Solwise Ltd.

Advanced Reference Guide for

Solwise SAR110 ADSL Router

Please Note: Incorrect usage of CLI commands can seriously damage the firmware settings and configuration of your router to the extent where you might be unable to reset/restore to an operable state. We reserve the right to charge for any faulty router returned for repair which has user corrupted firmware or settings.

April 11, 2003

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Table of Contents

1 Introduction

This document contains the following chapters:

- *Introduction*, provides basic information on this document.
- Chapter 2 shows how to set up, configure, and operate the SAR110.
- Chapter 3 gives a brief overview of the main features of the Command Line Interface (CLI).
- Chapter 4 defines and describes the reference unit's default configuration, and explains how you can alter the current configuration using flat files.
- Chapter 5 shows how to configure the unit's interfaces, and how to change its operating mode.
- Chapter 6 explains the CLI commands that can be used to modify and display DSL-related parameters and statistics.
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- Chapter 9 shows how to configure the modem as a DNS relay server.
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- Chapter 11 describes the configuration options of the Simple Network Transfer Protocol.
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- Chapter 13 details information on configuring NAT, Firewall and IP Filtering.
- Chapter 14 discusses the new Usage Control feature of the unit.
- Chapter 15 discusses the surfing profile feature that provides application security.
- Chapter 16 discussing how auto configuration is possible with auto detect and TR-37 support.
- Chapter 17 discusses mechanisms for management access to the modem, using SNMP, Web-based interface, and L2 Agent.
- Chapter 18 shows how to perform basic maintenance functions using CLI.
- Chapter 19 helps you understand how to use shell scrips

to your advantage, and provides a tutorial on shell programming.

A glossary of terms used in this document is also provided.

2 Quick Start

See Setup documention supplied with your router

3 CLI Introduction

See full SAR110 CLI manual.

4 Unit Configuration

This chapter describes the default configuration programmed into the flash memory, as well as how to modify the configuration after boot-up.

4.1 Default Configuration

The unit's default configuration is established by the *factory defaults file* named TEFacs.txt. You customize the default configuration by modifying this file, then creating and loading a new flash image (a description of this process and sample factory defaults files are provided in the *Image Handling User Manual*). At boot-up, the CLI commands in this file are automatically executed. Once the unit is operational, its configuration can be changed interactively using CLI, or in batch mode by script file upload (described in section).

The following list describes example settings that may appear in the default TEFacs.txt:

- **CLI user accounts**

One superuser account: name = 'DSL', password = 'DSL'

- **Maximum number of VCs: 8**
- **Maximum number of IP sessions: 192**
- **LAN interfaces**

Ethernet port: eth-0, IP address 192.168.7.1, subnet mask 255.255.255.0

- **DSL — configured for multimode coding standard**
- **WAN interfaces**

ATM port: atm-0; maximum VCs allowed = 8

ATM VC: aal5-0, lower interface atm-0, VPI = 0, VCI = 38

PPPoE interface: ppp-0, lower interface aal5-0, default route

PPP user name 'guest', password 'guest', PAP authentication

- **RIP — Enabled on PPP interface**
- **DHCP — enabled with one pool for LAN computers: Pool ID = 1, address range = 192.168.7.3 to 192.168.7.34, mask 255.255.255.0**
- **NAT — enabled with an NAPT rule for translating local private addresses to the public address assigned to ppp-0**
- **Bridging — enabled with ethernet interface defined as bridgeable**

❖ **IP Filter — enabled, with various rules configured for high, medium, and low security.**

Below lists the CLI commands in the factory defaults file that configures the unit as a router.

```
create user name DSL passwd DSL root

modify system logthresh 1

size maxvc 8 max1483vc 8 maxppe 8

modify nbsize maxipsess 192

create ethernet intf ifname eth-0 ip 192.168.7.1
mask 255.255.255.0 inside

modify dsl config gdmt

create atm port ifname atm-0 maxvc 8

create atm trfdesc trfindex 0 NOCLP_NOSCR

create atm vc intf ifname aal5-0 lowif atm-0 vpi
0 vci 38 vcmux

create ppp security ifname ppp-0 CHAP login guest
passwd guest

create ppp intf ifname ppp-0 start lowif aal5-0
droute true PPOA usedhcp false outside usedns
true

create rip intf ifname ppp-0

create dhcp relay intf ifname ppp-0


create nat rule entry ruleid 1 napt

modify nat global enable


modify ipf global pubdefact accept

modify ipf global pvtdefact deny

modify ipf global dmzdefact accept


create ipf rule entry ruleid 10 dir in act deny
destaddr bcast seclevel high

create ipf rule entry ruleid 20 dir in act deny
destaddr eq 255.255.255.255 seclevel high


create ipf rule entry ruleid 30 ifname private
dir in act accept storestate enable seclevel high
medium low
```

```
create ipf rule entry ruleid 40 ifname private
dir out srcaddr self act accept storestate enable
seclevel high medium low


create ipf rule entry ruleid 50 ifname private
dir out inifname dmz transprot eq udp destport eq
num 53 act accept storestate enable seclevel high
medium low

create ipf rule entry ruleid 60 ifname private
dir out inifname dmz transprot eq tcp destport eq
num 53 act accept storestate enable seclevel high
medium low

create ipf rule entry ruleid 70 ifname private
dir out inifname dmz transprot eq tcp destport eq
num 25 act accept storestate enable seclevel high
medium low

create ipf rule entry ruleid 80 ifname private
dir out inifname dmz transprot eq tcp destport eq
num 110 act accept storestate enable seclevel
high medium low

create ipf rule entry ruleid 90 ifname private
dir out inifname dmz transprot eq tcp destport eq
num 21 act accept storestate enable seclevel
medium low

create ipf rule entry ruleid 100 ifname private
dir out inifname dmz transprot eq tcp destport eq
num 80 act accept storestate enable seclevel
medium low

create ipf rule entry ruleid 110 ifname private
dir out inifname dmz transprot eq tcp destport eq
num 23 act accept storestate enable seclevel low

create ipf rule entry ruleid 120 ifname private
dir out inifname dmz transprot eq icmp act accept
storestate enable seclevel low


create ipf rule entry ruleid 130 ifname dmz dir
out inifname private transprot eq tcp destport eq
num 23 act deny seclevel high


create ipf rule entry ruleid 140 ifname dmz dir
out inifname public transprot eq udp destport eq
num 53 act deny seclevel high

create ipf rule entry ruleid 150 ifname dmz dir
out inifname public transprot eq tcp destport eq
num 53 act deny seclevel high

create ipf rule entry ruleid 160 ifname dmz dir
out inifname public transprot eq tcp destport eq
num 21 act deny seclevel high
```

```
create ipf rule entry ruleid 170 ifname dmz dir
out inifname public transprot eq tcp destport eq
num 23 act deny seclevel high medium low

create ipf rule entry ruleid 180 ifname dmz dir
out inifname public transprot eq icmp act deny
seclevel high medium


create ipf rule entry ruleid 190 ifname public
dir out transprot eq tcp destport eq num 23 act
deny seclevel high

create ipf rule entry ruleid 200 ifname public
dir out srcaddr self act accept storestate enable
seclevel high medium low


create ipf rule entry ruleid 210 ifname public
dir in act deny destaddr bcast seclevel medium

create ipf rule entry ruleid 220 ifname public
dir in act deny destaddr eq 255.255.255.255
seclevel medium

create ipf rule entry ruleid 230 ifname public
dir in act deny transprot eq udp destport eq num
7 seclevel high medium

create ipf rule entry ruleid 240 ifname public
dir in act deny transprot eq udp destport eq num
9 seclevel high medium

create ipf rule entry ruleid 250 ifname public
dir in act deny transprot eq udp destport eq num
19 seclevel high medium

create ipf rule entry ruleid 260 ifname public
dir in destaddr self transprot eq tcp destport eq
num 80 act deny seclevel high medium low

create ipf rule entry ruleid 270 ifname public
dir in destaddr self transprot eq udp destport eq
num 53 act deny seclevel high

create ipf rule entry ruleid 280 ifname public
dir in destaddr self transprot eq tcp destport eq
num 53 act deny seclevel high

create ipf rule entry ruleid 290 ifname public
dir in destaddr self transprot eq tcp destport eq
num 21 act deny seclevel high medium low

create ipf rule entry ruleid 300 ifname public
dir in destaddr self transprot eq tcp destport eq
num 23 act deny seclevel high medium low

create ipf rule entry ruleid 310 ifname public
dir in destaddr self transprot eq icmp act deny
seclevel high medium

create ipf rule entry ruleid 320 ifname public
dir in destaddr self transprot eq udp destport eq
```

```
num 53 act accept storestate enable seclevel
medium low

create ipf rule entry ruleid 330 ifname public
dir in destaddr self transprot eq tcp destport eq
num 53 act accept storestate enable seclevel
medium low


create ipf rule entry ruleid 340 ifname public
dir in act deny isipopt yes seclevel high

create ipf rule entry ruleid 350 ifname public
dir in act deny isfrag yes seclevel high


create ipf rule entry ruleid 360 ifname dmz dir
in destaddr self transprot eq tcp destport eq num
80 act deny seclevel high medium

create ipf rule entry ruleid 370 ifname dmz dir
in destaddr self transprot eq tcp destport eq num
21 act deny seclevel high medium

create ipf rule entry ruleid 380 ifname dmz dir
in destaddr self transprot eq tcp destport eq num
23 act deny seclevel high medium

create ipf rule entry ruleid 390 ifname dmz dir
in act accept storestate enable seclevel high
medium low


end
```

For detailed information on all CLI commands (except **`modify nbsize`** and **`size`**, which are described in section), see the SAR110*CLI Manual*.

4.1.1 System Sizing Parameters

The first two lines of the factory defaults file specify “sizing” parameters. These parameters set upper limits on some of the basic elements of the system, e.g., the number of VCs or IP sessions.

The sizing parameters are specified using the **`size`** and **`modify nbsize`** commands. While these commands are available in CLI, they are “hidden” from the user; they do not appear in the output of the **`help`** command and are otherwise undocumented. This is because these commands are only for OEM use; end users should have no knowledge of these commands.

Because parts of the system, the `size` and `modify nbsize` commands must come at the beginning of the factory defaults file.

The `size` command

This command sets upper limits on certain system properties. Its parameters are:

- **`maxvc`** and **`max1483vc`** – Maximum number of VCs (both: default 2)
- **`maxppe`** – Maximum number of PPPoE sessions (default 1)
- `maxmac` – Maximum number of MAC addresses that are learned by the bridge forwarding table (default 256)
- **`maxpfrawrule`** – Maximum number of raw filter rules (default 8)
- **`maxpfrawsubrule`** – Maximum number of raw filter subrules (default 8)
- **`maxipfrule`** - Maximum number of IP filter rules (default 8)

You should set these parameters in accordance with the anticipated needs of a typical end user of your product.

The `modify nbsize` command

This command is used to modify

- **the maximum number of IP sessions that can be active at any given time the TELNET server port**
- **the FTP server port**
- **the HTTP server port.**

An IP session is a connection between two applications, one running on one of your LAN's hosts and the other running on a host on the WAN, e.g., a connection between a host on your LAN and an Internet web site.

To see the maximum number of IP sessions currently configured or port on which TELNET, HTTP, FTP servers are running, enter:

```
$ get nbsize
```

To limit the maximum number of active IP sessions to 256, enter:

```
$ modify nbsize maxipsess 256
```

- **To modify the TELNET server port to 9000, enter:**

```
$ modify nbsize telnetport 8000
```

- **To modify the FTP server port to 1000, enter:**

```
$ modify nbsize ftpport 9000
```

❖ **To modify the HTTP server port to 8000, enter:**

```
$ modify nbsize httpport 10000
```

The **`modify nbsize`** command does not take effect until the next system reboot occurs. To initiate a system reboot, enter the following pair of commands:

```
$ commit
$ reboot last
```

4.2 Modifying the Unit's MAC Address and Serial Number

When you build a software image, it is coded with a default MAC address and serial number. You can change this data on a particular unit using the CLI.

Serializing an image

To change the MAC address and serial number on a board, enter:

```
do serialize AA-BB-CC-DD-FF-12 111122233334444
```

The MAC address is a 12-digit hexadecimal number, which can be entered with dashes, as shown, or as a single string. The same MAC address applies to all the unit's LAN-side interfaces (e.g., eth-0 and usb-0).

The serial number can contain up to 24 alphanumeric characters.

4.3 Modifying the Unit Configuration via Script Files

Besides CLI, another way of modifying the unit's current configuration is to use the script file upload method. Unlike CLI, this method does not require a serial port. This method is meant to be used primarily by ISPs, as a quick and easy way to update the configuration of their customers' boxes.

The script file is uploaded to the unit's IP address via ftp or tftp. Once the script file has been uploaded to the unit, the file may be executed immediately or at a later time, depending on the autoupdate flag (see note below). If the autoupdate flag is set to true, the CLI commands in the configuration file are executed immediately. If however, the autoupdate flag is set to false, then the CLI commands are held in RAM and are not executed until the `apply` command is issued via CLI.

Please refer to section in this document for details on CLI Scripting and Script Programming.

The autoupdate flag indicates whether configuration files will be executed immediately or only upon issue of an `apply` *command. For more details on the autoupdate flag and the commands related to its use, see the CLI Reference Manual.*

4.3.1 Notes on Using Script File Configuration

Important points concerning script file configuration include:

- **The script file can only be used to change the current configuration. It cannot be used to update or replace the factory defaults file (default configuration file) in the flash image.**
- **In order to modify an existing interface, it may be necessary for the script file to delete the interface first, and then recreate it.**
- **In order for the new configuration to be saved to flash memory, the script file must contain the commands** `commit` and `reboot`.

4.4 Managing Configuration Changes

Whenever you change the unit's configuration and do a **`commit`**, the changes are saved into the **`flash`**. Doing a **`reboot`** after a **commit** reboots the unit with the latest changes. The **`reboot`** command supports the following options.

- **`last`**: to reboot the unit using the latest saved configuration use the **`reboot last`** command.
- **`backup`**: to reboot the unit using the configuration of the operation that was committed before the last commit operation, use the **`reboot backup`** command.
- **`Default`**: to reboot the unit using the default configuration, use the **`reboot default`** command.
- **`Clean`**: to reboot the unit with zero configuration, use the **`reboot clean`** command. This assumes that the user has a serial port connected to the unit. This is so, because in a clean configuration even Ethernet is not configured.
- **`Minimum`** - to reboot the unit with only the **`size`** (with all default parameters), **`create ethernet intf`** and **`create user`** commands executed, use the **`reboot minimum`** command.

The Ethernet interface *and the* ***user*** *are created with the parameters used in the default configuration. The minimum configuration aims to configure the unit so as to allow a* ***telnet*** *to it from the LAN.*

Note that when you reboot with a given configuration, say ***`reboot clean`****, the other configurations are not lost. To go back to the last saved configuration after you have done a* ***`reboot clean`****, just do a* ***`reboot last.`***

4.5 Using FTP/TFTP to Upgrade and Retrieve the Flash Image

You can use FTP/TFTP to upload/download code to/from a unit's flash memory, assuming that a functioning image is already loaded on the unit. Uploads and downloads can be performed from a computer connected to the device through an IP-enabled interface, such as its LAN interface.

Uploading to the unit enables you to upgrade the image as you obtain new software releases from your router supplier. Downloading from the unit to your PC enables you to store code and configuration files before overwriting them with new code.

You can transfer an entire or a partial flash image. The filename must be one of those described in Table below.

Files Used with TFTP Upload/Download

Filename	Description
TEImage.bin	Entire binary image.
TEPatch.bin	Compressed file containing patch code representing one or more of the code blocks (for example, the DSL firmware and application code blocks). You can use TEPatch.bin to upgrade several blocks at a time, without overwriting all blocks. See the *Image Handling User's Manual* for more information about the content of TEPatch.bin and how to modify it to create the desired patch file.

Uploading Example

To upload a file to the unit, you can type a command such as the following at a DOS prompt on your PC (replace the IP address shown with the LAN port port IP address on the unit):

```
TFTP -i 192.168.1.1 put TEImage.bin
```

Reboot the unit when the upload is complete. See the section Recovering from a Failed Upgrade if the upload is not successful.

Downloading Example

To download a file, such as the configuration file, use a command such as the following:

```
TFTP -i 192.168.1.1 get TECfg.bin
```

If you later change the unit's configuration and find that it the device is not working properly, you can upload this file to restore a known-good configuration.

4.5.1 Data configuration Upgrade

Data configuration upgrade using *TEpatch.bin* will be required if you have committed certain CLI commands in a previous release, and want the same commands to work in an upgraded release.

For a list of supported releases, please refer to the relevant release notes. Normally, if the board fails to come up with the committed configuration, it reboots and tries to come up with the default configuration. But, while upgrading only a best effort attempt is made to recreate the older configuration. That is, errors are ignored. Hence, always check, after an upgrade, whether the new configuration appears as desired.

4.5.2 Recovering from a Failed Upgrade

If the upgrade process fails while uploading the application code file, (for example, your FTP/TFTP connection is lost during the process), or if for any reason the new application code fails to boot after loading, the device may boot to a special TFTP mode that enables you to continue the upgrade. This procedure enables you avoid having to re-flash the device with an entire image using a serial connection to the flash header.

This TFTP server mode is invoked automatically when the application checksum test fails during boot-up. If you have a serial connection to the board, the following message will display on the terminal:

```
Testing Application Checksum ... Failed

TFTP Server Started ...  Please upload flash image to 192.168.1.1
```

In addition, all the software controlled test LEDs will blink at about twice per second. This indicates that the application code has not been loaded and all subsequent routine boot processes were aborted. The unit's built-in TFTP server is invoked and an IP-enabled Ethernet interface is set up with the following properties:

- *IP Address*: 192.168.1.1
- *Mask*: 255.255.255.0

To continue the image upgrade via TFTP, verify that the IP properties on the PC assign it to the same subnet as this Ethernet interface. Then, upload the new application code file via TFTP (FTP is not supported in this mode). The LEDs will blink rapidly as the image is uploaded.

You can also access this mode as a shortcut if you want to boot a board solely to perform an image upgrade via TFTP. To force a unit into this mode, begin booting the board and monitor the boot messages on your PC. Before "*Testing Application Checksum.....*" displays (or during), type **"*tao*"** and press **<Backspace>**. The ordinary boot process will be aborted and the board will boot in the TFTP mode as described above.

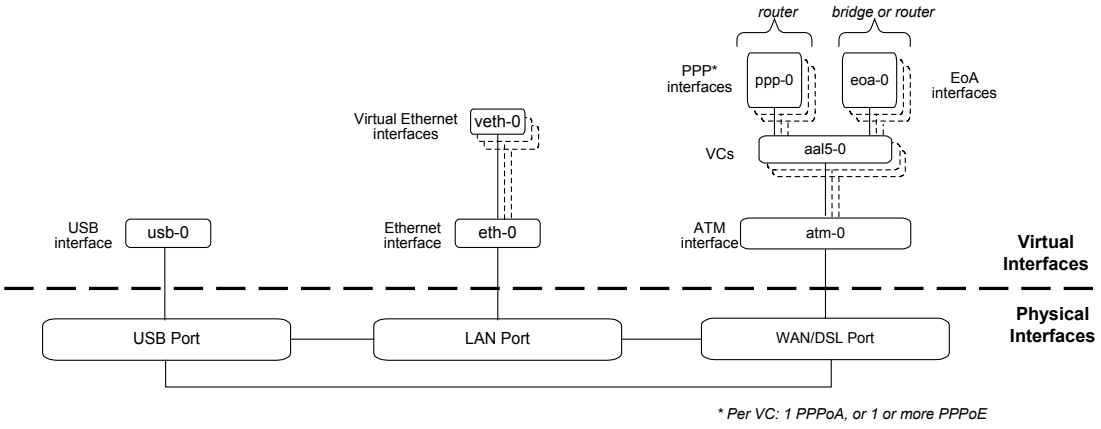
5 Interfaces and Operating Mode

This chapter briefly discusses the unit's interfaces, and explains how to create and configure the interfaces needed for the bridge and router operating modes, as well as how to select each mode.

5.1 Interfaces – Overview

At the physical level, the unit provides WAN-LAN connectivity through its physical WAN, and LAN ports. At the logical level, the connection can be made in a number of ways, depending on the virtual interfaces configured on top of the physical ports and how these interfaces are connected.

Figure below shows the virtual interfaces you can define on each physical port



In order to create an interface, you first create all the interfaces below it, starting at the lowest interface. For instance, to create a PPP interface, you first create the ATM port, then a VC.

5.2 Configuring the Ethernet Port

The Ethernet port is a physical port on that enables you to connect the unit to a computer or Ethernet network. You can configure only one physical Ethernet port, *eth-0*; however, you can define multiple virtual ethernet interfaces over this port, as described in section on page -27. This port can be created with or without an IP address (no IP address is required if it is a bridge port).

When creating the Ethernet port, you may need to consider the following:

- **IP address and subnet – To connect the unit to an existing LAN whose subnet differs from the Ethernet port's default subnet (192.168.1.1, mask 255.255.255.0), assign the Ethernet port an IP address in the same subnet as your LAN. (Alternatively, you would have to assign to each LAN computer a new IP address and mask that places it in the same subnet as the Ethernet port.)**

Commands related to the Ethernet port are briefly described below.

For a complete listing of these commands, including parameters and default values, refer to the SAR110CLI Manual

Creating the Ethernet port

To create the Ethernet port *eth-0*, enter:

```
$ create ethernet intf ifname eth-0 ip 192.168.1.1 mask 255.255.255.0
```

To display information on the Ethernet port, enter:

```
$ get ethernet intf
```

Setting Interface security type

You can set the interface security type to either pvt, pub, dmz, while creating the Ethernet interface.

```
$ create ethernet intf ifname eth-0 ip 192.168.1.1 mask 255.255.255.0
ifsectype private
```

Changing the Ethernet port's IP address

To change the Ethernet port's IP address to 10.1.1.1 with mask 255.0.0.0, enter:

```
$ modify ethernet intf ifname eth-0 ip 10.1.1.1 mask 255.0.0.0
```

If you are connecting the unit to an existing LAN, and if the Ethernet port's default subnet—IP address 192.168.1.1, mask 255.255.255.0—is different from the LAN's subnet, change the Ethernet port's IP address, as follows:

Set any LAN host's IP address to 192.168.1.3, mask 255.255.255.0.

Using this host, Telnet to 192.168.1.1 and log in to the system.

Enter the `modify ethernet intf` command (described above) to change the IP address and/or mask of the eth-0 interface.

Enter `commit` to save the changes.

Change the host's IP address and/or mask to the original value(s).

Reboot the host.

If you are connecting the unit to a new LAN, i.e., one whose subnet is not yet determined, you do not need to change the Ethernet port's IP address. Instead, assign each LAN host an IP address from the Ethernet port's default subnet, i.e., 192.168.1.2, 192.168.1.3, etc. Or, configure each PC as a DHCP client so that it will be assigned an appropriate address from the unit's default DHCP pool (assuming that this pool has been configured).

Using a LAN DHCP server to assign the port's IP address

To reconfigure the unit to get its LAN IP address from a DHCP server running on a LAN host, enter:

```
$ modify ethernet intf ifname eth-0 ip 0.0.0.0 mask 0.0.0.0 usedhcp
true
```

Both the IP address and mask must be set to 0.0.0.0. Setting **`usedhcp`** to **`true`** (default=**`false`**) invokes a DHCP client to obtain an IP address for this interface from a DHCP server.

The **`get ethernet intf`** command will show the IP address as *0.0.0.0* , while the **`get ip address`** command will show the address obtained from the dhcp server.

If you are changing the IP address of the Ethernet address over a telnet or HTTP connection, the connection will be lost once the address is modified.

Displaying the Ethernet port's IP address

To see the current configuration of the Ethernet interface, enter:

```
$ get ethernet intf ifname eth-0
```

If the displayed IP address is 0.0.0.0, the unit has been configured to get its LAN IP address from a LAN DHCP server (as explained in "Using a LAN DHCP server to assign the port's IP address" in this section). To see the actual IP address, use the **`get ip address`** command.

To see the IP address obtained from a DHCP server (plus the IP addresses for all configured IP-enabled interfaces), enter:

```
$ get ip address
```

Deleting an Ethernet Interface

To delete an Ethernet interface, enter:

```
$ delete ethernet intf ifname eth-0
```

5.3 Configuring Virtual Ethernet Interfaces

Virtual Ethernet interfaces give the impression of multiple subnets on a single physical subnet, by dividing your LAN hosts into groups, each with its own subnet mask. You can up to two virtual Ethernet interfaces, named veth-0 and veth-1, over the single physical Ethernet interface.

To create a virtual interface, enter:

```
$ create ethernet intf ifname veth-0 ip 172.25.1.1 mask 255.255.255.0
phyif eth-0
```

The **phyif** parameter indicates that the virtual interface *veth-0* actually sits on the physical interface *eth-0*. Unlike the physical Ethernet interface, the virtual Ethernet interfaces can be deleted using the **delete ethernet intf** command.

To list the virtual Ethernet interfaces (as well as physical Ethernet interfaces), enter:

```
$ get ethernet intf
```

5.4 Configuring the WAN ATM Port

Data traffic is carried over the DSL cable in ATM cells. To enable the DSL port (i.e., the WAN port) to carry ATM cells, you need to configure an ATM port on the unit. You can configure only one ATM port, *atm-0*.

When creating the ATM port, consider the following:

- **ATM priority scheduling – The relative priorities of the ATM service categories (described in section). By default, the priorities are in this order - CBR, RTVBR, NRTVBR, GFR, UBR.**

Commands related to creating the ATM port are briefly described below.

For a complete listing of these commands, including parameters and default values, refer to the CLI Reference Manual.

Creating the ATM port

To create the ATM port *atm-0*, enter:

```
$ create atm port ifname atm-0
```

To display information on the ATM port, enter:

```
$ get atm port
```

Setting ATM service category priorities

The `create atm port` command is also used to assign relative priorities to ATM service categories (described in section).

To give the UBR service category priority over GFR (GFR has higher priority by default), enter:

```
$ create atm port ifname atm-0 ubrpriority 2 gfrpriority 1
nrtvbrpriority 3 rtvbrpriority 4 cbrpriority 5
```

5.5 Configuring Permanent Virtual Circuits

Virtual Circuits (VCs), named *aal5-0*, *aal5-1*, etc., sit on top of the ATM port. Each VC has an associated Virtual Path Identifier (VPI) and Virtual Circuit Identifier (VCI) that identify a data path through the ATM network.

Besides the VPI and VCI, you should also consider the following when creating a VC:

- **AAL5 data encapsulation – VC-muxing, LLC-muxing (default), or none.**
- **Service category – Unspecified Bit Rate (UBR) (default) or Guaranteed Frame Rate (GFR), Non Real-Time Variable Bit Rate (NRTVBR), Real-Time Variable Bit Rate (RTVBR), or Constant Bit Rate (CBR).**

A UBR traffic descriptor usually exists as part of the default configuration. So a UBR VC can be created right away. For any other type of VC - GFR, NRTVBR, RTVBR, or CBR, you must also create a traffic descriptor of the same category if you have not yet done so.

- **Priority – The relative transmission priority of the VC vs. other VCs in the same service category.**

The commands used to create VCs statically are briefly described below. VCs can also be created automatically using the AutoDetect feature, which is described in detail in Chapter .

For a complete listing of these commands, including parameters and default values, refer to the CLI Reference Manual.

Creating a VC

To create a VC-muxed VC named aal5-0 with VPI 0 and VCI 35, enter:

```
$ create atm vc intf ifname aal5-0 vpi 0 vci 35 vcmux lowif atm-0
```

This creates VC aal5-0, with VPI 0 and VCI 35, on top of ATM port atm- 0. Since the default values for all other parameters are used, the traffic descriptor (described in section) is 0, and thus the ATM service category is UBR.

The number of VCs you can create is limited by the `maxvc` *parameter in the* `create atm port` *command and the* `maxvc` *and* `max1483vc` *parameters in the* `size` *command. All three parameters are typically set to the same value.*

To see a list of all currently configured VCs, enter:

```
$ get atm vc intf
```

5.5.1 AAL5 Data Encapsulation Method

The unit supports two data encapsulation methods: *VC mux* and *LLC mux*. Each allows you to create different types of interfaces on the VC. A third mode with no encapsulation is also supported.

VC-muxed VC

The allowed interfaces are:

- **EoA**
- **PPPoA**
- **IPoA**
- **EoA + PPPoE**
- **EoA + bridge port over EoA**
- **EoA + bridge port over EoA + PPPoE**

LLC-muxed VC

The allowed interfaces are:

- **EoA 1**
- **PPPoE**
- **PPPoA**
- **IPoA**
- **EoA + PPPoE**
- **EoA + PPPoE + PPPoA**
- **EoA + PPPoE + IPoA**
- **PPPoA + IPoA**
- **EoA + IPoA**
- **EoA + bridge port over EoA**
- **EoA + bridge port over EoA + PPPoE**
- **EoA + PPPoE + PPPoA + bridge port over EoA 2**
- **EoA + bridge port over EoA + PPPoE + IPoA 3**
- **EoA + PPPoA + IPoA**
- **EoA + PPPoE + PPPoA + IPoA**

5.5.2 ATM Service Categories: UBR, CBR, GFR, NRTVBR and RTVBR

Every VC has an associated ATM *service category*. The following service categories can be defined, based on the Quality of Service (QoS) provided:

- *Unspecified Bit Rate (UBR)* – ATM provides no rate guarantee; data is transmitted on the VC only as and when bandwidth is available.
- *Guaranteed Frame Rate (GFR)* – ATM guarantees a minimum bandwidth, called the *Minimum Cell Rate (MCR)*, for the VC. Depending on available bandwidth, GFR also provides a maximum bandwidth, called the *Peak Cell Rate (PCR)*.
- *Non Real-Time Variable Bit Rate (NRTVBR)* - ATM guarantees a Sustained Cell Rate (SCR) and allows the user to go up to a Peak Cell Rate (PCR) for a duration derived from the Maximum Burst Size (MBS). This category is used by non-real time applications.
- *Real-Time Variable Bit Rate (RTVBR)* - ATM guarantees a Sustained Cell Rate (SCR) and allows the user to go up to a Peak Cell Rate (PCR) for a duration derived from the Maximum Burst Size (MBS). This category is used by real

1 if the a5maxproto parameter in create atm vc command is >= 1
2 if the a5maxproto parameter in create atm vc command is >= 2
3 if the a5maxproto parameter in create atm vc command is >= 3

time applications like voice and video.

- ❖ Constant Bit Rate (CBR) - ATM guarantees bandwidth up to a Peak Cell Rate (PCR).

You specify a VC's service category when you create the VC, using a *traffic descriptor*. Traffic descriptors are explained in detail in section .

5.5.2.1 *UBR, GFR, and CBR, NRTVBR and RTVBR Transmission Priorities*

Each service category's transmission priority can be set using the **`create atm port`** command's **`ubrpriority`**, **`gfrpriority`**, **`nrtvbrpriority`**, **`rtvbrpriority`**, and **`cbrpriority`** parameters. The three parameters must have different values (by default, **`cbrpriority`** is 5 (highest), **`rtvbrpriority is 4, nrtvbrpriority is 3, gfrpriority`** is 2, and **`ubrpriority`** is 1).

When creating the ATM port, the relative priorities of the ATM service categories are, by default: CBR, RTVBR, NRTVBR, GFR, UBR.

5.5.2.2 *Transmission Priorities of VCs*

You can also assign relative priorities to the VCs within each service category, using the **`vcweight`** parameter in the **`create atm vc intf`** command (for details, refer to the *CLI Reference Manual*). The *Weighted Fair Queuing (WFQ)* algorithm is used to ensure fair and efficient bandwidth allocation for both service categories.

5.5.2.3 *Traffic Descriptors*

A VC's service category is assigned indirectly, using a *traffic descriptor*. A traffic descriptor defines a set of ATM traffic-related properties, the most important property being the service category, i.e., UBR, GFR, , NRTVBR, RTVBR or CBR.

When you create a VC using the **`create atm vc intf`** command, you define its service category using the **`trfdesc`** parameter. The default value of this parameter is 0, corresponding to the default traffic descriptor.

The default configuration provides an initial traffic descriptor with index 0. This *default traffic descriptor* specifies the UBR service category.

To create a UBR VC, omit the **`trfdesc`** parameter when creating the VC. To create a GFR, NRTVBR, VBR or CBR VC, you must create a traffic descriptor of the same category.

Creating a GFR traffic descriptor

To create traffic descriptor 1, for GFR VCs with MCR=50 and PCR=150:

```
$ create atm trfdesc trfindx 1  GFR CLP_NOTAG_MCR mcr 50 pcr 150
```

The **CLP_NOTAG_MCR** flag indicates that if PCR is exceeded, the VC will drop extra cells without tagging the Cell Loss Priority (CLP) bit.

