Cadant® C3™ CMTS

Cable Modem Termination System

C3 CMTS
User Documentation

Release 4.3, Standard

November 2005

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The ARRIS Cadant® C3™ Cable Modem Termination System (CMTS) has been qualified by CableLabs® for DOCSIS™1.1 and 2.0 and by tComLabs for Euro-DOCSIS 1.1.

Table of Contents

C3 CMTS

User Documentation

1 About this Manual

2 Getting Started

3 CMTS Installation

4 Bridge Operation

10 Command Line Interface Reference

A Specifications

B CMTS Configuration Examples

C Wireless Cable Applications

D DS1 Applications

List of Figures

1 About this Manual

Scope

This document provides necessary procedures to install, operate, and troubleshoot the ARRIS Cadant C3 CMTS in a DOCSIS®- or EuroDOCSIS-compatible environment. It is intended for cable operators and system administrators who configure and operate the CMTS. It is assumed the reader is familiar with day-to-day operation and maintenance functions in networks that rely on TCP/IP protocols and hybrid fiber/coax (HFC) cable networks.

This document applies to version 4.3 of the CMTS software, including minor revisions and point releases.

In this Document

This manual provides the following content:

- Chapter 2, “Getting Started,” provides a brief overview of the Cadant C3 CMTS and its components.
- Chapter 3, “CMTS Installation,” describes how to unpack and install the CMTS including how to bring up the CMTS from an “out of box” condition to full operation.
- Chapter 4, “Bridge Operation,” describes basic bridge operation of the CMTS and issues in upgrading to L3 capable code to restore DHCP operation.
- Chapter 5, “Providing Multiple ISP Access,” describes the supported 802.1Q VLAN capabilities.
- Chapter 6, “IP Routing,” describes how to configure the C3 CMTS as a layer 3 router.
- Chapter 7, “Managing Cable Modems,” describes common procedures for operating and troubleshooting DOCSIS systems.
- Chapter 8, “Configuring Security,” describes methods that can be used to improve security of management and user traffic.
- Chapter 9, “Service Procedures,” describes basic service procedures.
- Chapter 10, “Command Line Interface Reference,” describes the command line interface for managing and configuring the CMTS.
- Appendix A, “Specifications,” lists physical, electrical, and networking specifications.
- Appendix B, “CMTS Configuration Examples,” provides a configuration for a bench top trial. Includes both RF and CLI configuration.
- Appendix C, “Wireless Cable Applications,” describes features related to wireless cable support.
- Appendix D, “DS1 Applications,” provides example configurations for providing “circuit emulation” services.
- Appendix E, “SLEM MIB,” provides the Simple Law Enforcement Monitoring (SLEM) MIB.
- Appendix F, “Factory Defaults,” contains default configuration information.
- Appendix G, “Configuration Forms,” provides a form listing essential configuration parameters.
- Appendix H, “C3 Syslog Events and SNMP Traps,” provides a listing of supported traps and syslog events.

Conventions Used in This Manual

Various fonts and symbols are used in this manual to differentiate text that is displayed by an interface and text that is selected or input by the user:

Highlight	Use	Examples
bold	Keyword: Text to be typed literally at a CLI prompt.	Type **exit** at the prompt.
italics	Indicates a required user parameter.	**ping** {***ipaddr***}
bracketed	A parameter in a CLI command. A parameter enclosed in [square] brackets is optional; a parameter enclosed in {curly} brackets is mandatory.	ping {*ipaddr*} **terminal [no] monitor**
monospaced	Display text. Shows an interactive session of commands and resulting output.	
ipaddr	IP address: enter an IP address in dotted-quad format	10.1.105.128
macaddr	MAC address: enter a MAC address as three 4-digit hexadecimal numbers, separated by periods.	00a0.731e.3f84
NOTE Notes are intended to highlight additional references or general information related to a procedure, product, or system.		
CAUTION *Caution: Indicates an action that may disrupt service if not performed properly.*		
WARNING *Danger: Indicates an action that may cause equipment damage, physical injury, or death if not performed properly.*		

For More Information

For more detailed information about DOCSIS, refer to the following technical specifications, available online at www.cablelabs.com.

- Radio Frequency Interface (RFI) Specification—defines how data is passed over the cable
- Operations Support System Interface (OSSI) Specification—defines how DOCSIS components can be managed by the cable operator
- Baseline Privacy Interface (BPI) Specification—defines how data is encrypted while traveling on the cable to keep it private
- Computer to Modem Communications Interface (CMCI) Specification—defines how PCs can communicate to cable modems

For an overview of DOCSIS 2.0 features, see the ARRIS white paper "Getting to Know the New Kid on the Block" at http://www.arrisi.com/products_solutions/applications/white_papers/DOCSIS_20_Getting_To_Know_The_New_Kid.pdf

FCC Statement

This device complies with part 15 of the FCC Rules. Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the equipment.

Safety

Normal lightning and surge protection measures are assumed to have been followed in the RF plant that the ARRIS Cadant C3 CMTS RF input and output is connected to.

If AC supply is used to power the ARRIS Cadant C3 CMTS, suitable surge and lightning protection measures should be taken with this supply.

The equipment rack the ARRIS Cadant C3 CMTS is mounted in should have a separate safety ground connection. This ground should be wired in accordance with National Electric Code (NEC) requirements for domestic applications and paragraph 2.6 of EN60950/IE950 for international applications.

The safety ground wire must be #6 AWG or larger, and it must connect the equipment rack directly to the single-point ground in the service panel. The single-point ground can be an isolated ground or the AC equipment ground in the service panel or transformer. Depending on the distances between the cabinets and the location of the service panel, the wiring can be either daisy-chained through the cabinets or run independently from each cabinet to the service panel.

The remaining non-RF and non-AC supply connections of the ARRIS Cadant C3 CMTS should be made by SELV rated circuits.

2 Getting Started

This chapter introduces the ARRIS Cadant C3 Cable Modem Termination System (CMTS) and provides background information about the Data-Over-Cable Service Interface Specification (DOCSIS) standards with which the product complies.

About the C3 CMTS

ARRIS has designed the C3 specifically for DOCSIS and EuroDOCSIS specifications.

From its inception, it has been designed to take advantage of already defined Advanced Physical Layer features as well as new noise suppression technologies to deliver the most efficient utilization of the upstream spectrum. The hardware platform itself has been designed to scale to the most demanding needs of the operator from a packet classification and features perspective. The processing power of the system is capable of accommodating the emerging needs of cable operators worldwide.

With dual RISC processors in its architecture, the C3 supplies the processing power needed to support high volumes of traffic, with excellent latency control. The CMTS has scalable transmit and receive capacity, which can be configured to support one channel downstream and up to six channels upstream. It supports multiple network protocols, and multiple architectures such as PPPoE and NetBEUI, making it easy to add to existing router- or switch-based cable networks. Easy-to-use system management tools include an industry-standard command-line interface.

DOCSIS Compliance

The C3 is DOCSIS 1.1, DOCSIS 2.0, and EuroDOCSIS 1.1 qualified. The C3 is also compliant with EuroDOCSIS-2.0 when used with the DOCSIS 2.0 RF card.

The C3 CMTS works on any cable system with any DOCSIS or EuroDOCSIS compliant modems.

Fast Start

The basics of commissioning the Cadant C3 CMTS are covered in Chapter 3 and a complete example of a bench top installation is also provided in Appendix B.

Introducing the ARRIS Cadant C3 CMTS

The C3 is a flexible, powerful, and easy-to-use Cable Modem Termination System (CMTS). It is DOCSIS 1.1, DOCSIS 2.0, and EuroDOCSIS 1.1 qualified and compliant with EuroDOCSIS 2.0 standards, which includes specifications for features such as security enhancements, telephony, QoS, and tiered services.

The C3 has dual 10/100/1000 Mbps Ethernet interfaces and supports a 64 or 256 Quadrature Amplitude Modulation (QAM) cable TV downstream channel, and up to six variable-rate Quadrature Phase Shift Keying (QPSK) or 8, 16, 32, or 64 QAM upstream channels. Easy-to-use system management tools include an industry-standard command-line interface.

Table 2-1: C3 Features and Benefits

Features	Benefits
Advanced TDMA support: 8QAM, 32QAM, and 64QAM 200 KHz to 6.4 MHz channel width	Designed from the ground up to support advanced symmetrical data rate applications based on the DOCSIS 1.0, 1.1, and 2.0 specifications while maintaining compatibility with existing modems. Delivers superior performance in real-world cable plants through advanced noise cancellation technology
Compact size	Full DOCSIS 1.1 with ATDMA support, or DOCSIS 2.0 with ATDMA and SCDMA support, in a one-rack unit high system
Operator selectable Layer 2 and Layer 3 forwarding	Allows operators to choose the routing method most appropriate to their needs
ACL support	Up to 30 ACLs with 30 entries per ACL may be applied to any interface
Full upstream support 5 to 65 MHz	Allows better utilization of upstream frequency space for DOCSIS in plants outside of North America
DOCSIS and EuroDOCSIS support—selectable in software	Provides flexibility for operators by supporting either protocol on the same unit with no additional hardware to purchase
Efficient bandwidth management	User-configurable dynamic upstream channel bandwidth allocation allows the ARRIS Cadant C3 to respond to network conditions in real-time. Load-balancing allows the cable operator to automatically or manually distribute upstream traffic evenly across available channels.
Integrated RF up-converter	Complete ready-to-use CMTS in only one rack unit (1.75 in. of space)

Table 2-1: C3 Features and Benefits

Features	Benefits
DSx support	Provides support for up to 200 simultaneous telephony connections. DOCSIS DSx signalling occurs directly between the C3 and an MTA. DSx messages can Add (DSA), Change, (DSC) or Delete (DSD) service flows dynamically. The C3 currently supports CPE-initiated DSx transactions. For voice traffic, DSx is used to create UGS flows upstream on the fly. Unlike BE flows, data rates of UGS flows are guaranteed by the CMTS. In the Downstream direction, DSx is used to create flows with a Minimum reserved rate. Once established, these flows take priority over all others in the Downstream direction.
SIP Dynamic Polling	SIP signalling can be used to provide voice services using legacy CPE that does not support DOCSIS DSx. SIP Dynamic Polling dynamically creates upstream and downstream data flows for voice traffic; as with DSx, these flows have priority over DOCSIS BE data flows. When the voice call terminates, the bandwidth used by these flows is freed for use by other voice or data traffic. To enable this feature, configure the Cable Modem at the customer premises with a special configuration file. When the C3 detects appropriate SIP messages coming from the Cable Modem, the C3 activates prioritized flows to carry the voice traffic. Contact your ARRIS Technical Support representative if you require more information on this feature.

The following diagram shows the major components of the Cadant C3 CMTS.

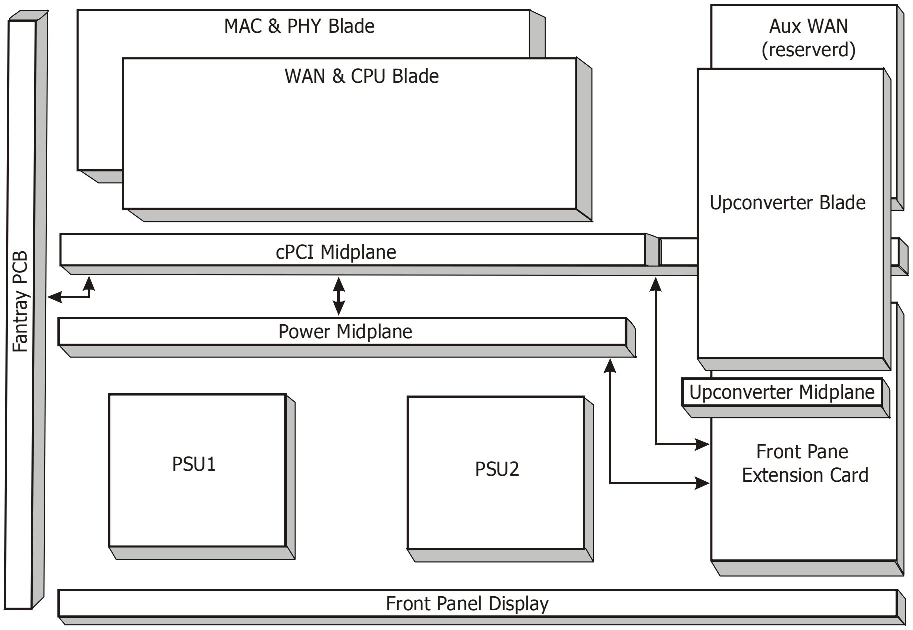


Figure 2-1: Major components of the C3 CMTS

Front panel

The following diagram shows the C3 front panel.

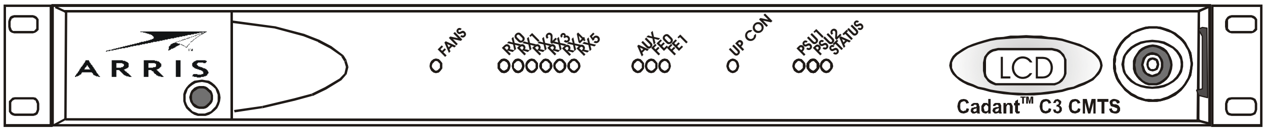


Figure 2-2: Front panel of C3

The following table lists and describes the front panel indicators.

Table 2-2: Front panel indicators

Name	Indication	Description
FANS	Green	Normal operation.
	Red	One fan has failed.
	Flashing Red	More than one fan has failed.
RX0 to RX5	Green	Upstream is active.
	Flashing Green	Upstream is in use.
AUX		not used
FE 0	Green	WAN network port is linked.
	Flashing Green	WAN network port is active.
FE 1	Green	MGMT network port is linked.
	Flashing Green	MGMT network port is active.
UP CON	Green	Upconverter is operating properly.
	Off	Upconverter not installed.
PSU 1	Green	Power supply 1 (on the left side behind the front panel) is operating properly.
	Flashing Red	Power supply 1 fault detected.
PSU 2	Green	Power supply 2 (on the right side behind the front panel) is operating properly.
	Flashing Red	Power supply 2 fault detected.
STATUS	Flashing Amber	CMTS is booting.
	Green	Normal operation.
	Flashing Red	CMTS fault detected.
RF test		Downstream output with signal level attenuated by 30 dB

Traffic LED flash rates

The Traffic LED flashes at variable rates to indicate the relative amount of data flowing through the CMTS. The following table interprets the LED flash rate.

Table 2-3: LED flash rates

Traffic Rate	Flash Rate
>2000 packets per second	50 milliseconds
>1000 packets per second	100 milliseconds
>500 packets per second	150 milliseconds

Table 2-3: LED flash rates

Traffic Rate	Flash Rate
>300 packets per second	200 milliseconds
>100 packets per second	250 milliseconds
>10 packets per second	300 milliseconds
less than 10 packets per second	500 milliseconds
0 packets per second	not flashing

Rear Panel

The following diagram shows the locations of ports on the rear panel.

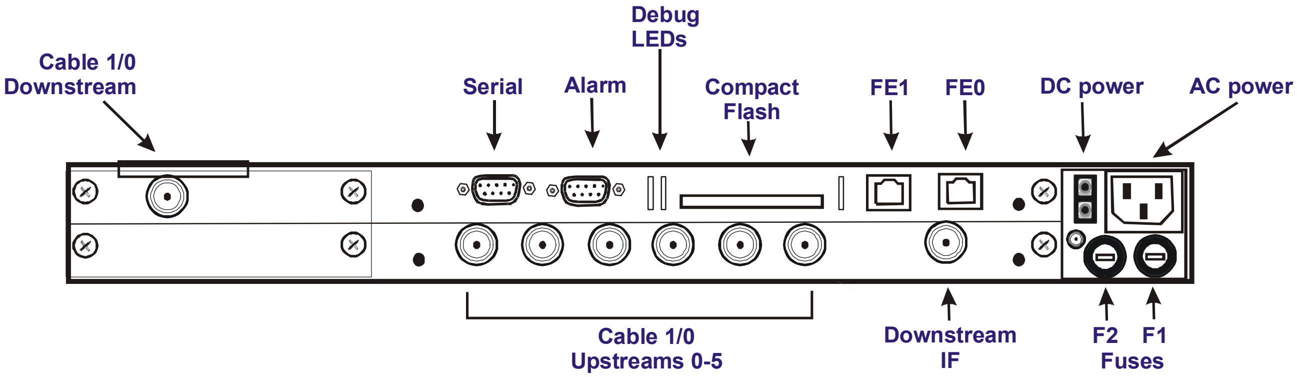


Figure 2-3: Rear panel port identification

The following table describes the ports on the rear panel.

Table 2-4: Rear panel ports

Port	Interface
FE1	10/100/1000Base-T interface
FE0	10/100/1000Base-T interface
AC power	Input receptacle for 90 to 264 volts AC
DC power	Input receptacle for –40 to –60 volt DC
RS232	RS-232 serial port for initial setup (38400/N/8/1)
Alarm	Reserved for future use.
RX0	Upstream #1 (cable upstream 0)
RX1	Upstream #2 (cable upstream 1)
RX2	Upstream #3 (cable upstream 2)
RX3	Upstream #4 (cable upstream 3)

Table 2-4: Rear panel ports

Port	Interface
RX4	Upstream #5 (cable upstream 4)
RX5	Upstream #6 (cable upstream 5)
Downstream	Downstream output from upconverter
Downstream IF Output	Intermediate frequency (IF) output (43.75 MHz for NA DOCSIS; 36.125 MHz for EuroDOCSIS) which may be routed to an external upconverter.

NOTE
ARRIS does not support simultaneous use of the Downstream and Downstream IF outputs.

Major Components of the Cadant C3 CMTS

Redundant Power Supplies

The Cadant C3 CMTS supports simultaneous powering from AC or DC using one or two power supplies. If two power supplies are installed, the load is shared between both. In this configuration, one power supply may fail without impacting system operations. The CMTS has separate connections for AC and DC power.

Up-Converter

The Cadant C3 CMTS incorporates a state-of-the-art up-converter for the downstream signal. The signal may be output in either the DOCSIS (6 MHz wide—Annex B) or EuroDOCSIS (8 MHz wide—Annex A) formats. The integrated up-converter can generate the full DOCSIS/EuroDOCSIS power range across the entire frequency. The up-converter is frequency agile. Either the command line interface or SNMP can be used to tune the upconverter and configure it for DOCSIS or EuroDOCSIS operation.

The CMTS is capable of using various frequency plans, including North American Standard, IRC, HRC, Japanese, European PAL, and European SECAM. For more information on supported channel plans, see Appendix B. The C3 can operate at any frequency (in 62.5 KHz steps) within the band.

Wideband Digital Receiver

The CMTS incorporates a wideband digital receiver for each upstream channel. The digital receiver section allows spectrum analysis as well as advanced digital signal processing to remove noise (including ingress) and deliver the highest possible performance.

Media Access Control (MAC) Chip

The MAC chip implements media access control (MAC) protocol and handles MPEG frames. It also supports Direct Memory Access (DMA) for high data transfer performance.

Ethernet Interfaces

The CMTS has two Ethernet interfaces, each which is capable of operating at 10, 100, or 1000 megabits per second. The ports are capable of both half-duplex and full-duplex operation and automatically negotiate to the appropriate setting. One port may be dedicated to data while the other port may be used for out-of-band management of the C3 and (optionally) cable modems.

Management Schemes

The CMTS management mode determines how traffic is assigned to the Ethernet ports, and may be selected through the C3 configuration. For example:

- C3 management traffic can be restricted to one Ethernet port, and all subscriber traffic restricted to the other Ethernet port.
- Cable modem traffic can be directed to either Ethernet port as required.

CPU

The CMTS is built around dual, state-of-the art, reduced instruction set (RISC) processors. One processor is dedicated to data handling while the other processor performs control functions including SNMP.

Flash Disk

The C3 uses a 128MB Compact Flash card to store operating software and configuration files. The disk may be removed without affecting normal operation; however, the C3 disables all configuration-related CLI and SNMP functions until you replace the disk.

3 CMTS Installation

Use this chapter to install the Cadant C3 CMTS.

Planning the Installation

Network Requirements

The CMTS may be connected to your network using one or both Ethernet interfaces. If it is desired to keep subscriber data traffic physically separate from management traffic, then both ethernet interfaces must be used. Alternatively, data and management traffic can be sent on different VLANS via a single Ethernet interface. Regardless of the connection method selected, at least one network connection is required to the CMTS.

Power Requirements

To assure high system reliability, the C3 chassis supports two hot-swappable, load-sharing power supply modules. A single supply can provide all the power that a fully loaded system needs with sufficient safety margin.

Each type of power supply has a separate power connector mounted on the rear panel of the C3 chassis. The power connectors are typically plugged into the AC power or DC power distribution unit of the rack or cabinet using the power cords supplied with the C3.

NOTE
Make sure that the power circuits have sufficient capacity to power the C3 before connecting power.

To disconnect power from the C3 for servicing, remove both power leads (AC and DC) from the rear socket. The C3 has no power switch.

Earthing

Reliable earthing of rack mounted equipment should be maintained. See *Safety*, page 1-4, for common safety considerations. Also consider using power strips instead of direct connections to branch circuits.

When using only DC power, earth the C3 chassis using the supplied M4 stud.

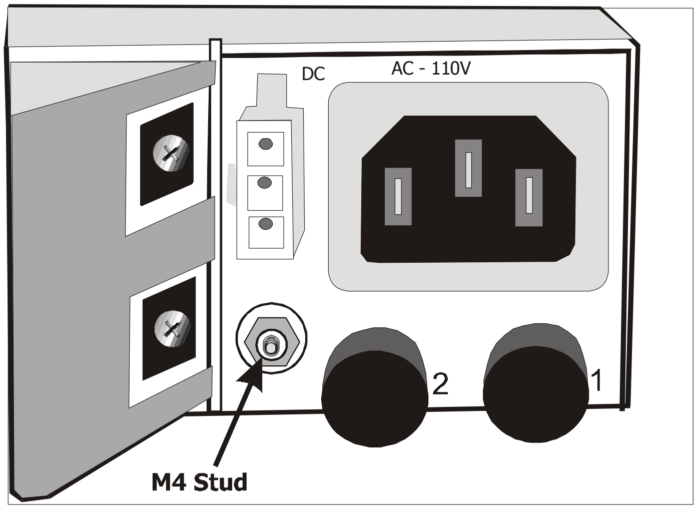


Figure 3-1: Earthing using only DC power

Use an M4 nut and M4 lock washers with the parts stacked as shown in the example figure below.

If using DC power, then the Earthing conductor on the DC power cable may be secured under either the top nut or the bottom nut.

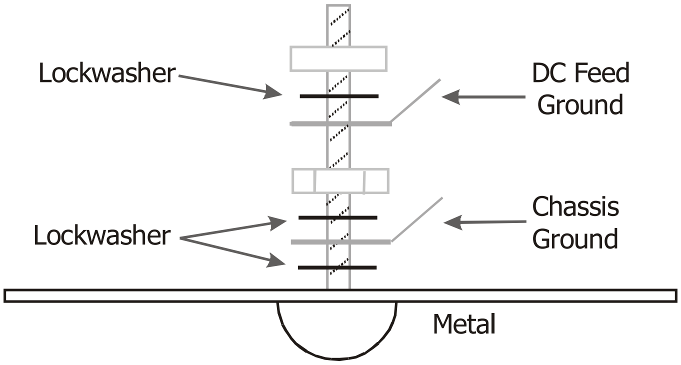


Figure 3-2: Example positioning of the M4 nut and lock washers

AC powering

The AC power modules require 100 to 240 volt, 2A, 47 to 63 Hz AC power. The socket-outlet must be properly earthed.

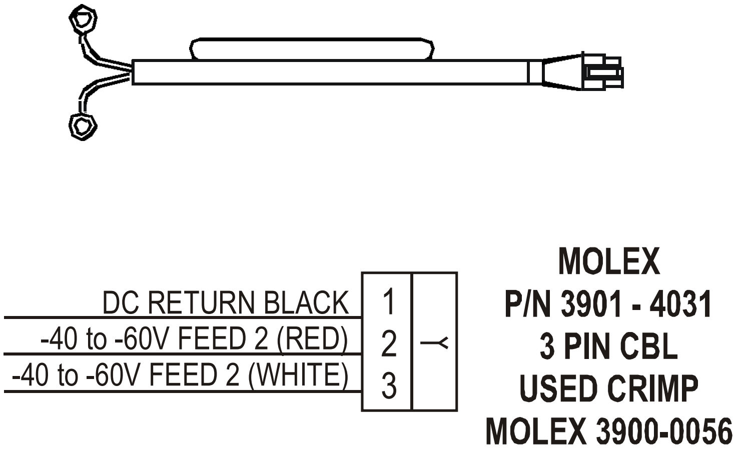
DC powering

The DC power modules requires –40 to –60 V DC, 4A power from a SELV rated source. The DC power source must have an over current protection device rated at 10 Amp.

The external DC cable assembly must not be modified in the field; route any excess length to avoid snags.

Connect both Feed 1 and Feed 2 to the DC power source even if only one DC power supply is to be installed. This allows placing a single DC power supply in either of the two possible locations, or placing two DC power supplies in the chassis.

The following diagram shows the connector and pin locations.



Signal	To	AWG	Color
DC Return	Pin 1	18	Black
-40 to -60V Feed 1	Pin 2	18	Red
-40 to -60V Feed 2	Pin 3	18	White

Figure 3-3: Connector and pin locations

Cable Requirements

A variety of cables and connectors and the tools to work with them must be obtained to complete the installation.

Table 3-1: Cable and connector types

Cable	Wire Type	Connector Type
Serial console (included with C3)	9 pin RS-232 serial cable	DB-9M
Ethernet connections	Category 3, 4, 5, or 5E twisted pair cable	RJ-45
CATV	RG-59 coaxial cable (all) RG-6 (DOCSIS 2.0 cards only)	F

NOTE

Use only RG-59 coaxial cable with DOCSIS 1.1 cards. RG-6 cable is not suitable for use with the connectors on these cards, but may be used with DOCSIS 2.0 cards.

Ethernet Connections

The C3 provides two 10/100/1000BaseT Ethernet ports to allow connection to a terminating router, server, or other networking devices such as a hub, switch, or bridge.

Both Ethernet connectors are standard RJ-45 connectors. For 10BaseT and 100BaseT, unshielded cable may be used. For 1000BaseT, use shielded category 5E wire.

Cable Plant Requirements

The RF cable plant should be designed so that all RF ports connect to SELV circuits (meeting the requirements of SELV as defined in UL60950). You must provide suitable protection between these ports and the CATV outside plant.

Table 3-2: Downstream RF cable plant requirements

Parameter	Value
Frequency Range	88 to 858 MHz (DOCSIS / JDOCSIS) 112 to 858 MHz (EuroDOCSIS)
Carrier-to-Nose ratio at the RF input to the cable modem	30 dB
Channel bandwidth	6 MHz (DOCSIS / JDOCSIS) 8 MHz (EuroDOCSIS)

Table 3-3: Upstream RF cable plant requirements

Parameter	Value
Frequency Range	5 to 42 MHz (DOCSIS) 5 to 65 MHz (EuroDOCSIS / JDOCSIS)
Carrier-to-noise ratio at the RF input to the C3	At least 10 dB
Channel Bandwidth	200 KHz, 400 KHz, 800 KHz, 1600 KHz, 3200 KHz, 6400 KHz

CATV System Connections

The C3 transmitter output is the downstream RF connection (head-end to subscriber). The receiver inputs (subscriber to head end) are the upstream RF connections. There are 2 upstream connections per upstream receiver module with a maximum of 6 upstream connections per CMTS.

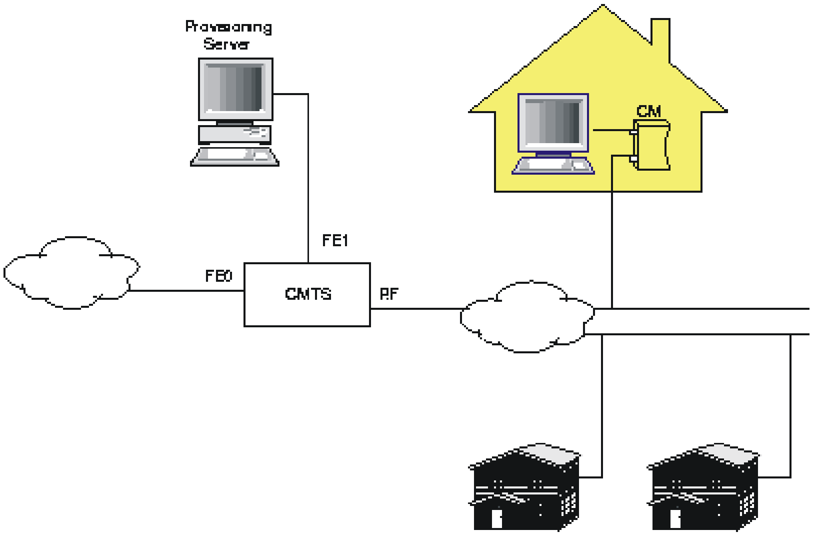


Figure 3-4: Example of CATV System Connections

Unpacking the CMTS

The carton in which the Cadant C3 CMTS is shipped is specifically designed to protect the equipment from damage. Save all shipping materials in case the product needs to be returned to the manufacturer for repair or upgrade.

Unpack the equipment carefully to ensure that no damage is done and none of the contents is lost.

Package Contents

The Cadant C3 package should contain the following items:

- Cadant C3 CMTS
- Rack mounting “ears” and mounting screws
- Power cord
- Serial console cable
- Safety and Quick Start guides

If any of these items are missing, please contact your ARRIS service representative.

Action

After unpacking the equipment, but before powering it up the first time, read this manual in its entirety, then perform a visual inspection of the equipment as follows:

1 Look for the following potential problems:
   - Physical damage to the chassis or components
   - Loose connectors
   - Loose or missing hardware
   - Loose wires and power connections
2 If any of the above are found, do not attempt to power on the CMTS. Contact your local service representative for instructions.

Mounting the CMTS

The C3 CMTS is 1.75 in. (4.4 cm) high and is suitable for mounting in a standard 19 in. (48.3 cm) relay rack.

NOTE
Install the CMTS in a restricted access location.

Environmental requirements

Installation of the equipment in a rack should not restrict airflow where marked on the top of the C3 case. In particular, provide adequate side clearance.

Mount the C3 properly to prevent uneven mechanical loading on the chassis. Improper mounting can cause premature failure and potentially hazardous conditions.

When installed in a closed or multi-unit rack assembly, the operating temperature inside the rack environment may be higher than ambient temperature. The C3 should be installed in an environment where the ambient temperatures remains below 40° Celsius.

Procedure 3-1

Follow these steps to mount the CMTS in a 19-inch rack.

1 Install one rack mounting bracket on each side of the CMTS so that the two-hole side is closest to the front of the CMTS and the brackets protrude away from the CMTS. Use four screws to fasten each bracket to the CMTS.

CAUTION
Heavy load. Handle with care.

The CMTS weighs approximately 22 lbs (10 Kg). If necessary, have a second person hold the CMTS while mounting it to the rack.

2 Mount the CMTS in the rack and secure it using two screws on each side.

End of procedure

Procedure 3-2

Connecting Cables

Use this procedure to connect RF, data, and power cables to the CMTS.

Depending on the configuration ordered, the C3 may have 2, 4, or 6 upstreams.

CMTS Rear View

Refer to the following figure to locate the cable ports.

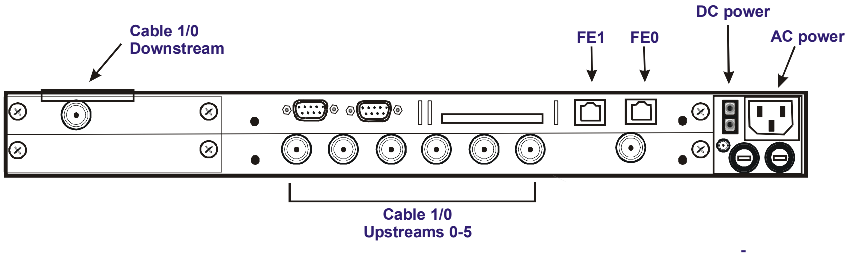


Figure 3-5: CMTS rear view

Procedure 3-3

Follow these steps to connect cables to the CMTS.

1 Connect the upstream cable from your plant to the appropriate upstream ports. The upstream ports are located on the lower board, and are numbered left to right as viewed from the rear.

NOTE
Connect all RF ports to SELV circuits (meeting the requirements of SELV as defined in UL60950). Your headend must provide suitable protection between the RF ports and the CATV outside plant.

2 Connect the downstream cable to the downstream port (the F-connector located at the upper left).

3 Connect a PC to the serial connector (male DB9 connector on the upper interface module). The pin-out for this connector is designed to function with a PC when used with a straight-through cable, and is shown in the following table. The serial port operates at 38,400 bps with 8 data bits, 1 stop bit, and no parity bit.

Pin	Signal
1	Data Carrier Detect (DCD)
2	Receive Data (RD)

Pin	Signal
3	Transmit Data (TD)
4	Data Terminal Ready (DTR)
5	Ground (GND)
6	Data Set Ready (DSR)
7	Request to Send (RTS)
8	Clear to Send (CTS)
9	Unused

4 (optional) Connect an Ethernet cable between the FE1 port and the network manager.

5 Connect an Ethernet cable between the FE0 port and the network bridge or router.

6 Make the power connection as follows:

- If using AC power, connect the power cord to the input socket in the upper right (above the fuses).
- If using DC power, connect the supplied DC power cable to the small white connector to the immediate left of the AC input connector.

NOTE
When DC powering, the chassis should be earthed to the rack using the supplied M4 earthing stud as detailed in *Earthing*, page 3-2.

7 Apply power to the CMTS.

The cooling fans should start to turn, and the CMTS should display initial startup messages on the LCD screen on the front panel. The following figure shows the location of the LCD.

End of procedure

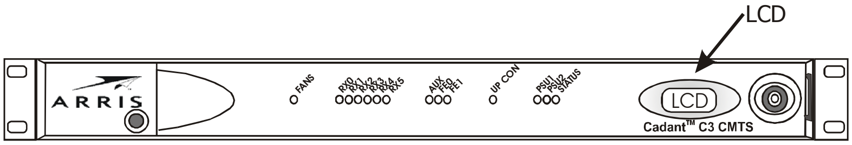


Figure 3-6: LCD location

Initial Configuration

The following sequence can be used to start up the ARRIS Cadant C3. This startup sequence assumes an "out of the box" initial condition.

Prerequisites

The following items must be set up before configuring the CMTS:

- An external DHCP server must be running.
- An external TFTP server must contain the cable modem configuration file specified by the DHCP server.

Optional Items

The following items are optional for the initial configuration, but may be required for normal operation:

- A ToD server is available for the cable modem.
- An NTP server is available for the CMTS.
- A Syslog server is available.

Initial Boot Parameters

Required boot parameters depend on how the C3 loads its software image.

Table 3-4: Required boot parameters

If the software image is on...	Required boot parameters are...
the C3 flash disk	none
an external TFTP server	booting interface (see below) initial IP address of the booting interface default gateway IP address to the TFTP server the 802.1Q VLAN ID if booting over an 802.1Q VLAN encoded backbone is required

The choice of the booting interface (**fa0/0** or **fa0/1**) also pre-defines certain bridging behavior of the CMTS. You can reconfigure this behavior, but from a factory default condition before the system loads it's code for the first time (or no startup-configuration on the compact flash disk):

- Selecting **fa0/0** configures "in-band" behavior. All cable modem and CPE traffic is directed to **fa0/0**; you can use either Ethernet port for managing the CMTS.
- Selecting **fa0/1** configures "out-of-band" behavior. All CPE traffic is directed to **fa0/0**. All cable modem traffic is directed to **fa0/1**. You can use either Ethernet port for managing the CMTS if "management-access" is specified in the interface configuration.

Factory Default Network Settings

Factory default network settings are:

- IP address is one of:
  - 10.1.127.120
  - 10.1.127.121
  - 10.1.127.122
  - 10.1.127.123
- Subnet mask: 255.255.128.0
- Gateway address:10.1.0.3

See Appendix F, *Factory Defaults* for a complete list of factory default settings.

Rear Panel Connectors

Refer to the following diagram when performing this procedure.

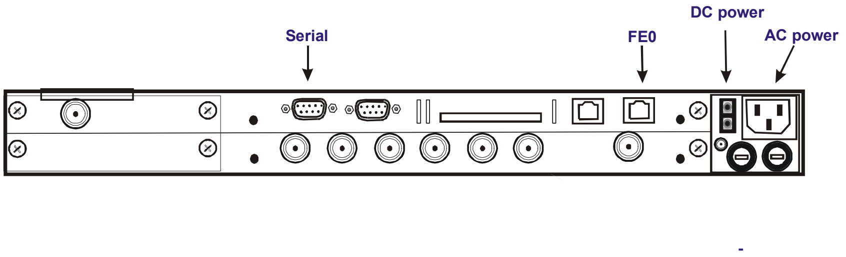


Figure 3-7: Rear panel connectors

Perform the following tasks in the order shown.

- *Preparing the Connections*, page 3-11
- *Verifying Proper Startup*, page 3-12
- *Setting Boot Parameters*, page 3-13
- *Configuring an Initial CLI Account*, page 3-16

Procedure 3-4

Preparing the Connections

1. Connect the appropriate AC or DC power cables to the CMTS. Do not power up yet.
2. Connect the RS232 serial cable to the serial port and connect the other end to a terminal (or PC with a terminal emulation program).

3 Start the console application and set the console configuration to:

- Port: Com1/Com2, depending on your connection
- Baud rate: 38400
- Data: 8 bits
- Parity: None
- Stop bit: 1
- Flow control: None

End of procedure

Procedure 3-5 Verifying Proper Startup

Follow these steps to start the C3 CMTS for the first time.

1 Power on the CMTS and verify that the following status LEDs on the front panel are illuminated green:

- FANS
- PSU1
- PSU2 (if second power supply is installed)
- Status

2 Verify that the FE0 and FE1 ports on the back of the CMTS have illuminated green Link LEDs (for the port that is being used).

3 Wait for the message "Press any key to stop auto-boot..." to appear on the console, then press any key to stop auto booting before the count reaches 0.

NOTE
Auto booting continues after two seconds.

4 At prompt, type **help** or **?** and press **Enter** to view the different commands available for boot options.

The first commands you see are user level commands.

```
CMTS>?
-----------------------------------------------------------------
Command          Description
-----------------------------------------------------------------
boot             Boot the CMTS using current boot parameters
bootShow         Display current boot parameters
enable           Enable Supervisor/Factory Level
sysShow          Show system configuration
timeShow         Displays current Date and Time from RTC
```

```
dir             Show directory of Compact Flash
vlevel          Set Verbosity Level
reboot          Reboot
help            Display general help or help about a command
?               Display general help or help about a command
@               Boot the CMTS using current boot parameters
>
```

End of procedure

Procedure 3-6

Setting Boot Parameters

1 Enter privileged mode using the **enable** command to change the boot parameters. The first time you enter this mode, there is no password set and you can enter with no password. Use the **setpwd** command if a password is required in the future.

Several more commands are now available. Type **?** to see the entire list.

```
>enable
No supervisor level password set yet
Use "setpwd" command to set password
Supervisor level enabled
>?
----------------------------------------------------------------
Command         Description
----------------------------------------------------------------
boot            Boot the CMTS using current boot parameters
bootShow        Display current boot parameters
bootCfg         Configure the boot parameters
cf              Select Compact Flash for booting
tftp            Select TFTP for booting
wan             Select FA0/0(WAN) port for network access
mgmt            Select FA0/1(MGMT) port for network access
enable          Enable Supervisor/Factory Level
disable         Disable Supervisor/Factory Level
sysShow         Show system configuration
setTime         Set time in RTC
setDate         Set Date in RTC
timeShow        Displays current Date and Time from RTC
dir             Show direcory of Compact Flash
setpwd          Set password
vlevel          Set Verbosity Level
setVlanId       Set the VLAN tag to be used
vlanEnable      Enable VLAN tagging/stripping as set by setVlanId
vlanDisable     Disable VLAN tagging/stripping
reboot          Reboot
help            Display general help or help about a command
?               Display general help or help about a command
@               Boot the CMTS using current boot parameters
>
```

2 Decide what Ethernet interface to use for network access, using the commands **wan** (to select FE0/0) or **mgmt** (to select FE0/1).

The **bootShow** command displays the selected interface as the “Network port” as shown in the next step.

Most CLI commands refer to the FE0/0 port as **fastethernet 0/0.0** and the FE0/1 port as **fastethernet 0/1.0**.

If the CMTS has been booting from one interface and you change this interface using the above commands, for the changed factory default configuration to take effect, you need to erase the old configuration using the CLI command “write erase” before entering the boot options. Then, power cycle the CMTS to re-create the startup configuration based on the new boot options.

3 Enter **bootShow** to view the current boot options. (Note that the CMTS does not show the TFTP server IP address unless BootCfg is selected as following).

A listing similar to the following displays:

```
C3>bootShow
*** Current Boot Parameters ***
Boot from            : Compact Flash
Boot file            : C:\2.0.3.12.bin
CMTS IP Address      : 10.1.127.121
CMTS subnet mask     : ffff7f00
Gateway Address      : 10.1.0.3
CMTS Name            : CMTS
Network port         : WAN
Vlan Tagging         : Disabled
```

4 If the C3 is to be managed over an 802.1Q VLAN, make the VLAN assignment so that remote management systems can communicate with the C3 during the boot process. This is also required if the C3 is configured to boot using TFTP, since the TFTP transfer might use the VLAN. Use the **vlanEnable** and **setVlanId** commands to set up the VLAN.

```
C3>vlanEnable
C3>setVlanId 1
C3>bootShow
*** Current Boot Parameters ***
Boot from            : Compact Flash
Boot file            : C:\4.3.0.32.bin
CMTS IP Address      : 10.1.127.121
CMTS subnet mask     : ffff7f00
Gateway Address      : 10.1.0.3
CMTS Name            : CMTS
Network port         : WAN
```

```
Vlan Tagging        : Enabled
Vlan Id             : 1 (0x1)
C3>
```

5 To change the above list of boot options, enter **bootCfg** at the command prompt. You can change the boot parameters one at a time. Enter the new value for each parameter in turn to modify them. Then enter **bootShow** to review the changes. Set the IP address for the ARRIS Cadant C3 to suit your network.

```
>bootCfg

Options:
*[1] Boot from TFTP
 [2] Boot from Compact Flash
Select desired option : [2]
Application Image path : [C:\4.3.0.32.bin]
CMTS Ip Address : [10.1.127.121]
CMTS Subnet Mask : [255.255.128.0]
TFTP Server Ip Address : []
Gateway Ip Address : [10.1.0.3]
Saving in non-volatile storage

>>
```

“Application Image path” is the name of the file and the file path if stored locally on the compact flash disk that contains the code image to be loaded. Note that the drive letter C is in UPPER CASE.

“Gateway Ip Address” is the IP address of the default router on the backbone network. The C3 uses this IP address for TFTP server booting.

6 Once the boot parameters have been modified as required, boot the system by entering **@** or **boot** at the prompt.

Once the system is booted, the serial port supports the CLI. When this is the first time the ARRIS Cadant C3 has been powered up, the CMTS automatically creates all of the required run time files from the specified image file.

The CMTS loads the image file and comes online.

The following output is representative of that generated on the console screen during boot and initialization.

```
*** Current Boot Parameters ***
Boot from           : Compact Flash
Boot file           : C:\4.3.0.32.bin
CMTS IP Address     : 10.1.127.121
CMTS subnet mask    : ffff7f00
Gateway Address     : 10.1.0.3
CMTS Name           : CMTS
```

```
Network port        : WAN
Vlan Tagging        : Disabled
Attached TCP/IP interface to sbe0.
Attaching network interface lo0... done.
.
.
.
etc
.
.
.

!    No CLI accounts - Telnet is disabled
!    Please configure a login account with the "cli
account" command
Arris CMTS
C3>
```

End of procedure

Procedure 3-7

Configuring an Initial CLI Account

You must create at least one CLI account before the CMTS allows telnet access. Follow these steps to create a CLI account.

1 If you have not done so already, type **enable** to enter privileged mode.

The prompt changes to a # symbol.

2 Enter the following commands to create an account:

```
C3# configure terminal

C3(config)# cli account {acctname} password {passwd }
```

The CMTS creates the account with the specified name and password.

3 Enter the following command to give privileged (enable) access to the account:

```
C3(config)# cli account {acctname} enable-password
{enapasswd}

C3(config)# exit
```

The login password and enable password may be the same if you prefer.

End of procedure

Procedure 3-8 **Configuring the Network Time Protocol (optional)**

The C3 optionally uses NTP to set its internal clock. You can configure the NTP server IP address from the CLI using telnet or a serial console once the application image is running. Follow these steps to configure NTP, if desired.

1 Log into the CMTS, using the account you created in the previous task.

2 Type **enable** to enter privileged mode, and then type the enable password (set in the previous task).

3 Enter the following commands to begin configuring NTP:

```
C3# config t

C3(config-t)# ntp server {ntp_ip_addr}
```

4 Create a timezone to specify the time offset from GMT:

```
C3(config-t)# clock timezone {name}{offset}
```

Where **name** is the name of the time zone (any string), and **offset** is the offset, in hours, from GMT.

Example: **clock timezone EDT -4**

5 Exit the global configuration mode by typing **exit** or **end**.

6 Confirm the time settings:

```
C3# show clock
```

7 Copy the running configuration to the startup configuration:

```
C3# copy running-config startup-config

C3# write
```

The CMTS stores the new time settings in non-volatile memory.

NOTE
If NTP is not available, set the internal clock using the **clock set** command.

End of procedure

Configuring IP Networking

The C3 applies the CMTS IP address configured in the boot parameters to the fastethernet interface selected as the boot interface, and to the cable interface when booting from the default configuration (or when no startup-configuration file is available). If these settings are not suitable, use this procedure to specify the IP address information required for normal C3 operation.

You should also specify at least one fastethernet sub-interface to be available for system management; see *management-access*, page 10-188, for details.

Configuration Options

The C3 CMTS supports two configuration options:

- bridging (no IP routing) mode—see Chapter 4, *Bridge Operation*
- IP routing mode—see Chapter 6, *IP Routing*

Default Bridge Groups

Depending on the boot interface you chose in *Setting Boot Parameters*, page 3-13, the C3 pre-configures two bridge groups.

Action

Perform one of the following tasks:

Configuring Bridging Mode, page 3-18

Configuring IP Routing Mode, page 3-19

Procedure 3-9

Configuring Bridging Mode

Follow these steps to configure a different default route.

1 Log into the CMTS.

2 Enter one of the following groups of commands:

a To assign the management IP address to the fastethernet 0/0.0 (FE0/0) primary sub-interface, enter the following commands:

```
C3# config terminal

C3(config)# interface fastethernet 0/0

C3(config-if)# ip address {mgmt-ip-addr} {mask}

C3(config-if)# exit

C3(config)# exit

C3# copy running-config startup-config
```

b To assign the management IP address to the fastethernet 0/1.0 (FE0/1) primary sub-interface, enter the following commands:

```
C3# config terminal

C3(config)# interface fastethernet 0/1

C3(config-if)# ip address {mgmt-ip-addr} {mask}}

C3(config-if)# exit

C3(config)# exit

C3# copy running-config startup-config
```

3 Enter the following commands to set the default gateway IP address:

```
C3# config terminal

C3(config)# ip default-gateway {gw_ip_addr}

C3(config)# exit

C3# copy running-config startup-config
```

End of procedure

Procedure 3-10

Configuring IP Routing Mode

Follow these steps to the configure the C3 CMTS for IP routing mode:

1 If IP routing is turned on while a cable subinterface has the same IP address as a fastethernet interface in the same bridge group, changing to pure IP routing is not successful. Remove the cable interface IP address or change the cable interface IP address before turning on IP routing mode. If pure IP routing with no bridge groups is required, use step **c**; otherwise, use steps **a** and **b**.

a IP routing with bridge-group memberships:

```
C3# config terminal

C3(config)# ip routing
```

b Configure the default route if necessary:

```
C3# config terminal

C3(config)# ip route 0.0.0.0 0.0.0.0 {route}
```

Where
route = IP address of the default route (or route of last resort)

c True IP routing, removing bridge-group memberships:

```
C3# config terminal

C3(config)# ip routing

C3(config)# interface fastethernet 0/0.0

C3(config-if)# no bridge-group

C3(config-if)# interface cable 1/0.0

C3(config-if)# no bridge-group

C3(config-if)# interface fastethernet 0/1.0

C3(config-if)# no bridge-group

C3(config-if)# interface cable 1/0.1

C3(config-if)# no bridge-group

C3(config-if)# exit

C3(config)# exit
```

2 Set the IP address of the cable interface:

```
C3(config)# interface cable 1/0.0

C3(config-if)# ip address {cbl_ip} {subnet}
```

The **cbl_ip** address may not be in the same subnet as the management IP address.

3 Configure the DHCP relay (this is required for a cable modem to register when the CMTS is in IP routing mode):

```
C3(config-if)# ip dhcp relay
```

4 Cable helper address is mandatory for IP routing cable sub-interfaces that are running DHCP relay.

```
C3(interface)# cable helper-address {ipaddr}

C3(interface)# exit
```

5 Enter the following commands to save the routing configuration:

```
C3(config)# exit

C3# copy running-config startup-config
```

End of procedure

Configuring the Cable Interfaces

Use this procedure to configure and connect the cable upstreams and downstream.

Appendix B shows some example configurations.

Appendix F shows the factory default configuration. The factory default configuration has the downstream in a shutdown condition so the C3 is in a passive state by default.

Requirements

Connect the downstream and any upstreams in use before performing this procedure.

Cable Connections

The following diagram shows the locations of the cable connections on the rear panel of the C3 CMTS.

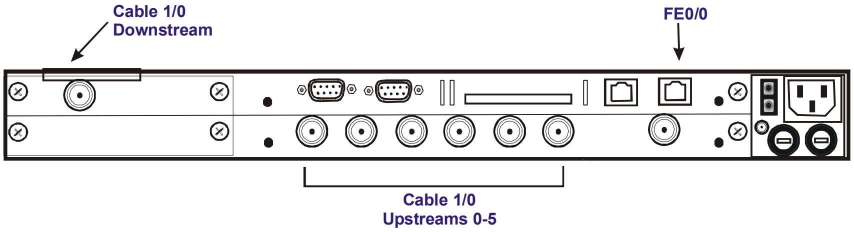


Figure 3-8: Rear cable connections

Action

Perform the following tasks in the order shown.

- *Configuring Downstream Parameters*, page 3-21
- *Configuring Upstream Parameters*, page 3-22
- *Enabling the Interfaces*, page 3-24

Procedure 3-11

Configuring Downstream Parameters

Follow these steps to configure the downstream cable interface.

1. Connect a PC to the CMTS, using either the serial port or the Ethernet interface (telnet connection).
2. Log into the CMTS.
3. Type **enable** to get into privileged mode, and then type the enable password.

4 Use the following commands to begin cable interface configuration:

```
C3# conf t
```

```
C3(config)# interface cable 1/0
```

5 Set the downstream frequency (in Hz) using the following command:

```
C3(config-if)# cable downstream frequency {freq}
```

Example: **cable downstream frequency 501000000**

6 Set the power level (in dBmV) using the following command:

```
C3(config-if)# cable downstream power-level {pwr}
```

Set the power level to match the parameters assigned by the plant designer. Example: **cable downstream power-level 51**

7 (optional) Set the DOCSIS mode using one of the following commands:

```
C3(config-if)# cable mac-mode {docsis}
```

```
C3(config-if)# cable mac-mode {euro-docsis}
```

8 (optional) Set the downstream modulation type using one of the following commands:

```
C3(config-if)# cable downstream modulation 64qam
```

```
C3(config-if)# cable downstream modulation 256qam
```

9 Proceed to *Configuring Upstream Parameters*, page 3-22.

End of procedure

Procedure 3-12 Configuring Upstream Parameters

Follow these steps to configure each upstream cable interface. The parameter **us** refers to the upstream interface ID, **0** to **5**, corresponding to upstreams RX0 through RX5 on the back of the C3 CMTS.

1 Set the upstream mac-mode using one of the following commands:

```
C3(config-if)# cable mac-mode {docsis}
```

```
C3(config-if)# cable mac-mode {euro-docsis}
```

2 Set the upstream channel type, using the following command:

```
C3(config)if)# cable upstream {us} channel-type {type}
```

Where *type* is one of: **tdma, atdma, tdma&atdma**, or **scdma**.

NOTE
All channel types for a particular channel must match the modulation profile selected for that channel. If any channel type does not match the modulation profile, the C3 disables that channel until you correct either the channel type or modulation profile.

3 Set the physical upstream channel width (in Hz) using the following command:

```
C3(config-if)# cable upstream {us} channel-width
{width}
```

The channel width specified must be a DOCSIS-standard upstream channel width.

ATDMA: **6400000** (6.4 MHz)

ATDMA and TDMA: **3200000** (3.2 MHz), **1600000** (1.6 MHz), **800000** (800 KHz), **400000** (400 KHz), or **200000** (200 KHz).

SCDMA: 1600000 (1.6 MHz), **3200000** (3.2 MHz), or **6400000** (6.4 MHz).

Example: **cable upstream 2 channel-width 3200000**

4 Set the physical upstream channel frequency (in Hz) using the following command:

```
C3(config-if)# cable upstream {us} frequency {freq}
```

The valid frequency range is **5000000** (5 MHz) to **42000000** (42 MHz) for North American DOCSIS, and **5000000** (5 MHz) to **65000000** (65 MHz) for EuroDOCSIS.

Example: **cable upstream 2 frequency 25000000**

5 Assign the modulation profile to an upstream using the following command:

```
C3(config-if)# cable upstream {us} modulation-profile
{n}
```

Where *n* is a modulation profile index, **0** to **5**.

The factory default modulation profile for each upstream is profile 1. This profile uses QPSK and is the safest profile to use to get modems online.

6 Set the input power level (the target receive power set during the DOCSIS ranging process) using the following command:

```
C3(config-if)# cable upstream {us} power level {power}
```

The valid power range depends on the channel width; the range **-4** to **14** is valid for all channel widths. See *cable upstream power-level*, page 10-239 for individual ranges.

Example: **cable upstream 2 power level 0**

7 Repeat steps 2 through 5 for each upstream that you need to configure.

Proceed to *Enabling the Interfaces*, page 3-24.

End of procedure

Procedure 3-13

Enabling the Interfaces

Follow these steps to enable the cable interfaces.

1 Enable an upstream cable interface using the following commands:

- For physical interfaces: **no cable upstream [n] shutdown**
- For logical interfaces: **no cable upstream [n.c] shutdown**

Repeat this command for each configured upstream or logical channel.

2 Enable the downstream cable interface using the following command:

```
C3(config-if)# no shutdown
```

The CMTS is now ready to acquire and register cable modems. To display the current CMTS configuration, use the **show running-config** command.

End of procedure

4 Bridge Operation

The C3 CMTS supports IP bridging and routing modes of operation. This chapter describes bridging mode.

For more information, see:

> Chapter 5, *Providing Multiple ISP Access* for information about using bridge groups to separate traffic and provide cable modem access to multiple ISPs.
>
> Chapter 6, *IP Routing* for information about the C3's optional IP routing mode.

Terms and Abbreviations

The following are terms and abbreviations used in this chapter.

booting interface — The Fast Ethernet interface specified in the boot options. Use the **wan** command to specify fastethernet 0/0, or **mgmt** to specify fastethernet 0/1.

bridge binding — Bridge binding maps a sub-interface *A* with VLAN tag *a* to a sub-interface *B* with VLAN tag *b*; packets with tag *a* arriving on sub-interface *A* are immediately bridged to sub-interface *B* with tag *b*, and vice-versa. No other layer 2 bridging rules are followed.

bridge group — A group of sub-interfaces that may forward (bridge) packets to other sub-interfaces in the group. There is no interaction between bridge groups at the MAC level.

default cm subinterface — A designated sub-interface used for cable modem traffic until the cable modem receives an IP address from a DHCP server.

default cpe sub-interface — A designated sub-interface, used as a source sub-interface for CPE traffic when it has no VLAN tag or other explicit mapping (using the **map-cpes** command or VSE method).

native tagging — Cisco routing nomenclature; sub-interfaces using native tagging do not actually tag packets transmitted from that sub-interface, but the tag number is still associated with the sub-interface for internal processing purposes.

routing sub-interface — A sub-interface that supports layer 3 routing. The default sub-interface behavior is layer 2 bridging.

sub-interface — A logical subdivision of a physical interface. The C3 supports up to 64 sub-interfaces per physical interface.

VLAN tag — The VLAN ID, used to associate a cable modem or CPE with a sub-interface. The tag can be specified either in 802.1Q VLAN encapsulated packets; or in native mode, in the cable modem’s VSE.

VSE — Abbreviation for Vendor-Specific Encoding. The VSE is a TLV, stored in the cable modem configuration file, that specifies the VLAN ID used to associate the cable modem’s CPE with a sub-interface. During modem registration, this information is passed to the CMTS allowing the CMTS to map traffic through the modem to a nominated cable subinterface with a matching native VLAN tag.

Bridging Features

The factory default operating mode of the C3 is bridging mode.

In general, normal bridging operation should not be assumed.

- In no configuration does bridging occur between the two Fast Ethernet interfaces.
- Bridging between the FastEthernet interfaces and the cable interfaces is controlled by:
  - the selection of the boot option network interface when no startup-configuration file exists
  - the selection of the boot option network interface when upgrading from release 2.0 to release 4.0 software
  - an existing startup-configuration file; the configuration overrides the boot options
- IP forwarding occurs even though the C3 is running in bridging mode.
- IP forwarding between bridge groups is turned off by default for security reasons.
- IP forwarding between bridge groups (IP traffic allowed to leave a bridge group) may be turned on using the command **ip l2-bg-to-bg-routing** in the interface specification of any interface attached to the bridge group.
- Static routes may be defined using the **ip route** command for:
  - C3 management traffic
  - the DHCP relay agent
  - IP forwarding between bridge groups (using **ip l2-bg-to-bg-routing**)

NOTE
In bridging mode, other cable modem and CPE traffic should be bridged and static routes should **not** be used.

NOTE
Define a default gateway for the C3 using the command *ip default-gateway*, page 10-142 from the CLI. A default gateway has the same purposes and restrictions as a static route.

Bridge Concepts

Bridge Groups

Bridge groups provide the ability to operate self contained and separate MAC domains in one physical device.

A bridge group is defined as a group of interfaces attached to a layer 2 bridge or a common broadcast domain.

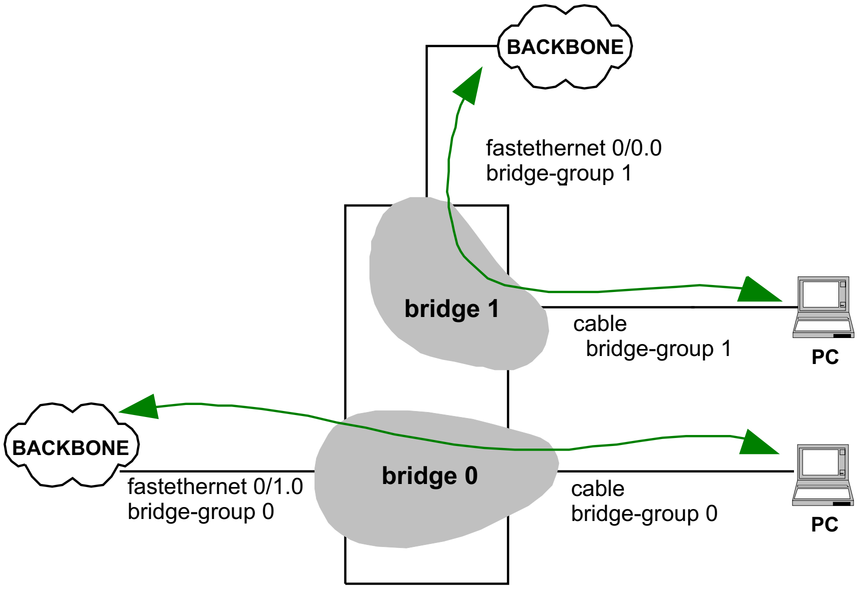


Figure 4-1: Example of a bridge group

When the C3 runs in bridging mode, there is no interaction between bridge groups at the MAC level or layer 2 level—whether by ARP or any other protocol.

The problem with this concept is that although there are two physical FastEthernet interfaces, allowing each to be assigned to a separate bridge group, there is only one physical cable interface. This issue is solved by the use of sub-interfaces.

Sub-Interfaces

Sub-interfaces split a physical interface into multiple logical interfaces to allow more flexibility in creating bridge groups. This allows each sub-interface to have different specifications for:

- bridge group membership
- IP addressing
- DHCP relay address provided to the DHCP server
- DHCP relay mode and helper address
- IP routing e.g. for RIP
- IGMP
- Filtering using both ACL and subscriber management
- C3 management access
- 802.1Q tagging
- other layer 3 parameters

A sub-interface is specified using a "dot" notation as follows:

- Cable 1/0.2 is a sub-interface of the physical interface cable 1/0.
- Similarly FastEthernet 0/1.5 is a sub-interface of the FastEthernet 0/1 physical interface.

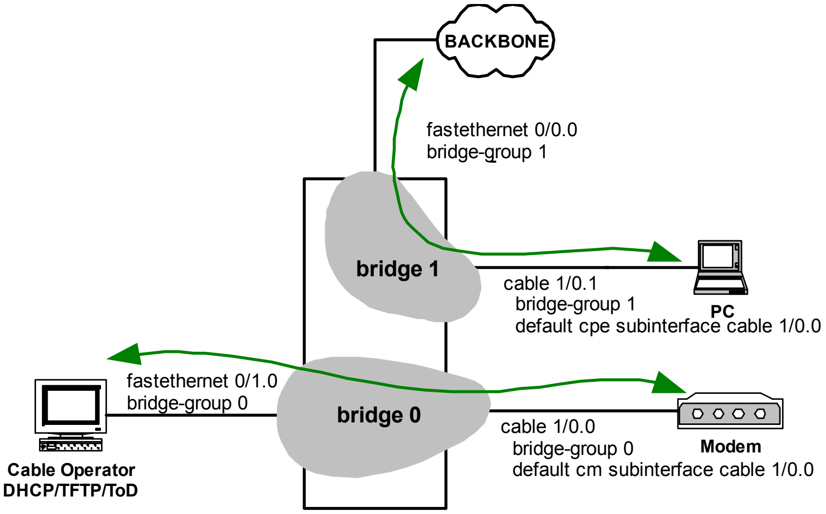


Figure 4-2: Example of a sub-interface to access different bridge groups

The C3 allows one sub-interface to be defined that is not a member of any defined bridge group. This interface is marked as "Management Access Only" in the "show interface" output—and as the description suggests, this interface can only be used to manage the CMTS.

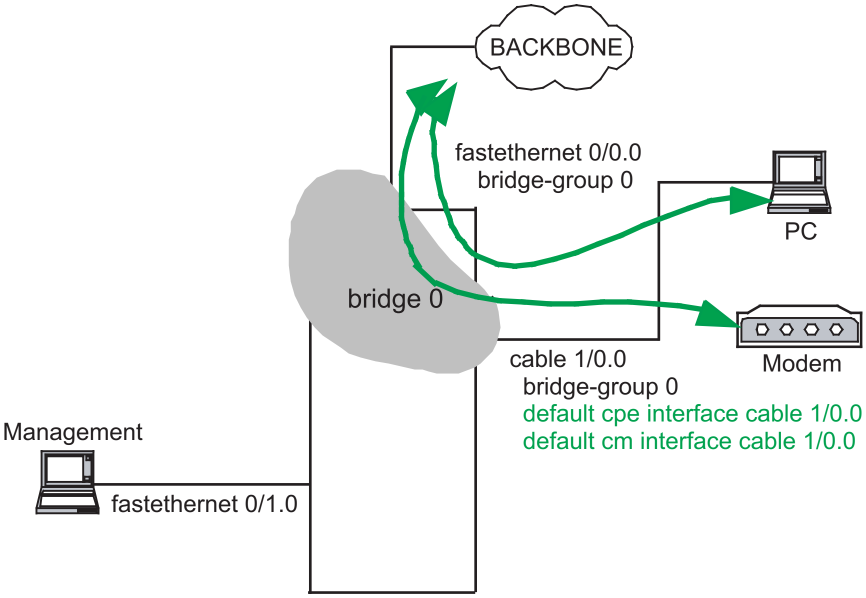


Figure 4-3: Example of a "Management Access Only" interface

The big issue with sub-interfaces is the decision making process of how traffic is mapped from the physical interface to a sub-interface for these different specifications to have an effect. This issue is discussed later in this chapter.

Default Bridge Operation

The factory default mode of operation of the C3 is bridging mode. In this mode, the C3 has two bridge groups. Without the use of the keyed bridge-group licensing feature, each of the two factory defined bridge groups can support a maximum of 2 sub-interfaces; only one may be a cable sub-interface. Without the bridge group license, up to the maximum of 64 subinterfaces may be created and used in static "ip routing" mode but they cannot be connected to a bridge group if the limit of two subinterfaces per bind group is exceeded. Once the bridge-group license is purchased, up to 10 sub-interfaces per bridge group and up to 64 bridge groups is allowed.

The Additional VLAN/Bridge Group License (Product ID 713869) extends the limits to 64 bridge groups, each of which supports up to 10 sub-interfaces with no restriction on the number of cable sub-interfaces. Contact your ARRIS representative for ordering information and other details. See the next chapter for more details about advanced bridging, even if you are not purchasing this license.

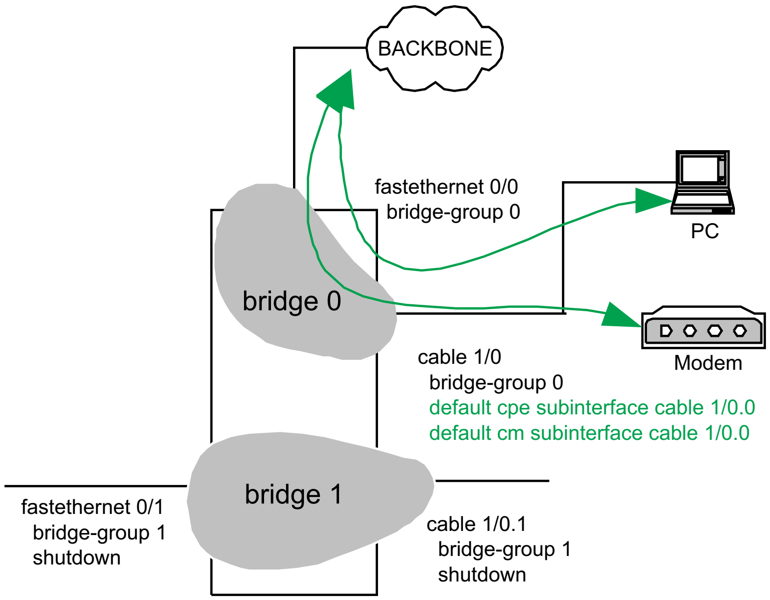


Figure 4-4: Illustration of the default bridge configuration

For more information, see:

- the CLI commands **ip default-gateway** and **ip route** for their relevance in bridging mode
- Appendix B, for sample bridging network configurations.

Selecting the Bridge Group Configuration

The above bridge group configurations may be changed:

- from the boot options using the **wan** or **mgmt** command to select the network interfaces labeled FE0/0 and FE0/1 respectively before a startup-configuration file is created on first power up. This can occur by deleting the existing startup-configuration file (using the **write erase** command) then power cycling, or the first time the C3 is powered up. In either case a default startup-configuration will be created based on the selected boot options network interface.
- by specification from the CLI after the Cadant C3 has been booted (with this configuration subsequently saved to the startup-configuration)

Fast Ethernet 0/0 as the Boot Options Network Interface

This is the factory default mode of operation of the C3.

In this mode, the C3:

- pre-assigns interface fastethernet 0/0.0 to bridge group 0
- pre-assigns interface cable 1/0.0 to bridge group 0
- pre-assigns interface fastethernet 0/1.0 to bridge group 1, and shuts down the interface
- pre-assigns cable 1/0.1 to bridge group 1, and shuts down the interface
- sets "default cm subinterface cable 1/0.0"
- sets "default cpe subinterface cable 1/0.0"
- carries the boot option specified IP address forward into a factory default configuration as the fastethernet 0/0 IP address, and also applies this IP address to the cable 1/0.0 sub-interface (this default configuration can be overwritten from the CLI).

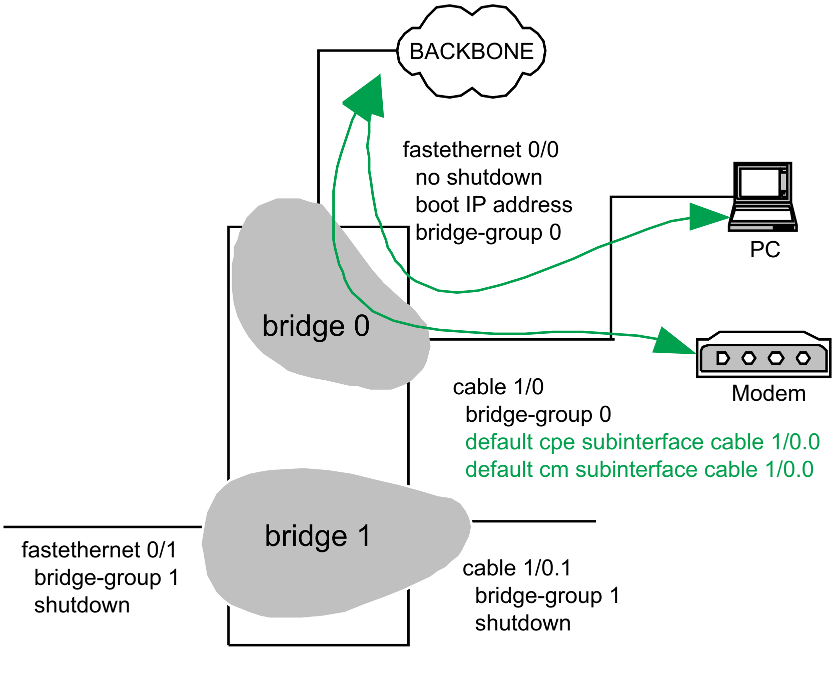


Figure 4-5: Illustration of the factory default configuration

NOTE
All the above settings may be changed at the CLI. For example, you can override the "management" IP address by a running-configuration

specification and subsequently save it to the startup-configuration. You could also assign that IP address to the FastEthernet 0/1.0 sub-interface.

The following is an example network configuration and the CLI commands required to set it up.

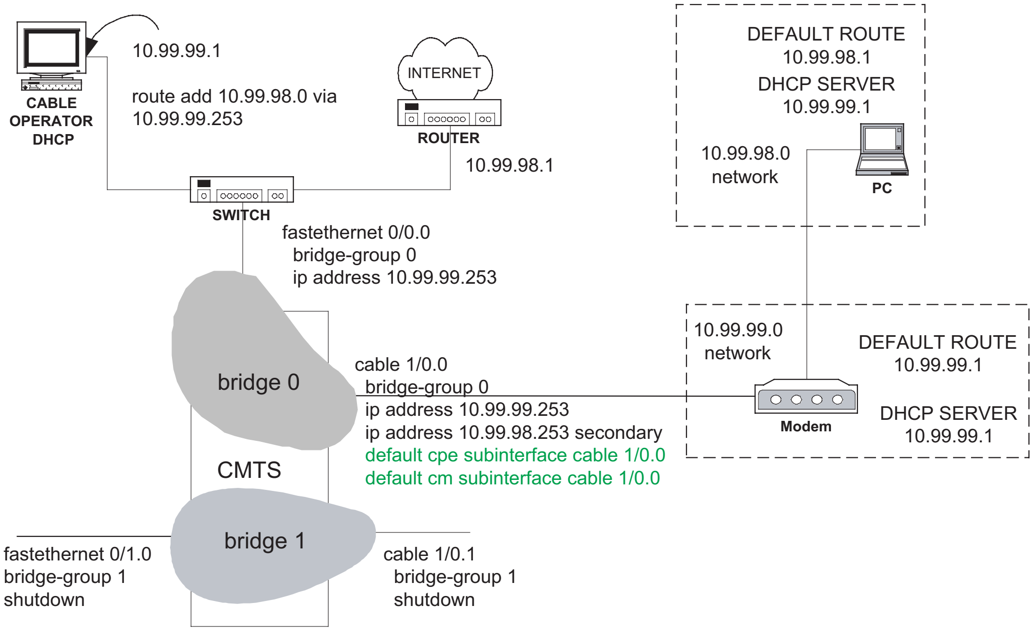


Figure 4-6: Example of a bridging network configuration

```
! if the following is to be pasted to the command line
! then paste from supervisor mode
configure terminal
!
! bridges already set up from factory default
! bridge 0
! bridge 1
!
interface fastethernet 0/0.0
ip address 10.99.99.253 255.255.255.0
bridge-group 0
no ip l2-bg-to-bg-routing
!
interface fastethernet 0/1.0
bridge-group 1
! no IP address required
! do not need running either
```

```
shutdown
!

interface cable 1/0.0
bridge-group 0
no shutdown
no cable upstream 0 shutdown
no cable upstream 0.0 shutdown
ip address 10.99.99.253 255.255.255.0
ip address 10.99.98.253 255.255.255.0 secondary
!
! Update giaddr with 10.99.99.253 for cable-modem
! update giaddr with 10.99.98.253 for host
ip dhcp relay
no ip dhcp relay information option
cable dhcp-giaddr policy
! unicast ALL dhcp to 10.99.99.1
cable helper-address 10.99.99.1
exit
!
interface cable 1/0.1
bridge-group 1
shutdown
!
! nothing to do here in this case
exit
exit
```

Fast Ethernet 0/1 as the Boot Options Network Interface

Selecting the fastethernet 0/1 interface as the boot options network interface, when there is no existing startup-configuration file, pre-assigns the bridge groups to force all cable modem traffic to the fastethernet 0/1 interface, and all CPE traffic to the fastethernet 0/0 interface. This results in "out of band" operation of the C3.

Selecting FE01 as the booting interface:

- pre-assigns interface fastethernet 0/0.0 to bridge group 1
- pre-assigns interface cable 1/0.0 to bridge group 0
- pre-assigns interface fastethernet 0/1.0 to bridge group 0
- pre-assigns cable 1/0.1 to bridge group 1
- sets "default cm subinterface cable 1/0"
- sets "default cpe subinterface cable 1/0.1"
- carries the boot option specified IP address forward into a factory default configuration as the fastethernet 0/1 IP address.

Again, all the above settings may be changed at the CLI.

The following diagram shows data flow in the C3 when fastethernet 0/1 is the boot interface.

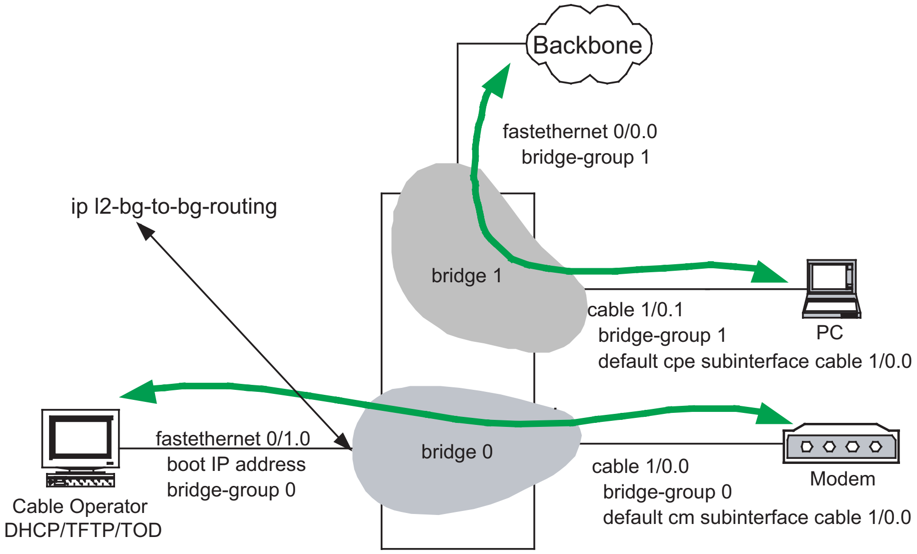


Figure 4-7: Data flow when FastEthernet 0/1 is the boot interface

In this example, DHCP relay must be turned on in the cable 1/0.1 sub-interface specification if CPE DHCP is to be served by a DHCP server on the fastethernet 0/1 sub-interface (MGMT port).

In addition, **ip l2-bg-to-bg-routing** must be enabled on the fastethernet 0/1.0 sub-interface for the CPE DHCP Renew to succeed. The DHCP Relay function relays the Renew from cable 1/0.1 to the fastethernet 0/1.0 sub-interface. The DHCP Renew ACK received at the fastethernet 0/1.0 sub-interface must be routed across bridge groups to cable 1/0.1; and the ACK function is not destined for cable 1/0.1 but it is destined for the CPE. Since the ACK is not relayed by the DHCP Relay function and must be routed by the C3, the fastethernet 0/1.0 must have **ip l2-bg-to-bg-routing** activated.

For more information, see the network examples in Appendix B.

Decide what is Management Traffic

Software releases prior to v3.0 locked the user into accepting cable modem traffic as “management” traffic.

This software release allows the user to decide what is management traffic:

- CMTS traffic only, or
- CMTS and cable modem traffic

By defining the default cable sub-interface for modem traffic to be different than the default for CPE traffic, modem traffic can be removed from the bridge group that contains the CPE traffic. This requires that the modem DHCP, TFTP, and ToD servers be present on the fastethernet 0/1 interface as in the following example.

The following diagram shows the default, version 2.0-compatible, operating mode. CMTS management traffic and cable modem traffic share bridge group 0.

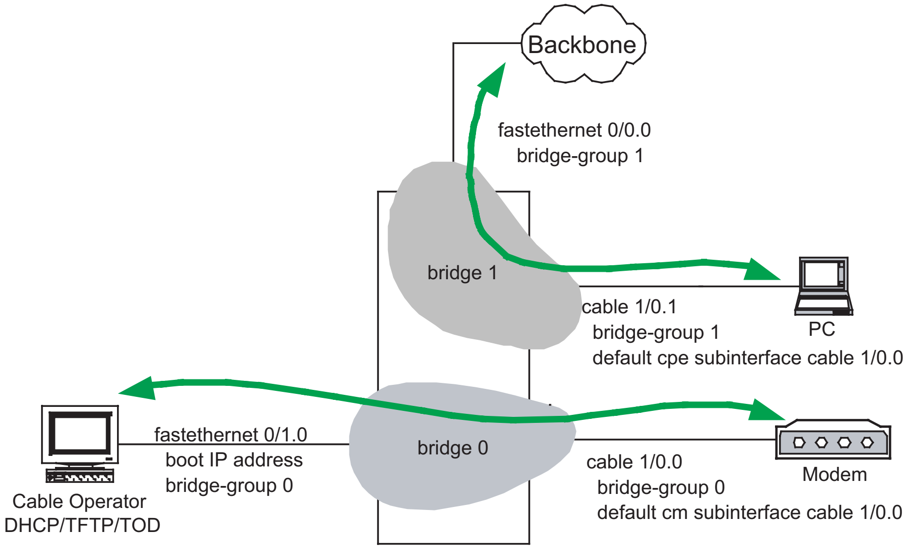


Figure 4-8: Default, V2.0 compatible, operating mode

The following diagram shows bridge group 0 restricted to carrying CMTS management traffic, and bridge group 1 used for all cable modem and CPE traffic.

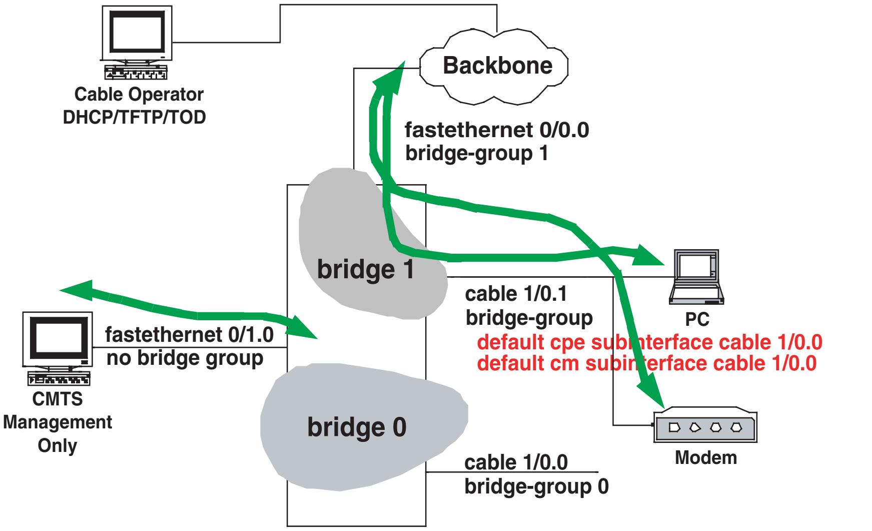


Figure 4-9: Example of Bridge group 0

The following diagram shows bridge group 0 unused, and bridge group 1 used for all cable modem traffic. CMTS management traffic is restricted to a management-only sub-interface. This sub-interface is configured with the CMTS IP address and has **management access** enabled.

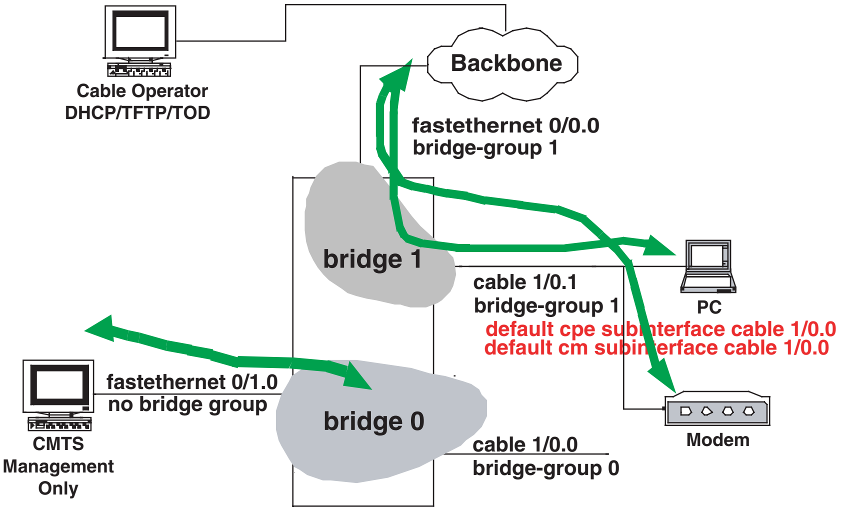


Figure 4-10: Example of Bridge group 1

The final example shows CMTS management traffic on a management-only sub-interface, as before, and cable modem traffic and CPE traffic on separate bridge groups.

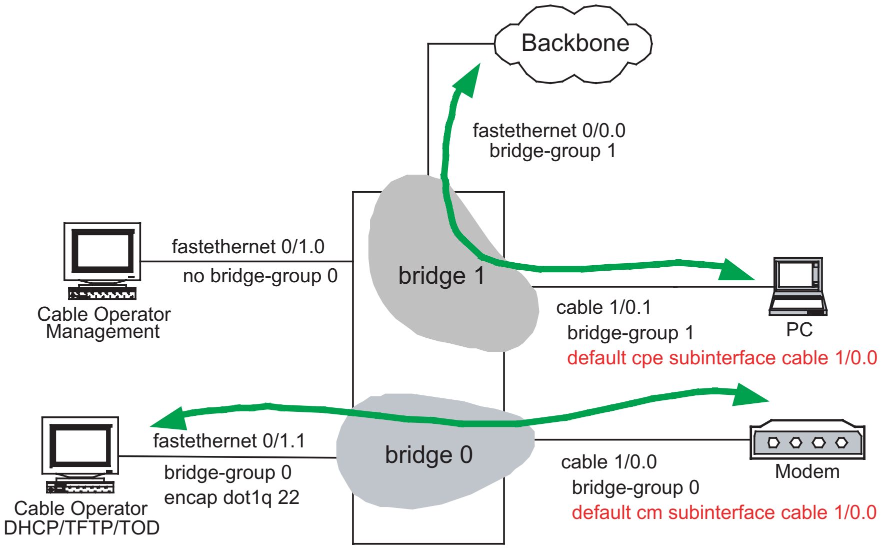


Figure 4-11: Example of CMTS management traffic

Bridge Binding

Bridge binding provides a direct link between a tagged cable sub-interface and a tagged FastEthernet sub-interface.

The cable sub-interface may use a native tag (used with VSE or **map-cpes**) or may use normal 802.1Q tagging. A FastEthernet interface must use 802.1Q tagging for bridge binding purposes.

Using a bridge bind specification can further reduce the broadcast domain. This is especially relevant in the cable interface where the downstream and upstream are treated as separate interfaces in the bridge group. A layer 2 broadcast received at the cable interface is re-broadcast on all interfaces attached to the bridge group. This includes the cable downstream interface if the command **l2-broadcast-echo** is present. This characteristic of the cable interface can be a security risk. Use of the bridge bind is one method provided in the C3 to restrict such broadcasts propagating into the cable downstream or to unwanted Ethernet interfaces.

The following diagram shows the effect of bridge binding on upstream Layer 2 broadcasts:

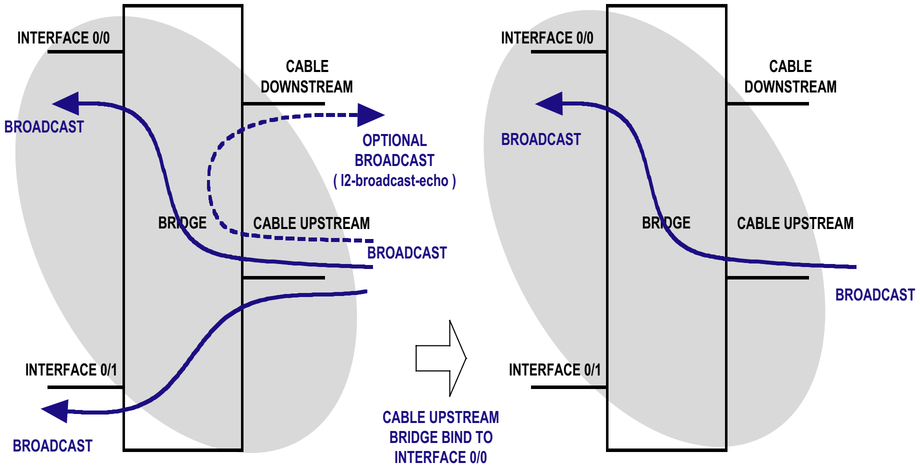


Figure 4-12: Bridge binding on US Layer 2 broadcast

Bridge binding may be used in another way.

If all CPE traffic is allocated to a cable sub-interface (how this is done is described following), it is possible to further restrict this traffic to 802.1Q encoded traffic by specifying an encapsulation command on the cable sub-interface. This would allow a number of 802.1Q VLANs to terminate on the cable sub-interface.

Implementation of the multiple encapsulation commands under the cable and fastethernet interfaces are illegal and will be rejected by the CLI.

This problem is shown in the following figure. The following example shows the legal use of the **bridge bind** command to implement the same configuration as that defined as the problem in the following figure.

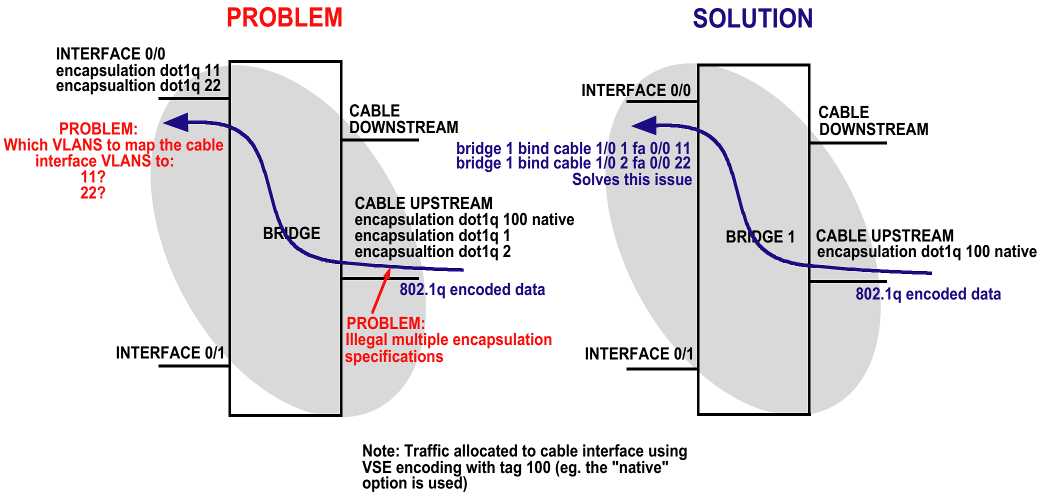

PROBLEM
INTERFACE 0/0
encapsulation dot1q 11
encapsualtion dot1q 22
PROBLEM:
Which VLANS to map the cable interface VLANS to:
11?
22?
BRIDGE
CABLE DOWNSTREAM
CABLE UPSTREAM
encapsulation dot1q 100 native
encapsulation dot1q 1
encapsualtion dot1q 2
802.1q encoded data
PROBLEM:
Illegal multiple encapsulation specifications
INTERFACE 0/1
SOLUTION
INTERFACE 0/0
CABLE DOWNSTREAM
bridge 1 bind cable 1/0 1 fa 0/0 11
bridge 1 bind cable 1/0 2 fa 0/0 22
Solves this issue
BRIDGE 1
CABLE UPSTREAM
encapsulation dot1q 100 native
802.1q encoded data
INTERFACE 0/1
Note: Traffic allocated to cable interface using VSE encoding with tag 100 (eg. the "native" option is used)

Figure 4-13: Example of legal use of the bridge bind command

IP Addressing

A bridge does not require an IP address to operate. The C3 however can be managed over an IP network and thus must be assigned a valid IP address for management purposes.

Due to the nature of operation of a bridge, any interface in either of the two default bridges on the C3 may be assigned an IP address and this IP address may be accessed again from any interface in the same bridge group for management purposes. You can also assign the same IP address to both a cable and fastethernet sub-interface; this allows continued management access if one of the interfaces is shut down for any reason.

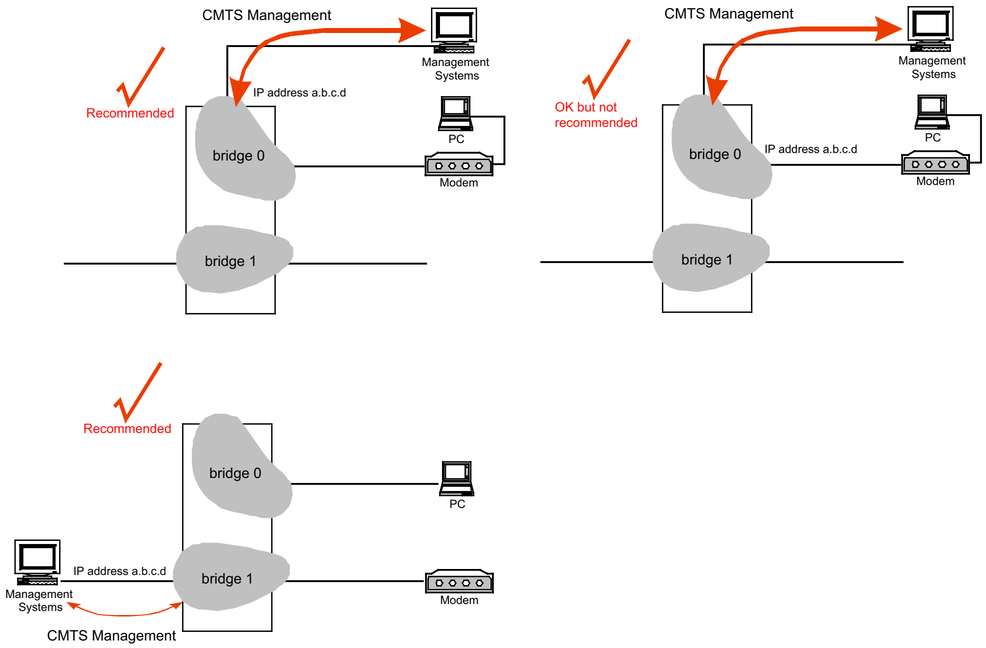


Figure 4-14: Example of IP addressing

This "management" IP address is normally assigned from the serial console and is programmed in the startup-configuration file found on the compact flash disk.

Do not confuse the management IP address with the IP address set in the boot options. The C3 uses the IP address specified in boot options and the booting Fast Ethernet interface only if a TFTP server based boot is required—the IP address provides enough IP information to allow a TFTP server-based boot to occur. This boot option specified address can be copied to a factory default startup configuration as detailed in previous sections of this document but can be changed from the CLI.

As the above diagram shows, you can assign the management IP address to a cable sub-interface. This is not recommended. If the cable interface is shutdown, you cannot manage the C3 from the network. Serial console access is not affected.

Replacing a Legacy Bridging CMTS

If the C3 is to be used in a system where only one IP address is allocated to the CMTS, and C3 DHCP relay is also required, the cable interface must have an IP address for DHCP relay to operate. In this case, in bridging mode, the cable interface can be allocated the same IP address as the "management" Fast Ethernet interface in the same bridge group.

Attaching Bridge Groups

Since a bridge group operates at the MAC layer, it can bridge IP protocols. However, the bridge group forms an isolated MAC domain and only has knowledge of devices connected to it. The bridge group can recognize IP protocols when it is attached to the C3's IP stack.

Attaching a bridge group to the IP stack requires at least one sub-interface in the bridge group to have an IP address, and for that sub-interface to be operationally up.

When a bridge group is attached, whether the C3 is configured for IP routing or bridging mode, IP packets entering the bridge group (whose MAC destination address is an interface on the C3) can now be passed to the C3's IP stack and IP-level communication between bridge groups can occur.

This communication is not always desirable, as it degrades bridge group isolation. Therefore, this function is turned off by default for every sub-interface created from the CLI. Use the sub-interface command **ip l2-bg-to-bg-routing** to allow such IP traffic to leave a bridge group and be passed to the IP stack. In some cases, this is a required step for DHCP to be successful.

In the following example:

- modem traffic is isolated to bridge group 0—the same bridge group that the DHCP server is connected to
- modem DHCP succeeds, even if DHCP relay is not turned on

Now consider the CPE devices:

- All CPE traffic is isolated to bridge group 1
- DHCP relay must be activated on cable 1/0.1 for DHCP from the CPE to reach the DHCP server connected to fastethernet 0/1.0
- DHCP relay requires that cable 1/0.1 be given an IP address.
- The DHCP ack and offer from the DHCP server will be received at fastethernet 0/1.0
- DHCP relay will forward the offer or ack back to the relaying interface—the cable 1/0.1 sub-interface.
- The ACK to a CPE DHCP renew is not captured by the DHCP Relay function (being addressed to the CPE and not the cable 1/0.1 sub-interface) but must be forwarded across bridge groups to the CPE device. For the ACK to be forwarded across bridge groups, **ip l2-bg-**

to-bg-routing again must be specified on fastethernet 0/1.0. No other sub-interface needs an **ip l2-bg-to-bg-routing** specification. CPE traffic is still securely restricted to bridge group 1.

