



CHAPTER 3

Cable Interface Bundling and Virtual Interface Bundling for the Cisco CMTS

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This document describes how to combine multiple cable interfaces in a Cisco Cable Modem Termination System (CMTS) universal broadband router into a single logical bundle, so as to conserve IP address space and simplify network management.



Note

In Cisco IOS Release 12.3(21)BC and later releases, all cable bundles are automatically converted to virtual bundles.

Feature History for Cable Interface Bundling

Release	Modification
12.0(7)XR	This feature was introduced on Cisco uBR7200 series routers.
12.1(5)EC1	Support for this feature was added for Cisco uBR7100 series routers.
12.2(4)BC1	Support for this feature was added for Cisco uBR10012 routers. Support for MPLS was also added for cable interface bundles on all Cisco CMTS routers.
12.1(20)EC	This feature was enhanced, so that adding an interface as a slave interface automatically removes the following Layer 3 parameters, if they are configured on that interface: IP address, IP access group, and PIM configuration.
12.2(15)BC2	This feature was enhanced, so that adding an interface as a slave interface automatically removes the following Layer 3 parameters, if they are configured on that interface: IP address, IP helper address, IP access group, PIM configuration, and IP policy-based routing. Also, creating subinterfaces on slave interfaces has been specifically prohibited. Previously, subinterfaces could be created on slave interfaces, although a warning message appeared advising users to remove the subinterface.

12.3(13a)BC	Cable bundling has been updated to virtual interface bundling, so that cable bundles are automatically converted to virtual interface bundles. Cable bundling concepts, such as master and slave linecards, are no longer supported. See the “ Virtual Interface Bundling for the Cisco CMTS ” section on page 3-11.
12.3(21)BC	All cable bundles are now automatically converted and configured to be in a virtual bundle, and standalone cable interfaces must be manually configured to be in a virtual bundle to operate properly. Previously, new virtual interface bundles and bundle members required reconfiguration, and there could also be standalone interfaces not part of a bundle at all. See the “ Virtual Interface Bundling for the Cisco CMTS ” section on page 3-11.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at <http://tools.cisco.com/ITDIT/CFN/jsp/index.jsp>. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

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Cable Interface Bundling for the Cisco CMTS

Prerequisites for Cable Bundling

- The cable interfaces that make up a bundle must all be in the same Cisco CMTS chassis router. You cannot bundle cable interfaces that are in separate routers.
- All cable interfaces must continue to be configured with the required DOCSIS upstream and downstream RF parameters. In addition, the master cable interface must be configured with all of the required Layer 3 parameters, such as the IP address and any helper addresses.
- When using both cable interface bundling and loadbalancing of downstreams, we recommend that each load balance group contain only downstreams in the same cable interface bundle group.
- Cable bundling applies to releases prior to Cisco IOS Release 12.3(13a)BC. For Release 12.3(13a)BC and later, see the [“Virtual Interface Bundling for the Cisco CMTS” section on page 3-11](#).

Restrictions for Cable Bundling

- Cable interface bundling is only supported on cable interfaces. It is not supported on other interfaces.
- Cable interface bundling can be used only in two-way cable installations. It is not supported for telco-return configurations.
- Each cable bundle must have exactly one interface that is designated as the master interface. All other cable interfaces in the bundle must be slave interfaces.
- All Layer 3 configurations, such as the IP address, access lists, DHCP relay, ARP handling, and source-verify checking, must be specified on the master interface. You cannot configure these parameters on the slave interfaces in the bundle. (However, you must still configure the DOCSIS upstream and downstream parameters on each interface.)
- If using subinterfaces, create the subinterfaces only on the master interface, and configure only the subinterfaces with the Layer 3 information, such as IP addresses and access lists. (Cable modems are associated only with the master subinterfaces and not the master main interface.)

Do not create subinterfaces on a slave interface. In Cisco IOS Release 12.2(15)BC2 and later releases, this is specifically prohibited. In prior releases, a warning message appeared when trying to create a subinterface on a slave interface, but the subinterface was still created.

- When you have configured a Cisco uBR7200 series router for both N+1 redundancy and cable interface bundling, the failure of one interface in a bundle causes the failover of the entire bundle. When you have configured a Cisco uBR10012 router for both N+1 redundancy and cable interface bundling, the failure of one cable interface results only in the failover of that particular interface. Switchover events for the Cisco uBR10012 is implemented (when needed) on a per-JIB basis.
- You must configure interface bundles only by using CLI commands. You cannot use MIB objects to configure cable interface bundles through SNMP sets.
- Multicast broadcasts have the following restrictions on bundled cable interfaces:
 - For multicast addresses, the multicast MAC address points to the group of interfaces in the bundle that have received Internet Group Management Protocol (IGMP) joins.

- Since the multicast IP to MAC mapping is not unique, multiple multicast IP address share one entry in the MAC forwarding table.
- When using bundled cable interfaces on the Cisco 7200 series routers, the input packet counts for the master interface also include the packet counts for slave interfaces, except when using a Broadband Processing Engine (BPE) cable interface (such as the Cisco uBR-MC16U/X and Cisco uBR-MC28U/X). On BPE cards and on the Cisco uBR10012 router, the input counters for master and slave cable interfaces are not combined.

Information About Cable Bundling

Cable bundling allows multiple cable interfaces to use the same IP subnet, which allows service providers to conserve their limited IP address space. Using this feature allows several physical cable interfaces to be logically bundled together into a single, Layer 3 interface.