To create a VC using the preceding traffic descriptor:

```
$ create atm vc intf ifname aal5-0 trfindx 2 vpi 5 vci 50 lowif atm-0
```

Creating a VBR Traffic Descriptor

To create traffic descriptor 3, for RTVBR VCs with PCR=150, SCR=75 and MBS=15:

```
$ create atm trfdesc trfindx 3 RTVBR NOCLP_SCR pcr 150 scr 75 mbs 15
```

The NOCLP_SCR flag indicates that the traffic parameters are valid for the aggregate flow and that an SCR is required.

To create a VC using the preceding traffic descriptor:

```
$ create atm vc intf ifname aal5-2 trfindx 3 vpi 5 vci 52 lowif atm-0
```

Creating a CBR Traffic Descriptor

To create traffic descriptor 2, for CBR VCs with PCR=150:

```
$ create atm trfdesc trfindx 2 CBR NOCLP_NOSCR pcr 150
```

The NOCLP_NOSCR flag indicates that the traffic parameters are valid for the aggregate flow and that no Sustained Cell Rate is required.

To create a VC using the preceding traffic descriptor:

```
$ create atm vc intf ifname aal5-1 trfindx 2 vpi 5 vci 51 lowif atm-0
```

To display all currently defined traffic descriptors, enter:

```
$ get atm trfdesc
```

Creating a RTVBR traffic descriptor:

To create traffic descriptor 3, for RTVBR VCs with PCR=150, SCR=75 and MBS=15:

```
$ create atm trfdesc trfindx 3 RTVBR NOCLP_SCR pcr 150 scr 75 mbs 15
```

The NOCLP_SCR flag indicates that the traffic parameters are valid for the aggregate flow and that an SCR is required.

To create a VC using the preceding traffic descriptor:

```
$ create atm vc intf ifname aal5-2 trfindx 3 vpi 5 vci 52 lowif atm-0
```

5.6 Configuring Switched Virtual Circuits (SVCs)

The modem supports Switched Virtual Circuits (SVCs) created through UNI version 3.1 or 4.0 signalling. To create an SVC, first create a signaling channel for UNI. This is simply a PVC which usually has the VPI = 0 and VCI = 5.

Create PVC for UNI signaling

```
$ create atm vc intf ifname aal5-0 vpi 0 vci 5 none
```

Here, **`none`** specifies the encapsulation as **none**.

- **To configure UNI signaling to run on this VC, give the following command:**

Configuring UNI

```
$ create atm uni ifname aal5-0 nplan atmes saddr
0x47000580ffde000000000001050000000000000000 version uni40
```

The parameter **`saddr`** is the ATM address of the modem, while **`nplan`** specifies this address to be an ATM End System type of address. With ATMES, the address must be specified as a string of hex bytes. Conversely, the **`nplan`** could be specified as ISDN, in which case the address should be given as a string of decimal digits. The **`version`** parameter specifies the UNI signaling version, which here, is 4.0. The default version is 3.1.

Signaling ATM Adaptation Layer (SAAL) is a layer in the SVC signaling stack that provides reliable transfer of signaling messages between peer UNI entities. If the signaling channel with the remote host is established, the SAAL status is set to UP, and the following trap is generated.

```
STATUS ALARM : SAAL UP
```

Otherwise, the SAAL status is DOWN. SAAL may come up later when the signaling channel gets established with the remote host.

The following trap is generated when SAAL goes down:

```
STATUS ALARM : SAAL DOWN
```

You can check the SAAL status at any time, using the command:

```
get atm uni ifname aal5-0
```

With UNI configured, you can now initiate the creation of an SVC by giving the following command:

Creating an SVC

```
$ create atm svccfg ifname aal5-1 nplan atmes daddr
0x39000760ff8900000000000119000000000000000
```

This tells the modem to establish an SVC with the host having the ATMES address specified by **`daddr`**. The **`ifname`** parameter indicates that the created SVC should be identified by the name *aal5-1*. Other parameters in the command (assumed default here) specify what characteristics you want for the SVC: the traffic descriptor, multiplexing type and so on, as with a PVC. After the command is executed, establishing the SVC with the remote host depends on the Signaling ATM Adaptation Layer (SAAL) status.

If SAAL status is **UP** the modem negotiates SVC parameters with the remote host by exchanging signaling messages. Once the VC is established the following trap is generated:

```
STATUS ALARM : ATM VC Up : Interface - aal5-1, PortId = 7, Vpi = 0,
Vci = 33
```

This indicates that the negotiated SVC has the VPI = 0 and VCI = 33 and has been created with the interface name *aal5-1* on the modem. Giving the **`get atm vc intf`** command will now show this new VC as well. The allocated VPI and VCI values can also be seen using the **`get atm svccfg`** command.

If SAAL status is **DOWN,** the modem does not exchange signaling messages with the remote host. So, SVC is not established at this point in time. In future, whenever SAAL comes up, the SVC gets established on its own.

To check out, at any time, if an SVC is established or not, its VPI and VCI value should be checked by issuing the **"get atm svccfg"** command. If it is not established, then, you see the printed value as **"-"** . Otherwise, the valid numerical value is printed.

All SVCs are disconnected when SAAL goes down. So, VPI and VCI value become unassigned for these VCs. Whenever SAAL comes up, the SVCs get established on their own.

To delete an SVC, use the `delete atm svccfg` command.

***SVC configuration can be specified in the tefacs.txt** file (default configuration). Also, SVC configuration is committed when the **`commit`** command is invoked. SVC configuration is retained across boots.*

Starting and Stopping an SVC

You can force SVC establishment or disconnection using the **start** and **stop** commands, discussed below.

To start/stop an SVC by exchanging appropriate signaling messages with the network side, enter:

```
modify atm svccfg ifname aal5-1 start

modify atm svccfg ifname aal5-1 stop
```

`Start` is particularly useful when an SVC is disconnected by the network side. If an upper layer protocol such as PPPOE is bound over this VC, and you want to re-establish the SVC, you can do so using the **`start`** command, without any configuration overheads. If you specify **`start`** command for an already established SVC, or a **`stop`** command for an already disconnected SVC, it is ignored.

The trap message “ATM VC Up” displays after the SVC is established. The trap message “ATM VC down” displays when the SVC is disconnected.

Deleting an SVC

To delete an SVC, enter

```
delete atm svccfg ifname aal5-1
```

SVC deletion fails if an upper layer, such as PPPoE, is bound over the VC.

To verify SVC deletion, use the **`get atm svccfg`** command. It should not show an entry corresponding to the specified interface name.

Deleting UNI

To delete a configured UNI signaling channel, enter:

```
delete atm uni ifname aal5-0
```

To verify UNI deletion, use the **`get atm uni ifname aal5-0`** command. It should not show any entry corresponding to the specified interface name.

Deleting PVC for UNI signaling

To delete the PVC for UNI signaling, enter:

```
delete atm vc intf ifname aal5-0
```

5.7 Configuring PPP Interfaces

The unit supports two types of PPP interfaces—PPPoA and PPPoE. For authentication, both Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP) are supported. Each PPP interface is IP-enabled, i.e., it has an associated IP address. You may specify this IP address in the **`create ppp intf`** command, if the address is allocated statically by the ISP. If the IP address is obtained dynamically using IPCP, do not specify it as part of the command.

To use the peer IP address as the gateway address, enter:

```
$ create ppp intf ifname ppp-0 start lowif aal5-0 PPOA droute true
usedns true usegw remote
```

In this case, the PPP stack adds the peer IP address obtained through IPCP, as the gateway address in default route.

The IP address passed in IPCP negotiation may also be the same as the PPP interface IP address. Alternately, the peer PPP may not send the gateway address in IPCP negotiation. In either of the two cases, the gateway address in the default route will be the same as the self IP address. In all other cases, the gateway address in the default route will be the one sent from the peer PPP.

To use the self IP address as the gateway address, enter:

```
$ create ppp intf ifname ppp-0 start lowif aal5-0 PPOE droute true
usedns true usegw local
```

In this case, the PPP stack will always ignore the peer IP address obtained through IPCP negotiation from the other side, and will always use its own IP address as the gateway address in the default route.

If a PPP interface is to be used as the default route, set the `droute` *parameter to* `true` *in the* `create ppp intf` *command.*

PPP interfaces are named *ppp-0*, *ppp-1*, etc. To create a PPP interface:

Create a login name and password for the PPP interface.

Create the PPPoE or PPPoA interface itself.

The commands related to both of these steps are briefly discussed in sections through .

For a complete listing of these commands, including parameters and default values, refer to the CLI Reference Manual.

5.7.1 Creating a Login Name and Password for a PPP Interface

To create the login name and password for the *ppp-0* interface, enter:

```
$ create ppp security ifname ppp-0 pap login user1 passwd paswd1
```

This creates the login *user1* and password *paswd1* for PPP interface *ppp-0* and configures it to use PAP authentication. Typically, each PPP interface has a unique login and password created by this command.

If you create a PPP interface without issuing this command, the interface will use the login and password of the PPP security *default entry. To create this default entry, either include the command* `create ppp security ifname all` *in the factory defaults file, or enter this command at the CLI prompt, specifying the login and password parameters as shown above.*

To show the currently configured PPP user names, enter:

```
$ get ppp security
```

To change the password for the *ppp-0* interface, enter:

```
$ modify ppp security ifname ppp-0 passwd newpwd
```

The new password *newpwd* will not take effect until a new PPP session is established, either by rebooting the unit, or by stopping and starting the session using the **`modify ppp intf`** command.

5.7.2 PPPoE Interfaces

Use the following commands to create PPPoE interfaces.

For a complete listing of these commands, including parameters and default values, refer to the CLI Reference Manual.

Creating a PPPoE interface with a fixed IP address

To configure a PPPoE interface with a *fixed* IP address, enter:

```
$ create ppp intf ifname ppp-0 lowif aal5-0 ip 202.1.1.1 ppoe sname
internet
```

This configures PPPoE interface *ppp-0* to run on VC *aal5-0*, using the service name *internet* and the fixed address *202.1.1.1*. (The service name identifies a paid service subscribed to by the end user.)

You must supply the `sname` parameter for a PPPoE interface. The ISP uses this to identify the type of connection to use for the interface.

Creating a PPPoE interface with a dynamic IP address

Enter the same command as above, but *without* the IP address:

```
$ create ppp intf ifname ppp-0 lowif aal5-0 ppoe sname internet
```

To retrieve additional configuration information from the ISP's DHCP server, use the `usedhcp` parameter. To do so, set the **`usedhcp`** parameter to **`true`** (this parameter is normally set to **`false`**).

5.7.2.1 *Access Concentrator Selection*

ISPs use **Access Concentrators (ACs)** to handle PPPoE connections from end users. Although an AC can handle more than one connection at a time, ISPs need multiple ACs to handle large numbers of subscribers. As a result, more than one AC may reply to a connection request. By default, the unit accepts only the first response from any AC ("first-come" policy).

An ISP may, however, require the user to accept responses only from a specific AC for a specific service; e.g., the user must use the AC *ac-i* to access the *internet* service. In this case, a *service-to-AC-name mapping* must be created, and the AC selection policy must be changed using the **`modify ppe cfg`** command.

Creating service-to-AC-name mapping

To create a mapping between the service called *internet* and AC *ac-i*:

```
$ create ppe pconf srvname internet acname ac-i
```

Changing the AC selection policy

To configure the unit to use service-to-AC-name mapping, enter:

```
$ modify ppe cfg serv-to-ac
```

When a subsequent connection is made for a specific service, the unit will only accept responses from the AC specified in the mapping.

Listing the available ACs

To list an ISP's ACs and the services supported by each AC, enter:

```
$ get ppe acserv ifname aal5-0
```

5.7.3 PPPoA Interfaces

Use the following commands to create PPPoA interfaces.

For a complete listing of these commands, including parameters and default values, refer to the CLI Reference Manual.

Creating a PPPoA interface with a fixed IP address

To create a PPPoA interface with a *fixed* IP address, enter:

```
$ create ppp intf ifname ppp-0 ip 202.1.1.1 lowif aal5-0 ppoa
```

This creates PPPoA interface *ppp-0* on VC *aal5-0* with address *202.1.1.1*.

Creating a PPPoA interface with a dynamic IP address

Enter the same command as above, but *without* the IP address:

```
$ create ppp intf ifname ppp-0 lowif aal5-0 ppoa
```

To retrieve additional configuration information from the ISP's DHCP server, use the **`usedhcp`** parameter. To do so, set the **`usedhcp`** parameter to **`true`** (this parameter is normally set to **`false`**).

5.7.4 Checking the IP Address of a PPP Interface

Whenever you create a PPP interface, its IP address is negotiated using the IPCP protocol, even if you specify the IP address. Because of this, you should check the IP address after creating a PPP interface.

You should also check a PPP interface's IP address if a "link up" trap is reported for that interface.

Displaying the requested address for a PPP interface

To see the IP address you specified when creating the interface, enter:

```
$ get ppp intf
```

Displaying the actual address of a PPP interface

To see the actual addresses of all PPP interfaces (and all IP-enabled interfaces), enter:

```
$ get ip address
```

5.7.5 Configuring the PPP Auto start/stop Feature

A PPP interface, once created, remains operational all the time. This proves to be a security risk sometimes. The modem allows you to take care of this with the PPP auto start/stop feature. The **`pppsesstimer`** parameter in the size command specifies a timeout value. If specified, say as 2, it means that if the configured PPP interface is lying unused for more than 2 minutes, it will be made unoperational automatically. Later, if you try to connect to the WAN side, the modem will automatically restart the PPP interface. Having the PPP interface operational only when required also helps in efficient bandwidth utilization for the ISP where many such PPP connections are being handled simultaneously.

Setting the **`pppsesstimer`** as 0, or not specifying it at all indicates that you do not want to use the auto start/stop feature, in which case the PPP interface will remain operational all the time.

5.7.6 IP Unnumbered PPP Interfaces

The modem's PPP interface is typically assigned a unique IP address from the ISP's PPP server. This IP address must be in a

different subnet than the IP addresses assigned to the modem's LAN interfaces, such as eth-0 and usb-0.

The IP Unnumbered feature provides an alternative configuration that enables the PPP interface to be created with an IP address that is the same as that assigned to the modem's Ethernet interface, eth-0. Using this feature, the PPP interface does not need to obtain an IP address from the ISP.

The PPP interface borrows the IP address from eth-0 to facilitate routing. During IPCP negotiations with the ISP's server, the PPP interface conveys this address to the other side as its own. If the ISP's server is configured to allow IP Unnumbered connections, then it does not provide another IP address to the PPP interface, as it would in normal operation.

If the ISP's PPP server is not configured to allow IP Unnumbered connections, then the server would respond with an IPCP negative acknowledgement (NAK) and instead assign a new IP address to the interface, as it would in normal operation.

The IP Unnumbered feature can be useful in environments in which conserving IP addresses is a priority.

It is assumed that the LAN hosts are configured with IP addresses that are visible to the ISP (i.e, not translated via NAT). In typical scenarios where the modem is configured with only one WAN interface (in this case, the IP Unnumbered PPP interface), users will not need to configure NAT in conjunction with this feature.

5.7.6.1 *Configuration*

To configure a PPP interface as IP Unnumbered interface, the PPP interface must be created without an IP address and must specify the interface from which to borrow an IP address (only eth-0 is supported):

Creating an IP Unnumbered interface

The following command creates a PPPoA unnumbered interface that borrows the IP address of eth-0 and specifies this interface as the default route.

```
create ppp intf ifname ppp-0 ppoa lowif aal5-0 numif eth-0 droute true
```

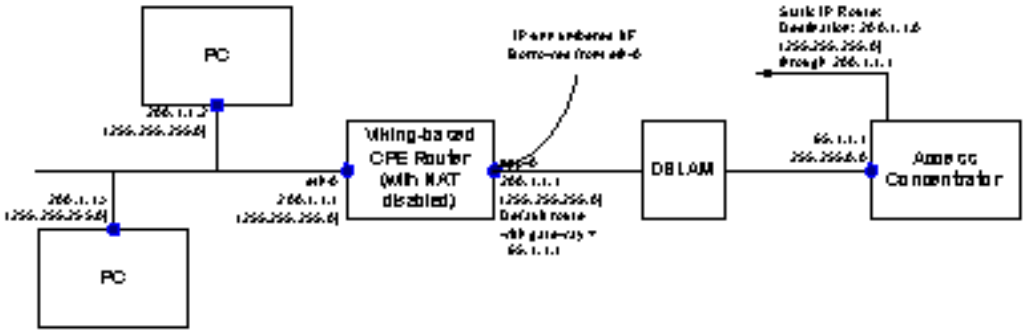
PPPoE interfaces can also be created in this manner. A gateway IP address can also be specified using the **gwy** parameter, or can be learned during the IPCP handshake. A specified gateway IP address will override any address learned via IPCP.

5.7.6.2 *Limitations*

The following limitations apply when implementing an IP Unnumbered interface:

- ❖ Only point-to-point interfaces can be IP Unnumbered. This feature is not relevant for EoA or IPoA interfaces.
- ❖ The interface from which the PPP interface borrows the IP address must be the modem's Ethernet interface, eth-0 ; it cannot be usb-0 or any other LAN interface.
- ❖ The interface eth-0 cannot be configured to receive its IP address through DHCP, and the IP address cannot be modified during an active PPP connection.
- ❖ The ISP's access server must be configured with an IP route that specifies the LAN's network address as the destination and the interface associated with that user's VPI/VCI as the gateway.

Figure below provides an illustration of IP Unnumbered configuration.



5.7.6.3 *IP Unnumbered with NAT*

The configuration shown above requires each LAN PC to have a public IP address (within a range given by the ISP) and does not make use of Network Address Translation (NAT). However, because each public IP address is normally available only at a cost to the user, there may be cases where the customer has more LAN PCs than available public IP addresses.

For example, a customer may obtain four public IP address from the ISP for use with servers on the LAN (web server, mail server, etc.), but may have 10 additional PCs that use private IP addresses in the subnet 192.168.1.x, mask 255.255.255.0.

The user can configure NAT to enable these 10 PCs to access the internet. This can be achieved by creating a virtual IP (VIP) LAN interface on the modem with private IP address (say, 192.168.1.1, mask 255.255.255.0). The user would then create a NAT rule (NAPT flavor) to translate the PCs' local IP addresses to the VIP IP address. The following CLI commands create a rule of this type and enable the NAT service:

```
create nat rule entry ruleid 1 napt lcladdrfrom 192.168.1.2 lcladdrto
192.168.1.254
modify nat global enable
```

5.8 Configuring the Operating Mode

The reference unit is preconfigured to boot up as a router. Once the unit is running, however, you can use CLI commands to interactively reconfigure the unit to run in either operating mode (router or bridge) or to configure special features of routing mode, such as simultaneous bridging and bridged IP.

For your own product, you can preconfigure the operating mode (and other settings) by modifying the factory defaults file and using it to create your own flash image. For complete information on this process, refer to the *Image Handling User Manual*.

5.8.1 Bridge Mode

To change the reference unit's operating mode to bridge mode:

- **create an EoA WAN interface without an IP address;**
- **create the Ethernet LAN interface without an IP address;**
- **configure the EoA and LAN interfaces as bridge ports; and**
- **enable bridge mode.**

Creating the EoA interface

Refer to section

Creating the Ethernet interface

Refer to section

Configuring bridge ports

Bridge ports can be created on the physical Ethernet interface (eth-0), and on the EoA interfaces (eoa-0, eoa-1, etc.).

To enable bridging on the eth-0, usb-0, and eoa-0 interfaces, enter:

```
$ create bridge port intf ifname eth-0
$ create bridge port intf ifname eoa-0
```

To list all interfaces on which bridge ports have been created, enter:

```
$ get bridge port intf
```

Enabling bridging

To enable bridging, enter:

```
$ modify bridge mode enable
```

To disable bridging, enter:

```
$ modify bridge mode disable
```

To see whether bridge mode is enabled or disabled, enter:

```
$ get bridge mode
```

5.8.1.1 *Bridge Forwarding Table*

In bridge mode, the unit is a *learning bridge*, i.e., it automatically learns the association between MAC addresses and interfaces. The unit stores this information in the *bridge forwarding table*, which maps each LAN host's MAC address to one of the bridge's interfaces.

Displaying the bridge forwarding table

To display the bridge forwarding table, enter:

```
$ get bridge forwarding
```

Setting an entry's timeout period

An entry remains in the bridge forwarding table for the duration specified by the *aging parameter*. After an entry is deleted, the bridge will relearn that entry the next time the associated host sends any data across the bridge.

To set the `aging` parameter to 300 seconds, enter:

```
$ modify bridge info aging 300
```

To see the current value of the `aging` parameter, enter:

```
$ get bridge info
```

5.8.1.2 *Static Bridge Entries*

Because of the **`aging`** parameter, every entry is eventually deleted from the bridge forwarding table (and later relearned), except for *static entries*. Static entries are not affected by the **`aging`** parameter; they never time out and are never deleted from the bridge forwarding table.

Creating a static entry in the bridge forwarding table

To create a static entry in the bridge forwarding table that maps MAC address 0:1:2:3:4:5 to a specific interface such as eth-0, enter:

```
$ create bridge static macaddr 0:1:2:3:4:5 ifname eth-0
```

5.8.1.3 *MAC Address Conflicts in Bridge Mode*

In bridge mode, the unit by default filters (i.e., does not forward) data for a set of 17 reserved MAC addresses, per the 802.1d bridge specification. These MAC addresses are 01:80:C2:00:00:00 through 01:80:C2:00:00:10.

Conflicts can arise if an application uses any of these reserved MAC addresses (one such application is 802.1x Dialup). If this occurs, you must override the default list of reserved MAC addresses, as follows:

Edit the text file *resvmac.txt* in *createfi\TEFileSys\bridge*.

Delete the address(es) that should *not* be filtered and save the file.

Run Createfi to create a new image.

Load the image into the unit, then bring up the unit in bridge mode.

When in bridge mode, the unit performs filtering as follows:

If resvmac.txt specified any MAC addresses, the unit filters all those addresses.

If resvmac.txt was left *blank*, the unit performs no filtering at all.

If resvmac.txt was *omitted* from *createfi\TEFileSys\bridge*, the unit will filter the default set of 17 MAC addresses.

For information on Createfi, refer to the *Image Handling User Manual*.

5.8.1.4 *Spanning Tree Protocol*

The *Spanning Tree Protocol (STP)* prevents the formation of loops among interconnected bridges.

By default, STP is enabled on all bridge ports. It is recommended that STP be enabled whenever three or more bridges are interconnected and at least one physical loop (multiple paths between two bridges) exists.

Modifying STP on all ports

To configure STP parameters applicable to all ports, use the command:

```
$ modify stp global
```

Modifying STP on a specific port

To configure STP parameters for a specific interface such as eth-0, use the command:

```
$ modify stp port ifname eth-0
```

You must create the bridge port before you can use this command.

Disabling STP

To disable the STP ports, enter both of the following commands:

```
$ modify stp port ifname eth-0 disable
$ modify stp port ifname usb-0 disable
$ modify stp port ifname eoa-0 disable
```

5.8.2 WAN to WAN bridging

The unit does not allow WAN-to-WAN bridging, as this behavior may not be desired by users in some configuration, for reasons such as security or bandwidth constraint. However, it allows LAN-to-WAN and WAN-to-LAN bridging. WAN-to-WAN bridging is enabled, by default.

- **To disable bridging packets between WAN ports, enter:**

```
modify bridge mode wan2wan disable
```

- **To disable WAN-to-WAN bridging using the HTTP interface, use the Bridging Menu.**

5.8.3 Router Mode

If the reference unit is not currently operating in router mode, you can change it to router mode as follows:

- **set the LAN interface as the default gateway for the LAN hosts;**

- **create one or more WAN interfaces (PPPoE, PPPoA, EoA, or IPoA); and**
- **configure one of the WAN interfaces as the default route.**

Making the LAN interface the default gateway

You can configure the IP properties on each LAN host to reflect the LAN interface IP address as their default gateway. Or, if you are using the unit as a DHCP server, you can configure the DHCP properties to automatically assign the LAN IP addresses.

Creating the WAN interfaces

PPP interfaces: refer to section

EoA interfaces: refer to section

IPoA interfaces: refer to section

Making the PPP Interface the Default Route

To make the PPP interface ppp-0 the default route, set the `droute` parameter to `true` while creating the interface:

```
$ create ppp intf ifname ppp-0 lowif aal5-0 ppoe sname games droute
true
```

5.8.3.1 *Simultaneous Bridging and Routing*

In this special feature of router mode, the reference unit simultaneously acts as a router for IP traffic and as a bridge for non-IP traffic. To configure the reference unit as a router with simultaneous bridging and routing:

- **configure the unit as a router as described in section** *but* with at least one IP-enabled EoA interface with a static default route;
- **configure the Ethernet interface and an IP- enabled EoA interface as bridge ports; and**
- **enable bridge mode.**

Creating the IP-enabled EoA interface

Refer to section

Creating the Ethernet interface

Refer to section

Configuring bridge ports

To enable bridging on the eth-0, usb-0, and the eoa-0 interfaces, enter:

```
$ create bridge port intf ifname eth-0
$ create bridge port intf ifname usb-0
$ create bridge port intf ifname eoa-0
```

To list all interfaces on which bridge ports have been created, enter:

```
$ get bridge port intf
```

Enabling bridging

To enable bridging, enter:

```
$ modify bridge mode enable
```

To disable bridging, enter:

```
$ modify bridge mode disable
```

To see whether bridge mode is enabled or disabled, enter:

```
$ get bridge mode
```

5.8.3.2 *Bridged IP*

In this special feature of router mode, the reference unit functions as a bridge over the WAN interface and as a router over the LAN interface. To configure the reference unit as a router with bridged IP:

- **configure the unit as a router as described in section but with at least one IP-enabled EoA interface**

Creating the IP-enabled EoA interface

Refer to section

Creating the Ethernet interface

Refer to section

Configuring bridge ports

To enable bridging on the eth-0, usb-0, and the eoa-0 interfaces, enter:

```
$ create bridge port intf ifname eth-0
$ create bridge port intf ifname usb-0
$ create bridge port intf ifname eoa-0
```

To list all interfaces on which bridge ports have been created, enter:

```
$ get bridge port intf
```

Enabling bridging

To enable bridging, enter:

```
$ modify bridge mode enable
```

To disable bridging, enter:

```
$ modify bridge mode disable
```

To see whether bridge mode is enabled or disabled, enter:

```
$ get bridge mode
```

5.8.4 Bridge Router Autosense (BRAS)

The Bridge Router Autosense feature will be useful in the following scenario. The unit is pre-configured completely, for the unit to run in either routing mode or bridging mode. Basically the unit would have both PPPoE and EoA interfaces pre-configured. When the unit is plugged in to the user's network, it is able to detect the mode in which it is required to operate. This means that, the user would be able to use either the unit's PPPoE client, or one on the LAN PCs, as the need may be, without having to configure anything on the unit. The unit would be able to withdraw it's PPPoE client at run time if it detects any PPPoE traffic.

5.8.4.1 *Configuration details*

When the unit boots, configured PPPs will try to come up as usual. If PPPoE traffic is detected from the LAN end, then the PPPoE client on the modem will get disabled. The PPPoE packet received from the LAN will get forwarded to the WAN side, because of the preconfigured bridge ports.

If later on, the user wants to switch to the unit's PPP, he just needs to re- enable the PPPoE client on the unit using the following CLI command:

```
modify bras <selfppe restart>
```

This will bring up the unit's PPPoE. Thereafter, starting the LAN PPPoE client again, will disable the unit's client.

To enable or disable the BRAS feature, the user can use the following CLI command:

```
modify bras enable | disable
```

A reboot is not required to switch back and forth between enabling and disabling this feature.

5.8.5 Zero Installation PPPoE Bridge (ZIPB) Mode

Configuring the modem in the Zero Installation PPPOE Bridge or ZIPB mode enables service providers to avoid installing a PPPoE client on subscriber PCs as well as avoid running NAT on the modem. ZIPB combines the advantages of routing and bridging modes.

5.8.5.1 *Advantages of the ZIPB mode*

Configuring the modem in the ZIPB mode:

- **does not require you to install any software on subscriber PCs**
- **does not require you to run NAT on the modem**
- **allows you to manage modem for both LAN and WAN sides, because the modem has an IP address on both LAN as well as WAN interfaces.**
- **allows you to run Firewall/filtering feature on the modem.**
- **allows you to use bandwidth efficient PPPoA, on the modem's WAN interface.**

5.8.5.2 *ZIPB mode - operation details*

LAN PCs get their global addresses through the DHCP server functionality. If a PPP IP address is available to the unit, the LAN PC gets this address on a DHCP request.

Initially, when PPP is not yet up, the IP address allocated to the LAN PC comes from the Ethernet pool, and PPP is triggered to come up.

When the LAN PC sends a renewed request for an IP address allocation, the unit checks if any PPP IP address is free to be allocated. If a PPP IP address is free, then, it will send a NACK to the renewal request for the Ethernet pool IP address. This will force the LAN PC to go in to the DHCP discovery state. Now, when the unit receives a fresh DHCP discovery message, it will allocate the PPP IP address and simultaneously de- allocate the IP address allocated from the Ethernet pool.

For proper functioning of ZIPB, PPP should be configured with the 'startondata' option. This will ensure that PPP comes up only when the LAN PC is up and that PPP goes down when the LAN PC is switched off.

The behavior of 'startondata' is different when ZIPB is enabled. With ZIPB enabled, PPP comes up only if the LAN PC sends a DHCP request for an IP address, and not on any other data activity.

The unit remembers the PPP IP address even after PPP goes down. The unit continues to allocate this same PPP IP address to the LAN PC. So, the user can access the Internet the minute PPP is up. He does not need to wait for IP address allocation, provided PPP comes up with the same IP address.

If the PPP IP address is different from the previously allocated address, it will send a ForceRenew message to the LAN PC. The next time the PC tries to get an IP address, it will get the new PPP IP address.

To enable ZIPB at the modem, enter,

```
modify zipb cfg enable
```

5.8.5.2.1 Management from LAN end

When the unit is working in ZIPB mode, the LAN side PCs get the PPP IP addresses allocated to the modem using IPCP or DHCP. If the PPP interface is not up, the PC gets an IP address from the DHCP server pool 0. The DHCP pool has a small default lease and clients will keep sending renew requests after 30 seconds.

Each request for renewing an IP address from DHCP pool 0, results in writing to NVRAM and more writes to NVRAM. This reduces the NVRAM life.

LAN machines can access the modem in ZIPB mode, as they would, in non-ZIPB mode, using the Ethernet IP address.

Instead of trying to access an IP address, the LAN side PC user should use the DNS relay capability of the modem. Please refer to the chapter on DNS relay for details on this feature.

5.8.5.2.2 Management from WAN end

When in ZIPB mode, with the PPP link up, all requests coming to the modem from the WAN end are passed on to the PC behind it, as the PPP IP address of the modem is considered the IP address of the PC behind the modem. The standard Telnet, FTP and HTTP services on the PC behind the modem, run on ports 21, 20 and 80 respectively. However, if you want to access any of the telnet, ftp or HTTP services on the modem, you can configure the ports to be other than the standard ones used on the PC behind the modem.

To access the modem from the WAN end, using telnet or http, use the PPP IP address allocated to the modem. The ports you will specify during WAN- end access should be the same as those specified for the modem in the **nbsize** command.

While configuring telnet and http ports, above, from both LAN and WAN ends, the user needs to remember to use the same ports as those mentioned in the get nbsize *command.*

5.8.5.2.3 Use of ForceRenew in ZIPB mode

When configured in the ZIPB mode, the modem is able to detect that the LAN PC is switched off, and it automatically brings down PPP. When the LAN PC comes up again, the modem senses it, and brings up PPP too.

ForceRenew, as defined in RFC 3203 is used in the ZIPB mode in the following scenarios.

If a LAN client is up with an IP address from the Ethernet pool, and the PPP interface comes up, a ForceRenew message is sent to the client. When the client sends a renew, it is sent a NACK by the server. The Client then sends a Discover and now it can be given any of the free PPP IP addresses maintained by the DHCP server.

The DHCP server initiates ForceRenew for the following trigger points:

- **ZIPB is enabled**
- **ZIPB disabled**
- **PPP Up trigger**

5.8.5.3 *Preconditions to configuring the modem in ZIPB mode*

- **An Ethernet interface should be created. You can use the following syntax,**

```
create ethernet intf ifname eth-0 ip 192.168.1.1 mask 255.255.0.0
```

❖ **You need to create and enable a DHCP server pool with poolId 0 and an Ethernet subnet with small lease time. For example, you can use the following syntax.**

```
create dhcp server pool poolid 0 start-ip 192.168.1.2 end- ip
192.168.1.5 mask 255.255.0.0 lease 60 mlease 120
```

❖ **Enable dhcp server, by entering,**

```
dhcp server cfg enable
```

You should also configure PPP with startondata.

```
$ create ppp intf ifname ppp-0 ppoe sname test lowif aal5-0
 droute true startondata
```

Configure the ftp, telnet and http ports to be different from the standard ports 23, 20 and 80 respectively, if you want to provide these services on the LAN PC as well.