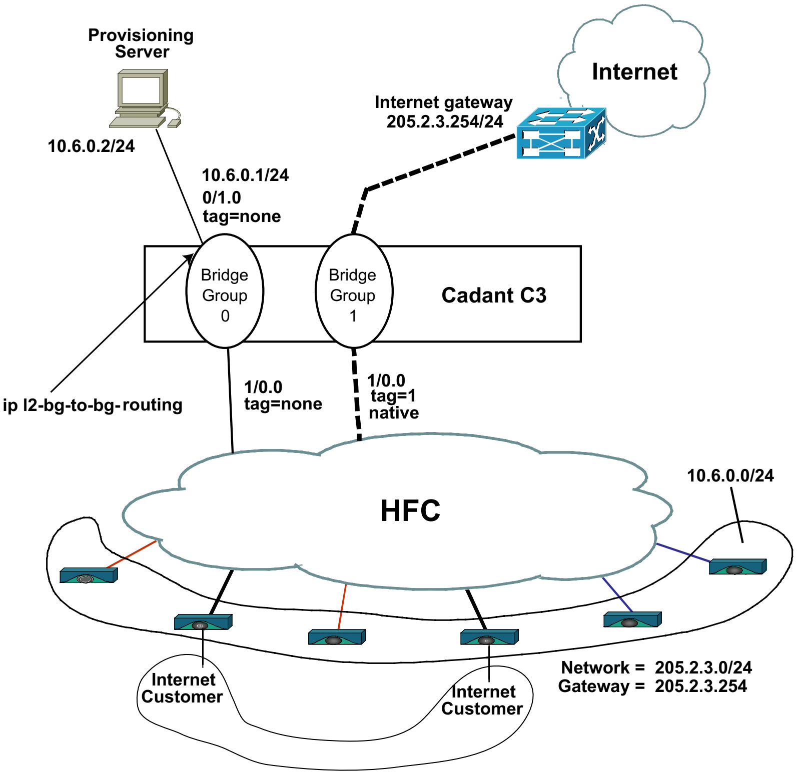


Figure 4-15: Example of attaching bridge groups

Incoming Traffic Allocation to a Sub-Interface

As detailed above, the concept of bridge groups and sub-interfaces is very powerful but hinges on how traffic arriving by a physical interface is allocated to a sub-interface by the Cadant C3.

In summary:

- Fastethernet sub-interfaces use 802.1q VLAN tags
- Cable sub-interfaces use:
  - VSE encoding
  - the **map-cpes** command
  - the **default cpe subinterface**
  - the **cable modem vpn** command

If a mapped frame has an 802.1Q tag, the C3 verifies that the tag is correct for the mapped sub-interface; if the tag does not match, the C3 drops the frame.

Fastethernet Interface

802.1Q VLAN tags are used to allocate incoming packets to FastEthernet sub-interfaces with matching **encapsulation dot1q** specifications.

Only one FastEthernet sub-interface per physical interface may have no encapsulation configured. All untagged traffic is directed to this subinterface. If a second FastEthernet sub-interface is defined with no VLAN tag, the sub-interface configuration is ignored and a CLI message warns of the incomplete configuration and informs the user which is the current untagged sub-interface.

Cable Interface
Default Mapping of CM to a Sub-Interface

If a global specification **default cm subinterface cable X/Y.Z** is present in the C3 global configuration, then all modem traffic received is mapped to the nominated cable sub-interface until the cable modem receives an IP address from DHCP and moves to its correct sub-interface. Note this is a default mapping and will be overridden by any modem IP address based mapping once the modem has an IP address.

If no default is specified, the C3 automatically assigns cable 1/0.0 as the default sub-interface.

Cable Modem IP Traffic

When a cable modem receives a DHCP Ack, the C3 inspects the assigned IP address to determine which sub-interface that the cable modem should be assigned to. The C3 maps all subsequent IP traffic from that cable modem to a sub-interface that has the same subnet specified.

If no subset match can be found in any cable sub-interface specification, the IP packet is mapped to the default cable sub-interface.

CPE Traffic

Upstream CPE traffic may be allocated to cable sub-interfaces using:

- the **cable modem vpn** command
- VSE encoding
- **map-cpes** specification
- **default cpe subinterface** specification

If a mapped frame has an 802.1Q tag, the C3 verifies that the tag is correct for the mapped sub-interface; if the tag does not match, the C3 drops the frame.

Again, one cable sub-interface may have no encapsulation specification. All other cable sub-interfaces must have an encapsulation specification in the form:

- encapsulation dot1q X or
- encapsulation dot1q X *native*

VSE and 802.1Q Native Tagging

The combination of native tagging and VSE encoding is one method that allows CPE traffic to be mapped to a cable sub-interface.

A cable sub-interface with native tagging means that:

- all traffic received at this interface will be internally tagged by the C3 before being passed to the bridge group to which the sub-interface is a member.
- Traffic leaving the bridge group via this natively tagged sub-interface will be tagged as it leaves the C3.

Contrast this behavior with the 802.1Q tagging on a FastEthernet sub-interface where all traffic leaving the C3 is tagged if the FastEthernet sub-interface has an 802.1q tag specification.

Thus native tagging is a means to identify traffic that has arrived at a particular cable sub-interface. This native tagging can also be used to map CPE traffic to a cable sub-interface.

During registration with the CMTS, all modems send a Vendor ID TLV, identifying the modem vendor to the CMTS in addition to any information received by the modem in the configuration file sent to the modem.

A cable modem configuration file may have added to it Vendor Specific Encoding (VSE) that can be used to send proprietary information to a vendor's modems. If a modem receives such information and this information has a vendor_id that does not match that of the modem vendor, the modem ignores this information. Thus a single configuration file may contain vendor specific information for multiple vendors without any impact on modems without a matching vendor_id. This is the original purpose of this DOCSIS feature.

Regardless of whether the modem has a matching vendor_id to the configuration file specified vendor specific information or not, the modem must under DOCSIS specifications send all such received information to the CMTS during registration.

This means that the C3 receives all vendor specific information that the modem received in its configuration file.

NOTE

The C3 ignores all other vendor-specific information; for example, the C3 ignores a Thomson vendor_id.

This mechanism thus provides a method to transfer information from a modem configuration file and the provisioning systems to the C3 during modem registration.

The C3 inspects all vendor specific encoding received during registration and accepts VSE information with an ARRIS vendor ID. This TLV can contain a number that identifies what cable sub-interface native tag all traffic passing through this modem is mapped to.

Thus all CPE traffic passing through a modem that received this configuration file can be mapped to a particular cable sub-interface.

Important: The C3 ignores all other vendor specific information; e.g. the C3 ignores a Thomson vendor_id.

The following diagram shows an example of an ARRIS VSE with a VPN ID of 000Bh (11 decimal)

.

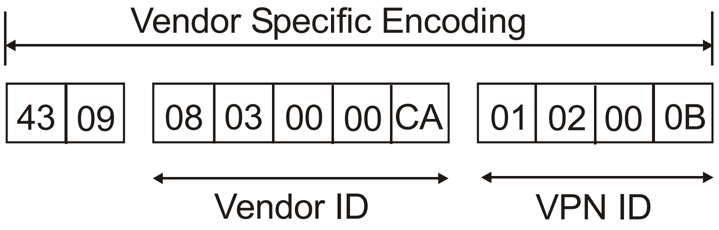
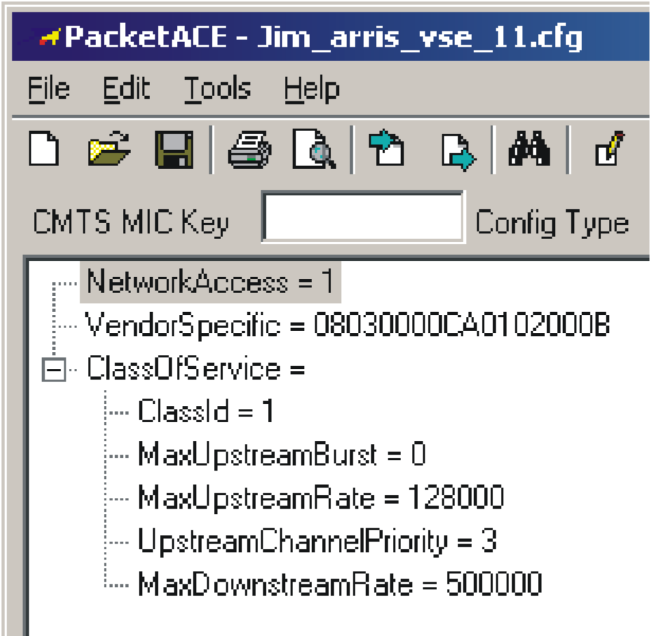


Figure 4-16: Example of ARRIS VSE with a VPN ID of 000Bh

The following diagram shows an example of a configuration file containing such VSE information - a VSE tag of 11 decimal is shown:



```
NetworkAccess = 1
VendorSpecific = 08030000CA0102000B
ClassOfService =
    ClassId = 1
    MaxUpstreamBurst = 0
    MaxUpstreamRate = 128000
    UpstreamChannelPriority = 3
    MaxDownstreamRate = 500000
```

Figure 4-17: Example configuration file with VSE information

If no VSE messages are received from a modem during registration, traffic from any attached CPE devices will be allocated using any **cable modem vpn** specification, **map-cpes** specification or **default cpe subinterface** specification. If no default is specified, the C3 automatically assigns cable 1/0.0 as the default sub-interface.

Example: — Let us first review quickly how standard non-DOCSIS aware DHCP servers allocate IP addresses.

DHCP servers use the giaddr IP address—the relaying IP address—to indicate from which address pool an IP address should be allocated from. It is thus important that the relaying address or the giaddr address be a meaningful address on the relaying device.

Defining cable sub-interfaces for CPE devices allows this to happen. Each cable sub-interface can have a different IP address specification with the IP address being used to populate the giaddr field as determined by the DHCP specifications of this sub-interface.

```
configure terminal
bridge 13
```

```
cable 1/0.0
! for modem only
bridge-group 0
ip address 10.99.99.1 255.255.255.0
ip DHCP relay
cable helper-address 10.0.0.1 cable-modem
cable dhcp-giaddr primary

cable 1/0.11
! for cpe with IP address
bridge-group 1
! define ip address
ip address 10.11.0.1 255.255.255.0
ip DHCP relay
cable helper-address 10.0.0.1 host
cable dhcp-giaddr primary
! for CPE traffic via modem with VSE tag = 11
encapsulation dot1q 11 native

cable 1/0.13
! for cpe layer 2 forwarding
! for CPE traffic via modem with VSE tag = 13
bridge-group 13
encapsulation dot1q 13 native
```

map-cpes

The ***map-cpes*** command allows re-direction of CPE traffic attached to a modem to a specified cable sub-interface.

Once a modem is allocated an IP address, the modem is mapped to any cable sub-interface that has a matching subnet. Thus if modems are allocated to different subnets, they can be mapped by the C3 to different cable sub-interfaces.

If a **map-cpes** specification is in place in the cable sub-interface that the modem is allocated to, all incoming CPE frames arriving via this modem are allocated to the specified cable sub-interface.

Example:

```
configure terminal
bridge 11
interface fastethernet 0/0.1
bridge-group 11
encapsulation dot1q 111

interface cable 1/0.0
! for modem only
bridge-group 0
ip address 10.99.99.1 255.255.255.0
ip dhcp relay
cable helper-address 10.0.0.1 cable-modem
cable dhcp-giaddr primary
map-cpe cable 1/0.11

interface cable 1/0.11
! for cpe bridging
bridge-group 11
! accept 802.1q tagged frames only
encapsulation dot1q 11
```

Default Mapping of CPE to a Sub-Interface

If a the global specification **default cpe subinterface cable X/Y.Z** is present in the Cadant C3 global configuration, the C3 maps all CPE traffic from any modem that cannot be mapped to any sub-interface to the this nominated default cable sub-interface and hence to a default cable VPN. Note this is a default mapping and is overridden by any VSE or **map-cpes** based mapping.

If no other form of mapping is used then the default mapping is cable 1/0.0 (the default cable sub-interface).

Cable Modem VPN

The standard modem configuration file VSE mechanism to map a modem's CPEs to a particular subinterface has been augmented by the addition of command-line facilities, the **cable modem VPN** command.

When cable modem X.X.X registers, traffic to and from all devices behind modem X.X.X will be mapped to the cable subinterface which has VLAN-TAG configured. This command is very useful when modem configuration file modifications are not possible or the number of cable modems is small.

If the cable modem in online when this command is issued, no changes will take place until the cable modem is rebooted.

CPE 802.1Q Traffic

The C3 uses 802.1Q tags for verification and binding purposes.

If a mapped incoming frame has an 802.1Q tag, the C3 verifies that the tag is correct for the mapped sub-interface; if the tag does not match, the C3 drops the frame.

If the incoming frame has an 802.1Q header but this frame is mapped to a cable sub-interface by a **map-cpes** specification, the mapped sub-interface must have a matching 802.1Q tag for this frame to be accepted.

In either case, the C3 passes the frame to the bridge group this cable sub-interface is a member of, bridging the frame to other sub-interfaces assigned to the bridge group.

Frames bridged to fastethernet sub-interfaces are treated as follows:

- If the fastethernet sub-interface has an encapsulation specification, the C3 encodes the frame with this tag and the frame leaves the CMTS with an 802.1Q encoding.
- If the fastethernet sub-interface does not have an encapsulation specification, the C3 strips the 802.1Q header and the frame leaves the CMTS untagged.

Note that the cable interface 802.1Q tag can be different from the fastethernet interface 802.1Q tag.

Example:

```
configure terminal
bridge 11
!
fastethernet 0/0.1
bridge-group 11
encapsulation dot1q 111

cable 1/0.0
! for modem only
bridge-group 0
ip address 10.99.99.1 255.255.255.0
ip dhcp relay
cable helper address 10.0.0.1 cable-modem
cable dhcp-giaddr primary
map-cpes cable 1/0.11

cable 1/0.11
! for cpe bridging
bridge-group 11
! accept 802.1q tagged frames only
encapsulation dot1q 11
```

bridge bind

The bridge bind can be used to bind a cable sub-interface directly to a FastEthernet sub-interface as detailed earlier. A bridge-bind can also be used with VSE and 802.1Q native encoding.

The following example shows CPE traffic mapped to a cable sub-interface using VSE encoding. All traffic is bridged and VLAN tagged on exit from the bridged fastethernet sub-interface.

A series of bridge-bind specifications also adds support for 802.1Q tagging to this cable sub-interface cable 1/0.13. This facility has been used by a customer to provide tiered services inside the VPN formed by the combination of the mapping of CPE traffic to this cable sub-interface and the use of the command **encapsulation dot1q xx encrypted-multicast** to provide downstream broadcast privacy to CPE using this cable-sub-interface.

Example:

```
Bridge 0
Bridge 1
bridge 2

int fa 0/0.0
! management ip address
ip address 10.1.0.1 255.255.255.0
bridge-group 0

int fa 0/0.13
bridge-group 2
! no ip address
encapsulation dot1q 13

int cable 1/0.0
! for modem only
ip address 10.99.99.1 255.255.255.0
bridge-group 0
ip dhcp relay
cable helper-address 10.0.0.1 cable-modem
map-cpes ca 1/0.13

int cable 1/0.13
bridge-group 2
! for cpe layer 2 forwarding
encapsulation dot1q 13 native
! create VPN privacy
encapsulation dot1q 13 encrypted-multicast

exit

! all traffic ariving at cable 1/0.13
! check for tag 4, bridge to fa 0/0.13
! and tag with 44 before leaving
bridge 2 bind cable 1/0.13 4 fastethernet 0/0.13 44

! all traffic ariving at cable 1/0.13
! check for tag 5, bridge to fa 0/0.13
! and tag with 55 before leaving
bridge 2 bind cable 1/0.13 5 fastethernet 0/0.13 55
```

Transparent bridging

One way the C3 applies VLAN tags on a subinterface is with the **encapsulation dot1q tag** command explained above. In addition, it is now also possible to configure the subinterface so that other tag values will also “map” to that subinterface. Use the following command:

```
encapsulation dot1q allow {tag[-tag] [,tag]}+
```

It is possible to have multiple **encapsulation dot1q allow** commands to fully specify which VLAN tags terminate on the subinterface.

Example:

```
interface cable 1/0.9
bridge-group 9
encapsulation dot1q9
encapsulation dot1q 9 encrypted multicast !! if
requried
encapsulation dot1q allow 101-199, 801-899
encapsulation dot1q allow 1200, 1205, 1599
end
```

The above sets Cable 1/0.9 to use tag 9 as before but also allows tags 101-199, 801-899, 1200, 1205 and 1599.

To ensure transparent bridging, all subinterfaces in a bridge-group should have the same encapsulations configured. Tagged packets arriving on one sub-interface destined for transmission out the other will then be passed with the tag “intact.”

Overlapping VLAN tag ranges are not allowed on different subinterfaces of the same physical interface.

To remove allowed tags from a subinterface, use the no form of the command:

```
no encapsulation dot1q allow 101-199, 801-899
no encapsulation dot1q allow 1-4094 !! removes all
‘allows’
```

The “primary” encapsulation (eg. **encapsulation dot1q *n***) cannot be removed in this manner but must be explicitly removed as before. The “allows” are just that — other tags which are also handled by the interface.

To ping a CPE which is in a transparently-bridged bridge-group, the C3 must have an ARP entry for the CPE. However, if the C3 doesn’t know the appropriate VLAN tag, the ARP will never reach the CPE. To overcome this, the ping command has been extended to allow the operator to enter the initial-arp-vlan-tag.

For example:

```
ping 1.2.3.4 arp-vlan 18
```

would cause the ARP for 1.2.3.4 to be tagged with 18. If the C3 already had an ARP table entry for 1.2.3.4, then the entry would be used and no ARP would be generated.

Traffic allocation—summary

The C3 processes incoming cable modem packets as follows:

- Before the cable modem receives an IP address, the C3 assigns all incoming packets from that cable modem to the default CM sub-interface.
- When the cable modem receives a DHCP Ack, the C3 inspects the assigned IP address and uses that to assign further cable modem packets to a sub-interface.

The C3 processes incoming CPE packets in the following order:

1. Check for the existence of the **cable modem VPN** command. If it exists, map all CPEs to the specified VLAN tag; then go to step 5.
2. Check for modem based VSE encoding and map the traffic to a cable sub-interface with an encapsulation tag matching the VSE tag allocated to the modem; then go to step 5.
3. Check the sub-interface the attached modem is assigned to for a **map-cpes** specification; if found, map the CPE traffic to the specified cable sub-interface, then go to step 5.
4. Check for default mapping of CPE to a cable sub-interface using the **default cpe-subinterface** specification and map CPE traffic to this cable sub-interface; then go to step 5.
5. Check for CPE-based 802.1Q VLAN tagging against the mapped sub-interface VLAN specification (specified under the cable sub-interface or using a bridge-bind specification). Bridge the frame with a matching tag and drop the frame if:
   - the VLAN specification does not exist, or
   - the VLAN specification exists but does not match the frame
6. Check that the sub-interface exists and is active. If not active or does not exist then drop the data frame.

This testing is performed for modem-sourced frames and CPE-sourced frames arriving via a cable modem.

The only test above that is relevant to a cable modem is the test allowing modems to be allocated to cable sub-interfaces based on the allocated modem IP address.

5 Providing Multiple ISP Access

Open Access

Open access is an operating concept that allows a subscriber to choose from a number of ISPs. On a practical networking side, open access requires that a subscriber CPE device attached to a cable modem be given a default route that is not associated with any of the cable modem plant. Typically this default route would be the gateway IP address of the chosen ISP's edge router.

Open access support is limited in the C3 to bridging mode only. In IP routing mode, the C3 requires that the CPE device have a default route of the nearest router—in IP routing mode, the nearest router is the C3 cable interface. The C3 as a whole has only has one default route and all CPE traffic would have to use this route thus not allowing an ISP edge router to be selected as the subscriber CPE device default.

The following example shows an open access system implemented with a C3 in bridging mode with three ISPs. Two of the ISPs issue their own IP address; one ISP requires the cable operator to issue CPE IP addresses. In each case, the router option passed to the CPE device is that of the ISP gateway routers and is independent of the cable modem plant.

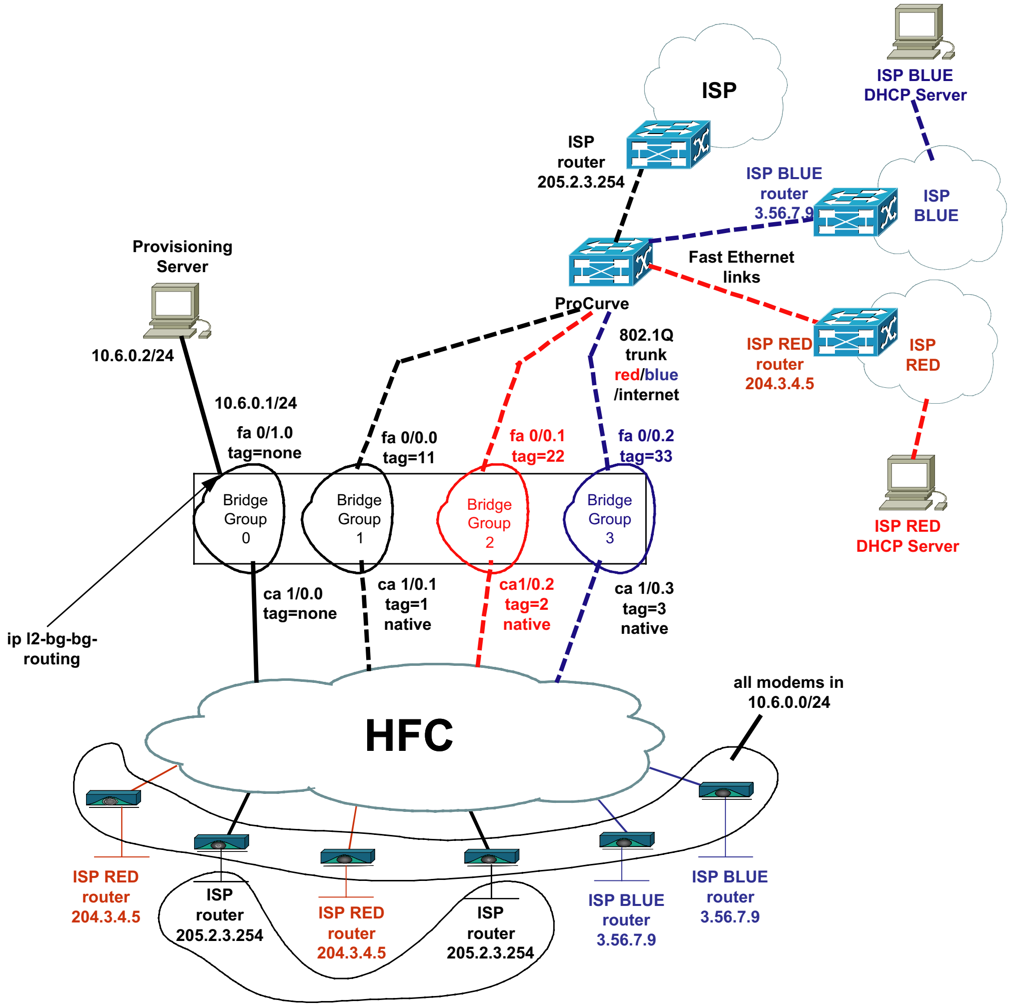


Figure 5-1: Example of an Open Access system

Cable-VPN Implementation

VLANs, combined with the ability to create native VLANs on the cable sub-interfaces may be used to create virtual private networks. In the above example, each subscriber would in effect be provisioned by the cable operator to join one of three virtual private networks, each virtual private network being connected to a single ISP.

Subscribers assigned to an ISP in the above example by the provisioning system can have complete downstream privacy from subscribers assigned to other ISPs, as follows:

- Downstream broadcast privacy
- Downstream unicast privacy
- Upstream unicast/broadcast privacy

The following discussion refers to a native VLAN with downstream privacy enabled as a *cable-VPN*.

All physical interfaces may have up to 64 sub-interfaces defined allowing up to 63 native VLANs to be defined per Cadant C3.

```
interface cable 1/0.0
bridge-group 1
encapsulation dot1q 33 native ! create native vlan
encapsulation dot1q 33 encrypted-multicast ! add
downstream privacy
exit
```

When this is done, the native VLAN provides downstream privacy for its members and is described following as a cable-VPN.

Traffic arriving on one interface with tag *X* will be bridged out to the other interface with tag *X*. Effectively, this allows 4094 VLANs. The number of bridge groups supported remains at 64.

Example:

```
configure terminal
interface cable 0/0.1
   encapsulation dot1q 1 !! as per normal
   encapsulation dot1q allow 1-4094
   bridge-group 1
interface cable 1/0.1
   encapuslation dot1q 1 !! as per normal
   encapsulation dot1q allow 1-4094
   bridge-group 1
   end
```

Cable-VPNs may use IP routing or bridging modes, or both, or may even decode or encode 802.1Q VLANS inside the cable-VPNs as required.

The provisioning systems may assign subscribers to a cable-VPN by the IP address assigned to the modem the subscriber uses or alternatively by the configuration file the modem receives from the provisioning system.

Assignment to a cable-VPN by modem IP address allows legacy provisioning systems to be compatible with the ARRIS Cadant C3 cable-VPN facility. No configuration file modifications are required. This method restricts the number of supported cable-VPNs to 31 (one cable modem sub-interface for every mapped CPE sub-interface) and the DHCP server must support a method to assign a modem an IP address outside the subnet of the giaddr (relay address) in the modem DHCP discover.

Assignment to cable-VPNs by a configuration file allows the full number of 63 cable-VPNs to be implemented but in this case, the DHCP server must support assignment of DHCP options (modem configuration file) to individual modems.

In either case, CPE are mapped to a specific cable sub-interface with native VLAN tagging with the properties of this cable sub-interface defining the properties of the cable-VPN.

- A layer 2 (bridged) cable sub-interface allows all layer 2 protocols inside the cable-VPN.
- When IP routing is active, a layer 3 sub-interface with **ip source-verify subif** specified only allows IP protocols inside the VPN and only source addresses within the subnets associated with the cable sub-interface (primary subnet and up to 15 secondary subnets per sub-interface).
- A hybrid layer 2 + 3 sub-interface allows both IP and layer 2 protocols.

All cable-VPN sub-interfaces are bridged using bridge groups or IP routed to FastEthernet sub-interfaces.

The C3 FastEthernet sub-interfaces use 802.1Q to propagate the bridged cable-VPN traffic into the operator backbone by maintaining privacy using 802.1Q tagging.

For Open Access purposes, we only consider bridged cable sub-interfaces as discussed above.

Using the Modem IP Address to allocate CPE to a VPN

This example uses the C3 **map-cpes** command.

Modems are issued IP addresses in different subnets. Modems are mapped to cable sub-interfaces by matching the assigned modem IP address to a matching cable sub-interface subnet. Modem cable-sub-interfaces in turn have a **map-cpes** specification that maps all CPE traffic (for CPE attached to these modems) to the cable sub-interface specified by the **map-cpes** command.

Items to note in the following example:

- Select the **no ip routing** mode of operation. This allows the CPE default route or gateway to be specified by the cable operator in the DHCP options given to the CPE and to be different to any IP addressing on the C3. Normally the CPE default route should be directed to the gateway router of the ISP the CPE is to be provisioned to use.
- All CPE traffic is bridged thus layer 2 protocols are supported.
- A default cable-VPN has been created for un-provisioned subscribers. This cable-VPN maps to an Ethernet VLAN directing un-provisioned subscribers to a specific subnet and backbone VLAN allowing access only to the provisioning web server.
- A default modem cable sub-interface has been created. All modem DHCP discover broadcasts are mapped to this cable sub-interface. This cable sub-interface is a member of bridge group 9. A sub-interface of the MGMT port is configured as a member of this bridge group and has a VLAN tag of 999, the same VLAN tag of the DHCP server.
- Once modems have an IP address, modem traffic is allocated to cable sub-interfaces by modem source IP address match to sub-interface subnet. All modem sub-interface are members of bridge group 9 and are thus connected to the DHCP server using tag 999. These sub-interfaces contain the map-cpes specifications re-directing CPE traffic to other (or the same) cable sub-interfaces and hence cable-VPNs.

The following shows the network diagram for this example.

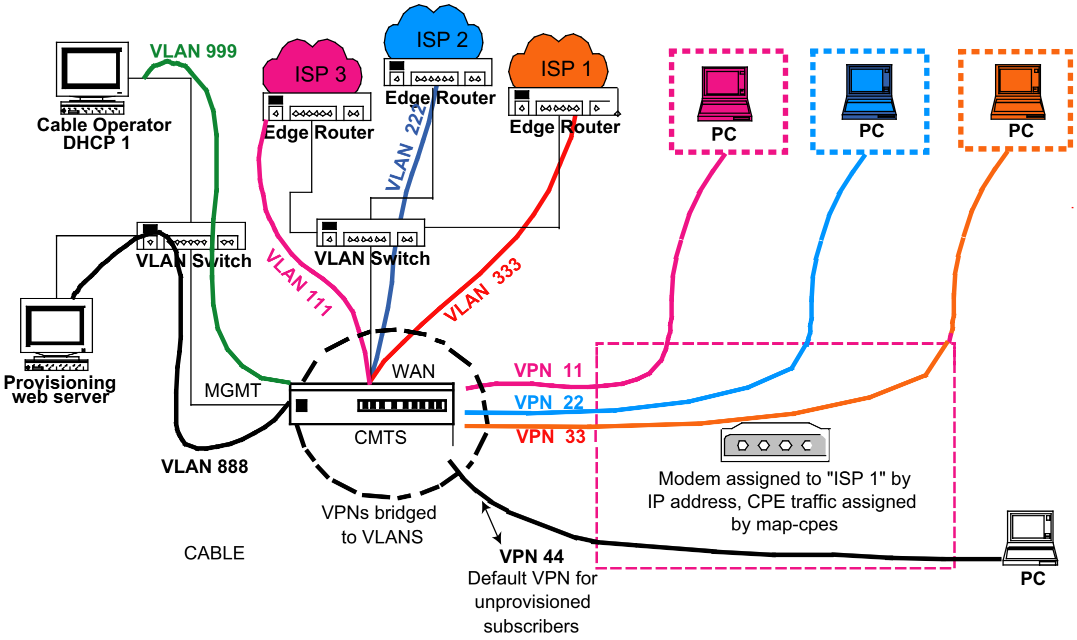


Figure 5-2: Example network diagram

The following shows how the C3 bridges data flowing through the above network.

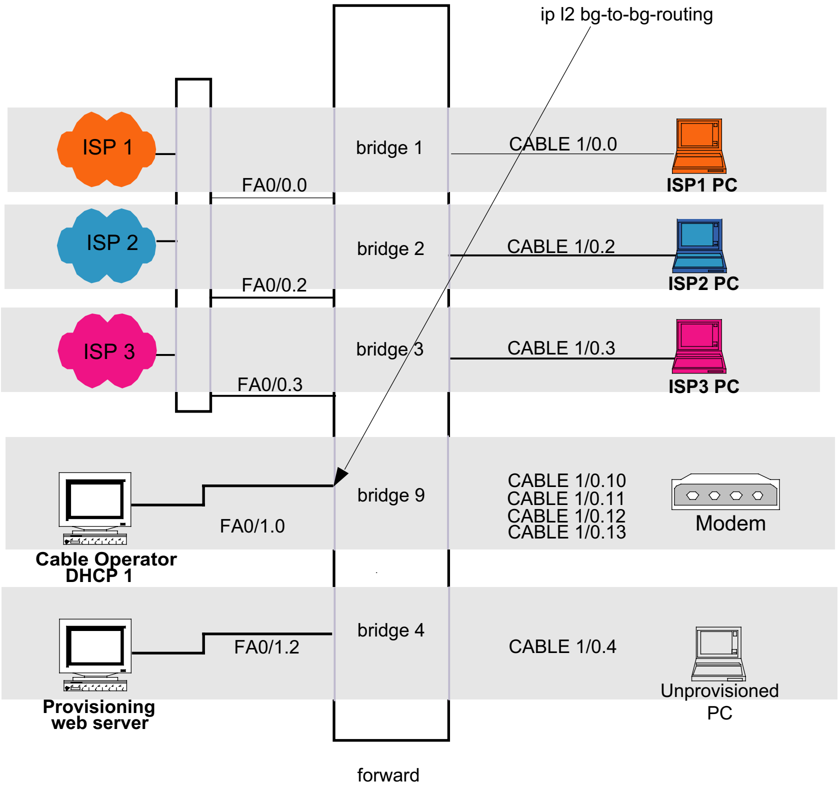


Figure 5-3: Bridging data flow through the C3

Configuration

Run the following as a script on a factory default C3 configuration:

```
!
conf t
!
! remove the factory default assignments
!
! remove bridges 0 and 1 so no sub-interfaces are attached
no bridge 0
no bridge 1
int ca 1/0
!
! remove any previous ip addresses from the cable interface
no ip address 10.99.99.253 255.255.255.0
exit
! remove the cable 1/0.1 subinterface
! as factory defined but not going to be used
no int ca 1/0.1
!
```

```
no ip routing
!
! set default subinterface for cm and cpe taffic
!  before  cm has an IP address
default-cm-subinterface cable 1/0.10
! catch any unknown CPE and direct to
! the provisioning web server
default-cpe-subinterface cable 1/0.4
!
! Define the bridges we will use
! for ISP1 traffic
bridge 1
! for ISP2 traffic
bridge 2
! for ISP3 traffic
bridge 3
! for provisioning server traffic
bridge 4
! bridge 9 used for cm dhcp discover
! and management access to CMTS
! all cm will have access to this bridge group no
! matter what ip address they end up with
bridge 9
!
int fa 0/0.0
description ISP1
! no ip address
bridge-group 1
encapsulation dot1q 111
no ip l2-bg-to-bg-routing
exit
!
int fa 0/0.2
description ISP2
! no ip address
bridge-group 2
encapsulation dot1q 222
no ip l2-bg-to-bg-routing
exit
!
int fa 0/0.3
description ISP3
! no ip address
bridge-group 3
encapsulation dot1q 333
no ip l2-bg-to-bg-routing
exit
!
interface fa 0/1.0
description Management
ip address 10.99.99.2 255.255.255.0
! NOTE: CMTS management can only occur from this VLAN
encapsulation dot1q 999
management-access
bridge-group 9
ip l2-bg-to-bg-routing
! ip address should be in subnet of DHCP server
! this is also the CMTS management address
!
! DHCP server should have static routes added
! for each CPE subnet with this address as the gateway
! e.g.
!     route add 10.1.0.0 mask 255.255.255.0 10.99.99.2
!     route add 10.2.0.0 mask 255.255.255.0 10.99.99.2
!     route add 10.3.0.0 mask 255.255.255.0 10.99.99.2
! so that CPE DHCP ofer and ack can be routed back to
! the appropriate bridge group and hence CPE device
! Note: dhcp relay must be active in all CPE bridge
! groups for this to happen and only DHCP will be routed
exit
!
interface fa 0/1.2
description Provisioning
! ip address should be a subnet
! of provisioning web server
ip address 10.88.88.2 255.255.255.0
encapsulation dot1q 888
no management-access
bridge-group 4
no ip l2-bg-to-bg-routing
exit
!
interface cable 1/0.0
description ISP1_CPE
ip address 10.1.0.1 255.255.0.0
! Note: up to 15 secondary IP addresses can be added
! for non contigous ISP subnets
no management-access
! set up dhcp relay for CPE devices
! must have dhcp relay active in each bridge group
! for dhcp to be forwarded across the bridge groups
! to the dhcp server in bridge-group 9
ip dhcp relay
cable helper address 10.99.99.1
no ip dhcp relay information option
! native tagging required for internal processing
encapsulation dot1q 1 native
! turn on downstream broadcast privacy
encapsulation dot1q 1 encrypted-multicast
bridge-group 1
no ip l2-bg-to-bg-routing
exit
!
interface cable 1/0.2
description ISP2_CPE
ip address 10.2.0.1 255.255.0.0
no management-access
ip dhcp relay
cable helper address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 2 native
! turn on downstream broadcast privacy
encapsulation dot1q 2 encrypted-multicast
bridge-group 2
```

```
no ip l2-bg-to-bg-routing
exit
!
interface cable 1/0.3
description ISP3_CPE
ip address 10.3.0.1 255.255.0.0
no management-access
ip dhcp relay
cable helper address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 3 native
! turn on downstream broadcast privacy
encapsulation dot1q 3 encrypted-multicast
bridge-group 3
no ip l2-bg-to-bg-routing
exit
!
interface cable 1/0.4
description UNPROVISIONED_CPE
! ip address should be in the subnet of the
! provisioning server
ip address 10.4.0.1 255.255.0.0
no management-access
ip dhcp relay
cable helper address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 4 native
! turn on downstream broadcast privacy
ecnapsulation dot1q 4 encrypted-multicast
bridge-group 4
no ip l2-bg-to-bg-routing
exit
!
interface cable 1/0.10
description modem_default
! default for cm devices before they have IP address
ip address 10.77.77.1 255.255.255.0
no management-access
encapsulation dot1q 10 native
bridge-group 9
ip address 10.77.77.1 255.255.255.0
no management-access
! set up dhcp relay for cm
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
! map attached CPE to the provisioning server
! if a cm is stil lusing this subinterface
! then cm has not been provisioned yet
map-cpes cable 1/0.4
!
exit
!
interface cable 1/0.11
description modem_isp1
! for cm devices for ISP 1 once cm has IP address
```

```
ip address 10.11.0.1 255.255.0.0
encapsulation dot1q 11 native
bridge-group 9
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no management-access
! map all cpe traffic
map-cpes cable 1/0.1
exit
!
interface cable 1/0.12
description modem_isp2
! for cm devices for ISP 2 once cm has IP address
ip address 10.12.0.1 255.255.0.0
encapsulation dot1q 12 native
bridge-group 9
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no management-access
map-cpes cable 1/0.2
exit
!
interface cable 1/0.13
description modem_isp3
! for cm devices for ISP 3 once cm has IP address
ip address 10.13.0.1 255.255.0.0
encapsulation dot1q 13 native
bridge-group 9
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no management-access
map-cpes cable 1/0.3
exit
!
interface cable 1/0.0
! Get rf running
! not no rf configuration here so check the factory
! defaults are ok
no cable upstream 0 shutdown
no cable upstream 1 shutdown
no shutdown
no management-access
! no ip address as sub-interface is not used
exit
!
exit
```

Using a Modem Configuration File to Allocate CPEs to a VPN

This example uses the Cadant C3 Vendor Specific Encoding in the modem configuration files to map CPE attached to modems to specific cable sub-interfaces and hence to specific cable-VPNs and backbone 802.1Q VLANs.

The following example:

- Uses fewer (one only) cable sub-interfaces for modems than the map-cpes method
- Uses VSE encoding to map CPE traffic to cable sub-interfaces with native VLAN specifications (cable-VPN) and hence to bridge-groups and hence to Ethernet sub-interfaces and hence to Ethernet backbone 802.1Q VLANS.

Items to note in the following example:

- A default cable-VPN has been created for un-provisioned subscribers. Modems given a configuration file with a VSE encoding of 44 will force attached CPE devices to the backbone 802.1Q VLAN with a tag of 888. This Ethernet VLAN connects to the provisioning web server.
- A default modem cable sub-interface has been created. All modem traffic before an IP address is allocated to the modem is mapped to this cable sub-interface. This cable sub-interface is a member of bridge group 9. A sub-interface of the MGMT port is configured as a member of this bridge group and has a VLAN tag of 999. As there are no sub-interfaces defined with matching subnets to that allocated for modems, all modem traffic will remain mapped to this interface.

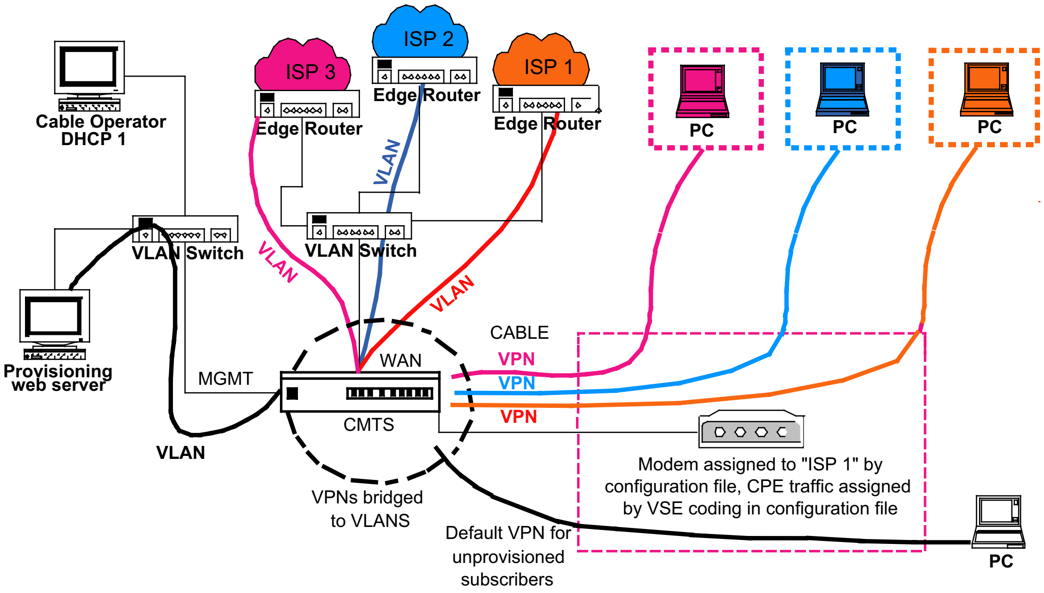


Figure 5-4: Diagram of network used in this example

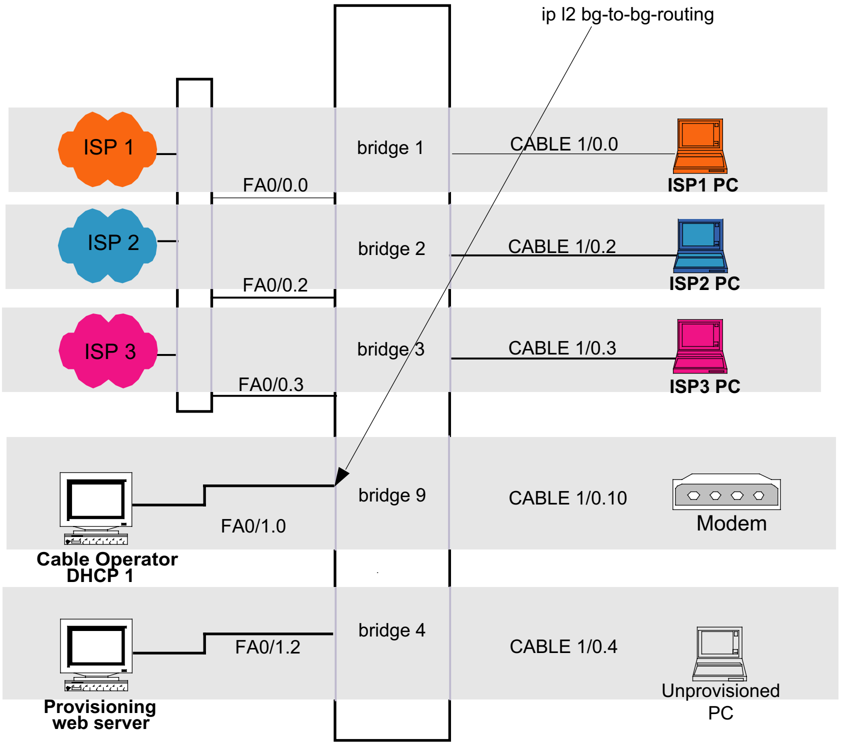


Figure 5-5: How the C3 bridges data in the example

Configuration

As can be seen following the level of configuration required is lower than the map-cpes method.

Notable differences are:

- All modems are now contained in the one IP subnet. This requires that the DHCP server must support the specification of DHCP options per reserved address.
- The encapsulation "native" commands in cable sub-interfaces 0.1 through 1/0.3 must match the VSE tagging. If no match is found, the CPE traffic will be mapped to the default cable 1/0.4 sub-interface and be bridged to the provisioning web server.
- Again option 82 processing is turned off but may be turned on again if an option 82 aware DHCP server is to be used.

Factory default C3 configuration

Run the following as a script on a factory default C3 configuration:

```
!
conf t
! remove bridges 0 and 1 so no sub-interfaces are attached
no bridge 0
no bridge 1
!
int ca 1/0
! remove any previous IP addresses from the cable interface
no ip address 10.99.99.253 255.255.255.0
exit
! remove the cable 1/0.1 subinterface -- not used
no int ca 1/0.1
!
no ip routing
!
! set default subinterface for cm taffic before
! cm has an IP address
default cm subinterface cable 1/0.10
default cpe subinterface cable 1/0.4
!
! Define the bridges we will use for CPE trafic
bridge 1
bridge 2
bridge 3
bridge 4
bridge 9
!
int fa 0/0.0
! description ISP1_WAN
encapsulation dot1q 111
bridge-group 1
exit
!
int fa 0/0.2
! description ISP2_WAN
encapsulation dot1q 222
bridge-group 2
exit
!

int fa 0/0.3
! description ISP3_WAN
encapsulation dot1q 333
bridge-group 3
exit
!
interface fa 0/1.0
! description MANAGEMENT
! ip address should be in subnet of DHCP server
ip address 10.99.99.2 255.255.255.0
management-access
encapsulation dot1q 999
bridge-group 9
ip l2-bg-to-bg-routing
exit
!
```

```
interface fa 0/1.2
! description PROVISIONING_SERVER
! ip address should be subnet of provisioning web server
ip address 10.88.88.2 255.255.255.0
encapsulation dot1q 888
no management-access
bridge-group 4
exit
!

interface cable 1/0.0
! description ISP1_CPE
ip address 10.1.0.1 255.255.0.0
no management-access
! set up dhcp relay for CPE devices
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
! VSE tagging
! all cm with VSE tag of 11 will cause all attached
! CPE to be mapped to this interface
encapsulation dot1q 11 native
! turn on VPN
encapsulation dot1q 11 encrypted-multicast
bridge-group 1
exit
!
interface cable 1/0.2
! description ISP2_CPE
! for CPE devices for ISP2
ip address 10.2.0.1 255.255.0.0
no management-access
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 22 native
encapsulation dot1q 22 encrypted-multicast
bridge-group 2
exit
!
interface cable 1/0.3
! description ISP3_CPE
! for CPE devices for ISP3
ip address 10.3.0.1 255.255.0.0
no management-access
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 33 native
encapsulation dot1q 33 encrypted-multicast
bridge-group 3
exit
!
interface cable 1/0.4
```

```
! description UNPROVISIONED_CPE
! for CPE devices for unprovisioned subscribers
ip address 10.4.0.1 255.255.0.0
no management-access
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 44 native
encapsulation dot1q 44 encrypted-multicast
bridge-group 4
exit
!
interface cable 1/0.10
! default for cm devices
! all cm will remain on this interface
bridge-group 9
ip address 10.77.77.1 255.255.255.0
no management-access
! set up dhcp relay for cm
! note: dhcp relay is not really required as DHCP bcast
! would be bridged to the DHCP server network
! via bridge group 9
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
exit
!
interface cable 1/0
! Get rf running
! not no rf configuration here so please check the factory
! defaults are ok
no cable upstream 0 shutdown
no cable upstream 1 shutdown
no shutdown
no management-access
! no ip address as sub-interface is not used
exit
!
exit
!------------ end script ----------------
```

An extension—no Ethernet VLANs used

Where the Ethernet backbone does not have VLAN support, Open Access is still possible.

A reminder of some rules to begin with—rules that drive the following configuration.

- One sub-interface on a physical interface may be untagged.
- There is a maximum of 10 sub-interfaces per any single bridge-group.
- Up to 64 sub-interfaces may be defined for each physical interface.
- Up to 64 bridge-groups may be defined.
- DHCP relay operates across bridge groups but must be turned on in the bridge groups where it is required. If turned on, the DHCP relay supporting sub-interface must have at least one IP address specification—even if bridging all other traffic.

With reference to this specific configuration example:

- There is a maximum of 10 sub-interfaces per any single bridge group.
- CPE cable sub-interfaces are created and are made members of bridge group 1.
- For bridge group 1 to access the Ethernet backbone, an Ethernet sub-interface must also be a member of this bridge group.
- All Cable CPE sub-interfaces are added to bridge group 1 that now has untagged access to the Ethernet backbone.
- A maximum of 9 CPE sub-interfaces may be supported in this manner. Thus a maximum of 9 cable-VPNs may be supported with this configuration.
- If DHCP relay is required, **ip dhcp relay** must be turned on and for IP DHCP relay to function, the CPE sub-interface must have at least one IP address specification. If the CPE are to receive IP address from the

operator DHCP server, **l2 bg-to-bg-routing** must be turned on to allow forwarded DHCP to pass across the boundary of bridge group 1 to bridge group 0.

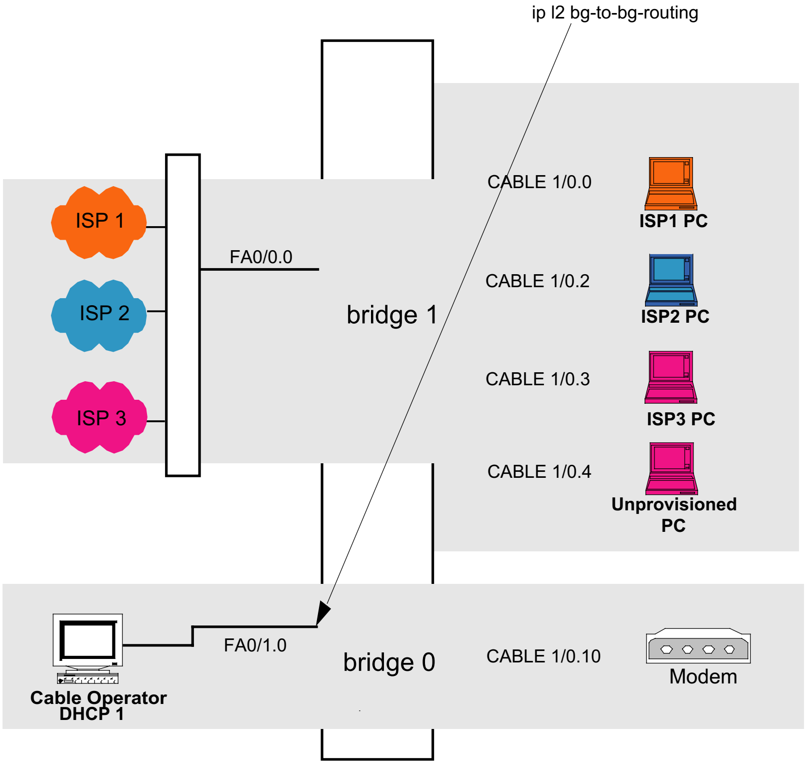


Figure 5-6: How the C3 bridges data in this configuration

Configuration

```
conf t
! remove bridges 0 and 1 so no sub-interfaces are attached
no bridge 0
no bridge 1
!
int ca 1/0
! remove any previous ip addresses from the
! cable interface
no ip address 10.99.99.253 255.255.255.0
exit
! remove the cable 1/0.1 subinterface
! not used
no int ca 1/0.1
!
no ip routing
!
! set default subinterface
default cm subinterface cable 1/0.10
default cpe subinterface cable 1/0.4
```

```
!
! Define the bridges we will use
bridge 0
bridge 1
!
int fa 0/0.0
! description ISP_WAN
bridge-group 1
exit
!
interface fa 0/1.0
! description MANAGEMENT
bridge-group 0
ip l2-bg-to-bg-routing
! ip address should be in subnet of DHCP server
ip address 10.99.99.2 255.255.255.0
management-access
exit
!
interface cable 1/0.0
! Get basic rf running
no cable upstream 0 shutdown
no shutdown
no management-access
! description ISP1_CPE
! for CPE devices for ISP1
ip address 10.1.0.1 255.255.0.0
no management-access
! set up dhcp relay for CPE devices
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
! all cm with VSE tag of 11 will cause all attached
! CPE to be mapped to this interface
encapsulation dot1q 11 native
! add to bridge group to get bridged eth access
bridge-group 1
exit
!
interface cable 1/0.2
! description ISP2_CPE
! for CPE devices for ISP2
ip address 10.2.0.1 255.255.0.0
no management-access
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 22 native
bridge-group 1
exit
!
interface cable 1/0.3
! description ISP3_CPE
! for CPE devices for ISP3
ip address 10.3.0.1 255.255.0.0
```

```
no management-access
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 33 native
bridge-group 1
exit

!
interface cable 1/0.4
! description UNPROVISIONED_CPE
! for CPE devices for unprovisioned subscribers
ip address 10.4.0.1 255.255.0.0
no management-access
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
encapsulation dot1q 44 native
bridge-group 1
exit
!
interface cable 1/0.10
! default for cm devices
! all cm will remain on this interface
ip address 10.77.77.1 255.255.255.0
no management-access
! set up dhcp relay for cm
ip dhcp relay
cable dhcp-giaddr primary
cable helper-address 10.99.99.1
no ip dhcp relay information option
exit
!
exit
```

6 IP Routing

This chapter describes Layer 3 (routing) operation of the Cadant C3 CMTS.

See Appendix B for a routing configuration example.

Routing Concepts

IP packets contain a source and destination IP address. But an IP packet is transported using lower layer protocols and these link-layer protocols require a destination hardware (MAC) address to forward the packet.

Default Route

When the destination subnet is not known to the C3, the C3 does not know what to do with the packet unless a route is present. If no other route is present, the **ip route 0.0.0.0 0.0.0.0 a.b.c.d** command can be used to tell the C3 to pass the packet to this gateway of last resort—IP address **a.b.c.d** in this example.

This default gateway also may not know how to route the packet. In this case, the gateway may return the ICMP "host unreachable" or "destination unreachable" message if the gateway routing policies allow any such response.

The gateway device is normally a router, and the unknown subnet may be on the other side of this router. This other device would also normally have knowledge of the network topology far beyond its own interfaces. Such knowledge is often propagated between such routing devices using an internal gateway protocol (IGP); the C3 supports both RIP (Routing Information Protocol) and OSPF (Open Shortest Path First) protocols for this purpose.

Static Routing

Static routing involves manually configuring routes to certain IP hosts, using the **ip route** command. If you are not using learned (dynamic) routing, you must configure a static route to the default gateway device using the **ip route** command. Use the **ip route** command to provide a route to a destination network or to a destination host. The **ip route 0.0.0.0 0.0.0.0 a.b.c.d** command is a special form of this command used to set a default route as discussed above.

Different gateways may be given for the same route with different administrative distances—the C3 uses the route with the lowest administrative distance until the route fails, then uses the next higher administrative distance, and so on. Up to 6 static routes may be configured in this manner. The route to a connected subnet (subnet of a sub-interface) always has an administrative distance of **0** and thus takes precedence over any static route.

In case of two static routes to the same prefix with equal administrative distance, the C3 uses the first provisioned route. If that route fails, then the C3 uses the next route. After rebooting, the C3 uses the first static route defined in the startup-configuration file. An example of this is shown in *Routing Priority*, page 6-3—refer to the 6 static routes (*) and (**) for network 15.0.0.0/24.

Static routing is supported in all C3 operating modes.

Dynamic Routing

Learned routing, or *dynamic routing*, means that the C3 learns routes to various destinations from messages sent by other routers on the network. In this version of C3 operating software, the C3 supports the following protocols:

- RIPv2 (RFC 2453).
- OSPFv2 (RFC 2328)

These protocols are known as Internal Gateway Protocols (IGP).

RIP and OSPF routing support is an extra-cost option. Contact your ARRIS representative to obtain a license key.

To enable routing in the C3, see *Routing Command Overview*, page 6-13.

About RIP

RIP (Routing Information Protocol) is an early and common standard protocol for exchanging routing information between routers and gateway devices.

The benefits of enabling RIP in the C3 are:

- You no longer need to specify a default gateway to let the C3 find distant destinations; the C3 learns about the network topology around it using RIP.
- Other devices on the Internet backbone use information from the C3 (through RIP) to learn how to contact cable interface subnets behind the C3.

About OSPF

OSPF (Open Shortest Path First) is an internal routing protocol that addresses several limitations of RIP:

- OSPF provides faster network convergence (that is, the time required to propagate changes to routers is shorter).
- OSPF routers send only updated routing information as needed (RIP routers send their entire routing table to other routers at regular intervals), thus using less bandwidth to keep networks updated.
- OSPF does not use the RIP assumption that a path of more than 15 hops is unreachable.
- OSPF's routing metrics account for bandwidth on each link (RIP uses a hop count metric).
- OSPF introduces the idea of areas, a method for limiting router updates to a specific group of routers.

In general, OSPF is better suited for use in large internal networks that may have a variety of links and long paths to various destinations.

Routing Priority

Use the **show ip route** command to display routing priority. In the following example, comments have been added using “<<<<<” to add some further clarification to the output:

```
C3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - ICMP, B - BGP
       E - EGP, G - GGP, O - OSPF, ES - ES-IS, IS - IS-IS
       * - candidate default, > - primary route
```

```
Gateway of last resort is 10.250.96.1 to network 0.0.0.0

S*   0.0.0.0/0 [1/0] via 10.250.96.1, FastEthernet 0/1.0
     4.0.0.0/24 is subnetted, 1 subnet
R    4.4.4.0 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
<<<<< rip learned - default AD=120
     5.0.0.0/24 is subnetted, 1 subnets
S>   5.5.5.0 [130/0] via 10.250.96.7, FastEthernet 0/1.0
<<<< primary static with AD changed to 130
S            [130/0] via 10.250.96.8, FastEthernet 0/1.0
<<<< backup static
     7.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
R    7.0.0.0/24 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
R    7.0.0.0/8 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
R    7.7.0.0/16 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
     10.0.0.0/24 is subnetted, 4 subnets
C    10.7.8.0 is directly connected, Cable 1/0.9
<<<< directly connected to c3 (configured on sub-int AD=0)
C    10.250.96.0 is directly connected, FastEthernet 0/1.0
C    10.250.99.0 is directly connected, FastEthernet 0/0.0
C    10.250.103.0 is directly connected, bridge-group #0
     15.0.0.0/24 is subnetted, 1 subnets
S>   15.5.5.0 [1/0] via 10.7.8.10, Cable 1/0.9
<<< static with default AD=1 (*)
S    [1/0] via 10.7.8.11, Cable 1/0.3
<<<< backup static, AD=1, second in config file (**)
S    [1/0] via 10.7.8.110, Cable 1/0.3
<<<< backup static, AD=1, 3 in config file (**)
S    [1/0] via 10.71.8.11, Cable 1/0.30
<<<< backup static, AD=1, 4 in config file (**)
S   [1/0] via 10.72.8.11,  FastEthernet 0/0.5
<<<< backup static, AD=1, 5 in config file (**)
S   [1/0] via 100.78.8.11, Cable 1/0.23
<<<< backup static, AD=1, 6 in config file (**)
     79.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R    79.79.79.0/24 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
R   79.79.79.101/32 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
```

Note the two numbers in brackets shown for each defined route:

- The first number is the administrative distance of the route.*Connected routes* (meaning a C3 sub-interface has an IP address within this subnet) have an administrative distance of 0; static routes have a default distance of 1. Routes learned through RIP have a default distance of 120. Routes learned through OSPF have a default distance of 110.

- The second number is the route metric, which is significant only for routes with the same administrative distance.

When there are several paths to a destination IP address, the C3 uses the following scheme to determine routing priority:

- The most specific route—that is, the route with the longest prefix (smallest subnet size) has the highest priority.
- Connected routes always have priority over static routes.
- Given equally specific routes, the C3 chooses the path with the lowest administrative distance.

  Given both equally specific routes with equal administrative distances, the C3 uses the route with the lowest metric; if the metrics are equal, the C3 chooses the first provisioned route. If that route fails, then the C3 uses the next route. Up to 6 routes are supported in this manner.

Routing Authentication

Dynamic routing protocols build a network topology using updates received from other routers. On a cable data network, a subscriber could potentially connect a router to a cable modem then advertise spoofed routes to other networks.

Authentication prevents malicious subscribers (or other entities) from polluting the C3's network topology with bogus information. The C3 uses a key chain that supports automatically changing keys over time. The authentication system is similar to that supported by Cisco routers.

Key Chains

Key chains consist of one or more keys. Each key in a key chain is a 16-character string or an MD5 key, and can be sent to other routers or accepted from other routers; the default is to both send and receive keys. In addition, each key can have a send or accept lifetime, allowing for a rotation of valid keys over time.

See *key chain*, page 10-176, for more details about configuring key chains.

Enabling Authentication

You can configure OSPF authentication against an interface (in interface configuration mode), or against an area (in OSPF router configuration mode). If both are configured, the interface configuration takes priority.

Use the **ip rip authentication** or **ip ospf authentication** command on a sub-interface to specify a key chain, text password, or MD5 password to accept from other routers in the network.

Configure text and MD5 passwords in key chain configuration mode (not interface configuration mode).

See *ip rip authentication*, page 10-185, or *ip ospf authentication mode*, page 10-185, for details about the commands.

Areas in OSPF

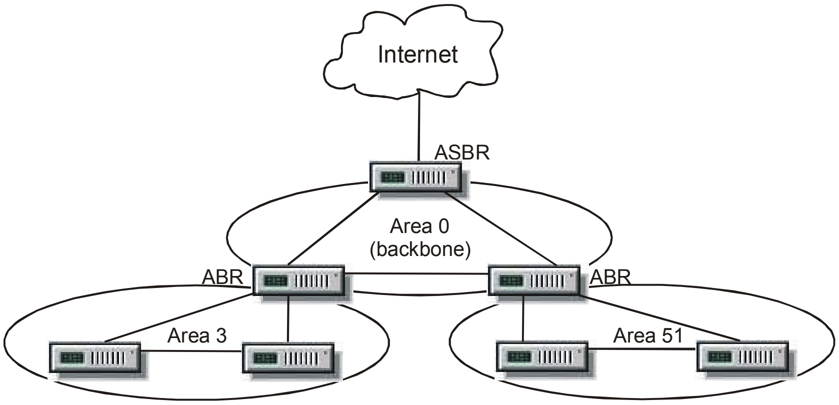


Figure 6-1: OSPF two-level hierarchy

In this diagram:

- Area 0, the backbone area, is the only area with a numbering requirement. Other areas can be numbered as desired.
- All other areas connect only to Area 0.
- The routers marked **ABR** (Area Border Routers) have one or more interfaces assigned to the backbone area and other interfaces assigned to the secondary area. Non-ABR routers have all their interfaces in a single area.
- The router marked **ASBR** (Autonomous System Border Router) connects the network domains (Autonomous Systems, or **AS**).
- Routers completely within an area exchange information about their networks only with other routers in the area. Traffic between areas goes through the ABRs.

Route Redistribution

Both RIP and OSPF support *route redistribution*, which allows a router to advertise networks on static routes or from a router running a different protocol. The following diagram is an example of how an OSPF-based network might redistribute RIP routes.

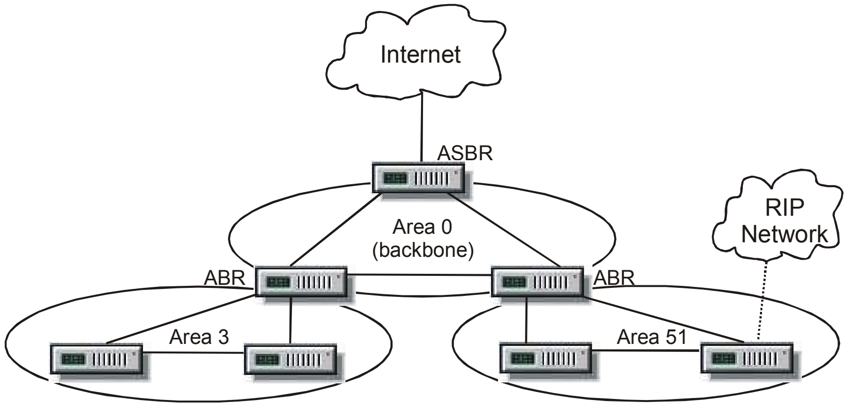


Figure 6-2: Example of an OSPF-based network redistributing RIP routes

The router in Area 51 connected to the RIP network can use route redistribution to advertise the RIP-based networks as if those networks were connected directly to the router.

See also: *redistribute connected [metric]*, page 10-251, and similar commands on the following pages.

The C3's static or learned routes can also be filtered before being redistributed into OSPF. See "OSPF Route Redistribution Filtering" on page 21, to use the route-map functionality to filter certain routes and prevent them from being propagated into OSPF.

Redistributing Subnets in OSPF

RF subnets can be advertised in the C3 originate router-LSAs within a single area only—then summarization could be used at the area border to hide them from the rest of the OSPF domain. To do this, enable OSPF on the necessary RF subnets in passive-mode using the network command.

There are two ways to set up OSPF route redistribution, depending on the number of subnets to advertise:

- If the number of RF subnets to be advertised are small (like single 10.5.6.0/24 secondary subnet on the cable 1/0.10 sub-interface):
  - put the subnet under OSPF using the **network 10.5.6.7 0.0.0.0 area 100** command
  - declare the cable 1/0.10 sub-interface (and other sub-interfaces, if needed) as passive using the **passive-interface cable 1/0.10** command
- If the number of RF subnets to be advertised is large:
  - make all subnets passive by default, using the **passive-interface default** command
  - cover all necessary subnets by appropriate **network** commands
  - declare all necessary subnets, which expect to have OSPF neighbors as active, using **no passive-interfaces X** commands.

NOTE

If the **redistribute connected** command is used to advertise RF subnets, the following problems are created:

- The C3 floods the subnets throughout the OSPF domain using Type 5 LSAs. This flooding greatly increases the LinkState DB and Route Table sizes.
- The C3 propagates every subnet flap over the entire OSPF domain.

Limitations

OSPF limitations are:

- 5000 router/network LSAs
- 7000 external LSAs

Loopback Interfaces

A loopback interface is a software-only interface used to emulate a physical port. Each loopback interface must be assigned a unique numerical ID and is subject to a limitation of 64 loopbacks. This gives them a global scope and does not associate them to a physical interface. A loopback interface is a virtual interface that is always up and allows sessions to stay up even if the outbound interface is down.

You can use the loopback interface as the termination address for an OSPF session. In applications where other routers or access servers attempt to reach this loopback interface, you should configure a routing protocol to distribute the subnet assigned to the loopback address.

Packets routed to the loopback interface are rerouted back to the router or access server and processed locally. IP packets routed out of the loopback interface but not destined to the loopback interface are dropped. Under these two conditions, the loopback interface can behave like a null interface.

Procedure 6-1

Steps to configure a loopback interface

The IP address for the loopback interface must be unique and not in use by another interface.

1 If you have not done so already, type **enable** to enter privileged mode.

The prompt changes to a **#** symbol.

2 To enter the interface config mode and name the new loopback interface:

```
C3# configure terminal
C3(config)# interface loopback {instance}
```

3 To assign an IP address and subnet mask to the virtual loopback interface using the ip address configuration command:

```
C3(config)# ip address {ip addr} {subnet mask}
```

4 To save the configuration changes:

```
C3(config)# end
```

To display the configuration of the loopback interface:

```
C3(config)#show interfaces {type instance}
```

End of procedure

Multicast Operations

This section describes the C3 CMTS implementation of multicasting as it relates to the handling and forwarding of IP multicast traffic.

What is IP Multicast?

IP Multicast is an Internet technology that permits a sender to send data (either clear or encrypted) simultaneously to many hosts. Unlike unicasting, multicasting does not send the same data as many times as there are recipients. And unlike broadcasting, it does not flood a network by sending packets to all the hosts when they are meant only for some. Multicasting sends the data only to those interfaces on which there are hosts that have requested it.

In order to receive a multicast service, hosts must join a multicast group. This multicast group has an associated group address. The source of this multicast traffic sends data to this group address. Any host belonging to the group processes the multicast data. Hosts that do not belong to the group do not process this data. The sender is not required to belong to the group: a multicast server can transmit to the group without belonging to it.

Application Scenarios

For example, a subscriber is web-surfing and clicks on an on-demand video that she wants to view. Her PC becomes a member of the multicast group by sending an Internet Group Management Protocol (IGMP) join message to the C3 CMTS. The join is then proxied on a proxy interface, which sends an IGMP join message to the next hop router that is set up to be an IGMP querier. The virtual path between the requesting subscriber and the sender is then set up by the next hop router. Then the subscriber begins to receive the multicast video she clicked on.

Another example of this application would involve a cable broadband subscriber. While using an Internet browser, he might click on an icon or online advertisement to receive real-time news updates or to listen to an online music concert. In this case the icon or ad contains embedded data containing the correct group address and code to tell the C3 CMTS to add this host to the group.

Multicasting suits applications in which the same data must be communicated to many hosts in a timely and efficient manner. Some examples:

- Colleges use it for distance learning — college courses or training delivered to anyone having a reliable Internet connection
- Large companies with multiple campuses use it for employee training and corporate addresses
- Groups can use it for teleconferencing (if combined with VoIP)
- Hotels and other chains use it to download software updates from headquarters to hundreds of reservations terminals simultaneously
- Retailer chains use it to update price lists quickly and simultaneously at all their locations.

Multicast in the Cable Data Industry

Multicast traffic is often used for network equipment communication protocols. Network protocols such as Internet Group Management Protocol (IGMP), Routing Information Protocol (RIP), and Open Shortest Path First (OSPF) all communicate via multicast.

Traffic sent to a multicast group can be received by multiple interfaces. An interface may belong to any number of multicast groups. As explained in RFC 1112, the membership group does not list the IP addresses of the individual hosts:

It is important to understand that an IP host group address is not bound to a set of IP unicast addresses. The multicast routers do not need to maintain a list of individual members of each host group. For example, a multicast router attached to an Ethernet need associate only a single Ethernet multicast address with each host group having local members, rather than a list of the members' individual IP or Ethernet addresses.

In order for IGMP multicast to work on the C3 CMTS, IGMP must be enabled for each interface that uses multicast. Once IGMP is enabled on an interface, it starts querying hosts for information on their multicast memberships. If the multicast group is not directly connected to the server, then a proxy interface is needed. One of the ethernet ports on the Ethernet interface must be designated as an IGMP proxy interface.

Membership groups must be assigned a Class D address. The range is specified in RFC 1112:

In Internet standard "dotted decimal" notation, host group addresses range from 224.0.0.0 to 239.255.255.255. The address 224.0.0.0 is guaranteed not to be assigned to any group, and 224.0.0.1 is assigned to the permanent group of all IP hosts (including gateways). This is used to address all multicast hosts on the directly connected network. There is no multicast address (or any other IP address) for all hosts on the total Internet. The addresses of other well-known, permanent groups are to be published in "Assigned Numbers."

Addresses in the range from 224.0.0.0 to 224.0.0.255 are reserved for protocol use and can not be joined by hosts nor can traffic be forwarded between interfaces.

Proxy Interface

Any fastethernet sub-interface on the C3 CMTS can be designated to proxy IGMP traffic for one or more interfaces. For a fastethernet sub-interface to be proxy enabled, the sub-interface must:

- have an IP address configured, or
- be a member of a bridge group with an IP address configured on at least one sub-interface of the group

The proxy interface must also have IGMP enabled. Once an interface becomes a proxy interface, it performs the following functions:

- Stops querying hosts for multicast membership information
- Becomes a host member for all active group memberships on the interfaces for which it is the proxy
- Forwards all multicast traffic going to or coming from joined multicast hosts on the C3 CMTS proxied interfaces.

IGMP Implementation

Internet Group Management Protocol (IGMP) is a IP protocol for managing multicast groups on the Internet. For an overview of standards related to IGMP, see RFCs 2236 and 2933.

DOCSIS® Compliance for IGMP

The DOCSIS® Specifications (SP-RFIv1.1-106-001215 and SP-OSSIv2.0-I01-011231, Annex E) describe IGMP DOCSIS 1.1 requirements as either Passive or Active operation modes. The C3 CMTS operates in either passive or active mode. It also complies with DOCSIS 2.0.

Encryption

The C3 CMTS can add encryption and authorization to multicast data over a DOCSIS cable interface. The encryption may be added statically (provisioned) or dynamically. Static operation operates with modems in either BPI or BPI+ mode. The dynamic operation operates only on modems running in BPI+ mode.

Enabling Multicast

Use the following command to enable multicasting:

1 Enable multicast for the cable sub-interface:

   C3(config)#**interface cable 1/0.4**

   C3(config)#**ip igmp enable**

2 Enable multicast for the IGMP proxy fastethernet sub-interface:

   C3(config)#**interface fastethernet 0/1.2**

   C3(config)#**ip igmp-proxy**

Layer 3 Multicast Operation

This section describes interactions between routing and multicasting.

If a C3 is configured with Layer 3 sub-interfaces, then the downstream IGMP sub-interface must be running in IGMP active mode for IP multicast forwarding to work correctly.

The same C3 can also have layer 2 bridge groups; these bridge-groups' downstream IGMP sub-interfaces can use either IGMP active or IGMP passive mode. The databases that are used for the Layer 2 and the Layer 3 sub-interfaces are mutually exclusive, so the Layer 2 database does not adversely affect the IP multicast forwarding of the Layer 3 sub-interfaces and vice versa.

Routing Command Overview

RIP Overview

The only routing commands required to start RIP routing are:

```
C3(config)# ip routing
C3(config)# router rip
C3(config-router)# network subnet wildcard
```

Where *subnet* is a standard subnet address, and *wildcard* is an inverted mask (for example, if the mask is **255.255.255.0**, the wildcard is **0.0.0.255**).

Tip: to enable RIP on all sub-interfaces, use the command **network 0.0.0.0 255.255.255.255**

Other routing parameters have reasonable defaults for most network configurations; for example, RIP version 2 is run by default.

RIP-related routing commands fall into two categories:

- general: described in *RIP-specific Subcommands*, page 10-248.
- sub-interface specific: described in *Common Interface Subcommands for Cable and fastEthernet Interfaces*, page 10-180.

OSPF Overview

The only commands required to start OSPF routing are:

```
C3(config)# ip routing
C3(config)# router ospf
C3(config-router)# network address subnet wildcard area id
```

Where *subnet* is a standard subnet address, *wildcard* is an inverted mask (for example, if the mask is **255.255.255.0**, the wildcard is **0.0.0.255**), and *id* is the area assigned to the router.

Tip: to enable OSPF on all sub-interfaces, use the command **network 0.0.0.0 255.255.255.255 area id**.

Other routing parameters have reasonable defaults for most network configurations. However, it is recommended to manually enter the router-id instead of allowing the C3 to auto-select it. This will allow OSPF to come up more reliably after a restart and/or upgrade.

OSPF-related routing commands fall into two categories:

- general: described in *OSPF-specific Subcommands*, page 10-255.
- sub-interface specific: described in "*Common Interface Subcommands for Cable and fastEthernet Interfaces*, page 10-180.

OSPF Point-To-Multipoint

The OSPF network is independent from the actual physical interface type. It is used to define the operation of the OSPF protocol on a sub-interface basis. OSPF supports four network types:

- Broadcast
- Non-Broadcast-Multiple-Access (NBMA)
- Point-to-Point (broadcast & non-broadcast)
- Point-to-Multipoint (broadcast & non-broadcast)

Any OSPF-enabled interface can be configured to operate in point-to-multipoint (PTMP) mode. After that, all adjacencies over this interface are treated as point-to-point. No Designated Router (DR) or Backup Designated Router (BDR) is elected, and no network-LSA is originated. Topological information is abstracted as if every adjacency were a point-to-point link; that is, every router reports connectivity to every adjacent router in its router-LSA. To distribute IP routing information, every router announces its own IP addresses, including secondary ones, as host routes in its router-LSA.

OSPF point-to-multipoint network types can operate in one of two modes; broadcast and non-broadcast. In PTMP broadcast mode, OSPF hello packets are multicast to AllSPFRouters (e.g. IP address 224.0.0.5) thus allowing the OSPF protocol to dynamically discover neighboring OSPF routers.

In contrast, PTMP non-broadcast mode must unicast all OSPF protocol messages to neighboring routers (including OSPF hello packets). Therefore it is necessary to explicitly configure the OSPF protocol with the list of neighbors with which it should form adjacencies. In order to configure this list of permitted OSPF neighbors, the neighbor ip-address OSPF router command is used.

To configure a sub-interface to operate in PTMP non-broadcast mode, the ip ospf network point-to-multipoint non-broadcast sub-interface configuration command is used. Applying this command on an OSPF sub-interface, operating in OSPF broadcast mode, will have the following operational effects:

- All existing adjacencies with neighboring OSPF routers on the sub-interface will be broken.
- The network-LSAs associated with the sub-interface (primary and secondary addressed configured in OSPF) will be deleted.
- The router-LSA will be updated to include host entries for the OSPF enabled IP addresses configured on the sub-interface.
- OSPF adjacencies will only be formed with neighboring OSPF routers which are configured, using the neighbor OSPF configuration command.

OSPF Over Cable Sub-interfaces

With this implementation of OSPF, no distinction is made on interface types. All interfaces automatically default to operate in OSPF broadcast mode. However, in the normal operation of OSPF over broadcast networks, the following multicast addresses are used:

224.0.0.5	AllSpfRouters
224.0.0.6	AllDrRouters

This means that unless a cable modem is capable of bridging these multicast addresses, it is not possible to successfully run OSPF broadcast mode on cable sub-interfaces. In these circumstances, it is possible to run OSPF over cable sub-interfaces by configuring them to operate in point-to-multipoint non-broadcast.

OSPF Operational Constants

The following is list of the OSPF scaling limits which have been defined for the C3 OSPF applications. Note that these values are fixed and cannot be modified via configuration.

Table 6-1: OSPF Scaling Limits

Name	Value
Maximum number of statically configured OSPF neighbors across all OSPF Point-to-Multipoint interfaces	32
Maximum number of OSPF neighbors across all OSPF interface	256

OSPF User interface

The following commands are grouped for convenience. This is not a step-by-step procedure.

Table 6-2: Global configuration mode commands

Command	Description

show ip ospf interfaces [{cable | fastethernet} X/Y.Z]	This command lists the local interfaces on which OSPF is enabled and the current configuration of those interfaces.
	C3#show ip ospf interfaces
	FastEthernet 0/1.0 is up, line protocol is up
	  Network Type POINT-TO-MULTIPOINT, Cost: 1
	  Transmit Delay is 1 sec, State POINT-TO-MULTIPOINT, Priority 1
	  Timer intervals configured, Hello 30, Dead 120, Wait 120, Retransmit 5
	  Internet Address 10.250.136.2/24, Area 0.0.0.2
	    No Designated Router elected
	    No Backup Designated Router elected
	    Neighbor Count is 2, Adjacent neighbor count is 2
	      Adjacent with neighbor 100.100.100.44
	      Adjacent with neighbor 13.13.13.13
	  Secondary Internet Address 11.250.136.2/24, Area 0.0.0.2
	    No Designated Router elected
	    No Backup Designated Router elected
	    Neighbor Count is 0, Adjacent neighbor count is 0

show ip ospf neighbor	This command lists the directly connected OSPF router neighbors, for each interface on which OSPF is enabled. C3#show ip ospf neighbor Neighbor ID Pri State Address Interface 100.100.100.44 3 FULL/ - 10.250.136.44 FastEthernet 0/1.0 13.13.13.13 1 FULL/ - 10.250.136.46 FastEthernet 0/1.0 N/A 1 DOWN 10.250.136.66 FastEthernet 0/1.0

Table 6-3: OSPF router configuration mode commands

Command	Description
[no] neighbor *ip-address*	To configure OSPF routers interconnecting to non-broadcast networks, use this form of the neighbor router configuration command. To remove a configuration, use the **no** form of this command.

Table 6-4: Interface configuration mode commands

Command	Description
ip ospf network {broadcast | point-to-multipoint non-broadcast} **no ip ospf network** .	To configure the OSPF network type to a type other than the default for a given media, use the **ip ospf network** interface configuration command. **broadcast** - Sets the network type to broadcast (default setting) **point-to-multipoint non-broadcast** - Sets the network type to point-to-multipoint. - The optional non-broadcast keyword sets the point-to-multipoint network to be non-broadcast. If you use the non-broadcast keyword, the neighbor command is required. To return to the default value, use the **no** form of this command.

Route-Maps

This section will not describe how the Route-Map is used, instead it will only focus on the features which pertain to Route-Map and route-map-entries. These features are the creation, deletion and modification of a route-map-entry, and the creation and deletion of a Route-Map.

It is important to note that the Route-Map is completely independent from any entity on the C3. Defined Route-Maps are saved at C3 shutdown and restored from the startup-configuration at C3 initialization.

If a Route-Map is deleted, any references made by it to other system features, such as ACLs, will not be affected. If there are features enabled which use the Route-Map, these features will still be enabled, but the application will now reference an Inactive Route-Map. In this way if the Route-Map is ever defined again, it will immediately be made available for use by the applications which previously used it.

Route-Maps and their entries are defined in the **(config-route-map)#** mode of the CLI. Any changes made to a route-map-entry from this CLI configuration is only applied after the user exits from this mode.

Route-Maps and their entries can only be deleted from the **(config)#** mode of the CLI and are applied immediately after the user hits the enter key.

Route-Map-Entry Actions

Each route-map-entry has an action associated with it, called *permit* or *deny*. The permit or deny option describes the actions to be taken if the match clauses for that route-map-entry are satisfied. The action is typically used to describe the action to take if all the match clauses for that particular route-map-entry are satisfied. If no option is specified, the system defaults to permit.

Creating/deleting route-maps and route-map-entries

From the global configuration mode, enter the following command to create, delete or modify a route-map and route-map-entry:

```
(config)# [no] route-map {tag-name} [permit | deny] [seq-num]
(config-route-map)#
```

The **{tag-name}** is the name given to the route-map and can be from 3-12 characters long.

The *[seq-num]* refers to the route-map-entry being created or modified.

NOTE
The route-map command can only be entered in the configuration mode of the CMTS. Entering the command causes the CLI to enter into the route-map configuration level. This is signified by the change in the CLI prompt, from **(config)#** to **(config-route-map)#.**

To create a Route-Map with the name "my-map1" and a route-map-entry identified by the sequence number "10", use the following command:

```
(config)# route-map my-map1 permit 10
(config-route-map)#
```

NOTE
A route-map-entry can exist without any clauses defined against it.

The no version of the command deletes the associated route-map entry or Route-Map if the sequence number is not supplied.

Route-map Sequence Numbers

Each route-map entry has an associated sequence number, defined using the following command:

```
(config)# route-map {tag-name} [seq-num]
```

A sequence number is associated with each route-map entry and is used to define the order of evaluation of each route-map entry. This is a numerical value between 1 and 65536. It must be a unique number for the route-map it is associated. It is a way of identifying one of four route-map entries in a route-map-list. These route-map entries will be evaluated in ascending order in accordance with their sequence number identifier.

Each Route-Map must be identified using a character string not less that 3 characters and not greater that 13 characters.

NOTE
A route-map-entry can exist without any clauses defined against it.

Committing Changes

Any changes made in the route-map configuration are only committed after the user exits from the route-map configuration mode using the following command:

```
(config-route-map)# exit
```

Match Clauses

The following command in the (config-route-map)# mode associates an ACL with the route-map-entry:

```
(config-route-map)# [no] match ip address [..acl-number]
```

The **{acl-number}** is a list of between 1 and 4 ACL numbers. These numbers identify the ACL which will be used for this clause.

If the ACL referred to does not exist, the route-map entry is not evaluated, and the next route-map-entry for that Route-Map is evaluated.

The no version of this command disables this match clause within the route-map entry. The match ip address clause can only be completely disabled by specifying the ACL numbers currently associated with that clause.

If the route-map is marked as invalid only because of the unresolved ACL in the match clause, then it’s state is changed to valid after the ACL has been created. By deleting an ACL associated with a match IP address clause will disable that clause and cause the state of the route-map entry to change to invalid. This means the route-map entry will not be evaluated when processing packets using the route-map list associated with that sub-interface. An ACL associated with a match IP address is not deleted if the clause is removed from the route-map-entry.

There is only a one-way association between ACLs and match clauses of a route-map entry. The ACL must be in some way linked to all the match clause instances that reference that ACL so as to satisfy the requirement above. This is not the case for route-map entry match clauses.

Provisioning Route-Maps

Route-Maps can exist as software entities even if they have no route-map-entries defined against them. They are visible through the **show route-map** command as "inactive". The reason for their existence in this state is because an application has registered with that Route-Map. For a Route-Map to become "active" it must have at least one route-map-entry defined against it.

No more than one CLI session can enter the (config-route-map)# mode for an individual route-map at any given time. This means that if one user is currently modifying the Route-Map "my-map1", and is in the config-route-map mode against that Route-Map, then if another user attempts to invoke the (config)# **route-map my-map1** command, then an error message will be displayed indicating that another user is currently modifying this Route-Map.

No more than 32 Route-Maps can be defined and no more than 4 route-map-entries can be created against any given Route-Map. This means that the maximum number of route-map-entries which can be created is 32 X 4.

Displaying Route-maps

Use the following CLI command to show all route-maps currently configured on the CMTS. This command may be evoked from either the global configuration or interface configuration modes of the CLI.

(config)# **show route-map** *[map-name]*

If the *[map-name]* parameter is not supplied with this command, then all currently defined Route-Maps (and their associated route-map-entries) will be displayed. If the *[map-name]* is specified, then just that Route-Map and it's route-map-entries will be displayed. The display of Route-Maps will be in the format outlined below:

An example of a system response is:

```
route-map my-policy, permit, sequence 10
  Match clauses:
    Ip address (acl): 202
  Set clauses:
    Ip next-hop 192.168.2.2
    Ip tos min-delay
  Policy routing matches:  1233 packets, 94990 bytes
```

Use the following CLI command to show the number of registered users of all Route-Maps currently configured on the CMTS. This command may be evoked from either the global configuration or interface configuration modes of the CLI.

(config)# **show route-map** *[map-name]*

An example of the system response is:

```
route-map my-map1, is not active, number of users 1
route-map my-map2, is active, number of users 3
route-map my-map4, is active, number of users 1
route-map my-map7, is active, number of users 0
```

An application can register for a Route-Map which does not exist. No more than 16 users can register for use against any given Route-Maps.

This command is ARRIS specific and the output format of it may change to include more useful information about Route-Maps.

NOTE

A Route-Map which is not currently active does not get displayed using the **show route-map {map-name}** command.

OSPF Route Redistribution Filtering

OSPF allows AS external routes to be injected into the OSPF routing domain by using the redistribute command. Filtering of these redistributed AS external routes is achieved by use of Route Maps. The route-map function is a generic mechanism which may be used by many routing tasks to filter both IP routes and traffic.

There are a number of parameters which can be used in the match clauses of a route map structure when used to control route redistribution.

The match ip address clause identified routes based on the network prefix; a standard or an extended access list number is used as the parameter. The access lists themselves can also be configured with either the permit of deny keyword.

The rules applied to the use of permit or deny keywords used by the referenced route maps and access lists are as follows:

- If an ACL is used in a route-map permit clause, routes permitted by the ACL are redistributed.
- If an ACL is used in a route-map deny clause, routes permitted by the ACL are not redistributed.
- If an ACL is used in a route-map permit or deny clause, and the ACL denies a route, then the route-map clause match is not found and the next route-map clause is evaluated.

The format of the OSPF redistribute command is as follows:

redistribute *[static|rip] [metric <1-16777215> | metric-type < 1-2> | route-map <WORD> | tag <A.B.C.D>]*

Value	Definition
metric	Specifies the metric value to be applied to routes from this source routing protocol to the OSPF routing domain. The default value is set at 20.
metric-type	The external link type associated with the default route advertised into the OSPF routing domain. It can be one of two values: • 1—Type 1 external route • 2—Type 2 external route The default metric-type is 2.
route-map	Route map that should be interrogated to filter the importation of routes from this source routing protocol to the OSPF routing domain. If not specified, all routes are redistributed. If this keyword is specified, and an undefined route map is specified, no routes will be imported.
tag	A 32-bit field attached to each external route. This is not used by the OSPF protocol itself. It may be used to communicate information between AS boundary routers. The default tag is 0.0.0.0

7 Managing Cable Modems

This chapter discusses various aspects of cable modem management. Proper management can result in a more efficient and secure network.

What CPE is attached to a modem?

Use the **show interface cable 1/0 modem 0** or **show cable host** commands.

Example:

```
C3#show interfaces cable 1/0 modem 0
SID   Priv bits   Type      State   IP address       method    MAC address
1     0           modem     up      10.17.208.230    dhcp      0000.ca30.326c
1     0           cpe       unknown 10.17.209.19     dhcp      0000.ca30.326d
```

Examples:

```
c3#show cable host ?
<N.N.N.N or H.H.H> - IP / MAC address of modem

c3#show cable host 10.17.208.230
MAC Address     IP Address               Type
```

```
                10.17.209.19             learned
c3#show cable host 0000.ca30.326c
MAC Address     IP Address               Type
                10.17.209.19             learned
```

Limitations — The C3 supports up to 4 classifiers per service flow.

Using DOCSIS 2.0 Upstreams

Several steps must be taken to use a DOCSIS 2.0 modem in ATDMA or SCDMA mode on a C3 upstream.

- Configure an ATDMA or SCDMA capable modulation profile in the C3.
- Configure the upstream with a modulation profile containing ATDMA or SCDMA burst descriptors.
- Configure the Upstream channel type for ATDMA or SCDMA operation.

Setting the Configuration File

The cable modem configuration file should either omit TLV 39 (D2.0 Enable) or specify a value of **1**, to enable the cable modem to use DOCSIS 2.0 upstreams.

Table 7-1: Cable modem configuration file parameters

Parameter	Value
Type	39
Length	1
Value	1 for DOCSIS 2.0

To disable DOCSIS 2.0 mode for cable modems registering with the C3, set the value for TLV 39 to **0** in the cable modem configuration file.

Configuring a Modulation Profile

The C3 has a short-cut method for creating an ATDMA or SCDMA modulation profile. Create a new modulation profile using one of the following commands:

```
conf t
cable modulation-profile 3 atdma
cable modulation-profile 3 scdma
```

Assign the new modulation profile to the required upstream logical channel using the command sequence:

```
conf t
int cab 1/0
cable upstream 0.0 shutdown
cable upstream 0.0 modulation-profile 3
```

The following is an example ATDMA modulation profile created using the above commands:

```
cable modulation-profile 3 request AdvPhy preamble-type qpsk0
cable modulation-profile 3 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 3 initial AdvPhy ATDMA 1 1536
cable modulation-profile 3 initial AdvPhy preamble-type qpsk0
cable modulation-profile 3 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 3 station AdvPhy ATDMA 1 1536
cable modulation-profile 3 station AdvPhy preamble-type qpsk0
cable modulation-profile 3 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 3 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 3 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 3 advPhyS 12 78 14 8 64qam scrambler 338 no-diff 104 fixed
cable modulation-profile 3 advPhyL AdvPhy ATDMA 1 1536
cable modulation-profile 3 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 3 advPhyL 16 220 0 8 64qam scrambler 338 no-diff 104 fixed
cable modulation-profile 3 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 3 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 3 advPhyU 16 220 0 8 64qam scrambler 338 no-diff 104 fixed
```

Changing the Upstream Channel Type

Use the command **cable upstream n.c channel-type atdma** or **cable upstream n.c channel-type scdma** to change the upstream channel type on the specified logical channel.

Provisioning a Channel Number

If you are using a provisioning file to assign a DOCSIS 2.0 cable modem to a particular channel, use the following table to determine the channel number to specify based on the upstream and logical channel.

Table 7-2: Channel numbers

Logical Channel	Upstream					
	1	**2**	**3**	**4**	**5**	**6**
0	1	2	3	4	5	6
1	7	8	9	10	11	12
2	13	14	15	16	17	18
3	19	20	21	22	23	24

DHCP

Dynamic Host Configuration Protocol (DHCP) is used by cable modems, and CPE devices attached to the cable modem, to obtain both an IP address and initial operating parameters. This parameter or “option” transfer is the first interaction a cable modem has with management systems beyond the CMTS.

DHCP traffic between the DHCP server and the clients (cable modems and subscriber CPEs) travel through the C3. The C3 in turn can either pass the traffic through or take a more active role.

You have two options:

- Transparent mode (the default): the C3 re-broadcasts DHCP broadcast packets received from a cable sub-interface to all active fastethernet sub-interfaces in the same bridge group. Transparent mode requires that a DHCP server or relay must be within the same broadcast domain as the CPE.
- DHCP relay mode: by specifying **ip dhcp relay** on a cable sub-interface, the C3 can reduce broadcast traffic by sending DHCP unicast packets only to specific fastethernet sub-interfaces.

NOTE
DHCP relay is required for routing sub-interfaces.

The following sections describe each mode.

Transparent Mode

The first option, transparent mode, is the factory default. In this case the C3 simply passes DHCP messages along and takes no part in the DHCP process. The following diagram shows the flow of DHCP traffic through the C3 in transparent mode.

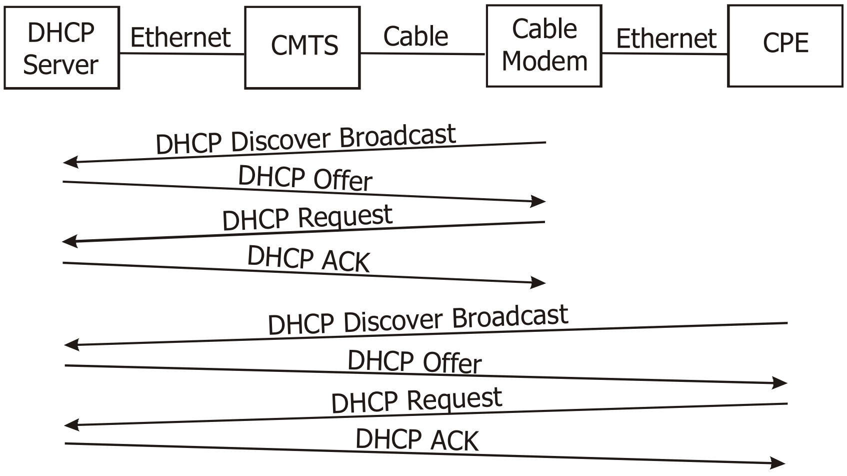


Figure 7-1: DHCP traffic flow through the C3 in transparent mode

DHCP Relay Mode

When DHCP Relay is active on a cable sub-interface, the C3 intercepts DHCP broadcast packets received at the cable sub-interface and re-directs them to all fastethernet sub-interfaces, or to a specific address if you specify **cable helper-address.**

You activate DHCP Relay on specific cable sub-interfaces using the **ip dhcp relay** command in interface configuration mode; there are also several options that can be activated individually on each sub-interface. The sections following describe these options and their uses.

What Happens During Relay

The C3 knows the difference between a cable modem and a CPE device and can:

- direct DHCP as a unicast to specific DHCP servers based on whether the DHCP message is coming from a cable modem or an attached host using the cable interface configuration command:

  cable helper-address {ipaddr} [cable-modem | host]

- assist the DHCP server to allocate different IP address spaces to cable modems and CPE devices using the cable interface configuration command:

  cable dhcp-giaddr {policy | primary | round-robin}

  where:

  policy - Use secondary giaddr for CPE devices

  primary - Use primary giaddr for all devices

  round-robin- Round robin on subinterface addresses for use as CM DHCP giaddr

- assist the subscriber management systems by telling the DHCP server what cable modem a host (CPE) is attached to and identifying a CPE device attached to a cable modem by using the cable interface configuration command:

  ip dhcp relay information option

- DHCP unicast (renew) is intercepted and forwarded—not bridged—to the required destination address regardless of the CPE or CM default route settings.