When interfaces are bundled together, one interface is designated as the master interface, and all of the other interfaces in the bundle become the slave interfaces. You then configure only the master interface with the Layer 3 information, such as IP addresses, access lists, **cable source-verify**, and so forth. This information is then propagated to the slave interfaces.

When cable modems come online any of the interfaces in a bundle, the Cisco CMTS router creates a MAC-based forwarding table that maps each cable modem (or customer premises equipment [CPE] device) with the actual physical cable interface that it is using. The router creates this table automatically, and you do not need to reconfigure the cable modems or the routing tables on the Cisco CMTS router.

When the Cisco CMTS router receives a multicast packet on an interface bundle, it forwards it to all of the interfaces that are associated with this address in the bundle forwarding table. If the multicast MAC address is not in the bundle forwarding table, the router forwards the multicast traffic to all interfaces in the bundle.

Multicast MAC addresses are added to the bundle forwarding table in two ways:

- A static group is configured on the interface, in which case the multicast MAC address is added for all cable interfaces in the bundle. The MAC address is removed from the table when the static group configuration is removed.
- An interface receives an IGMP join request, in which case the multicast MAC address is added only for that particular interface. The MAC address is removed from the table when the interface receives an IGMP leave request.

You can add, remove, or shut down slave interfaces without affecting any of the other interfaces in the bundle. However, when you shut down or remove the master interface in a bundle, the slave interfaces remain in an online state, but no data packets are sent to any of these slave interfaces.

When the master interface is shut down, the active slave interfaces continue to receive packets, but the interfaces discard those packets as long as the master interface remains shut down. In this situation, cable modems that are connected to the slave interfaces remain online for a period of time, but they cannot renew their IP address with the DHCP server if the DHCP lease expires. Also, other cable modems cannot come online, because they cannot obtain an IP address or download a DOCSIS configuration file.

Benefits

- Cable interface bundling eliminates the need for an IP subnet for each cable interface by using only one IP subnet for each bundle of cable interfaces. This simplifies network management and conserves IP address space.

- Using cable bundling simplifies adding new cable interface line cards. When you add a new cable interface line card, you can simply assign the new interfaces to a cable bundle, without having to reassign IP addresses or create new subnets for the new set of interfaces.
- Cable bundling simplifies scalability and network management, because you can add a new cable interface line card to a bundle, and move cable modems to the new interfaces, without having to reconfigure the cable modems with new IP addresses or having to make any changes to the modem provisioning system. You can also move cable modems to other interfaces in the bundle at any time, without having to change their configuration. In particular, cable modems being assigned a static IP address can be inserted on any interface that is part of the bundle.

Configuring Cable Bundling

To create a cable bundle and to configure one cable interface to be its master interface, and one or more cable interfaces to be its slave interfaces, use the following procedure.

Prerequisites

- The master cable interface should be configured with the proper Layer 3 operational parameters, such as IP address, access lists, DHCP relay information, and so forth.
- Slave cable interfaces cannot be configured with an IP address, IP helper address, or other Layer 3 information. You must remove all Layer 3 configuration parameters from an interface before adding it to a bundle as a slave interface.



Note In Cisco IOS Release 12.2(15)BC2 and later releases, configuring a cable interface as a slave interface automatically removes Layer 3 information, such as the IP address, helper address, access group, Protocol Independent Multicast (PIM) configuration, and policy-based routing.

- All cable interfaces must still be configured with the required DOCSIS RF upstream and downstream parameters.



Note Attempting to configure an IP address, IP helper address, or any other Layer 3 configuration on a slave interface in a bundle produces a warning message to remove the configuration. The Layer 3 configuration information must be removed from the slave interface to ensure proper operation of the interface bundle.

Restrictions

- Configuring a cable interface to be part of a bundle automatically shuts down the interface and reenables it. This automatically forces all cable modems on that interface to go offline and to reregister with the CMTS.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface cable** *x/y/z*

4. **cable bundle** *n* **master**
5. **ip address** *ip-address subnet*
6. (any other Layer 3 configuration parameters)
7. **interface cable** *x/y/z*
8. **no ip address**
9. **cable bundle** *n*
10. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable Router#</p>	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example: Router# configure terminal Router(config)#</p>	Enters global configuration mode.
Step 3	<p>interface cable <i>x/y/z</i></p> <p>Example: Router(config)# interface cable 5/1/0 Router(config-if)#</p>	Enters interface configuration mode for the indicated cable interface.
Step 4	<p>cable bundle <i>n</i> master</p> <p>Example: Router(config-if)# cable bundle 1 master Router(config-if)#</p>	<p>Configures the cable interface to be the master interface for the specified bundle group.</p> <ul style="list-style-type: none"> <i>n</i> = Bundle group number. The valid range is 1 to 255, with no default.
Step 5	<p>ip address <i>ip-address</i> <i>subnet</i></p> <p>Example: Router(config-if)# ip address 192.168.100.1 255.255.255.0 Router(config-if)#</p>	Assigns the specified IP address and subnet mask to the master interface for the bundle.
Step 6	<p><any other Layer 3 configuration parameters></p> <p>Example: Router(config-if)# ip address 10.10.1.1 255.255.255.0 secondary Router(config-if)#</p>	(Optional) Configure the master interface with any other Layer 3 configuration parameters that are necessary.
Step 7	<p>interface cable <i>x/y/z</i></p> <p>Example: Router(config-if)# interface cable 5/1/1 Router(config-if)#</p>	Enters interface configuration mode for the indicated cable interface.
Step 8	<p>no ip address</p> <p>Example: Router(config-if)# no ip address Router(config-if)#</p>	<p>(Optional) Removes the IP address (if any) that was previously assigned to this cable interface. This command is optional but recommended, because the show ip interface brief command reports an interface as being not OK if its configuration does not include some form of the ip address command. Specifying no ip address corrects this.</p> <p>Note In Cisco IOS Release 12.2(15)BC2 and later releases, configuring a cable interface as a slave interface automatically removes Layer 3 information, such as the IP address, IP helper address, IP access group, and IP policy-based routing.</p>