5.8.5.4 *Configuring ZIPB*

You can either enable or disable the ZIPB mode on the modem. It is disabled by default. You can set the mode by using either the default configuration (factory defaults file) or CLI commands.

You can dynamically configure the modem to work in the ZIPB mode. When disabled, the modem runs either in bridging or routing mode. When enabled, it runs in the ZIPB mode.

Configuring using the factory defaults file

❖ **To enable ZIPB enter:**

```
$ modify zipb cfg enable
```

Run the **createfi** utility and upload the image to flash.

Configuring using CLI

On the command line interface, use this command to enable ZIPB:

```
$ modify zipb cfg enable
```

The preconditions to configuring ZIPB, as mentioned in the section above, need to be met.

6 Viewing and Modifying DSL Information

The CLI enables you to configure various parameters that control how data is transmitted on the DSL line. You can also view statistics relating to the DSL line performance.

6.1 Modifying the DSL Configuration

You may need to modify various DSL parameters to ensure proper operation of the reference design with your test equipment, or to prepare your customer units for operation in the particular environment in which they will be deployed. DSL-related information can be modified using the following command:

```
$ modify dsl config <parameters>
```

The command parameters enable you to change a variety of properties, including the DSL standard to which the firmware complies and the DSL annex type. You can also start and stop operation of the DSL loop and set various operating characteristics, such as the coding gain due to Reed- Solomon or trellis coding, the level of framing overhead, and the power attenuation in dB.

Several examples follow. A complete list of parameters and their descriptions is provided in the *CLI Reference Manual*.

Modifying the DSL configuration

To change the DSL standard to G.dmt (G.992.1), enter:

```
$ modify dsl config gdmt
```

To change the DSL annex to Annex C, enter:

```
$ modify dsl config annexc
```

To enable (default) or disable the operation of the DSL loop, enter:

```
$ modify dsl config loop start
$ modify dsl config loop stop
```

Viewing the DSL configuration

To view current DSL configuration information, enter:

```
$ get dsl config
```

6.2 Viewing DSL Parameters and Statistics

You can use the following commands to view a variety of non-modifiable DSL parameters and performance statistics. For a complete list of all parameter values for all the following commands, see the *CLI Reference Manual*.

Viewing DSL parameters

To view DSL parameters, enter the following command:

```
$ get dsl params
```

The output displays static DSL information such as the vendor ID and serial number, and calculated values such as far- and near-end RS errors, the signal-to-noise ratio, the calculated line attenuation, and other statistics.

Viewing DSL statistics

To view the number of errored, severely errored, and unavailable seconds in the past 15-minute interval and in the past 24 hours, type the following command:

```
$ get dsl stats curr
```

To view the number of errored, severely errored, and unavailable seconds for eight 15-minute intervals, starting with four intervals ago (i.e., statistics for the intervals from 1 hour ago to 3 hours ago), enter:

```
$ get dsl stats hist 8 4
```

The display also shows the number of intervals in which valid data was transmitted. You can specify up to 96 past intervals to display.

To view near- and far-end errors counts relating to Reed-Solomon, CRC, and other errors types accumulated since the last reboot, enter:

```
$ get dsl stats cntrs
```

To view local and remote transmission failures accumulated since the last reboot, enter:

```
$ get dsl stats flrs
```

The output displays loss-of-signal defects (LOS), severely errored frame defects (SEF), no-cell delineation errors, and loss-of-cell delineation errors for the data stream.

Resetting DSL statistics

The DSL counters and failure statistics accumulate starting from the last reboot. You can use the following commands to reset these statistics to zero without rebooting:

```
$ reset dsl stats flrs
$ reset dsl stats cntrs
```

7 Configuring IP and Routing Management

This chapter shows you how to configure routes on the modem and on the LAN hosts.

Before you begin this chapter, configure the WAN and LAN interfaces as described above.

7.1 Configuring Routing on LAN Hosts

In *routing* mode, because the unit acts as the gateway for the LAN hosts, the LAN hosts should be configured to use the LAN IP address as their default gateway.

7.2 Configuring Routes

Of the WAN interfaces, the PPP, EoA, and IPoA interfaces are IP-enabled, i.e., can have IP addresses. A PPP, EoA, or IPoA interface can therefore be used as the default route *for the unit itself*.

Configuring a PPP interface as the default route

The `create ppp intf` command has a `droute` parameter that, when set to true, makes the interface the default route. In this case, PPP automatically creates the default route entry, where the default gateway address is the IP address of the other end of the PPP interface. Only one PPP interface can be made the default route using `droute`.

There can be only one default route on the modem.

You can use the **`create ip route`** command to create other, non- default routes also. These are called *static* routes. The **`ip`** and **`mask`** parameters indicate the destination for which the route is being created. If the mask is 255.255.255.255 then the route is towards a single host whose IP address is given by the **`ip`** parameter. Any other value of the mask indicates that the route is towards a subnet, the subnet address being determined by masking the **`ip`** parameter with the given mask.

Creating a static route

To create a static route to the subnet 172.25.0.0 (mask 255.255.255.0), via the gateway 10.2.1.1, enter:

```
$ create ip route ip 172.25.0.0 mask 255.255.255.0 gwyip 10.2.1.1
```

Be sure to verify that your modem can reach the gateway. This can be done beforehand using the **ping** command, e.g., **ping** *10.2.1.1*.

A *dynamic* route is one created automatically by the modem, either when you create an IP-enabled interface, or by learning through RIP.

To see the current routes, both static and dynamic, enter:

```
$ get ip route
```

Deleting a route

To delete a route, enter:

```
$ delete ip route ip 172.25.0.0 mask 255.255.255.0
```

Modifying an IP route

To modify an IP route, delete the existing route using the **delete ip route** command, then recreate the route using the **create ip route** command.

Suppose you create a static route to subnet 172.25.0.0 via gateway 10.2.1.1. To modify the route to use a different gateway, say 20.1.1.1:

First delete the existing entry by entering:

```
$ delete ip route 172.25.0.0 mask 255.255.255.0
```

Next, recreate the route with the new gateway address by entering:

```
$ create ip route ip 172.25.0.0 mask 255.255.255.0 gwyip 20.1.1.1
```

7.3 Routing Mode

Routing (or more appropriately, forwarding) is enabled by default. It can be disabled using the **modify ip cfg** command.

To disable IP forwarding on the modem, type the command:

```
$ modify ip cfg forwarding disable
```

To see the current state, type the command:

```
$ get ip cfg
```

7.4 RIP

Routing Information Protocol (RIP) is a dynamic routing protocol typically used inside the organization to exchange routes between various routers within the organization. The modem's RIP is an implementation of RIPv2 with compatibility with RIPv1 and can be configured to run as either RIPv1, RIPv2, or RIPv2-with-RIPv1 compatibility mode.

7.4.1 RIP Global Configuration

To enable or disable RIP on the IAD use the command :

```
$ modify rip global
```

The command also allows you to modify RIP timing parameters such as **updatetime** which is the frequency at which the modem broadcasts its routes, and **agetime** which is the time after which the modem would delete a route for which no updates have been received.

To see the current state and currently active global configuration, use the command:

```
$ get rip global
```

7.4.2 RIP Interface Configuration

To configure RIP on an IP enabled interface with the desired configuration, use the create rip intf command :

```
$ create rip intf ifname ppp-0 metric 1 send rip2 receive rip2
senddefroute enable recvdefroute enable auth text abcd
```

The above command enables RIP on ppp-0 interface.

The **send** and **receive** parameters indicate that RIPv2 is to be used for both sending and receiving RIP updates. The **senddefroute** parameter simply tells whether the modem should send updates for default routes or not. Similarly, the **recvdefroute** parameter tells whether the modem should process updates for default routes received from other routers or not. The **auth** parameter says that RIP authentication is to be provided using the clear text password **abcd**. Routers sending RIP updates to the modem on this interface must include this password in their messages. The same password is also used by the modem when it

sends out RIP updates to other routers on this interface. If no authentication is required, the **`auth`** parameter is set to none. In case of RIPv1, **`auth`** must be set to **`none`**.

The metric *is a kind of path cost associated with the interface. The higher the metric, the costlier it is to use that interface to get to a particular destination.*

When a router sends its routing updates to the modem it associates a metric value with each route. Suppose the modem receives RIP updates for routes to the same destination A from two of its interfaces, ppp-0 and ppp-1. The metric in the messages received on the two interfaces is, say, the same,3. Further suppose that we created the RIP interface on ppp-0 with the metric 1 and on ppp-1 with the metric 2. Now when the modem tries to decide whether to use ppp-0 or ppp-1 to reach the destination A, it adds the metric given during the **`create rip intf`** command to that update received in the RIP message. So reaching A via ppp-0 has a metric cost of 3 + 1 = 4, while reaching A via ppp-1 has a metric cost of 3 + 2 = 5. The route chosen finally is the one with the minimum metric cost, i.e. ppp- 0. The metric associated with the RIP interface is also used while sending RIP updates to neighboring routers. For a route received on ppp-0 with metric 2, the update to a router connected to ppp-1 would contain the metric calculated as follows -

Original metric + metric of ppp-0 = 2 + 1 = 3

The metric can be any number between 1 and 15. Setting the metric to 15 effectively disables that interface for IP traffic, i.e. routes using that interface are deleted from the routing table.

To modify RIP parameters, use the command:

```
$ modify rip intf
```

To view the current configuration, use the command:

```
$ get rip intf
```

7.5 IGMP

The Internet Group Management Protocol (IGMP) is used by multicast- enabled hosts to tell routers on their LAN that they want to receive multicast packets. Multicast routers use IGMP messages to learn the presence of multicast groups on their LAN so that they can forward relevant multicast packets to them. The modem supports IGMP version 1.0 and version 2.0.

Creating IGMP interfaces is useful only when the unit is configured in routing or ZIPB mode. When the unit is configured for routing and bridging simultaneously, then all multicast packets will go through routing path —and not through the bridging path — if the IGMP interface is created as described in this section. If you require that multicast packets go through bridge mode only, do not create an IGMP interface on the unit.

IGMP is enabled on the modem by configuring IGMP router and host interfaces.

- **IGMP router interfaces are typically the LAN side interfaces, and these can be multiple.**
- **The IGMP host interface is typically one of the WAN side interfaces (PPP, EoA or IPoA); there can be only one IGMP host interface.**

The modem listens to IGMP reports on its router interface(s), consolidates them, and forwards the consolidated reports out its host interface, thereby acting as an IGMP proxy agent for its LAN hosts. The reports generated on the LAN also help the modem learn what groups are currently active on each of its LAN interfaces. This information can be viewed using the **`get igmp groups`** command. If a packet is received for a group which the modem knows is active on at least one of its router interfaces, it forwards the packet out that interface.

The IGMP version can be configured individually for each of the modem's IGMP-enabled interfaces. As IGMPv2 can fall back to IGMPv1, it is preferable to configure all interfaces with IGMPv2; the modem will still be able to communicate with an IGMPv1-compliant LAN PC or uplink router.

Configuring IGMP router interface on eth-0

To configure an IGMP router interface on eth-0 with the default values, enter:

```
$ create igmp intf ifname eth-0 router
```

You can add these parameters to the command (see the example that follows).

- **query interval: the interval at which the modem periodically queries the hosts for currently active groups**
- **maximum response time (IGMPv2 only): the amount of time a host has to respond to a query**
- **last member query interval (IGMPv2 only): After receiving a "leave group" message from a host, the modem will send a query to determine if other hosts remain in the group, and wait for responses. This parameter determines the amount of time the modem waits for responses.**

For any IGMPv2 router interface, if you set the last member query interval as 0 seconds, then as soon as an IGMP "leave group" message is received from any LAN side host, the group will be detached from that router interface. This means that the modem will not send an IGMPv2 group- specific query to find other LAN hosts still interested in receiving data for this multicast group.

If you know that there is only one LAN host for a group particular group (e.g., if an IGMP-compliant video set-top box is connected to the modem), set this parameter to 0 so that the modem will detach the group immediately.

- **robustness indicator: a whole number used to multiply the specified query and response intervals, or to set the number of repeated queries that must be sent out when determining whether any hosts remain in a group. Specify a higher number when the network has a greater tendency to lose messages.**

Configuring an IGMP router interface with parameters

The following command configures an IGMP router interface on eth-0 with version IGMPv2, a last member query interval of 1 second, a robustness indicator of 3, and a query interval of 60 seconds:

```
$ create igmp intf ifname eth-0 router version igmpv2 lmqinterval 1
robust 5 qinterval 60
```

Configuring an IGMP host interface on ppp-0

To configure an IGMP host interface on ppp-0 with the default values, enter:

```
$ create igmp intf ifname ppp-0 host
```

To configure an IGMP host interface on ppp-0 with IGMPv1, enter:

```
$ create igmp intf ifname ppp-0 host version igmpv1
```

Viewing IGMP groups

To see which groups are currently registered on the modem's IGMP router interfaces, enter:

```
$ get igmp groups
```

If, for example, the command output reports group 224.1.1.1 on the eth-0 and usb-0 interfaces, then when a packet with the destination of 224.1.1.1 is received on the IGMP router interface, it will be forwarded to the eth-0 and usb-0 interfaces.

Deleting IGMP interfaces

To delete an IGMP host interface on eth-0, enter:

```
delete igmp intf ifname eth-0
```

To delete an IGMP host interface on ppp-0, enter:

```
delete igmp intf ifname ppp-0
```

8 Virtual Private Network

An internet-based virtual private network (VPN) uses the open, distributed infrastructure of the Internet to transmit data between corporate sites. This chapter explains how the modem uses the Layer 2 Tunneling Protocol (L2TP) to provide the benefits of a VPN.

8.1 Overview

Why VPNs?

Businesses today are faced with supporting a broader variety of communications among a wider range of sites even as they seek to reduce the costs of their communications infrastructure. Employees are looking to access the resources of their corporate intranets while they are mobile, or from customer sites. Businesses are finding traditional solutions to wide- area networking between the main corporate network and the branch offices, inflexible and expensive.VPNs using the Internet have the potential to solve many of these business networking problems. VPNs allow network managers to connect to remote branch offices and project teams to the main corporate network, economically, while providing remote access to employees without increasing the in-house requirements for equipment and support.

How a VPN functions

Organizations using Internet VPNs set up connections to the local connection points of their ISPs and let the ISPs ensure that the data is transmitted to the appropriate destinations via the Internet, leaving the rest of the connectivity details to the ISP’s network and the Internet infrastructure.

In VPNs, connections are set up according to organizational needs. The network is formed logically, regardless of the physical structure of the underlying Internet. Unlike leased lines used in traditional corporate networks, VPNs do not maintain permanent links between the end points that make up the corporate network. Instead, a connection is created only when it is required between two points. When the connection is no longer required, it is torn down, making the bandwidth and other network resources available to other users.

L2TP for VPNs

These connections or tunnels are set up between the remote client and the corporate network it is trying to access. The client initiates the creation of the tunnel in order to exchange traffic with the corporate network. To do so, the client uses special client software, which uses L2TP, to communicate with the gateway protecting the LAN.

L2TP is one of the various protocols suggested for creating VPNs over the Internet. L2TP uses PPP to provide dial-up access that can be tunneled through the Internet to a site. L2TP uses the authentication mechanisms within PPP, because it uses PPP for dial-up links. L2TP also supports PPP's use of the extensible authentication protocols for other authentication systems.

The modem-based VPN service is actually an add-on software that is a low-cost solution for client to LAN connections. This can run on existing servers and share server resources.

8.2 L2TP

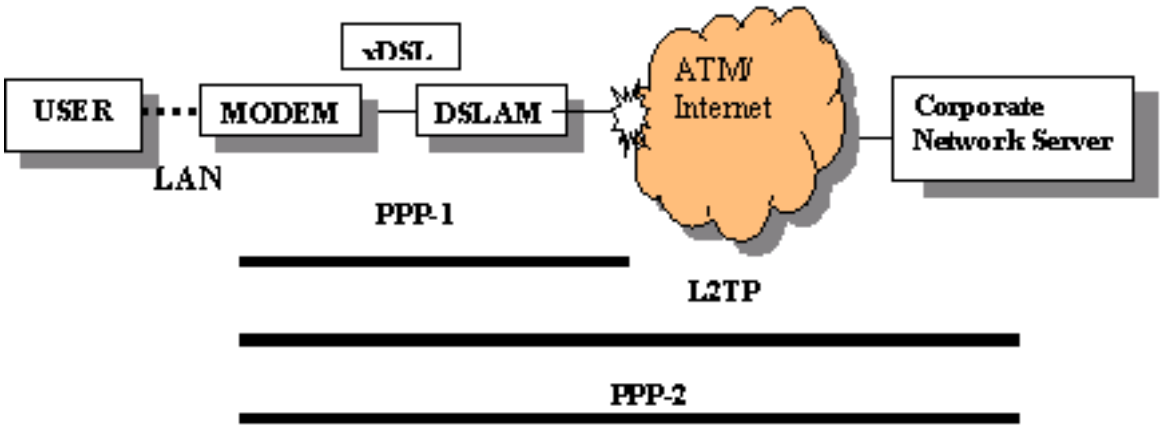
The Layer 2 Tunneling Protocol (L2TP) enables the user to connect to the corporate server directly, while using the local ISP. The user of a PPP session gets authenticated by the corporate server. This cuts down on costs that the user would have otherwise incurred on leased lines for branch offices or remote users.

The modem is a Customer Premises Equipment (CPE) used for transportation of data over Digital Subscriber Line (DSL). The modem uses Asynchronous Transfer Mode (ATM) technology over DSL to transport data to its counterpart at the Central Office. The software for the modem implements the protocol stack of ATM and its adaptation layers. In addition to this, the modem incorporates routing and bridging support for data protocols. Hence, all software components such as the IP stack and requisite drivers, such as the Ethernet driver, are also included.

L2TP is a tunneling protocol used for tunneling PPP packets through IP networks. In an xDSL environment, user ATM PVCs extend from the CPE to a centrally located NAS function. L2TP tunnels originate from the CPE and terminate on the LNS at the corporate servers connected to the Internet. The main application of this protocol is in Virtual Private Dial in Networks, providing access to corporate networks from mobile and remote users, and interconnecting various corporate offices together for access across the globe.

The diagram below shows the user or the Client connected to a LAN, talking to the modem installed at the CPE end. The modem creates a tunnel through the ISP to the network server of the corporate office, for gaining remote access. Here, the modem functions a the L2TP access client (LAC), creating the tunnel to the LAN network server (LNS), sitting at the corporate office router. The

link PPP-2 is first used to connect to the ISP. IPoA, EoA are interfaces that could also be used for this link. The link PPP-1, that connects the modem to the corporate server, uses L2TP.



Client-Corporate Office Connection using L2TP

L2TP Tunnel

A tunnel exists between an LAC-LNS pair. The Tunnel consists of a Control Connection and zero or more L2TP Sessions. The tunnel carries encapsulated PPP datagrams and Control Messages between the LAC and the LNS.

L2TP Session

The LNS and LAC maintain state for each call that is initiated or answered by an LAC. An L2TP Session is created between the LAC and LNS when an end-to-end PPP connection is established between a Remote System and the LNS. Datagrams related to the PPP connection are sent over the Tunnel between the LAC and the LNS. There is a one-to-one relationship between established L2TP Sessions and their associated Calls.

The L2TP protocol manages the tunnel in a way that makes it transparent to the PPP session inside it. L2TP clients are like "dial-up" users, and L2TP servers are like access concentrators or modem banks. Once the connection is "dialed", authenticated, and connected, data starts to flow through the tunnel in much the same

manner as a modem dial-up, except that the call is placed through the Internet (IP network) instead of the PSTN (telephone network).

If the tunnel server is on the corporate LAN, all branch office LANs can connect to the centrally located server in order to talk to each other. The user is connected to a LAN talking to the modem at the CPE. The modem creates a tunnel through the ISP to the network server of the corporate office in order to gain remote access. Here, the modem acts as a L2TP access client (LAC), creating the tunnel to the L2TP Network Server (LNS), at the corporate office router.

8.3 Configuration details

Configuring number of sessions over an L2TP tunnel

The maximum sessions over an L2tp tunnel can be configured using the **size** command in the following manner:

```
size maxl2tpsessionpertunnel 2 maxl2tptunnel b
```

The default value for the maximum number of L2TP tunnels is 1, and the maximum number of sessions possible over an L2tp tunnel is 1.

Modifying L2TP global configuration

To modify L2TP global configuration, enter:

```
modify l2tp global config timeout 180
```

The timeout value is specified in seconds. You can also specify the timeout value as infinite. If the user has configured the idle timeout (idletimeout) as infinite and the value for global config timeout is also set to infinite then the tunnel will never come down. This is because, the peer does not send a response to a control message, or , the upper PPP link goes down due to inactivity. The user should take care that these timers should not have infinite values.

Getting global information on L2TP tunnel configuration

To get L2TP tunnel global configuration information, enter:

```
get l2tp global config
```

Getting L2TP global information

To get L2TP global information such as protocol Version and Vendor name, enter:

```
get l2tp global info
```

Creating L2TP tunnel

To create an L2TP tunnel, enter:

```
create l2tp tunnel config ifname 12t-0 localip 178.10.10.10 remoteip
178.10.11.10 start authtype  simple secret passwd  hellointerval 300
idletimeout num 100 crws 5 maxretx 10 maxretxtimeout 10 payloadseq
always transport udpip initiator local localhostname titanium
remotehostname columbia
```

While creating an L2TP tunnel, peers are authenticated, either in a Simple mode, or in a Challenge mode.

While creating a tunnel, if the 'initiator' type is LOCAL then the localip *and* ***remoteip*** *fields in the command are mandatory. If the initiator type is REMOTE then* ***localip*** *is mandatory while the* ***remoteip*** *is optional.*

Deleting L2TP tunnel

Before deleting an L2TP tunnel it is necessary to delete all sessions above that tunnel, or else the tunnel deletion fails.

To delete a L2TP tunnel, enter:

```
delete l2tp tunnel config ifname interface-name
```

Tunnel Initiator Modes

A tunnel can be created with one of the two initiator modes - **LOCAL** or **REMOTE**.

When the tunnel is created with initiator as Local, the first message (SCCRQ) for the process of tunnel establishment is sent to the peer only on receiving the **start tunnel** trigger.

When the tunnel is created with initiator as Remote, a dormant state is evoked, and the first message for the process of tunnel establishment has to be sent by the peer.

Getting information on L2TP tunnel

To get information on one L2TP tunnel, or, all tunnels, enter:

```
get l2tp tunnel config ifname l2t-0
```

Modifying L2TP tunnel configuration

To modify L2TP tunnel configuration, enter:

```
modify l2tp tunnel config

ifname interface-name

localip local-ip-address

localhostname local-host-name

remoteip remote-ip-address

remotehostname remote-host-name

start|stop

[authtype  simple|challenge|none]

[secret tunnel-secret]

[hellointerval hello-interval]

[idletimeout {infinite|{num <decValue>}]

[crws contol-recv-windowsize]

[maxretx max-retransmission]

[maxretxtimeout max-retransmission-timeout]

[payloadseq  never|always}]

[transport udpip]

[initiator local|remote]

[enable|disable]
```

Starting and Stopping Tunnels

A Tunnel is created with two options START and STOP.

When the tunnel is created using the **start** option, creation and establishment of tunnel happens simultaneously. If you create a tunnel using the **stop** option, you can decide to start the tunnel later.

To stop an L2TP tunnel, issue the **Stop Tunnel** command. An L2TP peer can also stop the tunnel by sending a **StopCCN** message.

Creating PPP Session over L2TP

You can create a PPP session over an L2TP tunnel in any one of the three following modes.

- **Start** - In this mode, the PPP session is created and started simultaneously.
- **Starton data** - In this mode, a PPP session is created but not started till the data activity over that session starts.
- **Stop** - In this mode, a PPP session is created with stop option and can be started later.

To create a PPP session over L2TP, enter:

```
create ppp intf ifname ppp-1 start lowif l2t-0 L2TP usedhcp false
outside
```

Creation of PPP session fails if the lower layer (L2TP tunnel) doesn't exists.

Establishing and Ending Sessions

Once the tunnel is established, the process of establishment of L2TP session over this tunnel also begins, if there are PPP sessions configured with the lower layer as L2TP. Stopping an L2TP tunnel brings down the L2TP tunnel and all the sessions over that tunnel. When the user stops the PPP session over an L2TP session by entering the following command, the particular L2TP session stops. The command is

```
modify ppp intf ifname ppp-0 stop
```

Inactivity timer in lower layer PPP

When the link to the ISP is lost due to inactivity timer, L2TP brings down all the tunnels configured with that IP address and all the

sessions over those tunnels are also torn down. Whenever the link is restored, L2TP starts the process of establishment of all the tunnels, which are configured with that IP address. The process of establishment of all the sessions for those tunnels also begins once the tunnel is established.

When the link comes up after going down, it should come up with the fixed IP address. If the link comes up with an IP address which does not belong to the list of IP addresses configured for any of the tunnels, then the tunnel that has gone down due to the link going down, will not come up.

Getting L2TP tunnel statistics

To get L2TP tunnel status and statistics for a particular tunnel interface, enter:

```
get l2tp tunnel stats ifname l2t-0
```

To get the same information for all L2TP sessions omit the ifname parameter.

Getting L2TP UDP statistics

To get L2TP UDP statistics, enter:

```
get l2tp udp stats l2t-0
```

Getting L2TP session statistics

To get L2TP session status for a particular PPP/ PPPoE session interface:

```
get l2tp session stats pppifname ppp-o
```

To get the same information fof all L2TP sessions omit the ppifname parameter.

Resetting L2TP Session statistics

To reset L2TP session statistics for a L2TP session for particular PPP interface, enter:

```
reset l2tp session stats pppifname ppp-0
```

Resetting L2TP tunnel statistics

To reset L2TP tunnel statistics for a particular tunnel interface, enter:

```
reset l2tp tunnel stats
```

8.4 L2TP Traps

L2TP sends traps for:

- **Tunnel establishment** - This trap is generated when the tunnel establishment with the peer is successful.
- **Tunnel down** - This trap is generated when the tunnel goes down due to **stop tunnel** command from user, or , due to **stop tunnel** message from peer.
- **Session establishment** - This trap is generated when L2TP session is established successfully.
- **Session down -** This trap is generated when an L2TP session goes down.

9 Configuring DNS Relay

This chapter describes the commands for configuring the unit as a DNS relay server.

9.1 Overview of DNS Relay

PCs on a LAN can set the IP address of the unit as the DNS server. The SAR110 unit will thus act as a DNS relay server and forward the requests received from the PCs on the LAN to the actual DNS servers, whose addresses have been learned from PPP. If the PPP connection is not available (because of inactivity) at the time a DNS request is received from the LAN, the PPP link will start automatically. All the responses received from the DNS server will be forwarded to the LAN PCs.

When the unit is configured as a DNS relay server, a user will not need to change the DNS server IP address on their PC whenever their ISP changes DNS servers, or when the user connects to a different ISP.

9.2 Configuration Details

Enabling/Disabling DNS Relay

To enable or disable DNS relay, enter:

```
modify dns relay cfg [enable|disable]
```

Displaying Current Status

To display the current DNS relay statistics, enter:

```
get dns relay cfg
```

10 Configuring DHCP Server and DHCP Relay

This chapter describes the commands for configuring the unit as a Dynamic Host Configuration Protocol (DHCP) server, DHCP relay agent, and DHCP client.

- **As a DHCP server, the unit maintains a pool of IP addresses and distributes them to LAN hosts whenever they are switched on.**
- **As a DHCP relay agent, the unit forwards requests for IP addresses from LAN hosts to a DHCP server (often at the ISP's location), and then returns the IP information from the DHCP server to the hosts.**
- **If the LAN uses its own DHCP server, then the LAN interface on the unit can be configured as a DHCP client of that server.**

10.1 Default DHCP Configuration on the SAR110 Reference Unit

By default, the SAR110 reference unit is configured as a DHCP server, with two pools of IP addresses. The following commands are included in the default configuration file to set this configuration:

```
$ create dhcp server pool start-ip 192.168.1.2 end-ip 192.168.1.13
mask 255.255.255.0 gwy 192.168.1.1 enable

$ modify dhcp server cfg enable
```

The first line creates a single pool of IP addresses from 192.168.1.2 through 192.168.1.13 for distribution to up to 12 LAN hosts.

For the unit to operate as a DHCP server, LAN hosts must be configured to accept IP information dynamically.

For more information about the default configuration see above.

10.2 Configuring Unit as DHCP Server

The two commands used in the default configuration provide the basic instructions for configuring the device as a DHCP server. This section explains those commands in detail and describes additional commands and parameters you can use in your own configuration.

10.2.1 Creating DHCP Pools

A *DHCP pool* is a range of IP addresses made available on a server for distribution to LAN hosts.

Creating a Basic DHCP Pool

❖ **To create a basic DHCP pool, enter:**

```
$ create dhcp server pool start-ip 192.168.1.2 end-ip 192.168.1.13
mask 255.255.255.0
```

This command configures a pool of 12 IP addresses, from 192.168.1.2 to 192.168.1.13. The mask indicates that this pool is applicable to the subnet 192.168.1.0.

The IP addresses specified in the pool must belong to same subnet as the physical ethernet interface or one of the virtual ethernet interfaces.

Viewing Pools

To see the pool(s) you have created, along with other configurable parameters, enter:

```
$ get dhcp server pool
```

In addition to specifying the address ranges and network mask, you can add parameters to the **create** command, to:

- **Assign a specific ID number to the pool (if not specified, the next sequential number will be assigned by default, starting from 0 as first pool).**
- **Specify a lease period, which identifies how long computers can use a particular IP address before it is returned to the address pool (if not specified, the lease period is set to 1 day by default)**
- **Specify a low threshold, which determines when the unit will send an alert that the available pool of addresses is getting low.**
- **Specify a domain name for hosts that receive addresses from this pool (for the administrator's reference).**
- **Specify IP addresses that hosts should use to access various network servers (such as DNS, WINS, POP3 servers).**
- **Enable or disable the pool. IP addresses cannot be assigned from a disabled pool, but the configuration remains on the system for future activation.**

Assigning a Pool ID

You can configure multiple pools for assignment to different subnets on the LAN. Each pool is distinguished by a pool id. If the pool id is not specified in the **create** command, the pool is assigned the first available pool id.

To assign a particular pool id number include it in the command:

```
$ create dhcp server pool poolid 2 start-ip 192.168.1.3 end- ip
192.168.1.34 mask 255.255.255.0
```

Specifying a Lease Period

The DHCP server allocates IP addresses to clients for a specified duration, called the lease. You can specify a default lease period and a maximum lease period for each DHCP pool. If you do not specify a lease period when you create the pool, the default lease period is set to 2592000 seconds (30 days) and the maximum lease is set to 31536000 seconds (365 days).

When the lease period expires, the client may again request an IP address from the DHCP server. The client can request an address for a specific lease duration. The server will grant the request if the duration is less than the maximum lease period configured for the pool. If the client request does not specify a lease duration, the server assigns an IP address for the default lease period.

To specify a lease period of one day, for example, create pool as follows:

```
$ create dhcp server pool poolid 2 start-ip 192.168.1.2 end- ip
192.168.1.13 mask 255.255.255.0 dlease 86400 mlease 4294967295
```

If you do not want to limit the lease period, you can set the default lease and maximum lease periods to the maximum of 4294967295 seconds (greater than 136 years).

Specifying a Low Threshold Value

Each DHCP pool has a low threshold value associated with it. Whenever the number of available IP addresses in the pool drops below this threshold, the server produces the low threshold hit trap. This trap indicates that available addresses from the pool may soon be exhausted and hosts coming up on the LAN will not be allocated IP addresses dynamically.

By default, the low threshold parameter is given a value of 0. Since the number of available addresses can never fall below 0, this

means that the trap will be generated only if you have specifically set the low threshold to a non-zero value.

To specify the low threshold value, type:

```
$ create dhcp server pool poolid 2 start-ip 192.168.1.2 end- ip
192.168.1.13 mask 255.255.255.0 lthres 3
```

Enabling and Disabling Pools

By default, when you create a new pool it is enabled for use. You can disable a pool if you do not want to use it currently, but want to retain the information for future use.

To disable a pool, type the command:

```
$ modify dhcp server pool poolid 0 disable
```

To re-enable the pool, type the command:

```
$ modify dhcp server pool poolid 0 enable
```

10.2.2 Excluding Addresses from a Pool

If you do not want particular addresses to be assigned to LAN hosts, you can add these to a pool exclusion table.