  Where the destination address (or the gateway to the destination address) is not directly connected to a bridge group the unicast renew was received in, the unicast will be forwarded across bridge groups to the required interface but **l2-bg-to-bg-routing** must be activated in all the involved bridge groups for any ACK to a DHCP RENEW to be forwarded back to the originating bridge-group.

Directing DHCP Broadcasts to Specific Servers

The most useful functions of the **cable helper-address** command are:

- To change the broadcast DHCP message arriving at the cable sub-interface to a unicast message leaving the C3 directed to a specific DHCP server.
- To allow the DHCP server to exist on a routed backbone. The DHCP discover messages from cable-modems or hosts are now unicast to the specified DHCP server. Where routers are between the DHCP servers and the C3 (the DHCP server IP subnet is not known to the C3), the use of static routes using the "ip route" command in the C3 may be required or "router rip" activated.
- In bridging mode, DHCP can be forwarded across bridge groups.

  Where the helper address (or the gateway to the helper address) is not directly connected to a bridge group the broadcast was received in, the C3 forwards the unicast across bridge groups to the required interface, but **l2-bg-to-bg-routing** must be activated in all the involved bridge groups for any reply to this message to be forwarded back to the originating bridge group.

If no helper address is specified, the C3 bridges the broadcast to all FastEthernet sub-interfaces in the same bridge group, or drops the packet if no bridge group membership exists (such as on a routed sub-interface).

If the helper address is not within a subnet known to the C3, the C3 inspects its IP route table for a route to this destination subnet—this route then specifies the sub-interface to use for the unicast. If such a route does not exist, no unicast will occur.

The routing table can be influenced by:

- primary and secondary IP addresses of sub-interfaces and the resulting subnet memberships of those interfaces
- **ip default-gateway** specification in bridging mode
- **ip route 0.0.0.0 0.0.0.0 a.b.c.d** specification for the route of last resort in IP routing mode
- a static route configured with **ip route**
- RIP propagation in the network

The C3 can differentiate between DHCP messages from cable modems and hosts. The **cable helper-address** command allows such DHCP messages to be directed to different DHCP servers.

Example: — The cable operator manages the cable-modem IP addresses, an ISP manages the host IP addresses.

```
cable 1/0.0
cable helper-address 10.1.1.1 cable-modem
cable helper-address 10.2.2.2 host
```

Up to 5 helper-addresses may be specified per helper address classification (modem, host, or either). Only the DHCP helper-addresses of the sub-interface the DHCP message is received on are used.

Example 1:

```
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.0


interface Cable 1/0.0
 cable helper-address A cable-modem
 cable helper-address B cable-modem
 cable helper-address C
 cable helper-address D
 cable helper-address E
```

The C3 sends any cable modem's DHCP discover/request to helper addresses A and B, and any host's DHCP discover/request to helper addresses C, D and E.

Example 2:

```
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.0


interface Cable 1/0.0
 cable helper-address A host
 cable helper-address B host
 cable helper-address C host
 cable helper-address D
 cable helper-address E
```

Any cable modem's DHCP discover/request will be sent to helper addresses D and E. Any host's DHCP discover/request will be sent to helper addresses A, B and C.

Example 3:

```
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.0


interface Cable 1/0.0
 cable helper-address A cable-modem
 cable helper-address B host
 cable helper-address C host
 cable helper-address D
 cable helper-address E
```

Any cable modem’s DHCP discover/request is sent to helper address A. Any host’s DHCP discover/request will be sent to helper addresses B and C. Helper addresses D and E are redundant in this configuration.

See *cable helper-address*, page 10-216 for syntax and other information.

Redundant DHCP server support

Where multiple helper-addresses are specified, the C3 unicasts the DHCP Discover to each of the specified helper addresses. Any ensuing communication with the DHCP client is unicast only to the DHCP server that responded to the first DHCP Discover unicast. If a subsequent DHCP request is not answered by this DHCP server, the C3 again unicasts the message to all specified DHCP servers.

cable helper-address a.b.c.d — unicasts all DHCP broadcast messages to the specified DHCP server IP address

cable helper-address a.b.c.d cable modem — unicasts all cable modem generated DHCP broadcast messages to the specified DHCP server IP address

cable helper-address a.b.c.d host — unicasts all host generated DHCP broadcast messages to the specified DHCP server IP address

Verifying DHCP Forwarding

DHCP forwarding operation can be verified using the C3 debug facilities.

NOTE
If debugging CPE DHCP, turn on debug for the MAC address of the modem that the CPE is attached to.

For example, use the following commands from privilege mode.

```
terminal monitor
debug cable dhcp-relay
debug cable mac-address 00A0.7374.BE70
```

```
16:51:34: DHCPRELAY: DISCOVER: adding relay information option
16:51:34: DHCPRELAY: DISCOVER: setting giaddr to 10.250.139.2
16:51:34: DHCPRELAY: DISCOVER: from 00A0.7374.BE70 forwarded to
10.250.139.1
16:51:34: DHCPRELAY: OFFER: Removing information option from frame
16:51:34: DHCPRELAY: Broadcasting OFFER to client 00A0.7374.BE70
16:51:37: DHCPRELAY: REQUEST: adding relay information option
16:51:37: DHCPRELAY: REQUEST: setting giaddr to 10.250.139.2
16:51:37: DHCPRELAY: REQUEST: from 00A0.7374.BE70 forwarded to server
10.250.139.1
```

```
16:51:37: DHCPRELAY: ACK: Removing information option from frame
16:51:37: DHCPRELAY: Broadcasting ACK to client 00A0.7374.BE70

debug cable mac-address 00A0.7374.BE70 verbose

16:54:29: DHCPRELAY: DISCOVER: adding relay information option
16:54:29: DHCPRELAY: DISCOVER: from 00A0.7374.BE70 forwarded to
10.250.139.1
16:54:29: DHCPRELAY: Dumping outgoing UDP packet:
        01 01 06 01 73 74 BE 70 00 00 80 00 00 00 00 00
        00 00 00 00 00 00 00 00 0A FA 8B 02 00 A0 73 74
        BE 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 63 82 53 63
        35 01 01 3C 56 64 6F 63 73 69 73 31 2E 31 3A 30
        35 32 34 30 31 30 31 30 31 30 32 30 31 30 31 30
        33 30 31 30 31 30 34 30 31 30 31 30 35 30 31 30
        31 30 36 30 31 30 31 30 37 30 31 31 30 30 38 30
        31 31 30 30 39 30 31 30 30 30 61 30 31 30 31 30
        62 30 31 30 38 30 63 30 31 30 31 3D 07 01 00 A0
        73 74 BE 70 39 02 02 40 37 07 01 1C 43 03 02 04
        07 52 14 01 04 80 00 00 03 02 06 00 A0 73 74 BE
        70 04 04 00 00 00 00 FF 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00


16:54:29: DHCPRELAY: Dumping incoming UDP packet:
        02 01 06 00 73 74 BE 70 00 00 80 00 00 00 00 00
        0A FA 8B 0E 0A FA 8B 01 0A FA 8B 02 00 A0 73 74
        BE 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 76 6C 61 6E
        5F 34 32 2E 63 66 67 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 63 82 53 63
        35 01 02 36 04 0A FA 8B 01 33 04 00 07 A9 33 01
        04 FF FF FF 00 06 08 C0 A8 FA C2 C0 A8 FA C3 2C
        04 C0 A8 FA C2 1C 04 FF FF FF FF 03 04 0A FA 8B
        01 52 14 01 04 80 00 00 03 02 06 00 A0 73 74 BE
        70 04 04 00 00 00 00 FF
16:54:29: DHCPRELAY: OFFER: Removing information option from frame
16:54:29: DHCPRELAY: Broadcasting OFFER to client 00A0.7374.BE70
16:54:29: DHCPRELAY: Dumping outgoing UDP packet:
        02 01 06 00 73 74 BE 70 00 00 80 00 00 00 00 00
        0A FA 8B 0E 0A FA 8B 01 0A FA 8B 02 00 A0 73 74
        BE 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 76 6C 61 6E
        5F 34 32 2E 63 66 67 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 63 82 53 63
        35 01 02 36 04 0A FA 8B 01 33 04 00 07 A9 33 01
        04 FF FF FF 00 06 08 C0 A8 FA C2 C0 A8 FA C3 2C
        04 C0 A8 FA C2 1C 04 FF FF FF FF 03 04 0A FA 8B
        01 FF 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00


16:54:30: DHCPRELAY: Dumping incoming UDP packet:
        01 01 06 00 73 74 BE 56 00 00 80 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 A0 73 74
        BE 56 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 63 82 53 63
        35 01 03 3C 56 64 6F 63 73 69 73 31 2E 31 3A 30
        35 32 34 30 31 30 31 30 31 30 32 30 31 30 31 30
        33 30 31 30 31 30 34 30 31 30 31 30 35 30 31 30
        31 30 36 30 31 30 31 30 37 30 31 31 30 30 38 30
        31 31 30 30 39 30 31 30 30 30 61 30 31 30 31 30
        62 30 31 30 38 30 63 30 31 30 31 3D 07 01 00 A0
        73 74 BE 56 32 04 0A FA 8B 6C 36 04 0A FA 8B 01
        39 02 02 40 37 07 01 1C 43 03 02 04 07 FF 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00
16:54:31: DHCPRELAY: REQUEST: adding relay information option
16:54:31: DHCPRELAY: REQUEST: from 00A0.7374.BE70 forwarded to server
10.250.139.1
16:54:31: DHCPRELAY: Dumping outgoing UDP packet:
        01 01 06 01 73 74 BE 70 00 00 80 00 00 00 00 00
        00 00 00 00 00 00 00 00 0A FA 8B 02 00 A0 73 74
        BE 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 63 82 53 63
        35 01 03 3C 56 64 6F 63 73 69 73 31 2E 31 3A 30
        35 32 34 30 31 30 31 30 31 30 32 30 31 30 31 30
        33 30 31 30 31 30 34 30 31 30 31 30 35 30 31 30
        31 30 36 30 31 30 31 30 37 30 31 31 30 30 38 30
        31 31 30 30 39 30 31 30 30 30 61 30 31 30 31 30
        62 30 31 30 38 30 63 30 31 30 31 3D 07 01 00 A0
        73 74 BE 70 32 04 0A FA 8B 0E 36 04 0A FA 8B 01
        39 02 02 40 37 07 01 1C 43 03 02 04 07 52 0E 01
        04 80 00 00 03 02 06 00 A0 73 74 BE 70 FF 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00
```

```
16:54:31: DHCPRELAY: Dumping incoming UDP packet:
        02 01 06 00 73 74 BE 70 00 00 80 00 00 00 00 00
        0A FA 8B 0E 0A FA 8B 01 0A FA 8B 02 00 A0 73 74
        BE 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 76 6C 61 6E
        5F 34 32 2E 63 66 67 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 63 82 53 63
        35 01 05 36 04 0A FA 8B 01 33 04 00 07 A9 30 01
        04 FF FF FF 00 06 08 C0 A8 FA C2 C0 A8 FA C3 2C
        04 C0 A8 FA C2 1C 04 FF FF FF FF 03 04 0A FA 8B
        01 52 0E 01 04 80 00 00 03 02 06 00 A0 73 74 BE
        70 FF
16:54:31: DHCPRELAY: ACK: Removing information option from frame
16:54:31: DHCPRELAY: Broadcasting ACK to client 00A0.7374.BE70
16:54:31: DHCPRELAY: Dumping outgoing UDP packet:
        02 01 06 00 73 74 BE 70 00 00 80 00 00 00 00 00
        0A FA 8B 0E 0A FA 8B 01 0A FA 8B 02 00 A0 73 74
        BE 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 76 6C 61 6E
        5F 34 32 2E 63 66 67 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 63 82 53 63
        35 01 05 36 04 0A FA 8B 01 33 04 00 07 A9 30 01
        04 FF FF FF 00 06 08 C0 A8 FA C2 C0 A8 FA C3 2C
        04 C0 A8 FA C2 1C 04 FF FF FF FF 03 04 0A FA 8B
        01 FF 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00
```

Relay Agent Support

The C3 can modify the DHCP relay address information (giaddr field) in the DHCP messages from the cable modem or host.

The primary function of this DHCP field is to allow the DHCP Offer and DHCP ACK to be routed back to the requesting device through what may be many routers in the backbone network. The giaddr advertises the C3 as the gateway to the requesting device.

DHCP servers use this relay address as a hint to what address space programmed into the DHCP server (address scope) to allocate an address from.

The DHCP server looks at the relay address and searches its defined scopes looking for a subnet match. If a matching scope is found, it allocates a lease from that scope.

The following example uses the interface's secondary address to specify the host giaddr:

```
cable 1/0.0
ip address 10.1.1.1 255.255.255.0
ip address 10.2.2.1 255.255.255.0 secondary
ip dhcp relay
! use same DHCP server for host and cable-modems
cable helper-address 10.9.9.1
! update giaddr with 10.1.1.1 for modems
! update giaddr with 10.2.2.1 for hosts
cable dhcp-giaddr policy
```

If **cable dhcp-giaddr policy** is activated, the cable sub-interface used on the C3 to relay the DHCP (as dictated by **cable helper-address** and **ip route)** should be configured with a *secondary* IP address. Otherwise the C3 uses the primary IP address as the giaddr (even with **dhcp-giaddr policy** activated).

The following example uses VSE encoding and cable sub-interfaces to specify the host giaddr:

```
cable 1/0.0
! one subnet used for all cable modem access
ip address 10.1.1.1 255.255.255.0
ip dhcp relay
cable helper-address 10.9.9.1 cable-modem
cable dhcp-giaddr primary

cable 1/0.2
! VSE modems with tag 2 will have attached CPE
! mapped to this sub-interface
ip address 10.2.2.1 255.255.255.0
encapsulation dot1q 2 native
! use the primary sub-interface address for host giaddr
ip dhcp relay
cable helper-address 10.9.9.1 host
cable dhcp-giaddr primary

cable 1/0.3
! VSE modems with tag 3 will have attached CPE
! mapped to this sub-interface
ip address 10.3.3.1 255.255.255.0
encapsulation dot1q 3 native
! use the primary sub-interface address for host giaddr
ip dhcp relay
cable helper-address 10.9.9.1 host
cable dhcp-giaddr primary
```

```
The following examples uses map-cpes and cable sub-interfaces to
specify the host giaddr:
cable 1/0.0
! subnet used for cable modem DHCP access only
ip address 10.1.1.1 255.255.255.0
ip dhcp relay
cable helper-address 10.9.9.1 cable-modem
cable dhcp-giaddr primary

cable 1/0.2
! modems given 10.2.2.0 address will come here
ip address 10.2.2.1 255.255.255.0
encapsulation dot1q 2 native
map-cpes cable 1/0.12

cable 1/0.3
! modems given 10.3.3.0 address will come here
ip address 10.3.3.1 255.255.255.0
encapsulation dot1q 3 native
map-cpes cable 1/0.13

cable 1/0.12
! CPE mapped to this sub-interface
ip address 10.12.12.1 255.255.255.0
encapsulation dot1q 12 native
ip dhcp relay
cable helper-address 10.9.9.1 host
! use the primary sub-interface address for host giaddr
cable dhcp-giaddr primary

cable 1/0.13
! CPE mapped to this sub-interface
ip address 10.13.13.1 255.255.255.0
encapsulation dot1q 13 native
ip dhcp relay
cable helper-address 10.9.9.1 host
! use the primary sub-interface address for host giaddr
cable dhcp-giaddr primary
```

If the **cable helper-address** is not being used:

- If the sub-interface is Layer 3, then the DHCP message will be dropped; a cable helper-address is mandatory for Layer 3 Cable sub-interfaces that have DHCP Relay activated.
- If the sub-interface is Layer 2, then C3 broadcasts the DHCP message with updated giaddr from every active fastethernet sub-interface in the same bridge group.

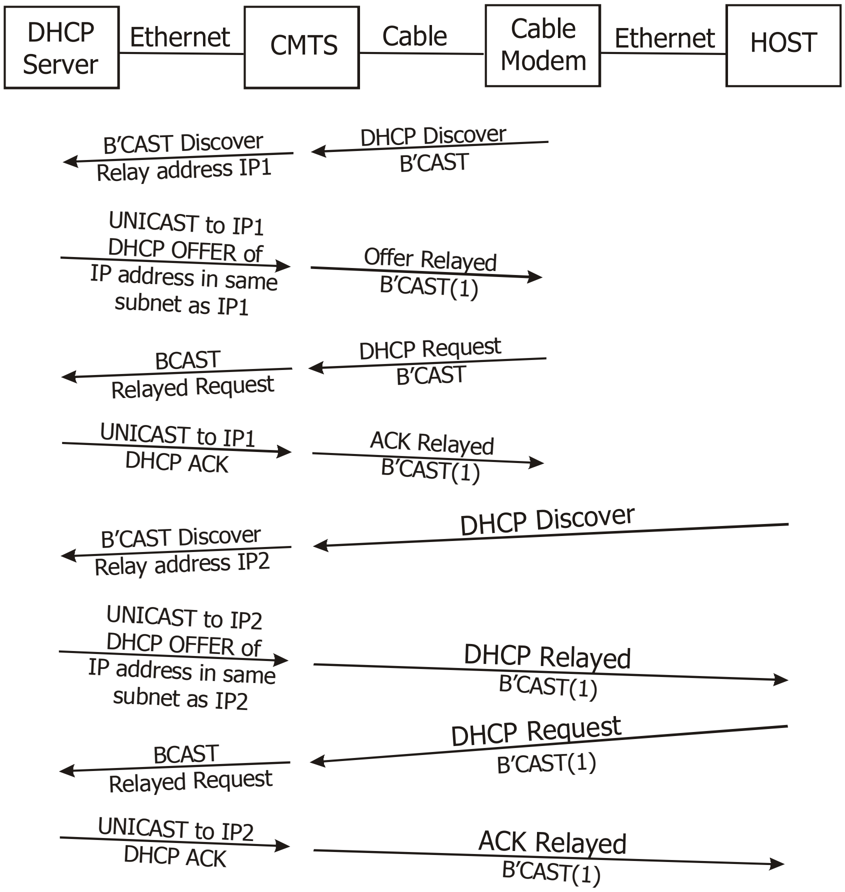


Figure 7-2: DHCP traffic flow with dhcp-giaddr enabled

DHCP Relay Information Option

The C3 can insert an option (option number 82) in the DHCP Discover or Request message that tells the management systems at the time of cable modem (or host) DHCP whether the DHCP is from a modem or a host. The MAC address of the cable modem is inserted into this option field for every DHCP Discover or Request message (with the exception of Renews) relayed by the C3 from the cable plant.

If the MAC address in the chaddr field matches the MAC address stored in the option 82 field, the discover or request must have come from a cable modem.

Similarly, if the MAC addresses do not match, then the Discover or Request can be assumed to have:

- come from a host, and
- the host is attached to the cable modem identified by the MAC address in the option 82 agent-remote-id sub-option (sub-option 2) field.

DHCP Server Use of Option 82

A DHCP server searches its defined scopes for a match to the giaddr of the incoming DHCP Discover or Request. (If the DHCP Discover or Request arrives as a broadcast, then the giaddr is assumed to be that of the received sub-interface IP address). If a matching scope is found, a reserved address is looked for in this scope. If no reserved address is found, then the next available IP address in this scope will be leased: that is, the leased address is always within the same subnet as the giaddr.

Where one modem subnet is required, this is not a problem. Where modems are required to be in different subnets, this is a problem. The DHCP server must be forced to lease an address in a different scope to the scope that matches the giaddr.

DHCP servers allow this to occur in different ways:

- For example Windows 2000 server DHCP server allows a *super scope* to be defined containing a number of scopes. In this case the super scope is searched for a matching scope to the giaddr; if a matching scope is found, the super scope is deemed to be a match. Then a reserved address is looked for. The reserved address can be in any scope in the super scope and does not have to be in the same subnet as the incoming giaddr. If no reserved address is found, then an address is leased on a round robin basis from any of the scopes in the super scope.
- Cisco Network Registrar operates in a similar manner. CNR uses the concept of *primary* and *secondary* scopes. One primary scope may have many secondary scopes. Together the primary and secondary scopes form a super scope in the Windows DHCP server sense.

To summarize DHCP server behavior:

- Where one scope only exists for a giaddr, either a reserved address is issued or an available address from this scope is issued.
- Where two scopes exist and an address is reserved in one scope, but the incoming giaddr matches the DHCP discover to the other scope, the reserved address is not issued. Further, no address from the scope matching the giaddr is issued.
- If the two scopes are a member of a super scope or are in a primary/secondary relationship, the reserved address is issued and if no reserved address is present, an address from either scope is issued on a round robin basis.

The main aim of DOCSIS provisioning is to reserve the MAC address of a modem in a scope, but not to have to do this for a PC. Option 82-aware DHCP servers can assist in this process.

Introducing a concept of primary and secondary DHCP clients:

- A *primary client* has a DHCP Discover with the chaddr field matching the option 82 agent-remote-id sub-option field (sub-option number 2).
- A *secondary client* has different MAC addresses in each of these fields and the option 82 agent-remote-id sub-option field (sub-option number 2) is the MAC address of the attached primary device.

When a DHCP Discover arrives from a primary device, all primary scopes are searched as per normal DHCP server operation and either a reserved address issued from a scope matching the giaddr or the next available address is issued from the primary scope matching the giaddr.

When a DHCP Discover arrives from a secondary device, the primary leases are searched for the attached primary MAC address. The lease then defines the primary scope used to issue the primary device IP address. Then the scopes secondary to this primary scope are searched for a reserved address. If no reserved address is found, the next available lease from the secondary scope is issued.

NOTE

A giaddr match is not performed to the secondary scope.

It is possible to have many secondary scopes to the one primary scope. If no reserved lease is found, then the next available lease from any one of the secondary scopes can be issued on a round robin basis.

Thus once the primary device is allocated an IP address, the secondary device is automatically allocated an IP address from a secondary scope with no need to reserve the address of the secondary device or no need to have a matching giaddr scope for the secondary device.

A side benefit of option 82 processing in a DHCP server is that if no option 82 information is present in the DHCP Discover or Request, primary and secondary scope processing still occurs but slightly differently.

Now the giaddr is used to search all defined scopes. If a matching scope is found but this scope has secondary scopes defined, the secondary scopes are searched for an address reservation. If no reservation is found, an address is issued from the primary and secondary scopes on around robin basis. This operation is very similar to the Windows 2000 server concept of super scopes.

With particular reference to the C3 and when operating in VSE mode, all modems exist in the one subnet and thus are assigned an address from the one scope.

The main requirement on the DHCP server is that modems are able to be given individual DHCP options that override the options normally associated with the scope. In this case, the different option of concern is the configuration file to be given to the modem.

Assuming the DHCP server supports this feature, CPEs are mapped to sub-interfaces by the modem configuration file VSE encoding.

CPEs subsequently perform DHCP using a giaddr of the mapped cable sub-interface. Where a single CPE scope is to be used, the CPE is issued an IP address based on the giaddr—an IP address of this cable sub-interface.

Where multiple CPE subnets are to be used (as in the case of an ISP having multiple non-contiguous or small subnets), the Windows DHCP server "super scope" or CNR's "primary + secondary" processing can be used to issue an IP address from the available scopes on a round robin basis.

- Windows 2000: The giaddr scope is just one scope of many in a super scope—an address is issued on a round robin basis from any of the scopes in the matching super scope.
- Cisco CNR: The giaddr scope matches at least one scope in a primary/secondary set of scopes —an address is issued from the primary and secondary scopes on a round robin basis.

Managing Modems Using SNMP

Simple Network Management Protocol (SNMP) enables you to monitor and control network devices in DOCSIS systems, and to manage configurations, statistics collection, performance, and security. SNMPv2c is used throughout DOCSIS. It supports centralized as well as distributed network management strategies, and includes improvements in the Structure of Management Information (SMI), protocol operations, management architecture, and security. The C3 also supports SNMPv3 for greater network security.

The configuration options available are defined in the *snmp-server* series of global configuration commands, starting on page 10-159.

By using an SNMP Manager application, such as HP OpenView, SNMPc, or NET-SNMP, you can monitor and control devices on the cable network using MIB variables.

NOTE
SNMP access to the CMTS is off by default. You can set up basic access using the following global configuration commands:

```
snmp-server community public ro
snmp-server community private rw
```

MIB Variables

Management information is a collection of managed objects, or variables, that reside in a virtual information store called the Management Information Base (MIB). Collections of related objects are defined in MIB modules.

MIB objects are defined by a textual name and a corresponding object identifier, syntax, access mode, status, and description of the semantics of the managed object.

The following shows the format of a DOCSIS MIB variable.

```
docsIfDownChannelPower OBJECT-TYPE
           SYNTAX      TenthdBmV
           UNITS       "dBmV"
           MAX-ACCESS  read-write
           STATUS      current
           DESCRIPTION
             "At the CMTS, the operational transmit power. At the CM,
               the received power level. May be set to zero at the CM
                if power level measurement is not supported.
                If the interface is down, this object either returns
             the configured value (CMTS), the most current value (CM)
             or the value of 0. See the associated conformance object
              for write conditions and limitations. See the reference
                for recommended and required power levels."
           REFERENCE
               "DOCSIS Radio Frequency Interface Specification,
                Table 4-12 and Table 4-13."
```

Configuring a Host as a Trap Listener

The following CLI commands register the host 192.168.250.107 as a SNMPv2c trap listener. Traps sent to this listener have 'MyCommunity' as a community string and only traps registered under the 'internet' domain are sent (which are basically all traps that a CMTS would send).

Each command requires a unique identifier for each trap listener. You should replace the 'My' prefix with a proper unique identifier, such as a host name.

```
C3# configure terminal
C3(config)# snmp-server user MyCommunity MyGroup v2c
access-list Trap
C3(config)# snmp-server group MyGroup v2c notify
MyTrapNotify
C3(config)# snmp-server view MyTrapNotify internet
included
C3(config)# snmp-server notif-sec-model MySecurity
MyCommunity v2c security-model v2
C3(config)# snmp-server host MyTrapReceiver MySecurity
192.168.250.107 traps
C3(config)# snmp-server enable traps
```

NOTE
Use the command **show snmp-server** to list these settings. These settings are persistent across reboots.

Controlling User Access

You can control access to the network using password-like community strings that enable you to assign users to communities that have names (for example, public or private). This system enables you to manage devices on the network. Community names should be kept confidential.

To prevent unauthorized users from accessing the modem, you assign the modem to a community. You can also specify that SNMP access is allowed only from the cable side. You assign a modem to a community using the docsDevNmAccess group MIBs from either a MIB Browser in an SNMP manager, or by specifying the MIB in the configuration file.

General Modem Status

The following table describes CM states and descriptions reported by the C3 CMTS:

State	Meaning
Offline	The cable modem is inactive.
init(r1)	The C3 has successfully received a ranging request from the modem in a contention interval (eg., initial ranging)
init(r2)	The CMTS has responded to an initial ranging request from the modem, but has not yet completed ranging (eg, the modem’s transmit parameters are still outside of the acceptable range as defined by the CMTS).
init(rc)	The cable modem has successfully adjusted its transmit power and timing so that initial ranging has completed successfully.

State	Meaning
init(d)	The cable modem has sent a DHCP request.
init(i)	The CMTS has relayed a DHCP response to the modem, but the modem has not yet acknowledged the new address to the DHCP server.
init(o)	The modem is ready to or is currently TFTP'ing the configuration file.
init(t)	Modem read for ToD.
Online	The modem has successfully completed registration
Online(d)	Online, network access disabled
Online(pt)	The modem is online and BPI is enabled. THe modem has a valid traffic encryption key (TEK)
Online(pk)	The modem is online, BPI is enabled, and a key encryption key (KEK) is assigned.
reject(m)	The CMTS rejected the registration request from the modem because the shared secret from the modem does not match the CMTS shared secret.
reject(c)	The class of service offered by the modem as part of the registration request was not valid.
reject(pk)	The Key Encryption Key (KEK) offered by the modem was invalid
reject(pt)	The Traffic Encryption Key (TEK) offered by the modem was invalid.

Use the following MIB to check general modem status.

Table 7-3: General Modem Status

MIB Object	Value	Description
docsIfCmStatusValue	2=notReady	Modem is searching for a downstream channel.
	3=notSynchronized	Modem has found a downstream channel but has not set timing.
	4=phySynchronized	Modem sees a digital signal and is looking for a UCD.
	5=usParametersAcquired	Modem has found a UCD and is ranging.
	6=rangingComplete	Modem is waiting for a DHCP address.
	7=ipComplete	Modem has IP address and is trying to contact a Network Time Protocol (NTP) server.
	8=todEstablished	Modem has determined the time.
	9=securityEstablished	
	10=paramTransferComplete	Received the configuration file.
	11=registrationComplete	CMTS accepted the registration request.
	12=operational	Modem is online.
	13=accessDenied	CMTS does not allow modem to pass traffic.

Data Errors

Use the following MIBs to check for data errors.

Table 7-4: Data Errors

MIB Object	Description
docsIfSigQUnerroreds	Number of data packets that arrived undamaged.
docsIfSigQCorrecteds	Number of data packets that arrived damaged, but could be corrected.
docsIfSigQUncorrectables	Number of data packets that arrived so damaged that they were discarded.

Signal-to-Noise Ratio

Use the following MIB to determine the downstream signal-to-noise ratio as measured at the cable modem.

Table 7-5: DS signal-to-noise ratio

MIB Object	Value	Description
docsIfSigQSignalNoise	35 to 37	Typical ratio for clean plant.
	Below 29	QAM256 is not usable.
	Below 26	QAM64 performance is significantly impaired.
	20	Modem cannot function.

Downstream Channel

Use the following MIBs to determine downstream channel issues.

Table 7-6: DS channel issues

MIB Object	Value	Description
docsIfCmStatusLostSyncs	should be small	Number of times modem detects downstream had trouble. A high number indicates problems on the downstream.
docsIfDownChannel-Frequency		Downstream frequency to which the modem is listening.
docsIfDownChannelWidth	6MHz or 8MHz	Set automatically based on whether the CMTS is operating in DOCSIS or EuroDOCSIS mode.

Table 7-6: DS channel issues

MIB Object	Value	Description
DocsIfDownChannelModulation	QAM64 or QAM 256	If different, modem has problem.
DocsIfDownChannelPower	> +15 dBmv	Signal is too strong; insert an attenuator.
	< -15 dBmv	Signal is too weak; modem might have reliability problems, such a bad cable, too many splitters, or unnecessary attenuator.
	+15 dBmv to -15 dBmv	Valid DOCSIS range.

Upstream Channel

Use the following MIBs to determine upstream channel issues.

Table 7-7: UP channel issues

MIB Object	Value	Description
docsIfUpChannel-Frequency	should be small	This variable is set automatically by the modem when it selects a particular upstream to use.
docsIfUpChannelWidth		The wider the upstream channel is, the higher the data rate.
docsIfCmStatusTx-Power	+8 to +58 dBmv	Legal range.
	Over +50 dBmv	Do not use 16 QAM; upstream is impaired to the point where QPSK is required.

Upgrading Modem Firmware

Inspecting and upgrading modem firmware is a fundamental part of managing modem operations.

Action

Perform any of the following procedures as necessary.

- *Upgrading from the Configuration File*, page 7-25
- *Upgrade a Single Modem Using an SNMP Manager*, page 7-25
- *Upgrading Software on All Cable Modems*, page 7-26

Procedure 7-1

Upgrading from the Configuration File

1. Using a configuration editor, modify the following fields in the cable modem configuration file:

   a. In the Software Upgrade Filename field, enter the path and filename of the firmware that you want to download.

   b. In the SNMP MIB Object field, enter the following hex string: **30 0F 06 0A 2B 06 01 02 01 45 01 03 03 00 02 01**

      This hex string sets the docsDevSwAdminStatus variable (MIB object ID **1.3.6.1.2.1.69.1.3.3.0)** to the integer value **2** which allows the modems to perform the upgrade.

   c. In the Software Upgrade TFTP Server, type the IP address of the TFTP server where the upgrade file is located.

2. Save your changes to the configuration file.
3. Reboot the modems.

End of procedure

Procedure 7-2

Upgrade a Single Modem Using an SNMP Manager

1. Type the IP address of the cable modem in the Name or IP Address field.
2. Type **private** (or the proper Set Community name) in the Community field.
3. Highlight the docsDevMIBObjects MIB (MIB Object ID **1.3.6.1.2.1.69.1**), then click **Down Tree**.
4. Highlight the docsDevSoftware MIB, then click **Down Tree**.
5. From the MIB Values field, highlight **docsDevSwServer**.
6. From the SNMP Set Value field, type the IP address of the TFTP server, then click **Set**.
7. Click **Close** on the pop-up information screen.
8. From the MIB Values field, highlight **docsDevSwFilename**.
9. From the SNMP Set Value field, type the location and filename of the image, then click **Set**.
10. Click **Close** on the pop-up information screen.
11. From the MIB Values field, highlight **docsDevSwAdminStatus**.
12. From the SNMP Set Value field, type **1** (**upgradeFromMgt**), then click **Set**.

13 From the MIB Values field, highlight **docsDevSwOperStatus**.

14 Click **Start Query** to verify the status of the software download.

The MIB object docsDevSwAdminStatus defaults to ignoreProvisioningUpgrade after a modem has been upgraded using SNMP. This prevents a modem from upgrading via the configuration file the next time a bulk upgrade is performed. To restore the original value of allowProvisioningUpgrade, perform the following steps in this procedure.

15 Type the IP address of the cable modem under the Name or IP Address field.

16 Type **private** (or the proper Set Community name) in the Community field.

17 Highlight docsDevMIBObjects, then click **Down Tree**.

18 Highlight docsDevSoftware MIB, then click **Down Tree**.

19 From the MIB Values field, highlight **docsDevSwAdminStatus**.

20 From the SNMP Set Value field, type **2** (**allowProvisioningUpgrade**), then click **Set**.

End of procedure

Procedure 7-3

Upgrading Software on All Cable Modems

The simplest way to update the software on all cable modems is to force cable modems to reset and specify a new software download image in the configuration file.

1 Modify the configuration file using the CMTS vendor’s configuration file editor so that it specifies the new software download image filename.

2 Make sure that the configuration file includes the Software Upgrade TFTP Server Address where the new software download image is located.

3 Reset all cable modems on the CMTS by using the **clear cable modem all reset** command or by using SNMP to set the docsDevResetNow MIB object on all cable modems to True(1). This forces all modems to reset. The reset process forces the cable modems to reacquire the RF signal and reregister with the CMTS. The cable modems download the new configuration file, which specifies a new software download image. Because the name of the new image does not match the software image of the cable modems, all cable modems download this new image.

4 After the downloading process has started, you can monitor the process using the docsDevSwOperStatus MIB object. During the download, this object returns a value of inProgress(1) and the Test LED on the front panel of the cable modem blinks.

5. If downloading fails, the docsDevSwOperStatus MIB object returns a value of failed(4).
6. If downloading is successful, the cable modem automatically resets and the docsDevSwOperStatus MIB object returns a value of completeFromProvisioning(2).
7. The docsDevSwAdminStatus MIB object automatically resets itself to ignoreProvisioningUpgrade(3). If desired, set the docsDevSwAdminStatus MIB object to allowProvisioningUpgrade(2), to allow software updates via the configuration file.

End of procedure

Provisioning Upstream Load Balancing

Load balancing offers the ability to distribute modems in different ways across grouped upstream channels. Use this procedure to provision upstream load balancing.

Load Balancing Methods

The C3 offers the following load balancing methods:

none — The C3 assigns cable modems to the upstream specified in the CM provisioning file, or the first available upstream if none is provisioned. Once the cable modem has registered, the C3 does not attempt to move it until rebooted (starts initial ranging).

initial — The C3 assigns cable modems to the upstream with the fewest number of cable modems currently assigned. Once the cable modem has registered, the C3 does not attempt to move it until rebooted (starts initial ranging).

periodic — The C3 initially assigns cable modems to the upstream with the lowest traffic levels, then periodically reassigns cable modems based on current traffic levels.

How Load Balancing Works

Before load balancing takes place, the C3 detects whether the modem is DOCSIS 2.0-compliant; if it is, the C3 assigns those modems to DOCSIS-2.0 channels.

Periodic load balancing requires an *upstream cable group*, a collection of upstream channels that can be assigned to one or more cable modems. Each upstream channel has a “group ID” assigned to it which is used to associate that channel with other upstream channels on the same physical cable. The C3 supports up to 6 cable groups.

Initial Ranging Requirements — The cable modem must support the RNG-RSP message (all DOCSIS-compliant modems should support this message).

Periodic Ranging Requirements — The cable modem must support the RNG-RSP, UCC-REQ, and UCC-RSP messages.

The cable modem provisioning file should not contain an upstream channel ID (TLV type 2).

Procedure 7-4 Set up a Cable Group and Assign Load Balancing

Follow these steps to set up a cable group and assign a load balancing method.

NOTE
Six cable groups are defined by default with each physical upstream assigned to a different cable group.

1 Assign desired US channels to a specified cable group using the following commands:

conf t

interface cable 1/0

cable upstream {us} **group-id** {id}

where...	is...
us	the physical upstream channel (**0** to **5**) to be assigned to a cable group
id	the cable group ID (**1** to **6**)

2 Enable load balancing and set desired method for the cable group using the following command:

cable group {id} **load-balancing** {type}

where...	is...
id	the cable group ID (**1** to **6**)
type	one of: **none**, **initial**, or **periodic**

End of procedure

8 Configuring Security

Overview

Management security can be implemented in a number of ways:

- Use the two Fast Ethernet ports to physically separate user data from management data or;
- Restrict access at each interface using the **management-access** specification or;
- Use ACLs to restrict access to/from the Cadant C3 at any sub-interface or;
- Use VLANs to separate user data from cable-modem and CMTS data or;
- Use the Cadant C3 cable sub-interface native VLAN and downstream privacy capability to isolate user groups from one another.

In addition, the following methods can provide security on the subscriber side of the network:

- Use subscriber management filters to restrict access by CPE devices;
- Use Cable Source Verify to prevent IP address spoofing or CPE configuration errors;
- Use Packet Throttling to reduce broadcast traffic in Layer 2 networks, and reduce the effect of Denial of Service (DoS) attacks in Layer 2 and Layer 3 networks.

With the requirement from law enforcement agencies to have the ability to intercept traffic, the 4.2 release of the C3 software introduced the Simple Law Enforcement Monitoring Feature (SLEM). The C3 supports SLEM in accordance with RFC 3924. This allows the operator to configure the CMTS to intercept customer data and supply the captured data to a mediation device that handles the collection of such information. Some of the key features are:

- Intercepts customer traffic by using a set of stream filters, encapsulates this traffic and forwards it to a remote collection point called a Mediation Device (MD)
- Allows for up to 20 interception sessions to be active at one time
- Uses the PacketCable Electronic Surveillance Specification encapsulation method for tunneling traffic to mediation devices
- Allows a particular DSCP value to be applied to the forwarded traffic
- Provides layer 3 and layer 4 IP related stream filter for matching customer data for interception
- Provides for an optional layer 2 stream filter for matching customer data for interception
- Allows for stream filters to be configured but not enabled on customer data
- Keeps count of the number of matched packets per stream filter
- Keeps count of the number of dropped packets per stream filter that were dropped during the lawful intercept process
- Maintains a timeout for each individual active interception session to ensure that the interception only runs for as long as the session is configured for
- Relies on SNMPv3 to secure the configuration of the legal intercept feature to ensure that the use of the feature is restricted to authorized users

The following sections discuss and explain each of these methods.

Physically Separating Data

The C3 has two physical FastEthernet interfaces, allowing C3 management to use a physically different interface to that used by subscriber traffic.

Bridge groups can be used to isolate CPE traffic from management traffic. The factory default C3 has two bridge groups pre-defined and allocated as follows:

```
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.0

fastethernet 0/0.0
bridge-group 0
no shutdown

cable 1/0.0
bridge-group 0
no shutdown

fastethernet 0/1.0
    bridge-group 1
    no shutdown

cable 1/0.1
    bridge-group 1
    encapsulation dot1q 1
    shutdown
```

In this configuration:

- Both modems and CPE are mapped to the cable 1/0.0 sub-interface
- Any broadcast traffic received at the cable sub-interface 1/0.0 is broadcast to the fastethernet 0/0.0 interface.

The CMTS management IP address can be assigned to either fastethernet 0/0.0 or 0/1.0.

NOTE
You can assign the management address to a cable sub-interface, but this is not recommended since shutting down the cable sub-interface also disables management access.

By adding the management IP address to fastethernet 0/1.0 and using the **management-access** specification, CMTS management can be isolated from the CPE and CM traffic in bridge group 0 as follows:

```
default cm-sub-interface cable 1/0.0
default CPE-sub-interface cable 1/0.0

fastethernet 0/0.0
bridge-group 0
no management-access

cable 1/0.0
bridge-group 0
no management-access

fastethernet 0/1.0
    bridge-group 1
    ip address 10.0.0.1 255.255.255.0
    management-access

cable 1/0.1
    bridge-group 1
no management-access
encapsulation dot1q 1 native
```

If required, CM traffic can be isolated from CPE traffic by reassigning the default interface for CM traffic as follows. Both modem and CMTS management traffic now use fastethernet 0/1.0:

```
default cm subinterface cable 1/0.1
default cpe subinterface cable 1/0.0

fastethernet 0/0.0
bridge-group 0
no management-access

cable 1/0.0
bridge-group 0
no management-access

fastethernet 0/1.0
    bridge-group 1
    ip address 10.0.0.1 255.255.255.0
    management-access

cable 1/0.1
    bridge-group 1
no management-access
encapsulation dot1q 1 native
```

The modem and CMTS traffic can be separated at this fastethernet interface by using the VLAN sub-interface capability of the C3.

- Once a fastethernet sub-interface is removed from a bridge group, this sub-interface is then assumed by the C3 to be the management interface for the C3.
- Another sub-interface is created and bridged to the modems on cable 1/0.1.
- One of the fastethernet 0/1.X sub-interfaces must have a VLAN tag—the following example shows the tagging being assigned to fastethernet 0/1.1:

```
default cm subinterface cable 1/0.1
default cpe subinterface cable 1/0.0

fastethernet 0/0.0
    ! for CPE traffic
bridge-group 0
no management-access

cable 1/0.0
    ! for CPE traffic
bridge-group 0
no management-access

fastethernet 0/1.0
    ! for CMTS management
no bridge-group
    ip address 10.0.0.1 255.255.255.0
    management-access

fastethernet 0/1.1
    ! for modem traffic
    bridge-group 1
    encapsulation dot1q 11

cable 1/0.1
    ! for modems
    bridge-group 1
no management-access
encapsulation dot1q 1 native
```

NOTE

This example still falls within the boundaries of the basic software license abilities; namely up to 3 sub-interfaces per bridge group, up to 2 bridge groups, one VLAN tag per sub-interface, and one management-only sub-interface allowed.

As other examples in this chapter show, access by CPE devices to the management network can also be restricted by:

- ACL
- Subscriber management filters

Filtering Traffic

The C3 supports subscriber management filtering and access control list (ACL) based filtering. You can also configure filters in the modem itself—this option, although not part of a CMTS user manual, should not be overlooked. For example, if upstream multicast traffic is to be eliminated, it is better to block this traffic at the modem (modem configuration file specified) before being propagated upstream than to block at the CMTS where the upstream bandwidth is already used.

At this point it is worth asking what you want to do with such filtering.

Subscriber management filters are upstream/downstream and modem and CPE specific and:

- Are defined in the CMTS in groups of filters.
- The CMTS configuration can specify one of these filter groups as the default for all modems and attached CPE.
- The CMTS defaults can be overridden using the cable modem provisioning system; the defaults may be overridden using TLVs in a modem configuration file by the TLV referencing different filters (filters still defined in the CMTS).

If Subscriber management filters are never going to be manipulated in this manner, then you should consider using ACLs. ACL filters are sub-interface and direction specific, form part of a sub-interface specification and may be used on any sub-interface in the CMTS.

In summary:

- ACL:
  - Sub-interface specific and can be used for filtering fastethernet traffic as well as cable traffic
  - Static configuration
  - More flexible filtering
- Subscriber management:
  - Cable-modem and CPE specific
  - CMTS default behavior can be specified
  - Default behavior can be overridden by cable modem configuration file TLVs passed to CMTS during registration.

See also: *cable filter group*, page 10-107, and related commands. See also *access-list*, page 10-100, and related commands.

Working with Access Control Lists

This section describes the **access-list** syntax for each type of Access Control List (ACL) definition. Common uses for ACLs include:

- Preventing illegal access to services provided by the C3, such as Telnet, DHCP relay, and SNMP, from sources external to it, such as CMs, CPEs or other connected devices.
- Preventing access to service via the C3; that is, traffic passing through the C3 can also be subjected to ACL-based filtering. For example, ACLs could prevent access to certain TCP ports on CPEs to block external access to proxies and other services.

The C3 applies ACLs to all network traffic passing through the CMTS.

ACLs and ACEs — Access Control Lists (ACLs) are lists of Access Control Entries (ACEs) that are used to control network access to a resource.

Up to 30 ACLs may be defined; each ACL can contain up to 30 ACEs.

The ACL-number defines the type of ACL being created or referred to:

Number	Type
1-99	Standard IP
100-199	Extended IP
1300-1999	Standard IP (expanded range)
2000-2699	Extended IP (expanded range)

Multiple use of the **access-list** command—each using the same ACL-number but with different parameters—creates a new ACE for the ACL referred to by the ACL-number.

Implicit Deny All — One important point to note about ACLs is that there is an implicit “deny all” ACE at the end of each ACL.

- If an ACL consists of a series of ACEs and no match is made for any ACE, the packet is denied.
- If an ACL number is referred to or is assigned to an interface but no ACEs have been defined for this ACL, the implicit “deny all” ACE is *not* acted on.

An example of this command is as follows:

```
access-list 102 permit 6 any eq 23
```

This ACL allows TCP (protocol 6) based traffic from any source IP address with a TCP source port of 23 (Telnet) to pass through. All other packets are denied since they match the implicit "deny all" ACE. Another more complete example is as follows.

access-list 102 permit 6 192.168.250.0 0.0.0.255 eq 23 10.0.0.0 0.0.0.255 gt 1023

This ACL passes all TCP based traffic from any host in the 192.168.250.0/24 network with a TCP source port of 23 (Telnet) to a host within the 10.0.0.0/16 network with a TCP destination port of greater than 1023 to pass through.

Standard ACL Definition

Syntax: **[no] access-list {*ACL-number*} {permit | deny} {host *ipaddr* | *ipaddr wildcard* | any}**

Creates a standard ACL definition with the specified entry, or adds a new entry to an existing ACL. The parameters are:

ACL-number — The ACL identifier. Value: **1** to **99** or **1300** to **1399**. The C3 supports up to 30 ACLs, with each ACL containing up to 30 ACEs.

ipaddr — A single IP address, or (when specified with *wildcard*) the base address of a subnet.

wildcard — The inverted mask defining the limits of a subnet. For example, if the subnet contains 256 addresses, the wildcard is **0.0.0.255**.

any — Matches any IP address.

Extended IP Definitions

Syntax: **[no] access-list {*ACL-number*} {permit | deny} {*protocol*} {host *source* | *source source-wildcard* | any} {host *dest* | *dest dest-wildcard* | any} [icmp-type [icmp-code]] [precedence *precedence*] [tos *tos*] [dscp *dscp*]**

Creates an ACL definition with the specified entry, or adds a new entry to an existing ACL. The parameters are:

ACL-number — The ACL identifier. Value: **100** to **199** or **2000** to **2699**. The C3 supports up to 30 ACLs, with each ACL containing up to 30 ACEs.

protocol — The IP protocol type: **0** to **255**, or one of the following:

Keyword	Description
ahp	Authentication Header Protocol
eigrp	EIGRP routing protocol
esp	Encapsulation Security Protocol
gre	GRE tunneling
icmp	Internet Control Message Protocol

Keyword	Description
igp	IGP routing protocol
ip	any Internet protocol
ipinip	IP in IP tunneling
nos	KA9Q NOS compatible IP over IP tunneling
ospf	OSPF routing protocol
pcp	Payload Compression Protocol
pim	Protocol Independent Multicast
tcp	Transmission Control Protocol
udp	User Datagram Protocol

icmp-code — See *ICMP Definition*, page 8-11.

precedence — Matches the precedence bits of the IP header's TOS field. Value: **0** to **7**, or one of the following:

Keyword	Description	Value
network	Match packets with network control precedence	7
internet	Match packets with internetwork control precedence	6
critical	Match packets with critical precedence	5
flash-override	Match packets with flash override precedence	4
flash	Match packets with flash precedence	3
immediate	Match packets with immediate precedence	2
priority	Match packets with priority precedence	1
routine	Match packets with routine precedence	0

tos — Matches Type of Service (TOS) bits in the IP header's TOS field. Value: one of **0**, **2**, **4**, **8**, **16**, or one of the following:

Keyword	Description	Value
min-delay	Match packets with minimum delay TOS	8
max-throughput	Match packets with maximum throughput TOS	4
max-reliability	Match packets with maximum reliability TOS	2
min-monetary-cost	Match packets with minimum monetary cost TOS	1

Keyword	Description	Value
normal	Match packets with normal TOS	0

dscp — The Differentiated Services Codepoint value: **0** to **63**, or one of the following:

Keyword	Description	Binary Value
af11	Match packets with AF11 dscp	001010
af12	Match packets with AF12 dscp	001100
af13	Match packets with AF13 dscp	001110
af21	Match packets with AF21 dscp	010010
af22	Match packets with AF22 dscp	010100
af23	Match packets with AF23 dscp	010110
af31	Match packets with AF31 dscp	011010
af32	Match packets with AF32 dscp	011100
af33	Match packets with AF33 dscp	011110
af41	Match packets with AF41 dscp	100010
af42	Match packets with AF42 dscp	100100
af43	Match packets with AF43 dscp	100110
cs1	Match packets with CS1 (precedence 1) dscp	001000
cs2	Match packets with CS2 (precedence 2) dscp	010000
cs3	Match packets with CS3 (precedence 3) dscp	011000
cs4	Match packets with CS4 (precedence 4) dscp	100000
cs5	Match packets with CS5 (precedence 5) dscp	101000
cs6	Match packets with CS6 (precedence 6) dscp	110000
cs7	Match packets with CS7 (precedence 7) dscp	111000
default	Match packets with default dscp	000000
ef	Match packets with EF dscp	101110

ICMP Definition

Syntax: **[no] access-list {ACL*-number}* {permit | deny} {icmp} {host *source* | *source source-wildcard* | any} {host *dest* | *dest dest-wildcard* | any} [*icmp-type* [*icmp-code]*] [fragment] [precedence *precedence*] [tos *tos*] [dscp *dscp*]**

Creates an ACL with the specified ICMP filter entry, or adds the specified ICMP filter entry to an existing ACL. The parameters are:

fragment — See *Fragment Support*, page 8-17.

icmp-code — One of the following:

icmp-type	icmp-code	Equivalent CLI Keyword	Query	Error
0		echo-reply	X	
3		destination-unreachable		
	0	net-unreachable		X
	1	host-unreachable		X
	2	protocol-unreachable		X
	3	port-unreachable		X
	4	fragment-needed-and-dont-fragment-was-set		X
	5	source-route-failed		X
	6	destination-network-unknown		X
	7	destination-host-unknown		X
	8	source-host-isolated (obsolete)		X
	9	communication-with-destination-network-is-admin-prohibited		X
	10	communication-with-destination-host-is-admin-prohibited		X
3	11	destination-network-unreachable-for-type-of-service		X
	12	destination-host-unreachable-for-type-of-service		X
	13	communication-admin-prohibited (by filtering)		X
	14	host-precedence-violation		X
	15	precedence-cutoff-in-effect		X
4		Source quench		X

icmp-type	icmp-code	Equivalent CLI Keyword	Query	Error
5		redirect		
	0	redirect-datagram-for-the-network-or-subnet		X
	1	redirect-datagram-for-the-host		X
	2	redirect-datagram-for-the-type-of-service-and-network		X
	3	redirect-datagram-for-the-type-of-service-and-host		X
8		echo-request	X	
9		router-advertisement	X	
	0	normal-router-advertisement	X	
	16	does-not-route-common-traffic	X	
10		router-selection	X	
11		time-exceeded		
	0	time-to-live exceeded-in-transit		X
	1	fragment-reassembly-time-exceeded		X
12		parameter-problem		
	0	pointer-indicates-the-error		X
	1	missing-a-required-option		X
	2	Bad-length		X
13		timestamp	X	
14		timestamp-reply	X	
15		information-request	X	
16		information-reply	X	
17		address-mask-request	X	
18		address-mask-reply	X	
30		traceroute	X	
31		datagram-conversion-error		X
32		mobile-host-redirect	X	
33		ipv6-where-are-you	X	
34		ipv6-I-am-here	X	
37		domain-name-request	X	

icmp-type	icmp-code	Equivalent CLI Keyword	Query	Error
38		domain-name-reply	X	
39		skip	X	
40		photuris		
	0	bad-spi		
	1	authentication-failed		
	2	decompression-failed		
	3	decryption-failed		
	4	need-authentication		
	5	need-authorisation		

NOTE

The icmp-types **destination-unreachable, redirect, router-advertisements, time-exceeded, parameter-problem,** and **photuris** have explicit code values associated with them. Other icmp-types have an implicit (not listed) code value of zero and thus no icmp-code option is expected at the CLI level.

TCP Definition

Syntax: **[no] access-list*{ACL-number}* {permit | deny} tcp {host *source* | *source source-wildcard* | any} [*oper por‡*] {host *dest* | *dest dest-wildcard* | any} [*oper port*] [*icmp-type* [*icmp-code*]] [fragment] [precedence *precedence*] [tos *tos*] [dscp *dscp*]**

Creates an ACL with the specified TCP filter entry, or adds the specified TCP filter entry to an existing ACL. The parameters are:

oper — Optional port specifier; one of **eq** (equal), **neq** (not equal), **lt** (less than), or **gt** (greater than).

port — The port number to match (using the defined operator): **0** to **65535**, or one of the following:

Keyword	Name	Port number
bgp	Border Gateway Protocol	179
chargen	Character generator	19
cmd	Remote commands (rcmd)	514
daytime	Daytime	13
discard	Discard	9

Keyword	Name	Port number
domain	Domain Name Service	53
echo	Echo	7
exec	Exec (rsh)	512
finger	Finger	79
ftp	File Transfer Protocol	21
ftp-data	FTP data connections (used infrequently)	20
gopher	Gopher	70
hostname	NIC hostname server	101
ident	Ident Protocol	113
irc	Internet Relay Chat	194
klogin	Kerberos login	543
kshell	Kerberos shell	544
login	Login (rlogin)	513
lpd	Printer service	515
nntp	Network News Transport Protocol	119
pim-auto-rp	PIM Auto-RP	496
pop2	Post Office Protocol v2	109
pop3	Post Office Protocol v3	110
smtp	Simple Mail Transport Protocol	25
sunrpc	Sun Remote Procedure Call	111
syslog	Syslog	514
tacacs	TAC Access Control System	49
talk	Talk	517
telnet	Telnet	23
time	Time	37
uucp	Unix-to-Unix Copy Program	540
whois	Nicname	43
www	World Wide Web (HTTP)	80

tcpflags — Matches TCP header flags. Value: A six-bit value, **0** to **63**, where:

Bit	Name
5	urgent
4	ack
3	push
2	reset
1	sin
0	fin

UDP Definition

Syntax: **[no] access-list*{ACL-number}*{permit | deny} udp {host *source* | *source source-wildcard* | any} *[oper port]* {host *dest* | *dest dest-wildcard* | any} *[oper port] [icmp-type [icmp-code]]* [fragment] [precedence *precedence*] [tos *tos*] [dscp *dscp*]**

Creates an ACL with the specified UDP filter entry, or adds the specified UDP filter entry to an existing ACL. The parameters are:

oper — See *TCP Definition*, page 8-14.

port — The port number to match (using the defined operator): **0** to **65535**, or one of the following:

Keyword	Name	Port number
biff	Biff (mail notification, comsat)	512
bootpc	Bootstrap Protocol (BOOTP) client	68
bootps	Bootstrap Protocol (BOOTP) server	67
discard	Discard	9
dnsix	DNSIX security protocol auditing	195
domain	Domain Name Service (DNS)	53
echo	Echo	7
isakmp	Internet Security Association and Key Management Protocol	500
mobile-ip	Mobile IP registration	434
nameserver	IEN116 name service (obsolete)	42
netbios-dgm	NetBios datagram service	138
netbios-ns	NetBios name service	137
netbios-ss	NetBios session service	139

Keyword	Name	Port number
ntp	Network Time Protocol	123
pim-auto-rp	PIM Auto-RP	496
rip	Routing Information Protocol (router, in.routed)	520
snmp	Simple Network Management Protocol	161
snmptrap	SNMP Traps	162
sunrpc	Sun Remote Procedure Call	111
syslog	System Logger	514
tacacs	TAC Access Control System	49
talk	Talk	517
tftp	Trivial File Transfer Protocol	69
time	Time	37
who	Who Service (rwho)	513
xdmcp	X Display Manager Control Protocol	

All Other Protocols

Syntax: **[no] access-list *{ACL-number}* {permit | deny} *{protocol}* {host *source* | *source source-wildcard* | any} *[oper port]* {host *dest* | dest *dest-wildcard* | any} [oper *port*] [*icmp-type [icmp-code]]* [fragment] [precedence *precedence*] [tos *tos*] [dscp *dscp*]**

Creates an ACL with the specified filter entry, or adds the specified filter entry to an existing ACL.

The [no] Option

Use the **no** option to remove an ACE from a ACL without having to re-enter the complete ACL.

Fragment Support

Full support of the fragment option is provided. Use this option to prevent attacks on hosts as detailed by RFC 1858. However, using this option restricts access to resources by non-fragment flows only.

The first packet of a TCP segment contains the IP header (Layer 3) and the TCP header (layer 4). This fragment is an “initial fragment.” Subsequent IP packets (fragments) of this segment only have a layer 3 header (no TCP header). Such fragments are “non-initial fragments.”

If a TCP segment is completely contained in the first IP Datagram then this is a “non-fragment” packet.

With regard to defining ACL filters, blocking initial fragments is often all that is required as the remaining packets cannot be re-assembled; that is, all packets with an offset greater than zero traditionally are allowed to pass through ACL filters. But this type of processing can allow both an overlapping fragment attack and a tiny fragment attack on the host as detailed in RFC1858. Thus, the C3 must also be able to deny non-initial fragments.

Where a data flow to port 80 on a host is to be protected, an ACL such as ACL 100 (see below) may be created. This ACL only tests for initial fragments.

When an ACL such as ACL102 (see below) is created, non-initial fragments (containing no layer 4 header) match the layer 3 part of the first ACE. As there is no Layer 4 information in the packet, no layer 4 information is tested. This packet is a non-initial fragment, so the fragment option also matches. Thus, all ACE filter options that can be matched are matched and the packet is denied.

In the case where an initial or non fragment hits this first ACE, the layer 3 filter matches, the layer 4 filter (port number) matches but this packet is an initial (or non-) fragment so the last filter—the fragment option— fails and the packet will be passed to the next ACE in the ACL.

Example:

```
access-list 100 permit tcp any host 192.168.253.65 eq 80
access-list 100 deny ip any any
```

This filter, applied to the C3 as an incoming filter, is designed to permit only HTTP (port 80) to the host 192.168.253.65. But is this true? A non-initial fragments HTTP packet (a packet with an incomplete layer 4 header) can also pass to the specified host, opening the host to an overlapping fragment or a tiny fragment attack.

```
access-list 102 deny ip any host 192.168.253.65
fragments
access-list 102 permit tcp any host 192.168.253.65 eq 80
access-list 102 deny ip any any
```

If filter 102 is applied, all non-initial fragments are denied and only non-fragmented HTTP data flows are permitted through to the specified host.

Using an ACL

Defining an ACL does not actually apply the ACL for use.

Use the **ip access-group** command to associate an ACL with inbound or outbound traffic on a specific interface or sub-interface.

It is not necessary, nor is it recommended, to apply an ACL to block protocols in a symmetrical manner. For example, to block PING access to an interface on the C3, it is only necessary to block either the ICMP echo or the ICMP reply—blocking either will block ping—so assigning only an inbound ACL is sufficient.

ACLs can be associated to interfaces before the ACL is defined.

The **ip access-group** command takes the following format, when configuring an interface:

```
access-group {ACL-number} {in | out}
```

An example of the command is as follows (note that the command only applies when configuring an interface):

```
C3>enable
C3#config t
(config-t)>interface fastethernet 0/0
(fastethernet 0/0)> ip access-group 102 in
(fastethernet 0/0)> ip access-group 103 out
(fastethernet 0/0)> ^z
```

This configuration associates ACL number 102 to incoming traffic on the fastethernet 0/0 interface, and ACL number 103 to outgoing traffic.

Example — The network must support the following features:

- CPEs can be allocated to a number of different subnets.
- No CPE with a static address should be usable on any subnet other than the assigned subnet.
- No CPE should have access to modem subnets.

One solution to this problem involves a mixture of ACL and subscriber management based filtering and provides a good example of the differences in these filtering techniques.

NOTE

It is possible to solve this problem using bridge groups, sub-interfaces, and ACLs per sub-interface; but the point of this example is to show the use of ACL and subscriber management filtering.

Blocking CPE access to modems is relatively straight forward. All the CPE subnets are known and are static. Use ACLs to drop all packets from the CPE subnets destined for modem subnets. One ACL could be used on all CPE sub-interfaces.

NOTE
If some CPEs must have access to modems (MSO technicians working from home) then the use of ACLs is still appropriate as these modems and hence attached CPE can be allocated to a known sub-interface by the provisioning system, a sub-interface that does not have so restrictive an ACL specification. Blocking a manually set CPE static IP address allocation providing access to "illegal" CPE subnets is not a static situation suitable for ACL application. The assigned subnet may be one of many subnets defined for a cable sub-interface. An ACL can protect against attempts to spoof an address outside the defined subnets for this sub-interface, but cannot be used to isolate a CPE to one subnet of the many in this situation. The "valid" subnet for this CPE is not known in advance by the CMTS. All the possible CPE subnets are known, but which one is used by this CPE? An ACL cannot be specified and is thus not appropriate in this case.

It is not until the modem is provisioned and allocated to an IP address space that attached CPE are allocated to an IP address space. The use of submgmt filters in this case allows one of many predefined filters in the CMTS to now be applied based on the modem provisioning. This filter-group would act on CPE packets and accept any packet with a source IP address in a subnet and drop all other packets. The CMTS can have pre-defined in it all such possible filters (one per CPE subnet). The correct filter-group number for the desired valid CPE subnet is then referenced in the modem configuration file and passed to the CMTS during modem registration; i.e. after the modem registers with the CMTS, this filter-group number will be assigned to any CPE attached to this modem. The result being even if a static IP address is given to a CPE, it will not provide any network access unless within the correct subnet.

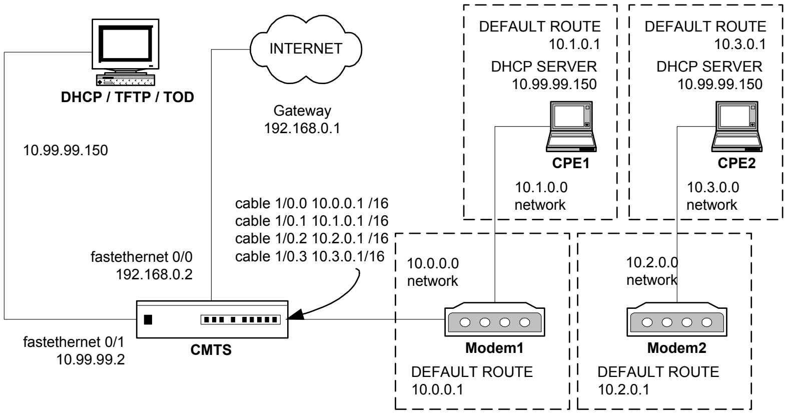


Figure 8-1: Simplified network diagram

Sample ACL definition

The following commands configure ACLs to provide the functionality described above.

```
! Requirement:
!   Block any CPE from accessing the cable modem address space.
!   Block CPE access to the DHCP server address space
!   except for DHCP
!   Block CPE from access to CMTS 192.168.0.2 port
configure terminal
! deny cpe on on cable 1/0.1 access to any modem subnets
access-list 101 deny ip 10.1.0.0 0.0.255.255 10.0.0.0 0.0.255.255
access-list 101 deny ip 10.1.0.0 0.0.255.255 10.2.0.0 0.0.255.255
! deny cpe on cable 1/0.1 ip access to 10.99.99.0 network
access-list 101 deny ip 10.1.0.0 0.0.255.255 10.99.99.0 0.0.0.255
! deny cpe on cable 1/0.1 ip access to 192.168.0.2
access-list 101 deny ip 10.1.0.0 0.0.255.255 192.168.0.2 0.0.0.0
! permit cpe on cable 1/0.1 dhcp access to 10.99.99.0 network
access-list 101 permit udp 10.1.0.0 0.0.255.255 10.99.99.150 0.0.0.0 eq bootpc
! permit all remaining ip
! remember that the last ACE is always an implicit deny all
access-list 101 permit ip any any
!
! deny cpe on cable 1/0.3 access to any modem subnets
access-list 103 deny ip 10.3.0.1 0.0.255.255 10.0.0.0 0.0.255.255
access-list 103 deny ip 10.3.0.1 0.0.255.255 10.2.0.0 0.0.255.255
access-list 103 deny ip 10.4.0.1 0.0.255.255 10.0.0.0 0.0.255.255
access-list 103 deny ip 10.4.0.1 0.0.255.255 10.2.0.0 0.0.255.255
! deny cpe on cable 1/0.3 access to 10.99.99.0 network
access-list 103 deny ip 10.1.0.0 0.0.255.255 10.99.99.0 0.0.0.255
```

```
! deny cpe on cable 1/0.3 ip access to 192.168.0.2
access-list 103 deny ip 10.3.0.0 0.0.255.255 192.168.0.2 0.0.0.0
access-list 103 deny ip 10.4.0.0 0.0.255.255 192.168.0.2 0.0.0.0
! permit cpe on cable 1/0.3 dhcp access to 10.99.99.0 network
access-list 103 permit udp 10.3.0.0 0.0.255.255 10.99.99.150 0.0.0.0 eq bootpc
access-list 103 permit udp 10.4.0.0 0.0.255.255 10.99.99.150 0.0.0.0 eq bootpc
! permit all remaining ip
! remember that the last ACE is always an implicit deny all
access-list 103 permit ip any any
!
interface cable 1/0.1
ip access-group 101 in
interface cable 1/0.3
ip access-group 103 in
exit
exit
```

Sample subscriber management filter definition

The following commands define subscriber management filters to provide the functionality described above.

```
! Requirement: define filters that can be referenced from modem
! configuration files that restrict CPE source address to a
! defined subnet.
! Assign default CMTS submgmt filters to block all
! IP based CPE access for the default subscriber management filters
!
configure terminal
!
! define filter group for CPE network 10.1.0.0
cable filter group 1 index 1
cable filter group 1 index 1 src-ip 10.1.0.0
cable filter group 1 index 1 src-mask 255.255.0.0
cable filter group 1 index 1 dest-ip 0.0.0.0
cable filter group 1 index 1 dest-mask 0.0.0.0
cable filter group 1 index 1 ip-proto ALL
cable filter group 1 index 1 ip-tos 0x0 0x0
cable filter group 1 index 1 match-action accept
cable filter group 1 index 1 status activate
cable filter group 1 index 1 src-port all
cable filter group 1 index 1 dest-port all
cable filter group 1 index 1 tcp-flags 0x0 0x0
!
! define a default action for this filter group ie drop all
!
cable filter group 1 index 2
cable filter group 1 index 2 src-ip 0.0.0.0
cable filter group 1 index 2 src-mask 0.0.0.0
cable filter group 1 index 2 dest-ip 0.0.0.0
cable filter group 1 index 2 dest-mask 0.0.0.0
cable filter group 1 index 2 ip-proto ALL
cable filter group 1 index 2 ip-tos 0x0 0x0
cable filter group 1 index 2 match-action drop
cable filter group 1 index 2 status activate
!
! define filter group for CPE network 10.3.0.0
!
cable filter group 3 index 1
cable filter group 3 index 1 src-ip 10.3.0.0
cable filter group 3 index 1 src-mask 255.255.0.0
cable filter group 3 index 1 dest-ip 0.0.0.0
cable filter group 3 index 1 dest-mask 0.0.0.0
cable filter group 3 index 1 ip-proto ALL
cable filter group 3 index 1 ip-tos 0x0 0x0
cable filter group 3 index 1 match-action accept
cable filter group 3 index 1 status activate
cable filter group 3 index 1 src-port all
cable filter group 3 index 1 dest-port all
cable filter group 3 index 1 tcp-flags 0x0 0x0
!
! define a default action for this filter group ie drop all
!
cable filter group 3 index 2
cable filter group 3 index 2 src-ip 0.0.0.0
cable filter group 3 index 2 src-mask 0.0.0.0
cable filter group 3 index 2 dest-ip 0.0.0.0
cable filter group 3 index 2 dest-mask 0.0.0.0
cable filter group 3 index 2 ip-proto ALL
cable filter group 3 index 2 ip-tos 0x0 0x0
cable filter group 3 index 2 match-action drop
cable filter group 3 index 2 status activate
!
! define filter group for CPE network 10.4.0.0
!
cable filter group 4 index 1
cable filter group 4 index 1 src-ip 10.4.0.0
cable filter group 4 index 1 src-mask 255.255.0.0
cable filter group 4 index 1 dest-ip 0.0.0.0
cable filter group 4 index 1 dest-mask 0.0.0.0
cable filter group 4 index 1 ip-proto ALL
cable filter group 4 index 1 ip-tos 0x0 0x0
cable filter group 4 index 1 match-action accept
cable filter group 4 index 1 status activate
cable filter group 4 index 1 src-port all
cable filter group 4 index 1 dest-port all
cable filter group 4 index 1 tcp-flags 0x0 0x0
```

```
!
! define a default action for this filter group ie drop all
!
cable filter group 4 index 2
cable filter group 4 index 2 src-ip 0.0.0.0
cable filter group 4 index 2 src-mask 0.0.0.0
cable filter group 4 index 2 dest-ip 0.0.0.0
cable filter group 4 index 2 dest-mask 0.0.0.0
cable filter group 4 index 2 ip-proto ALL
cable filter group 4 index 2 ip-tos 0x0 0x0
cable filter group 4 index 2 match-action drop
cable filter group 4 index 2 status activate
!
! define a default filter group to block all access from CPE
! so if mistake made with modem config file no danger of illegal
! access.
!
! Note this will block all CPE access if the modem config file
! does not call the correct filter-group id
!
cable filter group 99 index 1
cable filter group 99 index 1 src-ip 0.0.0.0
cable filter group 99 index 1 src-mask 0.0.0.0
cable filter group 99 index 1 dest-ip 0.0.0.0
cable filter group 99 index 1 dest-mask 0.0.0.0
cable filter group 99 index 1 ip-proto ALL
cable filter group 99 index 1 ip-tos 0x0 0x0
cable filter group 99 index 1 match-action drop
cable filter group 99 index 1 status activate
cable filter group 99 index 1 src-port all
cable filter group 99 index 1 dest-port all
cable filter group 99 index 1 tcp-flags 0x0 0x0
!
! activate filters
cable filter
! turn on subscriber managment in the CMTS
cable submgmt
! up to 16 cpe addresses per modem can be learned by the CMTS
cable submgmt default max-cpe 16
! let the cmts learn the attached cpe ip addres up to the maximum (16)
cable submgmt default learnable
! filter cpe traffic based on learned cpe ip address up to the maximum (16)
cable submgmt cpe ip filtering
! activate the defaults defined here for all modems and attached cpe
cable submgmt default active

! Assign default filters
cable submgmt default filter-group cm upstream 99
cable submgmt default filter-group cm downstream 99
cable submgmt default filter-group cpe upstream 99
cable submgmt default filter-group cpe downstream 99
!
! Now all set for a modem config file submgmt TLV to reference
! filter group 1 for CPE in network 10.1.0.0
! filter group 3 for CPE in network 10.3.0.0
! filter group 4 for CPE in network 10.4.0.0
!
exit
```

Using Simple VLANS to Isolate Modem and CMTS Traffic

Previous version of the C3 firmware supported the **cable vpn** command. This command is now redundant due to the extensive enhancements to the C3 VLAN and VPN capabilities. This section shows how to configure a C3 for the equivalent function of the old **cable vpn** command using the base C3 software license.

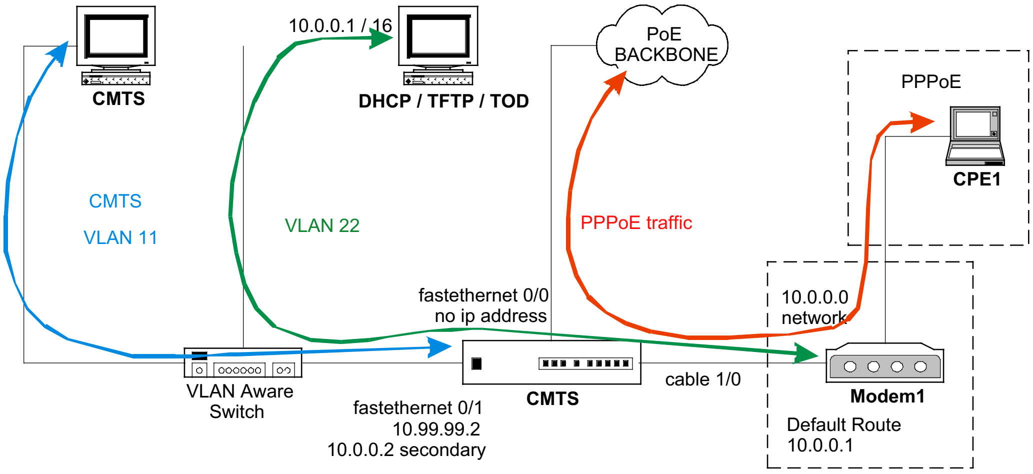


Figure 8-2: Example of bridging traffic to the FastEthernet

In the above diagram, all broadcast modem traffic is mapped to the cable 1/0.0 sub-interface by the **default cm sub-interface** specification, and thus to bridge group 0. This bridge group bridges traffic to fastethernet 0/1.1 and is thus VLAN encoded with tag 2 and sent to the L2/L3 switch then to the CM DHCP servers.

Modem discover broadcast, however, is unicast by the DHCP Relay function to both 172.16.5.48 and 172.16.5.49. This subnet is not directly connected to the C3, so is routed using the defined host routes to the

L2/L3 switch at 10.160.0.1. Again, modem Renew is directed to either 172.16.5.48 or 172.16.5.49, depending on which answered the original DHCP. Again these packets will be routed using the host routes.

All CPE traffic is mapped to cable 1/0.1 (on bridge group 1) and bridged to the fastethernet 0/0.0 sub-interface. CPE devices have no specified DHCP relay, so the C3 broadcasts DHCP from the fastethernet 0/0.0 sub-interface to the DHCP server. DHCP relay could be activated if required, in which case the cable 1/0.1 sub-interface would need an IP address—preferably in the subnet required for the CPE devices.

Fastethernet 0/1.0 is not a member of any bridge group and will thus be assumed by the CMTS to be a CMTS management interface only. Traffic from the CMTS to the 172.16.5.0 network is destined for a network not connected to the C3. To assist, a static route is added for this network via 172.16.11.1

The following is a sample configuration for the diagram above.

```
! if the following is to be pasted to the command line then paste from
! privilege mode and paste over a factory default configuration.
! Restore factory default using
!    write erase
!    reload
! then select do not save configuration and select yes to restart
!------------ start script ---------------------
configure terminal
no ip routing
default cm-subinterface cable 1/0.0
default cpe-subinterface cabel 1/0.1
!
interface fastethernet 0/0.0
! for all CPE traffic
! no ip address required
bridge-group 1
no shutdown
no management-access
!
interface fastethernet 0/1.0
! for CMTS management
! remove the factory default assignment
no bridge-group
! set management IP address
ip address 172.16.11.4 255.255.255.0
management-access
encapsulation dot1q 1
no shutdown
exit
!
```

```
interface fastethernet 0/1.1
! for modem traffic
bridge-group 0
ip address 10.160.0.4 255.252.0.0
no management-access
no shutdown
encapsulation dot1q 2
!
interface cable 1/0.0
! for modem traffic
bridge group 0
! get basic rf going
no shutdown
no cable upstream 0 shutdown
ip address 10.160.0.4 255.252.0.0
no management-access
ip dhcp relay
ip dhcp relay information option
cable dhcp-giaddr primary
cable helper-address 172.16.5.48
cable helper-address 172.16.5.49
exit
!
cable 1/0.1
! for CPE traffic
bridge-group 1
encapsulation dot1q 11 native
no ip dhcp relay
exit
!
! set the bridge mode default gateway
ip default-gateway 10.160.0.1
!
! route all traffic to network 172.16.5.0 to
! fa 0/1.1 and thus VLAN tag 1 for CMTS management
ip route 172.16.5.0 255.255.255.0 172.16.11.1
!
! add specific host routes for DHCP servers as they are on the same
! subnet as the CMTS traffic but a different VLAN
! ie force modem traffic to fa 0/1.1 and thus VLAN tag 2 for CM management
ip route 172.16.5.48 255.255.255.0 10.160.0.1
ip route 172.16.5.49 255.255.255.0 10.160.0.1
exit
!---------------- end script ---------------------
```

Cable Interface VLANS

Encrypting Native VLANS

Modems of CPE assigned to a cable subinterface are given a private broadcast domain encryption key and only allows the CPE using this cable subinterface to receive broadcasts with the bridge group attached to this cable subinterface. Other CPE assigned to other cable subinterfaces will not be able to decode such downstream broadcasts. Since downstream broadcasts such as ARP can provide network topology information of other subscribers, this feature eliminates such risk.

Access to the C3 itself may be secured using techniques defined in this chapter, but the C3 may also be configured to prevent:

- IP address spoofing of modems by CPE devices
- Spoofing of IP addresses by CPE devices to access the management system
- Spoofing of 802.1Q VLAN tags by CPE devices

The cable sub-interfaces on the C3 can be used to:

- restrict layer 2 traffic to the attached bridge-group;
- restrict access to defined IP subnets;
- restrict access to defined VLANS for devices allocated to cable sub-interfaces and
- add CPEs to private downstream broadcast domains.

Such restrictions are enforced by placing CPE devices in a native VLAN using either VSE encoding or using the **map-cpes** command. Both commands map all CPE traffic to defined cable sub-interfaces and thus force CPE traffic to obey the specifications of the this sub-interface.

Both options also allow the CPE assigned to a cable sub-interface and hence native VLAN to be placed in private downstream broadcast domains by using separately keyed downstream encryption for each native VLAN using the **encapsulation dot1q xx encrypted-multicast** command.

Example: —

```
conf t
ip routing
cable 1/0.1
no bridge-group
ip address 10.1.0.1 255.255.0.0
ip address 10.2.0.1 255.255.0.0 secondary
ip source verify subif
encapsulation dot1q 5 native
exit
exit
```

In IP routing mode, this restricts access by CPE allocated to this sub-interface to the stated subnets only.

Example (routing case): —

```
conf t
ip routing
cable 1/0.1
    no bridge-group
ip address 10.1.0.1 255.255.0.0
encapsulation dot1q 5 native
exit
exit
```

Example (hybrid case): —

```
conf t
ip routing
cable 1/0.1
    bridge-group 0
ip address 10.1.0.1 255.255.0.0
encapsulation dot1q 5 native
exit
exit
```

Example (bridging case): —

```
conf t
no ip routing
cable 1/0.1
    bridge-group 0
encapsulation dot1q 5
exit
exit
```

This restricts access by CPE allocated to this sub-interface to those CPE that generate 802.1Q encoded data and with a VLAN tag of 5.

In the above cases, the CPE incoming data is either allocated by the Cadant C3 to the specified cable sub-interfaces using 802.1Q tags generated by the CPE devices or allocated to matching native vlan using map-cpes or VSE encoding or a “cable modem VPN” command.

Sample Configuration

In the following sample configuration:

- All modems use the cable 1/0.0 sub-interface for initial DHCP.
- Regardless of the cable sub-interface used by a modem, VSE encoding in a modem configuration file modem directs attached CPE to either the cable 1/0.11 or the cable 1/0.13 sub-interfaces and hence subject to the restrictions imposed by these sub-interface's specifications.
- The default CPE sub-interface has been specified as cable 1/0.13.
- In the case of CPE traffic allocated to cable 1/0.11, incoming frames may be layer 2—they are bridged using bridge group 1.
- In the case of CPE traffic allocation to cable 1/0.13, only layer 3 traffic is accepted (non bridging sub-interface) and CPE DHCP is directed to only the DHCP server at 10.0.0.1; CPE source IP addresses must belong to subnet 10.11.0.0/16 or be dropped.

```
conf t
ip routing
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.13
bridge 1

!
cable 1/0.0
! for modem DHCP only
ip address 10.99.99.1
ip dhcp relay
cable helper-address 10.0.0.1 host
cable dhcp-giaddr primary
cable 1/0.1
! for modems once allocated an IP address
ip address 10.99.98.1

cable 1/0.11
! for cpe layer 2 forwarding
! for CPE traffic via modem with VSE tag = 11
encapsulation dot1q 11 native
bridge-group 1

cable 1/0.13
! for cpe layer 3 forwarding
! for CPE traffic via modem with VSE tag = 13
no bridge-group
ip address 10.11.0.1 255.255.0.0
ip dhcp relay
cable helper-address 10.0.0.1 host
cable dhcp-giaddr primary
ip source verify subif
encapsulation dot1q 13 native
```

```
exit
exit
```

Example: — Modems can be mapped by source IP to other cable sub-interfaces. In the following example, if the provisioning system allocated the modem to subnet 10.99.98.0, modem traffic will be allocated the cable 1/0.1 sub-interface.

The cable sub-interface cable 1/0.1 contains a map-cpes specification.

The map-cpes specification under this sub-interface directs attached CPE to the cable 1/0.11 sub-interface and hence subject to the restrictions imposed by these sub-interface's specifications.

In this case, **ip source verify subif** is specified and thus CPE source IP address must belong to the 10.11.0.0/24 subnet or be dropped—that is, a CPE IP address cannot belong to another subnet.

```
conf t
ip routing
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.2
cable 1/0.0
! for modem DHCP only
no bridge-group
ip address 10.99.99.1
ip dhcp relay
cable helper-address 10.0.0.1 cable-modem
cable dhcp-giaddr primary

cable 1/0.1
! for modems once allocated an IP address
no bridge-group
encapsulation dot1q 1 native
ip address 10.99.98.1
map-cpes cable 1/0.11
```

```
cable 1/0.2
! for unprovisoned cpe
no bridge-group
ip address 10.1.0.1 255.255.255.0
ip source-verify subif
encapsulation dot1q 11 native
ip dhcp relay
cable helper-address 10.0.0.1 host
cable dhcp-giaddr primary
cable 1/0.11
! for cpe IP forwarding
no bridge-group
encapsulation dot1q 11 native
encapsulation dot1q 11 encrypted-multicast
ip address 10.11.0.1 255.255.255.0
ip source-verify subif
ip dhcp relay
cable helper-address 10.0.0.1 host
cable dhcp-giaddr primary
```

Selective use of cable sub-interfaces can define with tight limits the address space and layer 2/3 capabilities of CPE devices attached to modems.

Cable Source Verify

Cable Source Verify blocks IP and ARP packets coming from subscriber equipment, when the incoming packets have improper source addresses. The following are common reasons for such packets:

- Misconfigured hosts; for example, a subscriber may have configured a static IP address instead of using DHCP.
- Malicious activity by a subscriber, such as IP address spoofing or ARP spoofing.

The C3 builds a database, associating cable modem MAC addresses with source IP and CPE MAC addresses:

- by snooping DHCP traffic for dynamically assigned CPE IP addresses.
- by DOCSIS pre-provisioning for statically assigned CPE IP addresses.
- by IP learning (using the first incoming packet with this IP address to determine the proper cable modem MAC address for that IP address).

To enable Cable Source Verify, use the **cable source-verify** command. When Cable Source Verify is active, the C3 denies packets whose source IP address does not match the associated cable modem MAC address.

To disable Cable Source Verify, use **no cable source-verify**.

Lease Query Mode

The C3 can optionally send a Lease Query to the DHCP server to verify that an IP address not found in its database is both known to the DHCP server, and that the cable modem is associated with the IP address. To enable this mode, use the command **cable source-verify dhcp**. This option requires that the DHCP server supports the DHCP Lease Query feature.

Any IP addresses found in the C3 database, such as static IP addresses found in cable modem configuration files, are assumed to be correct.

DHCP Authoritative Mode

The C3 can optionally bypass its internal database and use the DHCP server as the authoritative source for IP address information. To enable this mode, use the command **cable source-verify dhcp authoritative**. This option requires that the DHCP server knows of *all* CPE IP addresses, including static IP addresses provisioned in cable modem configuration files.

Support Methodologies

The Cable Source Verify feature effectively prevents MAC-level spoofing, but can also hamper valid on-site support functions where an engineer takes a laptop to various subscriber sites to check connectivity to the headend. In this situation, the C3 may prevent the laptop from connecting through subscriber cable modems.

To allow mobile use, enable DHCP Lease Query mode and use one of the following methods.

- After using the laptop with one cable modem, send a DHCP Release before moving to the next cable modem. This frees the laptop MAC address in the DHCP server and internal C3 anti-spoofing database.
- Reset the cable modem to clear the internal C3 database.
- Set the lease time for the laptop’s MAC address to a small value on the DHCP server. After disconnecting the laptop, wait for the lease time to expire and connect it to the next cable modem.
- Use USB instead of Ethernet to connect the laptop to the cable modem. This announces the laptop MAC address to the C3 as the MAC address of the cable modem plus one. Thus, the MAC address of the laptop as seen by the C3 is unique and the DHCP server. When the laptop is moved to the next cable modem, the C3 and DHCP server see a different MAC address associated with it.

Note that in all cases, the laptop needs to complete a new DHCP session to access the cable network.

Configuring Lease Query Parameters

The **dhcp-lq-params** command sets the DHCP codes used for LEASEQUERY, LEASEACTIVE, and UNASSIGNED responses, and optionally the leasequery response timeout. This may be necessary to configure the C3 to interoperate with provisioning managers that use different codes for these responses. The default values are for Cisco CNR.

Example (set up the default CNR LEASEQUERY parameters): —

```
dhcp-lq-params leasequery 0 active 0 unassigned 0
timeout 0
```

For details, see *dhcp-lq-params*, page 10-217.

Lease Query Overhead

When sending LeaseQuery requests to multiple DHCP servers (eg, servers operating in failover mode), the C3 now "holds an election" to determine the result:

- any server replying with conflicting info (i.e. CPE IP address is already in use by someone else). This is interpreted as having an unauthorized user on the network.
- if more than one DHCP server claims the lease is active, but report different lease times, the C3 will use the server which has handled that client most recently (if the C3 can tell this). If not, then the C3 uses the shortest lease time.
- any claims that the lease is not active are ignored in favor of a lease-active report.

The C3 uses a Cisco-network-registrar specific CLIENT-LAST-TRANSACION-TIME option (option #163) to help with the voting in the multi DHCP server case. The option code can be changed from 163 to another value using **`dhcp-lq-params`**. See *dhcp-lq-params*, page 10-217.

Packet Throttling

Packet throttling consists of:

- Broadcast throttling, for reducing the amount of broadcast traffic in Layer 2 (switched) networks
- IP throttling, for reducing the effect of Denial of Service (DoS) attacks in Layer 2 and Layer 3 networks

Both broadcast throttling and IP throttling operate on a sub-interface basis. The following sections describe each throttling type.

Interactions between Broadcast and IP Throttling

When both broadcast throttling and IP throttling are active on a sub-interface, the broadcast throttle ignores all IP broadcast packets, allowing the IP throttle to handle them.

Throttle Credits

Both broadcast and IP throttling use throttle credits to determine when to apply throttling. There are two types of credits:

- Initial credits: each host needs a certain number of packets to properly register on the network and obtain an IP address. This number should allow for retries and retransmits. The initial credit expires when the host has sent the specified number of packets, regardless of how long it takes to reach that number. The default initial credit is 15 packets.
- Running credits: after the initial credit expires, the C3 begins applying the running credit. When a host sends packets at a rate exceeding the running credit (initially 2 packets per second), the C3 applies a specified ACL to those packets. The ACL can throttle specific packets, such as broadcast or multicast, while allowing other packets through (even if those packets still exceed the running credit).

Broadcast Throttling

Broadcast throttling operates on packets incoming from cable modems and subscriber CPE. The C3 allows for an initial burst of broadcast packets necessary to register a modem on the network; after automatically allowing that initial number of packets to go through without throttling. After the initial count is reached, the C3 begins throttling broadcast and multicast packets when the number of those packets per second exceeds the specified threshold.

Use the command **l2-broadcast-throttle** in cable sub-interface configuration mode to set up broadcast throttling on a sub-interface.

IP Throttling

When the number of upstream packets per second from a modem reaches a specified threshold, the C3 applies a specified ACL to excess packets.

To set up IP throttling, use the following commands in any order:

```
access-list (to set up an ACL)
ip throttling acl#
throttle-credits
```

If you use the ip throttling command before you set up the ACL, throttling has no effect until you define the ACL.

An ACL used for IP throttling must use the permit action for all entries, not the deny action. You can use the same ACL for multiple sub-interfaces.

Simple Law Enforcement Monitoring (SLEM)

Simple Law Enforcement Monitoring (SLEM) consists of:

- Lawful Intercept (LI) Administration Function: This function provides the (typically manual) provisioning interface for the intercept as a result of a court order or warrant delivered by the Law Enforcement Agency (LEA). It could involve separate provisioning interfaces for several components, but more typically is a single interface to the mediation device (MD), which then takes care of provisioning of other components in the network. Because of the requirement in some laws to limit accessibility to authorized personnel, the provisioning interface has to be strictly controlled. In many cases, the identity of the subject received from the LEA has to be translated into an identity that can be used by the network to enable the intercept
- Intercept Access Point (IAP): An IAP is a device within the network that is used for intercepting lawfully authorized intercept information. It may be an existing device that has intercept capability or it could be a special device that is provided for that purpose. There are two types of IAP's: IAP's that provide content; and IAP's that provide intercept related information (IRI).
- Content IAP: A content IAP is an IAP that is used to intercept the IP traffic of interest
- IRI IAP: This is an IAP that is used to provide intercept related information (IRI).
- Law Enforcement Agency (LEA): This is the agency that has requested the intercept and to which the service provider delivers the information.
- Mediation Device (MD): The mediation device requests intercepts from IAPs. The mediation device receives the data from the IAP, packages it in the correct format (which may vary from country to country) and delivers it to the LEA. In the case where multiple law enforcement agencies are intercepting the same subject, the mediation device may replicate the information multiple times. The assumption is that the service provider operates the mediation device (via specially authorized personnel) and that the LEA only has access to and from the mediation device.

The C3 supports the transmission of intercepted data to an IPv4 Mediation Device, uses UDP as the transport protocol to the Mediation Device and SNMPv3 manages the instructions received from the Mediation Device.

For details, see the SNMP server commands beginning with *snmp-server*, page 10-159.

SLEM MIBs

SLEM is supported in accordance with RFC 3924 which outlines the Cisco proposed architecture for Lawful Intercept in IP Networks. This architecture is becoming the standard to which companies are adhering. The following diagram outlines the framework of RFC 3924.

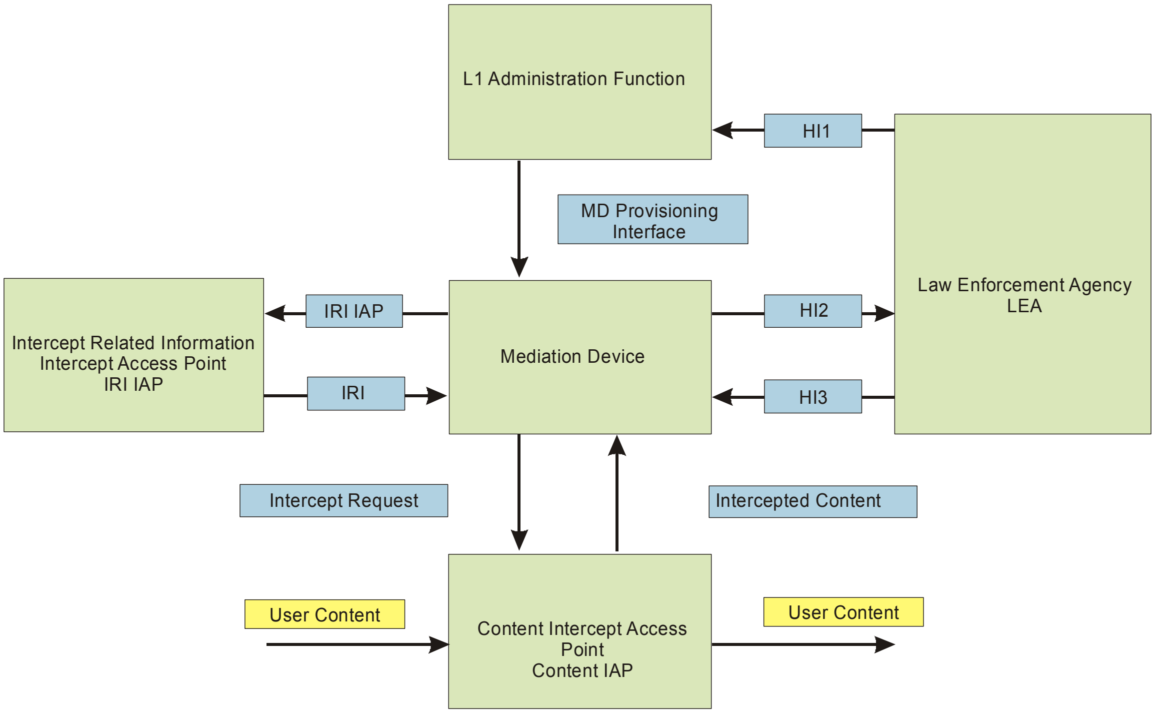

L1 Administration Function
HI1
MD Provisioning Interface
Law Enforcement Agency LEA
Intercept Related Information Intercept Access Point IRI IAP
IRI IAP
IRI
Mediation Device
HI2
HI3
Intercept Request
Intercepted Content
User Content
Content Intercept Access Point Content IAP
User Content

Figure 8-3: RFC 3924 framework

The Tap Mediation Capabilities offered are UDP and ipV4SrcInterface only; only UDP may be used as the transport protocol in transferring intercepted data to the Mediation Device, and an SNMP ifIndex value may be used to select the interface on the C3 from which intercepted data is transferred to the Mediation Device. IPV6SrcInterface, rtcpNack, tcp and stcp transport types are not supported.

The Tap Stream Capabilities offered are IPV4, l4Port, dscp, dstMacAddr, srcMacAddr, ethernetPid, dstLlcSap, and srcLlcSap; only IPV4 addresses, TCP/UDP ports, TOS byte, L2 source and destination MAC addresses, etherType, LLC DSAP/SSAPs may be used in filters.

Configuring SSH

SSH (Secure Shell) provides operators with encrypted access to the C3. This is important for remote access, since potential attackers often monitor such links looking for passwords or other privileged information.

SSH does not provide extra account access security; anyone with an SSH client and a valid C3 user account and password can access the C3 through SSH. SSH only provides a encrypted link that prevents password sniffing.

SSH Versions Supported

The C3 currently supports both SSH v1 and v2 access.

Terms and Concepts

The tasks in this procedure use the following terms and concepts.

