C H A P T E R 5

Managing Cable Modems on the Hybrid Fiber-Coaxial Network

After you have completed upstream and downstream configuration in Chapter 2, "Configuring the Cable Modem Termination System for the First Time,"you have additional options to manage how your cable modems (CMs) operate in the hybrid fiber-coaxial (HFC) network. You can set the following CM functions:

Section	Purpose
"Activating Cable Modem Authentication" section on page 5-2	Provides instructions to require all CMs to return a known text string to register with the CMTS and gain access to the network.
"Activating Cable Modem Insertion Interval" section on page 5-3	Limits the amount of time that a CM requests a channel for the first time from the Cisco uBR7200 series.
"Activating Cable Modem Upstream Address Verification" section on page 5-4	Ensures that only CMs that have received DHCP leases through the Cisco uBR7200 series CMTS can access the HFC network.
"Clearing Cable Modem Counters" section on page 5-5	Clears the counters for the CMs in the station maintenance list.
"Clearing Cable Modem Reset" section on page 5-5	Removes one or more CMs from the station maintenance list and resets the cable modem (or all CMs) on the network.
"Configuring Cable Modem Registration Timeout" section on page 5-6	Specifies the registration timeout interval for CMs connected to the Cisco uBR7200 series CMTS.
"Configuring Dynamic Contention Algorithms (Cable Insertion Interval, Range, and Data Backoff)" section on page 5-6	Configures the algorithms that control the capacity of the contention subchannel and how efficiently a given contention subchannel capacity is used.
"Configuring the Dynamic Map Advance Algorithm" section on page 5-7	Enhances the upstream throughput from a CM connected to the Cisco uBR7200 series CMTS. The system employs a new algorithm that automatically tunes the lookahead time in MAC allocation and management messages (MAPs), based on several input parameters for the corresponding upstream channel.
"Configuring Maximum Hosts Attached to a Cable Modem" section on page 5-8	Specifies the maximum number of hosts that can be attached to a subscriber's CM.
"Configuring Per-Modem Filters" section on page 5-8	Provides instructions to configure the Cisco uBR7200 series to filter incoming packets from individual hosts or cable interfaces based on the source Media Access Controller (MAC) or Internet Protocol (IP) address.
"Configuring Sync Message Interval" section on page 5-9	Specifies the sync message interval between successive sync message transmissions from the Cisco uBR7200 series CMTS.

Note Cisco recommends using default values for most commands. The default values for the commands used in these configuration steps are, in most cases, adequate to configure the Cisco uBR7200 series.

For information about setting rate limiting on CMs, refer to these sections in Chapter 3:

- "Setting Downstream Traffic Shaping" section on page 3-10
- "Setting Upstream Traffic Shaping" section on page 3-26

Activating Cable Modem Authentication

The Cisco uBR7200 series router can be configured to require all CMs to return a known text string to register with the CMTS and gain access to the network. The text string can be from 1 to 80 characters in length. The default setting is "on" (CM authentication is activated).

To activate CM authentication, use the following command in cable interface configuration mode:

Command	Purpose
`cable shared-secret` [*0*|*7*] `authorization-key`	Enables CM authentication: • *0* specifies an unencrypted authentication key. • *7* specifies an encrypted authentication key.
`no cable shared-secret`	Disables CM authentication.

Tip Ensure that you enter the correct slot and port number, and verify that the cable interface configuration file contains a matching key.

Note The Cisco uBR7200 series router will accept any DOCSIS configuration file with any shared secret if the CMTS configuration does not contain a setting for shared secret. However, if the CMTS configuration contains a setting for shared secret, the settings between the DOCSIS configuration file and the CMTS configuration must match. The shared secret for the CMTS configuration must be entered again or the file will no longer contain the correct MD-5 MIC setting, and CMs will stop working, registering in state reject(m).

Verifying CM Authentication

To verify if CM authentication has been activated or deactivated, enter the **more system:running-config** command and look for the cable interface configuration information. If CM authentication has been activated, it does not appear in this output. If CM authentication has been deactivated, it appears in this output as "`no cable secret-shared`," as shown in this sample command output:

```
Router# more system:running-config
Building configuration...
Current configuration:
!
interface Cable5/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
```

```
 no cable secret-shared
 cable insertion-interval 150000
cable downstream annex B
cable downstream modulation 64qam
cable downstream interleave-depth 32
cable downstream symbol-rate 5056941
cable upstream 0 frequency 15008000
cable upstream 0 fec
cable upstream 0 scrambler
no cable upstream 0 shutdown
!
```

Troubleshooting CM Authentication

If you are having trouble, make sure that you entered the correct slot and port numbers when you entered cable interface configuration mode. For additional troubleshooting information, refer to Chapter 8, "Troubleshooting the System."

