Transparent LAN Service over Cable

This document describes the Transparent LAN Service over Cable feature, which enhances existing Wide Area Network (WAN) support to provide more flexible Managed Access for multiple Internet service provider (ISP) support over a hybrid fiber-coaxial (HFC) cable network. This feature allows service providers to create a Layer 2 tunnel by mapping an upstream service identifier (SID) to an ATM permanent virtual connection (PVC) or to an IEEE 802.1Q Virtual Local Area Network (VLAN).

Feature Specifications for Transparent LAN Service over Cable

Feature History	
Release	**Modification**
Release 12.2(11)BC3	This feature was introduced for Cisco uBR7100 series and Cisco uBR7246VXR universal broadband routers to support Layer 2 encapsulation over ATM networks.
Release 12.2(15)BC2	Support was added for IEEE 802.1Q Virtual Local Area Network (VLAN) tagging on the Cisco uBR7246VXR universal broadband router. Support was also added for identifying mappings with a customer name.
Release 12.3(9a)BC	Support was added for Transparent LAN Services (TLS) for the following Cisco CMTS platforms: • IEEE 802.1Q on the Cisco uBR10012 router with Cisco uBR10012 PRE2 performance routing engine modules • ATM on the Cisco uBR7246VXR router

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://www.cisco.com/go/fn. 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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Contents

This document includes the following major sections:

Prerequisites for Transparent LAN Service over Cable

The Transparent LAN Service over Cable feature has the following prerequisites:

- Cisco uBR7100 series and Cisco uBR7246VXR routers must be running Cisco IOS Release 12.2(11)BC3 or later to support ATM PVC mapping. The routers must be running Cisco IOS Release 12.2(15)BC2 or later to support IEEE 802.1Q VLAN mapping.
- You must know the hardware (MAC) addresses of the cable modems that are to be mapped to ATM PVCs or IEEE 802.1Q VLANs.
- You must create a bridge group for each separate customer on the Layer 2 bridge aggregator, so that traffic from all of the Customer Premises Equipment (CPE) devices for the customer is grouped together into the same ATM or 802.1Q tunnel.

Restrictions for Transparent LAN Service over Cable

The Transparent LAN Service over Cable feature has the following restrictions and limitations:

- Configuring ATM L2VPN or 802.1q for a particular cable modem removes any previous cable modem configuration on the Cisco uBR7246VXR router. For example, if TLS with 802.1q is configured on the router for a particular cable modem, and then you configure ATM L2VPN for the same cable modem, the Cisco uBR7246VXR router supports the latter and removes the former with no additional warning or system messages.
- Cisco strongly recommends that TLS over Cable only be used when Baseline Privacy Interface (BPI) is enabled in the environment. If BPI is not enabled when using the TLS feature, traffic can flow between multiple virtual private networks (VPNs), and become vulnerable to denial-of-service attacks or snooping. Cisco also recommends that remote networks be isolated with a gateway or firewall router when BPI is not enabled.

  Commencing in Cisco IOS release 12.3(13a)BC, and later releases, when the TLS feature is used with Layer 2 VPNs, the participating cable modems *must* have the Baseline Privacy Interface security feature (BPI) enabled. Otherwise, the Cisco CMTS drops such Layer 2 traffic in the upstream or downstream.
- The Transparent LAN Service over Cable is not supported on the Cisco uBR10012 universal broadband router when using the PRE-1 module.

- You cannot mix IEEE 802.1Q and ATM PVC mapping in the same bridge group. To use both types of mappings on the same Cisco CMTS, you must use separate bridge groups.
- Packets are mapped to their Layer 2 tunnel only on the basis of Layer 2 information (the cable modem's MAC address and primary SID). Layer 3 services, such as access lists, IP address source-verify, and IP QoS, are not supported as packets are sent through the tunnel.
- All traffic from a cable modem is mapped to the same Layer 2 tunnel. It is not possible to differentiate traffic from different customer premises equipment (CPE) devices behind the cable modem.
- CPE learning is not available when using the Transparent LAN Service over Cable feature. When a cable modem is mapped to a Layer 2 tunnel, the **show interface cable modem** command shows that the IP addresses for its CPE devices are "unavailable."
- DOCSIS QoS is supported across the Layer 2 tunnel only on the primary SID. Traffic using secondary services uses the same Layer 2 tunnel as the primary SID.
- The Spanning Tree Protocol (STP) cannot be used with devices (cable modems, their CPE devices, and the endpoint CPE devices) that are using this feature. In particular, Spanning Tree Protocol cannot be used between the VLAN bridge aggregator and the endpoint customer devices.
- The following restrictions apply to Layer 2 tunnels over an ATM interface:
  - The virtual connections (VC) on the ATM interface must be configured to use ATM Adaptation Layer 5 (AAL5) IEEE 802.1a Subnetwork Access Point (SNAP) encapsulation. On Cisco routers, this means that each PVC endpoint must be configured for the proper encapsulation using the **encapsulation aal5snap** command.
  - If a cable modem is being mapped to an ATM PVC, all of its CPE traffic is sent through the ATM tunnel through the ATM cloud, even if the ultimate destination is another cable modem on the same CMTS.
  - Cable modems must have a one-to-one mapping with ATM PVCs, with each cable modem being mapped to its own ATM PVC. Cable modems cannot share a single PVC. Multiple PVCs from the same customer are aggregated at the ATM bridge aggregator into the same bridge group.
- The following restrictions apply to Layer 2 tunnels over an Ethernet IEEE 802.1Q VLAN interface:
  - IEEE 802.1Q tunnels are supported only on Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces.
  - The Cisco CMTS router supports a maximum of 4095 VLAN IDs, but the switches acting as the bridge aggregator might support a lower number of VLAN IDs. If this is the case, the Cisco CMTS should be configured only for the maximum number of VLANs that are supported by the bridge aggregator switches.

Information About Transparent LAN Service over Cable

This section describes the following variations of the Transparent LAN Service over Cable feature:

Feature Overview

The Transparent LAN Service over Cable feature enables service providers to provide Layer 2 tunnels for traffic to and from cable modems. This allows customers to create their own virtual local area network (VLAN) using any number of cable modems in multiple sites.

On the Cisco CMTS, you map each cable modem (on the basis of its MAC address) to the appropriate VLAN. The CMTS then creates an internal database of this one-to-one mapping of cable modems to VLANs, and uses it to encapsulate packets for the appropriate VLAN.

The CMTS encapsulates the CPE traffic from mapped cable modems using one of the following methods:

- ATM PVC Mapping—The cable modem's MAC address is mapped to a PVC on a specific ATM interface, so that all traffic from the cable modem is sent over that particular PVC.
- IEEE 802.1Q Mapping—The cable modem's MAC address is mapped to an IEEE 802.1Q VLAN on a specific Ethernet interface, so that all traffic from the cable modem is tagged with the specified VLAN ID.

Traffic to and from this group of cable modems is bridged into a single logical network (the VLAN) by the bridge aggregator, creating a secure Virtual Private Network (VPN) for that particular group of cable modems. Traffic in one VLAN cannot be sent into another VLAN, unless specifically done so by an external router.

The switch acting as the Layer 2 Bridge Aggregator uses the ATM PVC or the VLAN tagging to forward the traffic to the appropriate destination. This frees up service providers from needing to know the addressing, routing, and topological details of the customer's network.