To mark an address as unusable (for example 192.168.1.13) from an existing pool, type the command:

```
$ create dhcp server exclude ip 192.168.1.13
```

To remove the entry from the pool exclusion table and make it available for use, type the command:

```
$ delete dhcp server exclude ip 192.168.1.13
```

To view the pool exclusion table entries, type the command:

```
$ get dhcp server exclude
```

10.2.3 Modifying and Deleting Pools

You can modify the lease and other configurable parameters using the **`modify`** command or by giving the relevant parameters directly in the **`create`** command.

Modifying Pools

To modify a DHCP pool, use the command:

```
modify dhcp server pool poolid 0 [parameter value]
```

For example, to modify the DNS server assigned to DHCP clients, use:

```
$ modify dhcp server pool poolid 0 dns 192.168.1.11
```

The modification will be reflected on the host whenever it reboots next and gets its address and other parameters from the modem.

Deleting Pools

To delete a pool with pool id 2, use the command:

```
$ delete dhcp server pool poolid 2
```

If you delete a pool or modify its settings while IP addresses are currently allocated from the pool, the hosts will continue to use the allocated IP addresses with the original settings, till the next renewal.

10.2.4 Creating Static DHCP Assignments

The DHCP server will attempt to assign the same address to a host each time the host boots; however, this may not always be possible. A host may be assigned an IP address, different from the one it previously used, depending on the available addresses. In some situations, it may be important that the DHCP server always assigns the same IP address to a particular host.

The unit's static hosts table enables you to create a permanent one-to-one association between a host and an IP address. On the LAN, a particular host is uniquely identified by its MAC address. A static host entry stores the association between the MAC address and a fixed IP address, as in the following example.

Adding an Entry to the Static Hosts Table

To create an entry in the static hosts table that associates the MAC address 00:80:48:CB: B8: 83 with the fixed IP address 192.168.1.2, type the command:

```
$ create dhcp server host ip 192.168.1.2 mask 255.255.255.0 hwaddr
00:80:48:CB:B8:83 dlease 4294967295 mlease 4294967295
```

The lease periods carry the same meaning as for a pool. You can set them to 4294967295 if you do not want to limit the lease period. The hardware address parameter (hwaddr) refers to the MAC address or the Ethernet address. The specified IP address is reserved for the host regardless of whether the host is currently switched on. The IP address will not be allocated to any other host.

Viewing the Static Hosts Table

To see the details of all configured static hosts, type the command:

```
$ get dhcp server host
```

Deleting an Entry from the Static Hosts Table

To delete a static host entry that is no longer required, use the command:

```
$ delete dhcp server host ip 192.168.1.3
```

To delete all static hosts, type the command without specifying an IP address:

```
$ delete dhcp server host
```

After you delete the entry, the client will continue to use the IP address, but only for the next renewal.

10.2.5 Enabling the DHCP Server

After configuring DHCP pools, you must enable the DHCP server.

In the default software setting, DHCP server is disabled. However, on your reference board, DHCP has been enabled.

To enable the server, type the command:

```
$ modify dhcp server cfg enable
```

To disable the DHCP server, type the command:

```
$ modify dhcp server cfg disable
```

To see the current state of the server, type the command:

```
$ get dhcp server cfg
```

10.2.6 DHCP- DNS Relay Interaction

The DHCP server indicates the DNS Server addresses to DHCP clients in the following manner.

If the primary/secondary DNS addresses are provided as part of the pool configuration (using the DNS and SDNS parameters in the create/ modify dhcp server pool commands), then these are indicated to the client.

If the DNS and SDNS addresses are not specified in the pool configuration, then one of the following cases will arise.

If the DNS relay is enabled, the DHCP server gives the modem's LAN IP address as the DNS server address to the clients.(The actual DNS servers are learned by the modem, dynamically, via the PPP link. These can be viewed using the get dhcp server cfg command.)

If the DNS relay is disabled, the DNS addresses indicated to the client are the ones that are dynamically learned from the PPP link. That is, they are the same as the ones displayed by the get dhcp server cfg command.

10.2.7 Viewing DHCP Server Address Assignments

Once the server starts assigning IP addresses to clients, you can see the currently allocated addresses.

To see the currently allocated addresses, type the command:

```
$ get dhcp server address
```

10.3 Configuring DHCP Relay

To use the ISP's DHCP server, you can configure the unit to act as a *DHCP relay agent*. As a relay agent, the unit forwards DHCP requests from the LAN hosts on to the ISP. The ISP's DHCP server then sends back IP addresses and other configuration information, which the unit forwards to the LAN hosts.

To configure the unit as a DHCP relay agent, you first specify the interfaces on which the unit will listen for DHCP requests and responses. Then, you enable DHCP relay mode.

10.3.1 Configuring the DHCP Relay Interfaces

The unit's LAN interface must be enabled for DHCP relay in order to receive requests from the LAN hosts for IP information. If multiple LAN interfaces are defined on the unit, the DHCP relay service can be enabled on each interface simultaneously.

To receive responses from the ISP, the unit's WAN interface must also be enabled for DHCP relay. The WAN interface could be a PPP, EoA, or an IPoA interface.

Specifying the DHCP Relay Interfaces

To specify that the unit will receive DHCP requests on the LAN (eth-0) interface and the WAN (ppp-0) interface, enter these commands:

```
$ create dhcp relay intf ifname eth-0

$ create dhcp relay intf ifname ppp-0
```

Viewing DHCP Relay Interfaces

To see all the interfaces on which DHCP relay is enabled, type the command:

```
$ get dhcp relay intf
```

10.3.2 Specifying the DHCP Server IP Address

You can specify the IP address of the DHCP server by modifying the DHCP relay configuration. It is not mandatory to configure this address. The ISP should be able to route the request to the appropriate server. If you assign the DHCP server IP address, you should also define a route in the unit's IP routing table.

Specifying the DHCP Server IP address

To specify the IP address of the ISP's DHCP server (202.64.23.4 in this example), use the command:

```
$ modify dhcp relay cfg ip 202.64.23.4
```

10.3.3 Enabling DHCP Relay Mode

To enable the DHCP relay use the command:

```
$ modify dhcp relay cfg enable
```

You can enable only one DHCP server or relay at a time. To enable DHCP relay, the DHCP server must be disabled.

To see the current configuration of the DHCP relay agent, type the command:

```
$ get dhcp relay cfg
```

10.4 Using a DHCP Server on the LAN

If the unit is connected to a LAN that uses one of its own hosts as the DHCP server, the unit's LAN interface must be configured as a DHCP client so that it also gets its LAN-side IP address from the server.

Specifying the LAN interface as a DHCP client

To configure the modem's LAN interface as a DHCP client, create an ethernet interface without specifying an IP address. To do so, use the command:

```
$ create ethernet intf ifname eth-0 usedhcp true
```

To see the state of the DHCP client, type the command:

```
$ get dhcp client info ifname eth-0
```

The Status field will show **Bound,** once the modem has obtained an IP address from the DHCP server.

To see the actual IP address assigned to the modem, type the command:

```
$ get ip address
```

This command shows the IP addresses assigned to all the modem's interfaces. The entry for eth-0 will show the IP address assigned to the modem by the DHCP server.

10.5 DHCP Traps

The DHCP server not only provides automatic configuration for LAN hosts, but also watches for potential errors in configuration and informs you about them via the following traps.

10.5.1 Duplicate IP Address Trap

The duplicate IP address trap may occur when the unit is operating as a DHCP server. Before assigning an address to a requesting host, the unit probes the LAN to see if another host on the LAN is already using the address. If so, the server raises a duplicate IP address trap and assigns the next available address to the host.

10.5.2 Low Threshold Hit Trap

This trap is generated when the number of available IP addresses in a DHCP pool is below the low threshold assigned to the pool. For

instructions on setting the threshold value, please refer to the **`create dhcp server pool`** command.

10.6 ForceRenew

ForceRenew is supported by the DHCP server configured at the modem, according to RFC 3203. If DHCP client(s) also support ForceRenew, it is possible to increase the lease time defined in the pool. Authentication, as defined in RFC 3118, should also be sent in a ForceRenew message. At the client end too, there should exist a mechanism to configure authentication information to use ForceRenew procedure effectively.

11 Simple Network Time Protocol

11.1 Overview

The SAR110 software implements Simple Network Time Protocol (SNTP), Version 4, RFC 2030, to enable it to periodically synchronize its clock with a reference clock on the Internet. The firewall feature of the modem requires synchronized wall clock time. Firewall rules, which triggers a particular instance of time, require the triggering time to be absolute, i.e., hr:min:sec, mm/dd/yyyy, or periodic. Absolute time refers to an exact and particular point in time, while Periodic time indicates the lapse of time with reference to a pre-defined moment in time. This time synchronization protocol (SNTP) enables the wall clock time to be first initialized on the modem. Subsequently, SNTP enables the wall clock time to remain synchronized with an external reference clock on the Internet.

Simple Network Time Protocol (SNTP) is a simplified adaptation of the Network Time Protocol (NTP), that is used to synchronize computer clocks on the Internet. SNTP exchanges timekeeping information between servers and clients via the Internet. Extremely reliable sources, such as radio clocks and GPS satellite timing receivers, typically act as primary servers.

The SNTP client sends a request to a designated server at its unicast address and expects a reply. This reply helps it to determine the time and optionally, the round-trip delay and local clock offset, relative to the server.

SNTP uses User Datagram Protocol (UDP) for the transport and the UDP port number assigned to SNTP is 123.

11.2 SNTP implementation details

Synchronization Request and Response

The SNTP client, at the modem end, sends an SNTP request to the SNTP server for synchronization. The user can configure up to five SNTP servers, and the SNTP client sends an SNTP request to the first SNTP server in the list. If this server stops responding then the server mentioned in the next entry, is contacted. These periodic requests help the modem SNTP clock to be synchronized with the Network Time.

Polling Interval and Packet Time-out

The SNTP Polling Interval, or the time after which an SNTP request is sent, can be between 64 seconds to 1024 seconds, both inclusive. The polling interval adjusts automatically, depending on the clock drift.

The maximum number of retries, in case of no response from server, is 2. The wait time for the response, or the packet time-out is 5 seconds.

Response validation

Validation of responses from the server occurs at the modem end. A response is rejected if:

the timestamp stored at the time of sending request does not match with the Originated Timestamp field of SNTP response.

the deviation (calculated from SNTP response) in local clock is more than the polling interval.

Amortization

The very first time synchronization happens, the local clock is simply set to the server time. Very sudden or large changes in time never occur, due to amortization. If the local clock is lagging behind the Network clock, for less than a second, the local clock may jump to cover the lagging time. However, if the gap is more than one second, the time gradually increments at the local clock end, over a period of time, which is divided in to smaller synchronization periods.

If the local clock is leading, it does not go back to get synchronized with the network time.If the local clock is leading by 1 second or less, it will pause for the leading time period. If it is leading for a value greater than 1 second, it will gradually decrement the time. In this scheme whole synchronization period will be divided in to time intervals, and the time change will gradually occur over smaller synchronization periods.

Alarm Timer

It is possible to set periodic and one-shot alarms, synchronized with the network time, on applications connected to the modem. It is also possible to set the absolute time alarm system.

The system clock cannot be configured using CLI commands, while SNTP is enabled. You must first disable SNTP before modifying the system clock. All the SNTP time-based alarms will be affected by this operation. They will either expire early or late. Also, few may expire simultaneously.

11.3 Configuration details

Enabling or Disabling SNTP service

To modify the SNTP configuration, enter:

```
modify sntp cfg [enable | disable]
```

Configuring SNTP server address

To configure the SNTP server address, enter:

```
create sntp servaddr <ip-address> | dname <domain-name>
```

To delete the SNTP server address you have configured, enter:

```
delete sntp servaddr < ip-address | dname domain-name >
```

Obtaining SNTP server address information

To get SNTP server address information, enter:

```
get sntp servaddr  [<ip-address> | dname <domain-name>]
```

Obtaining SNTP configuration information

To get SNTP configuration information, enter:

```
get sntp cfg
```

This command indicates whether the SNTP service is enabled or disabled.

Obtaining SNTP statistical information

To get statistical information about SNTP, enter:

```
get sntp stats
```

This command displays

the number of SNTP Requests sent to the SNTP server
the number of valid SNTP responses received from the SNTP server
the number of invalid SNTP responses received from the SNTP server
the number of lost responses against the SNTP request
the time at which the local clock was last set or corrected.

Resetting SNTP statistics

To reset SNTP statistics, enter:

```
reset sntp stats
```

12 Layer 2 Security

Traffic flowing towards the modem can be blocked or filtered at different levels. Bridge mode (layer 2) traffic does not reach the IP layer (layer 3), and therefore requires its own security settings. This chapter describes methods for filtering traffic at layer 2. These include,

- **Configuring raw filters**
- **Protocol blocking**
- **Implementing L2 Wall**

12.1 Raw Filtering – Overview

This section provides details about the SAR110 unit's raw filtering capability and how to configure the rules and subrules for raw filtering.

The SAR110 unit's raw filtering feature allows it to examine each packet traveling in either direction (incoming or outgoing) and to filter out packets based on rules and subrules that you define. Because the raw filter scans packets at the layer 2 level (e.g., Ethernet), it can be used with either operating mode (i.e., bridge or router).

You can specify multiple rules, each with one or more subrules that apply only to that rule. Each rule tells what to do (accept or deny) to a packet that is moving in the specified direction (incoming or outgoing) on the specified interface, if that packet also matches the pattern(s) specified by the rule's subrule(s).

Each rule and subrule is also assigned an ID number. Rule IDs must be unique; subrule IDs must be unique within a rule. Like NAT rules, these ID numbers determine the order in which rules are evaluated—from lowest to highest number. A rule's subrules are evaluated in this manner as well.

To allow you to retain full control over the order of rule evaluation, do not number rules/subrules consecutively, e.g., 1, 2, 3, etc., but in increments, e.g., 10, 20, 30, etc. This will allow you to insert more rules/subrules between the existing ones at a later time. If you number your rules/subrules consecutively, you will have to delete and recreate all existing rules that are to follow the new rule.

When raw filtering is enabled, the unit scans the raw filter rules whenever a packet is received; if a rule is found that matches the packet, the packet is accepted or denied as specified by the rule.

A rule is said to match the packet only if all of its subrules match the packet. This is true whether a rule has one or many subrules. If a subrule is found that does not match the packet, that rule is skipped.

If none of the rules matches the packet, the default action is taken for that packet. The default action is specified as part of the raw filter global configuration.

The maximum number of rules and subrules is determined by the maxpfrawrule and maxpfrawsubrule parameters in the size command.

12.1.1 Using Raw Filtering Rules and Subrules

Rules specify, at a minimum, the interface and direction to be monitored, and the action to take if a packet matches the rule. Subrules specify the actual pattern to be searched for in each packet.

12.1.1.1 *Commands for rules*

The basic commands used to create, modify and delete raw filter rules are described below.

Creating a raw filter rule

❖ **To create a raw filter rule, enter:**

```
$ create pfraw rule entry ruleid 100 ifname ppp-0 dir in enable log
match act deny
```

It is also possible to specify an interface type, either private, public, or demilitarized, while specifying a rule for an interface type. For LAN interfaces such as Ethernet, you can specify private interfaces. For WAN interfaces, you can specify public interfaces.

This command creates a rule with rule ID 100 on interface ppp-0, for packets traveling in the incoming direction (dir in). The enable parameter indicates that the rule is enabled; log match indicates that all matching packets will be logged, and act deny indicates that if a packet matches the rule, the action is to deny the packet.

Modifying a raw filter rule

❖ **To modify a rule, enter:**

```
$ modify pfraw rule entry ruleid 100 act accept
```

Deleting a raw filter rule

❖ **To delete a rule, enter:**

```
$ delete pfraw rule entry ruleid 1
```

In order to delete a rule, you must first delete all of its subrules. (For information on deleting a subrule, refer to the following section.)

12.1.1.2 *Commands for subrules*

The basic commands used to create, modify and delete raw filter subrules are described below.

Creating a raw filter subrule

❖ **To create a subrule, enter:**

```
$ create pfraw subrule entry ruleid 100 subruleid 10 start linkh
offset 0 mask 0xffffffffffff cmpt eq 0xffffffffffff enable
```

This creates subrule 10 of rule 100. This subrule examines packets at an offset of 0 relative to the link layer header. If masking with 0xffffffffffff gives a result of 0xffffffffffff, the match is successful and the packet is accepted or denied as specified by rule 100.

Modifying a raw filter subrule

❖ **To modify a subrule, enter:**

```
$ modify pfraw subrule entry ruleid 100 subruleid 10 disable
```

Deleting a raw filter subrule

❖ **To delete a subrule, enter:**

```
$ delete pfraw subrule entry ruleid 2 subruleid 1
```

12.1.1.3 *Displaying rule/subrule configuration*

The basic commands used to show the current configuration of rules and subrules are described below.

Viewing raw filter rules

❖ **To see the configuration of all rules and subrules, enter:**

```
$ get pfraw rule info
```

❖ **To see the configuration of rules applicable to**

incoming packets on a particular interface, such as eth-0, enter:

```
$ get pfraw rule info ifname eth-0 dir in
```

- **To see the configuration of rules applicable to outgoing packets on a particular interface, such as eth-0, enter:**

```
$ get pfraw rule info ifname eth-0 dir out
```

Example

The following rule and subrule can be used to block all incoming Telnet requests on the ppp-0 interface:

```
$ create pfraw rule entry ruleid 200 ifname ppp-0 dir in act deny log
match enable

$ create pfraw subrule entry ruleid 200 subruleid 20 mask 0xffff start
tcph offset 2 cmpt eq 0x0017 enable
```

The subrule matches packets with the value 0x0017 (the Telnet port number) at offset 2 in the TCP header; the rule specifies that the action is deny; thus, all incoming Telnet packets will be dropped.

12.1.2 Raw Filtering Global Configuration

- **To enable or disable raw filtering and to set the default action, enter:**

```
$ modify pfraw global enable accept
```

This command enables raw filtering and specifies that the default action (i.e., the action taken if no rules are matched) is to accept the packet.

Do not enable raw filtering without first configuring raw filter rules.

Do not enable raw filtering without first configuring raw filter rules.

12.2 Protocol Blocking

The protocol blocking feature is provided for end users to have a simple way of preventing certain protocols from being trasmitted on their network (i.e., without having to create IP filter or raw filter rules). In the Web-based interface, users simply click on the protocol by name to enable it to be blocked; an the software invokes an IP filter or raw filter rule already defined in the system.

Note:

by name that they want to prevent from a protocol displaying a set of protocols in the HTTP a simple way for you to stop certain protocols from transmission, without having to create a raw filter or IP filter rule (in fact, the blocking command simply invokes the corresponding built-in filtering rules).

- **To view the list of protocols that have predefined filter rules, use the following command:**

```
$ get pfraw block?
```

- **To modify the pfraw blocking status for the PPPoE protocol, for example, enter:**

```
$ modify pfraw block protocol ppe enable
```

12.3 L2 Wall

The SAR110 software supports the L2 Wall security feature, which allows a LAN host to prevent accesses to it when the user is not using the Internet.

When active, L2 Wall causes all packets incoming to the host to be dropped, except for packets whose protocols have been specified as “transparent” to the L2 Wall. For example, DHCP and ARP can be specified as transparent protocols to allow DHCP renewals and ARP requests.

In this chapter, the term “dropped traffic” does not include transparent traffic.

12.3.1 Overview

L2 Wall has three modes, which can be set by the end user:

- **On**
- **Off**
- **Automatic**

When L2 Wall is On, no traffic may pass to or from the host. When L2 Wall is Off, all traffic may pass in both directions.

In Automatic mode, L2 Wall is activated and deactivated automatically, depending on whether there has been recent non-transparent traffic in the outgoing direction. Whenever such traffic is transmitted, a timer is set. If the timer expires without further outgoing traffic, L2 Wall is activated and no further incoming traffic is allowed. When the host again sends outgoing non-transparent traffic, L2 Wall is deactivated and the timer is reset.

The timer counts down an interval called the activation time, which is set by the user and can vary from 1 minute up to 1 day. During this interval, traffic can pass in both directions.

12.3.2 Configuration Files

L2 Wall filtering is controlled by three configuration files that are merged into the software image when you create it using the Createfi utility:

- **In the factory defaults file** *TEFacs.txt*, you set L2 Wall to automatic mode (unless already set by default in the software), and then add CLI commands that create raw filtering rules to be activated when the L2 Wall is on. These rules allow certain types of traffic (i.e., trasparent traffic) to be passed even though the L2 Wall is on. See section for instructions on creating raw filter rules.
- **The text file** l2wall_on.cfg contains a CLI command that configures the raw filtering global setting to deny all traffic. You add commands that enable the raw filtering rules defined in TEFacs.txt that configure transparent traffic.

The text file l2wall_off.cfg contains a CLI command that configures the raw filtering global setting to accept all traffic. You add CLI commands that disable the same raw filtering rules that were enabled in l2wall_on.cfg.

Whenever the L2 Wall mode is set to On, the system executes `l2wall_on.cfg`, and whenever the mode is set to Off, the system executes `l2wall_off.cfg`.

The file `l2wall_on.cfg` turns on the raw filter, specifying that packets not matching any raw filtering rules should be dropped, and defines the raw filter rules to be applied, while `l2wall_off.cfg` deletes the raw filter rules created by `l2wall_on.cfg`. The rules in `l2wall_on.cfg` thus define the “transparent” protocols, i.e., those protocols that can pass through while L2 Wall is active.

L2 Wall can be controlled by the following CLI commands (described in the CLI Reference Manual):

- **modify L2wall cfg**
- **get L2wall cfg**

12.3.3 AutoDetect Algorithm

The basic algorithm for the L2 Wall feature is as follows.

```
If (L2Wall is OFF) OR
   (L2Wall is AUTO) AND (time since last activity < activation time)
     Continue operating normally (i.e. bridged traffic)
Elseif (L2Wall is AUTO) AND (time since last activity > activation time)
     If the packet’s protocol is transparent to L2Wall
```

```
     //i.e. the       protocol is enabled in l2wall_on.cfg
        Forward the packet //from LAN to WAN or vice versa
     Else //not a transparent protocol
        If packet originated from LAN
           Reset the time since last activity
           Apply l2wall_off.cfg to disable filter rules
           Forward the packet to the WAN
        Else //packet originated from WAN
           Packet is dropped due to filter in l2wall_on.cfg
        Endif
     Endif
Else //L2Wall is ON
     If the packet's protocol is transparent to L2Wall
     //i.e. the protocol is enabled in l2wall_on.cfg
        Forward the packet //from LAN to WAN or vice versa
     Else //not a transparent protocol
        Packet is dropped due to filter enabled in l2wall_on.cfg
     Endif
Endif
```

12.3.4 Assumptions

L2 Wall assumes the following to be true:

- **The SAR110 unit is operating in bridging mode.**

12.3.5 Sample Configuration Files

Below shows an example of a factory defaults file that configures the L2wall feature in automatic mode, sets the timer to 5 minutes, and establishes rules for enabling transparent traffic.

```
                .
                        .
         modify l2wall cfg auto inacttime 5
         create pfraw rule entry ruleid 1 ifname all dir in enable act accept log match
         create pfraw subrule entry ruleid 1 subruleid 1 mask 0xFFFF start linkh offset
12 cmpt eq 0x0806
         create pfraw rule entry ruleid 2 ifname all dir out enable act accept log match
         create pfraw subrule entry ruleid 2 subruleid 1 mask 0xFFFF start linkh offset
12 cmpt eq 0x0806
         create pfraw rule entry ruleid 3 ifname all dir in enable act accept
         create pfraw subrule entry ruleid 3 subruleid 1 mask 0xFFFF start linkh offset
12 cmpt eq 0x8863
         create pfraw rule entry ruleid 4 ifname all dir out enable act accept
         create pfraw subrule entry ruleid 4 subruleid 1 mask 0xFFFF start linkh offset
12 cmpt eq 0x8863
         create pfraw rule entry ruleid 5 ifname all dir in enable act accept
         create pfraw subrule entry ruleid 5 subruleid 1 mask 0xFFFF start udph offset 0
cmpt range 0x43 0x44
         create pfraw rule entry ruleid 6 ifname all dir out enable act accept
         create pfraw subrule entry ruleid 6 subruleid 1 mask 0xFFFF start udph offset 0
cmpt range 0x43 0x44
         create pfraw rule entry ruleid 7 ifname eth-0 dir in enable act callmgmt log
match
         create pfraw subrule entry ruleid 7 subruleid 1 mask 0xFFFF start linkh offset
12 cmpt eq 0x0800
         create pfraw rule entry ruleid 8 ifname eth-0 dir in enable act callmgmt
         create pfraw subrule entry ruleid 8 subruleid 1 mask 0xFFFF start linkh offset
12 cmpt eq 0x8864
                        .
                        .
```

Below shows an example l2wall_on.cfg file that globally denies all traffic, and then enables the raw filter rules in TEFacs.txt that allow specific types of transparent traffic.

```
modify pfraw global deny
modify pfraw rule entry ruleid 1 enable
modify pfraw rule entry ruleid 2 enable
modify pfraw rule entry ruleid 3 enable
modify pfraw rule entry ruleid 4 enable
modify pfraw rule entry ruleid 5 enable
modify pfraw rule entry ruleid 6 enable
modify pfraw rule entry ruleid 7 enable
modify pfraw rule entry ruleid 8 enable
exit
```

Below shows an example l2wall_off.cfg file that globally accepts all traffic and disables the raw filter rules.

```
modify pfraw global accept
modify pfraw rule entry ruleid 1 disable
modify pfraw rule entry ruleid 2 disable
modify pfraw rule entry ruleid 3 disable
modify pfraw rule entry ruleid 4 disable
modify pfraw rule entry ruleid 5 disable
modify pfraw rule entry ruleid 6 disable
modify pfraw rule entry ruleid 7 disable
modify pfraw rule entry ruleid 8 disable
exit
```

13 Layer 3 Security

Layer 3 filtering at the IP layer enables easier configuration, as it allows working with various fields in the IP header. Also, as more information about the traffic flow is available at this layer, it allows you to provide increased protection.

To enable this protection, you need to configure NAT, Firewall and IP Filter.

13.1 NAT

This section describes how to create and use Network Address Translation (NAT) rules and application level gateways (ALGs).

A *NAT rule* specifies when and how to translate IP addresses. As data packets are received on the unit's interfaces, data in their protocol headers is compared to criteria established in the NAT rules. The criteria includes ranges of source or destination addresses. If the packet meets the criteria of one of the rules, the packet header undergoes the translation specified by the rule and the revised packet is forwarded. If the packet does not match any rule criteria, it is forwarded without translation.

Six types, or flavors, of NAT rules are supported. They are: *basic*, *napt*, *filter*, *rdr*, *bimap*, and *pass*. The most commonly used flavors are napt and rdr. NAPT rules are used to translate multiple private addresses on a LAN to a single public IP address for external communication. An rdr rule can be used to allow external access to a privately addressed LAN computer. The flavors are described in sections through .

Application Level Gateways

Creating rules is sufficient to handle most applications. However, applications such as FTP, H.323, Real Audio, CUseeMe, and others require additional configuration in the form of application level gateways (ALGs). These applications require ALGs because their payloads—not just the packet headers—contain IP addresses. When an ALG is configured, NAT translations occur not only on data in a packet's header, but also on data in the packet's payload.

The list here details ALGs supported by the modem.

ALGs for Protocols and Applications

ALG	PROTOCOL	PORT
FTP	TCP	21
SNMP	UDP	161
H.323	TCP	1720
L2TP	UDP	1701
PPTP	TCP	1723
RTSP	TCP	554
MSN Messenger	TCP	1863
MIRC	TCP	6661 to 6669
H225 RAS	TCP	1719
CuSeeMe	TCP	7648
NetMeeting	An application which uses H323,H245,LDAP,T120 etc.	
RealPlayer	TCP	7070
Timbuktu 200	UDP	407
RCMD	TCP	514
SGI-VoD	UDP	6301
T.120	Not configurable externally	
LDAP	TCP	389

ALGs for Games:

- **Quake**
- **Asheron Call**
- **Delta Force**
- **Half Life**
- **Heretic II**
- **Diablo**
- **Star Craft**

13.1.1 Default NAT Configuration on the SAR110 Unit

By default, NAT is enabled on the SAR110 reference unit, with an napt rule that translates all LAN side addresses to the public IP address assigned to the PPP-0 interface.

The following commands are included in the default configuration file to set this configuration:

```
$ create nat rule entry ruleid 1 napt
$ modify nat global enable
```

The first line creates a rule of type **napt** (Network Address Port Translation) and assigns it a rule ID of 1. The second line enables the NAT service.

For more information about the default configuration, see Chapter .

13.1.2 Configuring NAT Direction

NAT distinguishes between inside interfaces and outside interfaces. An inside interface is one on which you can use private IP addresses. An outside interface is one on which you can use only public IP addresses. Usually, the Ethernet is the inside interface and the PPP or EoA interfaces are the outside interfaces.

The direction of an interface is used to determine how to apply NAT rules. The basic, napt, filter, and pass rules manage the address translation for connections initiated from the inside interface and destined for the outside interface. These rules also translate the responses coming from outside to inside. The *rdr* rules manage address translations for connections initiated from the outside and destined for the inside interface. The *bimap* rule is unique because it works in both directions. You can use it for inside to outside as well as outside to inside connections. The *pass* rule is helpful when you want specific inside to outside connections passed through the unit without any change.

A connection, as used here, is simply a network access from one side of the unit to the other. A web browser on the LAN that accesses a web site on the WAN would be an inside to outside connection.

Configuring the NAT Direction

You can specify the NAT direction of these interfaces directly, as part of the corresponding **create** command. By default, the LAN interfaces (Ethernet) have the direction as **inside** while the WAN interfaces (PPP, EoA and IPoA) have the direction as **outside**.

For example, to configure the NAT direction, while creating the Ethernet interface, specify the direction as **inside**.

```
$ create ethernet intf ifname eth-0 ip 192.168.1.1 mask 255.255.255.0
inside
```

13.1.3 The napt rule

A Network Address and Port Translation (napt) rule translates the source address as well as the port number for inside to outside connections.

Creating an napt Rule with a Rule ID

To create a napt rule, type the command:

```
$ create nat rule entry napt ruleid 1
```

Although the command takes quite a few parameters, the default values suffice in most cases.

Note that the rule is assigned a rule ID. Rules are scanned in order of their rule IDs, lowest to highest. When the packet data does not match a rule, the next rule is tested for a match. You should always create NAT rules with gaps in the rule IDs so that you can add a new rule that you want to be applied between two existing rules. For instance, if you initially create two rules with rule IDs 10 and 20, then later create another with rule ID 15, this new rule would be applied after 10 but before 20. But if you had created the first two rules with rule IDs 10 and 11, then this sequence would not be possible without first deleting one of the rules.

Viewing NAT Rules

To see the existing NAT rules, type the command:

```
$ get nat rule entry
```

You can specify a rule ID to view a specific rule:

```
$ get nat rule entry ruleid 1
```

Creating an napt Rule with All Parameters

The following command includes all parameters for creating an napt rule:

```
$ create nat rule entry ruleid 1 napt ifname ppp-0 lcladdrfrom 0.0.0.0
lcladdrto 255.255.255.255 glbaddrfrom 0.0.0.0 glbaddrto 0.0.0.0
```

The **ifname** parameter says that the rule is applicable to the **ppp-0** interface. If you do not specify the interface, NAT assumes that the rule is applicable on all outside interfaces.

The **lcladdrfrom** and **lcladdrto** parameters tell NAT which outgoing packets to translate. If the source address in a packet lies within the range specified by these two parameters, the match is considered successful and the packet is translated using this rule. Setting **lcladdrfrom** to 0.0.0.0 and **lcladdrto** to

255.255.255.255 indicates that rule will be matched for all packets going out on the interface.

Suppose you have two subnets on the LAN: 192.168.1 and 172.25, and you want NAT to work for only one of them - 192.168.1 (if for example, the other subnet never needs to access the Internet). Then, setting **lcladdrfrom** to 192.168.1.0 and **lcladdrto** to 192.168.1.255 will indicate that the translation is required only if the first three numbers in the source IP address are 192.168.1.

The **glbaddrfrom** and **glbaddrto** parameters tell NAT what the source addresses should be translated into. If the ISP provides a fixed IP address, such as 202.1.1.1, then setting both **glbaddrfrom** and **glbaddrto** to 202.1.1.1 will specify that the source address should be translated into 202.1.1.1. Setting both to 0.0.0.0 indicates that you want the translated address to be the address of the outgoing interface. This is used when the IP address of the interface is not fixed. If **glbaddrfrom** and **glbaddrto** are not the same, i.e., if they indicate a range of IP addresses, then the translated address is chosen from among this range on a per connection basis.

