET HELP=helpfile
```

To display the current help file, enter the command:

```
SHOW SYSTEM
```

The help file is easily modified, for example to provide detailed site-specific support information. The mark-up language specification and preprocessor program are available from your authorised distributor or reseller.

Also, typing a question mark "?" at the end of a partially completed command displays a list of the parameters that may follow the current command line, with the minimum abbreviations in uppercase letters (see Figure 1). The current command line is then re-displayed, ready for further input.

**Figure 1: Using the question mark character ("?") to display help for the current command.**

```
Manager > ADD ?

  Options : ACC APPletalk BGP CLASSifier BOOTp BRIDge DECnet FRamerelay GRE IP IPX
     ISDN LAPD LOG MIOX NTP OSPF PERM PPP RADius SA SCript SNmp STReam STT TRIGger
    TACacs USEr X25C X25T TDM

Manager > ADD ACC ?

  Options : CALL SCript DOmainname

Manager > ADD ACC CALL ?

  Options : DIrection DScript CScript RScript POrt ENcapsulation AUthentication
    DOmainname
```

# Enabling Special Feature Licences

You must enable the special feature licence you have purchased before you can use the licenced features. You will need the password provided by your authorised distributor or reseller. The advanced upgrade licence and password are different from the standard software release licence and password. The licence cannot be transferred from one switch to another.

For software features that require a special feature licence see "*Special Feature Licences*" on page 11.

*You must order passwords for special feature licences from your authorised distributor or reseller. You must specify the special feature licence bundle and the serial number(s) of the switch(s) on which the special feature licences are to be enabled.*

The password for a special feature licence is a string of at least 16 hexadecimal characters. This password encodes the special feature, or features, covered by the license, and the switch serial number. The password information is stored in the router's FLASH memory.

To enable or disable a special feature licence, enter the commands:

```
ENABLE FEATURE=feature PASSWORD=password
DISABLE FEATURE=feature
```

To list the current special feature licences, enter the command:

```
SHOW FEATURE[={featurename|index}]
```

# Setting System Parameters

You can set some general system parameters to ensure the router's compatibility with the public network, and to aid network administration.

System name, location and contact parameters can help a remote network administrator identify the switch. By convention the system name is the full domain name. Set the name and location of the switch, for example:

```
SET SYSTEM NAME=nd1.co.nz
SET SYSTEM LOCATION="Head Office, 3rd floor east"
```

and a contact name and phone number for the network administrator responsible for the switch, for example:

```
SET SYSTEM CONTACT="Anna Brown 03-456 789"
```

The name, location, and contact are strings 1 to 80 characters in length of any printable character. If the string includes spaces enclose it in double quotes.

Set the router's real time clock to the current local time in 24 hour notation (hh:mm:ss), and to the current date (dd-mmm-yy, or dd-mmm-yyyy), for example:

```
SET TIME=14:50:00
SET DATE=29-JAN-02 or
SET DATE=29-JAN-2003
```

Chapter 3

# Getting Started with the Graphical User Interface (GUI)

## This Chapter

This chapter describes how to access the switch's HTTP-based Graphical User Interface (GUI), and provides basic information about using the GUI, including:

- What is the GUI?
  - an introduction to the Graphical User Interface
- Accessing the switch via the GUI:
  - browser and PC setup, including interaction with HTTP proxy servers
  - establishing a connection to your switch, including an example of configuring SSL for secure access
  - the System Status page, the first GUI page you see
- Using the GUI: navigation and features:
  - an overview of the menus
  - using configuration pages, with a description of key elements of GUI pages
  - changing your password
  - using the context sensitive online help
  - saving your configuration
  - combining GUI and CLI configuration
  - configuring multiple devices
- Upgrading the GUI
- Troubleshooting
  - diagnosing and solving connection problems
  - using the GUI to troubleshoot the switch's configuration.

# What is the GUI?

The GUI (Graphical User Interface) is a web-based device management tool, designed to make it easier to configure and monitor the switch. The GUI provides an alternative to the CLI (Command Line Interface). Its purpose is to make complicated tasks simpler and regularly performed tasks quicker.

The GUI relies on an HTTP server that runs on the switch, and a web browser on the host PC. When you use the GUI to configure the switch, the GUI sends commands to the switch and the switch sends the results back to your browser, all via HTTP.

The tasks you may perform using the GUI are not as comprehensive as the command set available on the CLI, but for some protocols, a few clicks of the mouse will perform many commands.

The GUI is stored on the switch in the form of an embedded resource file, with file extension `rsc`. Resource files are model-specific, with the model and version encoded in the file name.

# Accessing the Switch via the GUI

To use the GUI to configure the switch, you use a web browser to open a connection to the switch's HTTP server. Therefore, you need a PC, a web browser and the switch. Supported browsers and operating systems, and the settings you need on your PC and browser, are detailed in the following section. Switch setup is detailed in "*Establishing a Connection to the Switch*" on page 24.

## Browser and PC Setup

The GUI requires a web browser installed on a PC. Table 3 shows supported combinations of operating system and browser. A copy of Internet Explorer can be found on the switch's Documentation and Tools CD-ROM.

**Table 3: Supported browsers and operating systems**

| | IE 5.0 | IE 5.5 | IE 6.0 | NS 6.2.2 | NS 6.2.3 |
|---|---|---|---|---|---|
| Windows 95 | ✓ | | | | |
| Windows 98 | ✓ | ✓ | ✓ | | |
| Windows ME | ✓ | ✓ | ✓ | ✓ | ✓ |
| Windows 2000 | ✓ | ✓ | ✓ | ✓ | ✓ |
| Windows XP | ✓ | ✓ | ✓ | ✓ | ✓ |

JavaScript must be enabled. To enable JavaScript in Internet Explorer:

1. From the Tools menu, select Internet Options
2. Select the Security tab
3. Click on the Custom Level button
4. Under the Scripting section, ensure that "Active scripting" is enabled.

To enable JavaScript in Netscape 6.2.*x*:

1. From the Edit menu, select Preference
2. Select the Advanced menu option.
3. Ensure that the "Enable JavaScript for Navigator" checkbox is checked.

The minimum screen resolution on the PC is 800x600.

## HTTP Proxy Servers

An HTTP proxy server provides a security barrier between a private network's PCs and the Internet. The PCs send HTTP requests (and other web traffic) to the server, which then forwards the requests appropriately. Similarly, the server receives incoming HTTP traffic addressed to a PC on the private network, and forwards it to the appropriate PC. Proxy servers can be used to block traffic from undesirable websites, to log traffic flows, and to disallow cookies.

If your browser is configured to use a proxy server, and the switch is on your side of the proxy server, you will need to set the browser to bypass proxy entries for the IP address of the appropriate interface on the switch. (See "Establishing a Connection to the Switch" on page 24 for information about giving switch interfaces IP addresses.)

***To ensure that your network's security settings are not compromised, see your network administrator for information about bypassing the proxy server on your system.***

To bypass the proxy server on Internet Explorer, if your browser administration does not use a script, and the PC and the switch are in the same subnet:

1. From the Tools menu, select Internet Options.
2. Select the Connections tab and click the LAN Settings button.
3. Check the "Bypass proxy server for local addresses" checkbox.
4. If necessary, click the Advanced button and enter a list of local addresses.

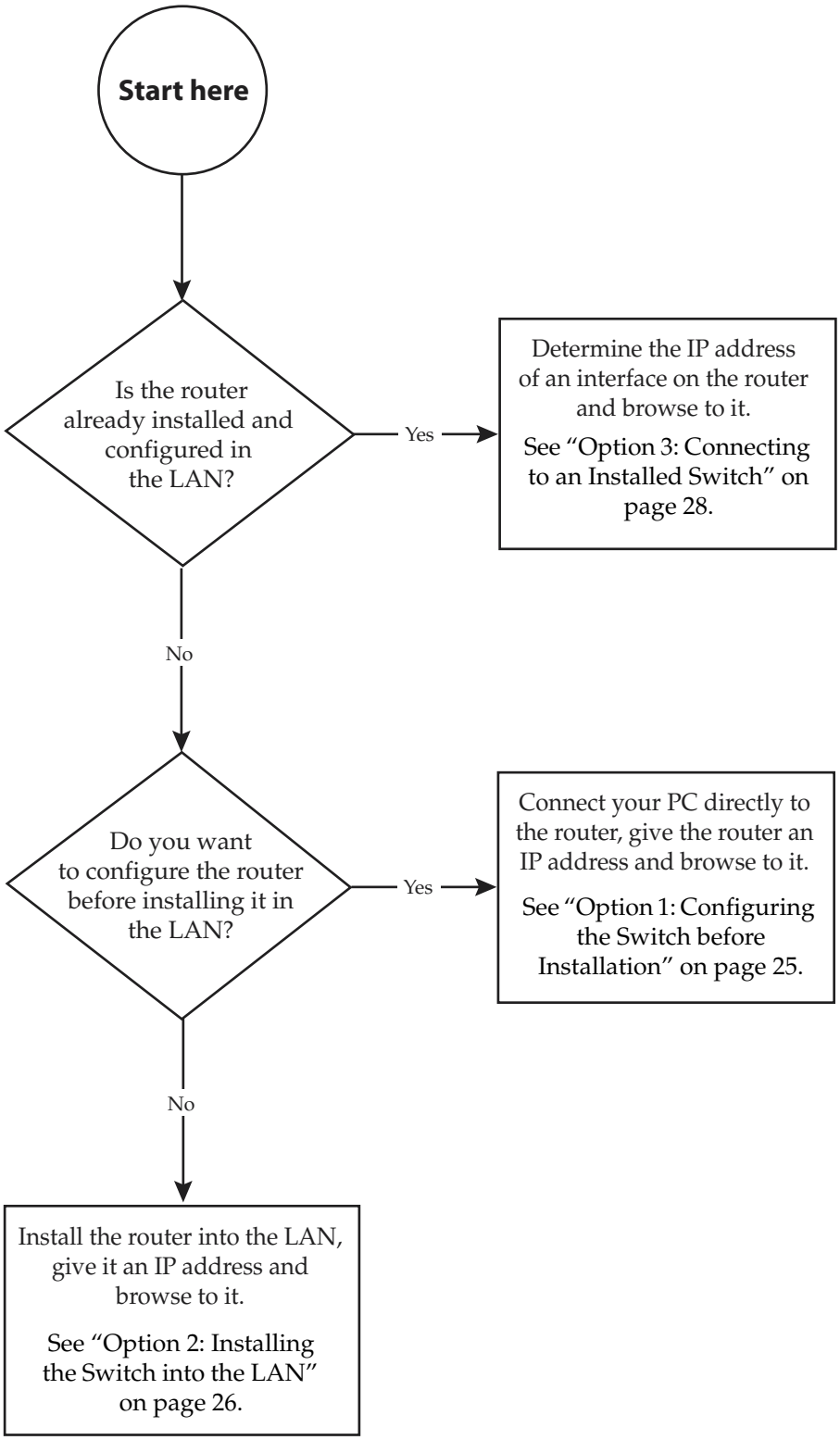
To bypass the proxy server on Netscape, if your browser does not use a script:

1. From the Edit menu, select Preferences
2. Click on the Advanced menu option to expand it.
3. Select the Proxies menu option
4. Enter the switch's IP address in the "No Proxy for" list.

## Establishing a Connection to the Switch

Before you start, consider how the switch fits into your network. If you are installing a new switch, consider whether you want to configure it before deploying it into the LAN, or want to configure it *in situ*. If you want to access a switch that has already been configured, consider the relative positions of the PC and the switch. The flow chart below summarises this process, and the procedures that follow take you through each possibility in detail.

**Figure 2: A summary of the process for establishing a connection via the GUI.**



# Option 1: Configuring the Switch before Installation

**Use this procedure if:**

- You want to configure the switch before installing it in your LAN.
- You will be installing the switch at a remote office or a customer site and want to configure it first.
- You want a dedicated management PC permanently connected to the switch.

**1. Select a PC to browse to the switch from**

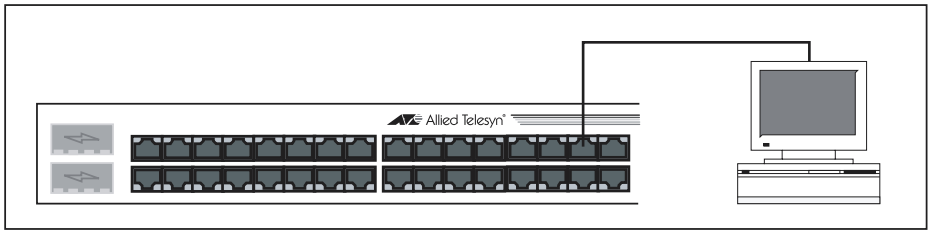
You can browse to the switch from any PC that is running a supported operating system with a supported browser installed. See "Browser and PC Setup" on page 22 for more information.

You need to know the PC's subnet.

**2. Connect the PC to the switch**

Use a straight-through Ethernet cable to connect an Ethernet card on the PC to any one of the switch ports (see Figure 3).

**Figure 3: Connecting a PC directly to the switch.**




*You can browse to the switch through any VLAN, as long as you give that VLAN an IP address (see below). These instructions assume you will use vlan1. The switch ports all belong to vlan1 by default.*

**3. Access the switch's command line interface**

Access the CLI from the PC, as described in "Connecting a Terminal or PC" on page 14.

**4. Enable IP**

```
ENABLE IP
```

**5. Assign the vlan1 interface an IP address in the same subnet as the PC**

```
ADD IP INTERFACE=vlan1 IP=ipaddress MASK=mask
```

**6. Save the configuration and set the switch to use it on bootup**

```
CREATE CONFIG=your-name.cfg
SET CONFIG=your-name.cfg
```

**7. On the PC, bypass the HTTP proxy server, if necessary**

See "HTTP Proxy Servers" on page 23 for more information.

**8. Point your web browser at the LAN interface's IP address**

**9. At the login prompt, enter the user name and password**

The default username is manager:

```
User Name: manager
Password: friend
```

The System Status page is displayed (Figure 6 on page 31). Select options from the sidebar menu to configure and manage the switch.

## Option 2: Installing the Switch into the LAN

**Use this procedure if:**

- You want to install the switch into the LAN before you configure it.

**1. Select a PC to browse to the switch from**

You can browse to the switch from any PC that is running a supported operating system with a supported browser installed, with JavaScript enabled. See "Browser and PC Setup" on page 22 for more information.

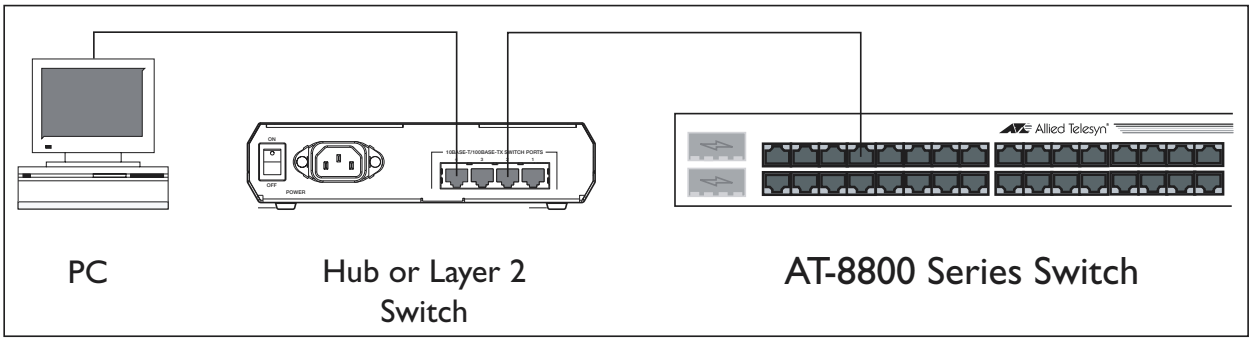
You need to know the PC's subnet.

**2. Plug the switch into the LAN**

**To install the switch into the same subnet as the PC:**

Use an Ethernet cable to connect one of the switch ports to a device on the LAN segment, for example, a hub, router or switch (see Figure 4).

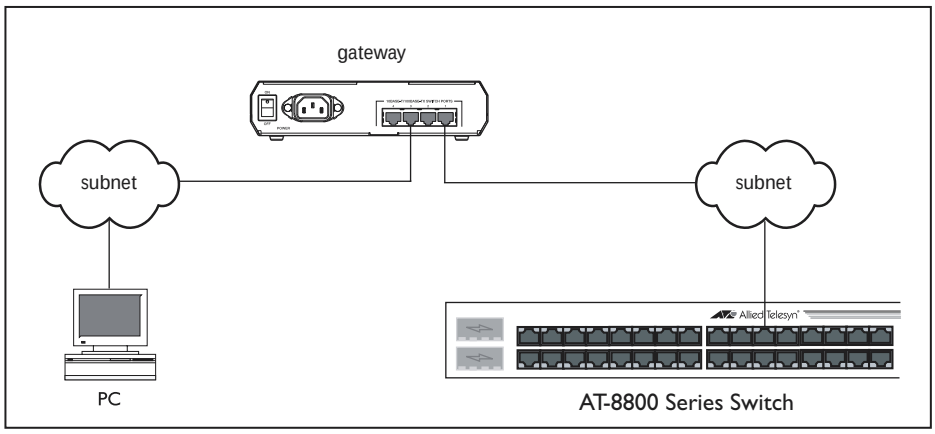
**Figure 4: Connecting the switch into the same LAN segment as the PC**




**To install the switch into a different subnet than the PC:**

Use an Ethernet cable to connect any one of the switch ports to a device on the LAN segment in which you require the switch to work, for example, a hub, router or switch (see Figure 5).

**Figure 5: Configuring the switch from a PC in another subnet.**




*You can browse to the switch through any VLAN, as long as you give that VLAN an IP address (see below). These instructions assume you will use vlan1. The switch ports all belong to vlan1 by default.*

**3. Access the switch's command line interface**

Access the CLI from the PC, as described in "Connecting a Terminal or PC" on page 14.

**4. Enable IP**

```
ENABLE IP
```

**5. Assign the vlan1 interface an IP address**

```
ADD IP INTERFACE=vlan1 IP=ipaddress MASK=mask
```

*If you use DHCP to assign IP addresses to devices on your LAN, and you want to manage the switch within this DHCP regime, it is recommended that you set your DHCP server to always assign the same IP address to the switch. This will enable you to access the GUI by browsing to that IP address, and will also let you use the switch as a gateway device for your LAN. If you need the switch's MAC address for this, you can display it using the command SHOW SWITCH. To set the interface to obtain its IP address by DHCP, use the commands:*
*ADD IP INTERFACE=VLAN1 IPADDRESS=DHCP and*
*ENABLE IP REMOTEASSIGN.*

where:

- *PC-subnet* is the IP subnet address of the PC. For example, if the PC has an IP address of 192.168.6.1 and a mask of 255.255.255.0, its subnet address is 192.168.6.0.
- *gateway-ipaddress* is the IP address of the gateway device that connects the PC's subnet with the switch's subnet (Figure 5 on page 27).

**6. If you want to be able to browse to the GUI securely, configure SSL (Secure Sockets Layer)**

See "Secure Access" on page 29 for more information.

**7. Save the configuration and set the switch to use it on bootup**

```
CREATE CONFIG=filename.cfg
```

```
SET CONFIG=filename.cfg
```

8. **On the PC, bypass the HTTP proxy server, if necessary**

   See "HTTP Proxy Servers" on page 23 for more information.

9. **Point your web browser at the LAN interface's IP address**

   For normal access, point your web browser to

   `http://ip-address`

   For secure access, point your web browser to

   `https://ip-address`

   where *ip-address* is the interface's IP address.

10. **At the login prompt, enter the user name and password**

    The default username is manager:

    ```
    User Name: manager
    Password: friend
    ```

    The System Status page is displayed (see Figure 6 on page 31). Select options from the sidebar menu to configure and manage the switch.

## Option 3: Connecting to an Installed Switch

### Use this procedure if:

- At least one interface on the switch already has an IP address, and the switch is already installed in a LAN.

1. **Find out the IP address of the switch's interface**

   Ask your system administrator. Alternatively, access the CLI, as described in "Connecting a Terminal or PC" on page 14, and enter the command:

   ```
   SHOW IP INTERFACE
   ```

*You can browse to the switch through any VLAN, as long as you give that VLAN an IP address (see below). These instructions assume you will use vlan1. The switch ports all belong to vlan1 by default.*

2. **Select a PC**

   You can browse to the GUI from any PC that:

   - has an IP address in the same subnet as the switch, or that the switch has a route to
   - is running a supported operating system
   - has a supported browser installed, with JavaScript enabled

   See "Browser and PC Setup" on page 22 for more information.

3. **If necessary, bypass the HTTP proxy server**

   See "HTTP Proxy Servers" on page 23 for more information.

4. **Browse to the switch**

   For normal access, point your web browser to

   `http://ip-address`

   where *ip-address* is the interface's IP address.

   To access the switch securely if SSL (Secure Sockets Layer) has been configured on the interface, point your web browser to

   `https://ip-address`

   For more information about secure access, see "Secure Access" on page 29.

5. **At the login prompt, enter the user name and password**

   The default username is manager:

   ```
   User Name: manager
   Password: friend
   ```

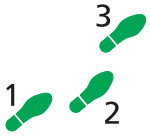
   The System Status page is displayed (see Figure 6 on page 31). Select options from the sidebar menu to configure and manage the switch.

***If the Firewall and/or VPN (IPSec) have already been configured on the switch using the CLI, this configuration may conflict with the GUI. Do not attempt to modify existing CLI firewall or VPN configuration with the GUI.***

## Secure Access

You can optionally browse to the switch using Secure Sockets Layer (SSL). This means that sensitive data including passwords and email addresses can not be accessed by malicious parties. This section details the required configuration. For information about SSL, refer to the *Secure Sockets Layer (SSL)* chapter of your *Software Reference*.

*For this configuration to succeed your switch must have PKI, ISAKMP, SSH and SSL feature licences. If these licences are not already present on your switch, please contact your authorised distributor or reseller.*




**To secure your switch's HTTP Server with SSL for secure switch management via the GUI.**

1. **Create a Security Officer user account**

*Only a user with Security Officer privilege can enable system security and SSL.*

To add a user with the login name "CIPHER", password "sbr4y3", login=yes, and SECURITY OFFICER privilege, use the command:

```
ADD USER="CIPHER" PASSWORD="sbr4y3"
    PRIVILEGE=SECURITYOFFICER Login=yes

CREATE CONFIG=ssl.cfg

RESTART SWITCH
```

2. **Login as a Security Officer**

   To login as the user with Security Officer privilege called “CIPHER”, use the command:

   ```
   LOGIN CIPHER
   ```

   And then enter the password for “CIPHER”, “sbr4y3”.

3. **Enable system security**

   To enable system security, use the command:

   ```
   ENABLE SYSTEM SECURITY
   ```

4. **Create an RSA key pair for this switch.**

   To create an RSA key pair, use the command:

   ```
   CREATE ENCO KEY=0 TYPE=RSA LENGTH=1024
   ```

5. **Set the switch’s distinguished name.**

   To set the switch’s distinguished name to "cn=switch1,o=my_company,c=us", use the command:

   ```
   SET SYSTEM DISTINGUISHEDNAME="cn=switch1,
      o=my_company,c=us"
   ```

6. **Set the UTC offset.**

   To set the Universal Coordinated Time to inform the switch that the difference between local time and GMT is 7 hours, use the command:

   ```
   SET LOG UTCOFFSET=7
   ```

7. **Create a self-signed certificate for the switch.**

   To create a PKI certificate without contacting a CA for browsing to the GUI, use the command:

   ```
   CREATE PKI CERTIFICATE=cer_name KEYPAIR=0
      SERIALNUMBER=12345 SUBJECT="cn=172.30.1.105,
      o=my_company, c=us"
   ```

***Using this command creates a certificate that is only suitable for secure switch management via the GUI. A pop-up message will appear in the browser window warning that the certificate is not issued by a trusted authority. You should create a certificate via a Certification Authority if you want to use SSL with the Load Balancer. For details, see the Public Key Infrastructure (PKI) chapter of your Software Reference.***

8. **Load self-signed switch certificate**

   To load the signed switch certificate onto the switch, use the command:

   ```
   ADD PKI CERTIFICATE=cer_name LOCATION=cer_name.cer
      TRUST=YES
   ```

9. **Enable SSL on the HTTP server**

   To enable SSL on the HTTP server with previously created SSL Key and the port 443, use the command:

   ```
   SET HTTP SERVER SECURITY=ON SSLKEY=0 PORT=443
   ```

**10. Configure an IP interface to run SSL over**

To configure an IP interface that SSL will be run over, first enable IP using the command:

```
ENABLE IP
```

To make `VLAN1` the IP interface, and 172.30.1.105 the interface's IP address, use the command:

```
ADD IP INTERFACE=vlan1 IP=172.30.1.105
```

To add an IP route on this interface with a next hop of 172.30.1.254, use the command:

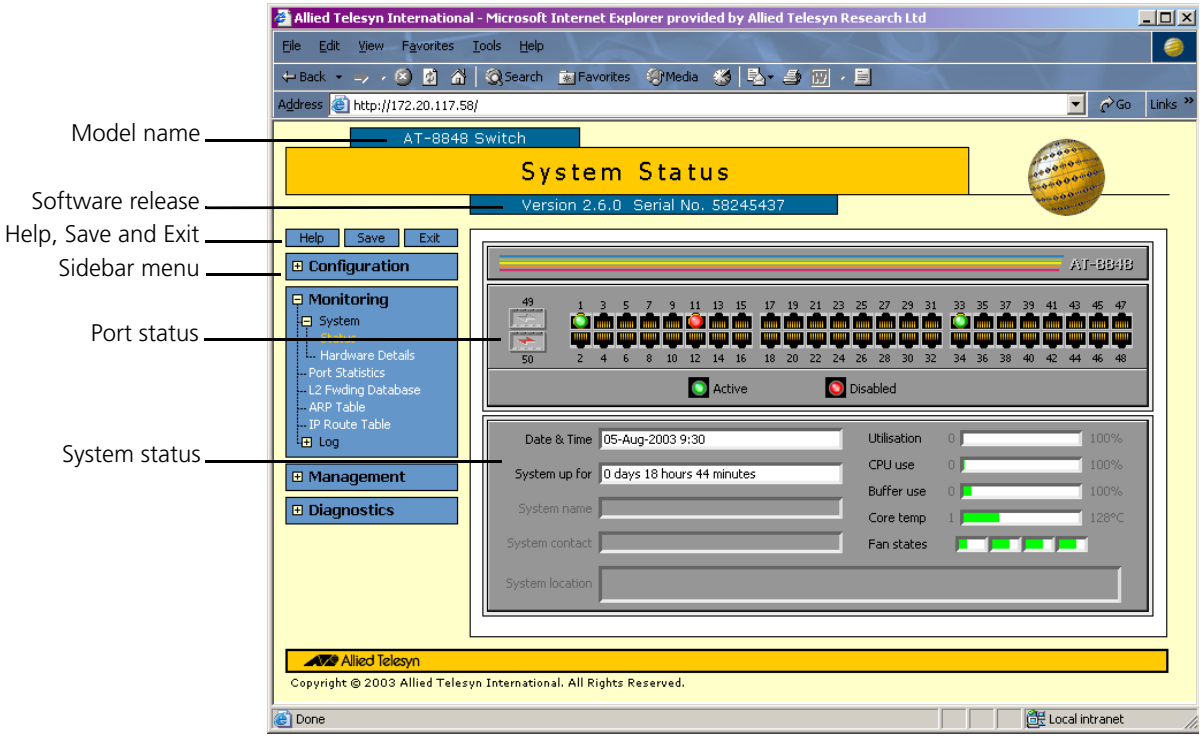
```
ADD IP ROUTE=0.0.0.0 INTERFACE=vlan1 NEXT=172.30.1.254
```

*For this example to succeed, you would have to log in as "cipher" rather than "manager" when connecting to the switch with a web browser.*

## System Status

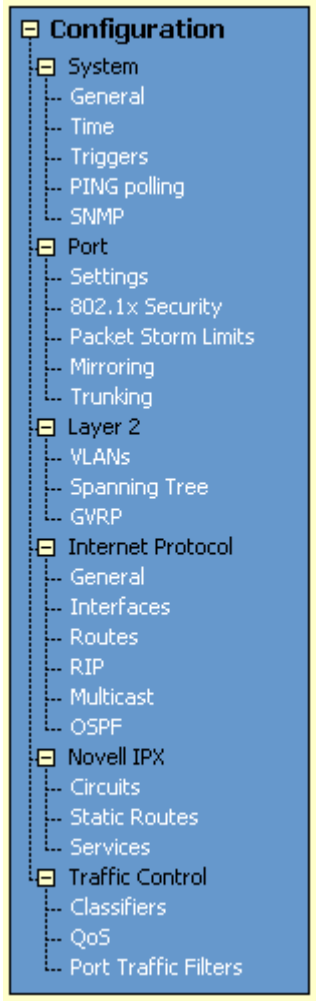
The GUI opens to display the System Status page. Figure 6 points out key information contained on the page.

**Figure 6: The System Status page**



# Using the GUI: Navigation and Features

The GUI consists of a large number of *pages*, which you navigate between using the *menu* on the left of the browser window. This section describes how to use the GUI, and gives an overview of its functionality.




## The Configuration Menu

You can use the GUI to configure:

- the system identity and mail server
- the system time, or NTP (Network Time Protocol)
- triggers, to automatically run scripts at a time you specify or in response to events you specify
- SNMP (Simple Network Management Protocol)
- switch port settings, including mirroring, trunking and storm limits
- 802.1x port security
- VLANs, STP and GARP
- Internet Protocol: interfaces, static routes, the preferences of dynamic routes, RIP, multicasting, and OSPF
- IPX
- Quality of Service and traffic filters

## Using Configuration Pages

Most protocols are configured by creating or adding an entry - a VLAN, a firewall rule, a DHCP policy, and so on. For such protocols, configuration with the GUI is based on sets of three pages: first you see a “summary” page, and from that you access an “add” page and a “modify” page. Complex protocols are sub-divided into different tabs, each with their own summary, add and modify pages.

*Only one person can configure a particular switch with the GUI at a time, to avoid clashes between configurations. Monitoring and diagnostics pages can be viewed by more than one user at a time.*

*Use the menus and buttons on the GUI pages to navigate, not your browser’s buttons, to ensure that the configuration settings are saved correctly.*

The summary page displays a *selection table* of existing items and information about them (for example, existing PIM interfaces; see Figure 7 on page 33). Below the selection table is a row of buttons, labelled Add, Modify and Remove.

To add a new item, click the Add button. This opens the popup “add” page, which lets you create a new item (for example, configure a new PIM interface; see Figure 8 on page 33).

To modify an existing item, select it by clicking on the option button at the beginning of its entry in the selection table. Then click the Modify button. This opens the popup "modify" page, which lets you expand or change the configuration (for example, change the Hello interval for a PIM interface; see Figure 9 on page 34).

To delete or destroy an item, select it by clicking on the option button at the beginning of its entry in the selection table. Then click the Remove button.

**Figure 7: An example of a configuration page with a selection table**

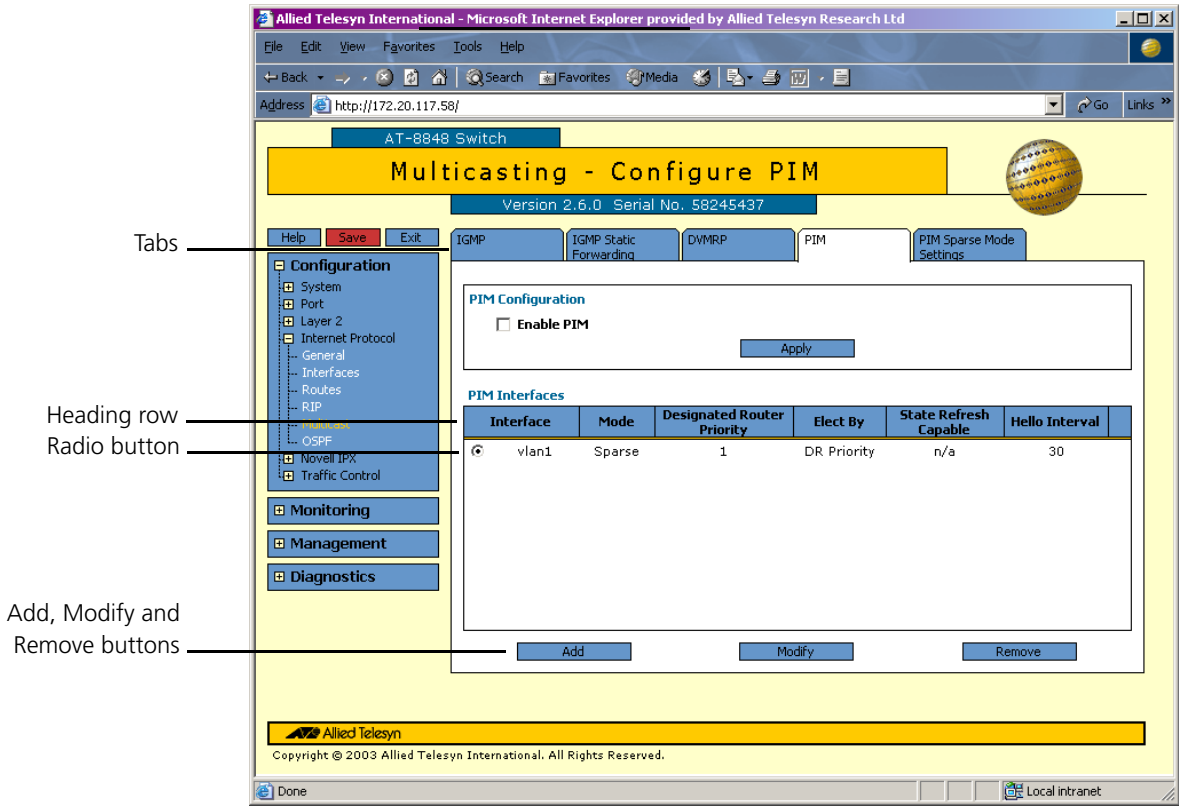



**Figure 8: An example of a popup "add" page**

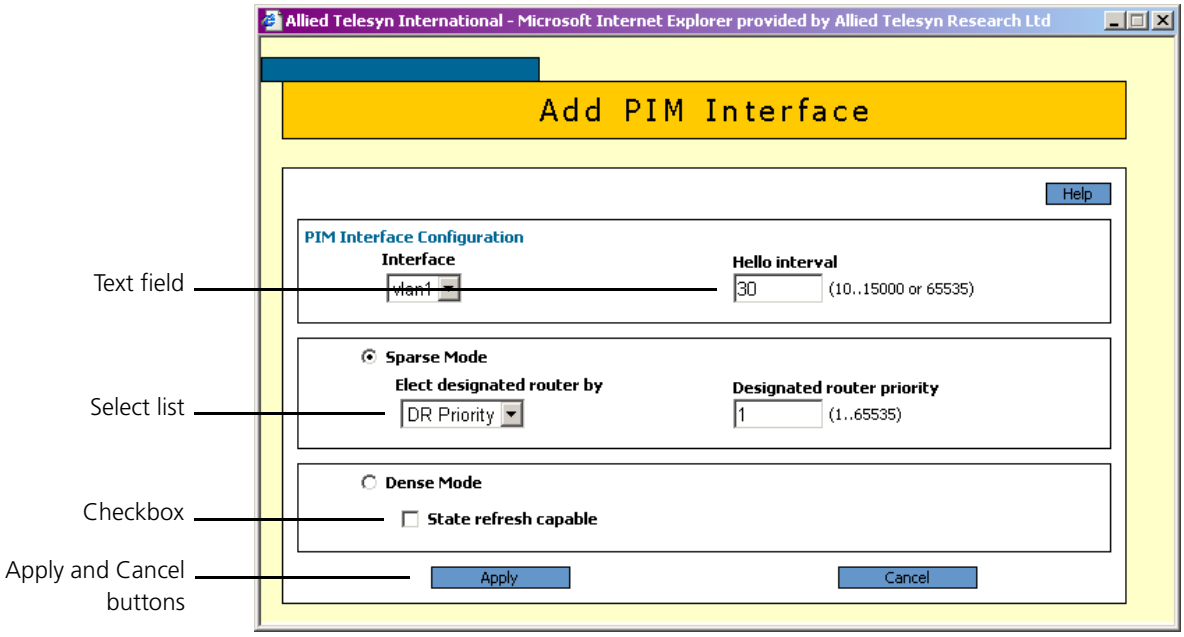
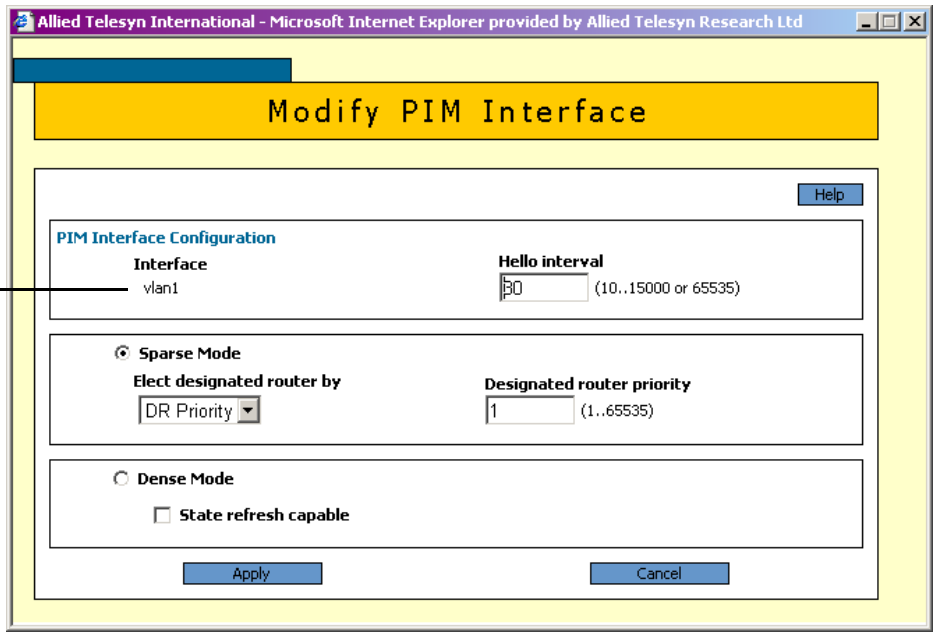
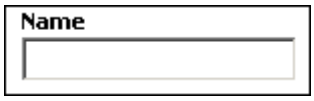


**Figure 9: An example of a popup "modify" page**



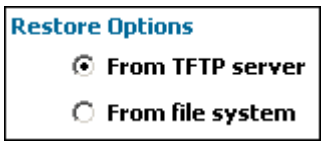

## Editable Fields

GUI pages allow you to enter values or select options through a range of field types. These include:




- text fields, to enter character strings or numbers, especially for fields where there are few limits on the entries (such as names). See the online help for valid characters and field length


- select lists, to select one option from a small number of possibilities. Only valid options are listed. For example, if you are asked to select an IP interface from a drop-down list, the only interfaces displayed will be those you have assigned an IP address to

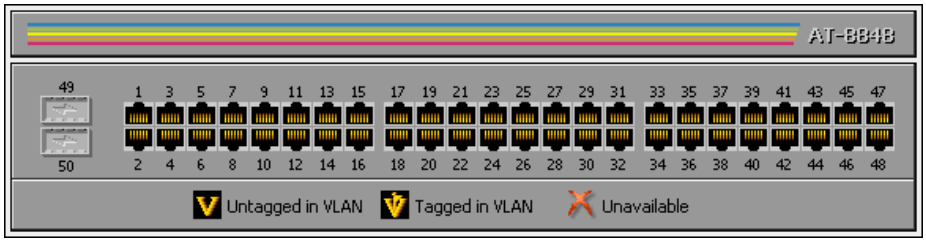



- radio button lists, to choose one of a series of mutually-exclusive options


- checkboxes, to enable or disable features.

## Ports Graphic

Pages on which you can select switch ports use a Ports graphic - a visual representation of the switch ports.To toggle through the selection options, click on the icon representing the port you want to select or deselect.



### Apply Button


An Apply button applies the configuration settings on the page or the section of the page. The new settings will take effect immediately, but are not automatically saved. To save the settings after clicking Apply, click the Save button above the menu.

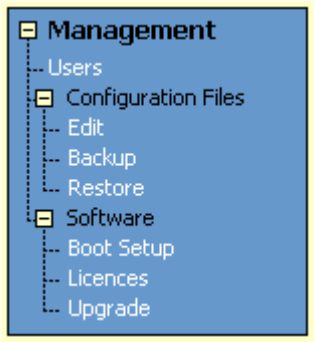
### Cancel Button


A Cancel button closes a popup page without making any changes to the configuration.

### Close Button


A Close button closes a popup page, and conserves any changes that you made to the settings on the page by clicking on buttons like Add, Modify, Remove or Apply. Changes you made to editable fields will not be conserved when you click Close (unless you first clicked Apply).

## The Management Menu

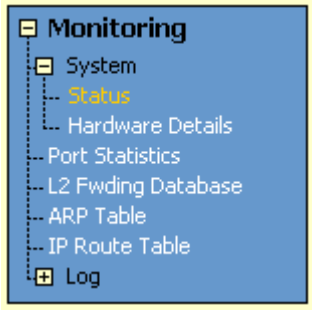



You can use the GUI to manage the switch itself, including:

- creating user accounts and enabling system security
- creating and editing files
- backing files up to the switch's Flash memory or to a PC or TFTP server
- restoring the switch's configuration from backup
- specifying which software and configuration files the switch uses on bootup, and displaying the currently-used files
- enabling software release and feature licences
- upgrading the switch's software

## The Monitoring Menu

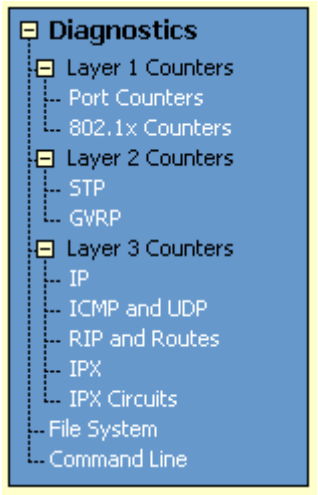
When you browse to the GUI, the sidebar menu opens to display the monitoring menu, opened at the System > Status. From this menu, you can also check:




- information about the switch's hardware
- information about traffic over each port
- the Layer 2 Forwarding Database, which shows the MAC addresses that the switch ports have learned, and out which port the switch will switch traffic to each MAC address
- information about Address Resolution Protocol (ARP) entries
- the IP route table
- the log messages that the switch automatically generates. You can also set up filters to determine where messages are saved to and which messages are saved.

## The Diagnostics Menu

The GUI's diagnostics pages enable you to troubleshoot network problems and observe traffic flow, including:




- displaying the number of good and bad packets received and transmitted over each switch port
- displaying the number and type of PPP packets received and transmitted
- displaying the number and type of packets received and transmitted by IP, and discarded by the IP gateway
- displaying the number and type of ICMP and UDP packets received and transmitted
- displaying the number and type of RIP packets received and transmitted; and the octets received and transmitted over each IP route
- displaying the contents of the switch's file system and how much memory is used and available. You can also delete files
- an interface to the switch's command line interface, allowing you to enter CLI commands.

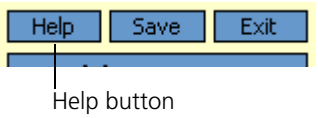
## Changing the Password

*As a security precaution, change the password as soon as possible.*

To change the password of the default Manager account, select Management > Users from the sidebar menu. Select the Manager account and click Modify.

For information about passwords, see "Changing a Password" on page 17.

## Context Sensitive GUI Help

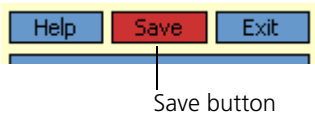



The GUI's context-sensitive help system is displayed in a pop-up window which covers the title of the GUI page. You can move the banner to any part of your screen and/or resize it. To display the help, click on the Help button above the sidebar menu or on the page for which you require assistance. Three types of help are available:


- Click **General Page Info** to see brief background and process flow information. The General Page Info displays when you click the Help button.
- Click **Page Element Info** and roll your mouse over an element, to see information about that element.

  To freeze the banner's display so that the help does not change when you move the mouse, press the [Ctrl] key. To unfreeze, press [Ctrl] again. Note that element information is not available for entries in tables. To see descriptions of the columns of tables, click Complete Help Page.
- Click **Complete Help Page** to see all available information, including the element information, in a separate printable window.

## Saving Configuration Entered with the GUI




Configuration changes applied using the GUI can be saved to a configuration script by clicking the Save button at the top of the sidebar menu. A pop-up Save window gives you the option of saving to the current configuration file, another existing file, or a new file. You can also choose to use this configuration at bootup.

When the Save button is red, this indicates that changes have been made to the configuration and not yet saved. If you attempt to exit the GUI without saving the configuration, a pop-up window will allow you to choose whether or not to save.

## Combining GUI and CLI Configuration

You can alternate between the GUI and the CLI without difficulty. Note that GUI pages will not automatically refresh to reflect changes in the CLI configuration; you must reload the relevant page (for example, by clicking the Refresh button on your browser).

## Configuring Multiple Devices

If you are configuring a number of switches with similar requirements, you may wish to:

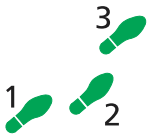
1. Configure one device, using either the CLI or the GUI
2. Save that configuration. This creates a configuration file, stored in the switch's FLASH memory. The file consists of a sorted list of the CLI commands that make up the configuration
3. Upload that file to a PC, using either the CLI or the GUI
4. Open the file in a text editor, make changes as required, and download the file onto each switch you need to configure.

# Upgrading the GUI

You can download the latest GUI resource file from the support site at http://www.alliedtelesyn.co.nz. Before you start, ensure that the switch is running the most recent release and patch files. The GUI is not part of the firmware release file, but the most recent resource file will generally only be compatible with the most recent software release. To check which files the switch is running, refer to the "Current Install" section of the command:

```
SHOW INSTALL
```

If you are updating both the release and the resource file, set the preferred release and restart the switch before installing the GUI as described below.




### To upgrade the GUI

**1. If required, delete the old GUI resource file**

If required, you can store more than one GUI resource file on the switch at a time. If you want to delete the previous GUI resource file (for example, to save memory), you must first disable the GUI, using the command:

```
DISABLE GUI
```

Then delete the GUI resource file, using the command:

```
DELETE FILE=old-gui.rsc
```

where:

- *old-gui*.rsc is the name of the GUI resource file that you are replacing.

Wait until FLASH compaction has finished. This will take several minutes.

***Do not interrupt the switch's power supply during FLASH compaction, under any circumstances.***

*If you have multiple valid resource files and releases stored on the switch, use the SET INSTALL command to change the release and resource file the switch uses (see below).*

**2. Load the new file onto the switch**

Download the GUI resource file for your model of switch from the website to your TFTP server. Do not rename the file.

*Resource files use a fixed naming convention, which includes a product code, a language code and a version code. For example, filenames for the AR450S are of the form d450se01.rsc. If you change the GUI resource file's name, the switch will not recognise it as a valid file and you will be unable to use it for configuration.*

Load the GUI resource file from your TFTP server to the switch, using the command:

```
LOAD FILE=filename.rsc SERVER=server
```

where:

- *filename* is the name of the GUI resource file, as shown on the support site for your switch. Do not rename the file.
- *server* is the IP address of the TFTP server the file is loaded from.

When the switch has loaded the file into its RAM, it displays the message "*File transfer successfully completed*". It then writes the file to FLASH memory, which takes approximately 30 seconds after the message. Once the file has been copied to FLASH, you can enter commands that refer to it.

**3. Install the new file as the preferred GUI**

If you are updating both the release and the resource file, set the preferred release and restart the switch before installing the GUI as described below.

To set the new GUI resource file as the preferred resource file, use the command:

```
SET INSTALL=preferred GUI=filename.rsc
```

You can use the GUI to load the new resource file onto the switch (Management > Software > Upgrade), but you need to use the CLI to install the new file.

If you disabled the GUI to delete the old resource file, enable it again, using the command:

```
ENABLE GUI
```

Check that the new GUI resource file is valid for your device, using the command:

```
SHOW GUI
```

If it is not, or if the file was corrupted during the download, disable the GUI, delete the file and try again.

**4. Point your web browser at the switch's IP address**

Your browser may have a local copy of the old GUI file stored. If so, you need to delete these temporary files (see "Deleting Temporary Files" on page 40).

# Troubleshooting

The GUI resource file has an 8-digit name, with the file extension `rsc` (for example, `d450se01.rsc`). To check which resource files are present on the switch use the command:

```
SHOW FILE
```

To see which GUI resource file the switch is currently using, and which it will use on bootup, use the command:

```
SHOW INSTALL
```

To display information about the GUI resource file that is currently installed, use the command:

```
SHOW GUI
```

In particular, this command lets you check the file's validity. If the file is invalid or damaged, download a new file.

To display information about the switch's HTTP server, use the commands:

```
SHOW HTTP SERVER
```

```
SHOW HTTP SERVER SESSION
```

## Deleting Temporary Files

Browsers store local copies of web pages as temporary files. If you upgrade to a new GUI resource file, or if you encounter problems in browsing to the GUI, you may need to delete these files (clear the cache). To clear the cache in Internet Explorer:

1. From the Tools menu, select Internet Options.
2. On the General tab, click the Delete Files button.
3. The Delete Files dialog box opens. Click the OK button.

To clear the cache in Netscape 6.2.*x*:

1. From the Edit menu, select Preferences
2. Click on the Advanced menu option to expand it.
3. Select the Cache menu option
4. Click the Clear Memory Cache and Clear Disk Cache buttons.

## Accessing the Switch via the GUI

**Problem** **You cannot browse to the switch.**

**Diagnosis** Check if you can ping the switch's interface from your PC. If you get a response, this indicates that the interface's IP address is valid, and that your PC has a route to it.

**Solution**

- If you cannot ping the switch's interface:
  - Check that your PC's gateway is correct, so that your PC has a route to the switch.
  - The IP address of the switch's interface may be incorrect. To correct this, access the CLI and use the IPADDRESS parameter of command SET IP INTERFACE
  - The IP address of the switch's default gateway may be incorrect, so that the switch does not have a route back to your PC's gateway. To correct this, access the CLI and use the NEXTHOP parameter of the command ADD IP ROUTE or SET IP ROUTE.
- If the switch should be dynamically assigned an IP address, check that the DHCP server can reach the switch, by pinging the switch from the DHCP server.
- If your PC accesses the Internet through a proxy server, you may need to set your browser to bypass the proxy when browsing to the switch's IP address range. See "HTTP Proxy Servers" on page 23 for more information.
- If you cannot access the GUI because your username or password fails, check that you are spelling them correctly. The username "manager" will always be valid. Its default password is "friend". Note that passwords are case sensitive.

**Problem** **The GUI is behaving inconsistently, or you cannot access some pages.**

**Solution**

- Delete your browser's temporary files (see "Deleting Temporary Files" on page 40) and try again.
- Check that you are trying to access the GUI from a supported operating system and browser combination. See "Browser and PC Setup" on page 22 for more information.
- Check that JavaScript is enabled.

**Problem** **The GUI does not seem to configure the switch correctly.**

**Solution**

- Use the buttons on the GUI pages to navigate, not your browser's Back, Forward or Refresh buttons. The GUI's navigation buttons perform aspects of the configuration.

## Traffic Flow

**Problem** **No traffic is passing through the switch to or from the LAN, the DMZ or both.**

**Solutions**

- Check that the switch's link to the LAN is functioning, by checking the interface status (Monitoring) and that the link LED is lit. If the LED is not lit, or the appropriate interfaces do not have an status of "active":
  - Check that the port is enabled (Configuration > Port > Settings)
  - Check that the IP address of the interface is still valid.
  - Check that the cables are connected correctly and function correctly.
- Check the RIP configuration (Configuration > Internet Protocol > RIP).
  - Check that the RIP neighbour can reach the switch, by pinging the switch from the RIP neighbour.
  - Any password and authentication settings must be configured on the neighbour as well as on this switch.
- Check that the switch is passing the correct DNS information to hosts on the LAN, if the switch is a DHCP server. If the switch acting as a DHCP client as well, and therefore is passing on DNS information from another DHCP server, check that this DHCP server is providing the switch with the correct information.

## IP Addresses and DHCP

**Problem** **The switch is enabled as a DHCP server, but cannot assign an IP address to a host.**

**Solution**

- Reboot the host machine.
- Check the host's TCP/IP settings, to make sure that the host is set to obtain its IP address dynamically:

  In Windows 95/98, click Settings > Control Panel > Network. Select TCP/IP and click Properties. Click **Obtain an IP address automatically**.

  In Windows 2000, click Settings > Control Panel > Network and Dial-up Connections > Local Area Connection > Properties. Select Internet connection (TCP/IP) and click Properties. Click **Obtain an IP address automatically**.
- Check that the switch's link to the LAN is functioning, by checking the interface status (Monitoring) and that the link LED is lit (see "*Traffic Flow*" on page 41).

## Time and NTP

**Diagnosis** The switch's time is displayed on the Configuration > System > Time tab. It will also be included in log packets.

**Problem** **The switch's time does not change, even though you entered the correct time.**

**Solution** Changing the time is a 3-step process. Select Configuration > System > Time. First, enter a time that is very shortly in the future (e.g. 20 seconds later than the current time). Then check **Set time**. Then wait until precisely the time you have entered, and click Apply.

**Problem** **The switch is not assigning the time to devices on the LAN.**

**Solutions**

- Check NTP is enabled (Configuration > System > Time).
- Check that the NTP peer's IP address is entered correctly.
- Check that the NTP peer can reach the switch, by pinging the switch from the NTP peer.
- Check that the switch's link to the LAN is functioning. See "*Traffic Flow*" on page 41.

**Problem** **The switch's clock does not synchronise with the NTP peer.**

**Solution**

- The switch's clock can only synchronise with the NTP peer if its initial time is similar to the NTP peer's time (after setting the UTC offset). Manually set the switch's time so that it is approximately correct, and enable NTP again.
- Check that the UTC offset is correct.

**Problem** **The switch's time is incorrect, even though it assigns the correct time to devices on the LAN.**

**Solution** The UTC offset is probably incorrect, or needs to be adjusted for the beginning or end of summer time. To correct this, select Configuration > System > Time and enter the correct offset.

## Loading Software

**Problem** **You have attempted to load a new release file onto the switch, but the load has failed and you cannot access the switch through the GUI.**

**Solution**

1. Access the switch's CLI (see "*Connecting a Terminal or PC*" on page 14).

   If the switch has been switched off or has rebooted since you attempted to load the release file, it will boot up with the default installation. This contains the commands you require to load a file.

   Log into the switch using the manager account and password.

2. Download the release file to the switch. See "Example: Upgrade to a New Software Release Using TFTP" on page 57 for an example.

Chapter 4

# Operating the switch

## This Chapter

This chapter introduces basic operations on the switch, including:



## User Accounts and Privileges

The switch software supports three levels of privilege for users: USER, MANAGER, and SECURITY OFFICER. By default, the switch has one account (*manager*) defined with manager privilege and the default password *friend*. The commands that a user can execute depends on the user's privilege level and whether the switch is operating in normal or security mode (see "*Normal Mode and Security Mode*" on page 47). A USER level prompt looks like:

```
>
```

while a MANAGER prompt looks like:

```
Manager >
```

and a SECURITY OFFICER prompt looks like:

```
SecOff >
```

The MANAGER level has access to the full set of commands when the switch is in normal mode. When the switch is operating in security mode, users with MANAGER privilege cannot execute a subset of the commands known as the security commands (see "*Normal Mode and Security Mode*" on page 47).

In normal mode, a user with manager privilege can create and delete accounts for users with any of these privilege levels. Users and passwords are managed by the User Authentication Facility. Users and passwords are authenticated using an internal database called the *User Authentication Database*, or by interrogation of external RADIUS (*Remote Authentication Dial In User Service*) or TACACS (*Terminal Access Controller Access System*) servers.

On the CLI, to use an account with manager privilege, log in to the account by entering the command:

```
LOGIN
```

The switch prompts you to enter a user name and password. To return to USER mode, enter the command:

```
LOGOFF
```

Make sure that you do not leave a manager session unattended. Unauthorised use of a manager session gives access to the User Authentication Database. To reduce the risk of unauthorised activity, a subset of manager commands have a security timer. These commands are shown in Table 4 on page 46. When you enter one of these commands from a manager session, the security timer is started and is then restarted each time you enter another of these commands. If you enter one of these commands after the timer has expired, you are prompted to re-enter the password. The secure delay timer is by default 60 seconds. If the password is not entered correctly the password prompt is repeated a set number of times. If the correct password is still not entered a log message is generated and the session is logged off.

The security timer enables a manager to make successive additions and modifications to the database at one time without having to re-enter the password for every command.

***The security timer does not provide a foolproof security mechanism. Managers should always attempt to log out of a manager session before leaving a terminal unattended.***

**Table 4: Secure commands controlled by the security timer.**

| Command | Description |
|---|---|
| ADD TACACS SERVER | Adds a TACACS server to the list of TACACS servers used for user authentication. |
| ADD USER | Adds a user to the User Authentication Database. |
| DELETE TACACS SERVER | Deletes a TACACS server from the list of TACACS servers used for user authentication. |
| DELETE USER | Deletes a user from the User Authentication Database. |
| PURGE USER | Deletes all users except MANAGER from the User Authentication Database. |
| SET MANAGER PORT | Assigns a port semipermanent MANAGER privilege. |
| SET USER | Modifies a user record in the User Authentication Database. |

*If the switch is operating in security mode, the manager must also log in to a user account with SECURITY OFFICER privilege in order to execute any of the commands listed in Table 4 on page 46.*

See the *Operations* chapter in the *AT-8800 Series Switch Software Reference* for:

- More information about managing and using accounts with user, manager and security officer privileges
- A full list of commands that require security officer privilege when the switch is in secure mode
- Information about enabling a *remote security officer*.

# Normal Mode and Security Mode

The switch operates in one of two modes, either normal mode or security mode. By default, the switch is in normal mode.

*When the switch is in security mode, the command SHOW DEBUG does not display output of the SHOW FEATURE and SHOW CONFIGURATION DYNAMIC commands, or the current configuration in the SHOW SYSTEM output unless the SHOW DEBUG command is entered by a user with security officer privilege.*

If you wish to use the following software features you need to enable security mode:

- IP authentication
- Secure Shell (see the *Secure Shell* chapter, *AT-8800 Series Switch Software Reference*)
- Encryption (see the *Compression and Encryption Services* chapter, *AT-8800 Series Switch Software Reference*)
- IPsec (see the *IP Security* chapter, *AT-8800 Series Switch Software Reference*)
- Public Key Encryption (PKI) (see the *Public Key Infrastructure* chapter, *AT-8800 Series Switch Software Reference*)
- Secure Sockets Layer (SSL) (see the *Secure Sockets Layer* chapter, *AT-8800 Series Switch Software Reference*)

To enable security mode, first create a user with security officer privilege, then enter the command:

```
ENABLE SYSTEM SECURITY_MODE
```

To access secure functionality you will need to log in again as the security officer.

When the switch restarts, it restarts in the same normal mode or security mode as it was before restarting. To restore the switch to normal operating mode, enter the command:

```
DISABLE SYSTEM SECURITY_MODE
```

***When security mode is disabled, the switch automatically deletes all sensitive data files, including encryption keys.***

To display the current operating mode, enter the command:

```
SHOW SYSTEM
```

When the switch is in security mode, a user with security officer privilege is the only person who can execute commands which affect switch security. Table 5 on page 48 lists commands that only a security officer can execute when the switch is in security mode. A complete list of commands limited by security mode are listed in the *Operation* chapter in the *AT-8800 Series Switch Software Reference*.

**Table 5: Commands requiring SECURITY OFFICER privilege when the switch is operating in security mode .**

| Command | Specific Parameters |
|---|---|
| ACTIVATE SCR | |
| ADD IP INT | |
| ADD SCR | |
| ADD USER | |
| CREATE CONFIG | |
| CREATE ENCO KEY | |
| CREATE PPP | |
| CREATE PPP TEMPLATE | |
| CREATE SNMP COMMUNITY | |
| DEACTIVATE SCR | |
| DELETE FILE | |
| DELETE SCR | |
| DELETE USER | |
| DISABLE USER | |
| DUMP | |
| EDIT | |
| ENABLE PPP DEBUG | |
| ENABLE PPP TEMPLATE DEBUG | |
| ENABLE SNMP | |
| ENABLE USER | |
| LOAD | |
| MODIFY | |
| PURGE USER | |
| RENAME FILE | |
| RESET ENCO | |
| RESET USER | |
| SET CONFIG | |
| SET INSTALL | |
| SET IP INT | |
| SET PPP | |
| SET PPP TEMPLATE | |
| SET SCR | |
| SET SNMP COMMUNITY | |
| SET USER | |
| SHOW CONFIG | |

**Table 5: Commands requiring SECURITY OFFICER privilege when the switch is operating in security mode (Continued).**

| Command | Specific Parameters |
|---|---|
| SHOW FILE | |
| SHOW PPP | CONFIG |
| UPLOAD | |

# Remote Management

You can manage remote switches as easily as you manage the local switch a terminal is connected to. From a terminal connected to any port (with either USER or MANAGER privilege), enter the command:

```
TELNET ipadd
```

to Telnet to the remote switch, specifying the remote router's IP address.

switchFor information about how to set routes and on how you assign an IP address to your switch, see "*Setting Routes*" on page 16 and "*Assigning an IP Address*" on page 15.

If the connection is successful, a login prompt from the remote switch is displayed. Login using a login name that has been defined with MANAGER privilege (such as the default MANAGER login name), and enter the password.

To return to the local switch and terminate the connection, enter the command:

```
LOGOFF
```

For more information about using Telnet, see the *Terminal Server* chapter in the *AT-8800 Series Switch Software Reference*.

# Storing Files in FLASH Memory

When you purchase the switch, the switch software release, the online help files, and a default configuration file are stored in FLASH memory, where they are saved even if the switch is powered down. You will use the FLASH memory to store updated software releases or patches, and files that record the router's configuration. FLASH memory is like a flat file system, with no subdirectories.

The switch also has Random Access Memory (RAM). The switch software uses RAM to run the switch. When you enter commands to configure the switch these commands affect the dynamic configuration in RAM.

FLASH memory is like a flat file system, with no subdirectories.

File names of up to 16 characters long, with extensions of 3 characters (DOS 16.3 format), are supported on the switch. However, files on the switch are **stored** in FLASH using the DOS 8.3 format of 8 characters long, with

extensions of 3 characters. For example, the file `extralongfilenam.cfg` may be saved as `extral~1.cfg` in the FLASH File System. Therefore, files can be accessed via two file names, either of which can be used for file management.

A translation table, named `longname.lfn`, converts file names between DOS 16.3 format and DOS 8.3 format. To reconcile file names the switch consults the translation table which is synchronised with file contents in memory. For more information about working with files see the *Working With Files* section, *Operation* chapter, *AT-8800 Series Switch Software Reference*.

To display the files in FLASH, enter the command:

```
SHOW FILE
```

**Figure 10: Example output from the SHOW FILE command.**

```
Filename                Device        Size     Created                  Locks
-------------------------------------------------------------------------------
28-72.pat               flash         111764   05-May-1997 12:41:42     0
28-74ang.rel            flash         2013756  09-May-1997 15:58:55     0
28f72-06.pat            flash         123268   18-Apr-1997 15:58:16     0
release.lic             flash         32       08-May-1997 16:43:49     0
test.cfg                flash         1698     09-May-1997 10:39:42     0
sixteenalongfile.scp    flash         24       30-May-1997 15:10:12     0
-------------------------------------------------------------------------------
```

*The Locks field indicates the number of concurrent software processes using the file.*

The switch automatically compacts FLASH memory when a maximum threshold of deleted files is reached. Compaction frees space for new files by discarding garbage. A message will appear when FLASH compaction is activated. Another message appears when FLASH compaction is complete.

***While FLASH is compacting, do not restart the switch or use any commands that affect the FLASH file subsystem. Do not restart the switch, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files.***

# Using Scripts

When you start or restart the switch, or when it automatically restarts, it executes the configuration commands in the boot script. A boot script is a text file containing a sequence of standard commands that the switch executes at startup. The default boot script is called `boot.cfg`. Commands run from a boot script are limited to 128 characters.

The commands you enter into the switch from the command line affect only the dynamic configuration in RAM, which is not retained over a power cycle. The switch does not automatically store these changes in FLASH memory. When the switch is restarted, it loads the configuration defined by the boot script, or if the switch was restarted using the RESTART command, any script file specified in the RESTART command.

In addition to the boot configuration script that the switch automatically runs when it restarts, you can run a configuration script manually at any time, by entering the command:

```
ACTIVATE SCRIPT=filename
```

You can also set a trigger to automatically execute a configuration script when a specified event occurs.

For more information about how to create and run scripts, see the *Scripting* chapter in the *AT-8800 Series Switch Software Reference*.

For information about creating triggers, see the *Trigger Facility* chapter in the *AT-8800 Series Switch Software Reference.*

## Saving the Switch's Configuration

To view the router's current dynamic configuration, enter the command:

```
SHOW CONFIGURATION DYNAMIC
```

To save any changes made to the dynamic configuration after the switch last restarted (booted) across a restart or power cycle, and save the modified configuration as a script file, enter the command:

```
CREATE CONFIG=filename.scp
```

To set the switch to execute this script file when it restarts, enter the command:

```
SET CONFIG=filename.scp
```

*The configuration file created by CREATE CONFIG command records passwords in encrypted form, not in cleartext.*

You can create a script file from any of the switch software commands. These are the same commands that are used to change the router's configuration dynamically. Manually edit a configuration file using the router's built in editor (see "*Using the Built-in Editor*" on page 60), or upload it to a PC using the UPLOAD command (see the *Operation* chapter, *AT-8800 Series Switch Software Reference)*, edit it using any text editor, and download it again. Give configuration script files an extension of `.scp` or `.cfg`.

To display the name of the configuration file that is set to execute when the switch restarts, enter the command:

```
SHOW CONFIG=filename
```

## Storing Multiple Scripts

You can store multiple configuration scripts on the switch. This allows you to test new configuration scripts once, before setting them as the default configuration. For example, to test the new configuration script `test.cfg`, enter the command:

```
RESTART SWITCH CONFIG=test.cfg
```

Storing multiple scripts also allows you to keep a backup switch with configuration scripts stored on it for every switch in the network to speed up network recovery time.

# Loading and Uploading Files

When you want to upgrade your switch to a new software patch or release, or use a new configuration file, load files onto the switch using the router's LOADER module. You can also use the LOADER module to upload files, such as configuration files or log files, from the switch onto a host on the network.

## File Naming Conventions

The file subsystem provides a flat file system—directories are not supported. Files are uniquely identified by a file name of the form:

```
[device:]filename.ext
```

where:

- *device* specifies the physical memory device on which the file is stored, FLASH. If *device* is specified, it must be separated from the rest of the file name by a colon (":"). *device* is optional. If *device* is not specified, the default is FLASH.
- *filename* is a descriptive name for the file, and may be one to eight characters in length. Valid characters are lowercase letters (a–z), uppercase letters (A–Z), digits (0–9) and the hyphen character (-).
- *ext* is a file name extension, one to three characters in length. Some file name extensions are shown in Figure 6 on page 52. Valid characters are lowercase letters (a–z), uppercase letters (A–Z), digits (0–9) and the hyphen character (-). The extension is used by the switch to determine the data type of the file and how to use the file (Table 6 on page 52). If *ext* is specified, it must be separated from the *filename* portion by a period (".")

**Table 6: File extensions and file types .**

| Extension | File type/function |
|---|---|
| CER | Public Key Infrastructure (PKI) certificate file. |
| CFG | Configuration or boot script. |
| CRL | PKI Certificate Revocation List file. |
| CSR | PKI Certificate Signing Request file. |
| GIF | (Graphics Interchange Format) graphic image file. |
| HLP | CLI help file. |
| HTM | HTML file used by the HTTP server. |
| INS | Stores install information created by using the SET INSTALL command. |
| JPG | (Joint Photographic Experts Group) graphic image file. |
| KEY | Public portion of an RSA key. |
| LIC | Licence information. |
| LOG | Log file. |
| MDS | Modem script. |
| REL | Software release. |
| REZ | Compressed release. |
| SCP | Script. |

**Table 6: File extensions and file types (Continued).**

| Extension | File type/function |
|---|---|
| SPA | Spam Mail Source files, listing email addresses, identified as spam mail sources, to be blocked by the firewall SMTP proxy, if it is active. |
| SPL | VPN client. |
| TXT | Generic text file. |
| VPF | Future VPN client. |
| LFN | Extension used for the long file name translation table |

You may see files on your switch with file name extensions not listed in Table 6 on page 52. If you require more information about file types and file name extensions, contact your authorised distributor or reseller.

***Do not change the header in a release or patch file. At best, this will cause the file load or install to fail, at worst the switch could be put into a state where it will not boot correctly until field service action is taken.***

## Loading Files

The LOADER module is responsible for loading and storing releases, patches, PKI certificates and other files into FLASH. The LOADER module uses the Trivial File Transfer Protocol (TFTP), Hypertext Transfer Protocol (HTTP), or ZMODEM over an asynchronous port, to retrieve files from a network host.

You can also load text files without using any of these protocols. For information about using Lightweight Directory Access Protocol (LDAP) to load PKI certificates or certificate revocation lists (CRLs), see the *Operation* chapter in the *AT-8800 Series Switch Software Reference*.

The router's default download method is TFTP. To load a file onto the switch from a TFTP server using the TFTP protocol, enter the command:

```
LOAD [METHOD=TFTP] [DELAY=delay] [DESTFILE=destfilename]
    [DESTINATION={BOOTBLOCK|FLASH}] [SERVER={hostname|ipadd}]
    [SRCFILE|FILE=filename]
```

To load a file onto the switch using the HTTP protocol, enter the command:

```
LOAD [METHOD={HTTP|WEB|WWW}] [DELAY=delay]
    [DESTFILE=destfilename] [DESTINATION=BOOTBLOCK|FLASH}]
    [HTTPPROXY={hostname|ipadd} [PASSWORD=password]
    [PROXYPORT=1..65535]] [SERVER={hostname|ipadd}]
    [SERVPORT={1..65535|DEFAULT}] [SRCFILE|FILE=filename]
    [USERNAME=username]
```

The switch can only load one file at a time. Wait for the current transfer to complete before initiating another transfer. To display the default configuration of the LOADER module, and the progress of any current transfer, enter the command:

```
SHOW LOADER
```

To stop a load at any time, leaving the LOADER module ready to load again, enter the command:

```
RESET LOADER
```

## Setting LOADER Defaults

You are likely to repeat the process of downloading files onto the switch using a similar method each time. You can set defaults for some or all of the LOADER parameters. You can then use or override some or all of these defaults for each particular load.

To set LOADER defaults, enter the command:

```
SET LOADER [ATTRIBUTE={CERT|CRL|CACERT|DEFAULT}]
    [BASEOBJECT={dist-name|DEFAULT}] [DELAY={delay|DEFAULT}]
    [DESTFILE=dest-filename] [DESTINATION={FLASH|DEFAULT}]
    [HTTPPROXY={hostname|ipadd|DEFAULT}]
    [METHOD={HTTP|LDAP|TFTP|WEB|WWW|ZMODEM|NONE|DEFAULT}]
    [PASSWORD=password] [PROXYPORT={1..65535|DEFAULT}]
    [{SCRFILE|FILE}=filename]
    [SERVER={host-name|ipadd|DEFAULT}]
    [SERVPORT={1..65535|DEFAULT}] [USERNAME=username]
```

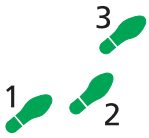
You can set all parameters except DESTFILE, SCRFILE and FILE back to the factory defaults with the option DEFAULT.

For more information about setting the LOADER defaults on your switch, see the *Operations* chapter in the *AT-8800 Series Switch Software Reference*.

## Example: Load a Patch File Using HTTP

This example loads a patch file onto the switch from an HTTP server on the network. Before following this procedure, make sure:

- The HTTP server is operating on a host with an IP address (for example 192.168.1.1) on the network, and that the patch file is in the server's HTTP directory.
- The switch has an IP address (for example 192.168.1.2) on the interface connecting it to the HTTP server, and that it can communicate with the server.
- There is enough space in the router's FLASH for the new patch file.




**To load a patch file**

1. **Configure the LOADER.**

   Set the LOADER module with defaults to make the process of downloading files in future simpler.

   ```
   SET LOADER METHOD=HTTP SERVER=192.168.1.1
      DESTINATION=FLASH
   ```

2. **Download the patch file.**

   Download the patch file onto the switch, using the defaults set above.

   ```
   LOAD FILE=52232-01.paz
   ```

   When the download has completed, check that the file is in FLASH.

   ```
   SHOW FILE
   ```

   This shows the file `52232-01.paz` is present.

To activate the patch see "*To upgrade to a new patch file:*" on page 59.

## Uploading Files From the Switch

The LOADER can upload files from the switch to a network host, using TFTP or ZMODEM. Upload files using one of the commands:

```
UPLOAD [METHOD=TFTP] [FILE=filename]
    [SERVER={hostname|ipadd}]

