BSR Troubleshooting Guide

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A Cable Modem Registration Process

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Preface

Scope

This document describes how to troubleshoot the Motorola™ Broadband Services Router™ 64000 (BSR 64000™) and Motorola™ Broadband Services Router™ 1000 (BSR 1000™), including hardware, applications, servers, databases, and routing and SONET-access features. This guide uses the term *network* to refer to subscriber cable modems, the BSR family of products, cables and equipment, and host servers.

Audience

This document is for use by those persons who will install and configure the BSR 64000™ product. Only trained service personnel should install, maintain, or replace the BSR 64000.

Documentation Set

This document is part of the following documentation sets:

- BSR 1000™ Documentation Set
- BSR 1000™ Documentation Set

BSR 1000™ Documentation Set

- *BSR 1000 Command Reference Guide*

  This document contains the Command Line Interface (CLI) commands for managing, configuring, and maintaining the BSR 1000.

- *BSR 1000 Configuration and Management Guide*

  This document provides the instructions and procedures for configuring and managing the BSR 1000.

- *BSR 1000 Installation Guide*

  This document describes how to install the BSR 1000 product.

- *BSR 1000 Release Notes*

  These documents provide information about features not described or incorrectly documented in the main documentation set; known problems and anomalies; product limitations; and problem resolutions.

- *BSR 1000 SNMP MIB Reference Guide*

  This document describes the Simple Network Management Protocol (SNMP) MIBs; provides information that describes standard and proprietary MIB support; describes how to walk the MIBs and how to compile and load the SNMP MIBs. It also provides task examples.

BSR 1000™ Documentation Set

- *BSR 64000 Command Reference Guide*

  This document contains the Command Line Interface (CLI) commands for managing, configuring, and maintaining the BSR 64000.

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- *BSR 64000 SNMP MIB Reference Guide*

  This document describes the Simple Network Management Protocol (SNMP) MIBs; provides information that describes standard and proprietary MIB support; describes how to walk the MIBs and how to compile and load the SNMP MIBs. It also provides task examples.

Conventions

This document uses the conventions in the following table:

Convention	Example	Explanation
angle brackets < >	**ping** <*ip-address*> **ping 54.89.145.71**	Arguments in italic and enclosed by angle brackets must be replaced by the text the argument represents. In the example, **54.89.345.71** replaces <*ip-address*>. When entering the argument, do not type the angle brackets.
bar brackets [ ]	**disable** [*level*]	Bar brackets enclose optional arguments. The example indicates you can use the **disable** command with or without specifying a *level*. Some commands accept more than one optional argument. When entering the argument, do not type the bar brackets.
bold text	**cable relay-agent-option**	Boldface text must be typed exactly as it appears.
brace brackets {}	**page** {**on** | **off**}	Brace brackets enclose required text. The example indicates you must enter either **on** or **off** after **page**. The system accepts the command with only one of the parameters. When entering the text, do not type the brace brackets.
italic text	**boot system** <*filename*>	Italic type indicates variables for which you supply values in command syntax descriptions. It also indicates file names, directory names, document titles, or emphasized text.

Convention	Example	Explanation
`screen display`	`Wed May 6 17:01:03 2000`	This font indicates system output.
vertical bar |	**page** {**on** | **off**}	A vertical bar separates the choices when a parameter is required. The example indicates you can enter either command: **page on** or **page off** When entering the parameter, do not type the vertical bar or the brace brackets.

Notes, Cautions, Warnings

The following icons and associated text may appear in this document.

Note: A note contains tips, suggestions, and other helpful information, such as references to material not contained in the document, that can help you complete a task or understand the subject matter.

Caution: The exclamation point, within an equilateral triangle, is intended to alert the user to the presence of important installation, servicing, and operating instructions in the documents accompanying the equipment.

Warning: This symbol indicates that dagerous voltages levels are present within the equipment. These voltages are not insulated and may be of sufficient strength to cause serious bodily injury when touched. The symbol may also appear on schematics.

Contacting Support

Use the following information to contact Support:

U.S.	1-888-944-HELP
	1-888-944-4357
International	+.215-323-0044
WWW	http://www.gi.com/BUSAREA/CUSACC/websupport.html
Email	cmtssupport@motorola.com

1

Introduction

Introduction

This chapter identifies the basic tasks you perform to solve problems with the network and hardware and software configurations.

The next sections describe how to perform standard troubleshooting techniques:

- Understanding Basic Troubleshooting
- Discovering Problems
- Viewing Symptoms
- Isolating the Problem
- Solving the Problem
- Evaluating the Solution

Understanding Basic Troubleshooting

The basic steps you need to perform to troubleshoot network problems are as follows:

1. Identify the cause or symptom of the problem, which can be any undesired result or behavior. See *Discovering Problems*, later, to learn how to identify problems.

Note: One or more symptoms or causes can be related to a single problem.

2. Isolate the cause or symptom of the problem and try to determine its scope. For example, determine if it is the whole HFC network, a particular subnetwork on the HFC network, or just one subscriber that is experiencing the problem. See *Isolating the Problem*, later in this document, for more information.
3. Once the cause or symptom of a problem is isolated, make a list of troubleshooting procedures that you plan to use. Refer to subsequent chapters in this document for specific troubleshooting procedures you can use.

4. Document the changes and effects of changes as you perform troubleshooting procedures, and note any new troubleshooting procedures that you use. This simple precaution helps to avoid repeating steps, allows for future reference in case the problem reoccurs, and is especially useful for troubleshooting intermittent problems.
5. Determine if the problem is solved. Ensure that the troubleshooting procedure did not cause new problems.
6. If the problem is not solved, try to identify problem causes more clearly, isolate any additional causes, and perform additional troubleshooting procedures to correct the problem.

Discovering Problems

Ensure that you thoroughly understand the network so that you can establish a baseline from which to work, and distinguish the differences between normal and abnormal activity on the network.

Perform the following steps to determine the source of problems:

- Review release notes and technical bulletins to determine if there are any incompatibilities or known problems.
- Gather information for all the possible causes or symptoms to more quickly isolate the problem.
- Discover if the problem relates to another problem that you must solve first.
- Record all configuration parameters that relate to the problem.
- Determine if the network configuration has changed recently, such as the addition or removal of components, upgrading, or reconfiguration.
- Identify aspects that causes or symptoms have in common to determine if they are related.
- Look for network patterns in the causes. What time of day did these problems occur? What events were logged? What network thresholds were transgressed?
- Record any changes that occurred since the network was last functioning correctly. Changes in network activity may relate to a configuration change.

- Record any changes that occurred since the last time the BSR was operating properly. Investigate any configuration changes that might be related to the problem.

Viewing Symptoms

Perform the following tasks to view and compare symptoms that are related to a problem:

- Repeat the conditions that led to the symptom. Consider any errors or failures that can cause a particular symptom, and test them to see if they are causing the symptom.
- Determine if any symptoms are related. Are there unexpected or undesired results in more than one area? If so, find the areas in common and the variables that affect them. The source of the problem is often found in similar areas.
- Focus on one symptom or a set of related symptoms of a problem. However, do not completely disregard other symptoms, because what may appear to be an unrelated problem may actually be related based on other symptoms.

Isolating the Problem

A problem can have one or more causes. To identify the cause of unwanted behavior, use the following techniques:

- Isolate the problem. For example, isolate a problem to one part of the network or to a specific access module.
- Find the functions that are working correctly.
- Retrace the steps that were taken, and return the network to its condition before the problem first appeared. Once the network is in a known condition, take incremental steps and observe the network to learn when and where the problems occur.
- Determine if there have been any additions, changes, or upgrades to the network. If so, consider any consequences the changes could have had on the network, and whether they affect the current situation.

Solving the Problem

Different problems require different actions and solutions, but follow these basic steps to fix any problem:

1. Identify the course of action and the steps you plan to take.
2. Decide what tools are necessary to fix the problem on the network. For example, you can use the CLI as a tool to look at events and set SNMP traps. You can use a cable tester to check physical media connections.
3. Perform each step for the course of action.
4. Verify the result of each action using the available CLI show commands. For example, if you enabled a port, use the appropriate **show ip interface brief** command in Privileged EXEC mode to verify that the port is enabled.
5. If more than one possible action exists, select the easiest one first to quickly eliminate possibilities, or select the action that appears most likely to solve the problem first, even if it is the most time-consuming or difficult to perform.

Evaluating the Solution

Once you find the solution, test it to ensure that no new symptoms or problems occur. If new symptoms or problems do occur, repeat the troubleshooting process to determine the cause. If problems or symptoms recur, create a standard test plan to evaluate fixes.

2

Checking Physical Equipment

Introduction

This chapter discusses how to check physical connections and observe LEDs on the BSR products. You should check power and network connections anytime you install new hardware, or whenever a problem occurs.

The next sections describe how to check physical problems on the BSR:

- Checking BSR 1000 Power Connections
- Checking BSR 64000 Power Connections
- Checking Physical Network Connections
- Interpreting BSR 64000 LED Displays

Checking BSR 1000 Power Connections

Inspect any uninterruptible power supplies (UPS) connected to the BSR 1000. Sometimes the UPSs can fail.

Checking BSR 64000 Power Connections

Inspect the power LEDs labeled A and B on the front of the Supervisory Routing Module (SRM). If power source A or B failed, the corresponding LED displays a failed condition. If the two -48V DC power filter modules A and B on the rear of the unit are operational, check the -48V DC (40-60 V DC input) power source. The power source could either be an AC-to-DC power converter, or a battery connection attached to a charger. Make sure the power converter or charger is operating properly.

Checking Physical Network Connections

Check network connections for loose, broken, or disconnected cables. Inspect the cable terminating connectors for damage.

Use the following techniques to troubleshoot physical cables on the network:

- Use the CLI **show** commands to view port and slot information.
- Use a cable tester to test the network cables for damage.
- Verify that all the networks associated with the BSR are within proper specifications.
- Use cable testing equipment to measure or ensure that the correct distances for cable runs are in place.
- If the BSR 64000 is installed, ensure that all modules are seated correctly in the chassis.
- Replace any suspected defective modules or devices with known working spare modules or devices.
- Refer to the system documentation or service contract information for replacements and on-site spares.

Interpreting BSR 64000 LED Displays

The BSR 64000 provides three types of LEDs that indicate its operational status:

- SRM LEDs
- DOCSIS CMTS Resource Module LEDs
- OC3/OC12 POS Resource Module LEDs

Observing LED displays on the BSR 64000 is the quickest way to diagnose possible power, network connectivity, and network traffic problems. The LEDs on the BSR can indicate problems from the fuse alarm panel in the cable headend offices to the port level. For example, if a problem occurs, use the following steps to determine the problem:

1. View the LEDs on the fuse alarm panel on the rack to determine which BSR has a detected fault.

2. Observe the LEDs on the SRM on the BSR 64000 or the front panel of the BSR 1000 to determine if there is a fail condition or alarm.
   - If there is a fail condition and the SRM circuitry is not receiving power, replace the SRM on the BSR 64000.
   - If there is an alarm condition, check the modules on the BSR 64000 to determine which one is faulty.
   - If there is a fail condition on a BSR 1000, replace it.
   - If there is an alarm condition on a BSR 1000, troubleshoot the faulty port.
3. Observe the LEDs on the faulty module of the BSR 64000 to determine if there is a fail condition or alarm.
   - If there is a fail condition and the module's circuitry is not receiving power, replace the module.
   - If there is an alarm condition, check the port interfaces to determine which ones are faulty. The solution may require that you swap the module with a new one, or troubleshoot the faulty port.

SRM LEDs

The SRM has the following groups of LEDs that indicate its operational status and the status of other chassis components. The subsections that follow describe the display states of these LED groups:

- Module LEDs
- Fan Status LEDs
- Alarm LEDs

Module LEDs

The DOCSIS CMTS Module LEDs are visible on the module front panel and are labeled: **Fail, Status**, and **Alarm**.

Table 2-1 describes the possible display states of these LEDs during operation.

Table 2-1 Module LED Display States for the SRM

Fail	Status	Alarm	Interpretation
Off	**Green**	Off	Normal operating status.
Off	**Green**	**Red**	Failure. SRM is operating with an alarm condition.
Red	Off	Off	Indicates a module hardware failure. The LED is red when the BSR is receiving power, but there is no power to the circuitry. This can occur if a fuse on a BSR 64000 module is down. A red LED can also occur if the BSR 64000 does not boot correctly.
Red	Off	**Red**	Failure. SRM is not operational.
Red	**Green**	**Red**	Reset. SRM is booting.
Off	Off	Off	If the Status LED is off and the Fail LED is off, there is no power. The power source for the BSR 64000 has failed. • Check the -48V DC power source(s) for power to the BSR 64000. The -48V DC power source may be faulty. Check the UPS for the BSR 1000.

Fan Status LEDs

The SRM provides a set of Fan Status LEDs for each of the fan arrays installed in the BSR 64000 chassis. These LEDs are visible on the module front panel of the SRM and are labeled: **OK** and **Fail**. Table 2-2 describes the possible display states of the LEDs.

Table 2-2 SRM Fan Status LED Display States

OK	Fail	Interpretation
Green	Off	Normal operating status.
Off	**Red**	Failure. One or more fans of the fan module failed or fan module is removed.

Alarm LEDs

Table 2-3 describes the BSR 64000 Alarm LEDs on the SRM. The SRM provides a set of three Alarm LEDs. These LEDs are visible on the module front panel of the SRM and are labeled: MIN (Minor), MAJ (Major), and CRIT (Critical).

Table 2-3 SRM Alarm LED Display States

LED	MIN State	MAJ State	CRIT State	Interpretation
MIN	Yellow	Off	Off	Minor alarms indicate problems that do not have a serious effect on service to customers or problems in circuits that are not essential to network element operation.
MAJ	Off	Red	Off	Major alarms are used for hardware or software conditions that indicate a serious disruption of service or the malfunctioning or failure of important circuits. These conditions require immediate attention and response to restore or maintain system capability. The urgency is less than in critical situations because of a lesser immediate or impending effect on service or system performance.
CRIT	Off	Off	Red	Critical alarms are used to indicate that a severe service-affecting condition has occurred and that immediate corrective action is imperative.

Note: When an audible alarm condition sounds, press the ACO button located on the front panel of the System Resource Module (SRM) to clear the audible alarm.

DOCSIS CMTS Resource Module LEDs

The DOCSIS CMTS Module has two groups of LEDs that indicate its operational status:

- Module LEDs
- Per-Port LEDs

The following subsections describe the possible display states of these LED types.

Module LEDs

The DOCSIS CMTS Module LEDs are visible on the module front panel and are labeled: **Fail, Status**, and **Alarm**.

Table Table 2-4 describes the possible display states of these LEDs during operation.

Table 2-4 Module LED Display States for the DOCSIS CMTS Resource Module

Fail	Status	Alarm	Interpretation
Off	**Green**	Off	Normal operating status.
Off	**Green**	**Red**	Failure. Module is operating with an alarm condition. **Note:** This sequence of LED occurs when an alarm condition is detected on individual upstream and downstream ports.
Red	Off	Off	Indicates a module hardware failure.
Red	Off	**Red**	Failure. Module is not operational.
Red	**Green**	**Red**	Reset. Module is booting.
Off	Off	Off	Module is not receiving power or is not secured in the chassis though its module ejectors and integrated ejector switch.

Per-Port LEDs

The DOCSIS CMTS downstream port and each upstream port have two LEDs to indicate their operational status. These LEDs are visible on the module front panel and are labeled **Link** and **Fail**.

Port LEDs are grouped vertically. A number to the right each LED group indicates the channel number associated with the group. The single downstream channel is numbered 0 and the four upstream channels are numbered 0, 1, 2, 3. Table 2-5 describes the possible display states of these LEDs during operation.

Table 2-5 BSR 64000 Downstream and Upstream Port LED Display States

Link	Fail	Interpretation
Green	Off	Normal operating status.
Green	**Red**	Operating with an alarm condition detected. **Note:** An alarm condition detected for an individual port also causes the System Alarm LED to light.
Off	**Red**	Failed port. Port is not operational.
Off	Off	Port is not configured. **Note:** Check module LEDs to determine if the module is receiving power.

OC3/OC12 POS Resource Module LEDs

The OC3/OC12 POS Resource Module has two groups of LEDs that indicate its operational status:

- Module LEDs
- Per-Port LEDs

The following subsections describe the possible display states of these LED types.

Module LEDs

The OC3/OC12 POS Resource Module LEDs are visible on the module front panel and are labeled: **Fail, Status**, and **Alarm**.

Table Table 2-4 describes the possible display states of these LEDs during operation.