Deleting a Rule

To delete a rule use the delete command and specify the rule ID:

```
$ delete nat rule entry ruleid 1
```

13.1.3.1 *Configuring Port Numbers for napt*

A napt rule translates the source IP address as well as the source port number. The IP address to be used for translation is picked up from the NAT rule parameters. The port numbers for translations are specified using the **portstart** and **portend** parameters in the **modify nat global** command. These parameters can be modified only when NAT is disabled.

13.1.4 The rdr Rule

The rdr, or redirect, rule enables you to route incoming connection requests referencing your public IP address and a specific port number to a private IP addresses and port number on your LAN.

Suppose there is a web server installed on one of the LAN hosts. If someone from outside tries to connect to this server, the connection request will arrive on the unit with the same destination address as the public IP address, 202.1.1.1. However, the web server on the LAN has the address, say 192.168.1.3. NAT allows you to forward such connections to the correct internal destination using the rdr rule. To handle such a case, use the command:

Creating an RDR Rule

```
$ create nat rule entry ruleid 2 rdr destportfrom 80 destportto 80
lcladdrfrom 192.168.1.3 lcladdrto 192.168.1.3
```

This command indicates that in all connection requests from the WAN side for the port number 80, which is the well known port number for a web server, the destination address should be substituted by 192.168.1.3. The incoming connection thus gets forwarded to the correct server.

Suppose multiple web servers exist on the LAN with IP addresses ranging from 192.168.1.3 to 192.168.1.6 and you need to distribute the load of incoming connections between these. The rdr rule allows you to do this by specifying the range using the **lcladdr** parameters. Setting **lcladdrfrom** to 192.168.1.3 and **lcladdrto** to 192.168.1.6 will distribute the load in a round-robin fashion.

Similarly, you can add rdr rules for other servers on the LAN, which are to be exposed to the outside world. Each server will typically have a well- known port number, which you can specify as the **destportfrom** and **destportto** parameters. These two parameters need not be the same. They can also be a range.

The rdr rule also enables you to substitute the port number in the incoming request. If the web server is running on some non-standard port number, say 8080, create the rule as:

```
$ create nat rule entry ruleid 2 rdr destportfrom 80 destportto 80
lcladdrfrom 192.168.1.3 lcladdrto 192.168.1.3 lclport 8080
```

This will not only forward the request to 192.168.1.3 but also modify the port number to what the server expects.

As with the napt rule, you can specify an interface name, say ppp-0.

To specify an interface name, type the command:

```
$ create nat rule entry ruleid 2 rdr ifname ppp-0
destportfrom 80 destportto 80 lcladdrfrom
192.168.1.3 lcladdrto 192.168.1.3 lclport 8080
```

This will make the rule operate only on requests received on the ppp-0 interface. Not specifying the interface makes the rule applicable on all outside interfaces. Further, if you have a fixed IP address, you can specify that as well.

To specify an interface and a fixed IP address, type the command:

```
$ create nat rule entry ruleid 2 rdr ifname ppp-0 destaddrfrom
202.1.1.1 destaddrto 202.1.1.1 destportfrom 80 destportto 80
lcladdrfrom 192.168.1.3 lcladdrto 192.168.1.3 lclport 8080
```

This will translate the request only if it contains the destination address 202.1.1.1.

13.1.5 The basic and filter Rules

The napt rule discussed earlier translates not only the source addresses but also the port numbers in outgoing connections. The unit also provides a more basic functionality in which only the addresses are translated and the port numbers remain unchanged. The basic and filter rules fall in this category.

With the basic rule you can translate a range of IP addresses, specified by **lcladdrfrom** and **lcladdrto**, into another group of addresses, specified by **glbaddrfrom** and **glbaddrto**.

Creating a basic Rule

To translate a group of IP addresses, use the command:

```
$ create nat rule entry ruleid 3 basic lcladdrfrom 192.168.1.10
lcladdrto 192.168.1.20 glbaddrfrom 202.1.1.1 glbaddrto 202.1.1.5
```

This will translate source addresses in the range 192.168.1.10 to 192.168.1.20 into the range 202.1.1.1 to 202.1.1.5.

The filter rule extends your control over NAT as it allows translation based on the source address and the destination address and port numbers.

Creating a filter Rule

For instance, with the following command, all accesses from the given local addresses to the web server on 202.64.2.5 will appear to originate from 202.1.1.2:

```
$ create nat rule entry ruleid 4 filter lcladdrfrom 192.168.1.0
lcladdrto 192.168.1.10 destaddrfrom 202.64.2.5 destaddrto 202.64.2.5
destportfrom 80 destportto 80 glbaddrfrom 202.1.1.2 glbaddrto
202.1.1.2
```

13.1.6 The bimap Rule

Suppose you want to provide a one-to-one mapping between one of the public IP addresses and one of the LAN hosts. All accesses to the public IP address should be forwarded to the particular LAN host, and all accesses from the host should appear to go out from that public IP address only. If you were to use the rules discussed so far, this kind of a situation would require you to create two rules, one to handle the inside to outside translations, and another to handle the outside to inside translations. The bimap rule simplifies this kind of a situation by enabling a two-way translation with a single rule.

Creating a bimap Rule

To enable a two-way translation with a single rule, type the command:

```
$ create nat rule entry ruleid 6 bimap lcladdrfrom 192.168.1.3
lcladdrto 192.168.1.3 glbaddrfrom 202.1.1.1 glbaddrto 202.1.1.1
```

This one rule will suffice to translate the source address in all outgoing accesses from 192.168.1.3 to 202.1.1.1 and also to translate the destination address in all incoming accesses on 202.1.1.1 to 192.168.1.3.

13.1.7 The pass Rule

The pass rule allows you to let connections from a range of inside addresses go through without getting translated. For instance the following rule lets all connections from the given range go through to the WAN without any translation:

Creating a pass Rule

```
$ create nat rule entry ruleid 7 pass lcladdrfrom 192.168.1.10
lcladdrto 192.168.1.20
```

13.1.8 Configuring ALGs

You will need to configure an *Application Level Gateway (ALG)* if you want to use certain applications such as FTP, SNMP, Real Audio, and a few others across the unit. For instance, if you want to ftp a file from some outside host, or you are providing an ftp server that has to be accessible to outside users, you will need to configure an ALG for FTP.

An ALG enables the unit to carry out address translations in the entire packet instead of just the packet headers. The mentioned applications need ALGs since they use IP addresses in their payloads also. Most other applications do not.

To be able to access external ftp servers from the LAN, type the command:

```
$ create alg port portno 21 algtype ftp
```

This enables the FTP ALG on all connections having the port number 21. The port number would, in most cases be the well-known port number of the application. For instance, 21 is the well known port number for an ftp server. The command also provides a protocol parameter using which you can enable the ALG selectively on packets carrying a particular protocol. By default, this parameter it is set to **any**, so that all protocols undergo translation (this setting usually suffices in normal usage).

The actual translation occurs in accordance with the corresponding NAT rules. The ALG just enables NAT to translate inside the payloads of these specific applications.

Deleting ALGs

To delete a configured ALG, type the command:

```
$ delete alg port portno 21 prot any
```

This will disable the additional processing required for accessing external ftp servers.

Viewing ALGs

To see the list of supported ALGs, type the command:

```
$ get alg type
```

To see all the configured ALGs, type the command:

```
$ get alg port
```

13.1.8.1 *Configuring unit for IPSec traffic*

IPSec is a mechanism to provide various security services for traffic at the IP layer. IPSec protects IP datagram by defining a method of specifying the traffic to protect, and how that traffic is to be protected. The method of protecting IP datagrams or upperlayer protocols is by using one of the IPSec protocols, the Encapsulating Security Payload (ESP) or authentication Header (AH). To properly encapsulate and decapsulate IPSec packets it is necessary for the communicating peers to agree on the security parameters (e.g. keys to use for encryption/decryption etc). Such a construct is called a Security Association (SA).

When NAT is enabled on the unit, IPSec traffic pass through is supported under certain conditions. IPSec pass through does not mean the unit can originate/terminate IPSec sessions (from/to the unit). This means that two more NAT ALGs called IKE ALG and ESP ALG are enabled on the unit, to allow the IPSec traffic to pass through transparently.

13.1.8.1.1 Configuration details

IPSec Pass through is required when the unit is running in routing mode with NAT enabled. The normal customer setup includes VPN client running on LAN PCs behind the unit, trying to connect to some VPN server on the Internet. For example, a telecommuter accessing the corporate Network through VPN from home.

Note: When SAR110 is in bridging or ZIPB mode, no extra configuration is required for any kind IPSec traffic to pass through (as NAT is not running on SAR110).

By default, the IKE and ESP ALGs are created.

To confirm if the IKE and ESP ALGs are configured on the unit, enter:

```
$ get alg port
```

You should see IKE and ESP ALGs configured.

Normally, only one NAPT rule is sufficient to access the internet. But with IPSec pass through, customers will be accessing a VPN server as well as Internet in parallel. So following NAT rule configuration is recommended :

```
$ create nat rule entry ruleid 1 filter destportfrom num 500
destportto num 500 prot udp

$ create nat rule entry ruleid 2 napt
```

In the above command set, the first rule indicates if the protocol is UDP and destination port number is 500 (that is, IKE port number).

Then, the IP address will be translated, but not the port numbers (similar to basic rule). This rule will be used for IKE ALG to translate IKE packets (when automatic keying is used by VPN clients).

The second rule indicates NAPT should be used if the first rule is not hit, which will be used for accessing internet.

13.1.8.1.2 Restrictions

IPSec pass through only takes care of passing ESP tunnel mode traffic. The pass through of the following, is not supported:

- **Authentication Header (AH) in tunnel mode or**

transport mode, or with UDP encapsulated. The reason this traffic cannot pass through is because AH header authenticates IP address in IP header also. So, intermediate NAT routers cannot translate the IP address.

- **Encapsulating Security Payload (ESP) in transport mode with TCP packets. The reason TCP traffic with ESP header in transport mode cannot pass through, is TCP header pseudo checksum is computed using IP address and as the TCP header is encrypted when it reaches intermediate NAT router. NAT cannot translate the IP address.**

Normally L2TP over IPSec transport is used by Window-based VPN client (and as L2TP uses UDP), and it can pass through.

- **Although multiple VPN clients on the LAN side are supported, only one VPN client should be involved in IKE negotiations, at a time. This limitation exists because, only the basic** NAT flavor can be enabled for IKE traffic. **NAPT** would change the port, whereas, IKE requires the source and destination ports to be only 500.
- **If the VPN traffic carries some protocols, which require ALGs (because they carry IP addresses in their payload), then, those protocols will not pass through properly. This is because, VPN traffic is encrypted. Hence, no ALGs can be applied to them.**

13.1.9 Enabling NAT

After you have configured the required NAT rules and ALGs, you need to enable NAT.

NAT can be enabled or disabled using the following command.

```
$ modify nat global [enable/disable]
```

13.2 Firewall

This chapter describes the firewall feature of the product. This feature protects the modem and the LAN hosts behind the modem from malicious attacks originating from the "unfriendly outside world" WAN hosts. Various kinds of attacks are known that can cause disruption in regular service for hosts behind the modem, or cause harm to internal LAN hosts. This feature detects and protects against such common attacks and reports such attacks to the network administrator, for appropriate action.

13.2.1 Attack protection

Typically, attacks from the WAN side exploit deficiencies in the OS and implementation problems.

- **Usage of malicious IP address - These attacks exploit usage of source IP address that are illegal on a given interface.** Some examples of illegal packets are, sending packets with source IP address as

internal addresses on a public interface

loopback address on any interface

network broadcast address on any interface

IP broadcast address on any interface

destination address in the same packet on any interface

Multicast address on any interface.

- **The network can also be potentially flooded if packets are being sent to**

network broadcast address on any interface

IP broadcast address on any interface

- **Hackers exploit OS vulnerabilities by sending packets with**

IP length greater than the one specified by the standards

overlapping fragments.

13.2.1.1 *List of Attacks*

The following table provides a the list of attacks against which the modem provides protection, through its firewall feature.

List of attacks and corresponding protection (Sheet of)

Protection	Attack
The modem drops all fragmented packets received on any interface in which the offset plus the current IP packet size exceeds 65535.	Ping of death
The modem drops any packet received on any public interface that has a source IP address, which is part of any network already present on private or service interfaces.	IP Spoofing
The modem drops any packets with overlapping fragments.	Tear Drop
The modem drops any packet received on any interface that has a source IP address as loopback address or standard multicast address.	IP Spoofing
The modem drops any packet received on any interface that has a source IP address as the broadcast address of that network or the IP broadcast address.	Smurf and Fraggle
The modem drops any packet received on any interface that whose source IP address is the same as the destination IP address.	Land attack
The modem detects various types of port scan attacks which include NULL Scan, XMAS Scan, TCP Fragmentation Scan, SYNACK scan, FIN scan, ACK scan, RST scan, UDP scan, ICMP scan and TCP session scan.	Port scan

13.2.1.2 *Denial of service (DOS) protection*

Flooding the modem with large number of packets, causing all the resources to be utilized causes denial of service to genuine connections. DOS protection works by enforcing limits on various types of IP sessions that can pass through the modem. They are,

- **Half open TCP connections**
- **ICMP sessions**
- **Number of connections from a single host.**

13.2.1.3 *List of DOS attacks*

The following table provides a the list of DOS attacks against which the modem provides protection, through its firewall feature.

List of DOS attacks and corresponding protection

Protection	Attack
The number of "half-open" active TCP sessions are limited to user configured percentage of total available sessions. Newer TCP connections are allowed by removing older “half-open” sessions.	SYN DOS
The number of active ICMP sessions are limited to user-configured percentage of total available sessions. Newer ICMP packets are allowed by removing older ICMP sessions.	ICMP DOS
The number of active IP sessions generated by one single host is limited to user configured percentage of total available sessions. All further IP packets are dropped until the older sessions time-out.	Per host DOS protection

13.2.1.4 *Service protection*

The firewall provides a mechanism to block certain services or protocols that may be misused by hackers. Using IP Filter rules, the modem restricts access to services for only a set of WAN hosts.The modem uses basic IP filter rules to provide this functionality. These IP filter rules also use the type of interface in determining whether a packet has to be blocked or not. The firewall provides a mechanism in which individual IP filter rules can be marked as whether they are part of a high, medium or low security level. The level of firewall security policy can be configured by the user at runtime. This makes user configuration simple and easy.

An IP filter rule can be configured to be active at one or more security levels. So the set of all rules configured to be active at the High security level determine the filtering support being provided at High.

The same holds for Medium and Low levels. When the security level is set to None, no IP filter rules are active, implying zero protection.

The default configuration provided with the modem contains IP filter rules to cater to typical user requirements. The private side of the network is the most secure. Most accesses from private to other interfaces are allowed, but accesses to the private side are restricted.

The demilitarized (dmz) side of the network is more accessible, since the publicly visible services, such as web servers, are expected to be hosted on the dmz side. Checks on accesses from the dmz side to the private side are less stringent as compared to those from the public side, since the dmz side is more "trusted".

Also, as a general rule, as the security level decreases from high to low, more services are made accessible. At High, only the most essential services are accessible. Services such as ICMP, which could be easily misused by intruders, are typically not allowed at High security level. For instance, HTTP access from the public to dmz side is allowed at all levels, but ICMP access is allowed only at Low. All accesses from self to any side are always allowed since the modem is expected to be a trusted host on all sides.

The following matrices are used to define default IP filter rules for high, medium and low security.

X indicates that no rules are configured to take care of the particular case, since that service does not exist .

Matrix for defining High level Security Rules

Service	***Private to Public***	***Private to DMZ***	***Private to Self***	***Public to Private***	***Public to DMZ***	***Public to Self***	***DMZ to Private***	***DMZ to Public***	***DMZ to Self***	***Self to Private***	***Self to Public***	***Self to DMZ***
HTTP	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*	*No*	*Yes*	*No*	*X*	*X*	*X*
DNS	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
FTP	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*No*	*Yes*	*No*	*X*	*X*	*X*
telnet	*No*	*No*	*Yes*	*No*	*No*	*No*	*No*	*No*	*No*	*X*	*X*	*X*
SMTP	*Yes*	*Yes*	*X*	*No*	*Yes*	*X*	*Yes*	*Yes*	*X*	*Yes*	*Yes*	*Yes*
POP 3	*Yes*	*Yes*	*X*	*No*	*Yes*	*X*	*Yes*	*Yes*	*X*	*X*	*X*	*X*
Chargen	*X*	*X*	*X*	*No*	*No*	*No*	*X*	*X*	*X*	*X*	*X*	*X*
Discard	*X*	*X*	*X*	*No*	*No*	*No*	*X*	*X*	*X*	*X*	*X*	*X*
Echo	*X*	*X*	*X*	*No*	*No*	*No*	*X*	*X*	*X*	*X*	*X*	*X*
ICMP	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Matrix for defining Medium Level Security Rules

Service	**Private**	**Private**	**Private**	**Public**	**Public**	**Public to**	**DMZ to**	**DMZ to**	**DMZ to**	**Self to**	**Self to**	**Self to**

	to Public	to DMZ	to Self	to Private	to DMZ	Self	Private	Public	Self	Private	Public	DMZ
HTTP	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	X	X	X
DNS	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FTP	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	X	X	X
telnet	Yes	Yes	Yes	No	No	No	No	Yes	No	X	X	X
SMTP	Yes	Yes	X	No	Yes	X	Yes	Yes	X	Yes	Yes	Yes
POP 3	Yes	Yes	X	No	Yes	X	Yes	Yes	X	X	X	X
ICMP	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Chargen	X	X	X	No	No	No	X	X	X	X	X	X
Discard	X	X	X	No	No	No	X	X	X	X	X	X
Echo	X	X	X	No	No	No	X	X	X	X	X	X

Matrix for defining Low level Security Rules

Service	Private to Public	Private to DMZ	Private to Self	Public to Private	Public to DMZ	Public to Self	DMZ to Private	DMZ to Public	DMZ to Self	Self to Private	Self to Public	Self to DMZ
HTTP	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	X	X	X
DNS	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FTP	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	X	X	X
telnet	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	X	X	X
SMTP	Yes	Yes	X	No	Yes	X	Yes	Yes	X	Yes	Yes	Yes
POP 3	Yes	Yes	X	No	Yes	X	Yes	Yes	X	X	X	X
ICMP	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chargen	X	X	X	X	X	X	X	X	X	X	X	X
Discard	X	X	X	X	X	X	X	X	X	X	X	X
Echo	X	X	X	X	X	X	X	X	X	X	X	X

In addition to the above, network and broadcast accesses from Public are denied at High security.

13.2.2 Firewall features

The powerful features of Logging and Blacklisting enable the modem to provide greater protection.

IP session - overview

The modem's IP filtering feature allows it to examine each packet traveling in either direction (incoming or outgoing) on an interface and to filter out packets based on rules that you define. On finding a matching rule, the modem remembers the matching rule on the particular interface in the particular direction, along with the unique combination of protocol and source/destination addresses and ports. This unique combination of protocol and source/destination addresses and ports is defined as an **IP session**.

An IP session is kept alive by packets flowing in either direction. A session can time out if no packets belonging to the session are encountered for some time. Thereafter, any packets with the same session parameters cause a new session to be formed. Rule

lookups for the new session begin afresh. The session time outs depend on particular protocols and, in case of TCP, on the state of the TCP connection as well.

13.2.2.1 *Logging*

The modem keeps track of TCP connections flowing from or through it. It also keeps track of any UDP, ICMP or other protocol messages exchanged between peers for traffic flowing through it. The network administrator is therefore also able to view all active sessions passing through the modem.

The firewall provides alerts to the network administrator through mails, system traces. These alerts inform the network administrator of detection of any of the attacks mentioned above.

The system does not generate a log every time an attack is detected. This holds good for some port scan attacks such as SYNACK scans, FIN scans, ACK scans, RST scans, UDP scans, ICMP scans and TCP session scan attacks. The logs are generated at a certain periodicity, which can be configured (default 30 minutes). For such type of scans, the system maintains counters on how many times a particular attack has been detected during the last logging period. It also reports when the log is generated.

13.2.2.2 *Blacklisting*

The network administrator may not always be available to read the mails sent as warning. To protect users during this time, firewall provides blacklisting, a mechanism by which the initiator of an attack is blacklisted so that, for some time, no traffic is allowed from that malicious host. No packets from a host from which a violation has been detected is allowed to pass through, until a user configured time.

Blacklisting is provided against the following attacks:

- **tear drop**
- **ping of death**
- **port scan.**

Immediate blacklisting is done for attacks when the system is sure, after examining the packet, that it has not arrived under normal circumstances. This holds good in case of single packet scans such as NULL Scan, XMAS Scan and TCP Fragmentation Scan.

13.2.3 Configuration details

13.2.3.1 *Logging*

The firewall feature of the modem provides the user with the ability to be alerted of violations, over e-mail. To avail of this benefit, the user needs to configure the IP address or fully qualified domain

name (FQDN) of his mail server. This mail server can be on the LAN or can be provided by the ISP.

You need to check the IP Filter rules to ensure that the connectivity to the configured SMTP server exists.

Use the **`modify smtp servaddr`** command to configure the IP address of the SMTP server.

To modify the global configuration of the IP firewall, enter:

```
modify fwl global [attackprotect enable|disable][dosprotect
enable|disable][blistprotect enable|disable][blistperiod
<decvalue>][maxtcpconn <decvalue>][maxicmpconn
<decvalue>][maxsinglehostconn <decvalue>][logdest
email|trace|both|none][email1 email-id][email2 email- id][email3
email-id][minlogtime <decvalue>]
```

Use the **`emailid`** parameter of the **`modify fwl global`** command to specify up to three email ids to which the alerts will be mailed.

Use the **`"log-tag"`** parameter and the **`destport`** parameter in the **`create ipf rule`** entry command to specify the logging destination as mail, or both.

Use the **`attackprotect enable|disable]`** parameter of the **`modify fwl global`** command to disable or enable attack protection.

Use the **`dosprotect enable|disable]`** parameter of the **`modify fwl global`** command to disable or enable DOS protection.

Use the **`dosprotect enable|disable]`** parameter of the **`modify fwl global`** command to disable or enable DOS protection.

Use the **`get fwl stats`** command to get firewall statistics such as the number of ICMP sessions, the number of Half open TCP Sessions, the type of attack, the time stamp, and other elated details. Use the **`reset firewall stats`** command to reset firewall statistics.

Use the **`minlogtime`** parameter to specify the minimum logging time between the mailing of logs that inform of attacks.The next log is generated only after the minimum log time, specified in minutes, elapses, and the system detects another attack.

13.2.3.2 *Blacklisting*

Getting information on blacklisted host

To get information on a blacklisted host, enter:

```
get fwl blacklist [ip <ddd.ddd.ddd.ddd>]
```

This command displays

the IP address of the blacklisted host

the reason for blacklisting the host

the IP Filter rule id which caused the blacklisting (valid only if blacklisted due to service protection violation)

the time duration in seconds after which the IP address entry will be removed from this table.

Deleting a Blacklisted host

To delete a blacklisted host, enter:

```
delete fwl blacklist ip <ddd.ddd.ddd.ddd>
```

Enabling or disabling Blacklisting

Using relevant parameters of the **`modify fwl global`** command described above, you can enable or disable blacklisting and configure the duration for blacklisting an attacking host. You can also configure the percentage of total connections that can be in a TCP half open state, the percentage of total connections that can be ICMP connections and the maximum percentage of connections from a single host, using the relevant parameters of the **`modify fwl global`** command.

13.3 IP Filtering and IP Sessions

This section provides details about the SAR110 unit's IP filtering capability and how to configure the rules for IP filtering.

The SAR110 unit's IP filtering feature allows it to examine each packet traveling in either direction (incoming or outgoing) on an interface and to filter out packets based on rules that you define.

Because the IP filter scans packets at the IP layer, it can be used only in the routing mode.

A rule can be configured to be applicable on a specific interface or on all interfaces but it applies only in one direction (in or out).

However, this does not hold good for rules with "storestate" feature as they get applied in both directions

Each rule is assigned an ID. Rule IDs must be unique. These IDs determine the order in which rules are matched - from lowest to highest number.

To allow you to retain full control over the order of rule evaluation, do not number rules/subrules consecutively, e.g., 1, 2, 3, etc., but in increments, e.g., 10, 20, 30, etc. This will allow you to insert more rules between the existing ones at a later time. If you number your rules consecutively, you will have to delete and recreate all existing rules that are to follow the new rule.

With IP filtering enabled, when a packet is received on an interface, the unit scans the rules applicable on that interface for the incoming direction. When a packet is sent out from an interface, all rules applicable on that interface for the outgoing direction are scanned. If a rule is found that matches the packet, the packet is accepted or denied as specified by the rule. A packet in transit from the LAN to the WAN, or from the WAN to the LAN thus needs to be cleared by two sets of rules - one on the incoming interface and one on the outgoing interface.

A rule is said to match the packet only if all the selectors specified in the rule match the fields in the packet. The selectors supported are - source and destination IP addresses, transport protocol, source and destination port numbers, ICMP type and code values, the TCP syn flag, filtering based on packet length, filtering based on presence of any IP options and filtering of all fragmented packets. If a rule does not match the packet, that rule is skipped and a match is tried with the next rule.

If none of the rules match the packet, the default action is taken for that packet. The default action is specified as part of the IP filter global configuration.

On finding a matching rule, the unit remembers the matching rule on the particular interface in the particular direction, along with the unique combination of protocol and source/destination addresses and ports. This unique combination of protocol and source/destination addresses and ports is defined as an IP session.

Now, when another packet with the same session parameters is encountered, the unit does not need to look up its rules once again It simply applies the remembered rule for the particular interface and direction.

A single IP session has four rules associated with it - one each for the incoming/outgoing directions on the incoming interface and one for each direction on the outgoing interface.

All four rules are remembered as part of the IP session.

At least one packet must flow in either direction before all four rules are determined. For instance, if a LAN client does a telnet to a WAN host, the first packet from the client to the server would enable the unit to determine two rules applicable for the session - one for the incoming direction on, say eth-0, and one for the outgoing direction on, say ppp-0.

The first response packet that comes from the server to the client will enable the unit to determine the remaining two rules for the session - one for the incoming direction on ppp-0 and one for the outgoing direction on eth-0.

If no matching rules are found for a given direction on a given interface, the unit also remembers to apply the default action for subsequent packets for the particular interface and direction.

An IP session is kept alive by packets flowing in either direction. A session can time out if no packets belonging to the session are encountered for some time. Thereafter, any packets with the same session parameters cause a new session to be formed. rule lookups for the new session begin afresh. The session time outs depend on particular protocols and, in case of TCP, on the state of the TCP connection as well. The time outs can be viewed using the **get nat global** command.

The maximum number of rules is determined by the **maxipfrule** parameter in the **size** command.

13.3.1 Using IP Filtering Rules

Rules specify, at a minimum, the interface and direction to be monitored, and the action to take if a packet matches the rule.

Commands for rules

The basic commands used to create, modify and delete IP filter rules are described below.

Creating an IP filter rule

To create an IP filter rule, enter:

```
$ create ipf rule entry ruleid 10 ifname ppp-0 dir in transprot eq
icmp act deny enable
```

This command creates a rule with rule ID 10 on interface ppp-0, for packets traveling in the incoming direction. Omitting the ifname parameter makes the rule applicable on all interfaces. If the protocol field in the IP packet equals ICMP, this rule drops the packet (since the action is deny). Hence, the rule drops all incoming ICMP packets on ppp-0. The enable indicates that the rule is to be created in the enabled state (the default being disable).

If the direction is set to out, you can also specify an In Interface name using the **inifname** parameter. Thus, the following rule will match only those packets that arrived on the unit on eth-0 and are leaving via ppp-0 -

```
$ create ipf rule entry ruleid 10 ifname ppp-0 dir out inifname eth-0
transprot eq icmp act deny enable
```

Various options for matching allow you to look for addresses equal to a value, not equal to a value, within a given range of values, outside a given range of values and so on. Similar options are also supported for ports. Following is an example.

```
$ create ipf rule entry ruleid 20 ifname ppp-0 dir out transprot eq
tcp srcaddr range 192.168.1.2 192.168.1.10 destaddr erange 202.1.1.20
202.1.1.30 act deny enable
```

This discards all TCP packets originating from addresses 192.168.1.2 to 192.168.1.10 (both inclusive) and destined for addresses other than those lying in the range 202.1.1.20 to 202.1.1.30 (both inclusive). This means, packets destined for 202.1.1.20 and 202.1.1.30 will be allowed by this rule. Only destinations less than 202.1.1.20 or greater than 202.1.1.30 will be denied.

You can also log the packets matching a given rule using the log option:

```
$ create ipf rule entry ruleid 10 ifname ppp-0 dir in transprot eq
icmp act deny enable log enable
```

The IPfilter logs are governed by firewall logging. The logs can be directed to trace-based destinations or can be sent as e-mails using the **modify fwl global** commands.

Modifying an IP filter rule

To modify a rule, enter:

```
$ modify ipf rule entry ruleid 10 accept
```

Deleting an IP filter rule

To delete a rule, enter:

```
$ delete ipf rule entry ruleid 10
```

Viewing all rule configurations

To see the configuration of all rules, enter:

```
$ get ipf rule entry
```

13.3.1.1 *IP filter rule configuration for enhanced security*

Predefined IP Filter rules enable you to set the levels of security as High, medium, Low or None, for the modem.

IP Filter rules are configurable such that they are enabled or disabled depending upon time of the day.

You can use the interface type as a selector, while configuring IP Filter rules The interface types you can choose between are, "public", "private" or "service"

You can configure IP Filter rules to filter out all fragmented packets and packets with IP options.

Each IP Filter rule has a 16 character long string as parameter. This string can be used for logging. Typically, the string is the name of the attack detected

IP Filter rules can take port ranges as service names (like HTTP etc.) Some standard port numbers, as mentioned in the list below, are used for the following service names, irrespective of the transport protocol selected.

Echo	**7**
Discard	**9**
CHARGEN	**19**
FTP	**21**
TELNET	**23**
SMTP	**25**
DNS	**53**
BOOTP	**67**
TFTP	**69**
HTTP	**80**
POP3	**110**
SNMP	**161**

IP Filter rules can take a keyword "netbcast", with the destaddr parameter, to mean the broadcast address of the network on which the packet was received. This can be used to match packets with the destination as the network broadcast address.

The keyword “self” can be given with scraddr and **destaddr** parameters to match packets generated by the modem, or destined for the modem.

IP Filter rules can be configured to indicate whether the host generating the packet should be blacklisted or not.

13.3.2 Configuring Time-of- day based rules

A rule can be configured to be active during a part of the day using the the todfrom, todto and todstatus parameters.

For example,

```
create ipf rule entry ruleid 20 transprot eq icmp deny todfrom
"9:30:00" todto "18:30:00" todstatus enable
```

The above rule will be active between 9:30 AM and 6:30 PM. Since it blocks all ICMP packets, it means that ICMP packets will be blocked between the given time values. If the the todstatus had instead been disable, then the rule would be inactive between the given times and active during the rest of the day, hence ICMP packets would be allowed between the given times and denied during the rest of the day.

The current time on the modem can be seen using the get system command, and can be modified using the modify system command.

Following is the list of time zones supported.