Key — A block of bits, used to encrypt or decrypt data on the SSH link. Keys can be from 512 to 2048 bits long, in increments of 128 bits. Longer keys are harder to decrypt by someone attempting to compromise your security, but can seriously impact CMTS performance.

Client — A system that a remote operator uses to connect to the C3 using SSH.

Host — The C3.

Host key — Actually a pair of keys, one public (sent to clients) and one private (not distributed) that the C3 uses to decrypt incoming traffic.

Server key or session key — A key that the C3 creates for each SSH session to encrypt outgoing traffic. This key is regenerated periodically for added security.

Default Values

The following shows the default values of the SSH server. Use the configuration-level command **show ssh** to see current settings.

```
SSH daemon             : disabled
Version configured     : 1.99 (SSH1 and SSH2)
Authentication timeout : 0 secs
Authentication retries: 3
TCP port in use        : 22
Secure CLI access      : disable
Secure FTP access      : disable
```

Key Sizes and Formats

The C3 supports both RSA and DSA key formats.

The default key size is 1024 bits, which provides commercial-grade encryption. Larger key sizes require a great deal of time and C3 processing resources to generate, and DSA keys require more time to generate than RSA. Worst-case, a 2048-bit DSA key requires nearly 12 minutes (950 seconds) with no connected cable modems or IP traffic.

Perform the following procedures as necessary.

Procedure 8-1 Generating SSH Keys

The C3 is not shipped with generated keys. Follow these steps to generate keys to enable SSH usage.

1 If you have not done so already, type the following commands to enter configuration mode.

```
C3> enable
```

Password: your password

```
C3# config t
```

The prompt changes to **(config)#**

2 Enter the command **crypto key generate {***type***} [modules** *len***]** to generate SSH keys, where:

type	is one of **rsa**, **dsa**, or **both**
len	is the key length, one of **768**, **1024**, or **2048** (default is **1024**)

The C3 creates public and private keys, and stores DSA and RSA public keys in **c:/ssh/cmts_dsa_pubkey.pem** or **c:/ssh/cmts_rsa_pubkey.pem** respectively.

End of procedure

Procedure 8-2 Importing SSH Keys

Follow these steps to load public keys for a specific user into the C3:

1 If you are loading public keys in ASCII format through the terminal, enter the following command before starting the upload:

```
C3(config)# crypto key import rsa {user} pem terminal
```

2 If you are loading public keys from a web or FTP server, enter the following command before starting the upload:

```
C3(config)# crypto key import rsa {user} pem url {url}
```

End of procedure

Procedure 8-3 Displaying SSH Keys

Follow these steps to display currently installed SSH keys.

1 To display CMTS public keys, use the following user-level command:

```
C3> show crypto key mypubkey {rsa | dsa}
```

2 To display the installed RSA public key for a specific user, use the following user-level command:

```
C3> show crypto key pubkey-chain rsa name {user}
```

End of procedure

Procedure 8-4 Deleting SSH Keys

Follow these steps to delete the current SSH keys on the C3.

1 If you have not done so already, type the following commands to enter configuration mode.

```
C3> enable
```

Password: **your password**

```
C3# config t
```

The prompt changes to **(config)#**.

2 Type the command **crypto key zeroize {*type*}** to delete keys of the specified type (**rsa**, **dsa**, or **both**).

End of procedure

Procedure 8-5 Starting and Stopping the SSH Server

Follow these steps to start or stop the C3 SSH server.

1 If you have not done so already, type the following commands to enter configuration mode.

```
C3> enable
```

Password: **your password**

```
C3# config t
```

The prompt changes to **(config)#**.

2 To start the SSH server, type **ip ssh server enable** at the **(config)**# prompt.

3 To stop the SSH server, type **no ip ssh server enable** at the **(config)#** prompt.

End of procedure

Procedure 8-6

Setting SSH Server Parameters

Follow these steps to set SSH server parameters.

1 To change the TCP port on which the SSH server listens for connections, use the following command (the default is **22**):

```
C3# ip ssh port {number}
```

2 To change the number of authentication retries allowed for access to the SSH server, use the following command (the default is **3**):

```
C3# ip ssh authentication-retries {number}
```

3 To set the SSH session idle timeout, use the following command (the default is **0**, which disables timeout):

```
C3#  ip ssh timeout {secs}
```

4 To enable or disable SSHv1 or SSHv2 connections, use the following command (the default is to allow both):

```
C3# [no] ip ssh version {v1 | v2}
```

End of procedure

Procedure 8-7 Managing SSH Connections

Follow these steps as needed to manage SSH connections.

1 To view existing SSH connections, use the following user-level command:

```
C3> show ip ssh
```

2 To disconnect an active SSH connection, use the following privileged command:

```
C3# disconnect ip ssh {user}
```

End of procedure

Configuring AAA

The AAA security model is an architectural framework for the management of common security functions within a mixed network environment and is an industry standard to which our competitors adhere to. The AAA security model includes support for Authentication, Authorization and Accounting.

NOTE
The C3 CMTS Release 4.3 supports authentication only.

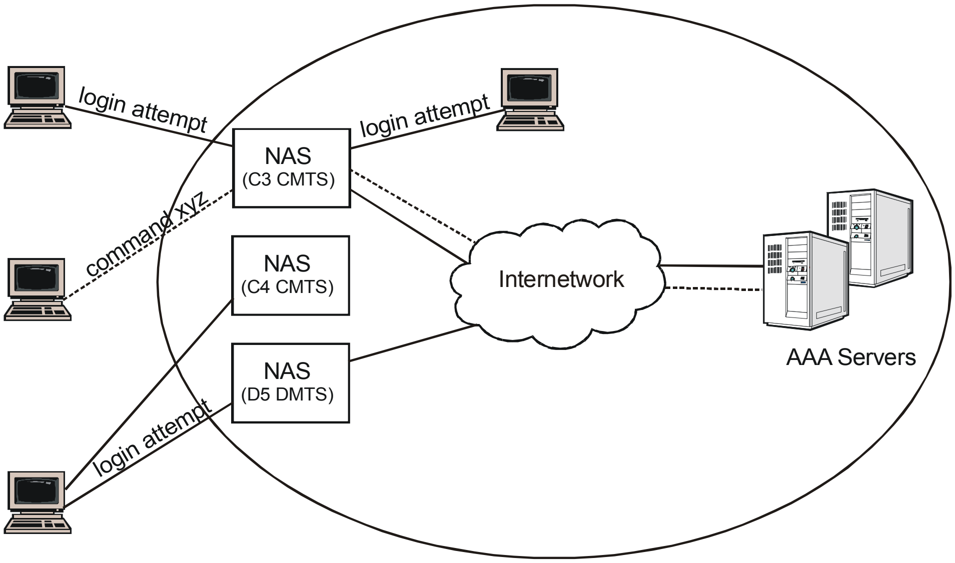


Figure 8-4: AAA Security Model

The C3 CMTS has partially implemented the AAA security model in this release. Currently, only authentication of telnet and console lines are supported. This is accomplished via the TACACS+ protocol. Included in this release is the support for multiple TACACS+ servers, method lists, and user-settable TACACS+ traffic source-address.

The TACACS+ protocol specification covers AAA capabilities for network services such as PPP and SLIP as well as for login and enable services.

NOTE
The TACACS+ feature cannot be used in conjunction with the SSH feature. Any attempt to configure TACACS+ on a SSH line will result in an error presented to the user.

TACACS+ Server and Server Group Operation

The C3 will recognize server/network failures during TACACS+ exchanges and gracefully "recover" if multiple servers are defined.

A TACACS+ server will be declared unreachable on a per-transaction basis. Each new AAA transaction will attempt to use the server regardless of past failures. However, the server's reachable or unreachable state will be maintained for status display purposes. For servers that maintain a single TCP connection, any communications failure must be followed by a second communications attempt using a fresh socket. The server may be declared unreachable only if the second attempt fails as well. The intent is to avoid misinterpreting a closed or reset socket on the server side as an unreachable server.

The order in which TACACS+ servers are accessed will follow the order in which they were added to the group. A given AAA transaction may be attempted using server *n* only if the same transaction was attempted using server *n-1* and server *n-1* was unreachable.

AAA Method List Operation

An AAA method list may contain one or more AAA methods. With multiple methods, AAA capabilities can continue to operate even if some methods become unavailable due to network failures or configuration errors.

The order of methods in an AAA method list will dictate the order in which the methods must be applied.

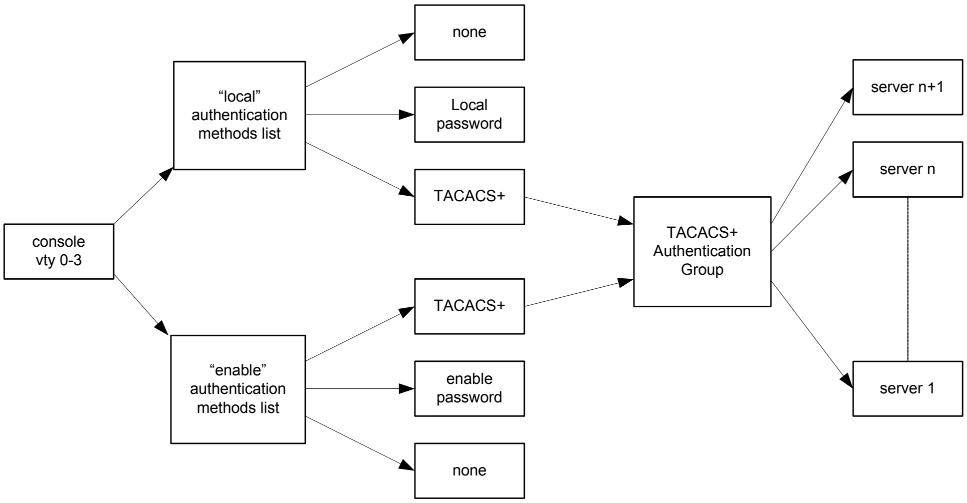

none
"local" authentication methods list
Local password
TACACS+
console vty 0-3
TACACS+ Authentication Group
server n+1
server n
server 1
TACACS+
"enable" authentication methods list
enable password
none

Figure 8-5: Method list example

Method *n* may be applied only if method *n-1* is unavailable. For example, the authentication method list {tacacs+, local, none} implies that authentication must first be attempted via a TACACS+ server group, then via the local password file if the server group is unreachable and finally bypassed altogether if a local password file does not exist.

All AAA methods return either a reject (service is denied) or an accept (service is allowed) indication. For example, a TACACS+ query will return a positive or negative response, while a local password file search yields either a match on user/password or no match. In a method list, method *n* may be applied only if method *n-1* does not produce a reject or accept indication. If a TACACS+ server group returns an authentication failure, no attempt may be made to authenticate via the local password file. If the TACACS+ server group is unreachable and the local password file does not contain the user's ID, authentication will fail.

If traversal of the entire method list does not produce a positive reject or accept, then a positive reject will be assumed. For example, the following authentication method list {tacacs+, local} will yield a reject indication if no TACACS+ server is reachable and a local password file does not exist. The "none" method always produces an accept indication and may be used to prevent this default behavior.

Line Operation

Each line interface supports a CLI session. The CLI session's behavior is completely dependent on the configuration of the associated line. However, a session's authentication process can override a line's configuration for the duration of a session.

- A session automatically terminates if its elapsed time exceeds the session time interval of the associated line. Session timing begins at the completion of authentication.
- A session automatically terminates if the elapsed time since the last I/O activity exceeds the idle time interval of the associated line. I/O activity includes input commands, output due to input commands, and unsolicited output (e.g. logging information.)
- *idletime* or *timeout* arguments received in an authentication reply override the associated line's provisioned parameters for the duration of the associated session.

CLI Infrastructure

This section identifies changes in CLI infrastructure as well as new or changed CLI commands.

By default, no local user IDs exist. Most customers view default user IDs and passwords as a security threat. As such, the C3's skeleton database (and its software executable) will not contain user IDs or passwords.

CLI commands are provided to:

- configure TACACS+ servers and TACACS+ server groups. The command is a privileged command and will be available in global configuration mode. It supports the creation and deletion of TACACS+ servers and groups. For TACACS+ servers, it supports the configuration of IP addresses, port numbers, shared secrets, and timeout values and must optionally allow assignment to a server group.
- display the status all configured TACACS+ servers and groups. The command is a non-privileged command. The information displayed includes the operational parameters, associated measurements, and reachable/unreachable status of each server.
- configure authentication method lists. The command is a privileged command and is available in global configuration mode. It supports the creation and deletion of authentication method lists.
- display the status of all configured lines. The command is a non-privileged command. The information displayed includes the operational parameters and measurements for each configured line. For each configured line with an active session, the information displayed will also include total connection time, session time remaining, idle time remaining, user ID (if available), and authentication method.

Common CLI Commands for AAA

If you have not done so already, type the following commands to enter configuration mode.

```
C3> enable
Password: your password
C3# config
The prompt changes to (config)#
```

Enabling AAA on a system

While in global configuration mode, follow these steps to create a default configuration for AAA.

To create a default configuration for AAA, type **aaa new-model** at the **(config)#** prompt.

To remove the existing configuration for AAA and revert to the default behavior, type **no aaa new-model** at the **(config)#** prompt.

Maintaining Login Authentication Method Lists

While in global configuration mode, use the following command to maintain or remove a login authentication methods list.

Enter the command **[no] aaa authentication login {default | list-name} method1 [method2...]** where:

Keyword	Description
default	When default is specified, then the default authentication method list is configured.

Keyword	Description
list-name	When list-name is specified, then a named authentication method list is configured.
method1 [method2...]	An ordered list of authentication methods to be associated with the specified method list.

Maintaining the Enable Authentication Methods List

While in global configuration mode, use the following command to create or remove a method list for use by the enable service.

Enter the command **[no] aaa authentication enable default *method1 [method2...]*** where:

Keyword	Description
method1 [method2...]	An ordered list of authentication methods to be associated with the enable list.

Assigning Authentication Methods Lists

In line configuration mode, use the following command to bind or release a configured method list to the authentication server for the selected line interface.

Enter the command **[no] login authentication login {default | list-name}** where:

Keyword	Description
default	Uses the default list created with the **aaa authentication login** command.
list-name	Uses the indicated list created with the **aaa authentication login** command.

TACACS+ Commands

TACACS+ Global Server Properties

While in global configuration mode, use the following command to create or remove the global default encryption key.

Enter the command **[no] tacacs-server key <key>** where:

Keyword	Description
key	Key used to set authentication and encryption. This key must match the key used on the TACACS+ daemon.

While in global configuration mode, use the following command to create or remove the global TACACS+ server timeout.

Enter the command **[no] tacacs-server timeout <timeout>** where:

Keyword	Description
timeout	Set the default TACACS+ server timeout

Specifying the TACACS+ Source Interface

While in global configuration mode, use the following command to create or remove the TACACS+ source interface.

Enter the command **[no] ip tacacs source-interface <subinterface-name>** where:

Keyword	Description
subinterface-name	Name of the interface that TACACS+ uses for all of its outgoing packets.

TACACS+ Server Groups

While in global configuration mode, use the following command to create or delete a TACACS+ server group.

Enter the command **[no] aaa group server tacacs+ <group-name>** where:

Keyword	Description
tacacs+	Uses only the TACACS+ server hosts.
group-name	Character string used to name the group of servers

Defining TACACS+ Server Group Membership

While in TACACS+ group server configuration mode, use the following command to assign or remove a server to a server group.

Enter the command **[no] server <ip-address>** where:

Keyword	Description
ip-address	IP address of the selected servers

Defining TACACS+ Server Hosts

While in global configuration mode, use the following command to assign a server to a server group. To remove a server from a server group, use the no command.

Enter the command **[no] tacacs-server {host *host-name}* [port *integer*] [timeout *integer*] [key *string*] [source-address *ip addr]*** where:

Keyword	Description
host-name	IP address of the selected servers.

Keyword	Description
port *integer*	(Optional) Specifies a server port number. Default port number is 49.
timeout *integer*	(Optional) Specifies a timeout value. This overrides the global timeout value set with the tacacs-server timeout command for this server only.
key string	(Optional) Specifies an authentication and encryption key. This must match the ky used by the TACACS+ daemon. Specifying this key overrides the key set by the global command tacacs-server key for this server only.
source-address *ip addr*	(Optional) The source IP address of outbound TACACS+ packets

Displaying Configuration

There are several show commands available in enable mode.

To display the configured TACACS+ configuration, use the following command:

show tacacs

To display AAA session details, use the following command:

show aaa sessions

To display AAA method list details, use the following command:

show aaa method-list [all | authentication]

where:

Keyword	Description
all	(Optional) Displays information on all method lists.
authentication	(Optional) Displays information on authentication lists.

9 Service Procedures

The procedures in this chapter cover basic maintenance and upgrade tasks.

Removing Power for Servicing

To disconnect power from the C3 for servicing, remove both power leads (AC and DC) from the rear of the chassis.

Front Panel Removal and Replacement

Removing the face plate can be done during normal system operation without any adverse impact.

Action

Locate the indentation on the right side of the CMTS front panel.

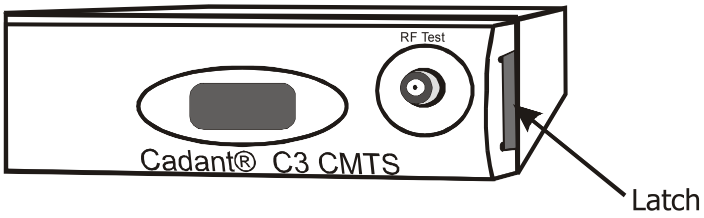


Figure 9-1: Front panel latch

Press the indentation to release the latch and then pull the right side of the faceplate away from the CMTS.

To reinstall the faceplate, place the left edge of the faceplate against the front of the fan tray so that the faceplate is at a 45 degree angle to the front of the CMTS. See the following photo.

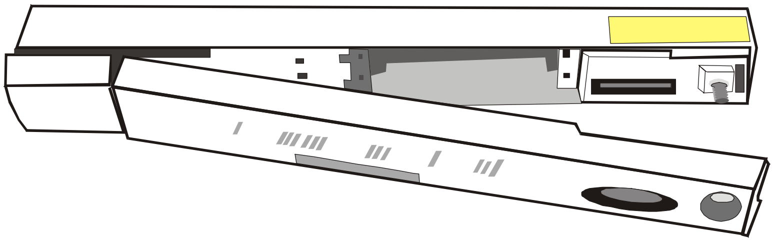


Figure 9-2: Front panel faceplate

Push the right side of the faceplate back towards the front of the CMTS slowly so that the edge connector on the rear of the faceplate mates properly with the connector on the front of the CMTS. Press the right side of the face plate in firmly to latch it to the CMTS.

Resetting the Power Supplies

If a power supply shuts down for thermal reasons, the “F” Amber LED on the front of the power supply lights up and the C3 becomes non-operational.

Procedure 9-1 **Resetting the Power Supplies**

1. Correct the thermal condition.
2. Remove the front panel.
3. Push the SW1 button with a non-conductive material (e.g. plastic probe) and hold in for 2 seconds. There will be an audible click and the fans will start up.
4. Replace the front panel and verify the LEDs and the LCD displays are working. The following figure shows the location of the reset switch.

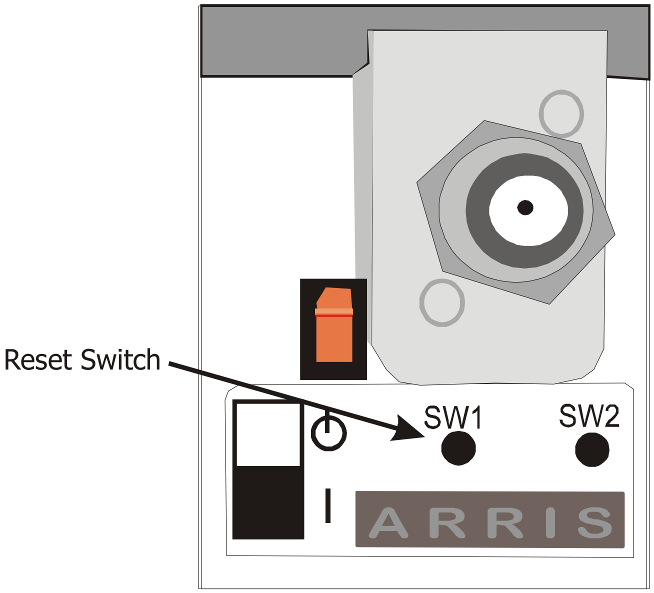


Figure 9-3: Reset switch

End of procedure

Replacing a Power Supply

Procedure 9-2

Replacing a Power Supply

The C3 CMTS can have two fully redundant power supplies. You can replace one supply without powering down the CMTS.

NOTE
If only one power supply is installed and active, the CMTS shuts down once the power supply has been removed.

Diagram

Refer to the following photo while performing this procedure.

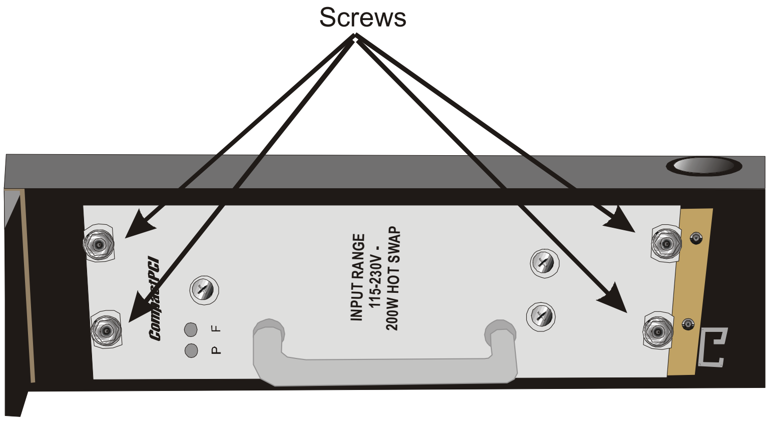


Figure 9-4: Power supply

Action

1. Remove the front panel as described in *Front Panel Removal and Replacement*, page 9-2.
2. Loosen the four screws at the corners of the power supply.
3. Pull the supply towards the front of the CMTS using the silver handle.

   The power supply slides out of the chassis.
4. Line up the replacement power supply with the slot, then push the power supply firmly into the slot.
5. Use the four screws fitted to the new supply to secure the replacement power supply.

End of procedure

Fan Tray Replacement

You can replace the fan tray while the ARRIS Cadant C3 is running, as long as you finish inserting the replacement tray within 60 seconds. Beyond that time, the C3 CMTS starts to shut down as the monitored internal temperature rises.

Refer to the following diagram for the location of the fan tray.

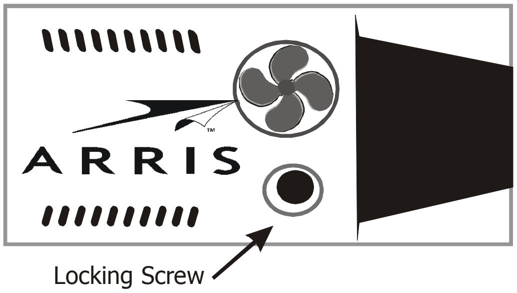


Figure 9-5: Fan tray

⮕

Procedure 9-3 **Fan Tray Replacement**

Follow these steps to replace the fan tray.

1. Loosen the Phillips screw located in the front of the fan tray by turning the screw counter-clockwise. The screw rotates 90 degrees to unlock the fan tray; it does not remove completely.
2. Insert your finger behind the ARRIS logo and pull the fan tray out towards the front of the C3.
3. Insert the new fan tray into the opening, and secure it with the locking screw.

End of procedure

Replacing the Battery

The expected lifetime of the C3 CMTS battery is 10 years. This is an average expectancy and the actual battery lifetime may be shorter or longer.

Requirements Replacing the battery requires a complete shutdown of the C3 CMTS.

WARNING

Risk of injury from battery explosion

The battery type is CR3020 lithium. There is a risk of explosion if the battery is replaced by an incorrect type. Dispose of used batteries according to the manufacturer's instructions.

Use anti-static precautions such as a wrist grounding strap grounded to a grounded work area when handling the CMTS CPU card.

The following diagram shows the location of the battery on the CPU card.

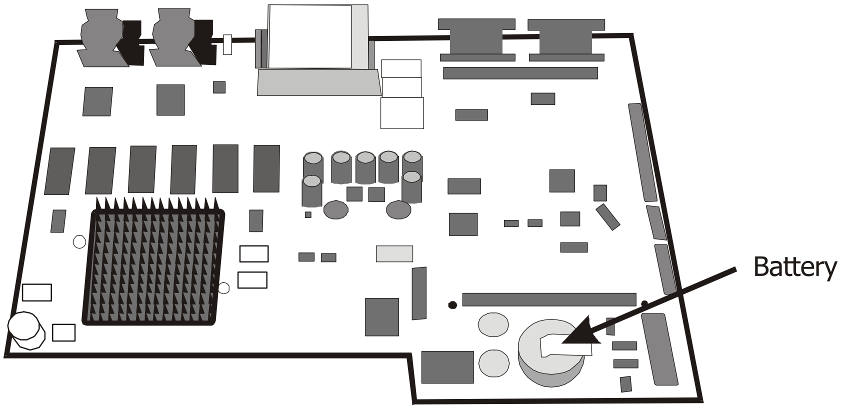


Figure 9-6: Location of battery on CPU card

Procedure 9-4

Replacing the Battery

1. Power down the CMTS by removing all power leads from the rear sockets.
2. Remove the CPU card from the CMTS chassis as follows:

a Loosen the two Phillips screws securing the CPU card to the chassis. The screws run through the black pull tabs on each end of the card.

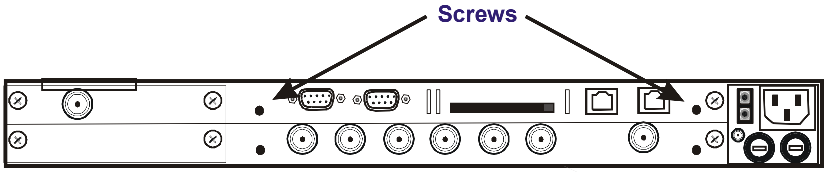


Figure 9-7: Removing the CPU card

b Push the red tabs towards the outer edge of the unit. The black latches will click when they have been released. Gently push the black latches towards the outer edge of the unit to release the card.

c Grasp the CPU by the black tabs on either end of the card and slide the card out of the chassis

3 Gently lift the spring metal contact over the battery and lift the battery from its holder. You may need to use a small screwdriver to gently pry the battery out of the holder.

4 Insert the new battery in the holder.

5 Replace the CPU card into the chassis:

a Line up the CPU card with the guides inside the chassis, and slide the card into the chassis.

b Push the card into the chassis until the latches click into place. Secure the card using the Phillips screws.

6 Replace the power connections.

End of procedure

Replacing the RF Card

The C3 may be shipped with 2, 4, or 6 upstreams.

Requirements

Contact your ARRIS representative to obtain a new upstream card.

Replacing the upstream card requires a complete shutdown of the C3 CMTS.

Use anti-static precautions such as a wrist grounding strap grounded to a grounded work area when handling the upstream card.

Procedure 9-5 **Replacing the RF Card**

1 Power down the CMTS by removing all power leads from the rear sockets.

2 Disconnect the upstream RF cables from the CMTS. Label the RF cables, if necessary, to prevent misconnection after replacing the upstream card.

3 Remove the upstream card from the CMTS chassis as follows:

a Loosen the two Phillips screws securing the upstream card to the chassis. The screws run through the black pull tabs on each end of the card.

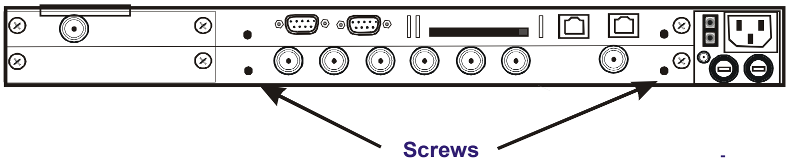


Figure 9-8: Replacing the RF card

b Push the red tabs towards the outer edge of the unit. The black latches will click when they have been released. Gently push the black latches towards the outer edge of the unit to release the card.

c Grasp the upstream card by the black tabs on either end of the card and slide the card out of the chassis.

4 Install the new upstream card into the chassis:

a Line up the upstream card with the guides inside the chassis, and slide the card into the chassis.

b Push the card into the chassis until the latches click into place. Secure the card using the Phillips screws.

Replace the RF cables and power connections.

End of procedure

Replacing Fuses

Procedure 9-6

Replacing Fuses

Use this procedure to replace the fuses. The C3 CMTS has two fuses, located beneath the power connectors on the back of the CMTS chassis.

Requirements

Replace F1 (AC fuse) only with: 250V/5A Antisurge (T) Glass.

Replace F2 (DC fuse) only with: 250V/10A Antisurge (T) Glass.

WARNING

Risk of fire.

For continued protection against risk of fire, replace only with same type and ratings of fuses.

The following diagram shows the fuse locations.

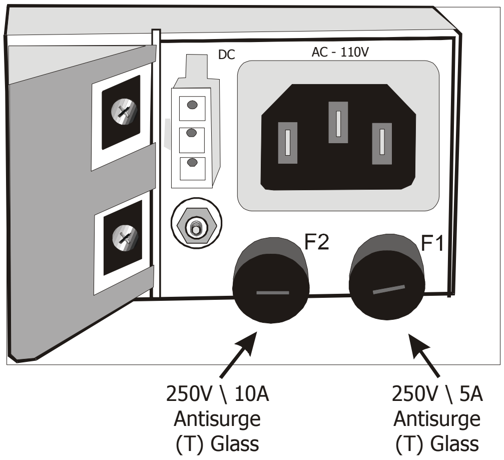


Figure 9-9: Fuse location

End of procedure

Resetting the CMTS after Thermal Overload

If a thermal overload occurs, the C3 shuts down safely with no damage. The power supplies are disabled and remain in an interlocked state until you clear the interlock manually.

Procedure 9-7 **Resetting the CMTS after Thermal Overload**

Follow these steps to clear the interlocked state.

1. Correct the condition that caused the thermal overload.
2. Remove the C3 front panel as described in *Front Panel Removal and Replacement*, page 9-2.
3. Locate the switch SW2, under the RF test jack on the right side of the C3. The following photo shows its location.

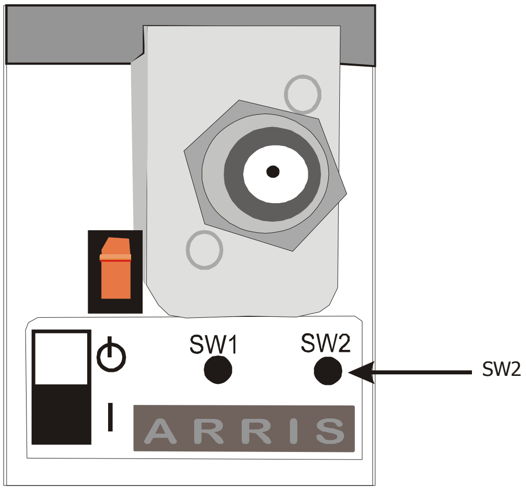


Figure 9-10: Location of the SW2 switch

NOTE
SW1 is the reset for the environmental monitoring CPU and should never be needed.

4. Press SW2 to clear the thermal overload interlock condition.

End of procedure

Upgrading the CMTS Software

The C3 can boot from a software image located on its local Compact Flash disk, or from an image on a TFTP server. Use this procedure to upgrade a C3 CMTS to the current software version and set the booting method.

Booting Methods

The C3 supports the following booting methods:

- Local boot—the C3 loads and runs a software image located on its Compact Flash disk.

Network boot — the C3 loads and runs a software image located on a TFTP server.

Requirements

Before performing this procedure, you need the upgrade software image. Contact your ARRIS representative for information about obtaining the upgrade software image.

For network booting, you must have an operating TFTP server containing the software image file that the C3 downloads at boot time. For best results, the TFTP server in question should be located on the same LAN (and preferably on the same hub) as the C3. Close location minimizes the possibility that a network failure could prevent the C3 from booting properly.

CAUTION
Service affecting

Upgrading the C3 requires a reboot to load the new software image. To minimize disruption of service, perform the reboot only during a scheduled maintenance window.

During the upgrade process, avoid using the **write erase** command to erase the startup configuration. While the C3 would create a new default startup configuration, the default does not include CLI accounts and passwords. Therefore, telnet access is disabled and you would need to use the serial console to restore the CLI accounts.

Procedure 9-8

Upgrading the CMTS Software

Perform the following tasks as needed:

- *Copying the Image Over the Network*, page 9-12
- *Using a Compact Flash Reader*, page 9-13
- *Configuring the C3 to Boot from the Flash Disk*, page 9-15
- *Configuring the C3 to Boot from a TFTP Server*, page 9-16

Copying the Image Over the Network

Procedure 9-9

Copying the Image Over the Network

Follow these steps to upgrade the C3. This procedure uses the IP address **10.1.12.5** and the file name **C3_v03.00.01.27** as examples; replace them with the IP address of your TFTP server and the actual software load file name.

1 Log into the C3 console and enter privileged mode, if you have not already done so.

```
Login: xxxxxxx

Password: xxxxxx

C3>enable

Password: xxxxxx

C3#
```

2 Enter the following commands to copy the new software image onto the C3:

```
C3#copy tftp flash

IP Address of remote host []? 10.1.12.5

Source filename []? C3_v04.03.00.32.bin

Destination filename [C:/C3_v04.03.00.32.bin]? <enter>
Accessing tftp://10.1.12.5/C3_v04.03.00.32.bin...
Load C3_v04.03.00.32.bin from
tftp://10.1.12.5:!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!
[OK - 8300967 bytes]
```

```
8300967 bytes copied in 25 secs (332038 bytes/sec)

C3#dir

Listing Directory C:/:
-rwxrwxrwx  1 0      0            690 Sep 15 19:56 autopsy.txt
-rwxrwxrwx  1 0      0            996 Aug 19 14:40 root.der
-rwxrwxrwx  1 0      0          10901 Sep 15 19:56 snmpd.cnf
-rwxrwxrwx  1 0      0             45 Sep 16 16:35 tzinfo.txt
-rwxrwxrwx  1 0      0          19213 Aug 19 14:40 fp_uload.hex
-rwxrwxrwx  1 0      0          10764 Sep 15 19:55 startup-configuration
-rwxrwxrwx  1 0      0           5208 Aug 19 14:40 dfu_uload.hex
drwxrwxrwx  1 0      0           2048 Aug 26 18:31 CONFIG/
drwxrwxrwx  1 0      0           2048 Sep 15 16:38 SOFTWARE/
-rwxrwxrwx  1 0      0          10901 Sep 15 19:56 snmpd.cnf~
drwxrwxrwx  1 0      0           2048 Aug 19 15:07 Syslog/
-rwxrwxrwx  1 0      0        8001301 Sep 17 19:57 vxWorks.bin.img
-rwxrwxrwx  1 0      0          10764 Sep 15 19:55 startup-temp
-rwxrwxrwx  1 0      0         161251 Sep 15 19:55 shutdownDebug.log
-rwxrwxrwx  1 0      0           1258 Sep 23 16:08 tmp_file-0001
-rwxrwxrwx  1 0      0        8300967 Sep 23 16:08 C3_v04.03.00.32.bin
```

Proceed to *Configuring the C3 to Boot from the Flash Disk*, page 9-15

End of procedure

Using a Compact Flash Reader

Procedure 9-10 **Using a Compact Flash Reader**

Instead of copying the software image over the network, you can eject the Compact Flash disk from the C3 and copy the image directly from another computer. You need a Compact Flash reader (and driver software, if not already installed) to perform this task. Follow these steps:

1 Attach the Compact Flash reader to your computer, if necessary.

2 Push the eject button to the right of the Compact Flash card on the back of the C3. The following figure shows the location of the eject button.

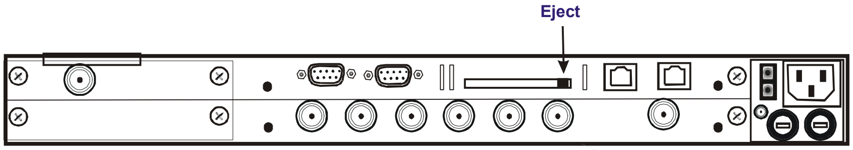


Figure 9-11: Location of compact flash

The console displays the message "interrupt: Compact Flash card removed"

NOTE
Removing the Compact Flash card from the C3 has no effect on normal operation. However, the C3 refuses all commands that would change the configuration or operation of the CMTS, or access the disk, until you replace the Compact Flash card.

3 Insert the Compact Flash card into your computer's reader.

The result depends on your computer. MacOS X and Windows systems automatically mount the disk; most Linux or BSD systems require you to use the **mount** command as root to mount the disk.

4 Copy the new software image onto the Compact Flash disk.

5 Eject the Compact Flash card from your computer and insert it in the slot in the C3 rear panel.

The C3 console displays the messages "interrupt: Compact Flash Card inserted" and "C:/ - Volume is OK"

6 Proceed to *Configuring the C3 to Boot from the Flash Disk*, below.

End of procedure

Configuring the C3 to Boot from the Flash Disk

Procedure 9-11 Configuring the C3 to Boot from the Flash Disk

Follow these steps to configure the C3 for local booting. This procedure uses the file name **C3_v04.03.00.32** as an example; replace it with the actual software load file name.

1 Use the following commands to configure the C3 to boot from the image on the Compact Flash disk:

```
C3# configure terminal
C3(config)# boot system flash C3_v04.03.00.32.bin ↵
C3# exit
```

CAUTION

Service affecting. Perform the following step only during a scheduled maintenance window to minimize service disruptions.

2 During the maintenance window, reboot the C3 using the **reload** command:

```
C3#reload
Save configuration when rebooting (Y/N)?Y
Are you sure you want to reboot the CMTS(Y/N)?Y
Reload in progress.
CadantC3 shutting down
...
```

3 After the C3 finishes rebooting, log in and use the **show version** command to verify that it is running the correct software image:

```
C3>show version


ARRIS CLI version .02
Application image: 4.3.0.32, Sep 20 2003, 15:26:37
BootRom version 1.26
VxWorks5.4.2


...
```

The “Application image” shows the software image version currently running. If this does not correspond to the image on the compact flash disk, a configuration problem may be preventing the C3 from accessing the new load, or the load file itself may be corrupt.

Configuring the C3 to Boot from a TFTP Server

Procedure 9-12 Configuring the C3 to Boot from a TFTP Server

Follow these steps to configure the C3 for network booting. This procedure uses the IP address **10.1.12.5** and the file name **C3_v04.03.00.32** as examples; replace them with the IP address of your TFTP server and the actual software load file name.

1 Use the following commands to configure the C3 to boot from the image on the TFTP server:

```
C3# configure terminal ↵
C3(config)# boot system tftp C3_v04.03.00.32.bin 10.1.2.3 ↵
C3# exit ↵
```

⚠ **CAUTION**

Service affecting.

Perform the following step only during a scheduled maintenance window to minimize service disruptions.

2 During the maintenance window, reboot the C3 using the **reload** command:

```
C3#reload
Save configuration when rebooting (Y/N)?Y
Are you sure you want to reboot the CMTS(Y/N)?Y
Reload in progress.
CadantC3 shutting down
.
.
.
```

3 After the C3 finishes rebooting, log in and use the **show version** command to verify that it is running the correct software image:

```
C3>show version
```

```
ARRIS CLI version .02
Application image: 4.3.0.32, Sep 20 2005, 15:26:37
BootRom version 1.26
VxWorks5.4.2
...
```

The “Application image” shows the software image version currently running. If this does not correspond to the image on the TFTP server, a network or configuration problem may be preventing the C3 from accessing the TFTP server at boot time.

Enabling Licensing Features

The C3 contains certain features that require a license key in order to be enabled and used. These features include:

- RIP
- BRIDGE_GROUPS
- OSPF
- SCDMA

Requirements

Contact your ARRIS representative to obtain a key(s) for the feature(s) being implemented.

The host ID of the CMTS and the feature(s) to be implemented must be provided to ARRIS. The host ID can be obtained using the privileged command **hostid** or **show license**. If privileged mode is not available the **show version** command can be used. The ARRIS representative will then provide a key for each CMTS and each feature enabled within the CMTS.

Procedure 9-13 **Enabling Licensing Features**

1. Obtain key from ARRIS representative.
2. Log into the CMTS and enter privileged mode.
3. Enter the key information for the feature being enabled using the **license key** command. Refer to Chapter 10, Mode 3 Privilege Mode Commands for correct command syntax.
4. To verify that the key has been accepted, the **show license** command can be used. An example of the output is:

```
C3#show license
-------------------------------------------------------------------
C3 - hostid 312 - Licensed Features

        * RIP                ARSVS01163
        * BRIDGE_GROUPS      ARSVS01164
-------------------------------------------------------------------
C3#
```

5 If the feature needs to be disabled for any reason the **license remove** command may be used. Refer to Chapter 10, Mode 3 Privilege Mode Commands for command syntax.

End of procedure

Upgrading Dual Upstream Receivers (DOCSIS 2.0 Systems)

This procedure outlines the steps necessary to add a second or third dual upstream receiver to a DOCSIS 2.0 MAC/PHY card. This procedure assumes that one dual receiver card is already installed.

Dual receiver cards should be populated from left to right.

Requirements

Before starting the upgrade procedure, ensure that you have the following:

- the upgrade hardware ordered from ARRIS
- torque driver with a size 1 Phillips head bit capable of measuring .2 Nm (28 oz-in).
- thread locking compound

Procedure 9-14

Upgrading Dual Upstream Receivers (DOCSIS 2.0 Systems)

1. Remove the MAC/PHY as outlined in procedure *Replacing the RF Card*, page 9-8.
2. Verify that the IF cable is routed as shown below, to avoid pinching or cutting the cable during the upgrade procedure.

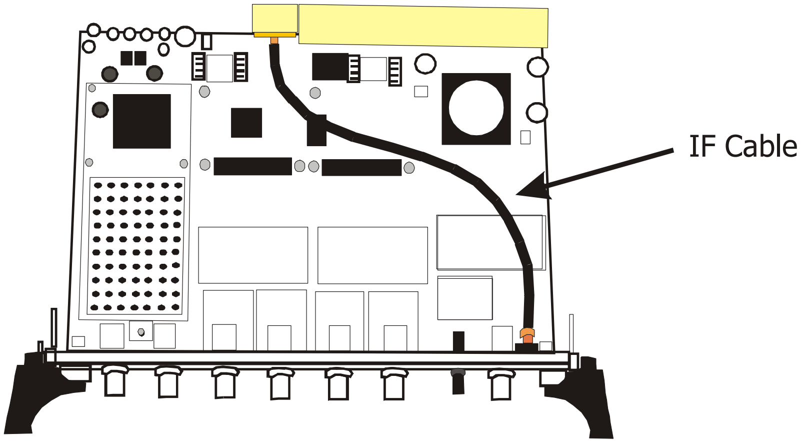


Figure 9-12: IF cable routing

3. Place a dab of thread locking compound onto the four screws attached to the dual receiver card. The dual receiver board has screws already attached.

4 Place a dual receiver board in the position shown below. Make sure the connectors line up properly and that the screws line up with the standoffs on the MAC/PHY board.

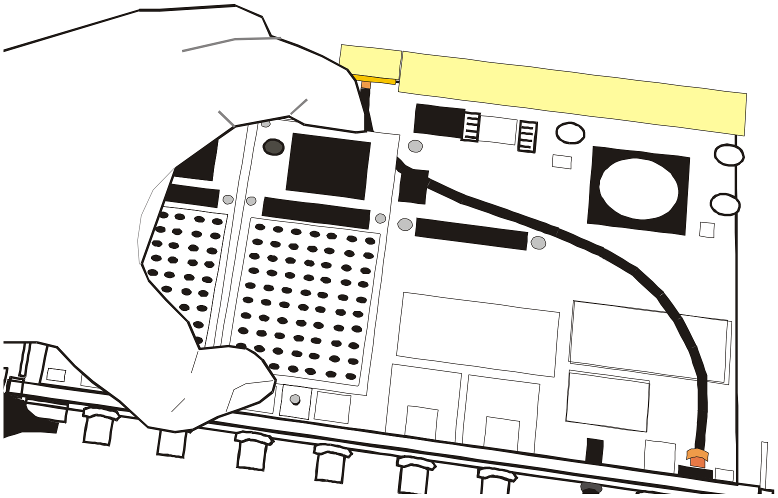


Figure 9-13: Adding a MAC/PHY card

NOTE

Do not attempt to push the dual receiver board into place at this time.

5 Use the torque driver to secure the dual receiver board to the MAC/PHY board. Turn each screw in sequence as shown below, 1 turn at a time, until all four screws are tightened to 0.2 nm torque.

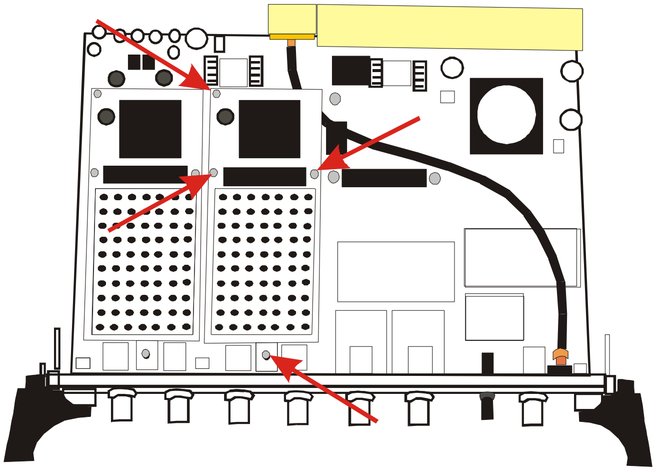


Figure 9-14: Securing the dual receiver board

6 Repeat these steps as necessary to install another dual receiver board, if required.

A fully-populated MAC/PHY card is shown below.

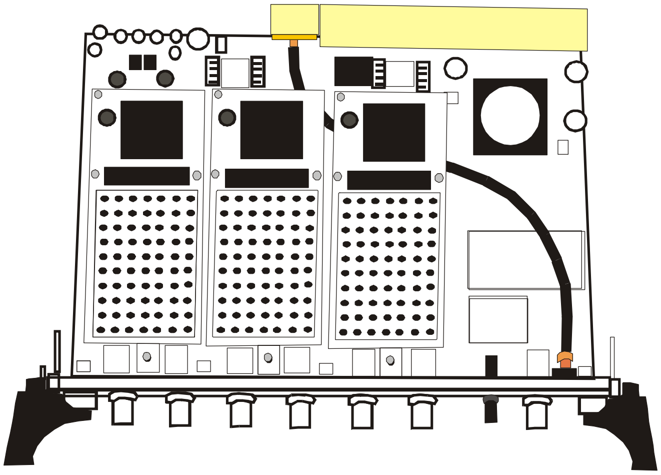


Figure 9-15: Fully populated MAC/PHY card

End of procedure

10 Command Line Interface Reference

The Cadant C3 command line interface (CLI) is intended to follow the familiar syntax of many other communications products and to provide ease of use for administrators.

Access Levels and Modes

The user interface operates in the following modes:

- **User mode—**This is the initially active mode when a user logs into the CLI. The user is limited to harmless commands, such as changing the terminal setting, pinging a host, or displaying certain configuration information.
- **Privileged mode**—Type **enable** and enter a valid password in order to enter privileged mode. In privileged mode, all the commands of user mode are available, along with extra commands for debugging, file manipulation, diagnostics, and more detailed configuration display.
- **Configure mode—**Type **configure** while in privileged mode to enter Configure mode. In configure mode, the commands available relate to general system configuration and are not specific to any particular interface. Cable modem commands are also available in configure mode.
- **Configure interface sub-modes—**To configure a particular interface, enter a configuration sub-mode by typing the appropriate command from Configure mode. The currently available interfaces are terminal, fastethernet, and cable.
- **Router configuration mode—**To configure routing parameters, routing configuration mode must be entered.

Command Completion and Parameter Prompting

Press the **Tab** key to complete a partially-typed command. If what you type previous to the **Tab** could be completed in two different ways (for example, **co** could be completed as **configure** or **copy**), the C3 console beeps and does not attempt to complete the command.

Example:

```
# con<tab>

# configure
```

The **?** (question mark) key has two purposes:

- When added to the end of a partially-typed command, the C3 lists commands that start with the current fragment.
- When separated from the command by one or more spaces, the C3 lists valid parameters or values that can follow the command.

Example:

```
(config)#lo?

logging  login

(config)#logging ?

buffered    Enable local logging of events in
            a circular buffer
on          Enable all logging
severity    Enable/disable logging for a particular
            severity
syslog      Enable syslog logging for events
thresh      Configure thresholds
trap        Enable traps
trap-control  Configure DOCSIS trap control
```

Input Editing

Use the following keystrokes to edit a command before entering it.

Character sequence	Common Name	Action
<CR>	Carriage Return	Passes completed line to parser
<NL>	Newline	Passes completed line to parser
<DEL>	Delete	Backspace one character and delete
?	Question Mark	Provides help information
^A	Control-A	Position cursor to start of line
^B	Control-B	Position cursor left one character
^C	Control-C	Telnet session: Clears input and resets line buffer. Serial console: Opens low-level console (prompting for password).
^D	Control-D	Delete current character
^E	Control-E	Position cursor to end of line
^F	Control-F	Position cursor right one character
^H	Control-H	Backspace one character and delete
^I	Tab	Complete current keyword
^K	Control-K	Delete to end of line
^L	Control-L	Redraw line
^N	Control-N	Move down one line in command history
^P	Control-P	Telnet session: Move up one line in command history. Serial console: Reboot the CMTS.
^R	Control-R	Redraw line
^U	Control-U	Clears input and resets line buffer.
^X	Control-X	Clears input and resets line buffer.
^Z	Control-Z	Pass control to user session exit function
<ESC>[A	Up Arrow	Move up one line in command history
<ESC>[B	Down Arrow	Move down one line in command history
<ESC>[C	Right Arrow	Position cursor right one character
<ESC>[D	Left Arrow	Position cursor left one character
<SP>	Space	Separates keywords

Character sequence	Common Name	Action
“	Quote	Surrounds a single token
^W	Control-W	Delete the last word before the cursor on the command line

Output Filtering

The C3 provides output filtering commands. You can use them to reduce the amount of output sent to the screen by certain commands.

You specify output filtering by appending a vertical bar character to the end of a command, followed by the filtering command and its arguments. The output filtering commands are **begin, include**, and **exclude**. The **?** (help) command prints a brief summary of the commands:

Example:

```
C3#show run | ?

begin    Begin with the line that matches
include  Include lines that match
exclude  Exclude lines that match
```

Filtering Previous Lines

Use the **begin** command to suppress output until an output line matches the specified string:

Example:

```
C3#show run | begin "interface Cable"

interface Cable 1/0
 cable insertion-interval automatic
 cable sync-interval 10
 cable ucd-interval 2000
! cable max-sids 8192
 cable max-ranging-attempts 16
 cable map-advance static
 cable downstream annex B
etc…
```

Including Matching Lines

Use the **include** command to display only output lines matching the specified string:

Example:

```
C3#show access-lists interface matches | include
“Outgoing”
```

```
FastEthernet 0/0        Outgoing              78        None Set  N/A
FastEthernet 0/1        Outgoing         Not Set        None Set  N/A
Cable 1/0               Outgoing             171               1  0
Cable 1/0               Outgoing             171               2  0
Cable 1/0               Outgoing             171               3  0
Cable 1/0               Outgoing             171               4  0
Cable 1/0               Outgoing             171               5  0
Cable 1/0               Outgoing             171               6  1529
Cable 1/0               Outgoing             171               7  1482
Cable 1/0               Outgoing             171               8  186184
```

Excluding Matching Lines — Use the **exclude** command to suppress output lines matching the specified string:

Example:

```
C3#show access-lists interface matches | exclude
“FastEthernet”
```

```
Interface               Direction         Acl ID        Entry No.Matches
Cable 1/0               Outgoing             171               1  0
Cable 1/0               Outgoing             171               2  0
Cable 1/0               Outgoing             171               3  0
Cable 1/0               Outgoing             171               4  0
Cable 1/0               Outgoing             171               5  0
Cable 1/0               Outgoing             171               6  1529
Cable 1/0               Outgoing             171               7  1482
Cable 1/0               Outgoing             171               8  186184
Cable 1/0               Inbound             2601        None Set  N/A
```

Mode 1 *User Mode Commands*

User mode is in effect when you log into the CMTS. Commands in this mode are limited to inquiry commands. The prompt in user mode is the hostname followed by a greater than sign (e.g., **C3>**).

The following is a summary of user mode commands:

C3>?

```
enable      -
exit        - Exit Mode / CLI
help        - Display help about help system
llc-ping    - Ping a specific MAC address using
                        802.2 LLC TEST frames
logout      - Exit the CLI
ping        - Ping a specific ip address
show        - Show system info
systat      - Display users logged into CLI
terminal    - Change terminal settings
C3>
```

debug

Enters debug mode.

enable

Enters privileged mode.

See *Privileged Mode Commands*, page 10-27 for more details. You need to use the enable password to enter privileged mode.

exit

Terminates the console (CLI) session.

help

Provides a list of the available commands for the current user mode.

llc-ping

Syntax

```
llc-ping {macaddr}[attempts] [interval]
```

Keyword	Description
macaddr	MAC address in the form N.N.N
attempts <continuous | *n*>	Number of repeat-count
interval <*number*>	inter-ping interval in seconds

Sends a series of MAC-level echo requests to the specified modem MAC address, and reports whether the CMTS received an echo response for each packet. This command runs until you press a key or until the C3 has sent the specified number of pings.

NOTE
Not all cable modems or MTAs respond to **llc-ping**.

Example:

```
C3>llc-ping 1111.1111.1111 continuous 5

C3>llc-ping 1111.1111.1111. 6 7
```

logout

Closes the connection to the CMTS regardless of operating mode.

ping

Syntax

One of:

```
ping {ipaddr}
ping {ipaddr} interval <0-3600>
ping {ipaddr} repeat <1-2147483647>
ping {ipaddr} size <36-4079>
ping {ipaddr} source {ipaddr}
ping {ipaddr} timeout <0-3600>
ping {ipaddr} arp-vlan <1-4094>
```

Sends a series of 5 ICMP echo requests to the specified IP address, and reports whether the CMTS received an echo response for each packet.

.

Keyword	Description
interval	Specifies the interval, in seconds, between successful, successive ping attempts. If the ping attempt is unsuccessful, the timeout setting will take priority over the interval setting. Valid range **0** to **3600**. The default is **0** seconds.
repeat	Specifies the number of ping attempts to be made. Valid range **1** to **2147483647**. The default is **5**.
size	Specifies the size (in bytes) of the ping packet generated. This size includes the IP packet header and the ICMP payload (i.e. not the L2 header size). Valid range **36** to **4079**. The default is **64** byte ip packet.
source	Specifies the source IP address to be included in the IP header of the ping packet. This IP address must be configured on an operational interface otherwise the command will fail. The source IP address specified does not determine the outbound interface of the ping request. instead it is used to select the inbound interface that the responding host will issue its corresponding ping response to.
timeout	Specifies the timeout, in seconds, between successive unsuccessful ping attempts (i.e. the period that will be waited for a ping response after a ping request has been issued). Valid range **0** to **3600**. The default is **2** seconds.
arp-vlan	Specifies the 802.1Q VLAN tag to use for the initial ARP if there is no current ARP table entry for <ip-address> and the ARP packet would be bridged out a transparently-bridging bridge-group. Note that the tag specified must actually be allowed on the outgoing subinterface. Valid range **1** to **4094**.

The ping operation may be terminated at any time by pressing any key on the CLI. The following example displays a successful ping of a host on f0/0 (eg subnet 10.250.0.0/24) where the ping response is received on f0/1 (eg subnet 10.250.136.0/24).

```
C3>ping 10.250.0.1 interval 1 size 1200 repeat 10 source
10.250.136.2 timeout 5
```

The successful system response would be:

```
Type any key to abort.
Sending 10, 1200-byte ICMP Echos to 10.250.0.1, timeout is
5 seconds:
Packet sent with a source address of 10.250.136.2
!!!!!!!!!!
Success rate is 100 percent (10/10) round-trip min/avg/max
= 0/0/0 ms
```

systat

Display users logged into the CLI.

Example:

```
C3>systat

Line     Disconnect   Location       User
           Timer
 console   none       serial-port     -
 vty 0     none       10.17.224.69    root
*vty 1     none       10.1.255.44     root
```

terminal

Changes the definition of the terminal type, width, or screen length.

```
C3>terminal ?

length             - Set num lines in window
monitor            - Turn on debug output
no                 -
timeout            - Set inactivity timeout period
vt100-colours      - Enable ANSI colours
width              - Set width of window
```

Syntax

```
terminal length {n}
```

Sets the number of lines that will be displayed before the user is prompted with MORE to continue terminal output. Valid entries of 0 or 2-512 are acceptable.

Syntax

```
terminal [no] monitor
```

Directs debugging output to the terminal window (the default is to send debug information only to the serial port).

Use the **no** form of this command to stop debugging information from being sent to the current terminal session.

Syntax

```
terminal [no] timeout {n}
```

Automatically disconnect terminal sessions if left idle for more than the specified number of seconds (**0** to **65500**). Setting the timeout value to **0**, or using the [**no**] form of this command, disables inactive session disconnection.

Syntax

```
terminal [no] vt100-colours
```

Enables or disables ANSI color output.

Syntax

```
terminal width {n}
```

Sets the width of displayed output on the terminal. Valid entries of 1-512 are acceptable.

Mode 2 *User Mode SHOW Commands*

show

Displays information about the system. The following options are available:

C3>show ?

```
aliases     - Show aliases
arp         - ARP table
bootvar     - Show boot parameters
calendar    - Show Date and Time
clock       - Show Date and Time
context     - Context info about recent crashes
crypto      - Displays user SSH connections
exception   - Show information from the autopsy file
hardware    - Hardware information
history     - Command History
ip          - IP related info
ipc         - IPC info
key         - Key Information
memory      - System memory
ntp                - NTP Servers
phs         - PHS configuration
route-map   - Display all configured route maps
snmp        - SNMP counters
ssh         - Displays the version and configuration data
for SSH
terminal           - Terminal info
users              - Users logged into CLI
version            - Version information

C3>
```

show aliases

Displays any defined aliases for commands.

Example:

```
C3>show aliases

=Alias=             =Command string=
scm                 show cable modem
```

See also: *alias*, page 10-102.

show arp

Equivalent to the **show ip arp** command without arguments.

Example:

```
C3>show arp

Prot Address         Age(min) Hardware Addr  Vlan Type Interface
IP   10.1.176.193    15       0001.5c20.4328   -  ARPA B#0-FastEthernet 0/0.0
IP   10.1.176.254    0        00e0.168b.fc89   -  ARPA B#0-FastEthernet 0/0.0
C3#
```

show bootvar

Displays boot variables.

Example:

```
C3>show bootvar

Boot Image Device: Compact Flash - C:/3.0.1.27.bin
Boot Config file Device: current flashdisk file
C3>
```

See also: *boot system flash*, page 10-103 (privilege mode required).

show calendar

Displays the date and time from the internal real time clock. The internal clock has a battery backup and operates whether or not the C3 is powered down.

Example:

```
C3>show calendar

20:13:38 GMT Tue Aug 27 2005
20:13:38 UTC Tue Aug 27 2005
C3>
```

See also: *clock timezone*, page 10-34.

show clock

Displays the date and time from the system clock. The C3 synchronizes the system clock with the calendar at boot time.

Example:

```
C3>show clock

15:54:27.481 GMT Tue Jul 15 2005
15:54:27.481 UTC Tue Jul 15 2005
C3>
```

See also: *clock timezone*, page 10-34.

show clock timezone

Displays the current time zone and its offset from GMT.

Example:

```
C3>show clock timezone

Local time zone is GMT (0:00 from UTC)
```

show context

Displays recent startup and shutdown history.

Example:

```
C3>show context

Shutdown: Date Tue 08-Jul-2005: time 02:27:54
Bootup  : Date Tue 08-Jul-2005: time 02:29:55
Bootup  : Date Wed 09-Jul-2005: time 01:38:21
Shutdown: Date Wed 09-Jul-2005: time 03:00:26
Bootup  : Date Wed 09-Jul-2005: time 03:01:16
```

show crypto key

Syntax

```
show crypto key mypubkey {type} or
show crypto key pubkey-chain rsa {name userid}
```

Displays public keys.

The first form of this command displays the SSH server host public key. Specify either **dsa** or **rsa** format. You can also copy the public keys in RSA or DSA format from **c:/ssh/cmts_dsa_pubkey.pem** or **c:/ssh/cmts_rsa_pubkey.pem** respectively.

The second form of this command displays the installed RSA public key for the specified C3 user ID.

See also: *clock timezone*, page 10-34.

show exception

Identical to **show context**.

show hardware

Displays a list of hardware installed in the CMTS with revision information and serial numbers where appropriate.

Example:

```
C3>show hardware

Arris C3 CMTS - Serial # 312
Component   Serial #     HW Rev       SW Rev
WAN/CPU     000312       unavailable  N/A
Cable       N/A          A            N/A
Upconverter N/A          6            N/A
Extender    N/A          2            7
FPGA S/W    N/A          N/A          5

Processor Module BCM1250
CPU       : 1250 A8/A10
Nb core   : 2
L2 Cache  : OK
Wafer ID  :   0x2C6C4019  [Lot 2843, Wafer 2]
Manuf Test: Bin A [2CPU_FI_FD_F2 (OK)]
Cpu speed : 600 Mhz
SysCfg    : 000000000CDB0600 [PLL_DIV: 12, IOB0_DIV:
CPUCLK/4, IOB1_DIV: CPUCLK/3]

Module        Description    Serial    PCB Assy  PCB Assy
                              Number     Revision   Number
MAC             BCM3214 Rev A3  N/A        N/A        N/A
Downstream      BCM3040 Rev A0  N/A        N/A        N/A
Upstream Slot 0 BCM3140 Rev A3  212013     2
ARCT00842
Upstream Slot 1 BCM3140 Rev A3  211054     A
ARCT00480
Upstream Slot 2 BCM3140 Rev A3  211154     A
ARCT00480C3>
```

show history

Displays a list of recently entered commands.

Example:

```
C3>show history

  show memory
  show tech
  show aliases
  show boot
  show calendar
  show class-map
  show clock
  show context
  show exception
  show history
C3>
```

show ip arp

Syntax **show ip arp [cable 1/0[.s] | fastethernet 0/n[.s] | macaddr | ipaddr]**

Displays the associated MAC and IP addresses for interfaces or addresses, learned through ARP.

Example:

```
C3>show ip arp

Prot Address          Age(min) Hardware Addr  Vlan Type  Interface
IP   10.1.176.254     6        00e0.168b.fc89   -  ARPA  B#0-FastEthernet 0/0.0
C3>
```

show ip igmp groups

Syntax **show ip igmp groups**

Shows all IGMP groups held in the C3 IGMP database.

Example:

```
C3> show ip igmp groups
```

```
IGMP Connected Group Membership
Group Address     Interface         Uptime      Expires     Last Reporter
239.255.255.254   Ethernet3/1       1w0d        00:02:19    172.21.200.159
224.0.1.40        Ethernet3/1       1w0d        00:02:15    172.21.200.1
224.0.1.40        Ethernet3/3       1w0d        never       171.69.214.251
224.0.1.1         Ethernet3/1       1w0d        00:02:11    172.21.200.11
224.9.9.2         Ethernet3/1       1w0d        00:02:10    172.21.200.155
232.1.1.1         Ethernet3/1       5d21h       stopped     172.21.200.206
C3>
```

show ip igmp interface

Syntax **show ip igmp interface [cable 1/0[.s] | fastethernet 0/n[.s]]**

Shows all IGMP attributes for all IGMP-aware sub-interfaces or for a specific sub-interface.

Example:

```
C3>show ip igmp interface
```

```
Cable 1/0.0:
         IGMP is disabled on subinterface
         Current IGMP version is 2
         Interface IGMP joins 0
         Packets dropped:
                Bad checksum or length 0
                IGMP not enabled on subinterface 0
C3>
```

show ip interface brief

Syntax **`show ip interface brief`**

Shows a summary of the current status of all IP interfaces, including any configured bridge-groups. Sub-interfaces within a bridge-group are displayed after the bridge-group number. These are indented in the summary display to distinguish them from the routable sub-interface.

Example:

```
C3>show ip interface brief

Interface          IP-Address     OK?   Method Status                Protocol
bridge-group #0                   YES                                   up
  Cable 1/0.1       2.2.2.2       YES   NVRAM  administratively down
  FastEthernet 0/0  10.250.0.42   YES   NVRAM                           up
Cable 1/0           10.250.150.2  YES   NVRAM  up                       up
FastEthernet 0/1    10.250.136.2  YES   NVRAM  up                       up
                    11.250.136.2
FastEthernet 0/1.4  14.14.14.14   YES   manual up                       up
Loopback.1          unassigned    YES   unset  administratively down    down
Loopback.5          5.5.5.5       YES   NVRAM  up                       up
C3>
```

show ip rip

Syntax **`show ip rip [database]`**

Displays routing parameters.

See also: *Router Configuration Mode*, page 10-248.

show ip route

Syntax

```
show ip route [connected | ospf| rip | static |
summary]
```

Shows IP-related information. If no parameter is given, this command will show all known routes. The optional parameters are:

Keyword	Description
connected	Shows connected networks.
ospf	Shows routes learned through OSPF.
rip	Shows routes learned through RIP.
static	Shows static routes
summary	Shows a count of all known networks and subnets

Example:

```
C3>show ip route
```

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - ICMP, B - BGP
       E - EGP, G - GGP, O - OSPF, ES - ES-IS, IS - IS-IS

Gateway of last resort is 192.168.253.70 to network 0.0.0.0

        192.168.253.0/24 is subnetted, 1 subnet
C       192.168.253.0/24 is directly connected, FastEthernet 0/0
C3>
```

See also: *ip route*, page 10-143.

show ip ssh

Displays currently active connections to the SSH server.

See also: *show ssh*, page 10-24.

show ipc

Displays inter-process communications information. This command is intended only for CMTS debugging use.

show key chain

Displays the configured key chains.

See also: *key chain*, page 10-176.

show memory

Displays current and cumulative memory usage.

Example:

```
C3>show memory

 status   bytes    blocks   avg block  max block
 ------ --------- -------- ---------- ----------
current
   free  98231520        5   19646304  98230848
  alloc   2946192     1367       2155         -
cumulative
  alloc   3707728     6254        592         -
C3>
```

show ntp

Displays NTP server details.

Example:

```
C3> show ntp
```

```
IP Address      Interval Master    Success /   Attempts Active Offset (s)
63.149.208.50        300 Yes             0 /         35 Yes    Unknown
C3>
```

show phs

Displays PHS configuration.

Example:

```
C3> show phs

PHS is enabled.
```

show route-map

Displays all configured route maps.

show snmp

Displays SNMP activity counters.

Example:

```
C3> show snmp

==SNMP information==
        Agent generates Authentication traps: yes
        Silent drops: 0
        Proxy drops: 0
Incoming PDU Counters:
        Total packets: 752
        Bad versions: 0
        Bad community names: 4
        Bad community uses: 1
        ASN parse errors: 0
        Packets too big: 0
        No such names: 0
        Bad values: 0
        Read onlys: 0
        General errors: 0
        Total MIB objects retrieved: 1588
        Total MIB objects modified: 0
        Get requests: 399
        GetNext requests: 348
        Set requests: 1
        Get responses: 0
        Traps: 0
Outgoing PDU Counters:
        Total packets: 802
        Packets too big: 0
        No such names: 6
        Bad values: 0
        General errors: 0
        Get requests: 0
        GetNext requests: 0
        Set requests: 0
        Get responses: 748
        Traps: 54
C3>
```

show ssh

Displays the configuration data for the SSH server.

Example:

```
C3> show ssh
```

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

SSH daemon            : disabled

Version configured    : 1.99 (SSH1 and SSH2)

Authentication timeout : 300 secs

Authentication retries : 3

TCP port in use       : 22

Secure CLI access     : disable

Secure FTP access     : disable

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

See also: *show ip ssh*, page 10-20.

show terminal

Displays information about the terminal session environment, including the terminal type and command history size.

Example:

```
C3>show terminal
```

```
Type: ANSI
Length: 54 lines, Width: 80 columns
Status: Ready, Automore on
Capabilities:
Editing is Enabled.
```

```
History is Enabled, history size is 10.
```

See also: *terminal*, page 10-10.

show tftp-server statistics

Displays the current TFTP server statistics.

Example:

```
C3#show tftp-server statistics

TFTP root directory is:


0 read request(s) is/were made.
0 read request(s) is/were dropped.
0 read request(s) had errors.
0 bytes were successfully read.


0 write request(s) is/were made.
0 write request(s) is/were dropped.
0 write request(s) had errors.
0 bytes were successfully written.


TFTP server is inactive
IP checking is done on TFTP transactions
C3>
```

show users

Displays active management sessions on the CMTS (serial or telnet).

Example:

```
C3>show users

Line    Disconnect Location        User
          Timer
```

```
 tty 0  none       serial-port     arris
*vty 0  0:15:00    192.168.250.80  arris
C3>
```

show version

Displays current software version information (information shown is for illustrative purposes only. Your file names and dates may differ.).

Example:

C3>show version

```
ARRIS CLI version .02
Application image: 4.3.0.33, Sep 13 2005, 14:48:16
BootRom version 4.1.0.2
VxWorks5.4.2

System serial number/hostid: 392
WAN/CPU card serial number: 000250
System uptime is 0 weeks, 0 days, 17 hours, 32 minutes

System image file is: tftp://10.17.224.12/4.3.0.33.bin
2 FastEthernet interface(s)
1 Cable interface(s)
256 MB DDR SDRAM memory

Compact Flash:
        18386944 bytes free,
        109651968 bytes used,
        128038912 bytes total
```

Mode 3 Privileged Mode Commands

To access commands in privileged mode, use the **enable** command from user mode and enter a valid password.

In privileged mode, the command prompt is the hostname followed by a number sign (e.g., **C3#**).

All commands in user mode are valid in privileged mode.

The following is a summary of Privileged mode commands:

C3#?

```
cable       - Cable related commands
calendar    - Modify date/time
cd          - Change Directory
chkdsk      - Check a DOS filesystem for errors
clear       - Reset commands
clock       - Clock
configure   - Enter configuration mode
copy        - Copy a file
delete      - Delete a file
dir         - Display contents of current directory
disable     - Exit privileged mode
disconnect  - Disconnect a CLI connection
elog        - Event logging
erase       - Erase a file-system
format      - Format a file-system
hostid      - Display id of CMTS, used when ordering
software licenses
license     - Scan C:/licenses for new license file
mkdir       - Create a directory
more        - Show contents of a file
no          -
pwd         - Show current directory
reload      - Restart CMTS
rename      - Rename a file
rmdir       - Delete a directory
script      - CLI command script
send        - Send message to other CLI users
test            - Perform Diagnostics
undebug         - Toggle Debug output
write           - Save/Display running-configuration
```

cable modem

Syntax

```
one of:
no cable modem {address}
cable modem {address} dsa {tftpaddr} {file}
cable modem {address} dsc {tftpaddr} {file} {sfid}
   [sfid2]
cable modem {address} dsd {sfid} [sfid2]
cable modem {address} max-hosts {n}
cable modem {address} subscriber {ipaddr | auto}
cable modem {address} ucc max-failed-attempts {n}
cable modem {address} vpn {vpn id}
```

Sets user and QoS parameters. The parameters are:

Keyword	Description
address	Specify a cable modem by IP address, MAC address, or **all** to specify all cable modems on the CMTS.
dsa	Initiate a Dynamic Service Addition (DSA) for the specified cable modem. Specify the TFTP server and configuration file containing the dynamic service to add
dsc	Initiate a Dynamic Service Change (DSC) for the specified cable modem. Specify the TFTP server and configuration file containing the dynamic service to change, and one or two Service Flow IDs that this change applies to
dsd	Initiate a Dynamic Service Deletion (DSD) for the specified cable modem. Specify one or two Service Flow IDs to delete
max-hosts	Sets the maximum number of CPE devices allowed to communicate through the cable modem. Use the keyword **default** to specify the default number of devices.
subscriber	Adds the specified static IP address to the list of valid subscribers. Use the keyword **auto** to automatically learn the subscriber’s IP address

Keyword	Description
ucc max-failed-attempts	Sets the maximum number of consecutive failed Upstream Channel Change (UCC) attempts that a modem is allowed before stopping further attempts. Use a value of **0** for unlimited retries
vpn	Maps all CPE behind a cable modem to a specific cable subinterface which has the specified native vlan-tag configured. If the cable modem is online, the mapping takes effect the next time the cable modem registers. A CPE behind cable modem can only be mapped to one subinterface at a time. Valid range of the VLAN-TAG is 1-4094. Debug this command using the "debug cable registration" command

calendar set

Syntax

```
calendar set {hh:mm:ss} [dd mmm yyyy]
```

Sets the internal CMTS real time clock to the specified time. The calendar keeps time even if the CMTS is powered off.

Example:

```
C3#calendar set 13:59:11 02 sep 2005
```

cd

Syntax

```
cd {dir}
```

Changes the working directory on the Compact Flash disk.

chkdsk

Syntax **`chkdsk {flash: | filesys} [repair]`**

Verifies that the file system is correct. The specified *filesys* may be any of the file systems listed by **show file systems**. If the **repair** keyword is specified, the C3 attempts to repair file system errors.

Example:

```
C3#chkdsk ?

flash:             - Check flash
<STRING>           - File system

C3#chkdsk flash

Are you sure you want to perform this command?(Y/N)Y
C:/  - disk check in progress ...
C:/  - Volume is OK

          total # of clusters:  62,519
           # of free clusters:  58,117
            # of bad clusters:  0
             total free space:  116,234 Kb
     max contiguous free space:  119,023,616 bytes
                   # of files:  14
                 # of folders:  11
         total bytes in files:  8,758 Ib
             # of lost chains:  0
   total bytes in lost chains:  0
```

clear access-list counters

Syntax **`clear access-list counters`**

Resets counters for access-list entries.

clear arp cache

Syntax

```
clear arp cache
```

Clears the entire arp cache.

clear ip cache

Syntax

```
clear ip cache [ipaddr]
```

Clears the route cache for the specified IP address, or the entire cache if no address is specified.

clear ip igmp group

Syntax

```
clear ip igmp group
```

Deletes all the IGMP group(s) from multicast cache.

clear ip ospf process

Syntax

```
clear ip ospf process
```

Restarts the OSPF routing process.

clear ip route

Syntax

```
clear ip route [all | rip | static]
```

Resets the specified routing table entries.

clear logging

Clears the local event log.

clear mac-address

Deletes the learned MAC address entry from the MAC address table.

clear mac-address-table

Deletes all learned entries from the MAC address table.

clear screen

Clears the terminal window.

clock summer-time date

Syntax

```
clock summer-time {timezone} date {start} {end}
```

Creates a specific period of summer time (daylight savings time) for the specified time zone. Use **clock summer-time recurring** to set recurring time changes.

The parameters are:

Keyword	Description
timezone	The time zone name. Use **clock timezone** to create the timezone.
start	The starting date and time. The format is: **day month year hh:mm**
end	The ending date and time

Example:

```
C3#clock summer-time EDT date 1 4 2003 02:00 1 10 2003
02:00
```

clock summer-time recurring

Syntax

```
clock summer-time {timezone} recurring [start end]
```

Creates a recurring period of summer time for the specified time zone. Use **clock summer-time date** to set a specific period of summer time.

The parameters are:

Keyword	Description
timezone	The time zone name. Use **clock timezone** to create the timezone.
start	The starting date and time. The format is: **week day month hh:mm**
week	This can be **first**, **last**, or **1** to **4**
day	This is a day of the week (**sun** through **sat**, or **1** to **7**)
end	The ending date and time

Example:

```
C3#clock summer-time EDT recurring first sun apr 02:00
first sun oct 02:00
```

clock timezone

Syntax

```
[no] clock timezone {name} {offset}
```

Creates a time zone. Use **no clock timezone** to delete a configured timezone.

Keyword	Description
name	Any text string to describe the time zone
offset	The offset, in hours (and optionally minutes), from UTC. Valid range: **–13** to **+13**

configure

Syntax **`configure {terminal | memory | network | overwrite-network}`**

Changes the command entry mode to global configuration mode. See *Global Configuration Commands*, page 10-98 for details.

Example:

```
C3#configure

Configuring from terminal, memory, or network [terminal]
?terminal
C3(config)#
```

copy

Syntax

```
copy {orig} {dest}
```

Duplicates the file **orig** and names it **dest**.

Specify files by name or use the following special qualifiers:

Keyword	Description
flash	Copies a file on the flash disk to the flash disk or a TFTP server
running-configuration	Copies the running configuration to a file or the startup configuration
startup-configuration	Copies the startup configuration to a file or to the running configuration
tftp	Copies a file from the default TFTP server to the flash disk
tftp://ipaddr/file	Copies a file (or configuration) to or from the TFTP server at the specified address

If copying to or from the local disk, make sure that the drive letter is in upper case.

Example:

```
C3#copy tftp://10.1.100.1/vxWorks1.st vxWorks1.st
```

```
C3#copy C:/test.txt C:/test.old.txt
```

```
Copying....!
C3#29886 bytes copied in 0 secs <29886 bytes/sec>
```

delete

Syntax

```
delete {filename}
```

Removes the specified file, from the Compact Flash module.

dir

Syntax

```
dir [path]
```

Displays a list of all files in the current directory or the specified directory path. Use **show c:** for even more information.

disable

Exits to user mode.

disconnect

Syntax

```
disconnect vty {id} or
disconnect ip ssh {user}
```

Disconnects telnet or SSH sessions even if not fully logged in yet. Valid range: **0** to **3**.

Example:

```
C3#show user
```

```
Line    Disconnect Location        User
          Timer
*tty 0  0:14:57    serial-port     arris
 vty 0  0:15:00    192.168.250.80  arris
 vty 1  0:15:00    192.168.250.80  arris
 vty 2  0:15:00    192.168.250.80  arris
 vty 3  0:15:00    192.168.250.80  arris
C3#disconnect vty 2
```

elog

Syntax

`elog {ascii-dump | clear | off | on | size rows}`

Controls and displays the event log. The parameters are:

Keyword	Description
ascii-dump	Dumps the log to the screen
clear	Empties the log
on	Turns on event logging
off	Turns off event logging
size	Sets the size of the event log as the number of rows to be stored

Example:

`C3#elog ascii-dump`

```
Index       Event Code Count  First Time      Last Time       CM MAC Addr
1           82010100   16     JUL 08 18:33:33 JUL 08 18:33:48 --------------
2           82010200   1      JUL 08 18:33:48 JUL 08 18:33:48 0000.ca30.1288
3           82010400   1      JUL 08 18:33:48 JUL 08 18:33:48 --------------
4           82010100   7      JUL 15 16:43:16 JUL 15 16:54:26 --------------
5           82010100   16     JUN 26 15:25:54 JUN 26 15:26:09 --------------
etc...
C3#
```

erase

Syntax

```
erase {c: | startup-configuration}
```

Erases the Flash disk or startup configuration, as specified.

format

Syntax

```
format c:
```

Completely erases a Compact Flash card and establishes a new file system on it.

hostid

Displays the host ID of the C3. Use this to find the proper host ID when ordering feature licenses.

See also: “license” below.

license

Syntax

```
license {file name | key n feature ARSVSnnnn |
remove n | tftp ipaddr file}
```

Enables or removes licensed features on the C3. Contact your ARRIS representative for available features and keys.

Example:

```
C3#license key 0123ABCD456789EF feature ARSVS01163

        RIP          ARSVS01163 enabled
```

See also: *show license*, page 10-92.

mkdir

Syntax

```
mkdir {dir}
```

Creates a new directory.

more

Syntax

```
more {file} [crlf | binary]
```

Displays the contents of the specified file, one page at a time. If no option is given, this command will ignore missing carriage returns in Unix files. The options are:

Press **c** to display the entire file without pausing, hit the enter key to view one line at a time, **space** to page down, or **esc** to quit viewing the file.

Keyword	Description
crlf	Properly displays a text file transferred from an MS-DOS or Windows operating system
binary	Displays a binary file

no

Reverses many commands.

pwd

Displays the name of the current working directory.

Example:

```
C3#pwd

C:/
C3#
```

reload

Syntax

```
reload [at time [reason] | cancel | in time [reason]]
```

Restarts the CMTS (same behavior as setting **docsDevResetNow** to **true**). The parameters are:

Keyword	Description
at	Specifies the clock time, in **hh:mm** notation, to reboot the C3. You can add an optional reason string, describing why the reboot was necessary
in	Specifies the amount of time, in **hh:mm** notation, to wait before rebooting the C3. You can add an optional reason string, describing why the reboot was necessary
cancel	Cancels a scheduled reboot

The CMTS prompts you to save the running configuration to the startup configuration if changes to the configuration have been made. If you choose not to save the running configuration to the startup configuration, the CMTS appends a copy of the running configuration to the shutdowndebug.log file on the Compact Flash disk.

Example (entering **N** for the confirmation):

```
C3#reload

Proceed with reload? (Y/N) N

Operation Cancelled!
C3#
```

rename

Syntax

```
rename {oldfile} {newfile}
```

Changes the name of the file called *oldfile* to *newfile* on the Compact Flash module.

rmdir

Syntax

```
rmdir {dir}
```

Removes the specified directory. The C3 does not remove a non-empty directory.

script start

Syntax

```
script start {file}
```

Starts recording a command script to the specified file.

script execute

Syntax

```
script execute {file}
```

Executes a recorded script in the specified file.

script stop

Finishes recording a command script.

send

Syntax **`send {all | console | vty0 | vty1 | vty2 | vty3} {message}`**

Sends a text message to the specified CLI users.

Example:

```
C3#send all "testing"

***
***
*** Message from  vty0 to all terminals:
***
testing
C3#
```

test cable ucc cable

Syntax **`test cable ucc cable {x/y.z}`**

Tests the specified cable interface.

undebug

Syntax

```
undebug
```

Turns off debugging facility.

write

Syntax

```
write [memory | terminal | network file | erase]
```

Writes the running configuration, or erases the startup configuration, based on the argument. If no argument is used, this command saves the running configuration to the startup configuration (to disk). The options are:

Keyword	Description
memory	Saves the running configuration to the startup configuration (to disk)
terminal	Displays the running configuration on the terminal
network	Saves the running configuration to the specified file. The file may be a path on the Compact Flash disk, or you can specify **tftp://n.n.n.n/filename** to copy the configuration to a TFTP server
erase	Erases the startup configuration on the Compact Flash disk. If you do not create a new startup configuration, the CMTS uses the factory default configuration at the next reload

See also *Bridge Groups*, page 4-4.

Mode 4 *Privileged SHOW Commands*

In privileged mode, displays detailed information about the CMTS configuration. Privileged mode supports the user mode **show** options, and adds the following options.

- show aaa
- show access-lists
- show bridge
- show bridge-group
- show c:
- show cable
- show cli
- show configuration
- show controllers
- show debug
- show environment
- show file
- show flash:
- show interfaces
- show license
- show logging
- show mib
- show processes
- show reload
- show running-configuration
- show snmp-server
- show startup-config
- show tacacs
- show tech-support

show aaa

Displays the Authentication configuration.

show access-lists

Syntax **show access-lists [acl | interface matches | cable X/Y.Z matches| fastethernet X/Y.Z matches]**

Displays access-list information. It can be supplied with an access-list-number. Implicit ACE, ACE index and ACL type (extended/standard) is shown in output. If no option is specified, this command will display the full list of configured ACLs. The options are:

acl Displays the specified ACL configuration.

interface matches|cable matches|fastethernet matches Displays statistics of matches against each interface in each direction. "Interface cable X/Y.Z matches" or "interface fastethernet X/Y.Z" shows ACL's for the selected sub-interface.

Example **(single ACL)**:

```
C3#show access-lists 1

access-list 1 permit 192.5.34.0  0.0.0.255
access-list 1 permit 128.88.0.0  0.0.255.255
access-list 1 permit 36.0.0.0  0.255.255.255
! (Note: all other access implicitly denied
```

```
C3#show access-lists

Extended IP access list 100
        [01] permit ip any any <matches 00>
        DEFAULT deny ip any any <matches 00>
```

Example **(no option, display the full list)**:

```
C3#show access-lists
Extended IP access list 2699
        [01] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos 5 precedence
priority (matches 0)
        [02] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos 5 precedence
immediate (matches 0)
        [03] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos 5 precedence
flash (matches 0)
        [04] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos 5 precedence
flash-override (matches 0)
```

```
        [05] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos 5 precedence
critical (matches 25)
        [06] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos 5 precedence
internet (matches 547)
        [07] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos 5 precedence
network (matches 0)
        [08] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
min-monetary-cost precedence network (matches 0)
        [09] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
min-monetary-cost precedence priority (matches 0)
        [10] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
min-monetary-cost precedence immediate (matches 0)
        [11] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
min-monetary-cost precedence flash (matches 0)
        [12] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
min-monetary-cost precedence flash-override (matches 0)
        [13] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
min-monetary-cost precedence critical (matches 0)
        [14] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
min-monetary-cost precedence internet (matches 765)
        [15] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
max-reliability precedence network (matches 0)
        [16] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
max-reliability precedence priority (matches 0)
        [17] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
max-reliability precedence immediate (matches 0)
        [18] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
max-reliability precedence flash (matches 125)
        [19] permit tcp host 1.1.1.2 eq 1 host 4.4.4.4 eq 5 tos
max-reliability precedence flash-override (matches 0)
        [20] deny ip any any (matches 43584779)
```

Example **(interface matches)**:

```
C3#show access-lists interface matches
```

```
Interface               Direction         Acl ID        Entry No.Matches
FastEthernet 0/0.0      Outgoing              78        None Set     N/A
FastEthernet 0/0.0      Inbound             2699               1     0
FastEthernet 0/0.0      Inbound             2699               2     0
FastEthernet 0/0.0      Inbound             2699               3     0
FastEthernet 0/0.0      Inbound             2699               4     0
FastEthernet 0/0.0      Inbound             2699               5     0
FastEthernet 0/0.0      Inbound             2699               6     0
FastEthernet 0/0.0      Inbound             2699               7     0
FastEthernet 0/0.0      Inbound             2699               8     0
FastEthernet 0/0.0      Inbound             2699                9     0
FastEthernet 0/0.0      Inbound             2699               10     0
FastEthernet 0/0.0      Inbound             2699               11     0
FastEthernet 0/0.0      Inbound             2699               12     0
FastEthernet 0/0.0      Inbound             2699               13     0
FastEthernet 0/0.0      Inbound             2699               14     0
FastEthernet 0/0.0      Inbound             2699               15     0
FastEthernet 0/0.0      Inbound             2699               16     0
FastEthernet 0/0.0      Inbound             2699               17     0
FastEthernet 0/0.0      Inbound             2699               18     0
FastEthernet 0/0.0      Inbound             2699               19     0
FastEthernet 0/0.0      Inbound             2699               20     45057477
FastEthernet 0/1.0      Outgoing         Not Set         None Set     N/A
FastEthernet 0/1.0      Inbound             2698                1     0
FastEthernet 0/1.0      Inbound             2698                2     0
FastEthernet 0/1.0      Inbound             2698                3     0
FastEthernet 0/1.0      Inbound             2698                4     0
FastEthernet 0/1.0      Inbound             2698                5     0
FastEthernet 0/1.0      Inbound             2698                6     0
FastEthernet 0/1.0      Inbound             2698                7     0
FastEthernet 0/1.0      Inbound             2698                8     0
FastEthernet 0/1.0      Inbound             2698                9     0
FastEthernet 0/1.0      Inbound             2698               10     0
FastEthernet 0/1.0      Inbound             2698               11     0
FastEthernet 0/1.0      Inbound             2698               12     0
FastEthernet 0/1.0      Inbound             2698               13     0
FastEthernet 0/1.0      Inbound             2698               14     0
FastEthernet 0/1.0      Inbound             2698               15     0
FastEthernet 0/1.0      Inbound             2698               16     0
FastEthernet 0/1.0      Inbound             2698               17     0
FastEthernet 0/1.0      Inbound             2698               18     38772
FastEthernet 0/1.0      Inbound             2698               19     0
FastEthernet 0/1.0      Inbound             2698               20     304
Cable 1/0.0             Outgoing             171                1     0
Cable 1/0.0             Outgoing             171                2     0
Cable 1/0.0             Outgoing             171                3     0
Cable 1/0.0             Outgoing             171                4     0
Cable 1/0.0             Outgoing             171                5     0
Cable 1/0.0             Outgoing             171                6     1529
Cable 1/0.0             Outgoing             171                7     1482
Cable 1/0.0             Outgoing             171                8     186184
Cable 1/0.0             Inbound             2601         None Set     N/A
```

Example **(interface cable 1/0.0 matches)**

```
C3<config>#show access-lists interface cable 1/0.0 matches
```

```
Interface               Direction          Acl ID        Entry No.     Matches
```

```
Cable 1/0.0              Outgoing          Not Set      None Set      N/A
Cable 1/0.0              Inbound           Not Set      None Set      N/A
C3<config>#
```

Example **(interface fastethernet 0/0.0 matches)**

```
C3<config>#show access-lists interface cable 1/0.0 matches
```

```
Interface                Direction         Acl ID        Entry No.     Matches
Fastethernet 0/0.0       Outgoing          Not Set      None Set      N/A
Fastethernet 0/0.0       Inbound           Not Set      None Set      N/A
```

show bridge

Displays information from the bridge MIB.

Example:

```
C3#show bridge
```

```
        Bridge Address = 0000.ca3f.63ca
        Number of Ports = 3
        Bridge Type = transparent-only
        Learning Discards = 0
        Aging Time(seconds) = 15000

 = Bridge forwarding table =
-MAC Address-    -CMTS Port-          -Status- -Bridge Grp-  -VLAN Tags-
0000.92a7.adcc   FastEthernet 0/0.0   Learned   0            Untagged
0000.ca31.67d3   Cable 1/0.0          Learned   0            Untagged
0000.ca31.6bf9   Cable 1/0.0          Learned   0            Untagged
0000.ca3f.63ca   FastEthernet 0/0     Self      N/A          N/A
0000.ca3f.63cb  *FastEthernet 0/1     Self      N/A          N/A  *NON-OPER
0000.ca3f.63cc   Cable 1/0            Self      N/A          N/A
0001.5c20.4328   FastEthernet 0/0.0   Learned   0            Untagged
C3#
```

show bridge-group

Syntax **`show bridge-group [n]`**

Shows details of the specified bridge group, or all bridge groups if you specify no bridge group.

Example:

```
C3#show bridge-group 1
bridge-group #1: ATTACHED
        Cable 1/0.1
                VLAN-tag #42 (native)
        FastEthernet 0/1.1 - not bridging (no VLAN-tag configured)
        FastEthernet 0/0.1
                VLAN-tag #42

C3(config)#
C3(config)# bridge 1 bind cable 1/0.1 28 fastethernet 0/0.1 44
C3(config)# bridge 1 bind cable 1/0.1 19 fastethernet 0/0.1 83
C3(config)# bridge 1 bind cable 1/0.1 73 fastethernet 0/1.1 53
C3(config)#show bridge-group 1

bridge-group #1: ATTACHED
        Cable 1/0.1
                VLAN-tag #42 (native)
                VLAN-tag #19 bound to FastEthernet 0/0.1 VLAN-tag #83
                VLAN-tag #28 bound to FastEthernet 0/0.1 VLAN-tag #44
                VLAN-tag #73 bound to FastEthernet 0/1.1 VLAN-tag #53
        FastEthernet 0/1.1
                VLAN-tag #53 bound to Cable 1/0.1 VLAN-tag #73
        FastEthernet 0/0.1
                VLAN-tag #42
                VLAN-tag #44 bound to Cable 1/0.1 VLAN-tag #28
                VLAN-tag #83 bound to Cable 1/0.1 VLAN-tag #19
The following example shows a cable sub-interface with an IP address but as this
sub-interface has no encapsulation, specification is “not attached:.
C3(config)#ip routing
C3(config)#int cable 1/0.4
!NOTE: sub-interface config will not be applied
!  (and will not be displayed by the “show” commands)
!  until after interface-configuration mode has been exited

C3(config-subif)# ip address 10.99.87.1 255.255.255.0
C3(config-subif)# exit
```

```
C3(config)# show bridge-group

bridge-group #4: NOT ATTACHED
        Cable 1/0.4
                         10.99.87.1/24
C3(config)#
```

See also: *bridge-group*, page 10-181, *show bridge-group*, page 10-51, *encapsulation dot1q*, page 10-202.

show c:

Syntax **show c: [all | filesys]**

Displays a complete file listing or optional information about the filesystem on the Compact Flash disk. Use the **filesys** keyword to view the filesystem information; use **all** to display both the file listing and the information (information shown below is for illustrative purposes only. Actual displays will vary).

C3#show c:

```
Listing Directory C:/:
-rwxrwxrwx  1 0       0          6077442 Jan  5  1980 shutdownDebug.log
-rwxrwxrwx  1 0       0             8326 Jan  1  1980 autopsy.txt
-rwxrwxrwx  1 0       0            19099 Jan  5  1980 startup-temp
-rwxrwxrwx  1 0       0              996 Jan  1  1980 root.der
-rwxrwxrwx  1 0       0              914 Jan  1  1980 rootEuro.der
-rwxrwxrwx  1 0       0            42750 Jan  1  1980 cppImg3140.txt
-rwxrwxrwx  1 0       0            38543 Jan  1  1980 icfImg3138.txt
-rwxrwxrwx  1 0       0            73591 Jan  1  1980 icfImg3140.txt
-rwxrwxrwx  1 0       0            73492 Jan  1  1980 icfImg3140_old.txt
-rwxrwxrwx  1 0       0               40 Jan  1  1980 tzinfo.txt
-rwxrwxrwx  1 0       0            19213 Jan  1  1980 fp_uload.hex
-rwxrwxrwx  1 0       0             5421 Jan  1  1980 dfu_uload.hex
-rwxrwxrwx  1 0       0            19099 Jan  5  1980 startup-configuration
drwxrwxrwx  1 0       0             2048 Jan  1  1980 security/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ssh/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 CONFIG/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 SOFTWARE/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 licenses/
drwxrwxrwx  1 0       0             2048 Jan  4  1999 Syslog/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 tftpboot/
```

```
-rwxrwxrwx  1 0       0            20440 Jan  3  1980  4.1.0.1_startup-
configuration.bkup
-rwxrwxrwx  1 0       0         12718456 Jan  4  1980 4.1.0.15.bin
-rwxrwxrwx  1 0       0         12636587 Jan  8  1980 4.1.0.2.bin
-rwxrwxrwx  1 0       0         12642315 Jan  7  1980 4.1.0.3.bin
-rwxrwxrwx  1 0       0            23944 Jan  7  1980  4.1.0.2_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            21507 Jan 15  1980  4.1.0.3_startup-
onfiguration.bkup
-rwxrwxrwx  1 0       0            21588 Jan  2  1980  4.1.0.7_startup-
configuration.bkup
-rwxrwxrwx  1 0       0         12533267 Jan  5  1980  4.0.4.12.bin
-rwxrwxrwx  1 0       0            22897 Jan  5  1980  4.1.0.8_startup-
configuration.bkup
-rwxrwxrwx  1 0       0         12705720 Jan 13  1980 4.1.0.11.bin
-rwxrwxrwx  1 0       0            23923 Jan 13  1980 4.0.4.12_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            24557 Jan  4  1980 4.1.0.11_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19344 Jan  2  1980 4.1.0.15_startup-
configuration.bkup
-rwxrwxrwx  1 0       0         12529091 Jan  1  1980 4.0.4.8.bin
-rwxrwxrwx  1 0       0         12716424 Jan 17  1980 4.1.0.18.bin
-rwxrwxrwx  1 0       0            23886 Jan  1  1980  4.0.4.8_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            24342 Jan  1  1980 4.1.0.21_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            24530 Jan  1  1980 4.1.0.18_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            24530 Jan  1  1980 4.1.0.17_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            24342 Jan  1  1980 4.1.0.23_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            22662 Jan  1  1980 4.1.0.27_startup-
configuration.bkup
drwxrwxrwx  1 0       0             2048 Jan  1  1980 configuration_backups/
-rwxrwxrwx  1 0       0            25679 Jan  1  1999 1.0.0.12_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            20467 Jan  6  1999 1.0.0.19_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            22661 Jan 12  1980 4.2.0.2_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            22661 Jan 10  1980 4.2.0.3_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            22759 Jan  1  1980  4.2.0.5_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            22759 Jan  1  1980 4.1.0.31_startup-
configuration.bkup
```