	Command or Action	Purpose
Step 9	<p><code>cable bundle n</code></p> <p>Example: Router(config-if)# <code>cable bundle 1</code> Router(config-if)#</p>	<p>Configures the cable interface to be a slave bundle for the specified bundle group.</p> <ul style="list-style-type: none"> n = Bundle group number. The valid range is 1 to 255, with no default. <p>Note When you configure a cable interface to be a slave interface in a cable bundle, the router automatically removes all Layer 3 and other generic configuration information from the interface (IP address, access lists, and so forth).</p>
	<p>Note Repeat Step 7 and Step 9 for each cable interface that is to be a member of this bundle. Repeat Step 3 through Step 9 for each cable bundle that is to be created on the router.</p>	
Step 10	<p><code>end</code></p> <p>Example: Router(config-if)# <code>end</code> Router#</p>	<p>Exits interface configuration mode and returns to privileged EXEC mode.</p>



Note To remove a cable interface from a bundle, use the **no cable bundle** command in interface configuration mode. Remember to reconfigure all of the Layer 3 IP information on the interface before attempting to bring cable modems back online the unbundled interface.

Monitoring Cable Interface Bundling

Table 3-1 lists the commands that are useful in monitoring the cable interface bundling feature:

Table 3-1 Commands to Monitor Cable Interface Bundling

Command	Description
<code>show arp</code>	Displays the entries in the router's ARP table.
<code>show cable bundle number forwarding-table</code>	Displays the MAC forwarding table for the specified bundle, showing the MAC addresses of each cable modem in a bundle and the physical cable interface that it is currently using.
<code>show cable modem</code>	Displays the cable modems that are online both before and after cable interface bundling has been configured.
<code>show running-config interface cable [slot/subslot slot/subslot/port]</code>	Displays the configuration for the specified cable interface.

show running-config interface cable Command

To display the bundles that are configured on a Cisco CMTS router, display the running configuration for each of the cable interfaces, using a command similar to the following:

```
show running-config interface cable slot/subslot
or
show running-config interface cable slot/subslot/port
```

For example, the following excerpt from a typical display shows that cable interface 3/0 is the master interface for bundle 1, and that cable interface 4/0 is a slave interface:

```
Router# show running-config interface cable 3/0

!
interface Cable3/0
 ip address 10.13.0.1 255.255.0.0 secondary
 ip address 10.12.0.1 255.255.0.0
 ip pim dense-mode
 ip igmp static-group 225.2.2.2
 no ip mroute-cache
 cable spectrum-group 5
 cable enable-trap cmonoff-notification
 cable max-hosts 2
 cable bundle 1 master

...

cable helper-address 172.22.127.2 cable-modem
cable helper-address 10.1.1.1
cable helper-address 10.2.2.2 host
no keepalive

Router# show running-config interface cable 4/0

interface Cable4/0
 no ip address
 cable bundle 1

...

cable helper-address 172.22.85.86
no keepalive
```

show cable bundle

Use the **show cable bundle** command to display the contents of the MAC forwarding information table for a specific cable interface bundle that has been configured on the Cisco CMTS router. This command has the following syntax:

```
show cable bundle n forwarding-table
```

The following example shows typical output for the **show cable bundle forwarding-table** command:

```
Router# show cable bundle 1 forwarding-table

MAC address      Interface      Flags Location  link      sublink
00c0.5e01.0203   Cable8/0/0    3    64E5BF60  0         64E5BE00
00c0.5e01.0203   Cable7/0/0    3    64E5BE00  0         0
00c0.5e01.0101   Cable8/0/0    3    64E5BEE0  0         64E5BE40
00c0.5e01.0101   Cable7/0/0    3    64E5BE40  0         0
00c0.a375.cc1c   Cable8/0/0    1    64E5BEC0  0         0
00c0.0e01.a835   Cable8/0/0    1    64E5BEA0  0         0
00c0.0e01.a799   Cable8/0/0    1    64E5BDE0  0         0
00c0.0e01.a405   Cable8/0/0    1    64E5BF00  0         0
00c0.0e01.a5d1   Cable7/0/0    1    64E5BE20  0         0
00c0.0e01.a5d9   Cable8/0/0    1    64E5BE60  0         0
00c0.0e01.a5e1   Cable7/0/0    1    64E5BF40  0         0
00c0.0e01.a5f1   Cable7/0/0    1    64E5BE80  0         0
00c0.0eb4.0a41   Cable5/0/0    1    63704D1C  0         0
00c0.f03b.ed59   Cable6/1/0    1    6370427C  0         0
00c0.f03b.ed97   Cable6/1/0    1    63703F3C  0         0
00c0.0eb4.1373   Cable5/0/0    1    6370479C  0         0
00c0.f03b.edd3   Cable6/1/0    1    637042BC  0         0
```

```
00c0.7371.6df6   Cable5/0/0   1   63703DFC   0   0
```

```
Total = 18, sublink total = 2
Free = 1016, low_mark = 1016
```

```
Router#
```

The **show bundle** command displays the following information:

- MAC address—Identifies the MAC (hardware) address for a cable modem that is using an interface in the bundle.
- Interface—Identifies the cable interface slot and port number.
- Flag—Bitmask showing the current value of the flag byte for this bundle entry. The following bits can be set:
 - Bit 0 (0x01) = Bundle is active.
 - Bit 1 (0x02) = Bundle is a static multicast group.