- **{"IDLW", -1200, "International Date Line West"},**
- **{"NT" , -1100, "Nome"},**
- **{"HST", -1000, "Hawaii Standard"},**
- **{"CAT", -1000, "Central Alaska"},**
- **{"AHST", -1000, "Alaska-Hawaii Standard"},**
- **{"YST", -900, "Yukon Standard"},**
- **{"HDT", -900, "Hawaii Daylight"},**
- **{"YDT", -800, "Yukon Daylight"},**
- **{"PST", -800, "US Pacific Standard"},**
- **{"PDT", -700, "US Pacific Daylight"},**
- **{"MST", -700, "US Mountain Standard"},**
- **{"MDT", -600, "US Mountain Daylight"},**
- **{"CST", -600, "US Central Standard"},**
- **{"CDT", -500, "US Central Daylight"},**
- **{"EST", -500, "US Eastern Standard"},**
- **{"EDT", -400, "US Eastern Daylight"},**
- **{"AST", -400, "Atlantic Standard"},**
- **{"NFST", -330, "Newfoundland Standard"},**
- **{"NFT", -330, "Newfoundland"},**
- **{"BRST", -300, "Brazil Standard"},**
- **{"ADT", -300, "Atlantic Daylight"},**
- **{"NDT", -230, "Newfoundland Daylight"},**
- **{"AT" , -200, "Azores"},**
- **{"WAT", -100, "West Africa"},**
- **{"GMT", +0000, "Greenwich Mean"},**

- {"UTC", +0000, "Universal (Coordinated)"},
- {"WET", +0000, "Western European"},
- {"CET", +100, "Central European"},
- {"FWT", +100, "French Winter"},
- {"MET", +100, "Middle European"},
- {"MEWT", +100, "Middle European Winter"},
- {"SWT", +100, "Swedish Winter"},
- {"BST", +100, "British Summer"},
- {"EET", +200, "Eastern Europe, Russia Zone 1"},
- {"FST", +200, "French Summer"},
- {"MEST", +200, "Middle European Summer"},
- {"SST", +200, "Swedish Summer"},
- {"IST", +200, "Israeli Standard"},
- {"IDT", +300, "Israeli Daylight"},
- {"BT" , +300, "Baghdad, Russia Zone 2"},
- {"IT" , +330, "Iran"},
- {"ZP4", +400, "Russia Zone 3"},
- {"ZP5", +500, "Russia Zone 4"},
- {"INST", +530, "Indian Standard"},
- {"ZP6", +600, "Russia Zone 5"},
- {"NST", +630, "North Sumatra"},
- {"WAST", +700, "West Australian Standard"},
- {"SSMT", +700, "South Sumatra, Russia Zone 6"},
- {"JT" , +730, "Java"},
- {"CCT", +800, "China Coast, Russia Zone 7"},
- {"WADT", +800, "West Australian Daylight"},
- {"ROK", +900, "Korean Standard"},
- {"KST", +900, "Korean Standard"},
- {"JST", +900, "Japan Standard, Russia Zone 8"},
- {"CAST", +930, "Central Australian Standard"},
- {"KDT", +1000, "Korean Daylight"},
- {"EAST", +1000, "Eastern Australian Standard"},
- {"GST", +1000, "Guam Standard, Russia Zone 9"},
- {"CADT", +1030, "Central Australian Daylight"},
- {"EADT", +1100, "Eastern Australian Daylight"},
- {"IDLE", +1200, "International Date Line East"},
- {"NZST", +1200, "New Zealand Standard"},
- {"NZT", +1200, "New Zealand"},

- **{"NZDT", +1300, "New Zealand Daylight"}**

13.3.3 IP Sessions – Advanced Configuration Issues

For an IP session, the unit looks up its rules for each of the two interfaces, and for each direction on that interface, only once. The matched rules are then applicable for as long as the session is alive. This optimizes the unit's search efforts.

Suppose you configure a rule with ruleid 20.

Some packets do pass through the unit using this rule so that the rule information in the session is initialized. Now suppose you add another rule with ruleid 10, having the same selectors as rule 20, but the action as **deny**. You might now find that the packets continue to pass through, even though you have configured a rule with a lower ruleid which is supposed to discard these very same packets.

This happens because the subsequent packets continue to use the session information stored in the unit, hence they continue to use the “older” rule 20. However, once the session has timed out, say because of inactivity, the new rule will apply to packets that are received thereafter.

There is, however, a get around to this situation. After adding the ruleid 10, you should invoke the **reset ipf sessions** command to force the rule lookup.

An IP filter rule has parameters such as the TCP syn flag, which can be used along with the protocol, the source/destination addresses and the ports, to identify a packet as belonging to a particular session.

Assume you have the following rule configured:

```
$ create ipf rule entry ruleid 20 dir out ifname ppp-0 transprot eq
tcp destport eq 23 tcptype syn act accept enable
```

This allows all TCP packets, which have TCP syn flags set, to reach a telnet server (port 23) via ppp-0. The first packet that flows out will have the TCP syn flag set, since this is the manner in which TCP initiates a connection formation. So the first packet passes through successfully.

The subsequent outgoing packets do not have the TCP syn flag set, but they still pass through successfully. This is because the first packet, which passed successfully, initializes the session information to say that the action specified by rule 20 is to be taken for packets belonging to this session going out via ppp-0.

With subsequent packets, the unit decides that they belong to the same session based only on the protocol and the source/destination addresses and ports (which are anyway the same as the first

packet). Hence the rule effectively allows all outgoing packets associated with a LAN client doing a telnet to a WAN host.

13.3.3.1 *Stateful Filtering*

The SAR110 unit's Stateful filtering feature allows you to permit packet flow in one direction only if a session has been initiated from the other direction.

If you want to permit telnet connections from your LAN to the WAN without anyone from outside being able to telnet into your LAN, you will create rules in both directions using the TCP flag option. The rules would resemble the following.

```
$ create ipf rule entry ruleid 20 dir out ifname ppp-0 transprot eq
tcp destport eq 23 tcptype syn act accept enable
```

The first rule allows all telnet connections initiated from the LAN.

```
$ create ipf rule entry ruleid 21 dir in ifname ppp-0 transprot eq tcp
destport eq 23 tcptype syn act deny enable
```

This rule denies all telnet connections initiated from the WAN,

```
$ create ipf rule entry ruleid 22 dir in ifname ppp-0 transprot eq tcp
srcport eq 23 act accept enable
```

This rule allows all packets coming from telnet servers, presumably in response to connections initiated from the LAN.

Stateful filtering will allow you to achieve all this by creating a single rule. To use it, you would create just an outgoing rule with the storestate flag set to enable:

```
$ create ipf rule entry ruleid 20 dir out ifname ppp-0 transprot eq
tcp destport 23 act accept enable storestate enable
```

Now, when a client on the LAN tries to telnet outside, its packets would go out because this rule allows them to. Thus, in the corresponding IP session, the outgoing rule on ppp-0 is marked as **rule 20**. Additionally, since the storestate flag is enabled, the unit also marks the incoming rule on ppp-0 for the session as **rule 20**. When it detects incoming packets on ppp-0 belonging to the same session, it lets them through.

Thus, the storestate flag allows you to permit the flow of packets in one direction on an interface, provided at least one packet belonging to the session has flown in the other direction first. This holds as long as the session is alive.

The storestate rule may affect the rule action in the other direction as well, and if this rule is matched, then it also updates the session parameters for the other direction, irrespective of the fact that there was some earlier rule present in the other direction.

On the ethernet interface, rule id 10 and rule id 20 are the rules used. If a telnet is originated from a PC to the modem, then, ruleID 10 will be used in IN direction. When the response to PC is sent from the modem, ruleid 20 is used. As this is a”storestate" rule, it will overwrite the ruleid 10 in the “IN” direction. So, now, even if ruleID 10 is disabled and changed to a DENY rule, it will not have any impact on the packet flow.

13.3.4 IP Filtering Global Configuration

The **modify ipf global** command is used to control the default actions on various types of interfaces and to set the modem's security level.

The default actions are controlled by the **pvtdefact**, **pubdefact** and **dmzdefact** parameters. For instance, to allow all packets on public interfaces by default, use

Configuring Default actions on various interfaces

```
$ modify ipf global pubdefact accept
```

To deny all packets on private interfaces by default, use

```
$ modify ipf global pvtdefact deny
```

Setting Security Levels

The security level of the modem is controlled using the **seclevel** parameter.

- **To set the security level to High, use the command -**

```
$ modify ipf global seclevel high
```

- **To set the security level to Medium, use the command -**

```
$ modify ipf global seclevel medium
```

- **To set the security level to Low use the command -**

```
$ modify ipf global seclevel low
```

At each level, different rules become active depending upon the security level specified with the rules.

Whether a given rule is currently active or not is determined by three factors. The first is whether the rule is administratively enabled or not. The second is whether the rule's security level matches the current security level (as shown by the get ipf global command*). The third is whether the rule's Time of Day parameters (todfrom, todto and todstatus) and the current system time (as shown by the* ***get system*** *command)*

indicate it to be active. The current status of the rule is shown as the "Rule Oper Status" in the ***get ipf rule entry*** *command.*

When the modem boots up, the time is set to the last committed time. Hence, the rules applicable on boot up will depend on this last committed time. This will hold as long as the actual current time is determined by the modem using SNTP (refer to Chapter) or till the user configures the correct time using the ***modify system*** *command.*

14 Usage Control

14.1 Overview

The Usage Control feature of the unit provides a user authentication mechanism for allowing LAN to WAN access, only after a login/password have been provided by the LAN user. The mechanism gets activated when a new LAN user tries to connect to the WAN.

Why is user authentication required?

A number of emerging scenarios require the unit to be under the control of the service provider, with strict limits set on the number of users connected. Enforcing this requires that whenever a user tries to connect through the unit, he be prompted for some authentication, and only then allowed through.

Who is a Data User?

To cater to the above requirements a new kind of user, the concept of Data User, has been introduced. A Data User has WAN access privileges through the unit, but does not have any administration privileges, except that he is allowed to modify his own login/password, or the PPP login/ password. The Data User is allowed WAN access only after he has provided this login/password. The data user, additionally, has the facility of "bumping off" another user by giving his login password from another machine. A data user is one who uses the unit to access the WAN but has no need to either view or modify the unit's configuration. Multiple Data users can login to the unit. For authentication, the unit interrupts HTTP packets from the unauthenticated user. Authentication is in the form of a login and password in a Data User login page.

Who is a Management User?

A management user can use CLI commands or the HTTP pages for configuring the unit. A management user with root privileges can modify the unit configuration. A management user with user privileges can view, but not modify the unit configuration. Management via HTTP is done by giving the unit's name or IP address, as the URL.

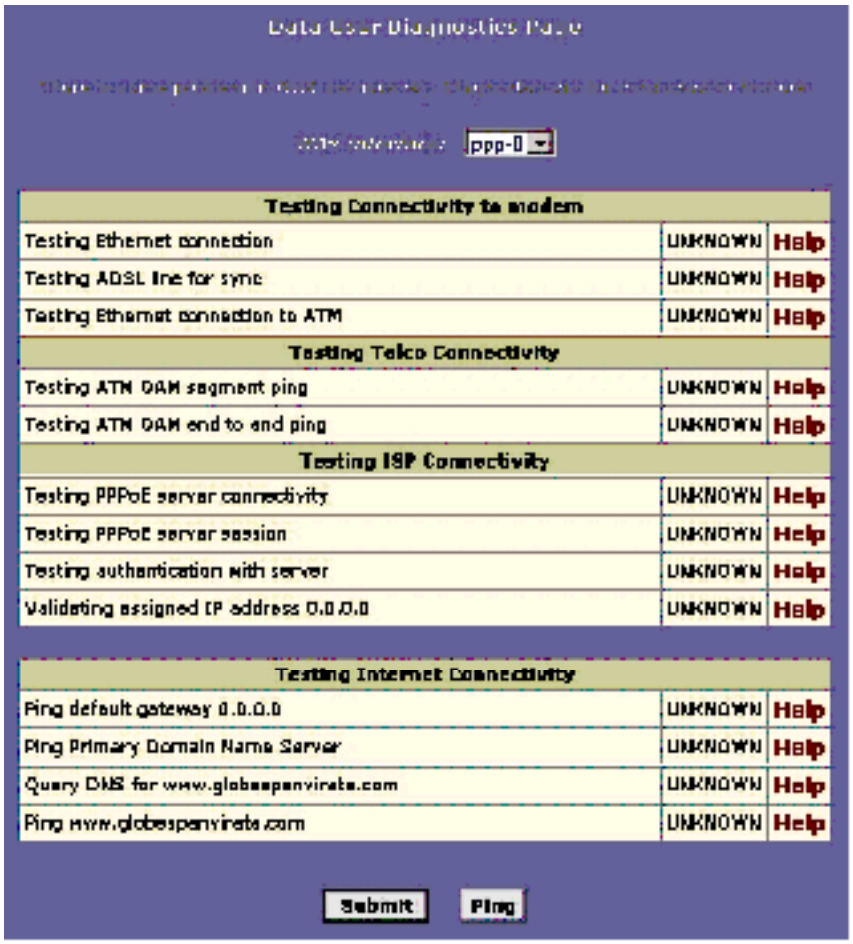
14.2 User Authentication process

When the Usage Control feature is enabled, the unit interrupts WAN-side access by displaying some HTTP pages that force a user to create a new user id or authenticate himself before he is allowed to access the WAN side. For taking this user input and providing appropriate responses to the end user, user-friendly HTTP pages are displayed

An existing user or a new user provides login name and password using the Data User Login Page. This page comes up whenever any unauthorized LAN to WAN access is detected by the IP layer

Data User Login Page

After authentication, if there is some problem in the WAN connectivity, and diagnostics need to conducted, the user sees the following display:



Data User Diagnostics Page

Data User Login Page

To begin authentication process, the data user uses the Login Name and **Password fields of** the Data User Login Page.

***Login Name* Input Field**

The data user uses this field to provide an existing data user name for authentication purposes, or, create a new data user, subject to the maximum number of data users allowed in the system.

***Password* Input Field**

The input password is provided by the user in this field, to authenticate an existing user or indicate a new data user entry.

***Same as PPP* Check Box**

This checkbox is displayed ONLY when the usage control feature for PPP interface is enabled. Choosing the common login option is allowed only when the PPP security entry is not created. The checkbox is not displayed at all, if the WAN interface used is not a PPP interface. The common login mechanism is provided purely as a convenience, so that the user does not have to configure the PPP login separately. The check box is checked by default, if the PPP security entry is not created. The check box is unchecked and greyed out if the security entry already exists.

Once authenticated, the unit remembers the Data User's IP address and all further packets from this data user pass through unhindered. The IP address is remembered across boots.

***Submit* Button**

Click this button to submit the user login and password information.

***Cancel* Button**

Click this button to cancel the changes and refresh the Data User Login Page.

On submitting above information, the user is directed to one of the following pages:

the original URL on the WAN side, if the data user already exists but is not active from any machine, and the correct password has been submitted. Or, if it is a new data user and the number of data users in the system has NOT exceeded the maximum permissible.

Usually, after the data user logs in, his browser gets automatically redirected to the site he was originally trying to access. However, in certain situations, after having logged in, the data user may need to close his existing browser window and open another one to get to the desired site. This limitation is due to the fact that most browsers cache DNS responses locally, instead of using the system DNS cache. This kind of a situation cally occurs only if the data user logs in while the WAN interface is down. Note that in such cases, it does not suffice to start a new window from the existing one, for instance, by doing a ctrl-N. The data user needs to actually close the existing window and open a new one.

Data User Maximum Connections Exceeded Page

the Data User Maximum Connections Exceeded Page, if the data user is a new user, and the maximum number of data users are already logged in. He will be allowed to input a new login/password combination from this page, very similar to the Data User Login Page.

Data User Maximum Connections Exceeded Page

the Data User Connection-in-Use Page appears only after a data user has provided correct input of an existing data user login and password, active from some other machine.

Data User Connection-in-Use Page

Data User Connection-in-Use Page

Release Other User **Check Box**

This checkbox is checked by the data user when he wants to bump off the existing user with the same login.

Submit **Button**

Clicking this button will "bump" off the existing data user, and the new IP address will be renumbered, for authenticating this particular

data user. The data user will automatically be redirected to the original IP address that he had typed in, to access the WAN side.

***Cancel* Button**

Clicking on this button cancels the changes made in the page by the user, and refreshes the page.

The Data User Session Management Page is used by the data user to Logout, Delete, and modify Login and/or PPP Security information for any data user.

Data User Session Management Page

Data User Session Management Page

***Logout* Option**

If this option is checked, the data user is removed and the information is updated.

***Delete Data User* Option**

If this option is checked, the data user entry will be deleted, provided the IP address for the input data user, and the IP address from where the delete request came, match.

***Modify Login Information* Option**

If this option is checked, the fields are enabled, and the user can modify his login information.

***Modify PPP Security Information* Option**

If this option is checked, the data user can modify his PPP security information.

***Submit* Button**

On clicking this button, appropriate action will take place. On successful completion of the action, a success page is displayed, and on failure, an operation failure page is displayed with the option to go back to the Data User Session Management Page.

***Cancel* Button**

This will cancel the changes made in the page by the user, and refresh the page.

For all other cases, the user will encounter a failure page, with an appropriate error message that will tell him what to do next.

14.3 Configuration using CLI

The management user can use the following CLI commands for configuring this feature.

Enable/Disable Usage Control

To enable or disable the usage control feature on the unit, enter:

```
$ modify usagectrl [enable|disable]
```

Configure number of data users

To modify the maximum number of data users, who can have simultaneous access to the WAN side, enter:

```
$ modify usagectrl   [ maxusers <decvalue> ]
```

View data user login and IP address

To view the login name of the data user, and the IP Address of host from which the data user is currently logged in, enter:

```
$ get datauserslist
```

Delete data users

To delete all data users, enter:

```
$ reset datauserslist
```

It is mandatory to reboot your system after the reset datauserslist *command.*

15 Application Security – Surfing Profile

15.1 Surfing Profile

The surfing profile feature of the modem controls the HTTP traffic passing through it. With the help of this feature, the modem restricts users on private interfaces, by allowing access only to given URLs, or, by allowing access to everything but for the list of the URLs. It can also be used to enforce some kind of registration to any of the given list of URLs, before allowing unrestricted access to the Internet.

The surfing profile feature works with applications that support upgraded HTTP/1.0, which have the host field in the request header, and HTTP/1.1 versions of HTTP protocol.

15.2 Invoking the Surfing Profile Feature

The surfing profile feature is automatically enabled when the system comes up. No separate configuration is required for this.

The user cannot enable or disable the surfing profile feature during run time. The configuration file is read during system initialization and cannot be changed during run time, to change the mode of operation.

The modem tries to open the URL file (e.g. iad_surf.prf) during the initialization of the system.Only a single file containing a list of URLs, can exist in the system, at a time. If any file exists in the pre-identified path, with valid entries, surfing profile is enabled. Otherwise, it is disabled by default. Surfing profile is also disabled if the file is blank.

15.3 Types of files

Files can be of one of the following types:

- **Registration enforcement**
- **Allow all in the list**
- **Deny all in the list**

The file type is identified by the keyword present in the first line of the file. Keywords for the file types mentioned above are, **"register"**, **"allow"** and **"deny"**, respectively.

Example

Sample format of a file:

<Start of file>

register/allow/deny

url ["string"]

url ["string"]

<End of file >

It is mandatory to specify the string only in case of registration. The other two file types contain only the URL and not the string. In case the file type is **registration enforcement**, and any one of the URLs is visited, and the corresponding string matches that in the response packet, the user will be allowed unrestricted access from next time onwards. The fact that the user has registered, is also stored in the NVRAM. This registration information is saved for availability across boots.

There is no provision for modifying the URL database file by the end user. So, you, the OEM, have to provide and edit the file, if required. The only way of changing the file is to reprogram the flash with the modified file.

15.3.1 Surfing profile - modes of operation

❖ Registration enforcement

In this case, the modem will allow HTTP traffic only to the URLs mentioned in the file. This access will be limited only to the list of URLS mentioned in the file until there is a match in response from one of the URLs.

File format:

<File Start>

register

url "string"

url "string"

<File End>

If the file format is as mentioned above, the end-user will not be allowed to browse any site other than the sites mentioned in the list. If any one of the URLs is visited and the string is matched in the message body of the response packet, HTTP traffic will be allowed unconditionally, next time onwards.

You may want the user to register for a second time, so that you can filter once again. To do so, you need to reset the surfing profile registration.

To reset the surfing profile registration, use the command:

```
$ reset surf profile reg
```

Allow All in the list

The modem will allow the HTTP traffic flowing through it only if the accessed URL is found in the file.

File format:

<File Start>

allow

url1

url2

url3

……

url n

<File End>

Deny All in the list

The modem will drop the HTTP traffic flowing through it only if the accessed URL is found in the file.

File format:

deny

url1

url2

url3

……

url n

<File End>

15.4 Surfing profile – feature details

Surfing profile operates only on the HTTP traffic going over the compile- time configured TCP port. TCP connection for the HTTP gets established and terminated as usual. Only those packets, which contain valid HTTP data as the TCP payload, are filtered.

Surfing profile is meant for all valid HTTP packets received by the modem on the private interface and routed on the public interface and vice-versa. It is not meant for any packet going or coming from the DMZ interface. The modem checks packets going from private interfaces to public interfaces for HTTP requests and examines packets coming from public to private interfaces for the registration completion. The "registration complete" information is provided by the NVRAM during system initialization, and is set to FALSE, when the system is coming up for the very first time after flash reprogramming.

The system reads the URL file from the flash when the system is coming up and populates the database to be used in run time processing

If the end user accesses some Internet sites by directly using the IP address (IP address of the yahoo.com, 66.218.71.112) and the file contains the URL name (in text format e.g. "yahoo.com"), the surfing profile feature will not function properly. This is due to the fact that information contained in the HTTP header depends on the accessing mechanism. It will contain the IP address in the HTTP header if site has been accessed by providing IP address and URL if accessed by giving the URL.

16 Auto-configuration

When an end-user buys a service from the service provider, and plugs in the unit, the unit can learn configuration details from the central office end. Two auto-configuration features are described in this chapter:

- **SAR110 AutoDetect feature, which enables the unit to dynamically configure its ATM virtual circuit (VC) at startup by attempting a connection using the first available VPI/VCI pair. If that pair does not result in a connection, the modem tries the next available pair, and so on, until a working VC is found.**
- **Auto-configuration as specified in the DSL Forum's technical report TR-37. This implementation uses the ATM Forum's ILMI specification to enable remote configuration of the unit's DSL/WAN properties and other settings.**

16.1 AutoDetect

AutoDetect enables automatic configuration of a valid ATM Virtual Circuit (VC). Autodetect can be used to establish both PPPoE and PPPoA connections and can be used in both bridging and routing modes.

Static VC creation is described in section .

16.1.1 Overview

When AutoDetect is enabled and a WAN connection is initiated (e.g., the modem is rebooted), the modem first attempts to communicate with the ISP's access server using the VC settings (VPI/VCI and mux type) from the most recent successful connection attempt, if any. If communication fails with that VC, then the modem changes the VPI/VCI values and attempts to establish a connection. These new values are determined in one of the following ways, depending on how AutoDetect has been configured:

- **AutoDetect selects the next VPI/VCI pair in a list of pre-defined values in** a text file named *autocfg.txt*, which is stored as part of the flash image.
- **AutoDetect selects the next numerical VPI/VCI combination.**

If a new connection cannot be established using these new values, Autodetect continues to modify the values and attempt a connection until a valid connection is made. The VPI/VCI values of the valid

connection are saved and used in the initial connection attempt if the modem is later rebooted or the WAN interface is restarted.

16.1.2 Configuring the Modem to Work with AutoDetect

AutoDetect requires that the WAN and LAN interfaces be specially configured. The following procedure describes the commands you can enter into the factory defaults file TEFacs.txt, which is combined into an image before loading it into flash.

Ensure that `TEFacs.txt` contains the appropriate commands relating to configuring the WAN interface.

Note the following:

The commands differ depending on whether Autodetect is operating in router mode or bridge mode:

Also note that "-7" is appended to the interface names. These names should be assigned only when AutoDetect is used.

Even though AutoDetect will determine the VC, TEFacs.txt must always contain a command that creates an ATM VC.

```
.
.
```

Notes:

1 .The vpi and vci can be assigned any value in the valid range.
Because no encapsulation is specified for the ATM VC, LLC mux is assumed by default.

2 .In router mode, the PPP interface should always be created as a PPPoE interface; AutoDetect will later modify this interface to PPPoA if necessary.

```
create atm vc intf ifname aal5-7 vpi 100 vci 100 //see note 1
create eoa interface ifname eoa-7 lowif aal5-7
create ppp security ifname ppp-7 login guest passwd guest
create ppp intf ifname ppp-7 lowif aal5-7 ppoe droute true stop
                                                  //see note 2
modify autodetect cfg enable
.
.
```

AutoDetect Commands in TEFacs.txt—Router Mode

```
.
.
create atm vc intf ifname aal5-7 vpi 100 vci 100
create eoa interface ifname eoa-7 lowif aal5-7
create ppp security ifname ppp-7 login guest passwd guest
create ppp intf ifname ppp-7 lowif aal5-7 ppoe droute true stop
create bridge port intf ifname eth-0
create bridge port intf ifname eoa-7
modify autodetect cfg enable
```

.
.

AutoDetect Commands in TEFacs.txt—Bridge Mode

Run the createfi utility to create the new image with the `autocfg.txt` file in the `TEFilesys\adet` directory.

Load the new image into flash using the Loadfi utility, the Web- based interface, or an FTP/ TFTP client.

16.1.3 AutoDetect Configuration Options

AutoDetect can be controlled by the following CLI commands:

- **modify autodetect cfg — configures and enables the feature**
- **get autodetect cfg — displays current configuration**

The modify command has several parameters, which are described in the following examples. You can enter these commands using the CLI.

Enabling/disabling AutoDetect

Use the following commands to enable or disable the Autodetect feature:

```
modify autodetect cfg enable
modify autodetect cfg disable
```

By default, Autodetect is disabled. When disabled, VC information must be configured manually.

Specifying how to determine possible VPI/VCI values

Use the following commands to specify that, when searching for a valid VC, Autodetect either use only the VPI/VCI values defined in a text file or use the entire range of valid VPI/VCI values:

```
modify autodetect cfg vcrange fromfile
modify autodetect cfg vcrange all
```

If *fromfile* is specified then AutoDetect retrieves the VPI/VCI values from the file *autocfg.txt*, which is stored in the flash image.

If *all* is specified, then AutoDetect performs an OAM test over the ATM connection, using each set of numerical VPI/VCI values starting with “0,1”, until a valid response is received.

Specifying the PPPoE/ PPPoA detection method

The following commands specify the criteria AutoDetect uses to determine whether to bring up a PPPoA interface or a PPPoE interface.

```
modify autodetect cfg pppdetect padilcp
modify autodetect cfg pppdetect fullblown
```

When the parameter *padilcp* is specified, AutoDetect begins by sending PADI packets over the first available VC. If AutoDetect receives a response to the PADI packets on a particular VC, it configures a PPPoE interface over that VC on the modem. If no response is received after all available VCs have been attempted, then AutoDetect sends LCP packets over each VC. If it receives a response to the LCP packets, it configures a PPPoA interface. (Depending on the AutoDetect bridge/ router mode setting, AutoDetect may skip the sending of LCP packets, as described in "Specifying bridge or router mode".)

When the parameter *fullblown* is specified, AutoDetect waits until the PPP authentication is complete before configuring the interface type. This setting is useful in cases where the modem has been configured with multiple VC interfaces, as when a user connects to both an ISP and a corporate LAN, using PPPoE on one and PPPoA on the other. In this case, if the padilcp parameter were specified instead and AutoDetect established the interface type based on the first response received, that interface may not be the type over which the user can be authenticated for the intended PPP session.

Specifying bridge or router mode

The following commands can be used to inform the AutoDetect algorithm that the modem is functioning in bridge or router mode:

```
modify autodetect cfg mode router
modify autodetect cfg mode bridge
```

Bridging mode must be enabled in the default configuration. Bridging mode is temporarily disabled when the AutoDetect starts, and then re- enabled when a valid VPI/VCI pair is found.

The bridge/router parameters only affect the functioning of AutoDetect; they do not change the actual bridge/router status of the modem or its interfaces.

When configured for bridging mode (or when no mode is specified), AutoDetect first attempts to connect using the first available VC with LLC Mux encapsulation. This procedure is performed with each successive VPI/VCI pair until a valid response is received. If the entire VPI/VCI list is exhausted with no valid response, then AutoDetect repeats the process, but this time using the VC Mux encapsulation type.

When configured in routing mode, AutoDetect allows for connection using the PPPoE, PPPoA, and DHCP protocols. Therefore, AutoDetect performs the steps as described for bridging mode, and

if no valid response is received after attempting connections using all available VCs, AutoDetect repeats the process, but this time checking for PPPoA.

The process will repeat until a valid response is received. If AutoDetect is configured to obtain the possible VCs from autocfg.txt, then the process will repeat indefinitely, even if all VCs have been tried without success using all combinations of settings (PPPoE/LLC Mux, PPPoE/VC Mux, PPPoA/LLC Mux, PPPoA/VC Mux). If AutoDetect is configured to send OAM tests on all available VCs, and no valid VCs are found after attempting all VCs, then AutoDetect connection process is halted.

16.1.4 Considerations

Assumptions

AutoDetect assumes the following to be true.

- **The Access Concentrator (AC) is available.**
- **The factory defaults (TEFacs.txt) file contains the configurations shown in section .**

Constraints

AutoDetect observes the following constraints:

- **The ATM VC interface name (ifname parameter) must always be configured as** `aal5-7`.
- **The autocfg.txt file, if used, can contain at most 64 VPI/VCI pairs, one pair per line. If more pairs are specified, they are ignored.**
- **The first response from the AC is taken as valid; i.e., once a response is received, no more VPI/VCI pairs are checked.**
- **AutoDetect configures only one VC.**
- **The aal5-7, eoa-7, and ppp-7 (router mode only) interfaces are used for the connection.**
- **When autocfg.txt is used, AutoDetect will loop indefinitely until a valid VPI/VCI pair is found. When OAM-based tests are instead performed on all possible VCs, then AutoDetect stops if no connection can be established after attempting each VC once (for each connection type).**
- **Changes made to the AutoDetect mode using CLI do not take effect until the subsequent system boot-up.**

Limitations

AutoDetect *cannot* be used in the following cases:

- **There is no DHCP/PPP server on the AC.**

16.2 Auto-configuration Using ILMI (TR-037)

The auto-configuration procedure helps minimize end-user involvement in the setup and configuration of the unit. As defined in DSL Forum's TR-037, auto-configuration allows the unit to obtain information needed to configure ATM VCs for one or more network services, by communicating with the DSLAM, using the Integrated Local Management Interface (ILMI) protocol. When the auto-configuration is complete, the unit is configured with VCs and higher layer interfaces (PPP, IPoA, EoA) retrieved from the network. The LAN side is either configured through default configuration, or at run time.

You can create interfaces such as RIP, DHCP relay and IGMP over IP- enabled interfaces, configured from the network.

You can also create VCs and higher layer interfaces manually. However, you should take care of constraints mentioned in section of this chapter.

By default, auto-configuration is disabled. You can enable it using CLI commands at run time, as discussed in section in this chapter, or through default configuration.

Viewing the ILMI configuration

To show the current ILMI configuration, enter:

```
$ get ilmi intf ifname atm-0
```

Creating ILMI interface

To create ILMI interface, enter:

```
$ create ilmi intf ifname atm-0 enable
```

The effect, however, takes place only after **commit** and **reboot**.

Enabling/Disabling ILMI Auto-configuration

To subsequently disable or enable auto-configuration, enter:

```
$ modify ilmi intf ifname atm-0 disable
```

or

```
$ modify ilmi intf ifname atm-0 enable
```

As with the **create** command, disabling or enabling takes effect only after you save the changes using **commit** and **reboot last**.

Starting ILMI auto- configuration

The command to start ILMI auto-configuration is as follows:

```
trigger ilmi
```

This command is only used when you want to start auto-configuration through default, and is not required to be given at command prompt. Please refer to section to start auto-configuration at run time. The following section describes starting auto-configuration through Default.

The ***`trigger ilmi`*** *command is not recommended at run time.*

16.2.1 Starting Auto- configuration through Default

You can set the default configuration to start the auto-configuration procedure by default. The following command sequence starts auto-configuration in the default configuration.

```
create ilmi intf ifname atm-0 enable

trigger ilmi
```

To start auto-configuration through default the *TEFacs.txt* should be as follows:

```
create user name root passwd root root

size maxvc <maximum vc> max1483vc <maximum vc>

create atm trfdesc trfindex 0 NOCLP_NOSCR UBR

create atm port ifname atm-0 maxvc <maximum vc>

modify ppp security ifname default login guest passwd guest

create ethernet intf ifname eth-0 ip 192.168.1.1 mask 255.255.255.0
inside

create bridge port intf ifname eth-0
```

```
modify bridge mode enable

create ilmi intf ifname atm-0 enable

trigger ilmi
```

The sizing parameters described in this document, must preferably be set to support the maximum number of VCs allowed. This means that the **`size`** command should contain the **`maxvc`** and **`max1483vc`** parameters set to the maximum. The same value should also be given for the **`maxvc`** parameter in the **`create atm port`** command.

`modify ppp security` command sets the default PPP login and password for PPP interfaces created through auto-configuration.

The ***`modify ppp security`*** *command is mandatory, otherwise, PPP interfaces will not be created for auto-configured VCs.*

For bridging mode configuration, a bridge port needs to be configured over **`eth-0`** interface and the bridging mode needs to be enabled through the **`modify bridge mode`** command.

The **`create ilmi intf`** command enables auto-configuration procedure over **`atm-0`** interface. This command does not initiate the auto- configuration procedure.

The **`trigger ilmi`** command starts the auto-configuration procedure. This command is used only with the default configuration. It is not required when enabling auto-configuration at run time. This command should be the last command in *TEFacs.txt*. All other commands for LAN side configuration should be placed before this command.

The **`trigger ilmi`** command starts the auto-configuration procedure if ILMI interface is enabled. The auto-configuration procedure creates an ILMI VC (VPI=0 and VCI = 16, by default) and starts communicating with the network side to retrieve information. The retrieved information is used to configure VCs and higher interfaces (PPP, IPoA, EoA depending upon access protocol).

