



# Virtual Interface Bundling for the Cisco CMTS

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## Note

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Cisco IOS Release 12.2(33)SCA integrates support for this feature on the Cisco CMTS routers. This feature is also supported in Cisco IOS Release 12.3BC, and this document contains information that references many legacy documents related to Cisco IOS 12.3BC. In general, any references to Cisco IOS Release 12.3BC also apply to Cisco IOS Release 12.2SC.

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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.

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.

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## Prerequisites for Virtual Interface Bundling

The Virtual Interface Bundling feature is supported on the Cisco CMTS routers in Cisco IOS Release 12.3BC and 12.2SCA. Table below shows the hardware compatibility prerequisites for the Admission Control feature.

**Table 1: Virtual Interface Bundling Hardware Compatibility Matrix**

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	Cisco IOS Release 12.2(33)SCA <ul style="list-style-type: none"> <li>• PRE2</li> </ul>	Cisco IOS Release 12.2(33)SCA <ul style="list-style-type: none"> <li>• Cisco uBR10-MC5X20S/U/H</li> </ul>
	Cisco IOS Release 12.2(33)SCB and later <ul style="list-style-type: none"> <li>• PRE4</li> </ul>	Cisco IOS Release 12.2(33)SCC and later <ul style="list-style-type: none"> <li>• Cisco UBR-MC20X20V</li> </ul>
	<b>Cisco IOS Release 12.2(33)SCH and later</b> <ul style="list-style-type: none"> <li>• PRE5</li> </ul>	Cisco IOS Release 12.2(33)SCE and later <ul style="list-style-type: none"> <li>• Cisco uBR-MC3GX60V</li> </ul>
Cisco uBR7246VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> <li>• NPE-G1</li> </ul>	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> <li>• Cisco uBR-MC28U/X</li> </ul>
	Cisco IOS Release 12.2(33)SCB and later <ul style="list-style-type: none"> <li>• NPE-G2</li> </ul>	Cisco IOS Release 12.2(33)SCD and later <ul style="list-style-type: none"> <li>• Cisco uBR-MC88V <sup>1</sup></li> </ul>
Cisco uBR7225VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> <li>• NPE-G1</li> </ul>	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> <li>• Cisco uBR-E-28U</li> <li>• Cisco uBR-E-16U</li> <li>• Cisco uBR-MC28U/X</li> </ul>
	Cisco IOS Release 12.2(33)SCB and later <ul style="list-style-type: none"> <li>• NPE-G2</li> </ul>	Cisco IOS Release 12.2(33)SCD and later <ul style="list-style-type: none"> <li>• Cisco uBR-MC88V</li> </ul>

<sup>1</sup> Cisco uBR-MC88V cable interface line card is not compatible with NPE-G1.

# Information About Virtual Interface Bundling

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

**Note**

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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.

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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.
- A virtual bundle interface is virtually defined, as with IP loopback addresses.
- 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**

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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.

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## 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](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](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.

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
Step 2	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.
Step 3	<p><b>interface bundle n</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# interface bundle 1</pre>	<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 <b>master</b> keyword, as supported in the <b>cable bundle master</b> 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><b>ip address address mask</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# ip address 7.7.7.7 255.255.255.0</pre>	<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><b>interface cable {slot /port  slot /subslot / port }</b></p> <p><b>Example:</b></p> <pre>Router# Router(config-if)#</pre>	<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"> <li>• <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.</li> <li>• <i>slot /subslot / port</i> — Cable interface on the Cisco uBR10012 router. The following are the valid values: <ul style="list-style-type: none"> <li>◦ <i>slot</i> —5 to 8</li> <li>◦ <i>subslot</i> — 0 or 1</li> <li>◦ <i>port</i> — 0 to 4 (depending on the cable interface)</li> </ul> </li> </ul>
Step 6	<p><b>cable bundle n</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# cable bundle 1</pre>	Configures a cable interface to belong to an interface bundle, where <i>n</i> is the bundle number.
Step 7	<p><b>cable upstream max-ports n</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# cable upstream max-ports 6</pre>	<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 <b>no</b> form of this command.</p> <ul style="list-style-type: none"> <li>• <i>n</i> —Number of upstreams, ranging from 1 to 8, with a default of 4.</li> </ul>

	Command or Action	Purpose
<b>Step 8</b>	<p><b>cable upstream</b><i>logical-port</i> <b>connector</b><i>physical-port</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# cable upstream 4 connector 16</pre>	<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 <b>no</b> form of this command.</p> <ul style="list-style-type: none"> <li>• <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.</li> </ul> <p><b>Tip</b> 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"> <li>• <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.</li> </ul>
<b>Step 9</b>	<p><b>cable upstream</b><i>n</i><b>frequency</b><i>up-freq-hz</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# cable upstream 4 frequency 15000000</pre>	<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 <b>no</b> form of this command.</p> <ul style="list-style-type: none"> <li>• <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.</li> <li>• <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.</li> </ul>
<b>Step 10</b>	<p><b>no cable upstream</b> <i>n</i> <b>shut</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# no cable upstream 4 shut</pre>	<p>Use as needed after Cisco IOS upgrade.</p> <p>The cable interface must be enabled using the no shutdown command for the specified cable interface.</p> <p><i>n</i> —Specifies the cable interface to enable for the virtual bundle.</p>
<b>Step 11</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# end</pre>	<p>Returns to privileged EXEC mode.</p>



### What to Do 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.

### Example: 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

```

## Additional References

### Related Documents

Related Topic	Document Title
CMTS Command Reference	<a href="#">Cisco IOS CMTS Cable Command Reference Guide</a>

### Standards and RFCs

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
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

### Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/support">http://www.cisco.com/support</a>

# Feature Information for Cable Interface Bundling and Virtual Interface Bundling for the Cisco CMTS

Table below lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.



## Note

The below table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 2: Feature Information for Bundling on the Cisco CMTS**

Feature Name	Releases	Feature Information
Virtual Interface Bundling	12.3(13a)BC	<p>Cable bundling was 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 <a href="#">Information About Virtual Interface Bundling</a>, on page 3.</p> <p>In Cisco IOS Release 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.</p>

Feature Name	Releases	Feature Information
Automatic Virtual Interface Bundling	12.2(33)SCA	Support for the Cisco uBR7225VXR Universal Broadband Router was added.