Multiple bits can be set, so that a value of 3 indicates an active, static multicast group.

Configuration Examples for Cable Interface Bundling

This section contains the following sample configurations for the cable interface bundling feature:

- [Basic Cable Interface Bundling Example, page 3-10](#)

Basic Cable Interface Bundling Example

The following excerpt from a configuration file shows cable interface 4/0 being configured as the master interface for bundle 1, and interface 5/0 being configured as the first slave interface in the bundle. Note that all Layer 3 information is configured only on the master interface, but Layer 2 information, such as the DOCSIS RF configuration, is still configured on each interface.

```
!
interface Ethernet2/0
 ip address 172.16.135.11 255.255.255.128
 no ip mroute-cache
 half-duplex
!

interface Cable4/0
 ip address 172.16.30.1 255.255.255.0
 ip helper-address 172.16.135.20
 no ip route-cache cef
 no keepalive
 cable bundle 1 master
 cable downstream rate-limit token-bucket shaping
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream frequency 555000000
 cable upstream 0 frequency 40000000
 cable upstream 0 power-level 0
 no cable upstream 0 shutdown
 cable upstream 1 shutdown
 cable upstream 2 shutdown
 cable upstream 3 shutdown
 cable upstream 4 shutdown
 cable upstream 5 shutdown
 cable dhcp-giaddr policy
!

interface Cable5/0
 no ip address
 load-interval 30
 no keepalive
 cable bundle 1
 cable downstream rate-limit token-bucket shaping
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream frequency 620000000
 cable upstream 0 frequency 25008000
 cable upstream 0 power-level 0
 cable upstream 0 channel-width 1600000 3200000
 no cable upstream 0 shutdown
 no cable upstream 1 shutdown
 no cable upstream 2 shutdown
 cable upstream 3 shutdown
 cable upstream 4 shutdown
 cable upstream 5 shutdown
 cable dhcp-giaddr policy
!
```

Virtual Interface Bundling for the Cisco CMTS

This section describes the Virtual Interface Bundling feature in Cisco IOS 12.3(13a)BC and later releases, to include configuration, guidelines, examples and additional information in these topics:

- [Overview of Virtual Interface Bundling, page 3-12](#)
- [Guidelines for Virtual Interface Bundling, page 3-13](#)
- [Migrating Bundle Information During a Cisco IOS Upgrade, page 3-14](#)
- [Configuring Virtual Interface Bundling, page 3-15](#)

- [Monitoring Virtual Interface Bundling, page 3-18](#)
- [Examples of Virtual Interface Bundling, page 3-18](#)
- [Show Commands for Virtual Interface Bundling, page 3-19](#)

Overview of Virtual Interface Bundling



Note

In Cisco IOS Release 12.3(21)BC and later releases, all cable bundles are automatically converted and configured to virtual interface bundles. Any standalone cable interfaces must be manually configured to be in a virtual bundle to operate properly.

Cisco IOS Release 12.3(13a)BC first introduced support for virtual interface bundling on the Cisco uBR10012 universal broadband router and the Cisco uBR10-MC5X20S/U/H Broadband Processing Engine (BPE), and the Cisco uBR7246VXR router.

In prior Cisco IOS releases, cable interface bundling was limited to physical interfaces as master or slave interfaces, and **show** commands did not supply bundle information.

Virtual interface bundling removes the prior concepts of master and slave interfaces, and introduces these additional changes:

- Virtual interface bundling uses *bundle interface* and *bundle members* instead of master and slave interfaces.
- The virtual bundle interface is virtually defined, as with IP loopback addresses, for example.
- Virtual interface bundling supports bundle information in multiple **show** commands.

Virtual interface bundling prevents loss of connectivity on physical interfaces should there be a failure, problematic online insertion and removal (OIR) of one line card in the bundle, or erroneous removal of configuration on the master interface.

Virtual interface bundling supports and governs the following Layer 3 settings for the bundle member interfaces:

- IP address
- IP helper-address
- source-verify and lease-timer functions
- cable dhcp-giaddr (The giaddr field is set to the IP address of the DHCP client.)
- Protocol Independent Multicast (PIM)
- Access control lists (ACLs)
- Sub-interfaces



Note

This virtual interface for the bundle should always remain on (enabled with **no shutdown**). Prior to Cisco IOS Release 12.3(13a)BC, the Cisco CMTS displays a warning message prior to execution of the **shutdown** command. In Cisco 12.3(13a)BC and later releases, no warning message displays.

Guidelines for Virtual Interface Bundling

The following guidelines describe virtual interface bundling, with comparison to the previous Cable Interface Bundling feature, where applicable:

- The former rules for bundle *master* are applicable to the new *virtual bundle interface*.
- The former rules for bundle *slaves* are applicable to the new virtual bundle *members*.
- With Cisco IOS Release 12.3(13a)BC, initial configuration of the first virtual bundle *member* automatically creates a virtual bundle interface.
- Beginning with Cisco IOS Release 12.3(21)BC, all cable bundles are automatically converted and configured to be in a virtual bundle after loading the software image.
- Beginning with Cisco IOS Release 12.3(21)BC, standalone cable interfaces must be manually configured to be in a virtual bundle to operate properly.
- The virtual bundle interface accumulates the counters from members; counters on member links are not cleared when they are added to the bundle. If a bundle-only counter is desired, clear the bundle counter on the members before adding them to the bundle, or before loading the image (for Cisco IOS Release 12.3(21)BC and later).
- Cisco IOS Release 12.3(13a)BC and later releases support a maximum of 40 virtual interface bundles, with the numeric range from 1 to 255.
- In releases prior to Cisco IOS Release 12.3(21)BC, if you delete the virtual bundle interface, the virtual bundle disappears.
- The virtual bundle interface remains configured unless specifically deleted, even if all members in the bundle are deleted.
- This feature supports subinterfaces on the virtual bundle interface.
- *Bundle-aware* configurations are supported on the virtual bundle interface.
- *Bundle-unaware* configurations are supported on each bundle member.
- While creating the virtual bundle interface, if the bundle interface existed in earlier Cisco IOS releases, then the earlier cable configurations re-appear after upgrade.