Transparent LAN Service and Layer 2 Virtual Private Networks

In addition, service providers can provide a Layer 2 VPN with only minimal configuration changes on the provider's routers. The service subscriber does not need to make any changes to their private network or cable modems, nor does the service provider have to provide any special DOCSIS configuration files to enable this feature.

Cisco IOS Release 12.3(13a)BC introduces the following changes or requirements for the TLS feature with Layer 2 VPNs:

- When the TLS feature is used with Layer 2 VPNs, the participating cable modems must have the Baseline Privacy Interface security feature (BPI) enabled. Otherwise, the Cisco CMTS drops such Layer 2 traffic in the upstream or downstream.
- Information about Customer Premises Equipment (CPE) does not display in the output of the **show cable modem** command.

ATM PVC Mapping

This section describes the mapping of cable modems to an ATM PVC, as it is available in the Transparent LAN Service over Cable feature:

- Overview, page 5
- Details of ATM PVC Mapping, page 5

Overview

The Transparent LAN Service over Cable feature enables service providers to provide Layer 2 tunnels over an existing ATM network. This allows customers to create their own virtual network using any number of cable modems that are located at multiple sites.

On the Cisco CMTS, you map each cable modem (on the basis of its MAC address) to a separate PVC on an ATM interface. The CMTS then creates an internal database of this one-to-one mapping of cable modems to PVCs, and uses it to determine which packets should be forwarded to the ATM network.

The CMTS encapsulates the CPE traffic from mapped cable modems using AAL5 SNAP encapsulation, as defined in RFC 1483, Multiprotocol Encapsulation over ATM Adaptation Layer 5. It then forwards those packets to the appropriate ATM interface and PVC.

Traffic to and from this group of cable modems is routed to a group of PVCs that are bridged into a single ATM network by the ATM bridge aggregator, creating a secure Virtual Private Network (VPN) for that particular group of cable modems.

Details of ATM PVC Mapping

To implement the Transparent LAN Service over Cable feature for ATM networks, a service provider must perform the following configuration steps:

1. Identify the cable modems and their MAC addresses that should be mapped to ATM PVCs.
2. Define one PVC (using AAL5 SNAP encapsulation) for each cable modem to be mapped. This must be done on both endpoints (the CMTS router and the ATM bridge aggregator).
3. Create a bridge group for each customer on the ATM bridge aggregator, and assign all of a customer's PVCs to the same bridge group, so that all of the mapped traffic for that customer is bridged into the same MAC domain on the ATM bridge aggregator.
4. Enable Layer 2 mapping on the CMTS, and then map each cable modem on that CMTS to the appropriate PVC.

After the Transparent LAN Service over Cable feature has been enabled and configured, the CMTS immediately begins mapping traffic between the associated cable modems and PVCs. For efficient mapping between the DOCSIS and ATM networks, the CMTS maintains an internal database that links SIDs to the PVCs. This ensures that all service flows from the cable modem are routed properly.

When the CMTS receives a packet on an upstream, it looks up the SID to see if it is mapped to a PVC. If so, and if the packet's source MAC address is not the cable modem's MAC address, the CMTS encapsulates the packet using an AAL5 SNAP header and forwards it to the appropriate PVC on the ATM interface. If the packet is not being mapped, or if the packet originated from the cable modem, the CMTS routes the packet as normal.

When the CMTS receives a packet from a PVC on the ATM interface, it looks up the PVC/PVI information to see if it is mapped to a SID. If so, the CMTS strips off the AAL5 SNAP header, adds a proper DOCSIS header, and transmits the packet on the appropriate downstream interface. If the packet's PVC is not being mapped, the CMTS continues processing the packet on the ATM network.

IEEE 802.1Q Mapping

This section describes the mapping of cable modems to an IEEE 802.1Q VLAN, as it is available in the Transparent LAN Service over Cable feature:

- Overview, page 6

Overview

The Transparent LAN Service over Cable feature enables service providers to provide Layer 2 tunnels over an Ethernet network, using IEEE 802.1Q standard tags. This allows customers to create their own virtual network using any number of cable modems in different sites.

On the Cisco CMTS, you map each cable modem (on the basis of its MAC address) to the appropriate VLAN. The CMTS then creates an internal database of this one-to-one mapping of cable modems to VLANs, and uses it to encapsulate packets for the appropriate VLAN.

The CMTS encapsulates the CPE traffic from mapped cable modems using VLAN tags, as defined in IEEE 802.1Q-1993, IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks. The switch acting as the Layer 2 Bridge Aggregator uses the VLAN tagging to forward the packets to the appropriate destination.

Traffic to and from this group of cable modems is bridged into a single logical network by the bridge aggregator, creating a secure Virtual Private Network (VPN) for that particular group of cable modems. Traffic in one VLAN cannot be sent into another VLAN, unless specifically done so by an external router.

Details of IEEE 802.1Q Mapping

To implement the Transparent LAN Service over Cable feature using IEEE 802.1Q VLANs, a service provider must perform the following configuration steps:

1. Identify the cable modems and their MAC addresses that should be mapped to the IEEE 802.1Q VLANs.
2. Create the required VLANs on the router that is acting as the bridge aggregator.
3. Enable Layer 2 mapping on the CMTS, and then map each cable modem on that CMTS to the appropriate VLAN.

After the Transparent LAN Service over Cable feature has been enabled and configured to use IEEE 802.1Q mappings, the CMTS immediately begins mapping traffic between the associated cable modems and VLANs. For efficient mapping, the CMTS maintains an internal database that links each cable modem's primary service flow ID (SFID) and service ID (SID) to the appropriate VLAN and Ethernet interface. This ensures that all service flows from the cable modem are routed properly.

When the CMTS receives a packet on an upstream, it looks up its SID to see if it is mapped to a VLAN. If so, and if the packet's source MAC address is not the cable modem's MAC address, the CMTS inserts the appropriate IEEE 802.1Q VLAN tag into the packet's header and forwards the packet to the appropriate Ethernet interface. If the packet is not being mapped, or if the packet originated from the cable modem, the CMTS routes the packet using the normal Layer 3 processes.

When the CMTS receives a packet from a WAN interface that is encapsulated with an IEEE 802.1Q VLAN tag, it looks up the packet's SID to see if it belongs to a cable modem being mapped. If so, the CMTS strips off the VLAN tag, adds the proper DOCSIS header, and transmits the packet on the appropriate downstream interface. If the packet is not being mapped, the CMTS continues with the normal Layer 3 processing.

Benefits

The Transparent LAN Service over Cable feature provides the following benefits to cable service providers and their partners and customers:

- Provides Layer 2 level mapping, which is transparent to Layer 3 protocols and services. This means that service providers do not need to know the details of their customers' network topologies, routing protocols, or IP addressing.
- Allows service providers to maximize the use of their existing ATM or Ethernet WAN networks. Multiple customers can be combined on the same outgoing interface, while still ensuring that each customer's network is kept private while it is transmitted over the tunnel.
- Provides a highly flexible and scalable solution for multiple customers. The service provider needs to create only one bridge group for each VPN, and then only one ATM PVC or VLAN mapping for each cable modem that should participate in that VPN tunnel.
- Customers retain full control over their private networks, while service providers retain full control over cable modems and the rest of the cable and ATM networks. Only the CPE traffic from the cable modems is mapped into the ATM tunnel, while traffic originating at the cable modem continues to be processed as normal by the service provider's network.
- Allows service providers to mix tunneled and nontunneled cable modems on the same DOCSIS cable network.
- Allows customers to create a single, secure virtual network with Ethernet Layer 2 connectivity for multiple sites.
- Allows multiple tunnels from different customers and endpoints to be aggregated into a single bridge, so as to maximize the use of bandwidth and other network resources.
- Supports the tunneling of multiple Layer 3, non-IP protocols, and not just IP Layer 3 services, as is the case with Layer 3 solutions, such as Multiprotocol Label Switching (MPLS) VPNs.
- All DOCSIS services, including BPI+ encryption and authentication, continue to be supported for all cable modems.

