



L2VPN Support over Cable

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In Cisco IOS Release 12.2(33)SCA, the Layer 2 VPN (L2VPN) Support over Cable feature on the Cisco CMTS provides point-to-point Transparent LAN Service (TLS) in support of the Business Services over DOCSIS (BSOD) CableLabs specification.

The L2VPN Support over Cable feature in Cisco IOS Release 12.2(33)SCA differs from prior L2VPN and TLS support for cable in Cisco IOS release 12.3BC in the following ways:

- Both features use an Ethernet trunking interface to transport traffic for multiple L2VPN tunnels in support of different cable modems (CMs) and service flows (SFs) based on IEEE 802.1q VLAN IDs. For the legacy TLS service, only the primary upstream or downstream SFs are used. With the new L2VPN Support over Cable feature, both primary and secondary SFs can be used.
- The TLS feature uses CLI to provision the service. The L2VPN Support over Cable feature uses the CM configuration file to provision the service, and a single CLI to identify the default Ethernet Network System Interface (NSI).
- Downstream traffic is forwarded on a per-CM basis and upstream traffic is forwarded on a per-SF basis. For L2VPN Support over Cable feature, upstream traffic for the same L2VPN can use multiple upstream service flows and downstream traffic can use different downstream service flows.

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 for L2VPN Support over Cable”](#) section on page 19.

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



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Prerequisites for L2VPN Support over Cable

- You should use crypto-supported images. Refer to the [Release Notes for Cisco Universal Broadband Routers in Cisco IOS Release 12.2SC](#) for the latest image information.
- Cable modems must be configured to support BPI+.

[Table 1](#) shows the hardware compatibility prerequisites for this feature.


Note

The hardware components introduced in a given Cisco IOS Release will be supported in all subsequent releases unless otherwise specified.

Table 1 L2VPN Support over Cable Feature Hardware Compatibility Matrix

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later	Cisco IOS Release 12.2(33)SCB and later
	• PRE2	• Cisco uBR10-MC5X20U/H
	Cisco IOS Release 12.2(33)SCB and later	Cisco IOS Release 12.2(33)SCC and later
	• PRE4	• Cisco UBR-MC20X20V
		Cisco IOS Release 12.2(33)SCE and later
		• Cisco uBR-MC3GX60V ¹

Table 1 L2VPN Support over Cable Feature Hardware Compatibility Matrix

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR7246VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> • NPE-G1 • NPE-G2 	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> • Cisco uBR-MC28U/X Cisco IOS Release 12.2(33)SCD and later <ul style="list-style-type: none"> • Cisco uBR-MC88V²
Cisco uBR7225VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> • NPE-G1 Cisco IOS Release 12.2(33)SCB and later <ul style="list-style-type: none"> • NPE-G2 	Cisco IOS Release 12.2(33)SCA and later <ul style="list-style-type: none"> • Cisco uBR-E-28U • Cisco uBR-E-16U • Cisco uBR-MC28U/X Cisco IOS Release 12.2(33)SCD and later <ul style="list-style-type: none"> • Cisco uBR-MC88V²

1. Cisco uBR-MC3GX60V cable interface line card is supported only with PRE4.
2. Cisco uBR-MC88V cable interface line card is compatible only with NPE-G2.

Restrictions for L2VPN Support over Cable

The L2VPN Support over Cable feature has the following general restrictions:

- DOCSIS 1.0 CMs are not supported. For other specific CM requirements, see the “Business Services over DOCSIS (BSOD) Layer 2 Virtual Private Networks” specification that can be found using the “Additional References” section on page 17.
- Load balancing and Dynamic Channel Change (DCC) are not supported for CMs that are enabled for L2VPN support.
- DSx messages (Dynamic Service Add [DSA], Dynamic Service Change [DSC], and Dynamic Service Delete [DSD]) are supported for L2VPN-provisioned CMs from Cisco IOS Release 12.2(33)SCF2 onwards. However, DSx with L2VPN type, length, values (TLVs) are not supported.
- Multipoint L2VPN is not supported, and any Simple Network Management Protocol (SNMP) MIBs for multipoint L2VPN are not supported.
- eSAFE (embedded Service/Application Functional Entities) DHCP snooping is not supported (L2VPN subtype 43.5.3)
- Maximum of 1024 L2VPNs are supported on a single MAC domain.
- Maximum of eight upstream SFs are supported per L2VPN service.
- Maximum of eight downstream classifiers are supported per L2VPN service.
- eSAFE exclusion is supported for only one eSAFE host. If the REG-REQ message for a compliant CM specifies multiple eSAFE hosts, then the eMTA (ifIndex 16) is selected as the eSAFE host to be excluded by the Cisco CMTS router. If the eMTA is not included as part of the capability of the CM, then the first eSAFE host in the capability is selected for exclusion.
- Maximum length of the Cable Modem Interface Mask (CMIM) is 4 bytes.
- Areas of the Business Services over DOCSIS (BSOD) Layer 2 Virtual Private Networks specification that are not supported are:

- Vendor-specific L2VPN encodings for the replacement of the required VPN ID and NSI Encapsulation subtype are not supported.
- Mapping of egress user priority to an NSI port transmission traffic class as specified by IEEE 802.1s is not supported.
- Forwarding with non-zero default user priority values with vendor-specific configuration is not supported.
- Accepting multiple Downstream Classifier L2VPN Encoding with the same VPN ID to classify packets to different service flows is not supported.
- Assigning multiple SAIDs to the same L2VPN on the same CM is not supported. The primary SAID is used for encrypting all downstream traffic.
- Assigning of the same group-level L2VPN SAID to different CMs on the same MAC domain attached to the same L2VPN identifier is not supported.
- Implementing the DOCSIS Spanning Tree Protocol (DSTP) and transmission of DSTP BPDUs on all NSI and RF interfaces configured for L2VPN operation is not supported.
- Implementing a DSTP SAID specifically for DSTP forwarding to the customer premises equipment (CPE) ports of all L2VPN CMs is not supported.

VPN ID Restrictions

- A maximum of four VPN IDs are supported for each CM.
- A maximum of one VPN ID can be associated with each SF in a CM; although multiple SFs in a CM can belong to the same L2VPN.
- A maximum of 4093 unique VPN IDs are supported per Cisco CMTS router.
- The maximum length of a VPN ID is 16 bytes.
- All L2VPN encodings must contain a VPN ID, except for upstream classifier encodings.

Information About L2VPN Support over Cable

L2VPN Support Over Cable provides the following benefits and functions on a Cisco CMTS router:

- Supports point-to-point L2VPN forwarding mode.
- Supports up to four VPN IDs per CM.
- Supports multiple upstream SFs per CM, with one or more SFs belonging to the same VPN ID.
- Supports a single Ethernet NSI that serves as a trunking port for one or more L2VPN tunnels on the Cisco CMTS router.
- Supports BPI+ encryption using primary SAID of the CM.
- Supports L2VPN encodings in the CM configuration file and CM registration (REG-REQ with L2VPN encoding).
- Supports upstream L2VPN tunnel in support of per-CM and per-SF forwarding.
- Supports synchronization and recovery of the L2VPN database and upstream and downstream SFs during PRE2 NSF/SSO and N+1 line card redundancy switchovers.
- Supports QoS in upstream and downstream.

- Supports stacked IEEE 802.1q tags.
- Supports exclusion of traffic from the L2VPN tunnel for a single Embedded Service/Application Functional Entity (eSAFE) host.
- Supports Layer 2 classifier via CMIM and IEEE 802.1p priority bits.
- Supports detection of provisioning errors, such as duplicate VLAN IDs across CMs or existing VLAN IDs in use, and moves a CM offline with a corresponding error message.
- Supports coexistence of L2VPN and non-L2VPN traffic on the same RF MAC domain, with non-L2VPN traffic isolated from other tunnel traffic.
- Supports voice calls from L2VPN-provisioned CMs. However, voice calls are not part of the L2VPN.