Virtual Interface Bundle-aware and Bundle-unaware Support

Virtual interface bundling uses two configurations: the virtual *bundle* itself, and the interfaces in that virtual bundle, known as *bundle members*. The virtual interface bundle and bundle members are either aware of the bundle, or unaware of the bundle, as follows.

- Bundle-aware features are maintained on the virtual *bundle*. These include:
 - IP Address
 - IP helper, cable helper
 - Dhcp-giaddr
 - Sub-interface
 - Source verify
 - Lease-query
 - Address Resolution Protocol (Cable ARP filtering, which also bundles cable interfaces, and Proxy ARP)
 - Cable match

- Access Control Lists (ACLs)
- Protocol Independent Multicast (PIM)
- Cable Intercept (supported on the Cisco uBR10012 router with PRE2 module, only)
- Bundle-unaware features are maintained on the *bundle members*. These include:
 - DS/US configurations
 - HCCP redundancy
 - Load balancing
 - DMIC, tftp-enforce, shared-secret
 - Spectrum management
 - Admission control
 - Max-host
 - Intercept (supported on the Cisco uBR7200 series router and Cisco uBR10012 router with PRE1 module, only)

Multicast Support for IGMPv3 SSM and Virtual Interface Bundling

Cisco IOS Release 12.3(13a)BC introduces support for Internet Group Management Protocol (IGMPv3) Source Specific Multicast (SSM). This enhancement provides support for virtual interface bundling on the Cisco CMTS.

IGMP is used by IPv4 systems to report their IP multicast group memberships to any neighboring multicast routers. The latest IGMPv3 enables an individual member to join a particular channel. This is a new per-channel function, in addition to group-based functions (per-group). This channel based membership is known as Source Specific Multicast (SSM). IGMPv3 SSM allows a multicast client to specify the IP source from which they intend to receive, in addition to normal per-group multicast traffic.

For additional information about using IGMPv3 and virtual interface bundling, refer to enhanced **show** commands in this document, and to the following document on Cisco.com:

- *Virtual Interfaces and Frequency Stacking Configuration on MC5x20S and MC28U Line Cards*
http://www.cisco.com/en/US/tech/tk86/tk804/technologies_white_paper09186a0080232b49.shtml
- *Configuring Virtual Interfaces on the Cisco uBR10-MC5X20S/U Card*
http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr10_mc5x20s_u_h/feature/guide/mc5x2vif.html

Migrating Bundle Information During a Cisco IOS Upgrade

Migration to virtual interface bundling is automatic the first time a supporting Cisco IOS image is loaded onto the Cisco CMTS.

- Previously configured cable masters and slaves are converted to be members of a new virtual bundle interface.
 For cable interface bundling configured in releases prior to Cisco IOS Release 12.3(13a)BC, a new virtual bundle is created with bundle numbers ranging from 1 to 255. However, only a maximum of 40 virtual bundles are supported.
- Bundle-aware configurations are transferred to the virtual bundle interface.

- In releases prior to Cisco IOS Release 12.3(21)BC, you can save new changes, however copying the startup-config to running-config does not translate cable interface bundling to virtual interface bundling, of itself.

**Note**

In Cisco IOS Release 12.3(21)BC and later releases, standalone cable interfaces must be manually configured to be a member of a virtual bundle interface to operate properly.

Configuring Virtual Interface Bundling

**Note**

When upgrading to Cisco IOS Release 12.3(21)BC or later from an earlier release, virtual bundles and bundle members are created and configured automatically. Standalone cable interfaces must be manually configured to be in a virtual bundle to operate properly.

When upgrading to Cisco IOS Release 12.3(13a)BC from an earlier release, it may be necessary to reconfigure all cable interface bundling information after loading the Cisco IOS software image. In this circumstance, cable modems do not receive an IP address from the Cisco CMTS until cable interfaces and cable interface bundling is reconfigured.

To enable virtual interface bundling, and to reconfigure interface information on the Cisco CMTS as required, you first configure the virtual interface bundle, then add additional bundle members for the specified virtual bundle. Perform these steps on each interface, as needed for all virtual interface bundles.