```
-rwxrwxrwx  1 0       0            22661 Jan 11  1980 4.2.0.6_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            22661 Jan  1  1980  4.2.0.7_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19306 Jan  1  1980  4.2.0.9_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19306 Jan  1  1980 4.2.0.10_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19094 Jan  8  1999  4.3.0.1_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19307 Jan  2  1980 4.2.0.11_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19306 Jan  7  1980 4.2.0.15_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19087 Jan  5  1980 4.3.0.11_startup-
configuration.bkup
-rwxrwxrwx  1 0       0            19094 Jan  4  1980 4.3.0.27_startup-
configuration.bkup

Listing Directory C://security:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../

Listing Directory C://CONFIG:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../
drwxrwxrwx  1 0       0             2048 Jan  1  1980 DELETED/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 TEMP/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 CURRENT/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ALT/

Listing Directory C://CONFIG/DELETED:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../

Listing Directory C://CONFIG/TEMP:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../

Listing Directory C://CONFIG/CURRENT:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../
Listing Directory C://CONFIG/ALT:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../
```

```
Listing Directory C://SOFTWARE:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../
drwxrwxrwx  1 0       0             2048 Jan  1  1980 DELETED/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 TEMP/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 CURRENT/
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ALT/

Listing Directory C://SOFTWARE/DELETED:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../

Listing Directory C://SOFTWARE/TEMP:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../

Listing Directory C://SOFTWARE/CURRENT:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../

Listing Directory C://SOFTWARE/ALT:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ../

Listing Directory C://licenses:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../

Listing Directory C://Syslog:
drwxrwxrwx  1 0       0             2048 Jan  4  1999 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../
-rwxrwxrwx  1 0       0             8680 Jan  2  1980 nvlog.bin

Listing Directory C://tftpboot:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../

Listing Directory C://configuration_backups:
drwxrwxrwx  1 0       0             2048 Jan  1  1980 ./
drwxrwxrwx  1 0       0             2048 Jan  1 00:00 ../
-rwxrwxrwx  1 0       0            20608 Jan  1  1980 4.1.0.27_config.bkup
-rwxrwxrwx  1 0       0            25679 Jan  1  1999 1.0.0.12_config.bkup
-rwxrwxrwx  1 0       0            20467 Jan  6  1999 1.0.0.19_config.bkup
-rwxrwxrwx  1 0       0            19306 Jan  1  1980 4.2.0.10_config.bkup
-rwxrwxrwx  1 0       0            19094 Jan  8  1999 4.3.0.1_config.bkup
-rwxrwxrwx  1 0       0            19306 Jan  7  1980 4.2.0.15_config.bkup
-rwxrwxrwx  1 0       0            19344 Jan  2  1980 4.1.0.15_config.bkup
-rwxrwxrwx  1 0       0            19087 Jan  5  1980 4.3.0.11_config.bkup
```

```
-rwxrwxrwx  1 0       0            19194 Jan  2  1980 4.3.0.22_config.bkup
-rwxrwxrwx  1 0       0            19194 Jan  1  1980 4.3.0.23_config.bkup
-rwxrwxrwx  1 0       0            19094 Jan  4  1980 4.3.0.27_config.bkup
-rwxrwxrwx  1 0       0            19100 Jan  1  1980 4.3.0.26_config.bkup
-rwxrwxrwx  1 0       0            19097 Jan  5  1980 4.3.0.29_config.bkup
-rwxrwxrwx  1 0       0            19107 Jan  7  1980 4.3.0.31_config.bkup
-rwxrwxrwx  1 0       0            19099 Jan  5  1980 4.3.0.32_config.bkup
C3#
```

show cable actions

Displays the currently configured spectral management actions in tabular format.

show cable filter

Syntax

```
show cable filter [group gid] [verbose]
```

Lists filters configured on the selected cable modems. If you do not specify a group, the C3 shows all configured groups.

Keyword	Description
group	Specifies the group ID. Valid range is **1** to **30**.
verbose	Prints a more detailed listing

See also: *cable filter*, page 10-106,and related commands.

show cable flap-list

Syntax **`show cable flap-list [cable x/y | settings | sort-flap | sort-interface | sort-mac | sort-time | summary]`**

Displays the current contents of the flap list. The following options restrict or sort output:

Keyword	Description
sort-flap	Sorts by flap count (default)
settings	Lists the current flap list data accumulation settings. the columns in the report are: **Column** — **Description** *Flap aging time* — Aging time in dats of cable modem flap events *Flap insertion-time* — If a modem is online less than this time (seconds), the CMTS records the modem in the flap list *Power adjustment threshold* — The power level change that triggers a flap event for a modem *Flap list size* — Number of entries recorded in the flap list
sort-interface	Sorts by MAC address
sort-time	Sorts by time
cable x/y	Shows the flap list for a specified cable interface

Example:

```
Mac Addr       CableIF Ins   Hit   Miss  CRC   Flap  Time
0090.836b.452d C1/0/U0 1384  7     0     12    1385  NOV 25 18:26:29
00a0.7300.0012 C1/0/U4 711   5     0     0     711   NOV 25 22:08:56
00a0.7312.4bd8 C1/0/U4 449   100   23    0     621   NOV 25 22:19:01
00a0.7312.4be9 C1/0/U4 361   70    4     0     549   NOV 25 22:02:33
00a0.7312.4c7b C1/0/U4 307   91    0     0     522   NOV 24 06:14:14
00a0.7312.4c1f C1/0/U5 145   21    23    0     509   NOV 24 06:10:44
00a0.7388.9167 C1/0/U4 5     2284  1525  179   288   NOV 25 22:20:22
00a0.7316.6a2e C1/0/U5 180   0     0     0     180   NOV 23 01:56:34
00a0.7311.43fe C1/0/U4 124   48    0     0     124   NOV 23 01:44:11
00a0.73ad.3827 C1/0/U2 5     21179 1354  0     43    NOV 23 15:25:35
00a0.7314.2ecc C1/0/U4 0     26546 27    0     29    NOV 25 18:48:12
```

```
C3#show cable flap-list summary

show cable flap-list: print per/upstream summary

CableIF Ins       Hit       Miss      CRC       Flap
C1/0/U0 597       22605     3320      16        1029
C1/0/U2 5         111       87        3         13
C1/0/U3 46        77        160       0         56
C1/0/U4 16        0         0         0         16
C1/0/U5 94        86        238       14        130
```

```
C3#show cable flap-settings

Flap      Flap      Range     Power     Flap
Aging     Insertion Miss      Adjust    List
Time      Time      Threshold Threshold Size
10        180       6         3         500
```

show cable frequency-band

Syntax

`show cable frequency-band [index]`

Displays the specified frequency group, or all frequency groups if no frequency group is specified.

See also: *cable frequency-band*, page 10-111.

show cable group

Syntax

`show cable group [n]`

Displays the selected cable group and its load balancing configuration. Specify no option to display all configured cable groups.

show cable host

Syntax

```
show cable host {ipaddr | macaddr}
```

Displays all CPE devices connected to the cable modem, specified by IP address or MAC address. Host IP address only returned if subscriber management is turned on. The information is returned using the C3 knowledge of active CPE behind the specified modem and not by using an SNMP query on the modem. The parameters are:

Keyword	Description
ipaddr	IP address of modem to view
macaddr	MAC address of modem to view

See also: *show interface cable 1/0 modem*, page 10-80, and *cable submgmt*, page 10-123.

show cable modem

Syntax

```
show cable modem [ipaddr | macaddr | cable 1/0
[upstream n]] [ detail | offenders | registered |
summary | unregistered | columns cols|snr] [count]
[verbose]
```

Displays information about the specified cable modem, or all registered cable modems if no modem is specified. The options are:

cable 1/0 View all modems on the cable interface (options limited to **registered** and **unregistered**).

cable 1/0 upstream [n] View all modems on the specified upstream (options limited to **registered** and **unregistered**). Valid range: **0** to **5**.

detail Displays information including the interface that the modem is acquired to, the SID, MAC, concatenation status, and the received signal-to-noise ratio.

ipaddr Optional IP address of modem to view.

macaddr Optional MAC address of modem to view.

offenders Displays modems that have had spoofing attempts detected and dropped by the **cable source-verify** feature (the Offenders column), and packets throttled by the throttling feature (Broadcast throttled and IP throttled columns).

registered Displays registered modems (**online** or **online(pt)**) and does not display the earlier states. All states are displayed by **show cable modem** without any modifiers.

summary Displays the total number of modems, the number of active modems, and the number of modems that have completed registration.

unregistered Displays modems which have ranged but not yet registered (including offline modems).

count Specify a maximum number of cable modems to display.

verbose Provide additional information.

columns Show selected columns (one or more, separated by spaces) from the following list. Allows customizing of output.

Column Name	Description
CORRECTED-FEC	Corrected FEC Codewords
CPE	CPE information
GOOD-FEC	Good FEC Codewords
INTERFACE	Interface
IP	IP address
MAC	MAC address
PROV-MODE	Provisioned mode
REC-PWR	Receive Power
REG-TYPE	Registration Type
SID	Prim
SNR	Signal to Noise Ratio
STATUS	Status
TIMING	Timing offset
UNCORRECTED-FEC	Uncorrected FEC Codewords
UP-MOD	Upstream Modulation
VLAN-BGROUP	VLAN ID

See also: *show interface cable 1/0 modem*, page 10-80.

Example (**detail**):

```
C3#show cable modem detail

MAC Address                   : 00a0.731e.3f84
IP Address                    : 10.99.88.100
Primary SID                   : 1
Interface                     : C1/0/U1
Timing Offset                 : 3167
Received Power               : -4.7 dBmV (SNR = 66.3 dBmV)
Provisioned Mode              : D1.0
Registration Type             : D1.0
Upstream Modulation           : TDMA
Ranging/Registration          : online - BPI not enabled
Total good FEC CW             : 377
Total corrected FEC           : 0
Total uncorrectable FEC       : 0
```

Example (**registered**):

```
C3#show cable modem registered
```

```
I/F        Prim Online    Timing Rec    CPE   IP address       MAC address    DOC
           SID  state     offset power
C1/0/U1.1 5    online(pt)2378   5.0    0/16  10.250.2.131    0000.ca3e.6c23 D2.0S
C1/0/U0.1 6    online    197    5.0    0/16  10.250.1.18     0000.ca3e.6c29 D2.0A
C1/0/U1.1 7    online(pt)5345   5.2    0/16  10.250.2.176    0000.ca3e.6c35 D2.0S
```

```
C1/0/U0.0 8    online    2845   4.8   0/1   10.250.2.9      00a0.7387.2bcd D1.0
```

The **show cable modem registered** command reports one of the following states for each modem:

State	Meaning
Offline	The cable modem is inactive.
init(r1)	The C3 has successfully received a ranging request from the modem in a contention interval (i.e., initial ranging)
init(r2)	The CMTS has responded to an initial ranging request from the modem, but has not yet completed ranging (i.e., the modem's transmit parameters are still outside of the acceptable range as defined by the CMTS).
init(rc)	The cable modem has successfully adjusted its transmit power and timing so that initial ranging has completed successfully.
init(d)	The cable modem has sent a DHCP request.
init(i)	The CMTS has relayed a DHCP response to the modem, but the modem has not yet acknowledged the new address to the DHCP server.
init(o)	The modem is ready to or is currently TFTP'ing the configuration file.
init(t)	modem ready for ToD
Online	The modem has successfully completed registration.
Online(d)	online, network access disabled
Online(pt)	The modem is online and BPI is enabled. The modem has a valid traffic encryption key (TEK).
Online(pk)	The modem is online, BPI is enabled, and a key encryption key (KEK) is assigned.
reject(m)	The CMTS rejected the registration request from the modem because the shared secret from the modem does not match the CMTS shared secret.
reject(c)	The class of service offered by the modem as part of the registration request was not valid.
reject(pk)	The Key Encryption Key (KEK) offered by the modem was invalid.
reject(pt)	The Traffic Encryption Key (TEK) offered by the modem was invalid.

Example (**summary**):

```
C3#show cable modem summary
```

```
Interface  Total Offline Unregistered Rejected Registered

Cable1/0/U0 1    0       0            0        1
Cable1/0/U1 0    0       0            0        0
Cable1/0    1    0       0            0        1

C3#
```

Example (**summary verbose**):

```
C3#show cable modem sum verbose
```

```
Interface  Total Offline Ranging     Ranging       IP         Rejected Registered
                                 Aborted|Completed Completed
Cable1/0/U0 1    0       0       0       0         0         0        1
Cable1/0/U1 0    0       0       0       0         0         0        0
Cable1/0    1    0       0       0       0         0         0        1

C3#
```

Example (**columns**):

```
C3#show cable modem columns IP MAC VLAN
IP address      MAC address    Vlan
                               ID
0.0.0.0         00a0.73ae.ec13 3
0.0.0.0         00a0.7374.b99e 4
C3#
```

show cable modulation-profile

Syntax

`show cable modulation-profile [advphy | n [type] [verbose]]`

Displays information about the specified modulation profile, or all profiles if none is specified. The parameters are:

Keyword	Description
advphy	Shows TDMA and SCDMA parameters for each modulation profile and IUC type
n	The modulation profile to display. Valid range is **1** to **10**
type	The IUC type; one of **advphy, advphyl, advphys, advphyu, initial, long, reqdata, request, short, station**
verbose	Shows the profile parameters in a list format. The default is to show parameters in a table format with abbreviated parameter names

Example (showing the factory default profile):

`C3#show cable modulation-profile 1`

```
Mod IUC     Type Preamb Diff FEC    FEC   Scrambl Max  Guard Last Scrambl
                 length enco T      CW    Seed    B    time  CW
                             BYTES  SIZE          size size  short
1   request qpsk  64    no   0x0    0x10  0x152   0    8     no   yes
1   initial qpsk  640   no   0x5    0x22  0x152   0    48    no   yes
1   station qpsk  384   no   0x5    0x22  0x152   0    48    no   yes
1   short   qpsk  84    no   0x6    0x4e  0x152   13   8     no   yes
1   long    qpsk  96    no   0x8    0xdc  0x152   0    8     no   yes
1   advPhyS 64qam 104   no   0xc    0x4b  0x152   6    8     no   yes
1   advPhyL 64qam 104   no   0x10   0xdc  0x152   0    8     no   yes
C3#
```

show cable service-class

Syntax **`show cable service-class [verbose]`**

Displays defined service classes. Use the **verbose** keyword to see a more detailed listing.

Example:

```
c3#show cable service-class
Name             State Dir Sched Prio MaxSusRate MaxBurst   MinRsvRate
Multicast        Act   DS  BE    0    0          0          0
```

show cable triggers

Displays the currently configured spectral management triggers in tabular format.

show cli

Displays CLI information.

show cli accounts

Shows login and password strings.

Example:

```
C3#show cli accounts
Login name          : arris
Login password      : arris
Enable password     : arris
Enable secret       :
---------------------
C3#
```

show cli logging

Syntax

```
show cli logging [session n]
```

Shows global logging information. Specify a user session (**0** to **4**) to display logging information for only one session; no specification displays the global logging parameters.

Example:

```
C3#show cli logging
```

```
CLI command logging is: disabled
        logging of passwords is: disabled
        File path for password logging: /

        Max file size: 1024 Kilobytes
C3#
```

show configuration

See *show running-configuration*, page 10-96.

show controllers

Syntax

one of:

show controllers cable {x/y} [upstream n.c | downstream]

show controllers fastethernet {x/y}

show controllers loopback {number}

Displays information about the specified interface (or all interfaces if none are specified).

Examples:

C3# show controllers cable 1/0

```
Cable1/0 downstream
      Frequency 123.0 MHz,Channel-Width 6.0 MHz,Modulation
64-QAM
        Power 60.0 dBmV, R/S Interleave I=32, J=4, Symbol
Rate 5056941 MSym/sec
        Downstream channel ID: 1
        Dynamic Services Stats:
                DSA: 0  REQs  0 RSPs  0 ACKs
                0 Successful DSAs  0 DSA Failures
                DSC: 0  REQs  0 RSPs  0 ACKs
                0 Successful DSCs  0 DSC Failures
                DSD: 0  REQs  0 RSPs
                0 Successful DSDs  0 DSD Failures

                DCC: 0  REQs  0 RSPs  0 ACKs
                0 Successful DCCs  0 DCC Failures

Cable1/0 Upstream 0.0
        Frequency 10.0 MHz,Channel-Width 3.200000 MHz
        Channel-type: ATDMA
        SNR 48.1 dB, MER 0.0 dB
        Nominal input power-level -4.0 dBmV(fixed), Tx
Timing offset 1821
       Ranging Insert Interval(ms) Set(   0)   Actual(Nom
1280, Min 40)
       Ranging backoff           Set(16,16)  Actual( 0, 3)
       Data backoff              Set(16,16)  Actual( 6, 9)
        Modulation Profile Group 42
        Ingress-cancellation is disabled
        Minislot Size in number of Timebase Ticks is = 4
        Upstream channel ID: 1

...

Cable1/0 Upstream 1.1
        Frequency 15.0 MHz,Channel-Width 3.200000 MHz
        Channel-type: TDMA
        SNR 50.0 dB, MER 0.0 dB
        Nominal input power-level -4.0 dBmV(fixed), Tx
Timing offset 0
       Ranging Insert Interval(ms) Set    0     Actual(Nom
-, Min -)
       Ranging backoff           Set(16,16)  Actual( -, -)
       Data backoff              Set(16,16)  Actual( -, -)
        Modulation Profile Group 6
        Ingress-cancellation is disabled
        Minislot Size in number of Timebase Ticks is = 4
        Upstream channel ID: 8
        Dynamic Services Stats:
                DSA: 0  REQs  0 RSPs  0 ACKs
                0 Successful DSAs  0 DSA Failures
                DSC: 0  REQs  0 RSPs  0 ACKs
                0 Successful DSCs  0 DSC Failures
                DSD: 0  REQs  0 RSPs
                0 Successful DSDs  0 DSD Failures

                DCC: 0  REQs  0 RSPs  0 ACKs
                0 Successful DCCs  0 DCC Failures
C3#
```

Example:

```
C3#show controllers fastethernet 0/0

Interface FastEthernet0/0
Hardware is ethernet
        tx_carrier_loss/tx_no_carrier=0
        tx_late_collision=0, tx_excess_coll=0
        tx_collision_cnt=0, tx_deferred=0
C3#
```

show debug

Shows the current debug state. The output of this command shows four tables:

Mac Addresses enabled for Debug: — Lists the MAC addresses, MAC address masks, and debug verbosity levels of all cable modems that were specified by MAC address (e.g. **debug cable mac-address 00a0.7300.0000 ffff.0000.0000 verbose**, etc).

The table is sorted by MAC address, and shows the latest verbosity level and MAC address mask associated with the MAC address. Thus, if two or more commands are entered with the same MAC address (but differing MAC address masks or verbosity levels), only the latest setting is displayed.

The list may include CM MAC addresses which are not yet online or are completely unknown to the CMTS.

A single command may enable many cable modems for debugging using the MAC address mask, but would display only one entry in the table.

This table is displayed in a form resembling a debug command to allow a user to cut and paste from the table to disable debugging on a cable modem with the specified MAC address/MAC address mask.

Primary SIDs enabled for Debug: — Lists the Primary SIDs and debug verbosity levels of all cable modems that were specified by Primary SID (e.g. **debug cable sid 123 verbose**, etc).

This table is displayed in a form resembling a debug command to allow a user to cut and paste from the table to disable debugging on a cable modem with the specified primary SID.

Debugging events/message types which are enabled: — Lists all events or message types which are enabled for debug (e.g. **debug cable range**, etc).

This table is displayed in a form resembling a debug command to allow a user to cut and paste from the table to disable debugging for a particular event or message type.

Contents of Cable Modem Database debug level: — Lists the interface, primary SID (if assigned), MAC address, and debug verbosity level of all cable modems that the CMTS knows about. The table shows which current cable modems (i.e. cable modems known to the CMTS) are selected for debugging.

Example:

```
C3#show debug

Mac Addresses enabled for Debug:
debug cable mac-address 00a0.731e.3f84 ffff.ffff.ffff

Primary Sids enabled for Debug:
```

Example:

Debugging events/message types which are enabled:

```
debug cable dhcp-relay

Contents of Cable Modem Database debuglevel:
I/F     PrimSid   MAC address     Debug
C1/0/U0 1         00a0.731e.3f84  Terse
C3#
```

show environment

Displays the current chassis power supply information, fan status, and temperature readings.

Example:

```
C3#show environment

Front Panel Display : attached
        HW rev = 2, SW rev= 7

==Power supply status==
        PSU1 : off
        PSU2 : on

==Temperature status==
        CPU1 : 34.0 degrees
        CPU2 : 32.0 degrees
        Kanga1 : 36.0 degrees
        Kanga2 : 36.0 degrees
```

```
==Fan status==
        Fan upper limit 12
        Fan lower limit 2
        Fan 1 : rotating
        Fan 2 : rotating
        Fan 3 : rotating
        Fan 4 : rotating
        Fan 5 : rotating
        Fan 6 : rotating

==LCD status==
        Contrast = 1024
        Msg 1 =   Cadant C3
        Msg 2 =  CMTS  VER:
        Msg 3 = 4.2.0.18  T
        Msg 4 = IME:17:12:2
        Msg 5 = 4  MG IP:10
        Msg 6 = .44.116.3
        Msg 7 = CMS T:008 A
        Msg 8 = :007 R:005
        Msg 9 =  DS:117.0Mh
        Msg 10 = z
C3#
```

show file

Syntax

`show file {descriptors |  systems}`

Lists detailed internal information about file usage, depending on the keyword used. The parameters are:

Keyword	Description
descriptors	Lists all open file descriptors
systems	Lists file systems and information about them

Example:

C3#show file descriptors

```
 fd name                 drv
  3 /tyCo/1                1 in out err
  4 (socket)               4
  5 (socket)               4
  6 (socket)               4
  7 C:/autopsy.txt         3
  8 /snmpd.log             3
  9 (socket)               4
 10 (socket)               4
 11 /pty/cli0.M            9
 12 /pty/cli1.M            9
 13 /pty/cli2.M            9
 14 /pty/cli3.M            9
 15 /pty/cli4.M            9
 16 /pty/cli0.S            8
 17 /pty/cli1.S            8
 18 /pty/cli2.S            8
 19 /pty/cli3.S            8
 20 /pty/cli4.S            8
 21 (socket)               4
 22 (socket)               4
C3#
```

Example:

```
C3#show file systems

drv name
  0 /null
  1 /tyCo/1
  3 C:
  5 Phoenix1:
  7 /vio
  8 /pty/cli0.S
  9 /pty/cli0.M
  8 /pty/cli1.S
  9 /pty/cli1.M
  8 /pty/cli2.S
  9 /pty/cli2.M
  8 /pty/cli3.S
  9 /pty/cli3.M
  8 /pty/cli4.S
  9 /pty/cli4.M
C3#
```

show flash:

Syntax

`show flash: [all | filesys]`

Displays detailed information about the Compact Flash disk, depending on the option used. If no option is specified, this command will display files and directories only (identical to the show c: command). Valid options are:

Keyword	Description
all	Displays all files, directories and filesystem detail
filesys	Displays only filesystem detail

Example:

```
C3#show flash: filesys

==== File system information ====

volume descriptor ptr (pVolDesc):       0x89ecf4f0
cache block I/O descriptor ptr (pCbio): 0x89ecf7dc
auto disk check on mount:               DOS_CHK_REPAIR | DOS_CHK_VERB_SILENT
max # of simultaneously open files:     22
file descriptors in use:                2
# of different files in use:            2
# of descriptors for deleted files:     0
# of  obsolete descriptors:             0

current volume configuration:
 - volume label:        NO NAME ; (in boot sector:      NO NAME    )
 - volume Id:           0x163317f2
 - total number of sectors:     250,592
 - bytes per sector:            512
 - # of sectors per cluster:    4
 - # of reserved sectors:       1
 - FAT entry size:              FAT16
 - # of sectors per FAT copy:   245
 - # of FAT table copies:       2
 - # of hidden sectors:         32
 - first cluster is in sector # 523
 - directory structure:         VFAT
 - root dir start sector:       491
 - # of sectors per root:       32
 - max # of entries in root:    512
```

```
FAT handler information:
------------------------
 - allocation group size:       7 clusters
 - free space on volume:        127,891,456 bytes
C3#
```

show interfaces

Syntax

`show interfaces [cable X/Y] | [fastethernet X/Y] | [stats]`

Displays statistics for the specified interface (or all interfaces if none is specified).

Keyword	Description
cable x/y	Specify the cable interface
fastethernet x/y	Specify the fast ethernet interface
loopback	Specify the loopback
stats	Displays interface packets and character in/out statistics

Traffic statistics consists of total input and output packets and bytes, and dropped packets. The "drops" counters are taken directly from the **ifTable** MIB row appropriate to the interface; input drops from **ifInDiscards** and output drops from **ifOutDiscards**.

See also: *show cable modem*, page 10-59.

Example:

```
C3#show interfaces

FastEthernet0/0 is up, line protocol is up
        Hardware is ethernet, address is 0000.caab.5612
        Description: ETH WAN - Cadant C3 CMTS - BCM5421 Rev A1
        Alias:
        Primary Internet Address 10.41.36.2/25
        Outgoing access-list is not set
        Inbound access-list is not set
        Direct Subnet Broadcast Propagation disabled
        Layer-II Bridge To Bridge/Routing-subIf  Routing disabled
        Src Ip Directly Connected NW filter disabled
        Src Ip SubIf Directly Connected NW filter disabled
        Valid Ip Address filter enabled
        Incoming non-IP/ARP packets allowed
        MTU 1500 bytes, BW 100000 Kbit
        Full-duplex, 100Mb/s
        Output queue 0 drops; input queue 226 drops
        5 minutes input rate 1114 bits/sec, 1 packets/sec
        5 minutes output rate 1839 bits/sec, 1 packets/sec
                1522 packets input, 214371 bytes
                Received 0 broadcasts  226 multicasts, 0 giants
                0 input errors, 0 CRC, 0 frame
                1735 packets output, 351712 bytes
                0 output errors, 0 collisions
                0 excessive collisions
                0 late collision, 0 deferred
                0 lost/no carrier

FastEthernet0/1 is up, line protocol is up
        Hardware is ethernet, address is 0000.caab.5613
        Description: ETH MGT - Cadant C3 CMTS - BCM5421 Rev A1
        Alias:
        Primary Internet Address 10.44.116.3/29
        Outgoing access-list is not set
        Inbound access-list is not set
        Direct Subnet Broadcast Propagation disabled
        Layer-II Bridge To Bridge/Routing-subIf  Routing disabled
        Src Ip Directly Connected NW filter disabled
        Src Ip SubIf Directly Connected NW filter disabled
        Valid Ip Address filter enabled
        Incoming non-IP/ARP packets allowed
        MTU 1500 bytes, BW 100000 Kbit
        Full-duplex, 100Mb/s
        Output queue 0 drops; input queue 628 drops
        5 minutes input rate 325 bits/sec, 0 packets/sec
        5 minutes output rate 0 bits/sec, 0 packets/sec
                628 packets input, 43762 bytes
                Received 0 broadcasts  628 multicasts, 0 giants
                0 input errors, 0 CRC, 0 frame
                1 packets output, 64 bytes
                0 output errors, 0 collisions
                0 excessive collisions
                0 late collision, 0 deferred
                0 lost/no carrier
```

```
Cable1/0 is up, line protocol is up
        Hardware is BCM3214(A3), address is 0000.caab.5614
        Description: DS 1 - Cadant C3 CMTS - BCM3040 Rev A0
        Primary Internet Address 10.21.36.1/25
        Secondary Internet Address #1 is 10.21.36.129/25
        Outgoing access-list is not set
        Inbound access-list is not set
        IP Throttling access-list is not set
        Direct Subnet Broadcast Propagation disabled
        Layer-II Bridge To Bridge/Routing-subIf  Routing disabled
        Src Ip Directly Connected NW filter disabled
        Src Ip SubIf Directly Connected NW filter disabled
        Valid Ip Address filter enabled
        Incoming non-IP/ARP packets allowed
        cable source-verify disabled
        ARP broadcast echo enabled
        L2 broadcast echo enabled
        L2 multicast echo enabled
        IP broadcast echo enabled
        IP multicast echo enabled
        L2 broadcast throttle enabled
        Downstream DHCP Server not allowed
        Throttle credits: initial 15, running 2
        Dhcp Relay enabled
        Dhcp Relay information option enabled
        Relaying non broadcast Dhcp packets
        Not adding information option to relayed non broadcast packets
        Dhcp Relay Agent not validating Dhcp Renew destination IP
        Dhcp Relay giaddr policy
        DEFAULT helper address 10.43.211.248
        Broadcast throttled 1 drops, IP throttled 0 drops
        Cable Source Verify - 0 verification attempts, 0 denied
        (0 DHCP LeaseQueries transmitted)
        MTU 1764 bytes, BW 30341 Kbit
        Downstream utilization 3%
        Upstream Avg. utilization 0%
        Output queue 0 drops; input queue 4 drops
        5 minutes input rate 728 bits/sec, 0 packets/sec
        5 minutes output rate 618 bits/sec, 0 packets/sec
                802 packets input, 175160 bytes
                Received 391 broadcasts  0 multicasts
                0 input errors
                582 packets output, 145671 bytes
                0 output errors
C3#
```

Example (**stats**):

C3#show interfaces stats

```
FastEthernet0/0
Switching path          Pkts In    Chars In   Pkts Out
Chars Out
Processor              4129      899510     4         579
Total                  4129      899510     4         579
FastEthernet0/1
Switching path          Pkts In    Chars In   Pkts Out
Chars Out
Processor               0          0          0          0
Total                   0          0          0          0
Cable1/0
Switching path          Pkts In    Chars In   Pkts Out
Chars Out
Processor               0          0          0          0
Total                   0          0          0          0
C3#
```

show interface cable

Syntax **show interface cable 1/0 [option]**

Displays detailed information about a specific cable interface. Each option is described in detail below. Specifying no option shows a summary of interface statistics.

Example:

```
C3#show interface cable 1/0
Cable1/0 is up, line protocol is up
        Hardware is BCM3212(B1), address is 0000.ca3f.63cc
        Description: DS 1 - Cadant C3 CMTS - BCM3034 Rev A1
        Alias:
        Bridge Group 0
        Primary Internet Address 10.17.43.10/24
        Outgoing access-list is not set
        Inbound access-list is not set
        IP Throttling access-list is not set
        Direct Subnet Broadcast Propagation disabled
        Layer-II Bridge To Bridge/Routing-subIf  Routing disabled
        Src Ip Directly Connected NW filter disabled
        Src Ip SubIf Directly Connected NW filter disabled
        Valid Ip Address filter enabled
        Incoming non-IP/ARP packets allowed
        cable source-verify disabled
        ARP broadcast echo enabled
        L2 broadcast echo enabled
        L2 multicast echo enabled
        IP broadcast echo enabled
        IP multicast echo enabled
        L2 broadcast throttle disabled
        Throttle credits: initial 15, running 2
        Dhcp Relay enabled
        Dhcp Relay information option enabled
        Relaying non broadcast Dhcp packets
        Dhcp Relay Agent not validating Dhcp Renew destination IP
        Dhcp Relay giaddr policy
        DEFAULT helper address 10.17.42.10
        Broadcast throttled 0 drops, IP throttled 0 drops
        Cable Source Verify - 0 verification attempts, 0 denied
        (0 DHCP LeaseQueries transmitted)
        MTU 1764 bytes, BW 30341 Kbit
        Downstream utilization 0%
        Upstream Avg. utilization 0%
        Output queue 0 drops; input queue 3 drops
        5 minutes input rate 56 bits/sec, 0 packets/sec
        5 minutes output rate 209344 bits/sec, 0 packets/sec
                1007 packets input, 77922 bytes
                Received 10 broadcasts
                0 input errors
                330487 packets output, 21903492 bytes
                0 output errors
C3#
```

show interface cable 1/0 classifiers

Syntax

```
show interface cable 1/0 classifiers [classid]
[verbose]
```

Displays all packet classifiers for the cable interface, or detailed information about a single classifier.

show interface cable 1/0 downstream

Displays downstream statistics for the cable interface.

Example:

```
C3#show interfaces cable 1/0 downstream


Cable1/0: downstream is up
       3125636 packets output, 190771028 bytes, 0 discards
        0 output errors
        0 total active devices, 0 active modems
C3#
```

show interface cable 1/0 modem

Syntax

```
show interface cable 1/0 modem {sid}
```

Displays the network settings for the cable modem with the specified SID. Use SID **0** to list all SIDs.

Example:

```
C3(config-if)#show interfaces cable 1/0 modem 0
SID   Priv bits  Type      State   IP address       method    MAC address
1038  0          modem     up      10.16.246.225    dhcp      0000.ca24.482b
```

```
1192  0          modem     up      10.16.246.126    dhcp      0000.ca24.4a83
1124  0          modem     up      10.16.246.189    dhcp      0000.ca24.43e7
1064  0          modem     up      10.16.246.188    dhcp      0000.ca24.4670
1042  0          modem     up      10.16.246.120    dhcp      0000.ca24.456d
8238  00         multicast unknown 230.1.2.3        static    0000.0000.0000
```

show interface cable 1/0 privacy

Syntax

show interface cable 1/0 privacy [kek | tek]

Displays privacy parameters.

Example:

```
C3#show interfaces cable 1/0 privacy

        Configured KEK lifetime value = 604800
        Configured TEK lifetime value = 43200
        Accept self signed certificates: yes
        Check certificate validity periods: no
        Auth Info messages received: 0
        Auth Requests received: 0
        Auth Replies sent: 0
        Auth Rejects sent: 0
        Auth Invalids sent: 0
        SA Map Requests received: 0
        SA Map Replies sent: 0
        SA Map Rejects sent: 0
```

Example:

```
C3#show interface cable 1/0 privacy kek

Configured KEK lifetime value = 604800
```

Example:

```
C3#show interface cable 1/0 privacy tek
```

```
Configured TEK lifetime value = 43200
```

show interface cable 1/0 qos paramset

Syntax

`show interface cable 1/0 qos paramset [sfid] [verbose]`

Displays QoS parameters for the cable interface, or the specified service flow ID. The **verbose** option provides a more detailed listing.

Example:

```
C3#show interface cable 1/0 qos paramset
Sfid  Type  Name             Dir Sched Prio MaxSusRate MaxBurst   MinRsvRate
1     Act                    US  BE    1    1000000    3044       0
1     Adm                    US  BE    1    1000000    3044       0
1     Prov                   US  BE    1    1000000    3044       0
32769 Act                    DS  UNK   0    5000000    3044       0
32769 Adm                    DS  UNK   0    5000000    3044       0
32769 Prov                   DS  UNK   0    5000000    3044       0
C3#
```

show interface cable 1/0 service-flow

Syntax

```
show interface cable 1/0 service-flow [sfid]
[classifiers | counters | qos] [verbose]
```

Displays service flow statistics for the cable interface. The options are:

Keyword	Description
sfid	Displays statistics for the specified Service Flow ID, or all Service Flows if none is specified
classifiers	Displays information about CfrId, Sfid, cable modem MAC address, Direction, State, Priority, Matches
counters	Displays service flow counters. Counters are Packets, Bytes, PacketDrops, Bits/Sec, Packets/Sec. The **verbose** option is not available for counters
qos	Displays statistics for all Service FLow IDs: Sfid, Dir, CurrState, Sid, SchedType, Prio, MaxSusRate, MaxBrst, MinRsvRate, Throughput
verbose	Displays selected statistics in more detail

Example:

```
C3#show interface cable 1/0 service-flow

Sfid  Sid   Mac Address     Type    Dir    Curr   Active
                                           State  Time
1     1     0000.ca31.3ed0  prim    US     Active 1h53m
32769 N/A   0000.ca31.3ed0  prim    DS     Active 1h53m
C3#
```

show interface cable 1/0 sid

Syntax

`show interface cable 1/0 sid [connectivity | counters | sid]`

Displays Service Flow information for all SIDs or optionally for a single SID. The options are:

Keyword	Description
sid	Displays Service Flow information for the specified SID. The default is to show all configured SIDs
counters	Displays information about Sid, PacketsReceived, FragComplete, ConcatpktReceived
connectivity	Displays information about Sid, Prim Mac Address, IP Address, Type, Age, AdminState, SchedType, Sfid

show interface cable 1/0 signal-quality

Syntax

`show interface cable 1/0 signal-quality [port]`

Displays signal quality for the specified upstream port (range **0** to **5**), or all ports if no port specified.

Example:

```
C3#show interface cable1/0 signal-quality

Cable1/0: Upstream 0 is up includes contention intervals: TRUE
Cable1/0: Upstream 1 is up includes contention intervals: TRUE
C3#
```

show interface cable 1/0 stats

Displays interface statistics.

Example:

```
C3#show interface cable1/0 stats

Cable1/0
Switching path          Pkts In    Chars In   Pkts Out   Chars Out
Processor               1118       60760      764        1060272851
Total                   1118       60760      764        1060272851
C3#
```

show interface cable 1/0 upstream

Syntax **`show interface cable 1/0 upstream [port[.logchan]`**

Displays upstream information for all ports and logical channels, or the specified port or logical channel.

Valid range: **0** to **5**.

Example:

```
C3#show interface cable1/0 upstream
Cable1/0: Upstream 0.0 is up, line protocol is up
        Description: US CH 1/0 - Cadant C3 CMTS - BCM3140 Rev A1
        Utilization 20%
        Modem throughput during last utilisation interval of 10 sec
                Lightest load 100.00% of Max-traffic-rate above Min-rsvd-rate
                Average load  100.00% of Max-traffic-rate above Min-rsvd-rate
                Heaviest load 100.00% of Max-traffic-rate above Min-rsvd-rate
        5 minutes Minislots for BE          00.00%
        5 minutes Minislots for NrtPS       00.00%
        5 minutes Minislots for RtPS        00.00%
        5 minutes Minislots for UGS_AD      00.00%
        5 minutes Minislots for UGS         19.99%
        5 minutes Minislots used            19.99%
        1 sec Voice minislots         0.00%
        5 minutes input rate 260 bits/sec, 0 packets/sec
        5 minutes output rate 0 bits/sec, 0 packets/sec
        355296 packets input, 1968 broadcasts, 0 multicasts, 353328 unicasts
        0 discards, 3 errors, 0 unknown protocol
        365125 FEC blocks input, 4 uncorrectable, 0 corrected, 365121 good
        0 microreflections
        Total Modems On This Upstream Channel : 1 (1 active)

Cable1/0: Upstream 1.0 is up, line protocol is up
        Description: US CH 2/0 - Cadant C3 CMTS - BCM3140 Rev A1
        Utilization 0%
        Modem throughput during last utilisation interval of 10 sec
                Lightest load 100.00% of Max-traffic-rate above Min-rsvd-rate
                Average load  100.00% of Max-traffic-rate above Min-rsvd-rate
                Heaviest load 100.00% of Max-traffic-rate above Min-rsvd-rate
        5 minutes Minislots for BE          00.00%
        5 minutes Minislots for NrtPS       00.00%
        5 minutes Minislots for RtPS        00.00%
        5 minutes Minislots for UGS_AD      00.00%
        5 minutes Minislots for UGS         00.00%
        5 minutes Minislots used            00.00%
        1 sec Voice minislots         0.00%
        5 minutes input rate 182 bits/sec, 0 packets/sec
        5 minutes output rate 0 bits/sec, 0 packets/sec
        182019 packets input, 12304 broadcasts, 0 multicasts, 169715 unicasts
        0 discards, 333 errors, 0 unknown protocol
        178976 FEC blocks input, 15 uncorrectable, 7 corrected, 178954 good
        0 microreflections
        Total Modems On This Upstream Channel : 1 (1 active)
C3#
```

show interface fastethernet X/Y [stats]

Syntax **show interface fastethernet X/Y [stats]**

Displays detailed information about a specific Ethernet interface. Specifying no option shows detailed interface statistics:

Example:

```
C3#show interface fastethernet 0/0

FastEthernet0/0 is up, line protocol is up
```

```
        Hardware is ethernet, address is 0000.ca3f.63cd
        Description: ETH WAN - Cadant C3 CMTS - Broadcom
5421 Rev A1
        Alias:
        Primary Internet Address 10.1.12.45/25
        Outgoing access-list is not set
        Inbound  access-list is not set
        MTU 1500 bytes, BW 100000 Kbit
        Half-duplex, 100Mb/s
        Output queue 0 drops; input queue 0 drops
                23138 packets input, 6456298 bytes
                Received 10545 broadcasts, 0 giants
                10 input errors, 10 CRC, 9 frame
                3395 packets output, 296344 bytes
                0 output errors, 0 collisions
                0 excessive collisions
                0 late collision, 0 deferred
                0 lost/no carrier
C3#
```

Example:

```
C3#show interface fastethernet0/0 stats

Fastethernet0/0
Switching path     Pkts In   Chars In   Pkts Out   Chars Out
Processor             9883     1251544     7991       537952
Total                 9883     1251544     7991       537952
C3#
```

show ip protocols ospf

Displays the list of networks, and the associated interfaces, configured in the OSPF routing database.

show ip ospf

Displays a summary of the current OSPF configuration (including the areas configured).

Example:

```
C3#show ip ospf

 Routing Process with ID 0.0.0.42
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 It is an autonomous system boundary router
 Redistributing External Routes from,
    static with metric mapped to 4
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
    Area BACKBONE(0.0.0.0)
        Number of interfaces in this area is 5
        SPF algorithm executed 12 times
        Number of LSA 7. Checksum Sum 0x2d9ef
```

show ip ospf interfaces

Syntax

show ip ospf interfaces [{cable | fastethernet} X/Y.Z]

Lists the local interfaces on which OSPF is enabled and the current configuration of those interfaces.

Example:

```
C3#show ip ospf interfaces

FastEthernet 0/1.0 is up, line protocol is up
  Network Type BROADCAST, Cost: 1
  Transmit Delay is 50 sec, State DROTHER, Priority 0
  Timer intervals configured, Hello 10, Dead 40, Wait 40,
Retransmit 8
  Internet Address 10.250.0.42/24, Area 0.0.0.0
    Designated Router (ID) 21.21.21.1, Interface address
10.250.0.17
```

```
    Backup Designated Router (ID) 11.250.0.1, Interface
address 10.250.0.45
    Neighbor Count is 2, Adjacent neighbor count is 2
     Adjacent with neighbor 21.21.21.1  (Designated Router)
     Adjacent with neighbor 11.250.0.1  (Backup Designated
Router)
  Secondary Internet Address 10.250.1.1/24, Area 0.0.0.0
    No Designated Router elected
    No Backup Designated Router elected
    Neighbor Count is 0, Adjacent neighbor count is 0

Loopback.1 is up, line protocol is up (PASSIVE)
  Network Type BROADCAST, Cost: 1
  Internet Address 10.7.7.7/32, Area 0.0.0.0
  Loopback interface is treated as a stub Host
```

show ip ospf neighbor

Lists the directly connected OSPF router neighbors, for each interface on which OSPF is enabled.

Example:

```
C3#show ip ospf neighbor
Neighbor ID     Pri   State           Address         Interface
21.21.21.1      1     FULL/DR         10.250.0.17     FastEthernet 0/1.0
11.250.0.1      1     FULL/BDR        10.250.0.45     FastEthernet 0/1.0show ip
ospf routing-table
```

Lists the internal OSPF route table. The table consists of routes for all the local interfaces running OSPF and all the routes learned through OSPF.

Example:

```
C3#show ip ospf routing-table
===========================================================================
Dest ID            Out I/F        Next-Hop       Cost Dest-Type Path-Type Area
===========================================================================
10.250.0.0/24      10.250.0.42    0.0.0.0        1    NETWORK   INTRA     0
10.3.3.0/24        10.3.3.3       0.0.0.0        1    NETWORK   INTRA     0
10.250.1.0/24      10.250.1.1     0.0.0.0        1    NETWORK   INTRA     0
10.250.136.0/24    10.250.0.42    10.250.0.45    11   NETWORK   INTRA     0
10.1.134.0/23      10.250.0.42    10.250.0.17    4    NETWORK   INTER     0
10.1.132.0/23      10.250.0.42    10.250.0.17    4    NETWORK   INTER     0
10.1.130.0/23      10.250.0.42    10.250.0.17    4    NETWORK   INTER     0
```

```
21.21.21.1/32     10.250.0.42    10.250.0.17    1    ABR        INTRA     0
```

show ip ospf database

Lists a summary of each LSA type currently held in the OSPF LSA database.

Example:

```
C3#show ip ospf database

       OSPF Router with ID (0.0.0.42)

                Router Link States (Area 0.0.0.0)

Link ID       ADV Router     Age        Seq#     Checksum
0.0.0.42       0.0.0.42       780        0x80000078 0xe2cd
11.250.0.1     11.250.0.1     332        0x80000044 0x16be
21.21.21.1     21.21.21.1     1625       0x8000003e 0xa59e

                Network Link States (Area 0.0.0.0)

Link ID       ADV Router     Age        Seq#     Checksum
10.250.0.17    21.21.21.1      1382       0x80000032 0xe2f

                Summary Net Link States (Area 0.0.0.0)

Link ID       ADV Router     Age        Seq#     Checksum
10.1.130.0     21.21.21.1     1625       0x8000002d 0x2021
10.1.132.0     21.21.21.1      1625       0x800000b1 0x1b9
10.1.134.0     21.21.21.1     1625       0x800000b1 0xeacd

                Type-5 AS External Link States

Link ID       ADV Router     Age        Seq#     Checksum
5.5.5.0        0.0.0.42       539        0x80000008 0x4b43
9.9.9.9        0.0.0.42        784        0x80000034 0x845
10.5.5.0       0.0.0.42       791        0x80000034 0xb1ab
```

show ip ospf database database-summary

Lists the total number of each LSA type currently held in the OSPF LSA database.

Example:

```
C3#show ip ospf database database-summary

             OSPF Router with ID (0.0.0.42)

Area ID      Router   Network  Summary  Summary  Type-7   Opaque   Opaque   SubTotal
                                Network  ASBR              Link     Area
0.0.0.0       3        1        3        0        N/A      0        0        7
Opaque AS                                                                    0
AS External                                                                  3
Total                                                                        10
```

show ip opsf database

Syntax **show ip ospf database [asbr-summary | external | network | opaque-area | opaque-as | opaque-link | router | summary]**

Displays detailed information on the various types of the link states currently held in the internal and external LS database.

Keyword	Description
asbr-summary	Type-4 ASBR summary routes Link States
external	Type-5 AS External Link States
network	Type-2 Network LSA
opaque-area	Type-10 area opaque Link States
opaque-as	Type-11 AS opaque Link States
opaque-link	Type-9 link local opaque Link States
router	Type-1 router Link States
summary	Type-3 network summary Link States

show license

Displays a list of additional license features enabled on this CMTS.

Example:

```
C3#show license
----------------------------------------------------------------------
C3 - hostid 312 - Licensed Features

         * RIP              ARSVS01163
         * BRIDGE_GROUPS    ARSVS01164
----------------------------------------------------------------------
C3#
```

See also: *license*, page 10-40.

show logging

Displays event logging information.

Example:

```
C3#show logging

Syslog logging: disabled
Logging Throttling Control: unconstrained
DOCSIS Trap Control: 0x0

Event Reporting Control:
        Event            Local  Trap   Syslog  Local-
        Priority                               Volatile
        0(emergencies)   yes    no     no      no
        1(alerts)        yes    no     no      no
        2(critical)      yes    yes    yes     no
        3(errors)        no     yes    yes     yes
        4(warnings)      no     yes    yes     yes
        5(notifications) no     yes    yes     yes
        6(informational) no     no     no      no
        7(debugging)     no     no     no      no

Log Buffer (- bytes):
```

show mib

Syntax

`show mib ifTable`

Displays the current state of the ifTable MIB.

Example:

```
C3#show mib ifTable

index ifType ifAdminStatus LinkTraps ifAlias
1     ETH    up            enabled
2     ETH    down          enabled
3     CMAC   up            disabled
4     DS     down          enabled
5     US     down          disabled
6     US     down          disabled
11    US-CH  down          enabled
12    US-CH  down          enabled
C3#
```

show processes

Syntax

`show processes [cpu | memory]`

Displays information about running processes and CPU utilization. The options are:

(no option) Show status for all processes, including stopped processes.

cpu Show CPU usage over time.

memory Show currently running processes.

Example:

```
C3#show processes
 NAME        ENTRY        TID     PRI   STATUS      PC        SP      ERRNO  DELAY
---------- ------------ -------- --- ---------- -------- -------- ------- -----
tExcTask   excTask      89ef85d0   0 PEND       813f9320 89ef8400       0     0
tLogTask   logTask      89ef5a10   0 PEND       813f9320 89ef5848       0     0
tAutopsy   autopsy      89efe6e0   0 PEND       813f9320 89efe3e8       0     0
tShell     shell        896ee9a0   1 SUSPEND    8132beb0 896ee3d8       0     0
tPcmciad   pcmciad      89ef4180   4 PEND       813f9320 89ef3fb0       0     0
Scheduler  schedulerMai 89521c40  10 PEND       8132beb0 89521a00  3d0002     0
tNetTask   netTask      89908200  50 PEND       8132beb0 899080f0       0     0
tTimerSvr  TimerSvr     89efc3b0  90 DELAY      813d88f0 89efc2c0       0     1
tMdp1      MdpMain      89620040  95 PEND       8132beb0 8961ff08       0     0
tMdp2      MdpMain      89613120  96 PEND       8132beb0 89612fe8       0     0
tPortmapd  portmapd     896f11f0 100 PEND       8132beb0 896f0f40      16     0
tIgmp      igmpTask     8956bcd0 100 PEND       813f9320 8956bae8       0     0
FftMgr     fftMain      89524ae0 100 PEND       8132beb0 895249a8  3d0002     0
tRngMgr    RngMain      8955c300 107 PEND       813f9320 8955c120       0     0
tAuthMgr   AuthMain     89571b40 108 PEND       813f9320 89571918       0     0
tRegMgr    RegMain      8956eb50 109 PEND       813f9320 8956e928       0     0
tTek       BPIPKHTask   8955ea00 109 PEND       813f9320 8955e818       0     0
tDsxMgr    DsxMain      895bd750 110 DELAY      813d88f0 895bd638  3d0002     1
tBpi       BPIPTask     89568eb0 110 PEND       813f9320 89568cc8       0     0
tPPIf      PPIf_main    896dc220 115 PEND       813f9320 896dbe78       0     0
tUsDsMgr   channelMgtMa 8957f160 120 PEND       813f9320 8957ef30  3d0002     0
tCmMgr     CmmMain      89575240 120 PEND       813f9320 89575058       0     0
tBridge    bridge_main  89557e60 120 PEND       813f9320 89557c40       0     0
tDhcpRelay dhcpRelayMai 895b54c0 125 PEND       8132beb0 895b4f98       0     0
tNTPMib    NTPMibMain   89510eb0 128 PEND       813f9320 89510cc8       0     0
tDsxHelper DsxHelper    895e48a0 129 DELAY      813d88f0 895e47c8  3d0002     1
tDDMibs    DocsDevMIBMa 895b9cd0 129 PEND       813f9320 895b9af0       0     0
SysMgr     8103e688     896c2f70 130 PEND       813f9320 896c2c80   30065     0
tCmtsDebugLSM_CmtsDebug 89606200 130 PEND       8132beb0 89605ff8       0     0
tSnmpD     snmpd_main   89603fb0 130 PEND       8132beb0 89603c58  2b0001     0
tTimeout   activeTimeou 895e1df0 130 PEND       8132beb0 895e1d38       0     0
tPtyCli    cli_ptyOutpu 895df340 130 DELAY      813d88f0 895dee50  388002     8
tRomCli    cli_main     895da430 130 READY      813d9430 895d9420  388002     0
tEthMgr    ethMgtMain   89578280 130 PEND       813f9320 89578048       0     0
tFPD       fpd_main     8953e470 130 PEND+T     813f9320 8953e098  3d0004    14
tIdlRngMgr idleRingMgrM 8957a8b0 131 PEND       8132beb0 8957a778  3d0002     0
tLogEvt    LogEventTask 895b26c0 140 PEND       813f9320 895b24e0       0     0
tMTmrs     MiscTimersMa 8950c870 150 PEND       813f9320 8950c688       0     0
SysMgrMonit8103eb34     896becc0 161 PEND+T     813f9320 896beae8  3d0004   260
tDcacheUpd dcacheUpd    89ed10e0 250 READY      813d88f0 89ed0fb8   3006c     0
IdleTask   8103f1d8     89efb0b0 255 READY      8103f224 89efb020       0     0
C3#
```

Example (**memory** option):

```
C3#show processes memory
  NAME        ENTRY        TID     SIZE   CUR  HIGH  MARGIN
------------ ------------ -------- ----- ----- ----- ------
tExcTask     excTask      89ef85d0  7680   464   624   7056
tLogTask     logTask      89ef5a10  4688   456   552   4136
tAutopsy     autopsy      89efe6e0  7872   760   856   7016
tShell       shell        896ee9a0 39008  1480  1704  37304
tPcmciad     pcmciad      89ef4180  7680   464   616   7064
Scheduler    schedulerMai 89521c40 65216   576  1448  63768
tNetTask     netTask      89908200  9680   272  2040   7640
tTimerSvr    TimerSvr     89efc3b0  3776   240   824   2952
tMdp1        MdpMain      89620040 50880   312  1080  49800
tMdp2        MdpMain      89613120 50880   312  1080  49800
tPortmapd    portmapd     896f11f0  4688   688  1056   3632
tIgmp        igmpTask     8956bcd0  9920   488  1136   8784
FftMgr       fftMain      89524ae0  9920   312  1080   8840
tRngMgr      RngMain      8955c300  9920   480  1256   8664
tAuthMgr     AuthMain     89571b40  9920   552  1080   8840
tRegMgr      RegMain      8956eb50  9920   552  1080   8840
tTek         BPIPKHTask   8955ea00  8976   488  1136   7840
tDsxMgr      DsxMain      895bd750  9920   280  1112   8808
tBpi         BPIPTask     89568eb0 16064   488  3984  12080
tPPIf        PPIf_main    896dc220 102080   936  1416 100664
tUsDsMgr     channelMgtMa 8957f160 16064   560  5672  10392
tCmMgr       CmmMain      89575240  9920   488  1016   8904
tBridge      bridge_main  89557e60 102080   544  1072 101008
tDhcpRelay   dhcpRelayMai 895b54c0  9920  1320  1496   8424
tNTPMib      NTPMibMain   89510eb0 16064   488  1016  15048
tDsxHelper   DsxHelper    895e48a0  9920   216  1048   8872
tDDMibs      DocsDevMIBMa 895b9cd0 16064   480  3072  12992
SysMgr       0x008103e688 896c2f70 16064   752  4672  11392
tCmtsDebugLo SM_CmtsDebug 89606200  7776   520  1024   6752
tSnmpD       snmpd_main   89603fb0 101408   856  3536  97872
tTimeout     activeTimeou 895e1df0  9920   184   408   9512
tPtyCli      cli_ptyOutpu 895df340  9920  1264  2968   6952
tRomCli      cli_main     895da430 102080  4944  8720  93360
tEthMgr      ethMgtMain   89578280  9920   568  4112   5808
tFPD         fpd_main     8953e470 102080   984  2184  99896
tIdlRngMgr   idleRingMgrM 8957a8b0  7872   312  1080   6792
tLogEvt      LogEventTask 895b26c0 16064   480  1008  15056
tMTmrs       MiscTimersMa 8950c870 16064   488  1016  15048
SysMgrMonito 0x008103eb34 896becc0  7872   472  3688   4184
tDcacheUpd   dcacheUpd    89ed10e0  4688   296  1400   3288
IdleTask     0x008103f1d8 89efb0b0   688   144   512    176
INTERRUPT                           5008     0  1712   3296
C3#
```

Example (**cpu** option):

```
C3#show processes cpu
        Mgmt CPU clock speed = 600Mhz
        Mgmt CPU running at  13% utilization
        Usage over last  20 periods
        |15%|13%|15%|20%|20%|20%|15%|15%|13%|15%|
        |20%|15%|13%|15%|27%|13%|19%|15%|15%|13%|

        Avg usage over last  20 periods = 16%
        (Period  36 ticks unloaded)
C3#
```

show reload

Displays a list of scheduled reload times.

See also: *reload*, page 10-42.

show running-configuration

Displays the running configuration on the console (CLI). This command may be abbreviated to **show run**.

show snmp-server

Displays the SNMP configuration as it is specified in the running configuration.

show startup-configuration

Displays the startup configuration on the console (CLI). Note that this is not necessarily the same as the running configuration.

Appendix C contains an example showing the factory default configuration.

show tech-support

Prints a very detailed listing of C3 status for technical support purposes. This is a compilation of the following reports:

- show version
- show running-config
- show interfaces
- show controllers
- show cable modem
- show cable modulation-profile
- show interfaces cable 1/0 downstream
- show interfaces cable 1/0 upstream
- show processes
- show processes memory
- show memory
- show bridge
- show environment
- show snmp
- show users
- show terminal
- show IPC
- show file systems
- show file descriptors

Mode 5 *Global Configuration Commands*

To access this mode, enter the **configure terminal** command from privileged mode. In Global Configuration mode, the prompt is **C3(config)#**.

In this mode, many normal user and privileged mode commands are available. Return to privileged mode by typing **end, exit** or **Ctrl-Z** before using other commands.

The following is a summary of the Global configuration mode commands:

```
aaa              - Authentication configuration parameters
access-list        - Access List Configuration
alias              - Create a command alias
arp                - Create a static ARP entry
banner             - Set the login banner for the headend
boot               - Configure boot parameters
bridge             - Configure bridging
cable              - Cable related commands
card               - Card Name
cli                - Configure the cli
crypto             - Configures SSH encryption
default           - Set the last resort cable subinterface
                       to use for CMs or CPEs
docsis             - Configure DOCSIS Test Modes
elog               - Event logging
exception          - Crash Autopsy Configuration
file               - Set the confirmation level for file
                        commands
hostname           - Set the systems name
interface          - Configure a particular interface
ip                 - Internet Protocol Configuration
key                - Key management
line               - Configure console or telnet
logging            - Configure message logging
login              - Change login user name or password
mac-address-table  - Create a static FDB entry
mib                - Modify the SNMP MIBS
ntp                - Network Time Protocol
phs-enable         - Enable PHS support
route-map          - Configure a route map
router             - Enable a routing process
snmp-access-list   - Create an access list
snmp-server        - Modify SNMP parameters
tacacs-server      - Set TACACS+ encryption key
```

```
tftp-server        - Configure TFTP server
```

aaa authentication enable

Syntax

`[no] aaa authentication enable default group {tacacs+ | groupname} | local | none}`

Creates or deletes a method list for use by the enable service. The options are:

Keyword	Description
tacacs+	TACACS+ server group
groupname	Custom name for a group of TACACS+ servers
local	Associated enable password
none	No authentication

aaa authentication login

Syntax

`[no] aaa authentication login {default | methodlist}{group {tacacs+ | groupname} | local | none}`

Maintains or removes a login authentication methods list. The options are:

Keyword	Description
default	Configures the default authentication method list
methodlist	Configures a named authentication method list
groupname	Character string used to name the group of servers

Keyword	Description
local	Associated enable password
none	No authentication

aaa new-model

Syntax

```
[no] aaa new-model
```

Creates or deletes a default configuration for AAA.

access-list

Defines and manages Access Control Lists (ACLs). Use ACLs to prevent illegal access to services provided by the C3, such as Telnet, DHCP relay, and SNMP, from external sources such as cable modems, CPEs or other connected devices. You can also use ACLs to prevent access to service via the CMTS; that is, traffic passing through the C3 can also be subjected to ACL based filtering.

You can define up to 30 ACLs; each ACL may contain up to 30 entries (ACEs). The C3 applies ACLs to all network traffic passing through the CMTS.

After defining ACLs, use *ip access-group*, page 10-182, to associate each ACL with a specific interface or sub-interface.

See *ACLs and ACEs*, page 8-8 for details about creating ACLs.

Standard ACL definition

Syntax

```
[no] access-list {ACL-number} {permit | deny} {host
ipaddr | any}
```

A standard ACL allows or denies access to traffic to or from a particular IP address. The valid range for standard ACLs is **1** to **99**, or **1300** to **1399**.

Extended IP definitions

Syntax

```
[no] access-list {ACL-number} {permit | deny}
{protocol} {options}
```

Extended ACLs support very precise definitions of packets. See *Filtering Traffic*, page 8-7, for more details.

The valid range for extended ACLs is **100** to **199**, or **2000** to **2699**.

alias

Syntax

```
[no] alias {aliasname} {string}
```

Creates an alias, which if entered as a command, executes the command *string*. The command string must be enclosed in quotes. Use **no alias** to remove an alias.

```
C3(config)#alias scm “show cable modem”
```

arp

Syntax

```
[no] arp {ipaddr} {macaddr} [cable 1/0[.s] [vlan] |
fastethernet 0/n[.s] [vlan]]
```

Creates or deletes a manual entry in the ARP table. You can optionally associate the entry with a specific sub-interface and VLAN ID.

See also: *show arp*, page 10-13.

arp timeout

Syntax

```
arp timeout {sec}
```

Sets the length of time, in seconds, to keep ARP entries before timing out. Default: **14400** (4 hours).

banner

Syntax

One of:

```
[no] banner {ascii string}
[no] banner filename {ascii text filename}
```

Sets the login banner for the CMTS to either a specified ascii string or to an ascii text file located on the flash disk which the banner text is read from. The maximum allowable length of the ascii string is 2000 characters. If the specified text file contains more than 2000 characters, it is truncated.

NOTE
To set a banner using an ascii string with spaces in the string, enclose the entire banner inside quotations (as show in the example below), otherwise the command will be rejected due to the spaces.

Use the **no banner** command to delete the banner completely.

```
C3(config)#banner “cmts3 Location Atlanta”
```

boot system flash

Syntax

```
boot system flash path/filename
```

Boots the system from an alternate image on the Compact Flash disk.

Specify the drive letter in UPPER case:

```
boot system flash C:/alternate_image.bin
```

See also: *show bootvar*, page 10-13, *reload*, page 10-42.

boot system tftp

Syntax

```
boot system tftp filename ipaddr
```

Boots the system from an alternate image with name *filename* on the TFTP server at the specified IP address.

See also: *show bootvar*, page 10-13, *reload*, page 10-42.

bridge

Syntax

```
[no] bridge {n}
```

Creates or removes a bridge group.

With a basic license, the two default bridge groups cannot be removed using the **no** form of this command. Use the **no bridge-group** command to remove sub-interfaces from the default bridge groups.

See also: *bridge-group*, page 10-181, *show bridge-group*, page 10-51, *encapsulation dot1q*, page 10-202.

bridge aging-time

Syntax

```
[no] bridge aging-time {n}
```

Sets the aging time (*n* = **0** to **1000000** seconds) for the learned entries in the Ethernet bridge or all bridge-groups.

Example:

```
C3(config)#bridge aging-time 300
```

bridge find

Syntax

```
bridge find cable-modem {macaddr}
```

Locates a cable modem in the bridge table by the source MAC address.

bridge mode

Syntax

```
bridge mode multiple-entry
bridge mode single-entry [no-relearning |
relearn-from-ethernet | relearning]
```

Sets the bridging table learning mode. The parameters are:

Keyword	Description
multiple-entry	Allows the same MAC address to appear on all ports
single-entry	Allows a MAC address to appear on only one port. Single-entry mode can be further configured to limit relearning, using one of the following keywords
no-relearning	In single-entry mode, the bridge table does not relearn MAC addresses. This is the default for single-entry mode
relearn-from-ethernet	In single-entry mode, the bridge can relearn MAC addresses on an Ethernet port over the RF port
relearning	In single-entry mode, the bridge can relearn MAC addresses on all ports. This is identical to C3 version 2.0 operation

cable filter

Syntax

```
[no] cable filter
```

Enables or disables filtering at the cable interface.

See also: *cable filter group*, page 10-107, *cable submgmt default filter-group*, page 10-125.

cable filter group

Syntax

```
[no] cable filter group group-id index index-id
[dest-ip ipaddr] | [dest-mask ipmask] | [dest-port
dest-port] | [ip-proto protocol] | [ip-tos tos-mask
tos-value] | [match-action accept | drop] | [src-ip
ipaddr] | [src-mask ipmask] | [src-port src-port] |
[status activate | deactivate] | [tcp-status activate
| deactivate] | [tcp-flags flag-mask flag-value]
```

Creates a filter specification for registered cable modems and hosts attached to registered cable modems. The parameters are:

Parameter	Values	Description
group-id	1 to 1024	
index-id	1 to 1024	
dest-port	0 to 65536	
protocol	0 to 256	IP Protocol
	all	Match all protocols
	icmp	Match the ICMP protocol
	igmp	Match the IGMP protocol
	ip	IP in IP encapsulation
	tcp	Match the TCP protocol
	udp	Match the UDP protocol
tos-mask	0 to 255	
tos-value	0 to 255	
src-port	0 to 65536	IP source port number
flag-mask	0-63	
flag-value	0-63	
status		Row status for pktFilterEntry
tcp-status		Row status for tcpUdpEntry

See also: *Filtering Traffic*, page 8-7, *cable submgmt default filter-group*, page 10-125, *show cable filter*, page 10-56, *cable filter*, page 10-106

Examples

Create a new filter using:

`cable filter group <1-1024> index <1-1024>`

Enter values for filter as required:

```
cable filter group <1-1024> index <1-1024> dest-ip <N.N.N.N>
cable filter group <1-1024> index <1-1024> dest-mask <N.N.N.N>
cable filter group <1-1024> index <1-1024> dest-port <0-65536>
cable filter group <1-1024> index <1-1024> ip-proto <0-256>
cable filter group <1-1024> index <1-1024> ip-tos <0x0-0xff(Mask)> <0x0-
0xff(Value)>
cable filter group <1-1024> index <1-1024> tcp-flags <0x0-0x3f(Mask)> <0x0-
0x3f(Value)>
cable filter group <1-1024> index <1-1024> src-ip <N.N.N.N>
cable filter group <1-1024> index <1-1024> src-mask <N.N.N.N>
cable filter group <1-1024> index <1-1024> src-port <0-65536>
```

Decide what to do if the filter matches:

```
cable filter group <1-1024> index <1-1024> match-action accept | drop
```

Activate the filter (or de-activate it):

```
cable filter group <1-1024> index <1-1024> status activate | deactivate
```

The following example creates filters to allow only SNMP traffic to/from modems from defined management networks and to block all multicast based traffic to/from hosts.

```
! activate filters
cable filter
! turn on subscriber managment in the CMTS
cable submgmt
! up to 16 cpe addresses per modem can be learned
! by the CMTS
cable submgmt default max-cpe 16
! let the cmts learn the attached cpe ip addres up to the maximum (16)
cable submgmt default learnable
! filter cpe traffic based on learned cpe ip address up to the maximum (16)
cable submgmt cpe ip filtering
! activate the defaults defined here for all modems and attached cpe
cable submgmt default active

! assign default filters
! note can be overridden for a modem(as can all submgmt defaults)
! by submgmt TLV's in a modem config file
cable submgmt default filter-group cm upstream 3
cable submgmt default filter-group cm downstream 2
cable submgmt default filter-group cpe upstream 1
cable submgmt default filter-group cpe downstream 1
!
! block mcast traffic
cable filter group 1 index 1
cable filter group 1 index 1 src-ip 0.0.0.0
cable filter group 1 index 1 src-mask 0.0.0.0
cable filter group 1 index 1 dest-ip 224.0.0.0
cable filter group 1 index 1 dest-mask 240.0.0.0
cable filter group 1 index 1 ip-proto ALL
cable filter group 1 index 1 ip-tos 0x0 0x0
cable filter group 1 index 1 match-action drop
cable filter group 1 index 1 status activate
cable filter group 1 index 1 src-port all
cable filter group 1 index 1 dest-port all
cable filter group 1 index 1 tcp-flags 0x0 0x0

cable filter group 1 index 2
cable filter group 1 index 2 src-ip 0.0.0.0
cable filter group 1 index 2 src-mask 0.0.0.0
cable filter group 1 index 2 dest-ip 0.0.0.0
cable filter group 1 index 2 dest-mask 0.0.0.0
cable filter group 1 index 2 ip-proto ALL
cable filter group 1 index 2 ip-tos 0x0 0x0
cable filter group 1 index 2 match-action accept
cable filter group 1 index 2 status activate

! allow SNMP from the management system to modems
! allow UDP from 172.16.5.0/24 network to modems
! on 10.160.0.0/16 network
cable filter group 2 index 1
cable filter group 2 index 1 src-ip 172.16.5.0
cable filter group 2 index 1 src-mask 255.255.255.0
cable filter group 2 index 1 dest-ip 10.160.0.0
cable filter group 2 index 1 dest-mask 255.252.0.0
cable filter group 2 index 1 ip-proto UDP
cable filter group 2 index 1 ip-tos 0x0 0x0
cable filter group 2 index 1 match-action accept
cable filter group 2 index 1 status activate

cable filter group 2 index 3
cable filter group 2 index 3 src-ip 0.0.0.0
cable filter group 2 index 3 src-mask 0.0.0.0
cable filter group 2 index 3 dest-ip 0.0.0.0
cable filter group 2 index 3 dest-mask 0.0.0.0
cable filter group 2 index 3 ip-proto ALL
cable filter group 2 index 3 ip-tos 0x0 0x0
cable filter group 2 index 3 match-action drop
cable filter group 2 index 3 status activate

! allow SNMP from modems to the management system
! allow UDP from modems on 10.160.0.0/16 network
! to 172.16.5.0/24 network
cable filter group 3 index 1
cable filter group 3 index 1 src-ip 10.160.0.0
cable filter group 3 index 1 src-mask 255.252.0.0
cable filter group 3 index 1 dest-ip 172.16.5.0
cable filter group 3 index 1 dest-mask 255.255.255.0
cable filter group 3 index 1 ip-proto UDP
cable filter group 3 index 1 ip-tos 0x0 0x0
cable filter group 3 index 1 match-action accept
cable filter group 3 index 1 status activate

cable filter group 3 index 3
cable filter group 3 index 3 src-ip 0.0.0.0
cable filter group 3 index 3 src-mask 0.0.0.0
cable filter group 3 index 3 dest-ip 0.0.0.0
cable filter group 3 index 3 dest-mask 0.0.0.0
cable filter group 3 index 3 ip-proto ALL
cable filter group 3 index 3 ip-tos 0x0 0x0
cable filter group 3 index 3 match-action drop
cable filter group 3 index 3 status activate
```

cable frequency-band

Syntax

```
[no] cable frequency-band {index} {band} {start
start-freq} {stop stop-freq}
```

Configures a frequency band with the given start and stop edge frequencies in Hz. The C3 assigns cable modems to a frequency group, restricting their upstream frequencies to a band within that group. The parameters are:

Keyword	Description
index	Specifies a frequency group. Valid range: **1** to **10**.
band	Specifies a frequency band within the group. Valid range: **1** to **10**
start-freq	Start frequency, in Hz. Valid range: **1800000** to **68200000**; the start frequency must be lower than the stop frequency
stop-freq	Stop frequency, in Hz. Valid range: **1800000** to **68200000**

You can create multiple frequency bands by configuring several bands with the same value of *index* but different values of *band*.

Use the **no** form of this command to remove a band from a frequency group. Removing the last band from a group also removes the group.

The following example defines 6 cable frequency groups with one frequency band per group.

```
cable frequency-group 1 1 start 1800000 stop 68200000

cable frequency-group 2 1 start 1800000 stop 68200000

cable frequency-group 3 1 start 1800000 stop 68200000

cable frequency-group 4 1 start 1800000 stop 68200000

cable frequency-group 5 1 start 1800000 stop 68200000

cable frequency-group 6 1 start 1800000 stop 68200000
```

If you attempt to modify an existing frequency band, all upstream channels in the cable groups that use this band must fall within all the frequency bands assigned to the frequency-group.

See also: *show cable frequency-band*, page 10-58, *cable group frequency-index*, page 10-113.

cable group

Syntax

```
[no] cable group {id} {option}
```

Manages cable groups. See the sections following for details.

cable group description

Syntax

```
[no] cable group id description {str}
```

Creates a textual description of this cable group that is displayed in the running configuration. Use the **no** form of this command to remove the current description. The parameters are:

Keyword	Description
id	The cable group identifier (1 to 6)
str	The cable group description

See also: *show running-configuration*, page 10-96.

cable group frequency-index

Syntax

```
cable group id frequency-index {freqIndex}
```

Assigns a group of frequency bands to the given upstream group. You must assign frequency bands to a upstream group before adding upstream channels. The parameters are:

Keyword	Description
id	The cable group identifier (1 to 6)
freqIndex	Frequency index (1 to 10)

The C3 always ensures that the channels in a group are within the frequency bands assigned to the group, and that no channel overlap occurs.

See also: *cable frequency-band*, page 10-111, *show cable group*, page 10-58.

cable group load-balancing

Syntax

```
[no] cable group id load-balancing {initial-numeric
| periodic}
```

Configures distribution of cable modems across grouped upstream channels.

Each upstream channel has a “group ID” assigned to it which is used to associate that channel with other upstream channels on the same physical cable.

Cable groups thus reflect the physical cable plant layout and specifically the reverse path combining of the plant. All upstream channels in the one cable groups should be available to a modem that can see any one of these channels.

Each cable group offers two configurations for load balancing:

Keyword	Description
none	No load balancing is performed. Modems come online using any upstream in the same group. Use **no cable group id load-balancing** to disable load balancing
initial-numeric	The number of modems is evenly distributed across the available active channels in the same group. Modems are redirected to the most appropriate upstream during initial ranging. Once a modem comes online it will remain on the same channel until rebooted at which time it may be moved to another channel if appropriate
periodic	The C3 periodically checks bandwidth usage on upstream cable groups, and (if necessary) moves cable modems to different upstreams to balance usage on each upstream channel.

See also: *cable upstream group-id*, page 10-234.

cable max-qos-active-timeout

Syntax

```
[no] cable max-qos-active-timeout {1-65535 seconds}
```

```
[no] cable max-qos-active-timeout {default}
```

Manages the timeout override for active DSX flows. If an MTA specifies a non-zero timeout value in its dynamic service message, then a value in the MTA request is used only if it is lower than the value configured in the CLI. If the

TTM specifies a higher value, zero or no value, then the CLI-specified value is used. The defaults ensure that inactive resources are released.

These commands apply to all upstream channels (including logical channels) and the downstream channel on the cable interface.

The parameters are:

Keyword	Description
1-65535 seconds	The maximum value is 65535 seconds
default	Default value is 30 seconds

Use the **no cable max-qos-terminal** command to disable this feature.

The display the current value, check the running config of the CMTS using the filter s*how running configuration | include qos-active*.

cable modem offline aging-time

Syntax

```
cable modem offline aging-time {tt}
```

Changes the offline aging time. The C3 removes cable modems from its database once they have been offline for the specified amount of time.

Specify the time in seconds, **3600** to **864000** (10 days). The default is **86400** (24 hours). A value of zero is not supported.

If the aging time is changed, the C3 restarts the aging timer for all modems currently offline.

cable modulation-profile

Syntax

One of:

```
cable modulation-profile {p} {default_prof}
cable modulation-profile {p} {IUC} [advphy] [feclen]
[maxburst] [guard_time] [modulation] [scram] [seed]
[diff] [prelen] [lastcw]
cable modulation-profile {p} {IUC} [fec_t] [feclen]
[maxburst] [guard_time] [modulation] [scram] [seed]
[diff] [prelen] [lastcw]
cable modulation-profile {p} {IUC} advphy atdma
[depth] [blksize]
cable modulation-profile {p} {IUC} advphy scdma
[trell] [step] [spread] [subframe]
no cable modulation-profile {p}
```

Creates or changes a modulation profile. Use the **no cable modulation-profile** command to remove the specified modulation profile.

If all modulation profiles are removed, modems using this CMTS go offline and do not come online again until you recreate modulation profiles referenced in the upstream interface specification.

p Selects the modulation profile. Valid range: **1** to **100**.

default_prof Specifies a modulation profile with reasonable defaults:

Code	Definition
qam	Create a default QAM16 modulation profile.
qpsk	Create a default QPSK modulation profile.
mix	Create a default QPSK/QAM mixed modulation profile.
advanced-phy	Create a default 64QAM profile with advanced PHY.

IUC The interval usage code; may be:

IUC code	DOCSIS 1.0 and 1.1	Description
1	request	Request burst
2	reqdata	Request/data burst
3	initial	Initial ranging burst
4	station	Station keeping grant burst
5	short	Short grant burst
6	long	long grant burst
	ATDMA operation	
9	advPhyS	Advanced PHY Short data
10	advPhyL	Advanced PHY Long data
11	advPhyU	Advanced PHY Unsolicited Grant Service (UGS)

fec_t The number of bytes which can be corrected per FEC codeword.

Range: 0 to 16.

For TDMA burst profiles: **fec_t** <= 10.

For IUCs 1 to 4: **fec_t** <= 10 if they are **tdma** or **tdmaAndAtdma**, <= 16 if they are being used on an ATDMA channel.

For IUCs 9 to 11: **fec_t** <= 16

feclen The FEC codeword length in bytes. Valid range: **1** to **255**.

For all burst profiles (feclen + 2 * fec_t) <= 255

maxburst The maximum burst size in mini-slots.

guard_time The guard time, in symbols. Valid range: **0** to **255**.

modulation The type of modulation to be used for the particular IUC—it may be **qpsk** or **qam16**. With the Advanced TDMA software option, the following additional modulation methods may be used: **qam8**, **qam32**, **qam64**. Using SCDMA (DOCSIS 2.0 only), the methods are: **qam8**, **qam32**, **qam64**, **qam128** (trellis coding must be enabled to use **qam128**).

scram Defines whether or not the scrambler should be used (**scrambler** or **no-scrambler**).

seed The scrambler seed in hexadecimal (0 to 7fff).

diff Indicates whether differential encoding should be used (**diff** or **no-diff**).

prelen Length of the preamble in bits (2 to 1024). For DOCSIS 1.x cable modems, the length must be divisible by 2 for QPSK and divisible by 4 for 16QAM.

lastcw Indicates the FEC handling for the last codeword (**fixed** or **shortened**).

depth For ATDMA modulation profiles, the byte interleaver depth. Use a value of **1** to disable interleaving. Valid range: **0** to **4294967295**.

blksize For ATDMA modulation profiles, the byte interleaver block size. Valid range: **0** to **4294967295**. Together, **depth** and **blksize** specify the size and dimensions of a data block; **depth** specifies the column height and the row length is equal to **blksize**/**depth**.

trell For SCDMA modulation profiles, specifies whether to use trellis code modulation. Use **trell** to enable trellis code modulation, or **no-trell** to disable it.

step For SCDMA modulation profiles, the interleaver step size. Valid range: **0** to **32**.

spread For SCDMA modulation profiles, specifies whether or not the SCDMA spreader is enabled. Use **spr** to enable, or **no-spr** to disable.

subframe For SCDMA modulation profiles, the SCDMA sub-frame size. Valid range: **0** to **128**.

Interleavedepth may be “off”, “static” or “dynamic” but should be “off” for TDMA mode.

Each row in a de-interleaver block corresponds to one RS codeword. When interleaving is active, and is in dynamic mode, InterleaveBlockSize will determine how many blocks are formed from a packet and thus the number of rows in each block. When in static mode, the number rows in a block is locked at the specified value. In either case, each block is sampled column wise to reconstruct the original packet before RS decoding occurs.

Off mode (number rows = 1):

Interleavedepth must be off (disabled) for tdma burst profiles

For IUCs 1 - 4 Interleavedepth must be off (disabled) unless they are being used in an atdma channel.

If forward error correction is not being used (fec_t = 0) Interleavedepth must be off (disabled).

static mode (number rows >=2 to <2048):

IF FEC is being used (fec_t != 0) and the interleaver is in static mode (Interleavedepth >= 2) you must have (InterleaveBlockSize- > Interleavedepth * (feclen + 2 * fec_t) <= 2048)

dynamic mode (number rows = 0):

The number of rows in each block is dynamically selected to uniformly distributed the number of rows across the blocks. The value of InterleaveBlockSize should be larger than a RS codeword size (feclen + 2 * fec_t) to achieve a useful number of rows in each block. If the number of rows is too small, interleaving will have little effect and robustness in the presence of noise will be degraded (just as low value of Interleavedepth would have in manual mode)

InterleaveBlockSize (will be ignored unless InterleaveDepth is in manual mode i.e. >=2).

InterleaveBlockSize must be 0 for tdma burst profiles

InterleaveBlockSize <= 2048 always

If FEC is being used (docsIfCmtsModFECCorrection != 0) and the interleaver is in dynamic mode (docsIfCmtsModByteInterleaverDepth = 0) you must have docsIfCmtsModByteInterleaverBlockSize >= 2 * (docsIfCmtsModFECCodewordLength + 2 * docsIfCmtsModFECCorrection)

For tdmaAndAtdma and atdma burst profiles InterleaveBlockSize >= 36, regardless of whether FEC or the interleaver are enabled

Example:

```
cable modulation-profile 1 request 0 16 2 8 qpsk scrambler
338 no-diff 64 fixed

cable modulation-profile 1 reqData 0 16 2 8 qpsk scrambler
338 no-diff 64 fixed

cable modulation-profile 1 initial 5 34 0 48 qpsk scrambler
338 no-diff 400 fixed

cable modulation-profile 1 station 5 34 0 48 qpsk scrambler
338 no-diff 384 fixed

cable modulation-profile 1 short 6 75 7 8 qpsk scrambler
338 no-diff 64 fixed

cable modulation-profile 1 long 8 220 0 8 qpsk scrambler
338 no-diff 64 fixed
```

Use the **no** form of this command with no parameters after **p** to remove a modulation profile.

Example:

```
C3(config)#show cable modulation-profile
```

```
Mod IUC      Type Preamb Diff FEC    FEC   Scrambl Max  Guard Last Scrambl
                  length enco T      CW    Seed    B    time  CW
                              BYTES  SIZE          size size  short
1   request qpsk  64     no   0x0    0x10  0x152   0    8     no   yes
1   initial qpsk  640    no   0x5    0x22  0x152   0    48    no   yes
1   station qpsk  384    no   0x5    0x22  0x152   0    48    no   yes
1   short   qpsk  64     no   0x6    0x4b  0x152   14   8     no   yes
1   long    qpsk  64     no   0x8    0xdc  0x152   0    8     no   yes
1   advPhyS 64qam 104    no   0xc    0x4b  0x152   6    8     no   yes
1   advPhyL 64qam 104    no   0x10   0xdc  0x152   0    8     no   yes
2   request qpsk  64     no   0x0    0x10  0x152   2    8     no   yes
2   reqData qpsk  64     no   0x0    0x10  0x152   2    8     no   yes
2   initial qpsk  400    no   0x5    0x22  0x152   0    48    no   yes
```

```
2   station qpsk  384    no   0x5    0x22  0x152   0    48    no   yes
2   short   qpsk  64     no   0x6    0x4b  0x152   7    8     no   yes
2   long    qpsk  64     no   0x8    0xdc  0x152   0    8     no   yes
2   advPhyS  64qam 104   no   0xc    0x4b  0x152   6    8     no   yes
2   advPhyL  64qam 104   no   0x10   0xdc  0x152   88   8     no   yes
                        C3(config)#no cable modulation-profile 2

                        C3(config)#show cable modulation-profile

Mod IUC     Type Preamb Diff FEC    FEC   Scrambl Max  Guard Last Scrambl
                 length enco T      CW    Seed    B    time  CW
                             BYTES  SIZE          size size  short
1   request qpsk  64    no   0x0    0x10  0x152   0    8     no   yes
1   initial qpsk  640   no   0x5    0x22  0x152   0    48    no   yes
1   station qpsk  384   no   0x5    0x22  0x152   0    48    no   yes
1   short   qpsk  64    no   0x6    0x4b  0x152   14   8     no   yes
1   long    qpsk  64    no   0x8    0xdc  0x152   0    8     no   yes
1   advPhyS 64qam 104   no   0xc    0x4b  0x152   6    8     no   yes
1   advPhyL 64qam 104   no   0x10   0xdc  0x152   0    8     no   yes
C3#
```

See *Default Modulation Profiles*, page F-18, for a listing of the default profiles.

cable service class

Syntax

[no] cable service class {name} {option}

Defines a DOCSIS 1.1 upstream or downstream service class.

The ***name*** is a character string that names the service class. Note that some devices, such as Touchstone Telephony Modems, use the service class name to find service flow parameters.

The ***option*** is one of the following:

activity-timeout {sec} Activity timeout in seconds. Valid range: **0** to **65535** seconds.

admission-timeout {sec} Admitted timeout in seconds. Valid range: **0** to **65535** seconds.

downstream Specifies that this is a downstream service class.

grant-interval {usec} Grant interval in microseconds. Valid range: **0** to **4294967295** µsec.

grant-jitter {usec} Grant jitter in microseconds. Valid range: **0** to **4294967295** µsec.

grant-size {byte} Grant size in bytes. Valid range: **0** to **65535** bytes.

grants-per-interval {grants} Grants per interval. Valid range: **0** to **127** grants.

max-burst {bytes} Max burst in bytes. Valid range: **1522** to **4294967295** bytes.

max-concat-burst {bytes} Max concat burst in bytes. Valid range: **0** to **65535** bytes.

max-latency {usec} Max latency in microseconds. Valid range: **0** to **4294967295** µsec.

max-rate {bps} Max rate in bits per second. Valid range: **0** to **4294967295** bps.

min-packet-size {bytes} Minimum packet size in bytes. Valid range: **0** to **65535** bytes.

min-rate {bps} Minimum rate in bits per second. Valid range: **0** to **4294967295** bps.

poll-interval {usec} Poll interval in microseconds. Valid range: **0** to **4294967295** µsec.

poll-jitter {usec} Poll jitter in microseconds. Valid range: **0** to **4294967295** µsec.

priority Priority. Valid range: **0** to **7**.

req-trans-policy {pattern} Request transmission policy bit field. Valid range: **0x0** to **0xffffffff**.

sched-type {type} Scheduling type; one of:

Type	Definition
UGS	Unsolicited grant
UGS-AD	Unsolicited grant with Activity Detection
best-effort	Best effort

Type	Definition
non-real-time-polling	Non-real-time polling
real-time-polling	Real-time polling

status {option} Set the operating status of this entry; one of **activate**, **deactivate**, or **destroy**.

tos-overwrite {mask} AND this mask with the ToS field. Valid range: **0x1** to **0xff**.

upstream Specifies that this is an upstream service class.

cable submgmt

Syntax

```
[no] cable submgmt [option]
```

Enables or disables subscriber management.

The cable modem may receive subscriber management TLVs in its configuration file. The cable modem passes that information to the CMTS during the registration process.

The **default** options specify the default behavior of the C3 if it receives no subscriber management information during modem registration. Where such information is received during registration, that information overrides the defaults.

In this manner, a provisioning system retains control over CMTS behavior with respect to enforcing:

Cable modem and CPE IP filters

Maximum number of CPE per cable modem

Fixing the CPE IP addresses allowed to be attached to the cable modem or allowing learnable IP addresses

See also: *cable submgmt default filter-group*, page 10-125, and Chapter 8, *Configuring Security*.

cable submgmt cpe ip aging

Syntax

```
[no] cable submgmt cpe ip aging
```

Enables or disables CPE IP aging. Aging is disabled by default.

Use the *cable submgmt default cpe-ip-aging-interval*, page 10-125, command to set the aging time.

cable submgmt cpe ip filtering

Syntax

```
[no] cable submgmt cpe ip filtering
```

Enables or disables CPE IP filtering.

If disabled, then CPE source IP address are not validated.

If enabled, CPE IP addresses learned by the CMTS up to the maximum number allowed (**default max-cpe**) are used to validate received CPE traffic. The CMTS discards any CPE traffic received that does not match this list.

The docsSubMgtCpeIpTable may be populated by:

- using SNMP on the CMTS MIB
- information received during modem registration, this information in turn being provided to the modem by its configuration file.
- the CMTS learning CPE addresses

Subscriber management filters are designed so that they can be re-assigned using the cable modem provisioning system; these defaults may be overridden using TLVs in a modem configuration file. If these filters are never going to be manipulated in this manner then you should consider using ACLs, a more suitable and more flexible static filtering mechanism.

cable submgmt default active

Syntax

```
[no] cable submgmt default active
```

Specifies that all modems and CPE devices are managed at the headend with the defined defaults.

This command establishes defaults for subscriber management. If the C3 receives subscriber management information during registration, that information overrides the defaults for this modem (and attached CPE).

cable submgmt default cpe-ip-aging-interval

Syntax

```
cable submgmt default cpe-ip-aging-interval {time}
```

Sets the CPE IP aging time, in seconds. Aging must be enabled using the *cable submgmt default cpe-ip-aging-interval*, page 10-125, command for this command to have any effect.

Default: **14400** seconds (4 hours).

cable submgmt default filter-group

Syntax

```
cable submgmt default filter-group [cm | cpe]
[upstream | downstream] {groupid}
```

Assigns default filters. The filter groups themselves can be created via SNMP or using the **cable filter group** command.

See also: *Filtering Traffic*, page 8-7, *cable filter group*, page 10-107, *show cable filter*, page 10-56.

cable submgmt default learnable

Syntax

```
[no] cable submgmt default learntable
```

Enables automatic subscriber address learning (use **no cable submgmt learntable** to disable).

This command establishes defaults for subscriber management. This information can also be received from a modem during the modem registration process, overriding this default setting. The modem in turn receives this information in its configuration file.

See also: *cable submgmt cpe ip filtering*, page 10-124.

cable submgmt default max-cpe

Syntax

```
cable submgmt default max-cpe {n}
```

Sets the maximum number of allowable CPE devices on any modem. Valid range: **1** to **1024**.

cable vpn

Syntax **`[no] cable vpn {cm | cmts} {vlan}`**

Enables or disables VLAN encoding for cable modem or CMTS traffic. The valid range for *vlan* is **1** to **250**.

The C3 must be running in out-of-band mode for VLAN mode to have any effect. You can define a single VLAN ID for cable modems, and a separate VLAN ID for CMTS data.

In VLAN mode:

- All host traffic leaves the C3 un-encoded from the WAN port.
- All cable modem and CMTS traffic leaves the C3 VLAN encoded from the MGMT port.
- VLAN encoding occurs only at the fastethernet 0/1 interface.

To delete a VLAN ID, use the **no** version of the command.

If you define a VLAN using the **cable vpn** command, the MGMT fastethernet port runs in trunk mode.

Example:

```
cable vpn cm 24
! add vlan-id 24 for CM traffic
cable vpn cmts 24
! add vlan-id 24 for CMTS traffic (both CM/CMTS

! share vlan-id)
no cable vpn cm 24
! delete vlan-id 24 for CM traffic
cable vpn cm 25
! add vlan-id 25 for CM traffic
```

cli logging

Syntax

```
[no] cli logging [password | path dir | size maxsize]
```

Controls CLI logging. Use **no cli logging** to turn logging off.

The options are:

Keyword	Description
password	Turns password logging on or off
path	The path in which the default log file will be stored. The filename will be “console.log,” “vty0.log,” “vty1.log,” “vty2.log.” or “vty3.log.”
size	Specifies the logging file size in Kbytes. Valid range: **1** to **50000**

cli account

Syntax

```
[no] cli account {account-name} [password pw  |
enable-password privpw | secret-password enpw]
```

Sets the login name and passwords for access to the C3 command line. Use **no cli account** to delete a password.

The parameters are:

Keyword	Description
account-name	Login name
pw	Login password for this account
privpw	Password to move into privilege mode for this account. This password is shown in clear text in the C3 configuration
enpw	Sets the encrypted password to move to privilege mode after login. This password is visible in the configuration file in encrypted format.

If you set an encrypted password, you must set a normal password as well. Accounts without normal passwords cannot access privileged commands.

crypto key generate

Syntax

```
crypto key generate {type} [modulus len]
```

Generates the host public and private keys for the C3 SSH server. The parameters are:

Keyword	Description
type	Specifies the key type; one of **dsa**, **rsa**, or **both**
len	The key length; one of **768**, **1024**, or **2048**. Default: **1024**

The C3 stores RSA and DSA public keys in **c:/ssh/cmts_dsa_ pubkey.pem** and **c:/ssh/cmts_rsa_pubkey.pem** respectively.

See also: *Configuring SSH*, page 8-38.

crypto key import

Syntax

```
crypto key import rsa {userid} pem {terminal | url
name}
```

Installs a public RSA or DSA key in PEM format for the specified user. The parameters are:

Keyword	Description
userid	The C3 user ID that the keys apply to
terminal	Specifies that the keys are entered from the current terminal session (ASCII upload)
url	Either the URL of a file on a TFTP server, or the name of a file on the C3 Compact Flash disk

Once a user’s public key is installed in the C3 user database, password authentication for that user is no longer available. Use the **crypto key zeroize** command to remove a user’s public keys.

See also: *Configuring SSH*, page 8-38.

crypto key zeroize

Syntax

```
crypto key zeroize {type} [userid]
```

Deletes the specified host public and private key types. The *type* is one of **dsa**, **rsa**, or **both**. Specifying the optional *userid* deletes only the public keys associated with that C3 user ID.

See also: *Configuring SSH*, page 8-38.

debug

Syntax

```
[no] debug
```

Enables debugging output to the serial console (or telnet sessions if the **term monitor** command is used in a telnet session).

Debug commands are global across terminal and telnet sessions. Use the **terminal monitor** command to send debug output to a telnet session. Debug may be enabled in one telnet session and disabled in another telnet session. Use **show debug** to show the state of debugging across all sessions.

⚠ **CAUTION**

Reduced system performance

Producing debugging information can consume extensive CMTS resources, which may result in reduced system performance. For best results, only enable debugging when necessary and disable it as soon as it is no longer needed.

To turn off debugging, give the command **no debug** or **undebug**.

Debugging can be turned on and off (the **no** form of the command) for one or many modems based on MAC address or primary SID. Modems are added to the debug list when specified and removed with the **no** command variant.

Commands that add/remove modems from the debug list are:

```
[no] debug cable interface <type x/y> [
     [mac-address <M.M.M> [m.m.m] ] | sid <nnnn> ]
[verbose]

[no] debug cable mac-address <M.M.M> [m.m.m] [verbose]

[no] debug cable sid <NNNN> [verbose]
```

Use the **show debug** command to see what modems are in the debug list:

```
C3#show debug

Mac Addresses enabled for Debug:
Primary Sids enabled for Debug:
Debugging events/message types which are enabled:
```

```
Contents of Cable Modem Database debuglevel:
I/F     PrimSid   MAC address     Debug
C3#
```

debug all

Syntax

```
[no] debug all
```

Provides all debugging information.

Use **no debug all** to turn off debug for all cable modems for all events.

Use **debug all** to turn on debug in terse mode for all cable modems previously being debugged.

debug cable dhcp-relay

Syntax

```
[no] debug cable dhcp-relay
```

Enables or disables DHCP relay debugging.

debug cable interface

Syntax

```
[no] debug cable interface cable 1/0 {mac-address
macaddr [macmask] | sid n} [verbose]
```

Enable or disable debugging on the selected cable modem or interface. The options are:.

Keyword	Description
macaddr	Enables debugging on the cable modem with the specified MAC address. If the optional mask is included, the CMTS enables debugging
mask	Enables debugging on all cable modems whose MAC address, AND'ed with the mask, matches the specified MAC address
sid	Enables debugging on the cable modem with the specified Service ID (SID)
verbose	Enables verbose debugging. The CMTS defaults to terse mode

debug cable load-balancing

Syntax

```
[no] debug cable load-balancing
```

Enables or disables debugging for periodic load balancing.

debug cable mac-address

Syntax

```
[no] debug cable mac-address {macaddr} [mask]
[verbose]
```

Enables or disables debugging on the cable modems matching the specified MAC address. The options are:

Keyword	Description
macaddr	Enables debugging on the cable modem with the specified MAC address
mask	Enables debugging on all cable modems whose MAC address, AND'ed with the mask, matches the specified MAC address
verbose	Enables verbose debugging. The CMTS defaults to terse mode

debug cable privacy

Syntax

```
[no] debug cable privacy [mac-address macaddr]
[level n]
```

Enables Baseline Privacy (BPI) debugging on the specified cable modem.

The options are:

Keyword	Description
macaddr	The MAC address of the cable modem.

Keyword	Description
level	The BPI debug level: 0 - no output 1 - trace incoming/outgoing message 2 - same as level 1 and display information of incoming message 3 - same as level 2 and display outgoing message data
verbose	Enables verbose debugging. The CMTS defaults to terse mode

debug cable range

Syntax

```
[no] debug cable range
```

Enables ranging debug messages for all cable modems.

debug cable registration

Syntax

```
[no] debug cable registration
```

Enables modem registration request debug messages.

debug cable sid

Syntax

```
[no] debug cable sid {NNN} [verbose]
```

Enables debugging on the cable modem with the specified primary SID.

debug cable tlvs

Syntax

```
[no] debug cable tlvs
```

Enables Type-Length Value (TLV) debugging messages.

debug cable ucc

Syntax

```
[no] debug cable ucc
```

Enables or disables Upstream Channel Change (UCC) debugging messages. The cable modem to test must have debugging enabled.

debug envm

Syntax

```
[no] debug envm
```

Enables environment debugging messages.

debug ip

Syntax

```
[no] debug ip [rip]
```

Enables debugging messages. The options are:

rip Enables RIP debugging messages.

Example:

```
C3#debug ip

RIP protocol debugging is on
!Note: this debug message typde is non-blocking and some
    messages may be lost if the system is busy
!Note: debug messages of this type can only be displayed
on teh     console, not on telnet sessions

C3#debug ip rip

RIP protocol debugging is on
!Note”: this debug message ytpe is non-blocking and some
    messages may be lost if the system is busy
```

debug snmp

Syntax `[no] debug snmp`

Enables debug messages for SNMP.

debug syslog

Syntax `[no] debug syslog`

Enables debug messages for Syslog traffic.

debug telnet

Syntax

```
[no] debug telnet
```

Enables debug messages for incoming telnet sessions.

default cm subinterface

Syntax

```
default cm subinterface {cable 1/0.s}
```

Defines the sub-interface used for cable modem traffic until the cable modem receives an IP address from a DHCP server.

default cpe subinterface

Syntax

```
default cpe subinterface {cable 1/0.s}
```

Defines the sub-interface used as a source sub-interface for CPE traffic when that traffic has no VLAN tag or explicit mapping (using the **map-cpe** command).

docsis test

Syntax

```
[no] docsis test
```

Enables or disables writing to DOCSIS test mode MIBs. Use the command **docsis test** to make the MIBs read/write, allowing SNMP-based testing. Use the **no** form of this command to make the MIBs read-only.

enable password

Syntax

```
[no] enable password {string}
```

This command sets the initial password to the specified *string*. To clear the password, use the **no enable password** command.

enable secret

Syntax

```
[no] enable secret {string}
```

Sets the privileged mode encrypted password to *string*. If this password is not set, then the enable password is required for privileged mode access. To clear this password, issue the **no enable secret** command.

The password *string* must be at least 8 characters long.

If both the enable and enable secret passwords have not been set, the C3 disables access to privileged mode using telnet. You can still enter privileged mode using a direct serial connection to the C3.

exception

Syntax

```
[no] exception {auto-reboot | 3212-monitor {reboot |
reset}}
```

Enables automatic re-boot on crash, or when the C3 detects a problem on the cable interface.

The parameters are:

Keyword	Description
auto-reboot	Specifies automatic reboot after a system crash
3213-monitor	Specifies CMTS behavior upon detecting a problem on the downstream interface (**reboot** or **reset**)

file prompt

Syntax

```
file prompt {alert | noisy | quiet}
```

Instructs the C3 to prompt the user before performing certain types of file operations.

Keyword	Description
noisy	The CMTS asks the user to confirm all file operations
alert	The CMTS asks the user to confirm only destructive file operations
quiet	The CMTS asks the user to confirm only **format** or **erase** commands

help

Displays a list of available commands and a brief description of each command.

hostname

Sets the C3 host name.

ip default-gateway

Syntax

```
[no] ip default-gateway {ipaddr}
```

Sets the default gateway for DHCP relay and TFTP routing operations.

Use *show ip route*, page 10-20, to verify the current default gateway.

This specification has no effect in "ip routing" mode. In IP routing mode, the running configuration contains the default gateway but the specification has no action.

See also: *ip route*, page 10-143.

ip domain-name

Syntax

```
ip domain-name {string}
```

Sets the domain name for the CMTS. The string is a domain name such as **example.net**.

The commands **hostname** and **ip domain-name** both change the SNMP variable "sysName." For example, if sysName should be "cmts.example.net," use the following commands to set it up:

```
hostname "cmts"
ip domain-name "arrisi.com"
```

The prompt displayed at the CLI is the hostname only; using the example above, the prompt would be **cmts(config)#.**

ip route

Syntax

```
[no] ip route {ipaddr subnet gateway} [dist]
```

Adds a static route to the C3.

The parameters are:

Keyword	Description
ipaddr	Destination network or host IP address to be routed. In bridging mode, a **0.0.0.0** address and **0.0.0.0** mask has no effect. Use **ip default gateway** instead
subnet	Netmask (or prefix mask) of the destination network or host IP address to be routed. In bridging mode, a **0.0.0.0** address and **0.0.0.0** mask has no effect. Use **ip default-gateway** instead
gateway	IP address that has routing knowledge of the destination IP address.
dist	The optional administrative distance for this route. Valid range: **1** to **255**. Default: **1**

In bridging mode, this command can be used to provide routing information for the DHCP relay function and specifically when "cable helper-address <N.N.N.N>" is used. The helper-address specified may not be on a subnet known to the Cadant C3 or known to the Cadant C3 default route (eg the DHCP server specified is behind an external router and this router is NOT connected to the management port).

Different gateways may be given for the same route with different administrative distances. The C3 uses the lowest administrative distance until the route fails, then uses the next higher administrative distance, and so on. Up to 6 static routes may be configured in this manner. The route to a connected subnet (subnet of a sub-interface) always has an administrative distance of 0, this is the first route selected if there is any conflict with a static route.

In case of two static routes to the same subnet with equal administrative distances, the C3 uses the first provisioned route. If that route fails, then the C3 uses the next route. After a reboot, the C3 uses the first static route defined in the startup-configuration file. An example of this is shown following—refer to the 6 static routes (*) and (**) for network 15.0.0.0/24.

Example C3#show ip route

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - ICMP, B - BGP
       E - EGP, G - GGP, O - OSPF, ES - ES-IS, IS - IS-IS
       * - candidate default, > - primary route

Gateway of last resort is 10.250.96.1 to network 0.0.0.0

S*   0.0.0.0/0 [1/0] via 10.250.96.1, FastEthernet 0/1.0
     4.0.0.0/24 is subnetted, 1 subnet
R    4.4.4.0 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
<<<<< rip learned - default AD=120
     5.0.0.0/24 is subnetted, 1 subnets
S>   5.5.5.0 [130/0] via 10.250.96.7, FastEthernet 0/1.0
<<<< primary static with AD changed to 130
S           [130/0] via 10.250.96.8, FastEthernet 0/1.0
<<<< backup static
     7.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
R    7.0.0.0/24 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
R    7.0.0.0/8 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
R    7.7.0.0/16 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
     10.0.0.0/24 is subnetted, 4 subnets
C    10.7.8.0 is directly connected, Cable 1/0.9
<<<< directly connected to c3 (configured on sub-int AD=0)
C    10.250.96.0 is directly connected, FastEthernet 0/1.0
C    10.250.99.0 is directly connected, FastEthernet 0/0.0
C    10.250.103.0 is directly connected, bridge-group #0
     15.0.0.0/24 is subnetted, 1 subnets
S>   15.5.5.0 [1/0] via 10.7.8.10, Cable 1/0.9
<<< static with default AD=1 (*)
S            [1/0] via 10.7.8.11, Cable 1/0.3
<<<< backup static, AD=1, second in config file (**)
S             [1/0] via 10.7.8.110, Cable 1/0.3
<<<< backup static, AD=1, 3 in config file (**)
S             [1/0] via 10.71.8.11, Cable 1/0.30
<<<< backup static, AD=1, 4 in config file (**)
S             [1/0] via 10.72.8.11,  FastEthernet 0/0.5
<<<< backup static, AD=1, 5 in config file (**)
S             [1/0] via 100.78.8.11, Cable 1/0.23
<<<< backup static, AD=1, 6 in config file (**)
     79.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R    79.79.79.0/24 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
R    79.79.79.101/32 [120/2] via 10.250.96.102, 00:00:03, FastEthernet 0/1.0
```

In bridging mode — One purpose for static routes is to provide routing information for the DHCP relay function. Specifically, when:

using the **cable helper-address** command, and

the specified helper address is not on a subnet known to the C3; for example, when the DHCP server specified is behind an external router and the router is not connected to the management port. The IP address specified with this command is not on a subnet known by the Cadant C3 IP stack. For example: the DHCP server specified is behind an external router and this router is NOT connected to the management port.