How to Configure the Transparent LAN Service over Cable Feature

This section describes the following tasks that are required to implement the Transparent LAN Service over Cable feature:

- Configuring Layer 2 Tunneling for ATM PVC Mapping, page 7
- Configuring IEEE 802.1Q VLAN Mapping, page 11

Configuring Layer 2 Tunneling for ATM PVC Mapping

This section describes how to enable Layer 2 mapping on the Cisco CMTS, and then to map particular cable modems to an ATM PVC.

- Enabling and Configuring Layer 2 Tunneling and ATM PVC Mapping, page 8
- Creating the ATM Virtual Connections and Bridge Group, page 9

Enabling and Configuring Layer 2 Tunneling and ATM PVC Mapping

This section describes how to enable Layer 2 mapping on the Cisco CMTS, and then to map particular cable modems to PVCs on an ATM interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **cable l2-vpn-service atm-vc**
4. **cable vc-map** *mac-address atm-interface vpi/vci* [*cust-name*]
5. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**enable**
	
	Example:
	`Router> enable`
	`Router#`
		Enables privileged EXEC mode. Enter your password if prompted.

Step 2	**configure terminal**
	
	Example:
	`Router# configure terminal`
	`Router(config)#`
		Enters global configuration mode.

Step 3	**cable l2-vpn-service atm-vc**
	
	Example:
	`Router(config)# cable l2-vpn-service atm-vc`
	`Router(config)#`
		Enables Layer 2 tunneling for the Transparent LAN Service over Cable feature.

Step 4	**cable vc-map** *mac-address atm-interface vpi/vci* [*cust-name*]
	
	Example:
	`Router(config)# cable vc-map 0000.0C04.0506 A3/0/0 1/1`
	`Router(config)#`
		Maps the specified MAC address of a cable modem to the indicated PVC and ATM interface.
		
		Note Repeat this command for each cable modem that is to be mapped to an ATM PVC.

Step 5	**end**
	
	Example:
	`Router(config)# end`
	`Router#`
		Exits global configuration mode and returns to privileged EXEC mode.

Creating the ATM Virtual Connections and Bridge Group

This section describes the minimum configuration needed to configure a Cisco router, which is acting as an ATM bridge aggregator, so that it can terminate the PVCs being used with the Transparent LAN Service over Cable feature.

Restrictions

Each bridge group used for the Transparent LAN Service over Cable feature must disable Spanning Tree Protocol. Each PVC used for this feature must be configured for AAL5 SNAP encapsulation.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **bridge 2 protocol ieee**
4. **interface ATM** *x/0.y* **point-to-point**
5. **bridge group** *number*
6. **bridge group** *number* **spanning-disabled**
7. **pvc** *vpi/vci*
8. **encapsulation aal5snap**
9. **exit**
10. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**enable**
	
	Example:
	`Router> enable`
	`Router#`
		Enables privileged EXEC mode. Enter your password if prompted.

Step 2	**configure terminal**
	
	Example:
	`Router# configure terminal`
	`Router(config)#`
		Enters global configuration mode.

Step 3	**bridge** *number* **protocol ieee**
	
	Example:
	`Router(config)# bridge 2 protocol ieee`
	`Router(config)#`
		Specifies that the bridge being used should use the IEEE bridge protocol.

	Command or Action	Purpose

Step 4	**interface ATM** *x/0.y* **point-to-point**
	
	Example:
	`Router(config)# interface ATM 4.0/1 point-to-point`
	`Router(config-if)#`
		Enters interface configuration mode for the ATM subinterface that will be used for this PVC.

Step 5	**bridge-group** *number*
	
	Example:
	`Router(config-if)# bridge-group 2`
	`Router(config-if)#`
		Assigns this subinterface to the bridge group that will be used for this particular customer.
		
		Note You cannot mix IEEE 802.1Q and ATM PVC mapping in the same bridge group. To use both types of mappings on the same Cisco CMTS, you must use separate bridge groups.

Step 6	**bridge-group** *number* **spanning-disabled**
	
	Example:
	`Router(config-if)# bridge-group 2 spanning-disabled`
	`Router(config-if)#`
		Disables the use of Spanning Tree Protocol on this bridge group.

Step 7	**pvc** *vpi/vci*
	
	Example:
	`Router(config-if)# pvc 1/1`
	`Router(config-if-atm-vc)#`
		Creates an ATM PVC with the given virtual path identifier (VPI) and virtual channel identifier (VCI), and enters interface-ATM-VC configuration mode.

Step 8	**encapsulation aal5snap**
	
	Example:
	`Router(config-if-atm-vc)# encapsulation aal5snap`
	`Router(config-if-atm-vc)#`
		Configures the PVC for AAL5 SNAP encapsulation.

Step 9	**exit**
	
	Example:
	`Router(config-if-atm-vc)# exit`
	`Router(config-if)#`
		Exits interface-ATM-VC configuration mode.

	Note Repeat Step 4 through Step 9 for each PVC to be created.	

Step 10	**end**
	
	Example:
	`Router(config-if)# end`
	`Router#`
		Exits interface configuration mode and returns to privileged EXEC mode.

Configuring IEEE 802.1Q VLAN Mapping

This section describes how to enable Layer 2 mapping on the Cisco CMTS, and then to map particular cable modems to an IEEE 802.1Q VLAN.

- Enabling and Configuring Layer 2 Tunneling for IEEE 802.1Q Mapping, page 11
- Creating the IEEE 802.1Q VLAN Bridge Group, page 12

Enabling and Configuring Layer 2 Tunneling for IEEE 802.1Q Mapping

This section describes how to enable Layer 2 mapping on the Cisco CMTS, and then to map particular cable modems to IEEE 802.1Q VLANs on an Ethernet, Fast Ethernet, or Gigabit Ethernet interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **cable l2-vpn-service dot1q**
4. **encapsulation dot1q** *vlan-id*
5. **cable dot1q-vc-map** *mac-address ethernet-interface vlan-id* [*cust-name*]
6. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**enable**
	
	Example:
	`Router> enable`
	`Router#`
		Enables privileged EXEC mode. Enter your password if prompted.

Step 2	**configure terminal**
	
	Example:
	`Router# configure terminal`
	`Router(config)#`
		Enters global configuration mode.

Step 3	**cable l2-vpn-service dot1q**
	
	Example:
	`Router(config)# cable l2-vpn-service dot1q`
	`Router(config)#`
		Enables Layer 2 tunneling for IEEE 802.1Q VLAN mapping.
		
		Note It is not required to configure VLAN trunking on the Cisco CMTS. Though VLAN trunking is supported, be aware of additional impact of VLAN trunking on the Cisco CMTS.

	Command or Action	Purpose

Step 4	**encapsulation dot1q** *vlan-id*
	
	Example:
	`Router(config-if)# encapsulation dot1q 10`
	`Router(config-if)#`
		Enters configuration of the dot1q subinterface and specifies that traffic on the Ethernet link should use IEEE 802.1Q tagging, using the specified *vlan-id*. The *vlan-id* can range from 1 to 4095, with no default.
		Note This step to perform dot1q encapsulation is not essential for dot1q tagging of frames but it is recommended.