UPLOAD [METHOD=ZMODEM] [FILE=filename] [ASYN=port]
```

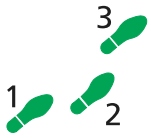
The UPLOAD command uses defaults set with the SET LOADER command, for parameters not specified with the upload command.

You can install Allied Telesyn's Trivial File Transfer Protocol Server (AT-TFTP Server) on any PC or server running Windows. This will provide a simple way to make files available to all Allied Telesyn routers and layer 3 switches in your network. The TFTP Server, and a readme file describing how to install and use it, are provided on the *AT-8800 Series Switch Documentation and Tools CD-ROM*.

## Example: Upload a Configuration File Using TFTP

This example uploads a configuration file from the switch to a TFTP server on the network. Before following this procedure, make sure:

- The TFTP server is operating on a host with an IP address (for example 192.168.1.3) on the network.
- The switch has a valid IP address (for example 192.168.1.2) on the interface connecting it to the TFTP server, and that it can communicate with the server.
- The configuration file is present in the router's FLASH.




**To upload a log file:**

1. **Configure the LOADER.**

   Set the LOADER module with defaults to make the process of downloading and uploading files in future simpler.

   ```
   SET LOADER METHOD=TFTP SERVER=192.168.1.3
   ```

2. **Upload the configuration file.**

   Upload the configuration file from the switch into the TFTP directory of the TFTP server on the network, using the defaults set above.

   ```
   UPLOAD FILE=filename.cfg
   ```

   Monitor the load progress.

   ```
   SHOW LOAD
   ```

   When the upload is complete, check that the file is in the TFTP directory on the network host.

## More information

For more information about loading files onto and uploading files from the switch, including using LDAP to load PKI certificate information, see the *Operation* chapter in the *AT-8800 Series Switch Software Reference*.

# Upgrading Switch Software

When you first start the switch, it automatically loads the software release from FLASH memory into RAM, where the CPU uses it to run all the router's software features. The switch may also load a patch file to improve the main release. The software release and any patch files are current when the switch is produced at the factory.

When Allied Telesyn makes a new patch or release available, you may want to upgrade the software on your switch to use a new patch or release file. You can download the latest software patches, full software releases, and CLI help files from the support site at: *http://www.alliedtelesyn.co.nz/support/ar400*.

Make sure you download a patch or release file that matches your switch model. A patch or release file for AT-8800 Series Switch has 86 as the first two digits of the filename. Patch files have the file extension `.paz` and release files have the file extension `.rez`. For example, the Software Release 2.6.1 for the AR450S has the filename `86s-261.rez`.

Release and patch files are compressed ASCII files, and consist of a header followed by a sequence of Motorola S-records containing the actual code for the release or patch. The header has a standard format, which provides information about the release or patch to the switch.

***Do not change the header in a release or patch file. At best, this will cause the file load or install to fail, at worst the switch could be put into a state where it will not boot correctly until field service action is taken.***

The current release and patch file are set as the preferred install. The switch also has a very limited version of the software stored in a specific part of FLASH (the FLASH boot block). You cannot delete this version as it is the default, or boot install. When you load a new software release or patch, you can set it to run once, the next time the switch reboots. This temporary install allows you to test run a new release or patch once, before you make it the preferred install. If the temporary install fails the switch will automatically run the preferred install if there is one, or otherwise the default install, the next time the switch reboots.

When the switch reboots, it checks the install information in a strict order:

- Firstly, the switch checks the temporary install. If a temporary install is specified, the switch loads it into RAM and runs it. At the same time, it deletes the temporary install information so it will not load a second time. This information is deleted even if the temporary install triggers a fatal condition causing the switch to reboot immediately.
- Secondly, if no temporary install is defined, or the install information is invalid, the switch checks the preferred install. If present, this install is loaded. The switch never deletes the preferred install information.
- Thirdly, if neither a temporary install nor a preferred install is specified, the switch loads the default install. The default install is always present in the switch because if, for some reason, it is not, the INSTALL module will restore it.

***The preferred install should not be set up with an untested release or patch. It is advisable to install new releases or patches as the temporary install, and***

*when the switch boots correctly, to then set up the preferred install with the new release or patch.*

To change the install information in the switch, enter the command:

```
SET INSTALL={TEMPORARY|PREFERRED|DEFAULT}
    [RELEASE={release-name|EPROM}] [PATCH=patch-name]
```

*For security reasons the SET INSTALL command is only accepted if the user has SECURITY OFFICER privilege.*

When you set a patch file as part of a temporary install or permanent install, you must also set the corresponding release file in the same command, if it has not already been set as part of that install. You can set the patch, but not the release (always EPROM), for the default install.

To delete a temporary install or preferred install, enter the command:

```
DELETE INSTALL={TEMPORARY|PREFERRED}
```

If a default install is set, only the patch information is deleted using the DELETE INSTALL command as the release information must always be left intact in the default install.

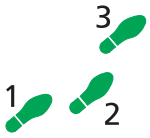
To display the current install information, including which install is currently running in the switch, and how the install information was checked at the last reboot, enter the command:

```
SHOW INSTALL
```

For more information about INSTALL commands, see the *Operations* chapter in the *AT-8800 Series Switch Software Reference*.

## Example: Upgrade to a New Software Release Using TFTP

This example assumes the switch is correctly configured to allow TFTP to function. This means that IP is configured and the switch is able to communicate with the designated TFTP server. The TFTP server is assumed to function correctly and the release and patch files are assumed present in the server's TFTP directory. The switch has no patch files, and is running the Software Release 2.6.1. The IP address of the server is 172.16.1.1. The name of the release file being loaded is `86s-262.rez`.




**To upgrade to a new software release:**

1. **Configure the LOADER.**

   The LOADER module is set up with defaults to make the process of downloading files in future simpler. All release and patch files in this switch are stored in FLASH.

   ```
   SET LOADER METHOD=TFTP SERVER=172.16.1.1 DEST=FLASH
   ```

2. **Load the new release file onto the switch.**

   Make sure there is space in FLASH for the new release file. Load the new file onto your switch. Make sure the release file matches your switch model (see "*Upgrading Switch Software*" on page 56). Load any patch files required, and the help file for the release (see "*Loading and Uploading Files*"

on page 52). To load the release file using your LOADER default settings, enter the command:

```
LOAD FILE=86s-262.rez
```

Wait for the release to load. This can take several minutes, even if you are loading the file over a high speed link. To see the progress of the load, enter the command:

```
SHOW LOAD
```

To check that the files are successfully loaded, enter the command:

```
SHOW FILE
```

**3. Enter licence information for the release.**

Enter the licence password for the software release.

```
ENABLE RELEASE=86s-262.rez PASSWORD=ce645398fbe
   NUMBER=2.6.2
```

The release licence password is provided by your authorised distributor or reseller and is unique for the release number (in this case 2.6.2), the file name and the router's serial number.

Enter passwords for any special feature licences.

```
ENABLE FEATURE=feature PASSWORD=password
```

**4. Test the release.**

Set the new release to run as a temporary install. This sets the switch to load the new release once only when it reboots.

```
SET INSTALL=TEMPORARY RELEASE=86s-262.rez
```

If you want to use the current switch configuration again, store the dynamic configuration as a configuration script file and set the switch to use this configuration when it restarts. Releases are generally backward-compatible, so your current configuration should run with little or no modifications on the later release.

```
CREATE CONFIG=myconfig.cfg

SET CONFIG=myconfig.cfg
```

The SET CONFIG information survives the release update.

Reboot the switch.

```
RESTART REBOOT
```

The switch reboots, loading the new release file and the specified configuration. Display the install history, and check that the temporary release was loaded.

```
SHOW INSTALL
```

**5. Make the release the default (permanent) release.**

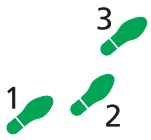
If the switch operates correctly with the new release, make the release permanent.

```
SET INSTALL=PREFERRED RELEASE=86s-262.rez
```

Every time the switch reboots from now on, it loads the new release from FLASH.

## Example: Upgrade to a new patch file

Use this procedure to upgrade the software release currently running on the switch with a new patch. This example assumes that the current release, Software Release 2.6.1, is set as the preferred release.




**To upgrade to a new patch file:**

1. **Load the new patch file onto the switch.**

   Load the new file onto your switch. See "*Loading and Uploading Files*" on page 52.

   ```
   LOAD FILE=86261-01.paz
   ```

   Check that the file is successfully loaded.

   ```
   SHOW FILE
   ```

2. **Test the patch.**

   Set the release to run as a temporary install, so that it loads the patch once only the next time it reboots.

   ```
   SET INSTALL=TEMPORARY RELEASE=86s-261.rez
      PATCH=86261-01.paz
   ```

   If you want to use the current switch configuration again, store the dynamic configuration as a configuration script file, and set the switch to use this configuration when it restarts.

   ```
   CREATE CONFIG=myconfig.scp

   SET CONFIG=myconfig.scp
   ```

   Reboot the switch.

   ```
   RESTART REBOOT
   ```

   The switch reboots, loading the new patch file and the specified configuration. Check that the switch operates correctly with the new patch file.

3. **Make the patch part of the default (permanent) release.**

   If the switch operates correctly with the new patch, make the release permanent.

   ```
   SET INSTALL=PREFERRED RELEASE=86s-261.rez
      PATCH=86261-01.paz
   ```

   Every time the switch reboots from now on, it loads the new release and patch from FLASH.

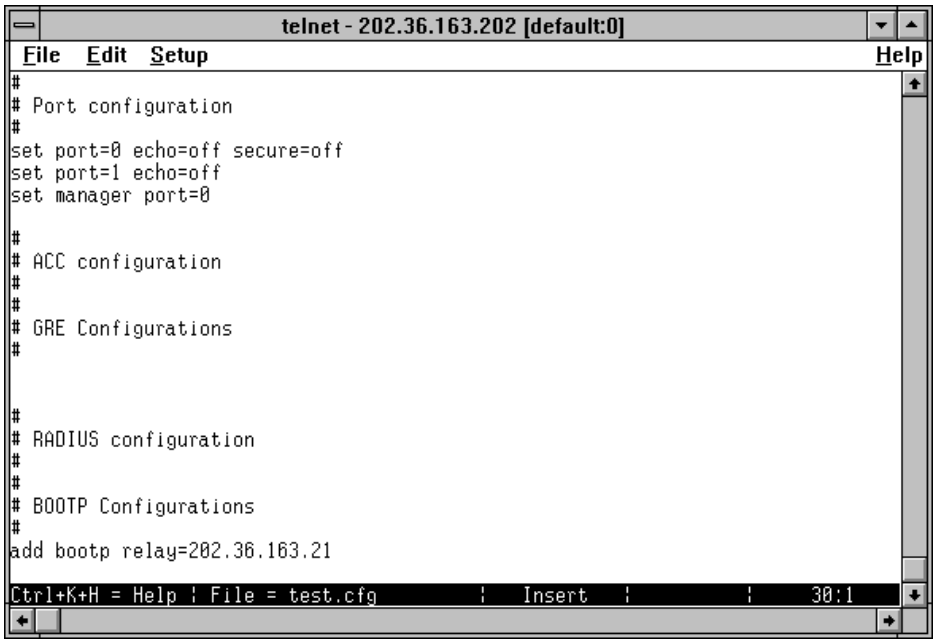
***Do not set an untested patch as part of the preferred install.***

# Using the Built-in Editor

The AT-8800 Series Switch has a built-in full-screen text editor for editing script files stored on the switch file subsystem. Using the text editor you can run script files manually, or set script files to run automatically at switch restart, or on trigger events. Figure 11 on page 60 shows a example screen shot of the text editor. To start the editor with a new file or an existing file, enter the command:

```
EDIT [filename]
```

**Figure 11: The editor screen layout.**




The editor uses VT100 command sequences and should only be used with a VT100-compatible terminal, terminal emulation program or Telnet client.

To display editor Help at any time while in the editor press [Ctrl/K,H]; that is, hold down the Ctrl key and press in turn the K key then the H key.

For more information about the inbuilt editor, see the *Operation* chapter in the *AT-8800 Series Switch Software Reference*.

# SNMP and MIBs

You can remotely monitor some features of the switch using Simple Network Management Protocol (SNMP).

For information about the MIBs supported by the switch, see *Appendix C: SNMP MIBs* in the *AT-8800 Series Switch Software Reference*.

The SNMP agent is disabled by default. To enable SNMP, enter the command:

```
ENABLE SNMP
```

SNMP *communities* are the main configuration item in the router's SNMP agent, and are defined in terms of a list of IP addresses which define the SNMP application entities (trap hosts and management stations) in the community. To create an SNMP community, enter the command:

```
CREATE SNMP COMMUNITY=name [ACCESS={READ|WRITE}]
    [TRAPHOST=ipadd] [MANAGER=ipadd]
    [OPEN={ON|OFF|YES|NO|TRUE|FALSE}]
```

*The community name is a security feature and you should keep it secure.*

To enable the generation of authentication failure traps by the SNMP agent whenever an SNMP authentication failure occurs, enter the command:

```
ENABLE SNMP AUTHENTICATE_TRAP
```

To enable the generation of link state traps for a specified interface, enter the command:

```
ENABLE INTERFACE=interface LINKTRAP
```

where *interface* is the name of an interface, such as "vlan11".

For more information see the *Simple Network Management Protocol (SNMP)* chapter and the *Interfaces* chapter in the *AT-8800 Series Switch Software Reference*.

To display the current state and configuration of the SNMP agent, enter the command:

```
SHOW SNMP
```

For a detailed description of the output from the SHOW SNMP command, see the *Simple Network Management Protocol (SNMP)* chapter in the *AT-8800 Series Switch Software Reference*.

# For More About Operations and Facilities

For more detail about operating the switch, and for full command syntax definitions, see the *Operation* chapter in the *AT-8800 Series Switch Software Reference*, including:

- How to use the User Authentication Facility, RADIUS, TACACs or TACACS+ for authenticating users who log on to the switch, and ensuring that only authorised login accounts are used.
- How to use the HTTP Client, which you can use to download software files onto the switch, and the HTTP Server.
- How to use the Mail Subsystem.
- How to use LDAP to load PKI certificates and CRLs onto your switch.
- Switch Startup Operations
- How to use FLASH compaction to regain storage space on the switch. Read "*Warning about FLASH memory*" on page 12 before you attempt to do this.
- How to set *aliases* to represent common command strings.
- How to define a *remote security officer*, so you can manage the security features remotely via Telnet.

See other chapters in the *AT-8800 Series Switch Software Reference* for more information on how to:

- Use the logging facility to monitor network activity and to select and display the results (see the *Logging Facility* chapter).
- Use SNMP to manage the switch remotely (see the *Simple Network Management Protocol (SNMP)* chapter and *Appendix C: SNMP MIBs*).
- Use the command line to create, delete and modify configuration scripts (see the *Scripting* chapter).
- Set up triggers to automatically run specified scripts at specified times, or at specified events (see the *Trigger Facility* chapter).
- Use NTP to synchronise your router's time clock with those of other network devices (see the *Network Time Protocol (NTP)* chapter).
- Use software to test whether the router's hardware functions correctly (see the *Test Facility* chapter).

Chapter 5

# Layer 2 Switching

This section describes the Layer 2 switching features on the AT-8800 Series Switch, and how to configure them.

## Switch Ports

Each Ethernet switch port is uniquely identified by a port number. The switch supports a number of features at the physical level that allow it to be connected in a variety of physical networks. This physical layer (layer 1) versatility includes:

- Enabling and disabling of Ethernet ports.
- Auto negotiation of port speed and duplex mode for all 10/100 Ethernet ports.
- Manual setting of port speed and duplex mode for all 10/100 Ethernet ports.
- Link up and link down triggers.
- Port trunking.
- Packet storm protection.
- Port mirroring.
- Support for SNMP management

### Enabling and Disabling Switch Ports

An switch port that is enabled is available for packet reception and transmission. Its administrative status in the Interfaces MIB is UP. Conversely, an Ethernet port that is disabled is not available for packet reception and transmission. It will not send or receive any frames; incoming STP BPDU packets are discarded. Its administrative status in the Interfaces MIB is DOWN. Every Ethernet port on the switch is enabled by default. Disabling a switch port does not affect the STP operation on the port. Enabling a switch port will allow the port to participate in spanning tree negotiation. A switch port that has been disabled by the Port Security feature cannot be enabled using the ENABLE SWITCH PORT command.

To enable or disable a switch port, use the commands:

```
ENABLE SWITCH PORT={port-list|ALL}

DISABLE SWITCH PORT={port-list|ALL}
```

Resetting Ethernet ports at the hardware level discards all frames queued for reception or transmission on the port, and restarts autonegotiation of port speed and duplex mode. Ports are reset using the command:

```
RESET SWITCH PORT={port-list|ALL} [COUNTER]
```

To display information about switch ports, use the command:

```
SHOW SWITCH PORT[={port-list|ALL}]
```

**Figure 12: Example output from the SHOW SWITCH PORT command.**

```
Switch Port Information
------------------------------------------------------------------------
 Port ......................... 1
   Description ................... To intranet hub, port 4
   Status ........................ ENABLED
   Link State .................... Up
   UpTime ........................ 00:10:49
   Port Media Type ............... ISO8802-3 CSMACD
   Configured speed/duplex ....... Autonegotiate
   Actual speed/duplex ........... 1000 Mbps, full duplex
   Configured master/slave mode .. Autonegotiate
   Actual master/slave mode ...... Master
   Acceptable Frame Types ........ Admit All Frames
   Broadcast rate limit .......... 1000/s
   Multicast rate limit .......... -
   DLF rate limit ................ -
   Learn limit ................... -
   Intrusion action .............. Trap
   Current learned, lock state ... 15, not locked
   Mirroring ..................... Tx, to port 22
   Is this port mirror port ...... No
   Enabled flow control .......... Pause
   Send tagged pkts for VLAN(s) .. marketing (87)
                                   sales (321)
   Port-based VLAN ............... accounting (42)
   Ingress Filtering ............. OFF
   Trunk Group ................... -
   STP ........................... company
   Multicast filtering mode ...... (B) Forward all unregister groups
------------------------------------------------------------------------
```

**Table 7: Parameters in the output of the SHOW SWITCH PORT command**

| Parameter | Meaning |
|---|---|
| Port | The number of the switch port. |
| Description | A description of the port. |
| Status | The state of the port; one of "ENABLED" or "DISABLED". |
| Link state | The link state of the port, one of "Up" or "Down". |
| Uptime | The count in hours:minutes:seconds of the elapsed time since the port was last reset or initialised. |
| Port Media Type | The MAC entity type as defined in the MIB object ifType. |

**Table 7: Parameters in the output of the SHOW SWITCH PORT command**

| Parameter | Meaning |
|---|---|
| Configured speed/duplex | The port speed and duplex mode configured for this port. One of "Autonegotiate" or a combination of a speed (one of "10 Mbps", "100 Mbps" or "1000 Mbps") and a duplex mode (one of "half duplex" or "full duplex"). |
| Actual speed/duplex | The port speed and duplex mode that this port is actually running at. A combination of a speed (one of "10 Mbps", "100 Mbps" or "1000 Mbps") and a duplex mode (one of "half duplex" or "full duplex"). |
| Configured master/slave mode | The master/slave mode configured for this port; one of "Autonegotiate', "Master", "Slave" or "Not applicable". |
| Actual master/slave mode | The master/slave mode actually selected; one of "-", "Master", "Slave" or "Not applicable". |
| Acceptable Frames Types | The value of the Acceptable Frames Type parameter, one of: "Admit All Frames" or "Admit Only VLAN-tagged Frames". |
| Broadcast rate limit | The limit of the rate of reception of broadcast frames for this port, in frames per second. |
| Multicast cast rate limit | The limit of the rate of reception of multicast frames for this port, in frames per second. |
| DLF rate limit | The limit of the rate of reception of DLF (destination lookup failure) frames for this port, in frames per second. |
| Learn limit | The number of MAC addresses that may be learned for this port. Once the limit is reached, the port is locked against any new MAC addresses. One of "None" or a number from 1 to 256. |
| Intrusion action | The action taken on this port when a frame is received from an unknown MAC address when the port is locked. One of "None", "Discard", "Trap" or "Disable". |
| Current learned, lock state | The number of MAC addresses currently learned on this port and the state of locking for this port. The lock state is one of "not locked", "locked by limit" or "locked by command". |
| Mirroring | The traffic mirroring for traffic in and out of this port. One of "None", "Rx" (for traffic received by this port), "Tx" (for traffic sent on this port) or "Both". The port to which mirrored frames are being sent is also displayed. |
| Is this port mirror port | Whether or not this port is a mirror port. One of "No" or "Yes". |
| Enabled flow control(s) | Flow control parameters set for the port; "Pause" or "-". If flow control is implemented on the switch, then Pause flow control is applied to the port. |
| Send tagged pkts for VLAN(s) | The name and VLAN Identifier (VID) of the tagged VLAN(s), if any, to which the port belongs. |
| Port-based VLAN | The name and VLAN Identifier (VID) of the port-based VLAN to which the port belongs. |
| Ingress Filtering | The state of Ingress Filtering: one of "ON" or "OFF". |
| Trunk Group | Name of trunk group to which the port belongs, if any. |
| STP | The name of the STP to which the port belongs. |

## Autonegotiation of Port Speed and Duplex Mode

Each of the switch ports can operate at either 10 Mbps or 100 Mbps, in either full duplex or half duplex mode. In full duplex mode a port can transmit and receive data simultaneously, while in half duplex mode the port can either transmit or receive, but not at the same time. This versatility makes it possible to connect devices with different speeds and duplex modes to different ports on the switch. Such versatility also requires that each port on the switch know which speed and mode to use.

Autonegotiation allows the ports to adjust their speed and duplex mode to accommodate the devices connected to them. Each switch port can be either configured with a fixed speed and duplex mode, or configured to autonegotiate speed and duplex mode with a device connected to it to determine a speed and mode that will allow successful transmission. An autonegotiating port will adopt the speed and duplex mode required by devices connected to it. If another autonegotiating device is connected to the switch, they will negotiate the highest possible common speed and duplex mode (Table 8 on page 67). Setting the port to a fixed speed and duplex mode allows it to support equipment that cannot autonegotiate.

It is also possible to require a port to operate at a single speed without disabling autonegotiation by allowing the port to autonegotiate but constrain the speed/duplex options to the desired combination. For example, if one end of a link is set to AUTO and other to 100MFULL then the AUTO end will select 100MHALF operation because without the other end autonegotiating the AUTO end has no way of knowing that the fixed end is full duplex capable. If a particular speed is required it is usually preferable to fix the speed/duplex combination using one of the autonegotiating speed values. Therefore, using 100MFAUTO at one end of a link and will allow the AUTO end to autonegotiate 100MFULL.

Switch ports will autonegotiate by default when they are connected to a new device. To change this setting, use the command:

```
SET SWITCH PORT={port-list|ALL}
   SPEED={AUTONEGOTIATE|10MHALF|10MFULL|10MHAUTO|10MFAUTO|10
   0MHALF|100MFULL|100MHAUTO|100MFAUTO|1000MHALF|1000MFULL|1
   000MHAUTO|1000MFAUTO}
```

Autonegotiation can also be activated at any time after this, on any port that is set to autonegotiate, by using the command:

```
ACTIVATE SWITCH PORT={port-list|ALL} AUTONEGOTIATE
```

On the first switch, the gigabit uplink ports always use 1000 Mbps speed and operate in full duplex mode, but these ports can also autonegotiate with peers in order to successfully pass the negotiation phase to get to successful operation.

**Table 8: Port speed and duplex settings for Ethernet Ports .**

| Speed | AT-8824<br>AT-8848<br>10/100 |
|---|---|
| 10MHALF | Yes |
| 10MFULL | Yes |
| 100MHALF | Yes |
| 100MFULL | Yes |
| 1000MHALF | No |
| 1000MFULL | No |
| 10MHAUTO | Yes |
| 10MFAUTO | Yes |
| 100MHAUTO | Yes |
| 100MFAUTO | Yes |
| 1000MHAUTO | No |
| 1000MFAUTO | No |
| AUTONEGOTIATE | Yes |

The SHOW SWITCH PORT command displays the port speed and duplex mode settings.

## Port Trunking

Port trunking, also known as port bundling or link aggregation, allows a number of ports to be configured to join together to make a single logical connection of higher bandwidth. This can be used where a higher performance link is required, and makes links even more reliable.

The switch supports up to 6 trunk groups, of up to 8 switch ports each. The two gigabit Ethernet ports can also be grouped together to form a trunk group. It is not possible for a trunk group to include both 10/100 Ethernet and gigabit Ethernet ports. Ports in the trunk group do not have to be contiguous. Port trunking is supported between AR800 Series and Rapier switches, and may be compatible with trunking algorithms on third party devices.

Port trunk groups are created and destroyed on the switch using the commands:

```
CREATE SWITCH TRUNK=trunk [PORT=port-list]
   [SELECT={MACSRC|MACDEST|MACBOTH|IPSRC|IPDEST|IPBOTH}]
   [SPEED={10M|100M|1000M}]

DESTROY SWITCH TRUNK=trunk
```

Port trunk groups can only be destroyed on the switch if no ports belong to them.

All the ports in a trunk group must belong to the same VLAN. Ports in a trunk group can be added to other VLANs, either as individual ports or as an entire group. A port in a trunk group cannot be deleted from any of the VLAN(s) to

which the whole trunk group belongs, unless it is first removed from the trunk group. The members of a trunk group can be specified when it is created, and ports can be added to or removed from a trunk group using the commands:

```
ADD SWITCH TRUNK=trunk PORT=port-list

DELETE SWITCH TRUNK=trunk PORT={port-list|ALL}
```

Ports which are members of a trunk group must operate in full duplex mode. When a port is added to a trunk group, the speed setting for the group overrides the speed setting previously configured for the port. When a port is removed from a trunk group, the port returns to its previously configured speed and duplex mode settings.

The speed of the trunk group can either be specified when it is created, or set using the command:

```
SET SWITCH TRUNK=trunk
    [SELECT={MACSRC|MACDEST|MACBOTH|IPSRC|IPDEST|IPBOTH}]
    [SPEED={10M|100M|1000M}]
```

The SELECT parameter specifies the port selection criterion for the trunk group. Each packet to be sent on the trunk group is checked, using the selection criterion, and a port in the trunk group chosen down which to send the packet. If MACSRC is specified, the source MAC address is used. If MACDEST is specified, the destination MAC address is used. If MACBOTH is specified, both source and destination MAC addresses are used. If IPSRC is specified, the source IP address is used. If IPDEST is specified, the destination IP address is used. If IPBOTH is specified, both the source and destination IP addresses are used. The user of the switch should choose the value of this parameter to try to spread out the load as evenly as possible on the trunk group. The default for this parameter is MACDEST.

The SPEED parameter specifies the speed of the ports in the trunk group. For gigabit ports, only the value 1000M is allowed. For switch ports, values of 10M and 100M are allowed. The default is 100M. When a port is added to a trunk group, its current speed and duplex mode settings are ignored and the port uses the speed of the trunk group and full duplex mode.

To display information about trunks on the switch, use the command:

```
SHOW SWITCH TRUNK[=trunk]
```

To display the VLANs to which the ports in the trunk groups belong, use the command:

```
SHOW VLAN[=ALL]
```

*Port trunking must be configured on both ends of the link, or network loops may result.*

## Packet Storm Protection

The packet storm protection feature allows the user to set limits on the reception rate of broadcast, multicast and destination lookup failure packets. The software allows separate limits to be set for each port, beyond which each of the different packet types are discarded. The software also allows separate limits to be set for each of the packet types. Which of these options can be implemented depends on the model of switch hardware.

By default, packet storm protection is set to NONE, that is, disabled. It can be enabled, and each of the limits can be set using the command:

```
SET SWITCH PORT=port-list [BCLIMIT={NONE|limit}]
   [DLFLIMIT={NONE|limit}] [MCLIMIT={NONE|limit}]
```

Packet storm protection limits cannot be set for each individual port on the switch, but can be set for each processing block of ports. The processing blocks are sets of 8 ports (e.g. as many as are applicable of ports 1-8, 9-16, 17-24, 25-32, 33-40 and 41-48) and each uplink port is a further processing block. Therefore, a 24-port switch has five processing blocks and a 48-port switch has eight. The two uplink ports are numbered sequentially after the last port, and therefore are 25 and 26 for a 24-port switch, and 49 and 50 for a 48-port switch. Only one limit can be set per processing block, and then applies to all three packet types. Thus each of the packet types are either limited to this value, or unlimited (NONE).

The BCLIMIT parameter specifies a limit on the rate of reception of broadcast packets for the port(s). The value of this parameter represents a per second rate of packet reception above which packets will be discarded, for broadcast packets. If the value NONE or 0 is specified, then packet rate limiting for broadcast packets is turned off. If any other value is specified, the reception of broadcast packets will be limited to that number of packets per second. See the note below for important information about packet rate limiting. The default value for this parameter is NONE.

The DLFLIMIT parameter specifies a limit on the rate of reception of destination lookup failure packets for the port. The value of this parameter represents a per second rate of packet reception above which packets will be discarded, for destination lookup failure packets. If the value NONE or 0 is specified, then packet rate limiting for destination lookup failure packets is turned off. If any other value is specified, the reception of destination lookup failure packets will be limited to that number of packets per second. See the note after the BCLIMIT parameter description for important information about packet rate limiting. The default value for this parameter is NONE. If packet storm protection limits are set on the switch, the PORT parameter must specify complete processing blocks.

*A destination lookup failure packet is one for which the switch hardware does not have a record of the destination address of the packet, either Layer 2 or Layer 3 address. These packets are passed to the CPU for further processing, so limiting the rate of reception of these packets may be a desirable feature to improve system performance.*

The MCLIMIT parameter specifies a limit on the rate of reception of multicast packets for the port. The value of this parameter represents a per second rate of packet reception above which packets will be discarded, for multicast packets. If the value NONE or 0 is specified, then packet rate limiting for multicast packets is turned off. If any other value is specified, the reception of multicast packets will be limited to that number of packets per second. See the note after

the BCLIMIT parameter description for important information about packet rate limiting. The default value for this parameter is NONE. If packet storm protection limits are set on the switch, the PORT parameter must specify complete processing blocks.

*The ability of the switch to limit packet reception rates for different classes of packets is dependent on the particular switch hardware. In particular, groups of ports may have to have the same limits set, and the same limit may be set for the different types of packets, depending on the hardware. Whenever packet rate limits are set on switches which have this type of constraint, the latest parameter values entered will supersede earlier values. When a command entered for specified ports changes the parameters for other ports, a message will indicate these changes.*

The SHOW SWITCH PORT command displays the packet storm protection settings (Figure 12 on page 64).

```
SHOW SWITCH PORT=port-list
```

## Port Mirroring

Port mirroring allows traffic being received and transmitted on a switch port to be sent to another switch port, the mirror port, usually for the purposes of capturing the data with a protocol analyser. This mirror port is the only switch port which belongs to no VLANs, and therefore does not participate in any other switching. Before the mirror port can be set, it must be removed from all VLANs except the default VLAN. The port cannot be part of a trunk group.

To set the mirror port (and remove it from the default VLAN) use the command:

```
SET SWITCH MIRROR={NONE|port}
```

*If another port was previously set as the mirror port, this command returns the previous mirror port to the default VLAN as an untagged port. Return this port to any VLANs to which it should belong, using the ADD VLAN PORT command, or set it as a tagged port using the SET VLAN PORT command if required.*

Either traffic received on a port or traffic transmitted by the port, or both, can be mirrored. This setting and the source port(s) from which traffic is sent to the mirror port are specified using the command:

```
SET SWITCH PORT={port-list|ALL} MIRROR={NONE|RX|TX|BOTH}
```

*Mirroring four or more ports may significantly reduce switch performance.*

The MIRROR parameter specifies the role of these port(s) as a source of mirror traffic. If NONE is specified, no traffic received or sent on these port(s) will be mirrored. If RX is specified, all traffic received on these port(s) will be mirrored. If TX is specified, all traffic transmitted on these port(s) will be mirrored. If BOTH is specified, all traffic received and transmitted will be mirrored. Traffic will actually only be mirrored if there is a mirror port defined and if mirroring is enabled. The default is NONE.

To send packets that match particular criteria to the mirror port, first create a classifier or classifiers using the command:

```
CREATE CLASSIFIER
```

Then create a hardware filter with the ACTION parameter set to SENDMIRROR, using the command:

```
ADD SWITCH HWFILTER CLASSIFIER=classifier-list
   ACTION=SENDMIRROR
```

By default mirroring is disabled, no mirror port is set, and no source ports are set to be mirrored. Mirroring can only be enabled after the switch mirror port has been set to a valid port. If mirroring has been enabled but the switch mirror port is set to NONE, then mirroring will be disabled. Mirroring is enabled and disabled using the commands:

```
ENABLE SWITCH MIRROR

DISABLE SWITCH MIRROR
```

The SHOW SWITCH PORT and SHOW SWITCH commands display the switch and port mirroring settings.

## Port security

The port security feature allows control over the stations connected to each switch port, by MAC address. If enabled on a port, the switch will learn MAC addresses up to a user-defined limit from 1 to 256, then lock out all other MAC addresses. One of the following options can be specified for the action taken when an unknown MAC address is detected on a locked port:

- Discard the packet and take no further action,
- Discard the packet and notify management with an SNMP trap,
- Discard the packet, notify management with an SNMP trap and disable the port.

To enable port security on a port, set the limit for learned MAC addresses to a value greater than zero, and specify the action to take for unknown MAC addresses on a locked port. To disable port security on a port, set the limit for learned MAC addresses to zero or NONE. Port security can be enabled or disabled on a port using the command:

```
SET SWITCH PORT={port-list|ALL} LEARN={NONE|0|1..256}
   [INTRUSIONACTION={NONE|DISCARD|TRAP|DISABLE}]
```

The INTRUSIONACTION parameter specifies the action taken when the port(s) receive packets from addresses which are not part of the learned list of addresses as specified by the LEARN parameter. If DISCARD is specified, packets received from MAC addresses not on the port's learn list will be discarded. If TRAP is specified, packets received from MAC addresses not on the port's learn list will be discarded and an SNMP trap will be generated. If DISABLE is specified, the first time a packet is received from a MAC address not on the port's learn list, it will be discarded, an SNMP trap will be generated and the port(s) will be disabled. To re-enable the port, disable the Port Security function on the port. The default value for this parameter is DISCARD.

If INTRUSIONACTION is set to TRAP or DISABLE, a list of MAC addresses for devices that are active on a port, but which are not allowed or learned for the port, can be displayed using the command:

```
SHOW SWITCH PORT={port-list|ALL} INTRUSION
```

**Table 9: Example output from the SHOW SWITCH PORT INTRUSION command.**

```
Switch Port Information
--------------------------------------------------------------------------------
Port 2 -    13 intrusion(s) detected
    00-00-c0-1d-2c-f8  00-90-27-87-a5-22  00-00-cd-01-00-4a
    00-d0-b7-4d-93-c0  08-00-5a-a1-02-3f  00-d0-b7-d5-5f-a9
    00-b0-d0-20-d1-01  00-90-99-0a-00-49  00-10-83-05-72-83
    00-00-cd-00-45-9e  00-00-c0-ad-a3-d0  00-a0-24-8e-65-3c
    00-90-27-32-ad-61
--------------------------------------------------------------------------------
```

A switch port can be manually locked before it reaches the learning limit, by using the command:

```
ACTIVATE SWITCH PORT={port-list|ALL} LOCK
```

Addresses can be manually added to a port locked list up to a total of 256 MAC addresses, and the learning limit can be extended to accommodate them, by using the command:

```
ADD SWITCH FILTER ACTION={FORWARD|DISCARD} DESTADDRESS=macadd
   PORT=port [ENTRY=entry] [LEARN] [VLAN={vlanname|1..4094}]
```

Learned addresses on locked ports can be saved as part of the switch configuration, so that they will be part of the configuration after a power cycle, using the command:

```
CREATE CONFIG=filename
```

If the configuration is not saved when there is a locked list for a port, the learning process begins again after the switch is restarted.

# Virtual Local Area Networks (VLANs)

A Virtual LAN (VLAN) is a logical, software-defined subnetwork. It allows similar devices on the network to be grouped together into one broadcast domain, irrespective of their physical position in the network. Multiple VLANs can be used to group workstations, servers, and other network equipment connected to the switch, according to similar data and security requirements.

Decoupling logical broadcast domains from the physical wiring topology offers several advantages, including the ability to:

- Move devices and people with minimal, or no, reconfiguration
- Change a device's broadcast domain and access to resources without physically moving the device, by software reconfiguration or by moving its cable from one switch port to another
- Isolate parts of the network from other parts, by placing them in different VLANs
- Share servers and other network resources without losing data isolation or security
- Direct broadcast traffic to only those devices which need to receive it, to reduce traffic across the network
- Connect 802.1Q-compatible switches together through one port on each switch

Devices that are members of the same VLAN only exchange data with each other through the switch's switching capabilities. To exchange data between devices in separate VLANs, the switch's routing capabilities are used. The switch passes VLAN status information, indicating whether a VLAN is up or down, to the Internet Protocol (IP) module. IP uses this information to determine route availability.

The switch has a maximum of 255 VLANs, ranging from a VLAN identifier (VID) of 1 to 4094. When the switch is first powered up, a "default" VLAN is created and all ports are added to it. In this initial unconfigured state, the switch will broadcast all the packets it receives to the default VLAN. This VLAN has a VID of 1 and an interface name of vlan1. It cannot be deleted, and ports can only be removed from it if they also belong to at least one other VLAN. The default VLAN cannot be added to any STP, but always belongs to the default STP. If all the devices on the physical LAN are to belong to the same logical LAN, that is, the same broadcast domain, then the default settings will be acceptable, and no additional VLAN configuration is required.

## VLAN Tagging

An Ethernet packet can contain a *VLAN tag*, with fields that specify VLAN membership and user priority. The VLAN tag is described in IEEE Standard 802.3ac, and is four octets that can be inserted between the Source Address and the Type/Length fields in the Ethernet packet (Figure 13 on page 74). To accommodate the tag, Standard 802.3ac also increased the maximum allowable length for an Ethernet frame to 1522 octets (the minimum size is 64 octets). IEEE Standard 802.1Q specifies how the data in the VLAN tag is used to switch frames. VLAN-aware devices are able to add the VLAN tag to the packet header. VLAN-unaware devices cannot set or read the VLAN tag.

Table 10 on page 73 lists the meaning and use of the fields in the Ethernet frame. Figure 13 on page 74 shows the format of VLAN data in an Ethernet frame. Twelve bits of the tag are the VLAN Identifier (VID), which indicates the VLAN that the packet belongs to. Table 11 on page 74 lists the VLAN Identifier values that have specific meaning.

**Table 10: Fields in the Ethernet frame for QoS and VLAN switching.**

| Field | Length | Meaning and use |
|---|---|---|
| TPID | 2 octets | The Tag Protocol Identifier (TPID) is defined by IEEE Standard 802.1Q as 0x81-00. |
| User Priority | 3 bits | The User Priority field is the priority tag for the frame, which can be used by the switch to determine the Quality of Service to apply to the frame. The three bit binary number represents eight priority levels, 0 to 7. |
| CFI | 1 bit | The Canonical Format Indicator (CFI flag) is used to indicate whether all MAC address information that may be present in the MAC data carried by the frame is in canonical format. |
| VID | 12 bits | The VLAN Identifier (VID) field uniquely identifies the VLAN to which the frame belongs. |

**Figure 13: Format of user priority and VLAN data in an Ethernet frame.**

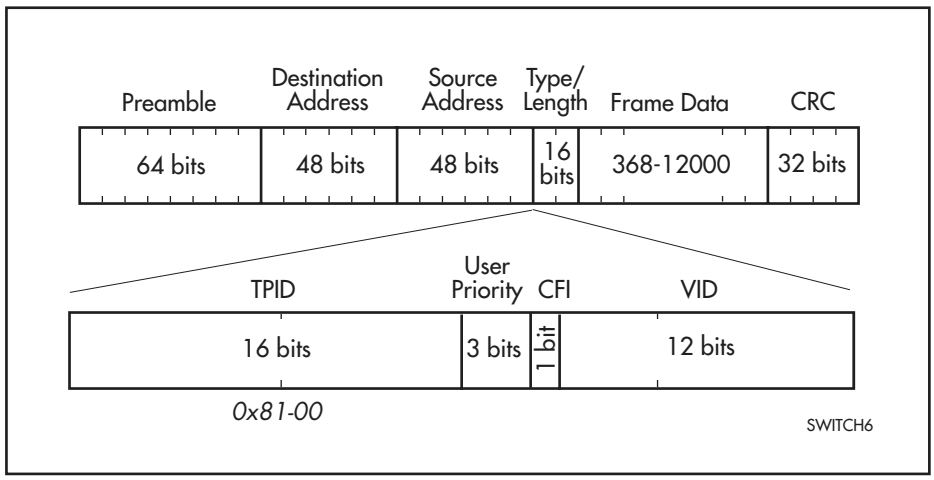



**Table 11: Reserved VID values .**

| VID value (hexadecimal) | Meaning and use of reserved VID values |
|---|---|
| 0 | The null VLAN ID. Indicates that the tag header contains only user priority information; no VLAN Identifier is present in the frame. This VID value must not be configured in any Forwarding Database entry, or used in any management operation. Frames that contain the null VLAN ID are also known as priority-tagged frames. |
| 1 | The default VID value used for classifying frames on ingress through an untagged switch port. |
| FFF | Reserved for implementation use. This VID value must not be configured in any Forwarding Database entry, used in any management operation, or transmitted in a tag header. |

Ethernet packets which contain a VLAN tag are referred to as *tagged* frames, and switch ports that transmit tagged frames are referred to as *tagged ports*. Ethernet packets which do not contain the VLAN tag are referred to as *untagged* frames, and switch ports that transmit untagged frames are referred to as *untagged ports*. VLANs can consist of simple logical groupings of untagged ports, in which the ports receive and transmit untagged packets. Alternatively, VLANs can contain only tagged ports, or a mixture of tagged and untagged ports.

The switch is VLAN aware. It can accept VLAN tagged frames, and supports the VLAN switching required by such tags. A network can contain a mixture of VLAN aware devices, for example, other 802.1Q-compatible switches, and VLAN unaware devices, for example, workstations and legacy switches that do not support VLAN tagging. The switch can be configured to send VLAN tagged or untagged frames on each port, depending on whether or not the devices connected to the port are VLAN aware. By assigning a port to two different VLANs, to one as an untagged port and to another as a tagged port, it is possible for the port to transmit both VLAN-tagged and untagged frames. A port must belong to a VLAN at all times unless the port has been set as the mirror port for the switch.

Every frame admitted by the switch has a VID associated with it. If a frame arrives on a tagged port, the associated VID is determined from the VLAN tag the frame had when it arrived. If a frame arrives on an untagged port, it is associated with the VID of the VLAN for which the incoming port is untagged. When the switch forwards a frame over a tagged port, it adds a VLAN tag to the frame. When the switch forwards the frame over an untagged port, it transmits the frame as a VLAN-untagged frame, not including the VID in the frame.

The VLAN tag that the switch adds to a frame on egress depends on whether the frame is switched in Layer 3 or Layer 2. In Layer 3 switching, the switch determines the destination VLAN from its routing tables. The VID of the destination VLAN will be added to the frame on egress. In Layer 2 switching, the frame's source and destination VLANs are the same. The VID that was associated with the frame on ingress will be associated with it on egress.

### VLAN Membership using VLAN Tags

Ports can belong to many VLANs as tagged ports. Therefore, when the VLAN tag is used to determine which VLAN a packet belongs to, it is easy to:

- Share network resources, such as servers and printers, across several VLANs
- Configure VLANs that span several switches

For tagged ports, the switch uses the VID of incoming frames, and the frame's destination field to switch traffic through a VLAN aware network. Frames are only transmitted on ports belonging to the required VLAN. Other vendors' VLAN aware devices on the network can be configured to accept traffic from one or more VLANs. A VLAN-aware server can be configured to accept traffic from many different VLANs, and then return data to each VLAN without mixing or leaking data into the wrong VLANs.

Figure 14 on page 76 shows a network configured with VLAN tagging. Table 12 on page 76 shows the VLAN membership. The server on port 2 on Switch A belongs to both the *admin* and *marketing* VLANs. The two switches are connected through uplink port 26 on Switch A and uplink port 25 on Switch B, which belong to both the *marketing* VLAN and the *training* VLAN, so devices on both VLANs can use this link.

**Figure 14: VLANs with tagged ports.**

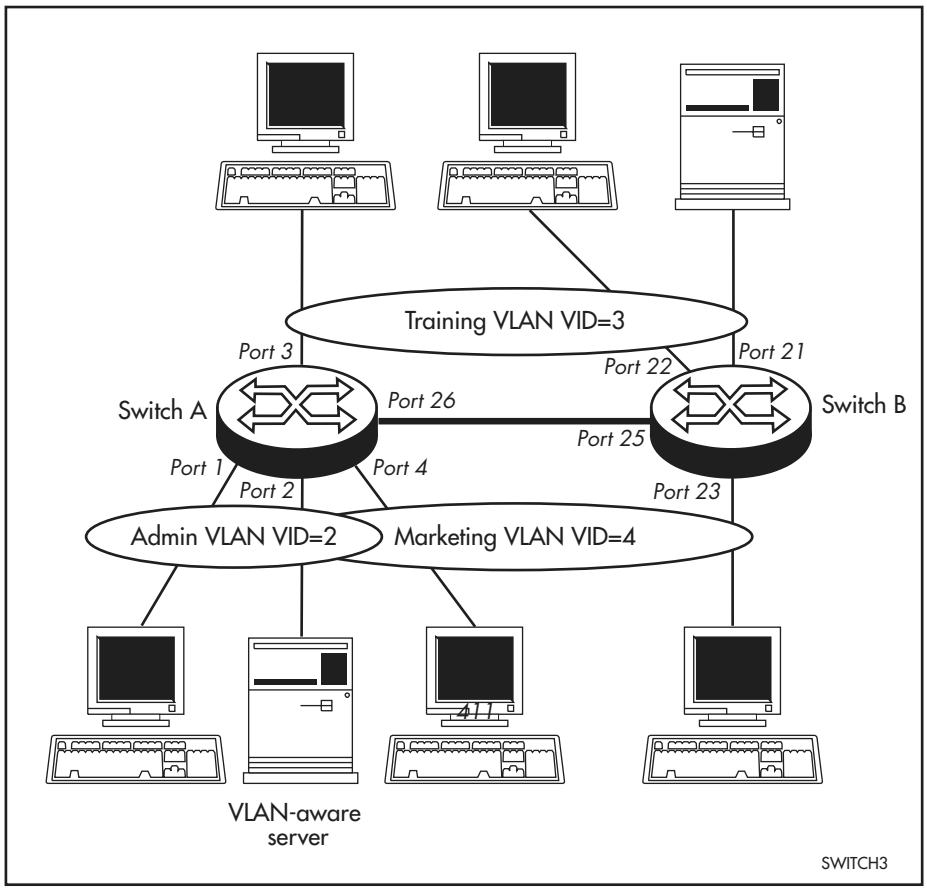



**Table 12: VLAN membership of example of a network using tagged ports.**

| VLAN | Member ports |
|---|---|
| Training | 3, 26 on Switch A<br>21, 22, 25 on Switch B |
| Marketing | 2, 4, 26 on Switch A<br>23, 25 on Switch B |
| Admin | 1, 2 on Switch A |

## VLAN Membership of Untagged Packets

A VLAN that does not send any VLAN-tagged frames is a logical grouping of ports. All untagged traffic arriving at those ports belongs to that VLAN.

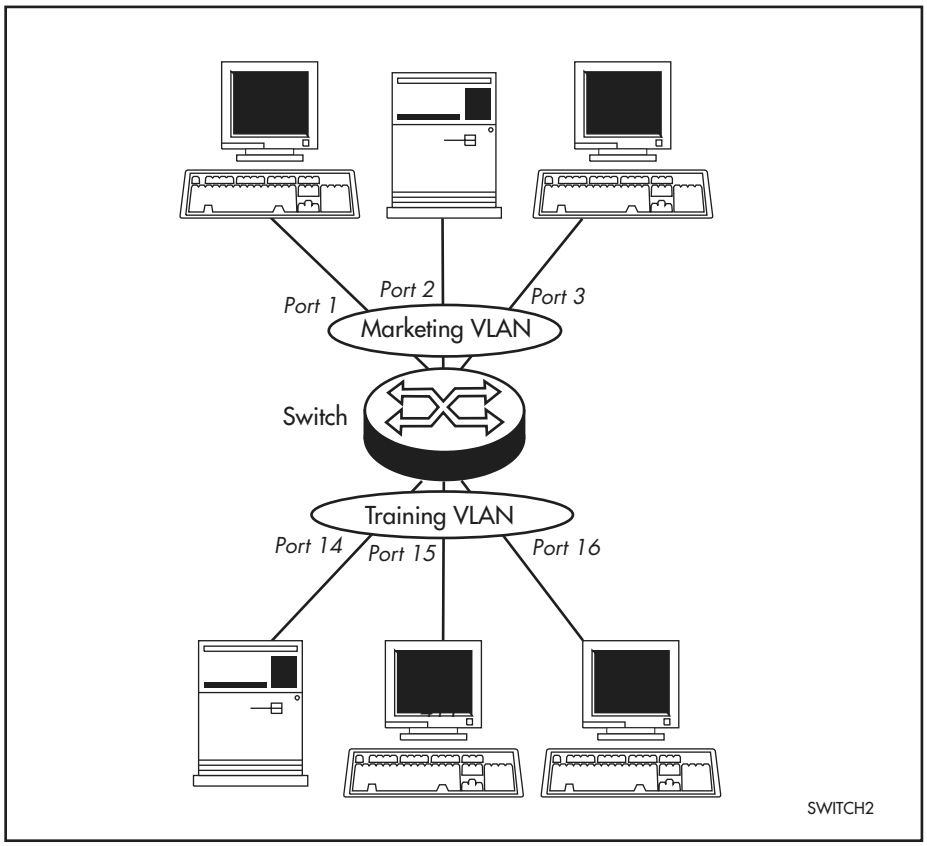
VLANs based on untagged ports are limited, because each port can only belong to one VLAN as an untagged port. Limitations include:

- It is difficult to share network resources, such as servers and printers, across several VLANs. The routing functions in the switch must be configured to interconnect using untagged ports only.
- A VLAN that spans several switches requires a port on each switch for the interconnection of the various parts of the VLAN. If there are several VLANs in the switch that span more than one switch, then many ports are occupied with connecting the VLANs, and so are unavailable for other devices.

If the network includes VLANs that do not need to share network resources or span several switches, VLAN membership can usefully be based on untagged ports. Otherwise, VLAN membership should be determined by tagging (see "*VLAN Tagging*" on page 73).

Figure 15 on page 77 shows two port-based VLANs with untagged ports belonging to them. Ports 1-3 belong to the *marketing* VLAN, and ports 14-16 belong to the *training* VLAN. The switch acts as two separate bridges: one that forwards traffic between the ports belonging to the *marketing* VLAN, and a second one that forwards traffic between the ports belonging to the *training* VLAN. Devices in the *marketing* VLAN can only communicate with devices in the *training* VLAN by using the switch's routing functions.

**Figure 15: VLANS with untagged ports.**




## Creating VLANs

To briefly summarise the process of creating a VLAN:

1. Create the VLAN.
2. Add tagged ports to the VLAN, if required.
3. Add untagged ports to the VLAN, if required.

To create a VLAN, use the command:

```
CREATE VLAN=vlan-name VID=2..4094
```

Every port must belong to a VLAN, unless it is the mirror port. By default, all ports belong to the default VLAN as untagged ports.

To add tagged ports to a VLAN, use the command:

```
ADD VLAN={vlan-name|1..4094} PORT={port-list|ALL}
    FRAME=TAGGED
```

A port can be tagged for any number of VLANs.

To add untagged ports to a VLAN, use the command:

```
ADD VLAN={vlan-name|1..4094} PORT={port-list|ALL}
    [FRAME=UNTAGGED]
```

A port can be untagged for zero or one VLAN. A port can only be added to the default VLAN as an untagged port if it is not untagged for another VLAN. A port cannot transmit both tagged and untagged frames for the same VLAN (that is, it cannot be added to a VLAN as both a tagged and an untagged port).

To remove ports from a VLAN, use the command:

```
DELETE VLAN={vlan-name|1..4094} PORT={port-list|ALL}
```

Removing an untagged port from a VLAN will return it to the default VLAN, unless it is a tagged port for another static VLAN. An untagged port can only be deleted from the default VLAN if the port is a tagged port for another static VLAN.

*Ports tagged for some VLANs and left in the default VLAN as untagged ports will transmit broadcast traffic for the default VLAN. If this is not required, the unnecessary traffic in the switch can be reduced by deleting those ports from the default VLAN.*

To change the tagging status of a port in a VLAN, use the command:

```
SET VLAN={vlan-name|1..4094} PORT={port-list|ALL}
    FRAME=TAGGED
```

To destroy a VLAN, use the command:

```
DESTROY VLAN={vlan-name|2..4094|ALL}
```

VLANs can only be destroyed if no ports belong to them.

To display the VLANs configured on the switch, use the command:

```
SHOW VLAN[={vlan-name|1..4094|ALL}]
```

Information which may be useful for trouble-shooting a network can be displayed with the VLAN debugging mode. This is disabled by default, and can be enabled for a specified time, disabled, and displayed using the commands:

```
ENABLE VLAN={vlan-name|1..4078|ALL} DEBUG={PKT|ALL}
    [OUTPUT=CONSOLE] [TIMEOUT={1..4000000000|NONE}]

DISABLE VLAN={vlan-name|1..4078|ALL} DEBUG={PKT|ALL}

SHOW VLAN DEBUG
```

To view packet reception and transmission counters for a VLAN, use the command (see the *Interfaces* chapter of the switch's Software Reference):

```
SHOW INTERFACE=VLANn COUNTER
```

## Summary of VLAN tagging rules

When designing a VLAN and adding ports to VLANs, the following rules apply.

1. Each port, except for the mirror port, must belong to at least one static VLAN. By default, a port is an untagged member of the default VLAN.
2. A port can be untagged for zero or one VLAN. A port that is untagged for a VLAN transmits frames destined for that VLAN without a VLAN tag in the Ethernet frame.
3. A port can be tagged for zero or more VLANs. A port that is tagged for a VLAN transmits frames destined for that VLAN with a VLAN tag, including the numerical VLAN Identifier of the VLAN.
4. A port cannot be untagged and tagged for the same VLAN.
5. The mirror port, if there is one, is not a member of any VLAN.

## Protected VLANs

If a VLAN is Protected, Layer 2 traffic between ports that are members of a Protected VLAN is blocked. Traffic can be Layer 3 switched to another VLAN. This feature prevents members of a Protected VLAN from communicating with each other yet still allows members to access another network. Layer 3 Routing between Ports in a Protected VLAN can be prevented by adding a Layer 3 filter. The Protected VLAN feature also allows all of the members of the Protected VLAN to be in the same subnet.

A typical application is a hotel installation where each room has a port that can be used to access the Internet. In this situation it is undesirable to allow communication between rooms.

To create a Protected VLAN, use the command:

```
CREATE VLAN=vlan-name VID=2..4094 [PROTECTED]
```

## VLAN Interaction with STPs and Trunk Groups

Each VLAN and port can only belong to one Spanning Tree entity (STP). A port cannot be added to a VLAN that is in a different STP from the VLANs to which the port already belongs, with one exception. The exception is that an untagged port in the default VLAN can be moved from the default VLAN to any other VLAN in any STP, if the port belongs only to the default VLAN as an untagged port.

All the ports in a trunk group must have the same VLAN configuration: they must belong to the same VLANs and have the same tagging status, and can only be operated on as a group.

# Generic VLAN Registration Protocol (GVRP)

The GARP application GVRP allows switches in a network to dynamically share VLAN membership information, to reduce the need for statically configuring all VLAN membership changes on all switches in a network. See the *Generic Attribute Registration Protocol (GARP)* chapter in the *Rapier Switch Software Reference*.

# Layer 2 Switching Process

The Layer 2 switching process comprises related but separate processes. The *Ingress Rules* admit or discard frames based on their VLAN tagging. The *Learning Process* learns the MAC addresses and VLAN membership of frames admitted on each port. The *Forwarding Process* determines which ports the frames are forwarded to, and the *Quality of Service* priority with which they are transmitted. Finally, the *Egress Rules* determine for each frame whether VLAN tags are included in the Ethernet frames that are transmitted. These processes assume that each station on the extended LAN has a unique data link layer address, and that all data link layer frames have a header which includes the source (sender's) MAC address and destination (recipient's) MAC address.

## The Ingress Rules

When a frame first arrives at a port, the Ingress Rules for the port check the VLAN tagging in the frame to determine whether it will be discarded or forwarded to the Learning Process.

The first check depends on whether the *Acceptable Frame Types* parameter is set to *Admit All Frames* or to *Admit Only VLAN Tagged Frames*. A port that transmits only VLAN tagged frames, regardless of which VLAN the port belongs to, will be automatically set to Admit Only VLAN Tagged Frames. The user cannot change this setting. Frames with a null numerical VLAN Identifier (VID) are VLAN-untagged frames, or frames with priority tagging only.

Every frame received by the switch must be associated with a VLAN. If a frame is admitted by the Acceptable Frame Types parameter, the second part of the Ingress Rules associates each untagged frame admitted with the VID of the VLAN for which the port is untagged.

Every port belongs to one or more VLANs, and therefore every incoming frame will have a VID to show which VLAN it belongs to. The final part of the Ingress Rules depends on whether *Ingress Filtering* is enabled for the port. If Ingress Filtering is disabled, all frames are passed on to the Learning Process, regardless of which VLAN they belong to. If Ingress Filtering is enabled, frames are admitted only if they have the VID of a VLAN to which the port belongs. If they have the VID of a VLAN to which the port does not belong, they are discarded.

The default settings for the Ingress Rules are to Admit All Frames, and for Ingress Filtering to be OFF. This means that if no VLAN configuration has been done, all incoming frames pass on to the Learning Process, regardless of whether or not they are VLAN tagged. The parameters for each port's Ingress Rules can be configured using the command:

```
SET SWITCH PORT={port-list|ALL} [ACCEPTABLE={VLAN|ALL}]
   [INFILTERING={ON|OFF}] [other-parameters...]
```

The ACCEPTABLE parameter sets the Acceptable Frame Types parameter, in the Ingress Rules, which controls reception of VLAN-tagged and VLAN-untagged frames on the port. If ALL is specified, then the Acceptable Frame Types parameter is set to Admit All Frames. If VLAN is specified, the parameter is set to Admit Only VLAN-tagged Frames, and any frame received that carries a null VLAN Identifier (VID) is discarded by the ingress rules. Untagged frames and priority-tagged frames carry a null VID. Untagged frames admitted according to the ACCEPTABLE parameter have the VID of the VLAN for which the port is untagged associated with them. The ACCEPTABLE parameter can only be set if the port is untagged for one VLAN. In this case, the default is ALL, admitting all tagged and untagged frames. If the port is tagged for all the VLANs to which it belongs, the ACCEPTABLE parameter is automatically set to VLAN, and cannot be changed to admit untagged frames.

The INFILTERING parameter enables or disables Ingress Filtering of frames admitted according to the ACCEPTABLE parameter, on the specified ports. Each port on the switch belongs to one or more VLANs. If INFILTERING is set to ON, Ingress Filtering is enabled: any frame received on a specified port is only admitted if the port belongs to the VLAN with which the frame is associated. Conversely, any frame received on the port is discarded if the port does not belong to the VLAN with which the frame is associated. Untagged frames admitted by the ACCEPTABLE parameter are admitted, since they have the numerical VLAN Identifier (VID) of the VLAN for which the port in an untagged member. If OFF is specified, Ingress Filtering is disabled, and no frames are discarded by this part of the Ingress Rules. The default setting is OFF.

To display the current Ingress Rules, use the command:

```
SHOW SWITCH PORT=port-list
```

## The Learning Process

The Learning Process uses an *adaptive learning* algorithm, sometimes called *backward learning*, to discover the location of each station on the extended LAN.

All frames admitted by the Ingress Rules on any port are passed on to the Forwarding Process if they are for destinations within the same VLAN. Frames destined for other VLANs are passed to the layer three protocol, for instance IP. For every frame admitted, the frame's source MAC address and numerical VLAN Identifier (VID) are compared with entries in the Forwarding Database for the VLAN (also known as a MAC address table, or a forwarding table) maintained by the switch. The Forwarding Database contains one entry for every unique station MAC address the switch knows in each VLAN.

If the frame's source address is not already in the Forwarding Database for the VLAN, the address is added and an ageing timer for that entry is started. If the frame's source address is already in the Forwarding Database, the ageing timer for that entry is restarted. By default, switch learning is enabled, and it can be disabled or enabled using the commands:

```
DISABLE SWITCH LEARNING

ENABLE SWITCH LEARNING
```

If the ageing timer for an entry in the Forwarding Database expires before another frame with the same source address is received, the entry is removed from the Forwarding Database. This prevents the Forwarding Database from being filled up with information about stations that are inactive or have been disconnected from the network, while ensuring that entries for active stations are kept alive in the Forwarding Database. By default, the ageing timer is enabled, and it can be disabled or enabled using the commands:

```
ENABLE SWITCH AGEINGTIMER

DISABLE SWITCH AGEINGTIMER
```

*If switch learning is disabled and the ageing timer has aged out all dynamically learned filter entries, only statically entered MAC source addresses will be used to decide which packets to forward or discard. If the switch finds no matching entries in the Forwarding Database during the Forwarding Process, then all switch ports in the VLAN will be flooded with the packet, except the port on which the packet was received.*

The default value of the ageing timer is 300 seconds (5 minutes), and this can be modified using the command:

```
SET SWITCH AGEINGTIMER=10..1000000
```

The Forwarding Database relates a station's (source) address to a port on the switch, and is used by the switch to determine from which port (if any) to transmit frames with a destination MAC address matching the entry in the station map.

To display the contents of the Forwarding Database, use the command:

```
SHOW SWITCH FDB [ADDRESS=macadd]
    [DISCARD={SOURCE|DESTINATION}] [HIT={YES|NO}]
    [L3={YES|NO}] [PORT={portlist|ALL}]
    [STATUS={STATIC|DYNAMIC}] [VLAN={vlanname|1..4094}]
```

To display general switch settings, including settings for switch learning and the switch aging timer, use the command:

```
SHOW SWITCH
```

## The Forwarding Process

The Forwarding Process forwards received frames that are to be relayed to other ports in the same VLAN, filtering out frames on the basis of information contained in the station map and on the state of the ports. If a frame is received on the port for a destination in a different VLAN, it is either Layer 3 switched if it is an IP packet, or looked up in the Layer 3 routing tables (see the *Rapier Switch Software Reference*.)

Forwarding occurs only if the port on which the frame was received is in the Spanning Tree 'Forwarding' state. The destination address is then looked up in the Forwarding Database for the VLAN. If the destination address is not found,

the switch floods the frame on all ports in the VLAN except the port on which the frame was received. If the destination address is found, the switch discards the frame if the port is not in the STP 'Forwarding' state, if the destination address is on the same port as the source address, or if there is a static filter entry for the destination address set to DISCARD ("*Layer 2 Filtering*" on page 83). Otherwise, the frame is forwarded on the indicated port.

This whole process can further be modified by the action of static switch filters. These are configurable filters which allow switched frames to be checked against a number of entries.

The Forwarding Process provides storage for queued frames to be transmitted over a particular port or ports. More than one transmission queue may be provided for a given port. Which transmission queue a frame is sent to is determined by the user priority tag in the Ethernet frame, and the Quality of Service mapping.

## Layer 2 Filtering

The switch has a Forwarding Database, entries in which determine whether frames are forwarded or discarded over each port. Entries in this Forwarding Database are created dynamically by the Learning Process. A dynamic entry is automatically deleted from the Forwarding Database when its ageing timer expires. Filtering is specified in the IEEE 802.1D Standard "*Media Access Control (MAC) Bridges*".

The user can configure static switch filter entries using the command line interface. Static switch filter entries associate a MAC address with a VLAN and a port in the VLAN. When the switch receives a frame with a destination address and VLAN Identifier that match those of a static filter entry, the frame can be either forwarded to the port specified in the static filter entry, or discarded.

The Forwarding Database supports queries by the Forwarding Process as to whether frames with given values of the destination MAC address field should be forwarded to a given port.

To add or delete static switch filter entries, use the commands:

```
ADD SWITCH FILTER DESTADDRESS=macadd ACTION={FORWARD|DISCARD}
    PORT[=port-list] [ENTRY=entry] [VLAN={vlanname|1..4094}]

DELETE SWITCH FILTER ENTRY=entry-list
```

*The switch automatically deletes static filter entries for a port if the port is deleted from the specified VLAN.*

To display current static switch filter entries, use the command:

```
SHOW SWITCH FILTER [DESTADDRESS=macadd] [ENTRY=entry]
    [PORT=port-list] [VLAN={vlanname|1..4094}]
```

**Figure 16: Example output from the SHOW SWITCH FILTER command.**

```
 Switch Filters
--------------------------------------------------------------------------
 Entry             VLAN         Destination Address   Port  Action  Source
--------------------------------------------------------------------------
    0           default (1)       aa-ab-cd-00-00-01     1  Forward  static
    1           default (1)       aa-ab-cd-00-00-02     1  Forward  static

    0           marketing (2)     aa-ab-cd-00-00-01     2  Discard  static
    1           marketing (2)     aa-ab-cd-00-00-02     2  Discard  learn
--------------------------------------------------------------------------
```

**Table 13: Parameters in the output of the SHOW SWITCH FILTER command**

| Parameter | Meaning |
|---|---|
| Entry | The number identifying the filter entry. |
| Destination Address | The destination MAC address for the entry. |
| VLAN | The VLAN name and identifier for the entry. |
| Port | The outbound port to match for the filter entry to be applied. |
| Action | The action specified by the filter entry; one of "Forward" or "Discard". |
| Source | This parameter is either "static" (indicating the filter is a static filter) or "learned" (indicating the filter is present either because it has been added with the LEARN parameter of the SET SWITCH PORT command, or has been dynamically learned during normal intrusion detection operation). |

For each VLAN, the destination MAC address of a frame to be forwarded is checked against the Forwarding Database. If there is no entry for the destination address and VLAN, the frame is transmitted on all ports in the VLAN that are in the 'Forwarding' or 'Disabled' states, except the port on which the frame was received. This process is referred to as *flooding*. If an entry is found in the Forwarding Database, but the entry is not marked as 'Forwarding' or the entry points to the same port the frame was received on, the frame is discarded. Otherwise, the frame is transmitted on the port specified by the entry in the Forwarding Database.

A dynamic entry is automatically deleted from the Forwarding Database when its ageing timer expires.

## The Egress Rules

Once the Forwarding Process has determined which ports and transmission queues to forward a frame from, the Egress Rules for each port determine whether or not the outgoing frame is VLAN-tagged with its numerical VLAN Identifier (VID). (See "*Virtual Local Area Networks (VLANs)*" on page 72).

When a port is added to a VLAN, it is configured to transmit either untagged or VLAN tagged packets, using the command:

```
ADD VLAN={vlanname|1..4094} PORT={port-list|ALL}
    [FRAME={TAGGED|UNTAGGED}]
```

This setting can be changed for a port which is already part of a VLAN, using the command:

```
SET VLAN={vlanname|1..4094} PORT={port-list|ALL}
    FRAME={UNTAGGED|TAGGED}
```

# Quality of Service

The switch hardware has a number of Quality of Service (QOS) *egress queues* that can be used to give priority to the transmission of some frames over other frames on the basis of their user priority tagging. The user priority field in an incoming frame (with value 0 to 7) determines which of the eight priority levels the frame is allocated. When a frame is forwarded, it is sent to a QOS egress queue on the port determined by the mapping of priority levels to QOS egress queues. All frames in the first QOS queue are sent before any frames in the second QOS egress queue, and so on, until frames in the last QOS egress queue, which are only sent when there are no frames waiting to be sent in any of the higher QOS egress queues.

The mapping between user priority and a QOS egress queue can be configured using the command:

```
SET SWITCH QOS=P0,P1,P2,P3,P4,P5,P6,P7
```

The switch has four QOS egress queues. It has a default mapping of priority levels to QOS egress queues as defined in *IEEE Standard 802.1Q* (Table 14).

**Table 14: Default priority level to queue mapping for four QOS egress queues**

| Priority level | QOS Egress Queue |
|---|---|
| 0 | 1 |
| 1 | 0 |
| 2 | 0 |
| 3 | 1 |
| 4 | 2 |
| 5 | 2 |
| 6 | 3 |
| 7 | 3 |

To display the mapping of user priority to QOS egress queues, use the command:

```
SHOW SWITCH QOS
```

**Figure 17: Example output from the SHOW SWITCH QOS command**

```
Priority Level       QOS egress queue
-------------------------------------
0 ................... 1
1 ................... 0
2 ................... 0
3 ................... 1
4 ................... 2
5 ................... 2
6 ................... 3
7 ................... 3
```

**Table 15: Parameters in the output of the SHOW SWITCH QOS command**

| Parameter | Meaning |
|---|---|
| Priority level | The priority level of the frame. |
| QOS egress queue | The Quality Of Service egress queue that frames with this priority level join. |

# Spanning Tree Protocol (STP)

The Spanning Tree Protocol (STP) makes it possible to automatically disable redundant paths in a network to avoid loops, and enable them when a fault in the network means they are needed to keep traffic flowing. A sequence of LANs and switches may be connected together in an arbitrary physical topology resulting in more than one path between any two switches. If a loop exists, frames transmitted onto the extended LAN would circulate around the loop indefinitely, decreasing the performance of the extended LAN. On the other hand, multiple paths through the extended LAN provide the opportunity for redundancy and backup in the event of a bridge experiencing a fatal error condition.

The spanning tree algorithm ensures that the extended LAN contains no loops and that all LANs are connected by:

- Detecting the presence of loops and automatically computing a logical loop-free portion of the topology, called a *spanning tree*. The topology is dynamically pruned to a spanning tree by declaring the ports on a switch redundant, and placing the ports into a 'Blocking' state.
- Automatically recovering from a switch failure that would partition the extended LAN by reconfiguring the spanning tree to use redundant paths, if available.

## Spanning Tree Modes

STP can run in STANDARD mode, or RAPID mode. Rapid mode allows for rapid configuration of the spanning tree. The Rapid Spanning Tree Protocol (RSTP) is specified in IEEE 802.1w.

A spanning tree running in standard mode can take up to one minute to rebuild after a topology or configuration change. The Rapid Spanning Tree algorithm provides for a more rapid recovery of connectivity following the failure of a bridge, bridge port, or a LAN.

For information about RSTP see the *Rapid Mode Spanning Tree Types* section, *Switch* chapter in the *Rapier Switch Software Reference*.

## Spanning Tree and Rapid Spanning Tree Port States

If STP is running in STANDARD mode, then each port can be in one of five Spanning Tree states, and one of two switch states. If STP is running in RAPID mode, then each port can be in one of four states. The state of a switch port is taken into account by STP. To be involved in STP negotiations, STP must be enabled on the switch, the port must be enabled on the switch, and enabled for the STP it belongs to.

The Spanning Tree states (see Table 16) affect the behaviour of ports whose switch state is enabled.

**Table 16: Spanning tree port states .**

| State | Meaning |
|---|---|
| DISABLED | STP operations are disabled on the port. The port can still switch if its switch state is enabled. |
| LISTENING | The port is enabled for receiving frames only. |
| LEARNING | The port is enabled for receiving frames only, and the Learning Process can add new source address information to the Forwarding Database. |
| FORWARDING | The normal state for a switch port. The Forwarding Process and the Spanning Tree entity are enabled for transmit and receive operations on the port. |
| BLOCKING | The Spanning Tree entity has disabled the Forwarding process for transmit and receive operations on the port, but the Spanning Tree entity itself remains enabled for transmit and receive operations on the port. |

**Table 17: Rapid Spanning Tree port states .**

| State | Meaning |
|---|---|
| DISABLED | STP operations are disabled on the port. |
| DISCARDING | The port does not participate in frame relay. The forwarding process discards received frames and does not submit forwarded frames for transmission. |
| LEARNING | The port is enabled for receiving frames only, and the Learning Process can add new source address information to the Forwarding Database. The port does not forward any frames. |
| FORWARDING | The normal state for a switch port. The Forwarding Process and the Spanning Tree entity are enabled for transmit and receive operations on the port. |

To specify whether the STP will operate in STANDARD mode or RAPID mode, use the command:

```
SET STP={stp-name|ALL} [MODE={STANDARD|RAPID}] [other
   parameters]
```

The default is STANDARD. If the mode is changed while the algorithm is running then the STP is re-initialised.

To display the STP state of the switch ports (Figure 19 on page 94), use the command:

```
SHOW STP[={stp-name|ALL}] PORT={port-list|ALL}
```

A Rapier switch in default LAN configuration has a *default* Spanning Tree enabled, spanning only a single default VLAN, to which all ports belong. The switches in the LAN run a distributed Spanning Tree Algorithm to create a single Spanning Tree. In a network of Rapier switches with VLANs configured, all VLANs belong by default to a default Spanning Tree called *default*. Multiple Spanning Trees can be created with each Spanning Tree encompassing multiple VLANs (in networks switched exclusively by Rapier switches).

For more information about multiple spanning trees, see the *Switching* chapter in the *Rapier Switch Software Reference*.

## Configuring STP

By default, the switch has one *default* STP which cannot be destroyed. In most situations this default STP will suffice.

By default, all VLANs, and therefore all ports, belong to the *default* STP. To add or delete a VLAN and all the ports belonging to it from any other STP, use the commands:

```
ADD STP=stpname VLAN={vlan-name|2..4094}

DELETE STP=stpname VLAN={vlan-name|2..4094|ALL}
```

The default STP is disabled by default at switch start up, and STPs created by a user are disabled by default when they are created. An STP must be enabled before STP can be enabled or disabled on particular ports belonging to it. To enable or disable STPs, use the commands:

```
ENABLE STP{=stpname|ALL}

DISABLE STP={stpname|ALL}
```

The Spanning Tree Protocol uses three configurable parameters for the time intervals that control the flow of STP information on which the dynamic STP topology depends: the HELLOTIME, FORWARDDELAY and MAXAGE parameters. All switches in the same spanning tree topology must use the same values for these parameters, but can themselves be configured with different, and potentially incompatible time intervals. The parameter values actually used by each switch are those sent by the root bridge, and forwarded to all other switches by the designated bridges.

The FORWARDDELAY parameter sets the time, in seconds, used to control how fast a port changes its spanning state when moving towards the Forwarding state. The value determines how long the port stays in each of the Listening and Learning states which precede the Forwarding state. This value is only used when the switch is acting as the Root Bridge. Any switch not acting as the Root Bridge uses a dynamic value for the FORWARDDELAY set

by the Root Bridge. The FORWARDDELAY, MAXAGE and HELLOTIME parameters are interrelated. See the note and formulae below. The default value for FORWARDDELAY is 15 seconds.

The HELLOTIME parameter sets the time, in seconds, between the transmission of switch spanning tree configuration information when the switch is the Root Bridge of the spanning tree or is trying to become the Root Bridge. The default value is 2 seconds.

The MAXAGE parameter sets the maximum age, in seconds, of Spanning Tree Protocol information learned over the network on any port before it is discarded. The default value is 20 seconds.

*The FORWARDDELAY, MAXAGE and HELLOTIME parameters should be set according to the following formulae, as specified in IEEE Standard 802.1D:*
*2 x (FORWARDDELAY - 1.0 seconds) >= MAXAGE*
*MAXAGE >= 2 x (HELLOTIME + 1.0 seconds)*

To modify the parameters controlling these time intervals, use the command:

```
SET STP={stp-name|ALL} [FORWARDDELAY=4..30] [HELLOTIME=1..10]
    [MAXAGE=6..40] [other parameters]
```

The value of the PRIORITY parameter is used to set the writable portion of the bridge ID, i.e. the first two octets of the (8-octet long) Bridge Identifier. The remaining 6 octets of the bridge ID are given by the MAC address of the switches. The Bridge Identifier parameter is used in all configuration Spanning Tree Protocol packets transmitted by the switch. The first two octets, specified by the PRIORITY parameter, determine the switch's priority for becoming the *root bridge* or a *designated bridge* in the network, with a lower number indicating a higher priority. In fairly simple networks, for instance those with a small number of switches in a meshed topology, it may make little difference which switch is selected to be the root bridge, and no modifications may be needed to the default PRIORITY parameter, which has a default value of 32768. In more complex networks, one or more switches are likely to be more suitable candidates for the root bridge role, for instance by virtue of being more central in the physical topology of the network. In these cases the STP PRIORITY parameters for at least one of the switches should be modified.

To change the STP priority value, use the command:

```
SET STP={stpname|ALL} PRIORITY=0..65535
```

The PRIORITY parameter sets the priority of the switch to become the Root Bridge. The lower the value of the Bridge Identifier, the higher the priority. If the PRIORITY parameter is set, either by specifying the PRIORTY or DEFAULT parameters, the specified STP is initialised. Counters for the STP are not affected. The default value for PRIORITY is 32768.

To restore STP timer and priority defaults, use the command:

```
SET STP={stpname|ALL} DEFAULT
```

Changing the STP PRIORITY using either of the previous commands initialises the STP, so that elections for the root bridge and designated bridges begin again, without resetting STP counters. To display general information about STPs on the switch, use the command:

```
SHOW STP[={stpname|ALL}] [SUMMARY]
```

**Figure 18: Example output from the SHOW STP command.**

```
 STP Information
-------------------------------------------------------------
 Name ................. grey
 Mode ................. Rapid
 RSTP Type ............ Normal
 VLAN members ......... vlan4 (4)
 Status ............... ON
 Number of Ports ...... 2
   Number Enabled ..... 2
   Number Disabled ..... 0
 Bridge Identifier ..... 32768 : 00-00-cd-05-19-28
 Bridge Priority ....... 32768
 Root Bridge ........... 32768 : 00-00-cd-05-19-28
 Designated Bridge ..... 32768 : 00-00-cd-05-19-28
 Root Port ............. (n/a)
 Root Path Cost ........ 0
 Max Age ............... 20
 Hello Time ............ 2
 Forward Delay ......... 15
 Switch Max Age ........ 20
 Switch Hello Time ..... 2
 Switch Forward Delay .. 15
 Transmission Limit .... 3

 Name ................. default
 Mode ................. Standard
 RSTP Type ............ (n/a)
 VLAN members ......... default (1)
                        vlan5 (5)
                        vlan6 (6)
                        vlan7 (7)
                        vlan8 (8)
                        vlan9 (9)
                        vlan10 (10)
                        vlan11 (11)
                        vlan12 (12)
                        vlan13 (13)
                        vlan14 (14)
 Status ............... OFF
 Number of Ports ...... 22
   Number Enabled ..... 0
   Number Disabled ..... 22
 Bridge Identifier ..... 32768 : 00-00-cd-05-19-28
 Bridge Priority ....... 32768
 Designated Root ....... 32768 : 00-00-cd-05-19-28
 Root Port ............. (n/a)
 Root Path Cost ........ 0
 Max Age ............... 20
 Hello Time ............ 2
 Forward Delay ......... 15
 Switch Max Age ........ 20
 Switch Hello Time ..... 2
 Switch Forward Delay .. 15
 Hold Time ............. 1
```

**Table 18: Parameters in the output of the SHOW STP command .**

| Parameter | Meaning |
|---|---|
| STP Name | The name of the Spanning Tree Protocol entity. |
| Mode | Whether STP is running in standard, or rapid mode. |
| RSTP Type | Whether RSTP is operating normally, or as STP compatible. In STP compatible mode, the rapid transitions to forwarding do not occur. |
| VLAN members | A list of the VLANs that are members of the STP. VLAN Identifiers are shown in brackets. |
| Status | The status of the STP; either ON or OFF. |
| Number of Ports | The number of ports belonging to the STP. |
| Number Enabled | The number of ports that have been enabled using the ENABLE STP command and are being considered by the Spanning Tree Algorithm. |
| Number Disabled | The number of ports that have been disabled using the DISABLE STP command and are not being considered by the Spanning Tree Algorithm. |
| Bridge Identifier | The unique Bridge Identifier of the switch. This parameter consists of two parts, one of which is derived from the unique Switch Address, and the other of which is the priority of the switch. |
| Bridge Priority | The settable priority component that permits the relative priority of bridges to be managed. The range of values is between 0 and 65535. A lower number indicates a higher priority. |
| Designated Root | The unique Bridge Identifier of the bridge assumed to be the root, (Standard Mode only). |
| Root Bridge | The unique Bridge Identifier of the bridge assumed to be the Root, (Rapid Mode only). |
| Designated Bridge | The unique Bridge Identifier of the bridge assumed to be the designated bridge. Displayed when STP is set to RAPID mode, (Rapid Mode only). |
| Root Port | The port number of the root port for the switch. If the switch is the Root Bridge this parameter is not valid, and (n/a) is shown. |
| Root Path Cost | The cost of the path to the Root from this switch. If the switch is the Root Bridge this parameter is not valid and is not shown. |
| Max Age | The maximum age of received Configuration Message information before it is discarded. |
| Hello Time | The time interval between successive transmissions of the Configuration Message information by a switch which is the Root or which is attempting to become the Root. |
| Forward Delay | In STP Standard mode, the time ports spend in the Listening state before moving to the Learning state and the Learning state before moving to the Forwarding state. In Rapid mode, the maximum time taken to transition from Discarding to Learning and Learning to Forwarding. In both modes, the value is also used for the ageing timer for the dynamic entries in the Forwarding Database. |

**Table 18: Parameters in the output of the SHOW STP command (Continued).**

| Parameter | Meaning |
|---|---|
| Switch Max Age | The value of the Max Age parameter when this switch is the Root or is attempting to become the Root. This parameter is set by the MAXAGE parameter in the SET STP command. |
| Switch Hello Time | The value of the Hello Time parameter when this switch is the Root or is attempting to become the Root. This parameter is set by the HELLOTIME parameter in the SET STP command. |
| Switch Forward Delay | The value of the Forward Delay parameter when this switch is the Root or is attempting to become the Root. This parameter is set by the FORWARDDELAY parameter in the SET STP command. |
| Hold Time | The minimum time in seconds between the transmission of configuration BPDUs through a given LAN Port. The value of this fixed parameter is 1, as specified in IEEE 802.1d. This parameter applies only to STP running in standard mode. |
| Transmission Limit | In Rapid mode, this indicates the number of BPDUs that may be transmitted in the interval specified by Hello Time. The value of this fixed parameter is 3, as specified in IEEE 802.1t. |

The various parameters used by the Spanning Tree Algorithm for the specified ports, or all ports within the specified STP, or all STPs, are set with the SET STP PORT command:

```
SET STP={stp-name|ALL} PORT={port-list|ALL}
```

A port can belong to a single STP. This means that if the port is member of multiple VLANs then all those VLANs must belong to the same STP.

The STP parameter specifies an STP name. If no parameter is entered, the default value is ALL.

The PORT parameter specifies a list of ports that can belong to any STP. The default value is ALL.

Each port has a port priority, with a default value of 128, used to determine which port should be the root port for the STP if two ports are connected in a loop. The lower number indicates the higher priority.

```
SET STP={stp-name|ALL} PORT={port-list|ALL}
   PORTPRIORITY=0..255 [other-parameters]
```

The PORTPRIORITY parameter sets the value of the priority field contained in the port identifier. The Spanning Tree Algorithm uses the port priority when determining the root port for each switch. The port with the lowest value is considered to have the highest priority. The default value is 128. Each STP has its own independent PORTPRIORITY parameter for each member port.

Each port also has a path cost, which is used if the port is the root port for the STP on the switch. The path cost is added to the root path cost field in configuration messages received on the port to determine the total cost of the path to the root bridge. The default PATHCOST values depend on the port speed, according to the formula:

```
PATHCOST = 1000 / Port_Speed_in_MB_per_second
```

so that a port operating at 10Mbps has a default pathcost of 100, a port operating at 100 Mbps has a default pathcost of 10, and a port operating at 1 Gbps has a default pathcost of 1. Setting the pathcost to a larger value on a particular port is likely to reduce the traffic over the LAN connected to it. This may be appropriate if the LAN has lower bandwidth, or if there are reasons for limiting the traffic across it. To modify the STP port pathcost, use the command:

```
SET STP={stp-name|ALL} PORT={port-list|ALL}
   PATHCOST=1..1000000
```

If the PATHCOST of a port has not been explicitly set by the user, or the default values have been restored to the port, then the default PATHCOST for the port will vary as the speed of the port varies.

The default value for PATHCOST is set according to the speed. For a port operating at 100 Mbps, the default value is 19. For a port operating at 10 Mbps, the default value is 100.

To restore default port pathcost and priority, use the command:

```
SET STP={stp-name|ALL} PORT={port-list|ALL} DEFAULT
```

When an STP is enabled in a looped or meshed network, it disables and enables particular ports belonging to it dynamically, to eliminate redundant links. All ports in a VLAN belong to the same STP, and their participation in STP configuration, and hence the possibility of them being elected to the STP's active topology is enabled by default. To enable or disable particular ports, use the commands:

```
ENABLE STP PORT={port-list|ALL}
```

```
DISABLE STP PORT={port-list|ALL}
```

To display STP port information, use the command:

```
SHOW STP[={stp-name|ALL}] PORT={port-list|ALL}
```

**Figure 19: Example output from the SHOW STP PORT command.**

```
STP Port Information
--------------------------------------------------------------
 STP ..................... grey
   STP Status ............ ON
   Port .................. 3
     RSTP Port Role ...... Disabled
     State ............... Discarding
     Point To Point ...... No (Auto)
     Port Priority ....... 128
     Port Identifier ..... 8003
     Pathcost ............ 200000
     Designated Root ..... 32768 : 00-00-cd-05-19-28
     Designated Cost ..... 0
     Designated Bridge ... 32768 : 00-00-cd-05-19-28
     Designated Port ..... 8003
     EdgePort ............ No
     VLAN membership ..... 1

   Port .................. 4
     RSTP Port Role ...... Disabled
     State ............... Discarding
     Point To Point ...... No (Auto)
     Port Priority ....... 128
     Port Identifier ..... 8004
     Pathcost ............ 200000
     Designated Root ..... 32768 : 00-00-cd-05-19-28
     Designated Cost ..... 0
     Designated Bridge ... 32768 : 00-00-cd-05-19-28
     Designated Port ..... 8004
     EdgePort ............ No

STP ..................... default
   STP Status ............ OFF
   Port .................. 1
     State ............... Disabled
     Port Priority ....... 128
     Port Identifier ..... 8001
     Pathcost ............ 19
     Designated Root ..... 32768 : 00-00-cd-05-19-28
     Designated Cost ..... 0
     Designated Bridge ... 32768 : 00-00-cd-05-19-28
     Designated Port ..... 8001
```

**Table 19: Parameters displayed in the output of the SHOW STP PORT command .**

| Parameter | Meaning |
|---|---|
| STP | The name of the STP that the port is a member of. |
| STP Status | Whether this STP is enabled or disabled; one of ON or OFF. |
| Port | The number of the port. |
| RSTP Port Role | The role of the port; one of Disabled, Alternate, Backup, Designated, or Root. (Rapid Mode only). |
| State | The state of the port; one of "Disabled", "Blocking", "Listening", "Learning" or "Forwarding" for Standard mode, and one of; "Disabled", "Discarding", "Learning", or "Forwarding" for Rapid mode. |
| Point To Point | Whether the port has a point to point connection with another bridge; one of NO or YES. (Rapid Mode only). |
| Port Priority | The priority of the port. Used as part of the Port Identifier field. In Standard mode it forms the upper 8 bits of the Port Identifier field. In Rapid mode it forms the upper 4 bits of the Port Identifier field. |
| Port Identifier | The unique identifier of the port. This parameter is used to determine the root port or designated port of the switch. |
| Pathcost | The path cost of the port. |
| Designated Root | The unique Bridge Identifier of the Root Bridge, as recorded in the configuration BPDU. |
| Designated Cost | The Designated Cost for the port. |
| Designated Bridge | Either the unique Bridge Identifier of the switch, or the unique Bridge Identifier of the switch believed to be the Designated Bridge for the LAN to which the port is attached. |
| Designated Port | The Port Identifier of the port on the Designated Bridge through which the Designated Bridge transmits Configuration BPDU information stored by this port. |
| Edge Port | An edge port is a port that attaches to a LAN that is known to have no other bridges attached; one of YES, or NO. |

The spanning tree algorithm can be recalculated at any time, and all timers and counters be initialised, using the command:

```
RESET STP={stpname|ALL}
```

To show STP counters, use the command:

```
SHOW STP[={stpname|ALL}] COUNTER
```

**Figure 20: Example output from the SHOW STP COUNTER command**

```
STP Counters
-------------------------------------------------------------
STP Name: default
  Receive:                      Transmit:
  Total STP Packets      0     Total STP Packets          1677
  Configuration BPDU     0      Configuration BPDU         0
  TCN BPDU               0      TCN BPDU                  0
  RST BPDU               0     RSTP BPDU                 1677
  Invalid BPDU           0

 Discarded:
  Port Disabled          0
  Invalid Protocol       0
  Invalid Type           0
  Invalid Message Age    0
  Config BPDU length     0
  TCN BPDU length        0
  RST BPDU length        0
-------------------------------------------------------------
```

**Table 20: Parameters in the output of the SHOW STP COUNTER command .**

| Parameter | Meaning |
|---|---|
| STP Name | The name of the STP. |
| **Receive** | STP packets received. |
| Total STP Packets | The total number of STP packets received. Valid STP packets comprise Configuration BPDUs and Topology Change Notification (TCN) BPDUs. |
| Configuration BPDU | The number of valid Configuration BPDUs received. |
| TCN BPDU | The number of valid Topology Change Notification BPDUs received. |
| RST BPDU | The number of valid Rapid Spanning Tree BPDUs received (RAPID mode only). |
| Invalid BPDU | The number of invalid STP packets received. |
| **Transmit** | STP packets transmitted. |
| Total STP packets | The total number of STP packets transmitted. |
| Configuration BPDU | The number of Configuration BPDUs transmitted. |
| TCN BPDU | The number of Topology Change Notification BPDUs transmitted. |
| RST BPDU | The number of valid Rapid Spanning Tree BPDUs transmitted (RAPID mode only). |
| **Discarded** | STP packets discarded. |
| Port Disabled | The number of BPDUs discarded because the port that the BPDU was received on was disabled. |
| Invalid Protocol | The number of STP packets that had an invalid Protocol Identifier field or invalid Protocol Version Identifier field. |
| Invalid Type | The number of STP packets that had an invalid Type field. |
| Invalid Message Age | The number of STP packets that had an invalid message age. |

**Table 20: Parameters in the output of the SHOW STP COUNTER command**

| Parameter | Meaning |
|---|---|
| Config BPDU length | The number of Configuration BPDUs that had an incorrect length. |
| TCN BPDU length | The number of Topology Change Notification BPDUs that had an incorrect length. |
| RST BPDU length | The number of Rapid Spanning Tree BPDUs that had an incorrect length (RAPID mode only). |

If necessary, all the STP configuration that users have created on the switch can be removed, so that all STPs except the default STP are destroyed, and all other defaults are restored, using the command:

```
PURGE STP
```

***The PURGE STP command should be used with caution, and generally only before major reconfiguration of the switch, as it removes all STP configuration entered on the switch.***

# Interfaces to Layer 3 Protocols

Interfaces can be configured to VLANs for IP, IPX and Appletalk routing protocols in the same way that other interfaces are created for other interface types. Concatenate VLAN with the VID of the VLAN giving VLAN*n*, for instance:

```
INTERFACE=VLAN3
```

# IGMP Snooping

IGMP (*Internet Group Management Protocol*) is used by IP hosts to report their multicast group memberships to routers and switches. IP hosts join a multicast group to receive broadcast messages directed to the multicast group address. IGMP is an IP-based protocol and uses IP addresses to identify both the multicast groups and the host members. For a VLAN-aware devices, this means multicast group membership is on a per-VLAN basis. If at least one port in the VLAN is a member of a multicast group, by default multicast packets will be flooded onto all ports in the VLAN.

*IGMP snooping* enables the switch to forward multicast traffic intelligently on the switch. The switch listens to IGMP membership reports, queries and leave messages to identify the switch ports that are members of multicast groups. Multicast traffic will only be forwarded to ports identified as members of the specific multicast group.

IGMP snooping is performed at Layer 2 on VLAN interfaces automatically. By default, the switch will only forward traffic out those ports with multicast listeners, therefore it will not act as a simple hub and flood all multicast traffic

out all ports. IGMP snooping is independent of the IGMP and Layer 3 configuration, so an IP interface does not have to be attached to the VLAN, and IGMP does not have to be enabled or configured.

IGMP snooping is enabled by default. To disable it, use the command:

```
DISABLE IGMPSNOOPING
```

Disabling IGMP snooping may be useful if filters are used extensively, because IGMP snooping uses a Layer 3 filter. When IGMP snooping is disabled, this filter becomes available. See "*Hardware Packet Filters*" in the *Switching* chapter of your Software Reference for information about filters. Note that multicast packets will flood the VLAN when IGMP snooping is disabled.

IGMP is used in conjunction with limited static multicast settings, or with DVMRP or PIM Sparse Mode for full multicast support (*IP Multicasting* chapter in the *Rapier Switch Software Reference*).

IGMP is enabled and disabled using the commands:

```
ENABLE IP IGMP
```

```
DISABLE IP IGMP
```

IGMP snooping is then enabled or disabled on a VLAN using the commands:

```
ENABLE IP IGMP INTERFACE=interface [DLC=1..1024]
```

```
DISABLE IP IGMP INTERFACE=interface [DLC=1..1024]
```

The switch will snoop IGMP packets transiting the VLAN and only forward multicast packets to the ports which have seen a membership report from network devices connected to those ports, instead of being forwarded to all ports belonging to the VLAN.

The command:

```
SET IP IGMP TIMEOUT=1..65535 QUERYINTERVAL=1..65535
```

sets operational parameters for IGMP. The QUERYINTERVAL parameter specifies the time interval, in seconds, at which IGMP Host Membership Queries are sent if this switch is elected the designated router for the LAN. The default is 125.

The TIMEOUT parameter specifies the longest interval, in seconds, that a group will remain in the local group database without receiving a Host Membership Report. The default is 270. If a value is specified for QUERYINTERVAL without specifying a value for TIMEOUT, TIMEOUT is calculated as 2*(QUERYINTERVAL + 10). The 10 seconds is the variation that hosts use when sending Host Membership Reports. If a timeout interval is specified, it will override any calculated value.

The command:

```
SHOW IP IGMP [COUNTER] [INTERFACE=interface]
```

displays information about IGMP, IGMP snooping, and multicast group membership for each VLAN-based IP interface (Figure 21, Table 21 on page 99).

**Figure 21: Example output from the SHOW IP IGMP command.**

```
IGMP Protocol
--------------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 270 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)

Interface Name .......... vlan1               (DR)
Other Querier timeout ... 164 secs
IGMP Proxy .............. Upstream
Group List ..............

  Group. 224.0.1.22         Last Adv. 10.194.254.254     Refresh time 184 secs
  Ports  24

  All Groups                Last Adv. 10.116.2.1         Refresh time 254 secs
  Ports  24
```

**Table 21: Parameters in the output of the SHOW IP IGMP command .**

| Parameter | Meaning |
|---|---|
| Status | The status of IGMP; one of “Enabled” or “Disabled”. |
| Default Query Interval | The default interval at which Host Membership Queries are sent. |
| Default Timeout Interval | The default interval after which entries will be removed from the group database, if no Host Membership Report is received. |
| Last Member Query Interval | Max Response Time inserted into Group-Specific Queries sent in response to Leave Group messages, and is also the amount of time between Group-Specific Query messages. |
| Last Member Query Count | The number of Group-Specific Queries sent before the switch assumes there are no local members. |
| Robustness Variable | IGMP is robust to (Robustness Variable-1) packet losses. |
| Query Response Interval | The Max Response Time (in 1/10 secs) inserted into the periodic General Queries. |
| Interface Name | The name of an interface configured for IGMP. |
| Other Querier timeout | The length of time that remains before a multicast router decides that there is no longer another multicast router which should be the querier. |
| IGMP Proxy | The status of IGMP Proxy; one of “Off”, “Upstream” or “Downstream”. |
| **Group List** | A list of multicast group memberships for this interface. |
| Group | The group multicast address. |
| Last Adv. | The last host to advertise the membership report. |
| Refresh time | The time interval (in seconds) until the membership group will be deleted if it does not receive another membership report before then. |
| Ports | The list of ports listening to this group. |

# Triggers

The Trigger Facility can be used to automatically run specified command scripts when particular triggers are activated. When a trigger is activated by an event, global parameters and parameters specific to the event are passed to the script that is run. For a full description of the Trigger Facility, see the *Trigger Facility* chapter in the *Rapier Switch Software Reference*.

The switch can generate triggers to activate scripts when a fibre uplink port loses or gains coherent light. To create or modify a switch trigger, use the commands:

```
CREATE TRIGGER=trigger-id MODULE=SWITCH
    EVENT={LIGHTOFF|LIGHTON} PORT=port [AFTER=hh:mm]
    [BEFORE=hh:mm] [DATE=date|DAYS=day-list] [NAME=name]
    [REPEAT={YES|NO|ONCE|FOREVER|count}] [SCRIPT=filename...]
    [STATE={ENABLED|DISABLED}] [TEST={YES|NO|ON|OFF}]

SET TRIGGER=trigger-id PORTS={port-list|ALL} [AFTER=hh:mm]
    [BEFORE=hh:mm] [DATE=date|DAYS=day-list] [NAME=name]
    [REPEAT={YES|NO|ONCE|FOREVER|count}]
    [TEST={YES|NO|ON|OFF}]
```

The following sections list the events that may be specified for the EVENT parameter, the parameters that may be specified as *module-specific-parameters*, and the arguments passed to the script activated by the trigger.

**Event** LINKDOWN

**Description** The port link specified by the PORT parameter has just gone down.

**Parameters** The following command parameter(s) must be specified in the CREATE/SET TRIGGER commands:

| Parameter | Description |
|---|---|
| PORT=*port* | The port on which the event will activate the trigger. |

**Script Parameters** The trigger passes the following parameter(s) to the script:

| Argument | Description |
|---|---|
| %1 | The port number of the port which has just gone down. |

**Event** LINKUP

**Description** The port link specified by the PORT parameter has just come up.

**Parameters** The following command parameter(s) must be specified in the CREATE/SET TRIGGER commands:

| Parameter | Description |
|---|---|
| PORT=*port* | The port on which the event will activate the trigger. |

**Script Parameters** The trigger passes the following parameter(s) to the script:

| Argument | Description |
|---|---|
| %1 | The port number of the port which has just come up. |

Chapter 6

# Layer 3

The AT-8800 Series Switch routes IP and IP multicasting traffic at wire speed between VLANs, and supports a number of other Layer 3 protocols. Once a VLAN has been created (see "*Virtual Local Area Networks (VLANs)*" on page 72), the VLAN name can be used wherever a logical interface is required in commands for configuring routing protocols.

VLAN names are of the form:

```
VLAN-vlanname
```

or

```
VLANn
```

where *vlanname* is the manager-assigned name of the VLAN, and *n* is the VLAN identifier (VID).

For example, to create a VLAN called "admin" with a VID of 11, and add port 3 to it, use the commands:

```
CREATE VLAN=admin VID=11

ADD VLAN=11 PORT=3
```

The following names can be used to identify this VLAN in routing commands:

```
vlan-admin

vlan11
```

The following sections illustrate the use of VLANs for IP, RIP, IPX, AppleTalk and RSVP. For a complete description of all the protocols supported by the switch, see the *Rapier Switch Software Reference*.

# Internet Protocol (IP)

The switch performs IP routing at wire speed between VLANs that have been configured as IP interfaces. For example, to add the admin VLAN as an IP interface, giving it an IP address of 192.168.163.39 in the subnet 192.168.163.0, first enable IP using the command:

```
ENABLE IP
```

Then use either of the following commands:

```
ADD IP INTERFACE=vlan-admin IPADDRESS=192.168.163.39
   MASK=255.255.255.0

ADD IP INTERFACE=vlan11 IPADDRESS=192.168.163.39
   MASK=255.255.255.0
```

The command:

```
SHOW IP INTERFACE
```

displays the interfaces enabled for IP routing (Figure 22).

**Figure 22: Example output from the SHOW IP INTERFACE command.**