Activating Cable Modem Insertion Interval

When a CM is ready to transmit data, it requests a channel from the Cisco uBR7200 series. You can limit the amount of time that a CM requests a channel for the first time from the Cisco uBR7200 series. A CM's initial channel request is known as *insertion*. The valid range is 100 to 2000 milliseconds.

To activate the CM insertion interval, use the following command in cable interface configuration mode.

Command	Purpose
cable insertion-interval *milliseconds*	Sets the insertion interval in milliseconds.

Validating Cable Modem Insertion Interval

To verify that a CM insertion interval has been set, enter the **more system:running-config** command, and look for the cable interface configuration information, as shown in this sample command output:

```
Router# more system:running-config
Building configuration...
Current configuration:
!
interface Cable5/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 cable insertion-interval 2000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Cable Modem Insertion Interval

If you are having trouble, make sure that you entered the correct slot and port numbers when you typed the command.

Activating Cable Modem Upstream Address Verification

CM upstream address verification ensures that only CMs that have received Dynamic Host Configuration Protocol (DHCP) leases through the Cisco uBR7200 series CMTS can access the HFC network. The Cisco uBR7200 series CMTS discards all packets received from or for hosts that have not received Dynamic Host Configuration Protocol (DHCP)-assigned addresses. The default setting is "off" (CM upstream address verification is deactivated).

To activate or deactivate CM upstream verification, use the following command in the cable interface configuration mode:

Command	Purpose
`cable source-verify [dhcp]`	Activates CM upstream verification. The **dhcp** option specifies that queries be sent to verify unknown IP addresses in upstream data packets.
`no cable source-verify`	Returns to the default upstream verification state.

Verifying Cable Modem Upstream Address Verification

To verify that CM upstream verification has been activated or deactivated, enter the **more system:running-config** command and look for the `no cable source-verify` notation in the cable interface configuration information. If CM upstream verification has been deactivated, it does not appear in this output. If CM upstream verification has been activated, it appears in this output as `cable source-verify`, as shown in this command output excerpt:

```
Router# more system:running-config
Building configuration...
Current configuration:
!
interface Cable5/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
  cable source-verify
  cable insertion-interval 2000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Tip   Be sure that you enter the correct slot and port number when you enter the cable interface configuration mode.

Note   If the Cisco uBR7200 series router is reloaded or the Address Resolution Protocol (ARP) table is cleared, all hosts on the network are forced to release and renew their IP addresses. Some systems might require restarting if the IP protocol stack is unable to renew using a broadcast IP address.

Clearing Cable Modem Counters

To clear the counters for the CMs in the station maintenance list, use one of the following commands in cable interface configuration mode.

Command	Purpose
`clear cable modem` *`mac-addr`* `counters`	Clears the counters in the station maintenance list for the CM with a specific MAC address.
`clear cable modem` *`ip-addr`* `counters`	Clears the counters in the station maintenance list for the CM with a specific IP address.
`clear cable modem all counters`	Clears the counters in the station maintenance list for all CMs.

Verifying Clear Cable Modem Counters

To determine if the counters in the station maintenance list are cleared, enter one of the **following** commands. The station maintenance list counter is 0.

Command	Purpose
`show cable modem` *`ip-address`*	Displays the status of a CM identified by its IP address.
`show cable modem` *`mac-address`*	Displays the status of a CM identified by its MAC address.
`show cable modem` *`interface-address`*	Displays the status of all CMs on a particular upstream.

Clearing Cable Modem Reset

To remove one or more CMs from the station maintenance list and reset the cable modem (or all CMs) on the network, use one of the following commands in cable interface configuration mode.

Command	Purpose
`clear cable modem` *`mac-addr`* `reset`	Removes the CM with a specific MAC address from the station maintenance list and resets it.
`clear cable modem` *`ip-addr`* `reset`	Removes the CM with a specific IP address from the station maintenance list and resets it.
`clear cable modem all reset`	Removes all CMs from the station maintenance list and resets them.

Verifying Clear Cable Modem Reset

To determine if the **clear cable modem reset** command has removed a CM from the station maintenance list and forced it to start a reset sequence, enter the **show cable modem** command.

Tip Be sure that you entered the correct CM IP address or MAC address when you typed the **clear cable modem reset** command. It might take up to 30 seconds for the CM to start the reset sequence.

Note The **clear cable modem reset** command is useful if a Simple Network Management Protocol (SNMP) manager is not available, or if the CM is unable to obtain an IP address or respond to SNMP messages.

