



## Maximum CPE and Host Parameters

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This document describes how to use different methods to control subscriber access that are allowed by the Data-over-Cable Service Interface Specifications (DOCSIS) for use on cable networks.

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## Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

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.

## Hardware Compatibility Matrix for the Cisco cBR Series Routers



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**Note** The hardware components that are introduced in a given Cisco IOS-XE Release are supported in all subsequent releases unless otherwise specified.

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Table 1: Hardware Compatibility Matrix for the Cisco cBR Series Routers

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	<p><b>Cisco IOS-XE Release 16.5.1 and Later Releases</b></p> <p>Cisco cBR-8 Supervisor:</p> <ul style="list-style-type: none"> <li>• PID—CBR-SUP-250G</li> <li>• PID—CBR-CCAP-SUP-160G</li> </ul>	<p><b>Cisco IOS-XE Release 16.5.1 and Later Releases</b></p> <p>Cisco cBR-8 CCAP Line Cards:</p> <ul style="list-style-type: none"> <li>• PID—CBR-LC-8D30-16U30</li> <li>• PID—CBR-LC-8D31-16U30</li> <li>• PID—CBR-RF-PIC</li> <li>• PID—CBR-RF-PROT-PIC</li> <li>• PID—CBR-CCAP-LC-40G</li> <li>• PID—CBR-CCAP-LC-40G-R</li> <li>• PID—CBR-CCAP-LC-G2-R</li> <li>• PID—CBR-SUP-8X10G-PIC</li> <li>• PID—CBR-2X100G-PIC</li> </ul> <p>Digital PICs:</p> <ul style="list-style-type: none"> <li>• PID—CBR-DPIC-8X10G</li> <li>• PID—CBR-DPIC-2X100G</li> </ul> <p>Cisco cBR-8 Downstream PHY Module:</p> <ul style="list-style-type: none"> <li>• PID—CBR-D31-DS-MOD</li> </ul> <p>Cisco cBR-8 Upstream PHY Modules:</p> <ul style="list-style-type: none"> <li>• PID—CBR-D31-US-MOD</li> </ul>



**Note** Do not use DPICs (8X10G and 2x100G) to forward IP traffic, as it may cause buffer exhaustion, leading to line card reload.

The only allowed traffic on a DPIC interface is DEPI, UEPI, and GCP traffic from the Cisco cBR-8 router to Remote PHY devices. Other traffic such as DHCP, SSH, and UTSC should flow via another router, since DPICs cannot be used for normal routing.

## Information About the MAX CPE and Host Parameters

The DOCSIS specification includes a number of provisions to allow service providers to control the number of subscribers who can access the network through any particular cable modem.

The following are the parameters that controls the number of CPE that can access the network:



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**Note** In addition, the DOCSIS configuration file contains a Network Access parameter that specifies whether the CPE devices behind the cable modem can access the cable network. If the Network Access parameter is set to Disabled, no CPE devices behind a cable modem are able to access the network.

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**Tip** Also, the Cisco CMTS lists offline cable modems in its internal database for 24 hours. The CMTS does not reset the CPE counts for these offline cable modems until the 24 hour period expires and the cable modems come back online. If the cable modems come back online before the 24 hour period expires, the CMTS continues to use the existing CPE counts.

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All of these methods are similar in purpose, but they are configured differently and have a different impact on cable modems and their CPE devices.

The cable modem enforces the MAX CPE value, the CMTS enforces the MAX Host, MAX CPE IP, and MAX CPE IPv6 values.



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**Note** The MAX CPE parameter provides Layer 2 control of CPE devices. The MAX CPE IP and MAX CPE IPv6 parameters provide Layer 3 control of CPE devices. The two methods are complimentary but not otherwise related.

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## MAX CPE

The MAX CPE is a required parameter and used to control the number of CPE devices that can access the network during the current session. In DOCSIS 1.0 cable networks, the MAX CPE parameter is the primary means of controlling the number of CPE devices that can connect to the cable network using any particular cable modem. This parameter is configured in the DOCSIS configuration file (TLV 18). If this parameter is not specified in the DOCSIS configuration file, it defaults to a value of 1.



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**Note** In DOCSIS 1.1 cable networks, the CMTS ignores the MAX CPE parameter that is specified in the DOCSIS configuration file, and uses the MAX Host parameter instead.