Point-to-Point L2VPN Forwarding Mode

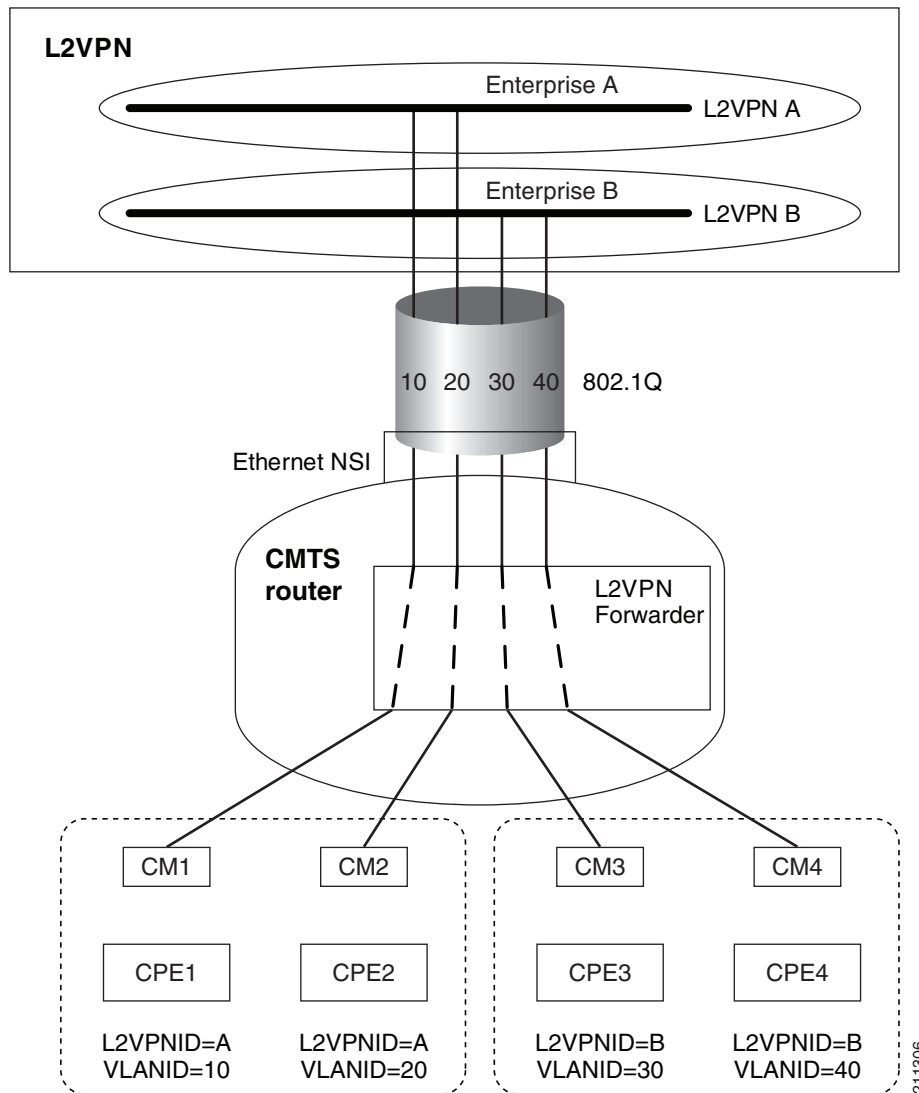
The Cisco CMTS routers in Cisco IOS Release 12.2(33)SCA support the point-to-point L2VPN forwarding mode described in the BSOD specification. Each attachment circuit (either SF or CM) on the Cisco CMTS router has a NSI encapsulation value, and is configured with an IEEE 802.1q VLAN ID.

The L2VPN forwarder on the Cisco CMTS router forwards both upstream and downstream traffic between the NSI port on the router and an attachment circuit without using MAC address learning for the forwarding decision. A L2VPN bridge on the backbone network of the cable operator performs the MAC-address learning to bridge packets between VLAN IDs.

[Figure 1](#) shows an example of a point-to-point L2VPN network using IEEE 802.1q NSI encapsulation. In this example, four CMs are associated with four different VLAN IDs: 10, 20, 30, and 40. The L2VPN encoding of the CM includes the logical L2VPN ID (in this case, A or B) with an NSI encapsulation subtype for IEEE 802.1q with the associated VLAN ID.

The logical L2VPN IDs allow creation of separate broadcast domains for certain VLAN IDs. In the diagram, traffic for VLANs 10 and 20 from CM1 and CM2 can be sent to the network of Enterprise A, and traffic for VLAN's 30 and 40 from CM3 and CM4 can be sent to the network of Enterprise B.

Figure 1 Point-to-Point L2VPN Network Diagram



L2VPN Encodings in the CM Configuration File

The CM configuration file contains a set of L2VPN encodings that control how the Cisco CMTS processes L2VPN forwarding of upstream and downstream CPE packets. As per the BSOD specification, the L2VPN encoding is encapsulated using a General Extension Information (GEI) encoding, which uses the type code 43 and subtype of 5 (43.5) with the reserved Vendor ID of 0xFFFFFFF.

L2VPN defines the following types of encodings:

- Per-CM L2VPN encodings—An encoding that appears at the top level of the CM configuration file.
- Per-SF L2VPN Encoding—An encoding that appears as a subtype of the Upstream Service Flow Encoding (type 24).
- Upstream Classifier L2VPN Encoding—An encoding that appears in an Upstream Packet Classification Configuration Setting (type 22).

- Downstream Classifier L2VPN Encoding—An encoding that appears in a Downstream Packet Classification Configuration Setting (type 23).

The simplest CM configuration file has a single per-SF L2VPN Encoding within the primary upstream SF definition and a single per-CM L2VPN Encoding with a NSI Encapsulation subtype for that L2VPN.