SUMMARY STEPS

Below is a sample configuration:

1. **enable**
2. **configure terminal**
3. **interface bundle *n***
4. **ip address *mask***
5. **interface cable *slot/subslot/port***
6. **cable bundle *n***
7. **cable upstream max-ports *n***
8. **cable upstream *logical-port* connector *physical-port***
9. **cable upstream *n* frequency *up-freq-hz***
10. **no cable upstream *n* shut**
11. **Ctrl-Z (end)**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p>interface bundle n</p> <p>Example: Router(config-if)# interface bundle 1</p>	<p>Adds the selected interface to the virtual bundle. If this is the first interface on which the virtual bundle is configured, this command enables the bundle on the specified interface.</p> <p>The previous master keyword, as supported in the cable bundle master command for prior Cisco IOS releases, is not used for virtual interface bundling in Cisco IOS release 12.3(13a)BC, and later releases.</p> <p>As many as 40 virtual interface bundles can be configured on the Cisco CMTS. Numeric identifiers may range from 1 to 255.</p>
Step 4	<p>ip address mask</p> <p>Example: Router(config-if)# ip address 7.7.7.7 255.255.255.0</p>	<p>Use as needed after Cisco IOS upgrade.</p> <p>Configures the IP address for the specified interface and virtual bundle.</p>
Step 5	<p>interface cable {slot/port slot/subslot/port}</p> <p>Example: Router# Router(config-if)#</p>	<p>Enters interface configuration mode for the selected interface, on which virtual interface bundling is to be enabled.</p> <ul style="list-style-type: none"> <i>slot/port</i>—Cable interface on the Cisco uBR7100 Series or Cisco uBR7200 Series. On the Cisco uBR7100 series router, the only valid value is 1/0. On the Cisco uBR7200 series router, slot can range from 3 to 6, and port can be 0 or 1, depending on the cable interface. <i>slot/subslot/port</i>—Cable interface on the Cisco uBR10012 router. The following are the valid values: <ul style="list-style-type: none"> <i>slot</i> = 5 to 8 <i>subslot</i> = 0 or 1 <i>port</i> = 0 to 4 (depending on the cable interface)
Step 6	<p>cable bundle n</p> <p>Example: Router(config-if)# cable bundle 1</p>	<p>Configures a cable interface to belong to an interface bundle, where <i>n</i> is the bundle number.</p>

Command or Action	Purpose
<p>Step 7</p> <p><code>cable upstream max-ports n</code></p> <p>Example: Router(config-if)# cable upstream max-ports 6</p>	<p>Use as needed after Cisco IOS upgrade.</p> <p>Configures the maximum number of upstreams on a downstream (MAC domain) on a Cisco cable interface line card. To reset the card to its default value of 4 upstreams per downstream, use the no form of this command.</p> <ul style="list-style-type: none"> <i>n</i>—Number of upstreams, ranging from 1 to 8, with a default of 4.
<p>Step 8</p> <p><code>cable upstream logical-port connector physical-port</code></p> <p>Example: Router(config-if)# cable upstream 4 connector 16</p>	<p>Use as needed after Cisco IOS upgrade.</p> <p>Maps an upstream port to a physical port on the Cisco cable interface line card for use with a particular downstream. To remove the mapping and shut down the upstream port, use the no form of this command.</p> <ul style="list-style-type: none"> <i>logical-port</i>—Specifies the upstream port number for the logical port assignment. The number of logical ports is configured with the cable modulation-profile command, and the valid range is from 0 to one less than the current value set with the cable modulation-profile command. <p>Tip The default value for max-ports command is 4, which means the default range for logical-port is 0 to 3.</p> <ul style="list-style-type: none"> <i>physical-port</i>—Specifies the upstream port number for the actual physical port to be assigned. The valid range is 0 to 19, with no default.
<p>Step 9</p> <p><code>cable upstream n frequency up-freq-hz</code></p> <p>Example: Router(config-if)# cable upstream 4 frequency 15000000</p>	<p>Use as needed after Cisco IOS upgrade.</p> <p>Enters a fixed frequency of the upstream radio frequency (RF) carrier for an upstream port. To restore the default value for this command, use the no form of this command.</p> <ul style="list-style-type: none"> <i>n</i>—Specifies the upstream port number on the cable interface line card for which you want to assign an upstream frequency. Valid values start with 0 for the first upstream port on the cable interface line card. <i>up-freq-hz</i>—The upstream center frequency is configured to a fixed Hertz (Hz) value. The valid upstream frequency range is 5 MHz (5000000 Hz) to 42 MHz (42000000 Hz), 55 MHz (55000000 Hz), or 65 MHz (65000000 Hz), depending on the cable interface line card being used. If you wish to have the Cisco CMTS dynamically specify a center frequency for the given upstream interface, do not enter any frequency value.

	Command or Action	Purpose
Step 10	no cable upstream <i>n</i> shut Example: Router(config-if)# no cable upstream 4 shut	Use as needed after Cisco IOS upgrade. The cable interface must be enabled using the no shutdown command for the specified cable interface. <i>n</i> —Specifies the cable interface to enable for the virtual bundle.
Step 11	Ctrl-Z Example: Router(config-if)# Ctrl^Z Router#	Returns to privileged EXEC mode.

What Next

To remove a virtual bundle from the interface, use the **no interface bundle** command in interface configuration mode, where *n* specifies the bundle identifier:

no interface bundle *n*

If you remove a member from a bundle, the bundle remains on the interface (even if empty) until the bundle itself is specifically removed.

In releases prior to Cisco IOS Release 12.3(21)BC, if you remove a bundle from an interface that still has active members, the bundle is removed.

Monitoring Virtual Interface Bundling

Cisco IOS Release 12.3(13a)BC introduces support for several enhanced show commands that display virtual bundle information. Refer to the [“Show Commands for Virtual Interface Bundling”](#) section on page 3-19 for additional information and examples.