Table 2-6 Module LED Display States for the OC3/OC12 POS Resource Module

Fail	Status	Alarm	Interpretation
Off	**Green**	Off	Normal operating status.
Off	**Green**	**Red**	Failure. Module is operating with an alarm condition. **Note:** This sequence of LED occurs when an alarm condition is detected on individual upstream and downstream ports.
Red	Off	Off	Indicates a module hardware failure.
Red	Off	**Red**	Failure. Module is not operational.
Red	**Green**	**Red**	Reset. Module is booting.
Off	Off	Off	Module is not receiving power or is not secured in the chassis though its module ejectors and integrated ejector switch.

Per-Port LEDs

The OC3/OC12 POS Resource Module supports four SONET ports and two 10/100BaseT Ethernet ports. Each SONET and Ethernet port on the OC3/OC12 POS Resource Module has two LEDs associated with it to indicate the port's operational status. These LEDs are visible on the module front panel and are labeled **Link** and **Fail**.

Port LEDs are grouped vertically. A number to the right each LED group indicates the port number associated with the group. Table 2-5 describes the possible display states of these LEDs during operation.

Table 2-7 BSR 64000 OC3/OC12 POS Port and Ethernet LED Display States

Link	Fail	Interpretation
Green	Off	The SONET or Ethernet port is operational and is receiving and transmitting data.
Green	**Red**	Operating with an alarm condition detected. The SONET port is not operational because there is a loss of signal (LOS), loss of frame (LOF), or loss of pointer (LOP) condition. **Note:** An alarm condition detected for an individual port also causes the System Alarm LED to light on the System Resource Module (SRM).
Off	**Red**	Failed port. Port is not operational.
Off	Off	Port is not configured or is disabled. **Note:** Check module LEDs to determine if the module is receiving power.

Interpreting BSR 1000 LED Displays

The BSR 1000 provides three types of LEDs that indicate its operational status:

- System LEDs
- Upstream and Downstream Port LEDs
- Ethernet Port LEDs

The following sections describe the LED types.

System LEDs

The BSR 1000 system LEDs are located on the left side of the BSR 1000 front panel and are labeled Fail, Status, and Alarm.

Table 2-8 describes the possible display states of these LEDs during operation.

Table 2-8 BSR 1000 System LED Display States

Fail	Status	Alarm	Interpretation
Off	Green	Off	Normal operating status.
Off	Green	Red	Failure. BSR 1000 is operating with an alarm condition. **Note:** This LED sequence occurs when an alarm condition is detected on individual upstream and downstream ports.
Red	Off	Off	Fuse failure possibly indicating a hardware failure.
Red	Off	Red	Failure. BSR 1000 is not operating.
Red	Green	Red	Reset. Reset button was pressed and the BSR 1000 is starting its boot process.
Off	Off	Off	BSR 1000 is not receiving power or is switched Off.

Upstream and Downstream Port LEDs

The BSR 1000 downstream port and each upstream port has two LEDs to indicate their operational status. These LEDs are located near the center of the BSR 1000 front panel and are labeled Status and Alarm.

Port LEDs are grouped vertically. A number above each LED group indicates the channel number associated with the group. The single downstream channel is numbered 0 and the four upstream channels are numbered 0, 1, 2, 3. Table 2-5 describes the possible display states of these LEDs during operation.

Table 2-9 BSR 1000 Downstream and Upstream Port LED Display States

Status	Alarm	Interpretation
Green	Off	Normal operating status. The downstream port is operational and is transmitting data to the cable modem (CM) network.
Green	Red	Operating with an alarm condition detected. **Note:** An alarm condition detected for an individual port also causes the System Alarm LED to light.
Off	Red	Failed port. Port is not operational.
Off	Off	Port is not configured.

Ethernet Port LEDs

The Ethernet port at the back of the BSR 1000 has two associated LEDs located to the right of the port. Table 2-10 provides an interpretation of the LED displays

Table 2-10 BSR 1000 Ethernet Port LED Display States

LED Label	Display State Interpretation
10/100BASE-T	On indicates that the port is operating at 100 Mbps. Off indicates that the port is operating at 10 Mbps.
Link	On indicates a working Ethernet connection between the BSR 1000 and the device at the other end of the physical connection. Off indicates that a connection to the device at the other end of the physical connection is not established.

3

Monitoring SNMP

Introduction

This chapter describes how to use Simple Network Management Protocol (SNMP) information to monitor BSR system management networking activity.

Displaying SNMP Information

SNMP information lets you monitor management activities on the network. For example, SNMP traps are error messages sent from the SNMP agent to the SNMP manager to alert system administrators about Cable Modems (CMs) going offline or online.

Follow the CLI **show** command to access SNMP Information:

```
RDN#show snmp
```

Table 3-1 describes the output of the SNMP **show** command:

Table 3-1 Understanding SNMP show Information

SNMP Information	Explanation
Status	Displays the status of SNMP as either stopped or enabled.
Port Number	Identifies the port number that the SNMP agent uses to listen for SNMP information. You must know which SNMP port is used when configuring servers for the BSR.
Contact	Identifies the network administrator responsible for configuring the BSR.
Description	Provides the hardware version, vendor name, and Boot Rom version.
Location	Identifies the BSR location.
SNMP In Packets	Incoming SNMP Packets.
• Bad SNMP version errors	SNMP version is incompatible with the SNMP in use.
• Unknown community names	Displays the total number of SNMP messages received that used an unknown SNMP community name.

Table 3-1 Understanding SNMP show Information

SNMP Information	Explanation
• Illegal operations for community names supplied	Displays command operations that are not allowed for the existing community names.
• ASN parse errors	Displays the total number of Abstract Syntax Notation (ASN) errors found in SNMP messages received.
• Requested variables	Shows the requested SNMP variables.
• Changed variables	Shows the changed SNMP variables.
• Get requests	Identifies the number of times that a MIB variable or object is selected.
• Get-next requests	Identifies the number of times the next MIB variable or object is selected.
• Set requests	Identifies the number of times that a MIB variable or object is set.
SNMP Out Packets	Outgoing SNMP Packets.
• Packets too big	Displays the total number of SNMP Protocol Data Units (PDUs) sent that contained an error-status field value of tooBig.
• No such name errors	Displays the total number of SNMP PDUs sent that contained an error-status field value of nosuchName.
• Bad values	Displays the total number of SNMP PDUs sent that contained an error-status field value of badValue.
• General errors	Displays the total number of SNMP PDUs sent that contained an error-status field value of genErr.
• Responses	Displays the total number of SNMP Get-Response PDUs sent and processed.
• Traps	Displays the total number of SNMP Trap PDUs received and processed. SNMP traps provide information about the following: • Potentially harmful network environment conditions • Processor status • Port status • Security issues The BSR generates SNMP traps based on the supported IOS features.

4

Troubleshooting the CMTS

Introduction

This chapter provides troubleshooting solutions to some common Data Over Cable Service Interface Specifications (DOCSIS) network problems with the following:

- Using Flap Lists to Troubleshoot CM Problems
- Resolving HFC Network Performance Problems
- Resolving Problems on the Upstream Path
- Resolving Problems on the Downstream Path
- Resolving Cable Modem Problems

Using Flap Lists to Troubleshoot CM Problems

The BSR maintains a database of flapping CMs to assist in locating cable plant problems. The flap list feature tracks the upstream and downstream performance of all CMs on the network, without impacting throughput and performance between the CM and BSR, or creating additional packet overhead on the HFC network.

Refer to the *BSR 64000 Configuration and Management Guide* for more information on configuring flap-list settings.

Viewing Flap List Statistics to Identify Network Health

Flap lists are used to collect statistics for determining CM problems on the network. There are several different options for sorting flap list statistics. The CM flap list keeps track of the CM MAC address, up and down transitions, registration events, missed periodic ranging packets, upstream power adjustments on the BSR. This section describes the different sorting options and describes the command output fields.

CMs appear in the flap list when any of the following conditions are detected:

- The CM re-registers more frequently than the configured insertion time.
- Intermittent keepalive messages are detected between the BSR and the CM.

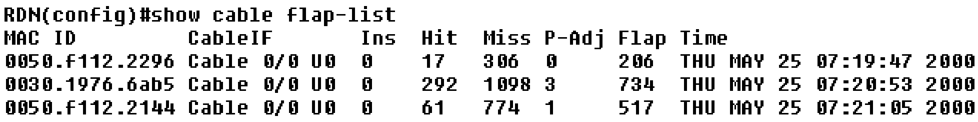
- The CM upstream transmit power changes beyond the configured power adjust threshold.

Follow these steps to view flap list statistics by using different sorting options:

1. To view all flap list statistics for CMs, use the **show cable flap list** command in Privileged EXEC mode as shown in the following example:

   RDN#**show cable flap-list**

   The following output displays:



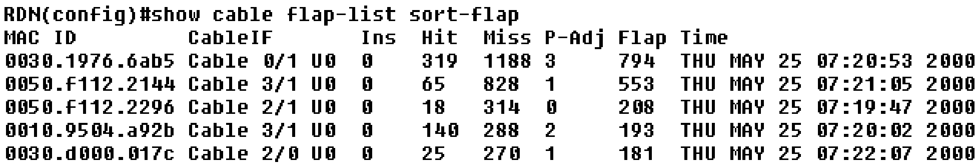
```
RDN(config)#show cable flap-list
MAC ID         CableIF       Ins  Hit  Miss P-Adj Flap Time
0050.f112.2296 Cable 0/0 U0  0    17   306  0     206  THU MAY 25 07:19:47 2000
0030.1976.6ab5 Cable 0/0 U0  0    292  1098 3     734  THU MAY 25 07:20:53 2000
0050.f112.2144 Cable 0/0 U0  0    61   774  1     517  THU MAY 25 07:21:05 2000
```

Figure 4-1 show cable flap-list Command Output

2. To sort the flap list statistics by the CM flap, use the **show cable flap-list sort-flap** command in Privileged EXEC mode as shown in the following example:

   RDN#**show cable flap-list sort-flap**

   The following output displays:



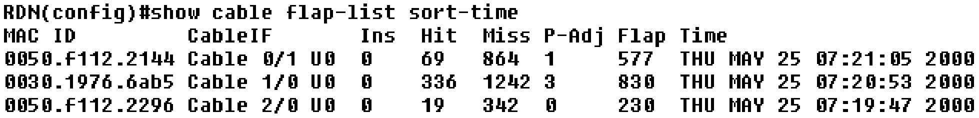
```
RDN(config)#show cable flap-list sort-flap
MAC ID         CableIF       Ins  Hit  Miss P-Adj Flap Time
0030.1976.6ab5 Cable 0/1 U0  0    319  1188 3     794  THU MAY 25 07:20:53 2000
0050.f112.2144 Cable 3/1 U0  0    65   828  1     553  THU MAY 25 07:21:05 2000
0050.f112.2296 Cable 2/1 U0  0    18   314  0     208  THU MAY 25 07:19:47 2000
0010.9504.a92b Cable 3/1 U0  0    140  288  2     193  THU MAY 25 07:20:02 2000
0030.d000.017c Cable 2/0 U0  0    25   270  1     181  THU MAY 25 07:22:07 2000
```

Figure 4-2 show cable flap-list sort-flap Command Output

3. To sort the flap list statistics by the time at which the CM flap occured, use the **show cable flap-list sort-time** command in Privileged EXEC mode as shown in the following example:

   RDN#**show cable flap-list sort-time**

The following output displays:



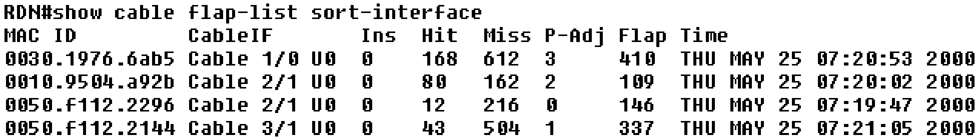
```
RDN(config)#show cable flap-list sort-time
MAC ID         CableIF       Ins  Hit  Miss P-Adj Flap Time
0050.f112.2144 Cable 0/1 U0  0    69   864  1     577  THU MAY 25 07:21:05 2000
0030.1976.6ab5 Cable 1/0 U0  0    336  1242 3     830  THU MAY 25 07:20:53 2000
0050.f112.2296 Cable 2/0 U0  0    19   342  0     230  THU MAY 25 07:19:47 2000
```

Figure 4-3 show cable flap-list sort-time Command Output

4. To sort the flap list statistics by the cable upstream interface on which the CM flap occured, use the **show cable flap-list sort-interface** command in Privileged EXEC mode as shown in the following example:

   RDN#**show cable flap-list sort-interface**

   The following output displays:



```
RDN#show cable flap-list sort-interface
MAC ID         CableIF       Ins  Hit  Miss P-Adj Flap Time
0030.1976.6ab5 Cable 1/0 U0  0    168  612  3     410  THU MAY 25 07:20:53 2000
0010.9504.a92b Cable 2/1 U0  0    80   162  2     109  THU MAY 25 07:20:02 2000
0050.f112.2296 Cable 2/1 U0  0    12   216  0     146  THU MAY 25 07:19:47 2000
0050.f112.2144 Cable 3/1 U0  0    43   504  1     337  THU MAY 25 07:21:05 2000
```

Figure 4-4 show cable flap-list sort-interface Command Output

Table 4-1 identifies the flap list command output column field identifications:

Table 4-1 Flap List Command Output Identifications

Field	Identification
MAC ID	Lists the MAC addresses of the CMs sorted by the flap rate or most recent flap time. The first six digits in the CM MAC address indicate the vendor ID of the CM manufacturer, followed by six digits indicating a unique host address. Each CM MAC address is unique.
Cable IF	Detects the cable interface up/down flap. This is the cable interface on the BSR 64000 DOCSIS module or BSR 1000. It denotes the DOCSIS module slot number (BSR 64000), the downstream and the upstream port number. The flap list data can be sorted based on the upstream port number which is useful when isolating reverse path problems unique to certain combining groups.

Table 4-1 Flap List Command Output Identifications

Field	Identification
Ins	The Insertions Link process is used by a CM to perform an initial maintenance procedure to establish a connection with the BSR. The Ins column is the flapping CM's (re) insertion count and indicates the number of times the a CM starts and inserts into the network in an abnormal way. An abnormality is detected when the time between link re-establishment attempts is less than the user-configurable parameter. This function can identify potential problems in the downstream interface such as incorrectly provisioned CMs repeatedly trying to reestablish a link.
Hit	The Hit and Miss column fields detect the intermittent upstream; the keepalive hits versus misses is the number of times CMs do not respond to the MAC layer keepalive messages. If there are a number of misses, this points to a potential upstream problem.
Miss	
P-Adj	The Power Adjustment column field shows power adjustment statistics during station maintenance polling. This column indicates the number of times the BSR tells a CM to adjust the transmit power more than the configured threshold. If constant power adjustments are detected, an amplifier problem is usually the cause. The source of failure is found by viewing CMs either in front or behind various amplifiers.
Flap Time	Indicates the most recent time a flap has occured for a particular CM.

Interpreting Flap List Statistics

This section describes how to interpret flap list statistics in order to troubleshoot the cable network

CM activity follows the sequence below.

- Power-on
- Initial maintenance
- Station maintenance
- Power-off

The initial link insertion is followed by a keepalive loop between the BSR and CM and is called station maintenance. When the link is broken, initial maintenance is repeated to re-establish the link.

Initial maintenance @ Time T1

Station maintenance

Init maintenance @ Time T2

The **Ins** and **Flap** counters in the flap list are incremented whenever **T2 – T1 < N** where **N** is the insertion-time parameter configured using the **cable flap-list insertion-time** command. The default value for this parameter is TBD seconds.

Use the following cause or symptom observations to interpret flap list activity and solve CM problems:

Table 4-2 Troubleshooting CM Problems

Cause or Symptom	Problem
Subscriber CM shows a lot of flap list activity	CM is having communication problems with the BSR.
Subscriber CM shows little or no flap list activity.	The CM is communicating with the BSR effectively, however there is still a problem. The problem can be isolated to the subscriber's CPE computer equipment or the CM connection.
Ten percent of the CMs in the flap list show a lot of activity.	These CMs are most likely having difficulties communicating with the BSR.
CMs have a lot of power adjustment (P-Adj) errors.	CMs have problems with their physical upstream paths or in-home wiring problems. Use corresponding CMs on the same physical upstream port interface with similar flap list statistics to quickly resolve problems outside the cable plant to a particular node or geographic location.
All CMs are incrementing the insertion at the same time.	There is a provisioning server failure.
A CM has more than 50 power adjustments per day.	The CM has a suspect upstream path. Corresponding CMs on the same physical upstream port interface with similar flap list statistics can be used to quickly resolve problems outside the cable plant to a particular node or geographic location.