Supported L2VPN Encodings

This section describes the supported L2VPN encodings in the CM configuration file that are supported by the Cisco CMTS routers.

- The Cisco CMTS routers support the following CM capabilities:
 - L2VPN capability (5.17)
 - eSAFE host capability (5.18)
 - Downstream Unencrypted Traffic (DUT) filtering (5.19)
- The Cisco CMTS routers support the following top-level encodings:
 - VPN identifier (43.5.1)
 - CMIM (43.5.4)—When provided, applies to all upstream SFs associated with an L2VPN tunnel; Supports only one eSAFE host.
 - NSI encapsulation (43.5.2) with format code 2 for IEEE 802.1q (43.5.2.2)
 - DUT filtering encoding
- The Cisco CMTS routers support the following per-SF encodings:
 - VPN identifier (43.5.1)
 - Ingress user priority (43.5.8)
- The Cisco CMTS routers support the following downstream classifier encodings:
 - VPN identifier (43.5.1)
 - CMIM (43.5.4) and (22/23.13)
 - User priority range (43.5.9)

For more information about the CM configuration file and L2VPN Encodings, see the “Business Services over DOCSIS (BSOD) Layer 2 Virtual Private Networks” specification that can be found using the “Standards” section on page 17.

For information about how to use the configuration file generator on the Cisco CMTS, see the “DOCSIS Internal Configuration File Generator for the Cisco CMTS” document that can be found using the “Related Documents” section on page 17.

SNMPv3 Interface

L2VPN Support over Cable in Cisco IOS Release 12.2(33)SCA supports the following MIBs in SNMPv3:

- DOCSIS-L2VPN-MIB

For a link to the Cisco IOS MIB tools, see the “MIBs” section on page 18.

DOCSIS-L2VPN-MIB

The DOCSIS-L2VPN-MIB contains the SNMP management objects used by the Cisco CMTS router for L2VPN support. The MIB is bundled with the Cisco IOS software images that support the L2VPN Support over Cable feature.

Table 2 lists the tables in the DOCSIS-L2VPN-MIB supported by the Cisco CMTS routers. For more information, see the MIB documentation.

Table 2 DOCSIS-L2VPN-MIB Tables

Object	Description
docsL2vpnIdToIndexTable	Indexed by the octet string DocsL2vpnIdentifier that provides the local agent's internally assigned docsL2vpnIdx value for that DocsL2vpnIdentifier value.
docsL2vpnIndexToIdTable	Indexed by agent's local docsL2vpnIdx that provides the global L2VPN Identifier.
docsL2vpnCmTable	Describes L2VPN per-CM information that is in common with all L2VPNs for the CM, regardless of forwarding mode.
docsL2vpnVpnCmTable	Describes the operation of L2VPN forwarding on each CM.
docsL2vpnVpnCmStatsTable	Contains statistics for forwarding of packets to and from a CM on each VPN.
docsL2vpnPortStatusTable	Displays summary information for the run-time state of each VPN that is currently operating on each bridge port.
docsL2vpnSfStatusTable	Displays SF-specific L2VPN forwarding status for each upstream service flow configured with a per-SF L2VPN encoding.
docsL2vpnPktClassTable	Provides the L2VPN-specific objects for packet classifiers that apply to only L2VPN traffic. The indices of this table are a subset of the indices of classifiers in the docsQosPktClassTable.
docsL2vpnCmNsiTable	Describes the NSI configuration for a single CM when operating in point-to-point forwarding mode for an L2VPN.

Voice-Call Support on L2VPN CM

Cisco IOS Release 12.2(33)SCF2 introduces the Voice-Call Support on L2VPN CM feature. This feature enables the Cisco CMTS routers to support dynamic service flows on L2VPN-provisioned cable modems to permit voice calls from a non-L2VPN CPE.

To provide voice-call support on a L2VPN CM, you have to configure correct classifiers and create two static service flows (primary and secondary) using the cable modem configuration file. If the eMTA is L2VPN-capable with the embedded CPE configured as an eSAFE host, then only one service flow is required. When correct CMIM bits are configured, the Cisco CMTS does not send packets from the eSAFE host to the L2VPN.

Though the L2VPN can be configured on the primary or secondary service flow, it cannot coexist with eMTAs on the same service flow. The eMTAs should always use a different service flow from that of L2VPN. The classifiers to direct the traffic should also be based on the service flows the L2VPN and eMTAs are using. When the above configuration is in place, the dynamic service flows are created automatically whenever voice calls are initiated.