Examples of Virtual Interface Bundling

The following example illustrates a virtual interface bundle with the **show ip interface brief** command:

```
Router# show ip interface brief
Interface                IP-Address      OK? Method Status      Protocol
FastEthernet0/0/0       1.8.44.1        YES NVRAM  up          up
POS1/0/0                 unassigned      YES NVRAM  up          up
GigabitEthernet2/0/0    11.0.0.2        YES NVRAM  up          up
GigabitEthernet3/0/0    10.1.1.101      YES NVRAM  up          up
GigabitEthernet4/0/0    1.1.1.1         YES NVRAM  down       down
Cable8/1/0               unassigned      YES NVRAM  up          up
Cable8/1/1               unassigned      YES NVRAM  up          up
Cable8/1/2               unassigned      YES NVRAM  up          up
Cable8/1/3               unassigned      YES NVRAM  up          up
Cable8/1/4               unassigned      YES NVRAM  up          up
Bundle1                 10.44.50.1     YES TFTP  up         up
Router#
```

The following example illustrates virtual bundle information for the specified bundle:

```

Router# show running-config interface Bundle 1
Building configuration...

Current configuration : 189 bytes
!
interface Bundle1
 ip address 10.44.51.1 255.255.255.0 secondary
 ip address 10.44.50.1 255.255.255.0
 ip access-group 130 in
 ip helper-address 1.8.35.200
 cable source-verify dhcp
end

```

The following examples illustrate subinterface information for the specified bundle on a Cisco uBR10012 router:

```

Router# sh ip int br | include Bundle
Bundle1                10.44.50.1          YES TFTP   up          up
Bundle150              unassigned         YES unset  up          up
Bundle150.1           30.0.0.1          YES manual up          up
Bundle200              unassigned         YES unset  up          up
Bundle255              unassigned         YES unset  up          up

```

```

Router# sh run int Bundle150.1
Building configuration...

Current configuration : 93 bytes
!
interface Bundle150.1
 ip address 30.0.0.1 255.0.0.0
 cable helper-address 1.8.35.200
end

```

Show Commands for Virtual Interface Bundling

Cisco IOS Release 12.3(13a)BC introduces enhanced **show** commands to support virtual interface bundling information on the Cisco CMTS. To display information about virtual interface bundling and Multicast functionality, use the following commands in privileged EXEC mode.

- [show cable bundle forwarding-table](#)
- [show cable bundle multicast](#)
- [show ip interface brief](#)
- [show pxf cable feature](#)

show cable bundle forwarding-table

To display the current Multicast Routing Table on the Cisco CMTS, to include virtual interface bundling, per-group and per-group Multicast information, use the **show cable bundle forwarding table** command in privileged EXEC mode.

show cable bundle *<bundle#>* **forwarding-table**

Syntax Description		
<i>bundle#</i>		The alphanumeric identifier for the virtual interface bundle.
<i>group</i>		Multicast group membership identifier.
<i>MAC addr</i>		Optional parameter specifies the MAC address for which to return information.
<i>IP addr</i>		Optional parameter specifies the IP address for which to return information.

Usage Guidelines

Unlike prior Cisco IOS releases, the MAC address indicated with this command is not based on RFC1112 format, as it was in previous releases.

show cable bundle multicast

To display Multicast information for the specified virtual interface bundle, based on IGMPv3, use the **show cable bundle multicast** command in privileged EXEC mode:

```
show cable bundle <bundle#> multicast <group>
show cable bundle bundle# multicast [ <MAC addr | IP addr >]
```

Syntax Description	
<i>bundle#</i>	The alphanumeric identifier for the virtual interface bundle.
<i>group</i>	Multicast group membership identifier.
<i>MAC addr</i>	Optional parameter specifies the MAC address for which to return information.
<i>IP addr</i>	Optional parameter specifies the IP address for which to return information.

The following example illustrates this new command. This command translates the bundle's multicast MAC address to Multicast IP address information, including the associated multicast source.

```
Router# show cable bundle bundle1.1 multicast

CableBundle  Interface  Source IP      Multicast IP    MAC Address
1             Bundle1.1      *              230.1.1.1      0100.5e00.0001
```

The following example illustrates multicast information for the specified virtual bundle:

```
Router# sh cable bundle 1 multicast

CableBundle  Interface  Source IP      Multicast IP    MAC Address
1             Bundle1    *              239.0.0.100    0100.5e00.0001
```

To translate a MAC address back to Multicast IP address, use the following optional syntax:

```
show cable bundle bundle# multicast [ <MAC addr | IP addr >]
```

The following example illustrates this enhanced **show** command:

```
Router# show cable bundle bundleID multicast 0100.5e00.0001
MAC address      Interface  Flags Location  link  sublink
0100.5e00.0001  Bundle1    1    646FE4D8    0    646FE4EC
0100.5e00.0001  Cable6/0/0 1    646FE4EC    0    0
^^^^^^^^^^^^^^
```

show ip interface brief

To display a brief summary of an interface's IP information and status, to include virtual interface bundle information, use the **show ip interface brief** command in privileged EXEC mode.

show ip interface brief

The following example illustrates a virtual interface bundle with the **show ip interface brief** command:

```
Router# show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
FastEthernet0/0/0  1.8.44.1        YES NVRAM   up          up
POS1/0/0           unassigned      YES NVRAM   up          up
GigabitEthernet2/0/0  11.0.0.2        YES NVRAM   up          up
GigabitEthernet3/0/0  10.1.1.101      YES NVRAM   up          up
GigabitEthernet4/0/0  1.1.1.1         YES NVRAM   down       down
Cable8/1/0         unassigned      YES NVRAM   up          up
Cable8/1/1         unassigned      YES NVRAM   up          up
Cable8/1/2         unassigned      YES NVRAM   up          up
Cable8/1/3         unassigned      YES NVRAM   up          up
Cable8/1/4         unassigned      YES NVRAM   up          up
Bundle1          10.44.50.1    YES TFTP  up        up
Router#
```

show pxf cable feature

To display multicast echo, packet intercept, or source-verify features for one or all cable interfaces, to include information for virtual interface bundles, use the **show pxf cable feature** command in privileged EXEC mode.