NOTE
This command cannot be used to add a default gateway in bridging mode. i.e. a "0.0.0.0 0.0.0.0" address and mask will have no effect in bridging mode. Use "ip default-gateway" instead.

In IP routing mode — This command adds a static route to the C3. Use the address mask **0.0.0.0 0.0.0.0** to add a route of last resort to the C3 routing table.

See also: *cable dhcp-giaddr*, page 10-215, *cable helper-address*, page 10-216, *ip route*, page 10-143, *show ip route*, page 10-20, *ip default-gateway*, page 10-142.

ip routing

Syntax

```
[no] ip routing
```

Turns on IP routing in the C3.

Must be executed from global configuration mode.

Starting IP routing retains configured bridge groups, sub-interfaces, VLAN IDs, and Layer 2 bindings between sub-interfaces. If pure IP routing is required, issue a **no bridge-group** command for each defined sub-interface.

The serial console reports the changed interface conditions. Changing from basic bridge operation to routing operation is shown as follows:

Init OK Logical i/f #0 (sbe0) changing state to ATTACH;

Logical i/f #1 (sbe1) changing state to ATTACH;

See also: *router rip*, page 10-158, *show ip route*, page 10-20, *Router Configuration Mode*, page 10-248.

ip ssh

These commands manage the C3 SSH server.

See also: *Configuring SSH*, page 8-38.

ip ssh authentication-retries

Syntax

```
[no] ip ssh authentication-retries {number}
```

Sets the number of authentication retries for SSH access. The default is **3**.

ip ssh port

Syntax

```
[no] ip ssh port {number}
```

Sets the TCP port at which the C3 listens for SSH connections. The default is port **22**.

ip ssh server

Syntax

```
[no] ip ssh server enable
```

Enables or disables the C3 SSH server.

ip ssh timeout

Syntax

```
[no] ip ssh timeout {secs}
```

Sets the SSH session idle timeout. The default is **0**, which disables session timeout.

ip ssh version

Syntax

```
[no] ip ssh version {1 | 2}
```

Enables or disables SSHv1 or SSH v2 connections. The default is to allow either version.

login user

Syntax

```
[no] login user [name string1 ] | [password string2]
```

Changes the user level login name and password for vty (telnet) sessions.

Example:

```
C3#login user ?
```

name Change login user name

password Change login user password

```
C3#login user name ?

<STRING>          -


C3#login user name arris

C3#login user password c3cmts

C3#
```

See also: *Initial Configuration*, page 3-10, to set the password for privilege access level.

logging buffered

Syntax

```
[no] logging buffered [severity]
```

Enables local logging of events in a circular buffer. If not buffered, events are written only to the console. The option is:

severity Severity level, 0 to 7.

logging on

Syntax

```
[no] logging on
```

Enables all syslog messages, traps, and local logging. To disable, use the **no logging on** command.

logging severity

Syntax

```
[no] logging severity {level} {local | no-local}
{trap | no-trap} {sys | no-sys} {vol | no-vol}
```

Controls event generation by the severity level of the event. The parameters are:

Keyword	Description
level	Configures the specified severity level
local or no-local	Enables or disables local logging for the specified security level
trap or no-trap	Enables or disables trap logging for the specified security level
sys or no-sys	Enables or disables syslog logging for the specified security level.
vol or no-vol	Enables or disables local volatile logging for the specified security level

Factory default settings are:

- logging thresh none
- logging thresh interval 1
- logging severity 0 local no-trap no-sys no-vol
- logging severity 1 local no-trap no-sys no-vol
- logging severity 2 local trap sys no-vol
- logging severity 3 no-local trap sys vol
- logging severity 4 no-local trap sys vol
- logging severity 5 no-local trap sys vol
- logging severity 6 no-local no-trap no-sys no-vol
- logging severity 7 no-local no-trap no-sys no-vol

See also: *elog*, page 10-38, *logging severity*, page 10-149, *logging thresh*, page 10-151, *logging trap*, page 10-152, *logging syslog*, page 10-150.

logging syslog

Syntax

```
[no] logging syslog [host ipaddr | level]
```

Enables syslog logging to the specified IP address, or set the syslog logging severity level (**0** to **7**).

Use the **no** form of this command to clear the syslog IP address. If no IP addresses are specified, the C3 sends no syslog messages.

logging thresh

Syntax

```
logging thresh {all | at events1 | below events2 |
interval sec | none}
```

Limits the number of event messages generated. The parameters are:.

Keyword	Description
all	Blocks logging of all events
at	Sets the number of events to allow. Valid range: **0** to **2147483647** events
below	Maintains logging below this number of events per interval. Valid range: **0** to **2147483647** events
interval	Sets the event logging event interval (used with **below**). Valid range: **1** to **2147483647** seconds
none	Sets the logging threshold to be unconstrained

Factory default settings are:

- logging thresh none
- logging thresh interval 1
- logging severity 0 local no-trap no-sys no-vol
- logging severity 1 local no-trap no-sys no-vol
- logging severity 2 local trap sys no-vol
- logging severity 3 no-local trap sys vol
- logging severity 4 no-local trap sys vol
- logging severity 5 no-local trap sys vol
- logging severity 6 no-local no-trap no-sys no-vol
- logging severity 7 no-local no-trap no-sys no-vol

See also: *logging severity*, page 10-149, *logging thresh*, page 10-151, *logging trap*, page 10-152, *logging syslog*, page 10-150, *logging buffered*, page 10-148.

logging trap

Syntax

```
[no] logging trap [level]
```

Enables or disables transmission of SNMP traps. To disable, use the **no logging trap** command.

The optional ***level*** (0 to 7) logs all traps with a priority higher or equal to the level specified.

logging trap-control

Syntax

```
[no] logging trap-control {val}
```

Sets the value of the docsDevCmtsTrapControl MIB to enable or disable CMTS SNMP traps.

Use a hexadecimal value for **val**. The MIB consists of 16 bits, with bit 0 being the most significant bit. Set a bit to **1** to enable the corresponding trap, **0** to disable it. The bits are:

Bit	Name	Description
0	cmtsInitRegReqFailTrap	Registration request fail
1	cmtsInitRegRspFailTrap	Registration response fail
2	cmtsInitRegAckFailTrap	Registration ACK fail
3	cmtsDynServReqFailTrap	Dynamic Service request fail
4	cmtsDynServRspFailTrap	Dynamic Service response fail
5	cmtsDynServAckFailTrap	Dynamic Service ACK fail
6	cmtsBpiInitTrap	BPI initialization
7	cmtsBPKMTrap	Baseline Privacy Key Management
8	cmtsDynamicSATrap	Dynamic Service Addition
9	cmtsDCCReqFailTrap	Dynamic Channel Change request fail
10	cmtsDCCRspFailTrap	Dynamic Channel Change response fail
11	cmtsDCCAckFailTrap	Dynamic Channel Change ACK fail

mac-address-table

Syntax

```
mac-address-table {static <n.n.n>}
```

Creates a static FDB entry to the specified MAC address.

mib ifTable

Syntax

```
mib ifTable {index} {down_ifAdmin | test_ifAdmin |
up_ifAdmin} {disable_ifLinkTrap | enable_ifLinkTrap}
{alias}
```

Sets or overrides the administrative state of an interface. The parameters are:.

Keyword	Description
index	The ifIndex of the interface to change: **1** - The FE0 Ethernet port (fastethernet 0/0) **2** - The FE1 Ethernet port (fastethernet 0/1) **3** - The MAC layer cable interface **4** - The downstream cable interface **5** to **10** - Thee upstream cable interfaces **11** to **35** - The upstream cable logical channels
down_ifAdmin	Sets the interface state to administratively down
up_ifAdmin	Sets the interface state to administratively up
test_ifAdmin	Sets the interface state to administratively test
disable_ifLinkTrap	Will not generate traps if this interface changes state. This is the default state for interfaces of type **docsCableMaclayer** and **docsCableUpstream**
enable_ifLinkTrap	Generates traps if this interface changes state. This is the default state for interfaces of type **ethernetCsmacd**, **docsCableDownstream**, or **docsCableUpstreamChannel**.
alias	Displays this interface name

The command “shutdown” and “no shutdown” provides a CLI means to shutdown or enable an interface but with the cable upstream and cable downstream interfaces, the interface is really composed of a CABLEMAC part and PHY part—the state of both interfaces in the MIB really define the state of the interface being referenced by the “shutdown” command.

If SNMP is used to change the state of one interface of such a “pair” and not the other interface, the CLI state of “shutdown” or “no shutdown” no longer applies—the user cannot know for sure from the CLI what is happening. Thus, the running configuration includes the current state of all interfaces and the CLI allows correction of such inconsistencies without using SNMP using the **mib** command (if the state has been altered remotely by SNMP). This possibility can occur on the downstream and upstream interfaces.

Example: what changes when an interface is shutdown in a 1x2 ARRIS Cadant C3.

```
C3#conf t
C3(config)#interface cable 1/0
C3(config-if)#no cable upstream 0 shutdown
C3(config-if)#no cable upstream 1 shutdown
C3(config-if)#show run | inc MIB
MIB ifTable 1 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 2 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 3 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 4 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 5 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 6 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 11 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 12 up_ifAdmin Enable_ifLinkTrap " "
```

Or from an SNMP viewpoint:

```
SNMP table , part 2
index                                           Descr
    1 ETH WAN - ARRIS C3 - Broadcom 5421 Rev A1
    2 ETH MGT - ARRIS C3 - Broadcom 5421 Rev A1
    3     MAC - ARRIS C3 - Broadcom 3212 Rev B1
    4    DS 1 - ARRIS C3 - Broadcom 3034 Rev A1
    5 US IF 1 - ARRIS C3 - Broadcom 3138 Rev A2
    6 US IF 2 - ARRIS C3 - Broadcom 3138 Rev A2
   11 US CH 1 - ARRIS C3 - Broadcom 3138 Rev A2
   12 US CH 2 - ARRIS C3 - Broadcom 3138 Rev A2

SNMP table , part 3
index                Type
    1      ethernetCsmacd
    2      ethernetCsmacd
    3   docsCableMaclayer
    4 docsCableDownstream
    5   docsCableUpstream
    6   docsCableUpstream
   11                 205
   12                 205

SNMP table , part 7
index AdminStatus
    1          up
    2          up
    3          up
    4          up
    5          up
    6          up
   11          up
   12          up
```

```
C3(config-if)#cable upstream 1 shutdown

C3(config-if)#show run | inc MIB
```

```
MIB ifTable 1 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 2 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 3 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 4 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 5 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 6 down_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 11 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 12 down_ifAdmin Enable_ifLinkTrap " "

SNMP table , part 7
index AdminStatus
    1          up
    2          up
    3          up
    4          up
    5          up
    6        down
   11          up
   12        down
```

Standard IANAtypes	Description
docsCableMaclayer(127)	CATV MAC Layer
docsCableDownstream(128)	CATV Downstream interface
docsCableUpstream(129)	CATV Upstream interface
docsCableUpstream(129)	CATV Upstream interface
docsCableUpstreamChannel(205)	CATV Upstream Channel
docsCableUpstreamChannel(205)	CATV Upstream Channel
docsCableUpstreamChannel(205)	CATV Upstream Channel
docsCableUpstreamChannel(205)	CATV Upstream Channel

Corresponding SNMP MIB variables

Parameter	MIB variable
<index>	ifIndex
downIfAdmin	ifAdminStatus
testIfAdmin	ifAdminStatus
upIfAdmin	ifAdminStatus
disable_ifLinkTrap	ifLinkUpDownTrapEnable
enable_ifLinkTrap	ifLinkUpDownTrapEnable
<alias>	ifAlias

Example: The current state of all the interfaces is reported in the running configuration.

```
C3#show run | inc MIB

MIB ifTable 1 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 2 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 3 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 4 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 5 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 6 up_ifAdmin Disable_ifLinkTrap " "
MIB ifTable 11 up_ifAdmin Enable_ifLinkTrap " "
MIB ifTable 12 up_ifAdmin Enable_ifLinkTrap " "
```

ntp

Syntax

```
[no] ntp {server ipaddr} [interval int | delete |
disable | enable | master]
```

Configures C3 time and date using an external NTP server.

The parameters are:

Keyword	Description
server	Sets the address of the Network Time Protocol server
delete	Removes the specified NTP server from the list
disable	Disables polling of the specified server
enable	Enables polling of a previously disabled server
interval	The time, in seconds, the C3 waits between NTP updates. Valid range: **1** to **2147483647** seconds
master	Designates the specified server as the master.router ospf

phs-enable

Syntax

```
phs-enable
```

Enables PHS support.

router ospf

Syntax

```
[no] router ospf
```

Enables or disables the Open Shortest Path First (OSPF) routing process. This command is only available if Layer 3 mode of operation has been enabled, using the **ip routing** command in global configuration mode.

IP routing must be enabled, and OSPF must be licensed, before the C3 executes this command. If IP routing is not enabled, the CMTS generates an error message.

NOTE
No OSPF configuration is applied until the OSPF configuration mode is exited, using the **exit** command. Also note that no **show** commands are available within the OSPF router configuration mode.

To disable OSPF routing, use the command **no router ospf**. The C3 keeps the configuration in memory; to completely erase OSPF data you must disable routing, save the configuration, then reboot the C3.

router rip

Syntax

```
[no] router rip
```

Enter router configuration mode.

IP routing must be enabled and RIP must be licensed before this command can be executed. If IP routing is not enabled, the CMTS generates an error message.

See also: *Router Configuration Mode*, page 10-248.

snmp-access-list

Syntax

```
Syntax:[no] snmp-access-list {list-name} {deny |
permit} {any | host {host-name | ipaddr} [port port]
| subnet mask}
```

Creates an SNMP access list.

The parameters are:

Keyword	Description
server	Sets the address of the Network Time Protocol server
host-name	The FQDN of the host
port	Port number. Valid range: **0** to **65536**
ipaddr	The host IP address
subnet	Subnet from which access to be controlled
mask	Subnet mask for this subnet

snmp-server

The **snmp-server** commands are designed around the SNMPv3 framework. Internally the C3 SNMP agent exclusively processes all SNMP transactions as SNMPv3 messages and communicates with external SNMP entities. The SNMPv3 agent can translate incoming and outgoing SNMP messages to and from SNMPv1, SNMPv2, and SNMPv2c.

The following commands are provided in logical rather than alphabetical order to make understanding easier.

A **view** defines what part of a MIB can be accessed.

A **group** defines what operations can be performed on a view with a security model.

A **user** is assigned to a group but user must have same security model.

A **notification** security model is assigned to a user.

A **host** is assigned to a security model to receive traps or informs.

Example shown step by step on the following command specifications:

```
C3(config)# snmp-server view MyTrapNotify internet included
C3(config)# snmp-server group MyGroup v2c notify MyTrapNotify
C3(config)# snmp-server user MyCommunity MyGroup v2c access-list Trap
C3(config)# snmp-server notif-sec-model MySecurity MyCommunity v2c security-model
v2
C3(config)# snmp-server host MyTrapReceiver MySecurity 192.168.250.107 traps
C3(config)# snmp-server enable traps
```

The host now receives traps or informs from the defined subset (internet) of the C3 MIB using defined security.

snmp-server view

Syntax

[no] snmp-server view {view-name} {mib-family} [mask mask] {excluded | included}

Creates or adds to an existing SNMP MIB view. A view defines which MIB sub-tree (MIB families) can be acted upon by an SNMP transaction. A transaction is defined by the **snmp-server group** command, and may be read/write or notify.

The parameters are:

Keyword	Description
view	Specifies the SNMP view by name. The factory default configuration includes two predefined views, **docsis-ManagerView** and **internet** (see below for details)
mib-family	Specifies a MIB sub-tree by name, and whether that sub-tree is to be included or excluded in this view. To add other MIB families in the same view, repeat this command with the same view name and a different MIB family
mask	A bit mask, used to create more complex rules. The mask is a list of hexadecimal octets separated by colons, such as **a0:ff**. The most significant bit of the first octet corresponds to the leftmost identifier in the OID. Thus, the command **snmp-server view test 1.3.5 mask A0 excluded** matches OIDs starting with 1.1.5, but not with 1.3.4 since the first and third bits of the mask are 1s

Views are unique and are stored in the SNMP table:

iso.dot.org.dod.internet.snmpV2.snmpModules.snmpVacmMIB.vacmMIB-Views;

.vacmViewTreeFamilyTable

In this SNMP table, views are indexed by the view name and the MIB subtree OID.

The factory default views are:

Keyword	Description
internet	A pre-defined view that includes all OIDs under **iso.org.dod.internet.**
default	If the C3 is rebooted with no startup-configuration, the default configuration has no SNMP settings. When a community is created with the **snmp-server community** command, the view used is called "default."

If the C3 is rebooted with no startup-configuration, the default configuration has no SNMP settings. When a community is created with the **snmp-server community** command, the view used is called "default."

The example shown following defines a view which includes all OIDs under iso.org.dod.internet. For a notification view, it means that only notifications whose OIDs starts with iso.org.dod.internet can be sent by a user, the user being a member of a group, a group defining actions that can be taken with this view.

Although the MIB subtree "internet" is used in the following example, the subtree can be specified using the SNMP interface to the C3.

```
C3(config)# snmp-server view MyTrapNotify internet
included
```

The following example shows SNMP parameters created for a default view.

```
C3(config)#snmp-server community public ro
C3(config)#
C3(config)#show snmp-server
snmp-server contact "support@arrisi.com"
snmp-server location "3871 Lakefield Drive, Suite 300, Suwanee, GA 30024"
snmp-server engineboots 1
snmp-server view "default" "iso" included
snmp-server view "default" "snmpResearch" excluded
snmp-server view "default" "snmpTargetMIB" excluded
snmp-server view "default" "snmpNotificationMIB" excluded
snmp-server view "default" "snmpUsmMIB" excluded
snmp-server view "default" "snmpVacmMIB" excluded
snmp-server view "default" "snmpCommunityMIB" excluded
snmp-server group "public" v1 read "default"
snmp-server group "public" v2c read "default"
snmp-server user "public" "public" v1
snmp-server user "public" "public" v2c
```

```
snmp-server community-entry "Community1" "public" "public"
C3(config)#
```

snmp-server group

Syntax

[no] snmp-server group {group-name} {v3 {auth | noauth | priv} | v2c | v1} [notify view] [read view] [write view]

Defines one or more transaction types a user can perform: read transaction, write transaction, or notify transaction. Each enabled transaction type must reference a view (defined using *snmp-server view*, page 10-160).

A group is identified by a group name (*group-name*), a security model, and the referenced *view*.

In a group, you can set a **read** view, a **write** view, and a **notify** view. A read view and a write view allows a user to respectively do SNMP GET and SNMP SET transactions on some MIB families (defined by the respective views). The **notify** view supports SNMP TRAP transactions.

The C3 predefines two groups, **public** and **private**, which correspond to the public and private SNMP community strings. The **public** group has read access; the **private** group has read and write access.

The example following and the example at the top of this section is focused on notification, but you can also create extra SNMP access lists to extend the default public and private community strings. For example, to disable the default public and private community strings, use the following commands:

```
no snmp-server group public v1
no snmp-server group public v2c
no snmp-server group private v1
no snmp-server group private v2c
```

To enable them again, use the following commands:

```
snmp-server group public v1 read default
snmp-server group public v2c read default
snmp-server group private v1 read default write default
```

```
snmp-server group public v2c read default write default
```

“default” is a predefined view in the C3 that allows access to all MIBs under the ISO family tree. Similarly, “public” and “private” are pre-defined group names allowing read access and read/write access, respectively.

A user (created by **snmp-server user**) can only be part of a group if they share the same security model.

Groups are unique and are stored in the SNMP table vacmAccessTable and users are stored in vacmSecurityToGroupTable:

> iso.dot.org.dod.internet.snmpV2.snmpModules.snmpVacmMIB.vacmMIBObjects;
>
> .vacmSecurityToGroupTable

and

> iso.dot.org.dod.internet.snmpV2.snmpModules.snmpVacmMIB.vacmMIBObjects;
>
> .vacmAccessTable

Example:

```
C3(config)# snmp-server group MyGroup v2c notify
MyTrapNotify
```

To add **MyCommunity** as a community string for SNMPv2c GETs as well as for notifications, use the following command:

```
C3(config)# snmp-server MyGroup v2c read myTrapNotify
notify MyTrapNotify
```

Now **MyGroup** may be used as view for both SNMP TRAP and SNMP GET transactions.

snmp-server user

Syntax

```
For (v1, v2c):
```

```
[no] snmp-server user {username} {group} {v2c | v1}
[snmp-access-list list]
```

Syntax

```
For (v3):
```

```
[no] snmp-server user {username} {group} v3 [{auth
{md5 | sha} passwd [priv des56 passwd2]} | enc]
[snmp-access-list list]
```

Defines an SNMP user.

The parameters are:

Keyword	Description
username	Specifies the user name string
group	Specifies the user security model group (**snmp-server group**)
V3 | v2c | v1	Specifies the SNMP version (and security model) to use. This must match the SNMP version specified in the group definition
list	Defines what ranges of IP addresses can perform gets/sets or receive notifications from SNMP

A user must be part of a group, which defines what type of transactions that user may perform. Use **snmp-server group** to create groups.

The **snmp-access-list** option applies only to notifications and defines which “notifications receivers” can receive notifications from that user. This argument is optional and if it is left out then all notification listeners are notified from the user.

Valid notifications receivers are defined by a list of rows in:

iso.dot.org.dod.internet.snmpV2.snmpModules.snmpNotification;

.snmpNotifyObjects.snmpNotifyTable.

Each row in this table is identified by a tag and defines the notification transport model. This table is not editable from the C3 CLI, but the C3 predefines two rows whose tags are **Trap** and **Inform** (the name implies the notification model). See *snmp-server host*, page 10-168 for more information.

Users are unique and are stored in the SNMP table:

iso.dot.org.dod.internet.snmpV2.snmpModules.snmpUsmMIB.usmMIBObjects;

.usmUser.usmUserTable

SNMPv3 uses a “user” security model for transactions. A user is defined by a security name and a security model (SNMPv1, SNMPv2, SNMPv3, etc...). SNMPv1 and SNMPv2 use a community string instead of a user. Thus, the C3 automatically converts a user name to a community string when a SNMPv3 message is converted to SNMPv2 and vice-versa.

Example:

```
C3(config)# snmp-server user MyCommunity MyGroup v2c ;
 access-list Trap
```

snmp-server notif-sec-model

Syntax

```
[no] snmp-server notif-sec-model
{security-identifier} {user-name-string} {v1 | v2c |
v3} {security-model {v1 | v2 | usm {auth | priv}}}
```

Defines a notification security model entry with identifier **security-identifier** and assigns this model to **user-name-string**.

A notification security model entry is used to define the parameters for the creation of traps and inform packets for a security model (SNMPv1, SNMPv2, SNMPv2c, SNMPv3, etc...). Those required parameters are a security model, user and one of the following authentication and privacy combinations:

- no authentication, no privacy
- need authentication, no privacy
- no authentication, need privacy
- need authentication, need privacy

The authentication and privacy schemes are selected in the user definition (SHA1, MD5, etc. for authentication and DES, etc. for privacy).

Only an SNMPv3 notification security model supports authentication and privacy schemes, hence no combination needs be specified for SNMPv1, SNMPv2, or SNMPv2c models whose schemes defaults to no authentication, no privacy. However, for these models, a community string is required, which is specified by the security name in the user definition.

The SNMP table:

iso.dot.org.dod.internet.snmpV2.snmpModules.snmpCommunityMIB

.snmpCommunityObjects.snmpCommunityTable

maps a security name to a community string, and using this CLI command implicitly creates an entry in this table where the security name and community string are identical.

Network security models are stored in the SNMP table:

iso.dot.org.dod.internet.snmpV2.snmpModules.snmpTargetMIB

.snmpTargetObjects. snmpTargetParamsTable

Example:

```
C3(config)# snmp-server notif-sec-model MySecurity
MyCommunity v2c security-model v2
```

snmp-server host

Syntax

```
[no] snmp-server host {notification-identifier}
{security-identification} {ipaddr | hostname} {traps
| informs} [udp-port port [timeout time [retries
retry]]]
```

Defines a host for each notification target or receivers. A host definition requires a notification security model, a transport type, a host address and one or more notification transport model tags.

The parameters are:

Keyword	Description
notification-identifier	A string identifying the notification device (the CMTS)
security-identification	The community string or password
ipaddr	IP address of the host
hostname	Qualified name of the host
udp-port	UDP prot number (default 162)
timeout	1-2147483647 seconds
retries	1-255 retries

The CLI command defaults the transport type to UDP, hence the host address must be specified using an IP address and an optional UDP port (defaults to 162).

Notification tags are specified by the **traps** or **informs** argument, which imply the 'Trap' or 'Inform' notification transport model tag.

Hosts are stored in the SNMP table:

iso.dot.org.dod.internet.snmpV2.snmpModules.snmpTargetMIB

.snmpTargetObjects.snmpTargetAddrTable

Example:

```
C3(config)# snmp-server host MyTrapReceiver MySecurity
192.168.250.107 traps
```

More examples: set up an IP address to receive traps/informs

snmp-server host < ***notification-identifier*** **> <** ***security-indentification*** **> <N.N.N.N> traps**

```
snmp-server host <> <> <N.N.N.N> traps udp-port <0-65535>

snmp-server host <> <> <N.N.N.N> traps udp-port <> timeout
<0-2147483647>

snmp-server host <> <> <N.N.N.N> traps udp-port <> timeout
<> retries <0-255>

snmp-server host <Notification Identifier string>
<Notification Security Identifier string> <N.N.N.N>
informs

snmp-server host <> <> <N.N.N.N> informs udp-port <0-
65535>

snmp-server host <> <> <N.N.N.N> informs udp-port <>
timeout <0-2147483647>

snmp-server host <> <> <N.N.N.N> informs udp-port <>
timeout <> retries <0-255>
```

snmp-server enable

Syntax **snmp-server enable {informs | traps}**

Enables configured traps or informs.

Example:

```
C3(config)# snmp-server enable traps
```

snmp-server disable

Syntax

```
snmp-server disable informs  {v2c | v3} or
snmp-server disable traps {v1 | v2c | v3}
```

Disables configured traps or informs.

Example:

```
C3(config)# snmp-server disable traps v2c
```

snmp-server engineid

Syntax

```
snmp-server engineid remote {string} {user-name}
[auth {md5 | sha}]
```

Configures a remote SNMPv3 engineID.

The parameters are:.

Keyword	Description
string	Octet string, in hexadecimal. Separate each octet by a colon
username	User name as a string
md5	Use the MD5 algorithm for authorization
sha	Use the SHA algorithm for authorization

snmp-server community

Syntax

```
[no] snmp-server community {community_name} {access}
[snmp-access-list name] [view mib-family {included |
excluded}]
```

Allows SNMP access to the C3 from the specified IP address and subnet using the specified community name.

Keyword	Description
access	One of the following: **ro** - read only **rw** - read and write
snmp-access-list	Specifies a defined access list
view	Specifies a defined view

Example:

```
C3(config)# snmp-access-list test permit host 1.2.3.4

C3(config)# snmp-server community jim ro snmp-access-list
test
```

or

```
C3(config)# snmp-server community jim ro snmp-access-list
test view docsisManagerView included
```

snmp-server contact

Syntax

```
[no] snmp-server contact {contact-string}
```

Sets the contact string for the C3. Typically, the contact string contains the name and number of the person or group that administer the C3. An SNMP manager can display this information.

snmp-server location

Syntax

```
[no] snmp-server location {location-string}
```

Sets the system location string. Typically, the location string contains the location of the C3.

snmp-server notif-entry

Syntax

```
[no] snmp-server notif-entry {name} {tag-value tag}
{trap | inform}
```

Configures or deletes a notification entry in the snmpNotifyTable.

The parameters are:.

Keyword	Description
name	The name of the notification entry. Must be a unique string, up to 32 characters long
tag	The tag value that selects an entry in the snmpTargetAddrTable (created, for example, by the **snmp-server host** command). Use an empty string (“”) to select no entry

Keyword	Description
trap	Messages generated for this entry are sent as traps
inform	Messages generated for this entry are sent as informs

snmp-server community-entry

Syntax

```
[no] snmp-server community-entry {index} {community-name} {user-name}
```

Configures or deletes an entry in the snmpCommunityEntry table. You can use this command to change the community entry for a user, previously defined by the **snmp-server user** command.

The parameters are:.

Keyword	Description
index	The name of an entry in the snmpCommunityEntry table. The **snmp-server user** command automatically creates an entry in this table
community-name	The community name to assign to this user (defined, for example, by the **snmp-server community** command)
user-name	The user name to assign to this community entry

The **snmp-server user** command creates an entry with identical community and user names. If you change one or the other, the C3 looks for the community name in messages from SNMP clients.

The user must be associated with a group of the same type **(v1 or v2c)** for the community entry to be useful.

tacacs key

Syntax

```
[no] tacacs key <string>}
```

Configures or deletes the per-server encryption key. The parameters are:

string The unencrypted (cleartext) shared key.

tacacs-server host

Syntax

```
[no] tacacs-server host {ip_addr}
```

Configures or deletes TACACS+ server. The parameters are:

ip_addr IP address of the TACACS server (in a.b.c.d form)

tacacs-server key

Syntax

```
[no] tacacs-server key {string}
```

Configures or deletes the TACACS+ encryption key. The parameters are:

string Default TACACS+ key

tacacs-server source-address

Syntax

```
[no] tacacs-server source-address {input}
```

Configures or deletes a source IP address of outbound TACACS+ packets. The parameters are:

input	Source IP address (in a.b.c.d form)

tacacs-server timeout

Syntax

```
[no] tacacs-server source-address {0-1000}
```

Configures or deletes the time to wait for a TACACS server to reply. The parameters are:

0-1000	Wait time in seconds (default is no timeout)

Mode 6 *Configure-keychain-key Mode*

key chain

Syntax

```
[no] key chain {name}
```

Enters keychain configuration mode for defining router authentication keychains. The [**no**] form of this command removes a keychain. In keychain configuration mode, the prompt is **C3(config-keychain)#**.

key-id

Syntax

```
[no] key-id {n}
```

Enters individual key configuration mode for the specified key (valid range: **0** to **255**). Upon entering the command, the prompt changes to **C3(config-keychain-key)#**.

Commands available are:

Command	Description
accept-lifetime *starttime* {duration *n* | infinite | *stoptime*}	Sets the accept lifetime for the key. The parameters are: ***starttime***, ***stoptime***: the time to start and stop accepting this key. The format is *hh*:*mm*:*ss day month year* **duration**: the number of seconds to accept this key. Valid range: **1** to **2147482646** seconds. **infinite**: always accept this key. The default is to accept the key immediately, with an infinite lifetime.
end	Exit to keychain configuration mode.
exit	Exit configuration mode to privileged mode.
help	Display this list of subcommands.
[no] key-string *name*	Set or delete the text for this key.
send-lifetime *starttime* {duration *n* | infinite | *stoptime*}	Sets the send lifetime for the key. The parameters are: *starttime*, *stoptime*: the time to start and stop sending this key. The format is *hh*:*mm*:*ss day month year* **duration**: the number of seconds to send this key. Valid range: **1** to **2147482646** seconds. **infinite**: always send this key. The default is to allow sending the key immediately, with an infinite lifetime.
show item	Show system info.

The [**no**] form of this command removes the specified key from the keychain.

See also: *show key chain*, page 10-21, *ip rip authentication*, page 10-185.

Mode 7 *Configure Line Mode*

line

Syntax

```
line {console | vty start end}
```

Configures default CLI parameters for the current user. When a new user logs into the CLI, the default CLI parameters come from the running-configuration line specifications. You can use the **terminal** commands to change your settings for the current session, but the settings revert to the defaults on the next login.

The options are:.

Keyword	Description
console	Configures the serial console
vty <start> <end>	Configures a range of telnet sessions

Upon entering the line command, the prompt changes to **C3(config-line)#**.

Commands available are:

Command	Description
end	Exits configuration mode.
exit	Exits configuration mode.
help	Displays this list of subcommands.
length	Changes the number of lines in the terminal window.
line	Configures console or telnet
login	Changes login user name or password
[no] monitor	Turns on debug output. Use the no option to turn off debug output.
show	Shows system info.
timeout	Set the inactivity timeout.
vt100-colors	Enables ANSI colors
width	Changes the number of columns in the terminal window.

Example:

C3(config)#line vty 0 3 —

```
Configuring telnet lines 0 to 3
C3(config-line)#timeout 0
C3(config-line)#exit
C3(config)#
```

Mode 8 Interface Configuration Commands

Use Interface configuration mode to configure the cable and Ethernet interfaces. When in this mode, the prompt changes to **C3(config-if)#** or **C3(config-subif)#** .

interface

Syntax

```
[no] interface {type} {number}
```

Enter Interface configuration mode. To remove a specified sub-interface, use the no version of the command.

Keyword	Description
type	Either **cable** or **fastethernet**
number	Either **X/Y** or **X/Y.Z** (defines a sub-interface)

Common Interface Subcommands for Cable and fastEthernet Interfaces

The following subcommands may be used on both cable and fastEthernet interfaces.

bridge-group

Syntax **[no] bridge-group {n}**

Assign this interface to the specified bridge group.

See also: *bridge*, page 10-104, *bridge-group*, page 10-181, *show bridge*, page 10-50.

description

Syntax **[no] description {text}**

Sets the textual description of the interface.

Scope: Not applicable to a cable sub-interface.

end/Ctrl-Z

Exit interface configuration mode to privileged mode.

exit

Exit interface configuration mode to configuration mode.

interface

Syntax **interface {cable | fastethernet | X/Y}**

Changes to a different interface configuration mode without having to exit the current configuration mode first.

See also: *Common Interface Subcommands for fastEthernet Interfaces (only)*, page 10-189, *interface cable*, page 10-193.

ip access-group

Syntax **[no] ip access-group {access-list-number} {in | out}**

Associates an ACL with a specific interface.

You must assign an ACL to an interface with a direction for the ACL to have any effect. For example, only when an ACL is assigned to a CMTS interface with an **in** direction does the source IP specification refer to a device external to the CMTS.

See also: *access-list*, page 10-100, *show access-lists*, page 10-47, and Chapter 8, *Configuring Security*.

ip directed-broadcast

Syntax **[no] ip directed-broadcast**

Enable or disable directed subnet broadcast forwarding on this interface.

ip l2-bg-to-bg routing

Syntax **[no] ip l2-bg-to-bg-routing**

Enables or disables IP routing of IP packets received at a sub-interface where the sub-interface must act as an IP gateway to other C3 sub-interfaces or devices connected to other C3 sub-interfaces.

You should allow management-access on this sub-interface to allow ARP to succeed.

If a layer 2 data frame containing an IP packet arrives at a sub-interface with a layer 2 destination MAC address of the C3 sub-interface, the C3 drops the frame containing the IP packet if it is not a acceptable “management” IP packet for the C3. That is, the data frame is addressed to the C3 at layer 2 and is interpreted as C3 management traffic.

When the C3 sub-interface is being used as an IP gateway to another sub-interface, the C3 does not forward the data frame containing the IP packet to the destination device unless **ip l2-bg-to-bg-routing** is enabled. Specify the **ip l2-bg-to-bg-routing** on the sub-interface that must act as an IP gateway to allow received IP packets to be passed to the C3 IP stack. Once the IP packet has reached the IP stack, the C3 routes it to the appropriate device.

If the C3 is being used as an IP gateway, DHCP Renew arrives at the cable sub-interface with an Ethernet MAC address of the C3 and is dropped (before seen by the DHCP Relay function) unless both **management-access** and **ip l2-bg-to-bg-routing** are enabled on the cable sub-interface. The **management-access** command allows accepting an IP packet addressed to the C3 from this sub-interface, and **ip l2-bg-to-bg-routing** allows this IP packet to be passed to the C3 IP stack.

Where the C3 is not being used as the IP gateway, DHCP Relay does not need this specification to route DHCP packets, but it may be required to return an ACK to a DHCP Renew under some network conditions.

ip ospf cost

Syntax **ip ospf cost {cost}**

Explicitly specifies the cost of sending a packet on an OSPF interface.

ip ospf retransmit-interval

Syntax **ip ospf retransmit-interval {seconds}**

Specifies the number of seconds between LSA retransmissions for adjacencies belonging to an OSPF interface.

ip ospf transmit-delay

Syntax **ip ospf transmit-delay {seconds}**

Sets the estimated number of seconds it takes to send a link-state update packet on an OSPF interface.

ip ospf priority

Syntax **ip ospf priority {number}**

Sets priority to help determine the OSPF designated router for a network.

ip ospf hello-interval

Syntax **ip ospf hello-interval {seconds}**

Specifies the length of time between the hello packets that the C3 software sends on an OSPF interface.

ip ospf dead-interval

Syntax **ip ospf dead-interval {seconds}**

Set the number of seconds that a device’s hello packets must not have been seen before its neighbors declare the OSPF router down.

ip ospf authentication mode

Syntax **[no] ip ospf authentication mode [text | md5]**

Enables authentication and specifies the type of authentication used in OSPF packets. To disable authentication, use the **no** form of this command.

ip ospf authentication key-chain

Syntax **[no] ip ospf authentication key-chain {name}**

Enables authentication of OSPF packets and specifies the key-chain to use on an interface. To prevent authentication, use the **no** form of this command.

ip rip authentication

Syntax **one of:**

[no] ip rip authentication key-chain {name}

[no] ip rip authentication mode {text | md5}

Controls the RIP authentication method used on this interface. You can specify authentication through a key chain, using plain text passwords or MD5 passwords.

See also: *key chain*, page 10-176, *Router Configuration Mode*, page 10-248.

ip rip cost

Syntax **ip rip cost {m}**

Manually overrides the default metric for this interface. Valid range: **1** to **16**. The default value is **1**.

ip rip default-route-metric

Syntax **[no] ip rip default-route-metric {m}**

Sets the metric for default routes originated from this interface. When 0.0.0.0/0 is advertised from a sub-interface it will have a metric set by this command. Valid range: **1** to **16**.

ip rip receive

Syntax **[no] ip rip receive {version versions}**

Controls which versions of RIP packets the C3 accepts. The valid range for *versions* is 1 and 2; you can specify one or both versions with the same command.

The **no** form of this command resets the receive version on the sub-interface to the default receive version (2). To block a specific version, simply specify the alternate version. For example, to block the reception of version 2 packets, specify that only version 1 packets are to be received using the **ip rip receive version 1** command.

ip rip send

Syntax **`[no] ip rip send {version v}`**

Controls which version of RIP packets the C3 transmits. Valid range: **1** or **2**.

The **no** form of this command resets the send version on the sub-interface to the default receive version (2). To block a specific version, simply specify the alternate version. For example, to block the sending of version 2 packets, specify that only version 1 packets are to be sent using the **ip rip send version 1** command.

ip rip v2-broadcast

Syntax **`[no] ip rip v2-broadcast`**

Enables or disables broadcasting of RIPv2 updates.

ip source-verify

Syntax **`[no] ip source-verify [subif]`**

Enables or disables source IP verification checks on this interface. The optional **subif** keyword verifies the IP address against the originating sub-interface subnet specifications.

This command is only valid, and has any effect only, on a routing only sub-interface.

Where a sub-interface is both a bridging and routing sub-interface—even if **ip routing** is turned on—this command has no effect as the sub-interface bridges all traffic.

ip verify-ip-address-filter

Syntax **`[no] ip verify-ip-address-filter`**

Enables or disables RFC1812 IP address checks on this interface.

load-interval

Syntax **`load-interval {time}`**

Sets the time, in seconds, to use as an interval for load averaging on this interface. Valid range: **30** to **600** seconds.

management-access

Syntax **`[no] management-access`**

If specified for an interface, this command blocks all telnet or SNMP access through this interface.

If specified in "ip routing" mode, ARP, ICMP replies and DHCP are still allowed so that modems can acquire to a cable interface even if **no management-access** is specified.

If specified on an interface (including sub-interfaces), specifying management access blocks routing to this interface across bridge-group boundaries that would otherwise be possible.

⚠ **CAUTION**
Loss of access possible

If you use the **no** form of this command on the interface being used for management, the CMTS blocks subsequent management access.

The serial port always allows management access.

See also: *access-list*, page 10-100.

qos trust cos

Syntax `[no] qos trust cos`

Allows 802.1p fields to be passed unchanged through the interface. Use the **no** form of this command (default) to zero 802.1p fields in IP packets exiting the interface.

snmp trap link-status

Enable link traps.

Common Interface Subcommands for fastEthernet Interfaces (only)

interface fastethernet

Syntax `interface fastethernet {0/y[.s]}`

Enters configuration mode for the specified FastEthernet interface. The valid interface numbers are:

FE00 port = **0/0**

FE01 port = **0/1**

Example:

```
C3>enable
Password:

C3#configure terminal

C3(config)#interface fastethernet 0/0
C3(config-if)#
```

For fastethernet interfaces, the following commands are available:

duplex

Syntax

duplex {auto}

Sets the duplex mode of the interface. The default is **auto**, which sets both duplex mode and interface speed. It should be acceptable under most conditions.

ip address

Syntax

ip address {ipaddr ipmask} [secondary]

Sets the interface IP address and subnet mask. If the **secondary** option is specified, specifies a secondary IP address for the interface.

ip broadcast-address

Syntax **ip broadcast-address {ipaddr}**

Sets the broadcast address for this interface.

ip igmp-proxy

Syntax **[no] ip igmp-proxy [non-proxy-multicasts]**

Enables or disables IGMPv2 proxy operation on this sub-interface. For a fastethernet sub-interface to be proxy enabled, the sub-interface must:

- have an IP address configured, or
- be a member of a bridge group with an IP address configured on at least one sub-interface of the group

Each fastethernet sub-interface must be separately enabled in this manner as each sub-interface connects to a physically different network.

For example:

If the fastethernet sub-interface is layer 2 (bridge group member) and has no IP address, then at least one sub-interface in the same bridge group must have an IP address for proxy to be enabled on that sub-interface. All cable sub-interfaces in that bridge group then operate in active mode.

If the fastethernet sub-interface is layer 3 (routed) then all routed cable sub-interfaces operate in active mode.

In other words, if a fastethernet sub-interface is configured with an IP address, and is within a bridge group, then all cable sub-interfaces within that bridge group operate in active mode instead.

Specifying the **ip igmp-proxy** command automatically enables active IGMP routing mode on connected cable sub-interfaces. Use the **ip igmp enable** command on a per cable sub-interface basis to enable IGMP processing.

In passive mode, cable group membership information is passed to the next upstream IGMP router using the connected fastethernet sub-interfaces within the same bridge group.

When processing IGMP messages, the cable interface tracks multicast group membership in a local IGMP database. If a multicast stream has no subscribing hosts (CPE or modem), the C3 does not pass the multicast stream to the cable downstream.

Proxy aware cable sub-interfaces also generate regular query messages downstream, interrogating multicast group membership from downstream IGMP hosts and possibly other downstream IGMP routers.

See also: *ip igmp*, page 10-204.

mac-address (read-only)

Not an actual command, but shown in the system configuration as a comment for information purposes only.

speed

Syntax

speed {10 | 100 | 1000}

Sets the speed of the interface, in Mbps. The **duplex auto** command automatically sets the interface speed as well as the duplex mode.

Scope: Not applicable to a fastethernet sub-interface.

Common Interface Subcommands for Cable Interfaces (only)

interface cable

Syntax

```
interface cable 1/0[.s]
```

Enters configuration mode for the cable interface. The only valid entry for a cable interface is **cable 1/0**.

Example:

```
C3>enable
Password:
C3#configure terminal

C3(config)#interface cable 1/0
C3(config-if)#
```

For cable interfaces, the following commands are available. Some commands are not applicable to a sub-interface where noted.

Cable Commands — General

Cable interface commands are grouped as follows:

arp-broadcast-echo

Syntax

```
[no] arp-broadcast-echo
```

Controls whether ARP broadcasts received on the cable interface are broadcast back downstream. This may be specified per cable sub-interface.

cable dci-upstream-disable

Syntax

```
cable dci-upstream-disable {macaddr} {enable |
disable period n}
```

Instructs the addressed modem to immediately enable its upstream transmitter, or to disable it for the stated period. The parameters are:.

Keyword	Description
macaddr	The MAC address of the modem
enable	Instructs the addressed modem to enable its upstream transmitter

Keyword	Description
disable	Instructs the addressed modem to immediately disable its upstream transmitter, no matter what state the modem is currently in. This state is not cleared in the C3 if the modem is rebooted. If the C3 is rebooted, it loses memory of this state but the modem is still disabled. The modem upstream must be re-enabled from the C3
n	The length of time to disable the transmitter. Valid range: **1** to **4294967294** milliseconds. Use **0** to disable the modem indefinitely, and **42949672945** to enable the modem

cable docsis10 max-traffic-burst

Syntax

```
cable docsis10 max-traffic-burst [size]
```

Sets the maximum DOCSIS 1.0 burst traffic size, in bytes. Valid range: **1522** to **100000** bytes.

cable encrypt

Syntax

```
cable encrypt shared-secret [string]
```

Activates MD5 authentication on DOCSIS configuration files. The expected shared secret is *string*. To disable MD5 authentication, use the **no cable shared-secret** command. Use **cable encrypt shared-secret** with no string specified to enable MD5 authentication and set the expected shared secret to "DOCSIS."

cable flap-list

Syntax

```
[no] cable flap-list {aging | insertion-time |
miss-threshold | size} {default | value}
```

Sets parameters for the flap list.

The parameters are:

Keyword	Description
aging	Sets the time that entries remain in the flap list. Use **no cable flap-list aging** to disable entry aging. Valid range: **300** to **864000** seconds (that is, 5 minutes to 10 days). Default: **259200** seconds (72 hours)
insertion-time	Sets the re-insertion threshold time. Use **no cable flap-list insertion-time** to disable re-insertion. Valid range: **60** to **86400** seconds (1 minute to 1 day). Default: **180** seconds
miss-threshold	Sets the miss threshold. Use **no cable flap-list miss-threshold** to disable. Valid range: **1** to **12**. Default: **6**
size	Sets the maximum number of flap list entries. Use no cable flap-list size to allow an unlimited number of entries. Valid range: **1** to **6000** entries. Default: **500**.

cable insertion-interval

Syntax

```
cable insertion-interval {automatic | t}
```

Sets the insertion interval.

The options are:

Keyword	Description
automatic	The CMTS controls the scheduling frequency of initial maintenance opportunities if the insert interval is set to zero. The ranging backoffs should also be set to **16** so that these can be varied dynamically also. The default interval between opportunities is about 1.2 seconds, but the C3 schedules additional opportunities if it detects that a previous opportunity resulted in a collision due to 2 or more modems trying to use it. The minimum interval between opportunities is about 40 ms (between 30 and 60 ms to align with a multiple of the dominant grant interval or the shortest grant interval admitted). If several physical channels have their opportunities aligned, then additional opportunities in one logical channel on a physical channel are accompanied by additional opportunities on the other channels as well because of the need to align all opportunities across all channels in the group. This may result in decreased efficiency in all channels.
t	The fixed period between initial ranging opportunities, in centi-second (1/100th second) intervals

cable mac-mode

Syntax

```
cable mac-mode {mode}
```

Sets the MAC mode for both downstream and upstream.

The **mode** is one of the following:

Keyword	Description
docsis	DOCSIS upstream and downstream
euro-docsis	Euro-DOCSIS upstream and downstream
mixed	DOCSIS downstream, Euro-DOCSIS upstream

See also: *cable downstream mac-mode*, page 10-222.

cable max-ranging-attempts

Syntax

```
cable max-ranging-attempts {k}
```

Sets the maximum number of ranging attempts allowed for modems. If modems exceed this limit, they are sent a ranging response with status ABORT and should proceed to attempt ranging on another advertised (via downstream UCDs) upstream channel.

Scope: Not applicable to a cable sub-interface.

Valid range: **0** to **1024**.

cable privacy

Syntax

```
[no] cable privacy {option}
```

Configures Baseline Privacy for the cable modems on this interface.

The options are:.

Keyword	Description
accept-self-signed-certificate	Allow self-signed cable modem certificates for BPI
check-cert-validity-periods	Check certificate validity periods against the current time of day
kek life-time n	Sets the lifetime of the Key Encryption Key (KEK). Valid range: **0** to **6048000** seconds.
tek life-time n	Sets the lifetime of the Traffic Encryption Key (TEK). Valid range: **0** to **6048000** seconds.

cable shared-secret

Syntax

```
[no] cable shared-secret [string] [encrypted]
```

Sets the shared secret to the specified *string*. If no string was specified, clear the string. This also enables or disables the CMTS MIC calculation. The **encrypted** keyword specifies that the string is to be encrypted.

The Message Integrity Check is performed during modem registration. The modem passes to the CMTS a secret given it by its configuration file and hence sourced from the provisioning systems. If this feature is turned on and the secret received in the configuration file does not match this configured value, the modem is not allowed to register.

The string is stored in the configuration in clear text. Use **cable encrypt shared-secret** if a hashed value is to be stored in the configuration.

See also: *cable encrypt*, page 10-195.

cable sid-verify

Syntax

```
[no] cable sid-verify
```

Enables accepting DHCP packets whose SID is zero. Use the **no** form of this command to accept such packets. The factory default settings reject DHCP packets with a SID of zero, in accordance with DOCSIS specifications. Some cable modems send these illegal packets; if your system needs to support such modems then you need to disable verification.

cable source-verify

Syntax

```
[no] cable source-verify [dhcp [authoritative]]
```

Enables safeguards against ARP spoofing, IP address spoofing, and misconfigured CPE devices, by verifying that the source IP address for incoming packets matches the MAC address of the device assigned the IP address.

The parameters are:

Keyword	Description
dhcp	Requires that the DHCP server supports the DHCP Lease Query feature. When active, the C3 can query the DHCP server to verify that the IP address being used by a CPE is both known to the server, and that cable modem is associated with the IP address. Any static IP addresses found in cable modem configuration files are assumed to be correct
authoritative	Specifies that the DHCP server is the authoritative source for IP address information. This option requires that the DHCP server knows of *all* CPE IP addresses, including static IP addresses provisioned in cable modem configuration files

See also: *Cable Source Verify*, page 8-32.

cable sync-interval

Syntax

```
cable sync-interval {k}
```

Sets the interval, in milliseconds, between SYNC messages.
Valid range: **1** to **200**.

For fastest acquisition of modems, use a low number (about **20**). Sync messages use a very minor amount of downstream bandwidth.

Scope: Not applicable to a cable sub-interface.

cable ucd-interval

Syntax

```
cable ucd-interval {k}
```

Sets the interval, in milliseconds, between UCD messages. Valid range: **1** to **2000**. Factory default is **2000**.

Modems check the change count in each UCD received against the last known change count. Only if this change count is different does the modem open the full UCD message and take action. If the upstream configuration is static, then decreasing this time interval achieves very little. If the upstream is being dynamically changed to move upstreams around noise, or upstream parameters are being changed rapidly for any other reason, then this time interval can be decreased.

Scope: Not applicable to a cable sub-interface.

cable utilization-interval

Syntax

```
cable utilization-interval {time}
```

Sets the utilization monitoring interval for US/DS channels.

Specify the time in seconds. Valid range: **0** to **86400** seconds.

encapsulation dot1q

Syntax

```
[no] encapsulation dot1q {N} [native | encrypted-multicast]
```

The options are:.

Keyword	Description
N	Specifies the VLAN ID. There can be only ONE VLAN specified per sub-interface using this command.
native	Checks certificate validity periods against the current time of day
encrypted-multicast	Downstream broadcast or multicast traffic to members of this VPN is encrypted if BPI or BPI+ is enabled. Only members of this VPN receive this multicast or broadcast.

NOTE
The VLAN tag is used internally. Outbound data is not encoded with this tag.Any un-encoded inbound data will be issued with this VLAN tag for internal use (tag will not leave the ARRIS Cadant C3).

This command is applicable on a bridged interface (no IP address) or a routed interface (has an IP address).

VLAN tags are the only way to allocate incoming fastethernet packets to a fastethernet sub-interface. This command may be omitted from only one fastethernet sub-interface per physical interface in which case un-encoded traffic will be allocated to this one sub-interface. This command must be used on all other fastethernet sub-interfaces whether they are bridged or routed sub-interfaces.

The native format of this command must be used on all cable sub-interfaces made a member of a bridge group—even if VSE encoding is not going to be used.

The 802.1Q VLAN IDs specified here do not have to match the VLAN IDs used on the cable side of the C3. 802.1Q The C3 remaps VLAN IDs as required by either bridge grouping, bridge binding or routing between sub-interfaces.

See *map-cpes*, page 4-24 as all the implications for the **map-cpes** command apply to the data mapped using VSE encoding and the "native" form of this command.

See also: *bridge*, page 10-104, *bridge-group*, page 10-181, *show bridge-group*, page 10-51.

Syntax

[no] encapsulation dot1q allow {tag [-tag] [,tag]}

This command makes it possible to configure the subinterface so that other tag values will also *map* to the subinterface *in addition* to the **encapsulation dot1q {*N*}** command. You can have multiple **encapsulation dot1q allow** commands to fully specify which VLAN tags terminate on the subinterface.

For example:

```
interface cable 1/0.9
bridge-group 9
encapsulation dot1q 9
encapsulation dot1q 9 encrypted multicast  !! if required
encapsulation dot1q allow 101-199, 801-899
encapsulation dot1q allow 1200,1205,1599
end
```

The above sets Cable 1/0.9 to use tag 9 as before, but also allows tags, 101-199, 801-899, 1200, 1205 and 1599.

To ensure transparent bridging, all sub-interfaces in a bridge-group should have the **same** encapsulations configured. Tagged packets arriving on one sub-interface destined for transmission out the other will then be passed with the tag *intact*.

Overlapping VLAN tag ranges are not allowed on different subinterfaces of the same physical interface.

To remove allowed tags from a subinterface, use the **no** form of the command:

```
no encapsulation dot1q allow 101-199, 801-899
no encapsulation dot1q allow 1-4094 !!removes all  "allows"
```

The *primary* encapsulation (eg., encapsulation dot1q *{n}*) cannot be removed in this manner, but must be explicitly removed as before. The *allows* are just that — other tags which are also handled by the interface.

See also: *bridge*, page 10-104, *bridge-group*, page 10-181, *show bridge-group*, page 10-51, *map-cpes*, page 4-24.

ip igmp

Syntax

```
ip igmp {enable | disable}
```

Enable or disable active IGMP message processing on cable sub-interface, whether the processing is in active or passive mode depending on whether the cable sub-interface can "see" a proxy fastethernet subinterface.

Use this command to start IGMP query messages downstream.

Scope: Cable sub-interface only

NOTE

The **ip igmp-proxy** must already be specified on a fastethernet interface and this fastethernet interface must be either:

- A fastethernet sub-interface with an IP address (i.e. a routed or Layer 3 sub-interface) or;
- A fastethernet sub-interface in the same bridge group as at least one other sub-interface having an IP address

See also: *ip igmp-proxy*, page 10-191.

ip igmp last-member-query-interval

Syntax

```
ip igmp last-member-query-interval {val}
```

Sets the interval between IGMP group specific query messages sent via the downstream to hosts.

Scope: Cable sub-interface only.

NOTE

The **ip igmp-proxy** must already be specified on a fastethernet interface and this fastethernet interface must be either:

- A routed fastethernet sub-interface or;
- A fastethernet sub-interface in the same bridge group as at least one other routed sub-interface (a sub-interface having an IP address)

See also: *ip igmp*, page 10-204, *ip igmp-proxy*, page 10-191.

ip igmp query-interval

Syntax

```
ip igmp query interval {val}
```

Sets the interval between host specific query messages.

Scope: Cable sub-interface only.

NOTE

The **ip igmp-proxy** must already be specified on a fastethernet interface and this fastethernet interface must be either:

- A routed fastethernet sub-interface or;
- A fastethernet sub-interface in the same bridge group as at least one other routed sub-interface (a sub-interface having an IP address)

See also: *ip igmp*, page 10-204, *ip igmp-proxy*, page 10-191.

ip igmp query-max-response-timeout

Syntax

```
ip igmp query-max-response-timeout {val}
```

Sets the maximum interval, in 1/10 second increments, the C3 waits for a response to an IGMP query. Valid range: **10** to **255**.

Scope: Cable sub-interface only.

NOTE

The **ip igmp-proxy** must already be specified on a fastethernet interface and this fastethernet interface must be either:

- A routed fastethernet sub-interface or;
- A fastethernet sub-interface in the same bridge group as at least one other routed sub-interface (a sub-interface having an IP address)

See also: *ip igmp*, page 10-204, *ip igmp-proxy*, page 10-191.

ip igmp robustness

Syntax

```
ip igmp robustness {val}
```

Variable for tuning the expected packet loss on a subnet. Valid range: **1** to **255**.

Scope: Cable sub-interface only.

NOTE

The **ip igmp-proxy** must already be specified on a fastethernet interface and this fastethernet interface must be either:

- A routed fastethernet sub-interface or;
- A fastethernet sub-interface in the same bridge group as at least one other routed sub-interface (a sub-interface having an IP address)

See also: *ip igmp*, page 10-204, *ip igmp-proxy*, page 10-191.

ip igmp verify ip-router-alert-option

Syntax

```
[no] ip igmp verify ip-router-alert-option
```

Enables or disables checking of the IP Router Alert option in IGMP v2 reports and leaves.

ip igmp version

Syntax

```
ip igmp version {val}
```

The version of IGMP running on the sub-interface. The value of *val* must be **2**.

Scope: Cable sub-interface only.

NOTE

The **ip igmp-proxy** must already be specified on a fastethernet interface and this fastethernet interface must be either:

- A layer 3 fastethernet sub-interface or;
- A fastethernet sub-interface in the same bridge group as at least one other sub-interface having an IP address

See also: *ip igmp-proxy*, page 10-191.

ip-broadcast-echo

Syntax

```
[no] ip-broadcast-echo
```

Controls whether IP broadcasts received on the cable interface are broadcast back downstream. This may be specified per cable sub-interface.

ip-multicast-echo

Syntax

```
[no] ip-multicast-echo
```

Controls whether multicasts received on the cable interface are broadcast back downstream. This may be specified per cable sub-interface.

NOTE

The **[no]** form of this command has implications in IGMP message processing as IGMP messages from hosts are not sent back downstream.

ip throttle

Syntax

```
[no] ip throttle {acl}
```

Enables IP throttling on the sub-interface. Use the **no** form of this command to disable IP throttling.

When a host on this sub-interface sends IP packets at a rate exceeding the per-second running credits, the C3 applies the specified ACL to transmitted packets and drops those packets matching ACL criteria with an **allow** action.

See also: *l2-broadcast-throttle*, page 10-209, *throttle-credits*, page 10-214, *Packet Throttling*, page 8-34.

l2-broadcast-echo

Syntax

```
[no] l2-broadcast-echo
```

Enables echoing of layer 2 broadcast packets to the downstream. Use the **no** form of this command to disable broadcast echo.

l2-broadcast-throttle

Syntax

```
[no] l2-broadcast-throttle {acl}
```

Enables Layer 2 broadcast throttling on the sub-interface. Use the **no** form of this command to disable broadcast throttling.

When a host on this sub-interface sends broadcast packets at a rate exceeding the per-second running credits, the C3 applies the specified ACL to transmitted packets and drops those packets matching ACL criteria with an **allow** action.

See also: *ip throttle*, page 10-208, *throttle-credits*, page 10-214, and *Packet Throttling*, page 8-34.

l2-multicast-echo

Syntax

```
[no] l2-multicast-echo
```

Enables echoing of layer 2 multicast packets to the downstream. Use the **no** form of this command to disable multicast echo.

map-cpes

Syntax

```
[no] map-cpes {cable 1/0.s}
```

Maps all CPE attached to a modem to the specified cable sub-interface.

This command provides a static (CMTS configured) means to allocate incoming CPE packets to a defined sub-interface based on modem IP address. Use of this command implies modems are allocated to multiple subnets if more than one CPE subnet is required as there needs to be a one to one match of modem to CPE sub-interfaces.

The specified cable sub-interface may or may not have an assigned IP address.

If the specified cable sub-interface has an IP address and dhcp relay parameters are configured for this cable sub-interface, this IP address will be the giaddr address for any relayed CPE DHCP. Thus, a simple non-DOCSIS aware or "standard" DHCP server can be used that allocates IP address based on the incoming DHCP giaddr value.

If the specified sub-interface does not have an IP address, it is assumed that layer 2 traffic is being bridged and that the sub-interface is a member of a bridge group.

You must specify **encapsulation dot1q <n> native** on such a sub-interface, even though VSE encoding is not being used for the sub-interface. The VLAN specification is used internally by the C3 and also allows the use of the **bridge bind** command to bind this sub-interface directly to a VLAN tagging fastethernet sub-interface if required.

If the CPE IP address must be configured on a dynamic basis or is not bound to the modem IP address—as would be the case if all modems are required to be allocated an IP address from one large single address pool—consider using VSE encoding (Chapter 8) instead of using the **map-cpes** command. VSE encoding and the use of the **encapsulation dot1q <n> native** command allows CPE attached to a modem to be allocated to a cable sub-interface based on modem configuration file specified (and hence provisioning system specified) parameters and is independent of the assigned modem IP address.

Example: One modem subnet—one CPE subnet—IP routing

```
ip routing
!
interface cable 1/0
!
ip address 10.1.0.1 255.255.0.0
ip dhcp relay
cable helper-address 10.2.0.1
cable dhcp-giaddr primary
! option 82 not really required for standard DHCP server
no ip dhcp relay information option
map-cpes cable 1/0.1
!
interface cable 1/0.1
! for CPE devices
ip address 10.11.0.1 255.255.0.0
ip dhcp relay
```

```
cable helper-address 10.2.0.1
cable dhcp-giaddr primary
! option 82 not really required for standard DHCP server
no ip dhcp relay information option
!

Example: One modem subnet—CPE data bridged—no IP routing
no ip routing
!
conf t
bridge 2
!
interface cable 1/0
!
ip address 10.1.0.1 255.255.0.0
ip dhcp relay
cable helper-address 10.2.0.1
cable dhcp-giaddr primary
! option 82 not really required for standard DHCP server
no ip dhcp relay information option
! map PPPoE CPE to another interface
map-cpes cable 1/0.1
!
interface cable 1/0.1
! for CPE devices running layer 2
! e.g. PPPoE
bridge-group 2
! add vlan spec for internal use
encapsulation dot1q 9 native
!
exit
exit
Example: Multiple modem subnets with mapped CPE subnets
ip routing
!
interface cable 1/0
! used for modem DHCP
ip address 10.1.0.1 255.255.0.0
ip dhcp relay
cable helper-address 10.2.0.1
cable dhcp-giaddr primary
! option 82 not really required for standard DHCP server
no ip dhcp relay information option
!
interface cable 1/0.1
! used for modem
ip address 10.10.0.1 255.255.0.0
! dhcp renews will be routed so no relay required
```

```
no ip dhcp relay
map-cpes cable 1/0.11
!
interface cable 1/0.2
! used for modem
ip address 10.20.0.1 255.255.0.0
! dhcp renews will be routed so no relay required
no ip dhcp relay
map-cpes cable 1/0.12
!
interface cable 1/0.11
! for CPE devices
ip address 10.11.0.1 255.255.0.0
! dhcp spec required for cpe dhcp
ip dhcp relay
cable helper-address 10.2.0.1
cable dhcp-giaddr primary
! option 82 not required or used by standard DHCP server
no ip dhcp relay information option
!
interface cable 1/0.12
! for CPE devices
ip address 10.12.0.1 255.255.0.0
! dhcp spec required for cpe dhcp
ip dhcp relay
cable helper-address 10.2.0.1
cable dhcp-giaddr primary
! option 82 not required or used by standard DHCP server
no ip dhcp relay information option
```

Example: self mapping using **map-cpes**

This example shows the **map-cpes** command referencing the same sub-interface. Only subnets in the mapped sub-interface are valid for CPE and so the primary sub-interface specification is also a valid subnet for CPE devices.

```
ip routing
!
interface cable 1/0.0
! valid subnet for CM and CPE devices
ip address 10.1.0.1 255.255.0.0
! valid subnets for CPE devices
ip address 10.11.0.1 255.255.0.0 secondary
ip address 10.21.0.1 255.255.0.0 secondary
ip address 10.31.0.1 255.255.0.0 secondary
ip dhcp relay
! use primary address for modem giaddr
! use first secondary address for cpe giaddr
```

```
cable dhcp-giaddr policy
! us the one dhcp server for cm and cpe
cable helper-address 10.2.0.1
! allow the dhcp server to tell what is cm what is cpe
ip dhcp relay information option
! map all cpe attached to cm using this interface
! to this interface
map-cpes cable 1/0.0
```

See also: *encapsulation dot1q*, page 10-202.

shutdown

Syntax **`[no] shutdown{}`**

Disables the cable interface or when used in conjunction with the "no" parameter enables the cable interface. This command will not take effect until the use exits out of the cable interface mode.

throttle-credits

Syntax

```
throttle-credits initial {init-credit} running {run-credit}
```

Sets the throttling credits on this sub-interface.

The parameters are:.

Keyword	Description
init-credit	Sets the initial credits. A host can send this many packets initially without throttling being applied. Initial credits allow the host to register and obtain a DHCP address. Default: **15**
run-credit	Sets the running credits, in packets per second. Hosts transmitting packets in excess of the running credit are subject to throttling using an ACL

See also: *ip throttle*, page 10-208, *l2-broadcast-throttle*, page 10-209, *Packet Throttling*, page 8-34.

Cable commands (DHCP)

cable dhcp-giaddr

Syntax

```
[no] cable dhcp-giaddr {policy | primary |
round-robin}
```

Replaces the giaddr field in DHCP packets.

The parameters are:.

Keyword	Description
primary	Replaces the giaddr with the relaying interface primary IP address for cable modems and hosts.
policy	For cable modems: replaces the giaddr with the relaying interface primary IP address. For hosts: replace the giaddr with the relaying interface’s first secondary IP address.
round-robin	Applies only when more than one secondary IP address is specified for a cable sub-interface. When active, the C3 rotates (in a “round-robin” fashion) through multiple secondary IP addresses for client DHCP Discover messages. If a DHCP request fails due to no leases being available, the C3 relays the next DHCP Discover using the next secondary IP address. Should this fail, the process repeats (next address used for the relay address) until all available address ranges in the DHCP server have been tested

If no **cable helper-address** is active, the CMTS broadcasts DHCP messages through all active Ethernet interfaces with the updated giaddr field.

See also: *ip dhcp relay*, page 10-217, *ip dhcp relay information option*, page 10-218, *cable helper-address*, page 10-216, *DHCP*, page 7-3.

cable helper-address

Syntax

```
[no] cable helper-address {ipaddr} [cable-modem |
host]
```

Updates the giaddr field with the relaying interface primary IP address (unless **cable dhcp-giaddr policy** is active) and then unicasts the DHCP Discover or Request packet to the specified IP address. If no option is specified, all cable originated DHCP broadcast messages will be unicast to the specified IP address.

Keyword	Description
host	Unicast all cable originated host DHCP broadcast messages to the specified IP address
cable-modem	Unicast all cable modem DHCP broadcast messages to the specified IP address

You can specify up to 5 helper addresses each for cable modems and hosts (CPE), for redundancy or load sharing. The C3 performs no round-robin allocation but unicasts the relayed DHCP to each of the helper addresses specified. The cable modem or CPE responds to and interacts with the first DHCP server that replies.

See also: *ip dhcp relay*, page 10-217, *ip dhcp relay information option*, page 10-218, *cable dhcp-giaddr*, page 10-215, *Directing DHCP Broadcasts to Specific Servers*, page 7-6.

dhcp-lq-params

Syntax

```
dhcp-lq-params {leasequery code [active code
[unassigned code [timeout ticks]]]}
```

Sets the DHCP codes used for LEASEQUERY, LEASEACTIVE, and UNASSIGNED responses, and optionally the leasequery response timeout.

The parameters are:

Keyword	Description
code	The DHCP response code. Valid range: **0** to **255**
ticks	The timeout, in 1/60 second ticks. Valid range: **0** (sets the default), **30** to **255**. Default: **105** ticks (1.75 seconds)

Example (set up the default CNR LEASEQUERY parameters):

```
dhcp-lq-params leasequery 0 active 0 unassigned 0 timeout 0
```

ip dhcp relay

Syntax

```
[no] ip dhcp relay [non-broadcast]
```

Enables the C3 to modify DHCP requests from cable modems or hosts attached to cable modems by updating the **giaddr** field with the WAN port IP address. The effect of this command is to allow the DHCP server to unicast DHCP responses back to the C3, reducing backbone broadcasts.

Use the optional keyword **non-broadcast** to prevent relaying of DHCP snooped unicast messages.

Use **no ip dhcp relay** (default) to disable DHCP relay. This command sends broadcast DHCP messages received at the cable sub-interface to all bridged fastethernet sub-interfaces. When specified on an IP routing-only cable sub-interface, no DHCP relay occurs at all.

See also: *DHCP Relay Mode*, page 7-5, *ip dhcp relay information option*, page 10-218, *cable dhcp-giaddr*, page 10-215, *cable helper-address*, page 10-216.

ip dhcp relay information option

Syntax

```
[no] ip dhcp relay information option
```

Enables modification of DHCP requests from modems or hosts attached to modems to include the modem’s address in the option 82 field. The CMTS adds option 82 information to any DHCP Discover or Request messages received from a cable modem or attached host.

DHCP relay **(ip dhcp relay**) must be active for this command to have any effect.

To disable, use **no ip dhcp relay information option** which passes relayed DHCP requests with no option 82 modification.

See also: *cable dhcp-giaddr*, page 10-215, *cable helper-address*, page 10-216,.

ip dhcp relay validate renew

Syntax

```
[no] ip dhcp relay validate renew
```

When this command is active, the destination IP address in a Renew message is validated against the configured helper address for cable sub-interface. If the destination address is not validated, the Renew is dropped.

See also: *cable helper-address*, page 10-216.

Cable Downstream

The following downstream commands are available.

Scope: Not applicable to a cable sub-interface.

cable downstream admission-control

Syntax

```
[no] cable downstream n admission-control [pct]
```

Specifies the level of oversubscription allowed on the downstream. For example, a value of **300** means that the C3 allocates 33% (100%÷300) of the configured minimum bit rate (worst case) to each modem.

Valid range: **100** to **10000**. Omit the percentage to disable oversubscription. Use the **no** form of this command to allow unlimited oversubscription.

cable downstream admission-limit

Syntax

```
[no] cable downstream admission-limit {pct}
```

Limits the bandwidth usage by services using reserved bandwidth on the downstream to the specified percentage.

Valid range: **0** to **99** percent. Use the **no** form of this command to allow unlimited usage.

cable downstream annex

Syntax

```
cable downstream annex {a | b}
```

Sets the annex type for the downstream. This command has been superseded by the **cable downstream mac-mode** command, and is now used only to set the annex type when the MAC mode is set to **wireless**.

Since the annex type alone is not sufficient to describe the actual mode of operation, this command behaves as follows:

Setting Annex A or B mode during startup after a firmware upgrade configures the system in EuroDOCSIS or DOCSIS mode.

Setting Annex A or B after startup changes only the annex type on the downstream.

See also: *cable mac-mode*, page 10-198, *cable downstream mac-mode*, page 10-222.

cable downstream channel-width

Syntax

```
cable downstream channel-width {6mhz | 8mhz}
```

Sets the downstream channel width. Use **6Mhz** for North America and Japan, **8Mhz** for Europe.

cable downstream frequency

Syntax **`cable downstream frequency {hz}`**

Sets the downstream center frequency in Hz.

Valid range:
91000000 to **857000000** for 6 MHz (North America and Japan) DOCSIS;
112000000 to **857000000** for EuroDOCSIS.
The tuner has a resolution of 62500 (62.5 kHz).

If an up-converter is not installed, the CMTS disables this command.

cable downstream if-frequency

Syntax **`cable downstream if-frequency {if}`**

Sets the CMTS IF output frequency. When changing the MAC mode to **docsis** or **euro-docsis,** the C3 resets the IF frequency to either 43.75MHz (**docsis**) or 36.125MHz (**euro-docsis**) to ensure proper output from the internal upconverter in the desired mode. Once the new mode is set, the IF frequency may be changed if the internal upconverter is not used.

Valid range: 10MHz to 60MHz.

See also: Appendix C.

cable downstream interleave-depth

Syntax

```
cable downstream interleave-depth {I}
```

Sets the FEC interleaving. Valid settings are:

Setting	R/S Interleave
128	I = 128, J = 1
64	I = 64, J = 2
32	I = 32, J = 4
16	I = 16, J = 8
8	I = 8, J = 16
12	I = 12, J = 17 (EuroDOCSIS only)

cable downstream mac-mode

Syntax

```
cable downstream mac-mode {mode} [wireless]
```

Sets the MAC mode for the downstream.

The mode is one of the following:

Keyword	Description
docsis	Standard DOCSIS
euro-docsis	Standard Euro-DOCSIS

When specifying **docsis** or **euro-docsis** modes, the C3 normally performs parameter checking to ensure proper operation for that mode. Specify the **wireless** option to allow setting the downstream symbol rate, modulation, and annex type to non-standard values.

See also: *cable mac-mode*, page 10-198, *cable upstream mac-mode*, page 10-236.

cable downstream modulation

Syntax

```
cable downstream modulation {1024qam | 512qam |
256qam | 64qam | 16qam | qpsk}
```

Sets the downstream modulation type. The **16qam** and **qpsk** choices are available only when the downstream MAC mode has the **wireless** option enabled.

Changing the downstream modulation type when in **wireless** mode does not affect the downstream symbol rate.

cable downstream power-level

Syntax

```
cable downstream power-level {dBmV}
```

Sets the downstream power level to the specified value.

Valid range: **45** to **65** dBmV.

If an up-converter is not installed, the CMTS disables this command.

cable downstream rate-limit

Syntax

```
[no] cable downstream rate-limit [token-bucket]
```

Enables rate limiting on the downstream, with optional token-bucket limiting.

The parameter is:

token-bucket Use token-bucket limiting for DOCSIS 1.0 Class of Service (CoS) flows.

The C3 limits downstream traffic to a modem based on the Class of Service (DOCSIS 1.0) or Service flow specification (DOCSIS 1.1).

The C3 enforces 1.0 CoS with a moving one-second-window algorithm and enforces 1.1 QoS with token-bucket rate-limiting according to the formula max(T) = T*R/8 +B over any interval T.

If the token-bucket option is specified, then 1.0 CoS will use the 1.1 token-bucket rate-limiting algorithm with a burst-size B specified in *cable docsis10 max-traffic-burst*, page 10-195.

If the required bandwidth exceeds the enforced bandwidth, the C3 either delays the packet or (in extreme cases) drops the packet.

NOTE
Using the **no cable downstream rate-limit** command will disable downstream rate limiting and the downstream rate limit parameters in the cable modem configuration file will be ignored. ARRIS strongly recommends that downstream rate limiting remain enabled at all times.

To disable token-bucket rate limiting, use either **cable downstream rate-limit** or **no cable downstream rate-limit token-bucket**.

cable downstream symbol-rate

Syntax

```
cable downstream symbol-rate {sr}
```

Sets the downstream symbol rate when the **wireless** MAC mode option is specified. When the **wireless** option has not been specified, this command returns an error.

Valid range: **1250000** to **6952000**.

See also: *cable downstream mac-mode*, page 10-222.

cable downstream upconverter

Syntax

```
cable downstream upconverter {type}
```

Specifies the upconverter to use.

The type is one of the following:

Keyword	Description
internal	Use the internal upconverter, RF appears at the standard downstream port
external	Use an external upconverter, IF appears at the Downstream IF Output port on the upstream card

Cable Upstream

The following upstream commands are available.

Syntax

```
no] cable upstream {n} [.c]
```

Enters configuration mode for the selected upstream.

The parameters are:

Keyword	Description
n	The physical upstream. Valid range: **0** to **5**
.c	The logical upstream channel (applies only to certain upstream commands). Specifying a logical channel in a **cable upstream** command automatically creates the channel. Valid range: **0** to **3**

To delete a logical channel, use the **no** form of this command (for example, **no cable upstream 0.2** deletes logical upstream channel 2 on upstream 0).

cable upstream admission-control

Syntax

```
[no] cable upstream n admission-control [pct]
```

Specifies the level of oversubscription allowed on the physical upstream. For example, a value of **300** means that the C3 allocates 33% (100%÷300) of the configured minimum bit rate (worst case) to each modem.

Valid range: **100** to **10000**. Omit the percentage to disable oversubscription. Use the **no** form of this command to allow unlimited oversubscription.

cable upstream admission-limit

Syntax

```
[no] cable upstream n admission-limit {pct}
```

Limits the bandwidth usage by services using reserved bandwidth on the physical upstream (such as UGS flows for telephony) to the specified percentage.

Valid range: **0** to **99** percent. Use the **no** form of this command to allow unlimited usage.

cable upstream channel-type

Syntax

```
cable upstream n.c channel-type {atdma | scdma | tdma
| tdma&atdma} [modulation-profile n]
```

Selects the desired type of logical channel operation.

To ensure DOCSIS 1.X compatibility, specify **tdma**.

The following channel types are valid for channel widths up to 3.2MHz on any logical channel: **tdma, tdma&atdma**.

atdma is valid for all channel widths up to 6.4Mhz on any logical channel.

The **scdma** channel type is valid only for the first or second logical channel on a physical upstream, and only for channel widths 1.6, 3.2, and 6.4Mhz.

cable upstream channel-width

Syntax

```
cable upstream n channel-width {w}
```

Sets the physical upstream channel width.

The channel width can be one of:

Value of W	Definition
6400000	Width 6400 KHz, Symbol rate 5120 ksym/s
3200000	Width 3200 KHz, Symbol rate 2560 ksym/s
1600000	Width 1600 KHz, Symbol rate 1280 ksym/s
800000	Width 800 KHz, Symbol rate 640 ksym/s
400000	Width 400 KHz, Symbol rate 320 ksym/s
200000	Width 200 KHz, Symbol rate 160 ksym/s

cable upstream concatenation

Syntax

```
[no] cable upstream n.c concatenation
```

Enables or disables concatenation on a logical channel (concatenation support is on by default).

cable upstream contention-opp-latency

Syntax

```
cable upstream n.c contention-opp-latency {default |
latency}
```

Sets the contention-based opportunity latency. Set the value high as possible to maximize throughput when two logical channels are configured on a physical upstream. When the value is small, logical channels carrying no traffic reduce the amount of bandwidth available for mapping BE opportunities.

Specify **10000** or the keyword **default** to use the default setting.

cable upstream contention-opps-with-data

Syntax

```
cable upstream n.c contention-opps-with-data
{automatic | disallowed | required}
```

Enables or disables sharing of contention opportunities with SCDMA data frames.

The options are:

Keyword	Description
automatic	The C3 may share contention opportunities with SCDMA frames.
disallowed	The C3 may not share contention opportunities with SCDMA frames
required	The C3 must share contention opportunities with SCDMA frames (default)

cable upstream data-backoff

Syntax

```
cable upstream n.c data-backoff {automatic | start
end}
```

Set the random backoff window for data on a logical channel.

The parameters are:

Keyword	Description
automatic	Automatically change the window
start, end	Manually specify the window (valid range is 0 to 15, end must be larger than start)

cable upstream description

Syntax

```
[no] cable upstream n[.c] description {string}
```

Sets the textual description of this upstream or logical channel to *string*.

cable upstream differential-encoding

Syntax

```
[no] cable upstream n.c differential-encoding
```

Enable differential encoding. Use the **no** form to turn off.

cable upstream docsis

Syntax

```
cable upstream n[.c] docsis
```

Sets this upstream or logical channel to standard DOCSIS (5 to 42 MHz) operation.

See also: *cable upstream euro-docsis*, page 10-232.

cable upstream dominant-interval

Syntax

```
cable upstream n.c dominant-interval {default |
interval [jitter]}
```

Specifies the grant interval and jitter for the dominant UGS flow on the logical channel.

The parameters are:

Keyword	Description
interval	Specifies the grant interval. The default is the first grant interval admitted
jitter	Specifies the allowable jitter for the dominant UGS flow type on the logical channel. The jitter value has a significant effect on the maximum grant size and minimum jitter supported for other grant intervals. Default: **2000**.

For aligned physical channels, the interval and jitter should be the same for all channels in the group.

cable upstream euro-docsis

Syntax

```
cable upstream n[.c] euro-docsis
```

Sets this upstream or logical channel to EuroDOCSIS (5 to 65 MHz) operation.

See also: *cable upstream docsis*, page 10-231.

cable upstream extended-frequency-detect

Syntax

```
[no] cable upstream n[.c] extended-frequency-detect
{all-ranging | initial-ranging | periodic-ranging}
```

Increases the range of upstream frequency offsets that the C3 can detect and correct for during ranging. The **no** command is the default for software releases prior to 4.2 and is not available in release 4.2 and later. It disables extended frequency detection.

The choices are:

Keyword	Description
all-ranging	Default mode and only mode available for software releases 4.2 and later. Detects large frequency offsets in all ranging bursts. If extended frequency detection is required, this is the recommended setting
initial-ranging	Not available in release 4.2 and later. Detects large frequency offsets in IUC3 bursts. With only initial ranging detection enabled, the offset may become so large that the C3 may not detect subsequent periodic ranging bursts
periodic-ranging	Not available in release 4.2 and later) Detects large frequency offsets in periodic ranging bursts. This setting requires initial ranging bursts to be within the standard offset limits

cable upstream fec

Syntax

```
[no] cable upstream n.c fec
```

Enable Forward Error Correction (FEC). Use the **no** form to turn FEC off.

cable upstream fragmentation

Syntax

```
[no] cable upstream n.c fragmentation
[forced-multiple-grant nn | forced-piggyback mm]
```

Configures fragmentation for the specified logical channel. Use the **no** form to disable fragmentation.

The options are:

Keyword	Description
forced-multiple-grant	Forced multiple grant mode where packets are broken up into *nn* size bytes and multiple grants are scheduled to transfer these smaller packets. Valid range: **0** to **1522** byte
initial-ranging	Forced piggy back for fragmentation. If the cable modem is instructed to fragment a packet in to size *mm* bytes, but multiple grants are not seen by the cable modem to transfer the fragments, this mode forces the cable modem to use piggybacking to transfer the fragments. Valid range: **0** to **1522** bytes

cable upstream frequency

Syntax

```
cable upstream n frequency {k}
```

Sets the upstream frequency for the physical upstream, in Hz.

Valid range:

North American DOCSIS: **5000000** to **42000000** (5 MHz to 42 MHz)

EuroDOCSIS: **5000000** to **65000000** (5 MHz to 65 MHz)

cable upstream group-id

Syntax

```
cable upstream n group-id {g}
```

Specify the upstream group that the physical upstream belongs to. Valid range: **1** to **6**.

This provides a form of load balancing by distributing cable modems across upstreams with the same group-id during registration according to the cable group policy.

The default group-ids are **1** to **6** for upstreams 1 to 6 respectively, so by default no load balancing occurs.

See also: *cable group*, page 10-112, *show cable group*, page 10-58

cable upstream high-power-offset

Syntax

```
cable upstream n high-power-offset {offset}
```

Specifies the maximum allowed input power on the physical upstream, in dB, above the nominal input power. Cable modems whose input power is higher than this limit are forced to range. The parameter is:

offset The maximum allowed offset, in 1/10 dB increments.
Valid range: **10** to **100**, in steps of 10 (**10**, **20**, and so forth).

See also: *cable upstream low-power-offset*, page 10-236.

cable upstream initial-ranging-delay

Syntax

```
[no] cable upstream n.c initial-ranging-delay {time}
```

Increases the size of the broadcast IUC3 by *time* microseconds. This may be needed in wireless applications with low downstream symbol rates or modulations, when a large delay in the downstream interleaver can cause the modem to perform initial ranging much later than expected.

Valid range:

300 to **3000** µs.
Default: **300** µs. The default value is adequate for standard HFC-based DOCSIS or Euro-DOCSIS installations.

cable upstream low-power-offset

Syntax

```
cable upstream n low-power-offset {offset}
```

Specifies the minimum allowed input power on the physical upstream, in dB, below the nominal input power. Cable modems whose input power is lower than this limit are forced to range.

The parameter is:

offset The minimum allowed offset, in 1/10 dB increments.
Valid range: **–10** to **–100**, in steps of 10 (**10**, **20**, and so forth).

See also: *cable upstream high-power-offset*, page 10-235.

cable upstream mac-mode

Syntax

```
cable upstream n mac-mode {mode}
```

Sets the MAC mode for the specified upstream.

The mode is one of the following:

Keyword	Description
docsis	Standard DOCSIS
euro-docsis	Standard Euro-DOCSIS

See also: *cable mac-mode*, page 10-198, *cable downstream mac-mode*, page 10-222.

cable upstream mer-timeconstant

Syntax

```
cable upstream n.c mer-timeconstant {tc}
```

Sets the amount of averaging of the upstream Modulation Error Rate (MER) over time on the logical channel.

The parameter is:

tc The amount of averaging desired. Valid range: **0** to **10**.

0 no averaging; the reported MER is the instantaneous value at the time of the request.

10 maximum averaging; provides an average over all time.