Step 5	**cable dot1q-vc-map** *mac-address ethernet-interface vlan-id* [*cust-name*]
	
	Example:
	`Router(config)# cable dot1q-vc-map 0000.0C04.0506 FastEthernet0/0 10`
	`Router(config)#`
		Maps the specified MAC address of a cable modem to the indicated VLAN and Ethernet, Fast Ethernet, or Gigabit Ethernet interface.
		Note Repeat this command for each cable modem that is to be mapped to an IEEE 802.1Q VLAN.

Step 6	**end**
	
	Example:
	`Router(config)# end`
	`Router#`
		Exits global configuration mode and returns to privileged EXEC mode.

Creating the IEEE 802.1Q VLAN Bridge Group

This section describes the minimum configuration needed to configure a Cisco router, which is acting as an IEEE 802.1Q VLAN bridge aggregator, so that it can terminate the VLANs being used with the Transparent LAN Service over Cable feature.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** [**Ethernet** | **FastEthernet** | **GigabitEthernet**] *x/0*
4. **ip address** *ip-address mask*
5. **interface** [**Ethernet** | **FastEthernet** | **GigabitEthernet**] *x/0.vlan-id*
6. **bridge group** *number*
7. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**enable**
	
	Example:
	`Router> enable`
	`Router#`
		Enables privileged EXEC mode. Enter your password if prompted.

Step 2	**configure terminal**
	
	Example:
	`Router# configure terminal`
	`Router(config)#`
		Enters global configuration mode.

Step 3	**interface** [**Ethernet** | **FastEthernet** | **GigabitEthernet**] *x/0*
	
	Example:
	`Router(config)# interface fastethernet 1/0`
	`Router(config-if)#`
		Enters interface configuration mode for the Ethernet interface that is in slot *x*.

Step 4	**ip address** *ip-address mask*
	
	Example:
	`Router(config-if)# ip address 10.10.10.85 255.255.255.0`
	`Router(config-if)#`
		Configures the interface with the specified IP address and subnet mask.

Step 5	**interface** [**Ethernet** | **FastEthernet** | **GigabitEthernet**] *x/0.y*
	
	Example:
	`Router(config)# interface fastethernet 1/0.10`
	`Router(config-if)#`
		Creates a subinterface on the Ethernet interface that is in slot *x*. The valid range for *y* is 1 to 4294967293, with no default.
		
		Note Note 1: To simplify network management, set the subinterface number to the same value as the VLAN ID that will use this subinterface (which in this case is 10). The valid range for the subinterface number is 1 to 4095. Note 2: The steps to create a subinterface is not essential for dot1q tagging of frames but it is recommended.

Step 6	**bridge group** *number*
	
	Example:
	`Router(config-if)# bridge group 20`
	`Router(config-if)#`
		Configures this subinterface to belong to the specified bridge group. The valid range for number is 1 to 255, with no default.
		
		Note You cannot mix IEEE 802.1Q and ATM PVC mapping in the same bridge group. To use both types of mappings on the same Cisco CMTS, you must use separate bridge groups.

	Note Repeat steps Step 5 through Step 6 for each subinterface to be created and bridged.	

	Command or Action	Purpose

Step 7	**end**
	
	Example:
	`Router(config-if)# end`
	`Router#`
		Exits interface configuration mode and returns to privileged EXEC mode.

Configuration Examples for Transparent LAN Service over Cable

This section lists sample configurations for the Transparent LAN Service over Cable feature on a CMTS router and on a Cisco router acting as an ATM bridge aggregator:

CMTS ATM PVC Mapping Configuration Example

The following partial configuration for a Cisco uBR7246VXR router shows a typical configuration that creates two ATM PVCs and maps them to two cable modems.

```
!
hostname "ubr7246vxr"
!
cable l2-vpn-service atm-vc
cable vc-map 0010.7bed.9c95 ATM2/0 1/2
cable vc-map 0007.0e03.69f9 ATM2/0 1/1
!
!
interface ATM2/0
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
!
interface ATM2/0.1 point-to-point
 no ip route-cache
 no ip mroute-cache
 pvc 1/1
  encapsulation aal5snap
 !
!
interface ATM2/0.2 point-to-point
 no ip route-cache
 no ip mroute-cache
 pvc 1/2
  encapsulation aal5snap
 !
!
```

ATM Bridge Aggregator Configuration Example

The following partial configuration for a Cisco 7200 or similar router shows a typical configuration that creates two ATM PVCs and configures them as part of the same ATM bridge group.

```
hostname IRB-Router
!
bridge irb
bridge 2 protocol ieee

!
!
```

```
interface ATM4/0
 no ip address
 no ip directed-broadcast
 no atm enable-ilmi-trap
 no atm ilmi-keepalive
!
interface ATM4/0.1 point-to-point
 pvc 1/1
  encapsulation aal5snap
 !
 bridge-group 2
 bridge-group 2 spanning-disabled
!
interface ATM4/0.2 point-to-point
 pvc 1/2
  encapsulation aal5snap
 !
 bridge-group 2
 bridge-group 2 spanning-disabled
```

CMTS IEEE 802.1Q VLAN Mapping Configuration Example

The following partial configuration for a Cisco uBR7246VXR router shows a typical configuration that shows a number of cable modems being mapped to two different IEEE 802.1Q VLANs.

```
cable l2-vpn-service dot1q

! Customer 1
cable dot1q-vc-map 000C.0e03.69f9 GigabitEthernet 1/0 10 Customer1
cable dot1q-vc-map 0010.7bea.9c95 GigabitEthernet 1/0 11 Customer1
cable dot1q-vc-map 0010.7bed.81c2 GigabitEthernet 1/0 12 Customer1
cable dot1q-vc-map 0010.7bed.9b1a GigabitEthernet 1/0 13 Customer1

! Customer 2
cable dot1q-vc-map 0002.fdfa.137d GigabitEthernet 1/0 20 Customer2
cable dot1q-vc-map 0006.28f9.9d19 GigabitEthernet 1/0 21 Customer2
cable dot1q-vc-map 000C.7b6b.58c1 GigabitEthernet 1/0 22 Customer2
cable dot1q-vc-map 000C.7bed.9dbb GigabitEthernet 1/0 23 Customer2
cable dot1q-vc-map 000C.7b43.aa7f GigabitEthernet 1/0 24 Customer2
cable dot1q-vc-map 0050.7302.3d83 GigabitEthernet 1/0 25 Customer2
...
```

IEEE 802.1Q Bridge Aggregator Configuration Example

The following example shows a router being used as a bridge aggregator to transmit VLANs across the same Fast Ethernet interface, using IEEE 802.1Q tagging.

```
!
interface GigabitEthernet0/1
 ip address 10.10.10.31 255.255.255.0
 duplex full
 speed auto
!

interface GigabitEthernet0/1.10
 description Customer1-site10
 encapsulation dot1Q 10
 bridge-group 200
```

```
interface GigabitEthernet0/1.11
 description Customer1-site11
 encapsulation dot1Q 11
 bridge-group 200

interface GigabitEthernet0/1.12
 description Customer1-site12
 encapsulation dot1Q 12
 bridge-group 200

interface GigabitEthernet0/1.13
 description Customer1-site13
 encapsulation dot1Q 13
 bridge-group 200

!-----------------------------------
interface GigabitEthernet0/1.20
 description Customer2-site20
 encapsulation dot1Q 20
 bridge-group 201

interface GigabitEthernet0/1.21
 description Customer2-site21
 encapsulation dot1Q 21
 bridge-group 201

interface GigabitEthernet0/1.22
 description Customer2-site22
 encapsulation dot1Q 22
 bridge-group 201

interface GigabitEthernet0/1.23
 description Customer2-site23
 encapsulation dot1Q 23
 bridge-group 201

interface GigabitEthernet0/1.24
 description Customer2-site24
 encapsulation dot1Q 24
 bridge-group 201

interface GigabitEthernet0/1.25
 description Customer2-site25
 encapsulation dot1Q 25
 bridge-group 201
!
bridge 200 protocol ieee
bridge 201 protocol ieee
...
```