The default configuration should not contain commands for creating VCs and higher interfaces, as these commands can cause a conflict with the configuration retrieved from the network. If this happens, the unit will come up without configuring the conflicting VCs retrieved from the network.

16.2.2 Starting auto- configuration at run time

As mentioned in the previous section,

- **the sizing parameters must preferably be set to support the maximum number of VCs allowed.**
- **default PPP security login and password should be set.**
- **bridging mode should be enabled and a bridge port should be created over `eth-0` interface**, if bridging is to be supported.

Start ILMI auto-configuration

To start auto-configuration, enter:

```
$ create ilmi intf ifname atm-0 enable

$ commit

$ reboot last
```

The auto configuration starts only after the unit is rebooted.

16.2.3 Viewing auto- configured VCs

To see the configured VCs, enter:

```
$ get atm vc intf
```

ILMI also controls the protocol that can run over the VCs configured by it.

To see what access protocols are configured over the VCs, enter:

```
$ get ilmi access protocol ifname atm-0
```

This displays the access protocol (as defined in DSL Forum TR-037) for

each VC configured on the unit.

Following is a list of supported access protocols, and the types of

interfaces that are created over the VC:

- **PPPoA** - PPPoA interface is created over this VC.
- **Bridging** - Only a non-IP enabled EoA interface is created over this VC. A bridge port is also created over this EoA interface.
- **Bridging and Brouter** - An IP enabled EoA interface is created over this VC. A bridge port is also created over this EoA interface.
- **Bridging and PPPoE** - Both a non-IP enabled EoA interface and a PPPoE interface are created over the VC.
- **IPOA** - non -1577 IPoA interface is created over this VC.
- **Classical IP** - Depending upon encapsulation either a 1577 IPoA (LLC) or non -1577 IPoA (VCMux) interface is created.
- **Any** - ILMI imposes no restrictions on what can be configured over the VC.

16.2.4 Best effort configuration

The auto-configuration procedure follows the principle of best-effort configuration.

If some of the parameters specified in TR-037 recommendation is not supported by the network, then an appropriate default value is assumed, in order to configure the interface. To illustrate, consider that the **`atmfAtmServiceTMConformanceDef`** parameter defined in the **`atmfAtmServiceTypeTable`** is not supported by the network. In this case, the procedure will assume a default value. The default value depends on the **`atmfAtmServiceTMCategory`** parameter retrieved from the network. However, if an incorrect or inconsistent value is retrieved for the **`atmfAtmServiceTMConformanceDef`** parameter, the interface will not be configured. An appropriate trap, as defined in TR-037, is then, sent to the network. This trap is also displayed on the console and logged by the unit.

It is recommended that you ensure mandatory support for some parameters from the network. Please refer to section in this chapter, for a list of recommended parameters.

If these parameters are not supported, auto-configuration of the interfaces may fail. In this case, an appropriate trap, as defined in TR-037, is sent to the network. This trap is also displayed on the console and logged by the unit. Other interfaces retrieved from the network are configured on a continuing basis. Hence, the best effort configuration procedure configures those interfaces whose parameter values are proper and discards those interfaces whose parameter values are improper.

16.2.5 VCC change and Cold Start Trap

The network can change the unit configuration by sending a VCC Change trap. On receiving the trap, auto-configuration procedure retrieves the configuration information for the VC from the network and re-configures itself. Only the VC for which the trap is received, is affected. Due to this action, a previously auto-configured VC may be deleted or modified. A new VC and higher interfaces (depending upon access protocol) may be also be configured, due to this action. If you had configured RIP, DHCP Relay, IGMP etc., over an IP enabled auto-configured interface and this auto- configured interface got deleted due to VCC Change trap, then you should delete the manually created interfaces. There will be no change in the unit configuration for the VCC Change traps received for manually created VCs.

The network can send Cold Start trap to re-start the auto-configuration procedure. On receiving Cold Start trap the unit re-configures itself from the network. Only ILMI-created VCs, whose configuration are changed at the network side, get affected.

16.2.6 Configuration Conflicts

With auto-configuration enabled, you can still manually create new VCs, as long as these VCs do not conflict with any ILMI-created VCs. Conflicts arise in the following cases.

A conflict exists if manual VC creation is successful, you `commit` to save the new configuration, `reboot last` to reboot from that configuration, and the auto-configuration procedure finds a VC with the same VPI/VCI as the one just added manually. In this case, the unit will come up with manually configured VC.

A conflict also arises if a VCC change trap is received for a manually created VC. In such a situation, the VC will not be modified or deleted at the unit.

Conflict also arises if a Cold Start Trap is received, and a VC, with the same VPI/VCI as the one created manually, is retrieved from the network side. In such a situation, the manually created VC will not be modified or deleted.

16.2.7 Configuration mismatch Traps

A configuration mismatch trap is raised if there is a mismatch between ILMI created VCs at the unit, and VCs retrieved from the network side.

To display a configuration mismatch trap, enter:

```
$ get traps
```

Manual VC creation is not recommended if auto-configuration is enabled.

16.2.8 Constraints

- **Manually created VCs and higher layer interfaces configured over them should have index names with**

same sub-script. For example, if you create a VC through CLI or HTTP, with interface name aal5-1, and you want to create PPP over it, then the interface name of PPP should be ppp-1.

16.2.9 Recommended parameters required from network

The following parameters, specified in TR-037, should be supported at the network side.

- **AtmfVccTable**

atmfVccPortIndex
atmfVccVpi
atmfVccVci
atmfVccTransmitTrafficDescriptorParam1
atmfVccTransmitTrafficDescriptorParam2
atmfVccTransmitTrafficDescriptorParam3
atmfVccTransmitTrafficDescriptorParam4
atmfVccTransmitTrafficDescriptorParam5
atmfVccTransmitFrameDiscard

- **AtmfAtmServiceConnInfo**

atmfAtmServicePortIndex
atmfAtmServiceVpi
atmfAtmServiceVci
atmfAtmServiceConnServiceIndex
atmfAtmServiceConnAALType
atmfAtmServiceConnAALIndex

- **atmfAtmServiceTypeTable**

atmfAtmServiceTypeIndex
atmfAtmServiceTMCategory
atmfAtmServiceTMConformanceDef

- **atmfAAL5ProfileEntry**

atmfAAL5ProfileIndex
atmfAAL5MaxCpcsSduSizeForward
atmfAAL5MaxCpcsSduSizeBackward

- **atmfAtmServiceTypeExtensionTable**

atmfAtmLayer2ProtocolID
atmfAtmLayer3ProtocolID

17 Other Device Access Mechanisms

This chapter discusses access mechanisms for the modem, other than CLI. They include, SNMP, a web-based interface, and the L2 Agent.

17.1 Simple Network Management Protocol (SNMP)

Simple Network Management Protocol (SNMP) specifies how information will be exchanged between a Network Management System (NMS) and the network devices managed by it. This information is used to configure and manage the network devices. The SAR110 software provides SNMP access to the following Management Information Base (MIB):

- **RFC 1213:** *Management Information Base for Network Management of TCP/IP-Based Internet: MIB-II*. Supported groups: system, interfaces, IP, ICMP, UDP, and SNMP groups.

In order to access the unit using an SNMP manager, you need to configure the unit's SNMP agent, as explained in this section.

17.1.1 SNMP Communities

Users of SNMP are grouped into categories called **communities**. A community has a name, such as *public*, and access permissions, which give its members read-only or read-write access to the database.

To create a community called *public* with read-only access, enter:

```
$ create snmp comm community public ro
```

To see a list of configured communities, enter:

```
$ get snmp comm
```

17.1.2 SNMP Hosts

The machines that are part of a community are indicated in the **SNMP Host table**. If you want to access the unit's SNMP agent from one of the LAN hosts, then you must add the host's IP address to this table.

To run an SNMP Manager on 192.168.1.3 and access the modem's SNMP Agent, enter:

```
$ create snmp host community public ip 192.168.1.3
```

Since the public community was created for read-only access, this will allow you to read the modem's MIB without allowing you to modify it.

To see the configured SNMP hosts, enter:

```
$ get snmp host
```

17.1.3 SNMP Traps

Traps inform a managing entity of noteworthy or unusual events in the system. The modem reports some of the events in the system by sending traps to the SNMP manager. In the current release, the modem supports **System Up** and **Authentication failure** traps via the SNMP interface. The **System Up** trap is generated whenever the system comes up successfully. The **Authentication failure** trap is generated whenever an unauthorized SNMP manager tries to access the modem via the SNMP interface.

To selectively enable or disable the generation of the authentication failure trap, enter:

```
$ modify snmp trap enable
or
$ modify snmp trap disable
```

By default, generation of the **Authentication failure** trap is enabled.

To display the current status, enter:

```
$ get snmp trap
```

17.1.4 Providing SNMP Access Across the Modem

To manage one of the LAN hosts from outside using SNMP, and to manage an external machine from one of your LAN hosts using SNMP, you will need to configure SNMP ALGs on the modem's inside and outside interfaces.

SNMP access is usually provided to trusted hosts only. These trusted hosts are configured on the SNMP agent using the IP addresses of the hosts. This means that the local machine that you are providing SNMP access to/from must always get the same public IP address. This is done best by configuring a bimap NAT

rule, which provides a one-to-one mapping between one of the modem's public IP addresses and the particular LAN host.

17.2 Web-based Interface

The SAR110 provides a Web-based interface that enables configuring the unit from a web browser. The Web-based interface includes a subset of the configuration options available in the CLI.

Functions *Not* Enabled in the Web-based Interface

- **Creating the Ethernet port**
- **Creating ATM ports and traffic descriptors**
- **Configuring SNMP**
- **Configuring IGMP**
- **Configuring ILMI**

You can easily modify the functionality and look and feel of the web pages to create a customized interface for distribution with your own SAR110- based products.

For detailed instructions on using the Web-based interface, refer to the *SAR110 User Guide or to the embedded online help.*

17.2.1 Accessing the Web- based Interface

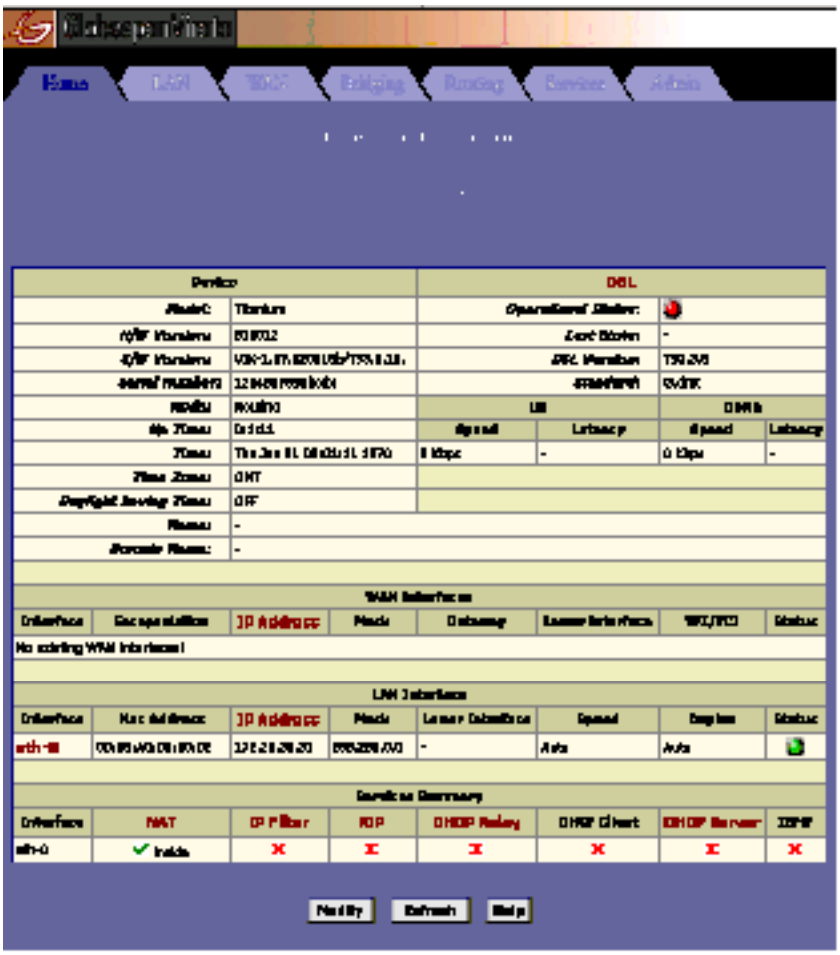
The Web-based interface, like the CLI, is part of the image you load in the system flash. You can access the interface from a computer that has a IP- enabled network connection to the unit via the LAN interface. The PC from which you access the interface *must be in the same subnet* as the device's LAN IP address.

The Web-based interface is best viewed using Microsoft Internet Explorer® version 5.0 or later versions. Support for Java® and Javascript® should be enabled in the browser.

To access the Web-based interface, simply type the LAN port IP address in your browser's address/location box. On the SAR110 the pre-assigned LAN port IP address is 192.168.7.1.

You are prompted to log in to the interface. The login name and password are the same as those pre-configured for the CLI interface. You can change the password. On the SAR110 the pre-assigned user name and password are DSL and DSL.

After you have logged in, the System View page displays, as shown in Figure .



System View Page

17.2.2 Accessing the Quick Configuration Page

The interface also includes a Quick Configuration page. This helps you access the settings that you may need to configure when you install your own product. You can also access all Quick Configuration settings under their respective tabs. This page is available under the Home tab and can also be accessed directly by specifying the LAN port IP address followed by “/setup”. For example:

http://192.168.7.1/setup

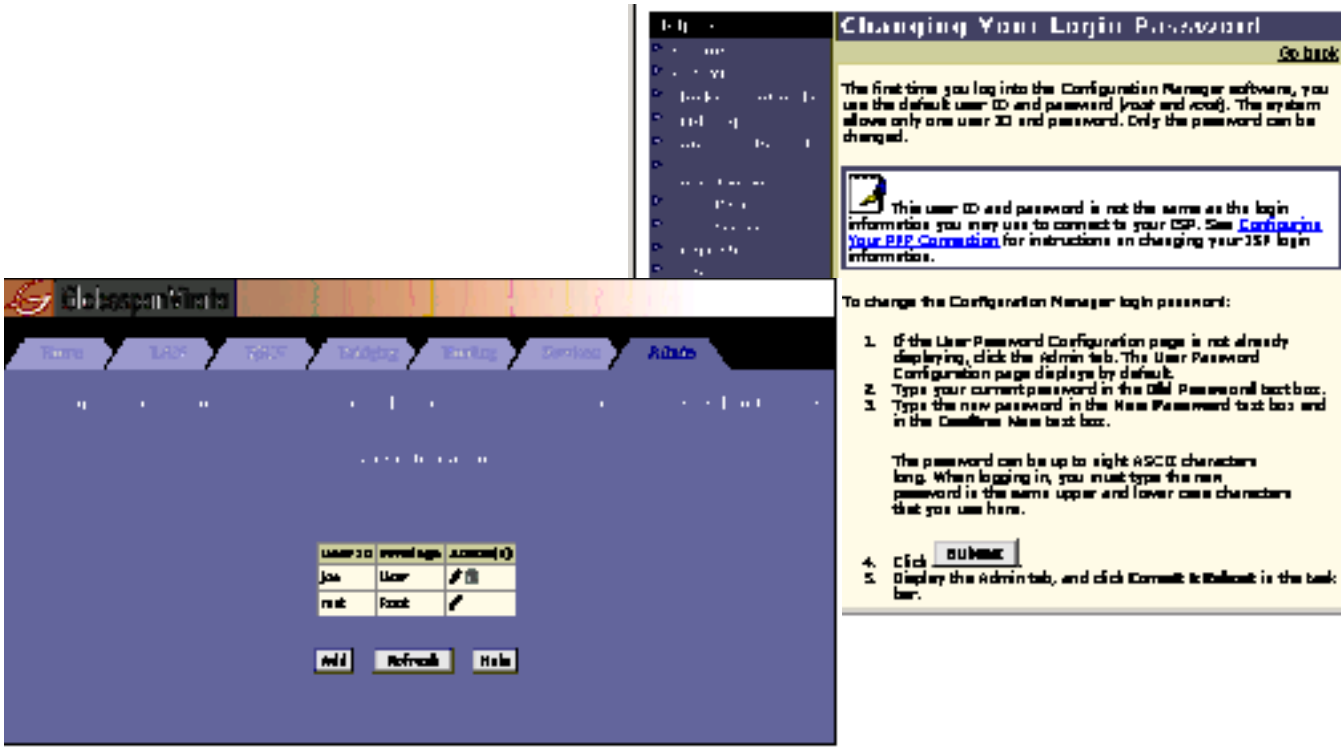
The Quick Configuration page in the Home tab displays. You can also access all other interface functions from the Quick Configuration page.

17.2.3 User Instructions

You can access all tasks by clicking the tabs that display horizontally at the top of the page. A menu of related tasks display at the top of each tab. Click these to display the specific tasks.

All changes are effective when submitted. However, you must **commit** changes to avoid having them overwritten by the previous configuration when the system reboots. The **commit** and **reboot** feature is located in the Admin tab, as shown in Figure

You can display online help in a separate window by clicking the Help button on any main topic page. A help topic displays relating to the current page, with sidebar navigation to other help topics, as shown below.



Web-based Interface and HTML Help

17.2.4 Web-based Diagnostics

The Web-based interface includes a diagnostics program that runs a series of system tests, which examine the system's physical layer functioning up to the point of connectivity with the Internet. You can access the diagnostics from the Admin tab. For an explanation of the diagnostic tests, please refer to the section in this document.

17.3 L2 Agent Module

The L2Agent (L2AG) module is defined to provide access to the modem's management information base through Ethernet. It provides a proprietary framework for exchange of messages between the L2-Manager and the GenAg module on the modem. This facilitates the L2-Manager to read the existing configuration information from the modem, and to set/modify the configuration on the modem.

L2AG receives Ethernet packets from the Ethernet interface. The Ethernet module hands over the packet to L2AG, when a given pattern is found in the received Ethernet packet. L2AG processes the incoming packet and requests GenAg to either provide the existing configuration information or to set the configuration information received in the packet. The response from GenAg is then, forwarded to the L2-Manager in a pre-defined format.

The communication packet between the L2-Manager and L2AG is through UDP packets. UDP packets are generated by the L2-Manager and L2AG. They do not use the existing IP stacks at either end. L2-Manger uses a pre- defined set of parameters for generating the packet and ignores the Ethernet header, IP header and the UDP header data in the received packet. The messages exchanged must be filled in network byte order. The packet information for both sides is given below:

- **From the L2-Manager to the agent, the UDP packet has the following parameters:**

Broadcast address at both MAC level and IP level (Destination MAC is ff:ff:ff:ff:ff:ff; Destination IP is 255.255.255.255)

Source port is 6001 and destination port is 6001

Source IP is 192.168.0.235.

- **From management agent to the L2-Manager, the UDP packet has the following parameters:**

MAC address of the manager (decoded from the packet received from the manager)

Destination IP is 192.168.0.235

Source port is 6001 and destination port is 6001

Source IP is 192.168.0.234

The L2AG is designed as a separate entity over the Ethernet module. It does not use the existing IP/UDP stacks. At the Ethernet module, the packet is sent to the L2AG module, based on a pre-defined pattern, in the packet received. In the transmit direction, the L2AG module builds the entire Ethernet packet and sends the packet directly to the EMac module for transmission.

L2 Agent is located above the Ethernet module. It is implemented as a separate task. This task interacts with the GenAg and Ethernet modules through messages. When a message is received at L2AG

from the Ethernet module, a message/event is sent to the L2AG task. This message is forwarded to GenAg and L2AG waits for a response from GenAg. After receiving the response from GenAg, L2AG creates the Ethernet packet to be sent to the L2-Manager, and hands it over to the EMac (functional interface) for transmitting the message over the Ethernet interface. L2AG does not interact with any other module in the modem.

18 System Maintenance

This chapter describes information useful for general administration and maintenance of the SAR110-based unit.

18.1 Diagnostics

18.1.1 Checking IP Connectivity

To check if a particular machine (router, PC, etc.) on the Internet is reachable (online), enter:

$ ping {ip-address|domain-name} [-t|-n number] [-i time-to-live] [-w seconds] [-s size]

To display a list of intermediate hops to a particular destination, enter:

*$ traceroute {**ip-address|domain-name} {ping|udp} [-m num-of-hops] [-w wait-time] [-p udp-port-number] [-q num-of-probes]***

***For further information on ping and traceroute, refer to the** CLI Reference Manual.*

18.2 Diagnostics page of the HTTP Agent

The Diagnostics page added to the HTTP Agent of the unit helps you test how live the system is. It runs a series of diagnostics on a given WAN interface, which test the system, physical layer upwards, to the point of the system's connectivity to the Internet.

18.2.1 Diagnostics - categories

The diagnostics page enables the following test categories:

- Testing connectivity to modem
- Testing Telco Connectivity
- Testing ISP Connectivity
- Testing Internet Connectivity

Testing connectivity to modem

This category has three diagnostics:

Testing Ethernet connection that verifies if the Ethernet interface is up.

Testing ADSL line for sync that verifies if the DSL line is properly initialized and running.

Testing Ethernet connection to ATM that verifies if both the Ethernet and ATM interfaces are up.

Testing Telco Connectivity

This category has two diagnostics:

Testing ATM OAM segment ping that verifies if the next node is reachable.

Testing ATM OAM e2e ping that verifies if the other end is reachable.

Testing ISP Connectivity

This category has four diagnostics:

Testing PPPoE server connectivity that verifies if the PPoE server is running.

Testing PPPoE server session that verifies if the PPoE server can be reached from the given WAN interface.

Testing authentication with server that verifies if the given WAN interface can successfully authenticate itself with the PPoE server.

Validating assigned IP address that verifies if the given WAN interface has received a valid PPP IP address.

Testing Internet Connectivity

This category has four diagnostics:

Ping default gateway that verifies if the default gateway is reachable.

Ping Primary Domain Name Server that verifies if the primary domain name server is reachable.

Query DNS for www.x.y that verifies if DNS query resolution is taking place.

Ping www.x.y that verifies if the queried server is reachable.

***In all the above diagnostics, PASS** means that the diagnostic is successful, **FAIL** implies diagnostic failure, **N.A.** implies that a particular diagnostic is not applicable, and **SKIPPED** means it was skipped.*

18.3 ATM Traffic Diagnostics

OAM F5 CC and loopback cells are used for network management and fault monitoring. The F5 flow is used for the operation and maintenance of virtual channel (VC) connections, and the F4 flow for the operation and maintenance of virtual path (VP) connections.

18.3.1 OAM F5 CC

ATM operation administration and maintenance (OAM) F5 continuity check (CC) cells enable network administrators to continuously monitor the continuity of VCC connections and detect misconfigurations in the ATM layer. Such misconfigurations can cause misdelivery of a cell stream to a third party or can cause unintended merging of cells from multiple sources.

The F5 flow is used for the operation and maintenance of virtual channel (VC) connections, and the F4 flow for the operation and maintenance of virtual path (VP) connections.

Fault management OAM cells and Activation/Deactivation OAM cells are used to support the management of VCCs.

Fault management - AIS, RDI and CC

Fault management cells consist of Alarm indication signal (AIS), remote defect indication (RDI) and continuity check (CC) cells, to monitor end-to- end defects.

AIS cells are used to report defects in the forward direction. RDI cells report defects in the backward direction. Loss of continuity (LOC) triggers AIS cells to be sent in the forward direction. The end node of a connection sends RDI cells in the backward direction. CC cells allow for continuous monitoring of a connection's availability. They are inserted, periodically, into a user data stream. Intermediate nodes can be set to look for the presence or lack of these CC cells.

Activation/Deactivation

The Activation/Deactivation procedure is used to initialize the OAM process at the two end-points of a VCC. OAM cell flows may also be enabled through the network management system of a switch. The initialization procedure coordinates the beginning or the end of CC cell transmission. The activation request end point sends an OAM activation- deactivation cell to the other far end point. The far end, then, must reply with a confirmation or denial. The procedure uses the Activation/ Deactivation to pass the user-given direction request.

The Table below summarizes this information detailed above.

OAM TYPE	OAM FUNCTION	MAIN APPLICATION
Fault Management	**Alarm Indication Signal (AIS)**	**For reporting defect indications in the forward direction**
	Remote Defect Indicator	**For reporting remote defect indications in the backward direction**
	Continuity Check	**For continuously monitoring the availability of a link**

Activation/Deactivation	Continuity Check Activation/Deactivation	For activation or deactivation of CC functionality in a standard manner

The product supports end-to-end F5 CC procedure and F4 loopback response. The CC procedure can be activated simultaneously on all VCCs configured in the system. The CC procedure may be activated when a VCC is in AIS/RDI state. When CC procedure is activated, then, the e2e CC cells are sent periodically (1 cell/sec), independent of user cell flow. The CC Activation will allow to add a new directional activation flow to the existing Activation flow. The continuity check procedure is directional and its failure affects the VCC operation state. It may be configured at both ends of a VCC by NM, or, it can use OAM CC cell-based activation/ deactivation.

The NM based configuration is known as manual mode of CC and the OAM Activation/Deactivation cell-based mode is known as auto mode of CC.

The CC activation takes an additional input from the user, which is an 'ethercheck' flag. If this flag has been specified, then the CC cells are transmitted to a peer only when the Ethernet device is up. This is a proprietary way to represent the end-to-end LAN level status.

Auto Mode

In case of auto mode, there exists one FSM per VCC for Activation/ Deactivation, and for the VCC role as source, or sink, or both. It is determined by the direction field of the Activate/Deactivate Cell. Any entity, source, or sink, can sent Activate or Deactivate. Hence, the entity sending the Activate request need not be the OAM source and the Deactivator can be different from the node that activated the particular CC session.

To trigger the auto mode, you need to pass the direction option for Activation/Deactivation (i.e., source, sink, or both).

Manual Mode

In case of manual mode, you will decide which side is going to act as source or sink. You will configure each source and sink point of VCC, accordingly. In this case, there is no Activation/Deactivation state negotiation with the peer CC entity.

Configuration details

To activate or de-activate OAM F5 end to end continuity check, enter,

```
$ modify oam cc vc ifname interface-name [mode auto|manual] [action
act|deact] [dir src|sink|both] [ethercheck enable|disable]
```

use the ***ifname*** *interface-name* parameter to specify the VC interface on which, the continuity check is to be activated or de-activated.

use the ***mode*** *auto|manual* mode parameter to specify the activation/deactivation of continuity check. Setting it to **Manual** activates/de-activates immediately. Setting it to **Auto** activates/ de-activates through the OAM activation/de-activation procedure.

use the ***action*** *act|deact* parameter to specify the CC action to be taken. This is used along with "dir" field. Setting it to **Act** activates it, while setting it to **Deact** deactivates it.

In auto mode, if CC is activated, the next activate command will fail. In manual mode, the activation state of source/sink is the combined effect of the activation commands issued. That is, if you give commands for activating source and then activating sink, then the final result will be that both source and sink will be in activated state. Similarly, if you have given commands for activation in both directions and then give a command for activating sink, the final result will be that both source and sink will be in activated state. Manual-to-auto mode transition is allowed only when the source and sink are in deactivated state. There is no such restriction in auto- to-manual mode transition.

use the ***dir*** *src|sink|both* parameter to specify the direction for CC activation/deactivation. The direction could be **source (src), sink or both**.

use the ***ethercheck*** *enable|disable* parameter to specify whether the Ethernet device status should be checked before transmitting a CC cell.

The command explained above, will not work if the operational status of VC is DOWN.

To get the OAM F5 end-to-end continuity check configuration and status parameters, enter,

```
$ get oam cc vc [ifname interface-name]
```

18.3.2 OAM Loopback

The operation of the ATM VCs may be disrupted if intermediate links or switches between the modem and the ISP fail to function. Therefore, the ISP keeps track of the health of the link on a regular basis. Operation Administration and Maintenance (OAM) provides a mechanism to check the continuity of the established ATM VCs. For this purpose, the ISP transmits OAM loopback cells to the unit and expects to receive these back within a specific period. On receiving such a loopback cell, the unit checks if the Loopback Location ID field in the cell is the same as its own. If so, it modifies the contents of the cell to acknowledge receipt and transmits it back to the ISP.

The Loopback Location ID is a 16-byte identifier that uniquely identifies the SAR110 unit. It is configured by the **oamsrc** parameter in the command **create atm port**. If the ISP provides you with a loopback location ID, use it when you are creating the ATM port on the unit.

The unit also enables you to probe other ATM network elements provided you know their location IDs. The commands **`modify oam lpbk vc`** and **`get oam lpbk vc`** are used for this purpose.

Both end-to-end and segment level loopbacks are supported.

***Refer to the** CLI Manual for details on the end-to-end and segment level loopbacks supported.*

18.4 Traps

Traps are informational or alarm messages that indicate specific events in the SAR110 unit. A trap appears as a line of output on your CLI session's console. For instance, the unit displays the following trap when it boots up:

```
Thu Jan 01 00:00:13 2001 : STATUS ALARM : System Up
```

Refer to the CLI Reference Manual for a detailed list of traps.

Displaying the 15 Most Recent Traps

Since the trap display lines could easily scroll off the top of the screen, the software saves the last fifteen traps issued.

To view these traps, enter:

```
$ get traps
```

Clearing Saved Traps

To clear out the list of the 15 most recent traps, enter:

```
$ reset traps
```

To enable or disable the display of traps, enter:

```
modify trapprints enable|disable
```

To check, whether trap prints are enabled or disabled, enter:

```
get trapprints
```

18.5 Requesting Status and Statistical Information

Certain `get` commands allow you to request status information and statistics for features such as DHCP and NAT, as well as for the unit's interfaces. These `get` commands and the information they display are summarized in Table . For a complete explanation of these commands, refer to the *CLI Manual*.

Commands Used to Request Status and Statistics

This get command	Displays
`get atm 1483 stats`	Global statistics for MEA5
`get atm aal5 stats`	Statistics for AAL5 VC
`get atm stats`	Statistics for all ATM virtual ports4
`get atm vc stats`	Statistics for all ATM virtual circuits
`get bridge port stats`	Statistics for all bridge ports
`get dhcp client stats`	Statistics for DHCP clients on all interfaces
`get dhcp relay stats`	Global statistics for DHCP relay
`get dhcp server stats`	Global statistics for DHCP server
`get dsl params`	DSL configuration information

4 A particular interface can be specified by adding the `ifname` parameter.

get dsl stats curr	Current 15-minute interval, current day, and previous day performance counters for DSL
get dsl stats hist	15-minute interval based current day performance counters for DSL
get dsl stats cntrs	DSL error counters
get ethernet stats	Statistics for all Ethernet interfaces
get icmp stats	Statistics for ICMP
get interface stats	Statistics for all LAN/WAN interfaces
get ip stats	Global IP-layer statistics
get pfraw rule stats	Statistics for all raw filtering rules5
get pfraw stats	Global statistics for raw filtering
get nat rule stats	Statistics for all NAT rules
get nat rule status	Status info for all NAT rules
get nat stats	Global statistics on NAT
get nat status	Status on currently active NAT sessions

5 A particular rule can be specified by adding the `ruleid` parameter.

get ppe stats global	Global statistics for PPPoE
get ppe stats session	Statistics for each PPPoE session
get ppp ipstatus	IP status for all PPP interfaces
get ppp lstatus	Link status for all PPP interfaces
get rip stats	Statistics for RIP
get snmp stats	Global statistics for SNMP
get trace stats	Statistics for trace logs
get udp stats	Global statistics for UDP

You can see an interface's *admin status* (requested state) and *operational status* (current state) by entering any `get` command for that interface (except those shown in Table). If the command shows both statuses as **Up**, the interface is functioning properly. This can be used to verify that a `modify` command has successfully enabled or disabled an interface.

18.6 Viewing complete system configuration

The **getcfg.cfg** file stored in the **home** directory on the unit contains a list of **`get`** commands, which display the entire system configuration.

❖ **To view the complete system configuration, enter**

```
apply fname/home/getcfg.cfg besteffort true
```

18.7 Managing User Accounts

If you are a superuser (i.e., have root-level privileges), you can create and delete users.

Determining Your Privilege Level

To find out if you have root-level or user-level privileges, enter the following root-level command:

```
$ get user
```

If CLI displays `Insufficient privileges for the command`, you only have user-level or intermediate-level privileges. You cannot create or delete user accounts.

Otherwise, you have root-level privileges, which CLI confirms by displaying a list of the currently defined users:

```
User Name : root

Privilege : root
```

The output shows that the system contains one superuser named "root."

18.7.1 Creating User Accounts

If you are a superuser, you can create other user accounts. These can be superuser accounts, intermediate-level accounts, or user-level accounts. You can create three additional user accounts (four user accounts total).