```
Interface     Type     IP Address       Bc Fr PArp  Filt RIP Met.   SAMode  IPSc
Pri. Filt     Pol.Filt Network Mask     MTU   VJC   GRE  OSPF Met.  DBcast  Mul.
-------------------------------------------------------------------------------
LOCAL         -        Not Set          -  n  -     ---  -          -       --
---           ----     -                -     -     ---  -          -       ---
vlan11        Static   192.168.163.39   1  y  On    ---  01         Pass    --
---           ---      255.255.255.0    1500  -     ---  0000000001 No      On
ppp1          Dynamic  0.0.0.0          1  y  -     ---  01         Pass    --
---           ---      255.255.255.255  1500  Off   ---  0000000001 No      On
-------------------------------------------------------------------------------
```

# IP Multicasting

Static multicast forwarding can be configured using the ADD IP INTERFACE or SET IP INTERFACE commands.

The switch supports dynamic IP multicast routing protocols:

- DVMRP (Distance Vector Multicast Routing Protocol)
- PIM-DM (Protocol Independent Multicast – Dense Mode)
- PIM-SM (Protocol Independent Multicast – Sparse Mode).

Management of group members is performed using IGMP (Internet Group Management Protocol). IGMP snooping reduces unnecessary multicast traffic between members of the same VLAN.

Full multicast functionality requires IGMP and at least one of DVMRP, PIM Dense Mode or PIM Sparse Mode. See the *IP Multicasting* chapter in the *Rapier Switch Software Reference* for detailed information about multicasting.

# Routing Information Protocol (RIP)

Routing protocols such as RIPv1 and RIPv2 can be enabled on a VLAN. For example, to enable RIPv2 on the admin VLAN, use the command:

```
ADD IP RIP INTERFACE=vlan11 SEND=RIP2 RECEIVE=BOTH
```

To display information about RIP (Figure 23 on page 103), use the command:

```
SHOW IP RIP
```

**Figure 23: Example output from the SHOW IP RIP command.**

```
Interface  Circuit/DLCI    IP Address     Send  Receive  Demand  Auth  Password
-------------------------------------------------------------------------------
vlan11     -               -              RIP2  BOTH     NO      NO
ppp0       -               172.16.249.34  RIP1  RIP2     YES     PASS  ********
-------------------------------------------------------------------------------
```

# Novell IPX

The switch's implementation of the Novell IPX protocol uses the term *circuit* to refer to a logical connection over an *interface*, similar to an X.25 permanent virtual circuit (PVC) or a Frame Relay Data Link Connection (DLC). The term *interface* is used to refer to the underlying physical interface, such as VLAN, Ethernet, Point-to-Point (PPP) and Frame Relay.

To create IPX circuit 1 with the Novell network number 129 over the admin VLAN, use the command:

```
ADD IPX CIRC=1 INTERFACE=vlan11 NETWORK=129 ENCAP=802.3
```

To display information about the circuits configured for IPX (Figure 24), use the command:

```
SHOW IPX CIRCUIT
```

**Figure 24: Example output from the SHOW IPX CIRCUIT command.**

```
IPX CIRCUIT information

Name ........................ Circuit 1
Status ...................... enabled
Interface ................... vlan11   (802.3)
Network number .............. c0e7230f
Station number .............. 0000cd000d26
Link state .................. up
Cost in Novell ticks ......... 1
Type20 packets allowed ....... no
On demand ................... no

Spoofing information
Keep alive spoofing ......... no
SPX watch dog spoofing ....... no
On SPX connection failure .... UPLINK
On end of SPX spoofing ....... UPLINK

RIP broadcast information
Change broadcasts ............ yes
General broadcasts ........... yes
General broadcast interval ... 60 seconds
Maximum age .................. 180 seconds

SAP broadcast information
Change broadcasts ............ yes
General broadcasts ........... yes
General broadcast interval ... 60 seconds
Maximum age .................. 180 seconds

Filter information
Filters ..................... none
```

# AppleTalk

To create an AppleTalk port (interface) associated with the admin VLAN, use the command:

```
ADD APPLE PORT INTERFACE=vlan11
```

To display information about the ports configured for AppleTalk (Figure 25 on page 105), use the command:

```
SHOW APPLE PORT
```

**Figure 25: Example output from the SHOW APPLE PORT command.**

```
Appletalk Port Details
----------------------------------
  Port Number ............. 1
  Interface ............... vlan11
  ifIndex ................. 1
  Node ID ................. 217
  Network Number ........... 22
  Network Range Start ...... 22
  Network Range End ........ 22
  State .................... ACTIVE
  Seed ..................... NO
  Seed Network Start ....... 0
  Seed Network End ......... 0
  Hint ..................... YES
  Hint Node ID ............. 179
  Hint Network ............. 22
  Default Zone ............. -

  Zone List is Empty
----------------------------------
```

# Resource Reservation Protocol (RSVP)

The Resource Reservation Protocol (RSVP) enables the receiver of a traffic flow to make the resource reservations necessary to ensure that the receiver obtains the desired QoS for the traffic flow.

RSVP is disabled by default. To enable RSVP, use the command:

```
ENABLE RSVP
```

Each IP interface that is to receive and process RSVP messages and accept reservation requests must be enabled. To enable RSVP on the admin VLAN, use the command:

```
ENABLE RSVP INTERFACE=vlan11
```

To display information about the interfaces enabled for RSVP (Figure 26), use the command:

```
SHOW RSVP INTERFACE
```

**Figure 26: Example output from the SHOW RSVP INTERFACE command.**

```
RSVP Interfaces
                    Maximum       Reserved       No. Of
Interface  Enabled  Bandwidth(%)  Bandwidth(%)   Reservations  Debug     Encap
-------------------------------------------------------------------------------
Dynamic      No        75             0              0         None      RAW
vlan11       Yes       75             0              1         None      RAW
ppp0         Yes       75             0              0         None      RAW
-------------------------------------------------------------------------------
```

Chapter 7

# Maintenance and Troubleshooting

## This Chapter

If you are familiar with networking and switch operations, you may be able to diagnose and solve some problems yourself.

This chapter gives tips on how to:

- start your switch (see "*How the Switch Starts Up*" on page 108).
- avoid problems (see "*How to Avoid Problems*" on page 109).
- reconfigure your switch if you accidentally clear the FLASH memory (see "*What to Do if You Clear FLASH Memory Completely*" on page 111).
- troubleshoot a PPP link that disconnects (see "*What to Do if the PPP Link Disconnects Regularly*" on page 112).
- reset passwords if they are lost (see "*What to Do if Passwords are Lost*" on page 112).
- gather information from your switch that support personnel need to provide accurate support tailored to your situation (see *"Getting the Most Out of Technical Support*" on page 112).
- restart the switch at any time with no configuration (see "*Resetting Switch Defaults*" on page 113).
- check whether there is a connection between the switch and another routing interface in the network (see "*Checking Connections Using PING*" on page 113).
- troubleshoot if no routes exists to the remote switch (see "*Troubleshooting IP Configurations*" on page 114 and "*Troubleshooting IPX Configurations*" on page 116).
- troubleshoot problems with DHCP IP addresses if the switch is acting as a client or as a server (see "*Troubleshooting DHCP IP Addresses*" on page 115)
- examine the route that packets pass between two systems running the IP protocol (see "*Using Trace Route for IP Traffic*" on page 117).

Information gained from the LEDs on the front panel of the switch is described in the *AT-8800 Series Switch Hardware Reference*.

# How the Switch Starts Up

The sequence of operations that the switch performs when it boots are:

1. Perform startup self tests.
2. Perform the install override option.
3. Load the FLASH boot release as the INSTALL boot.
4. Inspect and check INSTALL information.
5. Load the required release as the main boot.
6. Start the switch.
7. Execute the boot script, if one has been configured.

If a terminal is connected to *asyn0*, a series of status and progress messages similar to those shown in Figure 27 on page 108 are displayed during the startup process.

**Figure 27: switch startup messages.**

```
INFO: Self tests beginning.
INFO: RAM test beginning.
PASS: RAM test, 4096k bytes found.
INFO: BBR tests beginning.
PASS: BBR test, 128k bytes found.
PASS: BBR test. Battery OK.
INFO: Self tests complete
INFO: Downloading router software.
Force EPROM download (Y) ?
INFO: Initial download succeeded
INFO: Executing configuration script <boot.cfg>
INFO: Router startup complete

Manager >
```

The startup self tests check the basic operation of the switch. If your switch passes these tests the switch should be able to at least proceed far enough to perform the load of the FLASH boot release and to start operating.

The install override option is designed to allow a mandatory switch boot from the FLASH boot release. The message:

```
Force EPROM download (Y)?
```

is displayed on the terminal connected to *asyn0* and the switch pauses. If you do not press a key within a few seconds, the startup process will continue and all steps in the sequence are executed. If the [Y], [S], [N] or [Ctrl/D] key on the terminal are pressed immediately after the message is displayed, you can alter the switch startup process (Table 22 on page 109).

**Table 22: Switch startup sequence keystrokes.**

| Pressing key... | Forces the switch to... |
|---|---|
| Y | Load the FLASH boot release, with no patch, and skip straight to step 6. |
| S | Start with the default configuration. Any boot script or NVS configuration is ignored. |
| N | Configure from NVS, ignoring any boot script. |
| [Ctrl/D] | Enter diagnostics mode. |

When you start the switch the FLASH boot release is always loaded first. The FLASH boot release contains all the code required to obtain and check the INSTALL information. This first boot is known as the INSTALL boot. The INSTALL information is inspected and the switch is setup to perform another load. Even if the actual release required is the FLASH boot release, another load is always performed. At this point, if a patch load is required, it is also performed.

The switch startup occurs immediately after the install override option, or after the INSTALL information check. The INSTALL information check performs a full startup of switch software and initiates the normal operation of the switch.

Finally, if there is a defined boot script, this script is executed.

# How to Avoid Problems

If you perform the following procedures you may help reduce the likelihood and impact of some future switch events.

## Set system territory

Set the system territory to the country or region in which the switch is connected to the network. Some protocols are implemented in differently in some countries. To ensure that the switch uses variants that will work in the country your switch is routing in, enter the command:

```
SET SYSTEM TERRITORY={AUSTRALIA|CHINA|EUROPE|JAPAN|KOREA|
    NEWZEALAND|USA}
```

## Backup software files

Store a backup of the current switch software. If the switch software is accidentally cleared from the router's FLASH memory, you will need to reload the software release and patch files. If your access to the Internet is via the switch, then you will need the files on your LAN. You may wish to keep a copy of the current software and patch files on a TFTP server on your network. You can download switch software from the support site at *http://www.alliedtelesyn.co.nz/support/ar400*.

## Backup configuration script

Store a backup of the latest configuration script, in case the configuration file on the switch is accidentally deleted or damaged.

## Backup switch

If your network has many switches, you may wish to keep a backup switch ready to replace any switch that malfunctions. When you upgrade the software release or patch on the other switches in the network, upgrade the backup too. Store on it one current config script for each switch in your network, so that when it is needed, you need only set the configuration file with which it boots to match the switch it replaces.

## Configure logging

The logging facility stores log messages for events with a specified severity in a log file. You can change the size of the log file, and the kind of messages recorded. You can configure the switch to output log messages in several ways, including to a remote switch with a specified IP address, or as an email to a particular email address. The switch can also receive log messages from another switch. Set the Logging Facility to log and forward the log messages you need to monitor your network (see the *Logging Facility* chapter in the *AT-8800 Series Switch Software Reference*). Inspect the log file from time to time, and if difficulties arise.

## Configure Firewall

*The firewall facility is enabled with a special feature license. To obtain a special feature license contact an Allied Telesyn authorised distributor or reseller.*

Use the Firewall to protect your network from several kinds of unwanted traffic or deliberate attacks (see the *Firewall* chapter in the *AT-8800 Series Switch Software Reference*. A special feature licence is required.

## FLASH compaction

If the FLASH memory gets filled beyond a certain level, it will automatically activate FLASH compaction to recover any space that is made available from deleted files. You can also activate FLASH compaction manually if required.

***While FLASH is compacting, do not restart the switch or use any commands that affect the FLASH file subsystem. Do not restart the switch, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files. Damaged files are likely to prevent the switch from operating correctly.***

## Watch for software updates

From time to time patches may be released to improve the function of your switch software, and new software releases make new features available. Watch for patches and new software releases on the support site at http://www.alliedtelesyn.co.nz/support/ar400.

# What to Do if You Clear FLASH Memory Completely

***DO NOT clear the FLASH memory completely. The software release files are stored in FLASH, and clearing it would leave no software to run the switch.***

**If you accidentally do this, you will need to:**

1. **Boot with default configuration.**

   Reboot the switch from a terminal connected the asynchronous terminal port (not Telnet). Use the install override to run the default configuration (see "*How the Switch Starts Up*" on page 108).

2. **Log in.**

   Log in to the switch using the default password *friend* for the *manager* account.

3. **Put current software release on server.**

   Make sure you have the current software release and patch files on a server connected to the switch by the switch port or Ethernet port. Current software release and patch files are downloaded from the support site at http://www.alliedtelesyn.co.nz/support/ar400.

4. **Assign an IP address.**

   Assign an IP address to the switch interface over which the software files are downloaded (see "*Assigning an IP Address*" on page 15).

5. **Load software files onto switch.**

   Load the required software and patch onto the switch (see "*Loading and Uploading Files*" on page 52).

6. **Set the install information.**

   Set the switch to use the software installed (see "*Upgrading Switch Software*" on page 56).

7. **Reconfigure the switch.**

   If you have a copy of the recent configuration file stored on your network, you can download this onto the switch too. Otherwise you will need to re-enter all configuration.

***While FLASH is compacting, do not restart the switch or use any commands that affect the FLASH file subsystem. Do not restart the switch, or create, edit, load, rename or delete any files until a message confirms that FLASH file compaction is completed. Interrupting flash compaction may result in damage to files. Damaged files are likely to prevent the switch from operating correctly.***

If you accidentally restart the switch, or use any commands that affect the FLASH file subsystem, contact your authorised distributor or reseller. You may have to return the switch to the factory.

# What to Do if the PPP Link Disconnects Regularly

If the device at the other end of the PPP link is not an ATR router or switch but is supplied by another vendor turn LQR (Link Quality Reporting) off on PPP links (LQR=OFF) and instead use LCP Echo Request and Echo Reply messages to determine link quality (ECHO=ON). Enter the command:

```
SET PPP=ppp-interface ECHO=ON LQR=OFF
```

# What to Do if Passwords are Lost

If a user forgets their password, to reset the password from an account with MANAGER privilege, enter the command:

```
SET USER=login-name PASSWORD=password
```

You can reset passwords for accounts with MANAGER privilege with the same command, provided the manager can login to at least one account with MANAGER privilege.

If you require further assistance contact your authorised distributor or reseller.

# Getting the Most Out of Technical Support

For online support for your switch, see our on-line support page at http://www.alliedtelesyn.co.nz/support/ar400.

If you require further assistance, contact your authorised distributor or reseller. Gather as much of the following information from your switch and network as you can. This gives the support personnel as much information as possible to diagnose and solve your problem. They may ask you to send the information to them by email.

Gather this information:

- Your name, organisation and contact details.
- What is the make and model of your switch? Enter the command:

  ```
  SHOW SYSTEM
  ```

- Which software release and patch files is your switch running? For example, `86-261.rez`, `86261-01.paz`. Enter the command:

  ```
  SHOW INSTALL
  ```

- What software configuration is currently running? Enter the command:

  ```
  SHOW CONF DYN
  ```

- How is the switch connected to your network? A diagram showing the physical configuration of the network your switch is operating in may be useful.

- To get debugging output, enter the command:

```
SHOW DEBUG
```

- Depending on the problem, the support personnel may also ask you for the output from the following commands (see the *Monitoring and Fault Diagnosis* section in the *Operations* chapter, *AT-8800 Series Switch Software Reference*):

```
SHOW EXCEPTION
SHOW STARTUP
SHOW LOG
SHOW CPU
SHOW BUFFER
```

# Resetting Switch Defaults

To restart the switch at any time with no configuration, enter the command:

```
RESTART SWITCH CONFIG=NONE
```

If `boot.cfg` has changed, to set it back to the default configuration by saving the default dynamic configuration to the `boot.cfg` file, enter the command:

```
CREATE CONFIG=boot.cfg
```

To set the switch to restart with the boot configuration file, enter the command:

```
SET CONFIG=boot.cfg
```

***DO NOT clear the FLASH memory completely. The software release files are stored in FLASH, and clearing it would leave no software to run the switch.***

# Checking Connections Using PING

If an aspect of the router's configuration dependent on access to a server functions incorrectly, PINGing the server from the switch, and the switch from the server, is a useful first step in diagnosis.

You can use PING (Packet Internet Groper) to check whether there is a connection between the switch and another routing interface in the network. Use the router's extended PING command over IPv4, IPv6, IPX and AppleTalk network protocols. PING sends echo request packets in the chosen format, and displays responses at the terminal. Enter the command:

```
PING [{[IPADDRESS=]ipadd|[IPXADDRESS=]network:station|
    [APPLEADDRESS=]network.node}] [LENGTH=number]
    [NUMBER={number|CONTINUOUS}] [PATTERN=hexnum]
    [{SIPADDRESS=ipadd|SIPXADDRESS=network:station|
    SAPPLEADDRESS=network.node}] [SCREENOUTPUT={YES|NO}]
    [TIMEOUT=number] [TOS=number]
```

To set PING defaults, enter the command:

```
SET PING [{[IPADDRESS=]ipadd|[IPXADDRESS=]network:station|
    [APPLEADDRESS=]network.node}] [LENGTH=number]
    [NUMBER={number|CONTINUOUS}] [PATTERN=hexnum]
    [{SIPADDRESS=ipadd|SIPXADDRESS=network:station|SAPPLEADDR
    ESS=network.node}] [SCREENOUTPUT={YES|NO}]
    [TIMEOUT=number] [TOS=number]
```

To display the default PING settings and summary information, enter the command:

```
SHOW PING
```

The stop a PING that is in progress, enter the command:

```
STOP PING
```

If you can PING the end destination, then the physical and layer 2 links are functioning, and any difficulties are in the network or higher layers.

If PING to the end destination fails, PING intermediate network addresses. If you can successfully PING some network addresses, and not others, you can deduce which link in the network is down.

*Note that if Network Address Translation (NAT) is configured on the remote switch, PINGing devices connected to it may give misleading information.*

For more information about using PING, see the *Internet Protocol (IP)* chapter in the *AT-8800 Series Switch Software Reference.*

# Troubleshooting IP Configurations

## Telnet Fails

**1. If Telnet to switch fails**

Check that the IP address you used matches the one assigned to the switch.

To check that RIP is configured correctly, enter the command:

```
SHOW IP RIP
```

To check that the IP Telnet server is enabled on each switch, enter the command.

```
SHOW IP
```

If the Telnet server is disabled, enable the Telnet server with the command:

```
ENABLE TELNETSERVER
```

**2. If Telnet to host fails**

If Telnet into a host on the remote LAN fails, but works into the remote switch, check that the IP address you are using is correct. To check that both switches are gateways, not servers, enter the command:

```
SHOW IP
```

The "IP Packet Forwarding" field in the output should be set to "Enabled". Refer to the documentation for the host TCP/IP software for more information about configuring a gateway.

The host's TCP/IP software should be configured to use the Head Office switch as its gateway. Refer to the documentation for the host TCP/IP software for more information about configuring a gateway.

**3. Contact your authorised distributor or reseller for assistance**

If problems persist, contact your authorised distributor or reseller for assistance.

# Troubleshooting DHCP IP Addresses

### Your switch is acting as a DHCP client

If your switch is acting as a DHCP client the switch should receive its IP address dynamically. If your switch is not receiving an IP address, check that the domain name and host name are correct.

### Your switch is acting as a DHCP server

If your switch is not assigning IP addresses to a host, or hosts, on the subnet perform this procedure:

1. Reboot the host machine, to force it to re-request IP settings.
2. Check the host's TCP/IP settings.

   In Microsoft® Windows™ 95/98, click **Settings** → **Control Panel** → **Network**. Select **TCP/IP** and click **Properties**. Click **Obtain an IP address automatically**.

   In Microsoft® Windows™ 2000, click **Settings** → **Control Panel** → **Network and Dial-up Connections** → **Local Area Connection** → **Properties**. Select **Internet connection (TCP/IP)** and click **Properties**. Click **Obtain an IP address automatically**.
3. Check that the DHCP server has a large enough range of addresses. To assign a range, enter the command:

   ```
   CREATE DHCP RANGE
   ```

# Troubleshooting IPX Configurations

### No Routes are Visible to the Remote Router

**1. Check the PPP link**

To check that the PPP link is active, enter the command:

```
SHOW PPP
```

The display should look like that shown in Figure 28 on page 116. The state of the IPX control protocol (IPXCP) should be "OPENED". If not, then the fault lies with the connection between the two switches, or the PPP configuration at either end of the link.

**Figure 28: Example output from the SHOW PPP command for a basic Novell IPX network.**

```
Name            Enabled  ifIndex  Over                  CP           State
-------------------------------------------------------------------------
ppp0              YES      04                           IPXCP        OPENED
                                    isdn-roho            LCP          OPENED
-------------------------------------------------------------------------
```

To interpret output from the SHOW PPP command see the *Point-to Point (PPP)* chapter in the *AT-8800 Series Switch Software Reference*.

**2. Check IPX circuit configuration**

To check that the IPX circuits are correctly configured on each switch repeat steps 1 through 3 above, or enter the command:

```
SHOW IPX CIRCUIT
```

Check that there are two circuits, and for each circuit check that the circuit is enabled, uses the correct interface and encapsulation (for Ethernet interfaces), the network number is correct and "On demand" is set to "no". If not, then repeat steps 1 through 3.

**3. Contact your authorised distributor or reseller for assistance**

If you still have no visible routes to the remote switch, contact your authorised distributor or reseller for assistance.

### Local Workstations Can Not Access Remote Servers

A number of different events can cause this problem. The following list of events gives the most common:

**1. Move workstation to server LAN**

Check that when the workstation is moved to the same LAN as the file server, it is able to access the server. If not, the fault lies with the configuration of the workstation or file server. Check with your Novell network administrator.

**2. Check NET.CFG file**

Take care with the workstation NET.CFG file. Always specify the encapsulation (frame) as different LAN card drivers use different default encapsulations.

**3. Check for file server on Remote Office switch**

Does the file server appear in the IPX service table of the Remote Office switch? If the server does not appear in the table, its presence is not advertised to the local LAN. To check this, enter the command:

```
SHOW IPX SERVICE
```

This should produce a display like that shown in Figure 29 on page 117. The important point is that the file server must appear in the service table on the Remote Office switch and there must be a route to the file server's internal network number. If there is, and it still does not work, contact your authorised distributor or reseller for assistance.

**Figure 29: Example output from the SHOW IPX SERVICES command for a basic Novell IPX network**

```
IPX services
Name                                                                    Age
  Address                      Server type          Circuit      Hops  Defined
------------------------------------------------------------------------------
ACCOUNTS                                                                0
  00007500:000000000001:0451   0004:Fileserver        1 (vlan1)    1   SAP
ACCOUNTS                                                                0
  00007500:000000000001:8104   0107:RCconsole         1 (vlan1)    1   SAP
TYPISTS                                                                 0
  00000012:0080488018d8:0451   0004:FileServer        1 (ppp0)     2   SAP
------------------------------------------------------------------------------
```

To interpret output from the SHOW IPX SEVICES command see the *Novell IPX* chapter in the *AT-8800 Series Switch Software Reference*.

**4. Check route tables**

To check the route tables on both switches, enter the command:

```
SHOW IPX ROUTE
```

Check for the presence of networks on the remote side of the wide area network. If the remote network is missing from the route table on either switch, enter the command:

```
RESET IPX
```

which resets the IPX routing software and forces the switches to broadcast their routing and service tables.

# Using Trace Route for IP Traffic

You can use trace route to discover the route that packets pass between two systems running the IP protocol. Trace route sends an initial UDP packets with the Time To Live (TTL) field in the IP header set starting at 1. The TTL field is increased by one for every subsequent packet sent until the destination is reached. Each hop along the path between two systems responds with a TTL exceeded packet and from this the path is determined.

To initiate a trace route, enter the command:

```
TRACE [[IPADDRESS=]ipadd] [MAXTTL=number] [MINTTL=number]
   [NUMBER=number] [PORT=port-number] [SCREENOUTPUT={YES|NO}]
   [SOURCE=ipadd] [TIMEOUT=number] [TOS=number]
```

Any parameters not specified use the defaults configured with a previous invocation of the command:

```
SET TRACE [[IPADDRESS=]ipadd] [MAXTTL=number] [MINTTL=number]
    [NUMBER=number] [PORT=port-number] [SCREENOUTPUT={YES|NO}]
    [SOURCE=ipadd] [TIMEOUT=number] [TOS=number]
```

As each response packet is received a message is displayed on the terminal device from which the command was entered and the details are recorded. To display the default configuration and summary information, enter the command:

```
SHOW TRACE
```

To halt a trace route that is in progress, enter the command:

```
STOP TRACE
```

For more information about trace route, see the *Internet Protocol (IP)* chapter in the *AT-8800 Series Switch Software Reference.*