Configuring Cable Modem Registration Timeout

By default, registered CMs that have no upstream activity for three minutes are timed out and disconnected from the Cisco uBR7200 series CMTS. This timeout interval can be decreased to 2 minutes or increased up to 60 minutes.

To specify the registration timeout interval for CMs connected to the Cisco uBR7200 series CMTS, use the following command in cable interface configuration mode.

Command	Purpose
`cable registration-timeout` *n*	Specifies the maximum number of minutes allowed to elapse with no upstream activity before terminating the connection. Valid range is from 2 to 60 minutes. Default = 3 minutes.

Configuring Dynamic Contention Algorithms (Cable Insertion Interval, Range, and Data Backoff)

The Cisco uBR7200 series software includes the following algorithms that control the capacity of the contention subchannel and control the efficient use of a given contention subchannel capacity:

* Algorithm that dynamically controls the rate of upstream contention slots—initial ranging and bandwidth requests.
* Algorithm that varies the backoff parameters that CMs use. Backoff variation falls within each of the initial ranging and bandwidth request upstream contention subchannels.

In high contention mode, the Cisco uBR7200 series MAC scheduler uses collision statistics and sustains a high frequency of initial ranging slots until it detects a steady ranging state. The CMTS dynamically varies the frequency of initial ranging slots using the data grant utilization on the upstream channels. The CMTS trades upstream bandwidth between data grants and initial ranging slots. The CMTS autodetects a high collision state and switches to low insertion interval mode after a steady state is achieved where few collisions occur.

The CMTS is careful when monitoring the ranging channel health to revert to a steady state. In steady state mode, data grants—grant utilization—receive preference over initial ranging slots.

Although the binary exponential backoff algorithm operates in a distributed fashion at different CMs, the CMTS provides centralized control for the backoff algorithm. To achieve this, it remotely monitors traffic load—the backlog developing on the contention channel—and then varies the backoff start and end specified in the MAPs for that upstream channel. This ensures that colliding CMs are properly randomized in time.

The following cable interface commands are available to configure the dynamic contention algorithms:

```
[no] cable insertion-interval [automatic [Imin [Imax]]] | [msecs]
[no] cable upstream port num range-backoff [automatic] | [start end]
[no] cable upstream port num data-backoff [automatic] | [start end]
```

cable insertion-interval Command Examples

To deviate from system defaults when modifying the dynamic contention algorithm, use one of the following commands in cable interface configuration mode.

Command	Purpose
[**no**] **cable insertion-interval** [**automatic** [*Imin* [*Imax*]]] | [*msecs*]	Enables or disables the dynamic ranging interval algorithm. If lower and upper bounds for varying the period are not specified, the system uses default frequency values of initial ranging upstream slots between 60 milliseconds to 480 milliseconds, respectively.
cable insertion-interval automatic min 25-2000	Sets the lower bound on the initial ranging period for the automatic ranging algorithm.
cable insertion-interval max 500-2000	Sets the upper bound on initial ranging period for the automatic ranging algorithm.
no cable insertion-interval	Resets fixed initial ranging period to default value of 500 msecs. Also invokes fixed initial ranging algorithm.
cable insertion-interval 100-2000	Enables fixed initial ranging period algorithm with specified fixed period (msecs).

Tip   System defaults are to have dynamic ranging interval enabled, dynamic ranging backoff enabled, and fixed data backoffs for each upstream of a cable interface.

The default **automatic** insertion interval setting enables the Cisco automatic initial ranging period algorithm, where lower and upper default values of 60 msecs and 480 msecs are used. The default **automatic range-backoff** setting enables the dynamic backoff algorithm.

Configuring the Dynamic Map Advance Algorithm

A CMTS administrator can enhance the upstream throughput from a CM connected to the Cisco uBR7200 series CMTS. The system employs a new algorithm that automatically tunes the lookahead time in MAPs, based on several input parameters for the corresponding upstream channel. The use of dynamic and optimal lookahead time in MAPs significantly improves the per-modem upstream throughput.

Caution   Only a trained CMTS administrator should adjust these values.

To configure the dynamic map advance algorithm, use the **cable map-advance dynamic** [*n*]\|*static* command in cable interface configuration mode.

This command specifies a value to enhance the upstream throughput from a CM connected to the Cisco uBR7200 series router. The *n* argument provides the safety factor for the dynamic map advance algorithm. This argument is specified in usecs and controls the amount of extra lookahead time in MAPs to account for inaccuracies of the measurement system and software latencies. The default value is 1000 usecs.

You can vary this value from 500 to 1500 usecs. This argument is a delta value added to the dynamic **map-advance** setting that the algorithm computes. Using larger safety factors increases the run-time lookahead in MAPs, but reduces the upstream performance.