How to Configure L2VPN Support over Cable

This section contains the following procedures:

- [Configuring the Ethernet Network System Interface, page 9](#) (required)
- [Preparing the DOCSIS Configuration File for L2VPN Support, page 10](#) (required)
- [Verifying L2VPN Support over Cable, page 10](#) (required)
- [Enabling Voice-Call on a L2VPN CM, page 12](#) (required)
- [Verifying Dynamic Service Flows, page 12](#) (optional)

Configuring the Ethernet Network System Interface

To configure the L2VPN Support over Cable feature, you need to specify an Ethernet NSI to operate as the trunking interface for the L2VPN traffic. You must configure the NSI using a command on the Cisco CMTS router. It is not configurable through the CM configuration file.

Prerequisites

The following interface types can be configured as an NSI for L2VPN Support over Cable:

- Cisco uBR10012 Universal Broadband Router—Gigabit Ethernet.
- Cisco uBR7246VXR Universal Broadband Router—Fast Ethernet or Gigabit Ethernet

Restrictions

The Cisco CMTS routers only support the configuration of a single L2VPN NSI per CMTS.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **cable l2-vpn-service default-nsi *type number***

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none">Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	 cable l2-vpn-service default-nsi type number Example: cable l2-vpn-service default-nsi GigabitEthernet4/0/0	Configures an Ethernet Network System Interface for L2VPN support over cable.

Preparing the DOCSIS Configuration File for L2VPN Support

To support L2VPN, the DOCSIS configuration file must be configured with the appropriate encodings. For information about the supported encodings by the Cisco CMTS routers, see the [“L2VPN Encodings in the CM Configuration File”](#) section on page 6.

Verifying L2VPN Support over Cable

To verify L2VPN information on the Cisco CMTS router, use the **show cable l2-vpn dot1q-vc-map** command.

SUMMARY STEPS

- show cable l2-vpn dot1q-vc-map**
- show cable l2-vpn dot1q-vc-map vpn vpnid**
- show cable l2-vpn dot1q-vc-map mac-address vpn vpnid**
- show cable l2-vpn dot1q-vc-map mac-address vpn vpnid verbose**
- show cable l2-vpn dot1q-vc-map mac-address verbose**

DETAILED STEPS

- Step 1** To display VLAN information for all cable modems, use the **show cable l2-vpn dot1q-vc-map** command as shown in the following example:

```
Router# show cable l2-vpn dot1q-vc-map
MAC Address      Ethernet Interface      VLAN ID   Cable Intf  SID   Customer Name/VPN ID
0014.f8c1.fd66  GigabitEthernet4/0/0    68       Cable6/0/0  3     0234560001
```

- Step 2** To display VLAN information for a particular L2VPN ID, use the **show cable l2 dot1q-vc-map vpn** form of the command as shown in the following example:

```
Router# show cable l2-vpn dot1q-vc-map vpn 0234560001
MAC Address      Ethernet Interface  VLAN ID  Cable Intf  SID  Customer Name/VPNID
0014.f8c1.fd66  GigabitEthernet4/0/0      68      Cable6/0/0  3    0234560001
```

- Step 3** To display information for a particular L2VPN ID on a specific cable modem, use the **show cable l2-vpn dot1q-vc-map vpn** form of the command along with specification of the cable modem MAC address, as shown in the following example:

```
Router# show cable l2-vpn dot1q-vc-map 0014.f8c1.fd66 vpn 0234560001
MAC Address      Ethernet Interface  VLAN ID  Cable Intf  SID  Customer Name/VPNID
0014.f8c1.fd66  GigabitEthernet4/0/0      68      Cable6/0/0  3    0234560001
```

- Step 4** To display detailed information for a particular L2VPN ID on a specific cable modem, use the **show cable l2-vpn dot1q-vc-map vpn verbose** form of the command along with specification of the cable modem MAC address, as shown in the following example:

```
Router# show cable l2-vpn dot1q-vc-map 0014.f8c1.fd66 vpn 0234560001 verbose
MAC Address          : 0014.f8c1.fd66
Prim Sid             : 3
Cable Interface      : Cable6/0/0
VPN ID               : 0234560001
L2VPN SAID           : 12294
Upstream SFID        : 23
Downstream CFRID[SFID] : 2[24]
CMIM                 : 0x60
Ethernet Interface   : GigabitEthernet4/0/0
DOT1Q VLAN ID        : 68
Total US pkts        : 1372
Total US bytes        : 500226
Total US pkt Discards : 0
Total US byte Discards : 0
Total DS pkts        : 1248
Total DS bytes        : 415584
Total DS pkt Discards : 0
Total DS byte Discards : 0
```