Additional References

For additional information related to Transparent LAN Service over Cable, refer to the following references:

Related Documents

Related Topic	Document Title
ATM Interface Configuration	Configuring ATM in the *Cisco IOS Wide-Area Networking Configuration Guide, Release 12.2*, at the following URL: http://www.cisco.com/en/US/docs/ios/12_2/wan/configuration/guide/wcfatm.html
ATM Interface Command Reference	ATM Commands in the *Cisco IOS Wide-Area Networking Command Reference,* Release 12.2, at the following URL: http://www.cisco.com/en/US/docs/ios/12_2/wan/command/reference/fwan_r.html
CMTS Command Reference	*Cisco IOS CMTS Cable Command Reference Guide,* at the following URL: http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.html
Virtual LAN Configuration	Virtual LANS in the Cisco IOS Switching Services Configuration Guide, Release 12.2, at the following URL: http://www.cisco.com/en/US/docs/ios/12_2/switch/configuration/guide/fswtch_c.html
Virtual LAN Command Reference	*Cisco IOS Switching Services Command Reference*, Release 12.2, at the following URL: http://www.cisco.com/en/US/docs/ios/12_2/switch/command/reference/fswtch_r.html
Cisco IOS Release 12.2 Command Reference	Cisco IOS Release 12.2 Configuration Guides and Command References, at the following URL: http://www.cisco.com/en/US/products/sw/iosswrel/ps1835/products_installation_and_configuration_guides_list.html http://www.cisco.com/en/US/products/sw/iosswrel/ps1835/prod_command_reference_list.html

Standards

Standards[1]	Title
SP-RFIv1.1-I08-020301	Data-over-Cable Service Interface Specifications Radio Frequency Interface Specification
IEEE 802.1Q, 1998 Edition	IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks

1. Not all supported standards are listed.

MIBs

MIBs[1]	MIBs Link
No new or modified MIB objects are supported by the Transparent LAN Service over Cable feature.	To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

1. Not all supported MIBs are listed.

RFCs

RFCs[1]	Title
RFC 1163	A Border Gateway Protocol
RFC 1164	Application of the Border Gateway Protocol in the Internet
RFC 1483	Multiprotocol Encapsulation over ATM Adaptation Layer 5 (AAL5)
RFC 2233	DOCSIS OSSI Objects Support
RFC 2283	Multiprotocol Extensions for BGP-4
RFC 2665	DOCSIS Ethernet MIB Objects Support
RFC 2669	Cable Device MIB

1. Not all supported RFCs are listed.

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

Command Reference

This section documents the new or modified commands that are needed to document the Transparent LAN Service over Cable feature.

This section documents the following commands:

Other cable-specific commands are documented in the *Cisco IOS CMTS Cable Command Reference Guide,* at the following URL:

http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.html

All other commands used with this feature are documented in the Cisco IOS Release 12.2T command reference publications.

cable dot1q-vc-map

To map a cable modem to a particular Virtual Local Area Network (VLAN) on a local outbound Ethernet interface, use the **cable dot1q-vc-map** command in global configuration mode. To remove this mapping, or to remove a particular customer's name from the internal tables, use the **no** form of this command.

cable dot1q-vc-map *mac-address* [**ds-srvflow-ref** *ds-sfref* **us-srvflow-ref** *us-sfref*] *ethernet-interface vlan-id* [**interface** *sec-ethernet-interface sec-vlan-id*] [*cust-name*]

no cable dot1q-vc-map *mac-address*

no cable dot1q-vc-map customer *cust-name*

Syntax Description

mac-address	Specifies the hardware (MAC) address for the cable modem whose traffic is to be mapped.
ds-srvflow-ref *ds-sfref*	(Optional) Specifies that the specific downstream service flow ID (SFID) should be mapped to the VLAN. The valid range for *ds-sfref* is 1 to 65535, with no default.
us-srvflow-ref *us-sfref*	(Optional) Specifies that the specific upstream service flow ID (SFID) should be mapped to the VLAN. The valid range for *us-sfref* is 1 to 65535, with no default.
ethernet-interface	Specifies the outbound interface to which this cable modem should be mapped. On the Cisco uBR7100 series and Cisco uBR7246VXR routers, you can specify an Ethernet, Fast Ethernet, or Gigabit Ethernet interface, depending on what interfaces are actually installed in the chassis.
vlan-id	Specifies the ID for the IEEE 802.1Q Virtual Local Area Network (VLAN) that should be used to tag the frames for this cable modem. The valid range is 1 to 4095, with no default. **Note** The switches acting as the bridge aggregators might support a lower number of VLAN IDs. If so, the Cisco CMTS should be configured within the limits of the switches' maximum number of VLANs.
interface *sec-ethernet-interface*	(Optional) Specifies a secondary outbound interface to which this cable modem should be mapped. You can specify an Ethernet, Fast Ethernet, or GigabitEthernet interface.
sec-vlan-id	(Optional) Specifies the ID for a secondary IEEE 802.1Q Virtual Local Area Network (VLAN) that should be used to tag the frames for this cable modem. The valid range is 1 to 4095, with no default.
cust-name	(Optional) Identifies the customer using this VLAN. The *cust-name* can be any arbitrary alphanumeric string, up to 127 characters long.
customer *cust-name*	(Optional) Deletes all VCs belong to this customer. The *cust-name* can be any arbitrary alphanumeric string, up to 127 characters long.

Defaults

No default behavior or values

Command Modes

Global configuration

Command History

Release	Modification
12.2(15)BC2	This command was introduced for Cisco uBR7246VXR universal broadband routers.
12.3(X)BC	Added support for mapping upstream and downstream service flows (**ds-srvflow-ref** and **us-srvflow-ref** options). Also added support for a secondary Ethernet interface.

Usage Guidelines

This command maps a cable modem, on the basis of its hardware (MAC) address, to a particular IEEE 802.1Q VLAN on a particular outbound Ethernet interface. This enables the cable modem's traffic to be part of a virtual LAN at the Layer-2 level.

Note To use this command, first enable the use of IEEE 802.1Q Layer 2 tunnels, using the **cable l2-vpn-service dot1q** command. Then use this command to map individual cable modems to specific VLANs.

Examples

The following example shows how to enable the use of Layer 2 tunnels and then map specific CMs to VLANs on a specific interface:

```
Router# config terminal
Router(config)# cable l2-vpn-service dot1q
Router(config)# cable dot1q-vc-map 000C.0e03.69f9 GigabitEthernet 1/0 4
Router(config)# cable dot1q-vc-map 0010.7bed.9c95 GigabitEthernet 1/0 5
Router(config)# exit
Router#
```

Note It is not required to configure VLAN trunking on the Cisco CMTS. Though VLAN trunking is supported, be aware of additional impact of VLAN trunking on the Cisco CMTS.