Table 4-2 Troubleshooting CM Problems

Cause or Symptom	Problem
A CM has roughly the same number of hits and misses and contain a lot of insertions.	There is a problematic downstream path. For example, the downstream power level to the CM may have a power level that is too low.
A high flap list insertion (Ins) time number.	Intermittent downstream synchronization loss. DHCP or CM registration problems.
Low miss/hit ratio, low insertion, low P-adj, low flap counter and old timestamp.	Indicates an optimal network situation.
High ratio of misses over hits (> 10%)	Hit/miss analysis should be done after the "Ins" count stops incrementing. In general, if the hit and miss counts are about the same order of magnitude, then the upstream may be experiencing noise. If the miss count is greater, then the CM is probably dropping out frequently and not completing registration. The upstream or downstream is perhaps not stable enough for reliable link establishment. Very low hits and miss counters and high insertion counters indicate provisioning problems.
High power adjustment counter.	Indicates the power adjustment threshold is probably set at default value of 2 dB adjustment. The CM transmitter step size is 1.5 dB, whereas the headend may command 0.25 dB step sizes. Tuning the power threshold to 6 dB is recommended to decrease irrelevant entries in the flap list. The power adjustment threshold may be set using <*cable flap power threshold* <*0-10 dB*> from Global Configuration mode. A properly operating HFC network with short amplifier cascades can use a 2-3 dB threshold.

Table 4-2 Troubleshooting CM Problems

Cause or Symptom	Problem
High P-Adj (power adjustment)	This condition can indicate that the fiber node is clipping the upstream return laser. Evaluate the CMs with the highest number of correcteds and uncorrecteds first. If the CMs are not going offline (Ins = 0), this will not be noticed by the subscriber. However, they could receive slower service due to dropped IP packets in the upstream. This condition will also result in input errors on the cable interface.
High insertion rate.	If link re-establishment happens too frequently, then the CM is usually having a registration problem.This is indicated by a high ‘Ins’ counter which tracks the ‘Flap’ counter.

Note: CMs go offline faster than the frequency hop period and can cause the frequency to stay fixed while CMs go offline. Reduce the hop period to 10 seconds to adjust to the hop frequency period.

Table 4-3 describes how to interpret flap list statistics:

Table 4-3 Flap List Statistic Interpretations

Field	Description
Hit and Miss	The HIT and MISS columns are keepalive polling statistics between the BSR and the CM. The station maintenance process occurs for every CM approximately every 10 seconds. When the BSR receives a response from the CM, the event is counted as a Hit. If the BSR does not receive a response from the CM, the event is counted as a Miss. A CM will fail to respond either because of noise or if it is down. CMs which only log Misses and zero Hits are assumed to be powered off. Misses are not desirable since this is usually an indication of a return path problem; however, having a small number of misses is normal. The flap count is incremented if there are M consecutive misses where M is configured in the cable flap miss-threshold parameter. The parameter value ranges from 1-12 with a default of 6. Ideally, the HIT count should be much greater than the Miss counts. If a CM has a HIT count much less than its MISS count, then registration is failing. Noisy links cause the MISS/HIT ratio to deviate from a nominal 1% or less. High Miss counts can indicate: • Intermittent upstream possibly due to noise • Laser clipping • Common-path distortion • Ingress or interference Too much or too little upstream attenuation
P-Adj	The station maintenance poll in the BSR constantly adjusts the CM transmit power, frequency, and timing. The Power Adjustments (P-Adj)column indicates the number of times the CM's power adjustment exceeded the threshold value. The power adjustment threshold may be set using the <*cable flap power threshold* > parameter with a value range of 0-10 dB and a default value of 2 dB. Tuning this threshold is recommended to decrease irrelevant entries in the flap list. Power Adjustment values of 2 dB and below will continuously increment the P-Adj counter. The CM transmitter step size is 1.5 dB, whereas the headend may command 0.25 dB step sizes. Power adjustment flap strongly suggests upstream plant problems such as: • Amplifier degradation • Poor connections • Thermal sensitivity Attenuation problem

Table 4-3 Flap List Statistic Interpretations

Field	Description
Flap	The Flap counter indicates the number of times the CM has flapped. This counter is incremented when one of the following events is detected: Unusual CM insertion or re-registration attempts. The Flap and the Ins counters are incremented when the CM tries to re-establish the RF link with the BSR within a period of time that is less than the user-configurable insertion interval value. Abnormal Miss/Hit ratio The Flap counter is incremented when N consecutive Misses are detected after a Hit where N can be user-configurable with a default value of 6. Unusual power adjustment The Flap and P-adj counters are incremented when the CM's upstream power is adjusted beyond a user-configurable power level.
Time	Time is the timestamp indicating the last time the CM flapped. The value is based on the clock configured on the local BSR. If no time is configured, this value is based on the current uptime of the BSR. When a CM meets one of the three flap list criteria, the Flap counter is incremented and Time is set to the current time.

Tips for Administrating Flap Lists

Follow these suggestions for administrating flap lists:

- Write script(s) to periodically poll the flap list.
- Analize and identify CM trends from the flap list data.
- Query the billing and administrative database for CM MAC address-to-street address translation and generate reports. These reports can then be given to the Customer Service Department or the cable plant's Operations and Maintenance Department. Maintenance personnel use the reports to see patterns of flapping CMs, street addresses, and flap statistics that indicate which amplifier or feeder lines are faulty. The reports also help troubleshoot problems in the downstream and/or upstream path, and determine if a problem is related to ingress noise or equipment.

- Save the flap list statistics to a database server at least once a day to keep a record of flap list statistics which includes upstream performance and quality control data. These statistics can be used again at a later time to evaluate trends and solve intermittant problems on the HFC networks. Once the flap list statistics are backed up daily on the database server, the flap list statistics can be cleared.

Resolving HFC Network Performance Problems

If Cable Modem (CM) subscribers can use their data connection, but experience slow network performance during activities such as Web surfing and exchanging files. The problem may be the following:

- Downstream Signal Reflected on Upstream Path
- Slow Performance Detected on Upstream Port
- Too Many CPE Hosts on Subscriber CM

The following sections describe how to handle these problems.

Downstream Signal Reflected on Upstream Path

Follow these steps to correct common path distortion that occurs when the downstream signal is reflected on the upstream path:

1. Check for corrosion or loose connections on common point contacts such as F-connectors, G-connectors, screw-down seizures, or terminators.
2. Inspect connections for poor craftsmanship on common point contacts.
3. If one or more poor or damaged contacts have been detected, these contacts may develop an electronic potential that functions like a tiny diode. This situation causes the forward (downstream) signals to mix with the return (upstream) signal causing unwanted beat signals on the spectrum.
4. To determine if common path distortion is occuring, use a spectrum analyser to check for unwanted beat signals on the upstream path. This impairment happens on the spectrum at points where both the upstream and downstream signals are present.

5. Do the following tasks to repair damaged contacts:

   - Ensure that contacts are made of similar metals.
   - Ensure that contacts are clean.
   - Ensure that contacts are securely fastened.
   - Replace or repair defective equipment, if necessary.

Slow Performance Detected on Upstream Port

Subscriber CMs connected to an upstream port are experiencing poor or slow performance.

Follow these steps to gather information and correct slow performance related to a specific upstream port:

1. Determine the physical location or MAC addresses of the CMs having problems.

2. To enter the cable interface, use the **interface cable** command, in Global Configuration mode as shown in the following example:

   ```
   RDN(config-if)#interface cable <slot>/<interface>
   ```

   where:

   slot is the slot number of the DOCSIS module on the BSR 64000

   interface is the number of the cable interface

Note: The slot and interface number on the BSR 1000 are 0.

   port is the number of the upstream port

3. To determine the modulation profile number for an upstream port, use the **show cable upstream** command in Interface Configuration mode, as shown in the following example:

   ```
   RDN(config-if)#show cable upstream <port>
   ```

where:

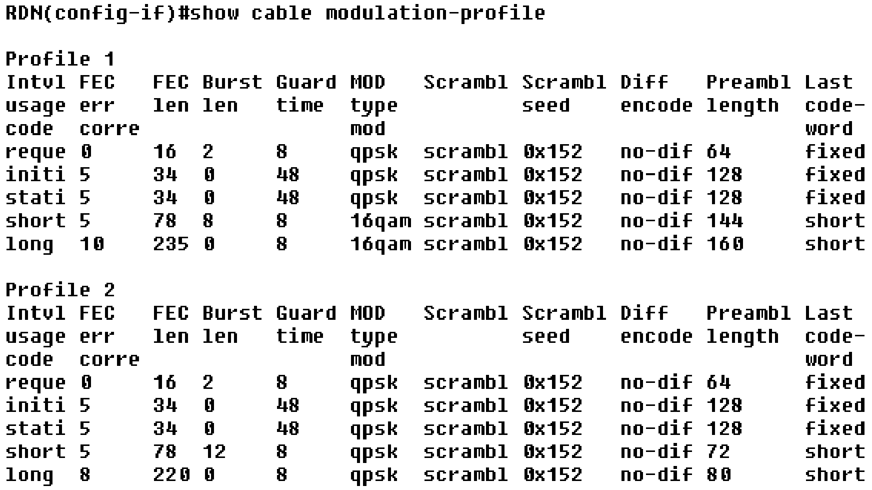
port is the number of the upstream port

4. To determine if modulation profile parameters are adequate for the upstream port, use the **show cable modulation-profile** command in Privileged EXEC mode as shown in the following example:

   `RDN#`**show cable modulation-profile** <*n*>

   where:

   n is the modulation profile number being used.



```
RDN(config-if)#show cable modulation-profile

Profile 1
Intvl FEC    FEC Burst Guard MOD   Scrambl Scrambl Diff   Preambl Last
usage err    len len   time  type          seed    encode length  code-
code  corre                  mod                                  word
reque 0      16  2     8     qpsk  scrambl 0x152   no-dif 64      fixed
initi 5      34  0     48    qpsk  scrambl 0x152   no-dif 128     fixed
stati 5      34  0     48    qpsk  scrambl 0x152   no-dif 128     fixed
short 5      78  8     8     16qam scrambl 0x152   no-dif 144     short
long  10     235 0     8     16qam scrambl 0x152   no-dif 160     short

Profile 2
Intvl FEC    FEC Burst Guard MOD   Scrambl Scrambl Diff   Preambl Last
usage err    len len   time  type          seed    encode length  code-
code  corre                  mod                                  word
reque 0      16  2     8     qpsk  scrambl 0x152   no-dif 64      fixed
initi 5      34  0     48    qpsk  scrambl 0x152   no-dif 128     fixed
stati 5      34  0     48    qpsk  scrambl 0x152   no-dif 128     fixed
short 5      78  12    8     qpsk  scrambl 0x152   no-dif 72      short
long  8      220 0     8     qpsk  scrambl 0x152   no-dif 80      short
```

Figure 4-5 show cable modulation-profile Command Output

5. If a different modulation profile must be set for the upstream port, use the **cable upstream modulation-profile** command in Interface Configuration mode, as shown in the following example:

   `RDN(config-if)#`**cable upstream** <*port*> **modulation-profile** <*n*>

   where:

   port is the upstream port.

   n is the modulation profile number.

If a new upstream modulation profile needs to be created, refer to the *Configuring and Managing the BSR 64000* and *Configuring and Managing the BSR 1000* documents for more information.

6. If there is no problem with the selected modulation profile, determine the signal quality on the upstream port. To determine the upstream signal quality use the **show interfaces cable signal-quality** command in Interface Configuration mode, as shown in the following example:

```
RDN(config-if)#show interfaces cable <slot>/<interface>
signal-quality
```

where:

slot is the slot number of the DOCSIS module on the BSR 64000

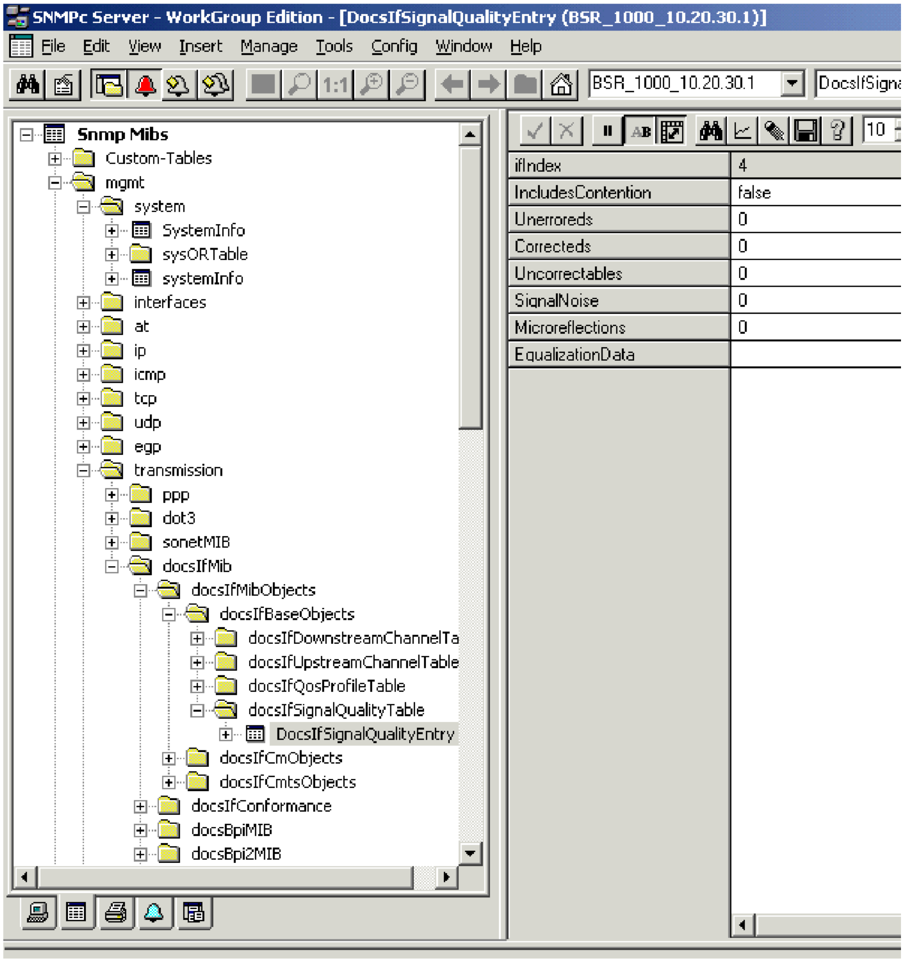
Note: The **show interfaces cable signal-quality** command is currently not available on BSR 1000.

interface is the cable interface number

Signal quality statistics for all the upstream interfaces (ports) displays.

7. To find the signal quality information for an upstream port on the BSR 1000, use a MIB browser to access the **DocsIfSignalQualityEntry** table by following the MIB tree path identified below and in Figure 4-6:

   Management -> Transmission -> DocsIfMib -> DocsIfMibObjects -> DocsIfBaseObjects -> DocsIfSignalQualityEntry



ifIndex	4
IncludesContention	false
Unerroreds	0
Correcteds	0
Uncorrectables	0
SignalNoise	0
Microreflections	0
EqualizationData	

Figure 4-6 DocsIfSignalQualityEntry Table

8. View the signal quality statistics for the upstream interface. If there is a high number of unerroreds (uncorrupted packets), the upstream signal-quality is good.

   Table 4-4 describes the signal quality statistics:

Table 4-4 Signal Quality Statistics

Field	Identification
correctables	Number of corrected error packets received through this upstream interface
ifIndex	Cable interface number
unerroreds	Number of unerrored packets on cable interface

9. If there is a large number of correctables there is a physical problem with the upstream signal. Use a spectrum analyzer to measure the signal to noise ratio for the upstream path. For 16 QAM and QPSK, the optimum signal-to-noise ratio is 33 dB or greater.

   The signal-to noise ratio learned from the spectrum analyzer may indicate the following conditions:

   - If there is under a 10 dB loss in signal quality, the cable interface has the ability to compensate by correcting packets.
   - If there is more than a 10 dB loss in signal quality, the signal is degraded to the point where it can no longer successfully carry data and the noise problem has to be manually troubleshooted and corrected.
   - A high number of correctables (corrected packets) and uncorrectables (uncorrected, dropped packets) occurs when the signal-to-noise ratio is around 25 dB for QAM 16 and QPSK. The problem has to be manually troubleshot and corrected. See if errors are incrementing from fixed points in time in a higher than normal way.
   - The number of micro reflections expressed in dB, can correlate to a high number of corrupted packets (erroreds) and fixed packets (correcteds), or can be attributed to burst errors.

If there needs to be manual intervention to correct the upstream signal-to-noise ratio, follow these steps to resolve a bad upstream signal-to-noise ratio:

1. Check for bad optical amplifiers in the HFC network.
2. Check for defective equipment in the HFC network.
3. Determine if there is a cable that is physically cracked or damaged in such a way to cause external ingress from a variety of sources is entering into the network.
4. Look for loose connections.
5. Study the HFC network topology and look for flaws that may be causing additional ingress noise.
6. If there is too much ingress noise detected, increase the interleave depth.To set the downstream port interleave depth, use the **cable downstream interleave-depth** command in Interface Configuration mode, as shown below.