- Step 5** To display detailed information for a particular cable modem, use the the **show cable l2-vpn dot1q-vc-map verbose** form of the command along with specification of the cable modem MAC address, as shown in the following example:

```
Router# show cable l2-vpn dot1q-vc-map 0014.f8c1.fd66 verbose
MAC Address          : 0014.f8c1.fd66
Prim Sid             : 3
Cable Interface      : Cable6/0/0
L2VPNs provisioned  : 1
DUT Control/CMIM    : Enable/0xFFFFFFFF

VPN ID               : 0234560001
L2VPN SAID           : 12294
Upstream SFID        : 23
Downstream CFRID[SFID] : 2[24]
CMIM                 : 0x60
Ethernet Interface   : GigabitEthernet4/0/0
DOT1Q VLAN ID        : 68
Total US pkts        : 1374
Total US bytes        : 501012
Total US pkt Discards : 0
Total US byte Discards : 0
Total DS pkts        : 1250
Total DS bytes        : 416250
Total DS pkt Discards : 0
Total DS byte Discards : 0
```

Enabling Voice-Call on a L2VPN CM

You can enable the Voice-Call Support on a L2VPN CM feature by registering a cable modem with a SID to VPN mapping cable modem configuration file (MPLS or 802.1q).

- If the L2VPN is on the primary service flow, you should use a cable modem configuration file with static secondary service flow and the classifiers should be configured on the secondary service flow for non-L2VPN packets.
- If the L2VPN is on the secondary service flow, then classifiers should be configured for L2VPN packets.



Note

The cable modem configuration file based L2VPN configuration provides the flexibility to configure L2VPN on the primary or secondary service flow. However, we recommend that you configure L2VPN on the secondary service flow and the primary service flow is used for the default traffic.



Note

In a CLI-based L2VPN configuration, the L2VPN is on the primary service flow; therefore the static secondary service flow should be used for the eMTAs.

Verifying Dynamic Service Flows

To verify dynamically created service flows on the Cisco CMTS router, use the **show interface cable service-flow** command.



Note

To verify information about PacketCable operations, use **show packetcable** commands. For more information on **show packetcable** commands, refer the following link:
http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_19_show_m_to_show_z.html

```
Router# show interface cable 5/1/0 service-flow

Sfid : 30191
Mac Address : 000a.739e.140a
Type : Secondary(Dynamic)
Direction : Upstream
Current State : Active
Current QoS Indexes [Prov, Adm, Act] : [0, 24, 24]
Active Time : 00:55
Sid : 7140
Admitted QoS Timeout : 200 seconds
Active QoS Timeout : 0 seconds
Packets : 1824
Bytes : 466944
Rate Limit Delayed Grants : 0
Rate Limit Dropped Grants : 0
Current Throughput : 68356 bits/sec, 32 packets/sec
Classifiers:
Classifier Id : 41
Service Flow Id : 30191
CM Mac Address : 000a.739e.140a
Direction : upstream
Activation State : active
Classifier Matching Priority : 128
PHSI : 1
```

```

Number of matches : -
IP Classification Parameters:
IP Source Address : 10.8.230.3
Source IP Address Mask : 255.255.255.255
Destination IP Address : 172.16.2.35
Destination IP Address Mask : 255.255.255.255
IP Protocol Type : 17
Source Port Low : 53456
Source Port High : 53456
Destination Port Low : 7052
Destination Port High : 7052

```

Configuration Examples for L2VPN over Cable

This section provides configuration examples for the L2VPN over Cable feature:

- [Example: Specifying the Ethernet NSI Interface, page 13](#)
- [Example: Enabling Voice Call Support on MPLS L2VPN, page 13](#)
- [Example: Enabling Voice Call Support on 802.1q L2VPN, page 14](#)
- [Example: Enabling Voice Call Support on CLI-based L2VPN, page 15](#)

Example: Specifying the Ethernet NSI Interface

You can specify the Ethernet NSI within the CM configuration file, or using the **cable l2-vpn-service default-nsi** global configuration command as shown in the following example:

```
cable l2-vpn-service default-nsi GigabitEthernet4/0/0
```

Example: Enabling Voice Call Support on MPLS L2VPN

The following is a sample cable modem configuration file that enables voice call support on MPLS L2VPN. In this example the L2VPN is applied to the primary service flow.

```

03 (Net Access Control)          = 1
18 (Maximum Number of CPE)      = 16
43 (Vendor Specific Options)
  S08 (Vendor ID)                = ff ff ff
  S005 (Unknown sub-type)        = 01 04 32 30 32 30 02 07 04 05 01 0a 4c 02 01 2b 06 26 04
00 00 01 90

22 (Upstream Packet Classification Encoding Block)
  S01 (Classifier Reference)      = 2
  S03 (Service Flow Reference)   = 2
  S09 (IP Packet Encodings)
    T03 (IP Source Address)      = 050 001 005 000
    T04 (IP Source Mask)        = 255 255 255 000

22 (Upstream Packet Classification Encoding Block)
  S01 (Classifier Reference)      = 3
  S03 (Service Flow Reference)   = 2
  S10 (Ethernet LLC Packet Classification Encodings)
    T02 (Source MAC Address)     = 00 e0 f7 5a c9 21