The following example shows the same command as above, but this time each VLAN is identified by the customer that is using it:

```
Router# config terminal
Router(config)# cable l2-vpn-service dot1q
Router(config)# cable dot1q-vc-map 000C.0e03.69f9 GigabitEthernet 1/0 4 ENTERPRISE-CO1
Router(config)# cable dot1q-vc-map 0010.7bed.9c95 GigabitEthernet 1/0 5 ENTERPRISE-CO2
Router(config)# exit
Router#
```

The following example shows how to remove the Layer 2 mapping for a specific cable modem. This particular cable modem's traffic is then routed using the normal Layer 3 routing processes.

```
Router# config terminal
Router(config)# no cable dot1q-vc-map 000C.0e03.69f9 GigabitEthernet 1/0 4
Router(config)# exit
Router#
```

Related Commands

Command	Description
cable l2-vpn-service dot1q	Enables the use of Layer 2 tunnels so that traffic for individual cable modems can be routed over a particular Virtual Local Area Network (VLAN) on an Ethernet interface.
debug cable l2-vpn	Displays debugging messages for the Layer 2 mapping of cable modems to particular PVCs or VLANs.
show cable l2-vpn dot1q-vc-map	Displays the mapping of one or all cable modems to VLANs on the router's Ethernet interfaces.

cable l2-vpn-service atm-vc

To enable the use of Layer 2 tunnels for the Customer Premises Equipment (CPE) traffic that is behind cable modems so that this traffic can be routed to a particular permanent virtual connection (PVC) on an Asynchronous Transfer Mode (ATM) interface, use the **cable l2-vpn-service atm-vc** command in global configuration mode. To disable the use of Layer 2 tunneling, use the **no** form of this command.

cable l2-vpn-service atm-vc

no cable l2-vpn-service atm-vc

Syntax Description

This command has no arguments or keywords.

Defaults

The use of Layer 2 tunneling for ATM PVC mapping is disabled.

Command Modes

Global configuration

Command History

Release	Modification
12.2(11)BC3	This command was introduced for Cisco uBR7100 series and Cisco uBR7246VXR universal broadband routers.

Usage Guidelines

This command enables the use of Layer 2 tunnels on all cable and ATM interfaces in the router—which in turn allows you to map cable modems, on the basis of their hardware (MAC) addresses, to particular PVCs on an ATM interface—using the **cable vc-map** command.

Examples

The following example shows how to enable the use of Layer 2 tunnels on a router so that cable modems can be mapped to particular PVCs on an ATM interface:

```
Router# config terminal
Router(config)# cable l2-vpn-service atm-vc
Router(config)#
```

Related Commands

Command	Description
cable vc-map	Maps a cable modem to a particular PVC on an ATM interface.
debug cable l2-vpn	Displays debugging messages for the Layer 2 mapping of cable modems to particular PVCs or VLANs.
show cable l2-vpn vc-map	Displays the mapping of one or all cable modems to PVCs on the ATM interfaces.

cable l2-vpn-service dot1q

To enable the use of Layer 2 tunnels so that traffic for individual cable modems can be routed over a particular Virtual Local Area Network (VLAN), use the **cable l2-vpn-service dot1q** command in global configuration mode. To disable the use of Layer 2 tunneling, use the **no** form of this command.

cable l2-vpn-service dot1q

no cable l2-vpn-service dot1q

Syntax Description

This command has no arguments or keywords.

Defaults

Layer 2 tunneling is disabled.

Command Modes

Global configuration

Command History

Release	Modification
12.2(15)BC2	This command was introduced for Cisco uBR7246VXR universal broadband routers.

Usage Guidelines

This command enables the use of Layer 2 tunnels, using IEEE 802.1Q VLAN tagging, on all cable interfaces in the router. This in turn allows you to map traffic to and from cable modems, on the basis of the modems' hardware (MAC) addresses, to a particular VLAN on a particular WAN interface, using the **cable dot1q-vc-map** command.

Examples

The following example shows how to enable the use of IEEE 802.1Q Layer 2 tunnels on a router so that cable modems can be mapped to particular VLAN:

```
Router# config terminal
Router(config)# cable l2-vpn-service dot1q
Router(config)#
```

Note It is not required to configure VLAN trunking on the Cisco CMTS. Though VLAN trunking is supported, be aware of additional impact of VLAN trunking on the Cisco CMTS.

The following example shows how to disable the use of IEEE 802.1Q Layer 2 tunnels on a router. All mapping of cable modems to IEEE 802.1Q VLANs is halted (but any other Layer 2 mapping, such as the mapping of cable modems to ATM PVCs, is unaffected).

```
Router# config terminal
Router(config)# no cable l2-vpn-service dot1q
Router(config)#
```

Related Commands

Command	Description
cable dot1q-vc-map	Maps a cable modem to a particular Virtual Local Area Network (VLAN) on a local outbound Ethernet interface.
debug cable l2-vpn	Displays debugging messages for the Layer 2 mapping of cable modems to particular PVCs or VLANs.
show cable l2-vpn dot1q-vc-map	Displays the mapping of one or all cable modems to IEEE 802.1Q Virtual Local Area Networks (VLANs) on the router's Ethernet interfaces.

cable vc-map

To map a cable modem to a particular permanent virtual connection (PVC) on an Asynchronous Transfer Mode (ATM) interface, use the **cable vc-map** command in global configuration mode. To remove this mapping, use the **no** form of this command.

cable vc-map *mac-address atm-interface vpi/vci* [*cust-name*]

no cable vc-map *mac-address*

no cable vc-map customer *cust-name*

Syntax Description

mac-address	Specifies the hardware (MAC) address for the cable modem whose traffic is to be mapped.
atm-interface	Specifies the outbound ATM interface to which this cable modem should be mapped.
vpi/vci	Specifies the virtual path identifier (VPI) and virtual channel identifier (VCI) on the ATM interface to which this cable modem should be mapped.
cust-name	(Optional) Identifies the customer for this PVC. The *cust-name* can be any arbitrary alphanumeric string, up to 127 characters long.
customer *cust-name*	(Optional) Deletes all PVCs belong to this customer. The *cust-name* can be any arbitrary alphanumeric string, up to 127 characters long.

Defaults

No default behavior or values

Command Modes

Global configuration

Command History

Release	Modification
12.2(11)BC3	This command was introduced for Cisco uBR7100 series and Cisco uBR7246VXR universal broadband routers.
12.2(15)BC2	Support for the **customer** option was added.

Usage Guidelines

This command maps a cable modem, on the basis of its hardware (MAC) address, to a particular PVC on an ATM interface.

Note To use this command, you must first enable the use of Layer 2 tunnels, using the **cable l2-vpn-service atm-vc** command. Then use the **cable vc-map** command to enable the mapping of individual cable modems to specific PVCs.