Use the **static** keyword for the **cable map-advance** command. The Cisco uBR7200 series router uses a fixed lookahead time in MAPs, regardless of the real propagation delay of the farthest CM on the network. This fixed lookahead time is computed based on the worst-case parameters, such as farthest DOCSIS propagation delay for the CMs.

Caution   If you are adjusting the dynamic map-advance algorithm, do not reduce the safety factor below the default value of 1000 usecs in a production network, until you are confident that the reduced safety factor suffices for your deployment. The default value is chosen to be a safe operating point for the algorithm.

Configuring Maximum Hosts Attached to a Cable Modem

To specify the maximum number of hosts that can be attached to a subscriber's CM, use the following command in cable interface configuration mode.

Command	Purpose
`cable max-hosts` *n*	Specifies the maximum number of hosts that can be attached to a CM on this interface. Valid range is from 0 to 255 hosts. Default = 0.
`no cable max-hosts`	Resets the allowable number of hosts attached to a CM to the default value of 0 hosts.

Configuring Per-Modem Filters

You can configure the Cisco uBR7200 series to filter incoming packets from individual hosts or cable interfaces based on the source Media Access Controller (MAC) or Internet Protocol (IP) address. Definition of filters follows standard Cisco IOS configuration practices for access lists and groups.

> **Note** Configuring per modem or host filters is supported in Cisco IOS Release 12.0(5)T1 or higher, as well as in Cisco IOS Release 12.0(6)SC or higher.

To specify the access group (per-modem filter), use the **cable modem access-group** command in privileged EXEC mode. To disable the specification, use the **no access-group** form of this command.

cable modem {*mac-addr | ip-addr*} **access-group** [*access-list | access-name*]

cable modem {*mac-addr | ip-addr*} **no access-group**

Syntax Description	*ip-addr*	Specifies the IP address for the CM.
	mac-address	Specifies the MAC address for the CM.
	access-list	Specifies the IP access list (standard or extended). Valid values are 1 to 199.
	access-name	Specifies the access-list name.

Examples   The following example shows the **cable modem access-group** command assigning access-list 1 to the CM with the MAC address of abcd.ef01.2345:

```
Router# cable modem abcd.ef01.2345 access-group 1
```

This command configures access lists to be specified on a per-interface and per-direction basis. The packets received from cable interfaces and/or individual hosts are filtered based on the cable interface or the host the packets are received from. Use *modem* if the device is a CM. Use *host* if the device is a CPE device attached to a CM.

The *macaddr* specifies the CM's or CPE device's unique MAC address. Define the filter to be applied to the device and a given address.

Use the *ipaddr* option to specify the CM or CPE device's current IP address.

Use the *acl* option to assign the CM or CPE device to an access list. This defines the per-CM or per-host filter requirements implemented at the CMTS, rather than at the CM. Access list numbers are 1 to 99 for fast IP access lists, 100 to 199 for show extended IP access lists.

> **Note**   Access list numbers of 700 to 799 do not apply.

> **Caution**   The system applies filters after the CM registers with the CMTS. Filter definitions are not saved across system reboots and must be applied each time a CM registers.

The software supports traps to alert CMTS administrators on CMs going offline or back online. A typical registration and login procedure is shown below:

1. The CM registers with the Cisco uBR7200 series.

2. The Cisco uBR7200 series sends traps to management systems in use for the network.

3. The management system sets per modem filters using SNMP or *rsh.*

4. The user logs in at the server.

5. The login server obtains required modem and CPE information from the Cisco uBR7200 series.

6. The login server sets per-CPE filter in the Cisco uBR7200 series. The per-CPE filter overrides the per modem filter settings.

7. If the CM goes offline for a brief period of time, filters defined using the Cisco uBR7200 series remain active. If a CM stays offline for more than 24 hours, filter settings are reset.

8. If the user logs out or the login server detects that the user is not online, the login server sets default filters for the CM or the CPE device.

Configuring Sync Message Interval

To specify the sync message interval between successive sync message transmissions from the Cisco uBR7200 series CMTS, use the following command in cable interface configuration mode.

Command	Purpose
`cable sync-interval` *msec*	Specifies the interval in milliseconds between successive sync message transmissions from the Cisco uBR7200 series CMTS. Valid values are from 1 to 200 msec. Default = 10 msec.
`no cable sync-interval`	Returns the sync message interval to its default value of 10 msec.

Verifying Sync Message Interval

To determine if a sync message interval is configured, enter the **show running-config** command and look for the cable interface configuration information. If the sync message interval is deactivated or reset to its default value, the `no sync interval` command line appears in the output.