   ```
   RDN(config-if)#cable downstream 0 interleave-depth {8 | 12 | 16 | 32 | 64 | 128}
   ```

   where:

   0 is the number of the downstream port.
7. If the cable plant is clean and the interleave depth is set too high, there may be too much latency on the downstream path causing CMs to experience slow performance. To decrease the interleave depth, use the **cable downstream interleave-depth** command in Interface Configuration mode.
8. Determine if there are too many nodes that are combined on an upstream port. Too much segmentation can affect the signal-to-noise ratio.
9. Check the individual nodes that are combined on an upstream port that is experiencing ingress problems. For example, there may be three nodes that have an acceptable signal-to-noise ratio, but the fourth node has a bad signal-to-noise ratio that is cascading into the other three nodes and causing poor performance on the upstream port.
10. Determine if impulse and electrical ingress noise is entering the network from electrical sources within a home, such as hair dryers, light switches, and thermostats; or from high-voltage lines that run near cabling in the network.

Too Many CPE Hosts on Subscriber CM

When too many Customer Premises Equipment (CPE) hosts, such as PCs, servers, and appliances are connected to a single subscriber's CM, that CM can use an excessive amount of network resources compared to other CMs on the HFC subnetwork.

Follow these steps to view the number of CPE hosts for a CM, and to limit that number:

1. To view the number of hosts connected to the CM, the maximum number of hosts allowed for the CM, and a list of all host CPE IP addresses behind the CM, use the **show cable modem** command in Privileged EXEC mode, as shown in the following example:

   `RDN#`**show cable modem** {<*MAC-address*> | <*ip-address*>} **hosts**

   where:

   MAC-address is the MAC level address of the CM.

   ip-address is the IP address of the CM.

2. If you determine that there are too many CPE hosts connected to the CM, use the **cable modem max-hosts** command in Privileged EXEC Mode, as shown in the following example, to specify the maximum number of hosts that can be attached to a CM on this interface. The valid range is from 0 to 16 CPEs. The default value is zero.

   `RDN#`**cable modem** {<*MAC-address*> | <*ip-address*>} **max-hosts** <*n*>

   where:

   MAC-address is the MAC level address of the CM

   ip-address is the IP level address of the CM

   n is the maximum number of CPE hosts for the CM

3. To verify the maximum number of hosts setting, use the **show cable modem hosts** command in Privileged EXEC mode.

Resolving Problems on the Upstream Path

When the upstream port fault LED is red, the upstream port is not operating and is not receiving data from the CM subnetwork.

Refer to the procedures in this section to troubleshoot an upstream port problem:

- Bad Upstream Signal-to-noise Ratio Detected
- Upstream Power Level Too Low or High

Bad Upstream Signal-to-noise Ratio Detected

If too much noise is detected on the upstream path a condition called *noise funneling* occurs. Noise funneling occurs when the cumulative upstream noise from anywhere on the HFC network becomes concentrated on the cable headend.

For example, the HFC branch and tree network architecture works in the following ways:

- Downstream: the trunk feeds the branches. As the signal propagates from the trunk, the signal weakens.
- Upstream: the branches feed the trunk. As the signal propagates from the branches, noise and ingress increase.

Follow these steps to troubleshoot ingress noise on the upstream path:

1. To determine the modulation profile number for an upstream port, use the **show cable upstream** command in Interface Configuration mode, as shown in the following example:

`RDN(config-if)#`**show cable** <*slot*>/<*interface*> **upstream** <*port*>

where:

slot is the slot number of the DOCSIS module on the BSR 64000 *interface* is the number of the cable interface

Note: The slot and interface number on the BSR 1000 are 0.

port is the number of the upstream port

2. To view the modulation profile for the upstream port to determine whether QAM 16 or QPSK modulation is used on the upstream interface, use the **show cable modulation-profile** command in Privileged EXEC mode as shown in the following example:

   ```
   RDN#show cable modulation-profile <n>
   ```

   where:

   n is the modulation profile number

3. View the **show cable modulation-profile** command output to determine whether the upstream modulation is 16 QAM or QPSK.

4. To determine the signal quality on the upstream port, use the **show interfaces cable signal-quality** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#show cable interface <slot>/<port> signal-quality
   ```

   where:

   slot is the slot number of the DOCSIS module on the BSR 64000

Note: The BSR 1000 uses the same syntax as the above command, however both the slot number and interface number are set to zero.

interface is the cable interface number

Signal quality statistics for all the upstream interfaces (ports) displays.

5. View the **show cable interface signal-quality** statistics for the specific upstream interface. If there is a high number of unerroreds (uncorrupted packets), the upstream signal-quality is good.

   Table 4-4 describes the **show cable interface signal-quality** statistics:

Table 4-5 show cable interface signal-quality Command Output Statistics

Field	Identification
correctables	Number of corrected error packets received through this upstream interface
ifIndex	Cable interface number
unerroreds	Number of unerrored packets on cable interface

6. If there is a large number of correctables there is a physical problem with the upstream signal. Use a spectrum analyzer to measure the signal to noise ratio for the upstream path. For 16 QAM and QPSK, the optimum signal-to-noise ratio is 33 dB or greater.

   The signal-to noise ratio learned from the spectrum analyzer may indicate the following conditions:

   - If the loss in signal quality is less than 10dB, the cable interface can compensate by correcting packets.
   - If the loss in signal quality is greater than 10 dB, the signal is degraded to the point where it can no longer carry data, and you must troubleshoot and correct the noise problem.
   - A high number of correctables (corrected packets) and uncorrectables (uncorrected, dropped packets) occurs when the signal-to-noise ratio is approximately 25 dB for QAM 16 and QPSK. You must manually troubleshoot and correct the problem. See if errors increment at a specific time at a higher than expected rate.
   - The number of micro reflections (expressed in dB) can signify a high number of corrupted packets (erroreds) and fixed packets (correcteds).

Follow these steps to manually resolve an upstream signal-to-noise ratio problem:

1. Inspect optical amplifiers in the HFC network to make sure they are working properly.
2. Make sure all HFC network equipment is working properly.
3. Inspect cables for damage.
4. Secure all cable connections.
5. Review the HFC network topology and identify any flaws that may cause additional ingress.
6. Determine if there are too many nodes on an upstream port. Too much segmentation can affect the signal-to-noise ratio.
7. Check the individual nodes on an upstream port that is experiencing ingress problems. For example, three nodes may have an acceptable signal-to-noise ratio, but the fourth node might have a bad signal-to-noise ratio that is cascading into the other three nodes and causing poor performance on the upstream port.
8. Determine if impulse and electrical ingress noise is entering the network from electrical sources within a home (such as hair dryers, light switches, and thermostats), or from high-voltage lines near network cabling.

Upstream Power Level Too Low or High

The cable interface controls CM output power levels to meet the desired upstream input power level. Input power level adjustments to an operational upstream port compensate for cable headend path loss between the optical receiver and the upstream RF port. This section describes how to troubleshoot physical problems that may affect power levels on the upstream channel.

This section also describes how to configure the upstream input power level when problems occur. The upstream input power level is configured in either an *absolute* or *relative* mode. If the upstream input power level is set in *relative* mode, the input power level changes when the upstream channel width is changed. If the upstream input power level is set to the *absolute* mode, the input power level does not change when the upstream channel width is changed. Defining the input power level in *absolute* mode could possibly cause upstream return lasers to clip on a completely populated upstream channel. Caution must be used when the input power level is increased in *absolute* mode because the CMs on the HFC network increase their transmit power level by 3 dB for every incremental upstream channel bandwidth change causing an increase in the total power on the upstream channel and possibly violating the upstream return laser design parameters.

Table 4-6 describes how the upstream channel bandwidth setting corresponds to the input power-level range and default power-level range for a specific upstream channel.

Table 4-6 Upstream Input Power Level Range Parameters

Channel Bandwidth	Default	Range
200 KHz	-1 dBmV	-16 to +14 dBmV
400 KHz	+2 dBmV	-13 to +17 dBmV
800 KHz	+5 dBmV	-10 to +20 dBmV
1.6 MHz	+8 dBmV	-7 to +23 dBmV
3.2 MHz	+11 dBmV	-4 to +26 dBmV

Follow these steps to troubleshoot upstream power-level problems:

1. Check all upstream passive equipment, such as combiners, couplers, and attenuators and cabling for flaws. The upstream signal may be weak because of low input power levels on a portion or portions of the upstream spectrum (5 to 42 MHz). This is known as a *frequency response* problem in the HFC network. The cause of a frequency response problem may be defective passive equipment, or damaged cable on the upstream path.

2. Verify that the path between the optical receiver and CMTS matches the design specification.

3. Inspect amplifiers if there is an attenuation problem on the upstream path. View CMs that proceed or follow an amplifier in the upstream path to isolate the defective amplifier and replace or repair it. Look for amplifier degradation. Improperly configured amplifiers can degrade digital data signals. The larger the network, the higher the possibility of amplifier noise affecting the signals.

4. Be aware of thermal sensitivity. Signal loss over coaxial cable is affected by temperature. This can cause variations of 6 to 10 dB per year.

5. Inspect the upstream physical cabling and passive equipment to be sure it is in good condition. If the problem persists, check the upstream input power-level configuration.

6. To adjust the upstream input power level in *relative* mode, use the **cable upstream power level default** command in Interface Configuration mode, as shown in the following example:

   `RDN(config-if)#`**cable upstream** <*n*> **power-level default** <*offset*>

   where:

   n is the number of the upstream port

   offset is the number of dB above or below the default input power level

7. To set the upstream input power level in *absolute* mode, use the **cable upstream power level** command in Interface Configuration mode, as shown in the following example:

   `RDN(config-if)#`**cable upstream** <*n*> **power-level** <*power*>

   where:

   n is the number of the upstream port

   power is the input power level expressed in dB

Resolving Problems on the Downstream Path

When the downstream port fault LED is red, the downstream port is not operating and is not sending data to the CM subnetwork.

Refer to the procedures in this section to troubleshoot a downstream port problem:

- Bad Downstream Signal-to-Noise Ratio Detected
- Downstream Power Level Too Low or High

Bad Downstream Signal-to-Noise Ratio Detected

Follow these steps to identify problems associated with a bad downstream signal-to-noise ratio:

1. To determine the type of Quadrature Amplitude Modulation (QAM) that is used on the downstream interface, use the **show cable downstream** command in Interface Configuration mode, as shown in the following example:

   `RDN(config-if)#`**show cable downstream** <*n*>

   where:

   n is the number of the downstream cable port.

2. View the qamMode field in the **show cable downstream** command output. The qamMode field displays whether the downstream modulation is 64 QAM or 256 QAM.

3. Isolate the CM on the network that is experiencing ingress problems, such as degraded performance or connection difficulties.

4. To get the CM MAC or IP address, use the **show cable modem** command in Privileged EXEC mode, as shown in the following example:

   `RDN(config-if)#`**show cable modem**

5. Use a spectrum analyzer to determine the downstream signal quality. For 256 QAM, the optimum signal-to-noise ratio is 33 dB or greater. For 64 QAM, the optimum signal-to-noise ratio is 25 dB or greater.

   The signal-to noise ratio learned from the spectrum analyzer may indicate the following conditions:

   - If the loss in signal quality is less than 10 dB, the cable interface can compensate by correcting packets.

   - If the loss in signal quality is greater than 10 dB, the signal is degraded to the point where it can no longer carry data, and you must troubleshoot and correct the noise problem.

- A high number of corrected packets and uncorrected, dropped packets occurs when the signal-to-noise ratio is approximately 25 dB for 256 QAM, and 20 dB for 64 QAM. You must manually troubleshoot and correct the problem. See if errors increment at a specific time at a higher than expected rate.
- The micro reflections number (expressed in dB) represents the amount of noise on the cable interface, and corresponds to a high number of corrupted packets (erroreds) and fixed packets (correcteds).

Follow these steps to manually resolve a downstream signal-to-noise ratio problem:

1. At the cable headend, make sure that the power levels of adjacent channels do not interfere with the downstream channel.
2. Inspect optical amplifiers in the HFC network to make sure they are working properly.
3. Make sure all HFC network equipment is working properly.
4. Inspect cables for damage.
5. Check for laser clipping on fiber-optic transmitters on the downstream path from the cable headend to the CMs. If the downstream power level is too high for the downstream path, laser clipping can occur. Laser clipping prevents the transmission of light, which can cause bit errors in downstream transmissions. If a laser is experiences excessive input power for even a fraction of a second, clipping can occur. Refer to the *Downstream Power Level Too Low or High* section for more troubleshooting information.
6. Secure all cable connections.
7. Review the HFC network topology to identify any flaws that may cause additional ingress.
8. Determine if impulse and electrical ingress noise is entering the network from electrical sources within a home (such as hair dryers, light switches, and thermostats) or from high-voltage lines near network cabling.

Downstream Power Level Too Low or High

Follow these steps to troubleshoot downstream power-level problems:

1. Check all downstream passive equipment (such as combiners, couplers, and attenuators) and cabling for flaws. The downstream signal may be weak because of a low power level on a portion of the downstream spectrum (88-860 MHz). This is known as a *frequency response* problem on the HFC network. The cause of a frequency response problem may be defective passive equipment, or damaged cable on the downstream path.

2. If the downstream physical cabling and passive equipment is in good condition and the problem persists, check the downstream input power-level configuration.

   To set the downstream power level to a value from 45 to 65 decibels per millivolt (dBmV), use the **cable downstream power-level** command, as shown below:

   ```
   RDN(config-if)#cable downstream <n> power-level {450-650}
   ```

   where:

   n is the number of the downstream cable port.

   450-650 is the downstream power level

Note: The downstream power level must be expressed in increments of ten.

   To return to the 55 dBmV default power-level setting, use the **no cable downstream power-level** command in Interface Configuration mode, as shown below:

   ```
   RDN(config-if)#no cable downstream <n> power-level {450-650}
   ```

   where *n* is the number of the downstream cable port.

3. Check for laser clipping on fiber-optic transmitters on the downstream path from the cable headend to the CMs. If the downstream power level is set too high for the downstream path, laser clipping can occur. Laser clipping prevents the transmission of light, which can cause high bit error rates on the downstream path.

4. Inspect amplifiers if there is an attenuation problem on the downstream path. View CMs that proceed or follow an amplifier in the downstream path to isolate the defective amplifier and replace or repair it. Look for amplifier degradation. Improperly configured amplifiers can degrade digital data signals. The larger the network, the higher the possibility of amplifier noise affecting the signals.

5. Be aware of thermal sensitivity: signal loss over coaxial cable is affected by temperature. This can cause variations of 6 to 10 dB per year. The downstream power level may need seasonal adjustment.

Resolving Cable Modem Problems

If CMs are not registering and cannot communicate with the cable interface, the problem may be one of the following:

- Misconfigured Authentication String or Key
- CM Does Not Reply to Station Maintenance Requests
- CM is Offline
- CM Cannot Obtain an IP Address
- Provisioning Problems Cause CMs Not to Register
- CM Does Not Respond to SNMP Messages

Misconfigured Authentication String or Key

All CMs must return a known authentication text string or key to register with the cable interface for network access. If the text string or key is improperly entered, the CMs cannot authenticate and register with the cable interface.

Follow these steps to re-enter the shared authentication text string or key so that the CMs can authenticate and register with the cable headend:

1. Ensure that the authentication string or hexadecimal key in the CM configuration file matches the authentication string or hexadecimal key configured on the CMTS. CMs cannot register with the CMTS if authentication parameters do not match.

2. To verify that CM authentication is deactivated, use the **show running-config** command in Privileged EXEC mode and view the cable interface configuration information. The output will show if CM authentication is deactivated.

   `RDN#`**show running-config**

3. To enter Interface Configuration mode from Global Configuration mode to configure the cable interface, use the **interface cable** command, as shown in the following example:

   `BSR64000(config)#`**interface cable** {<*slot number*>/<*interface number*>}

   where:

   slot number refers to the DOCSIS module slot number on the BSR 64000

   interface number refers to the cable interface

Note: The BSR 1000 uses the same syntax as the above command, however both the slot number and interface number are set to zero.

4. The default authentication parameters are enabled, but have a *null* value by default. Authentication parameters need to be set on the CMTS and the CMs to ensure security on the HFC network. To activate authentication on the CMTS so all CMs return a known text string to register with the CMTS for network access, use the **cable shared-secret** command in Interface Configuration mode, as shown in the following example:

Caution: Ensure that the authentication string or hexadecimal key in the CM configuration file matches the authentication string or hexadecimal key configured on the CMTS. CMs cannot register with the CMTS if authentication parameters do not match.

`RDN(config-if)#`**cable shared-secret** [*n*] [<**“***authentication string***”**> | <*0xkey*>]

where:

n is the number of the shared secret

"authentication string" is an alpha-numeric text string specified in double quotes

0xkey is a key specified in hexadecimal notation

5. To restore the default CM authentication, which is a null value, use the **no cable shared-secret** command in Interface Configuration mode, as shown in the following example:

   `BSR64000(config-if)#`**no cable shared-secret** [<*"authentication string"*> | <*hexidecimal key*>]

6. To verify that CM authentication is activated, use the **show running-config** command in Privileged EXEC mode and view the cable interface configuration information. If CM authentication is active, authentication information does not appear in the **show running-config** command output.

   `BSR64000#`**show running-config**

CM Does Not Reply to Station Maintenance Requests

If a CM does not reply to station maintenance requests after 16 retries, the cable interface assumes that it is offline. The cable interface marks the CM Service Identifier (SID) state offline, removes the SID from the ranging list and starts an aging timer to clear the SID if the CM does not come online within 24 hours.

Follow these steps to solve CM station maintenance registration problems:

1. To identify registration problems concerning CMs connected to the cable interface, use the **show cable modem** command in Privileged EXEC mode, as shown in the following example:

   `RDN#`**show cable modem**

2. To view the SID status of a CM that is marked offline by the cable interface, use the **show cable modem detail** command, as shown in the following example:

   `RDN#`**show cable modem detail** [<*mac-address*> | <*slot*>/<*interface*>] <*n*>

   where:

slot is the slot number of the DOCSIS module on the BSR 64000

Note: The BSR 1000 uses the same syntax as the above command, however both the slot number and interface number are set to zero.

interface is the number of the cable interface

n is the SID number for the CM

The SM Exhausted Count value in the command output refers to the number of times a CM was dropped because it did not reply to station maintenance requests.

The SM Aborted Count value in the command output refers to the number of times the CM was dropped because of unacceptable operating parameters. This can occur if the power level is outside the acceptable range, or the timing offset changes. The command output indicates the times when this occurs.

CM is Offline

If a CM is offline, it is disconnected from the network and unable to register.

Ping the CM to determine if the connection between the cable interface and the CM is online. A CM may appear to be offline if it does not have an IP address and is not registering; however, it may still be online. Pinging is necessary when the following symptoms occur:

- CM is unable to complete registration.
- CM has internal bugs.
- CM is unresponsive due to a crash.

The ping feature includes a real-time view and plot of requested power adjustments. It also measures the optimal headend reception power that allows the cable interface to solicit a configurable number of periodic ranging requests from a CM.

1. To ping a specific CM IP address or hostname to determine if the CM is online, use the **ping** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#ping {<ip-address> | <hostname>}
   ```