Examples

The following example shows how to enable the use of Layer 2 tunnels and then map specific CMs to specific PVCS:

```
Router# config terminal
Router(config)# cable l2-vpn-service atm-vc
Router(config)# cable vc-map 0007.0e03.69f9 ATM2/0 1/1
Router(config)# cable vc-map 0010.7bed.9c95 ATM2/0 1/2
Router(config)# exit
Router#
```

The following example shows the same configuration as above, but with the addition of a customer name that identifies the customer that is using each particular PVC:

```
Router# config terminal
Router(config)# cable l2-vpn-service atm-vc
Router(config)# cable vc-map 0007.0e03.69f9 ATM2/0 1/1 ENTERPRISE-CO1
Router(config)# cable vc-map 0010.7bed.9c95 ATM2/0 1/2 ENTERPRISE-CO2
Router(config)# exit
Router#
```

Related Commands

Command	Description
cable l2-vpn-service atm-vc	Enables the use of Layer 2 tunnels for the Customer Premises Equipment (CPE) traffic that is behind cable modems, so that individual CPE traffic can be routed to a particular PVC on an ATM interface.
debug cable l2-vpn	Displays debugging messages for the Layer 2 mapping of cable modems to particular PVCs or VLANs.
show cable l2-vpn vc-map	Displays the mapping of one or all cable modems to PVCs on the ATM interfaces.

debug cable l2-vpn

To display debugging messages for the Layer 2 mapping of cable modems to particular permanent virtual connections (PVC) or to a virtual local area network (VLAN), use the **debug cable l2-vpn** command in privileged EXEC mode. To stop the display of debugging messages, use the **no** form of this command.

debug cable l2-vpn [**conditional**]

no debug cable l2-vpn [**conditional**]

Note This command is not supported for the Cisco uBR10012 router, through release 12.3(13a)BC.

Syntax Description

conditional	(Optional) Displays the packets that are sent or received for a particular cable modem or cable interface. **Note** The **conditional** option does not display any output until you have also enabled debugging for a particular interface, using the **debug cable interface** command, or for a particular MAC address, using the **debug cable mac-address** command.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(11)BC3	This command was introduced for Cisco uBR7100 series and Cisco uBR7246VXR universal broadband routers to debug the Layer 2 mapping of cable modems to a PVC on an Asynchronous Transfer Mode (ATM) interface.
12.2(15)BC2	Support was added for the debugging of the Layer 2 mapping of cable modems to a virtual local area network (VLAN) on an outbound Ethernet interface.

Usage Guidelines

The **debug cable l2-vpn** command displays status information for the mapping of cable modems to PVCs on an ATM interface (see the **cable vc-map** command) or to a VLAN on an Ethernet, Fast Ethernet, or Gigabit Ethernet interface (see the **cable dot1q-vc-map** command). The debug messages show when a cable modem is mapped to a PVC or VLAN, when the mapping is changed or removed, and when packets are sent and received over the mapping.

The **conditional** option displays information for each packet that is sent and received over an ATM PVC or VLAN mapping. Because this can produce a large volume of debug information, the **conditional** option can be used only when you have also enabled debugging for a particular interface or MAC address, using the **debug cable interface** and **debug cable mac-address** commands, respectively.

Examples

The following example shows typical output for the **debug cable l2-vpn** command when a cable modem is mapped to an ATM PVC:

```
Router# debug cable l2-vpn

CMTS L2 VPN debugging is on

Router# configure terminal
Router(config)# cable l2-vpn-service atm-vc
Router(config)# cable vc-map 0007.0e03.69f9 ATM2/0 1/1

6d00h: Associating vc ATM2/0.1 1/1 to CM 0007.0e03.69f9 sid 0x1
6d00h: Writing vc-map info to sid 0x1

Router(config)#
```

The following example shows typical output for the **debug cable l2-vpn** command when a cable modem is mapped to an IEEE 802.1Q VLAN:

```
Router# debug cable l2-vpn

CMTS L2 VPN debugging is on

Router# configure terminal
Router(config)# cable l2-vpn-service dot1q
Router(config)# cable dot1q-vc-map 0007.0e03.69f9 FastEthernet0/0 5
Router(config)#

Set promiscuous mode for FastEthernet0/0
Mapped DS srv flow 13 on Cable5/0 to FastEthernet0/0 VLAN 5
Mapped US srv flow 11 sid 31 on Cable5/0 to FastEthernet0/0 VLAN 5
```

Note It is not required to configure VLAN trunking on the Cisco CMTS. Though VLAN trunking is supported, be aware of additional impact of VLAN trunking on the Cisco CMTS.

The following example shows typical output for the **debug cable l2-vpn** command when a mapping is deleted:

```
Router# debug cable l2-vpn

CMTS L2 VPN debugging is on

Router# configure terminal
Router(config)# no cable vc-map 0007.0e03.69f9 ATM2/0 1/1

6d00h: Disassociating vc ATM2/0.1 1/1 from CM 0007.0e03.69f9 sid 0x1
6d00h: Erasing vc-map info to sid 0x1

Router(config)#
```

The following example shows typical output for the **conditional** option. This example shows output for traffic to and from one particular cable modem. Each debug message shows the size of the packet, the source and destination MAC addresses, the cable interface and SID being used, and the ATM interface and PVC/PVI being used.

```
Router# debug cable mac-address 000C.0807.06.05
Router# debug cable l2-vpn conditional

CMTS L2 VPN conditional debugging is on
```

```
6d00h: Fwd pkt size 74 from 000C.0807.0605 on Cable4/0:0x1 to 0900.2b00.000f on ATM2/0:1/1
6d00h: Fwd pkt size 74 from 000C.0807.0605 on Cable4/0:0x1 to 0900.07ff.ffff on ATM2/0:1/1
6d00h: Fwd pkt size 1028 from 000C.0807.0605 on Cable4/0:0x1 to 0002.4a1d.dc1d on
ATM2/0:1/1
6d00h: Send pkt size 1020 encsize 6 from 0002.4a1d.dc1d on ATM2/0:1/1 to 000C.0807.0605 on
Cable4/0:0x1
6d00h: Fwd pkt size 74 from 000C.0807.0605 on Cable4/0:0x1 to 0900.07ff.ffff on ATM2/0:1/1

Router#
```

Related Commands

Command	Description
cable dot1q-vc-map	Maps a cable modem to a particular Virtual Local Area Network (VLAN) on a local outbound Ethernet interface.
cable l2-vpn-service atm-vc	Enables the use of Layer 2 tunnels for the Customer Premises Equipment (CPE) traffic that is behind cable modems, so that individual CPE traffic can be routed to a particular PVC on an ATM interface.
cable l2-vpn-service dot1q	Enables the use of Layer 2 tunnels so that traffic for individual cable modems can be routed over a particular Virtual Local Area Network (VLAN).
cable vc-map	Maps a cable modem to a particular PVC on an ATM interface.
debug cable interface	Enables debugging output for a specific cable interface.
debug cable mac-address	Enables debugging output for the cable modems that match the specified hardware (MAC) address or range of addresses.
show cable l2-vpn dot1q-vc-map	Displays the mapping of one or all cable modems to IEEE 802.1Q Virtual Local Area Networks (VLANs) on the router's Ethernet interfaces.
show cable l2-vpn vc-map	Displays the mapping of one or all cable modems to PVCs on the ATM interfaces.

show cable l2-vpn dot1q-vc-map

To display the mapping of one or all cable modems to IEEE 802.1Q Virtual Local Area Networks (VLANs) on the router's Ethernet interfaces, use the **show cable l2-vpn dot1q-vc-map** command in privileged EXEC mode.

show cable l2-vpn dot1q-vc-map [*mac-address*] [**verbose**] [**customer** *cust-name*]

Syntax Description

mac-address	(Optional) Displays the mapping for the cable modem with the specified hardware (MAC).
verbose	(Optional) Displays additional information about the Layer 2 mapping, including the number of packets and bytes received on the upstream and downstream.
customer *cust-name*	(Optional) Displays the VLAN mappings for this particular customer name.