9 is the default, which provides a long-term average. Smaller values provide more immediate averaging.

cable upstream minimum-unfrag-burst

Syntax

```
cable upstream n.c minimum-unfrag-burst {size}
```

Specifies the minimum unfragmented burst size for upstream data on the logical channel. You may need to set this parameter on channels carrying a large amount of UGS traffic to allow cable modems to send DHCP requests (and thus complete registration).

Use the DHCP request size for DOCSIS 1.1 or 2.0 cable modems; or (1522 + MAC overhead) for DOCSIS 1.0 modems. Default: **600**.

Specifying a large value impacts UGS capacity.

cable upstream minislot-size

Syntax

```
cable upstream n.c minislot-size {m}
```

Specifies the minislot-size for the logical channel, in 6.25 microsecond intervals. Allowed values are **128, 64, 32, 16, 8, 4, 2,** and **1**.

cable upstream modulation-profile

Syntax

```
cable upstream n.c modulation-profile {p}
[channel-type  type]
```

Selects the modulation profile for this logical channel. Valid range: **1** to **10**.

The optional **channel-type** parameter sets the modulation scheme; one of: **atdma, scdma, tdma,** or **tdma&atdma**.

See also: *cable modulation-profile*, page 10-116.

cable upstream nrng-prm-guard

Syntax

```
cable upstream n[.c] nrng-prm-guard {symbols}
```

Sets the number of guard symbols in the non-ranging preamble.

cable upstream periodic-maintenance-interval

Syntax

```
cable upstream n periodic-maintenance-interval {p}
```

Sets the periodic ranging interval for the physical upstream.

Valid range: **100** to **10000** in 1/100 second intervals. The default is 10000. If this value is too short and 1000's of modems are ranging, a lot of bandwidth will be wasted. If this value is too long less bandwidth is used but the modem's clock may drift possibly causing collisions where no collisions should occur.

cable upstream plant-length

Syntax

```
cable upstream n.c plant-length {l}
```

Sets the initial maintenance region size for the physical upstream, to allow for timing variation across modems separated by this distance.

Valid range: **1** to **160** km.

Set the distance to the maximum one-way distance between modems and the C3 in the plant.

cable upstream power-level

Syntax

```
cable upstream n power-level {p} [fixed | auto]
```

Sets the target input power level to be used by the physical upstream when the CMTS ranges modems.

NOTE
It is generally a bad idea to change this parameter.

The parameters are:

Keyword	Description
p	Target power level. The allowable values depend on the channel width: 200 kHz –16 to +14 dBmV 400 kHz –13 to +17 dBmV 800 kHz –10 to +20 dBmV 1600 kHz –7 to +23 dBmV 3200 kHz –4 to +26 dBmV 6400 kHz 0 to +29 dBmV
auto	Re-adjust the configured power level automatically when the symbol rate changes. In auto mode, doubling the symbol rate increases the configured power level by +3dB to maintain constant SNR on the upstream channel. Similarly, halving symbol rate decreases the configured power level by –3dB. You can reset the configured power level after a symbol rate change, but any subsequent symbol rate change again changes the configured power level. Any change in the power level results in a change in modem transmit power levels. The power level is still subject to the maximum ranges detailed above
fixed	Do not perform automatic power level readjustments

cable upstream pre-equalization

Syntax

```
[no] cable upstream n.c pre-equalization
```

Enable cable modem pre-equalization on the logical channel. Use the **no** form of this command to disable pre-equalization.

cable upstream range-backoff

Syntax

```
cable upstream n.c range-backoff {automatic | start
end}
```

Sets the random backoff window for initial ranging on the logical channel.

The parameters are:

Keyword	Description
automatic	Automatically change the backoff.
start, end	Manually set the backoff. *start* and *end* must be in the range **0** to_**15**; the value for *end* must be higher than *start*

cable upstream rate-limit

Syntax

```
[no] cable upstream n.c rate-limit [token-bucket]
```

Enables rate limiting on the logical channel, with optional token-bucket limiting.

The parameter is:

token-bucket Override DOCSIS 1.0 defaults with token bucket rate-limiting.

The C3 limits upstream traffic to a modem based on the Class of Service (CoS) (DOCSIS 1.0) or Service flow specification (DOCSIS 1.1).

The C3 enforces 1.0 CoS with a moving one-second-window algorithm and enforces 1.1 QoS with token-bucket rate-limiting according to the formula max(T) = T*R/8 +B over any interval T.

If the token-bucket option is specified, then 1.0 CoS will use the 1.1 token-bucket rate-limiting algorithm with a burst-size B equal to the maximum upstream channel transmit burst configuration setting in the 1.0 CoS.

If the required bandwidth exceeds the enforced bandwidth, the C3 either delays the packet or (in extreme cases) drops the packet.

NOTE
Using the **no cable upstream rate-limit** command will disable upstream rate limiting and the upstream rate limit parameters in the cable modem configuration file will be ignored. ARRIS strongly recommends that upstream rate limiting remain enabled at all times.

To disable token-bucket rate limiting, use either **cable upstream rate-limit** or **no cable upstream rate-limit token-bucket**.

cable upstream rng-prm-guard

Syntax

```
cable upstream n[.c] rng-prm-guard {symbols}
```

Sets the number of guard symbols in the ranging preamble.

cable upstream safe-config

Syntax

```
[no] cable upstream n.c safe-config
```

Enables or disables safe configuration mode for the specified logical upstream channel.

When safe configuration is enabled (the default), the C3 refuses SNMP and CLI commands which would result in an invalid channel configuration. Certain upstream configuration commands, primarily for burst profile or channel settings, can result in invalid configurations.

Use the **no** form of this command to turn off safe configuration mode. This may be required for scripts which temporarily misconfigure a channel in a sequence of upstream configuration commands. The C3 takes offline an upstream channel with an invalid configuration.

cable upstream scdma-active-codes

Syntax

```
[no] cable upstream n.c scdma-active-codes {codes}
```

For SCDMA-only logical channels, sets the number of codes used to carry data. Reducing the number of codes can improve performance in noisy upstreams. Valid range: **64** to **128** (prime numbers within this range are invalid).

Corresponds to the **docsIfUpChannelScdmaActiveCodes** MIB.

cable upstream scdma-codes-per-slot

Syntax

```
[no] cable upstream n.c scdma-codes-per-slot {codes}
```

For SCDMA-only logical channels, sets the number of codes per mini-slot. Valid range: **2** to **32**.

Corresponds to the **docsIfUpChannelScdmaCodesPerSlot** MIB.

cable upstream scdma-frame-size

Syntax

```
[no] cable upstream n.c scdma-frame-size {size}
```

For SCDMA-only logical channels, sets the frame size in units of spreading intervals. The number of spreading intervals, along with the signalling rate, determines the time duration of an SCDMA frame. Valid range: **1** to **32**.

Corresponds to the **docsIfUpChannelScdmaFrameSize** MIB.

cable upstream scdma-hopping-seed

Syntax

```
[no] cable upstream n.c scdma-hopping-seed {size}
```

For SCDMA-only logical channels, a 15 bit seed used to initialize the code hopping sequence. Valid range: **0** to **32767**.

Corresponds to the **docsIfUpChannelScdmaHoppingSeed** MIB.

cable upstream scrambler

Syntax

```
[no] cable upstream n.c scrambler
```

Enables the upstream scrambler. Use the **no** form of this command to disable the scrambler.

cable upstream short-periodic-maintenance-interval

Syntax

```
cable upstream n short-periodic-maintenance-interval
{p}
```

Sets the ranging interval used on the physical upstream after a parameter change (timing offset, power, etc.). This allows the modem to complete ranging adjustments quickly without waiting for periodic ranging opportunities.

Valid range: **10000** to **40000000** microseconds.
Recommended value is **1000000** (1 second).

cable upstream shutdown

Syntax

```
[no] cable upstream n[.c] shutdown
```

Disables the upstream or logical channel. Shutting down the physical upstream also shuts down all logical channels associated with that upstream.

Use the **no** form of this command to enable a physical upstream or logical channel. The physical upstream must be enabled for this command to have any effect on a logical channel.

cable upstream snr-timeconstant

Syntax

```
cable upstream n.c snr-timeconstant {tc}
```

Sets the amount of averaging of the upstream signal-to-noise (SNR) over time on the logical channel.

The parameters are:

Keyword	Description
tc	The amount of averaging desired. Valid range: **0** to **10**, where: **0** **=** no averaging; the value of the **docsIfSigQSignal Noise** MIB is the instantaneous value at the time of the request **9** = the default, which provides a long-term average. Smaller values provide more immediate averaging **10** **=** maximum averaging; provides an average over all time

cable upstream status

Syntax

```
cable upstream n.c status {activate | deactivate}
```

Activates or deactivates the upstream channel.

cable upstream token-bucket

Syntax

```
cable upstream n.c token-bucket
```

Overrides the DOCSIS 1.0 with token bucket rate-limiting.

cable upstream trigger-index

Syntax

```
cable upstream n[.c] trigger-index {index}
```

Sets the upstream spectral management trigger index.

Valid range: **0** to **10**.

cable upstream voice-allowed

Syntax

```
cable upstream n voice-allowed {time}
```

Limits the bandwidth usage for flows with sip-voice VSE. Valid range: **1** to **100** seconds.

cable upstream voice-timeout

Syntax

```
cable upstream n voice-timeout {time}
```

Sets the timeout for unused polls for flows with sip-voice VSE. Valid range: **1** to **100** seconds.

Mode 9 *Router Configuration Mode*

Use the global command **router rip** to enter router configuration mode.

Router configuration requires a license. Contact your ARRIS representative for a license key.

Common Routing Subcommands

passive-interface

Syntax

[no] passive-interface {cable 1/0.s | default | fastethernet 0/n.s}

Suppress routing updates on an interface. The C3 learns routes on this subinterface but does not advertise routes.

RIP-specific Subcommands

Use the global command **router rip** to enter RIP configuration mode.

Example:

```
C3(config)#router rip

C3(config-router)#?
```

```
auto-summary          - Enable automatic network number summarization
default-information   - Control distribution of default information
default-metric        - Set metric of redistributed routes
multicast             - Enable multicast routing packet support
network               - Enable routing on an IP network
passive-interface     - Suppress routing updates on an interface
redistribute          - Redistribute information from another routing protocol
timers                - Adjust routing timers
```

```
validate-update-source- Perform sanity checks against source address of routing
                        updates
version               - Set routing protocol version

C3(config-router)#
```

network (RIP)

Syntax **[no] network {ipaddr} [wildcard] [disable]**

Enables RIP routing on a network. This is the only required router configuration command to start routing.

Use **network 0.0.0.0 255.255.255.255** to enable routing on all interfaces.

Note that *ipaddr* should be a network address of one of the fastethernet interfaces. Use the **no** form of this command to disable routing on a network.

The wildcard is the inverse of a subnet mask; for example if the subnet mask is **255.255.255.0**, use **0.0.0.255** for the wildcard.

Use the **disable** keyword to turn off RIP on a subnet. You can use this to turn off routing for a portion of a subnet noting that this specification may affect more than one sub-interface:

```
network 10.1.0.0 0.0.255.255
!  turn off RIP for this scope
!  noting that more than one interface may match this scope
network 10.1.36.0 0.0.0.255 disable this scope
```

auto-summary

Syntax **[no] auto-summary**

Enables automatic network number summarization. This can reduce the number of networks advertised by the C3.

default-information originate

Syntax

```
[no] default-information originate
```

Controls whether the C3 advertises its default route (i.e. **0.0.0.0/0**) to neighbors. When this is disabled (the default), the C3 learns its default route.

default-metric

Syntax

```
[no] default-metric {m}
```

Sets the metric for advertised routes. This is primarily a way to override the default metric for advertised routes. When a connected or static route gets redistributed into an RIP domain, the C3 needs to start to advertise the route to the neighbor in RIP responses. Connected and static routes do not use a metric specification so the C3 needs to know which metric value to associate with them in RIP advertisement. This value is specified by the **default-metric** command.

When a connected or static route gets redistributed into a RIP domain, the C3 needs to start to advertise the route to the neighbor in RIP responses. Connected and static routes do not use a metric specification so the C3 needs to know which metric value to associate with them in RIP advertisement. This value is specified by the **default-metric** command.

Valid range: **1** to **15**. Default: **1**.

multicast

Syntax

```
[no] multicast
```

Enables or disables multicast of routing updates. When enabled, the C3 multicasts RIP updates to IP address 224.0.0.9; all RIP v2 routers listen for updates on this address. When disabled, the C3 broadcasts updates (required for RIP v1 operation).

redistribute connected [metric]

Syntax

```
[no] redistribute connected [metric m]
```

Controls whether the C3 advertises subnets belonging to sub-interfaces and are not under configured network scopes.

Example: Use this command to advertise cable sub-interface subnets into an MSO RIP backbone without running RIP on the cable sub-interface itself for security reasons. (do not want to receive or send RIP updates on the cable sub-interface).

redistribute static [metric]

Syntax

```
[no] redistribute static [metric m]
```

Controls whether the C3 advertises static routes.

Redistributed routes use the optionally-specified metric or the default metric if none is specified.

timers basic

Syntax

```
timers basic {interval} {invalid} {flush}
```

Sets various router-related timers.

The parameters are:

Keyword	Description
interval	The time, in seconds, between basic routing updates (that is, the C3 generates RIP update packets at this interval) Valid range: **0** to **4294967295** sec. Default: **30** sec
invalid	The time, in seconds, that the C3 continues to use a route without receiving a RIP update packet for that route. After the timer expires, the C3 advertises the route with metric 16 (no longer reachable) Valid range: **1** to **4294967295** sec.; the time must be at least 3 times longer than the interval timer. Default: **180** seconds
flush	The time, in seconds, after which the C3 flushes and stops advertising invalid routes. Valid range: **1** to **4294967295** sec; the time must be greater than or equal to the invalid timer. Default: **300** seconds.

validate-update-source

Syntax

```
[no] validate-update-source
```

Enables or disables sanity checks against received RIP updates, based on the source IP address of the packet. This check is disabled by default.

version

Syntax

```
version {1 | 2}
```

Sets the version of RIP to use over all C3 interfaces.

In most cases, you should use the default (**version 2**). RIP v1 supports only “classful networks,” the traditional class A/B/C subnetworks, which have been largely supplanted by classless subnets. RIP v1 summarizes all routes it knows on classful network boundaries, so it is impossible to subnet a network properly via VLSM. Thus, select **version 1** only if the network the C3 is connected to requires it.

Route-map specific Subcommands

Route-map commands can only be entered in the configuration mode of the CMTS. Entering the command causes the CLI to enter into the route-map configuration level. This is signified by the change in the CLI prompt from **(config)#** to **(config-route-map)#.**

Any changes made in the route-map configuration are only committed after the user exits from the route-map configuration mode using the **exit** command.

route-map

Syntax

```
[no] route-map {tag-name} [permit | deny] [seq-num]
```

Defines which networks are to be installed in the routing table and which are to be filtered from the routing table. To remove an entry, use the **no** form of this command.

The parameters are:

Keyword	Description
tag-name	Name given to the route-map and can be from 3 to 12 characters long
seq-num	The route-map entry being created or modified. This is a numeric value between 1 and 65535 and must be a unique number for the route-map it is associated.

redistribute

Syntax

```
redistributed [satic | rip [metric <1-16777215> |
metric-type <1-2> | route-map <word> | tag <a.b.c.d>]
```

Redistributes routes from one routing domain into another routing domain.

OSPF-specific Subcommands

Use the global command **router ospf** to enter OSPF configuration mode.

network (OSPF)

Syntax

```
[no] network address wildcard-mask {area area-id |
disable}
```

Enables OSPF routing on a network, and assigns area IDs to be associated with that range of IP addresses. This is the only required router configuration command to start routing. The parameters are:

wildcard-mask Specifies the size of the network to route, in wildcard format.

The wildcard format is the inverse of a subnet mask: for example, a subnet mask **255.255.255.0** corresponds to a wildcard mask of **0.0.0.255.** The wildcard bits must be set contiguously, starting from the least significant bit.

area The area assigned to the router. Area 0 is the "backbone" area, to which all other areas in the system connect. The C3 may be used in only one area, which means that it cannot be used as an Area Border Router (ABR). All routers in the same area must be configured with the same area number.

disable Disables routing on this network, but leaves the address range configured.

To remove an entry, use the **no** form of this command.

If no network address range exists for an interface, the interface does not participate in the OSPF routing process.

Overlapping address ranges are permitted. In this case, the interfaces are associated with the longest prefix match network address range. In the case of a tie, the C3 uses the first network address range match.

area authentication

Syntax

```
[no] area {area-id} authentication mode {text | md5}
```

Configures the authentication type on an area. This allows password-based protection against unauthorized access to an area.

If the **no** form of this command is used, both plain text and MD5 authentication for the specified area is disabled.

area default-cost

Syntax

```
[no] area {area-id} default-cost {cost}
```

Assigns a specific cost to the default summary route, sent by an ABR, into a stub area.

If the **no** form of this command is used, the metric assigned to the default summary route reverts back to the configured interface cost (i.e. configured by the **ip ospf cost interface** command).

area nssa

Syntax

```
[no] area area-id nssa [no-summary]
```

Creates a new Not-So-Stubby Area (NSSA) or modifies an existing area (configured using the **network** command) into an NSSA. All OSPF routers within an NSSA must be configured to be within an NSSA as well.

If the *area-id* entry was not previously created (using the **network** command, this command creates an area entry but associates no interfaces with the new area.

Use the **no** form of this command without the **no-summary** qualifier to reconfigure the specified NSSA area specified as a standard area. Otherwise, the specified attribute is removed from the NSSA area.

area stub

Syntax

```
[no] area {area-id} stub [no-summary]
```

Creates a new stub area or modifies an existing area (configured using the **network** command) into a stub area. All OSPF routers within the area must be configured to be within a stub area.

If the *area-id* entry was not previously created, using the **network** command, running this command creates an area entry but associates no interfaces with the new area.

Note that stub areas are areas into which information on external routes is not sent. Instead, there is a default external route, generated by the area border router (ABR), into the stub area, for destinations outside the area.

Specify the **no-summary** option to prevent an area border router (ABR) from sending summary LSAs into the stub area (i.e. creating a totally stubby area).

If the **no** form of this command is used without the **no-summary** qualifier being specified, the C3 reconfigures the specified stub area as a standard area. Otherwise, the generation of summary LSAs is enabled on the stub ABR.

default-information

Syntax

```
[no] default-information originate {metric metric-
value} {metric-type val} [always]
```

Allows an autonomous system boundary system (ASBR) to generate a default route into the OSPF routing domain.

Note that, whenever you specifically configure redistribution of routes into an OSPF routing domain, the router automatically becomes an ASBR. However an ASBR does not, by default, generate a default route into the OSPF routing domain.

To force the generation of a default route into OSPF, use **default-information originate always**. If a static default route is configured, this command behaves as before; otherwise a LSA type-5, specifying the default route, will be automatically generated,

In all cases, to disable this feature, use the **no** form of this command.

default-metric [metric]

Syntax

```
[no] default-metric {metric}
```

Use in conjunction with the **redistribute router configuration** command to cause the current routing protocol to use the same metric value for all redistributed routes. A default metric helps solve the problem of redistributing routes with incompatible metrics.

NOTE
The default value of the default-metric is **20**. The **no** form of this command resets the default-metric to this value.

If there is a specific metric value configured against a particular protocol (i.e. RIP or static), then that value takes precedence over the configured default metric value.

redistribute connected [metric] [metric-type]

Syntax

```
redistribute connected [metric metric-value] [metric-type
{1 | 2}] or
no redistribute connected [metric] [metric-type]
```

Allows OSPF to redistribute all directly connected routes, in external LSAs (type-5) (i.e. even those which are not configured with the **network** command). This command does not affect the interfaces on which the OSPF is running (i.e. only those interfaces for which the network is configured).

A metric value can be specified for these redistributed connected routes. Valid range is 1 to 16777215. This metric overrides the configured default metric value. Use **no redistribute connected** metric to revert to the default metric value, without disabling the redistribution of the connected routes.

Disable redistribution of connected routes by using the **no redistribute connected** command.

redistribute rip

Syntax

```
redistribute rip [metric metric-value] [metric-type
{1 | 2}] or
no redistribute rip [metric] [metric-type]
```

Allows OSPF to redistribute RIP learned routes, in external LSAs (type-5).

A metric value can be specified for these redistributed OSPF routes. Valid range is 1 to 16777215. This metric overrides the configured default metric value. Use the **no redistribute rip metric** command to revert to the default metric value, without disabling the redistribution of the RIP routes.

A metric-type can be specified for these redistributed OSPF routes. The uses of this option are explained in the section Route redistribution. Use the **no**

redistribute rip metric-type command to revert to the default metric-type (i.e. **2**), without disabling the redistribution of the RIP routes.

Disable redistribution of RIP routes by using the **no redistribute rip** command.

redistribute static [metric] [metric-type]

Syntax

```
redistribute static [metric metric-value]
[metric-type {1|2}] or
[no] redistribute static [metric] [metric-type]
```

Allows OSPF to redistribute all statically configured routes, in external LSAs (type-5) (i.e. excluding any configured default route).

A metric value can be specified for these redistributed static routes. Valid range is 1 to 16777215. This metric overrides the configured default metric value. Use the **no redistribute static metric** command to revert to the default metric value, without disabling the redistribution of the static routes.

A metric-type can be specified for these redistributed OSPF routes. The uses of this option are explained in the section Route redistribution. Use the **no redistribute static metric-type** command to revert to the default metric type (i.e. ‘2’), without disabling the redistribution of the static routes.

Disable redistribution of static routes by using the **no redistribute static** command.

List of CLI Commands

A Specifications

This appendix lists specifications for the ARRIS Cadant C3 CMTS.

Product Specifications

8,000 Unicast service identifiers (SIDs)

Dual 10/100/1000BT Network Interfaces

Management interface: command-line interface for system configuration and management tools (telnet, SNMP)

Physical Interfaces

10/100/1000-Base T—Data

10/100/1000-Base T—Out-of-band management

1 downstream, 2 to 6 upstream RF (F-connector)

Serial console port

F-connector (test) on front panel

Logical Interfaces

Sub-interfaces:

Sub-interfaces	Capacity	
	Default	Advanced Bridging
Per physical interface	64	64
Entire CMTS	3	192
Per bridge group	3	10

Private cable VPNs: up to 64 (one per cable sub-interface) with CPE membership specified by CMTS configuration or by modem provisioning system

IP addresses per sub-interface: up to 128 (1 primary + 127 secondary)

Bridge groups (default operation): 2

Bridge groups (Advanced Bridging): up to 64

Logical channels:

Modulation type	Supported channels
SCDMA	up to 2 logical channels per upstream
ATDMA	up to 4 logical channels per upstream
All TDMA types	up to 4 logical channels per upstream

Protocol Support

Layer 2 bridging with static routing (up to 128 static routes) and DHCP relay

Layer 3 IP routing with RIPv2 and OSPFv2

Hybrid Layer 2/Layer 3 operation

802.1Q VLAN support on cable and fastethernet sub-interfaces; each sub-interface can have:

- one configured VLAN specification
- up to 4 additional tags specified in a bridge bind
- DHCP relay in layer 2 (bridging) and layer 3 (IP routing) mode:
- up to 3 types of DHCP helper address per sub-interface and up to 5 addresses per type
- support for DHCP relay address update based on cable modem or host DHCP request
- support for DOCSIS option 82 update
- IGMPv2 proxy

Regulatory and Compliance

EMC: FCC Part 15 Class A, CE

DOCSIS: 2.0 qualified

Euro-DOCSIS: 1.1 qualified

Electrical Specifications

AC Power: 100 to 240 VAC ±10%, 2A, 47-63 Hz

DC Power: –40 to –60 V, 4A

Power consumption:

80 watts maximum (DOCSIS 1.1 hardware)

87 watts maximum (DOCSIS 2.0 hardware)

Redundant powering available—the C3 requires only one power supply to operate, but can be configured with two power supplies (DC and/or AC) for load sharing and automatic fault recovery

Fuse F1: (AC fuse): 250V/5A Anti-surge (T) Glass

Fuse F2: (DC fuse): 250V/10A Anti-surge (T) Glass

Physical Specifications

19 in (W) x 18.3 in (D) x 1.75 in (H)

48.3 cm (W) x 46.5 cm (D) x 4.4 cm (H)

Height: 1 RU (rack unit)

Weight: 10 Kg

Environmental Specifications

Operating Temperature: 0° to 40° C

Storage Temperature: –40° to +75° C

Humidity: 10% to 80% non-condensing

Electromagnetic: FCC Part 15 Class A, CE

MTBF (excluding fans): 150,000 hours at 25°C based on accelerated life testing

RF Specifications — Upstream

Number of Upstreams: 2, 4, or 6

Frequency Range: 5 to 42 MHz (DOCSIS);
5 to 55 MHz (Japan)
5 to 65 MHz (EuroDOCSIS)

Modulation: QPSK, 8QAM,16QAM, 32QAM, and 64QAM.

Symbol Rate: 160, 320, 640, 1280, 2560, 5120 Ksymbol/sec

Data Rate: 5.12 to 30.72 Mbps (max)

Channel Bandwidth: 200, 400, 800, 1600, 3200, 6400 KHz

Receive Signal Level: –20 dBmv to +26 dBmV (valid level varies by symbol rate)

RF Specifications — Downstream

Frequency range: 88 to 860 MHz

Modulation: 64 / 256 QAM

Data rate: 30 to 53.6 Mbps (max)

Transmit level: +45 to +61 dBmV

Output Impedance: 75 ohm

Modulation rate:

64 QAM: 5.056951 Msymbols/sec

256 QAM: 5.360537 Msymbols/sec

EuroDOCSIS: 6.952Msymbols/sec

B

CMTS Configuration Examples

This appendix provides the bare necessities to get an ARRIS Cadant C3 up and running with modems, and computers attached to modems, and a working DHCP server. It concentrates on the absolute minimal steps required to get a DOCSIS modem up and running after installing the C3.

Refer to Chapters 3 through 8 while following the examples in this appendix.

The most simple configuration is a cable modem, C3, and DHCP/TFTP server:

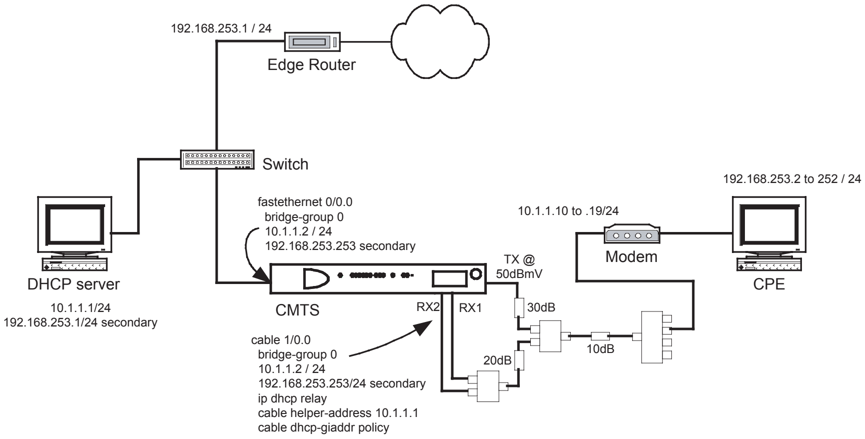


Figure B-1: Simple configuration

Modems, CPE, and the DHCP server are all in the same subnet, and management traffic co-exists with user traffic.

C3 Install

Use the information in "Getting Started" (Chapter 1) and use the following information that is correct for the above network.

Set the C3 boot options as follows:

The firmware filename you are using may be different from the file shown in this example.

```
>bootCfg

Options:
*[1] Boot from TFTP
 [2] Boot from Compact Flash
Select desired option : [2]
Application Image path : [C:/ 4.3.0.32.bin]
CMTS Ip Address : [10.1.1.2]
CMTS Subnet Mask : [255.255.255.0]
TFTP Server Ip Address : [10.1.1.1]
Gateway Ip Address : [10.1.1.1]
Saving in non-volatile storage

>>

Confirm the boot options:
```

```
CMTS>bootShow
*** Current Boot Parameters ***
Boot from           : Compact Flash
Boot file           : C:/4.3.0.32.bin
CMTS IP Address     : 10.1.1.2
CMTS subnet mask    : ffffff00
Gateway Address     : 10.1.1.1
CMTS Name           : CMTS
Network port        : FE 0
Vlan Tagging        : Disabled
Vlan Id             : 1 (0x1)
CMTS>
```

If the “Network port” shows “FE 1,” use the **wan** command at the prompt to change this. Use **bootShow** again to confirm this change.

Use the following script to configure the C3 (this script assumes a factory default configuration). If not in a factory default condition, the factory default configuration can be restored by erasing the stored configuration (file name is **startup-configuration)** using **write erase** from privilege mode. Then issue a **reload** command, responding first with **no** and then **yes** to reboot. The C3 detects no startup-configuration file and re-creates it.

If the C3 has been used elsewhere in the past, this step is *highly* recommended as it may be simpler than inspecting and changing the current configuration.

Script example:

Copy this script to the clipboard, log on at the serial console CLI, entering privilege mode and using the Hyperterm Edit/paste to console.

```
! make sure in privilege mode before running
! this script
conf t
! enable basic snmp
snmp-server community public ro
snmp-server community private rw
!
! create account so telnet will work
cli account arris password arris
cli account arris enable-password arris
!
no ip routing
bridge 0
!
inteface fastethernet 0/0.0
bridge-group 0
ip address 10.1.1.2 255.255.255.0
ip address 192.168.253.253 255.255.255.0 secondary
management-access
exit
!
interface cable 1/0.0
bridge-group 0
! give cable interface ip address so dhcp relay will work
! can be the same as the management ip address as running
! in bridging mode
ip address 10.1.1.2 255.255.255.0
ip address 192.168.253.253 255.255.255.0 secondary
! turn on the upstreams
no cable upstream 0 shutdown
no cable upstream 1 shutdown
! Turn on DHCP relay so DHCP will be unicast to
! the required DHCP server
ip dhcp relay
cable helper-address 10.1.1.1
cable dhcp-giaddr policy
! turn on the downstream
no shutdown
exit
!
! for convenience during testing
! remove telnet session timeout
line vty
timeout 0
exit
exit
! save the configuration
write
```

At this point, the two green LEDS for Rx1 and Rx2 on the front panel are lit and the RF ports (upstream and downstream) are active.

If a modem is connected, it finds the downstream, ranges on an upstream, but fails at the DHCP stage. This is expected at this early stage.

DHCP Server Configuration

The DHCP server receives DHCP Discovers and Requests with a relay address (giaddr option) of **10.1.1.2** for cable modems and **192.168.253.253** for CPEs (hosts).

Any basic DHCP server with two defined scopes containing these subnets can issue an IP address for the modems and to the CPE.

The DHCP options provided to the modem should include the following:

Table B-1: DHCP options

Option name	Number	Description
filename <name>	-	Sets the “file” field, which is the name of a file for the client to request from the next server, i.e. a modem configuration file
next-server <ip>	-	Sets the “siaddr” field, which defines the name of the next server (i.e. TFTP) to be used in the configuration process
time-offset <int>	2	Time offset in seconds from UTC, positive going east, negative going west.
routers <ip>	3	Router address for modem
time-servers <ip>	4	Time servers (as specified in RFC868)
log-servers <ip>	7	MIT-LCS log servers

Table B-1: DHCP options

Option name	Number	Description
broadcast-address	28	Broadcast address for subnet to which client is attached
min-lease-time max-lease-time	58 59	Default minimum (T1/renewal) and maximum (T2/rebinding) lease times

The options use may depend on the selected DHCP server.

One additional step is required in the route table of the DHCP server in this example. The DHCP server must be given a gateway for the 192.168.253.0 network so that the DHCP Offer and Acks can be sent back to the CPE relay address.

TFTP Server Configuration

For the modem to boot completely, an accessible TFTP server as specified by the "siaddr" DHCP option and the boot-file or filename specified in the DHCP options must be resident in the TFTP server root folder.

Debug—What to Do if DHCP is Not Working

If the DHCP server is located past a router on the operator backbone make sure that the DHCP server workstation can be pinged from the Cadant C3 CLI and that the Cadant C3 management address (10.1.1.2 in the above example) can be pinged from the DHCP server.

If secondary subnets exist on the Cadant C3, makes sure that these IP addresses can be pinged from the DHCP server. Note that "management-access" will have to be specified on the relevant sub-interfaces.

If the DHCP does not reach the DHCP server you should check the Cadant C3 configuration and specifically check (in the above example):

```
cable helper-address 10.1.1.1
```

On the C3, use the **debug** command to watch DHCP events on the cable modem and attached CPE:

```
! get modem mac address x.x.x.x that might be having
dhcp issues
! for CPE dhcp debug still use cable modem mac address
show cable modem
! now turn on debug for selected modem
debug cable mac-address x.x.x.x
debug cable dhcp-relay
term mon
```

Watch the console for DHCP:

- discover
- offer
- request
- ack (on the C3)

If CPE DHCP is to be monitored, enable DHCP debug for the attached cable modem MAC address NOT the CPE MAC address.

See also: Chapter 7, *Managing Cable Modems*, and the section on DHCP.Common Configurations

The following configurations provide C3 configuration from a factory default condition and in the more complicated examples, DHCP server configuration details.

Simple Bridging

In a factory default configuration, the C3 is configured with two bridge groups, only one of which is active.

- fastethernet 0/0.0 and cable 1/0.0 are members of bridge group 0
- cable 1/0.1 is pre-defined
- cable 1/0.1 and fastethernet 0/1.0 are both members of bridge group 1
- cable 1/0.1 is shutdown
- default-cm-subinterface cable 1/0.0
- default-cpe-subinterface cable 1/0.0

All traffic uses the fastethernet 0/0 (WAN) interface.

This configuration is the equivalent of v2.0 series software “inband-management” operation.

The following examples repeat the simple example given above but showing in a more diagrammatic form of the default allocation of sub-interfaces to the default bridge groups.

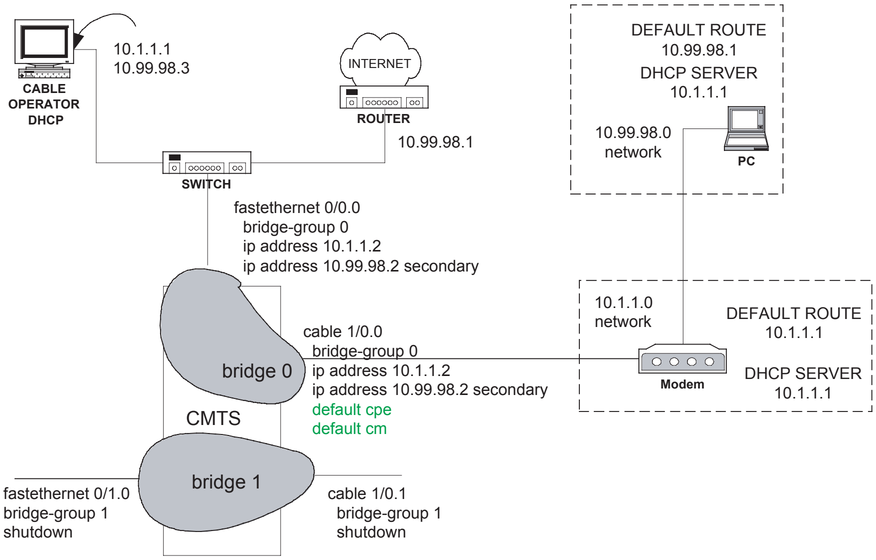


Figure B-2: Default allocation of sub-interfaces to the default bridge groups

C3 Configuration

The following commands configure the C3 for simple bridging operation.

```
! make sure in privilege mode before running
! this script
conf t
! enable basic snmp
snmp-server community public ro
snmp-server community private rw
!
! create account so telnet will work
cli account arris password arris
cli account arris enable-password arris
!
no ip routing
! this bridge-group is already defined
bridge 0
!
inteface fastethernet 0/0.0
bridge-group 0
ip address 10.1.1.2 255.255.255.0
ip address 10.99.98.2 255.255.255.0 secondary
management-access
exit
!

interface cable 1/0.0
bridge-group 0
! give cable interface ip address so dhcp relay will
work
```

```
! can be the same as the management ip address as
running
! in bridging mode
ip address 10.1.1.2 255.255.255.0
ip address 10.99.98.2 255.255.255.0 secondary
! turn on the upstreams
no cable upstream 0 shutdown
no cable upstream 1 shutdown
! do not broadcast dhcp as we do not know
! what else is out there
ip dhcp relay
cable helper-address 10.1.1.1
cable dhcp-giaddr policy
! turn on the downstream
no shutdown
exit
!
! for convenience during testing
! remove telnet session timeout
line vty
timeout 0
exit
exit
! save the configuration
write
```

Simple Bridging with Separate Management Traffic

It is possible to configure the C3 using the factory default bridge groups and sub-interfaces to separate management traffic from other network traffic:

- fastethernet 0/1 and cable 1/0 are members of bridge group 0
- cable 1/0.1 is pre-defined
- cable 1/0.1 and fastethernet 0/0 are both members of bridge group 1
- default-cm-subinterface cable 1/0
- default-cpe-subinterface cable 1/0.1

If the boot options network interface is changed to the fastethernet 0/1.0 sub-interface on first power up (no startup-configuration file exists) using the **mgmt** boot option command, this configuration is the resulting default.

The following example shows how the bridge group capability of the Cadant C3 can be used to completely isolate CPE traffic, including CPE broadcast traffic, from the management network.

The following example:

- makes use of the **default cm subinterface** and **default cpe subinterface** commands to map all CPE and modem traffic to separate cable sub-interfaces and hence to separate bridge groups and hence separate fastethernet sub-interfaces
- DHCP relay is being used for CPE and relies on the ability of the C3 to forward DHCP across bridge groups as long as **ip dhcp relay** is turned on in the bridge groups concerned.
- The specification **ip l2-bg-to-bg-routing** on fastethernet 0/1.0 is required for DHCP Renew Acks to be returned to the CPE across the bridge groups. No other sub-interface requires this specification.
- Does not require VLAN tagging of data on the CPE network attached to the WAN port.

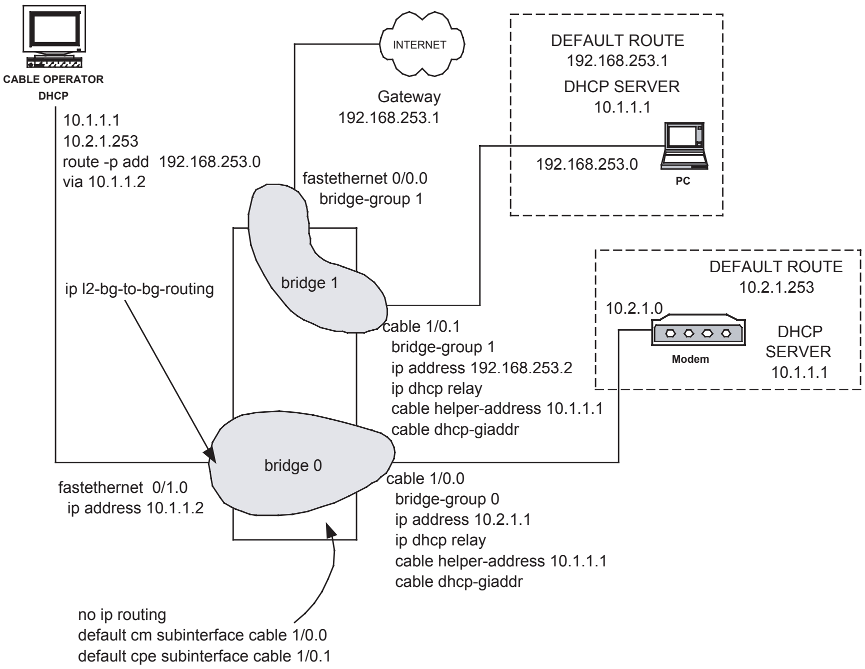


Figure B-3: Example of bridge-group capabilities

C3 Configuration

```
configure terminal
! turn on simple snmp access
snmp-server community public ro
snmp-server community private rw
!
no ip routing
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.1
```

```
!
! bridges already defined as factory default
! bridge 0
! bridge 1
!
interface fastethernet 0/0.0
bridge-group 1
! no ip address
no shutdown
no management-access
exit
!
interface fastethernet 0/1.0
bridge-group 0
! define management ip address
ip address 10.1.1.2 255.255.255.0
! need to allow bg to bg routing so cpe DHCP
! renew ack can be forwarded back to bg 1
ip l2-bg-to-bg-routing
no shutdown
!
interface cable 1/0.0
bridge-group 0
ip address 10.2.1.1 255.255.255.0
! all modem traffic will default here
! IMPORTANT: DHCP server must have static route
! to this interface via the management interface
! to allow CM DHCP to be routed back here
ip dhcp relay
cable helper-address 10.1.1.1
cable dhcp-giaddr

interface cable 1/0.1
! all CPE traffic will default here
bridge-group 1
! must have some form of vlan tagging
! use "native" format
encapsulation dot1q 99 native
ip address 192.168.253.2 255.255.255.0
! IMPORTANT: DHCP server must have static route
! to this interface via the management interface
! to allow CPE DHCP to be routed back here
ip dhcp relay
cable helper-address 10.1.1.1
cable dhcp-giaddr
 exit
!
exit
exit
!
write
```

Bridging, Separate Management Traffic, CM and CPE DHCP Servers

The following figure shows the same example as used above but in this case, an ISP based DHCP server manages CPE IP addresses.

This example shows complete separation between CPE traffic and modem plus CMTS traffic.

Variations from the previous example:

- now a separate ip route specification is used to tell the C3 how to find the ISP’s 176.16.5.0 network.
- Fastethernet 0/1.0 no longer needs **ip bg-to-bg-routing**. The CPE DHCP Renew does not use this interface.

For example:

```
ip route 176.16.5.0 255.255.255.0 192.168.253.1
```

NOTE

The fastethernet 0/0.0 sub-interface still does not need an IP address. Cable 1/0.1 has a 192.168.253.0 network address, so bridge group 1 is known to be attached to this IP network thus the C3 can find the specified route 192.168.253.1.

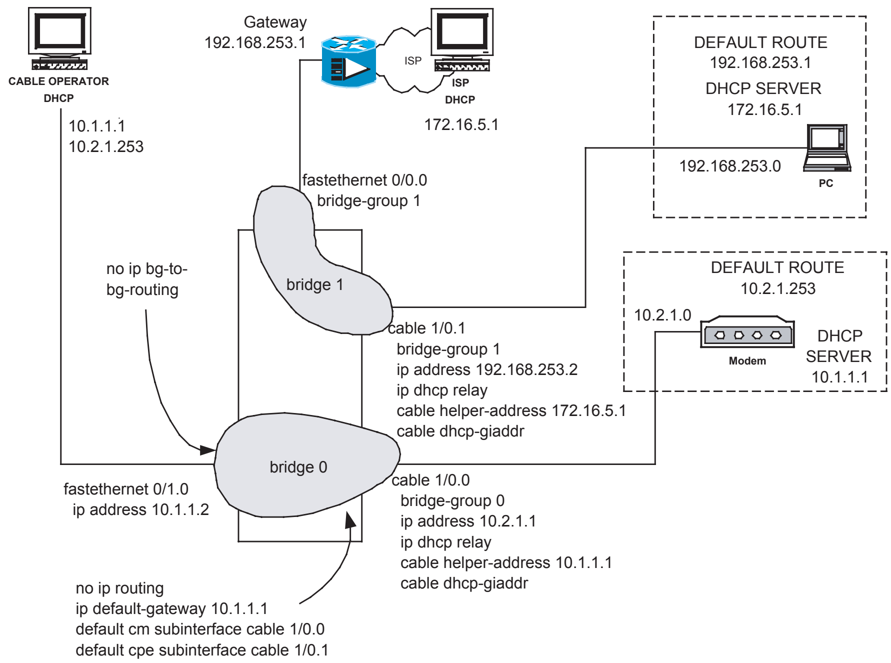


Figure B-4: Example of how an ISP based DHCP server manages CPE IP addresses

C3 Configuration

```
configure terminal
! turn on simple snmp access
snmp-server community public ro
snmp-server community private rw
```

```
!
no ip routing
ip route 172.16.5.0 255.255.255.0 192.168.253.1
default cm subinterface cable 1/0.0
default cpe subinterface cable 1/0.1
!
! bridges already defined as factory default
! bridge 0
! bridge 1
!
interface fastethernet 0/0.0
bridge-group 1
! no ip address
no shutdown
no management-access
exit
!
interface fastethernet 0/1.0
bridge-group 0
! define management ip address
ip address 10.1.1.2 255.255.255.0
! no need now as CPE dhcp never reaches this sub-
interface
! but if dhcp server is not dual homed on cm subnet
! will still be needed for cm operation (as will static
! route in dhcp server to this interface for the modem
! network)
no ip l2-bg-to-bg-routing
no shutdown
!

interface cable 1/0.0
bridge-group 0
ip address 10.2.1.1 255.255.255.0
! all modem traffic will default here
ip dhcp relay
cable helper-address 10.1.1.1
cable dhcp-giaddr

interface cable 1/0.1
! all CPE traffic will default here
bridge-group 1
encapsulation dot1q 99 native
ip address 192.168.253.2 255.255.255.0
ip dhcp relay
cable helper-address 172.16.5.1
cable dhcp-giaddr
 exit
!
exit
exit
!
write
```

Advanced Bridging

An additional software licence is required to support the following examples. Please contact your account manager.

802.1Q VLAN Backbone

The advanced bridging and VLAN features of the Cadant C3 allow the use of more bridge groups, more sub-interfaces and more 802.1Q VLANs.

The following example shows an open access system implemented with a Cadant C3 in bridging mode with three ISPs. This example is shown as all the advanced bridging and VLAN abilities of the C3 are used.

The C3 can support up to 63 ISPs using this model.

In this example, two of the ISPs issue their own IP address; one ISP requires the cable operator to issue CPE IP addresses. In each case the router option passed to the CPE device is that of the ISP gateway router and is independent of the cable modem plant.

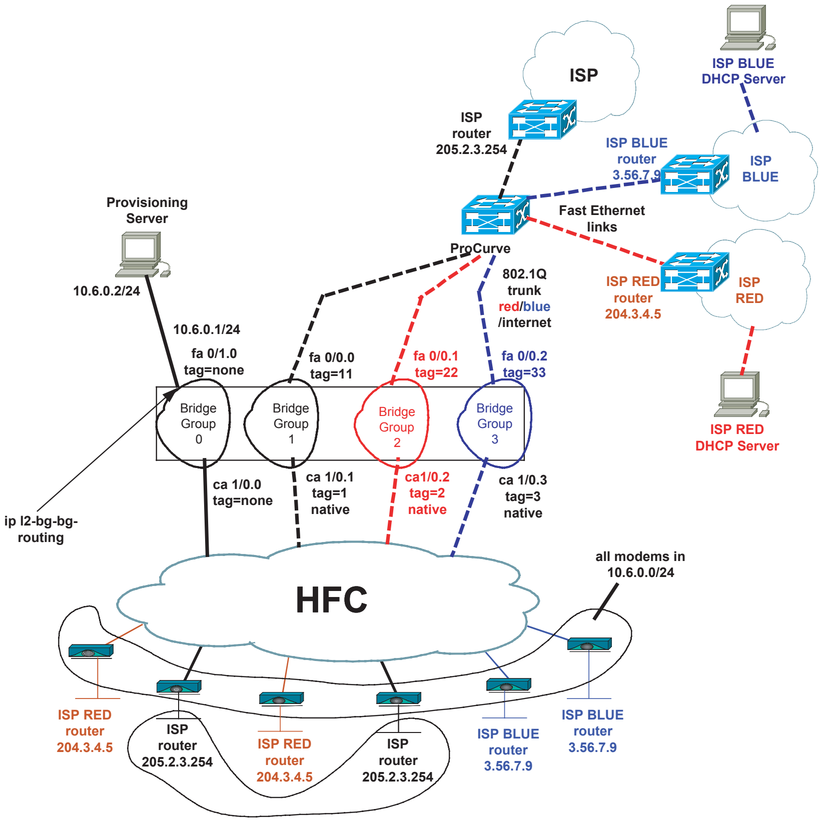


Figure B-5: Example of all the C3v advanced bridging and VLAN abilities

DHCP Server Configuration

To support this configuration the cable operator DHCP must have:

- A single scope defined for modems in the 10.6.0.0 network
- A scope defined for the network 205.2.3.0 network
- A method of providing specific DHCP options (including configuration file) for a specific modem (MAC address)

The modem DHCP Discover arrives at the DHCP server with its giaddr set to 10.6.0.1, so there must be an address pool for modems defined in the cable operator DHCP server for this subnet. For example, from 10.6.0.10 to 10.6.0.254.

Create a modem policy and assign to this address pool. This modem policy should have the DHCP server as the default route for the modems and should reference a suitable default set of DHCP options. This is the "default modem policy" for modems that have no other options specified (reserved).

The ISP's DHCP Discover arrives at the operator DHCP server with a giaddr of 205.2.3.253.

NOTE

You must enable **ip l2-bg-to-bg-routing** and management access on fastethernet 0/1.0 for CPE assigned to ISP to successfully renew the DHCP lease.

There should be a CPE address pool defined in the cable operator DHCP server for this subnet. For example, from 205.2.3.1 to 205.2.3.252.

The operator DHCP options in the policy for this address pool must have a router option of 205.2.3.254 (the internet gateway for ISP).

NOTE

The operator DHCP server needs a static route to the 205.2.3.0/24 network. Without this route, the DHCP server Offer and Ack responses to the CPE devices are not forwarded and DHCP Renew Ack to the CPE also fails. For example, **route -p add 205.2.3.0 mask 255.255.255.0 10.6.0.1**

The operator DHCP server needs to specify different configuration files for each modem depending on what the CPE attached to the modem is meant to be doing:

- Config file for "ISP" with VSE = 1
- Config file for "ISP RED" with VSE = 2
- Config file for "ISP BLUE" with VSE = 3

NOTE
The default CPE sub-interface is specified as cable 1/0.1; thus any CPE traffic arriving via a modem with no VSE tagging defaults to this sub-interface and ensuring that the CPE default allocation is to "ISP."

The "ISP RED" CPE uses **ip dhcp relay** to reach the "ISP RED" DHCP server and "ISP BLUE" DHCP is broadcast through the C3 to the "ISP BLUE" DHCP server.

- Policy for internet ISP modems—configuration file referenced should have VSE=1
- Policy for internet ISP RED modems—configuration file referenced should have VSE=2
- Policy for internet ISP BLUE modems—configuration file referenced should have VSE=3

Reserve the modem MAC address in the appropriate address pool but OVERRIDE the default modem policy (defined above) with either:

- Policy for internet CPE modems—config file referenced should have VSE=1
- Policy for internet VPN RED—config file referenced should have VSE=2
- Policy for internet VPN BLUE—config file referenced should have VSE=3

This needs to be done per modem that is provisioned.

If a modem MAC address is not reserved in an address pool, it gets the default modem policy defined above using basic DHCP processing rules (matching giaddr to the available address pools). If the default for an un-provisioned modem is for Internet CPE, then this default policy should specify the configuration file that has a VSE=1.

DHCP for CPE devices attached to modems assigned to ISP RED or ISP BLUE are bridged and VLAN'd directly to the ISP backbones for processing.

C3 Configuration

```
! make sure in priv mode and in factory default
! before trying to paste the following
!
conf t
```

```
Bridge 0
Bridge 1
Bridge 2
Bridge 3
!
no ip routing
ip default-gateway 10.6.0.2
!
! ISP RED requires DHCP relay so tell the C3
! how to find the ISP RED dhcp server network
ip route 204.6.6.0 255.255.255.0 204.3.4.5
!
default cm sub interface cable 1/0.0
! set CPE default for ISP access
default cpe sub interface cable 1/0.1
!
interface fa 0/0.0
bridge-group 1
! no ip address required as bridging only
encapsulation dot1q 11
no management-access
exit
!
interface fa 0/0.1
bridge-group 2
! no ip address required as bridging only
encapsulation dot1q 22
no management-access
exit
!
interface fa 0/0.2
bridge-group 3
! no ip address required as bridging only
encapsulation dot1q 33
no management-access
exit
!
interface fa 0/1.0
bridge-group 0
! this is the C3 management IP address
ip address 10.6.0.1 255.255.255.0
management-access
! need this to allow CPE DHCP renew ack from DHCP server
back to bg 1
ip l2-bg-to-bg-routing
exit

!
interface cable 1/0.0
! all modems are here by default
! enter RF config here
cable upstream 0 frequency 10000000
cable upstream 0 channel-width 3200000
cable upstream 0 ingress-cancellation
no cable upstream 0 shutdown
cable upstream 1 frequency 15000000
cable upstream 1 channel-width 3200000
cable upstream 1 ingress-cancellation
no cable upstream 1 shutdown
no shutdown
!
! Note can be the same as the management address
ip address 10.6.0.1 255.255.255.0
ip DHCP relay
cable helper-address 10.6.0.2 cable-modem
cable DHCP-giaddr primary
exit

!
interface cable 1/0.1
! for ISP CPE
bridge-group 1
! use this ip address to give giaddr to CPE DHCP
discovers
! CPE should be given 205.2.3.254 as their gateway
address
! and 205.2.3.254 should be the internet edge router
ip address 205.2.3.253 255.255.255.0
ip DHCP relay
cable helper-address 10.6.0.2
cable dhcp-giaddr primary
! VSE tag of 1 is required here
encapsulation dot1q 1 native
! turn on downstream privacy (BPI is on)
encapsulation dot1q 1 encrypted-multicast
! no cmts management allowed
no management-access
exit

!
interface cable 1/0.2
! for VPN RED
bridge-group 2
! need to use dhcp relay so set up
! ip addressing for relay to work
ip address 204.3.4.1 255.255.255.0
ip dhcp relay
cable helper-address 204.6.6.6
cable dhcp-giaddr primary
! VSE tag of 2 is required here
encapsulation dot1q 2 native
! give VPN members downstream privacy
encapsulation dot1q 2 encrypted-multicast
! allow l2 multicast and bcast echo
l2-broadcast-echo
l2-multicast-echo
! do not allow ip traffic to leave this bridge-group
no ip l2-bg-to-bg-routing
! no cmts management allowed
no management-access
! if required that VPN members get ip address from
operator
! provisioning system
! add the following
! ip address 10.2.0.254 255.255.255.0
! ip DHCP relay
! cable helper-address 10.6.0.2
! cable DHCP-giaddr primary
exit
!
interface cable 1/0.3
! for VPN BLUE
bridge-group 3
! VSE tag of 3 is required here
encapsulation dot1q 3 native
! give VPN members downstream privacy
encapsulation dot1q 3 encrypted-multicast
! allow l2 multicast and bcast echo
l2-broadcast-echo
l2-multicast-echo
! do not allow ip traffic to leave this bridge-group
no ip l2-bg-to-bg-routing
! no cmts management allowed
no management-access
! if required that VPN members get ip address from
operator
! provisioning system
! add the following
! ip address 10.3.0.254 255.255.255.0
! ip DHCP relay
! cable helper-address 10.6.0.2 host
! cable DHCP-giaddr primary
exit
```

Standard Ethernet Backbone

In the previous example, separate bridge groups are used for each ISP. This configuration however requires the use of an 802.1Q Ethernet backbone. In following example, 802.1Q VLANs are not used on the Ethernet backbone. This configuration is thus suitable for an operator that wishes to provide "open access" or "multi-ISP" without using 802.1Q backbone VLANs. The limitations of this configuration are:

- the number of ISPs that can be supported in this manner is 9
- Since all CPE traffic shares the same bridge group, some protection is required to maintain separation between ISP traffic

The ability to add up to 10 sub-interfaces to one bridge group is being used, with this bridge group having one sub-interface connection to the operator Ethernet backbone.

All cable sub-interfaces are members of the same bridge group as fastethernet 0/0.

Other features to note in the following example:

- CPE traffic is still split into 3 native VLANs on 3 cable sub-interfaces using configuration file VSE allowing different specifications for each native VLAN e.g. ACL filters, DHCP relay etc.
- Downstream privacy is still turned on for each native VLAN.
- Again, one ISP uses the operator DHCP server for CPE DHCP; the other two ISPs use their own DHCP servers for CPE DHCP.
- Again, CPE should be given a default route of the respective ISP gateway router in the DHCP options.
- Up to 9 ISPs may be supported in this manner.

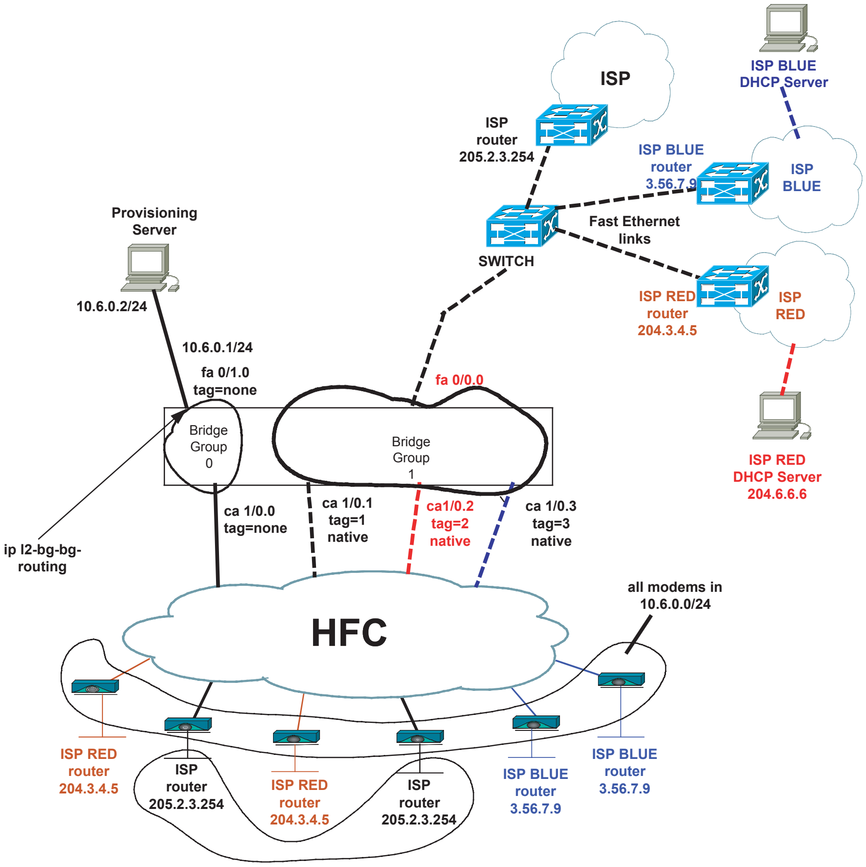


Figure B-6: Example of "open access" without using 802.1Q backbone VLANs

```
! make sure in priv mode and in factory default
! before trying to paste the following
!
```

```
conf t
bridge 0
bridge 1
!
no ip routing
ip default-gateway 10.6.0.2
ip route 204.6.6.0 255.255.255.0 204.3.4.5
!
default cm sub interface cable 1/0.0
! set CPE default for internet access
default cpe sub interface cable 1/0.1
!
interface fa 0/0.0
bridge-group 1
! no ip address required as bridging only
no management-access
exit
!
interface fa 0/1.0
bridge-group 0
! this is the C3 management IP address
ip address 10.6.0.1 255.255.255.0
management-access
! need this to allow CPE DHCP RENEW ACK  from DHCP server
back to bg 1
! and hence requesting CPE
ip l2-bg-to-bg-routing
exit
!

interface cable 1/0.0
bridge-group 0
! all modems are here by default
! enter RF config here
cable upstream 0 frequency 10000000
cable upstream 0 channel-width 3200000
cable upstream 0 ingress-cancellation
no cable upstream 0 shutdown
cable upstream 1 frequency 15000000
cable upstream 1 channel-width 3200000
cable upstream 1 ingress-cancellation
no cable upstream 1 shutdown
no shutdown
!
! Note can be the same as the management address
ip address 10.6.0.1 255.255.255.0
ip DHCP relay
cable helper-address 10.6.0.2 cable-modem
cable DHCP-giaddr primary
exit
!

interface cable 1/0.1
! for internet CPE
bridge-group 1
! use this ip address to give giaddr to CPE DHCP
discovers
```

```
! CPE should be given 205.2.3.254 as their gateway
address
! and 205.2.3.254 should be the internet edge router
ip address 205.2.3.253 255.255.255.0
ip DHCP relay
cable helper-address 10.6.0.2 host
cable dhcp-giaddr primary
! VSE tag of 1 is required here
encapsulation dot1q 1 native
encapsualtion dot1q 1 encrypted-multicast
! no cmts management allowed
no management-access
exit
!

interface cable 1/0.2
! for VPN RED
bridge-group 1
! need to use dhcp relay so set up
! ip addressing for relay to work
ip address 204.3.4.1 255.255.255.0
ip dhcp relay
cable helper-address 204.6.6.6
cable dhcp-giaddr primary
! VSE tag of 2 is required here
encapsulation dot1q 2 native
encapsulation dot1q 2 encrypted-multicast
! give VPN members downstream privacy
! allow l2 multicast and bcast echo
l2-broadcast-echo
l2-multicast-echo
! do not allow ip traffic to leave this bridge-group
no ip l2-bg-to-bg-routing
! no cmts management allowed
no management-access
! if required that VPN members get ip address from
operator
! provisioning system
! add the following
! ip address 10.2.0.254 255.255.255.0
! ip DHCP relay
! cable helper-address 10.6.0.2 host
! cable DHCP-giaddr primary
exit
!

interface cable 1/0.3
! for VPN BLUE
bridge-group 1
! VSE tag of 3 is required here
encapsulation dot1q 3 native
! give VPN members downstream privacy
encapsulation dot1q 3 encrypted-multicast
! allow l2 multicast and bcast echo
l2-broadcast-echo
l2-multicast-echo
! do not allow ip traffic to leave this bridge-group
```

```
no ip l2-bg-to-bg-routing
! no cmts management allowed
no management-access
! if required that VPN members get ip address from
operator provisioning system
! add the following
! ip l2-bg-to-bg-routing
! ip DHCP relay
! cable helper-address 10.6.0.2 host
! cable DHCP-giaddr primary
exit
!
```

Simple IP Routing — Network

This example is the equivalent of the bridging example given earlier in this chapter but in this case, bridge groups are not used—a pure routing model is used.

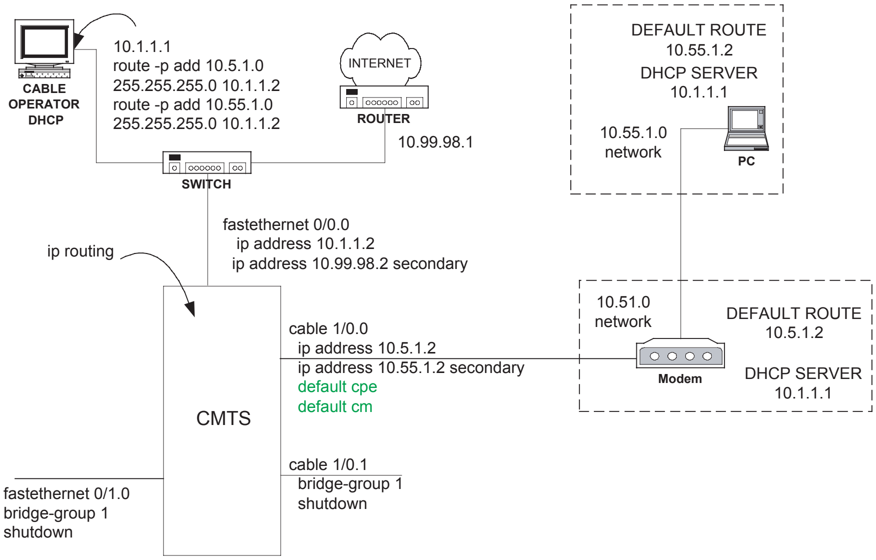


Figure B-7: Example of a pure routing model

```
! make sure in privilege mode before running
! this script
conf t
!
! provide default route for CPE
ip route 0.0.0.0 0.0.0.0 10.99.98.1
!
! enable basic snmp
snmp-server community public ro
snmp-server community private rw
!
! create account so telnet will work
```

```
cli account arris password arris
cli account arris enable-password arris
!
ip routing
!
inteface fastethernet 0/0.0
! remove the default bridge-group allocation
no bridge-group
ip address 10.1.1.2 255.255.255.0
ip address 10.99.98.2 255.255.255.0 secondary
management-access
exit
!
interface cable 1/0.0
no bridge-group
ip address 10.5.1.2 255.255.255.0
ip address 10.55.1.2 255.255.255.0 secondary
! turn on the upstreams
no cable upstream 0 shutdown
no cable upstream 1 shutdown
ip dhcp relay
cable helper-address 10.1.1.1
cable dhcp-giaddr policy
! turn on the downstream
no shutdown
exit
!
! for convenience during testing
! remove telnet session timeout
line vty
timeout 0
exit
exit
! save the configuration
write
```

Routing, Separate Management Traffic

Again, this example is the equivalent routing version of the simple bridging example presented above.

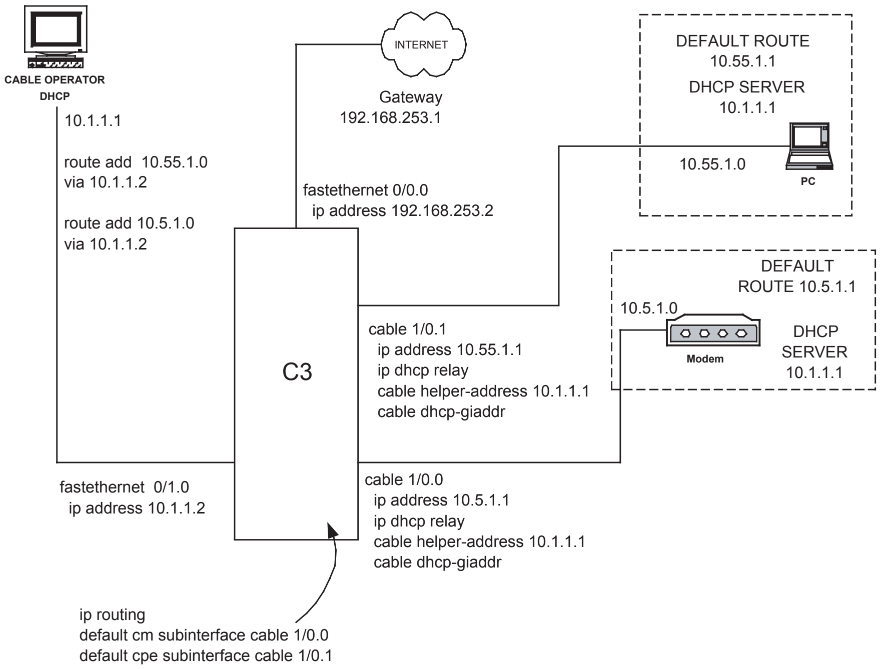


Figure B-8: Example of the equivalent routing version of simple bridging

```
configure terminal
! turn on simple snmp access
snmp-server community public ro
snmp-server community private rw
!
! inband-managment
!
ip routing
!
! provide default route for CPE
ip route 0.0.0.0 0.0.0.0 192.168.253.1
!
default cpe subinterface cable 1/0.1
default cm subinterface cable 1/0
!
interface fastethernet 0/0.0
ip address 192.168.253.2 255.255.255.0
no bridge-group
no management-access
no shutdown
!
interface fastethernet 0/1
ip address 10.1.1.2 255.255.255.0
management-access
no shutdown
```

```
!
interface cable 1/0.0
no bridge-goup
ip address 10.5.1.1 255.255.255.0
ip dhcp relay
ip dhcp relay information option
cable dhcp-giaddr primary
cable helper-address 10.1.1.1
exit
!
interface cable 1/0.1
ip address 10.55.1.1 255.255.255.0
ip dhcp relay
ip dhcp relay information option
cable dhcp-giaddr primary
cable helper-address 10.1.1.1
no management-access
no shutdown
exit
!
exit
exit
```

Hybrid operation

The following example shows bridging being used to support CPE running at layer 2 (PPPoE) and IP routing being used to support CPE running at the IP level and Ethernet 802.1Q VLANS being used to separate traffic on the Ethernet backbone.

Note that bridging and routing is being performed by separate cable sub-interfaces. It is possible to both bridge and route using the one sub-interface.

Configuration file "VSE" is being used to map CPE traffic to sub-interfaces and hence to the capabilities of that sub-interface, either bridging or IP routing.

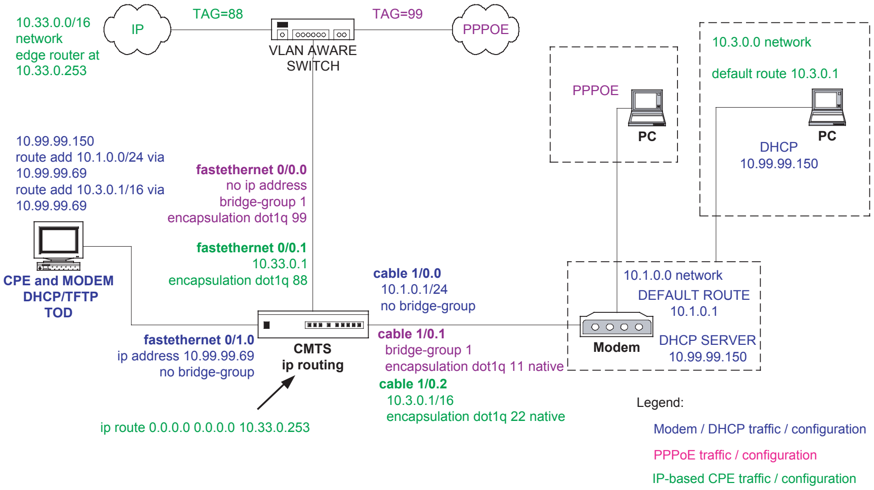


Figure B-9: Example of a hybrid operation

```
configure terminal
! turn on simple snmp access
snmp-server community public ro
snmp-server community private rw
!
cli account arris password arris
cli account arris enable-password arris
line vty
timeout 0
line console
timeout 0
exit
!
ip routing
! set default route for CPE ip traffic gateway
ip route 0.0.0.0 0.0.0.0 10.33.0.253
!
! factory defaults
! bridge 0
! bridge 1
!
interface fastethernet 0/0
bridge-group 1
! no IP address required
no shutdown
no management-access
encapsulation dot1q 99
exit
!
interface fastethernet 0/0.1
ip address 10.33.0.1 255.255.0.0
no shutdown
no management-access
encapsulation dot1q 88
exit
!
interface fastethernet 0/1.0
! management ip address of cmts
ip address 10.99.99.69 255.255.255.0
! make a routed sub-interface
no bridge-group
no shutdown
management-access
exit
!


interface cable 1/0.0
! for modems
! make a routed sub-interface
no bridge-group
no cable upstream 0 shutdown
no cable upstream 1 shutdown
no shutdown
ip address 10.1.0.1 255.255.0.0
no management-access
ip dhcp relay
ip dhcp relay information option
cable dhcp-giaddr primary
cable helper-address 10.99.99.150
exit
!
interface cable 1/0.1
! for PPPoE based CPE devices
! no ip address required
no management-access
bridge-group 1
encapsulation dot1q 11 native
exit
!
interface cable 1/0.2
! for IP based CPE devices
no bridge-group
ip address 10.13.0.1 255.255.0.0
encapsulation dot1q 22 native
no management-access
ip dhcp relay
cable helper-address 10.99.99.150
cable dhcp-giaddr primary
exit
!
exit
```

C Wireless Cable Applications

This appendix describes features related to wireless cable support in the C3.

Overview

The C3 includes extensions to DOCSIS 1.1 to support deployments in a wireless environment. The extensions are primarily to the downstream PHY, and can be accessed through both CLI commands and SNMP MIBs.

NOTE

The wireless extensions support TDMA operation only on DOCSIS 1.1 hardware.

Feature Summary

Wireless extensions support the following features:

- QPSK and 16QAM downstream modulation types in Annex A mode
- selectable internal or external upconverter
- programmable downstream IF frequency
- programmable downstream symbol rate in both Annex A and Annex B mode
- CLI and SNMP support for configuring the above features that provide full upgrade compatibility with currently deployed systems

Downstream Modulation Types

The C3 provides two extended downstream modulation types, QPSK and 16 QAM, for wireless applications. These modulation types are supported in Annex A mode only.

Selectable Upconverter

The C3 provides an internal upconverter for RF output in the DOCSIS or Euro-DOCSIS standard frequency ranges. The C3 can also feed an external upconverter through the downstream IF output for frequency plans outside the standard ranges.

IF Frequency

The downstream IF output is programmable through both SNMP and the CLI. The supported range is 10MHz to 60MHz.

Downstream Symbol Rate

Normally, the C3 automatically sets the downstream symbol rate based on the modulation and channel width. The C3 also supports setting the rate manually. The supported range is 1.25MSym/sec to 6.952MSym/sec (EuroDOCSIS maximum) in both Annex A and Annex B modes.

Downstream Annex Type

The downstream annex type may be set without affecting symbol rate and IF frequency.

Configuration

In normal operation, the C3 may be configured for DOCSIS, EuroDOCSIS or a mixed mode (DOCSIS downstream and EuroDOCSIS upstream) modes. The **cable downstream mac-mode** CLI command and the **dcxMACCmtsMacMode** MIB can set the annex type.

When setting a standard mode, the C3 automatically configures some parameters, including symbol rate and IF frequency, to ensure proper operation. The C3 also places limitations on parameters, such as modulation type and frequency range, to ensure standards compliance.

To configure the C3 for deployment in a wireless network, a fourth mode, **wireless**, is supported through both CLI and SNMP. The custom mode allows the C3 to set parameters independently to accommodate wireless operation.

User Interface

This section briefly describes new and changed commands and MIBs used to configure the C3 for wireless operation.

CLI

All of the following commands are invoked from configuration mode for the cable interface. From privileged mode, use the following series of commands to configure the cable interface:

```
C3#configure terminal
C3(config)#interface cable 1/0
C3(config-if)#
```

Setting the Cable MAC Mode

Syntax: **cable downstream mac-mode {*mode*} [wireless]**

Sets the MAC mode for the downstream. The mode is one of the following:

- **docsis** (standard DOCSIS)
- **euro-docsis** (standard Euro-DOCSIS)

When specifying **docsis** or **euro-docsis** modes, the C3 normally performs parameter checking to ensure proper operation for that mode. Specify the **wireless** option to allow setting the downstream symbol rate, modulation, and annex type to non-standard values.

Setting the Annex

`Syntax:` **cable downstream annex {a | b}**

Sets the annex type for the downstream. This command has been superseded by the **cable downstream mac-mode** command, and is now used only to set the annex type when the MAC mode is set to **wireless**.

Since the annex type alone is not sufficient to describe the actual mode of operation, this command behaves as follows:

- Setting Annex A or B during startup after a firmware upgrade configures the system in DOCSIS or EuroDOCSIS mode.
- Setting Annex A or B after startup changes only the annex type on the downstream.

Setting the IF Frequency

`Syntax:` **cable downstream if-frequency {*if*}**

Sets the CMTS IF output frequency. When changing the MAC mode to **docsis** or **euro-docsis**, the C3 resets the IF frequency to either 43.75MHz (**docsis**) or 36.125MHz (**euro-docsis**) to ensure proper output from the internal upconverter in the desired mode. Once the new mode is set, the IF frequency may be changed if the internal upconverter is not used.

Valid range: 10MHz to 60MHz.

Setting the Downstream Symbol Rate

`Syntax:` **cable downstream symbol-rate {*sr*}**

Sets the downstream symbol rate when the **wireless** MAC mode option is specified. When the **wireless** option has not been specified, this command returns an error.

Valid range: **1250000** to **6952000**.

SNMP

MIBs related to wireless support are part of the proprietary **cmtsC3MACMib**. The affected sections are as follows:

```
    DcxMACCmtsMacEntry ::= SEQUENCE {
        dcxMACCmtsMacMode INTEGER,
        ?
        }

    dcxMACCmtsMacMode OBJECT-TYPE
        SYNTAX      INTEGER { unknown(0), docsis(1), euroDocsis(2), mixed(3), 
custom(4) }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "Indicates the DOCSIS MAC mode that applies to this MAC domain where
            mixed mode consists of docsis downstream and euroDocsis upstream.
             When set to custom mode, the downstream symbol rate, modulation and
            mnnex type may all be configured to non-standard parameters.
            If set to docsis, euroDocsis or mixed, the downstream symbol rate
            and annex type will be set automatically. The IF frequency will also
            be set automatically to ensure proper operation with the internal
            upconverter but may be overridden by setting
            dcxMACDownChannelIfFrequency if the internal upconverter is not in
            use."
        ::= { dcxMACCmtsMacEntry 1 }

   ?

    DcxMACDownstreamChannelEntry ::= SEQUENCE {
        dcxMACDownChannelMacMode DocsisMacType,
        dcxMACDownChannelIfFrequency Integer32,
        dcxMacDownChannelSymbolRate Integer32,
        dcxMacDownChannelSymbolAlpha Integer32,
        dcxMacDownChannelAnnex Integer32
        }

    dcxMACDownChannelMacMode OBJECT-TYPE
        SYNTAX      DocsisMacType
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "Indicates the DOCSIS MAC mode that applies to this channel."
        ::= { dcxMACDownstreamChannelEntry 1 }

    dcxMACDownChannelIfFrequency OBJECT-TYPE
        SYNTAX      Integer32 (5000000..80000000)
        UNITS       "hertz"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The IF frequency output by the modulator for this channel."
        ::= { dcxMACDownstreamChannelEntry 2 }

    dcxMacDownChannelSymbolRate OBJECT-TYPE
        SYNTAX      Integer32 (1250000..6952000)
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "When dcxMACCmtsMacMode is set to custom mode, this value may
            written to set the downstream symbol rate."
        ::= { dcxMACDownstreamChannelEntry 3 }

    dcxMacDownChannelAlpha OBJECT-TYPE
        SYNTAX      Integer32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The excess bandwidth for the channel."
        ::= { dcxMACDownstreamChannelEntry 4 }

    dcxMacDownChannelAnnex OBJECT-TYPE
        SYNTAX      INTEGER { annexA(1), annexB(2) }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "When dcxMACCmtsMacMode is set to custom mode, this value may
            written to set the downstream annex type."
        ::= { dcxMACDownstreamChannelEntry 5 }
```

D DS1 Applications

The C3 can be used to carry packetized TDM circuits, such as DS1, E1, partial T1 (Nx64), etc. In this type of configuration, the C3 provides the IP transport and a third party device is required to convert the TDM circuit to a packet stream for transport over the DOCSIS network. This appendix provides example configurations for providing this “circuit emulation” service.

Provisioning Summary

The following steps are recommended to provision DS1 capability on the C3.

- Use ATDMA modulation and ingress cancellation
- Build a modulation profile with maximum FEC and custom codeword size
- Build a configuration file for the cable modem that provides reserved bandwidth (UGS flows)

Example Modulation Profile

The following listing is an example of a modulation profile used for DS1 transmission.

```
cable modulation-profile 42 request AdvPhy ATDMA 1 1536
cable modulation-profile 42 request AdvPhy preamble-type qpsk1
cable modulation-profile 42 request 0 16 0 8 qpsk scrambler 338 no-diff 32 fixed
cable modulation-profile 42 initial AdvPhy ATDMA 1 1536
cable modulation-profile 42 initial AdvPhy preamble-type qpsk1
cable modulation-profile 42 initial 10 34 0 48 qpsk scrambler 338 no-diff 512 fixed
cable modulation-profile 42 station AdvPhy ATDMA 1 1536
cable modulation-profile 42 station AdvPhy preamble-type qpsk1
cable modulation-profile 42 station 10 34 0 48 qpsk scrambler 338 no-diff 800 fixed
cable modulation-profile 42 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 42 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 42 advPhyS 16 223 8 8 16qam scrambler 338 no-diff 32 shortened
cable modulation-profile 42 advPhyL AdvPhy ATDMA 1 1536
cable modulation-profile 42 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 42 advPhyL 16 223 0 8 16qam scrambler 338 no-diff 64 shortened
cable modulation-profile 42 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 42 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 42 advPhyU 16 223 0 8 16qam scrambler 338 no-diff 64 shortened
```

Example Cable Modem Configuration File

The cable modem configuration file should be tailored to the specific settings of the TDM-to-IP converter in use. This example is for a converter using 5ms packetization, and generating 1080-byte packets at the rate of 200 pps. Thus, the configuration file has a UGS flow which reflects those parameters.

```
NetworkAccess = 1
BaselinePrivacy =
    AuthorizeWaitTimeout = 10
    ReauthorizeWaitTimeout = 10
    KekGraceTime = 300
    OpWaitTimeout = 10
    RekeyWaitTimeout = 10
    TekGraceTime = 600
    AuthorizeRejectWaitTimeout = 60
    SAMapWaitTimeout = 1
    SAMapMaxRetries = 4
MaxCpeAllowed = 16
UpstreamPacketClassification =
    PcReference = 2
    PcServiceFlowReference = 2
    PcRulePriority = 127
    PcActivationState = 1
    PcIpClassification =
        PcIpProtocol = 17
        PcIpDestPortStart = 2000
        PcIpDestPortEnd = 2142
DownstreamPacketClassification =
    PcReference = 102
    PcServiceFlowReference = 102
    PcRulePriority = 127
    PcActivationState = 1
    PcIpClassification =
        PcIpProtocol = 17
        PcIpDestPortStart = 2000
        PcIpDestPortEnd = 2142
UpstreamServiceFlow =
    SfReference = 1
    SfQosSetType = 7
    SfTrafficPriority = 0
    SfSchedulingType = 2
UpstreamServiceFlow =
    SfReference = 2
    SfQosSetType = 7
    SfSchedulingType = 6
    SfRqTxPolicy = 511
    SfUgsSize = 1040
    SfNominalGrantInterval = 5000
    SfToleratedGrantJitter = 2000
    SfGrantsPerInterval = 1
DownstreamServiceFlow =
    SfReference = 101
    SfQosSetType = 7
    SfTrafficPriority = 0
```

```
DownstreamServiceFlow =
    SfReference = 102
    SfQosSetType = 7
    SfMinReservedRatePktsize = 1014
    SfMinReservedRate = 1800000
MaxClassifiers = 10
PrivacyEnable = 1
```