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Each time a new CPE device attempts to connect to the cable network, the cable modem logs the hardware (MAC) address. If the cable modem has not reached the MAX CPE number of MAC addresses, the new CPE device is allowed to access the network. If the cable modem has reached the MAX CPE limit, it drops the traffic from any additional CPE devices.

By default, the cable modem learns new MAC addresses on a first-come, first-served basis. You can also preconfigure the allowable MAC addresses for CPE devices by entering those MAC addresses in the DOCSIS configuration file (TLV 14). These cable modem gives these preconfigured MAC addresses preference in connecting to the network.

The DOCSIS specification does not allow cable modems to age out MAC addresses, so a MAC address stays in the log table of the cable modem until the cable modem is reset. You should therefore think of this parameter as specifying the maximum number of CPE devices that can connect during any particular session, instead of the maximum number of CPE devices that can simultaneously connect to the cable network.

For example, if you set MAX CPE to 2, a customer could use their cable modem to connect a maximum of two CPE devices (two MAC addresses) to the cable network. A customer could choose to connect two PCs simultaneously to their cable modem and use both to access the network.

However, if the customer then disconnected these PCs and connected two new PCs, the cable modem would not allow the new PCs to come online, because they would be the third and fourth MAC addresses that are connected to the cable modem. The customer would have to reset the cable modem before being able to use the new PCs.




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**Note** The MAX CPE value, if present, must be a positive integer in DOCSIS 1.0 configuration files. This parameter can be zero in DOCSIS 1.1 configuration files, but if so, the cable modem uses a MAX CPE value of 1. If the MAX CPE parameter is not present in either type of DOCSIS configuration file, it defaults to 1.

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## MAX Host

The MAX Host parameter is an optional parameter and is configured on the Cisco CMTS and specifies the maximum number of CPE devices (MAC addresses) that the CMTS will allow to have network access. You can control this parameter for individual cable modems, for all cable modems on a particular cable interface, or for all cable modems on the Cisco CMTS, depending on the CLI command being used:

- **cable modem max-cpe**—Configures MAX Host for all cable modems on the Cisco CMTS. You can use the **unlimited** keyword to specify that the Cisco CMTS should not enforce a MAX Host limit for cable modems.

When this is enabled, the Cisco CMTS learns a MAC address the first time that the CPE device accesses the cable network. After the Cisco CMTS has logged the maximum number of MAC addresses specified by a MAX Host parameter, it drops all traffic from CPE devices that have any other MAC address.




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**Tip** In DOCSIS 1.1 cable networks, when both the MAX CPE IP and MAX Host parameters are configured, the Cisco CMTS uses the lesser value to determine the maximum number of CPE devices that are allowed behind each cable modem. By default, MAX Host is set to 16.

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**Note** The entire MAX Host address table is cleared whenever the Cisco TS is reset. You can also clear an entry for a particular CPE device using the **clear cable host** command.

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## Specifying an Unlimited Value for Max Host

The **cable modem max-cpe** command, which affects all cable modems on the CMTS, supports the **unlimited** keyword, which specifies that the CMTS should not enforce any limit on CPE devices. When you configure the CMTS with the unlimited **keyword**, this setting, you are allowing cable modems to support any number of CPE devices.

Do not use the **unlimited** option without also specifying the proper value for MAX CPE in the DOCSIS configuration file, so that each cable modem can control the maximum number of CPE devices it supports. In addition, to prevent users from requesting an unlimited number of IP address, be sure to configure the DHCP servers so that they control how many IP addresses are assigned to the CPE devices behind each cable modem.

## MAX CPE IP

The MAX CPE IP parameter is applicable only in DOCSIS 1.1 cable networks and is an optional parameter. This parameter specifies whether the cable modem should perform IP address filtering on the CPE devices. If so, this attribute also specifies the maximum number of simultaneous IP addresses that are permitted behind the modem at any one time.

The MAX CPE IP parameter is configured in the DOCSIS configuration file (TLV 35), or by using SNMP commands to set the docsDevCpeIpMax attribute (in DOCS-CABLE-DEVICE-MIB) for the cable modem. By default, this parameter is not enabled and the Cisco CMTS does not actively manage CPE devices, unless you enable the use of the MAX CPE IP parameter by using the **cable submgmt default active** command. The **cable submgmt default max-cpe** command can be used to limit the number of IP addresses behind the cable modem.