```

```

23 (Downstream Packet Classification Encoding Block)
  S01 (Classifier Reference)           = 21
  S03 (Service Flow Reference)        = 21
  S05 (Rule Priority)                 = 5
  S09 (IP Packet Encodings)
    T05 (IP Destination Address)      = 050 001 005 000
    T06 (IP Destination Mask)        = 255 255 255 000

23 (Downstream Packet Classification Encoding Block)
  S01 (Classifier Reference)           = 22
  S03 (Service Flow Reference)        = 21
  S05 (Rule Priority)                 = 5
  S10 (Ethernet LLC Packet Classification Encodings)
    T01 (Destination MAC Address)     = 00 e0 f7 5a c9 21 ff ff ff ff ff ff

24 (Upstream Service Flow Encodings)
  S01 (Service Flow Reference)        = 1
  S06 (QoS Parameter Set Type)       = 7
  S43 (Vendor Specific Options)
    T08 (Vendor ID)                  = ff ff ff
    T005 (Unknown sub-type)          = 01 04 32 30 32 30

24 (Upstream Service Flow Encodings)
  S01 (Service Flow Reference)        = 2
  S06 (QoS Parameter Set Type)       = 7

25 (Downstream Service Flow Encodings)
  S01 (Service Flow Reference)        = 20
  S06 (QoS Parameter Set Type)       = 7
  S07 (Traffic Priority)              = 0

25 (Downstream Service Flow Encodings)
  S01 (Service Flow Reference)        = 21
  S06 (QoS Parameter Set Type)       = 7
  S07 (Traffic Priority)              = 1

29 (Privacy Enable)                  = 1

```

Example: Enabling Voice Call Support on 802.1q L2VPN

The following is a sample cable modem configuration file that enables voice call support on 802.1q L2VPN. In this example the L2VPN is applied to the secondary service flow.

```

03 (Net Access Control)              = 1
43 (Vendor Specific Options)
  S08 (Vendor ID)                    = ff ff ff
  S005 (Unknown sub-type)            = 01 05 02 34 56 00 01 02 04 02 02 00 44

18 (Maximum Number of CPE)          = 16

22 (Upstream Packet Classification Encoding Block)
  S01 (Classifier Reference)          = 2
  S03 (Service Flow Reference)        = 2
  S10 (Ethernet LLC Packet Classification Encodings)
    T02 (Source MAC Address)         = 00 e0 14 e3 23 1c

23 (Downstream Packet Classification Encoding Block)
  S01 (Classifier Reference)          = 4
  S03 (Service Flow Reference)        = 4
  S43 (Vendor Specific Options)
    T08 (Vendor ID)                  = ff ff ff
    T005 (Unknown sub-type)          = 01 05 02 34 56 00 01

```

```

S11 (IEEE 802.1P/Q Packet Classification Encodings)
  T01 (IEEE 802.1P UserPriority) = 00 07

24 (Upstream Service Flow Encodings)
  S01 (Service Flow Reference) = 1
  S06 (QoS Parameter Set Type) = 7

24 (Upstream Service Flow Encodings)
  S01 (Service Flow Reference) = 2
  S06 (QoS Parameter Set Type) = 7
  S43 (Vendor Specific Options)
    T08 (Vendor ID) = ff ff ff
    T005 (Unknown sub-type) = 01 05 02 34 56 00 01 08 01 01

25 (Downstream Service Flow Encodings)
  S01 (Service Flow Reference) = 3
  S06 (QoS Parameter Set Type) = 7

25 (Downstream Service Flow Encodings)
  S01 (Service Flow Reference) = 4
  S06 (QoS Parameter Set Type) = 7