Creating a User with User- Level Privileges

To create a user with user-level privileges, enter:

```
$ create user name username passwd password user
```

Creating a User with Intermediate-Level Privileges

To create a user with intermediate-level privileges, enter:

```
$ create user name username passwd password intermediate
```

Creating a Superuser with Root-Level Privileges

To create a superuser with root-level privileges, enter:

```
$ create user name username passwd password root
```

18.7.2 Deleting User Accounts

If you are a superuser, you can delete any account provided that there remains at least one superuser account. The system does not allow you to delete the last remaining superuser.

Deleting a User

To delete a user with user-level or intermediate-level privileges, enter:

```
$ delete user name username
```

The command will fail if the specified user is the only superuser.

Verifying Deletion of User Account

To verify if a user has been successfully deleted, enter:

```
$ get user
```

18.8 Changing the Login Password

Using the **passwd** command, you can change any user's login password, provided that you know the user's current password. (This restriction does not apply if you are a superuser.) CLI updates the password and displays `Set Done` to confirm the change. The new password takes effect upon the following CLI session; if the user is currently logged in, the current session is not affected.

Note that passwords, like user names, are case-sensitive.

Changing Your Own Password

To change your own password, enter:

```
$ passwd
```

In response, CLI prompts for your old password, your new password, and for a confirmation of the new password.

Changing Another User's Password

To change the password of another user, enter:

```
$ passwd username
```

If you are not a superuser, CLI prompts for the old password, the new password, and for a confirmation of the new password.

If you are a superuser, CLI prompts for the new password and for a confirmation of the new password.

Setting password to board serial number

You can now set the password to the serial number of the board, as an enhanced security measure.

18.9 Modifying System Parameters

To change vendor-specific information, system time or the severity level of traps, enter:

```
$ modify system
```

To see the current system parameter values, enter:

```
$ get system
```

***Refer to the** CLI Manual for details on the system parameter values.*

18.10 Configuring Host Name and Domain Name on the Modem

You can provide any name to the end-user, as the name of the modem, which he can use for configuring, rather than using the IP address of the modem. For example, if you configure the host name as SAR110, the DNS resolution for hostname will return the IP address of SAR110 to the machine sending the DNS query.

The modem will parse all received packets to check whether it is a UDP packet on the DNS port on a private interface. The DNS packet is parsed for hostname query for the modem. This is checked against the hostname and domain name configured on the modem.

If only hostname is configured on the modem, the modem will reply to all queries matching the hostname. For example, if "xyz_sar110" is the configured hostname and no domain name is configured, the modem will reply to any DNS query for “xyz_sar110.*.*..."

If both hostname and domain name are configured on the modem, all queries matching the complete FQDN will be replied to. For example, if "xyz_sar110" is the configured hostname and "solwise.com" is the domain name configured, the modem will reply to any DNS query for "xyz_sar110.solwise.com". However, the modem will not reply to any DNS query for "iad_sar110.abc.com", and it will follow the normal DNS query message path.

The reply message is formatted in such a manner that the source IP address is reflected as the original intended destination IP address of the DNS query.

For example, if DNS relay is enabled, the original intended destination will be XYZ. Otherwise, it will be the DNS server configured on the machine generating the DNS query

The modem generates DNS reply packets with correct checksums so that the originator of the DNS query can take appropriate action on receiving the reply. The originator of the DNS query is transparent to the fact that this DNS reply packet is generated by the modem itself.

The TTL in the DNS record is set to one day. This means, that the client can cache the IP address received in the DNS reply for one day.

- **To see the configured domain name and host name, enter**

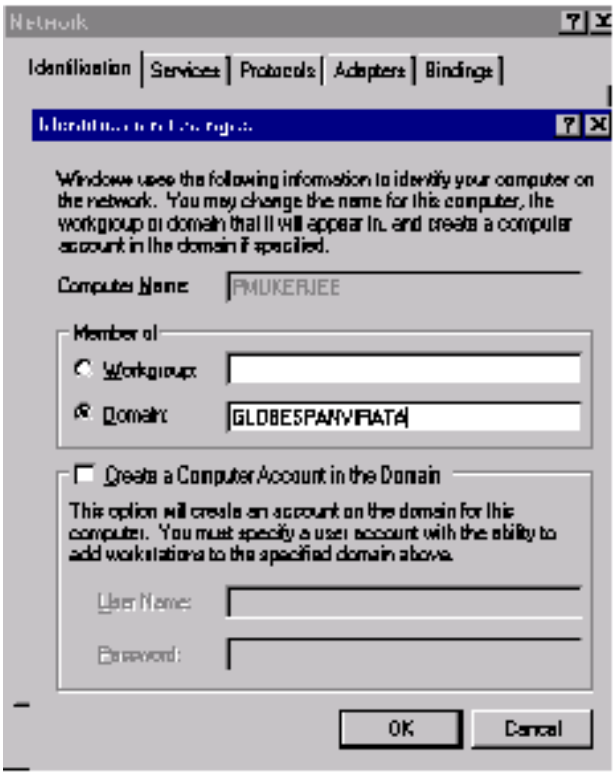
```
$ get system
```

- **To modify the existing domain name and host name, enter:**

```
modify system [contact sys-contact] [name sys-name] [location sys-
location] [vendor sys-vendor-info] [logthresh sys-log-threshold]
[systime systime] [dst <on | off>] [timezone <timezone>] [hname
<name>] [dname <name>]
```

While configuring the domain name, you should remember that, if your LAN Windows machines have domain names configured on them, you should use the same domain name on the modem.

The screens given below will help to explain the Note above. The first screen shows Solwise configured as the domain name on a LAN machine. The second screen, that brings up the **modify system** screen on the modem, should have SOLWISE in the Domain name field.


Network
Identification
Services
Protocols
Adapters
Bindings
Windows uses the following information to identify your computer on the network. You may change the name for this computer, the workgroup or domain that it will appear in, and create a computer account in the domain if specified.
Computer Name:
PMUKERJEE
Member of
Workgroup:
Domain:
GLOBESPANVIRATA
Create a Computer Account in the Domain
This option will create an account on the domain for this computer. You must specify a user account with the ability to add workstations to the specified domain above.
User Name:
Password:
OK
Cancel


System Parameters
Date:
Jan
1
1970
Time:
0
18
21
Time Zone:
GMT
DST:
ON
OFF
Host Name:
viking
Domain Name:
globespanvirata.com
Submit
Cancel
Help

18.11 Debugging using Memory Location

To debug at the system level, you may require to view and modify the contents of the memory location.

To debug by viewing contents of memory location, enter:

```
$ rdm [VREG | NREG | NONE] addr addr [len len] [format <hex | dec>]
```

Using this command, you can specify the base address. You can also specify the location from where the contents are to be read, from the memory. You need to specify it in hexadecimal format. By default, the number of bytes that are to be read from the specified offset is 32. Also, you have a choice of viewing the output in hexadecimal or decimal format.

To read from flash, enter:

```
$ rdf  [dev dev-name] [addr addr] [len len] [format <hex | dec>]
```

To modify multiple memory locations, using a single specified value, enter:

```
$ memset [VREG | NREG | NONE] addr addr [len len] [data data]
```

You can use this command to write single byte data into each of the first n bytes, starting from the address you have specified. Use the len parameter to indicate the number of bytes that are to be written at the specified location. The default value is 1. Use the Data parameter to specify the value that is to be written at the specified memory location. You need to specify this in hexadecimal format. By default, 0x00 will be written.

To modify 1, 2 or 4 bytes data at the memory location, enter:

```
$ wrm [VREG | NREG | NONE] addr addr data data
```

18.12 Serial Port Authentication

By default, the serial port does not require user authentication (username and password). You can, however, change this so that users must log in with a valid username and password on the serial port.

18.12.1 Using CLI Commands

Serial port authentication can also be enabled or disabled using CLI commands.

To require serial port authentication, enter:

```
$ modify nbsize serialauth enable
```

To disable serial port authentication, enter:

```
$ modify nbsize serialauth disable
```

The *`modify nbsize`* *command does not take effect until the next system reboot; i.e., you must also enter* *`commit`* *to save the information, and then* *`reboot`* *to reboot the system, in order to see the desired effect (enabled or disabled).*

19 Shell Tutorial

This appendix helps you understand how to use shell scrips to your advantage, and provides a tutorial on shell programming.

19.1 Shell Tutorial - Overview

Introduction

To execute a number of CLI commands at one go, you use **.cfg** files that are provided. The basic limitation of **.cfg** files is their sequential routine of executing the CLI commands. Shell overcomes this limitation by giving you the flexibility of executing the CLI commands conditionally.

Shell is the programming tool made available to you, that helps perform multiple tasks, with the execution of the same file. Different input parameters to the same Shell file can be used to achieve multiple functionality. Thus the functionality of the shell script is decided by the inputs parameters passed to the file.

Sample.sh

In this example, the order of executing commands is decided by the value of **$1,** which is the first input parameter.

```
if $1 eq 1
```

<commands to create ipoa>

goto end

fi

if $1 eq 2

<commands to create ipoa>

goto end

```
fi


if $1 eq 3
<commands to create l2tp tunnel>
goto end
fi


if $1 eq 4
<commands to create l2tp session>
goto end
fi


end:
```

19.2 Shell Programming Tutorial

This tutorial will help you understand the basics of shell script programming.

Introduction

Shell scripts are very easy to write and are especially useful for automating large jobs such as creation of PPP interfaces, creation of pfraw rules and creation of IPoA interfaces. They also help achieve a variety of jobs that require multiple commands to be executed at the CLI. The basic commands of shell scripting are the CLI commands.

Typographical Conventions Used in This Tutorial

Code segments and shell scripts are displayed as ***italics***. Output snapshots are displayed in gray background and italics text. Command- line entries will be preceded by the Dollar sign **($)**.

19.2.1 A First Script

First.sh

The first shell script you will create here, creates an atm port.

Create a file (first.sh) as follows:

```
# This is a comment !

create atm port ifname atm-0
```

The first line begins with a special symbol: **#**. This marks the line as a comment, and it is ignored completely by the shell.

The second line is to create an "atm port".

Precondition

```
$autoupdate false
```

Transfer the file **first.sh** to the unit. You can ftp the file from the host **OR** use the **"dncd"** command at the CLI prompt.

Execution

```
$ apply fname first.sh
```

Assumptions

"size" command is executed

Creation of atm port interface succeeds.

Output

```
$create atm port ifname atm-0

Entry Created


If-Name                 : atm-0  MaxVcs              : 2
CBRPriority             : 5      VBRPriority        : 1
RTVBRPriority           : 4      NRTVBRPriority     : 3
UBRPriority             : 2      Latency            : Interleaved
MaxConfVcs              : 0
OUISrc                  : 0xffffffffffffffffffffffffffffffff
Oper Status             : Up     Admin Status       : Up
```

19.2.2 Variables

Every programming language in existence has the concept of variables - a symbolic name for a chunk of memory. We can read this symbolic name, can assign values to it and manipulate its contents. Our shell is no exception, and this section discusses such variables.

Consider the "create atm port" example. You can create an atm port using variables.

Var.sh

```
# This is a comment !

a = create atm port ifname atm-0
```

This assigns the result value obtained on execution of the command **`"create atm port ifname atm-0"`** in to the variable **'a'**. The value in our case could be **0** or non-zero, depending upon whether the command is **Success (0)** or **failure**.

To refer to the variable, you can prefix a **Dollar ($)** sign to the variable. For example, **'$a'** would refer to the value assigned to the variable **'a'**.

To refer to the input parameters to the Shell file, use **$x,** where, **x = 1 to MaxVariables**. For example, **$1... $9** are the first nine parameters the script was called with. **$0** always refers to the result status of the last command executed.

Caution

All Shell keywords such as IF, **ELSE**, **EQ**, **=**, should be white space separated.

Please refer to the Keywords *section in this document.*

No arithmetic operations are supported on variables in the present software release.

Variables in the shell do not have to be declared, as we do in languages such as C programming. However, if we try to read an unassigned variable, the result is an error.

The maximum length of a variable can be 10.

A space character should follow any variable.

A '$' in a CLI command will be treated as a reference to a variable.

19.2.3 IF-ELSE Construct

Almost every shell scripts written, use the if-Else construct. IF-Else construct is a simple but powerful comparison construct.

The syntax for if...then...else... is:

```
if  $<variable-name>/IntegerValue/String  <operator>  $<variable-
name>/IntegerValue/String

    # if-code

else

    # else-code

fi
```

The current implementation supports nesting to level 5 and the operator can be **"eq"** or **"neq"** only.

Consider the create atm port example

IF_Else.sh

```
# This is a comment !

a = create atm port ifname atm-0

if $a eq 0

    # atm port creation succeeds.
```

```
    get atm port ifname atm-0

else

  # atm port creation fails…may be "size" command not
executed.

   size

fi
```

Precondition

```
$ autoupdate false
```

Transfer the file **if_else.sh** to the unit. You can ftp the file from the host **OR** use the **"dncd"** command at the CLI prompt.

Execution

```
$ apply fname if_else.sh
```

Assumptions

"size" command is already executed

Creation of atm port interface succeeds.

Output

```
$create atm port ifname atm-0

Entry Created


If-Name          : atm-0  MaxVcc          : 2
CARPriority      : 5      VARPriority     : 1
RIVARPriorit     : 4      NRIVARPriority  : 3
GARPriority      : 2      Latency         : Interleaved
MaxConfVcc       : 0
OUISrc           : 0xffffffffffffffffffffffffffffffff
Oper Status      : Up     Admin Status    : Up



$ get atm port ifname atm-0

If-Name          : atm-0  MaxVcc          : 2
CARPriority      : 5      VARPriority     : 1
RIVARPriority    : 4      NRIVARPriority  : 3
GARPriority      : 2      Latency         : Interleaved
MaxConfVcc       : 0
OUISrc           : 0xffffffffffffffffffffffffffffffff
Oper Status      : Up     Admin Status    : Up
```

19.2.4 Goto

Sometimes you may need to jump to some sequence of code. Like any other programming language, we need a Goto instruction to perform this task. Goto-s are implemented in Shell using GOTO and LABEL constructs. GOTO takes the control to the statement that starts with the <label-name> that is immediately following GOTO.

The syntax for **goto** ..label. is:

```
goto <label-name>

….

..

.

<label-name>:
```

A Label-name can be any string immediately followed by a colon (:). There is no restriction on the precedence of GOTO and LABEL. That is, a label can come before/after the goto-statement.

With reference to the create atm port example:

GotoLabel.sh

```
# This is a comment !

a = create atm port ifname atm-0

if $a eq 0

    # atm port creation succeeds.

    goto control1

else

    # atm port creation fails…may be "size" command not
executed.

    goto control2

fi



control1:

    get atm port ifname atm-0

    goto control3

control2:

    size

control3:
```

Precondition

$ autoupdate false

Transfer the file **gotolabel.sh** to the unit. You can ftp the file from the host **OR** use the **"dncd"** command at the CLI prompt.

Execution

$apply fname gotolabel.sh

Assumptions

- **"size" command is already executed**
- **Creation of atm port interface succeeds.**

Output

```
$create atm port ifname atm-0

Entry Created


If-Name        : atm-0 MaxVcc          : 2
CBRPriority    : 5     VBRPriority     : 1
RTVBRPriority  : 4     NRTVBRPriority  : 3
UBRPriority    : 2     Latency         : Interleaved
MaxConfVcc     : 0
OUBSrc         : 0xffffffffffffffffffffffffffffffff
Oper Status    : Up    Admin Status    : Up



$ get atm port ifname atm-0

If-Name        : atm-0 MaxVcc          : 2
CBRPriority    : 5     VBRPriority     : 1
RTVBRPriority  : 4     NRTVBRPriority  : 3
UBRPriority    : 2     Latency         : Interleaved
MaxConfVcc     : 0
OUBSrc         : 0xffffffffffffffffffffffffffffffff
Oper Status    : Up    Admin Status    : Up
```

Caution

- **A Label-name should be immediately followed by a colon.**
- **Any text on the line bearing <label-name> till '\n' (carriage return) is ignored. For example,** `Control2: get alg type`. In this case the text `"get alg type"` is ignored.

19.2.5 Readout and Search

Another important and very user-friendly feature of the shell is the **Readout and search** facility. Use this feature if you need to store the output of a command for later reference. Use the symbol **">"** to get the output of the previously run command to the variable of your choice. The Search command returns the output of the search to the variable on LHS of the assignment statement. A **search** statement is mostly followed by a **findval** construct. 'Findval' gets the string immediately after the first colon, in a given string.

The syntax for Readout is:

```
> variable-name
```

The syntax for Search is:

```
<variable-name> = search $<variable-name1> '<regular- expression>'
```

```
<variable-name> = findval $<variable-name1>
```

Readout.sh

```
# this a shell file to verify the readout
functionality.

a = get system

> b

if $a  eq 0

    c = search $b 'Name[ ]*:[ ]*[a-zA-Z]'

    d = findval  $c



    if d eq iad

        modify system name "titanium"

    else

       modify system name "iad"

   fi

   fi
```

In this case the output of the command **"get system"** gets stored in the variable **'b'** and then **'b'** is searched for a regular expression **'Name[ ]*:[ ]*[a-zA-Z]'** to get the variable **'c'**. That is, **'c'** gets the

string **" Name : iad"**. The value stored in **'c'** is searched using findval to get the string **'iad'**. In this case, **'d'** gets the value **"iad"**.

Precondition

```
$ autoupdate false
```

Transfer the file readout.sh to the unit. You can ftp the file from the host OR use the "**dncd**" command at the CLI prompt.

Execution

```
$apply fname readout.sh
```

Assumptions

- **"get system" command succeeds**
- **Variable 'd' gets the value "iad"**
- **Verbose Mode is Off.**

Output

```
Model              : Titanium
Name               : iad
Domain Name        :
Description        : DSL Modem
Location           : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Contact            : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Vendor             : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
LogThreshold       : 0
Object-id          : 1.3.6.1.4.1.200
HwVersion          : 71fb0922
SwVersion          : VIX-1.37.020618f/T93.3.16
DSL Version        : -
System Time        : Thu Jan 01 02:07:12 1970
Time Zone          : GMT
DST                : Off
Services           : physical datalink internet
                     end-to-end applications
UpTime(HH:MM:SS)   : 2:7:12

$ modify system name "titanium"

Set Done
```

Caution

- **Any text after the initial variable-name, in a readout statement is ignored.**
- **A readout string of length more than 1024 will be truncated appropriately.**
- **In the above example, > b** has to be on a separate line. That is, the readout statement should always be on a separate line. For example, **`> b get alg type.`** In this case the text "`get alg type`" is ignored.

19.2.6 Return

Most languages use the concept of return when we need to return the control back to the calling application, which invoked the Shell. Return is implemented in the very same way we do it in "C" language.

The syntax for return is:

```
return $<variable-name>/IntegerValue/string
```

Return.sh

```
# return statement


a = get system


if $a eq 0


     modify system name "iad1.38"

     if $0 neq 0

     goto end


else

     return $a
```

```
fi

end:
```

In case of failure of **`modify system name "iad1.38"`**, **$0** (which stores the result status of the previous command) is set to **0**. This takes the control to the label **"end"**. The value of **'$a',** which is **1/0,** depending upon the success/failure of the command **`get system,`** is returned.

Please refer to the section APIs *in this chapter.*

Precondition

```
$ autoupdate false
```

Transfer the file return.sh to the unit. You can ftp the file from the host OR use the "dncd" command at the CLI prompt.

Execution

```
$ apply fname return.sh
```

Assumptions

- **"get system" command succeeds.**
- **Verbose Mode is on.**

Output

```
Model              : Titanium
Name               : isd
Domain Name        :
Description        : DSL Modem
Location           : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Contact            : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Vendor             : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
LogThreshold       : 0
Object-id          : 1.3.6.1.4.1.200
EWVersion          : 71fb0922
SWVersion          : VER-1.37.020618f/T93.3.16
DSL Version        : -
System Time        : Thu Jan 01 02:07:12 1970
Time Zone          : GMT
DST                : Off
Services           : physical datalink internet
                     end-to-end applications
UpTime(HH:MM:SS)   : 2:7:12

$ modify system name "isdl.38"
Model              : Titanium
Name               : isd
Domain Name        :
Description        : DSL Modem
Location           : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Contact            : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Vendor             : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
LogThreshold       : 0
Object-id          : 1.3.6.1.4.1.200
EWVersion          : 71fb0922
SWVersion          : VER-1.37.020618f/T93.3.16
DSL Version        : -
System Time        : Thu Jan 01 02:07:12 1970
Time Zone          : GMT
DST                : Off
Services           : physical datalink internet
                     end-to-end applications
UpTime(HH:MM:SS)   : 2:7:12

Set Done

Model              : Titanium
Name               : isdl.38
Domain Name        :
Description        : DSL Modem
Location           : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Contact            : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
Vendor             : GlobespanVirata Inc.,100 Schulz Drive,
                     Red Bank,NJ 07701,U.S.A
LogThreshold       : 0
Object-id          : 1.3.6.1.4.1.200
EWVersion          : 71fb0922
SWVersion          : VER-1.37.020618f/T93.3.16
DSL Version        : -
System Time        : Thu Jan 01 02:07:12 1970
Time Zone          : GMT
DST                : Off
Services           : physical datalink internet
                     end-to-end applications
UpTime(HH:MM:SS)   : 2:7:12
```

Caution

The maximum length of the return string can be 50. A return value of length more than 50 will be truncated.

19.2.7 Keywords

Following keywords hold special meaning as part of shell scripts:

- **IF**: This keyword is used in IF-ELSE construct
- **ELSE**: This keyword is used in IF-ELSE construct
- **FI**: This keyword is used in IF-ELSE construct
- **SEARCH**: This keyword is used to search a regular expression in a readout variable
- **FINDVAL**: This keyword is used to get the string, which immediately follows a colon in a given string
- **EQ**: This keyword is used in the comparison of two values, where value could be a string, integer and could be a variable too
- **NEQ**: This keyword is used in the comparison of two values, where value could be a string, integer and could be a variable too
- **GOTO**: This keyword is used in GOTO-LABEL construct
- **RETURN**: This keyword is used to return the control back to the calling application.

19.2.8 Symbols

Following symbols hold special meaning as part of shell scripts:

- **">"**: This symbol is used in readout construct
- **> abc** Variable 'abc' gets the output of the last command
- **"="**: This symbol is used in assignment statements
- **"#"**: This symbol is used to comment a line
- **"$"**: This symbol is used to refer to the value of a variable
- **":"**: This symbol is used in GOTO-LABEL construct.

20 Glossary

AC
Access Concentrator. A type of server that handles multiple connections simultaneously. When the unit connects to the ISP, the connection is typically handled by an Access Concentrator.

ADSL
Asymmetric Digital Subscriber Line. The most commonly deployed “flavor” of DSL for home users. The term asymmetrical refers to its unequal data rates for downloading and uploading (the download rate is higher than the upload rate). The asymmetrical rates benefit home users because they typically download much more data from the Internet than they upload.

ALG
Application Level Gateway. An ALG needs to be configured if it is required to use applications such as FTP, Real Audio, etc., across the modem. An ALG enables NAT to carry out address translations in the entire packet instead of just the packet headers. The mentioned applications need ALGs since they use addresses in their payloads also.

ATM
Asynchronous Transfer Mode. A cell-based, very high-speed transmission technology with low-delay, packet-like switching and multiplexing techniques to segment video, voice and data into 53-byte cells.

Bridged IP
A feature of routing mode in which the SAR110 unit performs routing functions locally but communicates with the ISP via a bridged connection. This allows the user to keep an existing (and less expensive) bridge-only connection while gaining the benefits of full router functionality on the local network, such as DHCP, NAT, raw filtering, etc.

brouter
Bridge/router.

CHAP
Challenge Handshake Authentication Protocol. A protocol that both authenticates a remote user requesting a PPP link, and also periodically re- authenticates (challenges) the link after it is established. CHAP provides greater security than the Password Authentication Protocol (PAP) which only authenticates the user password. See also PAP.

CLI
Command Line Interface. A purely text-based user interface in which the user enters a command from the keyboard, and CLI displays the result of the command, then prompts for another command. MS-DOS® is a well-known example of a CLI.

DHCP
Dynamic Host Configuration Protocol. DHCP automates LAN address assignment and management. When a host connects to a DHCP-configured LAN, a DHCP server assigns the host an IP address from a shared pool of IP addresses; after a specified time limit called the lease period, the DHCP server returns the address to the pool.

DHCP relay
Dynamic Host Configuration Protocol relay. A computer that forwards DHCP messages between computers that request IP addresses and the DHCP server that assigns the addresses. Each of the modem's IP enabled interfaces can be configured as a DHCP relay. See also DHCP.

DHCP server
Dynamic Host Configuration Protocol server. A LAN host that is responsible for assigning IP addresses to the computers on a LAN. See also DHCP.

DNS
Domain Name System. The DNS maps domain names to IP addresses. DNS information is distributed hierarchically throughout the Internet among computers called DNS servers. When the user starts to access a web site, a DNS server looks up the requested domain name to find its corresponding IP address. If the DNS server cannot find the IP address, it communicates with higher-level DNS servers to determine the IP address. See also domain name.

domain name
A user-friendly name used in place of its associated IP address. For example, www.globespan.net is the domain name for IP address 209.191.4.240. Domain names are an element of URLs, which identify specific files at a web site, e.g., http://www.globespan.net/index.html. See also DNS.

DSL
Digital Subscriber Line. A family of technologies that transmit digital information (and sometimes analog telephone service) between customer and telephone company, over existing copper wire pairs for limited distances, or over fiber-optic cables. See also ADSL.

EoA
Ethernet over Asynchronous Transfer Mode. The transmission of Ethernet data through an ATM network.

Ethernet
The most commonly installed computer network technology, usually using twisted pair wiring. Ethernet data rates are 10 Mbps and 100 Mbps.

FTP
File Transfer Protocol. A program used to transfer files between computers connected to the Internet. Common uses include uploading new or updated files to a web server, and downloading files from a web server.

GFR
Guaranteed Frame Rate. An ATM service category designed to solve the performance degradation problems of the UBR service category. GFR guarantees a minimum bandwidth to each Virtual Circuit (VC) provided that the frame size does not exceed the specified Maximum Frame Size in a burst that does not exceed the Maximum Burst Size (MBS).

hop
When you send data through the Internet, it goes first from your computer to a router, then from one router to another until it finally reaches a router that is directly connected to the recipient. Each individual “leg” of the data’s journey is called a hop.

hop count
The number of hops that data has taken on its route to its destination. Also used to mean the maximum number of hops that a packet is allowed to take before being discarded.

host
A device (usually a computer) connected to a network.

HTTP
Hyper-Text Transfer Protocol. The protocol used to transmit web page-related information through the Internet.

ICMP
Internet Control Message Protocol. An IP protocol used to transmit messages to report errors and other IP data-related information. The ping program uses ICMP packets. See also ping.

ILMI
Integrated Local Management Interface. A protocol used for autoconfiguration.

image
Code that has been converted from binary format into the final image that is ready to be loaded into the serial data flash memory.

IP
Internet Protocol. The TCP/IP protocol that provides addressing and delivery of data from one computer to another on the Internet. See also TCP.

IP address
Internet Protocol address. An address that uniquely identifies a host (computer) on the Internet. Each IP address consists of four numbers expressed in “dotted decimal” notation, e.g., 201.45.6.224. See also network mask.

ISP
Internet Service Provider. A commercial vendor who sells Internet access usually bundled with other basic services such as e-mail.

LAN
Local Area Network. A network linking computers and peripherals together over a small area, usually a building or campus.

LED
Light Emitting Diode. A semiconductor diode that gives off light when a current is passed through it. LEDs are commonly used to implement indicator lights on electronic equipment. The indicator lights on the front of the reference unit are LEDs.

MAC address
Media Access Control address. A unique six-byte address assigned to a networking device (MAC addresses are controlled by the IEEE). Also called *hardware address*, *physical address*.

MCR
Minimum Cell Rate. A parameter used to express a guaranteed frame rate service. A GFR specifies a minimum cell rate (MCR) assuming a certain Maximum Frame Size (MFS) and Maximum Burst Size (MBS).

MIB
Management Information Base. A database containing information about managed objects in a network, such as configuration, performance statistics, etc.

NAT
Network Address Translation. A method by which IP addresses are mapped from one realm to another, in an attempt to provide transparent routing to hosts. NAT is traditionally used to connect more than one machine with private IP addresses to the Internet using one valid IP address obtained from an ISP.

network mask
A network mask is a sequence of bits applied to an IP address to select the network ID while ignoring the host ID. Bits set to 1 mean “select this bit” while bits set to 0 mean “ignore this bit.” For example, if the network mask 255.255.255.0 is applied to the IP address 100.10.50.1, the network ID is 100.10.50, and the host ID is 1.

OEM
Original Equipment Manufacturer. A company that uses components from one or more other companies to build a product that it sells under its own name.

packet
Data transmitted on a network consists of units called packets. Each packet contains a payload (the data), plus overhead information such as where it came from (source address) and where it should go (destination address).

PAP
Password Authentication Protocol. A protocol that authenticates a request to establish a PPP link, by verifying the user's login and password. See also

CHAP.

ping
Packet Internet (or Inter-Network) Groper. A program that uses a series of Internet Control Message Protocol (ICMP) messages to determine if a remote host is active or inactive, and to determine the round-trip delay in communicating with it. It can also be used to reveal the IP address for a given domain name.

port
A physical access point to a device such as a computer or router, through which data flows into and out of the device.

PPP
Point-to-Point Protocol. A connection-oriented protocol used to transmit data over a serial interface, such as a dial-up telephone line, on a point-to-point basis. PPP supports multiple level 3 protocols such as TCP/IP, IPX, etc.

PPPoA
Point-to-Point Protocol over ATM. The use of PPP over a DSL line, which uses the ATM protocol. PPPoA is one of two types of PPP interfaces you can define over a Virtual Circuit (VC), the other type being PPPoE.

PPPoE
Point-to-Point Protocol over Ethernet. PPPoE is used to allow multiple LAN users to share a single WAN connection via DSL (or cable) modem. PPPoE is a combination of the Point-to-Point Protocol (PPP) and the Ethernet protocol. Because a DSL or cable connection is always on (unlike a dialup connection), PPPoE requires a minimum of support from the telephone company and the ISP. PPPoE is one of two types of PPP interfaces you can define for a Virtual Circuit (VC), the other type being PPPoA.

protocol
A set of rules governing the transmission of data. In order for a data transmission to work, both ends of the connection have to follow the rules of the protocol.

router
See routing.

routing
Forwarding data between the user's network and the Internet on the most efficient route, based on the data's destination IP address and current network conditions. A device that performs routing is called a router.

Simultaneous bridging and routing
A feature of routing mode in which the SAR110 software routes IP packets, while simultaneously bridging packets for any other layer 3 protocol.

SNMP
Simple Network Management Protocol. The TCP/IP protocol used to manage TCP/IP, Ethernet, or OSI networks.

STP
Spanning Tree Procotol. A protocol used to prevent loops among interconnected bridges. It ensures that there is only one path between any two computers in the network.

subnet
A portion of a network. The subnet is distinguished from the larger network by a subnet mask which selects some of the computers of the network and excludes all others. The subnet's computers remain physically connected to the rest of the parent network, but they are treated as though they were on a separate network. See also network mask.

subnet mask
A mask that defines a subnet. See also network mask.

TCP
Transmission Control Protocol. The TCP/IP protocol that segments data into packets before transmission and reassembles and verifies them at the destination.

TCP/IP
Transmission Control protocol/Internet Protocol. A protocol suite that allows computers to communicate with each other and forms the basis for the Internet.

Telnet
An interactive, TCP-based terminal application used to log into and use a computer from a remote location.

UBR
Unspecified Bit Rate. An ATM service category that provides no guarantees for bandwidth, cell loss ratio, and cell transfer delay.

user interface
The way that a program or operating system “talks” with a user. User interfaces include Command Line Interfaces (CLIs), which communicate using text only, and Graphical User Interfaces (GUIs), which communicate via graphics.

VC
Virtual Circuit. A connection from your ADSL router to your ISP. The ATM cell stream carries data inside one or more virtual circuits. Also called Virtual Channel.

VCI
Virtual Circuit Identifier. A unique number that helps to identify a virtual circuit, in conjunction with another unique number known as the VPI. Also called Virtual Channel Identifier. See also VC, VPI.

VPI
Virtual Path Identifier. A unique number that helps to identify a virtual circuit, in conjunction with another unique number known as the VCI. See also VC, VCI.

WAN
Wide Area Network. With respect to the modem, WAN refers to the Internet. It also means any network spread over a large geographical area, such as a country or continent.

WFQ
Weighted Fair Queuing. This algorithm is used to ensure fair and efficient allocation of bandwidth. This algorithm allocates higher bandwidth in proportion to the weights of the VCs—the higher the weight, the higher is the bandwidth allocated. This is applicable to both GFR and UBR service categories.