show pxf cable feature

The following example illustrates Multicast Echo and virtual interface bundling information on the Cisco uBR10012 router.

```
Router# show pxf cable feature
Interface  SWInterface  VCCI  McastEcho  Intercept  SrcVfy  DHCP  DSGrp  InterceptGrp
Cable5/0/0 Bundle1    36    On        Off      On    On    On    0
Cable5/0/1  Cable5/0/1   15    On         Off       Off    Off    Off    11
Cable5/1/0 Bundle1    36    On        Off      On    On    On    0
Cable5/1/1  Cable5/1/1   17    On         Off       Off    Off    Off    9
Cable6/0/0 Bundle1    36    On        Off      On    On    On    0
Cable6/0/1  Cable6/0/1   19    On         Off       Off    Off    Off    12
Cable6/1/0  Cable6/1/0   20    On         Off       Off    Off    Off    7
Cable6/1/1  Cable6/1/1   21    On         Off       Off    Off    Off    8
Cable7/0/0  Cable7/0/0   22    On         Off       Off    Off    Off    255
Cable7/0/0  Cable7/0/0.1 42    On         Off       Off    Off    Off    255
Cable7/0/1 Bundle200 38    On        Off      Off   Off   Off   3
```

Additional References

The following sections provide references related to the cable interface bundling feature.

Related Documents

Related Topic	Document Title
Virtual Interface Bundling	<ul style="list-style-type: none"> <i>Virtual Interfaces and Frequency Stacking Configuration on MC5x20S and MC28U Linecards</i> http://www.cisco.com/en/US/tech/tk86/tk804/technologies_white_paper09186a0080232b49.shtml <i>Virtual Interfaces on the Cisco uBR-MC5X20S/U Card</i> http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr10_mc5x20s_u_h/feature/guide/mc5x2vif.html
CMTS Command Reference	<p><i>Cisco Broadband Cable Command Reference Guide</i>, at the following URL:</p> <p>http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.html</p>
Cisco IOS Release 12.2 Command Reference	<p>Cisco IOS Release 12.2 Configuration Guides and Command References, at the following URL:</p> <p>http://www.cisco.com/en/US/products/sw/iosswrel/ps1835/products_installation_and_configuration_guides_list.html</p> <p>http://www.cisco.com/en/US/products/sw/iosswrel/ps1835/prod_command_reference_list.html</p>
Cable Features Configuration Guide	<p><i>Cisco CMTS Feature Guide</i>, at the following URL:</p> <p>http://www.cisco.com/en/US/docs/cable/cmts/feature/guide/cmtsfgh.html</p>
Installing Cisco uBR7100 series routers	<i>Cisco uBR7100 Series Universal Broadband Router Hardware Installation Guide</i>
Configuring Cisco uBR7100 series routers	<i>Cisco uBR7100 Series Universal Broadband Router Software Configuration Guide</i>

Related Topic	Document Title
Installing Cisco uBR7200 Series Routers	<p>Cisco uBR7200 Series Universal Broadband Router Hardware Installation Guide</p> <p>Cisco uBR7200 Series Universal Broadband Router Cable Modem Card Installation and Configuration publication</p> <p>Cisco uBR7200 Series Universal Broadband Router Port Adapter Installation and Configuration publication</p> <p>Cisco uBR7200 Series Universal Broadband Router 550-Watt DC-Input Power Supply Replacement instructions</p> <p>Cisco uBR7200 Series Universal Broadband Router Subchassis and Midplane Replacement instructions</p> <p>Cisco uBR7200 Series Rack-Mount and Cable-Management Kit Installation Instructions</p> <p>Cisco uBR7200 Series Universal Broadband Router Fan Tray Replacement Instructions</p>
Configuring Cisco uBR7200 Series Routers	<p>Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide</p> <p>Cisco uBR7200 Series Universal Broadband Router Feature Roadmap publication</p>
Installing Cisco uBR10012 Router	<p>Cisco uBR10012 Series Universal Broadband Router Hardware Installation Guide</p> <p>2400W AC-Input Power Shelf for the Cisco uBR10000 Series Universal Broadband Router</p> <p>Cable Interface Line Card Processor Hardware Installation for the Cisco uBR10000 Series Universal Broadband Router</p> <p>Fan Assembly Module for the Cisco uBR10000 Series Universal Broadband Router</p> <p>DC Power Entry Module for the Cisco uBR10000 Series Universal Broadband Router</p> <p>Performance Routing Engine Card Hardware Installation for the Cisco uBR10000 Series Universal Broadband Router</p> <p>TCC+ Card for the Cisco uBR10000 Series Universal Broadband Router</p>
Configuring the Cisco uBR10012 Router	<p>Cisco uBR10012 Universal Broadband Router Software Configuration Guide</p>

Standards

Standards	Title
SP-RFIV1.1-I09-020830	Data-over-Cable Service Interface Specifications Radio Frequency Interface Specification, version 1.1
SP-RFIV2.0-I03-021218	Data-over-Cable Service Interface Specifications Radio Frequency Interface Specification, version 2.0

Standards	Title
SP-OSSIV2.0-I03-021218	Data-over-Cable Service Interface Specifications Operations Support System Interface Specification, version 2.0
SP-BPI+-I09-020830	Data-over-Cable Service Interface Specifications Baseline Privacy Plus Interface Specification, version 2.0

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://tools.cisco.com/ITDIT/MIBS/servlet/index

RFCs

No new or modified RFCs are supported by this feature.

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/cisco/web/support/index.html