Defaults

Displays information for all cable modems that have a defined IEEE 802.1Q VLAN mapping.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(15)BC2	This command was introduced for Cisco uBR7246VXR universal broadband routers.

Usage Guidelines

This command displays the cable modem to VLAN mappings that have been defined using the **cable dot1q-vc-map** command. It displays the MAC address, service ID (SID), and cable interface being used by the cable modem, and the interface and VLAN ID to which it has been mapped.

Tip The **customer** option displays only those VLAN mappings that have been configured with a particular customer name, using the **cable dot1q-vc-map** command.

Examples

The following example shows typical output for the **show cable l2-vpn dot1q-vc-map** command for all cable modems that are mapped to IEEE 802.1Q VLANs:

```
Router# show cable l2-vpn dot1q-vc-map

MAC Address    Ethernet Interface      VLAN ID   Cable Intf  SID   Priv Bits
0010.7bed.9c95 FE0/0.2                 3         Cable4/0    3     0
0007.0e03.69f9 FE0/0.1                 4         Cable4/0    1     0

Router#
```

The following example shows typical output for a particular cable modem with the MAC address of 0010.7bed.9c91:

```
Router# show cable l2-vpn dot1q-vc-map 0001.0203.0405

MAC Address    Ethernet Interface      VLAN ID   Cable Intf  SID   Priv Bits
0010.7bed.9c91 GE2/0                   5         Cable5/0    7     0

Router#
```

The following example shows a typical example for the **verbose** option:

```
Router# show cable l2-vpn dot1q-vc-map 0001.0203.0405 verbose

MAC Address                          : 0010.7bed.9c91
Prim Sid                             : 7
Cable Interface                      : Cable5/0
Ethernet Interface                   : GigabitEthernet2/0
DOT1Q VLAN ID                        : 5
Total US pkts                        : 6
Total US bytes                       : 1402
Total DS pkts                        : 71
Total DS bytes                       : 21975

Router#
```

Table 1 describes the fields shown in the display.

Table 1 show cable l2-vpn dot1q-vc-map Field Descriptions

Field	Description
MAC Address	Hardware (MAC) address for the CM being mapped.
Ethernet Interface	Destination interface (Ethernet, Fast Ethernet, or Gigabit Ethernet) for the VLAN being used for the mapping.
VLAN ID	Destination VLAN on the Ethernet, Fast Ethernet, or Gigabit Ethernet interface for the traffic coming from the CM.
Cable Intf	Cable interface to which the CM is connected.
SID	Primary service ID (SID) for this cable modem.
Priv Bits	Identifies the current settings of the two privacy bits in the extended header (EH) that is used for BPI-encrypted packets. • First bit = Enable bit. Set to 1 when BPI or BPI+ is enabled. • Second bit = Toggle bit. Matches the least-significant bit (LSB) of the key sequence number (KSN) in the EH. For example, a value of “0” indicates that BPI is not enabled. A value of “10” indicates that BPI is enabled and that the KSN is an even number. A value of “11” indicates that BPI is enabled and that the KSN is an odd number. **Note** For more information on these bits, see the DOCSIS Baseline Privacy Interface Plus Interface Specification (SP-BPI+-I08-020301 or later).
Total US pkts/bytes	Total number of packets and bytes sent on the upstream to the Layer 2 tunnel by this cable modem.
Total DS pkts/bytes	Total number of packets and bytes received on the downstream from the Layer 2 tunnel by this cable modem.

Related Commands

Command	Description
cable l2-vpn-service dot1q	Enables the use of Layer 2 tunnels for the Customer Premises Equipment (CPE) traffic that is behind cable modems so that individual CPE traffic can be routed over a particular Virtual Local Area Network (VLAN).
cable dot1q-vc-map	Maps a cable modem to a particular VLAN on a local outbound Ethernet interface.
debug cable l2-vpn	Displays debugging messages for the Layer 2 mapping of cable modems to particular PVCs or VLANs.

show cable l2-vpn vc-map

To display the mapping of one or all cable modems to permanent virtual connections (PVC) on Asynchronous Transfer Mode (ATM) interfaces, use the **show cable l2-vpn vc-map** command in privileged EXEC mode.

show cable l2-vpn vc-map [*mac-address*] [**customer** *cust-name*]

Syntax Description

mac-address	(Optional) Displays the mapping for the cable modem with the specified hardware (MAC).
customer *cust-name*	(Optional) Displays the PVC mappings for this particular customer name.

Defaults

Displays information for all cable modems that have a defined ATM PVC mapping.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(11)BC3	This command was introduced for Cisco uBR7100 series and Cisco uBR7246VXR universal broadband routers.
12.2(15)BC2	Support was added for the **customer** option.

Usage Guidelines

This command displays the cable modem to ATM PVC mappings that have been defined using the **cable vc-map** command. It displays the MAC address, service ID (SID), and cable interface being used by the cable modem, and the ATM interface and PVC/PVI to which it has been mapped.

Tip The **customer** option displays only those PVC mappings that have been configured with a particular customer name, using the **cable vc-map** command.

Examples

The following example shows typical output for the **show cable l2-vpn vc-map** command for all cable modems that are mapped to ATM PVCs:

```
Router# show cable l2-vpn vc-map

MAC Address    ATM Intf    VPI/VCI   Cable Intf  SID   Priv Bits
0010.7bed.9c95 ATM2/0.2       1/2    Cable4/0    3     0
0007.0e03.69f9 ATM2/0.1       1/1    Cable4/0    1     0

Router#
```

The following example shows typical output for a particular cable modem with the MAC address of 0001.0203.0405:

```
Router# show cable l2-vpn vc-map 0001.0203.0405
MAC Address    ATM Intf    VPI/VCI   Cable Intf  SID   Priv Bits
```

```
0001.0203.0405 ATM3/0.2       1/2    Cable5/0    3     0

Router#
```

Table 2 describes the fields shown in the display.

Table 2 show cable l2-vpn vc-map Field Descriptions

Field	Description
MAC Address	Hardware (MAC) address for the CM being mapped.
ATM Intf	Destination ATM interface that contains the VPI/VCI being used for the mapping.
VPI/VCI	Destination VPI/VCI on the ATM interface for the traffic coming from the CM.
Cable Intf	Cable interface to which the CM is connected.
SID	Primary service ID (SID) for this cable modem.
Priv Bits	Identifies the current settings of the two privacy bits in the extended header (EH) that is used for BPI-encrypted packets. • First bit = Enable bit. Set to 1 when BPI or BPI+ is enabled. • Second bit = Toggle bit. Matches the least-significant bit (LSB) of the key sequence number (KSN) in the EH. For example, a value of "0" indicates that BPI is not enabled. A value of "10" indicates that BPI is enabled and that the KSN is an even number. A value of "11" indicates that BPI is enabled and that the KSN is an odd number. **Note** For more information on these bits, see the DOCSIS Baseline Privacy Interface Plus Interface Specification (SP-BPI+-I08-020301 or later).

Related Commands

Command	Description
cable l2-vpn-service atm-vc	Enables the use of Layer 2 tunnels for the Customer Premises Equipment (CPE) traffic that is behind cable modems, so that individual CPE traffic can be routed to a particular PVC on an ATM interface.
cable vc-map	Maps a cable modem to a particular PVC on an ATM interface.
debug cable l2-vpn	Displays debugging messages for the Layer 2 mapping of cable modems to particular PVCs or VLANs.