If this feature is enabled, the cable modem learns the allowable IP addresses the first time that the CPE device sends an IP packet out into the network. The IP addresses are added to the docsDevFilterCpeTable table. This address table is cleared automatically when the cable modem is reset or powered off, or you can manually clear the IP address table by setting the docsSubMgtCpeControlReset attribute in the appropriate table entry for this cable modem.



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**Tip** The CMTS uses the MAX CPE IP value as part of its own filtering process, but the two filters operate independently on the cable modem and CMTS.

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## MAX CPE IPv6

The MAX CPE IPv6 parameter is an optional parameter and specifies the maximum number of simultaneous IPv6 addresses that are permitted for a cable modem at any time.

The MAX CPE IPv6 parameter is configured in the DOCSIS 3.0 configuration file (TLV 63), or by using the SNMP commands to set the docsSubmgmt3BaseCpeMaxIpv6PrefixDef attribute (in DOCS-SUBMGT3-MIB) for the cable modem. By default, this parameter is not enabled and the Cisco CMTS does not actively manage CPE devices, unless the use of the MAX CPE IPv6 parameter is enabled by using the **cable submgmt default active** command. The **cable submgmt default max-ipv6-cpe** command can be used to limit the number of IPv6 addresses allowed behind a cable modem.

When the MAX CPE IPv6 feature is enabled, the cable modem learns the allowable IPv6 addresses the first time that the CPE device sends an IPv6 packet out into the network. The IPv6 addresses are added to the IPv6 address table. The address table is cleared automatically when the cable modem is reset or powered off.

## Interoperation of the Maximum CPE Parameters

The different methods of CPE control can all be active simultaneously. They can interact with one another but do not conflict with one another. The table lists each method and compares their characteristics.

*Table 2: Comparison of the Different Max CPE and Max Host Control Mechanisms*

CM Configuration Parameter	Function	CMTS Equivalent	CMTS Enforcement Priority
Network Access Control	Prevents all network access for CPE devices	Cable submgmt default learnable	CMTS overrides CM Config File
MAX CPE	Limits MAC addresses per CM	Cable modem max-hosts	Least restrictive is enforced
MAX CPE IP	Limits IP addresses per CM	Cable submgmt default max-cpe	Most restrictive is enforced
MAX CPE IPv6	Limits IPv6 addresses per CM	Cable submgmt default max-ipv6-cpe	Most restrictive is enforced

The table lists the MAX CPE parameters in order of priority. For example, the Network Access Control and MAX CPE parameters interact as follows:

- If the Network Access Control field for a cable modem is set to Disabled, none of that modem's CPE devices will be able to access the network, regardless of how the other parameters are set.
- If Network Access Control is Enabled and MAX CPE is set to 1 for a cable modem, then a maximum of one CPE device will be able to access the network, no matter how the remaining parameters are configured.

## Benefits

- CMTS flexibility allows multiple service operator provisioners, service providers, and other users to synchronize between the CMTS and the cable modem, the maximum number of CPE devices, maximum number of IPv4 addresses, and maximum number of IPv6 addresses that can be connected behind a cable modem.
- Changes can be made by using CLI commands or by using SNMP commands.

## How to Configure the MAX CPE and Host Parameters

To reset the maximum number of permitted CPE devices recognized by the CMTS, use one of the following configuration commands. All procedures are optional, depending on the requirements.



**Note** The CMTS assigns the MAX Host value to a cable modem at the time that the cable modem registers with the CMTS. Changing any of the MAX Host commands affects only cable modems that register after the change.

## Configuring the Maximum Number of CPE Devices on the Cisco CMTS

To configure the maximum number of CPE devices per cable modem, use the following procedure:

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 3</b>	<p><b>cable modem max-cpe</b> [<i>number</i>   <b>unlimited</b>]</p> <p><b>Example:</b></p> <pre>Router(config)# cable modem max-cpe 8</pre>	<p>Sets the value of the MAX CPE parameter on the Cisco CMTS for all cable interfaces.</p> <p>The <b>show cable modem subscriber</b> displays the MAXIMUM value of cable modem max-cpe and the MAX CPE value in the DOCSIS configuration file of the cable modem.</p> <p>The number of the CPE that can be online is determined based on one of the following aspects:</p> <ul style="list-style-type: none"> <li>• If the number of the CPE is lower than the MAX CPE value in the DOCSIS configuration file of the cable modem, then the <b>cable modem max-cpe</b> command overrides the configuration file value.</li> <li>• If number of the CPE is higher than the MAX CPE value in the DOCSIS configuration file of the cable modem or is set as unlimited, then the value set in the configuration file takes precedence.</li> </ul> <p><b>Note</b> If the value in the configuration file is zero and <b>no cable modem max-cpe</b> is configured, then no CPE device is able to obtain an IP address.</p>
<b>Step 4</b>	<p><b>cable submgmt default active</b></p> <p><b>Example:</b></p> <pre>Router(config)# cable submgmt default active</pre>	<p>Specifies that the CMTS should actively manage CPE devices. The default is the <b>no</b> version of this command, so that the CMTS does not actively manage CPE devices.</p>