   where:

   ip-address is the IP address of the CM

   hostname is the DNS hostname of the CM

Note: You must use a IP address for the CM you are pinging. If you cannot ping the CM using its IP address, the CM is not registering.

2. If there is no IP level conectivity, but you suspect the CM has connectivity at the MAC layer, use the **ping docsis** command in to ping a specific CM at the MAC layer:

   ```
   RDN(config-if)#ping docsis [<mac-address> | <ip-address>]
   ```

Note: Be sure to use the correct MAC or IP address of the CM.

3. Determine if the CM is having registration problems by using the **debug cable reg** command in Interface Configuration mode, as shown in the following example:

   ```
   RDN#debug cable reg
   ```

4. To reset a specific CM by using its MAC address, use the **clear cable modem reset** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#clear cable modem [<MAC-address> | <ip-address>] reset
   ```

   where:

MAC-address is the MAC level address of the CM.

ip-address is the IP level address of the CM.

Note: It may take up to 30 seconds for the CM to respond and start the reset sequence.

5. If all CMs are unable to obtain an IP address, use the **clear cable modem all reset** command to remove all CMs from the station maintenance list and reset them:

```
RDN(config-if)#clear cable modem all reset
```

CM Cannot Obtain an IP Address

When a CM is unable to obtain an IP address it cannot successfully register and connect to the HFC network. Follow these steps to reset the CM:

1. To determine if a CM or several CMs are having registration problems, use the **debug cable reg** command in Interface Configuration mode, as shown in the following example:

```
RDN#debug cable reg
```

2. To force the CM to reset if the CM does not have an IP address, use the **clear cable modem** command in Privileged EXEC mode as shown in the following example:

```
RDN#clear cable modem <mac-address> reset
```

where:

mac-address is the MAC address of the CM

Note: It may take up to 30 seconds for the CMs to respond and start the reset sequence.

3. If the CM has an IP address and must be reset, use the **clear cable modem reset** command in Privileged EXEC mode as shown in the following example:

   ```
   RDN#clear cable modem <ip-address> reset
   ```

   where:

   ip-address is the IP address of the CM

4. If all CMs are unable to obtain an IP address, use the **clear cable modem all reset** command to remove all CMs from the station maintenance list and reset them:

   ```
   RDN(config-if)#clear cable modem all reset
   ```

5. If CMs still cannot obtain an IP address, there may be a problem with the DHCP server or the provisioning configuration. Ensure that the DHCP server is operational and configured correctly. Refer to Provisioning Problems Cause CMs Not to Register section for more information.

6. To verify that a particular CM obtained an IP address, enter the **show cable modem** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#show cable modem <mac-address>
   ```

   where:

   mac-address is the MAC address of the CM.

Provisioning Problems Cause CMs Not to Register

It is important to understand the basic communication process between the CM, cable interface on the BSR, and the DHCP server to troubleshoot provisioning problems.

The DHCP portion of the CM registration process works as follows:

1. The CM sends a broadcast discovery message to the DHCP server.
2. The DHCP server sends an offer message to the CM that identifies that the DHCP server is "alive," and presents connectivity information to the CM.
3. The CM sends a request message to use the information received in the offer message, and asks for options such as the default gateway, TFTP, configuraiton file, etc.
4. The DHCP server acknowledges the request, and provisions the CM with an IP address so that the CM can use TFTP to continue the registration process and returns options.

Follow these steps to identify CM registration problems associated with provisioning:

1. To review information about a CM attempting to register with the cable interface, use the **show cable modem** command in Privileged EXEC mode, as shown in the following example:

   `RDN#`**show cable modem** <*MAC address*>

2. View the Connectivity State column in the **show cable modem** command output.
3. Determine whether the cable interface is receiving a DHCP discover message from the CM. If the cable interface has received a DHCP discover message from the CM, a range complete message displays in the connectivity state column.
4. To show all DHCP traffic traversing the cable interface, use the **debug ip udp dhcp** command in Privileged EXEC mode, as shown in the following example:

   `RDN#`**debug ip udp dhcp**

5. If the cable interface is receiving a DHCP discover message from the CM, determine if the cable interface is forwarding DHCP discover messages to the DHCP server by checking if the DHCP sever is receiving DHCP discover packets and if it is sending DHCP offer packets to the CM.

   a. If the DHCP server is receiving DHCP discover messages from the CM, the DHCP server can reply by sending a DHCP offer. However, if the DHCP server is not receiving DHCP discover messages from the CM through the cable interface, the cable helper IP address may not be configured properly. Refer to Step 6 for more information.

   b. If the DHCP server is receiving DHCP discover messages from the CM, but is not sending DHCP offer messages, the DHCP server is misconfigured. Make sure that the DHCP is configured to service the subnet associated with the CM.

   c. If the CM receives a DHCP offer, the CM sends a DHCP request message to the DHCP server so that it can use the information received in the offer message. When the DHCP server acknowledges the request, it provisions the CM with an IP address so that the CM can use TFTP to continue the registration process. If the CM is able to obtain an IP address, but is unable to complete the registration process, make sure that the TFTP server IP address and CM configuration file name, including the full path from the TFTP root directory, are properly configured.

6. If there is no communication between the DHCP server and the cable interface, the CM does not have an IP address. Determine if DHCP parameters are set correctly on the cable interface. The **ip helper-address** command is used to disassemble a cable modem’s DHCP broadcast packet, and reassemble the DHCP broadcast packet into a unicast packet so that the packet can traverse through the router and communicate with the DHCP server.

   To configure the helper IP address for the cable modems (CMs) to forward only UDP broadcasts, use the **ip helper-address cable-modem** command in Interface Configuration mode, as shown in the following example:

   RDN(config-if)#**ip helper-address** <*ip-address*> **cable-modem**

   where:

   ip-address is the IP address of the destination DHCP server

7. If there is no communication between the TFTP server and the cable interface, the CM does not have an IP address. Determine if TFTP parameters are set correctly on the cable interface.

   To configure the helper IP address for the cable modems (CMs) to forward only UDP broadcasts, use the **cable helper-address cable-modem** command in Interface Configuration mode, as shown in the following example:

   ```
   RDN(config-if)#cable helper-address <ip-address> cable-modem
   ```

   where:

   ip-address is the IP address of the destination TFTP server

8. If CMs are registering successfully but there is no Customer Premises Equipment (CPE) connectivity, the helper IP address for the CPE must be configured. To set the helper IP address for the CPE behind a CM to forward only UDP broadcasts, use the **cable helper-address host** command in Interface Configuration mode, as shown in the following example:

   ```
   RDN(config-if)#cable helper-address <ip-address> host
   ```

   where:

   ip-address is the IP address of the destination TFTP server

9. If the DHCP server is operating correctly, but a CM remains unresponsive, reset the CM so that it can obtain a new IP address.

   To reset a CM, use the **clear cable modem reset** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#clear cable modem <mac-address> reset
   ```

   where:

   mac-address is the MAC address of the CM

Note: Be sure to correctly enter the CM MAC address in the command. It may take up to 30 seconds for the CM(s) to respond and start the reset sequence.

10. To reset all CMs so that they can obtain an IP address, use the **clear cable modem all reset** command in Privileged EXEC mode:

    ```
    RDN#clear cable modem all reset
    ```

11. If you have exhausted all the provisioning troubleshooting possibilities for CM registration problems, refer to other sections in this chapter for help on troubleshooting the upstream path from the CM to the cable interface.

CM Does Not Respond to SNMP Messages

Follow these steps to correct a CM that is not responding to SNMP messages:

1. To reset the CM so that it can respond to SNMP messages, use the **clear cable modem reset** command in Privileged EXEC mode:

    ```
    RDN#clear cable modem <MAC-address> reset
    ```

Note: Be sure to correctly enter the CM MAC address. It may take up to 30 seconds for the CM(s) to respond and start the reset sequence.

2. To reset all CMs so that they can respond to SNMP messages, use the **clear cable modem all reset** command in Privileged EXEC mode, as shown in the following example:

    ```
    RDN#clear cable modem all reset
    ```

3. To verify that the **clear cable modem all reset** command enabled CMs to respond to SNMP messages, enter the **show cable modem** command in Privileged EXEC mode.

4. Make sure that the community names for SNMP Version 1 and SNMP Version 2 and the user name for SNMP Version 3 are correct.

5

Troubleshooting TCP/IP

Introduction

This chapter provides troubleshooting solutions to some common TCP/IP internetwork problems:

- Resolving Host Connectivity Problems
- Handling Routing Problems
- Misconfigured Router
- Handling a Misconfigured Access List
- Access List and Filter Misconfigurations
- Handling UDP Broadcast Forwarding Problems
- Resolving PPP Link Over SONET Failures

Resolving Host Connectivity Problems

The following sections provide instructions for resolving local and remote host connectivity problems:

- Default Gateway Configuration Problems
- Misconfigured or Missing Default Routes
- Incomplete DNS Host Table
- DNS Not Running

Default Gateway Configuration Problems

If a local host cannot access a remote host, the default gateway might not be specified, or the default gateway could be incorrectly configured on local or remote host.

Note: This chapter presents host configuration solutions from a UNIX perspective. If you are working with a PC, consult the corresponding documentation to determine how to set the default gateway IP address.

Follow these steps to configure a default gateway for a local or remote host:

1. To determine whether the local and remote hosts have a default gateway, use the **netstat -rn** command at the UNIX prompt, as shown in the following example:

   ```
   unix-host% netstat -rn
   ```

   Check the output of this command for a default gateway specification.

2. If the default gateway specification is incorrect or not present, change or add a default gateway, as shown in the following example using the **route add default** command at the UNIX prompt on the local host:

   ```
   unix-host% route add default <ip-address> <n>
   ```

   where:

   ip-address is the IP address of the default gateway (the router local to the host).

   n indicates the number of hops to the specified gateway.

Note: You may need to reboot the host for this change to take effect.

3. You should specify a default gateway as part of the boot process. Specify the IP address of the gateway in the */etc/defaultrouter* UNIX host file. This filename might be different on your UNIX system.

Misconfigured or Missing Default Routes

Follow these steps to resolve misconfigured or missing default routes:

1. To view the host routing table (if the host is routed), use the **netstat -rn** command at the UNIX prompt, as shown in the following example:

   ```
   unix-host% netstat -rn
   ```

   The entry with the destination *default* denotes the default route.

2. The default route entry should specify the router that has the route to the remote host. If there is no default route entry, use the **route add default** command at the UNIX prompt to manually configure the default gateway:

   ```
   unix-host% route add default <ip-address> <n>
   ```

   where:

   > *ip-address* is the IP address of the default gateway (the router local to the host).
   >
   > *n* indicates the number of hops to the specified gateway.

Note: You may need to reboot the host for this change to take effect.

Incomplete DNS Host Table

If the Domain Name Server (DNS) receives a lookup request for a host name that is not in its cache, it cannot reply to the request, and the client cannot establish a connection.

Follow these steps to complete the DNS host table:

1. Enter the following **host** command at the UNIX prompt:

   ```
   unix-host% host <ip-address>
   ```

   where:

   > *ip-address* is the IP address of a server, router, or other network node.

2. If a `Host not found` message displays, but you can open the connection using the host’s IP address rather than its name, try connecting to other hosts using their names. If you can open connections to other hosts using their names, the host table might be incomplete. Add hostname-to-address mappings to the DNS cache for every host on the network.

3. If any connections cannot be opened using host names, the DNS might not be running. Refer to *DNS Not Running*, for more troubleshooting information.

DNS Not Running

If issuing the **host** command at the UNIX prompt returns a `Host not found` message, but you are able to open a connection using the host's IP address, the DNS might not be running. Consult the DNS software documentation or your system administrator for information on configuring and enabling the DNS.

Handling Routing Problems

The following sections describe how to re-enable a problem router and correct network router configuration problems that can occur after a new interface is added to a router:

- Problem Router
- Misconfigured Router
- Routing Interface Down

Problem Router

Follow these steps to enable a router that is having problems:

1. To isolate the problem router, use the **traceroute** command in Privileged EXEC mode, as shown in the following example:

   RDN#**traceroute** {<*hostname*> | <*ip-address*>}

   where *ip-address* is the destination IP address or host name on the command line.

   Table 5-1 describes the **traceroute** command output field descriptions:

Table 5-1 traceroute Command Output Field Descriptions

Field	Description
nn/msec	For each node, the round trip time in milliseconds for the specified number of probes.
*	The probe timed out.
?	Unknown packet type.

Table 5-1 traceroute Command Output Field Descriptions

Field	Description
Q	Source quench.
P	Protocol unreachable.
N	Network unreachable.
U	Port unreachable.
H	Host unreachable.

2. Once you isolate a problem router, determine whether routing is enabled on the BSR. To view the routing table, enter the **show ip route** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#show ip route
   ```

   Examine the command output to see whether the routing table is populated with routing information. If the command output displays no entries, the routing information is not being exchanged.

3. If the routing information is not being exchanged, a routing interface may not be configured.

4. To configure a routing interface, use the **interface ethernet** command, as shown in the following example:

   ```
   RDN(config)#interface ethernet 7/0
   ```

   where:

   7 is the SRM slot and **0** is the ethernet interface on the BSR 64000.

Note: The BSR 1000 uses the same syntax, however the ethernet slot and port are each set to zero.

5. To set the IP address and subnet mask for a routing interface, use the **ip address** command, as shown in the following example:

   ```
   RDN(config-if)#ip address 10.10.10.92 255.255.255.0
   ```

6. To enable the proper routing protocol on the router interface, use the **router** command in Global Configuration mode, as shown in the following example. The following example shows how to enable the RIP routing protocol on the router interface.

   ```
   RDN(config)#router rip
   ```

Note: The Autonomous System (AS) number needs to be entered when enabling BGP. The AS applies to BGP only.