E SLEM MIB

The C3 supports Simple Law Enforcement Monitoring (SLEM) based on the description of the Cisco SLEM concept outlined in the internet draft, RFC 3924. This MIB is defined below.

```
CISCO-TAP-MIB DEFINITIONS ::= BEGIN

IMPORTS
        MODULE-IDENTITY,
        OBJECT-TYPE,
        NOTIFICATION-TYPE,
        Integer32,
        Unsigned32,
        Counter32,
        enterprises
                FROM SNMPv2-SMI
        MODULE-COMPLIANCE,
        OBJECT-GROUP,
        NOTIFICATION-GROUP
                FROM SNMPv2-CONF
        InetAddressType,
        InetAddress,
        InetAddressPrefixLength,
        InetPortNumber
                FROM INET-ADDRESS-MIB
        RowStatus,
        TruthValue,
        DateAndTime,
        MacAddress
                FROM SNMPv2-TC
        SnmpAdminString
                FROM SNMP-FRAMEWORK-MIB
        InterfaceIndexOrZero
                FROM IF-MIB
--        Dscp
--                FROM CISCO-QOS-PIB-MIB
--        ciscoMgmt
--                FROM CISCO-SMI
        enterprises
                FROM RFC1155-SMI;

-- Explicitly set the cisco and ciscoMgmt OIDs:

cisco OBJECT IDENTIFIER
```

```
    ::= { enterprises 9 }

ciscoMgmt OBJECT IDENTIFIER
        ::= { cisco 9 }

cTapMIB MODULE-IDENTITY
        LAST-UPDATED  "200505100000Z"
        ORGANIZATION  "Cisco Systems, Inc."
        CONTACT-INFO
                "      Cisco Systems
                       Customer Service

                Postal:170 W. Tasman Drive
                       San Jose, CA  95134
                       USA

                   Tel:+1 800 553-NETS

                E-mail:cs-li@cisco.com"
        DESCRIPTION
                "This module is compatible with Cisco's intercept
feature."
                --"This module manages Cisco's intercept feature."
        REVISION        "200207250000Z"
        DESCRIPTION
                "Initial version of this MIB module."
        ::= { ciscoMgmt 252 }

cTapMIBNotifications OBJECT IDENTIFIER ::= { cTapMIB 0 }
cTapMIBObjects       OBJECT IDENTIFIER ::= { cTapMIB 1 }
cTapMIBConformance   OBJECT IDENTIFIER ::= { cTapMIB 2 }

cTapMediationGroup   OBJECT IDENTIFIER ::= { cTapMIBObjects 1 }
cTapStreamGroup      OBJECT IDENTIFIER ::= { cTapMIBObjects 2 }
cTapDebugGroup       OBJECT IDENTIFIER ::= { cTapMIBObjects 3 }

-- cTapMediationNewIndex is defined to allow a network manager
-- to create a new Mediation Table entry and its corresponding
-- Stream Table entries without necessarily knowing what other
-- entries might exist.

cTapMediationNewIndex OBJECT-TYPE
     SYNTAX     Integer32 (1..2147483647)
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
        "This object contains a value which may be used as an index
        value for a new cTapMediationEntry. Whenever read, the agent
       will change the value to a new non-conflicting value.  This is
        to reduce the probability of errors during creation of new
        cTapMediationTable entries."
     ::= { cTapMediationGroup 1 }

-- The Tap Mediation Table lists the applications, by address and
-- port number, to which traffic may be intercepted. These may be
-- on the same or different Mediation Devices.

cTapMediationTable OBJECT-TYPE
     SYNTAX     SEQUENCE OF CTapMediationEntry
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
        "This table lists the Mediation Devices with which the
       intercepting device communicates. These may be on the same or
        different Mediation Devices.

        This table is written by the Mediation Device, and is always
        volatile. This is because intercepts may disappear during a
        restart of the intercepting equipment."
     ::= { cTapMediationGroup 2 }

cTapMediationEntry OBJECT-TYPE
```

```
     SYNTAX     CTapMediationEntry
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
        "The entry describes a single session maintained with an
        application on a Mediation Device."
     INDEX      { cTapMediationContentId }
     ::= { cTapMediationTable 1 }

CTapMediationEntry ::= SEQUENCE {
        cTapMediationContentId          Integer32,
        cTapMediationDestAddressType    InetAddressType,
        cTapMediationDestAddress        InetAddress,
        cTapMediationDestPort           InetPortNumber,
        cTapMediationSrcInterface       InterfaceIndexOrZero,
        cTapMediationRtcpPort           InetPortNumber,
       cTapMediationDscp             Integer32, -- CISCO ORIG: Dscp,
        cTapMediationDataType           Integer32,
        cTapMediationRetransmitType     Integer32,
        cTapMediationTimeout            DateAndTime,
        cTapMediationTransport          INTEGER,
        cTapMediationNotificationEnable TruthValue,
        cTapMediationStatus             RowStatus
}

cTapMediationContentId OBJECT-TYPE
     SYNTAX     Integer32 (1..2147483647)
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
        "cTapMediationContentId is a session identifier, from the
       intercept application's perspective, and a content identifier
       from the Mediation Device's perspective. The Mediation Device
       is responsible for making sure these are unique, although the
       SNMP RowStatus row creation process will help by not allowing
       it to create conflicting entries. Before creating a new entry,
        a value for this variable may be obtained by reading
        cTapMediationNewIndex to reduce the probability of a value
        collision."
     ::= { cTapMediationEntry 1 }

cTapMediationDestAddressType OBJECT-TYPE
     SYNTAX     InetAddressType
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The type of cTapMediationDestAddress."
     ::= { cTapMediationEntry 2 }

cTapMediationDestAddress OBJECT-TYPE
     SYNTAX     InetAddress
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The IP Address of the Mediation Device's network interface
        to which to direct intercepted traffic."
     ::= { cTapMediationEntry 3 }

cTapMediationDestPort OBJECT-TYPE
     SYNTAX     InetPortNumber
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The port number on the Mediation Device's network interface
        to which to direct intercepted traffic."
     ::= { cTapMediationEntry 4 }

cTapMediationSrcInterface OBJECT-TYPE
     SYNTAX     InterfaceIndexOrZero
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
```

```
        "The interface on the intercepting device from which to
       transmit intercepted data. If zero, any interface may be used
        according to normal IP practice."
     ::= { cTapMediationEntry 5 }

cTapMediationRtcpPort OBJECT-TYPE
     SYNTAX     InetPortNumber
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
        "The port number on the intercepting device to which the
        Mediation Devices directs RTCP Receiver Reports and Nacks.
        This object is only relevant when the value of
        cTapMediationTransport is 'rtpNack'.

       This port is assigned by the intercepting device, rather than
       by the Mediation Device or manager application.  The value of
        this MIB object has no effect before activating the
        cTapMediationEntry."
    ::= { cTapMediationEntry 6 }

cTapMediationDscp OBJECT-TYPE
     SYNTAX     Integer32 (0..63)   -- CISCO ORIG: Dscp
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The Differentiated Services Code Point the intercepting
        device applies to the IP packets encapsulating the
        intercepted traffic."
     DEFVAL { 34 }        -- by default, AF41, code 100010
     ::= { cTapMediationEntry 7 }

cTapMediationDataType OBJECT-TYPE
     SYNTAX     Integer32 (0..127)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "If RTP with Ack/Nack resilience is selected as a transport,
        the mediation process requires an RTP payload type for data
        transmissions, and a second RTP payload type for
        retransmissions.  This is the RTP payload type for
        transmissions.

        This object is only effective when the value of
        cTapMediationTransport is 'rtpNack'."
     DEFVAL { 0 }
     ::= { cTapMediationEntry 8 }

cTapMediationRetransmitType OBJECT-TYPE
     SYNTAX     Integer32 (0..127)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "If RTP with Ack/Nack resilience is selected as a transport,
        the mediation process requires an RTP payload type for data
        transmissions, and a second RTP payload type for
        retransmissions.  This is the RTP payload type for
        retransmissions.

        This object is only effective when the value of
        cTapMediationTransport is 'rtpNack'."
     DEFVAL { 0 }
     ::= { cTapMediationEntry 9 }

cTapMediationTimeout OBJECT-TYPE
     SYNTAX     DateAndTime
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The time at which this row and all related Stream Table rows
        should be automatically removed, and the intercept function
        cease. Since the initiating network manager may be the only
        device able to manage a specific intercept or know of its
       existence, this acts as a fail-safe for the failure or removal
       of the network manager. The object is only effective when the
        value of cTapMediationStatus is 'active'."
     ::= { cTapMediationEntry 10 }

cTapMediationTransport OBJECT-TYPE
     SYNTAX     INTEGER {
                           udp(1),
                           rtpNack(2),
                           tcp(3),
                           sctp(4)
                }
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The protocol used in transferring intercepted data to the
        Mediation Device. The following protocols may be supported:
                   udp:     PacketCable udp format
                   rtpNack: RTP with Nack resilience
                   tcp:     TCP with head of line blocking
                   sctp:    SCTP with head of line blocking "
     ::= { cTapMediationEntry 11 }

cTapMediationNotificationEnable OBJECT-TYPE
     SYNTAX     TruthValue
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "This variable controls the generation of any notifications or
        informs by the MIB agent for this table entry."
     DEFVAL { true }
     ::= { cTapMediationEntry 12 }

cTapMediationStatus OBJECT-TYPE
     SYNTAX     RowStatus
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The status of this conceptual row. This object is used to
        manage creation, modification and deletion of rows in this
        table.

       cTapMediationTimeout may be modified at any time (even while
the
       row is active). But when the row is active, the other writable
        objects may not be modified without setting its value to
        'notInService'.

        The entry may not be deleted or deactivated by setting its
      value to 'destroy' or 'notInService' if there is any associated
       entry in cTapStreamIpTable, or other such tables when such are
        defined."
     ::= { cTapMediationEntry 13 }

--
-- cTapMediationCapabilities
--

cTapMediationCapabilities  OBJECT-TYPE
     SYNTAX     BITS {
                         ipV4SrcInterface(0),
                         ipV6SrcInterface(1),
                         udp(2),
                         rtpNack(3),
                         tcp(4),
                         sctp(5)
                     }
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
        "This object displays the device capabilities with respect to
       certain fields in Mediation Device table. This may be dependent
         on hardware capabilities, software capabilities.
         The following values may be supported:
          ipV4SrcInterface:  SNMP ifIndex Value may be used to select
                                the interface (denoted by
                                cTapMediationSrcInterface) on the
                                intercepting device from which to
                               transmit intercepted data to an IPv4
                                address Mediation Device.

          ipV6SrcInterface:  SNMP ifIndex Value may be used to select
                                the interface (denoted by
                                cTapMediationSrcInterface) on the
                                intercepting device from which to
                               transmit intercepted data to an IPv6
                                address Mediation Device.

            udp:              UDP may be used as transport protocol
                             (denoted by cTapMediationTransport) in
                               transferring intercepted data to the
                                Mediation Device.

             rtcpNack:         RTP with Nack resilience may be used
                                as transport protocol (denoted by
                             cTapMediationTransport) in transferring
                                intercepted data to the Mediation
                                Device.

            tcp:              TCP may be used as transport protocol
                             (denoted by cTapMediationTransport) in
                               transferring intercepted data to the
                                Mediation Device.

            sctp:            SCTP may be used as transport protocol
                             (denoted by cTapMediationTransport) in
                               transferring intercepted data to the
                                Mediation Device."
     ::= { cTapMediationGroup 3 }
--
-- the stream tables
--
-- In the initial version of the MIB, only IPv4 and IPv6 intercept is
-- defined. It is expected that in the future other types of
intercepts
-- may be required; these will be defined in tables like the
-- cTapStreamIpTable with appropriate attributes. Such tables, when
-- defined, will be used by the Mediation Entry in exactly the same
way
-- that the cTapStreamIpTable is used.
--
-- Such Tables all belong in cTapStreamGroup.
--

cTapStreamCapabilities  OBJECT-TYPE
     SYNTAX     BITS {
                         tapEnable(0),
                         interface(1),
                         ipV4(2),
                         ipV6(3),
                         l4Port(4),
                         dscp(5),
                         dstMacAddr(6),
                         srcMacAddr(7),
                         ethernetPid(8),
                         dstLlcSap(9),
                         srcLlcSap(10)
                     }
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
        "This object displays what types of intercept streams can be
         configured on this type of device. This may be dependent on
         hardware capabilities, software capabilities. The following
         fields may be supported:
             interface:   SNMP ifIndex Value may be used to select
                          interception of all data crossing an
                          interface or set of interfaces.
             tapEnable:   set if table entries with
                          cTapStreamIpInterceptEnable set to 'false'
                       are used to pre-screen packets for intercept;
                          otherwise these entries are ignored.
            ipV4:         IPv4 Address or prefix may be used to select
                          traffic to be intercepted.
            ipV6:         IPv6 Address or prefix may be used to select
                          traffic to be intercepted.
            l4Port:       TCP/UDP Ports may be used to select traffic
                          to be intercepted.
             dscp:        DSCP may be used to select traffic to be
                          intercepted.
           dstMacAddr:  Destination MAC Address may be used to select
                          traffic to be intercepted.
             srcMacAddr:  Source MAC Address may be used to select
                          traffic to be intercepted.
            ethernetPid: Ethernet Protocol Identifier may be used to
                          select traffic to be intercepted.
             dstLlcSap:   IEEE 802.2 Destination SAP may be used to
                          select traffic to be intercepted.
            srcLlcSap:   IEEE 802.2 Source SAP may be used to select
                          traffic to be intercepted."
     ::= { cTapStreamGroup 1 }
--
-- The 'access list' for intercepting data at the IP network
-- layer
--

cTapStreamIpTable OBJECT-TYPE
     SYNTAX       SEQUENCE OF CTapStreamIpEntry
     MAX-ACCESS not-accessible
     STATUS       current
     DESCRIPTION
       "The Intercept Stream IP Table lists the IPv4 and IPv6 streams
        to be intercepted.  The same data stream may be required by
       multiple taps, and one might assume that often the intercepted
        stream is a small subset of the traffic that could be
        intercepted.

        This essentially provides options for packet selection, only
       some of which might be used. For example, if all traffic to or
        from a given interface is to be intercepted, one would
        configure an entry which lists the interface, and wild-card
       everything else.  If all traffic to or from a given IP Address
        is to be intercepted, one would configure two such entries
       listing the IP Address as source and destination respectively,
        and wild-card everything else.  If a particular voice on a
        teleconference is to be intercepted, on the other hand, one
        would extract the multicast (destination) IP address, the
        source IP Address, the protocol (UDP), and the source and
       destination ports from the call control exchange and list all
        necessary information.

        The first index indicates which Mediation Device the
        intercepted traffic will be diverted to. The second index
        permits multiple classifiers to be used together, such as
        having an IP address as source or destination. "
     ::= { cTapStreamGroup 2 }

cTapStreamIpEntry OBJECT-TYPE
     SYNTAX     CTapStreamIpEntry
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
        "A stream entry indicates a single data stream to be
        intercepted to a Mediation Device. Many selected data
        streams may go to the same application interface, and many
        application interfaces are supported."
     INDEX { cTapMediationContentId, cTapStreamIpIndex }
     ::= { cTapStreamIpTable 1 }

CTapStreamIpEntry ::= SEQUENCE {
        cTapStreamIpIndex                 Integer32,
        cTapStreamIpInterface             Integer32,
        cTapStreamIpAddrType              InetAddressType,
        cTapStreamIpDestinationAddress    InetAddress,
        cTapStreamIpDestinationLength     InetAddressPrefixLength,
        cTapStreamIpSourceAddress         InetAddress,
        cTapStreamIpSourceLength          InetAddressPrefixLength,
        cTapStreamIpTosByte               Integer32,
        cTapStreamIpTosByteMask           Integer32,
        cTapStreamIpFlowId                Integer32,
        cTapStreamIpProtocol              Integer32,
        cTapStreamIpDestL4PortMin         InetPortNumber,
        cTapStreamIpDestL4PortMax         InetPortNumber,
        cTapStreamIpSourceL4PortMin       InetPortNumber,
        cTapStreamIpSourceL4PortMax       InetPortNumber,
        cTapStreamIpInterceptEnable       TruthValue,
        cTapStreamIpInterceptedPackets    Counter32,
        cTapStreamIpInterceptDrops        Counter32,
        cTapStreamIpStatus                RowStatus
}

cTapStreamIpIndex OBJECT-TYPE
     SYNTAX     Integer32 (1..2147483647)
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
        "The index of the stream itself."
     ::= { cTapStreamIpEntry 1 }

cTapStreamIpInterface OBJECT-TYPE
     SYNTAX     Integer32 (-1 | 0 | 1..2147483647)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The ifIndex value of the interface over which traffic to be
        intercepted is received or transmitted. The interface may be
       physical or virtual. If this is the only parameter specified,
        and it is other than -1 or 0, all traffic on the selected
        interface will be chosen.

        If the value is zero, matching traffic may be received or
      transmitted on any interface.  Additional selection parameters
        must be selected to limit the scope of traffic intercepted.
       This is most useful on non-routing platforms or on intercepts
        placed elsewhere than a subscriber interface.

        If the value is -1, one or both of
        cTapStreamIpDestinationAddress and cTapStreamIpSourceAddress
        must be specified with prefix length greater than zero.
      Matching traffic on the interface pointed to by ipRouteIfIndex
       or ipCidrRouteIfIndex values associated with those values is
       intercepted, whichever is specified to be more focused than a
       default route.  If routing changes, either by operator action
       or by routing protocol events, the interface will change with
      it. This is primarily intended for use on subscriber interfaces
        and other places where routing is guaranteed to be
        symmetrical.

       In both of these cases, it is possible to have the same packet
        selected for intersection on both its ingress and egress
        interface.  Nonetheless, only one instance of the packet is
        sent to the Mediation Device.

       This value must be set when creating a stream entry, either to
      select an interface, to select all interfaces, or to select the
        interface that routing chooses. Some platforms may not
        implement the entire range of options."
     REFERENCE  "RFC 1213, RFC 2096"
     ::= { cTapStreamIpEntry 2 }

cTapStreamIpAddrType OBJECT-TYPE
     SYNTAX     InetAddressType
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The type of address, used in packet selection."
     DEFVAL     { ipv4 }
     ::= { cTapStreamIpEntry 3 }

cTapStreamIpDestinationAddress OBJECT-TYPE
     SYNTAX     InetAddress
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The Destination address or prefix used in packet selection.
        This address will be of the type specified in
        cTapStreamIpAddrType."
     DEFVAL       { '00000000'H } -- 0.0.0.0
     ::= { cTapStreamIpEntry 4 }

cTapStreamIpDestinationLength OBJECT-TYPE
     SYNTAX     InetAddressPrefixLength
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The length of the Destination Prefix. A value of zero causes
       all addresses to match.  This prefix length will be consistent
        with the type specified in cTapStreamIpAddrType."
     DEFVAL { 0 } -- by default, any destination address
     ::= { cTapStreamIpEntry 5 }

cTapStreamIpSourceAddress OBJECT-TYPE
     SYNTAX     InetAddress
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
      "The Source Address used in packet selection. This address will
        be of the type specified in cTapStreamIpAddrType."
     DEFVAL       { '00000000'H } -- 0.0.0.0
     ::= { cTapStreamIpEntry 6 }

cTapStreamIpSourceLength OBJECT-TYPE
     SYNTAX     InetAddressPrefixLength
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The length of the Source Prefix. A value of zero causes all
       addresses to match. This prefix length will be consistent with
        the type specified in cTapStreamIpAddrType."
     DEFVAL { 0 } -- by default, any source address
     ::= { cTapStreamIpEntry 7 }

cTapStreamIpTosByte OBJECT-TYPE
     SYNTAX     Integer32 (0..255)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The value of the TOS byte, when masked with
        cTapStreamIpTosByteMask, of traffic to be intercepted.
        If cTapStreamIpTosByte & (~cTapStreamIpTosByteMask) != 0,
        configuration is rejected."
     DEFVAL { 0 }
     ::= { cTapStreamIpEntry 8 }

cTapStreamIpTosByteMask OBJECT-TYPE
     SYNTAX     Integer32 (0..255)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
```

```
       "The value of the TOS byte in an IPv4 or IPv6 header is ANDed
        with cTapStreamIpTosByteMask and compared with
        cTapStreamIpTosByte.

       If the values are equal, the comparison is equal. If the mask
       is zero and the TosByte value is zero, the result is to always
        accept."
     DEFVAL { 0 } -- by default, any DSCP or other TOS byte value
     ::= { cTapStreamIpEntry 9 }

cTapStreamIpFlowId OBJECT-TYPE
     SYNTAX     Integer32 (-1 | 0..1048575)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The flow identifier in an IPv6 header. -1 indicates that the
        Flow Id is unused."
     DEFVAL { -1 } -- by default, any flow identifier value
     ::= { cTapStreamIpEntry 10 }

cTapStreamIpProtocol OBJECT-TYPE
     SYNTAX     Integer32 (-1 | 0..255)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The IP protocol to match against the IPv4 protocol number or
        the IPv6 Next- Header number in the packet. -1 means 'any IP
        protocol'."
     DEFVAL { -1 } -- by default, any IP protocol
     ::= { cTapStreamIpEntry 11 }

cTapStreamIpDestL4PortMin OBJECT-TYPE
     SYNTAX     InetPortNumber
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The minimum value that the layer-4 destination port number in
        the packet must have in order to match.  This value must be
        equal to or less than the value specified for this entry in
        cTapStreamIpDestL4PortMax.

        If both cTapStreamIpDestL4PortMin and
cTapStreamIpDestL4PortMax
        are at their default values, the port number is effectively
        unused."
     DEFVAL { 0 } -- by default, any transport layer port number
     ::= { cTapStreamIpEntry 12 }

cTapStreamIpDestL4PortMax OBJECT-TYPE
     SYNTAX     InetPortNumber
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The maximum value that the layer-4 destination port number in
       the packet must have in order to match this classifier entry.
      This value must be equal to or greater than the value specified
        for this entry in cTapStreamIpDestL4PortMin.

        If both cTapStreamIpDestL4PortMin and
cTapStreamIpDestL4PortMax
        are at their default values, the port number is effectively
        unused."
     DEFVAL { 65535 } -- by default, any transport layer port number
     ::= { cTapStreamIpEntry 13 }

cTapStreamIpSourceL4PortMin OBJECT-TYPE
     SYNTAX     InetPortNumber
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The minimum value that the layer-4 destination port number in
        the packet must have in order to match.  This value must be
        equal to or less than the value specified for this entry in
        cTapStreamIpSourceL4PortMax.

        If both cTapStreamIpSourceL4PortMin and
        cTapStreamIpSourceL4PortMax are at their default values, the
        port number is effectively unused."
     DEFVAL { 0 } -- by default, any transport layer port number
     ::= { cTapStreamIpEntry 14 }

cTapStreamIpSourceL4PortMax OBJECT-TYPE
     SYNTAX     InetPortNumber
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
       "The maximum value that the layer-4 destination port number in
        the packet must have in order to match this classifier entry.
       This value must be equal to or greater than the value specified
        for this entry in cTapStreamIpSourceL4PortMin.

        If both cTapStreamIpSourceL4PortMin and
        cTapStreamIpSourceL4PortMax are at their default values, the
        port number is effectively unused."
     DEFVAL { 65535 } -- by default, any transport layer port number
     ::= { cTapStreamIpEntry 15 }

cTapStreamIpInterceptEnable OBJECT-TYPE
     SYNTAX     TruthValue
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "If 'true', the tap should intercept matching traffic.
         If 'false', this entry is used to pre-screen packets for
         intercept."
     DEFVAL { true }
     ::= { cTapStreamIpEntry 16 }

cTapStreamIpInterceptedPackets OBJECT-TYPE
     SYNTAX     Counter32
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
       "The number of packets matching this data stream specification
        that have been intercepted."
     ::= { cTapStreamIpEntry 17 }

cTapStreamIpInterceptDrops OBJECT-TYPE
     SYNTAX     Counter32
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
       "The number of packets matching this data stream specification
        that, having been intercepted, were dropped in the lawful
        intercept process."
     ::= { cTapStreamIpEntry 18 }

cTapStreamIpStatus OBJECT-TYPE
     SYNTAX     RowStatus
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The status of this conceptual row. This object manages
        creation, modification, and deletion of rows in this table.
       cTapStreamIpInterceptEnable may be modified any time even the
       value of this entry rowStatus object is 'active'.  When other
       rows must be changed, cTapStreamIpStatus must be first set to
        'notInService'."
     ::= { cTapStreamIpEntry 19 }

--
-- The "access list" for intercepting data at the IEEE 802
-- link layer
--
```

```
cTapStream802Table OBJECT-TYPE
     SYNTAX       SEQUENCE OF CTapStream802Entry
     MAX-ACCESS not-accessible
     STATUS       current
     DESCRIPTION
      "The Intercept Stream 802 Table lists the IEEE 802 data streams
        to be intercepted.  The same data stream may be required by
       multiple taps, and one might assume that often the intercepted
        stream is a small subset of the traffic that could be
        intercepted.

        This essentially provides options for packet selection, only
       some of which might be used. For example, if all traffic to or
        from a given interface is to be intercepted, one would
        configure an entry which lists the interface, and wild-card
       everything else.  If all traffic to or from a given MAC Address
        is to be intercepted, one would configure two such entries
       listing the MAC Address as source and destination respectively,
        and wild-card everything else.

        The first index indicates which Mediation Device the
        intercepted traffic will be diverted to. The second index
        permits multiple classifiers to be used together, such as
        having a MAC address as source or destination. "
     ::= { cTapStreamGroup 3 }

cTapStream802Entry OBJECT-TYPE
     SYNTAX     CTapStream802Entry
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
        "A stream entry indicates a single data stream to be
        intercepted to a Mediation Device. Many selected data
        streams may go to the same application interface, and many
        application interfaces are supported."
     INDEX { cTapMediationContentId, cTapStream802Index }
     ::= { cTapStream802Table 1 }

CTapStream802Entry ::= SEQUENCE {
        cTapStream802Index                 Integer32,
        cTapStream802Fields                BITS,
        cTapStream802Interface             Integer32,
        cTapStream802DestinationAddress    MacAddress,
        cTapStream802SourceAddress         MacAddress,
        cTapStream802EthernetPid           Integer32,
        cTapStream802SourceLlcSap          Integer32,
        cTapStream802DestinationLlcSap     Integer32,

        cTapStream802InterceptEnable       TruthValue,
        cTapStream802InterceptedPackets    Counter32,
        cTapStream802InterceptDrops        Counter32,
        cTapStream802Status                RowStatus
}

cTapStream802Index OBJECT-TYPE
     SYNTAX     Integer32 (1..2147483647)
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
        "The index of the stream itself."
     ::= { cTapStream802Entry 1 }

cTapStream802Fields  OBJECT-TYPE
     SYNTAX     BITS {
                         interface(0),
                         dstMacAddress(1),
                         srcMacAddress(2),
                         ethernetPid(3),
                         dstLlcSap(4),
                         srcLlcSap(5)
                     }
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object displays what attributes must be tested to
         identify traffic which requires interception. The packet
         matches if all flagged fields match.

              interface:     indicates that traffic on the stated
                             interface is to be intercepted
              dstMacAddress: indicates that traffic destined to a
                             given address should be intercepted
              srcMacAddress: indicates that traffic sourced from a
                             given address should be intercepted
              ethernetPid:   indicates that traffic with a stated
                             Ethernet Protocol Identifier should be
                             intercepted
              dstLlcSap:     indicates that traffic with an certain
                             802.2 LLC Destination SAP should be
                             intercepted
              srcLlcSap:     indicates that traffic with an certain
                             802.2 LLC Source SAP should be
                             intercepted

        At least one of the bits has to be set in order to activate an
         entry.  If the bit is not on, the corresponding MIB object
        value has no effect, and need not be specified when creating
         the entry."
     ::= { cTapStream802Entry 2 }

cTapStream802Interface OBJECT-TYPE
     SYNTAX     Integer32 (-1 | 0 | 1..2147483647)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The ifIndex value of the interface over which traffic to be
        intercepted is received or transmitted. The interface may be
       physical or virtual. If this is the only parameter specified,
        and it is other than -1 or 0, all traffic on the selected
        interface will be chosen.

        If the value is zero, matching traffic may be received or
       transmitted on any interface.  Additional selection parameters
        must be selected to limit the scope of traffic intercepted.
       This is most useful on non-routing platforms or on intercepts
        placed elsewhere than a subscriber interface.

        If the value is -1, one or both of
      cTapStream802DestinationAddress and cTapStream802SourceAddress
       must be specified.  Matching traffic on the interface pointed
      to by the dot1dTpFdbPort values associated with those values is
        intercepted, whichever is specified.  If dot1dTpFdbPort
       changes, either by operator action or by protocol events, the
       interface will change with it. This is primarily intended for
       use on subscriber interfaces and other places where routing is
        guaranteed to be symmetrical.

       In both of these cases, it is possible to have the same packet
        selected for intersection on both its ingress and egress
        interface.  Nonetheless, only one instance of the packet is
        sent to the Mediation Device.

       This value must be set when creating a stream entry, either to
      select an interface, to select all interfaces, or to select the
        interface that bridging learns. Some platforms may not
        implement the entire range of options."
     REFERENCE "RFC 1493"
     ::= { cTapStream802Entry 3 }

cTapStream802DestinationAddress OBJECT-TYPE
     SYNTAX     MacAddress
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The Destination address used in packet selection."
     ::= { cTapStream802Entry 4 }

cTapStream802SourceAddress OBJECT-TYPE
     SYNTAX     MacAddress
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The Source Address used in packet selection."
     ::= { cTapStream802Entry 5 }

cTapStream802EthernetPid OBJECT-TYPE
     SYNTAX     Integer32 (0..65535)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The value of the Ethernet Protocol Identifier, which may be
        found on Ethernet traffic or IEEE 802.2 SNAP traffic."
     ::= { cTapStream802Entry 6 }

cTapStream802DestinationLlcSap OBJECT-TYPE
     SYNTAX     Integer32 (0..65535)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The value of the IEEE 802.2 Destination SAP."
     ::= { cTapStream802Entry 7 }

cTapStream802SourceLlcSap OBJECT-TYPE
     SYNTAX     Integer32 (0..65535)
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The value of the IEEE 802.2 Source SAP."
     ::= { cTapStream802Entry 8 }


cTapStream802InterceptEnable OBJECT-TYPE
     SYNTAX     TruthValue
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "If 'true', the tap enables interception of matching traffic.
       If cTapStreamCapabilities flag tapEnable is zero, this may not
         be set to 'false'."
     DEFVAL { true }
     ::= { cTapStream802Entry 9 }

cTapStream802InterceptedPackets OBJECT-TYPE
     SYNTAX     Counter32
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
       "The number of packets matching this data stream specification
        that have been intercepted."
     ::= { cTapStream802Entry 10 }

cTapStream802InterceptDrops OBJECT-TYPE
     SYNTAX     Counter32
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
       "The number of packets matching this data stream specification
        that, having been intercepted, were dropped in the lawful
        intercept process."
     ::= { cTapStream802Entry 11 }

cTapStream802Status OBJECT-TYPE
     SYNTAX     RowStatus
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
        "The status of this conceptual row. This object manages
        creation, modification, and deletion of rows in this table.
       cTapStream802InterceptEnable can be modified any time even the
        value of this entry rowStatus object is active.  When other
       rows must be changed, cTapStream802Status must be first set to
        'notInService'."
     ::= { cTapStream802Entry 12 }

--
-- The debug table
--

cTapDebugTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF CTapDebugEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A table that contains Lawful Intercept debug information
        available on this device. This table is used to map an error
        code to a text message for further information."
    ::= { cTapDebugGroup 1 }

cTapDebugEntry OBJECT-TYPE
    SYNTAX      CTapDebugEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A list of the debug messages."
    INDEX { cTapDebugIndex }
    ::= { cTapDebugTable 1 }


CTapDebugEntry ::= SEQUENCE {
        cTapDebugIndex      Unsigned32,
        cTapDebugMessage    SnmpAdminString
}

cTapDebugIndex OBJECT-TYPE
     SYNTAX        Unsigned32
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
        "Indicates an error code."
     ::= { cTapDebugEntry 1 }

cTapDebugMessage OBJECT-TYPE
     SYNTAX       SnmpAdminString
     MAX-ACCESS   read-only
     STATUS       current
     DESCRIPTION
        "A text string contains the description of an error code."
     ::= { cTapDebugEntry 2 }




-- notifications

cTapMIBActive   NOTIFICATION-TYPE
     STATUS     current
     DESCRIPTION
        "This Notification is sent when an intercepting router or
       switch is first capable of intercepting a packet corresponding
       to a configured data stream. If the configured data stream is
       an IP one, the value of the corresponding cTapStreamIpStatus
      is included in this notification. If the configured data stream
        is an IEEE 802 one, the value of the corresponding
        cTapStream802Status is included in this notification.

        This notification may be generated in conjunction with the
        intercept application, which is designed to expect the
```

```
           notification to be sent as reliably as possible, e.g., through
            the use of a finite number of retransmissions until
            acknowledged, as and when such mechanisms are available; for
           example, with SNMPv3, this would be an InformRequest.  Filter
           installation can take a long period of time, during which call
            progress may be delayed."
        ::= { cTapMIBNotifications 1 }

cTapMediationTimedOut NOTIFICATION-TYPE
     OBJECTS    { cTapMediationStatus }
     STATUS     current
     DESCRIPTION
        "When an intercept is autonomously removed by an intercepting
         device, such as due to the time specified in
        cTapMediationTimeout arriving, the device notifies the manager
         of the action."
     ::= { cTapMIBNotifications 2 }

cTapMediationDebug NOTIFICATION-TYPE
     OBJECTS    { cTapMediationContentId, cTapDebugIndex }
     STATUS     current
     DESCRIPTION
        "When there is intervention needed due to some events related
         to entries configured in cTapMediationTable, the device
         notifies the manager of the event.

         This notification may be generated in conjunction with the
         intercept application, which is designed to expect the
        notification to be sent as reliably as possible, e.g., through
         the use of a finite number of retransmissions until
         acknowledged, as and when such mechanisms are available; for
         example, with SNMPv3, this would be an InformRequest."
     ::= { cTapMIBNotifications 3 }

cTapStreamIpDebug NOTIFICATION-TYPE
     OBJECTS    { cTapMediationContentId, cTapStreamIpIndex,
                  cTapDebugIndex }
     STATUS     current
     DESCRIPTION
        "When there is intervention needed due to some events related
         to entries configured in cTapStreamIpTable, the device
         notifies the manager of the event.

         This notification may be generated in conjunction with the
         intercept application, which is designed to expect the
        notification to be sent as reliably as possible, e.g., through
         the use of a finite number of retransmissions until
         acknowledged, as and when such mechanisms are available; for
         example, with SNMPv3, this would be an InformRequest."
     ::= { cTapMIBNotifications 4 }

-- conformance information

cTapMIBCompliances OBJECT IDENTIFIER ::= { cTapMIBConformance 1 }
cTapMIBGroups      OBJECT IDENTIFIER ::= { cTapMIBConformance 2 }

-- compliance statement

cTapMIBCompliance MODULE-COMPLIANCE
     STATUS  current
     DESCRIPTION
         "The compliance statement for entities which implement the
         Cisco Intercept MIB"
     MODULE        -- this module
         MANDATORY-GROUPS {
                 cTapMediationComplianceGroup,
                 cTapStreamComplianceGroup,
                 cTapMediationCpbComplianceGroup,
                 cTapNotificationGroup
         }
     ::= { cTapMIBCompliances 1 }
```

```
-- units of conformance

cTapMediationComplianceGroup OBJECT-GROUP
     OBJECTS {
        cTapMediationNewIndex,
        cTapMediationDestAddressType,
        cTapMediationDestAddress,
        cTapMediationDestPort,
        cTapMediationSrcInterface,
        cTapMediationRtcpPort,
        cTapMediationDscp,
        cTapMediationDataType,
        cTapMediationRetransmitType,
        cTapMediationTimeout,
        cTapMediationTransport,
        cTapMediationNotificationEnable,
        cTapMediationStatus
     }
     STATUS     current
     DESCRIPTION
        "These objects are necessary for description of the data
        streams directed to a Mediation Device."
     ::= { cTapMIBGroups 1 }

cTapStreamComplianceGroup OBJECT-GROUP
     OBJECTS {
        cTapStreamCapabilities
     }
     STATUS     current
     DESCRIPTION
       "These objects are necessary for a description of the packets
        to select for interception."
     ::= { cTapMIBGroups 2 }

cTapStreamIpComplianceGroup OBJECT-GROUP
     OBJECTS {
        cTapStreamIpInterface,
        cTapStreamIpAddrType,
        cTapStreamIpDestinationAddress,
        cTapStreamIpDestinationLength,
        cTapStreamIpSourceAddress,
        cTapStreamIpSourceLength,
        cTapStreamIpTosByte,
        cTapStreamIpTosByteMask,
        cTapStreamIpFlowId,
        cTapStreamIpProtocol,
        cTapStreamIpDestL4PortMin,
        cTapStreamIpDestL4PortMax,
        cTapStreamIpSourceL4PortMin,
        cTapStreamIpSourceL4PortMax,
        cTapStreamIpInterceptEnable,
        cTapStreamIpInterceptedPackets,
        cTapStreamIpInterceptDrops,
        cTapStreamIpStatus
     }
     STATUS     current
     DESCRIPTION
      "These objects are necessary for a description of IPv4 and IPv6
        packets to select for interception."
     ::= { cTapMIBGroups 3 }

cTapStream802ComplianceGroup OBJECT-GROUP
     OBJECTS {
        cTapStream802Fields,
        cTapStream802Interface,
        cTapStream802DestinationAddress,
        cTapStream802SourceAddress,
        cTapStream802EthernetPid,
        cTapStream802SourceLlcSap,
        cTapStream802DestinationLlcSap,
        cTapStream802InterceptEnable,
        cTapStream802InterceptedPackets,
        cTapStream802InterceptDrops,
        cTapStream802Status
     }
     STATUS     current
     DESCRIPTION
        "These objects are necessary for a description of IEEE 802
        packets to select for interception."
     ::= { cTapMIBGroups 4 }

cTapNotificationGroup NOTIFICATION-GROUP
     NOTIFICATIONS {
         cTapMIBActive,
         cTapMediationTimedOut,
         cTapMediationDebug,
         cTapStreamIpDebug
     }
     STATUS     current
     DESCRIPTION
        "These notifications are used to present status from the
        intercepting device to the Mediation Device."
     ::= { cTapMIBGroups 5 }

cTapMediationCpbComplianceGroup OBJECT-GROUP
     OBJECTS {
        cTapMediationCapabilities
     }
     STATUS     current
     DESCRIPTION
        "These objects are necessary for a description of the
        mediation device to select for Lawful Intercept."
     ::= { cTapMIBGroups 6 }

cTapDebugComplianceGroup OBJECT-GROUP
     OBJECTS {
        cTapDebugMessage
     }
     STATUS     current
     DESCRIPTION
        "These objects are necessary for debug information."
     ::= { cTapMIBGroups 7 }

END
```

F Factory Defaults

If no configuration is performed, the C3 uses the following default configuration.

NOTE
Under default conditions, the downstream is turned off, no user accounts are defined and telnet access will be disabled until they are defined. While telnet access is disabled, serial access will remain available.

IP addresses shown following are network dependent and are set from the boot configuration.

Default Configuration Listing

```
C3#show running-config
!****Generated on TUE SEP 20 05:36:07 2005

!****by S/W version 4.3.0.33
!
!
hostname "C3"
!
!boot system flash C:/4.3.0.33.bin

!
snmp-server contact "support@arrisi.com"
snmp-server location "3871 Lakefield Drive, Suite 300, Suwanee, GA 30024"
snmp-server engineboots 1
!
cable modem offline aging-time 86400
cable modem ucc max-failed-attempts 2
!
bridge aging-time 15000
bridge 0
bridge 1
!
file prompt quiet
no cli logging
no cli logging password
cli logging path /
cli logging size 1024
alias scm "show cable modem"
alias pacman "debug slot 0 sniff"
!
no ip dhcp-server enable
no ip dhcp-server allow bootp
!
clock timezone UTC 0 0
!
!
no ip routing

default cpe subinterface Cable 1/0.0

default cm subinterface Cable 1/0.0
!
! attached sub-interfaces
!
interface FastEthernet 0/0
 no description
 no shutdown
 ! mac-address 00a0.7384.0408
 duplex auto
 snmp trap link-status
 load-interval 300
 bridge-group 0
 ip address 172.16.1.2 255.255.255.0
 no allow-ip-only
 management-access
 no ip directed-broadcast
 no ip source-verify
 no ip source-verify subif
 no ip l2-bg-to-bg-routing
 ip verify-ip-address-filter
!
!
interface FastEthernet 0/1
 no description
 no shutdown
 ! mac-address 00a0.7384.0409
 duplex auto
 snmp trap link-status
 load-interval 300
 bridge-group 1
 no allow-ip-only
 no management-access
 no ip directed-broadcast
 no ip source-verify
 no ip source-verify subif
 no ip l2-bg-to-bg-routing
 ip verify-ip-address-filter
!
!
interface Cable 1/0
 cable utilization-interval 10
 cable docsis10 max-traffic-burst 3044
 cable insertion-interval automatic
 cable sync-interval 10
 cable ucd-interval 2000
 cable max-ranging-attempts 16
 cable sid-verify
 cable downstream rate-limit
 cable flap-list size 500
 cable flap-list aging 259200
 cable flap-list miss-threshold 6
 cable flap-list insertion-time 180
 cable downstream admission-control 100
 no cable downstream admission-limit
 no description
 shutdown
! mac-address 00a0.7384.040a
 load-interval 300
 snmp trap link-status
 bridge-group 0
 ip address 172.16.1.2 255.255.255.0
 no allow-ip-only
 no management-access
 no tftp-server-access
 no cable source-verify
 arp-broadcast-echo
 l2-broadcast-echo
 l2-multicast-echo
 ip-broadcast-echo
 ip-multicast-echo
 no l2-broadcast-throttle
 no downstream-dhcp-server-allowed
```

```
throttle-credits initial 15 running 2
ip igmp enable
no ip dhcp relay
no ip dhcp relay information option
no ip dhcp relay validate renew
ip dhcp relay non-broadcast
no cable dhcp-giaddr
cable downstream mac-mode docsis
cable downstream channel-width 6mhz
cable downstream frequency 501000000
cable downstream interleave-depth 32
cable downstream modulation 64qam
cable downstream power-level 50
cable privacy accept-self-signed-certificate
no cable privacy check-cert-validity-periods
cable privacy kek life-time 604800
cable privacy tek life-time 43200
no cable shared-secret

no cable upstream 0 description
cable upstream 0 shutdown
cable upstream 0 snmp trap link-status
cable upstream 0 mac-mode docsis

cable upstream 0 frequency 10000000
cable upstream 0 channel-width 3200000
cable upstream 0 power-level -4 fixed
cable upstream 0 low-power-offset -60
cable upstream 0 high-power-offset 60
cable upstream 0 group-id 1
cable upstream 0 plant-length 160
cable upstream 0 initial-ranging-delay 300
cable upstream 0 periodic-maintenance-interval 1000
cable upstream 0 short-periodic-maintenance-interval 100
cable upstream 0 minimum-unfrag-burst 600
cable upstream 0 admission-control 100
cable upstream 0 dominant-interval default
no cable upstream 0 admission-limit
cable upstream 0 voice-timeout 1
no cable upstream 0.0 description
cable upstream 0.0 shutdown
no cable upstream 0.0  snmp trap link-status
cable upstream 0.0 channel-type TDMA
cable upstream 0.0 modulation-profile 1
no cable upstream 0.0 pre-equalization
cable upstream 0.0 minislot-size 4
cable upstream 0.0 trigger-index 0
cable upstream 0.0 snr-timeconstant 4
cable upstream 0.0 mer-timeconstant 8
cable upstream 0.0 rng-prm-guard 1
cable upstream 0.0 nrng-prm-guard 2
no cable upstream 0.0 ingress-cancellation
no cable upstream 0.0 impulse-mitigation
cable upstream 0.0 safe-config
cable upstream 0.0 extended-frequency-detect all-ranging
cable upstream 0.0 concatenation
cable upstream 0.0 fragmentation
cable upstream 0.0 data-backoff automatic
cable upstream 0.0 range-backoff automatic
cable upstream 0.0 contention-opp-latency 10000
cable upstream 0.0 contention-opps-with-data required
cable upstream 0.0 rate-limit
cable upstream 0.0 status activate
no cable upstream 0.1 description
cable upstream 0.1 shutdown
no cable upstream 0.1  snmp trap link-status
cable upstream 0.1 channel-type SCDMA
cable upstream 0.1 scdma-active-codes 126
cable upstream 0.1 scdma-codes-per-slot 2
cable upstream 0.1 scdma-frame-size 16
cable upstream 0.1 scdma-hopping-seed 0
cable upstream 0.1 modulation-profile 6
no cable upstream 0.1 pre-equalization
cable upstream 0.1 trigger-index 0
cable upstream 0.1 snr-timeconstant 4
cable upstream 0.1 mer-timeconstant 8
cable upstream 0.1 rng-prm-guard 1
cable upstream 0.1 nrng-prm-guard 0
no cable upstream 0.1 ingress-cancellation
no cable upstream 0.1 impulse-mitigation
cable upstream 0.1 safe-config
cable upstream 0.1 extended-frequency-detect all-ranging
cable upstream 0.1 concatenation
cable upstream 0.1 fragmentation
cable upstream 0.1 data-backoff automatic
cable upstream 0.1 range-backoff automatic
cable upstream 0.1 contention-opp-latency 10000
cable upstream 0.1 contention-opps-with-data required
cable upstream 0.1 rate-limit
cable upstream 0.1 status activate
no cable upstream 1 description
cable upstream 1 shutdown
cable upstream 1 snmp trap link-status
cable upstream 1 mac-mode docsis

cable upstream 1 frequency 15000000
cable upstream 1 channel-width 3200000
cable upstream 1 power-level -4 fixed
cable upstream 1 low-power-offset -60
cable upstream 1 high-power-offset 60
cable upstream 1 group-id 2
cable upstream 1 plant-length 160
cable upstream 1 initial-ranging-delay 300
cable upstream 1 periodic-maintenance-interval 1000
cable upstream 1 short-periodic-maintenance-interval 100
cable upstream 1 minimum-unfrag-burst 600
cable upstream 1 admission-control 100
cable upstream 1 dominant-interval default
no cable upstream 1 admission-limit
cable upstream 1 voice-timeout 1
no cable upstream 1.0 description
cable upstream 1.0 shutdown
no cable upstream 1.0  snmp trap link-status
cable upstream 1.0 channel-type TDMA
```

```
 cable upstream 1.0 modulation-profile 1
 no cable upstream 1.0 pre-equalization
 cable upstream 1.0 minislot-size 4
 cable upstream 1.0 trigger-index 0
 cable upstream 1.0 snr-timeconstant 4
 cable upstream 1.0 mer-timeconstant 8
 cable upstream 1.0 rng-prm-guard 1
 cable upstream 1.0 nrng-prm-guard 2
 no cable upstream 1.0 ingress-cancellation
 no cable upstream 1.0 impulse-mitigation
 cable upstream 1.0 safe-config
 cable upstream 1.0 extended-frequency-detect all-ranging
 cable upstream 1.0 concatenation
 cable upstream 1.0 fragmentation
 cable upstream 1.0 data-backoff automatic
 cable upstream 1.0 range-backoff automatic
 cable upstream 1.0 contention-opp-latency 10000
 cable upstream 1.0 contention-opps-with-data required
 cable upstream 1.0 rate-limit
 cable upstream 1.0 status activate
 no cable upstream 1.1 description
 cable upstream 1.1 shutdown
 no cable upstream 1.1  snmp trap link-status
 cable upstream 1.1 channel-type SCDMA
 cable upstream 1.1 scdma-active-codes 126
 cable upstream 1.1 scdma-codes-per-slot 2
 cable upstream 1.1 scdma-frame-size 16
 cable upstream 1.1 scdma-hopping-seed 0
 cable upstream 1.1 modulation-profile 6
 no cable upstream 1.1 pre-equalization
 cable upstream 1.1 trigger-index 0
 cable upstream 1.1 snr-timeconstant 4
 cable upstream 1.1 mer-timeconstant 8
 cable upstream 1.1 rng-prm-guard 1
 cable upstream 1.1 nrng-prm-guard 0
 no cable upstream 1.1 ingress-cancellation
 no cable upstream 1.1 impulse-mitigation
 cable upstream 1.1 safe-config
 cable upstream 1.1 extended-frequency-detect all-ranging
 cable upstream 1.1 concatenation
 cable upstream 1.1 fragmentation
 cable upstream 1.1 data-backoff automatic
 cable upstream 1.1 range-backoff automatic
 cable upstream 1.1 contention-opp-latency 10000
 cable upstream 1.1 contention-opps-with-data required
 cable upstream 1.1 rate-limit
 cable upstream 1.1 status activate
 no ip directed-broadcast
 no ip source-verify
 no ip source-verify subif
 no ip l2-bg-to-bg-routing
 ip verify-ip-address-filter
!
interface Cable 1/0.1
 cable utilization-interval 10
 cable docsis10 max-traffic-burst 3044
 cable sid-verify
 shutdown
 bridge-group 1
 no allow-ip-only
 no management-access
 no tftp-server-access
 no cable source-verify
 arp-broadcast-echo
 l2-broadcast-echo
 l2-multicast-echo
 ip-broadcast-echo
 ip-multicast-echo
 no l2-broadcast-throttle
 no downstream-dhcp-server-allowed
 throttle-credits initial 15 running 2
 encapsulation dot1q 1 native
 no encapsulation dot1q 1 encrypted-multicast
 ip igmp disable
 no ip dhcp relay
 no ip dhcp relay information option
 no ip dhcp relay validate renew
 ip dhcp relay non-broadcast
 no cable dhcp-giaddr
 no ip directed-broadcast
 no ip source-verify
 no ip source-verify subif
 no ip l2-bg-to-bg-routing
 ip verify-ip-address-filter
!
!
! unattached subinterfaces
!
!
!
!
!

!
!
!
!
!
!
arp timeout 14400
!
cable modulation-profile 1 request AdvPhy TDMA
cable modulation-profile 1 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 1 initial AdvPhy TDMA
cable modulation-profile 1 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 1 station AdvPhy TDMA
cable modulation-profile 1 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 1 short AdvPhy TDMA
cable modulation-profile 1 short 6 78 15 8 qpsk scrambler 338 no-diff 84 shortened
cable modulation-profile 1 long AdvPhy TDMA
cable modulation-profile 1 long 8 220 0 8 qpsk scrambler 338 no-diff 96 shortened
cable modulation-profile 2 request AdvPhy TDMA
cable modulation-profile 2 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 2 initial AdvPhy TDMA
cable modulation-profile 2 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 2 station AdvPhy TDMA
cable modulation-profile 2 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 2 short AdvPhy TDMA
cable modulation-profile 2 short 8 78 8 8 16qam scrambler 338 no-diff 168 shortened
cable modulation-profile 2 long AdvPhy TDMA
cable modulation-profile 2 long 10 220 0 8 16qam scrambler 338 no-diff 192 shortened
cable modulation-profile 3 request AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 3 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 3 initial AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 3 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 3 station AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 3 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 3 short AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 3 short 6 78 15 8 qpsk scrambler 338 no-diff 84 shortened
cable modulation-profile 3 long AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 3 long 8 220 0 8 qpsk scrambler 338 no-diff 96 shortened
cable modulation-profile 3 advPhyS AdvPhy TDMA&ATDMA 1 1536
cable modulation-profile 3 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 3 advPhyS 12 78 6 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 3 advPhyL AdvPhy TDMA&ATDMA 1 1536
cable modulation-profile 3 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 3 advPhyL 16 220 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 3 advPhyU AdvPhy TDMA&ATDMA 1 1536
cable modulation-profile 3 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 3 advPhyU 12 78 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 4 request AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 4 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 4 initial AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 4 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 4 station AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 4 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 4 short AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 4 short 8 78 8 8 16qam scrambler 338 no-diff 168 shortened
cable modulation-profile 4 long AdvPhy TDMA&ATDMA 1 0
cable modulation-profile 4 long 10 220 0 8 16qam scrambler 338 no-diff 192 shortened
cable modulation-profile 4 advPhyS AdvPhy TDMA&ATDMA 1 1536
cable modulation-profile 4 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 4 advPhyS 12 78 6 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 4 advPhyL AdvPhy TDMA&ATDMA 1 1536
cable modulation-profile 4 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 4 advPhyL 16 220 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 4 advPhyU AdvPhy TDMA&ATDMA 1 1536
cable modulation-profile 4 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 4 advPhyU 12 78 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 5 request AdvPhy ATDMA 1 1536
cable modulation-profile 5 request AdvPhy preamble-type qpsk0
cable modulation-profile 5 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 5 initial AdvPhy ATDMA 1 1536
cable modulation-profile 5 initial AdvPhy preamble-type qpsk0
cable modulation-profile 5 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 5 station AdvPhy ATDMA 1 1536
cable modulation-profile 5 station AdvPhy preamble-type qpsk0
cable modulation-profile 5 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 5 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 5 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 5 advPhyS 12 78 6 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 5 advPhyL AdvPhy ATDMA 1 1536
cable modulation-profile 5 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 5 advPhyL 16 220 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 5 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 5 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 5 advPhyU 12 78 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 6 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 6 request AdvPhy preamble-type qpsk0
cable modulation-profile 6 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 6 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 6 initial AdvPhy preamble-type qpsk0
cable modulation-profile 6 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 6 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 6 station AdvPhy preamble-type qpsk0
cable modulation-profile 6 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 6 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 6 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 6 advPhyS 12 78 10 0 64qam scrambler 338 no-diff 64 shortened
cable modulation-profile 6 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 6 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 6 advPhyL 16 220 0 0 64qam scrambler 338 no-diff 64 shortened
cable modulation-profile 6 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 6 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 6 advPhyU 12 78 0 0 64qam scrambler 338 no-diff 64 shortened
cable modulation-profile 11 request AdvPhy TDMA
cable modulation-profile 11 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 11 initial AdvPhy TDMA
cable modulation-profile 11 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 11 station AdvPhy TDMA
cable modulation-profile 11 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 11 short AdvPhy TDMA
cable modulation-profile 11 short 8 78 15 8 qpsk scrambler 338 no-diff 84 shortened
cable modulation-profile 11 long AdvPhy TDMA
cable modulation-profile 11 long 10 150 0 8 qpsk scrambler 338 no-diff 200 shortened
cable modulation-profile 12 request AdvPhy TDMA
cable modulation-profile 12 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 12 initial AdvPhy TDMA
cable modulation-profile 12 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 12 station AdvPhy TDMA
cable modulation-profile 12 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 12 short AdvPhy TDMA
cable modulation-profile 12 short 6 78 15 8 qpsk scrambler 338 no-diff 84 shortened
cable modulation-profile 12 long AdvPhy TDMA
cable modulation-profile 12 long 8 220 0 8 qpsk scrambler 338 no-diff 96 shortened
cable modulation-profile 13 request AdvPhy TDMA
cable modulation-profile 13 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 13 initial AdvPhy TDMA
cable modulation-profile 13 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 13 station AdvPhy TDMA
cable modulation-profile 13 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 13 short AdvPhy TDMA
cable modulation-profile 13 short 6 78 15 8 qpsk scrambler 338 no-diff 84 shortened
cable modulation-profile 13 long AdvPhy TDMA
cable modulation-profile 13 long 4 220 0 8 qpsk scrambler 338 no-diff 96 shortened
cable modulation-profile 14 request AdvPhy TDMA
cable modulation-profile 14 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 14 initial AdvPhy TDMA
cable modulation-profile 14 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 14 station AdvPhy TDMA
cable modulation-profile 14 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 14 short AdvPhy TDMA
cable modulation-profile 14 short 8 78 10 8 16qam scrambler 338 no-diff 168 shortened
cable modulation-profile 14 long AdvPhy TDMA
cable modulation-profile 14 long 10 150 0 8 16qam scrambler 338 no-diff 304 shortened
cable modulation-profile 15 request AdvPhy TDMA
cable modulation-profile 15 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 15 initial AdvPhy TDMA
cable modulation-profile 15 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 15 station AdvPhy TDMA
cable modulation-profile 15 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 15 short AdvPhy TDMA
cable modulation-profile 15 short 8 78 10 8 16qam scrambler 338 no-diff 168 shortened
cable modulation-profile 15 long AdvPhy TDMA
cable modulation-profile 15 long 10 220 0 8 16qam scrambler 338 no-diff 192 shortened
cable modulation-profile 16 request AdvPhy TDMA
cable modulation-profile 16 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 16 initial AdvPhy TDMA
cable modulation-profile 16 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 16 station AdvPhy TDMA
cable modulation-profile 16 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 16 short AdvPhy TDMA
cable modulation-profile 16 short 8 78 10 8 16qam scrambler 338 no-diff 168 shortened
cable modulation-profile 16 long AdvPhy TDMA
cable modulation-profile 16 long 5 240 0 8 16qam scrambler 338 no-diff 192 shortened
cable modulation-profile 21 request AdvPhy ATDMA 1 1536
cable modulation-profile 21 request AdvPhy preamble-type qpsk1
cable modulation-profile 21 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 21 initial AdvPhy ATDMA 1 1536
cable modulation-profile 21 initial AdvPhy preamble-type qpsk1
cable modulation-profile 21 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 21 station AdvPhy ATDMA 1 1536
cable modulation-profile 21 station AdvPhy preamble-type qpsk1
cable modulation-profile 21 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 21 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 21 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 21 advPhyS 12 78 12 8 qpsk scrambler 338 no-diff 200 shortened
cable modulation-profile 21 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 21 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 21 advPhyL 16 150 0 8 qpsk scrambler 338 no-diff 304 shortened
cable modulation-profile 21 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 21 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 21 advPhyU 12 78 0 8 qpsk scrambler 338 no-diff 304 shortened
cable modulation-profile 22 request AdvPhy ATDMA 1 1536
cable modulation-profile 22 request AdvPhy preamble-type qpsk1
cable modulation-profile 22 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 22 initial AdvPhy ATDMA 1 1536
cable modulation-profile 22 initial AdvPhy preamble-type qpsk1
cable modulation-profile 22 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 22 station AdvPhy ATDMA 1 1536
cable modulation-profile 22 station AdvPhy preamble-type qpsk1
cable modulation-profile 22 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 22 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 22 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 22 advPhyS 12 100 12 8 qpsk scrambler 338 no-diff 104 shortened
cable modulation-profile 22 advPhyL AdvPhy ATDMA 5 1500
cable modulation-profile 22 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 22 advPhyL 5 220 0 8 qpsk scrambler 338 no-diff 104 shortened
cable modulation-profile 22 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 22 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 22 advPhyU 12 78 0 8 qpsk scrambler 338 no-diff 104 shortened
cable modulation-profile 23 request AdvPhy ATDMA 1 1536
cable modulation-profile 23 request AdvPhy preamble-type qpsk1
cable modulation-profile 23 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 23 initial AdvPhy ATDMA 1 1536
cable modulation-profile 23 initial AdvPhy preamble-type qpsk1
cable modulation-profile 23 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 23 station AdvPhy ATDMA 1 1536
cable modulation-profile 23 station AdvPhy preamble-type qpsk1
cable modulation-profile 23 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 23 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 23 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 23 advPhyS 12 100 8 8 8qam scrambler 338 no-diff 304 shortened
cable modulation-profile 23 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 23 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 23 advPhyL 16 150 0 8 8qam scrambler 338 no-diff 304 shortened
cable modulation-profile 23 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 23 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 23 advPhyU 12 100 0 8 8qam scrambler 338 no-diff 304 shortened
cable modulation-profile 24 request AdvPhy ATDMA 1 1536
cable modulation-profile 24 request AdvPhy preamble-type qpsk1
cable modulation-profile 24 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 24 initial AdvPhy ATDMA 1 1536
cable modulation-profile 24 initial AdvPhy preamble-type qpsk1
cable modulation-profile 24 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 24 station AdvPhy ATDMA 1 1536
cable modulation-profile 24 station AdvPhy preamble-type qpsk1
cable modulation-profile 24 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 24 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 24 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 24 advPhyS 12 78 8 8 8qam scrambler 338 no-diff 104 shortened
cable modulation-profile 24 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 24 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 24 advPhyL 5 220 0 8 8qam scrambler 338 no-diff 104 shortened
cable modulation-profile 24 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 24 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 24 advPhyU 12 78 0 8 8qam scrambler 338 no-diff 104 shortened
cable modulation-profile 25 request AdvPhy ATDMA 1 1536
cable modulation-profile 25 request AdvPhy preamble-type qpsk1
cable modulation-profile 25 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 25 initial AdvPhy ATDMA 1 1536
cable modulation-profile 25 initial AdvPhy preamble-type qpsk1
cable modulation-profile 25 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 25 station AdvPhy ATDMA 1 1536
cable modulation-profile 25 station AdvPhy preamble-type qpsk1
cable modulation-profile 25 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 25 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 25 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 25 advPhyS 12 100 13 8 16qam scrambler 338 no-diff 304 shortened
cable modulation-profile 25 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 25 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 25 advPhyL 16 150 0 8 16qam scrambler 338 no-diff 304 shortened
cable modulation-profile 25 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 25 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 25 advPhyU 12 78 0 8 16qam scrambler 338 no-diff 304 shortened
cable modulation-profile 26 request AdvPhy ATDMA 1 1536
cable modulation-profile 26 request AdvPhy preamble-type qpsk1
cable modulation-profile 26 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 26 initial AdvPhy ATDMA 1 1536
cable modulation-profile 26 initial AdvPhy preamble-type qpsk1
cable modulation-profile 26 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 26 station AdvPhy ATDMA 1 1536
cable modulation-profile 26 station AdvPhy preamble-type qpsk1
cable modulation-profile 26 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 26 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 26 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 26 advPhyS 12 78 13 8 16qam scrambler 338 no-diff 104 shortened
cable modulation-profile 26 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 26 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 26 advPhyL 5 220 0 8 16qam scrambler 338 no-diff 104 shortened
cable modulation-profile 26 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 26 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 26 advPhyU 12 78 0 8 16qam scrambler 338 no-diff 104 shortened
cable modulation-profile 27 request AdvPhy ATDMA 1 1536
cable modulation-profile 27 request AdvPhy preamble-type qpsk1
cable modulation-profile 27 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 27 initial AdvPhy ATDMA 1 1536
cable modulation-profile 27 initial AdvPhy preamble-type qpsk1
cable modulation-profile 27 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 27 station AdvPhy ATDMA 1 1536
cable modulation-profile 27 station AdvPhy preamble-type qpsk1
cable modulation-profile 27 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 27 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 27 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 27 advPhyS 12 78 12 8 32qam scrambler 338 no-diff 200 shortened
cable modulation-profile 27 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 27 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 27 advPhyL 16 150 0 8 32qam scrambler 338 no-diff 304 shortened
cable modulation-profile 27 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 27 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 27 advPhyU 12 78 0 8 32qam scrambler 338 no-diff 200 shortened
cable modulation-profile 28 request AdvPhy ATDMA 1 1536
cable modulation-profile 28 request AdvPhy preamble-type qpsk1
cable modulation-profile 28 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 28 initial AdvPhy ATDMA 1 1536
cable modulation-profile 28 initial AdvPhy preamble-type qpsk1
cable modulation-profile 28 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 28 station AdvPhy ATDMA 1 1536
cable modulation-profile 28 station AdvPhy preamble-type qpsk1
cable modulation-profile 28 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 28 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 28 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 28 advPhyS 12 78 12 8 32qam scrambler 338 no-diff 152 shortened
cable modulation-profile 28 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 28 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 28 advPhyL 5 220 0 8 32qam scrambler 338 no-diff 200 shortened
cable modulation-profile 28 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 28 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 28 advPhyU 12 78 0 8 32qam scrambler 338 no-diff 152 shortened
cable modulation-profile 29 request AdvPhy ATDMA 1 1536
cable modulation-profile 29 request AdvPhy preamble-type qpsk1
cable modulation-profile 29 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 29 initial AdvPhy ATDMA 1 1536
cable modulation-profile 29 initial AdvPhy preamble-type qpsk1
cable modulation-profile 29 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 29 station AdvPhy ATDMA 1 1536
cable modulation-profile 29 station AdvPhy preamble-type qpsk1
cable modulation-profile 29 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 29 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 29 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 29 advPhyS 12 78 11 8 64qam scrambler 338 no-diff 152 shortened
cable modulation-profile 29 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 29 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 29 advPhyL 16 220 0 8 64qam scrambler 338 no-diff 304 shortened
cable modulation-profile 29 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 29 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 29 advPhyU 12 78 0 8 64qam scrambler 338 no-diff 152 shortened
cable modulation-profile 30 request AdvPhy ATDMA 1 1536
cable modulation-profile 30 request AdvPhy preamble-type qpsk1
cable modulation-profile 30 request 0 16 0 8 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 30 initial AdvPhy ATDMA 1 1536
cable modulation-profile 30 initial AdvPhy preamble-type qpsk1
cable modulation-profile 30 initial 5 34 0 48 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 30 station AdvPhy ATDMA 1 1536
cable modulation-profile 30 station AdvPhy preamble-type qpsk1
cable modulation-profile 30 station 5 34 0 48 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 30 advPhyS AdvPhy ATDMA 1 1536
cable modulation-profile 30 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 30 advPhyS 12 78 11 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 30 advPhyL AdvPhy ATDMA 8 1504
cable modulation-profile 30 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 30 advPhyL 5 220 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 30 advPhyU AdvPhy ATDMA 1 1536
cable modulation-profile 30 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 30 advPhyU 12 78 0 8 64qam scrambler 338 no-diff 104 shortened
cable modulation-profile 31 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 31 request AdvPhy preamble-type qpsk0
cable modulation-profile 31 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 31 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 31 initial AdvPhy preamble-type qpsk0
cable modulation-profile 31 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 31 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 31 station AdvPhy preamble-type qpsk0
cable modulation-profile 31 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 31 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 31 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 31 advPhyS 12 78 10 0 qpsk scrambler 338 no-diff 120 shortened
cable modulation-profile 31 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 31 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 31 advPhyL 16 150 0 0 qpsk scrambler 338 no-diff 120 shortened
cable modulation-profile 31 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 31 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 31 advPhyU 12 78 0 0 qpsk scrambler 338 no-diff 120 shortened
cable modulation-profile 32 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 32 request AdvPhy preamble-type qpsk0
cable modulation-profile 32 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 32 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 32 initial AdvPhy preamble-type qpsk0
cable modulation-profile 32 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 32 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 32 station AdvPhy preamble-type qpsk0
cable modulation-profile 32 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 32 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 32 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 32 advPhyS 12 100 10 0 qpsk scrambler 338 no-diff 64 shortened
cable modulation-profile 32 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 32 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 32 advPhyL 5 220 0 0 qpsk scrambler 338 no-diff 64 shortened
cable modulation-profile 32 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 32 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 32 advPhyU 12 78 0 0 qpsk scrambler 338 no-diff 64 shortened
cable modulation-profile 33 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 33 request AdvPhy preamble-type qpsk0
cable modulation-profile 33 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 33 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 33 initial AdvPhy preamble-type qpsk0
cable modulation-profile 33 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 33 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 33 station AdvPhy preamble-type qpsk0
cable modulation-profile 33 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 33 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 33 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 33 advPhyS 12 100 10 0 8qam scrambler 338 no-diff 128 shortened
cable modulation-profile 33 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 33 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 33 advPhyL 16 150 0 0 8qam scrambler 338 no-diff 128 shortened
cable modulation-profile 33 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 33 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 33 advPhyU 12 100 0 0 8qam scrambler 338 no-diff 128 shortened
cable modulation-profile 34 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 34 request AdvPhy preamble-type qpsk0
cable modulation-profile 34 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 34 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 34 initial AdvPhy preamble-type qpsk0
cable modulation-profile 34 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 34 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 34 station AdvPhy preamble-type qpsk0
cable modulation-profile 34 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 34 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 34 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 34 advPhyS 12 78 10 0 8qam scrambler 338 no-diff 64 shortened
cable modulation-profile 34 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 34 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 34 advPhyL 5 220 0 0 8qam scrambler 338 no-diff 64 shortened
cable modulation-profile 34 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 34 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 34 advPhyU 12 78 0 0 8qam scrambler 338 no-diff 64 shortened
cable modulation-profile 35 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 35 request AdvPhy preamble-type qpsk0
cable modulation-profile 35 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 35 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 35 initial AdvPhy preamble-type qpsk0
cable modulation-profile 35 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 35 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 35 station AdvPhy preamble-type qpsk0
cable modulation-profile 35 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 35 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 35 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 35 advPhyS 12 100 10 0 16qam scrambler 338 no-diff 128 shortened
cable modulation-profile 35 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 35 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 35 advPhyL 16 150 0 0 16qam scrambler 338 no-diff 128 shortened
cable modulation-profile 35 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 35 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 35 advPhyU 12 100 0 0 16qam scrambler 338 no-diff 128 shortened
cable modulation-profile 36 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 36 request AdvPhy preamble-type qpsk0
cable modulation-profile 36 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 36 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 36 initial AdvPhy preamble-type qpsk0
cable modulation-profile 36 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 36 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 36 station AdvPhy preamble-type qpsk0
cable modulation-profile 36 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 36 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 36 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 36 advPhyS 12 78 10 0 16qam scrambler 338 no-diff 64 shortened
cable modulation-profile 36 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 36 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 36 advPhyL 5 220 0 0 16qam scrambler 338 no-diff 64 shortened
cable modulation-profile 36 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 36 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 36 advPhyU 12 78 0 0 16qam scrambler 338 no-diff 64 shortened
cable modulation-profile 37 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 37 request AdvPhy preamble-type qpsk0
cable modulation-profile 37 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 37 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 37 initial AdvPhy preamble-type qpsk0
cable modulation-profile 37 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 37 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 37 station AdvPhy preamble-type qpsk0
cable modulation-profile 37 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 37 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 37 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 37 advPhyS 12 100 10 0 32qam scrambler 338 no-diff 128 shortened
cable modulation-profile 37 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 37 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 37 advPhyL 16 150 0 0 32qam scrambler 338 no-diff 128 shortened
cable modulation-profile 37 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 37 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 37 advPhyU 12 100 0 0 32qam scrambler 338 no-diff 128 shortened
cable modulation-profile 38 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 38 request AdvPhy preamble-type qpsk0
cable modulation-profile 38 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 38 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 38 initial AdvPhy preamble-type qpsk0
cable modulation-profile 38 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 38 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 38 station AdvPhy preamble-type qpsk0
cable modulation-profile 38 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 38 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 38 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 38 advPhyS 12 78 10 0 32qam scrambler 338 no-diff 64 shortened
cable modulation-profile 38 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 38 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 38 advPhyL 5 220 0 0 32qam scrambler 338 no-diff 64 shortened
cable modulation-profile 38 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 38 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 38 advPhyU 12 78 0 0 32qam scrambler 338 no-diff 64 shortened
cable modulation-profile 39 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 39 request AdvPhy preamble-type qpsk0
cable modulation-profile 39 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 39 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 39 initial AdvPhy preamble-type qpsk0
cable modulation-profile 39 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 39 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 39 station AdvPhy preamble-type qpsk0
cable modulation-profile 39 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 39 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 39 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 39 advPhyS 12 78 10 0 64qam scrambler 338 no-diff 128 shortened
cable modulation-profile 39 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 39 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 39 advPhyL 16 150 0 0 64qam scrambler 338 no-diff 128 shortened
cable modulation-profile 39 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 39 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 39 advPhyU 12 78 0 0 64qam scrambler 338 no-diff 128 shortened
cable modulation-profile 40 request AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 40 request AdvPhy preamble-type qpsk0
cable modulation-profile 40 request 0 16 0 0 qpsk scrambler 338 no-diff 64 fixed
cable modulation-profile 40 initial AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 40 initial AdvPhy preamble-type qpsk0
cable modulation-profile 40 initial 5 34 0 0 qpsk scrambler 338 no-diff 640 fixed
cable modulation-profile 40 station AdvPhy SCDMA no-trell 5 no-spr 2
cable modulation-profile 40 station AdvPhy preamble-type qpsk0
cable modulation-profile 40 station 5 34 0 0 qpsk scrambler 338 no-diff 384 fixed
cable modulation-profile 40 advPhyS AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 40 advPhyS AdvPhy preamble-type qpsk1
cable modulation-profile 40 advPhyS 12 78 10 0 64qam scrambler 338 no-diff 64 shortened
cable modulation-profile 40 advPhyL AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 40 advPhyL AdvPhy preamble-type qpsk1
cable modulation-profile 40 advPhyL 16 220 0 0 64qam scrambler 338 no-diff 64 shortened
cable modulation-profile 40 advPhyU AdvPhy SCDMA no-trell 5 spr 2
cable modulation-profile 40 advPhyU AdvPhy preamble-type qpsk1
cable modulation-profile 40 advPhyU 12 78 0 0 64qam scrambler 338 no-diff 64 shortened
!
cable frequency-band 1 1 start 1800000 stop 68200000
cable frequency-band 2 1 start 1800000 stop 68200000
cable frequency-band 3 1 start 1800000 stop 68200000
cable frequency-band 4 1 start 1800000 stop 68200000
cable frequency-band 5 1 start 1800000 stop 68200000
cable frequency-band 6 1 start 1800000 stop 68200000
!
no cable group 1 load-balancing
!no cable group 1 description
no cable group 2 load-balancing
!no cable group 2 description
```

```
no cable group 3 load-balancing
!no cable group 3 description
no cable group 4 load-balancing
!no cable group 4 description
no cable group 5 load-balancing
!no cable group 5 description
no cable group 6 load-balancing
!no cable group 6 description
!
!
!
no logging syslog host
logging thresh none
logging thresh interval 1
logging severity 0 local no-trap no-sys no-vol
logging severity 1 local no-trap no-sys no-vol
logging severity 2 local trap sys no-vol
logging severity 3 no-local trap sys vol
logging severity 4 no-local trap sys vol
logging severity 5 no-local trap sys vol
logging severity 6 no-local no-trap no-sys no-vol
logging severity 7 no-local no-trap no-sys no-vol
logging trap-control 0x0
elog on
elog size 50
!
!cable service class "Multicast" priority  0
!cable service class "Multicast" sched-type best-effort
!cable service class "Multicast" downstream
!cable service class "Multicast" activity-timeout  0
!cable service class "Multicast" admission-timeout  0
!cable service class "Multicast" grant-interval  0
!cable service class "Multicast" grant-jitter  0
!cable service class "Multicast" grant-size  0
!cable service class "Multicast" grants-per-interval  0
!cable service class "Multicast" max-burst  0
!cable service class "Multicast" max-concat-burst  0
!cable service class "Multicast" max-latency  0
!cable service class "Multicast" max-rate  0
!cable service class "Multicast" min-packet-size  0
!cable service class "Multicast" min-rate  0
!cable service class "Multicast" poll-interval  0
!cable service class "Multicast" poll-jitter  0
!cable service class "Multicast" req-trans-policy  0x0
!cable service class "Multicast" tos-overwrite  0x0 0x0
!cable service class "Multicast" status activate
!
cable filter
cable submgmt
cable submgmt cpe ip filtering
no cable submgmt default active
cable submgmt default learnable
cable submgmt default max-cpe 16
cable submgmt default filter-group cm upstream 0
cable submgmt default filter-group cm downstream 0
cable submgmt default filter-group cpe upstream 0
cable submgmt default filter-group cpe downstream 0
```

```
no cable submgmt cpe ip aging
cable submgmt default cpe-ip-aging-interval 14400
!
!
line console
 length 24
 width 80
 timeout 900
 monitor
 no vt100-colours
line ssh
 length 24
 width 80
 timeout 900
 no monitor
 no vt100-colours
line vty 0 3
 length 24
 width 90
 timeout 900
 no monitor
 no vt100-colours
!
!
!
tftp-server setdir tftpboot
tftp-server stop
!
exception auto-reboot 0
exception 3212-monitor reset
!
!
ip ssh port 22
ip ssh timeout 300
ip ssh authentication-retries 3
!
phs-enable
!
C3#
```

Default Modulation Profiles

The following are the default modulation profiles created with the cable modulation-profile command.

Default QPSK Profile

```
C3(config)#cable modulation-profile 2 qpsk
C3(config)#show cable modulation-profile
```

```
Mod IUC     Type Preamb Diff FEC    FEC   Scrambl Max  Guard Last Scrambl
                 length enco T      CW    Seed    B    time  CW
                             BYTES  SIZE          size size  short
2   request qpsk  64    no   0x0    0x10  0x152   0    8     no   yes
```

```
2   initial qpsk  640   no   0x5    0x22  0x152   0    48    no   yes
2   station qpsk  384   no   0x5    0x22  0x152   0    48    no   yes
2   short   qpsk  64    no   0x6    0x4b  0x152   14   8     no   yes
2   long    qpsk  64    no   0x8    0xdc  0x152   0    8     no   yes
2   advPhyS qpsk  104   no   0xc    0x4b  0x152   6    8     no   yes
2   advPhyL qpsk  104   no   0x10   0xdc  0x152   0    8     no   yes
2   advPhyU qpsk  104   no   0x10   0xdc  0x152   0    8     no   yes
```

Default QAM Profile

```
C3(config)#cable modulation-profile 2 qam
C3(config)#show cable modulation-profile

Mod IUC     Type Preamb Diff FEC    FEC   Scrambl Max  Guard Last Scrambl
                 length enco T      CW    Seed    B    time  CW
                             BYTES  SIZE          size size  short
2   request 16qam 64    no   0x0    0x10  0x152   0    8     no   yes
2   initial 16qam 640   no   0x5    0x22  0x152   0    48    no   yes
2   station 16qam 384   no   0x5    0x22  0x152   0    48    no   yes
2   short   16qam 64    no   0x6    0x4b  0x152   14   8     no   yes
2   long    16qam 64    no   0x8    0xdc  0x152   0    8     no   yes
2   advPhyS 16qam 104   no   0xc    0x4b  0x152   6    8     no   yes
2   advPhyL 16qam 104   no   0x10   0xdc  0x152   0    8     no   yes
2   advPhyU 16qam 104   no   0x10   0xdc  0x152   0    8     no   yes
```

Default Advanced PHY Profile

```
C3(config)#cable modulation-profile 2 advanced-phy
C3(config)#show cable modulation-profile

Mod IUC     Type Preamb Diff FEC    FEC   Scrambl Max  Guard Last Scrambl
                 length enco T      CW    Seed    B    time  CW
                             BYTES  SIZE          size size  short
2   request qpsk  64    no   0x0    0x10  0x152   0    8     no   yes
2   initial qpsk  640   no   0x5    0x22  0x152   0    48    no   yes
2   station qpsk  384   no   0x5    0x22  0x152   0    48    no   yes
2   short   qpsk  64    no   0x6    0x4b  0x152   14   8     no   yes
2   long    qpsk  64    no   0x8    0xdc  0x152   0    8     no   yes
2   advPhyS 64qam 104   no   0xc    0x4b  0x152   6    8     no   yes
2   advPhyL 64qam 104   no   0x10   0xdc  0x152   0    8     no   yes
2   advPhyU 64qam 104   no   0x10   0xdc  0x152   0    8     no   yes
```

Default Mixed Profile

```
C3(config)#cable modulation-profile 2 mix
C3(config)#show cable modulation-profile
```

```
Mod IUC     Type Preamb Diff FEC    FEC   Scrambl Max  Guard Last Scrambl
                 length enco T      CW    Seed    B    time  CW
                             BYTES  SIZE          size size  short
2   request qpsk  64    no   0x0    0x10  0x152   0    8     no   yes
2   initial qpsk  640   no   0x5    0x22  0x152   0    48    no   yes
2   station qpsk  384   no   0x5    0x22  0x152   0    48    no   yes
2   short   16qam 64    no   0x6    0x4b  0x152   14   8     no   yes
2   long    16qam 64    no   0x8    0xdc  0x152   0    8     no   yes
2   advPhyS 16qam 104   no   0xc    0x4b  0x152   6    8     no   yes
2   advPhyL 16qam 104   no   0x10   0xdc  0x152   0    8     no   yes
2   advPhyU 16qam 104   no   0x10   0xdc  0x152   0    8     no   yes
```

G Configuration Forms

Use the following forms to record information about how the CMTS should be configured.

Booting Configuration

Boot device	□ Compact Flash disk □ TFTP server
Image file name	
Booting interface	□ fastethernet 0/0 □ fastethernet 0/1

TFTP Server Boot Parameters

(required only if you are network booting)

CMTS IP Address	
Subnet mask	

Gateway IP address	
VLAN ID (if necessary)	

Running Configuration - IP Networking

Ethernet interfaces in use	□ fastethernet 0/0 □ fastethernet 0/1
Management interface and options	□ fastethernet 0/0 □ fastethernet 0/1
Management IP address	
Management Subnet mask	
Gateway IP address	
VLAN ID (if necessary)	

TFTP Server Parameters

IP Address	
Subnet mask	
Gateway address (if necessary)	
VLAN ID (if necessary)	

DHCP Server 1 Parameters

IP Address	
Subnet mask	
Gateway address (if necessary)	
VLAN ID (if necessary)	

DHCP Server 2 Parameters

IP Address	
Subnet mask	

Gateway address (if necessary)	
VLAN ID (if necessary)	

DHCP Server 3 Parameters

IP Address	
Subnet mask	
Gateway address (if necessary)	
VLAN ID (if necessary)	

Fastethernet 0/0 Configuration

Physical Interface Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 1 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 2 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 3 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 4 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 5 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 6 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 7 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 8 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Fastethernet 0/1 Configuration

Physical Interface Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 1 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 2 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 3 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 4 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 5 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 6 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Sub-interface 7 Configuration

IP Address	

Subnet mask	
VLAN ID (if necessary)	

Sub-interface 8 Configuration

IP Address	
Subnet mask	
VLAN ID (if necessary)	

Cable Configuration

IP Networking

Make additional copies of this checklist for each sub-interface.

Helper Address 1	
	□ for modems □ for hosts
Helper Address 2	
	□ for modems □ for hosts
Helper Address 3	
	□ for modems □ for hosts
Helper Address 4	
	□ for modems □ for hosts
Helper Address 5	
	□ for modems □ for hosts

dhcp-giaddr	□ primary □ policy
Other DHCP options	□ ip dhcp relay □ ip dhcp relay information option

Downstream RF Configuration

DOCSIS type	□ DOCSIS (6 MHz) □ EuroDOCSIS (8 MHz)
Center Frequency (MHz)	
Modulation	□ 64 QAM □ 256 QAM

Upstream 0 RF Configuration

Center Frequency (MHz)	
Channel Width (MHz)	
Modulation	□ QPSK □ 8 QAM □ 16 QAM □ 32 QAM □ 64 QAM

Upstream 1 RF Configuration

Center Frequency (MHz)	
Channel Width (MHz)	
Modulation	□ QPSK □ 8 QAM □ 16 QAM □ 32 QAM □ 64 QAM

Upstream 2 RF Configuration

Center Frequency (MHz)	
Channel Width (MHz)	
Modulation	□ QPSK □ 8 QAM □ 16 QAM □ 32 QAM □ 64 QAM

Upstream 3 RF Configuration

Center Frequency (MHz)	
Channel Width (MHz)	
Modulation	□ QPSK □ 8 QAM □ 16 QAM □ 32 QAM □ 64 QAM

Upstream 4 RF Configuration

Center Frequency (MHz)	
Channel Width (MHz)	
Modulation	□ QPSK □ 8 QAM □ 16 QAM □ 32 QAM □ 64 QAM

Upstream 5 RF Configuration

Center Frequency (MHz)	
Channel Width (MHz)	
Modulation	□ QPSK □ 8 QAM □ 16 QAM □ 32 QAM □ 64 QAM

H C3 CMTS Syslog Events and SNMP Traps

Syslog Events

The shaded items are SYSLOG events which have no corresponding SNMP traps.

Event Msg Num	Severity	Message Text
77000100	SYSLOG_INFO	A transmit opportunity was missed because the MAP arrived too late
82010100	SYSLOG_WARNING	No Ranging Requests received from POLLED CM (CMTS generated polls)
82010200	SYSLOG_WARNING	Retries exhausted for polled CM
82010300	SYSLOG_WARNING	Unable to Successfully Range CM
73000400	SYSLOG_WARNING	Service unavailable - Other
73000401	SYSLOG_WARNING	Service unavailable - Unrecognized configuration setting
73000402	SYSLOG_WARNING	Service unavailable - Temporarily unavailable
73000403	SYSLOG_WARNING	Service unavailable - Permanent
73000500	SYSLOG_WARNING	Registration rejected authentication failure; CMTS MIC invalid
73010100	SYSLOG_WARNING	REG REQ has invalid MAC header
73010200	SYSLOG_WARNING	REG REQ has invalid SID or not in use
73010400	SYSLOG_WARNING	REG REQ missed required TLV’s
73010500	SYSLOG_WARNING	Bad DS FREQ - Format invalid
73010501	SYSLOG_WARNING	Bad DS FREQ - Not in use
73010502	SYSLOG_WARNING	Bad DS Freq - Not multiple of 62500 Hz
73010600	SYSLOG_WARNING	Bad US CH - Invalid or Unassigned
73010601	SYSLOG_WARNING	Bad US CH - Change followed with (RE0) Registration REQ
73010700	SYSLOG_WARNING	Bad US CH - Overload

Event Msg Num	Severity	Message Text
73010800	SYSLOG_WARNING	Network Access has invalid parameter
73010900	SYSLOG_WARNING	Bad Class of Service - Invalid configuration
73011000	SYSLOG_WARNING	Bad Class of Service - Unsupported class
73011100	SYSLOG_WARNING	Bad Class of Service - Invalid Class ID or out of range
73011200	SYSLOG_WARNING	Bad Max DS Bit Rate - Invalid format
73011201	SYSLOG_WARNING	Bad Max DS Bit Rate - Unsupported setting
73011300	SYSLOG_WARNING	Bad Max US Bit - Invalid format
73011301	SYSLOG_WARNING	Bad Max US Bit Rate - Unsupported setting
73011400	SYSLOG_WARNING	Bad US Priority Configuration - Invalid format
73011401	SYSLOG_WARNING	Bad US Priority Configuration - Setting out of range
73011500	SYSLOG_WARNING	Bad Guaranteed Min US CH Bit Rate Configuration setting - Invalid format
73011501	SYSLOG_WARNING	Bad Guaranteed Min US CH Bit Rate Configuration setting - Exceed Max US Bit Rate
73011502	SYSLOG_WARNING	Bad Guaranteed Min US CH Bit Rate Configuration setting - Out of range
73011600	SYSLOG_WARNING	Bad Max US CH Transmit Burst configuration setting - Invalid format
73011601	SYSLOG_WARNING	Bad Max US CH Transmit Burst configuration setting - Out of range
73011700	SYSLOG_WARNING	Invalid modem capabilities configuration setting
73011800	SYSLOG_WARNING	Configuration file contains parameter with the value outside of the range
73020100	SYSLOG_WARNING	REG REQ rejected - Unspecified reason
73020101	SYSLOG_WARNING	REG REQ rejected - Unrecognized configuration setting
73020102	SYSLOG_WARNING	REG REQ rejected - Temporary no resource
73020103	SYSLOG_WARNING	REG REQ rejected - Permanent administrative
73020104	SYSLOG_WARNING	REG REQ rejected - Required parameter not present - %s
73020105	SYSLOG_WARNING	REG REQ rejected - Header suppression setting not supported
73020106	SYSLOG_WARNING	REG REQ rejected - Multiple errors
73020107	SYSLOG_WARNING	REG REQ rejected - Duplicate reference-ID or index in message
73020108	SYSLOG_WARNING	REG REQ rejected - Parameter invalid for context -%s
73020109	SYSLOG_WARNING	REG REQ rejected - Authorization failure
73020110	SYSLOG_WARNING	REG REQ rejected - Major service flow error
73020111	SYSLOG_WARNING	REG REQ rejected - Major classifier error
73020112	SYSLOG_WARNING	REG REQ rejected - Major PHS rule error
73020113	SYSLOG_WARNING	REG REQ rejected - Multiple major errors
73020114	SYSLOG_WARNING	REG REQ rejected - Message syntax error %s
73020115	SYSLOG_WARNING	REG REQ rejected -Primary service flow error %s
73020116	SYSLOG_WARNING	REG REQ rejected - Message too big %s
73030100	SYSLOG_WARNING	REG aborted no REG-ACK
73030200	SYSLOG_WARNING	REG ACK rejected unspecified reason

Event Msg Num	Severity	Message Text
73030300	SYSLOG_WARNING	REG ACK rejected message syntax error
83000100	SYSLOG_WARNING	Service Add rejected - Unspecified reason
83000101	SYSLOG_WARNING	Service Add rejected - Unrecognized configuration setting
83000102	SYSLOG_WARNING	Service Add rejected - Temporary no resource
83000103	SYSLOG_WARNING	Service Add rejected - Permanent administrative
83000104	SYSLOG_WARNING	Service Add rejected - Required parameter not present
83000105	SYSLOG_WARNING	Service Add rejected - Header suppression setting not supported
83000106	SYSLOG_WARNING	Service Add rejected - Service flow exists
83000107	SYSLOG_WARNING	Service Add rejected - HMAC Auth failure
83000108	SYSLOG_WARNING	Service Add rejected - Add aborted
83000109	SYSLOG_WARNING	Service Add rejected - Multiple errors
83000110	SYSLOG_WARNING	Service Add rejected - Classifier not found
83000111	SYSLOG_WARNING	Service Add rejected - Classifier exists
83000113	SYSLOG_WARNING	Service Add rejected - PHS rule exists
83000114	SYSLOG_WARNING	Service Add rejected - Duplicated reference-ID or index in message
83000115	SYSLOG_WARNING	Service Add rejected - Multiple upstream flows
83000116	SYSLOG_WARNING	Service Add rejected - Multiple downstream flows
83000117	SYSLOG_WARNING	Service Add rejected - Classifier for another flow
83000118	SYSLOG_WARNING	Service Add rejected - PHS rule for another flow
83000119	SYSLOG_WARNING	Service Add rejected - Parameter invalid for context
83000120	SYSLOG_WARNING	Service Add rejected - Authorization failure
83000121	SYSLOG_WARNING	Service Add rejected - Major service flow error
83000122	SYSLOG_WARNING	Service Add rejected - Major classifier error
83000123	SYSLOG_WARNING	Service Add rejected - Major PHS rule error
83000124	SYSLOG_WARNING	Service Add rejected - Multiple major errors
83000125	SYSLOG_WARNING	Service Add rejected - Message syntax error
83000126	SYSLOG_WARNING	Service Add rejected - Message too big
83000127	SYSLOG_WARNING	Service Add rejected - Temporary DCC
83000200	SYSLOG_WARNING	Service Change rejected - Unspecified reason
83000201	SYSLOG_WARNING	Service Change rejected - Unrecognized configuration setting
83000202	SYSLOG_WARNING	Service Change rejected - Temporary no resource
83000203	SYSLOG_WARNING	Service Change rejected - Permanent administrative
83000204	SYSLOG_WARNING	Service Change rejected - Requestor not owner of service flow
83000205	SYSLOG_WARNING	Service Change rejected - Service flow not found
83000206	SYSLOG_WARNING	Service Change rejected - Required parameter not present
83000207	SYSLOG_WARNING	Service Change rejected - Header suppression serting not supported
83000208	SYSLOG_WARNING	Service Change rejected - HMAC Auth failure

Event Msg Num	Severity	Message Text
83000209	SYSLOG_WARNING	Service Change rejected - Multiple errors
83000210	SYSLOG_WARNING	Service Change rejected - Classifier not found
83000211	SYSLOG_WARNING	Service Change rejected - Classifier exists
83000212	SYSLOG_WARNING	Service Change rejected - PHS rule not found
83000213	SYSLOG_WARNING	Service Change rejected - PHS rule exists
83000214	SYSLOG_WARNING	Service Change rejected - Duplicated reference-ID or index in message
83000215	SYSLOG_WARNING	Service Change rejected - Multiple upstream flows
83000216	SYSLOG_WARNING	Service Change rejected - Multiple downstream flows
83000217	SYSLOG_WARNING	Service Change rejected - Classifier for another flow
83000218	SYSLOG_WARNING	Service Change rejected - PHS rule for another flow
83000219	SYSLOG_WARNING	Service Change rejected - Parameter invalid for context
83000220	SYSLOG_WARNING	Service Change rejected - Authorization failure
83000221	SYSLOG_WARNING	Service Change rejected - Major service flow error
83000222	SYSLOG_WARNING	Service Change rejected - Major classifier error
83000223	SYSLOG_WARNING	Service Change rejected - Major PHS rule error
83000224	SYSLOG_WARNING	Service Change rejected - Multiple major errors
83000225	SYSLOG_WARNING	Service Change rejected - Message syntax error
83000226	SYSLOG_WARNING	Service Change rejected - Message too big
83000227	SYSLOG_WARNING	Service Change rejected - Temporary DCC
83000300	SYSLOG_WARNING	Service Delete rejected - Unspecified reason
83000301	SYSLOG_WARNING	Service Delete rejected - Requestor not owner of service flow
83000302	SYSLOG_WARNING	Service Delete rejected - Service flow not found
83000303	SYSLOG_WARNING	Service Delete rejected - HMAC Auth failure
83000304	SYSLOG_WARNING	Service Delete rejected - Message syntax error
83010100	SYSLOG_WARNING	Service Add Response rejected - Invalid transaction ID
83010101	SYSLOG_WARNING	Service Add aborted - No RSP
83010102	SYSLOG_WARNING	Service Add Response rejected - HMAC Auth failure
83010103	SYSLOG_WARNING	Service Add Response rejected - Message syntax error
83010104	SYSLOG_WARNING	Service Add Response rejected - Unspecified reason
83010105	SYSLOG_WARNING	Service Add Response rejected - Unrecognized configuration setting
83010106	SYSLOG_WARNING	Service Add Response rejected - Required parameter not present
83010107	SYSLOG_WARNING	Service Add Response rejected - Service Flow exists
83010108	SYSLOG_WARNING	Service Add Response rejected - Multiple errors
83010109	SYSLOG_WARNING	Service Add Response rejected - Classifier exists
83010110	SYSLOG_WARNING	Service Add Response rejected - PHS rule exists
83010111	SYSLOG_WARNING	Service Add Response rejected - Duplicate reference-ID or index in message
83010112	SYSLOG_WARNING	Service Add Response rejected - Classifier for another flow

Event Msg Num	Severity	Message Text
83010113	SYSLOG_WARNING	Service Add Response rejected - Parameter invalid for context
83010114	SYSLOG_WARNING	Service Add Response rejected - Major service flow error
83010115	SYSLOG_WARNING	Service Add Response rejected - Major classifier error
83010116	SYSLOG_WARNING	Service Add Response rejected - Major PHS Rule error
83010117	SYSLOG_WARNING	Service Add Response rejected - Multiple major errors
83010118	SYSLOG_WARNING	Service Add Response rejected -Message too big - MAC
83010200	SYSLOG_WARNING	Service Change Response rejected - Invalid transaction ID
83010201	SYSLOG_WARNING	Service Change aborted - No RSP-
83010202	SYSLOG_WARNING	Service Change Response rejected - HMAC Auth failure
83010204	SYSLOG_WARNING	Service Change Response rejected - Unspecified reason
83010205	SYSLOG_WARNING	Service Change Response rejected - Unrecognized configuration setting
83010206	SYSLOG_WARNING	Service Change Response rejected - Required parameter not present
83010207	SYSLOG_WARNING	Service Change Response rejected - Multiple errors
83010208	SYSLOG_WARNING	Service Change Response rejected - Classifier exists
83010209	SYSLOG_WARNING	Service Change Response rejected - PHS rule exists
83010210	SYSLOG_WARNING	Service Change Response rejected - Duplicated reference-ID or index in
83010211	SYSLOG_WARNING	Service Change Response rejected - Invalid parameter for context
83010212	SYSLOG_WARNING	Service Change Response rejected - Major classifier error
83010213	SYSLOG_WARNING	Service Change Response rejected - Major PHS rule error
83010214	SYSLOG_WARNING	Service Change Response rejected - Multiple Major errors
83010215	SYSLOG_WARNING	Service Change Response rejected - Message too big
83010203	SYSLOG_WARNING	Service Change Response rejected - Message syntax error
83010300	SYSLOG_WARNING	Service Delete Response rejected - Invalid transaction ID
83020100	SYSLOG_WARNING	Service Add Response rejected - Invalid transaction ID
83020101	SYSLOG_WARNING	Service Add Aborted - No ACK
83020102	SYSLOG_WARNING	Service Add ACK rejected - HMAC auth failure
83020103	SYSLOG_WARNING	Service Add ACK rejected - Message syntax error
83020200	SYSLOG_WARNING	Service Change ACK rejected - Invalid transaction ID
83020201	SYSLOG_WARNING	Service Change Aborted - No ACK
83020202	SYSLOG_WARNING	Service Change ACK rejected - HMAC Auth failure
83020203	SYSLOG_WARNING	Service Change ACK rejected - Message syntax error
66010100	SYSLOG_NOTICE	Missing BP Configuration Setting TLV Type: %s
66010200	SYSLOG_NOTICE	d BP Configuration Setting Value: %s for Type: %s
66030102	SYSLOG_ERROR	Auth Reject - No Information
66030103	SYSLOG_ERROR	Auth Reject - Unauthorized CM
66030104	SYSLOG_ERROR	Auth Reject - Unauthorized SAID
66030108	SYSLOG_ERROR	Auth Reject - Permanent Authorization Failure

Event Msg Num	Severity	Message Text
66030109	SYSLOG_ERROR	Auth Reject - Time of Day not acquired
66030111	SYSLOG_ERROR	CM Certificate Error
66030202	SYSLOG_ERROR	Auth Invalid - No information
66030203	SYSLOG_ERROR	Auth Invalid - Unauthorized CM
66030205	SYSLOG_ERROR	Auth Invalid - Unsolicited
66030206	SYSLOG_ERROR	Auth Invalid - Invalid Key Sequence Number
66030207	SYSLOG_ERROR	Auth Invalid - Message (Key Request) Authentication Failure
66030300	SYSLOG_ERROR	Unsupported Crypto Suite
66050102	SYSLOG_ERROR	Key Reject - No information
66050103	SYSLOG_ERROR	Key Reject - Unauthorized SAID
66050203	SYSLOG_ERROR	TEK Invalid - No information
66050206	SYSLOG_ERROR	TEK Invalid - Invalid Key Sequence Number
66060200	SYSLOG_ERROR	Unsupported Crypto Suite
66060509	SYSLOG_ERROR	Map Reject - Not Authorized for Requested Downstream Traffic Flow (EC=7)
66060510	SYSLOG_ERROR	Map Reject - Downstream Traffic Flow Not Mapped to BPI+ SAID (EC=8)
66060600	SYSLOG_ERROR	Mapped to Existing SAID
66060700	SYSLOG_ERROR	Mapped to New SAID
67000100	SYSLOG_WARNING	UCC-REQ received with invalid or out of range US channel ID
67000200	SYSLOG_WARNING	UCC-REQ received, unable to send UCC-RSP
67010100	SYSLOG_WARNING	UCC-RSP not received on previous channel-ID
67010200	SYSLOG_WARNING	UCC-RSP received with invalid channel-ID
67010300	SYSLOG_WARNING	UCC-RSP received with invalid channel-ID on new channel
67020100	SYSLOG_WARNING	DCC rejected already there
67020200	SYSLOG_NOTICE	DCC depart old
67020300	SYSLOG_NOTICE	DCC arrive new
67020400	SYSLOG_WARNING	DCC aborted unable to acquire new downstream channel
67020500	SYSLOG_WARNING	DCC aborted no UCD for new upstream channel
67020600	SYSLOG_WARNING	DCC aborted unable to communicate on new upstream channel
67020700	SYSLOG_WARNING	DCC rejected unspecified reason
67020800	SYSLOG_WARNING	DCC rejected permanent - DCC not supported
67020900	SYSLOG_WARNING	DCC rejected service flow not found
67021000	SYSLOG_WARNING	DCC rejected required parameter not present
67021100	SYSLOG_WARNING	DCC rejected authentication failure
67021200	SYSLOG_WARNING	DCC rejected multiple errors
67021500	SYSLOG_WARNING	DCC rejected duplicate SF reference - %s
67021600	SYSLOG_WARNING	DCC rejected parameter invalid for context
67021700	SYSLOG_WARNING	DCC rejected message syntax error

Event Msg Num	Severity	Message Text
67021800	SYSLOG_WARNING	DCC rejected message too big
67030100	SYSLOG_WARNING	DCC-RSP not received on old channel
67030200	SYSLOG_WARNING	DCC-RSP not received on new channel
67030300	SYSLOG_WARNING	DCC-RSP rejected unspecified reason
67030400	SYSLOG_WARNING	DCC-RSP rejected unknown transaction ID
67030500	SYSLOG_WARNING	DCC-RSP rejected authentication failure
67030600	SYSLOG_WARNING	DCC-RSP rejected message syntax error
67040100	SYSLOG_WARNING	DCC-ACK not received
67040200	SYSLOG_WARNING	DCC-ACK rejected unspecified reason
67040300	SYSLOG_WARNING	DCC-ACK rejected unknown transaction ID
67040400	SYSLOG_WARNING	DCC-ACK rejected authentication failure
67040500	SYSLOG_WARNING	DCC-ACK rejected message syntax error
0x90130100	SYSLOG_ERROR	Source Verify Failure - Spoofing CM Mac: Count %s
0x90130101	SYSLOG_ERROR	Source Verify Failure - Spoofing CPE Mac: Count %s
0x90130102	SYSLOG_ERROR	Source Verify Failure - IP Spoofing: Count %s
0x90130103	SYSLOG_ERROR	Source Verify Failure - Duplicate IP: Count %s
0x90130104	SYSLOG_ERROR	Source Verify Failure - Static IP Spoofing: Count %s
0x90130105	SYSLOG_ERROR	Source Verify Failure - Duplicate Static IP: Count %s
0x90130106	SYSLOG_ERROR	Source Verify Failure - DHCP Lease Expired: Count %s
0x90130107	SYSLOG_ERROR	Source Verify Failure - Spoofing CMTS or STATIC MAC: Count %s
0x90130108	SYSLOG_ERROR	CM in SCDMA mode was ranging too often and was reset
0x90130109	SYSLOG_NOTICE	TACACS+: server unreachable for authentication on line %s: %s
0x9013010a	SYSLOG_NOTICE	TACACS+: server group unreachable for authentication on line %s: group=%s
0x9013010b	SYSLOG_INFO	AAA: successful authentication on line %s: %s
0x9013010c	SYSLOG_NOTICE	AAA: authentication failure on line %s: %s
0x9013010d	SYSLOG_INFO	AAA: successful enable authentication on line %s: %s
0x9013010e	SYSLOG_NOTICE	AAA: enable authentication failure on line %s: %s

SNMP Traps

The shaded items are SNMP traps which have no corresponding SYSLOG event.

Table H-1: docsDevNotification(2).docsDevTraps(1).docsDevCmtsTraps(3)

SNMP Trap OID	SNMP Trap Description
docsDevCmtsInitRegReqFailTrap(1)	An event to report the failure of a registration request from CM happened during the CM initialization process and detected in the CMTS side. The values of docsDevEvLevel, docsDevld, and docsDevEvText are from the entry which logs this event in the docsDevEventTable. DocsIfCmtsCmStatusDocsisMode and docsIfCmtsCmStatusMacAddress indicate the DOCSIS version of the CMTS and the MAC address of the CMTS (if there is a cable card/interface in the CMTS, then it is actually the MAC address of the cable interface which connected to the CM) cable card connected to the CM. This part of the information is uniform across all CMTS traps.
docsDevCmtsInitRegAckFailTrap(3)	An event to report the failure of a registration acknowledgement from CM happened during the CM initialization process and detected in the CMTS side.
docsDevCmtsDynServReqFailTrap(4)	An event to report the failure of a dynamic service request that happened during the dynamic services process and detected in the CMTS side.
docsDevCmtsDynServRspFailTrap(5)	An event to report the failure of a dynamic service response that happened during the dynamic services process and detected in the CMTS side.
docsDevCmtsDynServAckFailTrap(6)	An event to report the failure of a dynamic service acknowledgement that happened during the dynamic services process and detected in the CMTS side.
docsDevCmtsBpiInitTrap(7)	An event to report the failure of a BPI initialization attempt that happened during the CM registration process and detected in the CMTS side.
docsDevCmtsBPKMTrap(8)	An event to report the failure of a BPKM operation which is detected in the CMTS side.
docsDevCmtsDynamicSATrap(9)	An event to report the failure of a dynamic security association operation which is detected in the CMTS side.
docsDevCmtsDccReqFailTrap(10)	An event to report the failure of a dynamic channel change request that happened during the dynamic channel change process in the CM side and detected in the CMTS side.
docsDevCmtsDccRspFailTrap(11)	An event to report the failure of a dynamic channel change response that happened during the dynamic channel change process in the CMTS side.
docsDevCmtsDccAckFailTrap(12)	An event to report the failure of a dynamic channel change acknowledgement that happened during the dynamic channel change process in the CMTS side.

Table H-2: iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).arris(4115). arrisProducts(1).arrisProdIdCMTS(4).cmtsC3(3).cmtsC3FFPDMIB(3). dcxFPDObjects(1).dcxPFDTrapGroup(3).

SNMP Trap OID	SNMP Trap Description
dcxFPDAttached(1)	Front Panel Display has been attached.
dcxFPDDetached(2)	Front Panel Display has been detached.
dcxFPDFan1Fail(3)	Fan nearest the front of the box has failed.
dcxFPDFan1FailClr(4)	Fan nearest the front of the box is working.
dcxFPDFan2Fail(5)	Fan 2nd from the front failed.
dcxFPDFan2FailClr(6)	Fan 2nd from the front is working.
dcxFPDFan3Fail(7)	Fan 3rd from the front failed.
dcxFPDFan3FailClr(8)	Fan 3rd from the front is working.

SNMP Trap OID	SNMP Trap Description
dcxFPDFan4Fail(9)	Fan 4th from the front failed.
dcxFPDFan4FailClr(10)	Fan 4th from the front is working.
dcxFPDFan5Fail(11)	Fan 5th from the front failed.
dcxFPDFan5FailClr(12)	Fan 5th from the front is working.
dcxFPDFan6Fail(13)	Fan 6th from the front failed.
dcxFPDFan6FailClr(14)	Fan 6th from the front is working.
dcxFPDPwr1Fail(15)	Rightmost power supply has failed.
dcxFPDPwr1FailClr(16)	Rightmost power supply is working.
dcxFPDPwr2Fail(17)	Leftmost power supply has failed.
dcxFPDPwr2FailClr(18)	Leftmost power supply is working.
dcxFPDTempOkay(19)	System temperature is OK.
dcxFPDTempBad(20)	System temperature is too hot!
dcxFPDTempCritical(21)	System temperature is critical!! CMTS will shut itself down!!!!

Table H-3: iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).arris(4115). arrisProducts(1).arrisProdIdCMTS(4).cmtsC3(3).cmtsC3CMMIB(5).dcxCMMObjects(1). dcxCMMTrapGroup(4)

SNMP Trap OID	SNMP Trap Description
dcxCMMTrap(2)	General CMM trap. The reason for the trap is described in the DcxCMMTrapReason.

Table H-4: iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).cisco(9). ciscoMgmt(9).cTapBMIB(252).cTapMIBNotifications(0)

SNMP Trap OID	SNMP Trap Description
cTapMIBActive(1)	This notification is sent when an intercepting router or switch is first capable of intercepting a packet corresponding to a configured data stream. If the configured data stream is an IP one, the value of the corresponding cTapStreamIpStatus is included in this notification. If the configured data stream is an IEEE 802 one, the value of the corresponding cTapStream802Status is included in this notification. This notification may be generated in conjunction with the intercept application which is designed to expect the notification to be sent as reliably as possible, e.g., through the use of a finite number of retransmissions until acknowledged, as and when such mechanisms are available. For example, with SNMPv3, this would be an InformRequest. Filter installation can take a long period of time during which call progress may be delayed.
cTapMediationTimedOut(2)	When an intercept is autonomously removed by an intercepting device due to the time specified in cTapMediationTimeout arriving, the device notifies the manager of the action.

Table H-5: iso(1).org(3).dod(6).internet(1).mgmt(2).mib-2(1).ifMIB(31).ifConformance(2). ifGroups(1)

SNMP Trap OID	SNMP Trap Description
linkUpDownNotificationsGroup(14)	The notifications which indicate specific changes in the value of ifOperStatus.

Table H-6: iso(1).org(3).dod(6).internet(1).snmpV2(6).snmpModules(3).snmpMIBObjects(1). snmpTraps(5)

SNMP Trap OID	SNMP Trap Description
coldStart(1)	A cold start trap signifies that the SNMP entity supporting a notification originator application is reinitializing itself and that its configuration may have been altered.