	Command or Action	Purpose
<b>Step 5</b>	<b>cable submgmt default max-cpe cpe-ip</b> <b>Example:</b> <pre>Router(config)# cable submgmt default max-cpe 4</pre>	(Optional) Specifies the default value for the MAX CPE IP.
<b>Step 6</b>	<b>cable submgmt default max-ipv6-cpe ipv6-num</b> <b>Example:</b> <pre>Router(config)# cable submgmt default max-ipv6-cpe 4</pre>	(Optional) Specifies the default value for the MAX IPv6 CPE.
<b>Step 7</b>	<b>exit</b> <b>Example:</b> <pre>Router(config)# exit</pre>	Exits global configuration mode.

### What to do next



**Note** Use of the **cable modem max-cpe unlimited** command can open a security hole in the system by enabling denial of service attacks. It could allow a single user to obtain a large number of IP addresses, and thereby cause the entire network to go down after this single user has reserved all available IP addresses.

## Configuration Examples

To display the current configuration and status of a cable interface, use the **show running-config** command in privileged EXEC mode. The following is sample output that shows that the CMTS permits up to five CPE devices to use the specified cable interface to pass traffic.

```
interface Cable3/0
 ip address 192.168.1.1 255.255.255.0 secondary
 ip address 10.1.1.1 255.255.255.0
 load-interval 30
 no keepalive
 cable downstream annex B
 cable downstream modulation 256qam
 cable downstream interleave-depth 32
 cable downstream frequency 507000000
 cable upstream 0 frequency 27008000
 cable upstream 0 power-level 0
 cable upstream 0 minislotsize 32
 cable upstream 0 modulation-profile 2
 no cable upstream 0 shutdown
 cable upstream 1 frequency 29008000
 cable upstream 1 power-level 0
 cable upstream 1 channel-width 3200000
```



```

cable upstream 1 minislot-size 4
no cable upstream 1 shutdown
cable dhcp-giaddr policy
cable helper-address 172.17.110.131
end

```

You can also use the **more system:running-config** command to verify the maximum number of permitted CPE devices for a cable interface.

```

CMTS01# more system:running-config
Building configuration...
Current configuration:
!
interface Cable6/0
 ip address 10.1.1.1 255.255.255.0
 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

```

## Additional References

For additional information related to configuring the MAX CPE and Host parameters on the Cisco CMTS, refer to the following references:

### Related Documents

Related Topic	Document Title
Cisco CMTS Commands	<a href="#">Cisco CMTS Cable Command Reference</a>
Interaction of MAX CPE Parameters	<a href="#">Using the max-cpe Command in the DOCSIS and CMTS</a>

### Standards

Standards <sup>1</sup>	Title
<a href="#">SP-RFIV1.1-I08-020301</a>	<i>Data-Over-Cable Service Interface Specifications Radio Frequency Interface Specification , version 1.1 ( <a href="http://www.cablelabs.com/cablemodem/">http://www.cablelabs.com/cablemodem/</a> )</i>

<sup>1</sup> Not all supported standards are listed.

**MIBs**

MIBs <sup>2</sup>	MIBs Link
DOCS-CABLE-DEVICE-MIB DOCS-SUBMGT-MIB DOCS-SUBMGT3-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

<sup>2</sup> Not all supported MIBs are listed.

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Maximum CPE and Host Parameters

Use Cisco Feature Navigator to find information about the 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 the <https://cfng.cisco.com/> link. An account on the Cisco.com page is not required.



**Note** The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 3: Feature Information for Maximum CPE and Host Parameters**

Feature Name	Releases	Feature Information
Maximum CPE and Host Parameters	Cisco IOS XE Everest 16.6.1	This feature was integrated into Cisco IOS XE Everest 16.6.1 on the Cisco cBR Series Converged Broadband Routers.