```

Example: Enabling Voice Call Support on CLI-based L2VPN

The following is a sample cable modem configuration file that enables voice call support on L2VPN configured using CLI. L2VPN configured using the CLI is always applied to the primary service flow.

```

03 (Net Access Control) = 1
18 (Maximum Number of CPE) = 16

22 (Upstream Packet Classification Encoding Block)
  S01 (Classifier Reference) = 2
  S03 (Service Flow Reference) = 2
  S09 (IP Packet Encodings)
    T03 (IP Source Address) = 050 001 005 000
    T04 (IP Source Mask) = 255 255 255 000

22 (Upstream Packet Classification Encoding Block)
  S01 (Classifier Reference) = 3
  S03 (Service Flow Reference) = 2
  S10 (Ethernet LLC Packet Classification Encodings)
    T02 (Source MAC Address) = 00 e0 f7 5a c9 21

23 (Downstream Packet Classification Encoding Block)
  S01 (Classifier Reference) = 21
  S03 (Service Flow Reference) = 21
  S05 (Rule Priority) = 5
  S09 (IP Packet Encodings)
    T05 (IP Destination Address) = 050 001 005 000
    T06 (IP Destination Mask) = 255 255 255 000

23 (Downstream Packet Classification Encoding Block)
  S01 (Classifier Reference) = 22
  S03 (Service Flow Reference) = 21
  S05 (Rule Priority) = 5
  S10 (Ethernet LLC Packet Classification Encodings)
    T01 (Destination MAC Address) = 00 e0 f7 5a c9 21 ff ff ff ff ff ff

24 (Upstream Service Flow Encodings)
  S01 (Service Flow Reference) = 1
  S06 (QoS Parameter Set Type) = 7

```

```
24 (Upstream Service Flow Encodings)
  S01 (Service Flow Reference)      = 2
  S06 (QoS Parameter Set Type)     = 77

25 (Downstream Service Flow Encodings)
  S01 (Service Flow Reference)     = 20
  S06 (QoS Parameter Set Type)     = 7
  S07 (Traffic Priority)           = 0

25 (Downstream Service Flow Encodings)
  S01 (Service Flow Reference)     = 21
  S06 (QoS Parameter Set Type)     = 7
  S07 (Traffic Priority)           = 1

29 (Privacy Enable)                = 1
```

Additional References

The following sections provide references related to the L2VPN Support over Cable feature.

Related Documents

Related Topic	Document Title
Cable modem configuration file creation	“DOCSIS Internal Configuration File Generator for the Cisco CMTS” http://www.cisco.com/en/US/docs/ios/cable/configuration/guide/cmts_dsis_cfg_gen.html
SNMP configuration information	<i>Cisco IOS Configuration Fundamentals Configuration Guide, Part 3: Cisco IOS System Management</i> , “Configuring SNMP Support” section http://www.cisco.com/en/US/docs/ios/12_2/configfun/configuration/guide/fc014.html
SNMP command information	<i>Cisco IOS Network Management Command Reference, Release 12.2SB</i> http://www.cisco.com/en/US/docs/ios/netmgmt/command/reference/nm_book.html

Standards

Standard	Title
CM-SP-BPI+-I12-050812	<i>Baseline Privacy Plus Interface Specification</i> http://www.cablelabs.com/cablemodem/downloads/specs/CM-SP-BPI+_I12-050812.pdf
CM-SP-L2VPN-I03-061222	<i>Business Services over DOCSIS (BSOD) Layer 2 Virtual Private Networks</i> http://www.cablelabs.com/cablemodem/downloads/specs/CM-SP-L2VPN-I03-061222.pdf
CM-SP-RFIV2.0-I11-060602	<i>Radio Frequency Interface Specification</i> http://www.cablelabs.com/cablemodem/downloads/specs/CM-SP-RFI2.0-I11-060602.pdf
IEEE 802.1ad	<i>IEEE 802.1ad-2005 IEEE Standards for Local and metropolitan area networks—Virtual Bridged Local Area Networks</i> http://www.ieee.org
IEEE 802.1q	<i>IEEE Std 802.1Q Virtual Bridged Local Area Networks</i> http://www.ieee.org

MIBs

MIB	MIBs Link
DOCS-L2VPN-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
RFC 2685	<i>Virtual Private Networks Identifier</i> http://www.ietf.org/rfc/rfc2685.txt
RFC 4364	<i>BGP/MPLS IP Virtual Private Networks (VPNs)</i> http://www.ietf.org/rfc/rfc4364.txt

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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for L2VPN Support over Cable

Table 3 lists the features in this module and provides links to specific configuration information.

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://www.cisco.com/go/cfn>. An account on Cisco.com is not required.



Note

Table 3 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 3 Feature Information for L2VPN Support Over Cable

Feature Name	Releases	Feature Information
L2VPN Support over Cable	12.2(33)SCA	This feature was introduced and provides point-to-point Transparent LAN Service (TLS) in support of the Business Services over DOCSIS (BSOD) CableLabs specification. The cable l2-vpn-service default-nsi command is introduced.
Voice-Call Support on L2VPN CM	12.2(33)SCF2	This feature allows you to enable voice calls on L2VPN-provisioned cable modem.

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