7. To determine the network on which the routing protocol is running, use the **network** command, as shown in the following example. The following example shows how to enable the RIP routing protocol on the 10.10.10 network:

   ```
   RDN(config-rip)#network 10.10.10.0 255.255.255.0
   ```

8. Check if one or more networks need to be associated with the appropriate routing protocol. For example, to enable RIP routing for hosts 10.10.10.0 and 10.10.20.0, enter the following configuration commands:

   ```
   RDN(config)#router rip

   RDN(config-rip)#network 10.10.10.0 255.255.255.0

   RDN(config-rip)#network 10.10.20.0 255.255.255.0
   ```

Misconfigured Router

Follow these steps to resolve misconfigured or missing router command that can cause routes to be missing from routing tables:

1. To check routing tables on routers, use the **show ip route** command in Privileged EXEC mode.

2. Determine whether there are missing routes to specific networks that are known to be connected.

3. Reconfigure the identified missing routes so that they are associated to their designated network.

4. To view a specific router configuration, use the **show running-config** command in Privileged EXEC mode.

5. Try to ping another device that is on the same network that has a routing problem.

6. Make sure that there is a network router configuration command specified for the network to which the interface belongs. For example, if you assign the new interface IP address 10.10.10.0, enter the following commands to enable RIP on the interface:

   `RDN(config)#`**router rip**

   `RDN(config-rip)#`**network 10.10.10.5 255.255.255.0**

   Ensure that process IDs, addresses, and other variables are properly specified for the routing protocol you are using.

Routing Interface Down

Use the following steps to activate a routing interface:

1. Use the **show ip interfaces brief** command in Privileged EXEC mode to see whether the interface is *administratively down*, as shown in the following example:

   `RDN#`**show ip interfaces brief**

   Check the command output to determine if the Ethernet or POS interface is administratively down.

2. If the interface is *administratively down*, bring it up using the **no shutdown** command in Interface Configuration mode, as shown in the following example:

   `RDN(config)#`**interface** {<*interface*> | <*slot*>/<*interface number*>}

   where:

   interface is either identified as ethernet or POS.

   slot number refers to the POS, or SRM module slot number on the BSR 64000.

interface number refers to the ethernet or POS interface number.

Note: The BSR 1000 uses the same syntax as the above command, however the ethernet interface slot and interface number are set to zero.

```
RDN(config-if)#no shutdown
```

3. To discover if the router interface is enabled, use the **show ip interfaces brief** command in Privileged EXEC mode. If the interface is still down, there might be a hardware or media problem.

Handling a Misconfigured Access List

Access lists are used to filter IP packets so that certain IP packets are denied or permitted. Follow these steps to troubleshoot a misconfigured access list:

1. To determine whether IP packets are being sent and received and whether there are encapsulation problems, use the **debug ip packet** command in Privileged EXEC mode.

Caution: Debug commands can use considerable CPU resources on the router. Do not execute them if the network is already heavily congested.

2. If a router appears to be sending IP packets, but a connected router does not receive them, check the configuration of the connected router for access lists that might be filtering out packets.
3. To enter the router interface, use the **interface** command in Global Configuration mode, as shown in the following example:

```
RDN(config)#interface {<interface> | <slot>/<interface number>}
```

where:

interface is either identified as ethernet or POS.

slot number refers to the POS, or SRM module slot number on the BSR 64000.

interface number refers to the ethernet or POS interface number.

Note: The BSR 1000 uses the same syntax as the above command, however the ethernet interface slot and interface number are set to zero.

4. To disable all access lists enabled on the router, use the **no ip access-group access-list** command in Ethernet, Cable or POS Interface Configuration mode, as shown in the following example:

```
RDN(config-if)#no ip access-group <group number> access-list
[extended | standard] <list number>
```

where:

group number is the ip access group

extended or *standard* is selected for an access list

list number is the access list number

5. Execute the **debug ip packet** command to determine whether the router is receiving packets.

6. If the router is receiving packets an access list is probably filtering packets. To isolate the problem list, enable access lists one at a time until packets are no longer forwarded by using the **distribute-list** command in Router Configuration mode, as shown in the following example:

```
RDN(config)#router <protocol>
```

where *protocol* is the routing protocol used.

```
RDN(config-router)#distribute-list [extended | standard] | <list number>
```

where:

extended or *standard* is selected as the type of distribute list

list number is the access list number.

7. Check the access list to see whether it is filtering traffic from the source router. If it is, alter the access list to allow the traffic to pass. Enter explicit permit statements for traffic that you want the router to forward normally.

8. To enable the altered access list to see whether packets continue to pass normally, use the **ip access-group access-list** command in Router Configuration mode, as shown in the following example:

```
RDN(config-router)#ip access-group <group number> access-list <list
number>
```

where:

group number is the ip access group

list number is the access list number

9. If packets pass normally, perform steps 1 to 7 on any other routers in the path until all access lists are enabled and packets are forwarded properly.

Access List and Filter Misconfigurations

Application errors that drop host connections are frequently caused by misconfigured access lists or other filters.

Follow these steps to fix access lists or other filters:

1. Use the **show running-config** command in Privileged EXEC mode to check each router in the path. Discover if there are IP access lists configured on the BSR.

2. If IP access lists are enabled on the BSR, disable them using the appropriate commands. An access list may be filtering traffic from a TCP or UDP1 port. For example, to disable input access list 80, enter the following command in Router Interface configuration mode:

   ```
   RDN(config-if)#no ip access-group 80 in
   ```

3. After disabling all the access lists on the BSR, determine whether the application operates normally.

   If the application operates normally, an access list is probably blocking traffic.

4. To isolate the problem list, enable access lists one at a time until the application no longer functions. Check the problem access list to determine whether it is filtering traffic from any TCP or UDP ports.

5. If the access list denies specific TCP or UDP ports, make sure that it does not deny the port used by the application in question (such as TCP port 23 for Telnet).

6. Enter explicit permit statements for the ports the applications use. The following commands allow DNS and NTP2 requests and replies:

   ```
   RDN(config-if)#access-list <list number> permit udp 0.0.0.0
   255.255.255.255 0.0.0.0 255.255.255.255 eq 53
   ```

   ```
   RDN(config-if)#access-list <list number> permit udp 0.0.0.0
   255.255.255.255 0.0.0.0 255.255.255.255 eq 123
   ```

7. If you altered an access list, enable the list to see whether the application can still operate normally.
8. If the application operates normally, repeat the previous steps to isolate any other problem access lists until the application operates correctly with all access lists enabled.

Handling UDP Broadcast Forwarding Problems

The User Datagram Protocol (UDP) describes how messages reach application programs within a destination computer. The following sections describe how to solve problems that occur when forwarding BOOTP or other UDP broadcast packets. For example, if UDP broadcasts sent from network hosts are not forwarded by routers, or diskless workstations cannot boot.

- Missing or Misconfigured IP Helper-address Specification
- UDP Broadcast Misconfiguration

Missing or Misconfigured IP Helper-address Specification

1. Use the **debug ip udp** command in Privileged EXEC mode on the BSR that should be receiving packets from the host. Check the output of the command to see whether the BSR is receiving packets from the host.

Caution: The **debug ip udp** command can use considerable CPU resources on the BSR. Do not execute the command if the network is heavily congested. If the network is congested, attach a protocol analyzer to see whether the BSR is receiving UDP broadcasts from the host.

2. If the router receives packets from the host, there is a problem with the host or the application. Consult the host or application documentation.
3. If the router does not receive packets from the host, use the **show running-config** command in Privileged EXEC mode to check the configuration of the router interface that should first receive the packet from the host.

4. Look for an **ip helper-address** command entry for that router interface. Make sure that the specified address is correct (it should be the IP address of a server application such as a BOOTP server). If there is no command entry, no helper address is configured.

5. If there is no IP helper address configured, or if the wrong address is specified, add or change the helper address using the **ip helper-address** interface configuration command. For example, to configure the IP address 10.10.10.0 as the helper address on router Ethernet interface 0, enter the following commands:

   ```
   RDN(config)#interface ethernet <slot>/<interface number>
   ```

   where:

   slot number refers to the SRM module slot number on the BSR 64000.

   interface number refers to the ethernet interface number.

Note: The BSR 1000 uses the same syntax as the above command, however the ethernet interface slot and interface number are set to zero.

```
RDN(config-if)#ip helper-address 10.10.10.0
```

UDP Broadcast Misconfiguration

Specifying an IP helper address ensures that broadcasts from only a certain default set of UDP ports are forwarded. UDP broadcasts forwarded out other ports require further configuration.

1. For each applicable port, enter the **ip forward-protocol udp port** command in Global Configuration mode on the BSR. For example, to forward UDP broadcasts from port 200, enter the following command:

   ```
   RDN(config)#ip forward-protocol udp 200
   ```

2. To allow forwarding of all UDP broadcasts, enter the following command:

   ```
   RDN(config)#ip forward-protocol udp
   ```

Resolving PPP Link Over SONET Failures

This section discusses how to troubleshoot a problem Point to Point Protocol (PPP) link on the POS module.

Follow these steps to troubleshoot the PPP link:

1. To check the link state and running information about the PPP link, use the **show ip interface brief** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#show ip interface brief
   ```

2. To display the PPP packets that the Packet Over SONET (POS) module sends and receives, use the **debug ppp packet** command in Interface Configuration mode, as shown in the following example:

   ```
   RDN(config-if)#debug ppp packet
   ```

3. Review the **debug ppp packet** command output and identify the cause of the problem. To turn the PPP debugging function off, use the **no debug ppp packet** command.

   The **debug ppp packet** command output reveals if the PPP link is up or down and if low-level packet dumps are occurring.

4. If the PPP link is down, check for the following:

   - Network Control Protocols (NCPs) that are supported on either end of a PPP connection.
   - Loops that exist in the PPP internetwork.
   - Sections that are (or are not) properly negotiating PPP connections.

5. When there is no active link between local and remote devices, use the **debug ppp fsm** command in POS Interface Configuration mode.

   ```
   RDN(config-if)#debug ppp fsm
   ```

   The command output will show the network activity between the local and remote devices.

6. To determine if there is no network activity at the IP layer between the local and remote devices, use the **debug ppp ipcp** command in POS Interface Configuration mode, as shown in the following example:

   ```
   RDN(config-if)#debug ppp ipcp
   ```

7. If there are problems at the IP layer, such as a wrong routing configuration, use the **show ip route** command in Privileged EXEC mode to view the status of a route with the IP address of the destination device and its connection to the POS module. Also refer to the routing sections of this document for information on troubleshooting a specific route.

8. To determine if there is no network activity at the MAC layer between the local and remote devices, use the **debug ppp lcp** command in POS Interface Configuration mode.

   ```
   RDN(config-if)#debug ppp lcp
   ```

9. If there is a link, but no network activity, there might be a Cyclical Redundancy Check (CRC) level mismatch configuration on the local or remote device. For example, one device is set for 16 bit and the other for 32 bit. To match the correct CRC bit parameters, use the **crc** command in POS Interface Configuration mode:

   ```
   RDN(config-if)#crc [16 | 32 ]
   ```

Note: If the CRC level needs to be adjusted on the remote device, refer to the remote device’s documentation for information on changing this parameter.

10. To check if there are significant errors occurring on the other Synchronous Optical Network (SONET) device, use the **show controllers pos** command in POS Interface Configuration mode.

11. Look at the Active Defect field in the **show controllers pos** command output. An L-REI indicates high bit error rates from the transmitting (upstream) device.

12. To the check PPP link statistics, use the **show interface pos** command in Global Configuration mode, as shown in the following example.

`RDN(config)#`**show interface pos**

Determine if there is a high amount of errors occurring on the other SONET device.

13. Determine which configuration parameters need to be reconfigured to solve the packet error problems.
14. If you have examined all possible PPP link problems, and believe the problem is related to the SONET connection, refer to Chapter 9 for information on troubleshooting the SONET connection.

6

Troubleshooting RIP

Introduction

This chapter provides troubleshooting solutions to some common Routing Information Protocol (RIP) problems:

- Handling Routing Table Problems
- Handling RIP Version Inconsistencies

Handling Routing Table Problems

Problems that occur when hosts on one network cannot access hosts on another network may occur on an internetwork running only RIP.

The following sections provide instructions for resolving RIP routing table problems:

- Misconfigured or Missing Network Router Table Entries
- Misconfigured Route Filtering
- Split Horizon is Disabled

Misconfigured or Missing Network Router Table Entries

Follow these steps to resolve routes that are missing from the routing table:

1. To view the router configuration, use the **show running-config** command in Privileged EXEC mode.
2. Ensure that a **network** command is specified in Router Configuration mode for every network to which a router interface belongs.

   For example, enter the following commands to enable RIP on the interfaces:

   ```
   RDN(config)#router rip
   RDN(config-rip)#network 10.10.10.3 255.255.255.0
   RDN(config-rip)#network 10.10.20.3 255.255.255.0
   ```
3. Ensure the correct process IDs, addresses, and other variables are properly specified for the RIP routing protocol.

Misconfigured Route Filtering

If route filtering is misconfigured, it prevents a RIP router from receiving routing table updates or prevents a RIP router from transmitting routing table updates.

Follow these steps to discover and resolve misconfigured route filters:

1. Use the **show running-config** command to examine the suspect BSR.
2. See if any **distribute-list in** or **distribute-list out** command is configured in Router Configuration mode on the BSR.

   The **distribute-list in** command filters specific information in routing table updates received by a router. The **distribute-list out** command prevents a router from including specific information in routing table updates that it transmits. The information that is filtered is specified with an access list.
3. To redefine the distribute-list as *in* or *out* for a specific access list, use the **distribute-list** command in Router Configuration mode, as shown in the following example:

   `RDN(config)#`**router rip**

   where *protocol* is the routing protocol used.

   `RDN(config-`*router*`)#`**distribute-list** [*extended* | *standard*] | <*list number*> [*in* | *out*]

   where:

   extended or *standard* is selected as the type of distribute list

   list number is the access list number.

   in has an impact only on the traffic attempting to come into the router through the interface on which the access list is applied.

   - or -

   out has an impact only on the traffic attempting to leave the router through the interface on which the access list is applied.

Split Horizon is Disabled

If routing loops are occurring between neighboring RIP routers or the size of routing updates to routing tables are large, the problem may be that split horizon is disabled.

Follow these steps to enable split horizon:

1. To determine if split horizon is disabled, use the **show ip route** command in Privileged EXEC mode on the remote router.
2. View the `Split horizon is enabled` message in the **show ip route** command output.
3. If split horizon is not enabled, enter the **ip split-horizon** command in Router Interface Configuration mode on the remote router interface. For example, to enable split horizon on ethernet interface 0, enter the following commands:

```
RDN(config)#interface ethernet 0

RDN(config-if)#ip split-horizon
```

Note: The default split-horizon setting for all interfaces is enabled.

Handling RIP Version Inconsistencies

The following sections provide instructions for resolving inconsistent versions of RIP running between two RIP routers:

- Misconfigured Version of RIP Running on BSR
- Misconfigured Version of RIP Running on Specified Interface

Misconfigured Version of RIP Running on BSR

If the BSR is configured *globally* with the wrong version of RIP, remote RIP interfaces discard received RIP packets or do not receive RIP packets.

Follow these steps to ensure that the correct version of RIP is running on the BSR:

1. To determine which version of RIP is configured on the BSR, use the **debug ip rip** command in RIP Configuration mode, as shown in the following example:

   ```
   RDN(config-rip)#debug ip rip
   ```

2. Review the **debug ip rip** command output and identify the cause of the problem. Use **no debug ip rip** to turn off debugging.

3. If the wrong version of RIP is configured for receiving RIP packets, use the **ip rip receive version** command in RIP Configuration mode, as shown in the following example:

   ```
   RDN(config-rip)#ip rip receive version <option>
   ```

   where:

   option is the for the version or versions of RIP that are accepted over the interface.

   Table 6-1 lists the available command options:

Table 6-1 ip rip receive version Command Options

Option	Description
0	The BSR can receive RIP version 1 and 2 packets.
1	The BSR can receive only RIP version 1 packets.
2	The BSR can receive only RIP version 2 packets.

4. If the wrong version of RIP is configured for sending RIP packets, use the **ip rip send version** command in RIP Configuration mode, as shown in the following example:

   ```
   RDN(config-rip)#ip rip send version <option>
   ```

   where:

   option is the for the version or versions of RIP that are accepted over the interface.

Table 6-2 lists the available command options.

Table 6-2 ip rip send version Command Options

Option	Description
0	The BSR can send RIP version 1 and 2 packets.
1	The BSR can send only RIP version 1 packets.
2	The BSR can send only RIP version 2 packets.

5. To verify that the correct version of RIP is configured on the BSR, use the **show running-config** command in Privileged EXEC mode.

Misconfigured Version of RIP Running on Specified Interface

If a specific interface on the BSR is configured with the wrong version of RIP, follow these steps to run the correct version of RIP on the interface:

1. To determine which version of RIP is configured on the BSR, use the **debug ip rip** command in RIP Configuration mode, as shown in the following example:

   ```
   RDN(config-rip)#debug ip rip
   ```

2. Review the **debug ip rip** command output and identify the cause of the problem. Use the **no debug ip rip** command to turn off debugging.
3. Access the interface on which the wrong version of RIP is configured for receiving RIP packets. For example, use the **interface ethernet** command in Global Configuration mode to access the Ethernet port on the SRM, as shown in the following example:

   ```
   RDN(config)#interface ethernet <slot>/<port>
   ```

   where:

   slot number refers to the SRM module slot number on the BSR 64000.

interface number refers to the ethernet interface number.

Note: The BSR 1000 uses the same syntax as the above command, however the ethernet interface slot and interface number are set to zero.

4. To change the version of RIP received over the specified interface, use the **ip rip receive version** command in Interface Configuration mode, as shown in the following example:

```
RDN(config-if)#ip rip receive version <option>
```

Table 6-3 lists the available command options.

Table 6-3 IP RIP Receive Version Command Options

Option	Description
0	The specified interface can receive RIP version 1 and 2 packets.
1	The specified interface can receive only RIP version 1 packets.
2	The specified interface can receive only RIP version 2 packets.

5. To change the version of RIP sent over the specified interface, use the **ip rip send version** command in Interface Configuration mode, as shown in the following example:

```
RDN(config-if)#ip rip send version <option>
```

where:

option is the for the version or versions of RIP that are accepted over the interface.

Table 6-4 lists the available command options.

Table 6-4 ip rip send version Command Options

Option	Description
0	The specified interface can send RIP version 1 and 2 packets.
1	The specified interface can send only RIP version 1 packets.
2	The specified interface can send only RIP version 2 packets.

6. To verify that the correct version of RIP is configured on the specified interface, use the **show running-config** command in Privileged EXEC mode.

7

Troubleshooting OSPF

Introduction

This chapter provides troubleshooting solutions to some common Open Shortest Path First (OSPF) routing protocol problems:

- Handling OSPF-designated Interface Problems
- Handling Router Neighbor Misconfigurations
- Resolving Missing Routes in Routing Table

Handling OSPF-designated Interface Problems

OSPF uses an IP address on the BSR as its router ID. Therefore, to configure the OSPF protocol on the BSR, at least one active interface needs to be configured with an IP address.

1. To discover if there is no active OSPF interface with an IP address, use the **router ospf** command in Global Configuration mode, as shown in the following example:

   ```
   RDN(config)#router ospf
   ```

   The BSR returns the following error:

   ```
   RDN(config)#OSPF: Could not allocate router id
   ```

2. To ensure that a router interface is configured with an IP address and is enabled, use the **show ip interfaces** command in Privileged EXEC mode.

3. If there is no active interface with an IP address, configure an interface with the **ip address** command in Router Configuration mode. If necessary, use the **no shutdown** command in Router Configuration mode to activate an interface.

   For example, to enter Router Configuration mode from Global Configuration mode, assign an IP address to ethernet 7/0, and perform a **no shutdown** command on the interface, enter the following commands:

   ```
   RDN(config)#interface ethernet 7/0
   RDN(config-if)#ip address 10.1.1.5 255.255.255.252
   RDN(config-if)#no shutdown
   ```

Handling Router Neighbor Misconfigurations

The following sections explain why OSPF routers may not exchange information to establish neighbor relationships:

- Misconfigured Router
- Mismatched OSPF Parameters

Misconfigured Router

Follow these steps to resolve a misconfigured or missing network router command:

1. Use the **show ip ospf interfaces** command in Privileged EXEC mode to determine which interfaces have OSPF enabled.

2. If the output displays an interface that should be running OSPF, but is not, use the **show running-config** command in Privileged EXEC mode to view the router configuration.

3. Make sure that network router configuration commands are specified for each interface on which OSPF should run. For example, if the IP address of Ethernet interface 0 is 100.148.22.2 with a subnet mask of 255.255.255.0, enter the following commands to enable OSPF on the interface:

```
RDN(config)#router ospf
```

```
RDN(config-ospf)#network 100.148.22.0.0.0.0.255 area 0
```

4. Ensure the proper addresses, wildcard masks, and other variables are properly specified. To configure an OSPF routing process, use the **router ospf** command in Global Configuration mode, as shown in the following example:

```
RDN(config)#router ospf
```

Note: There is no relation between OSPF wildcard masks (used in OSPF network commands) and the subnet mask configured as part of an interface IP address.

5. Check other OSPF routers on the network by repeating steps 1 to 4. Make sure that OSPF is configured properly on all neighboring routers so that neighbor relationships can be established.

Mismatched OSPF Parameters

The Hello or dead timers, E-bits (set for stub areas), N-bits that are set for Not-So-Stubby Areas (NSSAs), area IDs, authentication types, or network mask parameters may be mismatched. The values set for these parameters (except for N-bits) should all be the same throughout an OSPF area, and, in some cases, the entire OSPF network.

Follow these steps to set consistent parameters for the OSPF network:

1. To identify the OSPF neighbors of each router, use the **show ip ospf neighbor** command in Privileged EXEC mode.
2. If the output does not list an expected neighbor, use the **show ip ospf interface** command in Privileged EXEC mode on the router and its expected neighbor, as shown in the following example:

   ```
   RDN#show ip ospf interface
   ```

   Examine the Hello and dead timer interval values configured on OSPF interfaces.
3. Compare the values configured for the timers on each router. If there is a mismatch, reconfigure the timer values so that they are the same on the router and its neighbor.

   For example, to change the Hello timer interval to 5 on Ethernet interface 0, enter the following commands:

   ```
   RDN(config)#interface ethernet <n>
   ```

   where:

   n is the number of the ethernet interface.

   ```
   RDN(config-if)#ip ospf hello-interval <seconds>
   ```

   The **ospf hello-interval** value must be the same for all nodes on a specific network. The default **ospf hello-interval** is 10 seconds.

4. Use the **debug ip ospf adj** command in Privileged EXEC mode. Check the output for mismatched values, as shown in the following example:

   ```
   RDN#debug ip ospf adj
   ```

5. If mismatches are indicated in the debug output, try to resolve the mismatch.
6. Ensure that all routers in an area have the same area ID and authentication type, and are configured as stub routers.

Mismatched IP MTU

This section describes what to do if the OSPF router rejects packets with a Maximum Transmission Unit (MTU) size that exceeds the configured IP MTU of the neighboring or adjacent OSPF interface.

Follow these steps to align IP MTU sizes between OSPF routers:

1. To determine the mismatched IP MTU size problem with the adjacent OSPF router, use the **debug ip ospf adj** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#debug ip ospf adj
   ```

2. Look in the **debug ip ospf adj** command output for a message similar to the following example, which identifies that the neighboring OSPF router has a larger MTU than the local OSPF router:

   ```
   OSPF: Nbr 102.2.2.2 has larger interface MTU
   ```

3. To get the MTU value for the local OSPF router, use the **show ip interface** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#show ip interface
   ```

4. Look in the **show ip interface** command output for a message for a specific interface that is similar to the one in the following example:

```
ethernet 7/0 is up, line protocol is up
  Internet address is 10.10.20.143/16
  Broadcast address is 255.255.255.255
  MTU 1500 bytes
  Directed broadcast forwarding is disabled
  Outgoing access list is not set
  Inbound  access list is not set
  Outgoing qos list is not set
  Proxy ARP is disabled
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachables are always sent
  ICMP mask replies are always sent
  Router Discovery is disabled
```

5. To adjust the MTU size on the neighboring OSPF router to match the local MTU size, Telnet into the neighboring OSPF router (which would be 102.2.2.2 using the example in step 2).

6. On the OSPF interface on the neighboring OSPF router, configure the MTU size to match the MTU size of the local OSPF router, as shown in the following example:

```
router(config-if)#ip mtu 1500
```

7. To verify that the MTU size matches on both OSPF router interfaces, use the **debug ip ospf adj** command in Privileged EXEC mode.

Resolving Missing Routes in Routing Table

When OSPF routes and networks are not advertised to other routers, routers in one area do not receive routing information for other areas. Some hosts cannot communicate with hosts in other areas, and routing table information is incomplete.

The following sections describe how to resolve missing OSPF routes in a routing table:

- RIP Routing Information Incorrectly Redistributed into OSPF
- ABR Configured Without Area 0 Interface

RIP Routing Information Incorrectly Redistributed into OSPF

Follow these steps to redistribute RIP routing information into OSPF:

1. To check the router configuration, use the **show running-config** command in Privileged EXEC mode.
2. Look for a **redistribute** command entry that was made in Router Configuration mode. Ensure that redistribution is configured and that the **subnets** keyword is used with the command. The **subnets** keyword must be included when RIP is redistributed into OSPF. If RIP is not redistributed into OSPF, only major routes (not subnet routes) are redistributed.
3. If the **redistribute** command is not present, or if the **subnets** keyword is not specified, add or change the configuration using the following commands:

   ```
   RDN(config)#router ospf
   ```

   ```
   RDN(config-ospf)#redistribute rip subnets
   ```

ABR Configured Without Area 0 Interface

If there are two or more OSPF networks, both should be configured with a different area ID, and at least one OSPF network must have an area ID of 0.

Follow these steps to configure an OSPF Area Border Router (ABR) with an Area 0 interface:

1. To verify that at least one ABR exists for the area, use the **show running-config** command in Privileged EXEC mode on OSPF routers. ABRs must belong to area 0, which is the OSPF backbone and one other area. Look for network statements that indicate that the router is part of area 0.

Note: Ensure that at least one OSPF network is defined as area 0.

2. To define the interfaces on which OSPF runs and to define the area ID for those interfaces, use the **network area** command in Router Configuration mode, as shown in the following example:

```
RDN(config)#router ospf
```

```
RDN(config-ospf)#router ospf network <address><wildcard-mask> area <area-id>
```

Table 7-1 describes the command options that are available for the **network area** command:

Table 7-1 router ospf network area Command Options

Command Option	Description
address	IP address of the OSPF interface.
wildcard-mask	IP-address-type mask that includes *don’t care* bits.
area-id	Area that is associated with the OSPF address range. It can be specified as either a decimal value or as an IP address. If you intend to associate areas with IP subnets, you can specify a subnet address as the area-id.

3. To configure an ABR if one does not exist in an area, use the **network** command in Router Configuration mode. For example, to configure OSPF router 100 to participate in the OSPF backbone area, follow these commands:

```
RDN(config)#router ospf
```

```
RDN(config-ospf)#network 10.10.3.7 0.0.0.255 area 0
```

8

Troubleshooting BGP

Introduction

This chapter provides troubleshooting solutions to some common Border Gateway Protocol (BGP) routing protocol problems:

- Handling BGP Routing Problems
- Handling BGP Peer Misconfigurations

Handling BGP Routing Problems

Follow these sections to correct BGP routes missing from the routing table so that the BGP router and network are advertised to other routers.

Missing Neighbor Table Entry

Follow these steps to add entries to the BGP neighbor routing table:

1. Check local and remote routers and ensure the specified autonomous system numbers and neighbors are correct.

2. Configure any autonomous system numbers and neighbors that are misconfigured or missing. For example, to specify that a router at the address 10.10.1.2 is a neighbor in autonomous system number 100, use the following series of commands, as shown below.

   ```
   RDN(config)#router bgp

   RDN(config-bgp)#network 10.10.0.0

   RDN(config-bgp)#neighbor 10.10.1.2 remote-as 100
   ```

3. To ensure any enabled route filters are not misconfigured, use the **show running-config** command in Privileged EXEC mode.

Misconfigured Access List

Follow these steps to resolve access list configuration problems:

1. Use the **show access-list** command in Privileged EXEC mode on suspect routers to determine if there are access lists configured and enabled on the router.
2. If there are access lists enabled on the router, disable them using the appropriate commands. For example, to disable input access list 10, follow this command:

   ```
   RDN(config)#no ip access-group 10 in
   ```

3. After disabling all access lists on the router, determine whether the missing routing information now appears in routing tables.
4. If the information appears, it is likely that an access list is filtering traffic. To isolate the problem access list, enable access lists one at a time until the routing information no longer appears in the routing table.
5. Check the access list to see whether it is filtering traffic from specific TCP ports. If an access list denies specific TCP ports, make sure that it does not deny TCP port 179, the port BGP uses. For example, enter an explicit permit statement for port 179 to ensure that BGP traffic is forwarded normally.

   ```
   RDN(config)#ip access-list 101 permit tcp 0.0.0.0 255.255.255.255 0.0.0.0
   255.255.255.255 eq 179
   ```

6. If you altered an access list, enable the list to see whether routing information can still pass normally.
7. If routing information is no longer missing, repeat steps 1 to 6 on any other routers in the path until all access lists are enabled and routing information appears in the appropriate routing tables.

Missing Network Destination Advertisement

When BGP routers do not advertise routes, routing updates from those routers do not contain information about certain network destinations that should be advertised.

Follow these steps to solve BGP advertising routing problems:

1. To view the router configuration, use the **show running-config** command in Privileged EXEC mode.
2. Ensure that the **network** command entered in Router Configuration mode is specified for every network that the BGP router should advertise (these networks need not be directly connected). For example, if the BGP router needs to advertise networks 10.168.52.0 and 10.168.0.0, enter the following commands to have the router include those networks in its routing updates, as shown in the series of commands below:

   ```
   RDN(config)#router bgp

   RDN(config-bgp)#network 10.168.52.0

   RDN(config-bgp)#network 10.168.0.0
   ```

Handling BGP Peer Misconfigurations

Follow these steps to find and resolve a misconfigured or missing configuration for BGP peers:

1. To verify that all the required BGP peers are configured with the correct IP addresses and AS numbers, use the **show ip bgp neighbors** command in Privileged EXEC mode, as shown in the following example:

   ```
   RDN#show ip bgp neighbors
   ```

2. If some BGP peer routers are misconfigured or are not configured, configure them with the proper IP addresses and AS numbers.

   To add an entry to the BGP neighbor table, use the **neighbor remote-as** command in Router Interface Configuration mode, as shown in the following example. The BGP neighbor table identifies a router as a BGP peer and maps its IP address to a specific AS.

RDN(config-bgp)#**neighbor**{*ip-address* | *peer-group-name*} **remote-as** *number*

where:

ip-address is the IP address of the neighbor

peer-group-name is the name of the BGP peer group

number is the AS to which the neighbor belongs

3. To associate a textual description of up to 80 characters with a BGP neighbor, use the **neighbor description** command in Router Interface Configuration mode, as shown in the following example:

RDN(config-bgp)#**neighbor** {*ip-address* | *peer-group-name*} description *text*

where:

ip-address is the IP address of the neighbor

peer-group-name is the name of the BGP peer group

text is up to 80 characters of text that describes the neighbor

For example, the following commands configure Routers Miami with Routers Chicago, Boston, and NY as neighbors:

```
RDN(config-bgp)#router bgp 100
RDN(config-bgp)##neighbor 172.30.20.2 remote-as 100
RDN(config-bgp)#neighbor 172.30.20.2 description peer NY
RDN(config-bgp)#neighbor 172.40.20.2 remote-as 100
RDN(config-bgp)#neighbor 172.40.20.2 description peer Chicago
RDN(config-bgp)#neighbor 192.50.30.2 remote-as 300
RDN(config-bgp)#neighbor 192.50.30.2 description peer Boston
RDN(config-bgp)#network 120.20.0.0
```

4. To verify that BGP peer routers have been established and are functioning correctly, use the **show ip bgp summary** command in Privileged EXEC mode, as shown in the following example:

RDN#**show ip bgp summary**

5. To view route entries in the BGP table after the BGP peer sessions are established, use the **show ip bgp** command in Privileged EXEC mode, as shown in the following example:

RDN#**show ip bgp**

6. To view route entries in the route table (also known as the forwarding table), use the **show ip route** command in Privileged EXEC mode, as shown in the following example:

   `RDN#`**show ip route**

7. If you suspect that the local BGP router is not receiving some routes, use the **show running-config** command in Privileged EXEC mode, as shown in the following example:

   `RDN#`**show running-config**

8. View the BGP portion of the **show running-config** command output to determine if any route-maps, access-lists, distribute-lists, AS-path-access-lists, and/or community-access-lists are applied. If they are applied, confirm that they are configured correctly.

9. Verify that a suspect remote BGP peer router is sending the route-maps, access-lists, distribute-lists, AS-path-access-lists, and/or community-access-lists to the local BGP router.

10. If there are routes in the local BGP router table that do not display in a peer router BGP table, use the **show ip bgp** command in Privileged EXEC mode, as shown in the following example to view the list of BGP peers to which the local router sends routes.

    `RDN#`**show ip bgp** <*prefix*> [<*mask*>]

11. If the suspect peer BGP router is absent from the list, verify the **route-map**, **access-list**, **distribute-list**, **AS-path-access-list**, and **community-access-list** parameters that belong to the suspect peer BGP router to ensure that it is configured correctly.

9

Troubleshooting SONET

Introduction

This chapter describes how to troubleshoot the Packet Over SONET (POS) access module. When SONET network problems occur, the major failure conditions and their associated alarm indicators occur.

The next sections describe how to respond to the following:

- Resolving Fault LED Issues
- Failed POS Module
- Handling Data Loss on SONET Link

Resolving Fault LED Issues

If the SONET port fault LED on the POS module is red, the port is not operational and a loss of signal (LOS), loss of frame (LOF), and or loss of pointer (LOP) condition exists.

LOS Determination

When a LOS condition occurs, follow these steps to resolve the LOS condition on a POS module port:

1. Locate the SONET termination equipment.
2. To view the status of the SONET link, use the **show controllers pos** command in Privileged EXEC mode, as shown in the following example:

   `BSR64000#`**show controllers pos** <*slot/port*>

   If the SONET link is down, the message `pos <slot>/<port> is down` appears.
3. View the Active Alarm field in the **show controllers pos** command output to determine if there is an LOS failure on the POS module port.

4. If LEDs on the POS module are green but you suspect that the module is has transmission problems on a port (causing an LOS on the other SONET device receive port), check for a Line Alarm Indication Signal (L-AIS) or Line Remote Defect (Degrade) Indication (L-RDI) failure. To do so, view the Active Defect field in the **show controllers pos** command output. An L-AIS and L-RDI failure is generated by the other SONET device and sent out its transmit port when a failure is detected on its receive port. An L-RDI can indicate an LOS failure condition.

   If there is no L-AIS ar L-RDI alarm, the problem may be with the other SONET device.

5. Check for an L-RDI failure. To do so, view the Active Defect field in the **show controllers pos** command output. An L-RDI failure is generated by the SONET device and sent out its transmit port when a failure is detected on its receive port. An L-RDI may indicate an LOS failure condition.

LOS Resolution

Follow these steps to resolve an LOS condition once the cause or problem area is isolated:

1. Ensure that the fiber optic cable is properly connected throughout the line between the receive port on the local POS module, regenerators, and the transmit port on the remote SONET device.
2. If the optic cable is properly connected, check the fiber cabling for damage or improper use. For example, SONET cables may be turned beyond their bending radius.
3. Check for signal degradation.
4. Check fiber optic connectors for damage.
5. Ensure the fiber optic connectors are clean.

   An LOS condition is cleared when a light source is present on the input.

LOF Determination

The SONET port may not operate if a Loss of Frame (LOF) condition occurs. LOF conditions occur when there is no valid framing pattern for 3 milliseconds.

When a LOF condition on a POS module port occurs, follow these steps to determine the LOF condition:

1. Locate the SONET termination equipment.
2. To view the status of the SONET link, use the **show controllers** command in Privileged EXEC mode, as shown in the following example:

   `BSR64000#`**show controllers pos** <*slot/port*>

   If the SONET link is down, the message `pos <slot>/<port> is down` appears.
3. View the Active Alarm field in the **show controllers pos** command output to determine if there is an LOF failure on the POS module port.
4. If LEDs on the POS module are green but you suspect that the module has transmission problems on a port (causing an LOF on the other SONET device's receive port), check if a L-AIS or L-RDI failure has occurred. To do so, view the Active Defect field in the **show controllers pos** command output. An L-AIS and L-RDI failure is generated by the other SONET device and sent out its transmit port when a failure is detected on its receive port. An L-RDI can indicate an LOF failure condition.

   If there is no L-AIS or L-RDI alarm, the problem may be isolated to the other SONET device.

LOF Resolution

Follow these steps to resolve an LOF condition once the cause or problem area is isolated:

1. Ensure that the clock source on one terminal device is external or *line* and that the other clock source on the other terminal device is *internal*.
2. Ensure that both terminal devices are operating at the same data rate; for example, OC3 or OC12.

3. Check for signal degradation.
4. Check fiber optic connectors are broken or unclean.
5. Check the fiber cabling for damage or improper use. For example, SONET cables may be turned beyond their bending radius.

LOP Determination

The SONET port may not be operational because there is a Loss of Pointer (LOP) condition that occurs when there is the absence of valid H1/H2 pointer bytes for eight, nine, or ten consecutive frames.

When a LOP condition occurs on a POS module, follow these steps to isolate the condition:

1. Locate the SONET termination equipment.
2. To display information about a POS module port failure, use the **show controllers pos** command in Privileged EXEC mode, as shown in the following example:

   `BSR64000#`**show controllers pos** <*slot*>/<*port*>

   where:

   slot is the POS module slot on the BSR 64000

   port is the POS interface.
3. View the Active Alarm field in the **show controllers pos** command output to determine if there is a LOP failure.
4. If LEDs on the POS module are green but you suspect that the module has transmission problems on a port (causing a LOP on the other SONET device's receive port), check if a L-AIS or L-RDI failure has occurred. To do so, view the Active Defect field in the **show controllers pos** command output. An L-AIS and L-RDI failure is generated by the other SONET device and sent out its transmit port when a failure is detected on its receive port. An L-RDI can indicate a LOP failure condition.
5. If there is no L-AIS or L-RDI alarm, the problem may be with the other SONET device.

6. Check for a Path Remote Error Indication (P-REI) failure by viewing the Active Defect field in the **show controllers pos** command output. A P-REI failure is generated by the SONET device and sent out its transmit port when a failure is detected on its receive port. A P-REI indicates a LOP failure condition, and indicates high bit error rates coming from the transmitting (upstream) device. Refer to the section *Handling Data Loss on SONET Link* for more information.

LOP Resolution

Follow these steps to resolve an LOP condition once you have isolated the cause or problem area:

1. Check the fiber cabling for damage or improper use. For example, SONET cables may be turned beyond their bending radius.
2. Ensure that both SONET terminal devices are operating at the same data rate. For example, ensure that the SONET terminal devices are operating at either an OC3 or OC12 data rate.
3. Check for signal degradation.
4. Check fiber optic connectors for damage, and make sure they are clean.

Failed POS Module

A red fail LED indicates a POS module failure.

Perform one or more of the following tasks to try to re-enable the POS module:

1. Ensure that the POS module is firmly seated in the chassis.
2. Reinsert the POS module.
3. Replace the POS module.
4. Insert the POS module in another slot.

Fail LED Blinks and Lights Repeatedly

Follow these steps to resolve the POS module failure:

1. Check for bent pins on the backplane.
2. If there are no bent pins, replace the POS module with a new POS module, or try inserting the POS module in a different slot.

   If the POS module works in a different slot, the BSR 64000 backplane may be defectivel

Handling Data Loss on SONET Link

Data loss can occur on a section, line, or path of a SONET link:

- A *section* may be between Customer Premises Equipment (CPE) and SONET Service Provider Equipment (SPE).
- A *line* may be between a SONET SPE, regenerators and another SONET SPE.
- A *path* may be between a CPE, SONET SPE, regenerators and another SONET SPE and CPE.

Data Loss Determination

Follow these steps to determine where data loss is occurring over the SONET link, and to resolve problems with a specific section, line, or path:

1. Locate the SONET termination equipment.
2. Check the LEDs on each device. A red port LED on either device indicates a Fault condition. Refer to the *Resolving Fault LED Issues* section of this chapter for more information. If the LEDs on both SONET devices are green, and packet loss is detected between the SONET terminating equipment, continue troubleshooting the problem.
3. The B1 (bit 1), B2 (bit 2), and B3 (bit 3) SONET frame overhead identifies the Bit Error Rate (BER) threshold crossing alarm associated with a different section, line, or path.

   To view b1-tca (bit 1 threshold crossing alarm), b2-tca (bit 2 threshold crossing alarm), and b3-tca (bit 3 threshold crossing alarm) information, use the **show controllers pos** command in POS Interface Configuration mode.

4. Use the information in Table 9-1 to troubleshoot b1-tca, b2-tca, and b3-tca information that indicates where the data loss may be occurring on a SONET section, line, or path.

Table 9-1 Data Loss Error Descriptions

Error	Description
b1-tca	Associated with a specific SONET section. B1 errors indicate a LOS or LOF condition. Reports a B1 bit error rate (BER) threshold crossing alarm. For B1, the bit interleaved parity error report is calculated by comparing the BIP-8 code with the BIP-8 code extracted from the B1 byte of the next frame. Differences indicate that section level bit errors have occurred.
b2-tca	Associated with a specific SONET line. B2 errors indicate an L-REI and L-RDI condition. Reports a B2 BER threshold crossing alarm. For B2, the bit interleaved parity error report is calculated by comparing the BIP-8/24 code with the BIP-8 code extracted from the B2 byte of the next frame. Differences indicate that line level bit errors have occurred.
b3-tca	Associated with a specific SONET path. B3 errors indicate LOP, P-RDI, and P-REI conditions. Reports a B3 BER threshold crossing alarm. For B3, the bit interleaved parity error report is calculated by comparing the BIP-8 code with the BIP-8 code extracted from the B3 byte of the next frame. Differences indicate that path level bit errors have occurred.

Data Loss Resolution

Once you isolate a specific SONET section, line, or path, follow these steps to resolve the problem:

1. Check the fiber cabling for damage or improper use. For example, SONET cables may be turned beyond their bending radius.
2. Check for signal degradation.
3. Check fiber optic connectors for damage, and make sure they are clean.
4. If you have examined all possible SONET problems, and believe the problem is related to the PPP link, refer to Chapter 5 for information on troubleshooting the PPP link.

A

Cable Modem Registration Process

Introduction

This appendix describes the cable modem registration process. A cable modem goes through a standard registration process as defined by the Data Over Cable Service Interface Specification (DOCSIS) to successfully connect to the BSR 1000 CMTS and the BSR 64000 DOCSIS 1:4 and DOCSIS 2:8 CMTS modules on the CM network.

Scanning

When attached to the network and powered on, the cable modem scans the downstream channel frequency for a valid 8 MHz channel frequency (European DOCSIS - Annex A) or 6 MHz channel frequency (North American DOCSIS - Annex B), or it uses its last known downstream frequency that is stored in its NVRAM.

The cable modem establishes a 64 or 256 Quadrature Amplitude Modulation (QAM) downstream connection. The cable modem listens on the downstream frequency for the following upstream interface management information:

- **Upstream Channel Descriptor (UCD) -** The UCD describes the characteristics of an upstream channel for the cable modem. The UCD contains information on the mini-time slot size, upstream channel ID, and downstream channel ID. It also contains information on how to transmit the symbol rate, frequency, and preamble length. The UCD also has a burst descriptor that identifies the maximum burst size, guard time size, and amount of Forward Error Control (FEC) for all six Interval Usage Codes (IUCs).
- **Upstream Bandwidth Allocation Maps (MAPs) -** MAPs tell the cable modem where and when there is an opportunity to transmit bursts of data in time slots that are in contention by using six types of IUCs:
    - **Request** uses discover time-slot contention areas on the upstream frequency in which a cable modem may request a future time when the cable modem could transmit.
    - **Request Data** discovers descriptions of time-slot contention areas in which it can transmit either small data packets or requests for future grants.
    - **Initial Maintenance** ranging uses time intervals to find a time slot opportunity on the upstream frequency and initializes and transmits a temporary Service Indentifier (SID) for a new cable modem to connect to the CM network.

- **Station Maintenance** ranging uses periodic time intervals to send a unicast message containing a registered SID between the cable modem and the CMTS.
- **Short Data Grants** and **Long Data Grants** are grants of time that a cable modem with a particular SID has to transmit upstream.

The cable modem establishes downstream synchronization with the CMTS.

Initial Ranging

The cable modem sends an Initial Ranging request to establish its time reference and transmit power settings from the UCD. The CMTS responds to the Initial Ranging request with a temporary SID equal to zero, and the downstream channel ID.

The cable modem receives the upstream interface information and transmits a Ranging Request to the CMTS that is consistent with the UCD and MAP information. The CMTS replies to the cable modem Ranging Request with a Ranging Response that contains the appropriate SID or SIDs, upstream channel ID on which the CMTS heard the Ranging Request, and specific adjustments to its MAP for the cable modem transmitter so that the cable modem can effectively transmit to the CMTS.

Establishing IP Connectivity

The cable modem obtains an IP address from the Dynamic Host Configuration Protocol (DHCP) server on the network to establish IP connectivity, and it exchanges configuration parameters automatically without manual intervention over the CM network.

1. The cable modem broadcasts a DHCP discovery packet containing its MAC address.
2. The DHCP server checks the validity of the cable modem MAC address and sends a response offer if the MAC address is valid.
3. The cable modem selects the response offer and sends a DHCP request for its IP parameters to the DHCP server. The DHCP server sends a response to the cable modem containing the following parameters:
    - Cable modem IP address.
    - Gateway Router IP address if the DHCP server is on a different network.

- Cable modem Subnet Mask.
- TFTP server IP address used to connect to the TFTP server.
- Download Configuration file name is the name of the cable modem configuration file to be read from the TFTP server by the cable modem.
- Cable Modem Lease Time used for keeping the correct time on error logs.

Establishing Time of Day

For security purposes, the cable modem obtains its IP parameters from the DHCP server and it establishes the Time of Day (TOD).

TFTP Connectivity

The cable modem communicates with the TFTP server on the network to obtain its configuration file. The configuration file contains bandwidth specifications, class of service parameters, network access authorization, and upstream and downstream operating frequencies. The cable modem requests the TFTP server configuration file. The TFTP server sends the configuration file.

Registration

The registration process authorizes the cable modem to forward traffic on the network. The cable modem must send a TFTP response containing its configured class of service, SID, Service Flow Identifier (SFID), and any other operational parameters in its configuration file to the CMTS.

The CMTS uses a Message Integrity Check (MIC) to verify the contents of the configuration file and checks that the configuration file was created by a valid TFTP provisioning server. The CMTS ascertains that if the configuration file was created by a valid TFTP provisioning server using a secret key shared with the TFTP server. The network administrator enters the secret key at both the TFTP provisioning server and the CMTS. Once the CMTS receives verification from the cable modem after computing the secret key, the CMTS sends a registration response telling the cable modem that it is authorized to forward data on the CM network.

Baseline Privacy

Baseline Privacy encrypts upstream and downstream data passed between the cable modem and CMTS using the shared Authentication Key (AK) and Traffic Encryption Key(s) (TEKs). The CMTS assigns an AK to a cable modem based on the cable modem SID. The CMTS AK can be set to expire based on a grace-time or a lifetime value. The TEK is assigned to a cable modem once the cable modem has a valid AK. The TEK encrypts data traffic between the cable modem and the CMTS. Each authorized SID is encrypted with a TEK. The AK and TEK encryption use 40-bit or 56-bit Data Encryption Standard (DES) encryption algorithms. Once the AK and TEK are accepted by the CMTS, the cable modem authenticated identity is associated with a paying subscriber and services, the cable modem is authorized to access.

Periodic Ranging

A cable modem performs periodic raging based on a configured time interval. Cable modems use periodic ranging to make adjustments according to the MAPs sent to them by the CMTS. This ensures that the cable modem transmits upstream information within acceptable limits.

A modem monitors the allocation map for Station Maintenance intervals. When the CMTS sends a ranging request to the cable modem, the cable modem goes through the ranging process and makes the appropriate adjustments in its ranging response. During this process, the cable modem continues to forward data over the network.

The CMTS may send an Upstream Channel Change (UCC) to the cable modem after the cable modem has successfully completed the Initial Ranging process on the current upstream channel. When the cable modem responds to this request, it monitors the downstream channel for the new UCD. Once the cable modem receives the new UCD, it goes through the Initial Ranging process on the new upstream channel. During the process, no data is forwarded over the network. If Initial Ranging cannot be accomplished within the configured timeouts and retries, then the modem goes through the Scanning process.

Data Exchange

Cable modems use the dedicated data intervals in the current upstream MAPs to transmit data to the CMTS. When no dedicated data interval in the current upstream bandwidth allocation map exists and the Protocol Data Unit (PDU) data frame is within the appropriate size range, cable modems compete for request and data contention intervals to transmit data to the CMTS. If a dedicated data interval becomes available while the cable modem is competing for a contention interval, the cable modem drops its bid for the contention slot and uses the dedicated data interval instead of the contention interval.

The cable modem sends data with bandwidth allocation requests whenever possible. The cable modem continuously monitors allocation MAP messages for short and long grants and for pending indications given by the CMTS. The cable modem also monitors its transmission rate to keep it within the maximum upstream data rate for its class of service.

The CMTS supports the concatenation of MAC level frames. Cable modems that support concatenation combine multiple MAC level frames into one larger frame for an efficient and smooth traffic flow over the upstream channel path. The CMTS processes these concatenated frames and sends the data to its destination.

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